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Wildlife Exposure Factors Handbook, Appendix: Literature Review Database, Volume II of II

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Wildlife Exposure Factors Handbook

Appendix: Literature Review Database

Volume II of II

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WILDLIFE EXPOSURE FACTORS HANDBOOK

APPENDIX: LITERATURE REVIEW DATABASE

Volume II of II

Office of Health and Environmental Assessment
Office of Research and Development
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DISCLAIMER

This document has been reviewed in accordance with U.S. Environmental Protection Agency policy and approved for publication. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

TABLE OF CONTENTS

The tables in this Appendix accompany the selected species profiles provided in Chapter 2 of the Handbook. The references for each of the tables are in Chapter 2 of the Handbook at the end of each individual species' profile.

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A-1. INTRODUCTION

This Appendix is intended to accompany the Wildlife Exposure Factors Handbook (hereafter referred to as the Handbook) and should be used only by individuals familiar with the Handbook. The species-specific values for the exposure factors presented in Chapter 2 of the Handbook of are a subset of the data included in the tables of this Appendix. Most values identified in the literature reviewed for the Handbook are included in this Appendix. For some exposure factors for some species, large quantities of data are available. For these factors and species, we tried to select data that represented a range of values and geographic locations for the Appendix, and did not include the other reviewed data. All data obtained from secondary sources are so identified in the "Notes" column of the tables. Appropriate data identified in primary sources were included in the Appendix unless the results were inadequately reported (e.g., no methods, units of measure unclear). The references for this Appendix are in Chapter 2 of the Handbook.

We caution users of this Appendix that some values or studies included may be inaccurate. We have not attempted to evaluate the quality of the original studies and associated data. When potential difficulties were obvious (e.g., method of estimating home range not reported), we have tried to indicate the limitation in the "Notes" column. Also in the notes column, we have tried to identify potential confounding factors (e.g., low reproductive success due to DDT or other pollutant). Due to resource limitations, our quality-assurance program consisted of reviewing all data for consistency with other reported values, reviewing any unusual values against the original reference, and verifying values that were included in Chapter 2 of the Handbook. Many of the data presented in the Appendix required conversion to metric units (e.g., density reported as N/acre to density as N/hectare), and we have not verified that all such conversions were performed correctly for the Appendix. For several factor values, we computed a mean and standard deviation (SD) from original data provided in the reference (e.g., mean ± SD of 10 density values representing 10 different years of study in the same location). Again, we have only verified a subset of these data as part of our quality assurance procedures. Users of this Handbook therefore are strongly encouraged to retrieve the original literature for any studies that are important to their exposure assessment. We would welcome being informed of any possible inaccuracies in the Handbook and this Appendix at the following address:

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The remainder of Section A-2 describes the column headers and abbreviations used in the Appendix. The exposure factor tables are provided for birds in Section A-3, for mammals in Section A-4, and for reptiles and amphibians in Section A-5. Again, the references for the citations in the Appendix are in Chapter 2 of the Handbook at the end of each individual species profile.

A-2. TABLE FORMAT AND ABBREVIATION KEY

In this section, we describe the organization of the tables (Section A-2.1), their column headers (A-2.2), and abbreviations used in the tables (Section A-2.3).

A-2.1. ORGANIZATION OF TABLES

Quantitative data for each species in the Appendix are presented in tables arranged in four main groups in the following order:

- Normalizing and Contact Rate Factors;
- Dietary Composition;
- Population Dynamics; and
- Seasonal Activities.

The exposure factors included in each of these groups are explained in Chapter 1 of the Handbook. As in the Handbook, exposure factors included under each of these four groups vary slightly from species to species according to the species' biology and available data. For example, under "Population Dynamics," factors related to reproduction for birds might include "Age at Fledging," whereas for mammals they could include "Age at Weaning." If no data were found for a given factor, the factor is not listed. The meaning of the exposure factors included in the Appendix should be clear to users who have read Chapters 1, 3, and 4 of the Handbook and corresponding species profiles.

We explain the Appendix table column headers for the four groups of factors in Section A-2.2 and the abbreviations used under each column header in Section A-2.3. A few table entries do not conform to the format as described below. Any exceptions are explained in the "Notes" column for the individual entry.

A-2.2. COLUMN HEADERS

The column headers for each of the four main groups of exposure factors are described below according to the group(s) of exposure factors to which they apply.

ALL GROUPS

Reference:	Reference citation (see Chapter 2 of the Handbook for full references). If a particular **subspecies** was studied and identified, the subspecies name will be listed under the reference in parentheses.
Age:	Age of animals, if reported and relevant.
Sex:	Sex of animals, if reported and relevant.
N:	Sample size if reported (sometimes, a sample size is described in the notes instead).
Location:	State (United States assumed) or Canadian province (identified by CAN).
Habitat:	Short descriptors of habitat if reported and if relevant.
Notes:	Additional information needed to evaluate the data, when necessary.

NORMALIZING AND CONTACT RATE FACTORS

Cond:	Condition of animals (e.g., lactating, swimming, non-breeding), or line-specific number to be described in the notes column.
Seas:	Season in which data were collected, if reported and relevant.
Mean:	Mean value for population sampled.
SD/SE:	Standard deviation, if reported, or else standard error if reported.
Units:	Units for measurements.
Minimum:	Minimum value reported for the population sampled, or minimum average value if several populations or years evaluated.
Maximum:	Maximum value reported for the population sampled, or minimum average value if several populations or years evaluated.

DIETARY COMPOSITION

Food type:	Type of food, usually identified in as much detail as reported.
Spring, Summer, Fall, Winter:	The data are reported by season whenever possible.
	Spring: March, April, May Summer: June, July, August Fall: September, October, November Winter: December, January, February
Habitat - Measure:	Habitat type and description of measure used to indicate dietary composition.

POPULATION DYNAMICS

Cond:	Condition of animals (e.g., lactating, swimming, non-breeding), or line-specific number to be described in the notes column.
Seas:	Season in which data were collected, if reported and relevant.
Mean:	Mean value for population sampled.
SD/SE:	Standard deviation, if reported, or else standard error if reported.
Units:	Units for measurements.
Minimum:	Minimum value reported for the population sampled, or minimum average value if several populations or years evaluated.
Maximum:	Maximum value reported for the population sampled, or minimum average value if several populations or years evaluated.

SEASONAL ACTIVITIES

Begin:	Month that the activity usually begins.
Peak:	Month(s) that the activity peaks (i.e., most of the population involved).
End:	Month that the activity usually ends.

A-2.3. ABBREVIATIONS

The abbreviations used in the Appendix for age, sex, condition, season, and units are defined below. They are arranged alphabetically unless otherwise noted. Any other abbreviations in the Appendix tables are explained in the "Notes" column.

AGE (LIFE STAGE) Listed in order of increasing age (not alphabetically):

All Species:

J	juveniles (i.e., independent, but not yet sexually mature)
A	adults (i.e., sexually mature)
B	both adults and juveniles
-	not specified or relevant

Birds:

E	egg
H	hatchling (i.e., on day of hatching)
C	chick (for precocial birds such as herring gulls and northern bobwhite)
N	nestling (for altricial birds such as osprey, kingfishers, robin)
F	fledgling (i.e., first day of sustained flight)

Mammals:

N	neonate (i.e., on day of birth)
P	pup (before weaning)
Y	yearling (i.e., one year of age)

Reptiles and Amphibians:

H	hatchling (for those species that lay eggs)
N	neonate (for water snakes)
T	tadpole (for frogs)
E	eft (for newts)

SEX

All Species:

B	both sexes
F	female
M	male

CONDITION (for non-metabolic records)

All Species:

BR	breeding (may be any stage of reproductive efforts, including courtship, mating, egg-laying or pregnancy, feeding young)
DI	diurnal (i.e., during the day)
NB	nonbreeding
NO	nocturnal (i.e., at night)
-	not specified or not relevant

Birds:

FY	feeding young
I	incubating
IC	in covey (for northern bobwhite only)
L	laying
LI	laying or incubating
MI	migrating
N	nesting

Mammals:

G	during gestation (i.e., during pregnancy)
L	lactating
NG	non-gestating (i.e., not pregnant)
NP	nulliparous (i.e., females that have never given birth)
P	parous (i.e., females that have given birth previously)

CONDITION (for non-metabolic records) (cont'd)

Reptiles and Amphibians:

HI	hibernating
L	laying eggs

CONDITION (for metabolic records)

All Species:

AC	light activity
AD	average daily metabolism
BA	basal metabolism
EX	existence metabolism
FL	free-living metabolism
R	resting
ST	standard metabolism
SW	swimming
-	not specified or not relevant
#	note number

UNITS

time:

d	day
wk	week
yr	year

energy:

cal	calorie
kcal	kilocalorie

mass:

g	gram
kg	kilogram

area:

ha	hectare
m^2	square meter

length:

mm	millimeter
cm	centimeter
m	meter
km	kilometer

volume:

ml	milliliter
l	liter

temperature:

°C	degrees Centigrade

A-3. TABLES FOR BIRDS

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*** NORMALIZING AND CONTACT RATE FACTORS ***

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
BODY WEIGHT													
Alexander 1977	A	B	-	-	2,400		g			72	nc lower Michigan	lakes, streams	Year of collection not specified.
Bayer 1981b	J	-	1	SU	1,820	300 SD	g	1,370	2,160	6	c Oregon 1974-80	estuary	Weights of herons found alive or dead but not decomposed. Juveniles found in (1) July; (2) August - December. Y = yearlings; they were collected from June - January.
	J	-	2	-	1,990	550 SD	g	1,370	2,750	8			
	Y	-	-	-	2,340	490 SD	g	1,940	2,970	5			
	A	-	-	WI	2,090		g			1			
Hartman 1961	A	F	-	-	2,204	337 SD	g			15	NS	NS	As cited in Dunning 1984.
	A	M	-	-	2,576	299 SD	g			17			
Hoffman 1978	A	B	-	SU	2,200		g			42	nw Ohio 1972-73	sw Lake Erie	
Poole 1938	-	-	-	-	1,905		g			1	NS	NS	
Quinney 1982	A	B	-	-	2,229	762 SD	g			37	e North America	NS	Based on records from museum collections.
NESTLING WEIGHT													
McAloney 1973	N	B	-	-	86		g day 1			4	Nova Scotia, CAN 1971	islands	Number of days in the units column is the age of the nestlings.
	N	B	-	-	170		g day 5			5			
	N	B	-	-	567		g day 10			8			
	N	B	-	-	983		g day 15			6			
	N	B	-	-	1,115		g day 20			5			
	N	B	-	-	1,441		g day 25			6			
	N	B	-	-	1,593		g day 30			7			
	N	B	-	-	1,786		g day 35			5			
	N	B	-	-	2,055		g day 40			4			
METABOLIC RATE (OXYGEN)													
Benedict & Fox 1927	-	-	-	-	14.6		lO2/kg-d				NS	NS	As cited in Altman and Dittmer 1968.

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
FOOD INGESTION RATE													
Alexander 1977	A	B	-	-	0.33		g/g-day				nc lower Michigan	lakes, streams	Estimate used by author to calculate effects of heron predation on fish.
Kushlan 1978	A	B	-	-	0.18		g/g-day				NS	NS	Estimate of food consumption calculated using Kushlan's equation for wading birds: log y = 0.966 log x - 0.640 where y = food consumption (g/day) and x = weight of bird (g). Value presented here based on heron weight of 2,230 g. Regression equation was derived from seven wading bird species.

***** DIET *****

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Alexander 1977	B	B	trout non-trout fish crustaceans amphibians insects birds and mammals vegetation unidentified		88 2 1 1 4 2 1 1			15	nc lower Michigan	streams - % wet weight; stomach contents	Collections made during spring, summer, and fall. Most fish were 8 to 23 cm long.
Alexander 1977	B	B	trout non-trout fish crustaceans amphibians		59 39 1 1			19	nc lower Michigan	lake - % wet weight; stomach contents	Collections made spring, summer, and fall. Most fish were between 20 and 28 cm long.
Alexander 1977	B	B	trout non-trout fish crustaceans amphibians birds and mammals		89 5 1 4 1			38	nc lower Michigan	river - % wet weight; stomach contents	Collections made spring, summer, and fall. Most fish were 8 to 33 cm long.
Collazo 1985	B	B	fish (brown bullhead) (tench) (yellow perch) (pumpkinseeds) meadow vole		67.5 (32.5) (20.5) (1.5) (3.0) 32.5			1,535	n Idaho 1977-78	lakes in park - % biomass; boluses, regurgitated pellets, and fish remains below nests	Bolus = food regurgitated by nestlings. Months of collection = March - August. N = number of items identified. Average of two years; invertebrates (mainly aquatic arthropods) may be under-represented due to their high digestibility.

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Cottam & Uhler 1945 (herodias & wardi)	-	-	non-game fish		43.2			189	throughout US	NS - % (measure NS); stomach contents	Season and basis for determining percentage unknown. As cited in Palmer 1962.
			valuable fish		24.8						
			unidentified fish		3.6						
			aquatic insects		8.2						
			crustaceans		8.9						
			herpetofauna		4.3						
			mice & shrews		4.7						
			misc. & plant		2.5						
Cottam & Williams 1939	-	-	fish		75.8			6	Vermont	marsh - % (measure NS); stomach contents	As cited in Palmer 1962.
			aquatic beetles		1.7						
			aquatic plants		22.5						
Hoffman 1978	B	B	Cyprinidae (carp, minnows, goldfish)		53.8			31	nw Ohio 1972-73	sw Lake Erie - % frequency of occurrence; stomachs	Mean of values for two heronries; N = total number of stomachs examined. Season = March - September.
			Centrarchidae (sunfish, crappie, large-mouth bass)		9.5						
			Sciaenidae		3.5						
			Percidae (perch)		10.1						
			Amiidae		6.5						
			Astacidae (crayfish)		31.3						
			Insecta		28.4						
Hoffman 1978	J	B	Cyprinidae (carp, minnows, goldfish)		50.0			166	nw Ohio 1972-73	sw Lake Erie - % frequency of occurrence; boluses regurgitated by nestlings	Mean of values for two heronries; N = total number of boluses examined (June - August). Items found in less than 1% of samples not included here.
			Ictaluridae		4.6						
			Clupeidae (gizzard shad, alewife)		5.0						
			Sciaenidae		10.1						
			Percidae (perch)		27.9						
			Centrarchidae (sunfish, crappies, black bass)		6.6						
			Astacidae		4.8						
Kirkpatrick 1940	J	B	crayfish		6			297	ne Wisconsin 1940	lakes - number of prey items; regurgitated by nestlings	Collected from June 28 - August 7. Species found 1 or 2 times not presented here. Number of fish = both whole fish and fragments. Size of whole fish and fragments ranged from 6 to 41 cm; most were between 6 and 23 cm.
			dragonfly		3						
			leopard frog		12						
			yellow perch		154						
			yellow pike-perch		21						
			northern rock bass		20						
			common white sucker		17						
			northern pike		14						
			large-mouthed bass		11						
			nort. black bullhead		9						
			bluegill		9						
			pumpkinseed		7						
			black crappie		4						

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Krebs 1974	A	B	staghorn sculpin					78	Br. Columbia, CAN 1972	coastal island - % of number of fish captured; observations	Other includes shiner sea perch and penpoint gunnels. Small = less than 1/3 beak length; medium = about 1/2 beak length; large = greater than beak length.
			small		27.8						
			medium		7.6						
			large		2.2						
			starry flounder								
			small		15.0						
			medium		8.1						
			large		5.2						
			other (see note)								
			small		30.6						
			medium		3.5						
Peifer 1979	A	M	bullhead		200+			4	c Minnesota 1977	lakes, uplands - number of prey items; observed eaten	Number of prey captured during observations of 4 radiotagged herons from April 7 - July 22.
			sunfish		10						
			13-lined ground squirrel		36						
			eastern chipmunk		5						
			prair. pocket gopher		5						
			eastern fox squirrel		1						
			eastern cottontail		1						
			leopard frog		8						
			grasshoppers		10+						
Quinney 1982	N	B	Atlantic silverside		3.6				Nova Scotia, CAN 1977-78	Boot island - % wet weight; items regurgitated by nestlings	Dates = May 15 to July 15. Percent wet weight calculated from % of total items collected and mean wet weights of items.
			mummichog		2.4						
			American eel		52.6						
			Gaspereaux		29.9						
			pollock		8.9						
			yellow perch		2.6						

***** POPULATION DYNAMICS *****

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
FEEDING TERRITORY SIZE													
Bayer 1978	A	B	1	FA	0.129	0.028 SD	km			7	Oregon 1972	freshwater marsh	Average length (1) and area (2) of area defended by one birds foraging territory.
	A	B	2	FA	0.6	0.1 SD	ha			7			
Bayer 1978	A	B	1	WI	0.355	0.168 SD	km			32	Oregon 1973-76	estuary	Average shoreline length (1) and area (2) of intertidal area defended as foraging territory by one bird. Territories were largest in the winter.
	A	B	2	WI	8.4	5.4 SD	ha			32			

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Peifer 1979	A	M	-	SU	0.98		km	0.60	1.37	4	c Minnesota 1977	lakes	Length of shoreline actively defended as foraging territory by radiotagged herons (April 7 - July 22). Two of the herons also foraged for small mammals in upland areas.
DISTANCE FROM HERONRY TO FORAGING GROUNDS													
Collazo 1981	A	B	-	SU			km	0.4-0.7			Idaho 1977-78	lake, mountain ridge	Distance from heronry to nearest feeding grounds.
Dowd & Flake 1985	A	B	-	SU	3.1		km		24.4		S Dakota 1980-81	river & tributaries	Conservative estimate of average and maximum distances flown from colony to foraging sites during the breeding season.
English 1978	A	B	-	-	-		-				Oregon 1975	Willamette River	Of 31 heronries, 24 were located within 100 meters of known feeding areas.
Mathisen & Richards 1978	A	B	-	SU	1.8		km	0	4.2		Minnesota	Chippewa National Forest	The average distance of heronries to possible feeding areas (i.e., lakes greater than 40 ha in size). As cited by Short and Cooper 1985.
Parnell & Soots 1978	A	B	-	SU	7 - 8		km				North Carolina	coastal	Most heronries along the North Carolina coast were located near inlets, which tend to have large concentrations of fish. The average distance from the heronries to the inlets was 7.0 - 8.0 km. As cited by Short and Cooper 1985.
Peifer 1979	A	M	-	SU			km	13.7	34.1	4	c Minnesota 1977	lakes, uplands	Distance of actively defended foraging territories from colony - radiotagged herons (April 7 - July 22). Other (non-defended) areas used for feeding, including uplands, were between 4-20 km of the colony (heronry).
Thompson 1978	A	B	-	-	6.5		km		20.4		NS	upper Mississippi R.	Average flight distances (probably foraging) of breeding herons. As cited in Dowd and Flake 1985.

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
POPULATION DENSITY													
Dowd & Flake 1985	B B	B B	1 2	SU SU	2.3 3.6		N/km N/km				N Dakota 1980-81	river & tributaries	Density of foraging herons based on censuses along water bodies; (1) stream with nearly continuous pools but little or no flow - 14 km sampled, almost half of the herons found were within 4 km of the heronry; (2) James River - sampled 12 km in each direction away from colony, 57% of herons found within 4 km.
Gibbs et al. 1987	-	-	-	SU	149	53.4 SD	nests/ha			11	Maine 1983	marine islands	Mean nest density for 11 colonies. Colonies usually occupied a small area in the interior of the island.
Werschkul et al. 1977	-	-	-	SU	461		nests/ha	447	475	2	w Oregon 1974	coastal island	Density of nests within colonies.
Werschkul et al. 1977	-	-	-	SU	160	123 SD	nests/ha	15	358	6	w Oregon 1974	coastal canyon	Density of nests within colonies.
Werschkul et al. 1977	-	-	-	SU	169		nests/ha	68	269	2	w Oregon 1974	coastal flat	Density of nests within colonies.
CLUTCH SIZE													
Baird et al. 1884	-	-	-	-	3						Florida	NS	As cited in Palmer 1962.
McAloney 1973	-	-	-	-	4.17	0.85 SD		3	6	36	Nova Scotia, CAN 1971	island	
Miller 1943	-	-	-	-	4.37			3	6	347	Pennsylvania	NS	As cited in Palmer 1962.
Mitchell 1981	-	-	-	-	3.58						Texas 1981	NS	As cited in Pratt and Winkler 1985.
Page 1970	-	-	-	-	3.6						California	NS	As cited in Pratt 1972.
Palmer 1962	-	-	-	-	4 +/-			3	7		NS	NS	
Powell & Powell 1986	- - - -	- - - -	1 2 3 4	- - - -	2.9 3.2 3.6 3.8	0.6 SD 0.7 SD 0.8 SD 0.4 SD				64 82 32 11	s Florida	bay	(1-3) For 1981 to 1984: (1) Unsupplemented colonies; (2) supplemented colonies (fed by nearby residents); (3) identified supplemented nests. (4) 1923 data (prior to human disturbances).

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Pratt 1972	-	-	-	-	3.6					53	c California 1967-70	coastal canyon	
Pratt & Winkler 1985	-	-	-	-	3.16	0.04 SE		1	5	297	c California 1967-79	coastal canyon	Yearly means ranged from 2.72 (1971) to 3.35 (1968).
Quinney 1982	-	-	1	-	4.6					42	Nova Scotia, CAN 1977-78	Boot Island	Year: (1) 1977; (2) 1978.
	-	-	2	-	5.0					26			
Vermeer 1969	-	-	-	-	5.0					11	s Alberta, CAN 1967-68	Dowling Lake	As cited in Pratt 1972 and English 1978.
CLUTCHES/YEAR													
English 1978	-	-	-	-	1		/yr				nw Oregon 1975	river	Renesting was not observed in undisturbed populations, but groups did lay new clutches after their original nesting trees were cut down.
Miller 1943	-	-	-	-	1		/yr				Pennsylvania	NS	May replace clutch if eggs are lost, but will raise only one brood. As cited in Henny 1972.
DAYS INCUBATION													
Bent 1926	-	-	-	-	28		days				United States	NS	
McAloney 1973	-	-	-	-	27.1		days	25	30	11	Nova Scotia, CAN 1971	island	Time from laying last egg to hatching of last egg.
Quinney 1982	N	B	-	-	200		g day 5				Nova Scotia, CAN 1977-78	Boot Island	Number of days in the units column is the age of the nestlings. Estimated from figure; average of 9 and 16 nestlings measured at each age in 1977 and '78 respectively. Regression equation for 1977: (weight) = 50.76 (age) - 37.2. For 1978: (weight) = 55.6 (age) - 47.4. Weight is in grams and age in days.
	N	B	-	-	500		g day 10						
	N	B	-	-	800		g day 15						
	N	B	-	-	1000		g day 20						
	N	B	-	-	1300		g day 25						
	N	B	-	-	1500		g day 30						
AGE AT FLEDGING													
Hancock & Kushlan 1984	-	-	-	-	60		days				NS	NS	

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
McAloney 1973	-	-	-	-	45		days				Nova Scotia, CAN 1971	island	Observed around the colony being fed by adults for another 10 days after leaving the nest at 45 days.
Quinney 1982	-	-	-	-	49 - 56		days				Nova Scotia, CAN 1977-78	Boot Island	Attained 86% of adult weight by 44 days.
N FLEDGE/ACTIVE NEST													
English 1978	-	-	-	-	1.96		N/pair			27	nw Oregon 1975	river	Windsor Island heronry.
Pratt 1972	-	-	-	-	1.7		N/pair	0	4		c California 1967-69	coastal canyon	Number fledged per pair; no pair raised more than one brood but many replaced lost clutches.
Pratt & Winkler 1985	-	-	-	-	1.45	0.06 SE	N/act nest	0.85	2.38	297	c California 1967-79	coastal canyon	Minimum and maximum are yearly means.
Quinney 1982	-	-	1	-	2.6		N/pair			42	Nova Scotia, CAN 1977-78	Boot Island	Fledging success in two different years: (1) 1977, (2) 1978; (3) = weighted average for both years. 1978.
	-	-	2	-	3.1		N/pair			26			
	-	-	3	-	2.8		N/pair			68			
McAloney 1973	-	-	-	-	2.84		N/pair			42	Nova Scotia, CAN, 1971	island	
N FLEDGE/SUCCESSFUL NEST													
Collazo 1981	-	-	-	-	2.17		N/suc nest	2.14	2.20		Idaho 1977-78	lake, mountain ridge	Average value of total of 257 nests over two years. Minimum and maximum = value for one of the years. Overall, 1.95 were fledged per pair.
English 1978	-	-	-	-	2.43		N/suc nest			107	nw Oregon 1975	river	Value for seven heronries combined.
Forbes et al. 1985	-	-	-	-	2.5	0.1 SE	N/suc nest	2.2	2.8	917	sw Brit. Col., CAN 1977-81	NS	Minimum and maximum are yearly means.
Henny & Bethers 1971	-	-	-	-	2.61		N/suc nest				w Oregon 1970	NS	As cited in McAloney 1973.
Kelsall & Simpson 1979	-	-	-	-	2.3 -2.9		N/suc nest				Brit. Col., CAN 1977-79	NS	As cited in Pratt & Winkler 1985.
McAloney 1973	-	-	-	-	3.09		N/suc nest			35	Nova Scotia, CAN 1971	island	

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Powell & Powell 1986	-	-	1	-	1.5	0.6 SD	N/suc nest			97	s Florida	bay	(1-3) for 1981 to 1984: (1) Unsupplemented colonies; (2) supplemented colonies (fed by nearby residents); (3) = identified supplemented nests. (4) = 1923 data (prior to human disturbances).
	-	-	2	-	1.9	0.7 SD	N/suc nest			101			
	-	-	3	-	2.5	0.7 SD	N/suc nest			41			
	-	-	4	-	2.6	0.7 SD	N/suc nest			22			
Pratt 1972	-	-	-	-	2.1		N/suc nest	1	4		c California 1967-70	coastal canyon	
Pratt & Winkler 1985	-	-	-	-	2.19	0.25 SD	N/suc nest	2	3	196	c California 1967-79	coastal canyon	Average of 13 yearly means; highest mean was 2.64, lowest was 1.87.
Vermeer 1969	-	-	-	-	2.2-2.5		N/suc nest				s Alberta, CAN 1967-68	NS	As cited in Pratt and Winkler 1985.
Werschkul et al. 1977	-	-	-	-	2.44		N/suc nest	2.18	2.70		Oregon 1974	coastal, 5 sites	Minimum and maximum of five site averages also listed.
PERCENT NESTS SUCCESSFUL													
English 1978	-	-	-	-	85		%/year				nw Oregon 1975	river	Percent fledging at least one young.
Forbes et al. 1985	-	-	-	-	92		%/year				se Brit. Col, CAN 1981-83	NS	
McAloney 1973	-	-	-	-	81		%/year	42			Nova Scotia, CAN 1971	island	Percent fledging at least one young.
Pratt & Winkler 1985	-	-	-	-	68		%/year	38	90	13	c California 1967-79	coastal canyon	Average value for 13 years of percent of nests fledging at least one young.
Pratt 1972	-	-	-	-	71		%/year	56	87		c California 1967-70	coastal canyon	
AGE AT SEXUAL MATURITY													
Bent 1926	-	B	-	-	2		years				NS	NS	Herons are "ready to breed" after their second winter.

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
ANNUAL MORTALITY													
Bayer 1981a	J	B	-	-	35		%/1st yr				nw US 1925-68	National Wildlife Refuges (NWRs)	Determined from life tables generated using banding data; birds banded as nestlings on NWRs from 1925-68.
	A	B	-	-	37		%/2nd yr						
	A	B	-	-	22		%/3rd+ yrs						
Bayer 1981a	J	B	-	-	69		%/1st yr				n US 1925-68	all areas except for National Wildlife Refuges	Determined from life tables generated using banding data; birds banded as nestlings from 1925-68.
	A	B	-	-	39		%/2nd yr						
	A	B	-	-	22		%/3rd+ yrs						
Collazo 1981	N	B	-	-	19		% nestling				Idaho 1977-78	lake, mountain ridge	Percent nestling mortality.
Henny 1972	J	B	-	-	64		%/1st yr				US & Canada 1946-65	NS	Values estimated by composite dynamic method based on recoveries of birds banded from 1946-65.
	A	B	-	-	36		%/2nd yr						
	A	B	-	-	22		%/3rd+ yr						
McAloney 1973	N	B	-	-	8.5		%/ 45 days			118	Nova Scotia, CAN 1971	island	Percent mortality by 45 days of age.
Owen 1959	J	-	-	-	71		%/1st yr				US 1916-1945	NS	Estimate for birds banded between 1916 and 1945; as cited in Henny 1972.
	A	-	-	-	29		%/2nd+ yr						

***** SEASONAL ACTIVITIES *****

Reference	Begin	Peak	End	Location	Habitat	Notes
MATING/LAYING						
Collazo 1981	mid Mar			Idaho 1977-78	lake, mountain ridge	
English 1978	mid Mar			nw Oregon 1975	river	
Howell 1932	Nov-Dec		Apr	Florida	NS	As cited in Palmer 1962.
McAloney 1973	mid Apr	earl May	late May	Nova Scotia, CAN 1971	island	
Miller 1943	late Mar		earl Apr	Pennsylvania	NS	As cited in Palmer 1962.
Palmer 1949		late Apr		Maine	NS	As cited in Palmer 1962.
Pratt & Winkler 1985	mid Feb	mid Mar	June	c California 1967-79	coastal canyon	
Wood 1951		Apr		Michigan	NS	As cited in Palmer 1962.

Reference	Begin	Peak	End	Location	Habitat	Notes
HATCHING						
Collazo 1981	mid Apr			Idaho 1977-78	lakes, mountain ridge	
English 1978		earl May		nw Oregon 1975	river	
Hoffman & Curnow 1979	mid May		mid Jul	Ohio 1973	sw Lake Erie	
Werschkul et al. 1977	late Mar	earl May		w Oregon 1974	coastal	
FLEDGING						
Collazo 1981			mid Aug	Idaho 1977-78	lakes, mountain ridge	
English 1978		earl Jul		nw Oregon 1975	river	
Hoffman & Curnow 1979	mid July		mid Sept	Ohio 1973	sw Lake Erie	
Werschkul et al. 1977		Jul		w Oregon 1974	coastal	
FALL MIGRATION						
Bent 1926			mid Oct	Nova Scotia & Manit., CAN	NS	Late date of departure.
Bent 1926			late Oct	Wisconsin	NS	Late date of departure.
Bent 1926			mid Nov	Illinois	NS	Late date of departure.
Hoffman & Curnow 1979		Oct		Ohio 1973	sw Lake Erie	Departure following breeding season.
Palmer 1962	mid Sep		late Oct	northern US	NS	
SPRING MIGRATION						
Bent 1926	mid Feb			Illinois	NS	Early date of arrival.
Bent 1926	late Mar			Nova Scotia, CAN	NS	Early date of arrival.
Bent 1926	mid Mar			Wisconsin & Minnesota	NS	Early date of arrival.

Reference	Begin	Peak	End	Location	Habitat	Notes
Bent 1926	mid Apr			Manitoba, CAN	NS	Early date of arrival.
Collazo 1981	late Feb			Idaho 1977-78	lakes, mountain ridge	First observation of herons on breeding grounds.
Hoffman & Curnow 1979		Mar		Ohio 1973	sw Lake Erie	Arrival for breeding season.
Werschkul et al. 1977	mid Feb		mid Mar	w Oregon 1974	coastal	Arrival at breeding grounds.

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
BODY WEIGHT													
Nelson & Martin 1953 (canandensis)	A	M	-	-	3,800		g		6,300	232	United States	NS	Data from USFWS records (from bird banders, game bag investigations).
	A	F	-	-	3,300		g		5,900	159			
Webster (unpubl.) (canandensis)	A	M	-	-	3,992		g			4,175	NS	NS	As cited in Bellrose 1976.
	A	F	-	-	3,447		g			3,452			
	J	M	-	-	3,402		g			3,406			
	J	F	-	-	3,084		g			3,444			
Ratti et al. 1977 (fulva)	A	F	-	SU	3,043		g +/- 46			134	se Alaska 1973	Glacier Bay	Molting geese captured in July. Values after the +/- in the units column are 95% confidence limits.
	A	M	-	SU	3,690		g +/- 41			175			
Nelson & Martin 1953 (hutchinsii)	A	F	-	-	1,900		g		2,400	37	United States	NS	Data from USFWS records (from bird banders, game bag investigations).
	A	M	-	-	2,000		g		2,700	31			
Estel 1983 (interior)	A	M	-	FA	4,058		g			66	Ilinois 1982-83	lakes in refuges	Fall weights are from October through November; Winter are from December to mid February (pre-migration).
	A	M	-	WI	4,173		g			235			
	A	F	-	FA	3,575		g			74			
	A	F	-	WI	3,652		g			323			
Estel 1983 (interior)	J	M	-	FA	3,567		g			98	Illinois 1982-83	lake	Fall weights are from October - November; winter weights are from December - mid February (pre-migration).
	J	M	-	WI	3,817		g			453			
	J	F	-	FA	3,152		g			90			
	J	F	-	WI	3,345		g			421			
Raveling 1968 (interior)	A	M	-	FA	4,212	35 SE	g	3,799	4,727	44	Illinois 1964-65	orchard, lake	Collected from October 12-24 (fall), November 16-December 9 (winter), and February 10 - March 9 (spring). Juveniles = young of the year. Data also provided for yearlings, but sample sizes were small (6-16); means for yearlings were always larger than juveniles and smaller than adults for the same sex and season.
	J	M	-	FA	3,645	24 SE	g	3,317	3,884	40			
	A	F	-	FA	3,550	31 SE	g	3,147	3,856	45			
	J	F	-	FA	3,067	39 SE	g	2,523	3,629	57			
	A	M	-	WI	4,215	36 SE	g	3,827	4,621	39			
	J	M	-	WI	3,642	29 SE	g	3,317	4,026	46			
	A	F	-	WI	3,573	45 SE	g	3,119	3,827	32			
	J	F	-	WI	3,122	36 SE	g	2,580	3,544	49			
	A	M	-	SP	4,122	31 SE	g	3,856	4,649	45			
	J	M	-	SP	3,582	44 SE	g	3,204	3,941	25			
	A	F	-	SP	3,433	31 SE	g	3,062	3,912	44			
	J	F	-	SP	3,132	31 SE	g	2,778	3,430	33			

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Thornburg et al. 1988 (interior)	B	B	1	FA	3,613	35 SE	g			187	s Illinois 1982-83	lakes in refuge	Months of weighing: (1) Oct - early Nov; (2) Nov - mid Dec; (3) mid Dec - Jan; (4) Jan - early Feb; (5) Feb - early March. Late winter and spring means were significantly lower the next year (3,628 and 3,227 respectively) - authors suggest this was due to severe winter weather and food shortages.
	B	B	2	FA	3,686	54 SE	g			139			
	B	B	3	WI	3,741	42 SE	g			118			
	B	B	4	WI	3,917	31 SE	g			258			
	B	B	5	SP	3,741	19 SE	g			640			
Johnson et al. 1979 (leucopareia)	-	M	-	SU	1,946	136 SD	g				Alaska	Buldir Island	
	-	F	-	SU	1,703	155 SD	g						
Johnson et al. 1979 (leucopareia)	-	M	-	SP	2,110	224 SD	g				California	NS	
	-	F	-	SP	1,863	193 SD	g						
Brakhage 1965 (maxima)	A	M	-	SU	4,960		g			66	Missouri 1963	reservoir, marsh	Resident geese weighed during molting period. Y = yearling.
	Y	M	-	SU	4,760		g			31			
	A	F	-	SU	4,160		g			83			
	Y	F	-	SU	4,140		g			38			
Hanson 1965 (maxima)	A	M	-	-	5,670		g			28	NS	NS	As cited in Bellrose 1976.
	A	F	-	-	5,035		g			25			
	J	M	-	-	4,808		g			29			
	J	F	-	-	4,037		g			15			
Mainguy & Thomas 1985 (maxima)	A	F	L	SP	5,385	59 SE	g			55	Ontario, CAN 1980-81	fields, farms	Breeding condition: L = beginning of laying; I = post-laying (incubating); P = post incubation; M = molting. Non-migratory population.
	A	F	I	SP	3,916	58 SE	g			41			
	A	F	P	SP	3,163	66 SE	g			10			
	A	F	M	SU	3,558	68 SE	g			15			
McLandress & Raveling 1981 (maxima)	A	F	MI	SP	4,040		g			104	Minnesota 1974	lake	Weighed from early February to early March (prior to migration).
	A	M	MI	SP	4,740		g			99			
McLandress & Raveling 1981 (maxima)	J	M	-	SP	4,080		g			42	Minnesota 1974	lake	Prior to migration (early February to early April). Y = yearlings (between 1 and 2 years old).
	J	F	-	SP	3,550		g			44			
	Y	M	-	SP	4,330		g	3,610	5,180	11			
	Y	F	-	SP	3,670		g			19			

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
McLandress & Raveling 1981 (maxima)	A	F	1	WI	3,712		g	3,252	4,117	5	Minnesota 1974	fields near lake	Prior to migration to breeding grounds, geese put on weight quickly. Collection dates: (1) February 12-16; (2) March 4-7; (3) March 14-16; (4) April 4-6.
	A	F	2	SP	3,942		g	3,845	4,160	4			
	A	F	3	SP	4,381		g	4,009	4,901	6			
	A	F	4	SP	5,033		g	4,725	5,243	4			
	A	M	1	WI	4,149		g	3,968	4,433	3			
	A	M	2	SP	4,883		g	4,535	5,128	5			
	A	M	3	SP	5,200		g	5,134	5,266	2			
	A	M	4	SP	5,574		g	5,424	5,725	2			
Johnson et al. 1979 (minima)	-	M	-	-	1,546	200 SD	g				Alaska	NS	
	-	F	-	-	1,312	200 SD	g						
Kortright 1942 (minima)	-	M	-	-	1,542		g			28	NS	NS	As cited in Bellrose 1976.
	-	F	-	-	1,270		g			17			
Nelson & Martin 1953 (minima)	A	M	-	-	2,000		g		2,500	30	United States	NS	Data from USFWS records (from bird banders, game bag investigations).
	A	F	-	-	1,400		g		2,300	20			
Raveling 1978a (minima)	J	M	-	FA	1,360	85 SD	g	1,180	1,510	13	California 1973-74	lakes in refuges	Fall geese collected in late October, winter geese collected in late December.
	J	M	-	WI	1,250	65 SD	g	1,150	1,310	5			
	J	F	-	FA	1,200	90 SD	g	1,070	1,350	18			
	J	F	-	WI	1,070	90 SD	g	940	1,210	8			
Raveling 1979 (minima)	A	M	1	FA	1,540	39 SE	g	1,380	1,705	9	California 1973-74	lakes in refuges	(1) Fall migration (Oct 23); (2) Dec 27; (3) spring migration (April 4-5).
	A	M	2	WI	1,398	33 SE	g	1,230	1,550	10			
	A	M	3	SP	1,487	53 SE	g	1,340	1,665	5			
	A	F	1	FA	1,287	53 SE	g	1,145	1,515	6			
	A	F	2	WI	1,205	33 SE	g	1,125	1,320	5			
	A	F	3	SP	1,295	47 SE	g	1,105	1,650	11			
Raveling 1979 (minima)	A	M	1	SP	1,530	37 SE	g	1,410	1,640	5	Alaska 1973-74	delta	(1) prelaying; (2) day their eggs hatched; (3) early molt.
	A	M	2	SU	1,460	52 SE	g	1,315	1,665	6			
	A	M	3	SU	1,443	32 SE	g	1,260	1,605	9			
	A	F	1	SP	1,387	61 SE	g	1,180	1,530	5			
	A	F	2	SU	1,095	37 SE	g	950	1,295	9			
	A	F	3	SU	1,362	54 SE	g	1,195	1,590	8			
Murphy & Boag 1989 (moffitti)	A	F	1	SP	3,817	229 SD	g			13	Alberta, CAN 1985-86	lakes	Incubation stage: (1) early; (2) late.
	A	F	2	SP	3,186	196.0 SD	g			12			
Nelson & Martin 1953 (moffitti)	A	M	-	-	4,600		g		5,700	9	United States	NS	Data from USFWS records (from bird banders, game bag investigations).
	A	F	-	-	3,500		g		4,300	6			
Yocom 1972 (moffitti)	B	M	-	FA	4,334		g			10	Washington 1940-51	Snake River area	Taken during hunting season.
	B	F	-	FA	3,930		g			9			

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Chapman 1970 (occidentalis)	J	M	-	-	3,163	294 SD	g	2,840	3,664	8	Oregon 1966-67	NS	Banded near Copper River Delta, Alaska; shot in Oregon from late October - early January. Adult values include yearlings (3 males, 2 females).
	J	F	-	-	2,722	265 SD	g	2,300	3,096	7			
	A	M	-	-	3,814	542 SD	g	3,181	4,942	10			
	A	F	-	-	3,038	402 SD	g	2,755	3,749	5			
Chapman 1970 (occidentalis)	A	M	-	WI	3,712		g	2,925	4,317	69	Oregon 1965-66	NS	Average of means of geese collected during December 9-22 and December 23 - January 26.
	J	M	-	WI	3,408		g	2,386	4,260	96			
	A	F	-	WI	3,093		g	2,272	3,806	55			
	J	F	-	WI	2,906		g	2,102	3,522	79			
Chapman 1970 (occidentalis)	A	M	-	FA	3,636		g	2,868	4,459	65	Oregon 1965	NS	Average of means of geese collected during November 10 - 24 and November 25 - December 8.
	J	M	-	FA	3,253		g	1,931	4,658	340			
	A	F	-	FA	3,059		g	2,244	4,044	43			
	J	F	-	FA	2,812		g	1,874	3,635	287			
Johnson et al. 1979 (occidentalis)	-	M	-	-	3,233	261 SD	g				Alaska	NS	
	-	F	-	-	2,640	202 SD	g						
Grieb 1970 (parvipes)	A	M	-	WI	2,769	30 SE	g			184	se Colorado 1951-64	reservoirs, lakes	Primarily parvipes subspecies, but likely to include 5-10% hutchinsii as well.
	A	F	-	WI	2,472	23 SE	g			194			
	J	M	-	WI	2,481	43 SE	g			125			
	J	F	-	WI	2,185	29 SE	g			151			
Nelson & Martin 1953 (parvipes)	A	M	-	-	2,700		g		4,800	113	United States	NS	Data from USFWS records (from bird banders, game bag investigations).
	A	F	-	-	2,500		g		3,900	129			
Johnson et al. 1979 (taverneri)	-	M	-	-	2,606.5	267.4 SD	g				Alaska	NS	
	-	F	-	-	2,420.7	238.2 SD	g						
Yocom 1972 (taverneri)	B	M	-	FA	2,665		g	2,835	2,495	2	e Washington 1940-51	NS	Taken during hunting season.
	B	F	-	FA	2,154		g	1,928	2,604	4			

BODY FAT

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Williams & Kendeigh 1982 (interior)	A	F	1	FA	440		g			2	from s Illinois	captive	Month: (1) Oct-Dec; (2) Jan; (3) Apr; (4) May; (5) June; (6) July.
	A	F	2	WI	550		g			2			
	A	F	3	SP	750		g			1			
	A	F	4	SP	610		g			1			
	A	F	5	SU	570		g			1			
	A	F	6	SU	150		g			1			

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Williams & Kendeigh 1982 (interior)	A	M	1	FA	550		g			2	from s Illinois	captive	Month: (1) Oct-Dec; (2) Feb; (3) Apr; (4) Jun; (5) July.
	A	M	2	WI	860		g			2			
	A	M	3	SP	930		g			2			
	A	M	4	SU	890		g			1			
	A	M	5	SU	330		g			1			
Mainguy & Thomas 1985 (maxima)	A	F	L	SP	726	27 SE	g			55	Ontario, CAN 1980-81	fields, farms	Breeding condition: L = beginning of laying; I = post laying (incubating); P = post incubation; M = molting. Non-migratory population.
	A	F	I	SP	563	26 SE	g			41			
	A	F	P	SP	166	18 SE	g			10			
	A	F	M	SP	436	43 SE	g			15			
McLandress & Raveling 1981 (maxima)	A	F	1	WI	642		g	433	854	5	Minnesota 1974	fields near lake	Prior to migration to breeding grounds, geese put on weight quickly. Collection dates: (1) February 12-16; (2) March 4-7; (3) March 14-16; (4) April 4-6.
	A	F	2	SP	619		g	433	925	4			
	A	F	3	SP	951		g	814	1,096	6			
	A	F	4	SP	1,442		g	1,303	1,577	4			
	A	M	1	WI	580		g	413	724	3			
	A	M	2	SP	639		g	375	948	5			
	A	M	3	SP	881		g	797	964	2			
	A	M	4	SP	1,253		g	1,133	1,372	2			
Peach & Thomas 1986 (maxima)	N	B	1	-	7.1	1.3 SD	g			14	Ontario, CAN 1983	lab	Total body lipids: Age: (1) at hatching; (2) 10 days; (3) 20 days; (4) 25 days.
	J	B	2	-	35	12 SD	g			14			
	J	B	3	-	160	41 SD	g			14			
	J	B	4	-	236	87 SD	g			13			
Thomas et al. 1983 (maxima)	A	F	1	SP	751	45 SE	g			34	Ontario, CAN 1981	captive	Non-migratory population from Toronto. Condition: (1) pre-laying; (2) post laying (incubating); (3) late incubation; (4) molting.
	A	F	2	SP	611	40 SE	g			29			
	A	F	3	SP	166	18 SE	g			10			
	A	F	4	SU	485	37 SE	g			21			
Raveling 1979 (minima)	A	M	1	FA	230	20 SE	g	129	292	9	California 1973-74	lakes in refuges	Total body lipid weight: (1) fall migration (Oct 23); (2) Dec 27; (3) spring migration (April 4-5).
	A	M	2	WI	70	8 SE	g	33	123	10			
	A	M	3	SP	205	19 SE	g	157	265	5			
Raveling 1979 (minima)	A	M	1	SP	56	26 SE	g	26	107	3	Alaska 1973-74	delta	Total body lipid weight: (1) Prelaying; (2) hatch day; (3) early molt.
	A	M	2	SU	53	9 SE	g	27	82	6			
	A	M	3	SU	93	11 SE	g	47	146	9			
Raveling 1979 (minima)	A	F	1	FA	182	24 SE	g	117	264	6	California 1973-74	lakes in refuges	Total body lipid weight: (1) fall migration (Oct 23); (2) Dec. 27; (3) spring migration (April 4-5).
	A	F	2	WI	57	6 SE	g	34	71	5			
	A	F	3	SP	172	25 SE	g	68	362	11			
Raveling 1979 (minima)	A	F	1	SP	171		g	136	205	2	Alaska 1973-74	delta	Total body lipid weight: (1) prelaying; (2) hatch day; (3) early molt.
	A	F	2	SU	33	5 SE	g	14	51	9			
	A	F	3	SU	108	13 SE	g	62	179	8			

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Murphy & Boag 1989 (moffitti)	A A	F F	1 2	SP SP	511 66	127 SD 32 SD	g g			14 12	Alberta, CAN 1985-86	lake	Incubation state: (1) early; (2) late. Energy from fat catabolism supplied 83% of energy requirements during incubation.
EGG WEIGHT													
Owen 1980 (hutchinsii)	-	-	-	-	116		g				NS	NS	As cited by Dunn and MacInnes 1987.
Manning 1978 (interior)	-	-	-	-	150	1.7 SE	g			125	Ontario, CAN 1973	islands	Weighed at an average of 1.5 days after the start of incubation.
Owen 1980 (interior)	-	-	-	-	152		g				NS	NS	As cited by Dunn and MacInnes 1987.
Thomas & Peach Brown 1988 (interior)	-	-	-	-	161.2	14.1 SD	g			544	s Ontario, CAN 1979	lake	
Owen 1980 (leucopareia)	-	-	-	-	127		g				NS	NS	As cited in Dunn and MacInnes 1987.
Owen 1980 (minima)	-	-	-	-	96		g				NS	NS	As cited by Dunn and MacInnes 1987.
LeBlanc 1987a (moffitti)	-	-	-	-	163		g			564	Alberta, CAN 1983-84	lake	Weight of eggs varied by clutch size and by position in the laying order.
Owen 1980 (moffitti)	-	-	-	-	175		g				NS	NS	As cited by Dunn and MacInnes 1987.
Williams (unpubl.) (moffitti)	-	-	-	-	145		g				Utah	NS	Just after laying (i.e., before water loss). As cited in Palmer 1962, 1976.
Kortright 1942 (occidentalis)	-	-	-	-	161		g				NS	NS	As cited by Dunn and MacInnes 1987.
HATCHING WEIGHT													
Sedinger 1986 (minima)	H H	M F	- -	- -	61.8 61.4		g g			4 1	Alaska 1978-79	coastal tundra	Males = 2 days old, female = 3 days old.

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
LeBlanc 1987b (moffitti)	H	M	-	-	108.7		g			90	Alberta, CAN 1983-84	lake	Weight at hatching of birds from six egg clutches. Weights varied by number in clutch and by egg-laying order.
	H	F	-	-	109.5		g			85			
GOSLING WEIGHT													
Sedinger 1986 (minima)	J	F	-	-	150		g day 10				Alaska 1978-79	coastal tundra	Interpolated from graph of age vs. weight; N=27 total. Age (days) is in units column.
	J	F	-	-	450		g day 20						
	J	F	-	-	755		g day 30						
	J	F	-	-	950		g day 40						
	J	F	-	-	1,050		g day 47						
Sedinger 1986 (minima)	J	M	-	-	150		g 10 days				Alaska 1978-79	coastal tundra	Interpolated from graph of age vs. weight, N=25 total. Age (days) is in the units column.
	J	M	-	-	515		g 20 days						
	J	M	-	-	875		g 30 days						
	J	M	-	-	1,100		g 40 days						
	J	M	-	-	1,200		g 47 days						
Williams (unpubl.) (moffitti)	H	B	-	-	110		g day 0			13	NS	NS	Age (days) of goslings is in units column. As cited in Palmer 1976.
	J	B	-	-	240		g day 9			13			
	J	B	-	-	440		g day 16			13			
	J	B	-	-	1,400		g day 30			13			
	J	B	-	-	2,400		g day 44			13			
	J	B	-	-	2,600		g day 51			13			
GOSLING GROWTH RATE													
Williams (unpubl.) (moffitti)	J	-	-	-	50.5		g/day			13	NS	NS	From 1 to 51 days. As cited in Palmer 1976.
FLEDGING WEIGHT													
Sedinger 1986 (minima)	J	M	-	-	1,284	47.2 SE	g			3	Alaska 1978-79	coastal tundra	Males weight was 87% of adult weight, female was 89% of adult weight. Note that N is very small.
	J	F	-	-	1,228		g			1			
LeBlanc 1987b (moffitti)	J	M	-	-	2,360		g 50 days			28	Alberta, CAN 1983	lake	Near fledging (50 days old).
	J	M	-	-	2,030		g 50 days			17			
LEAN (DRY) BODY WEIGHT													
Peach & Thomas 1986 (maxima)	N	B	1		16	2.1 SD	g			14	Ontario, CAN 1983	lab	Age: (1) at hatching; (2) 10 days; (3) 20 days; (4) 25 days.
	J	B	2		76	16 SD	g			14			
	J	B	3		244	25 SD	g			14			
	J	B	4		338	58 SD	g			13			

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
METABOLIC RATE (KCAL BASIS)													
Williams & Kendeigh 1982 (interior)	A A A A	M M M M	1 2 3 4	WI SP SU FA	105 105 115 100		kcal/kg-d kcal/kg-d kcal/kg-d kcal/kg-d				from s Illinois	lab	Existence metabolism at typical breeding ground (Ontario, CAN - spring and summer) and wintering ground (s Illinois - fall and winter) temperatures. Temperature (C) and weight of geese: (1) (December) 4.2 - 4.65 kg; (2) (May) 1.4 - 4.80 kg (average of April and June weight); (3) (July) 13.9 - 3.84 kg; (4) (Nov) 8.8 - 4.65 kg (Oct and Dec weight).
Williams & Kendeigh 1982 (interior)	A A	F F	1 2	SP SU	130 143		kcal/kg-d kcal/kg-d				from s Illinois	lab	Existence metabolism at typical breeding ground (Ontario, CAN - spring and summer) temperatures. Temperature (C) and weight of geese: (1) (May) 1.4 - 3.68 kg; (2) (July) 13.9 - 2.95 kg.
Williams & Kendeigh 1982 (interior)	A A A A	M M M M	1 2 3 4	WI SP SU FA			kcal/kg-d kcal/kg-d kcal/kg-d kcal/kg-d		209 203 253 209		from s Illinois	lab	Maximum free-living metabolism at typical breeding ground (Ontario, CAN - spring and summer) and wintering ground (s Illinois - fall and winter) temperatures. Temperature (C) and weight of geese: (1) (December) 4.2 - 4.65 kg; (2) (May) 1.4 - 4.80 kg (average of April and June weight); (3) (July) 13.9 - 3.84 kg; (4) (Nov) 8.8 - 4.65 kg (Oct and Dec weight).
Williams & Kendeigh 1982 (interior)	A A	F F	1 2	SP SU			kcal/kg-d kcal/kg-d		220 274		from s Illinois	lab	Maximum free-living metabolism at typical breeding ground (Ontario, CAN - spring and summer) temperatures. Temperature (C) and weight of geese: (1) (May) 1.4 - 3.68 kg; (2) (July) 13.9 - 2.95 kg.
FOOD INGESTION RATE													
Joyner et al. 1984 (interior)	A A A A	M F M F	- - - -	WI WI SP SP	0.030 0.033 0.030 0.031		g/g-day g/g-day g/g-day g/g-day			3 5 3 5	from Illinois 1982	captive	Original data in grams dry weight feed, corrected to grams wet weight feed. Feed (i.e., corn, sunflower, seeds, wheat, and milo) contained an average of only 11% moisture.

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Peach & Thomas 1986 (maxima)	N	B	1		49		g/day				Ontario, CAN 1983	lab	Age: (1) 5 days; (2) 10 days; (3) 15 days; (4) 20 days; (5) 25 days. From equation: gosling food consumption (g) = 8.36 x age (days) + 7.32.
	J	B	2		91		g/day						
	J	B	3		133		g/day						
	J	B	4		175		g/day						
	J	B	5		216		g/day						

***** DIET *****

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Buchsbaum et al. 1984	B	B	Zostera marina	27				1553	Massachusetts 1980-83	salt marsh - % frequency; plants observed eaten	Season = late spring and early summer. N = the total numbr of feeding observations. Available plants not eaten were Fucus vesiculosis, Limonium carolinium, Salicornia species, and Solidago semipervirens.
			Spartina alternifl. (tall)	18							
			Poa pratensis	15							
			Enteromorpha spp.	9							
			Juncus gerardi	9							
			Spartina alternifl. (short)	9							
			Spartina patens	8							
			Triglochin maritima	4							
			Iva frutescens	1							
			Phragmites communis	<0.1							
Craven & Hunt 1984	B	B	corn			23		90	ec Wisconsin 1979	marsh - % dry volume; gizzard & proventriculus	Calculated from volumes presented in paper. Only foods found in quantities of > 1ml dry volume were included.
			uniden. plant matter			8.6					
			alfalfa			10.4					
			Gramineae			12.6					
			oats			25.1					
			Setaria lutescens			8.4					
			Trifolium repens			10.9					
Korschgen 1955	-	-	wild millet		36			184	Missouri	NS - % (not specified); "stomach" contents	As cited in Bellrose 1976 (does not sum to 100%; season not specified).
			smartweed seeds		10.1						
			cut grasses		10.2						
			spike rushes		8.3						
			winter wheat		6.1						
			corn		5.5						
			nutgrasses		4.8						
			soybeans		3.2						

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Martin et al. 1951	A	B	sago pondweed FW				25-50	45	w WA, w OR, CA	NS - rough approx. of % diet; "stomach" contents	Eating the vegetative part of the plant and any other part noted in parenthesis. The initial at the end of each plant notes what season that item was important. Geese caught in winter = 35; spring = 0; summer = 1; and fall = 9. Items comprising 2% or less not included here.
			barley (seed) W				10-25				
			hardstem bulrush FW				10-25				
			wheat (seed) W				5-10				
			wildbarley W				5-10				
			bromegrass W				5-10				
			wild oats W				2-5				
Martin et al. 1951	A	B	saltgrass SuFW				10-25	183	w US, mostly Utah	NS - rough approx. of % diet; "stomach" contents	Eating the vegetative part of the plant and any other part noted in parenthesis. The initial at the end of each plant notes what season that item was important. Geese caught in winter = 92; spring = 0; summer = 19; and fall = 72. Items comprising 2% or less not included here.
			sago pondweed SuFW				10-25				
			glasswort FW				10-25				
			wheat SuW				5-10				
			bulrush (seed) FW				5-10				
			widgeongrass SuFW				5-10				
			bromegrass FW				2-5				
			wild barley FW				2-5				
			rabbitfoot grassSuFW				2-5				
			seepweed FW				2-5				
			peppergrass FW				2-5				
Martin et al. 1951	A	B	cordgrass				10-25	10	Gulf coast	NS - rough approx. of % diet; "stomach" contents	Eating the vegetative part of the plant and any other part noted in parenthesis. spring = 0; summer = 1; and fall = 9. Items comprising 2% or less not included here.
			saltgrass				5-10				
			glasswort				5-10				
			bulrush (seeds)				5-10				
			bermuda grass				2-5				
			naiad				2-5				
			lycium				2-5				
Martin et al. 1951	A	B	cordgrass FW				25-50	45	Atlantic coast	NS - rough approx. of % diet; "stomach" contents	Eating the vegetative part of the plant and any other part noted in parenthesis. 44 birds caught in winter, 4 in fall. Items comprising 2% or less not included here. Initial after plant name denotes what season that food was important.
			widgeongrass W				10-25				
			spikerush (seeds) W				10-25				
			sea lettuce W				5-10				
Yelverton & Quay 1959	B	B	sedges				63	294	NC 1951-52, 1953-54	lake - % volume; crop and gizzard contents	Sedges were roots, stems and seeds of spike rush and roots, rhizomes and seeds of American bulrush. From 263 gizzards and 31 crops collected during hunting season. As cited in Bellrose 1976 and Craven 1981.
			native grasses				11				
			corn kernels				22				
			animal				0.01				
			other				4				

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Bell & Klimstra 1970 (interior)	B	B	Glycine max			34.5		561	s Illinois 1953-54	lakes in refuge - % volume; crop (wet/ dry NS)	Collected from November 1 to December 15. Plants comprising less than 2% combined into "other plants."
			Zea mays			25.6					
			Sorghum halpense			12.3					
			Polygonum pennsyl- vanicum			4.8					
			Taxodium distichum			3.0					
			Eleocharis acicularis			2.4					
			Lemna minor			2.0					
			other plants			11.5					
			animal			0.1					
			undetermined			3.8					
Prevett et al. 1985 (interior)	A	B	Equisetum sp. (shoot	9.2				124	Ontario, CAN 1976-80	bay - % dry weight; esophagus, gizzard & proventriculus	Migrant and local pre-nesting geese
			Triglochin palustris (root)	3.4							
			grasses								
			(root)	23.4							
			(shoot)	2.1							
			sedges								
			(shoot)	25.3							
			(root)	5.3							
			(reed)	17.9							
			Plantago maritima (root)	6.5							
			unident. plant	6.1							
			invertebrates	0.7							
McLandress & Raveling 1981 (maxima)	A	B	corn	13			50	8	Minnesota 1974	lake - % occurrence; esophagi, gizzards, and proventriculi	Sample size = 8 for each season; winter (Feb. 12-16); spring (Apr. 4-6).
			bluegrass	75			13				
			roots (unident. sp.)	25			25				
			plant remains (green	25			13				
			spike rush	13							
			bullrush tubers	25							
			millet seeds	13							
			snails	13							
			no food items				38				
Sedinger & Raveling 1984 (minima)	J	B	Triglochin palustris		68			64	Alaska 1977-79	uplands/lowlands - % dry weight; esophagus contents	Goslings.
			Carex mackenzei (leaves)		18						
			C. ramenskii (leaves		1						
			Puccinella phyganodes (leave		1						
			Carex (seeds)		8						
			Empetrum nigrim (see		1						
			E. nigrim (berries)		1						
			other		2						

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Naylor 1953	-	-	BR	-	155		nests/ha				California	NS	Thirty-one nests on 0.5 ha. As cited in Palmer 1962.
Jensen & Nelson 1948	-	-	BR	-	136-163		nests/ha				se Idaho	NS	As cited in Palmer 1962.

HOME RANGE SIZE

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Brakhage 1965 (maxima)	A	M	BR	SP	0.8		ha				Missouri 1961-64	reservoir, marsh	Approximate size of nesting territory defended by "aggressive" males in this resident, managed population.
Eberhardt et al. 1989a (moffitti)	A	F	F	-	983	822 SD	ha	290	2,830	15	sc Washington 1983-4	river	Radiotagged females and broods. Estimate based 75% harmonic mean; values based on three other calculation methods are presented in the paper.
Eberhardt et al. 1989a (moffitti)	A	F	F	-	8.8	4.4 SD	km	2.8	18.1	15	sc Washington 1983-4	river	Length of river used by radiotagged females and broods.

POPULATION DENSITY

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Best et al. 1982	B	B	-	WI	4301		N/ha			6	S Dakota 1979-80	reservoir	N = number of "geese concentrations" found in aerial thermal infrared census of reservoir. Measured N/ha within these concentrations.
Cooper 1978	-	-	-	-			nests/ha	0.02	12.36	14	various locations	NS	Summary of nesting densities found in 14 locations. Both values represent mean densities. As cited in Byrd & Woolington 1983.
Humburg et al. 1985	B	B	1	FA	10.4		N/ha			44.8	Missouri 1955-1984	wildlife refuge	N reflects number of thousands of geese. Data are five year averages for early November of: (1) 1955-59; (2) 1960-64; (3) 1965-69; (4) 1970-74; (5) 1975-79; (6) 1980-84. Total area of refuge is 4,318 ha.
	B	B	2	FA	20.7		N/ha			89.2			
	B	B	3	FA	25.3		N/ha			109.2			
	B	B	4	FA	27.2		N/ha			117.6			
	B	B	5	FA	27.7		N/ha			119.6			
	B	B	6	FA	22.0		N/ha			94.8			

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Humburg et al. 1985	B	B	1	WI	3.6		N/ha			15.5	Missouri 1955-84	wildlife refuge	N represents number of thousands of geese. Data are five year averages for early January of: (1) 1955-59; (2) 1960-64; (3) 1965-69; (4) 1970-74; (5) 1975-79; (6) 1980-84. Total area of the refuge is 4,318 ha.
	B	B	2	WI	11.8		N/ha			50.9			
	B	B	3	WI	9.8		N/ha			42.2			
	B	B	4	WI	9.1		N/ha			39.1			
	B	B	5	WI	10.5		N/ha			45.4			
	B	B	6	WI	3.7		N/ha			15.9			
Byrd & Woolington 1983 (leucopareia)	-	-	1	-	0.35		nests/ha			288	Alaska 1975-77	Buldir Island	Nest density in preferred habitat: (1) "most" preferred = beach rye - umbel community; (2) "next most" preferred = beach rye - umbel - fern community. N = ha of each plant community on the island.
	-	-	2	-	0.16		nests/ha			203			
Geis 1956 (moffitti)	-	-	1	-	16.6		nests/ha			5	Montana 1953-54	wooded islands in lake	Density of nests on islands between (1) 0.2-0.8 ha in size; (2) 0.8-2.2 ha; and (3) 8-121 ha. N = number of islands in each size class.
	-	-	2	-	6.8		nests/ha			4			
	-	-	3	-	1.3		nests/ha			4			
McCabe 1979 (moffitti)	-	-	1	-	0.16-.20		nests/ha				OR, WA 1974-75	islands in river	Major nesting islands (1) largest; (2) smallest; (3) in-between sized islands. Nesting on ground and on man-made nesting platforms. Range is values found in 1974 and 1975.
	-	-	2	-	2.2-4.4		nests/ha						
	-	-	3	-	0.16-1.2		nests/ha						
Bromley (pers. comm.) (occidentalis)	-	-	BR	-			nests/ha		0.707		Alaska 1978	coastal wetland	Highest density found. As cited in Cornely et al. 1985.
Trainer 1959 (occidentalis)	-	-	BR	-	0.417		nests/ha				Alaska 1959	coastal wetland	As cited in Cornely et al. 1985.
Smith & Sutton 1953; 1954 (parvipes)	B	B	BR	SU	0.0051	0.0032 SD	N/ha	0.0013	0.0093	7	Yukon, CAN 1948-54	old crow flats	510,230 hectares sampled; N= number of years sampled. As cited in Grieb 1970.
Smith & Sutton 1953; 1954 (parvipes)	B	B	BR	SU	0.00038		N/ha	0.00031	0.00050	4	NW Terr., CAN 1951-54	forest tundra	25,062,900 hectares sampled; N= number of years sampled. As cited in Grieb 1970.
Smith & Sutton 1953; 1954 (parvipes)	B	B	BR	SU	0.00080	0.000086 SD	N/ha	0.00007	0.0019	5	NW Terr., CAN 1948-54	coastal tundra	2,241,645 hectares sampled; N= number of years sampled. As cited in Grieb 1970.
Smith & Sutton 1953; 1954 (parvipes)	B	B	BR	SU	0.0011	0.0018 SD	N/ha	0.00004	0.0046	6	NW Terr., CAN 1948-53	treeless delta	414,400 hectares sampled; N= number of years sampled. As cited in Grieb 1970.

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Smith & Sutton 1953; 1954 (parvipes)	B	B	BR	SU	0.0025	0.0015 SD	N/ha	0.001	0.0046	6	NW Terr., CAN 1949-54	closed forest	10,739,430 hectares sampled; N= number of years sampled. As cited in Grieb 1970.
CLUTCH SIZE													
MacInnes 1962; MacInnes et al. 1974 (hutchinsii)	-	-	-	-	4.34					580	NW Terr., CAN	river	As cited in Dunn and MacInnes 1987.
Raveling & Lumsden 1977 (interior)	-	-	-	-	4.57					272	Ontario, CAN	Kinoje Lake	As cited in Dunn and MacInnes 1987.
Byrd & Woolington 1983 (leucopareia)	-	-	-	-	5.6	0.1 SE		2	8	188	Alaska 1974-77	Buldir Island	82% of nests contained 5-7 eggs.
Bellrose 1976 (maxima)	-	-	-	-	5.22					2,982	NS	NS	Summary of many studies.
Bultsma et al. 1979 (maxima)	-	-	-	-	5.27					159	S Dakota 1974-75	wetlands/stock ponds	Only incubated nests counted.
Combs et al. 1984 (maxima)	-	-	-	-	5.6			5.2	5.9	277	se AL, sw GA 1977-82	reservoir	Nesting attempts: (1) initial attempt; (2) renesting attempt. Min and Max are yearly averages. Resident flock of mostly maximas, but also some interior and canandensis.
	-	-	1	-	5.9					14			
	-	-	2	-	5.1					14			
Spencer et al. 1951 (minima)	-	-	-	-	4.7					47	Alaska	NS	As cited in Palmer 1976.
Akesson & Raveling 1981 (moffitti)	-	-	-	-	5.5			5	7	11	California 1976-78	captive	
Dow 1943 (moffitti)	-	-	-	-	5.1					355	California	Honey Lake	As cited in Palmer 1976.
Geis 1956 (moffitti)	-	-	1	-	5.55			2	10	169	Montana 1953-54	lake, river	Year: (1) 1953; (2) 1954.
	-	-	2	-	5.15			3	9	189			

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Hanson & Eberhardt 1971; Fitzner & Rickard 1983 (moffitti)	-	-	-	-	5.64					3,816	Washington	NS	Hanford Reach. As cited in Dunn and MacInnes 1987.
Hilley 1976 (moffitti)	-	-	-	-	5.20					248	S Dakota	NS	Waubay, SD. As cited in Dunn and MacInnes 1987.
McCabe 1979 (moffitti)	-	-	-	-	5.9					255	WA, OR 1974-75	islands in river	
Sherwood 1966 (moffitti)	-	-	-	-	5.13					442	Michigan	NS	Seney MI. As cited in Dunn and MacInnes 1987.
Steel et al. 1957 (moffitti)	-	-	-	-	5.2			1	9	365	Idaho 1949-51	Gray's Lake	
Will 1969; Szymczak 1975 (moffitti)	-	-	-	-	4.72					688	Colorado	NS	Larimer County. As cited in Dunn and MacInnes 1987.
Lebeda & Ratti 1983 (occidentalis)	-	-	-	-	4.40					19	Alaska	Admiralty Island	As cited in Dunn and MacInnes 1987.
CLUTCHES/YEAR													
Brakhage 1985 (maxima)	-	-	-	-	1		/year		2		nw Missouri 1983	pond	Canada geese normally attempt 1 brood per year, but may replace clutches lost early in the incubation period. One pair in this study hatched two broods of one gosling each.
DAYS INCUBATION													
Byrd & Woolington 1983 (leucopareia)	-	-	-	-	28		days	27	29	3	Alaska 1974-77	Buldir island	
Brakhage 1965 (maxima)	-	-	-	-	28		days				Missouri 1961-64	reservoir, marshes	Resident population.
Mainguy & Thomas 1985 (maxima)	-	-	-	-	26		days				Ontario, CAN 1980-81	fields, farms	

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Laidley 1939 (minima)	-	-	-	-	25		days				NS	NS	As cited in Palmer 1976.
Mickleson 1973 (minima)	-	-	-	-	26		days	24	30	45	Alaska	Yukon Delta	As cited in Bellrose 1976.
Akesson & Raveling 1981 (moffitti)	-	-	-	-	27		days				California 1976-78	captive	
AGE AT FLEDGING													
Palmer 1976 ("giant")	-	-	-	-	56-63		days				NS	NS	"Giant" in this document refers to the maxima and moffitti subspecies.
MacInnes (pers. comm.) (hutchinsii)	-	-	-	-	52-60		days				NW Terr., CAN	river delta	As cited in Bellrose 1976.
Hanson 1965 (interior)	-	-	-	-	63		days				Ontario, CAN	island in James Bay	As cited in Bellrose 1976.
Lee (pers. comm.) (leucopareia)	-	-	-	-	55		days				NS	captive	Age flight attained; as cited in Byrd & Woolington 1983.
Sherwood 1965 (maxima)	-	-	-	-	71-73		days				Michigan 1963-65	refuge	As cited in Bellrose 1976.
Mickelson 1973 (minima)	-	-	-	-	40-46		days				Alaska	coastal	As cited in Bellrose 1976.
Eberhardt et al. 1989c (moffitti)	-	-	-	-	75-80		days				Washington 1983-84	river	Age when young seen flying.
Moffitt 1931 (moffitti)	-	-	-	-	49-56		days				California	NS	As cited in Bellrose 1976, and Palmer 1976.
N HATCH/ACTIVE NEST													
Geis 1956 (moffitti)	-	-	1	-	3.53		hatch/act			173	Montana 1953-54	lake, river	Number of eggs hatching per active nest: (1) 1953; (2) 1954.
	-	-	2	-	2.22		hatch/act			210			

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
N FLEDGE/ACTIVE NEST													
Eberhardt et al. 1989b (moffitti)	-	-	-	-	2.19	2.42 SD	fledge/act	0	7	27	Washington 1983-84	river	Counts of number of goslings of all breeding radiotagged females surviving to fledging.
N HATCH/SUCCESSFUL NEST													
Combs et al. 1984 (maxima)	-	-	-	-	4.0		hatch/suc				se GA, sw AL 1978-82	reservoir	Number hatching in nests hatching at least one egg.
Geis 1956 (moffitti)	-	-	1	-	5.14		hatch/suc			145	Montana 1953-54	lake and river	Number hatching per each nest successfully hatching young: 1953; (2) 1954.
	-	-	2	-	4.64		hatch/suc			115			
Steel et al. 1957 (moffitti)	-	-	-	-	4.4		hatch/suc				Idaho 1949-59	Gray's Lake	Number hatching in nests hatching at least one egg.
N FLEDGE/SUCCESSFUL NEST													
Dey 1966	-	-	-	-	3.9		fledge/suc				Utah	Ogden Bay	Number fledging per pair of adults fledging at least one gosling. As cited in Bellrose 1976.
Hardy & Tacha 1989 (interior)	-	-	1	-	1.3		fledge/suc				IL, WI 1985-87	lake	Number of young in family groups - counted from October through April on wintering grounds. Parental age: (1) 2.5-4.5 years; (2) > 5 years.
	-	-	2	-	2.2		fledge/suc						
Byrd & Woolington 1983 (leucopareia)	-	-	-	-	3.99	0.008 SE	fledge/suc	1	7	255	Alaska 1976	Buldir Island	Number fledged per pair fledging at least one young; based on family counts.
Raveling 1981 (maxima)	-	-	1	-	2.3	0.39 SE	fledge/suc			12	Manitoba, CAN	lake	Number raised from hatch to fledge by pairs fledging at least one young. Age: (1) 2 years; (3) 3 & 4 years; (4) 4+ to 18 years.
	-	-	2	-	2.9		fledge/suc			27			
	-	-	3	-	3.7	0.22 SE	fledge/suc			76			
Eberhardt et al. 1989b (moffitti)	-	-	-	-	3.93	1.87 SD	fledge/suc	1	7	15	Washington 1983-84	river	Counts of number of goslings of successful radiotagged females surviving to fledging.

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
PERCENT NESTS SUCCESSFUL													
Byrd & Woolington 1983 (leucopareia)	-	-	-	-	91		%/yr	89	93	188	Alaska 1975-76	Buldir Island	Percent hatching at least one egg; island does not have any mammalian predators.
Bultsma et al. 1979 (maxima)	-	-	-	-	57		%/yr			159	w S Dakota 1974-75	stockponds/wetlands	Percent hatching at least one egg.
Combs et al. 1984 (maxima)	-	-	-	-	44		%/yr	27	64	323	se AL, sw GA 1977-82	reservoir	Percent hatching at least one egg; resident flock descended from mostly maxima, but some interior and canandensis.
Geis 1956 (moffitti)	-	-	-	-	61		%/yr	51	73	423	Montana 1953-54	lake, river	Percent hatching at least one egg.
LeBlanc 1987c (moffitti)	-	-	-	-	53		%/yr	49	58	118	Alberta, CAN 1983-84	lake	Percent hatching at least one egg.
AGE AT SEXUAL MATURITY													
MacInnes & Dunn 1988 ("small")	-	B	-	-	2-3		years				NW Terr., CAN 1965-71	river	"Small" subspecies were hutchinsii and parvipes.
Palmer 1962 ("large")	-	B	-	-			years	2			NS	NS	
Moser & Rusch 1989 (interior)	-	F	-	-	4-5		years	2			Manitoba, CAN 1981-84	coastal	Mean age at first nesting; most 2, 3, and 4 year olds did not nest.
Brakhage 1965 (maxima)	-	M	-	-	2-3		years	1			Missouri 1961-64	reservoir, marsh	Resident population.
	-	F	-	-	2-3		years	2					
ANNUAL MORTALITY													
Samuel et al. 1990	A	B	1	-	21.4		%/yr				Wisconsin 1974-80	wildlife refuge	Band location: (1) leg banded; (2) neck banded. Neck vs. leg banding results were significantly different for the juvenile data, but not significantly different for the adult data. Difference thought to be due primarily to higher reporting percentage of neck bands. Subspecies not specified.
	A	B	2	-	23.1		%/yr						
	J	B	1	-	31.5		%/yr						
	J	B	2	-	41.4		%/yr						

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Chapman et al. 1969 (fulva)	A	B	-	-	33.5		%/yr				Alaska 1956-65	NS	Banded as adults; as cited in Bellrose 1976.
Hanson & Smith 1950 (interior)	J	B	-	-	65.4		%/yr				Illinois 1940-47	lake	As cited in Bellrose 1976.
	B	B	-	-	52.0		%/yr						
Vaught & Kirsch 1966 (interior)	J	M	-	-	62.6		%/yr				Missouri 1950-60	NS	Banded as immatures; as cited in Bellrose 1976.
	J	F	-	-	53.1		%/yr						
	A	M	-	-	35.4		%/yr						
	A	F	-	-	24.4		%/yr						
	B	M	-	-	49.5		%/yr						
	B	F	-	-	35.4		%/yr						
Brakhage et al. 1987 (maxima)	J	-	1	-	43		%/yr			229	Missourri 1983	lake	(1) Gosling mortality.
Brakhage 1965 (maxima)	J	B	-	-	32		% to fledge	20	36		Missouri 1961-64	reservoir, marsh	Gosling mortality from hatching to fledging; resident population.
Bultsma et al. 1979 (maxima)	J	B	-	-	16		% to fledge			159	S Dakota 1974-75	wetlands/stock ponds	Gosling mortality from hatching to fledging; N reflects number of nests in the study.
Cummings 1973 (maxima)	J	B	-	-	37.0		%/yr				Ohio 1968	NS	Banding study; as cited in Bellrose 1976.
	A	B	-	-	22.9		%/yr						
	B	B	-	-	28.4		%/yr						
Gulden & Johnson 1968 (maxima)	A	B	-	-	45.8		%/yr				Minnesota 1961-66	NS	Banded as adults; as cited in Bellrose 1976.
Sherwood 1965 (maxima)	-	-	-	-	35		%/yr				Michigan 1962-64	NS	As cited in Bellrose 1976.
West 1982 (maxima)	J	B	-	-	74		% to fledge				Missouri 1977-79	reservoir, marsh	Gosling mortality from hatching to fledging; as cited in Brakhage et al. 1987.
Nelson & Hansen 1959 (minima)	J	B	-	-	46.0		%/yr				Alaska 1949-54		Banded as immatures; as cited in Bellrose 1976.
	A	B	-	-	35.9		%/yr						
Eberhardt et al. 1989b (moffitti)	J	B	-	-	50.9	0.4 SE	% to fledge			152	Washington 1983-84	river	Gosling mortality from hatching to fledging.

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Geis 1956 (moffitti)	J	B	-	-	19		% to fledge			1,390	Montana 1953-54	river, lake	Gosling mortality form hatching to fledging. N = number that hatched.
Hanson & Eberhardt 1971 (moffitti)	A	B	-	-	30		%/yr				Washington 1950-60	NS	Banded as immatures; as cited in Bellrose 1976.
	J	B	-	-	40		%/yr						
Martin 1964 (moffitti)	J	M	-	-	63		%/yr				Utah 1952-58	Ogden Bay Refuge	As cited in Bellrose 1976.
	J	F	-	-	65		%/yr						
	A	M	-	-	46		%/yr						
	A	F	-	-	50		%/yr						
Martin 1964 (moffitti)	J	B	-	-	53		%/yr				Utah 1946-58	Bear River	Banded as immatures; as cited in Bellrose 1976.
	J	M	-	-	47		%/yr						
	J	F	-	-	47		%/yr						
	A	B	-	-	38		%/yr						
	A	M	-	-	40		%/yr						
	A	F	-	-	36		%/yr						
Rienecker 1987 (moffitti)	A	B	-	-	28	0.8 SD	%/yr				ne CA, w NV 1949-1979	lakes	Based on band recoveries from approximately 33,000 geese banded on nesting and molting areas; includes harvest and natural mortality.
	J	B	-	-	49	3.7 SD	%/yr						
Chapman et al. 1969 (occidentalis)	A	M	-	-	38.8		%/yr				Alaska 1952-59	NS	Banded as immatures; as cited in Bellrose 1976.
	J	M	-	-	58.8		%/yr						
	A	F	-	-	32.1		%/yr						
	J	F	-	-	53.5		%/yr						
Grieb 1970 (parvipes)	B	B	-	-	23.8		%/yr			1,540	Texas 1955-59	shortgrass prairie	Calculated using composite dynamic & relative recovery rate methods (Geis & Taber 1963).
Grieb 1970 (parvipes)	J	B	-	-	28.8		%/yr			4,052	Banded in CO 1951-64	shortgrass prairie	Calculated using composite dynamic recovery rate method (Geis & Taber 1963). N= number of geese banded.
	A	B	-	-	27.2		%/yr			3,168			
	B	M	-	-	41.0		%/yr			1,825			
	B	F	-	-	37.1		%/yr			1,857			
	B	B	-	-	28.0		%/yr			7,220			
Timm 1974 (taverneri)	J	B	-	-	45.6		%/yr				Alaska 1948-58	NS	Mortality in first year after banding; as cited in Bellrose 1976.
	A	B	-	-	24.0		%/yr						

*** SEASONAL ACTIVITIES ***

Reference	Begin	Peak	End	Location	Habitat	Notes
MATING/LAYING						
Bellrose 1976	earl Mar			California		Summary of several studies (i.e., Dow 1943; Naylor 1953; Miller & Collins 1953; Rienecker & Anderson 1960)
Collias & Jahn 1959	Apr 4			Wisconsin	marsh	As cited in Bellrose 1976.
Byrd & Woolington 1983 (leucopareia)	late May	late May	earl Jun	Alaska 1974-77	Buldir Island	
Brakhage 1965 (maxima)	mid Mar			Missouri 1961-64	reservoir, marsh	Resident population.
Combs et al. 1984 (maxima)	late Feb	Mar-Apr	mid May	se GA, sw AL 1972-82	reservoir	Resident poulation descended from primarily maxima but also some interior and canandensis.
Mainguy & Thomas 1985 (maxima)	earl Apr		mid Apr	Ontario, CAN 1981-82	farms, fields	
Mickleson 1973 (minima)	late May			Alaska	Yukon Delta	As cited in Bellrose 1976.
Akesson & Raveling 1981 (moffitti)		mid/late Mar		California 1976-78	captive	
Geis 1956 (moffitti)	mid Mar	late Mar-Apr	May	w Montana 1953-54	lake in valley	About 3,000 ft elevation; at 6,500 feet was about two weeks later.
McCabe 1979 (moffitti)	earl Mar	late Mar		OR, WA 1974-75	islands in river	
Steel et al. 1957 (moffitti)	earl Apr	mid Apr	earl May	Idaho 1959-51	Gray’s Lake	
Trainer 1959 (occidentalis)	mid May			Alaska	coastal wetlands	As cited in Bellrose 1976.

Reference	Begin	Peak	End	Location	Habitat	Notes
HATCHING						
Byrd & Woolington 1983 (leucopareia)		earl Jul		Alaska 1974-77	Buldir Island	
Combs et al. 1984 (maxima)	Mar	Apr - May	earl Jun	se GA, sw AL 1977-82	reservoir	Resident flock of primarily maxima, with some interior and canadensis also.
Sedinger & Raveling 1986 (minima)	mid Jun	mid-late Jun	mid Jul	Alaska 1977-79	river- up & lowlands	Hatching was highly synchronous each year.
Geis 1956 (moffitti)	mid Apr	late Apr-May	late May	w Montana 1953-54	lake in valley	About 3,000 ft elevation; at 6,500 feet was about two weeks later.
Steel et al. 1957 (moffitti)	earl May	mid May	late Jun	Idaho 1959-51	Gray's Lake	
FALL/BASIC MOLT						
Williams & Kendeigh 1982 (interior)	late Jun		late Oct	s Illinois	captive outside	Wing molt began in late June, body molt began in August when flight feathers were 70-80% regrown.
Byrd & Woolington 1983 (leucopareia)	mid Jul	mid Aug	late Aug	Alaska 1974-77	Buldir Island	Wing molt.
Mainguy & Thomas 1985 (maxima)		Jun 25		Ontario, CAN 1981-82	fields, farms	
Steel et al. 1957 (moffitti)	mid Jun			Idaho 1959-51	Gray's Lake	Wing molt.
FALL MIGRATION						
Bell & Klimstra 1970 (interior)	mid Sep	Nov		arrive S Illinois	refuges	Population often continues farther south in late Dec-early Jan when food becomes scarce.
Byrd & Woolington 1983 (leucopareia)		Sep		Alaska 1974-77	island	

Reference	Begin	Peak	End	Location	Habitat	Notes
Raveling 1978b (maxima)	Sep 20		Nov 20	Manitoba, CAN 1968-75	lake	Migrating south from Manitoba.
Grieb 1970 (parvipes)	Oct	earl Nov	mid Dec	arriving CO, TX	lakes in refuges	Coming from Yukon and North West Territories, Canada.
SPRING MIGRATION						
Bell & Klimstra 1970 (interior)	Feb	earl Mar		leave S Illinois	refuges	
Prevett et al. 1985 (interior)	mid Apr		earl May	Ontario, CAN 1976-80	bay	Migrating through the James Bay area.
Byrd & Woolington 1983 (leucopareia)	earl May	mid May		arrive Alaska 1974-7	Buldir Island	
Raveling 1978b (maxima)	late Mar	earl Apr		leave Minnesota	lakes	

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***** MALLARD *****

*** NORMALIZING AND CONTACT RATE FACTORS ***

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
BODY WEIGHT													
Bellrose & Hawkins 1947	A	M	-	FA	1,240		g			631	Illinois	NS	As cited in Palmer 1976.
	J	M	-	FA	1,170		g			730			
	A	F	-	FA	1,080		g			402			
	J	F	-	FA	1,030		g			671			
Bellrose 1976	A	M	-	-	1,247		g			1,809	NS	NS	
	A	F	-	-	1,107		g			1,417			
Delnicki & Reinecke 1986	A	M	-	WI	1,246	108 SD	g			1,308	w Mississippi 1979-83	NS	Alluvial Valley.
	A	F	-	WI	1,095	106 SD	g			453			
Delnicki & Reinecke 1986	J	M	-	WI	1,181		g			169	w Mississippi 1979-83	NS	Alluvial Valley.
	J	F	-	WI	1,040		g			188			
Heitmeyer 1988a	A	F	-	FA	1,010	24 SE	g			11	se Missouri 1981-83	Mingo Basin	The fall middle prealternate molt.
Heitmeyer 1988a	A	F	-	WI	1,118	21 SE	g			44	se Missouri 1981-83	Mingo Basin	Females initiating the prebasic molt.
Heitmeyer 1988a	A	F	-	WI	983	20 SE	g			21	se Missouri 1981-83	Mingo Basin	Females in midwinter, alternate plumage, unpaired.
Heitmeyer 1988a	A	F	-	WI	1,280	13 SE	g			10	se Missouri 1981-83	Mingo Basin	Females in basic plumage; prespring migration departure.
Krapu & Doty 1979	A	F	1	SP	1,197	104.9 SD	g			41	N Dakota 1974-76	prairie potholes	All are nesting females. Age Y = yearlings. Month: (1) April; (2) May; (3) June.
	Y	F	1	SP	1,137	106.9 SD	g			21			
	A	F	2	SP	1,079	104.5 SD	g			60			
	Y	F	2	SP	1,028	96.5 SD	g			20			
	A	F	3	SU	1,012	134.1 SD	g			4			
	Y	F	3	SU	889	13.6 SD	g			3			
Lokemoen et al. 1990a	A	M	-	SP	1,206		g		1277	660	c N Dakota 1976-81	uplands, wetlands	Maximum value represents mean of birds weighed during March 21-March 31; following this period males lost approximately 10% of body weight until about mid May when they began gaining weight again.
Nelson & Martin 1953	A	M	-	-	1,225		g		1,814	3963	US	NS	Data from US FWS records (from banders, game bag investigations).
	A	F	-	-	1,043		g		1,633	3169			

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Poole 1938	A	F	-	-	1,234		g			2	NS	NS	
Whyte & Bolen 1984	A	M	-	WI	1,237	118 SD	g			87	Texas 1980-82	s high plains	Late winter (January 8 to February 9).
	A	F	-	WI	1,088	105 SD	g			42			
Whyte & Bolen 1984	J	M	-	FA	1,214	121 SD	g			18	Texas 1980-82	s high plains	Late winter (January 8 to February 9).
	J	F	-	FA	996	145 SD	g			20			
BODY FAT													
Heitmeyer 1988a	A	F	1	-	>200		g				se Missouri 1981-83	wetlands	(1) Females beginning prebasic molt.
Krapu & Doty 1979	A	F	1	-	105.9	34.3 SD	g			19	N Dakota 1974-76	prairie potholes	All are nesting females. Age Y = yearling. Month: (1) April; (2) May; (3) June.
	Y	F	1	-	81.8	36.6 SD	g			8			
	A	F	2	-	49.4	29.8 SD	g			19			
	Y	F	2	-	39.5	16.3 SD	g			5			
	A	F	3	-	22.2	21.9 SD	g			4			
	Y	F	3	-	9.6	8.3 SD	g			3			
Whyte & Bolen 1984	A	M	NB	WI	174	66 SD	g			87	Texas 1980-82	s high plains	Late winter (January 8 to February 9). Percent fat is of body weight: males = 14%; females = 15%.
	A	F	NB	WI	171	56 SD	g			42			
Whyte & Bolen 1984	J	M	NB	WI	171	67 SD	g			18	Texas 1980-82	s high plains	Late winter (January 8 to February 9). Percent fat is of total body weight: males = 14%, females = 13%.
	J	F	NB	WI	128	72 SD	g			20			
EGG WEIGHT													
Eldridge & Krapu 1988	-	-	-	-	52.2		g	32.2	66.7	613	N Dakota	plains	
Eldridge & Krapu 1988	-	-	-	-	53.7		g	39.7	68.8	484	N Dakota	captivity	Some of the variation in egg weight induced by feeding of various diets.
Lokemoen et al. 1990b	-	-	1	-	49.3	3.5 SD	g			27	c N Dakota 1976-81	uplands, wetlands	(1) Fresh egg; (2) pipped egg.
	-	-	2	-	45.5	3.9 SD	g			302			
HATCHING WEIGHT													
Lokemoen et al. 1990b	-	-	-	-	32.4	2.4 SD	g			36	c N Dakota 1976-81	uplands, wetlands	One-day-old young: 42% were dry and 58% were damp at time of weighing.

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
DUCKLING WEIGHT													
Lokemoen et al. 1990b	-	B	1	-	32.4	2.4 SD	g - 3.5 d			36	c N Dakota 1976-81	wetlands, grasslands and croplands	Weights for age groups depicted under units column: (1) 3.5 days old, both males and females, (2) 9.5 days old, females only, and so on. Flying by 56 days of age.
	-	F	2	-	115.3	37.3 SD	g - 9.5 d			6			
	-	F	3	-	265.0	91.9 SD	g - 15.5 d			2			
	-	F	4	-	288.9	60.5 SD	g - 22.0 d			14			
	-	F	5	-	401.2	92.2 SD	g - 30.5 d			20			
	-	F	6	-	575.0	152.9 SD	g - 40.5 d			22			
	-	F	7	-	774.3	124.9 SD	g - 50.5 d			38			
	-	F	8	-	740.0	114.9 SD	g - 56.0 d			5			
Lokemoen et al. 1990b	-	B	1	-	32.4	2.4 SD	g - 3.5 d			36	c N Dakota 1976-81	wetlands, grasslands and croplands	Weights for age groups depicted under units column: (1) 3.5 days old, both males and females, (2) 9.5 days old, males only, and so on. Flying by 56 days of age.
	-	M	2	-	92.2	11.5 SD	g - 9.5 d			4			
	-	M	3	-	215.0	5.0 SD	g - 15.5 d			3			
	-	M	4	-	343.2	75.3 SD	g - 22.0 d			11			
	-	M	5	-	460.3	93.4 SD	g - 30.5 d			30			
	-	M	6	-	648.4	128.4 SD	g - 40.5 d			19			
	-	M	7	-	863.9	102.1 SD	g - 50.5 d			31			
	-	M	8	-	817.1	91.4 SD	g - 56.0 d			7			
FLEDGING WEIGHT													
Lokemoen et al. 1990b	J	M	-	-	817.1	91.4 SD	g			7	c N Dakota	uplands, wetlands	Average age = 56 days. Author suggests that weight loss may be associated with onset of flight.
	J	F	-	-	740.0	114.9 SD	g			5			
LEAN (DRY) BODY WEIGHT													
Whyte & Bolen 1984	A	M	NB	WI	260		g				Texas	s high plains	
	A	F	NB	WI	220		g						
Whyte & Bolen 1984	A	M	NB	FA	263.3		g	260	270	22	Texas	s high plains	Average of three intervals between Nov 2 and Dec 14. Min = average value for Nov 2 to 15. Max = average value for Dec 1 to 14.
	A	F	NB	FA	245		g	240	250	14			
METABOLIC RATE (KCAL BASIS)													
McEwan & Koelink 1973	A	B	1	-	104		kcal/kg-d				Canada	lab	Resting - estimated from figure. Temperature (degrees C): (1) 0; (2) 10; (3) 15-25. Measured O2 consumption and CO2 production to estimate kcal values; 43 observations on 9 birds.
	A	B	2	-	85		kcal/kg-d						
	A	B	3	-	80		kcal/kg-d						

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Whyte & Bolen 1984	A	M	1	WI	220		kcal/kg-d				Texas 1980-82	NS	Estimate of daily existence energy requirements for wintering ducks at (1) 0 C; (2) -10 C; (3) -20 C. Data converted from kcal/day to kcal/kg-day using mean weight of females (1,058 g) and males (1,233 g).
	A	F	1	WI	280		kcal/kg-d						
	A	M	2	WI	290		kcal/kg-d						
	A	F	2	WI	365		kcal/kg-d						
	A	M	3	WI	358		kcal/kg-d						
	A	F	3	WI	440		kcal/kg-d						

***** DIET *****

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Delnicki & Reinecke 1986	A	B	soybeans				28.8	311	Mississippi 1979-82	NS - % dry weight; esophagus contents	
			rice				19.8				
			non-agricultural								
			jungle-rice				4.3				
			broadleaf grass				1.8				
			fall panicum				0.5				
			rice cutgrass				26.7				
			flat sedge				1.2				
			dotted smartweed				3.8				
			animals								
			snails				1.5				
Dillon 1959	A	B	rice				24.3	106	Louisiana 1954-58	coast marsh, coast prairie - % volume; gullet contents	Collected in November, December, and January.
			jungle rice				20.7				
			brownseed paspalum				19.2				
			barnyardgrass				8.0				
			red rice				8.0				
			knot grass				6.5				
			signal grass				2.5				
			coast cockspur				1.9				
			Jamaica sawgrass				1.3				
			snails				1.0				
			flatsedge				1.0				
			insects				0.7				
			fall panic				0.6				
			unidentified vegetation				0.4				
			birdeye				0.3				
			swamp smartweed				0.2				
			squarestem spikesedge				0.2				
			smartweed				TR				
			schreber watershield				TR				

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Dillon 1959	A	B	rice				20.4	125	Louisiana 1954-58	coast marsh, coast prairie - % volume; gizzard contents	Collected in November, December, and January.
			unidentified vegetation				18.0				
			Jamaica sawgrass				13.6				
			junglerice				11.0				
			squarestem spikesedge				8.5				
			brownseed paspalum				8.1				
			barnyard grass				3.3				
			schreber watershield				3.2				
			stonewort				2.4				
			coast cockspur				1.8				
			knotgrass				1.7				
			red rice				1.6				
			flatsedge				1.4				
			smartweed				0.7				
			insects				0.5				
			signalgrass				0.3				
			birdeye				TR				
			California bulrush				TR				
Jorde et al. 1983			(plant total)				(96.8)	68	sc Nebraska 1979-80	river, agricultural area - % dry weight, esophagus contents	Data collected from 11 December to 13 March.
			corn				51.7				
			Polygonum spp. (seeds)				9.6				
			Echinochloa muricata (seeds)				3.8				
			Milo				2.6				
			Lemma minor (vegetation)				12.6				
			other plant				16.5				
			(animal total)				(3.2)				
			mollusca				2.9				
			insecta				0.3				
Martin et al. 1951	A	B	pondweed seed/veg.				10-25	87	OR, WA, CA	NS - rough approximation of % diet; stomach contents	Ducks shot in winter = 58, in fall = 29. Items in the 0.5 - 2% category not included here.
			bulrush				10-25				
			barley				5-10				
			spikerush				2-5				
			watermilfoil				2-5				
			smartweed				2-5				
			oats				2-5				
			marestail seed/veg.				2-5				
			cowlily				2-5				
			burreed				2-5				
			waterhemlock				2-5				
			arrowgrass				2-5				

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Martin et al. 1951	A	B	wild millet				5-10	266	se United States	NS	Items in the 0.5 - 2% category not included here.
			smartweed				5-10			-	
			bulrush				5-10			rough approximation of % diet; stomach contents	
			duckweed (veg.)				5-10				
			spikerush				5-10				
			pondweed (seed/veg.)				5-10				
			rice				5-10				
			naiad (seed/veg.)				2-5				
			widgeongrass				2-5				
			oak				2-5				
			arrowhead (tuber)				2-5				
			coontail (seed/veg.)				2-5				
			buttonbrush				2-5				
			chufa (tuber/seed)				2-5				
			bald cypress				2-5				
McAtee 1918	A	B	grasses		13.4			1578	US, CAN	NS	Data predominantly from Louisiana, but also from 22 other states and 2 Canadian provinces. Season not specified. As cited in Palmer 1976.
			sedges		21.6					-	
			smartweed seeds		9.9					percent (type NS) stomach contents	
			pondweeds		8.2						
			duckweeds		12.0						
			wild celery		4.3						
			tree seeds		8.2						
			misc. seeds		8.9						
			insects		2.7						
			snails		5.7						
Perret 1962	A	M	invertebrates					50	Manitoba, CAN	NS	As cited in Swanson & Meyer 1973. Evaluated in spring and summer.
			(primarily Insecta)	46						-	
			other	54						% by volume	
Perret 1962	A	F	invertebrates					46	Manitoba, CAN	NS	As cited in Swanson & Meyer 1973. Evaluated in spring and summer.
			(primarily Insecta)	64						-	
			other	36						% by volume	
Perret 1962	J	B	invertebrates					19	Manitoba, CAN	NS	As cited in Swanson & Meyer 1973. Evaluated in spring and summer.
			(primarily Insecta)	99						-	
			other	1						% by volume	
Stoudt 1944	B	B	seeds					306	Minnesota 1940	NS	As cited in Palmer 1976.
			Zizamia aquatica			35.5				-	
			Potamogeton strictifolius			22.8				% diet; measure NS	
			Sparganium chlorocarpum			11.1					

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Swanson, unpublished data	A	F	Mollusca		(14)			15	sc N Dakota 1969-76	prairie potholes - % wet volume; esophagus contents	All birds were laying females. As cited in Swanson et al. 1979. TR = trace.
			Gastropoda								
			Lymnaea spp.		14						
			Insecta		(14)						
			Odenata		5						
			Coleoptera		TR						
			Lepidoptera		7						
			Diptera		2						
			Crustacea		(16)						
			Anostraca		TR						
			Conchostraca		9						
			Ostracoda		TR						
			Cladocera		6						
			Amphipoda		1						
			Annelida		(26)						
			Oligochaeta (terrestrial)		24						
			Hirudinea		2						
			Vegetation		3						
			Fruits		(27)						
			Echinochloa crusgalli		15						
			misc.		12						
Swanson et al. 1985	A	M	seeds			86		63	North Dakota 1974-76	prairie potholes - % wet weight, esophagus contents	Estimated from Figure 1. Birds shot by hunters.
			vegetation			12					
			animal			2					
Swanson et al. 1985	A	F	seeds			100		20	North Dakota 1974-76	prairie potholes - % wet weight, esophagus contents	Estimated from Figure 1. Birds shot by hunters.
Swanson et al. 1985	A	F	MONTH	APRIL	MAY	JUNE		37	sc N Dakota 1974-80	prairie potholes - % wet volume; esophagus contents	Diet of laying females over the course of the breeding season.
			(total animal)	(67.8)	(66.8)	(89.4)					
			gastropods	TR	24.9	16.5					
			insects	13.1	25.6	48.1					
			crustaceans	7.9	15.1	13.9					
			annelids	38.3	0.2	10.9					
			misc. animal	8.5	1.0	-					
			(total plant)	(32.2)	(33.2)	(10.6)					
			seeds	28.7	28.7	10.6					
			tubers	2.4	4.3	-					
			stems	1.1	0.2	-					

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Swanson et al. 1985	A	M	(total animal)	(37.6)				39	sc N Dakota 1974-80	prairie potholes - % wet volume, esophagus contents	Season is breeding season.
			gastropods	6.3							
			insects	16.8							
			crustaceans	11.3							
			(total plant)	(62.4)							
			seeds	56.4							
			vegetation	6.0							
			roots and tubers	4.1							
Swanson et al. 1985	A	F	(total animal)	(37.0)				41	sc N Dakota 1974-80	prairie potholes - % wet volume, esophagus contents	Non-laying females during the breeding season.
			gastropods	4.5							
			insects	22.6							
			crustaceans	7.5							
			(total plant)	(63.0)							
			seeds	58.5							
			vegetation	4.5							
			roots and tubers	3.9							
Swanson et al. 1985	A	F	(total animal)	(71.9)				37	sc N Dakota 1974-80	prairie potholes - % wet volume, esophagus contents	Laying females during the breeding season. Consumption of invertebrates by laying females was significantly different from that of non-laying females and males.
			gastropods	16.4							
			insects	27.1							
			crustaceans	12.9							
			oligochaetes	11.8							
			(total plant)	(28.1)							
			seeds	24.8							
			vegetation	3.3							
			roots and tubers	2.8							

***** POPULATION DYNAMICS *****

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
HOME RANGE SIZE													
Dwyer et al. 1979	A	F	1	-	467.8	158.6 SD	ha	306.6	718.9	6	N Dakota 1973-75	prairie potholes, semi-arid	(1) Total home range; (2) laying home range.
	A	F	2	-	110.9	75.6 SD	ha	38.1	239.8	6			
Dzubin 1955	-	-	-	-	> 283		ha				Manitoba, CAN	NS	As cited in Palmer 1976 and Bellrose 1976.
Gilmer et al. 1975	A	F	-	SP	210		ha	66		12	Minnesota 1968-72	upland forest	Average minimum home range size. N = prenesting period; L = laying period.
	A	M	-	SP	240		ha			12			
	A	F	N	SP	135		ha			8			
	A	F	L	SP	70		ha			8			
	A	B	-	SP			ha		760				
Kirby et al. 1985	A	F	-	SP	540		ha	40	1440	8	Minnesota 1971-72	wetlands, river	
	A	M	-	SP	620		ha	70	1140	5			

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
POPULATION DENSITY													
Bellrose 1976	-	-	BR	-	0.0305		N/ha				n Montana	NS	
Duebbert & Kantrud 1974	A A	B B	1 2	SP SP	0.0270 0.0502	0.0062 SE 0.0073 SE	pairs/ha pairs/ha			15 20	n c S Dakota 1971	prairie potholes	Breeding pair density: (1) in area without predator reduction; (2) in area where egg predators were reduced.
Duebbert & Lokemoen 1976	A A A	B B B	1 2 3	SP SP SP	0.0265 0.0488 0.0377		pair/ha pair/ha pair/ha			43 79 276	S Dakota 1971-73	prairie potholes, fields	Density of breeding pairs: (1) 1971; (2) 1972; (3) 1973. Ducks seemed to show a preference for idle fields, rather than farmed or grazed ones.
Dzubin 1955	-	B	-	SU	1.5		pairs/ha				Alberta, CAN	NS	As cited in Palmer 1976.
Johnson et al. 1988	- - - - -	- - - - -	1 2 3 4 5	SU SU SU SU SU	0.0046 0.0069 0.033 0.0014 0.014		nests/ha nests/ha nests/ha nests/ha nests/ha				ND, SD, MT 1983	prairie potholes	Type of area: (1) grassland; (2) hayland; (3) planted cover; (4) cropland; (5) wetland.
Kantrud & Stewart 1977	A A A A A A	B B B B B B	1 2 3 4 5 6	SU SU SU SU SU SU	0.667 0.449 0.286 0.043 0.273 0.295		pairs/ha pairs/ha pairs/ha pairs/ha pairs/ha pairs/ha				N Dakota 1965, 67-69	prairie potholes	Density of breeding ducks on different wetland types containing ponded water (as defined in Stewart and Kantrud 1971): (1) temporary; (2) seasonal; (3) semi-permanent; (4) permanent; (5) fen; (6) undifferentiated tillage.
Lokemoen et al. 1990a	A A	B B	1 2	SP SP	0.036 0.047		pairs/ha pairs/ha	0.006 0.031	0.076 0.087	6 6	c N Dakota 1976-81	prairie potholes	N = number of years averaged to get mean. Density of breeding pairs: (1) Koenig study area; (2) Woodworth study area. Over the years of the study the number of wet basins in each area was highly variable.
Pospahala et al. 1974	A	B	-	SU	0.012		N/ha				s Canada 1955-73	prairie potholes	18 year mean based on aerial surveys in May and July. Location is prairie parkland area in southern portions of Alberta, Saskatchewan, and Manitoba.

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
CLUTCH SIZE													
Bellrose 1976	-	-	-	-	9			1	18	5170	NS	NS	
Coulter & Miller 1968	-	-	-	-	9.6					>100	Maine, Vermont		As cited in Bellrose 1976.
Doty 1975	-	-	1	-	10-11		1st clutch			8	w N Dakota		
	-	-	2	-	3-6		2nd clutch			5	1968-71		
Duebbert & Lokemoen 1976	-	-	-	-	8.6			8.2	8.8	100	S Dakota 1971-73	undisturbed fields	Min and max are yearly means.
Fuller 1953	-	-	-	-	9.6						Utah	Ogden Bay	As cited in Bellrose 1976.
Krapu & Doty 1979	Y	F	-	-	9.3	1.7 SE				7	N Dakota	prairie potholes	Initial completed clutches. Y = yearling female.
	A	F	-	-	10.3	1.1 SE				46	1968-76		
Lokemoen et al. 1990b	-	-	1	-	8.96	1.38 SE				78	c N Dakota	prairie potholes	(1) After-second-year females; (2) second-year females.
	-	-	2	-	8.49	1.23 SE				57	1976-81		
Palmer 1976	-	-	-	-	8.9					494	California	NS	Summarizing several other studies.
Palmer 1976	-	-	-	-	7.1					257	Montana	NS	Summarizing several other studies.
Palmer 1976	-	-	-	-	8.6					185	Utah	NS	Summarizing several other studies.
NUMBER OF CLUTCHES/YEAR													
Swanson unpub. Swanson et al. 1985	-	-	-	-					up to 4.5		N Dakota	experimental ponds	Nests purposely destroyed to stimulate renesting.
Bellrose 1976	-	-	-	-	1						North America	NS	Many females will renest if they lose their clutch.
DAYS INCUBATION													
Bent 1923	-	-	-	-	26		days	23	29		NS	NS	As cited in Palmer 1976.
Girard 1941	-	-	-	-	28	2 SD	days				NS	NS	As cited in Palmer 1976.
Klett & Johnson 1982	-	-	-	-	25		days				N Dakota	wetlands	

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
AGE AT FLEDGING													
Bellrose 1976	J	B	-	-	52-60		days				NS	NS	
Gollop & Marshall 1954	-	-	-	-	52-60		days				NS	NS	As cited in Palmer 1976.
N FLEDGE/SUCCESSFUL NEST													
Bellrose 1976	-	-	-	-	8.4		N/suc nest				United States	NS	Summary of many sources.
Cowardin & Johnson 1979	-	-	-	-	4.9		N/suc nest				NS	NS	Average fledged brood size. As cited in Johnson et al. 1987.
PERCENT NESTS SUCCESSFUL													
Duebbert & Lokemoen 1976	-	-	1	-	54		% hatched			33	S Dakota 1971-73	prairie potholes, undisturbed fields	Percent nests hatched: (1) 1971; (2) 1972; (3) 1973. Main egg predators found to include red fox, raccoon, badger, skunk, and avian species. Author suggests success is high in part because sample does not include actively farmed areas where more nests are destroyed.
	-	-	2	-	61		% hatched			61			
	-	-	3	-	51		% hatched			47			
Johnson et al. 1988	-	-	-	-	7		% hatched			99	ND, SD, MT 1983	various unmanaged areas in prairie pothole regions (e.g., grassland, hayland, right-of-way, wetland)	Mayfield measure of nesting success. Found predation to be the biggest cause of losses. Success falls below 15 % level thought to be needed to maintain a stable population.
Klett et al. 1988	-	-	1	-	9		% hatched			51	e S Dakota	prairie potholes	Years: (1) 1966-74; (2) 1980-84. Population not self-sustaining in this area.
	-	-	2	-	10		% hatched			79			
Klett et al. 1988	-	-	-	-	19		% hatched			487	c S Dakota 1966-74	prairie potholes	
Klett et al. 1988	-	-	1	-	8		% hatched			210	c N Dakota	prairie potholes	(1) 1966-74; (2) 1975-79; (3) 1980-84.
	-	-	2	-	11		% hatched			1,036			
	-	-	3	-	10		% hatched			929			
Klett et al. 1988	-	-	-	-	5		% hatched			314	w MN, e N Dakota	prairie potholes	Data from two study sites combined: w Minnesota 1980-84 and e North Dakota 1966-84.

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Lokemoen et al. 1990a	-	-	-	-	11		% hatched		27	53	N Dakota 1976-81	mixed	Calculated using the Mayfield 40% method. Habitats consisted of cropland, grazed mixed-grass prairie, hayland, wetlands, and miscellaneous.
Lokemoen et al. 1988	-	-	1	-	8		% hatched			12	c N Dakota 1985-86	NS	(1) untreated control areas; (2) areas with predator barriers.
	-	-	2	-	60		% hatched			12			
Simpson 1988	-	-	1	-	15.4		% success			14	ne S Dakota 1985-86	game production areas	Mayfield measure of nesting success in (1) 1985 and (2) 1986 in game production areas throughout ne S Dakota.
	-	-	2	-	31.7		% success			39			
Simpson 1988	-	-	1	-	43.2		% success			63	ne S Dakota 1985-86	island in large lake	Mayfield measure of nesting success in (1) 1985 on Lake Albert Island.
ANNUAL MORTALITY													
Bellrose 1976	A	M	-	-	27.2		%/yr				Eastern c flyway	NS	Summary of other studies.
	A	F	-	-	38.2		%/yr						
Brownie et al. 1978	A	F	-	-	37.2		%/yr			6 yr	Minnesota	NS	As cited in Kirby and Cowardin 1986.
	J	F	-	-	54.5		%/yr			6 yr			
Chu & Hestbeck 1989	A	M	-	FA	40.1	3.1 SE	%/yr	22	51	5376	w m Atlantic 1971-85	NS	H1 and H2 models of Brownie et al. 1985.
	J	M	-	FA	41.1	7.2 SE	%/yr	31	59	12391			
	A	F	-	FA	49.9	3.3 SE	%/yr	20	72	5429			
	J	F	-	FA	48.8	6.0 SE	%/yr	15	68	11137			
Chu & Hestbeck 1989	A	M	-	FA	36.3	1.8 SE	%/yr	12	52	5528	MI, n OH, IN 1971-85	NS	H1 and H2 models of Brownie et al. 1985.
	J	M	-	FA	46.6	3.0 SE	%/yr	21	60	12821			
	A	F	-	FA	45.6	1.7 SE	%/yr	16	69	7392			
	J	F	-	FA	50.7	3.1 SE	%/yr	38	74	12047			
Chu & Hestbeck 1989	A	M	-	FA	38.5	1.3 SE	%/yr	19	53	9252	WI, n IL 1972-85	NS	H1 and H2 models of Brownie et al. 1985.
	J	M	-	FA	55.9	1.8 SE	%/yr	43	73	20274			
	A	F	-	FA	47.7	1.4 SE	%/yr	23	59	12912			
	J	F	-	FA	57.3	2.0 SE	%/yr	41	68	22371			
Chu & Hestbeck 1989	A	M	-	FA	32.9	1.6 SE	%/yr	12	55	8908	w MN 1969-85	NS	H1 and H2 models of Brownie et al. 1985.
	J	M	-	FA	49.7	2.2 SE	%/yr	32	66	18553			
	A	F	-	FA	42.0	1.8 SE	%/yr	15	64	9129			
	J	F	-	FA	48.4	2.8 SE	%/yr	27	56	17570			
Chu & Hestbeck 1989	A	M	-	FA	33.8	1.2 SE	%/yr	16	56	15765	ND 1969-85	NS	H1 and H2 models of Brownie et al. 1985.
	J	M	-	FA	29.8	4.7 SE	%/yr	15	49	3613			
	A	F	-	FA	40.5	3.2 SE	%/yr	10	62	7373			
	J	F	-	FA	33.8	6.8 SE	%/yr	10	68	3463			

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Chu & Hestbeck 1989	A	M	-	-	32.7	0.9 SE	%/yr	8	54	18289	n CA 1971-85	NS	H1 and H2 models of Brownie et al. 1985.
	J	M	-	-	46.1	2.3 SE	%/yr	28	65	11372			
	A	F	-	-	45.5	1.3 SE	%/yr	26	64	13704			
	J	F	-	-	43.7	4.5 SE	%/yr	16	78	8205			
Chu & Hestbeck 1989	A	M	-	FA	39.0	2.3 SE	%/yr	9	60	4097	ne US 1971-85	NS	H1 and H2 models of Brownie et al. 1985.
	J	M	-	FA	48.1	5.3 SE	%/yr	7	69	10103			
	A	F	-	FA	51.5	1.9 SE	%/yr	33	64	4596			
	J	F	-	FA	56.8	3.2 SE	%/yr	38	68	9890			
Kirby & Cowardin 1986	A	B	-	-	37.2		%/yr				n c Minnesota 1968-74	NS	
	J	B	-	-	54.5		%/yr						
Lee et al. 1964	J	-	-	-	71		%/yr				Minnesota	NS	As cited in Bellrose 1976.
	A	-	-	-	56		%/yr						
Lokemoen et al. 1990a	J	B	-	-	32		%/yr				c N Dakota 1976-81	prairie potholes	Calculated mortality from hatching to near fledging.

*** SEASONAL ACTIVITIES ***

Reference	Begin	Peak	End	Location	Habitat	Notes
MATING/LAYING						
Bellrose 1976		May		CA,UT,MT,SD, NY,VT	NS	
Krapu & Doty 1979	Apr 4	May 3	Jul 17	s c N Dakota	NS	Total of 265 nests. Median date of nest initiation by adults was 7 days earlier than for yearlings.
Lokemoen et al. 1990b	late Apr	mid May	mid Jun	c N Dakota	prairie potholes	Time of nest initiation.
HATCHING						
Toft et al. 1984		June		NW Terr., CAN	wetlands	
FALL/BASIC MOLT						
Fredrickson & Heitmeyer 1988	mid Sept		Nov	Mississippi Valley	forested wetlands	Prealternate molt.
Fredrickson & Heitmeyer 1988	Dec		Mar	Mississippi Valley	forested wetlands	Prebasic molt.

Reference	Begin	Peak	End	Location	Habitat	Notes
Heitmeyer 1988a		mid Oct	late Nov	se Missouri 1980-83	lowland hardwood wetlands	
FALL MIGRATION						
Fredrickson & Heitmeyer 1988	mid Sep	Oct	earl Nov	Mississipi Valley	forested wetlands	Arrival of mallards to the upper Mississippi Alluvial Valley.
Palmer 1976	late Sep		Nov	Canada	NS	Leaving prairie provinces.
Palmer 1976	mid Oct	Nov		northern US	NS	Leaving northern third of US breeding areas.
Palmer 1976	mid Oct	Dec		mid-central US	NS	Leaving mid-central US breeding areas.
Rutherford 1966	mid Sep	mid Nov		Colorado	high plains	Arrival of wintering mallards. As cited in Ringelman et al. 1989.
SPRING MIGRATION						
Fredrickson & Heitmeyer 1988		mid Mar		Mississipi Valley	forested wetlands	Departure of mallards from the upper Mississippi Alluvial Valley.
Johnson et al. 1987	Mar 15		May 10	n c US	prairie potholes	Arrive on breeding grounds.
Lokemoen et al. 1990b	late Mar	mid Apr	mid May	c N Dakota	prairie potholes	Arrival of females on breeding grounds; second-year hens arrived significantly later than after-second-year hens.
Palmer 1976	late Mar	Apr		arrive Canada	prairie potholes	
Rutherford 1966		earl Mar		Colorado	high plains	Departure of wintering mallards. As cited in Ringelman et al. 1989.

***** LESSER SCAUP *****

*** NORMALIZING AND CONTACT RATE FACTORS ***

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
BODY WEIGHT													
Austin & Fredrickson 1987	A	F	1	SU	688		g			21	Manitoba 1981-82, 84	lake	Post breeding females collected from mid July-October; weights are sequential from beginning to end of wing molt. Molt stage (1) preflightless; (2) flightless; (3) postflightless; (4) migratory.
	A	F	2	SU	647		g			24			
	A	F	3	SU	693		g			8			
	A	F	4	SU	842		g			32			
Chappel & Titman 1983	A	B	-	-	814.9	13.4 SE	g			39	Quebec, CAN 1979,80	lake	Migrants (31 males and 8 females) collected in April, November, December, and October. Abbreviations: abd fat = abdominal fat; int fat = intestinal fat.
	-	-	-	-	57.7	0.72 SE	% water			39			
	-	-	-	-	11.2	1.14 SE	g abd fat			39			
	-	-	-	-	7.24	0.88 SE	g int fat			39			
Gammonley & Heitmeyer 1990	A	M	-	SP	734	24 SE	g			6	s OR, n CA 1986-87	palustrine wetlands	Spring migrants; males were non-molting, females were in early pre-basic molt.
	A	F	-	SP	663	52 SE	g			5			
Nelson & Martin 1953	A	M	-	-	860		g		1,100	130	United States	NS	Data from U.S. Fish and Wildlife Service records; collected from bird banders and game bag investigations.
	A	F	-	-	770		g		950	144			
Palmer 1976	A	F	-	-	790		g	540	960	118	NS	NS	As cited in Dunning 1984.
	A	M	-	-	850		g	620	1050	112			
Poole 1938	-	F	-	-	763		g			1	NS	NS	
BODY FAT													
Austin & Fredrickson 1987	A	F	1	SU	50.7		g (7.4%)			21	Manitoba 1981-82, 84	lake	Post-breeding females collected from July-October; weights are sequential from beginning to end of wing molt. Molt stage: (1) preflightless; (2) flightless; (3) postflightless; (4) migratory. Percent in units column is percent fat of total body weight.
	A	F	2	SU	37.2		g (5.7%)			24			
	A	F	3	SU	46.5		g (6.7%)			8			
	A	F	4	SU	188.1		g (22.3%)			32			
Gammonley & Heitmeyer 1990	A	M	-	SP	78	9 SE	g (11%)			6	s OR, n CA 1986-87	palustrine wetlands	Spring migrants; percent in units column = percent fat of total body weight.
	A	F	-	SP	53	27 SE	g (8%)			5			

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
DUCKLING WEIGHT													
Lightbody & Ankney 1984	J	B	-	-	150		g 15 days				Manitoba, CAN 1981	captive	Number of days in units column is age of scaup; values for days 15-45 estimated from Figure 1. Fledge (primary feathers are fully clear of shafts) at 65 days. By comparison with Sugden & Harris (1972), these captive scaup may have been 200 grams lighter than would be expected for wild scaup by fledging.
	J	B	-	-	390		g 30 days						
	J	B	-	-	470		g 45 days						
	J	B	-	-	530		g fledge			7			
Sugden & Harris 1972	J	B	-	-	45		g 1 week				Alberta, CAN	captive - eggs from wild nests	Weight of scaup at various ages between 1 and 12 weeks (see units column). Measurements taken at midpoint of the week. Starting at six weeks, growth rates slowed and scaup were about 200 grams lighter than expected for wild scaup by fledging (at 8 to 9 weeks).
	J	B	-	-	190		g 3 weeks						
	J	B	-	-	485		g 6 weeks						
	J	B	-	-	516		g 9 weeks						
	J	B	-	-	542		g 12 weeks						
DUCKLING GROWTH RATE													
Sugden & Harris 1972	J	B	1	SU	6.9		g/day				Alberta, CAN	captive - eggs from wild nests	Ages: (1) 0 to 3 weeks; (2) 3 to 6 weeks; (3) 6 to 9 weeks; (4) 9 to 12 weeks.
	J	B	2	SU	14		g/day						
	J	B	3	SU	1.5		g/day						
	J	B	4	SU	1.2		g/day						
METABOLIC RATE (KCAL BASIS)													
McEwan & Koelink 1973	A	B	1	-	125		kcal/kg-d				Canada	lab	Resting values estimated from figure. Temperature (degrees C) = (1) 0; (2) approximately 10 - 30. 85 observations on 9 birds. Measured oxygen consumption and CO2 production to estimate kcal values. Did not specify whether greater or lesser scaup.
	A	B	2	-	90		kcal/kg-d						

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
FOOD INGESTION RATE													
Sugden & Harris 1972	J J	B B	1 2	- -	0.162 0.077		g/g-day g/g-day			40 40	Saskatchewan	captive from wild-collected eggs	Based on dry weight of food. Ages: (1) 1 to 5 weeks; (2) 6 to 12 weeks. Food ingestion of young maintained in 18-27 C electric brooder. Fed commercial duck starter: ME of food = 3.09 kcal/g dry weight; GE = 4.47 kcal/g dry weight.

***** DIET *****

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Afton et al. 1991	A	B	animal (scuds) (dragonflies) (caddis flies) (snails) (fingernail clams) (brook stickleback) (fathead minnow) plant - seeds (bushy pondweed) plant - vegetative			90.5 (54.9) (2.4) (7.6) (10.2) (5.1) (4.1) (5.0) 9.4 (7.1) 0.1		14	nw Minnesota 1984-87	lake, marshes, pool - % dry weight; esophageal & proventricular contents	Adult diet during fall migration. Diets between males and females fairly similar, however males tended to consume more insects and fewer leeches. Items comprising less than 2% not included here.
Afton et al. 1991	J	B	animal (scuds) (crayfish) (midges) (snails) plant - seeds (bushy pondweed) plants - vegetative			92.8 (74.5) (2.9) (7.6) (3.0) 6.2 (5.8) 1.0		34	nw Minnesota 1984-87	lake, marshes, pool - % dry weight; esophageal & proventricular contents	Juvenile diet during fall migration; items comprising less than 2% not included here.
Afton et al. 1991	A	B	animal (scuds) (caddis flies) (midges) (other insects) (snails) (fingernail clams) (fish) plant - seeds plant - vegetative	91.8 (33.2) (8.8) (2.3) (4.9) (31.9) (6.0) (3.5) 6.0 2.2				57	nw Minnesota 1986-88	lake, marshes, pool - % dry weight; esophageal & proventricular contents	Spring migration; items comprising less than 2% not included here. Diets were similar for males and females.

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Afton et al. 1991	B	B	animal				60.9	41	Louisiana 1986	lakes & marshes	Midwinter; no differences found between sex or age classes. Items comprising less than 2% not included here.
			(midges)				(45.9)			-	
			(snails)				(7.7)			% dry weight;	
			(grass shrimp)				(7.3)			esophageal &	
			plant - seeds				36.1			proventricular	
			(bullrush)				(36.0)			contents	
			plant - vegetative				3.0				
			(green algae)				(2.3)				
Bartonek & Hickey 1969	A	M	animal foods		99			7	sw Manitoba 1963-64	wetlands, lake	Male diet during spring and summer. Author also presents data from esophagus, proventriculus, and gizzard contents, but suggests that esophagus only is most accurate because there is less bias due to digestion.
			(scuds)		(8)					-	
			(pond snails)		(4)					% wet volume;	
			(midges)		(6)					esophagael contents	
			(water boatmen)		(1)						
			(aquatic beetles)		(2)						
			(leeches)		(61)						
			(caddis flies)		(16)						
			plant foods		TRACE						
Bartonek & Hickey 1969	A	F	animal foods		98			7	sw Manitoba 1963-64	wetlands, lake	Female diet during spring and summer. Author also presents data from esophagus, proventriculus, and gizzard contents, but suggests that esophagus only is most accurate because there is less bias due to digestion.
			(scuds)		(46)					-	
			(pond snails)		(4)					% wet volume;	
			(midges)		(41)					esophagael contents	
			(water boatmen)		(2)						
			(caddis flies)		(2)						
			plant foods		2						
Bartonek & Hickey 1969	J	B	animal foods		99			25	sw Manitoba 1963-64	wetlands, lake	Duckling diet. Season = spring and summer. Author also presents data from esophagus, proventriculus, and gizzard contents, but suggests that esophagus only is most accurate because there is less bias due to digestion.
			(scuds)		(49)					-	
			(pond snails)		(39)					% wet volume;	
			(midges)		(8)					esophagael contents	
			(water boatmen)		(2)						
			(aquatic beetles)		(trace)						
			(leeches)		(trace)						
			(caddis flies)		(trace)						
			plant foods		(trace)						

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Bartonek & Murdy 1970	A	B	scuds		34 ± 7			23	Northwest Territory	lake - % volume; esophageal contents	Average percent volume ± - SE (standard error).
			snails		14 ± 6						
			clams		12 ± 4						
			water fleas		8 ± 5						
			caddis flies		7 ± 4						
			water beetles		7 ± 4						
			midges		7 ± 4						
			dragon/damselflies		4 ± 3						
			leeches		3 ± 2						
			fairy shrimp		2 ± 2						
Bartonek & Murdy 1970	J	B	scuds		1 ± 1	57 ± 9		19	Northwest Territory	lake - % volume; esophageal contents	Average percent volume ± - SE (standard error).
			midges		54 ± 8	1 ± 1					
			clam shrimps		30 ± 8	2 ± 2					
			dragon/damselflies		-	17 ± 8					
			water bugs		4 ± 3	11 ± 7					
			water mites		8 ± 3	-					
			caddis flies		-	6 ± 5					
			water beetles		1 ± 1	4 ± 3					
			mayflies		2 ± 1	-					
			plant matter		-	-					
Chabreck & Takagi 1985	A	B	plant					115	Louisiana, 4 years	crayfish impoundment - % dry weight; gullet and gizzard	Plant matter made up 99% of the diet and was composed entirely of seeds.
			Echinochloa colonum				50.4				
			Fimbristylis mileac				40.3				
			Panicum dichotomifl				4.7				
			Echinochloa frument				3.4				
			other plant				0.7				
			animal				0.5				
Dirschl 1969	A	B	plant seeds total	9.1	24.9	50.4			Saskatchewan 1964-65	shallow lakes - % dry weight; esophagus and proventriculus	All plant material was seeds. Diets determined monthly: for this summary, spring = May; summer = mean of values for June, July, and August; and fall = mean of values for September and October. Food types not comprising at least 1% during any season not included here.
			(Nuphar variegatum)	-	(13.2)	(42.8)					
			(Ceratophyllum)	(5.2)	(0.2)	(0.1)					
			(Myriophyllum)	(2.8)	(1.0)	(1.3)					
			(Potamogeton)	(0.3)	(2.0)	(2.1)					
			(Scirpus)	(0.6)	(3.1)	(2.0)					
			(Sparganium)	(0.2)	(6.6)	(1.5)					
			animal total	90.9	75.1	49.6					
			(Amphipoda)	(66.0)	(9.8)	(42.5)					
			(Diptera)	-	(1.3)	(0.1)					
			(Eubranchiopoda/ Conchostraca)	-	(3.1)	(0.5)					
			(Hirudinea)	(12.0)	(23.7)	(1.6)					
			(Odonata)	-	(1.2)	-					
			(Pelecypoda/ Spaeriidae)	(12.7)	(25.7)	-					
			(Pisces/Cyprinidae)	-	(2.9)	-					
			(Trichoptera)	(0.2)	(1.6)	(1.9)					
			Sample size	*12*	*63*	*33*					

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Gammonley &	A	M	animal	82				6	s OR, n CA	palustrine wetlands	Migrating scaup on lower Klamath
Heitmeyer 1990			(Chironomidae)	(50)					1986-87	-	National Wildlife Refuge. Items
			(Ostracoda)	(28)						% wet volume;	comprising less than 2% not
			(Planoribidae)	(3)						esophageal and	included here.
			plant - seeds	18						proventricular	
			(Potamogeton pectinatus)	(7)						contents	
			(Polygonium lapathifolium)	(5)							
			(Scirpus robustus)	(3)							
Gammonley &	A	F	animal	70				5	s OR, n CA	palustrine wetlands	Migrating scaup on lower Klamath
Heitmeyer 1990			(Chironomidae)	(34)					1986-87	-	National Wildlife Refuge. Items
			(Ostracoda)	(2)						% wet volume;	comprising less than 2% not
			(Planoribidae)	(14)						esophageal and	included here.
			(Copepoda)	(12)						proventricular	
			(Dytiscidae)	(4)						contents	
			(Physidae)	(2)							
			(Daphnidae)	(2)							
			plants - seeds	30							
			(Scirpus robustus)	(6)							
			(Potamogeton pectinatus)	(16)							
			(Polygonum pectinatus)	(4)							
			(Rumex spp.)	(2)							
			(Scirpus acutus)	(2)							
Hoppe et al. 1986	A	B	(plants)				(12.0)	14	sw S Carolina	reservoir	Scaup collected from October -
			unknown vegetation				11.9		1983-4	-	March; they consumed more animal
			Eleocharis sp				0.1			% dry weight;	matter in early winter than in
			(animals)				(88.0)			esophagus and	late.
			Diptera							proventriculus	
			Chironomidae				2.7				
			Gastropoda								
			Physella sp				8.0				
			Helisoma spp				16.8				
			Pelecypoda								
			Corbicula fluminea				45.8				
			Anodonta umbecilli				14.2				
			Anisoptera nymphs				0.5				
Perry & Uhler 1982	A	B	Rangia cuneata	86				4	North Carolina	freshwater creek	March 10.
			Brachiodontes recurv	4					1978	-	
			Macoma balthica	10						% wet volume;	
										gullet and gizzard	

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Perry & Uhler 1982			animal					23	North Carolina	Neuse River	December 6.
			Mulina lateralis				83		1976	-	
			Retusa canaliculata				1			% wet volume;	
			Gemma gemma				1			gullet and gizzard	
			plant								
			Najas gracillima				9				
			Quercus sp.				2				
			grit				0.3				
Perry & Uhler 1982			animal					28	North Carolina	Pamlico River	November 27.
			Mulina lateralis			62			1974	-	
			Rangia cuneata			15				% wet volume;	
			Brachiodontes recur			7				gullet and gizzard	
			Gemma gemma			2					
			Macoma balthica			7					
			plant								
			Ruppia maritima			2					
			other plant matter			2					
			grit			1.5					
Perry & Uhler 1982	A	B	animal					78	North Carolina	Bay River	December 31 to January 7.
			Mulina lateralis				74		77-78	-	
			Retusa canaliculata				2			% wet volume;	
			Rangia cuneata				1			gizzard and gullet	
			Gammarus sp.				1				
			other animal				4				
			plant								
			Ruppia maritima				4				
			Myriophyllum spicat				4				
			Eleocharis cellulos				2				
			other plant matter				4				
			grit				0.6				
Perry & Uhler 1982	A	B	animal					17	South Carolina	NS	November 24 to January 8.
			Polinices duplicatu				8		77-78	-	
			Mulina lateralis				8			% wet volume;	
			Brachiodontes recur				8			gullet and gizzard	
			Hyrobia sp.				8				
			Nassarius obsoletus				6				
			other animal				18				
			plant								
			Ruppia maritima				19				
			Potamogeton pussilu				8				
			Scirpus americana				5				
			other plant				10				
			grit				1.4				

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Rogers & Korschgen 1966	A	B	gastropods			70.1		88	Illinois 1948	pool on Mississippi - % wet volume; gizzard contents	Items comprising less than 1% not listed here; these include land snails and crayfish. Freshwater snails were from 6 genera - most were Campeloma spp. or Amnicola spp.
			(unident. snails)			(28.0)					
			(freshwater snails)			(42.0)					
			pelecypods			14.9					
			(fingernail clams)			(11.9)					
			(mussel)			(2.9)					
			insects			8.0					
			(mayflies)			(7.8)					
			plant foods			6.5					
			(pondweeds)			(3.3)					
			(bulrushes)			(2.9)					
Rogers & Korschgen 1966	A	B	unident. fish parts				26.7	37	sw Louisiana 1959-60	marshes - % wet volume; esophagus, proventriculus, and gizzard contents	Season = winter and early spring.
			sheepshead minnow				15.1				
			crustaceans				16.6				
			(crayfish)				(7.0)				
			(freshwater shrimp)				(4.5)				
			(sideswimmers)				(1.3)				
			insects				4				
			(water boatmen)				(1.3)				
			(midges)				(1.1)				
			snails				1.0				
			plants				36.3				
			(misc. fragments)				(18.0)				
			(saw-grass)				(6.9)				
			(bulrushes)				(3.8)				
			(ditch grass)				(1.9)				
			(other seeds)				(2.0)				
			(filamentous algae)				(3.7)				
Rogers & Korschgen 1966	A	B	crustaceans		60.1			39	Manitoba 1959-60	lakes, potholes - % wet volume; esophagus, proventriculus, and gizzard contents	Season = spring and summer; items comprising less that 1% not listed individually.
			(scuds)		(51.9)						
			(water fleas)		(7.7)						
			insects		22.9						
			(midges)		(10.2)						
			(caddis flies)		(7.4)						
			(dragonflies)		(1.4)						
			(water boatmen)		(1.3)						
			annelids - leeches		5.3						
			misc. animal foods		2.8						
			plant foods		7.8						
			(misc. fragments)		(2.6)						
			(bulrushes)		(2.4)						
			(pondweeds)		(1.3)						

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Sugden 1973	J	B	animal					135	Manitoba 1963-67	lake - % dry weight; esophagus and proventriculus	From hatching to 41 days of age. 52% of crustacea = amphipods; 16% insects = dipteran larvae and pupae.
			Hirundinae		1						
			Crustacea		53						
			Insecta		26						
			Gastropoda		16						
			plant								
			Characeae		1						
			Halora gacea		2						
			other plants		1						
Swanson et al. 1974	A	B	Hirudinea		3			23	NW Territories 1969	lake - aggregate %; esophageal contents	Aggregate % = average value of the proportion of each food item consumed by individual birds. Author suggests this measure limits bias due to different volumes of food found in birds and to effects of a few birds gorging on a particular food item.
			Crustacea		45						
			Insecta		26						
			Gastropoda		14						
			Pelecypoda		12						
Swanson et al. 1974	J	B	Hydracarina		4			38	NW Territories 1969	lake - aggregate %; esophageal contents	Aggregate % = average value of the proportion of each food item consumed by individual birds. Author suggests this measure limits bias due to different volumes of food found in birds and to effects of a few birds gorging on a particular food item.
			Crustacea		45						
			Insecta		50						
			Gastropoda		1						

***** POPULATION DYNAMICS *****

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
HOME RANGE SIZE													
Hammel 1973	A	B	-	-	89	6.5 SE	ha				Manitoba, CAN	NS	Mean minimum home range (relatively small, highly overlapping home ranges). As cited in Allen 1986.
POPULATION DENSITY													
Hoppe et al. 1986	B	B	-	WI			N/ha		1.6		South Carolina	reservoir	More than 1.6 scaup/ha have been recorded at Par Pond, a 1,130 ha reservoir (October - March).

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Kantrud & Stewart 1977	A	B	1	SU	0.029		pair/ha				N Dakota 1965, 67-69	prairie pothole region	Density of breeding ducks on wetlands containing ponded water. Wetland type (as defined in Stewart and Kantrud 1971): (1) seasonal wetland; (2) semi-permanent wetland; (3) permanent wetland; (4) fen; (5) alkali; (6) undifferentiated tillage.
	A	B	2	SU	0.047		pair/ha						
	A	B	3	SU	0.061		pair/ha						
	A	B	4	SU	0.049		pair/ha						
	A	B	5	SU	0.013		pair/ha						
	A	B	6	SU	0.012		pair/ha						
Nasser 1982	B	B	-	WI	8		N/ha				Louisiana	crawfish impoundments	Cited in Chabrek & Takagi 1985.
Vermeer 1970	A	B	-	SU	28.9		nests/ha	13.1	58.5		Alberta	islands in lakes	Mean for densities found on three islands in lakes of the parklands and boreal forest. As cited in Bellrose 1976.
CLUTCH SIZE													
Afton 1984	-	-	1	-	9.0	0.1 SE		8	10	26	Manitoba 1977-80	lake	Age of female (years): (1) 1; (2) 2; (3) 3; (4) > or = 4. First clutch only.
	-	-	2	-	10.0	0.2 SE		8	12	21			
	-	-	3	-	10.9	0.3 SE		9	12	16			
	-	-	4	-	12.1	0.2 SE		11	14	14			
Hines 1977	-	-	1	-	9.70	0.21 SE		7	14	56	Saskatchewan 1972-73	marsh islands	Mean omitting nests with: (1) more than 14 eggs; (2) more than 12 eggs. Greater than 12-14 considered to be due to parasitism (by females of the same species)
	-	-	2	-	9.47	0.18 SE		7	12	53			
CLUTCHES/YEAR													
Afton 1984	-	-	-	-	1						Manitoba	lake	Often renest if the first clutch is lost.
Hunt & Anderson 1966	-	-	-	-	1.4		/year	1	4	31	California	NS	5 renested once, 2 renested twice, and 1 renested three times (following loss of clutch). As cited in Bellrose 1976.
DAYS INCUBATION													
Vermeer 1968	-	-	-	-	24.8		days	21	27		NS	NS	As cited in Bellrose 1976.

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
AGE AT FLEDGING													
Gollop & Marshall 1954	-	-	-	-	47+		days				South Dakota	NS	Age at first flight; as cited in Bellrose 1976.
Lightbody & Ankney 1984	-	-	1	-	49	0.96 SE	days			7	Manitoba 1981	captive	Age when shafts of primaries (1) started to clear; (2) were completely clear (fledging).
	-	-	2	-	65	0.91 SE	days			7			
Rogers 1962	-	-	-	-	50		days				Manitoba	NS	Age at first flight; as cited in Bellrose 1976.
N FLEDGE/ACTIVE NEST													
Trauger 1971	-	-	-	-	2.3		N/act nest			636	NW Territ. 1967-70	NS	Count of downy ducklings (class 1); after this age number per brood is difficult to determine because broods mingle and combine. As cited in Bellrose 1976.
N FLEDGE/SUCCESSFUL NEST													
Bellrose 1976	-	-	-	-	6.98		N/suc nest			1,874	United States/Canada	NS	Summary of many studies; sources not presented. Number of ducklings (at downy or class 1 stage) per successful nest. Represents a 16% decline from 8.33 eggs hatched per successful nest. After this age, broods mingle and combine so determination of numbers per nest is difficult.
PERCENT NESTS SUCCESSFUL													
Afton 1984	-	-	1	-	26.3		% nest suc			38	Manitoba 1977-80	lake	Percent of nests in which at least one egg hatched; 90% of unsuccessful nests were due to predation. Age of female (years) (1) 1; (2) 2; (3) 3; (4) > or = 4.
	-	-	2	-	22.2		% nest suc			45			
	-	-	3	-	45.5		% nest suc			22			
	-	-	4	-	41.7		% nest suc			24			
PERCENT BROOD SURVIVAL													
Afton 1984	-	-	-	-	67.5	4.9 SE	% to 20 d			39	Manitoba 1977-80	lake	Percent of young in each brood surviving from hatching to 20 days (most mortality is in the first week).

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
PERCENT NESTS SUCCESSFUL													
Hines 1977	-	-	-	-	76		% nest suc			37	Saskatchewan 1972-73	marsh islands	Percent of nests in which at least one egg hatched.
Rowinski 1958	-	-	-	-	26		% nest suc				Alaska	Minto Lakes	Percent nests hatching young; N = 50 or more nests. As cited in Bellrose 1976.
Townsend 1966	-	-	-	-	67		% nest suc				Saskatchewan	delta	Percent of nests hatching at least one young; N = 50 or more nests. As cited in Bellrose 1976.
Trauger 1971	-	-	-	-	35		% nest suc			636	NW Territ. 1967-70	NS	Percent of nests hatching at least one young. As cited in Bellrose 1976.
AGE AT SEXUAL MATURITY													
Afton 1984	-	F	-	-	1		year				sw Manitoba 1977-80	prairie potholes	29% of 1 year olds did not breed.
Palmer 1976, Bellrose 1976	-	B	-	-	2		year	1			NS	NS	Most first breed in their second year.
ANNUAL MORTALITY													
Smith 1963	J A A	B M F	- - -	- - -	68-71 38-52 49-60		%/year %/year %/year				NS	NS	Juvenile value is based on recoveries of scaup banded at breeding areas; adult values are based on bandings made in winter and spring in eight states. As cited in Bellrose 1976.

***** SEASONAL ACTIVITIES *****

Reference	Begin	Peak	End	Location	Habitat	Notes
MATING/LAYING						
Afton 1984	earl Jun			Manitoba 1977-80	prairie potholes	First clutches only.
Ellig 1955	earl May	earl Jun	earl Jul	Montana	Freezeout Lake	As cited in Bellrose 1976.
Hines 1977		earl/mid Jun		Saskatchewan 1972-73	marsh	

Reference	Begin	Peak	End	Location	Habitat	Notes
Rienecker & Anderson 1960	mid May	earl Jun	mid Jul	n California	Klamath Basin	As cited in Bellrose 1976.
Townsend 1966	mid May	earl Jun	late Jun	Saskatchewan	Saskatchewan Delta	As cited in Bellrose 1976.
HATCHING						
Hines 1977	earl Jul	mid Jul	earl Aug	Saskatchewan 1972-73	marsh	
Toft et al. 1984		July 17		NW Territories, CAN	wetlands	
FALL/BASIC MOLT						
Austin & Fredrickson 1987	Jul		Sept	Manitoba 1981-82, 84	lake	Wing molt.
McKnight & Buss 1962	mid Jul		late Aug	Alaska	NS	Wing molt; as cited in Bellrose 1976.
FALL MIGRATION						
Bellrose 1976	mid Oct	mid Nov	Dec	United States	NS	Arrival of wintering scaup.
Gammonley & Heitmeyer 1990	Sept		mid Nov	s OR, n CA 1985-86	Klamath Basin	Seasonal presence of scaup at a primary migration area in the Pacific Flyway.
Rutherford 1966	mid Oct		late Nov	Colorado	high plains	Migration through the central high plains. As cited in Ringelman et al. 1989.
SPRING MIGRATION						
Afton 1984	mid Apr			sw Manitoba 1977-80	prairie potholes	Arrival at breeding grounds.
Bellrose 1976	earl Feb	Mar - Apr	May	United States	NS	Departure of wintering scaup.
Gammonley & Heitmeyer 1990	late Jan		late Apr	s OR, n CA 1986-87	Klamath Basin	Seasonal presence of scaup at a primary migration area in the Pacific Flyway.

Reference	Begin	Peak	End	Location	Habitat	Notes
Rutherford 1966	mid Mar		late Apr	Colorado	high plains	Migration through the central high plains. As cited in Ringelman et al. 1989.
Siegfried 1974	mid Apr		late May	s Manitoba	Delta Marsh	Scaup migrate through; most breed elsewhere.

***** OPSREY *****

*** NORMALIZING AND CONTACT RATE FACTORS ***

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
BODY WEIGHT													
Brown & Amadon 1968	A	M	-	-	1,403		g	1,220	1,600	10	NS	NS	Summarizing the work of others.
	A	F	-	-	1,568		g	1,250	1,900	14			
MacNamara 1977	A	M	-	-	1,437		g			7	ne United States	NS	As cited in Henny et al. 1991.
	A	F	-	-	1,798		g			10			
McLean 1986	N	M	-	-	250		g day 10			5	Maryland, Virginia	Chesapeake Bay	Weights of nestlings (N) at several ages. As cited in Poole 1989a - estimated from figure.
	N	F	-	-	280		g day 10			5			
	N	M	-	-	700		g day 20			5			
	N	F	-	-	800		g day 20			5			
	N	M	-	-	1,150		g day 30			5			
	N	F	-	-	1,420		g day 30			5			
	N	M	-	-	1,200		g day 40			5			
	N	F	-	-	1,620		g day 40			5			
	N	M	-	-	1,210		g day 50			5			
	N	F	-	-	1,510		g day 50			5			
Poole 1983	A	F	1	SP	1,939	59 SE	g			6	se MA 1981	estuary	(1) Upon arrival from migration; (2) after laying first egg.
	A	F	2	SP	1,975	39 SE	g			6			
Poole 1984	A	F	1	SP	1,880	20 SE	g			23	se Massachusetts	estuary	Breeding season variations in weight: (1) courtship period; (2) early incubation period; (3) early nestling period; and (4) late nestling period. For males, weight at (1) and (2) were basically the same. As cited in Poole 1989a; estimated from figure.
	A	F	2	SP	1,925	25 SE	g			23			
	A	F	3	SP	1,825	15 SE	g			28			
	A	F	4	SP	1,725	25 SE	g			23			
	A	M	1	SP	1,480	15 SE	g			23			
	A	M	3	SP	1,470	15 SE	g			28			
	A	M	4	SP	1,420	15 SE	g			24			
Wilcox 1944	N	-	-	-	54.1		g day 1			1	NS	NS	As cited in Henny 1988b; the osprey fledged at 49 days and its two siblings fledged at 52 days.
	N	-	-	-	216.4		g day 7			1			
	N	-	-	-	595.1		g day 14			1			
	N	-	-	-	1,001		g day 21			1			
	N	-	-	-	1,298		g day 28			1			
	N	-	-	-	1,433		g day 35			1			
	N	-	-	-	1,433		g day 42			1			
FLEDGING WEIGHT													
Henny et al. 1991	J	B	-	-	1,611		g			69	Idaho 1987	river, lakes	Large nestlings, almost ready to fledge.

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
EGG WEIGHT													
Poole 1989a	-	-	-	-	60-80		g				NS	NS	
Wilcox 1944	-	-	-	-	71.1		g			3	NS	NS	As cited in Henny 1988b.
Whittemore 1984 (carolinensis)	-	-	-	-	72.2	5.35 SD	g	66.0	81.3	6	North Carolina 1973-82	lake	Calculated from 6 years of data.
METABOLIC RATE (KCAL BASIS)													
Lind 1976	A J	B B	- 1	- -	286 254		kcal/day kcal/day				NS	NS	(1) Young at age of first flight. Body weights not reported. As cited in Henny 1988b.
FOOD INGESTION RATE													
Cramp 1980 (carolinensis)	-	-	-	-			g/day	200	400		NS	NS	
Poole 1983	A	F	-	SP	0.21		g/g-day				se MA 1981	estuary	Estimated food ingestion of female during courtship period. Calculated from estimate of 405 g of fish eaten per day (brought by males to nest) and mean body weight of 6 newly arrived females of 1,939 g.
Poole 1989a	A	M	BR	SU	360		kcal/day				se MA 1981	estuary	Three nests observed for 30 hours.
Poole 1989a	A	M	NB	WI	200-250		kcal/day				Senegal, West Africa		Data summarized from Prevost 1982.

***** DIET *****

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Collopy 1984	B	B	gizzard shad sunfish largemouth bass golden shiner	63.2 28.9 5.3 2.6				38	Florida 1983	Newnan's Lake - % of prey caught; identified at nests	Season = March through June. N = number of prey caught. Based on 139 hours of observations at four nests. Gizzard shad tended to be 15-20 cm in length; sunfish were usually 12-16 cm long.
French 1972	A	B	surf smelt & night smelt		98			144	California	Usal Creek - % of fish caught; identified at time of capture	Breeding season. N = number of dives; osprey had dive success rate of 69%. As cited in Swenson 1979.

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Garber 1972	A	B	Tui chub rainbow trout Tahoe sucker		48 34 18			36	California	Eagle Lake - % of fish caught; found in remains at nest/perch	Breeding season. N = number of dives; dive success = 56%. As cited in Swenson 1979.
Greene et al. 1983	-	-	alewife smelt pollock winter flounder		32 5 53 10				Nova Scotia, CAN 1981	harbor, bay - % wet weight; estimated from observed captures	
Grubb 1977	A	B	mullet crappie		52 48			283	Florida	Lake George - % of fish caught; identified at time of capture	Breeding season. N = number of dives; dive success = 36%. As cited in Swenson 1979.
Hughes 1983	B	B	starry flounder cutthroat trout		95 5			1	se Alaska 1979-80	habitat NS - % wet weight; estimated from observed captures and length of prey	Food brought to nest (i.e., food for male, female, and young) over a 9 day period.
Hughes 1983	B	B	carp crappie		67 33			1	w Oregon 1981	habitat NS - % wet weight; estimated from observed captures and length of prey	Food brought to nest (i.e., food for male, female, and young) over a 7 day period.
Lind 1976	A	B	Salmonidae Tui chub		57 43			60	Oregon	reservoir - % of fish caught; identified at time of capture	Breeding season. N = number of dives; dive success = 58%. As cited in Swenson 1979.
MacCarter 1972	A	B	largescale sucker whitefish other unidentified		59 21 9 11			202	Montana	Flathead Lake - % of fish caught; identified at time of capture	Breeding season. N = number of dives; dive success = 65%. As cited in Swenson 1979.
Nesbitt 1974	A	B	shad (gizzard & threadfin) sunfish, black crappie & large mouth bass unidentified fish		73 15 12			29	Florida	Newnans Lake - % of number; fish captured in dives	Breeding season; N = number of successful dives. Dive success was 91%. As cited in Swenson 1979.

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Poole 1984	-	-	winter flounder herring menhaden		50 20 20			NS	s New England	NS - measure NS	As cited in Poole 1989a.
Prevost 1977	A	B	winter flounder		90+			2,268	Nova Scotia, CAN	Antigonish Harbor - % of fish caught; identified at time of capture	Breeding season. N = number of dives; dive success = 69%. As cited in Swenson 1979.
Swenson 1978	A	B	cutthroat trout longnose sucker unidentified		88 7 5			153	Wyoming	Yellowstone Lake - % of fish caught; remains at nest or perch	Breeding season. N = number of dives; dive success = 47%. As cited in Swenson 1979.
Szaro 1978	B	B	speckled trout striped mullet sea catfish other fish		64 27 8 1			124	Florida	Seahorse Key - % of items; remains at nest/perch	Breeding season. N = number of dives; dive success = 19%. As cited in Swenson 1979.
Ueoka 1974	A	B	surfperch other unidentified		64 9 27			1,660	California	Humboldt Bay - % of fish caught; identified at time of capture	Breeding season. N = number of dives; dive success = 58%. As cited in Swenson 1979.
Van Daele & Van Daele 1982	A	B	brown bullhead salmonids northern squawfish yellow perch largescale sucker	37.7 20.8 19.3 11.6 10.6				207	Idaho 1978-80	Cascade Reservoir - % of fish caught; identified at time of capture	Season = spring and summer. Authors suggest that the establishment of the reservoir has increased the available food supply and allowed populations to increase.
Van Daele & Van Daele 1982	A	B	SIZE OF FISH CAUGHT < 10 cm 11 - 20 cm 21 - 30 cm 31 - 40 cm 41 + cm		 3.3 42.1 46.7 6.6 1.3			152	Idaho 1978-80	reservoir - % of fish sizes caught; from remains at perch	Shallow water fishery provided by Cascade reservoir considered by author to be an excellent food source.

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
FORAGING RADIUS													
Dunstan 1973	A	M	-	-	1.7		km	0.7	2.7	6	Minnesota 1971	lakes	Foraging radius based on longest fishing flight for 6 individuals (34 total observations). Author put radiotransmitters in floating fish and measured the distance the fish were carried by males to nests.
Greene et al. 1983	A	B	-	SP	10		km				Nova Scotia, CAN 1981	coastal	In late April and May, ospreys traveled up to 10 km inland to hunt for alewives and smelt on their spawning grounds.
Hagan 1984	A	B	-	-	15		km				North Carolina	swamps, coastal	Foraging radius of osprey equipped with radiotransmitters; ospreys traveled from nest sites in swamps to coastal foraging areas. As cited in Poole 1989b; Poole considers this a long commute.
Koplin 1981	A	B	-	-	3-8		km	1			nw California 1971-72	coastal lagoons, bay & ocean	Foraging radius; the majority of ospreys that fished these habitats built nests 2-5 miles inland. The author suggests that the nests were built in inland areas to avoid high winds (spring) and heavy fog (summer).
Van Daele & Van Daele 1982	A	B	-	-			km		10		Idaho 1978-80	Cascade Reservoir	Foraging radius of ospreys utilizing the reservoir; species composition of prey remains at nest showed that ospreys up to 10 km away were utlizing prey from the reservoir (particular fish species were not found in any of the other local water bodies).
POPULATION DENSITY													
Eichholz 1980 (carolinensis)	A	B	-	SP	0.028		nests/ha			45	Florida 1979	marsh & swamp forest	Calculated from 45 nests over 4,000 acres.
Henny 1988a	A	B	-	SU	1.9		nests/ha				Oregon 1899	lake	One of the largest osprey colonies ever reported in the United States.
Henny & Noltemeier 1975	A	B	-	SP	0.10		N/ha			62	North Carolina 1974	reservoir	Studied 31 pairs.

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Henny & Noltemeier 1975	A	B	-	SP	0.005		N/ha			76	North Carolina 1974	lake	Studied 38 pairs.
Stocek & Pearce 1983	A	B	-	-	0.0031		N/ha			206	New Brunswick, CAN 1974-77,80	coastal	Based on 1974 aerial survey (34 hours of flight) of a 0.4 km wide transect along coastal areas. 103 pairs observed in an area of 660 square kilometers.
Van Daele & Van Daele 1982	A	B	-	-	0.009		N/ha			100	Idaho 1978-80	reservoir	Population of ospreys (50 pairs) supported by a 11,452 ha reservoir containing an abundance of warmwater fish and some salmonids.
CLUTCH SIZE													
Bent 1937	-	-	-	-	3			2	4		NS	NS	
Henny et al. 1991	-	-	-	-	2.82			1	4	49	Idaho 1986-87	river, lakes	
Judge 1983	-	-	-	-	3.02	0.04 SE				43	ME, NH, VT pre-1947	NS	Data from museum specimens collected prior to 1947.
Judge 1983	-	-	-	-	3.09	0.02 SE				685	CT, MA, NY pre-1947	NS	Data from museum specimens collected prior to 1947.
Judge 1983	-	-	-	-	3.23	0.03 SE				299	Atlantic Seaboard	NS	Data from museum specimens collected prior to 1947. States include Delaware, Maryland, Virginia, and North and South Carolina.
Judge 1983	-	-	-	-	2.84	0.07 SE				57	Georgia, Florida	NS	Data from museum specimens collected prior to 1947.
Judge 1983	-	-	-	-	2.67	0.07 SE				76	s Calif., n Mexico	NS	Data from museum specimens collected prior to 1947.
Judge 1983	-	-	-	-	2.78	0.07 SE				51	Baja Calif., Mexico 1977-78	coastal islands	Non-migratory population.
Poole 1983	-	-	-	-	3.2	0.08 SE				36	se MA 1980-81	NS	
Poole 1984	-	-	-	-	3.3					94	e US 1979-83	coastal	Migratory populations; as cited in Poole 1989a.

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Poole 1982	-	-	-	-	3.2					110	e US 1978-79	coastal	Migratory populations; as cited in Poole 1989a.
Poole 1982	-	-	-	-	2.7					48	Florida 1978-79	coastal	Resident populations; as cited in Poole 1989a.
Prevost et al. 1978	-	-	-	-	3.0					34	Nova Scotia, CAN 1975-76	NS	As cited in Stocek and Pearce 1983.
Reese 1977	-	-	-	-	2.9			2.8	3.0	513	Maryland 1972-74	coastal Chesapeake	Three years of data; minimum and maximum are yearly means.
Spitzer 1980	-	-	-	-	3.23	0.09 SE					ne US 1968-71	coastal	As cited in Poole 1983.
Stocek & Pearce 1983	-	-	-	-	2.24			2.1	2.8	34	New Brunswick, CAN 1974-80	NS	N = 34 nests with two or more eggs. Minimum and maximum are averages from different years.
Van Daele & Van Daele 1982	-	-	-	-	2.58					140	Idaho 1978-1980	lakes, pond	Average of 3 subpopulations over 3 years in Long Valley, Idaho. Clutch size did not change significantly between years or subpopulations.
Whittemore 1984 (carolinensis)	-	-	-	-	2.25	0.37 SD		1.6	2.84	332	N Carolina 1973-82	lake	10 years of data; minimum and maximum are averages from different years.
CLUTCHES/YEAR													
Henny 1986	-	-	-	-	1		/year				NS	NS	Some ospreys lay replacement clutches if first clutch is lost/taken early in incubation period.
Poole 1989a	-	-	-	-	1		/year				NS	NS	Second clutch produced only if first is lost.
DAYS INCUBATION													
Judge 1983	-	-	-	WI	38.1	3.2 SD	days	32	42	16	Baja Calif., Mexico 1977-78	coastal islands	Non-migratory population.
Poole 1989a	-	-	-	-			days	35	43		Massachusetts	NS	

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
NESTLING GROWTH RATE													
McLean 1986	N	M	1	-	20		g/day			5	Virginia, Maryland	Chesapeake Bay	Growth for nestling ages (in days): (1) 4-11; (2) 12-19; (3) 20-27; and (4) 28-35. As cited in Poole 1989a; estimated from figure.
	N	F	1	-	26		g/day			5			
	N	M	2	-	51		g/day			5			
	N	F	2	-	55		g/day			5			
	N	M	3	-	42		g/day			5			
	N	F	3	-	63		g/day			5			
	N	M	4	-	24		g/day			5			
	N	M	4	-	38		g/day			5			
AGE AT FLEDGING													
Henny et al. 1991	-	-	-	-	50-55		days				NS	NS	Migratory osprey.
Judge 1983	-	-	1	-			days	52	76	6	Baja Calif., Mexico 1977-78	coastal islands	Time from hatching to first sustained flight. (1) Range in minimum nestling period for 6 broods. Non-migratory population.
	-	-	-	-	62.5	4.9 SD	days			10			
Stinson 1977	-	-	-	-	51		days	44	59		Virginia	NS	As cited in Henny 1988b.
Stotts & Henny 1975	-	-	-	-	54	3 SD	days	48	59		Maryland 1956	bay	Age at first flight.
Van Daele & Van Daele 1982	-	-	-	-	50-60		days			144	Idaho 1978-80	reservoir, ponds, lake	Habitats in Long Valley.
N FLEDGE/ACTIVE NEST													
Collopy 1984	-	-	1	-	1.63	0.17 SE				27	Florida 1983	lake	Location: (1) Newnan's lake; (2) Orange lake; (3) Santa Fe Lake
	-	-	2	-	1.05	0.22 SE				22			
	-	-	3	-	0.89	0.19 SE				19			
French & Koplin 1977	-	-	-	-	1.16		N/act nest			49	California 1971-72	coastal redwood & conifer forest	
Henny et al. 1977	-	-	-	-	0.86		N/act nest			30	New Jersey 1975	coastal	
Henny & Wight 1969 (carolinensis)	-	-	-	-			N/act nest	0.95	1.3		NS	NS	Estimate of the reproductive success required to maintain a stable population.
Henny 1977	-	-	1	-	1-1.3		N/act nest				Wisconsin	NS	(1) Late 1970's; (2) 1960's - may have a DDT problem. As cited in Peakall 1988.
	-	-	2	-	0.39-.71		N/act nest						

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Henny et al. 1977	-	-	-	-	1.09		N/act nest			24	Delaware 1975	coastal	
Henny & Noltemeier 1975	-	-	-	-	1.34		N/act nest			60	South Carolina 1974	lake	
Henny et al. 1978	-	-	1	-	1.37		N/act nest			68	Oregon 1973-77	reservoir and National Forest	Year: (1) 1973; (2) 1975; (3) 1977.
	-	-	2	-	1.11		N/act nest			47			
	-	-	3	-	1.21		N/act nest			28			
Judge 1983	-	-	1	-	1.0		N/act nest			28	Baja Calif., Mexico 1977-78	coastal islands	Non-migratory population. Year: (1) 1977; (2) 1978.
	-	-	2	-	0.9		N/act nest			24			
Koplin 1981	-	-	-	-	1.02		N/act nest	0.5	1.7		California 1971-72	coastal, river	Total of 63 nesting efforts over two years; minimum and maximum are one year means.
Parnell & Walton 1977	-	-	-	-	1.21		N/act nest	1.03	1.50		S Carolina 1969-71	reservoir	104 nests over 3 years; minimum and maximum are means for different years.
Poole 1984	-	-	-	-	1.92		N/act nest			94	e US 1979-83	coastal	Migratory populations; as cited in Poole 1989a.
Poole 1982	-	-	-	-	0.82		N/act nest			110	e US 1978-79	coastal	Migratory populations; as cited in Poole 1989a.
Poole 1982	-	-	-	-	0.52		N/act nest			48	Florida 1978-79	coastal	Resident populations; as cited in Poole 1989a.
Stocek & Pearce 1983	-	-	-	-	1.1		N/act nest				New Brunswick, CAN 1974-80	NS	
Van Daele & Van Daele 1982	-	-	-	-	1.58		N/act nest	1.17	1.89	77	Idaho 1978-80	Cascade Reservoir	Three years combined; minimum and maximum are yearly means.
Van Daele & Van Daele 1982	-	-	-	-	1.13		N/act nest	1.00	1.50	24	Idaho 1978-80	Warner Pond	Three years combined; minimum and maximum are yearly means.
Van Daele & Van Daele 1982	-	-	-	-	1.10		N/act nest	1.00	1.13	39	Idaho 1978-80	Payette Lakes	Three years combined; minimum and maximum are yearly means.
Whittemore 1984 (carolinensis)	-	-	-	-	1.16		N/act nest	0.79	1.47		N Carolina 1973-82	shallow lake	A total of 332 nests observed over ten seasons. Minimum and maximum are means for years within the study.

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
N FLEDGE/SUCCESSFUL NEST													
Collopy 1984	-	-	1	-	1.83	0.14 SE	N/suc nest			24	Florida 1983	lake	Location: (1) Newnan's lake; (2) Orange lake; (3) Santa Fe Lake.
	-	-	2	-	1.77	0.20 SE	N/suc nest			13			
	-	-	3	-	1.42	0.15 SE	N/suc nest			12			
Dunstan 1968	-	-	-	-	1.4-1.7		N/suc nest			132	Minnesota 1961-68	NS	Successful nest is one that produces at least one young to survive to late fledging stage. As cited in Dunstan 1973.
French & Koplin 1977 (carolinensis)	-	-	-	-	1.84		N/suc nest			31	California 1971-72	coastal redwood & conifer forest	
Henny et al. 1977	-	-	-	-	1.79		N/suc nest			14	Delaware 1975	coastal, bay	
Henny et al. 1991	-	-	-	-	2.14		N/suc nest	1	3	58	Idaho 1986-87	river	"N" determined prior to fledging.
Henny et al. 1991	-	-	-	-	1.93		N/suc nest	1	4	42	Idaho 1986-87	lake	"N" determined prior to fledging.
Henny et al. 1991	-	-	-	-	2.05		N/suc nest	1	3	74	Montana, 1985-86	lake	"N" determined prior to fledging.
Judge 1983	-	-	-	-	1.7		N/suc nest			35	Baja Calif., Mexico 1977-78	coastal islands	Non-migratory population.
Reese 1977	-	-	1	-	1.95		N/suc nest	0.86	1.43	314	Maryland 1972-74	coastal Chesapeake	(1) Accessible nests; (2) innaccessible nests.
	-	-	2	-	1.4		N/suc nest	0.64	1.10	294			
Van Daele & Van Daele 1982	-	-	-	-	2.10		N/suc nest	1.69	2.33	58	Idaho 1978-80	Cascade Reservoir	Mean for three years of data; minimum and maximum are yearly means. Productivity in 1978 was significantly lower than in 1979 or 1980.
Van Daele & Van Daele 1982	-	-	-	-	1.69		N/suc nest	1.63	1.80	16	Idaho 1978-80	Warner Pond	Mean of three years of data; minimum and maximum are yearly means. Productivity in 1978 was significantly lower than in 1979 or 1980.
Van Daele & Van Daele 1982	-	-	-	-	1.96		N/suc nest	1.68	2.22	22	Idaho 1978-80	Payette Lakes	Mean of three years of data; minimum and maximum are yearly means. Productivity in 1978 was significantly lower than in 1979 or 1980.

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
PERCENT NESTS SUCCESSFUL													
Van Daele & Van Daele 1982	-	-	-	-	68		percent			140	Idaho 1978-80	lakes, pond	Percent of eggs that developed into fledglings = 66%.
AGE AT SEXUAL MATURITY													
Henny & Wight 1969	-	B	-	-	3		years				North America	NS	
Spitzer 1980	-	B	-	-			years	3	5		New York to Boston	NS	As cited in Henny 1988b.
ANNUAL MORTALITY													
Henny & Wight 1969	J A	B B	- -	- -	57.3 18.5	 1.8 SE	%/yr %/yr			206 88	New York, New Jersey 1926-65	NS	Based on recoveries of birds banded from 1926-1947, including birds found dead and birds shot. Juvenile = first year mortality of birds banded as fledglings. Adult mortality calculated for 2nd through 18th year.
Spitzer 1980	J A	B B	- -	- -	41 15		%/yr %/yr				NS	NS	As cited in Henny 1986.
Whittemore 1984 (carolinensis)	J J	- -	1 2	SU SU	16 45		% H to FL % L to FL			397 397	North Carolina 1973-82	lake	(1) Percent mortality from hatching (H) to fledging (FL); (2) percent mortality laying (L) till fledging (FL).
AVERAGE LONGEVITY													
Brown & Amadon 1968	-	B	-	-	4.8		years				NS	NS	Average longevity = 4.8 years for osprey that reach sexual maturity (at 3 years).
Spitzer 1980	A	M	-	-			years		25	1	Gardiner's Isl. NY	island	Oldest known in the wild. As cited in Henny 1986.

*** SEASONAL ACTIVITIES ***

Reference	Begin	Peak	End	Location	Habitat	Notes
MATING/LAYING						
Bent 1937	late Apr	May	mid Jun	Delaware, New Jersey	NS	Based on 513 nest records.
Dunstan 1973		May		Minnesota 1963-73		
Judge 1983	earl Jan		earl Mar	Baja Calif., Mexico 1977-78	coastal islands	Non-migratory population.
Parnell & Walton 1977	mid Mar			N Carolina 1969-72	lake	
Poole 1989a	earl Dec		late Feb	Florida	NS	
HATCHING						
Bent 1937	mid Mar	earl May	late May	Maryland, Virginia	NS	Based on 90 nest records.
Bent 1937	late Apr	mid May	mid June	New York/New England	NS	Based on 48 nest records.
Bent 1937	late May	earl Jun	late Jun	Quebec, CAN	NS	Based on 35 nest records.
Dunstan 1973		mid June		Minnesota 1963-73	lakes	
Judge 1983	Feb		late Apr	Baja Calif., Mexico 1977-78	coastal islands	Non-migratory population.
Ogden 1977	late Nov	Dec & Jan	earl Mar	Florida	NS	Non-migratory population; as cited in Henny 1986.
Parnell & Walton 1977	late Apr			N Carolina 1969-71	lake	
Stotts & Henny 1975		May 25		Maryland 1956	bay	

Reference	Begin	Peak	End	Location	Habitat	Notes
FLEDGING						
Dunstan 1973		mid Aug		Minnesota 1963-73	lakes	
Judge 1983	earl Apr	May	earl Jun	Baja Calif., Mexico 1977-78	coastal islands	Non-migratory population.
Parnell & Walton 1977		earl July		N Carolina 1969-71	lake	
Stotts & Henny 1975		July 18		Maryland 1956	bay	
FALL MIGRATION						
Henny 1986	late Aug	Sep	Nov	United States	NS	
Kennedy 1973	late Aug			Virginia, Maryland	NS	As cited in Henny 1986; juvenile osprey.
Melquist et al. 1978	Sep		earl Oct	n Idaho	NS	As cited in Henny 1988b.
Prevost et al. 1978	Sep			Nova Scotia, CAN	NS	As cited in Henny 1986; juvenile osprey.
SPRING MIGRATION						
Dunstan 1973	earl Apr			Minnesota 1963-1973	NS	
Garber 1972	late Mar			California	NS	As cited in Henny 1986.
Henny et al. 1991		late Mar		n Idaho 1986-87	river, lakes	Arrive from southern Mexico and farther south.
Parnell & Walton 1977	earl Mar			N Carolina 1969-71	lake	
Prevost et al. 1978	mid Apr			Nova Scotia, CAN	NS	As cited in Henny 1986.

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***** NORMALIZING AND CONTACT RATE FACTORS *****

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
BODY WEIGHT													
Craighead & Craighead 1956	A	M	-	-	1,028		g			108	Michigan, Pennsyl.	NS	Tabulated by author primarily from own data and unpublished data from the Pennsylvania Game Commission.
	A	F	-	-	1,224		g			100			
Poole 1938	A	F	-	-	1,307		g			2	NS	NS	
Springer & Osborne 1983	J	M	-	-	963		g			6	c Ohio 1975-77	NS	Asymptotic juvenile weight.
	J	F	-	-	1,147		g			6			
Springer & Osborne 1983	A	M	-	-	1,024		g				c Ohio 1975-77	NS	Estimated from juvenile asymptotic weight divided by juvenile to adult weight ratio reported by author. Source of adult weights used by author not identified.
	A	F	-	-	1,235		g						
Steenhof 1983	A	M	-	-	957		g			90	sw Idaho	Snake River Area	Collected by BLM research project personnel.
	A	F	-	-	1,154		g			113			
HATCHING WEIGHT													
Springer & Osborne 1983	H	M	-	-	57		g			6	c Ohio 1975-77	NS	
	H	F	-	-	58		g			8			
NESTLING WEIGHT													
Springer & Osborne 1983	N	F	0	-	58		g			6	c Ohio 1975-77	NS	Nestlings measured in the field. Fed by parents. Age in weeks from hatching (0) to 6 weeks.
	N	F	1	-	209		g			6			
	N	F	2	-	436		g			6			
	N	F	3	-	714		g			6			
	N	F	4	-	875		g			6			
	N	F	5	-	980		g			6			
	N	F	6	-	1,147		g			6			
Springer & Osborne 1983	N	M	0	-	57		g			8	c Ohio 1975-77	NS	Nestlings measured in the field. Fed by parents. Age in weeks from hatching (0) to 6 weeks.
	N	M	1	-	190		g			8			
	N	M	2	-	431		g			8			
	N	M	3	-	693		g			8			
	N	M	4	-	868		g			8			
	N	M	5	-	934		g			8			
	N	M	6	-	962		g			8			

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
NESTLING GROWTH RATE													
Springer & Osborne 1983	N	B	1	-	20		g/day			14	c Ohio 1975-77	NS	Determined from Figure 1 in paper.
	N	B	2	-	34		g/day			14			
	N	B	3	-	39		g/day			14			
	N	B	4	-	26		g/day			14			
	N	B	5	-	10		g/day			14			
METABOLIC RATE (OXYGEN)													
Pakpahan et al 1989	A	B	SM	SP	17.7	5.9 SD	lO2/kg-d				Michigan 1986	metabolism chamber	Standard metabolic rate (SM) (fasted and in thermoneutral zone) measured in March.
METABOLIC RATE (KCAL)													
Soltz 1984	A	M	BR	SU	109		kcal/kg-d				California 1976	Santa Monica mnts.	Estimated from time and energy budgets.
	A	F	BR	SU	102		kcal/kg-d						
FOOD INGESTION RATE													
Craighead & Craighead 1956	A	F	1	WI	0.112		g/g-day			68	s Michigan 1939-42	captive outside	N = number of days hawks fed; 1 hawk for each mean. Hawks maintained using falconer techniques; fed mostly lean raw beef supplemented with natural prey. Weight of hawk and mean temperature during trial: (1) 1,218 g - 3 C; (2) 1,147 g - 5 C; (3) 855 g - 13 C.
	A	M	2	WI	0.102		g/g-day			106			
	A	M	3	SU	0.086		g/g-day			29			
Duke et al. 1976	A	-	-	SU	0.055		g/g-day				Utah	captive outdoors	Weight of hawk = 1,320 grams, diet = mice, ambient temperature = 27 C.
Fitch et al. 1946	J	-	-	WI	100		g/day				c California 1940-41	foothills	Juvenile followed 21 days during late fall/early winter; on many days hawk did not eat (with possible exception of minute items).

***** DIET *****

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Adamcik et al. 1979	J	B	item		mean	SD		3-17	Alberta, CAN	farm & woodlands	16 to 24 breeding pairs followed
			snowshoe hare		25.6	+/-19			1966-75	-	for 10 years; N = number of broods
			Rich ground squirrel		30.4	+/-10				% biomass; food	observed each year. Rich ground
			Fran ground squirrel		5.1	+/- 2				brought to chicks	squirrel = Richard's; Fran ground
			voles & mice		4.8	+/- 2					squirrel = Franklin's. Diet
			other mammals		7.8	+/- 6					reflects the varying availability
			waterfowl		16.2	+/-10					of snowshoe hare which shows
			ruffed grouse		2.0	+/- 2					strongly cyclical population
			sharp tailed grouse		1.2	+/- 1					fluctuations.
			other grouse		0.9	+/- 1					
			other birds		6.3	+/- 3					
Bohm 1978a	B	B	chipmunk		22			91	c Minnesota	woodlands/open areas	Author suggests that small prey
			pocket gopher		12				1976-77	-	such as mice are likely to be
			red-winged blackbird		11					number of prey;	under-represented because they
			13-lined ground squirrel		9					found at nest sites	would be more likely to be eaten quickly and completely. Items found
			meadow mouse		8						less than three times not included
			fox squirrel		7						here.
			gray squirrel		7						
			common crow		3						
Bosakowski & Smith 1992	B	B	eastern chipmunk		26			256	n NJ, se NY,	e deciduous forest	Prey items collected from
			gray squirrel		26				nw CT	-	1972-1990.
			white-footed mouse		24					number of prey;	
			short-tailed shrew		21					prey remains and	
			meadow vole		18					pellets at nests	
			eastern cottontail		11						
			red squirrel		10						
			unident. shrews		10						
			Norway rat		8						
			star-nosed mole		6						
			opossum		3						
			long-tailed weasel		3						
			snowshoe hare		3						
			house mouse		3						
			rock dove		6						
			American robin		4						
			starling		4						
			unident. warblers		4						
			song sparrow		5						
			green-winged teal		3						
			yellow-billed cuckoo		3						
			blue jay		3						
			house sparrow		3						
			unident. small to medium passerines		15						
			snakes		4						

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Craighead & Craighead 1956	B	B	meadow vole				86.6	229	s Michigan 1942,48	fields, woodlots - % frequency of occurrence; pellets	Average of two years, pellets collected from a total of 13 hawks. Species comprising less than 1% not presented. White-footed mice includes Peromyscus maniculatus and P. leucopus.
			white-footed mice				6.5				
			short-tailed shrew				1.4				
			rabbit				1.2				
			small birds				2.7				
Craighead & Craighead 1956	B	B	meadow vole		33.3			189	Wyoming 1947	grasslands, forest - % diet; number of food items in pellets, at nests, & regurgitated by nestlings	Season = spring and summer. Items comprising less than 2% not included here.
			ground squirrel		41.8						
			pocket gopher		4.8						
			marmot		4.2						
			jack rabbit		3.2						
			red squirrel		2.1						
			small & medium size birds		4.8						
Craighead & Craighead 1956	B	B	meadow vole		54.2			211	s Michigan 1942,48	woodlots, fields - % diet; number of food items in pellets, at nests, & regurgitated by nestlings	Diet of three hawk families; season = May - June. Items comprising less than 1% not presented here.
			rabbit		6.4						
			fox squirrel		4.1						
			muskrat		5.3						
			ground squirrel		1.9						
			pheasant		5.1						
			crow		1.1						
			small & medium sized birds		16.3						
			garter snake		3.7						
Fitch et al. 1946	B	B	ground squirrel		60.8			625	c California 1939-41	foothills - % wet weight; prey brought to nests	N = number of food items. Season = spring and summer. Prey identified by observation of items brought to nests and remains found at nests.
			rabbit		26.5						
			pocket gopher		4.3						
			other mammals		2.6						
			gopher snake		3.8						
			whiptail lizard		0.3						
			birds		1.3						
Fitch et al. 1946	B	B	ground squirrel		49.5			2094	c California 1939-41	foothills - % wet weight; pellets	N = number of pellets. Season = all year.
			rabbit		24.2						
			pocket gopher		7.4						
			other mammals		2.3						
			gopher snake		9.0						
			rattlesnake		2.1						
			other reptiles		4.0						
			birds		0.9						

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Gates 1972	B	B	ring-necked pheasant		22.7			176	ec Wisconsin 1963-64	farm, wetlands - % frequency of occurrence; prey remains at nest	Author believes small mammals were under-represented in this sample.
			red-winged blackbird		8.0						
			domestic chicken		5.1						
			European partridge		2.8						
			crow		2.8						
			other/unident. birds		16.4						
			meadow vole		16.5						
			cottontail rabbit		10.8						
			ground squirrel		4.5						
			other mammals		5.7						
			beetle		1.7						
			crayfish		2.8						
Janes 1984	B	B	mammals	78.5					nc Oregon 1973-82	pasture, wheat - % wet weight; observed captures and remains found at nests	Mostly March to June.
			(Belding's ground squirrel)	(52.8)							
			(mtn. cottontail)	(13.1)							
			(pocket gopher)	(7.3)							
			(Townsend's ground squirrel)	(2.9)							
			birds	8.5							
			(Alectoris graeca)	(3.5)							
			(western meadowlark	(1.8)							
			snakes	13.1							
			(gopher snake)	(6.1)							
MacLaren et al. 1988	A	B	rabbits		64.4			91	se Wyoming 1981-82	mixed sagebrush - % biomass; pellets	Season = April to August.
			ground squirrel		14.3						
			prairie dog		18.5						
			other mammals		0.5						
			birds		2.3						
Mader 1978	B	B	desert cottontail	3				55	Arizona 1974-76	desert - number of prey; remains at nest	Prey found less than two times not presented here.
			unidentified rabbit	16							
			round-tailed ground squirrel	7							
			Harris gr. squirrel	2							
			Bailey's pocket mice	2							
			desert spiny lizard	4							
			unid. horned lizard	2							
			gopher snake	2							
			unid. snakes	12							
Preston 1990	B	B	mammals (see note)				82	102	Arkansas	corn & old fields - % frequency of occurrence; pellets	Small mammals are likely to be under-represented in pellet analyses.
			unidentified mammals				10				
			reptiles, arthropods				3				
			birds				3				
			cottontail rabbit				2				

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Steenhof & Kochert 1985	B	B	ground squirrel		27.7			148	sw Idaho 1975-76	canyon, shrubsteppe community - % frequency of occurrence; pellets and prey remains at nests	Breeding season; data collected during "normal" prey years at 7 nests with young.
			pocket gopher		6.1						
			kangaroo rat		2.7						
			deer mouse		2.7						
			wood rat		2.7						
			mtn. cottontail		4.7						
			other mammals		6.2						
			birds		8.9						
			gopher snake		20.9						
			western whiptail		3.4						
			unident. snake		2.7						
			unident. lizard		2.0						
			other reptiles		4.2						
			scorpion		2.7						
			other invertebrates		2.7						
Steenhof & Kochert 1985	B	B	ground squirrel		16.7			234	sw Idaho 1977-78	canyon, shrubsteppe community - % frequency of occurrence; pellets, prey remains at nest	Breeding season, data collected at 7 nests during "low food" years. Low food abundance occurred during a year of severe drought, and the following year. Decreased populations of ground squirrels and snakes were found.
			kangaroo rat		17.9						
			jackrabbit		11.1						
			mtn. cottontail		10.7						
			unident. rabbits		2.6						
			other mammals		5.0						
			western meadowlark		2.6						
			other birds		8.6						
			gopher snake		13.2						
			striped whipsnake		2.1						
			unident. snake		4.7						
			other reptiles		3.7						
			scorpion		0.9						

***** POPULATION DYNAMICS *****

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
HOME RANGE SIZE													
Andersen & Rongstad 1989	A	B	-	FA	1,770		ha	957	2,465	4	Colorado 1986	upland shortgrass & prairie & pinyon-juniper woodlands	Radio-equipped hawks (2 of each sex), home range calculated by 95% ellipse method.
Andersen & Rongstad 1989	A	B	-	FA	965		ha	418	1,747	4	Colorado 1986	upland shortgrass & prairie & pinyon-juniper woodlands	Radio-equipped hawks (2 of each sex), home range determined by minimum convex polygon method.
Craighead & Craighead 1956	A	B	-	SU	229	114 SD	ha	83	386	10	Wyoming 1947	grasslands, forest	Breeding season home range for pairs based on observations (plotted on maps).

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Craighead & Craighead 1956	A	B	1	SU	377	146 SD	ha	130	557	6	s Michigan 1942,48	fields, woodlots	Breeding season home range for: (1) pairs; (2) unpaired birds. Based on observations (plotted on maps) from March - August. I = immature hawk.
	I	B	1	SU	307		ha	171	443	2			
	I	-	2	SU	150		ha	70	230	2			
Craighead & Craighead 1956	I	-	-	WI	187		ha	75	298	2	s Mich. 41-42,47-48	fields, woodlots	Seasonal home range from November - February based on observations (plotted on maps). I = immature hawk.
	A	B	-	WI	697	316 SD	ha	381	989	4			
Fitch et al. 1946	A	B	-	SP	60-160		ha				c California 1939-41	foothills	Breeding season home range (spring and summer).
Janes 1984	-	-	-	-	233	90 SE	ha			33	Oregon, 1973-82	pasture/wheat fields	Approximately 33 territories followed over 10 years.
Peterson 1979	A	B	-	WI	165		ha				Wisconsin	NS	As cited in Gatz and Hegdal 1987.
USDI 1979	A	B	-	SU	1,500		ha				sw Idaho	canyon, shrubsteppe community	Radio-equipped hawks during breeding season. As cited in Steenhof and Kochert 1985.
POPULATION DENSITY													
Adamcik et al. 1979	-	B	-	SU	0.0012		pairs/ha	0.0010	0.0015	10 yr	Alberta, CAN 1966-75	farm & woodland	16 to 24 breeding pairs followed for 10 years.
Baker & Brooks 1981	-	-	-	WI	0.014		N/ha			15	Toronto, CAN 1974-75	mixed old fields	
	-	-	-	SP	0.017		N/ha			16			
	-	-	-	FA	0.025		N/ha			16			
Baker & Brooks 1981	-	-	-	WI	0.002		N/ha			22	Toronto, CAN 1975-76	mixed old fields	
	-	-	-	SP	0.010		N/ha			20			
	-	-	-	FA	0.004		N/ha			20			
Bohm 1978b	A	B	-	-	0.0070		nests/ha			10	Minnesota 1976-77	farm & woodlands	
Craighead & Craighead 1956	A	B	1	SU	0.0004		pairs/ha	0.0002	0.0005		s Mich. 1942,47-48	woodlands, fields	9,600 ha sampled at each of two sites (1) Superior Township; (2) Check area.
	A	B	2	SU	0.0012		pairs/ha	0.0010	0.0013				
Craighead & Craighead 1956	A	B	-	SU	0.0039		pairs/ha				Wyoming 1947	grasslands, forest	3,100 ha sampled in the Jackson Hole area.

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Craighead & Craighead 1956	-	B	-	FA	0.0010	0.0005 SD	N/ha	0.0006	0.0015	3	s Mich. 41-42, 46-49	fields, woodlots	Counts of adults and immature birds (not nestlings or fledglings) in a 9,300 ha area. Spring (1) = transition period when some hawks are leaving, some are arriving, and others are staying in the same place. N = number of years of estimates.
	-	B	-	WI	0.0015	0.0003 SD	N/ha	0.0012	0.0018	4			
	-	B	1	SP	0.0016		N/ha	0.0015	0.0016	2			
	-	B	-	SP	0.0013	0.0007 SD	N/ha	0.0005	0.0018	3			
	-	B	-	SU	0.0013		N/ha	0.0006	0.0020	2			
Fitch et al. 1946	A	B	-	-	0.0078		pairs/ha				c California 1939-41	foothills	Habitat in San Joaquin Experimental Range.
Gates 1972	A	B	-	WI	0.0036		N/ha			14	ec Wisconsin 1958-59	farm & wetlands	Sprinvale area; roadside census.
Gates 1972	A	B	-	WI	0.0015		N/ha	0.0008	0.0019	9-21	ec Wisconsin 1959-64	farm & wetlands	Waupun area. Five years of data on population that ranged from 9 to 21 in the area; based on roadside census of 109 sq. km area.
Gates 1972	A	B	BR	SU	0.0019		N/ha	0.0017	0.0022		ec Wisconsin 1962-64	farm & wetlands	Waupun area; breeding adults determined by nest counts and roadside surveys.
Hagar 1957	A	B	-	-	0.0018		pairs/ha				New York 1951-52	NS	As cited in Luttich et al. 1971.
Johnson 1975	-	B	-	-	0.0012		pairs/ha				Montana	NS	As cited in Rothfels and Lein 1983.
Luttich et al. 1971	A	B	-	SP	0.0014		pairs/ha			NS	Alberta, CAN 1967-69	farm & forest	Number of resident pairs on the 155 sq. km site ranged from 21-23; each year three pairs did not lay eggs.
McGovern & McNurney 1986	A	B	1	SU	0.0017		pairs/ha			5 pr	Colorado	open aspen	Density of breeding pairs in: (1) area a (28.7 km2); (2) area b (140 km2). Both habitats were similar.
	A	B	2	SU	0.0050		pairs/ha			6 pr			
Orians & Kulhman 1956	A	B	-	-	0.0014		pairs/ha	0.0011	0.0016	NS	Wisconsin 1953-55	NS	As cited in Luttich et al. 1971 and Rothfels and Lein 1983.
Petersen 1979	-	B	-	SP	0.0024		pairs/ha				Wisconsin	NS	As cited in Rothfels and Lein 1983.
Rothfels & Lien 1983	A	B	BR	SP			pairs/ha	0.0042	0.0047		Alberta, CAN 1979-80	Rocky Mountain foothills	Study suggests that in this area both inter- and intraspecific territoriality occur (other species = Swainson's hawks).
Smith & Murphy 1973	-	B	-	-	0.0003		pairs/ha				Utah	NS	As cited in Rothfels and Lein 1983.

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Springer & Kirkley 1978	-	B	-	-	0.0016		pairs/ha				Ohio	NS	As cited in Rothfels and Lein 1983.
CLUTCH SIZE													
Adamcik et al. 1979	-	-	1	-	2.56						Alberta, CAN 1966-75	farm, woodland	16 to 24 breeding pairs followed for 10 years in area with strongly cyclical snowshoe hare population. Hare density (1) high - 1970 (2323/ha); (2) moderate - 1972 (990/ha); (3) low - 1975 (17/ha); (4) 10 year mean.
	-	-	2	-	2.61								
	-	-	3	-	1.90								
	-	-	4	-	2.2								
Bohm 1978b	-	-	-	-	2.26	0.75 SD				23	Minnesota, 1976-77	farm & woodlands	
Fitch et al. 1946	-	-	-	-	2.0	0.77 SD		1	3	18	c California 1939-41	foothills	
Henny & Wight 1970; 1972	-	-	-	-	2.11					9	Florida 1870-1868	NS	Most data collected prior to 1930; is from museum collections and banding records.
Henny & Wight 1970; 1972	-	-	-	-	2.44					36	TX, OK, NM 1870-1968	NS	Most data collected prior to 1930; is from museum collections and banding records.
Henny & Wight 1970; 1972	-	-	-	-	2.94					18	ID, ND, MO 1870-1968	NS	Most data collected prior to 1930; is from museum collections and banding records.
Henny & Wight 1970; 1972	-	-	-	-	2.92					231	California 1870-1968	NS	Most data collected prior to 1930; is from museum collections and banding records.
Henny & Wight 1970; 1972	-	-	-	-	2.9					20	sw Canada 1870-68	NS	Most data collected prior to 1930; is from museum collections and banding records.
Henny & Wight 1970; 1972	-	-	-	-	2.72					75	MI, MA, RI, IL	NS	Location also includes se Canada. Data collected from 1870 - 1968 (most prior to 1930); from museum collections and banding records.
Henny & Wight 1970; 1972	-	-	-	-	2.57					23	IL, IN, OH 1870-1968	NS	Most data collected prior to 1930; is from museum collections and banding data.

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Henny & Wight 1970; 1972	-	-	-	-	2.29					17	MD, DE, MA, WV, VA	NS	Location also includes New York. Data collected from 1870 - 1963 (most prior to 1930); from museum collections and banding records.
Henny & Wight 1970; 1972	-	-	-	-	2.96					26	OR, WA. 1870-1968	NS	Most data colected prior to 1930; is from museum collections and banding records.
Luttich et al. 1971	-	-	-	-	2.0	0.1 SE				98	Alberta, CAN 1967-69	farm, forest	
Mader 1978	-	-	-	-	2.32					59	Arizona 1974-76	desert	Average of four yearly means: 2.12; 2.57; 2.36; and 2.29 eggs/nest.
CLUTCHES/YEAR													
Bent 1937	-	-	-	-	1		/year				se Massachusetts	forest, swamp	May replace if first one is lost.
Craighead & Craighead 1956	-	-	-	-	1		/year				s Michigan 1942, 48	fields, woodlots	If first clutch is lost early in nesting cycle, it may be replaced.
DAYS INCUBATION													
Adamcik et al. 1979	-	-	-	-	32					16-24	Alberta, CAN 1966-75	farm & woodland	16 to 24 breeding pairs studied over 10 years.
Bent 1937; Hardy 1939	-	-	-	-	32		days			NS	NS	NS	As cited in Luttich et al. 1971.
Nice 1954	-	-	-	-	34		days				NS	NS	As cited in Steenhof 1987.
AGE AT FLEDGING													
Craighead & Craighead 1956	-	B	-	-	41		days				s Michigan 1942-48	fields, woodlots	
Fitch et al. 1946	-	B	-	-	45-46		days				c California 1939-41	foothills	
Luttich et al. 1971	-	B	-	-	44		days				Alberta, CAN 1966-69	farm, woodland	18 to 24 breeding pairs studied each of 4 years.

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Land Management U.S. Bureau of (unpubl.)	-	B	-	-	39		days				States w United	NS	As cited in Steenhof 1987.
N FLEDGE/ACTIVE NEST													
Adamcik et al. 1979	-	-	1	-	1.90						Alberta, CAN 1966-75	farm, woodland	16 to 24 breeding pairs followed for 10 years in area with strongly cyclical snowshoe hare population. Hare density (1) high - 1970 (2323/ha); (2) moderate - 1972 (990/ha); (3) low - 1975 (17/ha); (4) 10 year mean.
	-	-	2	-	1.29								
	-	-	3	-	0.28								
	-	-	4	-	1.15								
Bohm 1978b	-	-	-	-	1.07		N/act nest			72	Minnesota 1976-77	woodlots, farms	2 year mean.
Craighead & Craighead 1956	-	-	-	-	0.9		N/act nest			22	s Michigan 1948	woodlots, fields	Includes pairs that had nests but did not lay eggs.
Craighead & Craighead 1956	-	-	-	-	1.4		N/act nest			10	Wyoming 1947	grasslands, forest	Includes pairs that had nests but did not lay eggs.
Gates 1972	-	-	-	-	1.1		N/act nest	0.9	1.4	31	Wisconsin 1962-64	farm, wetlands	Minimum and maximum are yearly means.
Janes 1984	-	-	-	-	1.47	0.25 SE	N/terr-yr			10 yr	Oregon 1973-82	grazing, low hills	23 territories observed for 10 years.
Steenhof & Kochert 1985	-	-	1	-	1.9		N/act nest			20	sw Idaho 1975-78	canyon, shrubsteppe community	Prey abundance: (1) normal; (2) low. Low prey abundance recorded in 1977-78 due to a severe drought.
	-	-	2	-	1.2		N/act nest			23			
N FLEDGE/SUCCESSFUL NEST													
Bohm 1978b	-	-	-	-	1.79		N/suc nest			44	Minnesota 1976-77	woodlots, farms	2 year mean.
Gates 1972	-	-	-	-	1.8		N/suc nest	1.6	1.9	20	Wisconsin 1962-64	farm, wetlands	Minimum and maximum are yearly means.
Henny & Wight 1970	-	-	1	-	2.12		N/suc nest				various	NS	Summarizing data from various studies (prior to 1951). (1) north of 42 N latitude; (2) south of 42 N latitude.
	-	-	2	-	1.85		N/suc nest						
Luttich et al. 1971	-	-	-	-	1.4		N/suc nest			79	Alberta, CAN 1967-69	farm & forest	Number fledged/number of clutches that hatched.

Reference	Age Sex Cond Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Mader 1978	- - - -	1.91	0.0100 SE	N/suc nest			34	Arizona 1974-76	desert	Measured as still alive at 28 days.
AGE AT SEXUAL MATURITY										
Henny & Wight 1970; 1972	- B - -	2		years				North America	NS	Based on bandings and recoveries.
Luttich et al. 1971	- B - -	2		years	1			Alberta, CAN 1967-69	NS	One yearling individual found to have successfully bred (sex not given); determined to be juvenile because lacked some characteristics of adult plumage.
ANNUAL MORTALITY										
Craighead & Craighead 1956	A B - -	12		%/yr				s MI, WY 1942, 47-48	open areas, woods	Estimate for all raptor species in both study areas. J = from fleging to the nest summer.
	J B - -	88		%/yr						
Henny & Wight 1970; 1972	J B - -	62.4		%/1st yr				n N. America 1926-50	NS	Based on study of band recoveries recorded prior to 1951. Adults: (1) banded as nestlings; (2) banded as adults. Adult survival is for years 2-18; juveniles is from late nestling period until next year. Data for areas north of 42 degrees latitude.
	A B 1 -	20.6	1.3 SE	%/yr						
	A B 2 -	20.0	1.2 SE	%/yr						
	B B - -	35.3	1.6 SE	%/yr						
Henny & Wight 1970; 1972	J B - -	65.4		%/yr				US, CAN 1958-64	NS	
	A B - -	26.0		%/yr						
Henny & Wight 1970; 1972	J B - -	66		%/1st yr				s N. America 1926-50	NS	Based on study of band recoveries recorded prior to 1951. Adults: (1) banded as nestlings; (2) banded as adults. Adult survival is for years 2-18; juveniles is from late nestling period until next year. Data for areas south of 42 degrees latitude.
	A B 1 -	23.9	2.2 SE	%/yr						
	A B 2 -	23.0	1.8 SE	%/yr						
	B B - -	41.8	2.5 SE	%/yr						
Luttich et al. 1971	J B - -	54		%/1st yr				Alberta, CAN 1966-69	farm, forest	Juvenile mortality measured from fledging to first year.
	A B - -	20		%/yr						
LONGEVITY										
Henny & Wight 1970; 1972	- - - -			years		18		North America	NS	Oldest bird recovered in bird banding study.

*** SEASONAL ACTIVITIES ***

Reference	Begin	Peak	End	Location	Habitat	Notes
MATING/LAYING						
Bent 1937	earl Apr	mid May	mid June	Alaska, Canada	NS	Presented as "egg dates"; 26 records.
Bent 1937	late Mar	earl Apr	late Apr	Maryland, Virginia	NS	Presented as "egg dates"; 15 records.
Bent 1937	earl Mar	Apr	late Jun	Ohio to North Dakota	NS	Presented as "egg dates"; 85 records.
Bent 1937	late Mar	Apr, May	mid Jun	New England, NY	NS	Presented as "egg dates"; 148 records.
Bent 1937	late Feb	April	late Jun	Iowa to Colorado	NS	Presented as "egg dates"; 44 records.
Bent 1937	mid Feb	late Mar	late May	Washington to Calif.	NS	Presented as "egg dates"; 292 records.
Bent 1937	mid Feb	Mar	mid June	AR & TX to FL	NS	Presented as "egg dates"; 97 records.
Craighead & Craighead 1956	mid Apr			Wyoming 1947	grasslands, forest	
Craighead & Craighead 1956	late Mar		earl Apr	s Michigan 1942,48	fields, woodlots	
Fitch et al. 1946	mid Feb		earl Mar	c California 1939-40	foothills	Based on eight observed copulations.
Luttich et al. 1971	mid Apr	May 1	mid May	Alberta, CAN	farm & forest	
Mader 1978	mid Feb		earl Apr	Arizona	desert	
HATCHING						
Craighead & Craighead 1956	mid May		late May	Wyoming 1947	grasslands, forest	
Craighead & Craighead 1956	late Apr		earl May	s Michigan 1942,48	fields, woodlots	

Reference	Begin	Peak	End	Location	Habitat	Notes
Luttich et al. 1971	mid May	earl June	mid June	Alberta, CAN	farm & forest	
Mader 1978	late Mar		earl May	Arizona	desert	
FLEDGING						
Craighead & Craighead 1956	mid June		earl Jul	Wyoming 1947	grasslands, forest	
Craighead & Craighead 1956	earl Jun		mid Jun	s Michigan 1942,48	fields, woodlots	
Mader 1978	late Apr	late May	earl Jun	Arizona	desert	
FALL MIGRATION						
Bent 1937	earl Sep			New England	NS	Early departure date.
Bent 1937			mid Oct	Montana	NS	Late dates of departure.
Bent 1937			late Oct	Saskatchewan, CAN	NS	Late dates of departure.
Bent 1937			late Nov	Minnesota	NS	Late dates of departure.
Bent 1937			late Oct	North Dakota	NS	Late dates of departure.
Luttich et al. 1971			mid Oct	Alberta, CAN 1966-69	farm, forest	
SPRING MIGRATION						
Bent 1937	mid Mar			Maine, Montana	NS	Early date of arrival.
Bent 1937	late Mar			New Brunswick, CAN	NS	Nova Scotia also; early date of arrival.
Bent 1937	late Mar			Wyoming, Idaho	NS	Early date of arrival.
Bohm 1978b	mid Mar			Minnesota 1976-77	woodlots, farms	
Craighead & Craighead 1956	mid Mar			Wyoming 1947	grasslands, forest	Arrival of hawks for breeding season.

Reference	Begin	Peak	End	Location	Habitat	Notes
Craighead & Craighead 1956	late Feb	earl Mar		s Michigan 1942,48	fields, woodlots	Arrival of some hawks for breeding seaons; others wintered in same place.
Luttich et al. 1971	earl Apr			Alberta, CAN 1966-69	farm & forest	

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*** NORMALIZING AND CONTACT RATE FACTORS ***

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
BODY WEIGHT													
Bortolotti 1984a	J	M	-	-	4,066	35.08 SE	g	3,575	4,500	26	Saskatchewan	lake	Age = 60 days; growth not complete
	J	F	-	-	5,172	46.54 SE	g	4,800	5,600	21	CAN, 1980-82		at this age or at age of fledging.
Brown & Amadon	A	M	-	-			g	4,000	4,600		Alaska &	NS	
1968	A	F	-	-	6,300		g				Canada		
(alascensis)													
Chura & Stewart	A	M	-	WI	4,833		g	4,238	5,642	7	Alaska 1962	lab	Birds caught in November and
1967	J	F	-	WI	5,642		g			1			December for DDT tests. Juveniles =
	J	M	-	WI	4,904		g			1			immature eagles. Two juveniles were
	J	-	-	WI	4,677		g	4,706	4,649	2			of unkown sex.
Imler & Kalmbach	J	M	-	SU	4,014		g	3,524	4,568		Alaska	NS	Immature eagles (up to three years
1955	J	F	-	SU	5,089		g	4,359	5,756				old). N = 18 for both sexes combined. As cited in Maestrelli and Wiemeyer 1975; Bartolotti 1984a.
Snyder & Wiley	A	F	-	-	5,244		g			37	NS	NS	As cited in Dunning 1984.
1976	A	M	-	-	4,123		g			35			
Wiemeyer 1991	A	F	-	-	4,500		g				Florida	NS	Approximate.
pers. comm.	A	M	-	-	3,000		g						
EGG WEIGHT													
Bortolotti 1984b	-	-	-	-	114.4	10.59 SD	g			17	Saskatchewan CAN, 1980-82	lake	
Krantz et al. 1970	-	-	-	-	120.6	8.2 SD	g	108	134	14	Wisconsin 1968	NS	Weight estimate calculated from egg volumes (in ml) presented by author using 1.0 as the assumed specific gravity (after Stickel et al. 1966).
Krantz et al. 1970	-	-	-	-	102.5	17.9 SD	g	71	125	6	Florida 1968	NS	Weight estimate calculated from egg volumes (in ml) presented by author using 1.0 as the assumed specific gravity (after Stickel et al. 1966).

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
HATCHING WEIGHT													
Bortolotti 1984b	-	B	-	-	91.5	5.17 SD	g			6	Saskatchewan CAN, 1980-82	lake	Nestlings weighed soon after hatching.
NESTLING WEIGHT													
Bortolotti 1984b	N	B	-	-	500		g 10 days			47	Saskatchewan	lake	Number of days in units column is the age of nestlings. Values estimated from Figure 4.
	N	B	-	-	1,300		g 20 days			47	CAN, 1980-82		
	N	M	-	-	2,700		g 30 days			26			
	N	F	-	-	3,000		g 30 days			21			
	N	M	-	-	3,100		g 40 days			26			
	N	F	-	-	3,900		g 40 days			21			
	N	M	-	-	3,600		g 50 days			26			
	N	F	-	-	4,600		g 50 days			21			
FLEDGING WEIGHT													
Maestrelli &	-	-	-	-	3,639		g			1	Maryland	captive	Sample size too small.
Wiemeyer 1975	-	-	-	-	4,671		g			1			
NESTLING GROWTH RATE													
Bortolotti 1989	N	B	1	SU	0.067	0.0009 SE	K			20	Saskatchewan	lake	Value is the mean growth curve parameter (K) for individual Grompertz growth equations. Nestlings from (1) East end of lake; (2) west end. West end was thought to have better food supplies.
	N	B	2	SU	0.070	0.0007 SE	K			20	CAN, 1980-82		
METABOLIC RATE (KCAL BASIS)													
Craig et al. 1988	A	B	-	WI	448	17 SD	kcal/d				Connecticut	river	Estimated daily energy budget.
	J	B	-	WI	499	17 SD	kcal/d				1986		
Gessaman et al.	B	-	1	-	41.1	3.1 SD	kcal/kg-d			2	Utah 1987	lab	Resting (perching) metabolism determined by oxygen consumption. Values are means for trials conducted on one adult (3.7 kg) and one immature (3.9 kg) eagle. Conditions: (1) day (08:00 - 20:00), 0 degrees C; (2) night (20:00 - 08:00), 0 degrees C; (3) day, 15 C; (4) night, 15 C.
1991	B	-	2	-	37.4	4.5 SD	kcal/kg-d			2			
	B	-	3	-	42.1	2.1 SD	kcal/kg-d			2			
	B	-	4	-	40.2	2.7 SD	kcal/kg-d			2			

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Keister et al. 1985	B	B	R	WI			kcal/night	<120	209		sc Oregon, n California 1979-80	lake, forest	Energy demand per night roosting; these varied with roost site and ambient temperature.
Stalmaster & Gessaman 1982	A	B	1	-	96.4	25 SD	kcal/kg-d	57	140		NS 1980	lab	Resting winter-acclimatized eagles. Existence metabolism at temperature = (1) -10 C; (2) 5 C; (3) 20 C, calculated from equations developed from empirical data at the three temperatures. EM (kcal/kg-day) = 88.05 - 0.84 T ambient. SDs and ranges estimated from Figure 2.
	A	B	2	-	83.9	28 SD	kcal/kg-d	40	138				
	A	B	3	-	71.3	18 SD	kcal/kg-d	45	100				
Stalmaster & Gessaman 1984	B	B	BA	WI	66.6		kcal/kg-d			4	NS 1978-80	lab	Calculated by measuring oxygen consumption.
Stalmaster & Gessaman 1984	B	B	-	WI	90		kcal/kg-d			4	Washington 1978-80	river	Flying metabolism; 4.5 kg eagle assumed.
FOOD INGESTION RATE													
Chura & Stewart 1967	A	M	-	WI	0.0741	0.0033 SE	g/g-day	0	0.1652	112	Alaska 1962-63	captive	N = days of captivity. Food consumption by control birds in DDT test. Food was ground fish (frozen and then thawed for use). Weight of birds used was weight at capture; adult gained 0.3% body weight over test period, immature lost 14%.
	J	-	-	WI	0.0612	0.0034 SE	g/g-day	0	0.1487	112			
Craig et al. 1988	A	B	FY	WI	533	17 SD	g/bird-d				Connecticut 1986	river	Estimate of food consumed based on observed feeding behaviors and Stalmaster & Gessaman (1984) model.
	J	B	FY	WI	608	21 SD	g/bird-d						
Craig et al. 1988	A	B	FY	WI	519		g/bird-d				Connecticut 1986	river	Estimated using equation from Stalmaster & Gessaman 1984 that provides prey consumption based on time spent feeding. Authors noted inefficient juvenile feeding, and felt that the equation poorly predicts food ingestion rates for juvenile eagles.
	J	B	FY	WI	1569		g/bird-d						
Craig et al. 1988	A	B	-	WI	538	18 SD	kcal/day				Connecticut 1986	river	Daily gross energy consumption.
	J	B	-	WI	584	18 SD	kcal/day						
Duke et al. 1976	A	-	-	-	0.056		g/g-day				Utah	captive outside	Body weight of eagle was 3,870 g; it was fed mice at an ambient temperature of 27 degrees C. As cited in Duke et al. 1987.

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Stalmaster 1980	A	-	1	-	500		g/day				Washington 1974-80	river	Foods: (1) spawned-out salmon; (2) all other foods. Author notes that gorging of up to 900 g of food may permit eagles to eat every other day.
	-	-	2	-	300-400		g/day						
Stalmaster & Gessaman 1982	B	B	1	-	0.092	0.0255 SD	g/g-day			4	Utah 1980	lab	Winter-acclimatized eagles. Mean of 4 eagles tested at three temperatures (-10, 5, & 20 degrees C) and fed three types of food: (1) salmon; (2) black-tailed jackrabbit; (3) mallard duck. Authors provide model to predict food consumption with temperature for these three different diets.
	B	B	2	-	0.0748	0.0130 SD	g/g-day			4			
	B	B	3	-	0.0651	0.0115 SD	g/g-day			4			
Stalmaster & Gessaman 1984	B	B	1	WI	0.1087		g/g-day				Washington 1978-80	river	Estimated from observed captures of pre-weighed fish provided at a feeding station; in each case the food was salmon and the eagles were free living. (1) Calculated minimum food requirement; (2) mass food consumed with assuming eagle mass of 4.5 kg.
	A	B	2	WI	0.1227		g/g-day						
	J	B	2	WI	0.0911		g/g-day						
	Y	B	2	WI	0.1020		g/g-day						
Stalmaster & Gessaman 1982	B	B	1	-	118.4	26 SD	kcal/kg-d	74	170		NS 1980	lab	Existence metabolism conditions; winter-acclimatized eagles. Gross energy intake (GEI) at temperature = (1) -10 C; (2) 5 C; (3) 20 C. Estimated by author from equations developed from empirical data: GEI (kcal/kg-d) = 109.4 - 0.90 ambient temperature. Values were normalized to a 4.5 kg bird. Range and SD estimated from Figure 2.
	A	B	2	-	104.9	28 SD	kcal/kg-d	51	160				
	J	B	3	-	91.4	15 SD	kcal/kg-d	53	117				
Stalmaster & Gessaman 1984	B	B	-	WI	110		kcal/kg-d			4	Washington 1978-80	river	Flying metabolism; 4.5 kg eagle assumed. Total energy intake required.
Stalmaster & Gessaman 1982	B	B	1	-	0.0884	0.0239 SD	g/g-day			4	Utah 1980	lab	Winter-acclimated eagles; 4 birds each fed 3 different diets at temperatures of (degrees C): (1) -10; (2) 5; (3) 20. Three diets were salmon, jackrabbit, and mallard.
	B	B	2	-	0.0755	0.0186 SD	g/g-day			4			
	B	B	3	-	0.0680	0.0144 SD	g/g-day			4			

***** DIET *****

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Dugoni et al. 1986	B	B	muskrat		7.4			9	Louisiana	swamp	Remains collected from 9 nests following fledging of young.
			nutria		5.8					-	
			other mammal		2.4					% frequency of occurrence; prey remains at nest	
			American coot		20.2						
			mottled duck		4.5						
			blue winged teal		4.1						
			other birds		13.6						
			catfish		21.8						
			other fish		19.8						
			reptiles		0.4						
Dunstan & Harper 1975	B	B	bullhead catfish		35.1			6	Minnesota 1967-72	lake	Prey remains collected in and below 6 active nests.
			suckers		29.1					-	
			northern pike		13.9					% frequency of occurrence; prey remains at nests	
			largemouth bass		5.0						
			rock bass		4.0						
			other fish		3.0						
			ducks		4.6						
			other birds		3.3						
			other		1.9						
Fielder & Starky 1980	B	B	american coot				14.7	61	Washington 1977-79	reservoir	Lake Pateros (reservoir); N = number of prey items found.
			mallard				6.6			-	
			scaup				3.3			% frequency of occurrence; prey remains at and below nest	
			redhead				3.3				
			other waterfowl				8.2				
			chukar				45.9				
			other birds				8.2				
			brown bullhead				3.3				
			walleye				3.3				
			unidentified fish				3.2				
Fielder & Starky 1980	B	B	american coot				75	340	Washington 1977-79	reservoir	Rufus Woods Lake (reservoir); N = number of prey items found.
			american widgeon				4.7			-	
			mallard				4.1			% frequency of occurrence; prey remains at and below nest	
			other waterfowl				7.4				
			other birds				1.2				
			brown bullhead				4.1				
			carp				1.2				
			sucker				1.8				
			other fish				0.5				

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Fielder 1982	B	B	mallard				8	485	Washington 1977-82	reservoir - % frequency of occurrence; items found below perches	Lake Pateros (reservoir); N = number of prey items found.
			American widgeon				4.3				
			American coot				64.1				
			other waterfowl				9.2				
			non-waterfowl birds				4.7				
			brown bullhead				3.1				
			other fish				6.2				
Fielder 1982	B	B	mallard				11.8	85	Washington 1978-82	reservoir - % frequency of occurrence; prey remains below perches	Rufus Woods Lake (reservoir); N = number of prey items found.
			American coot				11.8				
			other waterfowl				12.9				
			chukar				45.9				
			other non-waterfowl				9.4				
			sucker				3.5				
			walleye				2.4				
			unidentified fish				2.4				
Fitzner & Hanson 1979	B	B	mallard				32	72	Washington 1975-76	river - % biomass; prey remains below communal roosts	N = number of prey items.
			American widgeon				9				
			American coot				9				
			other birds				3				
			Chinook salmon				21				
			sucker				4				
			European carp				1				
			other fish				1				
			unaccounted				20				
Frenzel & Anthony 1989	B	B	snow goose				7.6	913	n CA, s OR 1979-82	lake - % frequency of occurrence; prey remains from below hunting perches	N = number of prey items. Eagles were frequently observed feeding on montane voles which they probably ate whole (no remains).
			mallard				25.3				
			northern pintail				14.8				
			american widgeon				23.3				
			ruddy duck				9.4				
			american coot				4.1				
			other birds				14.9				
			mammals				0.5				
			reptiles				0.1				
Grubb & Hensel 1978	B	B	fish		25			36	Alaska 1963,67,68	coastal - % frequency of occurrence; prey remains at nest	Season not specified, but probably is spring/summer because eagles are nesting.
			(humpback salmon)		(15)						
			birds		62						
			(ducks)		(7.5)						
			(seabirds)		(15)						
			(glauc. winged gull		(22.5)						
			fox		5						
			invertebrates		7.5						

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Grubb & Hensel 1978	B	B	fish		85			36	Alaska 1963,67,68	inland - % frequency of occurrence; prey remains at nest	Season not specified, but is probably spring/summer because eagles are nesting.
			(char)		(44.6)						
			(sockeye salmon)		(36.5)						
			birds		10						
			(common goldeneye)		(5.4)						
			(other ducks)		(2.7)						
			(gulls)		(1.4)						
			mammals		5						
			(snowshoe hare)		(1.4)						
			(tundra vole)		(2.7)						
			(reindeer)		(1.4)						
Haywood & Ohmhart 1983	B	B	channel catfish		27.9			7	Arizona 1979-80	desert scrub, riparian - % frequency of occurrence; prey items at and below nests	N = number of nests. Seasons are spring and summer.
			carp		16.1						
			Sonora sucker		11.8						
			other fish		7.3						
			American coot		5.9						
			other birds		10.3						
			cottontail rabbit		4.4						
			jack rabbit		4.4						
			other mammals		11.8						
Haywood & Ohmart 1986	B	B	fish		57.6			481	c Arizona 1979-82	desert scrub, riparian - % biomass; prey brought to or found at nests	Breeding season; 11 nests observed over a five year period. N = number of prey identified. Individual prey types comprising less than 1% of the total not listed here.
			(channel catfish)		(21.8)						
			(Sonora sucker)		(8.6)						
			(carp)		(17.3)						
			(flathead catfish)		(2.4)						
			(desert sucker)		(3.3)						
			(bass species)		(2.8)						
			birds		14.1						
			(American coot)		(8.1)						
			(great blue heron)		(4.4)						
			mammals		28.1						
			(desert cottontail)		(8.1)						
			(jackrabbit)		(14.9)						
			(rock squirrel)		(1.1)						
			reptiles		0.2						
Kozie & Anderson 1991	B	B	suckers		27.6			156	Wisconsin 1983-88	islands & shoreline of Lake Superior - % frequency of occurrence; prey remains at nest	Found at 53 nests. To consolidate information, suckers were grouped together, and items with less than 2% occurrence were grouped as "other". Islands were the Apostle Islands National Lakeshore.
			burbot		13.5						
			round whitefish		3.8						
			other fish		5.1						
			(fish subtotal)		(50.0)						
			herring gull		21.8						
			blue jay		6.4						
			northern flicker		3.2						
			other birds		14.4						
			unidentified birds		2.6						
			(bird subtotal)		(48.4)						

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Kozie & Anderson (continued)			mammals (whitetailed deer, snowshoe hare)		1.2						
LeFranc & Cline 1983	B	B	fish		41			226	MD, VA, DE 1979-81	Chesapeake Bay - % frequency of occurrence; prey remains at nests	Season is early May to early June; N = number of nests. Each nest visited once each year.
			birds		35						
			mammals		14						
			turtles		10						
McEwan & Hirth 1980	B	B	fish	70.3				16	nc Florida 1976-76	lakes - % biomass; prey items in nests	Seasons = winter/spring. N = number of nests; items collected after young had fledged. 34 species found; summary includes species comprising 2% or more. Calculations of biomass did not include 4 large mammals probably obtained as carrion and thus only partially consumed by eagles.
			(brown bullhead)	(46.1)							
			(catfish)	(13.1)							
			(lake chubsucker)	(6.1)							
			(black crappie)	(2.3)							
			birds	25.8							
			(American coot)	(19.0)							
			(ruddy duck)	(2.3)							
			mammals	3.3							
			(rabbits)	(2.4)							
			reptiles	0.6							
Ofelt 1975	A	B	pink salmon		15.5			3	Alaska 1971	coastal - % frequency of occurrence; prey brought to nest	Summary of food items visually identified during 30 hours of observation at 3 nests.
			herring		32						
			trout		4.5						
			other fish		24						
			other animals		24						
Sherrod et al. 1977	-	-	Norway rat (Rathus norvegicus)		20			34	Alaska 1972	Amchitka Island - number collected; items in nests	
			sea otter (Enhydra lutris)		56						
			Northern fulmar (Fulmarus glacialis)		16						
			Short-tailed shear-water (Fulmarus tenuirostris)		6						
			Cormorant sp. (Phalacrocorax)		5						
			Rock Ptarmigan (Lagopus mutus)		9						
			Glaucous-winged gull (Larus glaucescens)		17						
			Ancient Murrelet (Synthiliboramphus antiquus)		13						
			Crested Aukulet (Aietha cristatella)		22						

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Sherrod et al. 1977 (continued)			Least Aukulet (A. pusilla)		9						
			Smooth lumpsucker (Aptocuclus ventricosus)		31						
			Rock greenling (Nexagrammus lagocephalus)		5						
Sherrod et al. 1977	-	-	mammals		36.1			78	Alaska 1971-72	Amchitka Island - average % of diet by biomass	Season not specified. Author notes that carrion comprises a large part of eagles' diet and that eagles regularly scavenge carcases of the harbor seal (Phoca vitulina), the Stellar sea lion (Eumetopias jerbata), sea otters, and whales.
			birds		49.4						
			fish		14.4						
			invertebrates		0.1						
Swenson et al. 1986	B	B	birds		42.7				Idaho, Wyoming 76-82	forested river, lake - % frequency of occurrence; pellets and remains in and under nests	40 species identified; species making up less than 2% of total not listed here.
			(mallard)		(5.4)						
			(coot)		(5.4)						
			(eared grebe)		(2.4)						
			(other aquatic bird		(16.4)						
			fish		43.5						
			(Utah sucker)		(20.4)						
			(cutthroat trout)		(8.2)						
			(Utah chub)		(6.3)						
			(salmonids)		(3.3)						
			mammals		13.9						
			(muskrat)		(3.3)						
Todd et al. 1982	B	B	brown bullhead		24.8			133	Maine 1976-80	inland - % frequency of occurrence; pellets	Season - includes all but winter. Summary of 32 food types presented in paper.
			white sucker		19.5						
			chain pickerel		20.1						
			smallmouth bass		3.8						
			white perch		3.6						
			other fish		4.9						
			black duck		3.0						
			other birds		13.5						
			mammals		6.8						
Todd et al. 1982	B	B	black duck		14.8			269	Maine 1976-80	coastal - % frequency of occurrence; pellets	All seasons. N = number of pellets collected. Summary of 67 food types presented in paper.
			herring gull		11.6						
			cormorant		7.6						
			other gulls		7.3						
			common eider		5.6						
			other birds		28.8						
			herring		5.2						
			other fish		11.9						
			mammals		6.9						

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Vermeer & Morgan 1989	-	-	birds		41.2			80	Br. Columbia, CAN 1988	islands - % frequency of occurrence; prey found beneath nesting trees	N = number of items found. Summary includes species found three or more times.
			(glauc. winged gull		(16.3)						
			marine invertebrates		45.0						
			(abalone)		(6.3)						
			(littleneck clam)		(18.8)						
			(California mussel)		(8.8)						
			(red crab)		(5.0)						
			fish		10						
			mammals		3.8						
Watson et al. 1991	B	B	fish		71.0			185	OR, WA 1984-86	Columbia River estuary - % frequency of occurrence; prey remains at nest	Season is year round; N = number of prey found. Fish and bird species comprising less than 2% not reported here.
			(largescale sucker)		(17.3)						
			(American shad)		(13.0)						
			(common carp)		(10.8)						
			(peamouth)		(9.7)						
			(other cyprinids)		(4.3)						
			(salmon)		(8.6)						
			birds		26.1						
			(mallard)		(4.9)						
			(green-winged teal)		(2.2)						
			(western grebe)		(4.3)						
			(cormorant)		(2.7)						
			(gull)		(2.7)						
			mammals		2.0						
			(brush rabbit)		(1.0)						

*** POPULATION DYNAMICS ***

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
HOME RANGE SIZE													
Craig et al. 1988	J	-	1	WI	4		km/day	1	6	4	Connecticut 1986	river	Daily foraging radius from roosts.
	B	B	2	WI	3-7		km/day						
Griffin & Baskett 1985	J	B	1	WI	1,830	1,460 SD	ha			6	Missouri	lake	Minimum home range; J = immature eagles (1-4 years of age). Year: (1) 1978; (2) 1976.
	A	B	1	WI	1,880	900 SD				4			
	J	B	2	WI	4,820	1,830 SD				4			
	B	B	1	WI	1,850	1,200 SD				10			
Grubb 1980	A	B	-	-	3.5		km	1.4	7.2	49	w Washington 1975	San Juan Islands	Occupied breeding territory length determined by aerial surveys of coastline.
Grubb 1980	A	B	-	-	5.5		km	1.1	14.5	28	w Washington 1975	Olympic Penninsula	Occupied breeding territory length determined by aerial surveys of coastline.

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Grubb 1980	A	B	-	-	7.2		km	1.4	24.5	24	w Washington 1975	Puget Sound	Occupied breeding territory length determined by aerial surveys of coastline.
Grubb 1980	A	B	-	-	4.8		km	4.2	21.2	4	w Washington 1975	Hood Canal	Occupied breeding territory length determined by aerial surveys of coastline.
Grubb 1980	A	B	-	-	15.8		km	11.1	26.6	6	w Washington 1975	Grays Harbor	Occupied breeding territory length determined by aerial surveys of coastline.
Grubb 1980	A	B	-	-	6.4		km	12.6	13.0	3	w Washington 1975	inland lake, river	Occupied breeding territory length determined by aerial surveys of coastline.
Haywood & Ohmhart 1983	A	B	-	SP	3,494	2,520 SD	ha	1,821	6,392	3	Arizona 1980-81	desert, riparian river	Minimum home range.
Keister et al. 1985	B	B	-	WI	6-20		km				sc OR, n CA 1979-80	Klamath Basin	Foraging radius; range of distances between communal roosts and the three main foraging areas used by the study population.
Mahaffy & Frenzel 1987	A	B	I	SU	0.56	0.18 SE	km radius			4	Minnesota 1979-80	lake, woods	Radius of territory defended against decoy: (I) incubating; (EB) early brooding; (LB) late brooding. feeding.
	A	B	EB	SU	0.55	0.17 SE	km radius			4			
	A	B	LB	SU	0.72	0.21 SE	km radius			2			
Mahaffy & Frenzel 1987	A	B	1	SU	0.67	0.18 SE	km radius			7	Minnesota 1979-80	lake, woods	During incubation and feeding. Radius of territory defended against decoy: (1) access to decoy across water or shoreline; (2) access to decoy across land.
	A	B	2	SU	0.40	0.03 SE	km radius			3			
Nash et al. 1980	A	B	-	SU			km		6		w Washington 1962-80	San Juan Islands	Foraging radius.
Stalmaster & Gessaman 1984	B	B	-	WI	6.1		km/day				Washington 1978-80	river	Daily foraging radius from roosts for wintering eagles.
POPULATION DENSITY													
Dzus & Gerrard 1989	A	B	-	SU	0.104		N/km shore	0.026	0.179	12	Saskatchewan CAN, 1984-87	lakes	Based on aerial surveys in May-June and July-August.
	J	B	-	SU	0.035		N/km shore	0.005	0.088	12			
	B	B	-	SU	0.139		N/km shore	0.031	0.242	12			

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Grier 1977	B B	B B	- -	SU SU	0.000084 0.000057		N/ha br area/ha				Ontario, Manitoba, CAN	NS	Total of 53 100 square km quadrats sampled; br area = breeding area. Breeding area counts considered by author to be more reliable than bird counts.
Hansen 1987	A	B	-	SU	0.38		pair/km			89	se Alaska 1980-83	riverine	Based on aerial surveys of 89 breeding territories located within the Chilkat Valley.
Hodges & King 1979	A	B	-	SU	0.9		N/km shore				se Alaska	coastal	As cited in Hodges et al. 1987.
Swenson et al. 1986	A A A	B B B	1 2 3	SU SU SU	0.0352 0.0255 0.0453		pair/km pair/km pair/km				WY, ID, MT 1972-79	rivers, lakes	Breeding areas per kilometer of shoreline. Aerial surveys of three study areas in the Greater Yellowstone Ecosystem: (1) Yellowstone; (2) Continental; (3) Snake.
Vermeer & Morgan 1989	A A	B B	1 2	SP SP	0.11 0.07		nest/km nest/km				Br. Columbia CAN 1988	Barkley Sound	Conservative estimate of nesting population along the edges of: (1) forested islands in the sound; (2) Vancouver Island. A total of 54 nests were observed.
CLUTCH SIZE													
Brown & Amadon 1968	-	-	-	-	2		eggs	1	3		NS	NS	
Schmid 1966-67	-	-	-	-	2.28		eggs	1	4	50	PA, DE, MD, NJ 1935-42,46	NS	Mean calculated from data presented in table. 19 of the 60 successful nestings observed had 3 young present.
Sherrod et al. 1977	-	-	-	-	1.9		eggs			46	Alaska 1969	Amchitka Island	
CLUTCHES/YEAR													
Sherrod et al. 1987	-	-	-	-	1		/year				NS	NS	Will often lay a second clutch if the first is lost early in incubation period.

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
DAYS INCUBATION													
Herrick 1932	-	-	-	-	34-35		days				Ohio	wild	As cited in Maestrelli & Wiemeyer 1975.
Hulce 1886; 1887	-	-	-	-	35-37		days			1	Ohio	captive	As cited in Maestrelli & Wiemeyer 1975.
Maestrelli & Wiemeyer 1975	-	-	-	-	35		days	34	38	3	Maryland	captive	
Nicholson 1952	-	-	-	-	35-36		days				Florida	NS	As cited in Maestrelli & Wiemeyer 1975.
AGE AT FLEDGING													
Bortolotti 1989	-	M	1	-	79.9	1.08 SE	days			9	Saskatchewan CAN, 1980-82	lake	(1) East end of lake; (2) west end. West end thought to support larger fish populations.
	-	F	1	-	83.0	0.94 SE	days			11			
	-	M	2	-	76.1	1.03 SE	days			14			
	-	F	2	-	81.2	1.58 SE	days			6			
Brown & Amadon 1968	-	-	-	-	70-77		days				NS	NS	
Green 1985	-	B	-	-			days	70	98		NS	NS	Summary of available information.
N FLEDGE/ACTIVE NEST													
Grier 1982	-	-	1	-	1.26		N/terr				Ontario, CAN	lake	Young per nesting territory. (1) 1966; (2) 1974; (3) 1981.
	-	-	2	-	0.46		N/terr						
	-	-	3	-	1.12		N/terr						
Henny & Anthony 1989	-	-	-	-	1.01		N/act terr	0.58	1.22	489	California 1977-86	NS	Mean of 10 years of data; minimum and maximum are yearly means. Number of nests surveyed per year = 29-68.
Henny & Anthony 1989	-	-	-	-	1.01		N/act terr	0.00	2.00	38	Colorado 1977-86	NS	Mean of 10 years of data; minimum and maximum are yearly means. Number of nests surveyed per year = 2-10.
Henny & Anthony 1989	-	-	-	-	1.10		N/act terr	0.91	1.38	132	Idaho 1979-86	NS	Mean of 8 years of data; minimum and maximum are yearly means. Nests surveyed per year = 11-26.

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Henny & Anthony 1989	-	-	-	-	1.28		N/act terr	1.07	1.58	305	Montana 1978-86	NS	Mean of 9 years of data; minimum and maximum are yearly means. Nests surveyed per year = 9-55.
Henny & Anthony 1989	-	-	-	-	0.95		N/act terr	0.72	1.18	882	Oregon 1978-86	NS	Mean of 9 years of data; minimum and maximum are yearly means. Nests surveyed per year = 35-142.
Henny & Anthony 1989	-	-	-	-	0.90		N/act terr	.76	1.14	1207	Washington 1980-86	NS	Mean of 7 years of data; minimum and maximum are yearly means. Nests surveyed per year = 99-250.
Henny & Anthony 1989	-	-	-	-	.89		N/act terr	.52	1.22	217	Wyoming 1978-86	NS	Mean of 9 years of data; minimum and maximum are yearly means. Nests surveyed per year = 19-35.
Kozie & Anderson 1991	-	-	-	-	1.30		N/act nest			1,469	Wisconsin 1983-88	nests from inland areas	Data reflects young produced by active nest; does not indicate whether young fledged. Diet analysis suggests that nearby Lake Superior birds (not included in mean presented) may be suffering from effects of contaminants; they fledged 0.8 per active nest.
McAllister et al. 1986	-	-	1	-	0.87		N/br terr			301	Washington 1981-85	coastal	(1) direct count; (2) Mayfield - 40% model.
	-	-	2	-	0.59		N/br terr						
McEwan & Hirth 1979	-	-	-	-	1.14		N/act nest			109	Florida 1973-76	lake	
Sherrod et al. 1977	-	-	-	-	0.86		N/act nest			71	Alaska 1972	Amchitka Island	
Sprunt et al. 1973	-	-	-	-	1.00	0.06 SE	N/act nest	0	3	312	Alaska 1963-70	wildlife refuge, island	Seven years of data. At the time of the study, the authors felt that this population represented "as nearly a normal situation as currently exists for this species." Overall, 63% of nests successful.
N FLEDGE/SUCCESSFUL NEST													
Grier 1982	-	-	1	-	1.6		N/suc nest			184	Ontario, CAN	lake	Young counted at nestling stage. Years: (1) 1966-69; (2) 1970-74; (3) 1975-79; (4) 1980-81.
	-	-	2	-	1.5		N/suc nest			184			
	-	-	3	-	1.7		N/suc nest			324			
	-	-	4	-	1.8		N/suc nest			149			

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Grubb et al. 1983	-	-	-	-	1.65	0.26 SD	N/suc nest			22	Arizona 1975-80	desert scrub, river	6 year mean; 3-4 nests per year.
Grubb et al. 1983	-	-	-	-	1.35	0.11 SD	N/suc nest	1.22	1.48	170	Washington 1975-80	San Juan Islands	6 year mean; minimum and maximum are yearly means of 23 and 29 nests, repsectively.
Grubb et al. 1983	-	-	-	-	1.47		N/suc nest			60	Washington 1980	spruce & hemlock, Olympic Penninsula	Study area includes the San Juan Islands, Olympic Peninsula, Puget Sound, and other areas.
Howard & Van Daele 1980	-	-	-	-	1.4		N/suc nest			7	Idaho 1979	NS	
Kozie & Anderson 1991	-	-	-	-	1.69		N/suc nest			1,132	Wisconsin 1983-88	nests from inland areas	Reflects young produced per succesful nest; data does not include whether young fledged.
McAllister et al. 1986	-	-	-	-	1.42		N/suc pair	1.35	1.51	45	Washington 1981-85	coastal	4 year mean; minimum and maximum are yearly means.
McEwan & Hirth 1979	-	-	-	-	1.59		N/suc nest			78	Florida 1973-76	lake	
Nash et al. 1980	-	-	-	-	1.3		N/suc terr	1.0	1.7		Washington 1970-79	coastal island	Ten years of study; minimums and maximums are yearly means of fledglings per successful territory.
Opp 1980	-	-	-	-	1.53		N/suc ter			8	Oregon 1978-79	various	
Schmid 1966-67	-	-	-	-	2.2		N/suc nest	1	3	47	PA, DE, MD, NJ 1936-42,46	NS	Data reflects young seen in nests, not number that fledged.
Sherrod et al. 1977	-	-	-	-	1.42		N/suc nest			71	Alaska 1972	Amchitka Island	
Sprunt et al. 1973	-	-	-	-	1.06	0.06 SE	N/suc nest	1	3	196	Alaska 1963-70	wildlife refuge, island	Mean of 7 years of data. Authors felt that at the time of the study, this population represented "as nearly a normal situation as currently exists for this species."
Swenson et al. 1986	-	-	-	-	1.64		N/suc nest			160	ID, MT, WY 1976-82	forested river, lake	Study of three populations in the Greater Yellowstone ecosystem over six years.

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
AGE AT SEXUAL MATURITY													
Nye 1983	-	B	-	-	4			3	5	7	United States	NS	Age of first breeding of seven nesting birds from U.S. hacking projects. The bird breeding at 3 was a male; total of 4 males, 3 females.
ANNUAL MORTALITY													
Grier 1980	A	B	-	-	10-30		%/yr				NS	NS	Hypothetical ranges based on author's experience used for population modelling. Juveniles are first year birds; adults are second year birds and older.
	J	B	-	-	30-70		%/yr						
Sherrod et al. 1977	A	-	1	-	5.4		%/yr				Alaska 1968-74	Amchitka Island	(1) Adults are five year birds. Mortality based on assumption that annual mortality rate is equal to the rate of recruitment of eye-stripe (as suggested by Ricklefs 1973), and that mortality of eye-stripe birds is low; (2) juveniles (subadults) from fledging to one year old.
	J	-	2	-	89.3		%/yr						
LONGEVITY													
Snow 1973	A	B	-	-			yrs		50		NS	captivity	Living 50 years in captivity is not unusual.

***** SEASONAL ACTIVITIES *****

Reference	Begin	Peak	End	Location	Habitat	Notes
MATING/LAYING						
Brown & Amadon 1968	late Mar		earl Apr	Vancouver, BC, CAN	coastal	
Brown & Amadon 1968	earl Nov		late Jan	Florida	NS	
Grubb et al. 1983	Dec		late Jan	c Arizona	desert scrub, river	

Reference	Begin	Peak	End	Location	Habitat	Notes
Grubb 1976	Jan		earl Mar	Colorado	NS	As cited in Green 1985.
Grubb 1976	late Feb		thru Mar	Washington	NS	As cited in Green 1985.
Hansen 1987	earl May			se Alaska	river	
Howard & van Daele 1980	mid Feb			w Idaho 1979	NS	
LeFranc & Cline 1983	Feb			MD, VA, DE	Chesapeake Bay	
Mager 1977	late Sep		thru Nov	Florida, Texas	NS	As cited in Green 1985.
Murphy 1965; Swenson 1975	earl Apr			nw Wyoming	NS	As cited in Howard & van Daele 1980.
Peterson (unpub.)	Mar			e Idaho 1979	NS	As cited in Howard & van Daele 1980.
Sherrod et al. 1977; Hensel & Troyer 1964	Mar		Apr	Alaska	NS	As cited in Green 1985.
Swenson et al. 1986	earl Mar	late Mar	late Apr	WY, MT, ID 1960-82	rivers, lakes	Habitats in and near Yellowstone Park.
US FWS 1989	late Oct	late Dec	March	se United States	NS	
Weaver 1980	mid Mar			w Wyoming	NS	As cited in Howard & van Daele 1980.
HATCHING						
Howard & van Daele 1980	late Mar		earl May	w Idaho 1979	NS	
Murphy 1965; Swenson 1975		late May		nw Wyoming	NS	As cited in Howard & van Daele 1980.
Peterson (unpub.)		late Apr		e Idaho 1979	NS	As cited in Howard & van Daele 1980.
Swenson et al. 1986	earl Apr	late Apr	late May	WY, MT, ID 1960-82	rivers, lakes	Habitats in and near Yellowstone Park.

Reference	Begin	Peak	End	Location	Habitat	Notes
Weaver 1980		earl May		w Wyoming	NS	As cited in Howard & van Daele 1980.
FLEDGING						
Hansen 1987		late Aug		se Alaska	riverine	
Harris et al. 1987	April		May	s Louisiana	various	
Howard & van Daele 1980	mid Jun		mid Jul	w Idaho 1979	NS	
Murphy 1965; Swenson 1975	mid Jun		mid Jul	nw Wyoming	NS	As cited in Howard & van Daele 1980.
Peterson (unpubl.)	mid Jul		late Aug	e Idaho 1979	NS	As cited in Howard & van Daele 1980.
Swenson et al. 1986	earl Jul	late Jul	mid Aug	WY, MT, ID 1960-82	rivers, lakes	Habitats in and near Yellowstone Park.
Weaver 1980	mid Jul		earl Aug	w Wyoming	NS	As cited in Howard & van Daele 1980.
FALL/BASIC MOLT						
McCollough 1989	spring		fall	n North America	NS	Begins in late spring, continues until early fall.
McCollough 1989	Nov - Dec		Apr - May	s North America	NS	Estimated timing for molt in southern populations; begins in late fall and continues until spring.
FALL MIGRATION						
Craig et al. 1988	mid Dec			Connecticut 1986	river	Arrival of wintering eagles.
Crenshaw & McClelland 1989	earl Oct	Nov	mid Dec	Montana 1980-85	Glacier Nat'l Park	Passing through of eagles going to wintering grounds; eagles utilized communal roosts.
Fielder & Starkey 1980	Oct			e Washington 1975-80	river	Arrival time of wintering eagles.

Reference	Begin	Peak	End	Location	Habitat	Notes
Fitzner et al. 1980	mid Nov	Dec - Jan		c Washington 1979-80	river	Arrival time of eagles wintering in Washington.
Grubb et al. 1983		July		nw Washington	coastal	Eagles leave breeding sites.
Grubb et al. 1983		June		c Arizona	desert scrub, river	Departure of eagles after breeding season.
Harris et al. 1987	Sept		Oct	Louisiana 1977-79	various	Arrival of eagles prior to breeding season.
Hodges et al. 1987	Nov	Dec	Jan	se Alaska 1979-82	river	Departure of 31 radiotagged eagles from the Chilkat River area.
Keister et al. 1987	late Oct	Dec - Jan		sc OR, n CA 1978-80	Klamath Basin	Arrival of wintering eagles.
McClelland 1973	earl Oct			Montana 1965-70	Glacier Nat'l Park	Arrival of wintering eagles; eagles are attracted to salmon runs.
Sabine 1981	late Oct	Jan & Feb		Illinois 1979-81	forest	Arrival of wintering eagles.
SPRING MIGRATION						
Craig et al. 1988			late Mar	Connecticut 1986	river	Departure of wintering eagles.
Fielder & Starkey 1980		earl Apr	mid Apr	e Washington 1975-80	river	Departure of wintering eagles.
Fitzner et al. 1980		earl Feb	earl Mar	c Washington 1979-80	river	Departure of wintering eagles.
Grubb et al. 1983		Dec		c Arizona	desert scrub, river	Arrival of eagles prior to breeding season.
Keister et al. 1987		Apr		sc OR, n CA 1978-80	Klamath Basin	Departure of wintering eagles.
McClelland 1973			late Dec	Montana 1965-70	Glacier Nat'l Park	Departure of wintering eagles; they leave when salmon are no longer available.

Reference	Begin	Peak	End	Location	Habitat	Notes
Sabine 1981	earl Mar			Illinois 1979-81	forest	Departure of wintering eagles.
Swenson et al. 1986	late Mar	earl Apr		WY, MT, ID 1960-74	rivers, lakes	Movement from wintering to breeding grounds (both are within Yellowstone National Park and vicinity).

***** AMERICAN KESTREL *****

*** NORMALIZING AND CONTACT RATE FACTORS ***

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
BODY WEIGHT													
Bird & Clark 1983	A	M	-	-	113	2.0 SE	g			25	Quebec, CAN	captive	
	A	F	-	-	120	5.3 SE	g			26			
Bloom 1973	-	M	-	FA	103	6.7 SD	g			12	s California 1970-73	inland	Season: August through October. From largely migratory population; "U.S. 395 & vicinity" site.
	-	F	-	FA	115	8.6 SD	g			16			
Bloom 1973	-	M	-	WI	114	7.8 SD	g			14	s California 1970-73	inland	Month: February. From largely migratory population; Imperial Valley site.
	-	F	-	WI	132	13.1 SD	g			70			
Bloom 1973	-	M	-	WI	108	8.1 SD	g			9	s California 1970-73	coastal	Sample thought to represent resident population of kestrels.
	-	M	-	SP	110	5.3 SD	g			3			
	-	M	-	SU	106	9.6 SD	g			8			
	-	M	-	FA	112	9.5 SD	g			49			
	-	M	-	YR	111	9.3 SD	g			69			
Bloom 1973	-	F	-	WI	124	8.9 SD	g			24	s California 1970-73	coastal	Sample thought to represent resident population of kestrels.
	-	F	-	SP	117	11.6 SD	g			3			
	-	F	-	SU	112	10.3 SD	g			11			
	-	F	-	FA	119	8.8 SD	g			73			
	-	F	-	YR	120	9.2 SD	g			111			
Craighead & Craighead 1956	A	M	-	-	109		g			50	Michigan, Pennsylvania	NS	Tabulated by authors primarily from own data and unpublished data from the Pennsylvania Game Commission, but may include data from some other sources.
	A	F	-	-	119		g			67			
Gessaman & Haggas 1987	A	F	-	WI	138		g			9	Utah	open agricultural	(LI) = laying, incubating.
	A	F	LI	SP	124		g			9			
	A	F	-	FA	127		g			9			
Gessaman & Haggas 1987	A	M	-	WI	119		g			9	Utah	open agricultural	(I) = incubating.
	A	M	I	SP	108		g			9			
	A	M	-	FA	111		g			9			
Porter & Wiemeyer 1972	-	F	-	FA	142		g	125	159	13	northeastern US 1964	captive	Captive kestrels caught in the northeastern U.S.

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Porter & Wiemeyer 1972	A	F	-	WI	138		g	130	142	5	Florida 1965-66	captive	Captive kestrels caught in Florida; thought to be wintering sparverius subspecies rather than resident paulus subspecies.

NESTLING WEIGHT

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Bird & Clark 1983	N	F	-	-	10	0.31 SE	g 1 day			8	Quebec, CAN	captive	Number of days presented in the unit column is age of nestling/fledgling birds. Birds were parent-reared in captivity; mass at day 31 was approximate mean adult weight for these birds. Values estimated from figure for days 7 through 31.
	N	M	-	-	11	0.12 SE	g 1 day			11			
	N	F	-	-	36		g 7 day			8			
	N	M	-	-	40		g 7 day			11			
	N	F	-	-	96		g 13 day			8			
	N	M	-	-	100		g 13 day			11			
	N	F	-	-	123		g 19 day			8			
	N	M	-	-	117		g 19 day			11			
	N	F	-	-	131		g 25 day			8			
	N	M	-	-	127		g 25 day			11			
	F	F	-	-	118		g 31 day			8			
	F	M	-	-	114		g 31 day			11			

BODY FAT

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Gessaman 1979	A	F	-	SP	8		g			1	Utah 1973-74	NS	Birds captured in: Spring = May; Summer = August; Fall (1) = early September; and Fall (2) = late September. (It appears that the figure upon which this information is based is mislabelled in the original; based on the text, we interpreted the dashed line to represent males, and the solid line to represent females.)
	A	M	-	SP	4.3		g			4			
	A	F	-	SU	4		g			2			
	A	M	-	SU	4		g			3			
	A	F	1	FA	5.5		g			3			
	A	M	1	FA	3.5		g			4			
	A	F	2	FA	12		g			2			
	A	M	2	FA	8		g			4			
Gessaman 1979	A	M	-	SP	4		% body wt				Utah 1973-74	NS	
	A	M	-	SU	3-4		% body wt						
	A	F	-	SU	3-4		% body wt						
	A	M	-	FA	5.3		% body wt						
	A	F	-	FA	7.0		% body wt						

METABOLIC RATE (KCAL BASIS)

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Gessaman & Haggas 1987	A	F	N	WI	327.2	5.72 SE	kcal/kg-d			9	Utah	open agricultural	(N) Nonbreeding; (LI) laying and incubating. Estimated from activity budgets of kestrels in the field and rates of energy expenditure with various activities measured in the lab.
	A	F	LI	SP	414.4	9.84 SE	kcal/kg-d			9			
	A	F	-	FA	368.7	17.0 SE	kcal/kg-d			9			

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Gessaman & Haggas 1987	A	M	N	WI	386.4	9.41 SE	kcal/kg-d			9	Utah	open agriculture	(N) Nonbreeding; (I) incubating. Estimated as for the females (previous record).
	A	M	I	SP	337.6	16.8 SE	kcal/kg-d			9			
	A	M	-	FA	364.9	26.9 SE	kcal/kg-d			9			
Koplin et al. 1980	A	B	FL	WI	50.6		kcal/day	42.0	61.0		nw California	agricultural areas	Predicted on the basis of a metabolic model, measures of energy expended in various activities, and time-activity budgets observed in the field. (1) Estimated assuming body weight of 119 g.
	A	B	1	WI	420		kcal/kg-d	353	512				
Koplin et al. 1980	A	F	FL	WI	42.9		kcal/day			317hr	nw California	coastal	Estimated on the basis of observed food intake and assuming a body weight of 119 g.
	A	F	FL	WI	360		kcal/kg-d			317hr			
Rudolph 1982	A	M	BR	SU	354	26.4 SD	kcal/kg-d			4	California 1979	agricultural areas	Estimated daily energy expenditures during laying, incubation, and brooding using observed time budgets and multiples of basal metabolic rate (BMR) as recommended by King (1974). BMR was estimated from Zar (1968, 1969) equation for Falconifornes assuming 110 g for both males and females. Males performed most of the foraging.
	A	F	BR	SU	287	19.1 SD	kcal/kg-d			4			
Toland 1987	A	B	-	-	60		kcal/day				Missouri 1981-84	grassland, agricultural	Metabolic rate estimated from daily activity budget and multiples of basal metabolic rate. Time of year unspecified, however.
FOOD INGESTION RATE													
Barrett & Mackey 1975	A	M	-	SU	0.31		g/g-day			2	Ohio 1970	semi-natural enclosure	Two kestrels kept in vegetated enclosure and preyed on a marked group of deer mice and meadow voles for 13 days. Mean weight of kestrels = 100.8 g; mean temperature during study = 24 C. Ingestion of food in g/g-day calculated from the kcal values presented using the caloric equivalent of 1.37 kcal/g for small mammals (given by author).
	A	M	-	SU	420		kcal/kg-d			2			

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Craighead & Craighead 1956	A	M	-	SU	0.223		g/g-day			40	s Michigan 1939-42	captive outside	N = number of days each bird was fed; one male bird (weight = 91 g) and two female birds (weights = 107 g and 112 g). Kestrels maintained using falconer techniques and fed lean raw beef supplemented with rodents, birds, and other natural prey. Mean outdoor temperature for males = 16 C; females = 22 C.
	A	F	-	SU	0.196		g/g-day	0.169	0.223	28			
Duke et al. 1976	A	-	-	-	0.14		g/g-day				Utah	captive outside	Kestrels fed mice; body weight was 105 g. Ambient temperature was 27 degrees C. As cited in Duke et al. 1987.
Koplin et al. 1980	A	B	1	WI	0.18		g/g-day				nw California	coastal, agricultural lands	(1) Biomass of vertebrates; (2) biomass of invertebrates; (3) total biomass (assuming kestrel body weight of 119 g). Estimated food intake by observing prey captured and by estimating prey weight on the basis of measured or reported values for identified prey (e.g., for shrews, mice) and by estimating weights from apparent size for unidentified prey (usually invertebrates).
	A	B	2	WI	0.11		g/g-day						
	A	B	3	WI	0.29		g/g-day						
Sparrowe 1972	A	-	-	-	15-20		g/day			15	Michigan 1968-69	captive	Amount of venison fed to captive kestrels that were kept at about 88-90% of their normal body weight during a prey-catching behavior study. Body weights not provided. Kestrels could also obtain up to 2 g a day of venison as a training "reward".
Wing & Wing 1939	A	-	-	-	0.22	0.05 SD	g/g-day	0.14	0.35	26	Tennessee 1937-38	captive in enclosed porch	Kestrel kept in 3 m by 4.5 m porch and fed lean beef. N = number of days bird was fed; months of study were December - March. Mean weight of kestrel was 113.8 g.

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Bohall-Wood & Collopy 1987	A	B	vertebrates (primarily lizards) invertebrates	49 51				3 PR	Florida 1983	dry pine/oak woodlands (sandhill) - % wet weight of prey; observed captured	More prey captured per unit time than in agricultural/mixed hardwood areas. PR = pair.
Bohall-Wood & Collopy 1987	A	B	vertebrates invertebrates	24 76				3 PR	Florida 1983	agricultural/mixed hardwoods - % wet weight of prey	
Collopy & Koplin 1983			Coleoptera other invertebrates frog (Rana aurora) other herpetofauna Microtus calif. Sorex vagrans other mammals				10.75 14.15 7.95 12.20 30.15 9.35 11.45	7	California	hayfields, pasture - % wet weight of prey observed captured	Two winters of data. Mean weights of prey species determined from a variety of sources, including literature. Prey captured identified with binoculars. 500 observation hours.
Craighead & Craighead 1956	A	B	meadow vole white-footed mice short-tailed shrew small birds insects				59.5 29.5 1.3 10.9 see note	84	s Michigan 1942,48	fields, woodlots - % frequency of occurrence; pellet analysis	Average of two years of study; pellets collected from a total of 4 kestrels. White-footed mice icludes Peromyscus maniculatus and P. leucopus. Kestrels also consumed insects when available, but number of insects could not be determined from pellets.
Craighead & Craighead 1956	B	B	meadow vole white-footed mice shrews pocket gopher ground squirrel least chipmunk jumping mice small & medium sized birds insects		57.3 12.7 1.4 2.7 4.5 1.8 0.5 19.1 see note			220	Wyoming 1947	grasslands, forest - % of diet; from number of items in pellets, food at nest, regurgitated by nestlings	Season = spring and summer; data from 8 nests. Insects not included here because the number could not be determined, but of 299 pellets, 60% contained insects, and in 19% of the pellets insects comprised the majority of the food. White footed mice includes Peromyscus maniculatus and P. leucopus.
Koplin et al. 1980 (continued)	A	B	Lepidoptera Orthoptera Coleoptera Lumbricidae unidentified invertebrates				0.5 1.0 17.4 7.1 10.9	1533	nw California	agricultural areas - % wet weight of prey observed captured	Sample size = number of prey observed captured. (1) California vole; (2) western harvest mouse; (3) vagrant shrew.

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Koplin et al. 1980 (continued)			Microtus californicus (1)				26.5				
			Reithodontomys megalotis (2)				1.9				
			Sorex vagrans (3)				8.5				
			Fringillid birds				2.9				
			snakes				4.1				
			Rana aurora				10.2				
			Hyla regilla				9.2				
Meyer & Balgooyen 1987	-	-	invertebrates				32.6	10	California	open areas, woods - % wet weight of prey observed captured	Mean weights of prey species determined from a variety of sources, including literature. Prey captured identified with binoculars.
			mammals				31.7				
			birds				30.3				
			reptiles				1.9				
			other				3.5				
Toland 1987	A	B	vertebrates (mostly voles)		81.5			429	Missouri	disturbed grassland - % by capture	Over the entire year, vertebrates comprised 67% of prey captured. Most studies report higher percentages of invertebrates than vertebrates in the diet of kestrels. (N = number of captures observed; number of different birds cannot be determined.)
			invertebrates		18.5						

***** POPULATION DYNAMICS *****

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
TERRITORY SIZE													
Craighead & Craighead 1956	A	B	-	SU	202	131 SD	ha	41	500	11	Wyoming 1947	grasslands, forest	Home range of breeding pairs. Based on records of observed movements plotted on maps.
Craighead & Craighead 1956	A	M	-	WI	466	109 SD	ha	300	601	6	s MI 1941-42, 1947-48	fields, woodlots	Seasonal home range estimates based on observations plotted on maps.
	A	F	-	WI	272		ha	168	376	2			
Craighead & Craighead 1956	A	B	-	SU	131	100 SD	ha	21	215	5	s Michigan 1942, 48	woodlots, fields	Home range of breeding pairs. Based on records of observed movements plotted on maps.
Enderson 1960	-	-	-	WI	452		ha				Illinois	NS	As cited in Mills 1975.
Haggas unpubl.	A	B	-	-	73		ha			18	n Utah	open agricultural	Home range estimate for all seasons based on observations; calculated from an average maximum diameter of 0.97 km. As cited in Gessaman and Haggas 1987.

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Meyer & Balgooyen 1987	A	F	-	WI	31.6	10.7 SD	ha	18.7	42.0	5	California 1976-78	open areas, woods	Territory size.
	A	M	-	WI	13.1	2.0 SD	ha	9.7	14.8	5			
Mills 1975	A	B	NB	WI	154		ha		452	16	Illinois 1970-72	agricultural area; scattered trees	Territory size for birds seen at least 5 times was determined by connecting the extreme points of observation.
POPULATION DENSITY													
Craighead & Craighead 1956	A	B	BR	SU	0.0003		pairs/ha	0.0002	0.0004	2	s Michigan 1942, 48	fields, woodlots	Breeding pairs in a 9,600 ha township. N = number of years of data.
Craighead & Craighead 1956	-	B	-	FA	0.0007	0.0004 SD	N/ha	0.0005	0.0012	3	s MI 1941-42, 1946-49	fields, woodlots	N = number of years of data. Counts include adult and immature birds (not nestlings or fledglings) on a 9,300 ha township. Spring (1) = transition period when some wintering birds leave, others remain, and new birds arrive for the breeding season.
	-	B	-	WI	0.0005	0.0001 SD	N/ha	0.0005	0.0006	4			
	-	B	1	SP	0.0008		N/ha	0.0005	0.0010	2			
	-	B	-	SP	0.0010	0.0002 SD	N/ha	0.0008	0.0011	3			
	-	B	-	SU	0.0018		N/ha	0.0016	0.0020	2			
Craighead & Craighead 1956	A	B	BR	SU	0.0035		pairs/ha			1	Wyoming 1947	grasslands, forest	Breeding pairs in a 3,100 ha portion of Jackson Hole. N = number of years of data.
Toland & Elder 1987	-	-	-	-	0.0026		nests/ha	0.0023	0.0031		Missouri 1981-84	urban	26 square km sampled.
Toland & Elder 1987	-	-	-	-	0.0004		nests/ha	0.0003	0.0006		Missouri 1981-84	rural	90 square km sampled.
CLUTCH SIZE													
Bloom & Hawks 1983	-	-	-	-	4.3		eggs			38	California 1977-80	juniper, sagebrush	Counted in nest boxes.
Brown & Amadon 1968	-	-	-	-	4-5		eggs	3	7		NS	NS	
Carpenter et al. 1987	-	-	-	-	4-5		eggs				Quebec, CAN	captive	
Craighead & Craighead 1956	-	-	-	-	4.4		eggs		5	17	s MI, WY 1942, 1947-48	open areas, woods	

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
CLUTCHES/YEAR													
Carpenter et al. 1987	-	-	-	-	1		/year				Quebec, CAN	captive	Kestrels raise one brood per year, but will replace a lost clutch of eggs; sometimes third or fourth clutches can be induced by clutch removal.
Craighead & Craighead 1956	-	-	-	-	1		/year				s MI, WY 1942, 1947-48	open areas, woods	May replace clutch if lost early in the nesting cycle.
DAYS INCUBATION													
Brown & Amadon 1968	-	-	-	-	29-30		days				NS	NS	
Porter & Wiemeyer 1972	-	-	-	-	33.7	0.33 SE	days	33	35	6	Maryland	captive	
AGE AT FLEDGING													
Bird & Clark 1983	-	B	-	-	25		days			19	Quebec, CAN	captive	
Bloom & Hawks 1983	-	B	-	-	28-30		days			30	California 1977-80	juniper, sagebrush	From parents nesting in artificial nest boxes. N = number of successful nests.
Craighead & Craighead 1956	-	B	-	-	31		days				s Michigan 1942, 48	fields, woodlots	
Craighead & Craighead 1956	-	B	-	-	29		days				Wyoming 1947	grasslands, forest	
Porter & Wiemeyer 1972	-	B	-	-	29.3		days	27	32	6	Maryland 1967	captive	Florida caught parents.
Porter & Wiemeyer 1972	-	B	-	-	27.4		days	26	30	10	Maryland 1967	captive	Northeastern caught parents.
N FLEDGE/ACTIVE NEST													
Bloom & Hawks 1983	-	-	-	-	3.1		N/act nest			36	California 1977-80	juniper, sagebrush	Counted in nest boxes.
Craighead & Craighead 1956	-	-	-	-	3.2		N/act nest			6	s Michigan 1942, 48	woodlots, fields	

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Craighead & Craighead 1956	-	-	-	-	3.8		N/act nest			11	Wyoming 1947	grasslands, forest	
N FLEDGE/SUCCESSFUL NEST													
Bloom & Hawks 1983	-	-	-	-	3.7		N/suc nest			30	California 1977-80	juniper, sagebrush	Counted in nest boxes.
AGE AT SEXUAL MATURITY													
Carpenter et al. 1987	-	B	-	-	1		year				Quebec, CAN	captive	
ANNUAL MORTALITY													
Craighead & Craighead 1956	A	B	-	-	12		%/year				s MI, WY 1942, 1947-48	open areas, woods	Estimate for all raptor species in the two study areas. Juvenile = from fledging until next summer.
	J	B	-	-	88		%/year						
Henny 1972	A	B	-	-	46.0	4.6 SE	%/year				North America 1946-65	NS	Mortality rates for kestrels banded as nestlings during years indicated. Estimates based on band returns using the composite dynamic life table method. Juvenile = from fledging to the next breeding season.
	J	B	-	-	60.7		%/year						
LONGEVITY													
Carpenter et al. 1987	-	-	-	-			years		9		Quebec, CAN	captive	Number of years that birds have bred in captivity; many live longer but do not continue to breed successfully.

***** SEASONAL ACTIVITIES *****

Reference	Begin	Peak	End	Location	Habitat	Notes
MATING/LAYING						
Bloom & Hawks 1983	May 6	May 22	Jun 26	California 1977-80	juniper, sagebrush	
Brown & Amadon 1968	mid Mar		earl Jun	Florida	NS	

Reference	Begin	Peak	End	Location	Habitat	Notes
Brown & Amadon 1968	mid Apr		earl Jun	central US	NS	
Craighead & Craighead 1956	mid Apr			s Michigan 1942	woodlots, fields	
Craighead & Craighead 1956	mid May			Wyoming 1947	grasslands, forest	
Gessaman & Haggas 1987	earl Apr		mid May	n Utah	open agricultural	
Toland & Elder 1987		earl Apr		c Missouri 1982	farmland	Occurred 2 weeks later in 1984, probably due to heavy spring rains.
HATCHING						
Bloom & Hawks 1983	Jun 7	Jun 21	Jul 26	California 1977-80	juniper, sagebrush	
Craighead & Craighead 1956	mid May			s Michigan 1942, 48	woodlots, fields	
Craighead & Craighead 1956		mid June		Wyoming 1947	grassland, forest	
Gessaman & Haggas 1987	earl May		mid June	n Utah	open agricultural	Estimated from Figure 1.
Toland & Elder 1987		earl May		c Missouri 1982	farmland	Occurred 2 weeks later in 1984, probably due to heavy spring rains during mating season.
FLEDGING						
Craighead & Craighead 1956	mid Jun			s Michigan 1942-48	woodlots, fields	
Craighead & Craighead 1956		mid Jul		Wyoming 1947	grasslands, forest	
Gessaman & Haggas 1987	earl Jun		mid Jul	n Utah	open agricultural	Estimated from Figure 1.
Toland & Elder 1987		earl June		c Missouri 1982	farmland	Occurred 2 weeks later in 1984, probably due to heavy spring rains during mating season.

Reference	Begin	Peak	End	Location	Habitat	Notes
FALL/BASIC MOLT						
Gessaman & Haggas 1987	mid May		mid Sept	n Utah	open agricultural	
FALL MIGRATION						
Gessaman & Haggas 1987	earl Sep		earl Nov	n Utah	open agricultural	
SPRING MIGRATION						
Craighead & Craighead 1956	earl Mar			s Michigan 1942-48	woodlots, fields	Arrival of migratory birds for breeding season; many (especially males) wintered and nested in the same area.
Craighead & Craighead 1956	mid Apr			Wyoming 1947	grasslands, forest	Arrival of kestrels for breeding season.
Gessaman & Haggas 1987	mid Mar		mid Apr	n Utah	open agricultural	

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***** NORTHERN BOBWHITE *****

*** NORMALIZING AND CONTACT RATE FACTORS ***

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
BODY WEIGHT													
Brenner & Reeder 1985	A	B	-	-	308	2.8 SE	g			10	Wisconsin	lab	Commercial breeding stock - "Wisconsin strain."
Brenner & Reeder 1985	A	B	-	-	198	1.8 SE	g			10	Georgia	lab	Commercial breeding stock - "Georgia strain."
Brenner & Reeder 1985	A	B	-	-	197	2.7 SE	g			10	Pennsylvania	lab	Commercial breeding stock - "Pennsylvania strain."
Buss et al. 1947	B	B	-	FA	203.0		g			845	Wisconsin	NS	During fall and winter. As cited in Tomlinson 1975.
Case 1982	A	F	1	-	194.2		g			24	Nebraska	lab	Weight: (1) seven weeks prior to egg laying; (2) while laying. 15 hr light/9 hr dark photoperiod.
	A	F	2	-	214.8		g			24			
Gutherey et al. 1988	-	M	-	SP	158		g				se Texas 1981-83	e Rio Grande Plains	Mean sex-specific sample sizes by region ranged between 6 and 81 birds. Estimated from graph of body weight by month.
	-	M	-	SU	154		g						
	-	M	-	FA	156		g						
	-	M	-	WI	160		g						
	-	F	-	SP	170		g						
	-	F	-	SU	169		g						
	-	F	-	FA	158		g						
	-	F	-	WI	162		g						
Gutherey et al. 1988	A	M	-	SP	156		g				sw Texas 1981-83	w Rio Grande Plains	Mean sex-specific sample sizes by region ranged between 6 and 81 birds. Estimated from graph of body weight by month.
	A	M	-	SU	154		g						
	-	M	-	FA	156		g						
	A	M	-	WI	161		g						
	A	F	-	SP	165		g						
	A	F	-	SU	157		g						
	-	F	-	FA	157		g						
	A	F	-	WI	157		g						
Hamilton 1957	A	M	-	WI	189.2		g			16	c Missouri 1953-54	Ashland Wildlife Research Area	Adults are 18 months old or older.
	A	M	-	SP	178.7		g			7			
	A	M	-	SU	173.7		g			14			
	A	M	-	SU	178.4		g			7			
	A	F	-	WI	198.0		g			11			
	A	F	-	FA	180.7		g			7			

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Hamilton 1957	J	M	-	WI	182.2		g			47	c Missouri 1953-54	Ashland Wildlife Research Area	Juveniles defined as first year adults (age 5 months to 18 months).
	J	M	-	SP	169.3		g			72			
	J	M	-	SU	171.1		g			44			
	J	F	-	WI	178.2		g			40			
	J	F	-	SP	166.9		g			12			
	J	F	-	SU	175.3		g			3			
Nelson & Martin 1953	A	M	-	-	173		g		249	899	United States	NS	Data from USFWS records (from bird banders, game bag investigations).
	A	F	-	-	170		g		255	692			
Nelson & Martin 1953	A	B	1	-	162		g				Florida, Wisconsin	NS	(1) Florida; (2) Wisconsin. Study states that records show a progressive increase in weight from south to north.
	A	B	2	-	193		g						
Robel 1969	A	B	-	FA	189.9	3.28 SE	g			8	Kansas 1961-67	farms, prairie	Collection months = October, January, and April.
	J	B	-	FA	174.0	3.49 SE	g			45			
	A	B	-	WI	193.9	4.56 SE	g			11			
	J	B	-	WI	193.9	3.90 SE	g			36			
	A	B	-	SP	190.0	4.98 SE	g			15			
	J	B	-	SP	184.1	2.99 SE	g			26			
Roseberry et al. 1979	B	B	1	WI	183.2		g			102	s Illinois 1967-69	agricultural	Captured from January - March. Year: (1) 1967; (2) 1968-69.
	B	B	2	WI	185.5		g			90			
Roseberry & Klimstra 1971	B	M	-	WI	180		g			277	s Illinois 1948-49	agricultural	Each seasonal value is an average of three monthly averages.
	B	M	-	SP	168		g			226			
	B	M	-	SU	162		g			226			
	B	M	-	FA	175		g			108			
Roseberry & Klimstra 1971	B	F	-	WI	178		g			243	s Illinois 1948-49	agricultural	Each seasonal value is an average of three monthly averages.
	B	F	-	SP	179		g			125			
	B	F	-	SU	180		g			28			
	B	F	-	FA	173		g			85			
Roseberry & Klimstra 1971	A	M	-	WI	181		g		224	106	s Illinois 1948-69	agricultural	Collected from November - March. Juveniles are young of the year from their first November to the following July.
	A	F	-	WI	183		g		221	83			
	J	M	-	WI	179		g		221	346			
	J	F	-	WI	175		g		220	312			
Rosene 1969	A	M	-	WI	168		g	140	202	50	S Carolina 1961-65	farm, forest	Juveniles includes birds between 125 days and 15 months old. Collected by hunters from December through February.
	A	F	-	WI	166		g	144	195	54			
	J	M	-	WI	164		g	141	189	109			
	J	F	-	WI	163		g	132	196	114			
Roseberry & Klimistra 1971	A	M	-	SU	162.8		g			385	s Illinois 1948-69	agricultural	
	A	F	-	SU	180.4		g			72			

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Simpson 1976	A	M	-	FA	161.6		g	142.6	178.9		sw Georgia	pine woods, farms	
	A	M	-	WI	180.6		g	154.0	221.0		1967-71		
	A	M	-	SP	170.1		g	130.5	210.0				
	J	M	-	WI	176.8		g	130.4	203.0				
	J	M	-	SP	165.6		g	97.1	203.0				
Simpson 1976	A	F	-	FA	160.2		g	135.5	182.5		sw Georgia	pine woods, farms	
	A	F	-	WI	177.9		g	142.0	220.0		1967-71		
	A	F	-	SP	169.3		g	139.0	197.3				
	J	F	-	WI	176.5		g	143.0	218.9				
	J	F	-	SP	164.5		g	129.0	195.0				
Stoddard 1931	B	M	-	WI	164.8		g			397	n FL, s GA	farm, woods, thicket	
	B	F	-	WI	165.5		g			342	1925-28		
Stoddard 1931	B	M	-	WI	177.2		g	148.8	212.7	138	S Carolina	island	
	B	F	-	WI	173.2		g	148.8	202.1	106	1927-28		
Tomlinson 1975	A	M	-	FA	168.6	3.04 SE	g	149	181	26	Sonora, MEX	mesquite, grasslands	Population of the endangered masked bobwhite; measured from October - January.
	A	F	-	FA	162.8	6.10 SE	g	146	195	19	1968-72		

BODY FAT

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Koerth & Guthery 1987	A	F	-	WI	10.6	0.8 SE	% dry wt	8.3	19.9	29	s Texas	plains	
	A	F	-	SP	9.7	0.3 SE	% dry wt	7.7	11.2	108	1982-83		
	A	F	-	SU	11.4	0.3 SE	% dry wt	9.0	12.8	98			
	A	F	-	FA	9.8	0.4 SE	% dry wt	7.1	14.0	50			
Koerth & Guthery 1987	A	M	-	WI	10.2	0.6 SE	% dry wt	9.0	11.9	34	s Texas	plains	
	A	M	-	SP	7.9	0.2 SE	% dry wt	6.5	10.0	134	1982-83		
	A	M	-	SU	9.9	0.3 SE	% dry wt	7.2	13.9	153			
	A	M	-	FA	9.8	0.4 SE	% dry wt	7.7	12.1	67			
McRae & Dimmick 1982	A	F	NB	WI	13.8	2.7 SD	% dry wt			11	Tennessee 1978	forest & farmland	Pre-breeding birds collected from Jan. 10 to March 10; breeding birds collected from April 10 through May 20.
	A	F	BR	SP	12.7	2.4 SD	% dry wt			5			
	A	M	NB	WI	15.5	2.8 SD	% dry wt			25			
	A	M	BR	SP	8.8	3.2 SD	% dry wt			21			

EGG WEIGHT

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Blem & Zara 1980	-	-	-	-	10.9	0.2 SE	g			22	Virginia	captive	Eggs obtained from local breeder.
Case 1982	-	-	-	-	8.7		g			367	Nebraska	captive	Produced by farm-raised birds.
Johnsgard 1988	-	-	-	-	10.7		g				NS	NS	

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Koerth & Guthery 1991	-	-	-	-	9.3	0.3 SE	g				Texas 1988	captive	No difference was found between eggs from wild-caught and domestic birds although domestic birds were significantly heavier.
Stoddard 1931	-	-	-	-	8.6		g	8.0	10.2	845	sw Georgia 1926-28	captive	Weight at laying.
Stoddard 1931	-	-	-	-	9.3		g			761	Virginia 1927	captive	Weight at laying.
CHICK WEIGHT													
Andrews et al. 1973	C	B	-	-	31.7		g 3 weeks			300	Florida	lab	Number of weeks in units column is age of chicks. Average of values for chicks fed from 20-30% protein in feed and 20-28% protein thereafter in weight gain maximization study.
	C	B	-	-	92.6		g 6 weeks			300			
	C	B	-	-	137.1		g 9 weeks			300			
Blem & Zara 1980	H	B	-	-	8.0	0.3 SE	g day 0				Virginia	lab	Number of days in the units column is the age of juvenile birds; domestic quail.
	C	B	-	-	40		g day 20						
	C	B	-	-	100		g day 40						
	C	B	-	-	170		g day 60						
	C	B	-	-	200		g day 80						
Jones & Hughes 1978	H	B	1	-	9		g day 0				South Carolina	lab	Day or week in unit column is age of young birds.
	C	B	2	-	47		g 3 weeks						
	C	B	3	-	117		g 6 weeks						
	C	B	4	-	143		g 9 weeks						
	C	B	5	-	175		g 16 weeks						
Stoddard 1931	H	B	-	-	6.26		g day 1			47	sw Georgia 1924-29	captive and wild (farms, woods, thickets)	"Approximate normal weight"; ages presented in the units column.
	C	B	-	-	9-10		g day 6						
	C	B	-	-	10-13		g day 10						
	C	B	-	-	20-25		g day 19						
	C	B	-	-	35-45		g day 32						
	C	B	-	-	55-65		g day 43						
	C	B	-	-	75-85		g day 55						
	C	B	-	-	110-120		g day 71						
	C	B	-	-	125-150		g day 88						
	C	B	-	-	140-160		g day 106						

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
CHICK GROWTH RATE													
Jones & Hughes 1978	C	B	1	-	1.8		g/day				South Carolina	lab	Ages: (1) hatching to 3 weeks; (2) 3 to 6 weeks; (3) 6 to 9 weeks; (4) 9 to 16 weeks.
	C	B	2	-	3.2		g/day						
	C	B	3	-	1.3		g/day						
	C	B	4	-	0.65		g/day						
Roseberry & Klimstra 1971	C	B	1	-	1.9		g/day				s Illinois 1948-69	agricultural	Growth rate from ages: (1) 1-74 days; (2) 75-138 days. Approximate weight at 74 days = 150 g; at 138 days = 178 g.
	C	B	2	-	0.42		g/day						
METABOLIC RATE (KCAL BASIS)													
Blem & Zara 1980	A	B	-	-	206.8		kcal/kg-d				Virginia	captivity	Metabolized energy for game birds in cages. For juveniles, metabolized energy/bird-day (in kcal) = 37.3(wt)**0.20 - 0.013 (age in days) + 0.03(age)*(wt change). Adult weight = 205 g; juvenile weight (at 65 days) = 175 g. Asymptotic weight (used for adults) was reached at 84 days.
	J	B	-	-	262.9		kcal/kg-d						
Case 1982	A	F	1	-	183.3		kcal/kg-d			24	Nebraska	lab	Metabolized (existence) energy requirements of farm-raised birds: (1) 7 weeks prior to laying (mean wt. = 194.2 g); (2) during laying (mean wt. = 214.8 g).
	A	F	2	-	243.9		kcal/kg-d			24			
Case & Robel 1974	A	M	1	WI	261		kcal/kg-d			20	Kansas 1969	lab	Existence energy based on male values; females require additional "productive energy" when laying. Temperature: (1) 0 C; (2) 30 C. Photoperiod: winter (WI) = 10L:14D; summer = (SU) 15L:9D. Mean weight of birds = 188.6 g.
	A	M	2	WI	125		kcal/kg-d			20			
	A	M	1	SU	348		kcal/kg-d			20			
	A	M	2	SU	155		kcal/kg-d			20			
Case 1973	A	F	1	-	147		kcal/kg-d				Kansas	lab	Existence metabolism at (1) 20 C and (2) 35 C. Values are for individually caged birds; values for caged coveys (8 individuals) were slightly higher. Mean weight of birds: for 20 C trials = 172.9 g; for 35 C trials = 189.7 g. Photoperiod = 10L:14D.
	A	F	2	-	127		kcal/kg-d						

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Case 1973	A	F	1	-	45		kcal/day				Kansas	lab	Existence metabolism for individually caged quail at temperature of: (1) 5 C; (2) 15 C; (3) 20 C; (4) 25 C; (5) 35 C. Regression equation for individually caged quail: Y (kcal/day) = 49.498 - 0.872(C). Values for coveys (8 individuals) were slightly higher for all temperatures from 15 - 35 C; at 5 C the covey value was lower. Mean body weights during trials ranged from 173 - 190 g.
	A	F	2	-	37		kcal/day						
	A	F	3	-	28		kcal/day						
	A	F	4	-	29		kcal/day						
	A	F	5	-	22		kcal/day						
Robel et al. 1979b	A	B	FL	WI	74		kcal/day				Kansas	NS (wild)	Energy of free living (FL) at 2 C with a photoperiod of 10L:14D. Estimate based on doubling the 49 kcal/day requirement of caged birds and incorporating an estimate of the metabolic advantage of covey behavior.

FOOD INGESTION RATE

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Blem & Zara 1980	A	B	-	-	370		kcal/kg-d				Virginia	lab	Gross energy intake estimates for adults (mean weight of 205 g) and 65 day old juveniles (mean weight 175 g).
	J	B	-	-	460		kcal/kg-d						
Koerth & Guthery 1990	A	B	-	WI	0.093	0.0032 SE	g/g-day			10	s Texas 1988	lab	Food intake (water and food provided ad libitum) of domestic and wild-caught birds exposed to conditions typical of s Texas. Fed commercial game bird food - % dry matter: winter = 90.5; spring = 92.1; summer = 95.7; and fall = 90.2. Temperature and relative humidity for each season: WI = 13 C, 72%; SP = 23 C, 69%; SU = 30 C, 49%; and FA = 22 C, 66%. The protein content of the food was adjusted seasonally to reflect the average crude protein of the native diet.
	A	B	-	SP	0.067	0.0021 SE	g/g-day			11			
	A	B	-	SU	0.079	0.0061 SE	g/g-day			12			
	A	B	-	FA	0.072	0.0017 SE	g/g-day			12			

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Nice 1910	A	B	-	FA	0.09		g/g-day	0.07	0.12		Massachusetts	captive	Captive raised; mean weight of birds was 170 g. Fed weed seeds. Consumption measured from October through February. As cited in Handley 1931.
Robel et al. 1974	A	-	-	WI	17		g/day				Kansas	NS (wild)	As cited in Robel et al. 1979b.
Robel et al. 1979a	A	B	-	WI	0.10	0.002 SD	g/g-day			3	Kansas	lab	Game farm birds fed laboratory mash (P-18). Lab conditions simulated midwinter in Kansas; Temp. = 1 C, photoperiod = 10L:14D. Mean weight of birds = 192 g.
	A	B	-	WI	409.7	9.2 SD	kcal/kg-d			3			
Robel et al. 1979a	A	B	-	WI	0.089		g/g-day			12	Kansas	lab	Same conditions as above except value is mean for diets of corn and sorghum. Mean weight at beginning of trial was 178.3 g.
	A	B	-	WI	373		kcal/kg-d			12			
Robel 1969	A	B	-	WI	587		kcal/kg-d				Kansas 1961-67	farms, prairie	Gross energy intake calculated from the average volume of the crop contents in shot birds (using 2.30 kcal/cc for energy estimates) and multiplying this by the number of 1.5 hour (daylight) feeding periods possible during that time of year.
	J	B	-	WI	571		kcal/kg-d						
	A	B	-	FA	657		kcal/kg-d						
	J	B	-	FA	598		kcal/kg-d						
	A	B	-	SP	519		kcal/kg-d						
	J	B	-	SP	327		kcal/kg-d						

WATER INGESTION RATE

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Koerth & Guthery 1990	A	M	-	WI	0.115	0.020 SD	g/g-day				s Texas 1988	lab	Water intake (from free water and food - both provided ad libitum) of domestic and wild-caught birds exposed to conditions typical of s Texas. Fed commercial game bird food - % dry matter: winter = 90.5; spring = 92.1; summer = 95.7; and fall = 90.2. Temperature and relative humidity for each season: WI = 13 C, 72%; SP = 23 C, 69%; SU = 30 C, 49%; and FA = 22 C, 66%. Values estimated from figure; N = approximately 12 for each trial. For food ingestion rate of the same birds see authors' data under "food ingestion rate."
	A	F	-	WI	0.106	0.010 SD	g/g-day						
	A	M	-	SP	0.093	0.012 SD	g/g-day						
	A	F	-	SP	0.086	0.013 SD	g/g-day						
	A	M	-	SU	0.100	0.023 SD	g/g-day						
	A	F	-	SU	0.131	0.037 SD	g/g-day						
	A	M	-	FA	0.101	0.013 SD	g/g-day						
	A	F	-	FA	0.102	0.044 SD	g/g-day						

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Koerth & Guthery 1990	A	M	-	WI	0.068	0.007 SD	g/g-day				S Texas 1988	lab	Minimum water intake (from free water and food) required daily for mass stasis. Diet and lab conditions are the same as those described above. Authors suggest that the minimum need of free ranging birds may be 2-3 times higher than those for captives. Values estimated from figure.
	A	F	-	WI	0.072	0.003 SD	g/g-day						
	A	M	-	SP	0.034	0.008 SD	g/g-day						
	A	F	-	SP	0.038	0.004 SD	g/g-day						
	A	M	-	SU	0.049	0.010 SD	g/g-day						
	A	F	-	SU	0.060	0.015 SD	g/g-day						
	A	M	-	FA	0.040	0.013 SD	g/g-day						
	A	F	-	FA	0.041	0.006 SD	g/g-day						

***** DIET *****

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Baldwin & Handley 1946	B	B	native & naturalized legumes			9.7	39.0		Virginia 1929-31	NS - % dry volume; crop contents	Collected from hunters. Fall = November; winter = December and January.
			ragweed			31.5	16.2				
			cultivated legumes			12.7	13.9				
			cultivated grains			16.6	8.9				
			mast			12.4	8.3				
			misc. seeds			6.4	6.6				
			fruits			4.8	4.0				
			forage			0.5	2.1				
			grasses			0.6	0.7				
			Orthoptera			3.4	0.3				
			misc. animal			1.4	0.4				
			(SAMPLE SIZE)			(115)	(380)				
Baldwin & Handley 1946	B	B	native & naturalized legumes				24.8	108	e Virginia 1929-31	coastal plain - agricultural - % dry volume; crop contents	Collected from hunters from November through January. Major types of crops grown in this area = peanuts, cotton, and truck crops.
			ragweed				15.0				
			cultivated legumes				31.4				
			cultivated grains				9.7				
			mast				6.9				
			misc. seeds				4.7				
			fruits				3.6				
			forage				1.3				
			grasses				1.2				
			Orthoptera				0.6				
			misc. animal				0.8				
Baldwin & Handley 1946	B	B	native & naturalized legumes				36.9	250	c Virginia 1929-31	piedmont section - agricultural - % dry volume; crop contents	Collected from hunters from November through January. Major types of farms in this area = dairy, general, tobacco, fruit, and livestock.
			ragweed				20.6				
			cultivated legumes				10.2				
			cultivated grains				5.7				
			mast				9.4				
			misc. seeds				6.9				

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Baldwin & Handley 1946 (continued)			fruits				6.2				
			forage				1.5				
			grasses				0.8				
			Orthoptera				1.4				
			misc. animal				0.4				
Baldwin & Handley 1946	B	B	native & naturalized legumes				17.9	132	w Virginia 1929-31	mountain section - agricultural - % dry volume; crop contents	Collected from hunters from November through January. Major types of farms in this area = general and livestock.
			ragweed				27.5				
			cultivated legumes				3.4				
			cultivated grains				24.9				
			mast				12.9				
			misc. seeds				8.4				
			fruits				2.2				
			forage				1.1				
			grasses				0.2				
			Orthoptera				0.6				
			misc. animal				0.9				
Campbell-Kissock et al. 1985	B	B	seeds of forbs		3.45	19.01	11.97		sw Texas 1979-80	grasslands - drought conditions - aggregate % wet volume; crop contents	Collection times: summer = June 1980; fall = September 1980; winter = late October 1979 - early February 1980.
			seeds of bulblets of grass & grasslike		51.66	42.93	4.85				
			seeds and fruits of woody plants		9.73	-	1.37				
			unident. seeds		4.55	0.03	2.26				
			green vegetation		4.81	1.81	72.38				
			animals		25.80	36.23	6.48				
			sample size		*12*	*9*	*91*				
Handley 1931	A	B	total plant foods	87.16	78.67	79.71	96.80		se US 1924-29	NS - % volume; crop and gizzard contents	Items that shrink from normal size when dried were measured wet (e.g., fruit) ; those that swell when wet were measured dry (e.g., seeds). Items comprising a mean of less than 2% in all seasons not included here. Each seasonal value is the mean of three monthly values.
			(miscell. seeds)	(21.24)	(6.04)	(11.07)	(2.61)				
			(legumes)	(15.19)	(3.93)	(10.08)	(31.47)				
			(senna)	(7.21)	(0.42)	(0.17)	(12.78)				
			(cultivated plants)	(2.12)	(2.07)	(5.34)	(2.61)				
			(grasses)	(3.08)	(11.28)	(25.95)	(2.29)				
			(sedges)	(1.08)	(1.22)	(2.36)	(1.08)				
			(mast)	(14.12)	(0.17)	(0.49)	(27.99)				
			(spurges)	(0.08)	(1.21)	(5.47)	(0.36)				
			(fruits)	(11.07)	(45.76)	(11.33)	(9.49)				
			(forage plants)	(11.52)	(0.27)	(0.29)	(5.17)				
			animal foods	12.84	19.64	20.29	3.20				
			(Orthoptera)	(3.15)	(7.50)	(16.62)	(2.43)				
			(Hemiptera)	(2.83)	(4.35)	(0.58)	(0.08)				
			(Coleoptera)	(4.63)	(6.29)	(0.81)	(0.19)				
			sample size	*86*	*92*	*129*	*1,352*				

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Handley 1931	J	B	total animals		25.91			34	GA, FL 1924-29	NS - % volume; crops and gizzards	Young birds 2 weeks to three months old. Items that shrink when dry were measured wet; those that swell when wet were measured dry. Season = May 1 to November 1. Items comprising less than 1% not listed here.
			(grasshoppers and their allies)		(8.18)						
			(beetles)		(5.76)						
			(bugs)		(4.68)						
			(lepidopterans)		(3.85)						
			total plants		74.09						
			(fruit)		(16.78)						
			(grasses)		(36.12)						
			(legumes)		(4.97)						
			(spurges)		(4.47)						
			(cult. plants - non legumes)		(1.88)						
			(sedges)		(2.21)						
			(misc. seeds)		(7.60)						
Handley 1931	J	B	total animals		83.7			20	GA, FL 1924-29	NS - % volume; crops and gizzards	Young birds 0-2 weeks old. Items that shrink when dry were measured wet; those that swell when wet were measured dry.
			(grasshoppers and their allies)		(26.7)						
			(beetles)		(31.7)						
			(spiders)		(8.0)						
			(lepidopterans)		(7.9)						
			(bugs)		(7.1)						
			(misc. insects)		(1.8)						
			(slugs and snails)		(0.5)						
			plant foods		16.3						
			(blackberries)		(9.6)						
			(seeds of grasses and sedges)		(4.4)						
			(seeds of spurge)		(1.1)						
			(misc. seeds, bits of vegetation)		(0.9)						
Heitmeyer 1980	B	B	soybeans				51.1	137	ne Missouri 1977	farms, woodlands - % volume; crop contents	Collected from hunters from November through January. Items comprising less than 1% not included here.
			weed seeds				6.5				
			(nodding foxtail)				(2.2)				
			(common ragweed)				(1.4)				
			corn				24.8				
			milo				15.7				
			animal matter				1.4				
Hurst 1972	J	B	beetle		3.6			126	Mississippi 1968-71	dense sedges, forbs and grasses - number of insects per chick; gizzard and crop contents	Insect foods only; listed in decreasing order of importance (based primarily on estimated weights). Chicks aged 2-15 days released on previously burned plots.
			true bug		2.2						
			leaf-hopper		1.7						
			spider		1.2						
			grasshopper		1.2						
			ant		3.6						
			fly		0.7						

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Hurst 1972	J	B	beetle		3.2			38	Mississippi 1968-71	pine forest - number of insects per chick; gizzard and crop contents	Insect foods only; listed in decreasing order of importance (based primarily on estimated weights). Chicks aged 1-20 days (mostly 6 days).
			leaf-hopper		4.2						
			ant		6.4						
			larval forms -mostly lepidopterans		2.0						
			spider		5.2						
			true bug		1.9						
			grasshopper		2.5						
			fly		1.9						
Judd 1905	A	B	plant matter				83.59	918	US, CAN, MEX	NS - % (measure not specified); stomach contents	All seasons, but mostly fall and winter. Also contained unspecified amounts of sand and gravel. As cited in Bent 1932.
			(grain)				(17.38)				
			(seeds)				(52.83)				
			(fruit)				(9.57)				
			animal matter				16.41				
			(beetles)				(6.92)				
			(grasshoppers)				(3.71)				
			(bugs)				(2.77)				
			(caterpillars)				(0.95)				
			(other)				(2.06)				
Korschgen 1948	B	B	Korean lespedeza				5.9	201	Missouri 1941-42	lowland region - croplands - % dry volume; crop contents	Collected from hunters in November and December. Items comprising < 1.5% not included here.
			corn				27.4				
			common ragweed				3.3				
			sorghum cane				3.8				
			oaks				18.1				
			sassafras				4.9				
			soybean				12.1				
			croton				1.8				
			cowpea				7.5				
Korschgen 1948	B	B	Korean lespedeza				25.9	2,722	Missouri 1941-42	ozark region - crops forest, pasture - % dry volume; crop contents	Collected from hunters in November and December. Volumes are means for three Ozark sites. Items comprising < 2% not included here.
			corn				7.4				
			common ragweed				12.2				
			sorghum cane				6.5				
			oaks				7.9				
			sassafras				4.0				
			beggars ticks				3.1				
			croton				2.4				
			small wild bean				2.0				
			ashes				2.1				
Korschgen 1948	B	B	Korean lespedeza				6.3	2,549	Missouri 1941-42	prairie region - cropland, pasture - % dry volume; crop contents	Collected from hunters in November and December. Volumes are means for four Prairie sites. Items comprising < 1% not included here.
			corn				31.6				
			common ragweed				12.7				
			sorghum cane				21.8				
			oaks				3.4				
(continued)			soybeans				3.5				

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Korschgen 1948 (continued)			Japanese clover				1.4				
			trailing wild bean				1.3				
			small wild bean				1.3				
			horseweed				1.1				
			hemp				1.2				
Lehmann 1984	B	B	total seeds	60.88	79.04	70.45	50.99		s Texas 1949-51	semi-prairie, brushland - % dry volume; crop contents	Greens = leaves, stems, buds and flowers. Data is provided in great detail in original paper. Age of quail; 80 = 1+ years, 114 = full grown in first year; 6 = 5 days to 3 weeks old.
			(weeds)	(43.64)	(33.71)	(29.97)	(34.29)				
			(woody plants)	(4.03)	(20.51)	(39.74)	(9.49)				
			(grasses)	(13.21)	(24.82)	(0.74)	(7.21)				
			greens	27.39	4.90	3.44	10.31				
			insects	8.03	14.20	17.85	23.33				
			cultivated grain and miscellaneous	3.70	1.86	8.26	15.37				
			sample size	*51*	*39*	*27*	*83*				
Martin et al. 1951	A	B	ragweed				25-50		ne United States	NS - approx. % diet; stomach contents	Caught year-round, N=: winter = 124; spring = 2; summer = 25; fall = 24.
			corn				10-25				
			smartweed				10-25				
			bristlegrass				5-10				
			wheat				5-10				
			grape				2-5				
			hogpeanut				2-5				
			blackberry				2-5				
			ash				2-5				
			poison ivy				2-5				
			sumac				2-5				
			oak				2-5				
Martin et al. 1951	A	B	Lespedeza				25-50	7668	se United States	NS - approx. % diet; stomach contents	All caught in winter except 29 caught in summer.
			beggarweed				5-10				
			oak				5-10				
			partridge pea				5-10				
			cowpea				5-10				
			ragweed				2-5				
			pine				2-5				
			milkpea				2-5				
			paspalum				2-5				
			soybean				2-5				
Martin et al. 1951	A	B	ragweed				25-50	105	ne prairies, US	NS - approx. % diet; stomach contents	From three seasons, N =: winter = 53; summer = 10; fall = 42.
			corn				25-50				
			bristlegrass				10-25				
			sunflower				5-10				
			wheat				2-5				
			sorghum				2-5				
			knotweed				2-5				
			panicgrass				2-5				
			poison ivy				2-5				

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Martin et al. 1951	A	B	sorghum				10-25	699	Texas,	NS	
			doveweed				5-10		Oklahoma	-	
			oak				5-10			approx. % diet;	
			panicgrass				5-10			stomach contents	
			ragweed				5-10				
			corn				5-10				
			sunflower				5-10				
			milkpea, downy				2-5				
			Lespedeza				2-5				
			wildbean				2-5				
			sumac				2-5				
Robel 1969	B	B	sorghum	19.7		10.7	27.5		Kansas 1961-67	farms, prairie	Habitat planted with corn, sorghum.
			sunflower	0.1		21.1	9.1			-	and wheat to improve food supply.
			western ragweed	0.1		10.0	4.6			% dry volume; crop	Data provided by month: spring =
			sumac	9.2		0.3	13.5			contents	mean of March and April; fall and
			corn	28.7		0.1	4.9				winter = mean of three monthly
			acorn meat	4.2		4.7	2.4				values. Plants comprising less than
			giant ragweed	0.8		2.1	3.0				3% in all seasons combined into
			osage orange	6.8		-	2.9				"other plants".
			dogwood	-		3.5	0.7				
			black locust	5.5		0.0	2.7				
			riverbank grape	-		1.2	0.8				
			native grasses	3.0		19.1	3.9				
			other plants	5.2		6.5	13.0				
			animal matter	9.8		14.0	1.3				
			debris	4.2		0.4	3.7				
			(SAMPLE SIZE)	(106)		(266)	(219)				
Rosene 1969	B	B	sesbania				17.1	1,400	sc Alabama	plantation managed	All items were seeds except green
			partridge peas				16.6		1950-62	for quail	leaves. Collected during the
			trailing wild bean				11.0			-	hunting season.
			beggar weeds				9.0			% volume; crop	
			lespedezas				9.7			contents	
			loblolly pine				5.5				
			green leaves				5.2				
			butterfly pea				2.4				
			corn				2.2				
			milk pea				1.8				
			other items				19.5				
Wood et al. 1986	B	B	croton species	6.5	46.4				s Texas	plains	Summarized from original.
			grasses	15.7	8.8				1982-83	-	
			(bristlegrass)	(2.1)	(4.5)					% dry weight;	
			(dicanthelium)	(7.8)	-					crop contents	
			(thin paspalum)	(3.8)	-						
			legumes	17.5	7.9						
			(leavenworth vetch)	(11.4)	(1.1)						
			(hoary milkpea)	(2.0)	(3.4)						
(continued)			(roundleaf scurfpea	(4.1)	-						

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat	Notes
Wood et al. 1986 (continued)			arthropods	14.1	8.4						
			snails	1.9	-						
			fruits	6.4	4.0						
			(ground cherry)	(6.4)	(1.9)						
			miscellaneous plants	22.1	7.9						
			(greens, flowers)	(6.0)	-						
			(yellow wood sorrel	(5.1)	-						
			(dayflower)	-	(6.1)						
			(spiny pricklepoppy	(4.2)	-						
			other foods	8.7	10.6						
			sand, gravel, unidentified seed husks	5.5	4.4						
			unknown	1.7	1.0						
			sample size	*130*	*159*						

***** POPULATION DYNAMICS *****

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
HOME RANGE SIZE													
Bartholemew 1967	B	B	-	WI	15.4		ha/covey	12.1	18.6	4	s Illinois	NS	Determined using radiotelemetry. As cited in Yoho and Dimmick 1972.
Crim & Seitz 1972	A	B	1	SU	3.6		ha/summer				Iowa	State Game Area	Individual home range: (1) for entire summer (763 m long by 473 m wide); (2) daily in summer (227 m long by 71 m wide). As cited in Schroeder 1985.
	A	B	2	SU	1.6		ha/day						
Roseberry & Klimstra 1984	B	B	1	WI	15		ha/covey	12	19	4	s Illinois 1953-80	agricultural	Winter conditions of (1) average snowfall; (2) prolonged snow cover.
	B	B	2	WI	9		ha/covey			4			
Rosene 1969	B	B	1	WI	3.3		ha/covey	2	9	166	Alabama 1947-58	farms, forest	Measurements made during four winters; based on repeated searches and plotting of locations on maps. Plantation: (1) Maytag; (2) Wyecott.
	B	B	2	WI	4.4		ha/covey	2	12	300			
Rosene 1969	B	B	1	WI	7.2		ha/covey	2	19	164	S Carolina 1947-58	farms, forest	Measurements made during eight winters; based on repeated searches and plotting of locations on maps. Plantation: (1) Oakland Club; (2) Friendfield.
	B	B	2	WI	6.0		ha/covey	2	31	524			

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Urban 1972	A	M	1	SU	7.6	5.0 SD	ha			11	s Illinois 1969	idle farms, woods, brush, cornfields	Monthly ranges from May - September; radiotagged individuals. Breeding status: males (1) mated, and (2) unmated; females (1) nesting, and (2) postnesting.
	A	M	2	SU	16.7	9.5 SD	ha			9			
	A	F	1	SU	6.4	4.0 SD	ha			5			
	A	F	2	SU	15.6	9.1 SD	ha			4			
Urban 1972	B	B	-	SU	8.5	6.0 SD	ha/covey			4	s Illinois 1969	idle farms, woods, brush, cornfields	Radiotagged coveys. Monthly ranges in fall: (1) September; (2) October; (3) November.
	B	B	1	FA	9.3	6.8 SD	ha/covey			7			
	B	B	2	FA	16.6	7.1 SD	ha/covey			11			
	B	B	3	FA	9.1	1.7 SD	ha/covey			7			
Wiseman & Lewis 1981	B	B	1	-	3.6	1.0 SE	ha/covey				Oklahoma 1975-76	pasture, shrubs, woodlands, stream channel	Size did not vary from fall through spring but did seem to vary with population density. Density at study sites (in fall - winter): (1) 0.30 - 0.34/ha; (2) 0.16 - 0.20.
	B	B	2	-	5.1	0.7 SE	ha/covey						
Yoho & Dimmick 1972	B	B	-	WI	6.8	2.9 SD	ha/covey	4.0	11.7	5	Tennessee 1970	woods, old fields, cultivated fields	Radiotagged 2-3 birds per covey, located coveys from 69-134 times each from January through March.
POPULATION DENSITY													
Brennan (unpubl.)	B	B	-	-	2		N/ha				s Mississippi	NS	Areas utilizing "good quail habitat management." As cited in Brennan 1991.
Craighead & Craighead 1956	B	B	1	WI	0.061		N/ha			2,073	sc Michigan 1942, 48	farms, woodlots	Year: (1) 1942; (2) 1948. Authors thought that severe winter weather led to the local disappearance of bobwhites in spring of 1948. N = number of hectares sampled.
	B	B	1	SP	0.046		N/ha			2,073			
	B	B	2	WI	0.015		N/ha			2,073			
	B	B	2	SP	0		N/ha			2,073			
Guthery 1988	B	B	1	FA	4.78	0.407 SE	N/ha			82	s Texas 1984-86	mixed brush rangeland	Hidalgo study site (1) 1984; (2) 1985; (3) 1986. N = number of km of transect sampled.
	B	B	2	SP	1.62	0.062 SE	N/ha			82			
	B	B	2	FA	5.00	0.300 SE	N/ha			82			
	B	B	3	SP	2.18	0.205 SE	N/ha			82			
Guthery 1988	B	B	-	SP	0.102	0.0003 SE	N/ha			382	s Texas 1981-83	upland rangeland	Dickens, King study site. N = number of km of transect sampled.
	B	B	-	SU	0.352	0.0038 SE	N/ha			573			
	B	B	-	FA	0.208	0.0031 SE	N/ha			382			
	B	B	-	WI	0.164	0.0013 SE	N/ha			282			
Kellogg et al. 1970	B	B	1	FA	4.6		N/ha			453	Florida 1968-69	fields, woodlands	Method for estimate: (1) walking census; (2) released banded birds, then shot a random sample and estimated density from ratio of banded to unbanded in shot group. N = size of site in ha.
	B	B	2	WI	3.0		N/ha			453			

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Lehmann 1984	-	B	-	WI	2.5		N/ha				s Texas 1949	tasjillo-running mesquite brush	Maximum density observed in study (natural conditions); determined by car census.
Lehmann 1984	-	B	-	WI	0.73		N/ha			2,053	s Texas 1950	medium grass prairie	N = number of hectares censused (by car). Winter = February; summer = August.
	-	B	-	SU	0.39		N/ha			1,038			
Lehmann 1984	-	B	-	WI	0.21		N/ha			3,387	s Texas 1950	open mesquite brushland	N = number of hectares censused (by car). Winter = February; summer = August.
	-	B	-	SU	0.094		N/ha			3,387			
Lehmann 1984	-	B	-	WI	0.40		N/ha			1,000	s Texas 1950	tasjillo-running mesquite brush	N = number of hectares censused (by car). Winter = February; summer = August.
	-	B	-	SU	0.44		N/ha			1,000			
Lehmann 1984	-	B	-	WI	0.48		N/ha			1,055	s Texas 1950	tall grass prairie	N = number of hectares censused (by car). Winter = February; summer = August.
	-	B	-	SU	0.63		N/ha			2,098			
Lehmann 1984	-	B	-	WI	0.43		N/ha			1,698	s Texas 1950	short-grass prairie	N = number of hectares censused (by car). Winter = February; summer = August.
	-	B	-	SU	0.21		N/ha			1,670			
Lehmann 1984	-	B	-	WI	0.25		N/ha			1,821	s Texas 1950	bulldozed brushland	N = number of hectares censused (by car). Winter = February; summer = August.
	-	B	-	SU	0.057		N/ha			1,821			
McRae & Dimmick 1982	B	B	-	WI	1		N/ha				Tennessee 1978	forest & farmland	Rough estimate.
Roseberry & Klimstra 1984	B	B	-	FA	0.62	0.21 SD	N/ha	0.28	1.0		s Illinois 1953-80	agricultural	27 years of data on hunted population at the Carbondale research area; censused in November and March.
	B	B	-	SP	0.21	0.061 SD	N/ha	0.11	0.34				
Roseberry et al. 1979	B	B	-	FA	0.63	0.24 SD	N/ha	0.28	0.92	8	s Illinois 1964-73	agricultural	Carbondale research area - hunted population. N = number of seasonal estimates. Censused in November and March.
	B	B	-	SP	0.24	0.05 SD	N/ha	0.18	0.33	9			
Roseberry et al. 1979	B	B	1	FA	1.36		N/ha				s Illinois 1965-73	agricultural	SIU Farms site - nonhunted population. Years: (1) 1965-66; (2) 1968-69; (3) 1972-73. Fall = November, spring = March. Population decline thought to be due to a rapid deterioration of habitat due to changes in farming practices.
	B	B	1	SP	0.85		N/ha						
	B	B	2	FA	0.61		N/ha						
	B	B	2	SP	0.22		N/ha						
	B	B	3	FA	0.23		N/ha						
	B	B	3	SP	0.11		N/ha						

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Rosene 1969	B	B	-	WI	1.63	0.49 SD	N/ha	0.93	2.28	4,830	S Carolina 1957-67	farms, woods	Groton plantation pre-hunting season density. Area managed for quail and hunted from December - February. N = number of ha censused. Value is mean of ten years of data.
Rosene 1969	B	B	-	WI	0.63	0.18 SD	N/ha	0.37	0.88	707	S Carolina 1952-57	farms, woods	Oakland Club pre-hunting season density. Area managed for quail and hunted from December - February. N = number of ha censused. Value is mean of six years of data.
Simpson 1976	B B	B B	1 2	FA FA	5 0.6		N/ha N/ha				sw Georgia 1967-71	pine woods, farms	(1) Intensively managed area; (2) areas with little or no management.
Smith et al. 1982	B B	B B	1 2	WI WI	3.65 2.25	2.22 SD 1.16 SD	N/ha N/ha	1.7 0.6	7.6 3.9		Florida 1970-79	pine woods	Ten years of data; minimum and maximum are yearly means. (1) Northern study site; (2) southern study site.
CLUTCH SIZE													
Lehmann 1984	-	-	-	-	12.9			4	33	317	s Texas 1942-52	prairie, brushland	
Lehmann 1984	- - -	- - -	1 2 3	SP SU FA	14.8 11.4 10.5			7 8	24 18	48 47 40	s Texas 1943	prairie, brushland	(1) May 11-22; (2) June 12 - July 6; (3) August 10-25. King Ranch site.
Roseberry et al. 1979	-	-	-	-	13.3			12.6	14.4		s Illinois 1965-68	agricultural	Minimum and maximum are yearly means.
Roseberry & Klimstra 1984	-	-	-	-	13.73	3.28 SD		6	28	347	s Illinois 1953-66	agricultural	Carbondale research area.
Simpson 1976	- - - - - -	- - - - - -	- - - - - -	- - - - - -	25.0 16.0 13.9 11.6 10.2 9.4		March April May June July August			2 22 51 80 97 44	sw Georgia 1968-71	pine woods, farms	Month in units column is the month when the first egg of the clutch was laid.
Stoddard 1931	-	-	-	-	14.4			7	28	394	GA, FL 1924-29	farm, woods, thicket	

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
CLUTCHES/YEAR													
CKWRI 1991	-	-	-	-	1		/year	0	3		NS	NS	Notes that double broods in wild birds have been documented in Iowa, Texas, and Georgia, and that one female in Iowa had three broods.
Stanford 1972b	-	-	-	-	1		/year	0	2		Missouri 1950-71	NS	May replace clutches if lost before hatching; may also produce second broods.
DAYS INCUBATION													
Bent 1932	-	-	-	-	23-24		days				NS	NS	
Lehmann 1984	-	-	-	-	23		days	21	25		s Texas 1942-52	prairies, brushland	
Rosene 1969	-	-	-	-	23		days				SC, AL 1947-58	NS	
N HATCH/SUCCESSFUL NEST													
Simpson 1976	-	-	-	-	20.0		N/suc nest	MARCH		2	sw Georgia 1968-71	pine woods, farms	Number hatching per successful nest (success defined as hatching at least one egg). Month in "min" column is the month when the first egg of the clutch was laid.
	-	-	-	-	13.4		N/suc nest	APRIL		5			
	-	-	-	-	12.4		N/suc nest	MAY		23			
	-	-	-	-	9.8		N/suc nest	JUNE		58			
	-	-	-	-	9.3		N/suc nest	JULY		85			
	-	-	-	-	8.4		N/suc nest	AUGUST		33			
N FLEDGE/SUCCESSFUL NEST													
Lehmann 1984	-	-	-	-	12.2		N/suc nest			217	s Texas 1942-52	semi-prairie, brush	Successful nest defined as nest hatching young; data from eight breeding seasons.
PERCENT NESTS SUCCESSFUL													
Lehmann (unpubl.)	-	-	-	-	40		% nest suc			40	e Texas	coastal prairies	Percent of nests hatching young. As cited in Lehmann 1984.
Lehmann 1984	-	-	-	-	45		% nest suc			532	s Texas 1936-52	Rio Grande Plains	Percent of nests hatching young.
Roseberry & Klimstra 1984	-	-	-	-	32.6	8.1 SD	% nest suc	21.0	52.8	793	s Illinois 1952-66	agricultural	Percent hatching young; minimum and maximum are yearly means out of 13 years of data. Carbondale study area.

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Roseberry et al. 1979	-	-	-	-	50.5		% nest suc	42.9	66.6		s Illinois 1965-68	agricultural	Percent of nests hatching young. Minimum and maximum are yearly means from four years of data. Carbondale study area.
Simpson 1976	-	-	1	-	17.5		% nest suc	15.4	19.0	412	sw Georgia 1968-71	pine woods, farms	Percent of nests hatching young. Study area: (1) Nilo; (2) Silver Lake. Minimum and maximum are yearly means.
	-	-	2	-	20.8		% nest suc	17.8	25.0	313			
Stoddard 1931	-	-	-	-	36		% nest suc	28	41	602	FL, GA 1924-27	farm, woods, thicket	Percent of nests hatching at least one egg; minimum and maximum are yearly means.
AGE AT SEXUAL MATURITY													
Johnsgard 1988	-	B	-	-	8-9		months				NS	NS (wild)	Notes that captive birds can be stimulated into reproductive activity by increased photoperiods at about 5 months of age.
Jones & Hughes 1978	-	B	-	-	16		weeks				South Carolina	lab	
ANNUAL MORTALITY													
Brownie et al. 1985	A	M	-	-	78.8	2.47 SE	%/yr	64.7	94.8	3,150	Florida	open woods	
	A	F	-	-	85.3	2.72 SE	%/yr	68.4	98.6	3,150			
	J	M	-	-	81.8	2.46 SE	%/yr	73.0	93.7	1,050			
	J	F	-	-	87.2	1.68 SE	%/yr	67.9	95.8	1,050			
Lay 1954	-	-	-	-	80						Texas	NS	As cited in Lehmann 1984.
Lehmann 1984	B	B	-	-	70		%/yr	38	87		s Texas 1940-76	semi-prairie, brush	Based on age ratio in autumn of non-hunted population. Includes juveniles surviving until fall and older birds.
	B	B	-	-	56		% Feb-Oct						
	B	B	-	-	26		% Oct-Feb						
Marsden & Baskett 1958	-	B	-	-	82		%/yr			1,546	c Missouri 1950-57	NS	Based on age ratio data from capture-recapture study of non-hunted population. Habitat described as "submarginal" with adequate cover but possibly limited winter food.
Pollock et al. 1989	B	M	-	-	81.3	1.2 SE	%/yr	70.4	90.1		Florida 1970-85	pine woods	Mortality including hunting losses; based on band recovery data.
	B	F	-	-	85.7	1.2 SE	%/yr	74.7	93.7				

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Pollock et al. 1989	B	M	-	-	52		%/yr				Florida 1970-85	pine woods	Natural mortality rate (excluding hunting losses); estimated based on above value and hunting losses. Authors suggest the experimental hunting had additive effect to natural mortality - possibly because harvest was in February, which is later than traditional hunting.
	B	F	-	-	56		%/yr						
Reid & Goodrum 1960	-	-	-	-			%/yr	60	83		sw Louisiana	NS	As cited in Lehmann 1984.
Roseberry et al. 1979	A	B	-	SU	59	12 SD	%/summer	53	80	5 yrs	s Illinois 1965-72	agricultural	Unhunted population; SIU farms site.
	B	B	-	WI	50		%/Nov-Mar	23	66	8 yrs			
Roseberry & Klimstra 1984	B	B	-	-	81		%/yr				s Illinois 1954-70	agricultural	Hunted population. Yearly value estimated from November to November. Abbreviations in units column: FA = fall; SP = spring. Juvenile rate is from hatching to 16 weeks old.
	B	B	-	-	70		%/FA-SP						
	B	B	-	-	37		%/SP-FA						
	J	B	-	-	25-47		%/0-16 wks						
Rosene 1969	A	B	-	-	71.7	5.7 SD	%/yr	48.7	75.7		AL, SC 1947-58	farms, forest	Spring to spring mortality. Average of mean values from hunted populations on four plantations. Years of study at each plantation ranged from 3 to 9. Populations from 4 plantations.
Simpson 1976	J	M	-	-	68		%/yr				sw Georgia 1967-71	pine woods, farms	Annual survival based on capture-recapture data from Oct. 15 to Oct. 15. Juvenile survival is from first to second fall.
	J	F	-	-	74		%/yr						
	A	M	-	-	54		%/yr						
	A	F	-	-	85		%/yr						
Stempel 1960	-	-	-	-	80-90		%/yr				s Iowa	NS	As cited in Lehmann 1984.
LONGEVITY													
Lehmann 1984	-	-	-	-	10.6		months			484	Texas 1942	semi-prairie, brush	Expected remaining longevity for quail surviving from hatching to November.

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Marsden & Baskett 1958	-	B	-	-	8.5		months			1,546	c Missouri 1950-57	NS	Expected remaining longevity for quail surviving from hatching to October. Based on age ratio data from capture-recapture study of non-hunted population. Habitat described as "submarginal" with adequate cover but possibly limited winter food.
Marsden & Baskett 1958	-	-	-	-			years		5		c Missouri 1950-57	NS	Greatest longevity found in capture-recapture study.
Rosene 1969	-	-	-	-	9.1-11.7		months				AL, SC 1947-58	farms, forest	Range of mean longevity estimates for hunted populations. Values apply to individuals surviving from hatching to November from four plantations.
Smith et al. 1982	-	-	-	-			years		5		Florida 1970-79	pine woodlands	Greatest longevity found in study.

***** SEASONAL ACTIVITIES *****

Reference	Begin	Peak	End	Location	Habitat	Notes
MATING/LAYING						
Bent 1932	Mar	May - Jun	Aug	Florida	NS	
Guthery et al. 1988	mid Mar	Apr-Aug	late Aug	s Texas 1981-83	plains	
Lehmann 1984	mid Apr		mid Aug	s Texas 1941-52	prairie, brushland	
Roseberry & Klimstra 1984	Apr	mid May-Jul	Sep	s Illinois 1953-80	agricultural	
Simpson 1976	late Mar	May - Jul	late Aug	sw Georgia 1968-71	pine woods, farms	
HATCHING						
Case & Robel 1974		Jun-earl Jul		Kansas	NS	
Lehmann 1984	mid Mar	May - Jun	mid Sep	s Texas 1946-64	prairie, brushland	

Reference	Begin	Peak	End	Location	Habitat	Notes
Roseberry & Klimstra 1984	mid May	Jun - Aug	earl Oct	s Illinois 1953-80	agricultural	
Rosene 1969	May	Jul-Aug	late Sep	S Carolina, Alabama	farm, woods	
Sermons & Speake 1987		Jul	Sep	Alabama 1984-85	NS	
Simpson 1976	late May	Jul - Aug	earl Oct	sw Georgia 1968-71	pine woods, farms	
Stanford 1972a	earl May	mid June	Oct	Missouri 1948-71	NS	A second smaller peak occurs in mid August.
Stoddard 1931	late Apr	May-Aug	Oct	sw GA, n FL 1924-29	farm, thicket, woods	
FALL/BASIC MOLT						
Bent 1932	Aug	Sep	Oct	NS	NS	Adults undergo a complete molt.
Bent 1932	Aug		Nov	NS	NS	First fall molt (juveniles); timing depends on when bird hatched.
Stanford 1972a	May	June-Sept	Oct	Missouri 1948-71	NS	Onset of molt in adult females; most delay wing molt until after young hatch.
Stoddard 1931	Aug-Sep		Oct-Nov	sw GA, n FL 1924-29	farm, thicket, woods	Complete molt.
SPRING/ALTERNATE MOLT						
Stoddard 1931	earl Feb	Mar-Apr	earl Jun	sw GA, n FL 1924-29	farm, thicket, woods	Renewal of feathers on throat, sides of head, and forehead.

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
BODY WEIGHT													
Dwyer et al. 1988	A	M	-	SP	134.6	2.9 SE	g - April			16	Maine 1976-85	NS	
	A	M	-	SP	133.8	5.8 SE	g - May			22			
	A	M	-	SU	151.2	9.5 SE	g - June			6			
Greeley 1953	A	M	-	FA	168	1.8 SE	g			45	Wisconsin	NS	As cited in Sheldon 1967.
	A	F	-	FA	209	2.1 SE	g			57			
	J	M	-	FA	169	2.1 SE	g			36			
	J	F	-	FA	212	2.4 SE	g			47			
Keppie & Redmond 1985	A	M	-	SP	134.8	7.9 SD	g	116	160	213	ne New Brunswick, CAN	NS	
Marshall (unpubl.)	B	M	-	FA	166		g			171	Minnesota	NS	As cited in Sheldon 1967.
	B	F	-	FA	212		g			221			
Marshall (unpubl.)	A	M	-	FA	169		g			71	Minnesota	NS	As cited in Sheldon 1967.
	J	M	-	FA	164		g			100			
	A	F	-	FA	213		g			109			
	J	F	-	FA	212		g			112			
Nelson & Martin 1953	A	M	-	-	176		g		221	390	United States	NS	Data from USFWS records (from bird banders, game bag investigations).
	A	F	-	-	218		g		278	313			
Owen & Krohn 1973	A	M	-	-			g	125	190		NS	NS	As cited in Owen et al. 1977.
	A	F	-	-			g	160	240				
Sheldon 1967	A	M	-	SU	145.9		g	127	165	31	c MA 1956-57	NS	Similar data for fewer birds caught in 1957. No variance estimates provided.
	J	M	-	SU	140.4		g	117	152	49			
	A	F	-	SU	182.9		g	162	216	48			
	J	F	-	SU	168.8		g	151	192	24			
Sheldon 1967	A	M	-	FA	166		g			57	New Brunswick, CAN	NS	
	A	F	-	FA	208		g			75			
Sheldon (unpubl.)	A	M	-	FA	163		g			31	Vermont	NS	As cited in Sheldon 1967.
	A	F	-	FA	199		g			33			
Tufts 1940	A	M	-	FA	176		g			87	Nova Scotia, CAN	NS	As cited in Sheldon 1967.
	A	F	-	FA	219		g			92			

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
EGG WEIGHT													
Gregg 1984	-	-	1	-	18-19		g			44	Wisconsin 1967-80	forest, open areas	Weight at: (1) laying; (2) hatching.
	-	-	2	-	14-16		g			44		brush	
Rabe et al. 1983b	-	-	-	-	17		g				NS	NS	G. A. Ammann pers. comm.
Wetherbee & Wetherbee 1961	-	-	-	-	15.5		g			3	NS	NS	Egg weight just prior to hatching. As cited in Sheldon 1967.
HATCHING WEIGHT													
Gregg 1984	H	-	-	-	13.0		g	9	16	42	Wisconsin 1967-80	wild (forest, open areas, brush) and captive	Newly hatched chicks.
CHICK GROWTH RATE													
Dwyer et al. 1982	C	M	-	-	5.1		g/day				Maine 1977-80	mixed forests, field	Chicks recaptured in the field (total of 338 chicks with 22 to 43% recapture rate over 4 year study). From 5 days (40 g both sexes) to 17 days of age (females 115 g, males 105 g).
	C	F	-	-	6.2		g/day						
METABOLIC RATE (KCAL BASIS)													
Rabe et al. 1983b	A	F	B	-	115		kcal/kg-d				s Michigan 1965-80	generic	Basal (B) metabolic rate computed from equation from Aschoff and Pohl 1970. Free-living (FL) MR based on energy budget model and temperatures typical for March in Michigan. Breeding (BR) energy requirement estimated for egg laying peak needs. All assuming female weight of 190 grams.
	A	F	FL	SP	315		kcal/kg-d						
	A	F	BR	SU	553		kcal/kg-d						
FOOD INGESTION RATE													
Sheldon 1967	A	B	-	SU	1.0		g/g-day				Massachusetts 1958-64	captive	Birds ate an average of 150 g of earthworms a day (water provided ad libitum); 150 g "approximated" the summer weight of the birds.

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Stickel et al. 1965	-	B	1	WI	0.77		g/g-day	0.11	1.43	23	Louisiana 1961	captive	(1) Fed heptachlor contaminated and untreated earthworms; (2) fed untreated earthworms only. Difference in ingestion rates not significant.
	-	B	2	WI	0.73		g/g-day	0.11	1.27	11			

***** DIET *****

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Aldous 1938	-	-	earthworms			87.4		55	Maine	habitat NS - measure NS; % stomach contents	Data from October. As cited in Trippensee 1948.
			coleoptera			3.8					
			diptera			1.4					
			other animal			3.5					
			Rubus (seeds)			2.2					
			other plant			1.7					
Krohn 1970	B	B	earthworms		83.4			36	Maine 1968-69	woods - % wet weight; mouth, esophagus, proventriculus, and stomach contents	Grit removed. See next entry for relative weight of grit.
			coleoptera		15.2						
			diptera		0.6						
			arachnida		0.8						
Krohn 1970	B	B	earthworms		58			36	Maine 1968-69	fields - % wet weight; mouth, esophagus, proventriculus, and stomach contents	Immature males most common; few adult females present. Illustrates high consumption of grit by weight. Grit comprised only 14 percent of the volume, however; see next entry.
			beetle larvae		10						
			grit		31						
			other		1						
Krohn 1970	B	B	earthworms		68			36	Maine 1968-69	fields - % wet volume; mouth, esophagus, proventriculus, and stomach contents	Immature males most common; few adult females present.
			beetle larvae		15						
			grit		14						
			other		3						
Mendall & Aldous 1943	-	-	animal		94.2				NS	habitat NS - measure NS; % stomach contents	Evidence of plant consumption. As cited in Trippensee 1948.
			plant		5.8						
Miller & Causey 1985	-	-	earthworms				87	13	Alabama	habitat NS - % volume; esophagus contents	Food collected from mouth and esophagus only. Should provide an accurate representation of the earthworms present.
			coleoptera				11				
			hymenoptera				2				

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Miller & Causey 1985	-	-	earthworms centipedes coleoptera diplura diptera				71 11 8 2 7	29	Alabama	habitat NS - % volume; proventriculus contents	Food collected from proventriculus only. May be somewhat biased against soft bodied earthworms.
Sheldon 1967	A	B	Coleoptera Diptera Lepidoptera Annelida other		38.7 15.3 14.7 30.0 1.1			15	NS	fields - % volume; stomach contents	Data from Table N; location of collection not specified.
Sperry 1940	A	B	earthworms diptera larvae coleoptera lepidoptera other insects other animals plants		67.8 6.9 6.2 3.3 2.0 3.3 10.5			261	North America	habitat NS - % volume; stomach contents	Sampling covered 10 months of the year, March through December, and 16 states, DC, and 3 Canadian provinces. Coleoptera included ground beetles and click beetles; lepidoptera included caterpillars and moths; plant material included many seeds and some debris.
Stribling & Doerr 1985	A	B	earthworms other				99+ <1	15	N Carolina 1978-82	soybean fields - % wet weight; digestive tract	Contents of esophagus, proventriculus, and gizzard. Two genera other than earthworms consumed: Aporectodea and Diplocardia.

***** POPULATION DYNAMICS *****

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
HOME RANGE SIZE													
Dunford & Owen 1973	J	B	-	SU	332	78 SE	m movement			113	Maine 1969-70	woods, fields	Distance moved between day and night sites - total of 133 flights. 15 radio-tagged birds tracked for a total of 183 woodcock-days.
Gregg 1984	B	F	-	SU	4.5		ha/brood			1	Wisconsin 1967-80	woods, open areas, brush	Minimum home range of one radiotagged brood (hen and chicks) followed from six days after hatching until the brood broke up at 32 days.

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Gregg 1984	B	B	-	SU	32.4	27.6 SD	ha	7	98	16	n Wisconsin 1976-78	forest, open areas, brush	Based on radiotracked individuals; data were not separated by age or sex due to differences in time followed and sample sizes between groups. Sample included 4 adult females, 3 adult males, 7 immature females, and 2 immature males followed between 12 and 101 days in summer-early fall.
Hudgins et al. 1985	A	M	1	SP	3.1		ha	0.3	6.0	2	Pennsylvania 1980-81	mixed trees, shrubs and fields	Median values reported (not means). Estimated using data from radio-tagged males and the minimum-area home range method: (1) generally inactive males; (2) generally active males, and (3) males known to be singing.
	A	M	2	SP	73.6		ha	38.2	171.2	6			
	A	M	3	SP	10.5		ha	4.6	24.1	4			
Owen & Morgan 1975	A	B	-	SU	170	17 SE	m movement			271	Maine 1971-73	woods, fields	Distance moved between day and night sites; N = number of flights. Radio-tagged birds tracked for a total of 271 movements between diurnal and nocturnal sites.
POPULATION DENSITY													
Connors & Doerr 1982	B	B	1	WI	3.38		N/ha			108	N Carolina 1977-78	agricultural fields	Density of roosting woodcock in (1) untilled soy stubble; (2) untilled corn stubble; (3) rebedded corn fields. None were found in winter wheat fields. N = number of hectares sampled.
	B	B	2	WI	0.202		N/ha			79			
	B	B	3	WI	0.034		N/ha			29			
Coon et al. 1982	-	-	-	SP	0.21		nests/ha			34	Pennsylvania 1972-74	mixed forests, plantations	Habitat a mixture of pine and hardwood forests, old fields, pine plantations, and mixed plantations.
Dwyer et al. 1988	B	B	-	SU	0.223		N/ha	0.190	0.250		Maine 1976-83	second growth forest, meadows, ponds	On wildlife refuge. Forest consisted of spruce and balsam fir, birch, red maple, and aspen, as well as meadows and abandoned fields and clearcuts. Average and minimum and maximum of 4 to 5 years of density estimates made using mark-recapture method.
	A	M	-	SU	0.035		N/ha	0.026	0.046				
	A	F	-	SU	0.056		N/ha	0.037	0.074				
	J	B	-	SU	0.125		N/ha	0.108	0.143				
Godfrey 1974	A	M	-	SP	0.017		sing M/ha				Minnesota 1967-70	forest	Density of singing males in 1,600 ha of the Cloquet Forest. As cited in Gregg 1984.

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Johnson & Causey 1982	B B B	B B B	1 2 3	WI WI WI	0.41 0.09 0.03		N/ha N/ha N/ha				sc Alabama 1979-80	longleaf pine stands	Density of areas burned in: (1) the same winter; (2) 1 year before; and (3) mean of value for areas burned 2, 3, and 10 years before. Authors suggest that standing vegetation at ground level and thick layers of pine litter that occur two or more years after burning decrease value of habitat for feeding and inhibit movement.
Mendall & Aldous 1943	A	M	-	SP	0.10		sing M/ha				Maine 1939	NS - known breeding habitat	Peak yearly value for density of singing males in 607 ha area. As cited in Gregg 1984.
Norris et al. 1940	A	M	-	SP	0.10		sing M/ha				Pennsylvania 1939	moist ("best") area in barrens	Density of singing males on 385 ha. As cited in Gregg 1984.
Sheldon 1967	A	M	-	SP	0.049		sing M/ha				Massachusetts 1951	forest	Entire Quabbis Reservation (35,600 ha); includes both suitable and unsuitable habitat.
CLUTCH SIZE													
Bent 1927	-	-	-	-	4			3	5		throughout range	NS	
Gregg 1984	-	-	-	-	4			2	4	220	Wisconsin 1967-80	forest, open areas, brush	89% of complete clutches contained four eggs; actual mean not presented.
McAuley et al. 1990	- -	- -	1 2	- -	3.8 3.0	0.42 SD 0.67 SD					Maine 1977-80	mixed	(1) First clutch; (2) second clutch if first clutch destroyed or brood lost.
Mendall & Aldous 1943	-	-	-	-	4						NS	NS	As cited in Owen et al. 1977.
Pettingill 1936	-	-	-	-	4			3	5		NS	NS	As cited in Trippensee 1948.
DAYS INCUBATION													
Bent 1927	-	-	-	-	20-21		days				NS	NS	
Gregg 1984	-	-	-	-	20-22		days			7	Wisconsin 1967-80	forest, open areas, brush	

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Gregg 1984	A A	M F	- -	SP SP	0.067 0.11		N/ha N/ha				Wisconsin 1967-80	aspen forest, open areas, brush, alder	Includes singing and non-singing males (estimated by multiplying the number of singing males by 1.3). Female value was estimated from the male value assuming an adult sex ratio of 0.61 M/F. Habitat described as "good."
Gregg 1984	-	-	-	SP	0.11		nests/ha		0.75		Wisconsin 1967-80	aspen forest, open areas, brush, alder	Mean is a rough estimate based on female density (described above). Maximum is density found in a 12 ha area described as the "best available breeding habitat" in the study area.
Mendall & Aldous 1943; Pettingill 1936	-	-	-	-			days	19	21		NS	NS	As cited in Trippensee 1948.
AGE AT FLEDGING													
Gregg 1984	-	-	-	-	18-19		days				Wisconsin 1967-80	forest, open areas, brush	Fledging defined as able to sustain flight for at least 100 m.
N FLEDGE/SUCCESSFUL NEST													
Gregg 1984	-	-	-	-	3.5		N/suc nest			104	Wisconsin 1967-80	forest, open areas, brush	Successful nest = nest hatching young.
PERCENT NESTS SUCCESSFUL													
Gregg 1984	-	-	-	-	48.5	11.6 SD	% nest suc	29	67	220	Wisconsin 1967-80	forest, open areas, brush	Success defined as hatching at least one egg. Mean of 12 yearly values. N = total number of nests (all years).
McAuley et al. 1990	- -	- -	1 2	- -	50 75		% nest suc % female suc				Maine 1977-80	mixed	(1) Percent nests initiated that hatched; (2) percent females that hatched one nest (reflects renesting attempts).
AGE AT SEXUAL MATURITY													
Sheldon 1967	A A	M F	- -	SP SP	< 1 1		yr yr				NS	NS	From data on age of singing males. Birds not examined for fertile sperm.

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
ANNUAL MORTALITY													
Dwyer et al. 1988	N	B	-	SU	41		% fledge				Maine 1976-83	conifer and hardwood forests, mixed with open areas	Percent mortality of chicks from hatching to fledging.
Dwyer & Nichols 1982	A	M	E	-	65	5.2 SD	%/yr				ne & nc US 1967-77	NS	E = northeastern United States (New England, NY, NJ, PA, MD); C = north central US (WI, MI). Birds banded from May - July 1967-77 and recovered in September and February of following years.
	A	M	C	-	60	15 SD	%/yr						
	J	M	E	-	80	4.8 SD	%/yr						
	J	M	C	-	64	12 SD	%/yr						
	A	F	E	-	51	7.3 SD	%/yr						
	A	F	C	-	47	9.6 SD	%/yr						
	J	F	E	-	64	7.7 SD	%/yr						
	J	F	C	-	69	9.4 SD	%/yr						
Gregg 1984	B	M	-	-	48	4.1 SE	%/yr				Wisconsin 1967-80	forests, open areas, brush	Based on band recovery study - hunted population.
	B	F	-	-	46	4.8 SE	%/yr						
Krohn et al. 1974	A	M	-	-	62		%/yr				Maine	NS	As cited in Derleth and Sepik 1990.
	A	F	-	-	63		%/yr						
	J	M	-	-	75		%/yr						
	J	F	-	-	63		%/yr						
Sheldon 1967	A	M	-	-	47		%/yr			384	throughout range	NS	Data from wings sent in by hunters for wing-collection survey sponsored by US Fish and Wildlife Service. Years of collection not specified.
	A	F	-	-	38		%/yr			638			
LONGEVITY													
Gregg 1984	-	M	-	-	1.5		years		8		Wisconsin 1967-80	forests, open areas, brush	Based on banding analysis; a few old age birds were recovered after the analyses were complete so values may be an underestimate. Maximum values are oldest recovered birds in study.
	-	F	-	-	1.6		years		11				

***** SEASONAL ACTIVITIES *****

Reference	Begin	Peak	End	Location	Habitat	Notes
MATING/LAYING						
Dwyer et al. 1982	earl Apr			Maine 1977-80	conifer and hardwood forests mixed with open fields	

Reference	Begin	Peak	End	Location	Habitat	Notes
Rabe et al. 1983a		end Mar		Michigan	NS	
Whiting & Boggus 1982	earl Feb		mid Mar	Texas 1979-80	pine plantation	
HATCHING						
Dwyer et al. 1982		mid May		Maine 1977-80	conifer and hardwood forests mixed with open fields	
Pettingill 1936	earl Feb			Louisiana	NS	As cited in Sheldon 1967.
Pettingill 1936	earl Feb			Georgia	NS	As cited in Sheldon 1967.
Pettingill 1936	late Feb			Virginia	NS	As cited in Sheldon 1967.
Pettingill 1936	earl Mar			New Jersey	NS	As cited in Sheldon 1967.
Pettingill 1936	late Mar			Connecticut	NS	As cited in Sheldon 1967.
Pettingill 1936	mid Apr			Maine	NS	As cited in Sheldon 1967.
Rabe et al. 1983a		earl May		Michigan	NS	
Sheldon 1967	mid Apr	earl May	earl Jun	Massachusetts 1950-61	NS	
Wright (unpubl.)	late Apr	earl May		New Brunswick, CAN	NS	As cited in Sheldon 1967.
FALL/BASIC MOLT						
Owen & Krohn 1973		Aug-earl Sep		NS	NS	Both adults and juveniles undergo extensive molts. Cited in Owen et al. 1977.
FALL MIGRATION						
Owen et al. 1977	late Sep		mid Dec	from Canada	NS	By mid-December, most birds have reached the southern wintering grounds.
Sheldon 1967	Oct		Dec	arrive N Carolina	NS	Summarizing other studies.
Sheldon 1967		Oct		leave New York	NS	Summarizing other studies.

Reference	Begin	Peak	End	Location	Habitat	Notes
Sheldon 1967		earl Oct		leave Pennsylvania	NS	Summarizing other studies.
Sheldon 1967		earl Nov		leave Ohio	NS	Summarizing other studies.
Sheldon 1967		late Nov	earl Dec	arrive Louisiana	NS	
Sheldon 1967		late Nov		leave Kentucky	NS	Summarizing other studies.
SPRING MIGRATION						
Connors & Doerr 1982	mid Feb		earl Mar	leave N Carolina	farm, woods, thicket	
Gregg 1984	Mar	Apr		arrive Wisconsin	forest, open, brush	
Owen et al. 1977	Jan	Feb		s part winter range	NS	Beginning spring migration.
Owen et al. 1977		Mar	Apr	northern range	NS	Arrival in northerly breeding grounds.
Sheldon 1967		Feb		leave Louisiana	NS	
Sheldon 1967		Mar		through Kentucky	NS	Summarizing other studies.
Sheldon 1967		earl Mar		arrive c Illinois	NS	Summarizing other studies.
Sheldon 1967		Apr		arrive Michigan	NS	Summarizing other studies.
Sheldon 1967		Mar		arrive Pennsylvania	NS	Summarizing other studies.
Sheldon 1967		Mar		arrive New		Summarizing other studies.

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
BODY WEIGHT													
Maxson & Oring 1980	A	F	-	SP	47.1		g	43	50	9	Minnesota 1975-77	island in lake	
	A	M	-	SP	37.9		g	34	41	8			
Oring & Lank 1986	A	M	-	SP	41.3		g				Minnesota 1973-84	island in lake	(N) Nesting.
	A	F	N	SP	49.7		g						
PNC (unpubl.)	A	B	-	SP	40.4	6.15 SD	g	29.4	59.8	56	Pennsylvania	NS	Birds collected during the spring migration. As cited in Dunning 1984.
Poole 1938	-	-	-	-	47.5		g			NS	NS	NS	
METABOLIC RATE (KCAL BASIS)													
Kuenzel & Wiegert 1973	A	B	-	-	9.9		kcal/day				NS	lab	Estimated from a formula (Zar 1968) and an assumed body weight of 57 g from Palmer (1949).
Maxson & Oring 1980	A	F	B	SP	7.82		kcal/day			9	Minnesota 1975-77	island in lake	(B) Basal metabolic rate. (1) Assuming body weights of 47.1 g for females and 36.9 g for males as reported by Maxson and Oring 1980.
	A	M	B	SP	6.67		kcal/day			8			
	-												
	A	F	1	SP	166		kcal/kg-d						
	A	M	1	SP	176		kcal/kg-d						
Maxson & Oring 1980	E	-	-	-	18		kcal/egg				Minnesota 1975-77	island in lake	Estimated energetic cost of producing an egg.
Maxson & Oring 1980	A	F	P	SP	19-37		kcal/day				Minnesota 1975-77	island in lake	Estimated daily energy expenditure for females (P) pre-breeding, (L) laying, and (I) incubating.
	A	F	L	SP	18-35		kcal/day						
	A	F	I	SU	17.3		kcal/day						
Maxson & Oring 1980	A	M	P	SP	16.3		kcal/day				Minnesota 1975-77	island in lake	Estimated daily energy expenditure for males during (P) pre-breeding, (L) female laying, (I) incubating, and (B) brooding stages; assuming weight of 37.9 g.
	A	M	L	SP	14.4		kcal/day						
	A	M	I	SU	11.2		kcal/day						
	A	M	B	SU	15.7		kcal/day						
Maxson & Oring 1980	A	F	P	SP	404-787		kcal/g-day				Minnesota 1975-77	island in lake	Estimated daily energy expenditure for females (P) pre-breeding, (L) laying, and (I) incubating, assuming weight of 47.1 g.
	A	F	L	SP	383-745		kcal/g-day						
	A	F	I	SU	368		kcal/g-day						

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Maxson & Oring 1980	A	M	P	SP	440		kcal/g-day				Minnesota 1975-77	island in lake	Estimated daily energy expenditure for males during (P) pre-breeding, (L) female laying, (I) incubating, and (B) brooding. stages.
	A	M	L	SP	390		kcal/g-day						
	A	M	I	SU	303		kcal/g-day						
	A	M	B	SU	425		kcal/g-day						

***** DIET *****

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Maxson & Oring 1980			mayflies		√				Minnesota 1975-77	island in lake - two major prey items available (biomass)	Determined by setting insect traps in prime foraging areas.
			midges		√						

***** POPULATION DYNAMICS *****

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
POPULATION DENSITY													
Oring et al. 1983	A	F	-	SU	10		N/ha	3.8	12.5		Minnesota 1974-82	island in lake	
	A	M	-	SU	13.9		n/ha	7.5	20.0				
CLUTCH SIZE													
Bent 1929	-	-	-	-	4		eggs	3	5		NS	NS	
Oring & Lank 1986	-	-	-	-	4		eggs				Minnesota 1973-84	island in lake	
Oring et al. 1983	-	-	-	-	3.6		eggs			9 yr	Minnesota 1974-82	island in lake	They are determinate layers with clutch size = 4. Clutches with fewer eggs are not complete or have lost eggs; larger clutches are the result of more than one female laying in one nest.
Oring et al. 1983	-	-	-	-	38.7		%eggs hatc	0.019	0.667	1142	Minnesota 1974-82	island in lake	
	-	-	-	-	61.3		%not hatch						

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
CLUTCHES/YEAR													
Oring et al. 1984	A	F	-	SU			clutch/yr		4-6		Minnesota	island in lake	
Oring et al. 1991b	-	M	-	-			clutch/yr		1		Minnesota 1975-89	island in lake	Value is for number of successful clutches/year per male; in this case successful clutch assumed to mean one that fledged young.
Oring et al. 1991a	-	F	-	-			clutch/yr		5		Minnesota 1974-90	island in lake	Number of clutches laid by female; each clutch could involve a different mate, but a male will often receive a second clutch if his first is destroyed.
DAYS INCUBATION													
Oring (unpubl.)	-				18-24		days				Minnesota	island in lake	Oring pers. comm.
Oring et al. 1991a	-	-	-	-	20		days				Minnesota 1974-90	island in lake	Approximate.
AGE AT FLEDGING													
Oring et al. 1991a	-	-	-	-	18		days				Minnesota 1974-90	island in lake	Approximate.
N FLEDGE/ACTIVE NEST													
Oring 1982	-	-	1	-	1.2		chcks/F-yr			59	Minnesota 1975-81	island in lake	Number of chicks fledged per female per year for: (1) monogamous, (2) bigamous, (3) trigamous, and (4) quadragamous females. Some females may be excluded from breeding.
	-	-	2	-	2.6		chcks/F-yr			50			
	-	-	3	-	2.9		chcks/F-yr			15			
	-	-	4	-	1.0		chcks/F-yr			2			
N FLEDGE/SUCCESSFUL NEST													
Oring et al. 1983	-	-	-	-	1.83		N/nst hatc	0.58	2.76	140	Minnesota	island in lake	1.83 fledged out of nests at which at least one egg hatched. 2.58 fledged out of nests where at least one chick fledged. Young fledged/nest with eggs hatching (140 nests).
	-	-	-	-	2.58		N/suc nest	1.67	2.91	99			

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
AGE AT SEXUAL MATURITY													
Oring et al. 1983	-	F			1		year				Minnesota 1974-82	island in lake	
	-	M			1		year						
LONGEVITY													
Oring et al. 1983	A	F	-	-	3.7		years				Minnesota 1974-82	island in lake	
Oring et al. 1991a	A	M	-	-	2.8	2.0 SD	years				Minnesota 1974-90	island in lake	Number of years breeding on the island; presumed very similar to longevity.
	A	F	-	-	3.0	1.9 SD	years						

***** SEASONAL ACTIVITIES *****

Reference	Begin	Peak	End	Location	Habitat	Notes
MATING/LAYING						
Lank et al. 1985	earl May	May-June		Minnesota 1973-82	island in lake	The peak of the mating season is from late May to early June.
HATCHING						
Lank et al. 1985	earl Jun	late Jun		Minnesota 1973-82	island in lake	
FALL/BASIC MOLT						
Bent 1929	Aug		Oct	NS	NS	
SPRING/ALTERNATE MOLT						
Bent 1929		Mar - Apr		NS	NS	Partial prenuptial molt.
FALL MIGRATION						
Lank et al. 1985	late Jun	ear-mid July		Minnesota 1973-82	island in lake	Adult females.
Lank et al. 1985	earl Jul	mid July		Minnesota 1973-82	island in lake	Adult males.

***** HERRING GULL *****

*** NORMALIZING AND CONTACT RATE FACTORS ***

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
BODY WEIGHT													
Belopolskii 1957	A	F	BR	-	1,044		g	717	1,385	139	Barents Sea (Arctic)	coastal	As cited in Dunning 1984.
	A	M	BR	-	1,226		g	755	1,495	220			
Coulson et al. 1982	A	M	1	-	1,009	77.3 SD	g			84	Scotland 1972-81	Isle of May	Data from birds culled during the breeding season. Between 1972 and 1981 large numbers of birds were culled each year; the breeding density of gulls in 1981 was about one fourth the breeding density in 1972. Year gulls culled: (1) 1972; (2) 1976; (3) 1981.
	A	F	1	-	849	69.1 SD	g			72			
	A	M	2	-	1,042	68.7 SD	g			68			
	A	F	2	-	862	61.6 SD	g			70			
	A	M	3	-	1,054	93.4 SD	g			129			
	A	F	3	-	888	65.9 SD	g			159			
Harris 1964	A	M	-	-	980		g				Wales 1962	Skomer Island cliffs	
	A	F	-	-	815		g						
Morris & Black 1980	A	F	BR	-	973		g	910	1,010	3	Ontario, CAN 1978	n shore Lake Erie	Birds with active nests; used in radiotelemetry study.
	A	M	BR	-	1,280		g	1,260	1,300	2			
Norstrom et al. 1986	A	F	1	SP	920	57 SD	g			10	Lake Huron 1980	island	Collection dates: (1) April 1; (2) May 15; (3) June 19-25; (4) July 30.
	A	F	2	SP	951	88 SD	g			10			
	A	F	3	SU	863	72 SD	g			10			
	A	F	4	SU	918	80 SD	g			10			
Norstrom et al. 1986	A	M	1	SP	1,047	58 SD	g			7	Lake Huron 1980-81	island	Collection dates: (1) May 5, 1981; (2) May 15, 1980; (3) May 18-23, 1980.
	A	M	2	SP	1,184	116 SD	g			9			
	A	M	3	SP	1,180	69 SD	g			6			
Poole 1938	-	-	-	-	850		g			1	NS	NS	
Threlfall & Jewer 1978	A	M	-	SU	1,232	106.6 SD	g	1,014	1,618	180	Newfoundland, CAN	bay	Years: 1962-64 and 1966-68.
	A	F	-	SU	999	89.7 SD	g	832	1,274	78			
BODY FAT													
Norstrom et al. 1986	A	M	1	SP	7.5	1.9 SD	% lipid			7	Lake Huron 1980-81	island	Collection dates: (1) May 5, 1981; (2) May 15, 1980; (3) May 18-23, 1980.
	A	M	2	SP	10.0	2.2 SD	% lipid			9			
	A	M	3	SP	11.3	3.0 SD	% lipid			6			

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Norstrom et al. 1986	A	F	1	SP	18.3	5.4 SD	% lipid			10	Lake Huron 1980	island	Collection dates: (1) April 1; (2) May 15; (3) June 19-25; (4) July 30.
	A	F	2	SP	8.2	2.0 SD	% lipid			10			
	A	F	3	SU	8.7	2.3 SD	% lipid			10			
	A	F	4	SU	7.7	2.1 SD	% lipid			10			
EGG WEIGHT													
Harris 1964	E	-	1	-	84.68		g				Wales 1962	Skomer Island cliffs	Total of 100 eggs measured: (1) first-laid egg; (2) second-laid egg; (3) third-laid egg. Weight was calculated by author from a calculated egg volume (in cubic centimeters) using a specific gravity value of 1.11.
	E	-	2	-	85.03		g						
	E	-	3	-	75.31		g						
Hebert & Barclay 1988	E	-	1	-	87.16		g			138	New Brunswick, CAN	island	Weighted mean egg weight for eggs from (1) three egg clutches and (2) two egg clutches.
	E	-	2	-	85.68		g			160			
Meathrel et al. 1987	E	-	1	-	7.5	0.51 SD	g lipid			36	Lake Superior, CAN	island	Egg lipids measured in two years: (1) 1983, (2) 1984.
	E	-	2	-	7.45	0.59 SD	g lipid			45			
Meathrel et al. 1987	E	-	1	-	143.72	9.58 SD	kcal/egg			36	Lake Superior, CAN	island	Egg energy content (kcal/egg) measured in two years: (1) 1983, (2) 1984.
	E	-	2	-	144.53	8.71 SD	kcal/egg			45			
Meathrel et al. 1987	E	-	1	-	66.92	5.32 SD	g water			36	Lake Superior, CAN	island	Egg water content (g/egg) measured in two years: (1) 1983, (2) 1984.
	E	-	2	-	68.89	5.54 SD	g water			45			
Meathrel et al. 1987	E	-	1	-	92.0	5.9 SD	g			93	Lake Superior, CAN	islands	Year: (1) 1983, (2) 1984.
	E	-	2	-	98.0	8.0 SD	g			156			
Pierotti 1982	E	-	1	-	91.1	7.9 SD	g			120	Newfoundland, CAN 1977	Great Island, grassy slope	Laying order of eggs: (1) first; (2) second; (3) third.
	E	-	2	-	88.4	7.4 SD	g			111			
	E	-	3	-	81.2	6.3 SD	g			40			
Pierotti 1982	E	-	1	-	94.8	7.9 SD	g			134	Newfoundland, CAN 1978	Great Island, grassy slope	Laying order of eggs: (1) first; (2) second; (3) third.
	E	-	2	-	92.7	7.7 SD	g			127			
	E	-	3	-	86.7	7.0 SD	g			102			
HATCHING WEIGHT													
Hebert & Barclay 1986	H	-	1	-	63.32	4.94 SD	g			14	New Brunswick, CAN 1984	island	Hatchlings from: (1) 1st laid egg; (2) 2nd laid egg; (3) 3rd egg laid. SD estimated from SE and N.
	H	-	2	-	63.42	6.21 SD	g			14			
	H	-	3	-	57.00	7.78 SD	g			14			
	H	-	AV	-	61.22	10.95 SD	g			42			

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Pierotti 1982	H	-	1	-	68.9	6.2 SD	g			85	Newfoundland, CAN 1977	Great Island, rocky	Masses of chicks from: (1) first-laid eggs; (2) third-laid eggs.
	H	-	2	-	61.7	7.2 SD	g			50			
Pierotti 1982	H	-	1	-	66.3	6.8 SD	g			85	Newfoundland, CAN 1977	Great island, grassy slope	Masses of chicks from: (1) first-laid eggs; (2) third-laid eggs.
	H	-	2	-	57.9	5.5 SD	g			51			
Pierotti 1982	H	-	1	-	65.5	6.3 SD	g			63	Newfoundland, CAN 1977	Great Island, meadow	Masses of chicks from: (1) first-laid eggs; (2) third-laid eggs.
	H	-	2	-	57.1	6.3 SD	g			34			
Pierotti 1982	H	-	1	-	70.0	5.9 SD	g			82	Newfoundland, CAN 1978	Great Island, rocky	Masses of chicks from: (1) first-laid eggs; (2) third-laid eggs.
	H	-	2	-	63.9	5.1 SD	g			56			
Pierotti 1982	H	-	1	-	66.0	6.0 SD	g			92	Newfoundland, CAN 1978	Great Island, grassy slope	Masses of chicks from: (1) first-laid eggs; (2) third-laid eggs.
	H	-	2	-	60.0	5.8 SD	g			49			
Pierotti 1982	H	-	1	-	66.1	7.3 SD	g			58	Newfoundland, CAN 1978	Great Island, meadow	Masses of chicks from: (1) first-laid eggs; (2) third-laid eggs.
	H	-	2	-	59.6	7.1 SD	g			33			
CHICK WEIGHT													
Dunn & Brisbin 1980	C	B	1	SU	65		g	50	80		Maine 1972-73	coastal island	Ages of chicks (C): (1) at hatching; (2) 10 days; (3) 20 days; (4) 30 days. Estimated from Figure 1 in Dunn & Brisbin 1980.
	C	B	2	SU	230		g	120	380				
	C	B	3	SU	590		g	420	800				
	C	B	4	SU	810		g	610	1,000				
CHICK GROWTH RATE													
Haycock & Threlfall 1975	C	-	-	-			g/day		40		Newfoundland, CAN 1969-71	Gull Island	Maximum weight growth of the chicks occurred at about 18 days of age.
Hebert & Barclay 1986	C	B	1	SU	1.08	1.01 SE	g/day			13	New Brunswick, CAN	island	Up to 5 days of age only. (1) 1st hatched; (2) 2nd hatched; (3) 3rd hatched. SD can't be estimated from SE because SE appears to be too high given the available data.
	C	B	2	SU	1.07	1.01 SE	g/day			13			
	C	B	3	SU	1.02	1.02 SE	g/day			5			
	C	B	AV	SU	1.06	1.01 SE	g/day			31			
Hunt 1972	C	B	-	SU	30.18	1.75 SD	g/day	26.7	31.4	136	Maine 1968-70	coastal islands	Between 5 and 25 days of age.
Kadlec et al. 1969	C	-	1	-	28.8		g/day			20	Massachusetts 1964	Gray's Rock (island)	Growth rate from (1) day 5 to day 30; (2) day 30 to day 50. Only six of the original twenty presumed to have lived to fledging.
	C	-	2	-	10.3		g/day			20			

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Pierotti 1982	- -	- -	1 2	- -	32.11 33.39	3.98 SD 4.72 SD	g/day g/day			93 89	Newfoundland, CAN	Great Island, rocky	Growth rate from day 5 to day 30. Year: (1) 1977; (2) 1978.
Pierotti 1982	- -	- -	1 2	- -	28.99 31.38	7.03 SD 4.57 SD	g/day g/day			111 119	Newfoundland, CAN	grassy slope	Habitat is on Great Island. Growth rate from day 5 to day 30. Year: (1) 1977; (2) 1978.
Pierotti 1982	- -	- -	1 2	- -	26.27 31.68	6.53 SD 5.43 SD	g/day g/day			79 80	Newfoundland, CAN	Great Island, meadow	Growth rate from day 5 to day 30. Year: (1) 1977; (2) 1978.
Pierotti 1982	- -	- -	1 2	- -	8.8 13.1		g/day g/day			115 85	Newfoundland, CAN	Great Island, rocky	Estimates of growth rate from day 0 - day 5 based on Tables 6, 7 & 8 (all chicks combined). N = number of chicks weighed on day 5. Year: (1) 1977; (2) 1978.
Pierotti 1982	- -	- -	1 2	- -	11.7 13.1		g/day g/day			125 146	Newfoundland, CAN	grassy slope	Habitat is on Great Island. Estimates of growth rate from day 0 - day 5 based on Tables 6, 7 & 8 (all chicks combined). N = number of chicks weighed on day 5. Year: (1) 1977; (2) 1978.
Pierotti 1982	- -	- -	1 2	- -	9.4 11.2		g/day g/day			98 88	Newfoundland, CAN	Great Island, meadow	Estimates of growth rate from day 0 - day 5 based on Tables 6, 7 & 8 (all chicks combined). N = number of chicks weighed on day 5. Year: (1) 1977; (2) 1978.
FLEDGING WEIGHT													
Pierotti 1982	F F F	- - -	1 2 3	- - -	912.2 887.4 853.4	100.1 SD 93.4 SD 90.2 SD	g g g			29 22 14	Newfoundland, CAN 1977	Great Island, rocky	Masses of 30-day old chicks from: (1) first-laid eggs; (2) second-laid eggs; (3) third-laid eggs.
Pierotti 1982	F F F	- - -	1 2 3	- - -	818.0 825.3 776.3	99.2 SD 99.1 SD 83.6 SD	g g g			27 28 13	Newfoundland, CAN 1977	Great Island, grassy slope	Masses of 30-day old chicks from: (1) first-laid eggs; (2) second-laid eggs; (3) third-laid eggs.
Pierotti 1982	F F F	- - -	1 2 3	- - -	832.9 842.2 759.4	90.7 SD 90.6 SD 75.3 SD	g g g			16 22 10	Newfoundland, CAN 1977	Great Island, meadow	Masses of 30-day old chicks from: (1) first-laid eggs; (2) second-laid eggs; (3) third-laid eggs.

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Pierotti 1982	F F F	- - -	1 2 3	- - -	964.4 974.8 985.5	77.3 SD 98.1 SD 88.8 SD	g g g			20 16 11	Newfoundland, CAN 1978	Great Island, rocky	Masses of 30-day old chicks from: (1) first-laid eggs; (2) second-laid eggs; (3) third-laid eggs.
Pierotti 1982	F F F	- - -	1 2 3	- - -	899.3 909.4 913.3	103.3 SD 102.3 SD 85.7 SD	g g g			30 17 12	Newfoundland, CAN 1978	Great Island, grassy slope	Masses of 30-day old chicks from: (1) first-laid eggs; (2) second-laid eggs; (3) third-laid eggs.
Pierotti 1982	F F F	- - -	1 2 3	- - -	935.6 976.2 952.5	99.6 SD 77.3 SD 61.2 SD	g g g			15 29 11	Newfoundland, CAN 1978	Great Island, meadow	Masses of 30-day old chicks from: (1) first-laid eggs; (2) second-laid eggs; (3) third-laid eggs.
METABOLIC RATE (KCAL BASIS)													
Dunn 1980	C C C C	B B B B	1 2 3 4	SU SU SU SU	110 185 230 250		kcal/day kcal/day kcal/day kcal/day				Maine 1972	coastal island	Estimated total energy requirement of free-living chicks under natural conditions (C) as they grow: (1) 10 days of age; (2) 20 days; (3) 30 days; (4) 40 days. Estimated from figure.
Dunn 1976	C C C C C C	B B B B B B	1 2 3 4 5 6	SU SU SU SU SU SU	8 50 100 137 155 155		kcal/day kcal/day kcal/day kcal/day kcal/day kcal/day				Maine 1972	coastal island	Estimated existence energy of chicks under natural conditions (C) as they grow: (1) at hatching; (2) 10 days of age; (3) 20 days; (4) 30 days; (5) 40 days; (6) 50 days. Estimated from Figure 2 in Dunn 1976 for sunny and shady locations.
Lustick et al. 1978	A	-	B	-	99		kcal/kg-d					laboratory	
Norstrom et al. 1986	C C C	B B B	1 2 3	SU SU SU	100 190 250		kcal/day kcal/day kcal/day				NS	captive	Metabolizable energy intake of chicks (C) at ages: (1) 10 days; (2) 20 days; (3) 30 days. From a 1973 study by Gilman (1978, unpublished thesis).
Sibly & McCleery 1983	A A	M F	I I	SU SU	79.2 67.2		kcal/day kcal/day				England 1976-77	marine island	Weights of birds not reported. I = incubating.

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
present study	A A	M F	I I	- -	97.1 70.2		kcal/kg-d kcal/kg-d				NS	NS	Estimated using the metabolic rate data of Sibly and McCleery (1983) and the body weights reported by Belopolskii (1957).

FOOD INGESTION RATE

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Pierotti & Annett 1991	A A	M F	BR BR	SU SU	0.20 0.21		g/g-day g/g-day				Newfoundland	NS	Diet of mussels. Estimated using 11.2 meals of mussel consumed per day per pair, weight of 80 g per mussel meal of which half is shell and not included in ingestion rate, assuming that the female accounts for 46% of pair's energy requirement and the male accounts for 54%, and using the body weights of Threfall and Jewer 1978.
Pierotti & Annett 1991	A A	M F	BR BR	SU SU	0.19 0.18		g/g-day g/g-day				Newfoundland	NS	Diet of garbage. Estimated using 4.2 meals of garbage consumed per day per pair, weight of 100 g per garbage meal, assuming that the female accounts for 46% of pair's energy requirement and the male accounts for 54%, and using body weights of Threfall and Jewer 1978.

THERMONEUTRAL ZONE

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Lustick et al. 1979	J	B	-	-			degrees C	17.5	30		Ohio, Michigan	lab	Oxygen consumption increased above and below these temperatures.

***** DIET *****

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Burger 1988	-	-	snails crabs garbage offal worms other inverts. fish		3 14 27 5 23 28 ?			21	CA,FL,NY,NJ,TX	terrest., coastal, open water - % of gulls feeding on the items	Birds feeding offshore not evaluated.

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Ewins et al. (unpubl. manuscript)	A	B	fish				76	231	Lake Erie 1978-91	Middle Island - % of total diet items; regurgitated pellets and faeces	Fish were comprised of more than 90 % Aplodinotus grunniens (freshwater drum) and a few percent Perca flavescens (yellow perch).
			mammal				5				
			bird				1				
			invertebrate				1				
			plant				16				
			garbage				-				
Ewins et al. (unpubl. manuscript)	A	B	fish				50	151	Niagara River 1978-91	river - % frequency; regurgitated pellets and faeces	Fish were comprised mostly of Osmerus mordax (rainbow smelt), Ictalurus nebulosus (brown bullhead), Nuturus flavus (stonecat), Alosa pseudoharengus (alewife); mammals consisted of voles and mice.
			mammal				1				
			bird				16				
			invertebrate				30				
			plant				15				
			garbage				45				
Ewins et al. (unpubl. manuscript)	A	B	fish				5	167	Lake Huron 1978-91	Chantry Island - % of total diet items; regurgitated pellets and faeces	The fish were largely unidentified to species.
			mammal				78				
			bird				10				
			invertebrate				2				
			plant				1				
			garbage				3				
Ewins et al. (unpubl. manuscript)	A	B	fish				98	224	Lake Ontario 1978-91	Scotch Bonnet Island - % of total diet items; regurgitated pellets and faeces	Fish consisted predominantly of Alosa pseudoharengus (alewife) and Osmerus mordax (rainbow smelt).
			mammal				4				
			bird				18				
			invertebrate				5				
			plant				21				
			garbage				7				
Ewins et al. (unpubl. manuscript)	A	B	fish				76	211	Lake Ontario 1978-91	Snake Island - % of total diet items; regurgitated pellets and faeces	Fish consisted primarily of Alosa pseudoharengus (alewife), Amploplites rupestris (rock bass), and Perca flavescens (yellow perch).
			mammal				23				
			bird				5				
			invertebrate				13				
			plant				33				
			garbage				15				
Ewins et al. (unpubl. manuscript)	A	B	alewife				35	1477	Great Lakes 1978-91	various - % frequency; regurgitated pellets and faeces	Summary of findings for all locations; sample size = 1298 pellets and 179 faeces examined.
			freshwater drum				23				
			rainbow smelt				13				
			sunfishes				11				
			perch				11				
Fox et al. 1990	A	B	Year:	1978	1979	1980	1981		Lake Ontario 1978-81	Gull Island - % of items; incubating adult regurgitation	All collections made during the summer. Other fish included yellow perch, sunfish, carp, smallmouth bass, and unidentified cyprinids. Shows annual variation in composition of diet.
			American smelt	46.1	18.4	61.2	57.8				
			alewife	23.1	73.7	16.7	23.4				
			other fish	20.5	0.0	3.4	3.1				
			birds	2.6	2.6	13.8	6.2				
			voles	2.6	2.6	3.4	9.4				
			insects & refuse	12.8	0	3.4	0				
			(N)	(31)	(23)	(15)	(26)				

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Fox et al. 1990	C	B	Lake:	Ontario	Erie	Huron	Superior		Great Lakes 1977-83	islands - % of occurrence; boli regurgitated by chicks	Season is summer for all data. Shows variations in diet among colonies.
			fish	91.8	94.1	75.8	38.6				
			insects	5.5	5.9	5.6	42.1				
			offal, garbage	0.5	2.9	13.6	21.0				
			gull chicks/ ducklings	2.2	-	1.0	-				
			adult birds	1.6	-	1.0	3.5				
			amphibians/aquatic larvae	0.5	-	-	-				
			earthworms	2.2	-	11.6	1.7				
			crayfish	-	-	0.5	-				
			(N)	(182)	(34)	(198)	(57)				
Fox et al. 1990	A	B	American smelt		35.6			132	Lake Ontario 1978-83	islands - % of occurrence; incubating adult regurgitation	Most data from regurgitations of incubating adults, but includes data from 7 observations of prey consumption and stomach contents of four incubating adults. Season is mid-April to mid-July.
			alewife		28.8						
			other fish		9.1						
			unidentified fish		8.3						
			birds		9.8						
			voles		8.3						
			refuse, offal		4.5						
			insects		3.0						
			bird eggs		1.5						
			earthworms		0.8						
			amphibians		0.8						
			crayfish		0.8						
Haycock & Threlfall 1975	-	-	Months:	Mid-May Mid-Jun	Mid-Jun Mid-Jul	Mid-Jul Mid-Aug			Newfoundland, CAN 1970-71	Gull Island - % of occurrence; regurgitation and pellets	Common names of species: Hyas sp.(crab), Oniscus sp. (woodlice), Acmaea sp. (limpet), Mytilus edulis (blue mussel), Illex illecebrosus (northern shortfin squid), Asterias sp. (starfish), Rana clamitans (frog), Oceanodroma leucorhoa (Leach's Storm-Petrel), Fratercula arctica (Atlantic puffin), Fratercula (puffin), Uria (murre), Larus sp. (gull), Rissa tridactyla (kittiwake), Vaccinum angustifolium (blueberries), and Gadus morhua (Atlantic cod). Fish include Atlantic herring, Atlantic tomcod, and small Atlantic cod, capelin, and American sand lance.
			Hyas sp.	0.7	0.0	0.0					
			Oniscus sp.	0.0	1.7	0.0					
			insects	0.0	2.7	2.3					
			Acmaea sp.	0.3	0.0	0.0					
			Mytilus edulis	30.9	0.9	9.1					
			Illex illecebrosus	0.0	0.0	1.5					
			Asterias sp.	0.0	0.9	0.7					
			sea urchin	5.8	0.0	4.5					
			fish	11.4	71.1	18.9					
			Rana clamitans	0.0	1.7	0.0					
			Oceanodroma leuchorhoa	22.4	7.0	15.9					
			Fratercula arctica adults	5.8	0.0	1.5					
			Fratercula, Uria chicks	0.0	3.5	9.1					
			Fratercula, Uria eggs	1.4	1.7	0.8					
			Larus sp. chicks	0.0	0.9	2.3					
(continued)			Larus sp. eggs	3.1	5.3	0.8					

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Haycock & Threlfall 1975 (continued)			Rissa tridactyla chicks	0.0	0.0	1.5					
			Vaccinium angustifolium	-	-	9.9					
			Gadus morhua offal	12.4	1.7	14.4					
			assorted refuse	5.8	0.9	6.8					
			(N)	(291)	(114)	(132)					
Mendall 1939	-	-	(fish)		(76.90)			62	Maine 1936-37	inland lakes - % of total diet items; stomach contents	Tabulation was of dry material and was made according to the percentage-by-bulk method as recommended by the Bureau of Biological Survey.
			white perch		36.08						
			sunfishes(Eupomotis gibbosus, Lepomis auritus)		10.10						
			yellow perch		8.18						
			minnows		6.14						
			small-mouthed bass		4.00						
			common sucker		3.60						
			trout or salmon		2.00						
			unidentified fish		6.80						
			(misc. animal food)		(6.86)						
			insects(Hymenoptera, Coleoptera)		3.44						
			mollusks (Unionidae)		2.06						
			birds (Compsothylpidae, Fringillidae)		1.36						
			(vegetable food)		(8.04)						
			misc. vegetation (Algae, Carex, Graminae)		4.64						
			blueberries		3.40						
			(refuse)		(8.20)						
Pierotti & Annett 1987	B	B	DATE:	5/1-6/7	6/8-6/21	6/22-7/7	7/8-7/23	NS	Newfoundland, CAN	Great Island - number of observed occurrences -- see notes	Dates for food observations are given at the top of each of the four columns. Based on number of occurrences observed in remains at nest, food fed to mates, or adult regurgitate. Foods that make up less than 1% of diet not included. Study shows shift in food taken over the course of the reproductive period.
			mussels (Mytilus edulis)	1,744	312	61	1				
			garbage	833	114	18	4				
			Leach's storm petrel (Oceanodroma leuc.)	509	58	28	2				
			capelin (Mallotus villosus)	0	118	233	124				
			squid (Illex illecebrosus)	0	3	26	152				
Vermeer 1973	-	-	plants		2			335	Manitoba, CAN 1971	Kawinaw Lake - % frequency of food items; pellets	Summer = May and June.
			insects		TR						
			crayfish		TR						
			rodents		6						
			fish		94						

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Vermeer 1973	-	-	Catostomidae unident. Percidae Perca flavescens Esox lucius Stizostedion ritreum Cyprinus carpio Ictalurus nebulosus		73 38 30 9 4 4 1			335	Manitoba, CAN 1971	Kawinaw Lake - number of pellets containing fish species and families	Summer = May and June.

***** POPULATION DYNAMICS *****

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
FORAGING RANGE													
Pierotti pers. comm.	A A	M F	- -	- -	10 - 15 5 - 10		km km	3 3	50 25		NS	coastal	
POPULATION DENSITY													
Brown 1967	-	-	-	SU	303		nests/ha		769		England 1962-65	low, gravelly island (Walney Island)	Mixed colony of herring gulls and lesser black-backed gulls; both types of nests included in density estimate. Author notes this is the highest density recorded for a colony of this type.
Haycock & Threlfall 1975	- - -	- - -	1 2 3	SU SU SU	389.1 295.8 383.0	154 SD 43 SD 128 SD	nests/ha nests/ha nests/ha				Newfoundland, CAN 1969-71	Gull Island	Densitites of nests across various regions of Gull Island. Year: (1)1969; (2)1970; and (3)1971. Converted from nests/100 square meters.
Kadlec 1971	-	-	-	SU	226.8		nests/ha	137.6	350.2		Massachusetts 1964	coastal islands	Over four years.
Kadlec 1971	-	-	-	SU	139.3		nests/ha				Massachusetts 1964-69	coastal islands	At peak of nesting season (early June); over four years.
Morris & Haymes 1977	-	-	-	SU			nests/ha	290	360	237	ne Lake Erie 1973-76	rocky shore	Nest density during breeding season. Total of 0.17 ha of this habitat sampled each of four years.
Morris & Haymes 1977	-	-	-	SU			nests/ha	5	9	110	ne Lake Erie 1973-76	flat grassy area	Nest density during breeding season; total of 4.54 ha of this habitat sampled each of four years.
Parsons 1976b	-	-	-	SU	788		nests/ha			819	Scotland 1968	Isle of May	Nests found within a 1.04 ha area on the island.

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Pierotti 1982	-	-	-	SU	74.7		nests/ha			1083	Newfoundland 1976-78	grassy slope	Habitat is on Great Island. N = number of nesting pairs. Total of 14.5 ha of grassy slope habitat available.
Pierotti 1982	-	-	-	SU	92.6		nests/ha			585	Newfoundland 1976-78	Great Island, meadow	N = number of nesting pairs. Total of 6.08 ha of meadow habitat available.
Pierotti 1982	-	-	-	SU	217.4		nests/ha			476	Newfoundland 1976-78	Great Island, rocky	N = number of nesting pairs. Total of 2.19 ha of meadow habitat available.
Schoen & Morris 1984	A	B	-	SU	20-25		pairs/ha				Ontario, CAN 1981	n shore Lake Erie, mainland	
Schoen & Morris 1984	A	B	-	SU	160-200		pairs/ha				Ontario, CAN 1981	n shore Lake Erie, insular rocky area	
Weseloh 1989	A	B	1	SU	0.0001		pairs/ha				s Ontario, CAN 1980s	NS	Total of 307 10 km squares sampled for breeding pairs in inland and lakeshore regions. Percent of squares with given density of pairs: (1) 10%; (2) 50%; (3) 28%; (4) 13%.
	A	B	2	SU			pairs/ha	0.0002	0.0010				
	A	B	3	SU			pairs/ha	0.0011	0.0100				
	A	B	4	SU			pairs/ha	0.0101	0.1000				
CLUTCH SIZE													
Brown 1967	-	-	1	-	2.77				3	40	England 1962-65	low, gravelly island (Walney Island)	Laying date of clutch: (1) to May 2; (2) May 3-7; (3) May 8-12; (4) after May 13.
	-	-	2	-	2.50				3	40			
	-	-	3	-	2.51				3	29			
	-	-	4	-	2.40				3	30			
Burger & Shisler 1980	-	-	-	-	2.72		eggs	2.61	2.87	330	New Jersey 1976-77	coastal	Five study areas; min and max are means from different study sites.
Burger 1979b	-	-	-	-	2.78		eggs	2.51	2.90	1031	New Jersey 1977	salt marsh islands	Weighted average clutch size for 8 study sites and the minimum and maximum values from the 8 sites.
Burger 1980a	-	-	-	-	2.64		eggs	2.6	2.7	163	New Jersey 1976, 78	coastal	Weighted average of two years (listed in the minimum and maximum columns).
Burger 1977	-	-	1	-	2.83	0.39 SD	eggs			15	New Jersey 1974-75	marsh	Average of clutch sizes in (1) dry, (2,3) wet-dry, and (4) wet habitats.
	-	-	2	-	2.71	0.40 SD	eggs			42			
	-	-	3	-	2.66	0.64 SD	eggs			42			
	-	-	4	-	2.38	0.79 SD	eggs			25			

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Davis 1975	-	-	-	-	2.66		eggs			590	Scotland 1969-72	islands	Weight averaged over different laying periods.
Haycock & Threlfall 1975	-	-	1	-	2.70		eggs				Newfoundland, CAN 1970-71	Gull Island	N = number of nests. Years: (1)1970; (2)1971; and (3)1970-71. Only two nests with four eggs were seen among the 5000 nests examined in the two years. Mean for 1970 = maximum average clutch size reached in periodic surveys of the Point and east side Square. Mean for 1971 = average of 109 marked nests on the Point.
	-	-	2	-	2.73		eggs			109			
	-	-	3	-			eggs		4	5000			
Hunt 1972	-	-	-	-	2.38		eggs	2.3	2.8	11 yr	Maine 1968-70	coastal islands	Minimum and maximum values from 11 seasons.
Meathrel et al. 1987	-	-	-	-	2.84	0.44 SD	eggs			782	Lake Superior, CAN	islands	Years 1975 through 1984 (except two).
Morris & Haymes 1977	-	-	-	-	2.65		eggs	1	5	100	Ontario, CAN 1973-75	n shore Lake Erie, flat grassy	Clutches of four or five were very rare.
Morris & Haymes 1977	-	-	-	-	2.79		eggs	1	5	231	Ontario, CAN 1973-76	n shore Lake Erie, rocky shore	Four and five egg clutches were very rare.
Nisbet & Drury 1984	-	-	-	-	2.54		eggs	1	6	24183	RI, MA, ME 1963-80	coastal	Surveyed just prior to hatching.
Parsons 1976b	-	-	-	-	2.71		eggs			771	Scotland 1968	Isle of May	Weighted average for all nests.
Paynter 1949	-	-	1	-	2.61	0.14 SE	eggs			44	New Brunswick, CAN 1947	Kent Island	Clutch size of successful nests (hatched at least one bird): (1) at least one egg hatched before June 27 (early group); (2) eggs hatched after June 27 (late group).
	-	-	2	-	2.54	0.15 SE	eggs			37			
Pierotti 1982	-	-	1	-	2.44	0.72 SD	eggs			66	Newfoundland, CAN	Great Island, rocky	Year: (1) 1976; (2) 1977; (3) 1978.
	-	-	2	-	2.65	0.56 SD	eggs			117			
	-	-	3	-	2.60	0.62 SD	eggs			120			
Pierotti 1982	-	-	1	-	2.27	0.72 SD	eggs			72	Newfoundland, CAN	grassy slope	Habitat is on Great Island. Year: (1) 1976; (2) 1977; (3) 1978.
	-	-	2	-	2.72	0.54 SD	eggs			134			
	-	-	3	-	2.67	0.61 SD	eggs			137			
Pierotti 1982	-	-	1	-	2.16	0.72 SD	eggs			88	Newfoundland, CAN	Great Island, meadow	Year: (1) 1976; (2) 1977; (3) 1978.
	-	-	2	-	2.51	0.63 SD	eggs			98			
	-	-	3	-	2.51	0.73 SD	eggs			94			

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
CLUTCHES/YEAR													
Burger 1979a, Bourget 1973	-	-	-	-	1		clutch/yr	1	2*		NS	NS	* If first clutch lost.
DAYS INCUBATION													
Haycock & Threlfall 1975	-	-	-	-	29.4	1 SE	days			24	Newfoundland, CAN 1969-71	Gull Island	Average egg volume = 79cc.
Niebuhr 1983	-	-	-	-			days	25	28		Cumbria, England 1980	Walney Island	
Parsons 1972	-	-	1	-	29.1	0.11 SE	days			75	Scotland 1968	Isle of May	Incubation period for "late"-laid eggs (after May 24): (1) first-laid egg (mean volume = 77.1cc +/- 0.58 S.E.); (2) second-laid egg (mean volume = 74.7cc +/- 0.57); (3) third-laid egg (mean volume = 67.8cc +/- 0.56).
	-	-	2	-	27.7	0.12 SE	days			75			
	-	-	3	-	26.7	0.14 SE	days			75			
Parsons 1972	-	-	1	-	30.0	0.19 SE	days			28	Scotland 1968	Isle of May	Incubation period for "early"-laid eggs (before May 10): (1) first-laid egg (mean volume = 80.2cc +/- 0.98 S.E.); (2) second-laid egg (mean volume = 78.3cc +/- 1.07); (3) third-laid egg (mean volume = 71.0cc +/- 1.11).
	-	-	2	-	28.4	0.19 SE	days			28			
	-	-	3	-	27.5	0.18 SE	days			28			
Parsons 1972	-	-	1	-	29.98	0.08 SE	days			67	Scotland 1967-69	Isle of May	Incubation period of first-laid eggs. Egg size: (1) greater than 76cc (mean = 82cc); (2) less than 76cc (mean = 71cc). All eggs laid during peak of laying season.
	-	-	2	-	29.31	0.11 SE	days			67			
Pierotti 1982	-	-	1	-	29		days			351	Newfoundland, CAN 1978	Great Island	Incubation period for: (1) first-laid egg; (2) second-laid egg; (3) third-laid egg. N = number of nests; not all pairs incubated three eggs.
	-	-	2	-	27		days						
	-	-	3	-	26		days						
Tinbergen 1960	-	-	-	-	30.5		days	28	33		Holland	coastal	

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
AGE AT FLEDGING													
Haycock & Threlfall 1975	-	-	-	-	45.2		days	42	48	12	Newfoundland, CAN 1970	Gull Island	
Holley 1982	-	-	1	-	45		days			16	England 1977-80	coastal	(1) Single chick broods; (2) multiple chick broods.
	-	-	2	-	48		days			3			
Kadlec et al. 1969	-	-	-	-	51		days	35-44	56-61	6	Massachusetts 1964	Gray's Rock (island)	N = 6 chicks fledging.
Paynter 1949	-	-	-	-	43		days	31	52		New Brunswick, CAN 1947	Kent Island	
N FLEDGE/ACTIVE NEST													
Burger & Shisler 1980	-	-	-	-	1.42		N/act nest	1.4	1.44		New Jersey 1976-77	coastal	Average, minimum, and maximum of three colonies (with a total of 688 active nests).
Davis 1975	-	-	-	-	0.65		N/pair	0.25	0.85	2 yr	England 1970-71	coastal	Minimum reflects a subgroup of clutches laid in a "later" time period than average; max is a subgroup with "earlier" hatch dates.
Kadlec 1971	-	-	-	-	0.83	0.27 SD	N/nest	0.4	1.1		Massachusetts 1964-69	coastal islands	Average, minimum, and maximum values over 6 years with between 1,400 to 1,900 nests/year. Not specified whether per active or successful nest; we assume per active.
Kadlec & Drury 1968	-	-	1	-	1.47		N/act nest			233	Rhode Island 1966	Block Island	Clutch size of nest: (1) 3 eggs; (2) 2 eggs.
	-	-	2	-	1.09		N/act nest			33			
Kadlec & Drury 1968	-	-	1	-	1.00		N/act nest			216	Rhode Island, 1965	Block Island	Clutch size of nests: (1) 3 eggs; (2) 2 eggs.
	-	-	2	-	0.60		N/act nest			42			
Kadlec & Drury 1968	-	-	1	-	0.73		N/act nest			51	Massachusetts 1965	Marblehead Rock	Hatch date: (1) before June 11; (2) June 11 to June 24; (3) after June 24.
	-	-	2	-	1.09		N/act nest			159			
	-	-	3	-	0.62		N/act nest			52			
Kadlec & Drury 1968	-	-	1	-	1.53		N/act nest			128	Rhode Island 1966	Block Island	Hatch date: (1) before June 11; (2) June 11 to 24; (3) after June 24.
	-	-	2	-	1.42		N/act nest			122			
	-	-	3	-	1.12		N/act nest			8			
Keith 1966	-	-	-	-	0.3-0.4		N/pair				Michigan, early 1960s	lake	As cited in Peakall 1988. Low fledging success might have resulted from effects of DDE/DDT.

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Mineau et al. 1984	-	-	-	-	1.65		N/act nest	1.40	2.13	6	Lake Ontario 1979-81	lakeshore	N = 6 colony years. Min and max represent min and max average values of the 6 colony-years. The low reproductive success (< 1 fledge per nest) of these colonies in the early 1970's, attributed to organochlorine contaminants, was no longer apparent.
Mineau et al. 1984	-	-	-	-	1.78		N/act nest	1.62	2.10	3	Lake Erie 1979-81	lakeshore	N = 3 colony years. Min and max represent min and max average values of the 3 colony-years.
Mineau et al. 1984	-	-	-	-	2.19		N/act nest	2.16	2.25	6	Lake Huron 1979-81	lakeshore	N = 6 colony years. Min and max represent min and max average values of the 6 colony-years.
Morris & Haymes 1977	-	-	1	-	0.48	0.18 SE	N/act nest			21	Ontario, CAN 1973-74	n shore Lake Erie, grassy near shore	Hatchlings considered to have fledged at 30 days of age. Year: (1) 1973; (2) 1974. Less than half of the eggs laid hatched; many were predated or addled -- authors suggest the low hatch rate may be due in part to the effects of pesticide related contaminants.
	-	-	2	-	0.32	0.10 SE	N/act nest			37			
Morris & Haymes 1977	-	-	1	-	0.48	0.08 SE	N/act nest			62	Ontario, CAN 1974-76	n shore Lake Erie, rocky shore	Hatchlings considered to have fledged at 30 days of age. Year: (1) 1974; (2) 1975; (3) 1976. Less than half of the eggs laid hatched; many were predated or addled -- authors suggest the low hatch rate may be due in part to the effects of pesticide related contaminants.
	-	-	2	-	0.45	0.13 SE	N/act nest			38			
	-	-	3	-	0.79	0.13 SE	N/act nest			42			
Parsons 1976b	-	-	1	-	0.58	0.07 SE	N/act nest			155	Scotland 1968	Isle of May	(1) number of nests within 2.3 meters (NN) = 0; (2) NN = 1; (3) NN = 2; (4) NN = 3. Nesting success appears unusually low; reason unknown.
	-	-	2	-	0.72	0.06 SE	N/act nest			254			
	-	-	3	-	0.88	0.05 SE	N/act nest			259			
	-	-	4	-	0.52	0.08 SE	N/act nest			103			
Pierotti 1982	-	-	1	-	1.32	0.81 SD	N/act nest			59	Newfoundland, CAN	Great Island, rocky	Year: (1) 1976; (2) 1977; (3) 1978.
	-	-	2	-	1.77	0.98 SD	N/act nest			106			
	-	-	3	-	1.84	0.96 SD	N/act nest			114			
Pierotti 1982	-	-	1	-	1.58	0.81 SD	N/act nest			59	Newfoundland, CAN	grassy slope	Habitat is located on Great Island. Year: (1) 1976; (2) 1977; (3) 1978.
	-	-	2	-	1.87	1.01 SD	N/act nest			110			
	-	-	3	-	1.81	0.92 SD	N/act nest			133			

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Pierotti 1982	-	-	1	-	1.03	0.89 SD	N/act nest			91	Newfoundland, CAN	Great Island, meadow	Year: (1) 1976; (2) 1977; (3) 1978.
	-	-	2	-	1.19	1.00 SD	N/act nest			98			
	-	-	3	-	1.28	1.00 SD	N/act nest			99			
Pierotti & Annett 1987	-	-	1	-	2.14		N/act nest			167	Newfoundland, CAN 1978	Great Island	N = number of nests for gulls with dietary focus of: (1) mussels, (2) petrels, and (3) garbage.
	-	-	2	-	1.36		N/act nest			47			
	-	-	3	-	0.68		N/act nest			58			
Schoen & Morris 1984	-	-	1	-	1.57	0.97 SD	N/pair				Ontario, CAN 1981	n shore Lake Erie, insular rocks	
Schoen & Morris 1984	-	-	-	-	1.41	1.08 SD	N/pair				Ontario, CAN 1981	n shore Lake Erie, mainland	
Weseloh et al. 1990	-	-	-	-				U 95% CL	L 95% CL		Lake Erie 1978	lakeshore	Numbers in max column are lower 95% confidence limits; numbers in min column are upper 95% confidence limits. Each entry reflects a different colony on Lake Erie and adjacent waters. Values are thought to represent a return to "normal" after a period of low reproductive success in this area from early 1970's to 1976.
	-	-	-	-	1.53		N/pair	1.67	1.39				
	-	-	-	-	1.67		N/pair	2.17	1.16				
	-	-	-	-	1.74		N/pair	1.92	1.55				
	-	-	-	-	1.70		N/pair	1.82	1.59				
	-	-	-	-	1.38		N/pair	1.43	1.34				
	-	-	-	-	1.45		N/pair	1.64	1.26				

N FLEDGE/SUCCESSFUL NEST

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Burger & Shisler 1980	-	-	-	-	1.8		N/act nest	1.79	1.80		New Jersey 1976-77	coastal	Averaged over three colonies (total of 550 nests at which at least one egg hatched).

PERCENT EGGS HATCHING

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Haycock & Threlfall 1975	-	-	1	-	72.9		% hatch			273	Newfoundland, CAN 1969-71	Gull Island	Average of first through third clutches. N = number of eggs laid. Location and year: (1)The Point, 1971; (2)predation nest area, 1969. Causes of hatching failure were identified as predation, disappearance without trace, death (no embryo), death while pipping.
	-	-	2	-	62.5		% hatch			88			
Pierotti & Annett 1987	-	-	1	-	86.2		% hatch			376	Newfoundland, CAN 1977	Great Island	N = number of eggs laid by gulls with dietary focus of: (1) mussels, (2) petrels, (3) garbage, and (4) generalist feeding.
	-	-	2	-	62.9		% hatch			62			
	-	-	3	-	42.4		% hatch			158			
	-	-	4	-	81.5		% hatch			168			

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
AGE AT SEXUAL MATURITY													
Coulson et al. 1982	-	B	1	-	5.8		years	4	8	85	Scotland 1972-81	Isle of May	Age at recruitment into the breeding population, based on a study of culled banded gulls. Breeding gulls were culled from 1972-81; this resulted in a 75% reduction of the 1972 breeding density by 1981. Prior to the start of the cull, there were no records of third year birds breeding at this location. Hatch year of gulls: (1) 1969; (2) 1970; (3) 1972; (4) 1973-75.
	-	B	2	-	5.6		years	3	7	57			
	-	B	3	-	5.3		years	3	6	334			
	-	B	4	-	4.3		years	3	5	448			
Greig et al. 1983	-	B	-	-	5		years				England		Not true mean; common value.
Kadlec & Drury 1968	A	B	-	-	4		years				New England	coastal/islands	
Pierotti pers. comm.	-	M	-	-	4		years				Newfoundland, CAN	NS	
	-	F	-	-	5		years						
ANNUAL MORTALITY													
Brown 1967	A	B	-	-	10		%/year				England 1962-65	low, gravelly island (Walney Island)	Adults four years and older.
Chabrzyk & Coulson 1976	J	B	-	-	22		%/1st yr	17	33	14000	Scotland	coastal	Bird banding experiment.
	A	B	-	-	7.3		%/2nd yr			14000			
Kadlec & Drury 1968	J	B	1	-	27		%/fled-Sep				New England 1920-64	coastal/islands	Based on age-class counts from banding data and assuming 4.7% population growth per year, 80% of adults breed per year, and production of one young per year by breeding pair. Age: (1) fledging to 1st September; (2) 1st Sept. to 1st March; (3) 1st March to 2nd March; (4) 2nd March to 3rd March; (5) 3rd March to 4rth March; (6) yearly adult mortality for 4 year-olds and up.
	J	B	2	-	25		%/Sep-Mar						
	J	B	3	-	20		%/year						
	J	B	4	-	9		%/year						
	J	B	5	-	8		%/year						
	A	B	6	-	8		%/year						
Kadlec 1976	A	B	-	-	15-20		%/yr				Massachusetts 1967-74	coastal island	Overestimate of mortality rate. Authors report that the age structure of the population is inconsistent with a mortality rate as high as 15 to 20 percent.

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Kadlec & Drury 1968	E	-	1	-	9		%/3 week				New England 1963	coastal	Time period: (1) egg - from laying to 3 weeks old; (2) chick - from week of hatching to two weeks old; (3) chick - from third week after hatching to seventh week. Based on the assumption that one chick survives to fledging from each three eggs.
	C	-	2	-	51.7		%/0-2 week						
	C	-	3	-	23.8		%/3-7 week						
Kadlec et al. 1969	C	-	-	-	41.8		% to d 15			1,726	Rhode Island 1965-67	Block Island	Mortality of chicks from hatch to day 15. Based on number of chicks found dead, and number "disappeared" and presumed dead.
Olsson 1958	A	B	-	-			%/yr	20	30		United States	NS	As cited in Chabryzk & Coulson 1976; based on recovery of ringed birds. Author thinks that these are too high.

LONGEVITY

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Gross 1940	-	-	-	-			years		45	1	New Brunswick, CAN	Kent Island	Also cites records of birds reaching 26 and 30. As cited in Paynter 1949.

***** SEASONAL ACTIVITIES *****

MATING/LAYING

Reference	Begin	Peak	End	Location	Habitat	Notes
Bourget 1973	earl May	mid May	earl Jun	Maine 1969	bay	
Burger 1980a		May 5		New Jersey 1976-78	coastal	
Burger 1977, 1979b	May 4	May	Jun 18	New Jersey 1974-77	marsh islands	Across different years. Within any single year, the laying season is shorter.
Erwin 1971	late Apr	May 4-13	May 14-19	Rhode Island 1969	coastal island	
Haycock & Threlfall 1975	late Apr	mid May	late Jun	Newfoundland, CAN 1969-71	Gull Island	
Meathrel et al. 1987	May 6		May 15	Lake Superior, CAN	islands	In 1983.

Reference	Begin	Peak	End	Location	Habitat	Notes
Meathrel et al. 1987	May 11		May 25	Lake Superior, CAN	islands	In 1984.
Morris & Haymes 1977	late Apr	earl May	earl Jun	Ontario, CAN 1973-76	n shore Lake Erie	
Morris & Black 1980	21 Apr	26-27 Apr	17 May	Ontario, CAN 1978	n shore Lake Erie	Timing of initiation of clutches.
Pierotti 1982	earl May	late May	end May	Newfoundland, CAN 1977-78	Great Island	In general, first and second eggs are laid about two days apart; the third is laid one or two days after the second.
Schoen & Morris 1984		late Apr		Ontario, CAN 1981	n shore Lake Erie,	
HATCHING						
Bourget 1973	mid Jun	late Jun	mid Jul	Maine 1969	bay	
Fox et al. 1990		mid-late May		Great Lakes 1977-83	islands	
Kadlec 1971	May	Jun	Jul	Massachusetts 1964	coastal islands	
Paynter 1949	Jun 19	late Jun	Jul 14	New Brunswick, CAN 1947	Kent Island	
Pierotti 1982; 1987	earl Jun	mid June	end June	Newfoundland, CAN 1977-78	Great Island	
FALL MIGRATION						
Burger 1982	Aug		Sept	nw Atlantic populations		
Moore 1976	Nov	Dec	Mar	Great Lakes 1929-71	various	Juveniles and one-year olds only. Adults and two-year olds are year-round residents. Determined from band recoveries.
SPRING MIGRATION						
Burger 1982	Feb		late Apr	nw Atlantic populations		

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***** BELTED KINGFISHER *****

*** NORMALIZING AND CONTACT RATE FACTORS ***

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
BODY WEIGHT													
Alexander 1977	A	B	-	-	150		g			98	nc lower Michigan	lakes, streams, river	
Brooks & Davis 1987	A	B	1	SU	136	15.6 SE	g			5	nc PA 1982,	streams	State: (1) Pennsylvania; (2) Ohio. Ohio stream found to have more available food resources.
	A	B	2	SU	158	11.5 SE	g			11	sw OH 1979		
Hamas 1975	A	B	-	-	147		g	140	169		Minnesota	lake	
Poole 1938	-	M	-	-	155		g			2	NS	NS	
Powdermill Nature Center (unpubl.)	A	B	-	-	148	20.8 SD	g	125	215	29	Pennsylvania	NS	As cited in Dunning 1984.
Salyer & Lagler 1946	A	B	-	-	170		g				Michigan	rivers, lakes	Converted from ounces; females average slightly more, males slightly less.
NESTLING WEIGHT													
Hamas 1981	N	B	-	-	10-12		g at hatch				Minnesota	lake	Number of days in unit column is age of nestlings. Values for day 2 - 28 estimated from figure; fledged at 28 days.
	N	B	-	-	16		g day 2	14	18	5			
	N	B	-	-	43		g day 6	39	46	5			
	N	B	-	-	64		g day 10	50	70	5			
	N	B	-	-	136		g day 14	127	146	5			
	N	B	-	-	165		g day 18	151	173	5			
	N	B	-	-	145		g day 22	141	150	5			
	N	B	-	-	121		g day 28	120	123	5			
FLEDGING WEIGHT													
Brooks & Davis 1987	F	B	1	-	148.6	13.3 SE	g			5	nc PA 1982,	streams	Weight at fledging; N = number of nests sampled. State: (1) Pennsylvania; (2) Ohio. Ohio stream found to have more available food resources.
	F	B	2	-	169.2	11.9 SE	g			6	sw OH 1979		
Hamas 1981	F	B	-	-	121		g	120	123	5	Minnesota	lake	Lost weight after day 18 when reached 165 g.

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
FOOD INGESTION RATE													
Alexander 1977	A	B	-	-	0.50		g/g-day				nc lower Michigan	lakes, streams, river	Estimate used for calculating predation pressure exerted by kingfishers on trout and other species.
Alexander 1974	N	B	-	-	0.41		g/g-day				nc lower Michigan	river	During second week of life; as cited in Alexander 1977.
White 1936	N	B	-	-			g/g-day	1.0	1.75	2	Nova Scotia, CAN 1935	river	Two hand-reared nestlings ate 40 or more yearling suckers (100 - 200 g total) per day. Kept from time prior to the breaking of flight feathers until fledging.

***** DIET *****

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Alexander 1977	B	B	trout		80			17	n lower Michigan	stream - % wet weight; stomach contents	Season is year round.
			non-trout fish		6						
			crustacea		2						
			insects		3						
			amphibians		9						
Alexander 1977	B	B	trout		17			19	n lower Michigan	lake - % wet weight; stomach contents	Season is year round.
			non-trout fish		29						
			crustacea		5						
			insects		19						
			amphibians		27						
			birds and mammals		1						
			unidentified		2						
Alexander 1977	B	B	trout		29			62	n lower Michigan	river - % wet weight; stomach contents	Season is year round.
			non-trout fish		32						
			unidentified fish		2						
			crustacea		17						
			insects		3						
			amphibians		13						
			vegetation		1						
			unidentified		3						

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Davis 1982	J	B	crayfish		13.3			165	sw Ohio 1979	creek	Season = May through June. All prey were between 4 - 14 cm; 88% were between 6-12 cm in length. Author feels crayfish may be over-represented due to conditions of high water and high turbity during part of sampling time.
			cyprinids		76.4					-	
			(minnows)		(12.7)					% of number of prey;	
			(stonerollers)		(37.6)					brought to nestlings	
			(unidentified)		(26.1)						
			other fish		10.2						
Gould unpubl.	-	-	Pomolobus sp.		5			25	sc New York	streams, lakes	Fish species found two or fewer times not listed here; all types of insects were combined. As cited in Salyer and Lagler 1946.
			Salmo trutta fario		9					-	
			Catostomus c. commersonnii		14					number of prey;	
			Cyprinidae		12					stomach contents	
			Semotilus a. atromaculatus		15						
			Rhinichthys a. atratulus		7						
Gould upubl. (continued)			Notropis sp.		13						
			Ameiurus sp.		4						
			Beleosoma nigrum		4						
			Micopturus salmoides		5						
			Lepomis sp.		6						
			frogs		6						
			snakes		2						
			insects		10						
			crayfish		19						
Salyer & Lagler 1946	B	B	game and pan fish (mostly perch)		17.5			45	Michigan	lakes	More detailed identification and enumeration (but not % volume) of food items provided in report; season not specified but probably mostly summer.
			forage fish (minnows sticklebacks, sculpins, etc.)		49.1					-	
			other fish		2.0					% wet volume;	
			fish remains		0.9					stomach contents	
			frogs		2.3						
			crayfish		7.4						
			insects		21.0						
Salyer & Lagler 1946	B	B	game and pan fish (perch, centrachids)		10.15			22	Michigan	non-trout streams	More detailed identification and enumeration (but not % volume) of food items provided in report; season not specified but probably mostly summer.
			forage fish (minnows sticklebacks, etc.)		31.3					-	
			other fish		16.2					% wet volume;	
			fish remains		0.1					stomach contents	
			crayfish		39.6						
			insects		2.2						

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Salyer & Lagler 1946	B	B	trout		29.8			92	Michigan	trout streams - % wet volume; stomach contents	More detailed identification and enumeration (but not % volume) of food items in paper; season not specified but probably mostly summer.
			other game and pan fish (perch and centrarchids)		13.0						
			forage fish (minnow, sticklebacks, etc.)		15.0						
			fish remains		0.9						
			crayfish		40.7						
			insects		0.6						
White 1936	B	B	salmon (1 year)		7			15	Nova Scotia, CAN 1935	river - % of number of prey; stomach contents	
			salmon (fry)		58						
			trout		4						
			stickleback		27						
			suckers		4						
White 1936	B	B	salmon fry		11			170	Nova Scotia, CAN 1935	riparian - % of number of prey; pellets	
			salmon (1 year)		42						
			salmon (2 years)		1						
			trout		15						
			sticklebacks		30						
			killifish		<1						
			suckers		<1						
White 1938	N	B	salmon (1 year old)		26			33	Nova Scotia, CAN 1937	river - number of prey; stomach contents	Nestlings between 12 days and 4 weeks old; collected in June and July. Not fed sticklebacks, which were common in the diet of the adults.
			salmon (2 year old)		7						
			trout		6						
White 1938	A	B	salmon		450			115	Nova Scotia, CAN 1937	river - number of prey; pellets and stomach contents	53 disgorged stomach pellets and 62 stomachs collected from May - Sept. The ratio of trout to salmon increased as water levels increased.
			trout		214						
			sticklebacks		19						
			water shrew		1						
White 1953	B	B	smelt		13			15	Prince Edward Island,CAN 1948	trout streams - number of prey; pellets	
			trout		1						
			killifish		2						
			sticklebacks		18						
White 1953	B	B	salmon		8			61	Maritime Provinces, CAN	streams - number of prey; pellets	Year = 1948; provinces include New Brunswick, Nova Scotia, and Prince Edward Island, Canada.
			trout		54						
			suckers		5						
			sculpins		101						
			minnows		29						
			sticklebacks		90						

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
White 1953	B	B	salmon		10			44	Maritime Provinces, CAN	Moser River - number of prey; pellets	Years = 1940-42.
			trout		4						
			suckers		8						
			killifish		24						
			minnows		23						
			sticklebacks		10						
			eels		6						
White 1953	B	B	salmon		20.1			81	Maritime Provinces, CAN	small salmon streams - % of number of prey; pellets	Years = 1948.
			trout		6.0						
			suckers		9.7						
			minnows		40.4						
			sticklebacks		12.7						
			other fish		9.7						
			insects		1.3						
White 1953	B	B	salmon		24			29	Maritime Provinces, CAN	large salmon rivers - % of number of prey; pellets	Years = 1946, 1948.
			trout		7						
			suckers		20						
			minnows		24						
			sticklebacks		8						
			insects		4						
White 1953	B	B	alewife		47			36	Nova Scotia, CAN 1948	Gasperau Lake - number of prey; pellets	
			9-spine stickleback		139						
			killifish		33						
			white perch		19						
			yellow perch		50						
White 1953	B	B	9-spine stickleback		94			36	c Nova Scotia, CAN 1948	ponds and lakes - number of prey; pellets	
			killifish		4						
			white perch		2						
			yellow perch		6						
			dragonfly nymphs		2						
White 1953	B	B	sticklebacks		32			46	Nova Scotia, CAN 1948	Northumberland Str. - number of prey; pellets	Location also includes Prince Edward Island.
			killifish		74						
			other fish		12						
White 1953	B	B	sticklebacks		81			27	New Brunswick, CAN 1948	Northumberland Str. - number of prey; pellets	
			killifish		26						
			other fish		26						

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
White 1953	B	B	sticklebacks killifish other fish		97 48 3			33	New Brunswick, CAN 1948	estuary - number of prey; pellets	

***** POPULATION DYNAMICS *****

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
TERRITORY SIZE													
Brooks & Davis 1987	A A	B B	1 2	SU SU	2.185 1.028	0.561 SE 0.280 SE	km km			8 8	nc PA 1982, sw OH 1979	streams	State: (1) Pennsylvania; (2) Ohio. Ohio stream found to have more available food resources. Breeding territory sizes measured by "herding" adults to the ends of their territorial boundaries.
Cornwell 1963	A	B	BR	SU	1.6		km	0.8	8.0		Minnesota 1958	lake, forest	Foraging radius; most flights were within 1.6 km but flights of 3.2 km were not uncommon.
Davis 1980	A B	B B	BR NB	SP FA	1.03 0.39	0.22 SE 0.093 SE	km km			6 21	sw Ohio 1979	stream	Length of breeding territories (occupied by pairs) and non breeding territories (occupied by individuals in the late summer and fall).
Salyer & Lagler 1946	A	B	BR	SU	0.80		km		2.4		Michigan 1931	lakes	Breeding territory of pairs along lake shore.
Salyer & Lagler 1946	A	B	BR	SU	2.4-4.8		km				Michigan 1931	rivers	Larger than along lakes because of limitation in feeding areas (faster, deeper water).
Salyer & Lagler 1946	A	B	BR	SU	14.2		ha			1	Michigan 1931	ponds and marsh	
POPULATION DENSITY													
Brooks & Davis 1987	A A	B B	1 2	SU SU	0.11 0.19		pairs/km pairs/km			45.8 16.1	nc Pennsylvania 1982	streams	Density of breeding pairs; (1) Sandy Lick Creek, (2) Bennett Branch. N = km of stream sampled.

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Brooks & Davis 1987	A	B	BR	SU	0.54		pairs/km			16.8	sw Ohio 1979	stream	Density of breeding pairs; the Ohio stream was found to have more available food than the Pennsylvania streams above. N = km of stream sampled.
Cornwell 1963	A	B	BR	SU	0.0022		pairs/ha			14	Minnesota 1958	lake, forest	6,475 ha censused.
White 1936	A	B	BR	SU	0.6		pairs/km			30	Nova Scotia, CAN 1935	streams	50 km surveyed.
White 1953	B	B	-	SU			N/km		6		Maritime Provinces, CAN	stream valleys	Population of young and adults in agricultural district often reaches this density.
CLUTCH SIZE													
Brooks & Davis 1987	- -	- -	1 2	- -	5.8 6.8	0.7 SE 0.4 SE				8 6	nc PA 1982, sw OH 1979	streams	State: (1) Pennsylvania; (2) Ohio. Ohio stream found to have more available food resources.
Hamas 1975	-	-	-	-	6.58			5	7		Minnesota	lake	
White 1953	-	-	-	-	7			5	7		Maritime Provinces, CAN	streams	Seven is the "usual" number of eggs laid.
CLUTCHES/YEAR													
Bent 1940	-	-	-	-	1		/yr				NS	NS	Known to renest up to three times if clutch is lost.
Brooks & Davis 1987	-	-	-	-	1		/yr				nc PA 1982, OH 1979	streams	May renest if clutch lost early in breeding season.
Hamas 1975	-	-	-	-	1		/yr				Minnesota	lake	Will renest if nest is destroyed.
DAYS INCUBATION													
Hamas 1975	-	-	-	-	22		days				Minnesota	lake	
AGE AT FLEDGING													
Bent 1940	-	-	-	-	28		days				NS	NS	
Hamas 1975, 1981	-	-	-	-	28		days	27	29		Minnesota	lake	

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
N FLEDGE/ACTIVE NEST													
Brooks & Davis 1987	-	-	1	-	4.5	1.9 SE	N/act nest			8	nc PA 1982,	streams	State: (1) Pennsylvania; (2) Ohio. Ohio stream found to have more available food resources.
	-	-	2	-	5.3	2.2 SE	N/act nest			6	sw OH 1979		
AGE AT SEXUAL MATURITY													
Bent 1940	-	B	-	-	1		year				throughout range		

***** SEASONAL ACTIVITIES *****

Reference	Begin	Peak	End	Location	Habitat	Notes
MATING/LAYING SEASON						
Hamas 1975	Apr	Apr-May	earl Jul	Minnesota	lake	
HATCHING						
Hamas 1975	May	June	late Jul	Minnesota	lake	
White 1936		earl Jun		Nova Scotia, CAN 1935	river	
FLEDGING						
White 1936			late Jul	Nova Scotia, CAN 1935	river	
FALL/BASIC MOLT						
Bent 1940	Aug		Oct	NS	NS	Complete molt.
Hamas unpubl.	June	July	Aug	Minnesota	lake	Personal communication.
SPRING/ALTERNATE MOLT						
Bent 1940	Feb		Apr	NS	NS	First complete molt for young birds.

Reference	Begin	Peak	End	Location	Habitat	Notes
FALL MIGRATION						
Bent 1940			mid Oct	Maine	NS	Departures.
Bent 1940			late Oct	Alberta, CAN, MT, ND	NS	Departures.
Bent 1940			mid Nov	SD, NE, WI, NY	NS	Departures.
Bent 1940			late Nov	Kansas	NS	Departures; sometimes overwinters.
Bent 1940			mid Dec	Mass., New Jersey	NS	Departures.
Bent 1940			late Dec	Connecticut	NS	Departures.
Salyer & Lagler 1946	Sept	Oct	Nov	Michigan	several	
White 1953		mid Sep	late Oct	Maritime Provinces, CAN	streams	
SPRING MIGRATION						
Bent 1940	late Feb			PA, RI, MO	NS	Beginning of arrivals.
Bent 1940	earl Mar			s MI, IA, Ontario, CAN	NS	Beginning of arrivals.
Bent 1940	mid Mar			NY, CT, IL, WI	NS	Beginning of arrivals.
Bent 1940	late Mar			VT, NH, MT	NS	Beginning of arrivals.
Bent 1940	earl Apr			Maine, Nova Scotia, CAN	NS	Beginning of arrivals.
Bent 1940	mid Apr			Quebec, CAN	NS	Beginning of arrivals.
Bent 1940	late Apr			Alberta, CAN	NS	Beginning of arrivals.
Hamas 1975	Mar	Apr	May	Minnesota	lake	
White 1953	earl Apr	late Apr		Maritime Provinces, CAN	streams	
White 1938	late Apr		earl May	Nova Scotia, CAN 1937	river	

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***** MARSH WREN *****

*** NORMALIZING AND CONTACT RATE FACTORS ***

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
BODY WEIGHT													
Kale 1965	A	M	-	-	10.61	0.7 SD	g			52	e Georgia 1958-61	salt marsh	Resident population only.
	A	F	-	-	9.41	1.1 SD	g			25			
	J	B	-	-	9.44	1.6 SD	g			56			
Kale 1965	A	M	-	WI	10.0	0.5 SD	g	9.4	10.7	7	Georgia 1962-63	captive	Average of mean weights of the same captive adults in winter (September to March) and spring (March to September). Field collections also followed this trend.
	A	M	-	SP	10.9	1.0 SD	g	9.8	11.9	7			
	A	F	-	WI	8.8	0.4 SD	g	8.4	9.2	3			
	A	F	-	SP	9.2	0.3 SD	g	9.0	9.6	3			
Tintle (unpubl)	A	F	BR	-	10.6	0.99 SD	g	9.0	13.5	38	New York	NS	As cited in Dunning 1984.
	A	M	BR	-	11.9	0.72 SD	g	10.5	13.5	38			
BODY FAT													
Kale 1965 (griseus)	A	M	-	-	1.03	0.23 SD	g			35	e Georgia 1962-63	salt marsh	Estimated percent of total body weight: adult males = 10%; adult females and immatures = 11%. Author notes that this subspecies is non-migratory and does not tend to accumulate large amounts of fat.
	A	F	-	-	1.04	0.26 SD	g			18			
	J	B	-	-	1.04	0.21 SD	g			34			
EGG WEIGHT													
Kale 1965	E	-	-	-	1.14	0.10 SD	g			127	e Georgia 1958-61	salt marsh	
Welter 1935	E	-	-	-	1.48		g	1.41	1.56		New York 1931	freshwater marsh	Eggs weighed from two complete clutches.
NESTLING WEIGHT													
Welter 1935	N	B	-	-	1.1		g day 1				New York, Minn. 1931	fresh marshes	Estimated from growth curve determined from weights of 50 nestlings. Day in unit column is age of nestling.
	N	B	-	-	2.1		g day 3						
	N	B	-	-	4.7		g day 5						
	N	B	-	-	6.8		g day 7						
	N	B	-	-	10.0		g day 9						
	N	B	-	-	10.6		g day 11						
	N	B	-	-	11.3		g day 13						

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
FLEDGING WEIGHT													
Kale 1965	F	B	-	-	8.84	0.70 SD	g			5	Georgia 1958-61	salt marsh	
Leonard & Picman 1988	F	B	1	-	9.5	0.5 SD	g day 8			8	Manitoba, CAN 1983-85	brackish marsh	(1) Fed by males and females; (2) fed by females only. Nestling weight at 8 days; fledging can occur as early as 11 days.
	F	B	2	-	8.1	1.3 SD	g day 8			29			
LEAN (DRY) BODY WEIGHT													
Kale 1965	A	M	-	-	2.60	0.2 SD	g			35	e Georgia 1962-63	salt marsh	Estimate of percent of total body weight: adult males = 25%; adult females = 24%; and juveniles = 23%.
	A	F	-	-	2.22	0.3 SD	g			18			
	J	B	-	-	2.20	0.3 SD	g			34			
METABOLIC RATE (OXYGEN)													
Kale 1965	A	B	BA	-	91.2		lO2/kg-d			7	Georgia 1962-63	lab	(BA) basal; (NB) near basal; and (AC) light activity metabolism. Calculated by oxygen respirometry.
	A	B	NB	-	112.8		lO2/kg-d			30			
	A	B	AC	-	169		lO2/kg-d			28			
METABOLIC RATE (KCAL BASIS)													
Kale 1965	A	B	FL	-	880	90 SD	kcal/kg-d			10	Georgia 1962-63	lab	"Free-living": Determined by measuring daily food intake, excretory losses, assimilation, and respiration for active birds in small cages (173 weekly determinations total). Daily intake = 1,155 kcal/kg-d and excretory losses = 270 kcal/kg-day.
Kale 1965	A	B	BA	-	444		kcal/kg-d			7	Georgia 1962-63	lab	(BA) basal; (NB) near basal; (AC) and light activity. Estimated from oxygen respirometry values.
	A	B	NB	-	557		kcal/kg-d			30			
	A	B	AC	-	788		kcal/kg-d			28			

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
FOOD INGESTION RATE													
Kale 1965	A	B	FL	-	1,155	130 SD	kcal/kg-d			10	Georgia 1962-63	captive	Measured food ingestion in the lab and caloric value of food; diet was live mealworms and a moist mixture of liver, fish, game bird food and Pablum. "Free-living"; see metabolic rate record for FL.
this study	A	B	FL	-	0.67		g/g-day				Georgia 1962-63	captive	"Free-living"; estimated from "free-living" caloric intake rate measured by Kale 1965 (1,155 kcal/kg-d). Assumed 5.62 kcal/gram insect diet (dry wt), a diet assimilation efficiency of 70%, and a 67% water content of insects.
this study	A	F	FL	-	0.99		g/g-day				NS	NS	Free-living; estimated from free-living metabolic rate estimate using Nagy (1987) allometric equation, which predicts 1,209 and 1,174 kcal/kg-day for a 9.4 g female and a 10.6 g male marsh wren, respectively. Assumed 5.26 kcal/gram insect (dry wt), assimilation efficiency of 70%, and a 67% water content for insects.
	A	M	FL	-	0.96		g/g-day						
THERMONEUTRAL ZONE													
Kale 1965	A	-	-	-			degrees C	23	35		Georgia 1962-63	lab	Calculated using an oxygen respirometer.

***** DIET *****

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Kale 1965	B	B	Hymenoptera		17.3		12.4	195	e Georgia 1958-61	salt marsh - % wet volume; stomach contents	Summer column = breeding season (April - August) and winter column = non-breeding season (September - March). Fulgoridae = Prokelisia marginata; Hemiptera = Ischnodemus badius; Orthoptera = Orchelimum fidicinum. Families with less than 2% in both season not reported here. Combination of fall and winter data.
			(Formicidae)		(10.2)		(7.4)				
			(Braconidae)		(3.7)		(1.2)				
			Homoptera		13.0		40.1				
			(Fulgoridae)		(11.9)		(39.8)				
			Coleoptera		11.6		12.6				
			(Curculionidae)		(3.6)		(8.2)				
			(Cleridae)		(3.5)		(8.9)				
			Lepidoptera		14.6		2.9				
(continued)			(larvae and eggs)		(10.4)		(2.9)				

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Kale 1965 (continued)			Diptera		8.9		7.7				
			(Ephydridae)		(2.8)		(4.8)				
			Hemiptera		5.4		10.0				
			Orthoptera		5.6		0.8				
			spiders		15.1		6.2				
			other arthropods (crabs, amphipods)		1.8		0.9				
			molluscs (Littorina irrorata)		3.5		4.0				
			undetermined		4.5		3.3				

***** POPULATION DYNAMICS *****

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
TERRITORY SIZE													
Kale 1965	A	M	1	SP	0.0060	0.0014 SD	ha			11	Georgia 1958-59	salt marsh	Study illustrates differences in territory size between nearby marshes and at the same marsh in different years: (1) marsh #1 - 1958; (2) marsh #2 - 1958; (3) marsh #2 - 1959; (4) marsh #4 - 1960; (5) marsh #4 - 1961.
	A	M	2	SP	0.0156	0.0050 SD	ha			12			
	A	M	3	SP	0.0085	0.0042 SD	ha			22			
	A	M	4	SP	0.0088	0.0047 SD	ha			13			
	A	M	5	SP	0.0113	0.0058 SD	ha			11			
Leonard & Picman 1986	A	M	BR	SP	0.07	0.06 SD	ha			13	Manitoba, CAN 1984	homogenous cattail marsh	Male breeding territory sizes on control (undisturbed) marsh. Spring = May 22 to June 5. Summer = June 19 to July 3.
	A	M	BR	SU	0.09	0.05 SD	ha			13			
Verner 1965	A	M	1	SP	0.169	0.021 SE	ha	0.0242	0.360	26	w Washington 1961-62	shallow mixed marsh	Seattle study site: (1) Red Marsh; (2) Blue Marsh; (3) Yellow Marsh. All three areas were extensive freshwater marshes (maximum depth 12 to 18 inches) with mixed stands of cattail and bulrush scattered throughout.
	A	M	2	SP	0.126	0.002 SE	ha	0.0688	0.220	27			
	A	M	3	SP	0.137	0.003 SE	ha	0.0419	0.240	29			
Verner & Engelson 1970	A	M	0	-	0.0516	0.0183 SE	ha			13	e Washington 1967	pond-margin marsh	Territory of males: (0) bachelors (no females); (1) monogamous; (2) bigamous. Turnbull study sites. Narrow freshwater pond-margin marshes consisted of strips of cattails and bulrushes.
	A	M	1	-	0.0642	0.0090 SE	ha			47			
	A	M	2	-	0.0685	0.0169 SE	ha			20			

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Verner 1964	A A A	M M M	0 1 2	- - -	0.099 0.154 0.222		ha ha ha	0.024 0.049 0.117	0.260 0.318 0.360	23 32 12	w Washington 1961-62	shallow mixed marsh	Territory of males: (0) bachelors (no females) males; (1) monogamous; (2) bigamous. Average of means for the three Seattle sites. pairs per year.
POPULATION DENSITY													
Kale 1965	A	B	BR	SP	48.3	5.3 SD	pairs/ha	45.1	56.2	4	e Georgia 1958-61	salt marsh	Density of pairs in potential available nesting habitat defined as narrow strips of tall Spartina bodering tidal ditches (= 10.1 ha of 882 ha marsh area). Almost all males in poulation were monogamous. N = number of years; min and max are yearly means; density measures associated with between 450 & 570
Leonard & Picman 1987	A	M	-	SP	2.6	0.9 SD	N/ha	1.8	3.6	3	Manitoba, CAN 1983-85	homogeneous cattail marsh	Density in suitable breeding habitat; N = number of years. Mating status of males; 11% = bachelors; 48% = monogamous; 37% = bigamous; and 3% = trigamous. Female density is difficult to determine because males may be associated with different numbers of them at various times during the breeding season.
Leonard & Picman 1987	A	M	-	SP	3.7	0.5 SD	N/ha	3.4	4.3	3	Manitoba, CAN 1983-85	cattail, bulrush and phragmites marsh	Density in suitable breeding habitat; N = number of years. Mating status of males; 5% = bachelors; 41% = monogamous; 43% = bigamous; and 12% = trigamous. Female density is difficult to determine because males may be associated with different numbers of them at various times during the breeding season.
Verner 1965	A A	B B	1 2	SP SP	8.5 16.9		N/ha N/ha				w Washington 1961-62	shallow mixed marsh	Seattle study site(s): (1) Red and Blue Marshes 1961 - 4.0 ha (19 males, 15 females); (2) Yellow Marsh 1962 - 1.3 ha (10 males, 12 females).

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
CLUTCH SIZE													
Kale 1965	-	-	-	-	4.5			3	5	192	e Georgia 1958-61	salt marsh	Completed clutches.
Leonard & Picman 1987	-	-	-	-	5.8	0.8 SE				79	Manitoba, CAN 1983-84	homogenous cattail marsh	
Leonard & Picman 1987	-	-	-	-	5.6	0.8 SE				96	Manitoba, CAN 1983-84	cattail, bulrush, and phragmites marsh	
Verner 1965	-	-	1	-	5.2	0.11 SD		4	6	32	w Washington 1961-62	shallow mixed marsh	Seattle sites. Year: (1) 1961; (2) 1962.
	-	-	2	-	4.4	0.14 SD		3	6	22			
Verner 1965	-	-	-	-	6.0	0.19 SD		4	8	25	e Washington 1962	pond-margin marsh	Turnbull sites.
Welter 1935	-	-	-	-	5			3	6	40	New York, Minn. 1931	fresh marsh	5 = "most frequent" number of eggs.
CLUTCHES/YEAR													
Kale 1965	-	-	-	-	1-2		broods/yr	0	3		e Georgia 1958-61	salt marsh	Broods raised per year.
Verner 1965	-	-	1	-	2-3		broods/yr	0	3		Washington 1961-62	fresh marshes	Number of broods raised per season at the: (1) Seattle study areas (western WA), and; (2) the Turnbull study areas (eastern WA).
	-	-	2	-	2		broods/yr	0	2				
Welter 1935	-	-	-	-	2		broods/yr				New York, Minn. 1931	fresh marsh	Broods per year.
DAYS INCUBATION													
Kale 1965	-	-	-	-	13.1		days	12	14	35	e Georgia 1958-59	salt marsh	Days from last egg laid to last egg hatched.
Verner 1965	-	-	-	-	15.1		days	13	16		w Washington 1961-62	shallow mixed marsh	Minimum in July; maximum in April.
Welter 1935	-	-	-	-	13		days				New York, Minn. 1931	fresh marsh	

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
AGE AT FLEDGING													
Kale 1965	-	B	-	-	12-13		days	10-11	13-15		e Georgia 1958-61	salt marsh	
Verner 1965	-	B	-	-	14		days	11-12	15-16		Washington 1961-62	fresh marshes	From age of oldest nestlings.
N FLEDGE/ACTIVE NEST													
Kale 1965	-	-	-	-	1.9	1.2 SD	N/pair	0.55	3.50	217	e Georgia 1958-61	salt marsh	Males in this population are almost all monogamous; includes both first and second broods. Minimum and maximum are yearly means. Sample size = number of fledglings.
Leonard & Picman 1987	-	-	-	-	2.3	2.6 SD	N/act nest			81	Manitoba, CAN 1983-84	homogeneous cattail marsh	
Leonard & Picman 1987	-	-	-	-	3.4	3.4 SD	N/act nest			95	Manitoba, CAN 1983-84	cattail, bulrush, and phragmites marsh	This site had denser vegetation and deeper water than the one above; this was thought to reduce losses due to predation.
N FLEDGE/SUCCESSFUL NEST													
Leonard & Picman 1987	-	-	-	-	5.1	1.2 SD	N/suc nest			37	Manitoba, CAN 1983-84	homogeneous cattail marsh	
Leonard & Picman 1988	- -	- -	1 2	- -	5.4 4.4	0.7 SD 1.8 SD	N/suc nest N/suc nest			10 45	Manitoba, CAN 1983-85	fresh marsh	Success with (1) both adults feeding nestlings; (2) female only feeding nestlings.
Leonard & Picman 1987	-	-	-	-	4.5	1.3 SD	N/suc nest			71	Manitoba, CAN 1983-84	cattail, bulrush, and phragmites marsh	
PERCENT NESTS SUCCESSFUL													
Kale 1965	-	-	-	-	21	15 SD	% eggs suc	7	42	1,111	e Georgia 1958-61	salt marsh	Percent of eggs laid that fledged young; N = number of eggs laid.
Leonard & Picman 1987	-	-	-	-	60		% nests su			176	Manitoba, CAN 1983-85	fresh marshes	Percent fledging at least one young.

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
AGE AT SEXUAL MATURITY													
Leonard & Picman 1987	-	B	-	-	1		year				Manitoba, CAN 1983-85	fresh marsh	
Verner 1971	-	B	-	-	1		year				Washington 1967-68	fresh marsh	
ANNUAL MORTALITY													
Kale 1965	N	B	-	-	79		% lost/yr			785	Georgia 1958-61	salt marsh	Percent eggs and young lost prior to fledging from all causes.
Kale 1965	A J	B B			32 70		%/yr %/yr				e Georgia 1958-61	salt marsh	Estimated by author from knowledge of this non-migratory population and review of other studies. Juvenile = from fledging to next breeding season.
Verner 1971 (platensis)	A J	B B	- -	- -	81.6 87.9		%/yr %/yr			173 91	w Washington 1967-68	fresh marsh	Nestlings and adults banded and censused at the start of the next season. Thought to be too high to maintain population; possible reasons for calculation of estimate to have come out so high are discussed in paper.

*** SEASONAL ACTIVITIES ***

Reference	Begin	Peak	End	Location	Habitat	Notes
MATING/LAYING						
Kale 1965	Apr		mid Aug	e Georgia 1958-61	salt marsh	Breeding starts when daily mean temperatures exceed 15 C. Includes first and second broods and renesting attempts (replacing lost nests).
Verner 1965	late Mar	Apr - May	mid Jul	w Washington 1961-62	shallow mixed marsh	Seattle sites; up to three broods raised per season.
Verner 1965	mid Apr	May - Jun	earl Jul	e Washington 1962	pond-margin marsh	Turnbull sites; up to two broods raised per season.
Welter 1935	late May	earl June		New York 1931	fresh marsh	First brood.
Welter 1935	late Jul		earl Aug	New York 1931	fresh marsh	Second brood.

Reference	Begin	Peak	End	Location	Habitat	Notes
HATCHING						
Verner 1965	mid Apr		earl Aug	w Washington 1961-62	shallow mixed marsh	Seattle sites; up to three broods raised per season.
Verner 1965	earl May		mid Jul	e Washington 1962	pond-margin marsh	Turnbull sites; up to two broods raised per season.
FLEDGING						
Verner 1965	mid May	Jun - Jul	late Aug	w Washington 1961-62	shallow mixed marsh	Seattle sites; up to three broods raised per season.
Verner 1965	earl Jun	Jun - Jul	earl Aug	e Washington 1962	pond-margin marsh	Turnbull sites; up to two broods raised per season.
FALL/BASIC MOLT						
Welter 1935	earl Sep		Oct	New York, Minn. 1931	fresh marsh	Adults molt the earliest, followed by juveniles from the first brood, and then juveniles from the second brood.
FALL MIGRATION						
Welter 1935	Sept		late Oct	New York, Minn. 1931	fresh marsh	Departure from breeding grounds. Most adults are gone by mid September; juveniles leave later.
SPRING MIGRATION						
Verner 1965		mid Mar		e Washington 1961-62	pond-margin marsh	Turnbull sites; Seattle sites had non-migratory populations.
Welter 1935	Apr	May 10	June	New York, Minn. 1931	fresh marsh	Arrival of males; males tend to arrive before females.
Welter 1935	Apr	May 20-28	June	New York, Minn. 1931	fresh marsh	Arrival of females.

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*** NORMALIZING AND CONTACT RATE FACTORS ***

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
BODY WEIGHT													
Clench & Leberman 1978	A	B	-	-	77.3	0.36 SE	g	63.5	103	401	Pennsylvania	NS	As cited in Dunning 1984 (collected in all seasons).
Hazelton et al. 1984	-	-	-	SU	55		g			6	Kansas 1981	NS	Age of birds not specified.
Howell 1942	A	B	-	-	80.8		g				sc New York 1937-38	forest	
Jung 1992	A	M	-	SU	77.2	4.0 SD	g	72.0	84.5	9	Wisconsin 1990	NS	Collected in late June through July. For 2 of the 7 adult females, weight at release rather than capture was used to determine the mean - for one it was unavailable, and for a second the value appeared to be a misprint (35.9 g).
	A	F	-	SU	79.5	7.4 SD	g	70.0	93.0	7			
	J	B	-	SU	74.6	3.8 SD	g	70.0	84.0	19			
Levey & Karasov 1989	-	-	-	SU	78.4	3.6 SD	g			10	Wisconsin	NS	
Morrison & Caccamise 1990	A	B	-	FA			g	73	84	9	c New Jersey 1987	garden	Weight of post-breeding robins captured in June - November for radiotagging study.
Skorupa & Hothem 1985	B	B	-	FA	82.3		g			45	California 1982	vineyards	Collected in August and September.
Wheelwright 1986	A	M	NB	-	86.2	6.1 SD	g			26	New York	woodlands	NB = during the non-breeding season; BR = during the breeding season.
	A	F	NB	-	83.6	6.4 SD	g			18			
	A	M	BR	-	77.4		g			21			
	A	F	BR	-	80.6		g			6			
NESTLING WEIGHT													
Howell 1942	N	B	-	-	5.5		g day 0	4.1	6.7	13	sc New York 1937-38	forest	Day in units column is age of nestling; day 0 is hatch day. Most fledge by 13-14 days. Juveniles reach adult weight at about six weeks of age.
	N	B	-	-	12.6		g day 2	8.4	17.5	25			
	N	B	-	-	24.3		g day 4	17.9	32.3	23			
	N	B	-	-	39.4		g day 6	32.5	45.9	23			
	N	B	-	-	50.9		g day 8	42.0	59.3	21			
	N	B	-	-	55.2		g day 10	49.0	63.2	19			
	N	B	-	-	55.0		g day 14	51.8	58.2	7			

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
EGG WEIGHT													
Howell 1942	E	-	-	-	6.26		g	4.6	8.4	60	sc New York 1937-38	forest	
Knupp et al. 1977	E	-	-	-	6.29		g			18	n Maine 1971	forest	
METABOLIC RATE (KCAL BASIS)													
Hazelton et al. 1984	-	B	EX	-	344		kcal/kg-d				Kansas 1981	captive	(EX) Existence energy requirement based on Kendeigh's (1969) equation with robin weight of 55 g. Age not specified.
FOOD INGESTION RATE													
Hazelton et al. 1984	-	B	-	-	1.52	0.25 SD	g/g-day	1.22	1.96	6	Kansas 1981	captive	Fruit consumption during two day feeding trials. Average of means determined in tests of various pairings of fruits (strawberries, pitted cherries, green grapes, purple grapes); 12 trials conducted on each pairing. Mean weight of robins = 55 g, mean temperature during trials = 26 C. Water was provided ad libitum.
	-	B	-	-	1,070	220 SD	kcal/kg-d	760	1,330	6			
Skorupa & Hothem 1985	B	B	1	FA	0.75	0.62 SD	g/g-day			45	California 1982	vineyards	Season = Aug. and Sept.; (1) consumption of grapes only; determined from assumption that gizzard samples contain 2 hours worth of foraging effort and foraging is possible 13 hours/day. Grapes comprised a mean of 85 aggregate % wet weight of food. (2) For this study an estimate of total food consumed was calculated from the grape only value. The aggregate % of the rest of the diet was 11.5 % animal and 4.5 % other plants. Mean weight of birds = 82.3 g.
	B	B	2	FA	0.89	0.73 SD	g/g-day			45			
SURFACE AREA													
Walsberg & King 1978	A	B	-	-	198.0		cm2				NS	NS	Beak surface area 3.1 cm2; leg surface area 14.0 cm2.

***** DIET *****

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Hamilton 1943	B	B	plants	81.5				200	c New York 1942	lawns, hedges - frequency of occurrence; fecal analyses	Droppings collected from May 1 to June 12.
			(barberry)	(61.0)							
			(sumac)	(29.0							
			(coral berry)	(4.5)							
			animals	93.5							
			(beetles)	(82.5)							
			(millipedes)	(38.5)							
			(ants)	(27.0)							
			(cutworms)	(9.5)							
			(sowbugs)	(6.5)							
			(wireworms)	(4.0)							
			(flies)	(3.0)							
			(cockroaches)	(1.5)							
Hamilton 1940	B	B	plants		73.14			700	c New York 1939	yard, hedgerow - frequency of occurrence; fecal analyses	Droppings collected from June 24-August 11. Lepidoptera found were chiefly cutworm larvae. Items found in less than 2% of the samples not included here.
			(choke cherry)		(58.29)						
			(blackberry)		(40.09)						
			(raspberry)		(21.10)						
			(pin cherry)		(17.00)						
			(rum cherry)		(11.71)						
			(Lonicera sp.)		(8.28)						
			(blue nightshade)		(5.86)						
			(shadberry)		(2.43)						
			Arthropoda		78.86						
			(Arachnida)		(3.43)						
			(Orthoptera)		(5.57)						
			(Coleoptera)		(11.30)						
			(Lepidoptera)		(6.86)						
			(Hymenoptera)		(38.43)						
			Mollusca		3.28						
			(Cochlicopidae)		(2.57)						
Howell 1942	J	B	earthworms		15.0			15	sc New York 1937	forest - % wet weight; stomach contents	Age of robins ranged from 3 - 35 days; collected from May 12 to July 10, 1937. Suggests that the presence of grass is accidental; it is carried along with prey. Items comprising less than 1% not included here.
			sowbugs		1.7						
			spiders		2.3						
			millipedes		3.1						
			short-horned grass-hoppers		4.9						
			beetles		11.6+						
			lepidopteran larvae		24.7						
			ants		3.2						
			unident. animal		5.2						
			grass (blades, stem, roots)		19.5						
			mulberries		3.2						
			honeysuckle family seeds		2.4						
			unident. plants		4.2						

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Martin et al. 1951	B	B	plant food	21	60	81	64		United States	NS - rough estimate of percent diet; stomach contents and observations	See records below for details regarding plant component of diet.
			animal food	79	40	19	36				
			(sample size)	(316)	(514)	(151)	(442)				
Martin et al. 1951	B	B	cherry (cult. and wild) - SuF		10-25			770	northeast US	NS - rough estimate of percent diet; stomach contents and observations	Plant foods only. All seasons together, but abbreviation following plant name notes what season that plant is important. Samples from: winter = 77; spring = 199; summer = 327; fall = 167. Species comprising less than 2% not included here.
			dogwood - FW		5-10						
			sumac - WSp		5-10						
			blackgum - FW		5-10						
			grape (cult. and wild) - SuFW		2-5						
			redcedar - FWSp		2-5						
			Virginia creeper - FWSp		2-5						
			blackberry - Su		2-5						
Martin et al. 1951	B	B	chinaberry - WSp		5-10			263	se US excluding FL	NS - rough estimate of percent diet; stomach contents and observations	Plant foods only. All seasons together, but abbreviation following plant name notes what season that plant is important. Samples from: winter = 215; spring = 29; summer = 17; fall = 2. Species comprising less than 2% not included here.
			blackberry - Su		5-10						
			hackberry - WSp		2-5						
			greenbrier - W		2-5						
			holly - W		2-5						
			cherry (cult. and wild) - Su		2-5						
			persimmon - W		2-5						
			grape - FW		2-5						
			corn - Sp		2-5						
Martin et al. 1951	B	B	holly				10-25	32	Florida	NS - rough estimate of percent diet; stomach contents and observations	Plant foods only - winter. Species comprising less than 2% not included here.
			palmetto				10-25				
			blackgum				10-25				
			chinaberry				5-10				
			beautyberry				5-10				
			greenbrier				2-5				
Martin et al. 1951	B	B	hackberry - WSp		10-25			130	central US	NS - rough estimate of percent diet; stomach contents and observations	Plant foods only. All seasons together, but abbreviation following plant name notes what season that plant is important. Samples from: winter = 39; spring = 29; summer = 52; fall = 10. Species comprising less than 2% not included here.
			grape (cult. and wild) - SuF		10-25						
			cherry (cult. and wild) - Su		5-10						
			Russianolive - Su		2-5						
			sumac - WSp		2-5						

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Martin et al. 1951	B	B	cedar - FW hackberry - F Russianolive - W sumac - W currant - Su serviceberry - Su		10-25 5-10 5-10 2-5 2-5 2-5			113	w US (excl. Pacific)	NS - rough estimate of percent diet; stomach contents and observations	Plant foods only. All seasons together, but abbreviation following plant name notes what season that plant is important. Samples from: winter = 5; spring = 50; summer = 53; fall = 5. Location is western US, not including California, western Oregon, or western Washington. Species comprising less than 2% not included here.
Martin et al. 1951	B	B	peppertree (CA) -WSp grape (cult.) - FW prune - FW cherry (cult. and wild) - SuF raspberry - Su apple - W		10-25 10-25 5-10 5-10 2-5 2-5			114	CA, w OR, w WA	NS - rough estimate of percent diet; stomach contents and observations	Plant foods only. All seasons together, but abbreviation following plant name notes what season that plant is important. Samples from: winter = 41; spring = 41; summer = 13; fall = 19. Species comprising less than 2% not included here.
Skorupa & Hothem 1985	B	B	grapes animal other plants		85 12 5			45	California 1982	vineyards - aggregate % wet weight; gizzard contents	Mean of values from two vineyards. Aggregate % wet weight = the mean of the percent (by wet weight) that each food item was in stomach contents of each bird.
Wheelwright 1986	B	B	fruit invertebrates	7 93	68 32	92 8	83 17	1,260	eastern US 1885-1950	NS - % by volume; stomach contents	Based on data from the U.S. Biological Survey and U.S. Fish and Wildlife Service collected from 1885-1950. Percentage of diet that is soft-bodied invertebrates (e.g., earthworms) are underestimated by an unknown amount.
Wheelwright 1986	B	B	fruit invertebrates	8 92	41 59	76 24	73 27	240	central US 1885-1950	NS - % volume; stomach contents	Based on data collected by the U.S. Biological Survey and the U.S. Fish and Wildlife Service from 1885-1950. Percentage of diet that is soft-bodied invertebrates (e.g., earthworms) are underestimated by an unknown amount.

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Wheelwright 1986	B	B	fruit invertebrates	17 83	29 71	63 37	70 30	436	western US 1885-1950	NS - % volume; stomach contents	Based on data collected by the U.S. Biological Survey and the U.S. Fish and Wildlife Service from 1855-1950. Percentage of diet that is soft-bodied invertebrates (e.g., earthworms) are underestimated by an unknown amount.
Wheelwright 1986	B	B	Prunus Cornus Rhus Rubus Smilax Vaccinium Ilex Morus Celtis Juniperus		23 7 7 6 6 4 4 4 3 3			1,260	eastern US 1885-1950	NS - % frequency of occurrence (fruit only); stomach contents	Ten most common fruit genera found in stomach contents (all seasons) based on data collected by the U.S. Biological Survey and U.S. Fish and Wildlife Service; see above record for eastern U.S. for distribution of % of fruit eaten across seasons. Total of 50 genera found.
Wheelwright 1986	B	B	Lepidoptera-unident. Carabidae Curculionidae Scarabaeidae Formicidae Elateridae Coleoptera-unident. Arachnida Pentatomidae		12 10 8 8 7 5 4 4 3			1,260	eastern US 1885-1950	NS - % frequency of occurrence (invertebrates only); stomach contents	Ten most common invertebrate taxa found (all seasons) based on data collected by the U.S. Biological Survey and Fish and Wildlife Service; see above record for eastern U.S. for distribution of % of invertebrates eaten across seasons. Soft bodied invertebrates (e.g. earthworms, caterpillars) are likely to be under-represented in this sample. Total of 91 invertebrate families found.

***** POPULATION DYNAMICS *****

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
TERRITORY SIZE													
Butts 1927	A	B	-	SP	0.21		ha				NS	NS	As cited in Armstrong 1965.
Howell 1942	A A	B B	1 2	SU SU	0.11 0.21		ha ha				sc New York 1937-38	forest	Nesting territory; some used additional areas for feeding. (1) Dense population in coniferous forest; (2) sparse population in unspecified forested area.
Pitts 1984	A	B	-	SP	0.42		ha	0.12	0.84	62	Tennessee 1971-80	suburban (campus)	"Territories" (occasionally left territory to feed).
Young 1951	A	B	-	SP	0.12		ha	0.04	0.24		Wisconsin 1947-49	park-like	Breeding season territory; robins occasionally left to feed.

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
FORAGING HOME RANGE													
Howell 1942	A	B	-	SU	0.4		km				sc New York 1937-39	forest	Foraging radius; robins found to travel "at least" this far "in search of food."
Weatherhead & McRae 1990	A A	B B	1 2	SU SU	0.15 0.81	0.021 SE 0.13 SE	ha ha			24 24	e Ontario 1987-88	deciduous forest	Foraging home range of adult: (1) feeding nestlings; (2) feeding fledglings.
POPULATION DENSITY													
Howell 1942	A A	B B	1 2	SU SU	8.6 4.9		pair/ha pair/ha				sc New York 1937-38	forest	(1) dense coniferous forest - 1.7 ha total area; (2) unspecified forest type - 3.7 ha.
Knupp et al. 1977	A	B	-	SU	0.106	0.0078 SE	pair/ha				n Maine 1971	forest	Conservative estimate of breeding density; mean of four study areas.
Pitts 1984	A	B	-	SP	1.98	0.48 SD	pair/ha	1.39	2.54	7 yr	Tennessee 1971-80	suburban (campus)	
Young 1951	A	B	-	SP	5.51	0.75 SD	pair/ha	4.69	6.17	3 yr	Wisconsin 1947-49	park-like area	Size of habitat = 2.1 ha.
CLUTCH SIZE													
Howell 1942	-	-	-	-	3.41	0.61 SD		1	5	127	sc New York 1937-38	forest	
Klimstra & Stieglitz 1957	-	-	-	-	3.17			1	5	29	Illinois 1955	suburban	Clutch size per completed (i.e., incubated) nest.
Klimstra & Stieglitz 1957	-	-	-	-	3.44			2	4	81	Iowa 1946-48	suburban & rural	Clutch size per completed (i.e., incubated) nest.
Knupp et al. 1977	-	-	-	-	3.16					38	n Maine 1971	forest	
Young 1955	-	-	-	-	3.45	0.59 SD		1	5	146	Wisconsin 1947-49	park	
CLUTCHES/YEAR													
Brackbill 1952	-	-	-	-	1.91		/yr	1	3	11	Maryland 1942-51	NS	One pair attempted 3 broods, 2 attempted one and 9 pairs attempted 2. As cited in Henny 1972.

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Howell 1942	-	-	-	-	2		/yr	1	3		sc New York 1937-38	forest	
Knupp et al. 1977	-	-	-	-			/yr		2		n Maine 1971	forest	Maximum possible due to the short breeding season in northern Maine.
DAYS INCUBATION													
Howell 1942	-	-	-	-	12-14		days			16	sc New York 1937-39	forest	
Young 1955	-	-	-	-	12.5	0.14 SE	days	10	14	57	Wisconsin 1947-49	park	Also included data from Howell 1942 (Ithaca, NY) in calculations.
AGE AT FLEDGING													
Howell 1942	-	B	-	-	13		days	10	15	33	sc New York 1937-38	forest	
Weatherhead & McRae 1990	-	B	-	-	13.0	0.02 SD	days			43	e Ontario 1987-88	deciduous forest	From hatching of first egg.
Young 1955	-	B	-	-	13.4	0.13 SE	days			89	Wisconsin 1947-49	park	
N FLEDGE/BREEDING PAIR													
Howell 1942	-	-	-	-	3.9		N/breed pr			78	sc New York 1937-38	forest	Estimate of young produced per pair over entire breeding season; pairs attempted to raise up to three broods. N = number of nests.
Weatherhead & McRae 1990	-	-	1	-	1.42	0.35 SE	N/breed pr			19	e Ontario 1987-88	deciduous forest	Year (1) 1987 - a total of 32 nests found, but no second nest fledged young; (2) 1988 - 28 nests found, 3 of 10 second nests fledged young.
	-	-	2	-	1.50	0.45 SE	N/breed pr			18			
Young 1955	-	-	-	-	5.6		N/breed pr				Wisconsin 1957-49	park	Estimate of young produced per pair over entire breeding season.

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
N FLEDGE/SUCCESSFUL NEST													
Howell 1942	-	-	-	-	2.4		N/suc nest			42	sc New York 1937	forest	
Knupp et al. 1977	-	-	-	-	2.5	0.15 SD	N/suc nest			38	n Maine 1971	forest	
Weatherhead & McRae 1990	- -	- -	1 2	- -	2.5 3.0		N/suc nest N/suc nest			11 9	e Ontario 1987-88	deciduous forest	Year (1) 1987; (2) 1988.
Young 1955	-	-	-	-	2.9		N/suc nest	2.4	3.4	86	Wisconsin 1947-49	park	Minimum and maximum of five study areas. N = number fledged.
PERCENT NESTS SUCCESSFUL													
Howell 1942	- -	- -	1 2	- -	35 75		% nest suc % nest suc			124 44	sc New York 1937-38	forest	Percent fledging at least one young from (1) first brood (1937-38); (2) second brood (1937).
Klimstra & Stieglitz 1957	-	-	-	-	93.5		% hatc suc			31	Illinois 1955	suburban	Nest success defined as one or more eggs hatched.
Klimstra & Stieglitz 1957	-	-	-	-	47.2		% hatc suc	42	51	81	Iowa 1946-48	suburban & rural	Nest success defined as one or more eggs hatched. Mean of three years.
Weatherhead & McRae 1990	- -	- -	1 2	- -	78 64		% hatc suc % hatc suc			32 28	e Ontario 1987-88	deciduous forest	Year (1) 1987; (2) 1988.
Young 1955	- -	- -	1 2	- -	58 49		% hatc suc % nest suc	46 32	66 62		Wisconsin 1947-49	park, cemetery	Three year mean of % of nests (1) hatching at least one egg; (2) fledging at least one young.
AGE AT SEXUAL MATURITY													
Henny 1972	-	B	-	-	1		year				NS	NS	Assumption used in population modeling study.

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
ANNUAL MORTALITY													
Farner 1949	-	B	-	-	53		%/yr				US, Canada 1920-1940	NS	Calculated from band returns of birds banded as fledglings in 1920-40 in ne, nw, and central U.S. and sw Canada. Annual mortality from Jan. 1 to next Jan. 1; (period from fledging to first Jan. 1 not included).
Henny 1972	A	B	-	-	50.8	0.5 SE	%/yr				N America 1946-65	NS	Adult value estimated by composite dynamic method based on birds banded from 1946-65. Juvenile value is from fledge to next breeding season based on assumption of stable populations with (1) the adult value; (2) 1 year olds try to breed; and (3) annual recruitment rate of 4.58 - 5.76 per pair.
	J	B	-	-	78-82		%/yr						
LONGEVITY													
Farner 1949	A	-	-	-	1.3-1.4		years				US, Canada 1920-40	NS	Calculated (from Jan 1. of first year) as 1/m - (1-p) where m = mean annual mortality rate and p = the mean period lived during the year in which death occurs.
Farner 1945	-	-	-	-			years		9		US, Canada 1920-40	NS	Oldest robin recovered in banding study; estimates potential natural longevity to be at least 9 or 10 years.

***** SEASONAL ACTIVITIES *****

Reference	Begin	Peak	End	Location	Habitat	Notes
MATING/LAYING						
Howell 1942	late Apr		earl May	sc New York 1937-39	forest	First brood.
Howell 1942	late May		earl Jun	sc New York 1937-39	forest	Second brood.
Howell 1942	earl Jun		mid Jul	sc New York 1937-39	forest	Third brood.

Reference	Begin	Peak	End	Location	Habitat	Notes
Klimstra & Stieglitz 1957	Apr 1	mid Apr	Apr 23	Illinois 1955	suburban	
Klimstra & Stieglitz 1957	earl Apr	mid+ Apr		Iowa 1946-48	suburban & rural	
Knupp et al. 1977	May 10	May 21-25	July 6	n Maine 1971	forest	
Pitts 1984		earl April		Tennessee, 1971-76	suburban (campus)	
Young 1955	mid Apr		late Jul	Wisconsin 1947-49	park-like area	Laying of up to three clutches.
HATCHING						
James & Shugart 1974	earl May			California, New Mex.	NS	
James & Shugart 1974	late Apr			Ohio, Missouri	NS	
James & Shugart 1974	earl May			VA, WV, NY, Wash. DC	NS	
James & Shugart 1974	mid May			VT, NH, CT	NS	
James & Shugart 1974	mid May			Montana	NS	
James & Shugart 1974	earl Jun			Colorado	NS	
James & Shugart 1974	mid Apr			Kentucky	NS	
Klimstra & Stieglitz 1957	Apr 20	late Apr		Illinois 1955	suburban	
Klimstra & Stieglitz 1957	Apr	earl May		Iowa 1946-48	suburban & rural	
FLEDGING						
James & Shugart 1974			earl Jul	California, New Mex.	NS	

Reference	Begin	Peak	End	Location	Habitat	Notes
James & Shugart 1974			earl Aug	Kentucky	NS	
James & Shugart 1974			earl Jul	VA, WV, Wash. DC	NS	
James & Shugart 1974			late Jul	MO, OH, MT, CO	NS	
James & Shugart 1974			mid Jul	VT, NH, CT, NY	NS	
Knupp et al. 1977			earl Aug	n Maine 1971	forest	
Young 1951	mid May	earl Jun	mid Aug	Wisconsin 1947-49	park, cemetery	Fledging of up to three broods per season.
FALL/BASIC MOLT						
Bovitz 1990	Aug		Sept	New Jersey	NS	As cited in Morrison and Caccamise 1990.
Wheelwright 1986		Jul & Aug		North America	NS	Robins undergo a complete molt.
FALL MIGRATION						
Fuller 1977	mid Sept	mid Oct	earl Nov	Minnesota 1971-76	NS	Robins migrating through Minnesota.
Howell 1942			earl Nov	sc New York 1937-39	forest	Last dates robins found in area.
SPRING MIGRATION						
Howell 1942	Feb		Mar	sc New York 1937-39	forest	Arrival of breeding robins.
Knupp et al. 1977		earl Apr		n Maine 1971	forest	Arrival of breeding robins.
Young 1951	Mar 11		mid Apr	Wisconsin 1947-49	park-like area	Arrival of males.
Young 1951	Mar 26		mid Apr	Wisconsin 1947-49	park-like area	Arrival of females.

A-4. TABLES FOR MAMMALS

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*** NORMALIZING AND CONTACT RATE FACTORS ***

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
BODY WEIGHT													
Barrett & Stueck 1976	A	B	-	-	16.35	2.47 SE	g			4	Ohio 1972	lab	Maintained on a diet of mealworms.
Buckner 1964	A	B	-	-	20.1		g			11	Manitoba CAN 1955-57	lab	
Deavers & Hudson 1981	-	-	-	-	22.1	0.5 SE	g			32	New York	lab	
Guilday 1957	-	M	-	SP	17.61	0.58 SD	g	14.0	22.0	13	e Pennsylvania	various	Animals caught in April and May.
	-	F	-	SP	17.33	1.08 SD	g	12.0	21.0	9			
Guilday 1957	-	M	-	SU	19.21	0.42 SD	g	17.0	22.0	14	w Pennsylvania	various	Summer animals caught in August, fall animals caught in October and November.
	-	F	-	SU	17.40	0.48 SD	g	14.0	21.0	15			
	-	M	-	FA	16.87	0.21 SD	g	13.0	22.0	63			
	-	F	-	FA	15.58	0.23 SD	g	12.5	22.5	57			
Guilday 1957	-	M	-	SU	15.70	0.37 SD	g	12.0	21.0	27	c Pennsylvania	various	Animals caught in August and September.
	-	F	-	SU	15.25	0.37 SD	g	12.0	19.0	20			
Lomolino 1984	-	-	-	-	18		g				New York	Thousand Islands	
Schlesinger & Potter 1974	A	B	-	-	15.0	0.78 SD	g			24	New Hampshire 1971	forest	Most females weighed less than the mean.
LEAN (DRY) BODY WEIGHT													
Schlesinger & Potter 1974	A	B	-	-	4.4	0.24 SD	g						

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
METABOLIC RATE (OXYGEN)													
Buckner 1964	A	B	ST	-	110.4	19.2 SD	lO2/kg-day	100.8	129.6	11	Ottawa, CAN	lab	9-14 C below the thermoneutral zone (TNZ).
Deavers & Hudson 1981	A	-	BA	-	77.3		lO2/kg-day			7	New York	lab	Temperature = 38.3 degrees C; mean body weight = 20.5 g. N = number of animals tested (total test runs = 14).
Martinsen 1969	A	-	BA	-	52.3		lO2/kg-day				NS	lab	As cited in Deavers and Hudson 1981. Mean body weight = 19.0 g.
Morrison 1948	A	-	AD	-	127	15.3 SD	lO2/kg-day	94	218	8	NS	lab	(AD) = average daily metabolic rate. Eight runs for 4 animals (avg weight 21g). Room temp. ranged between 15-25 C.
Neal & Lustick 1973	A	-	BA	-	76.3		lO2/kg-day				NS	lab	As cited in Deavers and Hudson 1981. Temperature = 38.0 degrees C; mean body weight = 20.3 g.
Pearson 1947	A	-	BA	-	82		lO2/kg-day	80	84	2	Pennsylvania	lab	Mean weight of shrews = 21.2 g. Test conditions: basal - food withheld for 15 hours previous to test, temperature = 27 degrees C; average daily (AD) - 24 hour tests at 25-30 degrees C, food and water both available.
	A	-	AD	-	125		lO2/kg-day	106	150	5			
Platt 1974	A	-	BA	-	62.4		lO2/kg-day				NS	lab	As cited in Deavers and Hudson 1981. Temperature = 37.0 degrees C; mean body weight = 21.0 g.
Randolph 1973	-	-	1	WI	124.8		lO2/kg-day				CAN, Ontario	lab	Subject to different thermal radiation (in cal/cm2-min): (1) 0.415, (2) 0.258, (3) 0.102. Equivalent temperatures: (1) + 20C; (2) 0 C; (3) -20 C.
	-	-	2	WI	147.8								
	-	-	3	WI	202.3								
	-	-	1	SU	126.5								
	-	-	2	SU	151.2								
	-	-	3	SU	207.1								
METABOLIC RATE (KCAL BASIS)													
Buckner 1964	-	B	-	-	482	+/- 48 SD	kcal/kg-d			11	Ottawa, CAN	lab	"Standard" metabolism"; however, measured at 9 to 14 degrees C, which is well below the shrews' thermoneutral zone. Value labelled SD is a 95% confidence interval.

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Morrison et al. 1957	A	B	AD	-	680		kcal/kg-d				Wisconsin 1952	lab	AD = average daily metabolic rate. Based on average consumption rate of liver at 25 degrees C (0.56 g/g-day) and 1.22 kcal/g wet weight for liver.
Pearson 1947	A	-	BA	-	390		kcal/kg-d			2	Pennsylvania	lab	Calculated based on oxygen consumption. Mean weight of shrews = 21.2 g. Test conditions: basal - food withheld for 15 hours previous to test, temperature = 27 degrees C; average daily (AD) - 24 hour tests at 25-30 degrees C, food and water both available.
	A	-	AD	-	600		kcal/kg-d			5			
FOOD INGESTION RATE													
Barrett & Stuek 1976	A	B	AD	FA	0.49		g/g-day			4	Oxford, Ohio 1972	lab	Diet of mealworms, equivalent to 2.33 kcal/g live weight. Shrew assimilation efficiency for mealworms was 89.5 +/- 1.9 SD percent.
	A	B	AD	FA	10.9	0.13 SD	kcal/g-day			4			
	A	B	AD	FA	7.95	0.17 SD	g/day			4			
	A	B	AD	FA	18.5	3.8 SD	kcal/day			4			
Morrison et al. 1957	A	B	1	-	0.43		g/g-day			22	Wisconsin 1952	lab	Animals fed beef liver; temperature = 25 degrees C. Weight of tested animals (1) one animal at 28 g; (2) seven animals averaging 21 g. N = number of trials. .
	A	B	2	-	0.62		g/g-day			94			
Morrison et al. 1957	A	B	1	-	0.52		g/g-day			3	Wisconsin 1952	lab	Animals fed beef liver; temperature = 5 degrees C. Weight of tested animals (1) one animal at 28 g; (2) seven animals averaging 21 g. N = number of trials.
	A	B	2	-	0.77		g/g-day			11			
Morrison et al. 1957	A	B	1	-	0.55		g/g-day			2	Wisconsin 1952	lab	Animals fed newborn rats; temperature = 25 degrees C. Weight of tested animals (1) one animal at 28 g; (2) seven animals averaging 21 g. N = number of trials.
	A	B	2	-	0.96		g/g-day			17			
Randolph 1973	-	-	-	-	4.493	0.036 SE	kcal/12 hr				Ontario, CAN	lab	Measured in units of kcal/12 hrs. Minimum estimate.
Richardson 1973	A	M	-	-	0.541		g/g-day			10	Virginia	lab	In aquaria with tunnels; food type not described.

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
WATER INGESTION RATE													
Chew 1951	A	B	-	-	0.223		g/g-day			5	Illinois	lab	Studied at 19 degrees C, 54.5% relative humidity. Shrews fed raw ground horsemeat.
SURFACE AREA													
Pearson 1947	A	B	-	-	54		cm2				Pennsylvania	lab	Estimate for 21.2 g shrew.
Randolph 1973	-	-	-	-	70		cm2				Ontario, CAN	NS	Assumed value; source not identified.
THERMONEUTRAL ZONE													
George et al. 1986	-	-	-	-			degrees C	25	33		NS	lab	Computed by authors based on review of oxygen consumption rates.
Neal & Lustick 1973	-	-	-	-			degrees C	25	33	12	NS, 1972	lab	95% confidence limit.

***** DIET *****

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Hamilton 1941	A	B	insects		77.6			460	e US, mostly NY	NS - % frequency of occurrence; stomach contents	All seasons combined.
			annelids		41.8						
			vegetable matter		17.1						
			centipedes		7.4						
			arachnids		6.1						
			snails		5.4						
			small mammals		5.2						
			crustacea		3.7						
			undetermined		2.4						
Whitaker & Ferraro 1963	B	B	earthworms		31.4			221	New York 1960-61	NS - % volume; stomach contents	Season June through October.
			slugs and snails		27.1						
			misc animals		8.1						
			Endogone (fungi)		7.7						
			beetles		5.9						
			misc vegetation		5.4						
			lepidopteran larvae		4.3						
			chilopoda		1.8						
			other		8.6						

***** POPULATION DYNAMICS *****

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
HOME RANGE SIZE													
Blair 1940	A	F	-	SU			ha	< 0.1	0.36	13	s Michigan	bluegrass	Monthly ranges calculated from live trapping during summer and early fall. Maximum ranges for both sexes recorded in September.
	A	M	-	SU			ha	< 0.1	1.8	13	1938-39		
Blair 1941	-	F	-	SU			ha	0.23	0.59	5	Michigan 1940	hardwood forest	Based on live trapping of animals caught five or more times in August and September.
	-	M	-	SU			ha		0.56	7			
Buckner 1966	B	B	-	-	0.3925	0.0364 SD	ha			34	s Manitoba 1952-58	tamarack bog	Mark and recapture (shows no relationship to sex, age, habitat or season).
Platt 1976	B	B	1	WI			ha	0.03	0.07		c New York	old field	Home ranges of resident shrews during period of (1) high prey density; (2) low prey density. Territories had little overlap, winter is non-breeding season.
	B	B	2	WI			ha	0.10	0.22		1968		
POPULATION DENSITY													
Blair 1940	-	-	1	SU			N/ha		0.89		s Michigan	bluegrass	Estimate based on live trapping during summer and early fall. Year (1) 1938 (peak in late September); (2) 1939 (peak in late August).
	-	-	2	SU			N/ha		0.32		1938-39		
Buckner 1966	B	B	1	-			N/ha	0.06	0.16		Manitoba CAN	tamarack bog	Trap-mark-release-recapture technique. Values estimated from figure showing data for Plot 3. Year: (1) 1955; (2) 1956; (3) 1957. Peak populations found in September of all years.
	B	B	2	-			N/ha	0	0.51		1955-57		
	B	B	3	-			N/ha	0.09	0.77				
Getz 1989	-	-	1	WI	5.3		N/ha				ec Illinois	bluegrass	Generalized annual population cycle for bluegrass habitat (estimated from figure). Average for (1) Jan. Feb., Mar.; (2) Apr., May, June; (3) July, Aug., Sept., and; (4) Oct., Nov., Dec.
	-	-	2	SP	12.1		N/ha				1972-85		
	-	-	3	SU	17.4		N/ha						
	-	-	4	FA	13.6		N/ha						
Getz 1989	-	-	1	WI	1.4		N/ha				ec Illinois	tallgrass	Generalized annual population cycle for tallgrass habitat (estimated from figure). Average for (1) Jan. Feb., Mar.; (2) Apr., May, June; (3) July, Aug., Sept., and; (4) Oct., Nov., Dec.
	-	-	2	SP	2.3		N/ha				1972-85		
	-	-	3	SU	7.8		N/ha						
	-	-	4	FA	8.0		N/ha						

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Getz 1989	-	-	1	WI	2.3		N/ha				ec Illinois 1972-85	alfalfa	Generalized annual population cycle for alfalfa habitat (estimated from figure). Average for (1) Jan. Feb., Mar.; (2) Apr., May, June; (3) July, Aug., Sept., and; (4) Oct., Nov., Dec.
	-	-	2	SP	5.9		N/ha						
	-	-	3	SU	11.4		N/ha						
	-	-	4	FA	10.0		N/ha						
Jackson 1961; Williams 1936	-	-	-	-			N/ha	1.6	121		Wisconsin	beech-maple	As cited in George et al. 1986.
LITTER SIZE													
Blus 1971	-	-	-	-	4.7	0.2 SE		1	8	80	Maryland 1966-68	lab	Count of young; considered minimal as some young may have been lost before they were counted.
Buckner 1966	-	-	-	-	6.3			5	8	8	Manitoba 1952-57	tamarack bog	Season is spring/summer; based on embryo count.
French 1984	-	-	-	-	5.4			2	8	18	Indiana 1976-79	NS	Season was February to September; based on embryo count.
Hamilton 1929	-	-	-	-	6-7						NS	NS	As cited in George et al. 1986.
Pearson 1944	-	-	-	-	4.5						NS	NS	As cited in George et al. 1986.
DAYS GESTATION													
Blus 1971	-	-	-	-	21-22		days				Maryland 1966-68	lab	Average period from pairing to parturition; includes a 2-3 day period during which ovulation is induced.
Hamilton 1929; Pearson 1944	-	-	-	-	21-22		days				NS	NS	As cited in George et al. 1986.
AGE AT WEANING													
Blus 1971	-	-	-	-	25-30		days				Maryland 1966-68	lab	
AGE AT SEXUAL MATURITY													
Blus 1971	-	M	-	-			days	65			Maryland 1966-68	lab	Approximate youngest ages of successful breeding. Female gave birth to a litter at the age of 65 days.
	-	F	-	-			days	45					

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Buckner 1966	-	-	-	-	10		months				Manitoba CAN 1952-57	tamarack bog	Age at which breeding began.
Dapson 1968	-	F	-	-			months	1-2			c New York 1960's	woods, field	
	-	M	-	-			months	1-2					
French 1984	-	F	-	-	< 1		yr				Indiana	NS	
French 1984	-	F	-	-			months	< 4			Indiana 1976-79	NS	Evidence of sexual maturity found in individuals in age class 1 (approx. 0 - 4 months), and in age class 2 (4 to 8 months).
Pearson 1944	-	M	-	-			days	83			NS	NS	As cited in George et al. 1986.
ANNUAL MORTALITY													
Barbehenn 1958; Gottschang 1965; and Jackson 1961	-	-	-	WI			%/yr		90		sw OH, WI		As cited in George et al. 1986.
Blus 1971	-	B	-	-	27.4		%/weaning			383	Maryland 1966-68	lab	Mortality of captive-born shrews from birth. Weaning takes place at 25-30 days.
	-	B	-	-	40.5		%/3 months			321			
	-	B	-	-	54.2		%/6 months			203			
	-	B	-	-	74.1		%/9 months			112			
	-	B	-	-	91.3		%/year			46			
Pearson 1945	B	B	-	-	93		%/yr				MD, PA, NY, MA	various	
LONGEVITY													
Blus 1971	-	M	-	-	4.6		months				Maryland 1966-68	lab	Mean longevity of animals that survived to weaning (born and weaned in captivity); considered a "minimal" estimate by the author.
	-	F	-	-	4.4		months						
Dapson 1968	-	B	-	-			months		20		c New York 1960's	woods, field	Approximate maximum age for wild Blarina sp.; few survive second winter.
Pearson 1945	-	B	-	-			years		2		MD, PA, NY, MA	various	Author notes that by two years a wild shrew would probably wear out its teeth and be unable to feed (only a small fraction survive long enough to have badly worn teeth).
Pearson 1945	-	F	-	-			months		30	1	MD, PA, NY, MA	lab	Female was wild-caught, male was captive-born.
	-	M	-	-			months		33	1			

*** SEASONAL ACTIVITIES ***

Reference	Begin	Peak	End	Location	Habitat	Notes
MATING						
Blair 1940		spring; fall		s Michigan 1938	bluegrass	Author suggests two peaks; one in spring and the other in early fall. Based on own data and review of papers from 1920 - late 1930's.
Buckner 1966	earl May		mid Aug	se Manitoba 1952-57	tamarack bog	
French 1984	Feb 29	Apr-May	Sept 11	Indiana 1976-79	NS	Latest and earliest dates of pregnancy in wild trapped shrews.
PARTURITION						
Dapson 1968		May-June		c New York 1960's	woods, field	Based on an investigation of tooth wear; some also born in March and January - December.
FALL/BASIC MOLT						
Findley & Jones 1956	Oct		Nov	NS	NS	As cited in George et al. 1986.
SPRING/ALTERNATE MOLT						
Findley & Jones 1956	Feb		July	NS	NS	As cited in George et al. 1986.

***** RED FOX *****

*** NORMALIZING AND CONTACT RATE FACTORS ***

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
BODY WEIGHT													
Allen & Gulke 1981	J	M	1	-	5,006	608 SD	g			317	e N Dakota 1970-78	NS	Age: (1) 0.5 years; (2) 1.5 years; (3) 2.5 years; (4) 3.5 years; (5) > 3.5 years. Estimated from skinned carcass weights and average ratio of skinned to unskinned weights of 0.87.
	A	M	2	-	5,361	521 SD	g			30			
	A	M	3	-	5,357	579 SD	g			48			
	A	M	4	-	5,597	649 SD	g			20			
	A	M	5	-	5,716	1,067 SD	g			18			
Allen & Gulke 1981	J	F	1	-	4,256	549 SD	g			250	e N Dakota 1970-78	NS	Age: (1) 0.5 years; (2) 1.5 years; (3) 2.5 years; (4) 3.5 years; (5) > 3.5 years. Estimated from skinned carcass weights and average ratio of skinned to unskinned weights of 0.87.
	A	F	2	-	4,263	566 SD	g			45			
	A	F	3	-	4,529	457 SD	g			36			
	A	F	4	-	4,611	647 SD	g			15			
	A	F	5	-	4,769	678 SD	g			16			
Hoffman & Kirkpatrick 1954	A	F	-	WI	4,213	74 SE	g	3,360	5,680	52	Indiana 1947-49	various	Weights of animals collected at bounty stations.
	A	M	-	WI	5,253	78 SE	g	3,980	6,090	47			
Samuel & Nelson 1982	A	-	-	-			g	3,000	7,000		NS	NS	Summary of literature reviewed.
Sargeant 1978	A	M	-	SP	4,750	410 SD	g	4,370	5,430	5	e N Dakota 1970-74	lab	
	A	F	-	SP	4,680	167 SD	g	4,430	4,850	5			
Storm et al. 1976	A	M	-	FA	4,822	81 SE	g	4,131	5,675	19	nw Iowa 1968-69	farm and woods	Juveniles approximately 8 to 9 months old.
	J	M	-	FA	4,646	47 SE	g	3,632	5,811	87			
	A	F	-	FA	3,938	79 SE	g	2,951	4,585	22			
	J	F	-	FA	3,724	39 SE	g	2,951	4,540	68			
Storm et al. 1976	A	M	-	SP	5,250	179 SE	g	4,540	7,037	14	nw Illinois 1962, 67	farm and woods	Juveniles approximately 8 to 9 months old.
	J	M	-	SP	4,818	93 SE	g	3,859	6,129	32			
	A	F	-	SP	4,128	111 SE	g	3,269	4,722	13			
	J	F	-	SP	3,986	52 SE	g	3,632	4,494	24			
Vogtsberger & Barrett 1973	J	B	-	-	4,200		g			4	Ohio	captive	Age 23 weeks.
Voigt 1987	A	M	-	FA	4,100	90 SE	g			37	s Ontario, CAN	NS	
	A	F	-	FA	3,400	70 SE	g			37			
	J	M	-	FA	3,900	30 SE	g			162			
	J	F	-	FA	3,300	30 SE	g			139			

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
NEONATE WEIGHT													
Sheldon 1949	N	B	-	-	100		g				New York	NS	Approximate. As cited in Hoffman and Kirkpatrick 1954.
Storm et al. 1976	N	B	-	-			g	71	120		Illinois, Iowa 1966-70	farm and woods	
Storm & Ables 1966	N	B	1	-	110.6	8.9 SD	g	94	120	7	Illinois, Wisconsin	NS (wild)	(1) One litter from Illinois; (2) one litter from Wisconsin.
	N	B	2	-	101.5	12 SD	g	71	109	9			
PUP GROWTH RATE													
Sargeant 1978	P	B	-	-	15.9		g/day			10	e N Dakota 1970-74	lab	From birth to weaning at 4.5 weeks of age. Estimated from unimpeded growth curve.
Storm et al. 1976	P	B	-	-	23		g/day			392	nw Illinois 1962, 67	farm and woods	From weaning to approximately 7 months of age.
Vogtsberger & Barrett 1973	P	B	-	-	25		g/day			4	NS	lab	From approximately 14 to 22 weeks of age.
WEANING WEIGHT													
Sargeant 1978	-	-	-	-	700		g				North Dakota	NS	Value is approximate.
METABOLIC RATE (KCAL BASIS)													
Vogtsberger & Barrett 1973	J	B	-	SU	193	56 SD	kcal/kg-d			4	Ohio 1971	lab	
FOOD INGESTION RATE													
Sargeant 1978	J	B	1	-	0.16		g/g-day			4	e N Dakota	lab	Ages(1) 5-8 weeks; (2) 9-12 weeks; (3) 13-24 weeks.
	J	B	2	-	0.12		g/g-day			4			
	J	B	3	-	0.11		g/g-day			4			
Sargeant 1978	A	B	1	SP	0.075		g/g-day			10	e N Dakota	captive	(1) Pair before whelping; (2) pair after whelping.
	A	B	2	SP	0.14		g/g-day			10			
Sargeant 1978	A	B	NB	-	0.069		g/g-day			10	e N Dakota	captive	Nonbreeding.
Vogstberger & Barrett 1973	J	B	-	SU	223	71 SD	kcal/kg-d				NS	lab	Units are in kcal ingested (not assimilated or metabolized) /kg body weight-day.

*** DIET ***

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Cook & Hamilton 1944	B	B	deer	5	-	2	7		New York 1937-42	riverine - frequency of occurrence; scats	From along Black River in southeastern Rensselaer County.
			grey squirrel	5	-	2	6				
			chipmunk	-	24	4	-				
			deer mouse	13	6	1	1				
			meadow vole	20	-	21	16				
			cottontail	60	35	18	57				
			short-tailed shrew	5	-	5	-				
			ruffed grouse	5	-	1	4				
			pheasant	-	6	-	-				
			grasshoppers	-	6	19	1				
			scarabs	3	6	-	-				
			ground beetles	-	6	3	-				
			other beetles	-	12	1	1				
			strawberries	-	24	-	-				
			brambles	-	24	1	-				
			apple	8	-	36	31				
			shadbush	-	29	2	-				
			cherry	-	12	33	3				
			wild sarsaparilla	-	6	-	-				
			blueberry	-	47	-	-				
			(sample size)	(40)	(34)	(141)	(70)				
Eadie 1943	B	B	prairie vole		52.3		63.1	313	s New Hampshire 1939-40	NS - % frequency of occurrence; scats	Summer = May 1 to Sept. 30; winter = Oct. 1 to April 30. Data represent mammalian portion of diet only. See next record for other types of food in diet.Prey representing less than one percent frequency not listed.
			NE cottontail		13.1		21.3				
			woodchuck		0.9		0				
			muskrat		0.9		6.3				
			livestock		0		5.8				
			gray squirrel		3.7		4.8				
			red squirrel		4.7		1.9				
			deer mouse		3.7		4.3				
			skunk		0		2.4				
			short-tailed shrew		2.8		1.9				
			long-tailed shrew		0.9		1.4				
			star-nosed mole		2.8		1.4				
			chipmunk		1.9		1.0				
Eadie 1943	B	B	mammals		82		95	313	s New Hampshire 1939-40	NS - % frequency of occurrence; scats	Summer = May 1 to Sept. 30; winter = Oct. 1 to April 30.
			birds		36		34				
			insects		81		3				
			vegetation		31		27				
			fishes		2		1				

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Green & Flinders	A	B	rabbit		32		32	38-37	se Idaho	sagebrush	
1981			rodent		82		71		1976-77	-	
			sheep		17		34			% occurrence in	
			birds		10		13			scats	
			insects		21		18				
			plants		34		34				
			(sample size)		(87)		(38)				
Halpin &	B	B	snowshoe hare				82.2		e Maine	deep snow cover/90cm	
Bissonette 1983			deer				17.7		1982-83	-	
			small mammals				9.6			% occurrence in	
			birds				11.3			scats	
			vegetation				3.2				
Halpin &	B	B	snowshoe hare				56.0		e Maine	shallow snow/31 cm	
Bissonette 1983			deer				9.1		1982-83	-	
			small mammals				36.3			% occurrence in	
			birds				11.3			scats	
			vegetation				7.8				
Hamilton 1935	B	B	meadow vole & mice				29.3	206	New York	NS	Most of the rodents consumed were
			cottontail rabbit				22.1		1927-34	-	meadow voles. Carrion included dead
			grasses				13.9			% bulk; stomach	cattle, horse, or sheep from
			dirt, sticks				6.2			contents	slaughter houses. Apple was the
			carrion				8.1				most frequent fruit consumed.
			fruit				5.3				Insects included grasshoppers,
			insects				3.4				crickets, and beetles. Foxes
			poultry				3.1				collected in late fall and early
			squirrels				2.9				winter.
			porcupine				1.8				
			game birds				1.4				
			small birds				0.5				
			shrews				0.8				
			worms				0.8				
			grains and nuts				0.4				
Hamilton 1935	B	B	meadow voles & mice			33		66	VT, NH, MA	NS	Data from Elton Clark, presented by
			fruit (apple						1913-32	-	Hamilton. Season is fall and
			& wild cherries)			32				Number of times	winter.
			grasses			14				present; stomach	
			rabbits			8				contents	
			poultry			6					
			carrion			5					
			corn			4					
			other			<4					

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Hamilton 1935	B	B	woodchuck		33+			31	NY & New England	NS - Number of items found in fox dens	
			rabbits		22+						
			poultry		13						
			game birds		6						
			moles & shrews		5						
			muskrat		5+						
			crow		3+						
			small birds		8						
			squirrels		4						
			insects		many						
			reptiles		5						
			other		< 3						
Hockman & Chapman 1983	B	B	meadow vole				11.3	128	Maryland 1977-78	Piedmont and Appalachian Province - % wet weight; stomach contents	Data from fall and winter and both Provinces combined.
			eastern cottontail				30.7				
			white-footed mice				1.3				
			unclassified mammal				4.8				
			raccoon				4.9				
			gray squirrel				2.8				
			norway rat				2.2				
			white-tailed deer				2.5				
			domestic cow				4.8				
			striped skunk				1.5				
			oppossum				1.4				
			unclassified bird				0.8				
			domestic chicken				6.6				
			ring-necked pheasant				0.8				
			pigeon				1.4				
			blackbird				1.2				
			starling				0.7				
			mallard duck				0.5				
			persimmon				11.4				
			corn				1.3				
			apple				0.7				
			black cherry				0.7				
			grasshopper/cricket				0.5				
			butterfly/moth larva				0.4				
			other/unspecified				4.2				
Hockman & Chapman 1983	B	B	mammal				81.4		Maryland 1977-78	Appalachian Province - % wet weight; stomach contents	Data from fall and winter combined. Summary for Province.
			bird				4.8				
			plant				7.0				
			insect				2.8				
			other/unspecified				4.0				
Hockman & Chapman 1983	B	B	mammal				67.0		Maryland 1977-78	Piedmont Province - % wet weight; stomach contents	Data from fall and winter combined. Summary for Province.
			bird				9.8				
			plant				15.6				
			insect				0.1				
			other/unspecified				7.5				

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Johnson 1970	B	B	moose	2.2	4.2	-	10.5		Michigan	Isle Royale, forest	Island wilderness with limited prey
			beaver	0.5	2.7	-	-		1966-68	-	diversity. Most moose thought to
			muskrat	11.9	9.6	4.9	5.8			% occurrence;	have been killed by wolves. Near
			snowshoe hare	10.6	11.2	23.0	57.9			scats	total dependence on fruit (mainly
			red squirrel	10.6	10.5	5.6	-				wild sasparilla) in Aug. and Sept.
			deer mouse	8.3	8.5	2.1	21.0				
			birds	15.1	6.7	16.7	-				
			amphibians/reptiles	2.2	2.1	-	-				
			fish	2.5	5.5	-	-				
			insects	8.9	4.6	4.2	-				
			plant matter	7.6	35.6	43.8	5.3				
			(number of scats)	(164)	(198)	(73)	(13)				
			(number of occur.)	(227)	(238)	(84)	(19)				
Knable 1970	A	B	mammals		67.1			170	Illinois	woodland,	Time of year not specified.
			(cottontail)		(25.2)				1956-67	agricultural	
			(prarie vole)		(15.2)					-	
			(deer mice)		(6.4)					% wet weight;	
			birds		10.3					stomach contents	
			reptiles		0.3						
			invertebrates		2.9						
			plants		18.6						
			(persimmon)		(10.2)						
			other/unspecified		0.2						
Knable 1974	A	B	mammals	92.2	37.1	61.7	65.0	18-82	Illinois	farm and woods	
			birds	2.4	43.2	0.2	8.6			-	
			arthropods	0.2	11.6	4.2	<0.1			% wet weight;	
			plants	4.6	6.3	31.1	26.1			stomach contents	
			unspecified/other	0.6	1.8	2.8	0.3				
			(sample size)	(51)	(18)	(32)	(82)				
Korschgen 1959	B	B	rabbits	24.8	10.7	36.5	38.7		Missouri	various	Stomachs from animals caught by
			mice/rats	24.2	6.2	21.3	22.5		1949-54	-	hunters in most counties of the
			poultry	21.0	45.0	16.3	11.6			% wet volume;	state. Only foods with percents
			other mammals	4.0	1.4	8.1	8.2			stomach contents	greater than 1 included.
			carrion	12.9	13.0	6.5	7.4				
			livestock	9.8	0.3	2.0	5.4				
			birds	0.6	1.2	1.1	3.8				
			invertebrates	TRACE	15.3	1.6	TRACE				
			plant foods	2.7	6.9	6.6	2.1				
			(sample size)	(52)	(29)	(86)	(839)				

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Kuehn & Berg 1981	B	B	snowshoe hare				28	430	nc Minnesota 1970-79	NS - % wet weight; stomach contents	Mice and voles included Microtus pennsylvanicus, Peromyscus spp., Clethrionymus gapperi, and Synaptomys cooperi. "Other" included 18 mammalian species, as well as birds, fish, reptiles livestock, domestic poultry, and unidentified.
			mice and voles				19				
			deer				16				
			other				37				
Llewellyn & Uhler 1952	A	B	insects			3	3	33	Maryland	mixed, wildlife ref. - % volume; how determined not specified	Values read from histograms.
			birds			8	2				
			rodents			28	48				
			rabbit			10	45				
			beechnut			17					
			pokeberry			9					
			grapes			3					
			persimmon			22					
			other				2				
MacGregor 1942	B	B	skunk			19.7		57	Massachusetts 1937-38	forested - % total volume; stomach contents	In the 1930's and 1940's, the meadow vole (Microtus pennsylvanicus) was called a field mouse or meadow mouse. We assume the author's listing of "field mouse" means meadow vole.
			rabbit			17.9					
			apple (fruit)			17.0					
			woodchuck			6.1					
			chicken			5.4					
			shrew			4.5					
			deer mouse			4.4					
			porcupine			4.2					
			horse			3.5					
			meadow vole			3.0					
			grass			2.5					
			muskrat			2.3					
			blueberry			2.1					
			other			< 2					
Major & Sherburne 1987	A	B	deer	5	1	-	15		w Maine 1979-82	coniferous forest - % occurrence; scats	
			hare	84	32	83	61				
			small mammals	11	48	50	32				
			birds	11	8	-	17				
			insects	5	14	-	-				
			raspberries	-	43	17	-				
			other fruit	-	13	-	-				
			(sample size)	(19)	(79)	(6)	(82)				

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Pils & Martin 1978	B	B	small mammals				2	85	s Wisconsin	various	Season not specified. 17 of samples were empty stomachs. Foxes collected off the Waterloo Study Area. Most collected in winter. In the Pils and Martin (1978) study, data are reported as % biomass; we assume this is equivalent to % wet weight. TR = trace.
			cottontails				66		1972-75	-	
			unknown mammals				10			estimated % wet weight; stomach contents	
			pig				1				
			domestic fowl				9				
			pheasant				8				
			unknown birds				4				
			plants (e.g. grass & corn)				TR				
Pils & Martin 1978	B	B	small mammals				4	47	s Wisconsin	various	Season not specified. 13 of sampled stomachs were empty. Foxes collected on the Waterloo Study Area. Most collected in winter. TR = trace.
			cottontails				49		1972-75	-	
			opossums				11			estimated % wet weight; stomach contents	
			skunk				7				
			domestic fowl				15				
			pheasant				3				
			unknown birds				8				
			plants (e.g. grass, corn)				TR				
			other/unspecified				3				
Pils & Martin 1978	B	B	cottontail	34.6				58	s Wisconsin	various	Data from March to July.
			muskrat	5.3					1972-75	-	
			fox squirrel	2.1						estimated % wet weight of prey found in dens	
			unknown mammal	2.1							
			domestic rabbit	5.4							
			opossum	3.1							
			raccoon	6.9							
			pig	1.4							
			ring-necked pheasant	17.2							
			mallard duck	1.0							
			domestic fowl								
			chicken	11.3							
			duck	3.2							
			goose	1.4							
			other/unspecified	5.0							
Pils & Martin 1978	B	B	small mammals				4.5	47	s Wisconsin	farm, pasture, woods	Percent biomass based on winter tracking of red foxes--frequency of kills.
			cottontail				80.8		1972-75	-	
			pheasant				6.5			estimated % wet weight; winter kills	
			unknown passerine				0.8				
			great horned owl				6.7				
			mourning dove				0.7				

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Pils & Martin 1978	B	B	cottontail	37	21	72	57.5	-	s Wisconsin	various	Sample sizes: 132 stomachs; 1,020
			skunk	-	-	-	3.5		1972-75	-	scat samples; 58 dens; and 182.6 km
			opossum	-	-	-	3.5			estimated % wet	of tracking.
			raccoon	5	-	-	7.5			weight; summary of	
			unknown mammal	16	44	12	7			den, scat, stomach	
			ring-necked pheasant	10	2	4	3			content and winter	
			domestic fowl	12	5	4	5			tracking data	
			unknown small mammal	-	2	1	2				
			muskrat	3	-	-	-				
			other birds	11	-	-	-				
			other	6	26	7	11				
Powell & Case 1982	B	B	rabbits				44.4	188	Nebraska	statewide	Summary of study below.
			small mammals				33		1978-79	-	
			pheasant				8.4			% wet volume;	
			other birds				11.2			stomach contents	
			misc.				2.0				
			not accounted for				1.0				
Powell & Case 1982	B	B	eastern cottontail				44.0	188	Nebraska	statewide	Measured by water displacement
			white-footed mouse				7.4		1978-79	-	method.
			vole (Microtus sp.)				5.9			% wet volume;	
			harvest mouse				3.0			stomach contents	
			jack rabbit(Lepus sp				5.2				
			unident. mammal				1.6				
			house mouse				1.3				
			Norway rat				2.5				
			striped skunk				2.6				
			grasshopper mouse				0.6				
			fox squirrel				2.2				
			raccoon				0.7				
			muskrat				0.7				
			unident. bird				6.3				
			ring-necked pheasant				8.4				
			meadowlark				2.0				
			domestic poultry				0.9				
			bobwhite				0.8				
			horned lark				0.5				
			mallard				0.5				
			powdery meal				1.2				
			apple				0.5				
			other/unspecified				1				

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Richards & Hine 1953	B	B	pheasant				2	63	sw Wisconsin	various - % occurrence; stomach contents	Sample includes 4 gray fox; trapped animals. Voles include prairie, meadow, and other Microtus spp.; mice include deer, other Peromyscus spp., harvest, and jumping.
			cottontail rabbit				45				
			muskrat				2				
			voles				50				
			mice				14				
			skunk				3				
			domestic cat				2				
			chicken				27				
			flicker				2				
			unident. bird				2				
			corn				7				
			deer				2				
			rat				2				
			woodchuck				3				
Richards & Hine 1953	B	B	upland game birds	18				33	sw Wisconsin 1948	various - % frequency of occurrence; prey remains at dens	Season is April to July. N = the number of dens. Upland game birds include pheasant, quail, and ruffed grouse; squirrels includes fox and gray; rodents include spermophile, chipmunk, deer mouse and Norway rat; and misc. birds include redwing, cardinal, flicker, meadowlark, catbird, crow, and unident. songbirds.
			cottontail rabbit	42							
			woodchuck	39							
			squirrels	48							
			muskrat	12							
			skunk	6							
			opossum	6							
			weasel	15							
			rodents	15							
			pig	9							
			chicken	88							
			misc. birds	66							
Sargeant et al. 1986	B	B	plants				49	70	ec N Dakota 1982-83	prairie farmland - % wet volume; stomach contents	Data from mean of two years. Foods making up less than 2% not included. Author notes that sunflowers have recently become one of the principal crops of N Dakota and waste seeds are often available in fall and winter.
			(sunflower seeds)				(47.5)				
			mammals				41				
			(Leporidae)				(10.5)				
			(Sciuridae)				(3)				
			(Cricetidae)				(20)				
			(Cervidae)				(5)				
			birds				3				
			refuse (carrion)				5.5				
			other				1.5				
Scott 1943 (regalis)	B	B	mammals		43.5			1,454	Iowa 1938-41	various - % frequency of occurrence in scats	Season = year round. Calculated from means of the three years of the study. A detailed breakdown of number of occurrences for 110 food types by month available in the Appendix of the original article.
			birds		14.7						
			invertebrates		23.2						
			plants		17.6						

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
HOME RANGE SIZE													
Ables 1969	A	M	-	-	512		ha			1	Wisconsin	diverse farmland	As cited in Samuel and Nelson 1982, and Maurel 1980.
Ables 1969	A	M	-	-	717		ha			1	Wisconsin 1964-65	mixed: marsh, forest, prairie, shrubs, savannah	Foxes tracked by radiotelemetry for 13 consecutive months. Home range size estimated from fixes using modified minimum area method.
	A	F	-	-	96		ha	57	170	3			
	J	M	-	-	78		ha			1			
	Y	F	-	-	167		ha	142	191	2			
Johnson, Siniff, & Warner (unpubl)	-	-	-	-			ha		1,040		NS	prairie pothole	As cited in Johnson and Sargeant 1977.
	-	-	-	-			ha		1,300				
Jones & Theberge 1982	A	B	-	SU	1,611		ha	277	3,420	7	nw British Columbia	alpine and subalpine	Number of radiotracking fixes for each animal was between 41 and 100.
	A	M	-	SU	1,967		ha	514	3,420	4			
	A	F	-	SU	1,137		ha	277	1,870	3			
Jones & Theberge 1982	A	M	-	-	1,967		ha				59.8 N latitude	NS	
	A	F	-	-	1,137		ha						
Kuehn & Berg 1981	J	M	-	WI	335		ha	90	580	2	nc Minnesota 1970-79	NS	Foxes fit with radiocollars; home ranges determined using the minimum area technique of Dalke and Sime (1938).
	J	F	-	WI	220		ha			1			
	A	F	-	WI	620		ha	330	980	3			
Major & Sherburne 1987	B	B	-	-	1,990		ha			4	w Maine 1979-82	forest and bogs	
Pils et al. 1981	-	-	-	-	1,037		ha				Wisconsin	NS	Supporting data not presented.
Sargeant 1972	A	F	-	SP	699	137 SD	ha	596	855	3	e c Minnesota 1964	woods, fields, swamp	May-June.
Sargeant et al. 1987	A	B	-	-	1,190	550 SD	ha/family	330	2,140	12	N Dakota	prairie farmland	Season = spring and summer. Some overlap found between the edges of fox and coyote territories.
Storm et al. 1976	-	-	-	-	960		ha/family				NS	NS	
Tullar & Berchielli 1980	J	B	-	SU	72.5		ha			137	sw New York	farm & woods	Estimated home range of pups during their first summer.
Voigt & Tinline 1980	-	-	-	-	900		ha	500	2,000		Ontario, CAN	farmland	As cited in Voigt 1987.

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
POPULATION DENSITY													
Ables 1974	B	B	-	-			N/ha	0.046	0.077		NS	"good fox range"	Summarizing maximum densities found in the United States.
Sargeant et al. 1975	B	B	BR	-	0.0010		family/ha	0.0005	0.0014	270	e N Dakota 1969-1973	prairie farmland	Min and max are means for one of the five years of the study. Based on aerial censuses of six townships in April (1969 only), May and June of each year.
Tullar & Berchielli 1980	B	B	BR	SP	0.0010		family/ha	0.0008	0.0011	151	nw New York 1972-77	farm & woods	Min and max are means from one of the five years of the study. About one third of the families were found to have ranges that overlapped those of other families.
Voigt 1987	B	B	-	SP	0.001		N/ha				n Ontario, CAN	northern boreal forests/arctic tundra	Summarizing his own unpublished data.
Voigt 1987	B	B	-	SP	0.01		N/ha				s Ontario, CAN	southern habitats	Summarizing his own unpublished data.
LITTER SIZE													
Allen 1984	-	-	1	-	4.96	2.94 SD				24	North Dakota	prairie potholes	Different years of the study: (1) 1972; (2) 1973; (3) 1974; (4) 1975; (5) 1976; (6) 1977; (7) mean across all years. Litter size determined by embryo count. Data averaged for all age females each year.
	-	-	2	-	4.07	2.05 SD				29			
	-	-	3	-	2.80	1.91 SD				20			
	-	-	4	-	3.50	2.62 SD				14			
	-	-	5	-	4.86	2.13 SD				42			
	-	-	6	-	4.29	2.06 SD				7			
	-	-	7	-	4.08		mean			136			
Allen 1984	-	-	1	-	3.13	2.31 SD				60	North Dakota	NS	Litter size determined by embryo counts. Females were divided into age groups; (1) 1 year old, and so on; (8) 8 years old.
	-	-	2	-	4.73	2.25 SD				26			
	-	-	3	-	4.85	2.19 SD				13			
	-	-	4	-	5.58	1.89 SD				19			
	-	-	5	-	4.75	1.28 SD				8			
	-	-	6	-	5.33	2.80 SD				6			
	-	-	7	-	6.50	0.71 SD				2			
	-	-	8	-	6.5	0.71 SD				2			
Dekker 1983	-	-	-	-	5			3	7	10	Alberta, CAN 1972-81	agricultural fields	

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Harris & Smith 1987	-	-	1	-	4.53	1.54 SD					Bristol, UK 1971-77	Urban	Age of female: (1) 1 year; (2) 2 years; (3) 3 years; (4) 4 years; (5) > 4 years; (6) mean across all ages.
	-	-	2	-	4.90	1.42 SD							
	-	-	3	-	4.75	1.73 SD							
	-	-	4	-	4.73	1.66 SD							
	-	-	5	-	4.94	1.70 SD							
	-	-	6	-	4.72	1.55 SD	mean			252			
Harris & Smith 1987	-	-	1	-	4.65	1.43 SD					London, UK 1971-77	urban	Age of female: (1) 1 year; (2) 2 years; (3) 3 years; (4) 4 years; (5) > 4 years; (6) mean across all ages.
	-	-	2	-	5.06	1.74 SD							
	-	-	3	-	4.95	1.25 SD							
	-	-	4	-	4.89	1.29 SD							
	-	-	5	-	3.45	1.44 SD							
	-	-	6	-	4.76	1.52 SD	mean			192			
Hoffman & Kirkpatrick 1954	-	-	-	-	6.8	0.338 SE		4	13	30	Indiana 1947-49	various	Based on horn enlargements and embryo counts. Female found with 13 normal appearing fetuses.
Pils & Martin 1978	-	-	1	-	5.2					27	s Wisconsin 1972-75	farm, marsh, pasture	Estimates (1) from excavated dens, (2) from embryo counts, (3) from placental scars.
	-	-	2	-	5.5					26			
	-	-	3	-	6.4					17			
Pils & Martin 1978	Y	-	-	-	5.9			2	8	22	s Wisconsin 1972-75	farm, pasture, woods	Average value of litters captured at dens, placental scars, and embryos. Y = yearling female.
	A	-	-	-	6.0			3	10	26			
	B	-	-	-	5.6			1	10	70			
Pils & Martin 1978	-	-	1	SP	5.4						s Wisconsin	farm, pasture, woods	(1) Average of 1972-75; (2) 1972, pups in dens; (3) 1973-75 pups, (4) 1973-75 placental scars, and (5) 1973-75 embryos.
	-	-	2	SP	4.6								
	-	-	3	SP	5.9								
	-	-	4	SP	5.9								
	-	-	5	SP	5.2								
Pils et al. 1981	A	-	1	-	6.9					326	Wisconsin 1976-78	NS	(1) Embryo count; (2) placental scars. Y = yearling female.
	A	-	2	-	5.4					43			
	Y	-	2	-	5.6					56			
Richards & Hine 1953	-	-	1	-	5.1	0.3 SE				25	sw Wisconsin 1946-50	various	(1) Live pups; (2) placental scars.
	-	-	2	-	5.1	0.2 SE				103			
Schoonmaker 1938	-	-	-	-	4.4						New York	NS	As cited in Storm et al. 1976; live pups.
Sheldon 1949	-	-	-	-	5.4						New York	NS	As cited in Samuel and Nelson 1982.
Stanley 1963	-	-	-	-	4.5						Kansas	NS	As cited in Samuel and Nelson 1982.

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Storm et al. 1976	-	-	1	SP	7.1						Illinois, Iowa	farms and woods	(1) Placental scars; (2) embryos; (3) live postpartum juveniles; (4) Illinois, pups in den; (5) Iowa, pups in den.
	-	-	2	SP	6.8								
	-	-	3	SP	4.2								
	-	-	4	SP	3.8			1	12	175			
	-	-	5	SP	3.5			1	10	384			
Storm et al. 1976	-	-	-	-	6.8			2	9	34	Illinois	farm and woods	Embryo count.
Storm et al. 1976	-	-	-	-	6.7			3	12	48	Iowa	farm and woods	Embryo count.
Switzenberg 1950	-	-	1	-	4.2						Michigan	NS	Live pups: (1) upper Michigan; (2) lower Michigan. As cited in Samuel and Nelson 1982.
	-	-	2	-	5.4								
DAYS GESTATION													
Asdell 1946	-	-	-	-	51-53		days				NS	NS	As cited in Voigt 1987.
Scott 1943	-	-	-	-	51		days				Iowa	NS	Approximate value.
Sheldon 1949	-	-	-	-	51-54		days				New York	NS	As cited in Samuel and Nelson 1982.
Storm et al. 1976	-	-	-	-	52		days				Illinois, Iowa	farm and woods	
AGE AT WEANING													
Ables 1974	-	-	-	-	8 - 10		weeks				NS	NS	Pups appear outside the den at about one month, and are weaned four to six weeks later.
Sargeant 1978	-	-	-	-	28-35		days				North Dakota	NS	Age leave the den; values approximate.
AGE AT SEXUAL MATURITY													
Asdell 1946	-	F	-	-	10		months				NS	NS	As cited in Samuel and Nelson 1982.
Storm et al. 1976	-	F	-	-	10		months				Illinois, Iowa	farm and woods	
ANNUAL MORTALITY													
Harris & Smith 1987	J	M	-	-	57.3		% as cubs				Bristol, UK 1971-77	urban	
	J	F	-	-	54.4		% as cubs						
	A	M	-	-	50.0		%/year						
	A	F	-	-	49.8		%/year						

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Harris & Smith 1987	J	M	-	-	66.2		% as cubs				London, UK 1971-77	urban	
	J	F	-	-	64.2		% as cubs						
	A	M	-	-	53.0		%/yr						
	A	F	-	-	56.0		%/yr						
Pils & Martin 1978	-	-	-	-	75.5		%/yr 1973				s Wisconsin 1973-75	various	Considered survival and recovery rates as function of the year recovered, independent of age.
	-	-	-	-	78.7		%/yr 1974						
	-	-	-	-	83.9		%/yr 1975						
	-	-	-	-	79.4		%/yr avg						
Pils & Martin 1978	-	-	-	-	76.5		%/yr 1973				s Wisconsin 1973-75	various	Assumed recovery rates were constant while survivorship rates were a function of year only and were independent of age.
	-	-	-	-	77.5		%/yr 1974						
	-	-	-	-	84.6		%/yr 1975						
	-	-	-	-	79.5		%/yr avg			3 yr			
Pils & Martin 1978	J	-	-	-	90		%/yr				s Wisconsin 1973-75	various	Estimated using life-table analysis to predict juvenile mortality from the remaining information.
	Y	-	-	-	80		%/yr						
	A	-	-	-	70		%/yr						
Pils et al. 1981	-	B	-	-			%/yr	75	85		Wisconsin 1973-75	NS	
Storm et al. 1976	J	M	-	-	83		%/yr				Illinois, Iowa 1966-70	farms and woods	
	J	F	-	-	81		%/yr						
	A	F	-	-	74		%/yr			45			
	A	B	-	-	77		%/yr			62			
LONGEVITY													
Ables 1974	-	B	-	-	< 1		yr		3 - 4		North America	NS	Summarizing other study findings.
Harris & Smith 1987	B	M	-	-	1.01		years			571	London, UK 1971-77	urban	
	B	F	-	-	1.03		years			551			
Harris & Smith 1987	B	M	-	-	1.38		years			904	Bristol, UK 1971-77	urban	
	B	F	-	-	1.48		years			732			
Kuehn & Berg 1981	A	M	-	-			years		8.5	2	nc Minnesota 1970-79	NS	Of 816 trapped animals, only 6% exceeded 2.5 years of age.
Storm et al. 1976	-	-	-	-	<1.5		years		6	1	Iowa	NS	Based on recovery of an individual tagged as a juvenile.
Tullar 1983	A	F	-	-			years		8.5	1	New York	farm & woodland	Recapture of animal tagged as a pup.

*** SEASONAL ACTIVITIES ***

Reference	Begin	Peak	End	Location	Habitat	Notes
MATING						
Allen 1984	Jan 22	Feb 3-12	Feb 21	N Dakota	prairie	
Layne & McKeon 1956		Jan, Feb		New York	NS	As cited in Samuel and Nelson 1982.
Pils & Martin 1978	Dec 27	Jan 14	Feb 3	Wisconsin	various; Waterloo	Data reflects the conception date found in the study.
Scott 1943	late Dec		earl Jan	Iowa	fields & woods	
Sheldon 1949	late Dec		March	New York	NS	As cited in Samuel and Nelson 1982.
Storm et al. 1976	earl Dec	mid Jan	mid Feb	nw Illinois	farm, woods	
Storm et al. 1976	earl Dec	late Jan	late Feb	Iowa	farm, woods	
Storm et al. 1976		Jan-earl Feb		N Dakota	farm, woods	Cites N Dakota Game and Fish Department.
Voigt 1987	late Jan		earl Feb	s Ontario, CAN	NS	Summary of other studies (latitude 40-45 N).
Voigt 1987	Feb		March	n Ontario, CAN	NS	Summary of other studies (latitude 60-80 N).
PARTURITION						
Pils & Martin 1978	Feb 16	Mar 8	Mar 28	Wisconsin	various; Waterloo	
Sargeant 1972; Sargent et al. 1975		late Mar/Apr		e N Dakota	prairie	
Sargeant et al. 1981	earl Mar	Mar 31	late Apr	N Dakota	prairie	
Voigt 1987		Mar		southern CAN	NS	
Voigt 1987		May		northern CAN	arctic	
FALL MOLT						
Voigt 1987	Apr		Jun	NS	NS	

Reference	Begin	Peak	End	Location	Habitat	Notes
DISPERSAL						
Phillips & et al. 1972	late Sep			nw Illinois, ne Iowa	farm & woodlands	
Pils & Martin 1978	Oct		Mar	Wisconsin	various; Waterloo	Dates are for subadult animals.
Storm et al. 1976	late Sep		Mar	Illinois, Iowa	farm, woods	Males dispersed earlier than females.
Tullar & Berchielli 1980	Oct			New York	farm & woodlots	

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***** RACCOON *****

*** NORMALIZING AND CONTACT RATE FACTORS ***

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
BODY WEIGHT													
Fritzell et al. 1985	Y	F	P	-	6,640	930 SD	g			115	n Illinois 1979-81	NS	P = parous female, NP = nulliparous female.
	Y	F	NP	-	6,800	1,070 SD	g			59			
	A	F	P	-	7,090	1,060 SD	g			149			
	A	F	NP	-	7,140	750 SD	g			7			
Johnson 1970 (various)	A	M	-	-	4,309		g		8,800	277	Alabama	NS	Summary of the four Johnson 1970 records below.
	A	F	-	-	3,674		g		5,900	174			
Johnson 1970 (various)	A	M	-	WI	4,850		g			69	ec Alabama	NS	Values estimated from graphs.
	A	F	-	WI	3,860		g			37			
	A	M	-	SP	3,450		g			10			
	A	F	-	SP	3,180		g			8			
Johnson 1970 (various)	A	M	-	SU	5,171		g			1	ec Alabama	NS	Values estimated from graphs.
	A	F	-	SU	3,720		g			2			
	A	M	-	FA	5,350		g			12			
	A	F	-	FA	4,360		g			17			
Johnson 1970 (various)	A	M	-	FA	3,770		g			30	sw Alabama	NS	Values estimated from graphs.
	A	F	-	FA	3,770		g			30			
	A	M	-	WI	4,310		g			56			
	A	F	-	WI	3,360		g			30			
Johnson 1970 (various)	A	M	-	SP	3,540		g			32	sw Alabama	NS	Values estimated from graphs.
	A	F	-	SP	3,270		g			15			
	A	M	-	SU	4,220		g			7			
	A	F	-	SU	3,540		g			9			
Kaufmann 1982	A	B	-	-			g	3,600	9,000		United States	NS	Males outweigh females by 10 to 15%. Northern specimens are heavier than those in the south.
Kaufmann 1982	J	-	-	FA			g	2,700	3,200		Alabama	NS	
Kaufmann 1982	J	-	-	FA			g		7,000		Missouri	NS	
Moore & Kennedy 1985	A	F	-	WI	4,300		g				Tennessee	NS	Total sample size (males and females) = 98 raccoons captured 256 times.
	A	F	-	SP	3,330		g						
	A	F	-	SU	3,700		g						
	A	F	-	FA	3,700		g						

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Moore & Kennedy 1985	A	M	-	WI	5,670		g				Tennessee	NS	Total sample size (males and females) = 98 raccoons captured 256 times.
	A	M	-	SP	4,280		g						
	A	M	-	SU	4,900		g						
	A	M	-	FA	5,100		g						
Nagel 1943	-	B	-	-	6,455		g			8,180	Missouri	statewide	Caught in Missouri raccoon season.
	-	M	-	-	6,759		g			5,371			
	-	F	-	-	5,742		g			2,809			
Sanderson 1984	A	M	-	-	7,600		g	7,000	8,300	2,115	wc Illinois	NS	NP = nulliparous female; P = parous female.
	A	F	NP	-	6,000		g	5,100	7,100	361			
	A	F	P	-	6,400		g	5,600	7,100	1,728			
	J	M	-	-	5,100		g	4,600	5,700	4,704			
	J	F	-	-	4,800		g	4,200	5,300	4,154			
Sanderson & Hubert 1981	A	M	-	-	7,740	89 SE	g			241	wc Illinois, 1955-80	NS	P = parous female; NP = nulliparous female.
	A	F	P	-	6,560	78 SE	g			183			
	A	F	NP	-	6,160	154 SE	g			52			
Sanderson & Hubert 1981	A	M	-	-	6,440	79 SE	g			149	se Illinois, 1955-80	NS	P = parous female; NP = nulliparous female.
	A	F	P	-	5,340	66 SE	g			135			
	A	F	NP	-	5,620	146 SE	g			15			
Sanderson & Hubert 1981	A	M	-	-	8,860	138 SE	g			126	nc Illinois, 1955-80	NS	P = parous female; NP = nulliparous female.
	A	F	P	-	7,560	108 SE	g			122			
	A	F	NP	-	7,600	237 SE	g			25			
Stuewer 1943a	A	M	-	WI	6,209		g			2	Michigan	riparian	
	A	M	-	SP	5,131		g			15			
	A	M	-	SU	6,521		g			23			
	A	M	-	FA	7,399		g			7			
Stuewer 1943a	A	F	-	WI	3,855		g			2	Michigan	riparian	
	A	F	-	SP	4,734		g			11			
	A	F	-	SU	5,358		g			23			
	A	F	-	FA	6,917		g			4			
NEONATE WEIGHT													
Ewer 1973	N	-	-	-	62-98		g				NS	NS	As cited in Eisenberg 1981.
Hamilton 1936	N	-	-	-	75		g				w New York	captive	
Stuewer 1943b	N	-	-	-	61.7		g			3	Michigan	riparian	

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
PUP WEIGHT													
Hamilton 1936	N	-	-	-	75	newborn SD	g				w New York	captive	
	P	-	-	-	200	7 days SD	g						
	P	-	-	-	450	19 days SD	g						
	P	-	-	-	570	30 days SD	g						
	P	-	-	-	680	40 days SD	g						
	P	-	-	-	910	50 days SD	g						
PUP GROWTH RATE													
Hamilton 1936	P	B	1	-	17		g/day				w New York	captive	Average growth rate for age classes: (1) 0-7 days; (2) 8-19 days; (3) 20-30 days; (4) 31-40 days; (5) 41-50 days.
	P	B	2	-	21		g/day						
	P	B	3	-	11		g/day						
	P	B	4	-	12		g/day						
	P	B	5	-	23		g/day						
Montgomery 1969	P	-	1	-	17.8		g/day				1962-63	lab	Different ages: (1) birth to 6 weeks; (2) approx. 6-9 weeks; (3) 10-16 weeks of age. All values combine two years of data.
	P	-	2	-	3.9		g/day						
	P	-	3	-	29.5		g/day						
Stuewer 1943b	P	F	-	SU	24.9		g/day			1	Michigan	riparian	Up to 14 weeks after birth.
	P	M	-	SU	26.4		g/day			2			
	P	B	-	SU	25.9		g/day			3			
METABOLIC RATE (OXYGEN)													
Mugaas et al. 1984	B	B	1	WI	9.36	1.68 SD	lO2/kg-day				Washington DC	National Zoo	Probably resting; conditions of experiment not described in abstract. Temperature ranges: (1) 15-35 C; (2) 5-10 C; (3) 25-35 C; (4) 20 C. Equations relating metabolic rate to ambient temperature provided.
	B	B	2	WI	11.04		lO2/kg-day						
	B	F	3	SU	8.64	1.68 SD	lO2/kg-day						
	B	M	3	SU	10.5		lO2/kg-day						
	B	B	4	SU	11.52		lO2/kg-day						
METABOLIC RATE (KCAL BASIS)													
Teubner & Barrett 1983	J	B	-	-	303.8		kcal/kg-d			4	Ohio	lab	Kcal ingested minus non-assimilated and growth energy.
	Y	-	-	-	402.1		kcal/kg-d			1			
FOOD INGESTION RATE													
Teubner & Barrett 1983	J	B	-	-	363.1	10.2 SD	kcal/kg-d			4	Ohio	lab	
	Y	B	-	-	457.0	10 SD	kcal/kg-d			1			

*** DIET ***

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Alexander 1977	B	B	trout	19				30	n. lower Michigan	aquatic - % wet weight; stomach contents	Year round.
			non-trout fish	4							
			crustaceans	14							
			molluscs	3							
			insects	3							
			amphibians	12							
			birds and mammals	19							
			vegetation	17							
			unidentified	9							
Dorney 1954	A	B	muskrat kits		34	9			Wisconsin 1949-50	marsh - % dry volume; scats	Age and sex not specified.
			muskrat adult	12	1	1					
			crayfish	31	31	16					
			fish	9	2	13					
			snails	2	3	10					
			corn	35	1	3					
			grapes		3	35					
			plums		9	2					
			other	11	16	11					
			(sample size)	(41)	(98)	(152)					
Hamilton 1951	A	B	fruits		37.9			94	New York 1947-50	NS - % wet volume; stomach contents	Season = April through October.
			insects		8.2						
			mammals		14.3						
			grains (e.g. corn)		14.7						
			earthworms		7.2						
			amphibians		4.4						
			vegetation		6.1						
			reptiles		3.0						
			molluscs		1.9						
			birds		1.5						
			carrion		1.5						
			unspecified		0.2						
Hamilton 1940	B	B	wild cherry		38.15			163	New York 1939	marsh - % dry volume; dry scats	Scats collected in July & September 1939.
			silky cornel		26.56						
			corn		6.65						
			insects		4.26						
			muskrat		4.07						
			grapes		3.70						
			mice		3.06						
			turtle		2.23						
			other		11.32						

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Hamilton 1936	A	B	buckwheat				15.78	127	w New York 1927-34	various - % by bulk; visceral tracts	Visceral tracts collected from hunters from mid November through late January.
			apples				14.33				
			beechnuts				14.17				
			acorns				5.96				
			garbage				1.51				
			mice				8.04				
			corn				8.23				
			earthworms				8.44				
			fruit and berries				10.70				
			crayfish				1.92				
			insects				7.19				
			grasses and leaves				4.61				
			birds				0.53				
Johnson 1970 (various)	B	B	plant material	90	90	90	53		Alabama	various - % occurrence; stomach, large intestine, and scats	Number of each type of sample not provided: Author feels combining the sample types provides a better overall picture of the diet than one type alone.
			(fruits)	(72)	(80)	(78)	(26)				
			(acorns, pecans)	(1)	(0)	(8)	(18)				
			(corn)	(1)	(12)	(3)	(10)				
			(tubers - chufa, groundnut)	(15)	(2)	(5)	(5)				
			animal material	39	34	25	44				
			(insects)	(33)	(32)	(22)	(23)				
			(crayfish)	(6)	(2)	(5)	(20)				
			(earthworms)	(0)	(0)	(TR)	(5)				
			(molluscs)	(0)	(0)	(0)	(6)				
			(fish)	(0)	(0)	(1)	(1)				
			(frogs)	(0)	(0)	(1)	(0)				
			(reptiles)	(2)	(0)	(TR)	(0)				
			(birds)	(2)	(2)	(TR)	(6)				
			(mammals)	(2)	(0)	(0)	(4)				
			(unidentified)	(5)	(12)	(8)	(13)				
			sample size	82	41	260	93				
Llewellyn & Uhler 1952	-	B	crayfish	37	8	3	9	520	Maryland 1943-46	forested bottomland - % wet volume; digestive tract	
			snails	5	5	3	6				
			insects	40	39	18	12				
			reptiles/amphibians	6	5	3	7				
			fish	3	2	TR	2				
			rodents	7	2	TR	8				
			corn	0	1	2	19				
			Smilax	0	TR	TR	6				
			acorns	0	TR	5	17				
			pokeberry	0	TR	17	2				
			wild cherry	0	17	2	0				
			blackberries	0	16	TR	0				
			grapes	0	TR	23	8				
			persimmon	0	0	11	7				

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
McComb 1981	A	B	corn			4.8	(12.1)		e Connecticut	forested	
			acorns			2.4	(7.1)			-	
			grapes			8.6	(21.2)			average weight (g)	
			apples			1.5	(5.2)			found in stomach and	
			pokeweed			0.2	(0.1)			intestines	
			other plants			1.5	(8.9)			(standard deviation	
			invertebrates			0.15	(0.35)			in winter column)	
			vertebrates			0.47	(1.40)				
			total ingested			19.62					
McComb 1981	A	B	corn			10.0	(22.2)		e Connecticut	agricultural	
			acorns			5.5	(10.4)			-	
			grapes			3.3	(12.6)			average weight (g)	
			apples			1.7	(10.2)			found in stomach and	
			pokeweed			0.8	(4.6)			intestines	
			other plants			2.6	(6.8)			(standard deviation	
			invertebrates			0.49	(1.93)			in winter column)	
			vertebrates			1.07	(4.38)				
			total ingested			25.5					
McComb 1981	A	B	corn			3.1	(10.8)		e Connecticut	urban	
			acorns			1.8	(4.5)			-	
			grapes			8.2	(16.2)			average weight (g)	
			apples			0.6	(2.7)			found in stomach and	
			pokeweed			0.4	(1.2)			intestines	
			other plants			0.5	(1.8)			(standard deviation	
			invertebrates			0.06	(0.09)			in winter column)	
			vertebrates			0.47	(1.36)				
			total ingested			15.13					
Schoonover & Marshall 1951	B	B	crayfish		31.60			135	nc Minnesota 1948-49	wildlife refuge	Age and sex not specified.
			juneberries		26.8					-	
			grasshoppers		10.5					% dry volume; scats	
			acorns		8.0						
			debris		5.7						
			meadow voles		2.7						
			plums		2.6						
			raspberries		2.5						
			other		10.2						
Stuewer 1943a	B	B	acorns	44.89	0	10.87	45.40		Michigan 1939-40	riparian	Other mammals includes squirrel and cottontail; birds includes chicken, gallinaceous birds, pheasants, and non game birds, and; other berries includes dogwood berries, sand cherries, blueberries, and Rubus sp. berries.
			corn	18.36	0	26.09	18.18			-	
			earthworms	14.28	0	2.17	18.18			% occurrence; scats	
			snails	16.32	6.66	0	18.18				
			insects	18.36	40.00	17.39	9.09				
			grapes	2.04	53.33	78.26	9.09				
			crustacea	0	0	0	9.09				
			Microtus	32.65	0	0	0				
(continued)			crayfish	34.69	13.33	10.85	0				

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Stuewer 1943a (continued)			buds	4.08	0	0	0				
			fish	12.24	0	4.34	0				
			moths	2.04	0	0	0				
			other mammals	4.08	0	0	0				
			frogs	10.20	0	0	0				
			snakes	4.08	0	0	0				
			birds	8.16	0	2.17	0				
			elderberry (Sambucus	0	0	10.87	0				
			other berries	0	40.00	0	0				
			caterpillars	2.04	6.66	0	0				
			amphipods	0	0	6.52	0				
			ragweed seeds	0	0	2.17	0				
			bark, wood, hair	0	0	0	18.18				
			(sample size)	(11)	(49)	(15)	(46)				
Tabatabai & Kennedy 1988	A	B	frogs	8.1	TR	0	0		Tennessee 1976-82	NS - % wet volume; digestive tract	Volume varied across regions: highest volume for western (across all seasons) = persimmon; for central = persimmon, corn, and sugar hackberry, and; eastern = persimmon and corn.
			fish	1.2	0	0	0				
			birds	TR	0	TR	8.4				
			mammals	1.7	0	1.4	0				
			other/unspecified	7.8	6.7	1.8	7.2				
			persimmon	0	35.8	57.3	27.4				
			corn	57.6	0	10.0	25.9				
			grapes	0	TR	10.2	0				
			pokeberry	0	20.5	4.5	0				
			acorns	0	0	5.4	4.2				
			sugar hackberry	0	0	5.5	18.4				
			cherry	0	29.5	0	0				
			insects	22.0	3.5	2.4	TR				
			crayfish	1.6	4.0	1.5	1.4				
			(sample size)	(11)	(18)	(104)	(74)				
Tabatabai & Kennedy 1988	A	M	persimmon		42.8			111	Tennessee 1976-82	NS - % wet volume; digestive tract	Data reflect all seasons; combined from eastern, central, and western Tennessee.
			corn		15.7						
			sugar hackberry		11.1						
			summer grape		6.7						
			acorns		1.9						
			pokeberry		2.1						
			peppervine		4.2						
			birds		3.9						
			other		TR						
			Alabama supplejack		2.8						
			Virginia creeper		1.5						
			bread		1.5						
			crayfish		1.3						
			frogs		2.4						
			beetles		0.7						
			wood		1.0						
			grasshoppers		0.5						
			voles		1.6						

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Tabatabai & Kennedy 1988	A	F	persimmon		43.8			96	Tennessee 1976-82	NS - % wet volume; digestive tract	Data reflect all seasons; combined from eastern, central, and western Tennessee.
			corn		16.7						
			sugar hackberry		6.1						
			summer grapes		1.9						
			acorns		6.8						
			pokeberry		5.7						
			greenbriar		3.9						
			peppervine		1.9						
			wasps		2.1						
			rabbits		2.1						
			birds		1.1						
			crayfish		1.6						
			wood		1.2						
			Virginia creeper		0.7						
			beetles		0.7						
			grasshoppers		0.5						
			voles		0.5						
			other		2.7						
Tester 1953	A	B	animals			27		94	ne Colorado 1951	riparian - % dry volume; scats	
			(crayfish)			(9.8)					
			(grasshoppers)			(12.4)					
			(small mammals)			(2.0)					
			plants			71.4					
			(corn)			(57.2)					
			(plums)			(6.9)					
			detritus			1.6					
Tyson 1950 (psora)	A	B	Mollusca (mussels & oysters)		44			20	sw Washington 1946	tidewater mudflats - % wet volume; stomach contents	
			Crustacea (shrimp & crabs)		25						
			Pisces (goby & cabezon)		9						
			Annelida (marine worms)		20						
			Echiurida (worm)		1						
Tyson 1950 (psora)	J	B	Crustacea (shrimp & crab)		50			9	sw Washington 1946	tidewater mudflats - % wet volume; stomach contents	
			Mollusca (mussels)		30						
			milk		18						
			Pisces (goby)		2						
			Echiurida (worm)		TR						

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Wood 1954	B	B	mammal				9.1	47	nc Minnesota	forest, prairie	
			bird				0.4		1950-52	-	
			cold-blooded verteb.				1.3			% dry volume; dried	
			insects				26.5			stomach contents	
			other invertebrates				5.5				
			plants				55.4				
			unidentified				1.5				
			other/unspecified				0.03				

***** POPULATION DYNAMICS *****

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
HOME RANGE SIZE													
Cauley & Schinner 1973	-	-	-	-	8.31		ha				NS	urban	As cited in Sherfy and Chapman 1980.
Fritzell 1978	A	M	-	SS	2,560		ha	670	4,946	9	N Dakota	prairie potholes	Spring/summer (SS); measured from
	Y	M	-	SS	1,139		ha	277	2,160	11	1973-75		April through July.
	A	F	G	SS	806		ha	229	1,632	7			
	Y	F	NB	SS	656		ha	222	1,263	8			
Hoffman &	A	M	-	-	15.8		ha			6	Ohio 1973-74	residential, woods	Trap determined minimum home
Gottschang 1977	Y	M	-	-	5.1		ha			6			ranges; based on animals caught
	J	M	-	-	2.8		ha			9			three or more times. Authors
	A	F	-	-	3.8		ha			10			describe the home ranges of this
	Y	F	-	-	4.6		ha			5			population as "extremely linear".
	J	F	-	-	2.3		ha			10			
Kaufmann 1982	A	B	-	-			ha	80	700		United States	NS	Kaufmann observed that most reported home range values reported fall into this range.
Lotze 1979	A	B	1	-	38	9 SE	ha			49	Georgia	coastal island	(1) Based on trapping data; (2)
	A	M	1	-	51	68 SE	ha			35			based on radiotracking. Includes
	A	F	1	-	6	10 SE	ha			14			data from all seasons.
	A	M	2	-	65	18 SE	ha			9			
	A	F	2	-	39	16 SE	ha			2			
Sherfy & Chapman	B	F	-	-	165		ha			7	Maryland	varied	Based on radiotracking data.
1980	B	M	-	-	285		ha			7	1976-77		Females: (1) without young; (2)
	-	F	1	-	122		ha						caring for young. Includes data
	-	F	2		207		ha						from all seasons.
Sherfy & Chapman 1980	B	B	-	-	289		ha			14	Maryland 1976-77	varied	Based on radiotracking data. Mean for all raccoons monitored during study (variety of habitats). Includes data from all seasons.

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Sherfy & Chapman 1980	B	B	-	-	433.7		ha			2	Maryland 1976-77	coastal plain	Based on radiotracking data. Includes data from summer and fall.
Sherfy & Chapman 1980	B	B	-	SP	231		ha			4	Maryland 1976-77	Piedmont	Based on radiotracking data.
Sherfy & Chapman 1980	B	B	-	SP	275		ha			4	Maryland 1976-77	Appalachian	Based on radiotracking data.
Sherfy & Chapman 1980	B	B	-	-	37.4		ha			4	Maryland 1976-77	urban	Based on radiotracking data. Includes data from winter, spring, and summer.
Stuewer 1943a	A	M	-	-	204		ha	18.2	814	19	Michigan 1939-40	riparian	Calculated based on live trapping data; traps located primarily along water bodies. Juvenile data reflects first year of life when animals tend to remain with their mothers. Season = May to December in 1939 and May to October in 1940.
	A	F	-	-	108		ha	5.3	376	17			
	J	M	-	-	108		ha	2.0	719	27			
	J	F	-	-	45		ha	2.0	323	24			
Urban 1970	-	-	-	-	48.4		ha			9	Lake Erie, Ohio	Sandusky Bay/marsh	
POPULATION DENSITY													
Cowan 1973	-	-	-	-			N/ha	0.015	0.032		Manitoba, CAN	prairie	As cited in Kaufmann 1982.
Dorney 1954	B	-	-	SP	0.022		N/ha				Wisconsin 1950	marsh	
Fritzell 1978	B	B	-	SP			N/ha	0.005	0.01		e N Dakota	prairie potholes	Supporting data not provided.
Hoffman & Gottschang 1977	-	-	-	-	1.46		N/ha				Ohio 1973-74	residential, woods	Study area = 234.1 ha.
Johnson 1970 (various)	-	-	-	WI	0.12		N/ha			4	Alabama 1962-63		
Kaufmann 1982	-	-	-	-			N/ha		0.20		nw & e US	bottomlands, marshes	Summary of studies by Yeager & Rennels 1943; Butterfield 1944; Dorney 1954, Urban 1970, Van Druff 1971.
Slate 1980	-	-	-	-	0.13		N/ha				New Jersey		As cited in Sanderson 1987.
Sonenshine and Winslow 1972	-	-	-	-	0.17		N/ha				Virginia		As cited in Sanderson 1987.

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Stuewer 1943a	-	B	-	SU	0.025		N/ha				Michigan 1939	marsh, riparian	Considered a maximum estimate (just after birth of young).
Urban 1970	-	-	1	SP	0.17		N/ha				Lake Erie, Ohio 1967-68	Sandusky Bay/marsh	Calculation method: (1) Schumacher-Eschmeyer Formula; (2) Lincoln Index; (3) Hayne's method; (4) Average of the three methods.
	-	-	2	SP	0.21		N/ha						
	-	-	3	SP	0.14		N/ha						
	-	-	4	SP	0.17		N/ha						
Yeager & Rennels 1943	-	-	-	-	0.07		N/ha	0.04	0.16	881	Illinois 1940-41	NS	Value = number of raccoons captured; not representative population estimate. Sample size = 881 hectares. As cited in Sanderson 1987.
LITTER SIZE													
Asdell 1964	-	-	-	-				2	5		NS	NS	
Clark et al. 1989	A	-	-	FA	3.8			3.6	4.1	189	sw Iowa	agricultural	Minimum and maximum reflect lowest and highest average litter sizes in five years of data.
	J	-	-	FA	3.1			2.5	3.4	131			
	-	-	-	-	3.6	0.1 SE		2.5	4.1	320			
Dew 1978	-	-	-	-	2.6						w Tennessee	NS	As cited in Moore and Kennedy 1985.
Fritzell et al. 1985	Y	-	1	-	3.2					136	c Missouri 1979-81	NS	Age class (in years): (1) 1; (2) 2-3; (3) 4; (4) 5; (5) 6-7; (6) 8-12. Based on count of uterine scars.
	A	-	2	-	3.4					163			
	A	-	3	-	3.9					24			
	A	-	4	-	3.8					21			
	A	-	5	-	4.4					25			
	A	-	6	-	3.1					12			
Fritzell et al. 1985	-	-	1	-	3.4					297	n Illinois 1979-81	NS	Age class (in years): (1) 1-3; (2) 4 and older. Based on count of uterine scars.
	A	-	2	-	3.8					61			
Johnson 1970 (various)	-	-	-	-	2.43					76	Alabama	bottomlands, marsh	Based on count of placental scars.
Johnson 1970 (various)	-	-	-	-	2.48					101	Alabama	various	Live litters.
McKeever 1958	-	-	-	-	3.2	0.18 SE		2	5		sw Georgia, nw Florida	NS	Embryo count.
Sanderson & Hubert 1981	-	-	-	-	3.62	0.11 SE				122	nc Illinois	NS	
Sanderson & Hubert 1981	-	-	-	-	3.51	0.08 SE				182	wc Illinois	NS	

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Sanderson & Hubert 1981	-	-	-	-	2.92	0.09 SE				135	se Illinois	NS	
Stuewer 1943b	-	-	-	-	4			3	7	10	Michigan	riparian	Live litters.
LITTERS/YEAR													
Sanderson 1987	-	-	-	-	1		/year				most of range	NS	
Stuewer 1943b	-	-	-	-	1		/year				Michigan	riparian	
DAYS GESTATION													
Brown 1936	-	-	-	-	69		days				NS	lab	As cited in Goldman 1950.
Goldman 1950	-	-	-	-	63-70		days				NS	NS	
Hamilton 1936	-	-	-	-	63		days				w New York	NS	
Kaufmann 1982	-	-	-	-	64		days	54	70		NS	NS	Summary of several studies.
Lotze & Anderson 1979	-	-	-	-	63		days				NS	NS	
Sanderson 1987	-	-	-	-	63		days				Illinois	NS	Value is approximate.
Stuewer 1943b	-	-	-	-	63		days				Michigan	riparian	Value is approximate.
AGE AT WEANING													
Ewer 1973	-	-	-	-	70		days				NS	NS	As cited in Eisenberg 1981.
Montgomery 1969	-	-	-	-	84		days	63	112		NS	lab	Complete functional weaning usually by this time.
Stuewer 1943b	-	-	-	-	98		days				Michigan	riparian	Approximate value.
AGE AT SEXUAL MATURITY													
Fritzell et al. 1985	-	F	-	-	1		year				Illinois, Missouri	NS	Pregnancy rates for yearlings ranged from 38 to 77%.

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Johnson 1970 (various)	-	M	-	-	15		months				Alabama	riparian, marsh	Juvenile males mature after the regular breeding season. About 10 percent of females thought to reproduce as yearlings in this study.
	-	F	-	-			year	1					
Sanderson 1951	-	M	-	-	1		year				Missouri 1947-49	NS	Most males are mature as yearlings, but probably do not breed successfully in their first year because they mature after most females are already pregnant.
	-	F	-	-	1		year						
Stuewer 1943b	-	F	-	-	10		months			28	Michigan	riparian	At least 53% of yearling females produced young.
	-	M	-	-	2		years						

ANNUAL MORTALITY

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Clark et al. 1989	A	-	-	-	38		%/yr				sw Iowa	agricultural	
	J	-	-	-	42		%/yr						
Cowan 1973	A	-	-	-	>50		%/yr				Manitoba, CAN	NS	As cited in Kaufmann 1982.
	Y	-	-	-	60		%/yr						
Sanderson 1951	A	B	-	-	56		%/yr				Missouri 1948	NS	Hunted population; estimated based on the percent of first year animals in late winter within the population (assuming stable population numbers).

LONGEVITY

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Eisenberg 1981	-	-	-	-	49		months		165		NS	captive	
Flower 1931	A	M	-	-			years		9.5		London zoo	captive	As cited in Goldman 1950.
	A	-	-	-			years		13.5				
Johnson 1970	A	B	-	-	3.1		years		16		Alabama	NS	Mean calculated following the methodology of Sanderson 1951.
Lowery 1936	A	-	-	-			years		14		United Kingdom	captive	As cited in Goldman 1950.
Sanderson 1951	A	B	-	-	1.8		years				Missouri 1948	NS	Hunted population; based on estimate of 56% annual mortality and a population turnover time of 7.4 years.

***** SEASONAL ACTIVITIES *****

Reference	Begin	Peak	End	Location	Habitat	Notes
MATING						
Bailey 1936		Jan-Mar		Oregon	NS	As cited in Stuewer 1943a.
Cagle 1949		Mar		Louisiana	NS	As cited in Sanderson 1987.
Cunningham 1962		Mar		S Carolina	NS	As cited in Johnson 1970.
Hamilton 1936		Jan-Feb		w New York	NS	The peak occurs between late January and early February.
Johnson 1970	Jan	Feb	Mar	n United States	NS	
Johnson 1970 (various)	Mar 8	late Apr	Jun 26	Alabama	NS	Conception calculated from fetal growth curves or assuming a gestation period of 63 days.
McKeever 1958	Feb	Mar	Aug	sw Georgia, nw Florida	NS	
Sanderson & Nalbandov 1973	Dec	Feb	Apr	Illinois	NS	As cited in Sanderson 1987.
Sanderson 1987	Feb		Jun	ND, MN, Manitoba CAN	NS	Summary of several studies.
Seton 1929		Jan-Feb		Ohio	NS	As cited in Stuewer 1943a.
Stains 1956	Dec	Feb	Jun	Kansas	NS	As cited in Lotze and Anderson 1979.
Stuewer 1943b	Feb	Feb-earl Mar	Mar	Michigan	riparian	
Whitney and Underwood 1952		March		ec Minnesota	forest, wetland	As cited in Schneider et al. 1971.
PARTURITION						
Arthur 1928	Feb		Apr	Louisiana	NS	As cited in Johnson 1970.
Johnson 1970 (varius)	May 4	June 18	Aug 27	Alabama	NS	
McKeever 1958	Apr	May	Oct	sw Georgia, nw Florida	NS	

Reference	Begin	Peak	End	Location	Habitat	Notes
Sanderson 1987		Apr		Illinois	NS	
Stuewer 1943b	Apr	earl Apr	May	Michigan	riparian	
Urban 1970	Mar 15		June 1	L. Erie, Ohio 67-68	Sandusky Bay	
Whitney and Underwood 1952		earl May		ec Minnesota	forest, wetland	As cited in Schneider et al. 1971.
FALL MOLT						
Goldman 1950		summer		northern range	NS	
HIBERNATION						
Whitney and Underwood 1952	lat Nov		Mar/Apr	ec Minnesota	forest, wetland	As cited in Schneider et al. 1971.
DISPERSAL						
Stuewer 1943a		Fall	Winter	Michigan	riparian	Represents males and females in their first year; not all disperse.
Urban 1970		Fall		L. Erie, Ohio 67-68	Sandusky Bay	Data represents juvenile males.

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*** NORMALIZING AND CONTACT RATE FACTORS ***

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
BODY WEIGHT													
Arnold 1986	A	M	-	-	1,420		g				NS	NS	As cited in Arnold and Fritzell 1987.
Birks & Dunstone 1985	A	M	-	-	1,195.3	175.3 SD	g	930	1530	15	Scotland 1981-83	coastal	Live trapped feral American mink; pregnant females excluded from calculation of female mean.
	A	F	-	-	688.2	64.7 SD	g	560	770	11			
Bleavins & Aulerich 1981	A	M	-	-	1,822	95.2 SE	g			6	Michigan 1979	farm-raised	
	A	F	-	-	873	35.5 SE	g			6			
Harding 1934	A	M	-	-			g		2,300		western races	NS	As cited in Linscombe et al 1982.
Harding 1934	A	M	-	-			g		1,400		eastern races	NS	As cited in Linscombe et al 1982.
Hornshaw et al. 1983	A	M	-	SP	1,734	349.7 SD	g			4	Michigan 1979-80	farm-raised	Mink 13-15 weeks old on Aug 15, fed controlled diet and weighed March 15.
	A	F	-	SP	974	202.2 SD	g			12			
Mitchell 1961	A	M	-	SU	1,040		g			5	Montana 1955-58	river	
	J	M	-	SU	777		g			46			
	A	M	-	FA	1,233		g			6			
	J	M	-	FA	952		g			35			
	A	M	-	SP	1,267		g			7			
	J	M	-	SP	1,189		g			21			
	J	M	-	WI	1,175		g			2			
Mitchell 1961	J	F	-	SU	533		g			54	Montana 1955-58	river	
	A	F	-	SU	550		g			25			
	J	F	-	FA	582		g			27			
	A	F	-	FA	586		g			14			
	J	F	-	WI	600		g			1			
	A	F	-	WI	625		g			3			
	J	F	-	SP	617		g			3			
	A	F	-	SP	622		g			9			
NEONATE WEIGHT													
Eagle & Whitman 1987	N	-	-	-			g	6	10		NS	NS	Summarizing unidentified data.

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Hornshaw et al. 1983	N	B	-	-	8.3	1.54 SD	g			38	Michigan 1980-81	farm-raised/lab	Control animals in toxicology study.
GROWTH RATE													
Wehr et al. (unpubl.)	P	M	1	-	7.0		g/day				NS	farm-raised	As cited in NRC 1982; estimated from figure. Age in days: (1) 0-30; (2) 31-90; (3) 91-120; (4) 121-150; (5) 151-180.
	P	F	1	-	6.5		g/day						
	J	M	2	-	21		g/day						
	J	F	2	-	13		g/day						
	J	M	3	-	15		g/day						
	J	F	3	-	6.7		g/day						
	J	M	4	-	9.0		g/day						
	J	F	4	-	1.7		g/day						
	J	M	5	-	4.3		g/day						
	J	F	5	-	0.6		g/day						
METABOLIC RATE (OXYGEN)													
Williams 1983	A	M	R	-	26.2	1.7 SE	LO2/kg-day			2	NS	lab	Resting metabolic rates for mink floating in still water; male = 1,236 grams; female = 969 grams; temperature = 20 degrees C.
	A	F	R	-	29.3	1.9 SE	LO2/kg-day			4			
METABOLIC RATE (KCAL BASIS)													
Farrell & Wood 1968a	A	F	BA	-	76.5		kcal/kg-d			3	NS	farm-raised	Based on 34 trials on 3 sleeping mink. Range of body weight of mink = 640-795 g. Value expressed relative to body weight raised to 0.73.
Farrell & Wood 1968b	A	F	1	-	202		kcal/kg-d			5	NS	farm-raised	Average digestible energy intake for maintenance for one set of non-breeding test animals in: (1) small "metabolism" cages; and (2) larger "ranch-type" cages. Approximate range of body weights = 690-920 g. Mean temperature was 10.7 degrees C; the temperature did not go below 7 degrees C.
	A	F	2	-	258		kcal/kg-d			5			
Harper et al. 1978, NRC 1982	J	M	1	-	176		kcal/kg-d				New York	farm-raised	As cited in NRC 1982; based on a conversion of Harper et al.'s (1978) values. Daily maintenance requirement for growing male mink with weight of: (1) 500 g; (2) 2,000 g.
	J	M	2	-	124		kcal/kg-d						

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
NRC 1982	A	B	-	-	140		kcal/kg-d				NS	farm-raised	Based on a review of studies; recommended for the maintenance of mature mink in captivity.
Perel'dik et al. 1972	-	-	-	-	200		kcal/kg-d				NS	farm-raised	As cited in NRC 1982. Estimate of daily maintenance requirement, year-round.
Williams 1980	A A	B B	SW RU	- -			kcal/kg-km kcal/kg-km	12.4 3.9			NS	NS	Abstract only. Minimum cost of swimming and running (water temperature not specified). Swimming speed of 0.90 to 2.51 km/hr and running speeds of 0.90 to 7.0 km/hr.
FOOD INGESTION RATE													
Arnold & Fritzell 1987	A	M	-	-	0.13		g/g-day				Manitoba, CAN	prairie potholes	Estimated for period from April-July based on an average male body weight of 1,420 g and Cowan et al.'s 1957 measured prey requirements for captive mink.
Bleavins & Aulerich 1981	A A A A	M F M F	1 1 2 2	WI WI WI WI	0.1194 0.1553 0.0405 0.0525	0.00476 SE 0.00747 SE 0.00161 SE 0.00252 SE	g/g-day g/g-day g/g-day g/g-day			6 6 6 6	Michigan 1979	farm-raised/lab	(1) Using wet weight of feed; (2) using dry weight of feed. Diet consisted of chicken (20%), commercial mink cereal (17%), ocean fish scraps (13%), beef parts, cooked eggs, powdered milk, and added water. Moisture content as fed = 66.2%.
WATER INGESTION RATE													
Farrell & Wood 1968c	A A	F F	1 2	- -	0.133 0.028		g/g-day g/g-day			5 5	NS	farm-raised	(1) Water intake from food and free water combined. Water was provided ad libitum from water bottle; food was 65% moisture. (2) Estimate of free water consumption only, based on diet of 65% moisture. This was calculated based on the following conclusion by Farrell & Wood 1968c: the average female mink (780 g) received 66% of its water from food, 14% from fluid water, and 20% from metabolic water.

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
THERMONEUTRAL ZONE													
Farrell & Wood 1968a	A	F	-	-	16-29		degrees C			3	NS	farm-raised	Estimate: metabolic rate determinations display little variation over this range. Based on 34 trials on 3 animals; body weight of animals ranged from 640 to 795g.

***** DIET *****

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Alexander 1977	B	B	trout	56				10	n lower Michigan	river - % wet weight; stomach contents	Year round.
			non-trout fish	26							
			unidentified fish	3							
			crustaceans	4							
			amphibians	3							
			birds/mammals	6							
			vegetation	1							
			unidentified	1							
Alexander 1977	B	B	trout	52				31	n lower Michigan	stream - % wet weight; stomach contents	Year round.
			non-trout fish	6							
			unidentified fish	3							
			crustaceans	11							
			molluscs	2							
			amphibians	5							
			birds/mammals	17							
			unidentified	4							
Arnold & Fritzell 1987	A	M	ducks	5.2	32.5				Manitoba, CAN	aspen parklands of prairie potholes - % dry weight; scats	Scats collected from radiotracked males.
			other birds	18.8	21.6						
			eggs	3.3	14.5						
			muskrats	42.0	2.1						
			ground squirrels	14.2	0.5						
			other mammals	15.5	25.3						
			insects	1.0	3.5						
			(sample size)	(270)	(127)						
Birks & Dunstone 1985	A	M	total fish		13.6			5	Scotland 1980-83	pasture, fields, conifer plantation on coast - % dry bulk; scats	Data is from all seasons. Feces of radio-tagged individuals collected and analyzed.
			crustaceans (11.5% crabs)		12.4						
			mammals (57.2% lagomorphs)		62.7						
			total birds		11.2						
Birks & Dunstone 1985 (continued)	A	F	fish (10.2% blenny)		32.4			4	Scotland 1980-83	coastal (pasture, field, pine) -	Data is for all seasons. Radio-tagged animals tracked, scat collected and analyzed.
			crustaceans (19.14% crabs)		21.4						

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Birks & Dunstone 1985 (continued)			mammals (20.2% lagomorphs)		27.7					% dry bulk; scats	
			birds (7.9% shorebirds)		18.6						
Burgess & Bider 1980	B	B	crayfish		20			40	Quebec, CAN	stream/riparian area - % volume; scats	Season not specified.
			frogs		12.0						
			aquatic insects		6.3						
			fish		7.6						
			small mammals		29.6						
			red squirrels		10.0						
			birds		5.0						
			large mammals		9.3						
			other		0.2						
Chanin & Linn 1980	B	B	Salmonids		34.2			475	England 1972-73	river - % frequency of occurrence; scats	Data from all seasons combined. Analysis of 475 scats.
			eels		16.8						
			other fish		2.9						
			Lagomorphs		6.3						
			other mammals		22.9						
			total birds		10.8						
			other		6.1						
Chanin & Linn 1980	B	B	eels		26.4			57	England 1972-73	eutrophic lake - % frequency of occurrence; scats	Data from all seasons combined.
			other fish		26.4						
			Ralliforms		15.3						
			other birds		13.9						
			Lagomorphs		9.7						
			other mammals		5.6						
			other		2.7						
Chanin & Linn 1980	B	B	total fish		34.4			153	England 1972-73	Chalk stream - % frequency of occurrence; scats	Data from all seasons combined.
			Ralliform		16.4						
			other birds		7.1						
			common rat		7.7						
			voles		15.8						
			other mammals		7.1						
			earthworm		7.7						
			other		3.8						
Cowan & Reilly 1973	B	B	muskrats		18			281	North Dakota 1956-66	river - % dry volume; scats	Data is from both summer and fall. Scat sample collected 6 years and results averaged.
			meadow voles		36						
			other mammals		9						
			bird eggs		0.5						
			passerines		12						
			waterfowl		15						
			herpetofauna		0.5						
			invertebrates (insects & crayfish)		6.5						
			vegetation		1.5						

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Eberhardt 1974	B	B	birds mammals amphibians/reptiles	78 19 3				NS	NS	NS - % of prey remains near den, and in scats	As cited in Pendleton 1982.
Gilbert & Nancekivell 1982	B	B	total fish (northern pike) (brook stickleback) (white sucker) total mammals (Soricidae) (Lepus americanus) (Synaptomys borealis) (Clethrionomys gapperi) (Microtus sp.) (Microtinae) (Ondantra zibethicus (mustela vison) total birds (Gaviformes or Anseriformes) (Gruiformes) total invertebrates (Insecta)		31.4 (21.0) (27.9) (2.1) 63.6 (11.4) (19.3) (2.9) (3.6) (4.3) (5.0) (21.4) (8.6) 32.9 (16.5) (7.1) 35.0 11.4			140	ne Alberta, CAN 1978	lakes - % frequency of occurrence; scats	Scats collected from April through November. Totals include prey not identified to species. Values given above include all prey species with % frequency of occurrence greater than 2.
Gilbert & Nancekivell 1982	B	B	total fish (brook stickleback) total mammals (Soricidae) (Lepus americanus) (Clethrionomys gapperi) (Microtus sp.) (Microtinae) (Ondatra zibethicus) (Mustela vison) total birds (Gaviformes or Anseriformes) (Gruiformes) total invertebrates Insecta		6.6 (3.3) 83.6 (13.1) (42.6) (3.3) (2.9) (31.2) (8.2) (3.3) 16.4 (9.9) (4.9) 32.9 (3.3)			61	ne Alberta, CAN 1978	streams - % frequency of occurrence; scats	Scats collected from April through November. Totals include prey not identified to species. Values given above include all prey species with % frequency of occurrence greater than 2.

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Guilday 1949			mammals				41.4	NS	sw Pennsylvania	NS	As cited in Pendleton 1982.
			crayfish				14.1			-	
			insects				9.4			% frequency of occurrence; NS	
			spiders				8.6				
			fish				19.5				
			birds				3.1				
			carrion				3.1				
			other				0.8				
Hamilton 1959	A	B	fish		32.4		34.1	NS	New York	NS	Collected from trappers.
			mammals		44.0		33.2			-	
			amphibians		18.9		21.9			% frequency of occurrence; (summer: scats; winter: stomach & intestine)	
			crayfish		12.7		14.4				
			insects		29.2		6.8				
			birds		9.3		2.7				
			earthworms		-		2.4				
			molluscs		0.7		1.6				
			reptiles		4.1		1.4				
Hamilton 1936	B	B	Mice (mostly microtu			32.94		70	New York 1927-34	Various (assumed near water)	Reliability questionable due to lack of methods description.
			Fish			18.82				-	
			Muskrat			16.47				"Frequency indices"	
			Rabbits			4.71					
			Insects			7.06					
			Frogs			2.36					
			Mole			2.36					
			Grasses			1.18					
Hamilton 1940	B	B	muskrat		37.95			300	New York 1939	Montezuma marsh	
			fish		27.25					-	
			aquatic beetles		13.85					% bulk; scats	
			birds		9.05						
			frogs		3.35						
			mice		3.00						
			snakes		2.70						
			rabbits		1.00						
			other		1.85						
Korschgen 1958	A	B	frogs				24.9	372	Missouri 1951-53	statewide	All caught in December (obtained from hunters). Nearly two thirds of the 1,028 stomachs examined were empty.
			mice & rats				23.9			-	
			fish				19.9			% dry volume; stomach contents	
			rabbits				10.2				
			crayfish				9.3				
			birds				5.6				
			fox squirrels				2.2				
			muskrats				1.3				
			other				2.7				

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
McDonnell & Gilbert 1981	-	-	Microtus pennsylvan.		13.2			164	Ontario, CAN 1978	marsh - % volume; scats	Scats collected in summer and fall. Volume measured by water displacement method.
			Ondatra zibethicus		35.0						
			Blarina brevicauda		3.1						
			Anseriformes		15.9						
			Gruiformes		4.3						
			Charadriformes & Passeriformes		1.4						
			frog		6.9						
			crayfish		8.8						
			insect		4.6						
			snails or bivalves		0.6						
			vegetation		2.0						
			eggshell		0.3						
			other		2.3						
Melquist et al. 1981	-	-	fish		59			659	wc Idaho 1976-79	river drainage - % frequency of occurrence; scats	Season = all. Food items with % frequency of occurrence less than or equal to 2 were not included.
			(mottled sculpin)		(7)						
			(unident. cyprinid)		(29)						
			(kokanee salmon)		(3)						
			(unident. salmonid)		(7)						
			(kokanee salmon and unident. salmonid)		(9)						
			(unident. fish)		(12)						
			mammals		43						
			(meadow mouse)		(37)						
			(deer mouse)		(24)						
			(muskrat)		(5)						
			birds		19						
			(unident. waterfowl		(9)						
			(other birds)		(10)						
			invertebrates		24						
			(terrestrial beetle		(12)						
			(aquatic beetele)		(7)						
Proulx et al. 1987	B	B	meadow voles		15.5	10.8			Ontario, CAN 1978	marsh - % volume; scats	Luther Marsh.
			muskrats		32.7	39.0					
			ducks		17.4	10.8					
			frogs		1.3	16.1					
			crayfish		12.1	4.5					
			insects		3.7	6.3					
			fish		-	1.1					
			vegetation		0.6	4.5					
			unspecified		16.7	6.9					
			(sample size)		(93)	(61)					

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Proulx et al. 1987	B	B	meadow voles		9.0			7	Ontario, CAN	marsh	
			ducks		2.7				1980	-	
			crayfish		35.2					% volume; scats	
			insects		0.3						
			vegetation		0.3						
			unknown		52.5						
Proulx et al. 1987	B	B	muskrat		17.1		24.0		Ontario, CAN	marsh	Luther Marsh.
			ducks		4.0		7.6		1979	-	
			passerine birds		10.2		-			% volume; scats	
			shorebirds		2.8		-				
			other birds		11.4		-				
			vegetation		0.6		-				
			snakes		0.3		-				
			meadow voles		-		5.3				
			frogs		-		4.7				
			fish		-		3.5				
			unknown		53.6		54.9				
			(sample size)		(8)		(8)				
Sealander 1943	A	M	muskrat				43	102	s Michigan	various areas	Collected from fur buyers. Sample
			cottontail				16		1940-41	-	size reflects both males and
			small mammals				5			% volume; stomach	females.
			large birds				18			contents	
			small birds				TR				
			snakes				2				
			frogs				10				
			fish				5				
			crayfish				1				
Sealander 1943	A	F	muskrat				14	102	s Michigan	various areas	Collected from fur buyers. Sample
			cottontail				12		1940-41	-	size reflects both males and
			small mammals				17			% volume; stomach	females.
			large birds				11			contents	
			small birds				TR				
			snakes				2				
			frogs				37				
			fish				4				
			crayfish				3				

***** POPULATION DYNAMICS *****

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
HOME RANGE SIZE													
Arnold & Fritzell 1987	A	M	-	-	770		ha			5	Manitoba, CAN	prairie potholes	

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Arnold 1986	A	M	BR	SU			ha	316	1,626		Manitoba, CAN	prairie potholes	Based on radiotracking data. Home ranges of males in breeding season; males may travel well beyond normal home ranges in search of females. As cited in Eagle and Whitman 1987.
Birks & Linn 1982	A	M	-	-	2.5		km river	1.9	2.9	3	England	riverine	Feral American mink; based on radiotracking data.
	A	F	-	-	2.2		km river	1.5	2.9	2			
Eagle (unpublished)	-	-	-	-			ha	259	380		North Dakota	prairie potholes	As cited in Allen 1986.
Gerell 1970	A	M	-	-	2.63		km stream	1.8	5.0		Sweden	stream	As cited in Linscombe et al. 1982.
	J	M	-	-	1.23		km	1.1	1.4				
	A	F	-	-	1.850		km	1.0	2.8				
Linn & Birks 1981	A	B	-	-			km river	2.8	5.9	8	England	riverine	Feral American mink; based on radiotracking data.
Mitchell 1961	A	F	-	-			ha	7.8		1	Montana	heavy veg. riverine	
	A	F	-	-			ha	20.4		1	1955-58	sparse veg. riverine	
POPULATION DENSITY													
Marshall 1936	A	F	-	WI	0.006		N/ha				Michigan	river	As cited in Eagle and Whitman 1987.
	A	F	-	WI	0.6		N/km river						
McCabe 1949	A	-	-	-	0.05		N/ha				Wisconsin	NS	As cited in Eagle and Whitman 1987.
Mitchell 1961	-	-	-	-	0.085		N/ha				Montana, 1957	river	
Mitchell 1961	-	-	-	-	0.03		N/ha				Montana, 1958	river	
LITTER SIZE													
Enders 1952	-	-	-	-	4.5				17		United States	farm-raised	Averaged from several successful ranches; kit counts. Author notes that litters of over 10 are rare.
Hall & Kelson 1959	-	-	-	-				4	10		North America	NS	
Hornshaw et al. 1983	-	-	-	-	4.2					9	Michigan 1979-80	farm-raised	
Mitchell 1961	-	-	-	-	4			2	8	8	Montana 1955-58	riverine	

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
LITTERS/YEAR													
Ewer 1973	-	-	-	-	1						NS	captive - zoo	As cited in Eisenberg 1981.
Hall & Kelson 1959	-	-	-	-	1						North America	NS	
DAYS GESTATION													
Enders 1952	-	-	-	-	51		days	40	75		United States	farm-raised	Pendleton (1982) notes that the wide range is due to variation in the duration of the pre-implantation period.
Ewer 1973	-	-	-	-	28-30		days				NS	NS	As cited in Eisenberg 1981. Corrected to account for delayed implantation; actual time from conception to birth is much longer.
Hall & Kelson 1959	-	-	-	-			days	39	76		North America	NS	
AGE AT WEANING													
Kostron & Kukla 1970	-	-	1	-	7		weeks				NS	NS	(1) Age fully homeothermic. Cited in Eagle and Whitman 1987.
Svilha 1931	-	-	1	-	37		days				Louisiana	NS	(1) Age observed eating meat. Cited in Eagle and Whitman 1987.
AGE AT SEXUAL MATURITY													
Enders 1952	-	B	-	-	10		months				United States	farm-raised	Usually reach this age by February or March.
Ewer 1973	-	B	-	-	1		year				NS	NS	As cited in Eisenberg 1981.
LONGEVITY													
Eisenberg 1981	-	-	-	-			years		10		NS	captive - zoo	
Enders 1952	-	F	-	-	7		years		11		United States	farm-raised	Number of years females are able to breed in captivity.

***** SEASONAL ACTIVITIES *****

Reference	Begin	Peak	End	Location	Habitat	Notes
MATING						
Burns 1964		April		Alaska	NS	As cited in Eagle and Whitman 1987.
Enders 1952	late Feb		earl Apr	United States	farm-raised	
Humphrey & Zinn 1982		fall		Florida	Cypress Swamp	
Mitchell 1961		March		Montana	riverine	
PARTURITION						
Eagle & Whitman 1987	Apr		Jun	most areas	NS	Presumably not in Florida.
Enders 1952		earl May		United States	farm-raised	
FALL MOLT						
Eagle & Whitman 1987		mid-late fall		NS	NS	General observation.

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
BODY WEIGHT													
Harris 1968	A	-	-	-			g	5,000	13,700		NS	NS	As cited in Toweill and Tabor 1982.
Lauhachinda 1978	A	M	-	-	8,130	1,150 SD	g	5,840	10,420	153	Alabama, Georgia	NS	Live weight. Years of data collection were trapping seasons from 1972-73 to 1976-77. The 2x SE values given by the author were divided by 2 to produce the values shown in the table. SE values are too large relative to the mean and range, however. We assume that these really are standard deviations instead.
	A	F	-	-	6,730	1,000 SD	g	4,740	8,720	71			
	Y	M	-	-	6,360	980 SD	g	4,410	8,310	26			
	Y	F	-	-	5,830	1,820 SD	g	3,750	7,010	30			
Melquist & Dronkert 1987	A	B	-	-			g	5,000	15,000		NS	NS	Summary of studies by Hall and Kelson 1959; Hall 1981; Woolington 1984.
Melquist & Hornocker 1983	A	M	-	-	9,200	600 SE	g			4	wc Idaho 1976-81	mountain streams and lakes	Age Y = yearling.
	A	F	-	-	7,900	200 SE	g			6			
	Y	M	-	-	7,900	400 SE	g			6			
	Y	F	-	-	7,200	100 SE	g			3			
Wilson 1959	A	M	-	-	8,250		g			138	N Carolina	coastal	Season for data = fall and winter. As cited in Tumlison and Shalaway 1985.
	A	F	-	-	7,002		g			100			
NEONATE WEIGHT													
Hamilton & Eadie 1964	N	-	-	-	132		g			2	New York	NS	Near-term fetuses from wild-trapped females.
Hill & Lauhachinda 1981	N	-	-	-	140-145		g			4	Alabama, Georgia	NS	Near-term fetuses from wild-trapped females.
Melquist & Dronkert 1987	N	-	-	-	120-160		g				NS	NS	
PUP GROWTH RATE													
Liers 1951a	P	-	-	-	26.7		g/day			1	NS	NS	Age 10 to 20 days. As cited in Toweill and Tabor 1982.

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Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Alexander 1977	B	B	trout	42				4	n lower Michigan	aquatic - % wet weight; stomach contents	Year round.
			non-trout fish	32							
			unidentified fish	9							
			crustaceans	2							
			unidentified	15							
Anderson & Woolf 1987b	B	B	fish	97	69	98	99	822	nw Illinois 1981-83	Mississippi River - % frequency of occurrence; scats	Spring = March-May; summer = June; fall = October-November; and winter = December- February.
			(sunfish)	(31)	(31)	(80)	(52)				
			(minnow/carp)	(52)	-	(17)	(44)				
			(herring)	(49)	(38)	(10)	(40)				
			(bass)	(26)	-	(5)	(14)				
			frogs	3	6	11	16				
			crayfish	12	50	8	7				
			dragonfly nymph	2	-	6	2				
			birds (unidentified)	4	13	3	1				
			(sample size)	(277)	(16)	(167)	(362)				
Chabreck et al. 1982	A	B	fish				83.0	53	Louisiana 1976-80	freshwater swamps - % frequency of occurrence; digestive tracts	
			(longear sunfish)				(9.4)				
			(killifishes)				(15.1)				
			(striped mullet)				(11.3)				
			(bowfin)				(18.9)				
			(largemouth bass)				(11.3)				
			blue crabs				3.8				
			crayfish				34				
			mammals				7.5				
			birds				0				
			snakes				5.7				
			molluscs				3.8				
Chabreck et al. 1982	A	B	fish				83.3	126	Louisiana 1976-80	saltmarsh - % frequency of occurrence; digestive tracts	
			(sheepshead minnow)				(57.9)				
			(diamond killifish)				(37.3)				
			(gulf killifish)				(15.9)				
			(top minnow)				(15.9)				
			(flounder)				(13.5)				
			(mullet)				(11.9)				
			(sailfin molly)				(10.3)				
			blue crabs				19.8				
			crayfish				1.6				
			mammals				7.9				
			birds				2.4				
			molluscs				1.6				
			shrimp				1.6				

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Gilbert & Nancekivell 1982	B	B	fish		78.9			251	ne Alberta CAN 77-78	lakes - % frequency of occurrence; scats	Season = year round. Species with percentages of less than 2% not included in this summary. Evidence of otter fur in scats believed to be due to grooming.
			(northern pike)		(8.4)						
			(brook stickleback)		(72.1)						
			(white sucker)		(6.0)						
			mammals		15.9						
			(Microtus sp.)		(2.0)						
			(muskrat)		(8.0)						
			(river otter)		(5.2)						
			birds		21.5						
			(Gaviformes or Anseriformes)		(16.4)						
			(Gruiformes)		(2.8)						
			(Charadiformes)		(2.0)						
			invertebrates		59.4						
			(Insecta)		(21.1)						
			(Mollusca)		(3.2)						
Gilbert & Nancekivell 1982	B	B	fish		91.1			247	ne Alberta CAN 77-78	streams - % frequency of occurrence; scats	Season = year round. Species with percentages of less than 2% not included in this summary.
			(northern pike)		(13.4)						
			(brook stickleback)		(63.6)						
			(white sucker)		(23.9)						
			(arctic grayling)		(2.4)						
			mammals		3.2						
			(Lepus americanus)		(2.0)						
			birds		9.3						
			(Gaviformes or Anseriformes)		(7.6)						
			invertebrates		45.8						
			Insecta		(18.6)						
			Mollusca		(3.2)						
Greer 1956	A	B	fish		99.9				Montana	river - % frequency of occurrence; scats	Season not specified. As cited in Tumlison and Shalaway 1985.
			invertebrates		45.1						
Greer 1955	A	B	invertebrates	41.6	44.2	33.3	26.3	596	nw Montana 1952-53	lakes and streams - % frequency of occurrence; scats	Winter = January-March; spring = April- June; summer = July-September; fall = October-December.
			(aquatic insects)	(19.6)	(19.2)	(10.7)	(4.0)				
			(fr water shrimp)	(14.3)	(8.9)	(10.7)	(4.0)				
			fishes	91.4	92.9	100	100				
			(trout)	(23.7)	(9.8)	(33.3)	(29.3)				
			(sculpin)	(20.5)	(20.9)	(21.3)	(25.3)				
			(sunfish)	(47.1)	(72.8)	(60.0)	(33.3)				
			(suckers)	(39.8)	(21.0)	(45.3)	(59.6)				
			salamanders	0.3	0.7	1.3	-				
			snakes	0.2	0.7	-	-				
			frogs	19.6	19.2	10.7	9.1				
			mammals	8.1	5.3	2.7	4.0				
			birds	6.7	4.1	1.3	1.0				
			(sample size)	(596)	(604)	(75)	(99)				

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Grenfell 1974	B	B	crayfish		98			118	c California	marsh - % frequency of occurrence; scats	Year round. As cited in Tumlison and Shalaway 1985.
Hamilton 1961	A	B	fish				70.0	141	New York	Adirondacks - % frequency of occurrence; digestive tract	As cited in Tumlison & Shalaway 1985.
			crayfish				34.7				
			frogs				24.8				
			aquatic insects				13.5				
			mammals				4.3				
Knudsen & Hale 1968	A	B	fish only	91	63	72	67	184	WI, MI, MN, 1951-54	NS - % frequency of occurrence; scats	Trace amounts of other items (e.g., insects & duck) also found.
			fish and crayfish	9	12	10	20				
			crayfish only	0	24	12	13				
Lagler & Ostenson 1942	A	B	game & pan fish	22.7				95	Michigan 1940-41	trout waters - % wet volume; stomach contents	Animals collected in March and April. Game and pan fish includes trout, bullheads, northern pike, perch, bass, and sunfish. Forage fish includes suckers, minnows, mudminnows, darters, muddlers, and sticklebacks.
			forage fish	35.9							
			unidentified fish	3.9							
			amphibians	25.2							
			other vertebrates	4.5							
			insects	0.4							
			crayfish	7.4							
Lagler & Ostenson 1942	A	B	game & pan fish	65.3				40	Michigan 1940-41	non-trout waters - % wet volume; stomach contents	Animals collected in March and April. Game and pan fish includes bullheads, northern pike, perch, bass, and sunfish. Forage fish includes suckers, minnows, mudminnows, darters, muddlers, and sticklebacks.
			forage fish	11.2							
			unidentified fish	2.0							
			amphibians	14.4							
			other vertebrates	0.5							
			insects	2.9							
			crayfish	3.7							
Larsen 1984	A	B	fish		96			272	se Alaska	coastal - % frequency of occurrence; scats	Year round data.
			(sculpins)		(65)						
			(greenlings)		(14)						
			(rockfish)		(17)						
			invertebrates		30						
			birds		1						
			mammals		<1						
			plants		<1						
Lauhachinda 1978	B	B	fish				91.7	12	c Alabama 1975-77	riverine - % frequency of occurrence; scats	Data from trapping seasons.
			crayfish				58.3				
			birds				8.3				

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Lauhachinda 1978	A	B	fish				83.2	315	Alabama, GA 1972-77	NS - % frequency of occurrence; digestive tracts	Data from trapping seasons.
			(Centrarchidae)				(53.6)				
			(Catostomidae)				(12.1)				
			(Ictaluridae)				(10.5)				
			(Cyprinidae)				(6.3)				
			amphibians				5.4				
			crayfish				62.5				
			other arthropods				10.8				
			molluscs (snail)				0.9				
			birds				0.3				
			plant material				3.8				
Loranger 1981	-	B	Ictaluridae			28.2		56	Massachusetts 76-78	NS - % dry volume; stomach contents	Season = late fall - early winter. Food material was air-dried for a 24-48 hour period prior to examination; % volume measured by water displacement. Carcasses supplied by trappers from eight counties following the 1976-77 and 1977-78 trapping seasons.
			Centrarchidae			20.3					
			Salmonidae			5.2					
			Percidae			3.5					
			Esocidae			0.2					
			Castostomidae			5.5					
			Cyprinidae			3.2					
			Cyprinodontidae			0.6					
			unidentified fish			9.9					
			bullfrogs			14.0					
			crayfish			0.4					
			vegetative matter			0.1					
			unidentified			8.9					
Melquist & Hornocker 1983	A	B	fish	100	93	97	99		wc Idaho 1976-81	mountain streams and lakes - % frequency of occurrence; scats	Most of the fish taken were greater than 30 cm in length.
			(sucker)	(52)	(47)	(17)	(30)				
			(sculpin)	(40)	(31)	(38)	(42)				
			(squawfish)	(5)	(4)	(1)	(6)				
			(perch)	(22)	(3)	(7)	(9)				
			(whitefish)	(21)	(10)	(24)	(66)				
			invertebrates	2	7	10	12				
			birds	<1	12	1	<1				
			mammals	1	4	3	1				
			reptiles	0	1	0	0				
			(sample size)	(264)	(327)	(1053)	(258)				
Melquist et al. 1981	A	B	fish		97			1,902	wc Idaho 1976-79	river drainage - % frequency of occurrence; scats	Season = all.
			(largescale sucker)		(29)						
			(mottled sculpin)		(38)						
			(north. squawfish)		(3)						
			(unident. cyprinid)		(24)						
			(brown bullhead)		(1)						
			(yellow perch)		(9)						
			(mountain whitefish)		(27)						
			(kokanee salmon)		(9)						
			(unident. salmon)		(34)						
			(kokanee & unident. salmon)		(43)						

(continued)

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Melquist et al. 1981 (continued)			(unident. fish)		(1)						
			mammals		3						
			(jumping mouse)		(2)						
			(unident. mammal)		(1)						
			birds		3						
			(waterfowl)		(2)						
			(other birds)		(1)						
			invertebrates		8						
			(aquatic beetle)		(1)						
			(stonefly nymph)		(7)						
			(unident. invert.)		(1)						
Modafferi & Yocom 1980	A	B	starry flounder		56.1			100	n California 1964	coastal - % volume; dry scats	Volume measured by water displacement method.
			crabs (Cancer spp.)		37.6						
			birds		4.6						
			dragonfly		1.3						
			ostracods and snails		0.4						
Pierce 1979	A	B	crayfish		82			209	Virginia 1977-78	Great Dismal Swamp - % frequency of occurrence; scats	As cited in Tumlison and Shalaway 1985.
			fish		62						
Ryder 1955 (canadensis)	B	B	game & pan fishes	40.7				54	Michigan 1942-43	trout & non-trout waters - % frequency of occurrence; stomach contents	25 animals from non-trout waters, 21 from trout waters, 8 from unclassified areas.
			other fish	55.5							
			fish remains	27.8							
			amphibians	16.7							
			crayfish	22.2							
			insects	13.0							
Sheldon & Toll 1964	A	B	fish	90	87	97	99	-	c Mass. 1955-57	reservoir - % frequency of occurrence; scats	Other fish for which value for all seasons was below 5: white perch, brown bullhead, banded killifish, and johnny darter.
			(centrarchids)	(26)	(39)	(84)	(74)				
			(yellow perch)	(64)	(62)	(30)	(48)				
			(white sucker)	(8)	(4)	(15)	(17)				
			(golden shiner)	-	(2)	-	(17)				
			(chain pickerel)	(1)	(3)	(5)	(8)				
			invertebrates	55	68	53	34				
			(crayfish)	(53)	(48)	(48)	(32)				
			(wasp)	-	(24)	(1)	-				
			(unident. insects)	(4)	(10)	(5)	(4)				
			vegetation	-	(28)	(2)	-				
			(blueberry)	-	(28)	-	-				
			mammals (unident.)	4	4	-	3				
			birds (unident.)	1	1	-	1				
			sample size	*73*	*226*	*116*	*102*				

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Shirley 1985	A	B	crayfish	89				1048	sw Louisiana 1982	brackish marsh - % frequency of occurrence; scats	Trace prey considered unimportant dietary components by author.
			fish parts	25							
			birds, crabs, snakes	TR							
			alligators, mammals	TR							
Stenson et al. 1984	A	B	fish		99.4			69	British Columbia	coastal marine - % frequency of occurrence; scats	Season is year round.
			(Embiotocidae)		(42.2)						
			(Cottidae)		(40.5)						
			(Pleuronectiformes)		(40.0)						
			(Blennoidea)		(33.3)						
			(Scorpaenidae)		(30.1)						
			(Hexagrammidae)		(13.1)						
			crustaceans		7.2						
			birds		4.2						
Stenson et al. 1984	A	B	fish				86.9	69	British Columbia	coastal marine - % frequency of occurrence; stomachs	Stomachs collected during the trapping season (December-February).
			birds				13.0				
			crustaceans				2.9				
Toll 1961	A	B	fish		92			517	c Mass. 1955-57	wildlife reservation - % frequency of occurrence; scats	Data from year round. As cited in Tumlison and Shalaway 1985.
			invertebrates		56						
			vegetable matter		13						
			mammals		3						
			birds		1						
Toweill 1974	A	B	fish				80	75	w Oregon 1970-72	NS - % frequency of occurrence; digestive tracts	
			(Cottidae)				(31)				
			(Salmanidae)				(24)				
			(Cypriidae)				(24)				
			(Ictaluridae)				(7)				
			crustacea				33				
			amphibians				12				
			birds				8				
			molluscs				11				
Wilson 1985	A	B	fish				91	30	North Carolina	swamps & marshes - % frequency of occurrence; scats and digestive tracts	Combined sample of 10 digestive tracts and 20 scats.
			(carp)				(11)				
			(suckers)				(11)				
			(killifish)				(9)				
			(minnows)				(7)				
			(eels)				(7)				
			(sunfish)				(15)				
			(catfish)				(11)				
			(white perch)				(7)				
			(pickerel)				(7)				
			crustacea				39				
			insects				6				
			birds				3				

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
HOME RANGE SIZE													
Erickson et al. 1984	A	B	-	-			ha	400	1,900		Missouri	inland marsh/streams	As cited in Melquist and Dronkert 1987. Habitat is in the Swan Lake National Wildlife Refuge.
Erickson et al. 1984	A	-	-	-			km	11	78		Missouri	inland marsh/streams	As cited in Melquist and Dronkert 1987. Habitat is in the Lamine River Wildlife Area.
Foy 1984	-	M	-	-	400		ha				se Texas 1981-83	coastal marsh	As cited in Tumlison and Shalaway 1985. Total range (includes both sexes) = 184 - 461 ha.
	-	F	-	-	295		ha						
Larsen 1983	-	-	-	-			ha	900	2,500		se Alaska	coastal	As cited in Melquist and Dronkert 1987. Author also provides home ranges in km of shore; 19 - 40 km.
Mack 1985	-	-	-	-			ha	2,900	5,700		Colorado	mountain valley	As cited in Melquist and Dronkert 1987. In this study, home ranges tended to be largest in the spring.
Melquist & Hornocker 1983	J	B	1	-	22	7.8 SD	km	8	29	7	wc Idaho 1978-81	shorelines of lakes and streams	Seasonal home range based on radiotracking. Due to lack of obvious trends, data combined across seasons: (1) solitary juveniles (fall and winter); (2) solitary animals (all seasons); (3) adult females and juveniles of both sexes in family groups (all seasons).
	Y	F	2	-	32	6.2 SD	km	25	40	4			
	Y	M	2	-	43	20 SD	km	10	78	7			
	A	F	2	-	31	9.2 SD	km	23	50	7			
	B	B	3	-	28	7.5 SD	km	15	39	11			
Woolington 1984	-	-	-	-			km	1.0	23		se Alaska	coastal	As cited in Melquist and Dronkert 1987.
POPULATION DENSITY													
Erickson et al. 1984	A	B	-	-	0.0025		N/ha				Missouri	inland marsh/streams	Swan Lake National Wildlife Refuge. As cited in Melquist and Dronkert 1987.
Erickson et al. 1984	A	B	-	-	0.13		N/km				Missouri	inland marsh/streams	Lamine River Wildlife Area. As cited in Melquist and Dronkert 1987.
Foy 1984	-	-	-	-			N/ha	0.0094	0.014		se Texas	coastal marsh	As cited in Melquist and Dronkert 1987.

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Larsen 1983	-	-	-	-			N/km	0.48	0.53		se Alaska	coastal	As cited in Melquist and Dronkert 1987.
Melquist & Hornocker 1983	B	B	-	-	0.26		N/km	0.17	0.37		wc Idaho 1976-81	mountain streams	Density along length of mountain streams.
	A	F	BR	-	0.05		N/km						
	A	M	BR	-	0.019		N/km						
	Y	B	-	-	0.071		N/km						
Reid 1984	-	-	-	-			N/km	0.06	0.1		Alberta CAN	lake	Habitat = lake in northwestern boreal forest. As cited in Melquist and Dronkert 1987.
Trippensee 1953	-	-	-	-	0.0001		N/ha				Oregon/Washing ton	National Forest	Habitat described as approximately 109,000 square km of "nearly primitive otter range."
Woolington 1984	-	-	-	-	0.85		N/km				se Alaska	coastal - island	As cited in Melquist and Dronkert 1987.
LITTER SIZE													
Anderson & Scanlon 1981	-	-	1	-	2.75	0.177 SE				8	e Virginia 1979-80	NS	Measure: (1) embryo counts; (2) corpora lutea counts.
	-	-	2	-	2.5	0.089 SE				24			
Docktor et al. 1987	-	-	1	-	0.53	0.91 SD		0	3	15	Maine 1982-83	NS	Corpora lutea counts; Age classes: (1) 1 year; (2) 2 years; (3) 3 years; (4) 4 years; (5) 5 to 12 years; (6) all ages combined.
	-	-	2	-	0.87	0.96 SD		0	3	16			
	-	-	3	-	1.60	1.42 SD		0	4	10			
	-	-	4	-	2.29	1.25 SD		1	5	7			
	-	-	5	-	2.67	1.40 SD		0	6	15			
	-	-	6	-	0.82	1.29 SD		0	6	114			
Hamilton & Eadie 1964	-	-	-	-	2.1	0.7 SD				9	New York	NS	Implanted embryo count conducted in March and April.
Hill & Lauhachinda 1981	-	-	-	-	2.68	0.71 SD		1	4	57	Alabama, GA 1972-77	NS	Embryo count; animals collected from trappers from 1972-77. Reproductive tracts of 56 of 116 females (all 2 years or older) contained embryos or blastocysts.
Hooper & Ostenson 1949	-	-	-	-	2-3			1	6		California	NS	As cited in Melquist & Dronkert 1987; measure not specified.
Johnstone 1978	-	-	-	-	2.3						NS	captive	As cited in Eisenberg 1981; measure not specified.
Lauhachinda 1978	-	-	-	-	2.6			1	4	48	Alabama, GA 1972-77	NS	Number of fetuses per pregnant female. Data from 1972-73 through 1976-77 trapping seasons.

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Liers 1966	-	-	-	-	3-4				5		Canada	lab	As cited in Tumlison and Shalaway 1985; measure not specified.
McDaniel 1963	-	-	-	-	3.0	1.0 SD					Florida	NS	As cited in Melquist and Dronkert 1987; measure not specified.
Melquist & Hornocker 1983	-	-	-	-	2.4						Idaho	NS	Number of pups per female that survived from birth until fall/early winter.
Mowbray et al. 1979	-	-	-	-	2.73	0.77 SD		1	4	22	Maryland 1975-77	wetlands	Implanted embryos.
Tabor & Wight 1977	-	-	1	-	2.73	0.24 SE		2	4	11	w Oregon 1970-71	NS	Age classes: (1) 2 years; (2) 3 years; (3) 4 to 11 years; (4) all ages combined. Measured blastocysts.
	-	-	2	-	2.80	0.20 SE		2	4	10			
	-	-	3	-	2.86	0.21 SE		2	4	14			
	-	-	4	-	2.80	0.12 SE		2	4	35			
Tabor & Wight 1977	-	-	1	-	2.5			2	3	2	w Oregon	NS	Age classes: (1) 2 years; (2) 3 years; (3) 4 to 11 years; (4) all ages combined. Measured implanted embryos.
	-	-	2	-	3.0					1			
	-	-	3	-	3.0					1			
	-	-	4	-	2.75			2	3	4			
LITTERS/YEAR													
Trippensee 1953	-	-	-	-	1						NS	NS	
DAYS GESTATION													
Hamilton & Eadie 1964	-	-	-	-	365		days				New York	NS	Entire period from copulation to birth of young; active gestation period is about two months.
Johnstone 1978	-	-	-	-	56		days				NS	captive	Active gestation (post-implantation). As cited in Eisenberg 1981.
Lancia & Hair 1983	-	-	-	-	60-63		days				NS	NS	Active gestation (post-implantation). As cited in Melquist and Dronkert 1987.
Liers 1951b	-	-	-	-			days	290	380		Wisconsin	captive	Entire period from copulation to birth of young.

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
AGE AT WEANING													
Johnstone 1978	-	-	-	-	112-140		days				NS	captive	As cited in Eisenberg 1981.
Harris 1968	-	-	-	-			days	91			NS	NS	Otters still nursing at 91 days. Eating solid foods by 9th week.
AGE AT SEXUAL MATURITY													
Hamilton & Eadie 1964	-	F	-	-	2		years				New York	NS	Wild-trapped animals.
	-	M	-	-	2		years						
Harris 1969 (canadensis)	-	M	-	-	2		years				Canada	captive/zoo	As cited in Tumlison and Shalaway 1985.
	-	F	-	-	2		years						
Liers 1951b	-	B	-	-	2		years				Minnesota	captive	In general, males cannot be counted on as successful breeders until they reach 5-7 years of age.
ANNUAL MORTALITY													
Lauhachinda 1978	A	M	-	-	17.8		%/year				Alabama, GA 1972-77	riverine	
	A	F	-	-	20.3		%/year						
Mowbray et al. 1979	J	F	-	-	17		%/year			23	Maryland 1974-77	NS	Adjusted mortality; estimated on the basis of age classes. Juveniles = < 1 year old; adult value applies to ages 1 through 9.
	A	F	-	-	31		%/year						
Tabor & Wight 1977	J	-	1	-	32		%/year				Oregon	NS	Age classes: (1) birth to 1 year; (2) yearling; (3) 2-11 years.
	J	-	2	-	54		%/year						
	A	-	3	-	27		%/year						
LONGEVITY													
Eisenberg 1981	-	-	-	-			years		19	1	NS	captive-zoo	
Grinnell et al. 1937	-	-	-	-	10-15		years				California	NS	As cited in Melquist and Dronkert 1987.
Lauhachinda 1978	A	B	-	-			years		15	439	Alabama, GA 1972-77	riverine	
Liers 1966	A	F	-	-			years		23	1	NS	captivity	As cited in Tumlison and Shalaway 1985.
Scheffer 1958	-	-	-	-			years		14.5	1	Washington	captive/zoo	As cited in Tumlison and Shalaway 1985.

*** SEASONAL ACTIVITIES ***

Reference	Begin	Peak	End	Location	Habitat	Notes
MATING						
Hamilton & Eadie 1964	Mar		Apr	New York	NS	
Harris 1969	mid Feb		mid Apr	NS	captive/zoo	As cited in Tumlison and Shalaway 1985.
Hooper & Ostenson 1949	Jan	Mar-Apr	May	Michigan	NS	As cited by Toweill and Tabor 1982.
Humphrey and Zinn 1982		Fall		Florida	cypress swamp	
Lauhachinda 1978	winter	late winter	spring	AL, FL, GA 1972-77	NS	
Liers 1951b	Dec		earl Apr	Minnesota	captive	
MacFarlane 1905	Mar	Apr	May	Mackenzie River, CAN	NS	As cited in Toweill and Tabor 1982.
Melquist & Dronkert 1987		earl spring		temperate regions	NS	Summary of several studies.
Trippensee 1953	Feb/Mar			NS	NS	Mating may continue through summer in favorable locations.
PARTURITION						
Anderson 1981	Feb 25		Mar 31	Virginia 1979-81	NS	As cited in Tumlison and Shalaway 1985.
Hamilton & Eadie 1964	Mar		Apr	New York	NS	
Hill and Lauhachinda 1981	earl Jan		earl Mar	AL, GA 1972-77	NS	
Lauhachinda 1978	late Jan		May	Alabama, Georgia	NS	Animals collected from trappers during the 1972-73 and the 1976-77 trapping seasons.
Liers 1966	Dec 25		Mar 25	Canada	lab	As cited in Tumlison and Shalaway 1985.

Reference	Begin	Peak	End	Location	Habitat	Notes
Melquist & Hornocker 1983	late Mar		earl Apr	wc Idaho 1976-81	mountain streams	
Mowbray et al. 1979	Mar 10		May 20	Maryland 1974-77	Chesapeake Bay area	
Tabor and Wight 1977	earl Apr			w Oregon	NS	As cited in Mowbray et al. 1979.
Toweill & Tabor 1982	Nov	Mar-Apr	May	NS	NS	Summary of several studies.
DISPERSAL						
Melquist & Hornocker 1983		Apr - May		wc Idaho 1976-81	mountain streams	Dispersal at age 12-13 months.

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******* HARBOR SEAL *******

***** NORMALIZING AND CONTACT RATE FACTORS *****

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
BODY WEIGHT													
Ashwell-Erickson & Elsner 1981 (richardsi)	J	F	-	-	40		kg 2 yrs				Bering Sea, Alaska	coastal	Amount of years in units column is age of seals. Total of 155 seals from the Aleutian Ridge and Pribilof Islands. Values estimated from the calculated growth curve presented in paper.
	J	F	-	-	56		kg 4 yrs						
	J	F	-	-	67		kg 6 yrs						
	A	F	-	-	76		kg 8 yrs						
	A	F	-	-	82		kg 10 yrs						
	A	F	-	-	90		kg 12 yrs						
	A	F	-	-	101		kg 16 yrs						
	A	F	-	-	112		kg 24 yrs						
	J	M	-	-	49		kg 2 yrs						
	J	M	-	-	70		kg 4 yrs						
	J	M	-	-	84		kg 6 yrs						
	A	M	-	-	95		kg 8 yrs						
	A	M	-	-	102		kg 10 yrs						
	A	M	-	-	110		kg 12 yrs						
	A	M	-	-	120		kg 16 yrs						
	A	M	-	-	124		kg 24 yrs						
Boulva & McLaren 1979 (concolor)	A	M	-	-	90.0		kg				e Canada 1968-73	marine	Asymptotic weights.
	A	F	-	-	70.0		kg						
FAO Adv. Comm. 1976	A	M	-	-	87.6		kg				NS	NS	Male length - 1.6 meters; female length 1.5 meters. As cited in Ronald et al. 1982.
	A	F	-	-	64.8		kg						
Irving 1972	A	F	-	-	89.0		kg				Arctic	NS	As cited in Ronald et al. 1982.
Pitcher & Calkins 1979 (richardsi)	A	M	-	-	84.6	11.3 SD	kg			112	Gulf of Alaska 1975-78	coastal/marine	Average length (+/- 95% CL): Males 155.4 (+/- 1.4) cm; females 144.8 (+/- 1.1) cm. All animals were seven years of age or older.
	A	F	-	-	76.5	17.7 SD	kg			134			
BODY FAT													
Ashwell-Erickson et al. 1979 (richardsi)	J	-	1	SP	27		% body wt				Alaska 1977-78	captive	Data from one seal from April of first year year, September of second year, and May of second year. Weight of seal (kg); (1) 39; (2) 47 kg; (3) 49 kg. Determined using the titrated water method.
	J	-	2	FA	24		% body wt						
	J	-	3	SP	29		% body wt						

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
NEONATE WEIGHT													
Bigg 1969a (richardsi)	N	B	-	-	10.2	0.77 SE	kg				British Columbia	coastal/marine	SE estimated from 95% CL of 1.5; average length of neonates was 81.6 (+/- 6.2 95% CL) cm. As cited in Pitcher and Calkins 1979.
Bryden 1972	N	-	-	-	10.0		kg				NS	NS	As cited in Ronald et al. 1982.
FAO Adv. Comm. 1976	N	-	-	-			kg	9.0			NS	NS	Length 0.75 m. As cited in Ronald et al. 1982.
Klinkhart 1967 (richardsi)	N	M	-	-	12.8		kg			34	Alaska	marine	As cited in Newby 1973.
	N	F	-	-	13.3		kg			34			
Newby 1973 (richardsi)	N	M	-	-	14.8	2.74 SD	kg			5	Washington 1969-72	marine	Mean male weight listed as 15,270 g in Table 1 but 14,810 g on page 543. We believe the lower value is more likely to be correct.
	N	F	-	-	10.7	2.76 SD	kg			13			
Newby 1978 (richardsi & P. largha)	N	-	-	-			kg	9.1	11.8	2	Pacific coast	coastal/marine	Data is for richardsi subspecies and P. largha.
Pitcher & Calkins 1979 (richardsi)	N	M	-	-	12.0	0.51 SE	kg				Tugidak Island, Alaska 1975-78	coastal/marine	Male mean standard length (+/- 95% CL) was 78.6 (+/- 2.7) cm; female length was 76.5 (+/- 1.9) cm. Total of 23 animals measured; SE estimated from 95% CL.
	N	F	-	-	11.5	0.31 SE	kg						
Rosen 1989 (concolor)	N	F	-	-	8.5		kg				Gulf of St. Lawrence	coastal/marine	Location is Miquelon Islands; male birth weight is significantly greater than female birth weight.
	N	M	-	-	10.1		kg						
PUP GROWTH RATE													
Rosen 1989 (concolor)	P	F	-	-	790		g/day				Gulf of St. Lawrence	island/marine	Pre-weaning growth rate on Island of Miquelon; birth weight: male = 10,100 g; female = 8,500 g.
	P	M	-	-	520		g/day						
WEANING WEIGHT													
Bigg 1969a (richardsi)	-	B	-	-	24,000		g				British Columbia	marine	As cited in Boulva and McLaren 1979. Weight doubled from birth.
Bryden 1972	-	B	-	-	24,000		g				NS	marine	As cited in Ronald et al. 1972.

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
METABOLIC RATE (OXYGEN)													
Ashwell-Erickson & Elsner 1981 (richardsi & P. largha)	J	-	1	-	5.97		lO_2/kg-d				Bering Sea, Alaska	captives from Bering Sea	Basal metabolic rate for harbor and spotted (P. largha) seals at rest in air and water at temperatures ranging from -20 to +20 C (air) and -1.8 to 16 C (water). Trials did not indicate a difference in rates at different temperatures. Age of seals (years): (1) 0.2 - 0.7; (2) 1; (3) 3; (4) 4; and (5) 9. Values for ages 4 and 9 were estimated from Figure 53.5.
	J	-	2	-	5.76		lO_2/kg-d						
	J	-	3	-	5.83		lO_2/kg-d						
	J	-	4	-	4.9		lO_2/kg-d						
	A	-	5	-	4.0		lO_2/kg-d						
Davis et al. 1985	J	B	R	-	7.3		lO_2/kg-day			2	California 1982-83	lab	Juvenile is a yearling; weight = 33 kg. Adult female weight = 63 kg.
	A	F	R	-	6.6		lO_2/kg-day			1			
METABOLIC RATE (KCAL BASIS)													
Ashwell-Erickson & Elsner 1981 (richardsi)	J	B	1	-	85.5		kcal/kg-d				Bering Sea, Alaska	NS	Basal metabolic rate used in energy flow modeling. Age of seals; (1) birth to weaning; (2) weaning to one year; (3) 1 to 4 years. For ages 16 and under, authors present equation BMR = 70 x (weight to the 0.75 power) kcal/day.
	J	B	2	-	59.5		kcal/kg-d						
	J	B	3	-	57.5		kcal/kg-d						
FOOD INGESTION RATE													
Ashwell-Erickson & Elsner 1981 (P. largha)	-	B	1	-	0.13		g/g-day			2	from Bering Sea	captive	Mean food consumption of Atlantic mackerel by 1 male and 1 female largha (spotted) seal during: (1) first year; (2) second year; (3) third year; (4) fourth year; and (5) fifth through ninth years.
	-	B	2	-	0.08		g/g-day			2			
	-	B	3	-	0.05		g/g-day			2			
	-	B	4	-	0.04		g/g-day			2			
	-	B	5	-	0.03		g/g-day			2			
Ashwell-Erickson & Elsner 1981 (richardsi & P. largha)	J	B	1	-	0.04		g/g-day				NS	captive	Approximate consumption in: (1) March-August; (2) winter. Based on consumption of subadult harbor and largha (spotted) seals.
	J	B	2	-	0.08		g/g-day						
Ashwell-Erickson & Elsner 1981 (richardsi)	J	B	1	-	121.6		kcal/kg-d				Bering Sea, Alaska	NS	Model results based on food ingestion and gross energy content of food. Age of seals (years) and mean weight (kg): (1) 1 - 38.7; (2) 2 - 44.9; (3) 4 - 60.7; (4) 6 - 75.2; (5) 8 - 88.3; (6) 10 - 97.4; (7) 12 - 103.8; (8) 14 - 108.2; and (9) 20 - 115.0.
	J	B	2	-	89.0		kcal/kg-d						
	J	B	3	-	63.6		kcal/kg-d						
	J	B	4	-	50.0		kcal/kg-d						
	A	B	5	-	41.5		kcal/kg-d						
	A	B	6	-	35.3		kcal/kg-d						
	A	B	7	-	32.2		kcal/kg-d						
	A	B	8	-	28.5		kcal/kg-d						
	A	B	9	-	26.4		kcal/kg-d						

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Ashwell-Erickson & Elsner 1981 (richardsi)	A	B	-	-	0.06-0.08		g/g-day				NS	NS	LG = lactating or gestating. Summary of several studies; estimates for free-living seals.
	A	F	LG	-	0.10		g/g-day						
Boulva and McLaren 1979 (concolor)	A	B	1	SU	0.05		g/g-day				e Canada 1968-73	marine	Ingestion rates for (1) 20 kg seal, (2) 60 kg, and (3) 100 kg seal. The weight of stomach contents (if < 30% digested) and an estimate of the % already digested were used to estimate the weight of the food ingested in the previous 24 hours.
	A	B	2	SU	0.04		g/g-day						
	A	B	3	SU	0.03		g/g-day						
WATER INGESTION RATE													
Depocas et al. 1971	A	F	1	-	0.0013		g/g-day	0.0009	0.0016	2	British Columbia 1966-68	captive	Seawater ingestion by: (1) Starved seals; (2) fed seals. Values are approximate. Sea water ingestion increased with food intake and is suggested to be coincidental to feeding rather than intentional.
	A	B	2	-	0.0048		g/g-day	0.0028	0.0091	5			
INHALATION RATE													
Angell-James et al. 1981	J	B	R	-	21.3	8.2 SD	breath/min			8	from Bering Sea	lab	3-4 months old, weighted 13.2-21.4 kg (mean=16.9 kg); anesthetized.
Craig & Pasche 1980	J	M	SW	-	36.6	1.4 SE	breath/min			1	Oslo, Norway 1975	lab	Two years old (frequency during surface time).
	J	F	SW	-	39.7	2.0 SE	breath/min			1			
	J	M	R	-	36.2		breath/min			1			
	J	F	R	-	28.2		breath/min			1			
INHALATION VOLUME													
Angell-James et al. 1981	J	B	R	-	5.9	2.02 SD	m3/day			8	from Bering Sea	lab	Control value; anesthetized wt.=16.9 kg (range 13.2-21.4 kg); 3-4 months old.
	J	B	R	-	0.374	0.173 SD	m3/kg-day			8			
Craig & Pasche 1980	J	M	SW	-	47.9	3.0 SE	m3/day			1	Oslo, Norway 1975	lab	Two years old. Volume while at surface; provides an overestimate of average daily breathing rate on land.
	J	F	SW	-	57.5	2.9 SE	m3/day			1			
	J	M	R	-	47.7		m3/day			1			
	J	F	R	-	47.7		m3/day			1			

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Everitt et al. 1981 (richardsi)	A	B	walleye pollock	3.7	27.3	32.2	1.3		Washington 1978-79	coastal island - % of total fish otoliths; scat samples	Protection Island population. One winter scat contained an octopus beak and two fall scats contained squid beaks.
			English sole	37.0	0.0	27.0	0				
			shiner perch	0.0	0.0	0.5	63.6				
			Pacific herring	0	54.6	3.9	28.6				
			Pacific cod	0	0	10.1	0				
			rex sole	37	9.1	2.9	0				
			Pacific tomcod	3.7	0	4.7	0				
			rockfish	3.7	-	4.7	-				
			Dover sole	3.7	-	3.4	2.6				
			Petrale sole	7.4	-	1.8	-				
			other fish	3.8	9.0	8.8	3.9				
			(sample size)	(12)	(14)	(89)	(14)				
Everitt et al. 1981 (richardsi)	B	B	Pacific hake		51.2	60.0			Washington 1979	coastal island - % of total fish otoliths; scats	Gertrude Island population.
			plain midshipman		11.0	16.1					
			shiner perch		15.6	4.2					
			English sole		6.3	8.4					
			Pacific tomcod		7.6	2.3					
			pile perch		-	3.9					
			staghorn sculpin		-	2.9					
			other fish		5.2	2.1					
			(sample size)		(44)	(57)					
Harkonen 1988 (vitulina)	A	B	Gadus morhua		37			32	Sweden 1980	marine islands - % weight; estimated from otolith freq. & size in scats	
			Ammodytidae		13						
			Trisopterus minutus		9						
			T. esmarkii		4						
			Microstomus kitt		21						
			Scomber scombrus		4						
			Enchelyopus cimbrius		2						
			Merlangius merlangus		2						
			other		8						
Harkonen 1988 (vitulina)	A	B	cod (Gadus morhva)		11			63	Scandinavia 1980	coastal/marine - % weight; estimated from otolith freq. & size in scats	
			Enchelyopus cimbrius		3						
			dab (Limanda limanda		44						
			flatfish (Pleuronectes plat		13						
			Platichthys flesus		8						
			sandeels		9						
			other		12						
Jones 1981 (richardsi)	A	B	surfperches		41.9			8	California 1973	coastal/marine - % of total number of fish otoliths; stomachs	
			blackbelly eelpout		27.9						
			flatfishes		9.3						
			rock greenling		9.3						
			Pacific tomcod		4.7						
			other		6.9						

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Payne & Selzer 1989 (concolor)	B	B	American sandlance		74			234	s New England 1983-87	haul-out sites - % frequency of occurrence; scat analysis	Season is year-round. Scats collected at three haul-out sites on Cape Cod; otoliths and other parts (e.g., diagnostic bones) used to identify prey.
			Gadidae (cod-like)		8						
			flounder spp.		5						
			Atlantic herring		5						
			Atlantic mackerel		1						
			skate (Raja spp.)		2						
			squid (short finned or long finned)		5						
Perez 1990 (concolor)	A	B	Pacific herring		5				Bering Sea/Aleutians	coastal/marine - % wet weight; measure not specified	All seasons. Estimated from data contained in six other studies.
			salmon		1						
			capelin		5						
			euchalon & smelts		4						
			walleye pollock		12						
			Pacific cod		8						
			saffron cod		3						
			Arctic cod		<1						
			rockfishes		1						
			Atka mackerel		9						
			greenlings		8						
			sculpins		9						
			Pacific sandlance		4						
			eelpouts		1						
			flatfishes		3						
			other fish		2						
			(fish subtotal)		(75)						
			squid		4						
			octopus		15						
			shrimp		2						
			crab		2						
			other		2						
			(invert. subtotal)		(25)						
Pitcher 1980 (richardsi)	A	B	squid, octopus		20			269	Gulf of Alaska 1973-78	coastal/marine - % wet volume; stomach contents	All seasons combined (i.e., not only summer).
			shrimp, crabs		3.7						
			herring		6.4						
			salmonids		4.4						
			osmerids		22.5						
			cod, tomcod, walleye pollock		26.0						
			other		14.1						
Pitcher & Calkins 1979 (richardsi)	B	B	walleye pollock		23.3			255	Gulf of Alaska 1975-78	coastal/marine - % of volume; based on wet weight of stomach contents	All areas, all seasons combined.
			octopus		19.9						
			capelin		11.3						
			herring		7.0						
			Pacific cod		3.4						
			flatfishes		2.8						
			shrimp		3.6						

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Pitcher & Calkins 1979 (continued)			squid		1.8						
			euchalon		4.4						
			salmon		4.3						
			Pacific sandfish		3.2						
			sculpins		2.0						
			skates		3.0						
			Pacific sandlance		0.5						
			Pacific tomcod		1.7						
Pitcher & Calkins 1979 (richardsi)	J	B	-		% Occur.	95% C.L.		13	Gulf of Alaska 1975-78	coastal/marine - % frequency of occurrence +/- 95 % C.L.; stomach contents	All seasons; based on identifiable individual items, skeletal remains and otoliths. Ages of pups = between 2.5 and 11 months; small fish were the primary food.
			shrimp		7.1	19.4					
			capelin		35.7	32.1					
			Pacific tomcod		7.1	19.4					
			walleye pollock		35.7	32.1					
			Pacific sandlance		7.1	19.4					
			unident. fish		7.1	19.4					
Pitcher & Calkins 1979 (richardsi)	A	B	octopus		29.5			102	Kodiak Isl., Alaska 1975-78	coastal/marine - % volume; stomach contents	All seasons.
			capelin		21.3						
			walleye pollock		5.8						
			flatfishes		5.8						
			Pacific cod		6.6						
			Pacific sandlance		1.1						
			herring		4.2						
			shrimps		2.2						
			salmon		2.9						
			sculpins		0.7						
			euchalon		4.6						
Pitcher & Calkins 1979 (richardsi)	B	B	octopus		17.6	17.7	30.4		Kodiak Isl., Alaska 1975-78	coastal/marine - % frequency of occurrence; stomach contents	Seasons defined as: summer = 10 May to 30 Sept.; fall = 1 Oct. to 30 Nov.; winter = 1 Feb. - 9 May. 95% C.L. values for each value range from 5.2 to 12.9.
			salmon		5.4	0.0	0.0				
			capelin		20.3	4.8	5.4				
			Pacific cod		6.8	8.1	10.7				
			walleye pollock		12.2	9.7	14.3				
			Pacific sandlance		4.1	21.0	0.0				
Pitcher & Calkins 1979 (richardsi)	B	B	walleye pollock		46.6			83	Prince William Sound 1975-78	coastal/marine - % of volume; stomach contents	All seasons.
			herring		11.2						
			squids		5.9						
			octopus		5.4						
			salmon		10.0						
			capelin		3.8						
			Pacific tomcod		3.3						
			Pacific cod		0.9						
			saffron cod		1.3						
			euchalon		1.9						

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Pitcher & Calkins 1979 (richardsi)	B	B	octopus euchalon shrimps capelin		43.4 30.6 23.1 1.9			17	Low. Cook Inlet, AK 1975-78	coastal/marine - % of volume; stomach contents	All seasons.
Roffe & Mate 1984 (richardsi)	A	B	salmonid lamprey unidentified (non salmonid) unidentified (sample size)	42.8 28.6 7.2 21.4 (14)	12.2 25.0 30.0 32.8 (23)	45.7 2.3 5.1 46.6 (18)	20 60 0 20 (5)		Oregon 1976-78	Rogue River - % of prey number; from surface feeding observations	Seals most abundant from September-April; least abundant in summer. Taking of salmon believed to be over-valued here because seals are more likely to bring them to the surface.
Roffe & Mate 1984 (richardsi)	A	B	Salmo gairdneri Lampetra tridentatus Thaleichthys pacificus Microgadus proximus Glyptocephalus zachirus Citharichthys sordidus Parophrys vetulus unident. fish	23.1 92.3 23.1 7.7 7.7 7.7 7.7 23.1				13	Oregon 1976-78	Rogue River - % frequency of occurrence; gastro-intestinal tracts	Data is from 13 seals; 10 collected in spring, 1 in summer, and 2 in fall. Only includes species that were found three or more times.

***** POPULATION DYNAMICS *****

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
HOME RANGE SIZE/FORAGING RADIUS													
Beach et al. 1985	-	-	-	-	30-55		km				Washington	Columbia River	Travel distance; 75% of 58 seals radio-tagged in the Columbia River were relocated at haul-out sites 30-55 km away. As cited in Hoover 1988.
Brown & Mate 1983	-	-	-	-	25		km			5	Oregon	bays	Movements between bays; 5 of 11 radiotagged seals made at least one move between two bays 25 km apart. As cited in Hoover 1988.
Pitcher & McAllister 1981	-	-	-	-			km		24-194		Alaska	sw Tugidak Island	Distance between haulout sites used by radiotagged seals. Of 35 seals tagged, about 75% used the Tugidak Island site on a full-time basis while others used it in addition to sites from 24-194 km away. As cited in Hoover 1988.

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Stewart et al. 1989	B	B	-	-	5		km		48	1	California 1988	Southern California Bight	One seal tracked by satellite telemetry for about two weeks indicated movements up to 48 km from haul-out, but most locations were within 5 km. Accuracy of locations at sea was +/- 15 km, however.
POPULATION DENSITY													
Richardson 1981 (concolor)	B	B	-	SU	0.0305		N/ha	0.00394	0.0611		Maine 1973	coastal/marine	Data on both harbor and gray seals from seven census flights.
LITTER SIZE													
Hoover 1988	-	-	-	-	1						throughout range	NS	
LITTERS/YEAR													
Hoover 1988	-	-	-	-	1		/yr				throughout range	NS	
DAYS GESTATION													
FAO Adv. Comm. 1976	-	-	-	-	10.5-11		months				NS	NS	As cited in Ronald et al. 1982.
Newby 1978	-	-	-	-	11		months				e Pacific coast	coastal/marine	
AGE AT WEANING													
Boulva & McLaren 1979 (concolor)	-	B	-	-	30		days				e Canada 1968-73	marine	The weaning process takes about one week.
Lawson & Renouf 1987	-	-	-	-	4		weeks				Newfoundland 1982	tidal bay	
Slater & Markowitz 1983 (richardsi)	-	B	-	-	35		days				c California 1978-79	coastal/marine	Approximate value.

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
AGE AT SEXUAL MATURITY													
Ashwell-Erickson & Elsner 1981	-	F	1	-	5		years				NS	NS	Age: (1) at first ovulation; (2) at first successful pregnancy.
	-	F	2	-	5.5		years						
Bigg 1969a (richardsi)	-	F	1	-	3.3	0.26 SE	years				British Columbia	coastal/marine	(1) Age at first ovulation; (2) age at first pregnancy. SE estimated from 95% CL. As cited in Pitcher and Calkins 1979.
	-	F	2	-	3.3	0.31 SE	years						
	-	M	-	-			years	3	6				
Boulva & McLaren 1979 (concolor)	-	M	-	-	6		years				e Canada 1968-73	marine	Only 50% of 4-year old females mature; 95% of 7+ year-olds are mature.
	-	F	-	-	3-4		years						
FAO Adv.Comm. 1976 (richardsi)	-	F	-	-			years	2	5		NS	NS	As cited in Ronald et al. 1982.
	-	M	-	-			years	3	6				
Newby 1978 (richardsi &) P. largha	-	M	-	-	4-5		years				Pacific coast	coastal/marine	Data is for both the richardi subspecies and P. largha.
	-	F	-	-	3-4		years						
Pitcher 1977 (richardsi)	-	F	1	-	3.7		years				Prince William Sound	coastal/marine	Age: (1) at first ovulation; (2) at first pregnancy. As cited in Pitcher and Calkins 1979.
	-	F	2	-	4.4		years						
	-	M	-	-			years	3	7				
Pitcher & Calkins 1979 (richardsi)	-	F	-	-	4.96	0.22 SE	years	3	7		Gulf of Alaska 1975-78	coastal/marine	Age at first ovulation. SE calculated from 95% CL of +/- 0.43.
Pitcher & Calkins 1979 (richardsi)	-	F	-	-	5.51	0.23 SE	years	4	9		Gulf of Alaska 1975-78	coastal/marine	For females age is at first pregnancy; SE calculated from 95% CL of +/- 0.46.
Pitcher & Calkins 1979 (richardsi)	-	M	-	-			years	5	7		Gulf of Alaska 1975-78	coastal/marine	
ANNUAL MORTALITY													
Boulva & McLaren 1979 (concolor)	A	B	-	-	17.5		%/yr				e Canada 1968-73	marine	Post-weaning mortality.
Pitcher & Calkins 1979 (richardsi)	J	B	1	-	77		%/4-yrs				Gulf of Alaska 1975-78	coastal/marine	Estimated cumulative mortality: (1) from birth to 4 years old; (2) for 4 year olds; (3) for 7 to 14 year olds; and (4) for 20 year olds.
	J	B	2	-	11		%/yr						
	A	B	3	-	8-9		%/yr						
	A	B	4	-	14		%/yr						

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
LONGEVITY													
FAO Adv. Comm. 1976	-	-	-	-			years		40		NS	NS	As cited in Ronald et al. 1982.
Newby 1978	-	-	1	-			years		30		e Pacific	wild	(1) Estimated natural longevity; (2) maximum longevity of captive seal.
	-	-	2	-			years		33	1		captive	
Pitcher & Calkins 1979 (richardsi)	A	M	-	-			years		26		Gulf of Alaska 1975-78	coastal/marine	Approximately equal sex ratios were noted in all age groups except the oldest one (21-31 years); this group was 78% female. Few males over 20 years old were collected.
	A	F	-	-			years		31				

***** SEASONAL ACTIVITIES *****

Reference	Begin	Peak	End	Location	Habitat	Notes
MATING						
Bigg 1969b		Feb		Mexico	NS	As cited in Hoover 1988.
Bigg 1969b		July		Bering Sea	NS	As cited in Hoover 1988.
Boulva & McLaren 1979 (concolor)	earl Apr		Jul	Nova Scotia, CAN 1968-73	coastal island	
PARTURITION						
Allen et al. 1989	late Mar			California	Gulf of Farallones	
Boulva and McLaren 1979 (concolor)		May 21-27		Nova Scotia, CAN 1968-73	coastal island	
FAO Adv. Comm. 1976	Mar		May	Washington		As cited in Ronald et al. 1982.
FAO Adv. Comm. 1976	Feb		Mar	Mexico		As cited in Ronald et al. 1982.
FAO Adv. Comm. 1976	Mar		Jun	w Atlantic		As cited in Ronald et al. 1982.
FAO Adv. Comm. 1976	Mar		Apr	Alaska		As cited in Ronald et al. 1982.

Reference	Begin	Peak	End	Location	Habitat	Notes
Johnson & Jeffries 1983 (richardsi)	May	1st week June	Jun	Washington 1975-77	marine/coastal	Along the coast and outer coast.
Johnson & Jeffries 1983 (richardsi)	Aug		Sep	Washington 1975-77	s Puget Sound	Pupping occurred later in southern Puget Sound (i.e., Aug and Sept) than the outer coastal areas of Washington (i.e., May and June).
Pitcher 1977	mid May	earl Jun	earl Jul	Prince William Sound	coastal/marine	As cited in Hoover 1988.
Pitcher & Calkins 1979 (richardsi)	mid May	mid Jun	late Jun	Tugidak Isl., Alaska 1975-78	island/marine	
Riedman 1990 (richardsi)	Jun		mid Jul	Bristol Bay, Alaska	coastal/marine	
Riedman 1990 (richardsi)	mid May		late Jun	Gulf of Alaska	coastal/marine	
Riedman 1990 (richardsi)	late Jun		Sep	w Canada	coastal/marine	
Riedman 1990 (richardsi)	earl May		late May	Washington	coastal/marine	
Riedman 1990 (richardsi)	late Mar		late May	n California	coastal/marine	
Riedman 1990 (richardsi)	late Apr		earl May	c California	coastal/marine	
Riedman 1990 (richardsi)	Mar		Apr	s California	coastal/marine	
Riedman 1990 (richardsi)	earl Feb			Mexico	coastal/marine	
Slater & Markowitz 1983 (richardsi)	mid Apr	late Apr		c California 1978-79	coastal/marine	Pups weaned on average by the end of May.
Wilson 1978/ Richardson 1973 (concolor)	mid May		mid June	New England	coastal/marine	As cited in Payne and Schneider 1984.

Reference	Begin	Peak	End	Location	Habitat	Notes
FALL MOLT						
Stutz 1966		none		NS	NS	As cited in Ling 1970.
SPRING MOLT						
Boulva & McLaren 1979 (concolor)		Jul		Nova Scotia, CAN 1968-73	coastal/island	Molting timing may vary locally.
Pitcher & Calkins 1979 (richardsi)	late Jun	late Jul	Sep/Oct	Gulf of Alaska 1975-78	coastal/marine	
Stutz 1966		spring		NS	NS	As cited in Ling 1970.
Thompson & Rothery 1987	7 Jun		6 Sep	Scotland 1985	coastal/marine	19-33 days to complete molt.
Thompson & Rothery 1987			Aug 15	Scotland 1985	coastal/marine	19-33 days to complete molt; data for a female on an island.
Thompson & Rothery 1987			Aug 16	Scotland 1985	coastal/marine	19-33 days to molt; data for a female on the mainland.
Thompson & Rothery 1987			Sep 3	Scotland 1985	coastal/marine	19-33 days to molt; data for a mature male.
Thompson & Rothery 1987			Aug 22	Scotland 1985	coastal/marine	19-33 days to complete molt; data for an immature male.
MIGRATION						
Schneider & Payne 1983 (concolor)	earl May			New England 1978-80	coastal/marine	Population leaves Stage Point, MA, prior to pupping season and travels north.
Schneider & Payne 1983 (concolor)	late Oct			New England 1978-80	coastal/marine	Study population leaves Maine following the pupping season and returns to Stage Point, MA.

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*** NORMALIZING AND CONTACT RATE FACTORS ***

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
BODY WEIGHT													
Abbott 1974 (cooledgei)	A	B	-	-	20.8		g				28.9 N latitude	NS	As cited in MacMillen and Garland 1989.
Brower & Cade 1966 (gracilis)	A	B	-	-	17.0		g				44.4 N latitude	NS	As cited in MacMillen and Garland 1989.
Dewsbury et al. 1980 (bairdii)	A A	M F	- -	- -	16.2 15.2		g g				NS	lab reared	As cited in Montgomery 1989.
Dewsbury et al. 1980 (blandus)	A A	M F	- -	- -	22.3 21.1		g g				NS	lab reared	As cited in Montgomery 1989.
Drickamer & Bernstein 1972	A	F	-	-	19		g			25	Nebraska	North Platte Valley	As cited in Millar 1989.
Fairbairn 1978	A A	M F	- -	SP SP	17.8 16.1		g g				NS	NS	As cited in Montgomery 1989.
Fairbairn 1977	S	B	-	-	15		g				Vancouver, CAN	2nd-growth coastal rain forest	Weight at which mouse assumed to be sexually mature.
Fordham 1971 (austerus)	A A	M F	- -	SP SP	15.7 14.8		g g				NS	NS	As cited in Montgomery 1989.
Glazier 1979	A	F	-	-	14		g			10	Maine	Bar Harbor area	As cited in Millar 1989.
Halfpenny 1980	A	F	BR	-	21		g				Colorado	NS	As cited in Millar 1989.
Hayward 1965 (nebrascensis)	A	B	-	-	18.9		g			20	45.2 N lat., Wyoming	alpine	Latitude identified by MacMillen and Garland 1989.
Hayward 1965 (artemisiae)	A	B	-	-	23.2		g			20	49.2 N lat., British Columbia, CAN	arid valley	Latitude identified by MacMillen and Garland 1989.
Hayward 1965 (austerus)	A	B	-	-	19.5		g			20	British Columbia, CAN	mesic coast	
Hayward 1965 (sonoriensis)	A	B	-	-	20.4		g			20	Nevada	high altitude desert	

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Hayward 1965 (oreas)	A	B	-	-	24.6		g			20	British Columbia, CAN	subalpine	
Linzey 1970	A	F	-	-	18		g				Tennessee	Smoky Mountains	As cited in Millar 1989.
McCabe & Blanchard 1950	A	F	-	-	19		g				California	NS	As cited in Millar 1989.
McNab & Morrison 1963 (gambelii)	A	B	-	-	19.1	0.13 SE	g			29	37.9 N lat., CA 1957	chaparral near stream	
McNab & Morrison 1963 (sonoriensis)	A	B	-	-	24.2	0.18 SE	g			29	38.0 N lat., Nevada	chaparral	Found at altitude of 6 to 7 thousand feet.
Millar 1989	A	F	-	-	20		g				N America, average	NS	
	A	M	-	-	22		g						
Millar & Innes 1983 (borealis)	A	F	NB	-	20.3	0.42 SE	g			40	NS	lab	
	A	F	G	-	31.5	0.43 SE	g			44			
	A	F	L	-	24.5	0.37 SE	g			37			
Millar 1989	A	F	-	-	20		g				US average	NS	
Millar 1982 (borealis)	A	F	NB	-	19.2	0.9 SE	g			103	NW Terr., CAN	near lake	Body weight during lactation represents an increase of 27% over nonbreeding body weight.
	A	F	L	-	24.4	0.4 SE	g			42			
Millar 1982 (maniculatus)	A	F	NB	-	17.0	0.4 SE	g			42	NW Terr., CAN	near lake	Mean weight increased from 21.9 to 25.4 g during the lactation (L) period.
	A	F	L	-	22-25	0.4 SE	g			42			
Murie 1961 (sonoriensis)	A	B	-	-	20.8		g				37.3 N latitude	NS	As cited in MacMillen and Garland 1989.
Myers & Master 1983	A	F	BR	-	21		g				Michigan	NS	As cited in Millar 1989.
Sadleir 1970	A	M	-	SP	16.0		g				NS	NS	As cited in Montgomery 1989.
	A	F	-	SP	14.0		g						
Schlesinger & Potter 1974	A	B	-	-	19.6	0.71 SE	g			24	New Hampshire	forest	

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Stebbins 1978	A	M	-	SU	18.9		g			8	Alberta, CAN	captive; cage in woods	SU = Aug & Sept; FA = Oct, Nov, Dec; WI = Jan, Feb, Mar.
	A	F	-	SU	16.7		g			8			
	A	M	-	FA	21.9		g			8			
	A	F	-	FA	19.0		g			8			
	A	M	-	WI	25.2		g			8			
	A	F	-	WI	20.4		g			8			
Stebbins 1977	A	F	L	-	29.0		g				NS	NS	Weeks 1-4 of lactation respectively (weeks after birth).
	A	F	L	-	29.0		g						
	A	F	L	-	29.0		g						
	A	F	L	-	23.9		g						
Svendsen 1964	A	F	BR	-	20		g				Kansas	NS	As cited in Millar 1989.
Svihla 1932, 1935	A	F	BR	-	15		g				MI, ND, IA	NS	As cited in Millar 1989.
Svihla 1932, 1934	A	F	-	-	21		g				Washington	NS	As cited in Millar 1989.
Thomas 1971 (balaclavae)	A	F	-	-	24.3		g				NS	NS	As cited in Millar 1982.
Thomas 1971 (carli)	A	F	-	-	28.1		g				NS	NS	As cited in Millar 1982.
Wolff 1985b (nubiterrae)	A	F	-	-	17		g			52	Virginia	oak forest	As cited in Millar 1989.
BODY FAT													
Cronin & Bradley 1988	A	F	1	-	1.6		g			8	Virginia	lab	Nonbreeding: (1) reproductively proven; (2) reproductively inhibited.
	A	F	2	-	0.6		g			8			
	A	M	1	-	1.7		g			8			
	A	M	2	-	0.9		g			8			
Gyug & Millar 1980	A	M	-	SP	1.18	0.14 SE	g fat			19	NW Terr., CAN	pine/spruce forests	PB = pre-breeding; g = gestating; L = lactating; PL = post-lactating. Body weights not reported, only lean dry weights, which ranged from around 4.1 to 4.7 g depending on the group.
	A	M	-	SU	0.79	0.04 SE	g fat			72			
	A	F	PB	SP	1.22	0.20 SE	g fat			21			
	A	F	G	SP	0.84	0.07 SE	g fat			15			
	A	F	L	SU	0.73	0.04 SE	g fat			43			
	A	F	PL	SU	0.63	0.09 SE	g fat			13			
Morris & Kendeigh 1981	A	B	-	WI	2.2	0.2 SE	g			8	Illinois 1972	grassland	
	A	B	-	SU	1.9	0.31 SE	g			8			

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
LEAN (DRY) BODY WEIGHT													
Cronin & Bradley 1988	A	F	1	-	5.3		g			8	Virginia	lab	Nonbreeding: (1) reproductively proven; (2) reproductively inhibited.
	A	F	2	-	4.2		g			8			
	A	M	1	-	5.4		g			8			
	A	M	2	-	4.9		g			8			
Marinelli & Millar 1989	A	M	1	SU	6.0	0.12 SE	g			17	Vancouver BC, CAN 1986	beach	(1) One island off Vancouver; (2) a second island off Vancouver; (3) mainland Vancouver.
	A	M	2	SU	5.7	0.09 SE	g			27			
	A	M	3	SU	5.2	0.07 SE	g			48			
Morris & Kendeigh 1981	A	B	-	WI	4.5	0.58 SE	g			8	Illinois 1972	grassland	
	A	B	-	SU	4.7	0.55 SE	g			8			
Schlesinger & Potter 1974	A	B	-	-	5.4	0.21 SE	g			24	New Hampshire	forest	
NEONATE WEIGHT													
Halfpenny 1980	N	B	-	-	1.8		g				Colorado	NS	As cited in Millar 1989.
Layne 1968 (artemesiae)	N	-	-	-				1.3	2.2		NS	NS	As cited in Eisenberg 1981.
Layne 1968 (bairdii)	N	-	-	-				1.1	2.3		NS	NS	As cited in Eisenberg 1981.
Layne 1968 (blandus)	N	-	-	-				1.5	2.1		NS	NS	As cited in Eisenberg 1981.
Layne 1968 (gambelii)	N	-	-	-	1.4						NS	NS	As cited in Eisenberg 1981.
Linzey 1970	N	-	-	-	1.8		g				Tennessee	Smoky Mountains	As cited in Millar 1989.
McCabe & Blanchard 1950	N	-	-	-	1.40		g				California	NS	As cited in Millar 1989.
Millar 1982	N	B	-	-	1.9	0.01 SE	g			281	NW Terr., CAN 1978-79	lab lab	
Millar 1975	N	B	-	-	1.8		g			312	Ontario, CAN	lab	
Millar 1979	N	B	-	-	1.65	0.01 SE	g			201	Manitoba, CAN	lab	
Millar 1989	N	B	-	-	1.8		g	1.6	2.8		US average	NS	
Millar 1989	N	B	-	-	1.7	0.02 SE	g			165	Alberta, CAN	NS	

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Myers & Master 1983	N	B	-	-	1.7		g				Michigan	NS	As cited in Millar 1989.
Myers et al. 1985	N	B	-	FA	1.53		g			55	Michigan 1976-80	field	Average fall temperatures experienced.
Myers et al. 1985	N N	- -	- -	SP FA	1.64 1.53		g g			63 55	Michigan 1976-82	captive and wild	
Myers & Master 1983	N	-	-	-	1.7		g				Michigan	NS	As cited in Millar 1989.
Svendsen 1964	N	B	-	-	1.8		g				Kansas	NS	As cited in Millar 1989.
Svendsen 1964	N	-	-	-	1.8		g				Kansas	NS	As cited in Millar 1989.
Svihla 1932, 1935	N	B	-	-	1.6		g				MI, ND, IO	NS	As cited in Millar 1989.
Svihla 1932	N	-	-	-	1.7		g				CA, NM	NS	As cited in Millar 1989.
Svihla 1932	N	-	-	-	1.7		g				Washington	NS	As cited in Millar 1989.
Svihla 1932, 1934	N	-	-	-	1.67		g				MI, ND, IA	NS	As cited in Millar 1989.
Svihla 1932	N	-	-	-	1.67		g				Colorado, New Mexico	NS	As cited in Millar 1989.
GROWTH RATE													
Drickamer & Bernstein 1972 (nebrascensis)	P	-	-	-	0.34		g/day				NS	NS	As cited in Millar 1982.
Drickamer & Bernstein 1972 (labecula)	P	-	-	-	0.45		g/day				NS	NS	As cited in Millar 1982.
Linzey 1970 (nubiterrae)	P	-	-	-	0.35		g/day				NS	NS	As cited in Millar 1982.
McCabe & Blanchard 1950 (gambelii)	P	-	-	-	0.34		g/day				NS	NS	As cited in Millar 1982.
Millar 1982 (borealis)	P	-	-	-	0.36	0.01 SE	g/day			57	NW Terr., CAN 1978-79	lab	N = 57 litters.
Millar 1979 (borealis)	P	-	-	-	0.35		g/day				Manitoba, CAN	lab	

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Millar et al. 1979 (maniculatus)	P	-	-	-	0.32		g/day				NS	NS	As cited in Millar 1982.
Millar & Innes 1983 (borealis)	P	-	-	-	0.34		g/day			150	Alberta, CAN 1978-81	various alpine	Average nestling growth rate.
Millar & Innes 1983 (borealis)	P P P	M F B	- - -	- - -	0.27 0.22 0.25	0.06 SE 0.05 SE 0.03 SE	g/day g/day g/day			31 30 61	Alberta, CAN	wild (not lab)	Growth rate of newly "emerged" pups.
Millar and Innes 1983 (borealis)	J	-	-	-	0.2	0.05 SE	g/day				Alberta, CAN	lab	From weaning (approximately 3 weeks) to 40 days of age.
Millar 1985 (nebrascensis)	P	B	-	-	0.38	0.01 SE	g/day	0.30	0.95	156	Alberta, CAN	NS	Growth rate varies with age.
Morrison et al. 1977 (bairdii)	P	-	-	-	0.35		g/day				NS	NS	As cited in Millar 1982.
WEANING WEIGHT													
Halfpenny 1980	-	B	-	-	8.0		g				Colorado	NS	As cited in Millar 1989.
King et al. 1963	-	B	-	-	9.5		g				Michigan	NS	As cited in Millar 1989.
Millar 1979	-	B	-	-	9.26	0.10 SE	g			232	NW Terr., CAN 1978-79	lab	
Millar 1979	-	B	-	-	8.40	0.06 SE	g			201	Manitoba, CAN	lab	
Millar & Innes 1983 (borealis)	-	B	-	-	9.9	0.1 SE	g			151	Alberta, CAN 1978-81	various alpine	
Millar 1989	-	B	-	-	8.8		g	7.7	11.2		N American average	NS	
METABOLIC RATE (OXYGEN)													
Abbott 1974 (cooledgei)	A	-	B	-	43.68		lO2/kg-day				28.9 N latitude	NS	As cited in MacMillen and Garland 1989.
Brower & Cade 1966 (gracilis)	A	-	B	-	43.2		LO2/kg-day				44.4 N latitude	woodlands	Temp: 37.5 C; body wt 17.0 g. As cited in Deavers and Hudson 1981 and MacMillen and Garland 1989.

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Hayward 1965	A	-	B	-	45.6		lO2/kg-day				NS	NS	Temp: 36.3 C; body wt. 22.5 g. As cited in Deavers and Hudson 1981.
Hock & Roberts 1966	A	-	B	-	48.0		lO2/kg-day				NS	NS	Temp: 36.6 C; body wt. NS. As cited in Deavers and Hudson 1981.
MacMillen and Garland 1989 (various)	A	F	BA	-	50		LO2/kg-day	40	61		N American average	NS	Data from seven studies.
McNab & Morrison 1963 (gambelii)	A	-	B	-	48.96		lO2/kg-day				37.9 N latitude	arid and mesic	Temp: 36.8 C; body wt. 19.1 g. As cited in Deavers and Hudson 1981 and MacMillen and Garland 1989.
McNab & Morrison 1963 (sonoriensis)	A	-	B	-	40.08		lO2/kg-day				38.0 N latitude	NS	Temp: 36.3 C; body wt. 24.2 g. As cited in Deavers and Hudson 1981 and MacMillen and Garland 1989.
Morrison 1948	A	-	AD	-	74.4	2.2 SD	lO2/kg-day	53	101	3	NS	lab	(AD) ADMR = average daily metabolic rate. Three runs with two animals (average weight 19 g). Room temperature ranged between 15 and 25 C.
Murie 1961 (sonoriensis)	A	-	B	-	54.72		lO2/kg-day				37.3 N latitude	NS	Temp: 36.8 C; body wt. 20.8 g. As cited in Deavers and Hudson 1981 and MacMillen and Garland 1989.
Stebbins et al. 1980	A	M	AD	WI	138	5.3 SE	lO2/kg-day			4	Alberta, CAN	lab, poplar grove	(AD) = average daily metabolic rate; (R) = resting metabolism. Temperatures for winter averaged -17.7 C (-6 to -22 C); for spring averaged 14.5 C (8 to 22 C); for summer averaged 20.6 C (14 to 32 C).
	A	M	AD	SP	102	7.2 SE	lO2/kg-day			4			
	A	M	AD	SU	74.9	3.4 SE	lO2/kg-day			4			
	A	M	R	WI	112	2.9 SE	lO2/kg-day			4			
	A	M	R	SP	77.0	2.4 SE	lO2/kg-day			4			
	A	M	R	SU	63.8	1.9 SE	lO2/kg-day			4			
Tomasi 1985	A	B	R1	-	142	7.0 SE				6	Utah	lab	Resting (R) metabolism at different temperatures: (1) 10 deg C; (2) 18 deg C; (3) 26 deg C; (4) 30 deg C; and (5) 36 deg C.
	A	B	R2	-	103	6.5 SE				6			
	A	B	R3	-	63.6	4.3 SE				6			
	A	B	R4	-	58.8	4.3 SE				6			
	A	B	R5	-	78.0	8.4 SE				6			
Zegers & Merritt 1988	A	B	R	WI			LO2/kg-day	31	60		Pennsylvania 1984-85	mature beech-poplar forest	
	A	B	R	SU			LO2/kg-day	43	60				

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
METABOLIC RATE (KCAL BASIS)													
Morris & Kendeigh 1981 (bairdii)	A	B	FL	WI	790		kcal/kg-d				Illinois	lab	(FL) Free-living metabolism. Estimated from lab-derived model assuming no reproduction, molt, or weight change and assuming summer temps avg. 17.5 C above ground and 20.2 in burrows and winter temps avg. -3 C above ground and 10.7 in burrows.
	A	B	FL	SU	592		kcal/kg-d						
Stebbins 1978	A	B	-	WI	18.75		kcal/mouse			16	Alberta, CAN	artificial nest in woods	Average energy consumed daily; WI = Nov, Dec, Jan; SP = Feb, Mar.
	A	B	-	SP	23.00		kcal/mouse			16			
Stebbins et al. 1980	A	M	AD	WI	668	25 SE	kcal/kg-d			4	Alberta, CAN	lab	(AD) = average daily metabolic rate; (R) = resting metabolism. Temperatures for winter averaged -17.7 C (-6 to -22 C); for spring averaged 14.5 C (8 to 22 C); for summer averaged 20.6 C (14 to 32 C).
	A	M	AD	SP	623	35 SE	kcal/kg-d			4			
	A	M	AD	SU	360	17 SE	kcal/kg-d			4			
	A	M	R	WI	545	15 SE	kcal/kg-d			4			
	A	M	R	SP	374	16 SE	kcal/kg-d			4			
	A	M	R	SU	306	9 SE	kcal/kg-d			4			
FOOD INGESTION RATE													
Cronin & Bradley 1988	A	F	NB	-	0.185		g/g-day				Virginia	lab	Animals were reproductively proven. Diet of lab chow.
	A	M	NB	-	0.218		g/g-day					lab	
Dice 1922 (bairdii)	A	M	1	-	0.536		cal/g-day	0.511	0.560	20	Illinois	lab	N = number of animal-days. Diet of wheat and peanut kernals. Conditions: (1) 21 deg C, dry air; (2) 32 to 34 deg C, dry air; and (3) 32 to 34 deg C, wet air.
	A	F	1	-	0.558		cal/g-day	0.480	0.699	59			
	A	B	2	-	0.348		cal/g-day	0.208	0.615	11			
	A	B	3	-	0.459		cal/g-day	0.427	0.502	7			
Dice 1922 (bairdii)	A	B	1	-	1.86		g wheat	1.35	2.93		Illinois	lab	Conditions: (1) 21 deg C, dry air; (2) 28 deg C, dry air. Diet consisted of wheat and peanuts (peanut intake restricted). Wheat was 10.6% water with 3.33 cal/gram. Peanuts were 9.2% water with 5.48 cal/gram. Weights of mice not reported, appears to be about 15 g.
	-	-	1	-	0.48		g peanuts						
	-	-	1	-	2.34		g total/d						
	A	B	2	-	1.45		g wheat	0.80	2.09				
	-	-	2	-	0.43		g peanuts						
	-	-	2	-	1.88		g total/d						
Dice 1922 (bairdii)	A	F	GL	-	3.12		g wheat				Illinois	lab	Conditions 21 deg C, dry air. Female gestating (G) and then lactating (L).
	-	-	-	-	0.50		g peanuts						
	-	-	-	-	3.62		g total/d						

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Drickamer 1970 (bairdii)	A	B	-	SU	0.133		g/g-day			30	Michigan 1968	lab	Fed seeds found in area they were trapped (i.e., sunflower, corn, multiflora rose, wheat, elm, and maple).
Drickamer 1976	J	B	-	-	0.12		g/g-day			10	NS	lab	Diet almost completely of wheat and Lespedeza (bush clover) seeds; weight of mice 15.2 +/- 0.67 SE.
Green & Millar 1987	A	B	1	-	3.3	0.3 SE	g/day			19	Alberta, CAN	lab	(1) 15% added fiber, 21.4 g avg wt; (2) 30% added fiber, 20.8 g avg wt; (3) 45% added fiber, 21.5 g avg wt. Fiber added to standard laboratory chow; moisture content not specified, but probably low (e.g., 10 - 15%). Maintained at 20 degrees C.
	A	B	2	-	3.0	0.2 SE	g/day			18			
	A	B	3	-	3.7	0.9 SE	g/day			19			
Green & Millar 1987	A	B	1	-	0.15		g/g-day			19	Alberta, CAN	lab	(1) 15% added fiber; (2) 30% added fiber; (3) 45% added fiber. Fiber added to standard laboratory chow; moisture content not specified, but probably low (e.g., 10 - 15%). Maintained at 20 degrees C.
	A	B	2	-	0.14		g/g-day			18			
	A	B	3	-	0.17		g/g-day			19			
Kantak 1983 (bairdii)	A	B	NB	-	0.07		g/g-day				Wisconsin	lab	Seed consumption (low probably because not starved prior to testing).
Millar 1982 (borealis)	A	F	NB	-	0.15		g/g-day			40	northern population, Alberta, CAN	lab	Diet of rat chow, 3% water content and 4.5 kcal/g dry weight. Temp 20 C.
	A	F	L	-	0.34		g/g-day			40			
Millar 1979 (maniculatus)	A	F	NB	-	0.19		g/g-day				Manitoba, CAN	lab	Diet of rat chow, 3% water content and 4.5 kcal/g dry weight. Temp 20 C.
	A	F	L	-	0.45		g/g-day						
Millar 1985 (nebrascensis)	A	F	NB	-	0.17		g/g-day				NS	lab	Diet of rat chow, 3% water content and 4.5 kcal/g dry weight. Temp 20 C.
Millar & Innes 1983 (borealis)	A	F	NB	-	0.180		g/g-day			40	montane population, Alberta, CAN	lab	Diet of Purina lab chow #5001; composition not specified.
	A	F	L	-	0.38		g/g-day			40			
Millar 1985 (nebrascensis)	A	F	L	-	0.33		g/g-day			33	Alberta, CAN	lab	Diet of purina rat pellets (water content 3%; energy value 4.5 kcal/g dry weight).

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Millar 1985 (nebrascensis)	A	F	N	-	0.17		g/g-day			49	Alberta, CAN	lab	Mean daily food intake over 3-6 days is related to body weight as Y(intake in g/day) = 1.09 + 0.12 X(mean body weight in g). The mean body weight of the tested females was 20.1 +/- 0.6 g.
Nelson & Desjardins 1987	J	M	1	-	0.21	0.01 SE	g/g-day			18	parents from S Dakota	lab	Conditions: (1) provided with unlimited water supply; (2) water supply limited to 50% of consumption when provided with unlimited supply. Diet of lab chow with 8 to 10% water content.
	J	M	2	-	0.17		g/g-day			62			

WATER INGESTION RATE

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Dice 1922 (bairdii)	A	B	1	-	0.126		g/g-day	0.082	0.177	79	Illinois	lab	N = number of animal-days. Diet of wheat and peanut kernals. Conditions, all dry air: (1) 21 deg C; (2) 28 deg C; and (3) 32-34 deg C.
	A	B	2	-	0.146		g/g-day	0.132	0.168	35			
	A	B	3	-	0.192		g/g-day	0.123	0.287	11			
Dice 1922 (bairdii)	A	M	1	-	1.98		cc/day	1.24	2.72	20	Illinois	lab	N = number of animal-days. Diet of wheat and peanut kernals. Conditions: (1) 21 deg C, dry air; (2) 32 to 34 deg C, dry air; and (3) 32 to 34 deg C, wet air.
	A	F	1	-	1.66		cc/day	1.12	2.39	59			
	A	B	1	-	1.7		cc/day	1.12	2.72	79			
	A	F	G1	-	3.78		cc/day						
	A	F	L1	-	2.98		cc/day						
	A	B	2	-	2.31		cc/day	1.55	3.37	11			
	A	B	3	-	1.14		cc/day	1.07	1.23	7			
	A												
Nelson & Desjardins 1987	J	M	-	-	0.34	0.02 SE	g/g-day			80	parents from S Dakota	lab	Animals 50-70 days old; temperature = 20 +/-2 deg C. Diet with 8 to 10% water content.
Ross 1930 (sonoriensis)	A	B	-	-	0.19			0.071	0.60	8	NS	lab	Diet of dry ground wheat, powdered milk, casein, etc. Moisture content probably < 10%. Temperature 21 to 24 deg C.
Ross 1930 (gambelii)	A	B	-	-	0.16			0.061	0.29	4	NS	lab	Diet of dry ground wheat, powdered milk, casein, etc. Moisture content probably < 10%. Temperature 21 to 24 deg C.

***** DIET *****

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Agnew et al. 1988	B	B	arthropods	25.9	59.1	58.4			S Dakota 1981-82	prairie dog colony/ Badlands Nat. Park - % of total items; fecal pellets	Data in fall column collected in late summer. Hard to determine N; 64 traps set at three-week intervals and pellets collected from traps after id animal.
			vegetation	42.8	26.9	29.1					
			seeds	31.3	14.0	12.4					
Agnew et al. 1988	B	B	arthropods	52.2	31.8	32.0			S Dakota 1981-82	mixed-grass pairie/ Badlands Nat. Park - % of total items; fecal pellets	Data in fall column collected in late summer. Hard to determine N; 64 traps set at three-week intervals and pellets collected from traps after id animal.
			vegetation	36.5	34.1	29.4					
			seeds	10.7	43.5	15.1					
Cook et al. 1982	B	B	Festuca arundinacea	0	0.7	6.2	1.8		sw Missouri 1975-76	old succession field - mean no. items per stomach	The mice ate seeds of the Festuca, Phleum, Setaria, and Bromus.
			Dactylis glomerata	1.5	2.2	1.0	4.7				
			Phleum pratense	2.5	4.2	7.5	1.7				
			Tridens flavus	2.5	1.0	1.2	3.1				
			Sertaria viridis	2.0	0.7	0.5	0.0				
			Taraxacum officinale	6.0	4.9	8.0	9.2				
			Lamium amplexicaule	9.0	1.4	0	8.9				
			Bromus tectorum	0	0	5.5	2.1				
			Sertaria faberi	2.0	0.0	0.6	3.6				
			Capsella bursa-pasto	4.0	1.7	3.5	5.6				
			Trifolium stolonifer	4.0	0.7	0	2.6				
			arthropod	11.5	22.2	0	0.4				
			animal material	2.0	5.4	0	1.0				
			miscellaneous	0	0.8	0	3.9				
			(sample size)	(6)	(11)	(3)	(7)				
Cook et al. 1982	B	B	Festuca arundinacea	2.0					sw Missouri 1975-76	old succession field - mean no. items per stomach	Average across the entire year in spring column. The mice ate seeds of the Festuca, Phleum, Setaria, and Bromus.
			Dactylis glomerata	2.4							
			Phleum pratense	3.3							
			Tridens flavus	1.7							
			Sertaria viridis	0.4							
			Taraxacum officinale	7.7							
			Lamium amplexicaule	6.5							
			Bromus tectorum	1.8							
			Sertaria faberi	1.6							
			Capsella bursa-pasto	4.6							
			Trifolium stolonifer	1.9							
			arthropod	8.2							
			animal material	1.9							
			miscellaneous	1.1							

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Flake 1973	B	B	coleopterans	14.6	23.8	9.4	4.9	565	Colorado 1969-70	short/mixed grass prairie - % volume by a ranking method; stomach contents	Spring = Mar - Apr.; summer = May - Aug; fall = Sept - Dec; winter = Jan - Feb.
			grasshoppers	6.4	4.2	6.4	2.5				
			leafhoppers	13.3	1.8	1.9	2.5				
			lepidopterans	21.7	12.7	1.5	1.8				
			spiders	2.6	2.7	2.5	0.3				
			seeds	22.5	25.9	56.8	65.4				
			forbs	4.7	10.0	5.6	4.3				
			grasses and sedges	4.0	2.6	2.8	4.8				
			shrubs	3.8	1.4	0.8	2.6				
			(sample size)	(108)	(215)	(236)	(97)				
Hamilton 1941	A	B	insects		71.4		72.8	180	e US, mostly NY	habitat NS - % occurrence; stomach contents	Beechnuts, acorns, and ripening seeds of all sorts are stored for winter use.
			seeds, other starch		20.8		43.9				
			greens		0		20.5				
			small mammals		4.3		4.4				
			snails		1.2		3.9				
			birds		3.7		1.7				
			annelids		0		1.7				
			fruit		52.3		0				
			fungi		3.7		0				
Harris 1986	B	B	arthropods	81	84	72		95	California	semi-stabilized dune - % relative frequency in fecal samples	Elevation 2,000 meters.
			vegetation	19	0	3					
			seeds	0	16	25					
			(sample size)	(40)	(31)	(24)					
Martell & MacAuley 1981	B	B	nuts and seeds		22.9			712	Ontario, CAN	habitat NS - % diet; measure NS	As cited in Wolff et al. 1985.
			arthropods		47.2						
			fruit		16.6						
			fungi		9.3						
			green plants		1.7						
			Achlorophyllon plant		2.6						
Sieg et al. 1986	B	B	arthropods		63.6			192	Montana 1979-80	betonite mine spoils & sagebrush grass lands; - % relative density in scats	Two years averaged.
			seeds		21.8						
			grasses		1.4						
			forbs		7.6						
			shrubs		2.3						
			algae		1.3						
			fungi		2.3						
Vaughn 1974	A	B	seeds		58.8			242	Colorado 1965-66	habitat NS - % frequency of occurrence; stomach contents	Data from 1965 and 1966 averaged together.
			arthropods		17.4						
			cut worms		11.3						
			flowers		2.8						
			leaves		5.1						
			fungus		2.7						
			fruit		0.5						

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Whitaker 1966	-	-	Setaria seeds	2.1	2.7	0.6	1.4	444	Indiana	several habitats	
			lepidopterous larvae	20.6	34.5	16.7	4.8		1962-65	-	
			corn	4.1	4.2	3.2	8.7			% volume;	
			misc. vegetation	15.8	3.1	8.0	13.4			stomach contents	
			wheat seeds	6.5	1.6	3.2	23.7				
			Digitaria seeds	0	2.6	0.7	0.6				
			Ambrosia	0	0	2.2	0.6				
			coleopterous larvae	1.8	.7	1.6	1.0				
			unidentified seeds	5.4	5	8.8	8.3				
			Endogone	TR	0	0.8	0				
			green vegetation	7.6	0	4.3	3.7				
			Echinochloa seeds	0	1.2	6.4	0				
			Coleoptera	3.9	5.3	5.1	1.4				
			soybeans	13.4	3.1	6.9	10.7				
			Hemiptera	1.3	2.7	4.2	0.9				
			earthworms	2.9	0	0	1.7				
			Prunus	0.2	1.2	0.7	0				
			Elymus seeds	0.3	0	0	0				
			Chilopoda	2.1	0	2.0	0.3				
			spider	0.7	1.8	0.3	0				
Whitaker 1966	-	-	Setaria seeds		0.7			67	Indiana	cultivated field	Year-round diet.
			lepidopterous larvae		14.9					-	
			corn		1.6					% volume;	
			misc. vegetation		9.4					stomach contents	
			wheat seeds		1.5						
			Digitaria seeds		0						
			coleopterous larvae		0.7						
			unidentified seeds		9.0						
			Endogone		0						
			green vegetation		12.5						
			sorghum halepense se		0						
			Coleoptera		1.2						
			cultivated sorghum s		6.0						
			soybeans		0						
			Lespedeza seeds		11.9						
			flesh		0.7						
			Hemiptera		4.6						
			earthworms		2.1						
Whitaker 1966 (bairdii)	B	B	nuts and seeds		39			113	Indiana	habitat NS	As summarized by Wolff et al. 1985.
			arthropods		26					-	
			green plants		20					% volume; stomach	
			other		8.4					contents	
			unspecified		6.6						

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Wolff et al. 1985 (nubiterrae)	A	B	nuts/seeds		0	24	23		Virginia	oak, maple, hickory forest	
			arthropods		56	30	46			-	
			lepidopteran larvae		3.8	0.2	1.5			% frequency of occurrence;	
			lepidopteran adults		3.4	26	6.7			stomach contents	
			green vegetation		4.7	12	18				
			fungus		7.2	0.3	1.0				
			fruit		25	3.5	1.1				
			unknown		0.8	4.1	3.0				
			(sample size)		(40)	(20)	(10)				
van Horne 1982	J	B	hard-body arthropods		6			53	Alaska 1977-79	spruce/hemlock forest	Measure = percentage cover of each fragment type in slides of stomach contents. Should approximate percent volume in diet.
			soft-body arthropods		12					-	
			vegetation		5					index of % volume;	
			fruits & seeds		53					stomach contents	
			flowers		14						
			hemlock spores		5						
			fungus		1						
van Horne 1982	A	B	hard-body arthropods		17			129	Alaska 1977-79	spruce/hemlock forest	Measure = percentage cover of each fragment type in slides of stomach contents. Should approximate percent volume in diet.
			soft-body arthropods		9					-	
			vegetation		6					index of % volume;	
			fruits & seeds		52					stomach contents	
			flowers		7						
			hemlock spores		4						
			fungus		1						

***** POPULATION DYNAMICS *****

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
HOME RANGE SIZE													
Blair 1940	A	M	-	SU	0.94		ha				Michigan	woodlands heterogenous	As cited in Bowers and Smith 1979.
	A	F	-	SU	0.54		ha						
Blair 1940	A	M	-	SU	0.25		ha				Michigan	homogenous grassland	As cited in Bowers and Smith 1979.
	A	F	-	SU	0.24		ha						
Bowers & Smith 1979	A	M	1	SU	0.0998	0.0063 SE	ha			30	UT, ID, OR 1977	see notes	Habitat: (1) ponderosa pine in Oregon; (2) artemisia-sarcobatus desert in Idaho; (3) atriplex-eurotia desert in Utah.
	A	F	1	SU	0.075	0.0063 SE	ha			25			
	A	M	2	SU	0.128	0.012 SE	ha			12			
	A	F	2	SU	0.094	0.0013 SE	ha			10			
	A	M	3	SU	0.123	0.014 SE	ha			8			
	A	F	3	SU	0.119	0.006 SE	ha			8			

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Bowers & Smith 1979	A	M	-	SU			ha	0.02	0.21	50	Utah, Oregon, Idaho	all habitats combined	Mark recapture 2x per day over a 7-day period. Home ranges estimated for individuals captured more than 4 times using Calhoun and Casby method.
	A	F	-	SU			ha	0.01	0.18	43			
Cranford 1984	A	M	-	WI	0.0189	0.0065 SD	ha			14	Utah 1974-76	subalpine meadow	Snowbound; calculated using boundary strip method.
	A	F	-	WI	0.0137	0.0050 SD	ha			9			
	J	-	-	WI	0.0252	0.0135 SD	ha			8			
Cranford 1984	A	M	-	SU	0.0390	0.0054 SD	ha			21	Utah 1974-76	subalpine meadow	Snow free.
	A	F	-	SU	0.0265	0.0047 SD	ha			22			
	J	-	-	SU	0.0446	0.0095 SD	ha			16			
Cranford 1984	A	M	-	SP	0.0276	0.0082 SD	ha			23	Utah 1974-76	subalpine meadow	Snowbound - calculated by boundary strip method.
	A	F	-	SP	0.0246	0.0035 SD	ha			18			
	J	-	-	SP	0.0075	0.0064 SD	ha			3			
Metzgar 1973a,b	-	-	-	-			ha		0.30		NS	NS	As cited in Wolff 1989.
Wolff et al. 1983	A	M	-	SU	0.0421		ha			4	Virginia 1981	mature oak maple forest	Minimum home range based on recapture in grid of traps; spring and summer.
	A	F	-	SU	0.0332		ha			6			
Wolff 1985a (nubiterrae)	B	B	-	-	0.0596	0.0040 SE	ha	0.0537	0.0678	76	Virginia 1981-83	mixed deciduous forest	Combined across control plots and low and high density experimental plots.
	B	M	-	-	0.0583	0.0061 SE	ha	0.0535	0.0645	39			
	B	F	-	-	0.0611	0.0053 SE	ha	0.0539	0.0715	37			
	J	B	-	-	0.0610	0.0062 SE	ha	0.0588	0.0655	27			
Wolff 1985a (nubiterrae)	B	M	1	-	0.0515	0.0072 SE	ha			25	sw Virginia 1981-83	oak, maple, hickory forest	Control plots. Estimated by trapping year-round except winter.
	B	F	1	-	0.0534	0.0060 SE	ha			23			
	J	B	1	-	0.0514	0.0060 SE	ha			13			
	B	B	1	-	0.0560	0.0033 SE	ha			61			
POPULATION DENSITY													
Brown & Zeng 1989	B	B	1	-	0.28		N/ha			74	Arizona 1977-85	desert	(1) All study plots; (2) mean value for two control plots surveyed year round.
	B	B	2	-	0.19		N/ha						
Cranford 1984	B	B	-	SP			N/ha	2.2	14.5		Utah 1974-76	subalpine meadow with clumps of fir and spruce	Determined by minimum number known alive.
	B	B	-	SU			N/ha	12.8	22.4				
	B	B	-	WI			N/ha	3.4	8.4				
Halford 1987	B	B	-	-	10.2		N/ha			57	Idaho	dry pond basin	Near radioactive waste disposal site.

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Metzgar 1980	A	B	1	-	5-6		N/ha				w Montana	mixed conifer, cottonwood river, bottom forest	Season: (1) Through July 2; (2) August.
	A	B	2	-	20		N/ha						
Metzgar 1979	B	B	-	-	12	6.7 SD	N/ha	3.9	28	16	Montana	thick understory near river	N = 16 months sampled over a three-year period.
Sullivan 1979	A	B	-	-			N/ha	12.7	45.5	4	Brit. Col., CAN 1977-78	burnt slash	Seasons = July through October and March through April. Minimum number alive on the plot.
Vaughn 1974	A	B	-	SU	2.8		N/ha				Colorado 1965-67	subalpine meadow	
Wolff 1985a (two)	B	B	1	FA	33.2	4.32 SE	N/ha	6	57		Virginia 1981-83	mixed deciduous forest	Data are for joint densities of P. leucopus and P. maniculatus: (1) from April- Nov. 1981; (2) from April-Nov. 1982-83.
	B	B	2	FA	13.6	1.11 SE	N/ha	6	57				
Wolff & Durr 1986	A	B	-	FA	15		N/ha				sw Virginia	mountain forest	
	J	B	-	FA	4		N/ha						
	A	B	-	SP	14		N/ha						
	J	B	-	SP	4		N/ha						
van Horne 1982	A	B	1	-	21		N/ha	6	33		Alaska 1977-79	forest spruce/hemlock	Estimated densities in 4 seral stages of spruce/hemlock forest following clearcut: (1) 2 years later; (3) 7 years later; (3) 23 years later; (4) never clear-cut. Minimum and maximum values are from one of the three study years that were averaged to get the mean value. Category 3 considered most favorable on basis of overwintering survival.
	J	B	1	-	19		N/ha	6	47				
	A	B	2	-	27		N/ha	15	41				
	J	B	2	-	15		N/ha	7	24				
	A	B	3	-	49		N/ha	32	58				
	J	B	3	-	12		N/ha	10	13				
	A	B	4	-	16		N/ha	9	23				
	J	B	4	-	20		N/ha	10	43				
LITTER SIZE													
Blair 1958	-	-	-	-	5.0					31	Texas	NS	As cited in Millar 1989.
Drickamer & Bernstein 1972	-	-	-	-	3.7						Nebraska	North Platte Valley	As cited in Millar 1989.
Glazier 1979	-	-	-	-	4.3					10	Maine	Bar Habor area	As cited in Millar 1989.
Halfpenny 1980	-	-	-	-	6.4					7	Colorado	NS	As cited in Millar 1989.
Linzey 1970	-	-	-	-	4.1						Tennessee	Smoky Mountains	As cited in Millar 1989.

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
May 1979; Gyug 1979	-	-	-	-	1.8						NW Terr., CAN	NS	As cited in Millar 1989.
McLaren & Kirkland 1979	-	-	-	-	4.3					195	Pennsylvania	NS	As cited in Millar 1989.
Meyers et al. 1985	-	-	1	SP	5.4					52	Michigan	NS	Temperature: (1) warmer than normal; (2) normal.
	-	-	2	SP	5.0					150	1976-82		
	-	-	1	FA	4.9					29			
	A	-	2	FA	5.6					98			
Meyers et al. 1985	-	-	-	SP	5.0			4.9	5.5	150	Michigan	captive and wild	
	-	-	-	FA	5.6			5.3	6.3	98	1976-82		
Millar 1982	-	-	-	-	5.0	0.18 SE		1	9	98	NW Terr., CAN 1978-79	lab lab	
Millar & Innes 1983 (borealis)	-	-	-	-	5.3	0.1 SE				102	Alberta, CAN	various alpine	
Millar 1989	-	-	-	-	4.4			3.0	6.4		N America	NS	Minimum average and maximum average of 23 populations in North America.
Millar 1985 (nebrascensis)	-	-	-	-	5.1	0.14 SE		1	8	104	Alberta, CAN	NS	Minimum average and maximum average of 7 years of data.
Millar 1982	-	-	-	-	5.0						NW Terr., CAN	NS	
Morrison et al. 1977	-	-	-	-	4.4						midwest US	NS	As cited in Millar 1989.
Myers & Master 1983	-	-	-	-	6.0						Michigan	NS	As cited in Millar 1989.
Rood 1966	-	-	-	-	4.7						n Michigan	NS	As cited in Millar 1989.
Svendsen 1964	-	-	-	-	3.8						Kansas	NS	As cited in Millar 1989.
Svihla 1932	-	-	-	-	4.3						California, New Mexico	NS	As cited in Millar 1989.
Svihla 1932	-	-	-	-	4.5						Washington	NS	As cited in Millar 1989.
Svihla 1932, 1934	-	-	-	-	3.0					21	MI, ND, IA	NS	As cited in Millar 1989.
Wolff 1985b (nubiterrae)	-	-	-	-	3.4					52	Virginia	NS	As cited in Millar 1989.

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
LITTERS/YEAR													
Layne 1968 (several)	-	-	-	-	2 - 4						NS	NS	For subspecies artemesiae, bairdii, blandus, gambelii. As cited in Eisenberg 1981.
McCabe & Blanchard 1950	-	-	-	-	4.0		/year				California	NS	As cited in Millar 1989.
Millar & Innes 1983 (borealis)	-	-	-	-	1.9	0.1 SE	/year			38	Alberta, CAN	various alpine	
Millar 1989	-	-	-	-	2.4		/year				N American average	NS	Average of 10 populations from Costa Rica to Canada.
Wolff 1985b (nubiterrae)	-	-	-	-	1.8		/year				Virginia	NS	As cited in Millar 1989.
DAYS GESTATION													
Layne 1968 (artemesiae)	-	-	-	-				22	26		NS	NS	As cited in Eisenberg 1981
Layne 1968 (bairdii)	-	-	-	-	25						NS	NS	As cited in Eisenberg 1981
Layne 1968 (blandus)	-	-	-	-				22	25		NS	NS	As cited in Eisenberg 1981
Layne 1968 (gambelii)	-	-	-	-	23.5						NS	NS	As cited in Eisenberg 1981
Millar 1982 (borealis)	-	-	-	-	26.3	0.8 SE	days	23	31		NW Terr., CAN 1978-79	lab lab	For postpartum litters.
Millar 1989	- -	- -	L NL	- -	26.9 23.6		days days				US average	NS	(NL) Not lactating; (L) lactating.
Millar 1985 (nebrascensis)	- -	- -	NL L	- -	25.5 29.5	0.3 SE 1.4 SE	days days	23 24	26 35	10 8	Alberta, CAN	lab	(NL) Not lactating; (L) lactating.
Millar 1989	- -	- -	NL L	- -			days days	22.4 24.1	25.5 30.6		NS	NS	Range in average gestation period for different populations, presumably in North America.
Myers & Master 1983	- -	- -	NL L	- -	23 27		days days				Michigan	NS	As cited in Millar 1989.

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Svendsen 1964	-	-	NL	-	22.4	0.1 SE	days	22	23		Kansas	NS	As cited in Millar 1989.
	-	-	L	-	24.1	0.3 SE	days	22	27				
Svihla 1932	-	-	NL	-	23.5	0.1 SE	days	23	24		Canada	NS	As cited in Millar 1989.
	-	-	L	-	26.6	0.7 SE	days	23	32				
Svihla 1932	-	-	NL	-	23.6	0.2 SE	days	22	27		ne Utah	NS	As cited in Millar 1989.
	-	-	L	-	27.0	0.4 SE	days	22	35				
AGE AT WEANING													
Halfpenny 1980	-	B	-	-	17.5		days				Colorado	NS	As cited in Millar 1989.
King et al. 1963	-	B	-	-	21.0		days				Michigan	NS	As cited in Millar 1989.
Millar 1982	-	B	-	-	21.4		days				NW Terr., CAN 1978-79	lab lab	
Millar et al. 1979 (maniculatus)	-	B	-	-	22.2		days			63	NS	lab	As cited in Millar 1979.
Millar & Innes 1983 (borealis)	-	B	-	-	24.9		days				Alberta, CAN 1978-81	various alpine	
Millar 1989	-	B	-	-	20.2		days	16	25		N American average	NS	
AGE AT SEXUAL MATURITY													
Millar 1985 (nebrascensis)	-	M	-	-	35		days				Alberta, CAN	lab	
Millar 1985 (nebrascensis)	-	F	-	-	60		days				Alberta, CAN	lab	
ANNUAL MORTALITY													
Fairbairn 1977	B	M	-	-	19		%/2 wks				Vancover, CAN	2nd-growth coastal rain forest	2-week mortality rate averaged over the year. Mortality was highest (about 30 to 35%) during spring as males dispersed and females began to breed.
	B	F	-	-	18		%/2 wks						

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Millar & Innes 1983 (borealis)	A	M	-	WI	33		%/winter			8	Alberta, CAN	various alpine	Small sample size for adults.
	A	F	-	WI	100		%/winter			6			
	J	M	-	WI	70		%/winter			30			
	J	F	-	WI	56		%/winter			34			
	A	B	-	SU	20		%/two wks			877			
	J	B	-	SU	19		%/two wks			639			
LONGEVITY													
Brown & Zeng 1989	-	-	-	-			years		1.6		Arizona	desert	
Eisenberg 1981	-	-	-	-			years	1.3				zoo (captive)	Unpublished data from M. Jones.
Millar & Innes 1983 (borealis)	B	B	-	-	<1		year				Alberta, CAN	various alpine	

***** SEASONAL ACTIVITIES *****

Reference	Begin	Peak	End	Location	Habitat	Notes
MATING						
Blair 1958	Nov		Apr	Williamson Co, Texas	NS	Breeding season 23 weeks long. As cited in Millar 1989.
Drickamer 1978	Apr		Aug	nw Massachusetts	NS	Breeding season 19 weeks long. As cited in Millar 1989.
Dunmire 1960	May		Aug	California	NS	Breeding season 11 to 16 weeks long. As cited in Millar 1989.
Howard 1949	Mar		Nov	Michigan	NS	Breeding season 33 weeks long. As cited in Millar 1989.
Metzgar 1979	May	May-June	Nov	Montana 1970-72	grassland	
Wolff 1985b (nubiterrae)	Mar		Oct	Giles Co, Virginia	NS	Breeding season 29 weeks long. As cited in Millar 1989.
TORPOR						
Tannebaum & Pivorun 1989		winter		northern range	NS	
DISPERSAL						
Fairbairn 1977		spring		Vancouver, CAN	2nd growth coastal rain forest	Males dispersed; females did not.

***** PRAIRIE VOLE *****

*** NORMALIZING AND CONTACT RATE FACTORS ***

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
BODY WEIGHT													
Abramsky & Tracy 1980	-	B	1	-	41.6		g				ne Colorado	short-grass prairie	(1) Average weight over all seasons. Sample size: A = approximate number of individuals.
	-	B	-	SU	41.9		g			150A			
	-	B	-	FA	44.2		g			148			
	-	B	-	WI	39.0		g			150			
	-	B	-	SP	41.3		g			150A			
Dupre 1983	A	B	-	-	46.2	1.5 SE	g			10	Kansas	lab	Drinking water provided ad libitum (animals fed dry food).
Dupre 1983	A	B	-	-	35.4	1.8 SE	g			10	Kansas	lab	Kept on minimum water regimen.
Martin 1956	-	B	-	-	43.78		g	25	73		ne Kansas 1950-52	grasslands	Females averaged slightly heavier than males, possibly in part due to pregnancy.
Myers & Krebs 1971	-	M	1	-	32.9	0.45 SE	g				s Indiana 1967-69	grasslands	Mean weights of resident voles in: (1) study grid F; (2) study grid I; (3) Carlson study area. Data pooled over complete study (all seasons). 2 SE given by authors divided by 2 to give SE shown here.
	-	F	1	-	31.1	0.35 SE	g						
	-	M	2	-	34.2	0.75 SE	g						
	-	F	2	-	32.7	0.45 SE	g						
	-	M	3	-	31.3	0.35 SE	g						
	-	F	3	-	33.3	0.30 SE	g						
Wunder et al. 1977	-	-	1	WI	41.0	5.6 SD	g			8	NS	lab	Voles acclimated in lab to temperature (degrees C) of: (1) 5; (2) 30. As cited in Wunder 1985.
	-	-	2	WI	48.4	8.9 SD	g			10			
	-	-	1	SU	50.0	4.7 SD	g			11			
	-	-	2	SU	48.5	8.7 SD	g			10			
BODY FAT													
Fleherty et al. 1973	-	-	-	-			% dry wt	14.59	16.08		Kansas 1969-70	NS	
NEONATE WEIGHT													
Fitch 1957	-	-	-	-	2.9	0.1 SD	g				NS	NS	As cited in Nadeau 1985.
Kruckenberg et al. 1973	-	-	-	-	3.1		g				NS	NS	As cited in Nadeau 1985.
Martin 1956	-	-	-	-	2.8	0.4 SD	g			16	ne Kansas 1950-52	grassland	

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Richmond & Conaway 1969	-	-	-	-	2.8		g				NS	NS	As cited in Nadeau 1985
GROWTH RATE													
Fitch 1957	-	-	-	-	0.61		g/day				NS	lab	As cited in Wunder 1985; to 20 days.
Kruckenberg et al. 1973	-	-	-	-	0.73		g/day				NS	lab	As cited in Wunder 1985; to 20 days.
Martin 1956	-	-	1	-	0.6		g/day				ne Kansas 1950-52	grassland	Age: (1) 1 to 10 days; (2) 11 days to 1 month; (3) one month until growth ceases - growth is highly variable at this stage.
	-	-	2	-	1.0		g/day						
	-	-	3	-	0.5		g/day						
Richmond & Conaway 1969	-	-	-	-	0.81		g/day				NS	lab	As cited in Wunder 1985; to 20 days.
METABOLIC RATE (OXYGEN)													
Bradley 1976	A	-	BA	-	28.3		lO2/kg-d			1	New York	lab	Body weight of vole = 54 g. As cited in Wunder 1985.
Wunder et al. 1977	-	-	1	WI	51.8	8.2 SD	lO2/kg-d			15	NS	lab	Measured at 27.5 degrees C; animals tested fresh from the field captured in (1) winter and (2) summer. Average body weights: (1) 38.5 g; (2) 47.4 g. As cited in Wunder 1985. (Probably resting metabolism; other conditions not specified.)
	-	-	2	SU	41.8	4.8 SD	lO2/kg-d			9			
Wunder et al. 1977	-	-	1	WI	65.3	9.6 SD	lO2/kg-d			8	NS	lab	Measured at 27.5 degrees C. Voles acclimated in lab during specified season to temperature (degrees C) of: (1) 5; (2) 30. Average body weights of voles: winter/5 degrees = 41.0 g; winter/30 degrees = 48.4 g; summer/5 degrees = 50.0 g; summer/30 degrees = 48.5 g. As cited in Wunder 1985. (Probably resting metabolism; other conditions not specified.)
	-	-	2	WI	52.6	6.0 SD	lO2/kg-d			10			
	-	-	1	SU	42.2	9.5 SD	lO2/kg-d			11			
	-	-	2	SU	33.6	3.6 SD	lO2/kg-d			10			

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
METABOLIC RATE (KCAL BASIS)													
Bradley 1976	A	-	-	WI	21.52		kcal/day				NS	NS	Do not know how determined, or if based on freeliving or captive individuals. As cited in Stalling 1990.
	A	F	BR	SU	20.13		kcal/day						
	A	F	NB	SU	8.22		kcal/day						
FOOD INGESTION RATE													
Dice 1922	A	B	1	-	3.31		g oats	2.08	4.80		Illinois	lab	Consumption of oats and dry grass in the lab in dry air at (1) 21 degrees C and (2) 28 degrees C. Body weight of animals ranged from 31 to 34 grams.
	A	B	1	-	0.94		g grass	-	-				
	A	B	1	-	4.25		g total	-	-				
	A	B	2	-	2.35		g oats	1.94	2.68				
	A	B	2	-	0.83		g grass	-	-				
	A	B	2	-	3.18		g total	-	-				
Dice 1922	A	M	1	-	0.561		cal/g-d	0.530	0.592		Illinois	lab	Diet of rolled oats and dried bluegrass for prairie voles maintained at (1) 21 degrees C in dry air; (2) 32 to 34 degrees C in dry air; (3) 32 to 34 degrees C in wet air.
	A	F	1	-	0.476		cal/g-d	0.424	0.622				
	A	B	2	-	0.195		cal/g-d	0.160	0.223				
	A	B	3	-	0.284		cal/g-d	0.214	0.509				
Dice 1922	A	B	1	-	0.13-0.14		g/g-day				Illinois	lab	Calculated from food ingestion rates of (1) 4.25 grams (oats and dry grass) at 21 degrees C; and (2) 3.18 grams (oats and dry grass) at 28 degrees C; assuming 31 to 34 gram body weight. Note that the variation in oat intake has not been accounted for.
	A	B	2	-	0.14-0.09		g/g-day						
WATER INGESTION RATE													
Chew 1951	A	B	1	-	0.37		g/g-day			5	NS	lab	Measured water drunk from water bottles. Diet consisted of rolled oats with sunflower seeds. Lab conditions: (1) 28 degrees C, 51 relative humidity (RH); (2) 33 degrees C, 45 RH. High temperature group incurred fatalities.
	A	B	2	-	0.43		g/g-day			5			
Dice 1922	A	B	1	-	0.211		g/g-day	0.152	0.255	71	Illinois	lab	Sample size (N) = number of test days for test condition: (1) 21 degrees C in dry air; (2) 28 degrees C in very dry air; (3) 28 degrees C in dry air; and (4) 32 to 34 degrees C in dry air.
	A	B	2	-	0.190		g/g-day	0.125	0.292	11			
	A	B	3	-	0.158		g/g-day	0.096	0.210	31			
	A	B	4	-	0.132		g/g-day	0.130	0.132	9			

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Dupre 1983	A	B	-	-	0.286	0.02 SE	g/g-day			10	Kansas	lab	Drinking water provided ad libitum (animals fed dry food).
Dupre 1983	A	B	-	-	0.162	0.015 SE	g/g-day			10	Kansas	lab	Minimum drinking water required to maintain steady body weight (animals fed dry food).

***** DIET *****

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Agnew et al. 1988	A	B	arthropods vegetation	0 100	1.6 98.4			40	wc South Dakota 1981	mixed grass prairie - % dry weight; fecal pellets	
Agnew et al. 1988	A	B	arthropods vegetation	17 83	19.8 80.2	44.3 55.7		40 40	wc South Dakota 1982	mixed grass prairie - % dry weight; fecal pellets	"Fall" column indicates values for late summer.
Cook et al. 1982	B	B	Festuca arundinacea Dactylis glomerata Phleum pratense Tridens flavus Setaria viridis Taraxacum officinale Lamium amplexicaule Bromus tectorum Setaria faberi Capsella bursa-past. Trifolium stolonif. arthropod animal material other (sample size)	20.5 6.7 8.3 17.1 6.7 5.8 3.9 2.8 5.6 2.7 2.4 0.2 0.0 3.9 (14)	25.0 1.7 2.0 11.1 6.2 4.8 2.9 4.7 3.9 1.2 0.8 0.3 0.2 1.4 (39)	10.6 1.1 2.1 1.9 1.7 3.9 5.2 2.5 0.7 0.5 0.5 0.0 0.2 1.5 (10)	28.9 4.2 5.3 11.0 6.2 1.5 3.4 4.8 21.0 0.6 1.4 0.1 0.0 0.9 (10)		Missouri 1975-76	old field - mean number of food items; stomach contents	Average of 10 months of data: Spring = March, April, May; Summer = June, July, Aug.; Fall = Sept. and Oct.; Winter = Jan. and Feb. Plant parts consumed: leaf, stem, and seeds of Festuca and Bromus; leaf and stem of Tridens and Setaria faberi; leaf and seeds of Dactylis and Setaria viridis; and leaves only of all other plant species.
Fleharty & Olson 1969 (haydenii)	B	B	Sporobolus asper Kochia scoparia Bouteloua gracilis Bromus japonicus Rumex crispus Triticum aestivum Carex sp. other (grass) (forbs)		19.54 22.51 6.50 8.50 9.20 3.43 2.01 28.31 (53.5) (46.5)			97	Kansas 1966	forb and grass field - % volume; stomach contents	Data for June and July and for two areas were averaged. Items less than 2% of volume were combined as "other".

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Zimmerman 1965			Poa compressa	15.8				47	Indiana	mixed	Season = year round. Percent
			unidentified roots	10.0					1964-65	-	volumes less than 1% of total were
			Trifolium pratense	9.7						% volume; stomach	combined as "other".
			Hespedeza sp.	6.7						contents	
			Setaria faberii seed	1.4							
			misc. vegetation	13.1							
			Panicum capillare	6.4							
			Trifolium pratense roots	5.2							
			Erigeron sp.	5.0							
			Microtus flesh	1.0							
			Plantago lanceolata	4.6							
			Festuca elatior	4							
			Medicago sativa	3.6							
			unidentified seeds	2.2							
			Lepidopteran larvae	1.9							
			Chenopodium sp.	1.8							
			Oxalis sp.	1.5							
			unidentified insects	1.4							
			misc. Coleoptera	1.4							
			Rumex crispus	1.1							
			other	2.6							

***** POPULATION DYNAMICS *****

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
HOME RANGE SIZE													
Abramsky & Tracy 1980	A	M	1	-	0.015		ha			9-16	ne Colorado	short-grass prairie	(1,2) Two replicate studies. Number of recaptures per animal not recorded. Home range calculated on the basis of the reported range length (RL) assuming a circular home range with a diameter of RL.
	A	M	2	-	0.011		ha			12-18			
	A	F	1	-	0.015		ha			3-22			
	A	F	2	-	0.0073		ha			5-30			
Harvey & Barbour 1965	-	M	-	-	0.045		ha	0.020	0.073	5	Kentucky 1963	pasture	Radioisotope tagged individuals; modified minimum area method. Authors note that these values are about 50% of values determined using the minimum area method on the same data, and feel that their modified method is more accurate.
	-	F	-	-	0.0081		ha			1			
Jike et al. 1988	A	-	-	-	0.0984	0.0116 SE	ha			30	Illinois 1985-86	bluegrass	3 days of radiotracking; size estimated using convex polygon method.

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Martin 1956	A	M	-	-	0.0567		ha	0.0081	0.146		ne Kansas 1951-52	grassland	Method: inclusive boundary strip. Data pooled for all seasons.
	A	F	-	-	0.0486		ha	0.0081	0.166				
	J	-	-	-	0.0041		ha						
Meserve 1971	-	M	-	SU	0.08		ha				w Nebraska 1968	xeric prairie (mid and short grass)	Three or more captures; inclusive boundary method; interior stations only.
	-	F	-	SU	0.09		ha						
	-	B	-	SU	0.09		ha			39			
Meserve 1971	-	M	-	SU	0.02		ha				w Nebraska 1968	xeric prairie (mid and short grass)	Three or more captures; minimum area method; interior stations only.
	-	F	-	SU	0.02		ha						
	-	B	-	SU	0.02		ha			39			
Meserve 1971	-	M	-	SU	0.016		ha				w Nebraska 1968	xeric prairie (mid and short grass)	Three or more captures; minimum area method; all stations.
	-	F	-	SU	0.028		ha						
	-	B	-	SU	0.024		ha			39			
Meserve 1971	-	M	-	SU	0.073		ha				w Nebraska 1968	xeric prairie (mid and short grass)	Three or more captures; inclusive boundary strip method; all stations.
	-	F	-	SU	0.093		ha						
	-	B	-	SU	0.089		ha			39			
Swihart & Slade 1989	A	M	1	-	0.0367	0.0029 SE	ha			183	Kansas	NS	(1) Year-round estimates. Estimates based on a small number of recaptures per animal, i.e., as few as four.
	A	F	1	-	0.0236	0.0018 SE	ha			118			
	A	M	BR	SU	0.0306	0.0034 SE	ha			32			
	A	F	BR	SU	0.0232	0.0032 SE	ha			19			

POPULATION DENSITY

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Carroll & Getz 1976	-	-	1	SP	78		N/ha				Illinois 1972	alfalfa field	Months: (1) April, (2) May, (3) June, (4) July, and (5) August.
	-	-	2	SP	118		N/ha						
	-	-	3	SU	96		N/ha						
	-	-	4	SU	104		N/ha						
	-	-	5	SU	81		N/ha						
Carroll & Getz 1976	-	-	1	SP	29		N/ha				Illinois 1972	bluegrass pasture	Month: (1) March, (2) April, (3) May, (4) June, and (5) July.
	-	-	2	SP	33		N/ha						
	-	-	3	SU	63		N/ha						
	-	-	4	SU	73		N/ha						
	-	-	5	SU	67		N/ha						
Gaines & Rose 1976	-	-	1	-			N/ha	0	115		e Kansas 1970-73	old field	Live trapping; data reported as minimum number alive for 0.8 ha grids. Population density in grid: (1) A; (2) B; (3) C; (4) D. Peaks generally occurred in June ’72 and were followed by a decline in numbers, a recovery, and a population crash in spring ’73.
	-	-	2	-			N/ha	0	91				
	-	-	3	-			N/ha	0	94				
	-	-	4	-			N/ha	0	64				

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Getz et al. 1987	-	-	1	-			N/ha	0	37		Illinois 1972-86	tallgrass prairie	Densities are peak for study periods, based on live trapping. Study period: (1) March ’72 - March ’77 (peak in April ’73); (2) April ’77 - May ’84 (peak in April ’83); and (3) Sept. ’84 - Feb. ’86 (peak in Summer of ’85). For the study period, the population fluctuations in tallgrass were erratically low and there was no evidence of multiannual cycles.
	-	-	2	-			N/ha	0	40				
	-	-	3	-			N/ha	5	83				
Getz et al. 1987	-	-	1	-			N/ha		125		Illinois 1972-86	alfalfa	Based on live trapping. Peak density during the six major peaks in abundance found in the study. Periods of abundance: (1) spring - fall ’72; (2) fall ’73; (3) summer - fall ’75; (4) winter ’82/’83 and summer ’83; (5) summer ’84 - winter ’84/’85; and (6) summer/fall ’85. Population was approximately zero eight times during the study.
	-	-	2	-			N/ha		45				
	-	-	3	-			N/ha		62				
	-	-	4	-			N/ha		45				
	-	-	5	-			N/ha		55				
	-	-	6	-			N/ha		125				
Getz et al. 1987	-	-	1	-			N/ha		127		Illinois 1972-86	bluegrass	Density peaks from the six major periods of abundance found in the study (based on live trapping). Abundance periods: (1) winter ’72/’73; (2) summer - fall ’75; (3) spring ’77; (4) fall ’80 - winter ’81/’82; (5) fall ’82 - fall ’83; (6) fall ’84 - fall ’85. Population decreased to near zero eight times during the study.
	-	-	2	-			N/ha		60				
	-	-	3	-			N/ha		30				
	-	-	4	-			N/ha		25				
	-	-	5	-			N/ha		38				
	-	-	6	-			N/ha		131				
Getz et al. 1987	-	-	-	-			N/ha		>125	2/13	Illinois 1972-86	bluegrass	Same data as above presented as the number of years out of the total of 13 study years that the population peak density exceeded the value given.
	-	-	-	-			N/ha		>75	3/13			
	-	-	-	-			N/ha		>50	4/13			
	-	-	-	-			N/ha		>25	7/13			
	-	-	-	-			N/ha		>5	11/13			
Krebs 1977	-	-	1	-			N/ha		94		Indiana 1966-68,70	grassland	Live trapping; data reported as peak density of number known alive on 0.8 ha grid during a four year period. Year: (1) 1966 (M. pennsyl. also present in this year); (2) 1967; (3) 1968; (4) 1970.
	-	-	2	-			N/ha		99				
	-	-	3	-			N/ha		54				
	-	-	4	-			N/ha		61				

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Martin 1956	-	-	-	SU	168-234		N/ha				ne Kansas 1951	grassland	Live trapping, Hayne method; maximum move between captures. Data reflect range of monthly means for given season.
	-	-	-	WI	160-197		N/ha						
	-	-	-	SP	203-247		N/ha						
	-	-	-	FA	94-123		N/ha						
Martin 1956	-	-	-	SU	67-151		N/ha				ne Kansas 1952	grassland	Live trapping, Hayne method; maximum move between captures. Data reflect range of monthly means for given seasons.
	-	-	-	WI	116-136		N/ha						
	-	-	-	SP	136-160		N/ha						
Martin 1960	-	-	-	-	17		N/ha		54		wc Kansas	mesic mixed prairie	As cited in Meserve 1971; assumed Hayne method and maximum move between captures.
Meserve 1971	-	-	-	SU	25-35		N/ha				w Nebraska 1968-69	xeric prairie (mid and short grasses)	Hayne method; average move between captures.
	-	-	-	WI	12		N/ha						
	-	-	-	SP	10		N/ha						
Myers & Krebs 1971	-	-	1	-			N/ha	0	95		s Indiana 1967-70	grasslands	Live trapping; data reported as minimum number alive on 0.8 ha grids. Values estimated from authors' figures. Control grid: (1) A; (2) F; (3) I. Authors note that during the study period, populations never reached high densities on these study areas.
	-	-	2	-			N/ha	0	44				
	-	-	3	-			N/ha	0	14				
Wooster 1939	-	-	-	-	95		N/ha				Kansas	mixed prairie	As cited in Meserve 1971.
LITTER SIZE													
Cole & Batzli 1978	-	-	-	-	4.25					28	Illinois	NS	As cited in Keller 1985. Placental scars or embryos count; spring and summer.
Cole & Batzli 1978	-	-	-	-	5.11					19	Illinois	NS	As cited in Keller 1985. Placental scars or embryos count. Food provided to population; spring and summer.
Colvin & Colvin 1970	-	-	-	-	3.9			1	7	28	NS	lab	As cited in Keller 1985. Embryo or pup count.
Corthum 1967	-	-	-	-	3.89			2	7	134	Indiana	NS	As cited in Keller 1985. Embryo or pup count.
Fitch 1957	-	-	-	-	3.37			2	5	82	Kansas	NS	As cited in Keller 1985. Embryo or pup count; pooled yearly values.

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Jameson 1947	-	-	-	-	3.4			1	7	58	Kansas	NS	As cited in Keller 1985. Embryo or pup count.
Keller & Krebs 1970	-	-	-	-	3.27			1	6	160	Indiana	NS	As cited in Keller 1985. Embryo or pup count.
Martin 1956	-	-	-	-	3.18	0.24 SD		1	6	65	ne Kansas 1950-52	grassland	Pup count.
Nadeau 1985	-	-	-	-	3.9	0.4 SD					NS	lab	Pup count. Calculated by author based on four studies (raw data not provided).
Nadeau 1985	-	-	-	-	3.5	0.4 SD					NS	field-caught	Pup count. Calculated by author based on four studies (raw data not provided).
Quick 1970	-	-	-	-	3.35			1	6	31	Kentucky	NS	As cited in Keller 1985. Embryo or pup count.
Richmond 1967	-	-	-	-	3.17			1	8	280	NS	lab	As cited in Keller 1985. Embryo or pup count.
Rolan & Gier 1967	-	-	-	-	4.19					198	Kansas	NS	As cited in Keller 1985. Embryo or pup count; winter and spring.
Rose & Gaines 1978	-	-	-	-	3.43					181	Kansas	NS	As cited in Keller 1985. Embryo or pup count; data pooled from several years.

DAYS GESTATION

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Fitch 1957	-	-	-	-	< 20		days				NS	NS	As cited in Nadeau 1985.
Johnson & Johnson 1982	-	-	-	-	20-23		days				NS	NS	General value for all Microtus species.
Keller 1985	-	-	-	-	21		days				NS	NS	
Kenney et al. 1977	-	-	-	-	22.8		days				NS	NS	As cited in Nadeau 1985.
Martin 1956	-	-	-	-	21		days				ne Kansas 1950-52	grassland	
Morrison et al. 1976	-	-	-	-	21		days				NS	NS	As cited in Nadeau 1985.
Richmond & Conaway 1969	-	-	-	-	21		days				NS	NS	As cited in Nadeau 1985.

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
AGE AT WEANING													
Thomas & Birney 1979	-	B	-	-	21		days				NS	lab	Note at 20 day preweaning period.
AGE AT SEXUAL MATURITY													
Gier & Cooksey 1967	-	F	-	-	35		days				NS	NS	As cited in Stalling 1990.
	-	M	-	-			days	42	45				
Johnson & Johnson 1982	-	F	-	-			weeks	3			NS	NS	General value for all Microtus species.
	-	M	-	-			weeks	6-8					
Martin 1956	-	F	1	-			days	26		1	ne Kansas 1950-52	grasslands	Female weighed 28 g.
	-	M	-	-			weeks	6					
ANNUAL MORTALITY													
Abramsky & Tracy 1980	-	B	-	-	93		%/year			150	ne Colorado	short-grass prairie	Seasonal mortality rates based on mean disappearance rate per month.
	-	B	-	SU	28		%/month			150A			
	-	B	-	FA	15		%/month			148			
	-	B	-	WI	15		%/month			150			
	-	B	-	SP	22		%/month			150A			
LONGEVITY													
Martin 1956	-	-	-	-	1.0		years		1.8		ne Kansas 1950-52	grassland	Maximum is an estimate of the age of the oldest individual found, based on recapture of animal tagged as a juvenile.

*** SEASONAL ACTIVITIES ***

Reference	Begin	Peak	End	Location	Habitat	Notes
MATING						
Keller 1985; Martin 1956		May to Oct		NS	NS NS	
PARTURITION						
Keller 1985; Martin 1956		May to Oct		NS	NS	
FALL MOLT						
Jameson 1947		any time		NS	NS	Cited in Stalling 1990.

*** NORMALIZING AND CONTACT RATE FACTORS ***

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
BODY WEIGHT													
Anderson et al. 1984	B	B	-	SP	26.0		g			40	Manitoba 1976-77	marsh	Estimated from graph on page 309.
	B	B	-	SU	24.3		g			34			
	B	B	-	FA	17.0		g			21			
	B	B	-	WI	17.5		g			7			
Boonstra & Rodd 1983	A	M	-	SP	52.4		g				Ontario, CAN	grassland	
	A	F	-	SP	43.5		g						
Boonstra & Rodd 1983	A	-	-	-			g	33			Toronto, CAN	NS	
Brochu et al. 1988	A	M	-	SU	40.0	8.3 SE	g			33	Quebec, CAN	old field	
	A	F	-	SU	33.4	8.2 SE	g			55			
Brooks & Webster 1984	B	B	1	SU	32.6	11.8 SD	g			152	Ontario, CAN 1977-78	grassland	Trap period: (1) 7/7-8/31; (2) 9/1-10/19; (3) 10/20-12/15; (4) 1/5-2/20; (6) 2/21-4/15.
	B	B	2	FA	31.3	10.0 SD	g			57			
	B	B	3	FA	32.6	7.9 SD	g			158			
	B	B	4	WI	34.2	5.2 SD	g			41			
	B	B	5	WI	33.3	6.4 SD	g			45			
Dark & Zucker 1986	A	M	1	-	54		g			14	NS	lab	(1) Group 1 - baseline - 14L:10D photoperiod; (2) Group 1 ten weeks later, same photoperiod; (3) Group 2 - baseline 14L:10D photoperiod; (4) Group 2 after 10 weeks on short photoperiod (i.e., 10L:14D).
	A	M	2	-	58		g			14			
	A	M	3	-	57		g			17			
	A	M	4	-	45		g			17			
Dueser et al. 1981	-	-	-	-			g	30			NS	NS	Cutoff weight between residents and dispersers. As cited in Tamarin 1984.
Golley 1961	N	-	-	-	2-10		g				s Michigan 1956-57	old field	N = neonate (0-10 days old); J = post-nestling juvenile (11-21 days old); Y = young adult, Adults: (1) 34-54 days old; (2) 55-103 days old; (3) 104+ days old.
	J	-	-	-	11-20		g						
	Y	-	-	-	21-30		g						
	A	-	1	-	31-40		g						
	A	-	2	-	41-50		g						
	A	-	3	-	> 51		g						
Lomolino 1984	-	-	-	-	40		g				New York	Thousand Islands	

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Mihok 1984	A	M	BR	SU	23.6		g	20.2	27.4		Manitoba, CAN	boreal	(1) Total sample size, both sexes. Factor is weight at sexual maturity. Min and Max values are actually 95% fiducial limits.
	A	F	BR	SU	18.8		g	17.7	20.1				
	-	-	1	-						1076			
Millar 1987	A	B	-	SU	28.1		g				Alberta, CAN 1980-83	NS	
Myers & Krebs 1971	A	M	1	-	32.9	0.2 SE	g				s Indiana 1967-69	grasslands	Mean weights of resident voles in: (1) study grid F; (2) study grid I. Data pooled over complete study period (all seasons). 2 SE given by authors (to one significant digit) divided by 2 to give SE shown here.
	A	F	1	-	39.1	0.25 SE	g						
	A	M	2	-	35.5	0.1 SE	g						
	A	F	2	-	39.0	0.3 SE	g						
Reich 1981	A	M	-	-	44.2	6.29 SD	g				NS	NS	
	A	F	-	-	44.0	10.25 SD	g						
Tamarin 1977b	-	M	1	WI	33		g				Massachusetts 1972-75	coastal field	Dispersing voles; values estimated from figure. Year: (1) 1972; (2) 1973.
	-	F	1	WI	34		g						
	-	M	2	SU	42		g						
	-	F	2	SU	39		g						
	-	M	2	WI	42		g						
	-	F	2	SU	41		g						
Tamarin 1977b	-	M	1	WI	36		g				Massachusetts 1972-75	coastal field	Resident voles; values estimated from figure. Year: (1) 1972; (2) 1973.
	-	F	1	WI	41		g						
	-	M	2	SU	40		g						
	-	F	2	SU	39		g						
	-	M	2	WI	43		g						
	-	F	2	SU	38		g						
NEONATE WEIGHT													
Hamilton 1941	N	-	-	-	2.1		g	1.6	3.0		NS	NS	As cited in Reich 1981 and Johnson and Johnson 1982.
Innes & Millar 1981	N	-	-	-	2.3	0.1 SD	g				NS	NS	As cited in Nadeau 1985.
Lee & Horvath 1969	N	-	-	-	2.0-3.0		g				NS	NS	As cited in Nadeau 1985.
McShea & Madison 1989	N	-	-	-	3		g				Pennsylvania	NS	As cited in McShea 1989.

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
GROWTH RATE													
Barbehenn 1955	-	-	1	-	0.40		g/day	0.2	0.5		NS	field study	Calculated to 20 days of age. Adult body mass = 35 g. Season of birth: (1) June - Aug; (2) July - Sept. As cited in Wunder 1985.
	-	-	2	-	0.20		g/day						
Golley 1961	-	-	1	-	0.95		g/day				s Michigan 1956-57	old field	Age: (1) from birth to 21 days; (2) 22 - 23 days; (3) 34 - 54 days; (4) 55 - 103 days. Adult body weight = 51+ grams.
	-	-	2	-	0.81		g/day						
	-	-	3	-	0.45		g/day						
	-	-	4	-	0.19		g/day						
Hamilton 1941	-	-	-	-	1.0		g/day				NS	NS	First 25-30 days after birth. As cited in Reich 1981.
Hamilton 1937	-	-	-	-	0.80		g/day				NS	lab	Calculated to 20 days of age; adult body mass = 48 g. As cited in Wunder 1985.
Innes & Millar 1979	-	-	-	-	0.67		g/day				NS	lab	Calculated to 20 days of age; adult body mass = 29 g. As cited in Wunder 1985.
McShea & Madison 1989	-	-	-	-	0.44		g/day				Pennsylvania	NS	As cited in McShea 1989.
Morrison et al. 1977	-	-	-	-	0.65		g/day				NS	lab	Calculated to 20 days; adult body weight = 40 g. As cited in Wunder 1985.
BODY FAT													
Mihok et al. 1985	B	B	1	SP	1.34	0.125 SE	g			17	Manitoba, CAN 1971, 1975	old fields	Two different years: (1) 1971; (2) 1975.
	B	B	2	SP	1.09	0.078 SE	g			26			
Millar 1987	J	F	-	SU	0.37	0.04 SE	g			10	Alberta, CAN 1980-83	NS	
	A	F	G	SU	1.20	0.15 SE	g			10			
	A	F	L	SU	0.60	0.09 SE	g			10			
Millar 1987	J	M	NB	SU	0.47	0.05 SE	g			10	Alberta, CAN 1980-83	NS	
	A	M	-	SU	0.93	0.15 SE	g			10			
Schwartz & Mihok 1983	B	-	BR	-	1.17		g				Manitoba, CAN 1973-78	NS	(1) Total sample size, both sexes.
	B	-	NB	-	0.908		g						
	-	-	1	-						1313			

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
LEAN (DRY) BODY WEIGHT													
Mihok et al. 1985	B	B	1	SP	5.7	0.1 SE	g				Manitoba, CAN 1971, 1975	old fields	Two different years: (1) 1971; (2) 1975.
	B	B	2	SP	5.2	0.1 SE	g						
Millar 1987	J	F	-	SU	2.91	0.28 SE	g			10	Alberta, CAN 1980-83	NS	
	A	F	G	SU	5.40	0.40 SE	g			10			
	A	F	L	SU	5.58	0.21 SE	g			10			
Millar 1987	J	M	-	SU	3.93	0.18 SE	g			10	Alberta, CAN 1980-83	NS	
	A	M	-	SU	6.58	0.36 SE	g			10			
Schwartz & Mihok 1983	-	-	BR	-	6.5		g				Manitoba, CAN 1973-78	NS	(1) Total sample size for both breeding and nonbreeding adults.
	-	-	NB	-	5.1		g						
	-	-	1	-						1313			
METABOLIC RATE (OXYGEN)													
Bradley 1976	A	-	BA	-	46.3		lO2/kg-day				New York	lab	Body weight of vole = 39.0 g. As cited in Wunder 1985.
Morrison 1948	-	-	AD	-	82.8	12 SD	LO2/kg-day	43.2	146	4	ne United States	lab	AD = average daily metabolic rate in captivity. Two runs with two individuals each. Temperature 15 to 25 C. Weight of animals = 26.3 to 32.0 g.
Pearson 1947	A	-	BA	-	53		lO2/kg-day			4	Pennsylvania	lab	Mean body weight of voles = 31.2 g. AD = average daily. Test conditions: 24 hour runs at 25-30 degrees C, food and water available. Basal estimate is lowest value from the 24 hour run - basal test produced higher value. Low end of AD range is value for 40 g vole, high end is for 26 g vole.
	A	-	AD	-	80		lO2/kg-day	58	89	4			
Wiegert 1961	A	-	BA	-	60.0		lO2/kg-day				NS	NS	Body weight = 35.6 g. As cited in Deavers and Hudson 1981.

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
METABOLIC RATE (KCAL BASIS)													
Pearson 1947	A	-	BA	-	295		kcal/kg-d			4	Pennsylvania	lab	Mean body weight of voles = 31.2 g. AD = average daily. Calculated from oxygen consumption. Test conditions: 24 hour runs at 25-30 degrees C, food and water available. Basal estimate based on lowest oxygen consumption value from the 24 hour run - basal test produced higher value.
	A	-	AD	-	395		kcal/kg-d			4			
FOOD INGESTION RATE													
Dark et al. 1983	A	M	1	-	410	10 SE	kcal/kg-d			12	NS	lab	Daily food intake during 10th week exposed to photoperiod (1) long day 14L:10D; (2) short day 10L:14D.
	A	M	2	-	370	20 SE	kcal/kg-d			12			
Ognev 1950	-	-	-	-	0.30 -		g/g-day				Russia	NS	Values are the low and high ends of a range. As cited in Johnson and Johnson 1982.
	-	-	-	-	0.35		g/g-day						
WATER INGESTION RATE													
Ernst 1968	-	-	-	-	0.21	0.02 SE	g/g-day				NS	NS	As cited in Reich 1981.
THERMONEUTRAL ZONE													
Wiegert 1961	-	-	-	-			degrees C	25	29		NS	NS	As cited in Reich 1981.

***** DIET *****

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Lindroth & Batzli 1984	-	-	dicot shoots	41	60	66	12		Illinois 1980-83	bluegrass	
			monocot shoots	50	26	9	40			-	
			seeds	1	9	1	13			% wet volume; stomach contents	
			roots	0	1	12	34				
			fungi	6	4	10	0				
			insects	2	0	2	1				
			(sample size)	(11)	(15)	(13)	(11)				

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Lindroth & Batzli	-	-	dicot shoots	53	65	41	41		Illinois	tallgrass prairie	
1984			monocot shoots	23	29	12	5		1980-83	-	
			seeds	7	1	16	36			% wet volume;	
			roots	4	0	6	17			stomach contents	
			fungi	12	1	20	0				
			insects	1	4	5	1				
			(sample size)	(12)	(25)	(17)	(11)				
Lindroth & Batzli	-	-	plant material only:						Illinois	bluegrass	Percent of plant material in
1984			monocot shoots:						1980-83	-	the diet by species.
			Poa pratensis	29	20	8	40			% wet volume;	
			Bromus inermis	9	4	0	0			stomach contents	
			monocot roots	0	1	11	24				
			dicot shoots:								
			Ambrosi trifida	18	6	3	0				
			Taraxacum officina	7	18	45	0				
			Trifolium pratense	0	27	11	12				
			dicot roots			1	10				
			other unknown	30	21	10	24				
			(sample size)	(11)	(15)	(13)	(11)				
Lindroth & Batzli	-	-	monocot shoots						Illinois	tallgrass prairie	Percent of plant material in the
1984			Andropogon gerardii	11.8	20.0	9.4	1.6		1980-83	-	diet by species.
			Poa pratensis	0.0	0.0	0.0	2.9			% wet volume;	
			dicot shoots							stomach contents	
			Lespedeza cuneata	23.7	27.9	26.1	10.6				
			Penstemon digitalis	12.0	16.1	9.3	22.6				
			(sample size)	(12)	(25)	(17)	(11)				
Zimmerman 1965	B	B	Poa compressa		32.1			43	Indiana	various	Season = year round. Species found
			Panicum capillare		24.7				1964-65	-	to occur in fields containing at
			Muhlenbergia sobolifera		14.6					% wet volume;	least 50% grasses and abundant
										stomach contents	cover.
			misc. vegetation		7.4						
			Plantago lanceolata		5.8						
			Achillea millefolium		4.7						
			Endogone		2.1						
			Taraxacum officinale		2.1						
			Microtus flesh		2.1						
			Lepidopterous larvae		1.7						
			Oxalis sp.		1.6						
			misc. Coleoptera		1.5						
			Phleum pratense		1.4						
			unident. roots		0.4						
			unident. insects		0.4						

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
HOME RANGE SIZE													
Ambrose 1973	-	-	-	SU			ha	0.0089	0.027		New York	NS	
Douglass 1976	-	-	-	SU	0.014		ha			14	Montana	alluvial bench	
	-	-	-	WI	0.0002					8			
Getz 1961b	-	M	-	FA			ha	0.043	0.097		Michigan 1957-58	old field	Values estimated from figure; home ranges calculated using the exclusive boundary method. Population density ranges (N/ha): fall 6-10; winter 7-13; spring 15-17; summer 16-18.
	-	F	-	FA			ha	0.019	0.041				
	-	M	-	WI			ha	0.013	0.033				
	-	F	-	WI			ha	0.012	0.013				
	-	M	-	SP			ha	0.043	0.057				
	-	F	-	SP			ha	0.023	0.032				
	-	M	-	SU			ha	0.051	0.078				
	-	F	-	SU			ha	0.058	0.061				
Getz 1961b	-	M	-	FA			ha	0.041	0.050		Michigan 1957-58	marsh	Values estimated from figure; home ranges calculated using the exclusive boundary method. Population density ranges (N/ha): fall 28-50; winter 15-35; spring 22-48; summer 38-62.
	-	F	-	FA			ha	0.041	0.044				
	-	M	-	WI			ha	0.042	0.078				
	-	F	-	WI			ha	0.040	0.085				
	-	M	-	SP			ha	0.068	0.070				
	-	F	-	SP			ha	0.043	0.046				
	-	M	-	SU			ha	0.042	0.059				
	-	F	-	SU			ha	0.038	0.049				
Madison 1980	A	M	BR	SU	0.01923	0.01097 SD	ha			16	Virginia 1975	old field	Based on radiotelemetry; positions recorded hourly for 24 hr periods 2 times a week from June-Aug. Total of 77 daily ranges for males and 72 for females. Population density increased during study from 111 voles/ha to 198 voles/ha (direct enumeration method).
	A	F	BR	SU	0.00686	0.00394 SD	ha			15			
Ostfeld et al. 1988	A	F	1	SU	0.00966	0.00458 SD	ha			13	Massachusetts 1986	grassy meadow	Home range of voles radiocollared from Aug 20-Sept 1. Calculation method: (1) 50% - represents core area of range; (2) 95 % - represents core area and peripheral areas; (3) minimum polygon method.
	A	F	2	SU	0.04977	0.03465 SD	ha			13			
	A	F	3	SU	0.03734	0.01982 SD	ha			13			
Ostfeld et al. 1988	A	M	1	SU	0.01955	0.00918 SD	ha			15	Massachusetts 1986	grassy meadow	Home range of voles radiocollared from Aug 20-Sept 1. Calculation method: (1) 50% - represents core area of range; (2) 95 % - represents core area and peripheral areas; (3) minimum polygon method.
	A	M	2	SU	0.11836	0.05331 SD	ha			15			
	A	M	3	SU	0.08328	0.03745 SD	ha			15			

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Tamarin 1977b	A	F	-	-			ha	0.001			Massachusetts 1972-75	coastal field	As cited in McShea 1989; McShea appears to have calculated this value from movement data provided in Tamarin 1977b.
Van Vleck 1969	-	M	1	SU	0.0502		ha			102	w New York 1962	old fields	Live trapping; population densities described as high (32-119 voles/ha). Ranges determined based on the number of stations at which vole was trapped; data shown here based on voles trapped at a minimum of 5 stations. Calculation method: (1) minimum area; (2) exclusive strip; (3) inclusive strip.
	-	F	1	SU	0.0405		ha			38			
	-	M	2	SU	0.1283		ha			102			
	-	F	2	SU	0.1145		ha			38			
	-	M	3	SU	0.1554		ha			102			
	-	F	3	SU	0.1299		ha			38			
Van Vleck 1969	-	M	1	SU	0.0652		ha			28	w New York 1961	old fields	Live trapping; population densities described as moderate (10-86 voles/ha). Ranges determined based on the number of stations at which vole was trapped; data shown here based on voles trapped at a minimum of 5 stations. Calculation method: (1) minimum area; (2) exclusive strip; (3) inclusive strip.
	-	F	1	SU	0.0469		ha			8			
	-	M	2	SU	0.1550		ha			28			
	-	F	2	SU	0.1246		ha			8			
	-	M	3	SU	0.1866		ha			28			
	-	F	3	SU	0.1433		ha			8			
POPULATION DENSITY													
Boonstra & Rodd 1983	-	B	-	-			N/ha	96	549		Ontario, CAN	grassland	
Getz et al. 1987	-	-	1	-			N/ha		131		c Illinois 1972-86	tallgrass	Values estimated from figures. Population showed a gradual increase after entering habitat in 1973: (1) peak for study period; (2) range found from summer 1977 - 1983; (3) population increased from the min shown to the max from Sept ’84 to Nov ’85 following a burn.
	-	-	2	-			N/ha	25	100				
	-	-	3	-			N/ha	7	46				
Getz et al. 1987	-	-	1	-			N/ha	9	83		c Illinois 1972-86	bluegrass	Values estimated from figures. Population showed essentially annual fluctuations from 1975-82, and after ’82 remained low through end of study. Period from (1) 1975-82; (2) 1982-85.
	-	-	2	-			N/ha	0	25				

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Getz et al. 1987	-	-	-	-			N/ha	0	70		c Illinois 1972-86	alfalfa	Values estimated from figures. Only occurred in this habitat from Oct. 1976 - October 1980; during this period populations showed annual fluctuations in density.
Getz 1961a	-	-	-	FA			N/ha	7	11		Michigan 1957-58	old field	Estimated from figure.
	-	-	-	WI			N/ha	6	13				
	-	-	-	SP			N/ha	13	20				
	-	-	-	SU			N/ha	17	20				
Getz 1961a	-	-	-	FA			N/ha	28	51		Michigan 1957-58	grass-sedge marsh	Estimated from figure.
	-	-	-	WI			N/ha	20	51				
	-	-	-	SP			N/ha	22	53				
	-	-	-	SU			N/ha	38	64				
Getz 1961a	-	-	-	FA			N/ha	0	6		Michigan 1957-58	Potentilla marsh	Estimated from figure.
	-	-	-	WI			N/ha	0	7				
	-	-	-	SP	0		N/ha						
	-	-	-	SU			N/ha	0	10				
Krebs 1977	-	-	1	SP			N/ha		143		Indiana 1966,68,70	grassland	Live trapping; reported as peak density of number known alive on 0.8 ha grid during three years. Year: (1) 1966 (peak density of M. ochrogaster also present during this peak); (2) 1968; (3) 1970.
	-	-	2	SP			N/ha		119				
	-	-	3	SP			N/ha		135				
Lindroth & Batzli 1984	-	-	-	-			N/ha	2	28		Illinois 1980-83	bluegrass field	
Lindroth & Batzli 1984	-	-	-	-			N/ha	26	128		Illinois 1980-83	tallgrass prairie	
Myers & Krebs 1971	-	-	1	-			N/ha	25	163		s Indiana 1967-70	grasslands	Live trapping; data reported as minimum number alive on 0.8 ha grids. Values estimated from figures for control grid: (1) A; (2) F; (3) I.
	-	-	2	-			N/ha	0	50				
	-	-	3	-			N/ha	6	95				
Ostfeld et al. 1988	-	-	-	SP	28		N/ha				Massachusetts	grassy meadow	
	-	-	-	SU	85		N/ha						
	-	-	-	WI	33		N/ha						
Tamarin 1977a	-	-	1	-			N/ha		160		se Mass. 1972-75	grassy field	(1,2) Two different study plots.
	-	-	2	-			N/ha		181				
Van Vleck 1969	-	-	1	SU			N/ha	10	86		w New York 1961-62	old field	Density in: (1) 1961 (described as moderate); (2) 1962 (described as high).
	-	-	2	SU			N/ha	32	119				

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
LITTER SIZE													
Beer & MacLeod 1961	-	-	-	-	5.72			1	11	251	Minnesota	NS	As cited in Keller 1985. All months, embryo or pup count.
Corthum 1967	-	-	-	-	4.46			1	9	153	Indiana	NS	As cited in Keller 1985. Samples from 11 months; pup or embryo count.
Goin 1943	-	-	-	-	6.05			1	8	24	Pennsylvania	NS	As cited in Keller 1985. Embryo or pup count.
Harris 1953	-	-	-	-	3.65					16	Maryland	NS	As cited in Keller 1985. Embryo or pup count.
Iverson & Turner 1976	-	-	-	-	3.82			1	11	312	Manitoba, CAN	NS	As cited in Keller 1985. Six years of data, months variable between years. Embryo or pup count.
Kott & Robinson 1963	-	-	-	-	5.5			1	8	124	Toronto, Ont. CAN	NS	As cited in Keller 1985. Summer samples; embryo or pup count.
Millar 1987	-	-	-	-	6.0						Alberta, CAN 1980-83	NS	
Townsend 1935	-	-	-	-	5.07			2	9	41	New York	NS	As cited in Keller 1985. Embryo or pup count.
LITTERS/YEAR													
Bailey 1924	-	-	-	-			litters/yr		17		NS	captive	As cited in Johnson and Johnson 1982.
DAYS GESTATION													
Dieterich & Preston 1977	-	-	-	-	21		days				NS	NS	As cited in Reich 1981.
Innes & Millar 1981	-	-	-	-	20		days				NS	NS	As cited in Nadeau 1985.
Johnson & Johnson 1982	-	-	-	-	20-23		days				NS	NS	Value refers to all Microtus species.
Kenney et al. 1977	-	-	-	-	21.0	0.2 SD	days				NS	NS	As cited in Nadeau 1985.
Lee & Horvath 1969	-	-	-	-	21		days				NS	NS	As cited in Nadeau 1985.

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
AGE AT WEANING													
Benton 1955	-	-	-	-	21		days				NS	NS	As cited in Johnson and Johnson 1982.
Golley 1961	-	-	-	-	21		days				s Michigan	NS	
Hamilton 1941	-	-	-	-			days	12	14		NS	NS	As cited in Reich 1981.
McShea 1989	-	-	-	-	21		days				NS	NS	Study notes that Madison (1978), and Innes and Millar (1981) suggest the age at weaning may be less than 21 days.
AGE AT SEXUAL MATURITY													
Johnson & Johnson 1982	-	F	-	-			weeks	3			NS	NS	Values refer to all Microtus species.
	-	M	-	-			weeks	6-8					
ANNUAL MORTALITY													
Golley 1961	N	-	1	-	50%		0 to 10 g				s Michigan 1956-57	old field	Age classes for which mortality was estimated: (1) nestlings; (2) post-nestling juveniles; (3) young adults; (4) adults; and (5) large (old) adults.
	J	-	2	-	61%		11 to 20 g						
	Y	-	3	-	58%		21 to 30 g						
	A	-	4	-	53%		31 to 50 g						
	A	-	5	-	100%		> 50 g						
Mihok 1984	J	-	-	-	81.2%		1st 28 d				se Manitoba, CAN 1968-78	old field	Juvenile mortality during first 28 days; based on juvenile survival rate (from birth to recruitment) of 18.8%.
LONGEVITY													
Beer & MacLeod 1961	-	-	-	-	2-3		months				NS	NS	As cited in Reich 1981.
Hamilton 1941	-	-	-	-	10-16		months				NS	NS	As cited in Reich 1981.
Johnson & Johnson 1982	-	-	-	-			months		24		NS	NS	
Ostfeld et al. 1988	A	B	-	SU	11.3	8.0 SD	weeks			28	Massachusetts 1986	grassy meadow	Average longevity of adult voles after time of first capture (>32 grams = adult).

***** SEASONAL ACTIVITIES *****

Reference	Begin	Peak	End	Location	Habitat	Notes
MATING						
Boonstra & Rodd 1983	Apr		Dec	Ontario, CAN 1979	grassland	
Boonstra & Rodd 1983	Apr		mid Sep	Ontario, CAN 1980	grassland	
Getz 1960		Oct - Nov		Michigan 1957-58	marsh	Fall - winter peak; as cited in Getz 1961b.
Getz 1960		Apr-June		Michigan 1957-58	marsh	Spring - summer peak; as cited in Getz 1961b.
Mihok 1984	Apr 3		Oct 13	Manitoba, CAN	boreal	Begin = >50% reproductively active; End= >50% reproductively inactive; males.
Mihok 1984	Apr 26		Oct 12	Manitoba, CAN	boreal	Begin = >50% reproductively active; End= >50% reproductively inactive; females.
Mihok 1984	Apr		Oct	Manitoba, CAN	boreal	Both sexes.
DISPERSAL						
Myers & Krebs 1971		fall/winter		Indiana	grassland	Peaks of dispersal in fall and winter.
Tamarin 1977b		summer		Massachusetts 1972-75	coastal field	Peak for females.
Tamarin 1977b		winter		Massachusetts 1972-75	coastal field	Peak for males.

***** MUSKRAT *****

*** NORMALIZING AND CONTACT RATE FACTORS ***

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
BODY WEIGHT													
Dean 1957	J	B	-	-	70		g -10 days				c New York 1954	marsh	Estimate based on study of 108 kits in 31 litters.
	J	B	-	-	130		g -20 days						
	J	B	-	-	180		g -30 days						
Donohoe 1961	A	M	-	-	1,299		g			>700	Lake Erie	marshes	As cited in Perry 1982.
	A	F	-	-	1,257		g			>700			
Dozier et al. 1948	A	M	-	-	1,030		g				Maryland	NS	As cited in Perry 1982.
	A	F	-	-	962		g						
Dozier 1950	B	M	1	WI	1,644		g	680	2,380	2,152	New York 1943-48	marsh	(1) 1944; (2) 1945; (3) 1946; (4) 1947; (5) 1948.
	B	F	1	WI	1,503		g	576	2,270	1,767			
	B	M	2	WI	1,440		g	1,410	1,480	3,847			
	B	F	2	WI	1,361		g	1,330	1,400	3,589			
	B	M	3	WI	1,450		g	1,360	1,570	3,583			
	B	F	3	WI	1,300		g	1,210	1,420	3,895			
	B	M	4	WI	1,510		g	1,430	1,570	3,215			
	B	F	4	WI	1,390		g	1,350	1,440	3,450			
	B	M	5	WI	1,350		g	1,300	1,410	1,775			
	B	F	5	WI	1,240		g	1,190	1,330	2,004			
Dozier 1950	B	M	-	WI	1,480		g	1,400	1,520	14911	New York 1944-48	marsh	Average of all years.
	B	F	-	WI	1,350		g	1,300	1,400	15001			
Erickson 1963	A	M	1	-	1,153		g				c New York	NS	(1) First year adults; (2) second year adults. As cited in Perry 1982.
	A	F	1	-	1,181		g						
	A	M	2	-	1,370		g						
	A	F	2	-	1,323		g						
Errington 1939a	J	B	1	-	616		g	540	683	5	Iowa	marsh	(1) Kit stage - age 3-4 months.
	B	B	-	WI	1,092		g			34			
	A	B	-	SU	1,132		g			10			
	A	B	-	-	1,129		g			18			
	A	F	-	-	1,103		g			20			
Fuller 1951	A	M	-	-	1,131		g				Peace Delta, CAN	NS	As cited in Boutin and Birkenholz 1987.
	A	F	-	-	1,053		g						
Low (unpublished) (osoyoosensis)	-	M	-	-	1,039		g				Utah	NS	As cited in Reeves and Williams 1956.
	-	F	-	-	957		g						

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
McDonnell & Gilbert 1981	A	F	-	SU	1,300	130 SD	g			37	Ontario, CAN 1978	marsh	Captured in summer and fall. Juveniles: (1) from first litter of the year; (2) from second litter of the year.
	J	F	1	SU	510	170 SD	g			65			
	J	F	2	SU	270	90 SD	g			5			
	A	M	-	SU	1,200	170 SD	g			37			
	J	M	1	SU	530	190 SD	g			69			
	J	M	2	SU	290	60 SD	g			12			
Neal 1968	J	M	-	-	510		g			112	Iowa 1967	marsh	Caught during summer and fall.
	J	F	-	-	510		g			91			
	A	M	-	-	1,190		g			21			
	A	F	-	-	1,219		g			18			
O'Neil 1949 (rivalicius)	A	B	1	-	820		g			20	Louisiana 1940-45	marsh	(1) LaFouche Parish - 12 males, 8 females; (2) Vermilion Parish - 12 males, 8 females; (3) w Cameron Parish - 12 males, 8 females.
	A	B	2	-	910		g			20			
	A	B	3	-	1,040		g			20			
Parker & Maxwell 1984	J	B	-	FA			g	500	1,400		New Brunswick, CAN	woods, upland, marsh	Spring 1978 to fall 1980.
	J	M	-	FA	1,092		g						
	J	F	-	FA	1,073		g						
Parker & Maxwell 1984	A	M	-	FA	1,511		g				New Brunswick, CAN	woods, upland, marsh	Spring 1978 to fall 1980.
	A	F	-	FA	1,523		g						
	A	M	-	SP	1,483		g						
	A	F	-	SP	1,433		g						
Parker & Maxwell 1980	A	F	1	SP	1,234	152 SD	g			100	New Brunswick, CAN	marsh	Year: (1) 1976; (2) 1977.
	A	F	2	SP	1,241	154 SD	g			143			
	A	F	1	FA	1,450	179 SD	g			7			
	A	F	2	FA	1,403	149 SD	g			4			
	J	F	1	FA	1,057	85 SD	g			17			
	J	F	2	FA	954	184 SD	g			28			
Parker & Maxwell 1980	A	M	1	SP	1,367	136 SD	g			134	New Brunswick, CAN	marsh	Year: (1) 1976; (2) 1977.
	A	M	2	SP	1,366	172 SD	g			141			
	A	M	1	FA	1,497	167 SD	g			4			
	A	M	2	FA	1,469	119 SD	g			11			
	J	M	1	FA	1,083	20 SD	g			22			
	J	M	2	FA	985	169 SD	g			43			
Reeves & Williams 1956 (osoyoosensis)	A	M	1	SP	909		g			315	Idaho	marsh	(1) Gray's Lake, 1950; (2) Dingle Swamp, 1953.
	A	F	1	SP	837		g			267			
	A	M	2	SP	843		g			1020			
	A	F	2	SP	830		g			573			
Sather 1958	B	M	-	WI	1,180		g	730	1,550	198	Nebraska, nc Kansas	marsh	Weighed between December and March.
	B	F	-	WI	1,090		g	770	1,450	215			
Schacher & Pelton 1978	A	F	G	SP	1,443	74.9 SE	g			8	e Tennessee 1972-73	Holston River	Pregnant females.
	A	F	G	SU	1,460	67.8 SE	g			5			

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Schacher & Pelton 1978	A	F	N	SP	1,288	53.2 SE	g			12	e Tennessee 1972-73	Holston River	Nonpregnant females.
	A	F	N	SU	1,352	55.9 SE	g			15			
	A	F	N	FA	1,241	42.9 SE	g			13			
	B	F	N	WI	1,221	54.2 SE	g			13			
Schacher & Pelton 1978	A	M	-	SP	1,306	29.9 SE	g			40	e Tennessee 1972-73	Holston River	
	A	M	-	SU	1,337	28.1 SE	g			19			
	A	M	-	FA	1,308	51.5 SE	g			11			
	B	M	-	WI	1,326	45.9 SE	g			23			
Stevens 1953	A	M	-	-	1,114		g				MacKenzie Delta	NS	As cited in Boutin and Birkenholz 1987.
	A	F	-	-	1,010		g						
Walker et al. 1975	A	B	-	-			g	700	1,800+		NS	NS	As cited in Willner et al. 1980.
Wilson 1956	A	M	-	-	1,102		g				Currituck Co. NC	NS	As cited in Perry 1982.
	A	F	-	-	1,053		g						
NEONATE WEIGHT													
Dean 1957	N	B	-	-			g	20	25	44	c New York	marsh	N = number of litters; mean litter size was 3.8 +/- 1.8 S.D.
Errington 1939a	N	B	-	-	21.3		g	16	28	41	Iowa 1934, 1936-38	marsh	
Svihla & Svihla 1931 (rivalicia)	N	B	-	-	21		g				Louisiana 1925-27	marsh	"Very young muskrat".
GROWTH RATE													
Dean 1957	J	B	-	-	5.3		g/day				c New York	marsh	From birth to 30 days (approximate age at weaning).
Errington 1939a	J	B	-	-	5.4		g/day	4.3	5.6		Iowa 1934, 1936-38	marsh	From birth to 30 days. Mean is estimated from the "median" growth curve; min and max are estimated from the minimum and maximum growth curves.
Parker & Maxwell 1980	J	M	-	-	10.7		g/day				se New Brunswick CAN	marsh	Growth rate for first summer (from approximately 0 to 90 days).
	J	F	-	-	6.7		g/day						
Parker & Maxwell 1984	J	M	-	-	7.5		g/day			54	New Brunswick, CAN	woods, upland, marsh	Based on growth rate after weaning until first fall; duration of study = spring 1978 - fall 1980.
	J	F	-	-	7.1		g/day			38			

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
WEANING WEIGHT													
Errington 1939a	-	B	-	-			g	112	184		Iowa 1934, 1936-38	marsh	Estimated from median growth curve for days 21 (early weaning) and 30 (late weaning).
Parker & Maxwell 1980	-	B	-	-	200		g			92	New Brunswick, CAN	woods, upland, marsh	Approximate weight of juveniles when they first leave the nest (at about 30 days of age).
METABOLIC RATE (OXYGEN)													
Fish 1982	A	B	SW	-	38		lO2/kg-d				Michigan	lab	Water temperature = 25 C; mean weight of muskrats = 649 g. Swimming (at surface) metabolic rate extrapolated from Figure 2, for swimming speed of 0.58 m/s (mean of swimming speeds measured). Resting rate measured with muskrat floating in water. Reference provides a regression equation for muskrat metabolic rate as a function of swimming speed.
	A	B	R	-	21	7.9 SE	lO2/kg-d			87			
Fish 1983	A	M	R	-	20.6	0.96 SE	lO2/kg-d			48	Michigan	lab	Muskrats floating in water; water temperature 25 C, mean body mass = 614 grams.
Fish 1983	A	M	R	-	18.5	0.96 SE	lO2/kg-d			48	Michigan	lab	Water temperature = 30 C; mean body mass = 614 grams. Resting = animals floating in water, swimming = animals swimming at surface at 0.58 m/s.
	A	M	SW	-	46.6		lO2/kg-d						
MacArthur & Krause 1989	-	-	R	-	18.7		lO2/kg-d				Manitoba, CAN	lab	Water temperature = 30 C. Resting = mean thermoneutral rate in air. Swimming = underwater swimming (voluntary dives).
	-	-	SW	-	53.3		lO2/kg-d						
METABOLIC RATE (KCAL BASIS)													
Fish 1982	A	B	R	-	101		kcal/kg-d			87	Michigan	lab	Water temperature = 25 C, mean weight of muskrats = 649 g. Resting = floating in water; swimming = swimming at surface at a speed of 0.58 m/s.
	A	B	SW	-	182		kcal/kg-d						

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
FOOD INGESTION RATE													
Svihla 1931 (rivalicius)	-	-	-	-	0.33		g/g-day				Louisiana	island	Muskrats eat about one third of their body weight per day. As cited in Perry 1982.
Svihla & Svihla 1931 (rivalicius)	- -	- -	1 2	- -	0.34 0.26		g/g-day g/g-day			7	Louisiana 1925-27	captive	Based on wet weight of food: (1) fed paille-fin grasses (Panicum hemitomum, P. virgatum, and Spartina patens); (2) fed paille-fin grasses and corn.
THERMONEUTRAL ZONE													
Perry 1982	-	-	-	-			degrees C	10	25		NS	lab	

***** DIET *****

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Martin et al. 1951	B	B	cattail bulrush burreed waterstarwort pondweed arrowhead corn				25-50 10-25 5-10 2-5 2-5 2-5 2-5	45	ne United States	NS - rough approximation of % diet; stomach contents	Species accounting for less than 2% of diet include willow, pear, buttercup, spikerush, horsetail, and pickerelweed. Author notes that there is also minor use of animal food.
O'Neil 1949 (rivalicius)	B	B	three-cornered grass wiregrass hogcane misc. plants	80 10 5 5				NS	Louisiana 1940-45	brackish marsh - % of total usage; observation	Year round. Includes total usage: food, house construction, living areas.
O'Neil 1949 (rivalicius)	B	B	three-cornered grass leafy three cornered grass & wiregrass hogcane misc.	70 10 10 10				NS	Louisiana 1940-45	prairie marshes - % of total usage; observation	Includes total usage: food, house construction, living areas.
O'Neil 1949 (rivalicius)	B	B	canouche cattail wapato, roseau cane shoots Sagittaria spp. animal matter	70 10 10 5 5				NS	Louisiana 1940-45	freshwater marsh - % of total usage; observations	Year round. Includes total plant usage: food, house construction, living areas.

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Willner et al. 1975	-	-	cattail		59			NS	Somerset Co., MD	brackish marsh - % diet; stomach contents	Each plant fragment was identified and the number of fragments of each plant species/total number of fragments determined to yield % species in diet.
			rush		17						
			millet		8						
			algae		5						
			grass		4						
			cord grass		4						
			seeds		2						
			other		3						
Willner et al. 1975	-	-	green algae		77			NS	Montgomery Co., MD	freshwater - % of diet; stomach contents	Each plant fragment was identified and the number of fragments of each plant species/total number of fragments determined to yield % species in diet.
			3-square rush		8						
			switch grass		8						
			soft rush		4						
			water willow		2						
			grass (Graminae)		1						
			other		<1						
Willner et al. 1975	-	-	green algae		81			NS	Washington Co., MD	freshwater - % of diet; stomach contents	Each plant fragment was identified and the number of fragments of each plant species/total number of fragments determined to yield % species in diet.
			switch grass		4						
			sedge		3						
			rush		3						
			rice cut grass		2						
			smartweed		1						
			other		6						
Willner et al. 1975	-	-	green algae		36			NS	Garrett Co., MD	freshwater - % of diet; stomach contents	Each plant fragment was identified and the number of fragments of each plant species/total number of fragments determined to yield % species in diet.
			sedge		16						
			switch grass		11						
			manna-grass		8						
			3-square rush		7						
			soft rush		7						
			rice cut-grass		4						
			corn		3						
			other		8						

***** POPULATION DYNAMICS *****

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
HOME RANGE SIZE													
Neal 1968	B	M	-	-	0.17		ha			10	Iowa 1966-67	marsh	Mark and recapture study; only animals captured more than 7 times listed here. Author found little further increase in home range size estimates after 5 recaptures.
	B	F	-	-	0.17		ha			7			

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Neal 1968	J	-	1	-	0.24		ha			6	Iowa 1966-67	marsh	Mark and recapture study; only animals captured more than 5 times listed here. Author found little further increase in home range size estimates after 5 recaptures. (1) Round Lake; (2) Rush Lake.
	A	-	1	-	0.17		ha			1			
	J	-	2	-	0.16		ha			20			
	A		2		0.12		ha			2			
Proulx & Gilbert 1983	-	-	1	SU	0.23	0.082 SD	ha				Ontario, CAN	marsh	Estimate of minimum home range size (i.e., area intensively used); (1) 1979, (2) 1980.
	-	-	2	SU	0.17	0.0078 SD	ha						
Proulx & Gilbert 1983	-	-	1	SU	0.39		ha			1	Ontario, CAN	pond	Estimate of minimum home range size (i.e., area intensively used); (1) Pond 1; (2) Pond 2.
	-	-	2	SU	0.32		ha			1			
Proux & Gilbert 1983	-	-	1	SU	0.0484	0.0238 SD	ha				Ontario, CAN 1979	east bay	Estimate of minimum home range size (i.e., area intensively used); (1) early summer, (2) late summer.
	-	-	2	SU	0.1112	0.0843 SD	ha						
POPULATION DENSITY													
Beshears 1951	-	-	-	-	2.8		N/ha				Alabama	NS	As cited in Perry 1982.
Brooks & Dodge 1986	B	B	-	SU	23		N/km river			2673	Pennsylvania	riverine little vegetation	Sandy Lick study area; unglaciated river.
Brooks & Dodge 1986	B	B	-	SU	48		N/km river			5425	Massachusetts	wetland/river/sedges	Ware River study area; glaciated river.
Butler 1940	-	-	-	-	7.4		N/ha				Manitoba, CAN	sedges	As cited in Perry 1982.
Butler 1940	-	-	-	-	64.2		N/ha				Manitoba, CAN	common reeds	As cited in Perry 1982.
Clay & Clark 1985	A	B	1	SP	1.3		N/ha			7	ne Iowa 1981-82	backwater riverine	Based on 5-night mark and recapture experiments in upper Mississippi sand sloughs. Dates for estimates: (1) late April 1981; (2) early September 1981; (3) late June 1982; (3) early October 1982.
	A	B	2	FA	2.4	0.6 SE	N/ha			4			
	A	B	3	SU	0.6		N/ha			3			
	A	B	4	FA	1.7	0.1 SE	N/ha			8			
Clay & Clark 1985	A	B	1	SP	9.3	1.3 SE	N/ha			28	ne Iowa 1981-82	open water riverine	Based on 5-night mark and recapture experiments in upper Mississippi capoli sloughs. Dates for estimates: (1) mid May 1981; (2) late September 1981; (3) mid June 1982; (3) early October 1982.
	A	B	2	FA	6.3	1.1 SE	N/ha			24			
	A	B	3	SU	2.6	0.3 SE	N/ha			11			
	A	B	4	FA	4.4	0.5 SE	N/ha			14			
Errington 1948	-	-	-	-	49		N/ha				Iowa	cattail marsh	As cited in Perry 1982.

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Errington 1948	-	-	-	-	25		N/ha				Iowa	Scirpus spp. marsh	As cited in Perry 1982.
Errington 1939b	A	B	-	SU	1.8		pairs/ha			30	Iowa 1935	marsh	Breeding pairs. Early summer. Low quality habitat; over the course of the summer as the water level decreased many animals left this area to go to areas with deeper water.
Gashwiler 1948	-	-	-	-	0.3-1.8		N/ha				Maine	marsh	As cited in Perry 1982.
Halbrook 1990	B	M	-	-	18.7		N/ha				Virginia	fringe marsh	Habitat is along the lower region of the Elizabeth River (75% Spartina sp.).
Halbrook 1990	B	M	-	-	2.1		N/ha				Virginia	marsh	Habitat is along the lower region of the Elizabeth River (75% Spartina sp.).
O'Neil 1949	-	-	-	-	28.3		N/ha	1	74		Louisiana 1942-45	Scirpus olneyi marsh	Min and max are extremes in yearly means from one of the six sites. Each site was studied for four years.
LITTER SIZE													
Arthur 1931	-	-	-	-	3.8					1058	Louisiana		As cited in Gashwiler 1950; based on embryo counts.
Beshears & Haugen 1953	-	-	-	-	4.0						Alabama	NS	Based on embryo counts; as cited in Parker & Maxwell 1984.
Chamberlain 1951	-	-	-	-	5.0						Massachusetts	marsh	As cited in Perry 1982.
Clay & Clark 1985	-	-	-	-	7.1	0.2 SE				219	ne Iowa 1981-82	riverine	Based on embryo counts.
Dean 1957	-	-	-	-	3.8	1.8 SD				31	c New York	marsh	Live litter counts.
Dibblee 1971	-	-	-	-	6.7						Prince Edward Island	NS	As cited in Parker & Maxwell 1984, based on embryo counts.
Dilworth 1966	-	-	-	-	5.8						s New Brunswick, CAN	NS	Based on embryo counts; as cited in Parker & Maxwell 1984.
Erickson 1963	-	-	-	-	6.3						c New York	ponds	As cited in Perry 1982.
Errington 1939a	-	-	-	-	8.2			5	11	6	Iowa 1934; 1936-38	marsh	Based on embryo counts.

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Errington 1939a	-	-	-	-	6.5			1	11	158	Iowa 1934, 1936-38	marsh	Liver litter counts.
Gashwiler 1950	-	-	-	-	7.1					494	Maine 1945-48	statewide trapping	Based on embryo counts.
Gashwiler 1950	-	-	-	-	5.4			2	9	62	Maine	Moosehorn NWR	Based on count of live litters.
Halbrook 1990	-	-	-	-	4.65			3	6		Virginia	marsh (75% Spartina)	Habitat is near the Elizabeth River.
Hall 1981	-	-	-	-	6.5			1	11		North America	NS	Summarizing many studies.
Harris 1952	-	-	-	-	3.9						Maryland	NS	As cited in Boutin and Birkenholz 1987.
Mathiak 1966	-	-	-	-	7.3			1	12	460	Wisconsin 1947-57	marsh	Live litter counts.
Neal 1968	-	-	1	-	2.8			2	4		Iowa	marsh	(1) Mapping groups with similar birth dates (Round Lake); (2) Mapping groups with similar birth dates (Rush Lake); (3) Litters found by opening lodges (Round Lake); (4) Litters found by opening lodges (Rush Lake).
	-	-	2	-	4.2			2	7				
	-	-	3	-	4.0								
	-	-	4	-	7.5								
O' Neil 1949 (rivalicius)	-	-	-	-	3.46					103	Louisiana	NS	Embryo count.
O' Neil 1949 (rivalicius)	-	-	-	WI	3.7						Louisiana 1943	marsh	Live litter counts: (1) Mean for whole year.
	-	-	-	SP	3.5								
	-	-	-	SU	2.3								
	-	-	-	FA	3.5								
	-	-	1	-	3.22								
O'Neil & Linscombe 1976	-	-	-	-	3-4						Louisiana	NS	As cited in Perry 1982.
Parker & Maxwell 1980	-	-	-	-	6.8						New Brunswick, CAN	marsh	Year = 1976-77. Based on counts of placental scars using an estimate of 2.5 litters/year.
Parker & Maxwell 1984	A	-	-	-	8.4					36	New Brunswick, CAN	woods, upland, marsh	Based on counts of placental scars.
	Y	-	-	-	7.5					8			
Proulx & Gilbert 1983	-	-	-	-	6.3						Ontario, CAN	marsh	Embyro count.

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Reeves & Williams 1956 (osoyoosensis)	-	-	1	-	7.0			2	9	35	Idaho 1949, 1953	marsh	(1) Live litters (Gray's Lake); (2) placental scars in fall-trapped females (Gray's Lake); (3) Live litters (Dingle Swamp); (4) mean of 66 live litters in both areas.
	-	-	2	FA	6.6			2	11	25			
	-	-	3	-	7.3			5	10	31			
	-	-	4	-	7.1					66			
Sather 1958	A	-	1	-	6.3					60	Nebraska 1949-52	marsh	(1) Live litter count; (2) placental scar count - precocial breeders.
	J	-	2	WI	4.9					46			
Schacher & Pelton 1975	-	-	-	-	5.38					13	e Tennessee	riverine	Counted fetal implantations.
Seamans 1941	-	-	-	-	6.8			5	8	5	Vermont	NS	As cited in Gashwiler 1950, based on embryo counts.
Smith 1938	-	-	-	-	4.4				7	10	Maryland	NS	Based on embryo counts.
Smith et al. 1981	-	-	-	-	6.4					26	Connecticut 1976	marsh	Placental scar counts from fall-trapped muskrats.
Stewart & Bider 1974	-	-	-	SP	6.6	0.3 SE		5	8	16	Quebec, CAN 1973	drainage ditch	Placental scar and embryo counts.
Svihla & Svihla 1931 (rivalicia)	-	-	1	WI	3.7			1	6	263	Louisiana 1926	marsh	(1) Number of embryos in trapped carcasses; (2) live litters observed in the wild. Data is from November - December.
	-	-	2	WI	2.6								
Wilson 1954	-	-	-	-	3.7			1	6		N Carolina	marsh	As cited in Perry 1982.
LITTERS/YEAR													
Chamberlain 1951	-	-	-	-	2.7		/yr				Massachusetts	marsh	As cited in Perry 1982.
Clay & Clark 1985	-	-	1	-	2.0		/yr				ne Iowa 1981-82	backwater sloughs	Habitat is part of the upper Mississippi River. Year: (1) 1981; (2) 1982.
	-	-	2	-	1.8		/yr						
Clay & Clark 1985	-	-	1	-	1.5		/yr				ne Iowa 1981-82	open water sloughs	Habitat is part of the upper Mississippi River. Year: (1) 1981; (2) 1982.
	-	-	2	-	1.9		/yr						
Erickson 1963	-	-	-	-	1.5		/yr				c New York	ponds	As cited in Perry 1982.
Errington 1939a	-	-	-	-	2		/yr				Iowa	marsh	
Errington 1937a	-	-	-	-	2		/yr				nw Iowa	marsh	

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Gashwiler 1950	-	-	-	-	2.1		/yr				Maine 1945-48	NS	In wildlife refuge.
Halbrook 1990	-	-	-	-	1.84		/yr				Virginia	marsh	Habitat is along the Elizabeth River.
Neal 1968	-	-	1	-	1.2		/yr				Iowa	marsh	(1) Mapping groups of similar birth dates (Round Lake); (2) mapping groups of similar birth dates (Rush Lake); (3) placental scars (Round Lake); (4) placental scars (Rush Lake). Rush Lake is the superior habitat.
	-	-	2	-	3.4		/yr						
	-	-	3	-	2.0		/yr						
	-	-	4	-	3.0		/yr						
O'Neil 1949 (rivalicius)	-	-	-	-	5-6		/yr		7-8		Louisiana	NS	Statewide data, general information.
Parker & Maxwell 1984	-	-	-	-	2.36		/yr			36	New Brunswick, CAN	woods, upland, marsh	Years from 1978-80.
Proulx & Gilbert 1983	-	-	-	-	2		/yr				Ontario, CAN	NS	
Reeves & Williams 1956 (osoyoosensis)	-	-	1	-	1.6		/yr			35	Idaho 1949-50,'52-53	marsh	(1) Placental scars/ avg. size (Gray's Lake); (2) uterus scars from fall trapped animals (Gray's Lake); (3) placental scars per breeding female/ avg. litter size (counted at less than one week of age)--(Dingle Swamp).
	-	-	2	-	1.7		/yr			25			
	-	-	3	-	2.4		/yr			-			
Schacher & Pelton 1975	-	-	-	-	2.3		/yr				e Tennessee	riverine	Calculated by dividing placental scars by mean litter size.
Smith 1938	-	-	-	-	3		/yr				Maryland	NS	
Smith & Jordan 1976	-	-	-	-	3.0		/yr				Connecticut	marsh	As cited in Parker and Maxwell 1984.
Smith et al. 1981	-	-	-	-	2.8		/yr	2	5		Connecticut 1976	marsh	
Stewart & Bider 1974	-	-	-	-	2		/yr				Ontario, CAN 1973	drainage ditch	
Wilson 1954	-	-	-	-	3		/yr				North Carolina	NS	As cited in Perry 1982.
DAYS GESTATION													
Asdell 1964	-	-	-	-	29-30		days				NS	NS	As cited in Wilson 1955.

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Beer 1950	-	-	-	-	22-25		days				Wisconsin	NS	Considered by author to be "true gestation period"; longer periods are due to delayed implantation.
Erickson 1963; McLeod & Bondar 1952	-	-	-	-	25-30		days				NS	NS	As cited in Willner et al. 1980.
Errington 1937a	-	-	-	-	29-30		days	22-23			nw Iowa	marsh	Based on data from F.G. Ashbrook of U.S. Biological Survey.
Errington 1963	-	-	-	-	30		days				Iowa	marsh	
Gashwiler 1950	-	-	-	-	29-30		days				Maine 1945-48	NS	In wildlife refuge.
O'Neil 1949 (rivalicius)	-	-	-	-	26-28		days				Louisiana	marsh	"Hearsay".
Reeves & Williams 1956 (osoyoosensis)	-	-	-	-	30		days				Idaho	marsh	
Wilson 1955	-	-	-	-	28-30		days				NS	NS	As cited in Perry 1982.
AGE AT WEANING													
Dozier 1953	-	B	-	-	28		days				United States	NS	
Errington 1939a	-	B	-	-	28		days	21	30		Iowa 1934; 1936-38	marsh	
Errington 1963	-	B	-	-	22-24		days		30		Iowa	marsh	
AGE AT SEXUAL MATURITY													
Svihla & Svihla 1931 (rivalicia)	-	B	-	-	6		months				Louisiana 1925-27	marsh	

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
ANNUAL MORTALITY													
Chamberlain 1951	J J	- -	1 2	- -	61 73		%/yr %/yr				Massachusetts	NS	(1) 1949; (2) 1950. As cited in Perry 1982.
Clay & Clark 1985	A J	B B	- 1	- -	87 90		%/yr %/yr				ne Iowa 1981-82	riverine	(1) Juvenile survival = survival from birth to the start of the next breeding season. Juvenile mortality from birth to October was 66% in 1981 and 45% in 1982. (Breeding season = March - September.)
Clay & Clark 1985	A A	B B	1 2	- -	66 78		%/Mar-Sept %/Mar-Sept				ne Iowa 1981-82	open water riverine	Adult mortality over the breeding season; (1) 1981 data, (2) 1982 data.
Clay & Clark 1985	B	B	-	WI	63		%/winter				ne Iowa 1981-82	riverine	
Clay & Clark 1985	A	B	-	WI	87		%/yr				ne Iowa 1981-82	riverine	
Dorney & Rusch 1953	J	-	-	-	18		% to fall				Wisconsin	NS	From birth to fall. As cited in Boutin and Birkenholz 1987.
Errington unpublished	A	B	-	SU	10		%/summer				NS	NS	In Olsen 1959 as cited in Proulx and Gilbert 1983.
Mathiak 1966	J J	- -	1 2	- -	22 87		% to fall %/yr	10	36		Wisconsin 1947-57	marsh	Mortality from: (1) birth to fall; (2) from birth to end of first year. Data from tag returns in a heavily trapped population. Author suggests that there is complete population turnover every 2 years. 1987.
Mathiak 1966	-	-	-	-			years		4	1	Wisconsin 1947-57	marsh	One muskrat in heavily trapped population found to have survived 3 winters.
Proulx & Gilbert 1983	J J	- -	1 2	FA WI	33.6 68.2		%/ fall %/ winter				Ontario, CAN	marsh	(1) % mortality of juveniles during the fall trapping season; (2) same during first winter.
Schwartz & Schwartz 1959	J	-	-	-	67		%/yr				Missouri	NS	As cited in Perry 1982.

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
LONGEVITY													
Errington 1963	-	-	-	-			years			4	Iowa	marsh	
Godin 1977	-	-	-	-	3-4		years				New England	NS	As cited in Willner et al. 1980.
Proulx & Gilbert 1983	-	-	-	-			years			5	Ontario, CAN	marsh	

***** SEASONAL ACTIVITIES *****

Reference	Begin	Peak	End	Location	Habitat	Notes
MATING						
Beer 1950	earl Apr	Apr-June	Jun	s and c Wisconsin	NS	Most of the breeding takes place in this range, but some occurs as early as mid February and as late as mid August.
Chamberlain 1951	March		Sept	Massachusetts	marsh	As cited in Perry 1982.
Errington 1937a	Apr		May	nw Iowa 1934-36	marsh	
Gashwiler 1950	March	May-mid Jun	July	Maine 1945-48	NS	Habitat is in Moosehorn National Wildlife Refuge.
Lay 1945		year-round		Texas	marsh	As cited in Wilson 1955.
O'Neil 1949	yr round	Nov & Mar		Louisiana	marsh	Breeding occurs all times of year, with peaks in November and March and lows in July and August.
Parker & Maxwell 1984	March			New Brunswick CAN	woods, upland, marsh	
Reeves & Williams 1956 (osoyoosensis)	late Apr		mid July	Idaho 1949	marsh	
Schacher & Pelton 1975	March	Apr-July	mid Sept	Tennessee	river	
Smith 1938	most yr	Mar-Sept		Maryland	NS	Breeding occurs in most months, with peaks in March and September.

Reference	Begin	Peak	End	Location	Habitat	Notes
Svihla & Svihla 1931 (rivalicia)	yr round	Nov-Apr		Louisiana	marsh	Breeding occurs at all times of year.
Wilson 1955		year-round		North Carolina	NS	Breed year-round except during very cold winters.
PARTURITION						
Beer 1950	late Apr	late May	July	Wisconsin	NS	Most born during this range, but some born as early as March and as late as September.
Clay & Clark 1985	Feb/Mar	May	Aug/Sept	Iowa 1981-82	river sloughs	Habitat is on the upper Mississippi River.
Errington 1937a	late Apr	June	late Aug	nw Iowa 1934-36	marsh	
Gashwiler 1950	earl May		late Aug	Maine 1945-48	NS	Moosehorn National Wildlife Refuge.
Mathiak 1966	late Apr	mid May		Wisconsin	marsh	
Neal 1968	Apr 20	May 10-Jun 8		Iowa 1967	marsh	Round Lake.
Neal 1968	May 1		June 30	Iowa 1966	marsh	Round Lake.
Neal 1968	Mar 31	Mar31-Apr19		Iowa 1967	marsh	Rush Lake.
Reeves & Williams 1956 (osoyoosensis)	late May	earl July	mid Aug	Idaho 1949	marsh	N = 69.
Reeves & Williams 1956 (osoyoosensis)	earl May	May	late Aug	Idaho 1953	marsh	N = 70.
Stewart & Bider 1974 (zibethicus)	Apr	May		Quebec, CAN 1973	drainage ditch	A second peak occurred in June/July.
DISPERSAL						
Errington 1963		spring		Iowa	marsh	
McDonnell & Gilbert 1981		fall		Ontario, CAN	marsh	

*** NORMALIZING AND CONTACT RATE FACTORS ***

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
BODY WEIGHT													
Chapman & Morgan 1973	A	M	-	-	1,134	122 SD	g	801	1,411	64	w MD, WV	farmland to woodland	
	A	F	-	-	1,244	165 SD	g	842	1,533	36			
Lord 1963	A	B	1	FA	1,140	277 SD	g				Illinois	sanctuary study area	Years: (1) 1956 (2) 1957 (3) 1958 (4) 1959 (5) Average of all four years.
	A	B	2	FA	1,168	249 SD	g						
	A	B	3	FA	1,132	262 SD	g						
	A	B	4	FA	1,002	240 SD	g						
	A	B	5	FA	1,111		g						
Lord 1963	A	B	1	WI	1,275	155 SD	g				Illinois	sanctuary study area	Years: (1) 1957 (2) 1958 (3) 1959 (4) 1960 (5) Average of all four years.
	A	B	2	WI	1,307	113 SD	g						
	A	B	3	WI	1,276	106 SD	g						
	A	B	4	WI	1,209	90 SD	g						
	A	B	5	WI	1,267		g						
Lord 1963	A	B	-	-	1,231	164 SD	g	700	1,800	691	Illinois	NS	L = Lactating
	A	F	L	-			g		1,786	1			
	J	B	-	-			g	100	1,300				
Lord & Casteel 1960 (mearnsi)	-	-	-	FA	1,140		g				c Illinois 1956-57	field/old field/ forest	(1) Late winter; Wildlife Sanctuary Area.
	-	-	1	WI	1,275		g						
Lord & Casteel 1960 (mearnsi)	-	-	-	FA	1,168		g				c Illinois 1957-58	field/old field/ forest	(1) Late winter; Wildlife Sanctuary Area.
	-	-	1	WI	1,307		g						
Lord & Casteel 1960 (mearnsi)	-	-	-	FA	1,132		g				c Illinois 1958-59	field/old field/ forest	(1) Late winter; rabbits were supplied with food. Wildlife Sanctuary Area.
	-	-	1	WI	1,276		g						
Lord & Casteel 1960 (mearnsi)	-	-	-	FA	1,002		g				c Illinois 1959-60	field/old field/ forest	(1) Late winter; Wildlife Sanctuary Area.
	-	-	1	WI	1,209		g						
Lord & Casteel 1960 (mearnsi)	-	-	-	FA	994		g				c Illinois 1959	field/forest	(1) Early winter; (2) late winter. Rabbits were supplied with food in the winter. 4-H study area.
	-	-	1	WI	1,226		g						
	-	-	2	WI	1,185		g						
Lord & Casteel 1960 (mearnsi)	-	-	-	FA	944		g				c Illinois 1958-59	field/forest	(1) Early winter; (2) late winter. 4-H study area.
	-	-	1	WI	1,169		g						
	-	-	2	WI	1,235		g						

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Lord & Casteel 1960 (mearnsi)	-	-	-	FA	931		g				c Illinois 1957-58	field/forest	(1) Early winter; (2) late winter. Rabbits were supplied with food in winter. 4-H study area.
	-	-	1	WI	1,249		g						
	-	-	2	WI	1,248		g						
Lord & Casteel 1960 (mearnsi)	-	-	-	FA	1,087		g				c Illinois 1956-57	field/forest	(1) Early winter; (2) late winter. 4-H study area.
	-	-	1	WI	1,256		g						
	-	-	2	WI	1,192		g						
Pelton & Jenkins 1970	A	B	NB	-	1,229	113 SD	g	1,093	1,461	24	Georgia 1965-68	mountain	
Pelton & Jenkins 1970	A	B	NB	-	1,313	141 SD	g	986	1,671	182	Georgia 1965-68	coastal	
Pelton & Jenkins 1970	A	B	NB	-	1,132	136 SD	g	793	1,579	189	Georgia 1965-68	Piedmont	
Pelton & Jenkins 1970	A	B	-	WI	1,176		g	793	1,671	96	Georgia 1965-68	coastal, piedmont mountain	
	A	B	-	SP	1,286		g	898	1,630	121			
	A	B	-	SU	1,197		g	910	1,608	101			
	A	B	-	FA	1,255		g	886	1,669	77			
NEONATE WEIGHT													
Ecke 1955	N	-	-	-			g	35	45		c Illinois	NS	
Hill 1972b	N	-	-	-	42.2		g	36.0	49.0	6	Alabama 1963-66	NS	
Lord 1963	N	-	-	-	25.6		g			10	Illinois	captive	
PUP AND JUVENILE WEIGHT													
Lord 1963	P	B	-	-	57.8	10 days	g			10	Illinois	captive	Weights at different ages of juvenile cottontails.
	P	B	-	-	94.4	20 days	g			4			
	J	B	-	-	158.9	30 days	g			8			
	J	B	-	-	269.7	40 days	g			9			
	J	B	-	-	401.3	50 days	g			8			
	J	B	-	-	504.8	61 days	g			5			
	J	B	-	-	765.3	91 days	g			4			
	J	B	-	-	822.0	101 days	g			3			
	J	B	-	-	1,106.0	149 days	g			3			
GROWTH RATE													
Hill 1972b	-	-	1	-	5.6		g/day				Alabama	lab	Age in days: (1) 0-30; (2) 31-50; (3) 51-100; (4) 101-150.
	-	-	2	-	8.0		g/day						
	-	-	3	-	5.8		g/day						
	-	-	4	-	3.2		g/day						

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Lord 1963	J	B	1	-	3.22		g/day				Illinois	lab	Age in days: (1) 0-10; (2) 11-30; (3) 31-50; (4) 51-100; (5) 101-150.
	J	B	2	-	3.66		g/day						
	J	B	3	-	8.77		g/day						
	J	B	4	-	11.3		g/day						
	J	B	5	-	6.4		g/day						

METABOLIC RATE (OXYGEN)

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Hinds 1973 (for similar species: *S. audubonii*)	-	-	-	SU	15.6		lO2/kg-d				NS	NS	As cited in Chapman et al. 1982.
	-	-	-	WI	19.0		lO2/kg-d						

***** DIET *****

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Bailey & Siglin 1966 (mearnsii)	J	B	dandelion		9			NS	Illinois 1965	captive - food preference ranking	Preference ranking of 3 to 7 week old cottontails. Each plant tested against all others. Palatability = number of times a plant species was preferred during the 10 tests.
			prickly lettuce		9						
			giant ragweed		7						
			red clover		6						
			Rugel's plantain		6						
			smartweed		6						
			curly dock		5						
			wild carrot		3						
			crabgrass		3						
			common ragweed		1						
Dalke & Sime 1941 (mallarus & S. transitionalis)	-	B	(trees)						Connecticut 1935-37	NS - frequency of occurrence; observations of feeding on plant	Most of the observations (85%) were on the mallarus subspecies of the eastern cottontail. The New England cottontail exhibited similar food preferences, and so the data were combined. Summer observations made from April through October. Winter observations from January through March.
			gray birch		4		47				
			red maple		4		42				
			apple		4		12				
			aspen		1		12				
			choke cherry		3		12				
			wild black cherry		3		12				
			white pine		-		7				
			white oak		2		7				
			box elder		2		2				
			(shrubs and vines)								
			blackberry		13		52				
			dewberry		-		49				
			willow		3		35				
			black alder		1		34				
			maleberry		1		34				
			highbush blueberry		4		31				
			lowbush blueberry		1		19				
			silky dowgwood		-		16				
			swamp rose		1		15				
			Spirea		2		14				
(continued)			arrowwood		3		1				

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Dalke & Sime 1941 (continued)			(herbs)								
			goldenrod		29		-				
			plantain		13		-				
			chickweed		11		-				
			sheep sorrel		10		-				
			wild strawberry		9		-				
			smartweed		6		-				
			other herbs		<6		-				
Dalke & Sime 1941 (mallarus & S. transitionalis)	-	B	trees	13	2	7	39		Connecticut 1937-38	several habitats - % frequency of occurrence; observations of feeding on plants	Months selected from the report to represent each season are April, July, October, and January.
			shrubs & vines	4	2	27	40				
			herbs	44	23	34	5				
			grasses, sedges, rushes	26	56	30	6				
			crops	13	17	2	10				
Dusi 1952 (mearnsii)	B	B	winter vetch		6	-	-	15	Ohio 1947	NS (Williams Co.) - mean % frequency of occurrence; scats	Data averaged from six sampling dates (with a total of 15 samples). Field observations show no utilization of woody plants.
			corn		2	-	-				
			timothy		-	2	4				
			bluegrass		36	33	9				
			unidentified plants		58	65	87				
			(no. days sampled)		(2)	(3)	(1)				
Dusi 1952 (mearnsii)	A	B	corn	1				11	Ohio 1947-48	NS (Wood Co.) - mean % frequency of occurrence; scats	Average of 3 days sampling (11 samples collected). Unidentified thought to be mostly woody material. At this time of year, preferred food is scarce.
			orchard grass	8							
			bluegrass	9							
			unidentified	82							
Dusi 1952 (mearnsii)	A	B	bluegrass	12	19		9	30	Ohio 1947-48	NS (Highland Co.) - mean % frequency of occurrence; scats	Data from 30 pellets collected on 4 days. Field notes show no evidence of eating woody plants.
			orchard grass	31	3		20				
			timothy	4	25		15				
			Korean lespedeza	2	3		12				
			wheat	8	-		-				
			red clover	-	10		-				
			alsike clover	-	-		3				
			unidentified	43	40		41				
Dusi 1952 (mearnsii)	A	B	bluegrass	34	34	25	32	101	Ohio 1947-48	NS (Highland Co.) - mean % frequency of occurrence; scats	Seasonal means calculated from data on 101 freshly dropped pellet samples collected on 27 dates. Woody tissues thought to make up the bulk of the unidentified materials on 3 of the winter sampling days.
			orchard grass	4	1	-	1				
			timothy grass	5	12	7	1				
			nodding wild rye	5	11	8	4				
			Canada goldenrod	-	-	3	-				
			red clover	-	-	6	-				
			unidentified	52	42	51	62				
			(no. sampling days)	(6)	(8)	(5)	(8)				

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Martin et al. 1951	B	B	smooth sumac				10-25	NS	Iowa	NS - rough approximation of % diet; observations	
			basswood				5-10				
			apple				5-10				
			red osier dogwood				2-5				
			hawthorn				0.5-2				
			oak				0.5-2				
			elderberry				0.5-2				
			willow				0.5-2				
			raspberry				0.5-2				
			elm				0.5-2				
Martin et al. 1951	B	B	sumac				25-50	NS	Michigan	NS - rough approximation of % diet; observations	Plants making up 0.5-2% of diet: sassafras, willow, hickory, grape, buckthorn, wild rose.
			plantain				5-10				
			dogwood				5-10				
			blackberry				5-10				
			yarrow				2-5				
			wild cherry				2-5				
			elderberry				2-5				
			oak				2-5				
			apple				2-5				
Martin et al. 1951	B	B	wheat		10-25			NS	Ohio	farm - rough approximation of % diet; observations	Season = all; season abbreviations following oats and carrots indicate the seasons when these food were present in diet.
			alfalfa		5-10						
			clover		5-10						
			soybean		5-10						
			oats (sp, su)		2-5						
			carrot (su, fa)		2-5						
			alsike clover		0.5-2						
			corn		0.5-2						
			rye		0.5-2						
			bluegrass		0.5-2						
			redtop		0.5-2						
Martin et al. 1951	B	B	crabgrass		5-10			76	Connecticut	NS - rough approximation of % diet; stomach contents and observations	Data is for eastern and New England cottontails in general for all seasons. Season abbreviations in parenthesis indicate particular seasons when food types were consumed; other foods were eaten in all seasons. Plants making up 0.5-2 % of the diet: wild millet, bristlegrass, chickweed, apple, wild strawberry, willow, dogwood, oak, winterberry, sumac, and paspalum.
			bluegrass		5-10						
			garden crops (su, fa)		5-10						
			clover		5-10						
			blackberry		5-10						
			plantain (sp, su, fa)		5-10						
			sheepsorrel (sp, su)		5-10						
			panicgrass		2-5						
			goldenrod (su, fa)		2-5						
			gray birch (su, fa)		2-5						
			red maple (wi, sp)		2-5						
			wild cherry (wi, sp)		2-5						
			blueberry		2-5						

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Spencer & Chapman 1986	A	B	woody plants	17	23	20	100	12	w Maryland	forest	
			forbs	19	30	46	-			-	
			grasses	64	47	34	-			% frequency of occurrence; stomach contents	
			(sample size)	(2)	(5)	(4)	(1)				

***** POPULATION DYNAMICS *****

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
HOME RANGE SIZE													
Allen 1939	A	M	-	WI	1.5		ha	0.1	41.7		Michigan	NS	As cited in Trent and Rongstad 1974; based on tag and recapture experiments.
	A	F	-	WI	0.89		ha	0.1	3.1				
Althoff and Storm 1989	A	M	-	WI	3.2		ha				c Pennsylvania	mixed	
	A	M	-	SP	7.2		ha						
	A	M	-	SU	7.8		ha						
	A	M	-	FA	3.1		ha						
Althoff and Storm 1989	A	F	-	WI	2.1		ha				c Pennsylvania	mixed	
	A	F	-	SP	2.8		ha						
	A	F	-	SU	2.4		ha						
	A	F	-	FA	1.5		ha						
Dixon et al. 1981	A	M	-	WI	3.05	0.72 SE	ha			2	Wisconsin	woodlot	
	A	F	-	WI	2.99	0.28 SE	ha			5			
	A	B	-	WI	3.01	0.25 SE	ha			7			
Haugen 1942	A	M	BR	SU			ha	9.8	41.7		Michigan	NS	As cited in Trent and Rongstad 1974; based on tag and recapture data.
	A	F	BR	SU	9.12		ha	6.1	12				
Haugen 1942	A	M	NB	WI			ha	5.06	16		Michigan	NS	As cited in Trent and Rongstad 1974; based on tag and recapture data.
	A	F	NB	WI	5.7		ha	5.06	7.08				
Heard 1963	-	M	-	-			ha	1.6			sw MS 1959-63	forest, old field, bottom areas	
	-	F	-	-			ha	1.2					
Janes 1959 (floridanus)	-	-	-	-	2		ha				Kansas	NS	As cited in Trent and Rongstad 1974; based on tag and recapture data.
Jurewicz et al. 1981	A	F	1	SP	0.7		ha	0.4	1.3	5	Wisconsin	woodlot, farm	Home range: (1) diurnal; (2) nocturnal. Based on movements of radiotagged females.
	A	F	2	SP	2.5		ha	2.1	3.2	5			
	A	F	1	SU	1.2		ha	0.6	2.6	7			
	A	F	2	SU	3.7		ha	2.3	6.4	7			

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Lord 1963	B	B	-	-	0.95	0.75 SD	ha			72	Illinois	NS	Based on tag and recapture data; some rabbits captured as few as three times.
	A	B	-	-	1.18	0.70 SD	ha			13			
	J	B	-	-	0.92	0.75 SD	ha			59			
	B	M	-	-	0.95	0.70 SD	ha						
	B	F	-	-	0.95	0.78 SD	ha						
Lord 1963	-	-	1	-	0.71	0.32 SD	ha			16	Illinois	agricultural fields	(1) Sanctuary; (2) 4-H study area. Based on tag and recapture data; some rabbits captured as few as three times.
	-	-	2	-	1.0	0.81 SD	ha			57			
Trent & Rongstad 1974	A	M	-	SP	2.7	0.77 SD	ha			5	sw Wisconsin 1970-72	woodlots	(1) Early summer (2) late summer. Determined by radiotracking.
	A	M	1	SU	4.0	1.8 SD	ha			4			
	A	M	2	SU	1.4	0.36 SD	ha			5			
	A	F	-	SP	1.7	0.75 SD	ha			5			
	A	F	1	SU	0.85	0.52 SD	ha			6			
	A	F	2	SU	0.41	0.27 SD	ha			6			

POPULATION DENSITY

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Bittner & Chapman (unpubl.)	-	-	-	-					10.2		St Clements Isl, MD	NS	As cited in Chapman et al. 1982.
Bittner & Chapman 1981	B	B	-	WI	10.2		N/ha				Maryland 1976-1977	island	
	B	B	-	FA	8.07		N/ha						
Crunden & Hendrickson 1955	-	-	-	-	2.93		N/ha				Iowa	NS	As cited in Bittner & Chapman 1981.
Eberhardt et al. 1963	B	B	1	FA	0.592		N/ha			728	sc Michigan 1951-57	woods/marsh/fields	Entries (1) through (7) correspond to the years 1951 through 1957, respectively. Hunting seasons were Oct 15-Dec 31 in 1951, Oct 20-Jan 31 in 1952-56, and Oct 21-Mar 1 in 1957.
	B	B	2	FA	0.641		N/ha			788			
	B	B	3	FA	0.777		N/ha			956			
	B	B	4	FA	0.773		N/ha			951			
	B	B	5	FA	0.747		N/ha			919			
	B	B	6	FA	0.644		N/ha			792			
	B	B	7	WI	0.996		N/ha			1225			
Eberhardt et al. 1963	-	-	-	FA	1.07	0.41 SD	N/ha	0.41	2.08	11	c Michigan 1947-57	woods/marsh/fields	Sample size is in years.
Edwards (unpubl.)	-	-	-	FA	3.1		N/ha			2400	Delaware, OH	NS	Sample size = 2400 hectares. As cited in Chapman et al. 1982
Edwards et al. 1981	B	B	-	FA			N/ha	1.8	7.4		c Illinois 1956-1978	forested 4-H area	
Heard 1963	-	-	-	WI	1.1		N/ha			46	sw MS 1959-63	forest, old field, bottom areas	

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Jurewicz et al. 1981	B	B	1	FA	8.1		N/ha				Wisconsin	woodlot & farms	Year: (1) 1973; (2) 1974; (3) 1975.
	B	B	2	FA	6.6		N/ha						
	B	B	3	SP	1.6		N/ha						
Leite 1965	-	-	-	FA	14.9		N/ha			210	Urbana, OH	NS	Sample size = 210 hectares. As cited in Chapman et al. 1982.
Lord & Casteel 1960 (mearnsi)	B	B	-	FA			N/ha	3.0	5.9		Illinois 1956-1960	old field	
	B	B	-	WI			N/ha	0.67	1.5				
Lord & Casteel 1960 (mearnsi)	B	B	-	FA			N/ha	5.9	8.2		Illinois 1956-1970	planted trees, field	
	B	B	-	WI			N/ha	0.77	3.2				
Pils & Martin 1978	-	-	-	FA	7.4		N/ha				s Wisconsin 1971-75	various	Data based on 331 individual cottontails plus 724 recaptures.
	-	-	-	WI	7.0		N/ha						
Sandt & McKee 1978	-	-	-	-	0.73		N/ha				e Maryland	wildlife manag. area	As cited in Bittner & Chapman 1981.
Trent & Rongstad 1974	-	-	-	SU	4.2		N/ha				sw Wisconsin 1970-72	experimental farm	
	-	-	-	FA	10.1		N/ha						
	-	-	-	SP	3.7		N/ha						
	-	-	-	SU	5.7		N/ha						
	-	-	-	FA	8.9		N/ha						

LITTER SIZE

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Allen 1939	-	-	-	-	5.1					11	Michigan	NS	As cited in Chapman et al. 1982.
Barkalow 1962	-	-	-	-	3.2						Alabama	NS	As cited in Bothma and Teer 1977.
Beule 1940	-	-	-	-	5.42					26	Pennsylvania	NS	As cited in Chapman et al. 1982.
Bittner & Chapman 1981	-	-	-	-	3.57	1.32 SD				21	Maryland 1976-1977	island	Measured as viable fetuses.
Bothma & Teer 1977	J	-	-	-	3.10					80	Texas 1965-68	grassland	(1) Older adults; (2) all ages. All seasons.
	A	-	-	-	3.38					138			
	A	-	1	-	3.56					52			
	-	-	2	-	3.33					270			
Chapman et al. 1977	-	-	-	-	4.8-5.3						w Maryland 1971-72	NS	
Conaway et al. 1963	-	-	2	-	6.2	0.28 SD				15	Missouri	J Reed Wildlife Area	(2) 2nd litter; (3) 3rd litter; (4) 4th litter; (A) average of 2-4. Embryo count.
	-	-	3	-	6.24	0.21 SD				14			
	-	-	4	-	5.5	0.39 SD				14			
	-	-	A	-	6.0					43			

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Conaway et al. 1974	-	-	1	SP	3.4					50	midwest, 30-35 N lat, 1964	NS	Size of (1) first litter and (2) second litter.
	-	-	2	SP	4.0					71			
Conaway et al. 1974	-	-	1	SP	4.2					158	midwest, 35-40 N lat, 1964	NS	Size of (1) first litter and (2) second litter.
	-	-	2	SP	5.5					86			
Conaway et al. 1974	-	-	1	SP	5.0					21	North Dakota 1964	NS	Size of (1) first litter and (2) second litter.
	-	-	2	SP	3.0					2			
Conaway et al. 1974	-	-	1	SP	5.1					36	midwest, 40-45 N lat, 1964	NS	Size of (1) first litter and (2) second litter.
	-	-	2	SP	7.0					4			
Conaway et al. 1974	-	-	1	WI	2.6					27	FL, TX, 25-30 N lat 1965	NS	
	-	-	2	WI	3.4					55			
Ecke 1955	-	-	1	-	4.7					5	c Illinois 1947-48	NS	(1) Placental scar counts; (2) embryo counts; (3) average number of young in nests; (4) mean of estimates 1, 2 & 3. Note: wide variation due to seasonal differences in collecting.
	-	-	2	-	6.5					13			
	-	-	3	-	4.9					13			
	-	-	4	-	5.6			3	9	31			
Hamilton 1940	-	-	-	-	4.5			2	7	22	wc New York 1932-38	NS	
Haugen 1942	-	-	-	-	5.4						Michigan	NS	As cited in Bothma and Teer 1977.
Heard 1963	-	-	-	-	3.50	1.02 SE		5	2	55	Mississippi 1959-63	forest, old field, bottom areas	
Hill 1972a	-	-	-	-	3.47					611	Alabama	NS	As cited in Chapman et al. 1982.
Hill 1972c	-	-	1	-	3.5	0.0416 SE				611	Alabama 1953-67	see footnotes	Habitat: (1) all habitats combined; (2) lower coastal plains; (3) piedmont plateau; (4) upper coastal plains; (5) Tennessee valley; (6) black belt. Embryo count.
	-	-	2	-	3.2					178			
	-	-	3	-	3.3					57			
	-	-	4	-	3.3					128			
	-	-	5	-	3.6					175			
	-	-	6	-	4.1					73			
Lord 1961	-	-	-	-	5.3						Illinois	NS	As cited in Bothma and Teer 1977.
Lord 1963	-	-	1	-	5.95					109	Illinois 1957-59	NS	(1) 1957; (2) 1958; (3) 1959; (4) total. Embryo count.
	-	-	2	-	5.06					165			
	-	-	3	-	5.31					195			
	-	-	4	-	5.31					469			
Lord 1963	-	-	1	-	4.77					34	Illinois 1957-59	NS	(1) s and e Illinois; (2) c Illinois. Embryo count.
	-	-	2	-	6.17					29			

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Pelton & Jenkins 1971	-	-	-	-	3.1						Georgia	NS	As cited in Chapman et al. 1980.
Trethewey & Verts 1971	-	-	-	-	5.10					106	w Oregon	NS	As cited in Chapman et al. 1982.
Wainright 1969	-	-	-	-				3.57			throughout range	NS	Value reflects most cottontails throughout range. As cited in Bittner and Chapman 1981.
LITTERS/YEAR													
Bittner & Chapman 1981	-	-	-	-	4.81		/year				Maryland 1976-1977	island	
Chapman et al. 1977	-	-	-	-	4.6		/year				w Maryland 1971-72	NS	
Chapman et al. 1980	-	-	-	-			/year	5	7		several	several	Summary of several studies (i.e., Sheffer 1957; Conaway et al. 1963; Evans et al. 1965; Tretheway & Verts 1971).
DAYS GESTATION													
Bothma & Teer 1977	-	-	-	-	28		days				s Texas 1965-68	grassland	
Chapman et al. 1982	-	-	-	-	28		days	25	35		NS	NS	Summary of several other studies.
Conaway et al. 1963	-	-	-	-	27		days				Missouri 1961	J. Reed Wildlife Area	Summarizing Hendrickson 1943; Marsden and Conaway 1963.
Ecke 1955	-	-	-	-	30		days	25	32		US	NS	Summarizing data from: Seton 1929; Prouty 1937; Gerstell 1937; Dalke 1942; Haugen 1942.
Peterson 1966	-	-	-	-			days	26	28		NS	NS	As cited in de Poorter and van der Loo 1981.
AGE AT WEANING													
Allen 1938	-	-	-	-	16		days				NS	NS	As cited in Ecke 1955; determined by length of time spent in nest.

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Dalke 1942	-	B	-	-			days	14	16		NS	captive	As cited in Ecke 1955; determined by length of time spent in nest.
Ecke 1955	-	-	-	-	20-25		days				Illinois	NS	Author notes that it appears that many young are nursed for at least 4-5 days after leaving the nest.
Peterson 1966	-	-	-	-			days	28	35		NS	NS	As cited in de Poorter and van der Loo 1981.
AGE AT SEXUAL MATURITY													
Bothma & Teer 1977	-	F	-	-			months	5			s Texas	grassland	
Conaway & Wight 1963	-	M	-	-			months	3	6		Missouri	NS	
Lord 1961; Negus 1959b	-	F	-	-			months	3	6		NS	NS	Cited in Conaway & Wight 1963.
ANNUAL MORTALITY													
Eberhardt et al. 1963	A	F	-	-	71.7		%/yr				sc Michigan 1938-55	woods/marsh/fields	Average of all 18 years of study.
	J	F	-	-	85.5		%/yr						
Eberhardt et al. 1963	A	F	1	-	77.1		%/yr				sc Michigan 1938-55	woods/marsh/fields	(1) 1938-45; (2) 1946-50; (3) 1951-55.
	A	F	2	-	66.0		%/yr						
	A	F	3	-	71.9		%/yr						
	J	F	1	-	84.0		%/yr						
	J	F	2	-	85.2		%/yr						
	J	F	3	-	87.2		%/yr						
Heard 1963	-	-	-	WI	79		%/yr			46	sw MS 1959-63	forest, old field, bottom area	Winter mortality, methods questionable.
Lord 1963	-	-	1	-	86		%/yr			333	Illinois 1957-60	4-H study area	(1) Winter with food supplied for rabbits; (2) no food supplied; (3) average over 4 years. Area was hunted.
	-	-	1	-	88		%/yr			259			
	-	-	2	-	59		%/yr			324			
	-	-	2	-	83		%/yr			239			
	-	-	3	-	79	14 SD	%/yr						
Lord 1963	-	-	1	-	74		%/year			238	Illinois 1957-60	sanctuary study area	(1), (2), (3) area hunted; (4) closed to hunting; (5) average of 4 years.
	-	-	2	-	65		%/year			120			
	-	-	3	-	62		%/year			171			
	-	-	4	-	57		%/year			125			
	-	-	5	-	65	7 SD	%/year			654			

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Trent & Rongstad 1974	-	-	1	-	85		%/yr				sw Wisconsin 1970-72	experimental farm	Estimate based on: (1) trapping;
	-	-	2	-	80		%/yr						(2) radiotracking.
LONGEVITY													
Bruna 1952	-	-	-	-	1.25		years				Kentucky	NS	As cited in Chapman et al. 1980.
Eisenberg 1981	-	-	-	-			years		9.6		NS	captive/zoo	
Lord 1963	-	-	-	-			years		10		Illinois	lab	Author's guess as to potential life span of the cottontail.

***** SEASONAL ACTIVITIES *****

Reference	Begin	Peak	End	Location	Habitat	Notes
MATING						
Barkalow 1962	Jan		Sep	Alabama	NS	As cited in Chapman et al. 1980 and Bothma and Teer 1977.
Bittner & Chapman 1981	mid Feb	Apr-May	mid Jul	Maryland 1976-1977	island	Total duration of about 130 days.
Bothma & Teer 1977	yr round	Jan-Apr		s Texas	grassland	Mated all year long, Jan-Apr is the peak.
Chapman et al. 1977	late Feb		Aug	w Maryland	NS	
Conaway et al. 1974		earl-mid Feb		midwest, 30-35 N lat, 1964-65	NS	Mean date of first conception.
Conaway et al. 1974		Feb-Mar		midwest, 35-40 N lat, 1964-65	NS	Mean date of first conception from early February to late March across two years.
Conaway et al. 1974		Mar		midwest, 40-45 N lat, 1964-65	NS	Mean date of first conception.
Conaway et al. 1974		Mar-Apr		North Dakota 1964-65	NS	Mean date of first conception, late March in 1964 and early April in 1965.
Conaway et al. 1974		earl Feb		Florida 1965	NS	Mean date of first conception.

Reference	Begin	Peak	End	Location	Habitat	Notes
Conaway et al. 1974		late Jan		Texas 1965	NS	Mean date of first conception.
Dalke 1942	mid Mar		mid Sep	Connecticut	NS	As cited in Chapman et al. 1982.
Eberhardt et al. 1963	mid Mar			sc Michigan 1951-57	woods/marsh/field	Breeding date changes depending on ratio of juvenile to adult.
Ecke 1955	late Feb	early Mar	Sept	Illinois	NS	
Hamilton 1940	late Feb			wc New York 1932-38	NS	
Haugen 1942	Mar		Aug	Michigan	NS	As cited in Bothma and Teer 1977.
Heard 1963	Feb.			sw MS 1959-63	forest, old field, bottom areas	
Hill 1972a	Dec			Alabama	NS	As cited in Bittner and Chapman 1981.
Lord 1961	Mar		Sept	Illinois	NS	As cited in Bothma and Teer 1977.
Pelton & Provost 1972		9 months		Georgia	NS	As cited in Chapman et al. 1982.
Pelton & Jenkins 1971			Oct	Georgia	NS	As cited in Bittner and Chapman 1981.
Rongstad 1966	late Mar			s Wisconsin	NS	As cited in Chapman et al. 1980.
Schierbaum 1967	Feb		Sep	New York	NS	As cited in Chapman et al. 1982.
PARTURITION						
Hamilton 1940	Apr	May-July	Aug	wc New York 1938	NS	
FALL MOLT						
Bothma & Teer 1982	Aug	Oct	Dec	s Texas 1967-68	brush/grass	
Negus 1959a		Sept-Oct		Connecticut	NS	As cited in Bothma and Teer 1982.
Spinner 1940	Sept	Sept-Oct	Nov	Connecticut 1936-38	NS	

Reference	Begin	Peak	End	Location	Habitat	Notes
Spinner 1940	Sept	Sept-Oct	Nov	Connecticut 1936-38	NS	
SPRING MOLT						
Bothma & Teer 1982	Feb	April	July	s Texas 1967-68	brush/grass	
Spinner 1940	late Mar	May-June	Aug	Connecticut	NS	

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A-5. TABLES FOR REPTILES AND AMPHIBIANS

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***** SNAPPING TURTLE *****

*** NORMALIZING AND CONTACT RATE FACTORS ***

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
BODY WEIGHT (AND LENGTH)													
Congdon et al. 1986	A	M	-	-	4,871	594 SE	g			15	S Carolina	bay, marsh, pond	
	A	F	-	-	4,831	931 SE	g			6			
	J	B	-	-	664	59 SE	g			68			
Congdon et al. 1986	A	M	-	-	4,159	277 SE	g			97	Michigan	bay, marsh, pond	
	A	F	-	-	3,160	197 SE	g			80			
	J	B	-	-	798	68 SE	g			128			
Congdon & Gibbons 1985	A	F	L	-	2,856		g			4	N Carolina	NS	
	A	F	L	-	(173)		mm plastron						
Ernst & Barbour 1972	A	F	B	SU			g	4,020	10,500		NS	NS	Discusses work of Hammer 1969.
Galbraith et al. 1988	A	M	-	SU	10,500	2,850 SD	g			17	Ontario, CAN 1984-85	large oligotrophic lake	
	A	F	-	SU	5,240	850 SD	g			26			
	J	B	-	SU	1,150	800 SD	g			8			
Galbraith et al. 1988	A	M	-	SU	9,340	2,150 SD	g			5	Ontario, CAN 1984-85	small oligotrophic lake	
	A	F	-	SU	4,780	860 SD	g			4			
	J	B	-	SU	2,600		g			1			
Galbraith et al. 1988	A	M	-	SU	5,520	2,230 SD	g			47	Ontario, CAN 1984-85	eutrophic pond	
	A	F	-	SU	5,030	1,120 SD	g			24			
	J	B	-	SU	1,400	200 SD	g			7			
Gerholdt & Oldfield 1987	-	-	-	SP	29,600		g			1	n Minnesota 1986	Popple River, Squaw Lake	Mass at the time of capture.
Graham & Perkins 1976	J	-	-	-	328.4		g (118 mm)			1	Massachusetts	polluted marsh	Weight and carapace length relationship. Ages not specified.
	J	-	-	-	444.2		g (127 mm)			1			
	J	-	-	-	531.4		g (134 mm)			1			
	J	-	-	-	1,026.6		g (167 mm)			1			
	J	-	-	-	1,508.4		g (192 mm)			1			
	J	-	-	-	2,362.1		g (220 mm)			1			
Hammer 1969	A	-	-	-	7,580		g				S Dakota	marsh	
Hammer 1969	A	M	-	-	9,435		g	2,495	18,190	37	S Dakota 1964-67	marsh	LaCreek Refuge.
	A	F	-	-	7,348		g	4,082	12,250	290			
Hammer 1969	A	F	-	-			g	4,080	10,660	311	S Dakota 1964-67	marsh	Mass of nesting females. LaCreek Refuge.

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Kiviat 1980	A	B	-	-	6,000		g			46	New York 1973	fresh tidal wetland	
Lagler & Applegate 1943	A	-	-	SU	1,873		g (197 mm)			2	lower Michigan	lakes, ponds, streams	Weight and carapace length relationship. Ages not specified.
	A	-	-	SU	3,357		g (248 mm)			25			
	A	-	-	SU	6,033		g (298 mm)			12			
	A	-	-	SU	9,979		g (349 mm)			2			
	A	-	-	SU	13,608		g (375 mm)			1			
Lonke & Obbard 1977	A	F	-	-	6,400	1,430 SE	g	4,300	11,100	43	Ontario, CAN 1972-74	Lake Sasajewun	

BODY LENGTH

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Congdon et al. 1986	A	M	-	-	187.5	3.38 SE	mm plastron			97	Michigan	bay, marsh, pond	
	A	F	-	-	184.2	3.08 SE	mm plastron			80			
	J	B	-	-	100.2	3.11 SE	mm plastron			128			
Congdon et al. 1986	A	M	-	-	193.9	7 SE	mm plastron			21	S Carolina	bay, marsh, pond	
	A	F	-	-	195.8	9.88 SE	mm plastron			8			
	J	B	-	-	98.7	3.11 SE	mm plastron			82			
Congdon et al. 1986	A	M	-	-	253.4	4.97 SE	mm carapace			97	Michigan	bay, marsh, pond	
	A	F	-	-	238.3	3.77 SE	mm carapace			80			
	J	B	-	-	132.8	4.22 SE	mm carapace			128			
Gibbons 1968	1	B	-	-	61.6	4.5 SD	mm carapace	54	66	6	Michigan 1965	polluted river	Ages in years. Numbers represent average carapace length at each age.
	2	B	-	-	102.2	5.8 SD	mm carapace	83	108	6			
	3	B	-	-	136.8	9.4 SD	mm carapace	124	145	6			
	4	B	-	-	168.2	14.2 SD	mm carapace	146	184	6			
	5	B	-	-	198.4	13.7 SD	mm carapace	177	211	6			
	6	B	-	-	222.2	12.9 SD	mm carapace	204	238	6			
Hammer 1969	A	M	-	-	246		mm plastron	165	305	37	S Dakota 1964-67	marsh	LaCreek Refuge.
	A	F	-	-	247		mm plastron	197	284	290			
Hammer 1969	A	F	-	-			mm carapace	254.0	371		S Dakota 1964-67	marsh	Carapace length of nesting females. LaCreek Refuge.
Kiviat 1980	A	F	BR	SU	262.4		mm carapace	216	330	54	New York 1974	fresh tidal wetland	
Lonke & Obbard 1977	A	F	-	-	281	24.6 SE	mm carapace	234.0	356.0	47	Ontario, CAN 1972-74	Lake Sasajewun	
Mosimann & Bider 1960	A	M	-	SU			mm carapace	210	393	12	Quebec, CAN 1956	river, bay	
	A	F	-	SU			mm carapace	219	281	12			

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
EGG WEIGHT													
Congdon et al. 1983	-	-	-	-	9.6		g			52	Michigan	NS	Wet mass. As cited in Congdon et al. 1986.
Congdon et al. 1986	-	-	-	-	9.6		g			16	S Carolina	bay, marsh	Wet mass.
Congdon & Gibbons 1985	-	-	-	-	237		g/clutch			4	N Carolina	NS	Mean clutch size= 23.6 (6.6 = 2 SE) eggs. Mean width of eggs = 25.8 (0.15 = 2 SE).
	-	-	-	-	9.6		g/egg			73			
Ernst & Barbour 1972	-	-	-	-			g	7	15		NS	NS	Summarizing other work.
Ewert 1979	-	-	-	-	12.5		g					NS	
Hotaling et al. 1985	-	-	-	-	9.32		g	5.73	13.76	58	New Jersey 1980-83	Great Swamp National Wildlife Refuge	N= number of nests; min and max are means for nests. Weights at time of oviposition.
Petokas & Alexander 1980	-	-	-	-	11.1		g/egg			380	n New York 1977	Cranberry Creek Marsh	
	-	-	-	-	308.0		g/clutch	142.0	468.0	12			
Punzo 1975 (osceola)	-	-	-	-			g	5	13		Florida 1970	stream, pond, swamp	
Yntema 1970, Vogt (unpubl.) (serpentina)	-	-	-	-			g	7	17.3		NS	NS	As cited in Ewert 1979.
HATCHING WEIGHT (AND LENGTH)													
Ewert 1979 (serpentina)	H	-	-	-	8.9		g			140	Minnesota	NS	Taken from seven clutches.
Hotaling et al. 1985	-	-	-	-	7.54		g	5.16	11.08	90	New Jersey 1980-83	Great Swamp National Wildlife Refuge	N= number of nests; min and max are means for nests.
Ernst & Barbour 1972	H	B	-	-	5.7		g body wt				NS	NS	Weight of turtle and length of carapace at hatching.
	H	B	-	-	(26-31)		(mm carapace)						
GROWTH RATE													
Gibbons 1968	J	B	-	-	32		mm carapace/yr			6	Michigan 1965	polluted river	

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Graham & Perkins 1976	J	B	1	SU	26.5		mm carapace/yr			2-8	Massachusetts	polluted marsh	Growth rate expressed as mm increase of carapace length/year: (1) from hatching through 6th year; (2) 5th to 6th year.
	J	B	2	SU	48.2		mm carapace/yr			2			
Kiviat 1980	J	B	-	-	20.0		mm/yr	9	31	2	New York	fresh tidal wetland	
	J	B	-	-	20.1		mm/yr	17	25	20	1972-75		
METABOLIC RATE (OXYGEN)													
Lynn & von Brand 1945	J	B	R	-	2.54		lO2/kg-day				NS	lab	Turtle weighing 7,180 g at a temperature of 25 C. As cited in Sievert et al. 1988.
FOOD INGESTION RATE													
Kiviat 1980	B	-	-	SU			g/g-day	0.01	0.016	2	New York 1973	captivity	

***** DIET *****

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Alexander 1943	B	-	plants		36.5			470	Connecticut 1939-41	lakes, ponds, streams, swamps - % wet volume; stomach contents	Totals of lakes, ponds, streams, and swamps. Volume was obtained by water displacement to the nearest cubic centimeter. Miscellaneous includes scavengings, paper, debris, and unclassified material. The ineffectiveness of bait left in the traps would lead one to believe that only a small amount of dead material is taken.
			(algae)		(12.8)						
			animals		54.1						
			(crayfish)		(8.0)						
			(fiddler crab)		(2.7)						
			(sucker)		(3.2)						
			(bullhead)		(6.3)						
			(sunfish)		(7.5)						
			(unknown fish)		(12.4)						
			miscellaneous		9.4						
Barbour 1950	-	-	Cambarus remains		100			1	Kentucky 1948	Big Black Mountain - % volume	Measure of volume not specified.
Budhabatti & Moll 1988	B	B	animal		50			NS	Illinois	habitat NS - measure NS	
			plant		50						
Bush 1959	-	-	Cambarus sp.		75				Kentucky 1955,56	NS - % volume; stomach contents	Dry or wet volume not specified.
			Hyla v.versicolor		25						

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Carr 1952	-	-	vegetable matter fish carrion		36.2 35.4 19.6				NS	NS - % volume	Measure of volume not specified. As cited in Bush 1959.
Hammer 1969	B	B	Potamogeton algae Polygonum sp. Lemna sp. other vegetation carp other fish snail insect other Molluscs birds turtle		68.2 36.4 27.3 18.2 40.9 72.8 63.7 95.4 50.0 18.2 22.7 4.5			22	Nebraska 1965	lakes - % frequency of occurrence	Carp was used as bait in traps.
Meyers-Schone & Walton 1990 (osceola)	A	B	fish vegetation clams mud and rocks		83.7 13.6 0.2 2.5			9	Tennessee	embayment - % wet volume; gastrointestinal tract contents	Summer = April 29-July 12.
Pell 1940	-	-	plant material animals		80.2 16.2				NS	NS - % volume	Measure of volume not specified. Animals include snails, clams, crayfish, insects, fish, and frogs. As cited in Bush 1959.
Punzo 1975 (osceola)	A	B	Platyhelminthes Annelida Insecta other Arthropoda Gastropoda amphibians reptiles plant		5.5 6.4 38.0 15.0 8.0 10.0 10.0 > 6.0			59	Florida 1970	NS - % occurrence; gastrointestinal tract contents	Summer = May to October.
Smith 1956	B	B	plants animals		35-70 6-35				NS	habitat NS - % of diet; measure NS	

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
HOME RANGE SIZE													
Budhabhatti & Moll 1988	-	-	-	SU			ha	0.28	15.2		Illinois 1986	NS	
Ernst 1968	-	-	-	-	1.8		ha				Pennsylvania	marsh	As cited in DeGraaf and Rudis 1983.
Ernst 1971	A	-	-	-	1.8		ha			9	Pennsylvania	pond	As cited in Bury 1979.
Galbraith et al. 1987	A	M	-	SU	1.03		ha	0.445	1.76	4	Ontario, CAN	lake	Estimated using quadrat summation area (QSA) method.
Galbraith et al. 1987	A	M	-	SU	0.7	0.29 SD	ha	0.24	1.3	4	Ontario, CAN	lake	Estimated using the modified minimum area (MMA) method.
Kiviat 1980	J	B	-	-	3.3		ha			10	New York 1972-75	fresh tidal wetland	
	A	M	-	-	8.9		ha			32			
	A	F	NB	-	7.2		ha			6			
Lonke & Obbard 1977	A	F	-	-	4.5		km			1	Ontario, CAN 1972-74	Lake Sasajewun	Distance from Lake Sasajewun. Overall, 91.9% of 47 turtles were seen at the nesting site in a year subsequent to their tagging. Sand and gravel fill for a dam created a nesting site which mature females visited annually in June.
Obbard & Brooks 1981	A	F	-	SU	3.79	1.46 SD	ha	2.5	5.19	4	Ontario, CAN	lake	Estimated using modified minimum area (MMA) method.
	A	M	-	SU	3.21	2.67 SD	ha	0.95	8.38	6			
	A	B	-	SU	3.44	2.18 SD	ha			10			
POPULATION DENSITY													
Congdon et al. 1986	B	B	-	-	8		N/ha				S Carolina	bay, marsh	
Congdon et al. 1986	B	B	-	-	7.3		N/ha				S Carolina	pond	
Congdon et al. 1986	B	B	-	-	12.8		N/ha				Michigan	marsh	
Congdon et al. 1986	B	B	-	-	13.3		N/ha				Michigan	bay, marsh, pond	

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Congdon et al. 1986	B	B	-	-	6.8		N/ha				Michigan	pond	
Froese & Burghardt 1975	A	B	-	SU	59		N/ha			48	Tennessee	pond	
Galbraith et al. 1987	A	M	-	SU	1.46		N/ha			4	Ontario, CAN	oligotrophic lake	
Galbraith et al. 1988 (serpentina)	A B	B B	- -	SU SU	1.67 2.03		N/ha N/ha	1.19 1.35	2.41 3.39		Ontario, CAN 1984-85	large oligotrophic lake	Density is based on modified Peterson estimate.
Galbraith et al. 1988 (serpentina)	A B	B B	- -	SU SU	2.45 2.73		N/ha N/ha	.88 0.97	4.91 5.45		Ontario, CAN 1984-85	small oligotrophic lake	Density is based on modified Peterson estimate.
Galbraith et al. 1988 (serpentina)	A B	B B	- -	SU SU	57.8 60.4		N/ha N/ha	38.5 40.3	90.8 95.0		Ontario, CAN 1984-85	eutrophic pond	Density is based on modified Peterson estimate.
Galbraith et al. 1988 (serpentina)	B	B	-	SU	2.31	1.45 SD	N/ha	1.0	4.9	6	Ontario, CAN 1984-85	oligotrophic lakes and ponds	Summary of six field studies, including the author's.
Galbraith et al. 1988 (serpentina)	B	B	-	SU	29.3	27.6 SD	N/ha	4.4	65.9	11	Ontario, CAN	eutrophic ponds	Summary of data from various authors for 11 eutrophic ponds.
Hammer 1969 (serpentina)	A	F	-	SU	1.2		N/ha				S Dakota	marsh	Estimate of population obtained by doubling the number of females (which were censused) to include males.
Kiviat 1980	- -	- -	1 2	- -	4 16		N/ha N/ha			600	New York 1972-75	fresh tidal wetland	Measure of (1) Crude density; (2) ecological density. Ecological density uses land area of pools and creeks only, which is less than or equal to 25% of the bay, as these are areas actually used by turtles.
Lagler 1943	-	-	-	-	5		N/ha				Illinois	lake	As cited in Bury 1979.
Major 1975	-	B	-	SU	62.5		N/ha				w West Virginia 1972	ponds	Two 0.40 ha ponds with 1.37 m maximum depth. Trapping from May 1972 - October 1972.

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Obbard 1983	A	-	-	SU	1.65		N/ha			6	Ontario, CAN	lake	As cited in Galbraith et al. 1987.
Pearse 1923	-	-	-	-	1.7		N/ha				Wisconsin	lake	As cited in Bury 1979.
CLUTCH SIZE													
Congdon et al. 1987	-	-	-	-	27.9	0.76 SE	eggs	12	41	68	se Michigan	aquatic	
Congdon et al. 1986	A	F	-	-	28.0		eggs			52	Michigan	pond, swamp, marsh	
Congdon and Gibbons 1985	-	-	-	-	23.6	3.3 SE	eggs			4	N Carolina	NS	
Ernst & Barbour 1972	-	-	-	-			eggs	11	83		NS	NS	Summarizing other work. Author states that the number of eggs in a clutch is usually 20-30.
Hammer 1969	-	-	-	-	49.0		eggs	31	87	102	S Dakota 1964-67	marsh	
Iverson 1977	-	-	-	-	16.6	1.6 SD	eggs	14	20	8	Florida	NS	As cited in Petokas & Alexander 1980.
Kiviat 1980	A	F	BR	SU	29.6	1.8 SE	eggs	16	54	27	New York 1974	fresh tidal wetland	
Lonke & Obbard 1977	-	-	-	-	33.9	10.03 SE	eggs	18	66	46	Ontario, CAN 1972-74	Lake Sasajewun	
Macnamara 1919	-	-	-	-			eggs	39	51	5	Ontario, CAN	NS	Author states that clutches containing 24 eggs or fewer had never been observed. As cited in Petokas & Alexander 1980.
Petokas & Alexander 1980	-	-	-	-	30.9	10.87 SD	eggs	16.0	59.0	16.0	n New York 1977	riverine marsh shore	Clutch sizes of 20 to 40 eggs most common (75% of all complete nests), with 36 eggs being the most frequently encountered (3 nests). Predators destroyed 94% of all nests under study.
Punzo 1975	A	F	L	SU			eggs	6	21		Florida 1970	stream, pond, swamp	
White & Murphy 1973	-	-	-	-	19.9		eggs	12.0	42.0	20.0	Tennessee	NS	As cited in Petokas & Alexander 1980.

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
CLUTCHES/YEAR													
Cahn 1937	-	-	-	-	2		/year				southern range	NS	As cited in DeGraaf and Rudis 1983.
Ernst & Barbour 1972	-	-	-	-	>1		/year				NS	NS	Summarizing other work.
Ewert (unpubl.)	A	F	BR	-			/year		3		Florida	NS	As cited in Moll 1979.
Minton 1972	-	-	-	-			/year	1	2		Indiana	NS	As cited in Graves and Anderson 1987.
White and Murphy 1973	A	F	BR	-			/year		1		Tennessee	NS	As cited in Moll 1979.
DAYS INCUBATION													
Breckenridge 1944	-	-	-	-			days	83	105		c Minnesota	natural	Days to pipping (101 days to emergence). As cited in Ewert 1979.
DeGraaf & Rudis 1983	-	-	-	-	80-91		days				NS	NS	Summarizing other studies.
Ewert 1979	- -	- -	1 2	- -	82 66.7		days days			24 20	Missouri	Lab	Temperature (1)25-25.5 C; (2)29.5-30 C.
Ewert 1979	- -	- -	1 2	- -	90.8 73.0		days days			5 5	Arkansas	artificial	Temperature (1)25-25.5 C; (2)29.5-30 C.
Ewert 1979	- - -	- - -	1 2 3	- - -	97.5 80.0 77.6		days days days			22 13 18	Florida	artificial	Temperature (1)25-25.5 C; (2)26-30 C; (3)29.5-30 C.
Ewert 1979	-	-	-	SU			days	67	73		se Wisconsin	natural	Days to pipping.
Hammer 1971	-	-	-	-			days	70	120				As cited in Graves and Anderson 1987.
Hammer 1969	-	-	-	-			days	91	125		NS	NS	Duration of incubation depends on environmental conditions.
Lynn and Von Brand 1945	- -	- -	1 2	- -	72-75.1 60.0		days days			34 34	Wisconsin	artificial	Temperature (1) 25-25.5 C; (2) 29.5-30 C. As cited in Ewert 1979.
Obbard & Brooks 1981	-	-	-	-	105		days	90	119	3	Ontario, CAN	lake	

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Punzo 1975 (osceola)	-	-	-	-			days	48	118		Florida 1970	stream, pond, swamp	
Yntema 1968	-	-	1	-	140		days				New York	artificial	Temperature (1) 20 C; (2)29.5-30 C. As cited in Ewert 1979.
	-	-	2	-	63.3		days						
AGE AT SEXUAL MATURITY													
Christiansen & Burken 1979	-	F	-	-	6-7		years			38	Iowa 1969-77	NS	Ovulations first occurred during the 6th & 7th year of growth.
	-	M	-	-	4-5		years			25			
Christiansen & Burken 1979	-	F	-	-	9-10		years				Iowa 1969-77	NS	Age at first nesting.
Galbraith et al. 1989	-	F	-	-	17-19		years	14-15		174	Ontario, CAN	river, mixed forest	Mean age at first nesting; minimum age determined as lower 96% confidence limit on age predicted from size.
Hammer 1969	-	F	-	-	9		years				S Dakota	NS	Age at first nesting.
Pell 1941	-	F	-	-	6-8		years				New York	NS	Age at first nesting. As cited in Galbraith et al. 1989.
LENGTH AT SEXUAL MATURITY													
Ernst & Barbour 1972	-	B	-	-	200		mm carapace				NS	NS	Summarizing other information.
Mosimann & Bider 1960	-	B	-	-	200		mm carapace				Quebec, CAN	NS	
White & Murphy 1973	-	B	-	-	145		mm plastron				Tennessee	NS	As cited in Bury 1979.
MORTALITY													
Galbraith & Brooks 1987	A	B	-	-			%/yr	3	7		NS	NS	As cited in Frazer et al. 1991.
LONGEVITY													
Gibbons 1987	-	-	-	-			years		24	2	Michigan	Sherriff's Marsh	Two turtles known to be between 15-24 years old from mark and recapture.

Reference	Age Sex Cond Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Gibbons 1987	- - - -			years		19	7	S Carolina	Savannah River Plant	Seven turtles known to be between 10-19 years of age from mark and recapture.

***** SEASONAL ACTIVITIES *****

Reference	Begin	Peak	End	Location	Habitat	Notes
MATING						
Ernst & Barbour 1972	Apr	Jun	Nov	NS	NS	Mating season depends on latitude. (May be discussing the observations of Smith 1956).
Kiviat 1980	earl Jun	mid Jun	end Jun	New York 1974	fresh tidal wetland	Hammer 1969 reported nesting stimulated by rain.
Punzo 1975	mid June			Florida 1970	stream, pond, swamp	Nesting behavior between 6 am to 8 am; Temperature from 60-70 F enhances nesting.
NESTING						
Congdon et al. 1987	late May		mid Jun	se Michigan	aquatic	
Ernst & Barbour 1972	May	Jun	Sep	NS	NS	Nesting season depends on latitude. (May be discussing the observations of Smith 1956).
Hammer 1969	earl Jun	mid Jun	end Jun	S Dakota 1964-67	marsh	
Lonke & Obbard 1977		Jun 19-20		Ontario, CAN 1972,73	Lake Sasajewun	
Lonke & Obbard 1977		Jun 26-28		Ontario, CAN 1974	Lake Sasajewun	
Lonke & Obbard 1977		Jun 13-14		Ontario, CAN 1975	Lake Sasajewun	
Obbard & Brooks 1981	earl Jun	mid Jun	late Jun	Ontario, CAN	lake	

Reference	Begin	Peak	End	Location	Habitat	Notes
Petokas & Alexander 1980	late May	earl-mid Jun	late Jun	n New York 1977	Cranberry Creek Marsh	Two separate nesting periods observed: (1) May 28-June 6 (N=17); (2) June 10-21 (N=35). Peaks: (1) June 1 (N=9); (2) June 12 (N=10).
Wilhoft et al. 1979	May 21		Jun 6	New Jersey	swamp	Nesting season; from daily field observations.
HATCHING						
Congdon et al. 1987	late Aug	Sep	earl Oct	se Michigan	aquatic	
Ernst & Barbour 1972	Aug		Oct	NS	NS	Depends on latitude. (May be discussing the observations of Smith 1956).
Obbard & Brooks 1981	Sep		earl Oct	Ontario, CAN	lake	
HIBERNATION						
Christiansen & Burken 1979	late Sep		mid Mar	Iowa 1969-77	NS	Based on earliest and latest observed turtle activity.
Ernst & Barbour 1972	Oct		Mar-May	NS	NS	Depends on latitude. (May be discussing the observations of Smith 1956).
Obbard & Brooks 1981	mid Oct		earl May	Ontario, CAN	lake	

***** PAINTED TURTLE *****

*** NORMALIZING AND CONTACT RATE FACTORS ***

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
BODY WEIGHT (AND LENGTH)													
Congdon et al. 1986	A	M	-	-	176.9	1.92 SE	g			770	Michigan	bay, ponds, marsh	
	A	F	-	-	326.7	4.95 SE	g			249			
	J	B	-	-	64.2	1.59 SE	g			375			
Congdon & Gibbons 1985 (dorsalis)	A	F	BR	-	361.0		g			1	Georgia	NS	
	A	F	BR	-	(136.0)		(mm plastron)			1			
Ernst 1971b (picta x marginata)	A	F	-	-	266.5	60.1 SD	g	83.5	450.3	142	Pennsylvania 1965-67	NS	Related lengths not provided.
	A	M	-	-	189.1	52.3 SD	g	102.0	274.5	163			
Morlock et al. 1972 (picta)	A	B	-	-	317.6		g			13	New York 1969-70	lab	Carapace length is approximate.
	A	B	-	-	(130)		(mm carapace)			13			
Tinkle et al. 1981 (marginata)	A	F	BR	SU	395.4		g			82	Michigan 1977-79	pond	
	A	F	BR	SU	(130.7)		(mm plastron)			82			
	A	F	BR	SU	(139.9)		(mm carapace)			82			
Wade & Gifford (1965; unpubl.)	-	-	-	-	230		g				Indiana	lake	As cited in Iverson 1982.
BODY LENGTH													
Congdon et al. 1986	A	M	-	-	99.9	0.48 SE	mm plastron			770	Michigan	bay, ponds, marsh	
	A	F	-	-	125.1	0.64 SE	mm plastron			249			
	J	B	-	-	65.0	0.65 SE	mm plastron			375			
Congdon et al. 1986	A	M	-	-	109.7	0.54 SE	mm carapace			770	Michigan	bay, ponds, marsh	
	A	F	-	-	134.2	0.81 SE	mm carapace			249			
	J	B	-	-	71.5	0.69 SE	mm carapace			375			
Ernst 1971b (picta x marginata	H	B	1	-	24		mm plastron	17	30		se Pennsylvania	NS	Ages: (1) hatchling (H); (2) one year old (Y); (3) two years; (4) three years; (5) four years.
	Y	B	2	-	42		mm plastron	33	52				
	J	B	3	-	53		mm plastron	38	68				
	J	B	4	-	66		mm plastron	47	78				
	J	B	5	-	72		mm plastron	62	89				
Ernst 1971c	A	F	-	-			mm plastron		145		Pennsylvania 1965-67	marsh	
	A	M	-	-			mm plastron		121				

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Gibbons 1968b	A	M	1	-	80-84		mm plastron				Michigan 1964-66	marsh	Age in years as of 1965: (1) 6.0-10.0; (2) 10.5-14.5; (3) 15.0-19.0; (4) 19.5-23.5; (5) 24.0-28.0; (6) 28.5-32.5; (7) 33.0-37.0; (8) 12.0-16.0; (9) 16.5-20.5; (10) 21.0-25.0; (11) 25.5-29.5; (12) 30.0-34.0; (13) 34.5-39.5. Estimates of mature turtle ages were based on a growth rate of 1.1 mm/yr for both sexes and on the number of turtles estimated to be in each size class.
	A	M	2	-	85-89		mm plastron						
	A	M	3	-	90-94		mm plastron						
	A	M	4	-	95-99		mm plastron						
	A	M	5	-	100-104		mm plastron						
	A	M	6	-	105-109		mm plastron						
	A	M	7	-	110-116		mm plastron						
	A	F	8	-	110-114		mm plastron						
	A	F	9	-	115-119		mm plastron						
	A	F	10	-	120-124		mm plastron						
	A	F	11	-	125-129		mm plastron						
	A	F	12	-	130-134		mm plastron						
	A	F	13	-	135-140		mm plastron						
Legler 1954	A	M	-	-	85		mm plastron				s Minnesota	NS	As cited in Bury 1979. Approximate average value is at least the value listed.
	A	F	-	-	125		mm plastron						
Mitchell 1985 (picta)	N	B	-	-	22.1	0.3 SD	mm carapace	21.8	22.4	4	c Virginia 1980-81	Grassy Swamp Lake	
	N	B	-	-	20.7	0.7 SD	mm plastron	20.3	21.8	4			
Mitchell 1985 (picta)	-	F	-	-	132.7	7.8 SD	mm carapace	112.5	148.2	65	c Virginia 1980-81	Grassy Swamp Lake	
	-	F	-	-	124.1	8.1 SD	mm plastron	105.6	144.6	65			
Moll 1973 (bellii)	A	F	-	-	157	2.6 SE	mm plastron	136	185	23	Wisconsin 1969-72	NS	
	A	M	-	-	132	2.9 SE	mm plastron	96	155	32			
Moll 1973 (bellii x marginata)	A	F	-	-	151	1.5 SE	mm plastron	130	165	45	Illinois 1969-72	NS	
	A	M	-	-	116	1.9 SE	mm plastron	81	147	55			
Moll 1973 (dorsalis x marginata)	A	F	-	-	125	2.5 SE	mm plastron	108	151	19	Tennessee 1969-72	NS	
	A	M	-	-	99	1.8 SE	mm plastron	65	123	17			
Moll 1973 (dorsalis)	A	M	-	-	73	1.4 SE	mm plastron	60	84	21	Louisiana 1969-72	NS	
Moll 1973 (dorsalis)	A	F	-	-	114	1.1 SE	mm plastron	100	131	37	Arkansas 1969-72	NS	
EGG WEIGHT													
Cagle 1954 (marginata, dorsalis)	-	-	-	-	6.15		g	5.5	7.6	95	Illinois	NS	
Cagle 1954 (marginata, dorsalis)	-	-	-	-	5.0		g	4.9	9.3	71	Tennessee	NS	

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Congdon and Tinkle 1982	-	-	-	-	4.14	0.22 SE	g				Michigan	aquatic	Wet mass.
Congdon & Gibbons 1985 (dorsalis)	-	-	-	-	6.17		g/egg			5	Georgia	NS	
	-	-	-	-	30.9		g/clutch			1			
Ernst & Barbour 1972 (picta)	-	-	-	-	7.2		g	6.1	9.1		Pennsylvania	NS	
Ernst 1971b (picta x marginata)	-	-	-	-			g	3.2	9.1		NS	NS	
Ewert 1979	-	-	-	-	6.3		g				NS	NS	
Ratterman & Ackerman 1989	-	-	1	-	6.65	0.67 SD	g			207	Iowa 1985-86	NS	(1) Initial mass, (2) final mass (gain water during incubation from soil).
	-	-	2	-	8.62	1.06 SD	g			162			
Schwarzkopf & Brooks 1986	-	-	-	-	6.56		g	6.08	7.00	74	Ontario, CAN 1983-85	pond	Adult females laying clutches in successive years.
HATCHING WEIGHT													
Ewert 1979 (dorsalis)	H	B	-	-	4.6		g			30	Tennessee	NS	From nine clutches.
Ewert 1979 (bellii)	H	B	-	-	4.4		g			27	North Dakota	NS	From three clutches.
Mitchell 1985 (picta)	H	B	-	-	3.7	0.2 SD	g	3.5	3.9	4	c Virginia 1980-81	Grassy Swamp Lake	
Ratterman & Ackerman 1989	H	B	1	SU	4.09	0.61 SD	g			175	Iowa 1985-86	NS	Weight at hatching: (1) wet (2) dry.
	H	B	2	SU	0.84	0.13 SD	g			165			
GROWTH RATE													
Christens & Bider 1986 (marginata)	J	F	1	-	35		mm/yr			5	Quebec, CAN 1983-85	pond	Estimated growth rate from histogram in figure. Age in years provided in condition column.
	J	F	2	-	20		mm/yr			11			
	J	F	3	-	19		mm/yr			10			
	J	F	4	-	12		mm/yr			9			
	J	F	5	-	12		mm/yr			8			
	J	F	6	-	10		mm/yr			10			
	J	F	7	-	8		mm/yr			13			
(continued)	A	F	8	-	5		mm/yr			12			

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Christens & Bider	A	F	9	-	4		mm/yr			8			1986
(continued)	A	F	10	-	3		mm/yr			9			
	A	F	11	-	3		mm/yr			2			
	A	F	12	-	6		mm/yr			4			
	A	F	16	-	3		mm/yr			2			
	A	F	20	-	1		mm/yr			4			
	A	F	24	-	1		mm/yr			2			
	A	F	26	-	2		mm/yr			1			
Ernst 1971b	A	M	-	-	1.31		mm/yr	0.2	4.4	57	Pennsylvania	NS	Plastron length (mm): (1) males
(picta x	A	F	-	-	1.76		mm/yr	0.1	7.1	51	1965-67		70-119, (2) females 80-139.
marginata)													
Gibbons 1968b	-	-	1	-	13.0		mm/yr				Michigan	marsh	Age in years: (1)1-2; (2)5-6;
	-	-	2	-	4.3		mm/yr				1964-66		(3)1-10. Increase in mean size in
	-	-	3	-	7.7		mm/yr						successive years.
Wilbur 1975b	A	B	-	-	0.55		mm/yr				MI 1953-57,	pond	Age = 10+ yrs.
											1968-73		
METABOLIC RATE (OXYGEN)													
Lynn & von Brand	J	B	R	-	4.46		lO2/kg-day				NS	lab	Temperature = 25 C; body weight =
1945													4.25 g; as cited in Sievert et al.
(picta)													1988.
Sievert et al.	J	-	1	-	5.06	0.42 SE	lO2/kg-day			16	NS	lab	Temperature = 25 C; average weight
1988	J	-	2	-	3.44	0.29 SE	lO2/kg-day			16			= 7.7 g. Condition: (1) day of
(marginata)	J	-	3	-	1.98	0.13 SE	lO2/kg-day			16			feeding; (2) 1-day fast; (3) 10-day
	J	-	4	-	1.57	0.19 SE	lO2/kg-day						fast; (4) 19-day fast.
Stockard & Gatten	A	B	1		0.725	0.442 SD	lO2/kg-day			41	N Carolina	lab	Temperature = 25 C. Average mass of
1983	A	B	2	-	0.218	0.324 SD	lO2/kg-day			41	1979		test animals: (1) on land, resting,
	A	B	3	-	0.386	0.679 SD	lO2/kg-day			26			215 g (79 to 395 g); (2) in water,
										26			resting, 215 g; (3) in water,
													swimming, 143 g (79 to 297 g).
METABOLIC RATE (KCAL BASIS)													
Congdon et al.	J	F	1	-	63		cal/day				Michigan	NS	Based on annual energy budget and
1982	J	F	2	-	134		cal/day						assuming one set of eggs per female
(marginata)	J	F	3	-	295		cal/day						per year after age 7. Annual growth
	J	F	4	-	411		cal/day						energy averages 4.9% over the first
	J	F	5	-	534		cal/day						seven years and then declines to
	J	F	6	-	674		cal/day						0.3% by the 14th year. Energy
(continued)	J	F	7	-	769		cal/day						devoted to eggs is approximately

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Congdon et al. 1982 (continued)	A	F	8	-	1,041		cal/day						14% of total energy budget for ages 7 to 14. In reality, each year approximately 30 to 50% of the Michigan population of adult females do not lay eggs. Age in years listed under condition column.
	A	F	9	-	1,115		cal/day						
	A	F	10	-	1,192		cal/day						
	A	F	11	-	1,230		cal/day						
	A	F	12	-	1,250		cal/day						
	A	F	13	-	1,282		cal/day						
	A	F	14	-	1,307		cal/day						
WATER INGESTION RATE													
Ernst 1972	A	B	NB	SU	0.02		g/g-day	0.016	0.022	6	Pennsylvania	lab	Measured as evaporative water loss.
Trobec & Stanley 1971 (bellii)	A	B	-	-	-		g/g-day		0.025	11	Wisconsin	lab	Uptake of water by turtles held in artificial tap water at 23 +/- 2 °C.
INHALATION VOLUME													
Milsom & Chan 1986	A	B	R	-	0.00246	0.00052 SE	m3/kg-day				NS	lab	

***** DIET *****

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Ernst & Barbour 1972 (picta)	A	B	snails		12.1			56	Pennsylvania	habitat NS - % wet volume; stomach contents	Season not specified.
			amphipods		3.0						
			crayfish		7.5						
			insects		11.5						
			fish		13.0						
			other animals		14.1						
			algae		14.7						
			vascular plants		24.1						
			other plants		0.8						
Gibbons 1967	-	-	plants		>95			5	Michigan 1964-66	marsh - wet weight; % stomach contents	

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Knight & Gibbons 1968	-	-	(Month)	June	August			47	Michigan 1964-66	polluted river	See companion record for percent of stomachs containing item.
			plants	31.6	38.7					-	
			filamentous algae	41.0	44.2					average %	
			higher aquatics	2.5	12.5					wet volume	
			animals	77.3	72.3					when present;	
			Oligochaeta	-	30.0					% stomach contents	
			Cladocera	1.5	48.5						
			Ephemeroptera nymp	-	1.0						
			Odonata nymphs	60.0	38.3						
			Hemiptera nymphs	3.0	5.0						
			Lepidoptera larvae	1.0	50.0						
			Coleoptera larvae	3.0	-						
			Culicidae larvae	-	11.0						
			Tendipedidae larva	30.8	7.7						
			Tendipedidae pupae	36.7	10.0						
			Stratiomyidae larv	-	1.0						
			unidentified anima	96.0	10.0						
			gastropods	18.7	17.8						
			detritus	7.8	1.9						
Knight & Gibbons 1968	-	-	(Month)	June	August			47	Michigan 1964-66	polluted river	See companion record for percent of bulk when present.
			plants	64.0	66.7					-	
			filamentous algae	48.0	47.6					average % of	
			higher aquatics	16.0	38.1					stomachs containing	
			animals	100	100					item	
			Oligochaeta	-	4.8						
			Cladocera	16.0	85.7						
			Ephemeroptera nymp	-	14.3						
			Odonata nymphs	4.0	14.3						
			Hemiptera nymphs	16.0	14.3						
			Lepidoptera larvae	4.0	4.8						
			Coleoptera larvae	8.0	-						
			Culicidae larvae	-	9.5						
			Tendipedidae larva	96.0	61.9						
			Tendipedida pupae	84.0	47.6						
			Stratiomyidae larv	-	4.8						
			unidentified anima	4.0	14.3						
			gastropods	52.0	47.6						
			detritus	92.0	71.4						
Marchand 1942 (dorsalis)	J	B	animal	85					NS	habitat NS	As cited in Mahmoud & Klicka 1979.
			plant	15						-	
										stomach contents; measure unspecified	
Marchand 1942 (dorsalis)	A	B	plant material	12					NS	habitat NS	As cited in Mahmoud & Klicka 1979.
			insects & amphipods	88						-	
										stomach contents; measure unspecified	

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Lagler 1943 (marginata)	-	-	insects aquatic plants		20 60				Michigan	habitat NS - measure NS	As cited in DeGraaf and Rudis 1983.
Cahn 1937 (marginata)	-	-	plants		100			25	NS	habitat NS - % volume	As cited in Smith 1961.

***** POPULATION DYNAMICS *****

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
HOME RANGE SIZE													
McAuliffe 1978 (bellii)	- -	F M	- -	SP SP	174 121		m m			25 10	e Nebraska 1974-75	oxbow lake complex	Measured mean straight-line distance between recaptures. Movements between overwintering areas and other locations in Beaver Slough.
Sexton 1959 (marginata)	A A A	B B B	1 2 3	SP SU FA	63-144 86-91 88-130		m movement m movement m movement		301 300 336		Michigan 1953-57	NS	Seasonal movements from: (1) hibernation ponds to other ponds w/floating vegetation; (2) spring ponds back to hibernation ponds; (3) hibernation ponds to deepwater areas.
POPULATION DENSITY													
Bayless 1975	-	-	-	-	24.7		N/ha	22.2	27.2	3	New York 1970-72	pond	
Congdon et al. 1986	B	B	-	-	41.6		N/ha				Michigan	ponds	
Congdon et al. 1986	B	B	-	-	39.9		N/ha				Michigan	pond, marsh, swamp	
Congdon et al. 1986	B	B	-	-	89.5		N/ha				Michigan	marsh	
Ernst 1971c	B	B	-	-	590		N/ha	240	941		Pennsylvania 1965-67	pond, marsh	Range = 95% confidence limit (i.e., mean +/- 2 SEs).
Frazer et al. 1991	B	B	-	-	827.7		N/ha				Michigan 1980-89	lake, marsh	

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Gibbons 1968b	-	-	-	-	576		N/ha				Michigan 1964-66	marsh	
MacCulloch & Secoy 1983	B	B	-	SU	11.1		N/ha			167	Saskatchewan, CAN 1978-81	river	
(bellii)													
Pearse 1923	-	-	-	-			N/ha	12	49		Wisconsin	lake	As cited in Bury 1979.
Sexton 1959 (marginata)	B	B	-	-			N/ha	98	410		Michigan 1953-57	ponds, marsh	
CLUTCH SIZE													
Blanchard 1923 (bellii)	-	-	-	-	8.8		eggs	5	13		Iowa	NS	As cited in Christiansen & Moll 1973.
Cagle 1954 (marginata, dorsalis)	-	-	-	-	6.3		eggs	3	8	48	Illinois	NS	
Cagle 1954 (marginata, dorsalis)	-	-	-	-	4.7		eggs	2	7		n Michigan	NS	
Cahn 1937 (marginata)	-	-	-	-	6.5		eggs	4	10		NS	NS	As cited in Smith 1961.
Christiansen & Moll 1973 (bellii)	-	-	1	-	8.8		eggs	2	15	46	New Mexico 1964-70	pond (captive)	Estimated by: (1) enlarged follicles; (2) eggs; (3) corpora lutea.
	-	-	2	-	9.0		eggs	5	15	46			
	-	-	3	-	8.9		eggs	5	15	46			
Christiansen & Moll 1973 (bellii)	-	-	1	-	9.6		eggs	1	22	28	Wisconsin 1969-70	varied	Estimated by: (1) enlarged follicles, (2) eggs, (3) corpora lutea.
	-	-	2	-	10.2		eggs	7	15	28			
	-	-	3	-	9.8		eggs	7	15	28			
Christens & Bider 1986 (bellii)	-	-	-	-	9.2	0.20 SD	eggs	5	12		Quebec, CAN 1983-85	freshwater	No significant relationship between clutch & body size, or egg size & age.
Congdon & Tinkle 1982 (marginata)	-	-	-	-	7.6		eggs	2	11		Michigan 1978-81	NS	
Congdon & Gibbons 1985 (dorsalis)	-	-	-	-	5.0		eggs			1	Georgia	NS	

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
DeGraaf & Rudis 1983 (marginata)	-	-	-	-	6.5		eggs	3	10		NS	NS	
Ernst & Barbour 1972 (bellii)	-	-	-	-			eggs	4	20		NS	NS	
Ernst & Barbour 1972 (picta)	-	-	-	-			eggs	2	11		NS	NS	
Ernst & Barbour 1972 (marginata)	-	-	-	-			eggs	3	10		NS	NS	
Ernst & Barbour 1972 (dorsalis)	-	-	-	-			eggs	2	7		NS	NS	
Ernst & Barbour 1972 (marginata)	-	-	-	-	4.73		eggs	4	6		Pennsylvania	NS	
Ernst 1971c	-	-	-	-	4.73		eggs	4	6		Pennsylvania 1965-67	NS	With the infertility and prehatching mortality rates measured in the lab, only 2.5 eggs on average are likely to hatch young.
Gibbons 1968a	-	-	1	-	6.6		eggs	5	8		Michigan 1964-66	marsh, lake	Year: (1) 1965; (2) 1966. Only two of 41 individuals had less than five eggs and only two had more than eight.
	-	-	2	-	6.1		eggs	5	8				
MacCulloch & Secoy 1983 (bellii)	-	-	-	-	19.8		eggs	17	23	5	Saskatchewan, CAN 1981	creek bank	
Mitchell 1985 (picta)	-	-	-	-	4.16	1.13 SD	eggs	1	7	38	c Virginia 1980-81	Grassy Swamp Lake	
Moll 1973 (bellii)	-	-	-	-	10.7		eggs	4	16	12	Wisconsin 1969-72	NS	Based on counts of enlarged follicles, corpora lutea, and oviducal eggs.
Moll 1973 (bellii x marginata)	-	-	-	-	8.7		eggs	6	14	24	Illinois 1969-72	NS	Based on counts of enlarged follicles, corpora lutea, and oviducal eggs.

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Moll 1973 (dorsalis x marginata	-	-	-	-	4.8		eggs	2	9	15	Tennessee 1969-72	NS	Based on counts of enlarged follicles, corpora lutea, and oviducal eggs.
Moll 1973 (dorsalis)	-	-	-	-	4.1		eggs	1	6	20	Louisiana, Arkansas 1969-72	NS	Based on counts of enlarged follicles, corpora lutea, and oviducal eggs.
Powell 1967 (picta)	-	-	-	-	-		eggs	5	11		NS	NS	As cited in Christens & Bider 1986.
Ratterman & Ackerman 1989	-	-	-	-	11.8	2.4 SD	eggs			29	Iowa 1985-86	NS	
Schwarzkopf & Brooks 1986	-	-	-	-	7.3		eggs			74	Ontario, CAN 1983-85	pond	Females that layed clutches in successive years.
Tinkle et al. 1981 (marginata)	-	-	-	-	7.55	0.35 SE	eggs	6.86	7.86	82	Michigan 1977-79	pond	Eggs per cm of plastron length = 0.578 (SE 0.013).
CLUTCHES/YEAR													
Christiansen & Moll 1973 (bellii)	-	-	-	-	14.8		eggs/yr				New Mexico 1964-70	varied	Average annual female reproductive capacity; animals yearly laid between 1 & 3 clutches.
Christiansen & Moll 1973 (bellii)	-	-	-	-	2		clutches/yr				New Mexico 1964-70	varied	67% of females (estimated).
Christiansen & Moll 1973 (bellii)	-	-	-	-			clutches/yr	1	3		Wisconsin 1969-70	NS	
Ernst 1971b (picta x marginata)	-	-	-	-	1		clutches/yr				Pennsylvania 1966-67	NS	
Gibbons 1968a	-	-	-	-	2.0		clutches/yr				Michigan 1964-66	lake, marsh	
Legler 1954; Gemmell 1970	-	-	-	-	1		clutches/yr				NS	NS	As cited in Christens and Bider 1986.
Moll 1973 (dorsalis)	-	-	-	-			clutches/yr		4		Louisiana	NS	The maximum is 4 or 5.
Moll 1973 (bellii)	-	-	-	-	>1		clutches/yr		2		Wisconsin 1969-72	NS	61.5% of females produced two clutches (total of 17.28 eggs per female per year).

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Moll 1973 (bellii x marginata)	-	-	-	-	>2		clutches/yr		3		Illinois 1969-72	NS	96.0% of females produced two clutches and 37.5% of females produced three clutches (total of 20.31 eggs per female per year).
Moll 1973 (dorsalis x marginata)	-	-	-	-	>3		clutches/yr		5		Tennessee 1969-72	NS	93.0% of females produced two clutches, 60% produced three clutches, 47% produced four clutches, and 7% produced five clutches (total of 14.74 eggs per female per year).
Moll 1973 (dorsalis)	-	-	-	-	> 3		clutches/yr		5		Louisiana 1969-72	NS	100 % of females produced two clutches, 80 % produced three clutches, 30 % produced four clutches, and 5 % produced five clutches (total of 12.92 eggs per female per year).
Schwarzkopf & Brooks 1986	-	-	1	-	1		clutches/yr			73%	Ontario, CAN 1983,85	NS	(1) Nesting both years; (2) nesting either year.
	-	-	1	-	2		clutches/yr			27%			
	-	-	2	-	2		clutches/yr			12.5%			
Snow 1980 (bellii x marginata)	-	-	-	-	1-2		clutches/yr	0	2		Michigan	kettle ponds	A minimum of 33% of females laide second clutches. The total number of eggs produced in two clutches by three females was 16, 14, and 12.
Tinkle et al. 1981 (marginata)	-	-	-	-	0.60		clutches/yr	0.43	0.71	216	Michigan 1977-79	NS	3.9% (5/129) of females produced two clutches in one year.
Wilbur 1975a (marginata)	-	-	-	-	2		clutches/yr				MI 1953-57, 1968-73	pond	No evidence presented.
DAYS INCUBATION													
Breckenridge 1944	-	-	-	-	79		days	75	81		c Minnesota	natural	As cited in Ewert 1979. Days to pipping.
Ernst & Barbour 1972 (picta)	-	-	-	-	76		days	72	80		Pennsylvania	NS	
Ernst 1971c	-	-	-	-	65-80		days				se Pennsylvania	NS	

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Ewert 1979	-	-	1	-	77.4		days			20	Tennessee	lab	Temperature: (1) 25-25.5 C; (2) 27.4 C; (3) 29.5-30 C. Eggs from local Tennessee populations. Incubation defined as days from laying to pipping.
	-	-	2	-	62.0		days			5			
	-	-	3	-	56.3		days			17			
Ewert 1979	-	-	1	-	72.0		days			3	Connecticut	lab	Temperature: (1) 25-25.5 C; (2) 30-32 C. Eggs from local Connecticut populations. Incubation defined as period from laying to pipping.
	-	-	2	-	48.7		days			20			
Ewert 1979	-	-	-	-			days	60	65		se Wisconsin	NS (natural)	Days to pipping.
Ewert 1979	-	-	-	-			days	72	99		nw Minnesota	NS (natural)	Days to pipping.
Ewert 1979	-	-	-	-	66.2		days			20	n Michigan	lab	Eggs from northern Michigan. Incubation period defined as days from laying to pipping. Sample size is in eggs.
	-	-	-	-	47.5		days			13			
Mitchell 1985 (picta)	-	-	-	-	71-76		days			2	c Virginia 1980-81	Grassy Swamp Lake	
Packard et al. 1983	-	-	1	-	49.2		days			80	Nebraska 1981	lab	Incubation conditions: (1) above wet substrate (2) above dry substrate (3) on wet substrate (4) on dry substrate substrate; Water potential = -130kPa (wet), -750kPa (dry).
	-	-	2	-	47.3		days			81			
	-	-	3	-	51.9		days			84			
	-	-	4	-	49.3		days			77			
Ratterman & Ackerman 1989	-	-	-	-	84.2		days	71	104	29	Iowa 1985-86	NS	
Ream 1967	-	-	1	-	95		days				Wisconsin	artificial	Temperature: (1) 21-23 C; (2) 25-25.5 C; (3) 25-25.5 C; (4) 29.5-30 C. Sample size is in eggs. As cited in Ewert 1979.
	-	-	2	-	74		days			69			
	-	-	3	-	71		days			69			
	-	-	4	-	51		days			18			
PERCENT NESTS SUCCESSFUL													
Breitenbach et al. 1984	-	-	-	WI	81.4		% nests/yr	20	100	43	Michigan 1977-82	terrestrial nests	Nest failures (18.6%) due to winter-kill; threshold temp. appears to be -3.3 C.
Snow 1982	-	-	-	-	59		% nests/yr			81	Michigan 1978	pond	Portion of nests lost to predation = 41 percent. Not all of the remaining necessarily hatched.

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Tinkle et al. 1981 (marginata)	-	-	-	-	67		% nests/yr			43	Michigan 1977-79	pond	Of the nests laid, predation caused failures of 21% per year (minimum of 10 and maximum of 27%). All causes resulted in 33% nests lost.
AGE AT SEXUAL MATURITY													
Cagle 1954 (marginata, dorsal	-	M	1	-	1		year				United States	NS	(1) Southern U.S.; (2) northern U.S.
	-	M	2	-	2-3		years						
Christens & Bider 1986 (marginata)	-	F	-	-			years		12		Quebec, CAN 1983-85	pond	All females greater than 11 yrs of age reproduced in all 3 years.
Christens & Bider 1986 (marginata)	-	F	-	-	6		years				Quebec, CAN 1983-85	pond	
Christiansen & Moll 1973 (bellii)	-	F	-	-	5-6		years				New Mexico	NS	
	-	M	-	-	3		years						
Christiansen & Moll 1973 (bellii)	-	F	-	-	8		years				Wisconsin	NS	
	-	M	-	-	4		years						
Ernst & Barbour 1972 (picta)	-	M	-	-	5		years				Pennsylvania	NS	Plastron length = 80-90 mm.
	-	F	-	-	6		years						
Ernst 1971a,c	-	M	-	-	4		years				Pennsylvania	NS	Mean plastron length: (1) 80-90 mm for males; (2) 100 mm for females.
	-	F	-	-	4-6		years						
Mitchell 1985 (picta)	-	F	-	-	6-8		years				c Virginia 1980-81	Grassy Swamp Lake	
Moll 1973 (bellii)	-	M	-	-	2-3		years				Louisiana, Arkansas 1969-72	NS	
	-	F	-	-	4		years						
Moll 1973 (dorsalis x marginata)	-	M	-	-	2-3		years				Tennessee 1969-72	NS	
	-	F	-	-	4-5		years						
Moll 1973 (bellii x marginata)	-	M	-	-	3-4		years				c Illinois 1969-72	NS	
	-	F	-	-	4-6		years						

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Moll 1973 (bellii)	-	M	1	-	4-5		years				Wisconsin 1969-72	NS	
	-	F	2	-	7-8		years						
Pope 1939 (marginata)	-	M	-	-	5		years				New England	NS	As cited in DeGraaf & Rudis 1983.
	-	F	-	-	6-7		years						
Wilbur 1975a (marginata)	-	M	-	-	5		years				MI 1953-57, 1968-73	pond	
	-	F	-	-	7		years						
LENGTH AT SEXUAL MATURITY													
Cagle 1954 (marginata, dorsalis)	-	M	-	-	90		mm plastron				n Michigan	NS	
	-	F	-	-	120-130		mm plastron						
Cagle 1954 (marginata, dorsalis)	-	M	-	-	70		mm plastron				s Illinois	NS	
	-	F	-	-	120-125		mm plastron						
Christens & Bider 1986 (marginata)	-	F	BR	-	143	1.6 SD	mm plastron	124	158		Quebec, CAN 1983-85	pond	Significant difference in plastron length between reproductive and non-reproductive turtles > 6 yrs old.
	-	F	NB	-	135	1.7 SD	mm plastron	114	147				
Christiansen & Moll 1973 (bellii)	-	F	1	-	150		mm plastron	132	205	54	New Mexico 1964-70	NS	Minimum breeding age in (1) females - 5 to 6 years; (2) males - 3 years.
	-	M	2	-	123		mm plastron	88	170	55			
Christiansen & Moll 1973 (bellii)	-	F	1	-	154		mm plastron	136	185	23	Wisconsin	NS	Minimum breeding age in (1) females - 8 years; (2) males - 4 years.
	-	M	2	-	132		mm plastron	96	155	32			
Gibbons 1968a	-	M	-	-			mm plastron	81			Michigan 1964-66	lake, marsh	Growth rates vary in different habitats: male turtles from the marsh reach greater than 80 mm in about three to five years, while those in the lake habitat reach 80 mm in their sixth or seventh year. Females are thought to become mature between 110 and 120 mm in plastron length.
	-	F	-	-			mm plastron	110	120				
Gibbons 1968b	-	F	-	-			mm plastron	113	115		Michigan 1964-66	marsh	
MacCulloch & Secoy 1983 (bellii)	-	M	1	-			mm plastron	129		64	Saskatchewan, CAN	river,pond	Study from 1977 to 1979. Study locations: (1) Qu'Appelle (2) Rinfret. Measure = minimum plastron length at sexual maturity.
	-	M	2	-			mm plastron	115		12			

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Tinkle et al. 1981 (marginata)	-	F	-	-			mm plastro	112	155	107	se Michigan	near ponds	Plastron length at sexual maturity.
MORTALITY													
Ernst & Barbour 1972 (picta)	B	B	-	-	51		%/yr				Pennsylvania	NS	
Frazer et al. 1991	A	F	-	-			%/yr	50	71		Michigan 1980-89	lake, marsh	Methodology may have underestimated survival rates.
	A	M	-	-			%/yr	17	36				
	J	B	-	-			%/yr	49	79				
Mitchell 1988	A	B	-	-			%/yr	4	6		Virginia	NS	As cited in Frazer et al. 1991.
	J	B	-	-	54.0		%/yr						
Tinkle et al. 1981 (marginata)	B	B	-	-	24		%/yr				Michigan 1977-79	pond	
Wilbur 1975a (marginata)	J	B	1	-	92		%/yr				MI 1953-57, 1968-73	pond	(1) % mortality from laying to arrival of hatchlings at pond.
	B	M	-	-	15		%/yr						
	B	F	-	-	18		%/yr						
Zweifel 1989	A	F	-	-			%/yr	0	14		MI, NY, NE, Saskatchewan, CAN	NS	As cited in Frazer et al. 1991.
	A	M	-	-			%/yr	2	46				
LONGEVITY													
Frazer et al. 1991	-	M	-	-			years		31		Michigan 1964-89	marsh	
	-	F	-	-			years		34				
Gibbons 1987	-	-	-	-			years		25+	18	Michigan	Sherriff's Marsh	Eighteen of 110 turtles were known to be older than 25 years (from mark-recapture).

*** SEASONAL ACTIVITIES ***

Reference	Begin	Peak	End	Location	Habitat	Notes
MATING						
Ernst 1971c	late Apr		mid Jun	se Pennsylvania 1965-67	pond, marsh	

Reference	Begin	Peak	End	Location	Habitat	Notes
Ernst & Barbour 1972 (picta)	Mar		mid Jun	NS	NS	
Gibbons 1968a	Mar	Apr-earl May	May	Michigan 1964-66	marsh, lake	Author suggests that a second ovulation (leading to second clutches), probably occurs in mid-June.
Gist et al. 1990		Oct		Ohio	ponds	Based on examination of oviducts for presence of sperm, and electroejaculation of males to detect presence of sperm.
Smith 1961 (marginata)		earl spring		Illinois	NS	
NESTING						
Cagle 1954 (marginata, dorsalis)	mid May		late Jul	Illinois 1937-43	creek	
Cagle 1954 (marginata, dorsalis)	earl Apr		late Jul	Louisiana 1946-51	NS	
Congdon & Gatten 1989	mid May	late May	earl Jul	Michigan 1976-86	marsh	
Ernst & Barbour 1972 (picta)	late May	late Jun	mid Jul	NS	NS	
Ernst 1971c	Jun		Jul	se Pennsylvania 1965-67	pond, marsh	
Moll 1973 (bellii)		Jun-earl Jul		Wisconsin 1969-72	NS	Nesting season.
Moll 1973 (bellii x marginata)		late May-Jun		Illinois 1969-72	NS	Nesting season.
Moll 1973 (dorsalis)	late May		late Jul	Louisiana 1969-72	NS	Nesting season.

Reference	Begin	Peak	End	Location	Habitat	Notes
Smith 1961 (marginata)	Jun		Jul	Illinois	NS	Mating in early spring.
Smith 1956 (bellii)	Jun		Jul	Kansas	terrestrial	Mating occurs in fall or spring with laying coming some time later.
Tinkle et al. 1981 (marginata)	late May	Jun	late Jun	se Michigan 1977-79	near ponds	
HATCHING						
Cahn 1937 (marginata)	Sep		spring	Illinois	NS	As cited in Smith 1961.
Ernst & Barbour 1972		Aug		NS	NS	Hatchlings from eggs laid in August may overwinter in the nest.
Smith 1956 (bellii)	Aug		Sep	Kansas	terrestrial	
Tinkle et al. 1981 (marginata)		late summer		se Michigan 1977-79	near ponds	
HIBERNATION						
Congdon et al. 1982 (marginata)	late Oct		late Mar	se Michigan	near ponds	End of hibernation ranges from late March to early April.
Ernst 1971c	late Oct		Mar	se Pennsylvania 1965-67	NS	
Smith 1956 (bellii)	late Oct		Apr	Kansas	mud underwater	

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***** EASTERN BOX TURTLE *****

*** NORMALIZING AND CONTACT RATE FACTORS ***

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
BODY WEIGHT													
Allard 1948	H	B	1	SU	11		g			22	Tennessee	NS	Ages: (1) hatched in July; (2) 2 months old in Sept.; (3) 1.3 years old in October - overwintering lose 1 gram; (4) 1.8 years old in May; (5) 3.3 years old in October. As cited in Ernst and Barbour 1972.
	J	B	2	FA	21		g			-			
	J	B	3	FA	40		g			-			
	J	B	4	SP	39		g			-			
	J	B	5	FA	54		g			-			
Brisbin 1972 (carolina)	A	M	-	FA	397.8	46.8 SE	g			13	Georgia 1965-67	captive	Average of two years of data.
	A	F	-	FA	381.1	28.8 SE	g			13			
Brisbin 1972 (carolina)	A	M	-	SP	387.6	47.0 SE	g			13	Georgia 1965-67	captive	Average of two years of data.
	A	F	-	SP	369.1	29.4 SE	g			13			
	A	M	-	SU	394.0	42.7 SE	g			14			
	A	F	-	SU	372.0	26.7 SE	g			15			
Congdon & Gibbons 1985	A	F	-	-	372.0		g			8	S Carolina	NS	
	A	F	-	-	(129.0)		(mm plastron)			8			
BODY LENGTH													
Oliver 1955	H	-	-	-	28		mm carapace				NS	NS	As cited in Auffenberg and Iverson 1979.
	A	-	-	-			mm carapace		198				
BODY FAT													
Brisbin 1972 (carolina)	-	B	-	FA	0.058	0.014 SE	g/g dry wt			5	Georgia 1965-67	captive	Measure is grams of fat per gram of lean dry weight.
	-	B	-	SP	0.060	0.016 SE	g/g dry wt			4			
	-	B	-	SU	0.059	0.006 SE	g/g dry wt			3			
EGG WEIGHT													
Congdon & Gibbons 1985	-	-	-	-	30.7	2.9 SE	g/clutch			8	S Carolina	NS	Mean clutch size = 3.4 +/- 0.3 eggs.
Congdon & Gibbons 1985	-	-	-	-	9.02	0.17 SE	g/egg			25	S Carolina	NS	Mean length of eggs = 35.60 +/- 0.37 mm; mean width of eggs = 20.70 +/- 0.15 mm.
Ernst & Barbour 1972	-	-	-	-			g/egg	6	11		NS	NS	Summarizing other studies.

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
HATCHING WEIGHT													
Ewert 1979 (major)	H	-	-	-	8.8		g			28	Florida	NS	From nine clutches.
Ewert 1979 (carolina)	H	-	-	-	8.4		g			74	Indiana	NS	From seventeen clutches.
GROWTH RATE													
Stickel & Bunck 1989 (carolina)	A	M	1	-	6.7		% mm/yr				Maryland	bottomland forest	Growth measured as percent increase in carapace length per year. Age: (1) 8-13 years; (2) 14-19 years.
	A	F	1	-	5.3		% mm/yr						
	A	M	2	-	2.3		% mm/yr						
	A	F	2	-	3.4		% mm/yr						
WATER INGESTION RATE													
Ernst & Barbour 1972	-	-	-	-	0.0072		g/g-day				NS	lab	Data source not identified. Evaporative water loss (which might need to be made up by drinking) at 10 to 29 C, relative humidity 45 to 95%.

***** DIET *****

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Klimstra & Newsome 1960 (carolina)	-	-	plant matter	35	39	20		115	w c s Illinois 1955-56	forest, prairie - % wet volume; digestive tract	Approximated from Figure 1. Season: spring = May; summer = June-August; fall = September, October.
			insects (adults)	18	12	12					
			insects (larvae)	4	5	9					
			seeds	8	16	33					
			Gastropoda	18	6	8					
			Isopoda	<1	5	3					
			Diplopoda	3	2	5					
			mammals	2	<1	2					
			Decapoda	2	2	0					
			reptiles	1	3	1					
			birds	3	1	<1					
			Annelida	1	1	4					
			others	5	8	2					
			(sample size)	(33)	(56)	(26)					
Barbour 1950 (carolina)	-	-	snails		60			2	Kentucky	Cumberland Mountains - % volume; stomach contents	Younger individuals are chiefly carnivorous; older individuals are more herbivorous.
			crayfish		15						
			plants		12.5						
			crickets		7.5						
			unidentified seeds		5						

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Bush 1959 (carolina)	B	B	snails and slugs		53			10	Kentucky	NS	
			mushrooms		10					-	
			caterpillars		10					% volume;	
			carabid beetles		4					stomach contents	
			centipedes		4						

***** POPULATION DYNAMICS *****

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
HOME RANGE SIZE													
Breder 1927	-	-	-	SU	1.13		ha	0.17	4.1	12	Long Island NY	NS	As cited in DeGraaf and Rudis 1983.
Dolbeer 1969	-	-	-	SU	0.46		ha				Tennessee	woodland	Foraging home range.
(carolina)													
Nichols 1939b	-	-	-	SU	4.6		ha			62	Long Island NY	NS	Twenty year study; opportunistic sampling; "normal", not mean, value reported.
Schwartz et al. 1984 (triunguis)	B	B	-	-	5.1		ha			37	Missouri 1965-83	mixed woods, fields	Home range of adults is larger than that of juveniles. Average home range during first 6 years of the study = 2.1 ha, indicating that average home range size increased during the length of the study.
	B	M	-	-	5.2		ha						
	B	F	-	-	5.1		ha						
Stickel 1989 (carolina)	-	M	-	-	1.20		ha			51	Maryland 1945-75	bottomland forest	Calculated assuming an eliptical home range. Nesting sites tended to be distant from the home range, extending the range by 400 to 700 meters. Hibernacula, on the other hand, tended to be within the foraging home range.
	-	F	-	-	1.13		ha			52			
	-	M	-	-	146	48 SD	m long			51			
	-	M	-	-	105	38 SD	m wide			51			
	-	F	-	-	144	52 SD	m long			52			
	-	F	-	-	100	38 SD	m wide			52			
Stickel 1950 (carolina)	A	M	-	SU	0.79		ha				Maryland 1944-47	wooded bottomlands	Used spools of thread attached to back of turtle to help delineate home range size. Also mark-recapture.
	A	F	-	SU	1.0		ha						
	A	M	-	SU	101.0	42 SD	m diameter						
	A	F	-	SU	113.0	45 SD	m diameter						
Stickel 1950 (carolina)	A	F	BR	SU			meters		774		Maryland 1944-47	wooded bottomlands	Distance traveled from normal home range to lay eggs.
Strang 1983	-	-	-	-	2.2		ha				Pennsylvania	mixed woodlands	

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
POPULATION DENSITY													
Dolbeer 1969	-	-	-	-	17.3-22.2		N/ha			270	Tennessee	woodland	
Schwartz et al. 1984 (triunguis)	-	-	-	-	17-35		N/ha				Maryland 1965-83	forest	Lincoln Index population estimate - based on mark-recapture.
Stickel 1950 (carolina)	B	B	-	-	9.9-12.4		N/ha			245	Maryland 1944-47	wooded bottomlands	Juveniles comprise less than 10 % of the total population.
CLUTCH SIZE													
Cahn 1937	-	-	-	-			eggs	3	8		NS	NS	As cited in Smith 1961.
Congdon & Gibbons 1985	-	-	-	-	3.4	0.3 SE	eggs			8	S Carolina	NS	
Ernst & Barbour 1972	-	-	-	-	4.5		eggs	3	8		NS	NS	Summarizing other studies.
Smith 1956	-	-	-	-	4		eggs	2	7		Washington DC	NS	
CLUTCHES/YEAR													
Oliver 1955	-	-	-	-			/yr		4		Florida	NS	As cited in Moll 1979.
Smith 1961	-	-	-	-	1		/yr				Illinois	NS	
DAYS INCUBATION													
Allard 1948	-	-	-	-			days	64	136		NS	NS	As cited in Ernst and Barbour 1972.
Allard 1935 cited in Carr 1952	-	-	-	-	87-89		days				NS	NS	As cited in DeGraaf and Rudis 1983.
Allard 1935,1948	-	-	-	-	80-90		days	69	136		Maryland	NS	Days to emergence. As cited in Ewert 1979.
Dickson 1953	-	-	-	-	60		days				s Florida	natural	As cited in Ewert 1979.
Dodge et al. 1979 (carolina)	- -	- -	1 2	- -	80 54		days days				Iowa	lab	(1) At 24 C; (2) at 30 C.
Ernst & Barbour 1972	-	-	-	-	90		days				NS	NS	Summarizing other studies.

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Ewert 1979	-	-	-	-			days	78	102		nw Minnesota	natural	Days to pipping.
Ewing 1933	-	-	-	-	99		days	69	161		Washington DC	natural	As cited in Ewert 1979.
Lynn & Von Brand 1945	-	-	1	-	63		days			12	Maryland	artificial	Temperature: (1) 25.0-25.5 C; (2) 25.0-25.5 C; (3) 30.0-32.0 C. N = number of eggs. As cited in Ewert 1979.
	-	-	2	-	76.0		days			12			
	-	-	3	-	50		days			12			
Rosenberger 1972	-	-	-	-			days	74	99		Pennsylvania	natural	Days to emergence. As cited in Ewert 1979.
AGE AT SEXUAL MATURITY													
Ernst & Barbour 1972	-	-	-	-	4-5		years				NS	NS	Summarizing other studies.
Minton 1972	-	-	-	-	5-10		years				NS	NS	As cited in DeGraaf and Rudis 1983.
LENGTH AT SEXUAL MATURITY													
Oliver 1955	A	B	-	-			mm carapace	100	130		NS	NS	As cited in Auffenberg and Iverson 1979.
LONGEVITY													
Nichols 1939a	-	-	-	-	20		years		80		NS	NS	
Oliver 1955	-	-	-	-			years		138		NS	captive	As cited in Auffenberg and Iverson 1979.

***** SEASONAL ACTIVITIES *****

Reference	Begin	Peak	End	Location	Habitat	Notes
MATING/LAYING						
DeGraaf & Rudis 1983	Jun		Jul	ne Carolinas	NS	
Ernst & Barbour 1972		spring		northern range	NS	
Smith 1956	Jun		Jul	Washington DC	NS	

Reference	Begin	Peak	End	Location	Habitat	Notes
HATCHING						
DeGraaf & Rudis 1983	Aug		Sep	ne Carolinas	NS	
Ernst & Barbour 1972	Sep		Oct	northern range	NS	
Smith 1956		Sept		Washington DC		
HIBERNATION						
Ernst & Barbour 1972	Nov		Apr	northern range	NS	
Schwartz & Schwartz 1974 (triunguis)	Oct		Apr	Missouri	mixed woods, fields	

*** NORMALIZING AND CONTACT RATE FACTORS ***

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
BODY WEIGHT (AND LENGTH)													
Brown & Parker 1984 (mormon)	0	M	J	SP	8.30		g (266mmSVL)				Utah 1969-72	desert shrub	Number in age column is age in years. Length measured from snout to vent (SVL). Snakes collected from dens.
	1	M	B	SP	27.0		g (420mmSVL)						
	2	M	B	SP	41.0		g (486mmSVL)						
	3	M	A	SP	49.1		g (520mmSVL)						
	4	M	A	SP	53.4		g (541mmSVL)						
	5	M	A	SP	60.4		g (564mmSVL)						
	6	M	A	SP	61.2		g (573mmSVL)						
Brown & Parker 1984 (mormon)	0	F	J	SP	8.8		g (272mmSVL)				Utah 1969-72	desert shrub	Number in age column is age in years. Length measured from snout to vent (SVL). Snakes collected from dens.
	1	F	B	SP	28.4		g (430mmSVL)						
	2	F	B	SP	51.6		g (524mmSVL)						
	3	F	B	SP	66.2		g (575mmSVL)						
	4	F	B	SP	71.4		g (599mmSVL)						
	5	F	B	SP	79.4		g (620mmSVL)						
	6	F	B	SP	84.0		g (632mmSVL)						
Brown & Parker 1984 (mormon)	A	F	1	SU	128.1	21.9 SD	g	103.1	156.6	4	Utah 1971-72	desert shrub	Weight of: (1)gravid females with eggs; (2)weight following laying of eggs; and (3)late summer weight - 31-53 days after laying. Length of snakes not provided.
	A	F	2	SU	73.7	12.5 SD	g	57.2	87.3	4			
	A	F	3	SU	114.7	32.5 SD	g	71.3	149.4	4			
Fitch 1982	A	B	-	-	126		g		538	1414	Kansas 1948-77	woodland, open field	
Gibbons & Semlitsch 1991	-	M	-	-	169.0		g (840mmSVL)				S Carolina	old fields, pine woods	
	-	F	-	-	150.0		g (830mmSVL)						
Fitch 1963 (flaviventris)	2	M	-	FA	68.2		g (615mmSVL)	51	92		Kansas 1949-62	woodland, grassland	Number in age column is age in years. Sampling occurred in both May and October. Length measured from snout to vent (SVL).
	2	M	-	SP	107.4		g (668mmSVL)	63	134				
	3	M	-	FA	102.1		g (706mmSVL)	65	129				
	3	M	-	SP	147.0		g (740mmSVL)	93	216				
	4	M	-	FA	139.0		g (757mmSVL)	95	251				
	4	M	-	SP	167.4		g (785mmSVL)	128	225				
	5	M	-	FA	152.4		g (806mmSVL)	110	198				
	5	M	-	SP	163.9		g (810mmSVL)	89	211				
	6	M	-	FA	175.9		g (827mmSVL)	130	230				
	7	M	-	FA	181.2		g (845mmSVL)	125	210				
	8	M	-	FA	217.5		g (868mmSVL)	194	225				

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Fitch 1963 (flaviventris)	2	F	-	FA	83.5		g (644mmSVL)	52	127		Kansas 1949-62	woodland, grassland	Number in age column is age in years. Sampling occurred in both May and October. Length measured from snout to vent (SVL).
	2	F	-	SP	135.2		g (743mmSVL)	73	200				
	3	F	-	FA	149.4		g (810mmSVL)	98	219				
	3	F	-	SP	181.2		g (836mmSVL)	120	268				
	4	F	-	FA	212.3		g (866mmSVL)	175	243				
	4	F	-	SP	191.2		g (883mmSVL)	143	300				
	5	F	-	FA	209.6		g (914mmSVL)	136	275				
	5	F	-	SP	250.4		g (932mmSVL)	195	336				
	6	F	-	FA	245.9		g (965mmSVL)	218	283				
	6	F	-	SP	271.0		g (970mmSVL)	243	336				
	7	F	-	FA	251.3		g (974mmSVL)	150	330				
	7	F	-	SP	295.6		g (1000mmSVL)	235	375				
BODY LENGTH													
Corn & Bury 1986	A	M	-	-	632.4	66.74 SD	mm SVL			10	e Colorado	foothills	Snout to vent length (SVL). Only adult snakes (>395mm SVL) used in analysis.
	A	F	-	-	739.5	77.29 SD	mm SVL			10			
Corn & Bury 1986	A	M	-	-	640.6	76.23 SD	mm SVL			11	w CO, ne VT	mountains	Snout to vent length (SVL). Only adult snakes (>395mm SVL) used in analysis.
	A	F	-	-	699.0	58.36 SD	mm SVL			8			
Corn & Bury 1986	A	M	-	-	602.2	166.5 SD	mm SVL			13	w Utah	foothills	Snout to vent length (SVL). Only adult snakes (>395mm SVL) used in analysis.
	A	F	-	-	682.5		mm SVL			2			
Fitch 1963 (flaviventris)	1	M	-	SP	539		mm SVL	432	609		Kansas 1949-62	woodland, grassland	Number in age column is age in years. Sampling occurred in both May and October. Length measured from snout to vent (SVL).
	2	M	-	FA	615		mm SVL	560	674				
	2	M	-	SP	668		mm SVL	620	710				
	3	M	-	FA	706		mm SVL	648	755				
	3	M	-	SP	740		mm SVL	667	780				
	4	M	-	FA	757		mm SVL	725	809				
	4	M	-	SP	785		mm SVL	720	850				
	5	M	-	FA	806		mm SVL	743	855				
	5	M	-	SP	810		mm SVL	773	858				
	6	M	-	FA	827		mm SVL	765	883				
	7	M	-	FA	845		mm SVL	788	900				
	8	M	-	FA	868		mm SVL	740	890				
	8	M	-	SP	870		mm SVL						
Fitch 1963 (flaviventris)	1	F	-	SP	581		mm SVL	415	658		Kansas 1949-62	woodland, grassland	Number in age column is age in years. Sampling occurred in both May and October. Length measured from snout to vent (SVL).
	2	F	-	FA	644		mm SVL	580	738				
	2	F	-	SP	743		mm SVL	670	826				
	3	F	-	FA	810		mm SVL	730	880				
	3	F	-	SP	836		mm SVL	736	915				
	4	F	-	FA	866		mm SVL	791	920				
(continued)	4	F	-	SP	883		mm SVL	810	952				

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Fitch 1963 (continued)	5	F	-	FA	914		mm SVL	833	1,088				
	5	F	-	SP	932		mm SVL	883	990				
	6	F	-	FA	965		mm SVL	892	1,020				
	6	F	-	SP	970		mm SVL	885	1,003				
	7	F	-	FA	974		mm SVL	919	1,050				
	7	F	-	SP	1,000		mm SVL	930	1,085				
Martoff et al. 1980	A	-	-	-			mm	914	1,676		NS	NS	Total length or snout-to-vent length (SVL) not specified.
Vermersch & Kuntz 1986 (flaviventris)	A	-	-	-			mm total	762	1,370		Texas	NS	
Wright & Wright 1957 (constrictor)	A	M	-	-			mm total	680	1,595		NS	NS	As cited in DeGraaf and Rudis 1983.
	A	F	-	-			mm total	710	1,683				
EGG WEIGHT													
Brown & Parker 1984 (mormon)	-	-	-	-	7.80	0.17 SE	g	5.9	10.8	54	Utah 1970-71	desert shrub	
Fitch 1963 (flaviventris)	-	-	1	-	5.5		g	4.4	6.0	17	Kansas 1949-62	woodland, grassland	Clutches from six females of SVL (1) 892 mm; (2) 773 mm; (3) 772 mm; (4) 807 mm; (5) 858 mm; and (6) 899 mm. Sample size = clutch size.
	-	-	2	-	4.9		g	4.4	5.2	12			
	-	-	3	-	5.2		g	4.4	6.2	14			
	-	-	4	-	6.0		g	5.6	6.5	10			
	-	-	5	-	5.4		g	5.0	5.8	11			
	-	-	6	-	6.0		g	5.6	6.7	8			
Fitch 1963 (flaviventris)	-	-	1	-	5.9		g	5.6	6.3	21	Kansas 1949-62	woodland, grassland	Clutches of five females of SVL (1) 1053 mm; (2) 907 mm; (3) 911 mm; (4) 843 mm; and (5) 846 mm. Sample size = clutch size.
	-	-	2	-	6.8		g	6.1	7.5	13			
	-	-	3	-	4.9		g	4.3	5.5	18			
	-	-	4	-	5.2		g	3.8	6.1	12			
	-	-	5	-	6.8		g	6.2	7.6	14			
HATCHING WEIGHT (AND LENGTH)													
Brown & Parker 1984 (mormon)	H	B	-	-	6.0		g			26	Utah 1969-72	desert shrub	
	H	B	-	-	(230)		(mm SVL)			26			
Fitch 1963 (flaviventris)	H	B	-	-	4.16		g	2.4	5.8		Kansas	lab	Size and weight at hatching.
	H	B	-	-	(214.5)		(mm SVL)	186	244				

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
HATCHING LENGTH													
Martof et al. 1980	H	-	-	-	290		mm				NS	NS	Total length or snout-to-vent length (SVL) not specified.
Vermersch & Kuntz 1986 (flaviventris)	H	-	-	-			mm total	305			Texas	NS	
GROWTH RATE													
Fitch 1963 (flaviventris)	J	B	-	SU	0.116		g/day			25	Kansas 1953-59	woodland, grassland	Growth during the ten week period from hatching to hibernation.
METABOLIC RATE (OXYGEN)													
Ruben 1976	A	-	ST	-	2.4		lO2/kg-day			6	NS 1974	lab	Standard (ST) metabolic rate at body temperature of 35 C. Number in condition column is (1)metabolic rate of active (electrically stimulated) snakes at 35 C body temperature. Mean weight of snakes was 262g; includes data from a masticophis sp. which was found to show similar results.
	A	-	1	-	24.5		lO2/kg-day			6			
FOOD INGESTION RATE													
Fitch 1982 (flaviventris)	B	B	-	-	0.02		g/g-day				Kansas 1948-77	woodlands, grassy areas	Rough estimate of food consumed from spring through fall based on author's calculation that these snakes eat approximately four times their body weight over the 213 day active season. Of the 12 snake species in the study area, C. constrictor thought to eat the most relative to its body weight.
BODY TEMPERATURE													
Brown 1973 (mormon)	A	B	-	SU	31.8	0.20 SE	degrees C	18.6	37.7	266	n Utah	desert shrub	Body temperature of active snakes under natural conditions; elevation 1,580 meters. As cited in Brown and Parker 1982.

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Brown & Parker 1982 (mormon)	A	B	-	SU	27.5	0.4 SE	degrees C	17.5	35.2	127	n Utah 1969-73	cold desert shrub	Snakes located underground (inactive) under natural conditions; elevation 1,580 meters.
Fitch 1963 (flaviventris)	A	B	-	SU			degrees C	15.5	32.4	60	Kansas 1962	grassland, woodlands	Active snakes captured by hand. The greatest densities of snakes were found when ambient temperatures were between 26-27 C.
Hammerson 1987	A	B	-	SU	32.15	0.16 SE	degrees C			130	w c California	"natural" enclosure	Body temperature of active snakes under natural weather conditions. Elevation 180 meters.
Hammerson 1987	A	B	-	SU	32.7	0.29 SE	degrees C			91	Kansas	outdoor enclosure	Active racers under natural conditions; elevation 300 meters; based on cloacal temperatures of snakes in outdoor enclosures. Mean and SE calculated by Hammerson 1987 from data published in Fitch 1963 (figure 5).
Hammerson 1987	-	-	1	SU	21.6	2.6 SD	degrees C	17.1	26.4	9	w c California	"natural" enclosure	Body temperature at (1)initial morning emergence: (2)end of morning basking; (3)end of daily activity. Measured during June and July.
	-	-	2	SU	33.8	1.0 SD	degrees C	33.4	35.0	7			
	-	-	3	SU	30.0	3.2 SD	degrees C	26.4	35.7	8			
Hammerson 1987	A	B	-	SU	32.7	0.29 SE	degrees C			91	Kansas	outdoor enclosure	Active racers under natural conditions; elevation 300 meters. Mean based on cloacal temperatures of snakes. Calculated from Fitch's (1963) Figure 5.

***** DIET *****

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Brown & Parker 1982 (mormon)	B	B	insects (mostly orthopterans)			96		102	Utah 1969-72	desert shrub - % frequency of occurrence; stomach contents	Snakes collected from May-October but most records were from September when snakes were returning to hibernacula.
			mammals (Peromyscus)			3					
			snakes (Masticophis taeniatus)			1					
Fitch 1963 (flaviventris)	B	B	small mammals		65.7			1351	Kansas 1949-62	grassland, woods - % wet weight; scats and stomach contents	From a variety of locations in Kansas. Stomach contents were squeezed out of live snakes.
			orthopterans		14.3						
			lizards		9.2						
			snakes		4.2						
			misc. insects		1.9						
			birds		3.5						
			frogs		1.2						

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Fitch 1963 (flaviventris)	B	B	mice		15.4			69	Kansas 1949-62	grassland, woods - % wet weight; stomach contents	From Harvey County Park. Stomach contents were squeezed out of live snakes.
			orthopterans		4.6						
			lizards		61.5						
			frogs		12.6						
			snakes		5.1						
			crickets		0.8						
Fitch 1982 (flaviventris)	B	B	Acheta assimilis		15			986	Kansas 1948-77	woodland, open field - % occurrence; in stomach, scat, or observed eating	All sizes of snakes.
			other insects		62						
			prairie vole		8						
			other small mammals		7						
			other vertebrates		8						
Klimstra 1959	B	B	insects	20	40	64			s Illinois 1950-57	pastures, meadows - % volume; digestive tracts	Size of snakes not specified; captured within the range of C. c. flaviventris and C. c. priapus. Values are averages of monthly data (March-October). Small mammal prey consisted primarily of meadow voles and Peromyscus spp; insects were primarily crickets and locusts; amphibians were primarily Ranid frogs.
			small mammals	62	27	21					
			amphibians	5	13	3					
			reptiles	7	8	-					
			birds	4	6	8					
			other	2	6	4					
			(sample size)	(58)	(52)	(11)					
Uhler et al. 1939 (constrictor)	-	-	reptiles		31.9			16	NS	NS - % volume; stomach contents	Season and size of snakes not specified. As cited in Klimstra 1959.
			small mammals		26.0						
			birds		17.8						
			insects		15.0						
			amphibians		9.4						

***** POPULATION DYNAMICS *****

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
HOME RANGE SIZE													
Fitch 1963 (flaviventris)	A	M	-	SU	11.7		ha			244	Kansas 1949-62	woodland, grassland	Based on average home range radius estimated from movement data (not including the shortest 10% of movements or longest 10% of movements).
	A	F	-	SU	9.6		ha			132			
Fitch 1963 (flaviventris)	A	M	-	SU	3.0		ha			15	Kansas 1949-62	woodland, grassland	Minimum home ranges from plots of recapture data. Range for both sexes combined was 1.3-5.2 ha.
	A	F	-	SU	1.8		ha			5			
Vermersch & Kuntz 1986 (flaviventris)	-	-	-	-	10.1		ha				Texas	NS	Source and methods of data not specified.

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
POPULATION DENSITY													
Brown & Parker 1984 (mormon)	B B	B B	1 2	- -	0.79 0.32		N/ha N/ha			528 271	Utah 1971	desert shrub	Density of snakes at least one year old in: (1) area M; and (2) area S. Density estimated from mark-recapture using the Jolly-Seber method.
Fitch 1963 (flaviventris)	A	B	-	SU	4.7		N/ha			75	Kansas 1955-61	bottomland pastures, old fields	Number of adults present at annual population low (early summer). N = estimated population size. Amount of first year young present thought to be equal to number of adults; young of year have not hatched yet.
Fitch 1963 (flaviventris)	A	B	-	SU	2.7		N/ha			153	Kansas 1958-62	prairie grasses, hilltop	Number of adults present at annual population low (early summer). N = estimated population size. Amount of first year young present thought to be equal to number of adults; young of year have not hatched yet.
Fitch 1963 (flaviventris)	A	B	-	SU	7.0		N/ha			135	Kansas 1958-62	upland prairie, weeds, grasses	Number of adults present at annual population low (early summer). N = estimated population size. Amount of first year young present thought to be equal to number of adults; young of year have not hatched yet.
Turner 1977 (flaviventris)	-	-	-	-	5.0		N/ha				Kansas	NS	As cited in Brown and Parker 1984.
CLUTCH SIZE													
Behler & King 1979	-	-	-	-			eggs	5	28		NS		
Brown & Parker 1984 (mormon)	-	-	-	-	5.28	0.24 SE	eggs	4	8	43	Utah	desert shrub	Clutch size increases with increasing female body size. Clutch size = -0.56+.10 SVL (cm).
Corn & Bury 1986	-	-	-	-	7.4		eggs	4	10	5	w Utah	foothills	
Corn & Bury 1986	-	-	-	-	12		eggs	9	14	6	e Colorado	foothills	

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Fitch 1963 (flaviventris)	-	F	2	SU	9.2		eggs	6	12	10	Kansas 1949-62	woodland, grassland	Age and snout-to-vent length (SVL) of females (mm): (2)2 yrs - 688mm (589-748); (3)3 yrs - 789mm (756-840); (4)4 yrs - 856mm (850-861); (5)5 yrs - 907mm (392-933); and (6)6+ yrs - 1005mm (955-1088).
	-	F	3	SU	9.9		eggs	5	14	19			
	-	F	4	SU	10.8		eggs	8	12	7			
	-	F	5	SU	13.0		eggs	8	17	6			
	-	F	6	SU	15.7		eggs	11	19	10			
Fitch 1963 (constrictor)	-	-	-	-	16.8		eggs	7	31	14	NS	NS	From own data and unspecified other studies.
Fitch 1963 (priapus)	-	-	-	-	12.6		eggs	7	21	11	NS	NS	From own data and unspecified other studies.
Fitch 1963 (mormon)	-	-	-	-	5.79		eggs	2	13	43	NS	NS	From own data and unspecified other studies.
Martof et al. 1980	-	-	-	-			eggs	4	25		Virginia, Carolinas	NS	
Pope 1944 (flaviventris)	-	-	-	-			eggs	19	25		Illinois	NS	As cited in Smith 1961.
Smith 1956	-	-	-	-			eggs	8	25		Kansas	NS	
Vermersch & Kuntz 1986 (flaviventris)	-	-	-	-			eggs	3	23		Texas	NS	
CLUTCHES/YEAR													
Fitch 1963 (flaviventris)	-	-	-	-	0.5		/yr	0	1		Kansas 1949-62	woodland, grassland	Only about 50% of adult females produce offspring each year, suggesting that an individual female might reproduce only in alternate years.
DAYS INCUBATION													
Behler & King 1979	-	-	-	-	42-63		days				NS		
Brown & Parker 1984 (mormon)	-	-	1	SU	42.6		days	41	44	3	Utah 1971-72	lab, desert	(1) Lab 1971; (2) lab 1972; (3) field. Lab temperature was 29 C.
	-	-	2	SU	44-45		days			3			
	-	-	3	SU	45-50		days			2			
Fitch 1963 (flaviventris)	-	-	-	SU	51		days	43	63	12	Kansas 1949-62	lab	Temperature range not specified.

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Smith 1956 (constrictor)	-	-	-	-	65		days	61	70		NS	NS	
AGE AT SEXUAL MATURITY													
Behler & King 1979	-	-	-	-	2-3		years				NS	NS	
Brown & Parker 1984 (mormon)	-	F	-	-	3		years	2	6	400	Utah 1969-72	desert shrub	
	-	M	-	-	13.5		months			174			
Fitch 1963 (flaviventris)	-	F	-	-	2-3		years				Kansas 1949-62	woodland, grassland	Males produce sperm at a little over a year, but do not breed until the following spring at about 20 months of age.
	-	M	-	-	13-14		months						
MORTALITY													
Brown & Parker 1984 (mormon)	A	M	-	-	29		%/yr	19	38	3 yrs	Utah 1970-72	desert shrub	Adults defined as snakes one year old or older; juveniles were young of the year.
	A	F	-	-	30		%/yr	21	45	3 yrs			
	J	B	-	-	76		%/yr	73	77	3 yrs			
Brown & Parker 1984 (mormon)	-	B	-	SU	8		%egg-hatch		45 days		Utah 1969-72	desert shrub	Percent mortality for various life-stage intervals (juv = juvenile, yrlng = yearling). Days listed in the maximum column indicate the duration of the period over which the mortality estimate was made.
	J	B	-	FA	21		%hatch-juv		45 days				
	J	B	-	FA	77		%juv-yrlng		345 days				
	J	B	-	-	83		%egg-yrlng		450 days				
Brown & Parker 1982 (mormon)	A	B	-	-	21		%/yr				Utah 1969-73	cold desert shrub	
	J	B	-	-	83		%/1st yr						
Fitch 1963 (flaviventris)	2	B	-	FA	58		%/yr				Kansas 1949-62	woodland, grassland	Number is age in years. Age-specific annual mortality with age measured in years.
	3	B	-	FA	30		%/yr						
	4	B	-	FA	25		%/yr						
	5	B	-	FA	35		%/yr						
	6	B	-	FA	30		%/yr						
	7	B	-	FA	38		%/yr						
LONGEVITY													
Brown & Parker 1982 (mormon)	A	B	-	-			years		20		Utah 1969-73	cold desert shrub	

***** SEASONAL ACTIVITIES *****

Reference	Begin	Peak	End	Location	Habitat	Notes
MATING						
DeGraaf & Rudis 1983 (constrictor)	May		earl Jun	NS	NS	
Fitch 1963 (flaviventris)	Apr	May	Jun	Kansas 1949-62	woodland, grassland	
Vermersch & Kuntz 1986 (flaviventris)	Apr		May	Texas	NS	
EGG-LAYING						
Brown & Parker 1984 (mormon)	Jun	Jul		Utah 1969-73	desert shrub	
DeGraaf & Rudis 1983 (constrictor)	Jun		earl Jul	NS	NS	
Fitch 1963 (flaviventris)	Jun 13		Jul 16	Kansas 1949-62	woodland, grassland	
Martof et al. 1980	Jun		Jul	Virginia, Carolinas	NS	
Smith 1956	Jun		Jul	Kansas	NS	
Vermersch & Kuntz 1986 (flaviventris)	Jun		earl Aug	Texas	NS	
HATCHING						
Brown & Parker 1984 (mormon)		mid-late Aug		Utah 1969-73	desert shrub	
DeGraaf & Rudis 1983 (constrictor)	late Aug		Sept	NS	NS	
Fitch 1963 (flaviventris)	late Aug		earl Sep	Kansas 1949-62	woodland, grassland	

Reference	Begin	Peak	End	Location	Habitat	Notes
Smith 1956	Aug		Sept	Kansas	NS	Based on laying season and incubation period.
Vermersch 1986 (flaviventris)	Aug		Sept	Texas	NS	
HIBERNATION						
Brown & Parker 1982 (mormon)	earl Oct		earl May	Utah 1969-73	cold desert shrub	
Fitch 1963 (flaviventris)	late Nov		earl Apr	Kansas 1949-62	woodland, grassland	Earliest and latest time active racers were found.

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***** NORMALIZING AND CONTACT RATE FACTORS *****

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
BODY WEIGHT (AND LENGTH)													
Alexander 1977	A	B	-	-	220.0		g			38	s lower Michigan	stream, lake	Length of snakes not specified.
Brown 1958 (sipedon)	J	B	1	SU	7.0	2.3 SD	g (285 mm)	5.3	10.4	4	New York 1938	captive	Snakes nearing the end of their (1) first; (2) second; (3) third; and (4) fifth or sixth year of life. Length is total length.
	J	B	2	SU	29.0		g (496 mm)	25.2	32.7	2			
	J	M	3	SU	53.2		g (607 mm)			1			
	A	B	4	SU	210.0	65.0 SD	g (868 mm)	114.0	255.0	4			
Fitch 1982	A	B	-	-	207.0		g		480	206	Kansas 1948-77	ponds, streams	Length of snakes not specified.
BODY LENGTH													
Beatson 1976 (sipedon)	J	B	1	-			mm SVL	180	340		Kansas 1972	stream	Length measured from snout to vent (SVL). Age of snakes: (1) one year; (2) two or more years.
	B	M	2	-			mm SVL	340	660				
	B	F	2	-			mm SVL	340	840				
Behler & King 1979	N	B	-	-			mm SVL	165	300		NS	NS	Newborn snakes. Length measured from snout to vent (SVL).
Behler & King 1979	A	B	-	-			mm SVL	559	1346		NS	NS	Length measured from snout to vent (SVL).
King 1989 (insularum)	A	M	-	-	620		mm SVL			398	Ohio, Ontario CAN 1980-85	shore, islands of Lake Erie	Weighted average. Length measured from snout to vent (SVL).
	A	F	-	-	745		mm SVL			313			
King 1986 (insularum)	J	B	1	SP			mm SVL	155	225		Ohio, Ontario CAN 1980-84	Lake Erie islands	(1) Young of the year; (2) snakes from 1-3 years old. Length measured from snout to vent (SVL).
	J	B	1	FA			mm SVL	270	340				
	J	M	2	-			mm SVL	270	430				
	J	F	2	-			mm SVL	270	590				
King 1986 (insularum)	A	M	BR	SP	625		mm SVL	520	730	27	Ohio, Ontario CAN 1980-84	Lake Erie islands	Snakes captured while courting. Length measured from snout to vent (SVL). Adults defined as male snakes >430 mm SVL and females >590 mm SVL (greater than 3 years old).
	A	F	BR	SP	821		mm SVL	660	1,000	18			

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Raney & Roecker 1947 (sipedon)	J	B	0	-	200-250		mm total				New York 1942, 1946	creeks	Measure reflects total length of snakes. Juveniles in their (0) first fall and spring; (1) second fall and spring. Collected from May-Sept. Maximum values are the largest snakes found in a collection of 59.
	J	B	1	-	360-400		mm total						
	A	F	-	-			mm total		980	59			
	A	M	-	-			mm total		780	59			
Wright & Wright 1957	A	M	-	-			mm total	635	1,148		NS	NS	Measure reflects total length of snakes. As cited in DeGraaf and Rudis 1983.
	A	F	-	-			mm total	650	1,295				
NEONATE WEIGHT													
Feaver 1977 (sipedon)	N	B	-	-	5		g			NS	Michigan	pond, marshes	Length measured from snout to vent (SVL). As cited in King 1986.
	N	B	-	-	(188)		(mm SVL)			NS			
Fitch 1982	N	B	-	-	5.0		g	3.6	6.8	57	Kansas 1948-77	ponds, streams	Length of snakes not specified.
King 1986 (insularum)	N	B	-	-	4.8		g	3.6	6.6	893	Ohio, Ontario CAN 1980-84	Lake Erie islands	Length measured from snout to vent (SVL).
	N	B	-	-	(181)		(mm SVL)	125	210	893			
Martof et al. 1980	N	B	-	-	200		mm SVL				NS	NS	Length measured from snout to vent (SVL) of young.
NEONATE LENGTH													
Beatson 1976 (sipedon)	N	B	-	-			mm SVL	135	220	263	Kansas 1972	stream	Length measured from snout to vent (SVL).
GROWTH RATE													
Brown 1958 (sipedon)	J	B	1	SU	1.0	0.43 SD	mm/day	0.46	1.5	4	New York 1938	captive	Daily growth rate during the summer (July-Aug). Mean temperature was 28 C. Snakes nearing the end of their (1) first; (2) second; (3) third; and (4) fourth year of life. Converted from weekly growth rate.
	J	B	2	SU	0.77		mm/day	0.77	0.78	2			
	J	M	3	SU	0.42		mm/day			1			
	A	B	4	SU	1.0	0.31 SD	mm/day	0.71	1.4	4			
Brown 1958 (sipedon)	J	B	1	SU	0.18	0.08 SD	g/day	0.13	0.27	4	New York 1938	captive	Daily growth rate during the summer (July-Aug). Mean temperature was 23 C. Snakes nearing the end of their (1) first; (2) second; (3) third; and (4) fifth or sixth year of life. Converted from weekly growth rates.
	J	B	2	SU	0.42		g/day	0.40	0.45	2			
	J	M	3	SU	0.80		g/day			1			
	A	B	4	SU	2.59	0.58 SD	g/day	1.74	3.02	4			

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
King 1986	B	F	1	-	0.12		mm SVL/day			56	Ohio 1980-84	Lake Erie islands	Annual growth rate for: (1) juveniles (1-3 years old) and adults; (2) young-of-the year. Length measured from snout to vent (SVL). Measured from May-Sept (most growth occurs during this period) and then adjusted to represent an annual rate. Highest growth rate for young-of-the year occurred from late July to mid August.
	B	M	1	-	0.14		mm SVL/day			42			
	Y	B	2	-	0.33		mm SVL/day			364			
METABOLIC RATE (OXYGEN)													
Gratz & Hutchinson 1977 (Nerodia rhombifera, a similar species)	B	B	1	-	0.607	0.0348 SE	lO2/kg-day	0.389	0.938	219	Oklahoma	lab	24 hour mean resting metabolism in Nerodia rhombifera (weights from 60g-1,400g). Snakes acclimated at a 12:12 light:dark photoperiod and at a temperature of (1) 15 C; (2) 25 C; (3) 35 C. Snakes exhibited significant daily cycles at 15 C and 35 C. Time of day (CDT) for min and max (respectively) were: (1) 2200-2400 and 1200; (2) 0100-0200 and 0800; and (3) 1100-1200 and 0700. N = number of animal hours used to determine mean value.
	B	B	2	-	3.29	0.101 SE	lO2/kg-day	2.81	4.44	240			
	B	B	3	-	7.33	0.226 SE	lO2/kg-day	5.70	9.99	235			
FOOD INGESTION RATE													
Brown 1958 (sipedon)	J	B	1	SU	0.088		g/g-day			4	New York 1938	captive	Mean temperature during study was 23 C. Snakes nearing the end of their (1) first; (2) second; (3) third; and (4) fifth or sixth year of life. Mean weight and length of the study groups are presented under "body weight". Snakes were all fed fish, except one of the adults was fed only frogs. Converted from % of body weight eaten per week; snakes did not eat every day.
	J	B	2	SU	0.043		g/g-day			2			
	J	M	3	SU	0.043		g/g-day			1			
	A	B	4	SU	0.061		g/g-day			4			
Brown 1958 (sipedon)	B	B	-	-	0.26	0.10 SD	g/g-day	0.11	0.43	19	New York 1938	captive	"Maximum" meals for empty snakes; snakes were fed fish and/or frogs until they refused to take more food. After a "maximum" meal the snakes generally refused food for the next 3-5 days. Temperature during study not specified.

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes

SURFACE AREA

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Baeyens & Rountree 1983 (Nerodia rhombifera, a similar species)	-	-	-	-	131.16		cm2			15	Arkansas 1981	pond	Length measured from snout to vent (SVL). This species (N. rhombifera) is not N. sipedon, but is a similar species.
	-	-	-	-	(155)		(mm SVL)						

BODY TEMPERATURE

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Justy & Mallory 1985 (sipedon)	A	-	1	-	30.4	0.4 SE	degrees C			3	Ontario, CAN 1980	lab	Mean internal temperature selected by snake when exposed to thermal gradient from 12-45 C in a: (1) lighted cage-morning; (2) lighted cage-afternoon; (3) dark cage-morning; and (4) dark cage-afternoon.
	A	-	2	-	34.0	0.2 SE	degrees C			3			
	A	-	3	-	32.0	0.4 SE	degrees C			3			

***** DIET *****

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Alexander 1977	B	B	trout		64			28	n lower Michigan	streams - % wet weight; stomach contents	Collected whenever they were found; thought to be active in area from May-Sept.
			non-trout fish		7						
			unidentified fish		1						
			crustaceans		1						
			amphibians		14						
			birds and mammals		12						
			unidentified		1						
Alexander 1977	B	B	trout		4			9	n lower Michigan	lake - % wet weight; stomach contents	Collected whenever they were found; thought to be active in area from May-Sept.
			non-trout fish		8						
			crustaceans		15						
			birds and mammals		2						
			amphibians		68						
			unidentified		3						
Barbour 1950 (sipedon)	-	-	unidentified fish		50.0			8	se KY 1939,1948	fork of a river - % volume; stomach contents	Collected in June, July. Presumed that the unidentified detritus was from the intestines of the fish. A specimen from a small woodland stream at 2450 ft. elevation contained the remains of two large Desmosnathus fuscus.
			Rana sp. tadpoles		12.5						
			Cambarus sp.		12.5						
			unidentified detritus		25.0						

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Brown 1958 (sipedon)	B	B	minnows		7.7			120	c New York 1933-38	rocky streams - % volume; stomach contents	Months of collection and size of snakes not specified.
			darters		3.1						
			suckers (Catostomus)		35.4						
			sculpin (Cottus)		1.4						
			catfish		9.3						
			lamprey		23.0						
			game fishes		1.2						
			unidentified fish		1.6						
			amphibians		17.3						
Brown 1958 (sipedon)	B	B	minnows			9.1		48	n lower MI 1933-38	lakes - % volume; stomach contents	Months of collection and size of snakes not specified.
			darters			1.4					
			amphibians			52.8					
			sculpin (Cottus)			2.2					
			trout perch (Percops			2.8					
			game fishes (Perca)			14.1					
			burbot (Lota)			17.4					
			catfish			0.3					
Brown 1958 (sipedon)	J	B	minnows		26.0			73	NY,MI 1933-38	streams, lakes, bog - % volume; stomach contents	Snakes estimated to be in their first year of life (207-380 mm total length). Months of capture not specified.
			darters		27.0						
			amphibians		18.0						
			sculpin (Cottus)		10.0						
			suckers (Catostomus)		7.0						
			catfish		1.7						
			troutperch (Percopsi		5.6						
			game fish (Micropter		5.0						
			unidentified fish		0.3						
Bush 1959 (sipedon)	-	-	Cyprinidae		42.8			7	Kentucky 1955-56	fork of river - % wet volume; stomach contents	
			Centrarchidae		28.5						
			Rana c.melanota		14.3						
			Eurycea b. rivicola		14.3						
Camp et al. 1980 (pleuralis)	-	-	Esocidae		7.0			14	Georgia 1977-79	aquatic (NS) - % wet volume; stomach contents	Percent volume measured by water displacement. Age, sex, size class, and season not specified.
			Catostomidae		22.5						
			Percidae		15.7						
			Proteidae		51.9						
			Cyprinidae		1.5						
			Centrarchidae		0.3						
			crawfish		1.5						
Lagler & Salyer 1945 (sipedon)	B	B	trout		19.0			106	lower Michigan 1944	trout streams - % volume; stomach contents	Mean length for entire study (N=287) = 620 mm total length. Most fish were between 3.8-12.5 cm in length. Number and size of prey (but not % volume) are listed in the reference.
			lampreys		3.3						
			forage fishes		55.8						
			fish remains		0.2						
			burbot		7.3						
			frogs		12.8						
			misc. invertebrates		1.6						

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Lagler & Salyer 1945 (sipedon)	B	B	game and pan fishes forage fishes other fishes fish remains frogs and salamander rodents		19.3 23.4 2.9 1.8 52.6 TR			18	lower Michigan 1944	inland lakes - % volume; stomach contents	Mean length for entire study (N=287) = 620 mm total length. Collected from May-Sept.; mostly in July-August. Most fish were between 2.5-10.0 cm in length. Number and size of prey found (but not % volume) are listed in the reference. TR = trace.
Lagler & Salyer 1945 (sipedon)	B	B	trout bass or sunfish forage fishes other fishes fish remains Amphibia Insecta misc. invertebrates		48.9 TR 44.0 3.8 1.4 1.1 0.5 0.3			64	lower Michigan 1944	trout-rearing stations - % volume; stomach contents	Mean length for entire study (N=287) = 620 mm total length (range 210-970 mm total length). Collected from May-Sept.; mostly during July & August. Mean size of trout = 4.8 cm (range 21.6-2.5 cm); greatest number eaten by one snake was 26; mean for all snakes collected was 2.5. Reference lists the number of each species caught but does not give volume estimates based on the species breakdown. TR = trace.
Raney & Roecker 1947 (sipedon)	B	B	suckers minnows catfish mudminnows darters fish remains Rana sp. tadpoles		39.9 29.0 3.7 2.7 5.3 15.2 4.2			59	w New York 1942, 1946	creeks - % volume; stomach contents	All size classes; 20-98 cm total length. Most eating fish had only one specimen in their stomach.
Uhler et al. 1939 (sipedon)	-	-	fish frogs & toads salamanders insects other		61 21 12 2.5 3.5			30	Virginia	habitat NS - % by volume	Season, age, and sex not specified. As cited in Raney and Roecker 1947.

***** POPULATION DYNAMICS *****

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
POPULATION DENSITY													
Beatson 1976 (sipedon)	B	B	-	SU	34-41		N/km			197	Kansas 1972	stream	Density per km of stream. 197 snakes captured; estimated to be 75 to 90% of the population. Measured prior to the birth of young of the year.

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Fitch 1982	B	B	-	-	0.131		N/ha				Kansas 1957-61	forest, streams, shrubs, prairies	Count excludes young of the year. Rough estimate based on comparison with more commonly found associated species censused by capture-recapture ratios.
King 1986 (insularum)	A	B	-	-	138		N/km	22	381	5	Ohio, Ontario CAN 1980-84	Lake Erie islands	Density per km of shoreline of snakes from five islands.
Lagler & Salyer 1945 (sipedon)	B	B	-	SU	160		N/km				lower Michigan 1944	streams	Estimate of number of snakes per km of stream based on observations of 32 snakes and authors assumption that this is only a fraction of the total population.
LITTER SIZE (young born live)													
Aldridge 1982	-	-	1	-	17	5 SD		9	42	15	e c Missouri 1976-79	streams	Size of females:(1) 570-700 mm SVL; (2) >700 mm SVL. Estimated based on figure 4.
	-	-	2	-	23	7 SD		15	63	16			
Bauman & Metter 1977 (sipedon)	-	-	-	-				15	63	55	Missouri	NS	
Beatson 1976 (sipedon)	-	-	-	-	18.8					14	Kansas 1972	stream	
Behler and King 1979	-	-	-	-	15-30			8	99		NS	NS	
Camin & Erlich 1958 (insularum)	-	-	-	-	20.8	8.2 SD		6	34	14	Ohio, Ontario CAN 1980-84	Lake Erie islands	
DeGraaf & Rudis 1983 (sipedon)	-	-	-	-	30			10	76		NS	NS	
Feaver 1977 (sipedon)	-	-	-	-	11.8			4	24	43	Michigan	pond, marshes	As cited in King 1986.
King 1986 (insularum)	-	-	-	-	22.9			9	50	39	Ohio, Ontario CAN 1980-84	Lake Erie islands	Litter size (because viviparous) increases with increasing female size.
Martof et al. 1980 (sipedon)	-	-	-	-				8	50		Carolinas, Virginia	NS	

Reference	Age Sex Cond Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Smith 1961 (sipedon)	- - - -	18			8	51	6	Illinois	captive	Text notes average brood size is smaller than that noted for N.s. pleuralis.
Smith 1961 (pleuralis)	- - - -	33			13	52	3	Illinois	NS	Author notes the average brood size is "much smaller" than this sample suggests.
Smith 1956 (sipedon)	- - - -				10	76		Kansas	NS	Clutch size positively correlated with female body size.
LITTERS/YEAR										
Bauman & Metter 1977 (sipedon)	- - - -	1		/yr				c Missouri 1973	fish hatchery	
Beatson 1976 (sipedon)	- - - -	1		/yr				Kansas 1972	stream	
DAYS GESTATION										
Bauman & Metter 1977 (sipedon)	- - - -	58		days				c Missouri	fish hatchery	The rate of development is temperature dependent and is likely to vary somewhat from year to year and by location.
AGE AT SEXUAL MATURITY										
Bauman & Metter 1977 (sipedon)	- F - - - M - -	2-3 21		years months				c Missouri 1973	fish hatchery	
Feaver 1977 (sipedon)	- F - - - M - -	34 23-24		months months				Michigan	pond, marshes	As cited in King 1986.
King 1986 (insularum)	- F - - - M - -	3 2		years years				Ohio, Ontario CAN 1980-84	Lake Erie islands	Growth of multiply recaptured individuals.
LENGTH AT SEXUAL MATURITY										
Aldridge 1982	- F - -	600		mm SVL	570		31	e c Missouri 1976-79	streams	Length measured from snout to vent (SVL). Largest immature female found was 680 mm SVL.

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Feaver 1977 (sipedon)	-	F	-	-			mm SVL	476	649		Michigan	pond, marshes	Length measured from snout to vent (SVL). As cited in King 1986.
	-	M	-	-			mm SVL	375	425				
King 1986 (insularum)	-	F	-	-	590		mm SVL				Ohio, Ontario CAN 1980-84	Lake Erie islands	Length measured from snout to vent (SVL).
	-	M	-	-	430		mm SVL						

***** SEASONAL ACTIVITIES *****

Reference	Begin	Peak	End	Location	Habitat	Notes
MATING						
Bauman & Metter 1977 (sipedon)	mid May		mid Jun	c Missouri 1973	fish hatchery	
Behler & King 1979	Apr		Jun	NS	NS	
Feaver 1977 (sipedon)		May		Michigan	pond, marshes	As cited in King 1986.
King 1986 (insularum)	May 11		Jun 11	Ohio, Ontario CAN 1980-84	Lake Erie islands	Season for courtship behavior.
Smith 1956 (sipedon)		Apr-May		Kansas	NS	Spring mating season.
PARTURITION						
Aldridge 1982 (sipedon)		late Aug		e c Missouri 1976-79	streams	
Bauman & Metter 1977 (sipedon)	late Aug		earl Sep	c Missouri 1973	fish hatchery	
Behler & King 1979	Aug		Oct	NS	NS	
Feaver 1977 (sipedon)	mid Aug		mid Sep	Michigan	pond, marshes	As cited in King 1986.
King 1986 (insularum)	Aug 18		Sep 27	Ohio, Ontario CAN 1980-84	Lake Erie islands	
Martof et al. 1980 (sipedon)		late summer		Virginia, Carolinas	NS	

Reference	Age Sex Cond Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Smith 1961 (sipedon)	late Aug			Sep				Illinois	NS	
Smith 1961 (pleuralis)	Aug			Sep				Illinois	NS	
Smith 1956 (sipedon)	Aug			Oct				Kansas	NS	
HIBERNATION										
Feaver 1977 (sipedon)	Nov			late Mar				Michigan	pond, marsh	Hibernation determined from earliest and latest capture dates. As cited in King 1986.
King 1986 (insularum)	mid Oct			mid Apr				Ohio, Ontario CAN 1980-84	Lake Erie islands	Hibernation based on earliest and latest capture dates.

***** EASTERN NEWT *****

*** NORMALIZING AND CONTACT RATE FACTORS ***

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
BODY WEIGHT (AND LENGTH)													
Burton 1977 (viridescens)	E	B	-	-	1.45		g			36	New Hampshire 1970-72	beech/maple/birch forest	Length of efts (E) was not specified.
Gill 1979	A	F	1	SU	2.51	0.04 SE	g			121	Virginia 1975-76	mountain ponds	Post breeding newts in control years for the Lower Feedstone pond. Year: (1) 1975; (2) 1976. Sampled in July.
	A	F	2	SU	2.27	0.04 SE	g			99			
	A	M	1	SU	2.82	0.04 SE	g			124			
	A	M	2	SU	2.63	0.03 SE	g			170			
Gillis & Breuer 1984	A	B	-	-	2.24	0.71 SD	g (91 mm total)	1.12	3.52	20	New York	NS	Length measure is total length of eft (E).
	E	B	-	-	1.10	0.40 SD	g (71 mm total)	0.42	1.82	36			
Gill 1979	A	M	1	SP	2.21	0.30 SD	g			86	Virginia 1977	mountain ponds	Age of adults: (1) first year as adult; (2) second year as adult; and (3) third or fourth year as adult. Sampled on April 9.
	A	M	2	SP	2.27	0.39 SD	g			62			
	A	M	3	SP	2.50	0.34 SD	g			203			
	A	F	1	SP	2.43	0.32 SD	g			60			
	A	F	2	SP	2.60	0.43 SD	g			30			
	A	F	3	SP	2.70	0.42 SD	g			52			
Gill 1979	A	F	1	SP	3.05	0.06 SE	g			45	Virginia 1975	mountain ponds	Weights of (1) pre-breeding (March 27-April 3); and (2) post-breeding (July 22) adult newts in Upper Feedstone Pond.
	A	F	2	SU	2.49	0.06 SE	g			48			
	A	M	1	SP	2.49	0.03 SE	g			89			
	A	M	2	SU	2.76	0.03 SE	g			138			
Morin 1986 (viridescens)	A	B	-	SP	2.91		g (44 mm SVL)				New Jersey 1984	ponds	Length measured was from snout to vent (SVL).
Pitkin 1983	A	B	-	SU	2.13	0.44 SD	g (44 mm SVL)			27	Massachusetts 1980	shallow pond	Data from mid-July, mid-January, mid-March, and the end of November. Length measured was from snout to vent (SVL).
	A	B	-	WI	1.94	0.33 SD	g (42 mm SVL)			20			
	A	B	-	SP	1.71	0.43 SD	g (43 mm SVL)			21			
	A	B	-	FA	1.63	0.28 SD	g (42 mm SVL)			21			
Stefanski et al. 1989	E	B	-	SU	1.23		g	0.63	2.17	27	New York 1986	NS	Age (E) = eft.
Taylor et al. 1988	L	B	-	SU	0.044	0.025 SD	g (13 mm SVL)			22	S Carolina 1984	pond, wetlands	Age (E) = eft. Length of larvae (L) measured from snout to vent (SVL). Data are from June and early September.
	L	B	-	FA	0.54	0.17 SD	g (22 mm SVL)			12			

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
BODY LENGTH													
Behler & King 1979	A	-	-	-	65-104		mm total				NS	NS	Total adult length.
Behler & King 1979	H	-	-	-	8		mm total				NS	NS	Total length of hatchling (H) larvae.
Behler & King 1979	E	-	-	-	35-86		mm total				NS	NS	Total length of eft (E).
Brophy 1980	L L	B B	- -	SP FA	12.3 19.2		mm SVL mm SVL				s Illinois 1976	shallow pond	Length of larvae (L) in May and September; total sample size was 68. Most transformed and left the pond by mid-September. Length measured from snout to vent (SVL).
Harris 1989 (dorsalis)	H L E A A P P	B B B M F M F	- - - - - - -	- - - - - - -	4.8 13.0 23.0 30.7 31.90 33.0 34.0	0.04 SE 0.41 SE 0.18 SE 0.77 SE 1.52 SE 0.44 SE 0.44 SE	mm SVL mm SVL mm SVL mm SVL mm SVL mm SVL mm SVL			25 124 58 24 8 18 31	N Carolina 1988	lab	Age (L) = larvae, age (H) = hatchling, (P) = paedomorph (sexually mature larval form), (E) = eft. Length measured from snout to vent (SVL).
Harris et al. 1988 (dorsalis)	A A	M F	- -	- -	35 35.0		mm SVL mm SVL	24 20	44 42		N Carolina 1983-84	shallow pond	Estimated from Figure 3. Length measured from snout to vent (SVL).
Harris et al. 1988 (dorsalis)	E	B	-	-	50.4	0.5 SE	mm total			73	N Carolina 1984	edge of shallow pond	Recently metamorphosed efts (E) with visible gill stumps. Total length measured.
Harris et al. 1988 (dorsalis)	L L L L L	B B B B B	1 2 3 4 5	- - - - -	10.0 26.0 32.0 37.3 47.8	 4.9 SE 6.1 SE	mm total mm total mm total mm total mm total			 156 25	N Carolina 1983-84	shallow pond	Age of larval (L) newts (May 1 = day 1): (1) 10 days; (2) 60 days; (3) 80 days; (4) late in larval period (approximate days 105-125) in 1983; and (5) late in larval period in 1984. Density of larvae in 1983 was much higher than the density in 1984. Total length measured.
Healy 1973 (viridescens)	J J J J J J	B B B B B B	1 2 3 4 5 6	SP SP SU SU SU SU	26.1 26.5 31.0 30.4 33.6 33.20	0.35 SE 0.17 SE 0.32 SE 0.45 SE 0.20 SE 0.41 SE	mm SVL mm SVL mm SVL mm SVL mm SVL mm SVL	20 22 26 26 27 29	32 31 36 33 38 36	50 109 56 20 116 25	Massachusetts 1961-65	coastal pond	Aquatic juveniles (J): have metamorphosed from larvae but are not sexually mature. Age: (1) 12 months Apr 1962; (2) 12 months Apr 1965; (3) 14 months June 1962; (4) 14 months June 1963; (5) 15 to 16 months July-Aug 1964; (6) 15 to 16 months July-Aug 1961. Length measured from snout to vent (SVL).

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Healy 1973 (viridescens)	E	B	1	SP	20.5		mm SVL				Massachusetts 1968-70	oak/pine woodland	Age (from time of hatching) of terrestrial efts (E): (1) one year; (2) 2 years; (3) 3 years; and (4) 4 years. Estimated from Figure 3. Length measured from snout to vent (SVL).
	E	B	2	SP	25.0		mm SVL						
	E	B	3	SP	31.0		mm SVL						
	E	B	4	SP	33.0		mm SVL						
	E	B	4	FA	37.5		mm SVL						
Hurlbert 1970	E	B	-	-			mm total	28	47		s c New York 1963-65	ponds, woods	Total length of migrating newly metamorphosed efts (E).
MacNamara 1977	A	B	-	SU	38.9		mm SVL	33	48	79	New York 1973	surface of leaf litter in forest	Adult migrants (aquatic adults using terrestrial habitats) and efts (E) caught in July and August. Length measured from snout to vent (SVL).
	E	B	-	SU	32.7		mm SVL	18	41	92			
Smith 1961	E	-	-	-	39-81		mm total				Illinois	NS	Total length of eft (E).
GROWTH RATE													
Harris 1987 (dorsalis)	E	-	1	SU	0.00635		g/day			2	N Carolina	outdoor labs	Growth rate of larvae becoming (E) efts, (A) mature adults, and (P) paedomorphs at two different densities of larvae; initial density: (1) 220 larvae/ha; (2) 55,000 larvae/ha.
	E	-	2	SU	0.00310		g/day			180			
	A	-	1	SU	0.00685		g/day			11			
	A	-	2	SU	0.00421		g/day			11			
	P	-	1	SU	0.00676		g/day			49			
	P	-	2	SU	0.00536		g/day			21			
Healy 1973 (viridescens)	E	B	-	-	6.6		mm SVL/yr			36	Massachusetts 1968-70	forest, pond	Annual growth of terrestrial efts (E) and aquatic juveniles (J). Eft stage lasts about 4 years; aquatic juveniles become sexually mature after 2 years (two-year stage).
	J	B	-	-	12.9		mm SVL/yr						
METABOLIC RATE (OXYGEN)													
Stefanski et al. 1989	E	-	R	-	1.47		lO2/kg-day			13	New York 1986	lab	Efts (E) at 15 C: (R) Resting; (E) exercising, i.e., forced activity. Mean weight of efts was 1.23 g.
	E	-	E	-	4.27		lO2/kg-day			12			

***** DIET *****

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Brophy 1980	L	B	Cypridae (Ostracoda)		61.3			68	s Illinois 1976	shallow pond - % dry weight; gut contents - 12-21 mm SVL	Larval (L) diet: items comprising <0.5 % not listed here. Plant matter found in guts was though to have been incidentally ingested and was not included in % dry weight determinations.
			Physa sp. (Gastropoda)		22.4						
			Chironomidae (Diptera)		1.7						
			Aphididae (Homoptera)		0.9						
			Chaoborus sp. (Diptera)		0.8						
			Macrocyclops albidus (Copepoda)		0.8						
Burton 1977 (viridescens)	A	B	Ephemeroptera		7.5	7.5			New Hampshire 1970-71	small oligotrophic lake - % wet weight; stomach and gut contents	Diet of aquatic adults. Wet weight estimated from linear measurements, calculated volume and specific gravity of 1.05. Summer data were collected on two days in July 1970; fall data were collected on October 3, 1971.
			Odonata		31.9	1.9					
			Lepidoptera		13.7	0.9					
			Diptera		5.8	0.3					
			other insects		9.9	0.6					
			Cladocerans		5.1	84.1					
			Amphipoda		5.6	3.1					
			Pelycepoda		6.2	1.5					
			N. viridiscens larva		11.4	0					
			other		3.2	0.1					
			(sample size)		(40)	(35)					
Burton 1976	E	B	mites		3.4			35	New Hampshire 1970-72	beech/maple/birch forest - % wet weight; stomach and gut contents	Diet of terrestrial eft (E). Wet weight estimated from linear measurements, calculated volume and specific gravity of 1.05.
			Collembola		9.1						
			Homoptera		4.0						
			Coleoptera		4.6						
			Diptera		10.5						
			Lepidoptera larva		2.3						
			Araneida		2.3						
			Gastropoda		59.7						
			Thysanoptera		0.6						
			Hemiptera		0.8						
			unidentified insects		1.4						
			other		0.4						
Burton 1977 (viridescens) (continued)	L	B	Zygoptera (Odonata)		0.8			20	New Hampshire 1970	small oligotrophic lake - % wet weight; stomach and gut contents	Diet of larvae (L). Wet weight estimated from linear measurements, calculated volume, and specific gravity of 1.05. Collected in August.
			Chironomidae (Diptera)		16.2						
			Cladocera		12.7						
			Ostracoda		5.3						
			Hyallela azteca (Amphipoda)		55.1						
(continued)			Sphaerium sp. (Pelycepoda)		9.4						

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Burton 1977 (viridescens) (continued)			Planorbidae (Gastropoda)		0.5						
			Rhizopoda (Protozoa)		0.01						
MacNamara 1977	A	B	Basommatophora		1.60			79	New York 1973	leaf litter surface in forest - % dry weight; stomach contents	Adult migrants (aquatic adults using terrestrial habitat). Mean snout to vent length (SVL) was 38.9 mm SVL (range 33 to 48 mm SVL). Items comprising <1.5 % not listed here.
			Stylommatophora		25.2						
			Acari		1.8						
			Collembola		5.6						
			Thysamoptera		2.5						
			Homoptera		3.5						
			Coleoptera (adult and larvae)		2.3						
			Lepidoptera larvae		19.7						
			Diptera adult		9.0						
			Diptera larvae		18.80						
			Hymenoptera adult		4.2						
MacNamara 1977	E	B	Basommatophora		5.5			92	New York 1973	leaf litter surface in forest - % dry weight; stomach contents	Eft (E) diet. Mean snout to vent length (SVL) of efts was 32.7 mm SVL (range 18-41 mm SVL). Items comprising <1.5 % not listed here.
			Stylommatophora		18.3						
			Acari		13.8						
			Collembola		10.4						
			Thysanoptera		3.4						
			Homoptera		4.7						
			Coleoptera adult		2.3						
			Coleoptera larvae		3.5						
			Lepidoptera larvae		7.9						
			Diptera adult		9.7						
			Diptera larvae		10.6						
			Hymenoptera adult		5.8						
Ries & Bellis 1966	A	B	Sphaeriidae (Pelecypoda)	4	4				c Pennsylvania 1963	shallow pond - % of total number of prey items; stomach contents	Spring newts collected in April and May; summer collected in June. N = number of prey items; total number of newts was 179 in spring and 89 in summer. Items comprising <1 % in both seasons not listed here.
			Enchytraeidae (Oligochaeta)	1	-						
			Crustacea	2	5						
			Pionidae (Arachnoidae)	2	-						
			Ephemeridae (Ephereroptera)	25	1						
			Odonata	2	3						
			Hemiptera	<1	6						
			Trichoptera	29	6						
			Coleoptera	1	21						
			Culicidae (Diptera)	12	2						
			Simuliidae (Diptera)	1	<1						
			Tendipedidae (Diptera)	14	47						
			Ceratopogonidae (Diptera)	6	4						
			(sample size)	(701)	(252)						

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Taylor et al. 1988	L	B	cladocerans copepods dipterans other crustaceans other		73 <1 6 20 <1	42 0 39 19 <1			S Carolina 1984	pond, wetland - % of number of items; gut contents	Larval (L) diet estimated from bar graphs of proportion of principal prey in the diet.

***** POPULATION DYNAMICS *****

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
HOME RANGE SIZE													
Bellis 1968 (viridescens)	A	-	-	SU	6.86		m				Pennsylvania 1962	small pond	Mean distance between capture and recapture sites.
Healy 1975 (viridescens)	E E	B B	1 2	- -	00.0087 0.0267		ha ha	0.00284 0.00954	0.01528 0.04661	10 10	Massachusetts 1969-71	oak/pine forest	Terrestrial home ranges of efts (E) estimated using: (1) Minimum polygon method; (2) radius method. Average captures = 7.3/eft. Average snout to vent length (SVL) = 31 mm.
POPULATION DENSITY													
Bellis 1968 (viridescens)	A A	M F	- -	SU SU	16,300 4,700		N/ha N/ha				Pennsylvania 1962	small pond	Estimate based on the number of newts observed between late June and late August.
Burton 1977 (viridescens)	A A	B B	1 2	SU SU	130-173 50-2,600		N/ha N/ha			2 2	New Hampshire 1971-72	small oligotrophic lake	Density of adult newts in (1) entire 15 ha lake and (2) in 1 ha portion of utilized habitat. Newt distribution was highly correlated with the distribution of rooted macrophytes in water <2 m deep so that most newts were found in scattered portions of the lake which totalled only about 1 ha. Population size determined by SCUBA quadrat technique (after Bennett 1970). N = number of yearly estimates.
Harris et al. 1988 (dorsalis)	L L L L	B B B B	1 2 3 4	- SP SU FA	0-5,000 65,000 25,000 10,000	 15,000 SE 5,000 SE 3,000 SE	N/ha N/ha N/ha N/ha			120 20 20 20	N Carolina 1984	shallow pond	Larval (L) density estimated from Figure 1. Month of samples: (1) December - mid-May; (2) late May; (3) July; and (4) early September. N = number of samples.

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Harris et al. 1988 (dorsalis)	L	B	1	-	0		N/ha			86	N Carolina 1983	shallow pond	Larval (L) density estimated from Figure 1. Month of sample: (1) February - mid-May; (2) late May; (3) July; (4) early September; and (5) late October. N = number of samples.
	L	B	2	SP	65,000	20,000 SE	N/ha			20			
	L	B	3	SU	230,000	30,000 SE	N/ha			20			
	L	B	4	FA	140,000	20,000 SE	N/ha			20			
	L	B	5	FA	10,000	3,000 SE	N/ha			20			
Harris et al. 1988 (dorsalis)	A	B	1	WI	14,000	4,000 SE	N/ha			20	N Carolina 1984	shallow pond	Estimated from Figure 1. Month of sample: (1) January; (2) late March; (3) early July, early August, and September; and (4) November. N = number of samples.
	A	B	2	SP	9,000	3,000 SE	N/ha			20			
	A	B	3	SU	2,000	500 SE	N/ha			60			
	A	B	4	FA	7,000	2,000 SE	N/ha			20			
Harris et al. 1988 (dorsalis)	A	B	1	WI	50,000	9,000 SE	N/ha			10	N Carolina 1983	shallow pond	Estimated from Figure 1. Month of sample: (1) February; (2) March; (3) May; (4) July - August; and (5) October. N = number of samples.
	A	B	2	SP	22,000	5,000 SE	N/ha			16			
	A	B	3	SP	5,000	2,000 SE	N/ha			20			
	A	B	4	SU	3,000	1,000 SE	N/ha			60			
	A	B	5	FA	8,000	3,000 SE	N/ha			20			
Healy 1975 (viridescens)	E	B	-	SP	300		N/ha			478	Massachusetts 1969	oak/pine forest	Eft (E) density.
Shure et al. 1989 (viridescens)	E	B	-	SU	34		N/ha	20	50	6	N Carolina 1987	mixed deciduous forest	Average of eft (E) density estimates made from single searches of area 1400-4500 square meters in size.
Taylor et al. 1988	L	B	-	SP	21,000		N/ha	0	350,000	18	S Carolina 1984	pond, wetland	Larval (L) density. Data collected 5/20/87; in April and March, none were present.
CLUTCH SIZE													
Behler & King 1979	-	-	-	-	200-400		eggs				NS	NS	
Gill 1978a	-	-	-	-	2.63		N survive	0	37.67	14	Virginia 1974-76	mountain ponds	Juveniles (efts) produced per breeding adult female. Average of five ponds over three years; regional variance = 8.30.
DAYS INCUBATION													
Behler & King 1979 (viridescens)	-	-	-	-	21-56		days				NS	NS	
Gage 1891	-	-	-	-	20-35		days				New York	ponds	As cited in Hurlbert 1970.

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Logier 1952 (viridescens)	-	-	-	-	21-35		days				NS	NS	As cited in DeGraaf and Rudis 1983.
Smith 1961	-	-	-	-	14-21		days				Illinois	NS	
Smith 1956 (viridescens)	-	-	-	-	20-35		days				e Kansas	NS	This information is likely to be based on Bishop 1941.
TIME TO METAMORPHOSIS													
Gibbons & Semlitsch 1991	E	-	-	-	1-3		years				S Carolina	ponds	Estimated duration of the eft (E) stage.
Healy 1974 (viridescens)	L	-	-	-	6		months				Massachusetts 1960-71	inland ponds	Larval (L) period (from hatching until metamorphosis to eft).
Hurlbert 1970	L	-	-	-	2		months				New York 1963-65	shallow ponds	Larval (L) period (from hatching until metamorphosis to eft).
Smith 1961 (louisianensis)	L	-	-	-	2-3		months				Illinois	NS	Larval (L) period until metamorphosis to eft.
Smith 1956 (viridescens)	L	-	-	-	3-4		months				e Kansas	NS	Larval (L) period until metamorphosis to eft; this information is likely to be based on Bishop 1941.
Smith 1961 (louisianensis)	E	-	-	-	2-3		years				Illinois	NS	Eft (E) period until metamorphosis to sexually mature adult.
Smith 1956 (viridescens)	E	-	-	-	2.5-3.5		years				e Kansas	NS	Eft (E) period after transformation to sexually mature adult. This information is likely to be based on Bishop 1941.
AGE AT SEXUAL MATURITY													
Healy 1974 (viridescens)	E	B	-	-	5-6		years	4	8		Massachusetts 1968-71	inland ponds, forests	Three to seven years in the eft stage.
Healy 1974 (viridescens)	- -	B B	1 2	- -	2 2		years years				Massachusetts 1960-65	coastal ponds	Age at sexual maturity in (1) Swampscott population (1961-65) and (2) Cape Cod population (1960-64). No eft stage.

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
LENGTH AT SEXUAL MATURITY													
Harris et al. 1988 (dorsalis)	E	B	1	-	28.4	1.3 SE	mm SVL			11	N Carolina 1982-84	pine/oak forest	Efts (E) that were transforming into breeding adults; (1) estimate of size at first reproduction. Efts in this stage were usually found in fall or winter.
MORTALITY													
Gill 1978a	A A	M F	- -	- -	45.8 54.1		%/yr %/yr				Virginia 1974-75	mountain ponds	Estimated from number of marked individuals returning to ponds in the spring following dormancy period.
Gill 1978a	A A	M F	- -	- -	53.1 59.5		%/yr %/yr				Virginia 1975-76	mountain ponds	Estimated from number of marked individuals returning to ponds in the spring following dormancy period.
LONGEVITY													
Gill 1978a	A A	M F	- -	- -	1.9 1.3		breeding seasons breeding seasons				Virginia 1974-76	mountain ponds	Assuming stationary population size. Estimated from survivorship. Estimate is qualitative due to demonstrable variation in survival rates between years.
Gill 1978b	A A	M F	- -	- -	2.1 1.7		breeding seasons breeding seasons				Virginia 1974-76	mountain ponds	Estimation of mean not specified.

***** SEASONAL ACTIVITIES *****

Reference	Begin	Peak	End	Location	Habitat	Notes
MATING/LAYING						
Behler & King 1979	lat winter	earl spring		NS	NS	
Gibbons & Semlitsch 1991	Feb - March		Apr - May	S Carolina	ponds	
Gill 1978a	Mar		Jun	Virginia 1974-76	mountain ponds	Observations of actively courting adults; egg-laying inferred to have occurred throughout this period.

Reference	Begin	Peak	End	Location	Habitat	Notes
Harris et al. 1988	winter		spring	N Carolina 1982-84	shallow pond	Courtship season.
Harris et al. 1988	Apr		Jun	N Carolina 1982-84	shallow pond	Egg laying season.
Massey 1990	lat Mar		lat Jun	Virginia 1984-85	woodland pond	
Morin et al. 1983	Apr			N Carolina 1981	tanks	Beginning of oviposition.
Taylor et al. 1988		winter		S Carolina 1984	pond, wetlands	Egg laying season.
HATCHING						
Behler & King 1979		spring		NS	NS	
Gill 1978a	Jun			Virginia 1974-76	mountain ponds	
Harris et al. 1988	lat Apr			N Carolina 1982-84	shallow pond	
Morin et al. 1983 (dorsalis)	May			N Carolina 1981	tanks	
METAMORPHOSIS TO EFT						
Behler & King 1979	lat summer	earl fall		NS	NS	
Brophy 1980		mid Sep		s Illinois 1976	shallow pond	
Gibbons & Semlitsch 1991	Jun		Sep	S Carolina	ponds	
Gill 1978a	mid Aug		lat Nov	Virginia 1974-76	mountain ponds	
Hurlbert 1970	mid Jul	Aug - Sep	earl Nov	New York 1963-65	ponds	The metamorphosis and migration of efts showed two more or less distinct "waves".
Taylor et al. 1988	Jul - Aug	Sep		S Carolina 1984	pond, wetlands	

Reference	Begin	Peak	End	Location	Habitat	Notes
FALL MIGRATION						
Gill 1978a	Aug - Sep		Nov	Virginia 1974-76	mountain ponds	Hibernation by adults begins with mass migration to hibernacula (terrestrial).
Hurlbert 1969	lat Aug	Sep - Oct	mid Nov	s c New York 1963-65	ponds, woods	One of two periods of breeding migrations of efts; coming from terrestrial habitats to aquatic.
Massey 1990	Aug			Virginia 1984-85	mountain ponds	Migration from ponds to terrestrial hibernacula.
Taylor et al. 1988		lat fall		S Carolina 1984	pond, wetlands	Return to the pond prior to breeding (pond dried in September).
SPRING MIGRATION						
Gill 1978a	Mar			Virginia 1974-76	mountain ponds	Arrival of adults at breeding ponds.
Hurlbert 1969	Mar	Apr - earl May	lat May	s c New York 1963-65	ponds, woods	One of two periods of breeding migrations of efts; coming from terrestrial habitats to aquatic.
Massey 1990	lat Mar		lat Apr	Virginia 1984-85	mountain ponds	Arrival of adults at breeding ponds.

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***** GREEN FROG *****

*** NORMALIZING AND CONTACT RATE FACTORS ***

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
BODY WEIGHT (AND LENGTH)													
McAlpine & Dilworth 1989	B	B	-	-	49.1	20.0 SD	g (73 mm SVL)	25.5	103.5	25	New Brunswick, CAN 1984	marsh	Length measured from snout to vent (SVL); range was from 59-87 mm SVL.
Pough & Kamel 1984	A	B	-	-	70		g				New York		Represents full grown adult; data not presented. Accuracy of value unknown.
Wells 1978 (melanota)	A	M	BR	SU	44	10 SD	g	27	66	36	New York 1973-75	ponds	Breeding (or attempting to breed) males captured in June. Lengths not provided. Estimated from Figure 6.
BODY LENGTH													
Behler & King 1979	A	-	-	-	54-102		mm SVL				NS	NS	Length measured from snout to vent (SVL).
Conant & Collins 1991 (melanota)	A	-	-	-	57-90		mm SVL		108		e c North America	NS	Length measured from snout to vent (SVL).
Conant & Collins 1991 (clamitans)	A	-	-	-	54-75		mm SVL		87		s e c North America	NS	Length measured from snout to vent (SVL).
Martof et al. 1980	-	-	-	-	54-86		mm SVL				Carolinas, Virginia	streams, ponds	Length measured from snout to vent (SVL).
Martof 1956b	A	M	-	-	79.8	8.5 SD	mm SVL		103	344	s Michigan 1948-49	streams, ponds	Mean size of all adults on study area. Length measured from snout to vent (SVL).
	A	F	-	-	80.3	8.9 SD	mm SVL		105	307			
Ryan 1953	A	F	-	-			mm SVL		98		New York 1949-50	streams, ponds	Length measured from snout to vent (SVL).
	A	M	-	-			mm SVL		90				
Smith 1961 (melanota)	A	-	-	-			mm SVL		95		n Illinois	NS	Length measured from snout to vent (SVL).
Wells 1978 (melanota)	A	M	-	-	74.1	0.7 SE	mm SVL	59.0	89.5	104	NS	NS	Sexually mature adults from museum collections. Length measured from snout to vent (SVL).
	A	F	-	-	75.6	0.9 SE	mm SVL	60.0	93.9	74			

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
GROWTH RATE													
Martof 1956b	-	B	1	-	33.6	1.08 SD	mm SVL/yr	30.3	36.9	13	s Michigan 1948-49	streams, ponds	Annual growth for transformed frogs in size classes: (1) 30-40; (2) 40-50; (3) 50-60; (4) 60-70; (5) 70-80; (6) 80-90; and (7) 90-100. Most growth occurs between mid May and mid September. Length measured from snout to vent (SVL).
	-	B	2	-	28.6	1.10 SD	mm SVL/yr	25.5	31.7	25			
	-	B	3	-	23.5	0.79 SD	mm SVL/yr	21.2	25.8	19			
	-	B	4	-	17.8	0.92 SD	mm SVL/yr	15.1	20.5	16			
	-	B	5	-	8.0	0.58 SD	mm SVL/yr	6.2	9.8	13			
	-	B	6	-	4.3	0.49 SD	mm SVL/yr	2.8	5.8	12			
	-	B	7	-	2.1	0.42 SD	mm SVL/yr	0.5	3.7	7			
WEIGHT AT METAMORPHOSIS													
Pough & Kamel 1984	-	-	-	-	3		g				New York	NS	Weight at metamorphosis can vary by 2 to 4 times between the smallest and largest individuals.
LENGTH AT METAMORPHOSIS													
Martof 1956b	-	B	-	-	32.6		mm SVL	28.4	36.3		s Michigan 1948-49	streams, ponds	Length measured from snout to vent (SVL).
Ryan 1953	-	-	-	-	26-38		mm SVL				New York 1949-50	streams, ponds	Length measured from snout to vent (SVL).
Ryan 1953	-	B	-	-			mm SVL	26	38		New York 1949-50	streams, ponds	Length measured from snout to vent (SVL).

*** DIET ***

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Bush 1959 (melanota)	A	B	carabidae		20.6			20	Kentucky 1955-56	stream - % wet volume; stomach contents	Items comprising less than 2% not listed here.
			brentidae		5.1						
			coccinellidae		5.1						
			cerambycidae		3.9						
			platypodidae		2.8						
			zontidae		30.0						
			unident. pulmonata		5.1						
			lepidoptera		5.1						
			hemiptera		3.9						
			astacidae		3.4						
			chilopoda		2.2						
			sand, rocks, gravel		4.4						
			unident., leaves		3.9						

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Hamilton 1948 (melanota)	A	B	coleoptera		22.1			434	New York 1928-47	lakes, streams - % "by bulk"; stomach contents	27 - 97 mm SVL frogs collected from May - October; 83% collected during summer. Items comprising less than 1% not listed here.
			diptera		13.5						
			orthoptera		12.8						
			caterpillars		11.8						
			hymenoptera		7.4						
			arachnids		6.7						
			cast green frog skin		3.9						
			hemiptera		3.8						
			frogs		3.3						
			molluscs		3.1						
			crustacea		2.1						
			millipedes		1.5						
			lepidoptera (adults)		1.4						
Hamilton 1948 (melanota)	A	B	coleoptera		21.2			85	New York 1928-47	lakes, streams - % "by bulk"; stomach contents	Large (60-97 mm SVL) frogs collected from May - October; most collected during the summer. Items comprising less than 1% not listed here.
			caterpillars		17.4						
			orthoptera		16.7						
			amphibia		7.8						
			hymenoptera		6.9						
			diptera		4.3						
			molluscs		4.1						
			crustacea		3.4						
			arachnids		2.7						
			earthworms		2.1						
			lepidoptera (adults)		1.8						
			cast green frog skin		1.4						
			hemiptera		1.2						
			millipedes		1.0						
Jenssen & Klimstra 1966	B	B	mineral	-	-	-	2.6		s Illinois 1963-64	swamp, stream - % wet volume; stomach contents	Size of frogs not presented. Items comprising less than 3% in all seasons not listed here.
			plant	5.7	8.3	4.2	0.5				
			animal	94.3	91.7	95.8	96.8				
			pulmonata	(15.7)	(18.3)	(6.4)	(11.0)				
			oligochaeta	(2.1)	(0.8)	(2.3)	(6.4)				
			amphipoda	(1.2)	(0.1)	-	(4.6)				
			isopoda	(5.6)	(1.4)	-	(4.6)				
			decapoda	-	-	(4.1)	-				
			julioforma	(7.5)	(0.3)	(1.7)	-				
			araneida	(2.8)	(3.4)	(6.6)	(7.4)				
			odonata	(1.6)	(12.4)	(5.9)	-				
			orthoptera	(0.9)	(3.0)	(1.5)	-				
			hemiptera	(1.0)	(7.0)	(6.1)	(2.2)				
			coleoptera	(9.6)	(19.6)	(15.9)	(9.1)				
			lepidoptera	(25.4)	(7.0)	(25.1)	-				
			diptera	(6.0)	(5.2)	(4.5)	(10.3)				
			hymenoptera	(9.9)	(6.0)	(13.5)	-				
			salientia	-	-	(3.9)	-				
			sample size	*127*	*126*	*119*	*103*				

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Stewart & Sandison 1973	A	B	plant material		10.8			24	New York 1968	lake	Total = 103.3%. Season of collection not specified.
			araneae		12.1					-	
			coleoptera		32.8					% total volume; stomach contents	
			hemiptera		12.9						
			hymenoptera		14.4						
			diptera		6.8						
			ephemeroptera		5.6						
			mollusca		5.4						
			lepidoptera		2.5						

***** POPULATION DYNAMICS *****

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
HOME RANGE SIZE													
Martof 1953b (melanota)	A	B	NB	-	0.0065	0.0036 SD	ha	0.0020	0.020	29	s Michigan 1948-49	stream banks, stream	Daily activity range of non-breeding frogs. Juveniles = subadults. Captured from May through October; adults left range for breeding.
	J	B	NB	-	0.0053	0.0024 SD	ha	0.0020	0.011	14			
Wells 1977 (melanota)	A	M	BR	SU	4.0-6.0		m shore				New York 1973-75	open nearshore areas	Defended breeding territory in open areas near the shores of shallow ponds.
Wells 1977 (melanota)	A	M	BR	SU	1.0-1.5		m shore				New York 1973-75	densely vegetated nearshore areas	Defended breeding territory in stands of dense bulrushes near the shores of shallow ponds.
POPULATION DENSITY													
Wells 1978 (melanota)	A	M	-	-	476		N/ha			21	New York 1973-77	artificial pond	Frogs initially hand-captured and placed in pond; the numbers given are for those frogs that stayed.
	A	F	-	-	567		N/ha			25			
CLUTCH SIZE													
Martof 1956a (melanota)	-	-	-	-	4,100		eggs	3,800	4,300	3	s Michigan 1948-49	pond	
Pope 1947 (melanota)	-	-	-	-			eggs	3,500	5,000		Illinois	shallow water	As cited in Martof 1956a.
Wells 1976 (melanota)	-	-	-	-			eggs	1,000	7,000		New York 1973-74	shallow ponds	Estimated from field counts and photographs.

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Wright 1914 (melanota)	-	-	-	-			eggs	3,500	4,000		New York	shallow water	As cited in DeGraaf and Rudis 1983.
CLUTCHES/YEAR													
Wells 1976 (melanota)	-	-	1	-	2		N/year			10	New York 1973-74	shallow ponds	(1) If the marked female was caught laying first clutch prior to July 21; (2) if caught laying clutch for the first time after July 21. Females caught for the first time after July 21 may have deposited a clutch at an earlier time in a different pond.
	-	-	2	-	1		N/year			12			
DAYS INCUBATION													
Babbitt 1937 (melanota)	-	-	-	-	3-6		days				Connecticut	shallow water	As cited in DeGraaf and Rudis 1983.
Martof 1956a (melanota)	-	-	-	-	3-5		days				s Michigan 1948-49	shallow ponds	
Ryan 1953	-	-	-	-	3-5		days				New York 1949-50	ponds, pools	Duration depends on water temperature.
TIME TO METAMORPHOSIS													
DeGraaf & Rudis 1983 (melanota)	-	-	-	-			years	1	2		New England	shallow water	
Martof et al. 1980	-	-	1	-	3		months				Virginia, Carolinas	shallow ponds	(1) Most tadpoles transform in a few months, (2) some overwinter.
	-	-	2	-	10-12		months						

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Martof 1956a,b (melanota)	-	-	1	-	2.5-3		months				s Michigan 1948-49	shallow ponds	(1) Eggs laid prior to June; (2) eggs deposited later in the season.
	-	-	2	-	11-12		months						
Wright 1914	-	-	1	SP	3		months				New York	shallow ponds	(1) Eggs laid in spring; (2) eggs laid in summer. As cited in Pough and Kamel 1984.
	-	-	2	SU	10-12		months						
AGE AT SEXUAL MATURITY													
Martof 1956a,b (melanota)	A	M	-	-	1-2		years				s Michigan 1948-49	shallow ponds	Years after transformation. Individuals may reach maturity at the end of their first year but generally do not attempt to breed until the following year.
	A	F	-	-	1-2		years						
Ryan 1953	-	B	-	-	1-2		years				New York 1949-50	ponds, streams	Years after transformation. Transformation size and date influence when individuals attain adulthood.
Wells 1977 (melanota)	-	B	-	-	1		year				New York 1973-77	pond	Sexual maturity reached usually in one year after transformation, although some may not breed until the second year.
LENGTH AT SEXUAL MATURITY													
Martof 1956b	A	M	-	-	60-65		mm SVL				s Michigan 1948-49	streams, ponds	Length measured from snout to vent (SVL).
	A	F	-	-	65-75		mm SVL						
Ryan 1953	-	F	-	-	65		mm SVL				New York 1949-50	streams, ponds	Length measured from snout to vent (SVL).
	-	F	-	-	60		mm SVL						
LONGEVITY													
Martof 1956b	A	-	-	-			years		5		s Michigan 1948-49	streams, ponds	Approximate longevity in natural populations.

***** SEASONAL ACTIVITIES *****

Reference	Begin	Peak	End	Location	Habitat	Notes
MATING/LAYING						
Martof 1956a (melanota)	May	earl Jul	mid Aug	s Michigan 1948-49	streams, ponds	

Reference	Begin	Peak	End	Location	Habitat	Notes
Mele 1980	lat May	June	mid Aug	New Jersey 1974-76	swamp	
Pough & Kamel 1984	lat spr		summer	New York	shallow ponds	
Ryan 1953	May	earl Jun	mid Aug	New York 1949-50	streams, ponds	
Smith 1961 (melanota)	May		Sep	Illinois	NS	
Wells 1976	earl Jun		mid Aug	New York 1973-74	shallow ponds	
METAMORPHOSIS TO ADULT						
Martof 1956a (melanota)	earl Aug	lat Aug	earl Oct	s Michigan 1948-49	streams, ponds	
Martof 1956b (melanota)	earl Aug		lat Sep	s Michigan 1948-49	streams, ponds	Eggs laid early in the season - metamorphosed in same year.
Martof 1956b (melanota)	earl Jun		mid Jul	s Michigan 1948-49	streams, ponds	Eggs laid late in the season - metamorphosed the following year.
Pough & Kamel 1984		Aug, Sep		New York	shallow ponds	For eggs laid in late spring.
Pough & Kamel 1984		next spring		New York	shallow ponds	For eggs laid in the summer.
Ryan 1953	May	Jun-Jul	lat Sep	New York 1949-50	streams, ponds	
HIBERNATION						
Martof 1956a (melanota)	Oct-Nov		Mar-Apr	s Michigan 1948-49	streams, ponds	
Ryan 1953	Oct		lat Mar	New York 1949-50	streams, ponds	
Smith 1961 (melanota)			Apr	NS	NS	

******* BULLFROG *******

***** NORMALIZING AND CONTACT RATE FACTORS *****

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
BODY WEIGHT (AND LENGTH)													
Cohen & Howard 1958	-	B	-	-	20		g (54 mm)	(SVL)			California 1950-51	artificial ponds	Values based on a graph of the relationship between snout to vent length (SVL) and weight of 274 bullfrogs.
	-	B	-	-	60		g (82 mm)						
	-	B	-	-	100		g (101 mm)						
	-	B	-	-	140		g (112 mm)						
	-	B	-	-	180		g (117 mm)						
Durham & Bennett 1963	-	B	0	-	9		g (84 mm)	(total length)		48	e c Illinois 1941-53	impoundment	Total length measured. Age: (0) at metamorphosis (September); (1) - (6) at end of first - sixth years after metamorphosis. Length measurements are total length - from snout to toe tips. Author notes that snout to vent length (SVL) is about 0.42 - 0.43 of total length. Converted from pounds and inches.
	-	B	1	-	91		g (240 mm)			19			
	-	B	2	-	210		g (307 mm)			5			
	-	B	3	-	240		g (320 mm)			5			
	-	B	4	-	260		g (335 mm)			3			
	-	B	5	-	290		g (348 mm)			6			
	-	B	6	-	360		g (356 mm)			5			
Durham & Bennett 1963	A	-	-	-			g (366 mm)	(total length)	545		e c Illinois 1941-53	impoundment	Heaviest frog found; Total length measured (from snout to toe tips).
Farrar & Dupre 1983	J	B	1	SU	35.0	5.0 SE	g (76 mm)	(SVL)		13	Iowa	lake	Juvenile frogs in summer/fall following transition. (1) July 30; (2) Sept 4; (3) Sept 17; (4) Oct 2; (5) Oct 15. Length measured from snout to vent (SVL).
	J	B	2	FA	46.2	4.1 SE	g (83 mm)			12			
	J	B	3	FA	53.3	1.5 SE	g (87 mm)			8			
	J	B	4	FA	68.5	5.2 SE	g (98 mm)			9			
	J	B	5	FA	53.4	5.8 SE	g (90 mm)			11			
Fulk & Whitaker 1968	B	B	-	SU	158.8		g (104 mm)	(SVL)		111	Indiana 1966-68	strip-pit ponds with cattails and algae	Collected in June and July. Length measured from snout to vent (SVL).
Fulk & Whitaker 1968	B	B	-	SU	153.2		g (107 mm)			78	Indiana 1966-68	farm ponds in field	Collected in June and July. Length measured from snout to vent (SVL).
Fulk & Whitaker 1968	B	B	-	SU	373.7		g (175 mm)	(SVL)		178	Indiana 1966-68	river	Collected in June; length measured from snout to vent (SVL); are larger than those above because since they were caught in June, more females had eggs. The author suggests the river has less hunting pressure, so large frogs are more common than at the ponds.

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
McAlpine & Dilworth 1989	B	-	-	-	142.8	77.4 SD	g (98 mm SVL)	9.5	274.0	39	New Brunswick, CAN 1984	marsh	Length in units column (from snout to vent - SVL) is a mean; range in lengths was 45 - 128 mm.
McKamie & Heidt 1974	A	B	-	SP	249		g (122 mm)	(SVL)		62	c Arkansas 1972	farm ponds	Length measured from snout to vent (SVL).
Modzelewski & Culley 1974	J	B	1	-	17.5		g	13.1	41.6		Louisiana 1971-72	lab	Age post-metamorphosis: (1) 1 month; (2) 2 months; (3) 3 months; (4) 4 months. Maintained at a temp of 24-27 C and fed a diet of mosquitofish, crickets and earthworms.
	J	B	2	-	29.8		g	18.5	51.6				
	J	B	3	-	42.4		g	27.6	77.2				
	J	B	4	-	55.8		g	40.5	100.8				
Viparina & Just 1975	T	B	1	SU	35.7	5.2 SD	g			67	Kentucky 1971-73	ponds	(1) July; tadpoles that overwintered; (2) July; new tadpoles.
	T	B	2	SU	2.0	1.1 SD	g			73			

BODY LENGTH

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Behler & King 1979	A	-	-	-			mm SVL	90	203		NS	NS	Length measured from snout to vent (SVL). Minimum is the approximate length at sexual maturity. Summarizing the work of others.
Behler & King 1979	T	-	-	-			mm total	102	171		NS	aquatic	Total length; summarizing the work of others.
Bruneau & Magnin 1980	-	B	1	-	59		mm SVL				Quebec, CAN	NS	Number in condition column is age of frog in years. As cited in Bury & Whelan 1984.
	-	B	2	-	81		mm SVL						
	-	B	3	-	108		mm SVL						
	-	B	4	-	125		mm SVL						
	-	B	5	-	137		mm SVL						
	-	B	6	-	143		mm SVL						
Conant & Collins 1991	A	-	-	-	90-150		mm SVL		203		e c North America	NS	Length measured from snout to vent (SVL).
Durham & Bennett 1963	-	B	0	-	84		mm total	76	89	48	ec Illinois 1941-52	impoundment	Total length (from snout to toe tips of back legs). Age: (0)=at metamorphosis (Sept.); (1)-(6)=at end of first through sixth years. Authors note that snout to vent length (SVL) is about 0.042-0.043 of total length. Converted from inches.
	-	B	1	-	240		mm total	200	270	19			
	-	B	2	-	307		mm total	290	325	5			
	-	B	3	-	320		mm total	318	323	5			
	-	B	4	-	335		mm total	335	338	3			
	-	B	5	-	348		mm total	340	363	6			
	-	B	6	-	356		mm total	345	366	5			

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
George 1940	-	B	0	-	40		mm SVL				Louisiana	NS	(0) = length at metamorphosis. (1)-(2) are size class limits for frogs aged from 1 to 2 years after transformation. Measured during the "growing season" - spring to early fall. Length measured from snout to vent (SVL). As cited in Turner 1960.
	-	B	1	SP			mm SVL	44	82				
	-	B	1	FA			mm SVL	101	120				
	-	B	2	-			mm SVL	101	133				
George 1940	A	M	-	-			mm SVL		171		Louisiana	NS	As cited in Turner 1960.
	A	F	-	-			mm SVL		184				
Howard 1981a	A	M	1	SU	131.72	8.92 SD	mm SVL		151	58	Michigan 1975,78	pond	Year: (1) 1975; (2) 1978.
	A	F	1	SU	142.63	11.91 SD	mm SVL		172	55			
	A	M	2	SU	114.73	12.15 SD	mm SVL		140	30			
	A	F	2	SU	124.22	12.79 SD	mm SVL		154	23			
Martof et al. 1980	A	-	-	-			mm SVL	85	200		Carolinas, Virginia	aquatic	
Martof et al. 1980	T	-	-	-			mm total	125	150		Carolinas, Virginia	NS	Total length.
Raney & Ingram 1941	-	B	0	-	45		mm SVL				New York	NS	(0) = length at transformation. (1) - (4) are size class limits for frogs aged from 1 to 4 years after transformation. Measured during the "growing season" - spring to early fall. Length measured from snout to vent. As cited in Turner 1960.
	-	B	1	-			mm SVL	67	90				
	-	B	2	-			mm SVL	82	110				
	-	B	3	-			mm SVL	113	126				
	-	B	4	-			mm SVL	125	139				
	-	F	-	-					155				
BODY FAT													
Farrar & Dupre 1983	J	B	1	SU	7.6	3.1 SE	mg/g			13	Iowa	lake	Juvenile bullfrogs in the summer/fall following transformation. (1) July 30; (2) Sept 4; (3) Sept 17; (4) Oct 2; (5) Oct 15. Fat body weight as mg fat per gram body weight.
	J	B	2	FA	3.0	0.6 SE	mg/g			12			
	J	B	3	FA	1.1	0.3 SE	mg/g			8			
	J	B	4	FA	1.2	0.3 SE	mg/g			9			
	J	B	5	FA	2.4	0.8 SE	mg/g			11			
GROWTH RATE													
George 1940	A	B	1	-	4		yrs to 120				NS	NS	Years required to reach 120 mm (SVL) in length in: (1) northern US, (2) southern US. As cited in Bury and Whelan 1984.
	A	B	2	-	1.5-2		yrs to 120						

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Raney & Ingram 1941; Treanor & Nichola 1972	A	B	-	-	9-18		mm/yr				NS	NS	Adults older than 4 years. As cited in Bury & Whelan 1984.

METABOLIC RATE (OXYGEN)

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Burggren et al. 1983	T	-	1	-	1.5	0.2 SE	lO2/kg-day				NS	lab	Restrained and cannulated tadpoles at (1) 15 C; (2) 25 C; and (3) 33 C. Mean weight = 5.7 g.
	T	-	2	-	2.6	0.2 SE	lO2/kg-day						
	T	-	3	-	5.4	0.7 SE	lO2/kg-day						
Glass et al. 1981	A	1	R	-	0.76	0.07 SE	lO2/kg-d			7	NS	lab	Resting (R) metabolism at: (1) T = 20 C; (2) T = 30 C; mean weight = 260 g in both cases.
	A	2	R	-	1.59	0.22 SE	lO2/kg-d			7			
Hutchinson et al. 1968	A	-	1	-	1.0		lO2/kg-day	0.31	2.3	9	NS	NS	Resting metabolism: (1) at 5 C; (2) at 15 C. Mean weight of frogs was 74.8 g.
	A	-	2	-	1.38		lO2/kg-day	1.05	1.56	4			
Weathers 1976	A	B	1	-	0.473	0.034 SE	lO2/kg-day			7	Louisiana	lab	All frogs weighed approximately 605-620 g. Acclimated for 2 weeks at 20 C then held at (1) 5 C; (2) 12 C; (3) 20 C; for 5 days fasting.
	A	B	2	-	0.794	0.038 SE	lO2/kg-day			7			
	A	B	3	-	1.28	0.050 SE	lO2/kg-day			8			
Weathers 1976	A	B	1	-	0.372	0.029 SE	lO2/kg-day			8	Louisiana	lab	All frogs weighed approximately 615-650 g. Acclimated for two weeks at 5 C then held at (1) 5 C; (2) 12.5 C; and (3) 20 C for 5 days fasting.
	A	B	2	-	0.624	0.043 SE	lO2/kg-day			8			
	A	B	3	-	0.912	0.062 SE	lO2/kg-day			8			

FOOD INGESTION RATE

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Farrar & Dupre 1983	J	B	-	SU	.027	0.008 SE	ml/g			13	Iowa	pond	Volume of food found in gastrointestinal tracts of recently transformed frogs.
	J	B	-	FA	0.00628	0.00183 SE	ml/g			40			
Frost 1935	A	-	-	SU	0.04	0.03 SD	g/g-day	0.005	0.10	48	NS	captive	Rough estimate based on the weight of frogs, nestling birds, insects and snails eaten by one 200 g captive frog. Value is likely to be on the high side because weight of food on days when ate only insects was not always reported. N = number of days from June-Sept. for which weight of food eaten was reported.

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Modzelewski & Culley 1974	J	B	1	-	0.098		g/g-day			24	Louisiana 1971-72	lab	Frogs in year after transformation. Weight range: (1) 7.9-17.6 g; (2) 17.1-34.7 g; (3) 21.5-45.7 g. Temp. maintained between 24-27 C. Diet of mosquitofish.
	J	B	2	-	0.048		g/g-day			24			
	J	B	3	-	0.033		g/g-day			24			
Modzelewski & Culley 1974	J	B	1	-	0.071		g/g-day				Louisiana	lab	Frogs during year after transformation. Body weight ranges: (1) 13.1 g to 41.6 g; (2) 18.5 g to 51.6 g; (3) 27.6 g to 77.2 g; (4) 40.5 g to 100.8 g. Temp. maintained at 24-27 C. Mixed diets of mosquitofish, crickets and earthworms.
	J	B	2	-	0.059		g/g-day						
	J	B	3	-	0.040		g/g-day						
	J	B	4	-	0.033		g/g-day						

***** DIET *****

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Brooks 1964	A	B	Insecta		6			34	e Virginia 1958	pond in open pasture - % weight; gut contents	Collected June-November. Items comprising < 2% not included. Wet/dry weight not specified. Anuran prey include both adults and tadpoles.
			(Coleoptera)		(4)						
			Decapoda		3						
			Anurans		50						
			Serpentia		12						
			pebbles & sand		17						
			vegetative material		7						
			digested invertebrat		2						
			digested vertebrates		2						
Brooks 1964	A	B	Insecta		49			19	e Virginia 1958	pond in dense hardwoods - % weight; gut contents	Collected from June-November. Items comprising < 2% not included. Wet/dry weight not specified.
			(Coleoptera)		(8)						
			(Orthoptera)		(8)						
			(Hymenoptera)		(2)						
			(Odonota)		(6)						
			(Lepidoptera)		(24)						
			Aranae		3						
			Decapoda		19						
			vegetative material		22						
			digested invertebrat		6						
			pebbles, sand		1						

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Bush 1959	A	B	Decapoda-Astacidae		47.7			18	Kentucky 1955-56	NS - % wet volume; stomach contents	Items comprising < 1% not included.
			Lepidoptera		19.0						
			Coleoptera		16.0						
			(Lampryidae)		(5.8)						
			(Chrysomelidae)		(5.8)						
			(Carabidae)		(4.1)						
			Pulmonata-Zonitidae		8.3						
			Chilopoda		7.7						
			sand,rock,gravel		1.2						
Carpenter & Morrison 1973	A	B	Odonata		17.8			28	nc Texas	ponds, impoundments - frequency of occurrence; stomach contents	All animals < 150 mm in total length (snout to back toes). Items with values less than 3 not included here.
			Hemiptera		10.7						
			Orthoptera		10.7						
			Hymenoptera		42.8						
			Coleoptera		50						
			Lepidoptera		17.8						
			Arachnida		10.7						
			Diptera		10.7						
			Diplopoda		3.5						
			Amphibia		3.5						
Carpenter & Morrison 1973	A	B	Odonata		8.6			46	nc Texas	ponds, impoundments - frequency of occurrence; stomach contents	All animals 151-300 mm in total length. Items with values less than three not included here.
			Hemiptera		13.0						
			Orthoptera		23.9						
			Hymenoptera		39.1						
			Coleoptera		63.0						
			Lepidoptera		28.2						
			Diptera		4.3						
			Crustacea		28.2						
			Diplopoda		10.8						
			Gastropoda		4.3						
			Amphibia		6.5						
			Osteicthyes		6.5						
Carpenter & Morrison 1973	A	B	Odonata		20			50	nc Texas	ponds, impoundments - frequency of occurrence; stomach contents	All animals > 300 mm in total length. Items with values less than 3 are not listed here.
			Hemiptera		12						
			Orthoptera		26						
			Hymenoptera		40						
			Coleoptera		40						
			Lepidoptera		24						
			Crustacea		8						
			Arachnida		14						
			Reptilia		6						
			Amphibia		16						
			Aves		4						
			Osteichthyes		4						

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Cohen & Howard 1958	-	-	Coloeptera		43.6			300	California 1950-51	artificial ponds - % frequency of occurrence; stomach contents	Season not specified. Items comprising <3% not included here.
			Notonectidae		10.3						
			Diptera		6.6						
			Hymenoptera		6.3						
			Ephemeroptera		4.3						
			Protura		3.3						
			decomposed tissue		18.0						
			spiders, Lycosidae		16.0						
			unidentified insect		21.3						
			rocks, grass, leaves bark		22.0						
			chitinous material		10.0						
			snails, Planorbid		9.0						
			frogs		5.6						
			snails, Physid		4.7						
			small fish		4.3						
Corse & Metter 1980	A	B	frogs	35	33	39			Missouri 1972-73	bait minnow pond - Number of items; stomach contents	Sample size = number of stomachs containing food. Spring = combined totals from May 1972 and Mar-Apr 1973; Summer = June-Aug 1973; and Fall = Sept 1973. Items found <5 times in all seasons not included. These included mammals, snakes, toads, Chilopoda, adult Diptera, Hymenoptera, and Hirudinea.
			tadpoles	8	11	0					
			shiners	305	157	25					
			other fish	7	2	5					
			Gastropoda	55	70	26					
			crayfish	22	162	18					
			other crustacea	71	42	47					
			Arachnida	3	23	3					
			Coloeptera-adult	31	33	15					
			Diptera larvae	2	7	0					
			Hemiptera	41	43	16					
			(sample size)	(164)	(175)	(84)					
Farrar & Dupre 1983	J	B	Diplopoda		4	1.5			Iowa	lake - % number of items; gastrointestinal tract	Juvenile bullfrogs (transformed that summer) collected on July 30 and from September through mid October.
			Gastropoda		11.8	3.0					
			Arachnida		1.3	1.1					
			Crustacea		1.3	-					
			Odonata		22.4	21.6					
			Orthoptera		6.6	5.8					
			Hemiptera		15.8	33.8					
			Diptera		1.3	-					
			Coleoptera		14.5	17.3					
			Hymenoptera		10.5	12.6					
			Lepidoptera		10.5	2.3					
			other			1					
			(sample size)		(13)	(40)					
Fulk & Whitaker 1968	-	B	Ranid tadpoles		20.0			78	Indiana 1966-68	farm ponds in pastures - % volume; stomach contents	Collected in June & July. Items comprising < 2.5% not included. Frogs averaged 107.2 mm SVL and 153.2 g.
			crayfish		14.8						
			Libellulidae		10.4						
			Lepidoptera		4.7						
			young Rana sp.		3.9						
(continued)			Aeschvidae		3.9						

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Fulk & Whitaker 1968 (continued)			Scarabaeidae		3.5						
			Formicidae		3.3						
			Hyla versicolor		2.6						
			Odonata naiads		2.6						
Fulk & Whitaker 1968	-	B	crayfish		21.3			111	Indiana 1966-68	strip pit-ponds - % volume; stomach contents	Collected in June, July. Items comprising <2.5% not included here. Frogs averaged 103.5 mm SVL and 158.8 g.
			Lepidoptera		10.5						
			spiders		7.7						
			vegetation		7.0						
			Dystiscidae		5.8						
			Libellulidae		5.4						
			Rana sp.		3.9						
			Lepid larvae		3.6						
			Aeschnidae		2.7						
Fulk & Whitaker 1968	-	B	Scarabaeids		14.2			178	Indiana 1966-68	river - % volume; stomach contents	Collected in June. Items comprising <3% not included. Frogs averaged 373.7 g and 174.8 mm SVL.
			crayfish		12.3						
			Lucanids		9.6						
			terrestrial snails		8.2						
			earthworms		7.1						
			carabids		6.8						
			aquatic snails		6.5						
			spiders		5.3						
			minnows		4.8						
			Diplopoda		3.6						
Hammer & Linder 1971	A	B	frog		76.1			40	South Dakota 1967	pond - % dry weight; stomach contents	"Large" bullfrogs.
			crayfish		11.2						
			debris		3.2						
			giant water bug		2.8						
			vegetation		2.6						
			water scorpion		1.4						
			odonata		0.9						
			snail		0.5						
			other		1.3						
Korschgen & Baskett 1963	A	B	crayfish		31.6			278	Missouri 1958-59,61	shallow impoundment - % dry volume; stomach contents	Frogs collected from May-Sept. Items comprising <2% not included. Both adult and nymph dragonflies are consumed.
			meadow vole		11.7						
			dragonflies		8.1						
			frogs		6.2						
			watersnakes (Natrix)		3.9						
			ground beetles		3.3						
			water scavenger beet		2.7						
			bluegill		2.5						
			spiders		2.5						
			diving beetles		2.4						
			scarab beetles		2.1						
			darkling beetles		2.0						
			vegetation, leaves,		3.1						

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
Korschgen & Baskett 1963	A	B	crayfish		39.2			130	Missouri 1958-59	streams - % dry volume; stomach contents	All frogs collected in June. Items comprising < 2% of volume not included.
			cicadas		15.8						
			ground beetles		7.8						
			scarab beetles		5.0						
			white-faced mouse		4.5						
			caterpillars, moths		3.3						
			tadpoles		3.2						
			dragonfly nymphs & a		3.0						
			frogs		2.7						
			hellgrammites		2.2						
			five-lined skink		2.1						
			spiders		2.1						
Korschgen & Moyle 1955	A	B	insects		32.6			455	c Missouri 1950-51	farm ponds - % dry volume; stomach contents	Collected from April-October. As cited in Korschgen & Baskett 1963.
			crustaceans		26.4						
			amphibians, reptiles		24.5						
			misc. invertebrates		3.3						
			mammals		3.0						
			fishes		2.8						
			other		7.4						
McKamie & Heidt 1974	A	B	Decapoda (crayfish)	43.2				62	c Arkansas 1972	pond - % dry weight; stomach contents	Mean size of frogs: 122 mm SVL, 249 g. Items comprising less than 2% not listed. 0.9% unaccounted for.
			Hydrophilidae	3.1							
			Lepidoptera larvae	2.3							
			other inverts	8.5							
			Pimphales sp.	5.1							
			Notemigonus sp.	8.6							
			Rana sp. (adults)	19.4							
			Natrix sp.	2.9							
			Chelydra serpentina	2.4							
			plants	1.9							
McKamie & Heidt 1974	A	B	Decapoda (crayfish)	36.7				29	c Arkansas 1972	strip pits - % dry weight; stomach contents	Mean size of frogs = 140 mm SVL, 252 g. Total exceeds 100% (i.e., 117%), which may indicate that there is a misprint in the values. Items comprising less than 2 % not listed.
			Coleoptera adult	6.2							
			Lepidoptera adult	4.9							
			Lepidoptera larvae	6.5							
			other inverts	14.3							
			Notropis sp.	6.4							
			Lepomis sp.	4.8							
			Rana & Hyla sp.	2.8							
			Pseudemys scripta	27.9							
			plants	7.2							

Reference	Age	Sex	Food type	Spring	Summer	Fall	Winter	N	Location	Habitat - Measure	Notes
McKamie & Heidt 1974	A	B	Gastropoda	3.3				48	c Arkansas 1972	river, stream - % dry weight; stomach contents;	Mean size of frogs: 119 mm SVL, 251 g. Items comprising less than 2% not listed; 7.6% unaccounted for in original.
			Decapoda	42.6							
			Corixidae	4.2							
			other insects	16.5							
			Urodela	2.4							
			birds	1.6							
			Blarina brevicauda	7.7							
			acorns	4.7							
			unidentified plant	9.4							
Stewart & Sandison 1973	A	B	plant		19.7			21	New York 1968	mountain lake - % volume; stomach contents	Collected during July.
			animal		65.2						
			(Odonata)		(8.8)						
			(Coleoptera)		(15.8)						
			(Hemiptera)		(0.5)						
			(Hymenoptera)		(2.2)						
			(Amphibia)		(26.4)						
			unaccounted		15.1						
Tyler & Hoestenbach 1979	A	B	Osteichthyes		10			307	sw Oklahoma 1973-76	pond - % weight; digestive tract contents	Caught in June - September 1975, May - August 1976, and June - November 1973.
			Crustacea		6						
			Odonata		2						
			Orthoptera		23						
			Hemiptera		19						
			Diptera		2						
			Coleoptera		34						
			Hymenoptera		2						
			other		2						
Tyler & Hoestenbach 1979	A	B	Mollusca		2			307	sw Oklahoma 1975-76	stream - % weight; digestive tract contents	Caught in June - September 1975 and May - August 1976.
			Crustacea		73						
			Odonata		1						
			Orthoptera		3						
			Hemiptera		0.5						
			Coleoptera		16						
			Hymenoptera		.5						

***** POPULATION DYNAMICS *****

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
HOME RANGE SIZE													
Currie & Bellis 1969	A	M	NB	-	2.9		m radius	0.76	11.3	65	Ontario, CAN 1960-61	pond	Mean activity radius for frogs captured 5 or more times in August and September.
	A	F	NB	-	2.4		m radius	0.61	10.2	66			

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Currie & Bellis 1969	A	B	1	-	2.5		m radius	0.61	10.2	88	Ontario, CAN 1960-61	pond	Mean activity radius for frogs captured 5 or more times in August and September. Year (1) 1960 - population density 1,376 frogs/ha; (2) 1961 - density 892/ha.
	A	B	2	-	3.5		m radius	1.1	11.3	43			
Emlen 1968	A	M	BR	SU	2.7		m radius			94	Michigan 1965-66	pond	Measured in June, when defended as breeding territory. Based on average distance between frogs in pond of 5.4 m +/- 1.8 S.D.
POPULATION DENSITY													
Cecil & Just 1979	T	B	1	FA	70,000		N/ha				Kentucky 1975-76	Fred Pond	Population that emerges from eggs in summer and overwinters in the pond, emerging between July and September of the next year. Month of estimate: (1) September (newly hatched only); (2) January; (3) May.
	T	B	2	WI	29,000		N/ha						
	T	B	3	SP	16,000		N/ha						
Cecil & Just 1979	T	B	1	FA	130,000		N/ha				Kentucky 1974-75	Coldstream Pond	Population that emerges from eggs in summer and overwinters in the pond, emerging between July and September of the next year. Month of estimate: (1) November; (2) March; (3) May.
	T	B	2	SP	69,000		N/ha						
	T	B	3	SP	42,000		N/ha						
Clarkson & DeVos 1986	A	B	-	SU	9.1		N/km			3	AZ, CA 1981	river banks	Number of frogs observed per km of the Colorado River (both banks). Does not include frogs in backwaters further than 5 m inland. N = the number of surveys conducted.
Currie & Bellis 1969	B	B	1	-	1,376		N/ha			115	Ontario, CAN 1960-61	pond	Density of frogs on study pond in (1) 1960; (2) 1961. N = population size. Pond was smaller in 1961 than in 1960.
	B	B	2	-	892		N/ha			50			
Emlen 1968	B	B	-	SU	100		N/ha				Michigan 1965-66	pond	Approximate density found at a 2 ha pond.

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
CLUTCH SIZE													
Howard 1978a							(female size)						
	-	-	1	-	10,200		(120 mm SVL)				Michigan 1975-76	pond	Length in units column (from snout to vent - SVL) is the size of the female; estimated from regression equation. Clutch: (1) first; (2) second.
	-	-	1	-	13,900		(130 mm SVL)						
	-	-	1	-	18,500		(140 mm SVL)						
	-	-	2	-	7,800		(130 mm SVL)						
	-	-	2	-	10,200		(140 mm SVL)						
Martof et al. 1980	-	-	-	-	12,000		eggs				Carolinas, Virginia	NS	
McAuliffe 1978	-	-	1	-	16,640		eggs			1	Nebraska	NS	Female lengths were (1) 128 mm SVL (2) 179 mm SVL; as cited in Bury and Whelan 1984.
	-	-	2	-	47,840		eggs			1			
Ryan 1980	-	-	-	-	7,360	741.7 SE	eggs			36	New Jersey 1976-77	pond	Mean snout to vent length of females was 140 mm.
Smith 1956	-	-	-	-			eggs	10,000	20,000		Kansas	NS	
Wright 1914	-	-	-	-			eggs	12,000	20,000		New York	NS	As cited in DeGraaf and Rudis 1983.
CLUTCHES/YEAR													
Emlen 1977	-	-	-	-	1		93% of fem.			68	Michigan 1966	pond	Incidence of double clutching based on the number of marked females captured two different times with eggs; estimates the clutches were three weeks apart.
	-	-	-	-	2		7% of fem.			5			
Howard 1978a	-	-	-	-	1-2		/yr				Michigan 1975-76	pond	Females at least 2 years past metamorphosis (>130 mm SVL) can produce a second clutch.
DAYS INCUBATION													
Clarkson & DeVos 1986	-	-	-	-	2-4		days				AZ, CA 1981	river	
Howard 1978b	-	-	-	-	2-4		days				Michigan 1975-76	pond	Based on own data and Collins 1975.
Martof et al. 1980	-	-	-	-	5		days				Carolinas, Virginia	NS	
Oliver 1955	-	-	-	-	5-20		days				NS	NS	As cited in DeGraaf and Rudis 1983.
Smith 1956	-	-	-	-	4-5		days				Kansas	NS	

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Wright 1914	-	-	-	-	4		days				New York	NS	As cited in DeGraaf and Rudis 1983.
TIME TO METAMORPHOSIS													
Bleakney 1952	-	B	-	-	3		years				Nova Scotia, CAN	NS	As cited in Bury and Whelan 1984.
Cecil & Just 1979	-	B	-	-	1		year				Kentucky 1974-76	shallow ponds	Overwinter as larvae and metamorphose between July and September.
Cohen & Howard 1958	-	B	-	-			months	6-7			California 1950-51	reservoirs	In artificial ponds that often dried up before the end of summer.
Collins 1979	-	B	-	-	1-2		years				Michigan 1972-74	pond	
Corse & Metter 1980	-	-	-	-			years	1	2		Missouri 1972-73	stock pond	About half of the tadpoles from one egg mass introduced in June transformed the next June at 31 mm SVL; the other half would have taken two years but pond went dry first.
Corse & Metter 1980	-	-	-	-			months	3.5	12		Missouri 1972-73	hatchery pond	About half of the tadpoles from one egg mass introduced into hatchery pond on June 27 with abundant food for the fish transformed in mid Sept. of same year; the rest transformed the next June. Size at transformation = 34 mm SVL in Sept, 44 mm SVL in June.
Durham & Bennett 1963	-	B	-	-	23-25		months				Illinois	NS	As cited in Collins 1979.
George 1940	-	B	-	-	4-6		months				Louisiana	NS	As cited in Collins 1979.
Gibbons & Semlitsch 1991	-	-	-	-			months	4-5	12-13		S Carolina	ponds	
Martof et al. 1980	-	B	-	-	1		year				Carolinas, Virginia	NS	
Ryan 1953	-	B	-	-	2-3		years				New York 1949-51	NS	
Smith 1956	-	-	-	-	1		year				Kansas	NS	

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Viparina & Just 1975	-	B	-	-	12-14		months	3-4			Kentucky 1971-73	ponds	A small percent (3-5%) transform after 3-4 months.
Willis et al. 1956	-	B	-	-	1		year				Missouri 1952-53	ponds	
Wright 1914	-	B	-	-	2-3		years				New York	NS	As cited in Willis et al. 1956.
AGE AT SEXUAL MATURITY													
DeGraaf & Rudis 1983	-	-	-	-			years	4	5		New England	aquatic	From time of hatching.
Dowe 1979	-	B	1	-	1		year				Arizona	NS	Years after metamorphosis: (1) adults which metamorphosed in fall following hatching; (2) adults which overwintered as larvae and metamorphosed in spring; as cited in Clarkson and DeVos 1986.
	-	B	2	-	2		years						
George 1940	-	B	-	-	2		years				Louisiana	NS	Years after metamorphosis; as cited in Turner 1960.
Howard 1978a	-	M	-	-	1		years				Michigan 1975-76	pond	Years after metamorphosis based on author's own data and Collins 1975.
	-	F	-	-	1-2		years						
Raney & Ingram 1941	-	B	-	-	2-3		years				New York	NS	Years after metamorphosis; as cited in Bury and Whelan 1984.
Ryan 1953	-	B	-	-	1-2		years				New York 1949-51	NS	Years after transformation.
MORTALITY													
Cecil & Just 1979	T	B	-	-	85.5		% tadpoles	82.4	88.2	3	Kentucky 1974-76	shallow ponds	% Mortality prior to metamorphosis; metamorphized after about one year in the pond. Min and max are the range found in different ponds/years.
Howard 1981a	A	M	-	-	79		%/winter			52	Michigan 1975-76	pond	Percent of number at end of breeding season (1975) not returning in spring (1976).
	A	F	-	-	80		%/winter			54			
Howard 1981a	A	M	-	-	88		%/winter			25	Michigan 1977-78	pond	Percent of number at end of breeding season (1977) not returning in spring (1978).
	A	F	-	-	92		%/winter			26			

Reference	Age	Sex	Cond	Seas	Mean	SD/SE	Units	Minimum	Maximum	N	Location	Habitat	Notes
Howard 1984	A	M	1	-	58		%/yr				Michigan 1975-76	pond	Mortality from age (in years) listed in condition column to the next year.
	A	M	2	-	58		%/yr						
	A	M	3	-	48		%/yr						
	A	M	4	-	77		%/yr						
LONGEVITY													
Howard 1978b	A	B	-	-			years		5-8		Michigan	ponds	Rough estimate.

***** SEASONAL ACTIVITIES *****

Reference	Begin	Peak	End	Location	Habitat	Notes
MATING/LAYING						
Behler & King 1979	Feb		Oct	southern range NA	NS	
Clarkson & DeVos 1986	Apr	May	late Jun	CA,AZ 1981	river	
Culley (pers. comm.)	Mar		Sep	Louisiana	NS	As cited in Bury and Whelan 1984.
DeGraaf & Rudis 1983; Behler & King 1979	late May	Jul	Jul	northern range	aquatic	
Durham & Bennett 1963	May		Jun	e c Illinois 1941-53	impoundment	
Ryan 1980	Apr 21		Jun 18	New Jersey	pond	
Ryan 1953	late Jun		earl Jul	New York 1949-51	NS	
Smith 1961	late Apr		Aug	Illinois	NS	
Smith 1956		May		Kansas	NS	
Storer 1922	Apr		late Jul	California	NS	As cited in Bury and Whelan 1984.
Viparina & Just 1975		Jun-July		Kentucky 1971-73	pond	
Willis et al. 1956	May	late Jun	Aug	Missouri 1950-54	farm ponds	

Reference	Begin	Peak	End	Location	Habitat	Notes
Wright & Wright 1949	late Jun		late Jul	New York	NS	As cited in Bury and Whelan 1984.
METAMORPHOSIS TO ADULT						
Cecil & Just 1979	July		Sept	Kentucky 1974-76	shallow ponds	After spending about one year as a tadpole.
Clarkson & DeVos 1986	Aug		Oct	CA, AZ 1981	river	Young of first clutches and some from second clutches that metamorphose in the year that they hatch.
Clarkson & Devos 1986	Mar		Apr	CA, AZ 1981	river	Young (of second clutches) which overwintered.
Collins 1979	late Jun		late Sep	Michigan 1972-74	pond	
Ryan 1953	July		Sept-Oct	New York 1949-51	NS	
Viparina & Just 1975		Jun-Aug		Kentucky 1971-73	pond	
Willis et al. 1956	Jun	late Jun-Aug	earl Oct	Missouri 1950-54	farm ponds	
HIBERNATION						
Durham & Bennett 1963	late Oct		late Mar	e c Illinois 1941-53	impoundment	
Ryan 1953	Oct-Nov		Apr-May	New York 1949-51	NS	Smaller frogs seem to emerge earlier and start hibernating later than large frogs.
Smith 1956			mid Feb	Kansas	NS	Earliest emergence from hibernation.
Willis et al. 1956	mid Oct		Mar	Missouri 1950-54	farm ponds	
Wright 1914	mid Oct		May	New York	NS	As cited in DeGraaf and Rudis 1983.