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Reproductive success of Canada geese in the Bitterroot Valley Montana

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REPRODUCTIVE SUCCESS OF CANADA GEESE IN THE BITTERROOT VALLEY, MONTANA

By

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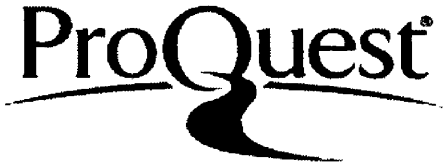

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF PLATES

Chapter 1

INTRODUCTION

The inherent wild qualities of the Canada goose (Branta canadensis) have been sung and told in song and legend to generations of Americans. In the past, human population pressures and resultant conflicts have eliminated valuable species of wildlife and have threatened many others. At present, the Canada goose appears to be in no danger, but research efforts and sound management policies must be pursued in order to insure a place for the Canada goose in our future.

The Great Basin Canada goose (B. c. moffitti) was first described by Aldrich in 1946. Breeding populations commonly occur on river systems and lakes from central British Columbia and Alberta, as far south as Lake Tahoe. In an east-west direction, breeding occurs from the Sierra-Cascade Range eastward to Dawson, North Dakota, and northwestern Colorado. Wintering areas extend from the Mexican to the Canadian borders of the United States wherever open water and adequate food may be found.

Yocom (1965) estimated the 1952 breeding population of B. c. moffitti at 17,150 pairs. Competition between Canada geese and ranching and agricultural interests is acute in some areas (Grieb et al. 1961), but development of these interests has apparently stimulated the spread of this species along river systems (Yocom 1962). These river-nesting populations provide an important source of high quality recreation for sportsmen and add to the aesthetic appeal of the outdoor experience for many people.

In order to realize the maximum benefit from this valuable waterfowl resource, it is desirable to learn as much as possible about the ecology of river-nesting Canada geese. Numerous workers have contributed valuable knowledge about nesting geese on river systems in the West (Craighead and Craighead 1949, Grieb et al. 1961, Cadwell 1968, and others). A review of the literature, however, revealed that the nesting Canada geese of the Bitterroot Valley in western Montana have not yet been studied.

The primary objectives of this study were to determine as accurately as possible the extent of the breeding population, clutch size, nesting success, and hatching success of Canada geese in the Bitterroot Valley. Secondary objectives were to determine what kinds of nesting sites are preferred and how the geese are distributed in relation to available resources. It was felt that examination of these data might provide an understanding of the Bitterroot population upon which management decisions could be based. The relative degree of reproductive success for the Bitterroot population was ascertained by comparing data with findings by other workers in the West.

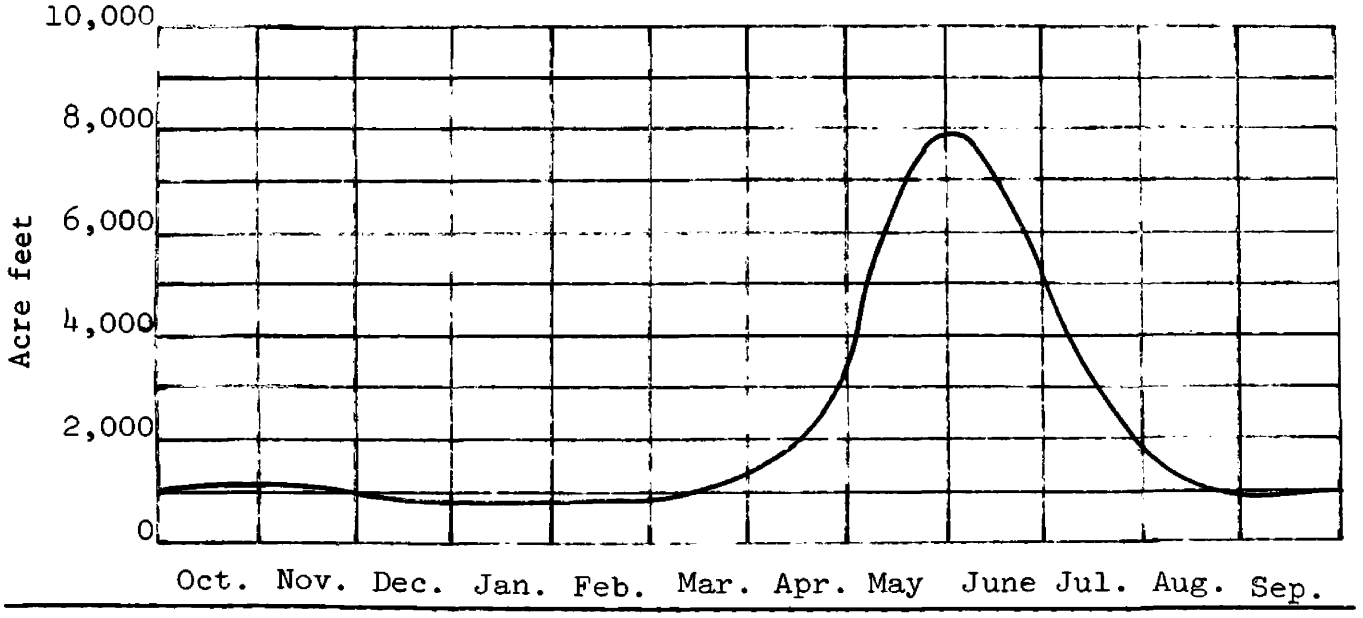
Chapter 2

THE STUDY AREA

The Bitterroot River flows from south to north through the Bitterroot Valley of western Montana. McMurtrey et al. (1959) indicate that this valley had its origin in the Cretaceous period as a marginal flexure concurrent with the intrusion of the Idaho batholith. The Valley is bounded on the east by the Sapphire Range, and on the west by the higher, more rugged Bitterroot Mountains. The Bitterroot River and its tributaries drain all of Ravalli County, an area of 2400 square miles.

As with other streams in mountainous areas, the outflow of the Bitterroot River increases markedly during the period of spring melt in the mountains and foothills (Fig. 1). McMurtrey et al (1959) state that

Figure 1. Average monthly surface outflow of the Bitterroot River at Florence, 1938-57. From McMurtrey et al. 1959.



53 percent of the total yearly discharge occurs during the months of May and June. The peak of run-off occurs about May 30th. A low level of flow occurs between August 1st and March 31st.

The lower portion of the Bitterroot Valley, from Hamilton to its confluence with the Clark Fork River at Missoula, constitutes the 40-mile-long study area (Figs 2 through 4). This stretch of river is characterized by a broad, irregular flood plain. In addition to the main river channel there are many side channels, oxbows, and sloughs. Between Woodside Crossing and Bell Crossing, the River forms a braided stream pattern which is particularly apparent during periods of high water (Plate 1). All along the River oxbows and sloughs become actively flowing channels during periods of high discharge.

The vegetation along the Bitterroot River forms a dense growth in many places, interspersed with open meadows and pastures. The dominant trees in the forested areas are black cottonwood (Populus trichocarpa), yellow pine (Pinus ponderosa), and river alder (Alnus incana). Many pastures contain extensive groves of hawthorn (Crataegus sp.), and islands in the river channels are often covered with willow (Salix spp.). The understory is composed of a wide variety of shrubs and herbs, the most common of which are red osier (Cornus stolonifera), raspberry (Rubus sp.), wild rose (Rosa woodsii), currant (Ribes spp.), snowberry (Symphoricarpos sp.), meadow rue (Thalictrum sp.), thistle (Cirsium sp.), cinquefoil (Potentilla sp.), false Solomon's seal (Smilacina sp.), cow parsnip (Heracleum lanatum), nettle (Urtica sp.), mint (Mentha arvensis), and dandelion (Taraxicum officinale and T. laeuigatum).

Moist areas along the River often contain extensive growths of sedges (Carex spp.), while dry pastures are often covered with knapweed (Centaurea repens). Irrigated hay meadows are attractive to grazing geese which utilize the abundant timothy (Phleum pratensis), clover (Trifolium spp.), and bluegrass (Poa spp.).

Water from the Bitterroot River is used to irrigate pasture land, forage crops, and small grains. Many farms in the study area raise beef cattle, but between Stevensville and Hamilton on the east side of the River the production of dairy products is a very important source of income. The western slope of the Sapphire Range between Florence and Missoula is not irrigated; it is used principally for grazing beef cattle and horses.

Ravalli National Wildlife Refuge was authorized by the Migratory Bird Conservation Commission in December, 1963. The Refuge consists of 2670 acres of marsh, impoundments, agricultural lands, and brush and timber located on the east side of the Bitterroot River just north of Stevensville (Fig. 3). Management of the Refuge was begun in September, 1964. Development of waterfowl habitat was started immediately and proceeded as fast as the land acquisition program would allow. Major land acquisition was completed in early 1969, and installation of water control structures is nearly completed. The completed water control structures will maintain 500 acres of permanent impoundments and create 200 acres of seasonal marshes.

Many of the permanent impoundments contain small, bulldozed nesting islands which are attractive to waterfowl. Refuge impoundments contain 38 goose nesting structures built on stilts or placed in trees. Structures

on stilts consist of a wire platform covered with a layer of straw and having four metal poles for legs. Tree structures are of two types, washtubs and woven wire baskets with a burlap floor. The height of these structures varies from a few feet to 50 or more feet above the surface of the water. In addition to providing waterfowl habitat, the Refuge also provides excellent cover for pheasants, white-tailed deer, and numerous non-game species of wildlife. In the fall, a portion of the refuge is open to public hunting.

Meadow and grassland areas on the refuge provide ideal brood raising habitat for Canada geese.

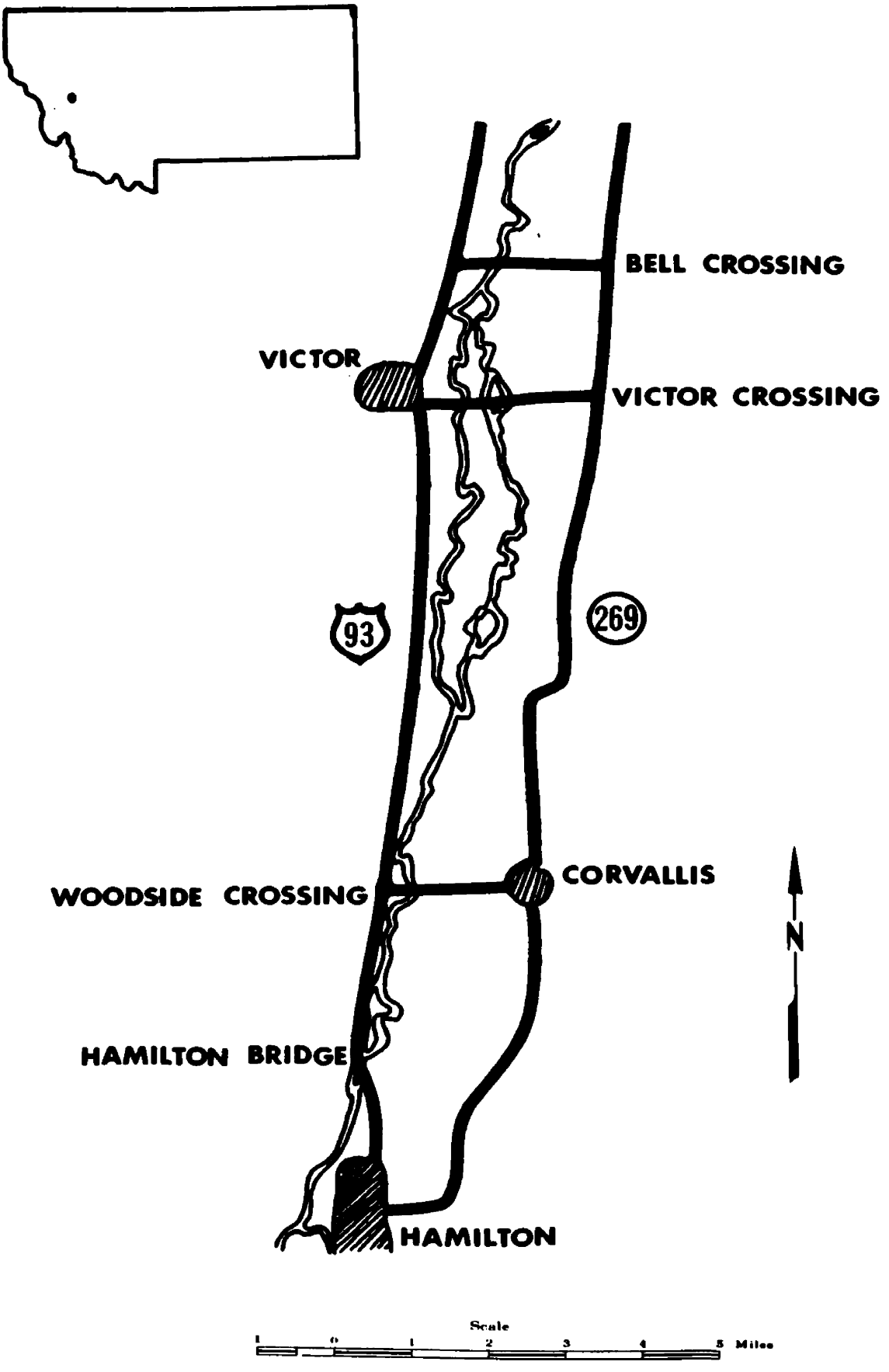


FIGURE 2: Southern portion of the study area

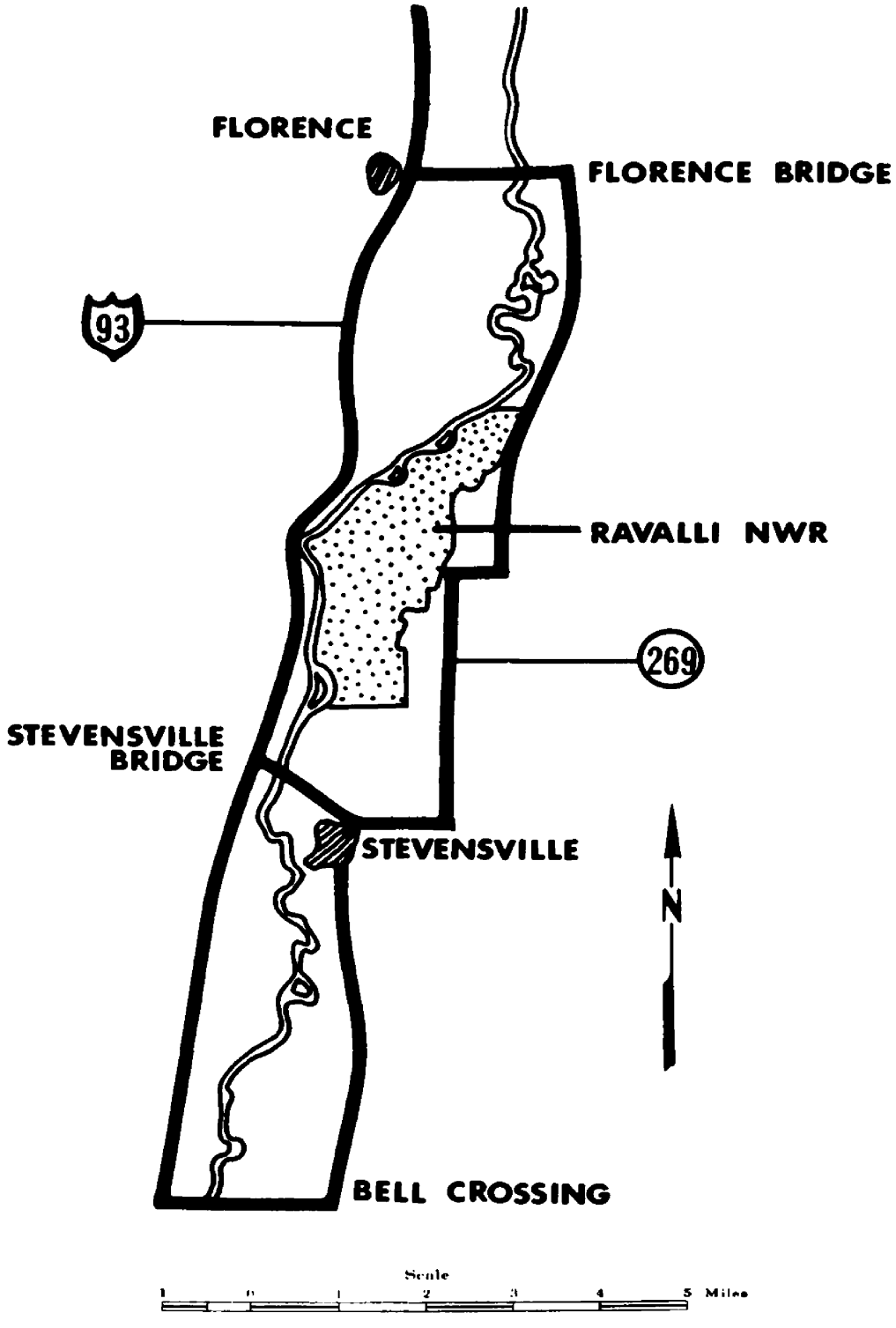


Figure 3: Central portion of the study

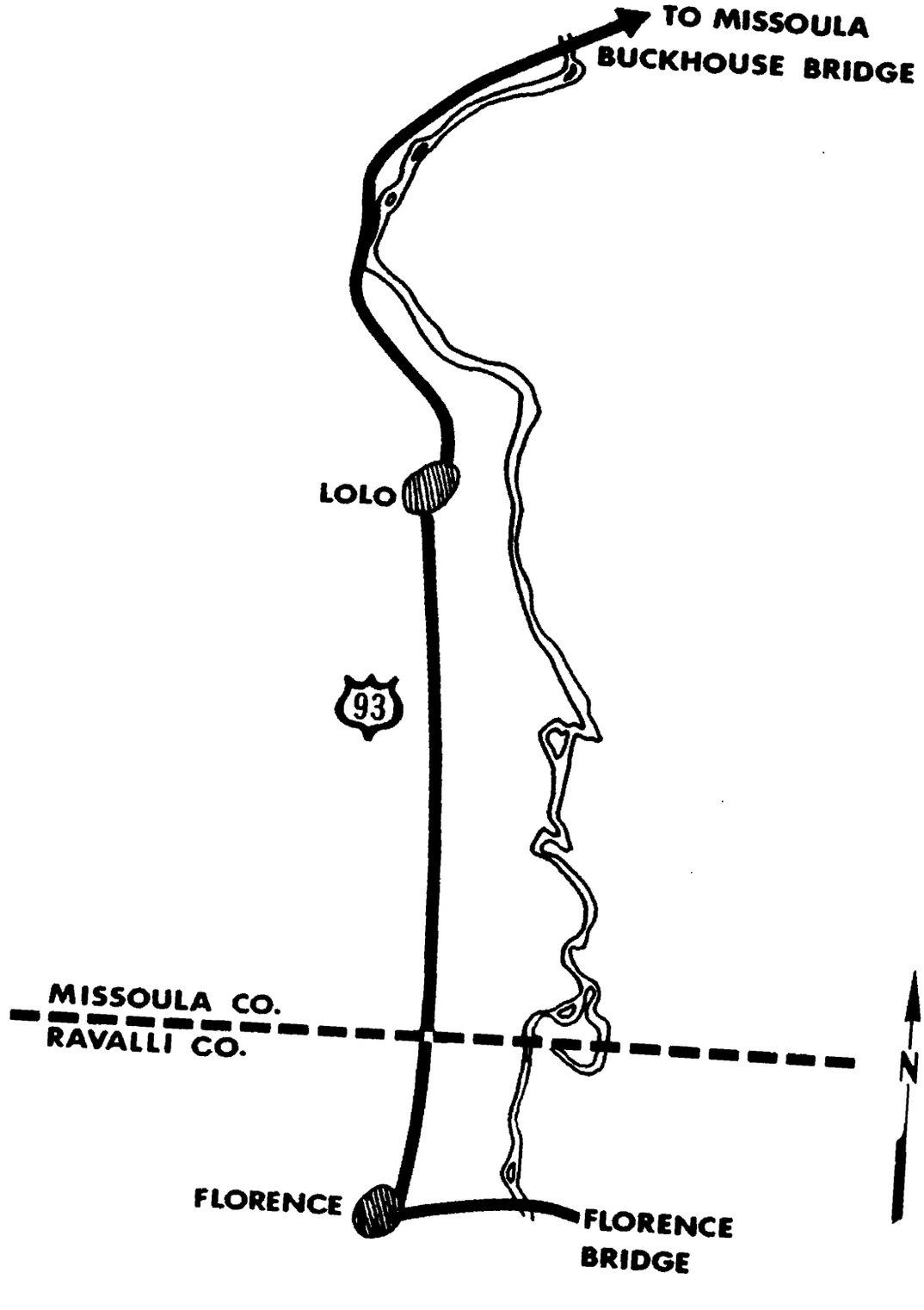
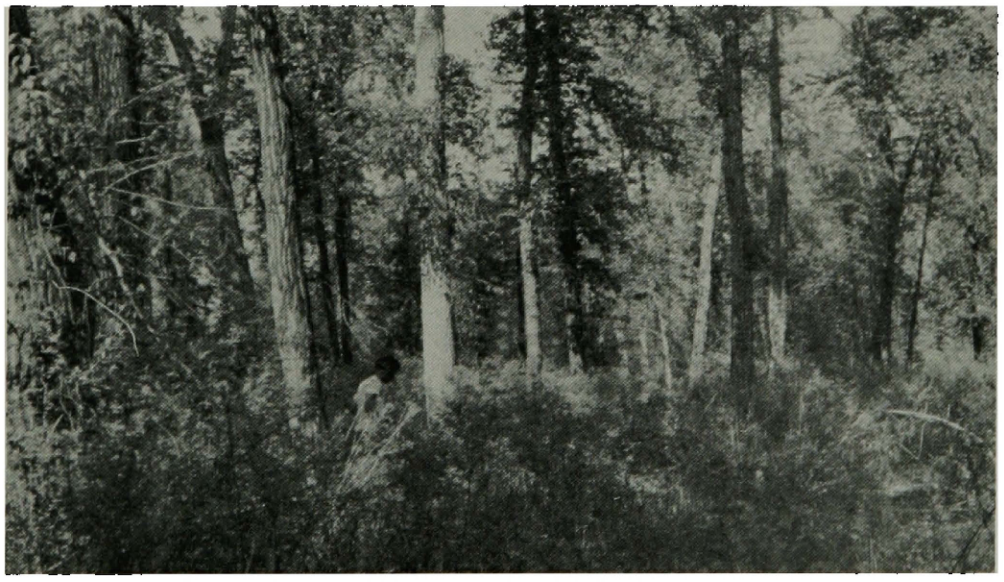


FIGURE 4: Northern portion of the study area

PLATE III

Upper: A Canada goose nest located on the ground.

Lower: Adult geese with a brood of goslings on their way to a brood area.



Chapter 3

METHODS

Floating the River in a rubber raft was considered the only practical means of transportation through the study area. During early spring three days were required to float the length of the study area whereas only two days were required in late spring due to spring run-off. As a safety factor, a second person always accompanied the investigator on the float trips. In areas where the river divided into several channels, the channel which contained the most water was followed. On several occasions two rafts and four observers were used. In this manner it was possible to search simultaneously on both sides of large islands.

A 1.5 hp outboard motor was used to propel the raft in slow water, especially when it seemed desirable to move into backwaters against a current. The motor was used as little as possible so that noise would not alert the geese and make observations more difficult. Normally a pair of oars was used to maneuver the raft; the current carried the raft along at about 2-5 mph.

The locations of all geese which were seen along the river were plotted on U. S. Forest Service 2-inch base maps. The maps had been cut into 8 x 10 inch pieces and each piece waterproofed by laminating it between two layers of plastic film. A black grease pencil was used to write on the plastic coated maps. Frequent stops were made in order to observe the activities of geese, and suspected areas were searched for nests. Observations were aided by the use of 8x30 binoculars and a 25x spotting scope.

Due to the vegetational characteristics of the study area, it was very difficult to spot nests from a long distance. Canada geese have a tendency to flatten themselves out on the nest in order to avoid detection. As the 1969 season progressed, it became increasingly apparent that the best way to find nests was to locate a territorial gander and thoroughly search the immediate area. However, this technique was only effective during the incubation period when the nest site was being actively defended by the gander.

When a nest was located, the site was marked by placing a metal rod in the River bank about 30-50 yards upstream. A piece of yellow plastic flagging was tied to the rod, or, in some cases, to vegetation. Trees with goose nests in them were marked by tying a piece of plastic flagging around the trunk of the tree. Individual nest history forms (Appendix I) were used to record pertinent data. Nests were numbered in the order that they were found. Little information was obtained from many of the nests which were found in trees because it was impossible to safely climb them.

Once a nest had been located and a count made of the completed clutch, all observations were made from a distance in order to avoid flushing the goose from the nest. In this manner human disturbance was kept to a minimum and unnecessary chilling of the eggs was prevented. All nests were checked at least once a week to see if the clutch was still being incubated. Eggs remaining in destroyed nests were collected in order to ascertain the stage of development.

Aerial reconnaissance was carried out with the use of a locally chartered Cessna 172. Two observers, in addition to the pilot, counted

geese and recorded their locations on a map. This procedure was particularly valuable just prior to the breeding season because distribution of geese, which were in the process of establishing territories, could be directly observed. This information could then be used to aid in locating nests from the ground. In addition to the pre-nesting season flights, flights were also made on June 18, 1969, and November 17, 1969, in order to observe numbers and distribution of geese.

Chapter 4

THE NESTING SEASON

The Breeding Population

Canada geese are present on the study area during the entire year, but it is not known if the breeding population remains throughout the winter. During spring and fall migrations the goose population of the Bitterroot Valley typically swells. Goose numbers build up to a peak in late December or early January as migrant geese stop in the Bitterroot Valley. When severe weather forces many of them to move southward, the population declines. A second peak of goose numbers is reached in March as migrant geese move northward. Appendices II, III, and IV illustrate the magnitude of these fluctuations.

The breeding population of the Bitterroot Valley is composed entirely of B. c. moffitti. Records at Ravalli National Wildlife Refuge show that a few B. c. parvipes have stopped briefly in the Bitterroot Valley during the fall migration, but this subspecies does not breed in Montana (Hansen and Nelson 1964).

During March float trips, in both 1969 and 1970, 70-80 geese were seen along the main channel of the Bitterroot River. Weekly counts at Ravalli Refuge showed that 80-120 geese utilized the Refuge impoundments in early March (Appendices II and III). Combining these counts yields a total population estimate of 160-180 geese for this time of year. With the advent of the breeding season (in late March and early April) this number decreased to approximately 110-130. Based on observations of

territorial behavior during this study, 25-30 pairs appeared to be reproductively active. This estimate indicates a breeding component of 45-50 percent of the entire flock.

Grieb (1970) constructed several hypothetical population models for the shortgrass prairie Canada goose population. These population models were based in part on the assumptions that 50 percent of all young and 28 percent of all adults were shot during the hunting season. The model, which most nearly approximates the estimated proportion of breeders for the Bitterroot flock, contained 49 percent breeders and resulted in a 4 percent rate of increase.

Although it is impossible to gauge the effect of hunting pressure on the Bitterroot population by merely estimating the proportion of breeders, my previously mentioned estimate (45-50 percent breeders) indicates that the age structure of the flock is near the "normal" postulated by Grieb (1970).

Length of the Nesting Season

In 1969 Canada geese of the Bitterroot Valley began laying eggs about March 25th; in 1970 the nesting season began somewhat earlier with the initiation of egg-laying occurring about March 8th. These dates were calculated by back-dating from the day of hatching for the first broods of each season. Twenty-eight days were allowed for the incubation period (Collias & Jahn 1959, Brakhage 1965), while 1.5 days were allowed for the laying of each egg (Kossack 1950). Kossack found the average incubation period for Canada geese to be 26 days, but most biologists accept 28 days as the normal incubation period for wild populations of large subspecies of Canada geese. In this study the first day of incubation was accurately

determined for two nests. One nest hatched on the 28th day of incubation while the other hatched on the 29th day.

According to Williams (1967), the advent of the nesting season is correlated with latitude, altitude, and local variations in climate. Hanson and Browning (1959) found that the beginning of nesting in Washington varied as much as 2 weeks due to weather, and Kossack (1950) noted that the 1945 nesting season began 3 weeks earlier than the 1944 nesting season in Illinois. The influence of weather on the beginning of the nesting season was apparent in this study. In 1969 deep snow was present on the River flood plain as late as mid-March with below zero temperatures. In 1970 the same area was almost devoid of snow by the end of February and temperatures were much warmer compared to the same time of year in 1969. Barraclough (1954), working in the Flathead Valley, found that geese began laying on March 10th in 1953 and on March 15th in 1954. It is believed that geese in the Bitterroot Valley begin nesting at about the same time as those in the Flathead Valley since both areas are at approximately the same latitude and altitude and both populations consist entirely of B. c. moffitti. The observed variations are probably due to the influence of local weather conditions. Table 1 depicts variations in length of the nesting season as reported by various biologists.

Brakhage (1965) and Klopman (1958) stated that renesting is probably the most important single factor in lengthening the nesting season. Renesting may be responsible for a significant proportion of the production in temperate climates (Errington 1942). The effect of a single renest in the Bitterroot Valley on the length of the nesting season in 1970 is well illustrated by the following example. The 1970 season was considered finished on May 15th after 69 days of nesting activity. On May 25th a

Table 1. Length of nesting season for selected areas.

Area	Subspecies	Season length (days)	Source
McConnell River, N.W.T.	hutchinsii	39	MacInnes 1962
Southampton Island, N.W.T.	hutchinsii	38	MacInnes 1962
Manitoba	interior	53	Klopman 1958
		61	
Montana	moffitti	77	Barraclough 1954
		72	
Montana	moffitti	58	This study
		97	
Washington	moffitti	77	Hanson & Browning 1959
Ohio	a	86	Bednarik 1968
Missouri	maxima	73	Brakhage 1965
Klamath Basin	moffitti	79	Rienecker & Anderson 1960
		83	Miller & Collins 1953

[a]Probably interior.

renesting goose was discovered incubating a clutch at Ravalli National Wildlife Refuge. The last day of incubation for this nest was June 12th, which extended the length of the nesting season to 97 days.

Preferred Nesting Sites

Nineteen of twenty-eight nests (67.9%) were found in trees, eight (28.6%) on the ground, and one (3.5%) on a man-made nesting platform. Aerial nesting sites included the nests of ospreys (Pandion haliaetus), red-tailed hawks (Buteo jamaicensis), and great blue herons (Ardea herodias). Several goose nests were also located in the hollow tops of broken-off cottonwood snags and in man-made tree structures at Ravalli National Wildlife Refuge.

In order to discuss the importance of tree nests in the Bitterroot Valley, it seems desirable to review the prerequisites for a suitable goose nesting site. Miller and Collins (1953), Rienecker and Anderson (1960), Williams (1967), and others have outlined some of the basic requirements for a good goose nesting site. These studies indicate that the most important considerations are for a wide range of visibility and nearness to open water. When available, small islands with little or no dense vegetation seem to be ideal. Klopman (1958) found that 94 percent of all goose nests at Dog Lake, Manitoba, were located on such islands. Craighead and Craighead (1949) found similar results on the Snake River as have researchers in many other areas (Barraclough 1954, Hammond and Mann 1956, Atwater 1959, Weigand 1960, MacInnes 1962). In marsh-type situations, muskrat (Ondatra zibethica) houses are often used (Dow 1943, Miller and Collins 1953, Nelson 1963).

Due to the rapid increase in run-off of the Bitterroot River during the month of May, most suitable nesting islands are subject to rather

sudden inundation. Ground nesting sites which are safe from flooding are often covered with dense vegetation. Buss and Wing (1966) pointed out that tall, dense vegetation resulted in low nesting density on one island in the Snake River of eastern Washington. Since incubating geese rely on their vision and power of flight to avoid danger, nest sites in dense cover probably do not provide adequate protection from predatory mammals.

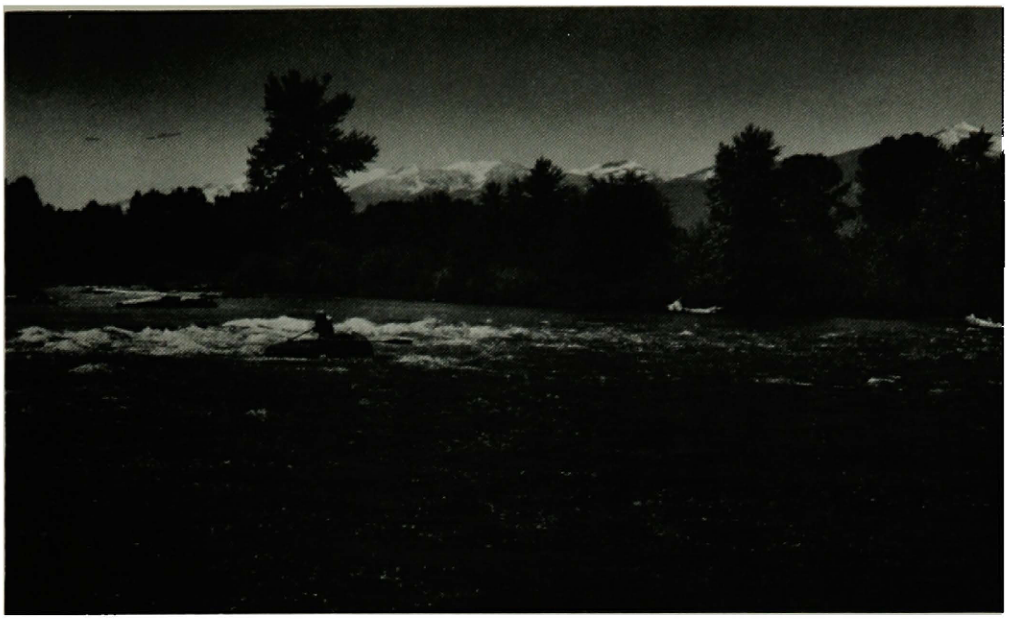
Williams (1967) mentioned that Canada geese may utilize trees when nest sites in marshes or on banks become unattractive or unavailable. The combination of danger from flooding and predation plus dense vegetation along the Bitterroot River has the tendency to severely reduce the desirability of terrestrial nesting sites. The selection of aerial nesting sites by Canada geese seems, therefore, to be partly a response to flooding and predation, and partly due to lack of suitable ground sites. This particular response may be learned or conditioned behavior as suggested by Craighead and Craighead (1949). However, it is possible that the forces of natural selection have operated by reducing the number of successful ground nests while at the same time increasing the number of successful tree nests.

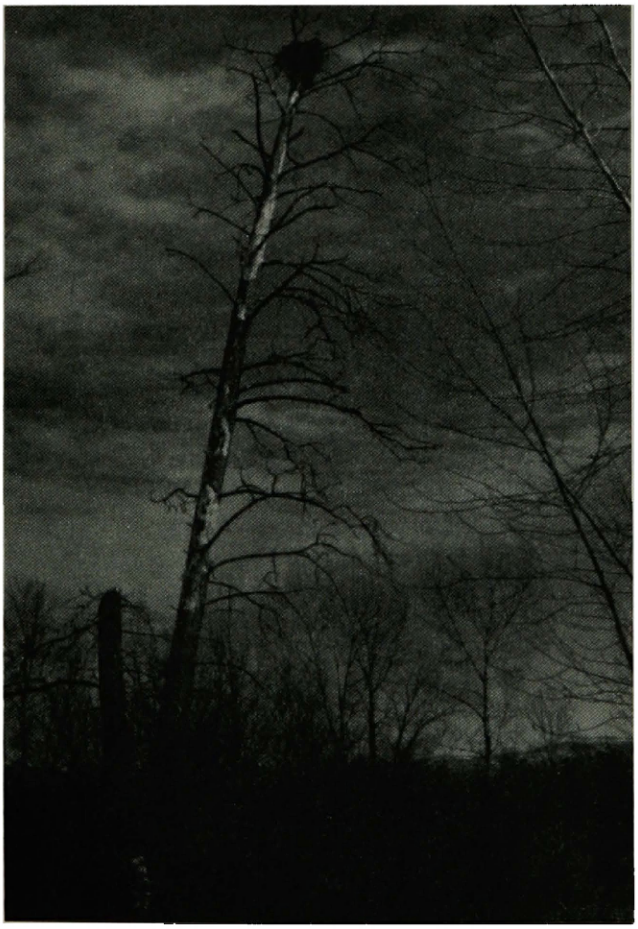
Brakhage (1965) suggested that female goslings were imprinted on tub nests. Hess (1959) found that ducklings were most effectively imprinted at 13-16 hours of age. He also pointed out that the peak of imprintability occurs at a very early age for many species of birds and mammals. Goslings are usually kept on the nest overnight after they hatch. Collias and Jahn (1959) stated that the "...initial day in the nest permits the young ones and their parents to become acquainted and conditioned

PLATE II

Upper: Dense vegetative cover immediately adjacent to the River. During high water all beach areas were flooded.

Lower: This osprey nest was occupied by Canada geese during both years of the study.





to each other, and serves later to help maintain family unity, after the goslings leave the nest."

With the development of several large impoundments at Ravalli National Wildlife Refuge, abundant ground nesting sites became available to Canada geese. In 1970 when nesting geese on the Refuge were included in this study, they chose tree sites over ground sites in a 2:1 ratio. It is felt that imprinting may be partly responsible for this selectivity. The preference for tree sites may also be genetically ingrained (i.e. produced by natural selection) since those geese that nested on the Refuge chose tree sites in the same ratio as those geese that nested along the River.

Tables 2 through 4 show the frequency distribution of distance from water for ground nests, tree nests, and all nests combined. The average distance from water for eight ground nests (platform excluded) was 6.5 feet. Tree nests averaged 113.2 feet from the nearest open water. Williams and Sooter (1940), working with Canada geese in Utah and Oregon, found that 72 percent of all nests were within 30 feet of water. MacInnes (1962) found that 78 percent of B. c. hutchinsii nests along Hudson Bay were within 5 feet of water, a statistic which is identical to that found for ground nests in this study. Similar results have been found by Dow (1943) in California, Kossack (1950) in Illinois, Rienecker and Anderson (1960) in California, and others.

Fifty-three percent of the tree nests found in this study were located from 80-400 feet from the nearest water. The visibility afforded by tree sites probably compensates for the desire to locate a nest near water. Nelson (1963) stated that the selection of aerial nesting sites indicates a preference of the nesting female for a wide range of visibility.

Table 2. Distance to water (ground and platform nests only).

Distance in Feet	Number of Nests	Percent	Cumulative Percent
Over water	2	22.2	22.2
1-5	5	55.6	77.8
6-10	0	0	77.8
11-15	1	11.1	88.9
16-25	1	11.1	100.0

Table 3. Distance to water (tree nests only).

Distance in Feet	Number of Nests	Percent	Cumulative Percent
Over water	5	26.3	26.3
1-25	4	21.1	47.4
26-50	0	0	47.4
51-75	0	0	47.4
76-100	3	15.8	63.2
101-200	3	15.8	79.0
201-300	2	10.5	89.5
301-400	2	10.5	100.0

Table 4. Distance to water (all nests).

Distance in Feet	Number of Nests	Percent	Cumulative Percent
Over water	7	25.0	25.0
1-25	11	39.3	64.3
26-50	0	0	64.3
51-75	0	0	64.3
76-100	3	10.7	75.0
101-200	3	10.7	85.7
201-300	2	7.15	92.85
301-400	2	7.15	100.0

Tree-nesting geese have been known to nest as much as 1/4 mile from the nearest water (Davison 1925). It is interesting to note that in this study every nest was so located that an incubating goose could easily see open water from the nest.

Height of tree nests ranged from 25-90 feet, averaging 53 feet. Distance from water appeared to be unrelated to tree height. The height of ground nests averaged 2.5 feet with a range of 1-4 feet. Height was estimated to the nearest foot above the water level prevailing at the time the nest was found.

During the course of this study the investigator watched a brood of goslings leave an osprey nest. The nest was located at the top of a 90-foot dead cottonwood snag in an open field about 400 feet from the nearest water. At 8:45 A.M. on the 30th day following the onset of incubation, both adults were seen on the nest with a brood of goslings that had apparently hatched the day before. A 25x spotting scope was focused on the nest from an adjacent tree-studded knoll so that the activities of the geese could be studied. At 10:45 A.M. the goose left the nest and flew to the base of the tree. As soon as she landed on the ground the gander flew down and joined her. One of the adults (probably the female) called a few times in an almost imperceptible voice. A gosling then walked to the edge of the nest and stepped into space. One by one the goslings tumbled out of the nest, spreading their little wings and feet as they made their descent. Total elapsed time, from the moment the female left the nest until the seventh and last gosling struck the ground, was 25 seconds.

Similar accounts concerning the exodus of young geese from elevated structures have been reported by Davison (1925) for Alberta, Craighead and Stockstad (1958) for Montana, and Brakhage (1965) for Missouri. Yocom

(1952) mentioned that goslings may be pushed out of the nest by the adults or carried to water. If these methods are employed they are probably the exception rather than the rule.

Occasionally a gosling is injured when jumping out of a tree nest. During this study only two goslings were known to have been injured while leaving elevated nests. Both goslings were alive when found, were taken into captivity and treated, hand reared to the flight stage, and subsequently released as full-winged birds-of-the-year. Gosling mortality due to jumping out of trees does not seem to be very significant. Craighead and Stockstad (1958) noted only one instance of a gosling being killed in this manner during observations of 77 tree nests in the Flathead Valley, Montana. Furthermore, they felt that this procedure is natural to the species and the goslings are well adapted to negotiate the fall.

Clutch Size

The mean size for 16 completed clutches was 5.88 eggs; this is somewhat higher than that which has been reported in other populations of B. c. moffitti. Craighead and Stockstad (1961) found an average clutch of 5.19 eggs in 1105 nests in the Flathead Valley, Montana. Hanson and Browning (1959), working with a sample of 732 nests along the Columbia River of Washington, found an average clutch size of 5.4 eggs per nest. Most clutch sizes recorded averaged about 5.2 to 5.5 eggs. Bednarik (1968), working with another subspecies, recorded an average clutch size of 4.18 from a sample of 226 nests in Mercer County, Ohio, in 1966. Buss and Wing (1966) stated that 228 nests along the Snake River of eastern Washington contained an average of 6.0 eggs per nest.

These last two figures probably represent the extremes that can be expected in Canada goose nests, provided an adequate sample is available.

The smallest and largest clutches found in this study were 4 and 8 eggs respectively. The frequency distribution of eggs per clutch is shown in Table 5.

Table 5 shows the average clutch size of tree and ground nests. Tree nests appeared to have larger clutches than ground nests, and it is interesting to note that this phenomenon has been recorded several times. At Killdeer Plains, Ohio, geese commonly nest in elevated structures. Bednarik (1968) found that the average clutch in these structures was 5.7 eggs while ground nests had an average of 5.2 eggs per nest. Brakhage (1965) found 108 tub nests of B. c. maxima at Trimble, Missouri, to contain an average of 5.5 eggs while 34 ground nests contained 4.6 eggs per nest. Craighead and Stockstad (1961) also found that platform-nesting B. c. moffitti on Flathead Lake, Montana, produced 5.37 eggs as compared to 5.19 eggs for the entire population.

Table 5. Frequency of distribution of clutch size.

Clutch Size	Number of Nests		
	Tree	Ground	Total
4	1	1	2
5	1	3	4
6	2	3	5
7	3	1	4
8	0	1	1
Average Clutch	6.0	5.78	5.88

Although these differences are not great enough to be statistically significant, geese using aerial nesting sites appear to produce larger clutches. The reasons for this are not fully understood. Brakhage (1965) showed that older geese laid larger clutches and were more successful nesters. It may be that tree nesting geese are primarily older and more experienced birds.

Nesting Success

The degree of nesting success is the proportion of known-fate nests that actually produce goslings. During the 2 years of this study the overall nesting success of 21 goose nests in the Bitterroot Valley was 81 percent. Table 6 presents some comparative data which illustrates the degree of nesting success found among other populations of Canada geese.

The degree of nesting success is meaningless without some guideline or criterion for comparison. Kalmbach (1939) presented a highly theoretical, but useful, guideline. He contrasted the nesting success of waterfowl with the nesting success experienced by many species of birds nesting in a wide variety of ecological situations. The conclusion reached was that a 30 percent loss among waterfowl can be considered normal, and the complimentary 70 percent success may be looked upon as satisfactory for managed areas.

Even though this criterion is somewhat arbitrary, it is helpful in deciding whether a particular waterfowl population is doing well or poorly in its reproductive efforts. The use of this "rule-of-thumb" enables us to look at Table 6 more critically. The Canada geese of the Bitterroot Valley are among the most successful flocks represented in

Table 6. Comparison of nesting success among various populations of Canada geese. All populations are B. c. moffitti unless otherwise noted.

Area	Number of nests	Nesting Success	Reasons for Failure	Source
California	418[a]	52.5% 60.0%	Desertion Predation (coyote, skunk) Flooding, fire	Dow 1943
Wyoming	88	24.0%	Flooding Predation (raven)	Craighead & Craighead 1949
Manitoba	104[b]	61.0% 35.0%	Flooding Predation (fox, gull, man) Interspecific strife (pelican)	Klopman 1958
Washington	1033	71.0%	Predation (magpie)	Hanson & Browning 1959
Colorado	68	84.0%	Flooding	Grieb, et al. 1961
Utah	124	82.3%	None listed	Dey 1964
Saskatchewan	130[c]	59.2%	Predation (coyote, bobcat) Flooding	Caldwell 1967
Montana	21	81.0%	Flooding (?) Predation (raccoon) Interspecific strife (osprey)	This study

[a]B. c. moffitti, based on the location of the study.

[b]B. c. interior.

[c]Subspecies not given.

the Table. This high rate of success in the Bitterroot Valley can be attributed to the fact that many geese nest in trees. This habit enables them to escape the dangers of predation and flooding which often plague ground-nesters.

Table 7 shows that tree nests of known fate had a higher degree of success than did ground nests of known fate. A differential degree of nesting success in elevated structures as compared to ground nests has been reported numerous times. Craighead and Stockstad (1961), working with B. c. moffitti in the Flathead Valley, Montana, found that 71 percent of aerial nests were successful while only 65 percent of all nests were successful. At Trimble, Missouri, Brakhage (1965) found that tub-nesting B. c. maxima had a 73 percent nesting success, but ground-nesting geese only had 47 percent nesting success. In both of these studies the destruction of nests due to predation was much lower while desertion was higher in elevated nests as compared to ground nests. Craighead and Stockstad (1961) pointed out that these two factors were not complimentary since they experienced a net gain in goslings from tree nests.

Table 7. Nesting success of Canada geese in the Bitterroot Valley, Montana.

Type of Nest	Successful	Unsuccessful	Unknown	% Known-Fate Nests Successful
Tree nests	12	2	5	85.7
Ground & Platform nests	5	2	2	71.4
Total-- all nests	17	4	7	81.0

PLATE I

Upper: Aerial view of the Bitterroot River near Victor.

Lower: A heavily forested area with dense brush along the Bitterroot River.

Nesting failures. The reasons for nesting failures are many and varied. Sometimes a single factor is responsible for loss of most unsuccessful nests but often a combination of factors is responsible. Table 6 lists the most commonly found reasons for failure of goose nests.

Due to the small sample size in this study, it is extremely difficult to assess the impact of any particular detrimental factor. Only four nests were known to have failed. Two ground nests were destroyed by predators, one by a raccoon and one by an unknown avian predator. Predator identification was based on criteria presented by Rearden (1951). Predators which are present on the study area include ravens (Corvus corax), magpies (Pica pica), skunks (Mephitis mephitis), raccoons (Procyon lotor), foxes (Vulpes fulva), mink (Mustela vison), coyotes (Canis latrans), and bobcats (Lynx rufus).

Whole eggs were collected from both destroyed nests and later opened. The eggs from the raccoon-destroyed nest showed about 40 hours of incubation, and the nest which was destroyed by an avian predator showed about 6 days of incubation. Since developmental data for goose embryos is not available, the stage of incubation was estimated by comparing embryo development with that of the chick (Patten 1957) and multiplying by 1.43 to compensate for the difference in incubation periods. In either case desertion could have occurred before predation.

Two ground nests which are listed as "unknown-fate" in Table 7 were washed out by high water. Since the flooding occurred fairly late in the season, and all traces of the nests were completely removed, it is impossible to know whether the broods hatched before flooding occurred. The effects of flooding can be quite variable from year to year. Caldwell (1967) found that the effect of flooding on goose nests along the South

Saskatchewan River was very small as long as water levels did not rise during incubation. However, in 1964 a sudden rise in water levels just before the hatching peak resulted in a loss of 44.4 percent of all goose nests. Craighead and Craighead (1949) estimated a loss of 25 percent of all nests due to a sudden rise in the Snake River of Wyoming during a critical period in the nesting season.

In the Bitterroot Valley the timing of the advent of nesting is particularly critical if losses due to flooding are to be avoided. In 1969 a nest was found in a backwater on a gravel bar with a goose incubating a clutch of six eggs. The nest was visited weekly until the eggs were nearly ready to hatch; at this time the water had risen to within 2 inches of the nest. On a subsequent visit two adult geese with six goslings were found swimming about in the backwater. Examination of the nest revealed that the eggs had hatched and the entire nest was under 3 inches of water. If this particular pair of geese had begun their nesting activities a few days later than they did, they might very well have lost their entire clutch.

One of the tree nests which failed was unsuccessful due to interspecific strife. The geese had chosen an osprey nest as a nest site but were evicted when a pair of ospreys decided to use the nest. Eggshells at the base of the tree indicated that the goose eggs may have been pushed out of the nest by the ospreys.

The second tree nest which failed was unsuccessful because the eggs failed to hatch. It is believed that the clutch was chilled during a late spring snow which was accompanied by below freezing temperatures. The goose incubated the eggs for at least 63 days before abandoning the nest. This represents an incubation period of 2.25 times the normal.

Skutch (1962) stated that most birds will incubate a clutch about 1.5 times the normal incubation period and occasionally 2 or even 3 times the normal. Brakhage (1965) found the average length of incubation for 12 dead clutches of B. c. maxima in Missouri was 42 days, with a range of 28-56 days. Dow (1943) reported a Canada goose in California as having incubated for 87 days, 3.1 times the normal.

Hatching success. Hatching success is the proportion of eggs that hatched in successful nests. The hatching success was not determined for many of the tree nests because of the difficulty encountered in trying to climb to them. Hatching success of Canada goose eggs is usually quite high, generally between 80-95 percent (Table 8). In the Bitterroot Valley six unhatched eggs were collected from four successful nests; two eggs were infertile, three were fertile and contained embryos which had died in early stages of incubation, and one contained an embryo which had died in about the third week of incubation. Collias and Jahn (1959), working at Horicon Marsh in Wisconsin, found that 10 of 21 unhatched eggs from successful nests were infertile. The rate of infertility for B. c. moffitti eggs has been found to range from 1 percent (Rienecker and Anderson 1960) to 7 percent (Steele et al. 1957) of all eggs in successful nests.

Table 8 shows that tree nests had a higher rate of reproductive success than ground nests. Brakhage (1965) in Missouri and Bednarik (1968) in Ohio also found that reproductive success in elevated nest sites was higher than for ground nests. Craighead and Stockstad (1961) evaluated the use of aerial nesting platforms for Canada geese in the Flathead Valley, Montana. They suggested that the use of such sites may increase

Table 8. Comparison of hatching success and productivity among various populations of Canada geese. All populations are B. c. moffitti unless otherwise noted.

Area	Number of Nests	Nesting Success (percent)	Hatching Success (percent)	Production Realized (percent)	Source
Manitoba	44[a]	61.0	95.0	57.9	Klopman 1958
	60[a]	35.0	97.0	33.9	
Washington	1033	71.0	92.0	65.3	Hanson & Browning 1959
California	210	78.7	87.2	68.6	Rienecker & Anderson 1960
Utah	124	82.3	89.9	74.0	Dey 1964
Missouri	179 tub[b]	73.0	72.0	52.6	Brakhage 1965
	77 ground[b]	47.0	77.0	36.2	
Washington	228	72.8	93.5	63.1	Buss & Wing 1966
Ohio	116 aerial[c]	95.0	78.0	74.1	Bednarik 1968
	84 ground[c]	89.0	76.0	67.7	
Montana	19 tree	85.7	95.0	81.8	This study
	9 ground	71.4	86.7	61.9	
	28 total	81.0	90.4	73.2	

[a] B. c. interior

[b] B. c. maxima

[c] subspecies not given

productivity and showed that hatching success increased with the use of platforms. They attributed the increased rate of success in aerial nests to reduced predation.

Two dumped eggs were found on the study area in 1970. In both cases a single egg was found within 20 feet of a successful ground nest. Both eggs were abnormally large, one measuring 97 x 58 mm and the other 104.6 x 64.3 mm. Williams and Nelson (1943) measured 174 eggs of Canada geese from northern Utah (probably B. c. moffitti) and found the largest egg to be 100 x 65 mm. The average size of all eggs measured by Williams and Nelson was 87.2 x 59.1 mm. The average size for 8 "normal" eggs (dumped eggs excluded) collected during this study was 83.5 x 56.8 mm.

Renesting. Only one instance of renesting was known to occur in the Bitterroot Valley during the course of this study. Errington (1942) pointed out that the phenomenon of renesting must be considered when evaluating the productivity of a bird species. The extent of renesting in Canada geese has been reported several times, but seems to be quite variable. Atwater (1959) studied renesting of Canada geese in Montana and found that only 16.6 percent of the geese renested after their first nest was destroyed. Weigand (1960), working with a captive flock in Michigan, found that 65 percent of all geese renested after removal of the first clutch. Barraclough (1954) estimated that 30-41 percent of unsuccessful B. c. moffitti in the Flathead Valley, Montana, renested after losing the first clutch. Weigand (1960) found the renesting interval to be 17.5 days, and noted that it was impossible to distinguish renests on the basis of clutch size or appearance.

The Brood Period

An average clutch size of 5.88 eggs with a hatching success of 90.4 percent indicates an average hatch of 5.32 goslings per successful pair. Brood counts of 29 separate broods revealed an average of 5.52 goslings per brood. The difference of + 0.20 goslings per brood can be attributed to sampling error, or the formation of creches or "gang broods."

The average brood size of 5.52 goslings found in this study compares favorably with that found by other investigators for other populations. Naylor and Hunt (1954) found an average brood size of 4.17 goslings on the Susan River, California. Grieb et al. (1961) found that broods averaged 4.8-5.5 in northwestern Colorado. The formation of creches is common. The largest group observed during this study consisted of 12 goslings, but as many as 110 goslings in a single creche have been recorded (Brakhage 1965).

After leaving the nest, adult geese moved the goslings to suitable brood areas where creche formation sometimes took place. Since broods were not marked, it was difficult to follow their movements. Identification of some individual broods was possible when hatching dates for nearby territories and nests were known. The age of the goslings was estimated and compared to the estimated hatching dates for all nests and territories known to be in the area. It is possible to estimate the age of goslings within a few days during the first 3 weeks of life and within 1 week thereafter until the 8th or 9th week. Criteria for aging goslings in the field were based on work by Hanson (1962) and Yocom and Harris (1965).

In 1970 seven breeding territories had been located along the River in the northern part of the study area (Fig. 4). During a float trip two broods of goslings were seen, one near the mouth of Lolo Creek, and the

other 1-1/4 miles above the mouth of Lolo Creek. These broods could not have come from any of the four downstream sites; two of those nests were still being incubated and the other two broods had hatched and were older than either brood observed. One upstream nest was being incubated while two additional territories had been abandoned. It was assumed that these two broods had come from the abandoned territories. If this is true, then one brood must have moved at least 1/2 mile and possibly 3 miles downstream. The second brood must have moved at least 1-3/4 miles and possibly 4-1/2 miles downstream. It should be pointed out, however, that there may have been an additional territory along this portion of the River that was not found. This possibility is remote, however, since all breeding birds that were seen on this portion of the River in 1970 could be accounted for by assigning them to one of the seven known territories.

Some broods spent the brood period in close proximity to the nest site. Nest #26 hatched five goslings which were the youngest goslings on the River in 1970. They were almost 2 weeks younger than the next youngest brood in the area where they hatched. A brood which could only have come from nest #26 was found to have spent the brood period in a marsh located only 200 yards south of the nest site.

On Ravalli Refuge three broods hatched on pool 10, one brood hatched on pool 8, and one brood hatched on pool 2 in 1970. Three broods spent the brood period on pool 10, while the other two spent the brood period on pool 2. In order for the brood from pool 8 to reach pool 2 they had to cross 1-1/2 miles of water and land areas as well as cross a major county road. Caldwell (1967) found that one color-marked brood moved 16 miles down the South Saskatchewan River in 2 days.

Geese in the Bitterroot Valley tended to select brood areas which offered plenty of lush green grass and forbs. Broods were usually located in areas where heavy brush was close at hand and a main river channel was easily accessible. When disturbed, adult geese would usually take to the water with the goslings, move around a bend in the River in order to get out of sight, then climb ashore and run into the brush to hide. Craighead and Craighead (1949) mentioned that broods on the Snake River of Wyoming would regroup and occupy a new downstream territory when swift water or disturbance caused the young to be swept down the River. Goslings from one brood area along the Bitterroot River were disturbed several times and forced to move short distances downstream. Each time, however, the goslings returned to the original brood area, probably by walking overland.

During the molting period the small flocks of non-breeders seemed to disappear. Several molting areas were found where these non-breeders had moved to heavily timbered areas with dense brush. These molting areas were usually adjacent to backwaters where adequate food was available. These geese were extremely secretive and very adept at conceling themselves. As soon as they regained their powers of flight they reappeared along the River in flocks of 5-40 birds. Some of the flocks seen at this time undoubtedly contained goslings which had attained flight.

Chapter 5

PRODUCTIVITY

Canada Geese

Due to the characteristics of the River flood plain and to the nesting habits of the geese themselves, it was extremely difficult to locate goose nests along the Bitterroot River. A total of 22 nests was found along the River, and an additional 20 territories were located which were being actively defended by a gander but in which a nest could not be found. Only territories which were defended during several visits ranging over 2-3 weeks are included in this figure. Observations of some territories were accurate enough to allow an estimate of the date of hatching within 2-3 days. At least 11 of these territories are known to have produced goslings. The remaining 9 territories may or may not have produced goslings.

Table 9 shows the estimated number of goose nests along the River for the 2 years of this study. The difference between the 1969 and 1970 estimates is not believed to be real, but is probably due to different levels of ability to interpret goose behavior on the part of the observer. It is felt that an estimate of 23 nesting pairs along the River for both years would present a more realistic picture of the nesting density. In addition to the data listed in Table 9, at least five pairs of geese are known to have nested on Ravalli Refuge in 1970.

In order to arrive at a meaningful estimate of the productivity of the Bitterroot flock, it was necessary to eliminate every conceivable instance of a duplicate count; this was done by relying on the age

Table 9. Estimated number of breeding territories along the Bitterroot River.

	1969	1970
Number of nests found	11	11
Additional broods	4	7
Minimum number of nests	15	18
Additional territories	4	5
Total breeding pairs (estimate)	19	23

estimates for the goslings. Only broods which could be positively separated on the basis of age and location were considered when arriving at gosling counts for the River. Size of broods was not considered a valid criterion for distinguishing one brood from another.

In 1969 at least 60 individual goslings were known to have been raised along the River. If only 19 breeding pairs nested along the River (Table 9), with a nesting success of 81 percent (Table 6),and each successful pair raised 5 goslings (cf. p. 38), a total of 77 goslings would have been raised on the River. Refuge records show that 50 goslings were raised on the Refuge impoundments. These figures indicate that 110-127 goslings were raised on the study area in 1969. It is believed that the River production is somewhat higher than the estimated 60-77 goslings, because some broods are believed to have moved to the Refuge for the brood period. If this movement did occur, those broods are included in the Refuge count.

In 1970 a minimum of 76 individual goslings is known to have been produced along the River. Application of the same mathematical treatment

to the 1970 data as to that for 1969 yields an estimated River production of 76-93 goslings. Since 27 goslings are known to have been produced at Ravalli National Wildlife Refuge, a total of 103-120 goslings was produced on the study area in 1970.

During 1970 a minimum of 24 pairs of geese is known to have nested on the study area. This total includes 18 pairs on the River and 6 pairs on the Refuge. One of the nests on the Refuge was a renest which was established by a pair of geese that are believed to have failed on the River and are probably included in "additional territories" of Table 9. The minimum production of goslings yields a ratio of 4.3 goslings per breeding pair. If the estimates of 28 nests and 120 goslings are considered valid, the ratio is also 4.3 goslings per breeding pair, or slightly over 2 goslings for each reproductively active adult.

Craighead and Craighead (1949) found that B. c. moffitti along the Snake River of Wyoming only produced 1.2 goslings per breeding pair. Dey (1964) found the Ogden Bay, Utah, population of B. c. moffitti produced 3.79 and 4.08 goslings per breeding pair in 2 successive years. The Ogden Bay population was considered to have a high rate of productivity.

Other Waterfowl

In addition to Canada geese, several other species of waterfowl nest along the Bitterroot River. Due to dangers of flooding and predation, tree or cavity nesting species are the only ducks that breed in significant numbers. These include American mergansers (Mergus merganser), hooded mergansers (Lophodytes cucullatus), and wood ducks (Aix sponsa). All three species appear to be quite productive with the American

merganser exhibiting an exceptional ability to produce a great number of large broods. In addition to the tree and cavity nesters, a few mallards (Anas platyhrynchos), green-wing teal (Anas carolinensis), and possibly cinnamon teal (Anas cyanoptera) nest along the River. With the exception of the wood duck, production of the Anatinae along the River is not believed to be very great. Most ground nesting ducks nest in sloughs and marshes that are not subject to sudden floods.

Chapter 6

IMPACT OF THE REFUGE

Canada Geese

The establishment of Ravalli National Wildlife Refuge in 1964 fulfilled a long-standing need in the Bitterroot Valley. Several private landowners and livestock corporations operate "private" wildlife refuges in the area, but nowhere is habitat managed specifically for waterfowl production. At Ravalli Refuge several large impoundments have been designed and built solely for the purpose of managing the available habitat for optimum waterfowl production.

Canada geese have responded to the presence of the Refuge by taking advantage of nesting sites placed at their disposal and utilizing the excellent brood raising areas which are now available. Production of geese on the Refuge impoundments can be expected to increase in future years. Nelson (1963) mentioned that one year's lead time should be allowed on new nesting structures before any results can be expected. The 1970 season was only the second year that pools 8 and 10 were available to geese. Five out of six nesting pairs used structures on these two pools in 1970. An increased use of these structures can be expected by 1972 or 1973 when the 1970 cohort begins to breed.

In addition to the nesting facilities already provided, three additional major impoundments are being planned. One will be flooded by 1971, in time for the nesting season. It is expected that geese will respond favorably to these expanded facilities in future years.

Other Waterfowl

Breeding habitat for many species of waterfowl is extremely limited along the River. Stable water levels and slough or marsh type situations are a necessity if ground nesting ducks are to produce many young. Ravalli Refuge provided habitat which significantly increased the production of waterfowl in the Bitterroot Valley (Table 10).

Table 10. Waterfowl production at Ravalli N.W.R.

Year	Ducks	Geese	Coots
1965	165	14	0
1966	780	15	100
1967	990	24	200
1968	1780	30	400
1969	1100	50	400
1970	1170	27	420

In addition to providing breeding habitat for many species of waterfowl, the Refuge also provides a valuable resting and feeding area for migrant ducks, geese, and swans. Refuge records indicate that as many as 11,500 ducks have used the Refuge at one time. Appendix VI illustrates the manner in which waterfowl use has increased in response to the Refuge development programs.

Chapter 7

MANAGEMENT SUGGESTIONS

The following recommendations are made for the purpose of defining hunting mortality, increasing the number of available nesting sites, and measuring goose response to those sites. These suggestions are not based on the results of this study, but upon impressions gained by the writer during extensive field observations.

1. A banding program was initiated at Ravalli Refuge in 1970. Goslings should be banded each summer as an aid in analyzing distribution and hunting mortality.

2. Development of new impoundments was begun on the Refuge in 1970. More nesting sites should be made available to geese by placing artificial tree structures over and around these new impoundments.

3. Nesting structures should be erected and maintained along the River. Such structures should be scattered along both major channels of the River between Woodside Crossing and Bell Crossing. Additional structures should be placed along the River between the Missoula-Ravalli county line and Deadman Gulch in Missoula County, with approximately six structures located on the east side of the River in the SE¼, Sec. 15, T12N, R20W.

These structures could be of the wooden box type as described by Craighead and Stockstad (1961), or could consist of a woven wire basket with a canvas or burlap floor; washtubs could also be used. In all cases the structures should contain abundant soil and litter or hay.

They should be placed in trees about 20-40 feet from the ground. The structures should be checked annually (about mid-March) so the soil and nesting materials could be replaced if necessary.

4. Since ospreys provide a certain number of nesting sites for Canada geese, the protection of ospreys should be promoted and encouraged.

5. After allowing 3-4 years lead time on the new impoundments at Ravalli Refuge, a study should be conducted to determine the response of geese to the new situation. Such a study should include consideration of band returns and a review of the breeding population numbers in the Bitterroot Valley as well as an estimate of breeding success.

Chapter 8

SUMMARY

1. Canada geese were studied by floating the Bitterroot River in a rubber raft.

2. Due to the small sample sizes obtained in this study it was difficult to assess the impact of the reproductive effort.

3. The breeding population contained 110-130 geese during both 1969 and 1970. An estimated 45-50 percent of this population was reproductively active.

4. The breeding population was evenly distributed along the River, with about 20 percent using the Refuge.

5. Canada geese of the Bitterroot Valley appeared to prefer aerial nesting sites. Tree sites were chosen in a 2:1 ratio over ground sites.

6. The average size for 16 completed clutches was 5.88 eggs.

7. The nesting success for 21 known-fate nests was 81 percent. The hatching success was 90.4 percent.

8. Tree nests appeared to have larger clutches, greater nesting success, and greater hatching success than ground nests.

9. Estimated production for 1969 was 110-127 goslings; the 1970 estimated production was 103-120 goslings.

10. Ravalli National Wildlife Refuge is extremely beneficial to all waterfowl species in the Bitterroot Valley.

11. Management suggestions include the continuation of a banding program, erection of nesting structures along the River and on the Refuge, protection of ospreys, and a future research project.

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APPENDIX

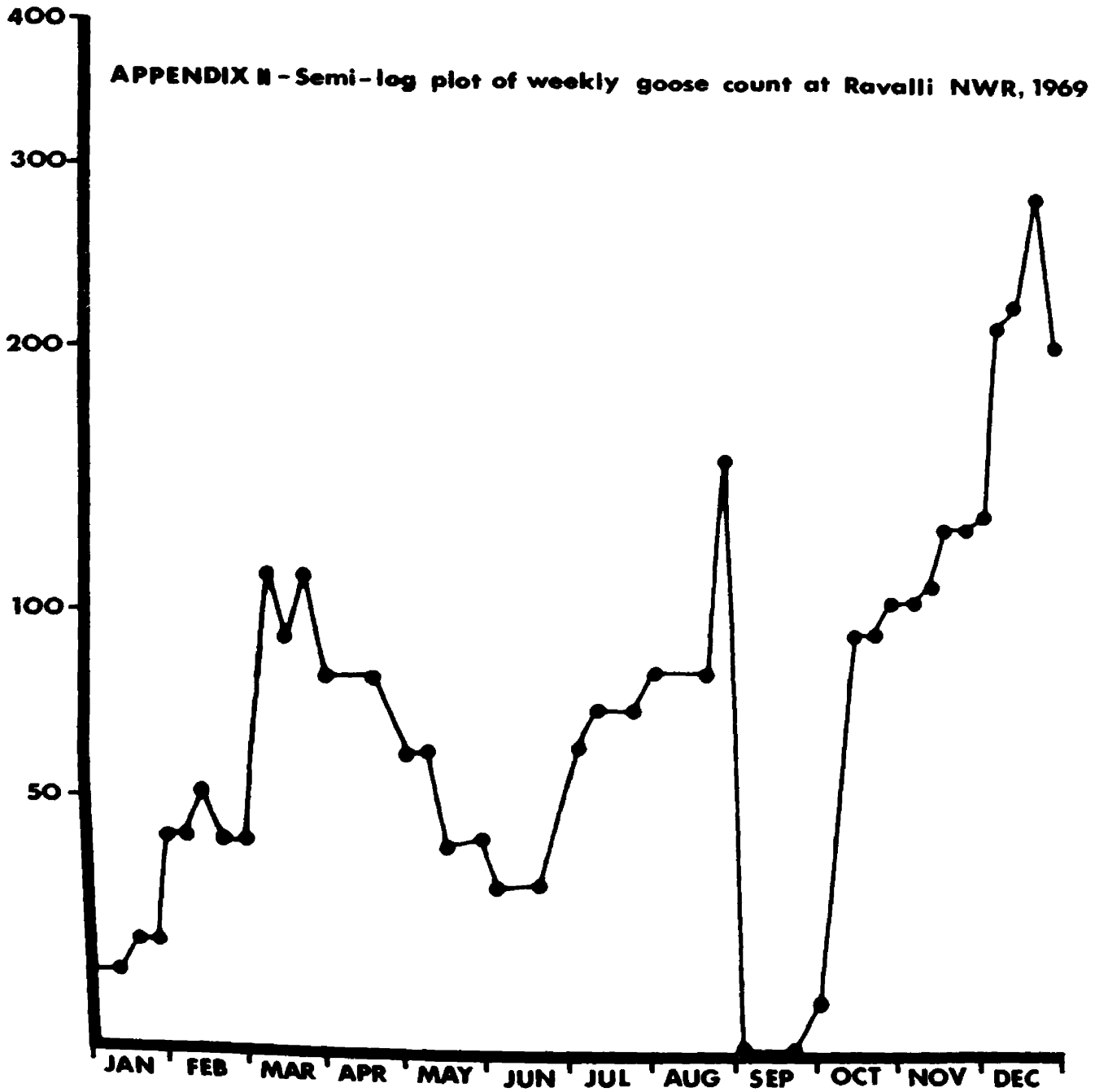
Appendix I. Form used to record data at goose nests.

NEST HISTORY RECORD

Nest number R-20 Nest materials: Washtub in tree.

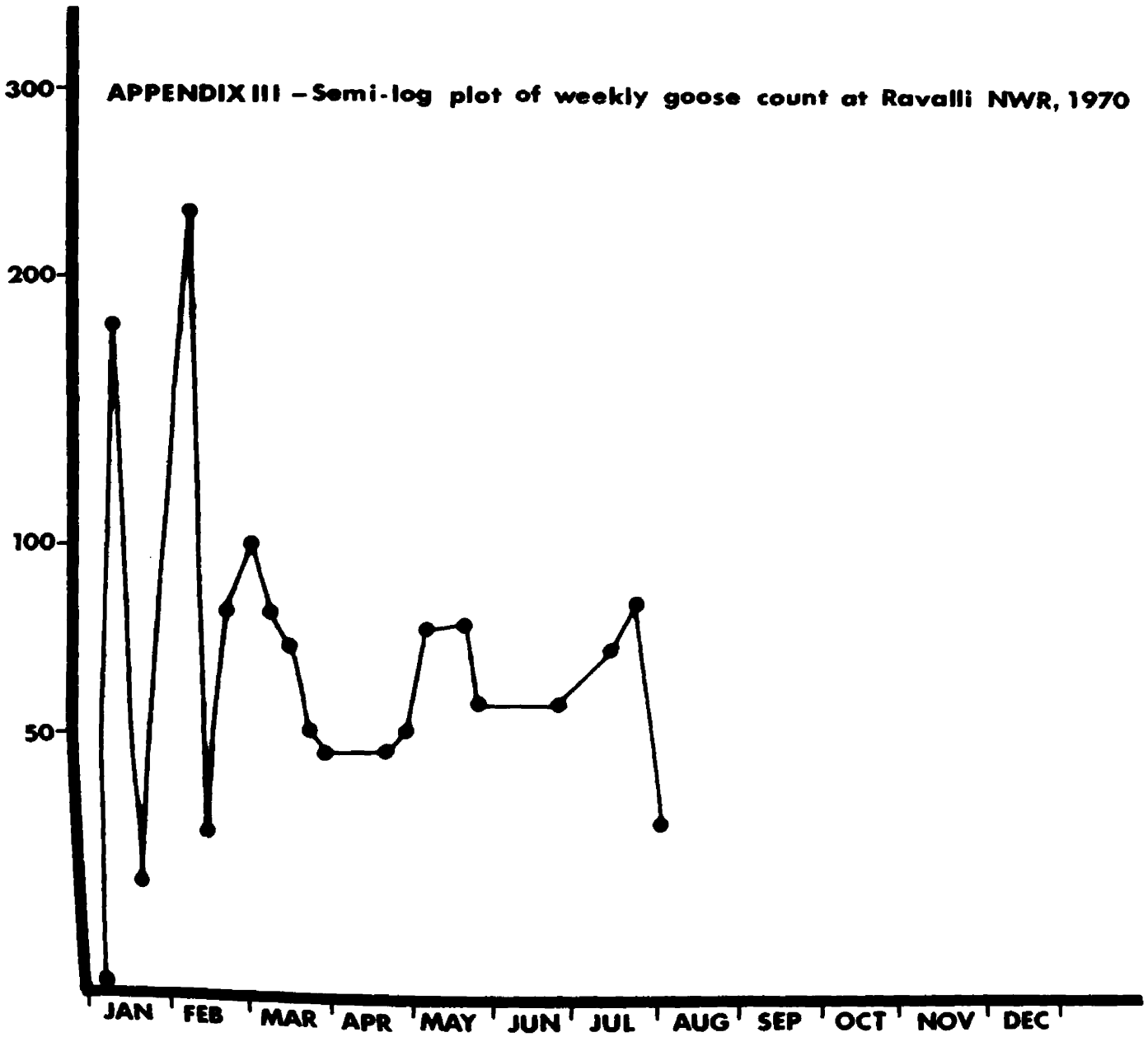
Location: Structure #14, pool 10, Ravalli NWR

Date	Time	Eggs	Adults	Remarks
4-20	1520	—	2	♀ incubating, ♂ 15 yds. west.
4-23	1430	-	1	♀ incubating
4-24	0830	6	1	♀ incubating
5-4	1400	0	0	2 goslings in nest ready to leave. Adults 50 yds. south with 4 goslings. Hatch date = May 3.



APPENDIX II - Semi-log plot of weekly goose count at Ravalli NWR, 1969

APPENDIX III – Semi-log plot of weekly goose count at Ravalli NWR, 1970



Appendix IV. Canada goose counts obtained by the Montana Fish and Game Department during January, 1960-70.

Year	Bitterroot River Missoula - Hamilton	Clark Fork River Missoula - Alberton
1960	147	0
1961	130	47
1962	119	216
1963	80	25
1964	174	60
1965	309	115
1966	30	33
1967	193	50
1968	75	75
1969	263	29
1970	371	22

Appendix V. Waterfowl seasons affecting Canada geese on the Bitterroot River.

Year	Season dates	Bag limits (Canada geese only)	Season length (days)
1959-60	Oct. 16 - Dec. 4	2/day	50
1960-61	Oct. 8 - Nov. 26	2/day, 6/season	50
1961-62	Oct. 22 - Dec. 20	2/day, 6/season	60
1962-63	Oct. 14 - Dec. 27	2/day	75
1963-64	Oct. 6 - Dec. 26	2/day	82
1964-65	Oct. 11 - Dec. 24	2/day	75
1965-66	Oct. 9 - Jan. 6	2/day	90
1966-67	Oct. 8 - Jan. 5	2/day	90
1967-68	Oct. 7 - Jan. 4	2/day	90
1968-69	Oct. 5 - Dec. 29	2/day, 6/season	86
1969-70	Oct. 4 - Dec. 28	2/day, 6/season	86

Appendix VI. Waterfowl use at Ravalli National Wildlife Refuge

Year	Peak population	Total use days	Peak population	Total use days
	Coots		Swans	
1965	100	6,230	20	343
1966	1,000	83,720	1	49
1967	1,670	148,570	150	1,540
1968	2,000	301,560	20	392
1969	2,500	389,130	112	2,030
	Canada geese		Snow & blue geese	
1964	70	1,365		
1965	400	10,199	200	4,725
1966	45	2,697	15	105
1967	200	9,611	50	931
1968	135	10,682	150	1,519
1969	280	27,363	115	1,925
	Redhead		Canvasback	
1966	20	1,162	50	840
1967	100	10,745	200	16,065
1968	100	12,390	100	8,330
1969	200	18,235	200	9,016
	Wood Duck		Widgeon	
1964	40	1,820	50	1,960
1965	140	10,178	300	10,213
1966	350	37,065	500	44,170
1967	300	31,725	500	71,505
1968	250	20,000	1,000	109,200
1969	200	17,367	1,000	119,630
	Mallards		All ducks	
1964	300	17,500		
1965	1,200	80,430	1,790	125,657
1966	6,000	385,980	6,990	626,213
1967	5,000	621,600	5,940	1,055,208
1968	9,000	910,700	10,650	1,413,979
1969	5,200	674,520	8,325	1,110,830