Proceedings of the Iowa Academy of Science

Volume 69 | Annual Issue Article 41

1962

Vernal Breeding of Cottontails in Iowa

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Vernal Breeding of Cottontails in Iowa

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Abstract. Studies of 399 cottontails (*Sylvilagus floridanus mearnsii*) taken during late winter and spring of 1958 through 1961 have established the early portion of the breeding season for the species in Iowa. Males attained breeding condition starting in February. Pregnant females occurred late in February. Most females became pregnant for the first time in March. All females examined after April 1 were pregnant. Differences in commencement of the breeding season from on year to another were noted. A statistically significant difference in average size of first and second embryonic litters was noted. Litters from northern Iowa averaged larger than those from southern Iowa. This difference was statistically significant at the 0.20 level of confidence.

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Vernal Breeding of Cottontails in Iowa

This study was prompted by the apparent paucity of information regarding commencement of the cottontail rabbit (*Sylvilagus floridanus mearnsii*) breeding season in Iowa. Knowledge of the breeding cycle of an animal is important in any form of wildlife management. Tradition requires that we abstain from pursuing game during the time young are carried by females or need parental care. Most hunting regulations are formed with this tradition in mind.

A few workers have written on early breeding of cottontails in Iowa. Hendrickson (1943) noted copulation of a pair of semi-captive cottontails February 19, 1937. A nest believed to be theirs was found one month later on March 18. Another pair apparently mated sometime during the last 3 days of February 1937. Their nest was found March 31. Hendrickson stated that searches for nests of cottontails in the wild in March were always unsuccessful. In an earlier paper, Hendrickson (1940) wrote, "In course of general observations of our cottontails during the past five years April 13 was the earliest date of an observed nest, and it contained five young with their eyes open." These young rabbits must have been 10 or more days old, or their eyes would not have been open. They were probably conceived very early in March.

Wallace (1950), working in central Iowa during the spring of 1949, estimated the first litter came off the nest April 27. If an average gestation period of 28 days and an in-the-nest period of 15 days is allowed, it appears this litter was conceived March 15. Wallace wrote of a litter sighted out of the nest on March 6 in the city limits of Ames. However, he did not see the rabbits personally.

Hubbard (1952) estimated the first 1951 litter on his study area in south-central Iowa was born March 28. Linder (1955), working on the same area, found his first occupied rabbit nest April 14. It contained young with their eyes closed. These records indicate mating first took place about February 28 and March 10 on that study area in 1951 and 1955, respectively.

Considerable work on breeding seaosns of cottontails has been done in states adjacent to Iowa or within the same latitudinal range. Trippensee (1936) mentioned four pregnant females taken in southern Michigan, January 25, 1933. These rabbits were not observed by him. Most workers seem to have agreed that little cottontail breeding takes place as early as indicated by Trippensee.

In his study in southern Michigan, Allen (1938) found only one female, taken February 21, pregnant during January or

February. One young rabbit, just off the nest, was retrieved by him on April 4. It probably had been conceived about February 20. These were his earliest records. Hamilton (1940), in New York, found no evidence of mating prior to early February; and most early mating seemingly occurred late in February or early in March. In Connecticut, Dalke and others (1942) noted only one pregnant female in March while working with S. *transitionalis* and S. *floridanus mallurus*. Only 3 of 204 Pennsylvania cottontail litters examined by Beule and Studholme (1942) were calculated to have been born in March 1939 and 1940. This indicates all other matings occurred after February during those seasons in Pennsylvania.

Haugen (1942) found no pregnant females prior to March 14, 1939, in southwestern Michigan. On that date, 3 of 6 females had uterine swellings. As these swellings would be difficult to detect prior to about 7 days development, the three females probably were bred sometime during the first week of March. Haugen concluded from his work that the breeding season extended from early March to mid-September. Schwartz (1942) agrees. Working in central Missouri, he found earliest dates of capture for 43 females containing uterine swellings were March 15 and 17; and these embryos were 10-14 days old.

More recent writers have corroborated these findings. Smith (1950) calculated an average conception date of March 25 from his five earliest New York nests found in 1941. In 1942 from seven records he calculated an average early breeding date of March 11. Ecke (1955), working with Illinois cottontails, discovered no pregnant females or females which had recently ovulated prior to February 22. Of his 6 early litters 2 were calculated to have been conceived during the last week in February and four between March 17 and 21. Another Illinois worker (Lord, 1958) found the 1957 breeding season began the last week of February. At that time 18 percent of the females he examined showed early pregnancy. A Wisconsin writer (Anonymous, 1956) found the earliest birth date records taken from 82 road-killed females gathered in 1951-55 were during the March 21-31 period; the first litter peak fell between April 21 and 30. These dates indicate some breeding occurs in Wisconsin during the last week of February with the first peak during late March.

All of these papers seem to indicate cottontails breed infrequently before the last week of February in the general latitude of Iowa. Mating does occur late in February during some years. In all instances March seems to be the month when breeding commences on an extensive scale. Some writers (Trippensee, op. cit.; and Hamilton, op. cit.) mention weather as a controlling factor which may establish early or late mating.

Methods

The investigation began during the winter of 1957-58 and has continued to the present. Specimens have been secured from roadsides as road kills, by box-trapping, from hunters' bags, and by shooting. Most specimens were retrieved from roadsides as traffic victims. Rabbits were captured in box traps on two areas, one in Benton County and one in Davis County, during the spring of 1959. Cottontails bagged by hunters were examined late during the hunting season on several occasions. Collections were secured during the springs of 1959-1961 by shooting when road-kills were not found in numbers adequate for the study. Most emphasis was placed on collections taken in February through April as these were the months when early breeding characteristics could be studied. During and after April female female cottontalis were found carring their second litters. It is difficult to secure early breeding data from these. Very little collecting was carried on after May 1.

Every specimen was given a serial number starting with "1" and continuing in sequence (2, 3, 4, etc.) of examination until the present. For every rabbit notes were recorded of unusual parasitic infestation, disease, or general condition. All were classed by sex in the manner described by Petrides (1951). Age was determined by closure of the notch on the humerus (Hale, 1949). Weights were recorded within one-tenth pound for most rabbits examined.

The condition of the testes in males was recorded as "descended" or "not descended." Testes were not recovered for weight, volume, or presence of sperm studies as it had been previously established rather conclusively by Brambell (1944) in European rabbits (*Oryctolagus cuniculi*) and by Ecke (1955) in cottontails that commencement of the breeding season is determined by oestrus in the females. These researchers demonstrated that males are capable of breeding long before the females. Therefore, the writer believed it necessary only to confirm these findings in Iowa cottontails by gross examination of the location of testes. Those males with testes descended into the scrotum were regarded as capable of mating.

Records for females were kept of condition of the vaginal membrane—whether or not intact; lactation and condition of the hair about the nipples; presence, number, and size of uterine swellings; and, frequently, number of ovarian eruptions or of corpora lutea. The uterus and ovaries of many females were removed for further laboratory examination.

Three females taken in box traps during 1959 were released after they were found not pregnant by palpation (Haugen, op.

cit.). These three females were marked with numbered ear-tags to prevent subsequent confusion from recapture. They actually may have bred as implantation does not occur until at least 6 days after mating (Wight and Conaway, 1962). Palpation would not indicate pregnancy prior to implantation and the subsequent uterine swellings.

Presence of the vaginal membrane in females is usually considered evidence that mating has not occurred. However, the writer experienced considerable difficulty in using the technique and gained little confidence in the results obtained. If cottontails follow the pattern of European rabbits (Brambell, op. cit.), copulation frequently may occur before females are capable of fertile coitus prior to the breeding season. In such cases inspection of the vaginal membrane would indicate misleading results.

A female was judged to have borne a litter when hair was pulled and matted about the nipples, and when the nipples were enlarged and yielded milk. Pregnancy was usually indicated by uterine swellings. These were measured in millimeters through their longest axis. They were found, when swellings measured 25 mm or greater, to measure about two mm more than head-rump lengths used by Schwartz (op. cit.) to determine embryonic age. For smaller uterine swellings a curve was developed from actual measure of seven sets of uterine swellings and head-rump lengths (Table 1). The probable head-rump lengths were read from known uterine swelling diameters, and the embryonic ages were calculated as described by Schwartz.

Table 1. Comparison of seven uterine swellings with head-rump lengths of enclosed embryos

Cottontail Number	Diameter of uterine swellings (mm)	Head-rump lengths (mm)
124	9	None*
103	17	3
131	17	6
133	22	13
136	22	14
139	22	19
145	40	38

* This embryo would have been implanted very recently and probably was not of measurable size.

The ovaries were examined for eruptions or corpora lutea. When eruptions were found and uterine swellings were not present the females was classed in the early stages of pregnancy (Wight and Conaway, op. cit.). These pregnancies could not be accurately back-dated to actual date of mating since they could have varied between 1 and 7 days old. Hence, for the sake of uniformity, all were classified as 3 days pregnant. Corpora lutea were counted and recorded in several instances when females were known to have borne litters.

Results

Records from 402 cottontails were obtained during 4 years of study. Of these, 202 were males and 200 females. These data cannot be considered as indicative of a true sex ratio as many males killed by automobile traffic were discarded without record after sex was established.

In the males 64 per cent of 50 examined in February had descended tests and were considered capable of mating. Of 90 males examined in March, 92 per cent had descended testes. All of 48 taken in April had descended testes. Samples of males December 28, 1957, showed none with testes descended. Males in several lots of cottontails shot by hunters were observed during January, 1959, 1960 and 1961, none of which had descended testes. These data indicate male cottontails in Iowa progress in breeding condition starting in February and reaching a peak in or in months following April.

Of 200 females examined, 197 were secured early enough in the breeding season to be pertinent to the study. The progressive "prevalence of pregnancy" is reported by Lord (1961) and Wight and Conaway (op. cit.) is recorded in Table 2. Differences in the progressive "prevalence of pregnancy" are apparent for the 4 years. In 1958, 33.3 per cent of females examained were pregnant on or prior to February 28. All were pregnant by March 28. Breeding apparently began about the same time in 1959. However, 100 per cent "prevalence of pregnancy" was reached 1 week earlier than in 1959. During the spring of 1960 the data indicate all mating was delayed until after mid-March. Mating began 2 weeks earlier in 1961 than during the previous 3 years. However, 100 per cent "prevalence of pregnancy" was not reached until March 28.

Table 2. Progressive prevalence of pregnancy in cottontails during spring months, 1958 through 1961

Date	Percentage of females pregnant			
	1958	1959	1960	1961
Feb. 14	0.0 (8)	0.0 (54)	0.0 (19)	2.9 (35)
Feb. 21	0.0 (7)	0.0 (54)	0.0 (16)	9.4 (32)
Feb. 28	33.3 (6)	5.9 (51)	0.0 (14)	28.1 (32)
March 7	83.3 (6)	27.1 (48)	0.0 (14)	45.5 (22)
March 14	80.0 (5)	58.1 (31)	0.0 (14)	42.9 (21)
March 21	80.0 (5)	100.0 (13)	14.3 (14)	77.8 (9)
March 28	100.0 (4)	....	83.3 (12)	100.0 (6)
April 4	....	....	100.0 (10)	....

Numbers in parenthesis represent number of females in sample from which percentage derived.

Earliest detected matings occurred February 28, February 26, March 16, and February 14 for 1958 through 1961 respectively. These data indicate cottontails normally start breeding in Iowa late in February. The peak of first seasonal mating activity

occurs sometime in March. There are variances in commencement of breeding activity from one year to another. All females examined after April 1 were found pregnant.

Ovarian eruptions or corpora lutea were recorded in conjunction with numbers of embryos present in 13 rabbits. The counts were in disagreement in only one instance. One female had 4 ovarian eruption sites but only 3 embryos. In the 13 females examined, 61 eruption sites were found as compared to 60 embryos. This demonstrates a very low loss of ova by cottontails in Iowa as compared to Brambell's (op. cit.) recorded loss of 9 to 10 per cent in European rabbits.

Evidence of resorption was found in 5 of 68 embryonic litters. During the spring of 1958 reabsorbtion was noted in three separate litters as follows: 1 of 9 embryos, 2 of 7 embryos, and 2 of 8 embryos. These litters were larger than normal. Two females taken March 11, 1959, after the blizzard of March 4-6 had litters, each of five, in the process of resorption. These females had bred prior to the storm, probably March 3. Possibly stress of deep snow and cold was responsible for reabsorbtion in these two instances. However, seven other females, taken from the same portion of Iowa, which had bred immediately prior to the storm did not reabsorb their embryos. One female evidently had bred during or immediately after the blizzard.

Comparison between 63 first and 13 second litters of the season was computed. Mean size of first litters for the 4 years of study was 4.8 embryos. Second litters averaged 7.1. These differences were highly significant (P less than .001). These data are in agreement with Lord (1961) who reported larger litters during May than during the remainder of the breeding season.

Sizes of embryonic litters or number of ova erupted per pregnancy were plotted separately for cottontails taken from southern Iowa loess soils and from northern Iowa recently-glaciated soils. Only first litters were used in making this comparison because of the difference in size of first and second litters. Seventeen litters from southern Iowa averaged 4.6 embryos. Average for 43 litters from northern Iowa was 4.9.

Statistical analysis of the data gave inconclusive results (P, 0.20). The writer is inclined to believe a difference in litter sizes exists between southern and northern Iowa. It is questionable whether this should be attributed to latitude as reported by Lord (1960 and 1961) and Barkalow (1962) or to soil fertility (Crawford, 1950). The older soils in southern Iowa generally have lower fertility than those in northern Iowa (Brown, 1936).

Comparisons of average embryonic litter sizes produced by adult and juvenile females gave inconclusive results. Ossification

of the epiphyseal plate of the humerus was the basis for separating juveniles from adults. Average for 27 females with the proximal notch of the humerus closed was 4.78; for 18 females with the notch not closed, 4.83. Since these rabbits were all taken during the early portion of the breeding season all were adult or near adult size. Therefore, closure or near closure of the humerus notch could be, at best, only a relative measure between adults and juveniles-all of which were born during or prior to the previous breeding season. These data, therefore, cannot be compared to those of Lord (1961) which demonstrated that litters produced by juvenile rabbits were significantly smaller than those produced by adults. His juveniles were young-of-the-year which had mated during the same season they were born.

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A Central Iowa Pheasant Nesting Study, 1961[1]

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Abstract. A study of nesting success of pheasants (*Phasianus colchicus*) on three areas in central Iowa in 1961 showed that the peak of nest establishment occurred between May 16 and May 30. Hatching success varied inversely with pheasant population density. Twenty-four of the 96 nests found hatched successfully. Roadsides sheltered the highest percentage of nests on a per acre basis (46 nests/100 acres), followed by hayfields (24 nests/100 acres) and oatfields (4.7 nests/100 acres). Idle land and fence rows contained the fewest number of nests. Most nests were located in cover from 16 to 22 inches in height. No significant relationship was found between the height and/or density of cover and the success of the nests. Farm machinery operations, especially hay mowing, caused the greatest destruction of nests.

INTRODUCTION

The rapid decrease of pheasant (*Phasianus colchicus*) numbers from Hamilton County southward has long been a mystery. This study is part of a larger investigation to study factors which may be the cause of decrease in numbers in this area. The central Iowa pheasant study was initiated in 1960 by Roger Bolstad, a Graduate Assistant at Iowa State University. Observations on nesting activity were continued by the authors.

This report deals mainly with an evaluation of differences in pheasant nesting intensity and success in central Iowa in 1961.

The preasant nesting study was made possible by a National Science Foundation Undergraduate Research Participation grant to the authors. The grants were for $600 to each of the two in-

[1] Journal Paper No. 4347 of the Iowa Agricultural and Home Economics Experiment Station, Ames, Iowa. Project No. 1452. Contribution of Iowa Cooperative Wildlife Research Unit; Iowa State University of Science and Technology; Iowa State Conservation Commission; Wildlife Management Institute; and U. S. Fish and Wildlife Service, Bureau of Sport Fisheries and Wildlife, cooperating. This study financed primarily by a special grant to the authors by the National Science Foundation, Undergraduate Research Participation Program.

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