

snow roosts. The question of whether or not ptarmigan normally excrete cecal contents in snow roosts was raised. In the winter of 1977, 60 recently evacuated snow roosts were examined. Each contained woody droppings. Only 3 contained cecal excrement, which in each case lay uppermost on the pile of woody droppings, presumably having been excreted last. Quite frequently cecal excrement was found lying within several meters of recently evacuated snow roosts. Krafft (Viltet, Jegerforb. Viltunders. 51-59, 1952) found cecal droppings in only 2 of 55 Willow Ptarmigan snow roosts examined, and in 2 instances, cecal droppings were found in the exit tracks within 5 m of the opening. Thus, pasty cecal droppings, as opposed to woody droppings, are seldom excreted in snow roosts.

The frequency and timing of emptying of the cecum in wild Willow Ptarmigan and the closely related Rock Ptarmigan (*L. mutus*) are poorly documented. A majority of birds shot during April in central Alaska appeared to have emptied their ceca in the early morning. Some ceca showed evidence of being emptied, possibly for a second time, during the late afternoon (Gasaway, Comp. Biochem. Physiol. 53A:115-121, 1976).

Our observations suggest that cecal excretion among wild Willow Ptarmigan during the short days of subarctic midwinter normally occurs just after snow roosts are abandoned. The length of time spent in the roost may be 1 factor influencing the timing of cecal excretion. Occasionally, Willow Ptarmigan excrete cecal droppings in snow roosts, presumably when experiencing extreme conditions of short days and winter storms. This can result in frozen wing tips and may increase susceptibility to predation.

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Observations on the life history of Willets on Long Island, New York.—Prior to 1966, Willets (*Catoptrophorus semipalmatus*) nested along the Atlantic coast north to New Jersey with an isolated population in Nova Scotia. In June 1966, 3 nests with eggs were found in salt marshes at Jones Beach State Park and at Tobay Beach, both in Nassau County on the western portion of the south shore of Long Island. These were the first known New York State nesting records (Davis, *Wilson Bull.* 80:330, 1968). The following year, the species had spread about 12 km eastward to Oak Beach, Suffolk Co., and by 1968 67 km further to Tiana Beach at Shinnecock Bay. The species is still increasing and spreading on Long Island; it is presumed that this population spread northward from the New Jersey coast. I began studying Willets at Shinnecock Bay in 1969.

General accounts of Willet behavior and nesting biology were given by Forbush (Birds of Massachusetts and Other New England States, Pt. 1. Mass. Dept. Agric., Boston, Mass., 1928), Bent (U.S. Natl. Mus. Bull. 146, Pt. 2, Washington, D.C., 1929) and Palmer (*in* Shorebirds of North America, G. D. Stout, ed., Viking Press, New York, 1967). The previously most intensive research on nesting Willets was reported by Tomkins (*Wilson Bull.* 44:46-47, 1932; 67:291-296, 1955; 77:151-167, 1965). The purpose of this paper is to report results obtained in a 10-year study of nesting Willets on Long Island.

Methods.—Willet nests were located by watching adults and searching the salt marshes. Adults were trapped on their nests with wire trip-step traps or occasionally captured with scoop nets. The average time needed to trap 23 adults on nests was 2 h and 25 min. I captured 20 adult males, 20 adult females and 1 bird of unknown sex, which included 23 new birds, 17 returns and 1 repeat. Four males and 6 females were caught with a scoop net

and the rest by traps. One can usually approach to within 1.5–2 m before the incubating bird flies from the nest, provided that the non-incubating bird is not close enough to give the alarm. In such a case, the incubating bird usually left long before I could get near the nest.

Adults, eggs and newly-hatched young were weighed and measured. Older young could never be found. The location of each nest was recorded and distances between nests were measured. Attempts were made to obtain previous data on incubation period and methods of sexing adults. Data on earlier Willet returns and recoveries were obtained from the Bird-Banding Office.

Nesting area.—In 1968, 1969 and 1970, only 1 pair nested at Tiana. There were 3 nests in 1971 and 1972, 5 nests in 1974 and 7 in 1975. The nesting area was 3 km long and of varying width. Willets nest in salt marshes just barely above the high tide mark, but some nests are washed out by unusually high tides that may occur once a month. Nests are well concealed in short grass, about 20 cm high. Tomkins (1965) reported that Willet nests are normally at least 61 m apart, although he once found 2 nests within a paced distance of 13 m. At Tiana, 1 pair nested within 13 m of another nest and still another pair 28 m from an adjacent pair. All other nests were at least 60 m apart.

It is very difficult to find Willet nests before the 4 eggs are laid and the birds have started incubation. Out of 31 nests that I have found, 25 already contained 4 eggs and one, 5 eggs. Only 5 nests were found before the clutch was complete.

Banding.—The Bird-Banding Office reported that 1017 Willets were banded in North America from 1930–1972 with 19 returns and recoveries for the same period. Among returns were 5 young banded in western Canada, of which 2 were recovered in the same region, 1 in Missouri, 1 in Mexico and 1 in Costa Rica. An adult from the same area was also recovered in Mexico. A young banded in Georgia was recovered in French Guiana and an adult from Alabama in Guyana. Five adults banded in California were retaken there, mostly near the place of banding and in the same, or the following year.

From 1969–1978, I succeeded in banding 23 adults and 31 young and obtained 17 returns, all at Shinnecock Bay. Two of the returning birds were banded as young and the rest as adults. The young, both males, were recaptured as nesting adults 2 and 3 years after banding on nests 204 m and 365 m from their hatching spot. These are the only known cases showing that Willets return to nest near their place of hatching. It would appear from records of the Bird-Banding Office that no other bander has attempted to trap adults on their nests.

The 15 adults that returned were taken on nests from 30–112 m from a previous nest, usually the one of the preceding year. These 15 returns included 10 separate birds. Eight were retaken only once. One male, first banded on the nest in 1969, was retaken 5 times, the latest in 1977. A female banded in 1976 was retrapped in 1977 and 1978. Two of these birds apparently established age records for the species. The male banded in 1969 was at least 9 years old in 1977 (Fig. 1) and a male banded in 1971 was at least 4 years old in 1974.

Adults.—A primary purpose of this study was to determine if adult Willets could be sexed. After a few years experience with Piping Plovers (*Charadrius melodus*), I was able to sex nearly all adults by plumage and call notes. Likewise, over 16 years I was able to sex all but 2 of 89 trapped American Oystercatchers (*Haematopus palliatus*).

Little guidance on sexual differences was found in the literature. Bent (1929) stated that the sexes are alike. Forbush (1928) reported that the female is larger than the male, and Palmer (1967) called the sexes similar. Measurements of specimens in the National Museum of Natural History showed no sexual differences (Watson, pers. comm.). Tomkins (1965) collected 12 breeding birds (6 males and 6 females) and found females to average slightly larger than males. These specimens were located in the research collection of the University of Georgia. From the specimen data the 6 males averaged 219 g and the 6 females 283 g. It would seem that no one has previously weighed and measured mated pairs trapped on their nests.



FIG. 1. Oldest known Willet, a 9-year-old male retrapped on 27 May 1977.

Data from adult Long Island Willets caught on their nests are given in Table 1. At 11 nests where I caught both birds, the average wing length of males was 183.9 mm and of females 194.4 mm. Average tail length of males was 67.8 mm and of females 71.5 mm. Average bill length of males was 53.9 mm and of females 56.6 mm. Average weight of males was 211.1 g and of females 241.3 g.

Females exceeded males in wing length in all cases and in tail length in 10 cases. The other pair had tails of equal length. In bill length, the female was greater in 7 cases, equal in 2 and less in 2, but these 2 were the same pair caught in successive years. Females exceeded males in weight in 10 pairs. In the other pair, the male weighed slightly more than the female. All female weights were taken after egg-laying was complete.

No overlap in wing length occurred within mated pairs, although a small amount of overlap occurred within the population (Table 1). Slight overlap was found in tail and bill length, but only the heaviest male slightly exceeded the lightest female in weight. Thus, it appears that most specimens, and nearly all mated pairs, can be sexed by size and weight.

As is obvious from the capture data, both sexes shared in incubation, but brood patches were not found on either sex. As shown in Table 1, 2 pairs remained mated for 2 years.

Eggs.—All complete clutches contained 4 eggs, except 1, which contained 5. Tomkins (1965) mentioned 2 sets of 5 taken by an earlier collector. Measurements of 66 eggs varied from 36.5–40.0 mm by 49.5–57.0 mm and averaged 38.0×53.5 mm. Weights of the same 66 eggs taken at various stages of incubation ranged from 31.5–44.4 g and averaged 38.5 g.

Weights of eggs in 9 clutches, whose date of hatching was known, were plotted as a function of days before hatching. The regression line of best fit drawn by eye suggested an average weight loss of about 0.2 g per day during incubation. This would give a weight loss of about 5 g during the incubation period and would account for about half of the variation in weight found. The remainder can be accounted for by variation in size of the eggs. Tomkins

TABLE I
MEASUREMENTS AND WEIGHTS OF ADULT WILLETS CAPTURED ON THEIR NESTS

| Year | Male | | | | | Female | | | | |
|-----------------------------------|----------------|-----------|-----------|-----------|------------|----------------|-----------|-----------|-----------|------------|
| | Band | Wing (mm) | Tail (mm) | Bill (mm) | Weight (g) | Band | Wing (mm) | Tail (mm) | Bill (mm) | Weight (g) |
| Mated pairs | | | | | | | | | | |
| 1971 | 1063-73835 | 183 | 66 | 52 | 206.2 | 983-01457 | 191 | 72 | 55 | 229.2 |
| 1972 | 1063-73835 | 185 | 67 | 53 | 215.6 | 983-01457 | 194 | 72 | 56 | 261.3 |
| 1975 | 1063-73835 | 185 | 68 | 53 | 213.0 | 1233-18872 | 193 | 72 | 57 | 236.3 |
| 1974 | 983-01456 | 180 | 69 | 50 | 203.0 | 1233-18868 | 197 | 72 | 57 | 223.2 |
| 1975 | 983-02824 | 181 | 65 | 56 | 213.0 | 1233-18870 | 195 | 69 | 56 | 246.2 |
| 1973 | 1003-69169 | 187 | 70 | 52 | 210.7 | 1003-69167 | 196 | 70 | 58 | 263.3 |
| 1974 | 1233-18856 | 190 | 69 | 57 | 211.8 | 1233-18855 | 196 | 75 | 55 | 249.0 |
| 1975 | 1233-18856 | 185 | 69 | 57 | 211.6 | 1233-18855 | 197 | 74 | 55 | 240.7 |
| 1975 | 1233-18865 | 179 | 69 | 54 | 211.6 | 1233-18887 | 192 | 73 | 59 | 240.6 |
| 1975 | 1233-18871 | 183 | 68 | 52 | 207.2 | 1233-18873 | 190 | 69 | 58 | 247.6 |
| 1974 | 1233-18867 | 185 | 66 | 57 | 218.2 | 1233-18866 | 197 | 68 | 57 | 217.2 |
| | \bar{x} (11) | 183.9 | 67.8 | 53.9 | 211.1 | \bar{x} (11) | 194.4 | 71.5 | 56.6 | 241.3 |
| Birds whose mates were not caught | | | | | | | | | | |
| 1969 | 1063-73835 | 186 | 66 | 51 | 199.0 | | | | | |
| 1970 | 1063-73835 | 189 | 68 | 53 | 206.4 | | | | | |
| 1977 | 1063-73835 | 181 | 67 | 53 | 202.5 | | | | | |
| 1971 | 983-01456 | 177 | 69 | 51 | 202.1 | | | | | |
| 1975 | | | | | | 1233-18868 | 198 | 74 | 56 | 221.0 |
| 1972 | 1003-69408 | 174 | 66 | 54 | 204.2 | | | | | |
| 1973 | | | | | | 1003-69168 | 190 | 73 | 55 | 226.5 |
| 1974 | 1233-10865 | 181 | 66 | 53 | 208.3 | | | | | |
| 1976 | | | | | | 1013-34768 | 191 | 69 | 56 | 244.8 |
| 1977 | | | | | | 1013-34768 | 188 | 67 | 54 | 231.8 |
| 1977 | | | | | | 733-94555 | 191 | 71 | 58 | 236.5 |
| 1977 | | | | | | 1013-34268 | 194 | 71 | 58 | 257.7 |
| 1978 | 1013-35012 | 186 | 63 | 53 | 200.9 | | | | | |
| 1978 | 1013-35029 | 182 | 68 | 54 | 203.6 | | | | | |
| 1978 | | | | | | 733-94555 | 188 | 73 | 57 | 244.1 |
| | \bar{x} (8) | 182.0 | 66.6 | 52.8 | 203.4 | \bar{x} (7) | 191.4 | 71.1 | 56.3 | 237.5 |
| | \bar{x} (19) | 183.1 | 67.3 | 53.4 | 207.8 | \bar{x} (18) | 193.2 | 71.3 | 56.5 | 239.8 |

(1965) weighed 1 clutch frequently throughout a 29-day incubation period and found an average loss of 4.5 g.

Weights of 12 complete clutches of 4 eggs each were compared to the weight of the female after laying. Clutch weight ranged from 57.8–73.6% of the female weight and averaged 64.9%. The range in these values is attributed to the stage of incubation at which the eggs were weighed and to the condition of the female when captured. Tomkins (1965) found a similar value, 65%, for a single clutch.

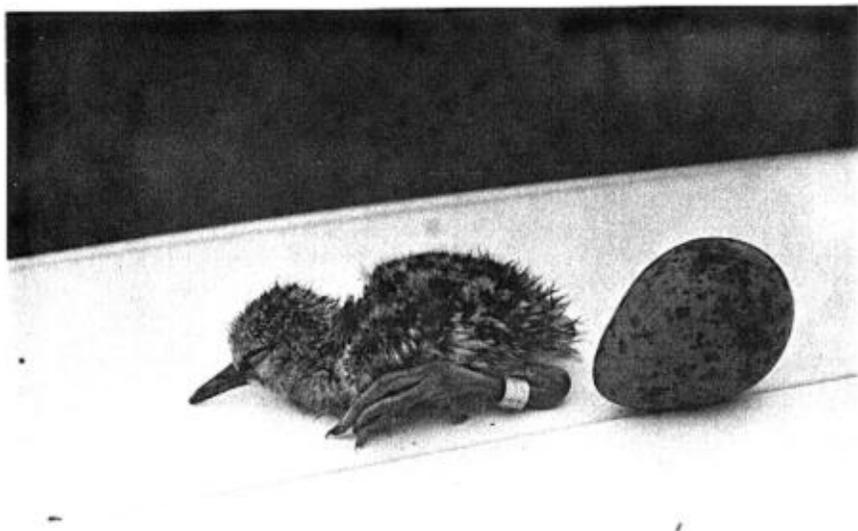


FIG. 2. Willet egg and newly-hatched young.

Incubation period.—The incubation period of the Willet was given as 21–23 days by Sprunt and Chamberlain (South Carolina Bird Life, Univ. S. C. Press, Columbia, S. C., 1949) and 22 days by Palmer (1967). Bent (1929) gave no information. Tomkins (1932) reported the period as 24–25 days based on only 1 clutch. Subsequent observations (Tomkins 1965) gave 22–29 days, but the longest period was apparently due to frequent weighing of the eggs, which kept the adults off the nest for longer than normal periods. I have an incubation period of 27 days for 1 clutch and 32 days for another, but the latter is certainly longer than normal, as the birds were kept off the nest for too long periods. Thus, the incubation period seems to range from 21–29 days, or less.

Hatching dates obtained for 9 clutches range from 9–19 June. Assuming an average 24-day incubation period, most clutches were apparently completed between 16 and 26 May.

Young.—The eyes of newly-hatched young (Fig. 2) are very dark brown, almost black, similar to those of adults. The young remain in the nest only a few hours, leaving after all are dry. Weights of 25 newly-hatched young from 7 nests varied from 23.6–30.6 g and averaged 28.0 g. For 3 nests in which all the eggs and young were weighed, the young averaged 70.9% of the egg weights. Tomkins (1965) gave 22.5 g as the weight of a single chick.

Willet young are difficult to find from the time of leaving the nest throughout the growing period. I have never been able to find young after the day of hatching. Possibly, the adults carry them away from the nest area. Wayne (Birds of South Carolina, Contrib. 1, Charleston Museum, Charleston, S. C., 1910) reported an observation in which he watched an adult carry the 4 young, 1 at a time, at least 440 yd. If I had not trapped both adults and the young had just hatched, I usually tied the young to a stake and placed the trap over them in order to capture the adult. In one instance, I placed the trap over a brood of young, but neglected

to tie them down. I went back in 1 h and the young were 23 m from the nest. I have never been able to find young at a greater distance than this from the nest, nor any young more than 1 day old, consequently, no weights or measurements during the growing stage have been obtained. This is in sharp contrast to young Piping Plovers which I could find almost anytime, up until flight (32 days). Young oystercatchers could also be found readily until flight stage (41 days).

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Unusual egg deposition in Mourning Doves.—The Mourning Dove (*Zenaida macroura*) is a determinate layer with a genetically controlled clutch-size of 2. Hanson and Kossack (Ill. Dept. Conserv. Tech. Bull. 2, 1963) mentioned no larger clutches in their extensive work, yet Harrison (A Field Guide to Birds' Nests, Houghton Mifflin Co., Boston, 1975) records clutch-size as "2, occasionally 3, rarely 4." Other workers have at times recorded >2-egg clutches, and both Quay (Mourning Dove Studies in North Carolina, Game Div., N.C. Wildl. Res. Comm., 1951) and Moore and Pearson (The Mourning Dove in Alabama, Ala. Coop. Wildl. Res. Unit, 1941) questioned the origin of the additional eggs in the cases they observed, i.e., whether they were produced by 1 or more females. Nice (Auk 39:457–474, 1922) found 3 nests that contained more than the normal clutch, and cited 8 previous reports of 4-egg clutches and 40 of 3-egg clutches.

In a study of nesting ecology and nest-site selection in Mourning Doves on Purdue Wildlife Area (PWA), Tippecanoe Co., Indiana, I examined 106 nests in 1975 and 228 in 1976, most in plots of deciduous shrubs or pine (*Pinus sylvestris*, *P. resinosa* and *P. strobus*). I found several >2-egg clutches and some other instances of abnormal egg deposition in doves that should help explain the origins of extra eggs.

Early March 1976 was exceptionally warm with daytime temperatures often above 15°C and night temperatures about 5°C; several nestings were initiated during this period. Colder weather returned in mid-March with highs just above freezing and lows to -8°C, followed by moderating temperatures in late March with lows only occasionally falling below 0°C. During this period, several intact or freshly broken (not punctured) eggs were found beneath pines many meters from the nearest nest. Although not previously described for Mourning Doves, these layings were apparently adventitious, perhaps resulting from warm weather initiation of follicular development and intervening cold weather having a depressing effect on nest-building and associated behavior. Nesting by doves is delayed in exceptionally cold springs (Hanson and Kossack 1963).

As elsewhere, doves frequently used old nests of other birds on PWA, usually adding some nesting material (McClure, Iowa Agric. Exper. Stat. Res. Bull. 310:355–415, 1943; Hanson and Kossack 1963). In 3 instances, however, single eggs were deposited in nests of other species without addition of nesting material. One of these, an old American Robin (*Turdus migratorius*) nest, was unoccupied when the egg was laid about 29 April 1975. However, the other 2 nests were active at the time of laying. On 17 April 1976, a dove was flushed from a Common Grackle (*Quiscalus quiscula*) nest containing 1 fresh dove egg. The nest was under construction and the egg rested on wet mud and organic matter. The egg was gone