ship's radar equipment was in continuous operation. At no time did any of the birds observed show modification of behavior which might have been attributed to the presence of pulsating radio waves. In fact, when in tropical waters, Gannets frequently committed nuisance by roosting on the yardarms within a few feet of the radar and other high frequency radio antennae. On a few occasions during exceptionally favorable sea conditions it was possible to track albatrosses and frigate-birds by means of surface radar. The fact that in every case these birds maintained a steady course and speed, even though well within the range of the radar beam, would be indicative of the fact that they were probably unaware of radio waves being reflected from their bodies.

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NESTING OF THE SPOTTED SANDPIPER AT DETROIT, MICHIGAN

BY J. ROBERT AND JEAN T. MILLER

Plate 15

THIS paper concerns the 1947 nesting of the Spotted Sandpiper (*Actitis macularia*) on Belle Isle, an island in the Detroit River at Detroit, Michigan. The island is about three miles long and about half that wide at its widest point, and is primarily a public park with attractions such as bathing beaches, boat clubs, zoos, picnic grounds, etc. At the eastern end of the island are two narrow peninsulas (approximately a quarter mile long) with a large bay between them. Spotted Sandpipers nest on both of these peninsulas. Approximately the outer two-thirds of the more southern peninsula was utilized for this study.

HABITAT

The study area (Plate 15, figs. 1, 2) consists of 17.6 acres (paced) of dry meadow with a few trees, bounded on three sides by water and on the fourth side by habitat similar to that within the area. About 75% of the study tract was covered with four species of grasses of which blue grass (*Poa pratensis*) was the most common. The remainder was rocky shore with blue grass and sweet clover; 25 to 35-foot American elms with ground beneath covered by blue grass; some

sandbar willow, chicory, and blue grass mixtures; a few wet areas of grass and sandbar willow; and a very small 'pond' with miniature mud flats (the 'pond' drys up in July). The sandy beaches are very narrow. A small garbage dump located in the study area is in daily use, and the shores are daily frequented by fishermen. In the fall of 1946 all the shrubs and trees about the 'pond' were cut. The peninsula was man-made several years ago. The meadow was flat and dry with the exception mentioned above. The elevation is 580 feet.

WEATHER AND COVERAGE

The preceding winter was unusually warm and dry. The spring months were cooler than normal and the rainfall was the heaviest in 75 years. June and July were about normal.

Visits to the tract were made daily, with the exception of four days, from June 4 through June 23, and at approximately weekly intervals from June 23 through July 22.

DENSITY

One pair (nest not found), 39 nests and three families with young were located. All 43 pairs foraged entirely within the study area. This gives a density of 244 breeding pairs per 100 acres. Subtraction of two large blocks of territory from the census area eliminates all the trees, large areas of rocky, weedy beach and the wet meadows. The total area becomes 13.5 acres containing 38 pairs, which gives a density of 272 pairs per 100 acres. Several pairs, however, foraged outside the 13.5 acres.

Other species of birds breeding within the 17.6 acres were: Killdeer (*Charadrius vociferus vociferus*), five pairs; Kingbird (*Tyrannus tyrannus*), one pair; Prairie Horned Lark (*Otocoris alpestris praticola*), one pair; Eastern Meadowlark (*Sturnella magna*), one pair; Cowbird (*Molothrus ater ater*), one pair; Savannah Sparrow (*Passerculus sandwichensis*), five pairs; Song Sparrow (*Melospiza melodia*), ten pairs.

COURTSHIP

In Bent's 'Life Histories of North American Shore Birds' (1929) descriptions of the 'nuptial performance' are similar to that described below but only one bird was active in the performances described and the imitation of incubation was not utilized. In my notes for June 4 appears the following entry. "At 1:10 P. M. two sandpipers were seen engaged in what appeared to be a 'nuptial ceremony.' They approached each other slowly from a separation of about 2½ feet and one bird, throughout, held its wings partially extended and fluttered

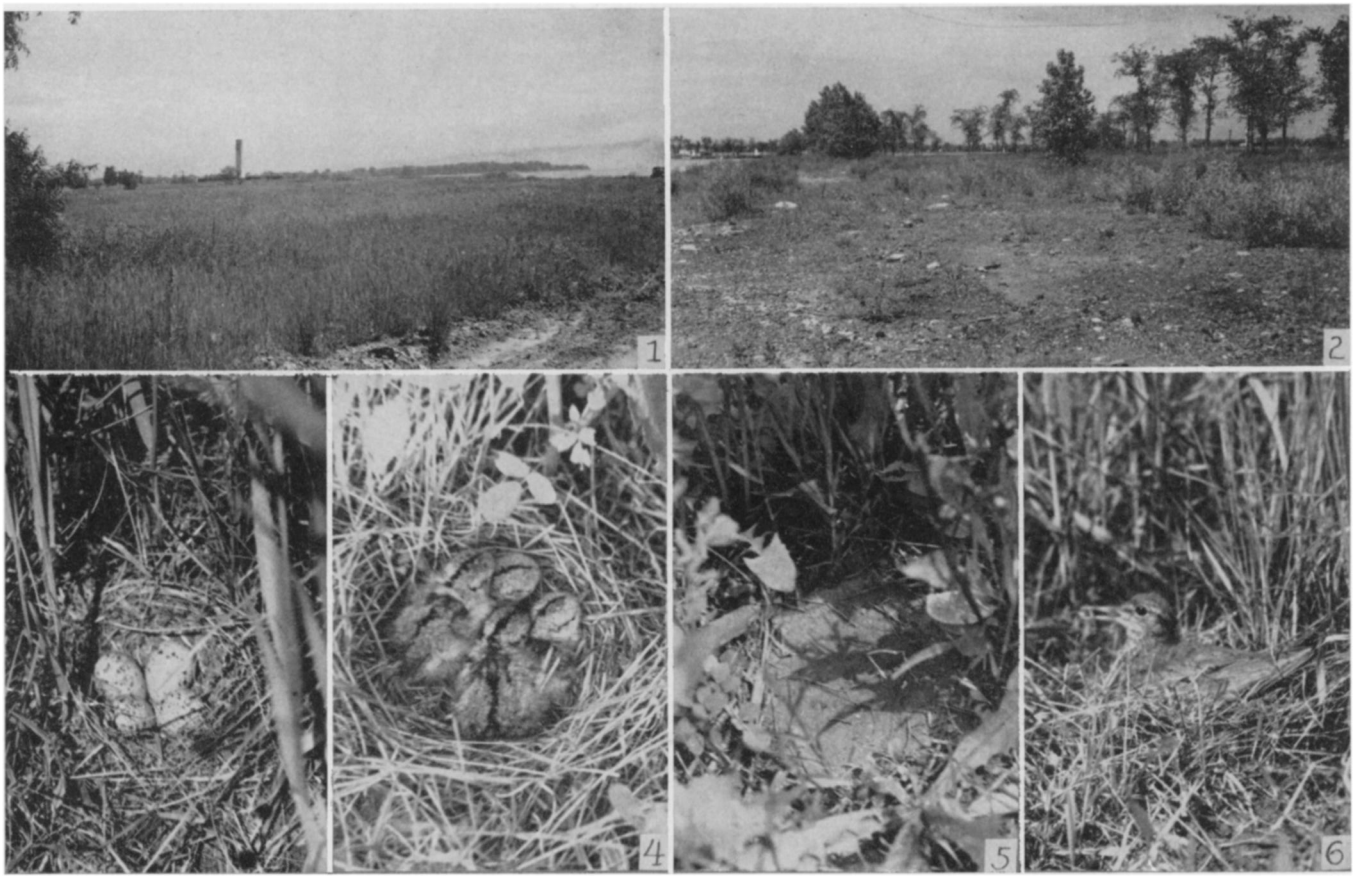
them slowly. No vocal accompaniment was noted. One of the same two repeated this 'wing fluttering' performance while the back of the other was turned. The 'non-fluttering' bird flew out of sight closely followed by the 'fluttering' one. Also (at the first 'fluttering' ceremony) they were seen to face one another at a separation of about one foot and both several times snuggle down to the ground as if incubating a clutch of eggs. A similar performance was executed by two other individuals. A third pair flew down within 10 feet of us, and with no preliminaries copulation took place, the male keeping his balance on the female by beating his wings. Copulation was repeated and the pair flew off." In Bent's life history of this species it is stated that a courting individual responding to a whistled imitation of a sandpiper call proved to be a female when collected and dissected.

NESTS AND TERRITORY

According to Forbush (1925) and Tyler (*in* Bent's 'Life Histories,' 1929), Spotted Sandpipers nest either in colonies or as single pairs, and the locations and structures of the nests may vary widely. Of the 39 nests located by the authors 35 (90%) were nestled among thickly growing grasses 6–30 inches tall. Only three were placed in areas covered solely with blue grass, the mixed grasses being preferred. Three were among small growths of unidentified three-foot green plants. One was placed in three-inch grass and was sheltered by a leaning, dead bush three feet tall; and one was placed on the beach among stones beneath a large leaf of a plant resembling burdock. All the nests were well shaded at all times of the day. They were all well-constructed nests and all were neat cups made solely of dead grass stems placed in slight depressions made by the prospective parents (Plate 15, figs. 3, 4). Two nests were located only 12 feet from one another. One of these was destroyed by unknown agency after two eggs had been deposited. The remaining 37 nests were all at least 40 feet apart.

No friction was observed between sandpipers and thus no territorialism was apparent. Most of them fed frequently on the same beaches and appeared to forage wherever they wished. However, no special effort was made to observe territorial behavior. Nelson (1930) found that: "Distinct territory rights have been observed in several cases."

One nest was 12 feet from the nest of a pair of Killdeers. No conflict was noted between the two species and both nests produced full broods. A pair of Killdeers and two pairs of sandpipers for several days had downy young hiding among the weeds on a small



SPOTTED SANDPIPER.—(1) MIXED GRASSES TYPICAL OF THE CENSUS PLOT; (2) THE ONE AREA WITH MUCH ROCKY SHORE AND TREES; (3) A TYPICAL NEST AMONG GRASSES; (4) A TYPICAL NEST AMONG OTHER PLANTS. FOUR CHICKS A FEW HOURS OLD; (5) NEST AT THE SAUCER DEPRESSION STAGE; (6) INCUBATING PARENT "SINGING" FROM NEST.

island (10 square feet) in a small pond. The adult Killdeers were often seen chasing the adult sandpipers but were not persistent about it.

In Bent's life history of the sandpiper (1929) it is stated that invariably a nesting site is deserted if the birds are flushed while in the process of building. Of the six sites from which we flushed birds while they were building, three were deserted the day after discovery. In all six cases a pair of birds was present. Never was more than one bird observed at any of the 37 nests after building was complete.

One of the sites which was not deserted was found June 5 (the birds were flushed from it twice that day) and subsequently observed daily. Blue grass had been removed from among two to three-foot green plants to make a bare spot roughly 4½–5 inches in diameter (Plate 15, fig. 5). This spot had been excavated to resemble a saucer with the depression at the center being about a half inch deep. The following day only one bird was flushed. The nest was then complete; there was the usual cup of dead grass stems except that the center one-third of the excavation remained unlined. One egg rested on the bare ground in the center. The next day the nest was completely lined and contained two eggs. A nest first found when it contained but one egg was complete. Of the four nests first located when they contained two eggs, all were complete.

EGG LAYING

For 37 nests the average number of eggs (complete clutch) per nest was 3.95. Four eggs appeared in each of 33 nests, three eggs in three nests and five eggs in one nest.

For seven nests, one egg was laid daily, and for each of two nests, one day was skipped so that the third egg was deposited a day 'late.' Of the two days on which the third eggs were not laid 'on schedule,' one was rainy throughout and the other succeeded a night during which the temperature had fallen sharply.

For calculating the laying dates for 29 nests not located until a complete clutch had appeared, an incubation period of 21 days was used (*see* incubation period below). For 39 nests the laying dates (date when clutch became complete) ranged from May 25 to June 22, inclusive. For nine nests the date was May 25 to June 3; for 19 nests it was June 4 to June 13; and for 11 nests it was June 14 to June 22. Probably the laying dates are influenced by several factors. These relationships can be determined only by several years' study. However, it could positively be seen that temperature was one of the factors involved. In almost every case the first egg appeared five to seven days after a two or three-day warm 'wave.' First egg dates were

calculated from the hatching date (assuming the incubation period was 21 days) for all (29 nests) except the 10 nests which were found before the sets were complete.

INCUBATION

Forbush (1925) states: "The female often begins to incubate as soon as the first egg is laid, and for this reason some eggs may hatch before the others, but usually the young emerge within the space of two days subsequent to the hatching of the first egg." In 64% of 22 successful nests the young hatched over a period of two or three days. In 36% the young all hatched the same day. At each of the 10 nests observed before the full complement of eggs had been deposited, an adult was apparently incubating. It has been reported for some birds that the last egg of a set is often the first to hatch even though earlier eggs have been incubated previous to the completion of the set.

In the nests in which the young emerged over a period greater than one day, some parents continued to incubate until all the eggs hatched; others did not. No figures are presented for the continuation of incubation, as it is not known what effect our daily observations had on this activity nor which and how many of the eggs were infertile.

Forbush (1925) quotes Knight as giving an incubation period of "about 15 days" and Burns as giving the period to be "15–16 days." In Bent (1929) the incubation period is given as 15 days. (The incubation period of the Common Sandpiper (*Tringa hypoleucos*) of Europe is known to be 21 days.) Nelson (1930) found the incubation period (last egg to first young) to be 21 days in one case and at least 19 days in a second case (Michigan). Mousley (1937) found it to be 21 days for two nests and 20 days for a third nest (last egg to first young). In 1939 he published the figure of 21 days for another nest. Knowles (1942) found incubation periods (last egg to first young) of 20 days and 19½ days for two nests (Regina, Saskatchewan, Canada). For three nests of the sandpipers on Belle Isle the periods (date of last egg to date of first young) were 22 days, 21–22 days, and 20 days. Unfortunately the other nests which were located before the eggs numbered a complete set were destroyed before any young hatched. Other nests which were not located until the full complements of eggs were present but for which the dates of the first young were known, disclosed incubation periods as follows: at least 17 days for one nest; at least 18 days for two nests; at least 19 days for one; at least 20 days for one; at least 21 days for two; and at least 22 days for one. Thus it appears that the incubation period was 20–22 days for Spotted

Sandpipers at Detroit in 1947 and is probably 20–22 days for most individuals of this species.

In Bent's life history of this species it is mentioned that one adult collected by van Rossem had obviously incubated considerably and was found to be a male. Mousley (1937) found only the male incubating each of two nests. Nelson (1930) found that: "Incubation and brooding are both done by the male bird alone. Six records of adults collected either on the nest or with downy young, support this assertion. In no case was there another adult present."

'SINGING' FROM THE NEST

Since I have been unable to find in the literature any record of 'singing' from the nest by Spotted Sandpipers, my notes of our observations on this interesting behavior are quoted in full. "On June 4 one nest was found at 2:45 P. M. when the unseen incubating bird flushed when we were about five or six feet away. We remained at this nest until 5:00 P. M. observing the incubating bird and taking photographs. This nest is a typical one (Plate 15, fig. 3) placed in a large meadow of one to two-foot grasses. We used no blind. A parent first returned to incubate while we were sitting immobile 15 feet away. Time—3 P. M. We had waited 15 minutes for its arrival. It quickly settled on the four large, tan eggs. [Later, we figured from the date of hatching that the clutch was probably just completed that morning.] Its bill was kept open (it was in full sun, as we had removed the protective grasses from one side of the nest to permit photography). The neck pulsed very rapidly. Fright or heat? It bobbed its head frequently and when changing position usually rotated a quarter circle. It seemed unaware of our presence, often facing directly away from us. It changed positions regularly once a minute from 3:00 to 3:20. Called *peet weet weet weet weet* both softly and loudly a total of four times while still incubating. The calls in every case followed similar calls from distant birds. Subsequently it often called fully from within a six-foot radius of the nest. Position changes —3:21, 3:22. I moved to within five feet of the nest and lay motionless on my stomach. Returned to incubate—3:25. Only two position changes from 3:25 to 3:36. 3:47—it spontaneously walked calmly off 3½ feet from the nest, called, teetered deliberately a few times and took wing. I remained motionless and at 4:03 an adult returned to incubate. Henceforth, the beak was always closed, no rapid pulsations in neck, no changes of position, and very calm and quiet. A different individual or the same one as before but no longer frightened or hot? Had the 'singing' been a signal for a change of 'shifts' at incubation?

4:09—flew when I attempted to cock camera shutter. 4:15—back again. Always after the bird had left the nest it returned slowly by varied and circuitous routes through the tall grass, with occasional soft, low calls that were variations of the common *peet weet* call. Three times it called from the nest again in apparent 'answer' to another individual. The call used these times was the *toot-a-wee* call (Plate 15, fig. 6). 5:00 P. M.—we left the nest."

At several other nests a bird was heard giving soft, low variations of the *peet weet* as it approached the nest through the grass. Later, individuals on two other nests were observed giving a full *peet weet* call while incubating. One nest had contained a complete set of eggs for five days, the other nest for eight days. Injury-feigning was never observed at either of the first two nests at which 'singing' from the nest was noted. Each raised two young to leave the nest. A full injury-feigning performance was observed three times at the third nest where 'singing' had been noted, and four young left the nest.

DISTRACTION DISPLAYS

Three types of distraction displays were commonly used. The first consisted of a rapid running away from the vicinity of the young. If we followed the bird only a few feet and then stopped, it returned closer to us and repeated the maneuver. This was used most commonly when the young were hiding in the grass but occasionally when they were still in the nest.

The second type was used only when we approached the young so closely as to be almost able to pick them up. Then an adult often fluttered erratically on the wing about us, just out of arm's reach, and continually called *peet peet, peet peet* in a very alarmed manner. This behavior was not exhibited by all the parents, possibly by about 50%.

The third distraction display was the injury-feigning so frequently exhibited by many species. In the Spotted Sandpiper this consists of an apparently helpless fluttering over the ground with wings partially extended and tail fully spread and dragging the ground. A most piteous cry is given throughout. One example of injury-feigning differed from all the rest. It was very similar to that seen in the Killdeer. The parent spread its wings fully and waved them, and rolled from side to side on the ground. The tail was not spread and there was no vocalization.

For one nest observed nearly daily, Mousley (1939) noted the occurrence of only one injury-feigning display during incubation and reported it as being given on each of the two days the young were in

the nest. Knowles (1942) states that for one nest no injury-feigning was given for the period from the laying of the first egg to the completion of the set of four. Observations were made again on the 15th day after the completion of the set, when a complete act was observed, and on the 20th day when a complete act was seen shortly before the first young hatched. At another nest he observed that the injury-feigning reached a peak about five days before the first egg hatched. Nice (1943) says: "The intensity of the reaction [distraction display] typically increases during the nesting cycle. Some birds, as mourning doves (Nice, 1922–23), and shore birds may show it with eggs, especially well-incubated eggs. With many birds, both precocial and altricial, it is at its height when the young are leaving the nest."

Each day we visited the census area we briefly inspected each nest. The nests were usually approached from the same directions each time. As soon as a bird flushed from a nest we stood still. Different nests were visited widely differing numbers of times, depending upon the stage of incubation at which they were when first found. Considering the group as a whole, the complete injury-feigning behavior, as described above, was noted on every day of the incubation period from the date of the deposition of the second egg to the completion of incubation. Our observations on 35 nests clearly indicated that for these particular birds no correlation existed between injury-feigning and the extent to which incubation had progressed. Some birds never gave the display during the whole of their breeding cycles; others gave it as often as five days out of nine during incubation. However, it was obvious that there was a marked increase in the number of displays after the first egg had hatched and that this peak continued until the young left the nest (two to three days). On three occasions this type of distraction display was seen in parents that were caring for young several days old. Once it was observed in a parent whose young had nearly complete juvenal plumage and were capable of flying three or four feet.

There appeared to be no correlation between injury-feigning and nesting success.

VOICE

The vocalizations of the Spotted Sandpiper have been well described by Saunders in Bent's life history of the species. Our observations fully agreed with his statements. However, mention might be made of the following, which I have not found described in the literature. The location call of both the chicks and the adults is *peet peet*. With the chicks it is a very thin, tiny, babyish sort of a call. With the

adults it merely differs in inflection from their alarm call. This call in young which are just beginning to fly (about 14–15 days old) resembles that of the one-day chick more than that of the adult.

THE CHICKS

The downy young left their nests at any time from the drying of the last hatched chick to three days later. None remained in the nest longer than this.

In every case the egg shells were removed very shortly after the hatching of a chick. It was not observed whether they were simply carried off or were eaten or both.

In general the sandpiper family remained within a few hundred feet of the nest until the young were able to fly. They 'preferred' to remain on the higher, grassy parts of the peninsula until able to fly, when they began to frequent the beaches.

NESTING SUCCESS

In 37 nests there were deposited 146 eggs, with an average of 3.95 eggs per nest. From 119 eggs (30 nests) there hatched 77 young (64.7%) of which 74 (96.0%) left the nest. The average number of young leaving the nest was 2.3 per nest (32 nests). A nest was considered to be successful if at least one chick left the nest. Of 35 nests 25 (71.5%) were successful. For seven other nests no young were seen in the nests, but the success could be judged from the behavior of adults near these nests. If these seven nests are added, the successful nests were 31 (73.7%) of a total of 42 nests. The average number of eggs per successful nest was 3.96 (22 nests). The average number of young leaving the nest was 3.4 per successful nest (22 nests). Thirteen nests produced four young each, five nests three young each, three nests two each, and one nest produced only one.

Possible enemies known to be present regularly were: Crow (*Corvus brachyrhynchos*), Starling (*Sturnus v. vulgaris*), Bronzed Grackle (*Quiscalus quiscula versicolor*), Cowbird (*Molothrus a. ater*), Herring Gull (*Larus argentatus*), Common Tern (*Sterna hirundo hirundo*), and man (often children were present in the area). Possible enemies seen in the area rarely were dogs and Blue Jays (*Cyanocitta cristata*). No rats were seen about the garbage dump. No nest was deserted unless one or more eggs had been broken or stolen. All nests not having one or more eggs broken or stolen were successful. Two of the young which died before leaving the nest were apparently drowned in a hard rain and the third was stepped upon by a child. One nest was known to have been destroyed by a bird and four nests were known to have

been destroyed by man. The other failures were due to unknown agencies.

SUMMARY

1. A short study of the 1947 nesting of 43 pairs of Spotted Sandpipers on 17.6 acres of dry meadow on Belle Isle in the Detroit River at Detroit, Michigan, is described. The density of breeding pairs was 244 per 100 acres.

2. Information is presented on the nuptial performance, nest location and construction, territorialism, egg laying and hatching, incubation period, 'singing' from the nest, and distraction displays.

3. Of 35 nests, 25 (71.5%) were successful. For 37 nests, the total number of eggs was 146 (3.95 eggs per nest). For 32 nests, 74 young left the nests (2.3 per nest).

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