

MEASUREMENT OF SOME LAKE-SHORE TERRITORIES OF THE SONG SPARROW

BY RODERICK A. SUTHERS

THIS paper presents data concerning the size and measurement of four adjacent Song Sparrow (*Melospiza melodia*) territories located along the northwest shore of Bear Paw Point, Lake Itasca, Clearwater County, Minnesota.

An attempt has been made to compare the territorial variations within a single species. Song Sparrows nesting on islands have been reported to fledge young successfully in areas less than one-tenth the size required in mainland situations (Beer *et al.*, 1956). In the present study, lake-shore territories were measured in order to retain the effects of shore line on territory size without the probable insular influences affecting the results of Beer *et al.* (*ibid.*) and Swedberg (1957).

The shore line studied rises a few feet above the level of the lake. The ground dips inland to form a boggy area—especially pronounced in the areas occupied by Pairs 2 and 3—before rising again to a mixed forest of conifers and hardwoods. The Song Sparrows held a single row of territories between this forest and the lake. The woods in this strip were rather open because of much windfall. Dominant canopy species included black ash (*Fraxinus nigra*), American elm (*Ulmus americana*), basswood (*Tilia americana*), paper birch (*Betula papyrifera*), and balsam fir (*Abies balsamea*). In the shrub layer, alder (*Alnus crispa*), paper birch, balsam fir saplings, and raspberry (*Rubus idaeus*) were present. The ground cover was of grasses (*Poa palustris*, *P. pratensis*), sedges (*Carex* sp.), and a little cattail (*Typha latifolia*). The nomenclature used here follows that of Fernald (1950).

The area was mapped with the aid of a compass and by pacing. Later accurate measurement of 11 of the approximately 80 paced distances indicated that pacing may have given results averaging about 3 per cent too long. I do not believe this exaggeration has a significant effect on the results, since the distances paced were rarely as long as 100 feet and often were less than 50 feet. Observations were made from 4:00 to 9:40 a.m. and from 3:15 to 7:35 p.m. (Standard Time).

Territories were measured according to the method described by Odum and Kuenzler (1955). The position of either member of a pair was recorded at approximately 5-minute intervals on a map of the study area. After about every 10 such spot observations, the outermost were connected by straight lines to form the largest possible polygon. The area of this polygon was then plotted on a graph using area as the ordinate and the number of observations as the abscissa. This was repeated for each additional 10 observations, and a

smoothed curve was drawn through the successive points. *Maximum territory*, as defined by Odum and Kuenzler (*ibid.*), is the point at which, according to the observation-area curve, an additional 10 observations increases the area less than 10 per cent. I also determined the point at which 10 observations increased the area less than 1 per cent. This I shall call the *utilized area* to avoid confusion with the maximum territory.

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RESULTS AND DISCUSSION

The maximum territories varied from 0.30 to 0.65 acre and averaged 96 per cent of the utilized area (Table 1). Although measurements of the utilized area for Pair 3 were not completed to the 1 per cent increment level, the observation-area curve for this pair indicates that 0.55 acre is probably within 0.01 acre of the actual size of the utilized area.

TABLE 1
COMPARISON OF UTILIZED AREA AND MAXIMUM TERRITORY

Type of Measurement	Pair				Mean
	No. 1	No. 2	No. 3	No. 4	
Utilized area (acres)	0.34	0.68	0.55 ¹	0.31	0.47
Maximum territory					
acres	0.32	0.65	0.53	0.30	0.45
as per cent of utilized area	94	96	96	97	96

¹ Measured with a 4.4 per cent increase as a result of the final 10 observations; all other utilized areas involved a 1 per cent increase or less in the final 10 observations as defined in the text.

Palmgren (1933) observed that a pair of birds may utilize only a part of its territory for from one to several successive days. Thus, if a territory is measured in a short period of a few days, the entire territory may not be included. I used two methods to check the possibility of this kind of error in my measurements: Remeasurement of the territory several days after the utilized area was first determined, and spot observations distributed over successive days after the initial determination of size.

The territory of Pair 2 was remeasured four days after the utilized area had been calculated. This new polygon added 0.02 acre not previously included and so increased the utilized area by 3.1 per cent. The territory of Pair 1 was remeasured eight days after the utilized area was calculated. The new polygon lay entirely within the utilized area as previously calculated.

TABLE 2
REPORTED SONG SPARROW TERRITORY SIZES (IN ACRES)

	Minimum	Mean	Maximum
Mainland (Nice, 1937, 1943)	0.5	0.67	1.5
Lakeshore (this study)	0.31	0.47	0.68
Island (Beer <i>et al.</i> , 1956)	0.04	—	—
(Swedberg, 1957 MS)	—	0.2	—

Nine spot observations distributed over six successive days, for Pair 4, gave a polygon enclosing 16 per cent of the utilized area and lying entirely within it.

Mainland territories in central Ohio were studied extensively by Nice (1943:152). She found that "in a region well filled with Song Sparrows" the average territory size was about two-thirds acre with a range from 0.5 to 1.5 acres. She emphasized (1937:205, 207) that "a fundamental trait of the Song Sparrow is that *it does not allow itself to be crowded*" and that the upper limit of a Song Sparrow population is fixed by territorial behavior.

Insular territories have been studied in Basswood Lake, Minnesota, by Beer *et al.* (1956). Two islands, each with an area of 0.04 acre, were found to have a pair of Song Sparrows nesting on them. One of these, Island 8, was used as a nesting area in each of six successive years. Swedberg (1957 MS) studied Song Sparrow territories on Schoolcraft Island, Lake Itasca, Minnesota. The territories of these pairs averaged 0.2 acre.

The four lakeshore territories I measured averaged 0.47 acre and were thus intermediate between sizes reported for mainland and those reported for island situations (Table 2).

As pointed out by Stickel (1954) and by Odum and Kuenzler (1955), caution must be used in comparing sizes of territories calculated by different methods. The home range, defended territory, and utilized territory may vary considerably among themselves and with the nesting cycle. Food-carrying activities of the parent sparrows which I observed would indicate that I measured their territories during the late incubation and young nestling stages. There appeared to be no measurable areas that were not utilized in any of the four territories. Pair I was even found to use several hundred square feet of upland forest floor as a feeding area, indicating that territorial boundaries may not always be safely assumed from the characteristics and distribution of the vegetation.

If home range is defined as the area in which an animal is usually found during a given season (Burt, 1946:20), then utilized area is probably analogous to the seasonal home range of Burt (*ibid.*). Stenger and Falls (1959), using a modified Odum and Kuenzler method on the measurement of Oven-

TABLE 3
PERCENTAGE OF UTILIZED AREA REMAINING WHEN OUTER OBSERVATIONS WERE EXCLUDED

Per cent of Observations Excluded	Pairs				Mean
	1	2	3	4	
2	79 (0.27) *	96 (0.65)	95 (0.52)	97 (0.30)	92 (0.44)
5	74 (0.25)	91 (0.62)	95 (0.52)	87 (0.27)	87 (0.42)
7	68 (0.23)	87 (0.59)	95 (0.52)	87 (0.27)	85 (0.40)
10	47 (0.16)	84 (0.57)	91 (0.50)	87 (0.27)	78 (0.38)
Number of Observations	49	67	41	62	54.75

* Acres in parentheses.

bird (*Seiurus aurocapillus*) territories, reported the outer 5 per cent of their spot observations were more isolated than the rest. They termed the area excluding these the "total utilized territory." While these authors imply that this 5 per cent is easily identified, the map that they present as an example shows the excluded percentage to be 6.4. Stenger and Falls found that these utilized areas for adjacent males varied in position from day to day but were distinct on any given day. This variation in daily position is not evident for the four Song Sparrow pairs that I studied.

When I excluded the outer 2, 5, 7, and 10 per cents from the utilized areas there resulted a rather even decrease in the size of territories of Pairs 1 and 2, but for Pairs 3 and 4 the progressive subtraction gave uneven results (Table 3).

It would be interesting to know if the extremely small territories of some island-nesting birds are supplemented by feeding areas on nearby shores. The two island territories of 0.04 acre described by Beer *et al.* (1956) were about one-eighth mile or less from the shore (L. D. Frenzel, pers. comm.). Schoolcraft Island is approximately 190 yards from the nearest shore. During June and July, 1959, L. D. Frenzel (pers. comm.) on several occasions saw Song Sparrows fly between Schoolcraft Island and the west shore—a distance of about 330 yards. During this same period, Mrs. J. J. Hickey (pers. comm.) saw a male Yellow Warbler (*Dendroica petechia*) fly from the east shore of Lake Itasca to Schoolcraft Island (*ca.* 200 yards). During 3 hours of observations from a canoe, however, in the early morning of July 5 and in the evening of July 13, 1959, I saw no Song Sparrows leave the island. Those seen in transit may well have been part of a drifting population of unmated birds, for

it is difficult to conceive of a strongly territorial bird with a Type A territory (Nice, 1941) regularly leaving it to feed in an undefended area or defending a separate feeding area.

The size of a bird's territory is no doubt determined by a number of inter-related factors. The relative importance of a given factor varies from one species to another. Dixon (1956) found that the distribution of blocks of woodland was an important factor contributing to the stability of Plain Titmouse (*Parus inornatus*) territories. These habitat features tended to form "neutral boundaries," i.e., boundaries not adjoining another territory (Southern and Morley, 1950). The inland boundary, as well as the lake-shore frontage, of the Song Sparrow territories I measured qualifies as such a neutral boundary. Stenger (1958) reports that the territory size of Ovenbirds varies inversely with the amount of invertebrate food present in the litter of the forest floor. In his study of the Song Sparrow (*M. m. samuelis*) population of San Pablo Salt Marsh, Richmond, Contra Costa County, California, Johnston (1956a) found that the size of the territory varied with the density and that the birds tended to "select particular habitats over others that they could conceivably live in" (Johnston, 1956b). Young (1951), however, found that density of Robins (*Turdus migratorius*) is not limited by their territories, which can be compressed and often overlap.

As habitat approaches the optimum for a species, it is logical to assume that the size of the maximum territory approaches that of the space actually utilized, which is itself decreased. The lower limit of the latter may be surprisingly small when all a species' requirements are met. The shore-line community is especially rich in insect life, has sufficient light to provide a band of dense brush required by Song Sparrows, and offers them immediate access to water. Thus it probably provides an optimal habitat for this species. In small islands the ratio of shore line to area is, of course, increased, and maximum densities of Song Sparrows reported for these islands seem to be logical. I do not, however, feel that the minimal figure of 0.04 acre for insular Song Sparrow territories (Beer *et al.*, 1956) should be accepted without further investigation in which the possibility of the birds crossing water to the mainland is completely ruled out. More information is needed concerning the distance island-inhabiting birds will fly *daily* over water.

SUMMARY

The territories of four pairs of Song Sparrows nesting along a lake shore in Clearwater County, Minnesota, were measured. The utilized area averaged 0.47 acre. The maximum territory averaged 96 per cent of the utilized area. Checks on original measurements in one case added 0.02 acre to the utilized area, and in two other instances did not change it. Deduction of given percentages of the peripheral locations caused a fairly even decrease in size of

two territories, but caused an uneven decrease in the others. The size of lake-shore territories was found to be intermediate between those reported by other workers for Song Sparrows on islands and for those on mainlands.

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