

A Report to the
Apostle Islands National Lakeshore

THE APOSTLE ISLANDS: CONCENTRATION AREA FOR
MIGRATORY BIRDS IN FALL

by

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Background

Wide bodies of water affect bird migration throughout much of the world (Rudebeck, 1950; Dobben, 1953; Dorst, 1962). Many birds, particularly passerines and hawks, display a reluctance to fly far from land. Migrants vary in their reactions to encountering a wide water obstacle, with the same species responding quite differently at different locations. Most species do routinely make wide crossings at certain places (see Lowery, 1945; Nisbet, Drury, and Baird, 1963). But along many coasts migrants alter their flight directions to remain over land, often being funneled by the water onto peninsulas or islands. Great concentrations of migrants appear at the most favored sites. These locations are heavily used by the birds for feeding and resting. They provide excellent conditions for the study of bird migration. Moreover, their value for recreation is high. Some of these sites -- Block Island, Cape May, and Point Pelee are good examples -- have become internationally known and attract large numbers of nature enthusiasts. Such a volume of human

visitors necessitates careful management of such natural areas.

The Great Lakes strongly influence migration pathways in the upper midwest, and impressive flights can be seen at certain shores of all five lakes (Dorst, 1962; Booth, 1969; Haugh, 1972; Weir, 1972). Lake Superior stretches nearly four hundred miles east to west across a portion of the heavily used Mississippi flyway. Large migrations have been studied at Duluth on Superior's west end (Hofslund, 1966), at Whitefish Point near Superior's east end (Kelley, 1972), and at Keweenaw Peninsula on the south shore (Wood, 1933; Frank Isaacs, personal communication). In 1976 and 1977 I observed spring migration in the Apostle Islands, documenting the presence and magnitude of large migratory flights of passerines and hawks (Harris, 1977; Harris and Jaeger, 1978). In 1978 I returned to Outer Island in the Apostles to observe the fall migration for a two-week period. In this paper, I present the results of the autumn study, closely comparing the observed flights with spring migration. In addition, I identify areas of special significance, either to the birds themselves or to the scientists and National Lakeshore visitors who may wish to watch the birds, and I recommend management measures to protect this resource.

For a detailed account of the spring study and of water impacts on migration routes, readers should refer to my earlier report (Harris, 1977). In brief, I found that large numbers of hawks appear on those Apostle Islands farthest from the mainland, apparently following the Superior shoreline out onto Bayfield Peninsula and then across narrow water channels from one island to another until they encounter the open lake (see Figure 1). Here almost all hawks turn around, making their way against the wind back onto the inner islands and presumably to the mainland. The many hawks retreating from Outer Island do so from the sand spit at the island's very south end, where the water crossing is shortest to Stockton Island. In 1977 a small number of hawks, comprising 3 percent of all hawks observed at the north shore of Outer, flew north over Superior. These included falcons, accipiters, and one osprey but no buteos.

Passerine flights were of two types. Species that typically migrate by day (see Brewster, 1886, for a listing of bird species migrating primarily by day and species migrating primarily by night) proceeded to the northern shores of the outer islands, where almost all of them turned about and flew back away from the open lake. Only 10 percent of the day-migrating birds actually set out across Superior. In contrast, night-flying passerines appeared to freely travel north in darkness. No movement out over the lake was noted during daylight; instead birds were discovered flying southward very high off the lake. These apparently were migrants that had found water under them at dawn and flew back south toward land rather than proceeding to the distant although generally visible

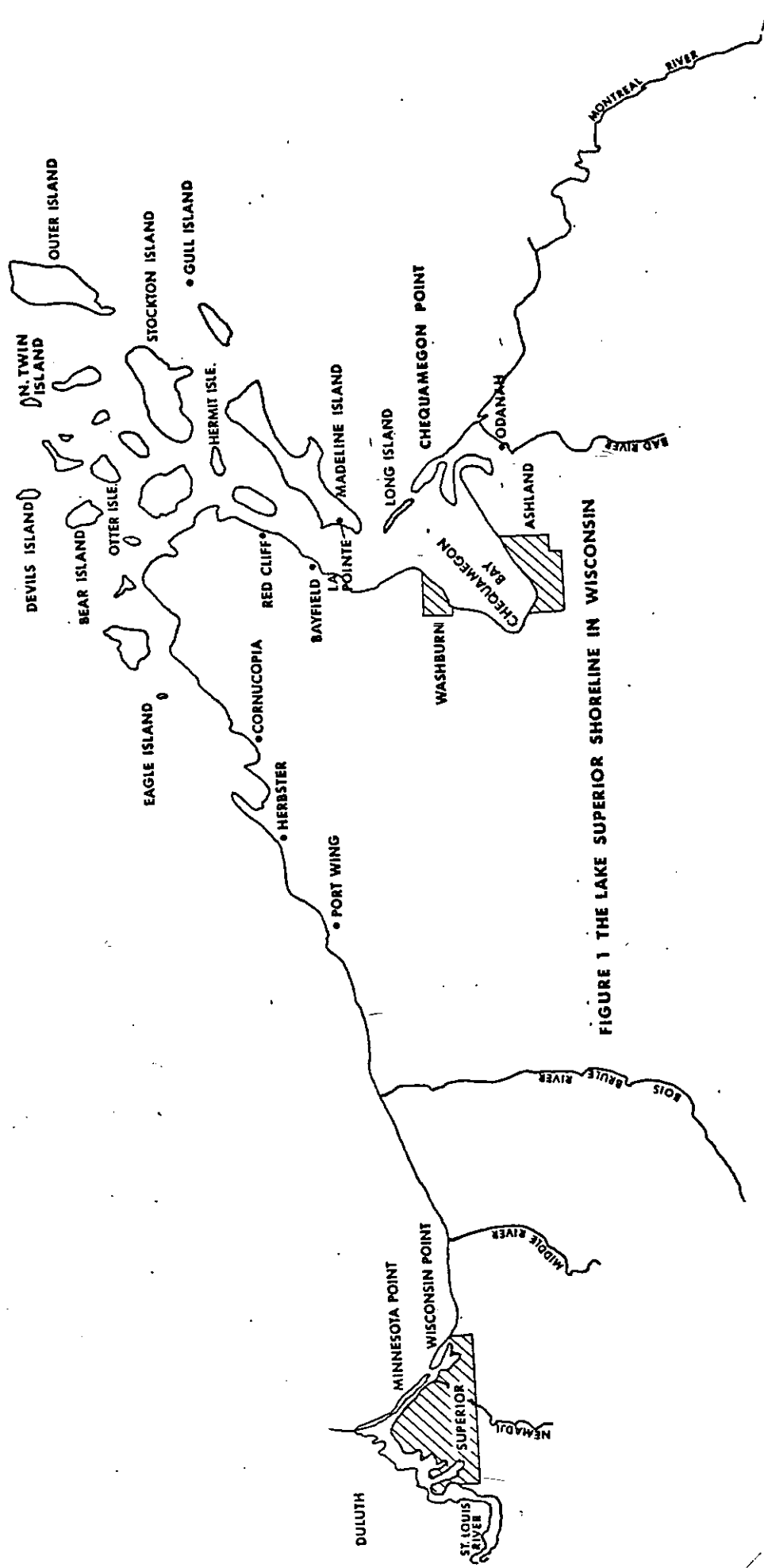


FIGURE 1 THE LAKE SUPERIOR SHORELINE IN WISCONSIN

Minnesota shore. Large numbers of both day and night-migrating species converged on the south ends of Outer, Devil's, and presumably others of the northern islands, taking the shortest possible water crossing to the inner islands.

Results of the spring study clearly indicated the value of similar observations in autumn. Although for migrants in spring the islands are the last land before open water, in fall, the islands are the first land after the water crossing. Size, locations, and species composition of migratory concentrations might be drastically different in fall than in spring. Also, autumn results would provide information on Lake Superior's impact on migration that is otherwise unobtainable by direct observation techniques. Only birds flying at low altitudes can be visually detected; birds flying higher might cross Superior much more frequently than their lower flying counterparts. An autumn study would allow me to compare species composition of spring and fall flights. Species particularly reluctant to migrate over Superior would exhibit greatly reduced numbers in fall as compared with spring.

Outer Island was chosen for the autumn study, in part because most spring data had been collected there. Also larger numbers of hawks and passerines were discovered in spring at Outer than at the other islands studied.

Methods

Observation methods were identical to those used in spring, allowing close comparison of data. Data were collected for periods lasting $\frac{1}{2}$ hour, with observation periods frequently taken in consecutive or near consecutive series. Numbers of migrant passerines and hawks, their flight directions, responses to water, and general behavior were recorded. Migrants were identified to family, genus, and even species to the extent possible. Many species, particularly warblers, had less distinctive plumages than in spring, making species identification difficult. For other species such as blackbirds and jays, identification remained equally easy.

Passerine counts for all analyses included woodpeckers and hummingbirds. Swallows were not included, because their feeding flights are very difficult to distinguish from migratory passages. Passerines in flight were categorized as flying north, flying south or southwest off Outer, or as initially flying south over the sand spit then turning back north away from the lake. Occasionally birds making local movements for feeding or to escape a predator were recorded, separately from the migrants. Local and migratory birds were sometimes difficult to distinguish and subjective determinations were made based upon height and location of flight, and whether or not the bird would alight. Certainly some birds were wrongly classified, but except in the case of the ubiquitous cedar

waxings, I do not believe errors were sufficiently large to affect conclusions from the data.

All hawks were recorded during watch periods, whether or not they appeared to be migrating. They were differentiated into four flight categories: flying north, flying south, turning away from the lake, and hunting. Flight behavior of hunting individuals was easily identified.

While 7- or 8-power binoculars were used to identify migrants, almost all birds were detected without aid of optical equipment. The one exception is clearly indicated in my presentation of results. Binoculars might have allowed discovery of migrants at greater distances from the observer, but the narrow field of view would have prevented adequate coverage of the entire vicinity of the observation site.

Data were collected by one, occasionally two, observers stationed where view of migrants would be unobstructed over a wide area near the shoreline. At the north end of Outer, data were collected from a rock point just north of Austad Bay and also from near the bluff edge by the lighthouse. At south Outer, we watched from the base of Sand Point, a short distance south of the last tall pine trees, and from well down the point near the south end of the dense growth of beach grass.

The study extended for 15 days from 28 August to 11 September, 1978. Regardless of weather I made frequent daily observations throughout this period. During the first seven days Michael John Jaeger also collected data. Another companion, Stephen Brick, assisted us during some of our watch periods.

Altogether we recorded migrant behavior for 138 ½-hour periods. These included 103 at the south end of Outer, 27 from the lighthouse, and 8 from Austad Bay. On September 1, 2, and 3, Harris watched from north Outer while Jaeger watched from Sand Point.

In addition to the standardized watch periods, we noted bird presence and movement throughout our stay on Outer. The bog was observed on several days, and beaver clearings within the interior forest were visited. On 6 days, the sand spit at south Outer was searched for shorebirds. On one of these days, the west sand beach as far north as the northwest end of the bog was also examined.

For every watch period on Outer Island we recorded wind direction and speed, temperature, cloud cover, visibility, and precipitation. The National Weather Service also supplied weather data that had been collected every hour at Duluth.

My 1978 data are complemented by notes I took on Michigan Island (6.1 miles south of the south tip of Outer) from September 24 to 28, 1976. I watched birds daily at Michigan's

west tip, where sand beach, forest, and bog offered migrants varied habitats. On the morning of September 28, I made one ½-hour long count of flight activity at the west end of the island (see Figure 1), where the water crossings to Madeline and Stockton Islands are shortest, being respectively 3.2 and 2.6 miles. This report includes these Michigan Island observations.

Results -- Passerine Migration

As in spring, large numbers of migrating passerines were observed at the south end of Outer Island. The composition of the flights and behavior of migrants are indicated in Table 1. Over 80 percent of the 17,194 birds tallied were night migrants, with only 15.2 percent being day migrants. The remainder were unidentified. These figures contrast with the composition of spring flights, for which at least 25.7 percent of the migrants were day-fliers. Numbers of corvids and blackbirds were especially reduced in fall. Although 2,339 blue jays were observed in spring 1977, only one flock of 21 was noted in 1978. Cowbirds in spring were the second commonest species (after blue jays) with 1,781 noted. In early fall, only one flock of 23 were seen. Starlings, third commonest spring migrant, did not appear at all in the fall flights. Red-winged blackbird counts dropped from 407 to 41 individuals, and common grackles from 208 to 2 individuals. Numbers of day-migrating birds remained significant in the early fall flights only because of the abundant cedar waxwing. Just 142 were noted in spring 1977, but 1,796 in autumn 1978 made them the most commonly identified migrant. However, this species often fed on the sand spit itself and some flocks may have been recorded while in their search for sand cherries rather than while migrating. Waxwing flocks ranged through the interior of Outer, feeding on berries of the mountain ash. Perhaps many of the waxwings seen were travelling from one island to another rather than completing a journey over Lake Superior.

The striking increase in percentage of total night-fliers is due in part to a greater effort in 1978 at identification of birds passing at a distance. Notice that we recorded an apparent, corresponding decrease in percentage of unknown passerines from 1977 to 1978.

Nearly 90 percent of all migrants noted were flying south off Outer. Volume of southward flight for night-flying and day-flying birds through the day is depicted in Figure 2. Numbers of birds sighted were averaged for all watches whose mid-points occurred during each half-hour period after sunrise. Where less than five watches were obtained for a half-hour period interval, watches from one or more subsequent time intervals were combined for analysis so that all data points on the figure represent averages of five or more watches.

Table 1. Behavior of Passerines in Flight, South Outer, Autumn 1978*

Species	# Flying South	% Flying South	# Flying North	% Flying North	# Turning at Shore	% Turning at Shore	Total	% of Grand Total	%, 1977 Grand Total
Passerine sp.	366	80.1	10	2.2	81	17.7	457	2.7	24.4
Woodpeckers	13	40.6	6	18.8	13	40.6	32	0.2	0.6
Night thrushes	369	73.7	5	1.0	127	25.3	501	2.9	0.1
Warblers	3782	92.3	59	1.4	255	6.2	4096	23.8	22.8
Night-flying sparrows and finches	400	82.6	11	2.3	73	15.1	484	2.8	7.3
Misc. night-fliers	8434	93.6	81	0.9	497	5.5	9012	52.4	19.1
Subtotal -- night-fliers	12998	92.0	162	1.1	965	6.8	14125	82.2	49.9
Corvids	22	31.9	22	31.9	25	36.2	69	0.4	9.0
Robins	17	30.4	0	0	39	69.6	56	0.3	1.2
Blackbirds	382	62.7	1	0.2	226	37.1	609	3.5	14.2
Day-flying finches	48	90.6	1	1.9	4	7.5	53	0.3	0.2

* compare with Table 9 in Harris (1977).

continued

Table 1 continued.

Species	# Flying South	% Flying South	# Flying North	% Flying North	# Turning at Shore	% Turning at Shore	Totals	% of Grand Total	%, 1977 Grand Total
Misc. day-fliers	1343	73.6	57	3.1	425	23.3	1825	10.6	1.1
Subtotal -- day-fliers	1812	69.4	81	3.1	719	27.5	2612	15.2	25.7
Total passerines	15176	88.3	253	1.5	1765	10.3	17194	100.0	100.0

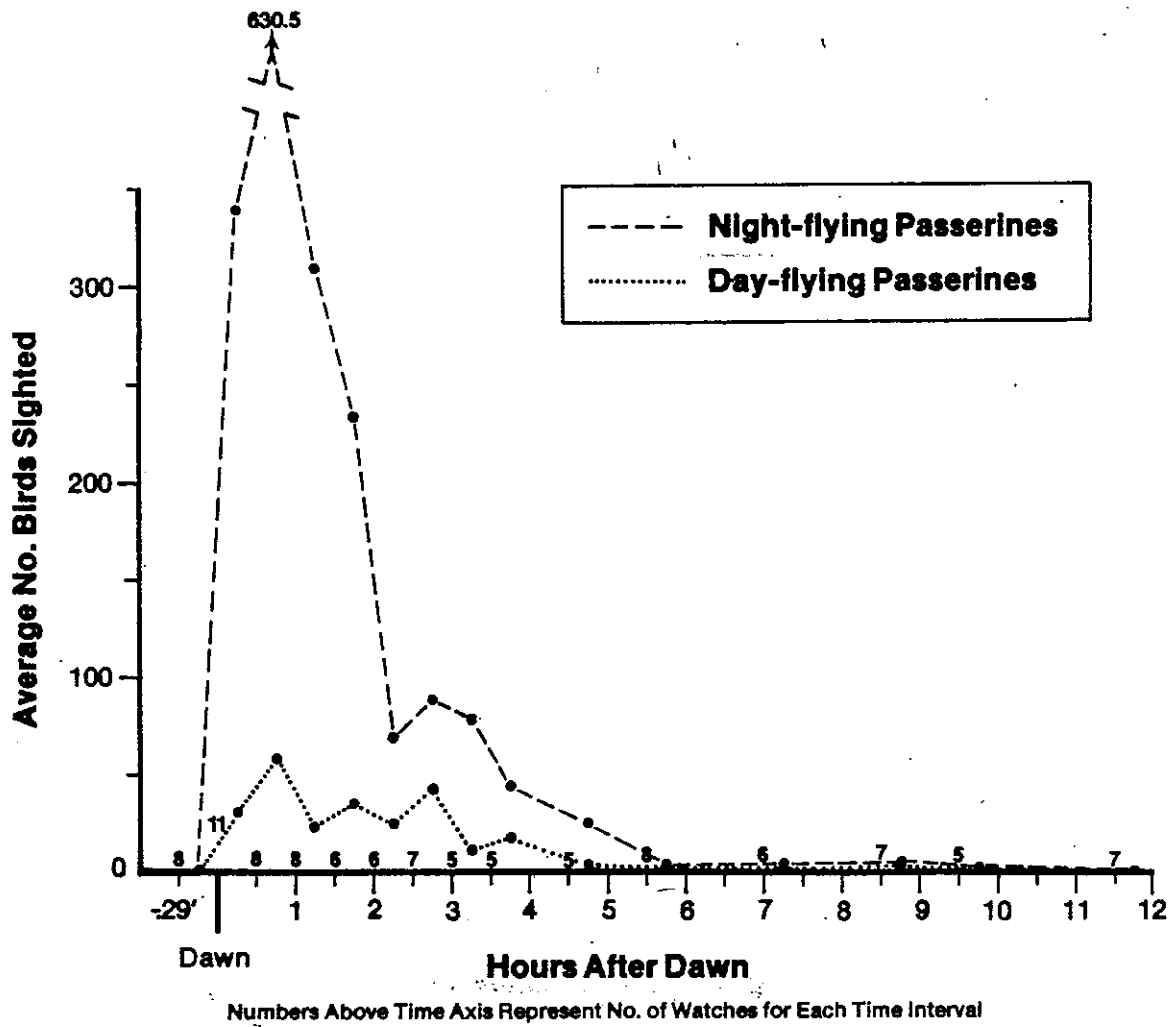


Figure 2. Volume of Southward Passerine Flight Through the Day at South Outer, 1978.

Very little activity was noted before sunrise. However, night-flying birds were abundant from sunrise until two hours after sunrise, and common until 3½ hours after sunrise. A marked peak occurred during the second ½-hour period. Day-flying birds peaked at exactly the same time; numbers did not show a marked decline until 3 hours after sunrise. Numbers of day-fliers did not approach numbers of night-fliers until 5½ hours after sunrise, when very little migratory activity was occurring.

Volume of flight for varying times of day closely resembles results for spring 1977. The chief difference in timing of flights occurs with the day-fliers, for which the peak was longer and later in spring (1 hour to 2½ hours after sunrise) and the significant decline in volume occurred later in the day (around 5 hours after sunrise).

The percentage of night migrants flying south off Outer was substantially larger than the percentage of day migrants--92 percent as compared with 69 percent. While 28 percent of the day migrants turned back at the lakeshore, only 7 percent of the night migrants turned (see Table 1).

Behavior of migrants over Outer's south end varied. Many birds flew high over the island without stopping. On some days many birds were traveling through the tree tops, frequently pausing on their way, and would accumulate at the southernmost pine trees before taking off over the sand spit. Sparrows, palm and yellow-rumped warblers, and a variety of woodland species would land in the beach grass or juniper on the sand spit, and at intervals flocks would leave the island. Some migrants might land far down the point before heading out across the water. The entire area south of the large bog, especially the forest and upper beach south of the railroad cut, were heavily used for feeding.

Wind speed and direction influenced the flight direction and departure point of migrants traveling south off Outer. This was seen most dramatically on the mornings of August 29 and 30. On August 29, winds were from 12 to 22 miles per hour out of the northwest. For one ½-hour watch I counted migrants from the south end of the beach grass far down Sand Point. All were heading straight down the point and took off southwest directly across the wind toward Stockton. Bill Fraundorf, who accompanied me, watched them with binoculars far out over the lake. None traveled south with the wind toward Michigan Island, preferring a more difficult flight over a shorter stretch of water.

The next day, August 30, winds blew up to 18 miles per hour out of the east northeast. From the west base of Sand Point I noted migrants leaving the forest end and traveling west southwest across the base of the point. Many of them left the island here with the wind toward Stockton's north

shore, rather than traveling to the end of the sand spit. Most of these birds were not visible from the east base of the point.

On both of these days, not all migrants were visible from any one location on Sand Point. The best location for seeing the maximum number of birds varied from day to day.

In Table 2 I compare passerine flights on Outer in spring 1977 and autumn 1978. In autumn, an average of 166.9 birds per watch were counted, down from 208.6 in spring. However, I held more afternoon watches in fall, when migration has practically stopped. I averaged the number of passerines per watch for the eight busiest half-hour intervals of the morning: 231.5 birds per watch were sighted in autumn and 232.0 in spring. It is likely that the autumn flights actually are heavier in general, for on 5 out of the 12 observation mornings at south Outer in 1978 I experienced heavy overcast and drizzle and saw practically no migration. Numbers of birds for the most active watch period on each of the three heaviest migration days totaled 1468, 2024, and 1838 birds. These totals were matched or exceeded on only five out of 34 observation mornings in the springs of 1976 and 1977.

My autumn observations do not cover a sufficient number of days to provide a basis for conclusions about the effects of weather on passerine flights. However, autumn weather effects have frequently been studied elsewhere, and results should be generally applicable to the Lake Superior region. Large passerine flights tend to occur with falling temperatures and winds out of the northwest to northeast (Lack, 1960; Richardson, 1972; and others), conditions that frequently occur after the passage of a cold front (Drury and Keith, 1962; Richardson, 1972; Able, 1973; and others).

In Table 2, I also present results of observations from the north end of Outer, at the lighthouse and at Austad Bay. Total numbers of birds per watch were 0.9 and 1.0 respectively. This visible flight was of negligible size and markedly smaller than the flight in spring 1977. In spring, an average of 23.0 birds per watch were seen at the lighthouse and 13.7 birds per watch at Austad Bay. Of the total of 32 migrants noted, all but 4 were night-travelers, again contrasting with spring when over 90 percent of birds seen at both locations were day-travelers. All autumn migrants were seen to fly directly south off the lake, but I cannot be certain that none of these 32 birds had previously wandered out over the water from the island without my noticing.

The birds I noticed at the lighthouse flew at moderately low altitudes. Eight individuals were seen in 5 watches on September 2. That same morning Jaeger at the south end of Outer counted 7,037 passerines in 9 watches. Thus the scarcity of visible migrants was not due to a pause in migratory activity during my 5-day visit to north Outer.

Table 2. Summary of Passerine Flight Observations, Outer Island, Spring 1977 and Autumn 1978*

	<u>1977</u> <u>South</u> <u>Outer</u>	<u>1977</u> <u>Light-</u> <u>house</u>	<u>1977</u> <u>Austad</u> <u>Bay</u>	<u>1978</u> <u>South</u> <u>Outer</u>	<u>1978</u> <u>Light-</u> <u>house</u>	<u>1978</u> <u>Austad</u> <u>Bay</u>
Number of watches	131	54	32	103	27	8
Average number of birds sighted	208.6	23.0	13.7	166.9	0.9	1.0
Average number flying south	183.0	-- ¹	-- ¹	147.3	0.9	1.0
Average number turning at shore	18.4	20.8	11.2	17.1	-- ²	-- ²
Per cent day-fliers	25.7	93.7	94.3	15.2	16.7	0
Per cent night-fliers	49.9	2.7	0.9	82.2	70.8	100.0
Per cent day-fliers turning	16.1	92.4	81.1	27.5	-- ²	-- ²
Per cent night-fliers turning	7.1	86.5	100.0	6.8	-- ²	-- ²
Total species sighted	55	23	10	32	3	-- ³

* 1997 data taken from Table 7 in Harris (1977)

- 1 not applicable to spring migration
- 2 not applicable to autumn migration
- 3 none of the migrants were identified.

Instead, most night migrants apparently flew at heights so great they could not be detected from the ground. On September 3 at Austad Bay, all 8 passerines I saw flying south off the lake were noted only with the aid of binoculars. In fact, even with binoculars I probably wouldn't have found them except for the behavior of a merlin. Four times during 3 early morning watches the lone bird flew out over the lake. Its random flight movements indicated it saw no prey upon leaving shore, but after an interval of steady wing-beating into the wind, the bird would stoop on small birds high over the lake. In one case the passerine was totally invisible, its presence betrayed only by the irregular flight of the hunter. These tiny birds, although they had just crossed Lake Superior after a night's travel, managed to dodge the merlin. I did not see a capture, although on one flight the falcon stooped about 15 times without success. The hunting behavior of this falcon almost exactly matched that of a kestrel at the same location in spring 1977.

The small number of migrants seen from north Outer can provide only limited information on time of day of passerine movement. All migrants observed arriving at Outer did so before three hours after sunrise. Of the 32 birds noted, all but three arrived by 1 and $\frac{1}{4}$ hours after sunrise.

In 1976, two of the four late September mornings I spent on Michigan Island had substantial passerine migration. Species present on September 25 and 28 were rather different than those common on Outer in early September 1978, with warblers scarce except for yellow-rumped, palm, and orange-crowned, and sparrows and juncos abundant (see Appendix 1, an annotated list of birds seen on Michigan Island). However, night migrants still formed the vast majority of migrants I saw leaving the island. On September 28 for the $\frac{1}{2}$ -hour period beginning 31 minutes after sunrise, I counted 1,456 passerines leaving Michigan westward for Madeline Island. This total includes about 200 robins, 50 to 75 rusty blackbirds, and 25 blue jays. That same morning I saw a much smaller flight northwest toward Presque Isle Point on Stockton Island. During my entire stay on Michigan Island I saw no blackbirds other than rusty blackbirds and no starlings.

Results -- Hawk Flights

A small number of hawks of 8 species were noted on Outer Island. Those counted during the 103 half-hour watches at the sand spit are listed in Table 3. Only 15 individuals were noticed leaving the island toward Stockton. Many of the 103 watch periods occurred early in the morning or on drizzly, misty days when hawk migration would not likely be occurring. Nevertheless, hawk movement was very light and contrasted greatly with the abundance of these birds in spring.

Table 3. Birds of Prey Observed During 103 Half-hour Watches at the South End of Outer Island, Autumn 1978.

<u>Species</u>	<u>Flying South*</u>	<u>Flying North*</u>	<u>Turning at Shore*</u>	<u>Hunting**</u>
Sharp-shinned	4	2	1	23
Red-tailed	0	0	6	3
Broad-winged	3	0	3	0
Bald eagle	1	0	0	0
Marsh harrier	1	0	0	5
Osprey	0	0	0	2
Merlin	0	0	0	38
Kestrel	5	0	1	4
Small falcon sp.	1	0	0	10
Hawk sp.	0	0	0	1
All species	15	2	11	86

* figures represent numbers of different individuals observed

** hunting figures represent numbers of sightings of hunting hawks, not numbers of individual hunters; see text for explanation.

Although only a small number of hawks were migrating, south Outer attracted many hunting individuals. For the totals of hunting birds in Table 3, I differentiated individuals only within particular watches, not between different watches. For example, a harrier that passed three times in a single watch would have been tallied just once, but if it passed in three separate watches it would have been tallied three times. The total number of hunters then does not represent the number of individual hawks that used the sand spit for feeding, but rather the frequency of usage for hunting.

Merlins were most frequently observed, but I do not know how many individuals were present. Most of the sightings were of three birds, probably immature, present September 6 through 11, often in flight together.

The 86 sightings of hunting hawks occurred during 52 of the 103 watches on the sand spit. Frequently more than one hunter was noted within a half-hour; four times 4 were noted, and once 5 were seen. Except for a merlin's perhaps playful dive at a butterfly, hunters at all times pursued passerines that were either feeding on the sand spit or in migratory flight. The inexperience of the 3 merlins at hunting was evident; they missed their prey an astonishing number of times. For them the abundance of passerines on the sand spit with its low vegetation provided an important opportunity for hunting practice and survival.

I noted several accipiters and falcons at the north end of Outer, but only in one case might the bird actually have been migrating. One small falcon flew south off the open lake and straight into the interior of Outer.

On Michigan Island in 1976, I found 7 species of hawks, including 2 peregrine falcons, 3 or 4 merlins, and a goshawk. The peregrines and merlins were hunting over the sand spit at the west end of the island, the area of greatest passerine concentration.

Discussion -- Passerine and Hawk Flights

Spring and fall passerine flights at south Outer are strikingly similar. Night-migrating passerines in large numbers reach Outer Island from the north in the early morning. These birds presumably found themselves part way across Superior at dawn and continued their flight. As in spring, a great many do not stop at the first land they reach but disperse off Outer toward the inner islands. Very likely in the early morning in fall, northward reverse migrations off Lake Superior can be seen along the lake's north shore. Night-flying migrants also reach Michigan Island in the early morning and, as on Outer, disperse off Michigan south and west.

Less definite conclusions can be drawn about movements of

day-flying passerines. As I had predicted from my spring studies, day-fliers are substantially less common on Outer in fall than in spring, suggesting that these birds tend not to cross Superior in the Apostle Island region, but journey east or west along the lakeshore seeking to cross elsewhere and perhaps entirely avoid a lake crossing. Seventy percent of the day-fliers I did see were cedar waxwings, possibly involved in local rather than migratory movements.

However, the peak migratory period in fall, for many of those day-flying species I found to be most common in spring, occurs in late September and October (Green and Janssen, 1975). These species include American robin, starling, red-winged blackbird, and common grackle. Cowbirds show a poorly defined migration, with some movement noted throughout the fall. Blue jays migrate from late August through the middle of October, with most birds traveling in September. It is possible that day-fliers cross Superior primarily after the early September period of our study.

Molly Kohlbry, who is employed to count hawks daily through the fall at the Hawk Ridge Nature Reserve in Duluth, also records presence of migrating passerines. During late August and early September 1978, no blackbirds or robins were noted passing the Duluth ridge (Molly Kohlbry, *in litt.*). But "many" cedar waxwings were noted on three days and "many" blue jays on 10 days. The migration of blue jays clearly was well under way -- further suggesting that this species does avoid the lake crossing.

My observations from Michigan Island in late September revealed a movement of robins but no red-winged blackbirds, starlings, cowbirds, or grackles. The implication is that while robins readily cross Superior, the majority of flocks of other species go around the lake throughout the fall migration. But more late fall observations are needed before any definite conclusions can be made.

Fall hawk migration at Duluth runs from mid August into November, with the largest counts in the second half of September (Hofslund, 1966; Green and Janssen, 1975). The significance of the small numbers of hawks we noted on Outer Island can only be determined by comparison with Duluth counts for the same period. Molly Kohlbry supplied me with the unofficial count from the Hawk Ridge Nature Reserve for the second half of August and the first half of September. These counts are not directly comparable to my totals because they are derived from continuous observation throughout most of each day, rather than from the sample ½-hour periods from which I derive my data.

During the 15 days of our study, a total of 4,883 hawks were tallied at Duluth, including high counts of 817 on 2 September and 1,364 on 6 September. Sharp-shinned hawks were by far the most abundant, with 1,186 counted on

6 September and over 100 on 7 other days. During this period over 200 each of red-tailed hawks, broad-winged hawks, and American kestrels were seen. Also observed were 129 marsh harriers, 84 ospreys, and small numbers of 6 other species.

Hawk migration then was well under way at Duluth but scarcely noticeable at Outer Island. As spring observations indicated, hawks generally avoid a lake crossing in the Apostle Islands region.

Only the rare merlins appeared with a roughly equivalent frequency at Duluth (8 tallied) and Outer Island. This species may be quite willing to cross Superior. Possibly the larger peregrine falcon, a very rare species migrating later in September, behaves similarly. The numbers of accipiters, kestrels, and ospreys on Outer and Michigan Islands indicate that small numbers of these species may cross Superior. I have no evidence suggesting that buteos or harriers cross.

Other Migrants

Small numbers of water birds of a variety of species were present on Outer Island (see Appendix 2). Herring and ring-billed gulls were most common, with up to 200 individuals roosting at the very tip of the sand spit. Fifteen species of shorebirds were identified. As in spring, the sand spit was by far the most important shorebird habitat. Elsewhere, only the spotted sandpiper was regularly seen. On the flat rock ledges at Austad Bay, I identified a single semipalmated plover and a single ruddy turnstone.

Shorebird counts for 6 days are presented in Table 4. My autumn counts are rather similar to my spring counts (see Table 14 in Harris, 1977). I found a good variety of species and relatively few individuals. The somewhat larger spring totals are due principally to the commonness of turnstones and dunlins, nearly unrecorded in fall, and the resident killdeers. The sand spit does attract certain uncommon species: the Baird's and buff-breasted sandpipers.

Areas of Special Value on Outer Island

I. In autumn, the south end is the area with greatest value for birds on Outer Island and probably throughout the Apostles. Habitats are highly varied and of types scarce elsewhere. Bird usage for feeding and resting is heavy, due to funneling of migrants at the south tip. Both forest and beach south of the railroad cut constantly support numerous flocks of passerines and are frequently hunted over by hawks. The areas north of the railroad cut are only slightly less important.

Table 4. Shorebird Counts at Outer Island's South End, Autumn 1978*

<u>Species</u>	<u>Aug 28</u>	<u>Aug 29</u>	<u>Aug 30</u>	<u>Aug 31</u>	<u>Sept 2</u>	<u>Sept 9</u>
Semipalmated plover	3	4	4	3	3	0
Golden plover	0	0	0	0	1	0
Yellowlegs sp.	0	1	0	0	0	0
Solitary sandpiper	1	1	0	1	0	0
Dowitcher sp.	0	0	0	1	0	0
Sanderling	3	3	5	3	4	5
Semipalmated sandpiper	0	0	0	0	0	1
Least sandpiper	2	1	2	0	0	1
Baird's sandpiper	2	0	0	0	0	0
Peep sp.	8	1	0	0	0	0
Dunlin	0	1	0	0	0	0
Buff-breasted sandpiper	1	0	0	0	0	0
Total species*	7	7	4	5	4	4
Total individuals*	20	12	11	8	8	7

* spotted sandpipers were present on all counts and the species is included in the daily species totals but not in the individual totals; killdeer, present on all the spring counts, was only seen on the sand spit in autumn on September 11.

The sand beaches are essential to the presence of shorebirds on Outer. My experience with shorebirds elsewhere in the Apostle Islands is limited, but I have visited all shores of all islands during my gull and tern survey in 1974 (Harris and Matteson, 1975). Outer Island has the most extensive habitat of any of the islands in the National Lakeshore and Outer probably receives heaviest use by shorebirds. Stockton Island's sand areas adjacent to Presque Isle bog are also favored, but my spring 1977 observations there yielded fewer birds than on Outer.

The bog on Outer Island receives special bird use because of its sheltered aquatic habitat. Only a few ducks were noted here, but their fall migration had hardly begun.

As in spring, the south end of Outer has great value for scientific study, education, and recreational bird watching.

II. We spent little time in the beaver clearings. We did observe American bitterns, hawks, and non-forest passerines in these open areas. From the numbers of passerines present on the sand spit, it is clear that the beaver openings must function similarly in fall as in spring, providing feeding areas for a great many birds that do not normally utilize uninterrupted forest. These open areas must also be especially attractive to hawks, although volume of usage is substantially less than in spring.

III. The areas at the north end of Outer do not have the observational values in fall that they have in spring. Because of the fall migration patterns, habitats at north Outer are not unusually significant for feeding birds.

Management Recommendations

I. Of all the migrants, shorebirds are perhaps most vulnerable to disturbance because they will feed only in the narrow strip of beach immediately adjoining the lake. This same area also has special attractions for humans. While some of the commoner and smaller species like spotted sandpipers and sanderlings can adjust to frequent intrusions by beach combers, picnickers, etc., the more unusual and striking species would abandon Outer with increased human disturbance. For none of these species is Outer Island critical habitat; the loss would be to the biological diversity of the National Lakeshore. Some birds might simply move to other islands, but more frequently these strong-winged birds would move out of the entire area.

Passerines are more tolerant of human presence, but Sand Point does provide many species with their only ideal feeding area on the island. I doubt obtrusive human use would directly cause the birds to move elsewhere. But vegetation changes resulting from walking and camping could

have serious impact. These birds depend on the beach vegetation for cover and for feeding. Similarly the low vegetation in the many forest openings is heavily used by both seed-eating and insect-eating birds. At present many south bound migrants assemble in the beach vegetation of the point before leaving the island. Extensive vegetation changes would by some quite small factor increase mortality of migrants under normal conditions. On rare occasions when severe weather held many migrants on the island, danger of extensive mortality would be heightened, although no populations of entire species could be significantly affected. With damaged vegetation, a greater proportion of migrants would leave Outer for northeast Stockton Island and dispersal beyond, reducing observable concentrations of birds on the ground on Outer.

Human disturbance, loss of cover, and particularly dwindling numbers of the prey species would degrade the area for hawk use.

Management practices for south Outer as a habitat for the migrants should therefore be aimed at minimizing the impact of visitors on vegetation and at avoiding such increases in the volume of human visitation that vegetation damage would be widespread. Visitors, knowledgeable about the special values of south Outer and of the fragility of the sand spit's plant communities, would be less likely to cause damage. One way of informing visitors would be to require a visitation permit, obtainable on the mainland or on another island with a ranger. When the permit was provided, information could be given, perhaps both orally and in a pamphlet about south Outer.

The bog itself is large and inaccessible enough that human use should have little impact, except on dunes between the bog and Lake Superior. Here trampling feet might easily wear down the low dunes; toward the south end of these dunes, where people step up from the lake to view the bog, damage is already evident. Some protective measure may be needed here. In the springs of 1976 and 1977, I did see sandhill cranes in the bog. People would be unlikely to disturb them unless a walking trail became established for a long distance along the east and/or south side of the bog.

Aside from the area's value for birds, south Outer provides a unique experience for bird watchers and other nature enthusiasts. Practically nowhere else can one observe such an abundance of birds in a highly primitive situation. This special value to Outer Island as a recreational resource would be injured by any new artificial structures such as outhouses, boardwalks, cabins, or piers. The fishermen's shack and the boat wreck are remarkably unobtrusive because of their age and weathered appearance. The advantages of any new structures should be carefully weighed against the resultant disruptions of this beautifully wild setting.

I believe the visible migration of birds on south Outer

is extraordinary enough for the location to merit designation as a State of Wisconsin Scientific Area. Such a designation would not risk overpublicizing the area to recreationists but would alert ornithologists and other researchers to the presence of this valuable scientific resource. The entire south end of the island should be considered for such status, including the bog complex.

Similarly, I think this same area definitely deserves careful evaluation for designation as a Research Natural Area. No similar areas have been designated from the midwest (Federal Committee on Ecological Reserves, 1977). One factor to be considered is the set of guidelines that have been established for recreational use of Research Natural Areas. The present popularity of Outer among visitors might impair the location's suitability for Research Natural Area status. If so, measures would need to be taken to alter present use patterns.

II. The beaver clearings are heavily used by migrants and increase the diversity of the island's avifauna. But the special habitat the beaver provide is not critical for any species, nor is it nearly as important for migrants as the island's south end. Therefore, future declines in the beaver population need not cause concern over bird populations. In particular the hawks, some species of which have become rare, are mobile and able to live for short periods with little or no food.

Management practices -- which are relatively nondisruptive of the island ecology -- to increase the longevity of the colonies would have benefits for migrant birds but are not essential. Bird usage of the clearings does not provide justification for artificial and drastic manipulations of the forest to support numerous beaver on the island indefinitely.

Fall Migration Elsewhere in the Apostle Islands

All of the other northernmost Apostle Islands, from Eagle to North Twin and Cat Islands, probably attract interesting varieties and numbers of passerine migrants in fall. Observations will be much better at the south ends of these islands than at the north. The sizable passerine flight from Michigan Island to Madeline, present in fall but not in spring, suggest that flightpaths among the inner Apostles may be more pronounced in fall than in spring. The southwest end of Madeline Island and Long Island are the likeliest concentration points. The number of migrants reaching the Apostles from the north indicate that bird watching throughout the area from late August into October would be rewarding even where not spectacular. Unusual opportunities to see feeding hawks probably exist along all beaches and in other open areas.

Future Study

I have previously indicated general needs for future studies on land bird migration in the Lake Superior region (Harris, 1977). Now I will merely suggest possibilities for future autumn studies within the Apostle Islands.

The first need is for more data from Outer Island, particularly in mid and late September and in October. A more extensive data base would allow closer analysis of migratory events. Observations later in the season would allow definite conclusions about the presence or absence of the hardier species such as robins, blackbirds, winter finches, goshawk, peregrine falcon, and larger butes.

A second need would be data from other locations in the Apostle Islands. Because of the spring data already obtained, Devil's, Stockton, and Michigan Islands would be excellent study sites. These observations would be most valuable if compared with concurrent data collections from Outer Island.

Because shorebirds are an interesting and varied group and for the most part restricted to the sand spits (attractive for human use also), it would be advantageous to document present status of shorebirds among the islands. If human use of sand spits increases, some special management may become necessary to retain the present diversity of shorebirds within the National Lakeshore.

Summary

Fall migration on Outer Island was observed from 28 August to 11 September. Primary data collections consisted of ½-hour watch periods made at the north and south ends of Outer. We recorded number, species, flight direction, and behavior of migrants, along with weather data. In total, we completed 138 watches, including 103 on Sand Point, 27 at the lighthouse, and 8 at Austad Bay. In addition, we examined bird use of the sand spit and adjacent bog at the south end of the island and generally noted bird activity throughout our stay on Outer.

We noted large passerine flights south off the south end of Outer toward Stockton Island. These flights resembled spring flights at the same location, with similarly (and spectacularly) large numbers of birds. The average passerine count per watch was 167 birds. On three out of our 12 observation mornings at the sand spit, we recorded maximums of 1,408, 1,969, and 1,665 individuals flying south during single observation periods. As in spring the great majority of birds seen flew south off Outer, with a minority turning back at the sight of the water crossing. And similar to spring, flights were heavily concentrated during the first two hours after sunrise.

Fall passerine flights differed in species composition with day-migrating species exhibiting greatly reduced numbers. Species very common in spring -- blue jay, cowbird, starling, red-winged blackbird, common grackle, and American robin -- were practically absent. Apparently in fall as in spring most individuals of day-migrating species do not cross Lake Superior in the Apostle Islands region. But peak numbers of blackbirds and robins migrate in late September and October. These species may prove to be more numerous later in the migration. In early fall the large flights primarily consist of warblers, sparrows, thrushes, and other birds that unhesitatingly migrate over Lake Superior by night.

Hawks, also day-migrants, were not abundant on Outer Island as in spring. Impressive numbers should have appeared by 11 September if the Apostle Islands lay on one of their significant autumn flightpaths. Small numbers of sharp-shinned hawks, merlins, kestrels, and ospreys did appear at south Outer, but broad-winged hawks -- the most abundant and one of the earliest migrants at Duluth -- were practically absent. As my spring observations indicated, broad-winged hawks did not appear to cross Lake Superior in the Apostles area.

Day-migrating passerines and hawks were not visible at Outer's north end. In the early morning night-flying passerines -- usually at such heights they were nearly impossible to see -- arrived on Outer from across the lake but did not pause at the lakeshore, instead continuing south and inland.

Outer Island thus provides an exciting opportunity for passerine observation at its south end in autumn. While hawks were few in number, at almost any time during our two-week visit several could be seen hunting over the sand beaches. At the sand spit we also recorded 14 species of shorebirds. Fall migration at south Outer should definitely prove attractive to numbers of National Lakeshore visitors.

Migratory birds are much less vulnerable to human disturbance than nesting birds. Nevertheless, the south end of Outer Island is the most important habitat in the entire National Lakeshore for hawks and passerines and probably for shorebirds. Increasingly heavy human use of the sand spit could have several detrimental impacts. Shorebirds will not remain on beaches busy with people and might be lost to the area. Passerines are more tolerant but the beach vegetation and open areas provide many species with their only feeding area. Loss of vegetation on the sand because of trampling would seriously injure the habitat. Human disturbance, loss of cover, and dwindling numbers of the prey species would degrade the area for hawk use.

Management practices for south Outer as a habitat for the migrants should therefore be aimed at minimizing the impact of visitors on vegetation and at avoiding such increases

in the volume of human visitation that vegetation damage
would be widespread.

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Appendix 1. Annotated List of Birds Observed on Michigan Island,
September 24 to 28, 1976.

- common loon Gavia immer -- seen daily.
- horned grebe Podiceps auritus -- daily, maximum of 4 on 9/27.
- Canada goose Branta canadensis -- a flock of 33 on 9/24; 13 on 9/25.
- snow goose Chen caerulescens -- flock heard on night of 9/24.
- mallard Anas platyrhynchos -- 11 on 9/25, at the bog; 2 on 9/27 at the northeast stream.
- black duck Anas rubripes -- 2 at bog on 9/25; 3 on northeast stream on 9/27.
- green-winged teal Anas crecca -- 1 on bog on 9/25; 2 teal (species unknown) flew from Michigan toward Madeline on 9/25.
- blue-winged teal Anas discors -- 1 at bog, 9/25-27.
- red-breasted merganser Mergus serrator -- daily, maximum of 7.
- goshawk Accipiter gentilis -- 1 immature on 9/25 and seen twice on 9/28, at west end.
- sharp-shinned hawk Accipiter striatus -- 1 at west end on 9/25.
- red-tailed hawk Buteo jamaicensis -- 1 at bog and 1 flying toward west end on 9/25.
- broad-winged hawk Buteo platypterus -- 1 at west tip on 9/25.
- marsh harrier Circus cyaneus -- 1 at Stockton on 9/24.
- peregrine falcon Falco peregrinus -- 1 adult at west end, eating small bird on 9/25; 1 adult at west tip on 9/28.
- merlin Falco columbarius -- 1 at bog on 9/25; at least 2 on south shore on 9/26, one of them catching a junco on the beach; 1 at west end on 9/26.
- American kestrel Falco sparverius -- 1 on south shore on 9/26.
- sora Porzana carolina -- 1 among juniper at west end on 9/25.
- common snipe Capella gallinago -- 1 at bog on 9/25; 1 on south shore on 9/27.

herring gull Larus argentatus -- daily; 20-30 on west tip; a flock on Gull Island on 9/27.

ring-billed gull Larus delawarensis -- 1 immature at west end on 9/26; 1 or more at west end on 9/28.

mourning dove Zenaida macroura -- 1 at west end on 9/25.

belted kingfisher Megaceryle alcyon -- almost daily.

common flicker Colaptes auratus -- daily.

yellow-bellied sapsucker Sphyrapicus varius -- daily.

hairy woodpecker Dendrocopos villosus -- 2 at west end on 9/25.

downy woodpecker Dendrocopos pubescens -- daily, maximum of 6 on 9/25.

eastern wood peewee Contopus virens -- 1 at lighthouse meadow on 9/26.

horned lark Eremophila alpestris -- 6 on west end on 9/25.

blue jay Cyanocitta cristata -- daily.

common raven Corvus corax -- almost daily.

common crow Corvus Brachyrhynchos -- daily.

black-capped chickadee Parus atricapillus -- daily.

red-breasted nuthatch Sitta canadensis -- daily.

brown creeper Certhia familiaris -- almost daily, maximum of 3 on 9/25.

winter wren Troglodytes troglodytes -- 1 on 9/26, 1 on 9/27.

short-billed marsh wren Cistothorus platensis -- 1 at lighthouse meadow on 9/25.

robin Turdus migratorius -- daily, maximum about 200 at west end on 9/28.

hermit thrush Catharus guttata -- daily.

Swainson's thrush Catharus ustulata -- almost daily.

gray-cheeked thrush Catharus minima -- at west end, 2 on 9/25 and 1 on 9/27.

veery Catharus fuscescens -- 3 on 9/25.

eastern bluebird Sialia sialis -- 1 at west end on 9/25.

- golden-crowned kinglet Regulus satrapa -- daily, maximum of 17 on 9/25.
- ruby-crowned kinglet Regulus calendula -- daily, maximum of 30 on 9/25.
- orange-crowned warbler Vermivora celata -- almost daily, maximum of 3 at west end on 9/26.
- yellow-rumped warbler Dendroica coronata -- daily.
- palm warbler Dendroica palmarum -- daily, maximum of 18 on 9/25.
- northern waterthrush Seiurus noveboracensis -- 1 on 9/26, 2 on 9/27, at northeast end.
- yellowthroat Geothlypis trichas -- 1 on 9/27 at northeast stream.
- rusty blackbird Euphagus carolinus -- daily.
- purple finch Carpodacus purpureus -- daily.
- pine siskin Spinus pinus -- daily.
- American goldfinch Spinus tristis -- 1 on 9/25.
- dark-eyed junco Junco hyemalis -- daily, most common bird along the shoreline.
- tree sparrow Spizella arborea -- at west end and along shore, 3 on 9/26 and 1 on 9/28.
- Harris' sparrow Zonotrichia querula -- daily, maximum of 5 on 9/25 and of 7 on 9/26.
- white-crowned sparrow Zonotrichia leucophrys -- daily, maximum of over 100 on 9/25, at west end.
- white-throated sparrow Zonotrichia albicollis -- daily, not so common at white-crowned sparrows.
- fox sparrow Passerella iliaca -- 4 on 9/26.
- Lincoln's sparrow Melospiza lincolni -- 3 on 9/26 at west end.
- song sparrow Melospiza melodia -- almost daily.
- Lapland longspur Calcarius lapponicus -- 2 at west end on 9/25, seen from distance of 10 feet; 1 at west end on 9/28 (this bird was one of the two present on 9/25).

Appendix 2. List of Bird Species Observed on Outer Island,
August 28 to September 11, 1978.

common loon Gavia immer
double-crested cormorant Phalacrocorax auritus
great blue heron Ardea herodias
American bittern Botaurus lentiginosus
mallard Anas platyrhynchos
black duck Anas rubripes
blue-winged teal Anas discors
American widgeon Anas americana
common merganser Mergus merganser
sharp-shinned hawk Accipiter striatus
red-tailed hawk Buteo jamaicensis
broad-winged hawk Buteo platypterus
bald eagle Haliaeetus leucocephalus
marsh harrier Circus cyaneus
osprey Pandion haliaetus
merlin Falco columbarius
American kestrel Falco sparverius
semipalmated plover Charadrius semipalmatus
killdeer Charadrius vociferus
golden plover Pluvialis dominica
lesser yellowlegs Tringa flavipes
spotted sandpiper Actitis macularia
ruddy turnstone Arenaria interpres
woodcock Philohela minor

dowitcher sp. Limnodromus
sanderling Calidris alba
semipalmated sandpiper Calidris pusillus
least sandpiper Calidris minutilla
Baird's sandpiper Calidris bairdii
dunlin Calidris alpina
buff-breasted sandpiper Tryngites subruficollis
herring gull Larus argentatus
ring-billed gull Larus delawarensis
barred owl Strix varia
common nighthawk Chordeiles minor
chimney swift Chaetura pelagica
ruby-throated hummingbird Archilochus colubris
belted kingfisher Megaceryle alcyon
common flicker Colaptes auratus
red-headed woodpecker Melanerpes erythrocephalus
hairy woodpecker Dendrocopos villosus
downy woodpecker Dendrocopos pubescens
eastern kingbird Tyrannus tyrannus
western kingbird Tyrannus verticalis
crested flycatcher Myiarchus crinitus
eastern phoebe Sayornis phoebe
Empidonax sp.
eastern wood peewee Contopus virens
olive-sided flycatcher Nuttallornis borealis
horned lark Eremophila alpestris

tree swallow Iridoprocne bicolor
bank swallow Riparia riparia
rough-winged swallow Stelgidopteryx ruficollis
barn swallow Hirundo rustica
cliff swallow Petrochelidon pyrrhonota
blue jay Cyanocitta cristata
northern raven Corvus corax
common crow Corvus brachyrhynchos
black-capped chickadee Parus atricapillus
red-breasted nuthatch Sitta canadensis
brown creeper Certhia familiaris
winter wren Troglodytes troglodytes
American robin Turdus migratorius
wood thrush Hylocichla mustelina
hermit thrush Catharus guttata
Swainson's thrush Catharus ustulata
veery Catharus fuscescens
ruby-crowned kinglet Regulus calendula
cedar waxwing Bombycilla cedrorum
red-eyed vireo Vireo olivaceus
black and white warbler Mniotilta varia
Tennessee warbler Vermivora peregrina
yellow warbler Dendroica petechia
magnolia warbler Dendroica magnolia
Cape May warbler Dendroica tigrina
yellow-rumped warbler Dendroica coronata

black-throated green warbler Dendroica virens
blackpoll warbler Dendroica striata
palm warbler Dendroica palmarum
ovenbird Seiurus aurocapillus
northern waterthrush Seiurus noveboracensis
yellowthroat Geothlypis trichas
Wilson's warbler Wilsonia pusilla
American redstart Setophaga ruticilla
bobolink Dolichonyx oryzivorus
red-winged blackbird Agelaius phoeniceus
northern oriole Icterus galbula
common grackle Quiscalus quiscula
brown-headed cowbird Molothrus ater
scarlet tanager Piranga olivacea
rose-breasted grosbeak Pheucticus ludovicianus
evening grosbeak Hesperiphona vespertina
purple finch Carpodacus purpureus
pine siskin Spinus pinus
American goldfinch Spinus tristis
savannah sparrow Passerculus sandwichensis
dark-eyed junco Junco hyemalis
chipping sparrow Spizella passerina
white-throated sparrow Zonotrichia albicollis
Lincoln's sparrow Melospiza lincolnii
swamp sparrow Melospiza georgiana
song sparrow Melospiza melodia