

THE SEASONAL OCCURRENCE OF SHOREBIRDS ON BAY FARM ISLAND, ALAMEDA COUNTY, CALIFORNIA

By ROBERT W. STORER

The mud flats on the north and west parts of Bay Farm Island, Alameda County, California, are known as one of the major shorebird concentration areas in the San Francisco Bay region; and, although the island has been visited frequently by ornithologists, to date no one has published an account of the seasonal variation in abundance of the shorebirds there. For this reason the shorebirds on these parts of Bay Farm Island were censused for a year beginning July 1, 1948.

In order to learn something about the habitat preferences of the species of shorebirds involved, the area suitable to shorebirds was divided into ten parts and the numbers of birds found on each sub-area (fig. 1) were recorded on mimeographed census sheets. Some of these sub-areas were found to attract few or no shorebirds and consequently were seldom visited.

The most important feeding area (B) was a large mud flat surrounded by dikes on the north and west, by Maitland Drive on the east, and by Island Road (also known as Mecartney Road) on the south. Until 1940 this area was farm land, but at the time of the census all except the south edge, which supported a salt marsh flora with *Salicornia* predominating, lay between the zero and five-foot tide levels. At the south side of B there was an artificial sand bar (F) with a small pond on its south side. The bar remained uncovered during all but the highest high tides and was sometimes used as a loafing area by gulls, terns, and shorebirds.

The second most important feeding area for shorebirds on the island included the mud flats (A) of San Leandro Bay, from the Bay Farm Island Bridge east to a point north of the pond (J), a distance of approximately one mile. This area was bordered on the south by a band of salt marsh of which *Spartina* and *Salicornia* were the dominant plants. There was a chain of islands covered with similar vegetation on the north-eastern part of this area. These marshy areas were used as loafing grounds by some of the larger species of shorebirds. The mud flats of the southeast side of the Island of Alameda lay across a narrow channel from A, and there was some interchange of feeding shorebirds between these two areas.

At the northeast corner of the junction of the bridge with Bay Farm Island, there was a small sandy area (C). The sand was mixed with stones, and during part of the year a growth of green algae covered much of the area, thereby changing its character considerably. Across the road from C was a dike (L) which was largely gravel overlying mud. Beyond the inlet at the west end of L a similar section of dike had been cut off from the rest of the dike and served as a roosting and loafing area for many birds, particularly gulls and terns.

The water level in the sandy-clay bordered pond (J) varied little, and this pond proved to be a favored place for Greater Yellow-legs, Northern Phalaropes, and Killdeer, which tended to remain there throughout the day regardless of the conditions on the mud flats. The pond was also regularly visited by flocks of Dowitchers and Avocets on their way to or from their feeding grounds. The pond (K) at the edge of the Alameda Dump was filled with and bordered by tin cans and bottles. An occasional Killdeer, Yellow-legs, or Snipe was seen there. Three small, cattail-bordered ponds (G, H, and I) on the golf course were apparently not suited for use by shorebirds.

The south and west shores of Bay Farm Island were bordered by intertidal areas of fine sand mixed with mud. These were occasionally visited at D and E, but there were never many shorebirds feeding there.

Censuses regularly covered the areas A, B, C, F, J, and L, although the last could not always be counted because of the presence of fishermen. A total of 39 counts was made between July 1, 1948, and June 30, 1949. These counts were distributed by months as follows: July, 5; August, 5; September, 5; October, 2; November, 3; December, none; January, 3; February, 2; March, 2; April, 2; May, 5; and June, 5. Of these counts, 30 were made by the writer, 7 (including all the June counts) were made by Mrs. Junea W. Kelly, and one each by Howard L. Cogswell and Galen Smith. Numerous

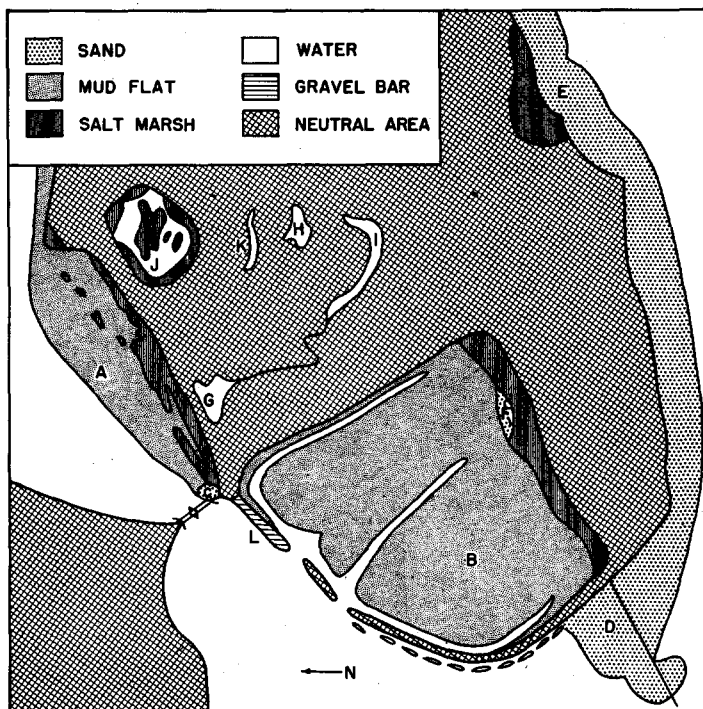


Fig. 1. Map of western end of Bay Farm Island, Alameda County, California, showing areas covered in census of shorebirds. Part of the island of Alameda shows in lower left corner.

others accompanied the writer on one or more occasions and assisted in making the counts. These included S. T. Bailey, Mrs. H. C. Austin, H. Bern, K. L. Dixon, W. Fox, G. Gullion, R. McCormick, A. H. Miller, F. A. Pitelka, T. A. Riney, and L. O. Williams. I am particularly indebted to Mrs. Kelly for much additional assistance—numerous partial censuses, field notes from other years, and helpful criticism based on her extensive knowledge of the area and its shorebirds.

On Bay Farm Island, most of the shorebirds fed during ebb tide. As the upper fringe of the mud flats became exposed, the birds arrived and began feeding. As the water receded, the birds followed, maintaining their general relation to the water's edge. Western Sandpipers, Willets, and Black-bellied Plovers tended to feed on the exposed mud; Red-backed Sandpipers and Dowitchers, in the shallow water; and Marbled Godwits and Avocets, in the deeper water. As the tide reached its lowest ebb and the birds had obtained sufficient food, there was often a period during which the birds flew about in

groups over the mud flats, alighting here and there for short periods before moving off to the loafing grounds to await the next ebb tide.

Most of the larger shorebirds, including Avocets, Marbled Godwits, Willets, and Dowitchers, spent the periods between ebb tides in the marshes to the east of Bay Farm Island, although some individuals used the marshy islands northeast of A for loafing. The Western Sandpipers seemed to prefer more open loafing grounds and were most often to be found on the sand bar at F during the flood tides. During the highest high tides, this bar was covered. At these times, as well as at other times when no cause could be ascertained, the Western Sandpipers roosted on the caked mud northwest of the pond (J) or, more frequently, at undetermined places off the island. (Shortly after the census period, Mrs. Kelly found thousands of sandpipers loafing on the dikes and flat surfaces of the old ships on the west end of B.)

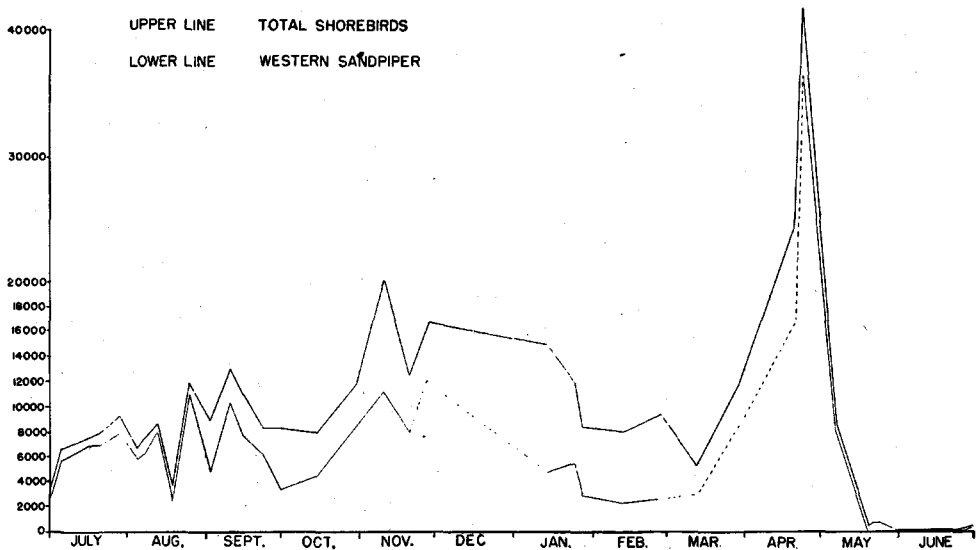


Fig. 2. Seasonal fluctuations in the abundance of the Western Sandpiper and of all shorebirds on Bay Farm Island, July 1, 1948, to June 30, 1949. The dashed lines indicate the numbers of Western Sandpipers based on estimates of the percentage of this species of the total number of small shorebirds.

When returning to the mud flats to feed, the shorebirds, especially the larger species, flew west over the estuary between Alameda and Bay Farm Island, and observers posted on the south end of the bridge across the estuary could at times observe spectacular flights. Occasionally, the flights of Avocets began before the tide had ebbed sufficiently to permit the birds to feed, and hundreds of Avocets waited, massed on the island north of B, until the tidal conditions were right for feeding. This island was occasionally used as a loafing area by the Avocets.

Several factors appeared to influence the time of feeding and the numbers of birds present. In the first place, variation in the height of the high and low tides was important. In the San Francisco Bay area, the differences in height between the two high tides and the two low tides of a given lunar day vary cyclically. The difference between the two low tides may reach four and one-half feet, and that between the two high tides, two feet. A period of tidal extremes occurs once during each lunar month and is suc-

ceeded by a period during which the two daily tidal cycles approach equality, after which the differences increase until the extremes are again reached. The lowness of a given low tide determines the extent of the intertidal zone exposed and the length of time during which the birds can feed. Since the birds follow the receding water-line, it will be seen that it was desirable to make counts when tidal conditions were such that the maximum numbers of shorebirds were feeding and before the birds got too far from the high tide mark for ready identification. These conditions were met when the tide was one-third to one-half ebb.

The water level is not, however, entirely dependent upon the tides. Strong winds tend to pile up the water on the east side of San Francisco Bay, and this raises the water level at Bay Farm Island to a considerable extent, flooding areas normally dry and delaying the uncovering of the mud flats. This makes it necessary for some birds to shift their loafing grounds and both shortens and delays the birds' feeding periods.

Bay Farm Island is a popular duck-hunting and fishing area, and, consequently, there is considerable disturbance to shorebirds by man. In 1948, the hunting season was divided, one-half occurring in October, and one-half in December. On October 31, when many duck hunters were present on B and L, very few large shorebirds were to be found on the island, although numbers of the smaller species were apparently little affected. The gravel dike (L) is a favorite place for fishing, and on several trips this area had no shorebirds on it for this reason. In view of the popularity of the area among sportsmen, censuses were conducted, when possible, on weekdays.

The seasonal fluctuations in numbers of shorebirds on Bay Farm Island are shown in figure 2. Southbound migrants began to arrive in late June and built up to a peak in numbers in August and September when from fourteen to sixteen species and from seven to thirteen thousand individuals were present. (The low count of 3,639 birds on August 18 was made when tidal conditions were unfavorable.) The higher peak in November reflects the arrival of wintering species such as the Red-backed Sandpiper and the Avocet before the primarily transient species had left. From November until late February there appeared to be a steady decline in numbers. The low count on March 12 was due to the departure of most of the wintering Avocets. From this date, the numbers of spring migrants rose rapidly until April 23 when an estimated 41,900 individuals of seventeen species were present. Following this peak, the numbers of birds declined to the yearly low of one to two hundred birds of six to seven species in late May and early June. The extended season of the fall migration as contrasted with the brief period of the spring migration and the consequently greater numbers of individuals present at the peak of the spring flight is similar to the pattern of migration of shorebirds on the New Jersey coast (Urner and Storer, *Auk*, 66, 1949:177-194) and, in general, to those of most species of highly migratory birds.

In the year covered by this census, twenty-three species of shorebirds were observed on the study area. These, listed in order of their abundance based on a combination of maximum numbers observed and frequency of occurrence, were:

Abundant or very common	Common
1. Western Sandpiper	8. Least Sandpiper
2. Short-billed Dowitcher	9. Semipalmated Plover
3. Avocet	10. Killdeer
4. Willet	11. Sanderling
5. Marbled Godwit	12. Greater Yellow-legs
6. Black-bellied Plover	13. Hudsonian Curlew
7. Red-backed Sandpiper	

Uncommon to rare	Very rare
14. Northern Phalarope	21. Snowy Plover
15. Black Turnstone	22. Golden Plover
16. Knot	23. Spotted Sandpiper
17. Red Phalarope	
18. Ruddy Turnstone	
19. Wilson Snipe	
20. Long-billed Curlew	

It should be emphasized that these expressions of abundance refer to the study area only. Many of these species are more numerous in other parts of the San Francisco Bay area. For instance, both species of phalaropes are abundant in migration off the coast, Sanderlings and Snowy Plovers are very common on the outer beaches, and Black Turnstones are common on the rocky parts of the coast. An annotated list of the species observed follows.

Squatarola squatarola. Black-bellied Plover. Common from late July to late April (see fig. 3). A few were present in late June and early July of 1948, but none was seen between May 21 and July 1 of 1949. The main fall flight took place during the first half of September, and the principal spring flight occurred in April. The largest number recorded was 992 on February 12 and probably represents a concentration of wintering birds. The drop-off in numbers in late October was a direct result of the presence of hunters in the area at that time. By March 29, some individuals were apparently in full nuptial plumage and many were in heavy molt.

This species was abundant on both the mud flats and sandy areas. It was seen in small numbers on gravelly shores and at least once with Killdeer on cultivated fields.

Pluvialis dominica. Golden Plover. A single bird of this species was seen on several occasions from May 6 until May 9 when it was collected and deposited in the Museum of Vertebrate Zoology. The bird was a male in nearly complete breeding plumage and weighed 146 grams. In wing length it falls in the area of overlap between *P. d. dominica* and *P. d. fulva* as given by Conover (Auk, 62, 1945:568-574).

I am aware of only one other California record for this species during the spring migration. This was recorded by Mrs. Kelly (Gull, 20, 1938:23) who has kindly sent me her notes on this bird: it was first reported on Bay Farm Island on April 25, 1938, and also was seen by Mrs. Kelly, May 7 and 8. By the latter dates the bird was in nearly complete breeding plumage.

The similarity of the dates when the two plovers were seen is of interest as is the fact that both birds were seen feeding on rocky and gravelly shores covered with green algae.

Charadrius hiaticula. Semipalmated Plover. Present continuously from July 16 to June 10. The principal fall flight occurred in late July and early August (53 birds on July 28, and 56 on August 12), and the principal spring migration on April 20 (237 birds), April 23 (178), and May 6 (62). The high for wintering birds was 66 on January 13.

The Semipalmated Plover is apparently becoming more common as a wintering bird in the San Francisco Bay region. The first wintering record for the area appears to be that of Mrs. Allen (Gull, 24, 1942:27-28), and Mrs. Kelly (Condor, 46, 1944:243-244) has recorded wintering birds of this species in Alameda.

This species occurs on both mud flats and sandy areas in the study area.

Charadrius alexandrinus. Snowy Plover. This species formerly was to be found regularly on the southwest side of the Island. In recent years much of the sandy area of this part of the Island has been covered by filling operations, and this sand-inhabiting species has become scarce there. I have only two records for the observation period: two birds reported by Mrs. Kelly on September 12, and a single bird by Cogswell near the pipe-line at the western end of the Island on January 24.

Charadrius vociferus. Killdeer. Present all year. Approximately ten pairs were found on the area during the nesting season. The 59 Killdeer present on November 20 indicated that, in fall and winter, the numbers of this species are augmented by non-resident individuals. Partly-grown young were observed on April 23 and June 26. Killdeer were found most commonly on cultivated fields, but they also visited mud flats and sandy and gravelly areas.

Numenius phaeopus. Hudsonian Curlew. Present in small numbers throughout most of the study period. First seen July 1; last seen May 31. The 33 birds seen on August 4 and the 50 on August 16 were the only indications of migratory movements. Up to eight curlew were present through the fall, winter, and spring months. These curlew were found on mud flats and sandy and gravelly areas.

Numenius americanus. Long-billed Curlew. Rare. Seen on seven occasions between August 12 and September 15, with a maximum of two birds on the latter day. Single individuals were found on November 11 and January 13.

Limosa fedoa. Marbled Godwit. Common to abundant from early September to May. Some non-breeding birds remained through the summer. In 1948, this group numbered between two and three hundred, but fewer godwits were present through the summer of 1949. The principal fall flight

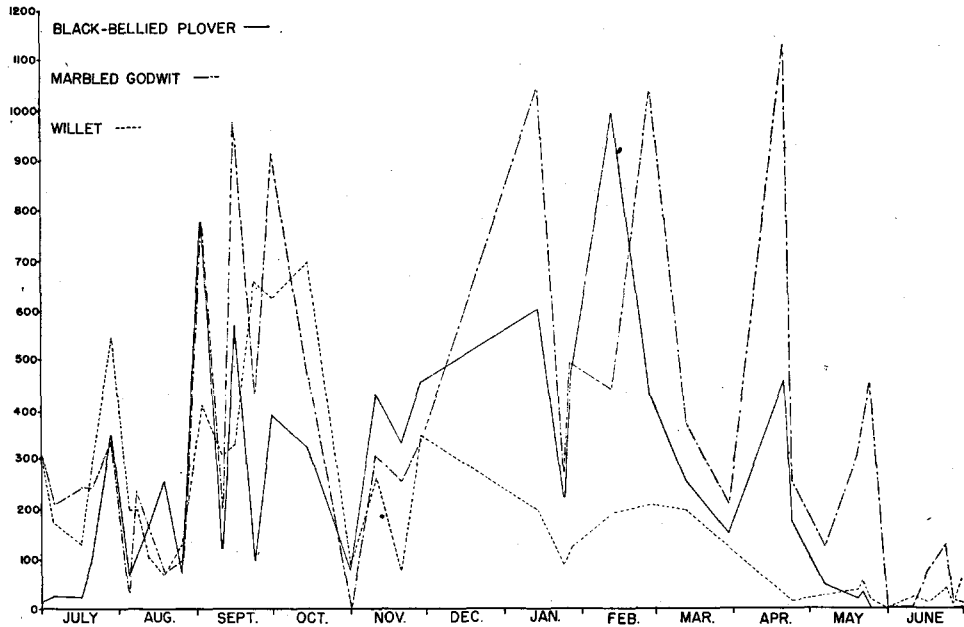


Fig. 3. Seasonal fluctuations in the abundance of the Black-bellied Plover, Marbled Godwit, and Willet on Bay Farm Island, July 1, 1948, to June 30, 1949.

occurred in September and the principal spring flight in April (see fig. 3). This species was most abundant on mud flats but also fed on sandy areas.

Totanus melanoleucus. Greater Yellow-legs. Present from July 1 to May 14, but never very numerous. The maximum number seen was 28 on September 2, and the greatest number in spring, 4 on May 14. The Greater Yellow-legs showed a decided preference for ponds, but was also found on sandy areas and occasionally on the mud flats.

Actitis macularia. Spotted Sandpiper. Rare, although according to Mrs. Kelly, at least one is reported in the area almost every year. One seen May 6 by S. T. Bailey was the only record for the period of this study.

Catoptrophorus semipalmatus. Willet. The status of the Willet was puzzling (see fig. 3). The species reached a peak in numbers of between six and seven hundred birds in late September and early October. The wintering population was lower, from 100 to 350 birds, until March; after this month the species became scarce. Willets were commonest on the mud flats, but also occurred on sandy and gravelly areas.

Arenaria interpres. Ruddy Turnstone. A rare transient spring and fall. Observed five times between July 28 and August 16 (maximum, 2) and four times between April 23 and June 10 (maximum, 5). Ruddy Turnstones were found on the mud flats as well as with Black Turnstones on gravelly

areas. The much greater range of ecological tolerances of *interpres* may well be a key to its much wider geographic distribution and greater numbers throughout much of its range.

Arenaria melanocephala. Black Turnstone. This species was present from July 16 to April 23. A flock of nine wintered on the gravelly dike on the northwest side of the island. This represents the maximum number seen on one trip. Black Turnstones were nearly always to be found on the gravelly dike and seldom anywhere else except on the adjacent areas of irregularly caked mud uncovered by the tide. The latter had more the configuration of rocks than of mud flats and for this reason may have been attractive to the turnstones.

Limnodromus griseus. Short-billed Dowitcher. Abundant transient, less common in winter (see fig. 4). The fall flight was protracted, lasting from early July until mid-November. A winter low

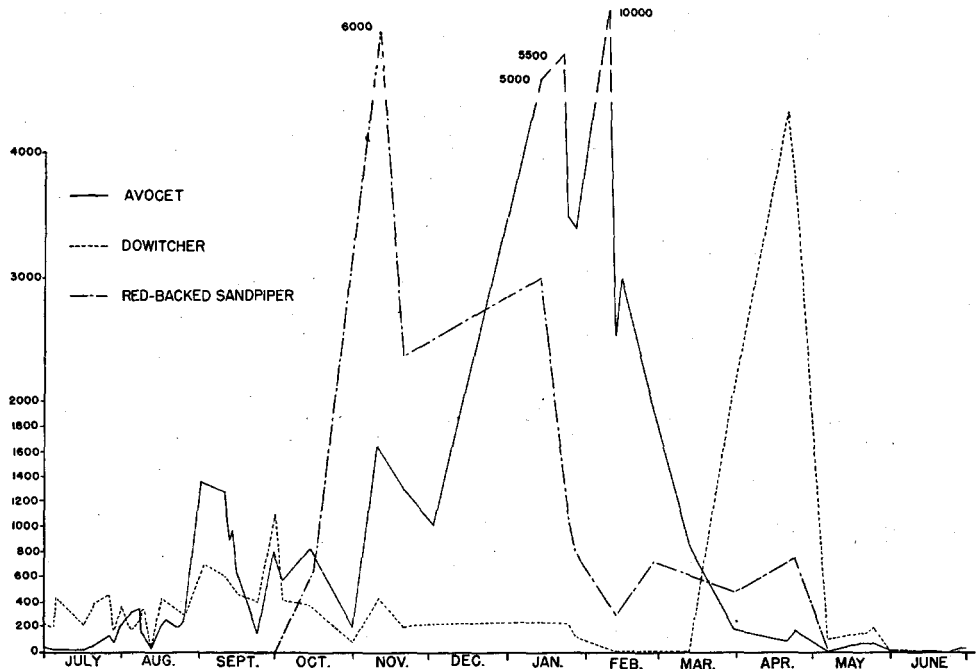


Fig. 4. Seasonal fluctuations in the abundance of the Avocet, Short-billed Dowitcher, and Red-backed Sandpiper on Bay Farm Island, July 1, 1948, to June 30, 1949.

occurred from mid-February to mid-March. The spring flight was very large, reaching a peak of approximately 4300 birds on April 23. A few non-breeding dowitchers were present through the month of June. No Long-billed Dowitchers (*L. scolopaceus*) were identified, although some may have been present. On May 19, F. A. Pitelka accompanied the writer on a census and identified all the dowitchers seen closely enough as *L. griseus*. A dowitcher, found dead on April 23 and preserved as a skin in the Museum of Vertebrate Zoology, is also *L. griseus*.

The Short-billed Dowitcher shows a definite preference for mud flats during the feeding periods. The majority was found feeding in the shallow water and following the retreating water-line during ebb tide.

Capella gallinago. Wilson Snipe. An uncommon winter visitor to the salicornia beds and vegetable gardens. Found on six occasions from October 31 to February 26 with a maximum of six individuals on the latter date.

Calidris canutus. Knot. An uncommon transient. One fall record, a single bird on August 18; more numerous in spring, six records from April 3 to May 21 with 78 birds on April 23 and 75 on May 5.

The Knot's partiality to sandy areas accounted for its scarcity on Bay Farm Island. The feeding mannerisms of the Knot were found to be useful in distinguishing this species from the Short-billed Dowitcher. On May 6, while a group of Knots was feeding in company with some Dowitchers, it was noted that the Dowitchers fed by repeatedly plunging the bill deep into the sand, the head moving vertically an inch or two with each thrust, whereas the Knots put only the tip of the bill into the sand, the head moving rapidly up and down through a distance of one-half to one-fourth of an inch.

Crocethia alba. Sanderling. Uncommon in winter and spring; more numerous in fall migration. Extreme dates for fall flight, August 4 and September 30, with a maximum of 205 on September 15. One winter record, two birds on January 24. Seen three times between March 29 and May 6 with a maximum of 8 on April 23.

Like the Knot and the Snowy Plover, the Sanderling's scarcity on Bay Farm Island was due to its preference for sandy beaches. That preference was reflected in the fact that it occurred almost exclusively on sandy areas there.

Ereunetes mauri. Western Sandpiper. The most abundant species of shorebird on Bay Farm Island (see fig. 2). The southward flight was protracted, lasting from early July until late November; the wintering population reached a minimum of 2300 on February 12; and the spring peak of approximately 26,500 birds was reached on April 23. The figures for this species undoubtedly include some Least Sandpipers, but the latter seldom occurred in large numbers. Western Sandpipers fed over both sandy and muddy areas.

Erolia minutilla. Least Sandpiper. The figures for the Least Sandpiper are the least satisfactory of those for any species, due to the impossibility of distinguishing this species at a distance from the more numerous Western Sandpiper. Least Sandpipers were observed from July 5 until April 23; and although probably overlooked after the latter date, they were certainly not numerous. This species was common from August 12 until January 13 with a peak of approximately 1700 birds on September 30. No large spring flight was observed.

When present, Least Sandpipers were usually found on gravelly areas covered with green algae. They also occurred commonly on the upper parts of the mud flats. The absence on Bay Farm Island of an especially favored habitat of this species (marshy areas with low grass) may account for the irregularity of the numbers of the Least Sandpiper there.

Erolia alpina. Red-backed Sandpiper. An abundant winter resident. Seen from September 23 to May 6; large numbers present from October 14 to April 23. A maximum of nearly 6000 was present on November 10. No spring peak was noted (see fig. 4). Red-backed Sandpipers were most numerous on the mud flats, most often feeding in the water near its edge, and, with the dowitchers, forming a line just beyond the water's edge.

Recurvirostra americana. Avocet. Only in recent years has the Avocet become common at Bay Farm Island. It was present through the whole period of this study, but common only during the fall and winter (see fig. 4). A maximum of approximately ten thousand was reached on February 9. Avocets fed almost exclusively in the water over the mud flats and in the pond (J).

Phalaropus fulicarius. Red Phalarope. This species appeared in late May and was found on five days between May 17 and 24, with a maximum of 20 on May 19. Red Phalaropes were of irregular occurrence on the Island and were usually found with the more numerous Northern Phalaropes. Both species were found on the ponds, the water over the mud flats, and occasionally foraged on the mud flats proper.

Lobipes lobatus. Northern Phalarope. Found regularly but in small numbers during the spring and fall migrations. Seen on 18 days between August 3 and September 23, with a maximum of 63 on August 25, and on six trips between April 23 and May 24, with a maximum of 144 on May 17. During the spring flight, individuals of both species of phalarope were found in full nuptial plumage, in winter plumage, and in various intermediate stages.

University of Michigan Museum of Zoology, Ann Arbor, Michigan, January 27, 1951.