Studies in Avian Biology No. 2:41–47, 1979.

BANDING STUDIES OF MIGRANT SHOREBIRDS IN NORTHWESTERN COSTA RICA

SUSAN M. SMITH[1] AND F. GARY STILES[2]

ABSTRACT.—The coastal shorebird fauna in northwestern Costa Rica was studied over two and a half years at two tidally exposed mud flat sites. Twenty-nine species were recorded and over 1500 individuals of 10 species were banded. Of these three bred locally, and 17 occurred regularly as migrants or winter residents or both. For 11, new distributional data for Costa Rica are reported. Differing patterns of seasonal occurrence are described. Several species showed strong site fidelity. Some data for the Western Sandpiper also suggest strong flock fidelity.

Although the land birds of Costa Rica are well known (Slud 1964 and several later authors), relatively little has been done there on shorebirds. Recent papers that do treat Costa Rican shorebirds (Orians and Paulson 1969, Jehl 1974, Stiles and Smith 1977) deal mainly with new records for the country.

Over the last two and a half years we have conducted a shorebird banding program in northwestern Costa Rica. On each of our regular visits to this area we have recorded numbers of all species present. These data shed new light on the abundances, status, seasonal distribution, and migration schedules of a variety of shorebird species.

STUDY AREA AND METHODS

Our major study site, Salina Bonilla, is located 1.5 km SE of the town of Colorado, Guanacaste Province, Costa Rica. It consists of a series of shallow salt ponds about 5 ha in total area, and is about 0.3 km inland from the Gulf of Nicoya (Pacific Ocean), being connected to it by channels through the intervening mangrove swamp. The salt ponds are separated from each other by mud dikes, and a system of sluices connecting the ponds with one another and with the mangrove swamp permits control of the water level. The water is usually 10–20 cm deep in the smaller ponds, but parts of some larger ponds may be up to 50 cm in depth. Pond bottoms are soft mud, and two areas of mud flats that were regularly exposed were important resting areas for shorebirds for the first 25 months of the study.

In addition, starting in February 1977 we have made observations at Salina La Flor, 3 km W of Salina Bonilla. This salina is slightly larger (8 ha) and closer to the sea (0.1 km), but is otherwise very similar to Salina Bonilla. At low tide extensive mud flats are exposed along the nearby coast, and are the major feeding areas of most of the birds from both salinas. There are no sandy beaches, salt marshes, grassy ponds, or rock outcrops in the immediate vicinity of either salina.

We found that the best way to catch birds for banding was to set mist nets along the dikes to intercept birds flying from the coast into the salinas on the incoming tide. The optimal conditions for this were a high tide around 21:00, such that most birds arrived within 1–2 hours after dusk. Optimal tide conditions thus occurred twice monthly, and we timed our visits accordingly. We usually made censuses either in late afternoons or the following morning. The data reported here were obtained from October 1974 to March 1977.

SPECIES RECORDED AND THEIR STATUS

Twenty-nine shorebird species have been recorded to date at Salinas Bonilla and La Flor. Of these, three are breeding residents, two apparently pass through only on migration, 15 have been recorded all winter in at least one year, with an additional species (Red Knot) almost certainly having wintered 1976–1977 at Sa-

[1] Dept. of Biology, Adelphi College, Garden City, N.Y. 11530.
[2] Escuela de Biologia, Universidad de Costa Rica, Ciudad Universitaria, Costa Rica.

TABLE 1
GENERAL STATUS OF SHOREBIRDS AT THE SALINAS

Species	Status	Recorded in summer
Central American Jacana, *Jacana spinosa*	Breeding resident	(x)
Black-necked Stilt, *Himantopus mexicanus*	Breeding resident	(x)
Am. Golden Plover, *Pluvialis dominica*	Irregular visitor	
Black-bellied Plover, *P. squatarola*	Winter resident	x
Semipal. Plover, *Charadrius semipalmatus*	Winter resident	x
Wilson's Plover, *C. wilsonia*	Breeding resident	(x)
Long-billed Curlew, *Numenius americanus*	Irregular visitor	
Whimbrel, *N. phaeopus*	Winter resident	x
Solitary Sandpiper, *Tringa solitaria*	Irregular visitor	
Greater Yellowlegs, *T. melanoleuca*	Winter resident	
Lesser Yellowlegs, *T. flavipes*	Winter resident	x
Willet, *Catoptrophorus semipalmatus*	Winter resident	x
Spotted Sandpiper, *Actitis macularia*	Winter resident	x
Least Sandpiper, *Calidris minutilla*	Winter resident	
Semipalmated Sandpiper, *C. pusilla*	Winter resident	
Western Sandpiper, *C. mauri*	Winter resident	x
White-rumped Sandpiper, *C. fuscicollis*	Migrant only	
Dunlin, *C. alpina*	Irregular visitor	
Pectoral Sandpiper, *C. melanotos*	Irregular visitor	
Sanderling, *C. alba*	Irregular visitor	
Red Knot, *C. canutus*	Winter resident	
Short-b. Dowitcher, *Limnodromus griseus*	Winter resident	x
Long-b. Dowitcher, *L. scolopaceus*	Winter resident	
Stilt Sandpiper, *Micropalama himantopus*	Winter resident	
Marbled Godwit, *Limosa fedoa*	Irregular visitor	
Surfbird, *Aphriza virgata*	Migrant only	
Ruddy Turnstone, *Arenaria interpres*	Winter resident	
Northern Phalarope, *Phalaropus lobatus*	Irregular visitor	
Wilson's Phalarope, *Steganopus tricolor*	Winter resident	x

lina La Flor (numbers constant from early February through late March); and eight have been recorded only irregularly (Table 1).

The average relative numbers of the 20 regularly occurring species are shown in Table 2. Since we have only biweekly numbers at best, this seems the most useful way to present these data. Most of the regular winter residents show peaks in spring and fall indicating birds passing through. Fall and spring peaks for a given species may be predictably different: for example, Red Knot is more common in spring than in fall, while Wilson's Phalarope is more common in fall than in spring. Of the three breeding residents, one (Wilson's Plover) shows clear peaks in numbers in fall and spring, indicating migrants passing through; one (Black-necked Stilt) increases in numbers during the winter, the additional birds being probably too many to be all young produced in the area, and thus including migrants; and one (Northern Jacana) being apparently totally non-migratory.

Figure 1 presents our numerical data for the three wintering peeps in greater detail. Unfortunately, as we have only biweekly censuses, some peaks in numbers probably were not detected (e.g. probably there was a spring peak of Semipalmated Sandpipers in April 1976 as there was in 1975; also, we have apparently

TABLE 2
AVERAGE RELATIVE NUMBERS[a]

Species	Month											
	A	S	O	N	D	J	F	M	A	M	J	J
Jacana	o	o	o	o	o	o	o	o	o	o	o	o
Blk-n. Stilt	x	xx	xx	xx	xx	xx	xx	xx	xx	x	x	x
Blk-b. Plover	–	xxx	xx	x	x	x	x	xx	xx	x	o	o
Semipal. Plover	x	x	x	x	xx	x	x	x	x	o	o	o
Wilson's Plover	x	xx	xx	xx	x	x	xx	xx	x	x	x	x
Whimbrel	xx	xx	x	x	x	x	x	xx	x	x	x	x
Grr. Yellowlegs	o	o	o	o	o	o	o	o	o	o	–	–
Lssr. Yellowlegs	x	x	x	x	x	x	x	x	x	o	o	o
Willet	xx	xxx	xx	x	x	x	x	xx	x	x	x	x
Spotted Sppr.	x	xx	x	x	x	x	x	x	x	x	o	o
Least Sppr.	x	xx	x	x	x	x	x	x	x	o	–	–
Semipal. Sppr.	xxx	*	*	xxx	xx	xx	xx	xx	x	o	–	–
Western Sppr.	xxx	xxx	*	*	xxx	xxx	xx	xx	xx	o	o	o
White-r. Sppr.	o	–	–	–	–	–	–	–	o	o	–	–
Red Knot	–	o	–	?	?	?	xxx	xxx	x	–	–	–
S-b. Dowitcher	xxx	xxx	xxx	xxx	xx	xx	xx	xxx	xx	xx	o	o
L-b. Dowitcher	–	–	x	x	x	x	x	x	x	–	–	–
Ruddy Turnstone	o	o	x	o	x	o	o	xx	x	o	–	–
Stilt Sppr.	x	x	x	xx	xx	xx	xx	xx	x	o	–	–
Wilson's Phal.	–	o	o	o	o	o	o	o	o	o	o	o

[a] Key to symbols: –, none; o, <50; x, <100; xx, <250; xxx, <500; *, <1000.

missed both spring peaks of westerns, if their spring and fall migratory routes are the same. Nevertheless, certain conclusions can be drawn from these data: even so far from the nesting grounds, spring peaks in numbers are considerably narrower, i.e., more synchronized and rapid, than fall peaks, at least in Semipalmated and presumably in Western Sandpipers. Secondly, in two of the three years, the fall peak of Semipalmated Sandpipers occurred earlier than that of westerns although in 1976 they may have peaked at the same time. Although the data are less clear, the fall peaks of the Least Sandpiper tended to coincide with those of semipalmateds, and precede slightly those of westerns. Recher (1966) found that leasts passed through central California before westerns.

The data in Tables 1 and 2 represent major differences in known status in Costa Rica for 11 species:

Black-necked Stilt: first breeding records for Costa Rica (see Stiles and Smith 1977 for details).

Black-bellied Plover: reported by Slud (1964) to be ". . . seldom met in larger parties . . ." than 2's or 3's in migration, and still rarer in winter. This species is probably common all winter along much of the Costa Rican Pacific coast.

Surfbird: previously recorded only in the fall (Slud 1964); now appears to be a regular early spring migrant as well.

Long-billed Curlew: first Costa Rican records.

White-rumped Sandpiper: first Costa Rican fall records.

Dunlin: first Costa Rican records (Stiles and Smith 1977).

Red Knot: first Costa Rican winter and spring records.

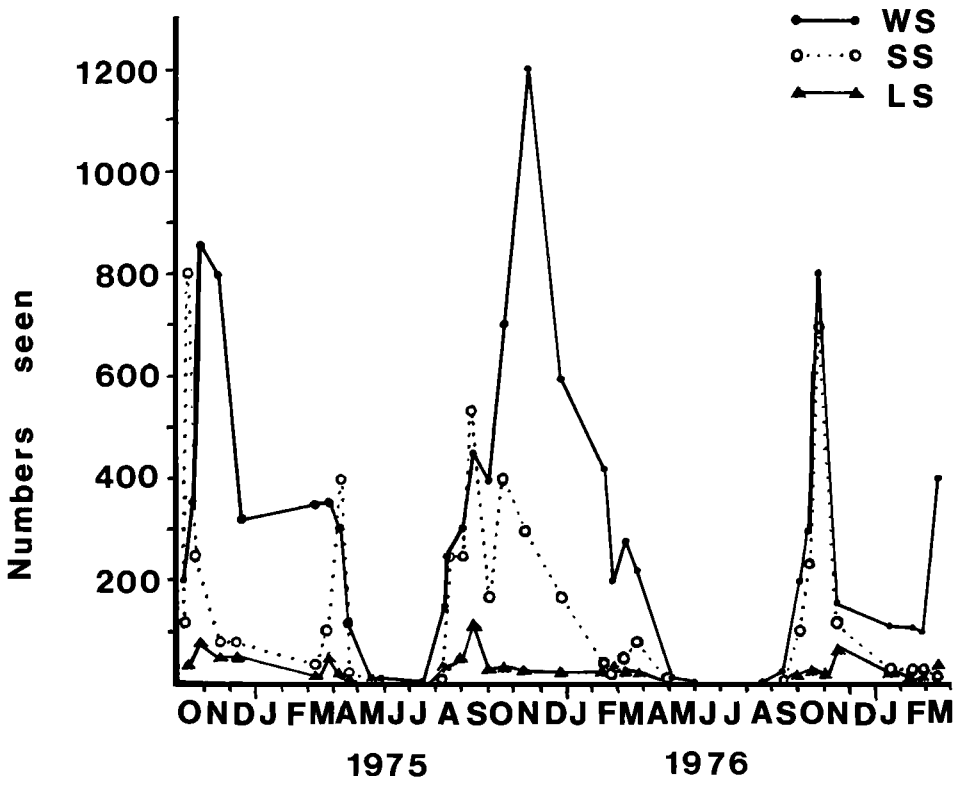

FIGURE 1. Observed numbers of the three wintering peeps: Western Sandpiper (WS), Semipalmated Sandpiper (SS) and Least Sandpiper (LS) in the study area.

Short-billed Dowitcher: Slud (1964) lists this as uncommon both in migration and in winter, being "met singly as a rule" (p 97). Our data indicate that it is locally common to abundant in winter.

Stilt Sandpiper: first recorded in Costa Rica by Orians and Paulson (1969) who found it in both migrations; our data are the first winter records.

Marbled Godwit: first Costa Rican spring records.

Wilson's Phalarope: first Costa Rican records.

TABLE 3
RECOVERIES OF SHOREBIRDS BANDED AT SALINA BONILLA

Species	Total banded	Total recovered	Per cent recovered
Black-bellied Plover	50	—	—
Semipalmated Plover	20	1	5.00
Willet	52	—	—
Spotted Sandpiper	128	14	10.94
Least Sandpiper	45	—	—
Semipalmated Sandpiper	342	7	2.05
Western Sandpiper	696	37	5.32
Red Knot	29	—	—
Short-billed Dowitcher	137	2	1.45
Long-billed Dowitcher	23	—	—

TABLE 4
TIMING OF RECOVERIES

Species	Recovered		
	Same winter	1 year later	2 years later
Western Sandpiper	13	21	3
Semipalmated Sandpiper	3	3	1
Spotted Sandpiper	7	6	1
Short-billed Dowitcher	1	—	1
Semipalmated Plover	—	—	1

Finally, individuals of nine migrant species have spent at least one summer at Salina Bonilla; these are birds that failed to go north to breed (Tables 1 and 2). Of these, four were found in only one of the two summers: Spotted Sandpiper, Lesser Yellowlegs, Western Sandpiper, and Wilson's Phalarope. The other five species were present both summers, two of these (Willet and Whimbrel) being present in far greater numbers (40 to 60 birds) than the other three. Since Willets do not breed until they are 2 years old (Palmer 1967), most of the summer Willets are probably yearlings; the same may be true also for Whimbrels.

BANDING RETURNS

To date we have banded 1567 individuals of 21 species at our study area; those species with 20 or more banded individuals are listed in Table 3. Of these, we have recaptured 61 individuals of five species, our highest return rates being for Spotted and Western sandpipers (Table 3). The timing of these returns is analyzed in Table 4. At least one individual from each of the five species was recaptured two years after having been banded.

Several shorebird species thus demonstrate strong site fidelity. Such tradition is well known for breeding sites, and has recently been demonstrated in a wide variety of wintering passerines (Diamond and Smith 1973, Ely 1973, Loftin et al. 1966, Thurber 1972 for Central and South America; Moreau 1969 for Africa). Considerably less is known about site fidelity in wintering shorebirds, although ffrench (1973) reports "numerous" returns on presumably wintering Semipalmated and Western sandpipers, some up to 3 years after banding, in Trinidad.

One of the most surprising aspects of our recapture data is shown in Table 5. On five instances, two or more Western Sandpipers that had been banded at the same time were recaptured together at the same later date. Yet four of the five instances, involving a total of nine birds, were recaptured the following year (i.e.,

TABLE 5
JOINT RECOVERIES OF WESTERN SANDPIPER

Birds recovered	Band numbers[a]	Date banded	Date recovered	Period
2	05, 11	10-17-76	11-29-76	same winter
2	79, 80	03-08-76	10-02-76	next winter
2	41, 46	02-08-76	10-31-76	next winter
2	66, 70	11-18-74	12-26-75	next winter
3	35, 38	10-28-74	03-09-76	next winter

[a] The last two digits if birds were from the same string of 100 bands.

after one round-trip north). Using the procedure outlined in Appendix I, we have analyzed these data, and find that Western Sandpipers marked on the same date were recaptured together significantly ($P < 0.01$) more often than expected by chance alone.

These data thus strongly suggest that not only site fidelity but also strong flock fidelity exists in migrant and wintering Western Sandpipers. It is even possible that mated pairs may remain together all winter and mate again the following spring. Clearly more data are needed, but the closeness of the band numbers in many cases (Table 5) indicate that this association is indeed a real phenomenon. For example, the two consecutive Western Sandpipers (79 and 80) banded in March 1976 were recaptured in the same net at the same time in October 1976. If this is a widespread phenomenon among wintering shorebirds, it could greatly affect our current understanding of how and when pairs are formed.

LITERATURE CITED

DIAMOND, A. W., AND R. W. SMITH. 1973. Returns and survival of banded warblers wintering in Jamaica. Bird-Banding 44:221–224.

ELY, C. A. 1973. Returns of North American birds to their wintering grounds in southern Mexico. Bird-Banding 44:228–229.

FFRENCH, R. 1973. A Guide to the Birds of Trinidad and Tobago. Livingston Publishing Company, Wynnewood, Pa.

JEHL, J. R., JR. 1974. The near-shore avifauna of the Middle-American west coast. Auk 91:681–699.

LOFTIN, H., D. J. ROGERS, AND D. L. HICKS. 1966. Repeats, returns and recoveries of North American migrant birds banded in Panama. Bird-Banding 37:35–44.

MOREAU, R. E. 1969. The recurrence in winter quarters (Orstreue) of trans-Saharan migrants. Bird Study 16:108–110.

ORIANS, G. H., AND D. R. PAULSON. 1969. Notes on Costa Rican birds. Condor 71:426–431.

PALMER, R. S. 1967. Species accounts in G. D. Stout (ed.), The Shorebirds of North America. The Viking Press, New York.

RECHER, H. F. 1966. Some aspects of the ecology of migrant shorebirds. Ecology 47:393–407.

SLUD, P. 1964. The birds of Costa Rica—distribution and ecology. Bull. Amer. Mus. Nat. Hist., 128:1–430.

STILES, F. G., AND S. M. SMITH. 1977. New information on Costa Rican waterbirds. Condor, 79:91–97.

THURBER, W. A. 1972. Some banding returns in El Salvador. Bird-Banding 43:285.

APPENDIX

The following procedure was used to determine whether or not the number of joint recaptures (birds banded on the same date being recaptured together) was greater than could be expected by chance alone:

a) Calculate the probability that 2 random recaptures would involve birds banded on the same date (BSD pair):

$$P_s = \sum_{i=1}^{i=n} \left(\frac{N_i}{N_T}\right)\left(\frac{N_i - 1}{N_T - 1}\right) = .065$$

where N_i = number banded on date i
N_T = total number banded = 696 Western Sandpipers
n = number of banding dates = 26.

b) Calculate the probability that any 2 recaptures would involve birds banded on different dates (BDD pair):

$$p_\alpha = \sum_{i=1}^{i=n} \left(\frac{N_i}{N_T}\right)\left(\frac{N_T - N_i}{N_T - 1}\right) = 1 - p_s = .935$$

c) Data: excluding all singles (only 1 bird recaptured on a date), we have 11 birds involved in BSD recaptures (4 pairs, 1 triple: Table 5) and 20 in BDD recaptures (2 pairs, 3 triples, 1 quadruple). Counting each triple as 3 pairs and each quadruple as 6 pairs (the number of possible 2-bird combinations), we get 7 BSD pairs and 20 BDD pairs (our *observed* data). Expected values, obtained from using the probabilities calculated in a) and b) above, are 1.75 and 25.25, respectively. χ^2 (1 d.f., Yates correction) = 13.78, $P < 0.01$.