

LENGTH OF STAY AND WEIGHTS OF INLAND MIGRATING SHOREBIRDS

BY WILLIAM POST AND MICOU M. BROWNE

Many species of shorebirds regularly migrate over land and due to shortage of suitable habitat are often found in concentrations at inland sites (Denton and Post, 1963; Oring and Davis, 1966; Hader, 1967). In the fall of 1968, we conducted a study of shorebirds at Raleigh, North Carolina, 176 km from the Atlantic Ocean, to determine: (1) yearly returns of banded birds; (2) local movements; (3) length of stay; and (4) fat condition of captured birds. We were able to fulfill the last three objectives, but not the first because suitable habitat was lacking in years subsequent to initial capture.

METHODS

In 1968 at Raleigh, conditions were particularly favorable for shorebird concentrations, due to a severe autumn drought. Two of Raleigh's reservoirs, Lake Johnson and Lake Wheeler, were reduced to extensive mudflats. The drought also eliminated many farm reservoirs and wet weather ponds, probably further concentrating shorebirds at the two larger reservoirs. We captured birds in mist nets at both sites on 13 days during early morning and late evening with the aid of silhouette decoys. The birds were banded with Fish and Wildlife Service bands only. Water levels fell first at Lake Johnson, and we began our trapping there on 26 July. During July, the water fell at Lake Wheeler, and shorebirds began appearing. At the same time, the mudflats on Lake Johnson progressively supported fewer shorebirds because of drying and hardening. On 26 August, we stopped netting at Lake Johnson and began at Lake Wheeler, continuing until 22 September.

RESULTS AND DISCUSSION

Movement Between Feeding Areas. Comparatively large numbers of shorebirds were seen at both reservoirs (Table 1), and although all shorebirds had left Lake Johnson by 31 August, including the 37 we had banded, none banded at Lake Johnson were recaptured at Lake Wheeler. At Lake Wheeler, only 7.5 km from Lake Johnson, we banded 125 more shorebirds and recaptured 12.

Length of Stay. Although our data are insufficient for statistical analysis, they indicate that some individual shorebirds lingered for long periods. One Pectoral Sandpiper was recaptured after 6 days, two Semipalmated Plovers were recaptured 1 day and 13 days; eight Semipalmated Sandpipers were recaptured, three after 1 day and 5 after 6 days; and seven Least Sandpipers were recaptured, one after 5 days, one after 6 days, three after 7 days, one after 14 days and one after 20 days.

Weight and Fat Conditions. For the species for which we have sufficient data (Table 2), we conclude that inland migrating shorebirds weigh about the same as shorebirds captured in the fall

TABLE 1
Shorebirds seen and banded at Raleigh, July-September 1968

Species	Maximum No. seen	Lake Johnson Number banded	Number recaptured	Maximum No. seen	Lake Wheeler Number banded	Number recaptured
Semipalmated Plover <i>Charadrius semipalmatus</i>	6	4	0	25	9	2
Killdeer <i>Charadrius vociferus</i>	20	6	0	40	5	0
American Woodcock <i>Philohela minor</i>	1	1	0	1	1	0
Lesser Yellowlegs <i>Tringa flavipes</i>	6	2	0	55	2	0
Pectoral Sandpiper <i>Calidris melanotos</i>	10	1	0	35	25	1
Least Sandpiper <i>Calidris minutilla</i>	10	7	4	30	17	4
Semipalmated Sandpiper <i>Calidris pusillus</i>	80	10	2	70	49	5
TOTALS	133	31	6	256	118	12

Other species banded: Piping Plover (*Charadrius melodus*) 1; Spotted Sandpiper (*Actitis macularia*) 3; Solitary Sandpiper (*Tringa solitaria*) 3; Greater Yellowlegs (*Tringa melanoleucus*) 1; White-rumped Sandpiper (*Calidris fuscicollis*) 1; Short-billed Dowitcher (*Limnodromus griseus*) 2; Western Sandpiper (*Calidris mauri*) 1; and Sanderling (*Calidris alba*) 1.

TABLE 2.
Weights in grams of shorebirds captured at Raleigh, August and September 1968, and in N.J.

Species	Number	Mean \pm SD	Range	Number	Murray (1964) Data ¹ Mean \pm SD	Range
Semipalmated Plover	9	49.7 \pm 4.8	40.9-58.0	11	52.8	32.2-69.1
Piping	1	47.0	—	—	—	—
Killdeer	7	90.4 \pm 2.3	84.2-96.3	—	—	—
American Woodcock	2	130.7	122.0-139.3	—	—	—
Spotted Sandpiper	2	50.4	43.9-56.9	1	28.0	—
Solitary Sandpiper	3	60.4	56.0-62.9	1	37.8	—
Greater Yellowlegs	1	178.0	—	—	—	—
Lesser Yellowlegs	4	89.4	82.7-102.6	1	81.7	—
Pectoral Sandpiper	12	70.7 \pm 7.1	57.6-79.1	—	—	—
White-rumped Sandpiper	1	38.4	—	—	—	—
Least Sandpiper	19	25.9 \pm 4.8	19.0-33.2	6	23.9	18.4-32.3
Short-billed Dowitcher	2	133.6	128.7-138.4	1	70.1	—
Semipalmated Sandpiper	27	29.0 \pm 5.5	20.2-39.7	102	28.1 \pm 3.96	19.8-41.3
Western Sandpiper	1	36.9	—	15	25.7	19.4-33.1
Sanderling	1	55.9	—	—	—	—

¹Three years combined

TABLE 3
Estimated flight ranges of individual shorebirds captured at Raleigh in 1968

	Capture date	Wing (mm)	Fresh weight (g)	Fat-free ¹ weight (g)	Fat weight (g)	Fat class (0-3)	Flight range (km) ¹
Semipalmated Plover	17 Aug.	113.0	58.0	40.12	17.88	—	2,052
	6 Sept.	114.5	48.4	40.56	7.84	1-	1,029
	6 Sept.	117.0	50.3	41.30	9.00	0+	1,148
	8 Sept.	116.0	47.6	41.00	6.60	0	877
	13 Sept.	112.0	49.8	39.83	9.97	2	1,281
	14 Sept.	110.5	40.9	39.39	1.51	0	225
White-rumped Sandpiper	8 Sept.	94.0	38.4	30.38	8.02	1+	1,787
	18 Aug.	87.3	33.2	20.99	12.21	3+	1,884
Least Sandpiper	25 Aug.	87.3	33.2	20.99	12.21	3	1,884
	25 Aug.	83.0	25.2	19.56	5.64	3	1,719
	25 Aug.	88.9	32.3	21.49	10.81	3+	2,739
	6 Sept.	89.0	25.5	21.56	3.94	1-	1,190
	7 Sept.	82.0	21.8	19.23	2.57	0	873
	7 Sept.	84.2	24.8	19.96	4.84	—	1,493
	7 Sept.	84.5	21.6	20.06	1.54	0	526
	13 Sept.	81.0	31.4	18.89	12.51	2	3,238
	15 Sept.	85.5	32.6	27.66	4.94	2	1,244
	22 Sept.	79.0	19.2	17.66	1.53	0+	571

Semipalmated Sandpiper	25 Aug.	90.0	26.5	23.05	3.45	1	1,013
5 Sept.	91.0	24.2	23.38	0.82	—		256
5 Sept.	89.0	24.0	22.72	1.28	1		405
5 Sept.	91.5	24.9	23.55	1.35	1		415
6 Sept.	88.6	24.9	22.58	2.32	1		713
6 Sept.	91.1	29.9	23.41	6.48	1		1,739
7 Sept.	90.5	31.4	23.22	8.18	1+		2,117
7 Sept.	91.0	25.3	23.38	1.92	0+		584
8 Sept.	94.0	34.8	24.39	10.41	1+		2,496
13 Sept.	91.0	36.9	23.38	13.52	2+		3,103
14 Sept.	91.5	39.7	23.55	16.15	2		3,510
14 Sept.	85.0	30.6	21.38	9.22	2		2,432
14 Sept.	91.5	34.9	23.55	11.35	2		2,715
14 Sept.	89.5	35.0	22.88	12.12	3-		2,893
14 Sept.	92.0	24.3	23.72	0.58	0		182
14 Sept.	95.0	39.6	24.72	14.88	2+		3,240
14 Sept.	89.1	26.9	22.75	4.15	1		1,205
14 Sept.	86.0	27.1	21.71	5.39	2-		1,555
22 Sept.	88.0	33.4	22.38	11.02	3-		2,725

¹Fat-free weights and flight range calculated from formula by McNeil (1969).

along the Atlantic Coast. For example, our weights for Semipalmated Sandpipers do not differ significantly from weights taken by Murray and Jehl (1964) in coastal New Jersey. For other species, Murray's sample weights are too small to make further meaningful comparisons. The few data we have suggest that inland migrating shorebirds' weight gain is about the same as those migrating along the coast (Page and Middleton, 1972). All recaptured birds except for 1 day recaptures had gained weight, as seen by increase in fat class. For example, three Least Sandpipers recaptured 7 days after banding had gained 3.2 g (10.7% increase), 5.9 g (22.4%) and 5.2 g (26.0%). Birds that remained in the area for longer periods did not show such rapid changes in weight or fat class. For example, a Least Sandpiper recaptured 20 days after banding had gained only 2.6 g (13.7% increase). A similar finding of long lingering birds was reported by Page and Middleton (1972), who speculated that factors unrelated to fat deposition governed the migratory behavior of lingering individuals. Possibly shorebirds that stopover for long periods are diseased or injured and unable to feed efficiently.

Using formulae developed by McNeil (1969) and used by McNeil and Cadieux (1972), we are able to estimate the flight ranges of individual shorebirds that we captured. In cases of birds with moderate fat reserves (fat class at least 1), flight ranges were estimated to be sufficient for direct flights to wintering areas in the Caribbean or northern South America (Table 3). Birds with less fat still had sufficient reserves for direct flights to coastal areas to the southeast.

SUMMARY

In fall 1968, shorebirds used two partially dried reservoirs in inland North Carolina as migratory stopover sites. Limited banding data indicated that there were no movements between the two sites, 7.5 km apart. Most recaptured birds had remained at least 6 days, and an individual Least Sandpiper remained as long as 20 days. Weights and weight gains were similar to those reported for coastal sites. Fat accumulated by many individuals was sufficient for long flights, up to 3,510 km. These findings indicate that overland migrating shorebirds use adventitious stopover points for extended periods, stay in one place as long as favorable conditions persist, and are able to accumulate sufficient energy for direct flights to wintering grounds.

ACKNOWLEDGMENTS

We thank R. J. Hader for generously making available his shorebird observations. We were aided in our netting by Darryl Moffett, Dale Lewis, and T. L. Quay.

LITERATURE CITED

- DENTON, J. F., AND W. POST, JR. 1963. An unusual gathering of shorebirds at Augusta, Georgia. *Oriole*, **28**: 43-45.

- HADER, R. J. 1967. Fall shorebird records at Raleigh, North Carolina. *Chat*, **31**: 25-26.
- MCNEIL, R. 1969. La détermination du contenu lipidique et de la capacité de vol chez quelques espèces d'oiseaux derivage (Charadriidae et Scolopacidae). *Can. J. Zool.*, **46**: 123-128.
- MCNEIL, R., AND F. CADIEUX. 1972. Numerical formulae to estimate flight range of some North American Shorebirds from fresh weight and wing length. *Bird-Banding*, **43**: 107-113.
- MURRAY, B. G., JR., AND J. R. JEHL, JR. 1964. Weights of autumn migrants from coastal New Jersey. *Bird-Banding*, **35**: 253-263.
- ORING L. W., AND W. M. DAVIS. 1966. Shorebird migration at Norman, Oklahoma: 1961-63. *Wilson Bull.*, **78**: 166-174.
- PAGE, G., AND A. L. A. MIDDLETON. 1972. Fat deposition during autumn migration in the Semipalmated Sandpiper. *Bird-Banding*, **43**: 85-96.

Reproductive Biology Laboratory, North Carolina, Department of Mental Health, Box 7532, Raleigh, N. C. 27611; North Carolina State Museum of Natural History, Box 27647, Raleigh, N. C. 27611. Received 8 June 1976, accepted 31 August 1976.