

PARTIAL MIGRATION AND WINTERING USE OF FLORIDA BY OSPREYS

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ABSTRACT.—We used satellite-monitored radiotelemetry to track 14 Ospreys (*Pandion haliaetus*) breeding on three study areas in southern Florida and four Ospreys breeding along the coast of Maine. Seven birds (50%) migrated from Florida to South America and one was tracked along its migration route and at its nonbreeding season destination in successive years. Four (29%) moved from their breeding areas, but stayed in Florida. Two birds (14%) remained in their breeding areas year round. One bird died (7%) before meaningful data could be collected. Ospreys migrating to South America left their nesting grounds 16 July–27 August and arrived on South American nonbreeding areas 31 July–11 September. The seven Ospreys spent between 142–180 d in South America and initiated northward migration 10–31 January. On average they traveled 4105 km, taking 25 d ($N = 7$), with a mean speed of 178 km/d ($N = 5$). Ospreys that remained in Florida departed nesting areas 13 May–20 July. Departure from Florida nonbreeding areas was between 28 October and 9 December ($N = 4$). Mean time spent on nonbreeding areas in Florida was 154 d ($N = 3$). From Maine, two birds went to Florida (St. Lucie and Indian River counties) and two went to the Caribbean (Haiti and Jamaica). These data show that some southern Florida breeding Ospreys migrate to South America, and some northern breeding Ospreys winter in Florida.

KEY WORDS: *Osprey; Pandion haliaetus; Florida; migration; satellite telemetry; wintering area.*

MIGRACIÓN PARCIAL Y USO INVERNAL DE LA FLORIDA POR ÁGUILAS PESCADORAS

RESUMEN.—Usamos el monitoreo vía radiotelegrafía satélite para seguir 14 águilas pescadoras (*Pandion haliaetus*) que anidaron en tres áreas de estudio en el sur de Florida y 4 águilas pescadoras que anidaron a lo largo de la costa de Maine. Siete aves (50%) emigraron de Florida a Sudamérica y una fue seguida a lo largo de su ruta de migración y a su lugar de destino durante la temporada no reproductora en años sucesivos. Cuatro águilas (29%) se movieron de sus áreas de reproducción, pero permanecieron en la Florida. Dos aves (14%) permanecieron en sus áreas reproductivas todo el año. Un ave murió (7%) antes de que algún dato significativo pudiera ser colectado. Las águilas pescadoras que emigraron a Sudamérica dejaron sus territorios de anidación entre 16 julio–27 de agosto y arribaron a Sudamérica a sus áreas de invernación del 31 de julio al 11 septiembre. Las siete águilas pasaron entre 142–180 días en Sudamérica e iniciaron su migración hacia el norte entre el 10 y el 31 de enero. En promedio viajaron 4105 km, tomando 25 días ($N = 7$), con una velocidad media de 178 km/día ($N = 5$). Las águilas pescadoras que permanecieron en la Florida se marcharon de sus áreas de anidación entre el 13 mayo–20 julio. La partida de las águilas de sus áreas no reproductivas en la Florida fue del 28 de

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octubre al 9 de diciembre ($N = 4$). El tiempo promedio que pasaron en las áreas no reproductivas en la Florida fue 154 días ($N = 3$). Desde Maine, dos aves fueron a la Florida (St. Lucie y los condados de Indian River) y dos al Caribe (Haití y Jamaica). Estos datos muestran que las águilas pescadoras que anidan al sur de la Florida migran a Sudamérica, y que algunas que anidan en el norte pasan su invierno en la Florida.

[Traducción de César Márquez]

Ospreys (*Pandion haliaetus*) nest from southern Florida north into Canada along the Atlantic and Gulf Coasts of North America (Poole 1989, Houghton and Rymon 1997). While most North American Ospreys winter in Latin America (Henny and Van Velzen 1972, Poole 1989), biologists have commonly believed that south Florida Ospreys do not migrate, and remain near their breeding grounds year-round (Poole 1989). Also, Florida has not been thought of as a wintering area for more northerly-breeding individuals.

Recent advances in satellite-monitored telemetry have allowed study of migratory patterns of birds large enough to carry the radios. Studies have revealed patterns of movement, timing, and wintering areas of a number of avian species, including Ospreys in Europe (Kjellen et al. 1997, Hake et al. 2001) and North America (Martell et al. 2001, Rodriguez et al. 2001).

We report here on: (1) the migratory movements of Ospreys breeding in Florida, (2) local movements of Florida breeding Ospreys, and (3)

the winter use of southern Florida by Ospreys that breed in the northern United States.

METHODS

Study Areas. We studied Ospreys in three study areas in southern Florida (27.5°–25° N latitude): Lake Istokpoga in Highlands County, Buoy Key Island in Everglades National Park, and Sanibel Island in Lee County (Fig. 1). Lake Istokpoga has one of the highest concentrations of breeding Ospreys in the world with a population of nearly 250 pairs nesting around an 11 207 ha lake. Annual population monitoring and banding of nestlings has been ongoing since 1991. The population in Florida Bay, Everglades National Park is less dense and consists of ca. 80 nesting pairs (O. Bass pers. comm.). Studies of this population have been conducted since the 1960s (Ogden 1977). Sanibel Island Ospreys have been monitored since 1978 with over 350 chicks banded and a current population of ca. 100 pairs (M. Westall pers. comm.). In Maine we tagged birds with satellite transmitters on Sutton Island, located at ca. 44°16'N, 68°15'W, near Acadia National Park on the Atlantic coast. The most recent estimates place Maine's Osprey population between 13 000–18 000 nesting pairs with the densest concentrations along the coast (Houghton and Rymon 1997).

Satellite Telemetry. From 1999–2001, we attached 30—



Figure 1. Study areas (triangles), non-breeding season areas of southern Florida Ospreys (circles), and wintering areas of northern breeding Ospreys (squares).

Table 1. Movement patterns of Florida breeding Ospreys, by year of trapping, gender, and breeding area.

	YEAR OF TAGGING			GENDER		BREEDING AREA		
	1999	2000	2001	F	M	ISTOK-	SANIBEL	FLA. BAY
						POGA		
Migrated to So. America	4	1	2	6	1	7	0	0
Moved within Florida	0	4	0	4	0	2	2	0
Stayed on breeding area	0	2	0	1	1	0	1	1
No Data	0	1	0	1	0	0	0	1
Total	4	8	2	12	2	9	3	2

35 g battery or solar-powered satellite linked radiotelemetry units (PTTs; Microwave Telemetry, Columbia, MD) to 14 adult Ospreys in Florida (12 females and two males, no members of the same breeding pair), and two breeding pairs of adult Ospreys in Maine. PTTs were attached with Teflon ribbon (Bally Mills, Bally, PA) using a back-pick method (Martell et al. 2001).

Birds were trapped using a noose carpet on the nest. All trapped and tagged birds were banded with standard U.S. Geological Survey aluminum leg bands and an alpha-numeric coded color leg band. From 1995–2001, M. McMillian fitted 600 nestling Ospreys on Lake Istokpoga with standard USGS bands, and a unique combination of color bands. Since 1993, B. Mealey banded 153 Osprey chicks in Florida Bay. Long-term studies were not conducted in Maine.

Satellite data were mapped and plotted using ArcView (GIS; Geographic Information System ESRI, Redlands, CA). We calculated distances by connecting “best of day” points along the route using an orthographic projection (Martell et al. 2001). Band recovery distances were measured as straight lines between banding and recovery points using ArcView GIS orthographic projection.

RESULTS

Florida Breeding Ospreys. One (7%) radio from Buoy Key stopped working after 14 wk, precluding collection of meaningful data; we suspect this bird died. Seven birds (50%), six females and one male, all from Lake Istokpoga, migrated out of Florida to South America (Table 1, Fig. 2). One bird with a radio that transmitted into a second season reused its migration route and nonbreeding season destination.

Four (29%) birds moved off their breeding area, but stayed in Florida. From Lake Istokpoga, one bird moved east to St. Lucie County on the Atlantic coast, while a second moved south to Lake Okeechobee (Fig. 1), both in two successive years. From Sanibel Island one bird moved north to the Tampa Bay area (in 2 successive years), while a second moved east across the state to St. Lucie County. Two birds (14%) remained on their breeding areas

(on Sanibel and Florida bays, respectively) year round.

Timing and Distance. Florida Ospreys migrating to South America left their nesting grounds later, and traveled longer and farther than Ospreys that migrated within Florida (Table 2). Two South American migrants tracked in successive years departed within 6–7 d of the same date in both years.

We have full return migration data for only two birds. One traveled from Venezuela in 2001 and 2002 in 7 d (averaging 389 km/d) and 10 d (272 km/d), respectively. Compared to post-breeding movements to South America, return trips during spring were 10 d (2001) and 5 d (2002) shorter. The return route was shorter (by a mean of 310 km; see routes below) and flown more quickly (a difference of 109 km/d in 2001 and 72 km/d in 2002). The second bird also traveled from Venezuela in 2001, but took 1 d more and averaged 28 km/d less on the return flight than going south.

Migratory Routes and Non-breeding Areas. Migrants leaving for South America flew south from Lake Istokpoga, along the Florida Keys, then across the ca. 200 km expanse of the Florida Straits to the Bahia de Santa Clara area of Cuba, ca. 200 km east of Havana. The birds continued southeast across Cuba, to Hispaniola, then across the Caribbean. Landfall in South America was between Lake Maracaibo, Venezuela and the mouth of the Magdalena River in Colombia. From there the birds continued to their respective wintering grounds (Fig. 2). Spring and fall routes were similar with one notable exception. One bird used Hispaniola on the southward journey in both 2000 and 2001, but took a more westerly route on the northward journey, avoiding Haiti and staying over water from Venezuela to Cuba.

Florida nesting Ospreys wintered in South Amer-



Figure 2. Migratory routes of Florida breeding Ospreys (circles = locations during migration, triangles = nonbreeding areas).

ica from 3.4°N to 16.70°S and 51.6°W to 68.5°W in Venezuela (3 birds), Brazil (2 birds), Colombia (1 bird), and Bolivia (1 bird) (Fig. 2). All Ospreys tracked more than 1 yr ($N = 4$) returned to the same nonbreeding area in successive years.

Ospreys that stayed in Florida appeared to take the most direct route to their wintering area. Birds from Sanibel went to Tampa on the western side of the state and also St. Lucie County on the eastern side of the state. One bird from Lake Istokpoga went to St. Lucie County (Fig. 1).

Band Returns. There have been 20 recoveries of birds banded as nestlings on Lake Istokpoga. Three juvenile Ospreys and one 2-yr-old were recovered in South America (20%); two juveniles and one 3-yr-old bird were recovered in the Florida Keys south of the study area (15%); three juveniles, two 2-yr-old, and two 3-yr-old birds were recovered on the Gulf or Atlantic coasts of Florida and Georgia (35%); and one juvenile and five 2–5-yr-olds were recovered from central Florida near Lake Istokpoga (30%). Four Ospreys banded as nestlings

Table 2. Timing, distance, and daily progress of migration by Florida breeding Ospreys.

	OSPREYS MIGRATING TO SOUTH AMERICA	OSPREYS MIGRATING WITHIN FLORIDA
Departure from breeding ground		
<i>N</i>	9 ^a	5 ^b
Median	27 July	25 May
Range	16 July–27 August	13 May–20 July
Distance traveled		
<i>N</i>	7	3
Mean	4105	145
Range	2964–6133	96–205
Days in travel		
<i>N</i>	7	
Mean	25	All arrivals occurred on same
Range	14–43	day as departure
Mean daily speed (km/day)		
<i>N</i>	5	
Mean	178	
Range	151–206	
Arrival at nonbreeding site		
<i>N</i>	8 ^c	
Median	26 August	
Range	31 July–11 September	
Days at nonbreeding site		
<i>N</i>	4	3
Mean	154	154
Range	142–180	134–170
Departure from nonbreeding site		
<i>N</i>	4	4
Median	27 January	9 November
Range	10–31 January	28 October–9 December

^a Includes two birds leaving 6 and 7 d apart respectively in successive years.

^b Includes two birds leaving 3 and 30 d apart, respectively, in successive years.

^c Includes one bird that arrived 8 d apart in successive years.

in Florida Bay were recovered on the east coast of Florida (two as juveniles, one 1-yr-old, and one 4-yr-old).

Northern Ospreys Wintering in Florida. Two of four Ospreys tagged in Maine, a male and female not from the same nesting pair, and a male from Shelter Island, NY (reported in Martell et al. 2001) wintered in Florida. Both males wintered in the St. Lucie/Indian River County area on the Atlantic Coast, while the female wintered in Lee County, near Sanibel Island (Fig. 1). The male from Maine used its Florida wintering area in two successive years, spending 183 and 165 d from October–

March. The second male spent 163 d from 8 October–19 March. The female from Maine spent 188 d from 30 September–6 April.

DISCUSSION

Our telemetry and banding data show conclusively that the Osprey population breeding in southern Florida is partially migratory with some individuals migrating long distances, others migrating shorter distances within the state, and a third group that does not leave their breeding grounds. To our knowledge this is the first documentation that some south Florida Ospreys are mi-

gratory (see Poole 1989). Also, our documentation of northern-breeding birds wintering in Florida shows that Ospreys present in southern Florida during the nonbreeding season cannot be presumed to be local, year-round residents. Ospreys use southern Florida for both breeding and wintering and during spring and fall as a migratory route to and from Latin America (Martell et al. 2001).

Our data on Florida birds was heavily biased toward females (12 females versus two males) and breeders from Lake Istokpoga (9/14 tagged birds). Satellite telemetry studies done on Ospreys from the northern United States showed gender-specific differences in timing and wintering locations (Martell et al. 2001). It is possible that south Florida Ospreys would also show gender-based differences with a larger sample size of male birds.

Fifty percent of the satellite-tracked birds we studied, and 20% of the band recoveries from Lake Istokpoga, showed complete migrations to South America. These Florida birds are true migrants, showing both similarities and differences in their migration patterns when compared to other North American Ospreys. Birds in this study used the same routes through the Caribbean and South America as Ospreys from northern states (Martell et al. 2001), and they also showed the same multi-year fidelity to routes and wintering areas. Florida Ospreys spent a similar amount of time on their South American wintering areas (146 d, Table 2) when compared with Ospreys migrating from New York and New Jersey (153 d) or Minnesota (160 d; Martell et al. 2001). However, Florida Ospreys arrived on their South American territories between the beginning of August and mid-September, ahead of the more northerly breeding birds that are just beginning their fall migration at this time. Moreover, Florida Ospreys began their return migration in January, which is well before any northern breeding Ospreys initiate northward movements (Martell et al. 2001).

Not all southern Florida Ospreys migrate to South America. Some move off their breeding areas to nonbreeding sites in Florida, while others remain on their breeding areas year round. Partial migration occurs in other avian species (Cristol et al. 1999) including some where the ratio of migrants to non-migrants changes with latitude (Henny 1972). No other Osprey population along the eastern seaboard appears to be non- or partially

migratory (Henny and Van Velzen 1972; Poole and Agler 1987).

Many questions remain regarding the migrating habits of South Florida Ospreys including possible differences between genders, age groups, and the effects of successful versus unsuccessful breeding. Data from other Osprey populations suggest that migratory behavior remains constant from year to year, but further observation of this population is warranted to determine if the same holds true in Florida. The extent to which northern breeders use Florida also needs to be examined in more detail, especially with respect to interactions of wintering birds, with local breeders.

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LITERATURE CITED

- CRISTOL, D.A., M.B. BAKER, AND C. CARBONE. 1999. Differential migration revisited: Latitudinal segregation by age and sex class. *In* V. Nolan, E.D. Ketterson, and C.F. Thompson [EDS.], *Current Ornithology*. Vol. 15. Kluwer Academic/Plenum, New York, NY U.S.A.
- HAKE, M., N. KJELLEN, AND T. ALERSTAM. 2001. Satellite tracking of Swedish Ospreys *Pandion haliaetus* autumn migration routes and orientation. *J. Avian Biol.* 32:47–56.
- HENNY, C.J. 1972. An analysis of the population dynamics of selected avian species. Wildlife Research Report 1, USDI-Fish and Wildlife Service, Washington, DC U.S.A.
- AND W.T. VAN VELZEN. 1972. Migration patterns and wintering localities of American Ospreys. *J. Wildl. Manage.* 36:1133–1141.
- HOUGHTON, L.M. AND L.M. RYMON. 1997. Nesting distribution and population status of U.S. Ospreys 1994 *J Raptor Res.* 31:44–53.
- KJELLEN, N., M. HAKE, AND T. ALERSTAM. 1997. Strategies of two Ospreys *Pandion haliaetus* migrating between Sweden and tropical Africa as revealed by satellite tracking. *J. Avian Biol.* 28:15–23.
- MARTELL, M.S., C.J. HENNY, P.E. NYE, AND M.J. SOLENSKY. 2001. Fall migration routes, timing, and wintering sites of North American Ospreys as determined by satellite telemetry. *Condor* 103:715–724.

- OGDEN, J. 1977. Preliminary report on a study of Florida Bay Ospreys. Pages 143–151 in J. Ogden [ED.], Transactions of the North American Research Conference, U.S. Natl. Park Service, Williamsburg, VA U.S.A.
- POOLE, A.F. 1989. Ospreys: a natural and unnatural history. Cambridge Univ. Press, Cambridge, UK.
- AND B. AGLER. 1987. Recoveries of Ospreys banded in the United States, 1914–1984. *J. Wildl. Manage.* 51:148–155.
- RODRIGUEZ, F., M.S. MARTELL, P.E. NYE, AND K.L. BILDSTEIN. 2001. Osprey migration through Cuba. Pages 107–117 in K.L. Bildstein and D. Klem, Jr. [EDS.], Hawkwatching in the Americas. Hawk Migration Association of North America, North Wales, Pennsylvania, PA U.S.A.

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