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WINTERING ECOLOGY OF ADULT NORTH AMERICAN OSPREYS

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ABSTRACT.—North American Ospreys (*Pandion haliaetus*) typically migrate long distances to their wintering grounds in the tropics. Beyond the general distribution of their wintering range (i.e., the Caribbean, South America, and Central America), very little is known about the wintering ecology of these birds. We used satellite telemetry to determine the duration of wintering period, to examine the characteristics of wintering areas used by Ospreys, and to quantify space use and activity patterns of wintering Ospreys. Adult Ospreys migrated to wintering sites and exhibited high wintering site fidelity among years. Overall, Ospreys wintered on river systems (50.6%) more than on lakes (19.0%), and use of coastal areas was (30.4%) intermediate. Ospreys remained on their wintering grounds for an average of 154 d for males and 167 d for females. Locations of wintering Ospreys obtained via GPS-capable satellite telemetry suggest these birds move infrequently and their movements are very localized (i.e., <5 km from selected roosting areas). Sizes of home ranges and core-use areas for wintering Ospreys averaged 12.7 km^2 and 1.4 km^2, respectively. Overall, our findings suggest wintering adult North American Ospreys are very sedentary, demonstrating a pattern of limited daily movements and high fidelity to a few select locations (presumably roosts). We suggest this wintering strategy might be effective for reducing the risk of mortality and maximizing energy conservation.

KEY WORDS: *Osprey*; Pandion haliaetus; *habitat use*; *home range*; *migration*; *wintering ecology*.

ECOLOGÍA DE INVERNADA DE INDIVIDUOS ADULTOS DE *PANDION HALIAETUS*

RESUMEN.—*Pandion haliaetus* típicamente migra grandes distancias hacia sus sitios de invernada en los trópicos. Más allá de la distribución general del rango de invernada (i.e., el Caribe, América del Sur y América Central), se sabe muy poco sobre la ecología de invernada de esta especie. Utilizamos telemetría satelital para determinar la duración del periodo de invernada, examinar las características de las áreas de

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invernada utilizadas por *P. haliaetus* y cuantificar el uso del espacio y los patrones de actividad de individuos de esta especie. Los individuos adultos de *P. haliaetus* migraron hacia los sitios de invernada y exhibieron una elevada fidelidad por el sitio de invernada entre años. En general, *P. haliaetus* invernó en sistemas riparios (50.6%) más que en lagos (19.0%) y el uso de zonas costeras fue (30.4%) intermedio. Los individuos de *P. haliaetus* permanecieron en sus áreas de invernada un promedio de 154 días para los machos y 167 días para las hembras. Las ubicaciones de individuos de *P. haliaetus* obtenidas vía telemetría satelital GPS sugieren que estas aves se mueven con poca frecuencia y que sus movimientos son muy localizados (i.e., <5 km de las áreas de dormideros seleccionadas). El tamaño de las áreas de hogar y áreas núcleo de uso para invernada en *P. haliaetus* promedió 12.7 km^2 y 1.4 km^2 respectivamente. En general, estos hallazgos sugieren que los individuos adultos de *P. haliaetus* invernantes son muy sedentarios, demostrando un patrón de movimientos diarios limitado y una elevada fidelidad a las ubicaciones seleccionadas (presumiblemente dormideros). Sugerimos que esta estrategia de invernada puede ser efectiva para reducir el riesgo de mortalidad y maximizar la conservación de energía.

[Traducción del equipo editorial]

Ospreys (*Pandion haliaetus*) from most North American breeding populations are considered to be complete long-distance migrants (Poole 1989, Alerstam 1990). Individuals spend much of the year (i.e., 5–6 mo) on their wintering grounds (Poole et al. 2002); however, much more is known about the breeding ecology of North American Ospreys than the ecology of these birds during the wintering period (Poole 1989, Poole et al. 2002). Thus, increased information on their ecology during this portion of the annual cycle is critical for understanding their life history and important for their conservation and management.

Wintering localities of North American Ospreys have been described for several breeding populations using either band recovery information (Henny and Van Velzen 1972, Poole and Alger 1987, Johnson and Melquist 1991, Niemuth 1991, Mestre and Bierregaard 2009) or satellite telemetry (Martell et al. 2001, Houston and Martell 2002, Martell et al. 2004, Elliott et al. 2007). Collectively, this work has shown that the winter distribution of Ospreys that breed in North America is widespread, ranging in latitude from the southern United States to southern reaches of South America and in longitude from the west coast of Mexico eastward throughout the Caribbean and the eastern coast of South America.

Advances in satellite telemetry technologies have allowed new insights into the ecology of long-distance migrants (Seegar et al. 1996, Limiñana et al. 2007, Gill et al. 2009). In particular, the recent development of global positioning system (GPS)-accurate satellite telemetry has the potential to further increase our understanding of avian ecology (Meyburg et al. 2006, Klaassen et al. 2008). This technology has the advantage of providing previously unobtainable information of unprecedented spatial and temporal resolution to researchers, most notably when birds are on their wintering grounds in distant and remote locations. These tools have led to a better understanding of the specific migration routes and wintering localities of many raptors, including Ospreys (Hake et al. 2001, Martell et al. 2001, Meyburg et al. 2004, McIntyre et al. 2008).

Here, we describe various aspects of the wintering ecology of North American Ospreys determined through the use of satellite telemetry. The objectives of our study were to: (1) determine the duration of their wintering period, (2) examine the characteristics of wintering areas used by Ospreys, and (3) quantify space use and daily activity patterns of wintering Ospreys.

METHODS

Osprey Capture and Marking. Adult Ospreys were studied from areas chosen to represent breeding populations from the northeastern, mid-east coast, southeastern, midwestern, and western United States (Henny 1983, Martell et al. 2004). During 1995–2009, we studied a total of 79 individual adult Ospreys (50 females and 29 males) from five separate breeding populations (regions) in the United States (Table 1). We captured Ospreys within their nesting territories using a carpet-noose trap placed over their nest or a modified dho-gaza trap baited with a Great Horned Owl as a lure (Bloom et al. 2007). We determined sex of all captured Ospreys by plumage, size, and behavior at the nest (Poole 1989). In addition, each Osprey was fitted with a satellite telemetry unit (weight of unit 30–35 g) via a standard backpack configuration (Kenward 2001, Martell et al. 2001) using a Teflon ribbon (Bally Ribbon Mills, Bally, Pennsylvania) harness.

Monitoring by Satellite Telemetry. Battery-powered satellite telemetry units (30-g PTT-100; Microwave

Table 1. Capture and satellite-tagging location of North American Ospreys from five breeding populations (regions) in the United States, 1995–2007.

Breeding Population	States	Females	Males	Total
East Coast–FL	Florida	6	1	7
East Coast–Mid	Virginia, North Carolina, South Carolina	7	4	11
East Coast–NE	Maine, Massachusetts, New York, New Jersey	16	14	30
Midwest	Minnesota	8	8	16
Pacific NW	Oregon	13	2	15
Total		**50**	**29**	**79**

Telemetry Inc., Columbia, Maryland) were used in 62 deployments during 1995–2001 and solar-powered satellite telemetry units (35-g PTT-100; Microwave Telemetry Inc., Columbia, Maryland) were used in 32 deployments during 1999–2004. Two Ospreys tagged with solar-powered satellite telemetry units provided wintering information during two successive years. Fourteen Ospreys were recaptured during breeding season in successive years (1–4 yr following the initial tagging) and fitted with a new satellite telemetry unit. All satellite telemetry units were programmed to transmit data for an 8– or 10–hr period followed by a 20–72 hr off period.

Accuracy of ARGOS-provided location estimates depends on a variety of factors, including the number of transmissions received during a satellite pass, the local environment where the satellite transmitter is located, the elevation and velocity of the transmitter, and other variables (Keating et al. 1991, Britten et al. 1999, Vincent et al. 2002). Estimates of location error were reported by the ARGOS satellite system as location classes (3, 2, 1, 0, A, B, and Z), in decreasing order of estimated accuracy. Evaluations of accuracy for ARGOS-acquired locations by other researchers using similar-sized satellite transmitters suggest that actual location estimates during field situations may be less accurate than the error rates reported by ARGOS (Britten et al. 1999, Soutullo et al. 2007). For this study we used only those location estimates with LCs of 3, 2, or 1 (CLS America 2008), used a ''best of day'' approach (i.e., we selected and used the most accurate location for a given transmission period based on reported location classes), and removed locations that appeared to be in error (based on visual inspection).

The seven Ospreys (four females and three males) captured and tagged in Virginia during 2006–2007 were fitted with solar-powered GPS-capable satellite transmitters (30-g Solar Argos/GPS PTT-100; Microwave Telemetry Inc., Columbia, Maryland). These units were programmed to operate at 2–hr intervals between 0500 and 2300 H local standard time and provided information (i.e., 10 times per d) prior to 1 November and after 14 January of each year. During 1 November–14 January, the telemetry units were programmed to provide information three times per day (at 0600, 1200, and 1800 H local standard time). At each individual operation, the GPS receiver within the satellite telemetry unit estimated the position (±18 m), altitude above sea level (±22 m), and flight speed (±1 km/hr; all accuracy estimates provided by the manufacturer). Two of the GPS satellite telemetry units provided wintering information during two successive years.

Wintering Period. Arrival dates on the wintering grounds were calculated using the median date between the last signal during fall migration and the first signal from the wintering area. Similarly, departure dates from the wintering areas were calculated using the median date between the last signal on the wintering grounds and the first signal during spring migration. The number of days Ospreys spent on their wintering grounds (i.e., duration of the wintering period) was determined by totaling the number of days between the arrival and departure dates for each individual bird. For Ospreys (n = 18) that were tracked for at least part of >1 wintering period, each individual winter period for a given bird was not independent from the wintering period for that bird in another year; to avoid pseudo-replication, we randomly selected one wintering period for each individual bird for the statistical analyses (see below).

Characteristics of Wintering Sites. The wintering site of each Osprey (n = 79) was determined by averaging the location estimates (range = 15 to 578 per bird) provided by the bird's satellite transmitter. Using Google Earth™ (http://earth.google.

com), we plotted a circle with a radius of 5 km around the wintering site of each individual Osprey (this plot size was selected based on space use of wintering Ospreys; see below). We determined the dominant habitat type within that circle from visual inspection of satellite images and aerial photographs (within Google Earth) and classified each wintering area as one of five categories: forested, wetland, grassland, agricultural, or residential (human). We acknowledge this provided a very rough estimate of habitat. In addition, we identified the type of water body contained within or nearest to that wintering area and classified each wintering area into one of three categories: coastal area, river (freshwater), or lake (freshwater).

Space Use of Wintering Osprey. Only the GPS-capable satellite transmitters provided information detailed enough to allow us to estimate space use and activity patterns of wintering Ospreys. Four Ospreys tagged with GPS satellite transmitters provided location information for complete wintering periods. One of these birds (ID: male 54) provided data for two consecutive complete wintering periods. For each Osprey (and each year for male 54), we used only locations obtained at 0600, 1200, and 1800 H local time (i.e., three locations per d) to ensure data consistency throughout the wintering period. We determined wintering home range (95% utilization distribution [UD]) and core-use area (50% UD) sizes for each Osprey using the fixed-kernel method (Seaman and Powell 1996, Kernohan et al. 2001). We used least-squares cross-validation for bandwidth selection (Seaman et al. 1999, Kernohan et al. 2001) and used Hawth's Analysis Tools (http://www.spatialecology.com/htools) and ArcGIS 9.2 (ESRI, Redlands, California) to calculate the sizes of wintering home ranges and core-use areas for each Osprey.

Activity Patterns. For this analysis, we used data from Osprey tagged with GPS-capable satellite transmitters ($n = 7$) and used only data obtained during periods when the transmitters provided 10 locations per d (we used a total of 5103 individual locations; range = 322 to 950 locations per bird). For each individual location of each Osprey, we determined whether the bird was actively moving using the information provided by the transmitters. The bird was considered active (e.g., fishing or flying) when the flight speed was >0 km/hr or when the flight speed was 0 km/hr and the altitude was >35 m above the ground level at that location (at altitudes below this height, we assumed the bird was perched). We determined the average proportion of activity for each Osprey during 10 time periods within a day (i.e., at 2–hr intervals) during the wintering period.

Statistical Analyses. We used two-way analysis of variance (ANOVA) to test for differences in arrival date onto wintering grounds, departure date from wintering grounds, and the duration of the wintering period associated with Osprey sex and breeding region. We used Fisher's protected LSD tests to compare among means when main effects were significant (Zar 1996). We compared the proportion of Osprey wintering areas that were classified into major (dominant) habitat types and water bodies using log-linear analysis for contingency tables (Zar 1996). For kernel home range estimates (95% UD) and core-use areas (50% UD), we present only descriptive statistics due to small sample sizes. We compared activity of wintering Ospreys during various time periods during the day using *G*-tests for independence (Zar 1996). We considered differences to be significant at $P \leq 0.05$ and conducted all analyses using SAS statistical software version 9.1 (SAS Institute, Cary, NC). Data are presented as mean ± 1 standard error.

RESULTS

Arrival, Duration of Wintering Period, and Departure. Ospreys arrived on their wintering areas as early as 31 July and as late as 4 December. We found differences in arrival date by breeding region ($F_{4,81} = 4.67$, $P = 0.002$); Ospreys that bred in Florida arrived on their wintering grounds in the Caribbean and South America prior to Ospreys whose fall migration originated elsewhere (Table 2). In addition, female Ospreys arrived at their wintering areas earlier than males (21 September ± 2 d vs. 7 October ± 3 d, respectively, $F_{1,81} = 6.63$, $P = 0.001$). We did not find a significant interaction between breeding region and sex ($F_{4,81} = 0.54$, $P = 0.70$).

Wintering site fidelity was very high for adult Ospreys. Eighteen of 18 (100%) of the Ospreys tracked for a second wintering period returned to the same wintering site (i.e., <1 km distance) as the previous year.

The duration of the wintering period did not differ ($F_{4,37} = 1.58$, $P = 0.21$) among Ospreys from various breeding populations in North America (Table 2). Overall, sex influenced the duration of wintering period in Ospreys, with females (167.0 ± 3.2 d) spending more ($F_{1,37} = 4.97$, $P = 0.02$) time wintering than males (153.6 ± 3.7 d). We did not find a significant interaction between breeding region and sex ($F_{4,37} = 0.22$, $P = 0.92$).

Table 2. Average arrival date, departure date, and number of days of the wintering period (±SE) for wintering female and male Ospreys from different breeding populations (regions) within North America.

	BREEDING REGION				
WINTERING DATES	EAST COAST–NE[a]	EAST COAST–MID	EAST COAST–FL[b]	MIDWEST[a]	PACIFIC NW[a]
Arrival date					
Females	21 September ± 3	26 September ± 10	19 August ± 6	2 October ± 3	21 September ± 2
Males	8 October ± 6	6 October ± 11	8 September ± 4	14 October ± 4	29 September ± 3
Departure date					
Females	10 March ± 5	3 March ± 15	19 January ± 9	15 March ± 2	20 March ± 3
Males	23 March ± 3	14 March ± 6	30 January ± 2	24 March ± 3	24 February ± 17
No. of days wintering					
Females	160.6 ± 5.4	170.3 ± 15.9	163.0 ± 17.0	163.1 ± 1.7	183.8 ± 3.2
Males	156.6 ± 6.4	158.3 ± 1.8	144.5 ± 2.5	153.2 ± 5.9	148.3 ± 20.0

[a] Arrival date information for some Ospreys from this breeding population was previously reported in Martell et al. (2001). In this study, we provide a reanalysis of these data with additional information.
[b] Arrival date information for some Ospreys from this breeding population was previously reported in Martell et al. (2004). In this study, we provide a reanalysis of these data with additional information.

At the end of the wintering period, Ospreys departed on their spring migrations as early as 10 January and as late as 7 April. We found no significant interaction between breeding region and sex ($F_{4,37}$ = 1.22, P = 0.33). Wintering Ospreys that nested in Florida during the previous summer departed the earliest, but among those from the Pacific Northwest, females had the latest median departure date, whereas males had the second earliest median departure date (Table 2).

Characteristics of Wintering Area. The wintering area of all Ospreys studied (n = 79) contained at least one major water body. Overall, Ospreys wintered on river systems (50.6%) more than on lakes (19.0%), and use of coastal areas (30.4%) was intermediate. Sex influenced the type of water body within Osprey wintering areas. Female Ospreys wintered on river systems more (G^2 = 28.62, df = 2, $P <$ 0.0001) than coastal areas or lakes, whereas male Ospreys wintered on all three water body types equally (G^2 = 1.28, df = 2, P = 0.57; Fig. 1A). Like sex, the breeding region of Ospreys influenced the type of water body within the wintering area. Ospreys from East Coast–Florida (G^2 = 7.68, df = 2, P = 0.02), East Coast–Northeast (G^2 = 9.42, df = 2, P = 0.001), and Midwest (G^2 = 4.03, df = 2, P = 0.04) breeding populations wintered on river systems more frequently than on coastal areas or lakes, whereas Ospreys from East Coast–Mid (G^2 = 3.42, df = 2, P = 0.21) and Pacific Northwest (G^2 = 0.72, df = 2, P = 0.68) breeding populations wintered on all three water body types with equal frequency (Fig. 2A).

Overall, Ospreys wintered in forest-dominated areas (50.6%) more than areas dominated by grasslands

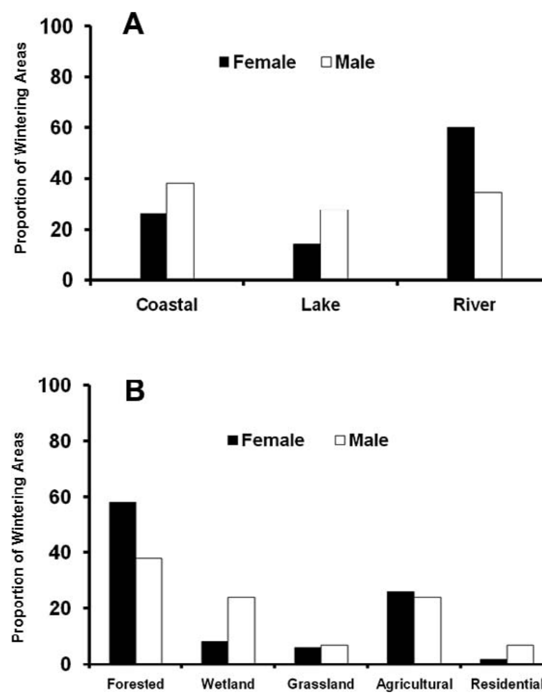

Figure 1. Proportion of female and male Osprey wintering areas (n = 79) that contained one of three water body types (A) or one of five dominant habitat types (B).

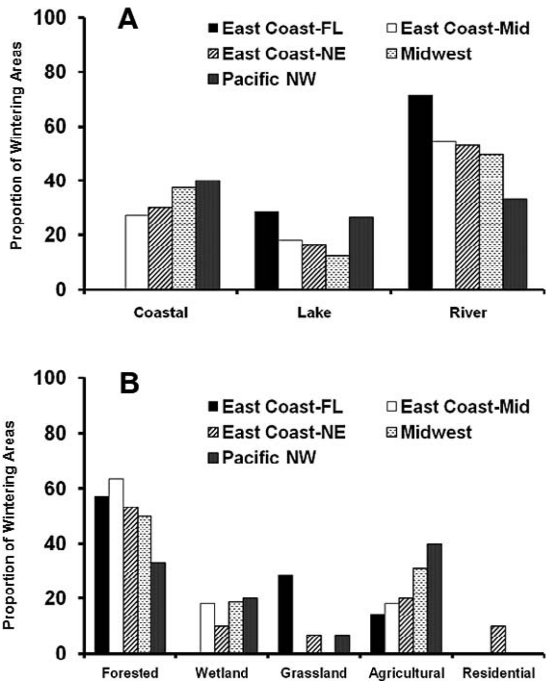

Figure 2. Proportion of wintering areas (n = 79) from five North American Osprey breeding populations that contained one of three water body types (A) or one of five dominant habitat types (B).

(6.3%) and residential areas (3.8%); wetland areas (13.9%) and agricultural areas (25.3%) were also commonly used habitat types for wintering Ospreys. Forested and agricultural areas were the most frequent habitat type found in both female ($G^2 = 64.38$, df = 4, $P < 0.0001$) and male ($G^2 = 12.14$, df = 4, $P = 0.01$) Osprey wintering areas (Fig. 1B). Forest was the most frequent, whereas residential was the most infrequent, dominant habitat type found in Osprey wintering areas from all five breeding populations (all $G^2 > 9.65$, df = 4, $P = 0.04$; Fig. 2B).

Space Use of Wintering Ospreys. The GPS-capable satellite telemetry provided unprecedented insight into the temporal and spatial patterns of activity and space use of wintering Ospreys. We found no evidence that adult Ospreys shift their habitat use or winter home ranges during the wintering period. Ospreys made only short-distance local movements, with one exception. A female Osprey (satellite-tagged in North Carolina) that spent 3 mo wintering in the Amazonian rainforest in western Peru moved 700 km north to the Cauca Valley in Colombia (where it spent another month before starting its spring migration).

The winter home-range size and core-use area for female Ospreys ranged from 18.3 to 26.0 km² and 1.9 to 2.5 km², respectively. Male Ospreys had winter home ranges and core-use areas that ranged from 2.2 to 14.5 km² and 0.7 to 0.9 km², respectively. The home ranges and core-use areas used by male 54 during two consecutive years (2007 and 2008) were very similar in size and location (Table 3).

Over 97% of the locations provided by the GPS satellite transmitters were within 5 km of the center of the Ospreys' core-use areas. All four Ospreys had winter home ranges that contained areas of water bodies (presumably for foraging) and selected roost sites (within core-use areas) that were used extensively. Ospreys (n = 3) that wintered on rivers had larger home ranges than the Osprey that wintered on a lake (male 54; Table 3). Ospreys wintering on rivers had home ranges that were more oval (linear) in shape than the Osprey that wintered on a lake.

Activity Patterns. Wintering Ospreys exhibited a diurnal activity pattern. Information from the satellite transmitters showed that Osprey movements were restricted to daylight hours, with the majority of activity occurring between 1000 and 1600 H local standard time (Fig. 3). The four female and three male Ospreys exhibited similar activity patterns during the wintering period (Fig. 3).

DISCUSSION

Ospreys tracked using satellite telemetry in this study wintered in areas consistent with the previously reported wintering range of North American Ospreys (Poole and Alger 1987, Martell et al. 2001, Poole et al. 2002). As in previous studies (Poole and Alger 1987, Martell et al. 2001), we found differences in the wintering localities of North American Ospreys due to sex and the breeding region where they nested the previous summer.

Close examination of satellite tracking information suggests that during the later stages of fall migration (e.g., arrival into South America), adult Ospreys traveled directly to wintering sites (Washburn and Olexa 2011, Martell et al. 2014). More specifically, Ospreys continued their diurnal movement pattern along a migration path that led directly to their wintering site. Hake et al. (2001) reported a similar pattern for Swedish Ospreys wintering in Africa. Furthermore, individual Ospreys exhibited a high level of wintering site fidelity and used the same wintering area in consecutive wintering

Table 3. Fixed-kernel home range (95% utilization distribution) and core-use area (50% utilization distribution) sizes (km^2) for four Ospreys during their wintering period. Osprey Male ''54'' was studied during two consecutive wintering periods.

OSPREY ID	WINTERING SITE	n	HOME RANGE (km^2)	CORE-USE AREA (km^2)
Female 48	Amazon River, Brazil	510	25.98	1.92
Female 94	Berbice River, Guyana	578	18.28	2.51
Male 52	Orinoco River, Venezuela	463	14.45	0.87
Male 54 (2007)	Lake Valencia, Venezuela	464	2.24	0.67
Male 54 (2008)	Lake Valencia, Venezuela	433	2.53	0.76

periods. We suspect that previous knowledge and familiarity with local foraging and roosting areas within an Osprey's wintering area are advantageous to their survival during the wintering period (Martell et al. 2001).

Like Martell et al. (2001), we found differences in arrival dates of Ospreys onto their wintering grounds due to sex and breeding population (region). Ospreys that nested in Florida were the first to arrive on their wintering grounds in the fall and were the first to leave on spring migration, compared to Ospreys from the other breeding populations. Overall, female Ospreys spent longer periods of time on their wintering grounds compared to males, consistent with their earlier arrival on wintering areas (on average 12 d prior to males).

The wintering areas used by all Ospreys in this study contained at least one water body within 5 km, such as a coastal area, lake, or river. This finding was expected, given the diet of Ospreys consists almost entirely of live fish (Poole 1989, Poole et al. 2002). Although Ospreys are piscivorous, they are able to use a diversity of aquatic habitats and successfully forage on a large variety of fishes from both marine and freshwater systems (Swenson 1978, Poole et al. 2002, Glass and Watts 2009). This dietary plasticity likely allows Ospreys to use a variety of aquatic systems for foraging during the wintering period. Although female Ospreys selected wintering sites on river systems more often than on lakes or coastal areas, males used inland (lakes and rivers) and coastal areas with similar frequency. As females arrive on their wintering grounds prior to males (this study, Hake et al. 2001, Martell et al. 2001), they might select the wintering areas that offer high quality or more abundant food resources (e.g., fish).

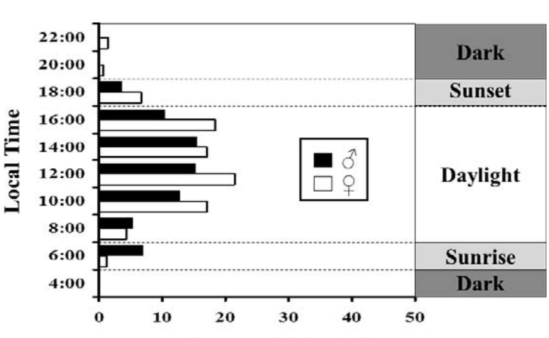

Figure 3. Daily activity patterns (% of times Osprey was moving when located by satellite) during 10 time periods for female (n = 4) and male (n = 3) Ospreys during their wintering period, 2006–2008.

Forest was the most common dominant habitat type within Osprey wintering areas, followed by agricultural lands. In general, Ospreys chose to winter in locations that were away from human settlements. However, Ospreys wintering in Florida near residential areas were an interesting exception to this pattern. Aquaculture facilities, a potential location of interaction and conflict between Ospreys and humans, were present in only three of the wintering areas (one in Jamaica and two in Honduras) selected by Ospreys in this study. Shooting has historically, and is currently, a major source of mortality for Ospreys (Poole and Alger 1987, Poole et al. 2002) and other raptors (Hoffman et al. 2002) during their wintering period, as evidenced by band recoveries (Poole and Alger 1987, Santana and Temple 1987, Niemuth 1991, Mestre and Bierregaard 2009). Although raptors currently receive protection from human-induced mortality while in the United States, while they are migrating to or on their wintering grounds there are fewer laws protecting them and little enforcement of such laws. Individual Ospreys that forage at aquaculture facilities might be at higher risk for human-induced mortality (Bechard and Márquez-Reyes 2003).

Overall, wintering Ospreys were very sedentary and active only during daylight hours. We suspect that wintering Ospreys selected an area with adequate forage resources. We suggest that this wintering strategy might be effective for reducing the risk of mortality and maximizing energy conservation (Prevost 1982).

Although our study provides the first detailed information regarding the wintering ecology of North American Ospreys, more research is needed. Evaluation of local distribution and densities of wintering Ospreys within habitat types (e.g., coastal areas, rivers), diet and habitat use of Ospreys throughout their wintering range, effects of deforestation and other landscape-scale habitat changes, impacts of human-induced mortality (e.g., shooting) on Osprey population dynamics, and the role of pesticides and contaminants obtained by Ospreys while on their wintering grounds (e.g., Elliott et al. 2007) are important areas for future research. Such information is essential for understanding the wintering ecology of Ospreys that breed in North America and thus allowing for their conservation and management in the future.

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