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WINTERING OF OSPREYS IN ARGENTINA: INSIGHTS FROM NEW RECORDS BETWEEN 1993–2008

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ABSTRACT.—The migratory subspecies of the ''American'' Osprey (*Pandion haliaetus carolinensis*) breeds across most of North America. Most of these Ospreys winter north of the equator, although significant numbers travel farther south, reaching Argentina. The number of Osprey sightings in Argentina has increased since the first review of their status in this country. We analyzed records of Osprey migration and distribution in Argentina from 1993 to 2008. We found that Ospreys occur year-round in Argentina, with a higher concentration in spring to summer (1 October to 31 March). Our data confirmed that in northern and northeastern Argentina, Ospreys use river systems and their major tributaries, and in central and northwestern regions, they commonly frequent reservoirs. The apparent increase in the number of Osprey records in Argentina in the last decades may result from an actual population increase but may also reflect a larger number of observers. Recent records suggest that Osprey should be considered a regular visitor to northern Argentina. We confirm the importance of northeastern rivers, and central and northwestern reservoirs as wintering areas. Argentina has been noted as an important wintering area for many migratory birds, but has been underestimated as a wintering area for Osprey.

KEY WORDS: *Osprey*; Pandion haliaetus; *Argentina*; *conservation*; *distribution*; *habitat*; *phenology*.

INVERNADA DE *PANDION HALIAETUS* EN ARGENTINA: PERSPECTIVAS A PARTIR DE NUEVOS REGISTROS ENTRE 1993–2008

RESUMEN.—La subespecie migratoria *Pandion haliaetus carolinensis* se reproduce a través de la mayor parte de América del Norte. La mayoría de estos individuos invernan al norte del Ecuador, aunque números significativos de individuos de esta especie viajan más hacia el sur, llegando a Argentina. El número de avistamientos de individuos de *P. h. carolinensis* en Argentina ha aumentado desde la primera revisión de su estatus en dicho país. Analizamos los registros de migración y de distribución de *P. h. carolinensis* en Argentina desde 1993 hasta 2008. Encontramos que los individuos de esta especie se pueden observar todo el año en Argentina, con una mayor concentración en primavera y verano (primero de octubre a 31 de marzo). Nuestros datos confirmaron que en el norte y el noreste de Argentina, *P. h. carolinensis* utiliza sistemas riparios y sus tributarios mayores, mientras que en las regiones centrales y del noroeste comúnmente frecuentan embalses. El incremento aparente en los registros de individuos de *P. h. carolinensis* en las últimas décadas puede ser el resultado de un incremento poblacional real pero también puede reflejar un mayor número de observadores. Los registros recientes sugieren que *P. h. carolinensis* debería ser considerada como un visitante regular del norte de Argentina. Confirmamos la importancia de los ríos del noreste y de los embalses del centro y noroeste como áreas de invernada. Argentina ha sido destacada como un área importante de invernada para muchas especies de aves migratorias, pero ha sido subestimada como un área de invernada para *P. h. carolinensis*.

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The ''American'' Osprey (*Pandion haliaetus*) comprises two subspecies. *Pandion h. carolinensis* breeds in Canada, the United States, and northwestern Mexico. A nonmigratory subspecies (*P. h. ridgwayi*) breeds from eastern Mexico and Central America as far south as Belize and across parts of the Caribbean (Poole 1989, Poole et al. 2002, Wiley et al. 2014). Most populations of *P. h. carolinensis* are complete migrants (Kerlinger 1989, Bildstein 2006, Goodrich and Smith 2008). Exceptions include birds from Florida and Mexico, which usually remain on their breeding ranges year-round (Farmer et al. 2008, Goodrich and Smith 2008). Most migratory individuals winter in tropical areas of central and northern South America (Henny and Van Velzen 1972, Poole 1989, Martell et al. 2001). Band recovery and satellite-telemetry data suggest that most Ospreys spend their winter north of the equator, although significant numbers travel farther south (Henny and Van Velzen 1972, Poole and Agler 1987, Poole 1989, Martell et al. 2001, Mestre and Bierregaard 2009). A relationship between wintering areas and the origin of the individuals (western, midwestern, eastern and mid-Atlantic populations) has been proposed (Poole and Agler 1987). Western Ospreys winter mainly in Mexico and Central America (Henny and Van Velzen 1972, Johnson and Melquist 1991, Martell et al. 2001), while midwestern, eastern, and mid-Atlantic populations winter mainly north of the equatorial line in Brazil, Colombia, and Venezuela (Henny and Van Velzen 1972, Melquist et al. 1978, Poole and Agler 1987, Santana and Temple 1987, Martell et al. 2001).

Ospreys also winter south of the equator in Paraguay, Bolivia, southern Brazil, Uruguay, Chile, and Argentina (Henny and Van Velzen 1972, Schlatter and Morales 1980, Poole and Agler 1987, Hayes 1995, Saggese et al. 1996, Sick 2001, Martell et al. 2001, Silva e Silva and Olmos 2002, Mestre and Bierregaard 2009, Juhant 2012). The southernmost areas Ospreys have been recorded in South America are central Chile, from Tarapaca to Valdivia along the Pacific Ocean (Schlatter and Morales 1980, Jaksic and Jiménez 1986), and the Atlantic coast of Chubut province, northern Argentinean Patagonia (Saggese et al. 1996, Harris 1998).

According to recent records of Ospreys in Argentina reported on electronic bird forums and email groups, it appears that the number of sightings has increased within the last decades, although only a small number of these records have been published (e.g., Ricchieri 1994, Babarskas et al. 1995, Nores 1996, Morici and Diéguez 1997, Martínez et al. 1998, Baigorria 1999, Heinonen Fortabat and Fabri 2001, Volkmann and Cargnelutti 2001, Babarskas et al. 2003, Raymundi 2006, Pereyra-Lobos and Yacante 2008) since Saggese et al. (1996) reviewed the status of Osprey in Argentina. This encouraged us to compile and analyze recent unpublished records with the aim of understanding the current status and migration of Ospreys in Argentina. In this report, we update the information available about Osprey migration in Argentina based upon our own sightings as well as on those obtained through a recent survey conducted among ornithologists and qualified bird-watchers. We focus on spatial and temporal distribution, water system use, and observations on behavior and diet when available. We also discuss possible causes of the increase in sightings, and potential threats. Finally, we identify potential areas in which further research is needed to better understand the biology and abundance of Ospreys wintering at the southernmost limit of its distribution.

METHODS

Observations of Ospreys in Argentina were collected from professional ornithologists and birdwatchers initially contacted primarily through electronic forums such as ''Alertaves,'' ''Fororapaces,'' ''FaunaLatina,'' ''Neoorn,'' ''Neotropicalraptors,'' ''Ornitologiauy,'' ''Americaves,'' and ''Americaves II,'' between March and September 2008. For each sighting, observers were asked to provide location (e.g., locality, department, and province), date, geographic coordinates (as precise as possible), and the type of aquatic or water system where the birds were observed (e.g., reservoirs associated with artificial dams, rivers, lagoons, or marshes). We also identified the biogeographical region where these observations were made, following Cabrera (1976). We tallied any number of birds observed on a single occasion as one visual sighting or record, although we also report and summarize total numbers. Records are presented by each austral season, defined as: summer (1 January–31 March); fall (1 April–30 June); winter (1 July–30 September); and spring (1 October–31 December). Osprey sex and age are difficult to differentiate under field conditions (Poole 1989, Blanco and Rodríguez-Estrella 1999) and even more difficult for observers without previous experience; thus, we made no attempt to classify these birds by sex or age class. Birds observed for several successive days in the same place were considered as

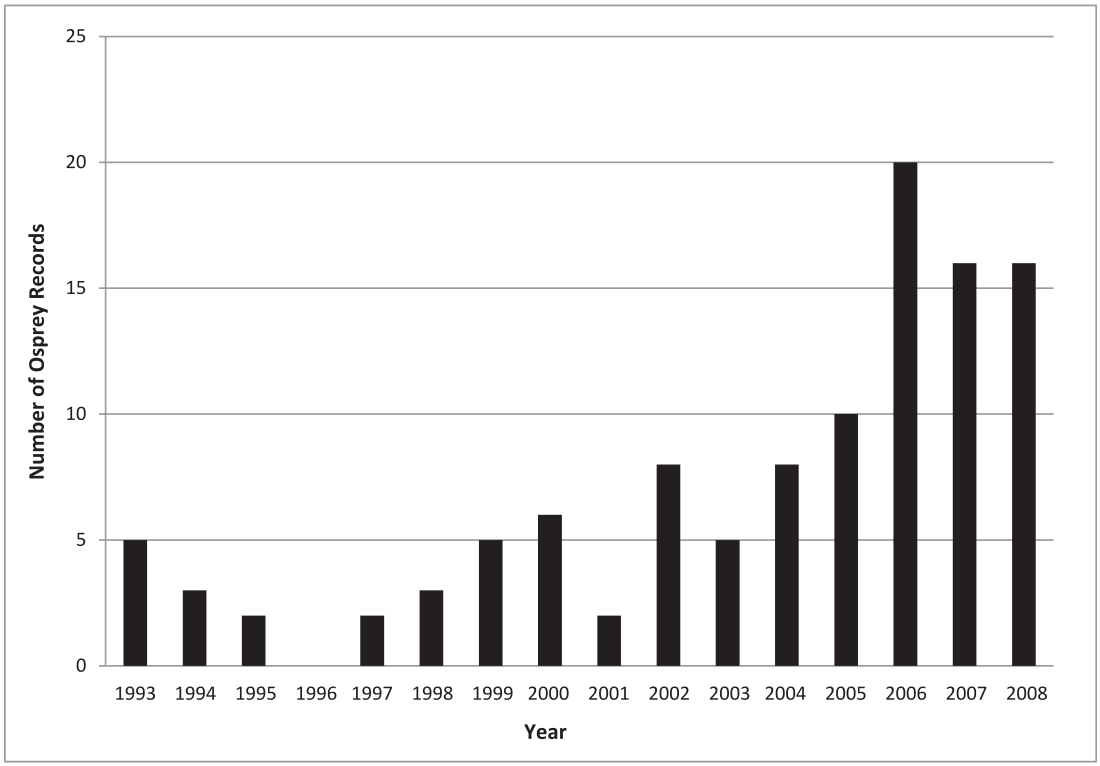

Figure 1. Records of Osprey observations in Argentina, 1993–2008.

a single record, but the extension of this permanence was also recorded.

Results

We collected 111 confirmed field sightings of Ospreys in Argentina between 1993–2008, including 12 previously published observations for this period (Appendix, Fig. 1). These 111 records were from the provinces of Misiones (n = 23), Tucumán (n = 16), Entre Ríos (n = 17), Formosa (n = 10), Santa Fé (n = 8), Corrientes (n = 10), Buenos Aires (n = 8), Chaco (n = 8), Mendoza (n = 3), Catamarca (n = 2), Jujuy (n = 1), San Luis (n = 1), Santiago del Estero (n = 1), Río Negro (n = 1), Salta (n = 1) and Ciudad Autónoma de Buenos Aires (CABA; n = 1; Appendix, Fig. 1). Pereyra-Lobos and Yacante (2008) observed Ospreys in Mendoza province from 1998 to 2000, but detailed information was not provided and their data were not included in our analysis.

Osprey sightings were recorded in all months, with more records during the austral spring and summer (n = 85; 76%) and only 26 (24%) in the austral fall and winter (Fig. 2). The highest number of Osprey sightings occurred in January (summer; n = 23; 21%), with the fewest occurring in the months of September (n = 2), August (n = 3), and May (n = 3). Most observations consisted of single birds (n = 88; 79%), but groups of two, three, four, and up to five Ospreys were observed in 12, 5, 4, and 2 instances, respectively. In central, northern, and northeastern Argentina, Ospreys were observed mainly along natural rivers (n = 70; 64% of all Osprey sightings), although reservoirs (n = 24; 22%) were the main water bodies used by Ospreys in central and northwestern provinces; marshes, lagoons and lakes were used less (n = 16; 14%). The largest number of sightings came from a few areas in central, northern, and northeastern Argentina, where Ospreys are regularly found (Fig. 3). Only one Osprey was observed flying over the High Andes plateau in Jujuy province (at 3500 masl), far from any important wetland or water system. Records of Ospreys along the Atlantic coast of Argentina were not obtained during this period. The largest number of Osprey observations we found were within two biogeographic regions, the Atlantic rainforest and

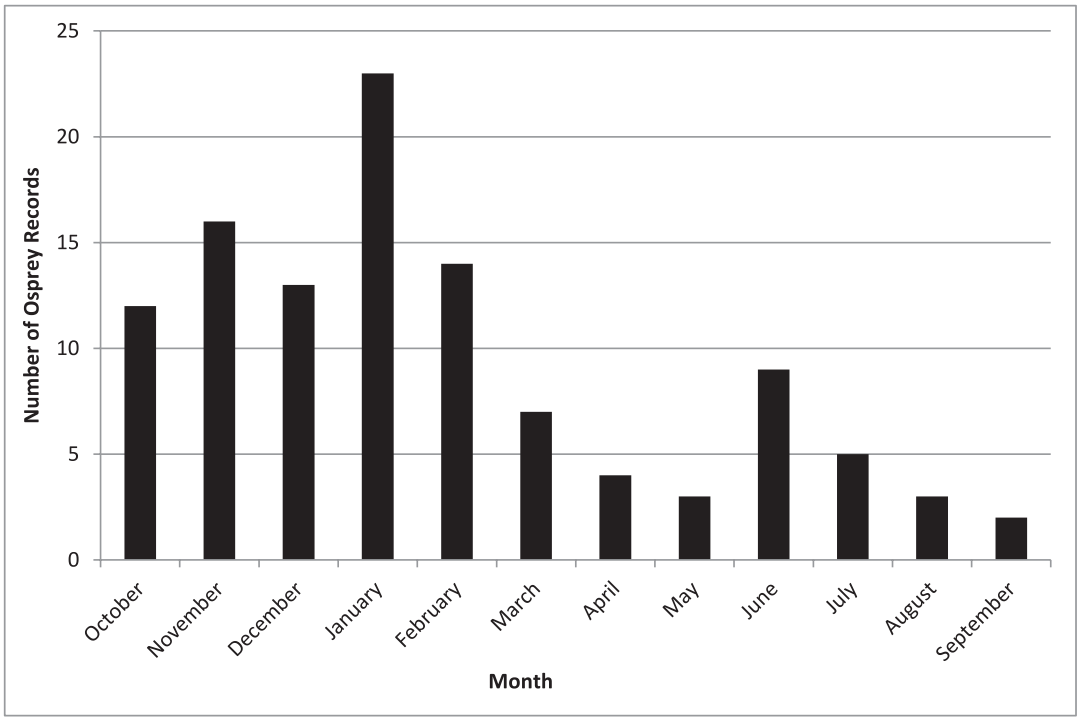

Figure 2. Total monthly records of Osprey observed in Argentina for the years 1993–2008.

Chaco (wet and dry Chaco) *sensu* Cabrera (1976). Ospreys appear to be selecting only areas with large shallow water bodies, such as rivers and reservoirs.

Observations of Ospreys' wintering behavior were obtained in some cases. For most of the sightings, no interactions with other species were reported. On two occasions, observers reported Ospreys being harassed by gulls and terns (Laridae) and by Gray-breasted Martin (*Progne chalybea*) on one occasion. They were also observed circling high on the Iguazú River and Isla San Martín and Atlantic Forest in company of Black Vultures (*Coragyps atratus*), a species fairly common in Iguazú National Park, Misiones province, and northeastern Argentina. One observer reported Turkey Vultures (*Cathartes aura*) harassing an Osprey that had recently caught a fish.

Fishing behavior was rarely reported and mostly limited to recently caught prey, including ray-finned fish (*Prochilodus platensis*), silverside fish (Atherinopsidae), carp (*Cyprinus carpa*), and armado catfish (Doradidae). Additional information about the diet of the species was provided by Alejandro Bodratti (pers. comm.) who, in December 1999, observed an Osprey perching at the same site for several days in Estancia Laguna Cora, Chaco province. At the base of the perch he found remains of twospot astyanax (*Astyanax bimaculatus)*, banded knifefish (*Gymnotus carapo)*, wolf fish (*Hoplias malabaricus)*, and two species of catfish, (*Pimelodus argentatus* and *P. albicans)*.

Discussion

Large-scale patterns of spatial variation in a species' geographic range size are important to fundamental questions in macroecology and conservation biology (Orme et al. 2006). Thus, understanding the spatial and temporal distribution and ecology of the Osprey, a migratory raptor species with a worldwide distribution, at the southern limit of its wintering range, is important for our comprehension of its ecology, natural history, and conservation. Data gathered at Ospreys' wintering grounds can contribute to our knowledge of migratory distribution patterns as well as phenology and ecology (Prevost 1982, Boshoff and Palmer 1983, Saggese et al. 1996, Silva e Silva and Olmos 2002). These results can be used to complement those provided by other techniques such as banding (Henny and Van Velzen 1972, Poole and Agler 1987, Mestre and Bierregaard 2009) and satellite telemetry (Martell et

Figure 3. Areas of high concentration of observations of Ospreys in Argentina. These areas include (1) southern Paraná River near Rosario city, Santa Fé province; (2) Uruguay River, El Palmar National Park, Entre Ríos Province; (3) Río Hondo Reservoir, Río Hondo, Santiago del Estero Province; (4) Iguazú River at Iguazú National Park, Misiones province; and (5) Formosa. BA:Buenos Aires, CA:Catamarca, CB:Córdoba, CH:Chaco, CT:Corrientes, ER:Entre Ríos, FS:Formosa, JU:Jujuy, MI:Misiones, MZ:Mendoza, RN:Río Negro, SA:Salta, SE:Santiago del Estero, SL:San Luis, SF:Santa Fé, TU:Tucumán.

al. 2001, Washburn et al. 2014). As mentioned above, since the first review of Osprey distribution and status in Argentina, a considerable number of published and unpublished records have appeared, helping to overcome the absence of significant band recoveries and information from satellite transmitters and expand our understanding of Ospreys' wintering ecology in Argentina.

As reported here and by Saggese et al. (1996), Ospreys have been recorded year-round in Argentina, with the highest frequency of records in the austral spring-summer, which is consistent with

other reports of Ospreys wintering in South America (Silva e Silva and Olmos 2002, Mestre and Bierregaard 2009). Ospreys are known to ''oversummer'' in their wintering areas for one or more years before returning to their breeding grounds (Bildstein 2006). North American and European Ospreys are known to stay in their wintering areas in their first and second years and then return to their breeding areas in their third calendar year, usually before they reach 2 yr of age (Cramp and Simmons 1980, Poole 1989, Poole et al. 2002). In Brazil, both hatch-year and after-hatch-year birds have been recorded during the winter (Silva e Silva and Olmos 2002, Mestre and Bierregaard 2009). Thus, records of Osprey in austral fall and winter suggest that some individuals, probably young birds, likely remain regularly in Argentina during this period (Saggese et al. 1996, Silva e Silva and Olmos 2002, Mestre and Bierregaard 2009). Alternatively, Ospreys may arrive in the country during these months as part of their wintering dispersion in South America. Satellite tracking of these birds is needed to understand their dispersion patterns in the austral winter.

A potential bias in casual observations for certain times of the year may occur because the late spring and austral summer (particularly December, January, and February) see an increase in bird-watching activity in Argentina, as many Argentineans use those months for their summer vacation. Thus, more Osprey records might occur during this time. During winter holidays (in June and July), birdwatchers tend to travel to the northern part of the country, thus representing another potential bias for these months. This bias could be overcome by dedicated year-round surveys.

Ornithologists and birdwatchers commonly reported successive sightings of Ospreys in the same vicinity during consecutive months, and Pereyra-Lobos and Yacante (2008) observed an Osprey at the same site during one entire austral winter in Mendoza province, suggesting the potential of site fidelity (although age and individual identity of the birds could not be confirmed). Most Ospreys stay at the same wintering site for several months (Boshoff and Palmer 1983, Prevost 1982, Poole 1989, Washburn et al. 2014). Individuals tracked by satellite telemetry and wintering in northern South America have some site fidelity (Martell et al. 2001, Washburn et al. 2014).

Wintering Ospreys appear to be strongly associated with the rivers, which are widely distributed along the South American subcontinent (Henny and Van Velzen 1972, Mestre and Bierregaard 2009, Washburn et al. 2014). Our data from Argentina confirm a previous report that Ospreys use large river systems, such as the Iguazú, Paraguay, Uruguay, and Paraná rivers, and their major subsidiaries in northern and northeastern Argentina (Saggese et al. 1996). However, in the central and northwestern provinces of Argentina, Ospreys frequent human-made reservoirs and natural lakes (Saggese et al. 1996). Most of those reservoirs were built during the last five decades (Adler 2005). Their creation and the stocking of native and exotic fishes (Mancini et al. 2009) may have provided a new habitat and feeding opportunities for Ospreys, as reported for Ospreys in Spain (Fuentes et al. 1998).

Although Ospreys are commonly found on the seacoast of Colombia, Venezuela, and other Caribbean countries and on the Atlantic coast from the Guianas to northern and eastern Brazil, an Osprey was reported only once on the southern Atlantic coast of Argentina (Harris 1998). Furthermore, there is a similar absence of Osprey records along the Atlantic coast of Uruguay, with the exception of one single confirmed recent record (T. Rabau pers. comm.). This lack of records along the southern Atlantic Coast shore may be explained by the presence of the Malvinas oceanic current, a cold mass of water originating in the subantarctic that extends north along the coast of Argentina up to Buenos Aires province, at approximately 38°S latitude. The warmer Brazilian oceanic current extends south along the Atlantic seacoast of southern Brazil, where Ospreys can be commonly found (Silva e Silva and Olmos 2002), but this current does not usually reach the southern Atlantic coast of Argentina, and does not usually reach most of the Uruguay seacoast.

Previous reports of Ospreys' prey in Argentina are limited (Saggese et al. 1996). Introduced common carp and silverside fish (*Odontesthes* spp.; Saggese et al. 1996) commonly found in reservoirs in central and northern Argentina can support the presence of Ospreys in these areas. Fish diversity is evidently higher along the Iguazú, de la Plata, Paraná, Bermejo, and Uruguay rivers, where there are a large number of potential prey species that could support wintering Ospreys in northern and northeastern Argentina. Careful searches for fish remains at the bases of Osprey perching sites could expand our knowledge on Osprey feeding habits in the country.

The natal origin of Ospreys wintering in Argentina remains largely unknown. Only two banded

birds were recovered in this country (Bird Banding Laboratory, Patuxent Wildlife Research Center, Laurel, Maryland; access band numbers 51846101 and 56819614). One was originally banded in Maryland and the other in Michigan; both were recovered in northeastern Argentina. Poole and Agler (1987) mention one additional bird banded in the midwest, but the record was not found in the Bird Banding Laboratory database. Most of the banded Ospreys recovered in Brazil (71 out of 90 records, Mestre and Bierregaard 2009) have an eastern North American origin, coming mainly from Maryland, New Jersey, and Virginia, but also from Michigan and Wisconsin (midwest). By extrapolation, we suggest that Ospreys that winter in Argentina may originate from similar North American Osprey populations. Ospreys from Canada have not been recovered in Argentina, but seven of eight Ospreys banded in Canada and recovered in South America were found in northern Brazil (Mestre and Bierregaard 2009); thus, Canada could potentially be a source of some of the Ospreys wintering in Argentina. As Osprey populations from western North America usually winter in Mexico and Central America, they are rarely found in South America (Johnson and Melquist 1991, Martell et al. 2001, Washburn et al. 2014), making a western North American origin for the Ospreys visiting Argentina unlikely.

Wintering areas are of special concern for migratory raptors due to potential mortality risks associated with habitat loss, pollution, and persecution (Newton 1979, Kerlinger 1989). Shooting and other forms of direct attack seem to be an important cause of human-related mortality for Ospreys in South America (Poole and Agler 1987, Poole 1989, Poole et al. 2002, Bechard and Márquez-Reyes 2003, Bechard et al. 2007). Poole et al. (2002) mention shooting associated with 93% of the recoveries of banded individuals; data from banded birds recovered in Brazil showed that 71 of 90 were shot (Mestre and Bierregaard 2009). Ospreys fishing at aquaculture farms are regularly hunted in Colombia and other South American countries (Bechard and Márquez-Reyes 2003), but direct persecution has not been reported in Argentina. However, there are more than 960 aquaculture farms in northern and northeastern Argentina provinces of Chaco, Corrientes, Formosa, and Misiones (Dirección de Acuicultura, Ministerio de Agricultura, Ganadería y Pesca 2013, Instituto Nacional de Tecnología Agropecuaria 2013). Other fish-eating species such as Neotropic Cormorants (*Phalacrocorax brasilianus*), kingfishers (Order Coraciiformes), and herons (Order Pelicaniformes) also fish at aquaculture facilities. These birds are usually discouraged by shooting and poisoning (R. Mattiello pers. comm.) and fish ponds protected with anti-hale nets to prevent fish predation (F. Vigliano pers. comm.). It is not known whether the lack of reports of Ospreys fishing at aquaculture farms reflects a true lack of a problem, under-recognition of the species, or simple under-reporting and this topic deserves further evaluation.

Exposure of Ospreys to environmental pollutants still occurs both in their breeding and wintering areas, although there are limited studies conducted on the species in South America. In southeastern Brazil, Silva e Silva and Olmos (2002) mentioned the presence of heavy metals and organochlorines in the estuaries of São Paulo and their potential risk for Ospreys consuming detritus-eating fish such as mullets (Mugillidae). Waters from areas with multiple records of Ospreys, such as the Iguazú, Paraná, Uruguay, and the de la Plata rivers are known for their high levels of contamination (Cataldo et al. 2001, Cid et al. 2011, Colombo et al. 2011). High levels of environmental pollutants, including polychlorinated biphenyls (PCBs), other organochlorines, and heavy metals have also been reported in ray-finned fish and other freshwater fish (Cataldo et al. 2001, Lombardi et al. 2010, Cid et al. 2011, Colombo et al. 2011) and fish-eating birds from central Argentina in La Florida reservoir, San Luis province (Cid et al. 2007); thus, Ospreys in Argentina could also be exposed to these pollutants.

The apparent causes for the increase in the number of records of Ospreys in Argentina in the last decades are unknown. We recommend caution regarding estimates of abundance prior to the 1980s, as the number of ornithologists and bird-watchers was fairly limited. In the late 1970s and early 1980s, Argentinean ornithology and bird-watching increased as several high-quality field guides were published (Narosky 1978, Nores and Yzurieta 1980, Olrog 1984, de la Peña 1986, Narosky and Yzurieta 1987), and the Aves Argentinas/Asociación Ornitológica del Plata (AOP) and Fundación Vida Silvestre Argentina, along with other wildlife research and conservation organizations, increased their educational and reference services. A near-doubling of the number of members of the most popular ornithological society, Aves Argentinas/AOP, during the last decade (D. Almirón pers. comm.) could partially explain this increase, as more bird-watchers and ornithologists in the field

should increase the likelihood of observing and identifying species. Modern communication and database technologies could also be linked to a sociological cause for the apparent increase in the number of recent sightings; the contact among birdwatchers and field ornithologists has also increased dramatically with the easy access to the internet and email lists. However, several sites, as Iguazú National Park among others, had been popular among birdwatchers and ornithologists for several decades at that point (see Saibene et al. 1996), and the number of records there seems to have increased only recently. Other places, like the Reserva Ecológica Costanera Sur and other birding sites along de la Plata River at Buenos Aires city, do not show an increase in observations of Ospreys proportionate to the increase in the number of bird-watchers, wildlife photographers, and ornithologists that visit it daily since 1985. That suggests that Ospreys are truly rare at de la Plata River. Additional results of our study show that for certain areas of Argentina intensively birded for decades, such as Iguazú National Park, El Palmar National Park, Rio Hondo, and the southern Paraná River, there were few or no reports of the species there before 1994, suggesting that Ospreys were not regularly observed there until recently.

Due to behavioral flexibility and rapid evolutionary changes, shifts in migratory tendencies can appear and disappear in raptors within years (Bildstein 2006). It is possible that Ospreys are just moving farther south than before and, as a result, the number of sightings paralleled the increase in the number of observers qualified to detect them. Changes in migratory patterns may be reflecting this shift. Alternative explanations should also be considered. Historically, Ospreys were widely distributed and abundant in North America but suffered a significant decline due to human abuses and the use of organochlorines such as PCBs and dichlorodiphenyltrichloroethane (DDT). After the 1950s, Osprey populations crashed (Poole 1989), and it took several decades for them to recover from this widespread decline. The ban on DDT in the 1970s allowed some populations to rebound, and reintroductions, the propensity of this species for nesting on artificial structures (poles, towers), and the increase in the number of reservoirs have facilitated an increase in their numbers and expansion into formerly unoccupied habitat (Ewins 1995, 1996, Houston and Scott 2001, Henny et al. 2010). The Osprey is now a common species throughout much of North America (Ewins 1997, Poole et al. 2002, Henny et al. 2010). Recent migration counts and Breeding Bird Surveys in North America show that most populations have either increased or remained stable since the late 1970s and early 1980s, although these tendencies have been reversed or slowed in the last decade in some areas (Farmer et al. 2008). It seems possible that Ospreys may have started to migrate farther south as this increase in their population has also increased the demand for new breeding and wintering areas.

The migration of Ospreys is complex and not fully understood (Hake et al. 2001). However, as a result of this study, we have extended the known spatial distribution of Osprey in South America; the southern cone seems to have been underestimated as a wintering area for Ospreys. The ultimate causes of the apparent increase in the number of observations are unknown. Studies using band recoveries and satellite telemetry indicate that most Ospreys do not travel farther south of the equator. However, birds equipped with satellite transmitters come from only a few areas of North America and are not fully representative of the overall North American Osprey population. The number of reported Osprey observations likely represents just a small fraction of the total number of Ospreys wintering in Argentina. Conducting systematic surveys along rivers and reservoirs throughout the year would provide more accurate estimates of Osprey numbers in Argentina. Research efforts focusing on Osprey behavior and feeding ecology during the wintering period would be useful for increasing our understanding of their natural history. Furthermore, a more detailed understanding of the distribution and habitat use of Ospreys in Argentina could help elucidate their exposure to pollutants and other threats. The use of satellite transmitters or the analyses of stable radioisotopes in feathers of wintering birds may provide insight into the natal origins and migratory strategies of these birds.

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Appendix. Records of Ospreys (*Pandion haliaetus*) in Argentina during the period 1994–2008.

Day	Month	Year	Location	Department/ County	Province	Latitude (S)	Longitude (W)	Number	Water Body	Observer/ Reference
7	January	1993	Concordia	Concordia	Entre Ríos	31°24.00′	58°02.00′	1	Uruguay River	M. de la Peña and N. Acosta
?	February	1993	El Palmar NP	Colón	Entre Ríos	31°51.00′	58°12.00′	1	El Palmar River	P. Moreira and M. Babarskas
5	March	1993	Puerto Campichuelo	Uruguay	Entre Ríos	32°42.00′	58°11.00′	1	Uruguay River	M. de la Peña and N. Acosta
?	October	1993	El Rey NP	Anta	Salta	24°38.00′	64°50.00′	1	Lagoon	Babarskas et al. 1995
12	December	1993	Colonia Cano	Laishi	Formosa	26°51.00′	58°20.00′	2	Paraguay River	Contreras 1993
?	January	1994	Estancia San Gará	Ituzaingó	Corrientes	27°36.00′	56°40.00′	1	Iberá Lake	G. Cabanne
15	April	1994	Laguna La Brava	Balcarce	Buenos Aires	37°52.87′	57°58.63′	1	Lagoon	Martinez et al. 1998
19	June	1994	PN El Palmar	Colón	Entre Rios	31°51.00′	58°12.00′	1	Uruguay River	R. Guller, A. Bodrati, G. Bodrati, C. Gauerke and P. Elias
4	March	1995	Laguna de los Padres	General Pueyrredón	Buenos Aires	37°57.00′	57°44.00′	1	Lagoon	Martinez et al. 1998
29	November	1995	Ñandubaysal	Gualeguaychú	Entre Rios	33°04.00′	58°23.00′	1	Uruguay River	A. Bodrati
21	January	1997	Dique Los Reyunos	San Rafael	Mendoza	34°35.00′	68°40.00′	1	Dam/Reservoir	Baigorria 1999
20	December	1997	Isla San Pedro	San Pedro	Buenos Aires	33°41.12′	59°38.36′	1	Paraná River	K. Sierra
?	June	1998	Campo San Juan	Candelaria	Misiones	27°21.00′	55°36.00′	1	Paraná River	G. Cabanne
12	December	1998	Isla del Cerrito	Bermejo	Chaco	27°17.00′	58°37.00′	1	Paraná River	A. Bodrati
12	December	1998	Arroyo Tragadero	Primero de Mayo	Chaco	27°28.00′	58°53.00′	2	Tragadero River	A. Bodrati
14	March	1999	Dique Carrizal	Rivadavia	Mendoza	33°19.00′	68°43.00′	1	Dam/Reservoir	P. Blendinger
7	June	1999	PN El Palmar	Colón	Entre Ríos	31°54.00′	58°13.00′	1	Uruguay River	P. Giorgis
16	August	1999	Delta	San Fernando	Buenos Aires	34°00.00′	58°30.00′	1	Undetermined River	D'Alessio et al. 2002
5	December	1999	Panza Cabra, PN Chaco	Sargento Cabral	Chaco	26°51.30′	59°40.71′	1	Lagoon	A. Bodrati
7	December	1999	Estancia Laguna Cora	Primero de Mayo	Chaco	27°10.45′	58°41.00′	2	Lagoon	A. Bodrati
5	January	2000	Delta	San Fernando	Buenos Aires	34°00.00′	58°30.00′	1	Paraná River	D'Alessio et al. 2002
?	January	2000	Rio Iguazú inferior	Iguazú	Misiones	25°35.00′	54°32.00′	1	Iguazú River	A. Bodrati

Appendix. Continued.

DAY	MONTH	YEAR	LOCATION	DEPARTMENT/ COUNTY	PROVINCE	LATITUDE (S)	LONGITUDE (W)	NUMBER	WATER BODY	OBSERVER/ REFERENCE
7	February	2000	Rio Iguazú superior	Iguazú	Misiones	25°32.00′	54°09.00′	2	Iguazú River	Heinonen Fortabat and Fabri 2001
?	April	2000	PN Iguazú	Iguazú	Misiones	25°41.00′	54°26.00′	1	Iguazú River	D. Monteleone
25	November	2000	Playa Boquerón	Iguazú	Misiones	25°40.37′	54°26.71′	1	Iguazú River	Heinonen Fortabat and Fabri 2001
12	December	2000	Bañado La Estrella	Patiño	Formosa	23°38.00′	61°27.00′	3	Lagoon	M. Romano and A. Talamo
16	January	2001	Puerto Antequera	Primero de Mayo	Chaco	27°26.57′	58°50.95′	2	Antequera River	A. Bodrati
7	February	2001	Embalse Yaciretá	Ituzaingó	Corrientes	27°30.00′	56°42.00′	1	Dam/Reservoir	P. Blendinger
3	February	2002	Costanera Sur ER	CABA	NA	34°36.67′	58°21.25′	1	Lagoon	J. Veiga
13	February	2002	PN El Palmar	Colón	Entre Ríos	31°51.00′	58°12.00′	1	Uruguay River	G. Marateo
21	February	2002	Puente Fortín Lavalle	General Güemes	Chaco	25°43.00′	60°11.00′	1	Bermejo River	M. Pearman, G. Pugnali and H. Casañas
8	May	2002	PN Otamendi	Campana	Buenos Aires	34°14.00′	58°53.00′	1	Lagoon	Babarskas et al. 2003
17	June	2002	PN Otamendi	Campana	Buenos Aires	34°14.00′	58°53.00′	1	Lagoon	Babarskas et al. 2003
28	July	2002	Reserva Teyú Cuaré	San Ignacio	Misiones	25°41.27′	54°26.55′	1	Iguazú River	G. Cabanne
?	August	2002	Laguna Cora	San Fernando	Chaco	27°27.00′	58°59.00′	1	Lagoon	D. Monteleone
28	November	2002	Vuelta de Obligado	San Pedro	Buenos Aires	33°45.00′	59°45.00′	1	Paraná River	A. Bodrati
3	January	2003	Las Pirquitas	Fray Mamerto Esquiú	Catamarca	28°17.07′	65°43.91′	1	Del Valle River	C. Barrionuevo
17	January	2003	Dique Las Pirquitas	Fray Mamerto Esquiú	Catamarca	28°14.70′	65°54.31′	1	Dam/Reservoir	C. Barrionuevo
28	July	2003	Reserva Teyú Cuaré	San Ignacio	Misiones	27°16.60′	55°35.66′	1	Paraná River	S. Seipke and G. Cabanne
?	October	2003	PN El Palmar	Colón	Entre Ríos	31°54.12′	58°12.05′	1	Uruguay River	I. Roesler
20	November	2003	Reserva Teyú Cuaré	San Ignacio	Misiones	27°16.60′	55°35.66′	1	Paraná River	D. Almirón
?	January	2004	Puerto Valle	Ituzaingó	Corrientes	27°36.00′	56°26.18′	1	Paraná River	G. Pugnali
10	January	2004	Esperanza	Las Colonias	Santa Fé	31°25.00′	60°56.00′	1	Salado River	M. de la Peña and N. Acosta
29	January	2004	Banco Caraballo Km 232	Colón	Entre Ríos	32°05.33′	58°10.02′	4	Uruguay River	F. Raffo
21	February	2004	Rio Paraná Km 428	Rosario	Santa Fé	32°50.27′	60°39.16′	1	Paraná River	C. Giarduz
14	March	2004	Estancia Tragua-Tragua	Avellaneda	Río Negro	39°26.00′	65°35.00′	1	Rio Negro River	Perez et al. 2006

Appendix. Continued.

Day	Month	Year	Location	Department/ County	Province	Latitude (S)	Longitude (W)	Number	Water Body	Observer/ Reference
21	April	2004	Campo San Juan	Candelaria	Misiones	27°45.00′	55°31.51′	1	Paraná River	R. Guller
11	July	2004	Rio Uruguay	Concordia	Entre Ríos	31°24.00′	58°02.00′	1	Uruguay River	L. Pagano
12	December	2004	Rio Uruguay	Uruguay	Entre Ríos	32°29.00′	58°14.00′	1	Uruguay River	L. Rodríguez
9	January	2005	Rio Paraná Km 428	Rosario	Santa Fé	32°50.27′	60°39.16′	1	Paraná River	C. Gíarduz
15	January	2005	Rio Paraná Km 428	Rosario	Santa Fé	32°50.27′	60°39.16′	1	Paraná River	C. Giarduz
27	January	2005	PN Iguazú	Iguazú	Misiones	25°41.72′	54°26.21′	1	Iguazú River	S. Seipke
28	January	2005	Panza Cabra, PN Chaco	Sargento Cabral	Chaco	26°51.30′	59°40.71′	1	Lagoon	O. Brasvslasky
8	June	2005	Rio Paraná Km 428	Rosario	Santa Fé	32°50.27′	60°39.16′	1	Paraná River	C. Giarduz
?	June	2005	Isla Yacaré, PN Iguazú	Iguazú	Misiones	25°42.00′	54°25.00′	1	Iguazú River	Raymundi 2006
19	October	2005	Ciudad de Formosa	Formosa	Formosa	26°10.85′	58°11.71′	1	Paraguay River	E. Merida
23	October	2005	Embalse Urugua-í	Iguazú	Misiones	25°52.00′	54°32.00′	1	Dam/Reservoir	P. Ramirez Llorens
6	November	2005	Rio Paraná Km 428	Rosario	Santa Fé	32°50.27′	60°39.16′	1	Paraná River	C. Giarduz
23	November	2005	Embalse La Angostura	Tafí del Valle	Tucumán	26°55.00′	65°41.00′	1	Dam/Reservoir	A. Echeverria and C. Marano
23	February	2006	PN El Palmar	Colón	Entre Ríos	31°54.00′	58°13.00′	1	El Palmar River	F. Raffo
?	February	2006	Barra Ramirez	Goya	Corrientes	29°24.42′	59°35.81′	1	Paraná River	H. Bregant
12	March	2006	Rio Paraná Km 428	Rosario	Santa Fé	32°50.27′	60°39.16′	1	Paraná River	C. Giarduz
28	March	2006	Remanso del Inglés	Diamante	Entre Ríos	32°07.00′	60°35.00′	1	Paraná River	J. Alonso
26	May	2006	Embalse Rio Hondo	Rio Hondo	Santiago del Estero	27°32.00′	64°57.00′	1	Dam/Reservoir	C. Marano
14	June	2006	PN Iguazú	Iguazú	Misiones	25°41.27′	54°26.55′	2	Iguazú River	I. Roesler and M. Juhant
?	June	2006	Ito 3 fronteras	Iguazú	Misiones	25°35.70′	54°35.40′	1	Iguazú River	M. Juhant
22	July	2006	Rio Paranár Km 428	Rosario	Santa Fé	32°50.27′	60°39.16′	1	Paraná River	C. Giarduz
9	September	2006	Rio Iguazú superior	Iguazú	Misiones	25°41.00′	54°26.00′	1	Iguazú River	P. Ramirez Llorens
17	September	2006	Laguna Oca	Formosa	Formosa	26°13.12′	58°10.71′	1	Lagoon	A. Di Giacomo, G. Pugnali and F. Gorleri
?	October	2006	Bañado la Estrella	Patiño	Formosa	24°20.97′	60°21.30′	1	Lagoon	C. Sparagino
?	October	2006	Laguna Oca	Formosa	Formosa	26°13.12′	58°10.71′	1	Paraguay River	A. Di Giacomo and C. D'Acunto
5	October	2006	Embalse Rio Hondo	Simoca	Tucumán	27°32.00′	64°58.00′	2	Dam/Reservoir	C. Marano
10	October	2006	Embalse Rio Hondo	Simoca	Tucumán	27°32.00′	64°58.00′	4	Dam/Reservoir	C. Marano

Appendix. Continued.

DAY	MONTH	YEAR	LOCATION	DEPARTMENT/ COUNTY	PROVINCE	LATITUDE (S)	LONGITUDE (W)	NUMBER	WATER BODY	OBSERVER/ REFERENCE
26	October	2006	Embalse Rio Hondo	Simoca	Tucumán	27°32.00′	64°58.00′	3	Dam/Reservoir	C. Marano
?	November	2006	Dique La Angostura	Tafí del Valle	Tucumán	26°55.00′	66°41.00′	1	Dam/Reservoir	E. Moyano and P. Caplonch
?	November	2006	Abra Pampa	Cochinoca	Jujuy	22°43.00′	65°42.00′	1	None	J.M. Barnett
6	November	2006	Embalse Rio Hondo	Simoca	Tucumán	27°32.00′	64°58.00′	1	Dam/Reservoir	C. Marano
20	November	2006	Embalse Rio Hondo	Simoca	Tucumán	27°32.00′	64°58.00′	5	Dam/Reservoir	C. Marano
27	December	2006	Dique Paso de las Carretas	Pringles	San Luis	33°18.97′	65°53.06′	1	Dam/Reservoir	R. Torres and G. Bruno
10	January	2007	Remanso del Inglés	Diamante	Entre Ríos	32°07.00′	60°35.00′	1	Paraná River	J. Alonso
15	January	2007	Embalse Rio Hondo	Simoca	Tucumán	27°32.00′	64°58.00′	3	Dam/Reservoir	C. Marano
20	February	2007	Embalse Rio Hondo	Simoca	Tucumán	27°32.00′	64°58.00′	2	Dam/Reservoir	C. Marano
3	March	2007	Estancia Yapeyú	San Martín	Corrientes	29°27.33′	56°48.04′	1	Uruguay River	A. Quaglia
?	July	2007	Villa Paranacito	Islas del Ibicuy	Entre Ríos	33°42.00′	58°41.00′	1	Uruguay River	R. Jenssen and P. Grilli
5	August	2007	Brazo Chico	Gualeguaychú	Entre Ríos	33°46.48′	58°33.63′	1	Brazo Chico River	R. Moller Jensen
13	October	2007	Laguna Oca	Formosa	Formosa	26°13.12′	58°10.71′	1	Paraguay River	A. Di Giacomo and C. D'Acunto
?	October	2007	Bañado La Estrella	Patiño	Formosa	24°21.13′	60°20.06′	1	Lagoon	C. Sparagino
26	October	2007	Bañado La Estrella	Bermejo	Formosa	24°22.00′	60°19.00′	1	Pilcomayo River	D. Almiron
15	November	2007	Bella Vista	Bella Vista	Corrientes	28°26.53′	59°05.41′	1	Paraná River	G. Rotta
23	November	2007	Embalse Rio Hondo	Simoca	Tucumán	27°32.00′	64°58.00′	2	Dam/Reservoir	C. Marano
28	November	2007	PN Iguazú	Iguazú	Misiones	25°42.00′	54°25.00′	1	Iguazú River	A. Bodrati
7	December	2007	Embalse Rio Hondo	Simoca	Tucumán	27°32.00′	64°58.00′	3	Dam/Reservoir	C. Marano
9	December	2007	Yapeyú	San Martín	Corrientes	29°28.00′	56°49.00′	1	Uruguay River	A. Bodrati
13	December	2007	Embalse Rio Hondo	Simoca	Tucumán	27°32.00′	64°58.00′	2	Dam/Reservoir	C. Marano
23	December	2007	Embalse Rio Hondo	Simoca	Tucumán	27°32.00′	64°58.00′	2	Dam/Reservoir	C. Marano
?	January	2008	PN Iguazú	Iguazú	Misiones	25°41.27′	54°26.55′	2	Iguazú River	M. Juhant, I. Roesler, L. Pagano, E. Jordan, A. Bodrati and J. Areta
5	January	2008	PN Iguazú	Iguazú	Misiones	25°41.27′	54°26.55′	2	Iguazú River	D. Almiron
16	January	2008	PN Iguazú	Iguazú	Misiones	25°41.27′	54°26.55′	1	Iguazú River	I. Roesler
17	January	2008	Seccional Apepú, PN Iguazú	Iguazú	Misiones	25°38.00′	54°21.00′	5	Iguazú River	A. Bodrati
17	January	2008	Embalse Rio Hondo	Simoca	Tucumán	27°32.00′	64°58.00′	3	Dam/Reservoir	C. Marano

Appendix. Continued.

DAY	MONTH	YEAR	LOCATION	DEPARTMENT/ COUNTY	PROVINCE	LATITUDE (S)	LONGITUDE (W)	NUMBER	WATER BODY	OBSERVER/ REFERENCE
2	February	2008	Embalse Rio Hondo	Simoca	Tucumán	27°32.00′	64°58.00′	1	Dam/Reservoir	C. Marano
4	February	2008	Embalse Rio Hondo	Simoca	Tucumán	27°32.00′	64°58.00′	1	Dam/Reservoir	C. Marano
7	February	2008	Yapeyú	San Martin	Corrientes	29°28.00′	56°49.00′	1	Uruguay River	A. Bodrati
27	February	2008	Isla San José	Colón	Entre Ríos	31°51.17′	58°12.18′	1	Uruguay River	G. Belloc
17	April	2008	Laguna La Juana	Pilcomayo	Formosa	25°55.55′	57°53.58′	1	Lagoon	A. Aldecoa
?	May	2008	Posadas	Capital	Misiones	27°25.00′	55°48.00′	1	Paraná River	H. Povedano
14	June	2008	Embalse El Carrizal	Rivadavia	Mendoza	33°18.00′	68°43.25′	4	Dam/Reservoir	F. Martinez
1	November	2008	Rio Paraná	Goya	Corrientes	29°34.55′	59°35.63′	1	Paraná River	H. Bregant
22	November	2008	PN Iguazú	Iguazú	Misiones	25°42.00′	54°25.00′	1	Iguazú River	A. Bodrati
30	November	2008	Isla Toledo	San Cosme	Corrientes	27°17.57′	58°29.30′	1	Paraná River	A. Caric
23	December	2008	Peninsula Andresito	Iguazú	Misiones	25°31.00′	54°08.00′	1	Iguazú River	A. Bodrati