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The role of Amazonian rivers for wintering ospreys (*Pandion haliaetus*): clues from North American band recoveries in Brazil between 1937 and 2006

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In this paper we describe band-recovery data from 90 ospreys (*Pandion haliaetus*), banded in North America and recovered in Brazil between 1937 and 2006. Data were obtained from the Bird Banding Laboratory (US Geological Survey, USA) and from the Centro Nacional de Pesquisa para Conservação das Aves Silvestres (IBAMA, Brazil). The majority of ospreys were banded near the coast in Maryland, New Jersey, and Virginia. The birds were mainly recovered in Brazilian Amazonian states of Amazonas and Pará, near large rivers. The bulk of recoveries were of birds shot less than one year after banding. Distances from banding and recovery sites were between 4191 and 7722 km. Elapsed time between banding and recapture were between 50 and 9752 days. We described in this study one of the oldest band returns, and we report the first osprey band recoveries for four Brazilian States (Paraíba, Ceará, Rondônia, and Tocantins). The importance of Brazil for ospreys, mainly Amazonian sites, needs to be emphasized in educational programs and considered in international conservation strategies.

Keywords: Amazonia; banding; Brazil; North America; osprey; recovery

Introduction

The osprey (*Pandion haliaetus*) reproduces primarily across large expanses of the world's northern hemisphere and is one of the best-studied raptors of North America and Europe (Poole et al. 2002). This raptor eats almost exclusively live fish, a characteristic that induces most medium to high latitude populations to migrate in anticipation of food scarcity in the fall and winter. Migratory osprey populations nest above 27.4°N in North America (Martell et al. 2001) and above about 40°N in Europe (Poole et al. 2002). Generally, the wintering sites do not overlap with resident population ranges, where fish are available in all seasons (Worth 1934, 1936; Gillespie 1960; Henny & Wight 1969; Henny & Velzen 1972; Kennedy 1973; Martell et al. 2001; Triay 2002), but some population ranges do overlap in winter as some northeastern North American ospreys overwinter along the southeastern US coast into Florida (Martell et al. 2001; Poole et al. 2002). Ospreys from the Pacific northwest of the USA and Canada overwinter in Mexico and Central America (Martell et al. 2001). The osprey populations that nest in central and eastern North America travel in the boreal winter to Central America, the Caribbean, and South America, reaching as far south as Chile, Brazil, Uruguay, and Argentina (Johnson & Melquist 1991; DeGraaf & Rappole 1995; Sick 1997; Poole et al. 2002). Nearly all juveniles spend about 18 months on the wintering grounds, returning to their breeding grounds only in their third spring (Poole et al. 2002). Because of this, ospreys are found in all months of the year across their wintering range.

A combination of pesticide contamination, shooting, and egg collecting contributed to dramatically reduce some populations of ospreys in the past (Poole et al. 2002). While conservation efforts in nesting countries helped to recover endangered osprey populations, the species remains vulnerable on migration and on the wintering grounds (e.g. Bechard & Marquez-Reyes 2003). Despite being well studied in its breeding range, the natural history of ospreys in their New World wintering grounds remains little known (Poole et al. 2002).

In South America, ospreys winter locally across most of the continent south to Argentina (Poole & Agler 1987; Martell et al. 2001). Wintering sites of ospreys in Brazil have been described (e.g. Magnanini & Coimbra-Filho 1964; Lara-Resende & Leal 1982; Martuscelli 1992; Stotz et al. 1992, 1997; Petermann 1997; Silva-e-Silva 1997; Silva-e-Silva & Olmos 2002; Gomes 2003; Teixeira et al. 2005), and band recoveries in Brazilian sites were documented by Poole & Agler (1987) and Sick (1997). Even though most ospreys seem to winter inland in South America

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(Poole et al. 2002), there is little information about the importance of Brazilian rivers to wintering osprey populations. In this study, we present band recovery data from ospreys banded in North America and recovered in Brazil between 1937 and 2006. We relate distances and time elapsed between banding and recapture and discuss the importance of Amazonian rivers to migratory osprey populations.

Materials and methods

We analyzed data from North American banded ospreys (*Pandion haliaetus*) recovered in Brazil. The recovery records were provided by the US Bird Banding Laboratory (US Geological Survey, Biological Resources Division), and include birds banded in the USA and one in Canada (Prince Edward Island). Additional data were provided by the Centro Nacional de Pesquisa para Conservação das Aves Silvestres (CEMAVE, IBAMA, Brazil). The following information was considered: band number; band date; band site (US state, latitude and longitude); sex; age; recovery date; recovery site (Brazilian state, latitude and longitude); and how the birds were obtained. "How obtained" data include: found dead; shot; caught due to injury; caught by hand; caught due to striking a man-made structure; and no information available. Two individuals were not included in some analyses because their data did not include recapture coordinates. The number of days between banding and recapture were calculated by the "difference between two dates" software. When only inexact dates were available in the database, we estimated the dates considering the first day of the season when only season was recorded (summer: 21 June; autumn: 22 September; winter: 21 December; spring: 21 March), and using the first day of the period of the month described when the date was recorded as first, second, or third 10 days of the month (estimated dates are marked with asterisks in Table 1). Cartographic distances between band and recovery sites, and the distances between these sites and geographic features (e.g. rivers and coast) were calculated by Track Maker Pro 3.5 software and ArcView 9.0 software.

Results

We reviewed data from 90 osprey band recoveries of birds banded in North America recovered in Brazil. We include the time period until 2006, but the last individual recovered was in 2003. Most (71) of these 90 individuals were banded as nestlings. The bulk of osprey recoveries in Brazil were from birds that were shot (65 individuals). Of these, 16 were shot before 1970, 18 were shot in the 1970s, 15 in the 1980s, and 15 in the 1990s, and only one after 2000 (in 2003). The other ospreys were found dead (14), caught by hand (three), recovered after striking an object (two), recovered the band number only (two), or had no recovery information (four). Nearly half (44%) of these ospreys were recovered in Brazil less than a year after banding, 36% were recovered between one and five years after banding, and 20% were recovered more than five years after banding. Of all recovered ospreys, 68% were less than three years old. Elapsed time between banding and recapture was between 50 and 9752 days (27 years and one month) (Table 1).

The 88 ospreys recovered in Brazil with known recovery locations were banded in 15 US states and one Canadian province. The majority of ospreys were banded on the east coast (Maryland 30.7%, New Jersey 20.5%, Virginia 15.9%; Figure 1). Eighty of these were banded less than 150 km from the coast, seven were banded in the Great Lakes region (Michigan and Wisconsin), and one was banded near the Mississippi River. The one Canadian banded bird recovered in Brazil was one of only eight ospreys banded in Canada that were recovered in South America (988 banded/37 total recoveries) (Ewins & Houston 1992). The other seven were recovered north of Brazil. All ospreys recovered in Brazil were banded in the boreal summer, mainly in June (48.9%) and July (45.5%).

The ospreys were mostly recovered in the Brazilian states of Amazonas (53.4%) and Pará (21.6%). Approximately 82% of osprey recoveries were in the Amazon, including the states of Acre, Rondônia, and Amapá. Other recoveries in Brazil were in the northeast (Bahia: three; Ceará: two; Paraíba: two), east (Mato Grosso: one; Mato Grosso do Sul: one; Tocantins: one; Federal District: one), southeast (Rio de Janeiro: two; Minas Gerais: one; São Paulo: one) and south (Paraná: one) (Figure 1). The recoveries from Paraíba, Ceará, Rondônia, and Tocantins are the first for these states.

The bulk of osprey recoveries in Brazil occurred in the austral summer, between October and March (75% of recoveries). The majority of recoveries in Brazil were less than 150 km from large rivers (87.5%). Most of these were in Amazonian rivers, including the Amazonas (32), Purus (seven), Madeira (five), Japurá (two), Xingu (two), Tocantins (two), Negro (one), Branco (one), Guaporé (one), and Teles-Pires (one) rivers. Other osprey recoveries near large rivers outside Amazonia were on the São Francisco (two), Paraná (one), and Paraguay (one) rivers. The distances between banding and recoveries sites varied from 4190 to 7721 km (mean = 5442.2 km, SD = 838.8).

Table 1. Band and recoveries of ospreys (*Pandion haliaetus*) in Brazil between 1936 and 2006.

Banding data					Recapture data					
Band number	Date	State[a]	Coordinates	Age/sex[b]	Date	State[c]	Coordinates	Method	Time (days)[d]	Distance (km)
0027-00460	20/06/36	NY	41°N, 72.2°W	J	12/08/37	BA	14.7°S, 39°W	Dead	418	7070
0388-08244	16/07/39	NJ	39°N, 75.2°W		16/12/39	RJ	22.8°S, 43.2°W	Shot	153	7627
0368-07846	13/08/39	NJ	39°N, 74.7°W	J	24/09/43	AM	3°S, 60°W	Shot	1503	4893
0418-08607	03/07/41	NY	41°N, 72°W		10/12/43	PR	25.3°S, 49.2°W	Shot	890*	7721
0448-11816	07/07/45	NY	40.8°N, 72.2°W		03/06/48	AM	3°S, 60°W	Dead	1062*	5013
0448-23309	06/07/47	NJ	39°N, 74.7°W	J	01/01/48	AM	7.5°S, 65.5°W	Shot	179*	5236
0398-23379	03/07/49	NJ	39°N, 74.7°W	J	01/11/55	PA	1.3°S, 48.3°W	Shot	2312*	5231
0498-77624	04/07/52	NJ	39°N, 74.7°W	J	01/05/55	AM	3.2°S, 59.8°W	Shot	1031*	4916
0508-54026	02/07/54	MD	38.8°N, 76.2°W	J	25/09/54	RO	11.5°S. 66.5°W	Shot	85	5663
0508-38826	17/07/54	NY	41°N, 72°W	J	22/02/60	PA	1.8°S, 50.7°W	Shot	2046	5225
0508-75970	05/07/56	MD	39°N, 76.2°W	J	07/01/57	RJ	22°S, 43°W	Shot	186*	7600
0518-09953	13/07/58	NJ	39°N, 74.7°W	J	13/11/63	AM	3.3°S, 61°W	Dead	1949*	4190
0518-04753	28/06/59	MD	38.8°N, 76.2°W	J	28/12/75	PA	1.5°S, 51.3°W	Shot	6027	5153
0558-22441	15/06/63	MD	38.2°N, 75°W	J	21/10/71	PA	1.7°S, 53.3°W	Shot	3050*	4951
0558-14042	29/06/64	NJ	39°N, 74.7°W		01/08/91	PA	1.5°S, 52.2°W	Shot	9894*	5053
0568-16730	26/06/65	MD	38.7°N, 76.2°W	J	03/11/66	AM	7.5°S, 70.5°W	Shot	270	5145
0558-14060	26/06/65	NJ	39°N, 74.7°W	J	23/03/66	AM	7.5°S, 63°W	Shot	495	5290
0558-86198	19/06/67	MD	38.2°N, 76.8°W	J	19/06/68	PA	1.8°S, 50.8°W	Shot	366	5187
0568-88506	22/06/67	MD	38.2°N, 76.7°W	J	01/10/67	AM	7.5°S, 72.5°W	Shot	101	5074
0588-24624	25/06/67	NJ	39°N, 74.7°W	J	03/04/68	AM	2.3°S, 65.2°W	Shot	283	4681
0568-18615	01/07/67	MD	38.7°N, 76.2°W	J	28/03/68	PA	1.5°S, 52.2°W	Shot	271*	5095
0518-66071	26/06/68	MD	38.2°N, 76.7°W	J	28/12/68	PA	3.7°S, 49.7°W	Shot	185	5419
0608-06514	04/07/69	MD	38.7°N, 76.2°W	J	10/02/83	CE	4.2°S, 40.5°W	Dead	4969	6022
0588-99837	04/07/70	MD	38.7°N, 76.2°W	J	21/03/71	AM	7.5°S, 62.8°W	Shot	260*	5298
0608-07652	19/06/71	VA	37.7°N, 76.5°W	J	04/02/73	PB	7°S, 34.8°W	Shot	596	6598
0608-13403	21/06/71	VA	37.5°N, 76.3°W	J	09/12/80	AM	4.2°S, 69.8°W	Shot	3459	4662
0608-07972	01/07/71	MD	38°N, 76°W	J	01/11/76	AP	1.2°S, 50.7°W	Shot	1950*	5071
0608-13783	03/07/72	MD	38.7°N, 76.2°W	J	06/01/73	AM	3.2°S, 64.7°W	Shot	187	4783
0608-14672	20/06/73	MD	38.2°N, 76.7°W	J	10/08/73	AM	1.8°S, 66°W	Dead	51	4565
0608-19317	27/06/73	VA	38°N, 76.5°W	J	30/11/73	AM	3.2°S, 60.5°W	Shot	156	4853
0608-19409	04/07/73	VA	37.7°N, 76.5°W	J	05/04/74	AP	1.2°S, 49.8°W	No info	275*	5115
0608-19391	04/07/73	VA	37.5°N, 76.3°W	J	28/03/74	SP	21.8°S, 51.8°W	No info	267	7059
0608-19460	05/06/74	VA	37.5°N, 76.7°W	J	18/01/77	AM	6°S, 61.8°W	Shot	958	5060
0638-51662	19/06/74	DE	38.5°N, 75°W	J	03/01/85	AM	4°S, 63.2°W	Shot	3851	4864
0608-22939	21/06/74	VA	37.8°N, 75.7°W	J	01/10/74	RO	11.3°S, 65°W	Shot	102*	5557
0568-73703	27/06/74	MD	38.3°N, 76.5°W	J	01/01/75	PA	2.8°S, 52°W	Shot	188	5221
0568-73793	01/07/74	VA	37.8°N, 76.7°W	J	02/11/75	PB	7.3°S, 35.8°W	Shot	489	6582
0658-58364	06/07/74	MD	38.7°N, 76.2°W	J	03/11/74	AM	7.2°S, 64.7°W	Shot	120	5214
0658-58357	06/07/74	MD	38.7°N, 76.2°W	J	13/10/74	AM	5.7°S, 61.2°W	Shot	99	5152
0658-58381	07/07/74	ND	38.8°N, 76.2°W	J	17/03/83	AP	1°S, 51°W	Shot	3175	5121
0608-19763	08/07/74	MD	38.2°N, 76.7°W	J	01/01/75	PA	1.7°S, 55.8°W	Shot	177*	4912
0608-27511	11/06/76	VA	37.7°N, 75.8°W	J	01/10/76	AM	8.5°S, 67.3°W	Shot	112*	5188
0638-07738	19/06/76	MD	38.7°N, 76.2°W	J	25/10/82	AM	7°S, 71.5°W	Shot	2319	5079
0608-19556	30/06/77	MA	41.5°N, 71°W	J	22/12/77	PA	1°S, 48.3°W	Shot	175	5248
0658-58500	07/07/77	MD	38.7°N, 76°W	J	01/12/77	AM	3.2°S, 60.5°W	Dead	147*	4904
0608-26590	08/07/77	MI	44.3°N, 84.8°W	J	07/10/90	MS	18.2°S, 55.2°W	Shot	4839	7571
0678-46173	08/07/77	MD	38.7°N, 76.2°W		01/01/93	PA	3.°S, 55.8°W	Hand	5656*	5108
0599-27834	10/07/77	MI	44.8°N, 83.8°W	J	01/04/78	AM	3°S, 64.3°W	Shot	265*	5655
0608-39871	28/06/78	VA	37.7°N, 76.3°W	J	13/10/78	PA	1.7°S, 57°W	Shot	107	4797
0608-37420	07/07/78	NY	41.2°N, 72.2°W	J	19/01/82	AM	2.5°S, 66°W	Shot	1292*	4877
0688-58831	01/07/79	NJ	39°N, 74.5°W	J	10/01/85	PA	0.7°S, 48.5°W	Shot	2020	5148
0608-38371	08/07/79	MI	44.3°N, 84.5°W	J	17/03/87	AM	4.3°S, 70.2°W	Hand	2809*	5584
0698-40015	21/06/80	MD	38°N, 76°W	J	20/02/99	AM	7.5°S, 60.3°W	Shot	6818	5298
0668-44003	30/06/80	NJ	39.7°N, 74.7°W		26/01/82			Shot	575	
0668-44039	24/07/80	NJ	39°N, 74.7°W	J	20/10/80	PA	1.7°S, 49.7°W	Shot	88	5193
0608-51408	24/06/82	NC	34.8°N, 77°W	J	01/02/83	AM	7°S, 71.5°W	Shot	222*	4666
0608-20286	03/07/82	WI	44.2°N, 89.8°W	J	15/12/82	AC	9°S, 71.3°W	Shot	165	6187

(*Continued*)

Table 1. (*Continued*).

Banding data					Recapture data					
Band number	Date	State[a]	Coordinates	Age/sex[b]	Date	State[c]	Coordinates	Method	Time (days)[d]	Distance (km)
0668-44085	14/07/82	NJ	39.7°N, 74.7°W	J	01/04/85	AM	8.7°S, 67.3°W	Shot	992*	5405
0608-28360	08/05/83	MN	44.2°N, 91.8°W		01/01/90	AM	4.3°S, 70°W	Band	2430*	5815
0608-52310	29/05/83	VA	37.2°N, 76.5°W	F	12/01/85	AM	4°S, 63.2°W	Dead	594	4766
0718-74368	28/06/83	NJ	39°N, 74.7°W	J	01/10/83	PA	1.7°S, 69.7°W	Shot	95*	4532
0608-37927	30/06/83	WI	44.5°N, 89.5°W	J	01/10/96	AM	5.5°S, 60.8°W	Shot	4842*	6263
0608-40886	30/06/83	DE	38.5°N, 75°W		11/01/83			Band	124*	
0528-50566	01/07/84	VA	37°N, 75.8°W	J	01/08/86	AM	5°S, 70.2°W	Shot	761*	4687
0608-08275	17/07/84	PE	46.2°N, 62.3°W	J	01/10/89	AM	3.2°S, 60.7°W	Shot	1902	5467
0688-48765	12/07/85	DE	38.5°N, 75°W	J	01/05/90	AM	3.3°S, 64.5°W	Shot	1754*	4758
0608-67546	15/07/86	WI	46.2°N, 90°W	J	01/08/97	AM	7°S, 71.5°W	Shot	4035*	6182
0608-56212	28/06/88	CT	41.2°N, 72°W	J	29/08/89	TO	9°S, 49.8°W	Shot	427	6013
0608-78647	30/06/88	MD	38.7°N, 76°W		09/12/93	AM	3.5°S, 61.3°W	No info	1988	4911
0608-81394	06/07/88	VA	37.8°N, 76°W	J	01/10/91	BA	9.7°S, 42°W	Shot	1182*	6357
0608-81108	19/05/89	MA	41.5°N, 71°W	J	13/09/97	AM	4.3°S, 61.3°W	Dead	3039	5172
0608-84701	22/06/89	MD	38.5°N, 76.7°W	J	09/02/90	PA	3.7°S, 51.7°W	Shot	232	5344
0608-81846	14/07/89	NJ	40.3°N, 74°W	M	21/04/93	AM	0°S, 69°W	Shot	1377	4496
0608-85219	25/07/89	MA	41.5°N, 71°W	J	10/02/93	AM	3.2°S, 60.8°W	Shot	1296	5055
0788-01854	20/06/91	MD	38.2°N, 76.3°W	J	01/04/99	PA	1.7°S, 56°W	Dead	2842*	4890
0788-07778	20/06/91	NJ	39.3°N, 75°W	J	28/09/91	AM	3°S, 64.7°W	Shot	100	4808
0608-85129	28/06/91	CT	41.2°N, 72.2°W	J	10/02/93	AM	3°S, 61.3°W	Shot	593	5016
0788-07752	30/06/91	NJ	39.7°N, 74.2°W	J	19/11/91	AM	5.8°S, 63.2°W	No info	142	5166
0788-15091	01/07/92	PA	41°N, 75.5°W	J	09/09/92	AM	4.2°S, 69.8°W	Hand	70*	5035
0788-19309	23/07/92	ME	43.8°N, 69.7°W	J	05/02/93	DF	15.7°S, 47.7°W	Hand	197	6971
0788-21314	22/06/93	MD	38.5°N, 76.7°W		21/03/94	AM	3°S, 60.3°W	Hand	272	4898
1207-63243	16/07/94	MI	44.8°N, 83.8°W	J	01/07/97	AM	8.3°S, 60.3°W	Shot	1081*	6361
0788-23833	19/07/94	MI	46.2°N, 84°W		22/12/94	MT	14.8°S, 56.3°W	Dead	156	7328
0788-19644	26/06/95	NJ	39.3°N, 74.3°W		01/11/96	AM	3.2°S, 60.5°W	Dead	494*	4919
0788-27429	26/06/96	NJ	39.7°N, 74°W		14/08/97	MG	22.5°S, 42.8°W	Dead	414	7620
0788-38002	08/07/97	ME	44.7°N, 67.8°W		01/12/01	AM	3.3°S, 63°W	Dead	1607	5339
0788-26920	16/06/98	NC	35.8°N, 76.7°W	J	16/03/99	PA	1.5°S, 52.5°W	Shot	273	4845
0608-44251	25/06/98	VA	36.5°N, 75.8°W	J	07/10/98	AM	0.5°S, 66.3°W	Shot	104	4214
0788-38410	17/06/99	CT	41.2°N, 72.2°W		24/11/03	BA	13.8°S, 44.2°W	Shot	1621	6754
0788-09416	02/05/00	FL	27.3°N, 81.3°W		18/10/00	CE	3.7°S, 38.5°W	Dead	169	5748

[a]North American state or province of banding: CT, Connecticut; DE, Delaware; FL, Florida; MA, Massachusetts; MD, Maryland; ME, Maine; MI, Michigan; MN, Minnesota; NJ, New Jersey; NY, New York; NC, North Carolina; ND, North Dakota; PA, Pennsylvania; PE, Prince Edward Islands, Canada; VA, Virginia; WI, Wisconsin.

[b]Age/sex (when banded): J, juvenile < 1 year; M, male > 1 year; F, female > 1 year.

[c]Brazilian state of recapture: AC, Acre; AM, Amazonas; AP, Amapá; BA, Bahia; CE, Ceará; DF, Federal District; MG, Minas Gerais; MS, Mato Grosso do Sul; MT, Mato Grosso; PA, Pará; PB, Paraíba; PR, Paraná; RJ, Rio de Janeiro; RO, Roraima; SP, São Paulo; TO, Tocantins.

[d]Time estimated from inexact records is marked with an asterisk, see text for explanation.

Discussion

Our results emphasize the role of Brazil, mainly the Amazon, as an important wintering site for ospreys, given that most of the eastern US ospreys winter in South America (Poole & Agler 1987), and more than 80% of Brazilian recaptures were from Amazonian sites (this study). These Amazonian sites are important because individuals are spread out over a vast area where the human population densities are low and where pesticides are not widely used.

Poole et al. (2002) reported that 93% of ospreys recovered after having been shot (1972–1984) were from wintering grounds in Central and South America. From 1960 to 1998 about 75% of the osprey recoveries were individuals shot in Brazilian sites (Poole et al. 2002). In our study, although 73% of ospreys recovered in Brazil were shot, the number of recoveries after gunshots has decreased in the current decade. Through the first six years of the 2000s, only one osprey has been recovered after gunshot, whereas during each of the previous three decades, between 15

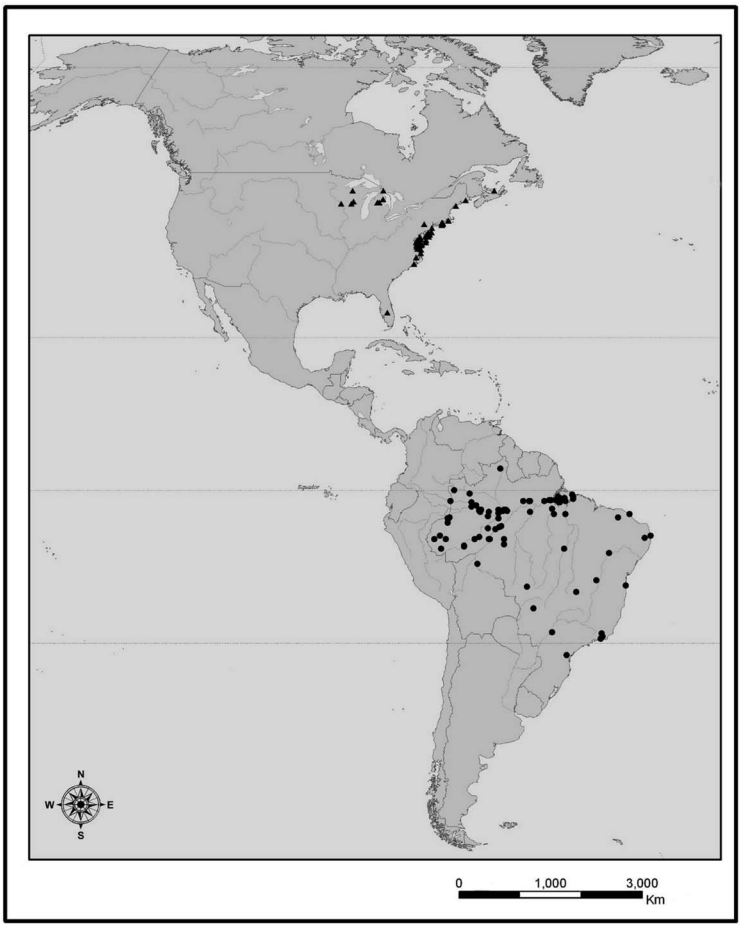

Figure 1. Band recoveries in Brazil (circles) of ospreys (*Pandion haliaetus*) banded in North America (triangles) between 1936 and 2006.

and 18 ospreys were in this category. The prevalence of shooting in wintering sites might be decreasing in the same trend as in breeding areas (Poole et al. 2002), however, this tendency could also be a result of fewer people reporting recoveries due to fear of punishment for illegal hunting in Brazil. We propose new programs that encourage local people to report osprey band recoveries without fear of prosecution. Information about ospreys could also be included in basic didactic books used in local schools.

It is possible that ospreys are more at risk during migration than on the wintering grounds. The vast area that ospreys occupy in the winter and their very sedentary nature at wintering locations (at least for adults) provides them with relative safety from many types of danger. It is worth commenting on the apparent contradiction inherent in making the claim that the Amazon is a relatively safe place for ospreys based on data that is predominantly derived from ospreys that were shot. We believe this apparent paradox can be explained by comparing banding returns and the distribution of satellite-tagged birds on their wintering grounds. Banding recoveries reported by Poole & Agler (1987) across South America show a very dense concentration in northern Colombia, particularly in the Cauca and Magdalena valleys – areas with high human population densities. Most of these recoveries were from birds that had been shot. In sharp contrast, the distribution of satellite-tagged birds reported by Martell et al. (2001) shows a fairly regular distribution across much of northern South America, with no concentration of birds in the areas where so many band recoveries were reported. From this we infer that the preponderance of recoveries in Colombia is an artifact of the bias inherent in band recoveries depending on encounters with humans and not indicative of very high population densities. In turn, we can conclude that there are indeed very many ospreys spread across the immense Amazon basin and the recoveries after gunshot represent a much lower percentage of the wintering population than in more densely populated areas.

We do not have reliable figures to estimate the relative proportion of juvenile ospreys in the population and therefore cannot determine if the 44% of returns

represented by juveniles is indicative of their relative abundance in the population or suggests an increased risk of fatal encounters with humans. If this figure (44%) represents a disproportionate percentage of juvenile ospreys in the Amazon, it might be explained by their year-round presence on the "wintering" grounds, their increased movement relative to adults (Bierregaard 2009), and perhaps less fear of humans.

Most of the eastern and some of the central North American population migrates through the very narrow bottleneck of Cuba, Hispaniola (Martell et al. 2001) and northern South America, where fish farming is increasing and ospreys and other fish-eating birds are routinely shot (Bechard & Marquez-Reyes 2003). An osprey radio-tagged in 2005 spent one and a half years in Cuba, safe in the Zapata swamps, and was shot at a fish farm two days into its first northward migration (Bierregaard 2009), and four out of four juvenile, satellite-tagged ospreys that tried to overwinter in the Dominican Republic were shot as they wandered across the countryside (Bierregaard 2009).

Although satellite tracking provides the most detailed window into wintering ecology, its expense precludes gathering data from a large sample, so banding data will continue to provide important information about age-specific mortality and site preferences. Banding data also provide information on longevity. Although the Canadian Wildlife Service reported a 35-year-old osprey (DesGranges et al. 1993), the oldest report we found from Brazil was 27 years and one month. Other old individuals include a 25- and a 23-year-old (Spitzer 1980; Postupalsky 1989).

We found that most of the original bandings were near the North American coast and a large number of recoveries in Brazil were inland, near rivers. Our data reinforce the observations of Poole (1994) and Triay (2002) that some populations of ospreys use different habitats in wintering sites, and support observations by Martell et al. (2001) that about 65% of ospreys followed by satellite were found wintering inland. Ospreys have a broad tolerance of different habitats, but habitats visited during migration remain poorly known (Poole et al. 2002).

We believe these data highlight the significance of Brazil as a wintering site to ospreys, but important questions about wintering habitats, ecological needs, and conservation of ospreys in Brazil remain unanswered.

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