2014

HUMAN–OSPREY CONFLICTS: INDUSTRY, UTILITIES, COMMUNICATION, AND TRANSPORTATION

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J. Raptor Res. 48(4):387–395

HUMAN–OSPREY CONFLICTS: INDUSTRY, UTILITIES, COMMUNICATION, AND TRANSPORTATION

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Abstract.—Although often perceived as a species of remote settings, Ospreys (*Pandion haliaetus*) are highly adaptable and currently are abundant in many urban and suburban landscapes. Living in close proximity to humans, Ospreys often come into conflict with people and several important issues require the attention of and management by natural resource professionals. These include effects on: (1) industry (e.g., foraging at aquaculture facilities), (2) utilities (e.g., nesting on electric utility power poles and transmission towers), (3) communication networks (e.g., nesting on cellular towers), and (4) transportation systems (e.g., risks posed to human health and safety due to Osprey–aircraft collisions). Due to the Osprey's migratory and wintering habits, conflicts between Ospreys and humans are generally seasonal in nature (i.e., during the nesting season); Florida is an important exception. Creative mitigation measures (many currently being developed and evaluated) that combine effective management and monitoring will provide a better understanding of human–Osprey conflicts and ensure our successful coexistence with Osprey populations in the future.

Key Words: *Osprey*; Pandion haliaetus; *bird strikes*; *conflict*; *urban areas*.

CONFLICTOS ENTRE HUMANOS Y *PANDION HALIAETUS*: INDUSTRIA, SERVICIOS PÚBLICOS, COMUNICACIÓN Y TRANSPORTE

Resumen.—Aunque a menudo es percibida como una especie de sitios remotos, *Pandion haliaetus* es una especie altamente adaptable y en la actualidad es abundante en muchos paisajes urbanos y sub-urbanos. Al vivir en cercanía de los humanos, a menudo *P. haliaetus* entra en conflicto con la gente y varios problemas importantes requieren de la atención y el manejo de profesionales de los recursos naturales. Estos problemas incluyen efectos en: (1) industria (e.g., forrajeo en instalaciones de acuacultura), (2) servicios públicos (e.g., nidificación en postes de electricidad y torres de transmisión), (3) redes de comunicación (e.g., nidificación en torres de telefonía celular) y (4) sistemas transporte (e.g., riesgos para la salud y seguridad humanas debido a colisiones entre individuos de *P. haliaetus* y aeronaves). Debido a los hábitos migratorios y de invernada de *P. haliaetus*, los conflictos entre esta especie y los humanos son generalmente estacionales (i.e., durante la temporada de nidificación); Florida es una excepción importante. Medidas creativas de mitigación (muchas de ellas están siendo desarrolladas y evaluadas) que combinen un manejo eficiente y el monitoreo proporcionarán un mejor entendimiento de los conflictos entre *P. haliaetus* y humanos y asegurará una coexistencia exitosa con poblaciones de esta especie en el futuro.

[Traducción del equipo editorial]

The recovery of Osprey (*Pandion haliaetus*) populations in the United States of America (U.S.A.) represents a true conservation success story. Substantial Osprey population increases and range expansion have occurred as a result of banning the use of dichloro-diphenyl-tricholorethane (DDT) and other organochlorine (OC) insecticides, intensive research and conservation efforts, and recovery activities (e.g., hacking and translocation programs), all of which have been well documented (e.g., Poole et al. 2002, Henny et al. 2010). The U.S. Geological Survey Breeding Bird Survey shows that Osprey populations within the U.S.A. have increased an average of 2.9% each year from 1966 to 2010, with an average annual increase of 5.1% during 2000–2010 (Sauer et al. 2011).

Although often perceived as a species of remote settings, Ospreys are highly adaptable and have become increasingly abundant in many urban and suburban landscapes (Poole 1989, Poole et al. 2002). More frequent interactions with humans also

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Figure 1. An Osprey nest built on an aid to navigation (e.g., channel marker) that poses a conflict. Photo taken by the author.

means greater opportunity for conflict to arise, with one example of such conflict being the use of nontraditional substrates for nesting. As reviewed by Henny et al. (2010), the first reported Osprey nest on a human-made structure (i.e., the roof of a house) was documented in 1835 by John James Audubon in Florida. Ospreys can shift their nesting habits from using predominantly natural structures (e.g., live trees, snags) to extensive use of artificial platforms (e.g., artificial nest supports intended to benefit Osprey). Along with the use of nesting platforms intended for Ospreys, there has also been increased use of nests in problematic locations, such as electric utility, communication, and transportation structures (e.g., electric utility poles, cellular towers, and aids to navigation; Fig. 1). This trend began in the eastern U.S.A. prior to the 1970s (Bent 1937, Henny et al. 1974, Blue 1996, Ewins 1996) and during the 1980s and 1990s in the western U.S.A. (Henny and Kaiser 1996, Haughton and Rymon 1997, Henny et al. 2010). Currently, field surveys show that more than 85% of Ospreys nesting in various regions of the U.S.A. (e.g., Chesapeake Bay, New Jersey, Kentucky, Indiana, Wisconsin, Idaho, Oregon) use human-made structures (Watts and Paxton 2007, Waterbury 2009, Clark and Wurst 2010, Eckstein et al. 2010, Henny et al. 2010, IDNR 2010, Heyden 2011). The Osprey's ability to exploit, and possible preference for, human-made structures for nest locations has also resulted in human–Osprey conflicts outside of North America (e.g., in Europe; Meyburg et al. 1996).

The Ospreys' ability to adapt to and prosper within urban and suburban areas, combined with their recent reproductive success and thriving populations, has resulted in conflicts between Ospreys and the electric utility, communication, and transportation (e.g., aviation) industries. Human–Osprey conflicts vary widely in scope and scale, ranging from minor conflicts such as an individual Osprey nest built on a human-made structure (e.g., cellular tower) to major problems, such as local populations of Ospreys directly or indirectly impacting human safety near civilian airports and military airfields through nesting and movement activities. Creative, mutually beneficial management and mitigation practices for both people and Ospreys are needed to allow for the successful coexistence of Ospreys and humans, especially in landscapes that are highly altered by humans.

CONFLICT SITUATIONS

Industry. *Aquaculture production.* Like other piscivorous birds (e.g., Double-crested Cormorants [*Phalacrocorax auritus*]), Ospreys are opportunistic and sometimes use fish-rearing facilities as foraging sites. Osprey–human conflicts associated with aquaculture production facilities during the breeding season have been documented and evaluated by Parkhurst et al. (1992), Pitt and Conover (1996), and Glahn et al. (1999) in the United States as well as during the wintering period in Central and South America by Bechard and Márquez-Reyes (2003) and Bechard et al. (2007).

Wind energy. Commercial wind-generated electrical energy is the fastest growing energy industry sector in the world (Manville 2005, 2009). Avian fatalities associated with wind energy facilities, in particular for raptors, are an important conservation concern. The effect that proposed large scale land-based and off-shore wind facilities in the U.S.A. (e.g., Nantucket Shoals, Massachusetts, and Long Island, New York) will have on wildlife has yet to be systematically assessed, but such facilities have the potential to severely affect resident and migrating Ospreys and other birds (Johnson et al. 2002, Manville 2005, 2009).

Utilities. Ospreys frequently build nests on electric power distribution poles and transmission line towers (Blue 1996, Henny et al. 2010; Table 1). This creates conflicts through risks to the birds (i.e., injuries and direct fatalities due to electrocutions and

Table 1. Percent of Osprey nests found on various natural and human-made structures during surveys conducted during 2008–2011.

		Nest Locations (%)						
State/Region	No. of Nests	Natural	Artificial Platforms	Cell Towers	Power Poles/Lines	Navigation Aids	Other[a]	Reference
Idaho, north-central	32	21.9	59.4	—[b]	18.8	—	3.1	Waterbury 2009
New Jersey	355	2.0	75.0	8.0	—	4.0	10.0	Clark and Wurst 2010
Indiana	45	8.9	53.3	20.0	17.8	—	—	Indiana DNR 2010
Wisconsin, central	62	4.8	31.7	9.5	68.3	—	1.6	Eckstein et al. 2010
Kentucky	87	21.8	4.6	6.9	27.6	24.1	14.9	Heyden 2011

[a] ''Other'' included miscellaneous man-made structures (e.g., buildings, bridges) that were not consistent with the previous categories.
[b] No Osprey nests were observed on structures within this category.

wire collisions) and damage to equipment and costly service interruptions to customers, from fires when Osprey nest material compromises critical components (Harness and Wilson 2001, APLIC 2006, 2012). Surveys indicate that wildlife (including birds) are the third leading cause of power outages in the U.S.A. (Southern Engineering Company 1996), that wildlife are the cause of 10–25% of all power outages in California and Wisconsin (Kysely 2004, Energy and Environmental Economics 2005), and that bird-caused outages occur with almost two-thirds (58%) of utility companies in the U.S.A. (APLIC 2005).

Communication. The number of communication towers (e.g., lattice and monopole cellular telephone towers, and tall, lattice guyed digital television antennas, among others) is growing exponentially across the U.S.A. (Manville 2005, 2007, 2009). Communication towers, especially cellular towers, seem to have characteristics that make these structures ideal nesting sites for Ospreys (Table 1). Conflicts arise when Osprey nest materials interfere with the function of the transmitting and receiving equipment on the towers (thus resulting in interruptions of service) or when repairs and maintenance must be completed.

Transportation. *Aids to navigation.* Aids to navigation, more commonly referred to as channel markers, are structures (e.g., wooden poles, buoys) that use lights and/or signage to provide important information to commercial and recreational watercraft to allow for safe navigation of waterways. Ospreys frequently use channel markers and other navigation structures as nesting sites (Olexa 2006, Watts and Paxton 2007, Heyden 2011; Table 1), which can influence the efficacy of the navigation aid by blocking the light and/or signage from view by watercraft operators (Fig. 1).

Collisions with aircraft. Wildlife-aircraft collisions (i.e., wildlife strikes) pose a serious safety risk to both civilian and military aircraft (Sodhi 2002, Thorpe 2010). Wildlife strikes cost civil aviation at least $718 million annually in the United States (Dolbeer et al. 2012). The expansion of breeding Osprey populations combined with this species' ability to successfully adapt to human encroachment and development has resulted in a growing concern to civilian and military aviation. Osprey commonly nest in coastal and riverine habitats that are in close proximity to airports and military airfields, thus increasing the risk of Osprey–aircraft collisions. For example, in 2000 an F-15 Strike Eagle fighter jet stationed at Langley Air Force Base, Virginia, collided with an Osprey, causing over $750 000 in engine damage and forcing the pilot to conduct an emergency landing (Olexa 2006). Although several examinations of wildlife strikes with civilian and military have been conducted (Dolbeer et al. 2000, Zakrajsek and Bissonette 2005, DeVault et al. 2011), there are currently no available analyses that specifically evaluate Osprey–aircraft collisions (i.e., Osprey strikes). I conducted such an analysis to provide a better understanding of Osprey strikes with civil and military aircraft within the U.S.A.

I obtained all available Osprey–aircraft strike records from the Federal Aviation Administration's (FAA) National Wildlife Strike Database (NWSD)

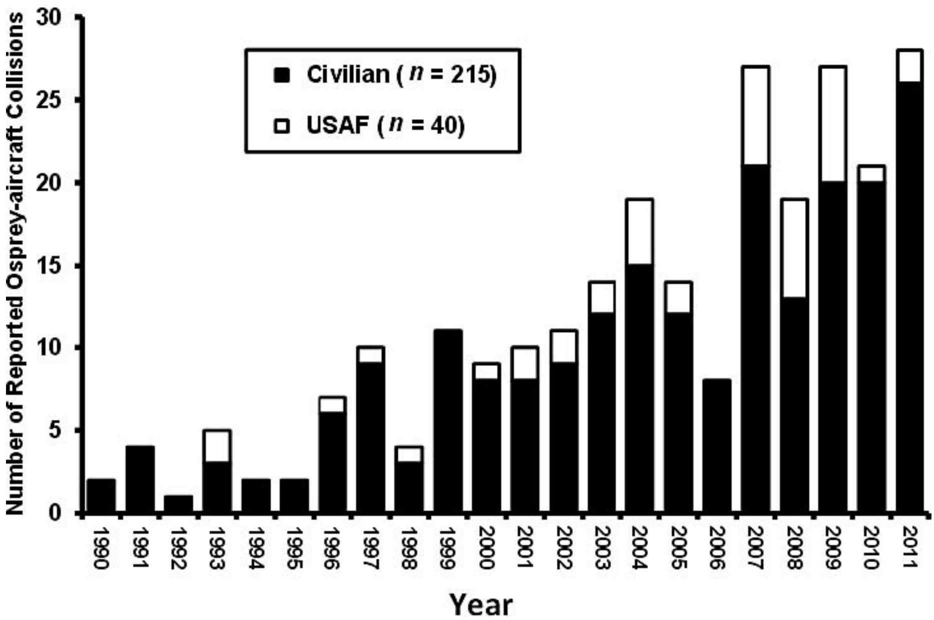

Figure 2. Annual number of Osprey–aircraft collisions in the U.S.A. reported for civilian and military (i.e., United States Air Force [USAF]) aircraft, 1990–2011.

and the U.S. Air Force (USAF) wildlife strike database from 1990 to 2011. After removing duplicate records and verifying data quality and integrity, I conducted a series of summaries and statistical analyses using chi-squared tests (Zar 1996) to better understand the risk Ospreys pose to civilian and military aircraft operations within the U.S.A.

Among the records of the FAA's NWSD and the USAF wildlife strike database, there were a total of 255 reported Osprey–aircraft strikes (215 with civilian aircraft and 40 with USAF aircraft) that occurred during 1990–2011, an average of 11.6 ($\pm$1.8 SE) annually (Fig. 2). The annual number of reported Osprey strikes to civilian and USAF aircraft (combined) increased ($y = 0.68x - 1992.7$; $R^2 = 0.80$, $F_{1,21} = 78.2$, $P < 0.0001$) during this time period, concurrent with an increase of 46% in commercial aviation flights in the U.S.A. (USDOT 2013). The observed increases in Osprey strikes to aircraft likely resulted from growing Osprey populations, increased reporting of Osprey strike incidents, increased military and/or civilian flights, or a combination of these factors.

The number of reported Osprey strikes varied among months (season) for civilian aircraft ($\chi^2 = 55.9$, df = 11, $P < 0.0001$) but not for USAF aircraft ($\chi^2 = 6.7$, df =11, $P = 0.82$). For civilian aircraft, Osprey strikes were highest during summer (May through August; Fig. 3). This time period coincides with the Osprey breeding season (Martell et al. 2001, Poole et al. 2002, Washburn and Olexa 2011). Osprey strikes varied ($\chi^2 = 112.0$, df = 3, $P < 0.0001$) among times of day (i.e., dawn, day, dusk, and night) and occurred almost exclusively (96.3%) during daylight hours, when Ospreys are active (Poole 1989, Poole et al. 2002, Washburn and Olexa 2011).

Osprey–aircraft collisions occurred in 28 states and the District of Columbia. Of the 215 reported Osprey strikes to civilian aircraft, 29.9%, 21.0%, and 13.1% occurred in Florida, New York, and the District of Columbia, respectively. The states with the highest frequency of reported USAF Osprey-strike incidents were Florida (37.5%) and South Carolina (12.5%).

For civilian and USAF aircraft (combined), the majority of reported Osprey strikes (85.8%) occurred within the immediate airfield environment. Osprey strikes to aircraft occurred during all phases of aircraft flight; however, only 3.9% and 6.7% of the strikes to civilian and USAF aircraft, respectively, occurred while the aircraft were *en route* to their destinations, outside the immediate airfield environment. Most Osprey strikes occurred when aircraft

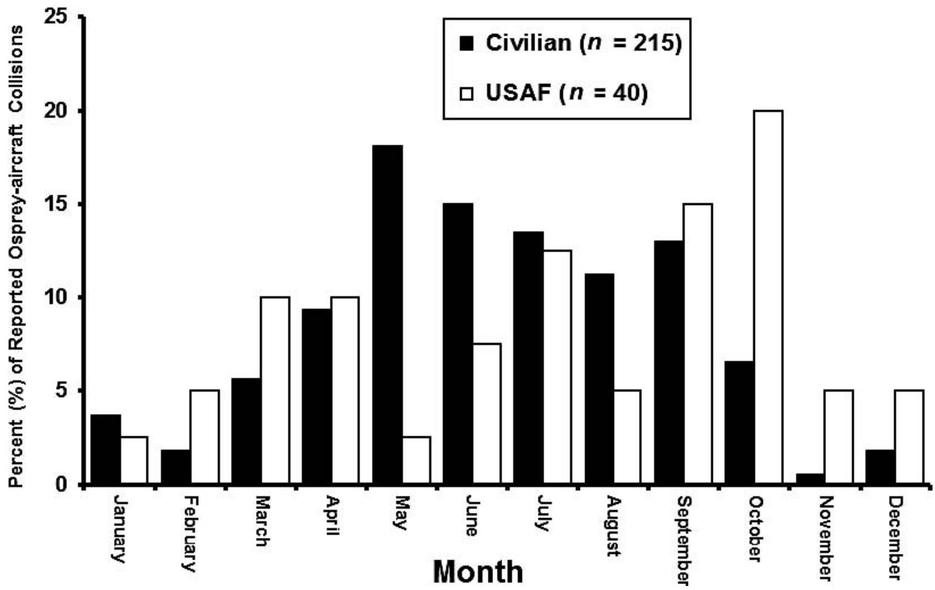

Figure 3. Reported Osprey–aircraft collisions (%), by month, in the U.S.A. for civilian and military (i.e., United States Air Force [USAF]) aircraft, 1990–2011.

were ''on approach'' to the airfields (38.2% of all strikes), landing (22.2%), or taking off (20.5%).

In almost all reported Osprey–strike incidents (98.8%), only one bird was involved. On four occasions, two Ospreys were struck by the same aircraft. The number of reported Osprey strikes to various sections of the aircraft (i.e., impact locations) varied for civilian ($\chi^2 = 28.7$, df = 8, $P = 0.0004$) and USAF ($\chi^2 = 17.1$, df = 8, $P = 0.03$) aircraft (Table 2).

Table 2. Percent of known impact locations (i.e., where the bird struck the aircraft) during Osprey–aircraft collisions with civilian and military (i.e., United States Air Force [USAF]) aircraft that occurred within the USA, 1990–2011.

Impact Location	Civil (%)	USAF (%)	Total (%)
Radome/nose	12.7	11.1	12.3
Windscreen	7.8	— [a]	5.8
Fuselage	9.8	13.9	10.9
Wing	30.5	25.0	29.0
Engine	12.7	27.8	16.7
Landing gear	8.8	8.3	8.7
Weapons system	—	8.3	2.2
Tail section	2.0	5.6	2.9
Multiple locations	15.7	—	11.5

[a] No strikes to this section of the aircraft were reported.

Osprey–aircraft collisions can be costly in regard to aircraft damage and losses, and result in human injuries and potential fatalities. The proportion of Osprey strikes that caused damage to the aircraft was 39.8% for civilian and 32.5% for USAF aircraft. The average cost of a damaging wildlife strike (i.e., estimate [US$ of damaged parts and repair costs]) to a civilian aircraft was $15 131 per incident (highest reported = $100 012), whereas the average cost of a damaging strike to a USAF aircraft was $40 270 per incident (highest reported = $750 000). In almost all cases, Osprey–aircraft collisions resulted in Osprey mortality. Three of the incidents resulted in injuries to the pilots of the aircraft.

MANAGEMENT IMPLICATIONS

Mitigation efforts (e.g., nest removal) to reduce or eliminate specific conflicts between Ospreys and humans must be conducted within the constraints and conditions outlined within legislation and their regulations related to wildlife conservation and management. Ospreys are protected in the U.S.A. by the federal Migratory Bird Treaty Act (16 United States Code 703-712) and its associated regulations. In addition, individual states may provide legal protection to Ospreys via state statues, regulations, or administrative code (e.g., Chapter 68A of the Florida Administrative Code, Code of Virginia

29.1-521). Although some states with low overall populations of Ospreys are encouraging increases in Osprey breeding and abundance (e.g., Indiana, Iowa, New Jersey) through installation of artificial nest platforms and use of hacking towers (Olexa 2006, Clark and Wurst 2010, Eckstein et al. 2010), other states (e.g., Florida, Virginia) are experiencing high levels of human–Osprey conflicts due to the large populations of Ospreys in these areas (FFWCC 2004, Olexa 2006).

Due to the migratory nature of North American Ospreys (Poole 1989, Poole et al. 2002), the occurrence of human–Osprey conflict situations across the U.S.A. is generally limited to the breeding and early migration periods, with one notable exception. Throughout the year, Ospreys in Florida include a combination of birds that summer (and breed) in northern states and winter in Florida (arguably much like some human demographics), birds that breed in Florida and winter in central or South America, and locally breeding Ospreys that make nonmigratory post-breeding movements but remain in Florida throughout the year (Poole et al. 2002, Martell et al. 2004).

Industry. *Aquaculture production.* A variety of methods and techniques, including exclusion, nonlethal hazing, and lethal control, are available to reduce the potential of human–Osprey conflicts associated with aquaculture production facilities (Salmon and Conte 1981, Bechard and Márquez-Reyes 2003). Although lethal control (i.e., shooting) is a commonly used method at aquaculture facilities in Central and South America (Bechard and Márquez-Reyes 2003, Bechard et al. 2007), promotion of effective, nonlethal methods (e.g., exclusion netting) has the potential to decrease the occurrence of human–Osprey conflicts, and more importantly, Osprey mortality. This represents an area of important research and outreach, particularly within Central and South American countries.

Wind energy. Like all migrating birds, Ospreys may be affected by existing or future wind energy facilities that occur in their migratory pathways. However, the nature and extent of such conflict situations is unknown. Recent advances in satellite tracking technology might provide particularly useful information for determining the potential influence that wind energy development could have on breeding and migrating Ospreys (Martell et al. 2001, Washburn and Olexa 2011, Martell et al. 2014) when such facilities are sited within coastal regions or offshore areas.

Utilities. Some state wildlife management agencies provide guidelines and information regarding processes and recommended procedures for the management of human–Osprey conflicts (FFWCC 2004, VDGIF 2010). The sociopolitical nature of human–Osprey conflicts can be particularly important due to the visibility of Osprey nests in residential and urban areas, combined with a high level of public interest in Ospreys and raptors in general. Consequently, some electric utility and power service companies are taking proactive approaches (e.g., developing protocols and guidelines, effectively using media and electronic outlets) to reduce the effects of Osprey nesting on utility poles, power transmission towers, communication towers, and other utility service structures. Such efforts are employed to decrease power outages and loss of customer service, increase service reliability, and gain valuable prestige (Kelly and Hodge 1996, Manville 2005, 2009, Eckstein et al. 2010). In emergency situations where Ospreys may be in danger (e.g., a fire at a nest on a power transmission tower or electric utility pole), assistance from state or federal wildlife management agencies (e.g., U.S.D.A. Wildlife Services, U.S. Fish and Wildlife Service), and/or licensed wildlife rehabilitators in resolving these conflicts may be available for utility companies, public service providers, and municipalities.

In situations where Ospreys are nesting on human-made structures and thus may create conflicts, the addition of an artificial nesting platform (either to the structure itself or preferably on a pole erected nearby the nest site) offers a mutually beneficial solution (APLIC 2006, 2012). Discouraging Ospreys from using problematic nest sites through modifications to the structures, concurrent with the installation of the artificial platform, is an important step in the process (APLIC 2006). In addition, modification of existing power distribution poles (e.g., installing avian perch deterrents, pole caps, thermoplastic coating, bushing covers, using bird deterrent and line-marking devices, and appropriately separating phase-to-phase and phase-to-ground wires, among other practices) can all reduce Osprey collisions and electrocutions with pole and line infrastructures (APLIC 2006, 2012). Nest platforms (APLIC 2006) and line-marking devices (APLIC 2012) can reduce fires, electrocutions, and collisions with power transmission towers and transmission lines and their static wires. Decreased perching and nesting should result in less Osprey mortality and fewer human–Osprey conflicts (Harness and Wilson 2001, APLIC 2006, 2012).

Communication. Increases in communication tower abundance and distribution (due to increasing demands for utilities and services by a growing human population), combined with the physical characteristics of towers that are attractive to nesting Osprey, appear to be creating the potential for an abundance of current and future human–Osprey conflicts. Although detailed information on the overall occurrence of human–Osprey conflicts related to communication towers is currently unavailable, such conflicts appear to be widespread and might be specific to Ospreys during the nesting period. Consequently, if human disturbance to Ospreys and nests (e.g., tower equipment maintenance activities) could be planned and conducted at times outside of the breeding season, many conflict situations could be avoided or mitigated.

The potential effects of low-level, nonthermal radiation emitted from communication towers on nesting and roosting birds in Europe has been strongly correlated with feather loss, reduced bird survivorship, injuries and death, but has yet to be studied in the wild in North America (see laboratory and field references cited in Manville 2005, 2009). Because Ospreys have a propensity to nest on communication towers and other structures close to them, the possible effects of radiation on eggs, nestlings, and adults are of concern, and I suggest this topic is an area needing considerable further study.

Transportation. *Aids to navigation.* Aids to navigation should be modified (e.g., relocation of signage, addition of perch deterrent devices) to discourage or prevent Ospreys from nesting on the channel markers (Olexa 2006). Alternatively, the modification of navigation aids, such as the addition of an artificial nesting platform above the structure, can allow for Osprey nesting without blocking the light and/or sign and reducing watercraft safety (Heyden 2011). Similar nesting platforms are already recommended to address electric distribution pole and transmission tower nesting issues (APLIC 2006, 2012).

Collisions with aircraft. Human safety issues related to Osprey–aircraft collisions can be serious. Addressing Osprey strike events effectively requires enhanced aviator awareness, proper reporting, and an emphasis on resolving this issue. The reduction of risk to aviation safety posed by Ospreys and other wildlife is best effected through the use of an integrated wildlife damage management program, which likely would include the use of nonlethal hazing and harassment, installation of perch deterrents on airport structures, possible use of infrasound and audible noise deterrents, pyrotechnics, translocation or removal of problematic individuals, and a variety of other tools and techniques (Cleary and Dolbeer 2005, Olexa 2006). Ospreys often demonstrate the interesting and dangerous habit of landing on airport taxiways and runways to eat fish. Although the reason for this behavior is unknown (perhaps it provides the birds with better opportunities to see approaching competitors, such as Bald Eagles [*Haliaeetus leucocephalus*]), this habit greatly increases the risk of Osprey–aircraft strikes and engine ingestions. Active, nonlethal hazing and harassment methods (e.g., use of pyrotechnics) are important for deterring this behavior and reducing Osprey presence within the airport environment.

Other activities designed to reduce Osprey presence and use of airfields can be also beneficial. The placement of artificial nest platforms in areas near or around airports to increase the number of nesting Ospreys should be discouraged and existing platforms should be removed. Where practical, forage resources such as fish should be removed from ponds and wetlands within the immediate airfield environment.

SUMMARY

Recent increases in Osprey populations across North America have resulted in more and diverse conflicts between humans and Ospreys. The nature of these conflicts varies considerably with regard to their scale and scope, and the effects upon Ospreys and humans. Because of the Osprey's high visibility, its use of urban and suburban areas for nesting, aquatic-based feeding behavior, and increasing trends for many populations, opportunities for public education regarding the resolution of human–Osprey conflicts abound. These opportunities for resolution include creative mitigation measures, many currently being developed and evaluated, that combine effective management and better monitoring, which ultimately will provide a better understanding of human–Osprey conflicts, help reduce these conflicts, and ensure our successful coexistence with Osprey populations in the future.

ACKNOWLEDGMENTS

Financial and logistical support for this research effort was provided by the U.S. Department of Agriculture and the Federal Aviation Administration. I appreciate the assistance provided by Dan Sullivan and Lt. Tiffany Robertson of the United States Air Force Safety Center. B. Blackwell, T. DeVault, A. Poole, and two reviewers provided helpful comments on the manuscript. Any use of trade, product, or firm names is for descriptive purposes only and does not imply endorsement by the U.S. government.

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Received 16 December 2013; accepted 2 July 2014
Associate Editors: Alan F. Poole and Ian G. Warkentin