

SHORT COMMUNICATIONS

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RANGE CONTRACTION OF AN OSPREY POPULATION FOLLOWING LETHAL CONTROL AT A STATE FISH HATCHERY IN MONTANA

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ABSTRACT.—Human-Osprey (*Pandion haliaetus*) conflicts are increasing as the species rebounds from the negative effects of DDT. Ospreys forage at aquaculture facilities in North America, South America, and Europe, where nonlethal and lethal control are used to reduce depredations. Under the authority of a federal depredation permit, personnel at a state-owned fish hatchery in Montana shot eight Ospreys from 2018–2020 to reduce loss of brood stock largemouth bass (*Micropterus salmoides*). Independent long-term data (2012–2022) of Osprey breeding ecology along the Yellowstone River, which included the hatchery, afforded a rare opportunity to examine nest occupancy and reproductive success of the local population before, during, and following lethal control. The local breeding population of Ospreys collapsed by 2021 and the breeding range contracted 48–67 km during and after shooting. Shooting at the hatchery was the greatest source of Osprey mortality on the 950-km linear study area. In 2021, an informal working group of diverse stakeholders began meeting to develop nonlethal methods to reduce Osprey depredations at the hatchery.

KEY WORDS: *Osprey*; *Pandion haliaetus*; *aquaculture*; *depredation*; *ecological trap*; *reproductive success*; *shooting*.

CONTRACCIÓN DEL ÁREA DE DISTRIBUCIÓN DE UNA POBLACIÓN DE *PANDION HALIAETUS* DESPUÉS DE SU CONTROL LETAL EN UNA PISCIFACTORÍA ESTATAL EN MONTANA, EEUU

RESUMEN.—Los conflictos entre humanos y *Pandion haliaetus* aumentan a medida que la especie se recupera de los efectos negativos del DDT. *P. haliaetus* se alimenta en instalaciones acuícolas en América del Norte, América del Sur y Europa, donde se utilizan controles no letales y letales para reducir las depredaciones. Bajo la autoridad de un permiso federal de control, el personal de una piscifactoría de propiedad estatal en Montana disparó contra ocho individuos de *P. haliaetus* entre 2018 y 2020 para reducir la pérdida de reproductores de *Micropterus salmoides*. Los datos independientes a largo plazo (2012–2022) de la ecología reproductiva de *P. haliaetus* a lo largo del Río Yellowstone, que incluía la piscifactoría, proporcionaron una rara oportunidad para examinar la ocupación del nido y el éxito reproductivo de la población local antes, durante y después del control letal. La población reproductora local de *P. haliaetus* colapsó en 2021 y el área de reproducción se contrajo de 48 a 67 km durante y después de los disparos. Los disparos en la piscifactoría fueron la mayor fuente de mortalidad de *P. haliaetus* en el área de estudio lineal de 950 km. En 2021, un grupo de trabajo informal de diversas partes interesadas comenzó a reunirse para desarrollar métodos no letales para reducir las depredaciones de *P. haliaetus* en la piscifactoría.

[Traducción del equipo editorial]

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INTRODUCTION

Human-wildlife conflicts are common and well-studied at aquaculture facilities where Double-crested Cormorants (*Nannopterum auritum*), Great Blue Herons (*Ardea herodias*), and Great Egrets (*A. alba*) prey on commercial, pond-reared channel catfish (*Ictalurus punctatus*) (Price and Nickum 1995). Economic losses as a result of depredating piscivores can be significant and even unsustainable for some operations (Kumar et al. 2021). Studies at hatcheries where trout and other warm water species are raised for recreational fishing also report conflicts with avian piscivores. These facilities attract many of the same species, such as cormorants and wading birds, but some also report occasional Osprey (*Pandion haliaetus*) depredations (Parkhurst et al. 1992, Pitt and Conover 1996, Glahn et al. 1999, Blackwell et al. 2000). Aquaculture facilities attempt to reduce depredations by using nonlethal techniques (e.g., hazing, netting) and lethal control (e.g., shooting; Pitt and Conover 1996, Glahn et al. 1999, Belant et al. 2000).

As Osprey populations in the USA continue to rebound from the negative effects of DDT (Bierregaard et al. 2020), the number of human-Osprey conflicts involving electric utilities, cellular communications, and aviation has increased (Washburn 2014). This pattern is reflected both in the geographic distribution of conflicts and in the number of Ospreys killed annually by the US Department of Agriculture Wildlife Services (Fig. 1). Although Osprey depredations at aquaculture facilities in the USA currently appear less severe than those of cormorants or wading birds (Parkhurst et al. 1992, Pitt and Conover 1996, Glahn et al. 1999), conflicts in some aquacultural areas of South America where many North American Ospreys overwinter are of concern. For example, an estimated 315 Ospreys were killed annually in the early 2000s in Colombia where tilapia (*Oreochromis* spp.) were commercially raised at fish farms (Bechard and Marquez-Reyes 2003). In Europe, Ospreys have also experienced high levels of shooting at fish farms in Poland (Mizera 2009), which has contributed to the species vulnerable status in the country (Woźniak et al. 2022).

Since 2012, I have been studying Osprey ecology in Montana in cooperation with volunteers from the Yellowstone Valley Audubon Society (YVAS). Currently, we monitor the annual occupancy and reproductive success of approximately 80 nests along the Yellowstone River. On 25 January 2020 I received a report from the US Geological Survey [USGS] Bird Banding Lab that two Ospreys I had banded had been “caught or found dead due to: control operations” during summer 2019 at a fish hatchery operated by Montana Fish, Wildlife and Parks (MFWP) in our study area. The birds had been shot under the authority of a US Fish and Wildlife Service (USFWS) Migratory Bird Depredation Permit held by MFWP. The permit also authorized “take” of Great Blue Herons, Double-crested Cormorants, and Canada Geese (*Branta canadensis*) to reduce depredations of largemouth bass

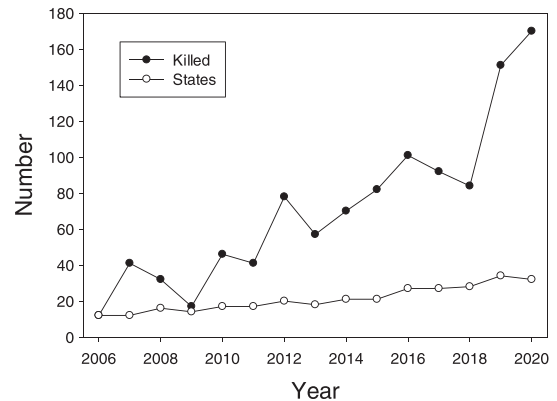


Figure 1. The number of USA states, and number of Ospreys killed, where US Department of Agriculture Wildlife Services used lethal control to reduce human-Osprey conflicts, 2006–2020 (US Department of Agriculture 2021).

(*Micropterus salmoides*), a nonnative species in Montana, which is bred at the hatchery to support recreational fisheries.

The reproductive data from our ongoing long-term study afforded the rare opportunity to evaluate the effects of lethal control at the hatchery on the local population dynamics of Ospreys. Whereas some researchers found no negative effects of lethal control on populations of depredating species at larger regional and national spatial scales (Belant et al. 2000, Blackwell et al. 2000), effects at local scales remain largely unknown. Therefore, Barrett et al. (2019) recommended that researchers measure survival and reproduction of depredating species to determine if aquaculture facilities act as ecological traps.

My objectives were to describe the nest occupancy and reproductive success of the local Osprey population before, during, and following lethal control at the MFWP hatchery. The hatchery was located at the easternmost range of Ospreys along the Yellowstone River, which allowed an examination of the effects of lethal control at the hatchery on range occupancy for a species (1) where growth of local populations appears driven largely by local reproduction and survival and (2) that colonizes new areas slowly (Bierregaard et al. 2020). Finally, I was able to compare the magnitude of shooting mortality with other mortality factors of adult Ospreys identified during the 11-yr study.

METHODS

The study area extends 950 km along the Yellowstone River from the Wyoming–Montana border (45.029°N, 110.694°W) to the Montana–North Dakota border (47.804°N, 104.043°W). As the river flows downstream, it changes from a high-gradient, clear, cold mountain system

to a low-gradient, turbid, warm-water system. The geomorphology of the dynamic, unregulated river comprises multi-channel reaches, forested islands, gravel bars, and straight channels abutting cliffs. Vegetation along the riparian corridor reflects the decrease in elevation, from foothill (1750 m) forests dominated by conifers (e.g., *Juniperus*, *Pinus*, *Picea*, and *Pseudotsuga* spp.) to river bottoms (615 m) that comprise shrubs (e.g., *Salix* and *Tamarix* spp.) and deciduous trees (e.g., *Fraxinus pennsylvanica*, *Populus* spp.). Anthropogenic land uses along the river include small grain farming, livestock grazing, recreation, and urban-centered industries such as oil refining. The climate is semi-arid.

The MFWP Miles City Fish Hatchery has a footprint of approximately 90 ha, and is located (46.385°N, 105.862°W, elevation 725 masl) 250 km upriver from the Montana–North Dakota border. Each year the hatchery raises warm water fish (e.g., largemouth bass, yellow perch [*Perca flavescens*], bluegill [*Lepomis macrochirus*]) in a variable number of the 49 available open ponds that range in size from 0.2 ha to 1.2 ha (total pond surface area of approximately 25 ha). The ponds did not have bird deterrents such as netting or overhead lines during the period of lethal control. Ospreys were shot because they predominantly depredated the oldest largemouth bass (C. Hagemeister, MFWP, pers. comm.), which served as brood stock in two 1.1-ha open ponds from mid-May to mid-August. Younger age classes of breeding bass are held in three 0.5-ha open ponds during summer. The bass are moved to smaller raceways (0.05 ha) after the breeding season where they are held until mid-September before being transferred to another hatchery for winter. The bass are also vulnerable to foraging Ospreys while in the raceways, which are not netted.

Each year from 2012–2022, 20–45 volunteers from YVAS and I conducted fieldwork during the Osprey breeding season (April–August). Beginning in early April, we used binoculars and spotting scopes to survey the study area for Ospreys, which nested almost exclusively on artificial platforms (Seacor et al. 2014) erected by power companies to deter use of energized power poles (Avian Power Line Interaction Committee [APLIC] 2006). We checked existing platforms and searched areas between occupied nests for new breeding pairs each season. Cooperating power companies also alerted us to the presence of new pairs, especially in cases where Ospreys attempted to build nests on energized power poles when establishing new territories in the study area.

We used binoculars and spotting scopes to observe Osprey nests at distances of 75–200 m at approximately 1-wk intervals throughout the breeding season to determine occupancy and to estimate dates of egg laying, hatching, and fledging; brood size; and reproductive success (i.e., number of young fledged [Harmata et al. 2007, Steenhof and Newton 2007]). Occupied nests were defined as refurbished nests with two adults, whether eggs were laid or not. Successful nests fledged at least one young. Causes

of mortality of nestlings and adults were determined in the field or carcasses were necropsied by personnel at the USGS National Wildlife Health Center in Madison, Wisconsin, USA. Mortalities were categorized as electrocution (APLIC 2006), collision (APLIC 2012), entanglement in baling twine (Seacor et al. 2014), predation (Restani 2015), disease (Restani unpubl. data), shooting (C. Hagemeister, MFWP, pers. comm.), or unknown.

Each summer beginning in late June, Osprey nestlings were banded when they were 4–6 wk old. Nests were accessed with bucket trucks provided by power company cooperators and a local tree trimmer. Nestlings were banded with a standard aluminum USGS lock-on band on the left leg and a unique aluminum alpha-numeric green color band (ACRAFT, Edmonton, Alberta, Canada) riveted on the right leg. The color band allowed individual identification from a distance with a spotting scope after the nestlings fledged.

RESULTS

MFWP hatchery personnel shot two Ospreys in 2018, five in 2019, and one in 2020. After combining years, two Ospreys were shot in June, three in July, one in August, and two in September. Two of five Ospreys shot in 2019 were banded; one was 3 yr old and had been banded as a nestling in 2016 and one was 2 yr old and had been banded as a nestling in 2017. Both of these banded Ospreys were produced from the same nest located 7.3 km southwest of the hatchery. Ospreys on the Yellowstone River have been observed breeding at 2 yr of age (M. Restani unpubl. data) but we were unable to confirm if the banded birds shot by MFWP hatchery personnel were breeding. A green-banded adult male occupied a nest adjacent to the hatchery in 2019 but the nest monitor was unable to read the alpha-numeric code prior to the bird disappearing during the incubation period.

In two of the 3 yr when lethal control occurred at the hatchery, the number of Ospreys shot at the hatchery exceeded the number of Ospreys found electrocuted in the 950-km study area (2018: two shot/one electrocuted; 2019: five shot/three electrocuted; and 2020: one shot/one electrocuted). Prior to lethal control at the hatchery, electrocution had been the primary cause of Osprey mortality.

The number of occupied Osprey nests and number of young fledged for five artificial platforms near (the farthest was approximately 16 km and the nearest three were within 0.75 km) the hatchery both declined to zero during and following the period of lethal control (2018–2020; Fig. 2). The five occupied nests were located at the easternmost extent of the study area (Fig. 3), and were within foraging range to the hatchery for breeding Ospreys (10–20 km, Bierregaard et al. 2020). Of the five occupied nest platforms, the three within 0.75 km of the hatchery were removed by Montana-Dakota Utilities (MDU) in July 2020

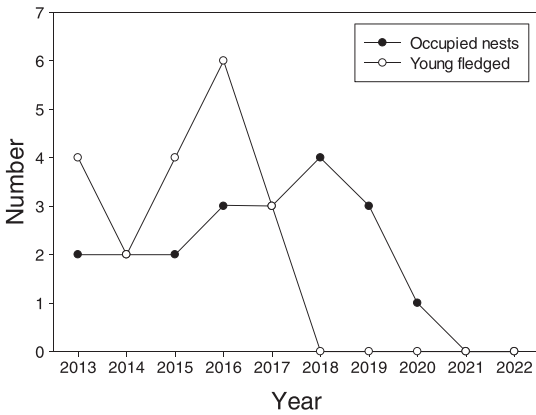


Figure 2. The number of occupied nests and young fledged for the five Osprey nests nearest to the Miles City Fish Hatchery, Montana, USA, 2013–2022.

at the request of MFWP hatchery staff (A. McDonald, MDU, pers. comm.; Fig. 3). One platform, 2.6 km from the hatchery, never supported an occupied nest from 2012–2022. Thus, the local breeding population of Ospreys had collapsed by 2021, resulting in the contraction of the breeding range to the west; the next nearest nests with a history of occupancy and successful reproduction for at least 1 yr from 2012–2022 were located 48 km and 67 km upriver from the hatchery (Fig. 3).

DISCUSSION

The breeding population of Ospreys adjacent to the Miles City Fish Hatchery collapsed after 3 yr of lethal control. Shooting at the 90-ha hatchery became the greatest source of documented annual mortality for Ospreys along the Yellowstone River study area, exceeding electrocution mortality. Shooting mortality appeared additive and the hatchery functioned as an ecological trap for nesting and foraging Osprey (Barrett et al. 2019). The number of

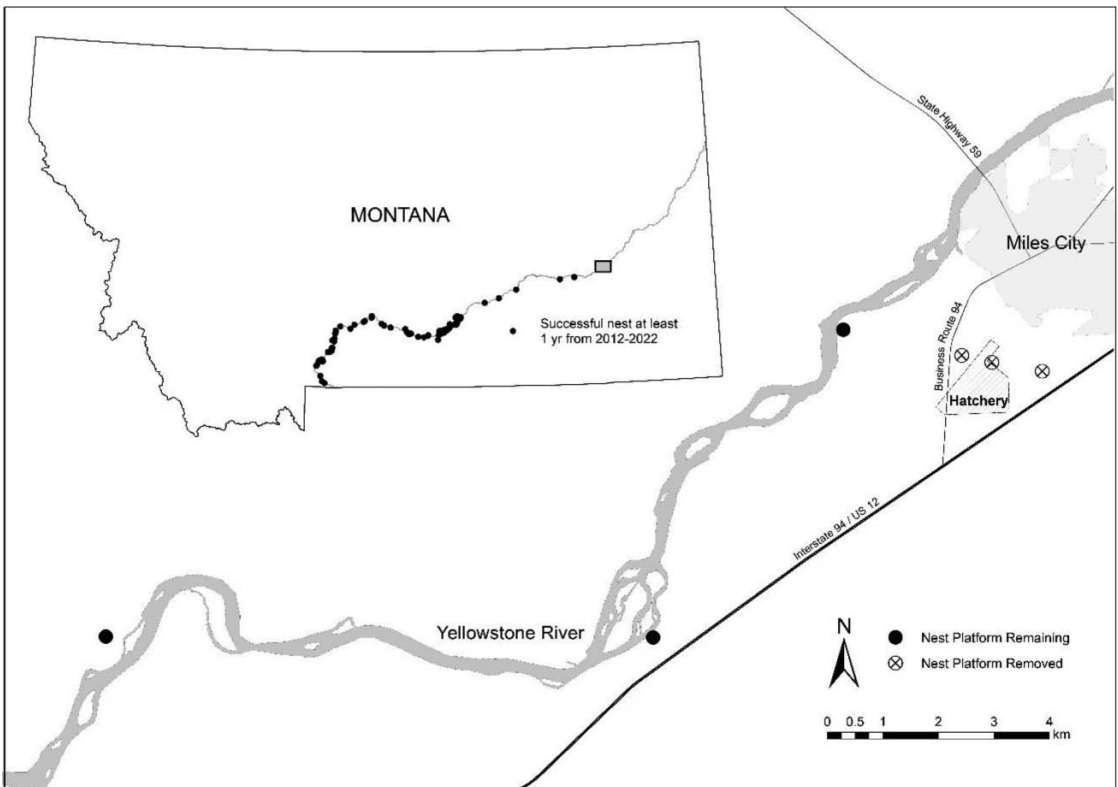


Figure 3. Location of the study area in Montana and detail near the Miles City Fish Hatchery. Three artificial platforms within 0.75 km of the hatchery and used by nesting Ospreys were removed during the period of lethal control (2018–2020). The breeding range of Ospreys on the Yellowstone River during and after lethal control contracted to the west about 48–67 km (based on nests that were successful at least 1 yr from 2012–2022.)

Osprey nests along the Yellowstone River doubled from 2012–2022 (M. Restani unpubl. data) and the subpopulation at the range periphery in Miles City was exhibiting similar growth trajectory until lethal control began in 2018. Although the Osprey population continued to increase at the regional scale (i.e., Yellowstone River) and maintained reproductive success greater than needed to offset mortality (based on estimates in Henny and Wight 1969), the local breeding population near the hatchery ceased to exist following shooting.

The breeding range of Ospreys contracted 48–67 km along the Yellowstone River during and following lethal control at the hatchery. Ospreys exhibit relatively limited natal dispersal and colonize new areas slowly (Bierregaard et al. 2020), facilitated by conspecific attraction (Löhms 2001). For example, in New England, all males and 80% of female Ospreys settled to breed within 50 km of their natal territories, and mean distances were even shorter in Michigan: males 15 km; females 38 km (Bierregaard et al. 2020). During summer 2020, MFWP requested the removal of artificial nest platforms nearest the hatchery that had been occupied by Ospreys, which may limit recolonization. Any new pairs may come into conflict with the local electric utility because the platforms were originally installed to deter colonizing Osprey from building nests on energized poles per APLIC (2006) guidelines. Removing Osprey nests from energized poles near the hatchery had been necessary to reduce power outages, electrocutions, and equipment damage. It may be possible to determine if adults recolonizing areas near Miles City come from nests within 16.4 km of the hatchery because the 19 fledglings produced there during 2013–2017 were banded.

Lethal control to reduce human-wildlife conflicts is not a long-term solution (Bechard and Marquez-Reyes 2003, Bergstrom et al. 2014, Linz et al. 2015, Lennox et al. 2018). Moreover, a federal depredation permit “is not considered a long-term solution for most situations” (USFWS 2020). MFWP hatchery staff attempted to deter depredating Ospreys for years without success prior to applying for a depredation permit. The bass ponds are relatively large and netting, which has been successful at other aquaculture facilities (Pitt and Conover 1996, Glahn et al. 1999, Bechard and Marquez-Reyes 2003, Washburn 2014), was deemed too costly by MFWP to implement at the hatchery.

Human-piscivore conflicts at the hatchery from 2017 to 2019 had increased to a level where the hatchery could no longer fulfill its annual production goals for largemouth bass (C. Hagemester, MFWP, pers. comm.). Although bass production improved during and after the period when Osprey shooting occurred (C. Hagemester, MFWP, pers. comm.), the management method was controversial and elicited strong negative reactions from the public. In summer 2021, an informal working group comprising diverse stakeholders (state and federal agencies, nongovernmental organizations, industries, and universities) began meeting to address human-piscivore conflicts at the hatchery. First efforts guided by the working group

included stringing lines above the bass ponds in 2021 and 2022 in an attempt to discourage Osprey foraging. Typically, members of working groups hold differing values, attitudes, and beliefs (Messmer 2002); this is true of the members of this current working group as they represent a diversity of ideas, but they have come together to try to reach consensus on limiting the shooting of native wildlife to support an exotic sport fishery in Montana.

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