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Birds breeding in or beneath Osprey nests in the Great Lakes basin.—Ospreys (*Pandion haliaetus*) build large stick nests, most commonly at the top of dead trees close to, or standing in, water. Material is added to nests each year, and if the supporting branches are strong enough, a nest may reach up to 3 m deep (Bent 1937, pers. obs.). There are scattered reports in the literature of other bird species breeding within occupied Osprey nests or immediately below them (e.g., Bent 1937, Reese 1977, Terres 1991), but many reviews of Osprey ecology do not mention this habit (e.g., Cramp 1980, Henny 1986, Poole 1989). In addition, a variety of open-nesting bird species will breed in unoccupied Osprey nests (e.g., Yocom 1952, Wetmore and Gillespie 1976, Poole 1989). During the course of eco-toxicological work on Ospreys in the Great Lakes basin in 1991 and 1992 (PJE), and during long-term studies of population biology and general ecology of Ospreys in central Michigan since the early 1960s (SP), we recorded a variety of bird species nesting either in Osprey nests or in the supporting structure. In this paper, we present details of these observations, as well as some recent incidental records, and provide a review of the scattered literature relating to this intriguing phenomenon.

Observations during the 1991 and 1992 breeding seasons (mid-April to early August) were made at intervals of 2–4 weeks, while we checked nests in four study areas in Ontario and Michigan. At Ogoki Reservoir (51°N, 88°W), north of Lake Nipigon, all nests were in dead conifer snags in deep water. In the St. Marys River (46°N, 84°W), in NW Lake Huron,

most nests checked were located either in live or dead eastern white pines (*Pinus strobus*) or on metal navigation towers. In SE Georgian Bay (45°N, 80°W), Lake Huron, nests were located mostly on artificial single-pole platforms, old hydro poles, or in dying eastern white pines. In the Kawartha Lakes (44°30′N, 78°30′W), Ospreys used artificial tripod or quadropod platforms, stumps, or dead snags in shallow water. At Fletcher Pond (45°N, 84°W), and other inland floodings in Michigan, nests were located on artificial platforms or dead snags over water.

We inspected the contents of Osprey nests with the aid of climbing equipment, ladders, or mirrors and noted details of any other bird nests or territorial behavior of adults of other species. Since we could not see into all available holes, either in the base of the Osprey nest or in the trunk of a supporting tree, a species was regarded to be nesting if it returned to a cavity after we had moved away from the site.

We recorded six species of small birds (a total of 20 cases) breeding within or immediately beneath occupied Osprey nests in the Great Lakes basin. Nests of Common Grackle (*Quiscalus quiscula*) (8), Tree Swallow (*Tachycineta bicolor*) (6), European Starling (*Sturnus vulgaris*) (1), and House Sparrow (*Passer domesticus*) (2) were noted within Osprey nests themselves, whereas Northern Flicker (*Colaptes auratus*) (one in hole in tree) and Barn Swallow (*Hirundo rustica*) (one in a concrete building in two consecutive years) bred only in the supporting structures. Excepting one site with nesting Tree Swallows at Ogoki Reservoir, Ospreys laid eggs at each occupied nest in which small birds bred. On no occasion did we detect any agonistic interactions between the Ospreys and the other nesting species.

In 1992, we recorded the following incidence of small birds nesting in or beneath occupied Osprey nests: Ogoki Reservoir = 4/14 (29%); St. Marys River = 2/10 (20%); Georgian Bay = 2/26 (8%); and Kawartha Lakes = 5/40 (12%). Overall, 13 of 90 (14%) occupied Osprey nests in 1992 also had small birds breeding in or beneath them. These species nested significantly less often in association with Osprey nests on artificial platforms (2 of 51 nests, 4%) than at natural sites (8 of 27 nests, 30%) ($G_1 = 10.1$, $P < 0.01$). Artificial platforms predominated in Georgian Bay and the Kawartha Lakes, but tree sites were most frequent at Ogoki Reservoir, and navigation aids predominated in the St. Marys River. At artificial platforms, Osprey nests were usually less than 1 m deep, whereas nests in trees, and some on tall metal towers, were often 2–3 m deep, and therefore offered fewer nest sites for small birds.

Seven large bird species bred in nests formerly occupied by Ospreys, involving a minimum of 25 cases. Great Blue Herons (*Ardea herodias*) bred in an unoccupied Osprey nest in the Kawartha Lakes in 1988 and continued to breed there until the nest blew down in 1991. Similarly, an Osprey nest on a tripod platform on Fletcher Pond was occupied by Bald Eagles (*Haliaeetus leucocephalus*) for two seasons after it was vacated by Ospreys (Postupalsky 1978), and one tripod platform there was occupied by Bald Eagles in 1989 after their natural tree nest fell down. In the St. Marys River, in late April 1991, an Osprey occupied what appeared to be a Bald Eagle nest, but by late May the eagles had taken over the site and were incubating. In 1992 and 1993, Bald Eagles again bred there. Red-tailed Hawks (*Buteo jamaicensis*) bred in an unoccupied Osprey tree nest in the Kawartha Lakes in 1982, and in the 1970s, Great Horned Owls (*Bubo virginianus*) (three cases) nested in old Osprey nests on artificial platforms at inland floodings in Michigan. In four cases, Herring Gulls (*Larus argentatus*) built nests on artificial Osprey platforms in Michigan which had not previously been unoccupied by Ospreys. In three instances Great Horned Owls bred in old Osprey nests in trees in Michigan. A pair of Common Ravens (*Corvus corax*) bred in 1990 and 1991 in an unoccupied Osprey nest on a transmission line tower in Georgian Bay.

Canada Geese (*Branta canadensis*) attempted to nest in Osprey nests on artificial plat-

forms at Fletcher Pond and other floodings in Michigan on at least 12 occasions during the past thirty years. In each case the geese were incubating by the time Ospreys returned in early to mid-April. In some cases the displaced Ospreys nested at a nearby alternative site (either another artificial platform, or a low stump), but more often the Osprey pair occupied the platform once the goose clutch hatched, although none of these pairs laid eggs in that same year.

At the St. Marys River, Canada Geese nested among a pile of sticks, which had fallen from an Osprey nest 6 m above, on top of an old navigation beacon. The geese were incubating by the time Ospreys arrived back each year, and were successful in both 1991 and 1992. Although the Ospreys occupied the upper nest in both years, they did not breed successfully in either year. In 1993 the Canada Geese bred elsewhere, and Ospreys bred successfully at this site. In the Great Lakes basin, most Canada Geese hatch eggs in May, just after the mean laying date for Ospreys (PJE, unpubl. data.). We witnessed no aggressive interactions between Canada Geese and Ospreys occupying the same sites, but in the Kawartha Lakes, Canada Geese approaching occupied Osprey nests later in the season were usually attacked fiercely. At one small lake in the Kawartha Lakes area, Canada Geese took over a regularly occupied Osprey nest on an artificial platform in 1988, and have bred there since. There appeared to be no suitable alternative nest sites nearby for Ospreys, so local landowners installed a second platform 400 m away in 1989, but this too was occupied by geese before the Ospreys returned. Since 1989 Ospreys have been seen only foraging occasionally at this lake.

Small birds breeding within or immediately beneath an active Osprey nest may benefit from a decreased risk of predation at the nest because Ospreys attack fiercely any potential predators such as crows, other raptors, and mammals (Bent 1937; Reese 1977; Poole 1989, pers. obs.). However, some potential avian predators were not attacked by some breeding Ospreys (Jamieson and Seymour 1983). Various "weaker" bird species have been recorded nesting around (or in) nests of birds of prey and other "aggressive" species, a phenomenon known as "protective nesting" (see reviews by Durango [1949], and Van Tyne and Berger [1959]). It is possible that in some cases Ospreys also benefit from such nesting associations, since potential predators that escape detection by the Ospreys may be spotted by a small bird breeding beneath. Adult Ospreys are usually alerted by alarm calls of other bird species near their nest (pers. obs.).

There has been some debate as to whether small birds actively select these nest sites because of the additional protection afforded, or simply because suitable sites are available there (e.g., Durango 1949). We suspect that suitable cavities for these six small bird species were not abundant in our study areas. Further, since Ospreys select larger, older, usually dead trees for nesting (due to support required for the large nest), these sites offer a greater number of nesting opportunities for such cavity nesters than are found in younger trees. Bent (1937) also noted that Osprey nests on artificial support structures were shallower than those in trees. Presumably there are more potentially suitable cavities for nesting passerines within the base of Osprey nests in trees, than on artificial platforms. Small birds may also benefit from an increased availability of nest material and insect food. Tree Swallows regularly collect down and feathers from around Osprey nests, and take them to line their nests (pers. obs.). Barn Swallows and Tree Swallows often feed on flying insects around Osprey nests—many insects appear to be attracted by the rotting fish remains (pers. obs.).

There has been no previous extensive review of other birds breeding at Osprey nests. In collating accounts of birds nesting in close association with Ospreys, or in their old nests, we found 14 species of small birds mentioned: Northern Flicker, Lewis' Woodpecker (*Melanerpes lewis*), Western Kingbird (*Tyrannus verticalis*), Tree Swallow, Violet-green Swallow (*Tachycineta thalassina*), Barn Swallow, Short-toed Treecreeper (*Certhia brachydac-*

tyla), House Wren (*Troglodytes aedon*), White Wagtail (*Motacilla alba*), European Starling, a shrike (*Lanius* sp.), Common Grackle, House Sparrow, and European Tree Sparrow (*Passer montanus*) (Allen 1892, Bahr 1907, Abbott 1911, Bent 1937, Moll 1962, Garber 1972, Reese 1977). Most accounts presumably refer to single pairs of small birds, but as many as four (Bahr 1907; Brehn 1878, cited by Moll 1962), and 6–7 (Abbott 1911) pairs of Common Grackle have been found breeding in the base of a single Osprey nest. Abbott (1911) also mentions meadow mice (*Zapus hudsonius*) living in the base of a nest.

Eleven larger bird species have been recorded previously to nest in or beneath Osprey nests: Black-crowned Night-heron (*Nycticorax nycticorax*), Green-backed Heron (*Butorides striatus*), Great Blue Heron, Canada Goose, Mallard (*Anas platyrhynchos*), American Black Duck (*A. rubripes*), Bald Eagle, Peregrine Falcon (*F. peregrinus*), Barn Owl (*Tyto alba*), Great Horned Owl, and Eurasian Jackdaw (*Corvus monedula*) (Allen 1892; Fannin 1894; Abbott 1911; Yocom 1952; Geis 1956; Craighead and Stockstad 1961; Moll 1962; Flath 1972; Garber 1972; Wetmore and Gillespie 1976; Reese 1977; Poole 1989; Campbell et al. 1990; R. H. Dennis, pers. comm.).

Green-backed Herons and Black-crowned Night-Herons have bred among sticks at the base of occupied Osprey nests, as close as 0.5 m from the Ospreys but usually separated by a solid board or dense brush (Allen 1892, Abbott 1911, Reese 1977). Great Blue Herons also breed occasionally in deserted Osprey nests, as the two species nest quite regularly in dead snags on the same beaver ponds; Ospreys will likewise nest in old Great Blue Heron nests (Fleming 1901; Macoun and Macoun 1909; Snyder 1931; Ivanovs 1972; Stocek and Pearce 1978; Ontario Nest Record Scheme, Royal Ontario Museum, Toronto; pers. obs.). In Chesapeake Bay, Mallard laid eggs in Osprey nests, both with and without Osprey eggs, but the Ospreys were rarely successful in such cases (Reese 1977).

The cases we report here of Red-tailed Hawk and Herring Gulls breeding in unoccupied Osprey nests in the Great Lakes basin appear to be the only ones on record. Mathisen (1977) noted three instances of Ospreys taking over unoccupied Bald Eagle nests in Minnesota, but Bald Eagles are usually dominant over Ospreys in areas of sympatry (Bent 1937; Ogden 1975; Poole 1989, pers. obs.). In Wisconsin, Bald Eagles took over two Osprey nests in 1992 which had previously been used by Ospreys (Gieck et al. 1992), but eagle nests in old Osprey sites in trees usually become top heavy and fall down (SP, unpubl. data). Ospreys have been recorded breeding at a few unoccupied Bald Eagle nests in the Great Lakes basin, particularly when eagle populations were severely depleted by the effects of organochlorine contaminants in their food (Ontario Nest Record Scheme, Royal Ontario Museum, Toronto, pers. obs.). Great Horned Owls in Labrador bred in 35 (54%) of 68 Osprey nests checked between 1969 and 1973, and there was some suggestion that in years of high hare and grouse numbers, a greater proportion of Osprey nests were occupied by the owls (Wetmore and Gillespie 1976).

Among non-passerine species, Canada Geese have been reported nesting in Osprey nests most frequently. In the Great Lakes basin we know of no instances of geese breeding in Osprey nests in trees, but this practice has been recorded in other areas, in trees up to 30 m high (e.g., Fannin 1894, Yocom 1952, Craighead and Stockstad 1961, Flath 1972). Mortality of goslings jumping from high tree nests is very low (Craighead and Stockstad 1961). Presumably such sites are attractive to geese owing to a reduced risk of predation. Increasing use of artificial nest platforms by Canada Geese (Craighead and Stockstad 1961, Rienecker 1971, Mullen 1975, cited by Poole 1989, this study) has resulted in increased conflicts with breeding Ospreys, usually in the form of direct take-over of the Osprey nest before Ospreys arrive in spring. In British Columbia, some Ospreys have been prevented from breeding by Canada Geese that breed before Ospreys arrive in spring (Campbell et al. 1990). In Montana, it is only in years when mild weather permits Canada Geese to lay in early March that there

is sufficient time for Ospreys to breed at the same site after the geese have hatched (Flath 1972). similarly, in two of three years at one site in California, Ospreys laid eggs in a nest after Canada Geese had hatched (Garber 1972). Ospreys have been known to evict Canada Geese from nests in trees (Flath 1972), but usually the attacks on incubating geese are unproductive (e.g., Mullen 1985 cited by Poole 1989, pers. obs.).

Clearly, in areas where suitable nest sites are in short supply, increasing Canada Goose populations reduce nest site availability for Ospreys, particularly when goose eggs do not hatch until a month or so after the Ospreys have returned in spring. At some small lakes and floodings in the Great Lakes basin, various measures are currently being considered to prevent geese from breeding on artificial platforms. These include: removal of all nest material after the Osprey breeding season; placement of tall (plastic) objects in the center of the nest scrape; or the covering of the complete nest platform with wooden sheeting or tarpaulins until just after Ospreys return. Although such measures present some logistical problems, on a local scale they would assist with the recovery of those Osprey populations affected by heavy use of organochlorine pesticides during the 1950s, 1960s, and 1970s (Poole 1989).

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Group size and flight altitude of Turkey Vultures in two habitats in Mexico.—The efficiency of carcass exploitation by scavenger guilds is related to patterns of searching and finding carcasses, feeding behavior and the efficiency of one or two species in the guild to find carrion (Alvarez et al. 1976; Attwell 1963; Houston 1974, 1979, 1988; Kruuk 1967; Rodríguez-Estrella 1986). The Turkey Vulture (*Cathartes aura*) is present in every existing scavenger guild (Brown and Amadon 1968) and is perhaps the most important scavenger species due to its efficiency in finding and exploiting carcasses (Houston 1986). Turkey Vultures forage individually or in widely scattered small groups with other vulture species. However, limited information is available on their foraging habits where Turkey Vultures are allopatric with respect to other vultures and variations in group size may be related to the density of the species (Prior 1990). In this study, I analyzed whether the foraging group size of Turkey Vultures was related to population density or to other factors, such as carrion size and availability. The vultures were studied in two areas with similar population density (Hiraldo et al. 1991, this study), different carrion size and availability, and without the presence of other vulture species.

Methods.—I studied vultures in La Michilía (23°20′–23°30′N, 104°07′–104°20′W) and Mapimí (26°29′–26°52′N, 103°58′–103°32′W) Biosphere Reserves at Durango, México. La Michilía is an irregular high plain (elevation 2250 m) between two mountain ranges. The climate is semiarid with summer rains, annual mean precipitation of 567 mm, and an annual mean temperature ranging between 17.4°C and 20.7°C. Vegetation of La Michilía is dominated by oak-pine forests (*Quercus* spp., *Pinus* spp., *Juniperus* sp., *Arctostaphylos pungens*). The Bolsón de Mapimí is a basin crossed by small mountains within the playas of the alluvial plains (elevation 1000–1350 m). The climate is arid with summer rains and cool winters. The average annual precipitation is 264 mm. The annual mean temperature varies between 3.9°C and 33°C. The Mapimí reserve contains a xerofitic shrubland vegetation (*Larrea divaricata, Fouquieria splendes, Prosopis glandulosa, Opuntia* spp., and *Hilaria mutica*).

La Michilía was surveyed in early September 1981 and late March 1982. Mapimí was surveyed from late March through early September in 1985 and 1986. As I was not able to distinguish between residents and migrants, and knowing that foraging flight may differ between the two groups, I did not make observations during the months when migrants could be in the area. Observations of foraging groups were made opportunistically from a car and from elevated vantage points between 09:30 and 16:00 h in both areas. Following Rabenold (1983) and Prior (1990), birds were considered to be in the same foraging group whenever they were observed in the air within 1 km of one another and heading in the same direction. For every foraging individual and group, I recorded the time of day, altitude of flight, and type of flight (flapping or soaring). I used a clinometer on several objects of known altitude and distance to confirm the accuracy of the estimations. I analyzed group size and flight altitude differences using chi-square tests. These tests detected differences between the two study areas in the frequency of four size groups, at three heights (below