

BALD EAGLE RESEARCH IN THE APOSTLE ISLANDS NATIONAL LAKESHORE

By JULIE VAN STAPPEN AND MICHAEL MEYER

APOSTLE ISLANDS NATIONAL Lakeshore is located in far northwestern Wisconsin (fig. 1). It includes 21 scenic islands in Lake Superior and a 19.2-km (12-mi) long strip of mainland. Bald eagles (*Haliaeetus leucocephalus*) (fig. 2) grace the skies above the islands; however, their low numbers have caused concern for both park managers and state resource management partners. Although eagles have increased in Apostle Islands and along the Lake Superior shoreline since DDT was banned in 1972, their reproductive rates have remained significantly lower than mainland populations. After years of monitoring and two research projects, we have begun to answer some questions about the eagle population at Apostle Islands.

POPULATION DECLINE

As in most of its range, the bald eagle in the Apostle Islands declined significantly after the widespread introduction of toxic chemicals into the environment. By the 1970s, no more than 24 breeding pairs of bald eagles remained along all Great Lakes shorelines. In the Apostle Islands, bald eagles were absent throughout the 1970s. Between 1980 and 1983, eagles began to reestablish territories here, although they produced no young until 1983.

Eagle research conducted in the park from 1984-86 (Kozie and Anderson 1991) found high levels of contaminants in prey items and nestling carcasses. The majority of food eaten by eagles during the study was fish; however, gull remains were also found in eagle nests. Apostle Islands gulls have high levels of organochlorine con-

taminants. During the study (Kozie 1991), eagles along the Lake Superior shoreline (including the park) produced an average of 0.9 young/occupied nest with an average nest success of 57%; statewide averages during that period were 1.3 young/occupied nest and 75% nest success.

From 1989-93, the Wisconsin Department of Natural Resources and Michigan State University sampled eaglet blood and found higher levels of PCBs (polychlorinated biphenyls) in Apostle Island eaglets than mainland eaglets; these levels now appear to be decreasing. In 1991, we began a pilot study (Meyer and Van Stappen 1991) to explore causes of lowered eagle productivity in the lakeshore and the impact of toxic chemicals on productivity; we also began to develop a protocol using bald eagles as an ecosystem monitor species for Great Lakes water quality.

EAGLES AS INDICATORS

In 1992, The Great Lakes Protection Fund financed a greatly expanded project. A primary focus of this study was to obtain data needed to develop a Great Lakes bald eagle biosentinel protocol; in 1990, the International Joint Commission recommended use of the bald eagle (and specifically its reproductive rate) as a bioindicator of "ecosystem health" and water quality in the Great Lakes basin (International Joint Commission 1990). This multiagency-university study included the Wisconsin Department of Natural Re-

sources, Apostle Islands National Lakeshore, University of Minnesota, and University of Wisconsin.

Before using the bald eagle as a biosentinel, the relationship between contaminants and eagle productivity needed further study. Primary factors suspected of lowering productivity of Lake Superior eagles included environmental contamination, low food availability, and harsh weather.

RESEARCH GETS UNDERWAY

During the 1992-93 field seasons, we conducted research along the Lake Superior shoreline, including the Apostle Islands, and at mainland Wisconsin bald eagle nest sites (fig. 3). We used direct and remote video camera observations to study eagle behavior through the help of Keith Warnke (University of Minnesota) who focused his master's thesis on analyzing these operations. We also used these techniques to determine nestling food-energy intake by determining the rate of prey delivery. Field metabolic rate on eaglets in control nests was measured



Figure 1 (map). Apostle Islands National Lakeshore, Wisconsin; site of the bald eagle biosentinel research.

Figure 2 (above). Bald Eagle chicks in nest at York Island.





Figure 3. Park tree climbers retrieved chicks for marking and blood samples.

using a doubly-labeled-water technique to validate observational data. Dr. Cheryl Dykstra of the University of Wisconsin focused her Ph.D. dissertation on this technique, which is used to measure energy expenditure by simultaneously measuring metabolizable energy intake in a feeding trial.

Research results indicate that Lake Superior nestlings in broods of one chick received about the same amount of food as did interior mainland nestlings in broods of one chick. However, Lake Superior nestlings in broods of two chicks received *significantly less* food than interior mainland broods of two chicks. Likewise, Lake Superior adults spent approximately 20% less time at the nest during the early nestling stage, and mortality in Lake Superior nests of two chicks was significantly higher than in interior mainland nests (27.3% vs. 8.6%). Nestlings at shoreline nests with two nestlings also modified their behavior to conserve energy by spending significantly less time feeding, being active and standing in the nest, and more time lying in the nest.

We tested the potential relationship between contaminants and productivity by analyzing eaglet blood and addled eggs. Between 1989 and 1993, blood samples were collected from 83 bald eagle nest-

lings in Wisconsin, 33 of which were along the Wisconsin shoreline of Lake Superior. Lake Superior nestlings contained elevated levels of DDE (a breakdown product of DDT) and PCBs. The highest concentration of PCBs (1,154 ppb) was found on Michigan Island in 1992 in the Apostle Islands National Lakeshore; there the nest is located about 1.6 km (1 mi) from a large herring gull and double-crested cormorant colony. Documentation shows that the eagles fed on both species in 1992.

The mean Wisconsin Lake Superior nestling plasma PCB concentration (100 µg total PCB/l plasma) was three times greater than interior mainland Wisconsin nestling plasma PCBs; however, this level is 45% less than the average plasma PCB concentration for Michigan and Ohio Great Lakes nestlings. Concentrations of DDE and PCBs in eggs collected on Lake Superior declined between 1969 and 1993. The DDE levels in eggs collected during the early 1990s were at or below the level (4 µg DDE/g egg fw [fresh weight]) considered to impact productivity. This indicates that Lake Superior eagle productivity may no longer be affected by these contaminants. In addition, Wisconsin Lake Superior egg PCB levels (14 µg total PCBs/g egg fw) are dramatically less than levels in the 1970s; they are now comparable to Wisconsin River egg PCB levels where productivity rates are excellent.

The research assessed Wisconsin eagle productivity through aerial overflights during incubation and again when chicks were 4-7 weeks old. For more than 25 years, Mr. Charles Sindelar (Waukesha, Wisconsin) and the Wisconsin Depart-

We did not find weather to be a significant factor in lowering productivity, with the possible exception of when Lake Superior completely freezes over. For the first time in 17 years, Lake Superior was completely ice covered in January 1994. During the first aerial overflight, six eagle nests in the Apostle Islands were active, but only one nest hatched chicks. Unfortunately, the two hatchlings were later preyed upon. An examination of the failed nests was inconclusive; however, most appeared to have been abandoned during incubation.

RESULTS

Results of this research indicate that the most likely cause of lower bald eagle productivity along the Lake Superior shoreline is low food availability. Low food abundance following hatching may be leading to low food delivery rates to chicks or prolonged adult foraging time away from the nest, resulting (indirectly) in increased chick mortality. The ratio of young produced per *successful* nest is consistently less on the Wisconsin Lake Superior shoreline than at interior Wisconsin nest sites; in raptors this productivity ratio is stable across wide geographical areas, only declining when nests are established in marginal habitat. The Wisconsin Lake Superior bald eagle productivity rate also fluctuates greatly, some years approaching the rate of a "healthy" population, only to be followed the next year by extremely poor reproduction (e.g., 1993-1.03 young per occupied territory; 1994 (Lake Superior ice-covered)-0.33 young per occupied territory; 1995-1.07 young per occupied territory). It is likely that reduced food availability chronically depresses Wisconsin Lake Superior bald

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ment of Natural Resources have conducted these overflights. From 1983-94, productivity of Lake Superior bald eagles was significantly lower than that of interior mainland eagles. However, it has been improving; more than one young per occupied territory was produced during five of the past eight breeding seasons.

eagle productivity and this effect is exacerbated during harsh weather conditions. The Wisconsin Lake Superior bald eagle nest density is low and the rate of increase has leveled off after a rapid expansion in the 1980s; this is in contrast to the rapidly expanding mainland Wisconsin population that continues to grow at an

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exponential rate. Other contributing factors to lowered productivity include: lowered nest attentiveness; higher predation rates of young; harsh spring weather or extensive ice cover; and somewhat elevated levels of PCB and DDT.

IN CLOSING

Eagle research methods and findings in the Great Lakes have been incorporated in the development of a Great Lakes bald eagle biosentinel protocol. The protocol is currently under consideration for adoption under the Great Lakes water quality agreement between the U.S. and Canadian governments. This protocol, if adopted, will standardize methods used by numerous state, provincial, and federal agencies to collect Great Lakes bald eagle habitat, productivity, and contaminant data, allowing the Apostle Islands eagle population to be put into a regional framework. However, the results of this project must be considered carefully when comparing productivity trends between Lake Superior and the other Great Lakes. In the other lakes, contaminants may be the primary factor limiting productivity, whereas food availability appears to be the primary limiting factor in Lake Superior. This knowledge will enable us to better interpret population trends in the Apostle Islands eagles.



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