

Observed Abnormalities in Mandibles of Nestling Bald Eagles *Haliaeetus leucocephalus*

W. W. Bowerman IV,¹ T. J. Kubiak,² J. B. Holt, Jr.,³ D. L. Evans,⁴
R. G. Eckstein,⁵ C. R. Sindelar,⁶ D. A. Best,⁷ K. D. Kozie⁸

¹Department of Fisheries and Wildlife, Pesticide Research Center, Institute for Environmental Toxicology, Michigan State University, East Lansing, Michigan 48824, USA

²U.S. Fish and Wildlife Service, Division of Environmental Contaminants, 4401 North Fairfax Drive, Arlington, Virginia 22203, USA

³858 Johnson Street, North Andover, Massachusetts 01845, USA

⁴2928 Greysolon Road, Duluth, Minnesota 55812, USA

⁵Bureau of Wildlife Management, Wisconsin Department of Natural Resources, P.O. Box 576, Rhinelander, Wisconsin 53186, USA

⁶S47 W22300 Lawnsdale Road, Waukesha, Wisconsin 53186, USA

⁷U.S. Fish and Wildlife Service, 1405 South Harrison Road, Room 302, East Lansing, Michigan 48823, USA

⁸Wrangell-St. Elias National Park, P.O. Box 29, Glen Allen, Alaska 99588, USA

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Abnormalities in avian bills have been observed in many fish-eating birds within the Great Lakes Basin including herring gulls (*Larus argentatus*), ring-billed gulls (*Larus delawarensis*), common terns (*Sterna hirundo*), Caspian terns (*Sterna caspia*), Forster's terns (*Sterna forsteri*), black-crowned night-herons (*Nycticorax nycticorax*), great blue herons (*Ardea herodias*), double-crested cormorants (*Phalacrocorax auritus*), and Virginia rails (*Rallus limicola*) (Ryder and Chamberlain 1972, Scharf and Buckingham 1974, Gilbertson et al. 1976, Hoffman et al. 1987, Kubiak et al. 1989, Fox et al. 1991a). A bald eagle (*Haliaeetus leucocephalus*) nestling with a crossed bill was observed previously in northwest Ontario (Grier 1968). We report here on five additional observations of bill deformities in nestling eagles in Michigan, Minnesota, and Wisconsin.

MATERIALS AND METHODS

Bill defects in nestling bald eagles were documented by contacting individuals who banded eagles throughout the Great Lakes Basin within the period 1966–1989 and from the authors field notes from this time period. Banding data were obtained from the U.S. Fish and Wildlife Service, Bird Banding Laboratory, Patuxent Wildlife Research Center, Laurel, Maryland. Numbers of nestlings banded during this time period were determined from these records and used for comparison of deformity rates using the method described by Fox et al. (1992b).

RESULTS AND DISCUSSION

On 29 June 1968, while banding nestling eagles, J Holt observed an 8–9 week old nestling with its upper mandible curved to the right. The upper mandible was crooked near the tip so most of the lower mandible was covered by the upper mandible. The nestling was observed in a nest located 10 km southeast of Crystal Falls, Iron County, in the western upper peninsula of Michigan. The nestling

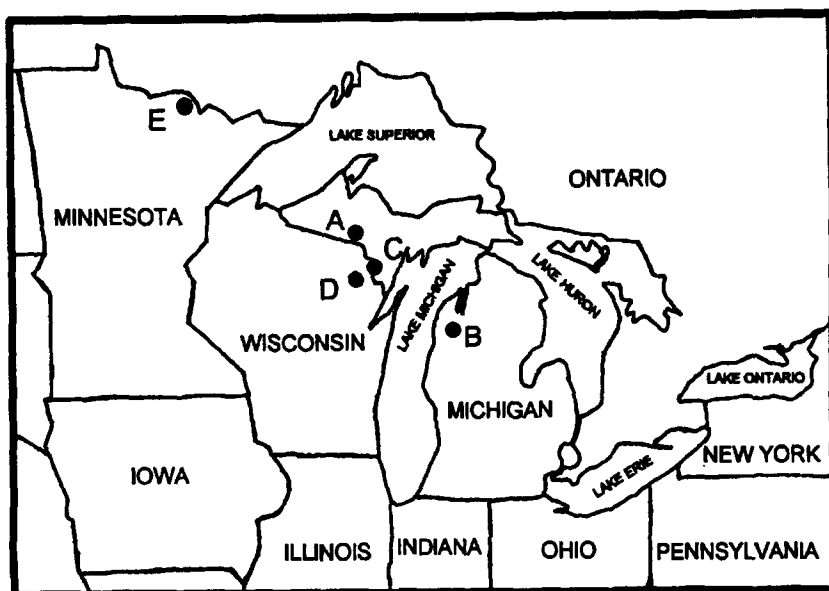


Figure 1. The geographical locations of bald eagle nestlings with bill defects in this study: (A) Benzie and (B) Iron counties, Michigan, (C) Marinette and (D) Forrest counties, Wisconsin, and (E) Voyageurs National Park, Minnesota.

appeared healthy and was left in its nest (Fig. 1).

A nestling with an abnormal bill was observed by J Holt on 18 June 1982 near Grass Lake Flooding, Benzie County, in the western lower peninsula of Michigan (Fig. 1). The upper mandible was crooked to the right but also had a fibrous growth on the left side of the upper mandible near the cere. This nestling appeared healthy and was left in its nest.

On 11 June 1986, D Evans observed a 6-7 week old nestling with its lower mandible extending 7 mm to the left farther than the upper mandible at a nest 14 km east of Pembine, Marinette County, Wisconsin (Fig. 1). The beak almost shut but had worn a groove on the side of the left upper mandible. The extending point was trimmed off and the beak closed better though not completely. This was the only nestling in the nest. This eagle was recovered injured and alive on 20 June 1989 near Turtle Lake, Ontario, Canada but was non-releasable.

On 9 June 1987, R Eckstein and C Sindelar observed a 7-8 week old nestling with its upper mandible curved to the right at a nest 2 km east of Laona, Forest County, Wisconsin (Fig. 1). The upper mandible was crooked near the tip and approximately 1.27 cm shorter than the lower mandible. Because of the deformity, the bill did not close completely. The single nestling appeared healthy

and its crop was approximately one-half full.

A nestling with a shortened upper mandible was observed on 26 June 1989 at Wolfpack Island, St. Louis County, within Voyageurs National Park, Minnesota by D Evans and K Kozie (Fig. 1). This nestling also had avian pox and was not handled. A sibling female nestling from this nest was handled and blood was drawn for contaminant analysis. The concentrations of total polychlorinated biphenyls (PCBs) in plasma collected from this nestling were 1600 ppb and p,p'-DDE were 216 ppb. The PCB concentration was the single greatest concentration recorded in plasma collected from 141 nestling eagles from Michigan, Minnesota, Ohio, Ontario, and Wisconsin between 1987-1989 (W Bowerman, unpubl. data). The concentrations of both PCBs and DDE were far greater ($P < 0.0001$, Kruskal-Wallis) than mean concentrations from nestlings from within 8.0 km of the Great Lakes shorelines (mean 183 ppb, PCBs; mean 61 ppb, DDE) and from more interior areas (mean 24 ppb, PCBs; mean 20 ppb, DDE) (Bowerman et al. 1990). Other geographically diverse nestling plasma samples (1984-1987) from the lower Columbia River, Oregon (Garrett et al. 1988) and subadult plasma samples (1977-1978) from Missouri and Colorado (Henny et al. 1981) have shown a wide range of contamination consistent with contamination of the general environment from which these samples were obtained. Table 1 provides comparative data sets on plasma values from these areas.

A comparison of bill deformity occurrences in relation to banding of nestling eagles in the Great Lakes region was performed using banding records from the USDI-Fish and Wildlife Service Bird Banding Laboratory (Table 2). The prevalence of bill deformities in eagles is comparable to the prevalence of bill deformities observed in double-crested cormorants in the Great Lakes Basin (Table 2)(Fox et al. 1991b). Congenital malformations in birds are uncommon (Dow and Hess 1965). Bill defects are an example of developmental asymmetry and are an indication of developmental instability in local populations (Fox et al. 1991b). The most likely causative agent implicated in bill defects of fish-eating birds from the Great Lakes are polyhalogenated aromatic hydrocarbons, specifically certain non-orthosubstituted coplanar PCB congeners which induce aryl hydrocarbon hydroxylase (AHH) (Hoffman et al. 1987, Kubiak et al. 1989, Smith et al. 1990, Fox et al. 1991a, Gilbertson et al. 1991). Although similar bill defects are observable in birds exposed to high concentrations of selenium (Ohlendorf et al. 1986, Hoffman et al. 1988), feather concentrations from nestling bald eagles from the Great Lakes Basin are low (mean 1.8 ppm, Bowerman 1991). Selenium is therefore an unlikely causative agent in this case.

Congenital defects in bald eagles are a rare occurrence with the likely observable incidence even further decreased, since only productive nests are visited, nests are only visited once a year, and few nests are located along the shores of the Great Lakes and other areas associated with high PCB concentrations. Congenital defects including deformed toes and bill defects have been observed in white-tailed eagle (*Haliaeetus albicilla*) nestlings in Sweden and have been linked to

Table 1. Plasma concentrations of PCBs in bald eagles from various regions of North America

Location	N	PCB Range (ug/kg, ppb)	Life Stage	Reference
<u>Great Lakes Region</u>				
Great Lakes	42	33.0 - 520.0	Nestling	Bowerman et al. 1990
Interior	79	5.0 - 217.0	Nestling	Bowerman et al. 1990
<u>Washington/Oregon</u>				
Lower Columbia	14	14.0 - 351.0	Nestling	Garrett et al. 1988
Oregon ¹	74	<100.0 - 580.0	Nestling	Weimeyer et al. 1989
<u>Western United States</u>				
Missouri	11	<100.0 - 680.0	Subadult	Henny et al. 1981
Colorado	10	<100.0 - 360.0	Subadult	Henny et al. 1981
Montana ¹	11	<200.0	Nestling	Weimeyer et al. 1989

¹Plasma concentrations estimated as 2x whole blood value.

PCB contamination in the Baltic Sea (Helander 1983). PCB concentrations from sea eagle eggs collected during this time period from the Baltic ranged from 18.7-159.0 ppm fresh weight where bill deformities were noted in 2 of 115 nestlings examined in comparison to Lapland concentrations of 8.8-11.1 ppm where no deformities were noted in 60 nestlings examined (Helander et al. 1982, Helander 1983). These types of anomalies have been shown to occur in domestic chicken embryos in PCB contaminated eggs (MacLaughlin 1963, Bush et al. 1974, Lillie et al. 1975, Brunstrom and Andersson 1988, Brunstrom 1990). A causal relationship between bill defects and high PCB concentrations appears likely in the Great Lakes Basin, since high PCB concentrations are known to have been present temporally and within the geographic realm of the eagles yearly range. Concentrations of PCBs in addled eggs of bald eagles in the Great Lakes Region ranged from 19.0-98.0 ppm fresh weight from 1976-1978 (Weimeyer et al. 1984) and from 3.4-119.0 ppm fresh weight from 1985-1990 (Kubiak and Best 1991,

Table 2. Geographical variation in bill deformity observations in nestling bald eagles in the Great Lakes Basin, 1966-1989.

Geographical Region	Years banded	Nests banded (a)	Chicks banded (b)	Chicks with defects (c)	Incidence (c/a) Prevalence (c x 10000/b)
<u>Bald Eagles</u>					
Michigan	24	1189	1594	2	0.2% 12.5
Minnesota ¹	24	521	1006	1	0.2% 9.9
<i>Voyageurs NP</i> ²	1	9	10	1	11.1% 1000.0
<i>Other Areas</i> ²	24	512	996	0	0.0% 0.0
Ohio	21	24	90	0	0.0% 0.0
Ontario ¹	24	541	1098	1	0.2% 9.1
<i>Southern</i> ²	15	53	83	0	0.0% 0.0
<i>Northwest</i> ²	24	468	1015	1	0.2% 9.9
Wisconsin	24	1727	3552	2	0.1% 5.6
<u>Double-crested Cormorants</u>					
Green Bay ³	9	N/A	11520	60	0.5% 52.1
Prairie ³	9	N/A	16778	1	0.0% 0.6

¹State or Provincial Data

²Regional Data within a State or Province

³Data from Fox et al. (1991b)

D Best unpubl. data). Schwartz et al. (1993) have recently published congener specific PCB data on an addled bald eagle egg salvaged from Lake Huron in 1986. PCB 126 (3,3',4,4',5-Pentachlorobiphenyl), a highly embryotoxic and teratogenic PCB congener, was quantified at a wet weight concentration of 71 ng/g. Normalization to a fresh weight concentration because of field dehydration yielded a concentration of approximately 42 ng/g (T Kubiak and D Best unpubl. data). The LD₅₀ for PCB 126 injected into American kestrel (*Falco sparverius*) eggs is 70-100 ng/g (Hoffman in prep.). The dead eagle embryo in the addled egg analyzed by Schwartz et al. (1993) was reported to have a "beak skewed to the right". No other reports of bill defects in bald eagles have been reported outside of the Great Lakes Region.

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