High Rates of Nonbreeding Adult Bald Eagles in Southeastern Alaska
Author(s): Andrew J. Hansen and John I. Hodges, Jr.
Source: *The Journal of Wildlife Management*, Vol. 49, No. 2 (Apr., 1985), pp. 454-458
Published by: Allen Press
Stable URL: http://www.jstor.org/stable/3801551
Accessed: 20/05/2009 18:33

Your use of the JSTOR archive indicates your acceptance of JSTOR's Terms and Conditions of Use, available at http://www.jstor.org/page/info/about/policies/terms.jsp. JSTOR's Terms and Conditions of Use provides, in part, that unless you have obtained prior permission, you may not download an entire issue of a journal or multiple copies of articles, and you may use content in the JSTOR archive only for your personal, non-commercial use.

Please contact the publisher regarding any further use of this work. Publisher contact information may be obtained at http://www.jstor.org/action/showPublisher?publisherCode=acg.

Each copy of any part of a JSTOR transmission must contain the same copyright notice that appears on the screen or printed page of such transmission.

JSTOR is a not-for-profit organization founded in 1995 to build trusted digital archives for scholarship. We work with the scholarly community to preserve their work and the materials they rely upon, and to build a common research platform that promotes the discovery and use of these resources. For more information about JSTOR, please contact support@jstor.org.

Allen Press is collaborating with JSTOR to digitize, preserve and extend access to *The Journal of Wildlife Management.*

http://www.jstor.org

LITERATURE CITED

ALEXANDER, W. C. 1983. Differential sex distributions of wintering diving ducks (*Aythyini*) in North America. Am. Birds 37:26–29.

ALLEN, A. A. 1931. The canvasback. Bird-Lore 33: 347–360.

BEER, J. R. 1945. Sex ratios of ducks in southwestern Washington. Auk 62:117–124.

BELLROSE, F. C., T. G. SCOTT, A. S. HAWKINS, AND J. B. LOW. 1961. Sex ratios and age ratios in North American ducks. Ill. Nat. Hist. Surv. Bull. 27:391–474.

DEGRAFF, L. W., D. D. FOLEY, AND D. BENSON. 1961. Distribution and mortality of canvasbacks banded in New York. N.Y. Fish and Game J. 8:69–87.

FERGUSON, E. L., D. G. JORDE, AND J. J. SEASE. 1981. Use of 35-mm color aerial photography to acquire mallard sex ratio data. Photogrammetric Eng. and Remote Sensing 47:823–827.

GEIS, A. D. 1959. Annual and shooting mortality estimates for the canvasback. J. Wildl. Manage. 23:253–261.

HOCHBAUM, H. A. 1944. The canvasback on a prairie marsh. Am. Wildl. Inst., Washington, D.C. 201pp.

LEONARD, R. M., AND E. B. FISH. 1974. An aerial photographic technique for censusing lesser sandhill cranes. Wildl. Soc. Bull. 2:191–195.

NETER, J., AND W. WASSERMAN. 1974. Applied linear statistical models. Richard D. Irwin, Inc., Homewood, Ill. 842pp.

NICHOLS, J. D., AND G. M. HARAMIS. 1980*a*. Inferences regarding survival and recovery rates of winter-banded canvasbacks. J. Wildl. Manage. 44:164–173.

———, AND ———. 1980*b*. Sex-specific differences in winter distribution patterns of canvasbacks. Condor 82:406–416.

OLSON, D. P. 1965. Differential vulnerability of male and female canvasbacks to hunting. Trans. North Am. Wildl. and Nat. Resour. Conf. 30: 121–135.

SNEDECOR, G. W., AND W. G. COCHRAN. 1967. Statistical methods. 6th ed. Iowa State Univ. Press, Ames. 593pp.

SOWLS, L. K. 1955. Prairie ducks. The Stackpole Co., Harrisburg, Pa., and The Wildl. Manage. Inst., Washington, D.C. 193pp.

STEWART, R. E., A. D. GEIS, AND C. D. EVANS. 1958. Distribution of populations and hunting kill of the canvasback. J. Wildl. Manage. 22:333–370.

VOELZER, J. F., E. Q. LAUXEN, S. L. RHOADES, AND K. D. NORMAN. 1982. Waterfowl status report 1979. U.S. Fish Wildl. Serv. Spec. Sci. Rep. Wildl. 246. 96pp.

WELLING, C. H., AND W. J. L. SLADEN. 1979. Canvasback sex ratios on Rhode and West Rivers, Chesapeake Bay, 1972–78. J. Wildl. Manage. 43: 811–813.

Received 20 April 1984.
Accepted 13 September 1984.

HIGH RATES OF NONBREEDING ADULT BALD EAGLES IN SOUTHEASTERN ALASKA

ANDREW J. HANSEN,[1] U.S. Fish and Wildlife Service, P.O. Box 1287, Juneau, AK 99802
JOHN I. HODGES, JR., U.S. Fish and Wildlife Service, P.O. Box 1287, Juneau, AK 99802

J. WILDL. MANAGE. 49(2):454–458

Present knowledge of bald eagle (*Haliaeetus leucocephalus*) demography is derived primarily from populations in environments that have been drastically altered by man. Most reproductive studies were done in the 1960's and 1970's when chemical toxins were inhibiting bald eagle productivity (Grier 1982, Wiemeyer et al. 1984). Earlier, the removal of old-growth forests (Ahlgren and Ahlgren 1983, Cronon 1983) and decimation of anadromous fish runs (Netboy 1974, Smith 1979) by Euro-Americans may have greatly reduced bald eagle abundance from presettlement levels.

Historical trends in this species are of interest because fundamental differences may exist between populations in pristine and man-altered environments. One difference may be breeding rate. Surpluses of nonbreeding adult bald eagles during the nesting season are rarely mentioned in the literature. Most surveys of reproductive success focus exclusively on eagles at nest sites, which assumes nearly all adults attempt to breed each year. We report herein that a majority of adults in the relatively pristine habitats of southeastern Alaska do not breed annually. This

[1] Present address: Centre for Resource Ecology, Department of Botany, University of the Witwatersrand, 1 Jan Smuts Avenue, Johannesburg 2001, South Africa.

finding is important because if surpluses of nonbreeding adults are a natural feature of the population, then hypotheses on density dependent population regulation and the evolution of delayed maturation are suggested. If, on the other hand, the abundance of nonbreeders is an artifact of recent environmental perturbations, serious population declines may occur in southeastern Alaska.

STUDY AREA AND METHODS

Southeastern Alaska includes the western slope of the Coast Range and numerous fiords and islands of the Alexander Archipelago. The land area at lower elevations is dominated by Sitka spruce (*Picea sitchensis*), western hemlock (*Tsuga heterophylla*), and falsecypress (*Chamaecyparis nootkatensis*). The seas support several fishes taken by eagles including five species of the Pacific salmon (*Oncorhynchus* spp.), Pacific herring (*Clupea harengus pallasi*), Pacific cod (*Gadus macrocephalus*), and eulachon (*Thaleichthys pacificus*). Bald eagles have flourished in this environment; southeastern Alaska and coastal British Columbia support the largest population yet described (King et al. 1972; Hodges et al. 1979, 1984).

The U.S. Fish and Wildlife Service has conducted bald eagle nest surveys by boat throughout coastal southeastern Alaska from April through August of 1969–79 (Hodges 1982). The timing of this work corresponded to the breeding period of the eagles; laying generally occurred in late April, hatching in late May, and fledging in late July (F. C. Robards and J. G. King, unpubl. data). The surveys were made by two observers traveling in an open skiff along the shoreline at speeds of 2–5 knots. When an eagle nest was sighted, its location, habitat characteristics, and status were recorded. Nests were classified as active if adults were present and behaved defensively or if young were seen.

Estimates of breeding rates were made during 1970–72 and 1979, when the number, location, and age-class of all eagles observed were also tallied (in 1979, the population counts were done only from June to August). Eagles with completely white heads and tails were classified as adults and all others as subadults. In 1979, birds not seen well enough to be placed in either category were listed as unclassified.

Bald eagle density was estimated by dividing the total number observed each year by the length of shoreline surveyed that year. Estimates of the ratio of breeding to nonbreeding adults were made with data from May and June 1970–72 and from June 1979. The use of data from these months represents a compromise between our desires to: (1) estimate breeder density after all pairs had laid eggs but before any nest failure had occurred; and (2) to have a large enough sample size. Calculations of the proportion of breeding adults were made by doubling the number of active nests (assuming two breeders per active nest) and dividing by the total number of adults tallied. The adults remaining after the nesting birds were accounted for included both those that did not breed and those whose nests had failed prior to our survey. Eagles in subadult plumage were omitted from these calculations because they are not known to breed in southeastern Alaska (F. C. Robards, pers. commun.).

Our survey locations were not selected randomly, but were well dispersed throughout southeastern Alaska, and we are aware of no important sampling biases.

Table 1. Density of bald eagles in southeastern Alaska.

	Survey		Eagles/km		
Year	Dates	Length (km)	Adults	Subadults	Total
1941[a]	3 May–30 Aug	1,339			0.51
1970	21 Apr–12 Jul	192	0.80	0.15	0.95
1971	21 Apr–23 Jul	586	0.94	0.18	1.12
1972	8 Apr–28 Jul	488	0.86	0.13	0.99
1979	6 Jun–18 Jul	415	0.79	0.22	1.01

[a] From Imler (1941).

RESULTS

Bald eagles were distributed along nearly all portions of the coastline and mean density was 1.02 ± 0.07 eagles/km (Table 1). Subadults composed between 13 and 22% of each year's total. They were well dispersed along the shoreline early in the breeding period. Later, when pink salmon (*O. gorbuscha*) began spawning in estuaries, many of the subadults gathered at these rich food sources.

Eagle nests were abundant; an average of one nest was found per 2.6 km of shoreline (Table 2), but only 49% of the nests were active in May and June of 1970–72. During those months the ratio of breeding adults to all adults varied from 0.84 in 1970 to 0.38 in 1971 (Table 2). Within the region surveyed in June 1979, 25% of the nests were active and breeders composed 14%

Table 2. Number of adult eagles and nests tallied in May and June of each year of study.

Year	Survey length (km)	Nests		Adult eagles		
		Total	Active	Breeders	Non-breeders	Breeders (%)
1970	115	24	13	26	5	84
1971	367	131	63	126	204	38
1972	416	180	89	178	238	43
1979[a]	87	44	11	22	137	14

[a] Surveys conducted 6–13 June only.

of the adult population. Thus, nonbreeders and breeders that had abandoned their nests prior to our surveys accounted for 16, 62, 57, and 86% of the adult populations in 1970, 1971, 1972, and 1979, respectively. The high proportion of nonbreeders estimated in 1979 was apparently not an artifact of population counts being conducted only in June of that year rather than in May and June as was the case in 1970–72. Boat surveys of nest occupancy in several regions of southeastern Alaska in May and June of 1979 indicated that the proportion of nests that were active was well below the 10-year mean for southeastern Alaska (Hodges 1982).

DISCUSSION

The findings of our boat surveys are consistent with the aerial census results of King et al. (1972) and Hodges et al. (1979) in showing that bald eagle density in southeastern Alaska remained stable during the 1970's. Imler (1941) reported eagle density in 1941 to be about half that of more recent times (Table 1). One interpretation of these findings is that the population in southeastern Alaska was substantially reduced in the years when eagles were killed for bounty. Alaska paid bounty on 128,000 bald eagles from 1917 to 1952 (Robards and King, unpubl. data). The population may have rebounded since that time and stabilized at the natural carrying capacity.

Known breeders composed less than half of the adult populations during 3 of 4 years of study despite an apparent abundance of vacant nest sites. We did not determine how many of the remaining adults laid eggs but abandoned nests prior to our surveys. Robards and Hodges (1976) estimated an average rate of nest failure between early May and late June of 1969–76 of 5.3%. Consequently, we infer that the majority of the adults that were not associated with nests were nonbreeders.

Whether surpluses of nonbreeders are common in other bald eagle populations is not known. The only other attempt to quantify breeding rate was by Sherrod et al. (1976). They found that nearly all adults were breeding on Amchitka Island, Alaska. Nonbreeders have been found in other avian species, but in only a few cases did they compose more than half of the adult population (Brown 1969). The only record, to our knowledge, of nonbreeder frequency exceeding that estimated in this study is for tawny owls (*Strix aluco*); Southern (1970) found that 100% of his study population failed to breed 1 year.

The Regulation of Breeding Rate

Apparently many adult bald eagles in southeastern Alaska do not breed annually. We conclude that reasonable hypotheses on the causes of depressed breeding rates in southeastern Alaska might involve chemical contaminants, habitat, or food. Only the chemical toxins hypothesis can be rejected with current information. The use of organochlorines resulted in serious declines in many raptor populations (Newton 1979). Bald eagles in eastern North America contained high levels of these toxins during the 1960's (Mulhern et al. 1970). Thin-shelled or inviable eggs were being produced then and serious population declines followed (Sprunt et al. 1973). Grier (1982) found an inverse relationship between DDE in eggs and the number of eaglets produced per nesting area in Ontario. After a ban on the use of many organochlorines in the United States, bald eagle reproduction improved (Grier 1982).

Bald eagles in southeastern Alaska, however, have apparently not accumulated these toxins. Bald eagle eggs collected in the region in 1970 and 1975 generally contained no abnormal levels of chemical residues, and average eggshell thickness of the 1970 sample was not different from the pre-1946 norm (Wiemeyer et al. 1972, 1984). Examination of 30 bald eagle carcasses from southeastern Alaska revealed no unusually high levels of chemical contaminants except for mercury. The mercury levels in livers averaged 5 ppm wet weight, a figure well below that thought to effect either survival or reproduction (S. N. Wiemeyer, pers. commun.). It seems unlikely that chemical contaminants caused depressed breeding rates or poor reproductive success in southeastern Alaska during 1970–79.

Loss of habitat is also thought to restrict productivity in bald eagles (Grubb 1976, Evans 1982). Our results, however, do not suggest that shortage of nesting habitat is the primary factor constraining breeding rate. First, the majority of nests we surveyed were inactive, although some may have been alternate nests on active territories. Second, the annual variability in breeding rate seems too great to be accounted for by fluctuation in habitat availability.

Another factor known to affect breeding rates in raptors is food. Several investigators have correlated yearly variations in food supplies with breeding density and reproductive success (see Newton 1979 for a review), but the time when food is most critical to breeding is not well understood. Newton (1979) suggested that some nutrients essential for laying may occur at low concentrations in food and can be accumulated only over a long period of time. Winter food shortages could inhibit female bald eagles from attaining laying condition and consequently depress breeding rates.

In contrast, food supplies within the breeding territory just before the nesting period could influence breeding rates. Some species of birds attain breeding condition on territory in the weeks preceding normal laying date (see Ewald and Rohwer 1982). Defense of food through territoriality could result in density dependent population regulation. In the variable environment of southeastern Alaska, only a portion of the breeding sites may offer food at levels sufficient for successful reproduction in spring. The most able bald eagles may saturate this suitable habitat forcing other adults to either forego breeding that year or attempt to nest in marginal habitat (Brown 1969).

Which of these hypotheses, if any, accounts for the abundance of nonbreeders in southeastern Alaska can only be determined through additional research.

IMPLICATIONS

The discovery of large numbers of nonbreeding adult eagles has important implications for research and management. Low breeding rates may be the norm where resources are such that more individuals survive than can reproduce. Ephemeral food supplies may be less effectively exploited by breeding eagles than by nonbreeding adults and subadults because breeders are constrained in movement by allegiance to nests. If surpluses of nonbreeders exist for long periods of time, evolutionary adaptation may result (Brown 1969). Delayed maturation may have evolved because young eagles, being poor competitors for saturated breeding sites, maximize lifetime reproduction by avoiding the risks of breeding too early.

An alternative to the assertion that low breeding rate is a long-term feature in the region is the hypothesis that recent environmental disturbance has artificially reduced breeding rate. In this case, nonbreeding surpluses may presage serious population declines.

We urge that efforts be made to determine the causes for low breeding rates in southeastern Alaska. Furthermore, we emphasize the importance of considering breeding rate in studies of population status. Measuring the reproductive success of those that breed may provide information on only a segment of the population. In southeastern Alaska, subadults, nonbreeding adults, and unsuccessful breeders composed approximately 30–89% of the total population during May and June of the years of study. By knowing only fledging rates and not population size, it is impossible to estimate what level of recruitment is sufficient to ensure a stable population.

Where excesses of nonbreeders are found, managers are prudent to enact strategies that not only focus on breeding habitat but also consider the requirements of subadults and nonbreeding adults. Young (1968) and Grier (1980) have suggested that changes in survival rates may be even more important than comparable changes in reproductive rates in influencing population dynamics.

Acknowledgments.—This research was sponsored by the Natl. Sci. Found. Ecosystem Stud. Program under Interagency Agreement DEB 80-24024 with the U.S. Dep. of Energy under Contract No. DE-AC05-840R21400 with Martin Marietta Energy Systems, Inc. This is Publication No. 2317, Environ. Sci. Div., ORNL.

We thank F. C. Robards and S. O. Morgan, who did the fieldwork in 1970–72, and A. A. Anderson, skipper of the MV Surfbird. We are also indebted to S. N. Wiemeyer, who provided data on chemical residues in bald eagles, and to E. L. Boeker for suggesting the winter food limitation hypothesis. The comments of M. I. Dyer, G. F. McCracken, J. R. Krummel, D. C. West, S. N. Wiemeyer, and J. W. Grier greatly improved earlier drafts of the manuscript.

LITERATURE CITED

AHLGREN, C. E., AND I. F. AHLGREN. 1983. The human impact on northern forest ecosystems. Pages 33–51 *in* S. L. Flader, ed. The Great Lakes Forest: an environmental and social history. Univ. Minnesota Press, Minneapolis.

BROWN, J. L. 1969. Territorial behavior and population regulation in birds. Wilson Bull. 81:293–329.

CRONON, W. 1983. Changes in the land. Indians, colonists, and the ecology of New England. Hill and Wang, New York, N.Y. 241pp.

EVANS, D. L. 1982. Status report on 12 raptors. U.S. Fish Wildl. Serv. Spec. Sci. Rep. Wildl. 238. 68pp.

EWALD, P. W., AND S. ROHWER. 1982. Effects of supplemental feeding on timing of breeding, clutch-size and polygyny in red-winged blackbirds *Agelaius phoeniceus*. J. Anim. Ecol. 51: 429–450.

GRIER, J. W. 1980. Modeling approaches to bald eagle population dynamics. Wildl. Soc. Bull. 8: 316–322.

———. 1982. Ban of DDT and subsequent recovery of reproduction in bald eagles. Science 218: 1232–1234.

GRUBB, T. G. 1976. A survey and analysis of bald eagles nesting in western Washington. M.S. Thesis, Univ. Washington, Seattle. 87pp.

HODGES, J. I. 1982. Observations of 3850 bald eagle nests in southeast Alaska. Pages 37–46 *in* W. N. Ladd and P. F. Schempf, eds. Proc. Management and Biological Symp., U.S. Fish Wildl. Serv., Alaska Reg. Off., Anchorage.

———, J. G. KING, AND R. DAVIES. 1984. Bald eagle breeding population survey of coastal British Columbia. J. Wildl. Manage. 48:993–998.

———, ———, AND F. C. ROBARDS. 1979. Resurvey of the bald eagle breeding population in southeast Alaska. J. Wildl. Manage. 43:219–221.

IMLER, R. H. 1941. Alaskan bald eagle studies. U.S. Fish Wildl. Serv., Denver, Colo. 17pp.

KING, J. G., F. C. ROBARDS, AND C. J. LENSINK. 1972. Census of the bald eagle breeding population in southeast Alaska. J. Wildl. Manage. 36:1292–1295.

MULHERN, B. M., ET AL. 1970. Organochlorine residues and autopsy data from bald eagles 1966–68. Pestic. Monit. J. 4:141–144.

NETBOY, A. 1974. The salmon. Their fight for survival. Houghton Mifflin Co., Boston, Mass. 613pp.

NEWTON, I. 1979. Population ecology of raptors. Buteo Books, Vermillion, S.D. 399pp.

ROBARDS, F. C., AND J. I. HODGES. 1976. Observations from 2,760 bald eagle nests in southeast Alaska. U.S. Fish Wildl. Serv., Prog. Rep. 1969–1976, Juneau, Alaska. 27pp.

SHERROD, S. K., C. M. WHITE, AND F. S. L. WILLIAMSON. 1976. Biology of the bald eagle on Amchitka Island, Alaska. Living Bird 15:143–182.

SMITH, C. L. 1979. Salmon fisheries of the Columbia. Oregon State Univ. Press, Corvallis. 117pp.

SOUTHERN, H. N. 1970. The natural control of a population of tawny owls (*Strix aluco*). J. Zool., London 162:197–285.

SPRUNT, A., IV, W. B. ROBERTSON, JR., S. POSTUPALSKY, R. J. HENSEL, C. E. KNODER, AND F. J. LIGAS. 1973. Comparative productivity of six bald eagle populations. Trans. North Am. Wildl. and Nat. Resour. Conf. 38:96–106.

WIEMEYER, S. N., ET AL. 1972. Residues of organochlorine pesticides, polychlorinated biphenyls, and mercury in bald eagle eggs and changes in shell thickness—1969 and 1970. Pestic. Monit. J. 6:50–55.

———, ET AL. 1984. Organochlorine pesticide, PCB, and mercury residues in bald eagle eggs—1969–79 and their relationships to shell thinning and reproduction. Arch. Environ. Contam. Toxicol. 13:529–549.

YOUNG, H. 1968. A consideration of insecticide effects on hypothetical avian populations. Ecology 49:991–994.

Received 24 February 1984.
Accepted 27 June 1984.