WINTER FEEDING AS A MANAGEMENT TOOL FOR WHITE-TAILED SEA EAGLES IN SWEDEN

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ABSTRACT

An extensive feeding programme for Sea Eagles has been in operation in southern and central Sweden during the cold season since 1971/72, in order (1) to provide uncontaminated food, thereby trying to improve survival, and (2) to provide food throughout the cold season, thereby trying to improve the survival of young birds. 100–140 tons of food were distributed annually to over 100 feeding stations. Although the nest success of 10 studied pairs increased significantly from 36 to 56 percent after feeding was started, the effects of the programme on nest success appeared to be limited. However, the population at the Swedish Baltic coast stabilized, in spite of a constantly low production of only 0.3 young per pair per year. This was most probably due to improved juvenile survival. Field observations of colour-ringed birds indicated a yearling survival of at least 50 percent, and the rate of ringed birds found dead as yearlings decreased significantly after the feeding programme started. The number of young Sea Eagles per feeding station increased for four seasons and then stabilized; this would be expected if supplemental feeding improved the survival of juveniles. Given a few assumptions, modelling the data suggested a survival of at least 80 percent of yearlings that utilized feeding stations. Counting eagles at feeding stations also proved useful for monitoring winter distribution and numbers.

INTRODUCTION

The White-tailed Sea Eagle (*Haliaeetus albicilla*) has suffered greatly from the effects of environmental pollutants and habitat destruction in most of its European range in recent decades. In Sweden, a project was started in 1971 by the Swedish Society for the Conservation of Nature in order to save this species in our country. 'Project Sea Eagle' includes research as well as management efforts.

BACKGROUND

Sweden has two geographically separated Sea Eagle populations: one on the coast of the Baltic Sea (50–60 pairs) and the other in parts of Lapland (about 30 pairs). Annual surveys have shown that the production averages about 0.3 fledged young per pair per year at the Baltic, and about 0.5 in Lapland. Analyses of pollutants in eggs have shown that the Baltic population is highly contaminated. Significant negative correlations exist between egg residue levels of some pollutants and the reproductive success within this population. In Lapland, pollutant levels in eggs are significantly lower (Helander *et al.* 1982). Breeding failures resulting from human disturbance at the nests occur in both areas; disturbance from snow-scooters, and even deliberate destruction, appear to be significant problems at several Lapland nests.

The production observed is probably too low to maintain population stability. Sprunt *et al.* (1973) estimated that Bald Eagle (*Haliaeetus leucocephalus*) populations required a productivity of 0.7 young per pair per year to maintain stability. A slow decrease in the number of pairs at the Baltic was observed from the mid-1960s (Helander 1975). Sea Eagles are normally long-lived birds once they reach maturity; a decline in the breeding population resulting mainly from depressed reproduction will therefore be slow.

A halt in the observed population decline could be achieved either by transfer of birds or fertile eggs, or by increasing the natural reproduction, or by increasing the survival rate. The possibility for transfer of eggs, nestlings or full-grown birds in large enough numbers was considered unlikely. Instead, an extensive winter feeding programme was organized, in order to (1) provide uncontaminated food for the birds, thus lowering their body burdens of pollutants and thereby trying to improve reproduction, and (2) provide food throughout the cold season in the hope of improving the survival rate, especially of yearlings, which normally suffer the greatest mortality.

METHODS

An outline of the feeding programme was presented elsewhere (Helander 1978, 1981). During subsequent seasons, about 100 feeding stations were in operation in southern and central Sweden and 100–140 tons of food were distributed, largely on a voluntary basis and by private initiatives. Between 1500 and 2000 food deliveries occurred each season. Many of the feeding stations were regularly inspected from a distance to check the numbers of eagles.

Table 1: Nest success of White-tailed Sea Eagle pairs (numbers 1–12) before and after feeding was introduced in their territories; nest success data from 1964–79. Legends: + successful; − unsuccessful; ? no data; 0 only one adult bird.

Average nest success before feeding		Start of feeding		Average nest success after feeding
Pair no.	%			%
1	20	+ − − − −	+ + − ? + 0 − − + + +	67
2	50	? ? + −	− + 0 − − + − + + + + +	64
3	40	− + − + −	+ + + + − − + + + +	82
4	50	? ? ? − + − 0 +	? − + + − 0 0 0	50
5	33	? ? ? + − − ? ?	? ? + − + − + −	50
6	20	+ − − − −	− − − − − − 0 0 0 0 0	0
7	100	? ? + + ? ? + +	+ + + + + + − −	86
8	0	? ? ? ? ? − − −	+ − − + − + − −	38
9	11	+ − − − − − − − ? ? −	+ + + − +	80
10	60	+ ? ? ? + − − +	− + − − − + − ?	29
11	0	− − − − − −	− − − − − − − − − −	0
12	0	− − − − −	− − − − − − − − − − −	0
1–12	29			44
1–10	36			56

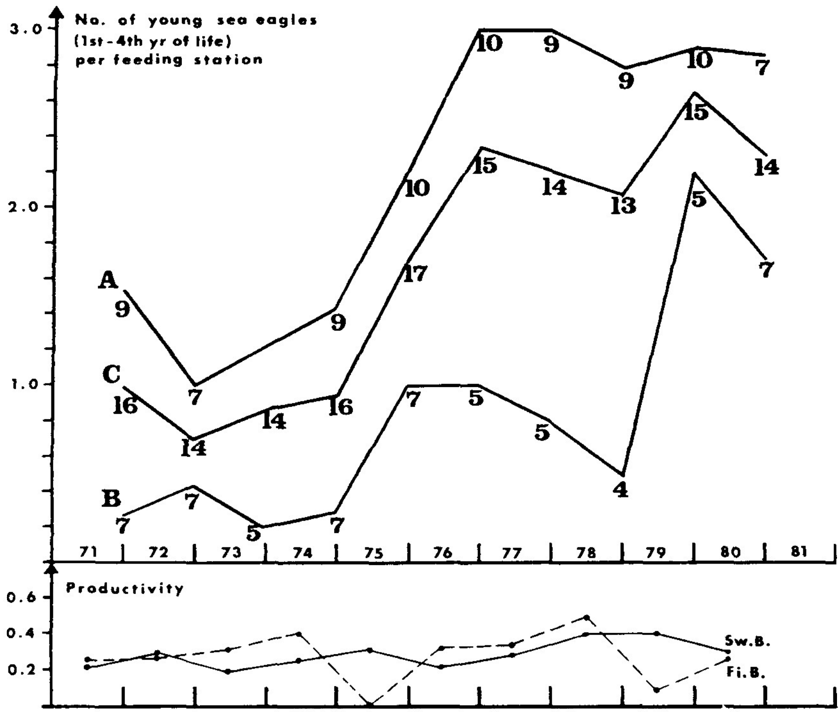

Figure 1: Upper part: Numbers of young White-tailed Sea Eagles (1st–4th year) per feeding station in Sweden during 1971/72–1980/81. A = southern and central Sweden; B = Baltic breeding range; C = A + B. Figures denote the numbers of feeding stations where counts were made. Lower part: Data on productivity (average number of fledged young per pair per year); Sw.B. = Swedish Baltic population (from Helander 1976, 1977–80), Fi.B. = Finnish Baltic population, except the archipelago of Åland (from Stjernberg 1977, Joutsamo 1978, WWF Finland 1977, 1979. 1980).

RESULTS AND DISCUSSION

The effects of the feeding programme on the population have so far been as follows.

The nest success of 12 pairs (*Table 1*), studied for several years before and after feeding was started, was recorded by Helander (1981). The average nest success of these pairs increased from 29 percent to 44 percent; the difference was not statistically significant ($p > 0.05$, test of homogeneity, Dixon & Massey 1969). Two of these pairs (11, 12) were unsuccessful every year, possibly through sterility. The nest success for the remaining 10 pairs increased from 36 percent to 56 percent; this difference was statistically significant ($p < 0.05$). The productivity of the population as a whole, however, has not improved (see *Figure 1*) in spite of the large-scale feeding programme. Furthermore, residue levels of DDT, PCB and mercury in unhatched eggs collected from seven pairs did not decline after supplemental feeding was introduced in their territories (since these eggs were all unhatched, however, they may have constituted a biased sample). The heterogeneity of the material made general interpretation difficult, but it seemed that the potential to decrease the body burdens of pollutants by supplemental feeding was limited in this species.

The minimum numbers of young Sea Eagles (1st–4th year of life) seen per feeding station during each winter from 1971/72 are given in *Figure 1*. The counts are from approximately the same stations each year. Data on productivity (number of fledged young per pair per year) of the Swedish and Finnish populations at the Baltic are included. The number of young Sea Eagles per station has doubled over the years, in spite of an approximately constant production. This increase may have resulted from an increase in the survival of yearlings. Precise data on the proportions of yearlings and older immatures were lacking from most stations; at one station, however, only 2 out of 14 young individuals were yearlings. With an improvement in yearling survival one would expect an increase in the number of immatures over a four-year period and then a stabilization, since the Sea Eagle is in adult plumage in its 5th winter (Glutz von Blotzheim *et al.* 1971; Forsman 1981). These data agree well with that prediction (*Figure 1*).

Based on counts at the feeding stations, it is not possible to be precise about how much survival has actually increased, since these figures are influenced by more than one factor. To estimate which survival rate would fit the observed increase best, a simple model was made, with the following assumptions:

(1) Production of fledglings was approximately constant over the years.
(2) 'Learning' occurs in the sense that young eagles that find feeding stations return there the following season(s) if they survive.
(3) 'Normal' survival rates were assumed to be 20 percent in the 1st year and 95 percent per year thereafter (see Holmquist *et al.* 1981).
(4) Supplemental feeding was assumed to influence survival during the 1st winter only.

With these assumptions, any increase in the number of immatures per feeding station depends on (A) the proportion of 'not-previously-fed' birds that locate feeding stations, and (B) the subsequent survival of those yearlings that do so. The calculated increase in the number of young birds per station for three values each of (A) and (B) suggests that learning alone (B = 20) can explain only a very small increase, and that a variation in (A) has a comparably small influence on the magnitude of the increase (*Table 2*). The model fits the observed increase best at values of (B) close to 80 percent, and thus suggests a very high survival of yearlings that utilize stations. These figures are very much above those generally accepted

Table 2: Hypothetical increase in the number of young (1st–4th year) White-tailed Sea Eagles per feeding station, at different values of two parameters: (A) = the proportion of not-previously fed birds that locate feeding stations, and (B) = the survival rate of those yearlings that do so. Calculations were made according to the assumptions given in the text. (Initial value set to one bird per station.)

A:	100%			75%			50%		
B:	20%	50%	80%	20%	50%	80%	20%	50%	80%
Year: I	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
II	1.0	1.19	1.38	1.09	1.28	1.47	1.18	1.37	1.56
III	1.0	1.37	1.75	1.11	1.48	1.85	1.24	1.61	1.98
IV	1.0	1.54	2.09	1.11	1.65	2.20	1.26	1.80	2.35
V	1.0	1.54	2.09	1.11	1.65	2.20	1.26	1.80	2.35

as natural survival rates for large eagles during their first year of life; e.g., data given by Sherrod *et al.* (1977) indicate a survival of only about ten percent collectively during the first four years in a Bald Eagle population in Alaska. I still think that the figures suggested here are realistic for birds that use feeding stations. There are several reasons for high survival in such birds: there is almost no persecution in the feeding areas; eagles that use the stations often stay within the area for long periods (sometimes throughout the winter), which probably makes them less vulnerable to accidents etc.; they have constant access to food throughout the cold season. The latter point is probably the most important, since food may often be the main problem during the first winter. Autopsy of dead juveniles from the 1950s and 1960s before feeding began often revealed that the birds were very thin but otherwise unharmed, thus indicating starvation as the cause of death.

Field observations and ringing recoveries also strongly suggest an improvement in survival. Of ten birds colour-ringed as nestlings in 1976, at least four were still alive in 1980 (they were observed at different feeding places at the same time). This gives a survival of at least 40 per cent over the first four years, and suggests a *minimum* survival of about 50 percent in the 1st year in this cohort. The true figure is probably higher; because it is not likely that all birds that were alive from this cohort would be observed at the same time.

The recovery rate of ringed birds found dead during their 1st year of life decreased significantly after the feeding programme was started: nine recoveries from 89 nestlings ringed during the period 1939–70 (10%), compared with three recoveries from 120 ringed during 1975–81 (2.5%). This difference was statistically significant ($\chi^2 = 4.16$, $p < 0.05$). At least seven of the early nine recoveries were made during the cold season, while only one of the latter three were (this bird was found alive and in shock but physically unharmed under power-lines it was examined and released at a feeding station, and survived). The Sea Eagle has been legally protected during this entire period, so the figures should be comparable in this respect (cf. Saurola 1980 and this volume). The better education of the public and the strong increase in camping, birdwatching and other outdoor activities in recent years should have rather led to an increase in the rate of reporting. In Sweden, dead eagles belong to the government, and since 1975 there is an obligation to report finds of such birds to the police.

Another encouraging indication of improved survival was that the breeding population at the Baltic stabilized during the 1970s and has shown a slight tendency to increase since (a few re-occupations of old, 'empty' territories have been confirmed in recent years). This proves that recruitment to the breeding population was sufficient to maintain stability, in spite of low productivity—only about one-third the production in healthy populations, as in Norway (Norderhaug 1975) and Greenland (Hansen 1979). Evidently survival increased enough to compensate for the low production.

High survival is also evident among young Sea Eagles in Scotland. In an attempt to re-introduce the species in this former breeding area, young birds have been released annually on the Isle of Rhum since 1975 (Love *et al.* 1978). In early spring 1981, at least 28 of the 42 birds released during 1975–80 were still alive; of these, 8 appeared to be in adult plumage (Love 1982). Since only 12 yearlings from 1975 and 1976 were released, and these were the only year-classes that should be in adult plumage in early 1981, this indicated a survival of 67 percent of these birds, collectively, during the first five to six years. Supplemental feeding of the eagles was regular in the release area.

In addition to its management merits, a geographically wide-spread feeding programme has also proved useful for monitoring the distribution and numbers of eagles during the winter. A nationwide count at the feeding places during two days in January 1980–82 was organized. In parallel to these counts, total surveys were conducted by local groups of ornithologists in parts of southern Sweden. These counts gave useful information on the local distribution of Sea Eagles and Golden Eagles (*Aquila chrysaetos*) in central and southern Sweden, and on winter population sizes. The numbers of Sea Eagles in these areas were too high to be made up only by Swedish birds. The occurrence in Sweden of Sea Eagles from other areas was confirmed by a few recoveries of ringed birds and by field observations of colour-ringed birds, mainly at the feeding stations. The feeding programme has thus had value for the management of migrating eagles from several populations.

In conclusion, winter feeding has proved a very useful management tool to increase juvenile survival of White-tailed Sea Eagles in Sweden; the effects on nest success appear to have been limited. Counting the eagles at the feeding stations proved a useful method to monitor winter distribution and numbers.

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REFERENCES

Dixon, W. J. & Massey, J. Jr. 1969. *Introduction to statistical analyses.* McGraw-Hill. Kogakusha Ltd., Tokyo.

Forsman, D. 1981. Ruggningsförlopp hos och åaldersbestämning av havsörn (*Haliaeetus albicilla L.*) (Moult sequence and ageing in the White-tailed Eagle). *Luonnonvarainhoitotoimiston julkaisuja* **3**, 165–93.

Glutz von Blotzheim, U. N., Bauer, K. M. & Bezzel, E. 1971. *Handbuch der Vögel Mitteleuropas. Vol. 4.* Frankfurt am Main.

Hansen, K. 1979. Status over bestanden av Havørn *Haliaeetus albicilla groenlandicus* Brehm i Grønland i årene 1972–74 (Population status for the Greenland White-tailed Eagle covering the years 1972–74.) *Dansk orn. Foren. Tidskr.* **73**, 107–30.

Helander, B. 1975. *Havsörnen i Sverige* (The White-tailed Sea Eagle in Sweden). Uddevalla.

Helander, B. 1976. *The White-tailed Sea Eagle —Swedish report.* Proceedings from the WWF sea eagle symposium at Svanøy, Norway, Sept. 1976.

Helander, B. 1977–80. Annual status reports (unpub.)

Helander, B. 1978. Feeding White-tailed Sea Eagles in Sweden. *In:* Temple, S. A. (ed.), *Endangered Birds: management techniques for preserving threatened species.* Univ. of Wisc. Press, Madison.

Helander, B. 1981. Utfodring av havsörn i Sverige. (Feeding White-tailed Eagles in Sweden.) *Luonnonvarainhoitotoimiston julkaisuja* **3**, 91–112.

Helander, B., Olsson, M. & Reutergårdh, L. 1982. Residue levels of organochlorine and mercury compounds in unhatched eggs and the relationships to breeding success in White-tailed Sea Eagles *Haliaeetus albicilla* in Sweden. *Holarct. Ecol.* **5**, 349–66.

HOLMQUIST, N., DAHL MIKKELSEN, J., LØNBERG, J., MEYER, B. & WILLE, F. 1981. *Populations dynamiske modeller for større rovfugle, specielt den Grønlandske havørn.*— Projekt i økologi A (Project report, in Danish).
JOUTSAMO, E. 1978. Finlands havsörnar 1978. *Finlands Natur* **37**, 89.
LOVE, J. A., BALL, M. E. & NEWTON, I. 1978. White-tailed Eagles in Britain and Norway. *Brit. Birds* **71**, 475–81.
LOVE J. A. 1982. White-tailed Sea Eagle introduction project, 1981 report. Nature Conservancy Council, UK.
NORDERHAUG, M. 1975. *En del spørsmål omkring status, forskning og forvaltning av havørn og Kongeørn i Norge.* Nat. Env. Prot. Bd., Norway. 18.11.75.
SAUROLA, P. 1980. Finnish Project Pandion. *Acta Orn.* **17**, 161–8.
SHERROD, S. K., WHITE, C. M. & WILLIAMSON, F. S. L. 1977. Biology of the Bald Eagle on Amchitka Island, Alaska. *The Living Bird* **15**, 143–82.
SPRUNT, A. IV., ROBERTSON, J. R. W. B., POSTUPALSKY, S., HENSEL, R. J., KNODER, C. E. & LIGAS, F. J. 1973. Comparative productivity of six Bald Eagle populations. *Transactions of the North American Wildlife and Natural Resources Conference* **38**, 96–106.
STJERNBERG, T. 1977. Havsörnen och havsörnskydd, *Finlands Natur* **36**, 35–40.
WWF, Finland 1977, 1979, 1980. Annual status reports (unpubl).