

RESTORATION OF A DECLINING POPULATION OF PEREGRINE FALCONS IN SWEDEN THROUGH CAPTIVE BREEDING: 30 YEARS OF EXPERIENCE

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BACKGROUND

While the peregrine falcon (*Falco p. peregrinus*) was a fairly common bird of prey in Sweden at the beginning of last century with an estimated wild population of appr. 1.000 pairs, a decline could be observed already in the 1930' and 40 years later only 10 to 15 pairs remained in the whole country (Lindberg et al. 1988; Lindberg 2001). Due to mainly heavy metals and PCB, the population continued to decline and in 1976, not a single bird was hatched in the southern pars of Sweden.

In order to save the species from extinction, the Swedish authorities for nature conservation drew up plans for an *ex situ* breeding programme with the aim to restore a population of 25 to 30 breeding pairs in the SW parts of the country. On an initiative of the *Swedish Society for the Conservation of Nature (SNF)*, "Project Peregrine Falcon" was established in 1972 with artificially hatched eggs collected from wild nests. Gradually a captive stock of peregrine falcons collected as nest chicks was established and the first successful reproduction took place in 1979. Three years later, in 1982, the first captive-bred falcons were released in the country.

As a joint effort by *SNF* and the *Ornithological Society of Göteborg* a new breeding station, "The Bird Centre" was opened at Tullare Hög, north of Gothenburg in 1987. In 1974-1999, a total of 1.130 eggs were laid under 36 different females at this facility, 72% of which were fertile. Although 279 falcons have been released in 1982-1997, significant signs of recovery could not be observed until the 1990's. During the last years of the millenium, 29 breeding pairs in the southwestern parts of the country had been established. At that time many of the breeding cages at The Bird Station were in poor condition after the intensive use and in 1999, the decision was made to transfer the breeding activities to Nordens Ark in Hunnebostrand where a new facility with 11 separate outside enclosures, incubation rooms, laboratories, an office and a kitchen were built in 1999-2000. The same spring the first peregrine falcons arrived from The Bird Centre to Nordens Ark.

Nordens Ark is a young zoo opened for the public in 1989, and located appr. 100 km north of Gothenburg. The Zoo has been modelled after the Jersey Wildlife Preservation Trust and has devoted itself to save and protect endangered animals through captive breeding, participation in ongoing reintroduction projects and promoting education and research on threatened wildlife (Lindén 2005). The Zoo

has therefore focused on endangered species with a collection mainly divided into three divisions: endangered fauna from Northern Europe, endangered exotic animals from colder regions and threatened old native domestic breeds. The current stock thus comprises 16 domestic breeds and 40 species of wild animals (*Blomqvist 2005*), 32% of which are included in continental EEP-programmes with six more taxa monitored on either global (*ISB*), European (*ESB*) or native levels (*SZA*). Some of the species in the collection, although not globally threatened, are, however, highly vulnerable in the Swedish fauna and national action plans for them have therefore been implemented. The peregrine falcon is a good example of such a species, and the decision to include it in our collection plan was therefore received with enthusiasm.

EX SITU BREEDING MOVES TO NORDENS ARK

Although the most acute crisis for the peregrines had vanquished in the late 1990's with 29 breeding pairs in SW Sweden and a slowly recovering northern population, the main supporter of the project, *SNF*, still considered an extension of the recovery programme worthwhile. Compared to previous decades, the peregrine falcon had still a limited distribution in Sweden with two main populations existing – one in the north and one in southwest without contacts to each other. Dozens of volunteers were also involved in observing falcons, registering nesting sites, tagging fledglings and collecting egg shells for continuing analysis. In order to expand the distribution to its former breeding localities, it was considered worthwhile to accelerate the species' recovery by combining the two populations through *ex situ* activities mainly in the county of Dalarna (Figure 1). Young falcons hatched at Nordens Ark were therefore planned to be released in this sparsely inhabited part of the country.

THE BREEDING FACILITY

The breeding facility consists of a south exposed building located in the non-public part of the zoo. The building consists mainly of a keeper's corridor adjacent to the outside enclosures with a heated room for preparing the daily food. Feeding, cleaning and observations take place from the keeper's corridor. The facility includes 11 outside enclosures, each measuring 20 m² with a height of 4.3 meters. Both side walls as well as the wall facing the corridor are built in a solid material with only the roof and the southern wall constructed in wire-mesh. As eagle owls (*Bubo bubo*) are common in the area, the roof is made in double netting to prevent the falcons from getting injured by free-flying raptors. To prevent foxes and badgers from digging into the enclosures, the floor is provided with a metallic wire mesh, covered with sand to facilitate cleaning. The three solid walls in each enclosure minimize outside disturbances and prevent the falcons from flying against the walls. For the same reason the enclosures are fairly small as falcons in large enclosures gain considerable speed and might injure themselves.

The wall facing the keepers' corridor is provided with a feeding shelf where food is served via a plastic tube. Each enclosure is provided with two windows on different levels facing the corridor to facilitate inspections without

disturbing the birds. The enclosures have two nesting shelves close to the roof, one of which is open and provided with a threshold in the front, while the other is built as a box protruding into the corridor. Both shelves have inspection holes with shutters making it possible to handle both eggs and chicks. The floor in the nesting shelf is covered with sand to make it possible for the falcons to dig their nest pits.

Each enclosure is furnished with a number of branches to sit on at different levels. To avoid problems with bumble feet, all branches are covered with a carpet of coconut fibre. A feeding platform located in the middle of each enclosure is used by the falcons at feeding. A small pool filled from the corridor is often used by the birds during warm summer days for drinking and bathing.

INCUBATION

Two laboratories are used for rearing the young falcons. An incubation room is provided with four incubators and one hatching machine (*Newlife; A.B. Incubators Ltd & Schumacher*). To control the development of the chicks, a *Mettler* weighing-machine connected to a computer is used, making it possible to regularly check weight decreases in the eggs as well as development of the foetus during incubation. For this purpose a software programme has been developed at the Zoo.

To obtain a maximum number of offspring, the first clutches from both wild- and captive-bred pairs are collected for artificial incubation. After removal of the eggs, females usually lay a second and even a third clutch. Some females can therefore lay as many as 15 eggs.

As an egg loses 15% of its weight from the day it is laid until hatching (Figure 2), each egg is weighed daily and brooded at different humidity conditions, depending on the quality of the eggshell. By doing this, it is possible to control weight reduction essential for the survival of the foetus. If weight reduction does not follow the normal curve, the egg has to be moved to another incubator with higher humidity where the reduction decreases, or *vice versa* to an incubator with less humidity to increase its evaporation. After 32 days of incubation, the egg starts to hatch and is then transferred to another incubator. Mean weight at hatching is 33.8 g for both sexes (N= 19.19) with no significant size difference in males and females (Figure 3).

DEVELOPMENT OF CHICKS

The newborn chicks are transferred from the incubators to a different room for drying and resting within 12 hours after hatching. All chicks are placed on an artificial shelf with electric floor heating and are for their first days of life covered by a blanket to maintain warmth. Young peregrine chicks gain weight quickly and are fed with minced chicken and added vitamins and minerals five times a day; at 07.00, 11.00, 15.00, 19.00 and 23.00. Weighing takes place prior to and after each feeding. Except for feeding times, the chicks are left totally undisturbed. During

their first weeks of life, both sexes develop equally, and sex determination based on weight cannot be done. However, as soon as the chicks are 10 days old, females start to grow faster than males (Figure 4), a development only accelerating with increasing age. After two weeks the chicks have gained ten times their body weight and males have now a mean weight of 364g (N=19; range: 280-403g), while females already are 15% larger, weighing 421g (N=19; range: 330-522g).

COURTSHIP BEHAVIOUR

Due to sexual dimorphism, larger females dominate the males and it is therefore essential to find compatible breeding pairs. During courtship strong males offer food to the females, while submissive males fear to feed their partners. In such cases, matings do not take place and the females, if left unobserved, might kill their partners. If a female fetches the offered food before the male grabs it, courting is interrupted and matings do not occur. A string has therefore been attached to the offered chicken and as soon as the female tries to grab it, the chicken is pulled away. Soon she learns that it is useless to try to get the chicken, and the male gets a chance to catch the prey. When females start begging, the males feed them and matings usually thereafter occur.

TIME OF RELEASE - A CRITICAL PERIOD FOR THE YOUNG FALCONS

Hand-rearing continues until the chicks are three weeks old which also is the most critical time for imprinting. At that age, the young falcons are moved to their foster parents in the breeding enclosures. After removal of the dummy eggs, the foster parents start feeding the introduced chicks without hesitation. This continues until the chicks are 38 days old. At that age the chicks are released into the wild through a method described as hacking (*Lindberg 1988*). Four to five birds are placed in a wire-mesh cage in the wild, located on a suitable mountain cliff. Here the birds are kept for a week with a minimum of human interference. Feeding takes place only through a plastic tube from the top of the mountain (Figure 4). At six weeks of age, the falcons are fully fledged and the hacking cage is opened.

The first days are dangerous for the young falcons, many of which fall victims to other birds of prey such as goshawks and eagle owls. During these weeks young falcons are still dependent on their parents and as they continue to return to the hacking cage, food has to be offered daily through the tube. In a short time, however, they learn to catch their own food and feeding is stopped. By using radio transmitters we have found that in the beginning, young falcons stayed within a radius of 1 km from the hacking cage, although they soon expanded their flights up to 10 km, although returning to their "home cliff" for feeding.

RESULTS

During the last six years a total of 88 falcons have been artificially hatched in Nordens Ark with a survival rate of 89% (Table 1). Of the survived chicks, 70 (35.26.9) have been released, mainly in the county of Dalarna. All released birds have been individually marked with both plastic, coloured leg bands as well as with metallic leg bands with identification numbers. A summary of the results can be seen in Table 1. At the end of 2005, 14.13 peregrine falcons were kept in the breeding facility at Nordens Ark.

Table 1. Summary of the breeding results at the falconary in Nordens Ark during the last six years.

Year	Hatched	DNS	Released
2000	6.4.4	0.0.2	4.1.1
2001	3.2.1	0.0.1	1.1
2002	6.3.1	0.0.1	6.2
2003	5.8.6	1.1	5.7.6
2004	8.9.1	0.0.1	8.9.2
2005	13.7.1	0.0.1	11.6
TOTAL	41.33.14	1.1.6	35.26.9

CONCLUSION

The project has demonstrated the possibilities to restore a weak or fragmented population through captive breeding. The breeding programme is estimated to cover four to five additional years until the two main sub-populations have been successfully combined. The breeding activities have provided the staff at Nordens Ark with useful knowledge of hand-raising methods, skills which also can be used for other species in the future. This method can also serve as a model for a number of *ex situ* projects, thus gaining useful know-how for a number of other reintroduction projects which in the future will be required to save other threatened species of birds.

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