

Captive Breeding and Releases of Peregrines *Falco peregrinus* in North America

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ABSTRACT

In response to the rapid decline of Peregrine Falcons in the 1950s and 1960s, four major projects were developed in North America to breed the species in captivity for management purposes. Techniques of artificial insemination and incubation were perfected in the 1970s. By 1980, about 250 captive-bred young were available for release annually; the maximum released annually was about 500 in 1987. Total production of the major facilities was about 5,500 birds through 1994 and private breeders accounted for about 750 more for release, 6,250 in all. Releases were mainly by hacking and totalled about 6,100 individuals in temperate North America 1974-94, including about 500 young hatched from eggs collected from wild Peregrines. About 80% of hacked young survived to independence. Captive breeding and releases have been drastically reduced since 1989 and will mostly end by 1996. Fewer than 500 more birds are likely to be released by then, owing to the vast improvement in counts of wild pairs on territory; about 1,000 pairs were found in 1994 in temperate North America.

This paper summarizes the advent of captive breeding and releases of Peregrine Falcons in North America and gives an overview of the effects these events had on subsequent population growth. A general awareness of the rapid decline of Peregrines resulted from the 1965 conference at the University of Wisconsin (Hickey 1969) and provoked interest in captive propagation and release as a means of restoring depleted or lost populations. The basic development of captive breeding occurred in the early 1970s and release techniques were perfected in the late 1970s. Through 1994, a total of about 5,700 captive bred Peregrines were released in Canada and the United States, in addition to about 500 young raised from wild eggs. The impact of this effort was on both distribution and abundance.

CAPTIVE BREEDING

Cade (1988) reviewed the history of captive breeding of Peregrines and other falcons. Apparently the first fertile eggs were laid in captivity by birds belonging to A. Johnstone in Scotland in 1852; the eggs failed to hatch. The first young were produced by R. Waller of Düsseldorf, Germany, in 1942-43. In 1967, F. Beebe produced two young in British Columbia, and about then Herr Röder (*fide* A. Koehler) raised one Peregrine by artificial incubation in Germany. In 1968, L. Schramm in Oregon produced one young, and in 1971-72 H. Meng produced eight young in New York using artificial incubation and hand rearing.

After 1972 successes occurred rapidly. Rocky Mountain Peregrines held by J. Enderson produced two young by natural copulation and one by artificial insemination in 1973. That same year J. Campbell and W. Nelson produced three young in Alberta, and the newly formed Peregrine Fund at Cornell University, New York, produced 20 birds from adults obtained from G. Hunt, H. Meng, J. Oar, C. White, and others (Cade *et al.* 1977). In Germany in 1974, C. Saar obtained six young from one pair. In 1975, R. Fyfe produced 18 young from seven pairs at the newly built Canadian Wildlife Service (CWS) facility at Wainwright, Alberta. The next year the Santa Cruz Predatory Bird Research Group (SCPBRG) in California was developed under the direction of B. Walton with fewer than 20 Peregrines.

The Peregrine Fund built a second facility in 1975 in cooperation with the Colorado Division of Wildlife, stocked with birds from F. Bond, W. Burnham, J. Enderson, and T. Smylie. In Canada, a breeding facility was built in 1976 at the University of Saskatchewan by L. Oliphant and was stocked mainly with birds from the CWS Wainwright facility. In 1975, almost 200 Peregrines were bred in captivity by the major facilities and in smaller projects. By 1976, the Peregrine Fund alone had produced 137 Peregrines and Wainwright had produced 63. Another Canadian project was begun in 1978 by D. Bird at the McGill University Science and Conservation Centre near Montreal. Many smaller projects were started in the United States about this time, notably those by D. Hunter, L. Boyd, R. Anderson, and J. Oar.

Captive Peregrines

Breeding projects were stocked with birds from many locations. The CWS Wainwright facility had birds taken from the wild as nestlings from northern and southern Alberta, the Yukon, and the Northwest Territories, Canada; the McGill facility had birds from northern Quebec. The Peregrine Fund at Cornell University had birds taken as nestlings from Alaska, Scotland, Australia and other places, while the Fort Collins facility had mainly birds from the Rocky Mountain region. Most of the birds at the SCPBRG were

from California. The early successes of F. Beebe, L. Schramm and H. Meng involved the *pealei* subspecies from coastal British Columbia. Nearly all birds were taken as nestlings because those caught after fledging showed no tendency to breed in captivity. An exception was a first-year female, caught by J. Enderson in Wyoming in late summer, that bred for many years.

Breeding techniques. A manual on propagation of falcons in captivity (Weaver & Cade 1991) is now in its third edition and is thoroughly up to date in regard to husbandry procedures. In general, pairs were best housed in chambers 3x5x5 m tall with large barred windows and skylights, and several perches. A gravel-covered ledge provided a substrate for eggs. Diet was normally *Coturnix* quail, raised to about eight weeks on vitamin (especially vitamin E) fortified feed.

About half of all pairs did not copulate; in these cases, a schedule of artificial insemination two days prior to the first egg and immediately after each subsequent egg was necessary. Semen was stripped manually from males, but the volume was usually small. Hawks and eagles imprinted on humans ejaculated after manipulation, suggesting imprinted Peregrines might do likewise (Grier *et al.* 1972). The usefulness of imprinted Peregrines was realized by use of a hat, worn by the handler, that caught semen in a rubber trough on the hat brim when the falcon ejaculated (Boyd & Schwartz 1981). Males often produced enough semen to inseminate several females per day. An imprinted male, taken from the wild in 1971 by J. Enderson, fathered hundreds of young released in the United States.

To enhance production of eggs, first sets and sometimes second sets of eggs were taken from adults and incubated artificially. Hatchability increased if about ten days of natural incubation were allowed. Eggs in the second clutch usually appeared 14 days after the first set was removed. Forced air incubators were normally used and their internal temperatures were mapped to obtain desired temperature. Humidity was a source of many early problems; it was finally found necessary to regulate water loss so that about 15 % of the fresh laid egg weight was lost by time of hatching.

Captive Peregrines are fully fertile at two years of age, but may not copulate until older. Egg and sperm production continues well into the second decade, but hatchability falls off after about age 14 years. Many of the early problems with captive breeding were lessened by the work of J. Weaver, W. Burnham, D. Konkel and W. Heck of the Peregrine Fund; by R. Fyfe, P. Trefry and H. Armbruster of the CWS; and by B. Walton of the SCPBRG. Since 1983 C. Sanford of the Peregrine Fund increased the efficiency of several crucial techniques.

Table 1. Production of captive Peregrines by major facilities used for release in North America.

Facility	Period	Production
Avian Sci. and Conserv. Centre, McGill Univ. (D. Bird, pers. comm.)	1979-1990	64
SCPBRG (Linthicum & Walton 1992)	1977-1992	4491
Saskatchewan Coop. Project, Univ. of Sask. (L. Oliphant, pers. comm.)	1982-1993	264
The Peregrine Fund, Cornell University, New York	1973-1990	1,1632
Fort Collins, Colorado	1975-1984	562
Boise, Idaho (C. Sandfort, pers. comm.)	1985-1994	1,504
Canadian Wildlife Service, Wainwright, Alberta	1974-1994	1,500

¹ captive-bred young released; several others were retained in captivity

² captive-bred young released; others were retained in captivity (W. Burnham, pers. comm.)

Table 1 shows the production of captive Peregrines by major organizations. In all about 5,500 birds were bred by the groups shown, and at least 750 more were produced by other projects for release. For example, the Midwest Peregrine Falcon Restoration Project (MPFRP) headed by P. Redig and H. Tordoff obtained Peregrines for release from at least 28 projects omitted from Table 1. In all, approximately 7,000 Peregrines were bred in North America, including birds not intended for release.

Captive breeding has fulfilled the demand for Peregrines by falconers. A recent catalogue (Northwoods Limited 1994) listed about 18 suppliers of captive-bred Peregrines, available to qualified people. Small private projects increased greatly 1981-1988. In that period, annual production by these independent breeders grew from 46 to 241 (R. Berry, pers. comm.).

The major captive breeding projects tended to reach full capacity for production within a few years of initiation. In Alberta, the CWS facility produced about 70 to 100 birds in most years from 1980-1994. Unlike the other major facilities, eggs were removed sequentially from pairs until 5-15 had been collected. This project was originally begun by R. Fyfe, H. Armbruster and U. Banasch doing field work. P. Trefry along with H. Trefry did the husbandry. Later, H. Armbruster was more involved. This project is to be curtailed in 1996.

By 1980, the Peregrine Fund produced about 250 Peregrines per year at the Cornell and Fort Collins, Colorado, facilities combined. Production was managed by J. Weaver, J. Barclay, W. Heck and V. Hardaswick at the former project, and by W. Burnham, D. Konkel and C. Sandfort at the latter. The Fort Collins facility moved to Boise, Idaho, in 1984. By 1990, annual

production exceeded 300 young at the Boise and Cornell facilities combined. Unlike most of the young produced by the other major facilities, non-native adults were often used at Cornell, including birds from the North American Arctic, South America, northwest Pacific islands, Europe and Australia.

The SCPBRG reached a production of 40-50 young per year 1984-93, but also successfully hatched and reared up to 43 young per year from eggs taken as first clutches from wild pairs. In all, 333 wild-bred young were released by the SCPBRG in this way.

Releases to Build Populations

Figure 1 shows releases of captive-bred Peregrines in North America excluding captive reared young from eggs taken from wild pairs. Releases peaked at about 500 per year in 1987-88, and are likely to become insignificant after 1997. Table 2 shows the cumulative releases of Peregrines in southern Canada and the United States. About 500 of the total of 6,116 were young from wild-laid eggs hatched by the projects. The first releases were in 1974 when two Peregrines were fostered to a wild pair in Colorado. In 1975, Peregrines were placed at hack sites in Maryland and New York; these were the first birds intended to restore the extirpated population in eastern North America.

Birds were released by hacking, where young learn to fly and hunt while under the care of concealed attendants, or by fostering to wild pairs of adults kept attentive by dummy eggs replacing original clutches. Rarely, Prairie Falcons *Falco mexicanus* were foster parents. Fostering was used sparingly in the East; but 279 young were fostered to Peregrines and 109 to Prairie Falcons in California (Kirven & Walton 1992). In Colorado 177 were fostered (G. Craig, pers. comm.). Hacking was done from cliffs, specially built towers on the eastern coastline, in Utah and Montana. Many were hacked from buildings, especially in eastern and midwestern Canada and United States.

Techniques for hacking were reviewed by Sherrod *et al.* (1982), a manual now in a third edition. Fostering of three-week old young, when dummy eggs were removed, nearly always resulted in immediate acceptance by adults. The success rate for hacking has generally been about 80%, measured by the proportion of young that become independent of food supplied by attendants (W. Heinrich, pers. comm.). However, the success of fostering was measured by the proportion of young placed in eyries that actually fledged, not those that gained independence.

By 1980, over 600 Peregrines had been released in temperate North America (Table 2). Of these, about 55% were in the east. By 1985, total releases had increased almost four-fold.

Figure 1. Releases of captive bred Peregrines in North America.

The last three data points are projections from 1995 onward based on reduced production of the ageing breeding stock at The Peregrine Fund in Boise, and on the scheduled closure of the Canadian Wildlife Service at Wainwright, Alberta, in 1996. Not included here are about 500 young hatched from eggs collected from wild Peregrines.

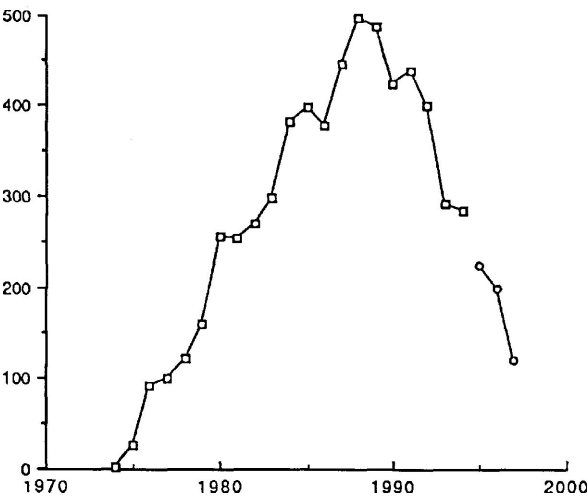


Table 2. Approximate numbers of cumulative releases of captive-bred Peregrines by the major projects in temperate North America

Region	Cumulative releases to year shown		
	1980	1985	1994
Canada¹			
Southeast	78	272	817
Prairies ²	132	281	619
United States			
East	273	752	1,229
Midwest	0	102 ³	729
West	<u>158</u>	<u>913</u>	<u>2,722⁴</u>
Totals	641	2,320	6,116

¹ Does not include about 45 releases in northern Canada.

² Alberta, Saskatchewan, Manitoba

³ through 1986

⁴ includes about 500 young reared from eggs taken from wild pairs.

Releases mainly ceased in the eastern United States after 1990, and were greatly reduced in the Midwest after 1992. No releases were made in Colorado after 1990 (G. Craig, pers. comm.) and none in California after 1992. Most releases in Canada, between 88 and 115 each year, were mostly

in Alberta and Ontario after 1991. The Peregrine Fund focused recent hacking in the northern tier of western states. Much of that effort is scheduled for curtailment after 1995. In Canada, few releases are planned after 1996. It is unlikely more than 500 additional Peregrines will be released in the future prior to termination of significant attempts to augment the wild population.

Effects of Releases

Prior to releases, no pairs were known to remain in southeast and prairie Canada, or in the eastern and Midwestern United States. Also, none remained in Idaho, Montana and Wyoming. In these states, 62 pairs were present in 1994 after 832 were released through 1992. No doubt some of these re-established pairs owe their existence to natural reproduction. Immigration was verified for one bird (W. Heinrich, pers. comm.).

In the Midwest, 667 Peregrines were released by the MPFRP through 1992. In 1994, 55 pairs were found on territory. The opportunity for immigration was probably not great and most territorial pairs were unlikely to avoid detection (P. Redig and H. Tordoff, pers. comm.).

In the East, 1,229 Peregrines were released through 1992. About 104 pairs were present in 1994 (T. Cade, pers. comm.). In southern Canada, about 1,300 Peregrines were released through 1992; 41 pairs were counted on territory in 1994.

Overall, total pairs counted on territory grew markedly after 1980. In 1980, about 200 pairs were known from mid-latitude Canada to interior Mexico. The count increased to 439, 698 and 1,001 in 1985-86, 1990 and 1994, respectively (Enderson *et al.* 1995). Count increases were surely due to actual population increases and to increased search effort. Most fascinating was the colonization of cities. In 1994, about 90 pairs of urban Peregrines were in the United States and southern Canada (Cade *et al.*, in press).

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