Worldwide review of reintroduction programs of birds of prey

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Order FALCONIFORMES

ID	Common Name	Scientific Name
Family CATHARTIDAE		
01	California Condor	*Gymnogyps californianus*
02	Andean Condor	*Vultur gryphus*
Family PANDIONIDAE		
03	Osprey	*Pandion haliaetus*
Family ACCIPITRIDAE		
04	Red Kite	*Milvus milvus*
05	White-tailed Eagle	*Haliaetus albicilla*
06	Bald Eagle	*Haliaetus leucocephalus*
07	Bearded Vulture	*Gypaetus barbatus*
08	Egyptian Vulture	*Neophron percnopterus*
09	Griffon Vulture	*Gyps fulvus*
10	Eurasian Black Vulture	*Aegypius monachus*
11	Cape Vulture	*Gyps coprotheres*
12	Crested Serpent-eagle	*Spilornis cheela*
13	Crested Goshawk	*Accipiter trivirgatus*
14	Harris´ Hawk	*Parabuteo unicinctus*
15	Northern Goshawk	*Accipiter gentilis*
16	Harpy Eagle	*Harpia harpyja*
17	Spanish Imperial Eagle	*Aquila adalberti*
18	Golden Eagle	*Aquila chrysaetos*
19	Crowned Hawk-eagle	*Stephanoaetus coronatus*
Family FALCONIDAE		
20	Lesser Kestrel	*Falco naumani*
21	Mauritius Kestrel	*Falco punctatus*
22	Aplomado Falcon	*Falco femoralis*
23	Orange-breasted Falcon	*Falco deiroleucus*
24	Lanner Falcon	*Falco biarmicus*
25	Peregrine Falcon	*Falco peregrinus*

Order STRIGIFORMES

ID	Common Name	Scientific Name
Family TYTONIDAE		
26	Barn Owl	*Tyto alba*
27	African Grass-Owl	*Tyto capensis*
Family STRIGIDAE		
28	Eastern Screech-Owl	*Otus asio*
29	European Eagle Owl	*Bubo bubo*
30	Ural Owl	*Strix uralensis*
31	Eurasian Pygmy Owl	*Glaucidium passerinum*
32	Little Owl	*Athene noctua*
33	Elf Owl	*Micrathene whitneyi*
34	Burrowing Owl	*Athene cunicularia*

Table 1. List of species of birds of prey involved in reintroduction and/or reinforcement programs around the world, ordered taxonomically and with common and latin names

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Introduction

Recently, the number of reintroduction programs has increased in the framework of active recovery of endangered birds of prey. These long-lived birds play an important role as top consumers and are a clear example of flag species. However, information still lacks about development and final outcomes from this kind of projects Thus, we conducted a global comprehensive survey of release programs of raptors in order to review the methods and biological traits associated with those projects

Methods

We reviewed peer-reviewed papers, technical surveys and official web sites dealing with wildlife reintroductions in order to compile all the information related with translocations of birds of prey until 2007. A data base was produced taking into account multiple variables (specific, taxonomic, spatial, temporal, methods, etc.) to be analyzed subsequently. The present results should be considered as preliminary outcomes since the information is still being updated.

Results

- 156 reintroduction/reinforcement programs of 34 species of birds of prey (Tab. 1) were recorded (6 programs still at viability analysis stage)
- Marginal differences were found between Falconiformes and Strigiformes in relative number of species involved in release programs (One-side Diff. Test, p = 0.0539), though the proportion of endangered species was the same (15.3%) in both taxons (IUCN List)
- Mean number of release programs per species was more than doubled in Falconiformes than in Strigiformes (5.4 vs 2.3 prog./sp.)
- More than 50% of the reintroduction programs were conducted only on five Falconiformes species. In particular, the most outstanding species were the Peregrine Falcon (19.2%) and the Bald Eagle (12.2%), both involved in long-term reintroduction projects in U.S.A. Large European vultures (Griffon Vulture, Bearded Vulture) and Osprey were also remarkable cases
- 91% of the programs were performed in Europe and North-America
- We found 27 countries with at least one reintroduction project. Mean number of reintroductions per country was 5.9 (N=27; Range: 1-60). U.S.A. was the country with the highest number of reintroductions (N=60)
- Most of the programs started after 1980, with maximum at the beginning of XXI c. (Fig. 1). Mean length of the projects was 9.1 years (N=64; Range=3-22)
- Mean total number of released birds per program was 140.3 (N=42; Range=12-1500) with a release rate of 15.6 birds/year (N=42; Range=2.1-68.1). Despite the lack of available data, almost all released birds were young and only in two programs adult birds were released together with young
- Other ecological differences according to diet, breeding behavior and spatial/temporal strategy were detected (Fig. 2)

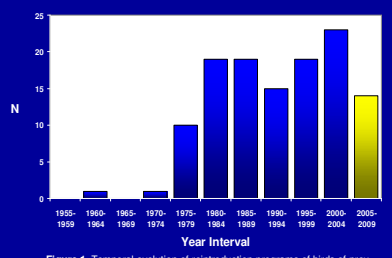
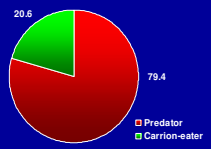


Figure 1. Temporal evolution of reintroduction programs of birds of prey. Number of started programs (N=64) classified into 5-year intervals is shown. 2005-2009 interval has been included though it is not complete (remarked in yellow)



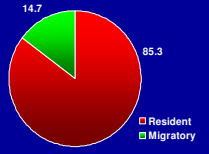
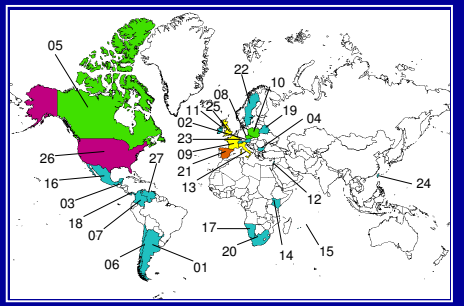


Figure 2. Up-left: Percentage of reintroduced species according to feeding behavior (predators vs carrion-eaters). **Down-left:** Percentage of reintroduced species according to breeding behavior (territorial vs colonial). **Down-right:** Percentage of reintroduced species according to spatial-temporal strategy (resident vs migratory)



ID	Country	ID	Country
01	Argentina	15	Mauritius
02	Austria	16	Mexico
03	Belize	17	Namibia
04	Bulgaria	18	Panama
05	Canada	19	Poland
06	Chile	20	South Africa
07	Colombia	21	Spain
08	Czech Republic	22	Sweden
09	France	23	Switzerland
10	Germany	24	Taiwan
11	Ireland	25	U.K.
12	Israel	26	U.S.A.
13	Italy	27	Venezuela
14	Kenya		

Figure 2. Spatial distribution of reintroduction programs around the world. In the table are listed all the countries recorded with at least one release project. The number correlates the country name with its geographical location on the map. Colors show the number of reintroduction programs per country:
0-4 5-9 10-14 15-19 20-24 25-29 ≥30

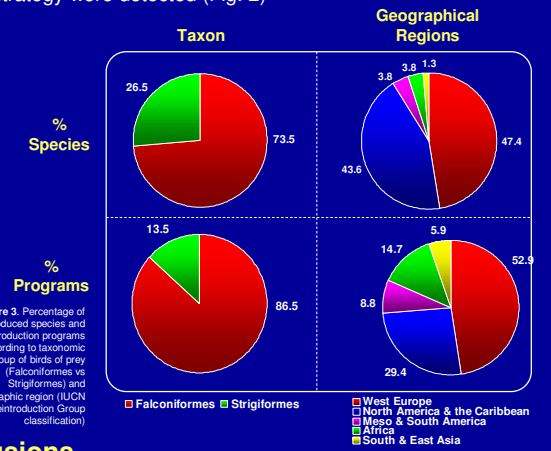


Figure 3. Percentage of reintroduced species and reintroduction programs according to taxonomic group of birds of prey (Falconiformes vs Strigiformes) and geographic region (IUCN Reintroduction Group classification)

Conclusions

- Since 1980, birds of prey, in particular Falconiformes, have received increasing attention in those countries where Cons. Bio. has developed
- Lack of non-biased published data about final results of reintroductions
- Medium-large size species with lower recovery capacity owing to slow dynamics are especially vulnerable. Therefore, long-term programs, habitat quality and demographic traits (survival/productivity) should be considered to assure success
- More multi-specific based studies are necessary to improve overall understanding of biological processes underlying reintroductions