

CONSERVATION STRATEGIES FOR THE RECOVERY OF THE BEARDED VULTURE IN NORTH-EASTERN SPAIN DURING 1998-2000

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Introduction

Seven main subjects have been addressed by the Spanish project (LIFE98 NAT/E/005296 / D.G.A.-Regional Government of Aragón):

1. Demography of the Pyrenean Population.
2. Toxicological assessment.
3. Infertility causes.
4. Mortality causes.
5. Supplementary feeding.
6. Avoidance of hunting disturbance.
7. Public awareness.
8. Population trends in Europe: Future perspectives - Possible management applications to the conservation of the Union's two island populations.

Demography of the Pyrenean Population: 1998-2000

The aim of the demographic analysis has been to use available population data to estimate demographic parameters and to ascertain their relative importance for population growth, to provide guidelines for population conservation.

Demographic parameters of the Pyrenean population

The main European population is located in the Pyrenean range. Its demographic traits in 1999 were:

- adult population size: 94 pairs,
- preadult population size: 160 birds,
- productivity: 0.47 fledglings / territorial pair,
- population growth: 5%,
- adult survival: 95%, and
- preadult survival: 66%.

Population size and reproductive success in Aragón

The population in Aragón represents about half of the Pyrenean population. It is also the demographically more productive subpopulation contributing about two thirds of the fledglings (65.9 % of the Pyrenean recruitment).

Its demographic traits in 1999 were:

- 46 territorial pairs;
- 29 fledglings,
- productivity: 0.69 fledglings / territorial pair.

In the year 2000, the population estimate is 52 territorial pairs, and a population growth of 13% (more than twice the mean number estimated for the whole Pyrenees). The long-term conservation actions, already initiated during the previous LIFE project, are considered the key determinants of the population growth in this region.

Marking Program 1998-2000

Survival estimates and population size are considered important parameters in understanding population dynamics and in identifying particularly vulnerable age groups. Bird marking and monitoring appears to be the only practical method to estimate survival rates and population size of non-territorial birds.

For this reason, since 1994, 53 juvenile and subadult birds were tagged (radio-transmitters and wing bands) and regularly monitored by periodic censuses and telemetry. During 1999 and 2000 we have marked 11 and 10 birds, respectively.

Monitoring of marked birds

During 1999, 294 observations and 161 radio-locations of marked birds have been obtained in the Pyrenees. Aerial radio-tracking have been specially important for obtaining regular locations. From 1998 to 2000, a total of 15 radio-tracking flights covering 9,150 km yielded 148 radio-locations.

The main result of this monitoring is that the subadult birds (4-6 years old) have relatively high mortality and wider movements than the other birds.

Satellite tracking of subadult Bearded Vultures

In spite of the interest in monitoring this vulnerable age group, the conventional tracking gave rather imprecise results about their seasonal movements and tempo-

rary settlements.

For this reason, two subadult birds have been equipped with transmitters that use the ARGOS satellite location system. The main results obtained from the first bird (ring number:12,012) are:

- 5 years old bird,
- 8 months tracking (January-September 1999),
- 46 locations (1 location every 6 days),
- minimum convex polygon home range was 3,854 km²,
- seasonal pattern of space use, and
- the tracking ended prematurely by an electrocution accident.

The results obtained until now from the second bird (ring number:12,034) are:

- 6 years old bird,
- 3 months (April-July 2000),
- home range: 4,230 km²,
- 8 locations (1 location every 12 days),
- seasonal pattern of space use, and
- expected tracking duration: 2 years.

Toxicological Assessment of the Pyrenean Population: 1997-1999

LVFS. Laboratorio Forense de Vida Silvestre.

DGA. Regional Government of Aragón.

FCQ. Spanish Foundation for the Conservation of the Bearded Vulture.

Chemical contamination is of concern for Bearded Vulture conservation because of its high position in the food chain. For this reason, we examined environmental contaminant levels in samples from the Pyrenean and Corsican populations.

Organochlorine and PCBs contamination

Organochlorine insecticides and PCBs have been identified as one of the main threats to raptors and to other wildlife. These stable compounds affect raptor populations through magnification in the food-chain, and can increase mortality from acute poisoning, and, more often, can have adverse effects on raptor breeding. At sub-lethal levels they may produce shell-thinning and egg breakage.

The Bearded Vulture diet, based mostly on herbivorous mammals, has not a great potential for magnification of the residue levels of these pesticides, however very low levels of only a few parts per million (ppm) in tissues can impair breeding in

other raptorial birds. For this reason, the prevalence of organochlorine compounds was determined in different tissues from 35 birds and 10 eggs.

Materials

Pesticide levels were determined in:

- 13 birds from Pyrenees (1986-1998),
- 2 birds from Corsica,
- 6 eggs removed from nests after breeding failure,
- eggshell fragments from Corsica (Tartagine nest, 1999), and
- 20 blood samples from marked birds (1995-1999)

Methods

Using gas chromatography/mass spectrography we analysed the levels of:

- 9 polychlorinated biphenyls (PCBs),
- 19 organo-chlorines:

α -HCH	Dieldrin	op'-DDE
β -HCH	Aldrin	pp'-DDE
γ -HCH	Endrin	op'-DDD
δ -HCH	Oxichlordane	pp'-DDD
Hexachlor bencene	α -endosulfán	op'-DDT
Heptachlor	β -endosulfán	pp'-DDT
Heptachlor epoxide		

Results

- Low levels of organochlorine pesticides and PCBs in all samples (tissues and eggs).
- DDE levels below 5 ppm (ww) in egg samples.

Conclusions

Pesticide levels found in samples from the Pyrenean and Corsican populations are lower than the critical threshold in raptors. Therefore, no contaminants were present at concentrations that might cause mortality or impair reproduction.

Lead contamination

Lead (Pb) poisoning, through the ingestion of gunshot, has been recognised as an important cause of mortality in several wild birds, and a major threat to very endangered species such as the California condor (*Gymnogyps californianus*).

Bearded Vultures are at risk of lead (Pb) toxicosis because of the shot imbedded in some of their prey. For this reason the prevalence of lead was determined in different tissues from 63 Pyrenean Bearded Vultures and 1 from Corsica.

Materials

Levels of lead were determined in:

- 44 blood samples from marked birds (1993-1999),
- levels in liver: 9 dead birds (2 nestling, 1 subadults and 6 adults),
- levels in bone: 19 dead birds from Pyrenees (3 nestling, 5 juveniles, 2 subadults and 6 adults) and 1 dead bird from Corsica.

Methods

Lead levels were measured by atomic absorption spectrometry.

Results

Blood samples:

- low levels
- mean: 0.0445 ± 0.07 ppm ww; range: <0.02 - 0.47 ppm
- only one bird found over the toxicity threshold
- nestlings showed lower lead levels than older birds

Liver samples:

- low levels
- mean: 1.79 ± 1.55 ppm ww; range: <0.25-4.02 ppm

Bone samples:

- low levels
- mean: 2.127 ± 0.95 ppm ww; range: <0.45-4.02 ppm
- Corsican bird: 1.79 ppm dw

Conclusions

- Lead levels below the toxicity thresholds with the exception of one individual with high residues in the blood.
- Although lead levels are low they indicate incidental exposure through the ingestion of shot imbedded in the prey.
- The possibility of high sensitivity to the toxic and direct mortality of birds could not be ruled out. Local mortality in areas not sampled is also possible. For this reason, we recommend periodic monitoring in Bearded Vulture populations for early detection of lead before negative effects on survival occur and managers give priority to reduce Pb shot use at species' distribution areas.

Infertility Causes

Egg infertility was studied through eggshell structure and composition analyses.

Materials

The eggshell fragments used come from:

- 26 Pyrenean eggs (1990-1999),
- 4 Corsican eggs (1998-1999), and
- 8 eggs from museum collections and collected in the Pyrenees between 1868 and 1907, before the use of pesticides.

Methods

The eggshell morphology and structure was studied by scanning electron microscopy, and the composition was measured by Energy-Dispersive X-Ray Analysis (EDAX).

Results

- The morphometric parameters studied were in the range found in the museum eggs. No significant differences between current and old eggs in thickness (Fig.1) and structure.
- Absence of eggshell thinning and other alterations produced by organochlorine pesticides.

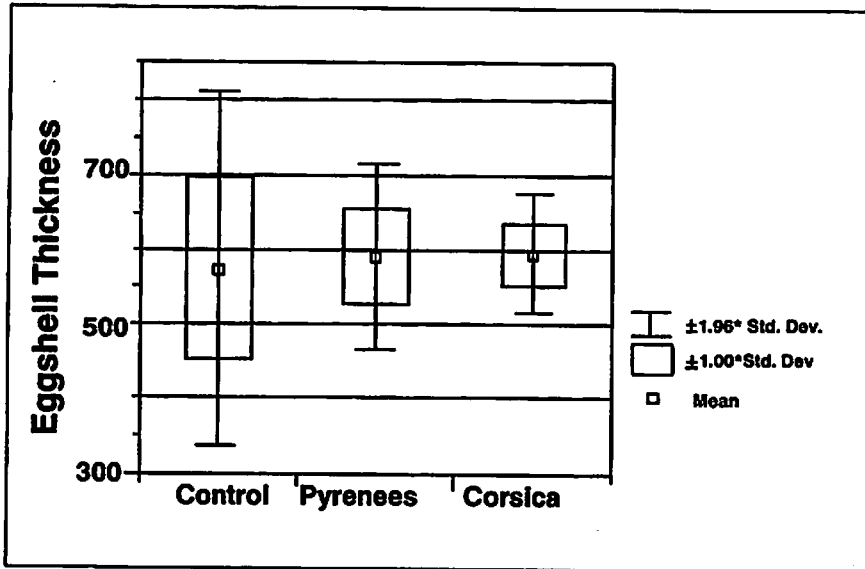


Figure 1. The morphometric parameters studied were in the range found in the museum eggs. No significant differences between current and old eggs in thickness and structure.

Mortality Causes

The reported mortality causes in the Pyrenean population from 1990 to 2000 were:

		%
Poisoning	7	46.6
Shooting	3	20.0
Collision	1	6.7
Electrocution	2	13.3
Natural	1	6.7
Unknown	1	6.7
TOTAL	15	100.0

From 1994 to 2000, telemetric tracking of 53 preadults yielded not biased data confirming that poisoning is the main mortality factor of the species. The toxic chemicals involved in the found poisoning causalities were: warfarin (1994), strychnine (1995), aldicarb/carbamats and 4 cases of strychnine (1997).

Supplementary Feeding

Supplementary feeding is considered responsible for the high juvenile survival through avoiding both food shortage and poisoning. In addition, it is a relatively inexpensive managing technique.

For these reasons, supplementary feeding is carried out throughout all its Pyrenean distribution area. During 1998 and 1999, 9 sites have been regularly supplied in Aragón with an average of 1,176 kg/year provided in each one of the sites. Three of the supplementary feeding points have been installed in the Iberian Ranges, located south of the Pyrenees, in order to help the species to expand.

Avoidance of Hunting Disturbance

This action consisted in mapping the Bearded Vulture sensitive breeding areas located inside private hunting grounds, and suspending hunting from these sites during the critical periods. Thus, during 1998-1999 hunting was banned from part of 14 hunting reserves, and during 1999-2000 from 17 hunting reserves.

Public Awareness Campaign

Two main actions have been carried out:

- Preparation and incorporation of a specific Bearded Vulture exhibition for viewing at the Information Centre in the Central Pyrenees (Aínsa) that during 1999 attracted 37,000 visitors.
- Lectures in schools located near or in the species distribution range (4,000 school pupils involved).

Population Trends in Europe - Future Perspectives and Management Applications to the Conservation of the EU's Two Island Populations

The European population of the Bearded Vulture has suffered a very severe decline during the last two centuries, having disappeared in much of its former range (Alps, Balkans, Carpathians, Cyprus and Sicily). Despite the EU conservation efforts in the last decade, this decline has continued in most of the remaining populations. As a result, the continental Greece population has very recently become extinct, and the Cretan and Corsican populations are under such grave threat that they should be considered on the brink of extinction. The Pyrenees support the EU's largest population (73% of the EU birds), and is unique in showing a positive trend.

The available field data clearly show the negative trend in the insular populations:

- Last censuses of territorial pairs show a decrease in both populations.
- The populations decline mostly because of the failure of recruitment to compensate for the annual adult mortality. After 15 years of dramatic decline, the reproductive rate has now become extremely low in both populations. As in any stable population the birth rate must equal the dead rate, the current low recruitment

(number of fledglings) in both islands may not be able to compensate average mortalities over 2-2.5%, which is an overly optimistic expectation. Therefore, it may not be possible to reverse this decline under the current breeding and adult mortality conditions.

- The recent formation in both populations of several new pairs with preadult birds reflects the present scarcity of adult floaters.

The already extremely low numbers of birds existing in both islands imply that a population crash may be imminent and that there is an urgent need for active management that minimises the risk of extinction.

The implementation of immediate management measures as well as the monitoring of the population are necessary to recover the island populations and to ensure their long-term persistence. These measures may be based on the following actions that successfully have been applied in the other populations.

1. Identification and monitoring of the main mortality factors.

1.1. Marking and radiotracking of nestling:

- 1.1.1. collection and analysis of blood samples,
 - 1.1.1.1. toxicological assessment,
 - 1.1.1.2. assessment of genetic variability and relationships,
 - 1.1.1.3. molecular sexing.

1.2. Collection and analysis of Bearded Vulture remains.

1.3. Monitoring of the mortality factors in surrogates.

2. Identification and correction of the factors that are limiting the potential for increase.

2.1. Identification of the major causes of breeding failure:

- 2.1.1. monitoring of nests with repeated failures,
- 2.1.2. collection and analysis of eggshell fragments.

2.2. Enhancement of the wild breeding:

- 2.2.1. clutch rescue of nests with repeated failure,
- 2.2.2. captive rearing by foster parents,
- 2.2.3. release of captive-reared birds using adapted 'hacking' techniques.

3. Assessment and improvement of the supplementary feeding.

4. Ex situ conservation of the last birds remaining in mainland Greece. The very few birds remaining in the Balkans have virtually no potential for a population recovery, even if immediate conservation action is taken. The maintenance and captive breeding of these birds may be of special interest for future reinforcement of the genetically closely related Cretan population.

5. Expertise in field techniques.

- 5.1. Identification of age groups and plumages.
- 5.2. Census methods for the non-territorial population.

Most of the proposed actions are usually applied to the Pyrenean population and are based on experiences gained from the previous LIFE project (1993-1998). One important objective of the current Pyrenean project is sharing the current experience on species management with the three other projects in Europe targeting Bearded Vulture conservation. In addition to the exchange of experiences and information in the workshops, specific technical collaboration is already being carried out in several of the proposed conservation actions: analysis of eggshell fragments and toxicological analysis of remains. Finally, technical assistance is available on the measures tested in the Pyrenees and that have not yet been undertaken in the other projects: marking and radiotracking of nestling, collection and analysis of blood samples, monitoring of the mortality factors in surrogates, monitoring and clutch rescue of nests with repeated failures, artificial incubation, release of captive-reared birds, and assessment and improvement of the supplementary feeding.

