REINTRODUCTION OF THE OSPREY

(*Pandion haliaetus*)

IN PORTUGAL

Annual Report 2011

December 2011

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PARTNERS AND SUPPORTS

The osprey reintroduction project had the partnership and support of the following entities:

Häme Centre for Economic Development, Transport and the Environment, Finland

Pirkanmaa Centre for Economic Development, Transport and the Environment, Finland

Finnish Museum of Natural History

Finnish Osprey Foundation

Swedish Environment Protection Agency

Swedish Museum of Natural History

Swedish Society for Nature Conservation

SAIP - Sociedade Alentejana de Investimentos e Participações, SGPS, SA.

ICNB – Instituto da Conservação da Natureza e da Biodiversidade

TAP – Transportes Aéreos Portugueses

EDIA - Empresa de Desenvolvimento e Infra-estruturas do Alqueva, S.A.

Veterinarian Hospital of the Évora University

Wild Fauna Hospital of GREFA, Madrid, Spain

Ministerio de Medio Ambiente y Medio Rural y Marino, Spain

Oceanarium of Lisbon

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Summary

The Osprey (*Pandion haliaetus*) reintroduction project in Portugal started in 2011 in the Alqueva dam. The aim is establishing a founder population, which ultimately may help out the re-colonization of the maritime coast, the historical breeding range of the species in Portugal, where the species got extinct as a breeder at the turn of the present century.

With that purpose, 10 nestlings were translocated from Sweden and Finland to a hacking tower at the shore of the Alqueva dam where they completed growth. The site is located within the Roncão estate, which belongs to the SAIP Company. The fledglings were released 22 days later, after being equipped with VHF radiotags.

After being released, the fledglings stayed c. 44 days around the release area, with increasing dispersive movements until the onset of migration, which seemingly occurred at the same time for all birds with one single exception. Although the latter was the first bird to start exploratory flights, it remained in the area for another 8 days.

The birds were primarily fed on exotic fishes from the very dam, having consumed around 30kg of fish (mainly Goldfish *Carassius auratus*) while in the tower, and around 97kg (mainly Goldfish and Common bleak *Alburbus alburnus*) after being released.

We had the following incidents:

a) During captivity in the hacking facilities, one bird suffered a lesion on the tibiotarso-tarsometatarsal joint and was transferred to the GREFA (Grupo de Reabilitación de la Fauna Autóctona y su Hábitat) veterinarian hospital in Madrid, where he was submitted to physiotherapeutic and chirurgical treatment until the outcome of its death on the 18th December 2011 through hypovolemic shock of hemodynamic disturbance origin. A second bird showed intense stressful reaction to captivity, which included pterotillomaniac behavioural disorder, resulting in the plucking of all tail feathers.

b) After release, a totally unexpected event occurred; two of the fledglings were predated by resident foxes. The cause of the death was determined by observation of the chewed up rachis base of the feathers, and the deposit of fox faeces and the intense fox smell at the site.

No further relevant negative events are to be reported, either during the captive or the post-release phases.

1. Introduction

The project aims at the reintroduction of the Osprey (*Pandion haliaetus*) to Portugal as a breeder. It is an initiative of CIBIO (Research Centre in Biodiversity and Genetic Resources) with the funding of EDP (Energias de Portugal) and the institutional collaboration of ICNB (Nature Conservation and Biodiversity Institute). Ultimately, the project seeks the re-establishment of an osprey population in its historical range along the Portuguese coastline, from where it disappeared as a breeder at the beginning of the 21st century.

The project integrates the international efforts for the recovery of the Osprey in the Mediterranean region, where its populations are presently very small and endangered. With that purpose, during the next 5 years, 10 nestlings will be translocated annually from Sweden and Finland for hacking facilities at the Alqueva dam, near Monte do Roncanito within Roncão estate. The project strictly follows the national, international and donating countries' pertinent legislation.

The present report summarizes the methods followed and results obtained during the first year of young ospreys release in the Alqueva dam.

The project enjoyed the collaboration of SAIP (Sociedade Alentejana de Investimentos e Participações, SGPS, SA) Company, owner of the Roncão estate, the Portuguese Air Company TAP, the Veterinarian Hospital of the Évora University, the Ministério de Medio Ambiente y Medio Rural y Marino of Spain and the Wild Fauna Hospital of GREFA in Madrid, Spain. It also had the collaboration of several individual volunteers.

2. Objectives

The general objective of the project is to achieve the re-establishment of a viable population of ospreys (*Pandion haliaetus*) in continental Portugal, with the purpose of favouring the expansion of the Mediterranean endangered Osprey population, thence reducing its risk of extinction. The ultimate goal is to rehabilitate the species along the Portuguese rocky coastline where there is historical breeding evidence, in the Sudoeste Alentejano e Costa Vicentina Natural Park in particular. With that in view, we intend to follow a stepwise procedure, in which the current phase applies to the establishment of a viable founder breeding population in an area with appropriate ecological conditions.

3. Preparatory tasks

3.1. Selection of the reintroduction site

The selection of the release areas must result from the evaluation of their suitability, namely in terms of potential risks, tranquillity, safety and prey availability (Casado, 1999). The choice of the first osprey release site was based on a previous evaluation of potential locations for the species reintroduction in Portugal (Dias et al., 2011).

A preliminary analysis showed that 11 areas were frequently used by wintering and migrating ospreys, so it was assumed that in general they might offer potential for the species reproduction (Fig. 1).

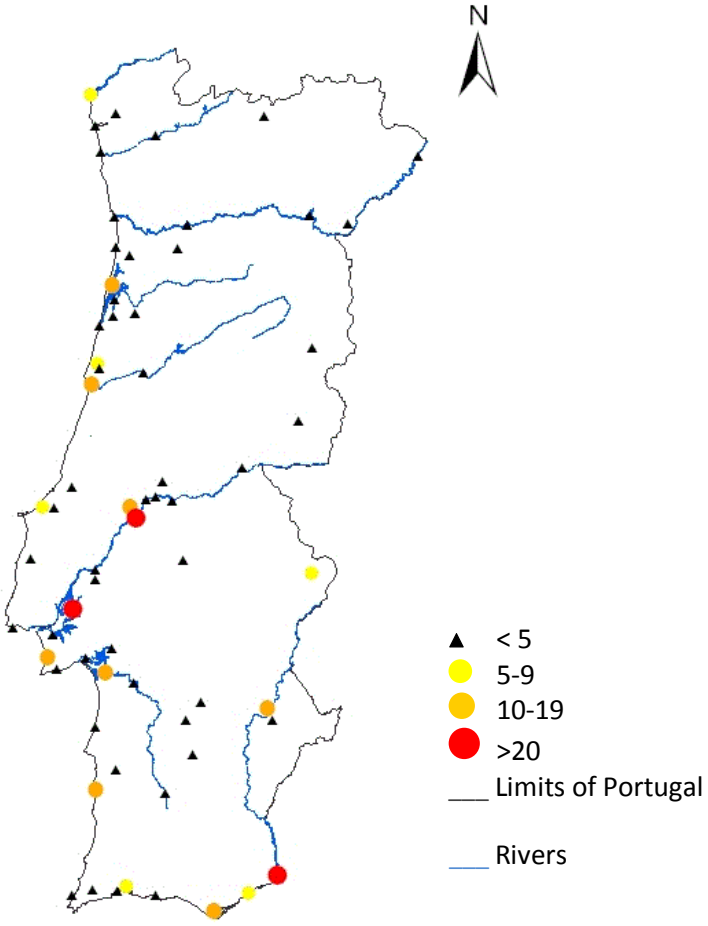

Figure 1 – Distribution of osprey (*Pandion haliaetus*) sightings in continental Portugal (1947-2010) (*Sources*: personal communications; census; ornithological newsletters (SPEA); ringing; www.avesdeportugal.info/).

However, only the Alqueva dam, the Tejo and Sado estuaries and the Ria Formosa marshes were strong candidates for the reintroduction of ospreys in the short and medium terms, due to a set of

basic conditions: (i) an extent of breeding and foraging habitat large enough to allow the settling of a viable founder population; (ii) high availability and good accessibility of prey to ensure a fair productivity of the breeding pairs; (iii) proximity of other areas adequate for breeding, allowing the expanding of the founder population; (iv) reduced or controllable threats and potential conflicts through relatively simple measures; (v) technical and logistic conditions favourable to the project's development.

From this analysis it came out that the Sudoeste Alentejano e Costa Vicentina Natural Park, from where the species disappeared more recently and could therefore be considered at first the most adequate area, may instead show problems related with: (i) high disturbance linked with recreational angling, hence calling for appropriate medium term management measures of the human access to potential nest sites during the critical periods of the breeding cycle, and/or the inducing of alternative nesting locations through the installation of artificial platforms in less conflictive areas; and (ii) limited access to prey caused by the recurrent maritime turbulence, which predictably may not assure a sufficiently high productivity of the founding pairs, even if this can be compensated by creating or rehabilitating small dams close to the shore as a complementary source of alternative prey (Palma, 2001; Cancela da Fonseca et al. 2011).

Ultimately, the reintroduction of the species in inland waters and estuaries is a strategy to facilitate the natural or assisted (by hacking) recolonization of the Portuguese rocky coast by ospreys. This initial reintroduction in distinct habitats from the rocky coast does not hinder its posterior recolonisation by the species, given the ecological plasticity shown by the species worldwide. In this context, the nesting preferences of the donor populations are irrelevant whatsoever as the nesting behaviour is acquired through imprinting at the final phase of the hacking process (Palma & Beja 1999).

By a more detailed analysis of the four more suitable areas, the Alqueva dam showed the best conditions for the establishment of a viable founder population in the short run: 1) high carrying capacity, with a large area of potential breeding habitat, and abundant and accessible prey; 2) much less human presence and activity than in the Tejo and Sado estuaries, and the Ria Formosa marshes, with presumably lower levels of threats and potential conflict linked with human activities (e.g. no fish farms) and therefore an easier implementation of the project in the short term; and 3) very favourable technical and logistic conditions, allowing the onset of the project in 2011 as planned,

whilst in the Tejo, Sado or Ria Formosa the existing local conditions would force the delay of the project start at least to 2012.

According to the results of the suitability analyses, is was assumed that the reintroduction project should start at the Alqueva dam, in a second phase at one of the remaining three candidate areas identified and later on at the Sudoeste Alentejano e Costa Vicentina Natural Park. The choice of a second release area should occur after the first year of the project, on the basis of a more detailed comparative analysis of the ecological, social, bureaucratic, administrative, technical and logistic conditions.

A large artificial lake such as the Alqueva dam may make up a suitable area for the re-establishment of a breeding population of ospreys. The same strategy was followed in Andalucia (Guadalcacín dam) in Spain and likely, taken its large extent, Alqueva dam may be more advantageous.

The Alqueva dam was built as a water reserve in the Alentejo region, and to supply water for irrigation and produce electricity (http://www.alqueva.com/; http://www.edia.pt). The dam covers 25 000 ha at its maximum height, being the largest in Portugal and the largest artificial lake in Europe. Because it is located in a relatively flat area, Alqueva dam has a rather jagged shoreline with above 1000km of perimeter (http://www.edia.pt).

As in other countries (Van Daele & Van Daele, 1982; Houghton & Rymon, 1997), dams can be important for osprey conservation for they increase food availability in a given region. Because of its large area, the Alqueva dam encompasses several safe and quiet places with good logistic conditions for a reintroduction project. Furthermore, direct observation and interviews with local fishermen let presume a high abundance of suitable prey.

Although neither being a natural habitat, nor a protected area, the Alqueva dam lies among the areas with a higher number of osprey sighting records (17). It occupies the 4th rank in number of sightings in the country despite the fact that the correspondent period of observation spans much less than in other areas. The dam started filling up only in February 2002 (Dias et al., 2011).

In spite of a few problems that may persist such as disturbance from nautical traffic, the Alqueva dam showed up as a very suitable place for the onset of the reintroduction program.

3.2. Supply of nestlings

Availability of donor populations

The minimum productivity needed for an osprey population being self-sustainable is 0.8 young/pair per year (Poole, 1989). In northern Europe and in some countries of central Europe there are large populations with an average productivity high above 0.8: Sweden with 3200 pairs and 1.4 young/pair (Saurola, 1997); Finland with 1200 pairs and 2.1 (Saurola, 1997); Germany with 450 pairs and 1.7 (Schmidt, 2001); and Scotland with 182 pairs and 1.4 (Dennis, 2004). Thus, removing some individuals each year cannot have negative effects upon any of these populations.

The donor populations that supported the reintroduction project in Andalucia are among the most suitable, according with their size and productivity: Finland, Scotland and Germany (Casado & Ferrer, 2004). The Spanish project largely benefitted from the international contacts set on within the context of the first reintroduction project prepared in Portugal (Meeting of European Experts, 1998). Therefore, as the Spanish project is currently approaching its end, the cooperation of some of the donor countries above could be reassigned to the Portuguese project as it is the case of Finland. Sweden, which holds one of the biggest osprey populations in the Palaearctic (3200 pairs; Saurola, 1997) joined next as a donor in the current phase of the project.

Genetic issues

Following the IUCN Position Statement on Translocation of Living Organisms (IUCN 1987), the animals to be reintroduced must be as far as possible genetically close to the extinct population. In the meeting of European osprey experts held in Portugal in 1998 (Meeting of European Experts, 1998), the German geneticist Andreas Helbig presented the results of a study based on mtDNA of ospreys from Germany, Scotland, Finland and the Balearic Islands showing no genetic divergence between populations of different origins. The only data available from ospreys of continental Iberia came from the female that died in the Sudoeste Alentejano e Costa Vicentina Natural Park in 1997. Its genetic analysis was done in Germany by two different geneticists, A. Helbig itself and Michael Wink. Again (Wink *et al*., 2004) no significant differences from birds of Corsica, Israel and Finland could be detected. The same applies for the Portuguese osprey in relation to other European populations (Wink *et al*., 2004; A. Helbig, pers. comm.)

With no significant divergence existing between the European and Mediterranean osprey populations (Wink *et al*., 2004), the translocation of individuals from any country in Europe can be carried out with no risk of genetic contamination. However, young from different countries should be used in order to enrich the genetic variability of the reintroduced population. Thus, nestlings born in European countries can be transferred to the Mediterranean region (Casado & Ferrer, 2008).

Furthermore, as the native Iberian population is now extinct, any reintroduction with birds of alien European origin can not cause any type of genetic pollution. Besides, as Spain has reintroduced the species with birds from 3 populations of northern and central Europe (Finland, Scotland and Germany) it is now irrelevant the geographic origin of the birds to be translocated to Portugal, provided they come from Western Europe.

Translocation agreements

Official agreements were established with the authorities of the donor countries. In the case of Finland the application was submitted to Jukka Airola (*Hämeen Environment Center*) and Ari Jokinen (*Pirkanmaan Environment Center*). The providing of 5-10 nestlings per year from 2011 to 2015 was authorized with the support of Pertti Saurola (*Finnish Museum of Natural History*). In Sweden the licence issued by the Swedish Environmental Protection Agency allows the collecting of 10 nestlings/year between 2011 and 2013 with the support of Björn Helander (*Swedish Museum of Natural History* and *Swedish Society for Nature Conservation*) and Peter Lindberg (*University of Gothenburg* e *Swedish Society for Nature Conservation*).

Scientific and technical support

The project counts on with the experience of several experts: Pertti Saurola, Finnish expert on ospreys, the raptor experts Peter Lindberg and Björn Helander from Sweden, Eva Casado e Miguel Ferrer (Doñana Biological Station and Migres Foundation) who have been responsible for the osprey reintroduction project in Andalucia, and Roy Dennis (Highland Foundation for Wildlife) who has been responsible for the osprey reintroduction in England as well as of the White-tailed and Golden eagles in Scotland.

3.3. Infrastructures

Location

The hacking facilities and release area are located in a narrow peninsula of the Alqueva dam in the Guadiana River valley in eastern Alentejo as it can be seen in the following maps.

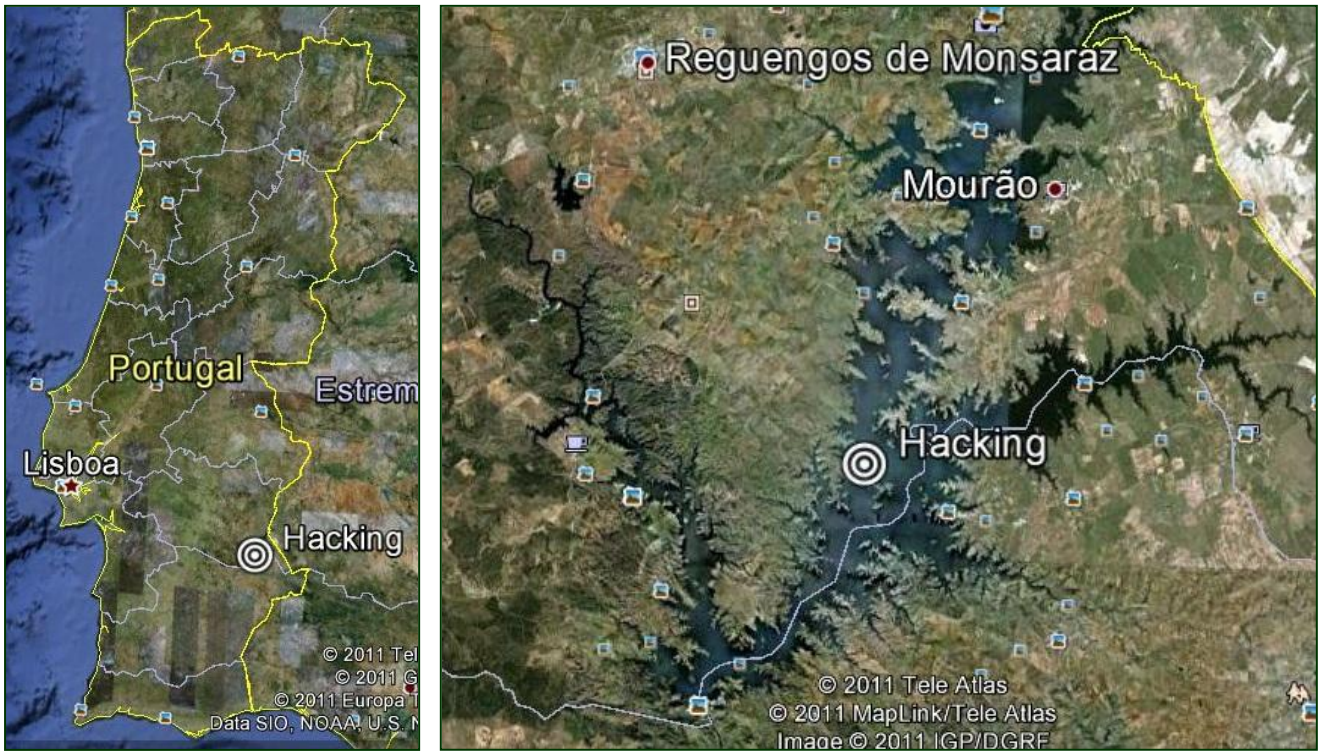

Figure 2 –Continental Portugal (A) and Alqueva dam (B).

Figure 3 – Google image of the osprey release area in the Alqueva dam (feeders A – H; artificial perches P1 – P9; hacking tower (*torre*), field base (*casa*) and floating fish cage (*jaula flutuante*).

Hacking tower

The hacking tower closely followed the one used in the Andalucia project (in Odiel, Huelva), which was previously visited by the Portuguese project team and the tower builder.

The tower is 5m tall (including the support poles), 2.2m wide and 8m long (c. 17 m^2). All but the rear wall are made of iron mesh allowing the free circulation of air and viewing of the surroundings. The rear wall is lined with plywood and has a door and two one-way crystal windows to allow the observation of the cage interior without the observer being seen by the birds.

The tower is divided in 4 pens, among which the nestlings are distributed. Food is provided through a hole with a plastic (PVC) tube. The front panel of each pen can be slowly and silently lowered with the aid of strings operated from behind the tower.

The hacking tower is located near the dam shore beside a group of Holm oaks that provide shadow from behind and is orientated northwards to minimize exposition of the young to high temperatures (Casado & Ferrer, 2004). For the additional mitigation of heat stress risk the roof was fully covered with palm fronds and equipped with an automatic water aspersion system, which allows an

immediate lowering of temperature inside the pens (Muriel et al., 2010). The system is water fed from the dam by an automatic pump and can be manually or automatically operated (by a thermostat calibrated for 25°C).

Figure 4 – Hacking tower near the dam shore. A – Front view with open panels; B and C – rear view; D – side view.

The pens possess a removable double floor to allow the removing of food remains and ease cleansing.

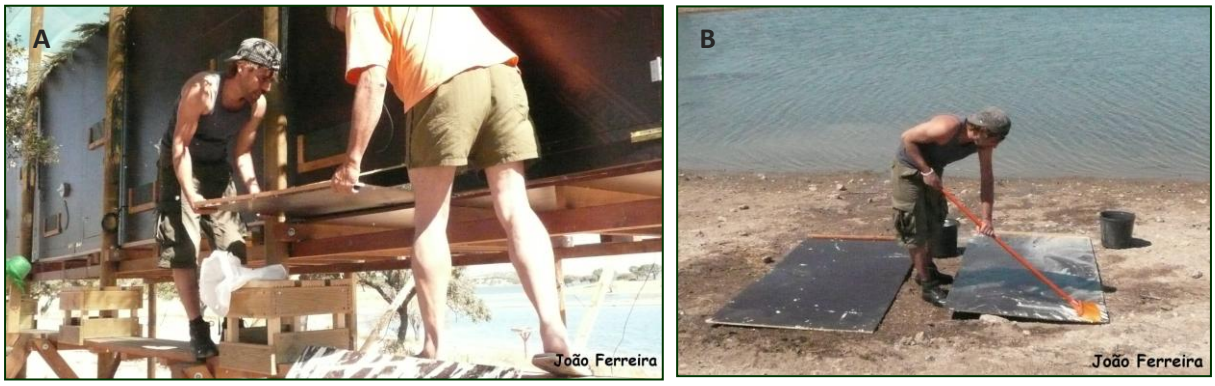

Figure 5 – Removal (A) and cleaning (B) of the removable double floor panels.

Inside each pen an artificial nest was built with wooden branches on an elevated structure. Thick cork oak logs were placed on the top of the nest to be used as perches.

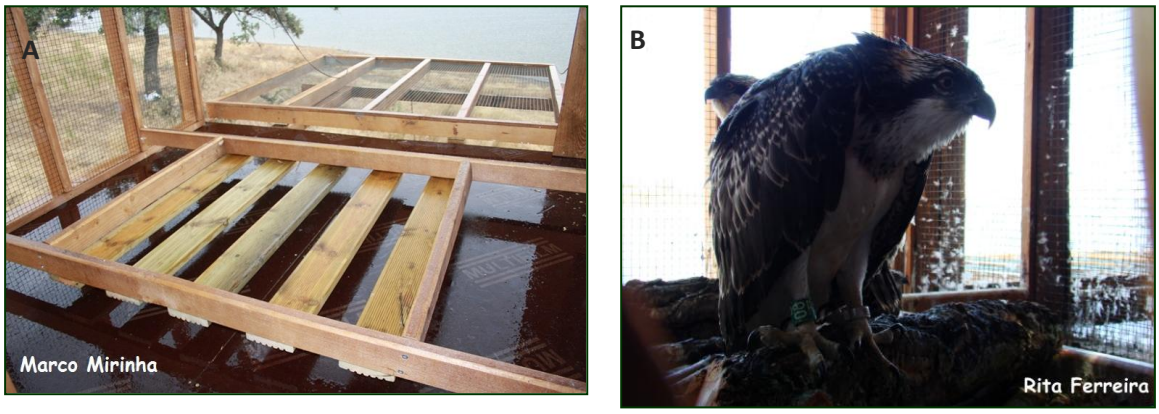

Figure 6 – Elevated artificial nest base inside the pens (A); log perches on the artificial nest (B).

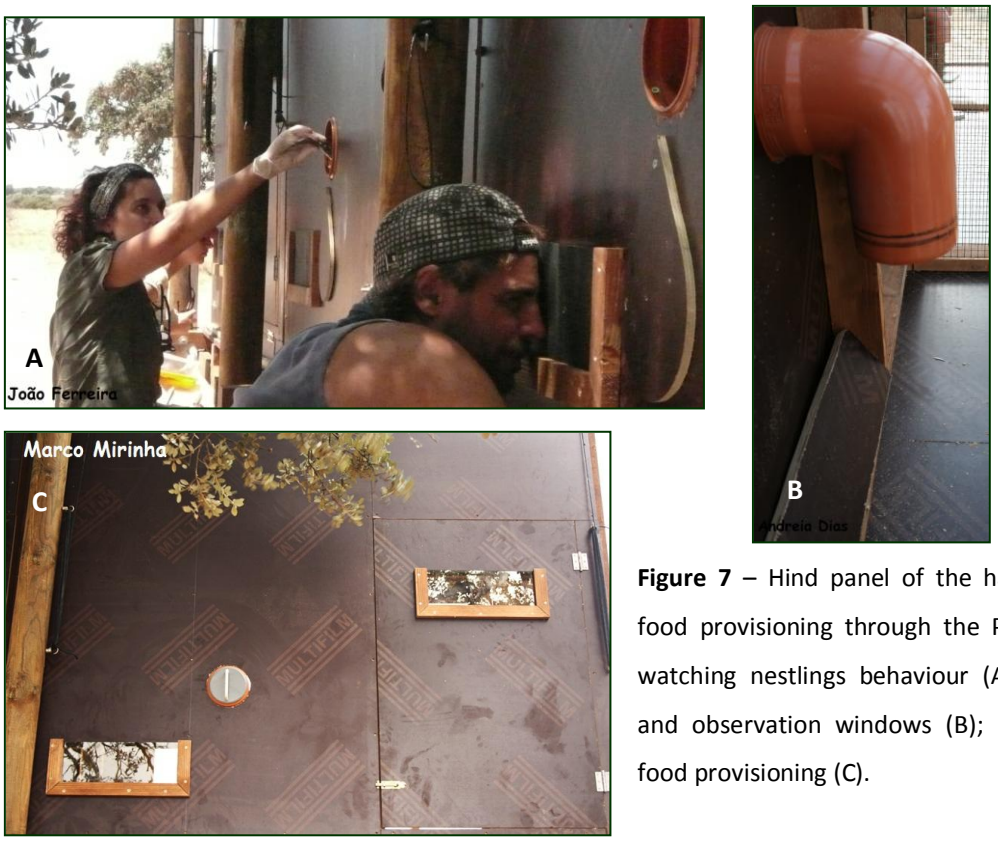

Figure 7 – Hind panel of the hacking tower: food provisioning through the PVC tube and watching nestlings behaviour (A); back door and observation windows (B); PVC tube for food provisioning (C).

At the back of the tower there is a boardwalk where the technicians can walk along, watch the nestlings and access the inside of the pens (Muriel *et al*., 2010).

All pens are equipped with video cameras linked by optical fibre to the field base house, where images can be viewed in a portable computer.

Monitoring

Nestling behaviour inside the pens was monitored through a CCTV system with colour video cameras (Fig. 8) and infrared night viewing, and through the one-way windows of the tower rear panel. The system is fed by the electric supply of the field base and the signal is received in the computer through optical fibre cable. Images are automatically stored in a digital recorder.

Figure 8 – Night viewing of a hacking tower pen.

Floating fish cage

The permanent supply of fresh fish for feeding the ospreys was assured by the keeping of live fish in a floating iron cage of 125x120x120cm at c.50m away from the dam shore (Figura 9). The cage was regularly supplied with Goldfish (*Carassius auratus*) and Carp (*Cyprinus carpio*) taken from the very dam. However, when there was a risk of stock collapse, the cage was restocked with live carp obtained at fishing contests.

Figure 9 – Floating cage for keeping live fish in the Alqueva dam.

Feeders

After release, food was provided upon the top platform of the feeders put in a row roughly in front of the hacking tower and near the shore. These wooden feeders are 1x1m square platforms held upon a 2m high pole. The platform surface is covered by artificial grass to help its cleaning. Eight feeders were set up under the principle of one feeder for each two birds.

Figure 10 – Platform for feeding the young after release.

Artificial perches

To make the perching and resting of the juveniles easier, especially in the first days after release, wooden artificial perches were erected. According to Muriel *et al*. (2010) these perches should be installed on the ground or on tree crowns and the recommended shapes are an inverted "L" or a "T". In Alqueva, 10 T-shaped perches were erected along the dam shore near the hacking tower, attached to dead Holm oaks.

Figure 11 – Setting up of an artificial perch at a dead Holm oak (A); two released juveniles using the same artificial perch (B).

Artificial nests

The most suitable of the many islands scattered throughout the dam were selected for the setting up of artificial nest platforms, in order to attract birds returning to the area and to speed up their settling down in breeding territories (Ferrer *et al*., 2003). Two platforms were already set up in two islands close to the release site and, shortly, more will be erected in other selected locations. The gradual putting in place of artificial nests will be in line with the return of potential breeders.

The bigger the nests the stronger the stimulation they exert on recruits to settle in (Muriel *et al.*, 2010). In our case, the metallic platforms are 1m wide and erected upon telescopic metallic poles up to 10m tall. The nest platforms are lined with fine broom branches (cf. *Retama sphaerocarpa*).

The use of artificial nest platforms was well succeeded in a range of other areas such as Corsica (Thibault & Patrimonio, 1989) and in the Balearic Islands (Triay, 1993).

Figure 12 – Transport of an artificial nest to be set up in an island.

Figure 13 – Setting up of an artificial nest platform attached to a Holm oak at the top of an island.

Figure 14 – Artificial nest erected on an island at the Alqueva dam.

Project field base

Part of a rural house at the *Monte do Roncanito* was restored as a field base to support the project logistics (e.g. lodging, food preparation, video vigilance…). The house is located close to the hacking tower and belongs to the SAIP Company who owns the area and provided all technical support to the house rehabilitation.

Figure 15 – Rehabilitation of a ruined house as field base of the reintroduction project – Monte do Roncanito.

Due to the relative remoteness of the release area, the field base required full autonomy of energy and water supply. Water is pumped up from the dam to a deposit where it is submitted to chemical treatment and filtering. All the energetic needs of the base are fulfilled by a photovoltaic system offered by the project's sponsor EDP. Sewage primary treatment is made in a septic tank on location.

Figure 16 – Photovoltaic panels of the solar energy system.

4. Reintroduction

In this section we describe the methods used in the translocation of the osprey nestlings from the donor countries to Portugal, as well as during their residence in the hacking tower and period of dependence until dispersal.

4.1. Collecting and transport of nestlings

Collecting

Both in Finland and Sweden, the nests from which the nestlings were to be taken were previously selected by or under the supervision of Pertti Saurola and Björn Helander, respectively. Broods with more than 2 nestlings were chosen, and looking in good condition to guarantee a higher probability

of survival. The nestlings were around 5 - 5 ½ weeks old according to feather development, an age when they can already feed by themselves (Casado et al, 2007).

Figure 17 – Pertti Saurola climbing to a nest in Finland to collect a nestling for translocation to Portugal.

After being collected, the young were injected with a mix of vitamine E and Selenium to reduce the chance of the deleterious effects of manipulation (capture myopathy). They were kept and fed in animal rescue centres until transportation to Portugal in plastic travel boxes.

Figure 18 – Nestling being force fed at a rescue centre after being taken from the nest.

All birds were ringed with official metallic rings of the donor countries on the left leg and with green PVC colour rings with white inscriptions on the right leg. The codes are the letter "P" (for Portugal) aligned horizontally and followed by 2 vertical digits, three times around, manufactured by Risto Juvarte (http://www.juvaste.fi).

Figure 19 – Green PVC rings used to identify birds released at the Portuguese osprey reintroduction project.

Transportation

The transportation of the nestlings from Sweden and Finland was made by direct flights from Helsinki and Stockholm to Lisbon. The flight was scheduled to arrive in Lisbon at dusk to minimize the high temperatures the birds could be subjected to at this time of the year. In both cases the birds arrived around 20:00h.

Arrived at Lisbon, the nestlings were examined by Pedro Melo the project's veterinarian for their general health state at the airport customs ("Posto de Inspecção Fronteiriço de Carga (PIF) do Aeroporto de Lisboa"). All birds were in good physical condition and were rehydrated and fed with 4-5 small 8-10g fishes each (Sprat, *Sprattus sprattus*, Clupeidae) offered by the Oceanarium of Lisbon. Blood and faeces samples were collected for further laboratorial analysis. Car travel to the hacking place was done at night, when the young are quieter and temperatures lower. All steps were accompanied by a project technician.

Figure 20 – Transportation of the nestling boxes to the TAP plane.

Table 1 – Young ospreys translocated to Portugal (origin, ring numbers, sex, collecting and arrival dates and radiotag frequency). ([1] – died; [2] – lost radiotag).

Rings				Dates		
PVC	**Metallic**	**Sex**	**Origin**	**Collecting**	**Arrival**	**VHF**
P01	92A05750	♂	Sweden	06-07-2011	08-07-2011	[1]
P02	92A05763	♂	Sweden	06-07-2011	08-07-2011	[2]
P03	92A05758	♂	Sweden	06-07-2011	08-07-2011	151.502
P04	92A05765	♂	Sweden	06-07-2011	08-07-2011	[1]
P05	92A05768	♀	Sweden	06-07-2011	08-07-2011	[2]
P06	M61516	♂	Finland	12-07-2011	13-07-2011	151.536
P07	M61529	♀	Finland	11-07-2011	13-07-2011	[1]
P08	M61558	♀	Finland	12-07-2011	13-07-2011	151.664
P11	M61521	♀	Finland	12-07-2011	13-07-2011	151.965
P00	M61564	♂	Finland	11-07-2011	13-07-2011	151.924

Sexing

Blood samples were used for sex determination of nestlings at CIBIO's Molecular Testing Centre (CTM) (cf. Table 1, p. 24).

Health monitoring

The ospreys were regularly followed by the project's veterinarian. A collaboration agreement was established with the Veterinarian Hospital of Évora University to tackle with emergency procedures and hospitalisation needs impossible to achieve in the hacking area.

4.2. Pre-release phase

This phase is the period during which the juveniles remain within the hacking tower. The nestlings were distributed by the 4 pens following their order of arrival and plumage development (joining together birds of close age).

Birds from Sweden arrived on the 8th July 2011 at the age of c. 6 weeks and birds from Finland on the 13th July 2011 at the age of c. 5 ½ weeks (Table 4).

After arriving at the tower at 01:00h the nestlings remained lying down quietly. The birds from Sweden started feeding for the first time only on their second day in the pen. Among those from Finland, some started eating on the second day and others on the third. A few conflicts arose during the first feedings events until the establishing of hierarchies.

Birds from Sweden remained caged 21 days and those from Finland 23 days. In general only common behaviour patterns were recorded, with some exceptions (P03, P04 e P07) that will be described ahead. The behaviour within pens was quiet in general with rare agonistic encounters in defence of food and maintenance of hierarchy. We recorded the evolution of motor and coordination abilities such as using the feet and beak for dealing with food, and the gradually standing up and moving around the pen on their feet instead of on their tarsus. Later they started spending more time looking outside, exercising the wings and making short flights within the pen. At this time, we considered the birds were prepared for release.

The animals were manipulated the least possible. Therefore, weight was only recorded in counted occasions such as ringing, radiotag mounting and veterinary screening. Even so, in certain occasions we restrained from weighing the birds not to increase manipulation stress.

Table 2 – Nestling weights recorded at collecting, ringing, veterinary screening and radiotag mounting.

	Collecting	In the tower	Collecting	Vet screening	Tag mounting
Osprey	**07-07-2011**	**11-07-2011**	**12-07-2011**	**01-08-2011**	**03-08-2011**
P01	1500g	1307g			
P02	1300g	1254g			
P03	1350g	1248g		1070g	1040g
P04	1400g	1273g		1370g	1100g
P05	1650g	1446g			
P00			1260g		1300g
P06			1450g		1310g
P08			1590g		1530g
P11			1610g		1450g
P07			1450g		

Differences in weight recorded for the birds from Sweden between 07 and 11 July may be due to different kinds of balances being used. However, the observed drop may also be justified by the fact the birds barely eat in the first days. P03 and P04 presented later lower values due to the health anomalies.

Feeding

Upon arrival, the juveniles already were feeding by themselves. While in the hacking tower, fish was provided three times a day (~8:00; 12:00-13:00 e 19:00 – 20:00) in order to be always available. Fish was previously weighed to keep account of the amount supplied and consumed. On the first days fish was cut into small pieces (~1,5cm long) and free of scales and spines before being delivered.

As the nestlings improved their food manipulation skills, larger pieces were supplied. By the second week, fish started to be given whole or in halves (depending on the size), and with scales and spines, together with small slices to increase consumption rate (Muriel *et al*., 2010).

Fish not consumed was regularly removed from the pens before the next meal to avoid possible outbreaks of salmonellosis. There was always special care in minimizing visual contact of the birds with the technicians.

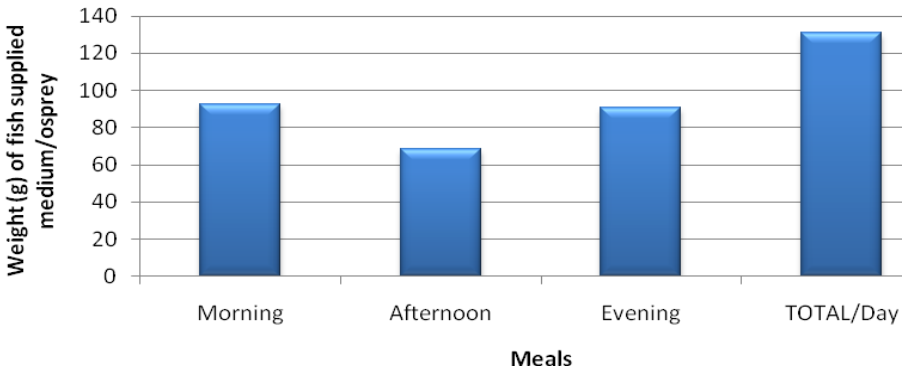

Figure 21 – Average daily fish weight (g) supplied to ospreys in the hacking tower.

In the afternoon, the quantity supplied was reduced because birds consumed less fish in that period, maybe due to the higher temperatures and related reduced activity.

Table 3 shows the time spent by each bird in the tower, the daily average and total amounts of fish consumed. We estimate at 30kg the total fish consumed during the pre-release phase.

Table 3 – Time spent by ospreys inside the tower and quantities of fish delivered, assuming 109.7g bird/day.

Osprey	Days in the tower	Total consumption
P01	21	2303.7
P02	21	2303.7
P03	38	4168.6
P04	38	4168.6
P05	21	2303.7
P05	23	2523.1
P06	23	2523.1
P07	17	1864.9
P08	23	2523.1
P11	23	2523.1
P00	23	2523.1
Total	**271**	**29728.7**

Fish supplied was primarily live fish caught in the dam: Goldfish, Carp and Common bleak. Yet in some occasions fish bought at the supermarket was supplied: Mackerel (*Trachurus* sp.) and Trout (*Salmo trutta fario*). Also a small emergency reserve of frozen fish previously caught in the dam or obtained at angling competitions was sometimes used.

Goldfish (*Carassius auratus*) Carp (*Cyprinus carpio*) Common bleak (*Alburnus alburnus*)

Figure 22 – The three main fish species supplied to the young ospreys in Alqueva.

The flowing figures show the relative contribution of fish species as food in the hacking tower, both in frequency (Fig. 23) and percentage (Fig. 24).

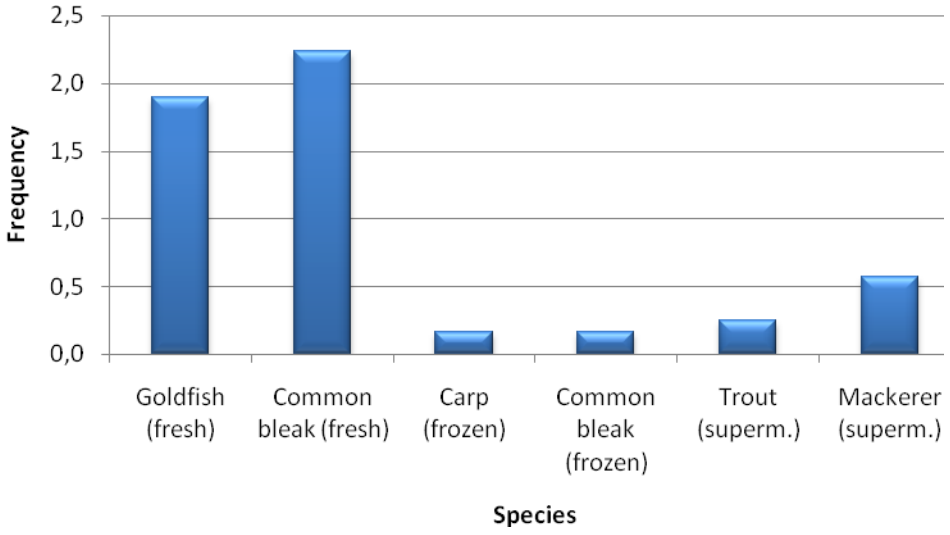

Figure 23 – Relative frequency of each fish species given as food in the hacking tower torre de *hacking*: Goldfish, Common bleak, fresh and frozen, frozen Carp, Trout and Mackerel, bought at the supermarket.

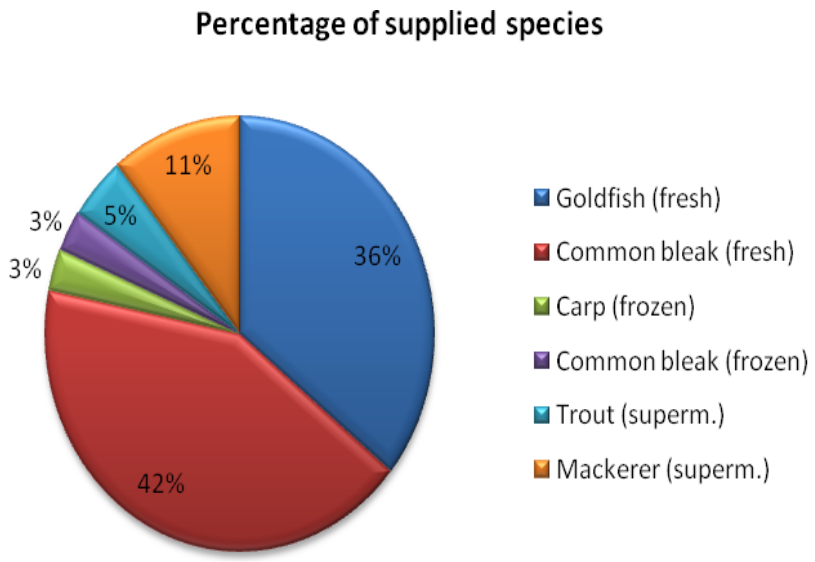

Figure 24 – Percentage of each fish species used as food in the hacking tower.

Because all juveniles could feed by themselves since arrival, fish was given directly through the PVC tubes, being not necessary to use an osprey dummy and tweezers (Fig. 25). There was only one exception when it became necessary to feed P07, isolated for clinical reasons, in order to feed it in the centre of the nest without the bird identifying the human hand.

Figure 25 – Dummy osprey for feeding ospreys within pens.

The sequence by which nestlings of similar age kept in the same pen generally ate depended on their relative hunger, eating first the one having ingested less food or no food at all in the previous meal.

In case of different ages, the largest of the young ate first in general. We often supplied fish carcasses together with slices to allow birds recognising the shape of prey.

Feeding behaviour of young in tower was observed through the one-way windows and video cameras. Special attention was paid to the amount of food ingested, wing exercising and interactions between individuals.

Pen occupation

The distribution of the nestlings by the four pens was at first done in accordance with their origin and age. Birds from Sweden, the first to arrive, were placed in pen 1 (the older) and 2 (the younger); then birds from Finland were placed in pens 3 and 4 also set by age. Still, some birds had to be moved because of the need to isolate P07 and P04 in pen 4 due to clinical problems. Thus, P06 and P11 were moved to pen 3 to vacate pen 4 for P07. Then, when P07 was sent to GREFA in Madrid P04 replaced it in pen 4. This distribution scheme remained up to release but P03 had to be kept inside the pen again after the first release attempt as it was still not fully fit (Table 4).

Table 4 – Sequence of pen occupation by the osprey nestlings

	PEN			
Date	**1**	**2**	**3**	**4**
08-07-2011	P01 and P05	P02, P03, P04	-	-
13-07-2011	P01 and P05	P02, P03, P04	P00, P07, P08	P06, P11
21-07-2011	P01 and P05	P02, P03, P04	P00, P06, P08,P11	P07
26-07-2011	P01 and P05	P02, P03	P00, P06, P08,P11	P04
30-07-2011	Release	Release	P00, P06, P08,P11	P04
01-08-2011	-	P03	P00, P06, P08,P11	P04
06-08-2011	-	P03	Release	P04
10-08-2011	-	Release	-	Release

4.3. Release and first flights

At about the age of 9 weeks (~60 days) ospreys are completely feathered and are prepared for the first free flights. For releasing the birds, the front panels of the pens were slowly lowered just before sunrise. The action was quietly watched from the distance by the project staff.

A few days before opening the pens, a larger amount of food was laid on the feeders, allowing the birds to recognise them as feeding posts. After release food was delivered twice a day (early afternoon and after sunset) to assure permanent food availability in good condition (Muriel *et al*. 2010).

Figure 26 – One of the first flights of a fledgling, a couple of hours only after the opening of the pens.

Because of age differences and the need of delaying the release of P03 and P04, the birds were released in different days (cf. Table 4). The birds from Finland were released 7 days later than those from Sweden, and P03 and P04 4 days later the latter. Therefore, for 11 days there were birds inside and outside the tower.

Radiotracking

In the Spanish project in Andalucia, satellite transmitters (PTTs) were deployed on some fledglings in the two first years (2004-2005) and tadiotags in all birds throughout the project, except in the two last years when no tracking devices were used on birds (Muriel *et al*. 2010).

In the case of the Portuguese project, it was not possible to use PTTs or other far-reaching tracking devices so far for financial reasons. Therefore, the birds were equipped only with VHF radiotags of

the same tail-mount model used in Spain (Biotrack TW-3 CR2032, with activity sensing and 4-6 months lifespan). The tags were mounted on all birds but P04 and P07, at night, two days before the first release (Swedish birds c. 9 weeks and Finnish birds 8 ½ old) by Víctor Matarranz, expert technician from the Spanish Ministry of Environment. The transmitters were previously tested and all procedures recommended by the manufacturer were followed.

Figure 27 – Tailmount tags (A); Transmitter fit to one of the central tail feathers (B).

However, the use of the tailmount tags quickly proved to carry unexpected shortcomings. On the same day the first birds were released we saw P05's tag drooping from the tail and eventually falling to the ground. The rectrices with attached tags of two birds while still inside the tower were also found on the pen floor. The fallen feathers showed to have been cut-off by the birds themselves. Tags recovered were adapted to backpack tags and deployed by Víctor Matarranz on the birds still not released.

Figure 28 – Tailmount tag recovered after the supporting feather being cut-off by the osprey.

Summary of Individual history and relevant events

P01 – First osprey to fly out after the opening of the pen. Predated by foxes on the 5th day after release. Transmitter and feather remains recovered (Fig. 29) 820m from the tower.

Figure 29 – Feather remains of P01 with signs of having been predated (shaft cut by teeth).

P02 – Contact was lost because of fallen transmitter, cut-off by the bird itself. The tag was recovered 2.87km from the tower 4 days after release. This bird could have been sighted by an external observer c. 5 km from the release area after loosing the tag but was not detected again.

P03 – The bird was released with its pen mates on the 30th July but flew out only on the second day. However, it readily landed on the ground and stayed there so it was recaptured and put inside the pen again. Clinical examination showed that the bird was too slim (1070g) and thus not fit for flying. In fact, days before release food intake decrease notoriously with no identified reason. It was kept caged for 10 more days and a vitamin complex (Duphaphral Multi®) was administrated. After a second release it remained in the surroundings of the release area until dispersal.

P04 – On the 26th July P04 was isolated from pen mates because of evident stress symptoms, often violently throwing itself against the wire mesh and damaging the plumage in the act. After a few days in the tower it had already plucked off all its tail feathers, a behavioural disorder (pterotillomania) very rarely observed in raptors (Fig. 30). The bird was released together with P03 10 days after the release of the Finland birds. Duphaphral was given during that period.

Following the advice of osprey experts and the veterinarian and in spite of the new rectrices being still growing, the bird was released in order to avoid the wing flight feathers to become irreversibly damaged, in the assumption that it could fly. A backpack transmitter was attached. Although it could fly quite reasonably it got predated by the same foxes that killed P01 only 327m from the hacking tower and within 1 hour of release.

Figure 30 – P04 without tail feathers, plucked off by the bird itself. Some new rectrices can be seen emerging.

P05 – Tore off the transmitter (later recovered) on the second day of release. Yer it could be followed on sight around the release area until dispersal with no further occurrences.

P07 – Suffered a lesion on the right tibiotarso-tarsometatarsal joint while caged, 6 days after arrival. It was taken immediately to the Veterinarian Hospital of Évora University where it was thoroughly examined. As the lesion worsened subsequently, 6 days later the bird was transferred to the Wild Fauna Hospital of GREFA (Grupo de Reabilitación de la Fauna Autóctona y su Hábitat) in Madrid where it was subjected to chirurgical interventions and physiotherapy. The bird was kept in a flight

enclosure since then but despite the commitment of the hospital staff during months its health suddenly deteriorated and the bird died on the 18th December. Death was attributed to hypovolemic shock of hemodynamic disturbance origin.

P06, **P08**, **P11** and **P00** – All birds released with backpack transmitters. They remained around the release area without incidents until dispersal.

Figure 31 – Recovery locations of lost transmitters (*emissor*) and distances from the hacking tower (*torre*): P01 – 820m; P02 – 2870m; P04 – 3270m; P05 – 33m.

4.4. Dependence phase

This period lasted from the release date to the dispersal/migration day. The behaviour of fledglings was followed through observation and radiotracking, recording data on flight and feeding events, movements and intra and interspecific relationships.

Food delivery after release

As in the first 11 days after the first release there were birds inside and outside the tower, in order to reduce disturbance we supplied food in the feeders at two moments of the day: 1) after sunset or just before dawn to reduce visibility and reactivity of birds towards the technicians, at the same time making food available at dawn; 2) at mid afternoon and hottest part of the day when released birds are resting and caged birds less reactive. Hence, food is available at late afternoon when the birds resume activity. Fish remains were removed at this time too.

As during the pre-release phase, fish placed on the feeders were also obtained from the dam. Although specific fishing techniques were used, we believe that fishes caught largely mirror the available food resources in the dam. A sample of the main fish species were measured and weighed (Table 5).

Table 5 – Length and weight of the fish caught in Alqueva dam and used as food of the ospreys.

Species	Biometry	Average	SD	Max	Min	n
Common bleak *Alburnus alburnus*	Lenght (cm)	17,7	1,6	26	15,1	196
	Weight (g)	43,9	10,9	97	28	
Golsfish *Carassius auratus*	Lenght (cm)	36,2	3,1	48,5	29,5	49
	Weight (g)	772,9	212	1966	396	
Carp *Cyprinus carpio*	Lenght (cm)	47	4,4	55,5	38	22
	Weight (g)	1272,8	332,6	1836	686	

The osprey is an opportunistic species that does not select its prey according to taxonomy (Ferrer *et al*, 2003). A combination between prey abundance and accessibility influences diet composition, which tends to be made up of fish 20-30 cm in length and 150-450 g in weight (Poole 1989). In a study carried out in the Southwest coast of Portugal on the diet of the Portuguese remnant osprey population (Cancela da Fonseca & Palma, 1980) prey sizes were between 20 and 45 cm long and 200-1500 g heavy. The minimum and medium length and weight values in Table 5 are therefore within the usual range for the species.

The amount of fish supplied on the feeders was increasingly reduced in accordance with the needs of the fledglings and their gradual departure from the area (Fig. 32).

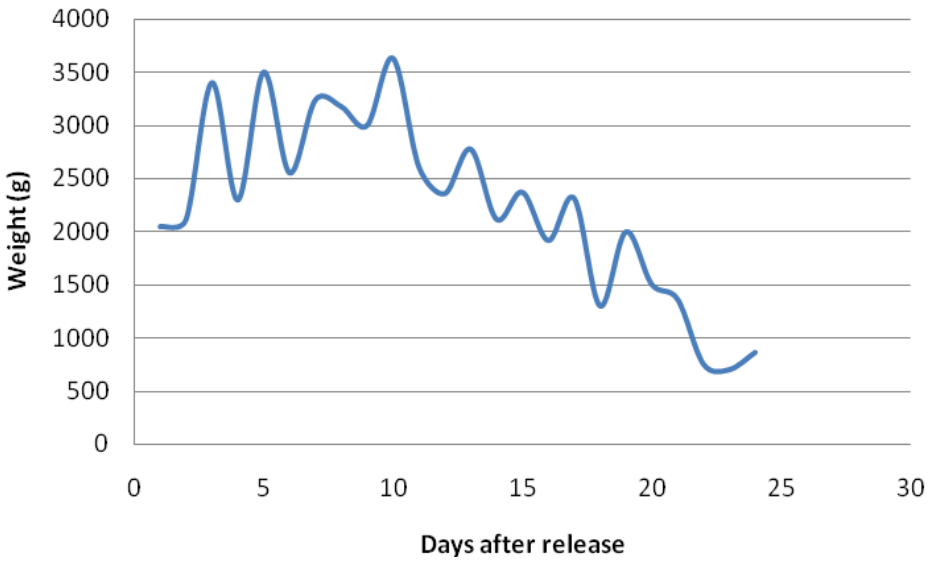

Figure 32 - Quantity of fish (g) supplied on the feeders after releasing the ospreys.

An average of 2308 g fish/day was supplied onto feeders. Considering that in average the ospreys remained 44 days in the release area, a total of c. 102 kg was supplied after release.

The following figure shows the frequency of each type of fish (fresh and frozen) provided after release.

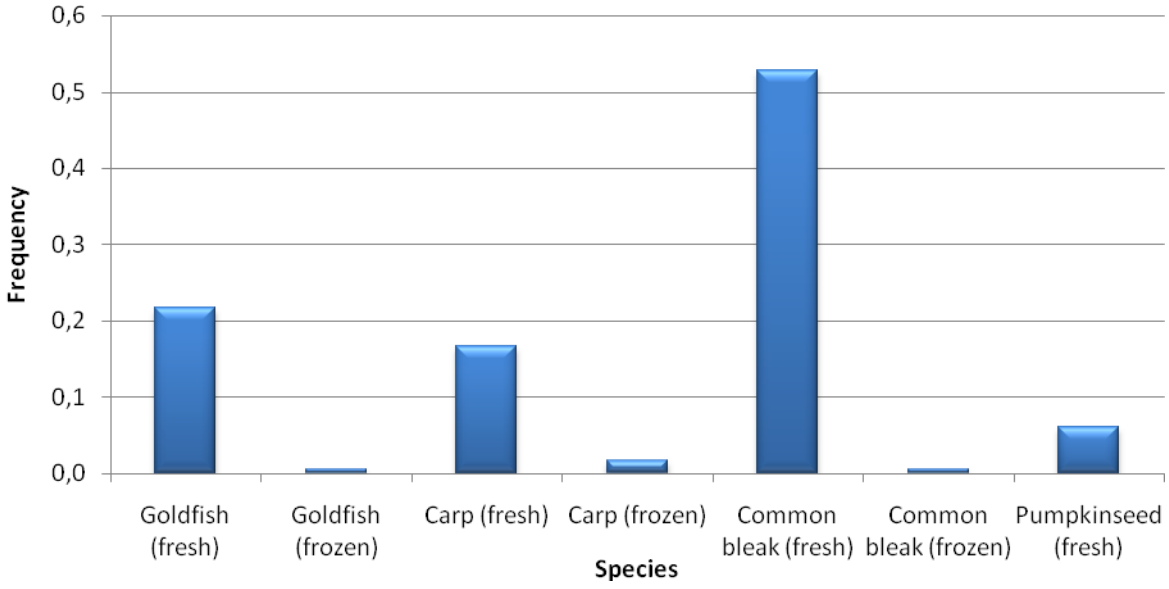

Figura 33 – Frequency of each type of fish (fresh and frozen) provided on feeders.

Food provided after release consisted by order of importance of: Common bleak, Goldfish, Carp and Pumpkinseed sunfish *Lepomis gibbosus* (all fresh). The use of frozen fish was ephemeral, with a frequency of 0.03. All fishes supplied in this phase, including frozen, were obtained from the dam.

Spatial use of the area

After release, the ospreys were followed by radiotracking and direct observation. The following figures illustrate the areas used by birds before dispersal.

Figure 34 – Radiotracking locations of P06, P08, P00 and P11 on the day of release (06/08/2011) at 18:00. Observation post (*ponto de observação*), hacking tower (*torre de hacking*); field base (*casa*).

Figure 35 – Radiotracking locations of P06, P08, P00 and P11 on the next day after release (07/08/2011) at 08:00. Observation post (*ponto de observação*), hacking tower (*torre de hacking*); field base (*casa*).

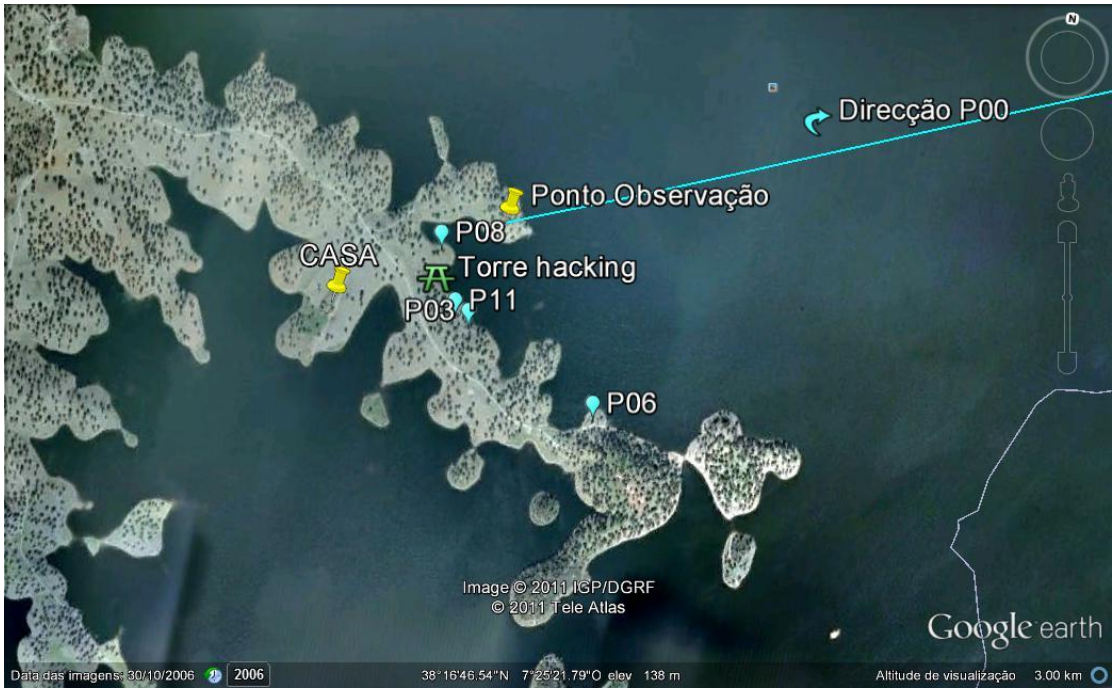

Figure 36 - Radiotracking locations of P03, P06, P08, P11 e P00 on the day P03 and P04 were released (10/08/2011) at 07:30. Observation post (*ponto de observação*), hacking tower (*torre de hacking*), field base (*casa*), P00 flight direction (direcção P00).

Figure 37 – Radiotracking locations of P06, P08, P00, P11, P03 e P04 on the day P03 and P04 were released (10/08/2011) at 11:50. Observation post (*ponto de observação*), hacking tower (*torre de hacking*), field base (*casa*).

Figure 38 – Locations of radiotracked ospreys on the 30th August 2011, 23 days after the release of Finnish birds: the last day with simultaneous signal of all birds. Observation post (*ponto de observação*), hacking tower (*torre de hacking*); field base (*casa*).

Areas used as resting sites

The areas ospreys used more often for perching shortly after release were those marked as “1” in Fig. 39. Later on they started to use resting places farther away, marked as “2” and “3”.

Before the onset of dispersal they routinely visited the release area at the beginning and end of the day to feed but making increasingly farther explorations around in the dam, some of the birds eventually staying out of reach of the receiver for hours or even days.

1

Figure 39 – Areas frequently used as resting areas by the ospreys after release.

Analysing 136 records of birds perched within sight around the hacking tower, the perch types more often used were the artificial perches (40%), followed by dead Holm oaks by the shore. Perching on feeders (the most common) was discarded because feeders were almost exclusively used to eat. Landing on the soil was much less common (3%) and more frequently occurring during the first days before flight and landing skills developed enough to allow easy and safe perching higher up in trees (Fig. 40). Landing on the ground was also common to reach the shore for drinking and bathing.

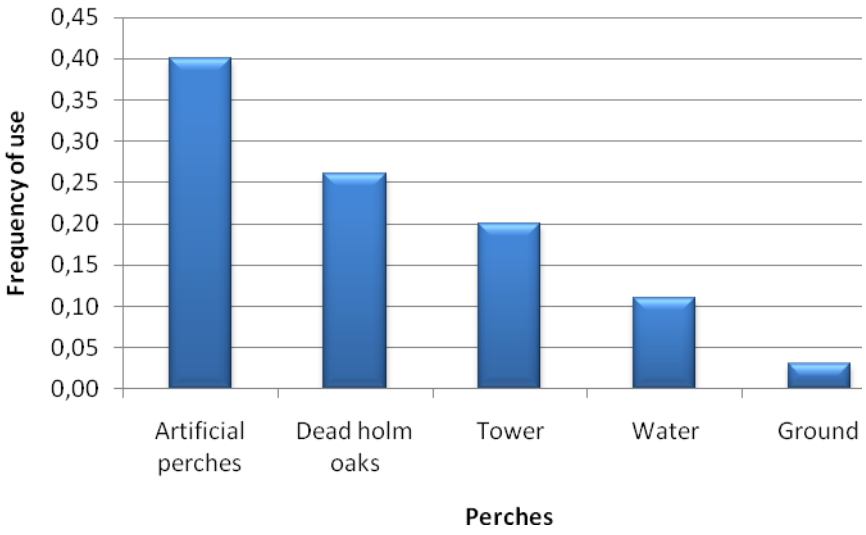

Figure 40 – Relative frequency of perch type use.

Intraspecific Interactions

During the whole dependence period the juveniles showed a semi-gregarious behaviour with frequent visual and vocal contact. Up to 4 individuals at the same feeder and up to three on the same artificial perch were seen.

On the 14th September, a likely migrating alien osprey stayed in the area without causing any disturbance among the translocated birds.

Interspecific Interactions

There were interactions between the ospreys and black-shouldered kites (*Elanus caeruleus*), black-backed gulls (*Larus fuscus*), black kites (*Milvus migrans*) and grey herons (*Ardea cinerea*). Just after releasing the first birds (from Sweden) black-shouldered kites began harassing the ospreys, which responded by simply changing of perch. Within a few days these encounters became much less common. The most common and intense agonistic interactions were by far between ospreys and grey herons. No other species but the ospreys were ever seen eating at the feeders.

Disturbance

Beyond the interaction with other bird species, the only source of disturbance was from anglers willing to fish the area. However, as soon as warned by the project's staff they quickly moved away

and would only come back after questioning about it. Nautical traffic also did not cause any major disturbance.

Flight behaviours

- Since the second day after release, there were birds gently touching by the water surface with their feet after meals (Fig. 41);

Figure 41 – An osprey touching the water surface with feet while flying by (Photos Andreia Dias).

- 2 days after the opening of pens, one osprey was seen deliberately falling into the water with open wings then floating, may be refreshing?

- 7 days after release swinging sky diving flights began to be observed;

- 11 days after release, seemingly fishing attempts were seen;

- 20 days after release, flights were perfectly controlled, including the ascending in thermals to great heights;

- 42 days after release, all birds made long flights beyond the 10 km maximum reach of the receiver. However, they all returned to the release area to feed.

4.5. Dispersal and migration

Based on the lack of observation of the different birds and their absence at the feeders we estimated a date for the beginning of the dispersal/migration.

We did not know the accurate age of the birds at the onset of migration because the exact birth dates were also unknown. Apparently, migration began in average 44±4.7 days after release (Table 6).

Table 6 – Dates of first flight and migration start of the reintroduced ospreys in Alqueva.

Osprey	1st flight	Migration	Nº days (1st flight - migration)
P03	10-08-2011	17-09-2011	38
P05	30-07-2011	17-09-2011	49
P06	06-08-2011	17-09-2011	42
P08	06-08-2011	17-09-2011	42
P11	06-08-2011	17-09-2011	42
P00	06-08-2011	25-09-2011	50

The 16th September, 48 days after the first release, was the last day with simultaneous records of all radiotracked birds. In the 9 days before final dispersal there were 2 birds per day in the area. With the exception of P00, all ospreys were absent on the 17th September and no observation or signal was obtained thereon. P00 abandoned the area on the 25th September, 8 days later and 50 days after its release. This bird was the first to start exploring the dam and was seen on the 2nd September, 27 days after release, 3km away from the tower. Although P05 was released on the 30th July and lost the transmitter, direct observation indicates that it joined the other ospreys when they left the area.

5. Project improvements

Mortality

The hacking and release area lie relatively close to the core of the home range and breeding site of a fox family. Although previously unsuspected, presence of foxes revealed to be very problematic as they were responsible for the killing of two of the fledglings. Aiming at removing the problem and avoiding new birds being predated in the next year, the scrub of the shelter and denning area will be totally cleared, in order to become unattractive to foxes. We hope this will be an effective solution.

Perches

Twelve more artificial perches will be erected along the shore in the area more often used by the juveniles. They will be especially important during the first days when the birds have difficulty in landing in trees. This way, they will also help reducing predation risk.

Telemetry

Radio telemetry does not allow tracking the birds conveniently during the dependence phase in the particular terrain conditions of the dam because of the extreme difficulty in getting accurate fixes by triangulation. Travelling by land is quickly hindered by the water and by boat the receiver is at a too low position and suffers interferences from the engine and the sonar. So, alternative solutions must be sought such as GPS/GSM transmitters.

6. Final considerations

In the first year of osprey reintroduction in Portugal we verified that:

1) The only serious incidents occurred with nestlings inside the hacking tower were: a) the leg lesion of P07 (the bird eventually died in December 2011) and b) the plucking of all rectrices by P04 apparently linked with an excess of captivity stress not watched in any other bird.

2) Almost all birds cut-off the tail feather that supports the tailmount transmitter. In result, contact with P02 was lost and P05 remained the whole dependence period without a tag. This forced to adapt all tags to packbacks, after which no other problems arose. Therefore, we consider that at least in these particular conditions, tailmounts are not recommended. As referred above, radio telemetry itself is not suitable for tracking the birds in the dam area.

3) Predation by foxes was totally unexpected and took a heavy toll in this first year of the project, applying for correction in the close future.

4) The food provisioning scheme chosen allowed a convenient supply of fresh fish, frozen fish being only used in moments when the floating cage stock went too low.

5) Before release the juveniles consumed 109.7 g per bird per day in average, totalizing c. 30 kg in whole. Goldfish was the most consumed. After release consumption was around 2308 g/fish/day, c. 102 kg in total. In this phase the Common bleak was the most consumed.

6) Interspecific interactions occurred mostly with the Grey heron.

7) Fledglings stayed about 44 days around in the release area, engaging in exploratory flights until dispersal/migration. This apparently occurred concurrently with the exception of P00, which in spite of having been the first to begin exploring the dam, kept on in the area for another 8 days.

7. Acknowledgments

Our special thanks are due to:

Prof. Pertti Saurola, Dr. Björn Helander and Dr. Peter Lindberg for all their crucial support in obtaining the birds.

All members of the consulting board: Prof. Pertti Saurola, Dr. Björn Helander, Dr. Peter Lindberg, Dr. Eva Casado and Prof. Miguel Ferrer, as well as Dr. Roy Dennis and Dr. Daniel Schmidt for all the prompt scientific and technical advice.

The Finnish entities who authorized or in some way contributed to the collecting and translocation of osprey nestlings - Finnish Museum of Natural History, Finnish Osprey Foundation, Häme and Pirkanmaa Environment Centres, Finnish Environment Institute (CITES), Control Department of Animal Health and Welfare Unit (EVIRA), also to the Embassy of Portugal in Helsinki for helping in the clarification of administrative procedures.

The Swedish entities who authorized or in some way contributed to the collecting and translocation of osprey nestlings – Swedish Museum of Natural History, Swedish Society for Nature Conservation, Swedish Environment Protection Agency, County Administration Board of Stockholm (veterinarian authority) and Swedish Board of Agriculture (CITES).

Volunteers Juhani Koivu and Harri Koskinen (Finnish Osprey Foundation) and Markku Alanko, from Finland, and Bill Douhan and Karl-Arne Rosling from Sweden, who collected, kept and cared for the nestlings.

Per Risberg and Krister Mild (Swedish Environmental Protection Agency), Camilla Jüllig (Stockholm County veterinarian), Pertti Heikennen and Jukka Airola (Häme Environment Centre), Mari Rajala and Susanna Lainamo (Pirkanmaa Environment Centre) for the issue of the export authorizations, and Harry Helmisaari and Stella Fromm (Finnish Environment Institute) for the issue of the Finnish CITES permission.

EDP for funding and supporting the project, in special to Eng. Neves de Carvalho, Dr. Vítor Batista, Dr. Amélia Novo and Eng. Pedro Paes.

ICNB for the institutional support, in special to its President Dr. Tito Rosa, as well as to Dr. Mário Silva, Dr. Júlia Almeida, Eng. Paulo Carmo, Dr. Luís Silva and Dr. Pedro Rocha.

SAIP for the lending of the field base house, and the technical and logistic support that were central to the project development, in special to Eng. José Roquete, Dr. André Roquete, Eng. Marta Garcia, Eng. Augusto Andrade; Arch. Joaquim Agostinho, Dr. António Eça Pinheiro and Mr. Domingos Moreno.

TAP for offering the transportation of nestlings and the tariff reduction of flight tickets and in special to Dr. Paula Pinto for her critical help.

EDIA for the technical and administrative support, in special to Dr. Ana Ilhéu, Dr. Rita Azedo and Dr. Bárbara Pinto.

The Veterinarian Hospital of the University of Évora, in special to Dr. José Nuno Tirapicos, Dr. Luís Martins, Dr. Cristina Queiroga and Dr. Ludovina Padre.

The Ministério de Medio Ambiente y Medio Rural y Marino of Spain e in special to Mr. Víctor García Mararranz for the help in putting the transmitters on birds and adapting them to backpacks.

GREFA in special to Dr. Ernesto Álvarez, Dr. Fernando González e Dr. Susana Jato for the admittance, treatment and maintenance of the diseased bird.

The Oceanarium of Lisbon and its director Dr. Núria Bailina, for providing the appropriate fish for the rehydration of ospreys upon their arrival at Lisbon's airport and to Dr. Elsa Santos for her help.

All volunteers in Portugal: Carla Ferreira, Valter Teixeira, Mamede Teixeira, Ricardo Gomes, Rita Ferreira, Raquel Alcaria, Kinta Fernandes, Luís Carapinha, Andreia Guerreiro, Carla and Miguel Conceição, Lília Marques and Nuno Santos.

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