OSPREY RESTORATION PROJECT IN THE URDAIBAI BIOSPHERE RESERVE (BASQUE COUNTRY)

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TABLE OF CONTENTS

1. BACKGROUND

The western osprey (*Pandion haliaetus*) is a bird of prey whose ecology has been the object of intense study over the years, as a result of the interest its presence arouses in Europe and North America and the drop in population that the American population suffered in the middle of the last century because of the intensive use of pesticides (Poole 1989, Dennis 2008). It has been extinct in the Iberian Peninsula since the beginning of the 1980s, although recently breeding has restarted pairs breed in Cádiz and Huelva (7 breeding pairs in 2012) as a consequence of a reintroduction programme using donor young birds from Scotland, Germany and Finland (Ferrer & Casado 2004, Muriel *et al.* 2006 y 2010, Triay & Siverio 2008).

On a global level, the osprey is in the category of Less Concern, while in Europe the species is Rare, with a unfavourable conservation status, since although the majority of their populations have increased or remained stable, there are risks that may affect the smaller populations (IUCN 1998, BirdLife 2009).

There are some records of nesting pairs in Northern Spain during the last century. Ospreys breed in Asturias until the 1960s (Bijleveld 1974) and a nesting attempt was described in a reservoir of the Basque Country in 1973 (Ferrer & Casado 2004). Moreover, during the last decade two nesting attempts occurred in reservoirs in Huesca (Lorente 2005).

Although at present there are no nesting pairs in Northern Spain, the osprey is a common and regular visitor to the area, with many sightings every year, mostly birds originating from Germany, Scotland and Norway, which stop off to fish in estuaries and reservoirs on their migratory route (Galarza 1997, Hidalgo & Del Villar 2004, Galarza & Dennis 2009, Zwarts *et al.* 2009).

The nearest breeding population is on the banks of the Loire, (Orleans, France; Thiollay & Wahl 1998), some 600 km from the Basque Country. The osprey has strong philopatry and the fact that osprey populations expand at a rate of about 4 km a year (Dennis 2008), natural colonisation based on the small French population is highly unlikely in the short and medium term.

Urdaibai Biosphere Reserve is one of the areas in Northern Iberia where a high number of ospreys stop, especially during migratory periods. The sighting in the area of many ospreys at once for several days can be considered proof of the suitability of the estuary and its surrounding woodlands. This consideration is preliminary supported by the

habitat use and high fishing success of ospreys in Urdaibai (Galarza & Dennis 2009, Galarza 2010).

Osprey reproduction is one of the Nature 2000 conservation measurements promoted in Urdaibai (Basque Government 2012). Therefore, with the aim of establishing it as a breeding bird in the Basque Country, an Osprey reintroduction project has been set up in the Urdaibai Biosphere Reserve (Biscay, Basque Country) by the Department of Environment of the County Council of Biscay (Diputación Foral de Bizkaia – Bizkaiko Foru Aldundia). Moreover, since osprey is a popular and charismatic species, i.e. a flagship species, its reintroduction will favour environmental awareness and will promote the Urdaibai Reserve as an ecotourism destination.

2. DIAGNOSIS OF THE POPULATION

2.1. European population

Osprey breeds mainly in Northern countries and the largest populations occurr in Scandinavia, Scotland, Germany, Baltic coasts and Russia. Lesser populations can still be found in Western Mediterranean, mainly in Corsica and the Balearic Islands. It has been suggested that this current breeding distribution, with large populations in the North and small populations in the Mediterranean coasts separated by a great empty strip could be the result of an historic intensive persecution by humans. The osprey was heavily persecuted from at least the 19th century onwards, which led to its extinction in Belgium, France, Great Britain (1916), Czechoslovakia (1850), Switzerland (1911), Denmark (1916), Austria (in the 1930s), West Germany (1933) and other countries. At this marked decline, countries like Finland and Sweden passed protection laws in the 1920s (Poole 1989).

Table 1. Estimate of osprey breeding pairs in Europe and neighbouring areas (modified from Dennis 2008).

Area	Breeding pairs	Trend
Sweden	3,297-3,592	
Russia	2,000-4,000	stable or decreasing
Finland	1,200	stable or increasing
Germany	500	increasing
Norway	210-260	increasing
Scotland	270	increasing
Byelorussia	120-180	
Latvia	120-150	increasing
Poland	70-75	stable or decreasing
Lithuania	50	
Estonia	40-45	increasing
Corsica	30-26	decreasing
Balearic Islands	21-15	stable or decreasing
Canary Islands	16-21	
Continental Spain	7	since 2009
Continental France	25-30	since 1985
Ukraine	5-10	
Armenia	1-4	
England	3	since 2000
Wales	2	since 2004
Azerbaijan	0-5	
Moldavia	0-2	
Bulgaria	0-10	

This was followed by another period of strong decline from the mid twentieth century on, which saw the extinction of populations in Sardinia (in the 60s), Greece (1966), Italy-Sicily (1956) and mainland Spain (in the 1980s).

The last European country to lose the osprey as a nesting species was Portugal (2002). Numbers of the bird reached a historical low in the middle of the 20th century and then started to rise slowly, due to conservation measures taken (Dennis 2008). In the 1990s it was estimated that there were 7,000-9,000 breeding pairs in Europe (Saurola 1997). However, the most recent estimate puts the population at 7,916-10,388 pairs (Dennis 2008, BirdLife Internacional 2009, Table 1). Nowadays, the majority of the European populations are growing or are stable, but it is a very rare species in southern European countries, and it is estimated that the European population is half of what it could be, considering the present availability of suitable habitat (Dennis 2008).

2.2. Breeding population in the Iberian Peninsula

The earliest reference to a nesting osprey in the Iberian Peninsula dates back to the 18th century in Irby (1895), who mentions the existence in 1776 of a nest built on the Rock of Gibraltar.

At the beginning of the 18th century it was a common species along the South and Southwest coast of Portugal, although at the beginning of the 20th century it seemed to have become more rare (Tait 1924). According to Palma & Beja (1999) in 1988 there were still two nesting pairs in Portugal although one of them disappeared in 1988, while the second survived until 1997, when the female was strangled in fishing net.

In the 19th and 20th centuries the osprey is known to have nested in a good number of the Mediterranean coastal provinces (Girona, Valencia, Alicante, Malaga and Cadiz), including Gibraltar. The earliest recorded losses were those in Malaga and Valencia in 1887. In 1932 the species stopped nesting in Gibraltar, while in Cadiz there were only two nesting pairs left in the fifties (Alonso 1983). The last pair in Alicante nested on a tree in the Beniarrés reservoir in 1981 (Urios *et al*. 1991). In Catalonia there were breeding ospreys in the lower Empordá in 1962, and between 1974 and 1979 there were unconfirmed signs of breeding in other points of the coast of Girona (Muntaner *et al*. 1983). The last known nest in Malaga was occupied until 1982 (in Ferrer & Casado 2004) while in Valencia it seems that they were breeding in the Albufera, at least until 1887 (Arévalo & Baca 1887) and also possibly in Gandía until the end of the 19th century (González *et al.* 1992). In the northwest of the Peninsula, the only reference to

breeding pairs of the species is the mention of a pair that nested on the cliffs near Ribadesella (Asturias) until approximately 1960 (Bijleveld, 1974) and there is reference to a bird adding material to its nest in the reservoir at Urrunaga (Basque Country) in 1973 (Ferrer & Casado 2004).

Therefore, at the beginning of the 1980s the osprey was thought to be extinct in the Iberian Peninsula. However, there are references to the construction of various nests in Cadiz, in the Bornos reservoir in 2000 (Triay & Siverio 2003) and in Los Barrios in 2005 (González 2005).

Moreover, there are reports of attempted nesting at El Grado reservoir (Huesca) in the 1990s, as well as of mating and nest building in the reservoir at Barasona (Huesca) in 2005 (Lorente 2005). Furthermore, there have been recent sightings of pairs with mating behaviour in the Urdaibai Reserve itself.

Thanks to a reintroduction programme carried out in Andalucía during the period 2003-2012, al least seven pairs bred in 2012 in the marshes of Odiel (Huelva) and in some reservoirs of Cádiz (Migres Foundation *com.pers.)*.

3. GENERAL BIOLOGY OF THE SPECIES

3.1. Taxonomic situation

Within the taxon *Pandion haliaetus* (osprey) there are four currently recognised subspecies (Prevost 1983): *P. h. carolinensis* (North America), *P. h. ridgwayi* (the Caribbean), *P. h. cristatus* (Australia) and *P. h. haliaetus* (Palearctic). The four subspecies have a similar morphology, differentiated by the patterns on their plumage and by their size (Ferguson-Lees & Christie 2001).

It is the Palearctic osprey (*P.h. haliaetus*) that nests in Europe, around 60º North (Scandinavia, the Baltic countries, Germany, Poland, Byelorussia and the United Kingdom) and around 40º North (the Canary Islands, the Balearic Islands, the Chafarinas Islands, Corsica and the Mediterranean coast). Genetic studies came to the conclusion that there are no genetic differences within European subpopulations (Ferrer & Casado 2004). Therefore it can be concluded that the translocation of birds from the North and Centre of Europe to the Basque Country would not constitute a risk of genetic contamination for the subpopulation of the Mediterranean basin.

However, these two subpopulations have been considered different units of conservation because they have some different reproductive behaviour and migration patterns (Triay & Siverio 2004): (1) while Mediterranean ospreys nest on rocky pinacles, those from the Centre and North of Europe use trees and other similar supports as perches for their nests; (2) while the Northern ospreys are clearly migratory (Poole 1989), the Mediterranean ones limit their movements to short winter trips make by the adults (Thibault *et al*. 2001) and certain dispersions among the juveniles (Thibault & Patrimonio 2001, Triay 2002).

3.2. Selection of nesting habitat

In general, it can be said that they nest near large bodies of water with fish, even when they are various kilometres away (Poole 1989). Thus for example in Estonia they nest 0,3-2 1,5 km from the water (Löhmus 2001), in Lithuania at a distance of 5-12 km (Drobelis 1990) and in Central France 8-25 km from the water (Thiollay & Wahl 1998). In Scotland there are even cases of ospreys that travel up to 28 km to fish (Dennis 2008).

The osprey is a very versatile species which nests on a great variety of structures, such as trees, rocks, artificial platforms, electricity poles and even on the ground itself in areas where there are no predators. As mentioned previously, in Europe, the Mediterranean subpopulation seems to differ from the present Northern subpopulation mainly in their different nesting habits. The former nest on rocky pinnacles on sheer cliffs over the sea, while the Northern ospreys make their nests in the tops of trees, generally located near inland waters (Cramp & Simmons 1980, Poole 1989). However, some authors consider that in Great Britain the species was widely distributed in the past, both in the interior lakes and on the coast (Dennis and Dixon 2001), with well-documented reports of pairs that nested on rocky outcrops and even on the ruins of castles (Dennis 2008). On the other hand, it is worth pointing out the coexistence nowadays of both breeding habits in some areas of North America, such as in the Yellowstone National Park (Swenson 1981) or in Baja California (Henny *et al.* 2007).

In humanized areas, ospreys that originally nested in trees substitute them for different kinds of artificial supports (posts and electricity poles, beacons, buildings etc.; Poole 1989, Castellanos & Ortega-Rubio 1995). Thus, for example, 64% of the nests in the United States are built on artificial structures (Houghton & Rymon 1997). In Germany, ospreys often use electricity pylons as the base for their nest (Sömmer 1995).

Any nesting area must have a stable platform, from which the osprey can have a good view (Vana-Miller 1987, Ewins 1997). When they breed in an open area where tree covering is scarce, the area must have suitable perches near the nest (Vana-Miller 1987, Ewins 1997). Although the particular type of tree or the density of the foliage are not important factors when selecting the breeding place, when they nest in trees, the particular tree they choose always stands out over the rest (Vana-Miller 1987). Artificial platforms built in trees or erected on posts in the middle of water can also be very attractive places for the birds to nest, and have been used extensively as a tool for reinforcing populations or widening their distribution (Poole 1989, Saurola 1995, Houghton & Rymon 1997, Dennis 2008, Nadal & Tariel 2008).

The suitability of the breeding habitat may depend on the proximity, quantity and nature of human activities in the area (Vana-Miller 1987). However, the nuisance caused by humans seems to be closely linked to how accustomed the pair involved is (D'Eon & Watt 1994). Therefore, pairs that nest or were born near areas with a lot of human activity, or that start hatching when human activities are already occurring

around them, are often more tolerant of the inconvenience (Van Daele & Van Daele 1982, Poole 1981). However, when sudden disturbances happen during incubation, this may cause the birds to abandon the nest (Levenson & Koplin 1984). Therefore, in reintroduction projects it has been suggested that it is a good idea to get the translocated chicks used to a certain level of human presence in the *hacking* tower (Dennis 2008).

3.3. Trophic Ecology

The osprey feeds almost exclusively on fish, whether fresh-water or salt-water. It is known to be able to catch other prey, such as birds or reptiles (Wiley & Lohber 1973, Poole 1989), but this behaviour should be considered accidental (R. Dennis *pers. comm.*).

It selects those fish that swim near the surface, for which it needs quiet, transparent, shallow water that makes it easier for the bird to find the fish and difficult the fish to get away. It is opportunist, in that it does not make any taxonomic selection, but fishes in terms of accessibility and the abundance of its prey. In Scotland and Finland, ospreys are known to catch the following species of fish: pike (*Esox lucius*), trout (*Salmo trutta* and *Salmo gairdneri*), perch (*Perca fluviatilis*), bream (*Abramis brama*), roach (*Rutilus rutilus*), goldfish (*Carassius auratus*) and flounders (*Platichthys flesus*; Green 1976, Häkkinen 1978, Dennis 2008). In the reservoirs of the interior in the southern Iberian Peninsula the most common prey is the carp (*Cyprinus carpio*; Gil Sánchez 1995) and in Navarra this is also eaten along with barbels (*Barbus graellsii*; Lekuona 1996). The species of the family Mugilidae (*Mugil* spp., *Chelon* spp. and *Liza* spp.) are reported to be osprey's favourite prey in shallow coastal temperate waters throughout the world (Szaro 1978, Prevost 1982, Boshof & Palmer 1983, Francour & Thibault 1996, Silva & Olmos 2002, Clancy 2005, Sayago 2008). Thus, for example, in the marshes of Huelva 90% of the prey were grey mullets (*Chelon labrosus*), and the rest consisted mainly of sea bass (*Dicentrarchus labrax*), spotted bass (*Dicentrarchus punctatus*) and bream (*Sparus aurata*). By contrast, in the Andalusian reservoirs osprey's diet is based primarily on various species of balbel (*Barbus* spp.), common carp (*Ciprinus carpio*) and to a lesser extent, largemouth bass (*Micropterus salmoides*; Sayago 2011).

Nevertheless, the osprey is selective about the size of fish that it catches, and the weight varies preferably between 150 and 350 g (20-35 cm) although they can catch smaller prey (50 g) and larger (1,200 g; Häkkinen 1978, Poole 1989, Sayago 2011). According to Van Daele and Van Daele (1982) nesting ospreys need to eat on average 4.6 fish a day

to raise 2 chicks, and 5.6 fish when the family has 3 chicks. Lind (1976) calculated that an adult needs 286 kcal a day (approximately 286 g/day), so that an adult with two chicks would need about 1,048 g/day (Van Daele & Van Daele 1982).

3.4. Selection and capacity of the feeding habitat

The osprey feeds in quiet, shallow waters that maintain an adequate and accessible population of fish (wide rivers, estuaries, deltas, lakes and shallow seas). The capacity of the area to feed breeding ospreys is variable and depends on the availability of prey, the useful area for fishing and the quality of the water. In continental water, ospreys more often use a sheet of water of more than 10 ha surface area, with the greatest fishing success in eutrophic waters (Löhmus 2001, Bai *et al*. 2009).

The behaviour of the osprey differs from other birds of prey in that it does not defend its hunting territory, so that one fishing area can be shared by several pairs that will compete with each other almost only for the perch to put their nest (Poole 1989). So, for example, two small Scottish estuaries of 850 ha (Findhorn) and 40 ha (Spey) are the main feeding waters for 10 and 4 pairs, respectively, with individuals that have built their nest on occasion more than 15 km from their habitual fishing areas (R. Dennis *pers. comm.*).

3.5. Social behaviour and reproductive cycle

The osprey is a semicolonial species (Cramp & Simmons 1980, Löhmus 2001, Mougeot *et al*. 2002; Bretagnolle *et al*. 2008), which only defends its nest and surroundings, as well as any perch that it uses to fish from or eat on. This means that it can breed in solitary or in lax colonies where the nests are only separated by 50-100 m and also that, if the trophic capacity of the area permits, various pairs of ospreys can fish at the same time in estuaries, rivers or lakes that are quite small. First-time breeders are strongly drawn to active breeding zones because they see that an occupied area is ideal and try to use nests that have already been built (Poole 1989).

Ospreys are extraordinarily faithful to their nests, with a return percentage of more than 90% (Henny & Van Velzen 1972) and they seem to be essentially monogamous, as usually the replacement of one of the members of the pair is only caused by its death. In the few cases of polygamy that are known, the most common thing is for the trio to be made up of a male and two females, although it is possible the other way round (Poole 1989, Kimbal *et al.* 2003).

The dates of arrival of ospreys to the breeding areas are related to weather conditions. Thus, it was found in Finland a strong correlation with the NAO index in February, the April average temperature and annual fluctuations (Solonen 2011). Once in its territory, the male takes charge of fishing both for himself and for the chicks and his partner, who will not leave the area of the nest until the end of the summer (Poole 1989). In Finland hatching occurs during the first half of june (Saurola 2011).

The nest is a heap of dry sticks that increases each year. It can measure nearly 2 m in diameter and about 0.75-0.80 m in depth, depending on the location and its age.

Egg laying usually happens 10-30 days after the ospreys reach the breeding territory (Poole 1989). The average date is 2nd April in the Mediterranean populations (Triay 1995), while in continental France laying occurr in 1-15th April (Thiollay & Wahl 1998) and in Scotland the first eggs are laid on 10th April and the last on 23rd May (Dennis 2008). In Finland, the average egg-laying date is related to the presence of ice in lakes and rain in April (Solonen 2011). The size of the normal brood is 3 eggs (87% in Scotland), with 2 being more rare and even rarer 1 or 4 eggs. Incubation lasts 35-37 days. The female is completely in charge of the incubation at night, and around 70% of the daytime hatching (Dennis 2008). The young start flying around the nest when they reach about 53 days (Dennis 2008) and stay in the area until they are between 12 and 14 weeks old (Dennis & Dixon 2001, Triay 2002). Until then, they are fed by the male, which tries to provide them with all the food they require. However, the quantity goes down as the fishing skills of the chicks improve (Bustamante 1995). This fishing behaviour is innate and the young ospreys are able to fish well without being taught by their parents (Schaadt & Rymon 1982).

Reproductive success per nesting pair has been calculated at 1.56 young for Scotland (Dennis 1983), 1.56 for Finland (Saurola 2011), 1.20-1.83 for continental France (Thiollay & Wahl 1998), 1.43 for Corsica (Thibault *et al*. 2001), 1.33 for Menorca (Triay 1995) and 1.32 for the Canary Islands (Siverio *unpublished*). Spitzer (in Poole 1989) calculated that 0.8 young per nest was the annual level needed to keep a population stable.

Sexual maturity is reached at three years and the first reproduction can take place from this age onwards, although some birds mate at two years old (Poole 1989). The average age of starting reproduction is variable and depends on the state of the population, with early reproduction occurring in birds that belong to expanding populations (Dennis 2008). Age of first breeding was 3.2 years for female and 4.4 years for males in the expanding population fom Central France (Wahl & Barbraud 2005).

3.6. Movements

Breeding ospreys from the Mediterranean islands limit their movements to short winter trips make by the adults (Thibault *et al*. 2001) and certain dispersions among the juveniles (Thibault & Patrimonio 2001, Triay 2002), whereas Northern and Cenral Europe are clearly migratory (Poole 1989, Zwarts *et al*. 2009).

Swedish ospreys start the autumn migration to their wintering grounds at the end of July (29th July-17th September) with average journey duration of 39 days (min-max 14-55; Alerstam *et al*. 2006). The females abandon the breeding areas before the males, while the young are the last to leave and also the last to reach the wintering grounds (Kjellén *et al*. 2001). Although ospreys migrate essentially during the day, night flights are not rare, especially when they have to fly over large expanses of water (De Candido *et al*. 2006, Alerstam *et al*. 2006). They migrate alone, whatever the wind direction (Thorup *et al*. 2006) and keep up an average speed of 127-257 km/day (Saurola 1995, Meyburg & Meyburg 1996, Kjellén *et al*. 2001).

Most of European migratory ospreys spend the winter in the tropical regions of West Africa, from Mauritania to Cameroon, but there are birds that are known to have spent the winter in other African countries, such as Sudan, Mozambique or South Africa (Österlöf 1977, Hake *et al*. 2001, Saurola 2002, Dennis 2008, Zwarts *et al.* 2009). In the last decade it has been observed that some birds also use the Iberian Peninsula for wintering in, especially the most southerly reservoirs and coasts (Casado & Ferrer 2005, Sayago 2008 and 2011).

The prenuptial migration starts in the African wintering grounds in mid March (19th March-12th April) and is usually faster, with an average duration of 26 days (min-max 21-33), and with hardly any difference between the sexes (Alerstam *et al*. 2006). The young normally remain in the wintering grounds during their first summer.

They take various flyways and are capable of crossing large portions of sea without apparent difficulty, so they do not seem to concentrate on the straights (Bernis 1973, Österlöf 1977, Cramp & Simmons 1980, Hake *et al*. 2001). However, they try to avoid the risks associated with crossing large areas of sea (Hake *et al*. 2001). Individual birds from Scotland have therefore been seen to be capable of crossing the Bay of Biscay in a few hours, although the majority, particularly the adults, tend to fly along the coasts, so that they fly in and out of the Iberian Peninsula between the western Pyrenees and the Bay of Biscay (see www.roydennis.org and www.ospreys.org.uk).

During migration, most ospreys make migratory stopovers that they use to rest and feed. They use them for an average of 14 days in autumn and 4 days in spring for this, spread out over 1-4 stops in places that some birds use year after year (Alerstam *et al*. 2006). Therefore, the protection and correct management of the spotover localities that are used assiduously by ospreys in these migrations may play an important role in the conservation of the species (Dennis 2008).

Most of the Northwest of the Iberian Peninsula, is situated right in the middle of the migratory flyway of the ospreys that nest in Scotland, Wales, England, France, Germany and Norway. The prenuptial migration takes place mainly between the beginning of March and the end of June, while the postnuptial, much more abundant, takes place from the end of August to mid November

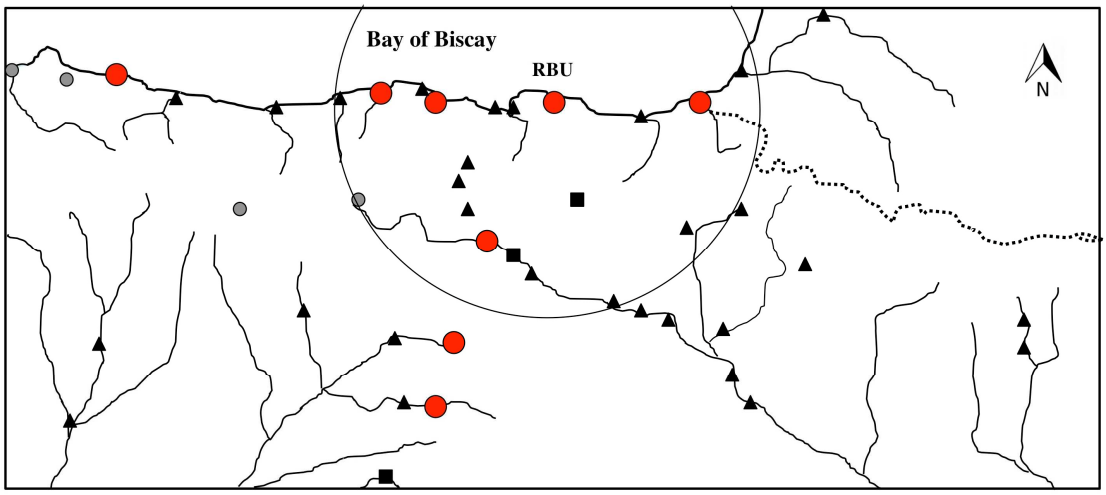

Figure 1. Sightings of ospreys in Northern Iberian Peninsula during 1995-2011. Red circle > 20 observations, Rectangle: 19-15, Triangle: 5-14, Grey circle: 1 observation. A radio of 100 km around Urdaibai is shown.

The more important stopover localities in Northern Iberian Peninsula are: the Urdaibai Biosphere Reserve (Basque Country), the Txingudy Bay (Basque Country), the Santoña Natural Park (Cantabria), the Santander Bay (Cantabria), the reservoirs of Zadorra river (Basque Country), Sobrón (Burgos) and Úzquiza (Burgos) and the river Ebro and river Duero, including its tributary, the river Arlanza (Figure 1). Wintering is much limited and focused mainly on the coast, with some few birds observed on the estuary of Villaviciosa and Nalón (Asturias), Santander Bay (Cantabria), Santoña Natural Park (Cantabria), Urdaibai reserve and Txingudy Bay (Basque Country). Wintering ospreys

have been observed also inland, in the Zadorra reservoirs (Basque Country) and the river Arlanzón, near Burgos city.

4. STUDY AREA: THE URDAIBAI BIOSPHERE RESERVE

4.1. Habitat availability and protection categories

On the 8th December 1984, the International Board of the MAB UNESCO programme added the 220 km^2 of the river basin and estuary of the river Oka, in the Basque Country, to the International Network of Biosphere Reserves under the name of the Urdaibai Biosphere Reserve. Five years after this declaration, the Basque Parliament passed law 5/1989, on the 6th July, for the protection and management of the Urdaibai Biosphere Reserve, with the general aim of establishing a special legal status to protect the integrity and promote the recovery of the flora, fauna, landscape, waters and atmosphere, in short, of all the ecosystems that are of special natural, scientific, educational, cultural, recreational and socio-economic interest. As an instrument for developing this law, in 1993 the Guidelines for Use and Management were approved, in order to protect and recover all of the ecosystems in the Biosphere Reserve (Basque Government, decrees 242/1993 and 27/2003).

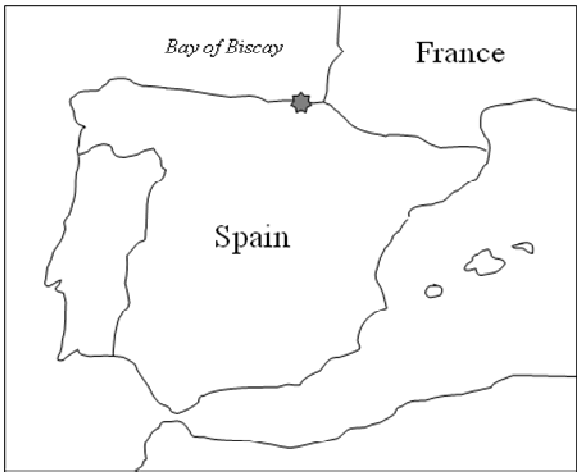

Figure 2. Geographical location of the Urdaibai Biosphere Reserve

66,8 % (14,709 ha) of the Reserve is forested, mainly with Monterey pine plantations (*Pinus radiata*; 9,600 ha), whereas 27,9% (6,138 ha) is occupied by openland, mainly farmlands, crops and grasslands (Figure 3)

The areas of Urdaibai where the protection reaches a priority fundamental level (because they hold unique or fragile ecosystems) are protected under the label of

Special Protection Areas, as the general objective is to preserve the natural environment. These areas are: (1) Estuary Area (918 ha), (2) Coastal Area (95 ha) and (3) Cantabrican holm-oak woods (1,582 ha).

With the general objective of ensuring the preservation of this particular area of nature and indeed its regeneration and extension, keeping this compatible with research, education about the environment, leisure areas and the exploitation of the resources, there are also various points of lesser protection, among which the most salient for this feasibility project are: (1) Coastal Protection Area and bank of streams (3,640 ha), (2) Protection Area for the Cantabrican Holm-oaks and natural copses (987 ha)

The areas of special protection of the estuary and the shoreline are a Ramsar site and are included as a Special Protection Area for the Birdlife of the Urdaibai Estuary (SPA ES0000144) and as Special Area of Conservation (SAC ES2130007). Also listed as Special Area of Conservation are the areas of special protection for the Cantabrian Holm-oak woods (SAC ES2130008) and part of the protection area for the coast and the riverbanks (SAC ES2130006).

In addition, the whole area of special protection for the Estuary and the Cantabrian Holm-oak woods (some 5,500 ha) is part of the wider Hunting-Free Area (Decrees 140/1987 and 5/1999 of the County Council of Biscay) (Figure 4).

This framewok of protection and the conservation status of the Reserve are an ideal setting for the development of the proposed reintroduction of the osprey, ensuring in the first instance the availability of suitable habitat to fulfill the ecological requirements and conservation of the species.

4.2. Connectivity with other potential colonization areas

There are numerous areas in the north of the Peninsula where the osprey can be regularly seen (Noval 1986, Galarza, 1997, Lekuona 1998, Pérez de Ana 2000, Ferrer & Casado 2004, ornithological annals of Asturias, Burgos and Cantabria) and which in principle might be suitable places to establish the species (Figure 1). Among these, the most interesting are the reservoirs on the River Zadorra (Basque Country) and the marshes of Santoña, Victoria and Joyel Natural Park (Cantabria).

The reservoirs of Zadorra (Ullibarri-Gamboa and Urrunaga; SCI ES2110011 and Hunting-free Area) are located in the middle of Álava plateau (Basque Country; 40 km south to Urdaibai). They form a water surface of about 2,559 ha, surrounded in Urrunaga by a landscape typical of this area with pastures and arable farmland, woods

and copses of oaks and coniferous plantations; on the shores of Ullibarri-Gamboa there also grow valuable groves of beech, Scots pines and oaks.

In this reservoir system there have been numerous sightings of ospreys passing through and also staying during the winter (Galarza 1997). In adittion, there is also a report of an osprey carrying material to build up a nest in 1973 (Ferrer & Casado 2004).

The natural park of the marshes of Santoña, Victoria and Joyel (SPA of Santoña, ES 0000143, and Hunting-free Area) is located in the eastern half of the Autonomous Community of Cantabria. This is an estuary formed by the conjunction of various rivers that empty into a large bay. The marshes cover around 4,500 ha which include about 2,000 ha of tidal waters and the large Holm oak woods and cliffs of Mount Buciero. The marshes are surrounded with pastureland and forest plantations that are located in a densely populated area. Osprey visits very often this estuary, with sightings all year round, including in winter (Pérez de Ana 2000, Ornithological annals of Cantabria).

Figure 3. Distribution of the main habitats (woodlands, openlands and wetlands) in the Urdaibai Biosphere Reserve.

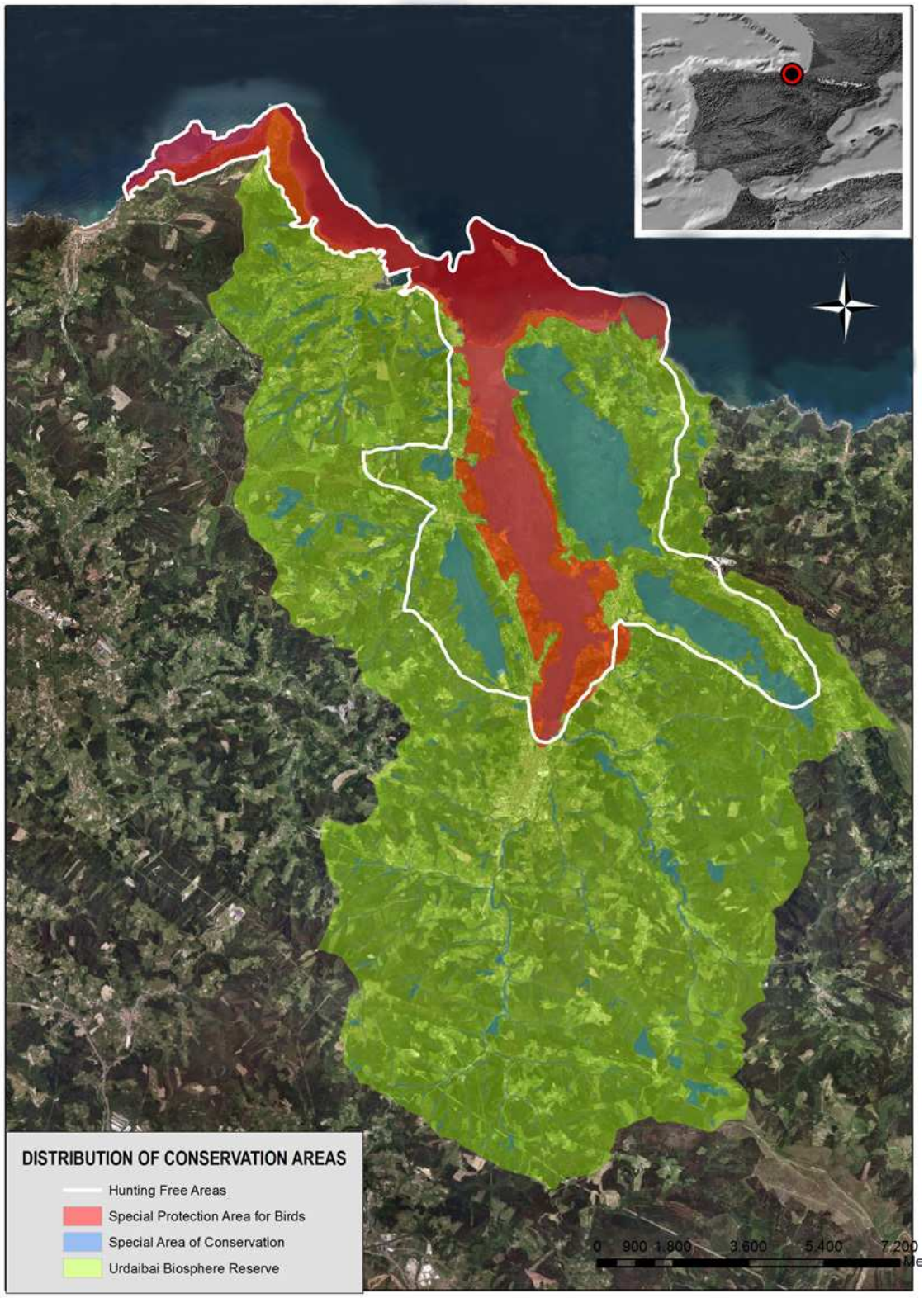

Figure 4. Distribution of the Hunting-free Area, the Special Protection Area for Birds, the Special Conservation Areas and the boundaries of the Urdaibai Biosphere Reserve.

5. OSPREY STUDIES AND MONITORING IN URDAIBAI

5.1. Phenology

The Basque Country is situated right in the middle of the migratory flight path of the ospreys that nest in Scotland, Germany and Norway in particular (Galarza 1997, Zwarts *et al.* 2009). The prenuptial migration takes place mainly between the beginning of March and the end of June, while the postnuptial, much more abundant, takes place from the end of August to mid November (Figure 5). In the Basque Country, the migratory and some rare wintering birds settle almost exclusively in the estuary of Urdaibai, the bay of Txingudi and the reservoirs in Álava.

Figure 5. Seasonal distribution of osprey sightings in the Basque Country (modified from Galarza 1997).

Ospreys are observed in Urdaibai all the year round, with a migratory pattern similar to that observed in general in the Basque Country as a whole (Figure 5). In Figure 6 we show the distribution of the sightings of birds over a total of 256 days of observation during the autumn period. The number of days they were recorded, and the number of birds seen is shown in Table 2. From the previous information it is possible to conclude that the osprey is a species with a regular presence in the Urdaibai estuary during the autumn migration (present on 74% of the days of observation), with a peak in migrants occurs in the second fortnight in September. Sometimes the estuary has been home to a minimum of 5 ospreys in one single day.

Figure 6. Seasonal evolution of the number of ospreys in Urdaibai from 20th August to 10th October during the period 2003-2007 (Garaita & Del Villar 2003-2007).

Table 2. Number of days with the presence of the osprey in Urdaibai between the 20th August and the 10th October in the period 2003-2007 (Garaita & Del Villar 2003-2007, Garaita 2009 & 2010).

Year	Nº days 1 bird	Nº days 2 birds	Nº days 3 birds	Nº days 4 birds	Nº days 5 birds	Total days
2003	25	10	5	-	-	40 (75%)
2004	27	8	1	-	-	36 (68%)
2005	7	13	10	5	4	39 (63%)
2006	22	13	10	-	-	45 (85%)
2007	26	6	-	-	-	32 (60%)
2008	31	13	4			48 (90%)
2009	25	14	1			40 (75%)
2010	31	4				35 (66%)
Total days	194	81	31	5	4	315 (74%)

The sightings of ospreys in the spring migration, although less, is quite regular, with recorded sightings common in March and April, while it is not uncommon to see birds until the beginning of the summer. In the spring and summer of 2006 a pair consisting of an adult female and a third year male developed courtship displays and feeding, and carried sticks, althought they didn't start building any nest (SEAR, *pers. comm.*).

5.2. Ringing of migrating individuals

During 2004-2010, seven ospreys were trapped and ringed with PVC colour rings in the Reserve of Urdaibai (Iraeta & Crespo 2010). From the information given by the reading of the rings and from information provided by three satellite tracked ospreys that stopped in the Reserve (Galarza & Dennis 2009; www.roydennis.org, http://icarusblog.es/2011/11/29/el-periplo-de-la-pescadora/), we know that some of the birds stopover for a considerable number of days and even weeks (2-36 days, n=14). Furthermore, it has been found that some ospreys repeated year after year stopover in Urdaibai, using the same roosts and foraging areas each time. This behaviour is determined by the fidelity of the ospreys to their stopover localities during migration (Alerstam *et al*. 2006, Dennis 2008), and even during wintering (Sayago 2008 & 2011).

5.3. Fitting an osprey with a satellite transmitter in Urdaibai

On April 16th 2010 an adult male was fitted with a satelitte transmitter in Urdaibai (http://icarusblog.es/2011/11/29/el-periplo-de-la-pescadora/). This osprey had been trapped and ringed two years previously in this Reserve. Thanks to the reading of the ring with alphanumeric codes it was determined that this individual occupied an specific area of the marsh each autumn, where it remained about ten days each stopover, before continuing its journey south. Back in March to the same area, this osprey remained two or three weeks before continuing to its breeding area in Scandinavia.

5.4. Analisys of diet and trophic availability

In the Basque coast, ospreys feed almost exclusively in the interior of estuaries. However, there are reports of them fishing at other points on the coast. In Urdaibai, the intertidal area is the habitual feeding habitat for birds that settle for periods of several days, mainly during migration.

The potential prey in the tidal areas of the estuary are the following species of fish: *Pagellus acarne, Anguilla anguilla, Balistes carolinensis, Arnoglossus thori, Solea vulgaris, Platichthys flesus, Pleuronectes platessa, Dicentrarchus labrax, Diplodus vulgaris, Lithognanthus mormyrus, Chelon labrosus, Mugil cephalus, Liza aurata, Liza ramada* and *Salmo trutta*. However, all the fish caught in Urdaibai that were identified belonged to the group of grey mullets (*Chelon spp., Mugil spp.* or *Liza s*pp.; Galarza 2010).

The fishing success in Urdaibai is 68.8%, although the percentages rises 92% when considering only adult individuals (Galarza 2010). The number of successful dives is 2.57, using on average 6.3 minutes per fishing event. The fishing success and the time needed to catch a prey can be considered similar or more successful to that observed in breeding areas (see Table 3).

Although fishing success may depend on other factors such as the weather conditions (Grubb 1977, Stinson 1978, Machmer & Ydenberg 1990), the tide (Ueoka & Koplin 1973, Castellanos-Vera & Rivera 2007), the individual experience and ability (Szaro 1978) or the ecology of the prey itself (Swenson 1979), a high rate of fishing efficiency is a good indicator of the trophic possibilities of the place, as a great abundance of prey increases fishing efficiency (Flook & Forbes 1983).

Tabla 3. Percentage of success and average time in fishing used by ospreys in Urdaibai and other localities

Location	Author	Period	% success	t (min)
Urdaibai, Basque Country	Galarza 2010	Migration	68.8	5,9
California,USA	Ueoka & Koplin 1973	Breeding	82	11,8
Florida, USA	Szaro 1978	Breeding	58	38,3
Wyoming, USA	Swenson 1978	Breeding	45-48	8,8-19,7
British Columbia, Canada	Steeger *et al.* 1992	Breeding	24-47	-
Australia	Clancy 2005b	Breeding	30	3,9
Baja California, México	Castellanos-Vera & Rivera 2007	Breeding	61	7,5
Navarra, Spain	Lekuona 1998	Wintering	65	-
Brazil	Silva & Olmos 2002	Wintering	71	-

5.5. Territorial use and analysis of habitat availability

Thanks to the monitoring of individuals ringed in Urdaibai and the data from the satellite-tracked birds, the individual osprey's ecological preferences have been mapped.

Figure 7 shows the fixes for a satellite-tracked osprey from Scotland, and the location of its night roosts. In addition, Table 3 shows the distribution of fixes of one of these satellite-tracked individuals (osprey 1, figure 7) according to activity and habitat.

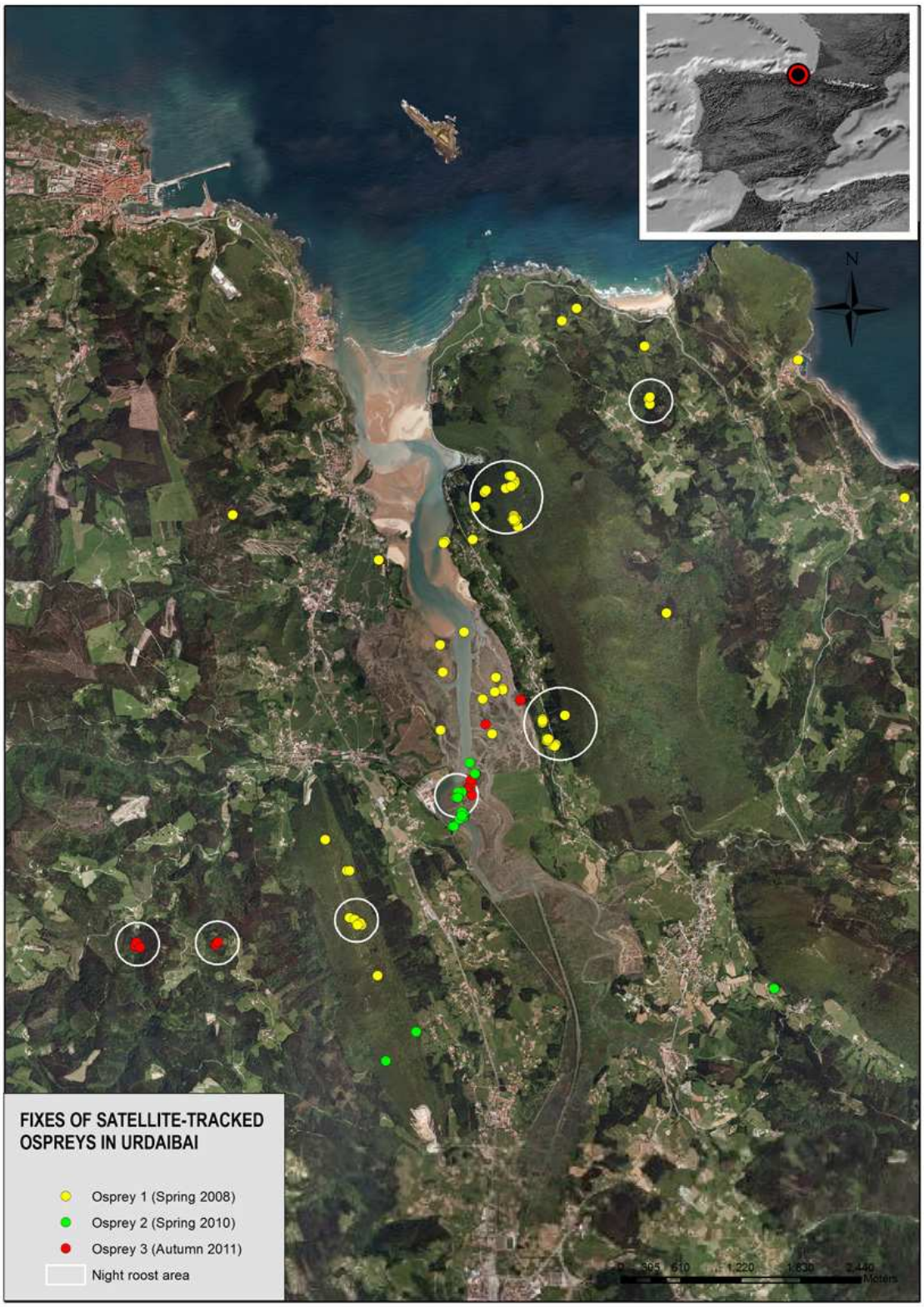

Figure 7. Fixes and night roosts of three satellite-tracked ospreys in Urdaibai

This osprey used mainly the woodland adjacent to the estuary as its area of resting and sleeping (Galarza & Dennis 2009). It seemed to prefer the Cantabrian holm-oak woods, 63.9% were in this type of wood of 122 fixes located in woodland. Furthermore, most of the night-roost was in the holm-oak woods or at the edge of them, often in the ecotone with old plantations of Monterey pines (Galarza & Dennis 2009). 52.5% of the fixes of this satellite-tracked osprey was in the Special Protection Areas, 35.8% in areas with a moderate protection and 10.3% in areas with lesser protection.

Table 3. Fixes of a satellite-tracked osprey according to activity and type of habitat in Urdaibai

Habitat	***Stop***	***Flight***	
Woodland	118	4	122 (84.1%)
Wetland	13	5	18 (12.4%)
Coast	4	1	5 (3.4%)
TOTAL	124	10	145

Since the ospreys choose their perches, and especially their night-roosts, according to a number of features (peacefulness, visibility, etc.) which could resemble the criteria that determine the choice of breeding points, we analysed the features of a buffer zone of 220m (Naylor and Watt, 2004; Toschik *et al*., 2006) from the night-roosts used by one of those satellite-tracked birds (osprey 1, Table 4). As previously mentioned, most of the roosts of this bird were in the interior of the oak woods, or at their edge, and generally less than a kilometre from the fishing area (Mean = 630.5 m) and away from roads (Mean = 231.8 m) and inhabited houses (Mean = 240.6 m) (Galarza & Dennis 2009). This information was used to select potential sites for the installation of artificial nests.

5.6. **Building artificial nests**

The availability of sites that are suitable for nesting is one of the factors that may limit an osprey population (Poole 1989, Ewins 1997, Saurola 1997, Schmidt & Muller 2008). The ospreys in Northern Europe nest in live or dead trees, and install their nests in the treetops (Poole 1989). As a tree substitute, they also can use a variety of artificial structures, especially pylons, most frequently in Germany nowadays (Sömmer 1995). The building of *ad hoc* structures to help ospreys with nesting was initiated by farmers in New England (USA) who wanted the ospreys to nest near their farms to keep other raptors away from their hens (Poole 1989). Since then, the building of artificial nests to

promote osprey nesting has extended to a great part of its breeding areas. Thus, for example, in the 1990s 42% of the nests in Finland and 50% of those in the US were built up on artificial platforms (Saurola 1995, Houghton & Rymon 1997). Thanks to this measure, populations have increased and extended their distribution area, as the artificial structures promote the settlement of new pairs, increasing productivity and providing new breeding points wherever there are few or no trees, or no suitable nesting structures (Castellanos *et al.* 1999, Dennis 2008, Bretagnolle *et al*. 2008). Moreover, the pairs that install their nests on artificial structures have better reproductive success than those that nest in trees, as a consequence of the better stability and inaccessibility of the artificial platforms (Van Daele & Van Daele 1982, Poole 1989). Finally, given their semicolonial behaviour (Löhmus 2001, Mougeot *et al*. 2002, Bretagnolle *et al*. 2008) and bearing in mind that ospreys are probably able to track the presence of conspecifics by watching their nests (Löhmus 2001), the installation of artificial nesting structures may benefit natural colonisation in regions where they do not yet nest (Nadal & Tariel 2008), and therefore forms an essential tool for any programme for reintroduction by translocation (Martell *et al*. 2002).

Following the experiences in other countries, six sites were chosen for the building of artificial nests (3 in the wetlands and 3 in the holm-oak wood) with the following criteria:

- Degree of peacefulness and difficulty of access. Places away from roads, inhabited buildings and busy paths are selected (>300 m).
- The osprey favourite spots (feeding points, night-roosts...). This is based on the use of habitat observed in migrating birds and the habits of the satellite-tracked ospreys in Urdaibai. The sites proposed in the wood are situated next to a satellite-tracked osprey's most frequently used night roosts (Galarza & Dennis 2009).
- The place selected and its surroundings (>300 m) should be within an area of maximum protection (Special Protection Area).
- Physical features of the place, related with the haunts of the species: the existence of a tree or suitable support, visibility, presence of places to perch etc.).

In addition, two artificial platforms were built in 2011 at the reservoir of Ullibarri-Gamboa (Basque Country), 40 km south to Urdaibai.

These artificial nests were built according to the recommendations of Roy Dennis, which are shown in www.roydennis.org. They are built in the top of prominent trees, using local materials to mimic a natural nest. Next to each nest a tree is prepared so that it can serve as a perch, or a perch have been placed there as required. In addition, decoys resembling ospreys have also been installed next to some of the artificial nests, which will be taken away as soon as breeding adults arrive in the breeding season.

Since their building in 2009, migratory ospreys in Urdaibai have often used these artificial nests for resting, eating and night roosting.

6. THE REINTRODUCTION OF THE OSPREY IN URDAIBAI BIOSPHERE RESERVE: FEASIBILITY APPROACH, PROBLEMS AND SOLUTIONS

6.1. Fundamentals

An osprey breeding population might be set up by encouraging the settlement of migrating individuals through the creation of ecological conditions (protection and adjustment of the habitat to the species requirements). However, due to the species strong philopatric character, it has been shown that the translocation of ospreys from other populations is the most effective way of guaranteeing that the birds will breed, as long as the area or region of the project has the required ecological conditions. The artificial displacement of fauna to restore or reinforce animal populations is a powerful tool for managing the natural environment, and can bring great benefits when carried out well.

In order for these artificial translocations to prove positive and not cause damage to the environment, the International Union for Conservation of Nature (IUCN) published a position statement in 1987 about the introduction, reintroduction and reconstitution of populations, and later produced the Guidelines for Reintroductions (1995).

This guide, that is not intended as an inflexible code of conduct, is based on an extensive review of numerous cases around the world and on advice from specialists in different fields. Its principle aim is to bring great rigour to the terms and designs used, and to help establish procedures and protocols in reintroduction programmes.

The IUCN's definitions are as follows:

- **Reintroduction** is an attempt to establish a species in an area that was once part of its historical range, but from which it has been extirpated or become extinct.
- **Translocation** is the deliberate and meditated movement of wild individuals to an existing population of conspecifics.
- **Reinforcement/Supplementation** is the addition of individuals to an existing population of conspecifics.
- **Conservation/ Benign Introduction** is an attempt to establish a species, for the purpose of conservation, outside its recoded distribution but within an appropriate habitat and eco-geographical area. This is a feasible conservation tool only when there is no remaining area left within a species' historic range.

According to these criteria, the translocation of individuals to the Reserve of Urdaibai would constitute a reintroduction. In which case, it would be a question of transferring birds to an area where the species regularly occurs as a migrant, or occasionally temporary resident, while en route between their breeding areas in the North of Europe and their wintering grounds, located mainly in Africa.

When should a reintroduction be carried out? According to the IUCN, a reintroduction can be made to enhance the long-term survival o a species, to re-establish a keystone species in an ecosystem (in the ecological or cultural sense), to maintain and/or restore natural biodiversity, to provide long-term economic benefits to the local and/or national economy, to promote public awareness about conservation, or any combination of these objectives.

The main objective of this plan is to set up a reproductive population of ospreys (*Pandion haliaetus*) in the Basque Country. This main objective is specified in the following sub-objective:

- To restore the osprey as a breeding species in the Basque Country
- To increase the osprey area of distribution and promote the connectivity between French and Southern Iberian populations.
- To contribute to social awareness about the conservation of the osprey and about biodiversity in general.
- To promote the image of the Urdaibai Biosphere Reserve and ecotourism.

6.2. Feasibility plan

6.2.1. Previous reintroduction projects

The osprey has been the subject of numerous reintroduction programmes in its area of distribution in North America, where the species suffered a severe drop in numbers, principally as a result of the use of pesticides (Poole 1989, Ewins 1997, Toschik *et al*. 2005). Hacking was the method used in all these projects, a technique that consists of the reintroduction of the species by translocating nestlings born in captivity or collected from a wild population and gradually releasing them in the selected area (Nye 1983). The first osprey reintroduction programmes were carried out in the states of Pennsylvania and Tennessee (USA), where a total of 110 and 165 chicks were released during the 1980s (Rymon 1989, Hammer & Hatcher 1983). Both projects were

successful and by 1988 there were already 12 nesting pairs in Pennsylvania and 77 in Tennessee by 1996. Up to now there have been various reintroduction projects in twelve American states and there are initiatives to extend the osprey population to the whole of the United States. Such is the case of South Dakota where in the period 2004/2010, 91 birds have been released in a reintroduction project (Horton 2003). The technique is so widespread and accepted now that it has even been suggested that the reintroduction of the species could act as an instrument for predicting the impact of pesticides on a possible reintroduction of the bald eagle (*Haliaetus leucocephalus*; Henny 2001).

As a result of the success of the American reintroduction programmes, Poole (1989) recommended the translocation of birds in Europe too as a method of extending populations and reducing their vulnerability. In Europe the first reintroduction programme was one carried out in Rutland Water (England; Dennis & Dixon, 2001). This project started with the building of 5 artificial nests in 1995. Between 1999 and 2001, following the protocol carried out in the United States, the technique of hacking 64 chicks taken from nests in a donor population, in this case Scotland, was applied. In 2001 the first pair bred successfully in Rutland Water and five pairs nested in 2011; while the translocation resulted in the return of the osprey as a breeding species in Wales (www.ospreys.org.uk). The second European project started in 2002 in the south of Spain (Ferrer & Casado, 2004), where 164 birds from Finland, Germany and Scotland were released during the period 2003-2012. In 2005 first breeding attempts were recorded (Muriel *et al.,* 2006), and in 2009 first breeding successes (Muriel et al. 2010). In 2012 a minimum of seven pairs were breeding in the area (Migres foundation *com. pers*.). The third project was started in Italy in 2003 with the building of artificial nests and the transfer of birds from Corsica to the National Park of La Maremma (Tuscany) in 2006 (Monti & Troisi 2008, Monti *et al.* 2012). The last project is still in progress and started in 2011 at the Alqueva reservoir (Alentejo, Portugal) with the release of 10 birds translocated from Sweden and Finland (Palma & Beja 2011).

Therefore, there is a considerable amount of experience on the most appropiate and effective methods to conduct a reintroduction programme. Moreover, previous reintroduction programmes have demonstrated no major negative impacts on local communities, which promotes social acceptance of osprey reintroduction.

Table 6. Period, number of translocated birds and year of the first successful breeding in several reintroduction projects already completed.

Locality	Period	Individuals	1st breeding year
Minnesota (USA)	1984/1995	143	4th
Pennsylvania (USA)	1980/1986	111	6th
Rutland Water (England)	1996/2001	64	5th
Andalucía (Spain)	2003/2012	164	6th
La Maremma (Italy)	2006/2011	33	5th

6.2.2. Analysis of potential threat factors in Urdaibai

The possible factors that could threaten the osprey in Urdaibai can be classified into those that represent a direct threat and those that are a diffuse threat, from the point of view of not causing direct death of the birds but which reduce the chances of establishing a breeding population. The analysis of all these risk factors is essential for deciding on the chances of success for any translocation programme, as well as for trying to correct any threats that are thought to be serious.

The direct threats are those that cause non-natural death in ospreys. Among these the most important are illegal hunting, electrocution or collision with power lines, poisoning and accidents involving fishing tackle. In Scotland it has been calculated that around 90% of adult birds survive each year and that approximately 40% of birds reach reproductive age (Dennis 2008).

6.2.2.1. Illegal hunting

Hunting pressure on ospreys has decreased notably in the last few decades, especially since the 1970s (Poole 1989, Saurola 1994). However, illegal hunting can still be considered a danger for the species, and for this reason should be evaluated for its potential effect on any possible reintroduction project.

Hunting is prohibited from February to mid-August in the whole territory of Biscay. In Urdaibai, hunting is banned in around 5,500 ha (Hunting-free Area), which include all the marshlands and the coastal areas, as well as the Cantabrian holm-oak woods and the intermediate areas of farmlands between these oak woods and the marshes. In the rest of the area under the rules of Urdaibai, hunting activities are regulated in a Controlled Hunting Area.

Both in the Reserve and in the adjacent areas the most common forms of hunting are for wild boar (*Sus scrofa*), woodcock (*Scolopax rusticola*), and migratory thrushes (*Turdus philomelos* and *Turdus iliacus*) and woodpigeon (*Columba palumbus*). This latter form of hunting is the only one that poses a potential risk for the osprey as it is sometimes practised near the seacliffs, which the ospreys may approach in their migratory movements. However, hunting for woodpigeons and thrushes is allowed only between October and December, when the local ospreys will have left for their wintering grounds. Furthermore, in last two decades there has not been any recorded death by shooting of ospreys in all the territory of Bizkaia.

In conclusion, hunting cannot be considered an important risk factor for the settlement of the osprey as a breeding species in Urdaibai.

6.2.2.2. Power lines

Both pylons and power lines pose a serious threat to the conservation of birds with a large wingspan (Janss 2000) and therefore represent a risk that must be taken into consideration for the conservation of ospreys. Electrocution is the main cause of death in the local population of Corsica (Thibault *et al*. 2001) and also in migrating individuals through Italy (Rubolini *et al.* 2005). Several cases of death by electrocution have been reported in Spain, especially in the population of the Balearic Islands (Viada & Triay 1999, Triay *et al*. 2004). Therefore, the removal of the electricity lines around wetlands which ospreys frequent is one of the measures proposed for the conservation of the osprey in Spain (Triay & Sivero 2004).

The Urdaibai Reserve is an area scattered with many small towns, villages and isolated houses that generate intricate electricity network which is a serious risk to large birds, especially herons, storks and raptors. The danger that this may pose to certain group of birds in Urdaibai is borne out by the results obtained during the reintroduction process of the white stork (*Ciconia ciconia*; Galarza & García 2012). Then it was found that at least 20% of the storks released in the Reserve died as a result of accidents with power lines (4 storks were electrocuted and 3 died of collision). Furthermore, the dangers of the electricity network situated in areas commonly frequented by ospreys during their stay in Urdaibai are further underlined by the electrocution of one at Cape Matxitxako in May 2005.

Under the technical direction of the Urdaibai Reserve, a map was made in 2002 of the location and features of each of the electricity pylons in the Reserve, with an inventory

of all the supports. In addition, an evaluation was made of the risks posed to the bird life together with recommendations for their correction. Thanks to a financial settlement between the Biodiversity Agency of the Basque Government and the company Iberdrola, anti-collision beacons were installed on 13 km of power lines and corrections were made on 128 poles (Basque Government 2007-2008). More recently, 2.5 km of power lines and 44 poles were removed as part of a marsh restoration promoted by the board of Urdaibai (Basque Government 2010). Therefore, nowadays the risk of electrocution is minimized considerably in the Urdaibai Reserve (Basque Government 2009).

Among the lesser threats, i.e. those that do not provoke death but reduce the average capacity to guarantee the establishment of a breeding population, the more important are Anthropisation of the territory, destruction of the habitat, low availability of trophic resources and pollution.

6.2.2.3. Anthropisation of the territory

Animal disturbance by human activities can induce behavioural changes that could impact the populations dynamics and conservation state of rare and/or endangered species (Platteeuw & Henkens 1997, Frid & Dill 2002), and appears to be a major conservation problem in most protected areas (Le Corre *et al*. 2009). Recreation, sports and tourist activities are among disturbances (walking, seashell gathering, canoeing, boating, etc) that produce negative effects on birds (Le Corre *et al*. 2009).

Numerous studies have shown that human interference can cause ospreys to abandon their nests or to fail to reproduce, especially when this consists of sudden interruption during incubation (Poole 1981, Levenson & Koplin 1984, Vana-Miller 1987, Saurola 1997, Triay *et al.* 2004). Therefore, the degree of human presence should be studied as a limiting factor in a reintroduction programme.

The Urdaibai Reserve had a population of 44,784 inhabitants in 2006. This means a density of 140 inhabitants/km^2, well below the general density of the population in Biscay (598 inhabitants/km^2) and the Basque Country (288 inhabitants/km^2). However, despite the fact that almost 75% of the population live in the towns of Gernika and Bermeo, the Urdaibai Reserve may be considered a moderately humanised space. The Reserve has a good scattering of small towns, villages and isolated houses and has an intricate network of paths, tracks and roads. Also, its coast and beaches are a growing source of attraction to thousands of people at the weekend and in the summer. Although most of this pressure falls mainly on certain areas, some leisure activities may put high levels of stress on the wildlife,

and in particular on the osprey. The effect of human activities on a possible reproduction of the species will depend on whether the potential placing of nests or the feeding areas is affected.

In the estuary, the nuisance deriving from human activities are much more intense than in the woods, because of the multitude of uses, mostly recreational, that go on (trekking, shell-fish gathering, fishing, sailing, water sports, etc). The effect of human nuisance on the estuary has been evaluated in relation to the autumn presence of the migrating spoonbills (*Platalea leucorodia*; Del Villar *et al.* 2007). Among the disturbances that could affect the fishing efficiency of the osprey, the most serious are amateur and semi-professional fishing (fishing from a boat and shellfish gathering), and sporting activities (canoeing mainly). Despite the limits on use permitted in this Special Protection Area, most of the activities take place without any special regulation. In fact, the only two measures of active management pertain to the transit of boats, regulated by law 5/1989 of the Urdaibai Ordinances and the bans on shellfish gathering decreed annually by the Basque Government. The former is wholly inadequate as it only regulates the speed of motor boats, without there being any areas or periods when the entry of boats to particular parts of the estuary are restricted to help the nesting or migratory birdlife. Thus, for example, it has been shown that the intrusion of canoes and boats into the secondary canals of the estuary are two of the worst causes of stress to migrating spoonbills (Del Villar *et al*. 2007). The latter measure of regulation affects the collecting of shellfish and other invertebrates in the estuary. This practice has also been described as one of the most important causes of stress in migrating spoonbills (Del Villar *et al*. 2007). However, the incidence of this stress factor is much smaller during the months of osprey breeding reproduction (April-July), as shellfish gathering finishes at the end of April. Although it is unknown how far these nuisance factors could affect breeding, the ospreys that stop in Urdaibai during their migration “show reasonable tolerance to the approach of boats, canoes or shellfish gatherers" (Del Villar & Garaita 2005). However, taking into consideration the stress that these activities cause to the birds (Del Villar *et al*. 2007), it would be desirable to have more strict regulations of the fishing and leisure activities during the osprey’s breeding period. When the first attempts occur a buffer zone around the nests will be set up under the Law for the Conservation of Biodiversity in the Basque Country during the critical period, so that access to the breeding area will be restricted, as has happened in many

other places (Naylor & Watt, 2004), and is also applied nowadays around the nests of the Egyptian vulture (*Neophron percnopterus*) in Biscay.

Preliminary information on the habitat use of ospreys stopovering in Urdaibai supports the hypothesis that the Cantabrican holm-oak woods (Special Protection Area), that line the banks of the estuary, could provide suitable habitat for osprey nesting. In this habitat the only activities permitted are some recreational uses and the forestry conservation and regeneration of the woods, with motor vehicles expressly forbidden. There are two recreational uses that might affect the reproduction: trekking and rock climbing. Currently, trekking in the oak woods is of low intensity and, because of the special features of the area the paths run through (highly dense coverage of trees) it does not seem to pose a threat to the reproduction of the osprey. Rock climbing is banned on the seacliffs during the breeding season in accordance with the management plans for the European storm petrel (*Hydrobates pelagicus*) and the shag (*Phalacrocorx aristotelis*; decrees 112/2006 and 116/2006 of the County Council of Biscay). Here it is worth pointing out that in recent years the necessary measures of guardian and signposting have been taken to prevent climbing during the breeding season of rock-dwelling birds of prey and sea birds. Thanks to these measures, in 2008 the Egyptian vulture (*Neophron percnopterus*), an species that is severely affected by disturbance around the nest (Zuberogoitia *et al.* 2008), bred successfully in Urdaibai, the first time that this has happened in the area. In addition, forestry activities in this Special Protection Area do not constitute a threat for the reproduction of the osprey, as they are practically nonexistent and limited to small scale thinning of trees for firewood at the periphery, given the difficulty of access to this area and the strict regulations of the governing plan of Urdaibai. Moreover, since the osprey may nest several kilometres away from foraging areas much of the Reserve of Urdaibai, which is 67% covered by trees, is potential nesting habitat. Although much of these forests area located outside the areas of highest protection level, current legislation allows the establishment of ad hoc measures to ensure the protection of sites around the nests.

It has been observed that the effects of human nuisance are closely related to the level of habitat of the pair concerned (D'Eon & Watt 1994). Consequently, the pairs that nest or have nested near areas with frequent human activity, or start incubating when human activities are already being carried out close by, are often more tolerant of the disturbance (Van Daele & Van Daele 1982, Poole 1981). For this reason, in areas that are intensely humanised it has been suggested that it would be a good idea to get the translocated

chicks used to a certain degree of human presence during their stay in the *hacking* tower (Dennis 2008). It is also noted that ospreys now breeding in the United Kingdom, often do so successfully in areas with high levels of human activity, often within in relatively close proximity (eg 200 metres) (R. Dennis *pers. com*.)

We conclude that some human activities could cause stress in breeding ospreys in Urdaibai, although these could be minimized adopting further protection measures.

6.2.2.4. Destruction of habitat

Although drastic changes in habitat can change their abundance and distribution, (Ewins *et al*. 1995), ospreys are capable of tolerating great changes in landscape as long as they still have structures suitable for building their nests (Naylor & Watt 2004).

Human activity in this area has caused great landscape changes in recent history. Until the middle of the 20th century the territory was intensely given over to agriculture and dairy farming, while the areas covered by forests were scarce and fragmented. Moreover, the intensification of agriculture and civil engineering (railways and canals) brought the construction of dykes and drainage channels and the occupation of marginal lands on the estuary. The historic deforestation of the territory got worse at the beginning of the 20th century and affected the Cantabrian holm-oak woods especially, which became greatly deteriorated as a result of intense brushwood clearing.

In the second half of the twentieth century there was a gradual abandonment of farming and fishing activities, and at the same time firewood was substituted by other sources of energy and there was intense reforestation with fast-growing trees (at first mainly all *Pinus radiata*, and in recent decades *Eucaliptus globulus*) (Ainz & González 2008). The general result is that of a landscape with more and more forest where there is a lack of autochthonous stands of trees and where the farming and dairy activities are considered marginal. This increase in forest area has led to a marked increase in the abundance of all species of raptors in the two last decades (Zuberogoitia *et al.* 2011).

Currently, all the feeding areas and most potential breeding areas of the osprey in the study area have been declared protected areas and, as a result, there exist legal instruments to guarantee the conservation of the habitat. Furthermore, from the analysis of the use of the territory by satellite-tracked ospreys, it is possible to presume, although provisionally, that there is a great coincidence between the legal figures of protection and the habitat use of the species in Urdaibai (Table 6; Galarza & Dennis 2009).

Tabla 6. Distribution of fixes of a satellite-tracked osprey in Urdaibai during 2008 spring (see 4.1.)*

Level of Protection*	**Area (has)**	**Nº fixes**
High (Special Protection Areas)	2,595.8	100 (68.9%)
Medium	1,599.8	41 (28.4%)
Low	8,586.2	3 (2.08%)

In addition, there are currently several projects to restore marshland (Basque Government 2011), and other already completed projects (Basque Government 2007-2008) that are recovering brackish lagoons, which are already being used by ospreys as fishing areas.

6.2.2.5. Low availability of trophic resources

The quantity of trophic resources that are available can be a limiting factor for maintaining a breeding population. In Urdaibai, ospreys feed mainly on mullets (*Chelon spp., Mugil spp.,* and *Liza spp*.; Galarza 2010). This group of fish is certainly the most abundant in the estuary, with a density apparently much higher than any other species present in the breeding areas of the North of Europe (Roy Dennis *pers. comm.*). The great abundance of mullets, the efficiency of fishing observed (Galarza 2010), and the continued presence of various ospreys in the estuary during both migratory trips enables us to deduce that the trophic resources do not constitute a limiting factor for establishing a breeding population in Urdaibai.

6.2.2.6. Pollution

Reproductive failure as a result of the bioaccumulation of toxic substances has in the past been one of the most serious causes of the decrease in the worldwide population of ospreys (Spitzer *et al*. 1977). As a result of the eradication of organochlorate pesticides (DDT), the species has partially recovered its area of distribution. However, despite the fact that the osprey can successfully breed in places that have been exposed to high levels of contamination (Rattner *et al*. 2008), the great persistence of DDT, as well as exposure to other pollutants such as polychlorinated biphenyls (PCBs) or mercury, it is still a factor that can limit its reproductive success in some regions (see for example Toschik *et al*. 2005). It is therefore necessary to find out the level of contaminants of the potential prey of the osprey in Urdaibai to be able to see

whether this could be a limiting factor to the breeding success of the species in the area.

Díez (1996) analysed the levels of metals (Ni, Pb, Cr, Cd, Cu, Fe and Zn) and the organic components (PHAs, PCBs, DDT, lindane) in muscle samples of flounder (*Platychthys flesus*) in various points of the estuary of Urdaibai. According to this author, the concentrations of metals and organic chemical compounds in the tissues of the *Platychthys flesus* in Urdaibai were found to be within the ranges seen in other studies (ICES 1980 and 1984, Murray & Norton 1982, Murray & Portmann 1984, Franklin 1987). Furthermore, this author considers that the bioaccumulated levels of metals and organic chemical compounds indicate a low bioavailibility of pollutants, particularly clearly for DDT and lindane, which have not been found in detectable quantities. Moreover, the monitoring network for the ecological state of the transition and coastal waters of the Basque Country (URA 2011) reported that, except for nickel, there are no cases where metals reached levels that could potentially be dangerous for organisms. Even in the case of nickel, concentrations were close to the lowest regional ranges and meets quality control objectives. Finally, an important improvement of water quality in Urdaibai is expected, once the runnning wastewater treatment planning is completed.

Therefore, we conclude that pollution cannot be considered an important risk for an osprey breeding population in Urdaibai.

6.3. Basic recommendations that should be satisfied in every reintroduction project (IUCN 1998) and its fulfillment in the Urdaibai Reserve

6.3.1. Target site for reintroduction should be within the historic range of the species

The osprey currently has big populations in northern Europe andsmall isolated groups in southern Europe, with this distribution being the result of long term persecution due to the bird competing with humans at fish ponds from the Middle Ages onwards. In the absence of persecution, the European distribution was considered to extend from the Artic circle to North Africa (Voous 1960, Dennis 2008). The analysis of fossil remains throws little light on this, as this is a species that appears very little in Pleistocene sites (Zachos & Schmölcke 2006). In fact, although it has been reported in Atapuerca (1.2-1.3 million years) (Research Team, Atapuerca 2008) it does not appear in any of the archaeological sites on the Mediterranean coast in its area of recent distribution (Sánchez 1996). Osprey sculptures are engraved in several Romanische churchs located in Northern Iberia Peninsula. Thus for example, there is in Santa María de Tiermes (Montejo de Tiermes, Soria), in San Martín de Mondoñedo (Foz, Lugo) and in the Colegiata de Santa Juliana (Santillana del Mar, Cantabria) (A.Galarza, *obs. pers*.). Althought it is not proof of breeding, it can be considered as evidence that the osprey was a familiar species for the inhabitants of Northern Iberian Peninsula during the XII century.

Ospreys breeding in the North of the Iberian Peninsula are reported in Ribadesella (Asturias), where a pair nested until 1960 (Bijleveld 1974). More recently (1973), a sighting was reported of an osprey bringing material to its nest in a reservoir in the Basque Country (Ferrer & Casado 2004), and later we know of failed attempts at breeding in two places in Huesca. The most recent was in 2005, when a pair of ospreys built their nest at the reservoir of Barasona (Lorente 2005). There also exist sightings of a pair showing breeding behaviour in the Urdaibai Reserve itself (SEAR *pers. comm.*). Right now, the nearest reproductive population is in France, 600 km north of Urdaibai, and is formed by 25-30 breeding pairs (Wahl *et al*. 2008).

6.3.2. Identification and elimination, or reduction to a sufficient level, of previous causes of decline

It has been hypothesized that the last North Iberian breeding pair dissapeared due to direct human persecution. Although it is not possible to identify with certainty the

causes of extinction at local level persecution would have been an important factor in previous centuries. However, given the characteristics of the osprey's nests and the important role of forest management in its conservation (Saurola 1997, Ewins 1997), it is worth hypothesizing that the intense processes of deforestation and/or forest management that happened in the region was the cause of the destruction of the nests, as a result of pillaging or the removal of suitable platforms for breeding. In fact, one of the limiting factors for the osprey in Urdaibai that has been already identified is the lack of tancient rees of the right size and shape to be used as nest siting (R. Dennis, *pers. comm.*).

Nowadays, the legal orders that protect the species as well as those that protect the Reserve mean that we can discard the option of direct hunting or destruction of the breeding and feeding habitats as a potential risk. Moreover, the lack of suitable sites for nesting may be countered perfectly well by the building of artificial platforms (Martell *et al*. 2002, Dennis 2008) and the maintenance of large trees.

Finally, regulations aimed at reducing disturbance resulting from human activity have been adopted throughout the Special Protection Area (Basque Government 2012).

6.3.3. The area should have sufficient habitat resources to sustain a viable population

Taking into consideration the trophic capacity, the size of the estuary and the large surface area of woodland that borders onto it, it is estimated that Urdaibai has the capacity to sustain a reproductive nucleus of about 8-10 pairs of ospreys, as long as nesting platforms are built at the start, present protection of the habitat is maintained and measures are taken to reduce disturbance from human activities during breeding season. Moreover, the initial population could expand towards other nearby locations which are equally suitable for the species, giving rise to a system of small reproductive populations spread out over the estuaries along the Bay of Biscay and also in many reservoirs (Sobrón, Aguilar, Ullibarri-Gamboa, Undurraga, etc.), which would create a viable population in the North of the Iberian Peninsula. Importantly this would create a 'bridging' population between southern Iberia and France, and lead to an increasing population in southern Europe.

6.3.4. The birds used for the reintroduction should ideally be closely related genetically to the original native stock

The genetic studies up to now indicate the existence of a single genetic pattern in the European osprey (see Ferrer & Casado 2004). Moreover, any possible natural recolonisation of the North of the Iberian Peninsula could be expected to come from the flourishing Northern subpopulation, given the geographical situation of the area that puts it right in the migration route and also considering the non-migratory habits of the Mediterranean subpopulation. Therefore, the reestablishment by translocation of a reproductive population of ospreys in the Basque Country from birds originated in the North of Europe would only accelerate a process of recovery.

6.3.5. The removal of individuals for reintroduction must not endanger the wild source population

Poole (1989) considers that an annual productivity of 0.8 chicks per pair is sufficient for maintaining a stable population, so it is essential that the donor population have at least this level of productivity. The average productivity of the population in Finland has been estimated at 2.1 and that of Scotland at 1.43 young per nest per year (Saurola 1997, Dennis 2001). Since these productivities are above the threshold considered sufficient to ensure the maintenance of their populations, these two countries can be considered potential donors in any reintroduction program. Moreover, these populations have increased in the last decades (Figures 9 and 10). In fact, the two countries mentioned donated birds to the reintroduction project that took place in the South of Spain (Ferrer & Casado 2004). In some ways, the westernmost population in Scotland may be the closest in migratory tracks to the Basque country. In any case, experts from the donor country should evaluate the impact of the extraction of nestlings from the wild population.

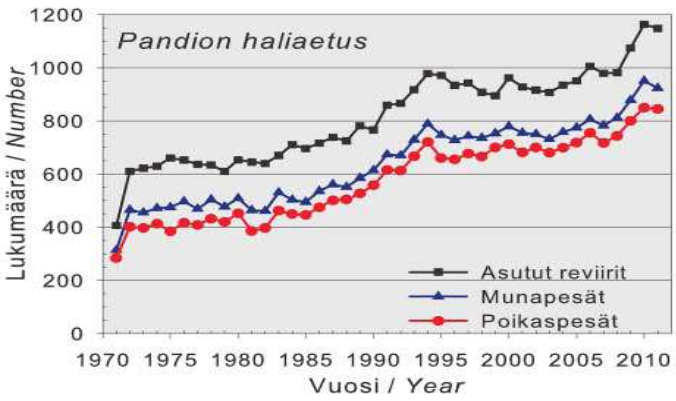

Figure 9. Number of successful nests (Black), Number of territories (blue) and Number of occupied nests (red) of Ospreys in Finland during 1979-2010 (Saurola 2011).

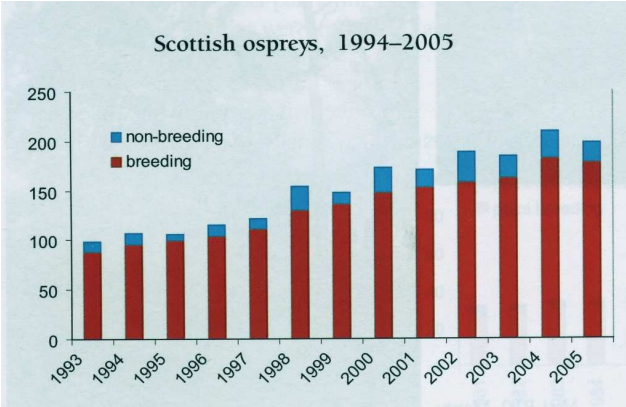

Figura 10. Number of pairs of Ospreys in Scotland during 1993-2005 (Dennis 2008)

7. REINTRODUCTION PROGRAM

7.1. Criteria to choice the reintroduction area

We selected the Urdaibai Biosphere Reserve (Basque Country) based on the combination of technical and biological reasons:

a) Its status as protected state.

This is a Biosphere Reserve and a Ramsar site, with an area of 220 km^2. The Reserve includes a Special Protection Area (SPA ES0000144) and three Special Conservation Areas (ZEC ES2130007, ZEC ES2130008 and ZEC ES2130006).

b) Good availability and abundance of preys.

It has high prey availability, as well as a high fishing success of migratory ospreys when at stopovers in Urdaibai (Galarza 2010).

c) Good availability of nesting sites.

Forested areas in the Basque Country occupy 55% of its territory, one of the highest rates in Europe. Furthermore, the Reserve has its 67% covered by forests, which ensures sufficient substrate for nesting. In addition, in recent years there have been installed artificial platforms in order to encourage nesting.

d) Its ideal location on the migratory flyway.

This favours the stopping off migrating subadult ospreys, especially those moving from Scotland, Germany and Norway, and therefore increases the chances of success. During the last decade more than a hundred sightings occurred in the Urdaibai Reserve.

e) Proximity of other suitable areas for the reproduction of the species.

Most of the localities in Northern Spain that are more assiduously visited by migrating or wintering ospreys (Natural Park of the marshes of Santoña, Bay of Santander, Bay of Txingudi, Sobrón reservoir, river Ebro and reservoirs of the river Zadorra) are located in a 100 km radius around the selected area.

g) Low level of threat.

Hunting is permanently prohibited (5,500 ha of Hunting-free Area), most of the power line infrastructure has been corrected, water quality is acceptable, habitat conservation is guaranteed and disturbance due to human activities is being controlled.

h) Good technical and logistical conditions.

There is a prior existence of a working team with experience on ospreys and facilities that favour the project (Urdaibai Bird Center, www.birdcenter.org). This working team

is currently developing several educational activities that involve local schools. Moreover the Urdaibai Bird Center is one of the founder participants in the educational project *Linking Schools and Communities* led by *The Osprey Migration Foundation* (UK).

7.2. Multidisciplinary working team

Director Executive:

Dr. Aitor Galarza (Aranzadi Society of Sciences)

General coordinator:

Juan Antonio Dublang (Environmental Department, County Council of Biscay)

Logistical coordinators:

Jose María Unamuno (Urdaibai Bird Center/ Aranzadi Society of Sciences)

Aitor Uriarte (Environmental Department, County Council of Biscay)

Scientific coordinators:

Dr. Íñigo Zuberogoitia (Icarus/ Aranzadi Society of Sciences)

Dr. Juan Arizaga (Urdaibai Bird Center/ Aranzadi Society of Sciences)

Field biologists:

Ainara Azkona and Edorta Unamuno (Urdaibai Bird Center/ Aranzadi Society of Sciences)

Programme of educational outreach:

Xarles Cepeda and Jon Maguregi (Urdaibai Bird Center/ Aranzadi Society of Sciences)

Veterinary care:

Ana Pérez (Private veterinary clinic)

7.3. Method

The system used is the translocation of nestlings from another region and its maintenance in captivity (hacking) until release in the area. Translocated chicks are kept in cages (hacking tower) (as used successfully at Rutland Water and Andalucia) where they are fed without being able to see their caregivers. The young ospreys remain in the hacking towers until they are able to fly, and then they are released. During the captivity and pre-migration periods, chicks become imprinted on the area. As a result, the young ospreys consider the release site as their natal area, which will favour the return to the Basque Country, due to the intense philopatric behaviour of the species.

There will be released at least 12 chicks each year for five consecutive years (60 birds in total). During first year most information about possible threats will be gathered and then possible changes in program will be considered.

One chick from broods of 2 – 3 nestlings in the donor population will be removed when they are about 6 weeks old. Chicks will be chosen on age, size and good physical condition, and as males exhibit a greater philopatry (Martell *et al*., 2002), the ideal proportion of sexes has been suggested to be of 75% males and 25% females.

Once the chicks are removed from the nest they will be flown by air to Madrid and then the short distance by road to Urdaibai. During transport, the individuals will be looked after with special care. The chicks will be ringed and identified in the donor country, and will be measured and weighed, before being put in the hacking tower.

7.3.1. Hacking tower

A tower for the release will be built up in an open place located on a soft slope at less than 100 meters from the marshes. The slope favours the visibility of the chicks because it increases the height of the tower over the fishing area. The front has to be without tree or shrub vegetation, what is very important for avoiding the accidents during the first weeks of flight and for facilitating the recovery of the individuals that could have difficulties at first.

The tower for the release will have a maximum height of 4 m, including the scaffolding and the crate where the nests are (Fig. 11 and 12). This crate will be made of wood and its dimensions will be 8 x 1.5 x 1.5 m height and it will be divided into 4 sections. The rear part of the cage will include a small section of one-way glass for observing the young, without being seen by the birds. Fresh fish will be passed through a plastic pipe to a feeding area for the young. The upper part will be made of metal net of 2 x 2 cm mesh, covered partially to protect the chicks from downpours. The front and side panels will be made of plastic net (or metalic net covered by plastic) of 2.5 x 2.5 cm mesh. The panel between cages is solid to prevent broods seeing each other. The sides of the tower will be made of wood, for avoiding the possibility of seeing the project staff. The front of the cages will be hinged at the base to allow the easy and silent opening through ropes on the day when they will be released.

In front of the hacking tower four platforms on poles will be built, resembling nests that will be used as feeding places during the first weeks after the release of the individuals. A system with a closed circuit of video-vigilance will be installed and will be monitored from a control point located away from the hacking tower. This control point will also be used as a laboratory where the personnel responsible for doing the work of taking care and feeding will prepare the daily food.

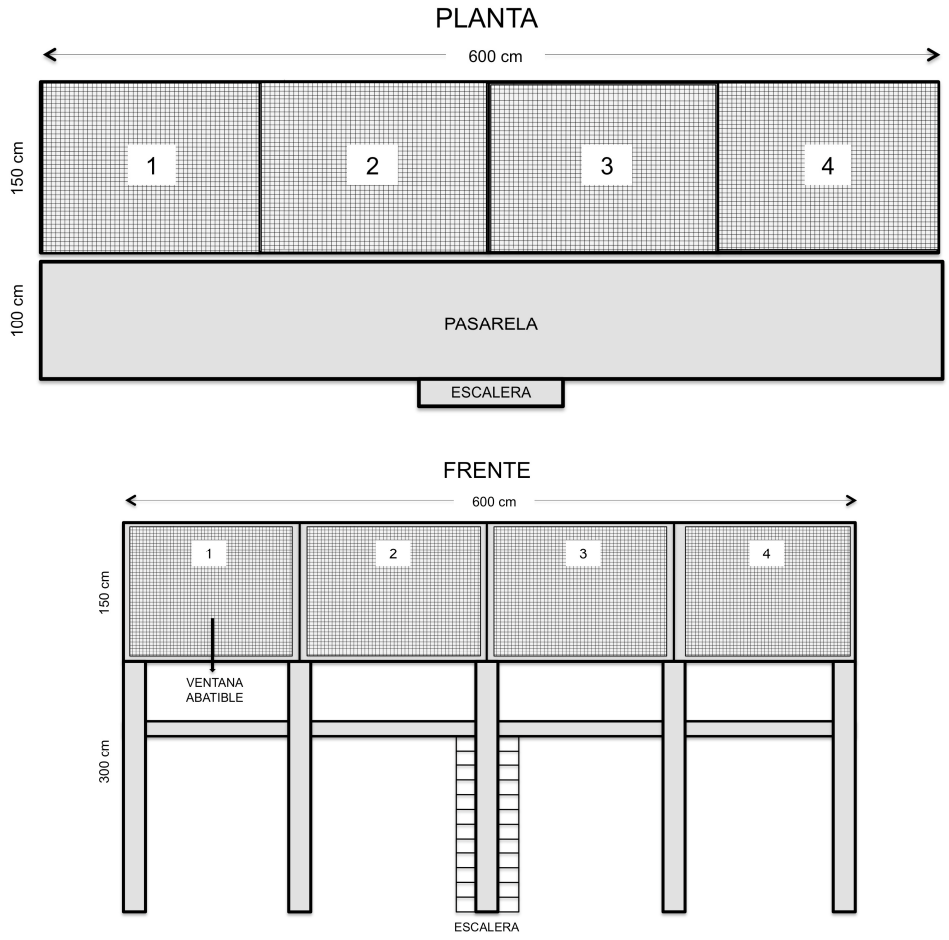

Figure 11. Hacking tower: plant and front view

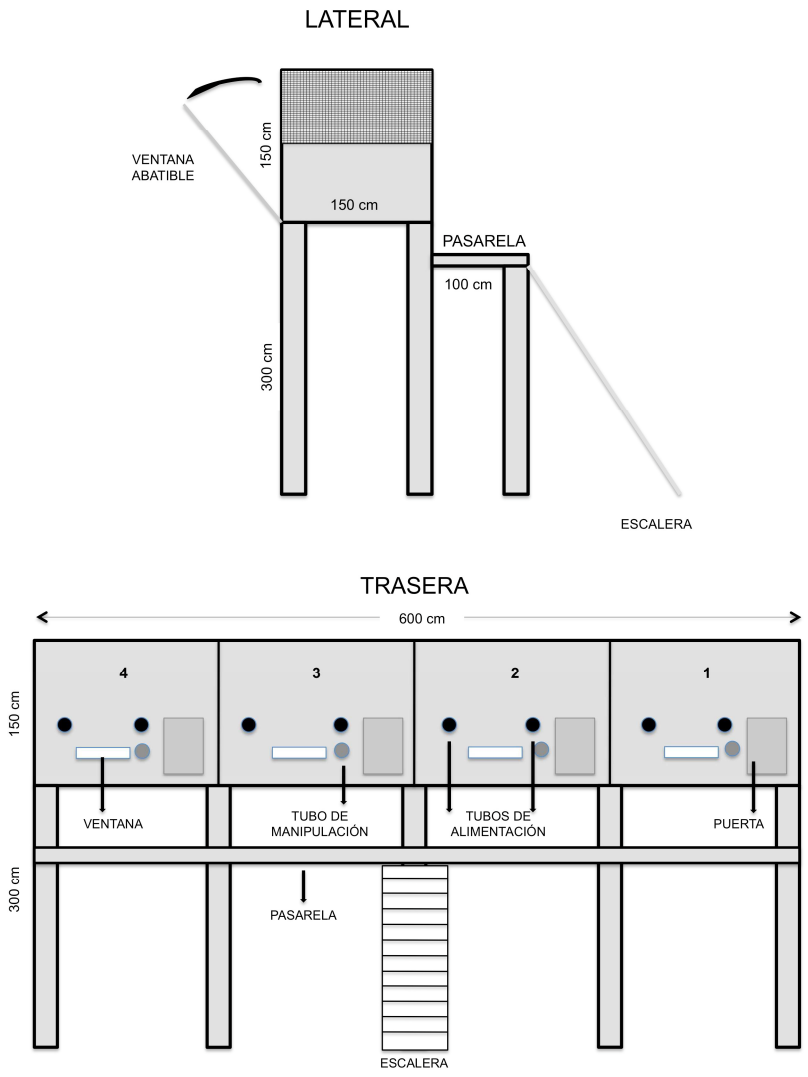

Figure 12. Hacking tower: lateral and back view

7.3.2. Maintenance

The nestlings will be carried to Urdaibai in the middle of July and they will remain in the hacking tower at least three weeks. During their stay in the tower they will be fed twice in a day, at dawn and at dusk, with fresh fish. The food will be supplied until the chicks are satisfied (about 500 g/day for each nestling). During the first days and until it is checked that the chicks eat adequately, the food will be provided cut up. The size of the pieces will be increased as the nestlings get skilled at handling their food.

As far as possible, the fishes will be recently caught in the area, and preferably, grey mullets (*Chelon labrosus* o *Mugil cephalus*). Just in case, some additional food will be bought and maintained frozen.

Because of human presence around the estuary of Urdaibai, it is very important that the chicks get used to humans in the landscape. For this reason, a project person will walk across the field of view from the release tower at 300m to 100 m several times per day.

Not only for the care and feeding of the chicks, but also for the radiotracking of them after the releasing, personnel specialized in the management and surveillance of the raptors will be contracted. This staff will be supported by the staff and volunteers of the Urdaibai Bird Center.

7.3.3. Tagging and release

Two days before the expected data of release, the chicks will be weighted and measured again. Moreover, individuals will be fitted with a very small conventional transmitter to allow the surveillance of the birds while they stay in Urdaibai, so that the potential initial problems of the birds can be solved. A few of the birds will be tagged with a GPS satellite transmitter to learn about migration routes, wintering areas and mortality and return rates. Some of these GPS transmiters will be fitted several weeks after release through recaptures, when young have reached maximum weights. Osprey nestlings leave the nest with 52.8 days old (Bustamante, 1995). For increasing of the possibilities of survival, the chicks will be released one week olders, so they will be more vigorous and their feathers will be more developed. Therefore, when they are about 60 days old, the front of the hacking cages will be opened slowly and they will go out of their own free will. This will be carried out at dawn and previously the nearest feeding places will be stocked with fresh fish.

7.3.4. Post-release period

Most young ospreys depend on their parents during almost all the time prior to the migration, which is usually about 30 days (Bustamante 1995), although young ospreys may try to fish. Therefore, once the chicks have left the hacking tower, an abundance of fresh fish will be placed on the feeding places. As it seems that there is no parental-filial conflict in this species, the amount of food put on the feeding places has to be appropriate to the needs of the young ospreys. From the moment of releasing until the

begining of the migration, the released birds will be followed throght a continous radio and satellite tracking.

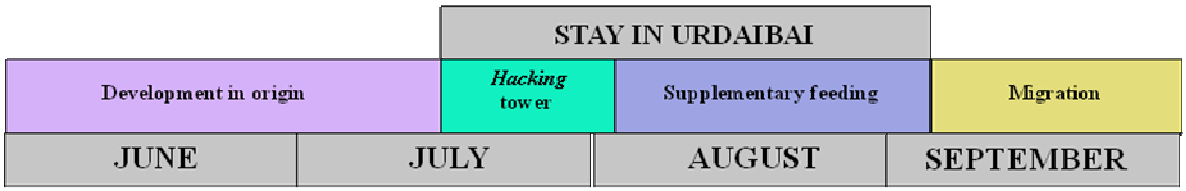

Figure 13. Annual schedule of the programme

7.3.5 Monitoring and evaluation

The staff of Urdaibai Bird Center will carry out the technical monitoring of the project. A committee drawn from qualified members of Urdaibai Bird Center, the Department of Environment of the County Council of Biscay, the corresponding entity of the donor country and the external consultants of the program will evaluate its development and level of success.

Once the first 5 years of the project passed, there will be a detailed evaluation of the results that will be published in scientific and popular journals.

7.3.6. Programme of educational outreach

A participation program will be carried out among the local community with the objective of explaining the project so that it can be understood, accepted and supported. For this reason, the following activities will be developed:

- Delivering talks in the schools of the Urdaibai Biosphere Reserve, PPT presentation will explain the biology of the species, the threats they face, the previous projects of reintroduction and the characteristics of the local project of reintroduction.
- Leaflet containing similar information, addressed to the student, social centers and town councils.
- Website including all the notable information about the osprey and the project of Urdaibai.
- Collaboration with student centers of other countries in the framework of the project *Linking Schools and Communities* leaded by *The Osprey Migration Foundation*.

- Publicity through the local and national press of the different stages of the project (arrival of the chicks, realease, monitoring, return, nesting...)

7.3.7. Expected results

Once the hacking tower is opened, it is expected that the ospreys will stay in Urdaibai and will feed on the feeding points during about 5 weeks. It is also expected that the young birds reach the typical osprey wintering areas presumably on the tropical countries of the Western Africa. Taking into account the previous experiences of reintroduction, it is expected that the first ospreys will come back to Urdaibai 2 or 3 years after their release. The first nesting attempts are expected to happen from the third year, although the first successful breeding doesn't usually happen until the fourth, fifth or sixth year (Table 5). The percentage of the released chicks that will survive until the age of reproduction is expected to be 40%, similar to the wild birds (Poole, 1989). For this reason, from the sixty chicks released until the end of this project, it is supposed that twenty-four osprey will survive. If the sex rate of those birds would be 1:1 and all the surviving birds come back to Urdaibai, there could be twelve reproductive pairs. Nevertheless, it is important to take into account that the released birds may pair up with not-released birds that might be attracted by the returned local ospreys. Taking into consideration the area of the estuary, the vast forest coverage and the great availability of preys we can estimate that the potential capacity of Urdaibai is 8-10 breeding pairs. The lack of suitable perches for the building of the nests can be a limitation that is being corrected by the implementation in the program of building up artificial nests. Nevertheless, this potential capacity can be limited by the increase of disturbances on the potential breeding areas, and for this reason, some measures that minimize this impact will be adopted especially on the marshes.

The presence of two close areas, the Natural Park of Santoña and the reservoirs of Ullibarri-Gamboa and Undurraga (Basque Country), with an adequate capacity and characteristics for this species can guarantee the maintenance of a viable breeding metapopulation on the region.

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