A spring stopover of a migratory osprey (*Pandion haliaetus*) in northern Spain as revealed by satellite tracking: implications for conservation

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Abstract

*A spring stopover of a migratory osprey (*Pandion haliaetus*) in northern Spain as revealed by satellite tracking: implications for conservation*.— Improvements in the accuracy of satellite telemetry locations now allow detailed studies on territorial behaviour or use of habitat that can be used to enhance bird conservation. In this paper we describe the behaviour of a satellite–tracked adult female osprey (*Pandion haliaetus*) in the Urdaibai Biosphere Reserve (N Spain) to evaluate the suitability of this protected area for the species. The data set consisted of 10 complete days with a total of 145 exact fixes received. Night roosts were mainly surrounded by high or intermediate level protected land, separated from roads or buildings by more than 200 m and located less than one km away from the feeding area. During daylight hours, most fixes (76.5%) were located in wooded areas. We found that the bird selected holm oak woods and we suggest that this is related to low disturbance from human activity. We also suggest that northern Spanish estuaries are important as stopovers by migrating ospreys for feeding during migration.

Key words: Behaviour, Habitat selection, Migratory raptor, Protected area, Site suitability, Urdaibai Biosphere Reserve.

Resumen

*Parada migratoria prenupcial de un águila pescadora (*Pandion haliaetus*) en el norte de España determinada por telemetría de satélite: implicaciones para la conservación.*— Actualmente, la mayor precisión de las localizaciones suministradas por la telemetría vía satélite permite llevar a cabo estudios más detallados sobre la migración, que pueden ser útiles para la conservación de las aves. En este trabajo describimos el comportamiento de una hembra adulta de águila pescadora seguida por telemetría vía satélite en la Reserva de la Biosfera de Urdaibai (N de España) para evaluar la adecuación de este área protegida a los requerimientos de la especie. Se utilizaron 145 localizaciones recibidas en 10 días de parada migratoria. Los dormideros utilizados estaban mayoritariamente rodeados de zonas con un nivel de protección alto o intermedio, separados más de 200 m de carreteras y edificios, y situados a menos de un km de la zona de alimentación. Durante las horas diurnas, la mayor parte de las localizaciones (76,5%) procedían de los bosques, con preferencia por los encinares, lo cual se sugiere que está relacionado con la tranquilidad que caracteriza a este tipo de bosques en el área de estudio. Asimismo, se sugiere que los estuarios del norte de España son un área importante para la alimentación de las águilas pescadoras en migración primaveral.

Palabras clave: Comportamiento, Selección de hábitat, Rapaz migratoria, Espacio protegido, Idoneidad del área, Reserva de la Biosfera de Urdaibai.

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Introduction

Migration routes and resting areas, including stopover sites, are priority areas for the effective conservation of any migratory bird (Berthold & Terrill, 1991; Hutto, 1998, 2000; Van Eerden et al., 2005). During recent years, satellite telemetry has enhanced knowledge of the migration movements and staging sites of several large bird species, with important implications for conservation (Harris et al., 2000; Gauthier–Clerc & Le Maho, 2001; Shimazaki et al., 2004; Shiu et al., 2006; Meyburg & Meyburg, 2007; López–López et al., 2009). Improvement in the accuracy of locations, using GPS technology, now allows detailed studies on territorial behaviour, use of habitats or feeding strategies (Meyburg et al., 2006; Meyburg & Fuller, 2007).

Ospreys (*Pandion haliaetus*) are long–distance migrants, with most of the birds wintering in tropical countries (Poole, 1989). Northern European ospreys cross the Mediterranean region both when travelling to wintering grounds, mainly in western Africa, and when returning to their breeding sites. Previous studies suggest that they may stop and feed up for several days at the same stopover sites on both migratory journeys (Hake et al., 2001; Alerstam et al., 2006). Although migratory ospreys regularly cross the Iberian Peninsula, there is little information regarding the use of the area for stopovers and the adequacy of site management for osprey requirements (Lekuona, 1998; Fuentes et al., 1998; Casado & Ferrer, 2005), despite concern for its conservation (Triay & Siverio, 2004).

This paper describes the behaviour regarding habitat selection of a satellite–tracked osprey during a 10–day stopover in an estuary in northern Spain (Urdaibai Biosphere Reserve). The suitability of this protected area for ospreys is also examined by taking into account the diverse level of protection of the habitats used by the bird.

Methods

Study area

Urdaibai Biosphere Reserve (Basque Country, N Spain) is located on the northern Iberian Atlantic coast (43º 29' N; 2º 40' W) and has been a protected area since 1989. It includes 17.5 km of coastline, 14,088 ha of forests, 4,860 ha of agricultural land, 919 ha of wetland (estuarine waters and marshes) and 760 ha of urban areas. Monterrey pine plantations (*Pinus radiata*) dominate nearly 80% of woodlands whereas natural woods are marginal and are represented basically by holm oak (*Quercus ilex*), which occupy 1,582 ha (11% of woodlands, 7.2% of the Reserve). Taking into account its protection level (see Gobierno Vasco, 2003), the site can be classified in three categories: High Protection (includes coastline, marshland and holm oak woods, 11.8% of the Reserve); Intermediate Protection (includes riparian woods, most areas adjacent to marshes –agriculture land, natural woods and some pine plantations– and holm oak woods, 7.3%); and Low Protection (includes other forest plantations and agriculture lands, 39.2%).

Field methods

A breeding female osprey was captured at its nesting site near Forres (Scotland, UK) (57º 37' N, 3º 37' W) on 13th July 2007. The bird was trapped using a Dho–gaza net (Bloom, 1987) with a Eurasian Eagle Owl (*Bubo bubo*) as a decoy. To allow tracking via satellite (CLS Service Argos, Toulouse, France), the bird was fitted with a 35 g Argos/GPS Solar PTT–100 satellite transmitter (Microwave Telemetry) and programmed to take GPS readings at hourly intervals from 04:00 to 20:00 with an accuracy of < 15 m.

Satellite data were mapped and plotted using ArcView GIS (Geographic Information System). We estimated the home range size used by the bird as the size of the minimum convex polygon that included all the locations (MCP). We computed the percentage of fixes occurring in the different types of habitat as well as in the areas with diverse protection levels. We measured distances to nearest paved road and building, shortest distance to feeding area and percentage of protected land in a 200 m radius around sleeping roosts. Trees used as sleeping perches were identified *in situ*. Direct sightings using binoculars and telescope were made to gather behavioural information when the bird was in the marsh.

Results

The tracked bird departed from wintering grounds in Guinea Bissau on March 12th 2008 and reached the northern Spanish coast (43º 17' N; 2º 14' W) on March 26th 2008 by a continuous series of daily flights. Then, it moved 40 km west to the Urdaibai Reserve where it stayed for 10 complete days (March 27th–April 7th). The osprey then flew east, instead of crossing the Bay of Biscay, before turning north along the Atlantic coast of France. On April 23rd it finally arrived at its breeding site where it subsequently reared two chicks.

The stopover data set consisted of 10 complete days (11 nights) with a total of 145 exact fixes received (mean fixes per day = 13.50 $\pm$ 3.47; range = 8–17) (mean fixes per hour = 8.17 $\pm$ 1.28; range = 6–10). The locations for the days when the bird arrived and departed are also included. There was a strong association between location of fixes and type of habitat (χ^2 test; $P < 0.001$), with 84.13% of the fixes (n = 122) located in woody areas, 12.40% (n = 18) in the marshland and 3.45% (n = 5) in or by the sea cliffs. Based on these data, the total area of the tracked bird's home range when in Urdaibai Reserve was 1.93 km^2 (mean = 0.26 $\pm$ 0.42; range = 0.11–1.54) (fig. 1). The biggest home range was on arrival, when all the roosting fixes on sea cliffs (n = 4) and flying fixes over the sea (n = 1) were received. Most fixes (n = 100) were received from highly protected zones, while 41 fixes were from intermediate protection level zones and three were from lowly protected zones (χ^2 test; $P < 0.001$).

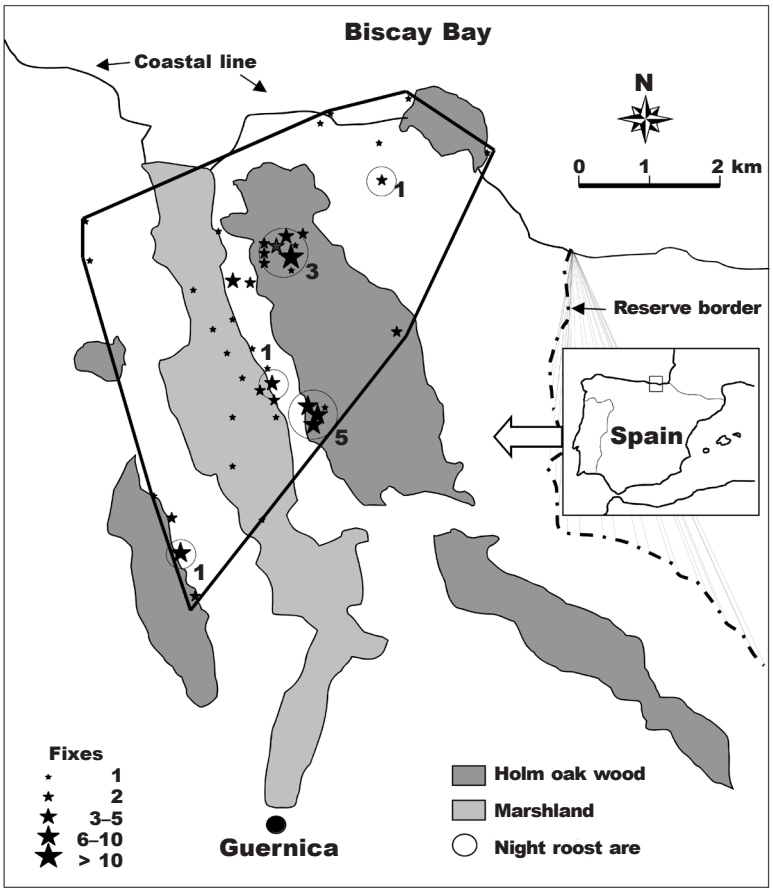

Fig. 1. Home range (Minimum convex polygon) of an adult osprey tracked by satellite telemetry during a spring migratory stopover in Urdaibai Reserve (N Spain): ★ Location of fixes; ● Location of night roost areas. (Number of nights in each area is also shown.)

Fig. 1. Área de campeo (polígono convexo mínimo) de un águila pescadora adulta, seguida por telemetría vía satélite durante su parada migratoria primaveral en la Reserva de la Biosfera de Urdaibai (N de España): ★ Situación de las localizaciones; ● Situación de las áreas de dormideros. (También se incluye el número de noches pasadas en cada área.)

The distribution of fix frequency in relation to daylight hour is shown in figure 2. Taking into account only hours of daylight, 76.53% of the fixes were located in wooded areas (74 fixes roosting and one flying), whereas 18.36% were in the marsh (13 roosting and five flying). Daily fixes in the marsh occurred through the daylight period with a mean frequency of 1.42 fixes per day (SD = 0.99). Direct sightings of the bird in the marsh revealed both foraging (one) and feeding (three) activities.

We found significant differences in the use of wooded areas, with most of wood fixes (63.93%) received from holm oak woodland (χ^2 = 9.47; P < 0.01), the habitat with the highest protection level, and 35.25% from forest plantations, mainly Monterrey pines, located in areas with intermediate or low protecting status.

Eight night roosts were used, three of them twice. The main features of the night roosts are shown in table 1. Night roosts were mainly surrounded by high or intermediate level protected land, separated from roads or buildings by more than 200 m and located less than 1 km away from the feeding area. The perches used by this tracked osprey as night roosts were high trees that stand out over the surrounding landscape: live Monterrey pine, *Pinus radiata* (seven nights), dead sweet chestnut, *Castanea sativa* (three nights) and live blue gum *Eucalyptus globulus* (one night).

Discussion

The use of a particular site by migratory ospreys is difficult to study since direct observations do not

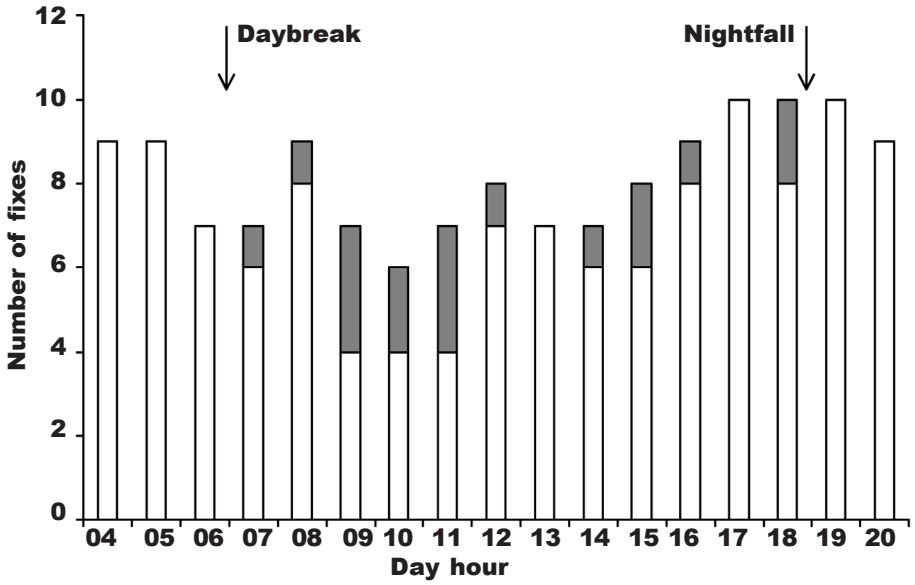

Fig. 2. Distribution of the number of fixes over day hours of an adult osprey tracked by satellite telemetry during a spring stopover in Urdaibai Reserve (N Spain): white. Fixes corresponding to roosting in the wood; grey. Fixes corresponding to flying or roosting in the marsh.

Fig. 2. Distribución del número de localizaciones durante las horas diurnas, de un águila pescadora adulta, sirviéndose de la telemetría por satélite y durante una parada migratoria primaveral en la Reserva de la Biosfera de Urdaibai (N de España): blanco. Localizaciones correspondientes a descansos en el bosque; gris. Localizaciones correspondientes a descansos o vuelos en la marisma.

usually record all movements and locations of individuals, additionally local trapping and satellite tracking requires huge effort and expensive investment, and possibilities of repeat stopovers by the tracked birds are limited. Therefore, the stopover of a satellite–tracked osprey is a valuable opportunity to gather information on local habitat use by this species. However, results derived from the study of a single bird should be considered provisional due to the low size of the sample.

An osprey requires less than two hours to fulfil its daily metabolic maximum when good foraging conditions are available (Candler & Kennedy, 1995). A preliminary study has shown that migratory ospreys have good fishing success in the study area, probably due to high stocks of mullet (Mugilidae) (Galarza, unpublished data). The habitat use of the tracked bird suggested a quick daily forage to catch fish and the rest of the time was mainly spent resting in the woodland. Proximity to the feeding area of suitable woods, where ospreys can roost and sleep safely and quietly, can improve refuelling rates and reduce risks. There was a significantly higher use of the forested areas that are close to the estuary, mainly the holm oak woods. Human disturbance is a factor that affects ospreys (Swenson, 1979; Van Daele & Van Daele, 1982) and may therefore limit its presence in an area. Mean distances of the night roosts at Urdaibai Reserve from roads and buildings indicate a similar tolerance to disturbance as in some breeding areas where management guidelines recommend the prescription of a 200 m buffer zone around nests (Penak, 1983; Naylor & Watt, 2004). Since local holm oak woodland is a quiet habitat, because it is relatively impenetrable to humans, we suggest that its positive selection by the tracked osprey is presumably associated to low disturbance from human activity rather than to forest characteristics. As in forested breeding areas, where ospreys select trees elevated over the surrounding canopy to build their nest (Swenson, 1981; Saurola, 1997; Ewins, 1997), the tracked bird used, as night roosts, trees that stood out in the landscape. These were mainly high Monterrey pines located at the edge of mature plantations bordering the holm oak woods or as isolated trees growing in them. We suggest that the conservation of old trees, especially pines growing in or beside natural holm oak woods, should be promoted when forestry management aims to enhance osprey presence in the study area, where there is a lack of old trees due to intensive historical land use (see Tellería et al., 2009). We also suggest that the holm oak woodland and adjacent habitat protection levels in Urdaibai Reserve provide suitable sheltering sites for ospreys, although this interpretation is provisional, since it is the result of tracking a single bird.

Table 1. Characteristics of the satellite–tracked osprey night roosts (n = 8) in a 200 m radius circle, in a spring stopover area in Urdaibai Reserve (N Spain).

Tabla 1. Características de los dormideros del águila pescadora seguida por satélite (n = 8) en un círculo de 200 m de radio, durante una parada migratoria primaveral en la Reserva de la Biosfera de Urdaibai (N de España).

Mean (± SD)	Range
High protection level (%)	
52.5 ± 32.8	0–100
Intermediate protection level (%)	
35.8 ± 27.7	0–67
Low protection level (%)	
10.3 ± 28.1	0–80
Distance to closest road (m)	
231.8 ± 217.5	80–690
Distance to closest building (m)	
240.6 ± 152.6	108–519
Distance to foraging area (m)	
630.5 ± 639.9	5–2,015

Female ospreys depart on average earlier than males from breeding grounds (Kjellén et al., 2001), but there are no significant differences between sexes in timing when ospreys return to breed (Alerstam et al., 2006). It has been described that an early arrival at breeding sites can benefit males because they can reclaim their nest (Poole, 1989) but also that it may benefit females by improving the possibility of mating with an experienced male (Alerstam et al., 2006), thus, promoting better reproductive success (Poole, 1989). However, the gradual development of suitable environmental conditions for the ospreys at northerly latitudes in spring will restrict the possibilities for early spring migration. Therefore, timing of pre–breeding migration could be explained as a result of a compromise between early arrival at breeding areas and fuel provision rates during winter (Alerstam et al., 2006). Ospreys seem to use different strategies to face this compromise. Most of the birds make a non–stop journey, whereas others, like the bird we tracked, make one or more feed up stopovers (Alerstam et al., 2006), and it has been suggested that the chosen strategy is a function of the availability of food en route (Candler & Kennedy, 1995). It remains unknown whether this second strategy may produce benefits in terms of better body conditions when arriving at the breeding grounds and, thus, result in better reproductive success.

Thorup et al. (2006) found no influence of wind on migrating ospreys, suggesting that they travel or stop without regard to the wind. They also found an unexpected lack of influence of rain, despite the high proportion of soaring flight that osprey use on migration (Kjellén et al., 2001). Although more evidence is needed to evaluate the role of weather on osprey migration (Thorup et al., 2006), it seems that frequency and duration of stopovers are more related to migrant body condition and feeding possibilities at the site than to weather variables. Experience with a particular site presumably confers advantages that may contribute to avoiding risks and restoring body condition (Cantos & Tellería, 1994; Merom et al., 2000; Catry et al., 2004; Shiu et al., 2006). Alerstam et al. (2006) suggested the existence of goal areas or familiar stopover sites that experienced ospreys may reach by local navigation (mainly piloting with landmarks as references) and use for feeding up on migration. The deviation by our tracked female of about 40 km to the west after reaching the northern coast of Spain, a visible landmark for any bird flying north, supports this view because it points towards a clear determination to reach the Urdaibai Reserve. Although these results must be supplemented by new data, we suggest that the Urdaibai Reserve and other northern Spanish estuaries are important stopover sites for ospreys on spring migration. They may be particularly important to British ospreys before facing the last part of the migration, which involves sea crossing from mainland Europe (Dennis, 2002).

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