Ostrich: Journal of African Ornithology
Publication details, including instructions for authors and subscription information:
http://www.tandfonline.com/loi/tost20

The vulnerable Osprey breeding population of the Al Hoceima National Park, Morocco: present status and threats

Flavio Monti[ab], Houssine Nibani[c], Jean-Marie Dominici[d], Hamid Rguibi Idrissi[e], Mathieu Thévenet[f], Pierre-Christian Beaubrun[a] & Olivier Duriez[a]

[a] Centre d'Ecologie Fonctionnelle et Evolutive (CNRS UMR5175), Université Montpellier 2, Biogeography and Ecology of Vertebrates, 1919 Route de Mende, 34293 Montpellier cedex 5, France

[b] Department of Biology and Evolution, University of Ferrara, Via Luigi Borsari 46, 44100 Ferrara, Italy

[c] Association de Gestion Intégrée des Ressources (AGIR), No. 1 Rue Oujda, Quartier Al Menzeh, 32000 Al Hoceima, Morocco

[d] Rèserve Naturelle Scandola, Parc Naturel Règional de Corse, 20245 Galeria, France

[e] University Chouaib Doukkali, Faculty of Sciences, El Jadida, Morocco

[f] 3 Rue Marcel Arnaud 13100 Aix-en-Provence, France

Published online: 17 Dec 2013.

To cite this article: Flavio Monti, Houssine Nibani, Jean-Marie Dominici, Hamid Rguibi Idrissi, Mathieu Thévenet, Pierre-Christian Beaubrun & Olivier Duriez (2013) The vulnerable Osprey breeding population of the Al Hoceima National Park, Morocco: present status and threats, Ostrich: Journal of African Ornithology, 84:3, 199-204

To link to this article: http://dx.doi.org/10.2989/00306525.2013.865280

OSTRICH 2013, 84(3): 199–204
Printed in South Africa — All rights reserved

OSTRICH
ISSN 0030–6525 EISSN 1727-947X
http://dx.doi.org/10.2989/00306525.2013.865280

The vulnerable Osprey breeding population of the Al Hoceima National Park, Morocco: present status and threats

Flavio Monti[1,2]*, Houssine Nibani[3], Jean-Marie Dominici[4], Hamid Rguibi Idrissi[5], Mathieu Thévenet[6], Pierre-Christian Beaubrun[1] and Olivier Duriez[1]

[1] Centre d'Ecologie Fonctionnelle et Evolutive (CNRS UMR5175), Université Montpellier 2, Biogeography and Ecology of Vertebrates, 1919 Route de Mende, 34293 Montpellier cedex 5, France
[2] Department of Biology and Evolution, University of Ferrara, Via Luigi Borsari 46, 44100 Ferrara, Italy
[3] Association de Gestion Intégrée des Ressources (AGIR), No. 1 Rue Oujda, Quartier Al Menzeh, 32000 Al Hoceima, Morocco
[4] Rèserve Naturelle Scandola, Parc Naturel Règional de Corse, 20245 Galeria, France
[5] University Chouaib Doukkali, Faculty of Sciences, El Jadida, Morocco
[6] 3 Rue Marcel Arnaud 13100 Aix-en-Provence, France
** Corresponding author, e-mail: flavio.monti@cefe.cnrs.fr*

In the Mediterranean, most areas belonging to the initial distribution range of the Osprey *Pandion haliaetus* have been lost and local populations have disappeared in recent decades because of persecution. Even though direct management actions have allowed local partial recovery, the Mediterranean population currently only holds a few tens of breeding pairs and is still exposed to local extinction risks. One of the last Mediterranean Osprey breeding areas lies along the North African coast between Morocco and Algeria. In this paper, we report new information on the Osprey population within the Al Hoceima National Park, Morocco. The status of the population for 2012 and 2013 is reported and compared with data collected during the period 1983–1990. A reduction in number of nests and breeding pairs was observed and a 35.7% decrease in the population size recorded. In addition, we discuss the main identified threats to Osprey habitats (e.g. dynamite and poison fishing) that affect the Osprey breeding population in this area. In this context, we stress the necessity for urgent measures to be adopted at the local scale for the protection of this vulnerable population in the light of a sound conservation strategy also at the scale of the Mediterranean.

Keywords: conservation, Morocco, *Pandion haliaetus*, population, threats

Introduction

The Osprey *Pandion haliaetus*, is a long-lived raptor distributed on all continents except Antarctica between 49° S and 70° N (Poole 1989). Although most exclusively a tree-nester in the vicinity of rivers and lakes in northern parts of their Palearctic range, in the Mediterranean area Ospreys choose rocky cliffs for nesting, close to marine or brackish water fishing environments (Poole 1989).

Despite direct management actions carried out in the last decades, allowing a partial recovery in Corsica and in the Balearics (Bretagnolle et al. 2008, Triay and Siverio 2008), the Mediterranean population still shows an unfavourable conservation status (Muriel et al. 2010), with less than 80 breeding pairs, distributed between Corsica (32 pairs), the Balearic islands (16–18 pairs), Algeria (supposedly 15–17 pairs) and Morocco (supposedly 14–18 pairs) (Monti 2012). Thanks to reintroduction projects the species is now also breeding in mainland Spain and central Italy since 2009 and 2011, respectively (Muriel et al. 2010, Monti 2012).

The Osprey population of Morocco was discovered only in 1983 when the first exhaustive survey was carried out along the Mediterranean coast (Berthon and Berthon 1984, Thibault et al. 1996). During the period 1983–1990, the population was regularly monitored, as reported by Hodgkins and Beaubrun (1990). This population, scattered along the rocky coast from Cala Iris to Al Hoceima, is thought to be the only reproductive nucleus in Morocco. Only in 1989, two nests were discovered near Jebha, a small town 30 km west of Cala Iris. In the Chafarinas Islands, two breeding pairs of Osprey were present in 1950 (Terrasse and Terrasse 1997). Since 1994, only one pair inhabits the archipelago, still observed in June 2013 (Triay and Siverio 2008, Monti 2012; G Dell'Ariccia, CEFE-CNRS, pers. comm., 2013). A breeding occurrence has never been proved for the Atlantic coast of the country, although it has been strongly suspected in a few places (Thévenot et al. 1985). In spite of the great importance of such a population for Osprey conservation at the scale of the Mediterranean, no additional census took place after 1990. Only in 2008, a new exploration was conducted by the local non-governmental organisation Association de Gestion Intégrée des Ressources (AGIR), which estimated a total of 14–18 pairs within the same area (Nibani 2010), nowadays recognised as the protected area of the Al Hoceima National Park (PNAH).

Supported by the Mediterranean Small Island Initiative, the 'Haut Commissariat aux Eaux et Forêts et à la Lutte contre la Désertification' took the initiative to realise a global census of the Osprey population of the Al Hoceima National Park in 2012 and 2013. For the first time, nests were thoroughly checked by climbing on the rocky cliffs. Such an approach allowed validation of the occurrence of reproduction and to record the exact number of active nests (number of breeding pairs) and of eggs and/or chicks in the population.

We report the current status of the Osprey population of the Al Hoceima National Park in 2012–2013. These results are compared with historical data from previous surveys conducted between 1983 and 1990 (only published as internal reports; Hodgkins and Beaubrun 1990). In addition, we describe and quantify the main threats to Ospreys that were identified during our field sessions in the area.

Materials and methods

Study site

The Al Hoceima National Park (Figure 1) is classified as a semi-arid to arid Mediterranean bioclimatic zone located on the northern coast of Morocco (Al Hoceima, 42°39′ N, 11°05′ E). It consists of both a marine and terrestrial area of 19 600 ha and 28 400 ha, respectively. The protected area, expanding over 40 km of coastline along the Mediterranean Sea from Cala Iris to Al Hoceima, is characterised by high calcareous cliffs, marine caves and small rocky islets close to the seashore, which for the most part belong to Spanish territories (e.g. Peñón de Vélez de la Gomera). The fish fauna is particularly rich and includes both Mediterranean and Atlantic species coming in through the nearby Strait of Gibraltar (Nibani 2010). Some of these species represent good potential prey for Ospreys, which nest on rocky pinnacles along the sea coast (Thibault et al. 1996).

Census methods

Previous surveys in the period 1983–1990 were performed only via distant observations, using boats at sea or a telescope from land. The position of each nest was recorded on a geographical map and photos taken for better identification (Hodgkins and Beaubrun 1990). Nests were considered as occupied according to Ospreys' behaviour, i.e. presence of individuals at the nest or in its surroundings when nest content was not visible at all from distance. In other cases, nests were considered as unoccupied if nothing was detected in the nest or no Ospreys were observed in the vicinity of it or as undetermined when no information was available.

The 2012–2013 census took place in May (as in 1983–1990), at the time when most breeding Ospreys are rearing chicks. A team of five observers, lead by JMD who has 30 years of experience in surveying Ospreys in the Mediterranean, participated in the mission. Fieldwork consisted of 4 d of observations each year from land and 4 d of coastal surveys at sea. Osprey nests were searched for along the cliffs during coastal surveys by means of local fishermen's boats, and nest contents were first checked at distance from land using a telescope. Since we covered the whole 40 km of coast included in the protected area,

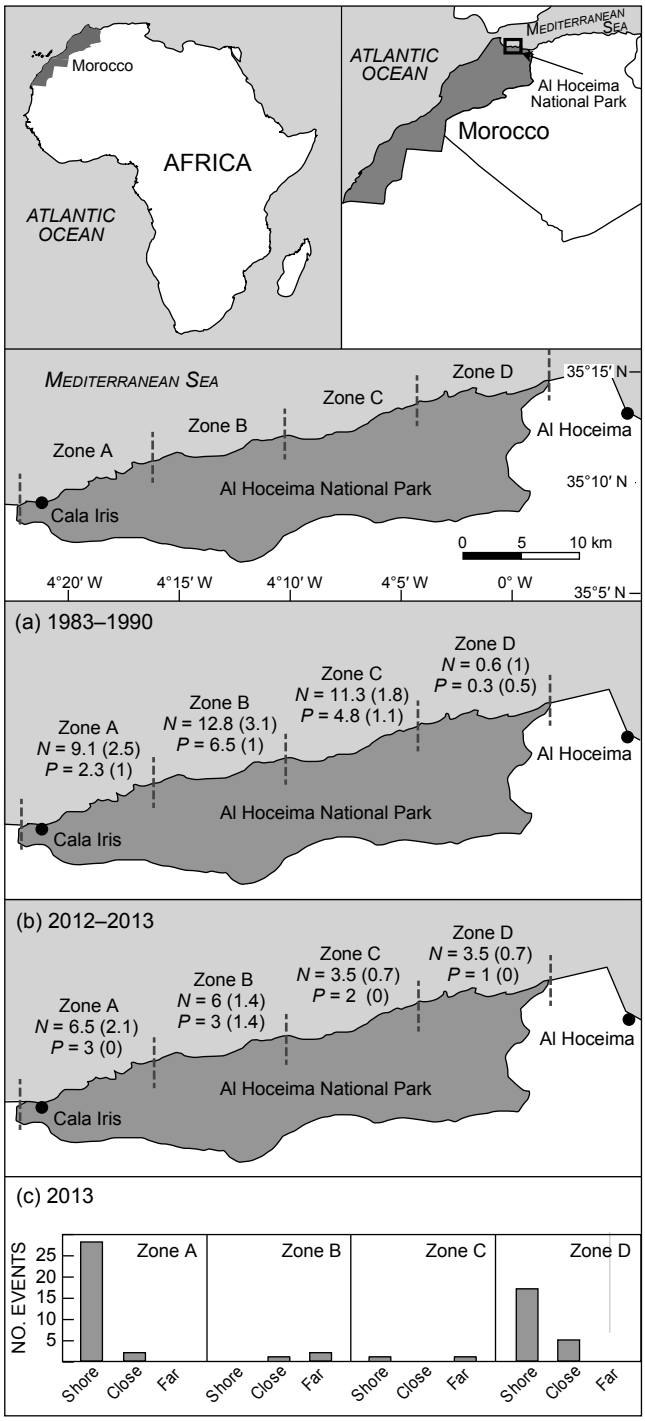

Figure 1: Location of Al Hoceima National Park, Morocco, of which the 40-kilometre coastline was divided into four zones (from A to D; from west to east) of 10 km each. For each sector the following parameters are reported: N = number of nest sites found; P = number of territorial pairs. These parameters are considered both for (a) the historical data collected during the period 1983–1990 and (b) those data collected in 2012–2013. Numbers expressed are the mean with the SD in parentheses. (c) Occurrences of potential threats, counted in 2013, are reported and ranked in three different classes of distance from the coast (shore = 0 m; close = $0 > x < 300$ m; far = $x > 300$ m) for each zone

all occupied Osprey territories were surveyed. A nest was considered as active if at least one egg was laid. In order to avoid risks of errors in counting eggs and chicks from above, nest occupancy and nest contents were validated by climbing rocky cliffs to the vicinity of nests. Osprey presence and number of eggs and chicks were hence unequivocally assessed. Hatchlings were measured, weighed and individually marked by a metal ring (CRBPO-MNHN, Paris) and a white-coloured ring with a three-letter code (for long-distance identification).

Both in 2012 and 2013, threats potentially affecting the Osprey population were observed in the protected area. The 40 km of coast along the PNAH were divided into four zones (from A to D; from west to east) of 10 km each. During 4 d of surveys at sea in 2013, we recorded all events representing a potential disturbance, assigned it to the relative geographical sector and noted its distance from the coast according to three different classes of distance (shoreline, within 300 m, or greater than 300 m). Annual quantification of fishing and estimates of each threat were reported also according to the National Office of Fisheries of Morocco (ONP) estimates (http://www.onp.co.ma) and to Nibani (2010); their negative effects on both habitats and species are here reported and discussed. Means ± SD are reported.

Results and discussion

Historical data and present population status

A regular census of the Osprey population was carried out during the 1983–1990 period, except for the years 1984 (partial census) and 1988 (Hodgkins and Beaubrun 1990). In 1983, this population was initially estimated at 10–15 pairs (Berthon and Berthon 1984, Hodgkins and Beaubrun 1990). During this early monitoring period, a total of 52 different nest structures were recorded (mean per year = 33.6 ± 6.2) and 14 (±1.8) territorial pairs were located (Figure 1). The population maintained a stable trend showing limited variation in numbers during the period 1983–1990 (Table 1).

In 2012 and 2013, a total number of 23 (mean per year = 19.5 ± 4.9) nest structures were recorded in the PNAH, between Cala Iris and Al Hoceima (Figure 1). In these two years, 6.5 (±3.5) nests were obviously abandoned (structures were formed by only a few branches and the nests appeared to have been unused for several years). Four nests were occupied by a territorial male alone, whereas another three hosted non-reproductive pairs (no egg/chick observed). A breeding occurrence was only recorded in five and seven sites in 2012 and 2013, respectively (6.0 ± 1.4 for both years).

The whole population was estimated at 20–25 adults, to which 8–12 chicks might be added per year. Chicks were about three weeks old at the time of our visits in 2012–2013, meaning that egg laying approximately occurred between March and April and hatching at the end of April (according to an incubation length of 35–42 d reported by Cramp and Simmons 1980). Only six out of the nine territorial pairs observed were actually breeding, and represented the effective reproductive nucleus of the population in May 2012 and 2013. A reduction in the number of nests and territorial pairs was hence recorded, and a 35.7% decrease in population size has occurred since 1990. In 2012 and 2013, the Osprey population size of Morocco was hence well below the numbers estimated during previous surveys (Berthon and Berthon 1984, Thibault et al. 1996).

Table 1: Historical (1983–1990) and present (2012–2013) population data recorded in the PNAH. For each year are reported the number of nests (*N* nests), the number of territorial pairs (*N* pairs), the number of abandoned nests (Nests abandoned) and number of nests with undetermined status (Nests undet.). For the periods 1983–1990 and 2012–2013, the mean values ± SD are reported. * = Incomplete census in 1984, not included in mean values, ** = number of pairs that actually reproduced in 2012 and 2013

Year	*N* nests	*N* pairs	Nests abandoned	Nests undet.
1983	24	14	9	1
1984*	9	6	3	0
1985	32	15	14	3
1986	33	15	17	1
1987	37	16	16	5
1989	33	11	10	12
1990	43	13	31	0
Mean	33.6 ± 6.2	14 ± 1.8	16.2 ± 7.9	3.7 ± 4.5
2012	16	8 (5**)	4	4
2013	23	10 (7**)	9	4
Mean	19.5 ± 4.9	9 ± 1.4 (6 ± 1.4**)	6.5 ± 3.5	4 ± 0

Due to the lack of systematic and repeated censuses during the early breeding season, no data on previous nest failure were available, meaning that the actual breeding population may be larger than our estimate based on the number of active nests. For instance, some of the breeding females that might have failed earlier in the season might have already moved away at the time of the census in May. Thus, the population decrease could be perhaps less dramatic than suspected.

However, old counts performed during 1983–1990 were carried out also in the month of May during each year and hence at the same breeding stage as those of 2012 and 2013. Therefore, if we assume that rates of breeding failure at incubation stages remained similar between the 1980s and 2010s, the surveys must be comparable. Nevertheless, since we employed a more reliable monitoring method (previous counts being carried out only via distant observations), this might have impacted total numbers.

On this basis, our survey strongly suggests that a strong decrease in population size has occurred during the last 20 years from 14–16 pairs in the 1980s to the only six breeding pairs and nine territorial pairs in 2012–2013. At the same time, the total number of observed nest structures decreased from 52 to 23 nests. Two types of factors could explain why some nest structures have disappeared in recent decades. First, environmental factors such as wind and rain could have destroyed unused nests. Second, inhabitants of the neighbouring villages frequently explore the coastal cliffs to use dynamite fishing and their repeated passages together with continuous explosions can have accelerated the process of nest demolition. Both factors could be responsible for rapid nest destruction.

To conclude, a systematic monitoring protocol to record population demographic parameters (e.g. the presence and number of birds and their breeding status, hatching and fledging success) during each breeding season is required and should be adopted as soon as possible by the PNAH. The current situation requires urgent and efficient measures aimed at the preservation of this vulnerable population (Monti 2012).

Potential threats identified within the PNAH

During the field census of 2012–2013 several important threats potentially affecting the Osprey population were observed. In 2013, we counted a total of 62 events during four days of coastal surveys within the park (Figure 1). The majority of them occurred at the borders of the protected area, in the surroundings of the villages of Cala Iris (zone A = 56.4%, n = 35) and Al Hoceima city (zone D = 35.4%, n = 22). Few cases were detected in the central zones of the park (zone B = 4.8%, n = 3; zone C = 3.2%, n = 2). In total, 95.1% (n = 59) of the events was recorded within 300 m from the coast (0 m = 74.2%, n = 46; $0 > x < 300$ m = 20.9%, n = 13), often close to Osprey nests. Only three occurrences (4.9%) were detected at a distance greater than 300 m. These potential threats are listed below:

(1) Fishing represented the main cause of both direct and indirect disturbance for Osprey. According to ONP (http://www.onp.co.ma) estimates, a total amount of 5 510 tons of fish has been officially extracted for the harbours of Al Hoceima and Cala Iris, in the first 10 months of 2012. In the same year, intensive trawl fishing was observed near the coast within the PNAH. Some 2 200 tons of fish are estimated to be extracted per year by the 14 vessels that currently work in the area of the PNAH (Nibani 2010). This practice is likely to strongly disturb the breeding grounds of demersal fish and may deplete breeding fish stocks (Jones 1992). Even if trawl fishing does not directly deplete Osprey prey (e.g. fishes living close to the sea surface) and/or disturb breeding Ospreys, if vessels work far away from the coast, it is certainly damaging for the whole marine ecosystem and consequently for bird species linked to it. In several studies, a negative effect of such practices has been described for seabirds (Arcos et al. 2008). Over a long time span, seabirds might run into difficulties satisfying their food requirements, with repercussions on both reproduction and survival (Cury et al. 2011). Trawl fishing is also known to deteriorate marine ecosystems by destroying non-target benthos, causing post-fishing mortality of damaged organisms, and long-term changes to benthic community structure (Jones 1992). In order to minimise disturbance and negative effects, the number of vessels should be regulated, access to the park forbidden, as well as traffic shifted to a set distance from the coast. In this context, artificial obstacles were placed (in the first months of 2013) on the sea bed to reduce trawlers activities inside the PNAH. Therefore, we only counted three passages of actively fishing trawling vessels (at >300 m from the coast) in May 2013.

(2) Dynamite fishing is commonly used within PNAH (Nibani 2010). Men sitting on vertical cliffs and watching for a shoal of fish represented the prelude to dynamite fishing (Nibani 2010). The dynamite is tossed from the cliff in order to kill fish, which come up to the sea surface and are collected by a swimmer. Ten to 15 individuals, mainly in the vicinity of the villages of Al Hoceima and Bades, are estimated to routinely use this illegal technique within the PNAH and to extract 367 tons of fish per year (Nibani 2010). In 2013 (during 4 d of surveys at sea), we recorded the presence of dynamite fishermen in two different cases.

(3) Copper sulphate fishing for octopus *Octopus vulgaris* is commonly used by at least 15 local fishermen (counts according to Nibani 2010). From an inflatable boat moving slowly on the sea surface, fishermen screened the water until an octopus was detected. They then forced the octopus to come out of its hole by means of copper sulphate spread from the surface. Although this fishing is focused on a single species, sulphate quickly spreads, poisoning marine organisms in the surroundings.

(4) Occurrence of scuba spear fishing was also recorded in one case. However, this fishing practice is currently performed by foreign people on powerful motorboats coming into the integral zone of the PNAH from the harbour of Cala Iris (Nibani 2010).

(5) Small-scale commercial or subsistence fishing practices, by means of small boats and traditional techniques such as rod and tackle, throw nets and drag nets, represent the principal economic income for c. 3 650 fishermen working within the PNAH territory (estimates for the province of Al Hoceima; Nibani 2010). They are able to extract a total biomass of 1 500 tons of fish per year (Nibani 2010). In 2013, we recorded a total of 54 cases of presence of local fishermen in close proximity of Osprey nests, within the integral protection zone of the park (Figure 1). Breeding Ospreys are disturbed both during the phase of territory settlement (adults were frequently observed changing nest structures at the beginning of the breeding season due to the steady presence of local people (HN unpublished data). This could lead to failures of breeding attempts, i.e. during the incubation or chick-rearing period. Human fishing zones should therefore be limited to areas distant from Osprey nests (e.g. >500 m to avoid any alarming displays of Ospreys; Bretagnolle and Thibault 1993).

(6) An old garbage dump has been releasing rubbish at sea in the vicinity of an Osprey nest located close to the borders of the National Park and to the harbour of Al Hoceima for decades. Rubbish was partially burnt or dumped directly into the sea. Although the dumping site has been officially moved far away inland, we still recorded occasional activities at this site. The foraging opportunities offered by the site, thanks also to abundant fish discards coming from the activities of the harbour, attract >1 000 Yellow-legged Gulls *Larus michaellis*. This gull species is known to be a potential threat for breeding seabirds, since gulls can plunder eggs or chicks at the nest (Libois et al. 2012). This Osprey nest was indeed one of the non-active ones in 2012–2013.

(7) Disturbance of breeding Ospreys by motor boats is suspected to occur. On the beach of Al Hoceima,

10–14 watercraft can be rented by tourists from April to September. Tourists are then allowed within the park, where no restrictions are specified. Noises from their boat engines can disturb nesting Ospreys. Such traffic should be forbidden, or at least regulated within the park.

(8) During the past, Osprey chick consumption was suspected to occur. As an ancient tradition, reported by elderly residents of villages and confirmed by the AGIR association, fishermen used to retrieve Osprey chicks from the nests to eat them for improving their own skills in fishing. An estimate of the past consumption's occurrences has not been clearly possible. Moreover, it is not known if this practice still occurs nowadays even if it may be directed to other species. Despite this, we recorded that a chick, previously ringed by us in 2012, was collected alive in the nest by a local person and illegally traded (HN pers. comm.). Environmental education programs should be improved, resulting in a future better knowledge of the local richness in term of habitat and species.

Conclusions

The PNAH appears to be strongly exposed to different human pressures that are likely affecting Osprey survival and threatening local biodiversity. Direct effects of such threats, especially those resulting from illegal fishing practices such as dynamite fishing and poisoning, have strong implications for Osprey conservation, but also for the entire marine biodiversity of PNAH. In the past, traditional fishing represented one of the major economic incomes for precarious local people living inside the park's boundaries. From the 1980s, a noteworthy exodus of persons that came from other parts of Morocco to settle in the Rif region occurred. As a result, the province of Al Hoceima witnessed a rapid demographic increase from 54 319 inhabitants in 1960 to 109 990 in 2004 (Nibani 2010). Better economic possibilities favoured progress in fishing methods (e.g. improvements in technical systems used on boats) that enhanced pressures on the marine environment. Decline of several fish stocks was one of the most evident negative effects exerted by such vessels and by the use of illegal fishing activities such as dynamite fishing and poisoning (Nibani 2010), even if there is currently no direct evidence of insufficient food supply for the Ospreys. The park is also threatened by possible future coastal development and urbanisation. Local practices in land use (e.g. in 2013, the building of a new harbour started within the PNAH territory) together with the increasing touristic pressure are seriously undermining the natural resources of this area, considered as one of the most representative Mediterranean biotope for its high biodiversity in terms of species and habitats.

The park should arrange for administrative authorities to plan strong conservation actions in the area. However, any management action must be based upon a good understanding of the functioning of animal populations. At present, basic information on the spatial ecology of Ospreys in the Mediterranean is still lacking, affecting the possibility of putting into action precise conservation measures for the species at regional scales. Further studies should investigate such topics with particular attention, to test the existence of connectivity between the different Mediterranean Osprey populations. This will help to understand the rate of isolation of these populations and allow evaluation of the extinction risk of each population, such as that of the Al Hoceima National Park.

Acknowledgements — We are grateful to Haut Commissariat aux Eaux et Forêt et à la Lutte Contre la Désertification and the Mediterranean Small Islands Initiative PIM coordinated by the French 'Conservatoire du Littoral'. This project benefits from the support of the Foundation Prince Albert II de Monaco and the Associazone italiana delle Fondation Prince Albert II de Monaco ONLUS. We thank R Choquet who supported us during fieldwork in 2013, D Grémillet and L Fusani helped us revise a previous draft of the manuscript, as well as P Saurola and an anonymous referee. FM is supported by a grant from the Maremma Regional Park, Italy, and by a mobility grant from the Università Italo Francese/ Université Franco Italienne.

References

Arcos JM, Louzao M, Oro D. 2008. Fishery ecosystem impacts and management in the Mediterranean: seabirds point of view. In: Nielsen JL, Dodson JJ, Friedland K, Hamon TR, Musick J, Verspoor E (eds), *Reconciling fisheries with conservation*. Proceedings of the 4th World Fish Congress. Bethesda, Maryland: American Fisheries Society. pp 1471–1479.

Berthon D, Berthon S. 1984. Compte rendu de l'expédition Balbuzard sur les côtes méditerranéennes du Maroc. *Oiseau et la Revue Francaise d'Ornithologie* 54: 201–213.

Bretagnolle V, Mougeot F, Thibault JC. 2008. Density-dependence in a recovering Osprey population: demographic and behavioural processes. *Journal of Animal Ecology* 77: 998–1007.

Bretagnolle V, Thibault JC. 1993. Communicative behavior in breeding Ospreys (*Pandion haliaetus*): description and relationship of signals to life history. *Auk* 110: 736–751.

Cramp S, Simmons KEL (eds). 1980. Osprey. In: *Handbook of the birds of Europe, the Middle East and North Africa. The birds of the western Palearctic, vol. 2: Hawks to bustards*. Oxford: Oxford University Press. pp 265–277.

Cury PM, Boyd IL, Bonhommeau S, Anker-Nilssen T, Crawford RJM, Furness RW, Mills JA, Murphy EJ, Österblom H, Paleczny M et al. 2011. Global seabird response to forage fish depletion: one-third for the birds. *Science* 334: 1703–1706.

Hodgkins M, Beaubrun P. 1990. Description et cartes de 52 emplacements de nids de Balbuzard (*Pandion haliaetus*) sur la côte du Parc biologique des Bokkoyas et dans d'autres lieux de la Province d'Al Hoceima. Unpublished report. USAID et Eaux et Forêts Maroc Ed.

Jones JB. 1992. Environmental impact of trawling on the seabed: a review. *New Zealand Journal of Marine and Freshwater Research* 26: 59–67.

Libois E, Gimenez O, Oro D, Minguez E, Pradel R, Sanz-Aguilar A. 2012. Nest boxes: a successful management tool for the conservation of an endangered seabird. *Biological Conservation* 155: 39–43.

Monti F. 2012. The Osprey, *Pandion haliaetus*. State of knowledge and conservation of the breeding population of the Mediterranean basin. Initiative PIM.

Muriel R, Ferrer M, Casado E, Calabuig CP. 2010. First successful breeding of reintroduced Ospreys *Pandion haliaetus* in mainland Spain. *Ardeola* 57: 175–180.

Nibani H. 2010. Recherche et planification participative du secteur de la pêche artisanale à travers l'analyse systémique et prospective de durabilité dans la Zone Marine du Parc National

d'Al Hoceima. Rabat-Chellah: Haut Commissariat aux Eaux et Forets et la lutte contre la désertification.

Poole AF. 1989. *Ospreys: a natural and unnatural history*. Cambridge University Press. Cambridge.

Terrasse JF, Terrasse M. 1997. Le Balbuzard Pêcheur *Pandion haliaetus* (L) en Méditerranée occidentale. Distribution, essai de recensement, reproduction, avenir. *Nos Oiseaux* 34: 111–127.

Thévenot M, Bergier P, Beaubrun P. 1985. Present distribution and status of raptors in Morocco. In: Newton I, Chancellor RD (eds), *Conservation studies on raptors*. Cambridge: International Council for Bird Preservation. pp 83–101.

Thibault JC, Triay R, Beaubrun P, Boukhalfa D, Dominici JM, Torre A. 1996. Osprey (*Pandion haliaetus*) in the Mediterranean: characteristic of a resident population with a patchy distribution. In: Muntaner J, Mayol J (eds), *Biologia y conservaciòn de las rapaces Mediterràneas*. Monographias no. 4. Madrid: Sociedad Española de Ornitología. pp 135–144.

Triay R, Siverio M. 2008. *El aguila pescadora en España: poblacion en 2008 y metodo de censo*. Madrid: Sociedad Española de Ornitología/BirdLife.

Received February 2013, accepted October 2013
Editor: A Monadjem