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RESPONSE

Conserving wildlife facing mass-tourism calls for effective management

F. Monti[1], O. Duriez[2], J.-M. Dominici[3], A. Sforzi[4], A. Robert[2] & D. Grémillet[2,5]

1 Department of Physical Sciences, Earth and Environment, University of Siena, Siena, Italy
2 CEFE UMR 5175, CNRS, Université de Montpellier, Université Paul-Valéry Montpellier, EPHE, Montpellier Cedex 5, France
3 Réserve Naturelle Scandola, Parc Naturel Régional de Corse, Galeria, France
4 Maremma Natural History Museum, Grosseto, Italy
5 FitzPatrick Institute, DST/NRF Centre of Excellence at the University of Cape Town, Rondebosch, South Africa

Correspondence
Flavio Monti, Department of Physical Sciences, Earth and Environment, University of Siena, Strada Laterina, 8, 53100 Siena, Italy.
Email: flaviomonti00@gmail.com

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We thank Drs Steven and Martinez-Abrain for elaborating on problems related to tourism impacting endangered bird species. In the 21st century, nature-based tourism has often reached the magnitude of mass-tourism. Even if it generates substantial revenues which may contribute to enhanced conservation, this industry is based on finite resources, such as accessible places rich in scenic beauty or charismatic wildlife (Steven, Pickering & Guy Castley, 2009). This is very much the case for the UNESCO site of Scandola, the focus of our study. Until the late 1990s, boat traffic within the reserve operated on a small scale for limited numbers of visitors, mainly naturalists. At that time, preliminary studies had already pointed out the risk that future enhanced ecotourism and related boat traffic would have affected marine biodiversity at Scandola in the long term (Francour, 1994). More recently, traffic in this area has been increasing exponentially, concomitant with a decrease in the environmental awareness of the visitors. This pattern is also visible at the scale of Corsica, with dire environmental consequences for the natural heritage of this sensitive Mediterranean island. Overall, we agree with Dr Steven (2018): Scandola is no longer an ecotourism destination because of the degradation of the status of its flagship species, the emblematic Osprey.

Dr Martinez-Abrain (2018) argued that Corsican ospreys, being long-lived birds, may not be seriously threatened because a reduction in their current breeding performance may not necessarily impact population viability. Indeed, the number of osprey pairs in Corsica and within the Scandola reserve has remained stable across 2010–2018, at respectively 27.2 and 5.4 pairs each year. Yet, as recently shown by Genovart, Oro & Tenan (2018) in other long-lived birds, if adult survival remains constant, other demographic traits such as fecundity or immature survival may then drive population size. Between 2010 and 2018, the osprey breeding success was 0.72 fledglings per nest in Corsica and 0.29 in Scandola. Using matrix population models developed by Wahl & Barbraud (2014) on the osprey, with survival estimates for continental France (Wahl & Barbraud, 2014) and a reintroduced population in Italy (Monti *et al.*, 2014), we found that all deterministic and demographic stochasticity models yielded population growth rates with a lambda <1 (range 0.938–0.985), indicating population declines. Simulations with demographic stochasticity for six pairs in Scandola yielded extinction probabilities of 0.478–0.854 within 50 years, depending on the survival rates. To obtain a population in numerical growth ($\lambda > 1$), using Italian osprey survival rates, it would be necessary to increase juvenile survival from 0.20 to 0.40, or breeding success from 0.72 to 1.4 fledglings per nest (unpublished results, available upon request to the authors). Because juvenile mortality mainly occurs during migration and wintering in North Africa (Monti *et al.*, 2018*a*), where conservation is difficult to promote, actions should rather focus on increasing breeding success in Corsica, to reach 1.5 fledgling per nest, which was the average before 2010. Therefore, the observed decrease in breeding success is both an ethical and a biological issue.

Regarding the adaptability of ospreys with respect to human disturbance, we agree that there might be regional differences. On this scale of sensibility, Corsican ospreys rate high, and we speculate that this might be due to intense persecutions to which they have been exposed in the past. Such particularism should also be taken into account when designing adequate conservation actions for the genetically unique Mediterranean population.

Nest site selection by ospreys may be affected by human activities: in many places in the world, ospreys build their nests on man-made structures (Washburn, 2014). However, it is questionable to use the argument of osprey behavioural plasticity to justify perturbation of the rocky coastal habitats to which they are tightly linked for reproduction. In this context, a comparison with ospreys from Andalucía does not hold, because Andalusian birds were translocated from northern Europe (Muriel *et al.*, 2010), from forested areas where ospreys mostly find their food in lakes, contrary to the indigenous Mediterranean birds. In an accompanying paper (Monti *et al.*, 2018*b*), we emphasized the importance of considering the origin of the birds prior to translocation, and stressed that north-European and Mediterranean ospreys are genetically distinct. The migratory habits of these two populations are also markedly different (Monti *et al.*, 2018*a*). Hence, we strongly disagree with the viewpoint by Ferrer & Morandini (2018) that Dr Martinez-Abrain (2018) cites as an example. The translocation of numerous birds from northern to southern Europe is not recommended and contradicts modern approaches of conservation genetics, since it would completely homogenize the species at European level, hindering the possibility to preserve the natural genetic diversity of the Mediterranean population.

Overall, vanishing ospreys provide strong warning signals about the general degradation of the marine environment within Scandola: in 2018, no less than 523 boats visited the reserve each day, and a long-term study demonstrated a 60% local decrease since 2012 in the abundance of emblematic fish species, such as dusky groupers *Epinephelus marginatus*, brown meagres *Sciaena umbra*, or white seabreams *Diplodus sargus* (Groupe d'Etude du Mérou, unpubl data). Such warning signals call strongly for a regulation of boat traffic: boats should stay at least 300 m away from osprey nests to avoid any disturbance to parents and offspring and to let the males fish efficiently. To delimit off-limits areas, waypoint buoys could be placed at sea according to the ospreys' active nest distribution. Enlarging reserve boundaries would dilute disturbance: this measure has been requested by the Parc Naturel Régional de Corse for many years. Surveillance should also be conducted around all osprey nesting sites, and it might be envisaged to visit Scandola only between August and March, outside of the osprey breeding season. Such measures have already proved efficient at other marine protected areas for the restoration of bird and fish communities (Velando & Munilla, 2011), often with the support of local stakeholders (Badalamenti *et al.*, 2000).

In a wider context, we agree with Dr Martinez-Abrain (2018) with respect to the necessity of designing what he calls "new conservation", yet with a slightly different angle: we strongly feel that wild nature should be protected for what it is, and not only in the context of its coexistence with humans (Wuerthner, 2014).

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Supporting Information

Appendix S1: *Prey resource availability (Methods and Results)*

We assessed prey availability to ospreys at 24 sites hosting osprey nests along the west coast of Corsica (8 sites inside and 16 sites outside the MPA; Fig. 1a). Surveys were performed twice each year at each site, and the monitoring protocol was repeated in 2012 and 2013, yielding a total of 96 sampling sessions.

The subsurface area (0-2m depth), which corresponds to the osprey feeding horizon, was filmed with a HD-Hero 2 GoPro camera (USA) attached below the bow of a kayak, set with a wide angle of 170° to scan a field of approximately 3 m left/right. Transects were composed of 4 stretches of 100 m parallel to the coastline, set at 20, 40, 60 and 80 m away from the shoreline (Fig. 1c-1d). Each transect was pre-recorded on a GPS, which allowed the paddler to maintain constant headings and speed (ca. 5 km.h^{-1}). Transects were performed during the osprey breeding season (in June and July), during daylight and on calm days, to optimize viewing conditions and mimic osprey foraging conditions (as ospreys usually do not hunt at sea when conditions are harsh; Thibault *et al.*, 2001). We used a Secchi disc to control water turbidity and to ascertain good visibility conditions before each transect.

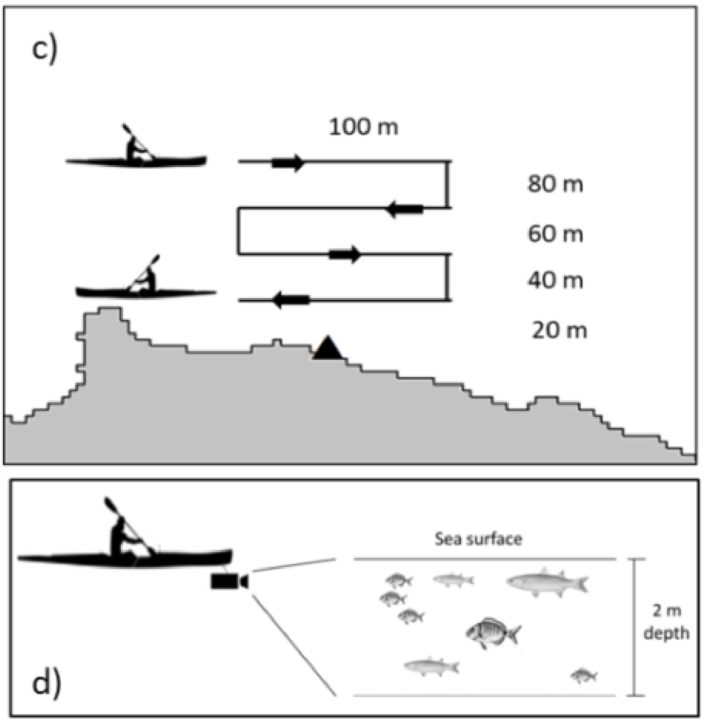

Fig. 1 c) structure of the transect for fish video recording from a kayak; d) simplified view of the water column recorded by the camera attached to the bow of the kayak.

Video recordings were inspected by two observers (FM and another person) to minimize errors in fish species identification and counting. Each fish was identified following Louisy & Trainito (2010). Since objects appear 4/3 larger in water than in the air (Ross & Nawaz, 2003), we performed preliminary tests using fish models of different sizes to calibrate fish sizes estimates. To further limit such errors, we used five size classes (1 = <10 cm; 2 = 10-20 cm; 3 = 20-30 cm; 4 = 30-40 cm; 5 = > 40 cm). To estimate biomass from underwater length observations we used the following formula: $W = aL^b$, where *W* is mass in grams; *L* is the standard length in centimetres and *a* and *b* are constants, following Morey *et al.* (2003). For each transect we calculated the following parameters: a) total number of fish; b) total fish biomass (g); c) density index (total number of fish per m transect); and d) the total number of fish >20 cm per transect. For data analyses all parameters were log+1 transformed to achieve normality; sites were ranked as 0 (outside reserve) and 1 (inside reserve). We used general linear models (GLM) to test between-year effects (2012 vs 2013). We then ran GLMM including ’year’ and ‘transect’ as random effects and log of biomass, log of number of fish and log of density index as dependent variables.

Fish biomass, fish numbers and density followed a Gaussian distribution after a logarithmic transformation (Shapiro-Wilk normality test: Log_Biomass, W=0.94 p<0.0001; Log_Number of fish, W=0.96 p<0.0001; Log_Density Index, W=0.69 p<0.0001). There were no significant differences between 2012 and 2013 for the three parameters: Log_Biomass (GLM: $F_{1,93}$ =0.426, p=0.515), Log_Number of fish (GLM: $F_{1,93}$=0.0, p=0.991), Log_Density Index (GLM: $F_{1,93}$=1.17, p=0.281). We therefore pooled data across years. Our models showed a strong reserve effect, and the three parameters considered were not affected by random effects such as transect and year repetitions. The MPA hosted a larger number of fish (Log_Number of fish: $F_{1,96}$ = 0.38, p = 0.016) and a higher total biomass (Log_Biomass: $F_{1,96}$ = 0.90, p = 0.001) compared to sites located outside of the MPA (Fig. a), although the density index was not significantly higher (Log_Density Index: $F_{1,96}$ = 0.005, p = 0.617). Furthermore, inside the MPA, large fish (> 20 cm) tended to be more abundant (MPA = 6.12 ± 11.2; outside = 1.9 ± 8.9 number of fish).

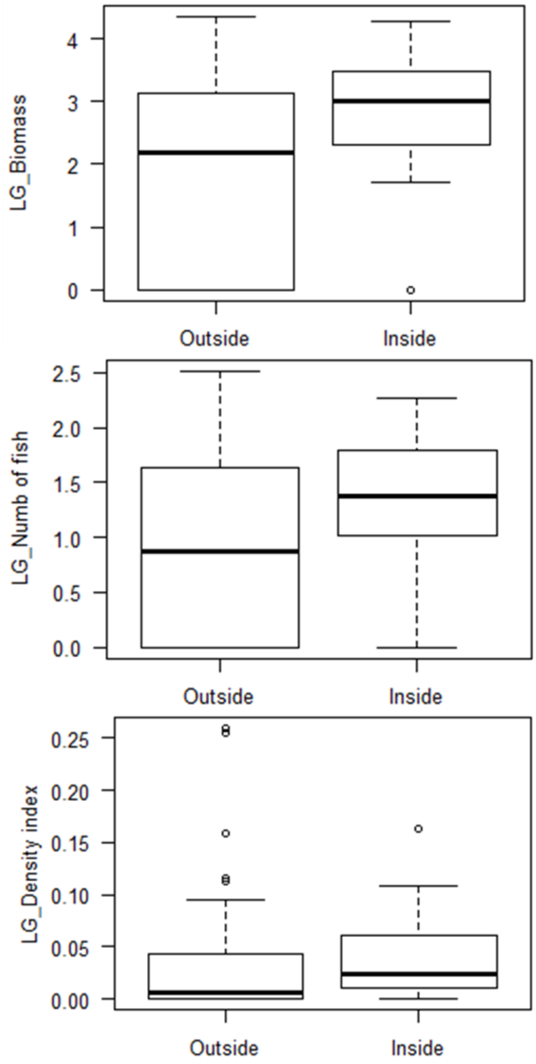

Fig. a Mean values of biomass, number and density index of fish (expressed as Log normal function) for transects located inside and outside of the MPA.

Appendix S2: ***Home ranges and feeding areas of breeding ospreys (Methods and Results)***

Foraging home ranges of 9 breeding adult ospreys (2 males and 7 females) were determined by GPS tracking. Birds were trapped at nests before the beginning of the breeding season (early March 2012 and 2013) and fitted with a GPS/GSM tag (Duck-4 model, ECOTONE, Poland, 35 x 55 x 15 mm, 24 g ~ 1.5% of body mass). Devices recorded one fix every 30 minutes across the entire breeding season (March-July). Since parental care and nest attendance is performed by both parents during incubation and chick rearing (Poole, 1989), we defined as failures any abrupt abandonment of the nesting site. In case of breeding failure, atypical ranging movements performed by birds were excluded from home range analyses. Thus, home ranges were calculated only during effective breeding activities. We used a fixed kernel density estimator (Worton, 1989), with Hawth's Tool extension in ArcGis v9.3.2 (www.esri.com) to calculate 95% foraging home ranges (UD95%) and 50% core foraging areas (UD50%). GPS tracking data can be consulted in Movebank (www.movebank.org; project name: Osprey in Mediterranean (Corsica, Italy, Balearics)).

Home ranges estimated during the breeding season showed that the feeding areas of adult ospreys were concentrated along the coast. Ospreys never ventured offshore to fish (median distance from the coast = 0.012 km, range: 0-3.2 km), but rather remained in the surroundings of the nesting sites, fishing in marine coves. Mean individual foraging home range was 64.05 ± 59.54 km^2 and mean core feeding area 5.5 ± 3.57 km^2 (Tab. a). Exploratory foraging trips were performed by ospreys along rivers and interior lakes when sea conditions were harsh for an extended period (Fig. a).

Table a: Estimates of core foraging areas (UD50%) and foraging home ranges (UD95%) of adult ospreys tracked by GPS in Corsica.

ID	Sex	Year	Monitoring Period	UD50% (km^2)	UD95% (km^2)
A02	M	2012	24/03-21/04	10.79	183.28
A03	F	2012	27/03-30/04	4.94	56.46
FOSP01	F	2013	27/03-30/06	4.01	32.16
FOSP02	F	2013	17/03-24/05	13.88	183.66
FOSP03	F	2013	23/03-28/05	9.13	94.94
FOSP04	F	2013	23/03/03/04	4.55	28.97
		2014	25/03-20/04	3.93	22.07
FOSP05	M	2013	27/03-24/06	4.11	77.17
		2014	06/02-30/06	4.15	50.43
FOSP06	F	2013	29/03-07/05	5.29	71.82
		2014	24/03-25/06	2.30	11.83
FOSP08	F	2013	05/04-24/06	2.23	9.88
		2014	09/03-08/07	2.22	10.01
Mean				*5.50*	*64.05*
SD				*3.57*	*59.54*

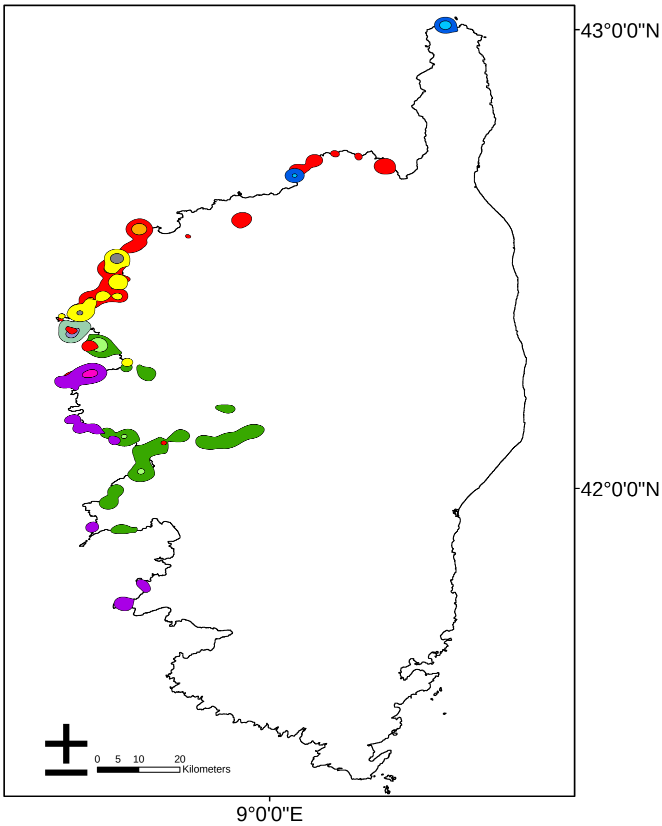

Fig. a Foraging home ranges (fixed kernel at 95%) and core foraging areas (fixed kernel at 50%) with darker and lighter colours respectively: each colour represents one of the 9 adult ospreys monitored during the breeding season in Corsica.

Appendix S3: ***Tourism and boat traffic evaluation (Methods and Results)***

We carried out two specific censuses in 2013 and 2014. In 2013 we assessed the at-sea distribution and frequency of boat passages within the MPA, as well as the distance of boat to the shore (in 2 classes: 0-250 m; >250 m), because ospreys are systematically disturbed by approaching boats at distance <250 m (Bretagnolle & Thibault, 1993). Two land-based vantage-points, located at the northern and southern limits of the MPA were used to monitor entrances and exits of boats. The same observations were performed within a control area (Revellata) outside of the MPA with a similar density of osprey nests. Both areas were located between two harbours from which tourist boats departed (Fig. 1b). Two observers worked simultaneously in each area between 9:00-17:00 during 4 observation-days (two days during the second half of June 2013 and two during the first half of July 2013). We selected this period because it corresponds to osprey chick-rearing, during which disturbance is critical for this species (Poole, 1989).

In 2014 the number of boat passages at osprey nests was recorded while studying the behaviour of breeding pairs (see details below). In this case, distance categories considered for boat passages were a) 0-100 m and b) 100-250 m, to focus on boats which were more likely to disturb ospreys.

The number of tourist shuttles operating inside the Scandola MPA and their passengers transport capacity increased from only 3 ships transporting c. 200 persons per day in 1977 to 32 ships transporting c. 2,200 persons per day in 2010 (Richez & Richez Battesti, 2007; Tavernier, 2010; Fig.a). However, data were not available for each year during the study period. Therefore, we extracted the total annual number of tourists visiting Corsica between 1986-2014 using data from the Observatoire régional des transports de la Corse (www.ortc.info;). A strong positive relationship was found between the annual number of tourists visiting Corsica and the number of shuttles working within Scandola (Spearman rank correlation: $r_{s(12)} = 0.963$, $p < 0.001$, Fig. b).

We therefore used this relationship to estimate the yearly transport capacity of touristic shuttles in Scandola for the study period (see also Fig. 4).

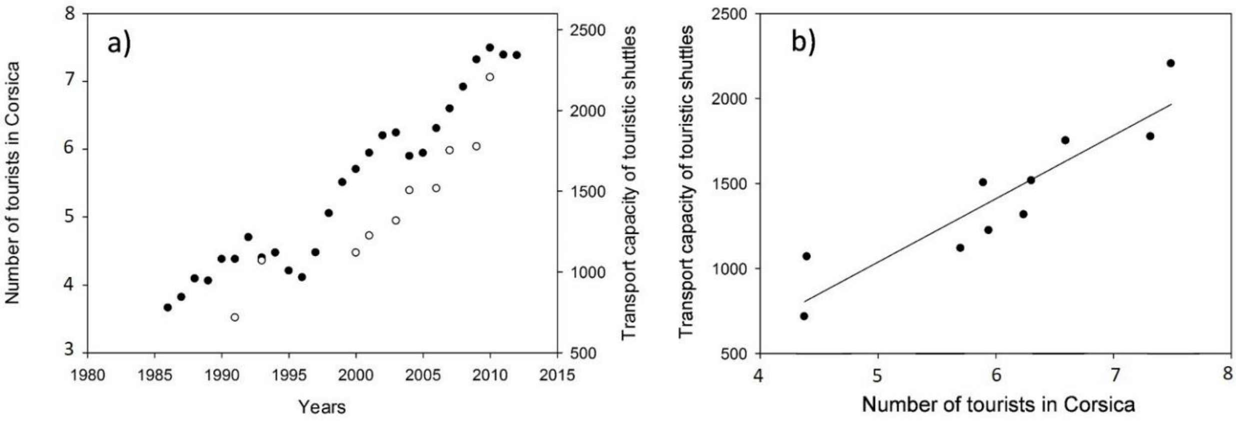

Fig. a Historical trends of total annual numbers of tourists (millions) visiting Corsica during 1986-2012 (black dots; data extracted from: http://www.ortc.info) and of the transport capacity of tourist shuttles operating in the Scandola MPA (open dots; data extracted from Richez & Richez Battesti, 2007; Tavernier, 2010);

Fig. b Linear regression between annual estimates of number of tourists in Corsica and daily number of visitors in the MPA.

The total annual number of tourists visiting Corsica increased consistently, from c. 3.6 millions in 1986 to c. 7.5 millions in 2013 (Fig. a). Our census conducted in 2013 showed that the number of boats visiting the MPA each day was twice that recorded within the control area outside of MPA (Fig. c). In both cases, numbers almost doubled between June and July (Fig. c). Further, >3 times more boats approached the coastline <250 m inside MPA compared to the control area (Fig. c). The number of boats passing at a distance >250 m from the coast was similar between the two areas in both months (Fig. c).

In 2014, the number of boat passing close to osprey nests (<250 m) was significantly higher for nests located inside the MPA than for those outside (GLMM: $\chi^2_{1,147} = 10.484$; $p = 0.001$), especially when considering those passing at <100 m (GLMM: $\chi^2_{1,147} = 15.95$; $p = 0.001$).

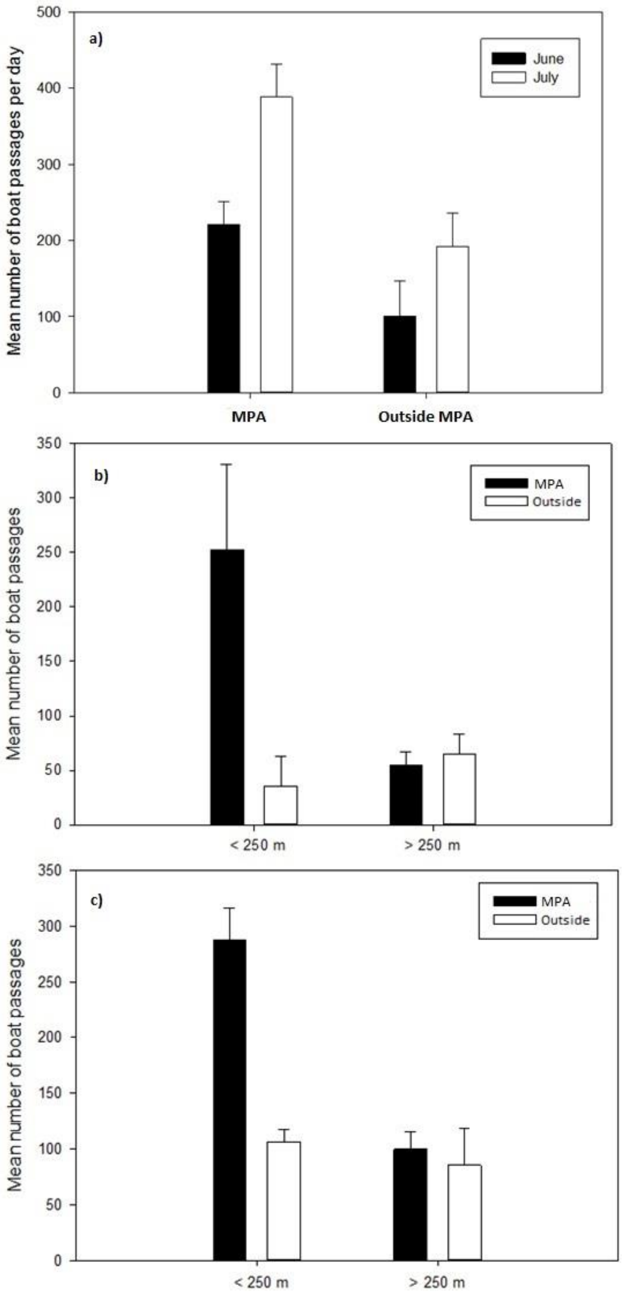

Fig. c Boat traffic during summer in Corsica: a) mean number of boat passages per day in June and July for sites inside and outside of the MPA. b) and c): mean number of boat passages per day < 250 m and > 250 m from the coast in June and July, respectively.

Appendix S4: ***Corticosterone analyses (Materials and method)***

Feathers were stored in paper envelopes before analyses, during which we extracted corticosterone following Bortolotti *et al.* (2008). Before removing the calamus we measured the length of the feather. Feathers were then cut into pieces < 5 mm^2 and placed in 16 x 100 mm glass tubes. Three glass beads and 10 ml methanol (HPLC grade) were added and the tubes were placed into an ultrasonic waterbath for 30 min and then at 50° C overnight. The methanol mixture was filtered through filter paper placed on a glass funnel. The methanol extracts were collected in tubes placed in a 50° C waterbath until dry. Feather extracts were then redissolved in 200ul steroid dilution of the ICN I^{125}radioimmunoassay kit (Cat. #07-120102; ICN Biomedicals/MP Biomedicals, Solon, Ohio; USA) for measurements. We followed the protocol of the company with modifications as described in Washburn *et al.* (2002): the volume of all reagents was halved; the dilution of the samples was performed at 1:50 instead of 1:200. The standard curve was extended by 2 points.

Appendix S5: *Complementary info on demographic data and behavioural parameters analyses*

a) Results of model selection of GLMM on the effects of the MPA and time on components of reproductive parameters on Corsican ospreys. Selected models are shown in bold.

Response variable	Model	Variables retained	K	logLik	AICc	ΔAICc	Weight
N eggs laid (541)	**1**	**Null**	**4**	**-815.09**	**1638.25**	**0.00**	**0.50**
	2	time	5	-815.03	1640.17	1.93	0.19
	3	Out/in MPA	5	-815.04	1640.19	1.94	0.19
	4	time+Out/in MPA	6	-814.98	1642.12	3.87	0.07
	5	time*Out/in MPA	7	-814.29	1642.80	4.55	0.05
N eggs hatched (730)	**1**	**time*Out/in MPA**	**7**	**-1181.01**	**2376.18**	**0.00**	**0.31**
	2	**Null**	**4**	**-1184.13**	**2376.31**	**0.14**	**0.29**
	3	Out/in MPA	5	-1183.51	2377.09	0.92	0.20
	4	time	5	-1184.01	2378.10	1.92	0.12
	5	time+Out/in MPA	6	-1183.40	2378.92	2.74	0.08
N chicks fledged (744)	**1**	**time*Out/in MPA**	**7**	**-1054.62**	**2123.40**	**0.00**	**0.99**
	2	time	5	-1062.52	2135.13	11.73	0.00
	3	time+Out/in MPA	6	-1061.53	2135.18	11.78	0.00
	4	Null	4	-1064.12	2136.29	12.90	0.00
	5	Out/in MPA	5	-1063.17	2136.41	13.01	0.00
Hatching success (538)	**1**	**time*Out/in MPA**	**7**	**-283.10**	**580.42**	**0.00**	**1.00**
	2	Null	4	-283.10	593.00	12.58	0.00
	3	Out/in MPA	5	-292.15	594.42	14.00	0.00
	4	time	5	-292.37	594.86	14.44	0.00
	5	time+Out/in MPA	6	-292.06	596.28	15.86	0.00
Fledging success (576)	**1**	**time**	**5**	**-332.80**	**675.70**	**0.00**	**0.40**
	2	time*Out/in MPA	7	-330.91	676.01	0.32	0.34
	3	time+Out/in MPA	6	-332.23	676.61	0.91	0.25
	4	Null	4	-338.95	685.97	10.27	0.00
	5	Out/in MPA	5	-338.45	687.01	11.31	0.00
Breeding success (540)	**1**	**time*Out/in MPA**	**7**	**-363.95**	**742.11**	**0.00**	**0.90**
	2	Null	4	-370.22	748.52	6.40	0.04
	3	Out/in MPA	5	-369.39	748.89	6.78	0.03
	4	time	5	-369.99	750.09	7.98	0.02
	5	time+Out/in MPA	6	-369.16	750.48	8.37	0.01
N eggs laid - threshold (541)	**1**	**Null**	**3**	**-815.09**	**1636.22**	**0.00**	**0.45**
	2	Threshold	4	-814.76	1637.59	1.37	0.22
	3	Out/in MPA	4	-815.04	1638.15	1.94	0.17
	4	Threshold+Out/in MPA	5	-814.71	1639.52	3.31	0.09
	5	Threshold*Out/in MPA	6	-813.82	1639.80	3.59	0.07
N eggs hatched - threshold (730)	**1**	**Threshold*Out/in MPA**	**6**	**-1185.80**	**2383.72**	**0.00**	**0.33**
	2	**Null**	**3**	**-1189.03**	**2384.09**	**0.37**	**0.28**
	3	Out/in MPA	4	-1188.37	2384.81	1.08	0.19
	4	Threshold	4	-1188.87	2385.79	2.07	0.12

	5	Threshold+Out/in MPA	5	-1188.24	2386.57	2.85	0.08
N chicks fledged - threshold (744)	**1**	**Threshold*Out/in MPA**	**6**	**-1057.48**	**2127.06**	**0.00**	**0.99**
	2	Threshold	4	-1064.45	2136.95	9.88	0.01
	3	Threshold+Out/in MPA	5	-1063.49	2137.05	9.99	0.01
	4	Null	3	-1068.37	2142.77	15.71	0.00
	5	Out/in MPA	4	-1067.52	2143.09	16.02	0.00
Hatching success - threshold (538)	**1**	**Threshold*Out/in MPA**	**6**	**-293.58**	**599.31**	**0.00**	**0.94**
	2	Threshold	4	-299.13	606.34	7.02	0.03
	3	Threshold+Out/in MPA	5	-298.75	607.60	8.29	0.01
	4	Null	3	-301.27	608.59	9.28	0.01
	5	Out/in MPA	4	-300.86	609.80	10.49	0.00
Fledging success - threshold (576)	**1**	**Threshold*Out/in MPA**	**6**	**-328.36**	**668.86**	**0.00**	**0.67**
	2	Threshold	4	-331.58	671.23	2.37	0.20
	3	Threshold+Out/in MPA	5	-331.05	672.21	3.35	0.13
	4	Null	3	-345.83	697.71	28.85	0.00
	5	Out/in MPA	4	-345.50	699.07	30.21	0.00
Breeding success - threshold (540)	**1**	**Threshold*Out/in MPA**	**6**	**-361.24**	**734.63**	**0.00**	**0.99**
	2	Null	3	-370.22	746.49	11.85	0.00
	3	Out/in MPA	4	-369.39	746.86	12.22	0.00
	4	Threshold	4	-370.08	748.24	13.61	0.00
	5	Threshold+Out/in MPA	5	-369.24	748.60	13.97	0.00

b) Estimated coefficients of variables influencing the reproductive parameters in Corsican ospreys, in the selected models.

Model Set	N_model set	Variables	B	0.95 confidence intervals	
N eggs laid	1	Intercept	1.046	0.99	1.09
N eggs hatched	1	Intercept	0.497	0.207	0.787
		time	0.005	-0.0044	0.0156
		Out/in MPA (IN)	0.264	-0.088	0.616
		time*Out/in MPA (IN)	-0.015	-0.151	-0.0014
	2	Intercept	0.617	0.475	0.751
N chicks fledged	1	Intercept	0.4502	-0.0626	0.9409
		time	-0.0115	-0.0317	0.0089
		Out/in MPA (IN)	0.474	0.0625	0.8828
		time*Out/in MPA (IN)	-0.030	-0.0475	-0.0144
Hatching success	1	Intercept	-0.251	-2.2174	1.4739
		time	0.034	-0.0339	0.1113
		Out/in MPA (IN)	4.095	1.859	6.7324
		time*Out/in MPA (IN)	-0.153	-0.2403	-0.077
Fledging success	1	Intercept	2.823	1.838	3.948
		time	-0.083	-0.127	-0.045
Breeding success	1	Intercept	-0.579	-1.382	0.171
		time	0.024	-0.001	0.052

		Out/in MPA (IN)	2.195	0.520	4.024
		time*Out/in MPA (IN)	-0.092	-0.153	-0.035
N eggs laid – threshold	1	Intercept	1.046	0.996	1.096
N eggs hatched – threshold	1	Intercept	0.677	0.572	0.774
		Threshold (before)	-0.132	-0.322	0.0569
		Out/in MPA (IN)	-0.177	-0.362	-0.0007
		Threshold (before)*Out/in MPA (IN)	0.345	0.0392	0.647
	2	Intercept	0.630	0.541	0.711
N chicks fledged – threshold	1	Intercept	0.154	-0.029	0.326
		Threshold (before)	0.233	-0.045	0.518
		Out/in MPA (IN)	-0.395	-0.684	-0.120
		Threshold (before)*Out/in MPA (IN)	0.618	0.269	0.969
Hatching success – threshold	1	Intercept	1.0999	0.634	1.579
		Threshold (before)	-1.549	-2.622	-0.538
		Out/in MPA (IN)	-0.499	-1.071	0.049
		Threshold (before)*Out/in MPA (IN)	3.377	1.207	6.547
Fledging success – threshold	1	Intercept	0.509	0.129	0.890
		Threshold (before)	1.707	0.887	2.629
		Out/in MPA (IN)	-0.523	-1.168	0.101
		Threshold (before)*Out/in MPA (IN)	2.149	0.295	5.135
Breeding success – threshold	1	Intercept	0.175	-0.134	0.472
		Threshold (before)	-0.868	-1.695	-0.090
		Out/in MPA (IN)	-0.657	-1.250	-0.066
		Threshold (before)*Out/in MPA (IN)	3.723	1.738	6.770

c) Results of model selection of GLMM on the effects of boat traffic on behavioural parameters of Corsican breeding ospreys. Selected models are shown in bold.

Response variable	Model	Variables retained	K	logLik	AICc	ΔAICc	Weight
N of prey items brought to the nest per hour (41)	**1**	**Traffic**	**6**	**43.48**	**-72.48**	**0.00**	**0.85**
	2	Null	5	40.34	-68.97	3.51	0.15
N of disturbing events (41)	**1**	**Traffic**	**6**	**-5.28**	**25.03**	**0.00**	**0.9**
	2	Null	5	-8.86	29.44	4.41	0.1
N of flight off events (41)	**1**	**Traffic**	**6**	**-52.64**	**119.75**	**0.00**	**0.56**
	2	**Null**	**5**	**-54.27**	**120.26**	**0.52**	**0.44**
Time female alarming (41)	**1**	**Traffic**	**6**	**-55.94**	**126.35**	**0.00**	**0.71**
	2	**Null**	**5**	**-58.23**	**128.17**	**1.82**	**0.29**

d) Estimated coefficients of variables influencing the behavioural parameters of Corsican breeding ospreys, in the selected models.

Model Set	N_model set	Variables	B	0.95 confidence intervals	
N of prey items brought to the nest per hour	1	Intercept	0.162	0.1134	0.2158
		Traffic (high)	-0.092	-0.1694	-0.0232
N of disturbing events	1	Intercept	-0.243	-0.627	0.1081
		Traffic (high)	0.216	0.066	0.371
N of flight off events	1	Intercept	0.435	-0.101	0.974
		Traffic (high)	0.729	-0.071	1.489
	2	Intercept	0.774	0.317	1.248
Time female alarming	1	Intercept	-0.656	-1.749	0.399
		Traffic (high)	0.493	0.047	0.925
	2	Intercept	0.386	-0.286	0.988