

Veiga JP 1993. Badge size, phenotypic quality, and reproductive success in the house sparrow: a study on honest advertisement. *Evolution* 47: 1161-1171.

Whitekiller RR, Westneat DF, Schwagmeyer PL, Mock DW 2000. Badge size and extra-pair fertilizations in the House Sparrow. *Condor* 102: 342-348.

Artificial lights and mortality of Cory's shearwater *Calonectris diomedea* on a Mediterranean island

NICOLA BACCETTI¹, PAOLO SPOSIMO², FRANCESCA GIANNINI³

¹Istituto Nazionale Fauna Selvatica, via Ca Fornacetta 9, I-40064 Ozzano Emilia (BO), Italy (nicola.baccetti@infs.it); ²NEMO s.a.s., via Giotto 33, I-50121 Firenze (FI), Italy; ³Parco Nazionale Arcipelago Toscano, via Guerrazzi 1, I-57037 Portoferraio (LI), Italy

Riassunto – *Luci artificiali e mortalità della berta maggiore Calonectris diomedea su un'isola mediterranea.* Si riporta il rinvenimento di giovani berte maggiori, appena involate dal nido, che erano state attratte da faretti recentemente attivati all'interno del porticciolo dell'isola toscana di Pianosa. Il fenomeno, che in assenza di interventi avrebbe potuto portare alla perdita almeno del 12% del totale di giovani involati nel 2004, è ben noto per la sua gravità al di fuori del Mediterraneo. Si sono sperimentate con apparente successo forme di illuminazione alternativa.

The phototactic behaviour of many nocturnal Procellariiformes, especially fledglings on their first take off from the natal colonies, can have lethal consequences as they can be attracted by bright artificial lights. Disoriented fledglings that crash into buildings, rocks or ships often die on impact or are forced to land at unsuitable sites, where they become victims of predation, road traffic or starvation (Reed *et al.* 1985, Telfer *et al.* 1987, Le Corre *et al.* 2002). This problem is known to occur especially on foggy nights and has been recorded for several species and in different geographical situations (Warham 1996).

This source of mortality is known to affect the Cory's shearwater *Calonectris diomedea* in the Azores and Canaries (Monteiro *et al.* 1996). It has not been reported for this or other petrel species in the Mediterranean (cf. Thibault *et al.* 1997, Cadiou *et al.* 2004), although lights placed close to colonies are known to disturb incoming adults of Cory's shearwater in the Maltese islands (up to the point of site desertion, Borg and Cachia-Zammit 1998) and

Balearic shearwater *Puffinus mauretanicus* in the Balearics (causing behavioural anomalies, Ruiz and Martí 2004). Dazzled juveniles of Cory's have been occasionally found on Malta (J. Borg, pers. comm.).

Here we report on a wreck of Cory's shearwater fledglings on Pianosa Island (42.35N-10.06E), 60 km off the Italian mainland coast and 40 off Corsica, France. Pianosa covers an area of 10.2 km² and was the site of a large state prison for more than a century, until 1998. It is now included in the Tuscan Archipelago National Park and is still closed to unauthorized visitors. The human population in the years 2000-2004 was less than 15, including personnel of different guard corps and 5-10 prisoners. Apart from the prison, there is only an abandoned village on the eastern coast, with a small port and an automatic lighthouse. Former prison buildings are scattered through the inner part of the island. The area has been totally dark at night over the last few years, except for dim street lights in the village, the nearby lighthouse and a single beam light 1 km inland, where the prisoners are presently lodged.

Pianosa has nearly lost its breeding shearwater population as a result of millennia of human presence and the consequent arrival of alien predators (cf Blondel and Vigne 1993 for details on this problem in the Mediterranean). Long-abandoned nesting sites can still be recognized in caves all around the island, but only 10-15 occupied nests of Cory's Shearwater are presently known from the southern coast (2.5 km from the village), and these may possibly represent a recent return. On the other hand, a larger colony of this species - known since 1877 (Baccetti 1989) - survives on a stack ('La Scuola'), 200 m offshore and

Received 18 October 2005, accepted 16 December 2005

Assistant editor: D. Rubolini

500 m from the village. La Scola was the most likely origin of some fledglings that were rescued while hanging around the village (5 birds) or found dead under walls (at least 2 birds), on 5-6 nights from 6-18 October 2004; feral cats, in the same period, took at least two more of the dazzled birds. Some disoriented shearwaters were also observed at night, continuously circling over the illuminated port, while it was raining; their fate could not be ascertained. No real fog was present throughout the wrecking period, but moonless nights (new moon on 14 October), overcast sky and rainy conditions prevailed. The dates coincided exactly with the usual fledging period of the Cory's shearwater on nearby Corsican islets (Thibault *et al.* 1997). All nine birds examined were fledglings. The surviving ones were successfully released from the seashore a few hours after they had been collected.

Two 400 W halogen beams, set to light the port permanently from adjacent rooftops, were the main cause of shearwater attraction. These were not directly visible from La Scola colony and had only been in use in that year, following a decision to keep a patrol vessel parked in the harbour for emergencies. Urgent requests to keep the lights switched off unless really needed, hood the lamps or replace them with less powerful ones, all received a negative response from the prison authority. As a compromise, the existing bulbs were eventually replaced on 19 October with equally powered high-pressure Sodium lamps, emitting a softer and hopefully less disturbing yellow light. No birds came ashore on the following nights till at least 1 November, but it is unclear to what extent other circumstances could have played a role in halting the phenomenon. The end of the fledging season (Thibault *et al.* 1997), a slight improvement in weather conditions, as well as a change in the phase of the moon, suggest that the losses would have diminished anyhow. Nocturnal brightness due to clear sky and waxing/full moon phase has been shown to decrease the activity of nocturnal petrels ashore (Mougeot and Bretagnolle 2000), as well as their attraction to artificial lights (Reed *et al.* 1985).

Burrow monitoring at La Scola colony in the 2005 breeding season suggested a total population size of 80-100 pairs. Breeding success of 0.85 chicks/pair was assessed one week before the earliest chicks fledged (P. Sposimo, unpubl. data). Assuming that all the stranded birds were found and that none of them would have been able to reach the

sea without human intervention, birds dazzled by artificial lights on their maiden flights would represent at least 12% of the juveniles fledged in 2004. The local topography suggests that both assumptions are probably realistic, or at least that missed birds were mainly those which managed to orient themselves correctly among buildings and reach the sea on their own before dawn. Although the potential loss for the population nearly equalled all sources of breeding failure recorded at the egg/chick stage in the same year, it was lower than in other case studies (e.g. 20% for *Pterodroma baraui* on Réunion island, Le Corre *et al.* 2002).

Much heavier losses, moreover, occurred on La Scola until recently. The productivity of the colony had been restored in 2001 by means of a successful campaign to eradicate the black rat *Rattus rattus* (Perfetti *et al.* 2001). No fledged birds were recorded in 1999 and 2000, or on an earlier occasional survey in 1989 (i.e. possibly in most years since the rats reached this stack, around 1980). After the rats were poisoned, the breeding success suddenly reached values very close to the theoretical maximum in all the following seasons (0.77-0.90 fledged chicks/pair, 2001-2004). No shearwaters were wrecked on Pianosa village in autumns 2001-2003, when breeding was successful, qualified observers were present, but the harbour lights were not being used (the lighthouse and street lights, of course, were in use). In addition, no relevant wrecks could have occurred in the previous two decades, because hardly any chick fledged at La Scola. Much more powerful and widespread lights must have been present in 1980-1989 when the prison was at its full capacity (human population size: 1500) and especially in 1992-1997 when a strictly surveyed confinement section was present (Piga and Foresi 2001). Memory about possible seabird wrecks in earlier times, i.e. before the rats colonized the stack, is lost. But, then, powerful lamps were probably not as easily available as at present and the electric energy was produced on the island in the strictly needed amount (a submarine connection has allowed a large energy supply only since 1990).

The future destiny of the island of Pianosa is still a matter of political discussion. Whatever decisions are taken, it is very unlikely that the human population will remain for a long time at its present low level. New inhabitants will most probably imply that the existing buildings will be restored and obsolete street lights replaced. A new hazard might, thus, face

the Scola colony soon after the problem of rat predation has been solved.

Acknowledgements - We thank the ringers of Centro Ornitologico Toscano, particularly Iacopo Corsi, Michele Giunti, Paolo Politi, and some of the Pianosa prisoners for promptly reporting and rescuing stranded shearwaters. Mike Smart improved our English phrasing.

REFERENCES

- Baccetti N 1989. Notizie sull'avifauna nidificante a Pianosa (Arcipelago Toscano). Quaderni del Museo di Storia Naturale di Livorno 10: 77-90.
- Blondel J, Vigne JD 1993. Space, time, and man as determinants of diversity of birds and mammals in the Mediterranean Region. In: Ricklefs RE, Schluter D (eds). Species diversity in ecological communities. The University of Chicago Press, pp. 135-145.
- Borg JJ, Cachia-Zammit R 1998. Monitoring Cory's Shearwater *Calonectris diomedea* colonies in a hostile environment. In: Walmsley J, Goutner V, El Hili A, Sultana J (eds). Ecologie des oiseaux marins et gestion intégrée du littoral en Méditerranée. AAO & Medmaravis, Tunis, pp. 31-47.
- Cadiou B, Pons JM, Yésou P (eds) 2004. Oiseaux marins nicheurs de France métropolitaine (1960-2000). Biotope, Méze.
- Le Corre M, Ollivier A, Ribes S, Jouventin P 2002. Light-induced mortality of petrels: a 4-years study from Réunion Island (Indian Ocean). Biological Conservation 105: 93-102.
- Monteiro LR, Ramos JA, Furness RW 1996. Past and present status and conservation of the seabirds breeding in the Azores Archipelago. Biological Conservation 78: 319-328.
- Mougeot F, Bretagnolle V 2000. Predation risk and moonlight avoidance in nocturnal seabirds. Journal of Avian Biology 31: 376-386.
- Perfetti A, Sposimo P, Baccetti N 2001. Il controllo dei ratti per la conservazione degli uccelli marini nidificanti nelle isole italiane e mediterranee. Avocetta 25: 126.
- Piga P, Foresi FA 2001. L'isola di Pianosa. Debate, Livorno.
- Reed JR, Sincock JL, Hailman JP 1985. Light attraction in endangered Procellariiform birds: reduction by shielding upward radiation. Auk 102: 377-383.
- Ruiz A, Martí R (eds) 2004. La Pardela Balear. SEO/BirdLife – Conselleria de Medi Ambient del Govern de les Illes Balears, Madrid.
- Telfer TC, Sincock JL, Byrd GV, Reed JR 1987. Attraction of Hawaiian seabirds to light: conservation efforts and effects of moon phase. Wildlife Society Bulletin 15: 406-413.
- Thibault JC, Bretagnolle V, Rabouam C 1997. *Calonectris diomedea* Cory's Shearwater. BWP Update 1: 75-98.
- Warham J 1996. The behaviour, population biology and physiology of the Petrels. Academic Press, London.