Balearic Shearwater

Puffinus mauretanicus

Pardela Balear
Puffin des Baléares

CRITICALLY ENDANGERED | ENDANGERED | VULNERABLE | NEAR THREATENED | LEAST CONCERN | NOT LISTED

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TAXONOMY

Order Procellariiformes
Family Procellariidae
Genus *Puffinus*
Species *P. mauretanicus (Lowe, 1921)*

In ornithological literature, the Balearic Shearwater was traditionally regarded as a subspecies of the Manx Shearwater *Puffinus puffinus* [1, 2, 3, 4] and, later on, of the Yelkouan Shearwater *Puffinus yelkouan* [5, 6]. However, enough evidence accumulated by the 1990s to recommend its consideration as a distinct species based on differences in morphology, genetics, behaviour and ecology [7, 8, 9]. This is the current view of the scientific and conservation communities. Recently, the genetics of *Puffinus mauretanicus* have again received attention due to concerns about possible hybridization with the sympatrically breeding *P. yelkouan* [10, 11, 12, 13, 14]. However, Genovart *et al.* (2012) conclude that although the introgression of *P. yelkouan* breeding in *P. mauretanicus* colonies in Menorca may induce natural hybridisation, this is not presently a conservation concern for *P. mauretanicus* [13]. In contrast, high levels of inbreeding at a local scale (although gene flow levels between colonies are unexpectedly high), and possibly low genetic variability, could represent a new potential threat for the species [13].

CONSERVATION LISTINGS AND PLANS

International

- 2012 IUCN Red List of Threatened Species – Critically Endangered (since 2004) [15, 16]
- Bonn Convention on Migratory Species (Appendix I and Resolution 8.29) [17, 18]
- European Union Council Directive 2009/147/EC on the conservation of wild birds [19]
- European Union Council Directive 92/43/EEC (Habitats Directive) [20]
- BirdLife International Species Action Plan [21, 22].
- Barcelona Convention on the Protection of the Mediterranean Sea (Appendix II and Action Plan) [23]
- OSPAR Convention for the protection of the marine environment of the North-East Atlantic (OSPAR List of endangered and/or in decline species and habitats) [24]
- Bern Convention – Protected Fauna (Appendix II) [25, 26]

Spain

- Listed in Annex IV of *Law 42/2007 on Natural Heritage and Biodiversity* [27]
- Listed as 'In danger of extinction' in *National Catalogue of Threatened Species*, which sets obligation to adopt a recovery plan [28]
- Strategy for the Conservation of the Balearic Shearwater (*Puffinus mauretanicus*) [29]
- Spanish Red Data Book [30]

Balearic Islands

- Autonomous Government of the Balearic Islands - Recovery Plan (Decree 65/2004) [31, 32]

BREEDING BIOLOGY

Puffinus mauretanicus is a philopatric, colonial species which breeds annually in crevices and caves on small islets and inaccessible cliffs. A single egg is laid between March and April and incubation lasts for 48-52 days [33]. There is a distinct pre-laying exodus period, longer for females than for males (median 13.5 and 1.5 days, respectively) [34]. Fledging period is around 60-70 days and is around late June [33]. Age of first breeding is no less than three years old and maximum longevity is at least 23 years [31]. Some birds are known to take 'sabbatical years' when they skip breeding and unusual reproductive behaviour, such as the formation of trios, has been described [35].

Table 1. *Breeding cycle of* P. mauretanicus

	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
At colonies	■		■	■	■	■	■	■	■	■	■	■
Egg laying										■	■	
Incubating										■	■	■
Chick provisioning	■	■									■	■

BREEDING SITES

The Balearic Shearwater is an endemic species breeding in the caves and cliff cavities of most of the Balearic islands and surrounding islets of Spain in the western Mediterranean [30, 36] (Table 2 and Figure 1). During the last decade, the total breeding population within the archipelago was estimated to be about 2,000 breeding pairs [21, 32]. In 2009, the breeding population was estimated at c. 3,000 breeding pairs (Table 3). However, this figure does not reflect a real increase in the population but rather better surveys of known breeding sites and changes in assumptions when carrying out indirect estimates. In fact, there is no evidence that negative population rates have been reversed [21]. Over half of the breeding population used to breed on the island of Formentera until the early 2000s [33], but a recent census on the island has shown a steep population decline to 685 pairs in 2007 [32].

Table 2. *Breeding distribution of the global population of* P. mauretanicus.

	Spain
Breeding pairs	100%

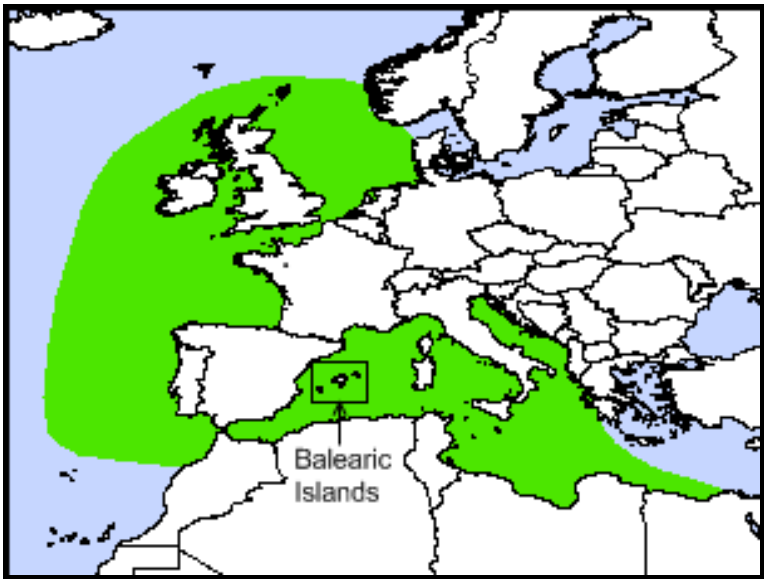

Figure 1. *The approximate range of* P. mauretanicus. *Map provided by BirdLife International [15].*

Table 3. *Estimates of the population size (breeding pairs) for* P. mauretanicus.

Breeding site location	Jurisdiction	Years monitored	Monitoring method	Monitoring accuracy	Annual breeding pairs (last census)
Balearic Archipelago 39° 55'N, 4° 10'E´	Spain	Early 1990s, 1999, 2001, 2005, 2007, 2008, 2009	?	Low	
Mallorca					900 (2009) [21]
Cabrera					449 (2008) [21]
Menorca					405 (2009) [21]
Ibiza					450 (2007) [32]
Formentera					685 (2007) [32]
Total for all sites					***2 889***

POPULATION TRENDS

This species is thought to have been abundant prior to human settlement in Pitiusas (Ibiza and Formentera), based on numerous fossil remains from the upper Pleistocene [33]. About 60% of the breeding colonies on Cabrera Island have disappeared in the past few decades, and a recent survey on Formentera Island recorded no breeding activity at 30 suitable caves where ancient remains of breeding activity were found [37]. Previously, the breeding range included extensive colonies on the mainlands of Ibiza and Cabrera, both of which are currently deserted [11]. The estimated adult survival rate of 0.78 (estimated from data on predator-free colonies) is unusually low for a long-lived seabird and the most important demographic parameter in the population dynamics influencing the growth rate [38]. Based on 1997-2002 data, the population was estimated to be declining at a rate of 7.4% per year [38]. Likewise, population viability analysis, published in 2004, estimated a mean extinction time of 40.4 years [38] for an initial population of 1,750-2,125 breeding pairs, making the Balearic Shearwater one of the world's rarest seabirds and earning the status of Critically Endangered [15]. The situation has changed little by 2010, when 20% of the estimated extinction time has elapsed and virtually the same threats continue to menace the species [37].

The size of the global population is difficult to assess, and it has been suggested that there may be a large floating population of immatures and non-breeders; however, recent winter at-sea surveys and counts from the Straits of Gibraltar suggest that the global figure must lie in the range of 20,000-30,000 individuals [15].

Table 4. *Summary of population trend data for* P. mauretanicus.

Breeding site	Current monitoring	Trend years	% average change per year	Trend	% of population
Mallorca					
Sa Cella and Conills	Yes?	1997-2002	-7.4% [38]	Declining	c. 50% (241 nests) [38]
Cabrera				Declining	
Menorca				Declining	
Ibiza				Declining	
Formentera		1990s - 2006	-	Declining	

Table 5. *Demographic data for* P. mauretanicus

Breeding site	Mean breeding success [95%CI] or range	Mean juvenile survival [95%CI]	Mean adult survival [95%CI]	Years
Mallorca				
Sa Cella and Conills	0.59 [0.51-0.67] [38]	0.70 [0.63-0.78] [38]	0.78 [0.74-0.82] [38]	1997-2002 [38]
Conills	0.45-0.81 [36]	no data	no data	1986-2004 [36]
Malgrats	0.33-1.00 [36]	no data	no data	1986-2000 [36]
Sa Cella	0.45-0.88 [36]	no data	no data	1997-2004 [36]
Cabrera	0.44-0.89 [36]	no data	no data	1993-2000 [36]
Menorca				
Maó	0.50-0.84 [36]	no data	no data	1999-2004 [36]
Ibiza	no data	no data	no data	-
Formentera	no data	no data	no data	-

BREEDING SITES: THREATS

The restricted breeding area, that is limited to the Balearic Archipelago, along with a small population, significantly adds to the vulnerability of this long-lived species to all threats, with a particular incidence of those factors that affect the survival of adult birds. The deterministic demographic model of Oro *et al.* (2004) [38] suggests a high adult mortality by sources other than predators. Historically, take for human consumption (mostly on Ibiza and Formentera) was common, with 2,400-2,700 birds taken yearly until the 1970s [18] but harvesting of shearwaters is currently mostly incidental [21]. In the past, large declines or local extinctions of Balearic Shearwaters were likely due to human predation and loss of breeding habitat through urban development [38]. Presently, alien mammals such as feral cats (*Felis domesticus*), black rats (*Rattus rattus*) and common genets (*Genetta genetta*) are thought to be the greatest threats on land [30] and have been responsible for the wiping out of Balearic Shearwaters on some islands in recent times [32]. European rabbits *(Oryctolagus cuniculus)* at some colonies may degrade nesting habitats [15].

Table 6. *Summary of known threats of* P. mauretanicus. *Data taken from Species Action Plans [21, 22, 23], and C. Carboneras, M. Louzao and J.M. Arcos (pers comm).*

Location	Human disturbance	Fisheries	Egg collection and hunting	Oil spills	Habitat loss or alteration	Predation (alien species)	Contamination	Increased impact by native species
Balearic Islands	Low	High [a]	Low at present; Locally high?	Potentially high	Low [b]	High	Unknown	Unknown [c]
Spanish Continental Waters	Low	High [a]	--	Potentially high	Medium [d]	--	Unknown	Unknown [c]

[a] - Category represents fishing bycatch in longlines and fishing nets. Overfishing (depletion of fish stocks), which may cause changes in winter and post-breeding distribution, is also rated as 'High'

[b] - All known colonies are included in the EC-Natura 2000 network as Special Protection Areas (SPAs), but management may be ineffective

[c] - Competition may occur for nest cavities with Cory's Shearwater (*Calonectris diomedea)*

[d] - Alteration of coastline already significant through housing developments (tourism) and construction of infrastructure and harbours. New threats include plans to develop extensive wind farms close to foraging areas or along migratory routes.

FORAGING ECOLOGY AND DIET

Balearic Shearwaters feed by surface-seizing and underwater pursuit, mainly on small pelagic fish such as shoaling clupeiforms [39, 40]. Although this species has been reported to feed on plankton in crepuscular hours, it is not known to feed at night [41]. Flocks have been recorded engaging in a pursuit sequence of plunging, diving, running on the water surface, short flights and then plunging repeatedly. Birds fly and plunge from about 1-2 m above the water and enter the sea head first with opened wings; dives may extend to a depth of 26 m and last up to 40 seconds [42]. They also obtain much of their food by taking advantage of fishery discards, particularly from trawlers; their excellent diving abilities give them an alternative for reducing competition with gulls [39]. During the breeding season, their diet is based on sardines (family Clupeidae) and anchovies (family Engraulidae), complemented to a various degree with fishery discards along the eastern Iberian Peninsula coastline, especially in the vicinity of the Ebro Delta [36, 39, 40, 41]. Within this area, there is evidence that the operation of trawlers influences the foraging ranges of shearwaters, suggesting that discards represent more than an opportunistic resource for the species [43], at least during part of the breeding cycle. Post-breeding birds tend to feed on discards in the Bay of Biscay [44] but concentrate mainly on pelagic fish during the rest of the year [41].

Although the Balearic Shearwater is threatened in the long-term by commercial fishing via bycatch and overfishing, trawler discards may favour the species in the short-term by supplying a significant proportion of the energy requirements during the breeding season [39, 41, 45]. Indeed, the time when Balearic Shearwaters take most advantage of discards coincides with the season when energetic demands are high and surface productivity is naturally low throughout the Mediterranean Sea [41, 46]. Availability of fishing discards is reported to influence breeding performance [39]. Establishment of fishery moratoria may therefore produce unknown short- and long-term outcomes as discards could decrease and thus increase forage fish populations [39, 45, 47]. To mitigate these and other potential threats, implementation of Marine Protected Areas (MPAs) has been recommended to protect the foraging areas and movement corridors of the Balearic Shearwater [39].

MARINE DISTRIBUTION

Balearic Shearwaters are restricted to the western Mediterranean during the breeding season. High concentrations of the species have been recorded both inshore and offshore, ≥ 200 km from breeding sites, with most concentrations in the highly productive waters off the Ebro Delta [47, 48]. After breeding, most of the population leaves the Mediterranean through the straits of Gibraltar and disperses into the Atlantic, concentrating in favourable areas like the Bay of Biscay, where moulting occurs [44]. However, some remain off western Iberia and others go into the North Sea, regularly reaching the English Channel and some travelling as far north as Scotland and southern Scandinavia; towards the South, vagrants have occurred along the West African coast [33]. These inter-annual shifts in distribution may be in relation to food availability [34]. After the Atlantic exodus, which occurs from June through to September, most birds return to the Mediterranean and concentrate in large gatherings along the eastern Iberian coast; at this time, they also visit the breeding colonies [33, 34, 36, 49]. It is believed that most birds, when coming back from the Atlantic, visit their colony immediately (median two first days) and spend around five months visiting it rather frequently, which could be important for synchronizing breeding and may even have other as yet unknown functions [34]. The recent, rapid northward range expansion of the post-breeding distribution to north-east Atlantic waters has been attributed to climate-driven shifts in prey distribution through increasing sea surface temperature (SST) [50]. However, this view has been disputed [51].

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Table 7. *Summary of the known Range States and Regional Fisheries Management Organisations that overlap with the marine distribution of* P. mauretanicus

	Breeding and feeding range	Foraging range only	Few records - outside core foraging range
ACAP Range States	Spain	France United Kingdom	Norway
Non-ACAP countries	-	Algeria Italy Morocco Portugal Ireland Tunisia Malta	Belgium Cape Verde Germany Greece Israel Netherlands Poland Sweden
Regional Fisheries Management Organisations	ICCAT [a] GFCM [b]	ICCAT NEAFC [c] GFCM	ICCAT NEAFC GFCM

[a] International Commission for the Conservation of Atlantic Tunas
[b] General Fisheries Commission for the Mediterranean
[c] North-East Atlantic Fisheries Commission

MARINE THREATS

The main conservation concern for Balearic Shearwaters is adult survival, which is unusually low for a procellariiform [38]. Mortality at sea, caused by interaction with fisheries, has been long suspected [38, 45] but until now has escaped detection by the scientific observer programmes in operation in Spain (by IEO), possibly because these were targeted at fisheries where bycatch occurs with low frequency or only sporadically. However, recent reviews [52, 53] have collated information that unveils the severity of this threat (particularly bycatch in longline fisheries) and the irregular pattern with which it occurs, at least in Spanish Mediterranean waters. The number of birds implicated in each mortality occasion is highly variable but may be substantial, with up to 0.6% of the global population involved in a single episode [54]. This variability makes the species more vulnerable to extinction.

Table 8. Summary of known bycatch events of Balearic Shearwaters in Spanish Mediterranean waters in the period 1999-2010. The list includes mortality episodes of both mauretanicus*-like and* yelkouan*-like phenotypes, since both have been known to co-occur and identification at species level may not be straightforward.*

Date	Fishing Ground	Province	*P. mauretanicus*	*P. yelkouan*	Total *Puffinus*	Fishery	No. sets	Source
29-11-1999	Tarragona	Tarragona	50?	0?	**50**	trawler?	?	Arcos & Oro 2004 [30]
winter 2000/01	Arenys	Barcelona	60	0	**60**	demersal longline	2	E. Badosa *in* ICES 2008 [52]
14-06-2001	Castellón	Castellón	3	0	**3**	demersal longline	237	Belda & Sánchez 2001 [55]
spring 2004	--	Valencia	12	0	**12**	demersal longline	89	Guallart 2004
18-05-2006	Torredembarra	Tarragona	0	1	**1**	demersal longline	?	C. Carboneras, unpublished
19-05-2006	Llançà – Gulf Lyons	Girona	?	> 2	**20**	unspecified longline	?	C. Carboneras, unpublished
2003-2007	--	Barcelona, Tarragona, Girona	27	0	**27**	unspecified longline	25 visits to port; 229 birds in total	J. González-Solís & J.L. Roscales *in* ICES 2008 [52]
June 2007	Ebro delta	Tarragona	12	0	**12**	unspecified longline	4 nm transect	J. Torrent *in* ICES 2008 [52]
16-05-2008	L'Escala	Girona	60	12	**72**	pelagic-type *coastal* longline	1	CRAM 2008 [54]

Due to its ecology and its tendency to aggregate, the Balearic Shearwater is also at risk from other threats at sea, particularly oil spills if they coincide in time or location with concentrations of the species [16]. Factors that contribute to the general degradation of the marine environment are also of concern: bioaccumulation of pollutants (mercury, hydrocarbons), reduced availability of prey (depletion of stocks through over-fishing) and increased presence of waste (plastics, remains of fishing gear) [15, 16, 56, 57].

Oro *et al*. (2009) [36] listed, by order of priority, the measures that should be put into practice for the long-term conservation of *Puffinus mauretanicus*:

1. Addressing accidental mortality in fisheries (bycatch)
2. Control of alien predators
3. Effective protection of nesting areas
4. Stopping direct take by humans
5. Sustainable fisheries (reducing overexploitation)
6. Fisheries discards reduction and trawling moratoria
7. Avoiding oil pollution and its effects
8. Addressing pollution by heavy metals
9. Measures to reduce competition with other species
10. Special Protection Areas of Mediterranean Importance (SPAMIs)
11. Applied research

Several countries have initiated the process to designate Marine Protected Areas (MPAs) for this species. The inventories of marine Important Bird Areas (IBAs) in Spain and Portugal, completed in 2009 by SEO/BirdLife and SPEA respectively [58, 59], was a significant step in that direction. The process is to be concluded with the designation of those areas as Special Protection Areas within the EC-Natura 2000 network and the establishment of appropriate management tools. This process is already ongoing in some countries within the species' the area of distribution.

Spain has legislation in place that promotes the use of some mitigation measures (bird-scaring lines, night-setting, reduced lighting on deck, minimisation of offal discharge) in domestic longline fisheries, although this is not compulsory, and is thus judged insufficient [60]. The development of a European Community Plan of Action for reducing seabird bycatch in longline fisheries has been proposed by BirdLife International as a conservation measure to benefit this species, amongst others [60]. ICCAT adopted Resolution 02.14 that urges its member States to adopt a National Plan of Action for reducing seabird bycatch in longline fisheries and to provide information on the incidental catch of seabirds in their fisheries [61]. Since 2011 the species has been covered by an International Plan of Action developed by SEO/BirdLife and BirdLife International for the European Commission [21].

KEY GAPS IN SPECIES ASSESSMENT

The Balearic Shearwater, as a Critically Endangered species, merits a rapid response to gaps in current knowledge. More comprehensive understanding of population trends, size and distribution (both at sea and at breeding colonies), threats and competition with other bird species is required, as well as research on small pelagic fish populations, fishery interactions and the impact of pollutants and heavy metals on this species [15]. Specifically, determination of factors that affect the breeding success and, most importantly, survival of adults is of high priority [21, 38, 39]. To achieve this, resumption of the population monitoring programme (through capture-recapture of breeding birds) and the establishment of observer programmes in the most relevant fisheries (particularly demersal longlining) are paramount.

REFERENCES

1. Murphy, R.C. 1952. The Manx shearwater, *Puffinus puffinus*, as a species of world-wide distribution. *Amer. Mus. Novitates* **1586**: 1-21.
2. Cramp, S. & Simmons, K.E.L. (eds.) 1977. *Handbook of the Birds of the Western Palearctic, vol. 1: Ostrich to ducks*. Oxford University Press, Oxford.
3. Brooke, M.de L. 1990. *The Manx Shearwater*. Academic Press, London.
4. Carboneras, C. 1992. Family Diomedeidae (Albatross). Pp. 198-215 *in* del Hoyo, J., A. Elliott, & J. Sargatal (eds.) *Handbook of Birds of the World*, vol. 1. Barcelona:Lynx Edicions.
5. Wink M, Heidrich P and Ristow D (1983). Genetic evidence for the speciation of the Manx Shearwater *Puffinus puffinus* and Mediterranean Shearwater *Puffinus yelkouan*. *Vogelwelt* **114**: 226-232.
6. Bourne WRP, Mackrill EJ, Paterson AM and Yésou P (1988). The Yelkoun Shearwater *Puffinus (puffinus?) yelkouan*. *British Birds* **81**: 306-319.
7. Snow DW and Perrins CM (1998). The *Birds of the Western Palearctic. Concise Edition. Volume 1. Non-Passerines*. Oxford University Press.
8. Brooke, M. de L. 2004. *Albatrosses and petrels across the world*. Oxford: Oxford University Press.
9. AERC TAC .2003. AERC TAC's Taxonomic Recommendations (1 December 2003). Association of European Rarities Committees. Available from: http://www.aerc.eu/aerc_tac.htm. Checked: 01/03/2010.
10. Genovart M, Juste J and Oro D. 2005. Two sibling species sympatrically breeding: a new conservation concern for the critically endangered Balearic shearwater. *Conservation Genetics* **6**: 601-606.
11. Heidrich P, Amengual JF and Wink M. 1998. Phylogenetic relationships in Mediterranean and North Atlantic shearwaters (Aves: Procellariidae) based on nucleotide sequences of mtDNA. *Biochemical Systematics and Ecology* **26**: 145-170.
12. Genovart M, Oro D, Juste J and Bertorelle G. 2007. What genetics tell us about the conservation of the critically endangered Balearic Shearwater. *Biological Conservation* **137**: 283-293.
13. Genovart, M., Juste, J., Contreras-Díaz, H. and Oro, D. 2012. Genetic and phenotypic differentiation between the critically endangered Balearic shearwater and neighbouring colonies of its sibling species. *Journal of Heredity*. **103**: 330-341.
14. Gonzalez, E. G., Genovart, M., Oro, D., Zardoya, R., Juste, J. 2009. Polymorphic microsatellite markers for the critically endangered Balearic shearwater, *Puffinus mauretanicus*. *Molecular Ecology Resources*, **9**: 1044-1046
15. BirdLife International (2010). Species fact sheet: *Puffinus mauretanicus*. Downloaded from http://www.birdlife.org
16. IUCN 2012. IUCN Red List of Threatened Species. Version 2012.1. Downloaded from http://www.iucnredlist.org/
17. Bonn Convention (Convention on the Conservation of Migratory Species of Wild Animals). Downloaded from http://www.cms.int/
18. Convention on Migratory Species. Proposal for the Inclusion of Species on the Appendices of the Convention on the Conservation of Migratory Species of Wild Animals. Downloaded from http://www.cms.int/bodies/COP/cop8/documents/meeting_docs/en/species_proposals/I_5_Puffinus_mauretanicus_ESP_ E_org_S.pdf
19. Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009 on the conservation of wild birds. Downloaded from http://ec.europa.eu/environment /nature/legislation/birdsdirective/index_en.htm
20. Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora. Downloaded from http://ec.europa.eu/environment/nature/legislation/habitatsdirective/index_en.htm
21. Arcos, J.M. (compiler) 2011. International species action plan for the Balearic Shearwater, *Puffinus mauretanicus*. SEO/BirdLife & BirdLife International. Downloaded from http://ec.europa.eu/environment/ nature/conservation/wildbirds/action_plans/per_species_en.htm

22. Gallo-Orsi U (2003). Species Action Plans for the conservation of seabirds in the Mediterranean Sea: Audouins' gull, Balearic shearwater and Mediterranean shag. *Scientia Marina* **67**: (Suppl. 2) 47-55.
23. UNEP MAP RAC/SPA. 2003. *Action Plan for the Conservation of bird species listed in Annex II of the Protocol concerning Specially Protected Areas (SPAs), and Biological Diversity in the Mediterranean*. Ed. RAC/SPA, Tunis. 80pp.
24. OSPAR Secretariat. 2008. *OSPAR List of Threatened and/or Declining Species and Habitats* (Reference Number: 2008-6)
25. Council of Europe. 1979. Bern Convention on the Conservation of European Wildlife and Natural Habitats
26. Council of Europe. 2002. Recommendation No. 92 (2002) on sixteen new Action Plans for most threatened birds in the Convention's area, adopted by the Standing Committee on 5 December 2002.
27. Ley 42/2007, de 13 de diciembre, del Patrimonio Natural y de la Biodiversidad. BOE 299: 51275-51327 (14-12-2007)
28. Royal Decree 139/2011, 4th February. Downloaded from http://www.magrama.es/es/biodiversidad/temas/conservacion-de-especies-amenazadas/catalogo-nacional-de-especies-amenazadas/
29. MARM. 2010. *Estrategia para la Conservación de la Pardela balear (Puffinus mauretanicus) en España*. Ministerio de Medio Ambiente, y del Medio Rural y Marino, Madrid.
30. Arcos, J.M. & Oro, D. 2004. Pardela balear *Puffinus mauretanicus*. *In:* Madroño A, González C and Atienza JC (Eds.) Libro Rojo de las Aves de España. SEO/BirdLife and Ministerio de Medio Ambiente, Madrid.
31. Govern de les Illes Balears. 2004. *Decret 65/2004, de 2 de juliol, pel qual s'aprova el Pla de Recuperació del Virot petit* Puffinus spss*, a les Illes Balears.*
32. DGCAPEA. 2007. Virot petit, *Puffinus mauretanicus*. DGCAPEA – Conselleria de Medi Ambient, Govern de les Illes Balears. Downloaded from http://dgcapea.caib.es
33. Ruiz, A. & Martí, R. 2004. *La Pardela Balear.* SEO/Birdlife - Conselleria de Medi Ambient del Govern de les Illes Balears, Madrid, Spain.
34. Guilford T, Wynn R, McMinn M, Rodríguez A, Fayet A, et al. (2012) Geolocators reveal Migration and Pre-Breeding Behaviour of the Critically Endangered Balearic Shearwater *Puffinus mauretanicus*. PLoS ONE 7(3): e33753.doi:10.1371/journal.pone.0033753
35. Genovart, M., Louzao, M., Igual, J. M. & Oro, D. 2008. Digit length may reveal unusual breeding behaviour in a seabird. *Biology Letters*, 4: 461–464
36. Oro, D., Louzao, M. & Genovart, M. 2009. Pardela balear – *Puffinus mauretanicus*. *In*: Enciclopedia Virtual de los Vertebrados Españoles. Salvador, A., Bautista, L. M. (Eds.). Museo Nacional de Ciencias Naturales, Madrid. Downloaded from http://www.vertebradosibericos.org/
37. Miguel McMinn, *in litt.*
38. Oro, D., Aguilar, J.S., Igual, J.M. & Louzao, M. 2004. Modelling demography and extinction risk in the endangered Balearic shearwater. *Biological Conservation* **116**: 93-102.
39. Louzao, M., Igual, J.Mm, McMinn, M., Aguilar, J.S., Triay, R. & Oro, D. 2006. Small pelagic fish, trawling discards and breeding performance of the critically endangered Balearic shearwater: improving conservation diagnosis. *Marine Ecology Progress Series* **318**: 247-254.
40. Kakela, R., Kakela, A., Martinez-Abrain, A., Sarzo, B., Louzao, M., Gerique, C., Villuendas, E., Strandberg, U., Furness, R.W. & Oro, D. 2010. Fatty acid signature analysis confirms foraging resources of a globally endangered Mediterranean seabird species: calibration test and application to the wild. *Marine Ecology Progress Series* 398: 245-258 doi: 10.3354/meps08291
41. Arcos, J.M. & Oro, D. 2002. Significance of fisheries discards for a threatened Mediterranean seabird, the Balearic shearwater Puffinus mauretanicus. *Marine Ecology Progress Series* **239**: 209-220.

42. Aguilar, J.S., Benvenuti, S., Dall'Antonia, L., McMinn-Grive, M. & Mayol-Serra, J. 2003. Preliminary results on the foraging ecology of Balearic shearwaters (*Puffinus mauretanicus*) from bird-borne data loggers. *Scientia Marina* **67** (Suppl. 2): 129-134.
43. Bartumeus, F., Giuggioli, L., Louzao, M., Bretagnolle, V., Oro, D. & A. Levin, S.A. 2010. Fishery Discards Impact on Seabird Movement Patterns at Regional Scales. *Current Biology*, **20** (3): 215-222, doi: 10.1016/j.cub.2009.11.073.
44. Le Mao P and Yésou P. 1993. The annual cycle of Balearic Shearwaters and western-Mediterranean Yellow-legged Gulls: some ecological considerations. *In*: Aguilar JS, Monbailliu X and Paterson AM (Eds.), Status and conservation of seabirds. Proceedings of the 2nd Mediterranean Seabird Symposium.
45. Arcos JM, Louzao M and Oro D. 2008. Fisheries ecosystem impacts and management in the Mediterranean: seabirds point of view. *American Fisheries Society Symposium* **49**: 1471-1479.
46. Navarro, J., Louzao, M., Igual, J.M., Oro, D., Delgado, A., Arcos, J.M., Genovart, M., Hobson, K.A. & Forero, M.G. 2009. Seasonal changes in the diet of a critically endangered seabird and the importance of trawling discards. *Marine Biology* **156** (12): 2571-2578, doi: 10.1007/s00227-009-1281-3
47. Louzao M, Hyrenbach KD, Arcos JM, Abello P, de Sola LG and Oro D. 2006. Oceanographic habitat of an endangered Mediterranean Procellariiform: implications for marine protected areas. *Ecological Applications* **16**: 1693-1695.
48. Abelló P and Oro D. 1998. Offshore distribution of seabirds in the northwestern Mediterranean in June 1995. *Colonial Waterbirds* **21**: 422-426.
49. Guitiérrez R and Figuerola J. 1995. Wintering distribution of the Balearic shearwater (*Puffinus yelkouan mauretanicus*, Lowe 1921) off the northeastern coast of Spain. *Ardeola* **42**: 161-166.
50. Wynn, R.B., Josey, S.A., Martin, A.P., Johns, D.G. & Yésou, P. 2007. Climate-driven range expansion of a critically endangered top predator in northeast Atlantic waters. *Biology Letters* **3**: 529-532.
51. Votier, S.C., Bearhop, S., Attrill, M.J. & Oro, D. 2008. Is climate change the most likely driver of range expansion for a critically endangered top predator in northeast Atlantic waters? *Biology Letters* **4**: 204-205.
52. International Council for Exploration of the Sea (ICES) WGSE Report 2008. Report of the Working Group on Seabird Ecology (WGSE). 10-14 March 2008, Lisbon, Portugal.
53. Arcos JM. 2008. *Puffinus mauretanicus* – information update. SEO/BirdLife - Conselleria de Medi Ambient del Govern de les Illes Balears, Madrid, Spain.
54. CRAM. 2008. *Episodio de captura incidental de 72* Puffinus spp. *en una ZEPA marina por un palangre de superficie ilegal: recuperación clínica y reintroducción de 20 individuos. Unpublished report.* CRAM - Fundació per a la Conservació i Recuperació d'Animals Marins, Premià de Mar.
55. Belda, E.J. and Sánchez A. 2001. Seabird mortality on longline fisheries in the western Mediterranean: factors affecting bycatch and proposed mitigating measures. *Biological Conservation* **98**: 357-363.
56. Oro, D., Louzao, M., Forero, M. G., Arcos, J. M., Genovart, M., Juste, J., Igual, J. M. 2007. Investigaciones aplicadas a la conservación de una especie en peligro de extinción (la Pardela Balear en el Parque Nacional de Cabrera): Requerimientos ecológicos, demografía y dinámica de poblaciones. Pp. 225-246. En: *Investigación en Parques Nacionales. Proyectos de investigación en Parques Nacionales: 2003-2006*. Ministerio de Medio Ambiente.
57. Arcos JM, Ruiz X, Bearhop S and Furness RW. 2002. Mercury levels in seabirds and their fish prey at the Ebro Delta (NW Mediterranean): the role of trawler discards as a source of contamination. *Marine Ecology Progress Series* **232**: 281-290.
58. Arcos, J.M., J. Bécares, B. Rodríguez y A. Ruiz. 2009. *Áreas Importantes para la Conservación de las Aves marinas en España*. LIFE04NAT/ES/000049-Sociedad Española de Ornitología (SEO/BirdLife). Madrid.

59. Ramírez I., P. Geraldes, A. Meirinho, P. Amorim & V. Paiva. 2008. *Áreas Marinhas Importantes para as Aves em Portugal*. Projecto LIFE04NAT/PT/000213 - Sociedade Portuguesa Para o Estudo das Aves. Lisboa.
60. Dunn E. 2007. *The case for a Community Plan of Action for reducing incidental catch of seabirds in longline fisheries. A report from BirdLife International's Global Seabird Programme.* BirdLife International, Cambridge, UK.
61. ICCAT 2002. Resolution 02.14 on incidental mortality of seabirds. Downloaded from http://www.iccat.es

COMPILED BY

Carles Carboneras
consultant, Ministry of Environment, Rural and Marine Affairs, Spain (2011)

CONTRIBUTORS

Ministry of Agriculture, Food and Environment, Spain

Heidi J. Auman, John Cooper and Wiesława Misiak
ACAP Secretariat

Barry Baker
ACAP Seabird Bycatch Working Group

José Manuel Arcos
SEO/BirdLife, Spain

Maite Louzao Arsuaga
Centre d'Etudes Biologiques de Chizé - CNRS, France

Miguel McMinn
Skua estudios ambientales S.L.

Map - BirdLife International

RECOMMENDED CITATION

Agreement on the Conservation of Albatrosses and Petrels. 2012. Species assessments: Balearic Shearwater *Puffinus mauretanicus*. Downloaded from http://www.acap.aq on 25 August 2012.

GLOSSARY AND NOTES

(i) **Years**.
The "split-year" system is used. Any count (whether breeding pairs or fledglings) made in the austral summer (e.g. of 1993/94) is reported as the second half of this split year (i.e. 1994).

The only species which present potential problems in this respect are *Diomedea* albatrosses, which lay in December-January, but whose fledglings do not depart until the following October-December. In order to keep records of each breeding season together, breeding counts from e.g. December 1993-January 1994 and productivity counts (of chicks/fledglings) of October-December 1994 are reported as 1994.

If a range of years is presented, it should be assumed that the monitoring was continuous during that time. If the years of monitoring are discontinuous, the actual years in which monitoring occurred are indicated.

(ii) Methods Rating Matrix (based on NZ rating system)

METHOD
A Counts of nesting adults (Errors here are detection errors (the probability of not detecting a bird despite its being present during a survey), the "nest-failure error" (the probability of not counting a nesting bird because the nest had failed prior to the survey, or had not laid at the time of the survey) and sampling error).
B Counts of chicks (Errors here are detection error, sampling and nest-failure error. The latter is probably harder to estimate later in the breeding season than during the incubation period, due to the tendency for egg- and chick-failures to show high interannual variability compared with breeding frequency within a species).
C Counts of nest sites (Errors here are detection error, sampling error and "occupancy error" (probability of counting a site or burrow as active despite it's not being used for nesting by birds during the season).
D Aerial-photo (Errors here are detection errors, nest-failure error, occupancy error and sampling error (error associated with counting sites from photographs), and "visual obstruction bias" - the obstruction of nest sites from view, always underestimating numbers).
E Ship- or ground- based photo (Errors here are detection error, nest-failure error, occupancy error, sampling error and "visual obstruction bias" (the obstruction of nest sites from view from low-angle photos, always underestimating numbers)
F Unknown
G Count of eggs in subsample population
H Count of chicks in subsample population and extrapolation (chicks x breeding success - no count of eggs)

RELIABILITY
1 Census with errors estimated
2 Distance-sampling of representative portions of colonies/sites with errors estimated
3 Survey of quadrats or transects of representative portions of colonies/sites with errors estimated
4 Survey of quadrats or transects without representative sampling but with errors estimated
5 Survey of quadrats or transects without representative sampling nor errors estimated
6 Unknown

(iii) Population Survey Accuracy
High Within 10% of stated figure;
Medium Within 50% of stated figure;
Low Within 100% of stated figure (eg coarsely assessed via area of occupancy and assumed density)
Unknown

(iv) Population Trend
Trend analyses were run in TRIM software using the linear trend model with stepwise selection of change points (missing values removed) with serial correlation taken into account but not overdispersion.

(v) Productivity (Breeding Success)
Defined as proportion of eggs that survive to chicks at/near time of fledging unless indicated otherwise

(vi) Juvenile Survival

defined as:

1 Survival to first return/resight;
2 Survival to x age (x specified), or
3 Survival to recruitment into breeding population
4 Other
5 Unknown

(vii) Threats

level of threat:

A combination of scope (proportion of population) and severity (intensity) provide a level or magnitude of threat. Both scope and severity assess not only current threat impacts but also the anticipated threat impacts over the next decade or so, assuming the continuation of current conditions and trends.

		Scope (% population affected)			
		Very High (71-100%)	High (31-70%)	Medium (11-30%)	Low (1-10%)
Severity (likely % reduction of affected population within ten years)	Very High (71-100%)	**Very High**	**High**	**Medium**	**Low**
	High (31-70%)	**High**	**High**	**Medium**	**Low**
	Medium (11-30%)	**Medium**	**Medium**	**Medium**	**Low**
	Low (1-10%)	**Low**	**Low**	**Low**	**Low**

(viii) Maps

Tracking maps shown were created from platform terminal transmitter (PTT) and global-positioning system (GPS) loggers. The tracks were sampled at hourly intervals and then used to produce kernel density distributions, which have been simplified in the maps to show the 50%, 75% and 95% utilisation distributions (i.e. where the birds spend x% of their time). The full range (i.e. 100% utilisation distribution) is also shown. Note that the smoothing parameter used to create the kernel grids was 1 degree, so the full range will show the area within 1 degree of a track. In some cases the PTTs were duty-cycled: if the off cycle was more than 24 hours it was not assumed that the bird flew in a straight line between successive on cycles, resulting in isolated 'blobs' on the distribution maps. It is important to realise that these maps can only show where tracked birds were, and blank areas on the maps do not necessarily indicate an absence of the particular species.