

CONSERVATION OF *PUFFINUS* SPECIES IN THE AZORES

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SUMMARY - Historical data on the Azores breeding *Puffinus* species is reviewed through the analysis of historical chronicles from the 16th and 17th century. The seabird populations of the Azores suffered dramatic declines following the colonisation of the islands mainly due to habitat destruction, the introduction of predators and direct human exploitation. Inventories of all the seabirds populations became available only recently and the first comprehensive surveys of shearwaters and petrels of the Azores were conducted from 1996 to 1998. The surveys detected 12 new locations of *Puffinus puffinus* on Flores and Corvo islands, with a total estimated population of 115-235 pairs. A total of 68 new locations of *Puffinus assimilis* were detected on all islands, except Terceira, with a total estimate of 840-1530 pairs. A revision of the Azores Special Protection Areas Network was proposed on the basis of that information, enlarging the present area by approximately 80%. Management plans for seven Special Protection Areas were produced. The present status of Manx Shearwater *Puffinus puffinus* and Little Shearwater *Puffinus assimilis* populations is outlined and conservation-orientated research priorities are discussed.

CONSERVAÇÃO DAS ESPÉCIES DO GÉNERO *PUFFINUS* NOS AÇORES – Dados históricos das espécies de Procellariiformes nidificantes nos Açores foram revistos através da análise de crónicas históricas dos séculos XVI e XVII. As populações de aves marinhas dos Açores sofreram declínios dramáticos no seguimento da colonização das ilhas essencialmente devido à destruição do habitat, à introdução de predadores e à exploração directa pelo homem. Inventários de todas as populações de aves marinhas tornaram-se disponíveis apenas recentemente e o primeiro censo exaustivo das espécies de pardelas e painhos que nidificam no arquipélago dos Açores decorreu entre 1996 e 1998. Os censos registaram 12 novas colónias de Pintainho *Puffinus assimilis* nas ilhas das Flores e Corvo, com uma população total estimada em 115-235 casais. Paralelamente foram registadas 68 novas colónias de Fura-bucho do Atlântico *Puffinus puffinus* em todas as ilhas, com excepção da Terceira, com uma população total estimada em 840-1530 casais. Com base nessa informação foi proposta uma revisão da rede de Zonas de Protecção Especial dos Açores, que aumenta em cerca de 80% a área designada. Foram produzidos planos de gestão para sete Zonas de Protecção Especial. O actual estatuto de conservação do Fura-bucho do Atlântico *Puffinus puffinus* e do Pintainho *Puffinus puffinus* é apresentado e prioridades de investigação aplicadas à conservação são discutidas.

The Azores archipelago consists of nine volcanic islands and numerous small islets, forming three groups along a tectonic zone running WNW-ESE between 37° and 40°N latitude, 25° and 32°W longitude, in the middle of the Atlantic Ocean ca. 1500 km west of mainland Portugal. The islands are the emergent part of underwater volcanoes with very

narrow insular platforms that descend rapidly to depths of 2000-3000 m in the channels between islands. Submerged seamounts (banks) are important topographic features and their combined area at 500m depth exceeds 2,160 km² (Tucker & Evans 1997).

Surrounded by the Atlantic Ocean, the Azores have a mild climate: low thermal amplitude, high

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precipitation and humidity are properties of this archipelago with a marked oceanic climate (Borges 1990). These warm-water seas are characterised by low relatively stable levels of productivity (Raymont 1980) but that can be substantially elevated locally, due to upwellings at seamounts, island shelfbreaks and thermal fronts.

On land, the natural vegetation of the Azores islands is composed of a fairly large number of endemic plant communities, originated to some extent from the Tertiary Period. These plant communities are susceptible to environmental change and invasion of alien species, in many cases being a consequence of such changes. Plant communities differ in all the islands depending on factors that include altitude, climate, topography, geological differentiation and human influence (Sjogren 1973).

The Azores were uninhabited by humans until 1433 when they were colonised by the Portuguese. The discovery of the Azores islands took place in 1427 in Santa Maria island and proceeded westwards until 1452, with the discovery of Flores and Corvo. Human settlement and land use had different levels of impact in the islands of the archipelago but the intensive use of the coast and its resources has been a common factor affecting seabird colony distribution since then. The introduction, accidental or intentional, of invasive alien plants and mammals together with the intensive exploitation of natural resources as a result of colonisation, caused significant changes in the natural habitats and communities of the Azores archipelago. In this paper historical data of the Azores breeding Procellariiformes is reviewed focusing on the available information of Manx Shearwater *Puffinus puffinus* and Little Shearwater *Puffinus assimilis*. The present status, distribution, conservation and management of these two species are outlined in order to provide a discussion on the conservation-orientated research priorities.

HISTORICAL REVIEW

The historical chronicles of Gaspar Frutuoso dating from 1561 list eight Procellariiformes among 10 seabird species distributed through all the islands of the archipelago in abundant colonies. The

breeding seabirds of the Azores archipelago currently comprise five species of Procellariiformes that include Bulwers' Petrel *Bulweria bulwerii*, Cory's Shearwater *Calonectris diomedea*, Manx Shearwater *Puffinus puffinus*, Little shearwater *Puffinus assimilis* and Madeiran Storm Petrel *Oceanodroma castro* (Monteiro *et al.* 1999). Two other species of Procellariiforme referred as "calca-mar" and "boeiro" are mentioned by Monteiro *et al.* (1996) as being the possible former breeders White-faced Storm Petrel *Pelagadroma marina* and Fea's Petrel *Pterodroma feae*, respectively. The species named "Alauda" referred as occurring in Ilhéu de Baixo (Graciosa) and solely used for the production of oil remains unidentified.

According to Warham (1996) seabirds, including petrels, were a mainstay of the economy of some human populations. In the Azores, according to Frutuoso (1561-printed as Frutuoso 1983) two main species were intensively captured, "Pardela" and "Estapagado" considered to be Bulwer's petrel and Manx shearwater respectively by Monteiro *et al.* (1996). The Procellariiformes were harvested in different periods of the year according to the breeding period of the species and the use of the resources. The adults would be captured for food and cooked fresh or salted like fish for later consumption. There are also references to the use of these birds to feed pigs. The feathers collected were used in beds and covers. The young birds would be captured later in the season for their stomach oil. Ten birds would produce approximately 2 l of oil (Frutuoso 1561-printed as Frutuoso 1983). The Manx Shearwaters were captured from January to April using fire to attract the birds and dogs to capture them. The exportation of "estapagados" from the island of Corvo to Flores and the market price of "1/2 vintém" for 8 to 10 "pardelas" reveals the economic importance of this species at that time (Frutuoso 1561 - printed as Frutuoso 1983). It is clear that enormous amounts of "estapagados" were captured following human colonisation as indicated by the mention of captures of 10,000 individuals per night and the references to people specialised in hunting seabirds (Frutuoso 1561 - printed as Frutuoso 1983).

According to the historical chronicles of Gaspar Frutuoso Manx shearwaters were abundantly

present in São Miguel, Santa Maria, Terceira, Graciosa, São Jorge, Flores and Corvo at the time of colonisation. Later, in the 16th century, a significant decline in the abundance of “estapagados” and “pardelas” is mentioned and related to predation by ferrets *Mustela furo*. In the early days of settlement, there is also indication of conflicts between the use of land for agricultural purposes and the burrowing behaviour of procellariiform species. This conflict must have intensified the exploitation of these bird species as an economic resource, limiting in a dramatic way, until the present days, the distribution of these species in the archipelago.

STATUS AND DISTRIBUTION

Puffinus puffinus

The Manx shearwater has a large world population (ca. 300,000 pairs) concentrated at a few sites off North-west Europe and it is a SPEC (Category 2) species with a threat status of localised (Tucker & Heath 1994). In the Macaronesian islands the species has small colonies and in recent years there is evidence of falling numbers (Tucker & Heath 1994).

The first comprehensive surveys of small to medium-sized shearwaters and petrels in the Azores archipelago, conducted from 1996 to 1998 detected 12 new locations of *Puffinus puffinus* on Flores and Corvo islands at the edges of inaccessible high cliffs where closer inspection was impossible (Monteiro *et al.* 1999). Four discrete breeding colonies were delimited according to presence or absence of birds calling associated with physical discontinuities (Monteiro *et al.* 1999). A total population of 115-235 pairs was estimated (Monteiro *et al.* 1999). Sea watches recorded rafts of ca. 50 individuals off Pão de Açúcar-Pingas (Corvo), both in mid April and early July (Monteiro *et al.* 1999). Other records for this species are listed in Table 1.

Puffinus assimilis

The endemic European race of the Little Shearwater, *Puffinus assimilis baroli*, breeds in the archipelagos of Madeira, Canaries and the Azores with an estimated population of 2,700-3,900 pairs (Tucker & Heath 1994).

The first comprehensive surveys of small to medium-sized shearwaters and petrels in the Azores archipelago, conducted from 1996 to 1998 detected 68 new locations of *Puffinus assimilis* on all islands, except Terceira (Monteiro *et al.* 1999). Virtually all locations occurred along inaccessible high cliffs and closer inspection was impossible. Most of the cliffs where calls of *P. assimilis* were heard seemed to have layers of soil for cavities, with little cover of Cane grass *Arundo donax*. In several cliffs in Santa Maria and S. Miguel islands it was clear that apparently occupied cliffs had very little *A. donax*, whereas nearby unoccupied cliffs were covered with this exotic plant species. Discrete breeding colonies were delimited according to presence/absence of birds calling associated with physical discontinuities (Monteiro *et al.* 1999). It was possible to confirm breeding on Morro de Castelo Branco (Faial) where an active nest site with a broken egg was found in the 4th May 1998 (Monteiro *et al.* 1999). With the addition of new sites a total population of 840-1530 pairs was estimated (Monteiro *et al.* 1999).

MAIN THREATS

According to the historical chronicles (Frutuoso 1561-printed as Frutuoso 1983) past threats include intensive human exploitation and habitat deterioration. Although human exploitation no longer constitutes a threat to these species habitat deterioration is a present threat and encompasses several aspects such as introduced predators, increased native predators, coastal development and vegetation change at nest sites (Tucker & Evans 1997). The introduction of alien mammals from continents, particularly predators, such as cats *Felis catus* and rats *Rattus* sp., has been a major factor contributing to the extinction of bird species in islands (Moors *et al.* 1992). In the Azores the past and present occurrence of predators such as *Mus musculus*, *Rattus rattus*, *Rattus norvegicus*, *Felis catus*, *Mustela nivalis* and *Mustela furo* has had a profound impact in the populations of small Procellariiformes depriving ground nesting birds of using otherwise suitable breeding sites (Tucker & Evans 1997). Colonies are now largely confined to precipitous cliffs and islets and it is likely that birds have either moved to such sites from more accessible areas, or that only those colonies in

Table 1. Records of Manx Shearwater *Puffinus puffinus* in the Azores archipelago. / **Tabela 1.** Registos de Fura-bucho do Atlântico *Puffinus puffinus* no arquipélago dos Açores.

<i>Place and date</i>	<i>Occurrence</i>	<i>Author</i>
Flores, May 1865	2 adults taken from holes with eggs in the ovaries*	Godman 1866
Santa Maria, 1903	specimen record	Colecção do Museu Carlos Machado
Corvo, 16 June 1929	1 egg in poor condition	Chavigny & Mayaud 1932
Corvo, July 1931	specimen record	Chavigny & Mayaud 1932
Flores, April 1962	12 birds of the south coast	Bannerman & Bannerman 1966
São Miguel, 7 September 1983	1 abandoned egg*	Le Grand 1993
Flores, June 1994	1 bird calling in Fajã Grande	Monteiro <i>et al.</i> 1999
Corvo, July 1994	few birds at sea	Monteiro <i>et al.</i> 1999
Santa Maria, 1994	individual without brood patch	Monteiro <i>et al.</i> 1999
Santa Maria, 27 March 1998	1 bird caught on the ground of Vila islet without a brood patch	Monteiro <i>et al.</i> 1999
Santa Maria, 9 August 1998	1 bird caught on the ground of Vila islet	Monteiro <i>et al.</i> 1999
Santa Maria, 1996-1998	1 bird calling off Vila islet	Monteiro <i>et al.</i> 1999
Graciosa, 1996-1998	1 bird calling off Praia islet	Monteiro <i>et al.</i> 1999
Santa Maria, 2000	2 birds on the ground of Vila islet	Pereira pers. com.
Flores, May 2000	numerous birds calling in Fajã Lopo Vaz	Pereira pers. com.

inaccessible sites have survived (Monteiro *et al.* 1999). Therefore breeding biotopes may be the limiting factor for the present populations of Procellariiformes (Ramos *et al.* 1997). Changes in the coastal plant communities mainly due to the invasion of *A. donax* (Sjogren 1973) has resulted in major losses of suitable burrowing ground (Monteiro *et al.* 1995) and high levels of intraspecific and interspecific interference competition for nest cavities may be a result of alteration of breeding habitat in historical times (Ramos *et al.* 1997). The reduction in exploitation of Cory's shearwater by humans may lead to greater pressure for nest cavities but this fact can be mitigated by building artificial nests for small petrels that are impossible to be excavated by Cory's shearwater (Ramos *et al.* 1997, Bolton *et al.* 2004). Coastal developments such as hotels, marinas and other tourist facilities, housing or industrial and agricultural land-claim can threaten seabirds by destruction of nesting sites and has a widespread impact in the Macaronesian archipelagos (Tucker &

Evans 1995). Fortunately, oil pollution, to which *Puffinus puffinus* is considered highly vulnerable (Tucker & Evans 1995), is less frequent in the Macaronesian seas.

CONSERVATION AND MANAGEMENT

Islands seabird populations are highly vulnerable and predisposed to extinction (Diamond 1985). The first inventory of the Important Bird Areas in Europe listed 7 sites recognising that the populations of seabirds breeding in the Azores were poorly known at the time (Grimmet & Jones 1989). But the first legal action towards the conservation of wild birds was the adoption of the Birds Directive in 1990 in the Autonomous Region of the Azores designating a total of 15 Special Protection Areas.

Recent inventories of the Azores breeding seabirds identified important breeding sites and provided population estimates (Monteiro & del Nevo 1992, Monteiro *et al.* 1996, Monteiro *et al.*

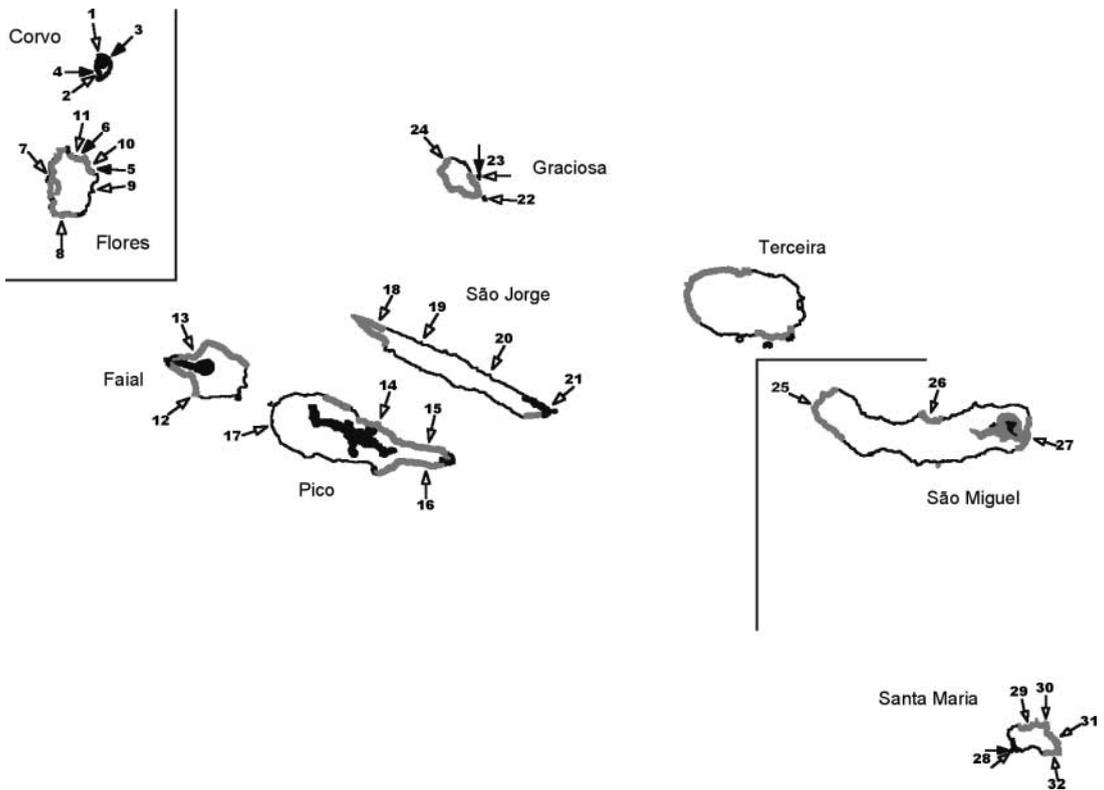


Figure 1. Map of the Azores archipelago showing the actual SPA area (black) and the enlargement area (grey) recently proposed by Monteiro & Groz (1999) plotted against the breeding colonies of *Puffinus puffinus* (black arrows) and the breeding colonies of *Puffinus assimilis* (white arrows) reported by Monteiro, *et al.* (1999): 1-Ponta do Marco to Pico João de Moura, 2-Pão de Açúcar to Pingas, 3-Ponta do Marco-Coroa do Pico, 4-Pão de Açúcar, 5-Alagoa, 6-Fajã da Gata to Peniche, 7-Ponta da Fajã-Fajã Grande, 8-Ponta dos Ilhéus-Fajã Lopo Vaz, 9-Ponta da Caveira-Ponta Fernão Jorge, 10-Baixa do Moínho-Alagoa, 11-Ilhéu Furado-Cabouco, 12-Morro Castelo Branco, 13-Ribeira Funda, 14-Mistério da Praínha-Baía de Canas, 15-Terra Alta, 16-Foros, 17-Mingato, 18-Ponta Ruiva-Fajã João Dias, 19-Pico do Loicano, 20-Fajã Santo Cristo, 21-Fajã Cubres-Fajã do Labaçal, 22-Ilhéu de Baixo, 23-Ilhéu da Praia, 24-Ponta da Barca, 25-Ponta da Ferraria-Ponta do Escalvado, 26-Porto Santa Iria, 27-Fajã Araújo-Água Retorta, 28-Ilhéu da Vila, 29-Baía do Raposo-Baía do Salto dos Cães, 30-Ponta do Norte, 31-Pontinha-Ponta do Cedro, 32-Ponta do Castelo-Malbusca. / **Figura 1.** Mapa do Arquipélago dos Açores onde se encontra representada a actual rede de ZPE (preto) e a proposta de alargamento (cinzento) recentemente proposta por Monteiro & Groz (1999) e as colónias de *Puffinus puffinus* (setas pretas) e *Puffinus assimilis* (setas brancas) de acordo com Monteiro *et al.* (1999): 1-Ponta do Marco to Pico João de Moura, 2-Pão de Açúcar to Pingas, 3-Ponta do Marco-Coroa do Pico, 4-Pão de Açúcar, 5-Alagoa, 6-Fajã da Gata to Peniche, 7-Ponta da Fajã-Fajã Grande, 8-Ponta dos Ilhéus-Fajã Lopo Vaz, 9-Ponta da Caveira-Ponta Fernão Jorge, 10-Baixa do Moínho-Alagoa, 11-Ilhéu Furado-Cabouco, 12-Morro Castelo Branco, 13-Ribeira Funda, 14-Mistério da Praínha-Baía de Canas, 15-Terra Alta, 16-Foros, 17-Mingato, 18-Ponta Ruiva-Fajã João Dias, 19-Pico do Loicano, 20-Fajã Santo Cristo, 21-Fajã Cubres-Fajã do Labaçal, 22-Ilhéu de Baixo, 23-Ilhéu da Praia, 24-Ponta da Barca, 25-Ponta da Ferraria-Ponta do Escalvado, 26-Porto Santa Iria, 27-Fajã Araújo-Água Retorta, 28-Ilhéu da Vila, 29-Baía do Raposo-Baía do Salto dos Cães, 30-Ponta do Norte, 31-Pontinha-Ponta do Cedro, 32-Ponta do Castelo-Malbusca.

1999, Furness *et al.* 2000). This work allowed the identification of 15 Important Bird Areas in Europe recently promoted by Birdlife International and made clear that the actual SPA of the region covered only 21% of that area. A revision of the Azores Special Protection Areas Network was proposed on the basis of that information enlarging the present area approximately 80% (22,028 ha that represent 9.4% of the region's territory, see Figure 1) (Monteiro & Groz 1999). Conservation and management programmes for seabirds are quite recent in the region. Only in 1998, a Governmental Nature Conservation Department was created aiming at the implementation of management plans for protected areas and species. However management actions such as the eradication of introduced mammals from SPAs (Ilhéu de Vila Franca do Campo in São Miguel and Ilhéu da Praia in Graciosa), habitat rehabilitation actions (Ilhéu de Vila Franca do Campo on São Miguel, Ilhéu do Topo on São Jorge and Ilhéu da Praia on Graciosa) the allocation of wardens to more accessible SPAs (Flores, Terceira, Graciosa and Faial), the allocation of interpretation signs to all the region SPAs and the implementation of educational programmes (leaflets, posters, rescue campaigns, radio and TV spots) have been developed since 1995 with funding from the European Union. Management plans for 7 Special Protection Areas in the islands of Santa Maria, Terceira, Faial, São Jorge, Graciosa, Flores and Corvo were produced.

CONSERVATION-ORIENTATED RESEARCH PRIORITIES

The best available knowledge regarding *Puffinus puffinus* and *Puffinus assimilis* populations of the Azores has allowed us to determine single management actions and to assist decision making. However conservation-orientated research is still lacking:

- Listening for nocturnal vocalisations has been shown to be the most practical method to determine the distribution and population levels of these populations but further research into vocal activity is needed in order to reduce the bias of the estimates obtained in this way;
- Extensive surveys to identify new breeding sites

are necessary along the entire coastline of the archipelago according to the unsurveyed sectors referred by Monteiro *et al.* (1999);

- Monitoring the breeding sites already identified is vital to follow population levels and determine the conservation status. Studies focusing on the relationships between cliff characteristics and presence of *Puffinus* species are also needed;
- Estimation of the impact of predators on local populations, especially cats and rats, is fundamental to implement further eradication programmes;
- Comprehensive studies of natural, social and economic factors and human activities regarding each SPA of the region is essential to implement management plans.

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