

A CONSERVATIONAL APPROACH ON THE SEABIRD POPULATIONS OF ILHÉU DE VILA FRANCA DO CAMPO, AZORES, PORTUGAL

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ABSTRACT

This study was performed to identify the seabird species occurring on Ilhéu de Vila Franca do Campo (IVFC) off São Miguel island, Azores, giving a special emphasis on the description of their ecology and threats. Flush counts, ground searches and raft counts were conducted and two types of natural habitats were identified. The results confirmed the nesting of two endangered species and revealed three other possible breeders enhancing the importance of the islet for the protection and conservation of Azorean seabird populations. Although playing an important role on the conservation of Cory's shearwater and Common tern populations, the islet can be threatened by continuous habitat degradation by human disturbance. The implementation of a habitat restoration program is suggested for the islet in a near future.

RESUMO

Foi feito um levantamento das espécies de aves marinhas que ocorrem no Ilhéu de Vila Franca do Campo, com especial ênfase para a sua ecologia e ameaças. Foram realizadas contagens visuais, procura de ninhos e contagem de jangadas ao longo de todo o ilhéu e zonas adjacentes, confirmando a nidificação de duas espécies ameaçadas e a possibilidade de nidificação de outras três. A identificação de dois tipos de habitats naturais evidencia a importância do ilhéu para a protecção e conservação das populações de aves marinhas. Apesar do importante papel na conservação das populações de cagarros e garajaus-comuns, o ilhéu de Vila Franca do Campo continua a ser ameaçado por uma contínua degradação dos seus habitats devido à acção humana. Este trabalho sugere, num futuro próximo, a implementação de medidas proteccionistas e um programa de restauração dos habitats naturais deste ilhéu.

INTRODUCTION

The Azorean archipelago, located in the north Atlantic Ocean, has always been recognized as an interesting place for birds, mainly seabirds, not only due to the coast line with steep scarps but also to its geographical location (N36-39°, W25-31°) that represents an ornithological transition between temperate and tropical zones (Monteiro *et al.*, 1996a, b).

Thirteen seabird species are known to occur in the Azores. The regular breeders are Bulwer's petrel (*Bulweria bulwerii*), Cory's shearwater (*Calonectris diomedea*

borealis), Manx shearwater (*Puffinus puffinus*), Little shearwater (*Puffinus baroli*), Band-rumped storm-petrel (*Oceanodroma castro*), Monteiro's storm petrel (*Oceanodroma monteiroi*), Yellow-legged gull (*Larus michaelis atlantis*), Common tern (*Sterna hirundo*) and Roseate tern (*S. dougallii*). There are two occasional breeders, Red-billed tropicbird (*Phaethon aethereus*) and Sooty tern (*Onychoprion fuscatus*), a possible breeder, Cape Verde petrel (*Pterodroma feae*), and a possible former breeder, White-faced storm-petrel (*Pelagodroma marina*) (Le Grand *et al.*, 1984; Monteiro *et al.*, 1996a).

The archipelago accounts for the largest population of Cory's shearwater of the world with more than 180.000 couples (79% of the European population) (Rodrigues & Nunes, 2002). Also representative are the populations of Band-rumped storm-petrel, 915 to 1240 couples (around 25% of the European population), Little shearwater, 800 to 1500 couples (around 20% of the European population) (Monteiro *et al.*, 1999), Roseate tern with more than 1000 couples (60% of the European population) and Common tern,

around 2000 couples (5% of the European population) (Rodrigues & Nunes, 2002).

All these seabird species have a vulnerable status, except Roseate tern which is in Danger, and the Common tern with a Favourable Conservation status (Rodrigues & Nunes, 2002).

Most seabird populations breeding in Azores have been suffering dramatic historical declines as a consequence of major habitat degradation, mainly by human activities from the late 15th century on, and the introduction of mammalian

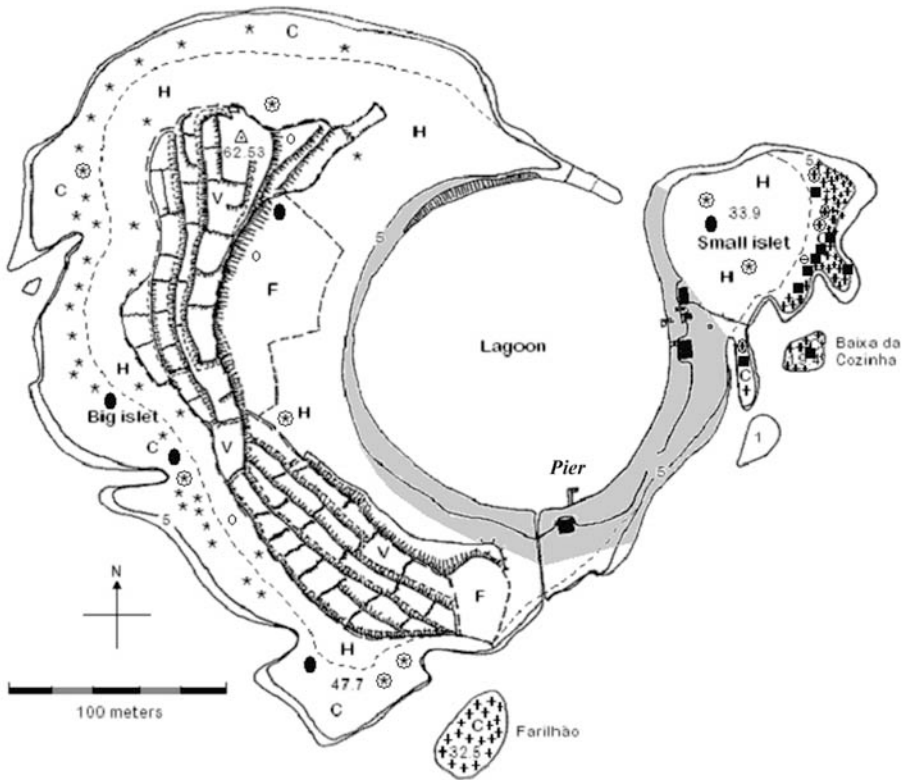


FIGURE 1. Ilhéu de Vila Franca do Campo with identified habitats, burrows and nests cavities. C - Vegetated Sea Cliffs of the Macaronesian Coasts habitat; H - Endemic Macaronesian Heaths habitat; F - Forests of iron trees; V - vineyards; * Common tern (CT) nests; * Cory's shearwater (CS) burrows/nests cavities; ⊕ CS destroyed nest; ● CS abandoned nest; ⊙ CS abandoned egg; ⊕ CT destroyed nest; ■ CT abandoned nest; ⊖ CT abandoned egg; ■ Area of public permitted access.

predators (Monteiro *et al.*, 1996b), so they tend to breed on isolated islets and sea cliffs, free of predators and human disturbance, with natural habitats without invasive alien species (Monteiro *et al.*, 1996b; Ramos *et al.*, 1997; Groz & Pereira, 2005).

One of these islets is the Ilhéu de Vila Franca do Campo (IVFC) (Figure 1), 1.2 km south of São Miguel island.

Several studies were published on the islet's biota, describing its general topography and biological characteristics, mainly about its marine life and coastal ecology (Martins, 1978, 1995, 2004; Morton, 1990; Britton, 1995; Backeljau *et al.*, 1995; Morton *et al.*, 1998) revealing the ecological and geological importance of the place.

Some surveys targeting Cory's shearwater and terns were made in the Azores (del Nevo *et al.*, 1993; Bolton, 2001 and Monteiro *et al.*, unpublished report) but none of them went to the islet. Monteiro *et al.* (1999) estimated 0 to 10 Band-rumped storm-petrel couples breeding on the islet.

Due to the unique importance of the IVFC as an agglomeration of various micro-ecosystems, the Azorean Government established it as a Nature Reserve in 1983, as provided by the Regional Legislative Decree nº 3/83/A, of March 3rd, and some rules were implemented with the intention to preserve and protect the islet; the public access was restricted to the lagoon, the marine area of the reserve was extended to 30 m deep, and fishing and any underwater activity were forbidden. In spite of these protection measures, the flora and fauna in the islet and its lagoon have suffered a significant negative impact caused by the flood of people mostly during the summer (Morton *et al.*, 1998). The islet is popular for recreation and between May and September a boat brings in about 400 persons a day.

This study was developed to identify the breeding species of seabirds on IVFC, giving special emphasis to habitat characterization and threats, thus contributing to the conservation and protection of the islet's natural habitats and their seabird populations.

MATERIAL AND METHODS

The study was carried out on the IVFC (N37°42.30', W25°26.52'), during July 2006, in the course of the 3rd international Workshop on Malacology and Marine Biology in Vila Franca do Campo, São Miguel, Azores (Figure 1).

The islet is a drowned volcanic crater with a surface area of 61.640 m², accessed by a narrow channel, but with several fissures also connecting the lagoon with the sea outside. The main length of the islet is 420 m from east to west, reaches an altitude of 62 meters, and is divided into two portions: the Big islet, that constitutes almost all the islet's area and the Small islet on the northeast side. There are also several rocks of different sizes, outstanding the Farilhão with 32.5 m, and Baixa da Cozinha with 19.4 m. On the islet there is an internal lagoon connected to the open sea trough chaps and underwater tunnels. Inside the lagoon there is a small pier where people enter the islet (Martins, 2004).

The habitat characterisation of the islet was made *in loco* following the Interpretation Manual of European Union Habitats (European Habitats Committee, 1991).

Three different methods were conducted to identify the seabird species of the islet, and to estimate species abundance and number of breeding pairs:

1. Flush counts

Six boat rides, of 15 minutes each, were undertaken for flush counts of seabirds and to observe the external

coast zone of the islet. The method consisted on counting the number of individuals visible from the boat (eye view), at different hours of the day, three rides in the morning and three on the afternoon. Species were identified and all the individuals standing on the islet or flying over the sea were counted.

2. Ground searches

Two ground searches were made for occupied nests of terns and Porcellariiformes (Figure 1). Signs of occupation included the presence of an adult, eggs or chicks in a visible nest chamber. In sites where a nest chamber was not visible, a burrow was considered to be occupied if it was of sufficient size to accommodate a bird or if there was one or more evidences of occupation (e.g. faeces; shed breast feathers, excavated soil or absence of obstructing vegetation or spider webs in the burrow's entrance).

3. Raft counts

During the breeding season, Cory's shearwater characteristically form flocks (called "rafts") on the sea, with the number of individuals increasing by the end of the day, waiting for nightfall to fly up to the breeding colony (Mallet & Coghlan, 1964). According to Richdale (1963) and Skira (1991) over half of the adult shearwaters at a colony are expected to be non-breeders.

Raft counts were conducted for Cory's shearwater from two places, one on the top of the south side of the islet, and another from Ponta de São Pedro (N37°42.39', W25°26.41') on the coast of São Miguel island and in front of the islet; raft counts were made by the end of the day, starting exactly at 08:00 pm, for 45 minutes long, using binoculars (10 X 50).

All the methods applied in this study involved two replicates from two different observers.

RESULTS

Habitats

Two types of natural habitats were identified on the IVFC (Figure 1): i) Vegetated Sea Cliffs of the Macaronesian Coasts habitat, dominated by the endemic fescue (*Festuca petraea*), with associated plants such as rush (*Juncus acutus*), wild carrot (*Daucus carota*), seaside goldenrod (*Solidago sempervirens*) and rock samphire (*Crithmum maritimum*); ii) Endemic Macaronesian Heaths habitat dominated by the endemic green heather (*Erica azorica*), with associated plants such as laurel (*Laurus azorica*), *Myrica faya*, *Cyrtomium falcatum*, *Holcus rigidus* and *Euphorbia azorica*. This last habitat presents plenty of exotic plants such as the giant reed (*Arundo donax*), used in the past for protective barriers of the vineyards, tamarisks (*Tamarix gallica*), brambles (*Rubus ulmifolius*) and australian pittosporum (*Pittosporum undulatum*).

On the higher southern and western inner slopes of the Big islet there are two small "forests" of iron trees (*Metrosideros tomentosa*) and vineyards (*Vitis labrusca*), although they are no longer cultivated.

Seabirds

There was evidence of two species of seabirds breeding on the islet (Figure 1), Cory's shearwater and Common tern, but three more species were registered, Little shearwater, Band-rumped storm-petrel and Roseate tern, although at present without any breeding evidence.

Table 1 shows avifauna abundance determined through the different methods used.

Cory's shearwater breeds on Big islet with Vegetated Sea Cliffs of the Macaronesian Coasts habitat where 34 burrows and nests cavities were found, and on slopes of Endemic Macaronesian Heaths habitat that exhibited 10 burrows

TABLE 1. Seabird abundance from flush and raft counts and number of couples from occupied nests/burrows on the Ilhéu de Vila Franca do Campo. SD = Standard Deviation.

Species	Flush counts (individuals)	Ground searches (couples)	Raft counts (individuals)
	Mean ± SD		Mean ± SD
Cory's shearwater	154 ± 22.6	44	395 ± 21.2
Common tern	325 ± 35.4	80	-
Roseate tern	2	-	-
Little shearwater	1	-	-
Band-rumped storm-petrel	1	-	-

and nests cavities. The three nests found on Small islet were destroyed or abandoned.

Common terns breed on two external rocks of the islet, Baixa da Cozinha (10 nests) and Farilhão (19 nests), and on the external coast of the Small islet with Vegetated Sea Cliffs of the Macaronesian Coasts habitat (41 nests).

Occasional observations on the populations of Cory's shearwater and Common terns allowed identification of chicks being reared, incubating parents, destroyed and abandoned nests and abandoned eggs (Table 2). It was not possible to identify the exact number of eggs laid per couple of Common terns.

Evidences of human disturbance were found near potential seabird nests, including recreation, wastes, and vandalism such as broken eggs and burrows destruction. There were an equivalent percentage of abandoned nests in both populations (11%) and about 18% of Cory's shearwater nests and 5% of Common tern nests were destroyed. Nearly 7% of Cory's shearwater eggs and

1% of Common tern eggs were abandoned by the progenitors.

DISCUSSION

The Vegetated Sea Cliffs of the Macaronesian Coasts habitat of the IVFC are well preserved probably because they occur on the external rocks of the islet and on inaccessible cliffs, but also because they are highly influenced by salt-water spray where exotic plants cannot grow. According to Sjögren (1973) the association *Festucetum petraeae* is characteristic of Azores coastal habitats, occurring mainly in the sea cliffs. The characteristic species of this association is the common endemic *Festuca petraea*, which usually develops coastal prairies. Other species are found in this association, such as the common *Solidago sempervirens* and *Crithmum maritimum*, the less common *Tolpis succulenta* and even rarest endemic plants like *Azorina vidalii* and *Myosotis maritima*.

The Endemic Macaronesian Heaths habitat was much degraded with exotic plants such as *Arundo donax*, *Lantana*

TABLE 2. Number of observations on Cory's shearwater and Common tern nests on Ilhéu de Vila Franca do Campo.

Species	Used nests	Destroyed nests	Abandoned nests	Abandoned eggs	Incubating couples	Rearing chicks
Cory's shearwater	44	8	5	3	9	6
Common tern	80	4	9	1	37	11

camara and *Pittosporum undulatum*. According to the Convention on Biological Diversity, invasive alien species which introduction and/or spread threatens biological diversity are now considered the second cause of biodiversity loss at a global level, after direct habitat destruction (Shine *et al.*, 2000; Groz & Pereira, 2005).

The methods used in this study to estimate species abundance and number of breeding pairs were effective because they complemented each other giving a broader view of the colonies. These results confirmed nesting of two endangered species and listed three other possible breeders revealing the importance of the IVFC for the protection and conservation of seabirds.

Cory's shearwater breeds generally in the inaccessible sea cliffs of the islet and less in slopes with Macaronesian vegetation. The differences between the numbers of burrows and nests found in the Vegetated Sea Cliffs of the Macaronesian Coasts habitat and in the Endemic Macaronesian Heaths habitat are probably related to human disturbance and degradation of this last habitat with invasive alien species that are a threat to seabird populations (Groz & Pereira, 2005). Adults arrive in colonies by late-February, lay eggs from late-May to early-June and hatching is relatively synchronous, most chicks hatching between 18 and 31 July (Granadeiro, 1991). Young birds fledge from late-October to early-November (Monteiro *et al.*, 1996b). They lay only one egg per year and do not replace it if it is damaged or lost soon after laying, so there is an ecological significance when a couple loses their egg, all the dispended energy is lost and it is one less breeding couple.

Common terns breed in inaccessible rocks with Vegetated Sea Cliffs of the Macaronesian Coasts habitat, where

human disturbance is almost absent, and where they can avoid possible predators. Adults arrive in colonies by early-April, egg laying occurs from early-May to mid-June and they stay in colonies until late-September (Monteiro *et al.*, 1996b). A clutch of 2-4 (usually 3) eggs is laid. One brood per season is typical but re-nesting is common when the first nest is destroyed (Peterson, 1988). This study indicates that the colony on IVFC represents at least 18% of the Azorean total population.

Although being a protected species, populations of these seabirds are becoming smaller than in the past, they have been chased and hunted by humans, and suffered with predation from introduced mammals and from deforestation (Monteiro *et al.*, 1996b).

The suite of terns and shearwaters is of major international conservation importance (Rodrigues & Nunes, 2002). Their breeding distributions in the Atlantic Ocean are concentrated in Europe and most species have small world populations (Monteiro *et al.*, 1999) being classified as globally threatened species (Collar *et al.*, 1994). The Azorean population of Cory's shearwater decreased around 50% between 1996 and 2001 (Rodrigues & Nunes, 2002), and a similar situation was observed for Common tern populations, estimated around 4000 breeding couples for 1992 (del Nevo *et al.* 1993), against 2000 breeding couples for year 2000 (Rodrigues & Nunes, 2002), probably due to the impact of continuous loss of their habitats.

People's access to nests and burrows represents an important threat over seabirds in the islet, and several impacts from recreation and vandalism, are leading to their distraction from normal activities; parents spend less time tending young birds or eggs, flying away from nests, leaving eggs or chicks vulnerable to predators and amenity, nests are destroyed and

seabirds entirely abandon the colonies. These impacts can affect Azorean seabirds, particularly Common terns, since the colony of IVFC represents one of the largest in the Azores.

Due to the importance of the Azores archipelago for seabirds in Europe, it is fundamental to protect every natural habitat and to conserve the few areas where they breed, usually steep scarps and islets (Monteiro *et al.*, 1996b, 1999; Ramos *et al.*, 1997).

In conclusion, results from the present work indicate that IVFC plays an important role on the conservation of Cory's shearwater and Common tern populations, since hundreds of couples of these two species breed on the islet. But this importance can be threatened by the continuous degradation of their habitats.

Seabirds become mature at a late age, experience low annual fecundity, often refrain from breeding, and enjoy annual adult survival rates as high as 98%. This suite of life history characteristics limits the capacity for seabird populations to recover quickly from major perturbations, and presents important conservation challenges (Russell, 1999).

An urgent management plan for IVFC is necessary, in order to conserve the natural habitats of the islet and protect their seabird populations.

According to Groz & Pereira (2005), islets habitats are expected to respond rapidly to habitat restoration, so it is urgent to implement an habitat restoration program and a major efficient islet control to people access, in order to improve seabirds breeding conditions on the islet. A well-designed legal and institutional framework is essential to provide a basis for effective eradication and control measures of alien plant species (Shine *et al.*, 2000), control of soil erosion and multiplication and re-introduction of native flora. A mark-recapture analysis is useful for tracking demo-

graphic changes in a population over time (i.e., assessing population size, adult survival, and juvenile recruitment) (Bricchetti *et al.*, 2000) and could be used to evaluate the effect of the habitat restoration programme.

Moreover, seabirds are believed to constitute useful samplers of the marine environment since they have been recognized as potentially useful and economical indicators of the status of marine environment and, in particular, the status of commercially important prey stocks (Furness & Greenwood, 1993).

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The experiments performed for the present study comply with the laws of the country in which they were performed.

LITERATURE CITED

- BACKELJAU, T., K. BREUGELMANS, C. BRITO, L. DE BRUYN, H. DE WOLF & J. TIMMERMANS, 1995. Macrogeographic genetic homogeneity in *Littorina striata* from the Azores (Mollusca: Prosobranchia). In: MARTINS, A..F. (ed.), *The Marine Fauna and Flora of the Azores (Proceedings of the Second International Workshop of Malacology and Marine Biology, Vila Franca do Campo, São Miguel, Azores, 1991)*. Açoreana, Supplement [4]:159-171.
- BOLTON, M., 2001. Population census of a threatened seabird, Cory's shearwater *Calonectris diomedea*, in the Azores

- archipelago. *Fauna & Flora International*.
- BRICHETTI, P., U.F. FOSCHI & G. BOANO, 2000. Does El Ninõ affect survival rate of Mediterranean populations of Cory's shearwater? *Waterbirds*, 23: 147-154.
- BRITTON, J.C., 1995. The relationship between position on shore and shell ornamentation in two size-dependent morphotypes of *Littorina striata* with an estimate of evaporative water loss in these morphotypes and *Melarhaphes neritoides*. In: GRAHAME, J., P.J. MILL & D.G. REID (eds.), *Developments in Hydrobiology III. Advances in Littorinid Biology*, pp. 129-142. Kluwer Academic Press, Dordrecht, The Netherlands.
- COLLAR, N., M. CROSBY & A. STATERSFIELD, 1994. *Birds to watch 2. The world list of threatened birds*. BirdLife International (Birdlife Conservation Series 4), Cambridge.
- EUROPEAN HABITATS COMMITTEE, 1991. *CORINE biotopes manual, Habitats of the European Community*. EUR 12587/3, Office for Official Publications of the European Communities, 1991.
- FURNESS, R., & J. GREENWOOD, 1993. *Birds as monitors of environmental change*, 325 pp. Chapman & Hall, London.
- GRANADEIRO, J., 1991. The breeding biology of Cory's shearwater *Calonectris diomedea borealis* on Berlenga island, Portugal. *Seabird*, 13: 30-39.
- GROZ, M., & J. PEREIRA, 2005. Invasive alien species as a threat to seabird populations: an account of habitat restoration on Ilhéu da Praia (Graciosa, Azores) special protection area. *Airo*, 15: 3-9.
- LE GRAND, G., K. EMMERSON & A. MARTIN, 1984. The status and conservation of seabirds in the Macaronesian islands. In: CROXALL, J.P., P.G.H. EVANS & R.W. SCHREIBER (eds.), *Status and conservation of the world's seabirds* pp. 377-391. ICBP Technical Publication.
- MALLET, G., & L. COGHLAN, 1964. Cory's shearwater *Procellaria diomedea* breeding in the Azores. *Ibis* 106: 123-125.
- MARTINS, A.M.F., 1978. *Mollusques des Açores. Ilhéu de Vila Franca do Campo, 1. Basommatophora*, 31 pp., 5 plates. Ponta Delgada: Centenary of "Carlos Machado" Museum Foundation.
- MARTINS, A.M.F., 1995. Terrestrial molluscs of Ilhéu de Vila Franca do Campo, São Miguel, Azores – an illustrated list. In: MARTINS A.M.F. (ed.), *The Marine Fauna and Flora of the Azores (Proceedings of the Second International Workshop of Malacology and Marine Biology, Vila Franca do Campo, São Miguel, Azores, 1991)*. Açoreana, Supplement [4]: 249-259.
- MARTINS, A.M.F., 2004. *The Princess' Ring*, 99 pp. Intermezzo-Audiovisuais, Lda., Lisboa.
- MONTEIRO, L., J. RAMOS & R. FURNESS, 1996a. Past and present status and conservation of the seabirds breeding in the Azores archipelago. *Biological Conservation*, 78: 319-328.
- MONTEIRO, L., J. RAMOS & R. FURNESS, 1996b. Movements, morphology, breeding, molt, diet and feeding of seabirds in the Azores. *Colonial Waterbirds*, 19(1): 82-97.
- MONTEIRO, L., J. RAMOS, J. PEREIRA, P. MONTEIRO, R. FEIO, D. THOMPSON, S. BEARHOP, R. FURNESS, M. LARANJO, G. HILTON, V. NEVES, M. GROZ & K. THOMPSON, 1999. Status and distribution of Fea's Petrel, Bulwer's Petrel, Manx Shearwater, Little Shearwater and Band-Rumped Storm-Petrel in the

- Azores Archipelago. *Waterbirds*, 22(3): 358-366.
- MONTEIRO, L., R. FEIO, J. PEREIRA, P. MONTEIRO, J. RAMOS, A. TAVARES, L. WILSON, L. HEWITSON, V. NEVES & R. FURNESS, unpublished report. *Population census of Cory's shearwater Calonectris diomedea borealis in the Azores archipelago*. University of Azores, Horta.
- MORTON, B., 1990. The intertidal ecology of Ilhéu de Vila Franca – a drowned volcanic crater in the Azores. In: MARTINS, A.M.F. (ed.), *The Marine Fauna and Flora of the Azores (Proceedings of the First International Workshop of Malacology, São Miguel, Azores, 1988)*. Açoreana, Supplement [2]: 3-20.
- MORTON, B., J.C. BRITTON & A.M.F. MARTINS, 1998. *Coastal Ecology of the Azores*, X + 249 pp. Sociedade Afonso Chaves, Ponta Delgada.
- del NEVO, A., E. DUNN, F. MEDEIROS, G. le GRAND, P. AKERS, M. AVERY & L. MONTEIRO, 1993. The status of Roseate Terns *Sterna dougallii* and Common Terns *Sterna hirundo* in the Azores. *Seabird*, 15: 30-37.
- PETERSON, D., 1988. Common tern, *Sterna hirundo*. In: ANDRLE, R.F., & J.R. CARROLL (eds.), *The Atlas of Breeding Birds in New York State*, pp 178-179. Cornell Univ. Press, Ithaca, NY.
- RAMOS, J., L. MONTEIRO, E. SOLA & Z. MONIZ, 1997. Characteristics and competition for nest cavities in burrowing procellariiformes. *The Condor*, 99: 634-641.
- RICHDALE, L., 1963. Biology of the sooty shearwater *Puffinus griseus*. *Proceedings of Zoology Society of London*, 141: 1-117.
- RODRIGUES, P., & M. NUNES, 2002. *Characterization of most appropriate territories for bird population in Azores archipelago*, 77 pp. Portuguese Society for Study of Birds, Lisbon.
- SHINE, C., N. WILLIAMS & L. GÜNDLING, 2000. *A guide to design in legal and institutional frameworks on invasive alien species*. World Conservation Union, Gland, Switzerland.
- SJÖGREN, E., 1973. Recent changes in the vascular flora and vegetation of the Azores islands. *Memórias da Sociedade. Broteriana*, 22: 1-515.
- SKIRA, I., 1991. The short-tailed shearwater: a review of its biology. *Corella*, 15: 45-52.