

Birds as a Tool for Island Habitat Conservation and Management

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Abstract: Problem statement: The Azores is a archipelago of nine volcanic islands, situated in the middle of the North Atlantic Ocean. Oceanic islands are known hotspots of biodiversity and the Azores, although relatively young (0.3-13 MA), conform to this general pattern. The local avifauna amount to 37 birding species, with two endemic species and 11 endemic subspecies. With an estimated population of 240,000 inhabitants, with increasing needs, most of the natural habitats that support bird populations are under a constant pressure. The use of bird distribution and species richness could be used as a suitable tool for management and would also be effective when applied in other archipelagos. **Approach:** In the course of the Bionatura project, the Atlantis Tierra 2.0 software provided the storage of biological data from all the islands, including the avifauna, in a 500×500 m grid. As an outcome, important items for bird conservation and habitat management were achieved for all the species occurring in the archipelago, including species richness. **Results:** A detailed knowledge of the spatial distribution of the endemic species and sub-species, plus the protected species, is a powerful tool for conservation and management policies in small islands where biodiversity is usually restricted to narrow distributions. **Conclusion:** The results defined an area of 39, 273 h (16.8% of Azores total area); providing an ideal area for conservation of suitable habitats for bird's species in the Azores.

Key words: Savage birds, habitat conservation and management, Azores islands, Special Protection Areas (SPA), volcanic islands, North Atlantic Ocean, oceanic islands, Atlantis Tierra

INTRODUCTION

According to the IUCN 2009, over 1200 (12%) of the world's bird species are considered threatened with extinction (i.e., in the categories of Critically Endangered, Endangered, Vulnerable and Extinct in the Wild). An additional 838 species are considered Near Threatened, giving a total of 2065 species that are urgent priorities for conservation action.

Only 17% of the world's bird species are found on islands (Johnson and Stattersfield, 1990). However islands hold disproportionately high numbers of threatened species, supporting over half of globally threatened species because birds inhabiting islands are particularly susceptible to human influences owing to an isolated evolutionary history (Bird Life International, 2004).

Oceanic islands are unique geological and biological units. In the majority of cases, they remained isolated from human influence until recently and have been the stage for many of the recent reported extinctions (Walter and Kenton, 1989; Bibby, 1994; Pimm *et al.*, 1994; Steadman, 1995; Steadman and Martin, 2003; Steadman, 2006). Indeed, the arrival of

humans on oceanic islands has precipitated a wave of extinctions among the islands' native birds (Blackburn *et al.*, 2004).

Compared with continents, greater rates of natural extinction might be expected among islands because they are relatively small areas with a large percentage of endemic species, their populations and ranges are smaller and species are therefore more vulnerable to any catastrophic event, habitat destruction and fragmentation, invasive species. (Paulay, 1994; Quammen, 1997; Biber, 2002; Yrjo, 2002; Newton, 2003; Duncan and Blackburn, 2007; Whittaker and Fernández-Palacios, 2007).

Maps of species distribution or habitat suitability are required for many aspects of environmental research, resource management and conservation planning. These include biodiversity assessment, reserve design, habitat management and restoration, species and habitat conservation plans and predicting the effects of environmental changes on species and ecosystems (Franklin and Miller, 2009).

The present study was developed on the oceanic islands of the Azores, one of the archipelagos belonging to the biogeographical region of Macaronesia, together

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with Madeira, Canary Islands and Cape Verde. Due to its isolated location in the heart of the North Atlantic Ocean, 1500 km from Europe and 1900 km from America, the Azores archipelago presents a small diversity of native species and birds are no exception.

The Azores were uninhabited by humans until 1433 when they were colonized by the Portuguese. Human settlements and land use had different levels of impact on the islands but the intensive use of the forest for wood and pasture and of the coast and its resources, have been common factors affecting bird distribution since then.

Actually, in these volcanic oceanic islands 37 species of birds breed regularly but their importance at the species and population levels are unique. Among them, one can list two endemic birds, the Azores bullfinch and the Monteiro's storm petrel (also considered as two of the most endangered species in the world); thirteen endemic sub-species from six orders; and some of Europe's most important populations of marine bird species, such as Cory's and Macaronesian shearwaters, Madeiran storm petrels and Roseate and common terns (Bannerman *et al.*, 1966; Bibby *et al.*, 1992; Nevo *et al.*, 1993; Ramos, 1995; Monteiro *et al.*, 1996; Monteiro and Furness, 1998; Monteiro *et al.*, 1999; Dickens and Neves, 2005; Clarke, 2006; Dietzen *et al.*, 2006; Bolton *et al.*, 2008).

In the Azores, the first inventory of the important bird areas in Europe listed seven sites, recognizing the poor knowledge at that time of the distribution of the breeding species of the archipelago (Grimmet and Jones, 1989). The first legal action towards the conservation of wild birds was the adoption of the Birds Directive in 1990 in the Azores, designating a total of 15 Special Protection Areas (SPA) (Table 1) and it made clear that the actual SPA of the region covered only 21% of the needed area for bird protection (Groz and Pereira, 2005).

Table 1: Special protected areas of the Azores (Anon, 1991)

Island	Place	Area (H)
Corvo	Coast and caldeirão	642
Flores	S and SW Coast	230
	NE coast	130
Faial	Caldeira and capelinhos	2076
Pico	Lages do pico	29
	Ponta da ilha	324
	Furnas de santo António	23
	Central area	5832
São jorge	Topo islet and adjacent coast	346
Graciosa	Baixo islet	30
	Praia islet	12
Terceira	Ponta das contendias	93
	Cabras islets	28
São miguel	Pico da vara and guilherme stream	1982
Santa maria	Vila islet and adjacent coast	48
	Total area	11825

The aims of this study were: (i) To propose priority areas for conservation of important habitats for birds and (ii) To propose a revision of their SPA, using maps of species distribution based on scientific publications, allowing correct management and providing a methodology that could be applied consistently to any other ocean archipelagos or islands.

MATERIALS AND METHODS

Study area: The Azores, a Portuguese Autonomous Region, is an archipelago of nine volcanic islands situated in the mid-north Atlantic Ocean (between 36° 55' and 39° 43' N and 25° 01' and 31° 07' W), 1500 km from Europe and 1900 km from North America (Fig. 1).

The discovery of the archipelago took place in 1427. At the time, there were reports of vast colonies of birds, particularly seabirds. The settlement of the islands, 12 years after the discovery, brought some changes, with species that used to breed abundantly in the archipelago decreasing drastically. This decrease was caused by their use as food and oil sources for the human population, by the introduction of predators and by many changes in habitat. Even a species of pigeon, reported to exist in abundance at the time of the colonisation, went extinct (Rodrigues and Michielsen, 2010). The majorities of the 260,000 inhabitants live and work around the coast resulting in significant development pressure on the environment. In the last 20 years, this trend has even increased considerably. The narrow littoral fringe of the 216

Azores islands are one of the few land areas that offers potential for settlement and Azoreans are strongly dependent upon the sea for income, communication and trade. This explains the coastal location of major commercial facilities and employment opportunities, together with economic activities and population (Andrade *et al.*, 2006).

Study species: In the Azores, 37 bird species breed regularly (Table 2): Two are endemic to the Azores, two are endemic to the Micronesia, ten are Azorean endemic subspecies and eight of them are endangered species protected by the European Council Directive 79/409/EEC, of April 2, 1979, on the conservation of wild birds.



Fig. 1: Location of the archipelago of the azores

Table 2: List of breeding birds of the Azores. N: Native; I: Introduced; N/I: Native or Introduced; EA: Endemic to the Azores; EM: Endemic to the Micronesia; BD-in annex A of Bird Directive (based on Rodrigues *et al.*, 2010)

Species	Status
<i>Anas platyrhynchos platyrhynchos</i> (Linnaeus, 1758)	N
<i>Anas rubripes</i> (Brewster, 1902)	N
<i>Alectoris rufa</i> (Seoane, 1894)	N/I
<i>Coturnix coturnix conturbans</i> (Hartert, 1917)	N/I
<i>Oceanodroma castro</i> (Harcourt, 1851)	N BD
<i>Oceanodroma monteiroi</i> (Bolton <i>et al.</i> , 2008)	N ES
<i>Bulweria bulwerii</i> (Jardine and Selby, 1828)	N BD
<i>Calonectris diomedea borealis</i> (Cory, 1881)	N BD
<i>Puffinus baroli</i> (Bonaparte, 1857)	N EM BD
<i>Puffinus puffinus</i> (Brünnich, 1764)	N
<i>Buteo buteo rothschildi</i> (Swann, 1919)	N ESS
<i>Fulica atra atra</i> (Linnaeus, 1758)	N
<i>Gallinula chloropus</i> (Linnaeus, 1758)	N
<i>Charadrius alexandrinus</i> (Linnaeus, 1758)	N
<i>Larus michahellis atlantis</i> (Dwight, 1922)	N ESS
<i>Gallinago gallinago</i> (Linnaeus, 1758)	N
<i>Scolopax rusticola</i> (Linnaeus, 1758)	N
<i>Onychoprion fuscatus</i> (Linnaeus, 1766)	N
<i>Sterna dougallii</i> (Montagu, 1813)	N BD
<i>Sterna hirundo</i> (Linnaeus, 1758)	N BD
<i>Columba livia</i> (Gmelin, 1769)	N
<i>Columba palumbus azorica</i> (Hartert, 1905)	N ESS BD
<i>Psittacula krameri</i> (Scopoli, 1769)	I
<i>Asio otus otus</i> (Linnaeus, 1758)	N
<i>Estrilda astrild</i> (Linnaeus, 1758)	I
<i>Carduelis carduelis parva</i> (Tschusi, 1901)	I
<i>Carduelis chloris aurantiiventris</i> (Cabanis, 1851)	I
<i>Fringilla coelebs moreletti</i> (Pucheran, 1859)	N ESS
<i>Pyrrhula murina</i> (Godman, 1866)	N ES BD
<i>Serinus canaria</i> (Linnaeus, 1758)	N EM
<i>Motacilla cinerea patriciae</i> (Vaurie, 1957)	N ESS
<i>Passer domesticus</i> (Linnaeus, 1758)	I
<i>Sturnus vulgaris granti</i> (Hartert, 1903)	N ESS
<i>Regulus regulus azoricus</i> (Seeböhm, 1883)	N ESS
<i>Regulus regulus inermis</i> (Murphy and Chapin, 1929)	N ESS
<i>Regulus regulus sanctae-mariae</i> (Vaurie, 1954)	N ESS
<i>Sylvia atricapilla gularis</i> (Alexander, 1898)	N
<i>Erithacus rubecula rubecula</i> (Linnaeus, 1758)	N
<i>Turdus merula azorensis</i> (Hartert, 1905)	N ESS

This directive seeks to protect, manage and regulate all bird species naturally living in the wild within the European territory, including their habitats (http://europa.eu/legislation_summaries/environment/nature_and_biodiversity/128046_en.htm).

Data analysis: Since 1998, the government of the Canary Islands developed a biodiversity project called BIOTA (Zamora and Esquivel, 2004), which consists of a visual basic software, called ATLANTIS Tierra 2.0, for biodiversity data storage. This software has several important tools, such as for taxonomic and conservation management, that allow the calculation of species richness, their rarity or complementarily in all 500×500 m cells of a special area (Borges *et al.*, 2010).

All of the existent data and publications about the species in the Azores were compiled by the project BIONATURA-Data Base for Azorean Biodiversity

(<http://www.azoresbioportal.angra.uac.pt/index.php?lang=en>) and introduced on the ATLANTIS Tierra 2.0, where individual island maps, with the most appropriate areas to preserve bird species and their habitats, were constructed based on species richness.

RESULTS

The results (Fig. 2), indicate that the ideal area to preserve the most important habitats for the Azorean Avifauna (BA) is some 39 273 h, which corresponds to 16.8% of the total area of the Azores.

The island with most BA was São Miguel, the biggest island in the archipelago (745 km²), but it is Corvo, the smallest one (17 km²), has the major percentage of BA in relation to the island Total Area (TA). Graciosa is the island with minor BA and TA.

DISCUSSION

The definition of the most appropriate areas to preserve the habitats of savage birds, based on species richness, represents a useful tool for species conservation planning and for management decision, not only for the species per se, but also for their habitats. This method takes into account all the species present in a given area, even the ones with lowest effectiveness. Species with a very restricted area of occupancy are obviously limited in the number of individuals they can maintain. This relation has been long known (Lawton, 2000) and further emphasizes the need to protect these “double rare” species, such as *Pyrrhula murina*, which is restricted to a small-forested area in the eastern part of São Miguel Island (Ramos, 1995). Species that are only able to survive in a single habitat type, which is a common situation for rare species, present all forms of rarity including distribution, abundance and habitat (Rabinowitz, 1981).

In this study, the maps in Fig. 2 revealed three different types of habitat that should be protected due to their importance to birds. These comprise: (i) The coastal zone, due to marine birds and their important ecological role on ocean islands; (ii) Forests, mainly of endemic type, due to their importance for the endemic land birds; and (iii) River basins and lakes, due to their importance to aquatic birds and to birds in general (Stone *et al.*, 1995; Monteiro *et al.*, 1999; Rodrigues and Michielsen, 2010).

We propose a total area of (39 273 h±16.8% of the total area of the Azores), three times larger than the actual SPA area (11 825 h±5% of the total area of the Azores). Some islands, such as Corvo and Faial, have all the proposed areas under protection by the Bird Directive. Pico already has 88%, but the rest of the islands need an urgent revision of their SPA, in order to include new areas in São Miguel (18%), Flores (10%), Graciosa (8%), São Jorge (5%), Santa Maria (3%) and Terceira (2%).

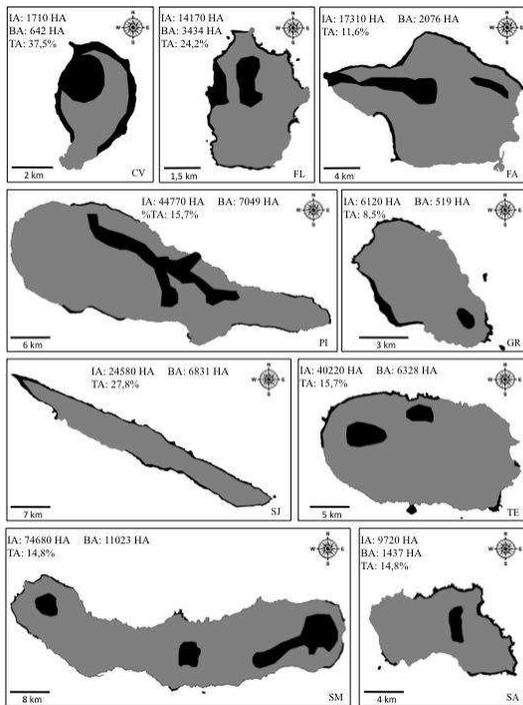


Fig. 2: Most appropriate areas to preserve the habitats of the Azorean bird species (dark areas). IA-Island total Area in hectares; BA-Most appropriate areas to preserve Azorean Avifauna, in hectares; TA-Total percentage of BA in IA; CV-Corvo; FL-Flores

The conservation of island birds is a daunting and expensive task that may require managers to simultaneously address habitat loss, exotic species and disease. More management attention is needed to stabilize or reverse the decline of the Azorean species. High levels of endemism on islands also justify an intensive recovery effort (Restani and Marzluff, 2002).

CONCLUSION

The results of this study should be applied to the management and conservation planning of the Azores islands, since the definition of the most appropriate areas to preserve wild birds' habitats is an effective way of identifying conservation priorities. These areas are key sites for bird conservation. Their relatively small size allows, effectively, for the conservation and management of the biological resources they enclose. Their importance was already recognized as some are part of a protected-area network. This model could be used as a functional tool for biodiversity assessments, reserve design, habitat management and restoration, as

well as, species and habitat conservation plans, not only in the Azores but also in other small archipelagos.

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