

A multi-scale analysis to support the implementation of a regional conservation policy in a small-island archipelago – the Azores, Portugal.



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ABSTRACT

Calado, H., Bragagnolo, C., Silva, S.F., Pereira, M. 2014. A multi-scale analysis to support the implementation of a regional conservation policy in a small-island archipelago – the Azores, Portugal. In: Green, A.N. and Cooper, J.A.G. (eds.), *Proceedings 13th International Coastal Symposium* (Durban, South Africa), *Journal of Coastal Research*, Special Issue No. 70, pp. 485-489, ISSN 0749-0208.

Small islands present both exceptional biodiversity and higher vulnerability. Their isolation has been identified as the main driver contributing to preserve the unique natural capital (10 of the 34 terrestrial biodiversity hotspots listed by Conservation International are wholly comprised of islands). However, small-island archipelagos may present a great variability among islands in terms of size and population, remoteness, incomes, natural and cultural landscapes, human pressures and vulnerabilities to global changes. This inexorably leads to different values, life-styles, and land use forms, which combine to shape cultural and socio-economic relationships of archipelagos, creating inter- and intra- island networks. Therefore, exploring inter- and intra-island relationships (based on historical, geographical, political and economic factors) can support a better understanding of networks and scale-dependent processes (ecological, economic, political, etc.), facilitating a more effective implementation of sustainable and biodiversity conservation policies at different levels. In this contribution, we present a multi-scale analyse to support the implementation of a regional conservation policy in a small-island archipelago (The Azores, Portugal). It represents a decision-making challenge for biodiversity conservation where a new management system of Protected Areas (PAs) was recently adopted. Three spatial units are considered: archipelago, island groups and island *per se*. The analysis integrates qualitative information, quantitative indicators and land use analyses in order to identify key areas of concern and relevant challenges for implementing the regional conservation policy at multiple levels. Findings underlined the importance to provide appropriate arrangements to better deal with scale mismatches arising from the divergence between spatial scale (where conservation challenges are identified) and administrative levels (where management interventions can be made).

ADDITIONAL INDEX WORDS: *Small islands, conservation, planning, archipelagos, the Azores, Pico island.*

INTRODUCTION

Regional island studies previously indicated that islands occupy unfavourable position with respect to the mainland (Niles and Baldacchino, 2011). As a result, small-island archipelagos are generally considered vulnerable, threatened by sea-level rise, climate change, over-dependence on sea resources, changes in agriculture trends, changing markets for their limited commodities and scale economies (van Beukering *et al.*, 2007; Rietbergen *et al.*, 2007).

However, archipelagos are complex systems made up of different island groups characterised by widely spread spatial units, mosaic of values, different life-styles and land-use forms (Ankre, 2009; Stratford *et al.*, 2011), which combine to shape

cultural and socio-economic relationships of Archipelagos, creating inter- and intra- island networks.

Therefore, analysing different spatial units and multi-scale relationships of archipelagos (based on historical, geographical, political and economic factors) may support a better understanding of scale-dependent processes (Cumming *et al.*, 2006; Guerrero *et al.*, 2012), improving the implementation of policies at different levels (Bunce, 2008).

Exploring multi-scale processes (ecological, socioeconomic, cultural, and political) further represents a key issue for island ecosystem conservation. Island ecosystems have been considered some of the most threatened in the world (Mueller-Dombois and Loope, 1990) as well as those hosting about one third of the terrestrial biodiversity hotspots (Mittermeier *et al.*, 2005).

According to Poiani *et al.* (2000), biodiversity conservation operates at multiple scales. Planning for conservation is about

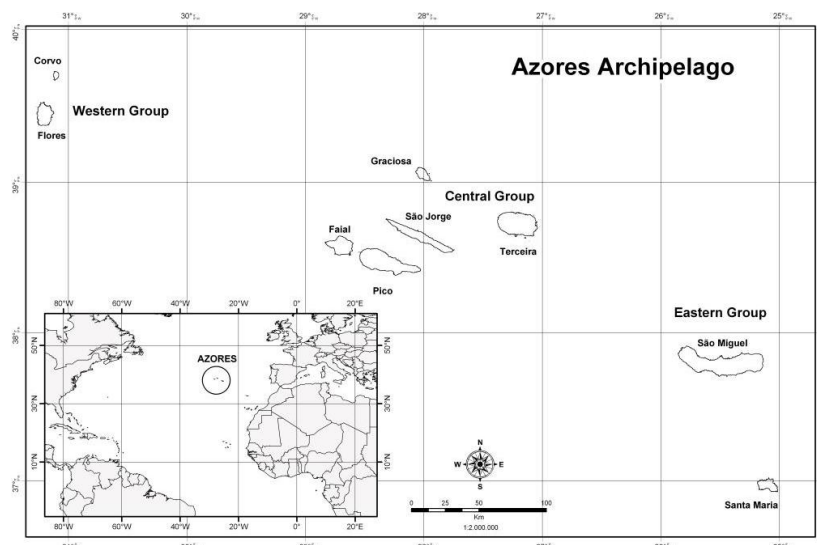


Figure 1. Azores geographic localization (Centre of Geographic Information Systems, University of the Azores).

translating conservation policies into actions at appropriate geographical scale and administrative level (Guerrero *et al.*, 2012). In this context, exploring the positioning of islands with respect to archipelago may contribute to a better understanding of the social-ecological systems in which conservation policies are to be implemented (Cumming *et al.*, 2006; Paloniemi *et al.*, 2012).

This paper presents a multi-scale analysis to support the implementation of a regional conservation policy in the Azores archipelago. Three spatial units are considered: Archipelago, groups of islands and the island *per se* (example of Pico Island). The study integrates qualitative information, quantitative indicators and land use analyses. Relevant challenges for achieving conservation objectives at each scale are identified and discussed.

THE STUDY REGION

The Azores Archipelago is an Autonomous Region located in the centre of the North Atlantic Ocean (Figure 1), formed by nine volcanic islands, characterized by both exceptional endemism and high vulnerability (Cardoso *et al.*, 2008).

The archipelago presents a unique natural and cultural capital, which is vital for maintaining the health of ecosystems and supporting local livelihoods and regional economy (Petit and Prudent, 2010). However, during the last decades, human pressures on the archipelago's biodiversity have increased, leading to habitat loss and fragmentation, pollution, invasion of exotic species and unsustainable exploitation of resources (McGinley, 2007; Calado *et al.*, 2011a).

The current economy of the Archipelago is mainly based on small domestic markets, depending mostly on biodiversity and natural resources (the main economic sectors are: agriculture, cattle grazing, tourism and fisheries). Manufacturing mostly relies on primary products (mainly livestock, dairy and fish) and tourism which is currently increasing in terms of both supply (lodging capacity) and demand (number of tourists per year).

In this context, biodiversity and natural resource conservation has become a priority of the regional policy agenda, in a way that 20% of the Azorean coastal and terrestrial surface is under protection, including Natura 2000 European Network sites.

In 2007, nine Island Natural Parks (one for each island – territorial sea up to 12 nautical miles) and a Marine Park were created by the Regional Government through the introduction of a new regional conservation policy. This was achieved by implementing a new management system of Protected Areas (PAs) which aims at preserving biodiversity and cultural landscapes of the archipelago.

The criteria developed by the International Union for Conservation of Nature (IUCN) were applied and adapted to assign different categories of protection to existing (Natura 2000, Ramsar sites, regional woodland reserves, etc.) and potential natural sites, leading to a network of Parks made up by PAs under the same designation and management regime.

The policy further created a series of Park Authorities (one per each island) and in this way designed the Parks to become key features in conservation and sustainable management of island resources. Nevertheless, to be implemented, the model needs to be effectively down-scaled and carefully tailored to local circumstances

METHODOLOGY

The method integrates qualitative information, socioeconomic indicators (i.e. GDP per island, number of international flights per island, etc.), expert opinions (this analysis is part of the Smartparks Project and informal opinions of the project team are used), and land use analyses.

Firstly, a scoping process was followed to analyse both the regional context (archipelago – *scale 1*) and three groups of islands (*scale 2*). Qualitative information, informal expert opinions and regional statistics were collected and applied to identify the most relevant socioeconomic drivers and the most important challenges with respect to key conservation issues (natural and cultural capital, Protected Areas management and governance, etc.).

Then, the island of Pico was analysed (*scale 3*). A simplified model of small volcanic islands was used to better explored land use patterns, conservation opportunities and conflicts at this scale. It distinguishes three spatial units of an island: coastal zone (0 m–150 m above the sea level), middle crown (between 150 m and

600 m above sea level) and core area (more than 600m above the sea level).

MULTI-SCALE ANALYSIS

Scale 1: The Azores Archipelago

The Archipelago is characterized by a "double" insularity, driven by the combination of its remoteness (about 1,500 km from the mainland and 4,000 km from the North American East-coast) and the large distance among the constituent islands (Table 1).

On one hand, these natural and physical barriers tend to increase the vulnerability of the archipelago, limiting the development of terrestrial and marine connections, increasing the dependence on distant external markets, and leading to an overspecialisation of the regional economy.

On the other hand, the Azores have started to achieve a significant importance in the management of the North Atlantic Ocean (the Economic Exclusive Zone surrounding the Azores represents the 55% of the national EEZ). Moreover, the strategic role of the Azores has recently increased, particularly concerning the protection of marine environments and the formulation of international transportation and maritime policies. The peculiar status of the Portuguese Autonomous Regions makes the Archipelago an active actor in ocean governance and environmental planning, giving it the right to define regional environmental policies and to participate in the negotiation of accords and international agreements concerning marine pollution, nature conservation, and the exploitation of living species (Calado *et al.*, 2011b).

The introduction of the new regional conservation policy (DLR, 2007) represents one of the greatest challenges for the future development of the region. The establishment of a network of nine Island Natural Parks and an offshore Marine Park has redesigned the governance system of the region, introducing new conservation authorities (each Park is represented by an authority), and redefining planning, management and administration issues.

However, there are many uncertainties threatening the effectiveness of this policy. Issues faced include the global economic crisis which could move the focus from conservation to prioritising human and financial resources for other purposes. There may be many institutional and non-institutional barriers, including: information gaps on biodiversity (mostly on marine ecosystems), scarce coordination among authorities, lack of coherent establishment or implementation of management plans, scarce involvement of public and poor attitude to participation and a restricted perception associated with PAs, etc.

These issues should be mainly addressed at this scale, by providing management guidelines and alternatives (e.g. financial options, development of tourism-related benefits, etc.) for a successful down-scaling of the regional conservation policy.

Scale 2: Groups of Islands

The Azores are made up by three groups of islands geographically separated, namely: Oriental, Central and Occidental.

1. The Oriental Group (islands: São Miguel and Santa Maria) represents the main gate of the archipelago, connecting the region with the world (during the last three year 78% of total international flights connecting Azores to foreign countries have departed from or landed in these two islands). The group further concentrates the largest population (more than 50% of total inhabitants) and density (about 15%) which influences the economy of the entire Archipelago (i.e. final demand of goods and services). Haddad *et al.* (2012) estimated the multipliers effect of the economic base on Azores, showing that more than half of Azores economy was represented by São Miguel.

The group presents unique natural features (fossil deposits with great scientific interest, exclusive geological formations with volcanic activity such as volcanic craters and cones, lake-filled calderas, lava domes, hydrothermal vents, etc.) and host endemic habitats and species (Laurissilva natural forest and inland birds), representing important sites for geo- and biodiversity conservation.

They are host to multiple research centres and environmental institutions (university, environmental ONGs, governmental agencies) presenting a greater conservation capacity, which may facilitate the implementation of the regional conservation policy.

2. The Central group (Graciosa, Terceira, São Jorge, Pico, Faial) was characterised by little interaction with foreign countries and strong integration among the constituent islands (sharing infrastructure, services, and exchanging basic goods). Inter-island connections of this group were significant; with 60% of the total inter-island flights departing/landing and 90% of the total passengers transported by inter-island ferries, were between this island group within the last three year.

The group presents a heterogeneous pattern of natural and cultural sites, including: active volcanos, UNESCO agricultural landscapes and heritage sites, wetlands, endemic terrestrial and marine habitats and species, volcanic ridges and marine caves, presence of significant colonies of seabirds, lava caves, peculiar rural architecture and colonial urbanism, etc.

The strong connection of the constituent islands gives the opportunity to develop combined strategies and initiatives to preserve and manage this huge natural and cultural capital, as different ecotourism activities and education programmes can be developed and integrated based on common natural features of islands. This would improve environmental attitudes and conservation knowledge of tourists and residents (e.g. bird and whale watching, scientific diving, mountain climbing and trekking, speleological activities, etc.), contributing to biodiversity conservation.

3. The Occidental Group (Flores and Corvo) is the most isolated sector of the Azores (with no international transportation and limited connection with other groups). These islands are interlinked and mutually dependent with a small economy with a highly vulnerable declining population and social problems, demanding strong investment in halting the abandonment of human activities and maintaining local livelihoods (Table 2).

Scale 3: The Island – the case of Pico

Pico is the second biggest island of the Azores and, with the largest area of protected land (35%) with various categories of protection represented by the island Park (five IUCN management categories were associated to this Island Park), it represents a challenge for regional conservation policies.

Table 1. Distance among Azores islands [km]

Islands	Santa Maria	São Miguel	Terceira	Graciosa	São Jorge	Pico	Faial	Flores	Corvo
Santa Maria	0	100	265	345	330	340	360	575	585
São Miguel	100	0	170	250	250	260	280	500	510
Terceira	265	170	0	95	120	125	145	360	370
Graciosa	345	250	95	0	75	80	85	270	280
São Jorge	330	250	120	75	0	20	40	250	260
Pico	340	260	125	80	20	0	25	240	250
Faial	360	280	145	85	40	25	0	235	245
Flores	575	500	360	270	250	240	235	0	15
Corvo	585	510	370	280	260	250	245	15	0

Table 2. Demographic and economic baseline

Island	Population		Population density [inhab./km ²]	Ageing ratio	GDP* [%]
	[inhab.]	%			
Corvo	507	0,21	29,65	204,2	0,1
Faial	15.784	6,42	91,18	91,3	6,6
Flores	4.168	1,70	29,56	138,6	1,2
Graciosa	4.950	2,01	81,55	146,0	1,1
Pico	14.923	6,07	33,55	149,2	4,8
Santa Maria	5.557	2,26	57,35	73,1	2,7
São Jorge	9.403	3,83	38,60	124,0	2,7
São Miguel	134.662	54,78	180,85	50,3	59,6
Terceira	55.857	22,72	139,54	82,0	21,2
Azores Archipelago	245.811	100,00	105,86	68,8	100

By applying a simplified model for small volcanic islands, three geographical rings can be recognised at island scale: a coastal zone, a middle crown and a core area (Figure 2).

According to this model, the coastal zone is where settlements, human activities and transportation infrastructures are mainly developed. The coastal zone of Pico is mainly covered by urban areas (approximately 8% of the coastal zone) and agricultural areas (approximately 30%), including a traditional viticulture area with a strong socio-cultural identity - *Landscape of the Pico Island Vineyard Culture* - designed as the UNESCO world heritage site.

The main conservation challenges include the protection of seabird habitats, the connection between fragmented PAs, the reduction of tourist pressures on designated sites and the improvement of environmental education activities and monitoring programs. Harmonising of human activities and biodiversity conservation in cultural vineyard landscapes is considered a priority, due to emerging conflicts between the preservation of the cultural landscapes and the conservation of protected endemic species and habitats which have recently occupied several abandoned vineyards.

The middle ring is mostly covered by pastures (approximately 40%) and semi-natural land with a significant presence of invasive non-indigenous species (more than 40%) with PAs covering only 7% of the ring. The creation of ecological corridors between coastal zone and core area should be considered. Appropriate actions for containing invasive species could be considered and assessed (e.g. habitat restoration, use of invasive woodland biomass for energy production, etc.).

Areas with large pastures and natural areas, with a significant presence of endemic species, predominantly occur in the core area (peatbogs, ancient volcanic lakes, etc.) where the majority of PAs are concentrated. The protected land includes Nature Reserves

(IUCN category I), areas for the protection of singular species or habitats (IUCN category IV), and a large natural landscape (IUCN category V), covering about 9,500 ha (70% of the core). The conversion of natural and semi-natural lands into pastures represents the main pressure for conservation with negative conservation behaviours frequently observed (e.g. animal grazing in habitats with natural high-level value) suggesting that human-conservation conflicts may increase without mobilizing the support of local communities.

DISCUSSION

Assuming that archipelagos are systems made up of spatial units with different features and values, a multi-scale analysis could then be applied. This enabled a better understanding of the social-ecological system in which the regional conservation policy to be implemented, generating insights for down-scaling the strategy at multiple levels.

Archipelagos represent a suitable context for applying a multi-scale analysis since the selection of spatial units is facilitated by their physical limits.

The Azores Archipelago was considered an excellent case study for performing this multi-scale analysis due to the recent implementation of the regional conservation policy, aiming at translating conservation principles into local actions.

The study identified a “double insularity” symptom in the Azores, associated with a greater dependence on external inputs and a poorly diversified economy (Kerr, 2005). Another archipelagic effect relies on its strategic location contributing to the management of the Atlantic space and to adaptation strategies for global environmental change. The new conservation policy seems to be a powerful way for promoting the sustainable future of the Archipelago. However, for a successful down-scaling of this policy a strategic approach to conservation is required where the major challenges for its implementation are:

- defining the role of conservation actors including duties and responsibilities;
- building expertise and improving institutional, technical and financial capacity;
- promoting inter-agencies coordination and integrating conservation and sectorial policies and;
- identifying financial needs and suitable funding programmes.

In island groups, the analysis highlighted the importance of connections among them to support appropriate conservation strategies and measures. Collaborative approaches should be adopted to provide overarching directions and objectives for sustainable development and conservation. The three main objectives for the implementation of the regional conservation policy at this scale are:

- identification of inter-island networks and promoting inter- and intra-institutional collaborations;
- definition of conservation strategies and desirable objectives for each group and;
- Optimisation of human and financial resources to capitalize on economies

At the island scale, the key challenges identified were the need to find consensual solutions for avoiding conflicts between conservation and local livelihoods. It may require a participatory approach, where public participation is crucial to find consensual solutions for implementing conservation and management measures.

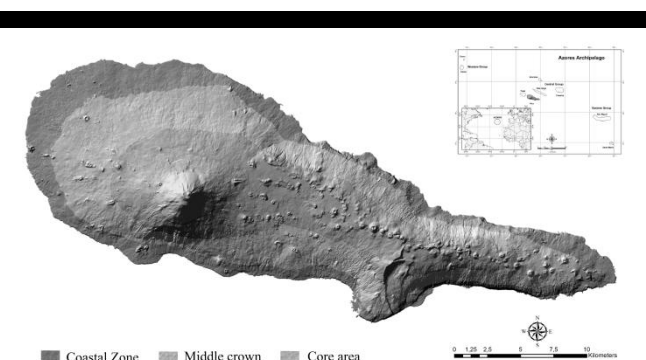


Figure 2. Simplified model of volcanic small islands in Pico island

CONCLUSION

The selection of an appropriate scale of analysis is critical for conservation planning as many conservation problems may occur when the levels at which management interventions are made do not correspond to the scales at which ecological processes and problems occur (Cumming *et al.*, 2006; Guerrero *et al.*, 2012).

This study has presented a multi-scale analysis to support the implementation of a regional conservation policy in the Azores archipelago. Three scales were selected (Archipelago, groups of islands and island per se) based on bio-physical and socio-cultural aspects. Among them, only the archipelago clearly aligns with an administrative level (Autonomous Region) and, to some extent, the island (even though the Park Authority does not represent an elective body). In this context, it is vital to strengthen cross-scale communication, cooperation and participation, through mechanisms that could facilitate to downscale the regional policy such as: the creation of a forum of Island Park Authorities, the establishment of inter- and intra-island partnerships for conservation, etc.

Finally, although the nature of the analysis was mainly qualitative, it showed a potential way for analysing naturally nested geographic units such as archipelagos. We believe that this multi-scale approach could be applied in the future in other small-island archipelagos and extended to support the implementation of other policies (e.g. spatial planning or sectorial policies). Nevertheless, criteria for selecting scales will always need to be re-formulated based on specific features and objectives of the study.

ACKNOWLEDGEMENT

The work described in this publication was developed under the Project SMARTPARKS – Planning and Management System for Small Islands Protected Areas (PTDC/AAC-AMB/098786/2008) funded by Fundação para a Ciência e a Tecnologia (FCT).

The authors wish to express their gratitude to Professor Richard James Ladle for providing important suggestions in this study.

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