

Understanding and mapping local conflicts related to protected areas in small islands: a case study of the Azores archipelago.

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ABSTRACT: Establishing Protected Areas (PAs) is considered one of the most appropriate ways to conserve nature and cultural landscapes. However, conservation constraints can generate social conflicts, especially at a local level. In small islands (SIs), local conflicts may escalate due to an increase in competition for limited space and resources. Pico island in the Azores Archipelago (Portugal), part of the Outermost European region, was considered a good case to study conservation-development conflicts due to the amount of designated protected land (> 35% of its surface) and the approval of a new Azorean PA network in 2007. This paper presents a new approach to understanding and mapping local conflicts within PAs in SIs by integrating qualitative data and spatially explicit information. This research takes stock of the benefits, needs and constraints related to Pico Natural Park as perceived by local stakeholders through face-to-face semi-structured interviews; it subsequently identifies and transposes the conflicts distilled from stakeholder discourse into spatially representative visual maps via GIS. Research outcomes show that PAs are perceived mainly as constraints to local development, showing inconsistency between local expectations and regional conservation policy. This highlights the importance of including public participation processes prior to any implementation of conservation strategies. The proposed method provides a springboard towards effective conflict management for PAs on Pico island, showing a relatively low-cost and straightforward approach to minimising future local conflicts which could be adapted to other similar Outermost European regions and SIs.

Keywords: conservation-development conflict, GIS, participatory approach, biodiversity conservation, Outermost European regions, protected areas, small islands, stakeholder analysis

Introduction

Protected Areas (PAs) are globally considered the most important instrument for conserving biodiversity and preserving cultural landscapes (Lockwood et al., 2006; Jepson et al., 2011; Watson et al., 2014). Since the first area set aside for nature protection in 1872 (the U.S. Yellowstone National Park), the concept of PAs has changed greatly, reflecting rapid social changes (Ervin et al., 2010). Although PAs have always been accepted worldwide as one of the main tools to protect nature, their role in conserving biodiversity only became explicit in 1990s when the International Union for Conservation of Nature (IUCN) defined a protected area as “an area of land and/or sea especially dedicated to the protection and maintenance of biological diversity, and of natural and associated cultural resources, and managed through legal or other effective means” (IUCN, 1994). Later, the concept was expanded, extending the function of PAs from conservation *tout court* (supplying habitat for wildlife species) to multi-purpose that encompasses maintenance of ecosystem functioning and support of local livelihood and economy (Watson et al., 2014). This led to redefining a PA as “a clearly defined geographical space, recognised, dedicated and managed, through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values” (Dudley, 2008). This new definition reflected a more anthropocentric view of PAs, emphasizing their role in supporting human life and well-being, and delivering multiple ecosystem services (Watson et al., 2014). Consequently, natural systems (and PAs) can no longer be treated as separate from human systems (Corlett, 2015). The role of local communities has, therefore, moved from passive to a more active participation and engagement in conservation activities (Ervin et al., 2010). However, in this context, conservation-development conflicts are more likely to emerge as multiple stakeholders may attach their different interests, values, power, perceptions and goals to PAs (Yasmi et al., 2006). By “stakeholders” we refer to individuals or groups who affect or are affected by certain decisions and actions taken by the organization (Freeman, 1984).

The establishment of a PA is considered one of the most representative examples of conflict between individual needs (i.e. short-term and local) and collective interests (i.e. long-term and global) (Bonaiuto et al., 2002). As defined by Moore (1996) and Kwaku Kyem (2004), a conflict is a misalignment of interests, values or actions between individuals or social groups. Of note, the nature and the magnitude of conflicts as well as the way in which people and communities respond to them may vary greatly over time and place, reflecting specific spatial and temporal contextual aspects (i.e. wealth, social status, power) (Paavola, 2004). From a psychological point of view, although different individuals may endorse the same values, different priorities may result in diverging preferences, choices or behaviours (Gifford & Sussman, 2012). Thus, the interests that sustain a conflict generally reflect opposite needs, desires and beliefs underlining the positions of individuals or social groups (Moore, 1996; DeChurch & Marks, 2001; Kriesberg, 2007).

Conflicts on PAs may arise due to disparate values attached to the use of common resources among stakeholders involved in the planning and management of the PAs (Bonaiuto et al., 2002). This is especially so at a local scale where the increase of restrictions imposed in PAs may considerably affect the local way of life and intensify social conflicts or impacts (Borrini-Feyerabend, 1996; Castro & Nielsen, 2003; West et al., 2006). Although highly dependent on local specificities, the most commonly reported conflicting situations in PAs are usually related to conservation-development disputes, poor or unfair access to natural

resources, land use pressures, and control over decision processes (Lewis, 1996; West & Brockington, 2006). However, disputes and disagreements over the use and protection of natural resources within communities are frequent and not necessarily negative (Castro & Nielsen, 2003). To manage conflicts within PAs, a participatory and inclusive approach involving and engaging stakeholders in PAs has been advocated as a proactive way of transforming conservation-development conflicts into opportunities (Borrini-Feyerabend, 1996; Indrawan et al., 2013). The importance of setting the groundwork of stakeholder participation early and throughout a planning process has been underscored by the philosophy of “empowerment, equity, trust and learning” (Reed, 2008). Similarly, Van Assche et al (2012) remind us that the impact and success of planning relies on effective communication, dissemination and public acceptance of “concepts, strategies, forms and materialities”, while Van Assche et al (2014) reflected on power in/on/of planning systems and deliberated that co-evolution of the planning realm and society is a consequence of the positionality of planning. Thus, during recent years, planning discourse has started to focus more on conflict resolution, emphasizing the importance of negotiation and mediation instruments based on communication and collaboration in contrast with conventional litigation tools which disregard the integration of interested groups into the decision-making processes (Sidaway, 2005).

By incorporating local perspectives early in the PA decision-making process, conflicts associated with conservation can be better identified, negative trade-offs can be minimized and public awareness about PAs can be raised (Lewis, 1996; Jamal, 2004). Most of the instruments and mechanisms to minimize conservation-development conflicts focus on: providing more equal incentives mitigating perceived losses (e.g. tourism revenue sharing) (Wynberg & Hauck, 2014); assessing and demonstrating the multiple values of conservation through educational projects (Thomassin et al., 2010; Leisher et al., 2012); and including local people in decision-making processes, eventually implementing co-management systems (Gilman, 1997; De Pourcq et al., 2015). However, regardless of the chosen strategy, relevant stakeholders need to be systematically included throughout the process (Reed, 2008). To this end, stakeholder analysis has demonstrated to be a useful tool in identifying positions of actors and their relationships as well as assessing relative powers and gaining knowledge about the social context in which conservation policies are being enforced (Rastogi et al., 2010). Reed et al (2009) defines stakeholder analysis as a multi-phase process where: (i) social and natural aspects of a phenomenon affecting a decision or action are defined, and (ii) individuals, groups or organizations who are affected by these aspects are identified and, then, (iii) prioritized in order to be part of the decision-making process. As presented by Andrade & Rhodes’s (2012) work on determining the main criteria for better compliance with PA conservation policies, the level of local community participation in the PA decision-making process was the only variable that was significantly correlated with the compliance level amongst the other six criteria considered. Drawing on their results suggests that the main strategy for assuring PA integrity lies in greater involvement of local communities in PA management (Andrade & Rhodes, 2012).

In small islands (SIs), local conflicts in PAs can greatly intensify due to the competition for limited space and resources (Aretano et al., 2013; Calado et al., 2016; Novy-Hildesley, 2001). Land use pressures, poor spatial planning and multiple uses of limited space have been frequently pointed out as drivers of local conflicts in SIs (Eadens et al., 2009; Lagabrielle et al., 2009), imposing even greater challenges in conciliating conservation and development

(Calado et al., 2007; Lagabrielle et al., 2009; Niles & Baldacchino, 2011). According to Brown and Raymond (2014), one of the most common consequences of land scarcity is the occurrence of land-use conflicts. Since most terrestrial PAs are pieces of land set aside and/or regulated for conserving biodiversity, land-use conflicts may emerge as a consequence of divergent interests on that land (e.g. development vs. conservation). A land-use conflict “occurs whenever land-use stakeholders (i.e. conflict parties) have incompatible interests related to certain land-use units (i.e. geographical component)” (von der Dunk et al., 2011). Thus, understanding social positions and mapping the spatial distribution of areas with different conflict levels could provide valuable information for conservation planning, facilitating communication and collaboration among decision-makers and stakeholders (Kwaku Kyem, 2004). With spatial representation, conservation-development conflict zones and low-conflict spatial options can be better identified and visualized, and alternative plausible spatial options, e.g. biodiversity conservation vs. rural development, could be effectively discussed and assessed without losing sight of the consequences to the other areas.

Among others, participatory mapping based on the visualization of conflicting areas has shown to be a useful and simple tool to anticipate and identify areas of potential land-use conflicts, facilitating conflict resolution and communication among decision-makers and stakeholders (Harris & Weiner, 1998; Kwaku Kyem, 2004; Brown and Raymond, 2014). Studies have demonstrated that the most influential factors on stakeholders’ attitudes towards PA are their cost-benefit perception of the park, their involvement in the park establishment and their previous experiences with the organizing institutions (Thuy et al., 2011; Nastran, 2015). According to Rauschmayer and Wittmer (2006), by combining deliberative and analytical methods, environmental conflicts can be more effectively resolved. In this context, many researchers suggested the use of Multi Criteria Analysis (MCA) as a potentially practical approach to dealing with conservation conflicts and/or assessing the trade-offs associated with alternative interventions to manage conflicts (Davies et al., 2013). Moreover, MCA has been frequently integrated with GIS, providing a useful tool to, for example, map environmental disputes associated with establishing PAs in coastal areas (Brody et al., 2004), identify potential sites for tourism development (Wong & Fung, 2015), develop a zoning scheme for supporting marine protected areas (MPAs) planning in a context with scarce resources (Habtemariam & Fang, 2016), support the evaluation for site selection of offshore marine fish farm (Dapueto et al., 2015), suggest specific zoning strategies to assist the establishment of MPAs in Taiwan (Lu et al., 2014), support PAs zoning (Geneletti & van Duren, 2008), among others.

A more sophisticated approach to mapping conflicts involves integrating agent-based models (ABMs) with GIS. The former is an artificial intelligence technique which allows the analysis of interactions between multiple and heterogeneous social agents (humans) and their environment (Ferber, 1999), being largely applied in the field of natural resources management and land-use science (Gary Polhill et al., 2011). For example, Dumrongrojwathana et al (2011) showed the benefit of using simulation tools for analyzing a conflict over access to grazing land in the Nan province of northern Thailand. A brief review of the application of participatory agent-based modelling can be found in Barnaud et al (2013) which showed how this approach has already been applied in many fields, e.g. land-use planning (Lagabrielle et al., 2010), conflicts over irrigation water (Becu et al., 2008), and, forest management (Simon and Etienne, 2010), among others.

However, it is broadly recognized that these techniques may require resources and skills that may not always be available or accessible (Rauschmayer & Wittmer, 2006). In addition, the application of complex models into participatory processes has been cautioned against, since it may increase the “black box” effect, ultimately decreasing transparency and public trust (Voinov & Bousquet, 2010). Further, developing participatory models can be very time-consuming, and in most cases decision-makers need quick and decipherable information. These complex approaches are challenging to execute in locations with limited financial and human resources such as in SIs. Consequently, a simple spatial tool that is achievable within limited time, financial and human resources constraints is proposed as a way of supporting conflict management in the context of PAs in SIs. This proposed method combines a participatory approach and GIS to visually map conflict levels and types across an island-wide PA network. This two-step method entails: 1) participatory approach: local stakeholder selection and semi-structured interviews with identified and available stakeholders; and 2) GIS: using available spatial data, this transposes the levels and types of conflicts determined in the first-step into spatially representative maps. Using Pico island as a case study, this research was undertaken within the *SmartParks* project, which focused on developing a novel approach towards supporting PA management in SIs. In this context, “participation” refers broadly to the interaction process with stakeholders. Using the influential “ladder of citizen participation” described by Arnstein (1969), the level of participation applied in this case study corresponds to level 4 - stakeholder consultation.

Pico island is located in the Azores Archipelago (Portugal) which is part of the Outermost European region. Pico island is considered a suitable case study for analyzing and mapping conservation-development conflicts due to the amount of designated protected land (i.e. > 35% of the island’s surface is classified under different degrees of protection) as well as a new regional conservation policy change which sets the groundwork for PA planning, management and administration (i.e. regional Azorean PA network introduced in 2007; Calado et al., 2016). The former indicates that conflicts in PAs will likely vary across Pico island, and also points towards a higher likelihood of conservation-development conflicts in areas where stricter land-use regulations have been implemented, especially for sectors with well-established human activities (i.e. dairy production, etc.). The latter infers a need for social adjustment and subsequent potential tension due to the establishment of new authorities responsible for the island Parks (i.e. the Park Authority). The creation of this new single planning authority at an island scale seems to have reconfigured powers and increased tensions among local stakeholders. In fact, social tensions are likely to heighten particularly in this case where reconfiguration of powers and redesigning of new governance network are taking place simultaneously (Paavola, 2007). In addition, the consultation process that took place during the establishment of the Park was apparently not enough to ensure local communities’ involvement in PA management and therefore inadequate in minimizing local conflict. This two-step approach incorporates: 1) taking stock of the benefits, current needs and constraints associated with Pico Natural Park by taking into consideration the local perspective of stakeholders that are involved in the existence, maintenance and use of the park; and 2) transposing local conflicts resulting from the qualitative data analysis into maps by adopting a land-use cover-type approach and using basic GIS operations. This simple and flexible approach provides a broad overview and visualization of the types and levels of land-use conflicts on the ground. It further allows for upscaling and fine-tuning data upon needs, and availability and accessibility in data, time, and financial and human resources. This approach

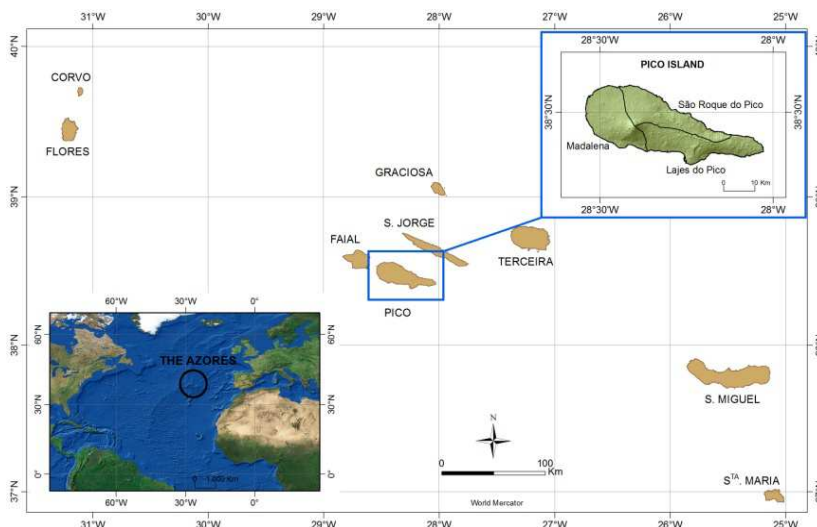
which supports directly the management of internal competitions over land and resources scarcity and indirectly spatial planning policies could be easily adapted to other similar SI contexts.

Study area

Location and geography

The Azores archipelago, an Autonomous region of Portugal, is an Outermost European region located in the North Atlantic about 1500 km from the west coast of the European continent and 4000 km from the North American subcontinent. It consists of nine inhabited islands of volcanic origin, grouped into three geographical clusters (Morton et al., 1998). Pico island belongs to the Central group and it is the second largest island of the archipelago with an area of 447 km² and 152 km of coastline (Figure 1). Its western part is occupied by a homonymous volcano reaching an altitude of 2,351 meters (the highest peak in Portugal) and which gives it the name of “*Mountain Island*” (Calado et al., 2014). This island has a temperate oceanic climate with an annual temperature of 17 degrees at sea level, and high relative humidity and increasing rainfall with altitude (1,500 to 3,000 mm/m²) (Cruz, 2003).

Figure 1: The Azores Archipelago and Pico island.



Pico island has approximately 14,150 residents according to the most recent regional census data taken in 2011 (INE, 2011). Natural areas, pastures and crops dominate the island’s core, while urban areas, harbours and infrastructures are mainly concentrated along the coast. The local economy relies mainly on agriculture. However, ecotourism is a growing sector with Pico mountain being one of its main attractions for both national and international visitors (Bentz et al., 2013). The increase in tourists subsequently led to an establishment of a daily threshold limit (carrying capacity: 160 persons) to control the number of visitors to the peak, particularly during the summer season.

The combining factors of isolation and geophysical characteristics of the island result in a wide diversity of sites and natural habitats of high conservation interests, hosting endemic

habitats (e.g. *Laurifolia* Humid Forest) and species such as *Erica azorica*, *Arceuthobium azoricum* and *Spergularia azorica* (Petit & Prudent, 2008). However, in recent decades the entire Archipelago has suffered from a reduction in the areas of natural vegetation by around 50% as a result of the conversion to pastures (Dias et al., 2005). Pastures and cattle grazing have resulted in serious changes in ecosystems, especially in mountain Azorean habitats, threatening nature conservation (Dias and Melo, 2010). In Pico, animal grazing is not an exception even within PAs, where the conversion of natural areas to other land uses is legally prohibited.

In addition to Pico's rich natural capital, its traditional man-made viticulture heritage, established since the arrival of its first settlers in the 15th century, contributes significantly to the shaping of the island's landscape character (UNESCO, 2004). The viticulture landscape comprises thousands of contiguous and rectangular plots known as *currais* that are separated by walls built of local volcanic rocks (Calado et al., 2016). In 2004, the *Landscape of the Pico island Vineyard Culture* was designated as a UNESCO world heritage site with the goal of protecting the cultural landscape and tackling the issue of vineyard abandonment. The site includes both a relict cultural landscape (areas of abandoned stone-walled enclosures) and a living and working landscape (areas where wine production continues to take place). Most of the deterioration of the abandoned *currais* results from disuse, while certain invasive plants species have colonised many of these enclosures. The integrity of this unique landscape is threatened by the construction and future development of new buildings with poor visual quality standards (UNESCO, 2004).

Protected Areas regional policy and governance

Since the beginning of the nineties, nature conservation in the Azores has changed greatly reflecting the evolution of international and national conservation policies. The first conservation effort in the Azores was the creation of several set-aside reserves to protect nature and forest (the first natural reserve established in the region dates back to 1972) (DL 78/72). Later, there was a first attempt to create a PA regional network as a consequence of the establishment of a PA network at a national level (DL 19/93). Thus, a Regional Decree (DLR 21/93/A) establishing the first PA network joined previously designated forest and natural reserves into a unique network. Then, in 2004, the Natura 2000 sites as well as all the important areas designated by international agreements or conventions were further included (i.e. IBA, Ramsar sites, etc.) (DLR 14/2004/A). Furthermore, ad-hoc legislation was elaborated to protect regional endemic species according to the Bern Convention and the EU-Habitat Directive. Nonetheless, this 'puzzle' of PAs was not meeting its objectives due to the fragmented nature of the designation criteria and objectives, the poor implementation of conservation strategies, and the scarce coordination of multiple authorities in charge of conservation (Calado, 2008; Calado et al., 2009). This led the regional government to design a more coherent network of PAs at a regional scale. Thus, in 2007 a regional legal framework introduced a new PA system which sets the groundwork for PA planning, management and administration (DLR, 2007; DLR, 2012). The most important changes refer to:

- The reclassification of PAs under the same designation and management regime. Since they were previously classified under different initiatives or legislations (e.g. Ramsar Convention, European Union Directives, National and Regional Reserves, etc.),

management criteria and objectives were different and inconsistent. The IUCN categories were adopted (Dudley, 2008)¹, establishing goals for each PA and related human activities;

- The creation and establishment of nine island Parks (one for each small island) and an offshore Marine Park (the Azores Marine Park – from 12 to 200 miles). At the core of the PA network is the concept of island natural park (INP) which integrates terrestrial and coastal (up to 12 miles) PAs of each island. This integration has been considered an innovative strategy for coastal conservation and planning, requiring cohesion between Coastal Management Plans (a key planning instrument for small islands) and INPs (Calado et al., 2009);

A new planning instrument and authority responsible for the management of each Park (hereafter referred to as the Park Authority) were introduced. The INP plan defines the zoning regulations of each PA and integrates the objectives and norms of other relevant plans, while the Park Authority is composed of a management and a consultative board. The former is an executive board formed by a group of selected delegates nominated by the Regional Environmental Authority together with the local authorities, i.e. municipalities. The latter serves as a consultative function and can include regional and local stakeholders, both public and private. Accordingly, the regional conservation policy defined the INP as the main unit for the management of each island and the establishing of the INP plan and the Park Authority as its main management tools (DLR, 2007; DLR, 2012). This new system was anticipated to play a key role not only in protecting nature but in contributing to more effective sustainable management of each island, facilitating the integration of different planning instruments, anticipating conservation-development conflicts and supporting more participatory decision-making (Calado et al., 2009).

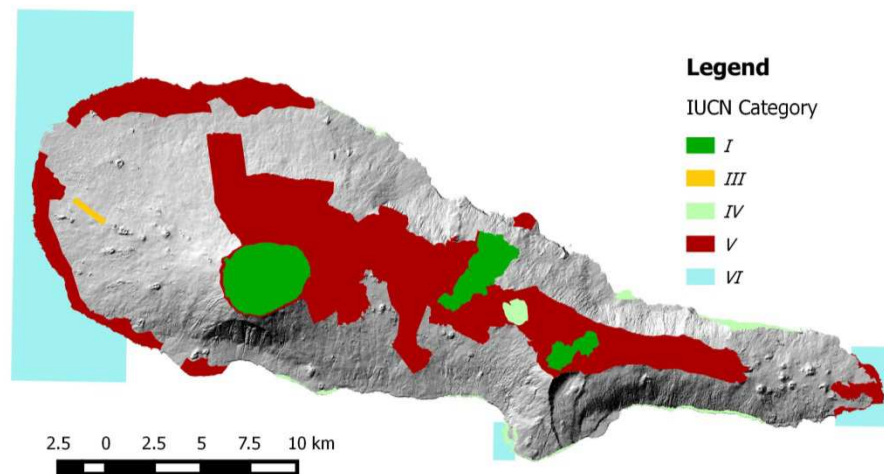
Management of PAs in Pico island

The Pico INP (hereafter also referred to as the Park) was subsequently established in 2008 (DLR 20/2008/A; a year after the approval of the regional PA network in 2007 (DLR 15/2007/A)). Pico INP integrates 22 PAs classified under IUCN categories (Dudley, 2008; [Figure 2](#)). The terrestrial part of the Park covers 35% of the island, which includes the Pico mountain and the central *plateau* with exceptional geological and ecological features, coastal sites important for the conservation of marine birds and the protection of the coastal-water resources, and the UNESCO site (*Landscape of the Pico island Vineyard Culture*). The Landscape of the Pico island Vineyard Culture was established in 2004 due to the unique

¹ The IUCN protected area management categories are a global framework, recognized by the Convention on Biological Diversity, for classifying the variety of PAs into six different management types. Accordingly, PAs are categorized into areas managed mainly for: Strict Protection (categories: Ia) Strict nature reserve, and Ib) Wilderness area); Ecosystem conservation and protection (Category II – i.e., National park); Conservation of natural features (Category III – i.e., Natural monument); Conservation through active management (Category IV – i.e., Habitat/species management area); Landscape/Seascape conservation and recreation (Category V – i.e., Protected landscape/seascape); Sustainable use of natural resources (Category VI – i.e., Managed resource protected area).

landscape, consisting of thousands of small, contiguous, and rectangular plots (*currais*) separated by linear volcanic rocky walls (Calado et al., 2016). It covers about 30% of the coastal zone and has been included into the INP under IUCN category V: protected landscapes/seascapes.

Figure 2: The Pico INP classified using IUCN category.



The reclassification of PAs consistently defined goals and management objectives for each PA. For example, more than 5% of the island was classified as Strict Reserve (IUCN category I) in which human activities are restricted and no human intervention is permitted, and about 28% of the island was classified as Protected Landscape (IUCN category V) in which a high level of interaction with human activities is allowed and promoted to maintain or restore traditional management practices along with the natural systems with which they co-exist.

At the time of this research, the Pico INP has been formally established, while the PA management plan has not yet been elaborated. Planning instruments with significant influence on island biodiversity conservation and guidelines for protecting the island landscapes, habitats and species need to be taken into consideration during the development of the plan. Amongst these instruments, the most relevant include: 1) the regional plan of watershed lagoons (POBHL, 2009) which aims to preserve the lagoons and water resources located in the core of the Azores islands. It establishes specific guidelines for the management of the five major lagoons located in the core of Pico island; 2) the regional plan of the Natura 2000 network (PRN2000, 2004) defining the scope and objectives for conserving the Natura 2000 network at a regional scale; 3) the UNESCO management plan (POPPVIP, 2006) which aims at preserving the cultural landscape of the World Heritage Site located in the coastal area (circa 3,000 ha); and 4) a set of national decrees concerning the protection of habitats and species, reflecting the transposition of the *Convention on the Conservation of European Wildlife and Natural Habitats* (Bern Convention) and the *EU Habitat Directive* into a national scale (DL n.316/89; DL n.140/99). Both instruments regulate the management of species including *Erica azorica* or *Urze*, establishing that harvesting, collecting or cutting them as well as harming their habitats is only allowed with a license. About 10% of the island is covered by this species (mainly in PAs located in the central plateau). This significant

percentage reflects the importance of considering these regulations as likely drivers of conservation-development conflicts.

Methods and Results

To understand local conflicts and delineate conflicting areas, this work integrates both qualitative data and spatially explicit information. The analysis includes two phases: Phase 1 involves conducting a stakeholder analysis and identifying the perception of stakeholders towards the park, while Phase 2 focuses on translating the qualitative outcomes into spatial representation through the mapping of conflicting areas.

Stakeholder analysis

Local conflicts related to Pico INP were determined through a stakeholder analysis and a set of semi-structured interviews with key actors. In our work, stakeholder analysis was mainly used to explore the attitude towards the park and identify potentially conflicting interests and/or alliances among stakeholders. The analysis included:

- Identification of key actors. By “key actors”, we refer to private or public organizations that may influence or may be affected by the decisions associated with the creation and management of INP. A first list of key actors was extracted from the yellow pages of Pico island, by selecting all public and private governmental and non-governmental organizations and/or associations having headquarters on the island. Then, stakeholders were selected based on three main criteria: legal nature (private and public), sector of interest (primary, secondary and tertiary) and area of action (land-use planning and management, nature conservation, business and economy, leisure and recreation, communication). Except for the tourism sector, we only considered *leaders* or *heads*, meaning people representing groups of individuals or members (i.e. heads of NGOs, leaders of associations, etc.). Among the governmental bodies, we included the 3 island municipalities and the Park Authority. From the non-governmental sector, we selected 3 environmental NGOs with headquarters on Pico island, and 9 local associations representing primary and secondary economic sectors (artisanal fishery, agriculture, dairy, wine production, and construction). In the absence of associations representing the interests of the tourism sector, we selected 9 micro enterprises (i.e. hotels, tourism entertainment, nautical sports, etc.). Additionally, we identified 3 associations related to tourism and recreation (i.e. tourist guides, recreational fishery and hunting, taxi-drivers). Finally, we selected 5 local media (radio and newspapers) as actors representing the communication sector.
- Classification of actors. They were classified into four broader groups, namely: local authorities, Park authority, economic sectors and non-governmental organizations/associations. This was done by assessing their importance and influence (Table 1). Influence reflects the power that a stakeholder has over the INP and the control of strategic resources (e.g. land), by influencing decision-making processes, whereas by “importance”, we refer to the degree to which achievement of conservation objectives depends on the involvement of a given stakeholder group (Rietbergen-McCracken & Narayan, 1998).

Table 1: Classification of stakeholders.

Group	Influence and importance
Park Authority (S1)	The actor with the greatest decision-making power with respect to nature conservation issues and Park management. However, since this authority has been recently introduced by the regional conservation policy, it can be largely exposed to the influence of those actors with longer decision-making power within the island, i.e. local authorities and powerful economic sectors.
Local authorities (S2-S4)	These represent the three municipalities of the island. Local governments play a strategic role in the Azores, being responsible for spatial planning and having leverage over most of land-use decisions. Moreover, they directly concur to the definition of several members of the Park Authority. Thus, understanding their influence on the Park (and Park Authority) is crucial for the long-term conservation of the island and the archipelago.
Local economy (S5-S14)	Representing the main economic sectors (wine and livestock farmers, dairy industry, traditional fishery, hotels, tour operators and tourist guides). Although this group of actors does not have a direct influence on the Park's decisions, their interaction with natural resources and landscape has results of great importance for Park management. The primary sector by definition makes direct use of natural resources, which frequently compete with conservation initiatives and PAs. This is particularly true for small island terrestrial PAs, considering their limited land. The secondary sector in Pico island mainly relies on the transformation of primary products, generating food (e.g. meat and cheese) and wine and potentially exerting an increasing demand of land for production. The tourism sector strongly depends on nature conservation as ecotourism represents one of the major businesses for the island (e.g. whale-watching, climbing, etc.).
Non-governmental organizations and associations (S15-S19)	These are public organizations and associations actively engaged in leisure, cultural and environmental issues, including their dissemination by the media. They are crucial mediators between the Park and local people, influencing the perception and interests of the public.

- Semi-structured interviews with key actors. The leaders or heads of the 33 determined organizations/associations were invited to participate in a semi-structured interview as representative stakeholders of their organization/association (e.g. Mayor of a municipality, CEO of an organization). An invitation was first sent by e-mail explaining the objective of the research, followed by a meeting with all available leaders and individuals (19 actors responded and were available to participate in this process, see Appendix I for a detailed list and classification). To maintain a neutral position yet with first-hand understanding of Pico SI, one of the authors, highly skilled and with extensive experience in qualitative social survey, was selected as the facilitator to conduct the interviews. Therefore, 19 face-to-face semi-structured interviews were separately administered with each selected and available stakeholder in July 2011. The interviews were guided by a framework including open-ended

questions asking interviewees to: (i) provide a general opinion about the INP and its boundaries; (ii) list park-related benefits and costs; and (iii) portray park-related needs.

Stakeholders' Perspective

The results of interviews were collected, transcribed and analyzed through qualitative content analysis based on Bardin (1977). Accordingly, three matrices were built to support the analysis of the stakeholders' perception: needs vs. actors, benefits vs. actors, and constraints vs. actors. Perception refers to park-related needs, benefits and costs as mentioned by each stakeholder. The results are summarized in [Table 2](#).

The outcomes reflected two main positions towards the Park, namely actors with negative and positive attitudes. The negative attitudes mainly pertain to the Park size (N1 – *reshaping PA boundaries*) and restrictions on the local economy (N2 and N3 – *need more flexible measures for ecotourism development; C9 – the Park constraints the development of ecotourism and related infrastructures*). Actors with a more positive attitude indicate that the Park should be primarily a way of protecting nature and natural resources (N5, N6 and N7 – *need to protect nature and better cope with human-conservation conflicts; B1 – the Park contributes to conservation*).

By relating the responses to stakeholders' categories (see [Table 1](#)), it can be highlighted that reshaping the Park boundaries for economic purposes (N1) is the need mainly cited by actors representing local authorities (S2, S3) and the local economy (S8, S9, S10, S14). Local authorities (S2, S3, S4) revealed an unfavourable position towards the Park, pointing out that it does not provide any benefits, at least not at the local scale (B5). On the contrary, economic and social actors recognised several Park-related benefits including supporting tourism development (B2) and preserving natural resources (B1). However, actors representing the local economy viewed the Park as a source of restrictions for the viability of their activities, mainly those related to ecotourism development (C8 and C9) and other specific aspects (C11). The most cited constraints associated to the Park were the limitations on pasture enlargement (C4) and the excessiveness of both building restrictions (C9) and species protection (C6). Nonetheless, the Park Authority (S1) stressed the need to ban the enlargement of grazing areas for protecting the island's biodiversity (N5).

Table 2: Needs, benefits and costs related to Pico INP as perceived by stakeholders.

ID	Needs	Stakeholders
N1	Reshaping PA boundaries. It refers to downsizing as several actors explicitly express the need to downsize PAs for economic purposes. Some of them further suggest finding a trade-off mechanism to permute pastures which are now under protection with other contiguous non-protected areas with a smaller economic value, avoiding downsizing PAs.	S2, S3, S8, S9, S10, S14, S17
N2	Redefining the carrying capacity of trails	S11, S5, S15
N3	Increasing urban capacity within the UNESCO site	S8, S10, S14
N4	Supporting the development of tourism (hotels, shops, etc.)	S6, S5, S14
N5	Banning the enlargement of grazing areas	S1, S15
N6	Coping with conservation-development conflicts	S10, S18, S19
N7	Preserving biodiversity	S1, S5, S13, S15
N8	Strengthening public participation	S19
N9	Others (e.g. supporting wine production, providing fresh water, establishing a monitoring plan, etc.)	S2, S3, S4, S10, S12, S16, S18
N10	None	S7
ID	Benefits	
B1	Conservation of natural resources	S5, S6, S11, S12, S18, S19
B2	Support for (eco)tourism development	S1, S5, S6, S11, S12, S13, S15, S16, S18, S19
B3	Improvement and enhancement of the island's image	S1, S5, S8, S16, S17
B4	Others (e.g. banning dangerous human activities, preserving landscape, etc.)	S1, S8, S15, S18
B5	None	S2, S3, S4, S7, S9, S10, S14
ID	Constraints	
C1	Excess of protected land	S6, S17
C2	Restrictions to local economy	S2, S3, S8, S9, S16, S19
C3	Loss of incomes	S9, S10
C4	Limitations on the enlargement of grazing	S2, S3, S4
C5	Ineffective management of PAs (scarce surveillance, poor organization and administration, lack of infrastructures, etc.)	S5, S13, S14
C6	Excess of species protection (e.g. <i>Urze</i>)	S1, S3, S8, S10, S17
C7	Increase of bureaucracy	S5, S18
C8	Limited exploitation of the mountain	S5
C9	Excess of building restrictions within the UNESCO site	S2, S6, S10, S13, S14, S19
C10	Scarce involvement of local people (creation and management of the Park)	S10, S18
C11	Others (e.g. hunting restrictions, lack of awareness, etc.)	S9, S10, S16
C12	None	S11, S12, S15

Mapping conflicting zones

To generate the map of conflicts, we converted qualitative information obtained from the semi-structured interviews into spatial data. The outcomes of the qualitative analysis were primarily used to: (i) identify the most conflicting zones of the island (zones where conflicts in PAs are occurring or more likely to emerge), and (ii) scope the type and level of conflicts. Then, (iii) conflicts were mapped starting from three main data sources: an existing Land Use Cover map (LUC) of Pico; a simplified model of volcanic SIs applied to Pico; and the parks' boundaries.

Identify conflicts

According to the stakeholders' perception, PA-related conflicts were mainly concentrated in two areas: the *core area* (central plateau and mountain peak) and the *coastal zone* (primarily the UNESCO site). Local conflicts identified in the core area were mainly associated with tourism activities on Pico mountain, pasture encroachment and enlargement, and water resources. There was an explicit interest of several stakeholders in increasing the carrying capacity at Pico mountain for recreational and tourism activities, i.e. attracting tourists all year round and enlarging the trail capacity and network. However, this may have a significant impact on future preservation of the nature reserve as the peak is the only place within the archipelago that hosts alpine and sub-alpine habitats.

There was also a demand to enlarge pastures for agriculture and livestock activities and a positive attitude towards other land-use changes such as the conversion of natural or semi-natural areas into non-natural forest. However, this may increase pressure on protected habitats located in the central plateau that are of great value to nature and biodiversity conservation. The conversion of high natural areas, i.e. wetlands, peat lands and grasslands into pastures is also in conflict with the objectives of the PRN2000, POBHL and national decrees that aim to protect species and habitats (see above). Nonetheless, the expansion of pastures together with the loss of incomes from agriculture and livestock keeping were unsurprisingly among the most cited constraints by those actors representing the local economy.

Of grave cumulative consequences, the multiple uses of water resources, such as for animals, farming and energy production are contributing to water quality deterioration. Although several measures were implemented to mitigate both water resources conflicts and water quality impacts, namely conversion of pastures into semi-natural areas and alternative basins for animal watering outside of the watersheds, conflicts may still escalate due to future pressure on both water and land.

Conflicting areas pointed out along the coast were concentrated mainly within the UNESCO site. In particular, land-use conflicts in this area may greatly increase due to stakeholders' negative attitudes towards building restrictions. For example, a respondent representing wine farmers expressed discontent with the park as the imposed building restrictions hampered the enlargement of certain infrastructures supporting traditional wine production, e.g. wineries, warehouses and manor houses. Similarly, the tour operators demanded less building restrictions in rural areas to ensure better ecotourism facilities. Within the site, an additional conflict associated with the development of wine-related activities emerged. Yet, developing the vineyards is essential in maintaining the nominated status of the

site even though the perceived benefits for farmers of conserving vineyards seemed to be restricted only to their economic profit.

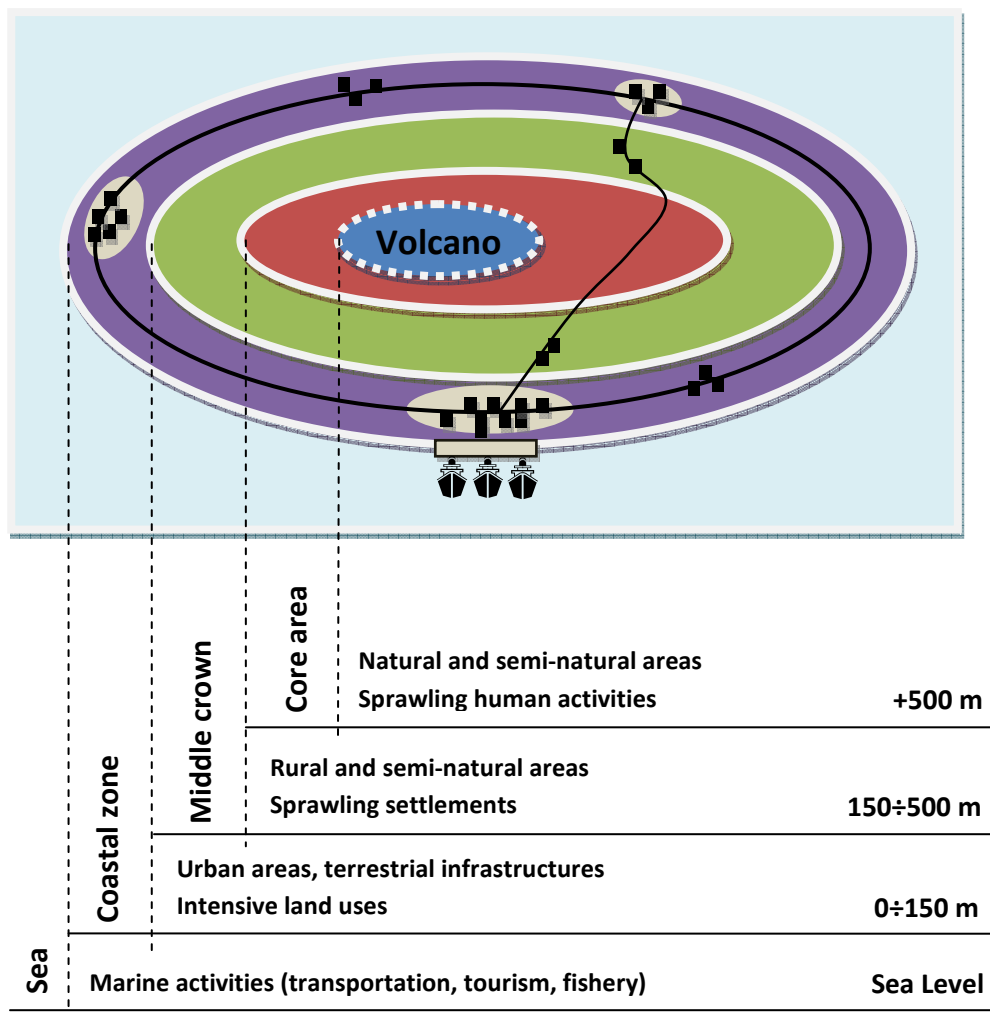
The cultural landscape was also in conflict with nature conservation due to the presence of several protected and non-protected species. Such species (e.g. *Urze*, Azores woodpigeons, blackbirds, etc.) were frequently mentioned as pests by wine farmers due to the damage they cause to their vineyards. The restriction on hunting, together with the conservation status assigned to several species (e.g. *Urze*), were further augmenting this conflict. For instance, cutting *Urze* in traditional vineyards is allowed with a license, but the application process for the license was perceived bureaucratically complicated, hence encouraging wine farmers to adopt illegal behaviours. Furthermore, the abandonment of viticulture practices frequently resulted in non-productive vineyards that were colonised by different ecological communities with high level of biodiversity and presence of both endemic, e.g. *Spergularia azorica*, *Azorina vidalii* and *Erica azorica*, and invasive plant species, e.g. *Pittosporum undulatum*. The multiple objectives of the UNESCO plan are further exacerbating these conflicts.

The simplified model of SIs

A simplified model describing the spatial distribution of natural resources, human settlements and activities in volcanic SIs in relation to topography and altimetry was developed. It is based on the fact that most volcanic islands are characterized by an elevation profile and the spatial pattern of the landscape is strongly shaped by its volcanic origin (Pernetta and Manner, 1994; Aretano et al., 2013). In this context, natural factors generate a complex mosaic of ecosystems and shape the distribution of human activities with a recognizable elevation concentric spatial pattern ([Figure 3](#)). Generally speaking, settlements and more intensive land uses are mainly concentrated in flat coastal zones (up to 150 m above sea level) and are usually interconnected by a main circular road. Conversely, extensive land uses (e.g. natural and semi-natural areas) tend to increase with distance from the coast and, eventually, with elevation, thereby dominating the landscape of the core area. The middle crown zone can be defined as a transition ring between the coastal zone and the core area where human settlements are generally more sprawling and land uses are predominantly rural.

Using GIS operations and freely available spatial data, this simplified model was adapted and applied to Pico island in order to support the identification of those rings where conflicts are predominantly occurring or likely to occur, namely the core area and coastal zone. The input data for elaborating it included: the Digital Elevation Model (DEM); the main road network and aerial imagery of Pico island. Firstly, the DEM was sliced obtaining four elevation classes. Then, a shape file for each class was built, obtaining four rings. Finally, each ring was overlaid with both the main road network and aerial imagery in order to validate shape and boundaries. This was done manually in GIS, by altering the boundaries of the rings according to landscape features. For example, the main circular road was entirely included inside the coastal zone even though in some sectors of the island the elevation was more than 150m above the sea level.

Figure 3: The simplified model of volcanic SIs.



The conversion of the LUC map into a map of conflicts

The map of conflicts was built starting from three main data sources:

- the LUC map of Pico derived from aerial imagery and developed by the University of the Azores within the *Smartparks* project (Moreira, 2013; Fernandes et al., 2014);
- the SMP described in [Figure 3](#) which sorts the island into four rings according to the main landscape features;
- the map of PAs distinguishing between protected and non-protected land.

The LUC map was reclassified, by assigning alternative conflict levels to different LUC categories. However, in order to arrive at this outcome, two preliminary steps were required. Firstly, the original LUC classes were reduced from 17 to 12 LUC categories, by aggregating those land covers with similar features or uses. For example, urban areas and roads were aggregated into “artificial surfaces” as well as areas predominantly covered (more than 80%) by *Erica azorica* or *Myrica faia* being aggregated into “natural areas with significant presence of endemic species”.

Subsequently, a set of spatial conditions were defined based on two criteria: (i) whether the area was located in those rings of the island the conflicts were mostly in place (or were likely to occur) (i.e. core area and coastal zone); and (ii) whether or not the land was under protection (inside or outside of PAs). Operationally, the LUC map was firstly overlaid and masked with both the SMP and the map of PAs and then reclassified. The reclassification followed a land-use cover type approach. This meant that different levels of conflict were assigned to LUC categories under different spatial conditions. This was achieved through GIS by establishing Boolean conditions (i.e. choice between two spatial alternatives – e.g. whether inside or outside the Park) allowing LUC categories to be reclassified (cf. Bragagnolo & Geneletti, 2014).

Three levels of conflict were defined: potential, high and moderate. To illustrate, due to the current encroachment of pastures into natural areas induced by agriculture and livestock activities, the *highest level of conflict* in the core area was assigned to pastures located within PAs and natural areas outside the Park, whereas pastures outside the park were associated with a *moderate conflict level* due to their likely effects on biodiversity and water resources. Considering the uncertain effectiveness of conservation instruments, natural protected land located in the core area was identified and mapped as zone of *potential conflict* due to the uncertainty of the implementation of appropriate conservation instruments aiming at containing the encroachment of pasture in PAs. A high level of conflict was associated with natural areas located outside the park resulting from an expected greater pressure from grazing due to direct consequence of restrictions within the Park's boundaries. The mountain peak was classified as a zone of potential conflict level since the increase of tourism could impact the future preservation of the Mountain Reserve (Table 3). The results are visually presented in Figure 4.

Figure 4: Local conflicts in the core area (top) and coastal zone (bottom) – scale 1:100,000.

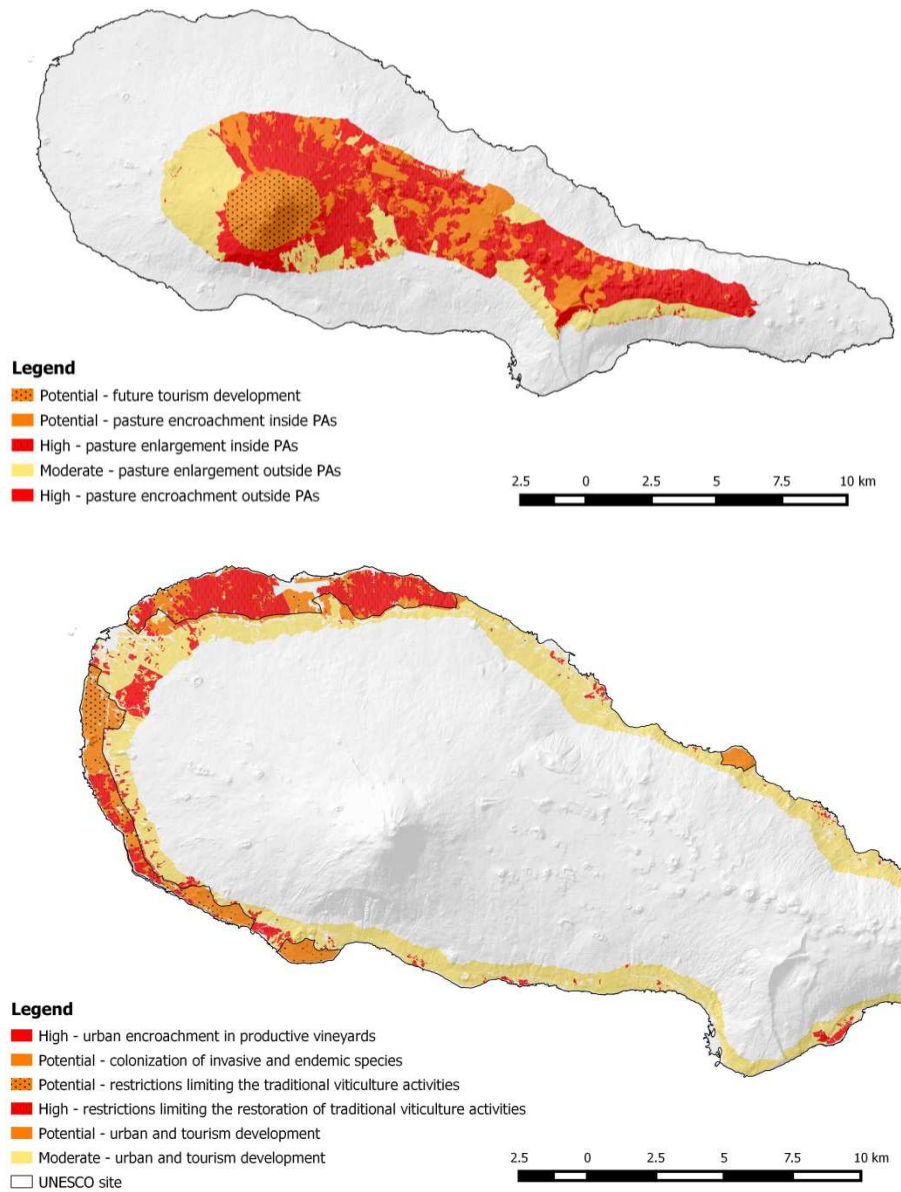


Table 3: Criteria used to map local conflicts.

LUC categories	Spatial conditions	Outcomes of qualitative analysis	Type of conflict	Level of conflict	Area** (%)
Pastures	Core area - inside the Park	<ul style="list-style-type: none"> ▪ explicit demand to enlarge pastures and altering PA boundaries ▪ pressure on protected habitats with a great biodiversity value (e.g. IUCN category I) ▪ pressure on water resources ▪ conflicting objectives with conservation instruments (IUCN category I, PN2000, POBHL) ▪ uncertainty of conservation instruments ▪ perception of loss of incomes from agriculture/livestock and related activities ▪ restrictions to local economy 	pasture enlargement inside PAs	<p>High</p> <p>The conflict was classified as high since grazing is not allowed in most of PAs located in core area (e.g. IUCN category I). Pastures inside the park could also contribute to the degradation of protected resources (i.e. land and water) and despite several initiatives being implemented to mitigate land and water quality impacts, conflicts may still escalate due to the poor implementation and enforcement of conservation measures.</p>	40.7
	Core area - outside the Park	<ul style="list-style-type: none"> ▪ pressure on habitats, species and water resources ▪ provision of employment and incomes from agriculture/livestock and related activities 	pasture enlargement outside PAs	<p>Moderate</p> <p>The conflict was classified as moderate since grazing occurs in areas where the activity is allowed. However, it could intensify, increasing land-use pressures around PAs.</p>	24.4
Natural areas*	Core area - inside the Park	<ul style="list-style-type: none"> ▪ positive attitude towards the conversion of natural or semi-natural areas into non-natural areas ▪ protected habitats and endemic species with a great biodiversity ▪ uncertainty of conservation instruments ▪ loss of incomes from agriculture/livestock and related activities ▪ restrictions to local economy 	pasture encroachment inside PAs	<p>Potential</p> <p>The conflict was classified as potential due to the degree of uncertainty related to the implementation of appropriate conservation instruments aiming at containing the encroachment of pasture in PAs.</p>	19.0

	Core area - outside the Park	<ul style="list-style-type: none"> ▪ positive attitude towards the conversion of natural or semi-natural areas into non-natural areas ▪ landscape connectivity and buffer zones ▪ loss of incomes from agriculture/livestock and related activities ▪ lack of regulatory and planning instruments 	pasture encroachment outside PAs	<p>High</p> <p>The conflict was classified as high since outside the park there is a lack of regulatory and planning instruments to control the encroachment of pasture in natural areas. And this could be further exacerbated considering the support of people for the conversion of these areas.</p>	6.0
Bare rocks and soil	Core area - inside the Mountain Reserve	<ul style="list-style-type: none"> ▪ demand for increasing the carrying capacity of the mountain peak for recreation ▪ presence of alpine and sub-alpine habitats ▪ ineffective management of the Mountain Reserve 	future development of tourism	<p>Potential</p> <p>The conflict was classified as potential since the future consequences of tourism development on mountain ecosystems are uncertain and depend on future decisions (e.g. whether the carrying capacity will be augmented)</p>	9.8
Vineyards (productive)	Coastal zone - inside the UNESCO site	<ul style="list-style-type: none"> ▪ protected and non-protected plants and animals considered pests by farmers ▪ multiple objectives of UNESCO plan ▪ negative perspective associated with building restrictions ▪ provision of employment and incomes 	restrictions limiting the traditional viticulture activities in productive vineyards (building, conservation of protected species, etc.)	<p>Potential</p> <p>The conflict was classified as potential since only if the grape production continues to take place can the vineyard cultural landscape be preserved. However, since the main purpose of the UNESCO site is preserving the vineyard cultural landscape, the mitigation/resolution of conflicts greatly depends on future decisions (e.g. incentives and subsidies for wine production, etc.)</p>	12.3
	Coastal zone - outside the UNESCO site	<ul style="list-style-type: none"> ▪ protected and non-protected plants and animals in vineyards ▪ preservation of cultural landscape ▪ provision of employment and incomes ▪ urban pressure 	urban encroachment in productive vineyards outside the UNESCO site	<p>High</p> <p>The conflict was classified as high since outside the UNESCO site the chance of maintaining the vineyards productive is lower due to the greater urban pressure resulting from less strict building restrictions and the absence of clear initiatives supporting wine production. Thus, these areas can also be more prone to the abandonment.</p>	7.1
Abandoned	Coastal zone -	<ul style="list-style-type: none"> ▪ presence of protected endemic 	restrictions limiting	<p>High</p>	13.2

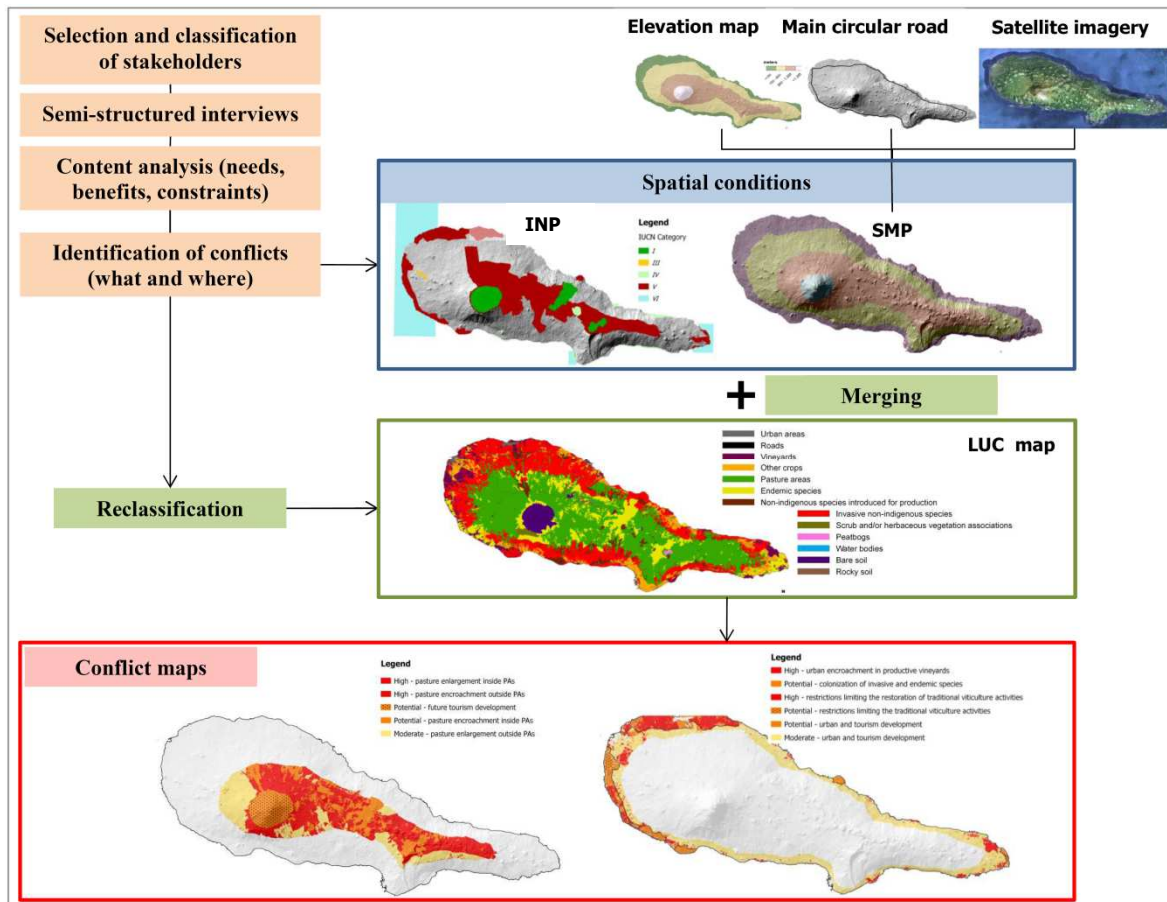
Understanding and mapping local conflicts related to protected areas in small islands

vineyards	inside the UNESCO site	<p>species</p> <ul style="list-style-type: none"> ▪ multiple objectives of the UNESCO plan ▪ negative perspective associated with building restrictions 	the restoration of traditional viticulture activities in abandoned vineyards (building, conservation of protected species, etc.)	The conflict was classified as high due to the explicit conflict between the objectives of conservation instruments (protection of endemic species vs. preservation of cultural landscape).	
	Coastal zone - outside the UNESCO site	<ul style="list-style-type: none"> ▪ presence of protected endemic species ▪ preservation of cultural landscape ▪ urban and tourism pressure 	colonization of invasive and endemic species in abandoned vineyards	Potential The conflict was classified as potential since the management of invasive and endemic species outside the park mainly depend on future decisions, e.g. prioritizing restoration of cultural landscape, eradicating invasive species, protecting endemic species, etc.	1.7
Semi-natural areas, crops and pastures	Coastal zone - inside the UNESCO site	<ul style="list-style-type: none"> ▪ negative perspective associated with building restrictions ▪ presence of both endemic and invasive species ▪ urban and tourism pressure 	urban and tourism development inside the UNESCO site	Potential The conflict was classified as potential since, although urban and tourism development inside the park is restricted, building regulations could be altered due to future pressures of powerful sectors (e.g. tourism enterprises) and administrations (e.g. local municipalities).	6.4
	Coastal zone - outside the UNESCO site	<ul style="list-style-type: none"> ▪ presence of both endemic and invasive species ▪ preservation of cultural landscape ▪ urban and tourism pressure 	urban and tourism development outside the UNESCO site	Moderate The conflict was classified as moderate since, although building restrictions outside the park are less strict, urban development is already regulated by municipal spatial plans.	54.6

* Natural areas include forests, natural areas with significant presence of endemic species, scrub and/or herbaceous vegetation, peat bogs, bare rocks, bodies of water.

** Percentage of area within each ring area (i.e. core area ring and coastal zone ring).

Figure 5: Methodology applied to map conflicts in Pico.



Discussion

This case study demonstrated how a common LUC map can be used to obtain a map of land-use conflicts in PAs. This was done by integrating social data obtained from semi-structured interviews with key stakeholders into a spatially explicit approach, delineating the patterns of landscape features and analyzing land and resource uses that connect conflicting human activities to that particular landscape and land use. The identification and visualization of conflicting zones can support spatial planning policies and conservation initiatives, especially in SI contexts where land-use conflicts can escalate due to resource scarcity.

Methodological limitations and biases

The novel application of the land use cover-type method for mapping land-use conflicts in SIs operationalizes a human ecology mapping approach integrating social data into conservation planning (McLain, et al., 2013). However, there are several limitations in our method.

Apart from the recognized limitations associated with using qualitative methods (Newing, 2011), our stakeholder analysis suffered from:

- the limited number of actors. Although our final list included 33 stakeholders, only 19 were available to participate in our interview at the time of the research. Consequently, there may be a bias in our results due to a lack of representativeness of stakeholders, reflecting a lack of perspective from e.g. construction stakeholders;
- the homogeneity of interests and priorities assumed in selecting stakeholders. Our selection assumed that *leaders* and *heads* represented the interests of a group of members (or affiliates – e.g. the association of farmers represents more than 300 members – however, this is not always the case as role-based stakeholder group members have different priorities (Wolfe & Puter, 2002);
- the limited exploration of stakeholder inter-relationships. For instance, the analysis showed that reshaping the Park's boundaries was a need mainly declared by stakeholders representing local authorities and economy. This suggests that a potential alliance against the Park might be established between these two social groups unless the values of the INP are well understood, perceived and shared. One of the methods to better unfold indirect relations would be to build a map of stakeholder interactions (see Rastogi et al., 2010).

Additionally, the main weaknesses related to our method for mapping conflicts rely on:

- data availability. As with most spatially explicit approaches, our method depends on the availability of GIS-based data (Van Loenen & Onsrud, 2004);
- the consideration of predefined rigid boundaries. By adopting a land-use cover type approach, boundaries of conflicting areas were mostly traced based on landscape and land-use features, disregarding important non-spatial aspects connecting humans to landscapes (social relationships, local identity, etc.) which may influence land-use preferences and values and, thereby, drive land-use conflicts.
- limited spatial conditions. To simplify the complexity of land-use conflicts, our method only considers island rings and PA boundaries as conditions that determined the spatial distribution of land-use conflicts. In this way, we may disregard other key factors which may conflict with conservation biodiversity on the ground – e.g. land tenure and land-use rights (Phalan et al., 2011). According to Hausner et al (2015), considering land use tenure is essential for understanding conservation and the potential for land use conflict;
- subjectivity affecting the definition of the conflict levels. In our work, conflict levels were established through a qualitative analysis which exposes the method to great subjectivity.

Implications of results for local land-use management

Key stakeholders were identified with input from local institutions based on their influence on PAs. The results of the semi-structured interviews provided insights regarding possible local conflicts occurring due to the establishment of the Pico INP. In general, the majority of the respondents attached a more anthropocentric value to the Park, either viewing it as a support or constraint to economic development and activities. When these results were transposed into visual maps, the spatial pattern reflects different levels of local conflicts concentrated mainly in the core area and in the UNESCO site (see [Figure 4](#)).

Despite the challenge of conciliating nature conservation with landscape protection, preserving traditional landscape is vital for coping with local conflicts within the UNESCO area due to its identity value. This is not to down-play the role of SIs in preserving exceptional biodiversity (Rietbergen et al., 2007). On the contrary, developing tailored mechanisms for *in situ* biodiversity conservation is considered a key priority for preserving agricultural landscapes.

To resolve conflicts associated with building restrictions, the authors suggest a greater integration between conservation and land-use planning both inside and outside the park's boundaries. To this end, the Park Authority can play a crucial role, supporting the resolution of conflicts related to the overlapping of planning and management instruments. As elaborated by von Haaren (2002), a more flexible approach to landscape planning needs to be adopted to mitigate conflicts. Future work may include a land-use based analysis to identify, for example, vineyard plots that have been replaced by endemic and protected species. Additionally, vineyard damage should be monitored in order to assess the extent to which protected species are conflicting with the viability of viticulture and vineyard landscape conservation. This could allow restoration and conservation priorities to be defined together with key stakeholders, i.e. the Park, land owners and farmers. Following Lagabrielle et al's (2011) work, a planning protocol to assess future land-use allocations that combine both biodiversity and socioeconomic criteria is also necessary as part of future work. This would be a valuable approach for prioritising sites for conservation, restoration or transformation of land in an SI context.

Although not raised as a major issue during this analysis, the issues of land tenure and land use rights deserve greater attention within the UNESCO site. It is crucial to find financial mechanisms that could meet the needs of landowners who are not interested in vineyard maintenance and potential landless viticulturists such as young farmers, as well as compensating owners whose land has biodiversity conservation potential, e.g. vineyards colonized by endemic species with a great biodiversity value (Pascual & Perrings, 2007).

In the core area, the results highlighted that the main conflict associated with PAs revolves around the encroachment of pastures into natural areas. Stakeholders representing the local economy and authorities held the Park responsible for the reduction of areas suitable for livestock grazing that consequently constrained local development in farming, livestock keeping and the dairy industry.

To resolve this major conflict, the authors suggest exploring alternative measures to cope with invasive species inside and outside the Park in order to gain pasture or natural areas, e.g. restoration and energy generation from wood biomass (Lourenço et al., 2011). They also recommend implementing measures proposed in the watershed lagoons regional plan for controlling the eutrophication process of lakes such as restoration of grassland surrounding the watersheds and allocation of water tanks for livestock outside of the watersheds. It is also important to adopt a strategic approach, by proactively assessing and monitoring the environmental consequences of different management options such as biodiversity loss, risk of erosion and eutrophication. Nevertheless, halting the encroachment of pasture into natural areas ultimately requires the consensus of key stakeholders. In line with research from van de Velde et al. (2007), the authors noted that the greater degree of social homogeneity and cohesion in SI is an encouraging starting point for increasing the cooperation of different social groups.

Minor conflicts on tourism-related issues also emerged from this analysis such as scarce services and limited access to the mountain, and excessive restrictions on ecotourism development. With the increasingly growing tourism sector, these issues need to be attended to in order to avoid intensification of future impacts and conflicts.

Lessons learnt and challenges on PA conflict mapping for SIs

This research contributes to the transposition of conflicts described by stakeholder discourse into a spatially explicit tool that can help conflict identification and further work on conflict resolution. Through analyzing local conflicts related to PAs on Pico island, we provided a first approach to mitigating conservation-development conflicts in SIs, by showing how limited resources together with restrictions associated with nature conservation may increase the emergence of social tensions and provide a first approach to visualize where stakeholder perceptions are most likely to come into dispute. The work provided some useful insights for advancing PA conflict mapping in SIs.

Firstly, we demonstrated how a common LUC map can be used to generate a map of land-use conflicts in PAs. This is particularly noteworthy for the SI context, considering their limited human and financial resources (Calado et al., 2007), as this approach does not require advanced skills and expertise in comparison to other more sophisticated and expensive approaches used to map and model land-use changes and conflicts (Barnaud et al., 2013). The method may also represent an important communication tool and can be used as a springboard for participatory mapping and scenario exercises, guiding strategic decision-making towards the sustainable future development, an important prerequisite for facing challenging development problems in SIs (Stratigea & Katsoni, 2015). The map of conflicts can also be improved, by combining the method with MCA, including additional spatial criteria (e.g. land use tenure) and performing a more robust ranking of conflict levels using different land-use preferences (or weights) of multiple stakeholders (Iojă et al., 2014). Finally, the map can be validated with different stakeholders (e.g. citizens) by using interactive tools (e.g. touch screen interface) allowing boundaries to be changed and levels of conflict to be altered. Alternatively, a new land-use conflicts map can be elaborated starting from a topographic map, by organizing participatory workshops with stakeholders and applying drawing interactive tools (Arciniegas & Janssen, 2012). The result can be overlaid and compared with our original map.

Secondly, our method showed how the LUC map derived from aerial imagery provided an efficient and low-cost tool to perform a preliminary analysis of biodiversity patterns at an island scale. According to Lagabrielle et al (2011), a basic habitat patterns map is essential for supporting conservation in insular regions by providing a prompt way of representing biodiversity at an island scale before gathering additional costly biological data. However, even when a fine-scale LUC map/landscape map is not available at an island scale, the method could also work using coarse-scale maps with less detail to obtain a more general map of conflicts. Conversely, this method also allows for up-scaling depending on local specificities and capabilities temporally and spatially, e.g. more refined LUC map as it becomes available, inclusion of more details based on on-site reconnaissance.

As shown in the Pico case study, conciliating biodiversity and landscape conservation is very challenging. The decision to include the UNESCO site in the INP has escalated disparity among local stakeholders, compromising their perception of the original purpose of the site and exacerbating asymmetries among stakeholder positions. Pico island is shown to be an

emblematic SI by observing local stakeholder perspectives towards nature conservation and landscape protection. Considering the unique characteristics of the Pico landscape, its UNESCO status plays a key role in building local identity and cohesion, and correspondingly reducing local conflicts in PAs. Thus, when PAs with conflicting objectives are integrated into the same management system, e.g. different IUCN categories, a more flexible governance framework should be considered for each type of PA such as co-management or government management. In place of risking the implementation failure of the conservation policy, this could be a good starting point for implementing a more adaptive approach to conservation.

Findings from this study underlined several key challenges for dealing with local conflicts in PAs. Of significance, the results demonstrated how conservation policies established at a broader scale may generate or increase social tensions when implemented at a local level, thereby limiting the achievement of global conservation goals. As the case study revealed, despite the new conservation policy having received a broad consensus at regional level (the protection of natural resources is considered a key priority for the sustainable development of the Azores archipelago), its implementation at a local scale encountered conflicting positions gaining unexpected resistance. The need to harmonize conservation policies with multiple scales governance is very important for SIs (Aretano et al., 2013). Consequently, the authors generally recommend PA managers to disseminate and communicate effectively both their rationale and objectives prior to implementing any changes such as reclassification of PAs and restructuring of PA staff or authorities. This is an essential prerequisite for achieving a better alignment between PAs' goals and people's values which is a proactive form of minimising social conflicts. One way of fostering a favourable perception towards the Park is: to establish incentive measures for conservation such as encouraging park visitors to pay user fees (Steckenreuter & Wolf, 2013), implementation of socially inclusive programs for residents (Pretty & Smith, 2004) as well as development of tailored educational awareness programmes.

Conclusion

This case study presented a cost-effective and simple approach for translating qualitative local conflicts into visually representative spatial maps within an SI context. This approach could be adapted to other similar Outermost European regions and SIs. By allowing decision-makers and stakeholders to visualize conflicts spatially presented across the Pico INP as well as corresponding vested interests, the resulting conflict maps for Pico INP could be used as a springboard for participatory mapping and conflict management, i.e. developing feasible actions to minimize or resolve conflicts. The conflict base map could be updated as new data becomes available and fine-tuned with higher quality spatial maps and data in the same way, and including more local (e.g. citizens) and non-local stakeholders' perspectives and interrelationships. Further, it sets up a good starting point for an extensive participatory mapping exercise (i.e. progressing up the ladder of participation as described in Introduction). Integrating both social techniques and land use data, and translating the data into simple visual maps provide a valuable tool for decision-makers as well as for communication among decision-makers and stakeholders, which would serve as a big step towards minimising potential local conflicts and preserving unique ecosystems.

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- DL n. 19/93. Estabelece as normas relativas à Rede Nacional de Áreas Protegidas.
- DL n. 140/99. Revê a transposição para a ordem jurídica interna da Directiva n.º 74/409/CEE e da Directiva 92/43/CEE.
- DLR 21/93/A. Aplica a região o regime jurídico estabelecido pelo DL n. 19/93 (Rede Nacional de Áreas Protegidas).
- DLR 14/2004/A. Classifica as zonas de protecção especial (ZPE) da Região Autónoma dos Açores.

- DLR n. 15/2007/A. Decreto Legislativo Regional que procede à revisão da Rede Regional de Áreas Protegidas da Região Autónoma dos Açores e determina a reclassificação das áreas protegidas existentes.
- DLR n. 20/2008/A. Decreto Legislativo Regional que cria o Parque Natural da Ilha do Pico.
- DLR n. 15/2012/A. Decreto Legislativo Regional que estabelece o regime jurídico da conservação da natureza e da biodiversidade.
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Appendix I: List of stakeholders.

#	Stakeholder
S1	INP Authority
S2	Local municipality (<i>Madalena</i>)
S3	Local municipality (<i>Lajes</i>)
S4	Local municipality (<i>São Roque</i>)
S5	Association of mountain guides
S6	Taxi drivers association
S7	Association of artisanal fisheries
S8	Association of farmers (more than 300 affiliates)
S9	LactoPico cooperative – Dairy production (more than 70 affiliates)
S10	Wine and viticulture cooperative
S11	Caminhando – private tourism operator
S12	Futurismo – private tourism operator
S13	Hotel Caravelas
S14	Pocinho Bay – rural tourism
S15	Os Montanheiros (Environmental NGO)
S16	Association of recreational fishing
S17	Association of recreational hunting
S18	Radio Montanha (local media)
S19	Jornal Ilha Maior (local media)

Categories: Park authority (white); Local authority (light gray); Local economy (dark gray); Non-governmental organizations and associations (black)

Criteria \ Actor		S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	S18	S19
		Legal nature	Public	✓	✓	✓	✓											✓		
	Private					✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓
Economic Sector	Primary							✓	✓		✓									
	Secondary									✓										
	Tertiary	✓	✓	✓	✓	✓	✓					✓	✓	✓	✓	✓	✓	✓	✓	✓
Area of influence	Land-use planning and management	✓	✓	✓	✓															
	Nature conservation	✓														✓				
	Business and economy						✓	✓	✓	✓	✓									
	Leisure and recreation	✓				✓	✓	✓				✓	✓	✓	✓	✓	✓	✓		
	Communication															✓			✓	✓