

Sustaining marine wildlife tourism through linking Limits of Acceptable Change and zoning in the Wildlife Tourism Model



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ARTICLE INFO

Article history:

Received 7 January 2016

Received in revised form

18 February 2016

Accepted 19 February 2016

Available online 24 March 2016

Keywords:

Wildlife Tourism Model

Diving

Ecotourism Opportunity Spectrum

Management

Zoning

Sustainability

ABSTRACT

Marine wildlife tourism can benefit both conservation and communities when managed effectively. The Wildlife Tourism Model (WTM) is a framework used to assess sustainability. This paper illustrates how two aspects of the model, the Limits of Acceptable Change (LAC) and zoning can be linked to improve management direction. Four of the nine steps of the LAC process were applied to identify sustainability concerns about Scuba diving in five Azorean islands and to propose standards of acceptable limits. Qualitative and quantitative survey data were used as well as descriptive indicators. Stakeholder interviews identified main concerns (step 1). Case study islands were described according to the Ecotourism Opportunity Spectrum (step 2) and indicators were selected (step 3). Indicators were measured with the help of gap analysis based on a diver survey (step 4). The islands demonstrated differences in access, infrastructure, diving attractions, clientele and satisfaction levels suggesting two zone types. Results show that perceived and descriptive indicators are valuable input variables for the LAC process and LAC can be related to zoning as suggested by the WTM.

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1. Introduction

Marine wildlife tourism has the potential to provide significant benefits to both local communities and conservation when it is carefully managed [1]. At a time when marine ecosystems are increasingly under pressure and fisheries declining [2–4], coastal and marine tourism remain one of the largest and fastest growing segments of the global tourism market [5–7]. However, herein lies the essential management problem. Conservation can benefit from the income derived from coastal and marine tourism activities as fishing dependent communities turn to less extractive, tourism-based sources of income generation. However, conservation values can also be highly impacted if those tourism activities are not planned and executed effectively to foster sustainability [8–12]. The Wildlife Tourism Model suggested by Duffus and Dearden [13] has been widely used as a framework to assess the sustainability of marine wildlife tourism including whale watching [14,15], sharks [16], birds [17], manatees [18] and diving [14]. The study reported here relates to the sustainable management of diving, but applies two aspects of the model that have previously received virtually

no attention, but are potentially the most important, application of the Limits of Acceptable Change (LAC) framework and its link to spatial zoning and the Recreation Opportunity Spectrum (ROS). The paper contributes to the continued development of the model through this application and also makes specific recommendations based on a case study of scuba diving on the Azores.

2. Conceptual frameworks

2.1. The Wildlife Tourism Model

The Wildlife Tourism Model [13], first developed in relationship to whale watching, is recognised as being the most commonly used wildlife tourism management framework [19]. The framework (Fig. 1) synthesises several different theoretical approaches. It uses the Butler curve of resort development [20] to show how a wildlife attraction can pass through several stages as use grows and how the increasing impacts of visitation can lead to the demise of that particular attraction. Wildlife-based tourism is particularly susceptible to this progression, due to its popularity, and this outcome, due to the frequent vulnerability of the attraction. Duffus and Dearden [13] observed that as visitation increases there is also a change in the type of clientele attracted and this has many implications for management. Using Bryan's specialization

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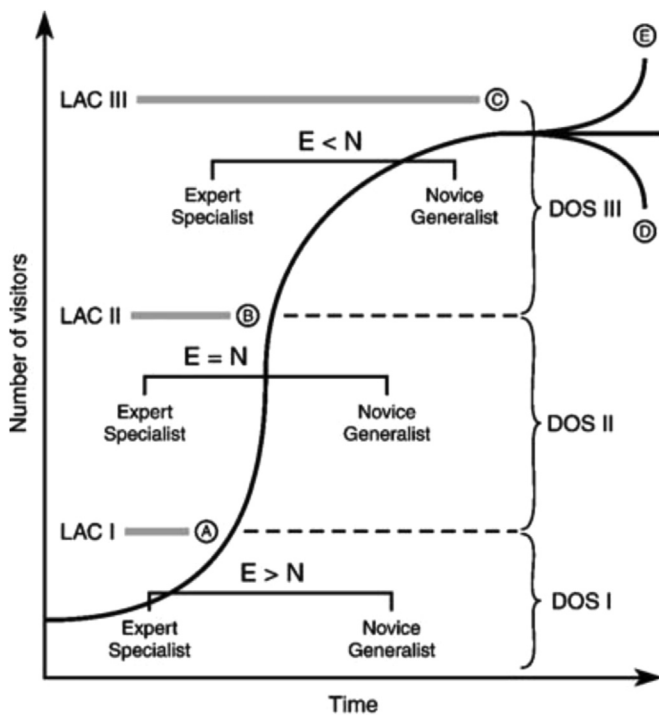


Fig. 1. The relationship among users specialization, Limits of Acceptable Change (LAC I–III) in the stages of evolution of a wildlife tourism site (A–E) over time [after 13, 23]. The diver opportunity spectrum (DOS I–III) is used as a basis for matching dive site characteristics with specialization levels.

theory they proposed an initial tourist clientele composed mainly of more highly specialised participants, who have the knowledge and impetus to find out about new attractions, that over time becomes displaced by an increasingly generalist clientele. As the latter occur in greater numbers, often have higher impacts and are willing to pay less for the activity, this progression is often not of benefit to conservation [21]. Many studies have documented these changes in clientele over time at wildlife attractions [22,16] and this has been the dominant use of the model.

Duffus and Dearden [13] suggest that unless management is applied then there is a certain inevitability about the outcome. The key to effective management is to determine explicit objectives for the site. For example, is this a fragile and rare phenomenon where the target market will be a smaller number of higher-paying participants (A in Fig. 1) or a resilient site that can accommodate large numbers of participants (e.g. C in Fig. 1), or somewhere in between (e.g. B in Fig. 1). The challenges then is to determine the Limits of Acceptable Change (LAC) that should be ascribed to that site to enable those objectives to be met and development of indicators, standards and monitoring systems to achieve those LACs.

2.2. Limits of Acceptable Change

Stankey et al.'s [24] *Limits of Acceptable Change* framework has been used to monitor nature-based tourism activities by identifying standards of quality and placing emphasis on positive planning and management anticipating over-use e.g. [11,25–29]. The Secretariat of the *Convention on Biological Diversity* and IUCN recommend it as a control mechanism for tourism in natural and protected areas in part due to its potential to achieve a sustainable balance between environmental and social needs [30–32].

The LAC framework is similar to the concept of carrying capacity that establishes the number of recreationists that an area can sustain without sustaining ecological damage or impairing the recreation experience. However researchers realised that it is not

only the numbers of visitors that create impacts but also other factors, such as their behaviour. In response the approach to managing impacts changed to setting targets for the amount of change allowed in particular settings and developing monitoring to assess these changes. The LAC approach is now used widely in management of recreation settings e.g. [1,11,13,27–29] and this paper shows how LACs can be applied to the management of scuba diving activities.

LAC focuses on setting targets for the amount of change allowed in particular settings and on developing monitoring to assess these changes [33]. Appropriate limits are determined to meet the objectives through the establishment of indicators, standards and monitoring programmes. The process of establishing LAC identifies desirable (and achievable) social and ecological conditions, assesses current conditions, identifies management actions, and monitors and evaluates implemented management actions [24]. Both physical indicators and users' perceptions are potential input sources of social indicators and their acceptable thresholds.

The original LAC process involves nine steps: (1) identification of the area of concern and related issues, (2) definition of opportunity classes or zones, (3) selection of indicators of resource and social conditions (as they apply to classes or zones), (4) inventory of resource conditions, (5) specification of standards for resource indicators, (6) identification of alternative opportunity class allocations, (7) identification of management actions for each alternative, (8) evaluation and selection of an alternative, and (9) implementation of actions and the monitoring of conditions [24].

Of particular interest in this study are the first four steps of the LAC process. In the first step main issues and concerns are identified, such as features needing special attention or managerial problems that have to be dealt with. In this step usually the opinion of stakeholders and public is gathered. The second step implies the definition and description of the (recreation) activity with its conditions and resources according to opportunity classes. In the third step indicators are selected that represent specific elements of the biophysical and social setting conditions and are deemed to be appropriate and acceptable in each opportunity class. The fourth step requires an inventory of resources and social conditions, through the measurement of indicators identified in the previous step.

Most studies applying the LAC framework use either descriptive e.g. [27] or perceived indicators e.g. [28,34,35]. Limited research on LAC applications has integrated both biophysical descriptive and perceived indicators [11,30]. In this study management zones are determined with the help of LAC through the measurement and analysis of social and biophysical indicators providing practical management suggestions for a relatively new and quickly growing dive industry in the Azores. Only Roman et al. [11] have previously used LAC in scuba diving management applications and their application was at a very site specific level. The current study explores the use of LAC to distinguish amongst different islands in the Azores archipelago at the mesoscale. The approach can also be applied to other marine tourism activities elsewhere.

2.3. Recreation Opportunity Spectrum (ROS)

The WTM suggests that in the absence of management interventions wildlife tourism sites will progress along the curve and foster increased displacement of specialists by generalists. In many cases, as suggested above, this may not be desirable and it may be beneficial to retain the full range of recreational opportunities within a site or region. An early manifestation of this variation in settings, infrastructure, access, social attributes and management needs was the Recreation Opportunity Spectrum (ROS). This approach divides a landscape into zones along a continuum from

“primitive” (e.g. wilderness) through to developed (e.g. urban) settings. Different opportunities are created by varying social, environmental and managerial conditions to match visitor preferences [36]. The WTM was extended by Dearden et al. [23] to show how the determination and implementation of LAC could have a spatial zoning component, in this case related to variation in provision of a range of diving opportunities (DOS in Fig. 1), however they were not explicit in how this might be derived. A more detailed approach focusing on ecotourism has been suggested by Boyd and Butler [33] and known as the Ecotourism Opportunity Spectrum (ECOS). This model classifies zones or activities into *eco-specialist*, *intermediate* or *eco-generalist* based on access, other resource related activities, attractions offered, existing infrastructure, social interaction, level of skill and knowledge, and acceptance of visitor impact and ECOS forms the basis of the zoning methodology used in this study [37].

3. Objectives and study site

This article illustrates the use of the WTM for the management of scuba diving in the Azores through application of the LAC framework and the Ecotourism Opportunity Spectrum (ECOS) model to:

1. Assess the main concerns of stakeholders associated with diving (Step 1 of the LAC process).
2. Define and describe diving conditions and resources according to opportunity classes (step 2 of the LAC process).
3. Select indicators that represent specific elements of the biophysical and social setting conditions (step 3).
4. Measure the indicators identified in the previous step (step 4) and identify management zones (DOS).
5. Provide input for sustainable diving management in each management zone.

The Azores archipelago, a Portuguese Autonomous Region, is situated in the Atlantic Ocean about 1500 km from Lisbon and 3900 km from the east coast of North America and consists of nine islands with a total land area of 2333 km². Tourism is becoming an important economic sector. Coastal recreation is a major tourist attraction with some of the main activities being sailing, boat tours, cruise tourism, scuba diving, whale and dolphin watching, swimming with dolphins, sport fishing and hiking [38].

Despite being a major tourist attraction in the Azores, there is limited data about the number of divers. The Regional Directorate for Air and Maritime Transport estimated around 4000 divers in the Azores in 2011. However diving with blue sharks, an emerging subsector of the diving industry, was calculated to involve approximately 7000 divers in the same year [39,40]. Forty-five diving operators are registered on the Regional Tourism Portal (<http://www.visitazores.com/pt-pt/experience-the-azores/scuba>).

Five out of nine islands were selected for inclusion in the case study: São Miguel, Pico, Faial, Santa Maria and Graciosa (Fig. 2). These islands comprise 88.80% of the divers in the Azores. Santa Maria, Pico and Faial have attracted increasing numbers of more experienced divers due to the possibility to see blue sharks and manta rays offshore. In contrast São Miguel and Graciosa offer a variety of coastal dive spots for all levels of diving [14].

4. Methods

The data presented in this paper were obtained through structured interviews with local stakeholders and a questionnaire survey with divers. Eighteen structured interviews were conducted during

the summer season of 2012, to identify main concerns with diving (LAC step 1). Representatives of six different stakeholder groups – tourism operators, Regional Government institutions, Maritime Police, fisheries associations, University staff, professional divers – were interviewed. The questions asked had three main axes: the strengths, the weaknesses and the problems or conflicts with diving activity in the Azores. During the interviews, notes were taken and after the interview, the answers were grouped and summarised.

The perceived problems and concerns of local stakeholders formed the base for the following steps of the LAC process, the definition of opportunity classes (step 2) and the selection of indicators (step 3). To define opportunity classes, diving was analysed according to the Ecotourism Opportunity Spectrum (ECOS) model [33]. Based on the ECOS model the indicators, access, accommodation opportunities, other tourism activities, diving infrastructure and diving attractions were used for the classification of the selected islands according to the model.

To identify the most important conditions of a setting and then the specific indicators that might best measure any change in that condition is a challenging step [41,42]. To describe the variation in diving conditions in the case study, variables included government data on the number of operators, number of hotels as well as diver survey and stakeholder interview-derived indicators such as motivations to dive, overall satisfaction and specialization of divers. Users' motivations to dive can constitute indicators, which contribute to the establishment process of the LAC. Previous research has shown the critical importance of biophysical setting conditions, including water clarity, underwater rock formations and the quality and diversity of fish communities for divers [11,43]. Divers are also attracted by large iconic marine species such as sharks and manta rays [44–46]. Other important factors include interest in learning more about marine life and various social factors.

Specialization has been shown to be related to impacts, pro-environmental behaviour and attitudes, environmental awareness, and to growing support for management interventions [9,13,47,48,49]. Quantitative data on the perceived indicators were obtained through a survey, administered to 435 divers between June and October 2013. Divers were approached when returning from their dives. All diving operators listed on the Webpage of the Regional Government of the Azores (visitazores.com) in Pico, Faial, São Miguel, and Santa Maria and one dive operator on Graciosa Island was sampled. The questionnaire consisted of 25 mainly closed-ended questions addressing various aspects of the diving tour experience including demographics, specialization level, motivations, satisfaction, impact perceptions and willingness to return. The questions were developed through a literature review and refined following a pilot study in May 2013. Surveys were provided in Portuguese, English, Spanish and German.

The indicator “satisfaction compared to expectation” was measured with a gap analysis [50]. Respondents were asked to rate 10 environmental and service features according to their importance for the decision to dive in the Azores on a five-point Likert scale (between 1=not at all important and 5=very important). Respondents were then asked to rate their satisfaction with the same 10 environmental and service features on a five-point Likert scale (between 1=very unsatisfied to 5=very satisfied). The gap analysis identifies features with different importance and satisfaction mean scores through subtraction of mean satisfaction mean scores from mean importance scores. When the satisfaction scores exceeded expectation scores, it was assumed that expectations were met, and thus users were satisfied (Table 2). When the expectation scores exceeded satisfaction scores it was assumed that expectations were not met. The overall satisfaction of participants was measured on a 10-point scale (1=very unsatisfied; 10=very satisfied).

Specialization of divers was measured through a single-item self-classification variable. This method constitutes an effective

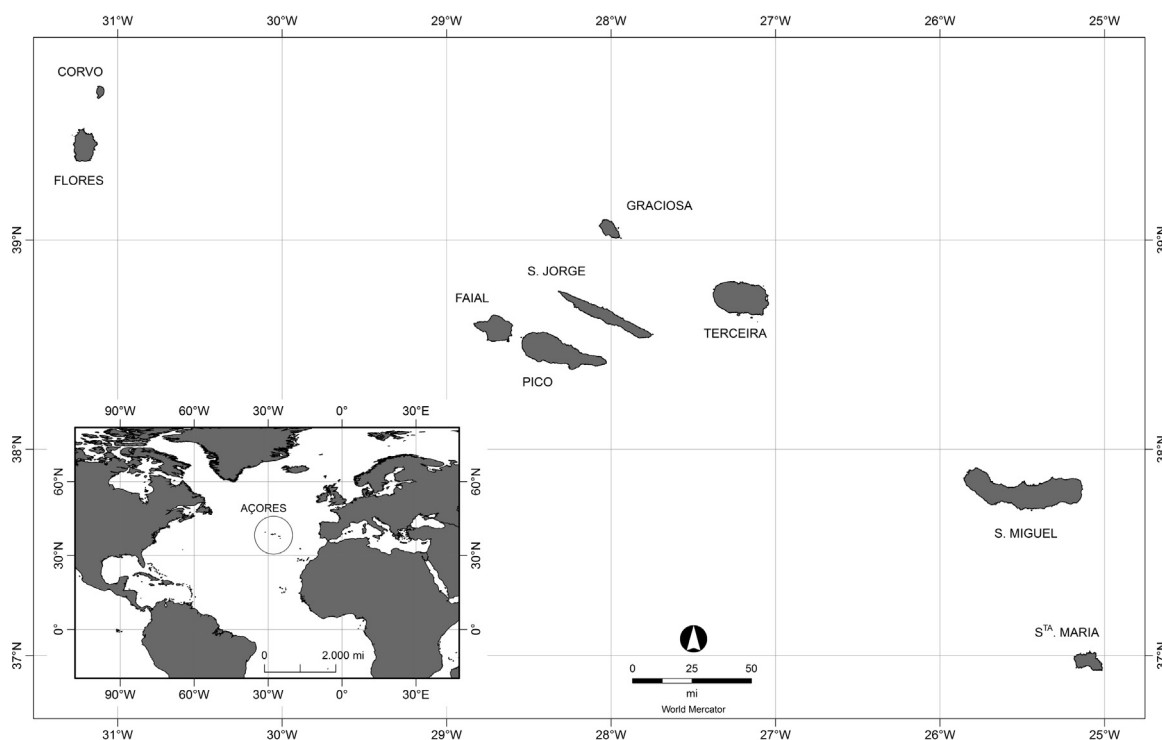


Fig. 2. Azores geographic location (source: Centre of Geographic Information Systems, University of the Azores).

measure for categorizing wildlife tourists [51,52]. Respondents choose between four categories describing combinations of various dimensions of specialization taking into account the multi-dimensional nature of specialization, which is composed of a behavioural component, a cognitive component and an affective component. Four diver types were proposed: *new diver*, *casual diver*, *active diver*, *committed diver*, describing different degrees of previous participation, experience and possessed equipment (behavioural components), skill level and diving certificates (cognitive dimension) and centrality to lifestyle and enduring involvement (affective attachment and commitment).

5. Results

5.1. Main concerns of stakeholders associated with diving in the Azores (step 1 of the LAC process)

A major stakeholder concern was marine biodiversity decline in the Azores in the last decade. In part this was seen as result of increased fishing effort and of limited management and implementation of marine protected areas. Shark sightings in Santa Maria, for example, have declined by eighty percent in two years [53]. Commercial fishing has grown illegal fisheries have increased, and control mechanisms are limited. The steep increase of blue shark landings in Azorean harbours is especially a concern. Lack of cooperation between fishermen and government agencies is a problem in trying to rectify these challenges. Waste and pollution are also of concern, as well as the destruction of important habitats (fish nursery areas) as a result of coastal construction. The infrastructure that supports diving, specifically harbour conditions, was seen to be inadequate and there is a lack of experienced diving staff.

5.2. Diving in the Azores according to the ECOS model (step 2 of the LAC process)

Due to the relative remoteness of the Azores archipelago,

access to the islands is possible only by airplane, with direct flights to São Miguel and Faial Island (from various European and North American airports). São Miguel, Pico and Faial islands offer a lot more accommodation opportunities hotels than the other islands. Other marine related tourism opportunities are also more abundant on these islands. Diving infrastructure, namely the number of diving operators and safety support (hyperbaric chamber) is best in São Miguel. However in terms of diving attractions, the more remote islands, Santa Maria, Pico and Faial are better off, featuring diving with blue sharks, whale sharks and manta rays (Table 1).

5.3. Selected indicators of the biophysical and social setting diving conditions (step 3 of LAC process)

The third step of the LAC process requires selection of indicators representing specific elements of the biophysical and social setting conditions. In this study, both physical (Table 1) and perceived indicators (Table 2) were selected. Physical indicators included the type of access (direct flight or 1 stopover), number of accommodation opportunities and other marine wildlife activities as well as diving infrastructure and principal attractions. Perceived indicators included, variables related to access (cost of the trip), environmental diving features (e.g. presence of sharks, mantas and variety of marine species), service setting features (e.g. type of boat, information provided, safety) overall satisfaction and specialization for divers.

5.4. Measurement of indicators (step 4 of LAC process)

The majority of the perceived indicators (Likert scale 1–5) identified in the previous step were measured with a gap analysis. The performance was considered positive when mean satisfaction scores were equal to, or exceeded, expectation scores. When mean satisfaction scores were inferior to expectation scores, the performance was considered negative or very negative with a gap value greater than 1 [50]. In all five islands diver expectations about the variety and abundance of marine life were not fulfilled

Table 1
Physical indicators
Source: Regional Directory of Tourism, 2015.

	Sta. Maria	S. Miguel	Graciosa	Pico	Faial
Access					
Flights from continents	1 Stop	Direct	1 Stop	1 Stop	Direct
Accommodation					
Hotels	4	32	2	5	6
BB (rural tourism)	6	56	7	40	26
Youth hostel	1	2	0	1	0
Camp ground	0	4	2	3	3
Other marine tourism activities					
Whale watching operators	0	6	2	5	4
Big game fishing operators	5	13	4	6	6
Sailing operators	2	12	2	6	7
Surf spots	2	16	3	5	4
Diving infrastructure					
Dive operators	4	7	4	4	3
Hyperbaric chamber	No	Yes	No	No	Yes
Diving attractions					
Environmental diving features	Blue sharks, whale sharks, manta rays, geological underwater formations	Wreck diving, cave diving, geological underwater formations	Wreck diving, cave diving	Blue sharks, whale sharks, manta rays, wreck diving, geological underwater formations	Blue sharks, whale sharks, manta rays, wreck diving, geological underwater formations
Marine protected areas	6	5	4	3	5

Table 2
Gap-analysis of perceived indicators.

	Santa Maria	São Miguel	Graciosa	Pico	Faial
Access (performance)					
Cost of the trip	Negative	Positive	Negative	Positive	Negative
Attractions (performance)					
Species variety and abundance	Negative	Negative	Negative	Negative	Negative
Pristine dive sites	Negative	Negative	Positive	Positive	Negative
Underwater rock formations	Positive	Positive	Positive	Positive	Positive
Presence of blue sharks	Very negative	n. a.	n. a.	positive	Positive
Presence of manta rays	Very negative	n. a.	n. a.	Negative	Negative
Existing infrastructure (performance)					
Boat type	Negative	Positive	Positive	Positive	Positive
Information provided	Negative	Positive	Positive	Positive	Negative
Safety	Negative	Negative	Negative	Negative	Negative
Expertise of dive master	Negative	Positive	Positive	Negative	Negative

(Table 2). The presence of manta rays also obtained negative results in all islands with very negative performance in Santa Maria. The presence of blue sharks fulfilled the expectations of divers in Pico and Faial islands. Underwater rock formations such as caves and seamounts obtained positive results in all case study islands. Safety was also identified as an area of concern due to unfulfilled expectations.

In accordance with Pearce's [55] benchmarking study and Hanan and Karp [54], most of the satisfaction scores obtained in this study can be classified as mediocre (Table 2). Pearce [55] analysed various cases in an international satisfaction study and developed a scale whereby mean overall satisfaction scores smaller than 7.1 are considered low, mean scores between 7.1 and 7.8 are moderate and mean scores greater than 7.8 are good. Hanan and Karp [54] considered the satisfaction level high when 85–90% of the scores were between 8 and 10. When 70–80% of scores are 8–10, the satisfaction is considered medium and when 60% or fewer responses were 8, 9 or 10, satisfaction is considered low.

Divers were mainly specialized users with 37% *active divers* and 30.7% *committed divers* and these out-numbered the generalist divers (21.4% *casual divers* and 10.8% *new divers*). Specialization levels varied significantly among the islands ($\chi^2=36.117$, $df=12$, $p=0.000$). The more remote islands of Pico, Faial, Santa Maria and

Graciosa, attracted mainly specialized divers. São Miguel attracted more generalist divers (14.6% *new divers* and 30.5% *casual divers*).

Both physical and perceived indicators were evaluated and compiled (Table 3). Accommodation, other recreational opportunities and other supporting infrastructure were classified according to visitor evaluations and official data and summarised. The five case study islands differed in terms of access, diving attractions and supporting infrastructure.

São Miguel Island is easier to access, has numerous accommodation opportunities and reasonable diving services but has fewer diving attractions. The more remote islands have less developed infrastructure but more diving attraction. Blue and whale sharks were removed from available diving attractions in Santa Maria because stakeholders had expressed concern over the steep decline in occurrence of blue sharks and the unreliability of sightings of whale sharks see also [39]. Divers evaluations were also very negative. As manta ray sightings are also not very reliable, this attraction can be advertised only with precaution.

6. Discussion

The measurement and evaluation of indicators allowed the

Table 3

Compilation of biophysical and perceived indicators of diving in five Azorean islands.

	Santa Maria	São Miguel	Graciosa	Pico	Faial
Access	Difficult, expensive	Easy, well-priced	Difficult, expensive	Difficult, well-priced	Easy, expensive
Attractions	Geological underwater formations (manta rays)	Wreck diving, geological underwater formations	Wreck diving, geological underwater formations	Blue sharks, wreck diving, geological underwater formations (manta rays)	Blue sharks, wreck diving, geological underwater formations (manta rays)
Existing infrastructure					
Accommodation (nr./diversity)	Limited	Various	Limited	Moderate	Moderate
Dive operators (nr.)	Limited	Moderate	Limited	Limited	Limited
Hyperbaric chamber	No	Yes	No	No	Yes
Diving services and safety (quality)	Weak	Reasonable	Reasonable	Moderate	Moderate
Others					
Specialization of divers	Medium and high	Low and medium	Medium and high	Medium and high	Medium and high
Satisfaction of divers	Moderate	High	High	High	High

Table 4

Island Zoning policy recommendations for the five case study islands in the Azores.

Zone type	Eco-generalist	Eco-specialist
Islands	São Miguel	Santa Maria Pico Faial Graciosa
Access	Easy, reasonable priced	Difficult, expensive
Number and quality of diving attractions	Few, average	Several, special
Supporting infrastructure	Developed	Limited
Diving clientele	Generalists	Specialists
Recommended management objectives	1. Conservation 2. Nature appreciation and recreation 3. Tourism, economic revenue	1. Conservation 2. Nature appreciation and recreation 3. Tourism, economic revenue
Policy recommendation	• Promote recreation • Adequate marketing • Fisheries management • Diver education/information	• Limit access to small licensed ecotourism operators • Fisheries management • Diver education/information • Shark protection

identification of two principal zones among the five case study islands. São Miguel differed from the other islands in terms of access, number and quality of diving and other marine related attractions, diving clientele and supporting infrastructure. São Miguel has a more developed infrastructure, is easier to access but has fewer and more average diving attractions and thus captures a less specialized clientele (Table 4). Therefore, this island was classified as an *Eco-generalist zone* (Table 4) that would equate to DOS II in the WTM (Fig. 1). Potential management interventions in this zone should foster conservation, as nature related activities (such as diving, hiking, whale watching, and sailing) constitute the major travel motivation to this island [56]. Appropriate marketing is important to avoid dissatisfaction of users e.g. see [51] as well as improved fisheries management, as the decline of fish was identified as a concern in the qualitative and quantitative analyses. For the predominantly less specialized divers in this island, the focus should be on limiting potentially damaging diving practices and providing rich experiences to encourage higher specialization. Delivery of effective education programs is essential in this regard [9,57]. The educational aspects of diving in the Azores could be strengthened through comprehensive briefings with a strong conservation component prior to the trip, an approach which is used for whale watching tours.

The other four case study islands, Santa Maria, Graciosa, Pico and Faial were classified an *Eco-Specialist zone*, based on the fact

that the access was difficult and expensive, the supporting infrastructure limited but the attractions more special and the clients more specialized (Table 4). This zone would equate to DOS I in the WTM (Fig. 1), a zone that has been rarely distinguished in the dive literature where the progression to a generalist-dominated has been most dominant [21]. Marine conservation and especially shark protection should constitute important management objectives and policies in these islands. Protecting blue sharks and manta rays through a regional sanctuary would be a possible intervention and/or to review and restrict shark fishing in the area. Additionally, managing the shark diving activity through license system would be beneficial [39,58]. Marine protection seems especially important for Santa Maria, where shark and manta sightings have declined heavily and with it the satisfaction of users. In order to avoid displacement of specialist divers in Santa Maria Island, satisfaction of users should be improved. Diver education and information can play an important role in this regard avoiding false expectations. In order to provide high quality diving experiences with low environmental impact, access should be limited to small scale, ecotourism operators. Previous research on user profiles has recommended to preserve specialist markets where these exist, being a higher yielding and more distinctive niche with lower environmental impacts [23,59,60].

Studies applying the LAC framework use generally either descriptive e.g. [27,28,35] or perceived indicators for their measurements e.g. [34]. Few have integrated both biophysical descriptive and perceived indicators as input variables for the LAC framework in marine tourism management [11,30]. An advantage of using different indicator types is the provision of a more complete picture of a study site's conditions, which thus enables better-informed management applicability. The results of this study show that integrating biophysical descriptive and perceived indicators produces clear direction for management intervention with the potential to be applied to other case studies.

Small islands and archipelagos in particular facilitate tourism management with zoning plans. The access to an island is easier to control than to land areas, which favours a differentiated approach with different management zones among different islands e.g. limiting access to certain islands with more specialized high quality experiences. The relative remoteness of the archipelago and of several islands within the archipelago is an advantage in this regard. The more remote islands Santa Maria, Pico, Faial and Graciosa, could be reserved for ecotourism operators, offering a high quality product to a specialist clientele who do not spare the increased costs to have an outstanding experience, such as a dive with blue sharks or manta rays.

Zoning plans should also address a wider range of values and activities besides conservation and tourism [11,61]. Fisheries, for example, are an important source of income in many communities

of the Azores islands. However without integrated management of fisheries and diving industries, the future sustainability of the dive industry might be at risk [39]. Pico and Faial islands are one of the few destinations worldwide where diving with blue sharks is offered with a high success rate to see the sharks. Steep decline of shark sightings and increased shark fishing may put future sustainability at risk. The growing shark-watching industry is of special interest to conservationists, being a strong argument for protecting sharks [45] with the potential to provide economic benefits for local communities [62,63]. Results of this study suggest that acceptable limits of biophysical conditions are already exceeded indicating a downgrading of diving conditions. Tourism management must protect natural assets on which it depends if it is to be sustainable.

7. Conclusion

Marine wildlife tourism can provide an important livelihood support for coastal communities and also benefit conservation. However it is essential that the activities be managed effectively. Use of the WTM is one way to assess the potential sustainability of marine tourism. However to date application of the WTM for linking LACs and zoning has not been attempted. This study illustrates how the WTM can be used to determine more specific management direction using diving in the Azores as an example. Further empirical work along the same lines, as suggested by Catlin et al. [19] can only help strengthen the applicability of the model to a wider range of situations and help improve the effectiveness of management interventions.

The application of the LAC framework and link to the ECOS model can provide useful input for sustainable management practices of marine wildlife activities. The results of this study show that both perceived indicators as well descriptive biophysical indicators can be valuable input variables for this management tool. The combination of the two types of indicators provides a holistic perspective on the activity and facilitates the development of specific guiding principles for improved management. This approach of using input variables from different sources to feed a LAC process enables a more complete opportunity spectrum. The methodology chosen in this study provides results with direct application to diving tourism management in the case study and is applicable to other activities elsewhere.

Acknowledgements

Funding for this research was provided by Fundação da Ciência e Tecnologia under Grant [SFRH/BD/75928/2011]. The cooperation and assistance of numerous dive companies is acknowledged.

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