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RESEARCH ARTICLE

Can the Diving Industry Promote Marine Conservation and Enhance Environmental Awareness? (Sal Island, Cape Verde Case)

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Abstract:

Introduction:

The growth in tourism in the Cape Verdean Sal Island has been a cause as well as a consequence of a number of investments (both by the State and the private entities) to create synergies for that sector, ensuring and promoting the island's touristic attractiveness. Such increases in the number of visitors, allied with the island's marine biodiversity - that make up much of its economic potential - have caused the growth of the diving industry, which has become one of the biggest attractions for tourists. In light of the scarcity of scientific studies on the impacts associated with this activity and means for diver engagement, the local diving operators have proposed the development of several tools.

Method:

An Underwater Species Identification Guide and four underwater routes were proposed for four popular scuba diving sites off Santa Maria Bay (Sal Island, Cape Verde): "Kwarcit", "Sargo", "Três Grutas" and "Tchuklassa". To better understand how the diving industry could promote environmental education, conservation and enhance biodiversity awareness among divers, we also established the diver tourists' profile using an online survey.

Results:

A total of 347 respondents, of which 85% have higher education, showed that 67% stay more than seven nights in Cape Verde. Moreover, natural reefs are the 1st dive site to be visited, while artificial reefs preference increases after a second dive on the man-made reefs. The majority would recommend the use of the Underwater Species Identification Guide and the underwater routes.

The results showed that divers strongly embrace the use of new tools for better understanding of diving site biodiversity and that the diving industry can play an important role in the enhancement of biodiversity awareness.

Keywords: Awareness, Environmental education, Sal Island (Cape Verde), Scuba diving, Underwater routes, Underwater species guide, Underwater tourism, Socio-economic and travel profile, Online surveys.

1. INTRODUCTION

The Cape Verde Archipelago is composed of ten islands (and thirteen islets), located 750 km off Senegal (west coast of Africa), between 15-17ºN and 22-25ºW. Tourism is the country's main source of income and of socioeconomic development for several of the islands. Tourism in the Archipelago has a close relationship with marine-related activities, due to the warm weather, sandy beaches, clear water and high diversity of marine species. Cape Verde

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was visited by 539,621 tourists in 2014 [1], with 41.5% visiting Sal Island, the main tourist area, followed by Boavista Island with 32.9% of the total number of visitors to the Archipelago [2]. Diving is one of the fastest growing industries [3] and, worldwide, there are over 25,000,000 PADI individual divers [4], with an increase of 66.1% between 1996 and 2010 [5] and the business activity supporting scuba diving tourists has become an important tourism sector stimulating a billion dollar global industry [6]. Even though there are no statistical data covering Cape Verde's diving industry, there are six dive centres currently operating in Santa Maria Bay, Sal Island [7], which constitute an increased human pressure on local reefs - both natural and artificial - further aggravated by the scarce scientific literature on the impact of tourism on marine coastal areas [8] which, despite being an increasing concern for the scientific community [9, 10] remains largely unknown [11, 12].

Several studies have reported how diving activity can affect marine biodiversity: damage may come to benthic marine organisms, such as corals – soft and hard –, sponges, ascidians and large bryozoans, through the direct (physical contact) or indirect (raised sediments) action of divers [13 - 16]. Fish too can be disturbed, and their natural behaviour changed (*e.g.* during mating) due to selective search by divers (*e.g.* cryptic species) [17, 18]. Scientific information on local fish assemblages, however, is very limited, consisting mostly of inventories of species found in the area [19 - 23]. This is particularly worrisome given the biological richness and singularity of Cape Verde, with almost half of the total cryptobenthic fish species on the archipelago's waters comprising endemic species [24] and being listed in the top 10 coral reef biodiversity hotspots in the world, but also in the top eight of threatened centres of endemism [25]. Such a scenario - biological richness and singularity, general unawareness and consequential threats by human activity - led a private diving operator (Manta Diving Centre, Sal Island, Cape Verde) to put forward, with the support of the Ministry of Environment and Marine Resources of Cape Verde, a project to deploy artificial reefs in Cape Verde coastal waters [26] to satisfy the demand for 'non-natural' habitats [27] and promote environmental awareness among divers using "soft" management tools (*i.e.* education and interpretation) instead of "hard" management tools such as restrictions or visitors' fees [28] (Fig. **1**).

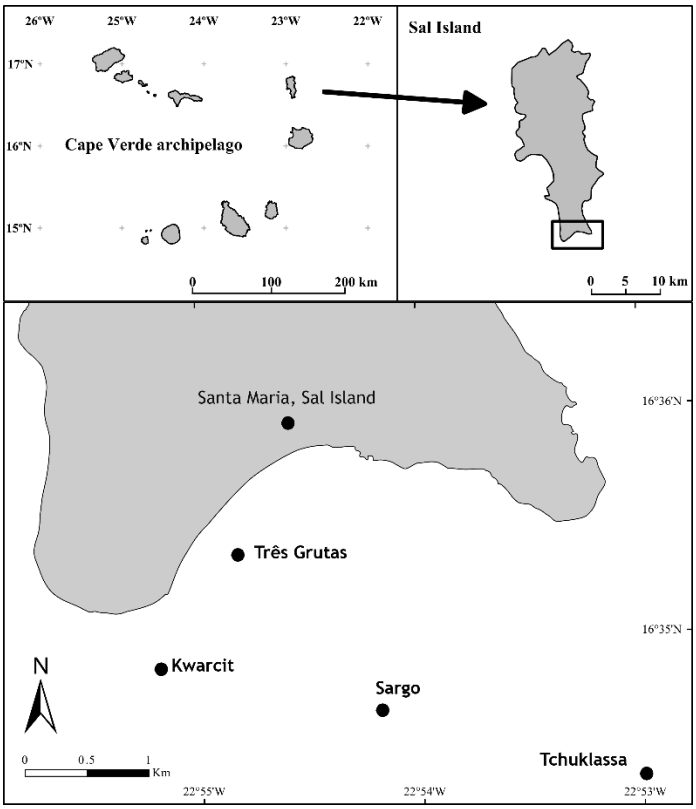


Fig. (1). Map of the Baía de Santa Maria, Sal Island, Cabo Verde with diving sites marked. Três Grutas and Tchuklassa represent natural reefs, Sargo and Kwarcit are artificial reefs (deployed vessels).

Divers are open minded and eager to learn about the dive sites visited. They tend to look for information and support regarding the dive in general [29] and environmental education must be included in diving activities through

"pre-diving environmental briefings" [29, 30]. Education is advocated as an advisable method for reducing environment damage caused by divers [29, 31], but to be truly effective it should be adapted to each diving site, the socio-demographic characteristics of the divers, their previous knowledge about the environment and their learning capacity [29].

Underwater routes are perceived as an effective way to improve biodiversity awareness among divers' community [32] and have been used to enhance environmental awareness [33, 34] and to reduce scuba-diver impacts on the environment [12, 31, 35, 36], by constraining divers to certain areas [37, 38], as well as to provide information along the path [12].

For the purpose of this study, the book *Sob os Mares de Cabo Verde - Diving Into Adventure* and an *Underwater Species Identification Guide* were published. Additionally, four *Underwater Diving Routes* were proposed for popular scuba diving sites off Santa Maria Bay (Sal Island, Cape Verde): "Kwarcit" and "Sargo", the artificial reefs off Santa Maria Bay and two natural reefs within the area, "3 Grutas" and "Tchuklassa".

A growing number of publications in recent years have highlighted many issues and concerns relevant to scuba diving tourism but little research has included the scuba diving industry, host communities or efforts towards sustainability [39]. Scuba diving tourism is an economically important industry as evidenced by the increasing number of other locations promoting their marine resources in efforts to become scuba diving destinations and Cape Verde aspires to follow popular, 'must dive' places widely promoted in social and other media such as Koh Tao in Thailand, Layang Layang and Sipadan in Malaysia, and the Great Barrier Reef, Australia and Sharm El Sheikh - Red Sea, Egypt, among others [25, 40, 41]. In this study, a survey was carried out to provide some preliminary data for Sal Island, Cape Verde, on the socio-economic profile of divers, their perceptions about the environmental awareness of the local area and potential uses of the produced tools for environmental awareness.

2. TOOLS DEVELOPED

2.1. Environmental Education and Interpretation

2.1.1. Sob os Mares de Cabo Verde - Diving Into Adventure

The conservation of marine biodiversity can only be achieved with engagement of all stakeholders. Following the challenge put forward by a Cape Verde bank to develop a book about the local oceanic waters to serve as a Christmas gift for their clients, *Sob os Mares de Cabo Verde - Diving Into Adventure* became a reality in 2008 (Fig. **2**). This work was carried by a large team of people including biologists, diving operator's managers, marketers, dive masters and an internationally recognized underwater photographer. 3500 units were produced of this book, which covered the following aspects: Artificial Reefs - History and Applications, Rebuilding Nature Project, Diving into Nature, Fauna and Flora [42].

Fig. (2). Covers of the book: *Sob os Mares de Cabo Verde - Diving Into Adventure's*.

2.1.2. Underwater Species Identification Guide

The first step to produce the Species Identification Guide was the selection of species. This work was carefully carried out by a team of marine biologists with the collaboration of dive masters from local dive centres in order to select the most interesting species within the area, but also keeping in mind the most relevant to divers. A total of 124 species were selected, photographed underwater and distributed among 12 slates (Fig. **3** and Annex **A**). The scientific and common names (Portuguese and English) of each species were given. Through a set of produced pictograms, several aspects that are important to divers were included (*e.g.* Danger, Fragile, Cryptic, Pelagic and Schooling) as well as the warning "do not stress, touch or feed the animals" to increase the diver's responsible behaviour following Lindgren *et al*. [43]. This guide was published in 2009 with 1200 units in its 1st edition [44].

a) b)

Fig. (3). a) *Underwater Species Identification Guide*, 6 slates, 12 pages. b) *Underwater Species Identification Guide*, page 1.

2.1.3. Underwater Routes

Two Artificial Reefs (Kwarcit and Sargo) and two Natural Reefs (Tchuklassa and Três Grutas) diving sites, among the 25 available diving sites in Sal Island, were selected [45 - 48]. This selection was based on site popularity and pre-established features such as high biodiversity, charismatic fauna and flora species and geological features. Pictograms (Danger, Fragile, Cryptic, Pelagic and Schooling) and "do not stress, touch or feed the animals" were included as described for the Underwater Species Identification Guide. The selected sites were also used for several studies carried out within the framework of the *Rebuilding Nature - Cape Verde Artificial Reef Creation Project*. Motivating features for divers visits, such as presence of fish and other aquatic life forms, pristine surroundings [49] were also considered in order to provide a a better description of the sights for divers (Figs. **4** to **7**).

(a) Kwarcit - One of the artificial reefs created by Manta Diving Center is now an obligatory stopping-off point for all divers who visit Sal Island. A short boat ride, of 5 to 7 minutes, brings divers to the site.

Sunk on January 6, 2006 by Manta Diving Center, this former soviet trawler has become, in a short space of time, a refuge for the numerous species that it protects from the attentions of larger predators. This site offers multi-level diving, from the rocky platform, at a depth of 28 meters, which encircles the slightly starboard-leaning hull to the top of the mast, at 14 meters.

As it is near the cape marking the western edge of Santa Maria Bay, it is a place where larger ocean-going species, such as Mantas, can sometimes be encountered. The dive is of medium to high difficulty, with visibility ranging from 15 to 35 meters.

This was the first of the artificial reefs created by Manta Diving Center and it is one of the many research sites of the Cape Verde Artificial Reef Creation Project.

Fig. (4). *Underwater route - KWARCIT* (Front and back page).

(b) Sargo - This is the second of the ships sunk by Manta Diving Center in order to create an artificial reef diving spot. This former Coastguard patrol vessel was offered to the project by the Cape Verde Ministry of Defense and sunk on the 28th of April 2008.

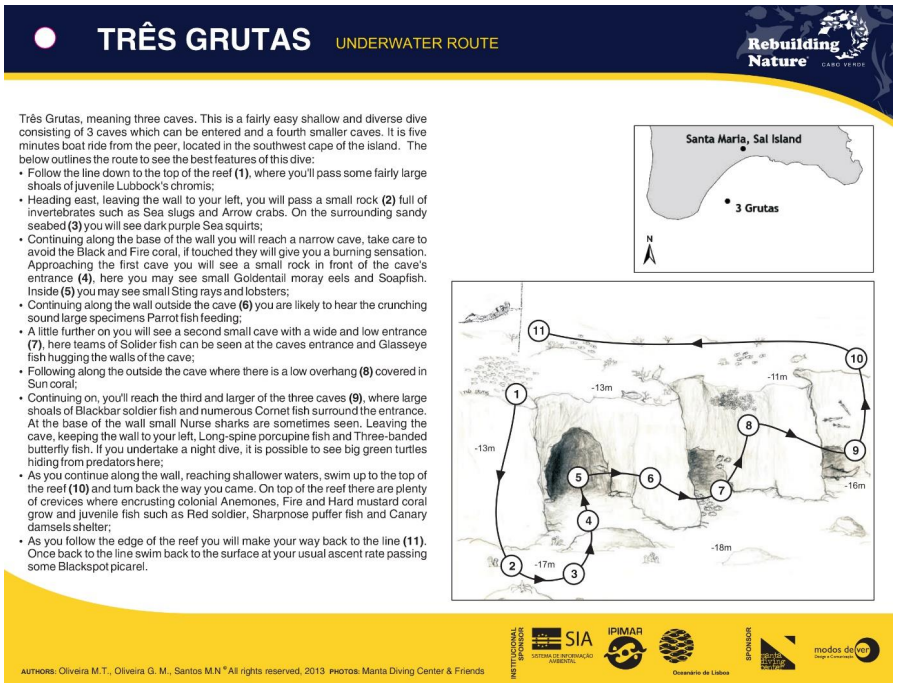
One mile out from the Santa Maria pontoon, only a few minutes are needed to reach this site that, within a month of its deployment, had already been colonized by many species. Lying at a depth of between 34 and 41 meters, it serves today as habitat for a vast range of species, as well as a stopping-off point for others, such as cutlass fish, rays and turtles. The dive is of medium difficulty, with visibility ranging from 15 to 30 meters.

Fig. (5). *Underwater route - SARGO* (Front and back page).

(c) Tchuklassa - Located about two miles off the Santa Maria pontoon, this is one of Sal's natural sanctuaries for underwater fauna. Thanks to its location, extent and morphology, this natural reef offers the possibility of more than one dive. Its rounded wall, covered in yellow polyps, is one of the dive highlights. Standing out from the coast, this reef rises from the depths of the channel separating Boavista and Sal Island and is sometimes bathed by currents that bring nutrients that enhance productivity, making it a place where many species settle and thrive. It is also a waypoint for tuna, jacks, some species of sharks, mantas and other species. The dive is of medium to high difficulty, with depths ranging from 20 to 40 meters. Visibility is between 15 and 40 meters. This site was one of the natural reefs that served as points of comparison in the study which is part of the Cape Verde Artificial Reef Creation Project [26].

Fig. (6). *Underwater route - TCHUKLASSA* (Front and back page).

(d) Três Grutas - This is another natural reef that was studied in the Cape Verde Artificial Reef Creation Project, namely in terms of possible migrations between this natural reef and the artificial reefs created by Manta Diving Center [50]. An 18 meters descent take divers to the bottom of a wall that runs east to west. One of the characteristics of this wall, as in many of other reef walls in Cape Verde, is the existence of a narrow cavity along the base which affords an excellent refuge for a wide variety of species. Those that can be seen here range from rays to lobsters, puffer fish to parrot fish and, less frequently, turtles and sharks. Following this wall to the east we pass by three caves, in descending order of size. These are modestly-sized rather than extensive caverns, but they do allow us to come face to face with the huge quantity and variety of fauna that shelter within. The second cave is actually known as Trumpet Fish Cave. Sharply focused eyes might even catch sight of the virtually undetectable frog fish that sits motionless on top of the coral waiting for a pray.



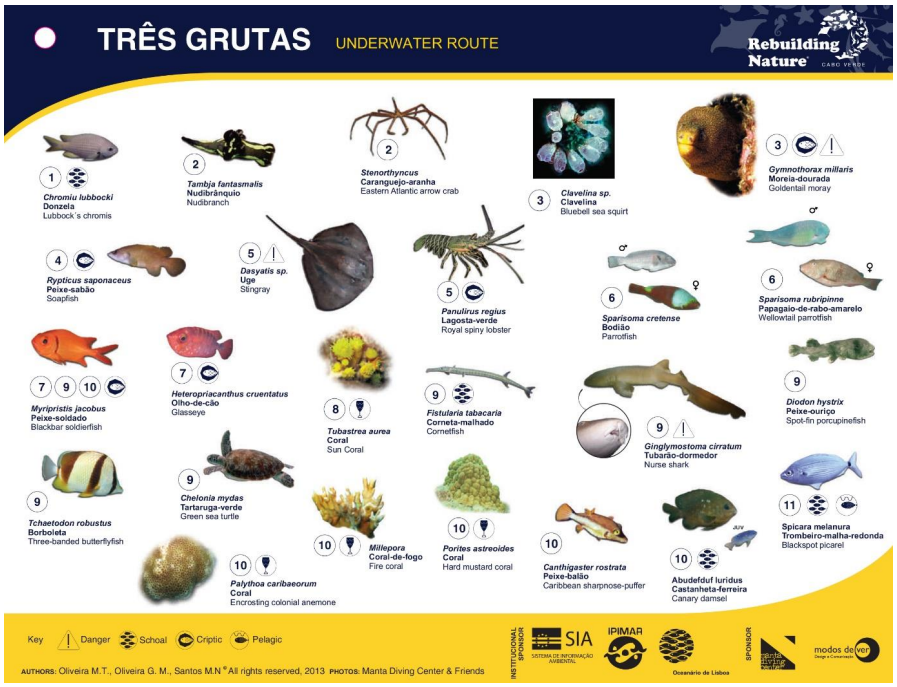


Fig. (7). *Underwater route - TRÊS GRUTAS* (Front and back page).

2.1.4. Environmental Diving Briefing

Specific diving environmental briefings where designed, with a scuba diving operator, for each of the four selected diving sites. Dive masters were also trained to provide correct information. The briefing, given by Manta Diving Center dive masters (Fig. **8**), addressed subjects such as a quick description of the diving site, the underwater route presentation, geographical characteristics of the zone, expected currents, possible dangers and difficulties, expected species and environmental issues considered important and/or interesting for the visitor.

Fig. (8). Nuno Marques da Silva, Manta Diving Center owner and diving instructor giving an environmental *dive briefing* (© Manta Diving Center) [51].

3. DIVERS' SOCIO-ECONOMIC AND TRAVEL PROFILE

3.1. Survey and Data Analysis

The survey instrument was pre-tested on a sub-sample of five divers in October 2012. After some adjustments, a questionnaire survey was placed online. The questionnaire survey was designed to maximize responses and avoid response bias [52]. Best practices for survey questions were followed such as the use of a brief introduction and a well-structure layout [53], limited use of drop-down boxes [54], use of closed-ended or short open-ended questions, graphics and other features that increase page download time were minimize and a progress bar was included [54, 55], horizontal scrolling was not required and a fast and accurate reading font was used [55], multiple questions per page were used [53 - 56]. According to Phillips *et all* [57] web surveys should be built in mind so as to reach as many respondents as possible. Therefor a full responsive design was used ensuring the questionnaire is clearly visible at any devices' screen size [53 - 55, 58, 59].

A covering letter introducing the purpose of the survey about the value of marine biodiversity conservation off Sal Island and a link to a survey was emailed to 7,434 addresses drawn from a list of divers who had visited Sal Island and went out with a local dive operator. The questionnaire was active between February 18th and March 18th, 2013 and during this period two reminders were send to improve response rates and reduce nonresponse bias [53, 60]. Because it was aimed to reach a wide audience, both the cover letter and the questionnaire were presented in English. The expected average time to complete the questionnaire was 15-20 minutes and it consisted of 29 questions. The survey included questions about the geographic origin of respondents and some of their personal characteristics (*e.g.* age group, gender, marital status, job occupation group), holiday and tourism choices (*e.g.* season of the year to go on holidays, number of visits to Cape Verde, staying time, accommodation type), diver characteristics (*e.g.* dive expertise, dive avidity, preferences), and specific questions related to marine biodiversity (perceived status of marine biodiversity, perceived diving impact). This survey was also used to estimate the value of marine biodiversity off Sal Island [61].

Differences between demographic and social characteristics of the divers, who perceived questions regarding environmental education, were tested using the independent sample chi-square test.

4. RESULTS

4.1. Socio-Economic and Travel Profile

From the 7,434 e-mails sent out, we received 347 replies (4.67%). Of those, only 292 surveys were filled out completely; these were used for subsequent analyses. Most respondents were Portuguese (70%), males (69%), over 40 years old (48%), married (53%), with a college degree (85%) and with Professional and technical occupations such as doctor, teacher and engineer, among others (62%) (Table **1**). For the majority it was the first visit (73%), on vacations (92%) and hotels with four or more stars were preferred (77%) for stays of seven to fourteen days (58%) (Table **2**).

Table 1. Socio-economic profile of the respondents in the case study (n=292).

SOCIO-ECONOMIC PROFILE	**%**
Nationality	
Portugal	70%
Netherlands	5%
United Kingdom	3%
Spain	3%
Sweden	3%
Other European	16%
Gender	
Male	69%
Female	31%
Age	
<26	8%
26-40	44%
41-60	46%
>60	2%
Education	
<9 years (Secondary education)	2%
9-12 years (High schools)	14%
>12 years (College degree)	85%
Marital status	
Single	27%
Married	53%
Divorced	8%
Widowed	1%
Other	12%
Professional area	
Professional & technical occupations (such as: doctor, teacher, engineer)	62%
Higher administrator occupations (such as: banker, executive, government official)	9%
Clerical occupations (such as: secretary, clerk, office manager, book keeper)	4%
Sales occupations (such as: sales manager, shop owner, shop assistant)	8%
Service occupations (such as: restaurant owner, police, waiter, caretaker, barber, armed forces)	6%
Skilled worker (such as: foreman, motor mechanic, printer, tool and die maker, electrician)	4%
Semi-skilled worker (such as: bricklayer, bus driver, cannery worker, carpenter, baker)	1%
Student	7%

Table 2. Travel profile of the respondents in the case study (n=292).

TRAVEL PROFILE	**%**
How many times have visited Sal island?	
1	73%
2	12%
3 to 5	8%
>5	7%
How long did stay in Cape Verde?	
< 7 days	33%
7 to 14 days	58%
15 to 30 days	5%
> 30 days	4%
Your last trip to Sal Island was due to:	
Exclusively vacation	92%
Exclusively work	4%
Working and vacation	4%

(Table 2) contd.....

TRAVEL PROFILE	%
Enter the month of your last arrival /visit to the Sal island.	
January	3%
February	8%
March	6%
April	10%
May	7%
June	11%
July	8%
August	15%
September	7%
October	10%
November	8%
December	8%
During your visit where do you usually stay?	
5 stars hotel	24%
4 stars hotel	53%
3 stars hotel	12%
Residential / Hostel	6%
Personal residence	3%
Friends / relatives	2%

The majority of divers were inexperienced, with less than 50 dives (62%) and under 10 dives per year (65%) and less than half of them commonly dive in foreign countries. On the other hand, 77% of the divers claimed to have enjoyed the experience of diving in artificial reefs for their uniqueness (42%) and for the feeling of adventure (23%). Only 5% disliked artificial reefs and the main reason was their unnatural look (46%).

Diving packages with 6 dives and an attractive price are the most preferred ones (40%) and 95% of the tourist divers would recommend diving in Sal Island to family and friends (Table **3**).

Table 3. Travel profile of the respondents in the case study (n=292; *n=225, **n=15).

DIVING PROFILE	%
Diving experience?	
< 50 dives	62%
50 to 200 dives	21%
201 to 500 dives	8%
> 500 dives	9%
How often do you dive in a year?	
< 10 dives	65%
10 to 25 dives	18%
26 to 50 dives	8%
> 50 dives	9%
Do you often travel abroad to dive?	
Yes	46%
No	54%
Do you Like to dive into artificial reefs (wrecks, sunken ships or other man-made structures)?	
Yes	77%
No	5%
Indifferent	18%
Let us know why you like to dive into artificial reefs.*	
More interesting	22%
For the adventure	23%
Greater adrenaline	7%
Different than usual dives	42%

(Table 3) contd.....

DIVING PROFILE	**%**
Other (specify)	6%
Let us know why you do not like to dive into artificial reefs.**	
Unnatural	46%
Unaesthetic	13%
Dangerous	8%
Fear	17%
Other (specify)	16%
Imagining that you stay 7 days at Sal Island, which of the following "packages" of dives would be your choice?	
1 Try dive (40€)	4%
2 dives (60 €)	22%
4 dives (€ 110)	26%
6 dives (€ 150)	40%
2 dives + boat + fishing aboard (120 €, one day program)	8%
Would you recommend a diving trip to Sal island to your friends and family?	
Definitely not	0%
Probably not	5%
Probably Yes	40%
Definitely yes	55%

3.2. Opinions and Perceptions Regarding Environmental Education

Although a high proportion (41%) of divers are aware of the vulnerability of the marine ecosystem, there are just as many divers who have no opinion or knowledge about this issue (39%). More than half of the respondents claim that diving has low or no impact on marine ecosystems (Table **4**).

Table 4. Environmental awareness profile of the respondents in the case study (n=292).

ENVIRONMENTAL AWARENESS PROFILE	**%**
In your opinion what is the current state of Cape Verde's marine ecosystems?	
Least concern	6%
Near Threatened	9%
Vulnerable	41%
Critically endangered	5%
I do not know	39%
In your opinion what is the negative impact of diving in the Cape Verde's marine ecosystem?	
None	13%
Low	41%
Moderate	19%
High	3%
I do not know	24%

The perceptions of the current state of Cape Verde's marine ecosystem and the recommendation for diving trips to Sal island it is not influenced by the demographic and social characteristics of the diver respondents (Chi-square test: $p>0.05$). Regarding the negative impact of diving on the Cape Verde's marine ecosystem, however in this question a gender difference was observed with females perceiving a negative impact of diving on Cape Verde's marine ecosystem while males did not (Table **5**).

The majority of divers reported a positive overall appreciation of the underwater identification guides and routes, claiming an improvement of the diving experience (99% and 100%, respectively) and a better understanding of marine biodiversity of the dive site (99% for both) and there was a consensual opinion for recommending the use of such guides and route plans (Table **6**).

Most respondents agreed (12%) or strongly agreed (87%) that the information about biodiversity provided during the briefing increased their environmental awareness.

Table 5. Demographic characteristics and their perceptions regarding environmental education. Significant differences were tested with independent samples Chi-square test.

Demographic/Social Characteristics	Frequency of ocurrence (%)	In your opinion what is the current state of Cape Verde's marine ecosystems?	In your opinion what is the negative impact of diving in the Cape Verde's marine ecosystem?	Will you recommend a diving trip to Sal island to your friends and family?
Nationality	–	–	–	–
Portuguese	70	$\chi2 = 2.1137$,p-value = 0.3475	$\chi2 = 5.0181$, p-value = 0.1705	$\chi2 = 4.6556$, p-value = 0.09751
Others	30	–	–	–
Gender	–	–	–	–
Male	69	$\chi2 = 0.81191$, p-value = 0.6663	$\chi2 = 13.444$, p-value = 0.003768	$\chi2 = 3.6623$, p-value = 0.1602
Female	31	–	–	–
Age	–	–	–	–
less 40 years	53	$\chi2 = 1.5424$, p-value = 0.4625	$\chi2 = 2.83$, p-value = 0.4186	$\chi2 = 0.71195$, p-value = 0.3988
more 40 years	47	–	–	–
Education	–	–	–	–
<12 years	15	$\chi2 = 0.66965$, p-value = 0.7155	$\chi2 = 0.74487$, p-value = 0.8626	$\chi2 = 0.16778$, p-value = 0.9195
>12 years	85	–	–	–

Table 6. Tools for environmental awareness (n=292).

SPECIES ID FIELD GUIDE & DIVING ROUTES	%
***Species ID field guide* improve your diving experience.**	
Strongly agree	48%
Agree	43%
Disagree	8%
Strongly disagree	1%
***Species ID field guide* provides a better undurstand of marine biodiversity of the dive site.**	
Strongly agree	67%
Agree	32%
Disagree	1%
Strongly disagree	0%
I will recommend the use of Species ID field guide to my diving friends.	
Strongly agree	89%
Agree	9%
Disagree	2%
Strongly disagree	0%
Did the *Information about biodiversity provided during the briefing* improve your environmental awareness?	
Strongly agree	87%
Agree	12%
Disagree	1%
Strongly disagree	0%
***Diving routs guide* improve your diving experience.**	
Strongly agree	77%
Agree	23%
Disagree	0%
Strongly disagree	0%
***Diving routes guide* provides a better undurstand of marine biodiversity of the dive site.**	
Strongly agree	71%
Agree	28%
Disagree	1%
Strongly disagree	0%

(Table 6) contd.....

SPECIES ID FIELD GUIDE & DIVING ROUTES	**%**
I will recommend the use of Diving routes guide to my diving friends.	
Strongly agree	94%
Agree	6%
Disagree	0%
Strongly disagree	0%

4. DISCUSSION

In order to ensure the sustainability of scuba diving tourism in the future, it is imperative to consider certain factors: the issues which may improve the dive experience; the industry's search for commercial profit out of the same experiences; the local community's needs and priorities; the overall necessity to preserve and protect the marine environments in which such activities take place. The conciliation of all these different, complex and at times contradictory goals presents a challenge to the several stakeholders who utilise, manage and value the marine environments in question [62 - 64].

Preferences for marine biodiversity may vary according to different cultural backgrounds [65]. However, a higher value is attributed to visiting a place where there is a strong conservation culture. The origin of the diving tourists may vary according to the destination, but certain patterns can be found, especially regarding tropical destinations [66 - 68], perhaps due to the pristine waters and higher biodiversity of marine species [69]. The need for a reinforced ecological management of the coastal areas where diving is practiced [8, 14, 15, 70] should include measures to maintain ecosystem equilibrium and increase visitors' environmental awareness [71].

Several authors highlighted the importance of socio-demographic studies for defining diver motivations and perceptions towards several aspects of the activity and better address environmental awareness and education programs [16, 70, 72, 73].

Most of the surveyed divers were Portuguese, probably due to the fact that Portuguese tourists are among the four main nationalities visiting the Islands [1] and, as perceived by the authors, being a Portuguese owned diving center tends to attract more Portuguese divers.

As observed in most other diver surveys [32, 33, 72, 74 - 78] male divers are the majority, most have a college degree, and professional and technical occupations such doctors, teachers, and engineers. In fact, it was observed that diving is mostly practiced by individuals with a high level of formal education [8]. Similar results have been observed in other surveys [75, 79]. Nevertheless, more than half of respondents claim that diving has low or no impact in the marine ecosystems and only 41% are aware of the vulnerability of the marine ecossistem.

With almost half of the diver population with ages above 41 years and 77% hosted in four or more stars hotels, it is clear that diving is mostly practiced by people who are economically well off, as suggested by Musa *et al.* [80].

The vast majority of the interviewed divers were inexperienced, with less than 50 dives and many of them were experiencing diving as part of a holiday or once-only activity [81]. Similar results were obtained by Rangel [32] for south Portuguese coast divers. Given that more experienced divers (measured in number of dives) caused less impact on the system [16], divers' profiling should be evaluated and adjusted prior to the educational programs.

Understand if teaching environmental education can, in fact, influence the way people behave in practice is fundamental [82]. Addressing environmental problems by placing youngsters in natural, undisturbed places can act as a powerful environmental education tool [82], and the marine environment can be used as an "outdoor laboratory", where the diving operator provides *in situ* biological and ecological information to visitors [83].

The sustainability of scuba dive tourism requires not only the conservative use of natural and social resources, but also economic viability of all stakeholders, community integration and the provision of satisfying diving experiences [84]. Sal Island, having multiple artificial and natural reefs contributing to conservation and socio-economic purposes [85], seems to be in the right path to achieve a good position among the world's leading scuba diving hotspots. In fact, 95% of the respondents would recommend a dive trip to Sal Island to friends and family, indicating a high level of diving satisfaction.

When it comes to the interaction between diving and social and environmental issues, Sal Island's case does not differ much from those of Belize in the Caribbean [86], Mozambique, in East Africa [87] and Palau, in the Pacific [68,

88] since in all cases fishing and agriculture coexist with scuba diving tourism. However, given the predominance of the dive tourism industry in Sal Island over other industries, both land and marine-based, which is not discernible in the previously referred cases, there has been an increasingly high competition between several tourism operating businesses, resulting in irresponsible management practices (M. T. Oliveira, pers. Observ.). Hence the suggestion by the present study of a new paradigm for the management of Sal Island as a reef-based dive tourism destination, one that integrates the concepts of Sustainable Tourism Development (STD) - important for the establishment of development guidelines - and Integrated Coastal Management (ICM) - essential for the practice of a sustainable management effort [89, 90]. These conceptual frameworks draw inspiration from the principles present in Agenda 21, devised at the Rio Earth Summit in 1992 [91] and are meant to represent a new step towards the solution for increasing constraints in coastal zones and offer a better answer to the growing pressures from tourism development [92 - 96]. The implementation of STD and ICM approaches opens the way for a more integrated management framework for Sal Island's dive tourism, one which can be practised with the contemplation of multiple domains, such as scientific management integration, spatial integration and stakeholder integration. These key factors of 'integration' in the management of dive tourism must not be separately considered, but rather taken as overlapping and interacting with one another (Fig. **9**). Leadership can prove vital in helping the host community engage in a series of adaptive management opportunities, besides encouraging participation and inclusion, thus benefiting the diving industry. The Leadership class should also address and foment some main factors of development, needed for a healthy management of the sector:

a. The complementarity of natural and social sciences, which would monitor the impact of the activity on both the natural resources explored and the local host community, as well as the relation between these two;
b. The development of a community-oriented tourism;
c. Voluntary management which, if coordinated with education and good governance, can ensure a long-term viability of the dive tourism industry [84].

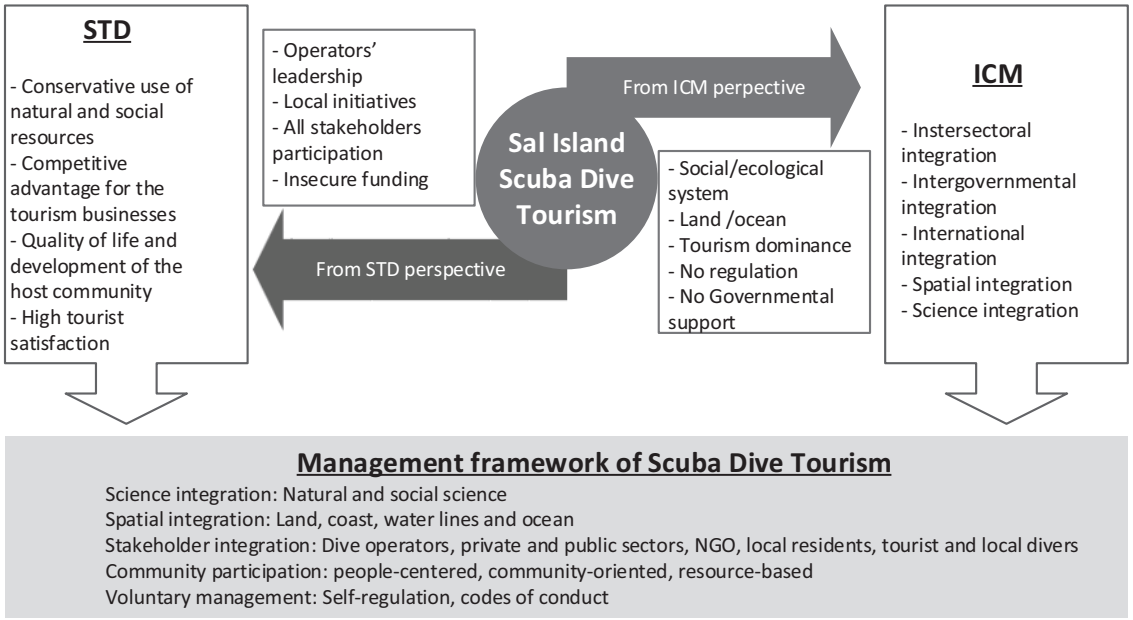


Fig. (9). Illustrative diagram for the management of scuba dive tourism. Adapted from Pearce [97] and Wongthong & Harvey [84].

The vast majority of our surveyed divers claim that the *Species ID field guide* and the *Diving routes guide* had contributed to improving their diving experience and provided a better understanding of marine biodiversity of the dive site and would recommend them to their friends and family. The same was observed for the dive briefing, where 87% strongly agreed that this is a powerful tool to improve environmental awareness. Barker & Roberts [30] and Camp & Fraser [98] advocated on-board "environmental briefings", provided immediately before diving, thereby ensuring a pleasant and safe experience, while simultaneously effectively promoting an increase in environmental awareness.

These pre-diving briefings are highly effective at reducing divers' contact with the surroundings, since they emphasize the importance of buoyancy control and careful action, important educational tools, resulting in an increase in environmental awareness and, thus, reduction of diver damage [16, 17, 28, 29, 99].

CONCLUSION

Marine environmental sustainability is a critical global issue which, nonetheless, has the potential to be a strategic business opportunity for host communities and the scuba diving tourism industry that seeks to attract tourists to a destination.

In this study, Sal Island's divers can be classified as promoters of the diving sites visited and related products, as they seemed to enjoy their experience with the environmental tools designed for them, namely the Species ID field guide, Diving routes guide and the Environmental diving briefing. Moreover, these tools appear to have increased the diver's environmental awareness and were considered an effective way to increase environmental education and knowledge, but also to improve divers experience within the dive site.

This study was a 1st approach to better understand the diving industry in Cape Verde. A theoretical approach that incorporates human and social dimensions into the management of the said industry in Sal, through the implementation of ICM and STD in a more integrative way is proposed. Nonetheless, future research is needed to better understand this industry in a more holistic manner, identifying the concerns of each separate stakeholder, as well as the interactions between them, improving the management and planning processes currently in practice, reviewing present issues and elaborating solutions. All this is of core importance in allowing the decision-making processes to modify and adapt management models and principles, such as ICM and STD, to best serve the local conditions, thus attaining a more efficient and sustainable management of the dive tourism industry off Sal Island.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Not applicable.

HUMAN AND ANIMAL RIGHTS

No animals/humans were used for studies that are the basis of this research.

CONSENT FOR PUBLICATION

Not applicable.

CONFLICT OF INTEREST

The authors declare no conflict of interest, financial or otherwise.

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SUPPLEMENTARY MATERIAL

Supplementary material is available on the publishers Website along with the published article.

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