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Underwater ecotourism in the Algarve, South of Portugal: implementation and divers' perceptions

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Declaro ser o(a) autor(a) deste trabalho, que é original e inédito. Autores e trabalhos consultados estão devidamente citados no texto e constam da listagem de referências incluída.

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Resumo

O presente estudo visou analisar, pela primeira vez em Portugal, diferentes aspectos relacionados com ecoturismo subaquático e mergulho. Mais especificamente pretendeu-se: 1) criar e implementar uma rede de roteiros subaquáticos (a realizar em mergulho livre – apneia - e com escafandro autónomo – "scuba") na região Algarvia (Sul de Portugal); 2) identificar a valorização económica efectiva da implementação dos roteiros de apneia; 3) analisar o grau de satisfação e as diferentes percepções dos utilizadores relativamente ao mergulho nos roteiros e às infra-estruturas de apoio existentes na região; 4) perceber o efeito potenciador de consciencialização ambiental dos roteiros. Para efectivar a análise do presente estudo, implementaram-se três roteiros de apneia na Praia da Marinha, e dois roteiros "scuba" em populares locais de mergulho da região: "B24", ao largo de Faro, onde se encontra submergido um bombardeiro que afundou durante a II Guerra Mundial; e "Poço", ao largo de Armação de Pêra, constituído por um afloramento rochoso típico da região algarvia, com elevada biodiversidade e beleza paisagística. Os roteiros foram implementados em 2008, com placas interpretativas localizadas em pontos pré-definidos ao longo dos percursos. Uma equipa de investigadores foi disponibilizada para apoio nos diversos locais de mergulho, por forma a efectuar os *briefings* ambientais prévios ao mergulho, dar o apoio logístico necessário e efectivar os questionários pós mergulho. De acordo com o método do custo de viagem, e assumindo uma capacidade de carga de 1000 mergulhos/ano, o valor económico total referente aos três roteiros de apneia foi estimado em 250000€. A maior parte dos mergulhadores classificam a experiência de mergulhar em roteiros como "boa" ou "excelente". Na generalidade, tanto os mergulhadores de apneia como os de escafandro autónomo consideram os roteiros uma ferramenta interessante e eficiente para o desenvolvimento da actividade e para a sua promoção na região. Paralelamente, as vertentes de educação e interpretação ambiental associadas aos roteiros parecem agradar aos visitantes, estimulando de forma efectiva o conhecimento e a preservação do meio envolvente e, em consequência, potenciando a consciencialização ambiental dos mergulhadores. De uma forma geral, os mergulhadores consideram mais satisfatório mergulhar em locais de mergulho com roteiros implementados.

Palavras-chave: Ecoturismo, turismo de mergulho, mergulho com escafandro autónomo, apneia, roteiro subaquático, educação ambiental, interpretação ambiental.

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Abstract

The main aims of this study on underwater ecotourism, the first in Portugal, were: 1) to develop and implement a network of underwater routes (snorkelling and scuba diving) in the Algarve, South of Portugal; 2) identify the economic valuation of snorkelling routes; 3) analyse the degree of satisfaction of users in relation to the routes and to the support infrastructures; 4) understand if the routes increase environmental awareness of divers. Three snorkelling routes were implemented in Marinha Beach along with two scuba diving routes, "B24" (off Faro city), the wreck of a World War II bomber, and "Poço" (off Armação de Pêra city), a rocky outcrop rich in biodiversity and landscaped features. All the routes were implemented in 2008, with interpretive slates at fixed locations along the route. Researchers were at the sites to answer any questions, carry out the pre diving environmental briefing, and questionnaire surveys. Based on the travel cost technique, and assuming a carrying capacity of 1000 dives *per* year, a total economic value for the 3 snorkelling routes of 250000€ was estimated. Most respondents perceived the existence of routes to be good for the preservation of the local biodiversity and reported this experience as "good" or "excellent". Overall, both snorkelling and scuba routes seem to be an effective tool for developing ecological awareness in tourists, as they enhance the preservation and the understanding of the marine coastal environment. Results show that *in situ* education and interpretation can raise environmental awareness if properly addressed. Also, the interpretative and educational tools used seem to please visitors, resulting in a satisfactory way of engaging snorkelers in the protection of the visited environments. Overall, divers seem to consider that diving within the routes framework is more pleasant than diving without this infrastructure.

Keywords: Ecotourism, diving tourism, scuba dive, snorkelling, underwater route, environmental education, environmental interpretation.

Resumo alargado

A crescente atractividade de zonas costeiras impõe elevada pressão antropogénica nestas áreas onde podem ser identificados alguns dos *habitats* com maior biodiversidade do planeta, incluindo alguns dos mais ricos, produtivos e frágeis ecossistemas.

Deste modo, a utilização recreativa da orla marinha costeira, o mais procurados destino turístico actualmente identificado, constitui um factor de preocupação crescente entre gestores, ambientalistas, cientistas e população em geral, uma vez que apresenta óbvios conflitos entre utilização humana, recreação e conservação da natureza.

O turismo marinho e costeiro constitui uma das áreas do turismo com maior taxa de crescimento a nível mundial, podendo constatar-se o desenvolvimento acelerado de actividades marinhas por todo o mundo, em parte devido à crescente popularidade destas actividades recreativas.

A prática de ecoturismo parece apresentar-se como a única forma viável de exercer actividades recreativas em ambiente costeiro e, paralelamente, proteger o património biológico e sociocultural associado.

Dentro das actividades enquadradas no ecoturismo, o sector de mercado turístico com crescimento mais acentuado a nível mundial, encontram-se as diversas tipologias de mergulho, tais como o mergulho em apneia e o mergulho com escafandro autónomo. De facto, o mergulho é actualmente uma das actividades comerciais mais importantes em zonas como Áreas Marinhas Protegidas (AMPs), o que enfatiza a necessidade de analisar e compreender em detalhe os seus possíveis impactos.

No entanto, contrariamente ao que parece evidenciado pelos números apresentados, a análise dos impactos que a actividade de mergulho provoca nos sistemas naturais e socioeconómicos associados, é reduzida, e os estudos que podem ser identificados na literatura científica referem-se, maioritariamente, ao efeito do contacto directo de mergulhadores em recifes de coral. Na sua maioria, a literatura existente cinge-se a relatórios de projecto, inacessíveis ao público em geral.

O mergulho, independentemente do formato em que é praticado, permite ao visitante o contacto directo com o ambiente subaquático e, consequentemente, com os seus mais diversos elementos biológicos, geológicos e históricos. Assim, ainda que existam diversas ferramentas de gestão aplicáveis a esta actividade, a utilização de medidas "suaves" associadas à educação e interpretação ambiental, aplicadas como parte integrante de uma actividade ecoturística, são cada vez mais consideradas na gestão desta actividade recreativa.

Uma forma comummente aceite para a introdução de educação ambiental na actividade de mergulho é a criação e implementação de roteiros subaquáticos, em que o visitante é "guiado" através de sinais interpretativos num trajecto previamente seleccionado para visitação. A selecção do trajecto deve incluir factores como a satisfação do mergulhador e, paralelamente, deve permitir o desvio dos mergulhadores de zonas mais sensíveis do ponto de vista conservacionista. A definição do roteiro deve ainda ter em consideração o mapeamento

criterioso de fauna e flora existente, assim como a localização de qualquer área potencialmente sensível ao contacto humano. Paralelamente, os sinais interpretativos devem ser apelativos, identificar-se com os mergulhadores alvo, localizar cada indivíduo no trajecto, funcionar como guias de espécies faunísticas e / ou florísticas potencialmente avistáveis, e fornecer toda a informação adicional considerada necessária.

A implementação de um roteiro subaquático não deve descurar a existência de um *briefing* abrangente e com carácter ambiental, precedente a cada imersão.

No presente estudo pretendeu-se genericamente: 1) criar e implementar uma rede de roteiros subaquáticos (a realizar em apneia ou com escafandro autónomo) na região Algarvia (Sul de Portugal); 2) identificar a valorização económica efectiva da implementação dos roteiros de apneia; 3) analisar o grau de satisfação e as diferentes percepções dos utilizadores relativamente ao mergulho nos roteiros e às infra-estruturas de apoio existentes na região; 4) perceber o efeito da função de consciencialização ambiental introduzida no *design* dos roteiros.

Para a efectivação dos roteiros a estudar no âmbito do presente estudo foi levado a cabo, em cada zona considerada, o mapeamento das biocenoses marinhas, de acordo com a metodologia de censos visuais. O mapeamento foi executado no âmbito do projecto RenSub (responsável pela cartografia e caracterização das biocenoses marinhas da Reserva Ecológica Nacional Submarina do Algarve entre 2003 e 2010). Nas áreas de mergulho seleccionadas, a definição dos trajectos de mergulho com maior interesse para o visitante foi efectuada de acordo com a classificação (de "1" – não interessante até "5" – extremamente interessante) mais consensual em cada uma das características pré-consideradas (biológicas, geológicas, paisagísticas, infra-estruturais, entre outras), definidas num quadro preenchido pós mergulho por cada investigador envolvido no mapeamento. Em cada ponto do roteiro identificados como local de observação potencialmente interessante (do ponto de vista do mergulhador), foi colocada uma placa informativa (presa a bóias sinalizadoras à superfície da água em roteiros de apneia, ou suspensa por cabos amarelos presos ao substrato por âncoras "amigas do ambiente" em roteiros de escafandro - "scuba"). As placas (com dimensões de 15cm por 10cm) em acrílico colorido, foram dotadas de informação diferenciada na frente e no verso. Assim, na frente expôs-se o mapa do percurso com a localização do mergulhador e os diversos pontos com placas sinalizadoras. Informações relativas a características físicas da zona (como o tipo de substrato e a profundidade média) foram também consideradas. No verso ilustraram-se oito fotografias de exemplares biológicos com maior probabilidade de avistamento no ponto interpretativo em questão (incluíram-se nomes comuns e nomes científicos). Para efeito de ilustração de procedimentos apresenta-se a metodologia detalhada do desenho do roteiro de apneia da Praia dos Arrifes (Algarve, Sul de Portugal). Para as diversas análises posteriores apresentadas nesta tese, implementaram-se três roteiros de apneia na Praia da Marinha (Algarve, Sul de Portugal) na época balnear de 2008, sempre com uma equipa de investigadores no local para todo o apoio necessário e para efectivação de questionários pós actividade. Paralelamente foram ainda implementados dois roteiros "scuba" em populares locais de mergulho Algarvio: "B24", ao largo de Faro; e "Poço" ao largo de Armação de Pêra. Estes roteiros foram implementados pela primeira vez em 2008, e sempre operados em associação com centros de mergulho locais ("Dive Spot" em Armação de Pêra e

"Hidroespaço" em Faro). A presença de investigadores para apoio no local e para efectivação dos questionários pós mergulho foi, do mesmo modo, uma constante. Os roteiros foram incluídos em diversas campanhas de divulgação de actividades recreativas com o nome de "EcoSub", sendo publicitados em diversos meios de comunicação social (rádio, televisão, jornais nacionais, revistas de divulgação turística e páginas *web*).

Para a definição do valor da utilização recreativa de mergulho em apneia, foram utilizados dados referentes aos três roteiros implementados na Praia da Marinha de acordo com o método do custo de viagem. Com esta análise pretendeu-se definir o valor de uso, e os benefícios de recursos naturais utilizados para esta actividade de recreação. Validaram-se 115 inquéritos efectuados entre Julho e Setembro de 2008, analisando-se os dados pelo modelo de regressão. Considerou-se como variável independente o número de mergulhos efectuados e como variável dependente os diversos custos, considerando o tempo despendido na actividade ponderado por uma fracção do rendimento declarado. Concluiu-se que o excedente médio por mergulho é de 5€, pelo que o valor de uso dos roteiros é de 600€/ano, correspondente a um total de 30000€ admitindo uma taxa de desconto de 2% e a manutenção do recurso. Com uma capacidade de carga de 1000 mergulhos por ano, a renda total do recurso por ano passa a ser de 5000 € e o valor económico total de 250000€.

As percepções dos visitantes relativamente aos roteiros implementados na Praia da Marinha, considerando as percepções relativamente aos roteiros e às infra-estruturas de apoio, foram analisadas utilizando 202 questionários validados e correspondentes a todos os utilizadores dos roteiros das épocas balneares de 2008 e 2009. Todos os questionários foram efectuados presencialmente e imediatamente após cada experiência de mergulho. Foi recolhida informação relativa às percepções dos indivíduos relativamente a diversos aspectos dos roteiros, à sua caracterização socioeconómica, às características demográficas da amostra, aos custos associados à realização da actividade, e ainda às opiniões reveladas relativamente à oferta de infra-estruturas de apoio da praia. De uma forma geral, concluiu-se que os roteiros favorecem um amento da consciencialização relativamente à preservação da biodiversidade. O mergulho em roteiros foi considerado como uma experiência "boa" ou "excelente". Na generalidade, os roteiros parecem actuar como uma ferramenta eficiente apara atrair mergulhadores e, paralelamente desenvolver a consciência ecológica através do aumento do conhecimento relativamente ao ambiente circundante.

A análise do efeito de consciencialização ambiental dos roteiros de apneia da Praia da Marinha foi também investigada. A avaliação de possíveis impactos humanos os roteiros foi efectuada, através da técnica dos censos visuais, por definição da percentagem de cobertura de macroalgas e macrófitas no interior da área do roteiro mais utilizado e na área exterior imediatamente adjacente. A partir dos 202 questionários validados definiu-se o perfil do mergulhador e avaliaram-se as suas percepções em relação a diversos aspectos dos roteiros (tais como a sua função no desenvolvimento da consciência ambiental). Os questionários foram realizados presencialmente a cada utilizador imediatamente após a experiência de mergulho, durante as épocas balneares de 2008 e 2009. Observou-se a existência de um padrão de cobertura vegetal, muto provavelmente associado as diferenças sazonais de temperatura da água do mar na área em análise. A existência de actividade recreativa humana não parece ter um papel relevante neste processo. Os mergulhadores identificados apresentam

idades que rondam os trinta anos, elevado nível de educação formal e preocupação com questões ambientais. De uma forma geral, interpretação e educação subaquática *in situ* adequada parece promover um aumento da consciencialização ambiental. De facto, na generalidade, ferramentas de interpretação e educação ambiental parecem agradar os visitantes, resultando numa actividade satisfatória, enquanto cativam os mergulhadores para a protecção do ambiente que os circunda.

Por forma a analisar diferentes percepções de mergulhadores relativamente a vários aspectos de roteiros subaquáticos a efectuar com escafandro autónomo (roteiros "scuba"), foram seleccionados dois populares locais de mergulho Algarvios: "B24", localizado ao largo de Faro (local de mergulho onde se pode visitar um bombardeiro americano atingido e afundado no decorrer de operações militares na 2ª Guerra Mundial), e o "Poço", ao largo de Armação de Pêra (um afloramento rochoso, paisagisticamente complexo, com diversos túneis e cavernas escavadas, rico em biodiversidade característica do litoral Algarvio). Os roteiros foram implementados em 2008 e as estruturas têm sido mantidas sempre que as condições marítimas/atmosféricas o permitem. O perfil dos utilizadores e as suas percepções relativamente a diferentes factores como satisfação, motivação ou estruturas de apoio, foram obtidos através e um questionário efectuado presencialmente. Todos os mergulhadores que visitaram os roteiros entre 2008 e 2012 foram abordados para efectivação do questionário. Foram utilizados para análise um total de 246 questionários, que permitiram classificar uma população inquirida maioritariamente Portuguesa, de sexo masculino, com mais de trinta anos de idade e mais de 12 anos de educação formal. Relativamente às percepções gerais visando infra-estruturas de apoio salienta-se a opinião menos positiva identificada em algumas das estruturas oferecidas. Este aspecto deve ser cuidadosamente observado por gestores, uma vez que as percepções positivas geram opiniões positivas relativamente aos destinos turísticos que são, por norma, expressas a possíveis visitantes. Concluiu-se ainda que o mergulho em roteiros é considerado, de uma forma geral, mais satisfatório que o mergulho em zonas onde esta estrutura não se encontra implementada.

Os roteiros implementados para efectuar com escafandro autónomo nos locais de mergulho "B24" e "Poço" foram ainda utilizados para avaliar o seu potencial relativamente ao efeito de consciencialização ambiental entre mergulhadores. Para este efeito, foram utilizados 106 questionários (efectuados entre 2008 e 2012, presencialmente e imediatamente após a actividade de mergulho) referentes a mergulhadores que utilizaram estes roteiros. A maioria dos entrevistados referiu encontrar-se em período de férias. Observou-se uma população maioritariamente masculina, com mais de 30 anos, e com elevado grau de educação formal. De uma forma geral, educação e interpretação ambiental, quando conduzidas de forma consciente e adaptadas à população alvo, parecem promover efectivamente a consciencialização ambiental dos visitantes. De facto as ferramentas de interpretação e educação ambiental utilizadas (*briefing* ambiental e placas interpretativas subaquáticas) parecem agradar os visitantes, resultando numa actividade satisfatória, e potenciando a consciencialização dos mergulhadores para a protecção do ambiente que os circunda.

Palavras-chave: Ecoturismo, turismo de mergulho, mergulho com escafandro autónomo, apneia, roteiro subaquático, educação ambiental, interpretação ambiental.

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CHAPTER 3 – PAPER 2

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CHAPTER 4 – PAPER 3

Rangel, M.O., Pita, C., Gonçlaves, J.M.S., Leite, L., Costa, C., Erzini, K., 2011. Ecotourism snorkelling routes at Marinha Beach (Algarve). Journal of Coastal Research, *Special Issue* 61:274-281.

CHAPTER 5 – PAPER 4

Rangel, M.O., Pita, C., Gonçlaves, J.M.S., Oliveira, F., Costa, C., Erzini, K. Developing eco-tourist snorkelling routes in protected beaches: diving tourism education and monitoring. Submitted to *Journal of Sustainable Tourism.*

CHAPTER 6 – PAPER 5

Rangel, M.O., Pita, C., Gonçlaves, J.M.S., Oliveira, F., Costa, C., Erzini, K. Developing self-guided scuba dive routes in the Algarve (Portugal) and analysing visitors' perceptions. Submitted *to Marine Policy.*

CHAPTER 7 – PAPER 6

Rangel, M.O., Pita, C., Gonçlaves, J.M.S., Oliveira, F., Costa, C., Erzini, K. Can self-guided scuba dive routes enhance environmental awareness? The case of the Algarve (Portugal). Submitted to *Ocean & Coastal Management.*

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List of Acronyms and Abbreviations

EU	European Union
UNWTO (former WTO)	World Tourism Organization
WCED	World Commission on Environment and Development
TIES	International Ecotourism Society
NOAA	United States National Oceanic and Atmospheric Administration
FPAS	Portuguese Federation of Underwater Activities
CMAS	World Confederation of Underwater Activities
PADI	Professional Association of Diving Instructors
SSI	Scuba Schools International
SDI	Scuba Diving International Representative System
PADI AWARE	Aquatic World Awarness, Responsibility and Educatin
REEF	REEF Environmental Fountadion
MPA	Marine Protected Area
FAO	Food and Agriculture Organization of the United Nations
EcoSub	Ecoturismo Subaquático (project designation for advertisement purposes)
REN	Reserva Ecológica Nacional –National Ecological Reserve
CFRG	Coastal Fishery Research Group (CCMAR)
CCDR - Algarve	Regional Development and Coordination Commission of the Algarve
INE	National Statistical Institute
RenSub	Research project of CFRG / CCDR - Algarve responsible for mapping biocenoses of the Algarve underwater REN
TCM	Travel Cost Method
NPV	Net Present Value
TC	Travel Cost
OCL	Opportunity Cost of Labour
H’	Shannon Diversity Index
R	Margalef Index
λ	Simpson Diversity Index
J’	Eveness
TCM	Cost Travel Method
NPV	Net Present Value
INE	National Statistical Institute
OCL	Opportunity Cost of Labour
VIF	Variance Inflation Factor
$\chi 2$	Chi-square test
t	t-test
z	Wilcoxon-Mann-Whitney test
VAMP	Visitor Activity Management Process
H	Kruskal-Wallis test
MDS	Non-metric Multi-Dimensional Scaling
ANOSIM	Analysis of Similarities
SIMPER	Similarities Percentage analysis

CHAPTER I

GENERAL INTRODUCTION

General Introduction

The aim of this chapter is to introduce and discuss the major concepts addressed in this thesis. Key definitions such as the differences between mass tourism, sustainable tourism, and ecotourism are the focus of the first section of the chapter. Diving tourism, its framework, the development of the industry and the impacts that it has on the biological and socio-economic environments are discussed in the second section. The use of educational and interpretation tools for enhancing sustainability within dive tourism is also discussed, along with the description of some examples of underwater routes available in different locations around the world. Finally, major objectives and an overview of all papers that constitute the thesis' chapters are presented along with details of the links between the chapters.

1.1 Principles of Tourism

Tourism is one of the fastest growing industries in the wold (Neto, 2003) and is defined by the World Tourism Organization (UNWTO) (UNWTO, 1995) as:

"The activities of persons travelling and staying in places outside their usual environment for not more than one consecutive year for leisure, business and other purposes."

Visitors are the individuals who are involved in tourism activity and can be divided in two different groups: **tourists**, if they stay overnight and **same-day visitors**, if they do not stay overnight.

According to Eurostat (1998), to distinguish visitors from other travellers, three criteria must be used:

1 – The trip must have a destination different from the usual environment;

2 – The visitation cannot be longer than 12 consecutive months;

3 –The main purpose of the visit must not be the exercise of a remunerated activity of the visited place.

1.1.1 Sustainable tourism

According to Wong (1998), the need for **sustainable tourism** originated from the excesses of coastal tourism activities. The UNWTO emphasises that biological equilibrium in touristic

natural areas can only be ensured through sustainable tourism (WTO, 2001). The publication of *Our Common Future* (WCED, 1987) defined the early stages of matching development with environment and governance (Sneddon *et al.*, 2006). After more than 20 years there are still numerous definitions for sustainable tourism (Sharpley and Stone, 2009), but an adapted definition of sustainable development of the Brundtland Report (WCED, 1987) seems to be consensual:

"Sustainable [tourism] development is development which meets the needs of tourists, the tourism industry, and host communities today without compromising the ability of future generations to meet their own needs."

In the tourism industry, the concept of sustainability was established under the notion that there is a need to balance the relationship between environment and tourism, yielding some compromises to ensure that planning and all predictable involved conflicts are included in the overall stability (Swarbrooke, 2000).

In fact, some authors felt the need to emphasise environmental, social and economic aspects within the above definition. Hence, we can also use the Swarbrooke (1999) definition for sustainable tourism:

"Tourism which is economically viable but does not destroy the resources on which the future of tourism will depend, notably the physical environment and the social fabric of the host community."

Nevertheless, the most broadly accepted definition for sustainable tourism seems to be the one defined by the World Tourism Organization which defines sustainable tourism as (UNWTO, 2004):

"All forms of tourism that meets the needs of present tourists and host regions while protecting and enhancing opportunities for the future. It is envisaged as leading to management of all resources in such a way that economic, social and aesthetic needs can be fulfilled while maintaining cultural integrity, essential ecological processes, and biological diversity, and life support systems."

In all proposed concepts of sustainability, however, there is a baseline key concept of balancing the relationship between tourism and environment, engaging all stakeholders in the production and consumption processes, in order to guarantee long-term economic, environmental, socio-cultural and political wellbeing of all stakeholders (UNWTO, 2004; Cooper, 2008). Including all stakeholders reinforces the capacity to deal with perceived

conflicts or problems (Byrd, 2007; Butts and Sukhdeo-Singh, 2010).

Byrd (2007) emphasises an important question related to decision-making. The author refers that, in some cases, decision taking is a top-down process, and does not reflect the point of view of host communities. Butts and Sukhdeo-Singh (2010) reinforce that sustainable tourism has to take into consideration the needs of the communities, assuring no endangering of the future ones.

Taking all definitions into consideration, and according to Fallon and Kriwoken (2003), overall, sustainable tourism is about:

"Providing visitors with the opportunity to observe and interact with a protected environment without destroying or damaging the resources on which its future depends."

1.1.2 Ecotourism

Ecotourism is often considered as the ideal method for enhancing long-term conservation of wildlife and wildlife habitats (Reynolds and Braithwaite, 2001; Wilson and Tisdell, 2001; Ballantyne and Packer, 2005). According to Hawkins and Khan (2013), ecotourism defines touristic activities conducted in harmony with nature, in opposition to traditional **mass tourism** activities. However, as with sustainable tourism, there is no consensus regarding the formal definition of ecotourism.

As a concept, ecotourism emerged in the mid-1960s when Hetzer (1965) identified four principles of **responsible tourism**: minimize environmental effects; respect local host cultures; maximize benefits to local people; maximize tourism satisfaction. This concept was first used by (Miller, 1978), when planning for National Parks in Latin America, when he introduced the term **ecodevelopment**, defined as the integration of economic, social and political factors into biological considerations to meet environmental and human needs.

The first formal definition of ecotourism was developed at the end of the 1980s by (Ceballos-Lascurain, 1987):

"Travelling to relatively undisturbed or uncontaminated natural areas with the specific objective of studying, admiring and enjoying the scenery and its wild plants and animals, as well as any existing cultural manifestations (both past and present) found in these areas."

In 1990, the International Ecotourism Society (TIES, 1990) defined ecotourism as:

"Responsible travel to natural areas that conserves the environment and improves the wellbeing of local people."

More recent definitions of ecotourism tend to highlight principles of sustainable development. In fact, Wight (1993) refers that sustainable tourism imposes a "ethical overlay on **nature-based** tourism, which has a heavy educational dimension". In fact, over the years, the "sustainable ecotourism" concept was imbedded within the ecotourism definition (Blamey, 2001).

According to Allcock *et al.* (1994) the National Ecotourism Strategy of Australia definition of ecotourism is:

"A nature-based tourism that involves education and interpretation on the natural environment and is managed to be ecologically sustainable."

It should be highlighted that the last definition involves cultural components and that ecological sustainability addresses long-term conservation and returning to local communities (Blamey, 2001). Overall, this author considers that there are three main common dimensions within the consensual ecotourism definitions (Blamey, 2001):

- Nature-based;
- Environmentally educated;
- Sustainably managed (encompassing both natural and cultural environments).

In fact the essence of ecotourism can be described in three core principles (Blangy and Mehta, 2006):

- Protection of the environment and enhancement of biodiversity protection;
- Financial benefits for local communities without disrespect for their culture;
- Education provider for indigenous communities as well as for visitors.

Moreover Honey (2008) defines seven characteristics for "real ecotourism", that seem to "fit" the major core principles of Blangy and Mehta (2006), and which nowadays ecotourism needs:

1. Travelling to natural destinations;
2. Minimizing impacts on environment and on local culture;
3. Increasing environmental awareness for locals and tourists;
4. Endorsing direct financial benefit for conservation through ecotourism;
5. Promoting financial benefit and empowerment for locals;

6. Enhancing respect for local culture, such as learning local customs and accepting cultural differences;
7. Supporting and encouraging human rights.

In 1992, the International Union for Conservation of Nature stated that tourism is one of the biggest threats to biodiversity. Through ecotourism, it is possible to minimize and even avoid those negative effects but it needs to be carefully planned and well organized (Gössling, 1999).

In fact, Hawkins and Khan (2013) summarized a definition of ecotourism, based on several others available in the literature as:

"Ecotourism is a travel to natural areas, to learn about host communities, at the same time providing economic opportunities that work towards conservation and preservation of the ecosystem."

To conclude, it is important to mention that accepted definitions on ecotourism and sustainable tourism seem to agree on core issues. In fact, some authors (such as Honey and Gilpin, 2009; Wearing and Neil, 2009) are currently using both concepts with no distinction, since they are considered similar enough in their key principles.

1.2 Marine and Coastal tourism

Underwater images, crystal clear waters and white sands have become the *trade-mark* of a growing number of coastal destinations all around the world (Garrod and Gössling, 2008).

Coastal tourism began in the 19th century, mainly encouraged by a combined effect of mass transports development, globalization and consequent cheapening of tourism activities (Davenport and Davenport, 2006). Nowadays, **marine and coastal tourism** is one of the fastest growing areas within contemporary tourism all around the world (Davis and Tisdell, 1995; Hall, 2001; WTO, 2001; Milazzo *et al.*, 2002; Davenport and Davenport, 2006; Luna *et al.*, 2009; Mola *et al.*, 2012). In fact, the appeal of coastal resorts increased substantially due to the environmental attractiveness of sun, sea and landscape (Davenport and Davenport, 2006; Newsome and Moore, 2012), and in the nineties the EU (1998) indicated that 63% of European holidaymakers preferred the coastal area for tourism. Actually, Meng *et al.* (2008) emphasize an increasing pressure on local terrestrial and marine coastal environments due to the increasingly frequent short time holidays.

Mola *et al.* (2012) refer that coastal tourism is, in fact, the fastest growing industry in the world. The authors emphasize that this is mostly due to the fact that a significant percentage of the earth's surface contains coastlines, and most of the world's "megacities" are located in coastal areas.

Although the development of tourism has been spatially focused, for the last 50 years, on beach areas, Miller and Auyong (1991) refer that the marine environment has become "*one of the new frontiers and one of the fastest growing areas of the world tourism industry"*. In fact, the current numbers of marine tourists remains unknown but the increasing number of new beach resorts, "*sun, sea and surf* " experiences, and the growing popularity of marine related tourism activities such as diving, windsurfing, fishing and yachting, has placed an increasing pressure on the coastal zone (Hall, 2001).

Coastal habitats are amongst the most productive in the world and are placed within the most important biodiversity hotspots (McClain *et al.*, 2003; Abir, 2008; Duarte *et al.*, 2009). The increasing anthropogenic pressure in coastal areas is leading to a worldwide decline of important ecosystems, biological diversity and ecosystem functions (Balmford and Bond, 2005). In fact, the final years of the 20th century were marked by a worldwide environmental degradation caused by increasing human use of natural areas (Hart *et al.*, 1999).

According to the United States National Oceanic and Atmospheric Administration (NOAA), costal tourism and recreation are the activities with higher increase in volume and diversity (NOAA, 1997). Furthermore, this institution recommends that coastal tourism needs to be considered in plans, policies and programmes, since costal tourism and recreation affect virtually all coastal areas, directly or indirectly (NOAA, 1997). In fact, the use of coastal areas for human recreation has always been a concern for scientists, environmentalists and managers, due to evident conflicts between recreational uses and conservation of nature (Davis and Herriot, 1996; Lim and McAleer, 2005; Claudet *et al.*, 2010).

The concept of **coastal tourism** and recreation embraces "*the full range of tourism, leisure, and recreationally oriented activities that take place in the coastal zone and the offshore coastal waters. These include coastal tourism development (hotels, resorts, restaurants, food industry, vacation homes, second homes, etc.), and the infrastructure supporting coastal development (retail businesses, marinas, fishing tackle stores, dive shops, fishing piers, recreational boating harbours, beaches, recreational fishing facilities, and the like). Also included is ecotourism and recreational activities such as recreational boating, cruises,*

swimming, recreational fishing, snorkelling and diving" (NOAA, 1997).

Marine tourism "*is closely related to coastal tourism but also includes ocean-based tourism such as deep-sea fishing and yacht cruising"* (Miller and Auyong, 1991; Orams, 1999a; Hall, 2001). Orams (1999a) defines marine tourism as "*all recreational activities that involve travel away from one's place of residence and which have as their host or focus the marine environment"* (marine environment is defined as the one that embraces all saline and tide-affected waters).

The problem with these concepts lies with the definition of **coastal tourism** *per se*, since, according to Eurostat (2009) there is no consensual definition. However, in most cases the definition is based on geographical delimitations, e.g. administrative areas located near to the seashore (Söderqvist *et al.*, 2012). Visitor' surveys can also help with this definition, if they classify the touristic experience as a coastal one (Söderqvist *et al.*, 2012). According to Eurostat (2009), these two methods are complementary and can be used together.

Despite increased awareness of the economic and environmental significance of marine and coastal tourism, it is only in recent years that a substantial body of research has emerged (Hall, 2001). Nevertheless, Townsend (2003) emphasises that marine tourism encompasses risks and opportunities and that both public and private sector share responsibilities in effective management.

1.2.1 Dive tourism

Definition

Diving is a niche within the coastal-marine tourism industry (Townsend, 2008a). Its development resulted from the increasing appeal of pristine coastal touristic destinations (Garrod and Gössling, 2008).

The World Tourism Organization forecasts that in 2020 scuba diving will be one of the fastest growing sectors within the tourism trade (WTO, 2001). In fact Buckley (2004) highlight that dive tourism is a major recreational activity worldwide and, according to Davenport and Davenport (2006), scuba diving and snorkelling are among the fastest growing industries in the world. According to Garrod and Gössling (2008) diving has been considered a recreational activity for at least 75 years and Davenport and Davenport (2006) report that, *per* year, around one million new recreational divers are trained.

More than half a million new scuba divers were certified in 2000 by the Professional Association of Diving Instructors (PADI), which claims to certify 60% of all divers worldwide. From 1976 to 2012, PADI has issued 21,258,914 certificates. However it is emphasised that one diver is likely to have more than one certification (PADI, 2013). Overall, based on the estimated growth rate of WTO (2001), there were at least 28 million active divers in the world in 2008 (Garrod and Gössling, 2008).

Given the numbers of scuba divers worldwide, scuba diving is now a multibillion dollar industry (Bennet, 2003) as yearly this industry accounts for sales of around 540 million dollars in diving equipment and yields over 1 billion dollars in trips and tourism related profits (Brotto *et al.*, 2012).

There are several different dive formats, with scuba diving and snorkelling being the most popular worldwide diving activities (Orams, 1999a).

Scuba diving, a shortening for "self-contained underwater breathing apparatus" involves the use of portable air supply, allowing the diver to attain greater depths and remain underwater for longer periods than **snorkelling**, which involves minimum equipment, normally only mask, snorkel, fins and some weight (Garrod and Gössling, 2008). As snorkelling requires less equipment no specific training, it has a wider appeal and greater participation rate (Garrod and Gössling, 2008).

Scuba dive tourism is defined as (WTO, 2001):

"Persons travelling to destinations with the main purpose of their trip being to participate in scuba diving. The attraction of the destination is almost exclusively related to its dive quality rather than any other factor, such as the quality of accommodation or land-based attractions".

Nonetheless, the definition given raises some pertinent questions, since to be useful, a definition on some kind of tourism must include a method for distinguishing those who are tourists from those who cannot count as such. Garrod and Gössling (2008) list some of the questions raised by this definition:

- travel motivation: different for the individuals who select their destination based on the diving opportunities, and for "sideline" divers (WTO, 2001) or resort divers (Davis and Tisdell, 1995), who eventually take part in diving activities;
- geographical proximity: some individuals dive close to home, or travel, for one or

more days, within their own country to dive. These can also be considered as diving tourists since they travel away from their homes with the purpose of diving. WTO (2001), reports that only one in three divers travel overseas regularly for diving holidays;

- dive formats: snorkelling, scuba, and use of rebreathers are also ways of diving and one visitor may participate in a scuba dive experience one day and go snorkelling the other.

In fact, considering divers' motivations, Rice (1987), classifies divers into "hard core", "tourist", and "potential". The first are interested in flora, fauna and the challenges of all diving conditions. "Tourist divers" are the ones that will participate in diving activities as a part of their holidays. "Potential divers" are novices who want to try scuba diving.

Considering the above questions, Garrod and Gössling (2008) suggest another conceptual definition of diving tourism:

"*Diving tourism involves individuals travelling from their usual place of residence, spending at least one night away, and actively participating in one or more diving activities, such as scuba diving, snorkelling, snuba or the use of rebreathing apparatus*".

There are some important differences in this definition. In fact it does not imply that the main travelling motivation is diving, but it ensures at least one night stay, guaranteeing that the individuals are tourists and not same-day visitors. Nevertheless, it comprehends all domestic tourism.

Motivations

Divers are drawn to the most attractive diving sites, in particular warm-water sites, with high visibility and high biodiversity areas, such as coral reefs (Davenport and Davenport, 2006; Garrod and Gössling, 2008). In fact, natural scenes and pristine habitats are especially attractive to tourists, as reported by Honey and Krantz (2007) and Curtin (2009). Also, several authors indicate that snorkelers and divers are more attracted to biological attributes of the surroundings, such as the presence of fishes and coral (Shafer and Inglis, 2000; Ramos *et al.*, 2006; Uyarra *et al.*, 2009) or fish number and size (Leujak and Ormond, 2007; Uyarra *et al.*, 2009). In the Shafer and Inglis (2000) study, however, no preference related to biological attributes is reported.

Nevertheless, Curtin (2009) and Polak and Shashar (2013) emphasise that these reported preferences are closely related to several environmental conditions of the dive site, such as water clarity (Shafer and Inglis, 2000; Uyarra *et al.*, 2009) or social conditions (Shafer and Inglis, 2000)

Garrod and Gössling (2008) listed the 100 world top dive sites; all are crystalline clear, warm, and high visibility waters sites. From this list, the top 10 sites are: Yongala, Australia; Thistlegorm, Egyptian Red Sea; Blue Corner Wall, Palau, Micronesia; Barracuda Point, Sipadan Island, Malaysia; Shark and Yolanda Reef, Egyptian Red Sea; Manta Ray Night Dive, Kailua Kona, Hawaii; Navy Pier, Australia; Big Brother, Egyptian Red Sea; Great Blue Hole, Belize; and Liberty, Bali, Indonesia.

Within Marine Protected Areas (MPAs) dive tourism is more and more popular due to aesthetic appeal and support facilities (Badalamenti *et al.*, 2000) and also an increase in environmental consciousness (Davis and Tisdell, 1995; Harriott, 2002; Milazzo *et al.*, 2002; Zakai and Chadwick-Furman, 2002; Barker and Roberts, 2004; Davenport and Davenport, 2006). Nonetheless, the intensification in diving activities within MPAs will unavoidably generate environmental degradation and a decrease of resource value (Davis and Tisdell, 1995; Plathong *et al.*, 2000; Di Franco *et al.*, 2009). The control of its potential impacts on the marine environment remains a key factor for the management of this recreational activity (Di Franco *et al.*, 2009).

1.3 Diving impacts

Nowadays the condition of the coastal and marine environment is undoubtedly a public concern, but its distressed status is not only related to touristic activities. However, the increasing economic importance of this industry, the intensification of the demand for nature based tourism activities, and the desire of experimenting any form of tourism in pristine environments has contributed to an increase in research on the physical impacts of tourism (Hanna and Wells, 1992; Mola *et al.*, 2012).

Snorkelers and scuba divers visit underwater sites to observe marine creatures in a diferent environment where undiscovered landscapes can be explored. But these activities cause obvious socio-economic threats to host communities. In fact, despite obvious economic benefits, tourism raises important socio-economic and environmental questions (Davenport and Davenport, 2006). The same authors state that impacts can have devastating effects for

small island resorts but can also affect large areas such as the Algarve (Portugal).

According to Townsend (2008a), the link between environmental protection and diving first appeared in the 1960s, thanks to Jacques Cousteau's diving, and the publicity of his underwater photos and documentaries. Subsequently, organizations such as PADI AWARE (Aquatic World Awarness, Responsibility and Educatin) or REEF (REEF Environmental Fountadion) appeared, gathering information in order to promote the increase in marine environmental awarness. Their projects are examples of diving conservation attempts, which usually have benefits for local people (Townsend, 2008a). The latter author considers that the most obvious benefits of local communities are related with fishing restrictions, leading to the development of stocks that can be explored by locals, but basic healthcare and education can also be reported as direct benefits (Townsend, 2008a).

Regrettably, nowadays, the impact of touristic use of marine coastal areas, and mostly divers' impacts, on the ecosystem remain largely unknown (Claudet *et al.*, 2010). Research on this issue is scarce, and mostly found in "grey literature" (such as project reports) that are not available to the wider public (Hall, 2001; Garrod and Gössling, 2008). In fact, the scientific community agrees that the lack of scientific data makes it difficult to understand the significance of these activities (Hall, 2001; Milazzo *et al.*, 2002; Hawkins *et al.*, 2005; Garrod and Gössling, 2008).

1.3.1 Environmental impacts

Tourism can have harmful impacts on the physical and marine environments and this fact has become well recognised (Beekhuis, 1981; Archer, 1985; Hanna and Wells, 1992; Davenport and Davenport, 2006). Biological impacts related to dive pressure on natural areas are an increasing concern for the scientific community (Hall, 1996; Milazzo *et al.*, 2002; Townsend, 2003; Davenport and Davenport, 2006; Di Franco *et al.*, 2009; Rouphael *et al.*, 2011; Townsend, 2008a), but most of the available literature relates to coral reef ecosystems (e.g. Plathong *et al.*, 2000; Rouphael and Inglis, 2001; 2002; Zakai and Chadwick-Furman, 2002; Barker and Roberts, 2004; Davenport and Davenport, 2006; Sorice *et al.*, 2007; Uyarra *et al.*, 2009; Poonian *et al.*, 2010; Rouphael *et al.*, 2011; Camp and Fraser, 2012; Liu *et al.*, 2012). Also, data on marine coastal environments and their associated tourism impacts is rather scarce (Wong, 1993; Orams, 1999a), and data on the *status quo* of the environment is highly

fragmented (Wong, 1993), with base-line data regarding the condition of the natural environment prior to tourism development invariably lacking (Milne, 1990).

Nonetheless, several intentional and/or unintentional biological direct impacts of divers (scuba and snorkelers) are listed and some of them should be emphasised (Rouphael and Inglis, 1997; Rouphael and Inglis, 2001; Milazzo *et al.*, 2002; Rouphael and Inglis, 2002; Di Franco *et al.*, 2009; Rouphael *et al.*, 2011; Garrod and Gössling, 2008; Lindgren *et al.*, 2008; Liu *et al.*, 2012):

- kicking, brushing, hitting, holding, grabbing, rubbing, bumping into, standing on or kneeling on the bottoms (such as kicking rocky outcrops with divers' fins, hitting corals with dive tanks, standing on coral or seaweed, hanging on to corals to get pulled out of the water, rubbing against corals or coralline algae);
- creating sediment clouds (endangering the feeding process of filter feeding animals);
- altering feeding behaviour habits of marine fauna;
- disturbing marine mammals;
- entrapping air bubbles in marine caves.

As mentioned before, the vast majority of studies address divers' direct damage to coral reefs. But, in the absence of coral beds, other indicators can be used for defining human impacts. Some studies have been undertaken with success, and used as disturbance indicators: quantification of the tunicate *Halocynthia papillosa* (Luna-Pérez *et al.*, 2010; Luna-Pérez *et al.*, 2011); census of different sessile invertebrates (Povey and Keough, 1991; Eckrich and Holmquist, 2000; Plathong *et al.*, 2000; Di Franco *et al.*, 2009); definition of macroalgae cover, seagrass cover and/or fish assemblages (Eckrich and Holmquist, 2000; Claudet *et al.*, 2010; Liu *et al.*, 2012); and accounting for direct contact with the seabed (Luna *et al.*, 2009).

It is important to emphasise that, as recognized by Kulbicki (1998), the mere presence of divers in the underwater environment can, *per se*, disturb natural biological communities, altering their behaviour.

There are several management measures that can be used to mitigate the negative effects of divers. Milazzo *et al.* (2002) propose several tools for management of touristic activities in MPAs, such as education, training and alterations in legislation and policy. Moreover, the use of diving quotas in sensitive areas should also be considered, since the number of users influences the site impact (Barker and Roberts, 2004). As reported by Luna *et al.* (2009), an effort has been made to define carrying capacity: the number of divers that can be

accommodated at particular sites before serious damage is done (Hawkins and Roberts, 1994; Davis and Tisdell, 1995). The numbers, however, vary significantly around the world, ranging from 5000 to 50000 divers *per* site *per* year (Dixon and Sherman, 1991; Davis and Tisdell, 1995; Schleyer and Tomalin, 2000b; Zakai and Chadwick-Furman, 2002). In the underwater trails developed at Isabel Island National Park (Gulf of California) by Ríos-Jara *et al.* (2013) a tourism carrying capacity of 1,252 to 1,642 divers/trail/year was estimated, corresponding to an average of 8,897 divers/trail/year for all the six routes implemented, a higher number than the approximated recreational divers 1,000 *per* year recorded for the island.

In fact, there is an urgent need to control potential biological impacts of this recreational activity to avoid an increasing overall loss in natural resources, but more scientific information, directly aiming at divers and their different effects on the systems, is also needed (Milazzo *et al.*, 2002).

Overall, as suggested by Luna *et al.* (2009) and Poonian *et al.* (2010), proactive management is essential to mitigate negative impacts of diving on ecosystems and to maintain the aesthetic appeal of diving sites. Nonetheless, management measures must be decided under a new paradigm that embraces all three dimensions of natural systems: ecological, economic and social.

1.3.2 Socio-economic impacts

It is a recognized fact that dive tourism is potentially important for the environmental, economic and social sustainability of many marine and coastal areas (Townsend, 2008a). However, socio-economic and environmental sustainability of diving destinations, in particularly *hot spots* (areas of concentration of large number of divers), is more and more important with the increasing of the popularity of diving tourism (Garrod and Gössling, 2008).

According to Townsend (2008a), the concern about positive and negative impacts of tourists on their destinations began in the seventies, involving the three main interested groups: scientists, tourists and industry. The author argues that, initially, the concern was largely about environmental and social negative impacts such as animal disturbance or cultural change. Dive tourism, similarly to all other forms of tourism, causes different conflicts, such as: cultural changes, conflict with regard resource use (e.g. marine areas closed to fisherman

but opened for divers), and envy of outsiders due to their spending power. On the other hand, employment opportunities in a new and growing industry, genuine cultural exchange and income for local businesses can become the "other side of the coin" (Townsend, 2008b). In MPAs located in isolated areas, a broad range of new income opportunities, such as accommodation and meals or boat related activities may be offered to fisherman by tourism (Badalamenti *et al.*, 2000).

In fact, MPAS are increasingly an attraction for divers, and they are willing to pay entrance fees for the opportunity of diving in these high diversity areas (Garrod and Gössling, 2008). There are some studies on the economic importance of divers' revenues resulting from entrance fees. White and Resales (2003) report that almost all local divers, and around 80% of foreign divers were willing to pay user fees for diving at Moaboal, Cebu, Philippines, p*er person* and *per trip*, with locals willing to pay 1.06€ and foreigners 7.80€. In fact, in MPAs divers' revenue can be significant but it is important to note that for these users it is extremely important to know that the revenue is used for conservation of the MPA (White and Resales, 2003).

While environmental impacts have been addressed by both the scientific community and the tourism industry, this is yet to be contemplated for social issues caused by diving tourism. In fact, as emphasized by (Milazzo *et al.*, 2002), the scarcity of data on human impacts in Mediterranean MPAs is worrying. A huge amount of criticism arises towards the negative impact of diving tourism because of the inappropriate use of resource-rights and of the exclusion of local population (Townsend, 2008b).

Moreover, the lack of organization of the diving industry does not seem to economically favour small scale local business. Large companies such as PADI train and certify a large number of divers each year but dive companies that effectively do the training are mainly small or medium size, or part of hotels (Townsend, 2008b). It is also important to emphasize that diving is an expensive business to set up. It is extremely expensive to be trained as a professional and to be qualified as a dive instructor, the equipment is very specific, expensive and has to be frequently renewed due to the salt water. Also, to open a dive company employees need to be highly trained and fluent in several languages (Townsend, 2008b).

As in all forms of tourism, dive tourism has the responsibility to guarantee that it brings social and economic benefits to the place where it is operating, avoiding any negative

impacts. It also has the obligation to develop good relationships with local community. The following are some good examples:

- Wakatobi Dive Resort in Southeast Sulawesi, Indonesia, a resort with an environmental programme that includes the development and management of a MPA and that directly employs 100 local people, sells local products, sponsors electricity for the village, provides educational material for the schools, sponsors waste-management and sponsors a credit scheme for local small business;
- The Ecotourism Training Centre (ETC) in Thailand – a non-profit making enterprise that provides training in scuba diving but also teaches other disciplines such as English, mathematics, science or computers, because it recognizes that additional training is necessary as a prerequisite for scuba diving;
- Sandals Beach Resort, Montego Bay, Jamaica – an exclusive beach resort for couples that sponsors an out-of-school education centre and has a programme for training in the resort young people from the community.

Sustainability within diving tourism implies, as in all other industries, social, economic and environmental balance. It is ever more important to find this balance within the communities where the activities take place, to address the overall diving positive and negative impacts for these three dimensions of sustainability.

1.4 Education and interpretation as a tool to define management rules

Education is suggested by some authors as one effective way to reduce diver damage to the environment (Milazzo *et al.*, 2002; Luna *et al.*, 2009; Barker and Roberts, 2008; Brotto *et al.*, 2012). According to Orams (1999a) and Townsend (2008a) environmental education and interpretation can be effectively used as management tools for divers to prevent impact on sites and to increase awareness for marine conservation, if carefully designed according to the specifications of each dive situation. Townsend (2008a) emphasises that these tools have the advantage of being *"soft"* tools, in that they tend to increase diver enjoyment, unlike *"hard"* regulations that impose restrictions or fees on visitors and companies.

Education and interpretation are separate disciplines. Education relates to a more formal information provision that has the purpose of changing behaviours. Interpretation, on the other hand, uses guiding, information panels, leaflets to make the visitation enjoyable and to encourage empathy with the site (Townsend, 2008a). Interpretation can be defined as *"a tool*

for education aimed at developing a resource-based awareness whereby components of the environment are used to build a holistic understanding of the whole" (Leal Filho *et al*., 1998).

Hart *et al.* (1999) point out there is the need to understand if theory can influence practice in areas such as environmental education. The author mentions that environmental education attempts to help the public to understand their own questions related with their activities and *environmental dilemmas*. Addressing environmental problems by placing youngsters in natural, undisturbed places can act as a powerful environmental tool (Hart *et al.*, 1999). The marine environment, e.g., can be used as an "outdoor laboratory", where the operator provides *in situ* biological and ecological information to visitors (Salm and Siirila, 2000).

It is important to realize that little research has been done in this field, and there is almost no information on the effect that education tools have on diver impact (Townsend, 2008a). Nonetheless, the same author suggests that the limited available research advocates that impacts tend to be reduced if education is provided immediately before, or during, diving experience. In fact, on board environmental briefings, provided immediately before diving, are able to ensure a pleasant and safe experience and, simultaneously, effectively promote an increase in environmental awareness (Barker and Roberts, 2008).

As emphasized by Townsend (2008a) it is important to note that dive operators, diver leaders and entities responsible for managing dive environments, must act as a group to develop effective means of transmission of the accurate messages, at the right time, to divers. Also, it is extremely important that all training schools give particular emphasis on environmental importance of buoyancy skills, and on the importance of communication and communication skills for delivery effective messages (Townsend, 2008a).

Divers and snorkelers enjoy learning about the sites they visit, and tend to look for assistance, giving managers an excellent opportunity to reinforce environmental friendly behaviours and reduce *in situ* environmental impacts (Hannak *et al.*, 2011; Camp and Fraser, 2012).

A pre-defined briefing should be given prior to each dive because the limited number of studies focusing on the issue of information provided by briefings generally conclude that divers and snorkelers tend to be receptive to environmental education given this way, resulting in an increase in self-awareness and a reduction of damage to the underwater environment (Medio *et al.*, 1997; Zakai and Chadwick-Furman, 2002; Townsend, 2003; Barker and Roberts, 2004; 2008).

Rangel *et al.* (*submitted a*) report that "*Enviornmental Briefings*" should provide information concerning conservation, protection and possible dangers. The briefings should be designed especially for each particular dive, with important, selected and contextualized information, and should be given to the visitor immediately before the diving experience (Rouphael and Inglis, 2001; Barker and Roberts, 2004; 2008; Townsend, 2008a). In fact, several studies have shown a direct correlation between the quality of the briefing and the number of divers' contacts with the coral (Medio *et al.*, 1997; Barker and Roberts, 2004; Camp and Fraser, 2012).

Diving allows the visitation of underwater surroundings, acting as an excellent opportunity to promote *in situ* rising of environmental awareness for visitors. But, more importantly, this visitation can be used by coastal managers as a starting point for an overall educational strategy, enhancing environmental awareness amongst all coastal users and promoting more assertive environmental behaviours.

1.5 Underwater routes

Underwater routes can be used to constrain divers' concentration in certain areas that are less resilient to humans, such as coral reefs (Hawkins and Roberts, 1993; Ríos-Jara *et al.*, 2013) and to provide information (e.g. biological, scenic, geological, security), enhancing the activity, increasing the knowledge on the rules, promoting safety concerns, and driving appropriate environmental behaviours (Tabata and Miller, 1991; Hawkins and Roberts, 1993; Plathong *et al.*, 2000; Ríos-Jara *et al.*, 2013). Underwater routes are more and more used as an attempt to increase divers' environmental awareness, by recognizing underwater behaviour responsibilities and promoting a better understanding of the marine environment. As a result, a reduction in the potential damaging effect of divers on the environment is expected (Harriott, 2002; Claudet *et al.*, 2010).

In sensitive areas such as reefs, divers are relatively free to explore the surroundings since they do not have the physical and biological topography limits of the terrestrial environment (Salm, 1986) and an interpretative route can make a difference in promoting visitors' appropriate behaviour. In fact, in marine parks, for example, underwater routes are commonly used as interpretative tools (Plathong *et al.*, 2000; Silva *et al.*, 2012).

According to Plathong *et al.* (2000), interpretation associated with snorkelling routes can be used to help in mitigating divers' concentration effect, in the cases where enforcement is not

effective. Moreover, this effect is only achievable if information along the trail is carefully designed (Rangel *et al., submitted a*). It is important to note that damage in the environment is more evident near interpretative signs (Plathong *et al.*, 2000). In fact, Ríos-Jara *et al.* (2013) emphasise that it is not clear if it is preferable to concentrate divers in defined trails or spread them over a large area, since there are some studies that indicate biological damage inside trails (e.g. Plathong *et al.*, 2000). In these cases, other measurement tools should be used simultaneously (Ríos-Jara *et al.*, 2013).

The first documented snorkelling trail was established in 1958 in the U.S Virgin Islands National Park (Plathong *et al.*, 2000) and, since then, these educational and interpretative tools have increased in popularity and have been implemented in various marine sites all over the world (Robinson, 1976; Tabata and Miller, 1991).

In MPAs, scuba diving and snorkelling are increasingly important as touristic activities (Davis and Tisdell, 1995; Plathong *et al.*, 2000). Consequently, MPA managers are also becoming increasingly interested in reducing underwater effects on the environment using self-guide routes, with several examples of established routes (Lloret *et al.*, 2006; Di Franco *et al.*, 2009; Claudet *et al.*, 2010).

In the Mediterranean MPAs, there are several examples of established routes, such as: Port Cros National Marine Park and Bouches de Bonifacio Marine Reserve, French Mediterranean (Lloret *et al.*, 2006; Di Franco *et al.*, 2009; Claudet *et al.*, 2010) . In the buffer zone of the Cerbère-Banyuls Natural Marine Reserve (CBNMR), French Mediterranean coast, a self-guided snorkelling trail was implemented in 2001 to promote the concentration of snorkelers within a defined area. Environmental information is displayed in buoys with specific acoustic hearing devices, in order to promote an increase in awareness and responsibility (Claudet *et al.*, 2010).

In the South of Portugal, at Marinha Beach, Algarve, three underwater self-guided snorkelling routes were designed and implemented in 2008 and 2009. Information for divers was first provided through pre-dive briefings in the beach area near the routes. Once inside the water, acrylic slates attached to buoys provided detailed information on different aspects of the surrounding environment and guided visitors (Rangel *et al.*, 2011). Following the same project, two underwater scuba diving routes were developed and made available to the wider public in two popular diving spots of the Portuguese Algarve coast (off Faro and Armação de Pêra) since 2008 (Rangel *et al., submitted b*). The aim was to provide information along the

routes so that scuba divers would enhance their understanding of the biological, geological and geographic features of the different areas of the paths. Safety, conservation and historical relevant issues were also considered, firstly during the briefing and, once inside the water, through interpretative slates positioned along each route (Rangel *et al.*, *submitted a*).

In Brazil, Pedrini *et al.* (2010), reported that the use of underwater routes is ever more important, and the scientific community is becoming aware of its importance. Despite the fact that there are many terrestrial trails in the country, there is almost no reference to underwater trails, probably due to the inexistence of marine ecotourism, regardless of the extensive Brazilian coastline (Pedrini *et al.*, 2007; Pedrini *et al.*, 2010). One interpretative trail can however be named: Anchieta Island's Park (Southeast Brazil) underwater trail, probably a unique documented example for this country, but an important example of the scientific-based development of an underwater route (planned differently for snorkelers and scuba divers) that aims to promote environmental education. This trail, in 2010, had already received around 6.000 visitors (Pedrini *et al.*, 2010).

In Mexico, at Isabel Island National Park, six underwater trails were implemented following information obtained during underwater field observations (Ríos-Jara *et al.*, 2013). Biological, geological, and scenic aspects were considered. The aim of these trails was to concentrate scuba diving within established routes and define carrying capacity of recreational diving in this popular island.

Diving also allows the visit of archaeological underwater sites, promoting a particular tourism that is culturally demanding and with increased conservation concerns (Delgado, 2011). According to the same author, and for this purpose, media virtual tours, snorkelling, scuba diving or glass-bottomed boat tours can be used as a visitation method. Lück (2008) emphasises that the development of scuba dive and snorkelers equipment, viewing platforms, submarines and glass-bottom boats, increased the popularity of the diving activity, promoting more and more contact with underwater habitats.

The Nordic Blue Parks Project, implemented in 2009, is an example of recreation in underwater trails at wreck park sites, with three underwater parks in Finland, Denmark and Sweden, and the improvement of two already existing trails in Finland. All routes were designed to allow scuba diving in shipwreck sites and to enhance biological and cultural heritage awareness. Visitation is promoted through in situ wreck information signs, specialized underwater guides, museum exhibition, internet sites, publications, films, digitally

enhanced movies, animated reconstructions of ships, boat and canoes trips, and even occasional Remote Operated Vehicles (ROV) dives (Tikkanen, 2011).

Vrouw Maria Underwater Project that began in 2009 illustrates another example of underwater visitation of a shipwreck, the Vrouw Maria Dutch snow ship. This vessel sank in a restricted area of the Archipelago National Park (Finland) where scuba diving is prohibited. Thus, visitation is made through a blog site, a virtual simulation and a museum exhibition but, an interactive, real-time, 3D virtual reality simulation was developed to provide the visitor with a "being there" experience, allowing tourists to experience this specific underwater landscape with environmental, historical, danger and orientation information available (Tikkanen, 2011).

Nevertheless, studies of environmental education on underwater routes, and their effect in the reduction of divers' impact are rare (Berchez *et al.*, 2005), and the lack of overall knowledge in this area conflicts with the increasing use of interpretative trails as management measures all around the world (Rangel *et al.*, *submitted a*). In fact, underwater routes seem to be an appropriate instrument for enhancing divers' behaviour towards environmental awareness increase if designed and accompanied with accurate and specific educational and interpretative tools,

1.6 Diving in Portugal

In Portugal there are 272 diving sites identified and operated by diving clubs. Of these, 114 are located in the Azores Islands, 32 in Madeira Island and 126 in the mainland. In the Algarve, 53 diving sites can be identified (Skaphandrus, 2010).

Portuguese diving sites are characterized by blue waters and high biological diversity, with coral reefs, big fishes, rock formations (such as caves and outcrops) and ship/boat wrecks. The water is warmest from June to September, and the average visibility can range from anywhere between 10 and 25 meters (Skaphandrus, 2010).

For the Algarve region, the RenSub Project (2003 to 2010), responsible for mapping the underwater marine life, undertook 297 dives (from the shoreline to the 30m bathymetry) and determined an average visibility of 5.8m, and an average water temperature of 17.2ºC (Gonçalves *et al.*, 2004a; Gonçalves *et al.*, 2004b; Gonçalves *et al.*, 2007a; Gonçalves *et al.*, 2008a; Gonçalves *et al.*, 2010).

Portuguese legislation

In Portugal, there are no specific regulations for snorkelling. Regarding scuba diving, the Act n.º 24/2013 (*Diário da República, 1.ª série, N.º 56 of March, 20 2013*) regulates recreational diving throughout the national territory, particularly with regards the requirements for its practice, process for certification and control systems training, as well as the requirements and procedures authorization for the provision of diving services.

Diário da República 2ª série, Nº 148, of August 3, 2009 established the equivalence to all training levels of the training systems that submitted applications and fulfilled the requirements established by Portuguese law: the Portuguese Federation of Underwater Activities (FPAS); the World Confederation of Underwater Activities (CMAS); the Professional Association of Diving Instructors (PADI); the Scuba Schools International (SSI) and Scuba Diving International representative system SDI training. In Portugal a scuba diver can have one of the certifications described in table 1.

Table 1 Portuguese equivalences for the different diving training levels of: Portuguese Federation of Underwater Activities (FPAS); World Confederation of Underwater Activities (CMAS); Professional Association of Diving Instructors (PADI); Scuba Schools International (SSI); Scuba Diving International representative system SDI, (adapted from *Diário da República* 2ª série, Nº 148, of August 3, 2009).

Portuguese equivalence	**FPAS**	**CMAS**	**PADI**	**SSI**	**SDI**
Level 1 diver ***Supervised Diver***	Mergulhador Iniciado (FPAS NI)	Débutant Plongeur (CMAS DP)	Scuba Diver (PADI)	Passport Diver	-
Level 2 diver ***Autonomous Diver***	Praticante Nível 1 (FPAS N1); Praticante Nível 2 (FPAS N2)	Plongeur P1 (CMAS P1); Plongeur P2 (CMAS P2)	Open Water Diver (PADI)	Open Water Diver	SDI Open Water Scuba Diver
Level 3 diver ***Dive Leader***	Praticante Nível 3 (FPAS N3); Instructor auxiliary (FPAS IA)	Plongeur P3 (CMAS P3)	Divemaster (PADI)	Dive Control Specialist (DiveCon)	SDI Dive Master
Instructor	Instrutor N1 (FPAS IN1); Instrutor N2 (FPAS IN2)	Moniteurs Niveaux M1 (CMAS M1); Moniteurs Niveaux M2 (CMAS M2)	Assistant Instructor; Open Water Scuba Instructor	Associate Instructor; Open Water Instructor	SDI Assistant Instructor; SDI Open Water Instructor

1.7 General objectives

In Portugal, to our knowledge, no scientific study has ever been carried out to analyse and describe the diving activity that occurs in the coastal waters.

The present thesis aims at analysing several aspects related to underwater diving activity carried out in the Algarve, Portugal, as a first national overview on the subject. Several specific objectives will be addressed:

- Describe the design and the implementation of snorkelling/scuba diving self-guided routes in marine areas (Chapter II, IV, VI);
- Analyse the economic valuation of self-guided snorkelling routes as a way to understand the increased value of beaches, a natural resource of common use (Chapter III);
- Describe visitors' perceptions towards self-guided snorkelling routes and support infrastructures, to define if routes can be used as a tool to effectively attract visitors and develop underwater sustainable tourism (Chapter IV);
- Evaluate if underwater snorkelling routes' education and interpretation can enhance users biodiversity awareness (Chapter V);
- Describe visitors' perceptions towards self-guided scuba diving routes and support infrastructures, to define if routes can be used as a tool to effectively attract visitors and develop underwater sustainable tourism (Chapter VI);
- Evaluate if underwater scuba diving routes' education and interpretation can enhance users biodiversity awareness (Chapter VII).

1.8 Chapters Outline

This thesis was prepared in the paper-style format. Overall, all chapters are related, but they can be read independently. The General introduction (Chapter I) and the General discussion (Chapter VIII) are the only exceptions, and should be looked upon as liaison chapters, guiding the reader through overall objectives and critical interaction.

To further illustrate how the different chapters interact, Figure 1 is presented.

Underwater ecotourism routes in the Algarve

Dimension	Snorkelling				Scuba dive		Dimension
	Biological	Biological / Economic	Social	Biological / Social	Social	Biological / Social	
Scientific Issue	**Paper 1** (CHAPTER II)	**Paper 2** (CHAPTER III)	**Paper 3** (CHAPTER IV)	**Paper 4** (CHAPTER V)	**Paper 5** (CHAPTER VI)	**Paper 6** (CHAPTER VII)	Scientific Issue
	Implementation of underwater routes	***Travel cost analysis of Snorkelling routes***	***Snorkelling routes: visitors' perceptions***	**Snorkelling routes: diving tourism education and monitoring**	**Scuba diving routes: visitors' perceptions**	**Scuba routes: diving tourism education**	
Overall objectives	Design and implementation of underwater snorkelling routes - Arrifes' Beach example	Definition of the value of recreational snorkelling for Marinha Beach, using the Travel Cost technique.	Evaluate visitors' perceptions and describe the implementations of snorkelling routes in the Algarve (South Portugal), as a sustainable ecotourism offer.	Evaluate interpretative snorkelling routes as a way to preserve and enhance biodiversity awareness.	Evaluate visitors' perceptions and describe the implementations of scuba diving routes in the Algarve (South Portugal), as a sustainable ecotourism offer.	Evaluate interpretative scuba diving routes as a way to preserve and enhance biodiversity awareness.	Overall objectives
Methods	Implementation of underwater routes using visual census techniques for biotopes mapping and environmental education and interpretation to promote environmental awareness.	Analysis of data collected from a survey of snorkelers of Marinha Beach implemented routes (summer season of 2008) using several regression models.	Analysis of data collected from a survey of snorkelers of Marinha Beach implemented routes (summer season of 2008 and 2009) using univariate and multivariate statistic methods	Analysis of data collected from a survey to snorkelers of Marinha Beach implemented routes (summer season of 2008 and 2009) using univariate and multivariate statistical methods	Analysis of data collected from a survey of scuba divers who dived in sites considered for implementation of routes an on implemented routes (2008 to 2012) using univariate and multivariate statistical methods	Analysis of data collected from a survey of scuba divers who dived in "B24" and "Poço" routes (2008 to 2012) using univariate and multivariate statistical methods	Methods
Major results	Appealing underwater eco-routes can be designed with accurate scientific information, and can be used to preserve marine environments, and enhance tourism activities. Information provided by eco-tourists and researcher can be used for appropriate coastal management.	The average surplus *per* dive was defined on 5€. Assuming a carrying capacity of 1000 dives *per* year, a total economic value of 250000 € can be assumed for the use of the three snorkelling routes.	Overall, routes seem to be an effective tool for enhancing diving activity in the Algarve. Furthermore, ecological awareness is improved by increasing the understanding of the marine environment. Snorkelers seem to acknowledge the importance of all support infrastructures available in the study beach.	Results show that *in situ* education and interpretation used within underwater snorkelling routes can effectively raise environmental awareness if properly addressed. Furthermore, snorkelers do not seem to have negative impacts on biological diversity inside the routes.	Divers seem to enjoy scuba diving routes. Some support infrastructures available in the study area do not seem to please users. This aspect should be carefully considered when panning diving tourism in the study area.	Scuba divers enjoy diving at the Algarve, and they prefer to dive in routes. If properly addressed, *in situ* education and interpretation, of underwater routes, can effectively raise environmental awareness,.	Major results

Figure 1 Structure and content of the thesis: general description and papers' linkage.

In Chapter II a thorough description of the design and implementation of self-guided snorkelling routes is given. For demonstration purposes, Arrifes' underwater snorkelling route definition is explained, with underwater mapping for defining fauna and flora composition and describing geological and landscape features of the area. For implementation, and enhancement of routes, the availability of basic snorkelling equipment is suggested, along with portable acrylic slates for route interpretation. The routes have an easy/medium level of difficulty and a high level of interest. Along the routes, slates describing local fauna, flora and other interesting features should be placed in specific sites to increase visitors' interest. At the end, tourists using the routes must be invited, by local managers, to fill up a questionnaire so that researchers can understand and correct all the unachieved objectives, improving the routes for the next beach season. The route designed for Arrifes' Beach, Algarve (South Portugal) is described in detail as an example. It is important to emphasize that, during the course of this thesis, routes' design was improved with the effective introduction of interpretative slates along the trails, allowing for self-guidance. These routes were implemented at a well-known beach, and in two popular scuba diving locations of Central Algarve National Underwater Ecological Reserve (REN).

Chapter III defines the value of recreational snorkelling in defined underwater self-guided snorkelling routes of Marinha Beach, Algarve (South Portugal). The travel cost technique was used for valuation. Regression analysis considered the number of dives as the independent variable, and different costs sustained during the trip, plus time spent on the activity weighted by a fraction of the declared income were defined as dependent variables.

In Chapter IV implementation and visitors' perceptions towards three underwater snorkelling routes located at Marinha Beach, Algarve (South Portugal) (Chapter III), are analysed. Also, an evaluation of the routes as a sustainable ecotourism offer is undertaken. Visitors' observations followed a face-to-face questionnaire, after diving experience, to collect information about individuals' opinions regarding the underwater routes, their social demographic characteristics, ecological appreciation, opinions about beach facilities and trip expenditures. The survey was undertaken during the summer months of 2008 and 2009.

Chapter V uses the three implemented routes of Marinha Beach, Algarve (South Portugal) (Chapter III; IV) in order to analysis the role of *in situ* interpretative trails and guidance as enhancers of biodiversity awareness. To evaluate possible human impacts, floral composition and cover area were evaluated trough visual census techniques. Divers profiles and perceptions about several issues related to the routes (e.g. role in enhancing biodiversity

awareness) were analysed through a survey using a face-to-face questionnaire during the summer months of 2008 and 2009.

In Chapter VI a detailed explanation on designing and implemented scuba diving self-guided routes in two touristically famous diving sites of the Algarve coastal area (South Portugal) is given. The chosen diving sites are: "B24", a ship wreck off Faro coast; and "Poço", a rocky reef with high biodiversity and appealing landscape located off Armação de Pêra coast. Divers' perceptions about the routes and their role in enhancing underwater tourism is carefully analysed according to scuba divers' demographic profile and motivations, users perceptions towards the diving service and the overall supporting infrastructures provided. Study areas were assessed for biodiversity mapping to characterize local fauna and flora, identify characteristics and/or protected species, locate conspicuous species and define geological and/or landscape characteristics. Mapping was undertaken using visual census techniques. Visitors' perceptions were defined through a questionnaire survey carried out from 2008 to 2012.

In Chapter VII scuba diving underwater routes of "B24" and "Poço" (Algarve, South Portugal) (Chapter VI) are used to analyse and discuss if they can effectively promote environmental awareness among divers. Visitors' opinions and perceptions were defined through a face-to-face questionnaire survey carried out from 2008 to 2012.

Chapter VIII presents the general discussion, the main conclusions obtained during this study and some final considerations regarding the most important findings. A critical analysis is done relating the initial objectives with the most relevant results obtained, taking into consideration all the constraints that followed the research process.

CHAPTER II

Underwater ecotourism routes – a case study in Central Algarve, Portugal

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Underwater ecotourism routes – a case study in Central Algarve, Portugal

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2.1 Abstract

The aim of this work was to define and describe a touristic sustainable use for the Central Algarve National Underwater Ecological Reserve (Portugal). For this purpose five underwater routes were developed for implementation in well-known beaches of the Algarve. Fauna, flora and geographic features of the underwater areas (to a depth of 7m) were scientifically described. The routes were graded with an easy/medium level of difficulty and a high level of interest. Slates describing local fauna, flora and other interesting features were defined to be placed in specific sites along the routes, to enhance environmental awareness among users, and to make the routes more appealing for diving tourism. It is suggested that basic snorkelling equipment should be made available for every interested tourist, along with acrylic slates to take underwater for route interpretation. At the end of a visit, tourists are invited to fill up a questionnaire so that researchers can understand and correct all the unachieved objectives, and improve them for the next summer season. The design of the route of Arrifes' Beach is carefully described as an example.

Keywords: ecotourism, underwater ecotourism, underwater routes, underwater walk.

2.2 Introduction

The use of coastal areas for human recreation has always been a concern for scientists and managers, because of the obvious conflict between recreational uses and natural preservation (Davis and Herriot, 1996; Apate *et al.*, 2005; Lim and McAleer, 2005). A new tendency for the promotion of sustainable ecotourism, as an alternative to mass tourism, is increasing, but market tendencies continue to dictate touristic rules (Lindberg *et al.*, 1993). Nowadays there

is the need for sustainable planning in coastal management in order to avoid adverse impacts not only for the preservation of nature, but also for market and tourism plans. As Ayala (1995) reports, ecotourism presents itself as an alternative to classic mass tourism, as a guarantee of ecosystem preservation and valorisation of local cultures and economies. As recognised by Agenda 21, ecotourism is a potential tool for sustainable development, particularly in fragile environments (e.g. protected areas), relieving pressure from traditional tourism, such as pollution and destruction of biodiversity (Stancliffe, 1998).

Regarding the choices and preferences of dive tourists in Marine Protected Areas (MPAs), Sorice *et al.* (2007) clearly states that divers prefer reductions in the level of site use to allow the implementation of conservation and education measures that can lead to a scenario of restricted underwater defined routes.

Central Algarve, including Albufeira County (the study area) was considered a National Underwater Ecological Reserve (REN) in June 1995. This classification implies special management procedures from the shore to the 30m bathymetric mark. To date, no measures have been taken to preserve and enhance sustainable underwater tourism in this popular Portuguese mass sand and sea tourism area. The Portuguese underwater REN zone covers a considerable area, in comparison with the terrestrial one. But, as reported by Gonçalves *et al.* (2007a), the systematic scientific study and data analysis of this extended area is still in the early stages, and only a global approach, considering both geologic and biologic features, associated with an understanding of coastal biological communities, especially habitats and vulnerable or endangered species, can lead to integrated tools and to the sustainable management of this natural patrimony.

The mapping and characterization of marine communities of the Central Algarve REN has been carried out through the RenSub project since 2003 by the Coastal Fisheries Research Group (CFRG) of the Centre of Marine Sciences (CCMAR). This project was financed by Regional Development and Coordination Commission of the Algarve (CCDR - Algarve) and provided the tools that allowed the definition of underwater routes, with accurate scientific information on the fauna, flora and geographic features. Underwater routes represent an attempt to reduce mass tourism, to provide accurate ecotourism facilities and infrastructures to diving tourists, and can represent a step forward in the sustainable use of the Portuguese coast.

2.3 Methodology

In this study route design procedures and subsequent data analysis refer only to the Arrifes' Beach, but it should be emphasised that the same procedures were undertaken at the beaches of the S. Rafael (1 route) and Marinha (3 routes), all located in the Algarve (South Portugal).

2.3.1 Visual census

Following the RenSub project methodology (Gonçalves *et al.*, 2004; Gonçalves *et al.*, 2007a; Gonçalves *et al.*, 2007b), only rocky shores were assessed and surveyed, since their habitat complexity is associated with high species richness (Turner *et al.*, 1999). Also, they may contain mixed rock and sand areas, thereby allowing the analysis of a variety of different types of bottom and habitats. For these substrates, transect (fauna) and quadrat (flora) techniques were used (Figure 1).

Figure 1 Transect technique.

To allow visual sampling techniques in triplicate, a 60m tape was stretched along the area. For flora composition, a 50x50cm iron quadrat was placed in three randomly chosen portions of the tape (10m 20m, and 40m of tape). For faunal composition, three main groups were identified and counted in three different transect areas according to the behaviour of the targeted species (Gonçalves *et al.*, 2007a): demersal fishes (#3 transects of 4x20m), cryptic fishes (#3 transects of 1x10m) and benthic invertebrates (#3 transects of 1x5m). Every visual census sampling trip involved three researchers equipped with scuba equipment: one expert in fishes, another in benthos and another in macroalgae. Photographic records were taken whenever *in situ* identification was unsatisfactory. After the scuba diving procedure, snorkelling, always with three team members, was used to review the areas, identify unrecorded species and to define the routes and the reference points to mark with underwater slates (Table 1).

Table 1 Sampling scheme defined for Arrifes' Beach underwater characterization.

Beach / Sampling date (2007)	Sampling method	Depth and dive time
Arrifes – 10 – Aug	Scuba dive	10m - 90'
Arrifes – 26 – Aug	Scuba dive	4m - 90'
Arrifes – 28 – Aug	Snorkelling	4m - 135'
Arrifes – 30 – Aug	Snorkelling	5m - 150'

2.3.2 Exploratory data analysis

To illustrate the biodiversity richness of the chosen beach, hence its possible use as a reference eco-area for tourism, diversity indices were calculated for identified and quantified fauna and flora (visual census techniques). Each calculation was based on the density of observed individuals along transects ($n/1000m^2$). Shannon Diversity Index (H') (Shannon and Weaver, 1949), Eveness (J') (Krebs, 1989) and Species Richness, according to Margalef Index (R) (Margalef, 1958) were obtained with Primer 6.1.5 software (Clarke and Gorley, 2006).

Flora and fauna analysis included the definition of the Frequency of Occurrence of different taxonomic groups: major groups for algae (Phaeophyta, Chlorophyta and Rhodophyta), families for fishes, and classes for invertebrates.

To allow the use of underwater routes for ecotourism, several important characteristics were rated in a five-point scale for: difficulty of routes; interest of routes; conservation of support infrastructures; and utility of support infrastructures. In order to do that a table (Table 2) was filled out by every researcher of the group at the end of each underwater survey. The results allowed the definition of important information that should be available in visible wooden boards near the beginning of the route. Information regarding safety and conservation rules should also be specified on the boards.

Table 2 Form for classifying several characteristics of the routes. Characteristics measured on a five-point scale.

ROUTE	Considered characteristic	Difficulty	Interest	Conservation	Utility
Dive technique	Free dive			-	-
	Scuba dive			-	-
Beach support infrastructures	Access to the beach without equipment		-	-	-
	Access to the water without equipment		-	-	-
	Access to the beach with equipment		-	-	-
	Access to the water with equipment		-	-	-
	Access to the physical disable people		-	-	-
	Organized parking place				
	Support bar	-	-		
	Support restaurant	-	-		
	Public WC	-	-		
	Public phone	-	-		
Terrestrial environment	Landscape	-		-	-
	Cliffs' consistency	-	-		-
	Geology of the cliff	-		-	-
	Visitable caves	-		-	-
	Flora	-		-	-
	Fauna	-		-	-
	Endemic or protected flora	-		-	-
	Endemic or protected fauna	-		-	-
Marine environment	Flora	-		-	-
	Fauna	-		-	-
	Endemic or protected flora	-		-	-
	Endemic or protected fauna	-		-	-
	Geologic formations	-		-	-
	Landscape	-		-	-

Note: Five-point scales considered:
Degree of difficulty of route: 1 - extremely easy; 2 – easy; 3 – average difficulty; 4 – difficult; 5 – extremely difficult.
Interest degree of route: 1- no interest; 2 – reduced interest; 3 – interesting; 4 – very interesting; 5 – extremely interesting.
Utility of support infrastructures: 1 – not utile; 2 –reduced utility; 3 – utile 4 – very utile; 5 – extremely util.
Conservation of support infrastructures: 1 – not conserved; 2 – hardly conservation; 3 – conserved; 4 – very well conserved; 5 – extremely conserved.

2.4 Flora and fauna analysis

Fauna and flora were identified and quantified. Table 3 represents the values obtained for the diversity indices at Arrifes' Beach.

Table 3 Diversity indices (Shannon (H'); Evenness (J'); Margalef (R)) obtained at Arrifes' Beach.

Beach	**Shannon H'**	**Evenness J'**	**Margalef R**
Arrifes	2.08	0.71	2.41

According to Margalef (1958), the R index can reach a maximum of 5 (usually varying between 1.5 and 3.5). Low values indicate high dominance of some taxonomic groups (Begon *et al.*, 1996). That does not seem to be the case in this beach.

In the RenSub II project (Gonçalves *et al.*, 2007a), the Shannon, Margalef and Evenness indices for the whole central Algarve area were 2.5, 3.6 and 0.76, respectively; close to the values we obtained. These authors refer the study area (which includes Arrifes beach) as one of high specific richness and biologic diversity.

Appendices A and B show the identified flora and fauna species. For algae (Appendix A) Rhodophyta and Phaeophyta were the main *taxon* identified (Figure 2), while Chlorophyta seems relatively poorly represented.

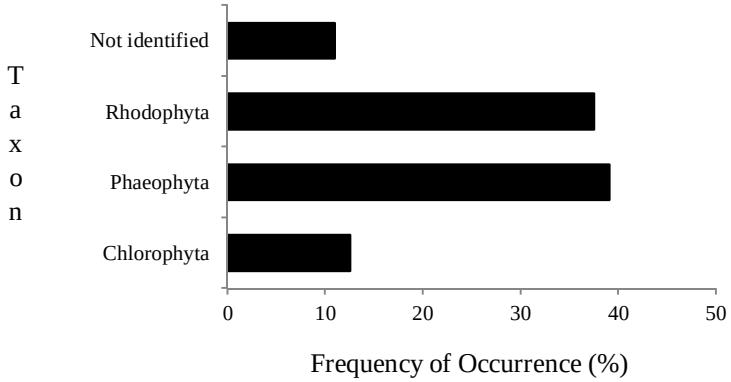

Figure 2 Frequency of Occurrence of algae considered *taxon* at Arrifes' Beach.

Of the identified algae species, the Rhodophyta *Lithophyllum incrustans* and the Phaeophyta *Halopterys scoparia*, both with 13% of the mean percentage of coverage, are noteworthy (Figure 3).

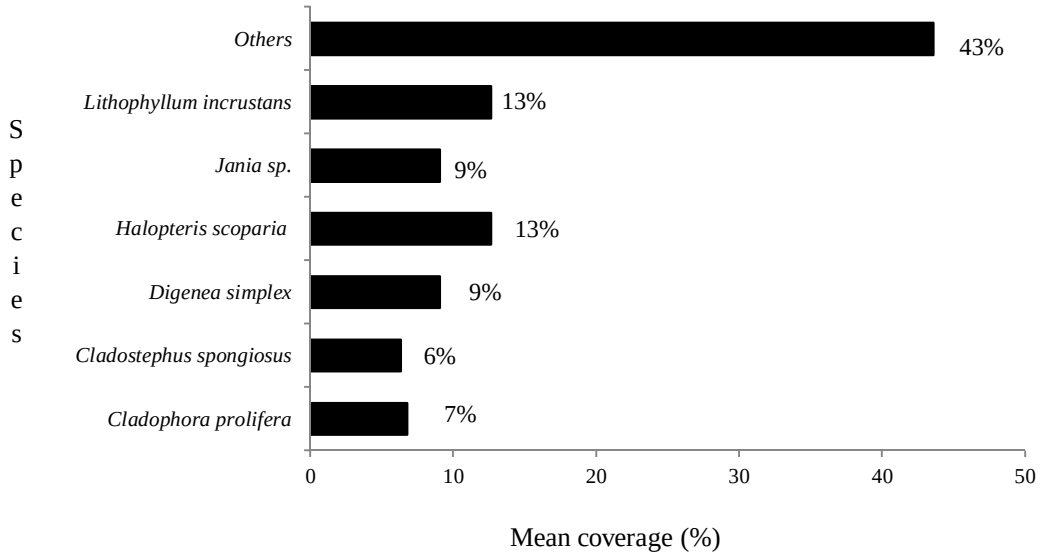

Figure 3 Mean coverage percentage of identified algae species at Arrifes' Beach. Group "others" corresponds to algae with < 30% of coverage percentage.

Graphs based on the list of identified fauna (Appendix B) allow a better analysis of key vertebrate and invertebrate (Figure 4A, Figure 4B).

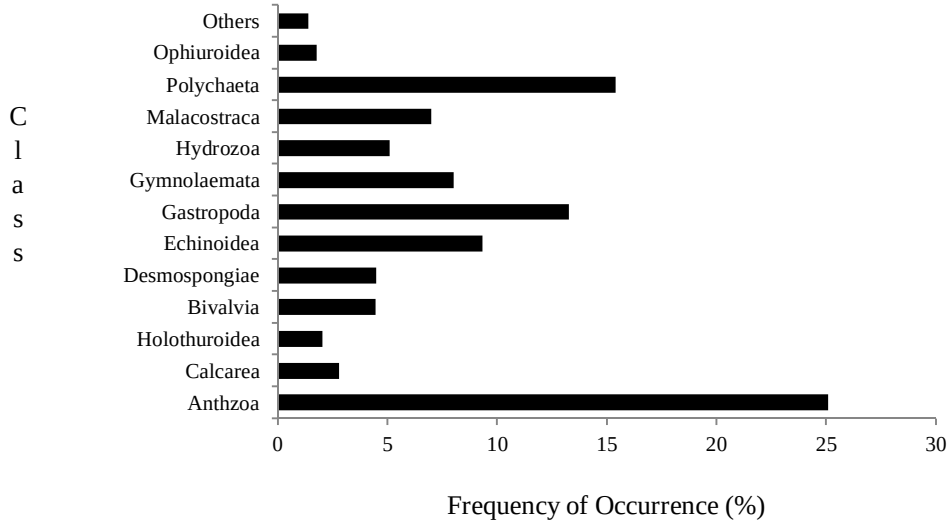

Figure 4A Frequency of Occurrence of identified invertebrate classes at Arrifes' Beach.

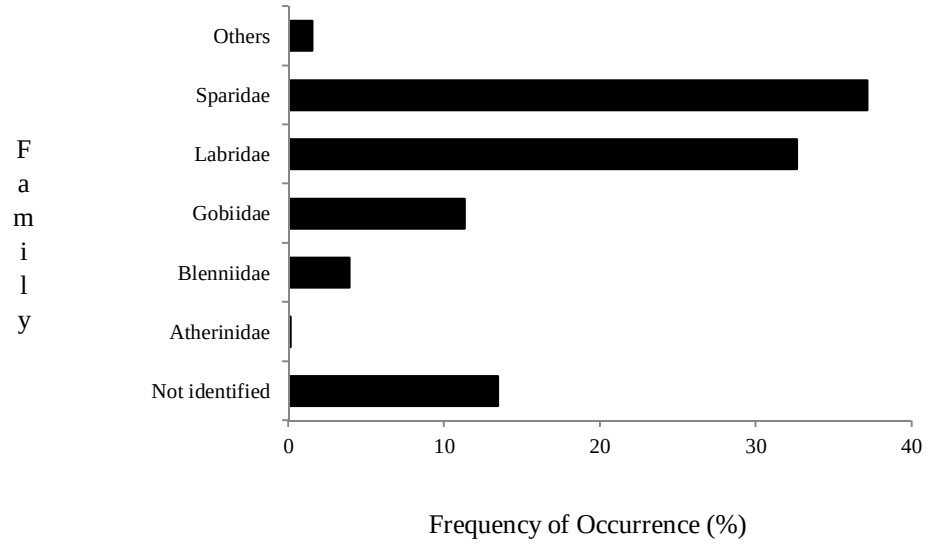

Figure 4B Frequency of Occurrence of identified vertebrate families at Arrifes' Beach.

In the sampled area, 16 classes of invertebrates, and 10 families of vertebrates were identified. While Anthozoa, Polychaeta and Gastropoda should be noted for their importantance in terms of Frequency of Occurrence among invertebrate classes, Sparidae and Labridae were the main fish families detected.

2.5 Arrifes' beach underwater route

The average grade attributed by the researchers to each characteristic of the routes' dive (table 2), together with a careful and systematic observation of the study area, allowed the definition of the technical profile of the underwater route:

Technical profile:

Dive gear – free dive preferentially; scuba dive only in high tide
Access - Beach
Mean duration - 25min
Maximum depth – 4m
Habitat – Sand, pebble beach, rocky areas
Difficulty level – 2
Global interest level – 3
Marine interest level – 4
Conservation of support infrastructures level – 3
Utility of support infrastructures level – 3

An illustration of Arrifes' beach, with the designed route incorporated is shown in Figure 5.

Figure 5 Arrifes' beach illustration and underwater route definition.

It is important to note that rare species and/or habitats with some status of conservation were carefully considered when analysing the possible areas for underwater routes.

In fact, when choosing Arrifes' beach as a pristine ecotourism area, the existence of a seagrass bed (*Cymodocea nodosa*) (included in the *Habitats Directive* as a particularly fragile ecosystem) (Begon *et al.*, 1996; IUCN, 2008) (Figure 6) that lies at the edge of the east side of the beach

was carefully considered, since there are only three records of these beds in the littoral area of the Algarve.

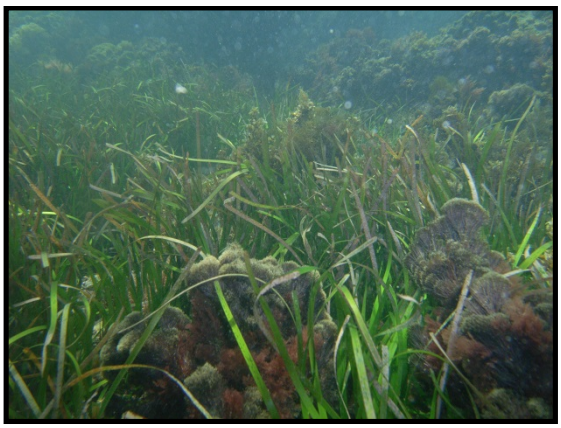

Figure 6 Seagrass bed of *Cymodocea nodosa.*

The probable sighting of the blenny *Parablennius parvicornis* (Figure.7), recorded for the first time in continental Portugal at this beach, was also appealing.

Figure 7 Blenny *Parablennius parvicornis.*

Moreover, the abundance of the sea star *Asterina gibbosa* (Figure 8), with the status of "endangered species" in the Mediterranean Sea, was also considered important.

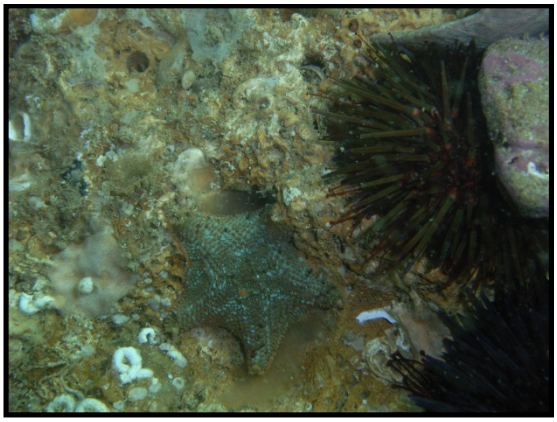

Figure 8 Sea-star *Asterina gibbosa.*

Besides the above mentioned, there are many species of fauna and flora that can be observed by snorkelling or scuba diving in the proposed beach.

2.5.1 Underwater trail description

In this section, the path of the underwater route defined for the Beach of Arrifes is described in detail.

The route begins in front of the support bar, bearing a straight line with the middle of the two outcrops of the eastern part of the beach (with 1.0 – 2.0m depth).

Tourists should make their way along the rocky wall side to their left. The first part of the marine beach area is mainly a pebble area with a dense algal cover (*Halopterys* sp.; *Codium* sp.; *Plocamium cartilagineum*; *Jania* spp.; *Coralina elongate; Lithophyllum incrustans*; *Mesophyllum lichenoides* among other species). In these habitats the invertebrate population is usually very diverse and specimens such as the gastropods *Gibbula cineraria* and *G. pennanti*, the sea anemone, *Anemonia viridis*, the sea urchins (*Paracentrotus lividus*) and sea stars (*Martastherias glacialis*) can be observed. Cryptic fishes, like gobies and blennies (*Gobius buchichii, Pomatoschistus* spp. or *Parablennius pilicornis*) are also common.

A closer look should be paid to the central bay of the beach, delimited by the three outcrops and an underwater rocky wall. Rocky enclaves create unique habitats in this area.

In both described zones, salemas (*Sarpa salpa*), common seabream (*Diplodus sargus*), two-banded seabream (*D. vulgaris*), schools of sand smelt (*Atherina presbyter*) and several wrasse species such as *Symphodus bailloni* and *S. melops* abound.

In the middle of the two eastern outcrops (3.0 – 4.0m depth) the rocky enclaves intensify.

Besides the colonization by algae similar to the first part of the route, a considerable number of cracks in rocks hide blennies, crabs, spider crabs and octopus; in seek of refuge and food. Those are also habitats for macroinvertebrates such as sea slugs (*Hypselodoris midatlantica* – Figure 9), sea urchins (*P. lividus*) and sea anemones (*A. viridis*) (Figure 10).

Figure 9 Sea slug, *Hypselodoris midatlantica.*

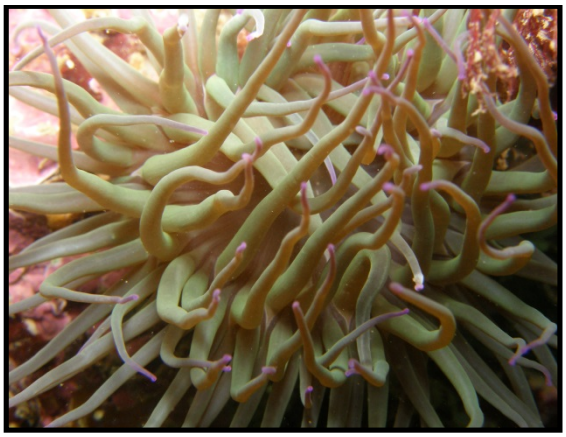

Figure 10 Sea anemone, *Anemonia viridis.*

Fishes like seabreams (Figure 11), sand smelt, salemas, and wrasses are also frequently seen. It was in this area that *P. parvicornis* was recorderd for the first time.

Figure 11 Zebra seabream, *Diplodus cervinus.*

The underwater landscape is extremely beautiful here, with several caves (Figure 12) and hiding spots.

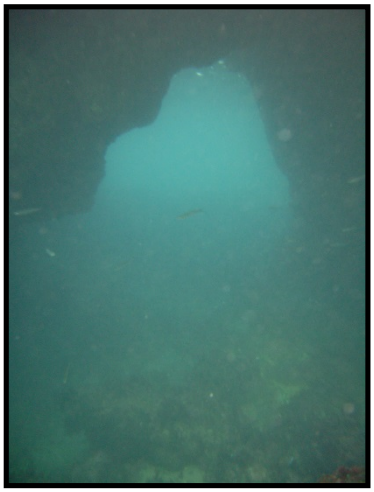

Figure 12 Underwater cave.

As divers go along the route, they can observe the interesting behaviours of some marine specimens when feeling endangered. One *Octopus vulgaris* was photographed immediately before and after spotting the diver. The abrupt colour change and the mimicry are outstanding (Figure 13 A/B).

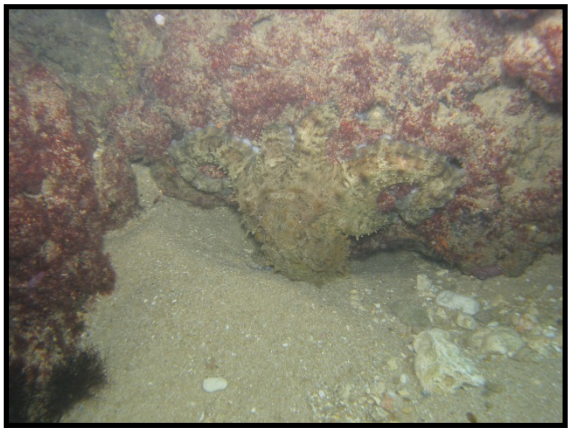

Figure 13A Common octopus, *Octopus vulgaris,* before spotting the diver.

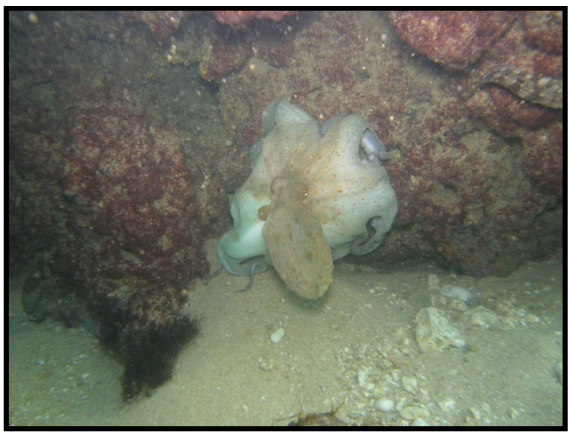

Figure 13B Common octopus, Octopus vulgaris, after spotting the diver.

After the outcrop, tourists should continue their way some 100m to the east side (towards the entrance to the Albufeira Marina) until coming to the *Cymodocea nodosa* seagrass bed. Then the diver can initiate the route back, arriving to the beach in the same spot from where the dive was started.

After the route, tourists are invited to answer a questionnaire that will provide important data to researchers, coastal managers and touristic operators such as: biodiversity interest and preservation needs of the area, landscape planning, and needs in terms of infrastructures.

2.6 Conclusions

The use of scientific knowledge in association with tourism operators and coastal managers, as shown here, can provide enjoyable experiences within an environmentally sustainable framework. That is the main goal of ecotourism (Lindberg *et al.*, 1993) as an agent of change (Wall, 1997).

Nevertheless, ecotourism success, as a tool for biodiversity sustainability, relies upon local knowledge and needed behavioural alteration passed on during the tourist experience. Educational background should always precede any leisure activity (Malavasi and Malavasi, 2004). Traditionally, tourism-related educational programs have focused on enhancing tourist knowledge of the natural and social environments that they visit (Currey, 2000). However, as noted by Forestell (1990) ecotourism will only play a role in environmental protection based on education if, firstly, it changes behaviours. Therefore, tourism-related educational programs should facilitate "environmental learning", a method of knowledge enhancement that is psychologically conducive to human learning, attitude adjustment and behavioural change (Currey, 2000).

In fact, the underwater marine ecotourism system here proposed, designed on the basis of biodiversity understanding of the area, and with very well established rules, can preserve marine environments, enhancing tourism activities in new unexplored fields and reinforcing attitude changes in behaviour.

Tools provided by ecotourists information and researchers analysis can, and should, be used for appropriate coastal management.

.

2.7 APPENDICES

Appendix A

Table 1 Identified flora at Arrifes' Beach.

Taxon	Species
Chlorophyta	*Cladophora lehmannia* *Codium effusum* *Codium fragile* *Codium tomentosum* *Codium vermilara* *Codium bursa* *Codium* spp. *Valonia macrophysa*
Phaeophyta	*Cystoseira usceneoides* *Colpomenia peregrina* *Dictyota dichotoma* *Dilophus fasciola* *Halopteris filicina* *Halopteris scoparia* *Cladostephus spongiosus* *Padina pavonica* *Sargassum vulgare* *Taonia atomaria* *Zonaria flava*
Rhodophyta	*Jania longifurca* *Jania* sp *Lithophyllum dentatum* *Peyssonelia squamaria* *Gelidium latifolium* *Sphaerococcus coronopifolius* *Asparagopsis armata* *Coralina elongata* *Plocamium cartilagineum*

Appendix B

Table 1 Identified fauna at Arrifes' Beach.

Group	Phylum	Class	Species	Common name
I	Arthropoda	Anomura	*Galathea squamigera*	galathea
I	Arthropoda	Anomura	*Porcellana platycheles*	porcelain crab
I	Arthropoda	Brachyura	*Xantho hydrophilus*	crab
I	Arthropoda	Crustacea	*Palaemon serratus*	common prawn
I	Arthropoda	Malacostraca	*Polybius puber*	spider Crab
I	Arthropoda	Malacostraca	*Maja squinado*	spiny spider crab
I	Bryozoa	Gymnolaemata	*Schizobrachiella sanguinea*	bryozoan
I	Bryozoa	Gymnolaemata	*Schizobrachiella* sp.	bryozoan
I	Cnidaria	Anthozoa	*Anemona viridis*	sea anemone
I	Cnidaria	Anthozoa	*Aiptasia diaphana*	sea anemone
I	Cnidaria	Scyphozoa	*Rhizostoma pulmo*	sea anemone
I	Echinodermata	Ophiuroidea	*Ophiothrix fragilis*	brittle star
I	Echinodermata	Asteroidea	*Asterina gibbosa*	sea star
I	Echinodermata	Echinoidea	*Paracentrotus lividus*	sea urchins
I	Echinodermata	Holothuroidea	*Holothuria tubulosa*	cotton-spinner
I	Mollusca	Bivalvia	*Anomia ephippium*	saddle oyster
I	Mollusca	Bivalvia	*Striarca lactea*	bivalve
I	Mollusca	Bivalvia	*Cardita calyculata*	bivalve
I	Mollusca	Cephalopoda	*Octopus vulgaris*	common octopus
I	Mollusca	Gastropoda	*Gibbula cineraria*	grey top-shell
I	Mollusca	Gastropoda	*Gibbula philberti*	gastropod
I	Mollusca	Gastropoda	*Gibbula pennanti*	pennant´s top-shell
I	Mollusca	Gastropoda	*Columbella rustica*	dove-shell
I	Mollusca	Gastropoda	*Stramonita haemastoma*	red-mouth purpura
I	Mollusca	Gastropoda	*Melanella* sp.	gastropod
I	Mollusca	Gastropoda	*Nassarius reticulatus*	netted dog whelk
I	Mollusca	Gastropoda	*Nassarius incrassatus*	thick-lipped dog whelk
I	Mollusca	Gastropoda	*Nassarius cuvieri*	gastropod
I	Mollusca	Gastropoda	*Ocenebra erinaceus*	hedge hog murex
I	Mollusca	Gastropoda	*Ocinebrina aciculata*	gastropod
I	Mollusca	Gastropoda	*Ocinebrina edwardsi*	gastropod
I	Mollusca	Gastropoda	*Haliotis tuberculata tuberculata*	green ormer
I	Mollusca	Gastropoda	*Conus ventricosus*	cone
I	Mollusca	Gastropoda	*Calliostoma zizyphinum*	painted top-shell
I	Mollusca	Gastropoda	*Jujubinus exasperatus*	exasperating jujubine
I	Mollusca	Gastropoda	*Hypselodoris midatlantica*	sea slugs
I	Mollusca	Polyplacophora	*Chiton olivaceus*	green chiton
I	Porifera	Calcarea	*Leucosolenia complicata*	sponge
I	Porifera	Desmospongiae	*Ircinia* sp.	sponge
I	Chordata	Osteichthyes	*Diplodus sargus*	white seabream
D	Chordata	Osteichthyes	*Diplodus vulgaris*	two-banded bream
D	Chordata	Osteichthyes	*Diplodus cervinus*	zebra seabream
D	Chordata	Osteichthyes	*Diplodus* spp.	seabream
D	Chordata	Osteichthyes	*Coris julis*	rainbow wrasse
D	Chordata	Osteichthyes	*Oblada melanura*	saddle bream
D	Chordata	Osteichthyes	*Symphodus baillomi*	scalycheek wrasse
D	Chordata	Osteichthyes	*Symphodus melops*	corkwing wrasse
D	Chordata	Osteichthyes	*Sarpa salpa*	cow bream
D	Chordata	Osteichthyes	*Spondyliosoma cantharus*	black bream
D	Chordata	Osteichthyes	*Sardina pilchardus*	pilchard
D	Chordata	Osteichthyes	*Boops boops*	bogue
D	Chordata	Osteichthyes	*Atherina presbyter*	sand smelt
D	Chordata	Osteichthyes	*Symphodus roissali*	five-spotted wrasse
D	Chordata	Osteichthyes	*Labrus bergylta*	ballan wrasse
C	Chordata	Osteichthyes	*Tripterygion delaisi*	yellow triplefin
C	Chordata	Osteichthyes	*Parablennius pilicornis*	variable blenny
C	Chordata	Osteichthyes	*Gobius pagannelus*	rocky goby
C	Chordata	Osteichthyes	*Parablennius gattorugine*	tompot blenny
C	Chordata	Osteichthyes	*Parablennius sp.*	blenny
C	Chordata	Osteichthyes	*Parablennius parvicornis*	morocco blenny
C	Chordata	Osteichthyes	*Gobius buchichii*	anemone goby
C	Chordata	Osteichthyes	*Pomatoschistus* spp.	goby

Group identifies: invertebrates (I), demersal (D) or cryptic fishes (C). Taxonomic classification is based on phylum, class and species of each individual. Common name, whenever occurs, is referred

CHAPTER III

Travel-cost analysis of snorkelling underwater routes of Marinha beach (Algarve)

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Travel-cost analysis of snorkelling underwater routes of Marinha beach (Algarve)

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3.1 Abstract

The value of recreational snorkelling in defined underwater routes was evaluated for Marinha Beach, Algarve. The travel cost technique was used for defining the value of recreational use and the benefits of this natural resource. A total of 115 questionnaires were analysed, based on surveys carried out from the 15 of July to 15 of September 2008. Regression analysis used considered the number of dives as the independent variable, while dependent variables referred to different costs incurred during the trip and time spent on the activity weighted by a fraction of the declared income. The estimated average surplus *per dive* was 5€ and the value of the three routes was of 600€/year, corresponding to a total of 30000€, considering a discount rate of 2% and the maintenance of the resource for several years. Assuming a carrying capacity of 1000 dives *per* year, the total resource rent *per* year was estimated at 5000€, corresponding to a total economic value for the use of these underwater route of 250000€.

Keywords: Marinha Beach; travel cost technique; ecotourism; snorkelling; underwater trails.

3.2 Introduction

Conflict between the use of marine areas for recreation and concerns for their management and conservation concerns is currently a major issue (Davis and Herriot, 1996; Lim and McAleer, 2005). One of the challenges is the establishment of sustainable tourism, which promotes balanced development of local communities, an aspect that has been overlooked (Apate *et al.*, 2005), while providing a satisfactory experience to the visitor (Lim and McAleer, 2005).

Various environmental resources are considered to be common goods (Grasso *et al.*, 1995) implying a certain lack of responsibility for their use and some degree of unaccountability for their preservation. By definition common goods such as forests and fishing grounds are open access and therefore difficult to manage in a sustainable way (Gibson *et al.*, 2000).

Although ecotourism aims to ensure that tourism is practiced taking into consideration the sustainability of the environment, if carried out in an uncoordinated way, it can lead to disorderly mass tourism that can damage social, economic and environmental systems (Soriano, 1998). Natural resources valuation may be used by managers to implement measures that are environmentally rational and adapted to the surroundings, adjusting visitation and recreational activities. According to King (1995), economic valuation of natural resources is achievable, and guarantees robust management tools that can and should be used in the management of coastal marine areas.

Marinha Beach (Figure 1) is a part of National Ecological Reserve (REN - *Reserva Ecológica Nacional*) and was considered one of the top ten most beautiful beaches of the world by the Michelin Guide. In 1998 the Portuguese Ministry of Environment awarded it the "Golden Beach" trophy for its singular natural resources and in 2003 the non-governmental environmental association *Quercus* awarded this beach the Gold Quality Citation.

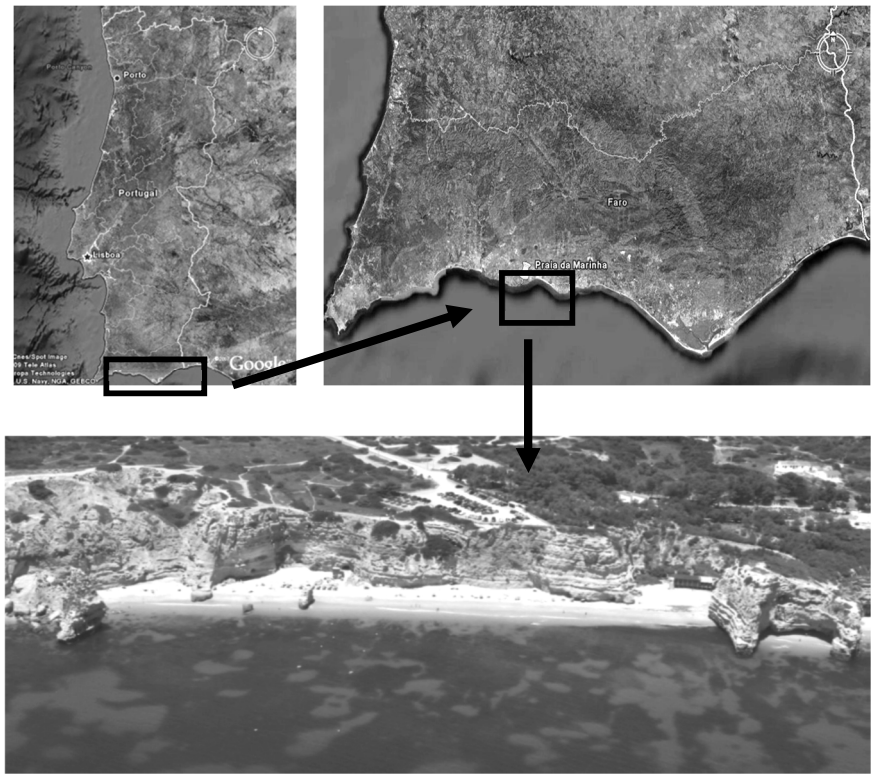

Figure 1 Location of Marinha beach, on the South coast of Portugal, Algarve.

The implementation and valorisation of ecotourism activities in areas of particular natural interest, such as Ecological Reserves or *Natura 2000* zones may function, as stated, as an efficient management tool with regard the safeguarding of the local ecological maintenance and economies. If a natural system is not given an economic value it will always be considered by managers as "common access", and it will, therefore, not be included in a decision making system (Green and Tunstall, 1993).

In the Algarve, despite the coastal area being extensively used for touristic activities, information relating to the sustainable use of this area is scarce.

The project "Underwater Routes at Marinha Beach" (Gonçalves *et al.*, 1998) aimed to define, signal and promote three underwater routes at Marinha Beach. The routes were developed to be self-guided and accessible to all visitors of the beach, simultaneously promoting an increase in environmental awareness as well as a pleasant touristic experience.

The present study aims to estimate the value of recreational snorkelling in defined underwater routes at Marinha Beach using the Travel Cost Method, as proposed by Boardman *et al.* (2001) and Atkinson and Mourato (2006).

3.3 Travel Cost Method

Cost-benefit analysis allows measuring the monetary value of systems which have no explicit market value, even though they have real and indispensable value to society. It also allows to identify the advantages and the disadvantages of policy measures, and to determine the net benefits of altering or creating new regulations (Boardman *et al.*, 2001).

The Travel Cost Method (TCM) (Clawson Method) as defined by Boardman *et al.* (2001) is an indirect economic valuation technique that uses cost-benefit analysis to calculate the economic value of a certain resource that cannot be valued through market prices (e.g. beaches, fishing grounds, ecosystems). The objective is to reveal how much users are willing to pay for maintaining an outdoor recreational site.

The TCM recognizes that the actual costs associated with visiting a particular site is more than just the ticket price for admission, and must also include the cost of travelling back and forth, the time spent travelling weighted as a proportion of earned income *per* unit time, and food expenditure, among others. The total cost of the visit is, hence, acknowledged as the willingness to pay revealed by the visitor (Boardman *et al.*, 2001). Several studies have used Travel Cost Methods to value marine resources (Alban *et al.*, 2006).

The Travel Cost Method seems be a credible method for the valuation of recreational exploitation of natural resources (Cesario, 1976) and according to Smith (1993) is the most widely used method in coastal environmental management. In fact, this method was designed to analyse economic gains of recreational activities, or benefits produced by natural resources, which by definition are freely accessible to all consumers (Ward and Beal, 2000). It should however be noted that the TCM is a method of revealed preferences, and therefore is based on the amount that each individual is willing to spend to make use of a natural resource (usage value), thereby disallowing an analysis encompassing all values set by the total economic value approach (Boyle and Bishop, 1985).

This approach can be implemented using a stated preferences approach with contingent valuation, based on a hypothetical market where the individual responds taking into account the values of use and non-use of a given resource.

The TCM is based on questionnaire surveys carried out to tourists during a recreational visitation. Recreational attribute values can also be estimated if data is available from different visit sites (Brown and Mendelsohn, 1984). After collection and validation of data, a regression model is applied for the subsequent calculation of the demand curve. For this

procedure it is necessary to determine the independent variables that explain the real cost that can be assigned to the tourists.

Consumer surplus is defined by the maximum amount that the consumer is willing to pay, in addition to the market value of a specific good or service. Thus, the estimated total economic benefit of the use of a resource or a service is the consumer surplus (Dixon and Sherman, 1991).

3.4 Survey

The survey was performed during the summer season of 2008, from the 15th of July to the 15th of September. During this period three underwater routes were implemented and advertised at Marinha Beach with illustrative leaflets and up to date scientific information posted on wooden placards distributed in the beach area. A national and regional marketing campaign accompanied the beach procedures. During the sampling period, researchers were available at the beach to provide all needed information prior to the dive, and to guide users through the answering of the questionnaires after the ecotourism experience.

It is important to note that the definition and implementation of the Marinha Beach underwater routes was based on data collected during the RenSub Project, that mapped marine *biocenoses* of this area of the Algarve coast from the shore to the 30m bathymetry (Gonçalves *et al.*, 2004a; Gonçalves *et al.*, 2004b; Gonçalves *et al.*, 2007a; Gonçalves *et al.*, 2008a; Gonçalves *et al.*, 2010), as well as the implementation of other underwater routes in the Algarve region (CCDR, 2007; Gonçalves *et al.*, 2007b; Gonçalves *et al.*, 2008b; Gonçalves *et al.*, 2008c; Rangel *et al.*, 2011).

The survey was based on a structured face-to-face questionnaire where questions followed a dichotomous (yes/no) and five-point scale (ranging from strongly disagree to strongly agree, and from terrible to excellent) formats. Although no questions were left open-ended in order to constrain the respondents to provide an answer to every question, the option “I don't know” was available in some questions.

Questionnaires were designed to examine snorkelers’ perceptions about biodiversity awareness, their degree of environmental education, socio-economic characterization of the interviewee, user diving experience, degree of satisfaction, and all specific costs related to the snorkelling experience.

A total of 120 questionnaires were completed. Of these, 115 were validated for TCM analysis. It should be noted that only five snorkelers refused to fill the questionnaire, which indicates that nearly all users are represented in year 0. One entire morning or afternoon was necessary to complete the three available routes, and the *in situ* rental rate for wetsuit, mask, fins and tube was 8 €.

Prior to the summer season, a Financial Feasibility Study was carried out to enhance the implementation and maintenance of underwater routes, sponsored by the University of the Algarve, with the support of the Beach Commissioner and the Regional Coordination Committee (CCDR Algarve). According to this analysis, the implementation of underwater paths is feasible assuming a 25% increase in visits *per* year, with a Net Present Value (NPV) of 4.915,35 € for a discount rate of 5% and a recovery of invested capital from the 3rd year.

The aim of this study is to define the value of recreational snorkelling use of underwater routes developed at Marinha Beach, Algarve. Moreover an attempt is made to implicitly calculate the value of the use of the visited marine resources.

3.5 Results and Discussion

3.5.1 Sample characterization

The description of respondents' characteristics is shown in Table 1. Although 15 nationalities were represented, most of the subjects who were interviewed were Portuguese (50%), male (73%), ranging from 11 to 30 years old, single (45%) or married (43%), and with an undergraduate degree or more (48%).

Table 1 Demographic and other characteristics of the respondents (n=120). Data is shown as percentages.

Characteristics of respondents	**Frequencies of Occurrence (%)**
Gender (%):	
Male	72.5
Female	27.5
Age class (%):	
[0-10]	1.67
[11-20]	30.00
[21-30]	31.67
[21-40]	20.00
[41-50]	15.00
[51-60[	2.50
Marital status (%):	
Single	44.77
Married	43.02
Divorced	5.23
Living together	6.98
Nationality (%):	
Portuguese	50.83
Spanish	9.17
English	13.33
Other	26.67
Educational level (%)[1]:	
Up to standard grade	23.89
Up to high school grade	25.66
Undergraduate degree or more	47.79
No information	2.65
Income level (%):	
zero	1.10
< 1000 €	14.29
€ 1000-1500	17.58
€ 1500-2500	30.77
€ 2500-5000	20.88
> € 5000	6.59
No information	8.79
Visitation month	
July	18.33
August	68.33
September	13.33

Note: [1]Level of formal education: standard grade corresponds to 9 years of schooling. High school grade corresponds to 12 years of schooling. Undergraduate degree or more corresponds to undergraduate and postgraduate levels.

The number of interviewees living together (7%) seems high when compared with the pattern described in the national census (Leite, 2004), which may be related to the several nationalities that can be observed in the surveyed sample.

The educational level of the individuals interviewed seems also noticeably higher than expected, according to the national standard on education (INE, 2006). This may also be related to the diversity of nationalities, or may be associated with the specific selection of this beach because of the underwater ecotouristic activities provided and the desire to learn more about marine biodiversity of the Algarve.

Spanish tourists, due to the proximity, are frequent in the Algarve. Likewise, English visitors are frequent in this region, and this is related to the low cost terminal built at the international airport of Faro, with frequent flights to and from the United Kingdom (UK).

The results of the questionnaires show that tourists prefer to visit the Algarve in August (68%), followed by July (18%) and September (14%). In fact, August is by far the favourite month for Portuguese and foreigners' holidays in the Algarve (INE, 2008) (Figure 4). Children's school holiday periods and high atmospheric and sea temperatures are the main reasons for this.

Average monthly income seem higher than expected, probably due to the significant higher income of some foreign nationals, which force the average of the sample to a higher value. Nonetheless, average monthly incomes seem to present some variation when compared to official national statistics. These may be related to the number of individual *per* nationality in this sample (such as reported for the USA with only one interviewed) (Table 2).

Table 2 Average monthly gross income for the nationalities considered in the sample.

Country	*Average monthly gross income* (€)
Belgium	750
Brazil	2500
Denmark	2750
England (UK)	1750
France	1500
Germany	3500
Luxembourg	1500
Netherlands	3000
Portugal	1000
Russia	5000
Spain	750
Switzerland	5000
USA	12000

3.5.2 Estimating economic value of routes through the Travel Cost Method (TCM)

To estimate the regression model parameters, Travel Costs associated with recreational activity (TC) had to be defined for each country. Expenses of travel from place of residence to the Algarve divided by the staying days, transportation to and from the recreation site, housing cost *per* day, expenditures on food and drinks, diving gear rental, and Opportunity Cost of Labour (OCL) were considered (Table 3). The Opportunity Cost of Labour represents what the tourist does not earn during recreational activity time. Although the literature is not fully explicit on how to calculate the OCL, a proportion of the individuals salary rate is usually used (McConnell and Strand, 1981). Following the available literature, and after testing several options, a quarter of the average wage by nationality *per* day was used, as suggested by Caulkins *et al.* (1986). Estimates of the total costs *per* dive are presented in Table 3.

Table 3 Estimates of total cost *per* dive considering: country of origin, travel, housing and average daily food expenditure, OCL, and dive cost.

Country	*Travel*	*Housing*	*Feeding*	*OCL*	*Dive activity*	*Total cost per dive*
Belgium	71.43 €	27.14 €	8.00 €	8.53 €	8.00 €	123.10 €
Brazil	25.00 €	70.83 €	22.71 €	22.73 €	8.00 €	149.27 €
Denmark	19.05 €	95.24 €	30.00 €	31.26 €	8.00 €	183.54 €
England	26.73 €	78.15 €	15.92 €	19.89 €	8.00 €	148.69 €
France	14.35 €	11.84 €	11.82 €	17.05 €	8.00 €	63.06 €
Germany	40.91 €	42.42 €	11.21 €	39.78 €	8.00 €	142.32 €
Luxembourg	28.57 €	30.00 €	30.00 €	17.05 €	8.00 €	113.62 €
Netherlands	60.32 €	131.75 €	14.37 €	34.10 €	8.00 €	248.53 €
Portugal	5.44 €	16.69 €	8.25 €	11.37 €	8.00 €	49.75 €
Russia	23.08 €	150.00 €	50.00 €	56.82 €	8.00 €	287.90 €
Spain	7.71 €	13.02 €	12.09 €	8.53 €	8.00 €	49.34 €
Switzerland	20.00 €	40.00 €	20.00 €	56.82 €	8.00 €	144.82 €
USA	30.00 €	0.00 €	10.00 €	136.36 €	8.00 €	184.36 €

As expected, Travel Costs are lowest for Portuguese and Spanish visitors. Accommodation costs are higher for Russians and the Dutch and null for Americans (sample included just one visitor that logged at a friend' house). However, the Opportunity Cost of Labour for the latter tourists is higher.

Data were used in the regression analysis to estimate the behaviour of demand. Total costs *per* dive were used as the dependent variable, while the number of dives *per* country of origin was used as an independent variable (Table 4).

Table 4 Variables of the regression models.

Country	*Total cost per dive*	*Number of dives*	*Logarithm of the total cost per dive*	*Logarithm of the number of dives*
Belgium	123.10 €	5	4.746	1.609
Brazil	149.27 €	3	4.951	1.099
Denmark	183.54 €	2	5.168	0.693
England	148.69 €	11	4.947	2.398
France	63.06 €	9	4.008	2.197
Germany	142.32 €	3	4.958	1.099
Luxembourg	113.62 €	2	4.660	0.693
Netherlands	248.53 €	5	5.483	1.609
Portugal	49.75 €	56	3.732	4.025
Russia	287.90 €	1	5.634	0.000
Spain	49.34 €	16	3.722	2.773
Switzerland	144.82 €	1	4.919	0.000
USA	184.36 €	1	5.173	0.000

Four regression models were fitted (Table 5; Figure 2).

Table 5 Outputs of regression models fitted to describe the economics of recreational snorkelling at Marinha Beach.

	Linear Model	*Exponential Model*	*Logarithmical Model*	*Power Model*
Total cost *per* dive	Y	Y		
Logarithm of the total cost *per* dive			Y	Y
Number of dives	X		X	
Logarithm of the number of dives		X		X
R Squared	0.31	0.46	0.44	0.58
Constant	161.28	5.023	192.78	5.314
t statistic	8.000	32.976	8.033	29.671
P Value	0.000	0.000	0.000	0.000
Number of dives	-2.646	-0.028	-39.231	-0.384
Number of dives t statistic	-2.206	-3.078	-2.974	3.903
Number of dives P Value	0.050	0.011	0.013	0.002
Constant exponential	-	151.96	-	203.33

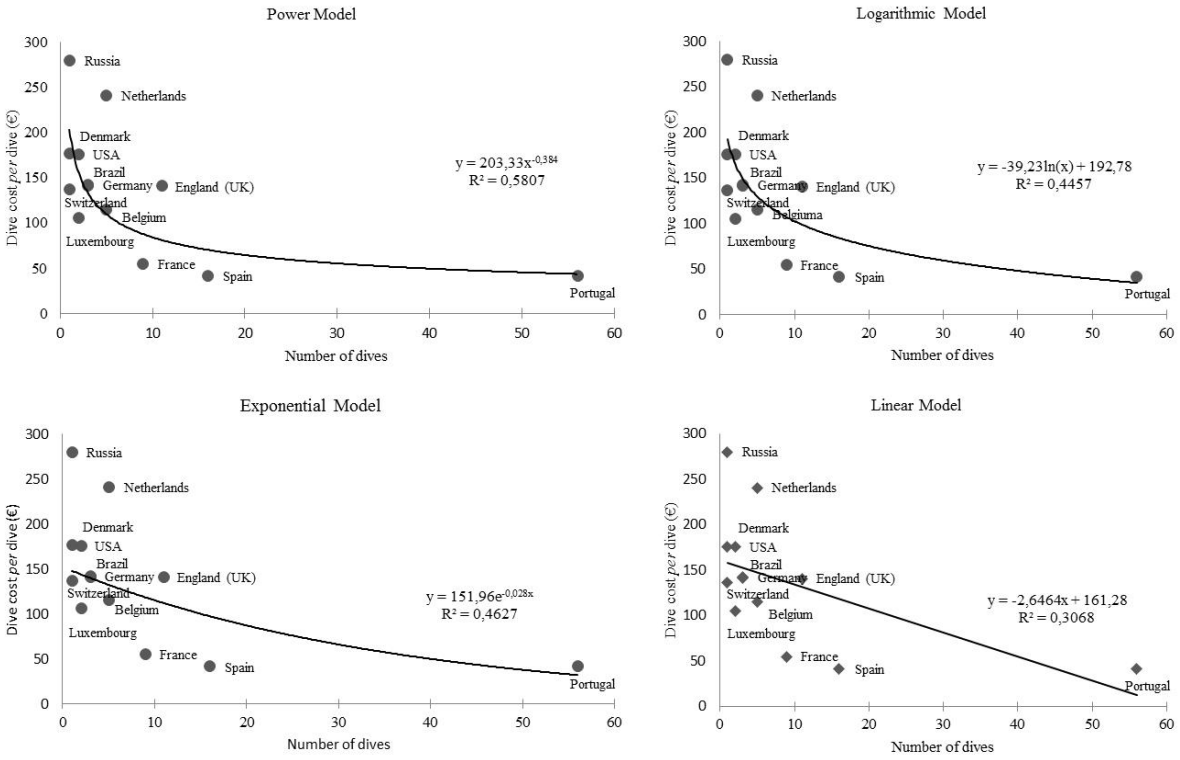

Figure 2 Regression models fitted to analyse dive costs at Marinha Beach.

According to the results (Table 5; Figure 2), the Power Model gave the best fit and was used to define consumer surplus *per* dive through the demand curve (Figure 3). Different multiple regression models were also fitted, considering the income and dummy variables for tourists and emigrants typologies. In the first case the results were not satisfactory, and in the second the model was not robust, considering the unavailability of information on the typology of the divers.

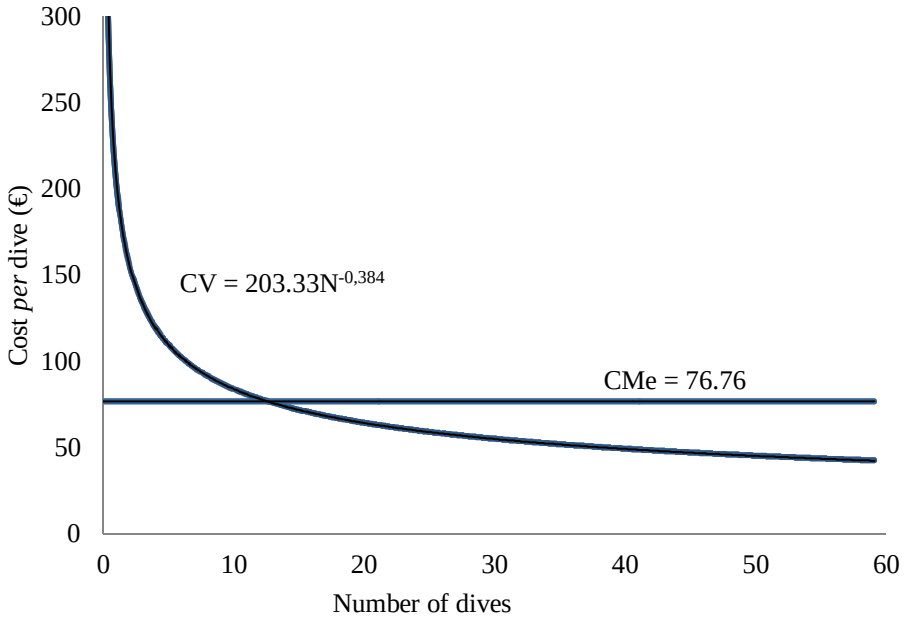

Figure 3 Consumer surplus of snorkelling activity at Marinha Beach obtained with the Travel Cost Method.

The definition of the consumer surplus area (see Figure 3) allowed to calculate an average surplus of 5€ *per* dive, which multiplied by the total dives *per* year gives 600€/year, corresponding to a total resource value of 30000€, assuming that the discount rate for this type of property is 2%.

Although relatively low, it must be considered that this is the experimental year of implementation of underwater routes in the Algarve (and Portugal). Also, although an effort was undertaken to disseminate this activity, it only really started in the middle of the summer season. Therefore, it is expected that, in future years, the demand for these routes will be significantly greater, thereby increasing the average surplus calculated.

According to Ruschmann (1990), the carrying capacity of routes corresponds to the number of tourists that an area can accommodate before negative impacts occur on the physical environment, the psychological attitudes of tourists, the level of social acceptance of the host communities, and the economic optimization level. Considering an estimated routes carrying capacity of 1000 tourists *per* year (corresponding to 400 in July, 400 in August and 200 in September), the total resource rent is 5€ *per* year, which corresponds to a total of 250000€.

The monetary valorisation of the use of the implemented routes implies an indication of the real value of the system and, thus, of its effective management and preservation importance,

since it presents not only an ecological value, but also an economic one, essential for appropriate and consistent management of different coastlines.

According to Harriott (2002), in coral systems the internationally accepted carrying capacity for scuba diving is approximately 5000 divers *per* year and site. In fact, an average number of divers was estimated to be 5000 to 6000 divers *per* year per *site* for the Red Sea and confirmed for Australia (Hawkins and Roberts, 1997; Harriott, 2002); Egypt (Hawkins and Roberts, 1997); Caribbean and Seychelles (Hawkins *et al.*, 1999) and South Africa (Schleyer and Tomalin, 2000b). In this case study, the carrying capacity considered took into consideration the fact that unlike what happens in the above examples, diving tourism does not occur throughout the year due to site characteristics. At Marinha Beach only summer months were considered as having necessary facilities, and satisfactory marine and atmospheric conditions for the practice of safe and interesting underwater ecotourism. Similarly, it should be emphasized that no official statistics exist for the carrying capacity of snorkelling that, in contrast to scuba diving, implies a less intrusive interaction with the environment.

In future studies the authors aim to estimate the economic value of each of the three routes of Marinha Beach, and explain the different features of Portuguese and Spanish tourists, while searching for the best regression model. Also, with data on the carrying capacity of the Algarve's beaches, the authors aim to extrapolate the total economic value of the diving activities of the Algarve coast using the Travel Cost Method.

CHAPTER IV

Ecotourism snorkelling routes at Marinha Beach (Algarve)

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Ecotourism snorkelling routes at Marinha Beach (Algarve)

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4.1 Abstract

Coastal ecotourism is one of the fastest growing leisure industries in the world and snorkelling is emerging as an important beach-based activity. Snorkelling has the potential to enhance biodiversity conservation when developed within environmental education framework. The aim of this study was to implement and evaluate snorkelling routes, in the Algarve (South Portugal), as a sustainable ecotourism offer. To achieve these objectives, three snorkelling routes were established at the pristine Marinha beach. After the diving experience, a face-to-face questionnaire survey was conducted to collect information about individuals' opinions regarding the underwater routes, their social demographic characteristics, ecological appreciation, opinions about beach facilities and trip expenditures. The survey was undertaken during the summer months of 2008 and 2009, and 202 people were interviewed. Data was analysed using univariate and multivariate statistical methods. Most respondents perceived the existence of routes to be good for the preservation of the local biodiversity and reported this experience as "good" or "excellent". The only difference in perceptions was observed by visitor snorkelling in groups of more than two people. Interviewers consider that emergency support and sanitary facilities are the most important beach support infrastructures. Overall, these routes seem to be an effective tool for developing ecological awareness in tourists, as they enhance the preservation and the understanding of the marine coastal environment.

***Keywords*:** Ecotourism, beach, snorkelling, sustainability, biodiversity

4.2 Introduction

Coastal tourism started in the 19th century (Davenport and Davenport, 2006), but it only become problematic when coastal recreational activities started to neglect nature preservation issues (Davis and Herriot, 1996; Lim and McAleer, 2005; Apate *et al.*, 2005). Ecotourism presents a touristic option, with concerns for the environment, as well as local economic development and environmental education (Pedrini, 2006), hence minimizing the negative

effects of traditional mass tourism (Lindberg *et al.*, 1993; Doan, 2000; Gray, 2003). In fact ecotourism is, according to Bulbeck (2004), the fastest-growing sector in global tourism. Agenda 21 states that ecotourism is a potential tool for sustainable development, particularly in fragile environments (like protected areas), relieving certain pressures from traditional tourism, such as pollution and biodiversity destruction (Stancliffe, 1998).

According to Leeworthy and Bowker (2005), the total number of individuals participating in marine recreational activities, especially beach activities, is expected to increase in the future. Pendleton and Rooke (2006) point out the special interest in snorkelling and scuba diving sports, as they represent a large proportion of marine recreation users. However, marine tourism (defined as recreational activities, which involve travelling, with a focus on the marine environment) presents a policy dilemma; on the one hand, it generates important incomes for local economies, on the other it contributes to the destruction of valuable marine resources (Asafu-Adjaye and Tapsuwan, 2008).

An important aspect of ecotourism is its potential to provide environmental education (Pedrini, 2006). In marine ecotourism, environmental education is mainly achieved through the development of underwater self-guided trails, or routes (Andrade *et al.*, 2005). According to Lima (1998) and Andrade *et al.* (2005), guided routes are a good way to provide environmental education in ecotourism. In this respect, these routes can be both land paths or underwater routes (Pedrini, 2006). Regarding snorkelling and scuba diving sports, underwater defined routes could be a good way to contribute to reducing the impact caused by tourist divers and, thus, help the preservation of the marine environment. Indeed, Sorice *et al.* (2007), while investigating the choices and preferences of tourist divers in different U.S. Marine Protected Areas (MPAs), noticed that, from a range of measures, divers' preferred reductions in the level of site use to allow for the implementation of conservation and education measures. This can lead to a scenario of restricted underwater defined routes in marine protected zones.

The Algarve (South of Portugal) is known worldwide for its touristic coastline, and is a good example of socio-economic and environmental distressed caused by tourism development (Davenport and Davenport, 2006). The Central Algarve coast, including Marinha beach (case study area), was classified as part of the National Underwater Ecological Reserve (REN) in June 1995. This classification implies special management procedures, from the shoreline to the 30m bathymetric mark. To date (December 2010), no measures have been taken to preserve and enhance sustainable underwater tourism in this popular costal area. The

Portuguese underwater REN zone covers a considerable area, in comparison with the terrestrial zone but, as reported by Gonçalves *et al.* (2007a), the systematic scientific study of this zone is still at an early stage.

To promote environmental education that ecotourism entitles, the creation of underwater guided routes was defined for this beach, as suggested by Pedrini (2006). The routes represent an attempt to reduce the effects of mass tourism, providing quality snorkelling. They represent a step forward for the sustainable use of the Portuguese coast.

The development of underwater self-guided routes is in its early stages, and scientific data is still scarce. As quoted by Berchez *et al.* (2005) and Berchez *et al.* (2007), most of the marine underwater trails developed are not published, being only available in internal reports or academic theses.

This work aims to contribute to increase the knowledge about underwater ecotourists' perceptions about routes and their impact on biodiversity conservation. This work will examine the attitudes of snorkelers, in the Marinha beach, towards the use of routes for the conservation of marine biodiversity, their main reasons for visiting the area and their perceptions about beach support infrastructures. It also investigates which socio-demographic characteristics influence the marine environment conservation conscience.

4.3 Material and Methods

4.3.1 Sampling site and period

The study was conducted at the UNESCO classified Marinha beach, located on the South coast of Portugal (Figure 1). This beach is also classified as part of the National Underwater Ecological Reserve (REN), central Algarve.

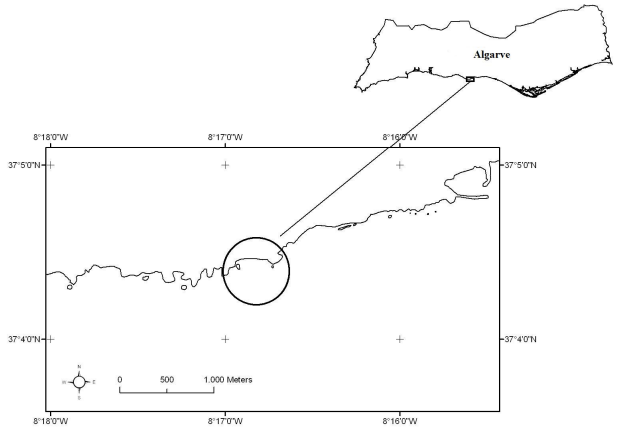


Figure 1 Marinha beach location in the south coast of Portugal, central Algarve.

In order to calculate the sample size for the interviews, we started by doing a census of the population using the beach. As such, the number of individuals at the beach was counted every day at 11 a.m, 14 a.m and 17 p.m.. The counting was done by visual census, on the same trail along the beach, always by the same researcher to avoid multiple observers' biases. An average of 381, 512 and 214 beach users was reported for July, August and September respectively. The survey sample accounted for 202 individuals being highly representative of route's visitors, with the amount of interviews representing 16% of the average beach summer season users and 89% of the snorkelers.

4.3.2 Routes setting

During 2007, the Marinha beach underwater communities (both flora and fauna) were assessed through visual underwater census surveys, following the RenSub project methodology (Gonçalves *et al.*, 1998; Gonçalves *et al.*, 2004a; Gonçalves *et al.*, 2004b). Fauna was surveyed with 3x20m transects, along a 60m ruler tape, and flora was surveyed by 50cm x 50cm triplicate quadrat sampling. These surveys allowed for the baseline description of the subtidal community of this ecosystem and facilitated the choice of the best biodiversity spots.

Following this, three different aquatic areas were selected for ecotourism use, leading to the development of three underwater routes. Rare species and/or habitats with conservation status were carefully considered when analysing the possible areas for underwater routes. For instance, a seagrass bed of *Cymodocea nodosa*), included in the EU *Habitat Directive* as a particularly fragile ecosystem (Begon *et al.*, 1996; IUCN, 2008), was recorded in the central

area of the beach. A route was carefully considered for this zone (there are only four of these beds in the Algarve littoral), as an attempt to protect it from nautical tourism impacts.

During the summer months of 2008, the routes were implemented with buoys in each turnover point. Placards with information – conduct code and routes specifications – were positioned along the beach, to ensure that routes could be done in an autonomous way. An information desk was always available, to provide any assistance, including renting of snorkel equipment.

The routes are shown in Figure 2. Route 1, a rectangular shaped trail, was located near the beach entrance, in the alignment with the sea cliff wall. Route 2, also a rectangular shaped one, was placed in the middle area of the beach and was delimited by its navigational channel. Route 3, the one with an irregular trajectory rounded the huge western rocky outcrop of the beach.

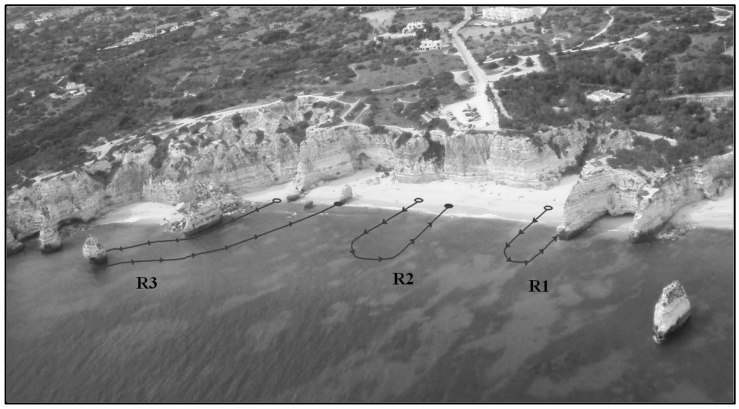


Figure 2 Marinha beach underwater routes in the south coast of Portugal, central Algarve (R1: Route 1; R2: Route 2; R3: Route 3).

4.3.3 Survey

The survey was based on a structured questionnaire, constructed to collect information on snorkelers' perception of the role of routes for biodiversity preservation. The questionnaires also collected information about their perceptions about beach support infrastructures, the available routes and demographic characteristics (such as age, gender, nationality, education level, income, etc.). Items were measured in a dichotomous format (yes/no) and a five-point scale (ranging from strongly disagree (1) to strongly agree (5), and from terrible (1) to excellent (5)). No questions were left open-ended, as to constrain the respondents to provide an answer to every question, although the option "I don't know" was available in some questions.

The survey was carried out through face-to-face interviews, with snorkelers that dived in all routes, and took place from July 15th to September 15th (beach season) of 2008 and 2009. The

response rate was high (89.0%) and the average length of the interviews ranged from 25 to 45 minutes.

4.3.4 Data analysis

Differences between respondents, who perceived routes to be good for biodiversity and those who did not, were tested with independent sample t-test, in case of continuous data, chi-square test (or Fisher's exact test, when assumptions were not met by the data), for categorical data, and Wilcoxon-Mann-Whitney test, for ordinal or interval data. Comparisons between groups were carried out using a Bonferroni correction to counter the effects of multiple testing.

Following this, in order to identify which individual characteristics influence respondents' perceptions about the impact of routes on biodiversity, a logit model was fitted, using Huber–White robust standard errors. The logit model is the most widely used of the discrete choice models and it identifies *ceteris paribus* (i.e. all other variables being constant) the intensity by which the explanatory variables influence the binary dependent variable (i.e. perceiving that routes are good for biodiversity) (Tabachnick and Fidell, 1996). The explanatory variables were tested for collinearity; when variables exhibited a bivariate correlation above 0.7 one of the variables was omitted (Tabachnick and Fidell, 1996). In these cases, the variables used in the analysis were chosen on the basis of relevance to the study based on the literature. Post-estimation analysis for multicollinearity was also calculated, with tolerance and VIF (Variance Inflation Factor) and no multicollinearity was found amongst the explanatory variables.

Respondents' perceptions about several issues related to beach support infrastructures were also investigated. The several items were measured on a five-point Likert-scale, which for the purpose of analysis, and due to the small sample size, was collapsed to a three-point scale (agree, neutral and disagree). Univariate statistics were used to test for departures from neutrality for each statement in isolation, with Wilcoxon signed-rank test.

Stata SE 10 (Data Analysis and Statistical Software, Stata Corporation, College Station, TX, USA) was used in all the analysis performed.

4.4 Results

4.4.1 Sample characterization

Table 1 describes the characteristics of the respondents that took part in the survey. Although people from 15 different nationalities were interviewed most respondents were Portuguese nationals (53%), male (68%), with an average age of 29 years. Around half had an undergraduate degree or higher (52.1%), were single or divorced (64%) and came from households with three to four people (47%). Most people were interviewed during the month of August (59%) and were diving either alone, or in groups of two or more people.

Table 1 Demographic and other characteristics for the respondents in the case study, and their perceptions about routes impact on biodiversity (n=181). Data is shown as means (± Standard Deviation) for continuous variables and percentage for categorical variables. Significant differences were tested with independent samples t-test, Chi-square test (or Fisher's exact test, when assumptions were not meet by the data) and Wilcoxon-Mann-Whitney test.

	Frequencies of occurrence (%) / Mean (±SD)	**Routes are good for biodiversity (Statistical test results)**
Demographic characteristics		
Nationality (%)		
Portuguese	52.9	$\chi^2(1) = 0.47$, $p = 0.495$
Other	47.1	
Gender (%)		
Male	68.2	$\chi^2(1) = 1.35$, $p = 0.245$
Female	31.8	
Mean age (years)	29 (12)	t = -0.78, $p = 0.437$
Married status (%)		
Single/divorced	64.1	$\chi^2(1) = 0.08$, $p = 0.779$
Married/living together	35.9	
Size of the household (%)		
1-2 people	36.0	$\chi^2(1) = 0.54$, $p = 0.463$
3-4 people	47.2	
More than 4 people	16.8	
Education level (%)[1]		
Up to standard grade	20.1	$\chi^2(2) = 0.57$, $p = 0.752$
Up to high school grade	27.8	
Undergraduate degree or more	52.1	
Income level (%)		
zero	39.4	z = -0.98, $p = 0.326$
< € 1000	11.7	
€ 1000-2000	16.8	
> € 2000	32.1	
Perceptions and opinions		
Routes good for biodiversity (%)	86.2	–
Would return and dive (%)	89.7	Fisher's exact = 0.06
Biological conservation is important (%)	96.0	Fisher's exact = 0.58
Other		
Group size (%)[2]		
1 person	28.7	z = 0.55, $p = 0.585$
2 people	30.2	
More than 2 people	41.1	

Note: [1]Level of formal education: standard grade corresponds to 9 years of schooling, high school grade corresponds to 12 years of schooling, undergraduate degree or more corresponds to undergraduate and postgraduate levels; [2]Size of the group snorkeling.

4.4.2 Perceptions about the impact of routes on biodiversity

The vast majority of respondents perceived the existence of routes to be good for the preservation of the local biodiversity (86%), that biological conservation is important (96%) and would return to do the routes again (90%) (Table 1).

A regression model was estimated to investigate which demographic characteristics influence individuals' perceptions about routes ability to protect biodiversity (Table 2). The logit model was not significant. However, it indicated that only the size of the group of divers seems to influence people's perceptions about the impact of routes on biodiversity conservation, with individuals that dived in bigger groups (groups with more than two people) having a negative perception about routes contribution to biodiversity when compared to snorkelers who dived alone.

Table 2 Logit model estimates for respondents' perceptions about routes impact on biodiversity.

	Routes are good for biodiversity		
	O.R.	[Robust S.E.]	p-value
Male	0.416	[0.235]	0.121
Log age	1.723	[1.727]	0.480
Education level (omitted: Up to 9th year schooling)			
Up to 12th year schooling	0.762	[0.512]	0.686
Graduates and postgraduates	0.826	[0.642]	0.806
Portuguese national	1.426	[0.794]	0.456
Size of group diving (omitted: 1 person)			
2 people	0.351	[0.259]	0.155
>2 people	0.256	[0.178]	**0.050**
Number of obs.	137		
Wald χ^2 (d.f.), p-value	13.23, 0.13		
Pseudo R^2	0.06		
Hosmer-Lemeshow χ2 (d.f.), p-value a	7.95, p=0.44		
Mean VIF (min – max) [b]	1.69 (1.03-1.45)		
% correctly classified	86.1%		

Note: [a]Hosmer and Lemeshow's goodness-of-fit test. Non-significant p-values indicate that the model fits the data well; [b]Mean Variance Inflation factor (VIF) (minimum and maximum VIF values).

The perceptions of the respondents about several issues related to the three routes are summarized in Table 3. The three routes were generally rated highly, with all the characteristics under investigation (e.g. landscape, flora, fauna) being classified as "good" or "excellent". Overall, route 3 can be considered as the most satisfactory, and route 2 the less pleasing from the snorkelers' point of view. It should be emphasized that no item achieved less than "good" in the interviewees average classification.

Table 3 Descriptive statistics for statements designed to quantify interviewees' perceptions about the several routes. Results presented as means (± Standard Deviation).

Items	Route 1	Route 2	Route 3
Route selected by the club	4.15 (0.79)	4.00 (0.83)	4.38 (0.66)
Geography of the area	4.07 (0.81)	4.00 (0.88)	4.44 (0.63)
Landscape	4.20 (0.82)	4.03 (0.96)	4.56 (0.69)
Fauna	3.93 (0.97)	3.70 (0.96)	4.21 (0.83)
Flora	3.95 (1.13)	3.85 (1.05)	4.07 (0.90)
Charismatic or unique species	3.72 (1.04)	3.65 (0.99)	4.03 (0.97)
Accessibility	4.67 (0.55)	4.63 (0.64)	4.65 (0.62)
Classification of the route in general	4.35 (0.62)	4.19 (0.80)	4.61 (0.52)

Note: Statements were measured on a five-point scale: Terrible (=1), Bad (=2), Acceptable (=3), Good (=4), Excellent (=5).

4.4.3 Perceptions about beach support infrastructures

The perceptions of the respondents about several issues related to beach support infrastructures are given in Table 4. Respondents regarded all the items under investigation as important. However, emergency support and sanitary facilities were the items classified the highest.

Table 4 Descriptive statistics for statements designed to quantify interviewees' perceptions about beach support infrastructures. Individual statements were tested for departure from neutrality with Wilcoxon signed-rank test.

Likert-scale items	% Responses [a]			Wilcoxon signed-rank test
	Disagree	Neutral	Agree	
"Access to the beach is important"	7.6	15.1	77.3	z= 9.93, p<0.001
"Infrastructures for disabled people are important"	15.5	1.8	82.7	z= 8.79, p<0.001
"Parking facilities are important"	4.2	10.7	85.1	z= 11.10, p<0.001
"A bar is important"	9.9	16.0	74.1	z= 8.92, p<0.001
"Emergency support facilities are important"	1.8	7.6	90.6	z= 12.01, p<0.001
"Sanitary facilities (toilets) are important"	3.3	7.1	89.6	z= 11.12, p<0.001

Note: [a] Statements were measured on a five-point Likert-scale, subsequently dropped to a three-point Likert-scale: Disagree (=1), Neutral = Neither agree nor disagree (=2), Agree (=3).

4.5 Discussion

Ecotourism is widely described as ecologically responsible tourism, benefiting the resources and having nature educational concerns (Whelan, 1991; Palacio, 1997; Wearing and Neil, 2009). Ecotourists are generally portrayed as recreationists, engaging in nature activities and interested in learning and appreciating natural environments. They are also seen as people interested in being involved in adventurous activities, maintaining a healthy travel lifestyle and sharing experiences (Boo, 1990; Fennell and Eagles, 1990; Williams, 1992). Priorities in outdoor recreational ecotourism management must, therefore, include a balance between supply and demand, i.e. a balance between resource adequacy and human recreational needs (Kenchington, 1993).

The implementation of the Marinha underwater routes was considered to be an important activity within the ones offered by the beach. The routes attracted 227 visitors engaged in connecting with nature underwater environment. It was, for the large majority of users, an excellent experience, that 90% of the surveyed snorkelers stated they would like to repeat.

The enhancement of sustainable management practices in natural areas, with the inclusion of visitors in recreational sustainable activities, increases tourists' conservation awareness. Ecotourism activities, together with environment education, lead to tourists having an increased responsiveness to and connection with natural environment (Wearing and Neil, 2009). The percentage of Marinha beach visitors involved in underwater eco-trails (16%) sheds light on the importance of the development of environmental education activities in Portuguese beaches in order to preserve marine ecosystems.

4.5.1 Sample characterization

There are different strategies for managing and achieving the sustainable development of protected areas. One such strategy is the Visitor Activity Management Process (VAMP), which is related with visitors' interpretation and services. VAMP involves the description of social demographic characteristics of participants, the activity infrastructure requirements, and the trends affecting the activity (Wearing and Neil, 2009). Hence, to correctly manage the resource, accurate social demographic characterization of eco-visitors is required.

Diving tourism seems to attract more male that female participants. In fact, most respondents were male (68%). Musa (2002) found a similar gender distribution while doing a survey in

Sipadan Island (Malaysia) to analyse scuba divers' satisfaction. Tabata *et al.* (1992) reported the same distribution in the surveys regarding scuba diving recreational activity carried out by Skin Diver magazine in 1988 and Underwater USA in 1989. The average age for Marinha snorkelers was approximately 29 years, similar to the one reported in Skin Diver survey, and near to the mean age of divers in Sipadan Island (35 years) (Musa, 2002). As was also observed by Musa (2002), most interviewees in Marinha beach have a high level of formal education (undergraduate or more education level). As such, it can be seen that in Marinha beach, as in other locations, young adult males, with a high degree of formal education seem to constitute the general profile of recreational divers.

4.5.2 Perceptions about the impact of routes on biodiversity

The vast majority of divers that took part in the survey perceived the existence of routes to be good for the preservation of the local biodiversity and stated they would come back and experience the routes again, which indicates a high degree of satisfaction with the activity. The same degree of satisfaction was found among scuba divers in the Sipadan Island (Musa, 2002).

The vast majority of interviewees perceived that eco-routes enhance nature preservation. This becomes a problem when trying to fit the logit model, since it is build upon a binomial response variable. Thus, having around 86% of respondents replying in one direction, results in the model not being significant. However, the model indicates that only group size impacted on interviewees' perceptions about routes being good for the preservation of biodiversity (with visitors from snorkelling groups with more than two people having a different perception than snorkelers that dived alone). This was probably due to the fact groups were constituted by members of the same family or friends visiting the beach together, hence having similar background in environment conservation conscience.

Most respondents perceived that underwater eco-routes enhance nature preservation. This was probably related with the profile of this kind of tourists, who in general are people interested in nature related outdoor activities. As reported by Gössling (1999), biodiversity-based tourism must meet all requirements of ecotourism, including environmental education. If correctly conducted, eco-education can lead to behaviour change in tourists, making them more aware of nature conservation issues (Dufft, 2002; McLaren, 2003).

In marine ecotourism, environmental education is mainly achieved through the development of underwater self-guided trails (Andrade *et al.*, 2005). According to (Lewis, 1980), ecotourism

interpretation facilities (e.g. trails, guides or signs) will focus the visitor's desire for a connection with the surrounding environment, providing educational and recreational experience. In fact, Berchez *et al.* (2005) reported that the most important aspect highlighted after a snorkeling experience in an underwater self-guided trail of Anchieta Island's Park, southeast Brazil, was the educational experience within the marine environment (71% of the inquiries).

Self-guided routes allow tourists to move at their own pace, stopping for as long as they want, and provide opportunities to learn about the environment through signs along the way. Nevertheless, this is a topic with scarce published data, as referred by Berchez *et al.* (2005) and Berchez *et al.* (2007), which makes understanding the impact of underwater trails on biodiversity conservation difficult.

Overall, tourists enjoyed all the self-guided routes of the Marinha beach, classifying them as "Good" or "Very Good". Nevertheless, route 3 was the most appealing. This fact must be related to items such as "route selected by the club"; "geography of the area"; "landscape"; "fauna"; "flora" and "charismatic or unique specie". Route 3 was the only route with a sinuous shape, and it also had rocky outcrops, sand beds and pebble areas along the path, making it more diverse that the other routes. Route 1, the second most appreciated, also had an interesting feature: the intertidal area was "engraved" in the rocky wall that delimited it. This characteristic was often used in the briefing since it offered an *in situ* learning spot on tidal effects on biological communities. In fact, low, middle and high tide effects on fauna and rocks could be easily explained just by looking at the cliff. Route 2, which has been selected because of its seagrass bed of *Cymodocea nodosa*, was the less appreciated by snorkelers. This may have been related with the fact that shortly before the trail has been implemented, most of the seagrass disappeared. As a consequence, snorkelers were unsuccessful in finding these important ecological habitats, which were identified in the underwater slates. Additionally, this route was delimited by the beach's navigational channel, making it sometimes a less attractive place for snorkelers (e.g. noise from the boats approaching).

4.5.3 Perceptions about beach support infrastructures

As Wearing and Neil (2009) pointed out, ecotourism requires sensitively developed tourist infrastructures, meaning that tourist operators must accept integrated planning and regulation.

Ecotourists who participated in this study considered that the most important infrastructures were the emergency support and the sanitary facilities. However, all the other support infrastructures were also considered very important, with an emphasis on parking facilities. In the Algarve region parking in rocky beaches is usually done on the surrounding cliffs, creating coastal management problems due to their instability. In Marinha beach parking was strongly conditioned in 2008 as a result of the public growing awareness of this problem.

4.6 Conclusions

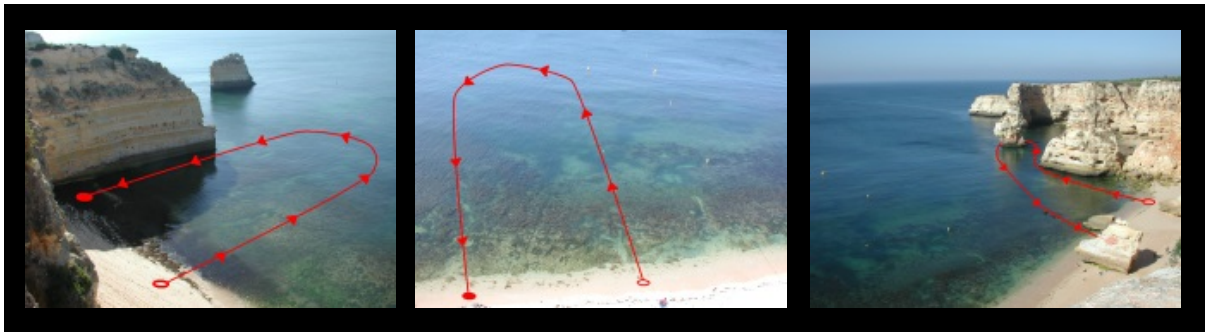
This study has highlighted the importance of snorkeling activities within the framework of coastal marine ecotourism. The implementation of underwater routes, with strong environmental educational component enhances this activity in a sustainable way. Nevertheless, scientific published data in the subject is scarce, which complicates attempt to replicate such actions.

The three underwater routes implemented in the study beach, and the subsequent survey of snorkelers, revealed that this is an efficient method of enhancing biodiversity conservation amongst snorkelers. Nevertheless the reduced number of beach users who participate in the snorkeling activity indicates the need to develop marine environmental education activities in Portugal and to develop environment sensibility awareness of beach users.

Nonetheless, this initiative was well received by the population, and acted as a starter in the promotion of marine environment awareness amongst Algarve summer season beach tourists.

CHAPTER V

Developing eco-tourist snorkelling routes in protected beaches: diving tourism education and monitoring



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Developing eco-tourist snorkelling routes in protected beaches: diving tourism education and monitoring

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5.1 Abstract

The use of pristine natural areas for diving activities is growing, but the amount of socioeconomic data on these activities is scarce and relates mainly to coral reef areas. We implemented three underwater self-guided routes at Marinha Beach (Portugal), with *in situ* interpretative trails and guidance, as a way to preserve biodiversity and to enhance environmental awareness. The routes were implemented in two consecutive summer seasons and after each season, visual census techniques were used to describe floral composition and cover area in order to evaluate human impacts. Divers profiles and perceptions about several issues related to the routes (e.g. role in enhancing biodiversity awareness) were investigated by questionnaire after diving. An annual pattern of macroalgae cover was found, that is probably associated with seasonal differences in water temperature, rather than impacts by snorkelers. Snorkelers of Marinha Beach are mostly in their thirties, with high level of formal education and with environmental concerns. Results show that *in situ* education and interpretation can raise environmental awareness if properly addressed. Also, the interpretative and educational tools used seem to please visitors, resulting in a satisfactory way of engaging snorkelers in the protection of the visited environments.

Keywords: Ecotourism; eco-routes; scuba diving; environmental education; monitoring

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5.2 Introduction

Coastal areas harbour some of the most diverse habitats in the planet, including important biodiversity hotspots for species assemblages, and some of the richest, productive and most fragile ecosystems on earth (McClain *et al.*, 2003; Abir, 2008; Duarte *et al.*, 2008). As such, the use of coastal areas for human recreation has always been a concern for scientists, environmentalists and managers, due to obvious conflicts between recreational uses and conservation of nature (Davis and Herriot, 1996; Lim and McAleer, 2005; Claudet *et al.*, 2010).

Tourism is one of the fastest growing leisure industries in the world (Neto, 2003). Furthermore, marine-based tourism has been growing at a rapid rate all around the world (Davis and Tisdell, 1995; WTO, 2001; Milazzo *et al.*, 2002; Davenport and Davenport, 2006; Luna *et al.*, 2009) due to the increasing popularity of human recreational activities in the marine environment, particularly in coastal areas (Badalamenti *et al.*, 2000; Milazzo *et al.*, 2002). Marine-based tourism includes all tourism, leisure and recreational activities that take place in the coastal zone and the offshore coastal waters (Hall, 2001; Hawkins *et al.*, 2005). In fact, the World Tourism Organization (WTO) identifies coastal areas as amongst the most visited locations worldwide and in many coastal areas tourism is the most important economic activity (WTO, 2001). The exact numbers of coastal marine tourists remains unknown. However, the increasing development of '*sun, sand and surf experiences*', the expansion of beach resorts and the increasing popularity of marine tourism activities (e.g. sunbathers, shell collectors, bird watchers, beach combers, snorkelers, recreational fishers, scuba divers) has turned coasts into areas of enormous human pressure (Davenport and Davenport, 2006; O'Dea *et al.*, 2011). In fact, the high number of different coastal users and the pressure they exert on coastal habitats has resulted in a continued global loss of several important ecosystems (Duarte *et al.*, 2008). Nowadays it is widely acknowledged that touristic activities must be developed within a sustainable framework, where it is fundamental to protect fragile marine environments (McGinn, 2002).

According to the WTO, biological equilibrium in touristic natural areas can only be insured through sustainable tourism, e.g. a responsible form of tourism, both ecologically and culturally sensitive, aiming at minimal impact on the environment and culture of the host community (WTO, 2001). Ecotourism aims to make *all* tourism sustainable (Cater and Lowman, 1994), through activities coordinated by a professional guide or interpreter and included in tours designed to entertain and educate clients. Over 80 activities have been listed

as ecotourism, amongst which are diving, birdwatching and kayaking (Taylor *et al.*, 2003). Ecotourism is considered the fastest growing market in the tourism industry worldwide, with an annual growth rate of 5% (Taylor *et al.*, 2003). In coastal areas, scuba diving and snorkelling (diving without portable air supply) are important marine-based tourism activities, with a long tradition of at least 75 years (Garrod and Gössling, 2008), and may be the most popular diving activities worldwide (Orams, 1999a; Claudet *et al.*, 2010). In fact, currently, diving is one of the major commercial uses of Marine Protected Areas (MPAs) around the world, and the control of its potential impacts on the marine environment remains a key factor for the management of this recreational activity (Di Franco *et al.*, 2009). Snorkelling is more accessible as a recreational activity than scuba diving since it requires less equipment and training, ensuring a wider appeal and greater participation (Garrod and Gössling, 2008).

Irrespectively of the type of diving, the activity allows people to visit underwater cultural and natural structures, acting as an excellent tool for environmental education and a powerful device for successful management, since it is able to raise environmental awareness among visitors and locals. As an example, in the buffer zone of the Cerbère-Banyuls Natural Marine Reserve (a small Mediterranean MPA), an underwater snorkelling trail was implemented as a measure to concentrate snorkelers in particular areas and increase their awareness of marine habitats and species (Skanavi *et al.*, 2003).

The impact of touristic use of marine coastal areas, and mostly snorkelers' impacts on the ecosystem, remains largely unknown (Claudet *et al.*, 2010) and there is a general lack of background data on coastal tourism and its associated biological impacts (Hall, 2001; Hawkins *et al.*, 2005). In fact, reliable data on these activities is scarce, and most scientific research can only be found in "grey literature" (e.g. as project reports) unavailable to the wider public (Hall, 2001; Garrod and Gössling, 2008). The lack of data makes it almost impossible to determine the significance of these diving activities. Moreover, the ecosystem impact studies carried out so far relate to the count of divers' direct contacts with reef communities, especially corals (Medio *et al.*, 1997; Plathong *et al.*, 2000; Schleyer and Tomalin, 2000a; Rouphael and Inglis, 2002; Zakai and Chadwick-Furman, 2002; Sorice *et al.*, 2007; Uyarra *et al.*, 2009; Camp and Fraser, 2012). In the absence of corals, different indicators for human distress were tested. Several successful experiments have been done with other macrobenthos species, such as counting of *Halocynthia papillosa* (Luna-Pérez *et al.*, 2010; Luna-Pérez *et al.*, 2011), and of different sessile invertebrates (Povey and Keough, 1991; Eckrich and Holmquist, 2000; Di Franco *et al.*, 2009). Definition of macroalgae cover,

seagrass cover and/or fish assemblages (Eckrich and Holmquist, 2000; Claudet *et al.*, 2010; Liu *et al.*, 2012), and direct contact with the seabed itself (Luna *et al.*, 2009) have also been used as a possible impact assessment frameworks.

In this study we implement and evaluate underwater self-guided snorkelling routes at Marinha Beach, a protected beach located in the Algarve region (South of Portugal), as a way to improve tourists' environmental awareness. Snorkelers' perceptions about conservation and environmental education are analysed and discussed. Lastly we assess changes in underwater flora assemblages in the areas of the routes as a possible measure or indicator of human impacts.

5.3 Methodology

5.3.1 Study area

Marinha Beach is located in the South coast of Portugal, within the central area of the Algarve's National Underwater Ecological Reserve (REN - *Reserva Ecológica Nacional*). This pristine beach, nested at the base of rocky outcrops, ranks among the world's top 500 beaches according to UNESCO. The Michelin Guide also characterizes this beach as one of the 100 most beautiful of the world, and one of Europe's top 10 beaches. In 1998 the Marinha Beach was distinguished with the prize of "Golden Beach/*Praia Dourada*" by the Portuguese Ministry of the Environment because of its remarkable natural attributes (Figure 1).

The REN, in place since 1983 (DL n.º 321/83, of 5 of July), is a biophysical structure with a series of zones which, by its values, ecological sensitivity, exposure and susceptibility to natural impacts are object of special protection. All Portuguese beaches, from the shore to the 30m bathymetric mark, are considered within this framework (Minister Council Resolution n.º 81/2012). However, to date, no measures have been taken to preserve and enhance sustainable underwater tourism in this popular Portuguese beach. Furthermore, it is important to note that despite the great importance of the national ecological reserve, the Portuguese government announced its decommissioning in September of 2012.

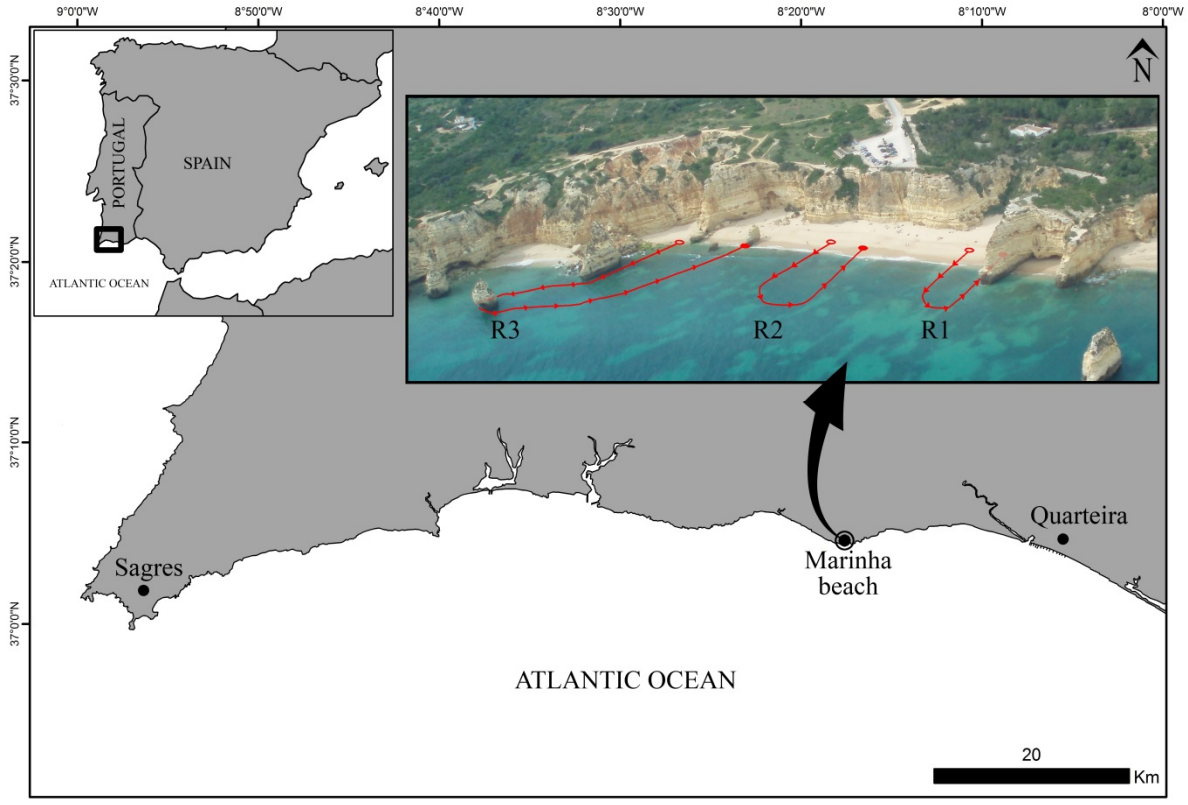

Figure 1 Marinha beach location (South coast of Portugal, Algarve) and the underwater snorkelling routes implemented: route 1 (R1); route 2 (R2) and route 3 (R3) (Adapted from Rangel *et al*., 2011).

5.3.2 Underwater routes

The mapping and characterization of marine communities of the Central Algarve Underwater REN has been carried out since 2003 as part of the RenSub project (Gonçalves *et al.*, 2004a; Gonçalves *et al.*, 2004b; Gonçalves *et al.*, 2008a; Gonçalves *et al.*, 2010). This study provided the tools that allowed the design of underwater routes with accurate scientific information on fauna, flora, geographic and landscape features (see Rangel *et al.*, 2011).

5.3.3 Biotopes mapping for routes' areas

Marine underwater communities of Marinha Beach were assessed during 2007 and 2008 using the RenSub visual census methodology (Gonçalves *et al.*, 2004).

Three snorkelling areas were designated for the implementation of routes. In order to select the route areas, a field research team was asked to characterize, report, and select the three most appealing underwater beach areas in terms of: location, presence of charismatic species

(e.g. pipefish *Syngnathus acus*) and protected species (e.g. seagrass *Cymodocea nodosa;* clingfish *Lepadogaster lepadogaster;* blenny *Lipophrys canevai*), appealing landscape (e.g. rocky outcrops), geological features, and existence of key biotope species (e.g. calcareous macroalgae *Lithophyllum incrustans*). Accessibility and support infrastructures, as well as motivating features for diving visitation (Ditton *et al.*, 2002) were also considered when choosing the areas of the routes (e.g. presence of fish and other aquatic life; underwater adventure; natural and unpolluted surroundings).

After defining the areas for the routes, biodiversity was mapped with fauna and flora visual census assessment following RenSub project methodology (see Rangel *et al.*, 2011) for a detailed description of the sampling procedures).

5.3.4 Routes implementation

Route 1 (R1) was designed as a rectangular shaped trail, and located near the beach entrance, in alignment with the sea cliff wall. Route 2 (R2), also with a rectangular shape, was located in the middle of the beach and delimited by its navigational channel. Route 3 (R3), the only one with an irregular trajectory, was designed around the large rocky outcrop at the western end of the beach. Figure 1 shows the three routes.

Double sided acrylic slates were deployed in four specific locations along each route (inversion points). Slates were attached to a highly visible orange buoy. Each slate showed the route map (with the location of the slates), mean depth, substrate type, snorkelers' location within the route, and photos of eight common species (Figure 2).

Figure 2 Double sided acrylic slates for underwater routes (first table of R3).

On land, wooden information boards were fixed along the beach displaying the major features of the routes (e.g. difficulty level, biological interest, ecological interest, charismatic species, and landscape interest). The boards graded each parameter on a scale from 1 to 5 (not interesting to extremely interesting and easy to extremely difficult) to facilitate information regarding each section of the routes. Detailed information about geographic definition, most commonly observed species, safety features and mandatory code of conduct were also provided. During the summer seasons, a team composed of marine biologists and lifeguards provided support to tourists and guided the snorkelling tours whenever required.

5.3.5 Substrate assemblage pattern

There is little information available on quantitative data regarding spatial patterns in subtidal hard substrate assemblages, even though this information is essential to understand responses to anthropogenic disturbances in these habitats (Fraschetti *et al.*, 2001). In order to identify variations in substrate along the underwater paths at Marinha Beach, flora assemblages were assessed after the summer seasons of 2008 and 2009 inside and outside R3, the most visited route (48% of the divers visited this route).

The use of underwater flora coverage as an indicator for substratum disturbance followed the methodologies of Di Franco *et al.* (2009), Claudet *et al.* (2010) and Liu *et al.* (2012), as a tool to characterize benthic communities potentially affected by diving. This methodology was favoured due to the lack of other sessile quantifiable benthic organisms with all the characteristics needed for scuba diving census assessment (e.g. being benthic, sessile, quantifiable and visible).

Species identification and flora coverage definition followed the "biotopes mapping" technique. A quadrat was placed every 5m along a 60m randomly positioned tape. All sampling started from one of the four buoys (with the interpretative slates) located in the Route 3, where five quadrat samplings were undertaken. The tape was then stretched to the inside or outside of the route, following a random direction.

5.3.6 Data analysis

For biotope data analysis, all species belonging to Chromista and Plantae kingdoms (seaweeds of the *Phyla* Clorophyta, Ochrophyta and Rodophyta and seagrass *Cymodocea*

nodosa of Tracheophyta *Phylum*,) of Route 3 were identified and considered. All specimens were identified to the species level. Mean coverage and total number of species *per Phylum* (%) were defined inside and outside of the route's area.

The diversity of seagrass and seaweed was characterized for each study area (inside and outside Route 3 paths) using several indices. Shannon Diversity Index (H') (Clarke and Warwick, 2001), Simpson Diversity Index (λ) (Simpson, 1949 *in* Krebs, 1989), Eveness (J') (Krebs, 1989) and Species Richness, according to Margalef's Index (R) (Margalef, 1958) were calculated based on the coverage percentages of observed species in the sampling quadrats.

Data was analysed using multivariate techniques after square root transformation to decrease the importance of the most abundant/dominant species. The Bray-Curtis coefficient was used to obtain the matrix of similarities (Clarke and Warwick, 2001) from which Non-metric Multi-Dimensional Scaling (MDS) was used to determine similarities between mean quadrat coverage of algae species.

Statistical comparison between mean coverage compositions of considered species was evaluated using Analysis of Similarities (ANOSIM), a multivariate non-parametric similarity statistical test (Clarke and Gorley, 2006). Similarities Percentages analysis (SIMPER) was used to define species contributions to sample homogeneity. All analysis was carried out using Primer 6.1.5 software (Clarke and Gorley, 2006).

5.3.7 The opinions and perceptions of visitors

The opinions and perceptions of snorkelers were investigated using a questionnaire survey. The survey was based on a structured face-to-face questionnaire designed to investigate snorkelers' perceptions about the role of underwater routes in enhancing (a) environmental education and (b) biodiversity preservation of underwater environments. Additionally, the questionnaire collected information about snorkelers' socio-demographic characteristics such as age, gender, nationality, educational level, amount of experience snorkelling, and their views on several other issues, including ecotourism and preferred routes.

The survey was undertaken from mid-July to mid-September (beach season) of 2008 and 2009. Questions followed a dichotomous (yes/no) and five-point scale (ranging from strongly disagree to strongly agree, and from terrible to excellent) formats. Although no questions

were left open-ended in order to constrain the respondents to provide an answer to every question, the option "I don't know" was available in some questions.

Sample size was defined after visual census of the beach visitors. The number of individuals at the beach was counted every day during the three months of the beach season at 11 a.m., 2 p.m. and 5 p.m. on the same trail along the beach, always by the same researcher to avoid multiple observers' bias. Daily number of Marinha beach users averaged 381, 512 and 214 during July, August and September, respectively, of 2008. Overall, in 2008 and 2009, the routes attracted 227 snorkelers, 120 during 2008 and 107 in 2009. A total of 202 individuals were interviewed, representing 89% of the total snorkelers (see Rangel *et al.*, 2011) for a detailed description of the sampling procedures).

It is important to emphasize that only snorkelers who contacted the support team for *in situ* pre-diving briefing and guided tours were interviewed. The data collected was analysed with descriptive statistics.

5.4 Results

5.4.1 Underwater routes

A total of 141 quadrats were sampled along Route 3 (inside and outside the route). Overall, 23 different flora species were identified during the sampling season of 2008. In 2009 this number increased to 30. A considerably higher mean coverage of red algae was recorded in 2008 (47% in 2008 and 19% in 2009). Also, the "No coverage area" is rather higher in 2009 when compared with 2008 (7% in 2008 and 43% in 2009) (Table 1).

Table 1 Mean coverage percentage (± Standard Error) and number of different species of macrophytes and macroalgae recorded per Phyla in Route 3.

Phylum	**2008**		**2009**	
	Mean coverage (± SE)	**N**	Mean coverage (± SE)	**N**
Clorophyta	6.35 ± 1.30	4	8.91 ± 0.43	6
Ochrophyta	36.86 ± 2.27	9	46.17 ± 2.40	13
Rodophyta	46.79 ± 2.63	9	18.67 ± 1.36	10
Tracheophyta	2.61 ± 1.40	1	7.50 ± 0.12	1
No coverage area	7.39 ± 1.68	-	43.05 ± 2.79	-

Overall diversity indices indicate consistently higher values for 2008, when compared with the same area and period for 2009. The same pattern is clear for inside path area *versus* outside path area within each sampling year (Table 2).

Table 2 Mean diversity indices (± Standard Error) for the coverage percentage of flora quadrats in Route 3 during summer seasons of 2008 and 2009. Inside: sampling area inside routes' path; Outside: sampling area outside routes' paths.

	Routes' area	Richness (Margalef) R	Shannon Diversity H'($\log_e$)	Simpson Diversity 1-λ	Pielou's evenness J'
2008	Inside	1.09 ± 0.02	1.53 ± 0.02	1.73 ± 0.01	0.87 ± 0.01
	Outside	1.01 ± 0.02	1.49 ± 0.02	1.72 ± 0.01	0.87 ± 0.01
2009	Inside	0.43 ± 0.06	0.47 ± 0.06	0.41 ± 0.08	0.17 ± 0.02
	Outside	0.30 ± 0.04	0.32 ± 0.04	0.29 ± 0.10	0.14 ± 0.02

5.4.2 Macroalgae similarity analysis

Considering coverage and diversity discrepancies identified in macroalgae assemblages in Route 3 for sampling seasons 2008 and 2009, similarity analysis was performed to understand the significance of these differences. The MDS analysis highlighted a clear difference in the grouping of the samples from 2008 and 2009 (Figure 3). These results seem to indicate seasonal variations of algae species between sampling years.

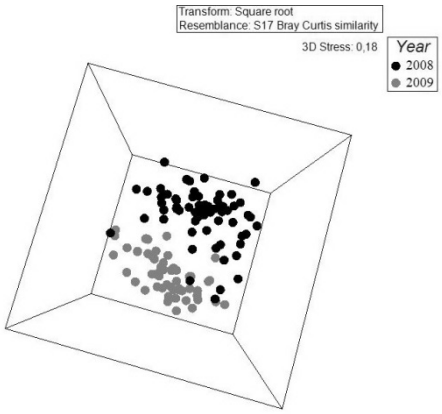

Figure 3 Non-metric Multi-Dimensional Scaling 3D (MDS) of Bray Curtis similarities between flora coverage of Route 3 in 2008 and 2009.

The similarity analysis (ANOSIM) for inside *versus* outside areas of Route 3 in 2008 and 2009 did not indicate significant differences in macroalgae coverage. Nevertheless, for this route, the difference in community structure is evident for the two years, with significantly different macroalgae overall coverage composition (R=0.549; p=0.0001), inner area coverage composition Route 3 (R=0.483; p=0.0001), and outer area coverage composition (R=0.687; p=0.0001) (Table 3).

Table 3 ANOSIM Analysis of Similarities of mean coverage by quadrat sampled with sample statistic (Global R) and associated significance level.

Year	Routes' area	R	p-value
2008	Inside v. Outside	0.008	0.194
2009	Inside v. Outside	0.026	0.280
2008 *v*. 2009	Inside	**0.483**	**0.001**
2008 *v*. 2009	Outside	**0.687**	**0.001**
2008 *v*. 2009	Inside and Outside	**0.549**	**0.001**

5.4.3 Visitors' opinions and perceptions

The average snorkeler in the survey was 29 years old, most were men and of Portuguese nationality. Most respondents had a high level of formal education, with 52% having an undergraduate degree or more. More than 9% of visitors reported being a member of a nature conservation group/association (Table 4).

Table 4 Characteristics of the respondents in the study (n=181). Data is shown as means (± Standard Deviation) for continuous variables and percentage for categorical variables.

Characteristics of respondents	Frequencies of occurrence (%) / Mean (±SD)
Nationality (%): Portuguese	52.9
Other	47.1
Gender (%): Male	68.2
Female	31.8
Mean age (years)	29 (12)
Education level (%)[1]: Up to standard grade	20.1
Up to high school grade	27.8
Undergraduate degree or more	52.1
Is (has been in the past) a member of a nature conservation group/association (%)	9.4

Note: [1]Level of formal education: standard grade corresponds to 9 years of schooling, high school grade corresponds to 12 years of schooling, undergraduate degree or more corresponds to undergraduate and postgraduate levels.

The large majority of snorkelers were interested in ecotourism in general (89%) and sub-aquatic ecotourism in particular (90%). Most were of the opinion that routes are good for biodiversity (86%) and would return to repeat the dive (95%). Most acknowledged having learned something new about the local biodiversity by doing the routes (79%) and that the information provided *in situ* describing species and the route in general was important (93%) (Table 5). Route 3 was considered as the most satisfactory route, with 62% of snorkelers classifying this route as excellent.

Table 5 Perceptions and opinions about conservation and routes (n=181). Data is shown as percentages.

Perceptions and opinions	**% responses**
Conservation and ecotourism	
"I am worried about the possibility of carrying out sustainable tourism activities. such as ecotourism"	89.4
"I am worried about the possibility of carrying out subaquatic ecotourism"	90.0
"I knew this beach was classified by MICHELIN as one of the top 100 most beautiful beaches in the world"	38.9
Underwater routes	
"Routes are good for biodiversity"	86.2
"I would return to dive in this site again"	94.8
"I have learned something new about the local biodiversity from doing the routes"	78.9
"I think it's important that routes are marked with situ information describing species and routes"	92.9
Number of routes done (%): one route	44.4
two or more routes	55.6
Preferred route (%): route 1	10.6
route 2	11.2
route 3	78.2

The quality of the briefing and the support team were perceived as highly satisfactory by more than 90% of the respondents. During the briefing snorkelers were informed about conservation, protection and dangerous features of the site. The vast majority of visitors considered that all the subjects were important components of the briefing (96%, 94% and 93%, respectively) and they rated their satisfaction in agreement (90%, 87% and 92%, respectively) (Table 6).

Table 6 Perceptions and opinions about the briefing and the information provided during the dive experience (n=181). Data is shown as percentages. Statements measured on a five-point scale subsequently dropped to a three-point scale (terrible/bad, neutral, good/excellent) or as binary response (Yes is reported under good, No is reported under bad).

Perceptions and opinions about the briefing and the information provided during the dive experience	**% responses**		
	Bad	**Neutral**	**Good**
Classification of the briefing	0	7.3	92.7
Classification of the support team	0	1.5	98.5
Information provided about biodiversity / fauna during the briefing			
Importance of information provided on conservation[1]	0.7	3.3	96.0
Satisfaction with information provided on conservation[2]	4.5	5.1	90.4
Importance of information provided on protection[1]	1.4	4.0	94.6
Satisfaction with information provided on protection[2]	5.1	8.3	86.6
Importance of information provided on danger [1]	2.7	4.7	92.6
Satisfaction with information provided on danger[2]	3.2	5.1	91.7
Information provided about underwater routes during the briefing			
Importance of information provided on the routes[1]	2.8	6.2	91.0
Satisfaction with information provided on the routes [2]	2.6	10.1	87.3
Importance of information provided about the level of difficulty of the routes[1]	8.3	7.7	84.0
Satisfaction with information provided about the level of difficulty of the routes[2]	7.0	4.4	88.6
Importance of information provided on interest features[1]	2.1	7.6	90.3
Satisfaction with information provided on interest features [2]	0.6	5.7	93.7
Boards/flyers/booklets – hand-outs			
"I received underwater slates with information about species to take into the water"	34.4	–	65.6
"I think it is important to have this information (flyers/booklets/boards) about the routes" [1]	7.8	3.2	89.0
"The information (flyers/booklets/boards) provided about the routes was satisfactory" [2]	5.3	6.6	88.1

The information regarding the routes features provided in the briefing was considered very important (91%) and snorkelers were highly satisfied (87%). Likewise, the information regarding the difficulty of the routes was regarded as highly important (84%) and the manner in which the information was provided was also graded as "very satisfactory" (89%). Overall the data provided on interesting features of the trails was also reported to be important (90%) and satisfactory (94%).

The majority of visitors had received underwater slates with information about species to take into the water (66%) but most of the respondents reported they did not receive flyers/booklets describing the routes (59%). The vast majority of visitors acknowledged the importance of having flyers, booklets and/or boards regarding the routes' features (89%) and reported that the information given was satisfactory (88%).

5.5 Discussion and conclusions

As emphasized by Hawkins *et al.* (2005) the demand for diving activities at Marinha Beach highlights the importance of pristine habitats, natural beauty of landscapes and abundance of wildlife as top motivations for the "ecotourism" experience. In fact, pristine conditions rank amongst the most important factors for the selection of diving locations (Davies, 1990; Wallace *et al.*, 1993; Orams and Mark, 2002) and seem to be important for snorkelers at Marinha Beach, since most visitors reported their preference for doing tourism through ecotourism activities, particularly in the underwater environment.

Several authors highlight that diving activities are likely to have several impacts on marine ecosystems, hence the need for a more ecological management of the coastal areas where diving activities are practiced (Hawkins *et al.*, 1999; Tratalos and Austinb, 2001; Rouphael and Inglis, 2002; Zakai and Chadwick-Furman, 2002; Barker and Roberts, 2004; Garrod and Gössling, 2008). In fact, snorkelers are able to damage the sessile fauna and flora by trampling (Plathong *et al.*, 2000), contacting with their fins (Barker and Roberts, 2004), raising of sediments (Zakai and Chadwick-Furman, 2002) or by disturbing vagile fauna (Hawkins *et al.*, 1999).

Two important aspects of beach tourism management should be enhanced: maintenance of ecosystems and rising of visitors' awareness (Vanhooren *et al.*, 2011). The present study aimed to investigate these matters in this important touristic beach destination of the Algarve region. Lindgren *et al.* (2008) point out that in the dive tourism industry environmental management has to include policies, education, communication, and actions aiming at avoiding or minimizing environmental impacts. In this industry, environmental management has to consider that production and consumption occur at the same time (individual divers directly cause environmental damage), forcing the management process to focus primarily on the clients and involving all interested parts in the process (Lindgren *et al.*, 2008).

From the scarce scientific information available, there is an overall consensus on the direct correlation between damage to underwater organisms and the number of diving visitors (Rodgers and Cox, 2003; Hannak *et al.*, 2011), with the vast majority of these studies focusing on impacts on coral reef (Harriott, 2002). Nevertheless, identifying the behaviour of divers and their environmental effects may help managers to develop more effective management procedures, such as pre-dive briefings and site regulations, preventing or reducing the incidence of destructive conducts (Rouphael and Inglis, 2001).

The development of snorkelling routes aims to increase divers' environmental awareness, by recognizing underwater behaviour responsibilities and increasing the understanding of the marine environment, and is being increasingly used as an attempt to reduce damaging impacts in defined areas (Harriott, 2002; Claudet *et al.*, 2010). In the French Mediterranean coast, a self-guided snorkelling trail was implemented in the buffer zone of the Cerbère-Banyuls Natural Marine Reserve (CBNMR) as a way to concentrate snorkelers within a defined area. In this trail, environmental information was displayed in buoys with specific acoustic hearing devices, promoting an increase in awareness and responsibility (Claudet *et al.*, 2010). At Marinha Beach the information regarding the self-guided snorkelling routes was firstly provided through pre-dive briefings. Once inside the water, acrylic slates attached to buoys provided detailed information on the surrounding environment. The objective of these routes, in consonance with the Mediterranean CBNMR underwater paths, was to increase environmental awareness as a way to minimize possible impacts on marine features, such as important seagrass meadows of *Cymodocea nodosa*.

Overall, 89% of the total number of snorkelers who dived in the beach used the eco-routes. This is indicative of the popularity of the routes amongst snorkelers, and suggests that the routes did contribute to concentrating divers in the chosen areas and make environmental information more available.

In fact, there were no significant differences between the floral communities inside and outside the underwater most used route (Route 3) in each studied year (2008 and 2009), indicating an absence of impact from this eco-activity. Nevertheless, significant differences in the macroalgae assemblages were identified, in the inner and adjacent outer areas of Route 3, with an obvious loss of diversity, richness and cover area from 2008 to 2009.

Data shows that the decrease in cover area is accompanied by a reduction of red algae, and an increase of "No coverage area". This fact coincides with the disappearance from the samples of *Asparagopsis armata*, the most abundant non-calcareous red algae of the 2008 census. *A. armata*, a recent invasive species from Australia (Chualáin *et al.*, 2004), has long hooked stolons (Bonin and Hawkes, 1987), which enable the algae to get entangled with other marine organisms and, thus, cover large areas of the substrate (Andreakis *et al.*, 2004). The life cycle and temperature tolerance of this species is rather complex, requiring short day lengths (Oza, 1977; Guiry and Dawes, 1992) and temperatures approximately between 17ºC and 18ºC (Guiry and Dawes, 1992; Chualáin *et al.*, 2004). In fact, in the Northern Mediterranean the critical factor limiting the distribution of *A. armata* is the high summer temperatures which

are lethal to the species (Andreakis *et al.*, 2004).

AVHRR (Advanced Very High Resolution Radiometer) data of the National Oceanic Atmospheric Administration (NOAA) show that in September and October (sampling season) of 2008 the average temperature recorded for the sea surface of the Algarve coast ranged from 19ªC to 22ªC. In the same period for 2009 the same records showed values of 22ªC to 24ºC (NOAA, 2013). These variations may explain the dissimilarities observed in the floral community pattern from 2008 and 2009. Moreover, they indicate that these differences cannot be directly assigned to human impacts but, most probably, to the difference in sea surface water temperature between the two summers.

Overall, the results are in agreement with the findings of Claudet *et al.* (2010), who reported inter-annual variability of macroalgae composition in coastal subtidal areas. This variability seems to be related with the abrupt rise of sea surface water temperature along the Algarve coast rather than with snorkelers' use of the area. In fact, similarly to the procedures undertaken by several other authors, some procedures were developed to avoid human impact on marine communities: underwater trails were, as much as possible, confined to areas where water is deep enough for snorkelers to avoid damaging macroalgae with their fins (Plathong *et al.*, 2000), and interpretative buoys, were equipped with a device that allowed snorkelers to hold on, which could be effective in minimising fin damage (Claudet *et al.*, 2010). It is also important to mention that the vast majority of Marinha Beach snorkelers did not use belt weights even though they were available, thereby reducing the probability of contact with the substrate and, therefore, potential damage.

Davis and Tisdell (1995); Medio et al. (1997); Townsend (2003); Barker and Roberts (2004); Camp and Fraser (2012); Townsend (2008a) and Barker and Roberts (2008) argue that the best and most popular way of reducing divers' environmental damage is through education. Education is, according to Lindgren *et al.* (2008), a "soft" management strategy, aiming at promoting divers awareness by increasing their knowledge about the activity and the environment. It is important to emphasize that environmental education (formal way of delivering information) and interpretation (informal information provider through encouragement and improvement of visitors' empathy with the visited site) are both used to supply relevant environmental information as a conservation tool. These strategies have the capacity to provoke a satisfactory experience and, thus, promote the "desire to preserve" and increase compliance with management conservation measures (Townsend, 2008a).

According to Garrod and Gössling (2008b), diving is an activity practiced mostly by tourists with a high level of formal education. In fact, Musa (2003) investigating scuba divers in Malaysia noticed that 71% of divers visiting Sipadan Island, considered one of the top scuba dive destinations in the world, had at least some years of college education. Also, 58% of divers visiting Layang Layang Malaysian Island had a university degree or postgraduate qualifications (Musa *et al.*, 2006). Garrod and Gössling (2008b) also report that 58% of scuba-divers and snorkelers of Mauritius had a college degree. This was also the case of Marinha Beach, where over 52% of interviewees had an undergraduate degree or more. Also, more than 9% of the respondents had already been engaged in some nature conservation organization. The high level of formal education and the pre-existing conservation awareness amongst visitors must be carefully considered when designing an educational framework, since as emphasized by Townsend (2008a), interpretation and environmental education must be adapted to the targeted users or it will not have the expected results in increasing public awareness.

Almost half of the respondents were not Portuguese (47%). The area where Marinha Beach is located is generally frequented by foreign tourists and, as reported by Liu *et al.* (2012) these are likely to engage in diving recreational activities in their holiday period.

Lindgren *et al.* (2008) noted that the gender imbalance of divers is becoming less marked, which is another important feature to consider when designing environmental management and awareness strategies. However, surveyed individuals were predominantly males in their 30s, as is also the case in most diving surveys (Tabata *et al.*, 1992; O'Neill *et al.*, 2000; Mundet and Ribera, 2001; Musa, 2003; Maccarthy *et al.*, 2006; Musa *et al.*, 2006). Access to Marinha Beach is not easy, since access to the sand has to be made through a demanding stairway, and this could be a reason for the observed age distribution of snorkelers.

The limited number of studies focusing on the issue of information provided by briefings generally find that divers and snorkelers tend to be receptive to environmental education given this way (Medio *et al.*, 1997; Zakai and Chadwick-Furman, 2002; Townsend, 2003; Barker and Roberts, 2004). In most of these studies, providing information resulted in an increase in self-awareness and a reduction of damage to the underwater environment. The need to reinforce the development of "environmental briefings", with important, selected and contextualized environmental information, that engage the divers and effectively attenuate harmful underwater behaviour care should however be emphasized (Barker and Roberts, 2004). In fact, evidence shows that divers are keen to learn about the visited sites and look to

guides for assistance, offering a unique opportunity to reduce negative underwater impacts (Barker and Roberts, 2004) and diminish environmental *in situ* impacts (Hannak *et al.*, 2011; Camp and Fraser, 2012). In the study case, great effort was made to inform divers about all important features of the Marinha Beach underwater area. The briefing also provided detailed information on issues such as conservation, protection and dangers. Visitors seem to enjoy and recognize the importance of such information, considering the briefing and the information given highly satisfactory. Barker and Roberts (2004) found a direct correlation between the quality of the briefings and the number of scuba diver contacts with the reef in St. Lucia Island (Eastern Caribbean). Camp and Fraser (2012), while studying the influence of environmental information on briefings for Florida Keys' divers, observed that over one-quarter of the available briefings did not provide any environmental education, resulting in poor environmental protection.

Education and interpretation, if properly delivered, help to control diver impacts' *in situ* and to increase conservation awareness. Townsend (2008a) emphasizes that the challenge is to deliver this information in ways that enhance diver satisfaction and interest in these issues. Interpretation of a site through panels, leaflets and so on, increases visitors' appreciation of the surrounding areas and encourages empathy with the site (Townsend, 2008a). In the case study, the large majority of snorkelers perceive the manner in which information was provided as highly satisfactory.

The vast majority of Marinha Beach interviewees perceived the existence of the routes as being good for the preservation of local biodiversity, recognizing that they learned something new with *in situ* interpretation. Furthermore, snorkelers reported that in addition to the information available on buoys, they received underwater interpretative slates to take into the water. Overall, users report that they would like to return to this beach and take part in this activity again. This is a positive outcome since we defined the underwater routes with the aim to provide environmental *in situ* information in a way that would enhance visitors' empathy with the surroundings, increasing their willingness to protect as recommended by Townsend (2008a). Also, when information is provided along the route, snorkelers can appreciate the area better and be made more aware of rules, safety and appropriate behaviour (Tabata *et al.*, 1992).

Plathong *et al.* (2000) and Townsend (2008a) highlight the interest of underwater self-guided trails, emphasizing that they must be unique for each dive trail. As Barker and Roberts (2004) note, divers appreciate all efforts made to provide information as a part of "good customer

service", and they do not even mind to pay for it, as long as they are pleased.

At Marinha Beach, all major features concerning diving, education and interpretation were carefully considered while developing and implementing underwater snorkelling routes, in order to enhance their use and promote environmental awareness. The study seems to indicate that there was overall a high level of satisfaction amongst divers, leading to an effective rise of environmental awareness and a more sustainable use of this touristic underwater area.

CHAPTER VI

Developing self-guided scuba dive routes in the Algarve (Portugal) and analysing visitors' perceptions

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Developing self-guided scuba dive routes in the Algarve (Portugal) and analysing visitors' perceptions

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6.1 Abstract

Scuba diving allows for underwater visitation of cultural and natural resources. Underwater routes can be used as a tool for guided and supervised underwater visits. Two scuba diving routes were implemented in the Algarve (South of Portugal), at the "B24" and "Poço" diving sites. The perceptions of scuba divers regarding several aspects of the routes and the existing support infrastructures were studied following a survey carried out through face-to-face interviews from 2008 to 2012. Divers profile and their perceptions were analysed using 246 valid questionnaires. Divers were mainly Portuguese, over thirty years old and with more than 12 years of formal education. Some of the support infrastructures did not achieve a "good" or "acceptable" grade. This should be carefully considered by diving operators and managers, because perceptions tend to circulate throughout the diving tourism community. All features of interpretative slates were graded as highly satisfactory. Overall, diver satisfaction increased slightly after route implementation, with an average ranking of "good". These findings support the implementation of underwater routes as a way to promote diving activity, and to increase divers 'environmental education and awareness.

Keywords: Underwater routes, scuba diving, environmental awareness, coastal tourism, dive tourism, ecotourism.

6.2 Introduction

Large scale coastal tourism began in the 19th Century, with increased prosperity and mass transports, and consequent affordability of tourism activities (Davenport and Davenport, 2006). Currently, coastal tourism represents the fastest growing tourism industry in the world (Mola *et al.*, 2012), triggering the development of a wide variety of marine recreational activities (Leeworthy and Bowker, 2005; Pendleton and Rooke, 2006).

Diving allows visitation of subaquatic cultural and natural resources. In fact greater underwater autonomy, along with higher cultural and ecotourism demand, have encouraged *in situ* preservation of underwater sites with archaeological features, promoting the development of underwater tourism, either through media virtual tours, snorkelling, scuba diving or glass-bottom boat tours, thereby increasing the popularity of the diving activity *per se* (Lück, 2008; Delgado, 2011). Scuba diving and snorkelling are also increasingly important touristic components of multiple-use Marine Protected Areas (MPAs) (Davis and Tisdell, 1995; Plathong *et al.*, 2000). The use of underwater routes (or trails), mostly by scuba divers, but also by snorkelers (Plathong *et al.*, 2000) allows divers to carry out guided and supervised underwater visits of the natural and/or cultural patrimony, and have been in use for some time now (Hall, 2010; Delgado, 2011; Rangel *et al.*, 2011; Tikkanen, 2011). The use of trails is also important because these restricts divers' access to defined areas, and serve to enhance their knowledge of the marine environment (Harriott, 2002; Hannak, 2008; Hannak *et al.*, 2011). The latter issue is particularly important since the broadening of divers' knowledge, especially with regard to (potential negative) impacts and diving skills, enhances environmentally responsible behaviour (Rouphael and Inglis, 2001).

In the Mediterranean, MPAs managers are increasingly interested in reducing the environmental effects of underwater recreational activities using self-guide trails, and there are several examples of routes established for this purpose, such as in the Port Cros National Marine Park, the Bouches de Bonifacio Marine Reserve and the Cerbère-Banyuls Natural Marine Reserve, all located in France (Lloret *et al.*, 2006; Di Franco *et al.*, 2009; Claudet *et al.*, 2010)] .

In Brazil the interpretative trail located at Anchieta Island Park (southeast Brazil) represents an important example (probably the sole example for this country) of a scientifically-based underwater route that aims to promote environmental education for snorkelers and scuba divers (Pedrini *et al.*, 2010). In Mexico, at Isabel Island National Park, six underwater trails

were implemented to concentrate scuba diving within established routes and define carrying capacity of recreational diving in this popular island (Ríos-Jara *et al.*, 2013). In the Nordic and the Baltic Sea Regions, Tikkanen (2011) presents two innovative projects for the regulation of visits of underwater cultural heritage sites: the Nordic Blue Parks Project that enhances recreation through underwater trails at wreck sites; and the Vrouw Maria Underwater Project, that provides underwater visits to the Vrouw Maria Dutch snow ship using virtual simulation, because of the "Natura 2000" protected area in which the wreck is located. In Portugal, three underwater snorkelling routes have been developed, in 2008, as a way to promote environmental knowledge at a popular summer season beach, the Marinha Beach (Algarve) (Rangel *et al.*, 2011).

Independently of the method used, carefully planned briefings are essential for reducing divers' underwater impact (Hannak *et al.*, 2011; Camp and Fraser, 2012). However, in order to be effective, briefings must be "environmentally friendly" (Barker and Roberts, 2008), site and target specific, and be provided immediately prior to the dive (Townsend, 2008a). If properly delivered, *in situ* interpretation and education can contribute to increase environmental awareness. Furthermore, these methods increase divers' satisfaction and their perception about the surrounding environment (Townsend, 2008a).

A number of studies have been conducted on scuba diver visits (e.g. Barker and Roberts, 2004; Hannak *et al.*, 2011; Rangel *et al.*, 2011; Garrod and Gössling, 2008; Musa and Dimmock, 2012), with most research focusing on divers' impacts on the environment, especially on coral reefs, an issue of increasing concern amongst the scientific community (Hall, 1996; Rouphael *et al.*, 2011; Townsend, 2008a). Some studies have analysed divers' perceptions about their impacts on the system or their satisfaction regarding different aspects of the dive, support facilities and infrastructures. Analysis of divers' perceptions about this recreational activity are rare and mainly relate to specific crowded and popular diving sites, explicit concerns of managers, divers' satisfactions and motivations, or environmental education procedures. Musa (2003, 2003) studied Sipadan (Malaysia) diving site in order to examine overall divers' satisfaction, define divers' profile and understand their impact on the tourism development of the island. O'Neill *et al.* (2000), Atilgan *et al.* (2003) and Maccarthy *et al.* (2006) analysed operators performances by investigating divers perceptions. Reef management preferences of sport divers, in offshore Texas, were studied by Ditton *et al.* (2002). Demographic characteristics of divers in the Medes Island (Spain) were analysed by Mundet and Ribera (2001). Musa *et al.* (2010) analysed the influence of scuba divers'

personality, experience and demography on their underwater behaviour. Divers' environmental perception and its implications for the management of the activity was studied by Brotto *et al.* (2012) for the coastal area of Rio de Janeiro (Brazil).

Specific scientific research on underwater routes use is even rarer. In Brazil, Berchez *et al.* (2005) and Pedrini *et al.* (2010), worked on improving environmental education for Anchieta Island's Park underwater routes, reporting the absence of research data for comparison purposes. Hannak (2008) analysed visitor characteristics and their perceptions about the management tools used for the implementation of a snorkelling underwater route in Dahab (South Sinai, Egypt). In Portugal, (Rangel *et al.*, 2011) analysed visitors' satisfaction and overall perceptions about three underwater snorkelling routes implemented at Marinha Beach (Algarve). The general lack of knowledge in this area conflicts with the increasing use of interpretative trails as management measures all around the world.

Two underwater scuba dive routes were implemented in the Algarve (South of Portugal), allowing visitors to engage with natural underwater biodiversity, landscape, and historical heritage in the area. The objectives of this paper are to gauge divers' perceptions about these routes and their role in enhancing underwater tourism, the diving service provided and the supporting infrastructures. In adition the paper investigates their motivations and defines divers' demographic profiles.

6.3 Methods

6.3.1 Mapping, characterization and selection of dive sites for routes' implementation

Diving spots were selected based on defined features: high biodiversity, existence of charismatic (e.g. *Muraena helena*) and protected species (e.g. *Eunicella verrucosa*), appealing landscape (e.g. rocky outcrops), geological features, existence of key biotope species (e.g. *Dyctiota dichotoma*), existence of wrecks, accessibility and supporting infrastructures. Motivating features for diving visitation such as presence of fish and other dynamic aquatic life, site popularity, underwater adventure, natural and unpolluted surroundings (Ditton *et al.*, 2002) were also considered.

All dives were undertaken with local operators to allow customary dive procedures within each company and to enable immediate surveys of the tourists after diving. When choosing the study areas, all dive operators of the Algarve were considered for taking part in the study.

Of the thirteen dive clubs that existed in 2007 in the Algarve, Dive Spot (Armação de Pêra) and Hidroespaço (Faro) were chosen due to the interest and willingness they showed in taking part in the research and to the fact that both clubs are owned and managed by marine biologists who were receptive to collaborating in a scientific study. Initially, in 2007 and 2008, five well known diving spots were analysed for possible route implementation: "Anzol", "B24" and "Cavalos do Mar", operated by Hidroespaço, and "Poço" and "Nudis", by Dive Spot.

Marine underwater communities were assessed (to characterize local fauna and flora, identify characteristics and/or protected species, localize interesting landscape features and locate conspicuous species) in all five dive spots using the RenSub projects (Gonçalves *et al.*, 2004a; Gonçalves *et al.*, 2004b; Gonçalves *et al.*, 2007a; Gonçalves *et al.*, 2008a; Gonçalves *et al.*, 2010) visual census methodology for characterization of the marine communities of the Central Algarve Underwater Ecological Reserve.

In 2008 two diving spots, "B24" and "Poço" (Figure 1), were chosen for the implementation of routes. Selection was first based on RenSub field research team choice of most appealing and feasible underwater spots for route development. Accessibility, possible dangers and routes' drawings, support infrastructures, as well as motivating features for diving visitation, as identified by Ditton *et al.* (2002), were later considered for the final selection of areas for the routes. The chosen spots were considered the most consensual for all described features.

Both study areas are part of the National Underwater Ecological Reserve REN (*Reserva Ecológica Nacional*; DL n.º 321/83, of 5 of July), consisting of areas under special protection, from the shore to the 30m bathymetric mark (Minister Council Resolution n.º 81/2012), due to their ecological sensitivity, exposure and susceptibility to natural impacts.

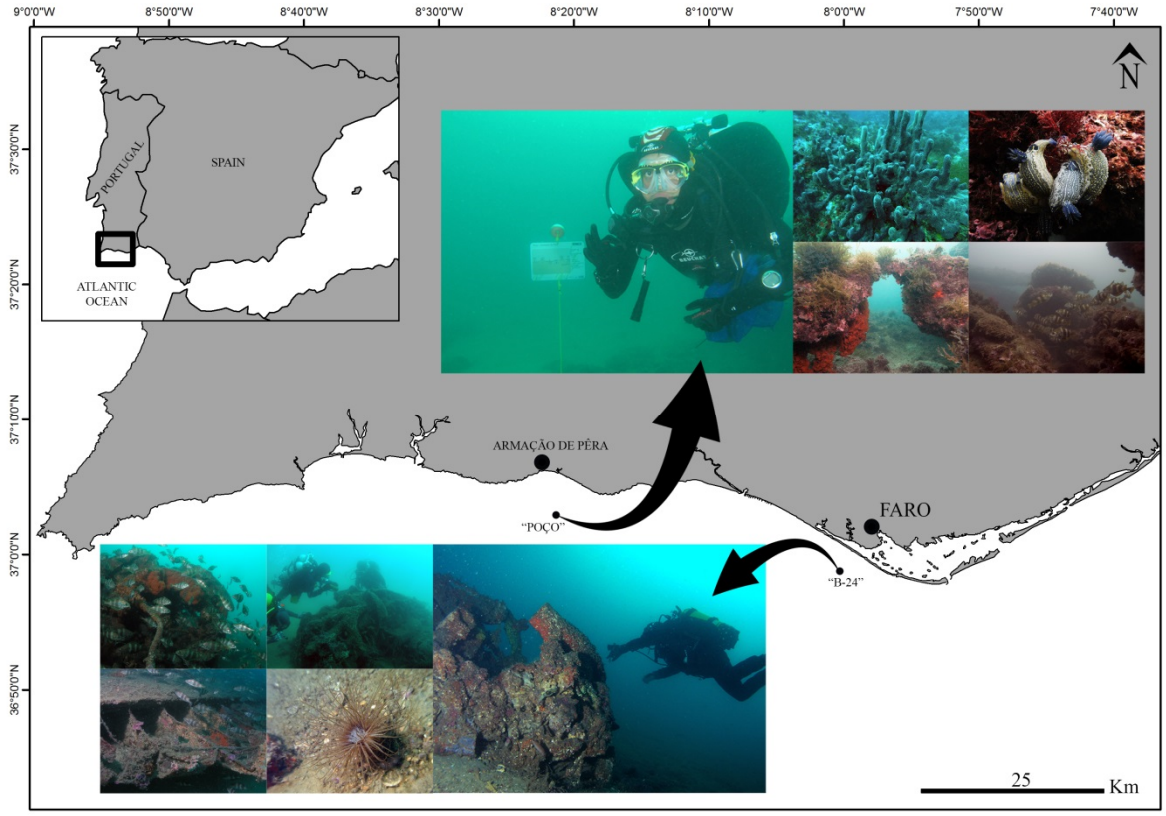


Figure 1 Location of "B24" and "Poço" underwater routes (Algarve, South of Portugal). Some characteristic/interesting features are displayed.

6.3.2 Route sites

"B24" – Faro

The "B24 Liberator" (Figure 1) is the wreck of the U.S. B-24 Liberator bomber PB4Y that sank in 1943 off Faro (coordinates: N36 59.235; W008 00.251. The historical aspect of the spot, along with its rich biological assemblages and its popularity amongst divers were the main reasons for its selection. Nowadays it is possible to identify the structure of two complete wings (34m long) in inverted position, the motors and the cavities for the landing gear storage bay. Unfortunately, the fuselage has disappeared, but two of the propellers, a motor rotor and one vertical rudder are located quite near the main structures and can be seen during the same dive.

"Poço" – Armação de Pêra

The diving spot "Poço", located off Armação de Pêra (coordinates: N37 03.103; W008 21.197) (Figure 1), consists of an underwater outcrop with multiple recesses and large caves.

The area is known for its biological diversity and beauty, and is the most popular dive location operated by "Dive Spot". Also, it is a fairly straightforward dive trail, with the outcrop running along the left side of the diver, and sandy bottom on the right side. The characteristics of the spot allowed the implementation and integration of a self-guided route in the regular activities of the club.

6.3.3 Routes' implementation

After biodiversity mapping and careful description of geographical features of each area, specific locations were selected in each area, which contained appealing fauna, flora and landscape features. Double sided acrylic slates, five in "B24" and six in "Poço", were then deployed in specific places along each route (Figure 2). Slates were attached to a highly visible yellow cable. The first one, indicating the beginning of the route, had an orange buoy to mark the spot. Each slate had an illustration of the route's map with the location of the slates, mean depth, substratum type, snorkelers' location within the path, and photos of eight of the most common species.

Figure 2 Example of the double sided acrylic slates for "B24" (A; B) and "Poço" (C; D) underwater routes.

"*Environmental briefings*", following Barker and Roberts (2004, 2008), were carefully planned and designed with each diving operator, considering the overall route' characteristics

such as: diving area, characteristics of the usual divers, difficulties and dangers, and environmentally interesting features.

For the "B24" site special care was taken when providing information regarding the historical aspects of the plane wreck. In this context, structure conservation procedures were carefully considered. Also, for all dives, a researcher provided support to visitors, and the clubs' dive masters were trained to follow all procedures required to enhance this activity.

The first route was implemented in "B24" during November 2008. In "Poço" the project was launched in June 2009. After each dive visitors were asked to reply to a questionnaire about their opinions regarding several aspects of the routes, their satisfaction with the dive, and other related items. Slates were periodically cleaned (each 15 days) by researchers, divers from the clubs and even visitors, to prevent fouling.

6.3.4 Survey and data analysis

Divers' perceptions were investigated using a structured face-to-face questionnaire designed to investigate diver' opinions regarding several features of the underwater routes, such as biological diversity of the area and landscape attractiveness. The survey also collected information about divers' views of several issues related to the dive (e.g. supporting structures, preferred routes), and on their main perceptions concerning several features of the dive sites, implemented routes and interpretative slates characteristics. Additionally, the survey also gathered information on divers' socio-demographic profile (age, gender, nationality, educational level).The survey was undertaken from 2008 to 2012. The questionnaire was carried out with all divers who used the five sites considered for route implementation. After the implementation of routes, only "B24" and "Poço" divers were interviewed.

A total of 365 scuba divers were approached in the course of 75 dives, with 246 questionnaires validated for analysis. A total of 140 divers surveyed dived before routes were implemented and 106 afterwards. It should be noted that 64 questionnaires are related to sites that were not selected for route implementation ("Anzol", "Cavalos", "Nudis"). Of the interviews related to route dives, 70% (74) dived in "B24", and 30% (32) in "Poço".

Questions followed a dichotomous format (yes/no) and a five-point Likert-scale format (ranging from strongly disagree to strongly agree, and from terrible to excellent). No questions were left open-ended in order to constrain respondents to provide an answer to every question, although the option "I don't know" was available for some questions. For some analyses, and due to the sample size, the five-point Likert-scale scale was collapsed to a three-point scale (agree, neutral and disagree).

Differences between respondents were tested with the chi-square test (or Fisher's exact test, when assumptions were not met by the data) for categorical data, and with Kruskal-Wallis and Wilcoxon-Mann-Whitney tests for ordinal or interval data. All data were analysed with Stata SE 10 (Data Analysis and Statistical Software, Stata Corporation, College Station, TX, USA).

6.4 Results and discussion

6.4.1 Divers' characteristics

Marine ecotourism is by definition a sustainable activity, but its associated negative ecological and socio-economic impacts are acknowledged by several authors (e.g. Hawkins *et al*., 1999; Rouphael and Inglis, 2002; Barker and Roberts, 2004; Garrod and Gössling, 2008). Hence, to allow the definition of accurate management measures able to effectively prevent negative impacts, socio-economic profiling of users is essential (Brotto *et al.*, 2012). In fact, Pedrini *et al.* (2011) emphasize that in marine ecotourism the knowledge of environmental perceptions of recreational divers is essential for installing touristic facilities. According to Brotto *et al*. (2012), these perceptions can be identified through socio-economic profiling of ecotourists, allowing the identification of possible problems and the definition of mitigation measures.

Table 1 Demographic characteristics of the respondents in the case study (n=246). Significant differences between divers who used routes and those who did not use routes were tested with Chi-square and Kruskal-Wallis tests.

	All data		Dive in Routes		Dive not in Routes		Statistical test results
	N	%	N	%	N	%	
Gender							
Female	57	23.2	25	23.6	32	22.9	$\chi^2 = 0.02$, p = 0.893
Male	189	76.8	81	76.4	108	77.1	
Nationality							
Portuguese	219	89.0	98	92.5	121	86.4	$\chi^2 = 2.24$, p = 0.134
Other	27	11.0	8	7.6	19	13.6	
Marital status							
Single or divorced	120	49.8	52	49.1	68	50.4	$\chi^2 = 0.04$, p = 0.840
Married or living together	121	50.2	54	50.9	67	49.6	
Education level[1]							
Standard grade or High school grade	71	30.5	34	32.7	37	28.7	$\chi^2 = 0.44$, p = 0.509
Undergraduate degree or more	162	69.5	70	67.3	92	71.3	
Age group							
≤ 20	37	15.7	11	10.5	26	20.0	H(3) = 5.24, p = 0.155
[21-30]	44	18.7	20	19.1	24	18.5	
[31-40]	84	35.7	37	35.2	47	36.2	
≥ 41	70	29.8	37	35.2	33	25.4	
Income levels							
< € 1000	100	45.1	47	48.5	53	42.4	H(3) = 1.44, p = 0.696
€ 1000-1500	32	14.4	15	15.5	17	13.6	
€ 1500-2500	53	23.9	21	21.7	32	25.6	
> € 2500	37	16.7	14	14.4	23	18.4	

Note: [1]Level of formal education: standard grade corresponds to 9 years of schooling, high school grade corresponds to 12 years of schooling, undergraduate degree or more corresponds to undergraduate and postgraduate levels.

The majority of interviewees were Portuguese, single males, over thirty years old, with more than 12 years of schooling. The majority reported a monthly income of less than 1500€ (Table 1). The high percentage of nationals interviewed highlights the local character of the Algarve diving companies. As reported by Townsend (2008b), companies that effectively dive with tourist and do the training, are mainly small or medium sized and work with local communities. It can also be argued that, as observed by Mundet and Ribera (2001), the geographical proximity between diving site and divers' home location is considered as one of the major motivation for site selection.

A high level of formal education is also a characteristic of divers (Townsend, 2008b). This was observed by Rangel *et al.* (2011) for snorkelling routes developed at Marinha Beach, Algarve, where over 52% of the snorkelers had an undergraduate degree or higher. Musa (2003) found that 71% of the divers in Sipadan Island (Malaysia) had at least some years of college education. The same pattern was also observed for divers in Layang Layang Island, Malaysia, where 58% had a university degree or postgraduate qualifications (Musa and

Dimmock, 2012), and for scuba divers and snorkelers of Mauritius, with 58% with a college degree (Garrod and Gössling, 2008b).

Divers ranged in age from 14 to 60 years, similar to St. Lucia (Caribbean Sea) divers (15 to 60 years) (Barker and Roberts, 2004) and divers in Napoleon reef in Egypt (14 to 65 years) (Hannak *et al.*, 2011). It should be noted that the average age of divers is increasing due to technological advances in diving apparatus, allowing older people to engage in this activity (Dignan, 1990; Musa *et al.*, 2006).

Gender imbalance is reported in the vast majority of studies, with males accounting for the greater portion of divers (e.g Tabata *et al.*, 1992; Mundet and Ribera, 2001; Musa, 2003; Musa *et al.*, 2006; Hannak, 2008; Hannak *et al.*, 2011; Rangel *et al.*, 2011). In fact, in the study conducted by Mundet and Ribera (2001), 80% of divers were male, as were 68% of the snorkelers in underwater routes of Marinha Beach (Rangel *et al.*, 2011) and 77% of scuba divers questioned in the present study. Nevertheless, Lindgren *et al.* (2008) and Musa *et al.* (2006) state that this gender disparity is becoming gradually less marked.

Musa *et al.* (2010) report that several authors observed patterns relating demographic variables to underwater behaviour. In fact, Rouphael and Inglis (2001) and Luna *et al.* (2009) concluded that male divers are less responsible than female divers.

Table 2 Descriptive statistics for statements designed to quantify interviewees' perceptions about support infrastructures. Data presented in percentage. Comparisons between the perceptions of "B24" divers and "Poço" divers were tested for departure from neutrality with Wilcoxon signed-rank test.

Perceptions about infrastructures	All data % Responses			"B24" % Responses			"Poço" % Responses			Kruskal-wallis test ("B24" – "Poço")
	Disagree	Neutral	Agree	Disagree	Neutral	Agree	Disagree	Neutral	Agree	
"Access points are important"	3.7	11.5	85.0	4.2	12.6	83.2	5.6	11.1	83.3	W (2) = 0.15, p = 0.927
"I am satisfied with the access area"	17.3	34.6	48.2	15.8	36.8	47.3	25.0	33.3	41.7	W (2) = 1.47, p = 0.479
"Access point is in good condition"	19.0	40.2	40.8	14.4	44.4	41.1	37.5	46.9	15.6	W (2) = 10.52, p = 0.005
"Infrastructures for disabled people are important"	5.4	11.2	83.4	5.4	11.8	82.8	8.6	17.1	74.3	W (2) = 1.17, p = 0.556
"I am satisfied with existing infrastructures for disabled people"	46.6	31.8	21.6	40.5	36.9	22.6	72.7	21.2	6.1	W (2) = 10.30, p = 0.006
"Infrastructures for disabled people are in good condition"	42.8	34.0	23.3	37.2	46.2	16.7	66.7	14.8	18.5	W (2) = 9.02, p = 0.011
"Parking facilities are important"	5.2	8.4	86.4	2.1	7.4	90.5	13.9	13. 9	72.2	W (2) = 8.95, p = 0.011
"I am satisfied with the existing parking facilities"	35.1	37.2	27.8	42.1	39.0	19.0	25.0	30. 6	44.4	W (2) = 9.01, p = 0.011
"Parking facilities are in good condition"	33.5	42.5	24.0	32.2	47.8	20.0	50.0	31.3	18.8	W (2) = 3.50, p = 0.174
"A bar is important"	9.1	27.8	63.1	6.4	34.0	59.8	17.6	23.5	58.8	W (2) = 4.23, p = 0.121
"I am satisfied with the existing bar facilities"	25.3	37.6	37.1	22.5	41.6	36.0	38.2	29.4	32.4	W (2) = 3.30, p = 0.193
"The existing bar is in good condition"	21.6	51.2	27.7	17.1	58.5	24.4	40.7	40.7	18.5	W (2) = 6.40, p = 0.041
"Sanitary facilities (toilets) are important"	2.6	8.4	89.0	2.1	9.5	88.4	8.6	5.7	85.7	W (2) = 3.20, p = 0.202
"I am satisfied with existing sanitary facilities (toilets)"	44.1	33.0	22.5	40.7	34.1	25.3	57.1	22.9	20.0	W (2) = 2.82, p = 0.245
"Sanitary facilities (toilets) are in good condition"	48.2	31.9	19.9	49.5	30.1	20.5	48.4	35.5	16.1	W (2) = 0.43, p = 0.807
"Emergency support facilities are important"	5.7	3.4	90.9	5.6	5.6	88.7	12.5	3.1	84.4	W (2) =1.83, p = 0.401
"I am satisfied with existing emergency support facilities"	34.6	29.2	36.2	38.3	30.0	31.7	26.0	29.6	44.4	W (2) = 1.67, p = 0.435
"Emergency support facilities are in good condition"	32.5	35.8	31.7	36.8	38.6	24.6	33.3	29.8	37.5	W (2) = 1.46, p = 0.483
"Onboard emergency equipment is important"	0.5	0.5	98.9	0.0	1.1	98.9	2.9	0.0	97.1	W (2) = 2.99, p = 0.224
"I am satisfied with onboard emergency equipment"	1.2	3.5	95.4	2.4	1.2	96.4	0.0	0.0	100.0	W (2) = 1.20, p = 0.550
"Onboard emergency equipment is in good condition" f	3.8	10.1	86.1	5.2	7.8	87.1	3.3	3.3	93.3	W (2) = 0.91, p = 0.636
"Dive material of the dive club is important"	2.1	4.8	93.1	0.0	6.4	93.6	3.0	6.1	90.9	W (2) = 2.849, p = 0.241
"I am satisfied with dive material of the dive club"	2.2	7.7	90.1	1.1	9.1	89.8	3.0	3.0	93.9	W (2) = 1.737, p = 0.420
"Dive material of the dive club is in good condition"	5.3	13.5	81.2	6.0	13.1	81.0	3.1	9.4	87.5	W (2) = 0.737, p = 0.692
"Local hyperbaric chamber is important"	4.3	1.6	94.1	4.4	1.1	94.5	8.6	5.7	85.1	W (2) = 3.24, p = 0.198
"I am satisfied with local hyperbaric chamber facilities"	80.8	9.0	10.2	87.84	7.3	4.9	61.7	20.6	17.7	W (2) = 10.27, p = 0.006

Note: Statements were measured on a five-point Likert-scale, subsequently dropped to a three-point likert-scale Disagree, Neutral = Neither agree nor disagree, Agree.

6.4.2 Visitors' opinions and perceptions about support infrastructures

Interviewees' perceptions about support infrastructures are given in Table 2. The analysis is shown for all divers and for the ones who visited the "B24" (off Faro) and "Poço" (off Armação de Pêra) routes' sites.

Mundet and Ribera (2001), Musa (2002) and Musa *et al.* (2006) emphasise the importance of diver satisfaction, stating that a satisfied customer will recommend diving sites and services to friends. Sites with warm water, high visibility, and high biodiversity are the most attractive to divers (e.g. Davenport and Davenport, 2006; Garrod and Gössling, 2008). In fact, several studies indicate that divers prefer biological attributes of the marine environment, such as the presence of corals and of fishes (Shafer and Inglis, 2000; Uyarra and Côté, 2007). The satisfaction of users towards different aspects of the dive, such as quality of service, facilities, and nature were carefully evaluated in this study.

The importance of access points is highlighted by the large majority of the interviewees. This was also pointed out by snorkelers diving in the Marinha Beach (Algarve) routes (Rangel *et al.*, 2011) and by scuba divers in Layang Layang (Malaysia) (Musa *et al.*, 2006). In this study, however, the relationship between satisfaction and conservation of access points does not seem consensual between divers who boarded in Faro and in Armação de Pêra. This fact could be related to differences in the starting points, with Faro divers boarding in a marina, while in Armação de Pêra the departure was made from the beach, with the help of a tractor, as used by local fishing vessels; a more traditional way of going to the sea but one which hampers logistics.

Infrastructures for disabled people are considered important by the majority of users, as found amongst snorkelers in Marinha Beach (Algarve) (Rangel *et al.*, 2011). It should be emphasised that Hidroespaço has a special group of dive instructors trained to dive with disable people. Nevertheless, an overall discontentment about infrastructures for disabled people was noted. Also, even though the overall disappointment seems obvious, there is no apparent consensus amongst divers from "B24" and "Poço". In fact, there are no specific walkways for disabled people near the beach access point in Armação de Pêra, while the marina of Faro has the minimum mandatory state regulation for access structures for the disabled in place.

Similarly, parking facilities are not a consensual subject. In fact, although the large majority of interviewees agreed on their importance, as also found for underwater route snorkelers of

Marinha Beach (Rangel *et al.*, 2011), there are significant differences between the opinions of "B24" and "Poço" divers with regard to this issue. This fact may be related to an additional small improvised parking facility at an affordable price near the Armação de Pêra diving club facilities. In fact, these divers seemed more satisfied overall but the majority did not regard the facility to be "in good conditions". In Faro marina there is usually a lack of parking places and parking is much more expensive.

The importance of a support bar is acknowledged by 63% of divers, with surveyed divers from "B24" and "Poço" sharing the same opinion (60% and 59%, respectively). Nevertheless there are significant differences in perceptions with regard to the condition of the existing bars. These differences may be due to the fact that Faro marina has a support bar within its facilities, while in Armação de Pêra Beach the closest bar is not in the vicinity of the club boarding facilities.

The large majority of visitors interviewed agreed on the importance of the existence of sanitary facilities (89%), but only 23% were satisfied with the existing facilities, and only 20% perceived them to be in good condition. The pattern is similar to the one found in the perceptions of "B24" divers and "Poço" divers. Similarly, in Dahab (Egypt), 73% of snorkelers identified sanitary facilities as the most important support infrastructures to implement in a snorkelling trail programme (Hannak, 2008).

Divers were unanimous with regard to the importance of having emergency support facilities, as was the case with snorkelers of Marinha Beach (Rangel *et al.*, 2011) and scuba divers in Layang Layang (Malaysia) (Musa *et al.*, 2006). Nevertheless, overall perceptions regarding the existence of emergency facilities around the diving area were not as consensual, and it seems that satisfaction regarding emergency backup remains a concern for some of the divers. This fact may be due to lack of information regarding this issue which should be provided by diving operators during dive preparation. In fact, dive safety is usually a concern for divers when going on a dive trip, as reported by Mundet and Ribera (2001), where divers were reported to be satisfied with overall diving safety facilities available in the diving area. The existence and condition of on board emergency equipment satisfied the majority of interviewees (95% and 86% respectively) in both diving clubs.

The dive material belonging to the diving clubs is a key concern for the majority of divers (93%), and most divers were extremely pleased with the material belonging to the clubs (90% were satisfied and 81% considered the material to be in good condition). During the surveys

carried out in Layang Layang (Malaysia) and in Sipadan (Malaysia) scuba divers reported a "low satisfaction" with the equipment they had rented (Musa *et al.*, 2006). A large majority of respondents (94%) were concerned about the existence of hyperbaric chambers in the diving area. Nevertheless it should be highlighted that there are significant differences between divers of "B24" and "Poço". This may be related to the absence of reported barotrauma accidents and to the individual hyperbaric chamber that exists in a yacht in Lagos marina, close to Armação de Pêra. This chamber belongs to a local yachtsman, and can be used by the diving community in an emergency, although this fact is not very well known.

Mundet and Ribera (2001) suggest that divers' surveys provide important information regarding satisfaction levels towards the services, which can be used to improve scuba diving offer. During this study, information regarding scuba diving support infrastructures in the Algarve can be acknowledge and used by managers and operator to improve the services provided and overall divers satisfaction.

6.4.3 Visitors' diving motivations

There are several attributes that motivate the choice of a diving site (Ditton *et al.*, 2002; Musa *et al.*, 2006). Musa *et al.* (2006) reviewed literature on the most significant attributes for divers in seven diving sites around the world (USA, Canada, Hawaii, Malaysia, Australia, Maldives) and reported that divers highlighted marine life and visibility as the most important motivations for diving. The existence of coral reefs and the professionalism of staff in diving centres were also main motivations. Nevertheless, many other characteristics are listed, such as: existence of wrecks, conditions for underwater photography, ice diving, possibility of spear fishing, interesting geological features, safety support infrastructures, easy accesses, calm atmosphere, no currents, professional dive masters, food operators, no crowding, cost of diving, friendly and helping staff, good dive buddies, water temperature, boat size, and quality of the equipment.

In this survey there were no obvious or significant differences in the motivation for diving between the divers diving in route or the ones not diving in routes (Table 3). Interestingly, it was obvious that the costs of diving are not considered by the majority of divers as a concern. In contrast, in the survey undertaken by Mundet and Ribera (2001) in L'Estartit Resot (Spain) divers were somewhat concerned about the costs of diving and they rated the costs practiced negatively.

The "type of dive" and "new place to explore" seemed to be the most common diving motivations, although less than 50% of the surveyed divers agreed on these. "Other", "friends' recommendation" and "natural beauty" follow in the ranking of motivations.

Marine life is reported in many studies as the main reason for diving site location (such as Mundet and Ribera, 2001; Musa *et al.*, 2006), but that does not seem to be a major concern for divers in our study sites. In this study, the large majority of surveyed divers are local residents and have been diving with their "local" diving club for a while, thus diving site selection tends to be made by the dive master, who sometimes choses dive location based on weather and ocean conditions prior to departure; changes in diving destination after entering the boat are quite common.

Table 3 Descriptive statistics for the motivations to dive in the two locations. Results presented in percentage. Significant differences were tested with Chi-square test.

Motivations to dive	All		Route divers		Non-route divers		Chi-square test
	No	Yes	No	Yes	No	Yes	
Dive type	53.8	46.2	53.6	46.2	53.7	46.3	$\chi^2 = 0.0004$, p = 0.983
Dive costs	85.9	14.2	88.5	11.5	83.3	16.7	$\chi^2 = 1.1469$, p = 0.284
Friends recommendation	60.9	39.2	63.5	36.5	58.3	41.7	$\chi^2 = 0.5849$, p = 0.444
Natural beauty	60.9	39.2	65.4	34.6	56.5	43.5	$\chi^2 = 1.7628$, p = 0.184
New place to explore	56.1	43.8	60.6	39.4	51.9	48.2	$\chi^2 = 1.6380$, p = 0.201
Other (e.g. social contacts)	51.4	48.6	55.8	44.2	47.2	52.8	$\chi 2 = 1.5494$, p = 0.213

6.4.4 Visitors' satisfaction with route characteristics

Underwater trails are used for guided visits to natural and cultural patrimony and simultaneously to enhance divers' knowledge of the marine environment (Harriott, 2002; Hannak, 2008; Hall, 2010; Delgado, 2011; Hannak *et al.*, 2011; Tikkanen, 2011). Actually, by enhancing divers' knowledge and diving skills, environmental responsibility is also likely to be enhanced (Rouphael and Inglis, 2001). In fact there is the need to design, integrate and regulate activities that take part in coastal marine areas, in order to avoid user–environment conflicts and, thus, negative environment impacts (Douvere, 2008).

Nevertheless, underwater routes must be carefully designed in order to achieve their goals and for users to be satisfied with them (Rangel *et al.*, 2011). In fact, as reported by Wiener *et al.* (2009), commercial tours performed in marine areas can have negative impacts (such as crowding and pollution) but they can also reinforce environmental awareness, which can

facilitate conservation and protection. The marine environment can be used as an "outdoor laboratory", where the operator provides *in situ* biological and ecological information to visitors (Salm and Siirila, 2000). Education is considered an important tool for increasing environmental awareness, leading to changes in damaging behaviours Townsend (2008a). In this educational process, operators serve as environmental interpreters (Medio *et al.*, 1997; Cheng *et al.*, 2005) emphasizing the importance of the environment, since negative attitudes towards the environment can be easily associated with lack of motivation to engage in conservation (Wiener *et al.*, 2009).

Overall divers' satisfaction regarding several characteristics of the trips to "B24" and "Poço" before and after the implementation of routes seems to be "good" (Table 4). Nonetheless there are some characteristics, such as the existence of charismatic or unique species or floral cover, which are mostly graded as "acceptable". That is also the case for "the geography of the area" and the "landscape" in "B24", probably due to the fact that this is a sandy bottom site, with the plane wreck as the only visible hard structure. It is important to emphasize that there is a general upgrading, though not statistically significant, in divers' satisfaction towards all the characteristics in analysis, in both study sites, after the implementation of routes.

Overall divers ranked their trip as "good", and even better after the implementation of both routes. In fact, divers seem to enjoy diving in the selected sites, and their satisfaction increased slightly after implementation of routes. At Marinha Beach, all three available snorkelling trails were also ranked as "good" or "excellent" (Rangel *et al.*, 2011), and the one that attracted more divers achieved a classification of "excellent". Berchez *et al.* (2005) also observed a high degree of satisfaction amongst snorkelers diving in the routes in Anchieta Island Park (Brazil), who ranked the experience with an average 2.7 out of 3. As perceived by several authors, if an experience reveals itself to be better than expected, satisfaction will be achieved (Musa *et al.*, 2006).

Musa (2002) noted that the large majority of Sipadan (Malaysia) divers (98%) perceived their diving experience as "highly satisfactory" and marine life, friendly/helpful staff, good dive buddies, water temperature and easy dive access were the most important features. Musa *et al.* (2006) reported that 93% of surveyed scuba divers of Layang Layang (Malaysia) were also "highly satisfied", while Pedrini *et al.* (2010) reported that 75% of divers of the underwater route in Anchieta Island graded their experience as "excellent". In fact divers

seem to appreciate overall diving experiences, and their satisfaction seems to increase if an underwater route is implemented and available.

Table 4 Descriptive statistics for statements designed to quantify interviewees' satisfaction with the dive trips in "B24" and "Poço" before the implementation of the routes (NR) and after the implementation of the routes (R). Results presented as means (± Standard Deviation).

Satisfaction with the dive	B24 (NR)	B24 (R)	Kruskal-wallis test	Poço (NR)	Poço (R)	Kruskal-wallis test
Path selected	4.39 ± 0.70	4.44 ± 0.70	H(4) = 5.158, p = 0.271	4.16 ± 0.97	4.44 ± 0.73	H(4) = 1.060, p = 0.787
Geography	3.92 ± 0.89	3.98 ± 0.77	H(4) = 1.006, p = 0.800	4.04 ± 0.89	4.20 ± 0.98	H(4) = 2.713, p = 0.438
Landscape	3.80 ± 0.91	4.00 ± 0.83	H(4) = 1.500, p = 0.682	4.08 ± 0.86	4.13 ± 0.72	H(4) = 2.081, p = 0.353
Fauna	4.04 ± 0.79	4.06 ± 0.77	H(4) = 0.132, p = 0.988	3.76 ± 0.93	4.06 ± 0.93	H(4) = 1.261, p = 0.738
Flora	3.51 ± 1.06	3.70 ± 0.89	H(4) = 2.841, p = 0.585	3.76 ± 0.97	3.94 ± 0.77	H(4) = 2.035, p = 0.565
Charismatic species	3.55 ± 1.55	3.60 ± 1.25	H(4) = 3.208, p = 0.524	3.56 ± 1.29	3.88 ± 1.02	H(4) = 2.572, p = 0.632
Accessibility	4.20 ± 0.93	4.04 ± 0.88	H(4) = 3.243, p = 0.518	3.96 ± 1.10	4.06 ± 0.78	H(4) = 2.338, p = 0.674
Route in general	4.22 ± 0.69	4.32 ± 0.77	H(4) = 4.244, p = 0.236	4.24 ± 0.72	4.50 ± 0.90	H(4) = 5.476, p = 0.140

Note: Statements were measured on a five-point scale: Terrible (=1), Bad (=2), Acceptable (=3), Good (=4), Excellent (=5).

6.4.5 Visitors' levels of satisfaction regarding slates characteristics

Interpretation can be defined as "*a tool for education aimed at developing a resource-based awareness whereby components of the environment are used to build a holistic understanding of the* whole" (Leal Filho *et al.*, 1998). Interpretation can effectively increase visitors' environmental knowledge, change perceptions, increase environmental awareness, and successfully modify behaviours (Orams, 1999a; Dearden *et al.*, 2007).

All divers characterized their level of satisfaction with regard to several aspects of the slates displayed along each underwater route on a five-point scale, ranging from terrible (1) to excellent (5). None of the items in analysis was ranked below "good" (4), indicating a high appreciation for the underwater *in situ* information method chosen and implemented (Table 5).

Table 5 Descriptive statistics for statements designed to quantify interviewees' satisfaction with several aspects of the slates available in the routes. Results presented as means (± Standard Deviation).

Slates features	All	Poço	B24	Kruskal-wallis test
Information on the slate	4.33 ± 0.72	4.36 ± 0.75	4.28 ± 0.63	H(4) = 1.553, p = 0.6700
Design of the slate	4.43 ± 0.75	4.47 ± 0.77	4.35 ± 0.71	H(4) = 1.672, p = 0.6432
Habitat correspondence	4.39 ± 0.72	4.39 ± 0.74	4.41 ± 0.67	H(4) = 0.614, p = 0.8931
Divers' utility	4.49 ± 0.76	4.44 ± 0.82	4.59 ± 0.61	H(4) = 1.174, p = 0.8824
Conservations usefulness	4.30 ± 0.77	4.23 ± 0.81	4.44 ± 0.67	H(4) = 1.939, p = 0.7470
Utility for structures conservation	4.38 ± 0.75	4.33 ± 0.79	4.48 ± 0.63	H(4) = 1.234, p = 0.8725
Visibility of the slate	4.03 ± 1.15	4.16 ± 1.09	3.72 ± 1.25	H(4) = 4.099, p = 0.3928
Overall quality	4.23 ± 0.82	4.23 ± 082	4.21 ± 0.92	H(4) = 2.353, p = 0.6712

Note: Statements were measured on a five-point scale: Terrible (=1), Bad (=2), Acceptable (=3), Good (=4), Excellent (=5).

Marine tourism provides a unique scenario for providing information about conservation but, although tours work as a natural setting for learning, unpredictable factors may make the interpretation and learning process complex (Orams, 1999a; Garrod and Gössling, 2008). For instance, bad weather conditions, poor visibility, and client anxiety towards wild marine life are some obstructing factors for successful interpretation within marine activities (Wiener *et al.*, 2009).

While studying snorkelers' perceptions about underwater information at Anchieta Island, (Pedrini *et al.*, 2010) observed that the majority of the respondents reported that the interpretative signs were the most interesting feature of the visit.

Divers ranked the overall information slates of "B24" and "Poço" routes as "good" or higher (≥4). When analysing their views about the slates in more detail, "visibility" was the characteristic graded lowest and still "visibility" of slates was graded 3.72 by the "B24" divers, and 4.16 for "Poço". The Algarve waters, at around 20m depth, have an average visibility of around 5.8 m (see Gonçalves *et al.*, 2004; Gonçalves *et al.*, 2007a; Gonçalves *et al.*, 2008a; Gonçalves *et al.*, 2010) and the "B24" diving site is in a sandy area, where excellent buoyancy control is essential to avoid suspension in the water. Visibility is one of the top motivations for divers around the world, as reported by Musa *et al.* (2006). Slates could have different dimensions, as some divers verbally stated particular concerns regarding interpretative slate size, with some stating they were too big (too much human presence) and some that they were too small (and thus, difficult to interpret). In fact, smaller slates would make interpretation almost impossible, while bigger slate sizes would make reading and understanding easier, but this would result in an increased visibility of human presence. The best compromise is to keep the current slate size and reinforce information through other

means such as environmentally structured and targeted briefings.

6.5 General conclusions

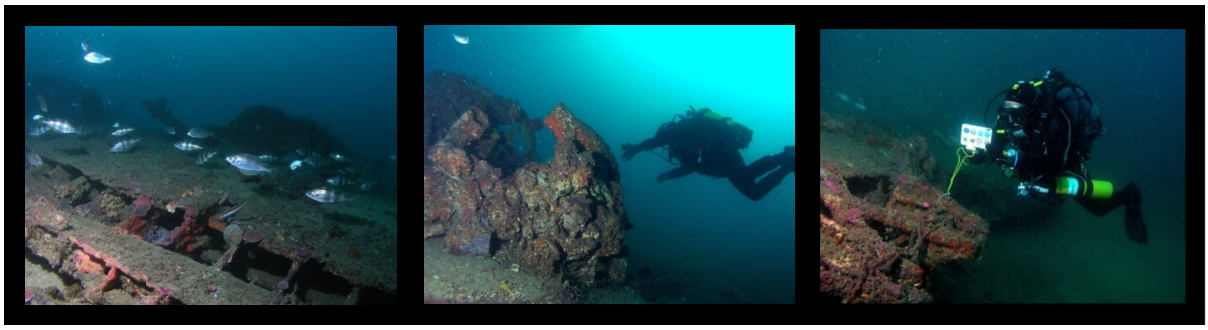
In marine tourism, socio-economic profiling of divers is essential to define effective management measures (Brotto *et al.*, 2012). The divers that took part in this study seem to present a typical socio-economic profile as such management measures used on other locations could be considered for diving tourism in the south of Portugal.

Overall, divers were disappointed with some of the infrastructures, e.g. parking facilities, support bar, sanitary facilities, absence of a hyperbaric chamber, and infrastructures for the disabled. These aspects should be carefully considered when planning dive tourism support facilities in the Algarve, since their improvement will most probably increase divers' satisfaction and, thus, the number of visiting diving tourists.

"Natural beauty", reported in many studies as the most important motivation for diving, was not considered a prime motivation for diving in the case studies. This is not surprising since mainland Portugal is not a prime diving location; visibility and temperature are usually relatively low and sediment suspension is high. Still, divers are satisfied with their diving experience, ranking it as "good", and seem to enjoy diving in the Algarve overall. Nevertheless, satisfaction was slightly higher amongst divers diving in routes. In fact, satisfaction towards diving in underwater routes seems to be consensual, as also reported by Pedrini *et al.* (2010) and Rangel *et al.* (2011). Routes seem to have pleased the divers who visited them and thus can be used as an important asset to promote Algarve diving sites, and enhance visitors' environmental awareness with *in situ* interpretation.

CHATPTER VII

Can self-guided scuba dive routes enhance environmental awareness? The case of the Algarve (Portugal)



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Can self-guided scuba dive routes enhance environmental awareness? The case of the Algarve (Portugal)

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7.1 Abstract

Diving is one of the fastest growing sectors within contemporary coastal and marine tourism, but scientific studies on the impacts associated with this activity are scarce. Underwater routes are increasingly used as a tool for restricting divers in certain areas and supervising their visits to the underwater surroundings. Two underwater routes were implemented in popular scuba diving sites of the Algarve coast (South of Portugal): "B24" and "Poço". Routes were designed according to expected socio-demographic characteristics of visiting divers, and education/interpretation was provided immediately before diving experience and during the dive. The aim of this study was to understand if environmental education and interpretation, used within the routes diving activity, is able to effectively enhance biodiversity awareness among divers. Users were surveyed through a face-to-face questionnaire from 2008 to 2012, immediately after completing the dive routes. A total of 106 questionnaires were used for analysis. Most respondents reported no to be on vacation. Divers were mainly Portuguese males, over 30 years old, with an undergraduate degree or more. The major part of respondents perceived the routes as a good experience that they would repeat in the future. Also, educational and interpretative aspects of the routes (environmental briefing and underwater signalling) were appreciated by the vast majority of divers. Overall, routes are perceived as an effective way to improve biodiversity awareness among divers community.

Keywords: Underwater routes, scuba diving, awareness, environmental education, environmental interpretation.

7.2 Introduction

Marine and coastal tourism are among the fastest growing sectors of contemporary tourism all around the world (Davenport and Davenport, 2006; Hall, 2001; Luna et al., 2009; Milazzo et al., 2002; WTO, 2001). The attraction for coastal areas, together with people's desire for new experiences in pristine environments, have led to an increase in anthropogenic pressure on these areas (Garrod and Gossling, 2008; Meng et al., 2008), with biological and also socio-economic impacts that can have important effects on host coastal communities (Davenport and Davenport, 2006). Unfortunately, the impact of tourism on marine coastal areas remains largely unknown (Claudet et al., 2010) and there is a lack of background data on coastal tourism and its associated biological impacts (Hall, 2001; Hawkins et al., 2005).

The diving tourism sector represents one of the most important sectors within coastal tourism (Davenport and Davenport, 2006; Rouphael et al., 2011; Townsend, 2003, 2008a, 2008b), but research on diving impacts is scarce, and is mostly found in "grey literature" such as project reports, sports magazines, and newsletters, not easily available to the scientific community (Garrod and Gossling, 2008; Hall, 2001). Furthermore, in most cases the available studies are related to direct biological impacts of divers in coral reef areas (Camp and Fraser, 2012; e.g Davenport and Davenport, 2006; Liu et al., 2012; Poonian et al., 2010; Rouphael et al., 2011), disregarding the possible socio-economic impacts on the local coastal communities. In fact it is widely recognized that dive tourism raises environmental, social and economic questions for sustainability of host marine and coastal areas (Townsend, 2008a). The sustainability of diving destinations, in particular the "dive hot spots" (areas of high diver concentration), is increasingly important due to the growing popularity of diving tourism activities (Garrod and Gossling, 2008).

Accurate management is essential to reduce divers' impacts. Townsend (2008a) refers to the possibility of using "soft" management tools (i.e. education and interpretation) instead of "hard" management tools such as restrictions or visitors' fees. Education is considered an advisable method for reducing environment damage caused by divers (Barker and Roberts, 2004; Plathong et al., 2000). If correctly designed, adapted to the diving site and to divers' specific socio-demographic profiles, environmental education and interpretation can be effectively used as management tools to prevent unwanted impacts and to increase awareness of marine conservation (Townsend, 2008a).

Divers enjoy learning about the sites they visit, and they tend to look for information and

support regarding the dive in general, interesting features, the area, potential dangers etc., giving managers an excellent opportunity to reinforce and/or create environmental friendly behaviours (Barker and Roberts, 2004), thus potentially reducing environmental *in situ* impacts (Camp and Fraser, 2012; Hannak et al., 2011). Environmental education must be included in diving activities through "environmental briefings" (Barker and Roberts, 2004, 2008). To be truly effective briefings should be given immediately before divers enter the water and should be adapted to each diving site, the socio-demographic characteristics of the divers, their previous knowledge about the environment and their learning capacity (Barker and Roberts, 2004).

Underwater routes are increasingly used to enhance environmental awareness (Hannak, 2008; Harriott, 2002). Routes, together with the environmental briefing, should provide information to allow divers to understand the impact they can cause in the ecosystem, identify responsible underwater behaviours and promote a better understanding of the marine environment (Harriott (2002); Claudet et al. (2010).

Most underwater routes are implemented in Marine Protected Areas (MPAs), where scuba diving and snorkelling are increasingly important touristic activities (Davis and Tisdell, 1995; Plathong et al., 2000). Self-guided underwater routes in these sites are used to reduce scuba-diver impacts on the environment (Claudet et al., 2010; Di Franco et al., 2009; Lloret et al., 2006; Plathong et al., 2000), by constraining divers to certain areas (Hawkins and Roberts, 1993; Ríos-Jara et al., 2013) as well as provide information along the path (Claudet et al., 2010).

The first underwater interpretative trail was established in the US Virginia Islands National Park in 1958 (Plathong et al., 2000). However, there are only a few examples of published information about underwater routes, and scientific work on underwater routes for environmental education is even scarcer. The Cerbère-Banyuls Natural Marine Reserve (CBNMR), in the French Mediterranean coast, has a self-guided snorkelling trail since 2001, aiming to concentrate divers in certain areas and to increase their environmental awareness. Several radio beacons are deployed along the trail to inform snorkelers about local fauna and flora through acoustic hear phones (Claudet et al., 2010). In Portugal, three underwater self-guided routes were implemented in 2008 at Marinha Beach (Algarve), aiming to promote environmental education and interpretation among snorkelers (Rangel et al., 2011). Information for divers was first provided through pre-dive briefings at the beach, near to the routes. Once inside the water, acrylic slates attached to buoys provided detailed information

on different aspects of the surrounding environment and guided visitors along the route (Rangel et al., 2011). In Brazil, a guided interpretative trail was developed at Anchieta Island's Park using pre-defined interpretative sites, with the aim of promoting environmental education for snorkelers and scuba divers (Pedrini et al., 2010). In the Nordic and the Baltic Sea Regions, the Nordic Blue Parks Project and the Vrouw Maria Underwater Project brought together, for the first time, the enhancement of underwater natural and cultural heritage with recreation (Tikkanen, 2011). The Nordic Blue Parks Project developed underwater trails and/or guided visitation to several shipwreck sites (in Finland, Denmark, Norway and Sweden), in order to enhance biological and cultural awareness among visitors. The Vrouw Maria Underwater Project provides virtual archaeological visits to the Vrouw Maria Dutch ship, at the Archipelago National Park (Finland). This project uses virtual simulation since the wreck is located in a *Natura 2000* site, an area where scuba diving is prohibited (Tikkanen, 2011). In Mexico, at Isabel Island National Park, six underwater trails were implemented mostly to concentrate scuba divers, define carrying capacity of recreational diving and to move divers away from the most sensitive areas (Ríos-Jara et al., 2013). Regardless of all available examples, studies on the effectiveness of underwater routes in reducing divers' impact are regrettably insufficient (Berchez et al., 2005).

For the purpose of this study we implemented scuba diving underwater routes in two of the most popular diving sites of the Algarve coast (South of Portugal), "Poço" (West coast) and "B24" (central Algarve coast). We aimed to identify divers' profiles, their pre-existing environmental awareness, and their opinion about several aspects of the educational and interpretation characteristics of these routes, such as the environmental briefings and underwater interpretative signs, and their perceptions about the routes' environmental awareness potential.

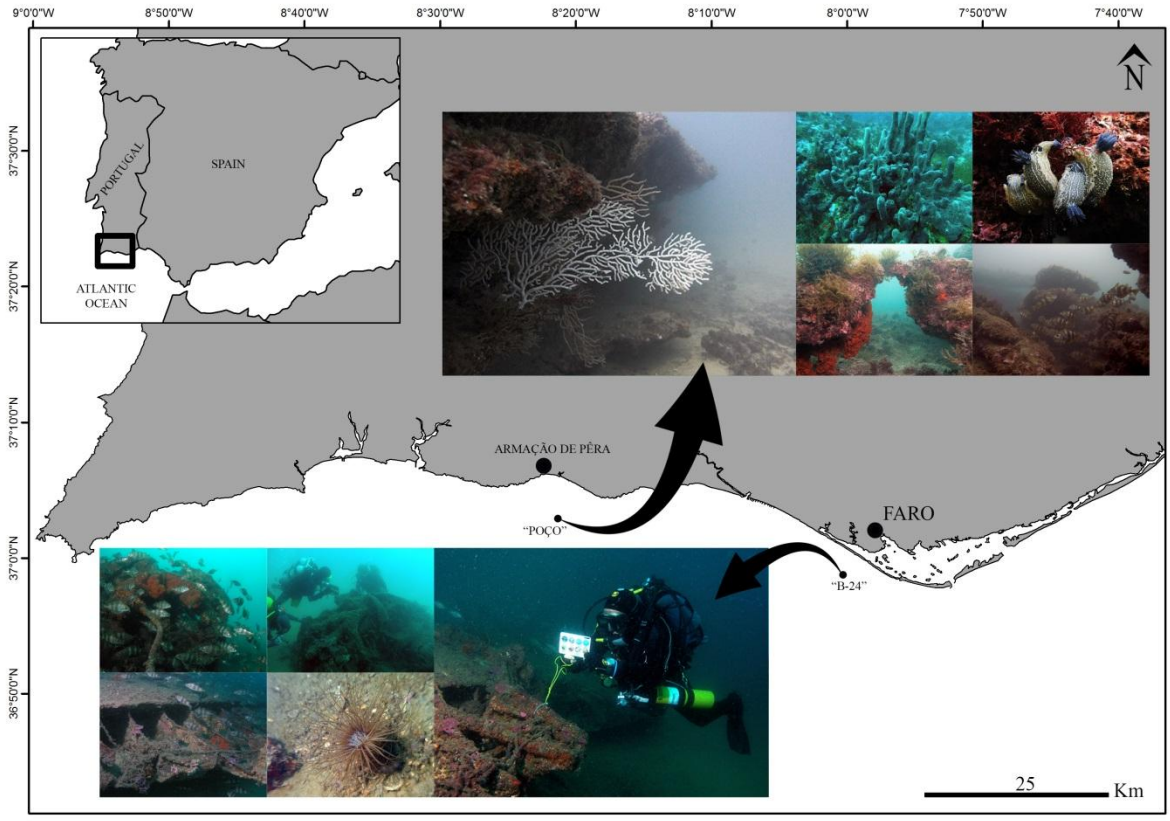

Figure 1 Location of "B24" and "Poço" underwater routes (Algarve, South of Portugal). Some characteristic/interesting features are displayed.

7.3 Methods

7.3.1 Underwater routes

The first step in implementing routes entails selecting the most interesting diving areas (based on popularity), doing their biological mapping, and characterizing and selecting the most interesting areas within the diving sites for interpretative purposes. All steps of implementing the underwater routes used in this study are described in detail in (Rangel et al., *submitted b*). The final trails were defined based on accessibility, appealing landscape, geological features, interesting biodiversity, existence of charismatic species, existence of protected species, and key biotope species.

The two diving spots selected for the implementation of routes were "Poço" and "B24" (Figure 1). Both areas are located within the National Underwater Ecological Reserve (REN - *Reserva Ecológica Nacional*). The "B24" is a plane wreck diving site where a U.S. B-24 Liberator bomber PB4Y rests. The bomber, which crashed and sank in 1943 when returning

from an anti-submarine patrol in the Gulf of Cadiz, is located off the coast of Faro. This site was chosen due to its popularity among the diving community of the Algarve and because of the historical appeal. It is important to note that along the years a rich biological community colonized the remaining parts of the wreck, creating a unique environment. Two complete wings (34m long) in inverted position, the motors and the cavities for the landing gear still exist. No part of the fuselage survive nowadays, but two of the propellers, a motor rotor and one vertical rudder are located quite near the main structures (Rangel et al., *submitted b*).

The "Poço", located off Armação de Pêra, is a diverse and rich underwater rocky outcrop carved with numerous caves and various recesses. There are several appealing features at this site, since it resembles a typical reef from the Algarve area, with high biodiversity levels and beautiful underwater rocky scenario. This is the most popular dive location operated by the local diving operator. It is important to emphasise that the outcrop extends along a straight line, making underwater signs easy to identify and follow (Rangel et al., *submitted b*).

7.3.2 Environmental educations and interpretation

Underwater interpretative signs

After selecting the dive sites, specific locations were selected at each diving site to deploy double sided acrylic slates (five in "B24" and six in "Poço"). To avoid any disturbance of local biological communities, slates were attached by highly visible yellow cable (at least 1.5m long) to the sandy bottom using "environmental friendly anchors". Whenever anchors were not considered a convenient solution, cables were instead attached to rocky outcrops. The first slate of each route also had an orange buoy to mark the starting point. Figure 2 illustrates the information provided in the slates. A detailed map of the route was displayed on the front of the slate, with the location of the other slates, mean depth, substratum type, and snorkelers' location within the path. On the back, eight high definition photos were exhibited showing the most common fauna and flora species of that area.

Figure 2 Example of one double sided acrylic slates of "B24" (A; B) underwater routes (third slate of the route).

Environmental briefing

Specific environmental briefings where designed, with scuba diving operators, for each site following Barker and Roberts (2004, 2012). The briefing took into consideration the important and/or interesting aspects of the route, diving area, geographical characteristics of the zone, the most common divers' profile (i.e. most probable socio-demographic profile, experience, and certifications), possible dangers and difficulties, and environmental issues considered important and/or interesting for the visitor. Special care was taken when addressing preservation aspects of underwater historical structures at the "B24" site. During most dives, a researcher was present on board providing support to visitors. Nevertheless, all dive masters were also trained in order to provide information to divers diving in the routes.

7.3.3 Survey and data analysis

After each dive, visitors were asked to fill in a face-to-face questionnaire about their opinions regarding several aspects of the routes, their satisfaction with the dive and routes, their opinions about several aspects of the briefing and their perception regarding the routes' potential for enhancing environmental awareness.

The survey was undertaken from 2008 to 2012. All divers who dived the routes were approached (182). A total of 106 questionnaires were used for the purposes of the present analysis (58% response rate): 70% (74) refer to "B24" and 30% (32) to "Poço".

Questions followed a dichotomous format (yes/no) and a Likert-scale format (ranging from not satisfied to satisfied; not useful to useful; do not prefer to prefer; not important to important). No questions were left open-ended in order to constrain respondents to provide an answer to every question, although the option "I don't know" was available for some questions. For the purpose of analyses, and due to the small sample size, the five-point Likert-scale scale was collapsed to a three-point scale (negative, neutral and positive).
Differences between divers of "B24" and "Poço" were investigated with the chi-square test. Since no significant differences were found between the two groups for any of the questions, results are given solely for all questionnaires pooled together.

7.4 Results

7.4.1 Divers' characterization

Most respondents were Portuguese males (76%), over 30 years old, with an average monthly income of less than 1500€ (64%), and an undergraduate degree or more (67%). The majority reported not to be on vacations (60%) (Table 1).

The diving profile of users indicates that 82% had a Level 2 certification (i.e. Autonomous Diver), and 12% possess higher diving qualifications (i.e. Dive Leader). The large majority of divers defined their activity as "Recreational – ludic" (87%), and 51% had carried out up to 50 dives in the previous five years. It should be emphasized that 28% reported to have dived over 100 times during the same five years period. About 45% of the interviewees stated that their equipment cost more than 1500€. Plus, half of the inquiries reported willingness to spend up to 1500€ to renew diving equipment, whereas the other half indicated willingness to spend more than 1500€ for the same purposes. Almost half the visitors (48%) paid up to 50€ for the current dive, although some individuals reported to have paid more than 100€ (13%) (Table 1).

Table 1 Socio-economic characteristics and divers' profile of the respondents in the case study (n=106).

Characteristics of divers	Dive in Routes	
	N	%
Socio economic profile		
Gender		
Female	25	23.6
Male	81	76.4
Nationality		
Portuguese	98	92.5
Other	8	7.6
Holidays		
Yes	42	40
No	63	60
Marital status		
Single or divorced	52	49.1
Married or living together	54	50.9
Education level[1]		
Standard grade or High school grade	34	32.7
Undergraduate degree or more	70	67.3
Age group		
≤ 20	11	10.5
[21-30]	20	19.1
[31-40]	37	35.2
≥ 41	37	35.2
Income levels		
< € 1000	47	48.5
€ 1000-1500	15	15.5
€ 1500-2500	21	21.7
> € 2500	14	14.4
Diving profile		
Diver certification		
Autonomous (Level 2)	83	82.2
Dive leader or Instructor (Level 3)	12	11.9
Type of diver		
Recreational - Ludic	88	86.8
Recreational – Professional / Scientific	14	13.74
Average number of dives (last 5 years)		
≤ 50	49	51.0
]50-100]	20	20.8
> 100	27	28.1
Amount spent in equipment		
≤ 500	22	21.4
]500-1500]	35	34.0
> 1500	46	44.7
Amount willing to spend renewing equipment		
≤ 500	23	28.8
]500-1500]	17	21.2
> 1500	40	50
Amount spent in the current dive		
≤ 10	5	4.8
]10-30]	16	15.1
]30-50]	30	28.3
]50-100]	41	38.7
> 100	14	13.2

7.4.2 Visitors' opinions and perceptions regarding routes and biodiversity preservation

Engaging in underwater eco-activities is a concern for the vast majority of the questioned divers (96%), but most interviewed did not indicate any previous engagement with any nature conservation group (80%). Nevertheless, most of the divers stated that they were willing to contribute financially (a one off value) to support biodiversity conservation projects in the Algarve (76%).

The majority of divers reported a positive overall appreciation for the routes (89%) and there was a consensual opinion that routes help to protect the underwater environment (83%). Most divers reported that they prefer to dive within the routes' framework (96%), and they would prefer routes if they were available in other diving clubs (87%). The majority would repeat the experience (91%) and would pay an extra fee, if needed, for diving in routes (67%).

Regarding interpretative signs of routes, most divers prefer *in situ* slates (81%) and they perceive their implementation as being good for biodiversity preservation (88%) and for the conservation of structures like the sunken bomber of the "B24" site (88%). Overall 58% of divers reported to have learned something new about biodiversity while diving in routes.

Table 2 Divers' perceptions about conservation and routes (n=106). Data is shown as percentages.

Perceptions about conservation and routes	All % responses		
	Negative	Neutral	Positive
Conservation and ecotourism			
"I worry about the possibility of doing subaquatic ecotourism"[1]	3,85	-	96,15
"I am (have been in the past) involved in nature conservation groups"[1]	79,69	-	20,31
"I would be willing to contribute financially (a one off value) to support Algarve' biodiversity conservation projects"[1]	24,47	-	75,53
Underwater routes			
"Overall I am satisfied with the routes" [2]	4,55	6,06	89,39
"Routes are useful to protect the underwater environment" [3]	5,77	11,54	82,69
"I prefer a to dive on a site with routes"[1]	4,00	-	96,00
"If this route's framework[a] was available elsewhere I would rather dive on a route"[1]	13,33	-	86,67
"I would pay an extra fee to dive in routes"[1]	33,33	-	66,67
"I would return to dive in this site again" [1]	8,65	-	91,35
"I prefer interpretation *in situ* rather than slates to take into the water"[4]	7,92	10.89	81.19
"Route signalling (*in situ* slates) is useful for biodiversity preservation" [3]	0,98	10,78	88,24
"Route sings (*in situ* slates) are useful for underwater structures' conservation (e.g. bomber)" [3]	5,77	6,73	87,50
"I learned something new about local biodiversity during the dive experience" [1]	41,90	-	58,10

Note: [1] measured in a binary format (yes/no) with no reported under negative, and yes reported under positive; [2] measured in a scale (not satisfied, neutral, satisfied), with not satisfied reported under negative, and satisfied reported under positive; [3] measured in a scale (not useful, neutral, useful), with not useful reported under negative, and useful reported under positive;[4] measured in a scale (do not prefer, no opinion, prefer), with do not prefer reported under negative, no opinion reported under neutral and prefer reported under positive

.[a] Route's framework refers to the underwater routes designed for the purposes of this work, including: biodiversity/landscape assessment; historical heritage description; trail selection; *in situ* signing; environmental targeted briefing and on board support team.

7.4.3 Visitors' opinions and perceptions regarding the briefing

The vast majority of respondents reported to have appreciated the briefing (95%) and the supporting team (96%). Also, most divers considered the briefing important and were satisfied with the information given on conservation (97%, 93%), protection (93%, 93%) and possible dangers associated with the dive (88%, 93%). The same overall result was obtained when analysing the importance and satisfaction regarding the information provided about underwater routes (94%, 96%), level of difficulty of the dive (89%, 92%) and the description of interesting features of routes (93%, 96%).

Most respondents declared they received slates to take into the water with information about existing fauna (84%), and they regard the given information, such as flyers, booklets and boards, as important (90%) and satisfactory (87%).

Table 3 Opinions about the *briefing* and the information provided (n=106).

Opinions about the briefing and the information provided during the dive experience	All % responses		
	Negative	Neutral	Positive
Classification of the briefing	2,88	1,92	95,19
Classification of the support team	0,00	3,85	96,15
Information about biodiversity / fauna provided during the briefing			
Importance of the information provided on conservation[1]	2,91	0,00	97,09
Satisfaction with the information provided on conservation[2]	0,98	5,88	93,14
Importance of the information provided on protection[1]	5,83	0,97	93,20
Satisfaction with the information provided on protection[2]	0,98	5,88	93,14
Importance of information provided on danger [1]	7,69	3,85	88,46
Satisfaction with the information provided on danger[2]	0,98	5,88	93,14
Information about underwater routes provided during the briefing			
Importance of the information provided on the routes[1]	2,94	2,94	94,12
Satisfaction with the information provided on the routes [2]	1,00	3,00	96,00
Importance of the information provided about the level of difficulty of the routes[1]	5,94	4,95	89,11
Satisfaction with the information provided about the level of difficulty of the routes[2]	2,00	6,00	92,00
Importance of the information provided on interest features[1]	2,97	3,96	93,07
Satisfaction with the information provided on interest features [2]	2,00	2,00	96,00
Boards/flyers/booklets – hand-outs			
"I received underwater slates with information about species to take into the water" [3]	16,19	-	83,81
"I think it is important to have this information (flyers/booklets/boards) about the routes" [1]	5,94	3,96	90,10
"The information (flyers/booklets/boards) provided about the routes was satisfactory" [2]	7,14	6,12	86,73

Note: [1] measured in a scale (not important, neutral, important), with not important reported under negative, and important reported under positive; [2] measured in a scale (not satisfied, neutral, satisfied), with not satisfied reported under negative, and satisfied reported under positive; [3] measured in a binary format (yes/no) with no reported under negative, and yes reported under positive.

7.5 Discussion

Diving is one of the fastest growing industries in the world (Davenport and Davenport, 2006), but scientific literature on the issue is scarce (Garrod and Gossling, 2008), and the impacts related to dive pressure on natural areas are an increasing concern for the scientific community (Milazzo et al., 2002; Rouphael et al., 2011; Townsend, 2003, 2008a). And several authors reinforce the need for a more ecological management of the coastal areas where diving is practiced (Garrod and Gossling, 2008; Rouphael and Inglis, 2002; Tratalos and Austinb, 2001; Zakai and Chadwick-Furman, 2002) comprehending measures related to maintain ecosystem equilibrium and increase visitors' environmental awareness (Vanhooren et al., 2011). Lindgren et al. (2008) reported that dive tourism environmental management should comprehend policies, education, communication, and actions aiming to avoid or

minimize environmental impacts. In fact, education is suggested as one effective way to reduce diver damage to the environment (Barker and Roberts, 2008; Brotto et al., 2012; Camp and Fraser, 2012; Luna et al., 2009; Milazzo et al., 2002) by preventing impact on sites and increasing awareness for marine conservation, if carefully designed according to the specifications of each specific dive situation (Orams, 1999; Townsend, 2008a).

Rouphael and Inglis (2001) and Luna et al. (2009) highlighted that, firstly, it is important to identify divers socio-demographic characteristics, since individual underwater behaviours, and associated impacts, are likely to vary significantly with, for example, socio-demographic characteristics, technical competences, underwater activities, diving instruction or characteristics of diving sites. Mundet and Ribera (2001) and Pedrini et al. (2010) emphasized that socioeconomic profiling of divers is essential for defining their motivations and perceptions towards several aspects of the activity. Overall, factors that describe diver behaviour and their environmental effects are a contribution to the development of effective training procedures, pre-dive briefings, site regulations, etc., that will ensure the diminishing of damaging behaviours (Rouphael and Inglis, 2001).

In our study the vast majority of divers declared to have an undergraduate degree or more. The same pattern was obtained at Marinha Beach, Algarve (Portugal) by Rangel et al. (2011) where 52% of snorkelers declared having these qualifications. Musa and Dimmock (2012) also referred that 58% of divers surveyed in Laylang Island (Malaysia) had a university degree, while Musa (2003) observed that 71% of divers interviewed in Sipadan Island (Malaysia) had some degree of formal education and 58% of divers of Mauritius had a college degree (Garrod and Gossling, 2008). In fact, it is common to observe that diving is mostly practiced by individuals with a high level of formal education (Garrod and Gossling, 2008), and this should be carefully considered when implementing educational and interpretative tools, as these can only be effective in increasing environmental awareness if designed according to the target audience, as referred by Townsend (2008a).

Most of the surveyed divers were Portuguese nationals, probably due to the fact that small or medium size companies that operate with local communities (Townsend, 2008b) tend to attract more local people, and to the geographical proximity of diving site and home location, one of the major factors for site selection (Mundet and Ribera, 2001). In fact, during the survey, a substantial degree of personal proximity between divers and company owners was perceived, mostly because divers lived near the diving centre or because the diving club was located in their usual holiday destination. This proximity, and the inexistence of a language

barrier, can be used to enhance and reinforce the educational process.

Divers are mainly older than 30 years of age, ranging in age from 14 to 66 years. The dominance of divers in their 30s and 40s may reflect, as suggested by Musa et al. (2010), a better economic situation that allows for the participation in such an expensive activity. Overall, the age pattern observed is similar to that of most scuba diving studies, such as in St. Lucia (Caribbean Sea) (Barker and Roberts, 2004) and Napoleon Reef (Egypt) (Hannak et al., 2011) where divers ranged in age 14 to 65 years old. It is important to emphasise that nowadays technological advances in scuba diving equipment allow older divers to engage in this activity (Dignan, 1990; Musa et al., 2006). When designing educational messages to a specific target population, age structure is also an important aspect to consider, as the type of language used should obviously be adapted to the age distribution of the listeners. In our study, although no previous knowledge existed on the age pattern of scuba divers of the Algarve, the overall consensual age profile described in the worldwide available literature was used, along with the one obtained in the survey undertaken at the snorkelling routes implemented at Marinha Beach, Algarve (Rangel et al., 2011).

It seems consensual that underwater behaviour is related with socio-demographic characteristics, as referred by Musa et al. (2010). In fact, Rouphael and Inglis (2001) and Luna et al. (2009) concluded that male divers are more adventurous and, thus, more likely to take risks and present a more irresponsible behaviour. Also, Vredenburgh and Cohen (1993) observed that men seem to be more likely to ignore pre-dive instructions on safety and environmental behaviour advice, having a more independent attitude.

In our study case, most of divers were men, as observed in most other divers surveys (Hannak, 2008; Hannak et al., 2011; Mundet and Ribera, 2001; Musa, 2003; Musa et al., 2006; Rangel et al., 2011; Tabata and Miller, 1991). Although authors such as Lindgren et al. (2008) and Musa et al. (2006) referred that this imbalance is becoming less marked, the gender proportion found is still highly distinctive of a male type activity.

No diver reported a Level 1 certification (Supervised Diver), and some had a Level 3 (Dive Leader) or Instructor certification. Also, although the vast majority of the interviewed divers identified diving as a recreational activity, around half of them had done more than 50 dives in the previous 5 years. Luna et al. (2009) compared Sierra Helada Marine Park (Spain) divers' experience and level of certification with environmental impact, concluding that more experienced divers (measured in number of dives) caused less impact on the system.

Nevertheless, the authors did not achieve the same result when comparing divers' certifications with underwater damaging behaviour, and Roberts and Harriott (1995) go even further reporting that divers with more qualifications show less responsibility towards negative environmental impacts. In fact, according to Luna et al. (2009), dive training certificates are lifetime qualifications and, therefore, should not be used as an indicator for diving skills, because they do not require periodic renewal. Those authors stated that this topic needs to be carefully considered when adopting management strategies as environmental educational tools. Rouphael and Inglis (2001) undertook a similar study in the Great Barrier Reef Marine Park (Australia) and found out that there was no strong relationship between dive experience and damaging behaviour. However, Camp and Fraser (2012), studying scuba divers in John Pennekamp State Park Key Largo (Florida) found no relation between gender and experience in negative interactions with the underwater surroundings. The same outcome was obtained by Di Franco et al. (2009) amongst scuba divers in Capo Gallo - Isola delle Femmine (Italy) MPA.

In fact, even though the importance of profiling target divers' is fundamental, since diver underwater behaviour seems to be related to individual characteristics, divers profile must be carefully evaluated and adjusted prior to establishing any educational framework, once the relation between underwater behaviour and general profile is not always straightforward.

Overall "B24" and "Poço" divers were concerned about the possibility of taking part in subaquatic ecotourism, and they were willing to contribute monetarily to help support nature conservation projects in the Algarve, although most of them had never been engaged in nature conservation groups. Moreover, almost half reported that their diving equipment cost more than 1500€, and half is willing to pay more than 1500€ to renew it. These statements should be carefully considered when designing educational tools, because these divers seem to be effectively engaged in this activity and seem to be willing to invest some of their income in dive related activities, marine environmental conservation programmes and dive equipment, even though almost half of the interviewed stated monthly incomes below 1000€.

Overall, as suggested by Luna et al. (2009) and Poonian et al. (2010), proactive management is essential to promote environmental awareness, mitigate negative impacts, and maintain the aesthetic appeal of diving sites. Townsend (2008a) emphasised that education and interpretation can be used for these purposes but the challenge is to deliver the information in a way that enhances diver satisfaction and interest in these issues.

Underwater routes are increasingly used as an attempt to implement education and interpretation tools for identifying underwater behaviour responsibilities and promoting a better understanding of the marine environment. As a result, a reduction in the potential damaging effect of divers on the environment is expected (Claudet et al., 2010; Harriott, 2002).

There are a few studies investigating the impact of underwater routes on to the underwater environment. Nonetheless, in the studies of Cerbère-Banyuls Natural Marine Reserve (CBNMR) self-guided snorkelling trail (Claudet et al., 2010), Marinha Beach (Algarve) self-guided snorkelling underwater routes (Rangel et al., 2011), no evidence was found relating divers and/or snorkelers behaviour with underwater negative impact.

Hart et al. (1999) emphasised the need to understand if teaching environmental education can, in fact, influence the way people behave in practice. In fact, addressing environmental problems by placing youngsters in natural, undisturbed places can act as a powerful environmental education tool (Hart et al., 1999), and the marine environment can be used as a "outdoor laboratory", where the operator provides *in situ* biological and ecological information to visitors (Salm and Siirila, 2000).

Overall, in our study, the vast majority of divers enjoyed diving in the self-guided interpretative routes, and perceived them as a way to protect biodiversity and underwater historical heritage. In fact, most of respondents reported that they learned something with *in situ* interpretation, that they would come back to dive again, that they did not mind to pay an extra fee to dive in this route framework, and that they would select a route elsewhere if this structure was available. However, in this study divers' impact on the environment was not considered for analysis, but the overall positive opinions and perceptions obtained, quite similar to the ones found by Rangel et al. (*submitted a*) with Marinha Beach underwater routes (Algarve) snorkelers, seem to acknowledge that routes were designed according to users' preferences, and seem to contribute to an increase in environmental education and awareness.

At Anchieta dive trail (Brasil), divers reported that the route feature that they most enjoyed were the interpretative signs, followed by further education provided, briefings and posters (Pedrini et al., 2010). During this study, divers preferred *in situ* interpretation, while interpretative signs were considered as a good measure for biodiversity preservation and underwater structures' conservation.

Plathong et al. (2000) reported that damage in the environment is more evident near interpretative signs. In fact, Ríos-Jara et al. (2013) emphasise that it is not clear if it is preferable to concentrate divers in defined trails or spread them over a large area, since there are some studies that indicate a high degree of biological damage inside trails (e.g. Plathong et al., 2000). Claudet et al. (2010) reported that absence of divers impacts in an underwater trail implemented in the buffer zone of the Cerbère-Banyuls Natural Marine Reserve (CBNMR) was mostly due to the fact that snorkelers were the main users, and mostly concentrated at the water surface. During the implementation of scuba diving routes used in the present work, the slates were attached to a cable at least 1.5m long to avoid any unintentional contact by divers to existing underwater structures while reading the slates.

In the research field of environmental education there is almost no information on the effect that environmental education has on reducing negative diver impacts, but evidence suggests that negative impacts tend to be reduced if education is provided immediately before, or during the diving experience (Townsend, 2008a).

Barker and Roberts (2008) and Camp and Fraser (2012) 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. In fact, Luna et al. (2009) reported, as also highlighted by several other authors (e.g. Barker and Roberts, 2004; Medio et al., 1997; Townsend, 2008a; Uyarra and Côté, 2007), that pre-diving briefings are highly effective at reducing divers' contact with the surroundings, since they emphasizes the importance of buoyancy control and careful action, important educational tools, resulting in an increase in environmental awareness and, thus, reduction of diver damage.

Nevertheless, it is important to emphasise that each briefing must be designed specifically for each dive and target divers, with important, selected and contextualized information, and should be provided immediately before the diving experience (Barker and Roberts, 2004, 2008; Rouphael and Inglis, 2001; Townsend, 2008a). In fact, Camp and Fraser (2012) highlight that John Pennekamp State Park Key Largo (Florida) scuba divers with previous conservation education experience (like PADI AWARE or REEF courses) did not show to have any additional environmental care, but the information provided during the environmental briefing just before dive influenced divers by reducing negative interactions.

It should be noted that there is a direct correlation between the quality of the briefing and the

underwater environmental conscious behaviour of divers (Barker and Roberts, 2004; Camp and Fraser, 2012; Medio et al., 1997). Barker and Roberts (2004) emphasised that a tipical "environmental briefing" contains information on the topography of the diving area, marine life, safety procedures and environmental behaviours. The last issue, according to Barker and Roberts (2004) comprehends an important missing issue in traditional briefings.

In this study, specific environmental briefings were designed for each diving site, with careful and detailed chosen information that the dive master provided immediately before each dive. Divers of "B24" and "Poço" underwater routes were unanimous in grading highly the on board "environmental briefings" and the support team that provided them. Also, quality and importance of information delivered during the briefing about fauna, biodiversity conservation and dangers was, overall, much appreciated. The same positive outcome was obtained regarding the importance and satisfaction with the information provided on the underwater routes, their level of difficulty, and their level of interest. The same questions were asked to the snorkelers that dived in the underwater routes of Marinha Beach (Algarve), with a similar highly positive outcome (Rangel et al., *submitted a*).

Overall, divers seemed to enjoy their experience while diving within an underwater self-guided scuba diving routes framework implemented for this study. Also, although little information is available on the effect of environmental education and interpretation of underwater routes as a way to promote environmental awareness, it seems clear that divers appreciate *in situ* information provided through interpretative slates and environmental briefings. Moreover, these tools seemed to have increased the environmental awareness of users, validating the routes framework as an effective way to increase environmental education and knowledge.

CHAPTER VIII

GENERAL DISCUSSION

General Discussion

The aim of this chapter is to describe and analyse the major findings of this thesis. In order to achieve these objectives, the main conclusions, major difficulties and some important procedures of all chapters are analysed in detail. In the final section of the chapter a critical overview of the major findings with regard management implications is presented. It is important to emphasise that no background information is available on diving tourism in Portugal. In fact, although diving tourism represents one of the most important sectors within coastal tourism (Townsend, 2003; Davenport and Davenport, 2006; Rouphael *et al.*, 2011; Townsend, 2008a), worldwide research on this subject is scarce, and consists mostly of "grey literature" such as project reports (Hall, 2001; Garrod and Gössling, 2008). Furthermore, no scientific information is available on diving tourism in Portugal. Thus, all the work developed during this thesis was based on research examples undertaken in other areas, where, most of the times, general dive conditions are far from the ones Portugal has to offer. Overall, the main goal of this thesis was to implement an innovative network of underwater self-guided routes in the Algarve (South of Portugal) and provide scientific information on the Algarve diving tourism for the first time, aiming at achieving a more biological, social and economically sustainable diving activity. All the specific objectives will be considered during the following discussion: 1) the development and implementation of a network of underwater routes in the Algarve (snorkelling and scuba diving routes); 2) the economic valuation of snorkelling routes; 3) the analysis of the degree of satisfaction of divers in relation to the routes and to the available support infrastructures; 4) the analysis of the potential of the routes in effectively increasing environmental awareness of divers.

8.1 Designing and implementing snorkelling/scuba diving self-guided routes in the Algarve (South of Portugal) (Chapter II, IV, VI)

The first objective of this thesis was to design and implement a network of underwater routes in the Algarve (South Portugal) for the purposes of promoting diving tourism and effectively enhancing environmental education of users. The design and the implementation of underwater routes were specifically conducted for each selected site, with some obvious similarities. In fact, the development of underwater self-guided routes is in its early stages, scientific data is scarce, and most of the marine underwater trails that have been implemented are not published, being only available in internal reports or academic theses (Berchez *et al.*,

2005; Berchez *et al.*, 2007). Considering the lack of knowledge on this issue, and the absence of a defined methodology for developing underwater trails, some of the major choices made during our design are discussed below.

The National Underwater Ecological Reserve (REN), in place since 1983 (DL n.º 321/83, of 5 of July), is a biophysical structure with a series of zones which, by its values, ecological sensitivity, exposure and susceptibility to natural impacts is object of special protection. When choosing locations for the implementation of all underwater routes used during this thesis, only Algarve REN areas were considered. In fact, most underwater routes are set in Marine Protected Areas (MPAs), where scuba diving and snorkelling are increasingly important touristic activities and there is the need to avoid damaging behaviours to the environment (Davis and Tisdell, 1995; Plathong *et al.*, 2000). It is important to refer that although the Algarve REN covers a considerable area, in comparison with the terrestrial zone, scientific studies and data analysis regarding this area are still in the early stages, and even though its socio-economic and biologic importance is acknowledged, no actions have ever been taken to preserve and enhance sustainable underwater tourism occurring in these sensitive natural areas (Gonçalves *et al.*, 2007a). It was our purpose, when deciding to use the Algarve REN area for implementation of routes, to enhance the promotion of sustainable development of diving recreational activities that take part in this region.

The first step in implementing routes entailed selecting the most interesting diving areas, doing their biological mapping, and characterizing and selecting the most interesting spots within the diving sites for interpretative purposes. The routes were defined based on accessibility, appealing landscape, geological features, interesting biodiversity, existence of charismatic species, existence of protected species, and key biotope species. The RenSub project, carried out from 2003 to 2010 (Gonçalves *et al.*, 2004a; Gonçalves *et al.*, 2004b; Gonçalves *et al.*, 2007a; Gonçalves *et al.*, 2008a; Gonçalves *et al.*, 2010) was essential during this phase, because it was responsible for the mapping of biological coastal communities of the Algarve REN.

Local dive clubs (Dive Spot in Armação de Pêra and Hidroespaço in Faro) and Marinha Beach operator (Navibordo) were included in all steps of the process of designing and implementing the routes. The fact that both diving clubs are owned by marine biologists interested in participating in environmental awareness enhancement was an important asset for the project. As emphasised by Townsend (2008a) dive operators, diver leaders and entities responsible for managing dive environments must act as a group to develop effective means of transmitting

accurate messages to divers. Also, it is extremely important that all training schools place particular emphasis on environmental importance of diving skills (such as buoyancy control), and on the importance of developing effective communication methods for accurate message delivery (Townsend, 2008a).

After selecting the dive sites, specific locations were defined in each area to deploy double sided acrylic slates (four in each Marinha Beach route; five in "B24" and six in "Poço"). To avoid any disturbance of local biological communities, slates at Marinha Beach were fastened to orange buoys located at the surface. Along the scuba diving routes, slates were hooked to highly visible yellow cables (at least 1.5m long), and attached to the sandy bottom using "environmental friendly anchors". The distances between slates and all underwater structures were carefully calculated, aiming at reducing any possible negative impact due to divers' direct contact with the underwater surroundings. In fact, Claudet *et al.* (2010) reports that absence of divers impacts in the underwater trail implemented in the buffer zone of the Cerbère-Banyuls Natural Marine Reserve (CBNMR) was mostly due to the fact that snorkelers were the main users, and thus the main impact was on the buoys at the surface. Plathong *et al.* (2000) highlights that more negative impact are likely to occur near interpretative signs.

Slates were endowed with important information that allowed self-guidance of trails and, at the same time, informed divers of interesting biological, geological and historical features that surround them. As referred by Pedrini *et al.* (2010), in the interpretative dive route of Anchieta trail (Brazil), divers reported that the location of slates was the most interesting feature of the diving route. In fact, we believe that this *in situ* knowledge can create empathy with the surroundings, promoting the enhancement of environmentally friendly behaviours.

To further promote environmentally friendly behaviours, specific "environmental briefings" where designed, with diving operators, for each site. It is important to emphasise that in order to be effective, educational tools of routes must be specifically designed for each diving site, taking into consideration the socio-demographic profile of visitors, since underwater behaviour is related to the characteristics of the divers (Mundet and Ribera, 2001; Rouphael and Inglis, 2001; Barker and Roberts, 2004; Luna *et al.*, 2009; Pedrini *et al.*, 2010; Barker and Roberts, 2008). All "environmental briefings" considered the important and/or interesting aspects of the specific route, diving area, geographical characteristics of the zone, the most common divers' profile (i.e. socio-demographic profile, experience, and certifications), possible dangers and difficulties. The divers' profile considered while designing "environmental briefings" followed pre-existing scientific studies on divers' socio-

demographic characteristics. That proved to be the an accurate choice because the surveys undertaken with the studied divers revealed that the questioned population presents a socio-demographic profile pattern similar to the one observed for most of the scientific studies consulted (see Chapter IV; V; VI; VII).

During most dives, a researcher was present providing support to visitors. Furthermore, all dive masters were trained in order to be able to provide all important information to divers diving in the routes. In fact, divers tend to look for educated guidance during their dive, and this is a unique opportunity to present them with information that can enhance underwater environmentally friendly behaviours (Barker and Roberts, 2004), giving managers an excellent opportunity to reinforce and/or create environmentally friendly behaviours, thereby potentially reducing environmental *in situ* impacts (Hannak *et al.*, 2011; Camp and Fraser, 2012). In fact, the marine environment can be used as an "outdoor laboratory", where the operator provides *in situ* biological and ecological information to visitors (Salm and Siirila, 2000).

Routes, together with the environmental briefing, and accurate environmental interpretation, should provide information to allow divers to understand the impact they can cause in the ecosystem, identify responsible underwater behaviours and promote a better understanding of the marine environment (Harriott, 2002; Claudet *et al*., 2010; Townsend, 2008a). During this thesis, an effort has been done to design, implement and develop underwater snorkelling and scuba diving routes that would me*et al*l the above mentioned characteristics, in order to allow accurate target information, enjoyable visitation, diving promotion and environmental awareness among visitors.

8.2 Economic valuation of self-guided snorkelling routes of Marinha Beach. Valuating the use of natural common resources (Chapter III)

Environmental resources such as beaches and diving sites are considered to be common goods (Grasso *et al*., 1995), implying a certain lack of responsibility for their use and some degree of unaccountability for their sustainable management (Gibson *et al*., 2000).

Natural resources valuation may be used to implement measures that are environmentally rational, and adjust recreational activities to natural preservation. According to King (1995), economic valuation of natural resources is achievable, and guarantees robust management tools that can and should be used in the management of coastal marine areas.

At Marinha Beach, the monetary valorisation of the use of the implemented routes gave an indication of the real value of the system and, thus, of its effective management and preservation importance, since it presented not only an ecological value, but also an economic one, essential for appropriate and consistent management of different coastlines.

Although the total resource value obtained was considered relatively low, it should be emphasised that only the experimental year of the implementation of routes was considered for this calculation. It is expected that in future years, the demand for these routes will increase significantly, thereby increasing the calculated average surplus. In fact, if we consider a routes carrying capacity of 1000 tourists *per* year, the total resource rent for the monetary valorisation of the recreational use of the implemented routes is estimated to be 250000€. This assessment gives a strong indication of the real importance of preserving this natural area.

8.3 Divers' characteristics and their opinions and perceptions towards self-guided routes and support infrastructures (Chapter IV; VI)

In marine tourism, socio-demographic and economic profiling of divers is essential to define effective management measures because underwater behaviour is related to the characteristics of the divers (Mundet and Ribera, 2001; Rouphael and Inglis, 2001; Luna *et al*., 2009; Pedrini *et al*., 2010; Brotto *et al*., 2012). The divers who took part in this study, both snorkelers and scuba divers, seem to present a socio-economic profile comparable to that reported in most other diving studies (see Chapter IV; V; VI; VII).

High levels of formal education were observed for Marinha Beach snorkelers and for scuba divers. A high level of formal education is often widely reported as a common characteristic of divers (Garrod and Wilson, 2003; Townsend, 2008b). Musa (2003) found that 71% of the divers in Sipadan Island (Malaysia) had at least some years of college education. The same pattern was also observed for divers in Layang Layang Island, Malaysia, where 58% had a university degree or postgraduate qualifications (Musa and Dimmock, 2012), and for scuba divers and snorkelers of Mauritius, with 58% with a college degree (Garrod and Gössling, 2008b).

The vast majority of surveyed divers were male (68% of snorkelers and 77% of scuba divers). In fact, this gender imbalance is a typical feature of most studies (e.g Tabata *et al.,* 1992; Mundet and Ribera, 2001; Musa, 2003; Musa *et al.*, 2006; Hannak, 2008; Hannak *et al.*,

2011). Nevertheless, although Lindgren *et al.* (2008) and Musa *et al.* (2006) state that gender disparity is becoming gradually less marked, we found no indications that this dominance is diminishing.

Snorkelers ranged from 14 to 60 years, and scuba divers from 14 to 66 years old. In both surveys, most divers were over 30 years old. The dominance of divers in their 30s and 40s may reflect, as suggested by Musa *et al.* (2010), a better economic status that allows participation in such expensive touristic activities. Overall, this age pattern is similar to the one found in the scientific literature. Divers surveyed at St. Lucia (Caribbean Sea) reported also an age range from 15 to 60 years (Barker and Roberts, 2004). In Napoleon reef in Egypt divers ranged in age from 14 to 65 years old (Hannak *et al*., 2011). It is, however, important to highlight that average age of divers is increasing due to technological advances in diving apparatus, allowing older people to engage in this activity (Dignan, 1990; Musa *et al.*, 2006).

Integrated planning and regulation should be carefully considered when developing ecotourism activities. This implies special tourist infrastructures, adjusted to the users and activities proposed (Wearing and Neil, 2009) that can lead to satisfying experiences. Mundet and Ribera (2001), Musa (2002) and Musa *et al.* (2006) emphasise the importance of diver satisfaction, stating that a satisfied customer will recommend diving sites and services to friends.

At Marinha Beach, ecotourists considered that the most important infrastructures were the emergency support and the sanitary facilities, but all the other support infrastructures were also considered very important, with an emphasis on parking facilities. It should be referred that Marinha Beach is located at the bottom of a cliff and parking is usually done on the surrounding cliffs. Due to instability of the cliffs, this creates a coastal management problem. In Marinha beach parking was strongly conditioned in 2008 as a result of the public growing awareness of this problem.

Scuba divers who dived at “B24” and “Poço” also highlighted the importance of the several support infrastructures, and overall, divers were disappointed with some of them, e.g. parking facilities, support bar, sanitary facilities, absence of a hyperbaric chamber, and infrastructures for the disabled. These aspects should be carefully considered when planning dive tourism support facilities in the Algarve, since their improvement will most probably increase divers’ satisfaction and, thus, the number of visiting diving tourists. It should be emphasised that

"Natural beauty", reported in many studies as the most important motivation for diving, was not considered a prime motivation for scuba diving in our case study. This is not surprising since mainland Portugal is not a prime diving location; visibility and temperature are usually relatively low and sediment suspension is high.

At Marinha Beach, snorkelers enjoyed all the three self-guided routes, classifying them as "good" or "very good". Route 3 was the most appealing, probably because of its sinuous shape, with rocky outcrops, sand beds and pebble areas along the path, making it more diverse than the two other routes. Route 2, which has been selected because of its important seagrass meadow of *Cymodocea nodosa* (included in the *Habitats Directive* as a particularly fragile ecosystem), was the least appreciated by snorkelers. This may have been related with the fact that shortly before the trail had been implemented, most of the seagrass disappeared. As a consequence, snorkelers were unsuccessful in locating these important ecological habitats, which were on the underwater slates. Additionally, this route was delimited by the beach's navigational channel, making it sometimes a less appealing place for snorkelers (e.g. noise from the approaching boats).

Scuba divers reported to be satisfied with their diving experience in the Algarve, ranking it as a "good" experience. Nevertheless, satisfaction was higher amongst divers diving in routes.

In fact, satisfaction towards diving in underwater routes seems to be consensual, as also reported by Pedrini *et al*. (2010). Routes seem to have pleased the divers who visited them and thus can be effectively used as an important asset to promote Algarve diving sites, and enhance visitors' environmental awareness with targeted *in situ* interpretation and planned "environmental briefings".

8.4 Can underwater self-guided routes enhance environmental awareness? (Chapter V; VII)

Marine tourism presents a policy dilemma; it generates important incomes for local economies, but it contributes to the destruction of valuable marine resources (Asafu-Adjaye and Tapsuwan, 2008).

In marine ecotourism, environmental education is mainly achieved through the development of underwater self-guided trails, or routes (Andrade *et al.*, 2005; Pedrini, 2006). According to

Lima (1998) and Andrade *et al.* (2005), guided routes are a good way to provide environmental education in ecotourism. Nevertheless, and despite the obvious consensus on the subject, available scientific literature on underwater routes is scarce, especially with regard to their implementation and their design as environmental educational tools. However, some aspects seem to be consensual: routes must be designed and implemented considering the target population and the specifications of the site where the activity is developed (Mundet and Ribera, 2001; Rouphael and Inglis, 2001; Luna *et al*., 2009; Pedrini *et al*., 2010; Brotto *et al*., 2012). Furthermore, environmental educational and interpretation tools must also be specific and provided in carefully defined ways, preferably immediately after and during the activity (Barker and Roberts, 2004; 2008), in order to ensure that all messages are effectively delivered (Townsend, 2008a).

During this thesis, some of the few existing examples of implemented underwater routes, and their main objectives are analysed. Cerbère-Banyuls Natural Marine Reserve (CBNMR), in the French Mediterranean coast, is referred as an example of a self-guided snorkelling trail (implemented in 2001) that aimed at concentrating divers in certain areas and increasing their environmental awareness. It was designed in an innovative way with several radio beacons displayed along the trail to inform snorkelers about local fauna and flora through special acoustic hear phones (Claudet *et al.*, 2010). One of the major findings of the author was that snorkelers did not have any negative impacts on the underwater system, probably due to the fact that environmental information was given at the surface.

Another example of underwater visitation guidance aiming at concentrating divers in less sensitive areas can be observed at Isabel Island National Park (Mexico), where six underwater trails were implemented (Ríos-Jara *et al*., 2013). No evidence was found relating divers with underwater negative impacts.

In Brazil, an interpretative trail was developed at Anchieta Island's Park, with *in* situ guidance and pre-defined interpretative sites. The main aim was to promote environmental education for snorkelers and scuba divers (Pedrini *et al.*, 2010). Although no results are available on the environmental awareness effect, the author reports that divers prefer the interpretative locations, and that no negative impacts associated with divers were observed.

Additional impressive examples of underwater routes, aiming not only at enhancing environmental awareness, but also at engaging visitors with their cultural heritage, are the Nordic Blue Parks Project and the Vrouw Maria Underwater Project (Tikkanen, 2011). The

Nordic Blue Parks Project developed underwater trails and/or guided visitation of several shipwreck sites (in Finland, Denmark, Norway and Sweden), but in the Vrouw Maria Underwater Project, the visitation to the Vrouw Maria Dutch ship was achieved through virtual simulation, since the wreck is located in a *Natura 2000* site, an area where scuba diving is prohibited (Tikkanen, 2011).

Regardless of all available examples, studies on the effectiveness of underwater routes in reducing divers' impact are regrettably insufficient (Berchez *et al.*, 2005; Berchez *et al.*, 2007) and the general lack of overall knowledge in this area conflicts with the increasing use of interpretative trails as management measures worldwide. Nevertheless, if designed and accompanied with accurate and specific educational and interpretative tools, underwater routes seem to be an appropriate instrument for enhancing divers' behaviour

For the Marinha Beach (Algarve) snorkelling routes, information to divers was first provided through pre-dive "environmental briefings" at the beach (following Barker and Roberts, 2004; 2008), near to the routes. Once inside the water, acrylic slates attached to buoys at the surface (following Claudet *et al.*, 2010) provided detailed information on different aspects of the surrounding environment and guided visitors along the route. At Marinha Beach there was no evidence of snorkelers interfering with the environment.

For the "B24" and "Poço" scuba diving self-guided routes, environmental briefings were given on-board immediately before each dive as proposed by Barker and Roberts (2004). After that, interpretative signs were located along the trails, respecting a 1.5m distance to underwater structures (following Claudet *et al.*, 2010).

Self-guided routes allowed tourists to move at their own pace, stopping for as long as they want, and having the ability to learn about the environment through signs along the way. Nevertheless, with almost no published data (Berchez *et al.*, 2005; Berchez *et al.*, 2007), it is difficult to understand the real effect of underwater trails impact in terms of biodiversity conservation enhancement.

In the vast majority of studies snorkelers and scuba divers perceived underwater eco-routes as a way to enhance nature preservation and to better understand their historical heritage, by increasing their knowledge on the surrounding environment. Most reported they enjoyed the experience and that they would repeat it. *In situ* interpretation was appreciated by the divers and "environmental briefings" were overall highly graded.

According to Leeworthy and Bowker (2005), the total number of individuals participating in marine recreational activities is expected to increase in the future. Pendleton and Rooke (2006) point out the special interest in snorkelling and scuba diving sports, as they represent a large proportion of marine recreation users. The Algarve (South of Portugal), for example, is known worldwide for its touristic coastline, but it is also a good example of socio-economic and environmental distress caused by unregulated marine coastal tourism development (Davenport and Davenport, 2006).

The use of underwater routes to promote diving tourism and to enhance environmental awareness seems to be an effective alternative for underwater ecotourism in the Algarve region. In fact, accurately designed underwater routes, with carefully chosen environmental information, and implemented according to the target population and specific diving sites, should be carefully considered by managers as a way to promote diving tourism in the Algarve and, at the same time, increase environmental awareness of users.

The development of ecotourism activities, together with properly designed and correctly provided environment education, leads to an increased responsiveness amongst tourists, due to a stronger connection with the natural environment and, consequently, an increasing in environmentally friendly behaviours.

Final considerations

The main goal of ecotourism is to promote enjoyable experiences within an environmentally sustainable framework. To effectively promote sustainable diving tourism and environmental awareness, updated scientific knowledge must be associated with the development of sustainable diving activities. In fact, in designing adequate underwater routes, the target implementation areas must be carefully considered. This implies previous biological mapping of the routes' areas. Although this is not the case for most underwater coastal areas in Portugal, in the Algarve the RenSub project (Gonçalves *et al.*, 2010) mapped the South Portugal coast, from the shore to the 30m bathymetric mark, representing an essential tool that enabled the design of environmental education and interpretation tools for the proposed underwater routes of this study.

The economic valuation undertaken for the snorkelling underwater routes of Marinha Beach highlighted the real value of the natural system where the eco-routes were developed. In fact, management tools must be defined considering not only the ecological sustainability of the system, but also the economic value of the recreational use of the "common resource", since it emphasises its real global value.

Furthermore, it is essential to acknowledge that without the cooperation of all entities operating in the selected areas (e.g. scientists, coastal managers, dive clubs, and beach operators) the objectives of an underwater route will not be achieved. In fact, all entities must work as one to allow the development of all coastal ecotouristic activities, as emphasised by Townsend (2008b). Sites and routes must be adequately promoted in the available media, addressing the target audience with assertive messages that encourage possible visitors to choose the advertised destination. Appealing support infrastructures must also be available to divers and their accompanying visitors, so that visitors will repeat the experiences and invite others to join them. It should be noted that some support infrastructures seem to be more relevant to divers (e.g. sanitary facilities, emergency backup, and access facilities for disabled people). These facilities should be carefully prepared for receiving tourists, in order to enhance their experience in the designated area. In fact, although the major part of worldwide surveys points out "natural beauty" as the main reason for choosing a diving site (Garrod and Gössling, 2008), our study clearly indicates that features such as the support diving team can encourage divers to visit a site.

Another important outcome of this study was the importance of the design of environmental education and interpretation tools. In fact, traditional briefings should be replaced by "environmental briefings", as proposed by Barker and Roberts (2008), since the information tends to be more effective, targeting all issues that need to be addressed in order to enhance accurate underwater behaviours. Information should also be reported immediately before the diving experience and/or during the dive (as suggested by Barker and Roberts, 2004). Also, environmental interpretation must be developed according to the target population since its main objective is to increase environmental awareness of the users by enhancing empathy with the surrounding and, as reported by Townsend (2008a). During the educational process it is important to acknowledge that the marine environment offers a unique opportunity of an outdoor laboratory (Salm and Siirila, 2000), where the diving experience is a privileged activity for developing and promoting environmentally friendly behaviours that can be effectively enhanced by the operators and scientists. The accurate transmission of the environmental messages is also an important feature to consider, and it is essential to assure that all personnel involved are trained to facilitate all the needed information in an assertive way. This is definitely a feature that can be used by managers to developed diving activity in a sustainable way.

It is also significant to acknowledge that all divers have individual underwater behaviour, and their profiling is a mandatory procedure prior to the definition of the tools to use in any underwater route. In the Algarve, the diving population seems to present socio-demographic characteristics that overall are similar to the majority of diving profiles reported in the scientific literature.

Overall, divers who participated in this study seem to have liked diving at the Algarve and they clearly enjoyed and preferred the sites where underwater routes were implemented. Moreover, most divers perceived the existence of routes as a way to preserve the environment and they stated that they learned something new about local biodiversity. Also, all environmental education and interpretative features were highly graded in all routes (e.g. interpretative slates and "environmental briefings"). In fact, the Algarve routes seem to be an effective tool for promoting diving tourism, while at the same time increasing environmental awareness among users.

Furthermore, underwater routes can be easily enhanced and provided for the Algarve region if all entities work together gathering information about target tourists, developing adequate support infrastructures, advertising these activities, implementing the routes and maintaining

them. Scientists should be encouraged to update biological monitoring of the Algarve's underwater biodiversity, without which no touristic activity should be developed in an underwater coastal area. If underwater routes are defined and implemented according to the methodologies proposed in this thesis, diving tourism can be sustainably developed and environmental awareness of visitors will be effectively increased.

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APPENDICES

Appendix I

Original publication of the paper presented in Chapter III

(Portuguese language)

Rangel, M.O., Dentinho, T.P., Araújo, G., Lopes, J., Gonçalves, J.M.S., Erzini, K. 2009. Análise custo viagem de roteiros subaquáticos (de apneia) na Praia da Marinha (Algarve). Revista Portuguesa de Estudos Regionais, 22:77-89.

ANÁLISE CUSTO VIAGEM DE ROTEIROS SUBAQUÁTICOS (DE APNEIA) NA PRAIA DA MARINHA (ALGARVE)

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Resumo:

Pretendeu-se definir o valor da utilização recreativa de mergulho em apneia, em três roteiros implementados na Praia da Marinha, Algarve. Utilizou-se o método do custo de viagem para definir o valor de uso e os benefícios de recursos naturais utilizados para esta actividade de recreação. Validaram-se 115 inquéritos efectuados entre 15/07 a 15/9 de 2008, analisando-se os dados pelo modelo de regressão. Considerou-se como variável independente o número de mergulhos efectuados e como variável dependente os diversos custos, considerando o tempo dispendido na actividade ponderado por uma fracção do rendimento declarado. Concluiu-se que o excedente médio por mergulho é de 5,0 €, pelo que o valor de uso dos roteiros é de 600 €/ano, correspondente a um total de 30000 € admitindo uma taxa de desconto de 2% e a manutenção do recurso por muitos anos. Com uma capacidade de carga de 1.000 mergulhos por ano, a renda total do recurso por ano passa a ser de 5000 € e o valor económico total de 250000 €.

Palavras-chave: Praia da Marinha; Método do Custo de Viagem; Eco-turismo; Apneia; Roteiros subaquáticos

Códigos JEL: Q50-Q500, Q51-Q510, Q57-Q570

Abstract:

The value of recreational snorkeling in defined underwater routes was evaluated for Praia da Marinha, Algarve. Travel cost technique was used for defying the value of recreational use and benefits of this natural resource. A total of 115 questionnaires were analyzed, based on surveys carried out from 15/07 to 15/09 of 2008. Regression analysis was used, with the number of dives as the independent variable, while dependent variables refer to different costs incurred during the trip and time spent on the activity weighted by a fraction of the declared income. The estimated average surplus was 5,0 € and the value of the three routes was of 600 €/year, which corresponds to a total value of 30000 €, considering a discount rate of 2% and the maintenance of the resource for many years. Assuming a carrying capacity of 1000 dives per year, the total resource rent per year is 5000 €, corresponding to a total economic value of 250000 €.

Keywords: Marinha Beach; Travel Cost Technique; Eco-tourism; Snorkeling; Underwater trails

JEL Codes: Q50-Q500, Q51-Q510, Q57-Q570

1. Introdução

O conflito entre o uso de áreas marinhas para fins recreativos, e a sua gestão e conservação é extremamente actual (Davis & Herriot, 1996; Lim & McAleer, 2003). Um dos desafios passa, assim, pelo estabelecimento de turismo sustentável e promotor do desenvolvimento equilibrado das comunidades locais (aspecto que tem sido descurado, de acordo com Apate *et al*., 2005)), providenciando, ao mesmo tempo, uma experiência satisfatória ao visitante (Lim & McAleer, 2005).

No entanto, diversos recursos ambientais são considerados bens comuns (Grasso *et al.,* 1995), implicando a desresponsabilização pela sua preservação, e o seu uso indevido. Na realidade, tal como referido por (Gibson *et al*., 2000), os bens comuns, ou recursos comuns, são, por definição, de livre acesso, pelo que são difíceis de gerir sustentadamente e podem esgotar-se com facilidade. O autor refere como exemplos para bens comuns que se podem extinguir as florestas e determinados pesqueiros.

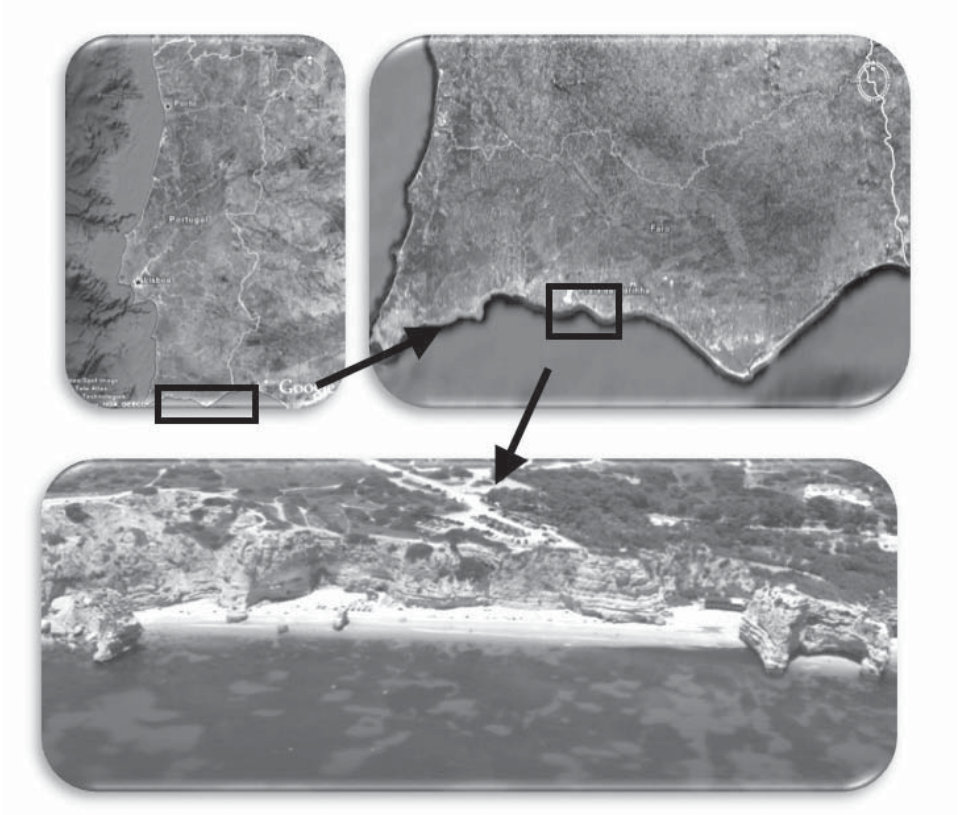
O ecoturismo, embora se apresente como uma forma sustentável de utilização do meio, quando realizado de forma descoordenada, pode levar ao turismo desordenado e de massas, o que, como consequência, prejudica todo o sistema sociológico, económico e ambiental em questão, assim como o envolvente (Soriano, 1998).

A valoração dos recursos naturais pode servir como um parâmetro, utilizado pelos gestores, para a implementação de medidas racionais e adaptadas ao meio, adequando a visitação e as actividades recreativas. Na realidade, de acordo com King (1995), a avaliação económica dos recursos naturais é exequível e fornece ferramentas de gestão robustas que podem, e devem, ser utilizadas para a gestão de sistemas costeiros marinhos.

A praia da Marinha (Figura 1) integrada no regime jurídico da REN (Reserva Ecológica Nacional), trata-se de uma das mais bonitas e emblemáticas praias portuguesas, tendo sido considerada "Praia Dourada" pelo Ministério do Ambiente em 1998, devido aos seus

FIGURA 1

Localização da Praia da Marinha, no Sul de Portugal (adaptado de Google Earth; CCDR-Algarve, 2007)



valores naturais singulares. Além dessa distinção, passou ainda a ser a imagem promocional do 'Guia de Portugal'. Em 2003, a Associação Ambientalista Quercus, atribuiu-lhe o galardão de Qualidade de Ouro, e em 2007 foi considerada uma das cem melhores praias do mundo pelo Guia Michelin.

A implementação, e valorização, do ecoturismo em zonas com particular interesse sob o ponto de vista natural, como as classificadas como Reservas Ecológicas ou integrantes da Rede Natura 2000, pode funcionar, como acima referido, como uma ferramenta de gestão eficiente para a manutenção ecológica, e económica das populações integradas nestas áreas. De acordo com Green & Tunstall (1993), se um determinado sistema não possuir uma valorização expressa em valor monetário, continuará a ser considerada pelos gestores como "de livre acesso", pelo que não será incluída num sistema de tomada de decisões.

Na região algarvia, muito embora a utilização da orla marítima seja extensa do ponto de vista do turismo, a informação disponível relativamente à sua utilização, sustentável ou não, é escassa.

O projecto "Percurso Subaquático Praia da Marinha" (Gonçalves *et al*., 1998) pretendeu delinear, sinalizar e divulgar três roteiros subaquáticos na Praia da Marinha, acessíveis a qualquer utente da praia, promovendo simultaneamente estes roteiros em duas vertentes: a preservação ambiental e a experiência turística agradável. O presente estudo pretende estimar o valor do uso do mergulho em apneia associado à visitação ao sistema natural aquático associado à Praia da Marinha, de acordo com a valoração da utilização dos roteiros na área em questão, utilizando-se para este efeito o Método do Custo de Viagem (como sugerido por Boardman *et al.*, 2001; Pearce *et al.,* 2006).

2. Método de análise custo viagem

A análise custo-benefício permite medir o valor monetário de sistemas cujo valor económico não é revelado explicitamente pelo mercado, muito embora seja real e imprescindível para a sociedade. Permite também sistematizar as vantagens e desvantagens das políticas e determinar quais são os benefícios líquidos de propostas de alteração ao que está implementado em termos de legislação (Boardman *et al.*, 2001).

Assim, tal como referido por Boardman *et al.* (2001), o Método do Custo de Viagem (MCV) (*Clawson Method*) consiste num método económico indirecto de valoração utilizado na análise custo-benefício para calcular o valor económico de algo que não pode ser valorado através dos preços de mercado (como por exemplo, praias, pesqueiros, ecossistemas). Na realidade, o objectivo deste método é calcular a "vontade de pagar" (*willingness to pay*) para a manutenção de um determinado local.

O MCV reconhece que o custo efectivamente dispendido pelas pessoas para visitar um determinado local é maior do que apenas o preço do bilhete de admissão, e deve incluir, também, o custo da viagem de ida e volta, o tempo gasto na viagem ponderado por uma proporção do rendimento auferido por unidade de tempo, o custo de alimentação, entre outros. O custo total da visita é assim tomado como a vontade de pagar efectivamente revelada pelo visitante (Boardman *et al*., 2001). Existem vários estudos que utilizam métodos custo de viagem para valorar recursos marinhos (Alban *et al.,* 2006).

O MCV parece apresentar-se como um método credível para a valoração da exploração recreativa de recursos naturais (Cesario, 1976) sendo, de acordo com Smith, (1993) o mais utilizado na gestão costeira ambiental. Na realidade, este método foi delineado para analisar os ganhos económicos da actividade recreativa, ou os benefícios produzidos pelos recursos naturais, que por definição são de livre acesso a todos os consumidores (Ward & Beal, 2000). Deve, no entanto, referir-se que o MCV é um método de preferências reveladas e portanto baseia-se no valor que cada indivíduo gasta para usufruir

de um recurso natural (valor de uso), não permitindo uma análise que abarque todos os tipos de valores definidos pela abordagem do valor económico total (Boyle & Bishop, 1985). Este tipo de abordagem pode ser alcançada utilizando um método de preferências declaradas, nomeadamente a avaliação contingente, que se baseia na criação de um mercado hipotético em que o indivíduo reage tendo em conta os valores de uso e não uso que um determinado recurso apresenta.

O MCV baseia-se em dados recolhidos sobre os turistas que efectuam determinada visita recreativa. Os valores dos atributos recreativos podem ser estimados igualmente se houver dados sobre diferentes locais de visita (Brown & Mendelsohn, 1984). Após a realização e validação dos dados, é definido o modelo de regressão para o posterior cálculo da curva de procura, sendo necessário determinar quais as variáveis independentes que explicam o custo efectivamente suportado pelos turistas.

O excedente do consumidor é determinado pelo valor máximo que o consumidor está disposto a pagar, para além do valor de mercado de determinado bem ou serviço, sendo que a estimativa do benefício económico total, do consumo de um bem ou serviço, consiste no excedente do consumidor (Dixon & Sherman, 1991).

3. Recolha de dados

A experiência em causa foi realizada no decorrer da época balnear (15 Julho a 15 Setembro) de 2008. Neste período foram implementados três roteiros subaquáticos, promovidos com painéis ilustrativos e informação científica actualizada, sendo associados a uma campanha de marketing regional e nacional. Este trabalho foi precedido de intensa investigação referente aos fundos marinhos associados aos sistemas aquáticos em questão (integrada no projecto RENSUB III), assim como à implementação de outros roteiros na região algarvia (Gonçalves *et al*., 2008 A,B.C; Gonçalves *et al*, 2007A,B; Rangel *et al.,* 2008). A efectivação dos roteiros implicou o acesso a informação disponibilizada por monitores especialmente formados, assim como o preenchimento de um questionário no final da experiência de ecoturismo.

O questionário realizado compreendeu um conjunto de questões, maioritariamente de resposta fechada, com diversas componentes para análise: percepção de preservação da biodiversidade pelos turistas; conhecimentos relativos à temática da bio-preservação; definição dos valores dispendidos por cada turista para efectuar a experiência eco-turística; caracterização da experiência realizada; caracterização da experiência pessoal em mergulho e caracterização socioeconómica do universo estudado.

Efectuaram-se um total de 120 questionários aos turistas que efectuaram os roteiros. Destes, 115 foram considerados válidos para análise. Deve referir-se que apenas se registaram 5 recusas e que todos os restantes praticantes de apneia preencheram o questionário, pelo que a amostra representa a quase totalidade de utentes do serviço no ano 0. A realização dos 3 roteiros implicou, em média, uma manhã, sendo a taxa para aluguer de fato isotérmico, máscara, tubo e barbatanas *in situ* de 8€.

De notar que foi efectuado um Estudo de Viabilidade Financeira para potenciar a implementação e manutenção dos roteiros subaquáticos, promovida pela Universidade do Algarve, com o apoio de diversos patrocinadores (como o concessionário da praia e a Comissão de Coordenação Regional – Algarve). De acordo com esta análise, a implementação de percursos subaquáticos é viável assumindo um acréscimo de 25% de visitas por ano, apresentando um Valor Actualizado Líquido (VAL) de 4.915,35 € para uma taxa de desconto de 5% havendo recuperação do capital investido a partir do 3º ano.

O que se pretende com o presente estudo é estimar o valor do uso do mergulho em dos percursos e implicitamente calcular o valor de uso dos recursos marinhos visitados.

4. Resultados e discussão

4.1 Caracterização da Amostra

O universo analisado (120 indivíduos) foi, na sua maioria masculino (73%) (Figura 2).

Quando a amostra é analisada por estado civil (Figura 3), verifica-se que a diferença entre indivíduos casados e solteiros não se revela muito significativa (2%). Paralelamente, o número de indivíduos que declara viver em União de facto (7%) é relativamente elevado para o padrão nacional. Assim e, de acordo com os *censos* efectuados pelo INE em 2004 (Leite, 2004), este cenário não parece reportar um padrão nacional, mas uma mistura entre diversas nacionalidades e, por isso, diversas realidades.

Deve salientar-se que esta experiência, embora preferida por indivíduos entre os 11 e os 30 anos, foi efectuada por pessoas desde os 9 aos 59 anos

FIGURA 2

Percentagem de indivíduos entrevistados de acordo com o sexo

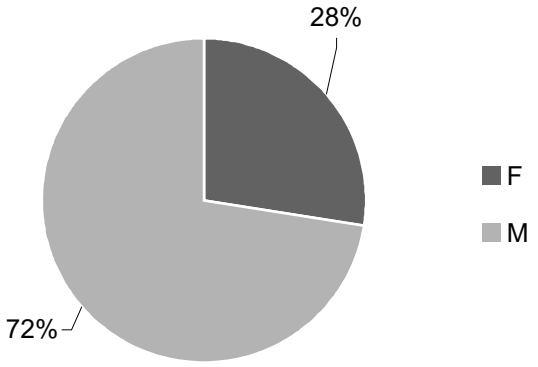
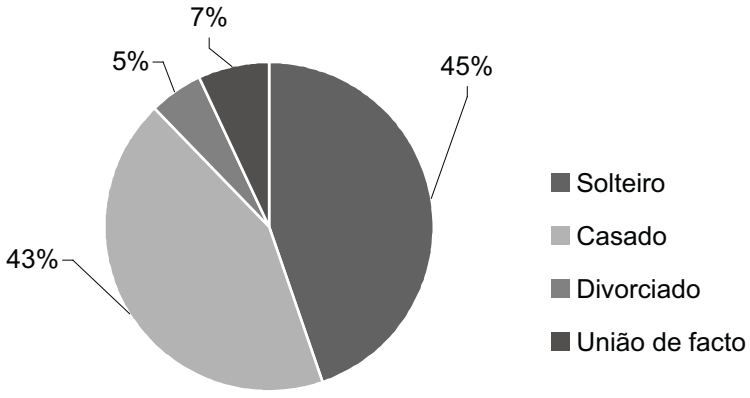


FIGURA 3

Percentagem de indivíduos entrevistados de acordo com o estado civil



Da totalidade dos entrevistados, pode constatar-se (Figura 5) que 51% eram portugueses, sendo os restantes de nacionalidades diversas.

Devem salientar-se o número de indivíduos provenientes de Espanha, provavelmente por ser um país mais perto, e de Inglaterra, por ser o mercado emissor tradicionalmente mais importante. Para este facto, como constatado *in situ* pelos entrevistadores, muito contou a construção do terminal *low cost* no aeroporto de Faro, que opera frequentemente voos do Reino Unido para o Algarve.

FIGURA 4

Número de indivíduos entrevistados de acordo com a classe etária

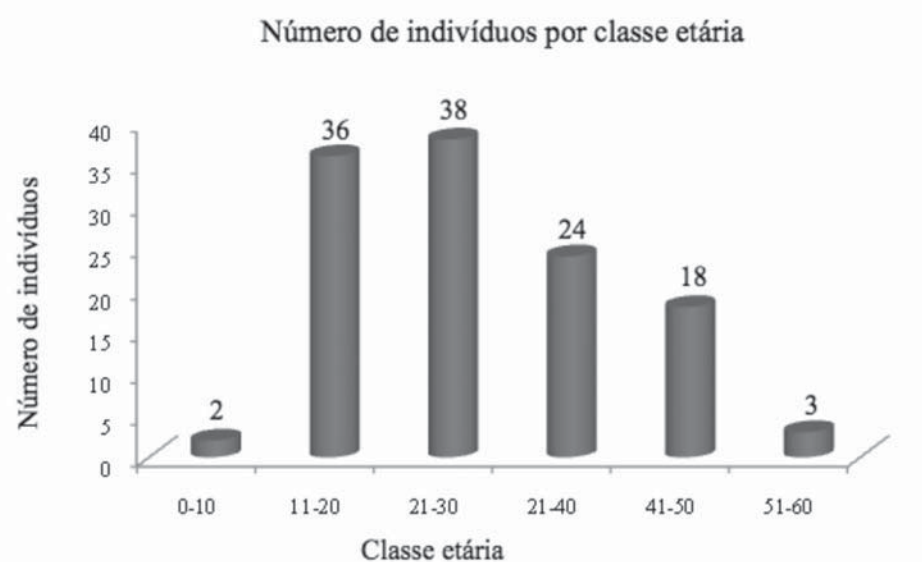
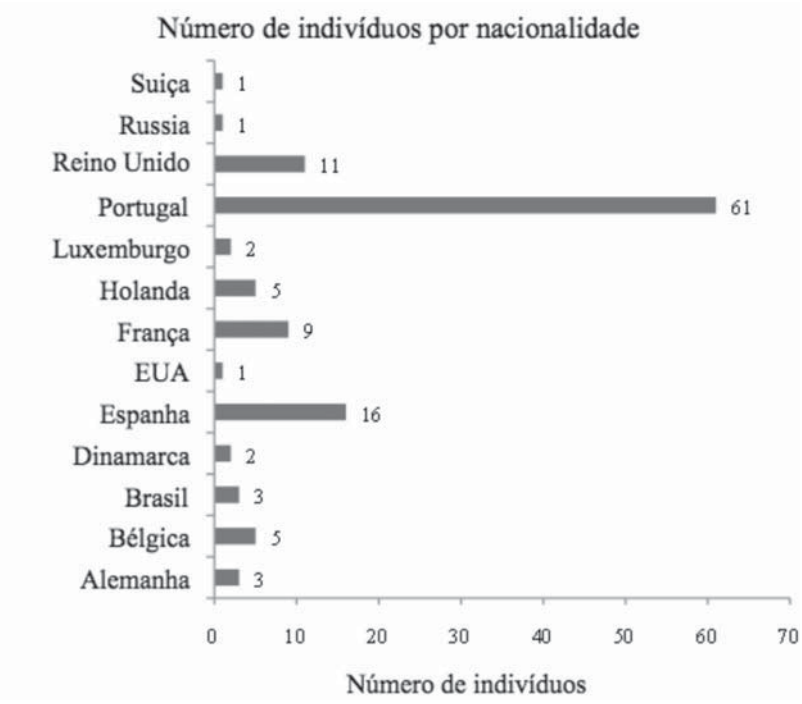


FIGURA 5

Número de indivíduos entrevistados de acordo com a nacionalidade



O mês de Agosto continua, notoriamente, a ser o mês de eleição para as férias de portugueses e estrangeiros no Algarve (INE, 2008) (Figura 6). Este facto deve relacionar-se com o aumento de temperatura do ar e da água que, normalmente, se regista em Agosto face aos restantes meses. No entanto, é de salientar que este foi um ano (2008) atípico neste sentido, sendo que a temperatura média da água do mar rondou os 17ºC.

O grau de escolaridade dos indivíduos entrevistados foi notoriamente acima do esperado, de acordo com o padrão nacional relativo à escolaridade (INE, 2006) (Figura 7). Este aspecto pode estar relacionado com a mistura de nacionalidades que se denota na amostra ou, com uma selecção prévia da actividade pelos turistas, indicando a sua deslocação à praia especificamente para efectuar a experiência de eco-turismo, com o intuito de aprender algo mais sobre a biodiversidade marinha algarvia.

Foi ainda efectuada a análise do número de indivíduos entrevistados de acordo com o seu rendimento bruto médio mensal (Figura 8), verificando-se que os rendimentos mais baixos são preponderantes. Saliente-se, no entanto, um elevado grupo de indivíduos com rendimentos entre os 2001€ e os 3000€, que parecem contrariar este dado. No

FIGURA 6

Percentagem de indivíduos entrevistados de acordo com o mês de período de férias seleccionado

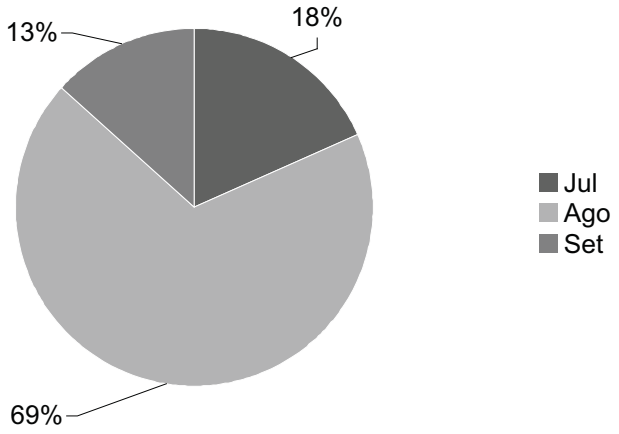


FIGURA 7

Número de indivíduos entrevistados de acordo com o grau de escolaridade

entanto, este aspecto pode apenas relacionar-se com os salários médios de países como a Alemanha, Holanda ou Inglaterra, notoriamente superiores aos portugueses (Quadro I).

4.2 Estimativa do Valor dos Roteiros pelo Método do Custo De Viagem (MCV)

Para a estimar a regressão, foi necessário definir qual o custo de viagem associado à actividade de recreação por cada país de origem (CV). No caso em estudo (Quadro III) foram considerados como custos de viagem desde o local de residência até ao local de alojamento no Algarve a dividir pelos dias de estadia, os gastos com transporte de e para o local de recreação, os gastos de alojamento do dia em questão, os gastos com alimentação e aluguer de material de mergulho e o custo de oportunidade do trabalho (COT). O custo de oportunidade do trabalho representa o que o turista deixa de ganhar ao utilizar o tempo da actividade de recreação nessa actividade. Embora a literatura não seja totalmente explícita em como calcular o COT, este é normalmente calculado utilizando uma proporção da taxa de salário dos indivíduos (McConnell & Strand, 1981). De acordo com o discutido na literatura consultada, e após se ter experimentado as diversas opções

FIGURA 8

Número de indivíduos entrevistados de acordo com o seu rendimento bruto médio mensal

QUADRO I

Rendimento bruto médio mensal por nacionalidade em Euros

Pais	Euros
Alemanha	3500
Bélgica	750
Brasil	2500
Dinamarca	2750
Espanha	750
EUA	12000
França	1500
Holanda	3000
Luxemburgo	1500
Portugal	1000
Reino Unido (Inglaterra)	1750
Rússia	5000
Suíça	5000

referidas, foi utilizado um quarto do salário médio por nacionalidade, por dia útil. A bibliografia consultada indica a utilização de um terço a um quinto do salário médio, sendo que Caulkins *et al.* (1986) sugere a utilização de um quarto. As estimativas dos custos totais por mergulho vêm apresentadas no Quadro II.

Naturalmente os custos da viagem para portugueses e espanhóis são mais reduzidos do que para os restantes países. Os custos de alojamento revelados pela amostra são mais elevados para russos e holandeses e nulos para os americanos que, no entanto, têm um custo de oportunidade do trabalho muito elevado.

Os dados que foram incluídos na análise de regressão para estimar o comportamento da procura foram os custos totais por mergulho como variável dependente e o número de mergulhos por país de origem como variável independente, como representados no Quadro III.

QUADRO II

Custos totais por mergulho, considerando o país de origem, os custos da viagem, do alojamento e alimentação média diários, o COT, o preço do mergulho e o custo total por mergulho

Pais	Viagem	Alojamento	Alimentação	COT	Preço por mergulho	Custo total por mergulho
Alemanha	40,91€	42,42€	11,21€	39,78€	8,00€	142,32€
Bélgica	71,43€	27,14€	8,00€	8,53€	8,00€	123,10€
Brasil	25,00€	70,83€	22,71€	22,73€	8,00€	149,27€
Dinamarca	19,05€	95,24€	30,00€	31,26€	8,00€	183,54€
Espanha	7,71€	13,02€	12,09€	8,53€	8,00€	49,34€
EUA	30,00€	0,00€	10,00€	136,36€	8,00€	184,36€
França	14,35€	11,84€	11,82€	17,05€	8,00€	63,06€
Holanda	60,32€	131,75€	14,37€	34,10€	8,00€	248,53€
Luxemburgo	28,57€	30,00€	30,00€	17,05€	8,00€	113,62€
Portugal	5,44€	16,69€	8,25€	11,37€	8,00€	49,75€
Inglaterra	26,73€	78,15€	15,92€	19,89€	8,00€	148,69€
Rússia	23,08€	150,00€	50,00€	56,82€	8,00€	287,90€
Suíça	20,00€	40,00€	20,00€	56,82€	8,00€	144,82€

QUADRO III

Dados para os Modelos de Regressão

Pais	Custo total por mergulho	Número de mergulhos	Logaritmo do Custo total por mergulho	Logaritmo do Número de mergulhos
Alemanha	142,32€	3	4,958	1,099
Bélgica	123,10€	5	4,746	1,609
Brasil	149,27€	3	4,951	1,099
Dinamarca	183,54€	2	5,168	0,693
Espanha	49,34€	16	3,722	2,773
EUA	184,36€	1	5,173	0
França	63,06€	9	4,008	2,197
Holanda	248,53€	5	5,483	1,609
Luxemburgo	113,62€	2	4,66	0,693
Portugal	49,75€	56	3,732	4,025
Inglaterra	148,69€	11	4,947	2,398
Russia	287,90€	1	5,634	0
Suiça	144,82€	1	4,919	0

Foram estimados quatro regressões cujos resultados vêm apresentados no Quadro IV e representados nos Gráficos da Figura 9.

Dos quatro modelos, aquele que apresenta melhores resultados é o que utiliza a equação potencial e é com base nele que se calcula o excedente do consumidor por mergulho, através da curva de procura (Figura 10). Foram ainda tentados modelos de regressão múltipla considerando o rendimento e variáveis *dummy* que retratassem as tipologias dos

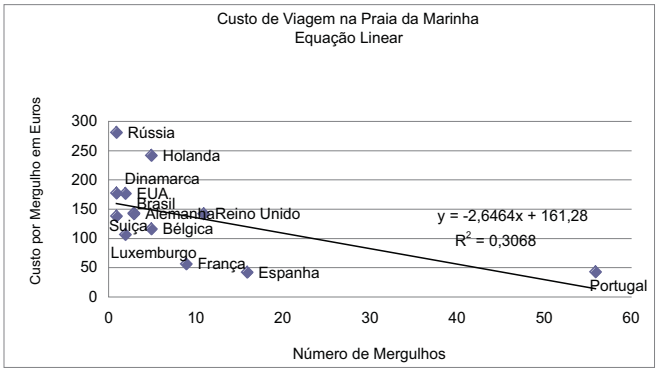
QUADRO IV

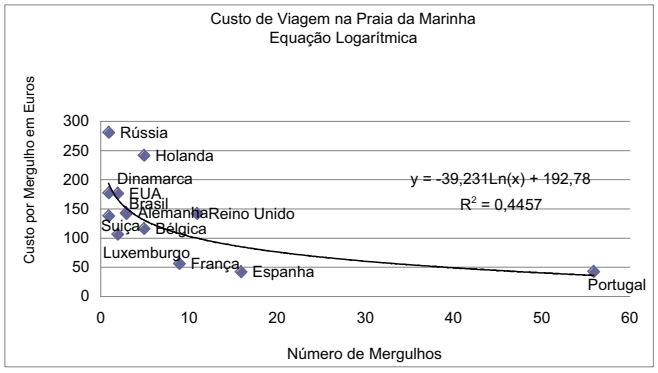
Resultados dos Modelos de Regressão para Explicar o Comportamento dos Mergulhos na Praia da Marinha

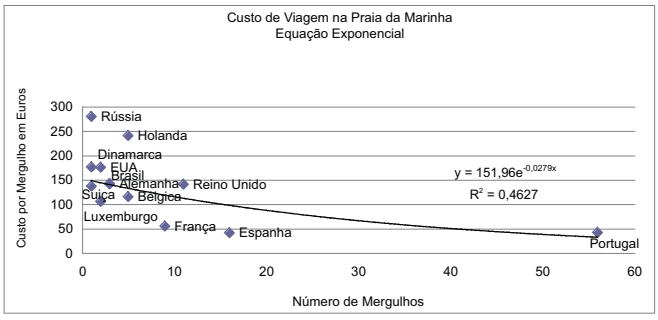
	Modelo Linear	Modelo Exponencial	Modelo Logaritmo	Modelo da Potencia
Custo total por mergulho	Y	Y		
Logaritmo do Custo total por mergulho			Y	Y
Número de mergulhos	X		X	
Logaritmo do Número de mergulhos		X		X
Quadrado de R	0,31	0,46	0,44	0,58
Constante	161,28	5,023	192,78	5,314
Estatística t da Constante	8	32,976	8,033	29,671
Valor de P da Constante	0	0	0	0
Coeficiente da variável independente	-2,646	-0,028	-39,231	-0,384
Estatística t da variável independente	-2,206	-3,078	-2,974	3,903
Valor de P da variável independente	0,05	0,011	0,013	0,002
Exponencial do valor da constante	-	151,96	-	203,33

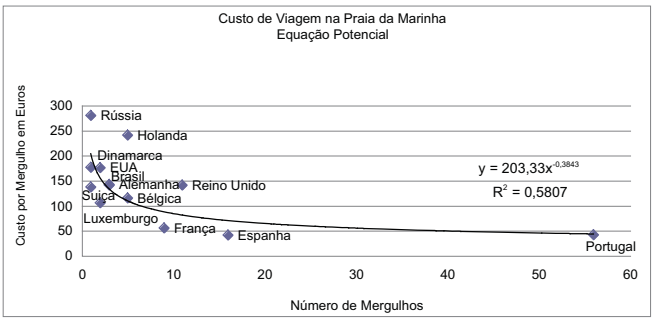
FIGURA 9

Modelos de regressão calculados para analisar o comportamento dos mergulhos na Praia da Marinha









visitantes entre turistas e emigrantes. No primeiro caso os resultados obtidos não foram satisfatórios e no segundo a divisão entre tipo de mergulhadores, sem ter obtido dados explícitos sobre os mesmos, é pouco robusta.

Através do cálculo da área do excedente do consumidor determinou-se que o excedente médio é de 5,0 € por mergulho, o que multiplicado pelo total mergulhos por ano dá 600 € / ano a que corresponde um valor global do recurso de 30000 € admitindo que a taxa de desconto para este tipo de bens é de 2%.

Embora este seja um valor relativamente reduzido, deve considerar-se que se trata do ano experimental de introdução dos roteiros subaquáticos na região algarvia e em Portugal. Assim, muito embora tenha sido efectuado um esforço no sentido da divulgação da actividade, esta só começou a tornar-se óbvia a meio da época balnear. Assim sendo, prevê-se que, em anos futuros, a procura destes roteiros seja significativamente maior, aumentando, assim, o excedente médio calculado.

Assim, se assumirmos uma capacidade de carga do roteiro (correspondente, de acordo com Ruschmann (1990), ao número de turistas que uma área pode acomodar, antes que ocorram impactos negativos no ambiente físico, nas atitudes psicológicas dos turistas, no nível de aceitação social da comunidade receptora e no nível de optimização económica) de 1000 turistas por ano, correspondentes a 400 em Julho, 400 em Agosto e 200 em Setembro, obtém-se uma renda total do recurso de 5000 Euros por ano, o que corresponde um valor total de 250000 Euros.

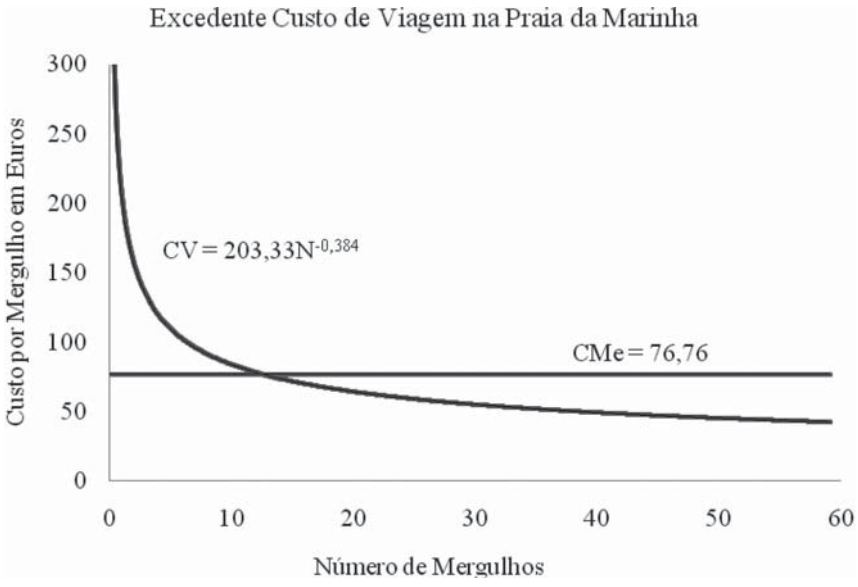
A valorização da utilização dos roteiros implementados em termos monetários implicou, desta forma, uma indicação real do valor do sistema e da importância da sua preservação efectiva do ponto de vista dos gestores, uma vez que se apresenta não apenas a sua valorização ecológica, mas também a económica, essencial para uma gestão coerente e ajustada às diferentes orlas costeiras.

De acordo com Harriot (2002), em sistemas de corais, a capacidade de carga, internacionalmente aceite para mergulho com escafandro, é de cerca de 5000 mergulhadores por ano por local. Na realidade, um valor estimado de mergulhos entre os 5000 e os 6000 mergulhadores por ano por local foi estimado no Mar Vermelho e confirmado para a Austrália por Harriot *et al*. (1997), no Egipto por Hawkins & Roberts (1997), nas Caraíbas e Seicheles por Hawkins *et al.* (1999) e na África do Sul por Schleyer & Tomalin (2000).

A capacidade de carga considerada para o local em estudo teve em consideração o facto de, ao contrário do que acontece nos países supra-citados, o mergulho turístico não acontecer todo o ano, devido às características do local. Assim, apenas foram

FIGURA 10

Representação do Excedente dos Consumidores do Mergulho na Praia da Marinha (através do custo de viagem)



considerados os meses balneares, com apoios de praia, condições atmosféricas e marinhas satisfatórias para efectuar eco-turismo subaquático de forma segura e interessante. Do mesmo modo, deve ter-se em conta o facto de não terem sido encontradas estatísticas oficiais para a capacidade de carga do mergulho livre (em apneia), que implica uma interacção diferente, e menos intrusiva, com o meio.

Em trabalhos posteriores pretende-se estimar o valor de cada um dos três roteiros da Praia da Marinha, explicitar as várias origens de Portugal e de Espanha na busca de uma melhor regressão e, com base nos dados sobre os fundos da Costa do Algarve e da capacidade de carga, extrapolar o valor económico total da Costa do Algarve pelo Método do Custo Viagem.

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Appendix II

Questionnaire used for the face-to-face interviews during the Marinha Beach surveys (Chapters III, IV, V)

Portuguese version

O presente questionário destina-se à avaliação e implementação de roteiros subaquáticos na região algarvia. Todos os dados obtidos são estritamente confidenciais e serão utilizados unicamente no âmbito do presente trabalho.

DATA: ___ / ___ / ___ Recusas: _____ Obs: _____ Maré: _____

1. FÉRIAS

1. Qual o seu país / cidade de origem/tipo _____ €
2. Está de férias? Onde? _____ €
3. Está em que instalação turística? _____ €
4. Quando chegou? _____ €
5. Quanto tempo duram as férias? _____ €
6. Quanto estima gastar no total? _____ €
7. E em actividades náuticas? _____ €

8. Que tipo produtos turísticos algarvios utiliza?

		Especifique
Sol e mar		
Touring (cidades)		
City break		
Turismo de negócios		
Turismo de natureza		
Golf		
Turismo residencial		
Gastronomia e mesa		
Turismo náutico		
Montanha		
Ecoturismo		

9. Que tipo actividades náuticas realiza?

		Qual a praia e a actividade (se aplicável)
Sol e mar		
Deitado ao sol		
Passear na praia		
Apneia		
Escafandro		
Recolha lúdica		
Pesca lúdica de cana		
Caça submarina		
Fotografia		
Outro (surf, nadar…)		

10. Quais as suas motivações para visitar esta praia e fazer estes roteiros?

		Observações
Localização		
Custo do mergulho		
Recomendação de amigos		
Beleza do sítio		
Novo loca para explorar		
Outro		
Outro (surf…)		

11. Ordene as suas preferências em termos de locais de mergulho e apneia?

	Mergulho	Apneia	Observações
Recife natural			
Recife artificial			
Navio afundado			
Naufrágio de barco ou avião			
Sítio arqueológico			
Local conhecido (só por isso)			
Local novo e desconhecido			

2. DESPESAS

12. Quanto gastou, em média, em equipamento de mergulho ao longo da vida

Apneia: _____ €

Mergulho com escafandro: _____ €

13. Quanto estaria disposto a gastar para renovar todo o seu equipamento?

Apneia: _____ €

Mergulho com escafandro: _____ €

14. Quanto estaria disposto a gastar, uma vez na vida, para preservar a biodiversidade marinha algarvia? _____ €

15. Quanto gastou, em média, nesta saída:

	Valor despendido (€)
Viagem:	
Alojamento:	
Restauração:	
Guia de mergulho para acompanhamento nos roteiros:	
Outros:	

3. ECOLOGIA

16. A possibilidade de efectuar turismo de uma forma sustentável, como ecoturismo (com regras pré-estabelecidas), é para si uma preocupação?

SIM ☐ NÂO ☐

17. E ecoturismo subaquático?

SIM ☐ NÂO ☐

18. Se nas restantes praias que frequenta existissem roteiros subaquáticos estabelecidos, detalhadamente descritos faunística, florística e geograficamente, à superfície e subaquaticamente, ao alcance de todos os turistas, efectuava-os?

SIM ☐ NÂO ☐ Não sei ☐

19. Se nos clubes contactados existiam estes roteiros, optou por esses mergulhos?

SIM ☐ NÂO ☐ Não sei ☐

20. Fuma?

SIM ☐ NÂO ☐

21. Alguma vez deitou restos de cigarros para o mar?

SIM ☐ NÂO ☐

22. E outro lixo?

SIM ☐ NÂO ☐

23. Faz ou já fez parte de algum grupo de conservação da natureza?

SIM ☐ NÂO ☐

24.Qual? _____

25. Desde quando?_____

26. No total quanto investiu nesse/s grupo? _____ €

3. ROTEIROS SUBAQUÁTICOS

27. Faz mergulho com escafandro / apneia por recreação ou trabalho? _____

28. Se mergulha por trabalho, qual é a sua actividade? _____

29. Quantas vezes mergulhou de garrafa e apneia nos últimos 5 anos?

Escafandro ☐ Apneia ☐

30. No mergulho ou na apneia recorre sempre a algum clube de mergulho /organização?

Escafandro ☐ Porquê? _____

Apneia ☐ Porquê? _____

31. Qual o seu clube preferencial? _____

32. Porquê? _____

33. Prefere apneia ou mergulho com escafandro?

Escafandro ☐ Apneia ☐

34. Porque efectuou estes roteiros? _____

35. Como tomou conhecimento deles? _____

36. Foi com o operador?

SIM ☐ NÃO ☐ Porquê? _____

37. Quantos guias foram por pessoa? _____

38. Que roteiros fez? _____

39. Porquê? _____

40. Quantas pessoas vieram consigo? _____

41. Classifique as diferentes características (de 1 – péssimo a 5 – excelente)

Característica	Importância	Satisfação	Conservação
Acessibilidades na praia			
Infra-estruturas a deficientes do ponto de partida			
Estacionamento organizado no ponto de partida			
Bar de apoio do ponto de partida			
Apoios de emergência na praia			
Instalações sanitárias do local de apoio			
Outro:			

42. Como classificara o *Briefing* efectuado antes do mergulho

Péssimo ☐ *Mau* ☐ *Aceitável* ☐ *Bom* ☐ *Excelente* ☐

43. O que acrescentaria? _____

44. Quanto tempo durou? _____ minutos

45.Foram distribuídas placas com as espécies a observar?

SIM ☐ NÂO ☐

46. Foram distribuídos *flyers* ou livros com descrição dos roteiros?

SIM ☐ NÂO ☐

47.Considera que ter acesso a esta informação é:

Nada importante ☐ *Pouco importante* ☐ *Importante* ☐ *Muito importante* ☐ *Extremamente importante* ☐

48. Ficou satisfeito com as placas recebidas?

Nada satisfeito ☐ *Pouco satisfeito* ☐ *Satisfeito* ☐ *Muito satisfeito* ☐ *Extremamente satisfeito* ☐

49. Durante o *Briefing* classifique a informação fornecida sobre as questões referidas (classifique entre 1 – nada importante; nada satisfeito a 5 – extremamente satisfeito; extremamente importante)

	Importância	**Satisfação**
BIODIVERSIDADE/FAUNA		
Conservação		
Protecção		
Perigosidade		
ROTEIRO/S		
Roteiro		
Dificuldade		
Interesse		

50. Classifique ao seu mergulho em cada roteiro (1, 2 e 3):

ROTEIRO	**Temp (min.)**	**Prof máx**	**Temp (ºC)**	**Visibi (m)**	**Dificul (1-5)**	**Interesse (1-5)**	**Segurança (1-5)**	**Qualidade (1-5)**
1								
2								
3								

51. Como classificaria o comportamento da equipa de apoio:

Péssimo ☐ *Mau* ☐ *Aceitável* ☐ *Bom* ☐ *Excelente* ☐

52. Voltaria a mergulhar no mesmo local?

SIM ☐ NÂO ☐

53. Porquê? _____

54. Aprendeu algo de novo sobre a biodiversidade local? _____

55. O quê? _____

56. Que espécies viu que consiga identificar ou que lhe tenham despertado a atenção?

_____

57. Mesmo involuntariamente tocou em:

Algas:	SIM		NÃO		Nº vezes	
Animais:	SIM		NÃO		Nº vezes	
Substrato:	SIM		NÃO		Nº vezes	

58. Retirou algo da água? _____

59. Para quê? _____

60. O facto de os roteiros estarem sinalizados na água com placas e bóias a definir as espécies e com os trajectos é importante?

SIM ☐ NÃO ☐

61. Classifique essa importância:

Nada importante ☐ *Pouco importante* ☐ *Importante* ☐ *Muito importante* ☐ *Extremamente importante* ☐

62. Sabe que esta praia está classificada pela MICHELIN como uma das 100 praias mais belas do mundo? _____

63. Tendo esta informação, considera a existência de roteiros com marcação, divulgação, utilização de guias e apoios de praia benéfica ou prejudicial para a preservação da biodiversidade local?

SIM ☐ NÃO ☐

64. Porquê?

_____

_____

65. Como classificaria o mergulho nos seguintes aspectos:

1 – péssimo: 2 – mau; 3 – aceitável; 4 – bom; 5 – excelente

Característica	Roteiro 1	Roteiro 2	Roteiro 3
Definição do roteiro pelo clube			
Geografia da zona			
Paisagem			
Fauna			
Flora			
Espécies emblemáticas			
Acessibilidade			
ROTEIRO NA GENERALIDADE			

66. Qual roteiro gostou mais?_____

67. Porquê? _____

68. Porque gosta de mergulhar com escafandro/ fazer apneia? _____

69. Há quanto tempo mergulha com escafandro? _____ meses / anos

70. Há quanto te faz apneia? _____ meses / anos

71 Que tipo de mergulho faz:

apneia ☐ mergulho com escafandro recreativo ☐ mergulho com escafandro científico ☐ mergulho com escafandro profissional ☐

72. Pertence a algum clube de mergulho ou de actividades náuticas? _____

73. Qual? _____

4. SÓCIO-DEMOGRAFIA

Nome (opcional): _____ Contacto (opcional): _____

Sexo: _____ Idade: _____ Estado civil: _____ Agregado familiar: _____

Escolaridade: _____ Profissão: _____

Rendimento mensal individual bruto:

Nada □	1501€ - 2000€ □	3501€ - 4000€ □
Até 500€ □ Salário mínimo? _____	2001€ - 2500€ □	4001€ - 5000€ □
501€ - 1000€ □	2501€ - 3000€ □	>5000€ □
1001€ - 1500€€ □	3001€ - 3500€ □	> 1200€ □

Muito obrigado pela sua colaboração! O ambiente agradece e nós também!

Appendix III

Questionnaire used for the face-to-face interviews during the Marinha Beach surveys (Chapters III, IV, V)

English version

This survey aims to understand and evaluate the implementation of underwater routes in the Algarve to enhance sustainable underwater tourism. This questionnaire e is confidential and all data will only be used for the purpose of this study.

DATE: ___ / ___ / ___ Refusals: _____ Obs: _____ Tide: _____

1. HOLLIDAYS

1. Country / city of origin? _____ €
2. Are you on holiday? Where? _____ €
3. Where are you staying in? _____ €
4. When did you arrived? _____ €
5. How long is your holiday? _____ €
6. How much do you think you will spend in all? _____ €
7. And in nautical activities? _____ €

8. Which Algarve tourist products will you enjoy/partake?

		Specify the beaches, cities and mountains
Sun and sea		
Touring (cities)		
City break		
Business tourism		
Nature tourism		
Golf		
Residential tourism		
Gastronomic and table		
Nautical tourism		
Mountain		
Ecotourism		

9. Which nautical activities do you take part in?

		Which beach and activity (if applicable)
Sun and sea		
Sun bathing		
Walking on the beach		
Snorkelling		
Diving		
Collecting sea food		
Recreational/sport fishing		
Underwater spear fishing		
Photography		
Other (surfing, swimming…)		

10. What were your motivations for doing these diving routes (paths)?

		Observations
Location		
Dive cost		
Friends' recommendation		
Beauty of the area		
New site to explore		
Other		

11. Put in you a preference order these diving places?

	Dive	Snorkelling	Observations
Natural reef			
Artificial reef			
Ship sunk			
Shipwreck or plain wreck			
Archaeological Site			
Known place (safety)			
Local new and unknown			

2. EXPENDITURES

12. How much have you spent on diving equipment during your lifetime? ´

Snorkelling: _____ €

Scuba dive: _____ €

13. How much are you willing to spend to renew all your equipment?

Snorkelling: _____ €

Scuba dive: _____ €

14. How much would you be willing to spend, once in your life, to conserve Algarve marine biodiversity? _____ €

15. In this dive, how much did you spend in:

	Value (€)
Trip:	
Housing:	
Food:	
Dive guidance for the routes:	
Others:	

3. ECOLOGY

16. Is the possibility of carrying out sustainable tourism, such as ecotourism (with established guidelines and rules), an important consideration for you?

YES ☐ NO ☐

17. What about underwater ecotourism?

YES ☐ NO ☐

18. If the other beaches you go to had established underwater routes, with readily available and detailed information on fauna, flora and geography, would you try them?

YES ☐ NO ☐ Don't know ☐

19. If these routes were available in the diving clubs you contacted, would you opt for these dives?

YES ☐ NO ☐ Don't know ☐

20. Do you smoke?

SIM ☐ NÂO ☐

21. Have you ever thrown a cigarette butt in the sea?

SIM ☐ NÂO ☐

22. And other garbage?

SIM ☐ NÂO ☐

23. Do you integrate (or have integrated) any nature conservation group?

SIM ☐ NÂO ☐

24. Which? _____

25. Since when? _____

26. How much did you invested in it? _____ €

3. UNDERWATER ROUTES

27. Do you scuba dive / snorkel for recreation or work? _____

28. If you dive within a professional activity what is the activity? _____

29. How many times did you dive during the previous 5 years?

Scuba dive ☐ Snorkelling ☐

30. For diving or snorkelling, do you always use a dive club or organisation?

Scuba dive ☐ Why? _____

Snorkelling ☐ Why? _____

31. What is your preferred dive club?

32. Why?

33. Do you prefer snorkelling or scuba diving?

Scuba dive ☐ Snorkelling ☐

34. Why did you choose this/these underwater routes? _____

35. How did you learn about them? _____

36. Did you go with a dive operator/guide?

YES ☐ NO ☐ Why? _____

37. How many people were there per guide? _____

38. Which route(s) did you do? _____

39. Why? _____

40. How many people went with you? _____

41. Classify (from 1 – terrible to 5 – excellent)

Factor	Importance	Satisfaction	Conservation
Access to the beach			
Infrastructures for handicapped people at the starting point			
Parking facilities			
Bar			
Emergency support facilities			
Sanitary facilities (toilets)			
Other:			

42. How would you classify the pre-dive briefing ?

Terrible ☐ *Bad* ☐ *Average* ☐ *Good* ☐ *Excellent* ☐

43.. What would you add? _____

44. How much time did it take? _____ minutes

45. Were boards with species likely to be seen distributed?

SIM ☐ NÂO ☐

46. And flyers?

SIM ☐ NÂO ☐

47. Do you think this information is important?

Not important ☐ *Small importance* ☐ *Important* ☐ *Very important* ☐ *Extremely importance* ☐

48. Are you satisfied with it?

Not satisfied ☐ *Small satisfaction* ☐ *Satisfied* ☐ *Very satisfied* ☐ *Extremely satisfied* ☐

49. Classify the information provided on the following items during the briefing (from 1 – not important; not satisfied to 5 – extremely important; extremely satisfied)

	Importance	Satisfaction
BIODIVERSITY/FAUNA		
Conservation		
Protection		
Danger		
ROUTE(S)		
Route		
Difficulty		
Interest		

50. Classify your dive along each route (1, 2 e 3):

ROUTE	Temp (min.)	Depth Max.	Temp (ºC)	Visibility (m)	Difficulty (1-5)	Interest (1-5)	Safety (1-5)	Quality (1-5)
1								
2								
3								

51. How would you classify the behaviour of the support team?

Terrible ☐ *Bad* ☐ *Average* ☐ *Good* ☐ *Excellent* ☐

52. Would you return to dive in the same place?

YES ☐ NO ☐

53. Why? _____

54. Did you learn anything new about the local biodiversity? _____

55. What? _____

56. What species were you able to identify or that caught your attention? _____

57. During the dive (accidentally or not) did you touch in:

Algae:	YES		NO		Nº	
Animals:	YES		NO		Nº	
Substrate:	YES		NO		Nº	

58. Did you take anything you found during the dive? _____

59. Why/for what purpose? _____

60. Do you think that the sign posts and buoys indicating the path and the species are important?

YES ☐ NO ☐

61. Classify that importance:

Not important ☐ *Small importance* ☐ *Important* ☐ *Very important* ☐ *Extremely importance* ☐

62. Did you know that this beach is classified by MICHELIN as one of the best 500 in the world? _____

63. Knowing this, did you think that the existence of advertised underwater routes, with signs, guides and beach support facilities is beneficial or harmful for local biodiversity?

YES ☐ NO ☐

64. Why? _____

_____

65. How would you classify the dive in terms of:

1 – terrible: 2 – bad; 3 – acceptable; 4 – good; 5 – excellent

Issue	Route 1	Route 2	Route 3
Route selected by the club			
Geography of the area			
Landscape			
Fauna			
Flora			
Charismatic or unique species			
Accessibility			
ROUTE IN GENERAL			

66. Which route did you like most? _____

67. Why? _____

68. Why do you like to scuba dive / snorkel? _____

69. For how long have you been scuba diving _____ monhs / years

70. For how long have you been snorkelling? _____ monhs / years

71. What kind of diving do you do? Snorkel □ recreational scuba dive □ scientific scuba dive □ professional scuba dive □

72. Do you belong to a dive club or a club for other nautical activities _____

73. Which? _____

5. SOCIO-DEMOGRAPHY

Name (optional): _____ Gender: _____ Age: _____

Civil status (married, single): _____ Profession: _____

Family size: _____ Educational level: _____ Contact (optional): _____

Gross individual monthly income:

None □	2501€ - 3000€ □
Less than 500€ □ Minimum salary? _____	3001€ - 3500€ □
501€ - 1000€ □	3501€ - 4000€ □
1001€ - 1500€€ □	4001€ - 5000€ □
1501€ - 2000€ □	>5000€ □
2001€ - 2500€ □	> 1200€ □

Thank you very much for your collaboration! The environment appreciates it and so do we!!

Appendix IV

Questionnaire used for the face-to-face interviews during the scuba dive surveys (Chapters VI, VII)

Portuguese version

O presente questionário destina-se à avaliação e implementação de roteiros subaquáticos na região algarvia. Todos os dados obtidos são estritamente confidenciais e serão utilizados unicamente no âmbito do presente trabalho.

DATA: ___ / ___ / ___ **Local de mergulho: _____**

1. GERAL

1. Está em férias? SIM ☐ NÃO ☐

2. Onde está alojado? _____

3. Dias de férias: _____ dias

4. Quais as suas despesas nas férias:

	Valor despendido (€)
Viagem:	
Alojamento:	
Restauração:	
Outros	

5. Quantos mergulhadores hoje vieram consigo? _____ pessoas

6. Hora do mergulho (hora de saída e retorno ao local de embarque): ___h___; ___h___

7. Quanto gastou, em média, nesta saída:

	Valor despendido (€)
Viagem:	
Alojamento:	
Restauração:	
Mergulho:	
Outros:	

8. Quanto gastou, em média, em equipamento de mergulho ao longo da vida:

Escafandro: _____ € Apneia: _____ €

9. Quanto estaria disposto a gastar para renovar todo o seu equipamento?

Escafandro: _____ € Apneia: _____ €

10. Que tipo actividades turísticas realiza?

a. Sol e mar □
i. Sem actividade □
ii. Passear na praia □
iii. Apneia □
iv. Escafandro □
v. Recolha lúdica □
vi. Pesca lúdica de cana □
vii. Caça submarina □
viii. Fotografia □

b. Montanha □
c. Urbano □
d. City-break □
e. Turismo de negócios □
f. Turismo de natureza □
g. Eco-turismo □
h. Gastronomia □
i. Golf □
j. Turismo residêncial □
k. Turismo náutico □

11. Quais as suas motivações para fazer esta actividade?

	X	Observações
Localização		
Custo do mergulho		
Recomendação de amigos		
Beleza do sítio		
Novo loca para explorar		
Trabalho		
Outro		

12. Faz mergulho por recreação ou trabalho? _____

13. Quantas vezes mergulhou nos últimos 5 anos:

- Com escafandro autónomo _____ vezes

- Em apneia _____ vezes

14. Se mergulha profissionalmente, quais são as suas funções? _____

15. Quanto aufere com a actividade de mergulho? _____

16. Nas seguintes modalidades de mergulho recorre sempre a algum clube de mergulho?

Apneia: SIM [ ] NÂO [ ] Porquê? _____

Escafandro: SIM [ ] NÂO [ ] Porquê? _____

17. Qual o seu clube preferencial? _____

18. Porquê? _____

_____

19. Quais os serviços normalmente solicitados?

_____

_____

_____

20. Refira 3 clubes com que mergulhou que o marcaram / cidade? Classifique-os

Clube	Péssimo	Mau	Aceitável	Bom	Excelente

21. Ordene as suas preferências em termos de locais de mergulho e apneia?

	Mergulho	Apneia	Observações
Recife natural			
Recife artificial			
Navio afundado			
Naufrágio			
Sítio arqueológico			
Local conhecido (só por isso)			
Local novo e desconhecido			

22. Se nas praias que frequentou existissem em roteiros subaquáticos estabelecidos, detalhadamente descritos faunística, florística e geograficamente, ao alcance de todos os turistas, efectuava-os? (ex: Praia da Marinha)

SIM ☐ NÂO ☐ Não sei ☐ Porquê? _____

23. Se nos clubes contactados existiam estes roteiros, optou por esses mergulhos?

SIM ☐ NÂO ☐ Não sei ☐ Porquê? _____

24. A possibilidade de efectuar turismo de uma forma sustentável, como eco-turismo (com regras pré-estabelecidas), é para si uma preocupação?

SIM ☐ NÂO ☐

25. E ecoturismo subaquático?

SIM ☐ NÂO ☐

26. Faz ou já fez parte de algum grupo de conservação da natureza? _____

27. Qual? _____

28. No total quanto investiu nesse/s grupo? _____ €

29. Quanto estaria disposto a gastar, uma vez na vida, para preservar a biodiversidade marinha algarvia?_____ €

30. Fuma?

SIM ☐ NÂO ☐

31. Alguma vez deitou restos de cigarros para o mar?

SIM ☐ NÂO ☐

32. E outro lixo?

SIM ☐ NÂO ☐

33. Prefere apneia ou mergulho com escafandro?

Escafandro ☐ Apneia ☐

34. Porque seleccionou esta saída? _____

35. Nesta saída caracterize (entre 1 e 5: 1 – nada importante; nada satisfeito; nada conservado a 5 – extremamente importante; extremamente satisfeito; extremamente conservado)

Característica	Importância	Satisfação	Conservação
Acessibilidades na marina (Faro, Armação de Pêra)			
Infra-estruturas a deficientes do ponto de partida			
Estacionamento organizado no ponto de partida			
Bar de apoio do ponto de partida			
Apoios de emergência na marina / praia de partida			
Material de mergulho do clube			
Material de emergência a bordo			
Instalações gerais do clube de mergulho			
Instalações sanitárias do local de apoio			
Material de emergência da zona (câmara hiperbárica)			

36. Como classificara o *Briefing* efectuado antes do mergulho?

Péssimo ☐ Mau ☐ Aceitável ☐ Bom ☐ Excelente ☐

37. O que acrescentaria? _____

38. Quanto tempo durou? _____ minutos

39. Foram distribuídas placas com as espécies a observar?

SIM ☐ NÂO ☐

40. Considera que ter acesso a estas placas é:

Nada importante ☐ Pouco importante ☐ Importante ☐ Muito importante ☐ Extremamente importante ☐

41. Ficou satisfeito com as placas recebidas?

Nada satisfeito □ Pouco satisfeito □ Satisfeito □ Muito satisfeito □ Extremamente satisfeito □

42. Informações fornecidas no *briefing* (classifique entre 1 – nada importante; nada satisfeito a 5 – extremamente satisfeito; extremamente importante)

	Importância	Satisfação	Observações
Conservação			
Protecção			
Perigosidade			
Roteiro			
Dificuldade			
Interesse			

2. ROTEIRO SUBAQUÁTICO

43. Já tinha mergulhado neste *site* sem roteiro implementado?

SIM ☐ NÂO ☐

44. Prefere com ou sem roteiro implementado?

Com roteiro ☐ Sem roteiro ☐

45. Porquê?

---

46. Na sua opinião quais são as vantagens e desvantagens da existência das placas interpretativas?

	Vantagens	Desvantagens	Observações

47. Pensa que em termos de conservação de biodiversidade a existência de placas é benéfica? _____ (classifique entre 1 – nada importante a 5 – extremamente importante)

48. Pensa que em termos de estruturas de interesse (ex: arqueológicas) a existência de placas é benéfica? _____ (classifique entre 1 – nada importante a 5 – extremamente importante)

49. Porquê _____

50. Classifique de 1 (péssimo) a 5 (excelente) os seguintes aspectos:

Placas interpretativas	Nº	Porquê?
Informação das placas		
Grafismo		
Correspondência com o habitat		
Utilidade para o mergulhador		
Utilidade para a preservação da biodiversidade		
Utilidade para a preservação de estruturas (ex: bombardeiro)		
Visibilidade		
Outros:		

51. Viu as espécies que estavam nas placas?

SIM ☐ NÃO ☐

52. Consegue identificar alguma? _____

53. Onde identifica dificuldades relativamente às placas interpretativas?

Placas interpretativas	X	Porquê?
Informação das placas		
Grafismo		
Correspondência com o habitat		
Utilidade para o mergulhador		
Utilidade para a preservação da biodiversidade		
Utilidade para a preservação de estruturas (ex: bombardeiro)		
Visibilidade		
Outros:		

54. Prefere as placas fixas no fundo ou para levar no mergulho?

Fixas ☐ Móveis ☐

55. Porquê?

_____

_____

56. Identifique locais de mergulho algarvios onde considera que este roteiro faria sentido:

_____

_____

57. Classifique ao seu mergulho:

Temp (min.)	Prof. máx	Temp (ºC)	Visibi (m)	Dificul (1-5)	Interesse (1-5)	Segurança (1-5)	Qualidade (1-5)

58. Como classificaria o comportamento da equipa do clube no mergulho?

Péssimo □ Mau □ Aceitável □ Bom □ Excelente □

59. Voltaria a mergulhar no mesmo local?

SIM ☐ NÃO ☐

60. Porquê? _____

61. Voltaria a mergulhar no mesmo com o mesmo clube?

SIM ☐ NÃO ☐

62. Porquê? _____

63. Aprendeu algo de novo sobre a biodiversidade local?

SIM ☐ NÃO ☐

64. O quê? _____

65. Que espécies viu que consiga identificar ou que lhe tenham despertado a atenção?

_____

_____

66. Mesmo involuntariamente tocou em:

Algas:	SIM	☐	SIM	☐	Nº vezes	☐
Animais:	SIM	☐	SIM	☐	Nº vezes	☐
Substrato:	SIM	☐	SIM	☐	Nº vezes	☐
B24	SIM	☐	SIM	☐	Nº vezes	☐

67. Teve cuidado no controle da flutuabilidade?

SIM ☐ NÂO ☐ Porquê? _____

68. Como classificaria o mergulho nos seguintes aspectos (de 1 – péssimo a 5 – excelente)

Característica	1	2	3	4	5
Definição do trajecto pelo clube					
Geografia da zona					
Paisagem					
Fauna					
Flora					
Espécies emblemáticas					
Acessibilidade (viagem de barco)					
ROTEIRO NA GENERALIDADE					

69. Quanto pagou pelo mergulho? _____ €

70. O que inclui? _____

71. Considera um preço justo?

SIM ☐ NÂO ☐

72. Porquê? _____

73. Considera que o mergulho vale mais por ter a sinalização?

SIM ☐ NÂO ☐

74. Quanto estaria disposto a pagar mais para usufruir da sinalização apresentada? _____ €

75. Porque gosta de mergulhar?

_____

76. Há quanto tempo mergulha? _____ anos / meses

77. Que tipo de mergulho faz:

Recreativo ☐ Científico ☐ Trabalho ☐

78. Que habilitações de mergulho têm?

_____

79. Pertence a algum clube de mergulho ou de actividades náuticas?

SIM ☐ NÂO ☐ Qual? _____

3. SOCIO-DEMOGRAFIA

Nome (opcional): _____

Qual o seu país / cidade de origem: _____

Sexo: _____ Idade: _____ Contacto (opcional): _____

Estado civil: _____

Agregado familiar: _____

Escolaridade: _____

Profissão: _____

Rendimento mensal individual bruto:

Nada □	2501€ - 3000€ □
Até 500€ □ Salário mínimo? _____	3001€ - 3500€ □
501€ - 1000€ □	3501€ - 4000€ □
1001€ - 1500€€ □	4001€ - 5000€ □
1501€ - 2000€ □	>5000€ □
2001€ - 2500€ □	> 1200€ □

Obrigado pela sua colaboração!

OUTROS REGISTOS

Recusas:

Observações:

Appendix V

Questionnaire used for the face-to-face interviews during the scuba dive surveys (Chapters VI, VII)

English version

This survey aims to understand and evaluate the implementation of underwater routes in the Algarve to enhance sustainable underwater tourism. This questionnaire e is confidential and all data will only be used for the purpose of this study.

DATE: ___ / ___ / ___ **Dive site: _____**

1. GENERAL INFORMATION

1. Are you on holidays?

YES ☐ NO ☐

2. Where are you staying?

_____

3. Number of days: _____

4. How much did you spend in:

	Value (€)
Trip:	
Housing:	
Food:	
Others	

5. How many divers came with you today? _____ divers

6. At what hour did boarded and when did you return ___h___; ___h___

7. In this dive, how much did you spend in:

	Value (€)
Trip:	
Housing:	
Food:	
Dive:	
Others:	

8. Overall, how much did you spend with your diving equipment?

Scuba dive: _____ € Snorkelling: _____ €

9. How much would be willing to spend to renovate all your equipment?

Scuba dive: _____ € Snorkelling: _____ €

10. Select the touristic activities you practice:

a. Sun and sea □
i. Just laying at the beach □
ii. Walking in the beach □
iii. Snorkelling □
iv. Scuba dive □
v. Collecting shellfish □
vi. Recreational angler fishing □
vii. Spearfishing □
viii. Photography □
b. Mountain visit □
c. Urban touring □
d. City-break □
e. Business tourism □
f. Nature tourism □
g. Ecotourism □
h. Gastronomy □
i. Golf □
j. Residential tourism □
k. Nautical tourism □

11. Select the motivations that drove you to do this dive?

	X	Observations
Site		
Dive cost		
Friends recommendation		
Beauty of the site		
New place to explore		
Work		
Other		

12. Do you do recreational dive or professional dive? _____

13. How many times have you dived during the last 5 years:

- Scuba dive: _____ times

- Snorkelling: _____ times

14. If you dive professionally what is your occupation? _____

15. What is your monthly income from the diving activity? _____

16. Do you always use a diving club assistance while scuba diving or snorkelling?

Snorkelling: YES ☐ NO ☐ Why? _____

Scuba dive: YES ☐ NO ☐ Why? _____

17. Name your favourite dive club: _____

18. Why is that? _____

_____

19. What are the services you usually use?

_____

_____

_____

20. Define and classify three dive clubs that you can remember:

Club	Lousy	Bad	Acceptable	Good	Excellent

21. Sort your preferences in terms of dive sites while scuba diving and snorkelling:

	Scuba dive	Snorkelling	Observations
Natural reef			
Artificial reef			
Sunk boat (on purpose)			
Sunk boat or airplane			
Archaeological site			
Known site			
Unknown site			

22. If these underwater routes were available in beaches you usually go to, would you engage in this activity? (e.g. Marinha Beach)

YES ☐ NO ☐ I don't know ☐ Why? _____

23. If these underwater routes were available in other dive clubs would you chose these dives?

YES ☐ NO ☐ I don't know ☐ Why? _____

24. Is the possibility of practicing ecotourism a concern for you?

YES ☐ NO ☐

25. What about practicing underwater ecotourism?

YES ☐ NO ☐

26. Have you ever been involved in nature conservation groups? _____

27. Which one? _____

28. How much money did you spend in it? _____ €

29. Would you be willing to contribute financially (a one off value) to support Algarve' biodiversity conservation projects? _____ €

30. Do you smoke?

YES ☐ NO ☐

31. Have you ever throw remains of cigarettes to the sea?

YES ☐ NO ☐

32. What about other garbage?

YES ☐ NO ☐

33. Do you prefer snorkelling or scuba diving?

Scuba diving ☐ Snorkelling ☐

34. Why did you select this dive? _____

35. Grade the following features (from 1 to 5: 1 - not important; not satisfies; not preserved to 5 - extremely important; extremely satisfied; extremely preserved)

Feature	Importance	Satisfaction	Preservation
Marina access (Faro, Armação de Pêra)			
Infrastructures for handicapped people			
Parking			
Support bar			
Emergency facilities			
Club diving equipment			
On board emergency equipment			
General dive club facilities			
Sanitary facilities (toilets)			
Emergency equipment in the area (hyperbaric chamber)			

36. How would you rate the dive briefing?

Lousy ☐ Bad ☐ Acceptable ☐ Good ☐ Excellent ☐

37. What would you add? _____

38. How much time did the briefing last? _____ minutes

39. Did you receive interpretative slates with pictures of species likely to be seen during the dive?

YES ☐ NO ☐

40. Do you think that these slates are:

Not important ☐ Of small importance ☐ important ☐ Very important ☐ Extremely important ☐

41. Were you satisfied with the slates received?

Not satisfied □ Small satisfaction □ Satisfied □ Very satisfied □ Extremely satisfied □

42. Classify the information given during the briefing(from 1 – not important; not satisfied to 5 – extremely important ; extremely satisfied)

	Importance	Satisfaction	Observation
Conservation			
Protection			
Dangers			
Route			
Difficulties			
Interests			

2. UNDERWATER ROUTE

43. Have you ever dived in this site?

YES ☐ NO ☐

44. Do you prefer this dive with the underwater route implemented or without it?

With route ☐ Without route ☐

45. Why?

_____

46. What are the advantages and disadvantages of underwater routes (underwater identification slates)?

	Advantages	Disadvantages	Observations

47. Do you think that this route can help the preservation of underwater biodiversity (from 1 – definitely no; to 5 – clearly yes)

48. Do you think that this route can help the preservation of interesting structures (like the bomber)? _____ (from 1 – definitely no; to 5 – clearly yes)

49. Why? _____

50. Classify from 1 (lousy) to 5 (excellent) the following aspects of the underwater slates:

Interpretative slates	Nº	Why?
Information		
Design		
Match to the habitat		
Diversity preservations' utility		
Biodiversity conservations' utility		
Bomber conservations' utility		
Slates visibility		
Other:		

51. Did you see any of the species illustrated on the slates?

YES ☐ NO ☐

52. Can you name one? _____

53. While reading the slates underwater where do you identify difficulties?

Interpretative slates	X	Why?
Information		
Design		
Match to the habitat		
Diversity preservations' utility		
Biodiversity conservations' utility		
Bomber conservations' utility		
Slates visibility		
Other:		

54. Would you prefer the slates available to carry with you during the dive or to read in the spot along the route?

In the route ☐ To carry ☐

55. Why?

_____

_____

56. Can you identify other dive sites in the Algarve that would benefit from having an underwater route: _____

_____

57. Describe and classify the following aspects of your dive (from 1 – lousy tp 5 – excellent):

Duration (min.)	Max. Depth.	Temp (ºC)	Visibility (m)	Dificul (1-5)	Interess (1-5)	Security (1-5)	Quality (1-5)

58. How would you classify the behavior of the club diving team?

Lousy □ Bad □ Acceptable□ Good □ Excellent □

59. Would you dive again in this site?

YES ☐ NO ☐

60. Why? _____

61. Would you dive again with this diving club?

YES ☐ NO ☐

62. Why? _____

63. Did you learn anything new about local biodiversity?

YES ☐ NO ☐

64. Can you give an example? _____

65. Can you identify any marine species that you saw?

_____

_____

66. Even if not intentionally did you:

Algae:	YES	☐	NO	☐	Nº	☐
Animals:	YES	☐	NO	☐	Nº	☐
Substrate:	YES	☐	NO	☐	Nº	☐
Bomber	YES	☐	NO	☐	Nº	☐

67. Did you mind your floatability?

YES ☐ NO ☐ Why? _____

68. How would you classify the following features of your dive (from 1 – lousy tp 5 – excellent):

Feature	1	2	3	4	5
Trail defined					
Topography of the area					
Landscape					
Fauna					
Flora					
Charismatic or unique species					
Accessibility (boat trip)					
ROUTE IN GENERAL					

69. How much did you pay for your dive? _____ €

70. What did it include? _____

71. Is it a fair price?

YES ☐ NO ☐

72. Why? _____

73. Is the dive more valuable because it has an underwater route?

YES ☐ NO ☐

74. How much would you be willing to pay extra to see this route? _____ €

75. Why do you enjoy diving?

_____

76. How long have you been diving? _____ years / months

77. What type of scuba diving do you practice:

Recreational ☐ Scientific ☐ Work ☐

78. What scuba diving course/s do you have?

_____

79. Do you belong to any scuba diving club?

YES ☐ NO ☐ Which? _____

3. SOCIO-DEMOGRAPHY

Name (optional): _____

Country / city of origin _____

Gender: _____

Age: _____

Civil status: _____ Family size: _____

Formal education: _____

Occupation: _____

Mensal individual income:

Nothing □	2501€ - 3000€ □
To 500€ □ Minimum salary? _____	3001€ - 3500€ □
501€ - 1000€ □	3501€ - 4000€ □
1001€ - 1500€€ □	4001€ - 5000€ □
1501€ - 2000€ □	>5000€ □
2001€ - 2500€ □	> 1200€ □

Thank you for your cooperation!

OTHER OBSERVATIONS

Refusals:

Observations: