

BLUEMED

Activity 3.4

Policy studies, consultation and recommendations

Deliverable 3.4.4

Guidelines for the conservation of the marine ecosystem and
biodiversity

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Abbreviations

DP: Diving Parks

FTE: Full-time Equivalent

ICCROM: International Centre for the Study of the Preservation and Restoration of Cultural Property

ICOM: International Council of Museums

ICOMOS: International Council on Monuments and Sites

INTERPOL: International Police

ISCR: Istituto Superiore per la Conservazione ed il Restauro

JMD: Joint Ministerial Decision

LAC: Limits of Acceptable Change

MIBACT: Ministry of Cultural Heritage and Activities and Tourism of Italy

MPA: Marine Protected Area

SAC: Site of Community Importance

SPA: Special Protection Area

UAS: Underwater Archaeological Site

UCH: Underwater Cultural Heritage

UCNH: Underwater Cultural and Natural Heritage

UM: Underwater Museums

UNESCO: United Nations Educational, Scientific and Cultural Organization

UNIDROIT: International Institute for the Unification of Private Law (French: Institut international pour l'unification du droit privé).

Deliverable 3.4.4 Guidelines for the conservation of the marine ecosystem and biodiversity

Introduction

Underwater Cultural Heritage (UCH) is considered one of the key factors in unveiling the details that shaped the development of human civilisation. Through the preservation and scientific research on the submerged prehistoric sites, shipwrecks and sunken cities, we can learn a lot about the cultural exchanges, trade relations and influences of the past. Additionally, information regarding the local life of those days, the religious ceremonies and sacrifices the people made in the past can help us understand their way of life (UNESCO, 2013).

As mentioned in the report of UNESCO (2013) on the benefits gained for sustainable growth and development, from protecting the UCH, the link between culture and tourism is tight and inexorable. Apart from the great scientific interest, the UCH sites offer various long-term opportunities for cultural enrichment, recreational tourism and sustainable development. Year by year, the reported public interest on visiting UCH sites is increasing, since according to a recent study, more than 37% of global tourism was characterised as culturally motivated.

In general, the public interest towards diving tourism in areas of high ecological and archaeological importance has been increasing (Zainal Abidin and Mohamed, 2014). Diving tourism is now considered a source of great financial income to a region, as well as a critical component of funding towards the successful conservation of many national parks, marine reserves and Marine Protected Areas in general (Carbone *et al.*, 2005). Also, access to UCH sites, offer visitors the opportunity to learn and appreciate up-close the underwater cultural artefacts, in their original location on the seabed, and can significantly contribute towards the cultural public awareness for the preservation of those sites. Additionally, through the careful cultural and touristic exploitation of those sites, the economic benefits gained can sometimes outbid the financial return of the land-based museums.

Although such benefits are important, the UNESCO 2001 Convention emphasizes that if the open accessibility to an UCH site is threatening in any way the integrity and preservation of those sites, then it should not be permitted. However, according to Carbone *et al.* (2005) the areas that attract the interest of visitors are usually the ones which are the most vulnerable. Coral reefs are considered one of the most vulnerable marine ecosystems in the world, and information regarding the environmental impacts caused by diving tourism usually focuses on them. As mentioned in the report of the United Nations and of the World Tourism Organization, many areas with coral reefs have been recorded worldwide to have serious habitat loss and reef destruction, linked to diving operations (Carbone *et al.*, 2005).

According to a number of bibliographical sources ((Milazzo *et al.*, 2002, Di Franco *et al.*, 2009) the majority of the relevant studies focus in the investigation of tourism-related environmental impacts on tropical systems, mainly in coral reefs. Subsequently they note that information regarding the effects of recreational activities on temperate subtidal habitats like photophilic algae, encrusting fauna and flora etc. is limited, particularly those focusing in the Mediterranean. According to Milazzo *et al.* (2002), this can be explained by the relatively recent creation of Marine Protected Sites, compared to those created in the tropical areas, where the understanding of the anthropogenic impact from recreational diving activities to the marine environment is better recognized and considered. Additionally, they add that the present limited knowledge on the biology and ecology of most Mediterranean marine organisms is an additional constraint in detecting the consequences of visitor frequentation in the marine habitats.

As mentioned in the report of OCEANA (2007) regarding the corals of the Mediterranean, sites which are characterised as popular for scuba diving are often correlated with an increased natural mortality of the corals. Specifically, the natural mortality rate of gorgonians is increased by three-fold by damaging linked to scuba diving. A significant number of gorgonians and other large anthozoans have been found ripped out by divers, or severely damaged by the anchoring of vessels. As reported, some marine protected areas of the Mediterranean, like the Medas Islands in Spain, or Port Cros in France have been significantly affected by the

excessive use of tourism diving practices and anchoring in the vulnerable zones (OCEANA, 2007).

According to Di Franco *et al.* (2009), coralligenous and pre-coralligenous communities in the Mediterranean Sea are characterized by the presence of calcareous benthic organisms which are found in shaded environments, and for this reason are considered highly vulnerable to the impacts of scuba diving. However, as they note, there are currently few studies focusing specifically on the environmental effects on such habitats, with even less information available on other subtidal habitats. As addressed in the study of Milazzo *et al.* (2002), coralligenous assemblages in the Mediterranean (e.g. *Paramuricea clavata*, *Eunicella spp.*, *Lophogorgia ceratophyta*, *Pentapora fascialis*) can be significantly affected by boat anchoring and by scuba diving activities. Seagrass beds, like the *Posidonia oceanica* and *Cymodocea nodosa* meadows, as well as the infralittoral algal assemblages have been found to be mainly affected by anchoring (Milazzo *et al.*, 2002). Scuba diving has been related to the impacts caused on the sciaphilous assemblages of marine caves, whereas trampling has been reported to be responsible for the destruction on rocky lower and upper midlittoral communities as well as on Vermetid reefs.

The lack of measures taken towards the protection of the reefs and other vulnerable marine ecosystems is considered the most important reason behind bad management and conservation practices. This has been the case of the Malaysian islands of Sipadan and Perhentian, where the limited measures taken towards the protection of the reefs and the poorly planned resort and tourism developments has resulted in severe damaging of the coral reefs and of the cultural heritage sites (UNESCO, 2013). Additionally, the increased number of vessels congested in such an area of high natural and archaeological value, linked to the increased on-site anchoring, as well as the “souvenir” hunting and pillaging practices are just some of the impacts caused by diving operations.

When no proper management measures and controls are implemented in an area of high ecological and archaeological importance, then unplanned tourism growth can result to an important environmental and cultural degradation, which in the end could destabilize the

longstanding tourism growth. For this reason, in order to ensure that people's ability to visit those sites would not jeopardise the efforts towards their protection and preservation, specific management and preservation measures are usually taken and enforced. Although emphasis is given in the protection of the archaeological artefacts on those sites, limited studies relate this to the subsequent preservation mechanisms implemented for the preservation of the marine environment and vice versa. As is documented in the UNESCO (2013) report, research on the conclusive impacts caused by diving tourism on the Underwater Cultural and Natural Heritage (UCNH) sites has been limited. Apart from this, there is currently inadequate knowledge regarding the impacts caused on the marine environment by the activities linked to underwater archaeological research.

Through deliverable D3.4.4, information regarding the effects of diving tourism and of the overall operation of Underwater Museums (UM) and Diving Parks (DP), on the marine environment will be reported. As mentioned above, taking into consideration the limited knowledge on tourism-related effects in the Mediterranean Sea, information was collected from various studies, in a worldwide spectrum. Additionally, since the majority of studies were focusing on the impacts on coral reefs, information regarding the activities which can affect such habitats, or guidelines towards their protection and conservation was collected from such studies and could be extrapolated to other similarly vulnerable marine ecosystems.

As mentioned above data regarding the specific activities that might negatively affect the marine environment will be documented as well. Taking the aforementioned points into consideration, it is essential to clarify that in this deliverable focus will be given only on the direct and indirect effects related to the operation of Diving Parks, Underwater Museums and diving tourism in general. Information regarding other anthropogenic effects, such as ocean acidification, marine pollution etc. will not be presented. Similarly, information regarding the effects of marine life to the underwater archaeological artefacts such as bioerosion will not be given as well, since the major objective of this deliverable is the investigation of factors which have been reported to affect the marine environment and the preparation of protection and conservation guidelines related to this.

This will be followed by a collection of information regarding the protection and preservation mechanisms which are either implemented or suggested to be implemented in UCNH sites. Regarding this, as is mentioned in the UNESCO (2013) report, some of the conclusions drawn from studies that focus on the effects from the operation of UM and DP on the archaeological artefacts could be implemented for the subsequent preservation of the marine environment and vice versa. For this reason, a more holistic approach will be followed in this deliverable, through the collection of information regarding the preservation guidelines implemented for the protection of both the underwater cultural heritage and the marine environment.

Deliverable's objectives

Through Activity 3.4, a study on the existing strategies, action plans and protocols regarding the preservation of Underwater Cultural and Natural Heritage sites will be developed, taking into consideration the information included in D3.1.1, D3.2.1 and D3.3.1. The information will include data on the protection and preservation mechanisms followed before, during, and after the field surveys, data collection, impact analysis processes etc. The produced guidelines will act as recommendations to the national/regional authorities, in order to achieve sustainable and responsible tourism development, with the valorisation of underwater natural and cultural heritage.

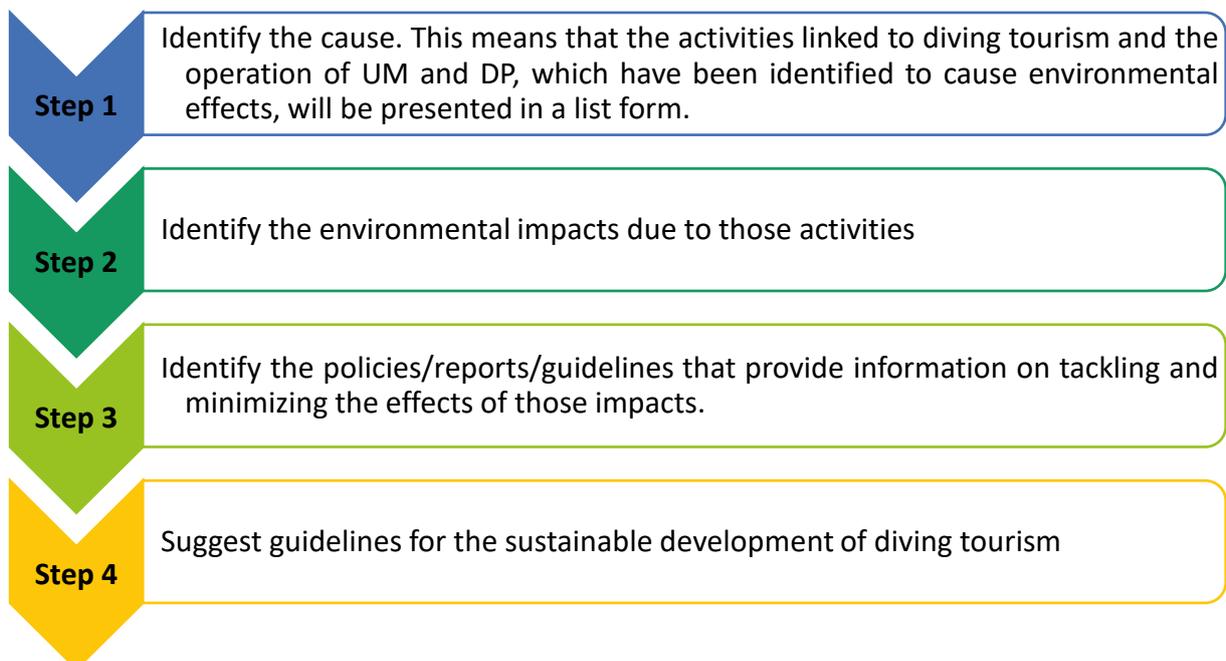
Deliverable D3.4.4 specifically aims to develop a report on guidelines for the protection of the marine ecosystem and marine biodiversity, with the purpose of primarily tackling and minimising the impacts on marine species and habitats, due to the operation of the underwater museums and diving parks. However, as was mentioned in the introduction, specific protection and preservation mechanisms currently applied for the protection of the underwater archaeological artefacts, could be also applied for the protection of the marine environment and vice versa. For this reason, a more holistic approach will be followed, taking into consideration the preparation of a set of guidelines for the overall protection of these important, yet fragile sites.

Methodology

The 4-step approach

The development of D3.4.4 will be based on the following 4-step methodology, which will contribute towards the holistic and conclusive collection of knowledge relevant to the environmental effects, caused by the operation of UM and DP, and diving tourism in general, as well as the guidelines towards the successful protection and preservation of UCNH sites.

Information regarding the activities taking place in the Underwater Museums and Diving Parks, which have a high impact risk on the marine species and habitats will primarily be given in a list form. Subsequent data regarding each activity's possible effects on the marine environment will be also given under each activity. Additionally, information on the measures and guidelines that can be followed for protection and management purposes, in order to tackle and decrease these anthropogenic effects of diving tourism, will be listed as well. These guidelines will be literature-based, following certain policies and reports that suggest ways in minimizing those impacts.



In order to ensure coherence within text, each activity will be developed separately with information primarily given in its effects (positive and negative effects). The information regarding the guidelines that should be followed will be provided as well, which are literature-based.

Effects due to the operation of DP, UM and diving tourism

Positive effects

As was briefly mentioned in the introduction, the operation of Diving Parks, Underwater Museums and the promotion of activities linked to diving tourism can result in important positive socio-economic benefits (UNESCO, 2013). According to Barker and Roberts (2004), the economic benefits gained through the payment of entry fees in a marine park, can contribute significantly towards the overall costs needed for the area's management and protection. However, they also mentioned that this benefitted system can be inefficient, when the overall costs from destroying such sensitive areas are more than the benefits gained (Barker and Roberts, 2004).

Additionally, as mentioned in the study of Canty (2014) the development of diving tourism can contribute to the overall economic development of the area, since through such activities, there is a greater need for infrastructure development and more job openings for the local communities. According to his case study on the diving tourism of Utila, the economic benefits gained through the dive industry during the last 20 years resulted in a higher standard of living for the locals (Canty, 2014). An example of a study case which emphasizes the measurable financial benefits gained through diving tourism, is the example of Scylla wreck in the United Kingdom. This frigate became Europe's first artificial wreck site, in 2004, and attracted a great number of divers who wanted to enjoy this historical wreck. The initial investment of 2 million USD, during the first operational year, resulted in an overall return of 2.25 million USD on the same year, associated to a subsequent opening of 35.46 full-time equivalent (FTE) jobs for supporting the area's diving clubs, centres, charter boat operators, as well as the tourism-related businesses (UNESCO, 2013).

Moreover, through the protection of underwater archaeological areas and the operation of underwater museums and diving parks in such areas, a number of social, educational and cultural benefits can be achieved as well. According to UNESCO (2013), the protection, research and public display of UCH can contribute towards the cultural development of the local societies, through fostering interaction between the communities and their past. Through cultural tourism activities, the local communities have the opportunity to have a more tangible connection to their past; their history becomes more alive, and more vivid than someone's imagination. According to UNESCO, the local communities can learn through a more interactive way about their home's greatest historic events, and gain information regarding the trade relationships, the religious views of the past, as well as the influences gained throughout time from other civilisations.

To our realization, information regarding the overall positive environmental effects gained through the operation of UM, DP and diving tourism in general was very limited compared to the data found on the socio-economic gains. Apart from this, focusing on the information found on the positive environmental effects of diving tourism, this was primarily focused on wildlife tourism (diving with sharks, stingrays etc.). This gap in knowledge emphasizes the need in preparing conclusive studies focusing on the overall benefits and overall environmental effects linked to diving tourism.

According to some studies on wildlife diving tourism, people who engage in these activities can develop a greater appreciation for the marine biodiversity of the area, as well as become more environmentally aware of the need to protect and preserve these pristine sites (Gallagher *et al.*, 2015). However, as Gallagher *et al.* (2015) add, the development of such positive attitudes often characterises visitors who already had a conservation ethos and were willing to learn more on that specific group of marine organisms, than those who just participated for the thrill of the moment.

It is important to mention, that the majority of cases, even when a study focused on the benefits gained through the operation of UM, DP and diving tourism activities in general, data regarding the negative environmental effects caused due to inefficient management and

protection mechanisms was usually reported as well. For example, as mentioned in the study for the diving tourism of Utila, although diving tourism activities resulted in financial benefits and urban development, this development is linked to rather short-term than long-term gain (Canty, 2014). As Canty (2014) concludes, the key in the prolonged development of Utila would be in the successful application of environmental protection measures, which is basically the key to every similar situation. For this reason, the long-term benefits of a protected diving site can only be linked to the long-term, successful management, protection and preservation of the area.

Tourism-linked activities that might cause environmental impacts

As was mentioned in the introduction, the operation of Underwater Museums and Diving Parks is often related to both positive and negative effects to the marine biodiversity and the archaeological artefacts that can be found in those protected areas. Despite, the positive socioeconomic impact they can cause at a regional and even national level, the negative effects that are usually linked to a number of activities associated with diving tourism, can outbid such benefits.

According to a report by (Carbone *et al.*, 2005), a number of recreational touristic activities are often related to the physical degradation of the environment. For example, physical erosion of an area can be also linked to the over-use of the site, which can be a significant issue at cases where surfaces are fragile. Additionally, diving (scuba diving and snorkelling), as well as boating activities are often associated with a number of impacts on the marine structures, like damaging and changes in the behaviour of marine life. Apart from this, impacts related to activities involving wilful damage, as well as environmental degradation due to marine littering are also included as important causes of environmental impacts to areas of such important natural and archaeological importance (Carbone *et al.*, 2005).

Additionally, as mentioned in the review of Zainal Abidin and Mohamed (2014), on the effects of scuba diving on coral reefs, these can be separated in two categories, the direct and the indirect effects. In the first category are included the activities associated with the direct cause

of damage on the marine environment through accidental disturbance, which include coral breakage, collision of boats with reefs and damage caused by vessel anchoring (Zainal Abidin and Mohamed, 2014). In the indirect effects, they have included the impacts caused through activities linked with water pollution, like nutrient enrichment, addition of pollutants as toxic substances, sewage disposal issues etc. As they mentioned, the intensity of an impact is related to the frequency, size, type and season of an area used, as well as the associated behaviours and the environmental conditions at that time. Such impacts can indirectly affect marine life, since an animal under such stress could lose the ability to respond to other environmental stressors, like storm damage, flood runoff or even warm water events (<http://www.reefresilience.org/coral-reefs/stressors/local-stressors/coral-reefs-tourism-and-recreational-impacts/>).

Understanding these effects, and how an activity linked to the operation of UM, DP and diving tourism in general, might affect the marine environment, is vital. Regarding the information found in the literature, effects focused on coral reef damage are usually the ones reported more often, as well as the impacts caused by snorkelling and scuba diving activities. The direct relation between these two, as well as the increased ability to visit those sites might be the reasons behind this increased reporting. Information focused specifically on the impacts caused on the marine environment in Underwater Museums and Diving Parks was more limited. Since an action which can cause a negative effect on the coral reefs, might also be detrimental for the archaeological artefacts of a protected area and the marine life in general, we realized that reporting these activities conclusively and not collectively was more beneficial (UNESCO, 2013).

For example, the direct contact of a person on coral reef colonies, through walking, touching, kicking, or standing, as well as boat anchoring and vessel collision could cause extensive coral breakage (<http://www.reefresilience.org/coral-reefs/stressors/local-stressors/coral-reefs-tourism-and-recreational-impacts/>). The same could be also applied to any other fragile marine habitat, and on the archaeological artefacts of a protected area. Similarly, impacts from trash and debris deposited on the marine environment, as well as fish feeding have been

reported. Additionally, impacts caused by fin kicks, pushing of people underwater, kneeling or standing on the seabed for the perfect capture of underwater photograph, are also considered highly related to both environmental and archaeological damage caused in UM, DP and MPAs.

However, as has been identified through the study of Hammerton (2017), understanding the causes behind the physical contact of scuba divers with the sensitive natural and archaeological areas, is equally important to improve the protection and preservation mechanisms implemented in such important sites. Through their study they found that the following variables had a significant correlation to the contact frequency of divers. These included: a) the number of days since a diver's last dive, b) the location of original diving certification, c) awareness and understanding of marine park zoning, d) site selection, e) use of photographic equipment, f) total number of dives logged and g) diving depth. For this reason, it's important to understand not only how an impact could be caused (e.g. which activities), but also the underlying causes (Hammerton, 2017). Based on the aforementioned results, long-term and recent diving experience is equally important to the knowledge of the area's regulations and restrictions, which could subsequently suggest that both education and sufficient training prior to a dive in selected locations might be vital for such sensitive areas.

Activities related to environmental effects

- 1 Snorkel, scuba diving and trampling
- 2 Anchoring
- 3 Vessel Groundings
- 4 Underwater photography
- 5 Fish feeding
- 6 Purchase of dead marine animals as souvenirs

Negative effects

In this section, information regarding the environmental effects caused by a number of activities will be provided, following the 4-step methodology. For this reason, each of the activities listed below, as well as the impacts caused to the marine environment because of them, will be analysed separately, under each activity, for better clarity.

As illustrated in the fishbone diagram below, there are many primary and secondary factors which have been related to environmental effects on sensitive marine habitats, such as coral reefs, which had been the centre of focus for the study of Zainal Abidin and Mohamed (2014). For example, the lack of experiences in scuba divers, as well as the bad environmental conditions, and low visibility can lead to a greater number of contacts on the seabed. Other reasons that are indicated in this diagram include underwater photography, bad bracing of scuba diving equipment, boat anchoring, as well as the non-existence and/or the non-implementation of protection, management and monitoring mechanisms by the responsible authorities.

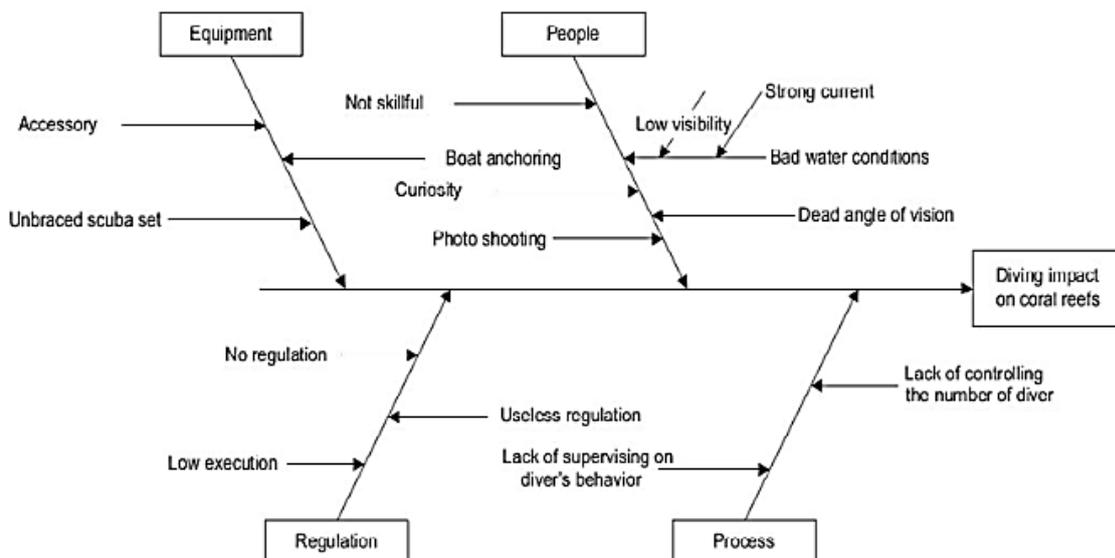


Figure 1: Fishbone diagram, which illustrates the environmental impacts caused on coral reefs by a number of scuba diving associated activities (Zainal Abidin and Mohamed, 2014).

The observation mentioned in UNESCO's report (2013), that emphasis is usually given on the effects caused on coral reefs, is not biased, since the majority of studies found for the preparation of this set of guidelines, do focus on this. Similarly, as observed during the collection of material for the development of this report, data on the effects of diving tourism to other marine ecosystems is usually limited. This can be related to the fact that they are important ecosystems which are usually found in shallow waters, thus inexperienced divers, or even the over-abundance of divers/swimmers in an area can result to the physical damaging of corals. Grabbing in corals, while fighting a current, walking on them or even touching them can affect them significantly, since coral reefs are extremely vulnerable ecosystems, which can be easily affected by physical damage, and most of the times they need decades to recover. Taking into consideration the similar vulnerability of other sensitive ecosystems, as well as of the archaeological artefacts found underwater, similar conclusions on the factors contributing to the damage of such important sites can be extrapolated.

1. Snorkel, Scuba Diving and Trampling

The majority of studies focusing on the environmental impacts due to diving tourism in general, include information on the negative effects from scuba diving, snorkelling and trampling. According to some of them (Zainal Abidin and Mohamed, 2014, Hammerton, 2017), the diver's experience is reported as one of the most frequent reasons behind environmental impacts on marine ecosystems. Based on the findings of Hammerton (2017), the divers' qualifications were not as important as their recent diving experiences, neither were their total number of accumulated dives, since the divers who had more recent experiences were significantly more comfortable and careful in the water, than the ones who didn't. Specifically, according to that study, the divers who did not dive during the past 6 to 12 months had 42% more contacts than the ones who had dived during the last 24 hours (Hammerton, 2017).

Apart from this, the divers' nationality was reported to have an even greater impact on incidences of reef damage, than the divers' experience and ability. Additionally, as reported by Hammerton (2017), the knowledge of the zoning policies of the Marine Protected Areas

was subsequently important, since the divers who understood the regulations of each zoning area were the ones who made significantly less contacts than the ones who had no aware of them. This suggests, that the visitor's attitudes, perceptions, beliefs and even knowledge background can play an also important role, and would need to be taken into account by the managing authorities, since user-specific strategies might be more effective in reducing the impacts caused by physical damage (Hammerton, 2017).

Lastly, as reported by Hammerton (2017), even when a diver is highly experienced, properly trained and educated can perform badly underwater. This can be related to a series of physiological, psychological and environmental factors which can affect the diver's underwater behaviour, cognitive perception and function. These include, temperature (e.g. cold), nitrogen narcosis, motion sickness, strong ocean currents, poor visibility as well as nervousness, claustrophobia, isolation altered perception and many more, which can affect the skill level and impair the judgment of even the most experienced divers (Hammerton, 2017).

II. Anchoring

The damage caused by anchoring of vessels on the seabed has also been reported as one of the most important impacts linked to diving tourism. Boat anchors can cause significant damage to the sensitive ecosystems of the seabed, as well as on the archaeological artefacts. As documented by Zainal Abidin and Mohamed (2014), it has been observed that large anchors and chains could result in breakage or even dislodging of corals, and for this reason mooring buoys have been installed in many locations to minimize such impacts. This however is usually not applied by the smaller vessels, especially in developing countries, where anchoring on the seabed is quite common, even today (Zainal Abidin and Mohamed, 2014). Unfortunately, the damage costs by anchors is usually irreversible, and in the case of coral reefs it can result in a decrease of live coral coverage, which persists many years after the incidence. Other habitats which can be similarly affected are seagrasses, which play an important role as nursery and juvenile habitats for many benthic species, thus such damage can have detrimental effects on the functional dynamics of the marine ecosystem.

III. Vessel Groundings

The grounding of vessels can also cause detrimental effects to the seabed communities, and despite the fact that such incidences are not usually linked to the environmental effects instigated due to the operation of UM and DP, the links with marine tourism make them worth mentioning in this manuscript. Their impacts can range from a few hundred square meters to several hundred thousand square meters of seabed. For example, during such an incidence in the Virgin Islands, a cruise ship was grounded, resulting in the damaging of an area of 5300 square meters of coral reefs (Zainal Abidin and Mohamed, 2014). If we take into consideration the subsequent environmental effects which can be caused by fuel spilling, leaching of toxins and even vessel sinking, we can understand the size of impact such incidences can cause. Several factors can play a key role in the extent of the effects in an occasion of a vessel grounding, such as the weather conditions, the vessel's size and even the readiness of the local area to address the collision at the time of incidence.

IV. Underwater photography

The use of photographic equipment has been reported many times as one of the reasons behind the cause of damage on the seabed communities. According to Hammerton (2017), scuba divers carrying photographic equipment, tend to be careless along the way, focusing more on achieving the perfect shot, rather than looking not to damage the benthic communities or the underwater cultural heritage. The number of contacts to the seabed increases a lot, when the divers aim to capture the picture of small and well-camouflaged species. Regarding the gender, as reported by Hammerton (2017), there are studies indicating that male underwater photographers were more irresponsible than females, and other studies showing the opposite scenario. Other, studies indicated that divers using professional cameras had been responsible for more contacts than the ones without. Also, when scuba diver photographers were compared to snorkelers, the former had been responsible for more damaging contacts to the seabed than the latter, since snorkelers were usually floating above the corals, whereas scuba divers were usually resting directly on the seabed when taking pictures (Shackley, 1998).

V. *Fish feeding*

This activity has become very popular during the last few years, since through fish feeding a greater number of marine animals, mostly fish are aggregated in the diving site, giving the opportunity to the participated divers/swimmers to capture amazing underwater photos (Shackley, 1998). Apart from this, the opportunity for a visitor to encounter and interact with marine animals like stingrays, sharks, dolphins and many more, sounds so appealing and interesting to a great number of tourists (Orams, 2002).

According to many marine biologists though, this could have detrimental effects on the marine animals, since based on a great number of observations, this activity could be responsible for altering the animals' behaviour, and population levels, making them more dependent on humans (Shackley, 1998, Orams, 2002). This dependency could subsequently cause changes on the habitat range of the animals, their reproductive activity, migration patterns, species composition and even aggressiveness, since there have been reports for divers being bitten by otherwise shy and nonaggressive animals (<http://www.reefresilience.org/coral-reefs/stressors/local-stressors/coral-reefs-tourism-and-recreational-impacts/>).

According to the study of Milazzo *et al.* (2005), in the Marine Protected Area of Ustica, fish feeding could also lead to significant spatio-temporal changes of hundreds of meters and months, which has been linked to the visitor activity in the MPA, and specifically fish feeding. Based on their observations, the provision of supplementary food by the visitors for feeding the area's saddled brems and dusky groupers has resulted in an increase of these species abundances (Milazzo *et al.*, 2005). As they reported, an increase in the aggregation numbers of top-level predators, like *Epinephelus marginatus* could affect the abundance of their preys, which could subsequently lead to changes in the whole shallow ecosystem. This could go both ways, since the increase of top-level predators aggregated to an area could lead to the decrease in the numbers of other fish species, due to a greater direct competition for food. The overall shift could also cause changes in the marine habitats, due to the removal up to depletion levels of some important prey species. On the other hand however, the increase of the number of top predators being additionally fed by humans could lead to a greater

releasing of prey species from predation (Milazzo *et al.*, 2005). Increases in the excretion levels has also been reported as a factor which could contribute towards habitat modifications.

Changes in the behaviour of stingrays in the Cayman Islands, as a result of fish feeding and other tourist related activities, were also indicated through the study of Shackley (1998). The great amount of visitors per day (~500 divers on a busy day) were shown to be responsible for the development of shoaling behaviour, skin abrasion, due to their handling, as well as changes in their feeding habits (Shackley, 1998). The stingrays, especially females, were observed to come closer to humans and formed large aggregations during the artificial feeding. There was an indication that these changed behavioural patterns were learnt and transferred to the new generation of rays, since the youngest, which were supposed to be shy, had gained confidence and started coming closer to humans. Aggressiveness was also reported in times where artificial feeding was delayed due to bad weather, which contrasted the general behavioural profile of these animals which are considered very calm and shy. This suggested that the animals had learnt to expect artificial feeding, thus they were either not supplementing their diet with normal-wild like-feeding, or that such feeding was minimal.

While the majority of studies show indications of great direct and indirect environmental effects associated to fish feeding, reports on the possible positive benefits due to this activity were also given (Orams, 2002). According to some MPA management authorities, this method can be used to re-channel the detrimental recreational pursuits of wild life, by scuba divers and snorkelers, away from vulnerable sites (Milazzo *et al.*, 2005). There are certainly many more positive effects for the human side of the interaction, including a variety of psychological, social and economic benefits. However, any benefits gained against the marine life populations are unimportant when the overall disadvantages turn out to be a boomerang for the affected community. For example, as was observed in the study of Milazzo *et al.* (2005), some fishermen took into advantage the behavioural changes in the feeding habits of some fish, and lured them outside of the boundaries and the no-take zone of the MPA, using artificial feeding. This can subsequently affect the overall efforts in increasing the fish stocks through the enforcement of protection in zoning areas.

The matter of fish feeding is being considered, even today, a controversial topic, with little information being provided on how to properly execute and manage such activities (Orams, 2002). Some approaches included complete prohibition, others active promotion and management, and others complete ignoring of the practices. However, as was repeatedly reported in a number of studies ((Shackley, 1998, Orams, 2002, Milazzo *et al.*, 2005), the implementation of long-term monitoring programmes might be the key in controlling this activity and its subsequent environmental effects. Apart from this, the need for further research, examination and consideration on the issue was also indicated as important during the following years (Orams, 2002).

VI. Purchase of dead marine animals, as souvenirs

Although this activity is not directly linked to diving tourism and the operation of UM and DP it was considered important mentioning it, since many tourists often choose to purchase dead marine animals, like seahorses (*Hippocampus* sp.), as souvenirs from their travels. This action, might be considered unimportant at the moment, however, it contributes to the worldwide trade of dead marine animals which can have devastating chain results to vulnerable marine organisms and their sensitive living habitats.

For example, a number of studies (Baum and Vincent, 2005, Giles *et al.*, 2006) indicated the catastrophic fishing of seahorses, which have been collected in mind-blowing numbers (several millions per year), through both direct and indirect fishing methods. The dried and live seahorse trade takes place on a global scale, even today, for their use in traditional Asian medicines, or as curios, souvenirs and as aquarium fishes (Baum and Vincent, 2005). Taking into consideration their high market value, as well as the fact that this value would increase substantially when the rarity of such species increases, it is now vital that strict management measures are implemented in this area as well, in order to prevent them from being over-exploited and extinct (Giles *et al.*, 2006). Small changes play a significant role as well, since when the need in purchasing such dead marine animals decreases, so would eventually their trade.

Environmental impacts caused from the wrecks per se and from the preservation of underwater archaeological artefacts

There is currently limited knowledge focusing on the impacts caused by archaeological artefacts, and archaeological surveys on the marine environment, whereas knowledge regarding the effects the environmental conditions and marine organisms cause on the underwater cultural heritage are more frequent. Although archaeological surveys are often characterised by the multidisciplinary approaches they follow, this does not seem to be the case in scientific writing. The majority of studies focus only on the one side of effects, studying mainly the effects the environmental conditions can cause to the preservation of archaeological artefacts. There are also a few studies investigating the role those conditions play(ed) for the initial preservation of the wrecks (Robinson, 1981). For example, Gonzalez-Duarte *et al.* (2018) studied the relationships between the environmental conditions, sessile organisms and the material type of the archaeological artefacts, in order to see how this could influence the conservation status of the archaeological sites.

In UNESCO's website (2017), information regarding the environmental effects that can be caused due to a variety of factors related to the wrecks is provided, as well as a data on the impacts linked to the archaeological interventions at the environment.

1. Materials related to wrecks, which have been identified to affect the environment

a) Metals:

The effects from the corrosion of metals from wrecks are two-fold. The metals like iron and steel tend to produce oxides during corrosion, which is generally not considered a menace for the environment. In the presence however of several metals, the electrolytic processes continue producing materials, which are called minerals when they are used from marine organisms for bio-production and contaminants when they are found to impact them. The latter is usually the case for heavy metals and other alloys, which might cause significant impact to the marine environment of the wreck site.

b) Sacrificial anodes:

They are basically highly active metals, which are occasionally mounted in order to stop the corrosion processes, for the sake of cultural heritage protection. As noted by UNESCO (2017), “environmentally speaking, it just replaces one contaminant with another”.

c) Oils:

Oil spills from modern day wrecks, are considered very likely to happen, which can result in very devastating results. These however, might occur many years after the wrecks were sunk, due to the gradual corrosion of their tanks.

d) Toxic or explosive content:

The use of toxic and corrosive substances has increased a lot, since the industrial revolution. Containers with such content have been lost in the sea, or even dumped in great quantities in cases of armed conflicts, or clearance actions. This constitutes a great threat for the marine environment and a health & safety issue to the people who are actively involved with the sea, such as fishermen, marine scientists etc.

II. Environmental effects caused by the archaeological interventions

Sessile organisms and many marine algae usually require hard substrates for their overall development and growth. For this reason, “foreign bodies” such as archaeological artefacts, are often colonized by many different organisms, which results in the development of a sensitive ecosystem, within the wider archaeological site (UNESCO, 2017). This will subsequently attract sedentary fish and predators which are higher at the food chain, resulting in the creation of a rich biotope, around this isolation of foreign materials.

As the time pass by, the site formation processes achieve a state of relative stability and equilibrium, something which is disrupted by the discovery of the archaeological site. This leads to the physical and chemical disturbance of the archaeological artefacts, and of the resilience of the environment. The proper assessment of the archaeological findings usually requires the removal of the site’s growing flora and fauna, which are basically the key to this

fragile ecosystem. The subsequent stabilization and consolidation measures, as well as the excavation processes which are often taken affect both the site's seabed and associated marine animals (UNESCO, 2017).

According to UNESCO (2017), the protection and preservation of the marine environment, in an archaeological site, can be easily achieved through the inclusion and implementation of environmental policies, which aim to balance the scale of archaeological interventions to the ecosystem's resilience. These interventions are considerably small scale compared to the stress conditions the ecosystem stands to survive, and the overall spatial extent of the biotope. However, this is not the case in times when the ecosystem is especially sensitive, and under great stress, as during the phases of breeding and blooming. Taking into consideration such seasonal phases when the archaeological interventions should be minimized is key to the overall protection and preservation of the site's ecosystem. This is exactly the multidisciplinary approach which should characterize the archaeological surveys, since the integration of an environmental policy, as well as the knowledge of the local environmental and ecological data, during the project's design should be of utmost priority (UNESCO, 2017).

Legislative framework

Taking into consideration the fact that information regarding the legislative framework is provided in BLUEMED deliverables D3.1.1, D3.2.1 and D3.3.1, reference to this topic are given in titles only. This way links with past deliverables are enhanced, without excess use, or repetitiveness of words and material.

International legislation

- 2001 UNESCO Convention on the protection of Underwater Cultural Heritage
- 1976 – Barcelona Convention for the protection of the Mediterranean

EU legislation

- Directive 92/43/EEC on the conservation of natural habitats, wild fauna and flora
- Directive 2008/56/EC on establishing a framework for community action in the field of marine environmental policy (Marine Strategy Framework Directive)
- Directive 2008/99/EC on the protection of the environment through criminal law
- Directive 2014/89/EU on establishing a framework for Maritime Spatial Planning

Policies and guidelines implemented in Croatia, Greece and Italy for the conservation of

UCNH sites

A. Croatia

- Legislation on recreational diving on Underwater Cultural Heritage
- Legislation on Underwater Cultural Heritage
- Legislation on Underwater Archaeological Research
- Tourism Development Strategy of the Republic of Croatia until 2020
- Action plan for the development of cultural tourism
- Strategy on the conservation, protection and sustainable economic use of cultural heritage of the Republic of Croatia.

B. Greece

- Accessible Underwater Archaeological Sites (Underwater Museums)
- Legislation on recreational diving
- Legislation on Spatial Planning
- Legislation on Diving Parks
- Legislation on Archaeological Diving Parks (Marine Archaeological Sites open to the public)
- Legislation on Marine Protected Areas
- Legislation on Special Areas of Conservation
- Legislation on Special Protection Areas
- Specifications on the characterization of areas, elements or groupings of nature and landscapes
- Policy recommendations on protection, management and monitoring issues of UCNH sites

C. Italy

- National public authorities and their functions
- Legislation about cultural heritage safeguarding
- Legislation on the marine natural and cultural areas
- Legislation on underwater natural and cultural heritage
- Alternative ways towards the promotion and support of cultural and natural tourism and conservation of UCNH sites

Guidelines on minimizing the effects due to diving tourism

Tourism is one of the most important financial axis for a country's economy. The introduction of alternative ways of tourism, such as the visitation of Underwater Cultural and Natural Heritage sites can be beneficial for a number of reasons, resulting to great socio-economic, cultural and even positive environmental effects through the promotion of environmental awareness. However, there is a very thin line between the positive and the negative effects that can be caused through the operation of Underwater Museums, Diving Parks and through diving tourism in general.

Each country has set specific regulations regarding the permitted and prohibited activities allowed in UM, DP and MPAs in general. Croatia, Greece and Italy where the BLUEMED pilot sites are, have established specific policies regarding this matter. Zone specific access, as well as the prohibition of impact-related activities, such as anchoring, underwater fishing etc in these protected sites is usually implemented. Taking into consideration the aforementioned information, and aiming to further enhance the material regarding the guidelines already implemented for the successful protection and conservation of the environment, data from bibliographic sources were collected and are presented below.

Tourism policies, plans and management

Tourism related strategies and regulations can be the backbone of the successful management in a protected site which has increased tourism visitability. Taking into consideration the negative impacts which can result from bad-management practices, the importance of the successful implementation of a tourism plan for the prevention and mitigation of such impacts is considered more vital than ever (IUCN, 2004). Guidelines focusing on an agreed tourism development framework, which will reflect the national and regional regulations of each country will allow the controlled tourism growth (Carbone *et al.*, 2005). Through this approach, the maximization of the tourism-related benefits can be achieved, with the subsequent minimization of environmental damage and local-stakeholder conflicts.

According to IUCN (2004), as well as Carbone *et al* (2005), tourism plans, should reflect the national policy framework and developmental strategies, and should take into consideration the policy-related issues given below:

- a) Each management authority should have a clear vision of the objectives aimed to be achieved through its tourism plans. The activities which will be provided, encouraged or excluded in the different zoning regions, as well as the offered amenities should be taken into consideration. Apart from this, areas which need protection, but are currently not included in the protected zoning regions, should be identified and considered as well.
- b) The national and regional policy framework, as well as current facts regarding tourism development (e.g. tourism growth rates, impact of global or national socio-economic events).
- c) The carrying capacity of each protected site, as well as the limits of acceptable change. Additionally, information regarding the suggested number of visitors and behaviour permitted in each site should also be included.
- d) The user fees and income from tourism and local visitors, which are expected to financially support the operation and management activities of the protected areas.
- e) The cultural and environmental awareness educational programmes. Apart from this, consideration of including the operation of activities aiming to involving tourists to the cultural and environmental conservation of the protected site.
- f) The required standards for the tourism-related activities operated in the protected areas and which are set through the regional and national regulations.
- g) The role of each management authority for a protected area, of each government agency, private sector and local communities, related to tourism development and any possible conflicts with other economic activities such as fishing.
- h) The development of partnership agreements between the aforementioned stakeholders, and the development of concession-based relationships between them, aiming to benefit the conservation and management of the UCNH site, as well as the communities and its users.

- i) The monitoring framework, which will include information on the key parameters that should be recorded, including visitor trends, social, cultural, and environmental effects caused by tourist-activities, the quality of the provided services, as well as the feedback obtained from tourists through questionnaires or comments book.
- j) The prohibition of illegal trade of endangered species, or its stimulation in any way, as well as the purchasing of souvenirs made from them.
- k) The establishment of sustainable tourism strategies which will integrate the managing authority's management plans, regional and national strategies and link them to the interest of the relevant stakeholders.

Reflecting sustainability in national tourism law

The importance of supporting the development of tourism plans at the national and regional legislative levels has been mentioned above. Through the development of tourism-focused national laws the responsibilities towards tourism are being set, leaving little flexibility for political influence from each short-term government (Carbone *et al.*, 2005). The enforcement of national tourism laws sets the long-term constitutional basis for tourism policies, including the principles of sustainable tourism. In this way, communities can be supported, as well as the national resources, and the tourism-related financial benefits can be secured for the long run. Additionally, through this specific legislative framework, a better control and licencing of the tourism-related activities can be achieved, as well as the undertaking of tourism development supporting actions.

Additionally, as emphasized in the manuscript of Carbone *et al.* (2005), the development and enforcement of specific regulations regarding certain aspects of tourism, certain activities, or certain other parameters affected from the operation of tourism-related activities, is required. For example, the development of specific articles, or even subsequent national laws focusing on the following aspects could be necessary, in securing the sustainable benefits of tourism, with the subsequent minimization of the tourism-caused impacts.

Regulations could cover various tourism-related aspects, such as:

- a) Especially vulnerable communities and habitats.
- b) Particular types of activity (i.e. scuba diving and snorkelling) which could be potentially dangerous to the participants, or cause impacts to the environment.
- c) Access to certain areas.
- d) Frequency and length of tourism uses.
- e) Qualifications of operators.
- f) Safety standards of equipment and facilities.
- g) Specific seriously damaging activities which could be controlled.

Finding commonality

Complementing the aforementioned statements, regarding the development and enforcement of tourism-based national regulations, is the need for proper management of plans and monitoring of the communities' interests and attitudes regarding tourism (Kreag, 2001). Taking into consideration the tourism issues each community is facing, as well as the challenges and trouble areas in regard to tourism can contribute towards the prevention of negative effects, or even of a tourism-related crisis.

For this reason, as emphasized by Kreag (2001), the majority of groups with interests in one area of tourism are having interests to other areas of tourism as well. This is also applied to the tourism-related benefits and impacts. The identification of the common line of practice, the common interests, or concerns as well as the common impacts that can be caused from touristic activities is vital, for the successful operation of tourism and the resolving of such issues.

As illustrated in Figure 2 below, through the identification of the common interests each tourism-related group can have, as well as their subsequent impacts (including those of economic, socio-cultural and environmental nature), is essential for the sustainable development of tourism. Finding this commonality and following specific plans and actions, can increase the tourism benefits, or decrease the associated negative effects. Understanding

the wide scope of impacts from the communities is key, since this is the way to take responsibilities and address negative actions. Having a common and clear vision for tourism, through the development of common plans and uniting multiple interests, can successfully contribute towards the increase of tourism-related benefits.

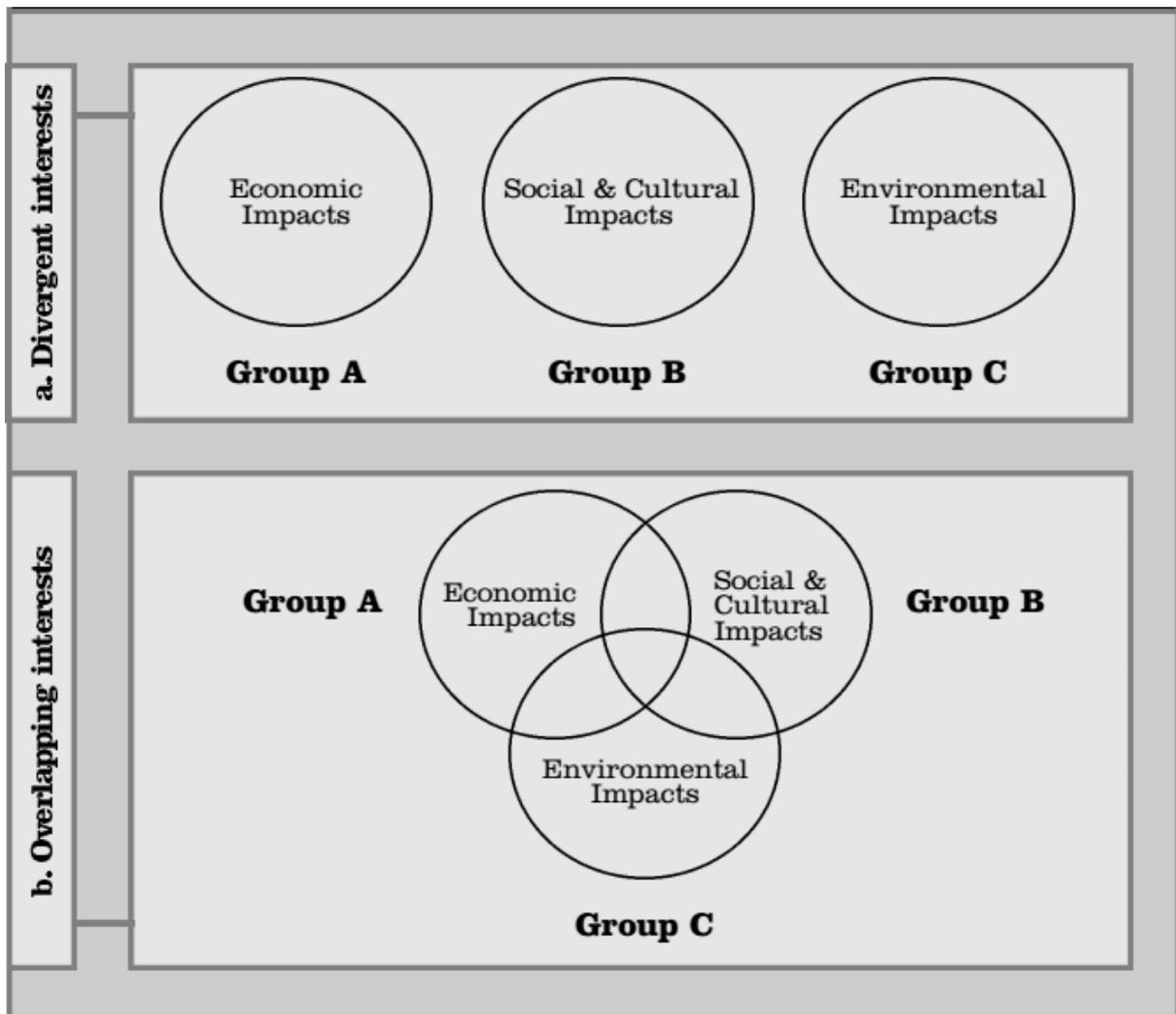


Figure 2: The illustration of the importance of finding commonality, through the identification of the overlapping interests, as well as their subsequent impacts (economic, social and cultural, as well as environmental) of separate tourism-related groups (Kreag, 2001).

Estimation of carrying capacity

Taking into consideration the environmental impacts that can be caused from diving activities to a protected site, the concept of the optimum diver carrying capacity has been developed (Zainal Abidin and Mohamed, 2014). According to IUCN (2004), the optimum diver carrying capacity is the optimum number of visitors or of any particular activity within an area, during a set time frame (e.g. a year). In other words, this describes how much pressure can the environment hold before damage occurs or before the visitors' enjoyment is substantially decreased. However, the quantification of carrying capacity can be very difficult, and it varies between one protected area to another, since it depends on the ecological conditions, the ecosystems' resilience to recover from disturbance and the visitors' behaviour. Taking into consideration the typical lack of availability of the aforementioned required knowledge, it is realized how difficult this estimation can be.

The estimation of carrying capacity usually reflects the estimation of those limits for scuba divers in coral reefs and other similar underwater sites. According to an example given by IUCN (2004), in the Red Sea and Bonaire (Caribbean) an indicative number of 5000 – 6000 divers per site per year has been estimated, although there is a great variation between reefs. As stated in that report, a large number of divers and snorkelers can sometimes cause less damage than fishers using unsound fishing methods.

Apart from this, as mentioned in IUCN (2004), carrying capacity can overall have very limited practical application. Taking into consideration the great variety of reasons which can affect the scuba-diving related effects, (i.e. diving behaviour, the activities being carried out and the ecological characteristics of the ecosystem), it is clear that the estimation of the optimum amount of diving in a site has a secondary value. Spending resources in identifying carrying capacity is less important and useful, since the figures generated would not have a long-term application and could vary in different parts of a protected site. However, as emphasized in IUCN (2004) it is important to be aware of this concept and to recognize that too much use will ultimately damage the habitats and species with an underwater protected site.

The concept of Limits of Acceptable Change (LAC), may be a more practical approach, since through this estimation, the standards are being set for the minimum acceptable conditions (not the desirable conditions), which involves the definition of the limit of ecological or sociological change permitted at a site. In order to achieve this, the successful monitoring of the minimum acceptable conditions is vital for the identification of the limits when management actions should intervene. This way, the management actions required to prevent change beyond limit can be identified and successful conservation strategies can be achieved.

Visitor and/or operator qualifications

According to Eagles *et al.* (2002), allowing entry only to those possessing the required qualifications or knowledge background, might also be a complementary solution for minimizing the negative effects from tourism-related activities in protected sites. As they describe, entry can be limited only to:

- a) Scuba divers which are qualified to use marine protected areas.
- b) Ecotour leaders which have a certificate of competence.
- c) Visitors accompanied by a qualified local guide.

Allowing access only to the people who have for example the relevant diving qualifications can be beneficial for two reasons, since the visitors' safety is more ensured, as well as the subsequent protection of the site. When the visitors are more competent, they pose less threats to the protected area's values (Eagles *et al.*, 2002). However, as mentioned in Chapter 3, regarding negative effects from scuba diving, having high-level diving qualifications is not as important as having recent, frequent diving experience and knowledge of the requirements for the protection of an Underwater Cultural and Natural Heritage site.

However, this can be very beneficial to the protected areas manager, since only those with the necessary training, equipment and group co-ordination can be allowed. This way, the local employment in training and guiding is increased. Additionally, when operators, such as guides are licensed, the managers have an additional control over tourism operations, and they can

provide better services to the visitors. As mentioned above, the safety levels can be higher this way, and the search and rescue costs can be way lower. However, this can have a financial cost, since the arrangements required for setting up this external system of qualification, certification and verification can be high, as well as the enforcement costs required. Apart from this, the development of the proper requirements for the negotiations needed between the user groups can have an additional cost as well. But, if you compare these short-term costs to the long-term socio-economic and environmental benefits it is made clear that the development and enforcement of this system is critical for the successful operation of UCNH sites.

Working with private parks and reserves

According to Carbone *et al.* (2005), private parks and nature reserves have increased significantly during the last years, in so many countries. These include most of the times, tourism-related activities. For this reason, as they emphasized, there is a current need for influencing and controlling their development and management, through a set of monitoring priorities and even through the legislative framework in order to ensure the following:

- a) That private parks do not siphon away resources, such as tourism income, to the detriment of conservation in public parks.
- b) That private parks keep high conservation and tourism standards, following the relevant legislative framework.
- c) That the management of private and public parks will be integrated into a single biodiversity plan.

Raising visitor awareness of biodiversity

Focusing on visitor awareness activities can also play an essential role towards the indirect conservation of UCNH sites. Focusing on the development of a better appreciation and understanding about cultural and natural heritage can contribute significantly towards the successful prevention of adverse impacts, as well as encourage the supporting actions for

conservation. This of course can contribute towards increasing the visitors' enjoyment as well, through meaningful engagement activities. Through a variety of communication tools, such as printed materials, videos, websites, media, exhibitions and special events, the awareness among the involved stakeholders and the encouragement of their participation can be achieved (IUCN, 2004). Similarly, through this way, peoples' thinking, and behaviours can be changed in relation to specific environmental and cultural issues (e.g. illegal underwater fishing). Apart from this, information regarding the protected sites, its achievements, as well as the legislative framework, or management practices for some tourism related activities can help the visitors understand how they should address certain issues and how to act in a protected area. Additionally, raising awareness about the protected site at both regional and international levels can contribute towards strengthening linkages, whereas fundraising activities can contribute financially towards the monitoring, management and conservation activities of the UCNH site (IUCN, 2004).

According to Carbone *et al.* (2005), there are various policies and actions that can be taken in support of raising cultural and environmental awareness, such as the following:

- a) Good quality guiding, involving local people wherever possible.
- b) Interpretative events.
- c) Visitor centres, where appropriate, containing creative interpretative facilities.
- d) Relevant information given on the pre-arrival of visitors.
- e) Enhancing the educational activities amongst local people and of the domestic markets.
- f) Better knowledge amongst tourism enterprises regarding the UCNH sites, which can be passed on to the staff and guests.

1. Publicity materials and promotion

Effective oral communication can be very essential towards the successful transfer of important cultural and environmental awareness issues. This requires both skills and practice, since if executed unsuccessfully can have a number of negative effects, through the distortion of the professionalism of the management authorities and the work behind the conservation

of UCNH sites. Such awareness activities are considered part of the job requirements of the management authority officers, the staff working in the UCNH sites, as well as the community development and public relations officers. The preparation of subject and audience specific presentations is usually necessary for achieving the effective transfer of knowledge and cultural and environmental awareness (IUCN, 2004).

Apart from this, the development of a strong communication strategy, can be very useful for the organization of awareness-specific events and for the successful execution of the management plan. As reported in D2.1.1, regarding the Communication strategy of BLUEMED project, the definition of target audiences, and the issues which should be addressed, as well as the types of materials and products which are considered more useful for such dissemination purposes are essential. Conservation International has developed a strategic planning tool which can be used for the identification of the problems, audience, products and plan which are required for the successful development of a communication plan.

Regarding the publicity materials which can be used for awareness purposes these include the following:

- a) Posters (with simple, eye-catching designs with strong clear messages).
- b) Leaflets (for advertising awareness events and informing about the UCNH site).
- c) Brochures (for describing the UCNH site in more details or for specific relevant topics).
- d) Newsletters (to be produced regularly and inform about any updates in the UCNH site).
- e) Calendars (provide fun facts about the UCNH sites and have year-long awareness success).
- f) T-shirts, caps, badges, stickers etc. (taken as souvenirs or gifts, instead of animal souvenirs).
- g) Display boards (use at exhibitions and events).
- h) Website (very informative and can contain various details about the UCNH sites).
- i) Video (can disseminate a message more strongly and widely, than printed material).

Taking into consideration that some of the publicity materials can go quickly out-of-date, especially in a highly active UCNH site, it makes sense to counter-balance the costs for their production and to design more life-long materials instead of too specific.

II. Using the media

The preparation of effective press releases for the local media (e.g. newspapers, radio and television media) can be an additional effective tool towards successful awareness campaigns. The social media can play a subsequent important role towards this goal in the modern society. Through the careful preparation of clear, strong messages, regarding the important role of the UCNH sites, as well as their associated interesting events (e.g. information on protected species, on jellyfish blooms, coral-bleaching events, historical background of those sites) can be very useful for successful dissemination and awareness. Similarly, publicising the protected site through exhibitions, talks and displays at trade fairs, local museums, schools and through the activities organized by the local/relevant NGOs can prove very supportive and should be encouraged as well (IUCN, 2004).

III. Educational activities

Environmental and cultural education activities are also considered as an essential tool towards successful awareness campaigns. Developing an educational programme can be often overlooked, although it can be very beneficial to the cause, through direct communication with local youngsters and adults. Through activities with schools, local fishing groups and local government departments, the managing or generally the competent authorities for the UCNH sites can help stimulate awareness and develop the local capacity required for the marine resource management (IUCN, 2004).

As mentioned in deliverable D2.1.1, and in the topic above, through the identification of the target groups and their needs, the development of a more successful plan is constructed regarding awareness education activities. These target groups can include the following:

- a) Universities and institutions: The UCNH site management authorities can provide a venue for, and assist with input into the field courses and the training activities.
- b) Schools: Through the development of a joint environmental and cultural education programme, including workshops addressed to the teachers, broader issues regarding the

UCNH sites can be taught, especially when the activities offered are linked to the current curriculum.

- c) General public and local communities: Through short courses, one-day events, or talks and lectures by visiting researchers, the local communities can be educated on subjects that matter to them, such as the sustainable use of the marine resources.
- d) Tourists and casual visitors: Visitors can be equally interested in the activities offered to schools or other target groups mentioned above, thus they should be always offered at request.

Apart from the identification of the target groups and their needs, the means used for the successful dissemination of the environmental and cultural awareness topics should also be taken into important consideration. The most successful learning is often based on activities developed through personal experiences and reflection, built upon the “sense experience” approach. Exploring through the five senses, has been proven to maximise learning (IUCN, 2004). For this reason, the use of such activities and games for both classrooms and outdoors can easily win the audience’s attention. If an UCNH site has a dedicated visitor centre, then such activities can be easily hosted around their facilities, although the involvement of local museums, environmental groups and wildlife clubs can be additionally beneficial.

Additionally, there are two approaches towards environmental and cultural education activities, those which are field-based and those who are not. The non-field activities are usually easier to be organized and executed and could include relevant board and card games and specially designed quizzes or even online games through the UCNH site’s website. Additionally, sport, art, photographic, recycling and handicraft competitions, special awareness raising events and so many other ways can subsequently contribute towards successful dissemination. Overall, providing the proper incentives for the targeted groups is very valuable for increasing the motivation for people to learn. For example, linking the educational programmes to national youth award schemes can be very beneficial.

On the other hand, field activities, which are probably the best in developing awareness, can include visits to the UCNH sites with glass bottom boats, and snorkelling or even diving for the

qualified target teams. Additionally, through visits/tours and participation in the associate activities in the intertidal section, or in beach-cleaning events etc., the involved parties can realise how everything is connect and how our actions can affect the environment. Field activities can be quite more costly than non-field ones, although more successful in terms of developing a better appreciation and respect for the UCNH sites. Other matters than must be taken into consideration regarding the field activities, are the health & safety rules which will need to be followed, in order to ensure the safety of all the participants. For this reason, careful organization of each activity, depending on the field site, as well as constant supervision of the participants and knowledge of first-aid and life saving techniques can be essential as well.

IV. Visitor centres

As mentioned before, the creation of a visitor centre, close to the Underwater Cultural and Natural site can be very beneficial for dissemination purposes, since the visitors interested in the site can get more information about it before or after their visit. They can also serve as environmental and cultural education centres, or briefing stations where the most important information to take into consideration before associating in any marine activity could be transferred to them (IUCN, 2004). Visitors can learn about the importance of protecting the UCNH sites, about the marine environmental and the archaeological artefacts of the area, as well as the relevant regulations applied in the area. For this reason, visitor centres hold an important task of interpretation, since through good dissemination activities the visitors' behaviour can be affected in such a positive way, which could lead to the subsequent protection of the site and also with their contribution (financially or voluntarily) on the conservation activities (IUCN, 2004).

A visitor centre can have several components which can serve the aforementioned purpose, with separate areas for displays and exhibits, meetings, slide shows/video presentations as well as interactive educational activities. Although this is not the purpose of this deliverable, brief information on the topics, which could be exhibited and could benefit indirectly the conservation activities is given here as well.

Displays and exhibits focused on conservation could include the following:

- a) Natural history activities (e.g. use of touch-tanks, guess the organism game etc.)
- b) Fun facts about the marine environment and protected species and habitats
- c) Socio-cultural issues related to the protected site
- d) History of the site and of the archaeological artefacts found in the area
- e) Map of the surrounding area and activities offered
- f) Legislative framework regarding what's permitted and what's prohibited in the water
- g) Special courses on correct scuba-diving and snorkelling behaviour
- h) Topics related to the management, protection and monitoring of the site
- i) Ways which visitors can contribute towards the conservation efforts

Raising support for conservation from visitors and enterprises

The promotion and support of cultural and natural tourism can be subsequently enhanced through various alternative ways. Many tourism enterprises realize the importance of the lifelong support of conservation activities to the visitors' enjoyment and thus the long-term tourism-related financial benefits (Carbone *et al.*, 2005). Certain policies can be developed for encouraging enterprises to support biodiversity conservation actions, through supporting the local conservation initiatives financially, or voluntarily. The financial support for the conservation activities can also be obtained through tourists (e.g. with special admission fees, or through members' subscription), providing an important source of income for the managing authorities of the UCNH sites. Tourists can also become engaged in practical ways, for example through participating in conservation holidays.

Guidelines already implemented for the protection of UCNH sites

1. Scuba diving and snorkeling

Scuba diving and snorkelling are two of the most popular marine activities in a protected Underwater and Cultural Heritage site. The increase in the promotion and support of diving tourism during the last years has been correlated to the continuous increase of such activities in these areas, which through bad monitoring and management practices can lead to catastrophic effects for the marine environment. Scuba diving and snorkelling can cause significant damage to the sensitive habitats and vulnerable species of the marine ecosystems, especially if the participants are not properly informed, experienced or supervised. For this reason, according to a number of bibliographic sources (Kreag, 2001, Eagles *et al.*, 2002, IUCN, 2004), it is clear more than ever, how important is to follow and implement certain guidelines, for better control of these activities.

Poor buoyancy control, careless kicking with fins, trampling on the seabed/reefs as well as a number of psychological and physiological reasons, as well as the natural conditions in the seawater can affect the diving behaviour and lead to the damage of sensitive habitats. Additionally, inexperience, or lack of recent experience have been mentioned to affect these activities as well. But, even the most novice divers have been proven to cause environmental damages as well, especially those involved with underwater photography.

Many protected UCNH sites have certain codes of practice or guidelines which should be followed by the scuba divers and snorkelers. These include the following:

- a) Securing trailing equipment, such as gauges.
- b) Making buoyancy checks at the beginning of a dive.
- c) Discouraging the use of gloves to prevent divers from touching or even collecting marine life. Explain the importance of no-contact rule for vulnerable species and habitats.
- d) Explain why walking or standing on shallow areas with sensitive ecosystems should be avoided, as contacts with the seabed during diving.
- e) Accompany novice divers with experienced personnel.

- f) Carrying out practice activities for mastering buoyancy control, and snorkelling for the beginners, away from sensitive marine habitats. Offer refresher courses to divers with little experience, or no recent experience since their last dive.
- g) Good briefings before visitors enter the water, which have been proven incredibly helpful for understanding and appreciating the marine environment and archaeological artefacts, thus wanting to protect it, or minimize any damage caused by personal contacts.
- h) Offer special cultural and environmental courses, as part of normal briefing by dive clubs, specialized NGOs or certified maritime archaeologists and marine biologists.
- i) Avoid using beach access points close to sensitive habitats.
- j) Monitor the impacts of divers and snorkelers through questionnaires.
- k) Limit numbers of divers participating in dives per year, through the estimation of the diver carrying capacity, or the Limits of Acceptable Change.

II. Dive club guardianship of sites

According to UNESCO (2013), the use of controlled site access in the protected UCNH sites, through granting responsibility and guardianship to authorized dive clubs is another way to better control and manage the UCNH sites. As mentioned in D3.2.1, such a system is already implemented in Croatia. Permissions for exclusive access to selected sites can be negotiated by the national authorities and the registered/authorized dive clubs. Through this way, more fragile sites can be opened up to the public without compromising their protection.

The authorized diving clubs pay a specific permission cost to access the sites, after collecting an entry fee from their clients, which financially benefits the national authority and can subsequently support better investment in research, protection and monitoring of UCNH sites. Apart from this the diving clubs guarantee, by contract, the control and integrity of the site, and are responsible for its regular monitoring by a certified underwater archaeologist and a marine biologist. Through this way, the diving community engages more towards the protection, management and monitoring efforts of their country, which supports the development of successful sustainable tourism.

III. Underwater trails

Underwater diving trails are considered an alternative, much more appreciated way of showing the underwater cultural heritage and the marine biodiversity of a protected site to the participated divers. Many underwater trails have been created or are currently being created all over the world, and can offer a new boost to the local marine activities and improve the attractiveness and visitability of specific sites, compared to others (UNESCO, 2013). Through this way the participated visitors can learn more about the history of the area, as well as appreciate more the marine environment of the site, which can be very beneficial for the indirect conservation actions. Through this way, the visitors learn the importance of protecting the visited site and are more eager to financially and voluntarily contribute towards its protection, conservation and monitoring through citizen science activities (UNESCO, 2013).

Whether guided or not, underwater trails also required to follow specific guidelines, in order to prevent the cause of environmental damage related to their operation, or the participants' actions. For this reason, according to IUCN (2004), the following are being suggested:

- a) They must be designed in such a way to prevent the concentration of too many divers at fixed points, which could lead in damages.
- b) Rest stations (e.g. poles and floating inner tubes for snorkelers and divers) can be installed.
- c) In case underwater signs are installed, they should be placed in areas away from sensitive habitats or species. Such signs are often difficult to read, need regular and careful cleaning from algae and other fouling organisms, thus their use should be within reasonable limits.
- d) The use of numbered markers with portable waterproof information sheets explaining each point, carried by the supervisor diver might be preferable for providing information.
- e) Briefings in advance about the trail should be carried out.
- f) Visitor numbers and group sized should be monitored regularly and adapted accordingly if required, to prevent damage.
- g) The underwater trails should be periodically closed to aid recovery.

- h) They should be sited away from waves and strong currents for safety reasons, and in water they should be sufficiently deep to avoid fin damage, however shallow enough to provide good viewing. A minimum depth of 2.2m is recommended.

IV. Glass-bottom

Glass-bottom boats offer the opportunity to view the protected UCNH site, without getting wet, to those who prefer it this way. Although it is a less direct experience than scuba diving or snorkeling activities to the sites, they are very popular as well during the past years. As mentioned in the third chapter, they can also cause damage to the protected site, mainly due to anchoring or operating in shallow waters. For this reason, boatmen should be trained accordingly and informed on what to avoid and why this is extremely important for the marine environment. Boats should be well maintained, and mooring buoys should be installed near popular viewing areas.

V. Metal cage protections and underwater display

As mentioned in D3.2.1 metal cages have been installed over many Roman wrecks in Croatia, as a way to protect the important cultural artefacts of the areas and diving has been permitted only to the approved diving clubs. These cages are very large, and permit diving into them, or to see through them, as long as algae are removed regularly. Although metal cages have been reported as an excellent initiative, according to UNESCO (2013), they can also cause some negative effects to the underwater cultural and natural heritage sites. Additionally, when they are not properly cleaned or maintained, fixed and monitored, they can also pose a threat to the visiting divers. For this reason, maintenance efforts should be kept in order to ensure the divers' safety, in such a way however, to subsequently ensure the environment is not negatively affected.

VI. Replica site construction

According to UNESCO (2013), the construction and use of replica sites can be a way to remove some pressure from the affected UCNH sites, and help address the issue of over-storage land-based museums. Through the creation of replica sites in areas where minimum damage to the environment is ensured (through the legislative framework and guidelines), the visitors can continue learning about the history of the site and the importance of the marine environment, without causing any damage to the original archaeological artefacts. However, an authentic site is always considered more significant and thus preferable, for this reason the importance of constructing replica sites should be sufficiently explained to the visitors.

VII. Zone specific access and special training

The implementation of specific zoning areas within a protected Underwater Cultural and Heritage Site has been reported to offer an appropriate level of protection, to a range of representative species and habitats (Hammerton, 2017). Through the application of multiple-use zoning, the conservation efforts are being maximized, by the spatial separation of activities that pose different degrees of threats or/and benefits, including the tourism-related activities. This can provide better management and monitoring of the protected site, and overall increases the conservation efforts.

Apart from this, through the restricted access to the particularly sensitive areas, to the divers with no recent experience or information on the site can contribute to the overall protection of the cultural and natural heritage. For this reason, managing authorities, or the authorized diving clubs which organized diving tours in the UCNH sites, usually offer refresher training sessions with the diving operators, as a prerequisite for diving. These has been successfully implemented in a handful of popular diving locations, including locations in the Red Sea, Egypt, Heron, and in Lady Elliot Islands in Australia, where divers have to complete a qualifying dive prior to open water dives, in an either shallow house reef, or a refresher pool session (Hammerton, 2017).

Additionally, as reported by Hammerton (2017), planned dive tours can also contribute towards the minimization of contacts with the sensitive habitats. As mentioned, narrow-trenches and caves have been considered as habitats which are especially susceptible to diver contacts. For this reason, guides usually prefer to avoid those areas, since this way they lower the environmental impacts associated to the divers. A different measure is to rate popular diving locations based on a sensitivity index and allow access to the divers who are considered sufficiently experienced, and who have the skills and knowledge required for each diving zone. This is something which can be easily accepted, since special certifications are already required for diving in specific habitats, like the cave diving qualifications.

With the introduction of a rating system based on the complexity and sensitivity of the reef, combined with the divers' levels of skill and experiences, a reduction on diver impacts associated to seabed-contacts could be achieved more successfully (Hammerton, 2017). Through this way, the interested divers have an opportunity to refamiliarize with the diving equipment, thus gain more in-water comfort, and improve their underwater techniques, such as practicing basic recreational diving skills, which in turn can boost their confidence and improve their fine-tuning buoyancy and trim.

Additionally, a supervised ocean dive can give them the opportunity for in-water assistance, which contributes at reducing contacts with the seabed or the archaeological artefacts. This can be very important to the divers who use photographic equipment, who have been reported to be responsible for the majority of seabed contacts (Hammerton, 2017). When these measures are combined with gaining post-dive feedback through questionnaires, the management system implemented can be improved through their suggestions. Additionally, this feedback can offer an opportunity for marketing of extra diving courses for improving the visitors' skills and knowledge background, which can have an additional financial benefit to the diving clubs.

Conclusions

Underwater Cultural Heritage (UCH) is considered one of the keys in unveiling the details that shaped the development of human civilisation. Through the preservation and scientific research on the submerged prehistoric sites, shipwrecks and sunken cities, we can learn a lot about the cultural exchanges, trade relationships and influences of the past. Additionally, information regarding the local life of those days, the religious ceremonies and sacrifices the people made in the past can help us understand their way of life (UNESCO, 2013).

When no proper management measures and controls are implemented in an area of high ecological and archaeological importance, then unplanned tourism growth can result to an important environmental and cultural degradation, which in the end could destabilize the longstanding tourism growth. In order to ensure that people's ability to visit those sites would not jeopardise the efforts towards their protection and preservation, specific management and preservation measures are usually taken and enforced.

Through this deliverable, the positive and negative environmental effects related to the operation of Underwater Museums and Diving Parks have been reported in detail. The operation of Diving Parks, Underwater Museums and diving tourism in general can result in important positive socio-economic benefits (UNESCO, 2013). According to Barker and Roberts (2004), the economic benefits gained through the payment of entry fees in a marine park, can contribute significantly towards the overall costs needed for the area's management and protection. Moreover, through the protection of underwater archaeological areas and the operation of underwater museums and diving parks in such areas, a number of social, educational and cultural benefits can be achieved as well.

However, despite the overall positive benefits related to the operation of UM, DP and diving tourism in general, is it considered by many that the environmental impacts linked to tourism activities can outbid those benefits. In order to have a better understanding of the causes of the negative effects, through this deliverable links with the impact-related activities have been reported in detail.

Environmental impacts were more highly associated to snorkelling, scuba diving and trampling on protected sites. A variety of reasons, including the divers' experience (including diving qualifications and recent diving experience), as well as a variety of physiological, psychological reasons and the environmental conditions in the sea have been associated to increased contacts with the seabed. Apart from these, underwater photography has been reported numerous times as one of the most common reasons for increased contacts. Apart from this anchoring of vessels to the seabed and not on buoys, vessel groundings, fish feeding activities and souvenir-keeping behaviours have been reported as well to cause environmental damage, one way or another.

An effort to collect information regarding the environmental impacts caused from the wrecks per se, or from the archaeological research activities for the preservation of archaeological artefacts has been attempted as well. However, as reported in the relevant sub-chapter, there is currently very limited knowledge focusing on this. Although archaeological surveys are often characterised by the multidisciplinary approaches they follow, this does not seem to be the case in scientific writing. Most studies focus only on the one side of effects, studying mainly the effects the environmental conditions can cause to the preservation of archaeological artefacts. There are also a few studies investigating the role those conditions play(ed) for the initial preservation of the wrecks (Robinson, 1981). For this reason, it is now clear that a more holistic approach should characterize research and scientific writing on UCNH sites, taking into consideration the benefits and possible effects to cultural and natural heritage.

Aiming to further enhance the material regarding the guidelines already implemented for the successful protection and conservation of the environment, data from bibliographic sources was also collected and presented in this deliverable. Specifically, information regarding the usefulness of tourism-focus policies and plans, as well as the need of implementation of national laws for the protection of the environment and cultural heritage from tourism-related activities have been presented. The identification of the common line of practice, the common interests, or concerns as well as the common impacts that can be caused from

touristic activities has been reported as well, as a vital practice for the successful operation of tourism and for the better resolving of such issues.

Proper control of scuba diving activities has been reported numerous times as the key for minimizing contact-related impacts to natural and cultural heritage. This includes many approaches, such as the estimation of diver carrying capacity of an area, which sets the acceptable limits in numbers of divers allowed per year, before damage occurs, although this has been proven quite difficult. Another measure included the specification of required qualifications by both divers (visitors) and operators, as well as the restricted access to special zones or habitats based on the level of experience or the area's sensitivity.

The use of diver guardians of the protected sites has also been reported as one of the most successful ways of in-situ monitoring and management of the area, through better control of the diving tours. This measure is already implemented in the countries where BLUEMED's pilot regions are (Croatia, Greece, Italy). Croatia however, has been praised by UNESCO (2013), as an example of good practices, since they established a system of authorized access to diving clubs, allowing more underwater sites of cultural and natural heritage importance to be explored by visitors. Underwater trails have also been suggested as a good way of visiting an UCNH site, since through this controlled way divers can learn more about the history of the site, and the importance of the area's marine biodiversity. Other measures/guidelines which should be followed by the operators of glass-bottom vessels were also given, as well as information regarding the metal cages used for the protection of archaeological artefacts.

Finally, information regarding the development and implementation of a successful communication plan, focusing on the importance of ecosystem conservation has been reported as well. According to IUCN (2004), activities focusing on visitor cultural and natural awareness can play an essential role towards the indirect conservation of UCNH sites. Through successful communication with the visitors (e.g. through educational programmes, visitor centres, using the media and other publicity materials), both the visitors and the local can built a better appreciation for the cultural and natural richness of the area. Additionally, through such activities they can realize the important role managing authorities play, as well as the

legislative framework applied for conservation purposes. Lastly, their interest in contributing financially, or voluntarily, as a community can be enhanced, when the realization of the overall benefits of sustainable tourism come clear.

Taking into consideration all the aforementioned topics and overall suggestions, it is easy to understand that efforts aiming towards the protection and conservation of the cultural and natural heritage should be addressed in a multidisciplinary way. Finding commonality is the key towards successful efforts of cultural and natural conservation of the sites. Through the identification of the overall effects (both positive and negative), the causes linked to each touristic activity as well as the overall benefits gained for all those different sectors (e.g. environment, economy, society, culture, education etc.), and through the implementation of common strategies, the goal of achieving sustainable tourism seems more feasible.

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