Underwater Cultural Heritage as an Engine for Social, Economic and Cultural Development. State of Research at the University of Cadiz (Andalusia, Spain)

Carlota Pérez-Reverte Mañas [1,*]**, Felipe Cerezo Andreo** [1]**, Pablo López Osorio** [2]**, Raúl González Gallero** [1]**, Luis Mariscal Rico** [2] **and Alicia Arévalo González** [3]

[1] Line of Underwater Archaeology, Department of History, Geography and Philosophy, Cádiz University, Av. Dr. Gómez Ulla, 1, 11003 Cádiz, Spain; felipe.cerezo@uca.es (F.C.A.); raul.gonzalez@uca.es (R.G.G.)

[2] Department of Computer Engineering, Campus Universitario de Puerto Real, Cádiz University, CASEM—Escuela de Ingenierías Marinas, Náutica y Radioelectrónica, 11519 Puerto Real, Spain; pablo.osorio@gm.uca.es (P.L.O.); luis.mariscal@uca.es (L.M.R.)

[3] Department of History, Geography and Philosophy, Cádiz University, Av. Dr. Gómez Ulla, 1, 11003 Cádiz, Spain; alicia.arevalo@uca.es

* Correspondence: carlota.perezreverte@uca.es

Abstract: Public access to underwater and maritime cultural heritage has proven to have a very positive effect on the local economy. This type of heritage is very attractive for the cultural tourism sector in general and for active and diving tourism. The Nautical and Underwater Archeology Line of the University of Cadiz, within the framework of the TIDE Project (Interreg Atlantic Area) and Herakles Project (FEDER-UCA18-107327) have been working on the enhancement of maritime and underwater heritage through the application of new technologies. In this paper, we will present the advances in the project in the Strait of Gibraltar, based on the first phase of scientific analysis and on the definition of a common working methodology that has resulted in a toolkit for the development of tourism activities linked to the MCH and UCH. Pilot activities under development are focused on accessible underwater heritage routes, VR applications to create Dry Dive experiences and the streaming of underwater archaeological works, thanks to a bottom-surface acoustic communication buoy. Results show that these types of outreach solutions and, by extension, of tourism application, must be preceded by a rigorous archaeological research process, a study of the target audience and the evaluation of the carrying capacity of the sites, to avoid falling into the mercantilisation or deterioration of the UCH. On the other hand, virtual or indirect access solutions are very useful, but always through the correct interpretation of the heritage.

Keywords: underwater heritage; underwater accessible heritage; VR applied to underwater heritage; shipwreck; Strait of Gibraltar; underwater heritage toolkit; underwater communications

1. Introduction

The development of scuba diving and technology, which has been fundamental to the evolution of underwater archaeology, has also encouraged an exponential increase in sport diving [1]. As a consequence, the plundering and destruction of UCH have reached unprecedented levels [2,3]. Given the difficulties and limitations faced by administrations in the protection and control of the enormous underwater archaeological heritage, education is an essential measure for its conservation as stated in the UNESCO Convention on the Protection of the Underwater Cultural Heritage [4]. In Spain, The Green Paper shares this position and highlights the need to build a clear and powerful, suggestive and rigorous, image of the true nature of UCH, with special emphasis on these aspects: knowledge and understanding, and citizen involvement and responsible access, recalling that "the involvement of fishermen, divers and local inhabitants in the conservation of local sites has been shown to be the most effective measure of protection" [5] (p. 59).

Awareness-raising and education favour the involvement of communities and their active participation in the protection of this heritage, not only because it turns them into "guardians of the past" [6,7] but also because it has a direct impact on the local economy, fostering sustainable development and strengthening the idea that preserving heritage has more advantages than passively witnessing its despoilment. Thus, socio-cultural and economic development is currently considered by a growing number of authors as one of the social functions of UCH and an essential line of work for its preservation, especially in developing countries or socially depressed areas [8–13]. Tourism has begun to play an important role in this regard.

If the potential of UCH for tourism development was already outlined in the Regional Seminar on Underwater Archaeology held in Italy in 1983 [2] and in the ICOMOS International Charter on the Protection and Management of the Underwater Cultural Heritage [14], today, UNESCO itself links UCH with tourism [15,16]. The European Commission does as well, which, in its Communication on a European Strategy for More Growth and Jobs in Coastal and Maritime Tourism [17], invites member states to develop tourism based on cultural heritage and underwater archaeological parks.

The Blue Tourism sector (developed on coastal spaces and including heritage resources) has been identified as an area of particular potential within the EU Blue Growth Strategy and it is the most important tourism subsector in Europe [18]. Even with the recession brought on by the COVID-19 virus, current policies are still committed to boosting this sector as a recovery engine for the economy [19].

In Spain, as well as in much of the Mediterranean, this model is of particular interest. Tourism in coastal areas has changed its policies in recent years, seeking diversification and considering UCH-related experiences as an important ally when it comes to diversifying what is on offer for tourists and breaking with the seasonality that characterises the model based on the sun and beach binomial, so widespread in these areas, and considered now to be obsolete, harmful and of low economic performance. UCH has not gone unnoticed in this sense and this new social interest has led many national and local development and management plans to consider it as another tourism resource.

The framework offered by European policies, with regard to Blue Tourism, is based on responsibility and systemic sustainability and there are important benefits to be found in this UCH-tourism tandem [16,20]; however, there are also potential risks to be considered in this relationship. Some of the main ones include: generating or perpetuating extractive models, in which the social, cultural and economic benefit does not fall directly on the host community; generating low-quality employment; the distortion of cultural values; the loss of historical rigour, and the displacement of culturally related groups; the commodification, degradation or loss of heritage [21,22].

In 2015, the Nautical and Underwater Archeology Line was created at the University of Cádiz. It is the first time that space for training, research, conservation and dissemination has been created in a Spanish university, focused on Underwater Cultural Heritage (UCH).

Since its foundation, one of the main objectives of the Line has been the training of new professionals through a specific master's degree and a doctorate program. At the same time, in collaboration with other researchers, it has been possible to provide the institution with a conservation and restoration laboratory and a new technologies and virtual techniques laboratory applied to the documentation and dissemination of heritage. Of note, is the UCADIZ, the oceanographic research vessel, which is frequently used by researchers on the Line.

Among the usual tasks of the Line is the research and dissemination (Table 1) of the UCH. There are currently three research projects with regional funding and two with European funding that are active. In all of them, the dissemination and communication of heritage are promoted as some of the most relevant objectives.

Considering both the benefits and the aforementioned risks, at present, most of the activity of the Nautical and Underwater Archaeology Line of the University of Cádiz is taking place in the Bay of Algeciras. The Bay of Algeciras is located in the south of the

Iberian Peninsula, on the northern shore of the Strait of Gibraltar: a meeting point between the Atlantic Ocean and the Mediterranean Sea of extraordinary historical, maritime, archaeological and natural interest (Figure 1).

Table 1. Activities and dissemination projects conducted over the previous five years at the University of Cádiz.

| Project Code	Project Name	Date	Type
FCTA2020-07	Steamboat UCH Route and Itineraries	2000–2021	Underwater Routes + VR
FEDER-UCA18-107327	Herakles Project	2020–2023	Underwater Routes + VR
EAPA_630/2018	TIDE: Atlantic Network for Developing Historical Maritime Tourism	2019–2022	Underwater Routes + Exhibition
AD2019-007	Exhibition: La Caleta (Cádiz): Between the Land and the Sea	2020	Exhibition
DIV2019-005	Modelling UCH artifacts at Algeciras Bay	2019–2020	3D Modelling
AD2019-014	UCH in European Researchers' Night	2019	Public Awareness
FCT-18-13006	UCH in the school.	2018	Public Awareness
AD2018-092	UCH in European Researchers' Night	2018	Public Awareness
AD2016-005	UCH in 3d prints. La Caleta Sites	2016	3D Modelling
AD2015-021	UCH in European Researchers' Night	2015	Public Awareness
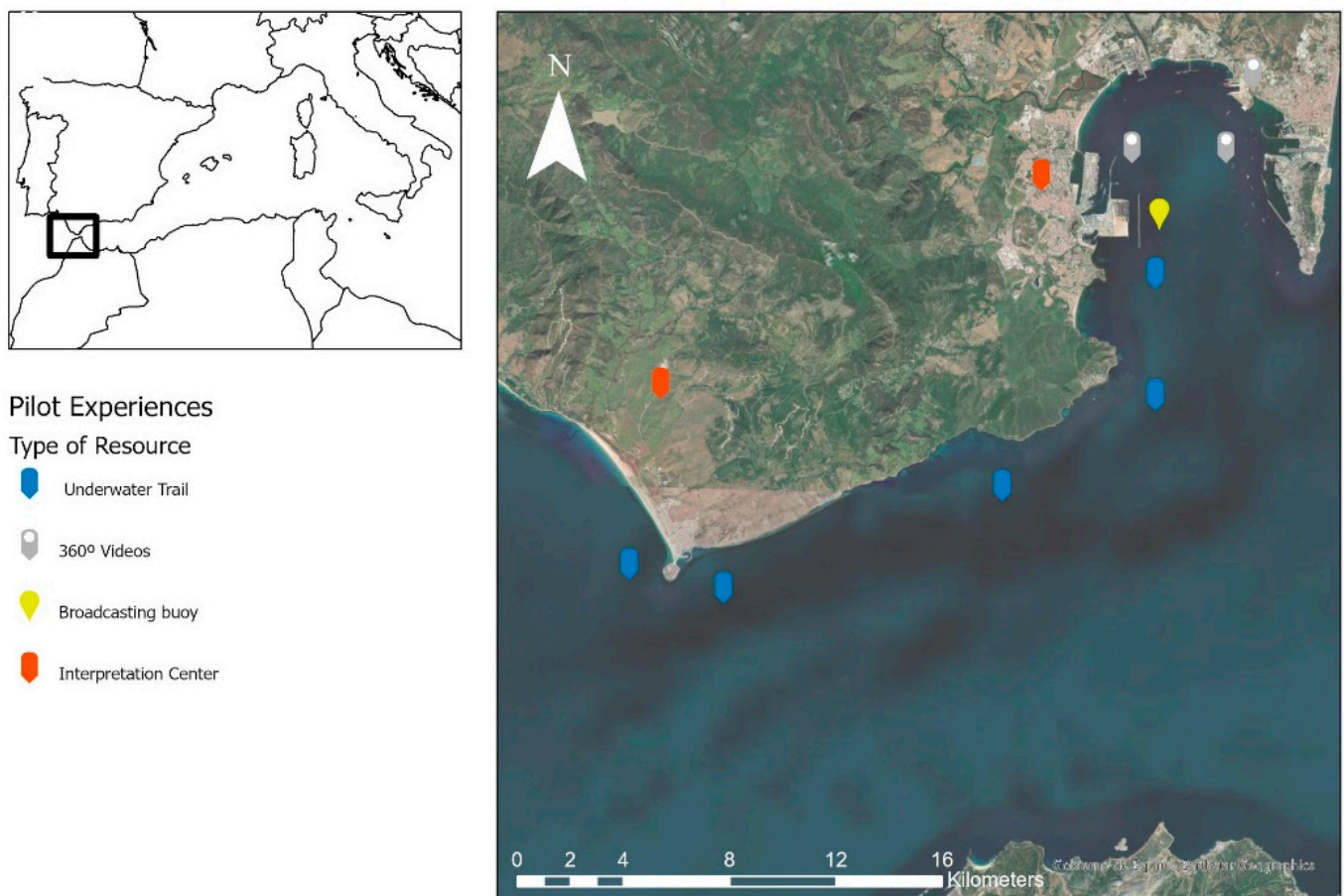
Figure 1. Regional location of the project activities.

From a nautical and maritime point of view, the Bay of Algeciras and the Strait of Gibraltar represent a crossroads of navigation routes that, from protohistoric times to the present, have connected the Mediterranean with the Atlantic, and Europe with Africa, and eventually America. As a result of this intense maritime traffic and the importance as a refuge area of the bay, we have numerous and varied heritage remains that help us to study

and tell the nautical and maritime history of a place that has always been in contact with countless cultures.

This wealth of heritage (with shipwrecks and maritime activities dating from the Phoenician period), at the same time, contrasts with a current problematic situation.

The area suffers from one of the highest unemployment rates in all of Europe, conditioned by a tourist model of sun and beach. At the same time, it is a problematic point due to drug trafficking, with the fight against it being one of the highest economic priorities of the municipalities. Port activity, of great development in the last 40 years, making Algeciras the second most important port by number of containers in Europe, here, becomes a threat to the conservation of this heritage, having lost ancient harbour areas and possibly the wrecks that should remain in them.

However, this heritage wealth is precisely an opportunity to propose a development model based on the cultural values of the area and the maritime and underwater heritage. Thanks to the involvement of stakeholders, such as the Estrecho Natural Park (PNE, Spanish acronym), the Algeciras City Council, small local active tourism companies or diving centres, coordinated by the Spanish Federation of Underwater Activities, actions are being developed in which the education of the public, the interpretation and the protection of heritage, are the main objectives.

To this end, the University of Cadiz is working in this area through an international project, "TIDE", and a national project, "Herakles".

2. Methodological Developments

TIDE, or the Atlantic Network for Developing Historical Maritime Tourism (EAPA_630/2018), is an Interreg project which aims to identify resources and develop possible specialised tourism packages in relation to the maritime and underwater heritage shared by the regions of the Atlantic area. The frame of work is focused on the Napoleonic Era, The Great Armada, the European Migrations in the 19th century, and The World Wars. Among its outcomes, TIDE expects to develop and market new types of multi-regional activities for Atlantic visitors through the exchange of resources based on the shared heritage between regions. In this sense, it highlights the use of new technologies and transnational collaboration tools. This project is 75% Interreg funded and has a total budget of 2,462,267.52 euros. The foreseen dates of development are from 1 May 2019 to 30 April 2022. The partners include organisations, regional and local public institutions, virtual reality companies, universities, tourism boards and development associations from Newfoundland and Labrador in Canada, and Donegal, Sligo, Derry and Strabane, Devon, Loire, Cantabria, Cadiz and Madeira in Europe [23].

It is important to note that the TIDE Project is conceived as a research project. In this sense, there are different lines of work.

2.1. Research

In this phase, an exhaustive bibliographic study, and the analysis of more than a hundred practical cases related to tourism products linked to maritime and underwater heritage was carried out with the collaboration of all the partners and through a doctoral thesis developed at the University of Cadiz [22]. The objective was to create a methodological framework that would allow all the partners to work under the same parameters. This research also resulted in a toolkit, already available on the Project website [23].

Tourism Toolkit for European Maritime and Underwater Cultural Heritage

The success and long-term stability of maritime and underwater heritage-based tourism products depend on the balance between social and heritage needs and requires a proper planning and development strategy. To address these challenges and facilitate this process for other stakeholders, Atlantic Area-funded TIDE has launched the "Tourism Toolkit for European Maritime and Underwater Cultural Heritage", developed by the University of Cádiz.

This toolkit contains a collection of good practices, knowledge, methods and tools to aid historical site identification and tourism product development. It presents a series of exercises designed to help those responsible for the development and promotion of these sites to piece together the elements of a comprehensive management framework. It outlines a strategy that ranges from initial site identification to the creation of a narrative, and environmental preservation and enhancement using digital transformation technologies to enrich visitor experiences. The expertise of the TIDE partnership has ensured that the toolkit is rooted in practical realities and the requirements of the end-users.

It is a toolkit for the identification and enhancement of maritime and underwater heritage. It follows UNESCO's guidelines, even though not all the countries that are part of the project have signed the Convention. It is currently being used to develop the pilot experiences, and in Donegal, it is also being used by all the institutions involved in maritime heritage in the area to develop new strategies for dealing with the crisis caused by the COVID-19 virus.

2.2. Development and Implementation of Pilot Experiences

In this phase currently underway and based on the general guidelines established after the research, the different partners are developing, together with their respective stakeholders, a series of pilot experiences based on maritime and underwater heritage. In the case of the University of Cadiz, also supported by the Herakles Project (FEDER-UCA18-107327) and the Steamboat Route Project (FCTA2020-07), the lines of work are as follows:

2.2.1. Underwater Routes

Trails are a way of organising space and giving it a narrative through a combination of physical and cognitive elements. They "can be used to increase visitors' and local communities' appreciation and active engagement with places"; and their flexibility to incorporate "both tangible and more experiential place-based features in their story-telling" suggests that "these popular attractions can contribute to a much more nuanced and rewarding experience" [24].

As mentioned above, in the case of UCH, the link between knowledge, social participation and protection is widely accepted, and there is an increasing number of initiatives and work along these lines, with special emphasis on the sport diving environment. On the other hand, and as stated in the UNESCO Convention on the Protection of the Underwater Cultural Heritage [4] new researchers and new trends increasingly favour in situ preservation and access to underwater sites [25,26], not only for conservation reasons [27–29], but also to preserve the context that gives meaning to the heritage and the relationship between the different elements offering important educational opportunities [7,30–32]. Furthermore, it opens up new possibilities as a new tourist–cultural resource in a market generally saturated with dives based on the observation of marine life or geological environments.

In our case, we are carrying out this approach from a research perspective to quantify and measure the impact of visits on the site and also on the surrounding economy.

Collaboration agreements have been established with local entities (stakeholders) to develop various routes that meet our educational objectives, but also with the sustainability and economic profitability necessary to maintain these experiences. It also seeks to introduce other elements in the discourse, such as the preservation of the marine environment. There is a total of five routes in five archaeological sites, all of them in waters that have a degree of environmental protection as they are part of the PNE.

Four 19th century wrecks have been selected. They are steamships that accidentally sank off the shores of the Strait of Gibraltar and that allow us to observe the evolution of steam navigation and the technological evolution of iron shipbuilding. The other wreck is the Ballenera wreck, a merchant ship from the late 16th century with a shipment of Ligurian pottery and plates with Maiolica decorations. In addition, the shipwreck is located in a

historical anchorage, with an abundance of anchors and other objects with a diachrony dating from the 4th BC until the 19th century.

The wrecks are:

- Ship S.S. Cingalesse (Algeciras). It sank in 1878 at 12 m deep. Steamboat;
- Ship S.S. Queen Elisabeth (Algeciras). It sank in 1875 at 5 m deep. Steamboat travelling from Alexandria to Southampton;
- Ship S.S. Don Juan (Tarifa). It sank in 1837 between 25 to 35 m deep, one of the oldest steamboats known in the strait;
- Canary Islands wreck (Tarifa). French merchant ship that sank in 1893 near the Tarifa Island;
- La Ballenera (Algeciras). Late 16th century merchant shipwreck. Wrecked while in charge of Ligurian and Majolican pottery.

In collaboration with the PNE, a certificate is being created, a "Passport of the Underwater Archaeological Heritage of the Estrecho Natural Park", in which each diver can seal each of the dives made within the itineraries offered by the PNE, in collaboration with the clubs and diving centres involved. This seal will be awarded to divers who have attended the best practices and information talks on each wreck/archaeological site offered.

It is necessary to establish a management model to carry out the dives of the Underwater Archaeological Heritage Route of the Estrecho Natural Park so that the dives that are carried out in any of the five wrecks presented in the previous sections must be carried out through diving centres or clubs authorised by the Estrecho Natural Park. It is also necessary to be certified by the PNE after an information and training session by those responsible for the diving centre or club.

This training and certificate are based on education in good practices and responsible diving by centres and divers. The training program is being carried out between the PNE together with the University of Cadiz and the Andalusian Underwater Archaeology Center. Diving clubs or centres that want to offer dives in the established sites, must previously carry out the training that must be renewed annually. Anyone interested should dive through these centres or clubs certified by the PNE.

Once the diving centre or club is certified, it must carry out a briefing prior to the dive where it will inform users of the interpretive points to see in the underwater itinerary, emphasizing historical and cultural data, as well as the ecological values of the environment.

The selection of these wrecks have been made in accordance with the patrimonial interests, the storytelling, and the interests and needs of the stakeholders who collaborate in the project, in this case, the Estrecho Natural Park, the Foundation of the Technological Campus of Algeciras and the Spanish Federation of Underwater Activities (FEDAS, Spanish acronym). In addition, an important factor in choosing the wrecks has been to try to regulate what is, today, a common practice: diving centres and some recreational divers already visit these sites, but, in general, without adequate training on diving in archaeological sites, nor knowledge on the history of the sites they are visiting.

In the fieldwork phase, the carrying capacity of each site is being evaluated based on the scarcely known bibliography. In parallel, several evaluation dives are being performed for archaeological research and the development of storytelling. The investigation of the sites is very important, it is not possible to communicate and interpret what is not known and, therefore, it has not been investigated, that is why it is very important that every process of communication and interpretation of heritage is preceded by correct research and evaluation of its fragility and conservation [21].

2.2.2. Virtual Heritage: Dry Diving Enriched with Augmented Reality

Virtual heritage is "the use of computer-based interactive technologies to record, preserve, or recreate artefacts, sites and actors of historic, artistic, religious, and cultural significance and to deliver the results openly to an audience in such way as to provide formative educational experiences through electronic manipulations of time and space" [33]. It involves a number of functions to facilitate the synthesis, conservation, reproduction, rep-

resentation, digital reprocessing, and display of cultural evidence with the use of advanced VR imaging technologies [34]. The benefits of virtual heritage are especially relevant in the case of UCH due to its lack of visibility, its fragility, the limited access, and the abstract concepts and complex realities it is linked to (trading routes, sailing technics, etc.) [35]. Virtual museums have been the focus of interest lately as an effective way to stimulate interest in UCH and there is a growing number of related experiences in different countries [36,37]. Virtual heritage allows us to establish connections between different objects and their context; to improve the readability by the non-specialist public; to facilitate the understanding of concepts and realities; to combine tangible and intangible manifestations and information from different sources and disciplines; to generate more relevant visitor experiences [38]. The learning-by-doing system and the visual quality of these tools accelerate the formation of an emotional bond with the heritage and increase the visitor's engagement, facilitating their learning and elevating their degree of interaction [39].

Moreover, the developments of underwater photogrammetry and 3D models of submerged cultural assets have opened new paths "to improve the digital accessibility to both scholars and the general public. (. . .) These kinds of applications can benefit from the edutainment approach in order to educate, entertain and inspire the wider public through creative storytelling and self-motivating learning" [40].

Considering all this, the benefits of controlled and directed access to heritage through virtual resources, in this case, are numerous in order to educate divers and the public to appreciate significant sites for their natural and cultural value considering not only the historic shipwreck sites and their interpretation but also the natural environment where they are located, the species of fauna and flora they harbour, etc. In sum, to make the public aware of the archaeological heritage value and the natural wealth that the Strait of Gibraltar has, not only on land but also underwater.

Virtual solutions can adapt their message to different levels of the public depending on their interest, training and even time available for the visit. The professionalism of those responsible for developing the scripts, content and format of these communication elements is essential to achieve a truly useful product to disseminate the values of the UCH del Estrecho.

In this framework, and thanks to the synergies generated with our partners of the TIDE project, 3d scans are being carried out using underwater photogrammetry of objects from the study wrecks, as well as virtual visits through 360° videos so that visitors and the public who cannot or want to dive can approach this heritage using virtual reality glasses

This allows three objectives to be addressed. On the one hand, to educate the public that will not be able to access this heritage, reduce the stress to which an immersion zone can be subjected, and at the same time, it is an attraction that will allow the public to promote initiation into diving and respect for heritage.

In this case, two main collaborators will host these solutions, the Estrecho Natural Park and the Algeciras Museum, which will house a permanent interpretive space on the UCH of the Bay of Algeciras and the Strait of Gibraltar, and where they will have four Oculus Go glasses, so users can perform these virtual dives.

2.2.3. Underwater Streaming: Real-Time Broadcasting Buoy

Between direct access to heritage in situ and completely virtual access, a third way of working opens up, halfway between digital and analogue: accessibility through live audio and video broadcasting from an underwater site. Thus, an underwater archaeologist guide can give a tour of a site or show the underwater work of his or her colleagues to an online audience. These types of highly visual, educational and interactive experiences have proven very useful for increasing the level of awareness on the archaeological and environmental heritage, allowing the public to experience the underwater environment in a non-invasive way [41]. In this case, the process is developed through a real-time broadcasting buoy.

The purpose of this buoy is to capture and transmit both underwater images and weather conditions in the environment of the site to be studied, all autonomously, wirelessly and in real-time.

Considering that these wrecks are located at a distance of between 50 and 200 m from the coast, it will be possible to equip the buoy with an antenna that transmits all the data captured through a closed Wi-Fi network, where the transmitter will be the omnidirectional antenna installed on the buoy and the receiver will be a portable station on the coast, which will be responsible for ordering the data received and, depending on the needs of the moment, store these data for later processing or display them in real-time in museum complexes.

The entire system of cameras, sensors and other electronic components will be constantly powered by three batteries interconnected in parallel, installed inside the buoy, and powered in turn by three solar panels that will ensure a much greater autonomy to the entire system, since at the time when the batteries begin to supply energy to the data capture and transmission system, the solar panels will recharge these batteries, extending the maximum time the system can work.

As for real-time image capture, it is possible to use up to a total of five independent cameras to place them where desired, since they have 50 m of underwater cable between each of these and the hub concentrator, so it is estimated that it is enough to observe a wreck in its entirety without losing areas that may be interesting for the study. In addition, it is possible to slightly modify the angle of the cameras remotely, so it would not be necessary for the team of divers to be on the seabed every time they want to make a brief modification of the position of any of the cameras.

Furthermore, between the hub and the surface of the buoy, there is a single 100-m cable that handles both the power supply to the camera system and the wreck-to-surface communication, thus, eliminating a large amount of additional cabling, providing the system with a great capacity for modification and adaptation.

To capture water conditions, a triple sensor will be used to collect parameters such as temperature, pH, ORP, conductivity, salinity, TDS, oxygen saturation percentage or the current turbidity of the water where the wreck is located.

Finally, the buoy will be equipped with a weather station installed on the upper part together with the omnidirectional antenna, which will allow knowing parameters such as wind speed and direction, air temperature, barometric pressure or relative humidity, among others, as well as the real-time position of the buoy thanks to the global positioning system (GPS) incorporated in the station.

3. Projects and Findings

3.1. Underwater Routes

As stated previously, our goal with this research project is not only to develop certain experiences and evaluate the direct impact (i.e., on heritage and divers) but to extend our view to the social and economic aspects of the area. For this purpose, it is necessary to develop a known and adapted methodology capable to properly involve stakeholders and other agents related (private and public), balancing the needs of research and dissemination, of heritage and the local community. That is, from our perspective, the only way to ensure long-term sustainability.

For this, work is being carried out on three parallel lines: to define the appropriate management model; to define the education strategy for diving centres and divers; to evaluate the carrying capacity of each site.

These lines of work begin to offer the first results. Regarding the first line, a management model that allows control of access to routes and guarantees continuous training and education of the visitor has been defined in collaboration with diving centres, the Department of Culture and the Estrecho Natural Park. This model is inspired by the one used to manage dives in protected natural environments of the Estrecho Natural Park. It

involves public and private entities and, as has been said, aims to normalize and regulate an activity that is already being carried out without the necessary rigour.

The work scheme is as follows: after studying and establishing the heritage diving points, the Estrecho Natural Park and the University of Cádiz, based on a series of quantitative and qualitative factors, define the carrying capacity of the site and the museum resources (this is the phase in which we are working now). The Estrecho Natural Park installs an anchor buoy to prevent the diving centre boats from anchoring freely by dropping their anchor, and the damage that this action can produce for the natural and cultural environment. Once the immersion point has been established, those diving clubs or centres that want to offer the immersion must undergo training given by the University of Cádiz and the Estrecho Natural Park on responsible diving and an interpreter guide for the UCH, following the standards established by UNESCO, CMAS, FEDAS (Spanish Federation for Diving Activities) and the criteria of each site evaluated by the University of Cadiz. With the training carried out, diving centres will be able to offer cultural immersion, and visitors will receive a talk about responsible diving in underwater archaeological sites and in the Estrecho Natural Park. During the first dives, divers and guides will be asked to fill out a series of surveys in order to evaluate the experience and propose the necessary corrective measures.

Currently, we are in the phase of evaluating the carrying capacity of the sites. In some of them, experiences of visits with divers of different levels have already been carried out to quantify, for example, aspects such as the turbidity of the water caused by inexperienced groups, the number of touches on the bottom, the dive profiles, the duration of the dive, etc. Principles that we borrow from the assessment of carrying capacity in the natural environment in terrestrial sites or the many experiences of coral reefs that are currently being applied. We are working on converting quantifiable variables of these equations to calculate the number of divers that an archaeological site may have, depending on the type of bottom and site, the exhibition resources, the length of the route, and the fragility of the cultural asset amongst other factors.

We are also experimenting with different exhibition materials (such as underwater informative signs) to evaluate their long-term durability, as well as their sustainability with the environment. All these solutions are being developed looking for sustainability and easy replacement in case of destruction by the natural environment (storms) or by vandalism.

3.2. Virtual Heritage: Dry Diving Enriched with Augmented Reality

In reference to virtual tours in archaeological sites, we have been able to verify that it is a technique that can be applied to a multitude of sites and greatly facilitates public interaction and rapid "immersion" in underwater heritage issues, as it is a very straightforward way to feel like part of a team diving in and exploring a heritage site.

For this experience, Oculus Go glasses are being used and the images are recorded with an Insta One x2 camera. This is a technological solution that is not very expensive and that may be available to various institutions or centres dedicated to the dissemination of UCH.

Two types of technological solutions are being carried out, one by recording an exploratory tour of a site, without any type of audiovisual complement, and others incorporating text or graphics in the 360 video to provide the visitor with certain information (augmented reality). Preliminary public studies conducted as part of the project suggest that the virtual visit is more fluid without text in the image but incorporating a narration to explain to the "virtual diver" what he/she is seeing.

The videos are recorded at different times and for different purposes, for example, during the excavation of a wreck (within the framework of the Herakles Project of the University of Cádiz) or during the group visit of another wreck. This allows us to elaborate on different discourses and be able to offer the user a bank of diverse experiences that, through the figure of a guide or interpreter from the UCH, can produce a positive educational impact on the user.

The tours and videos do not last longer than three minutes so that several users can enjoy the same experience. This requires planning the image capture correctly and knowing the site.

One of the main handicaps that we are finding is the impact that an invasive species Rugulopterix Okamurae is having in our area, an alga from the seas of China that proliferates and covers the entire seabed, hiding wreck structures and rocks and seriously damaging marine ecosystems. This, which is inconvenient when taking videos and carrying out archaeological work, is also an opportunity to introduce a discourse on the preservation of the environment and the impact of humans on it.

The videos are available to users at two points, at the Algeciras Museum and the Interpretation Center of the Estrecho Natural Park. Each one has been given four Oculus Go glasses and a device that allows them to view on a screen what a user is experiencing at that moment. This allows, for example, in the case of school groups, to involve everyone in the experience.

In these first cases, we are preparing a study of the public and a study of the need to have a guide interpreter of the videos so that they can communicate and explain to the user what they are seeing and the importance of some artifacts that can be seen in the same.

Establishing control indicators on these videos (evaluating their educational function and promoting a responsible attitude towards the UCH) is one of the aspects that we must work on in the coming months.

3.3. Underwater Streaming: Real-Time Broadcasting Buoy

So far, tests have been carried out inside the University Institute of Marine Research (INMAR) and in the swimming pool of the sports pavilion of the University of Cadiz, achieving distances of up to 75 m without losing the connection with the buoy. It is expected that this distance will increase to over 200 m once the implementation is carried out on the coast since there will be no buildings that interfere with the transmission and reception of the data.

To power the entire marine system, three Odyssey Extreme PC925 [42] batteries connected in parallel will be used, obtaining a capacity of up to 84 Ah at a total voltage of 12 V. In addition, these batteries will be recharged, weather permitting, thanks to three 32 Watts solar panels installed on the buoy tower.

The buoy used is the NexSens CB650 model [43], which incorporates a housing large enough to incorporate all the electronics necessary for the transmission of images and parameters.

Inside the buoy housing, there is a 12 V input and 32 V output voltage regulator designed to power the entire camera system, a switch to easily interconnect the sensors, cameras, and weather station to the omnidirectional antenna, and an AV homeplug to transmit the captured images via Ethernet.

The sensor used is a TRIPOD-ODEON from Aqualabo [44], which will allow us to know the conditions of the water in which the wreck to be studied is located, providing data on oxygen, pH, turbidity, or conductivity, among others. This sensor uses a Modbus RS485 signal interface, which will later be converted to Ethernet for transmission via Wi-Fi.

As for the weather station, an Airmar WeatherStation 200WX [45] will be mounted, which will provide data on position, wind speed and direction, temperature and air pressure, as well as the humidity of the environment in which the buoy is located. In addition, it will make it possible to know in real-time the position of the buoy, thanks to the Global Positioning System (GPS) that it incorporates. This station uses an RS232 telecommunication protocol, which will also be converted to Ethernet for transmission via Wi-Fi.

Finally, the cameras used [46] will allow the visualization, with total clarity, of the seabed with a resolution of 1080p at 25 fps. In addition, they incorporate two servomotors that allow for the modification of the viewing angle of these, which facilitates the modification of the images obtained remotely.

4. Discussion

Although the European charts and conventions from organisations such as ICOMOS or UNESCO always present tourism as a way of sharing and protecting heritage, of making it accessible and ensuring its survival [4,5,7,15,16], it is necessary to bear in mind that European strategies reconcile many other interests and are fundamentally oriented towards development. Of course, these strategies give heritage its cultural value, link it to regional and community identity, and do not promote its commodification. On the other hand, whether we are talking about the Europe 2030 agenda, national or regional strategies, cohesion policies or spatial planning, maritime heritage in general and underwater heritage, in particular, are considered as resources for development, especially in relation to tourism [17–19].

The general model proposed by the EU is compatible with the best scenario we can imagine in the relationship between tourism and heritage. The keywords here are sustainability, stability and resilience. The Blue Growth Model highlights the interdependence of the different sectors, directly or indirectly involving all agents with an impact and influence on heritage. The sustainability it proposes is, therefore, systemic and the incentive for the different groups is the mutual benefit at cultural, social and economic levels. In this sense, it establishes a reasonable and reasoned balance between social needs and the protection of cultural and natural assets [22].

Furthermore, it is a model that seeks to combat overcrowding and seasonality, prioritising quality over quantity, promoting collaboration between different agents, stimulating social participation and pursuing a transversal development; ultimately trying to build much more stable foundations with future projection [18,47].

Interreg programmes are very useful within the EU on this path to development: they bring together the interests of different groups from different regions, they allow common problems to be addressed, different solutions to be tested and the necessary feedback to be gathered to determine difficulties, inhibitors or obstacles and the effectiveness and efficiency of potential solutions. They allow the sharing of resources, experience and knowledge.

However, the lines established by the EU are general, and each region is responsible for optimising this process and adapting it to its regulations and legislation. Thus, the success of such tools rests, to a large extent, on the responsibility and capacity of each part involved. Additionally, underwater archaeologists are not usually involved in the drafting of these rules, guidelines, regulations and aids. Nor is it usual for them to be consulted in these cases [22].

We must be aware that this scenario (funding opportunities, high institutional and tourism interest, public interest, absence of archaeological experts in the decision-making process, etc.) can sometimes result in an increased pressure on archaeologists to create tourism products quickly and without adequate planning, to bypass research as part of the process, and even to generate experiences of low cultural value or that imply the distortion of heritage in favour of marketing.

Archaeologists must be aware that in the present time, a social function that goes beyond communication is demanded from UCH. Moreover, tourism agents, policy-makers and other agents involved, need to listen to the voice of archaeology, to properly achieve the sustainability, stability and success that Blue Tourism promises.

An example of the need and urgency to carry out more projects and research into the interpretation and underwater archaeological routes is shown in Figure 2. In the figure, we can see an iron chain, installed by public authorities and moored on the remains of the naval architecture of a steam wreck from 1863 in the Estrecho Natural Park. This buoy is one of the many installed by environmental authorities to facilitate the mooring of recreational diving boats, and to prevent the dropping of anchors on benthically sensitive bottoms. These divers go to visit a wreck, which is heritage and not protected, without knowledge about the history of the site, and moreover, their first image is to see how a chain is destroying the site.

It is urgent that archaeologists, historians and heritage professionals take an active and direct part in the design of these recreational diving activities, and in their implementation. If this trend is not regulated and supervised, we run the risk that underwater archaeology becomes, or becomes again, an activity of exploration and hobby, but not of protection and research. It is important not only to have a legal framework to develop these activities and protect the heritage but also that the administration and relevant institutions properly supervise and monitor these types of initiatives, whether public or private, to ensure the survival of the heritage and the correct transmission of the associated values.

Figure 2. A chain moored on an iron shipwreck.

We must not forget that, although there can be a very positive symbiosis between heritage and tourism, when this relationship is not balanced, the main victims are the host community and the heritage itself, which runs a great risk of commodification, either directly, through plundering (which is strongly prosecuted in Spain), or indirectly, by skewing its cultural value in the pursuit of tourist products full of marketing and empty of content such as products that may use gimmicky resources (such as treasures and pirates) generating a distorted vision of heritage that erodes awareness-raising efforts. The final image we show is an example that there is still a long way to go and that these dangers are much closer than they sometimes appear.

Author Contributions: Writing—C.P.-R.M., F.C.A. and P.L.O. All the authors contributed to the design of all aspects of the project. All authors have read and agreed to the published version of the manuscript.

References

1. Staniforth, M. Issues in Education in Maritime Archaeology. In *Heritage 2010: Heritage and Sustainable Developmen*; Amoeda, L., Pinheiro, C., Eds.; Greenlines Institute for Sustainable Development: Evora, Portugal, 2010; pp. 315–322.
2. Jiménez Melero, M.; Alonso Villalobos, C. La gestión de la puesta en valor in situ del patrimonio arqueológico subacuático desde la perspectiva andaluza. In *Arqueología Subacuática Española. Actas del I Congreso de Arqueología Náutica y Subacuática Española*; Nieto, X., Bethencourt, M.C., Eds.; Universidad de Cádiz: Cádiz, Spain, 2013; Volume 2, pp. 764–774.
3. Henderson, G. Opening address. In *Towards Ratification: Papers from the 2013 AIMA Conference Workshop*; Henderson, G., Viduka, A., Eds.; Australasian Institute for Maritime Archaeology Special Publication: Adelaide, Australia, 2014; p. 1.
4. UNESCO. Convention on the Protection of the Underwater Cultural Heritage. Available online: http://portal.unesco.org/en/ev.php-URL_ID=13520&URL_DO=DO_TOPIC&URL_SECTION=201.html (accessed on 10 August 2021).
5. Green Paper. National Plan for Protection of Underwater Cultural Heritage. Available online: https://www.libreria.culturaydeporte.gob.es/libro/green-paper-national-plan-for-the-protection-of-underwater-cultural-heritage_1040/ (accessed on 10 August 2021).
6. Leshikar-Denton, M.E.; Scott-Ireton, D.A. A Maritime Heritage Trail and Shipwreck Preserves for the Cayman Islands. In *Out of the Blue*; Jameson, J.H., Scott-Ireton, D.A., Eds.; Springer: New York, NY, USA, 2007; pp. 64–84.
7. Maarleveld, T.J.; Guérin, U.; Egger, B. *Manual para Actividades Dirigidas al Patrimonio Cultural Subacuático*; UNESCO: Paris, France, 2013. Available online: http://www.unesco.org/culture/es/underwater/pdf/UCH-Manual.pdf (accessed on 10 August 2021).
8. Villegas, T. Culture and Development from the protection of the Underwater Cultural Heritage perspective. *Cult. Dev.* **2012**, *7*, 62–67.
9. Suvanatap, M. Intangible heritage as a tool for underwater heritage conservation: An interdisciplinary approach to increase capacity for sustainable heritage safeguarding. *Australas. Inst. Marit. Archaeol.* **2014**, *38*, 6–12.
10. Nunes, C.H.; Roeder, F. Tourism and Algarve's underwater heritage valorisation. A case study. *J. Marit. Res.* **2014**, *11*, 35–44.
11. Secci, M.; Spanu, P.G. Critique of Practical Archaeology: Underwater Cultural Heritage Best Practices. *J. Marit. Archaeol.* **2015**, *10*, 29–44. [CrossRef]
12. Jeffery, B.; Applegate Palmer, K. The Need for a Multivocal Approach to Researching and Managing Guam's World War II Underwater Cultural Heritage. *IJNA* **2017**, *46*, 164–178. [CrossRef]
13. El-Kady, M. Potentials of Underwater Cultural Heritage in Tourism from the Perspective of Tour Guiding in Alexandria, Egypt. *J. Tour. Res.* **2017**, *17*, 222–237.
14. ICOMOS. Charter on the Protection and Management of Underwater Cultural Heritage. Available online: https://www.icomos.org/en/faq-doccen/179-articles-en-francais/ressources/charters-and-standards/161-charter-on-the-protection-and-management-of-underwater-cultural-heritage (accessed on 10 August 2021).
15. UNESCO. Underwater Museums. Available online: http://www.unesco.org/new/es/culture/themes/underwater-cultural-heritage/documents-publications/underwater-museums-and-dive-trails/ (accessed on 10 August 2021).
16. UNESCO. The Benefit of the Protection of Underwater Cultural Heritage for Sustainable Growth, Tourism and Urban Development. Available online: http://www.unesco.org/new/fileadmin/MULTIMEDIA/HQ/CLT/pdf/UCH_development_study_2013.pdf (accessed on 10 August 2021).
17. European Commission. A European Strategy for More Growth and Jobs in Coastal and Maritime Tourism. Available online: https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2014:0086:FIN:EN:PDF (accessed on 10 August 2021).
18. European Commission. The EU Blue Economy Report. 2020. Available online: https://op.europa.eu/es/publication-detail/-/publication/83843365-c18d-11ea-b3a4-01aa75ed71a1 (accessed on 10 August 2021).
19. UNTWO. Supporting Jobs and Economies through Travel & Tourism. A Call for Action to Mitigate the Socio-Economic Impact of COVID-19 and Accelerate Recovery. Available online: https://webunwto.s3.eu-west-1.amazonaws.com/s3fs-public/2020-04/COVID19_Recommendations_English_1.pdf (accessed on 10 August 2021).
20. Stathis, T.; Markatos, D.; Koutsis, K. New institutions for diving tourism: Diving Parks, Archaeological Diving Parks, Modern Shipwrecks. In Proceedings of the International Conference in Management of Accesible Underwater, Cultural and Natural Heritage Sites: Dive in Blue Growth, Athens, Greece, 16–18 October 2019; pp. 366–379.
21. Pérez-Reverte, C.; Cerezo Andreo, F. Creación de una ruta arqueológica subacuática en el pecio fenicio del Bajo de la Campana y el entorno de Isla Grosa, La Manga (Murcia). *Cuadernos de Turismo* **2020**, *46*, 1–24. [CrossRef]

22. Pérez-Reverte, C. Arqueología Subacuática Y Participación Social. Elaboración de una Guía de Herramientas para la Activación Turística del Patrimonio Cultural Marítimo y Subacuático. Ph.D. Thesis, University of Cádiz, Cádiz, Spain, 2021.

23. Atlantic Network for Developing Historical Maritime Tourism Project—TIDE. Available online: https://www.tide-atlantic.eu/ (accessed on 14 August 2021).

24. MacLeod, N. The role of trails in the creation of tourist space. *JHT* **2016**, *12*, 1–8. [CrossRef]

25. Corfield, C. Preventive Conservation for Archaeological Sites. *Stud. Conserv.* **1996**, *41*, 32–37. [CrossRef]

26. Menders, M. In Situ Preservation: The preferred option. *Mus. Int.* **2008**, *60*, 31–34. [CrossRef]

27. Staniforth, M.; Shefi, D. Protecting underwater cultural heritage. In *2010 World Universities Congress Proceedings*; Canakkale Onseklz Mart University: Cannakale, Turkey, 2010; pp. 1546–1552.

28. Gregory, D. In situ Preservation of Marine Archaeological Sites: Out of Sight but Not out of Mind. In *In Situ Conservation of Cultural Heritage: Public, Professionals and Preservation*; Richards, V., McKinnon, J., Eds.; Flinders University: Adelaide, Australia, 2010; pp. 1–16.

29. Richards, V.; Macleod, I.; Veth, P. The Australian Historic Shipwreck Preservation Project: In situ Preservation and Long-Term Monitoring of the Clarence (1850) and James Matthews (1841) Shipwreck Sites. *Conserv. Manag. Archaeol. Sites* **2016**, *18*, 240–253. [CrossRef]

30. Jameson, J.H.; Scott-Ireton, D.A. Introduction: Imparting Values/Making Connections. In *Out of the Blue*; Jameson, J.H., Scott-Ireton, D.A., Eds.; Springer: New York, NY, USA, 2007; pp. 1–6.

31. Nieto, X. Problemática de la visita pública a los yacimientos arqueológicos subacuáticos. El caso del Puerto de Ampurias. In Proceedings of the Comunicare La Memoria Del Mediterraneo. Atti del Convegno Internazionale Organizzato Dalla Regione Toscana Nell'ambito del Progetto Europeo Antiche Rotte Marittme del Mediterraneo (ANSER), Pisa, Italy, 29–30 October 2004; Gravina, F., Ed.; Publications du Centre Jean Bérard: Naples, Italy, 2007; pp. 125–130.

32. Scott-Ireton, D.A.Y.; Mckinnon, J. As the Sand Settles: Education and Archaeological Tourism on Underwater Cultural Heritage. *J. Public Archaeol.* **2015**, *14*, 157–171. [CrossRef]

33. Stone, R.; OjiKa, T. Virtual Heritage: What's Next? *IEEE MultiMedia* **2000**, *7*, 73–74. [CrossRef]

34. Roussou, M. Virtual Heritage: From the Research Lab to the Broad Public. In *Virtual Archaeology: Proceedings of the VAST 2000 Euroconference, Italy*; Niccolucci, F., Ed.; Archaeopress: Oxford, UK, 2002; pp. 93–100.

35. Bruno, F.; Lagudi, A.; Barbieri, L.; Muzzupappa, M.; Ritacco, G.; Cozza, A.; Cozza, M.; Peluso, R.; Lupia, M.; Cario, G. Virtual and augmented reality tools to improve the exploitation of underwater archaeological sites by diver and non-diver tourists. Digital heritage. Progress in cultural heritage: Documentation, preservation, and protection. In Proceedings of the 6th International Conference, EuroMed 2016, Nicosia, Cyprus, 31 October–5 November 2016; pp. 269–280. Available online: https://link.springer.com/chapter/10.1007/978-3-319-48496-9_22 (accessed on 14 August 2021).

36. UNESCO Virtual Underwater Cultural Heritage Museums. Available online: http://www.unesco.org/new/en/culture/themes/underwater-cultural-heritage/access/virtual-museums/ (accessed on 14 August 2021).

37. Manglis, A.; Fourkiotou, A.; Papadopoulou, D. Sustainable management and protection of Accessible Underwater Cultural Heritage sites; global practices and bottom-up initiatives. In Proceedings of the International Conference in Management of Accessible Underwater, Cultural and Natural Heritage Sites: "Dive in Blue Growth", Athens, Greece, 16–18 October 2019; pp. 16–25.

38. Gisbert Santaballa, A.G. La arqueología virtual como herramienta didáctica y motivadora. *Rev. Tecnol. Cienc. Educ.* **2019**, *13*, 119–147.

39. Roussou, M. The components of engagement in virtual heritage environments. In Proceedings of the New Heritage: Beyond Verisimilitude—Conference on Cultural Heritage and New Media, Hong Kong, China, 2007; pp. 265–283. Available online: https://www.taylorfrancis.com/chapters/edit/10.4324/9780203937884-25/components-engagement-virtual-heritage-environments-maria-roussou (accessed on 14 August 2021).

40. Bruno, F.; Cozza, M.; Mangeruga, M.; Skarlatos, D.; Agrafiotis, P.; Davidde Petriaggi, B.; Petriaggi, R.; Rizvic, S.; Liarokapis, F. Raising the awareness about underwater archaeological heritage through Edutainment and Virtual/Augmented Reality. In Proceedings of the International Conference in Management of Accessible Underwater, Cultural and Natural Heritage Sites: "Dive in Blue Growth", Athens, Greece, 16–18 October 2019; pp. 35–46.

41. Simeone, M.; Masucci, P.; De Vivo, C. Results of the "Sommergiamoci" Project in the MPA Gaiola Underwater Park. In Proceedings of the International Conference in Management of Accessible Underwater, Cultural and Natural Heritage Sites: "Dive in Blue Growth", Athens, Greece, 16–18 October 2019; pp. 47–56.

42. ODYSSEY Extreme Battery—ODS-AGM28L (PC925). Available online: https://eu.odysseybattery.com/product/ods-agm28l-2/ (accessed on 17 August 2021).

43. NEXSENSE CB-650 Data Buoy. Available online: https://www.nexsens.com/products/data-buoys/cb-650 (accessed on 17 August 2021).

44. AQUALABO Multiparameter Probe Oxygen/pH/Turbidity 3m TRIPOD-ODEON. Available online: https://en.aqualabo.fr/tripod-optod-ph-ntu-3-m-of-cable-with-connector-fischer-b4074.html (accessed on 17 August 2021).

45. AIRMAR 200WX WeatherStation Instrument. Available online: https://www.airmar.com/weather-description.html?id=154 (accessed on 17 August 2021).

46. SPOPX Cameras. Available online: https://www.spotx.com.au/custom-projects/custom-projects-web-streaming-diver-held-cameras-remote-access (accessed on 17 August 2021).
47. European Commission: COM(2013) 279 Final. Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions Action Plan for a Maritime Strategy in the Atlantic Area Delivering Smart, Sustainable and Inclusive Growth. Available online: https://eur-lex.europa.eu/legal-content/ES/TXT/PDF/?uri=CELEX:52013DC0279&from=EN (accessed on 15 August 2021).