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Creation of best-practice-protocols of monitoring using citizens' activities

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1. INTRODUCTION

Citizen science reflects active citizenship, since citizens are involved in the collection of large quantities of data, regarding a number of different habitats, locations, even scientific goals, over a long period of time. According to Bonney *et al.* (2009), citizen science projects have been proved remarkably successful since citizen scientists provide an immense amount of data, regarding species occurrence and distribution, while being involved in projects all over the world. This has resulted in a remarkable advancement of scientific knowledge, and an active involvement towards the protection of environment.

Environmental monitoring using citizen science projects has increased worldwide over the past few years. These projects have been implemented in many ecosystems including marine and terrestrial environments. It not only serves the purpose of increasing knowledge and awareness about the environment, but it also increases the amount of information and data that can be collected when funding is limited. In other words, choosing a Citizen Science approach can be a cost-effective way of gathering a large amount of data, since the balance between the long-term cost of acquiring suitable data from scientists is greater than the cost of supporting volunteers to acquire these data (Pocock, et al., 2014).

Apart from the aforementioned benefits for science, citizens are also benefited from their involvement. Through their participation the citizens spend their time having fun, exploring a subject of their interest, gain valuable knowledge and experiences and feel pleased for their contribution to a common goal, the protection of environment. Such initiatives are also benefited for the society in general, since through these projects, citizens and scientists come closer, and collaborate in tackling common challenges. Scientists seem less distant and different and their efforts are more recognized by the citizens, once the people understand the difficulties in executing scientific projects. On the other hand, citizens' efforts are also appreciated. Also, citizen science projects manage to increase the understanding of citizens towards scientific subjects, since the more they are involved in a scientific project the more knowledge and experiences they gain in that subject. Furthermore, the opportunities for engaging in scientific discussions increases, especially through social media groups of citizen science projects.

It's important to mention that there can be tensions between the motivations of participants and organizers. People might participate in such a project, because of their personal interest and motivations, driven by their curiosity and concern, or just because they want to have fun with people with whom they share common interests. Sometimes these increased expectations are not met, and the participants are left disappointed. For this reason, it's essential that the participants understand from the beginning their level of involvement and what to expect from the project. The organizers of such projects must also take into consideration some ways to enhance and maintain the participants' interests (e.g. through regular communication in social media, through the organization of blue cafes etc.). Nonetheless, involving people in scientific data directly engages people with environmental issues and their local environment. Many volunteers are willing to follow protocols (even quite complex ones) in order to collect data in a standardized way when they are confident that their input is valuable.

Despite the aforementioned benefits from the organization of citizen science projects, it's important to take into consideration the possible risks from running such initiatives. For example, there is an increased risk for the provision of unreliable data by the citizen scientists, especially when the participants do not have any background knowledge and experience in following scientific protocols. For this reason, it's essential that the methodologies given to the citizen scientists are easy to understand and straight forward to implement. Protocols should be short, and easy to memorize and not very time demanding. Otherwise participation would likely decrease, or the data collected would not be very reliable, or useful.

For all the aforementioned reasons, it was considered essential to initially study former citizen science projects, in a worldwide scale, and collect all the best practices they followed. This valuable knowledge will prove to be the cornerstone for the preparation of the methodology the citizen scientists will follow during RECONNECT project. For this reason, the following chapter focuses on the several case studies, which were considered important for designing the RECONNECT's citizen science protocols.

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1.1 Case studies

1.1.1 Case study 1: The COMBER project

The COMBER (Citizens' Network for the Observation of Marine BiodivERsity) pilot project for divers was initiated under the ViBRANT EU e-infrastructure. It was a project designed and implemented for divers and snorkelers who were interested in participating in marine biodiversity citizen science projects. The basic characteristics of this pilot project were the following (Arvanitidis, et al., 2011):

a) The development of a website which functioned as the main communication and dissemination vehicle of the network, offering data-entry tools for collecting information from the citizen scientists.
b) A well-defined scientific hypothesis which was formulated to be tested with the collected data;
c) It focused on fish species;
d) It had a suite of tools, such as a waterproof identification guide, on-the-spot professional introductory lectures and underwater training, as well as a demonstration of the proper usage of the online platform. Training on the correct data entry was also offered to the participated divers, including lectures on the in vivo identification of fish species;
e) A collaboration with two commercial diving centers, in order to ensure operational safety and to explore the potential for the market development of this initiative, something which could ensure the sustainable continuation of these actions after the end of the project COMBER;
f) Exploration of new services and tools which aimed to enhance the SCUBA diving and snorkeling services, and which were targeted towards the tourism industry.

Fish species were chosen as the target taxon for the implementation of this pilot project, since they are abundant, and they easily attract the attention and interest of the scuba diving community. The species observation and data collection were facilitated through the usage of a waterproof card, named as "BIOWATCH", and which included information (e.g. pictures) of a selected number of fish species. The BIOWATCH card included information for the forty

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most common fish species of the Mediterranean coastal environment and it presented the differences between them regarding their morphological characteristics (e.g. body shape, fin morphology), colour pattern, and habitat.

During the two months of the project (July–August 2011), 48 users (excluding the four supervising scientists) participated in the project, and twenty of the users provided data from more than one dive or snorkeling trip. In total, 1,879 species observations were recorded during 95 reported dives and 39 snorkeling trips. The majority of the divers declared that some fish were easy to recognize, but they had doubts about the validity of their results, while the remaining persons had no difficulties in identifying species. Ninety percent (90%) of the participants found the short seminars before their diving trips to be helpful and claimed that by only using the fish cards, they would have had problems in identifying the fish species.

1.1.2 Case study 2: The RELIONMED-LIFE project

RELIONMED-LIFE (https://relionmed.eu/) project's general aim was to make the island of Cyprus the first line of defense against the invasion of the lionfish *Pterois miles* in the Mediterranean. It specifically aimed to develop the necessary capacity and mechanisms in Cyprus to promptly act against the lionfish (and other lessepsian migrants) invasion. It also targeted towards demonstrating the effectiveness of a range of lionfish invasion prevention measures, such as the development and implementation of an early surveillance and detection system and a removal response system. Also, it aimed to build the capacity and knowledge which could be transferred and replicated by other countries of the Mediterranean, so that they could control lionfish expansion in their waters.

The success of this EU funded project relied on the following axis:

a) It performed questionnaires and interviews on stakeholder groups to assess risks associated with the lionfish and to inform the specific target groups.

b) It developed tools for the safe targeted removals of lionfish.

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c) It created "Removal Action Teams" consisted of highly interested scuba divers which were initially screened prior their involvement with the project. The goal of the RATs was to participate during the coordinated removals of lionfish on preselected sites in the Kavo Gkreko area, which is the same area chosen for Cyprus in RECONNECT project.

The RATs were offered a number of seminars and trainings throughout their involvement in the RELIONMED-LIFE project, especially during the stage prior the targeted removals. The partners involved in the RELIONMED-LIFE project managed to maintain the participants' interest by creating a specific Facebook page only for the RATs, where the RAT members were encouraged to report the number of lionfish they recorded during a random dive anywhere in Cyprus. They were also able to follow the suggestions from their RAT members and organize further removals outside the pilot area, such as the Zenovia wreck. Through this way the volunteers received positive feedback from the project's partners on their concerns on the matter and their willingness to act in a coordinated way. Another deliverable related to increasing the volunteers' enthusiasm was the organization of competitions where the participants had to catch lionfish during a specific timeframe. The competitors with the highest numbers of caught lionfish, as well as those which caught the smallest and biggest lionfish were given awards. After the completion of the events, the participants had the opportunity to try the lionfish they caught cooked in a number of ways.

Another important aspect was the creation of a well-structured website which included information about the project, the lionfish and the study sites, and which provided additional information on lionfish uses, and how the people could be further involved in the project. Also, the project's website hosted a link to the MedMIS platform, which had a specific lionfish portal where the users could see a map of Cyprus with all the current reports on *Pterois miles*, and they could also provide their own recordings.

d) The project also aimed towards the exploration of potential small local market niches (such as the fish market, as well as the arts and jewelry markets), which would make the future removals economically sustainable.

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e) Finally, the project subsequently aimed to develop tools and guides for managers and transfer the cost-effective practices. Also, it aimed to train the key stakeholders in neighboring countries and establish a coordinated response to tackle the cross-border issue of lionfish and invasive alien species.

1.1.3 Case study 3: Survey of Non-Indigenous Fish Species in the Eastern Mediterranean Sea, by citizen scientists.

This case study focused on the monitoring of fish assemblages in the Kas Peninsula, Turkey with the valuable help of citizen scientists. The area is considered as the most important recreational diving area of Turkey, due to its important marine biodiversity. In September/October 2004, 2007 and 2010, underwater visual censuses (UVC) were conducted in the area to survey fish assemblages (Bodilis, et al., 2014). Censuses were carried out in four sites: Oasis, Besmi, Guvercin, and Neptune. These sites are well-known among local and foreign divers and are highly appreciated for their fish diversity. The different sites were surveyed by both non-scientists, volunteer divers, and by two highly qualified observers/ scientists. The main requirement for the participation in the project was that divers should be competent in the water and have a keen desire to learn more about the marine environment and participate in the survey program.

The volunteers were given a short two-day training focusing on identifying the different fish species and learning the methodology which they would later follow. Training consisted to the learning of the key-characteristics (e.g. body form, colors and behavioural characteristics) of the different fish families and species. At the end of the training, a synthetic waterproof sheet, which included a picture of all the fish species surveyed, was given to each diver in order to help them identify the fish species and distinguish similar looking fish (e.g. the two species of *Siganus* sp.). Data were collected along transects by both groups of observers, in order to compare results and determine the usefulness of the method for volunteer divers. For each transect, the abundance of all individuals belonging to a pre-determined list of 29 species (11 families) was recorded.

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A total of 175 transects were surveyed, representing 875 min of census. Data collected by scientists and volunteers did not show any significant differences among species richness regardless of the year studied.

This case study showed that the method used was easy to follow because of the short training given to the volunteers (citizen scientists) before the initiation of the census period and the pre-determined number of species to be surveyed. There was a good correlation obtained between volunteers and scientists' data even if volunteer divers had no particular skills in marine biology. Nevertheless, there were some differences between volunteers and scientists' observations in the genus of Serranidae.

1.1.4 Case study 4: Investigating the efficacy of citizen science relative to other methods for monitoring marine non-native species.

This project was funded by the Department for the Environment Food and Rural Affairs of the United Kingdom. It confirmed the general prevalence of non-indigenous species in marina through 1-hour rapid assessment surveys (RASs) on the south coasts of Devon and Cornwall. The Cornwall Wildlife Trust, in collaboration with the Marine Biological Association of the United Kingdom developed this citizen science project as part of their local action group work on marine non-indigenous species.

Specifically, it evaluated the applicability of using volunteers to provide photographic surveillance by comparison with data from traditional sampling methods, and to explore its potential to play a role in delivering monitoring requirements to aid the evaluation of Good Environmental Status (under Descriptor 2), as described in the Marine Strategy Framework Directive (MSFD).

Participants were sent an information pack or asked to collect one from a drop off point (e.g. a marina). The pack included an assembled panel ready for deployment, with instructions, identification materials, recording sheets, background information including guidance on how to take suitable images, and a 'Check Clean Dry' information poster (Bishop, et al., 2014). All information resources were available online together with a gallery of previous panel images.

The citizen scientists were requested to deploy their panel at a depth of 1.5m for a minimum of 8 weeks, then to remove and photograph the panel. Panel details including location, dates of deployment and retrieval were submitted online with an image of each panel side plus close-ups of species thought to be of interest (maximum of 5Mb per image). The digital images were taken using a range of photographic equipment including mobile phones. Participants were encouraged to attempt to identify the organisms and submit an online recording form with their photographs. Panels were then either discarded or put back in the water for further monitoring. Surveys of the 10 marinas were carried out in July-August (RAS1) and repeated in September (RAS2). Eighteen species from the target list were recorded during RAS1 (July-August), and 19 during RAS2 (September), but the similarity of these overall figures gave a slightly misleading impression.

Across the 19 species and 10 marinas, the two RASs provided 124 species–site records, but in 34 of these (27%) the species were only recorded on one of the RASs, rather than both. Images submitted by citizen scientists reflected varying capability and understanding of what was required. Some images were of good quality, with high resolution and correct exposure and focus, and with the panel filling the whole of the frame, to allow for maximum detail, while others were of low resolution, limiting the amount of enlargement possible during analysis, or had incorrect focus or exposure.

Not all of the panels distributed to volunteers led to results, for several potential reasons. Panels were lost either as a result of poor fixing or being snagged by passing debris. In some circumstances, volunteers reported that their panels had been cut free, which tended to be more likely in open public areas outside of marinas. There was also a degree of 'drop-out' whereby volunteers disengaged with the project.

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1.1.5 Case study 5: The role played by citizen scientists in monitoring marine alien species in Greece.

The fifth case study aimed at presenting a plethora of new information provided by "citizen scientists". The project was executed in 2012 and focused on the observation of photographs. These data confirmed the spatial and temporal distribution of some IAS and were useful for the trend indicators proposed by the Marine Strategy Framework Directive (MSFD).

Recognizing the need for national and international cooperation in research, scientific information exchanges and management of alien species in Greece, a network of experts was established in 2007: ELNAIS (the Ellenic Network on Aquatic Invasive Species) based at the Hellenic Centre for Marine Research (HCMR). Fourteen Research Institutes/Universities and more than 77 scientists were carrying out research related to aquatic (marine and freshwater) alien species in Greece. A web page was created addressing all the aspects of research regarding the alien species found in the Greek Seas, including maps for visual distribution of the species. Photographs of the alien species played the role of an early warning system. The ELNAIS webpage (https://elnais.hcmr.gr/) has been advertised in newspapers and public means (Poursanidis & Zenetos, 2013). An info page encouraged the readers (marine experts and citizen scientists) to join ELNAIS by:

a) Reporting the occurrence of species, which is after verification published in the news,
b) Sought external expert knowledge on species unknown to them, and
c) Contributed new info by sending photos and environmental details of species they consider as new to the Greek biota. Based on the photos received, taxonomic experts of the ELNAIS experts network confirm the species observed;

As a matter of fact, 14 out of the approximately 240 alien species found in Greek waters (6%) were reported for the first time by citizen scientists. This compilation of citizen scientist input, validated by taxonomic experts, demonstrated the geographic expansion of more than twenty invasive species in Greece, while it provided information on four previously considered "casual" species known only from single records. The contribution of citizen

scientists had been vital in understanding and monitoring the phenomenon of biological invasions in the Greek Seas.

However, validation of the produced information through scientific expertise was a pre-requisite to its use. It has been demonstrated that the accuracy of data collected by volunteers was affected by certain variables such as the volunteers' age and education.

1.1.6 Case study 6: The Mediterranean Hippocampus Mission

The sixth case study focused on the contribution of volunteers in the marine conservation monitoring marine environments and the collection of data on the distribution of two Mediterranean seahorse species. The areas surveyed included the islands of Corse, Sardegna, and Sicilia, and the mainland regions of Provence in France and the regions of Liguria, Toscana, Lazio, Campania, Basilicata, and Calabria in Italy. The Adriatic coastal regions were Puglia, Molise, Abruzzo, Marche, Emilia-Romagna, Veneto, and Friuli–Venezia Giulia in Italy and Istra in Croatia. Through this case study the distribution of seahorses was monitored through the collaboration of marine scientists with recreational scuba divers.

In 1999 the Biology Department of the University of Bologna began to work on a 3-year research project called "Mediterranean Hippocampus Mission", which aimed to do the following:

a) Test the effectiveness of volunteers for monitoring marine environments to save time and money and
b) Collect data regarding the distribution of the two Mediterranean seahorse species, *Hippocampus hippocampus* and *H. ramulosus* (= *H. guttulatus*).

This project required that the participated volunteers had an interest in marine conservation, and a willingness to raise environmental awareness regarding this issue. Also, the participated citizen scientists had to be trained to suit the project's needs, and they should have already obtained their scuba diving qualifications.

According to the project's methodology, the participated citizen scientists had to report the distribution of the seahorses they observed during their dive, on a specially formulated

questionnaire, which was handed to them after their dive. The educational scuba diving agencies, in collaboration with the university, also organized thematic workshops for instructors, dive-masters, and private divers, in order to train them in the required research methods. The trained divers had an obligation of instructing other volunteers at the dive sites of their interest.

The workshops, called Hippocampus Day, took place over weekends at various tourist localities and at the annual European Eu.Di. scuba diving show in Italy and included general ecological awareness and environmental education as well as conservation of marine biodiversity. In a relatively brief period of time, a considerable number of motivated volunteers were trained in the collection of data and in the recruitment of other divers. Recorded information included the diver's name, address, and dive site (site, date, depth, time) and details of seahorse sightings (depth, habitat, number of individuals sighted, species). Seahorse species were identified based on the presence or absence of dorsal dermal flaps in the two species of interest *Hippocampus ramulosus* (presence) and *H. hippocampus* (absence), which is, a distinguishing trait between the two species. If uncertain, the divers recorded *Hippocampus* spp.

The reports were mailed to divers who had contributed the most through these questionnaires. This direct feedback from the university to divers was a way of thanking them for their contribution to the project, probably enhancing their commitment to the study.

The authors of this study concluded that the volunteer-collected data presented in their paper were reliable. According to their findings:

a) Volunteers were assisted during data collection in the field by dive guides and instructors who had previously attended workshops and received training on project objectives and methodology.
b) Seahorse identification was not difficult, because there are clear morphological differences between the two species.

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c) Information requested on the questionnaire, such as dive location, depth, dive time, and habitat are data most divers routinely record in their personal dive logs, whether the purpose of the dive is recreation, or data collection.
d) Finally, data were markedly consistent across years, indicating a strong degree of reliability.

1.1.7 Case study 7: Using a citizen science program to monitor coral reef biodiversity through space and time.

The seventh case study focused on the contribution of volunteers in monitoring Red Sea coral reef biodiversity. The study period was from 2007 to 2010 and the surveyed area consisted of Egypt, including the Sinai Peninsula and the African coasts to the border with Sudan, and a small portion of Saudi Arabia, including Yanbu al Bahr and Rabigh coasts (Branchini, et al., 2015). Participation in the project was open to snorkelers and all SCUBA diving levels, from open water diver (at least 4–6 recorded dives) to instructor (at least 100 recorded dives).

During the study periods, recreational volunteer divers and snorkelers completed questionnaires immediately following a dive, with each recreational diver recording one questionnaire per dive. Each questionnaire contained an initial section providing guidance for limiting anthropogenic impacts on the reef and throughout the vacation period, a second section with photographs to be used in species identification, and a third section for recording data obtained by the volunteers on animal taxa, negative environmental conditions, and recreational divers' behavior. A total of seventy-two animal taxa were included on the survey questionnaire, which enabled assessment of environmental quality based on biodiversity.

The surveyor was asked to provide:

a) General information about himself (name, address, e-mail and diving license—level and agency),
b) Technical information about the dive (place, date, time, depth, dive time),
c) Type of habitat explored (coral reef, sandy bottom, or other habitat) and

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d) Estimated abundance for each sighted taxon (abundance for each taxon was categorized as ‘‘rare’’, ‘‘frequent’’ or ‘‘abundant’’ based on the expected natural occurrence during a typical dive).

The presence of dead, bleached, broken, and sediment covered corals, as well as the presence of marine litter in the area, were considered as negative environmental indicators, and the area was considered to be anthropogenically impacted.

The research team held training courses for professional divers before the beginning of the project (five 2-hours courses were organized in diving centers in the Sharm el Sheik area from July to November 2006) and during hobby fairs every year (2 or 3 courses in February during Eu.Di. —European Dive Show). The research team trained professional divers on the project objectives and methods, including taxa identification and data recording (the training program comprised lectures, video, slideshows, and field identification). Topics such as biodiversity and its application in assessing environmental change caused by natural and anthropogenic pressures were covered. In the field, divemaster’s and SCUBA instructors briefed the divers, providing information about the habitat features, the species that may be encountered, and tips on how to minimize the impact of diving activities on coral reefs.

Over 4 years, a total of 7,125 volunteer recreational divers participated to the monitoring program. A total of 6827 volunteers participated for only 1 year, 236 for two, 45 for three and 17 participated for all 4 years and 17,905 valid survey questionnaires were completed. Of the 72 organismal taxa surveyed, 38.9 % (28 taxa) were classified as not common, 52.8 % (38 taxa) were common and only 8.3 % (6 taxa) were very common.

The authors of this study concluded that the volunteer-collected data presented in their paper were reliable. According to their findings:

a) Volunteers were trained and assisted during data collection in the field by dive guides and instructors who had previously been trained by professional researchers;

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b) The method is suitable for amateurs (i.e., user-friendly questionnaire and taxa that are easily recognizable by recreational divers);
c) The tasks selected for the volunteers during project planning were appropriate, since volunteer skills and abilities vary, and volunteers had to collect data for which they could be trained quickly and reliably.

1.1.8 Case study 8: Can citizen science contribute to fish assemblages monitoring in understudied areas? The case study of Tunisian marine protected areas.

In this project three future Tunisian MPAs and adjacent unprotected areas were chosen as case studies: Tabarka, Cap Negro Sidi Mechreg and Kuriat islands. For each location, four sampling sites were randomly selected inside the location and 2 sampling sites were selected outside (Lamine, et al., 2018). All sampling sites had similar characteristics in terms of habitat (70% rocky bottoms, with 30% *Posidonia* meadows) and depth (10 to 20 meters). Sampling was carried out in two consecutive years (2014 and 2015), during August-September.

The aim of this study was:
1) To test the consistency of fish-assemblage spatio-temporal variability data, resulting from two underwater visual census (UVC) (transects with variable width and Fish Assemblage Sampling Technique (FAST)),
2) To test the reliability of data collected by Scientifically - Trained Volunteers (STV) using FAST in three Tunisian Marine Protected Areas (MPAs).

Standard UVC (S-UVC) along transects with variable width (TVW) was applied by Scientist Divers (SD), and the Easy-to-use UVC method (E-UVC) Fish Assemblage Sampling Technique (FAST) method was applied by both SD and STV.

Scientifically - Trained Volunteers (STV) were briefly trained by Scientist Divers (SD) in underwater fish identification and in the use of FAST method. The same STV performed FAST censuses with the same SD at all locations for 2 years.

For transect with variable width (TVW), transects of three different widths were used for different fish categories, based on their mobility: (1) transect 35 m x 10 m for large mobile high trophic level predators, (2) transect 25 m x 5 m for necto-benthic fish (except high trophic level predators, censused in transect 35mx 10m), and (3) transect 10 m x 1 m for crypto-benthic fish (Prato *et al.* 2017). At each transect species and size classes were estimated and recorded using 2 cm precision.

For each sampling site in the Fish Assemblage Sampling Technique (FAST), the data collection consisted of six replicates of 15 minutes carried out between 10 and 20 m depth, along a random pathway using scuba diving. At each replicate, the following was considered: the presence/absence of fish species from a pre-established list, and their size-class (two classes were considered: large fish, (i.e. longer than two-thirds of the maximum size for each species, and small fish, shorter than two-thirds of maximum size).

The comparison between SD and STV FAST data showed no significant difference in the 3 indices. The same STVs carried out FAST censuses at the three locations. In this project STVs did not experience difficulty in identifying species underwater and recorded the presence of the same species as the SD. A significant difference was highlighted for Large Proportion index at two locations out of three. Before the fish census, volunteer divers received training in the FAST method. The authors in this project highlighted the problem that some volunteers faced in the size estimation of fish underwater.

1.1.9 Case study 9: Findkelp, a GIS-based community participation project to assess Portuguese kelp conservation status.

In order to promote the study of kelp species and their dependents, as well as provide guidelines for an effective management, the Center for Marine Sciences developed the project Findkelp (Assis, et al., 2009). The aims of this project were the following:

a) Obtain present-time valuable information about kelp species (i.e., Laminariales and Tilopteridales) distribution in Portugal and,
b) Identify and map the geographic and depth distribution limits of these species.

For this project 194 volunteers (scuba divers and spear fishermen) participated. From the 15th of May to the 31st of August 2008, 388 georeferenced sites were reported at the project's webpage. The volunteers' team worked independently as field observers, reporting kelp species observations and uploaded photos in an online database.

The project also invested in the dissemination of these activities through the website, using the project's website, alongside with magazines and newspapers articles. In order to better achieve this promotion, a set of didactic and awareness materials including leaflets, posters, underwater species identification slates and t-shirts were prepared and distributed. At the same time, to increase the extent of field data records from the volunteers and to make them more reliable, lectures and workshops on how to identify kelp species were given nationally. In order to make use of the volunteers' kelp distribution data, a large-scale field validation process (i.e. groundtruth) was made using non-destructive sampling techniques. The groundtruth process was conducted by means of underwater scuba diving and free diving transects at 56 randomly chosen locations, from haphazardly chosen sites from the volunteer reported sites.

Fifty-six sites were randomly chosen from the volunteers' reported sites to assess the structural descriptors of kelp populations. At each site, the accurate GPS (Geographic Positioning System) positions were recorded and three replicated 50 m long belt transects were made at randomly chosen underwater sampling locations. Transect depth was also recorded. At chosen shallow subtidal sites, inaccessible by boat, visual transect evaluations were made by means of free diving (snorkelling) in clear water conditions. At deep water or low visibility subtidal sites, visual evaluations were made by means of scuba diving. Along transects, kelp species were recorded on waterproof paper. From a landscape ecology perspective, the spatial structure of the habitats was also recorded at 6 different levels: (1) Rocky reefs; (2) Stable boulders; (3) Cobbles; (4) Pebbles; (5) Gravel; (6) Sand; (7) Mud; (8) Artificial reefs.

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Finally, in order to perform a GIS-based kelp species distribution habitat map, the statistically validated volunteers' reported data and the groundtruthed data were integrated in GIS in the form of electronic shape files. GIS query point analyses were made to evaluate (1) the number of reported kelp species sites, (2) the reports depth, (3) the reports average depth, (4) the overall confidence level average, (5) the kelp species depth range, (6) the kelp species average depth and (7) the geographical limits of kelp species distribution.

To motivate the Findkelp volunteers, so that they could keep contributing with report data, electronic bulletins were delivered with relevant information, a ranked table of honour was generated and the volunteers' data were spatially represented at the project's webpage. Moreover, the fact that each time a volunteer reported a field observation gained a point, and that this information was present at the webpage, might account for the disparity in the number of observations of the five most participant volunteers, as these seemed to be competing for the first place in the rank. The authors of this paper stated that these approaches seemed to be very useful in keeping the volunteers motivated.

Most volunteers (63.4%) sent reported data with the correct site coordinates. When this information was missing, volunteers were asked to detail the site location, or to point it out through accessible mapping tools (e.g. Google earth), such that all reported sites were geographically referenced at a landscape level. Where kelps were present, the volunteers were able to identify 84% of the species with a confidence level near 1.

This high confidence level in species identification can be explained by the authors, because of the previous workshops that the volunteers were attended to and by the delivered underwater species identification slates, as these seemed to have a positive effect over the volunteers' level of understanding of species identification.

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1.1.10 Case study 10: Employing citizen science to study the Mediterranean coralligenous habitats – CIGESMED for Divers

Mediterranean coralline reefs, widely known as "coralligenous", are bioherms built by calcifying rhodophytes on hard substrates under dim-light conditions. They are considered hotspots of biodiversity, harbouring rich assemblages and valuable biological resources. CIGESMED (Coralligenous based indicators to evaluate and monitor the "Good Environmental Status" of the Mediterranean coastal waters) was an FP7 SeasEra project implemented between 2013 and 2016 and aiming to enhance scientific understanding on the links between natural and anthropogenic pressures and ecosystem functioning to define and maintain the “Good Environmental Status” (GES) of the Mediterranean Sea, through the integrated study of coralligenous assemblages.

Coralligenous beds are extremely popular among SCUBA divers due to their complex structure, conspicuous biological wealth and high aesthetic value. Nevertheless, data on their distribution, structure and conservation status is lacking for several Mediterranean areas (e.g. southern and eastern Mediterranean regions) while they are vulnerable to an increasing number of threats. To this end, a specialized CS initiative was launched aiming to engage divers in the study of this important habitat in order to obtain information regarding its spatial distribution, enable a primary characterization of the basic structure of its assemblages, and monitor potential pressures and threats to the habitat. The module was specifically designed to appeal to enthusiast (i.e. experienced and motivated) divers, since diving in coralligenous sites is often challenging due to depth and other environmental conditions and the required data collection which demand a considerably elaborate working protocol in order to be usable by scientists.

For its active implementation, a data collection protocol and a multilingual website (http://cs.cigesmed.eu/) were developed, comprising an educational module and a data submission platform. Georeferenced data reporting focuses on: (a) basic topographic and abiotic features for the preliminary description of each site, and the creation of data series for sites receiving multiple visits; (b) presence and relative abundance of conspicuous species, as well as (c) existence of pressures and imminent threats, for the characterization

and assessment of coralligenous assemblages. A variety of tools is provided to facilitate users, while divers have the choice to report additional information and are encouraged to upload their photographs. The methodological approach and the base components of CIGESMED for Divers are thoroughly described in Gerovasileiou et al. 2016 (full text available at https://bdj.pensoft.net/article/8692/). The project website, providing all reference, educational and operational resources and also serving as the online platform for the submission of observation data, is accessible at http://cs.cigesmed.eu/en. A Facebook page and group, entitled "Mediterranean coralligenous observatory - Citizen Science for CIGESMED", have also been created to disseminate the project's results, increase public awareness about coralligenous habitats and engage direct communication with divers and interested parties.

To date 231 observations from across the Mediterranean have been recorded and 111 members have registered to the website. Moreover, several training events have taken place in different parts of the Mediterranean (e.g. Marseille, National Marine Park of Zakynthos and Izmir) where coralligenous habitats are present, educating local diving groups to the application of the CIGESMED for Divers protocol for data collection. The goal of this initiative is the development and maintenance of an active community of amateur observers providing widespread and ecologically significant data on coralligenous assemblages at a pan-Mediterranean scale.

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2. METHODOLOGY

2.1 LERU's guidelines for Citizen Science projects

According to the advice paper of the League of European Research Universities (LERU), published in 2016, there are certain guidelines which should be followed when implementing citizen science projects. These guidelines which are presented below, set the stepping stones for the design of the methodology which will be followed in the citizen science actions throughout project RECONNECT.

2.1.1 Guideline 1: Recruitment and retention.

When designing a citizen science project, researchers should plan for substantial and sustained investment in outreach and community management, to ensure adequate numbers and diversity in the citizen science community that will participate in the project. This aspect was already taken into consideration during the project proposal, which resulted in securing the funding for the successful implementation of these actions.

Also, as mentioned in the respective advice paper, successful identification of audiences also plays a vital role. Audiences can be identified and targeted through the internet and the media, tapping into existing groups or partner organizations, which appears particularly effective. Targeting civic groups, neighborhood organizations and non-profit environmental protection groups can help amplify participation. Retention can create a core of participants with advanced levels of experience, providing local leadership and resulting in the collection of more reliable data. Taking this into consideration, it was considered important to create stakeholder lists, focusing on specific target groups such as diving organizations, diving centres, and diving federations etc., for each pilot site. Through this way, contact points with already experienced diving instructors can be achieved, and they are expected to be more motivated to be involved in the project's citizen science actions. These experts will be later trained during the citizen science training seminar of the project and will be responsible to successfully transfer the project's methodology to their groups of divers.

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Furthermore, as was briefly mentioned in the introduction, retaining participants requires consistent support, including a rapid response to questions and suggestions as well as online resources for communication among participants (Cooper, et al., 2007).

2.1.2 Guideline 2: Quality and impact.

As mentioned in the LERU's advice paper, researchers planning citizen science projects should clearly define the impact they aim to have at the outset of the project, as well as regularly communicate with the participants to track their progress towards this impact, or deviations that may occur, through a broad range of indicators, from scientific publications to more popular forms of dissemination.

Taking the aforementioned guideline into consideration, it was considered important to create presentations for the citizen science training, which will clearly explain the steps which the citizens will need to follow. Also, the overall outcomes from the citizens' engagement will also be explained to the participants, in an easy-to-understand way. Citizen scientists will have the opportunity to communicate with the organizers and with other participants, through the project's social media. The organizers on the other hand should follow this guideline and arrange meetings with representatives of the participants' in order to check whether the methodology is indeed easy to follow and learn if they experience any difficulties in the field.

2.1.3 Guideline 3: Learning and creativity.

Where feasible, projects should be designed to encourage all participants fully to contribute their talents and creativity, to grow their skills and responsibilities within the project, and to increase their knowledge of the related science in a pedagogically sound way. Researchers should encourage creativity from volunteers for two reasons: Creativity appears to be an indicator of high engagement in the project; Creativity can lead to innovation and helping the project to operate better. Being part of a project community appears to be an important motivating factor for creativity to take place. It is through the community that creative individuals have an audience to share their ideas with and to receive validation for their efforts (Jennett, et al., 2016).

Understanding the importance of this guideline, the partners explored different ways to motivate the citizens to express their talents. For example, the Cypriot partners are considering organizing an underwater photography competition, which will further motivate the citizen scientists to take photos of the pilot site and report through their artistic lenses the pilot site of Cavo Greco. In order to do so however they will need to secure funding through budget modifications.

2.1.4 Guideline 4: Openness and transparency.

Researchers developing citizen science projects should adopt open science standards consistent with their institutional policies, including open access publication, open data standards, open source software, and extending to full transparency of the research methods. These guidelines will be also taken into consideration, during the development of the project's methodology which will be further analyzed below.

2.1.5 Guideline 5: Organization, communication and sustainability.

Citizen science projects require appropriate organizational and oversight structures to represent the interests of all stakeholders, codes of conduct to ensure respectful communication between all participants, and a long-term data preservation plan that enables open access to results and data, ideally sustainable beyond the end of the project. These aspects will be considered by the project's lead partner, during the development of the citizen science platform.

2.1.6 Guideline 6: Credit and reward.

Citizen participation should be recognized properly, for example through acknowledgement or co-authorship in publications, where appropriate, through motivational rewards and through a credit system that enables tracking of contributions. One of the aspects which were generally decided to be implemented in RECONNECT's pilot regions, was the placement of permanent quadrats in diving trails in the pilot regions. Ten quadrats will be placed in each underwater plate, and the citizen scientists will be encouraged to search for these quadrats, as if they will be looking for a treasure. Then they will be asked to provide a photo of that quadrat (including its label). Through this way, the citizens will have an

additional motivation to find and report these quadrats, and as a result the scientists will receive valuable data, which will be later analysed.

In order to further follow this guideline, the lead partner of the project which will develop the citizen science platform, will need to take into consideration a way to add a credit system in the citizen science webpage. Through this way, the participants will have an additional motivation to report more.

2.1.7 Guideline 7: Ethical and legal considerations.

Researchers should provide clear terms and conditions for participating citizen scientists consistent with both open science and personal privacy requirements. Where useful to the project, citizens may be involved in decision making aspects. Where appropriate, they should retain control over personal data they have shared, also beyond the end of the project.

As mentioned in this guideline the protection of citizens' personal data is vital. In the RECONNECT project, the partners have already considered that, and followed the respective General Data Protection Regulation (GDPR) of the European Union. Specific disclaimers are already applied and will be used prior to the communication with the participants for survey, or email purposes. As you can see in the disclaimers presented below, the participants will be informed about the project, and how their data will be used and stored, and they will consent prior to the provision of their data. Apart from this, they will be informed of their rights, such as having access to their data, and the opportunity to have their data deleted upon their request.

2.1.7.1 GDPR disclaimer to be used in the newsletters, when emailed to stakeholders:

You have been selected to receive this newsletter because of your expertise and relevance to the project. Your email will be held securely in a Google database. You can unsubscribe any time by clicking in the relevant link. All data will be deleted 12 months after the project's end date. For further information, or if you have any queries, please contact reconnect@hcmr.gr

2.1.7.2 GDPR disclaimer to be used in the online questionnaires for the Essential Socio-Economic Variables

You have been selected to take part in this survey because of your expertise and relevance to the project. Your participation in the survey is entirely voluntary and you can opt out at any stage by closing and exiting the browser. If you are happy to take part, please give your consent by providing your email above. The survey should take approximately 10-15 minutes to complete. Your email will be held securely in a Google database. All data will be deleted 12 months after the project's end date. For further information, or if you have any queries, please contact reconnect@hcmr.gr

Thank you for taking the time to participate in this survey. You are free to withdraw your questionnaire responses from the project data set at any time until the data are destroyed. You should note that the analysed questionnaire data may be used in the production of formal research outputs (e.g. journal articles, conference papers, and reports). Your answers will be treated confidentially and the information you provide will be kept anonymous in any research outputs/publications. You are advised to contact reconnect@hcmr.gr at the earliest opportunity, should you wish to withdraw from the survey. You do not need to give a reason. A decision to withdraw, or not to take part, will not affect you in any way.

2.2 RECONNECT's methodology

The methodology which will be applied in RECONNECT project is presented below. It was developed following the aforementioned guidelines from LERU's advice paper on citizen science projects and focusing on the best practices mentioned in the case studies analyzed in this report.

Table 1 below showcases the implementation methods used in the aforementioned studies based on which the methodology followed for the citizen science actions in RECONNECT project was developed. The implementation methods were the i) Online platform, ii)Demonstration of the proper usage of the online platform, iii)Waterproof identification guide, iv)Workshops, v)Workshop for instructors, dive-masters, and private divers, vi)Underwater training and vii)Reporting the occurrence of species on questionnaires.

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Table 1: The implementation methods used in each case study (**1**= *The COMBER project,* **2=** The RELIONMED-LIFE project, **3**= *Survey of Non-Indigenous Fish Species in the Eastern Mediterranean Sea, by citizen scientists,* **4**=*Investigating the efficacy of citizen science relative to other methods for monitoring marine non-native species*, **5**= *The role played by citizen scientists in monitoring marine alien species in Greece*, ***6***= *The Mediterranean Hippocampus Mission*, **7**= *Using a citizen science program to monitor coral reef biodiversity through space and time*, **8**= *Can citizen science contribute to fish assemblages monitoring in understudied areas? The case study of Tunisian marine protected areas*, **9**= *Findkelp, a GIS-based community participation project to assess Portuguese kelp conservation status*, ***10=*** *Employing citizen science to study the Mediterranean coralligenous habitats – CIGESMED for Divers.*)

Project implementation methods	**Case studies**										**Sum of implementation methods for Case studies**	**RECONNECT project**
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**		
Online platform	✓	✓		✓	✓				✓	✓	6	✓
Demonstration of the proper usage of the online platform	✓	✓								✓	3	✓
Waterproof identification guide	✓		✓	✓				✓	✓		5	
Workshops	✓	✓	✓						✓	✓	5	✓
Workshop for instructors, dive-masters, and private divers		✓				✓	✓	✓		✓	5	✓
Underwater training	✓	✓									2	
Reporting the occurrence of species on questionnaires		✓				✓	✓				3	

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2.2.1 Placement of permanent quadrats in the pilot sites

The partners which will be responsible for organizing the citizen science actions in their pilot regions will place a number of permanent quadrats in underwater sites, which preferably have high visitability by divers. The amount of permanent quadrats will depend on the number of the habitats to be studied and the number of replicates each country will aim to study per study site. For example, in Cyprus 10 permanent quadrats were placed in each pilot site (5 in *Posidonia oceanica* meadows and 5 in rocky substrates), whereas in Bulgaria, 4 quadrats were placed in the rocky infralittoral substrate, and at least 2 were placed in shipwreck sites and seagrasses. A similar application of this method was also implemented in the third case study, described by Bishop *et. al.* (2014), where the citizen scientists were requested to deploy their panel at a depth of 1.5m for a minimum of 8 weeks, and then they were instructed to remove and photograph the panel.

Already designed diving trails can also be used, or if possible, new underwater trails can be designed, which will serve this purpose. For example, in Cavo Greco, the pilot region of Cyprus, 10 permanent quadrats were placed in each of the three selected underwater trails, which are visited by a high number of divers. Five permanent quadrats were placed in *Posidonia oceanica'*s meadows, in each site, and the rest were placed in hard substrates. Submerged buoys have been attached to the quadrats, rising 1-2 m from the seafloor, in order to mark the quadrats locations, identification labels were also used, which will make it easier to track the participants' photos.

2.2.2 Develop a simple-to-follow methodology

As was mentioned in the introduction, keeping things simple is vital for the successful implementation of the citizen science actions. For this reason, the methodology which was prepared, and which will be asked by the participants to follow was kept simple, and easy-to-follow. The citizen scientists will need to follow the 5 steps described below, and through this way they will be able to produce useful data, reported in a systematic way.

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I. *Dive to the site*

The participants will know about the pre-selected diving trails and will be suggested to look for the quadrats GPS coordinates in the citizen science platform (https://cs-reconnect.hcmr.gr/), which will have a map for each pilot site, and the locations of all the quadrats will be displayed. Through this way, the citizen scientists will be familiarized with the area of the pilot stations before the dives.

II. *Search for the quadrats*

The citizen scientists will need to dive to the sites, and search for the quadrats. As was mentioned before, in the Cypriot study sites for example, the divers will need to look for 10 quadrats, in each of the three selected diving sites. The challenge will be to track and report all the quadrats.

III. *Take a photo*

The participants will be requested to take a photo of the quadrat. They will need to make sure that the quadrat's label will be in the picture and will need to double-check that it's in focus. Through this way they will be able to record the marine biodiversity which will be developed in the quadrats and report it back to the scientists.

IV. *Report what's important*

Apart from taking pictures of the quadrats, the citizen scientists will be able to report anything they think it's important mentioning. A pre-defined list with the most important species per study site will be offered as an option for additionally reporting. Also, a pre-defined list on threats and anthropogenic effects on the diving site such as marine litter, abandoned fishing gear (e.g. ghost nets), diver recklessness etc. will be included in the database in order to help the volunteers report back anything they believe it's worth to mention to the organizers. This will contribute to the overall management of the area. It will be emphasized to them that their contribution in this project would be the realization of the importance of acting. Each citizen has to take a level of responsibility and contribute in any possible way towards the overall protection of the marine environment. Each act, each initiative for reporting would be welcomed.

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V. *Upload the photo*

After taking their pictures, the citizen scientists will be requested to upload them in the citizen science platform which will be built in serving this purpose. They will be able to upload each quadrat in each study site separately and thus easily see their success in finding all the requested quadrats. It will be the main media of reporting and a way of communication between the participants and the organizers.

2.2.3 Develop a citizen science platform

As was mentioned above, the citizen scientists will be instructed to upload their pictures and create their reports through an online platform which will be used for these specific actions. The Hellenic Centre for Marine Research (LP1) will be responsible for designing this platform, during the following months. The domain name for this website is already secured and is the following: https://cs-reconnect.hcmr.gr.

Each case study mentioned above, described the importance of creating such a platform. For example in the COMBER project the website which was created (http://www.comber.hcmr.gr), was proven a helpful tool for the citizen scientists.
According to Arvanitidis *et.al* (2011) this online platform functioned as the main communication and dissemination vehicle of the network, offering data-entry tools for collecting information from the citizen scientists. Many elements of the site, such as user management, profile creation, image galleries and discussion fora were created using built-in features or readily available Drupal modules. Users were able to log into the site with their Facebook account which was a valuable feature to strongly facilitate the registration process on the site. Registered users were able to continue contributing towards the data collection after they participated in the seminars. Additionally, they were able to use the diving log to keep track of their dives and species observations, upload photos of fish species and discuss various topics in the discussion fora. A competitive element was introduced by a five-star ranking system indicating the activity level of the user. The more dives with fish observations were contributed to the system, the higher the user ranked in the "Top contributors" list, thus providing a playful incentive towards these contributions.

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The platform will have the following features:

a) The platform will be offered in English and Bulgarian languages.

b) Maps for each pilot site, where the citizen scientists will be able to see the areas where the permanent quadrats are placed. Through this way, it will be easier for them to dive to each site and locate each quadrat.

c) The users will be able to upload their pictures and provide some baseline information on what they've generally observed in the area.

d) The users will be able to link with a click to all the social media pages of the project and also send to the organizers an email, if they want to.

d) A list of key species, for each country will be also available and citizens will be able to report if they've seen those species, and if they were under environmental threats. Also, they will be able to report any anthropogenic effects or marine life threats they observed such as ghost nets, plastic pollution, oil and sewage spills through a pre-defined list and through a comment box. In general, the users will be able to share what in their opinion think is important mentioning.

e) A forum will be created in order to give to the participants the opportunity of sharing their thoughts with other citizen scientists. This will be an additional way to communicate with the organizers.

f) A credit system will be developed, which will rank the participants based on the number of reports they submit. Two aspects will need to be taken into consideration, i) the overall number of reports they submit and ii) the number of quadrats per each site. The users might want to locate all the quadrats in each pilot region, thus they should be able to track their progress. These two aspects will be additional ways to enhance the participants motivation.

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2.2.4 Design dissemination materials

As was mentioned in the 8th case study, developing a successful dissemination strategy is essential for the smooth implementation of such initiatives. For RECONNECT project, an information leaflet (Images 1-4) was created by the Department of Biological Sciences, of the University of Cyprus and their external expert AP Marine. The leaflet which was written both in Greek and English languages, includes information regarding the Cypriot study site, explains the importance of citizen science, provides the 5-step guidelines which will be implemented in the field, and gives some advice on best diving practices, in order to avoid causing any harm to the environment, whilst diving. Each study site was also responsible in preparing their own information leaflet following Cyprus's example.

Apart from that, a citizen science poster (Images 5-6) was created by DBS-UCY, which will be given to the participants of the citizen science training. As with the citizen science leaflet, the citizen science poster was also prepared in Greek and English languages. The rest of the countries were advised to do something similar. Furthermore, a citizen science kit was also developed by DBS-UCY which included designed T-shirts (Image 7), hats (Image 8), shopping bags (Image 9) and lanyards (Image 10), which had the project's slogan (RE-CONNECT the lines to protect marine life), and the project's logo (and co-funding phrase) printed on them.

Other dissemination materials which were created by DBS-UCY as part of the project identity set included customized portfolios (Image 11-13), notepads (Images 14-17), pens (Image 18), USBs (Image 19) and a roll-up banner (Image 20), which will be used during both the citizen science training and the open day event. Last but not least, the citizen science kits would also include the trifold flyers which were prepared by the partners for describing the main projects and actions set by project RECONNECT. The flyer (Images 21-24) was also translated in Greek and Bulgarian. In Cyprus, both the Department of Biological Sciences and the Department of Fisheries and Marine Research printed both versions (English and Greek) of the flyer in order to give it to interested parties during the open day event, the training seminars and other dissemination events they will both participate.

The Adobe Illustrator files of the designs of these information materials were given by DBS-UCY to the rest of the partnership, in order to give them the opportunity to change them accordingly. Last but not least, a power point presentation was also prepared by DBS-UCY and submitted to the partnership, which included some guidelines which would need to be taken into consideration prior of ordering any dissemination materials.

Image 1: The first side of the tri-fold citizen science leaflet, created for the citizen science actions in Cyprus, by the Department of Biological Sciences, University of Cyprus and their external expert, AP Marine Ltd. The flyer was designed in Adobe Illustrator and it was written in Greek and English languages. This is the Greek version.

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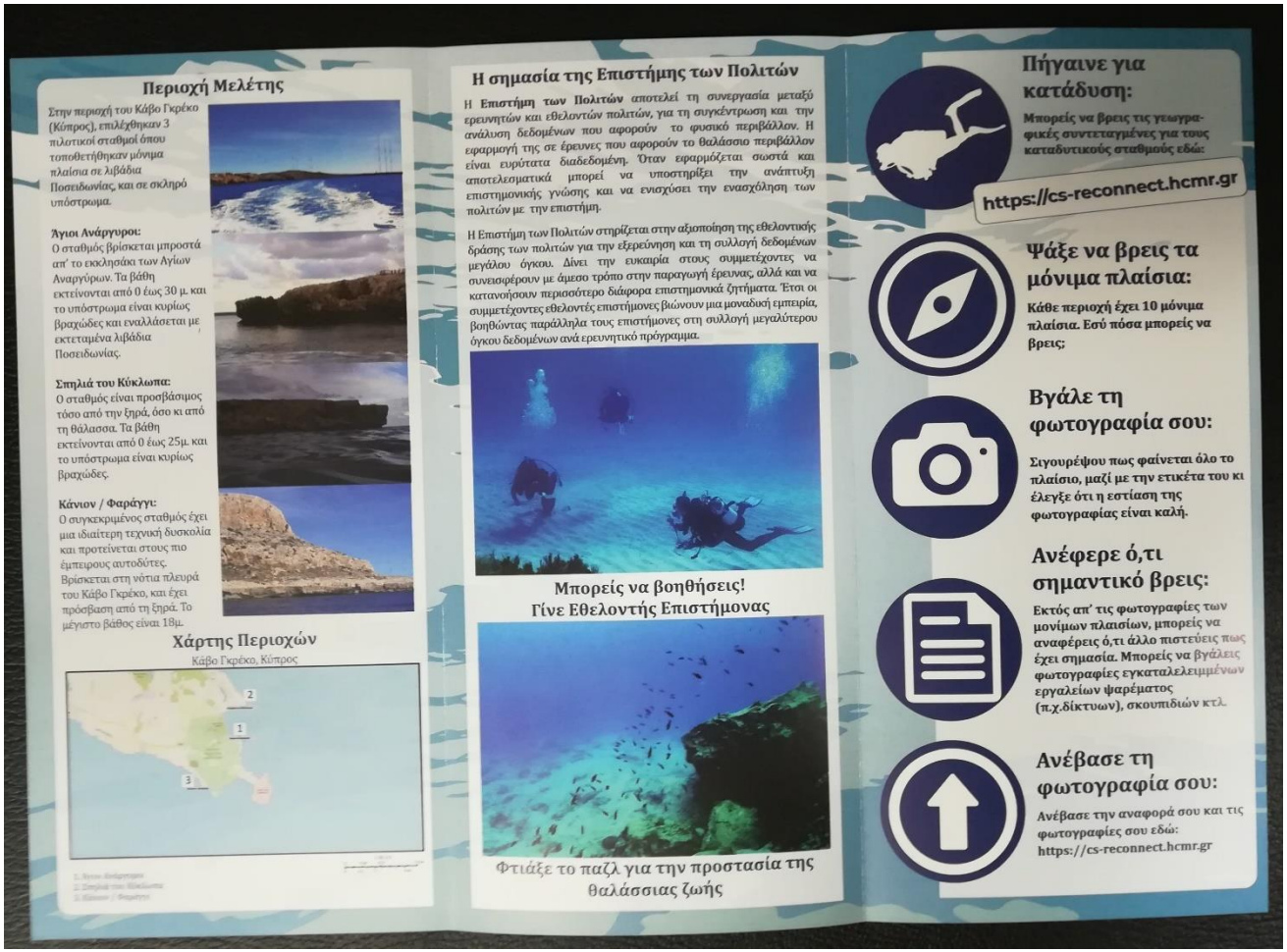

Image 2: The second side of the tri-fold citizen science leaflet, created for the citizen science actions in Cyprus, by the Department of Biological Sciences, University of Cyprus and their external expert, AP Marine Ltd. The flyer was designed in Adobe Illustrator and it was written in Greek and English languages. This is the Greek version.

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Image 3: The first side of the tri-fold citizen science leaflet, created for the citizen science actions in Cyprus, by the Department of Biological Sciences, University of Cyprus and their external expert, AP Marine Ltd. The flyer was designed in Adobe Illustrator and it was written in Greek and English languages. This is the English version.

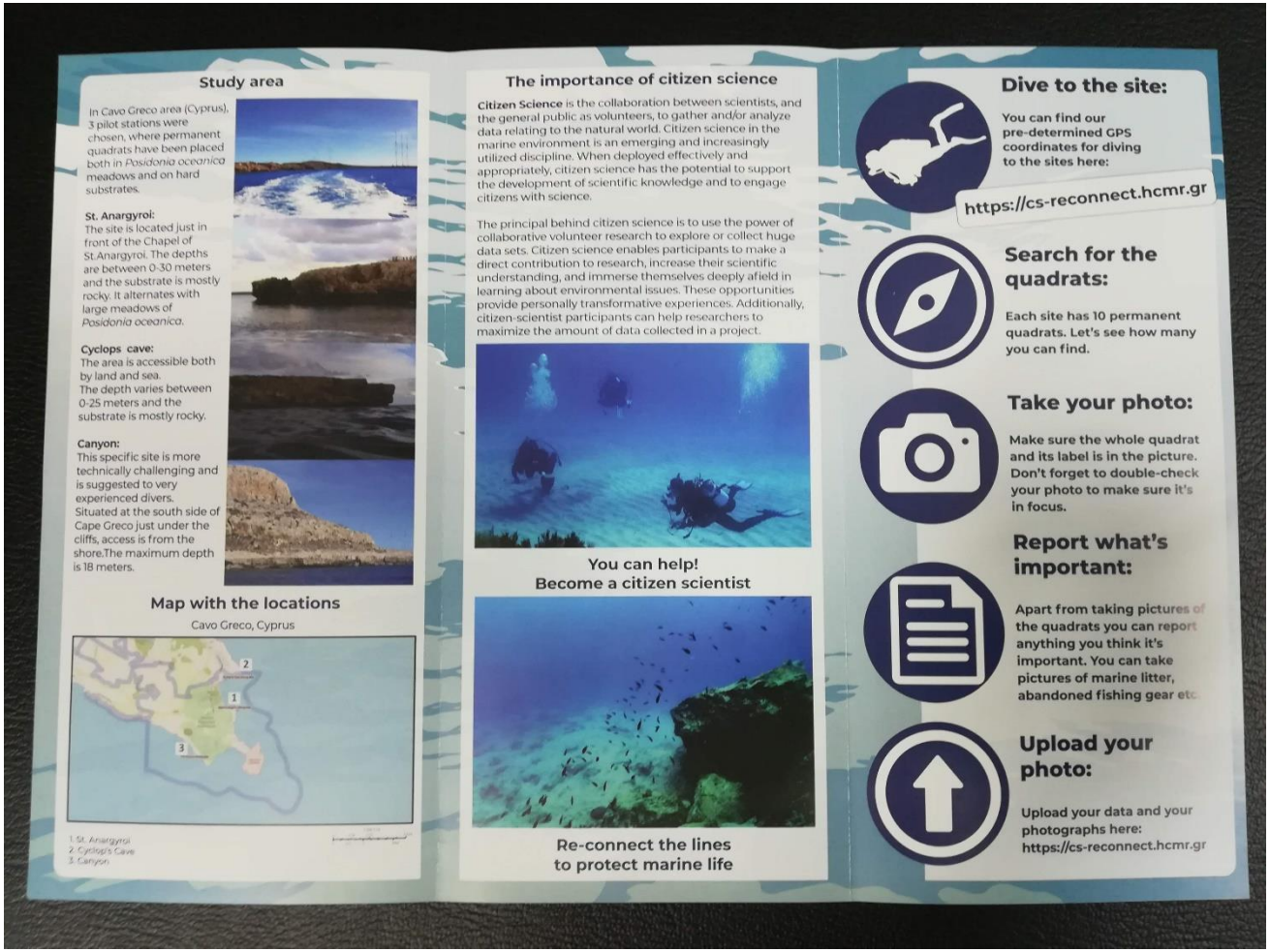

Image 4: The second side of the tri-fold citizen science leaflet, created for the citizen science actions in Cyprus, by the Department of Biological Sciences, University of Cyprus and their external expert, AP Marine Ltd. The flyer was designed in Adobe Illustrator and it was written in Greek and English languages. This is the English version.

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Image 5: The citizen science poster which was created in Adobe Illustrator by the team of the Department of Biological Sciences, University of Cyprus. This poster will be given to the diving instructors, during the citizen science training and during the open day event. The participants will be requested to place these posters in high visibility areas, such as meeting areas for divers. This is the English poster.

Image 6: The citizen science poster which was created in Adobe Illustrator by the team of the Department of Biological Sciences, University of Cyprus. This poster will be given to the diving instructors, during the citizen science training and during the open day event. The participants will be requested to place these posters in high visibility areas, such as meeting areas for divers. This is the Greek poster.

Image 7: The T-shirt created by the Department of Biological Sciences, University of Cyprus, which will be given as part of the dissemination material (citizen science kit) designed for the citizen science actions' promotion. The T-shirts were ordered in Cotton fabric and displayed the project's slogan "RE-CONNECT THE LINES TO PROTECT MARINE LIFE". Only the front side of the T-shirt had something printed on. Various sizes were also ordered (S, M, L, XL, XXL) in order to make it easier for the participants in finding their correct size. The participants were asked to wear the T-shirt during their diving practices for further promoting the project.

Image 8: The hat created by the Department of Biological Sciences, University of Cyprus, which will be given as part of the dissemination material (citizen science kit) designed for the citizen science actions' promotion. All hats ordered by DBS-UCY were in Blue colour and featured the project's slogan and logo on the front side. Each participant was requested to wear the hat whenever possible to further promote the project.

Image 9: The cotton shopping bag created by the Department of Biological Sciences, University of Cyprus, which will be given as part of the dissemination material (citizen science kit) designed for the citizen science actions' promotion. All shopping bags ordered by DBS-UCY were in Blue colour to match the T-shirt and hat and featured the project's slogan and logo on the front side. Each participant was requested to use the shopping bag whenever possible to further promote the project.

Image 10: The name tags/lanyards which were prepared by the Department of Biological Sciences for the citizen science training seminar. The lanyards were created in Microsoft Word using pre-designed templates.

Image 11: The paper portfolio created by the Department of Biological Sciences, University of Cyprus, which was designed as part of the project identity set, and which will be used during the open day event, the training seminar and other dissemination events for the promotion of the project. The portfolio was designed in Adobe Illustrator.

Image 12: The printed version of the paper portfolio created by the Department of Biological Sciences, University of Cyprus, which was designed as part of the project identity set, and which will be used during the open day event, the training seminar and other dissemination events for the promotion of the project. This is the outside of the portfolio.

Image 13: The printed version of the paper portfolio created by the Department of Biological Sciences, University of Cyprus, which was designed as part of the project identity set, and which will be used during the open day event, the training seminar and other dissemination events for the promotion of the project. This is the inside of the portfolio.

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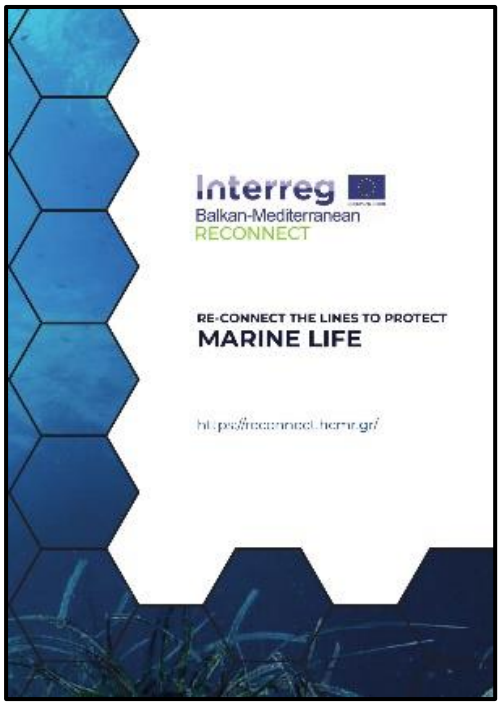

Image 14: The front site of the notepad, which was created by the DBS-UCY as part of the project identity set. The notepads will be given to the participants of the open day events and the training seminar. The notepad was created in Adobe Illustrator.

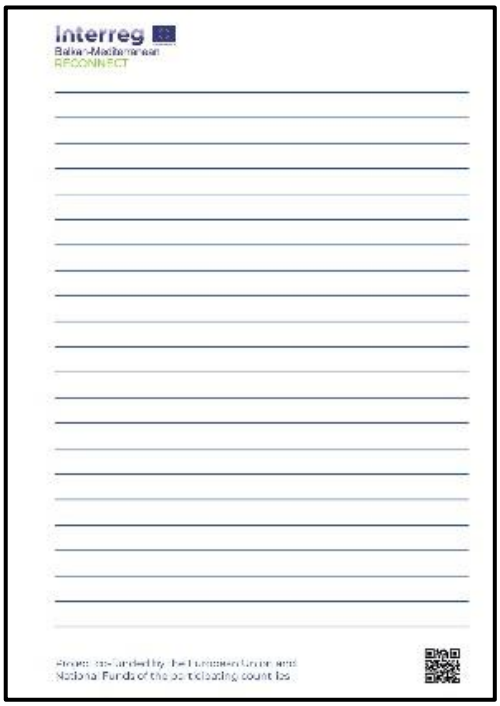

Image 15: The inside of the notepad, which was created by the DBS-UCY as part of the project identity set. The notepads will be given to the participants of the open day events and the training seminar. The notepad was created in Adobe Illustrator.

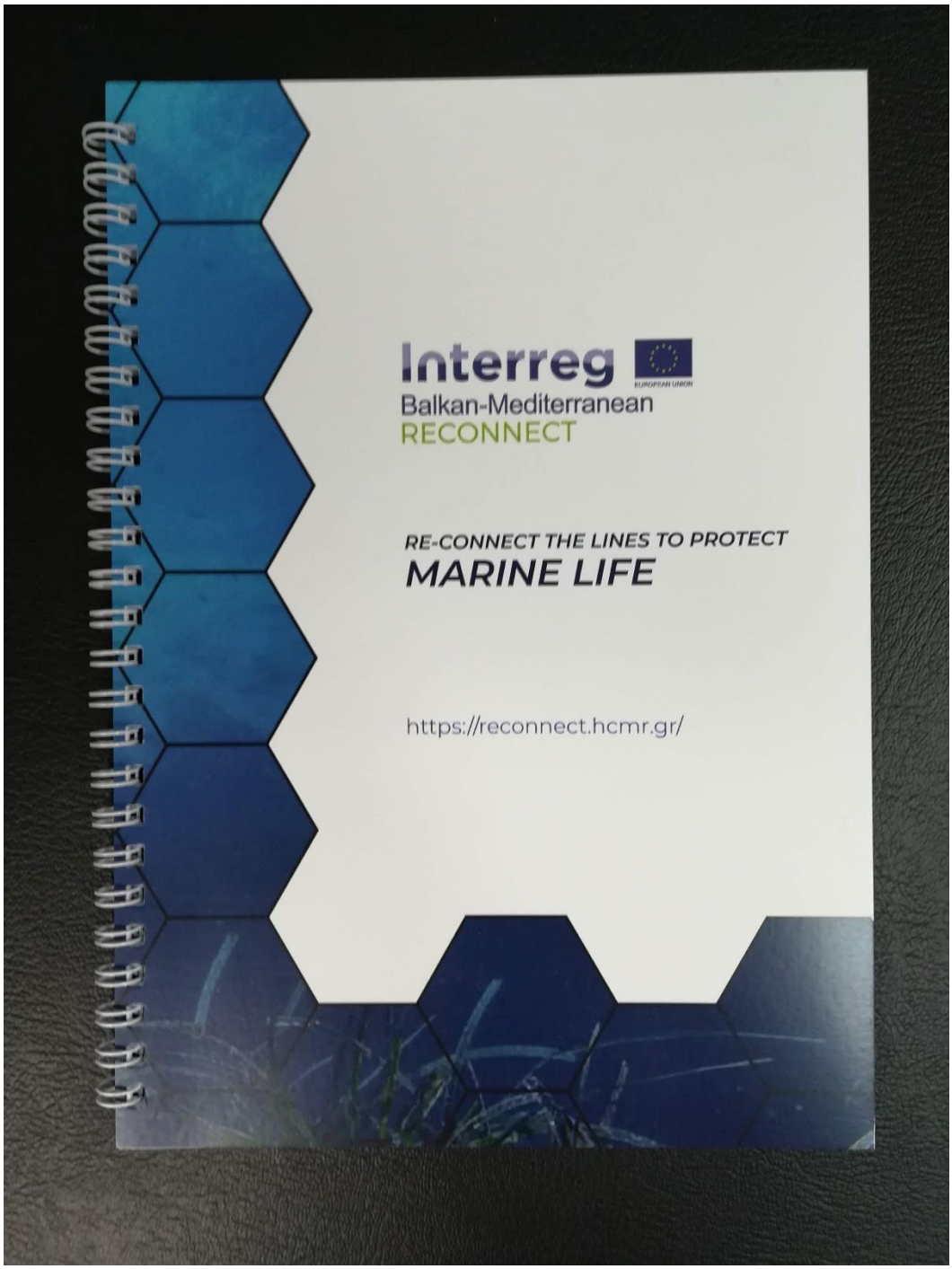

Image 16: The printed version of the RECONNECT's notepad, which was created by the DBS-UCY as part of the project identity set. In Cyprus, DBS-UCY chose to bind the notepad with a metallic spiral. Also, the front and back cover of the notepad was made with thick paper. The notepads will be given to the participants of the open day events and the training seminar.

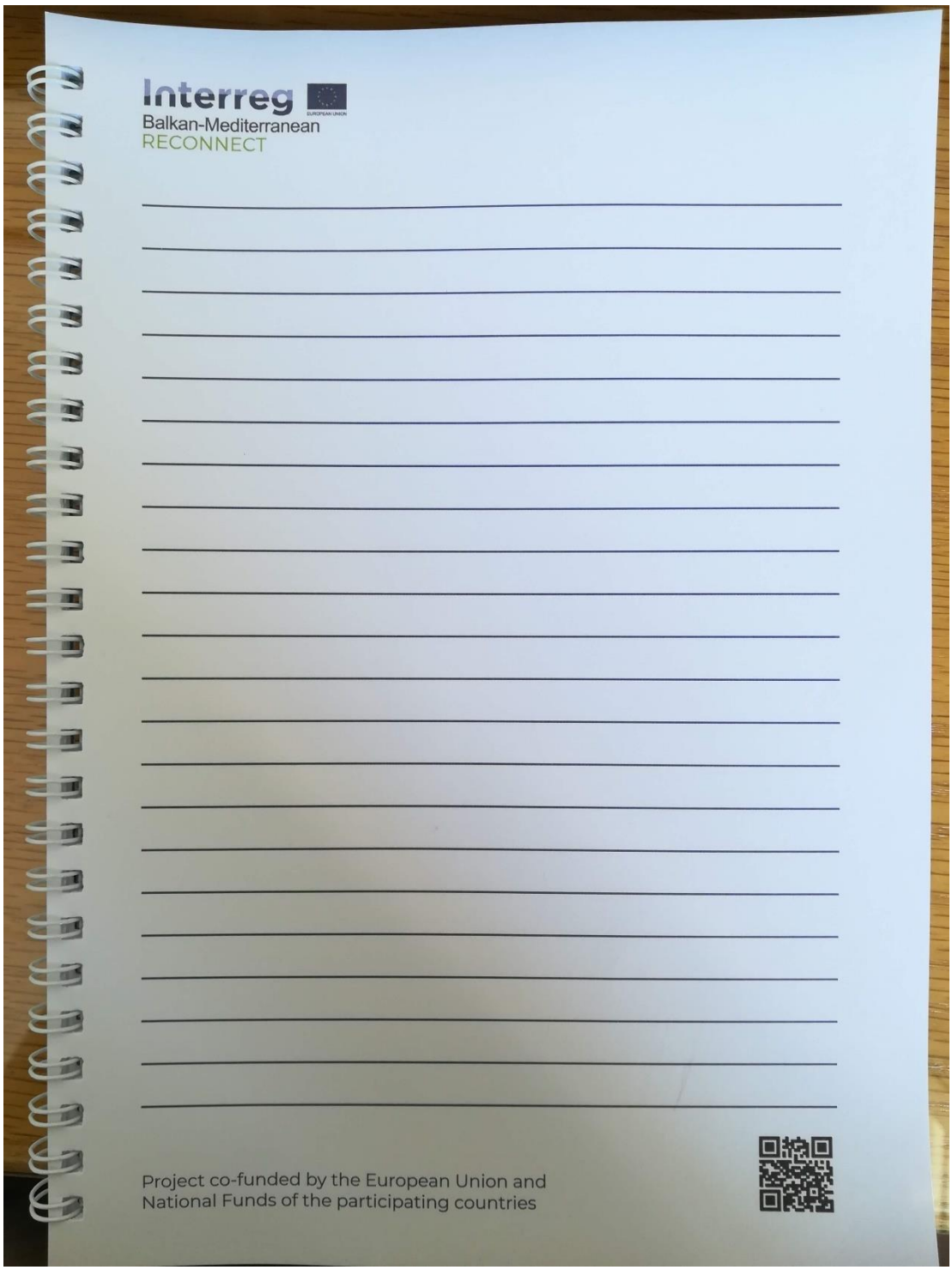

Image 17: The printed version of the RECONNECT's notepad, which was created by the DBS-UCY as part of the project identity set. In Cyprus, DBS-UCY chose to bind the notepad with a metallic spiral. Each notepad had 30 pages similar to the one displayed here. The notepads will be given to the participants of the open day events and the training seminar.

Image 18: The pen which was designed as part of the project identity set, and which will be used during the open day event, the training seminar and other dissemination events for further promoting the project.

Image 19: The USBs which were designed as part of the project identity set, and which will be used during the open day event, the training seminar and other dissemination events for the promotion of the project.

Image 20: The printed version of the roll-up banner, designed by the team of the Department of Biological Sciences, University of Cyprus, in Adobe Illustrator.

Image 21: The project flyer created for describing the project's main goals and actions. The trifold flyer was translated in Greek and Bulgarian in order to easily promote the project within the local communities, during various dissemination events, including the open day events and the citizen science training seminar. This image presents the front side of the Greek flyer.

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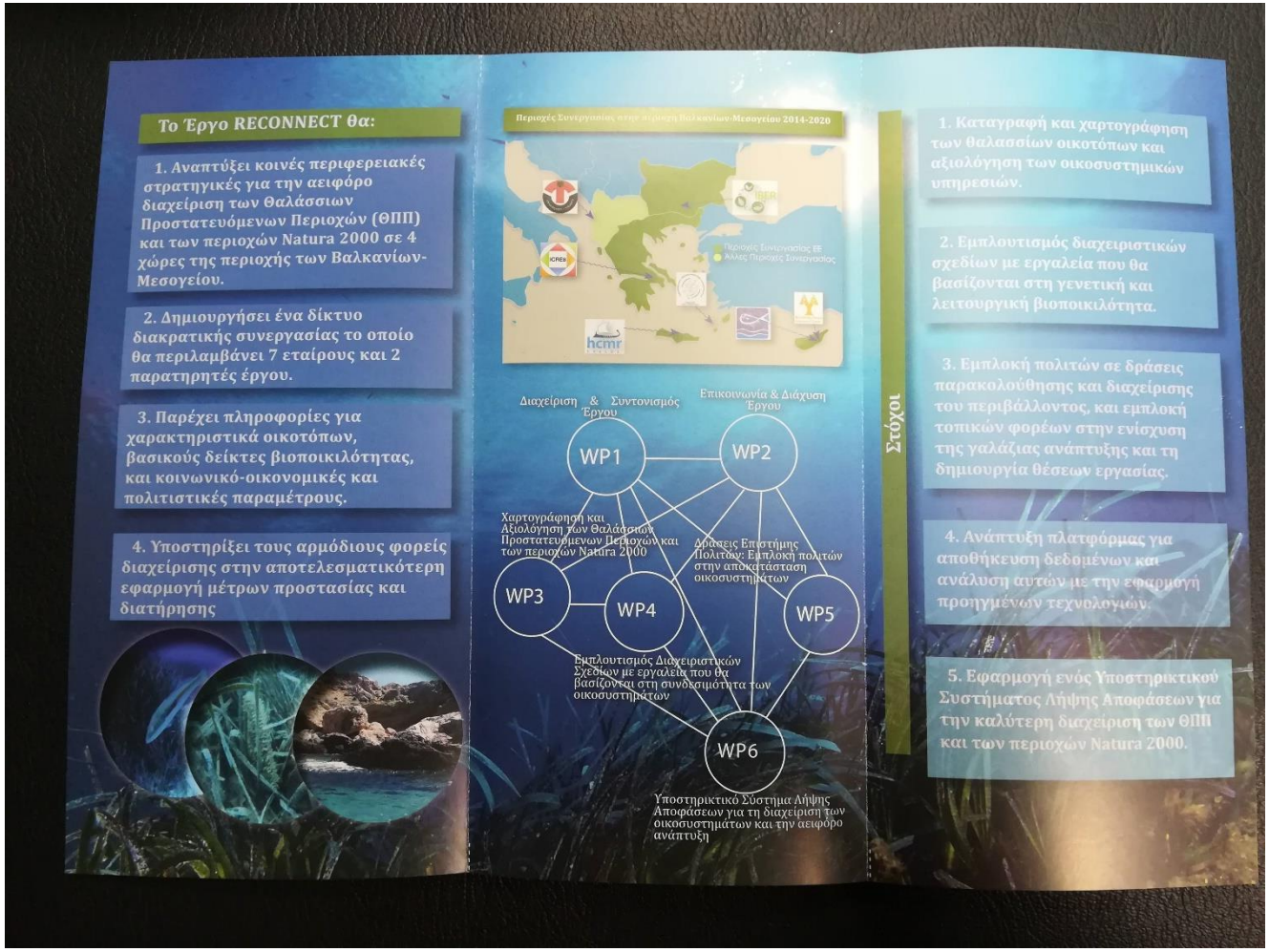

Image 22: The project flyer created for describing the project's main goals and actions. The trifold flyer was translated in Greek and Bulgarian in order to easily promote the project within the local communities, during various dissemination events, including the open day events and the citizen science training seminar. This image presents the back side of the Greek flyer.

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Image 23: The project flyer created for describing the project's main goals and actions. The trifold flyer was translated in Greek and Bulgarian in order to easily promote the project within the local communities, during various dissemination events, including the open day events and the citizen science training seminar. This image presents the front side of the English flyer.

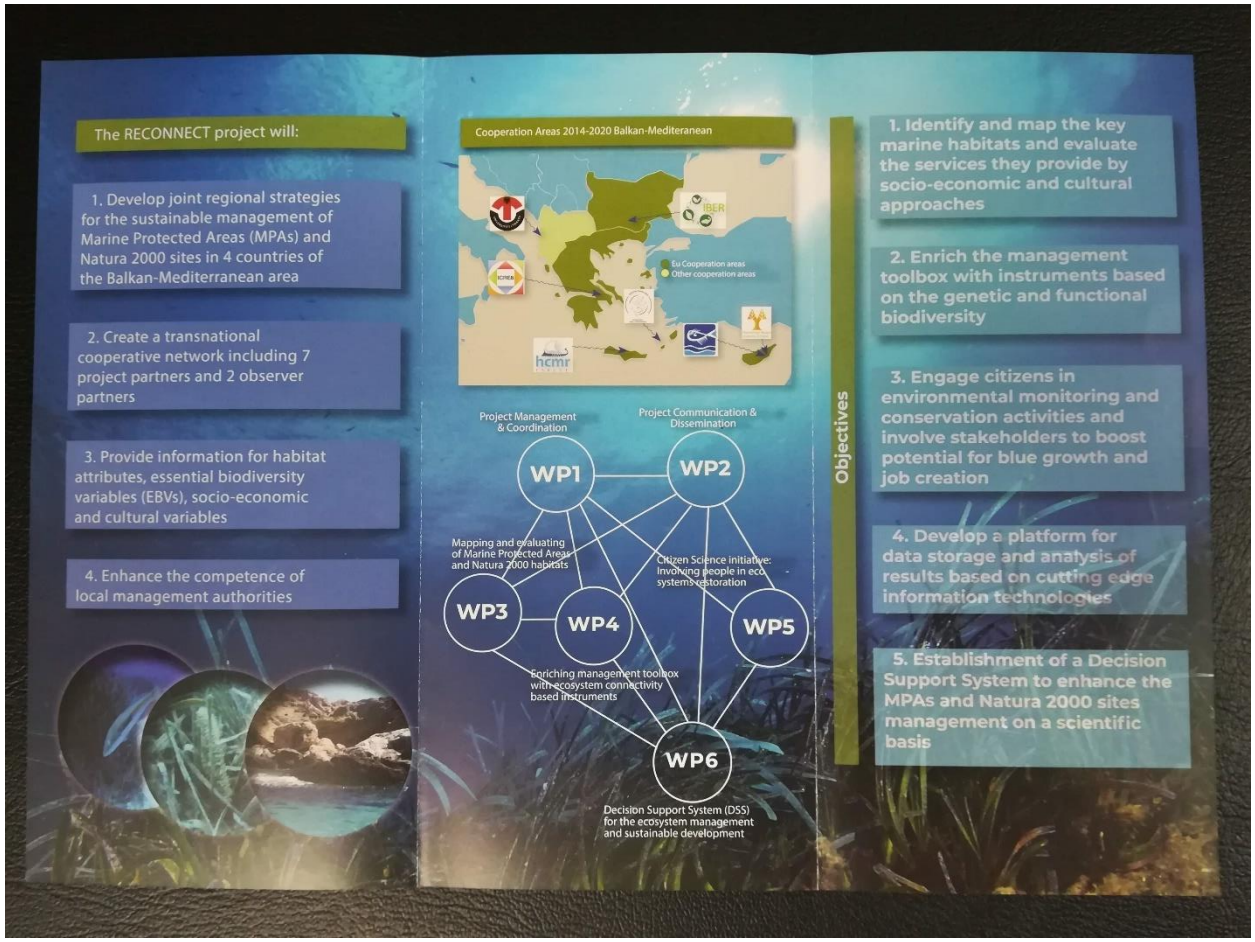

Image 24: The project flyer created for describing the project's main goals and actions. The trifold flyer was translated in Greek and Bulgarian in order to easily promote the project within the local communities, during various dissemination events, including the open day events and the citizen science training seminar. This image presents the back side of the English flyer.

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2.2.5 Prepare stakeholder lists

In order to successfully run the training seminars in each of the four countries, and in order to secure adequate participation of representatives of target groups, stakeholder lists would need to be prepared on time. As target groups for these activities were considered people with sufficient experience and involvement with the diving sector, as for example diving instructors, members of diving associations and diving clubs, diving centres etc.

Taking into consideration the GDPR regulation, the Department of Biological Sciences, University of Cyprus and their external expert proceeded to the preparation of specific forms (both in English and in Greek) which were sent through email communication to possible interested parties, or given to them in a printed form during dissemination events, such as the Open Day Event and the Researcher's Night. As you can see below (Image 25), the people were briefly informed about the project RECONNECT and what will follow in the upcoming months. They were then informed about the GDPR regulation, and their rights, and were then requested to fill-in and return this form. Through this way they had the opportunity to define whether they will be interested in participating to the citizen science training, and whether they wish to receive any updates regarding the project.

2.2.6 Design a citizen science training

According to Bodilis, *et al.* (2014), the successful implementation of citizen science projects often depends on the quality of the training seminars. The results from Bodilis' project on the monitoring of fish assemblages in the Kas Peninsula, Turkey, showed that there was a good correlation between volunteers and scientists' data, because of the short training given to the citizen scientists before the initiation of the census period. Another example which emphasizes the necessity of workshops is the project "Findkelp", where its results showed that the citizen scientists were able to identify a large percentage of kelp species, because they attended a workshop before the scheduled dives.

Based on the aforementioned case studies, the successful implementation of citizen science projects is often correlated to the time the organizers spend on training the participants

Image 25: The Application form given to interested parties during dissemination events such as the Open day event in order to formally request them if they want to receive updates regarding the project RECONNECT and whether they would like to participate in the Citizen Science Training Seminar. This form was also forwarded via email to possible interested parties (chosen from pre-defined mailing lists from DBS-UCY's and DFMR's database) prior the organization of the citizen science training seminar.

Application for further information on the RECONNECT project and its activities.

The RECONNECT project (Regional cooperation for the transnational ecosystem sustainable development), is implemented under the framework of the transnational Cooperation Programme Interreg V-B Balkan Mediterranean 2014-2020, and is co-funded by the European Union and National Funds of the participating countries. RECONNECT project aims to develop a transnational cooperative network for sustainable management of Marine Protected Areas (MPAs) and Natura 2000 sites. The new transnational and holistic approach which will be developed, will change the current protection strategies in the Balkan-Mediterranean area, promoting more efficient and accurate management practices. The main outputs of the RECONNECT project will provide information concerning habitat attributes, as well as the essential biodiversity, socio-economic and cultural variables of the participating countries.

An important innovation element of the RECONNECT Project is the involvement of civil society, through the evaluation of ecosystem services, using questionnaires. Subsequently, the project partners plan to implement training seminars for stakeholders, in order to contribute to the systematic monitoring and evaluation of the marine ecosystems.

Respecting the European «GDPR» policy, for the protection of personal data.

The General Data Protection Regulation (GDPR) which was applied on 25th May 2018, aims to protect the rights of natural persons regarding the processing of their personal data. Considering this policy, you are invited to fill in the existing application form and give us your consent in including your personal information (email) in the RECONNECT project's database. Your personal data will only be used for communication purposes with you, through the promotion of informative material, like the project's newsletters, and by subsequently providing you with information about our future activities (such as the citizen science training). Your data will be deleted twelve months after the end of the RECONNECT project. Please be aware that at any time, you have the right to ask for your data to be deleted from our database by contacting us at reconnect@hcmr.gr

- Are you interested in receiving updates for the RECONNECT project?

YES/NO

- Are you interested in participating in the training seminar on citizen science?

YES/NO

Full Name: ……

Email address: ……

Date:……

Signature: ……

prior to their involvement in the projects. For the non-scientists it's often very hard to follow a specific methodology, neither do they realise why data need to be collected and reported in a systematic way. For this reason, it's vital to dedicate some time, for explaining to the motivated citizens how they can properly contribute to the project.

In the project RECONNECT this necessity was identified during the preparation of the project proposal. For this reason, there is a dedicated deliverable (D5.X.2), designed specifically for the organization of a training seminar on citizen science. In this training seminar, the methodology which will be followed by the citizen scientists, as well as some guidelines on what to do and what to avoid doing during scuba diving will be discussed. Through this way, the citizen scientists which will participate during the pilot actions will have a better understanding of how-to better act in order to protect the marine environment. Moreover, a demonstration on the proper usage of the online platform and how to insert their data and photographs will be presented as well. In order to assess the participants' understanding of the project's expectations, a questionnaire will be given to them at the end of the training seminar.

The aims of the questionnaire are the following:

a) To examine if the citizen scientists have understood what would be expected from them, how they would need to take their photos and how they would need to send to the organizers their reports.
b) To check whether they were previously involved in a citizen science project, and how they participated in that.
c) Collect general information regarding their diving experience.
d) Assess their understanding on what they should avoid during diving, in order to further protect the marine environment.

Overall, through this questionnaire (example shown below), the organizers will be able to assess the successfulness of the seminar and citizen scientists will assess the level of their understanding and ask the participants for clarifications before they leave from the seminar. The results from this questionnaire will be presented in the report for D5.X.2 deliverable.

You have been selected to take part in this survey because of your expertise and relevance to the project. Your participation in the survey is entirely voluntary. If you are happy to take part, please give your consent by writing a ✓in the box below, and by providing us your email. The survey should take approximately 10-15 minutes to complete.

Do you wish to take part in this survey, regarding citizen science, and best diving practices? If you do, please write a tick (✓) in this box and your email below. ☐
Email: ……

Your email will be held securely in a Google database. All data will be deleted 12 months after the project's end date. For further information, or if you have any queries, please contact reconnect@hcmr.gr. According to the General Data Protection Regulation (GDPR), you are free to withdraw your questionnaire responses from the project data set at any time, until the data are destroyed. You should note that the analysed questionnaire data may be used in the production of formal research outputs (e.g. journal articles, conference papers, and reports). Your answers will be treated confidentially and the information you provide will be kept anonymous in any research outputs/publications. You are advised to contact reconnect@hcmr.gr at the earliest opportunity, should you wish to withdraw from the survey. You do not need to give a reason. A decision to withdraw, or not to take part, will not affect you in any way.

SECTION 1: Demographics

Please check the appropriate box or, where relevant, specify your answer.

1.1. **Age**:

18-30 ☐	40-49 ☐	60-69 ☐
31-39 ☐	50-59 ☐	70 plus ☐

1.2. **Gender:**

Male ☐
Female ☐

1.3. **Educational level:**

Primary school ☐
High school ☐
University ☐
Master ☐
Doctorate/PHD ☐

1.4. **Nationality**:……

1.5. **Occupation**:……

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SECTION 2: Scuba diving profile

Please check the appropriate box or, where relevant, specify your answer.

2.1. **Working in Scuba diving industry?**

YES ☐

NO ☐

2.2. **Date you began diving:** .....

2.3. **What is your diving organization (e.g. PADI, CMAS, NAUI?):**.....

2.4. L**evel of certification:** .....

2.5. **Maximum depth attained**:.....

2.6. **Date of last dive**:.....

2.7. **Approximate total number of dives:**.....

SECTION 3:

Please check the appropriate box or, where relevant, specify your answer.

3.1. **Did you hear about RECONNECT project before?**

YES ☐

NO ☐

3.2. **Have you ever participated in a Citizen Science project?**

YES ☐

NO ☐

If your answer was YES, which was this citizen science project, and how were you engaged?

.....

.....

.....

.....

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3.3. **Which of the following sentences describe the reasons for participating in this project?**

Rate the most important reasons by 5 and the least by 1

	1	2	3	4	5
To spend quality time with my friends/family	☐	☐	☐	☐	☐
To acquire skills	☐	☐	☐	☐	☐
For networks and collaborations	☐	☐	☐	☐	☐
To spend time with like-minded people	☐	☐	☐	☐	☐
For the sake of future generations	☐	☐	☐	☐	☐
For public recognition	☐	☐	☐	☐	☐
For the sake of society/the environment	☐	☐	☐	☐	☐
For the knowledge gained	☐	☐	☐	☐	☐
For my interest in the subject under study	☐	☐	☐	☐	☐
For emotional satisfaction	☐	☐	☐	☐	☐
For the contribution I can give	☐	☐	☐	☐	☐
For personal satisfaction	☐	☐	☐	☐	☐
For the sake of science	☐	☐	☐	☐	☐
For the reward	☐	☐	☐	☐	☐

3.4. **Did you ever visit the 3 pilot study areas (Agioi Anargyroi, Cyclops cave and Canyon)?**

YES ☐

NO ☐

IF YES, ANSWER THE FOLLOWING QUESTIONS:

3.4.a. **Declare which of them did you visit.**

Agioi Anargyroi ☐

Cyclops cave ☐

Canyon ☐

3.4.b. **How many times did you visit these sites?**.....

3.4.c. **How often do you visit these sites?**.....

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3.4.d. **Do you plan visiting these sites this summer season?**

YES ☐

NO ☐

3.4.e. **Please evaluate the species richness (number of species) in these 3 pilot sites, according to your previous visits:**

AGIOI ANARGYROI:		**CYCLOPS CAVE:**		**CANYON:**	
Very Rich	☐	Very Rich	☐	Very Rich	☐
Rich	☐	Rich	☐	Rich	☐
Medium	☐	Medium	☐	Medium	☐
Good	☐	Good	☐	Good	☐
Poor	☐	Poor	☐	Poor	☐

SECTION 4: Training Workshop-Best diving practices

Please check the appropriate box or, where relevant, specify your answer.

4.1. Please indicate your level of agreement with each of the following statements according to the training seminar you participated in:

	Very satisfied	**Somewhat satisfied**	**Neutral**	**Somewhat dissatisfied**	**Very dissatisfied**
Presentations					
Provided material					
Knowledge gained					
Methodology					

4.2. **Do you feel ready to use the methodology you have learnt in the training workshop?**

YES ☐

NO ☐

If NO state your reasons:

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4.3. **State whether the following statement is either wrong or right:**

1. Feeding fishes or any other marine species.

Wrong ☐ Right ☐

Choose what applies:

a) It allows weak organisms to survive. ☐
b) It changes their behavior and diet. ☐
c) It allows close proximity to fish. ☐
d) Feeding attracts additional predators. ☐
e) Don't know. ☐

2. Changing the position of marine species for the perfect photo.

Wrong ☐ Right ☐

Choose what applies:

a) It changes their feeding behavior. ☐
b) They enjoy touching them. ☐
c) It provokes aggressive reactions. ☐
d) It changes their mating behavior. ☐
e) Don't know. ☐

3. Good buoyancy control is important during diving.

Wrong ☐ Right ☐

Choose what applies:

a) Use appropriate weights. ☐
b) Remain in a vertical position in the water. ☐
c) Don't stir the sandy bottom. ☐
d) Fully inflate your BCD while ascending. ☐
e) Don't know. ☐

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4. The diver-photographer must be sufficiently skilled so that underwater photography remains a reasonably safe activity.

Wrong ☐ Right ☐

Choose what applies:

a) Get your buoyancy and diving skills down before taking a camera underwater. ☐

b) Heavy currents and poor visibility are the ideal conditions for underwater photography. ☐

c) Good diving skills are necessary to avoid damaging the reefs when you are closely approaching them. ☐

d) Move and orientate the marine life freely to get the perfect picture. ☐

e) Don't know. ☐

5. Marine litter disposed by human activities pollute the marine ecosystem.

Wrong ☐ Right ☐

Choose what applies:

a) Avoid buying single use plastics such as straws and plastic bags. ☐

b) Fertilizers and animal wastes do not pollute the marine ecosystem. ☐

c) Microplastics and other marine litters bio accumulate in fish. ☐

d) Most of the marine litter especially plastics biodegrade very fast. ☐

e) Don't know. ☐

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The Department of Biological Sciences, of the University of Cyprus, as the responsible partner for D5.X.1 and D5.X.2 has already prepared with AP Marine's contribution two Power Point presentations which will be used in the training seminar. These presentations (Appendix 1) will be given to the rest of the partnership as a baseline for preparing their own presentation.

2.2.7 Organize an underwater photography competition

As was mentioned in the introduction, keeping the interest of the participants throughout the implementation of citizen science activities is of essential importance. For this reason, the project's partners shared some ideas on how to achieve this. One of those ideas was the organization of an underwater photography competition. The Department of Biological Sciences discussed this idea with the Department of Fisheries and Marine Research and how to make this competition successful. However, this will be only possible after securing the relevant funding through budget modifications, since it wasn't initially included in the project proposal, but identified through the completion of this deliverable.

2.2.8 Appreciate the citizens' contribution

Last but not least, citizens will need to have their contribution appreciated. The credit system which will be created in the online platform will be able to define the citizen scientists with the most recordings, and according to their involvement in the project they will have their initiatives recognized. For example, these participants could be featured in a special section in the online newsletter, and in the social media pages, special commemorative plaques could be awarded to them with the completion of the project etc.

3. REFERENCES

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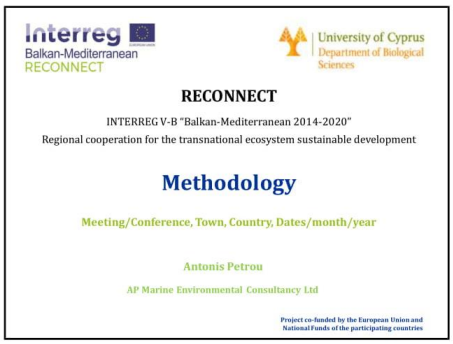
4. APPENDIX 1: The presentations prepared for the citizen science training



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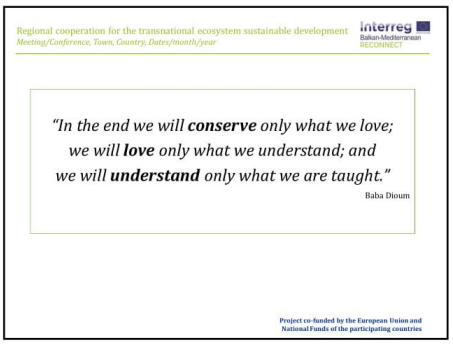

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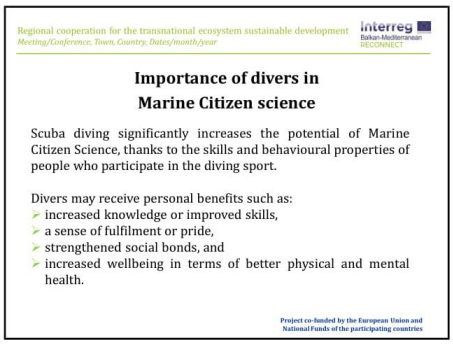

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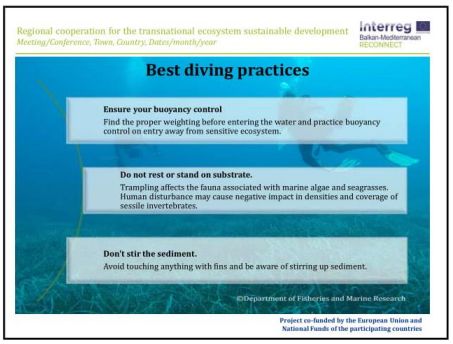

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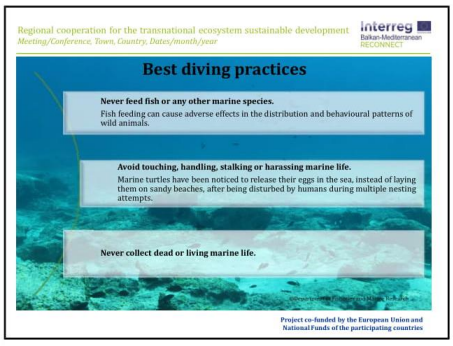

5

6

Introduction

The **main outputs** of the RECONNECT project will be to provide information:

- concerning habitat attributes,
- the essential biodiversity,
- socio-economic and cultural variables.

The **overall goal** of the **data collection** is the:

- identification of marine species found in the quadrats,
- monitoring of changes in biodiversity over time.

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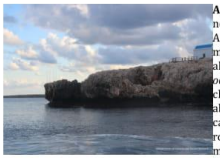
Study area

In Cavo Greco area (Cyprus), 3 pilot stations were chosen, where, permanent quadrats have been placed both in *Posidonia oceanica* meadows and on hard substrates.



Ag. Anargyroi (Chapel): The site is located near Cavo Greco, just in front of the chapel of Ag. Anargyroi. The depths are between 0-30 meters and the substrate is mostly rocky. It alternates with large meadows of *Posidonia oceanica*. Going down the stairs from the chapel of Ag. Anargyroi, we arrive in a large aboveground cave. Entering the water (with caution because in some places there are rough and slippery rocks), depths starts at 7 meters.

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Study area

Cyclopes cave: The area is accessible both by land and sea. The depths of the route are between 0-25 meters and the substrate is mostly rocky. We follow a narrow path from the rocks- the cave of the Cyclops overlooks at the seafront. Entering the water, the substrate is initially rocky for about 50 meters (southeast), reaching 5 meters depth, having the land on our left.

Photo of the area

Project co-funded by the European Union and National Funds of the participating countries

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Study area

Canyon: This specific site is more technical challenging and it's suggested to very experienced divers. Situated at the south side of Cape Greco just under the cliffs, access is from the shore. The maximum depth is 18 meters.

Photo of the area

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Study area

Each site has:

- 5 permanent quadrats in *Posidonia oceanica* meadows and
- 5 permanent quadrats on a hard substrate.
- Submerged buoys have been attached to the quadrat, rising 1-2 m from the seafloor to mark the quadrats locations, as well as identification labels.

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"You can help! Become a citizen scientist"

Methodology

Step 1: Dive the site
A website where citizens scientists will be able to find GPS coordinates and information regarding the pilot sites has been developed.
https://cs-reconnect.hcmr.gr.

All citizen scientists should familiarize themselves with the local area of the 3 pilot stations before diving.

RE-CONNECT the lines to protect marine life.

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12

"You can help! Become a citizen scientist"

Methodology

Step 1: Dive the site

Familiarize yourself with the local area. This can be done by:

- Visiting the project website https://cs-reconnect.hcmr.gr. and find the coordinates for each quadrat for the dives sites.
- If you have never dived these sites, consider going with someone who is familiarize with the locations (i.e a friend or with a dive center).

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"You can help! Become a citizen scientist"

Methodology

Step 2: Search for the quadrats
For each quadrat, a code name was given.

Site	Code: *Posidonia oceanica* meadows	Code: Hard substrate
Cyclop's Cave	CY_A1 CY_A2 CY_A3 CY_A4 CY_A5	
Agioi Anargyroi	CY_B1 CY_B2 CY_B3 CY_B4 CY_B5	
Canyon	CY_C1 CY_C2 CY_C3 CY_C4 CY_C5	

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"You can help! Become a citizen scientist"

Methodology

Step 2: Search for the quadrats
For each quadrat, a code name was given.

Site	Code: *Posidonia oceanica* meadows	Code: Hard substrate
Cyclop's Cave	CY_A1 CY_A2 CY_A3 CY_A4 CY_A5	
Agioi Anargyroi	CY_B1 CY_B2 CY_B3 CY_B4 CY_B5	
Canyon	CY_C1 CY_C2 CY_C3 CY_C4 CY_C5	

Hard substrate

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"You can help! Become a citizen scientist"

Methodology

Step 3: Take your photo

- Make sure the whole quadrat and its label is in the picture.
- Don't forget to double-check your photo to make sure it's in focus.
- Make sure that the lighting settings is adjusted to the environmental conditions, e.g. cloud coverages and visibility.

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"You can help! Become a citizen scientist"

Methodology

Step 4:Report what's important

Apart from taking pictures of the quadrats you can report anything you think it's important. You can take pictures:

- of marine litter,
- any marine organism that may found interesting or you are curious about,
- abandoned fishing gears etc.

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"You can help! Become a citizen scientist"

Methodology

Step 5:Upload your photo:

Upload your data and your photographs to the website https://cs-reconnect.hcmr.gr.

Screenshot of the website

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Regional cooperation for the transnational ecosystem sustainable development
Meeting/Conference, Town, Country, Dates/month/year
interreg
Balkan-Mediterranean
RECONNECT
Thank you for your attention
Any questions??
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Department of Biological Sciences
RECONNECT
INTERREG V-B "Balkan-Mediterranean 2014-2020"
Regional cooperation for the transnational ecosystem sustainable development
Importance of Citizen Science
Meeting/Conference, Town, Country, Dates/month/year
Antonis Petrou
AP Marine Environmental Consultancy Ltd
Project co-funded by the European Union and National Funds of the participating countries

1


Regional cooperation for the transnational ecosystem sustainable development
Meeting/Conference, Town, Country, Dates/month/year
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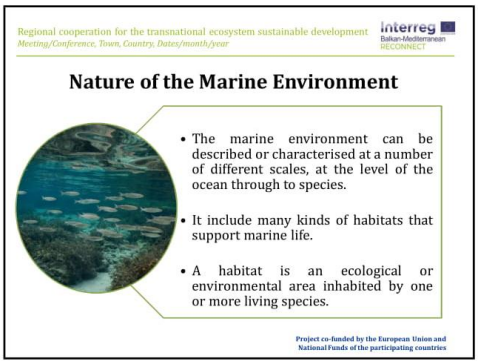
"Citizen science projects gives citizens a voice about change and responsibility for solutions to influence their welfare, their concerns and interests. Citizen Science research is interactive; it is 'with' and not 'by' or 'on' citizens."
European Marine Board
Project co-funded by the European Union and National Funds of the participating countries

2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Nature of the Marine Environment
The marine environment can be described or characterised at a number of different scales, at the level of the ocean through to species.
It include many kinds of habitats that support marine life.
A habitat is an ecological or environmental area inhabited by one or more living species.
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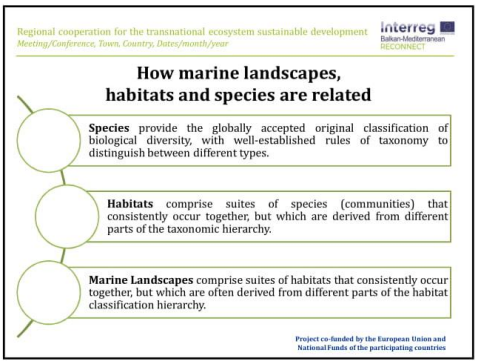
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How marine landscapes, habitats and species are related
Species provide the globally accepted original classification of biological diversity, with well-established rules of taxonomy to distinguish between different types.
Habitats comprise suites of species (communities) that consistently occur together, but which are derived from different parts of the taxonomic hierarchy.
Marine Landscapes comprise suites of habitats that consistently occur together, but which are often derived from different parts of the habitat classification hierarchy.
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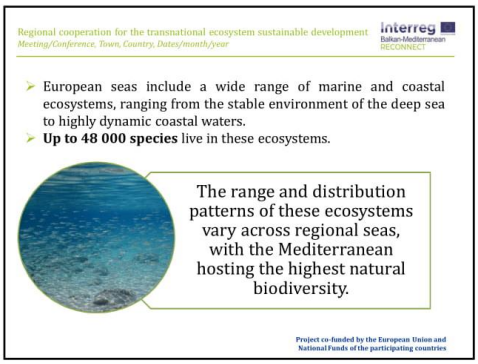
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European seas include a wide range of marine and coastal ecosystems, ranging from the stable environment of the deep sea to highly dynamic coastal waters.
Up to 48 000 species live in these ecosystems.
The range and distribution patterns of these ecosystems vary across regional seas, with the Mediterranean hosting the highest natural biodiversity.
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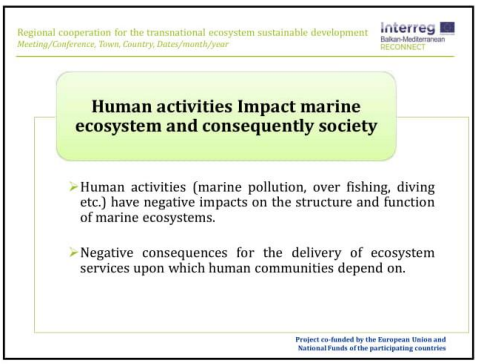
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Human activities Impact marine ecosystem and consequently society
Human activities (marine pollution, over fishing, diving etc.) have negative impacts on the structure and function of marine ecosystems.
Negative consequences for the delivery of ecosystem services upon which human communities depend on.
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Unsustainable Fisheries Activity Impact Marine Environment

Fishing equipment including new technologies and overfishing causes the **reduction of fish stocks worldwide.**

Unsustainable fishing practices such as dredging and trawling can cause **irreversible damage** to marine ecosystem.

These techniques often capture non-target species (known as **bycatch**) which are then discarded.

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Pollution caused by human activity

Direct impact e.g. oil spills caused by tanker accidents.

Indirect impacts e.g. coastal activities, waste.

Oceans have long been used as an intentional dumping ground for all sorts of **waste** including sewage, industrial run-off and chemicals.

Some effects may not be immediately obvious, such as **bioaccumulation**.

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Eutrophication **Ocean acidification** **Climate change**

Eutrophication is the release of excess nutrients int o coastal areas via streams and rivers.

e.g. nutrients which come from agriculture.

The world's oceans currently absorb as much as one-third of all CO_2 emissions in our atmosphere. This absorption of CO_2 causes the pH to decrease, resulting in the seawater becoming more acidic.

The marine environment is already registering the impacts of climate change. The current increase in global temperature of 0.7°C since pre-industrial times is disrupting life in the oceans, from the tropics to the poles.

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Marine Environment and Society

- The marine environment supports a diverse range of sea life that is important for global biodiversity.
- A healthy marine environment supports our cultural and social well-being, and the ocean's resources contribute to our economy.
- The marine and coastal environment also plays a significant role in the economy and way of life.

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Marine Environment and Society

Everyone can protect the environment.

Fishermen

Tourists

Divers

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How fishermen can contribute to the environmental protection

Practice **sustainable fishing** without depleting the population or put in danger the ecosystem.

How fishermen can achieve this:

- Choosing appropriate fishing gear to minimize the negative impact on the marine ecosystem.
- Avoid using bottom trawls as they can damage important seafloor habitat such as *Posidonia oceanica* meadows and destroy bottom-dwelling wildlife such as corals and sponges.
- Avoid throwing any wastes (e.g. fishing gear, like nets and any source of garbage such as straws and plastic bags).

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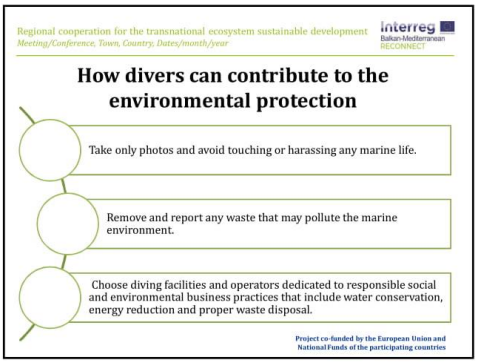

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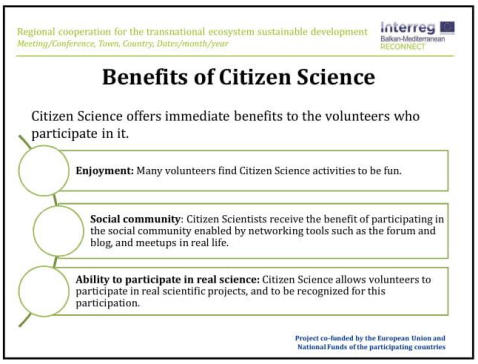

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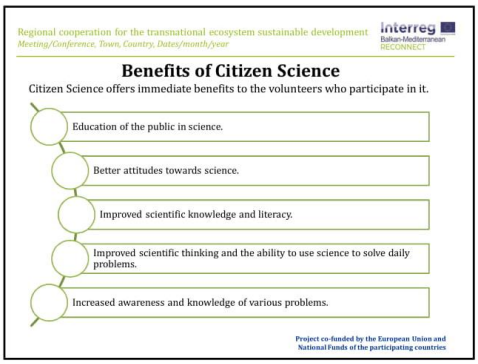

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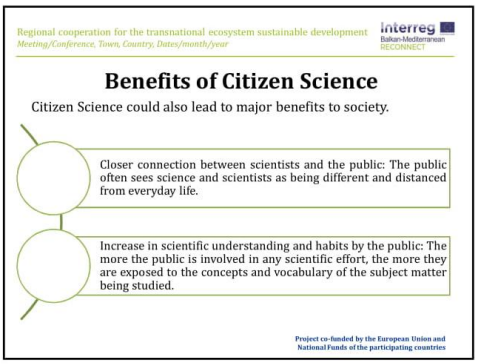

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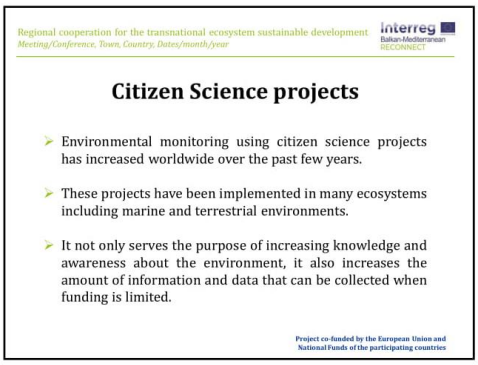

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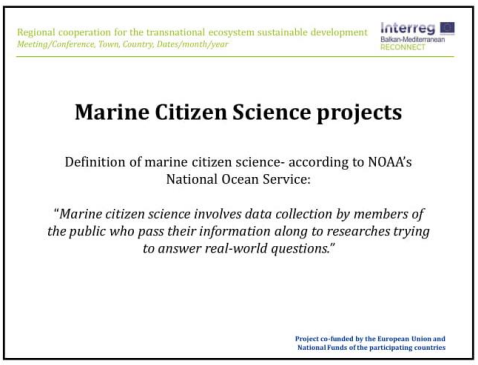

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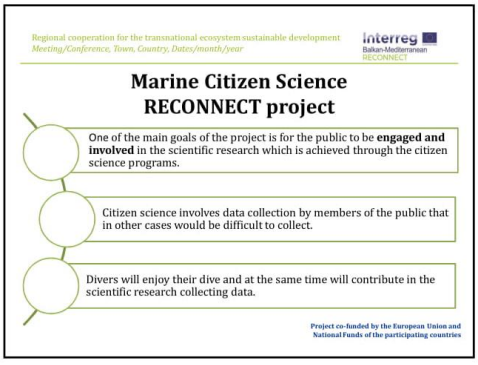

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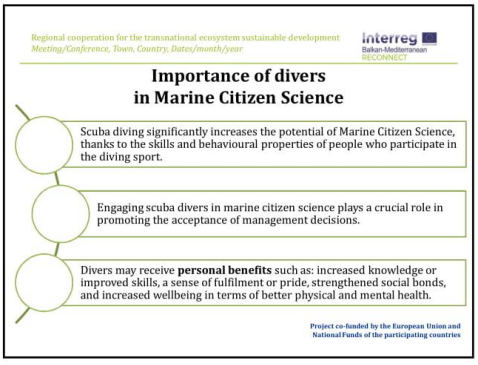

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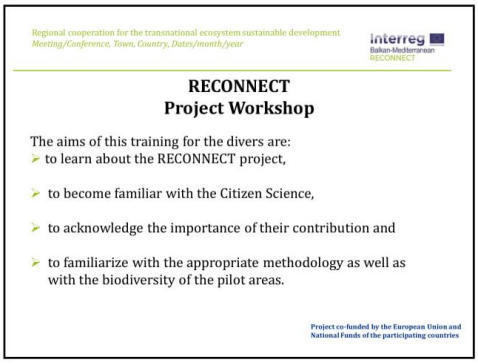

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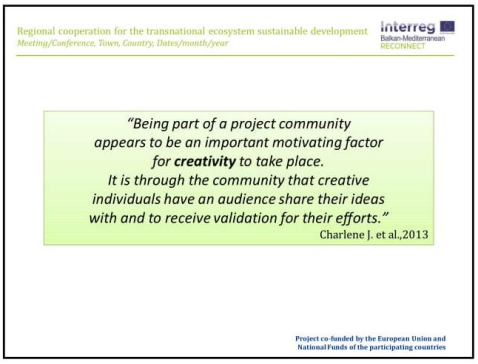

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Thank you for your attention
Any questions??
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