Seas, Oceans & Public Health in Europe

Linking oceans and health research

Pilot "Tourism & Citizen Science" Program on Oceans & Human Health

Report on Results and Recommendations 2019 - 2020

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Travelecoology and **Submon** produced this report and are solely responsible for its statements and opinions. If you have any doubts or questions please write them directly at info@travelecoology.com or info@submon.org, respectively.

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https://sophie2020.eu/

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Executive summary

The "**S**eas, **O**cean and **P**ublic **H**ealth in **E**urope" (SOPHIE) Project has championed the development of a pilot **"Tourism & Citizen Science" Program.** The Program is a **scoping effort** aimed at identifying the **strengths**, **weaknesses**, **risks**, **opportunities** and **critical success factors** of launching a **sentinel network** that activates **coastal & marine tourism operators** and their **clients** (or "blue tourism stakeholders") as "***citizen sensors***" that contribute to build knowledge on Oceans and Human Health (OHH) interactions in Europe.

SOPHIE's **"Tourism & Citizen Science" Program** ran between **March 2019** and **March 2020**, when it had to be unfortunately interrupted due to the COVID-19 pandemic outbreak. In spite of its shorter life span, the Program has fully served its purpose, confirming a **broad scope of opportunity** to use **citizen science** as a vehicle to gather data for **OHH research**. However, it has also identified relevant risks that need to be addressed for it to deliver useful results, efficiently and cost-effectively.

Building a **sentinel network** of **blue tourism stakeholders** in **Europe** to gather data on OHH can render clear **benefits**, capitalizing on an existing broad base of **coastal & marine tourism operators** that are willing and able to partake in **citizen science** initiatives, namely:

- Offering an **opportunistic platform** for scientists to undertake research on OHH interactions. Tourism operators spend most of their time by the coast or at sea, with the potential to become the "eyes" of researchers on the field. Additionally, these operators offer researchers access to thousands of tourists, visitors and citizens in coastal communities, who are seemingly willing to team up with science when invited to do so by a trusted tourism operator.
- **Broadening** the **geographical scope** of **long-term OHH research**, **cost-effectively**. International citizen science initiatives successfully contribute to the gathering of data from a broad range of geographies using digital tools without requiring the physical presence of researchers beyond an initial engagement and training effort, capturing economies of scale.
- **Generating synergies** between **research** and **Ocean literacy efforts**. Educational efforts invested in engaging coastal & marine tourism operators in citizen science initiatives have a positive spill over effect on their customers, as knowledge gained by operators is passed onto them.

However, for such a sentinel network to render results, a number of **critical success factors** need to be properly addressed and managed, amongst which:

- **Scientists** should play an **active role** in such a network, ensuring that initiatives align with existing strategic research agendas for OHH. Appropriate protocols and tools are needed to ensure data reliability and robustness.
- Citizen science initiatives must run with a **long-term perspective** of minimum 3 and preferably 5 years, in order to gather enough data and thereby ensure its statistical significance and relevance.
- Periodic **training** and **networking** with operators must be maintained and managed, to keep them interested and engaged in on-going initiatives.

Any future citizen science network should connect to existing efforts undertaken by local stakeholders and capitalize on relationships established through existing tourism networks, such as the **WILDSEA Europe** network – https://wildsea.eu.

1 About this Report

This Report has been produced in the framework of the "**S**eas, **O**cean and **P**ublic **H**ealth in **E**urope" (SOPHIE) Project, funded by the European Union's Horizon 2020 Programme.

The objective of this Report is to present the **results** of **SOPHIE**'s **Citizen Science Program**, launched as part of the activities planned under the Project's **Work Package 5 (WP5): Building Awareness & Skills**. The Report has been produced by **Travelecoology** and **Submon**, as co-leads of WP5.

Fig. 1: Outreach material for SOPHIE's "Blue spaces & wellbeing" citizen science initiative.

2 Scope & objectives of SOPHIE's Citizen Science Program

The "**S**eas, **O**cean and **P**ublic **H**ealth in **E**urope" (SOPHIE) Project 's primary aim has been to:

a) Deliver a clear, evidence-informed **Strategic Research Agenda** (SRA) for **Oceans and Human Health** within the European context, based on extensive involvement by diverse stakeholders; and

b) Ensure that the **structures** needed to develop and implement this **SRA** are in place and will exist as a legacy beyond the life of the project.

In the framework of **SOPHIE** (https://sophie2020.eu/), Work Package (**WP**) 5 "**Building Awareness & Skills**" aimed to contribute to improving the **professional skills** and **competences** for those working and being trained to work within the blue economy, and specifically in **Sustainable Blue Tourism**, through a training program geared at **building awareness** and **knowledge** on ocean and marine issues relevant to public health. WP5 proposed to engage, train and work with tourism stakeholders to specifically **pilot citizen science initiatives** as **innovative vehicles** that can contribute to increasing interdisciplinary awareness and knowledge in Oceans and Human Health (**OHH**), particularly around its interactions with **Healthy Coastal Living** and **Sustainable Blue Tourism**.

In addition, WP5 sought to **test** and **improve** practical approaches to gather and disseminate relevant quality data on OHH through tourism networks, targeting two complementary audiences: Tourism Operators (Target Audience 1) and local communities, tourists and visitors (Target Audience 2) at coastal destinations. Specific objectives in this regard were:

1. To engage and train tourism operators in OHH and in the gathering of relevant OHH data through **citizen science** initiatives.
2. To test the effectiveness of the resulting data collection processes and to develop practical approaches on how to improve the quality of OHH data gathered through citizen science.
3. To nurture OHH literacy amongst tourists, visitors and local communities of European coastal areas through tourism networks.

To this end, **Travelecoology** and **SUBMON** launched a pilot **"Tourism & Citizen Science" Program** seeking to activate tourism operators and their clients as "*citizen sensors*" that contribute to building knowledge on Oceans and Human Health (OHH) interactions. The pilot Program was launched as a **scoping effort** aimed at identifying the **strengths**, **weaknesses**, **risks**, **opportunities** and **critical success factors** for launching such a network at a broader European level.

SOPHIE's **"Tourism & Citizen Science" Program** was launched in March 2019 in coastal destinations across Europe, both in the Mediterranean and Atlantic basins and ran for 1 year up to March 2020.

3 Methodology applied to SOPHIE's Citizen Science Program

SOPHIE's **Citizen Science Program** is a **scoping effort** aimed at identifying the **strengths**, **weaknesses**, **risks**, **opportunities** and **critical success factors** for launching a network of "**tourism sentinels**" at a European level that can contribute to gather and deliver data on **Oceans and Human health** in support of scientific research, contributing to advance the effective implementation of Europe's Strategic Research Agenda on Ocean and Human Health.

In order to achieve this objective, **SOPHIE**'s **Citizen Science Program** was set up following a structured methodology geared at ensuring its successful implementation, while providing a framework to monitor and evaluate its results. It contained the following milestones:

- Building factors of success into the design and implementation of SOPHIE's Citizen Science Program.
- Defining the citizen science initiatives for SOPHIE's Citizen Science Program, including target audiences and clear goals.
- Developing data gathering surveys and tools.
- Screening the citizen science initiatives for ethics compliance.
- Reaching out, engaging and training tourism operators to partake in the citizen science initiatives.
- Following up with engaged operators and monitoring results.
- Analysing results.

3.1 Building factors of success into the design and implementation of SOPHIE's Citizen Science Program

In order to properly guide the design and implementation of **SOPHIE's Citizen Science program**, a set of success factors were identified and taken into consideration. The authors referred to the **European Marine Board**'s Position Paper 23 "**Advancing Citizen Science for Coastal and Ocean Research**" (García-Soto *et al*. 2017), which sets out general guidelines for successful citizen science. Based on the exploration of past European experiences of marine citizen science, a Working Group had identified 6 common **factors** of **success** that had influenced the results of such experiences (see Figure 2).

The following factors were therefore taken into considerations when planning the design and implementation of **SOPHIE**'s **Citizen Science Program**:

1. Contribution to science.
2. Clear goals.
3. Reliable data.
4. Good communication.
5. Engagement of citizens.
6. Improved Ocean literacy.

Fig. 2: Factors of success in Citizen Science projects (Source: Paula Kellet-European Marine Board)

3.2 Defining citizen science initiatives for SOPHIE's Citizen Science Program

The target audience for **SOPHIE**'s **"Tourism & Citizen Science" Program** had been pre-established at the outset of the **SOPHIE Project**, namely:

- **Target Audience 1:** Tourism Operators.
- **Target Audience 2:** Local communities, tourists and visitors.

An initial scoping review of OHH and previous successful OHH (citizen science) initiatives and projects was completed to assess different fields of work and research initiatives within the large discipline of OHH.

In order to address to **factor of success #1** "**Contribution to Science**", scientists working in very different OHH areas were contacted to discuss whether potential citizen science (**CS**) initiatives engaging coastal and marine (eco)tourism operators, their customers and visitors of coastal destinations could be of use for their research. The aim was to feed the results of these citizen science initiatives into ongoing, framing scientific research projects, seeking to join efforts with research teams to define the CS initiatives to be developed. Organizations engaged included:

- Deltares (Netherlands)
- Institute of Marine Sciences (Spain)
- IS Global (Spain).
- NUI Galway (Ireland)
- Plymouth University (UK)
- RIVM (Netherlands)
- Seascape Belgium (Belgium)
- Sonic kayaks (UK)
- UNEXE (UK)
- University of Girona (Spain)

During this period, contact was also established with other social organizations and NGOs with an active involvement in OHH, citizen science and ocean literacy initiatives, in order to learn about previous experiences and conclusions drawn, with the aim to enrich the citizen science initiatives to be designed and rolled out in the framework of the Program. Conversations were had with:

- Clean Coasts
- CoastWatch Europe
- Leave No Trace Ireland
- The Surfrider Foundation
- uMotif platform

Considering the objectives and scope of the SOPHIE Project, only research projects with an objective related to OHH research were brainstormed and considered, preferably with the potential to be applied both in the **Mediterranean** and **Atlantic** basins for comparison. This would allow comparing results across basins, as well as to increase the chances of gathering more data, in support of the application of the Program's results to ongoing research initiatives on both topics.

Ideally, the **Citizen Science Program** should encompass projects addressing both the **positive** and **negative** effects of interacting with the Ocean.

Based on the scoping work, conversations with scientists and other stakeholders, and discussions with SOPHIE partners and SOPHIE's Advisory group, 2 OHH topics were chosen for the **Citizen Science Program**, addressing different OHH descriptors and leading to the development of the following, distinctive initiatives:

- **Initiative #1: Mapping *Ostreopsis* spp.**
- **Initiative #2: Blue spaces and wellbeing.**

With the input of the consulted scientific organizations, and in order to address **factor of success #2** "**Establishing Clear Goals**", specific objectives were set for these initiatives, as detailed below.

Initiative #1: Mapping *Ostreopsis* spp.

This project focused on a **negative environmental aspect** of the relationship between Oceans & Human Health: exposure to *Ostreopsis* spp., a toxic microalgae that produces blooms in the Mediterranean basin and in the past years also further along the Atlantic coast of southern Europe (possibly due to warming of sea water temperature). The project is related to the **Marine Strategy Framework** (D.1. Biodiversity; D.2. Non-indigenous species).

Rationale: Ostreopsis spp. is a **toxic dinoflagellate alga** that has been slowly spreading in the Mediterranean Sea since the end of the 20th century, causing **algal blooms and episodes of toxicity** to marine animals and humans (Vila *et al.* 2016). It produces toxins that affect invertebrates and fish. On some occasions it has been related to **respiratory and skin symptoms in swimmers and people on the beach**. These episodes of human toxicity of *Ostreopsis* are extremely difficult to detect because symptoms are usually mistaken for those of a cold or mild sunstroke. The algal blooms are also very occasional and local, and last for short periods of time (usually just days). For these reasons, it is complicated for researchers to detect areas where *Ostreopsis* might be a

potential problem, to further understand its expansion throughout the Mediterranean, and why and where it blooms and produces toxins.

Value of citizen science: Tourism operators spend most of their time by the coast or at sea. They can become the "eyes" of scientists, reporting the presence of an algal bloom or the medical symptoms its toxins might produce.

Goal: To **detect potential new areas** where ***Ostreopsis*** is becoming a problem in Europe.

Target audience: Target Audience 1 (Tourism Operators).

Partners: The project was developed in collaboration with researchers at the **Marine Science Institute** of **Barcelona**. In order to effectively reach a critical mass of tourism operators working both in **Atlantic** and **Mediterranean** destinations, the project teamed up with the **WILDSEA Europe** network (https://www.wildsea.eu).

Fig. 3: Tourism operator interpreting the marine environment in Catalonia, Spain.

Initiative #2: Blue spaces and wellbeing

This project focused on a **positive aspect** of the relationship between Oceans & Human Health: how interacting with the marine environment and carrying out an activity affects peoples' **physical** and **mental wellbeing**, and even their attitude towards marine conservation. It was **social** research, which relied on customers of coastal & marine tourism operators answering an on-line survey.

Rationale: There is an increasing body of evidence pointing at the positive effects of spending time in blue environments (known as the "blue health effect") (Elliot *et al*. 2018; Hooyberg *et al*. 2020; Papathanasopoulou *et al*. 2016; White *et al*. 2014 & 2016). Spending time by the sea tends to increase physical activity, improving general health, and social interaction with friends and family. It has been suggested that taking part in an environmental or study activity by the sea makes you feel good emotionally and

mentally, and generates personal satisfaction through contribution and socialising with others (Koss & Kingsley 2010); but only so many people get involved in this type of activities. On the contrary, every year hundreds of thousands of tourists flee to the coasts to enjoy the sea for a few days or weeks. The influence of the blue environments on these people, who usually live far from the coasts, has an extraordinary potential not just on their wellbeing, but also on their Ocean Literacy and awareness on marine conservation, a potential which has not yet been studied.

Value of citizen science: In order to understand the impact that carrying out a coastal or marine activity has on a person, researchers need to reach out to a large number of tourists during a short period of time (mainly summer), preferably along all of the European coast, and just after completing such an activity. Tourism operators receive hundreds, if not thousands, of visitors every year to carry out activities at sea and discover its wonders. They are the perfect means to reach out to visitors, handing them a questionnaire to fill in after engaging in an activity.

Goal: To assess the effect that **undertaking an activity by the coast or at sea** has on the **wellbeing** of **citizens**, **tourists** or **visitors** of coastal destinations, as well as on their relationship with the ocean.

Target audience: Target Audience 2 (Local Communities, Tourists and Visitors of Coastal Destinations).

Partners: The project was developed in collaboration with researchers from the **European Centre for Environment and Human Health** of the **University of Exeter**. In order to effectively reach a critical mass of citizens, tourists and visitors, the project teamed up with the **WILDSEA Europe** network (https://www.wildsea.eu) and with local NGOs working in **Mediterranean** and in **Atlantic** coastal destinations, such as **Irish Doctors for the Environment** (https://www.ide.ie) and the Greek environmental NGOs **iSea** (https://isea.com.gr/?lang=en) and **Tethys Research Institute** (https://www.tethys.org).

Fig. 4: Father and son sighting dolphins from a boat in Kerry, Ireland.

3.3 Developing data gathering surveys and tools

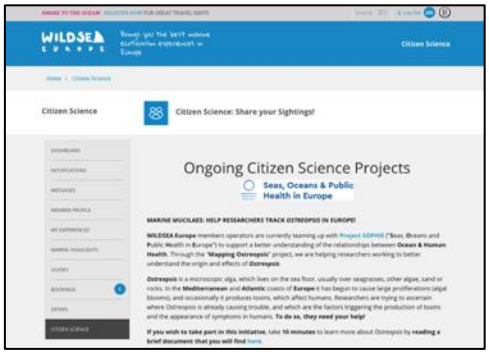
In order to address **factor of success #3** "**Reliable Data**", well-structured and robust **surveys** and **tools** were produced and **data gathering protocols** established to support the citizen science initiatives developed within the **Citizen Science Program**. A set of training and awareness materials were developed to support the engagement of target audiences.

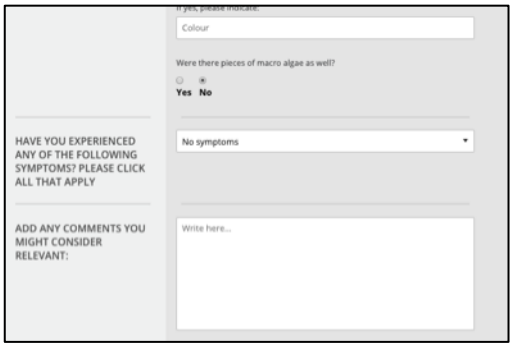
Initiative #1: Mapping *Ostreopsis* spp.

Specific training materials and data collection protocols were developed for this project in collaboration with microalgal researchers of the **Marine Science Institute** (Instituto de Ciencias del Mar/CSIC) in Barcelona. They were made available to participating tourism operators, so that they knew about the project and its objective, knew what to look for, and how to report any suspicious event. So as not to cause unnecessary concern among citizens, all materials were kept in the **WILDSEA Europe**'s operators' private area within the network's website (www.wildsea.eu), so that only participating operators had access to them.

A document was developed with basic and clear information about *Ostreopsis* spp.: what it was, the potential problems related to this microalga, why researchers needed the help from tourism operators, what exactly was needed from them and how to report the information. Figures 5 to 7 show the training document and the form used.

Fig. 5: Image of a section of a training material developed for the *Ostreopsis* spp. initiative.





Figs. 6 and 7: Screenshots of the survey and data collection form developed for the *Ostreopsis* spp. initiative.

Initiative #2: Blue spaces and wellbeing

SOPHIE's **"Wellbeing" Citizen Science Initiative** sought to assess the effect that **undertaking an activity by the coast or at sea** has on the **wellbeing** of those who engage in it, as well as on their relationship with the ocean. The initiative sought to answer the following specific questions:

- Does engagement in (guided vs. unguided) marine ecotourism activities make a difference in increasing awareness on Ocean conservation issues or Ocean & Human Health interactions?
- Can participation in marine ecotourism activities trigger behaviour change on environmental issues related to Ocean & Human Health?
- Is this change short- or long-term?
- Does the previous experience of the participant have an influence on the response?

To answer these questions, people who had just taken part in a marine activity (diving, kayaking, whale-watching, coasteering, swimming, etc.) were invited to share their experience by filling-in a survey. The **survey** for this project was developed in collaboration with researchers at the **European Centre for Environment and Human Health** from the **University of Exeter**, and took into consideration previous research conducted on citizen science and on the effects of exposure to blue environments on the mood, wellbeing, environmental attitudes and behaviours of people (Chase & Levine 2018; Dean *et al*. 2018; Jordan *et al*. 2013; Koss & Kingsley 2010; Toomey & Domroese 2013), as well as on previous work undertaken in the framework of the "BlueHealth" project (https://bluehealth2020.eu/).

Potential respondents to the survey were targeted and approached by:

- **Inviting customers** who had booked a marine activity through www.wildsea.eu to take part in the survey;
- **Distributing posters** and **materials** amongst **coastal & marine tourism operators** offering activities by the coast or at sea. Such materials contained information encouraging customers or associates to take part in the survey after engaging in a marine activity.

If participants agreed and shared their e-mail address, 1 month after the activity they would get an invitation to complete a last survey, in order to assess their emotions and attitudes in the medium term once back home.

The full research paradigm had three components, although authors did acknowledge from the beginning that many individuals would not complete all three parts, and thus the survey was designed in such a way that even partial completion could provide meaningful results. The full design featured three questionnaires, to be administered at three separate time points: **T1**, **T2** and **T3**, respectively:

- **T1:** Was a short questionnaire that sought to assess the expectations that a respondent had regarding the marine activity that he/she was about to engage in, and his/her declared level of Ocean literacy. T1 wanted to determine whether such expectations and literacy level might have an influence on his/her responses to T2.
- **T2:** Embodied the main questionnaire, seeking to assess the impact that the activity had had on the respondent.
- **T3:** Was a follow-up questionnaire, seeking to assess the degree to which the impact of the activity had stayed with the respondent or had otherwise diminished through time. T3 also introduced certain questions on health impacts not addressed in T2.

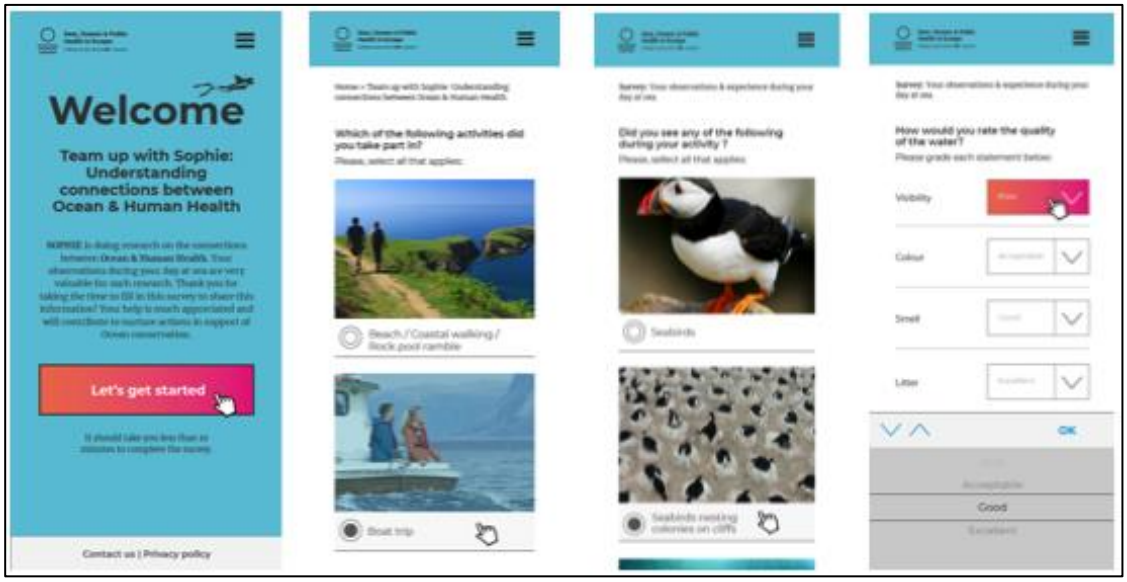


Fig. 8: Snapshots of the WEB APP for SOPHIE's Citizen Science "Blue spaces & wellbeing" initiative as seen in a smartphone.

A **specific web-based application (WEB APP)** (Figures 8 and 9) was developed to gather all answers to the surveys: this APP made it possible for researchers to collect and structure the responses from all participants anywhere in Europe in a digital database for easier analysis, and for participants to quickly answer the questions without the hassle of paper and with assurance of the privacy of their information. The survey could be comfortably answered on a computer, tablet or smartphone, with no need to sign up or get registered.

The WEB APP was hosted in a public URL (https://www.teamupwithsophie.eu), which held all questionnaires in **English**, **Spanish** and **Dutch**, but also all of the education and awareness materials that had been developed for the project (Figures 10-12).

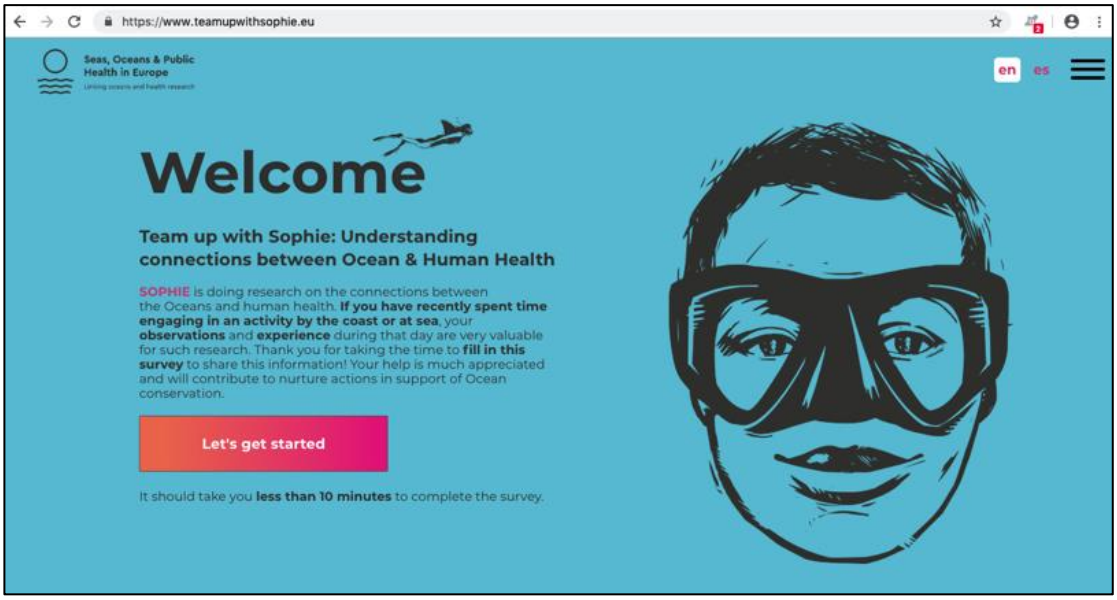


Fig. 9: SOPHIE's WEB APP seen in a computer - https://www.teamupwithsophie.eu

In addition to the data collection instructions & protocols, and in order to address **factor of success #6** "**Improved Ocean Literacy**", tourism operators were provided with **education/awareness resources** on the intimate relationship between Oceans and Human Health (Figures 10 to 12), to build their capacity to engage in meaningful conversation with their customers on OHH interactions during their activities and promote higher awareness and understanding of these connections. These resources were included in the web-based app (https://www.teamupwithsophie.eu/what-is-ocean-and-human-health), and contained information about OHH in different formats:

- 7 animated videos with the "7 reasons why you should love the Ocean" explained in a simple and entertaining way the services that a healthy Ocean provides us, and how we impact it – and our own health in return - through our everyday actions. The video is currently available in English, with subtitles in Spanish, French, Italian, Greek, Dutch and German.
- 7 factsheets based on the 7 videos, but with more thorough information and facts about the relationship between the Ocean and our health. These were especially developed for tourism operators willing to join the CS program, in order to provide them with useful, rigorous, background information to

improve their confidence and knowledge when sharing information on Ocean & Human Health interactions with their customers. The factsheets are only available in English.

- 6 infographics explaining how we can reduce our negative footprint on the marine environment in our everyday life, suggesting simple actions we can adopt in the kitchen, in the bathroom, when commuting, etc. These infographics were developed during the SeaChange project and were used for this project, capitalizing on its results. The infographics are available in English and Spanish (translated during the SeaChange project).

Fig. 10: The education/awareness page in SOPHIE's web-based App - https://www.teamupwithsophie.eu

Fig. 11: One of the seven videos in SOPHIE's web-based App - https://www.teamupwithsophie.eu

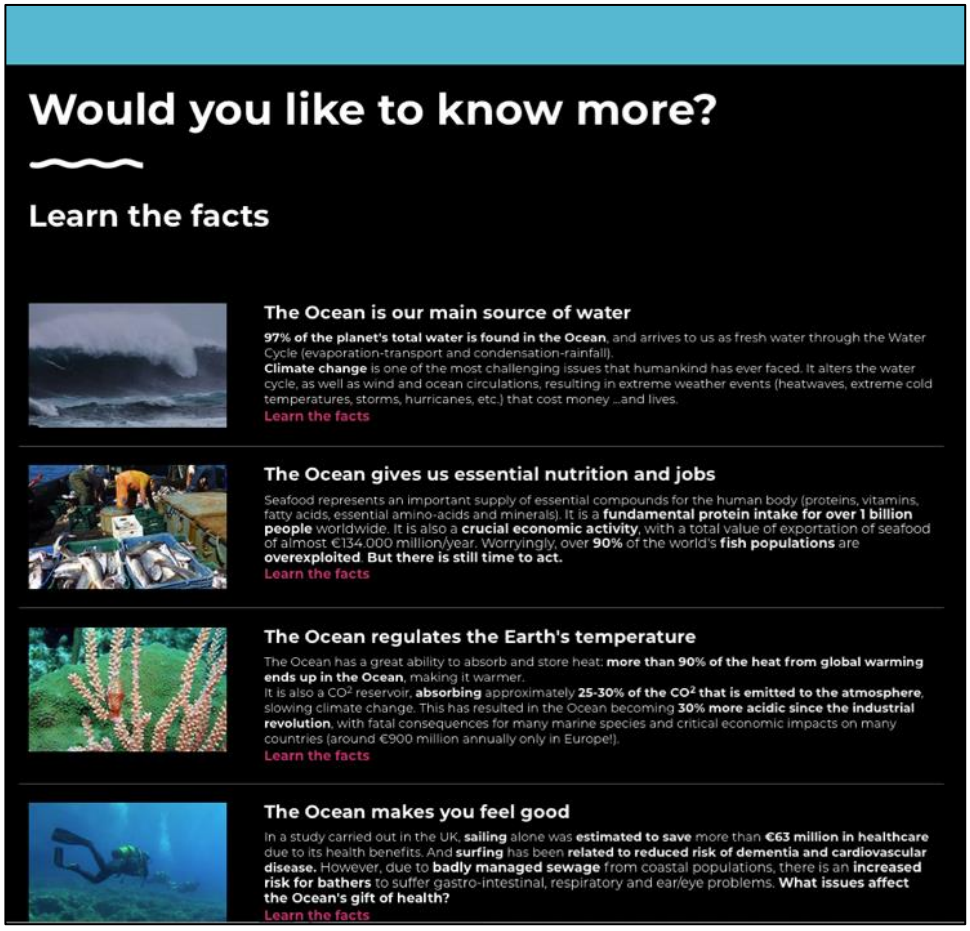


Fig. 12: Factsheets in SOPHIE's WEB APP - https://www.teamupwithsophie.eu

3.4 Screening the citizen science initiatives for ethics compliance

As required for all activities of the **SOPHIE project**, the citizen science initiatives passed **ethics scrutiny** before being rolled out. This process was swiftly completed through the **Bioethics Commission** of the **University of Barcelona**, which approved of both initiatives under certain conditions. The most important of such conditions were:

- No children could be asked to complete the survey, and;
- The complete anonimization of the responses after the 1-month response.

3.5 Outreach, engagement & training of tourism operators and citizens

Several actions were devised to address **factors of success #4 and #5** "**Good communication**" and "**Engagement of citizens**", respectively.

Engaging tourism operators

In order to engage coastal tourism operators in **SOPHIE**'s **Citizen Science Program**, both communication and outreach actions and information and training sessions were rolled out targeting coastal & marine tourism operators in Europe from **March** to **June 2019**.

A **newsletter**, a **blog entry** and an **e-mailing** calling to action were launched through the **WILDSEA Europe** network and distributed amongst its member operators, inviting them to team up with SOPHIE and to attend the planned **information & training sessions**. Additional outreach actions were undertaken through local stakeholders.

A total of 8 destinations were selected to roll out specific, on-site **information & training sessions**, 4 in the Atlantic and 4 in the Mediterranean basin (see Table 1).

Country	Destination	Date	Number of attendees
Greece	Thessaloniki	April 19th 2019	30
	Ionian Islands	June 15th-21st, 2019	26
Spain	Majorca	May 6th-8th, 2019	7
	Basque Country	June 4th, 2019	19
	Catalonia	April 29th & 30th 2019	29
Ireland	West Coast (Sligo, Kerry and Cork)	May 26th-31st, 2019	32
		TOTAL	**143**

Table 1: Information &training sessions rolled out under SOPHIE's Citizen Science Program

In addition to these sessions, **additional outreach** to **SOPHIE**'s **Citizen Science Program** was given between March and May 2019 amongst another 152 tourism operators in Portimao, Sesimbra and Cascais (**Portugal**), Galicia (**Spain**), Cornwall (**UK**) and Donegal (**Ireland**). This took place in the framework of another EU funded project (the "WILDSEA Atlantic Ocean Heritage (WAOH!) Route"- https://www.wildsea.eu/about-us/waoh-route-project), in which both **Submon** and **Travelecoology** were partners. These sessions were instrumental in extending **SOPHIE's Citizen Science Program** to other Atlantic destinations.

During these **information & training sessions**, operators were informed about the **objectives** of **SOPHIE's Citizen Science Program**, its **citizen science initiatives** (*Ostreopsis* only in the Mediterranean basin, and all of Spain and Portugal) and **OHH interactions**. Short presentations were made on the intimate relation between the Ocean and human health and on how humans impact on the Ocean, with clear examples on how to reduce our negative effect on the marine environment. The aim of these presentations was to provide the operators with a framing understanding of the **OHH** topic, while providing them with resources to enable them to trigger meaningful conversations with their customers during their activities on OHH interactions, promoting higher public awareness and understanding. Following this introduction, specific presentations were made to ensure a clear understanding of the **scope** and **goals** of the **citizen science initiatives**, the **data gathering protocols** established and the **tools** available for tourism operators to engage and support data gathering throughout the Program. During these sessions operators were also provided with **communication** and **awareness materials** (posters and postcards) to help them encourage their customers to take part in the "**Blue spaces and wellbeing" initiative**.

In certain areas (such as Western Ireland and Majorca) **one-to-one sessions** were organized to reach out to operators. These were shorter sessions, mainly to explain to them about the citizen science initiatives, direct them to the on-line education materials, and give them the necessary outreach materials.

All in all, the training program reached **295 coastal & marine tourism operators**, and a total of **109 tourism operators formally signed up** to **SOPHIE**'s **Pilot Citizen Science Program**[1].

Fig. 13: Training session with tourism operators in Thessaloniki, Greece.

[1] A higher number of tourism operators showed interest in joining the Program during the sessions, but no written evidence/commitment was requested from them at their outset. At a later stage, a formal sign up form was provided and filled-in voluntarily by 109 tourism operators, as proof of commitment.

Engaging tourists and visitors of coastal destinations

Attractive outreach materials (posters and postcards) were produced for the "**Blue spaces and wellbeing**" initiative (the one seeking to engage the wider public, which was not the case for the "**Mapping *Ostreopsis* spp**." initiative), calling out for visitors of coastal destinations to "team up with science" by filling in a survey after engaging in a coastal activity. These materials were distributed amongst tourism operators and other local stakeholders, in order to reach out to a large base of citizens and visitors arriving to the coast to engage in a physical activity.

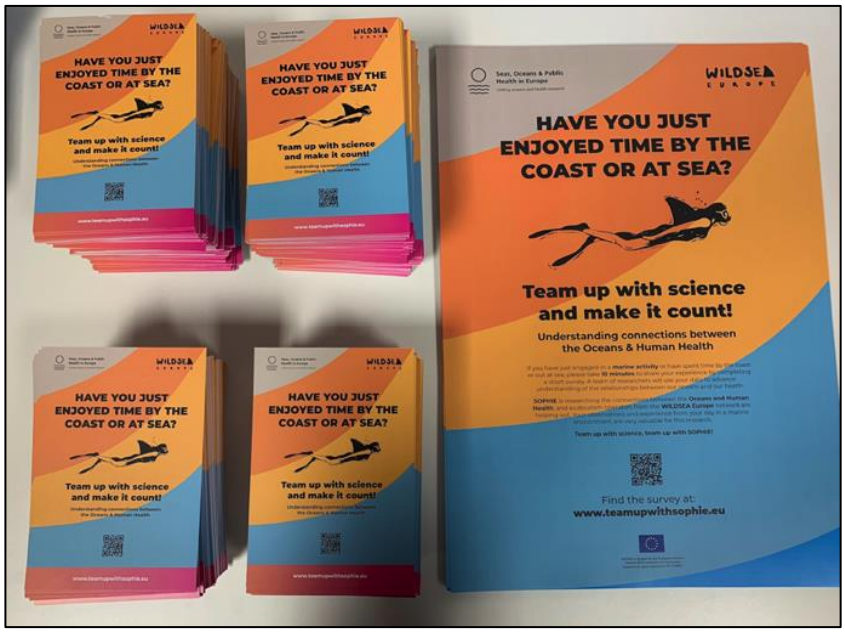


Fig. 14: Engagement/communication materials given to tourism operators for customers.

3.6 Following up with engaged operators and monitoring results

SOPHIE's **Citizen Science Program** launched in **March 2019**. By June 2019, **109 tourism operators** had committed to partake in the Program, supporting the **citizen science initiatives** encompassed.

Throughout 2019 and 2020, periodic communication with participating operators was maintained, to sustain their interest in the Program and resolve any issues arising during its implementation:

- In **August 2019**, telephone conversations were held to follow up and provide support to operators, reminding them of the tools and resources available.
- In **September 2019**, a newsletter and an on-line questionnaire were distributed amongst participating tourism operators (in Spanish and English) to gather their feedback on the evolution of the Program and to identify any gaps or difficulties, as well as picking up on any recommendation. Operators were also contacted via telephone to gather feedback on the difficulties encountered during their participation in the Program in **October 2019**.

- Another round of telephone conversations was held in **February 2020**, in advance of the beginning of the new season. Unfortunately, data gathering had to be interrupted in **March 2020** because of the outbreak of the COVID-19 pandemic, which restricted mobility and caused operators to shut down operations throughout Europe. The same questionnaire shared in September 2019 was distributed again in **March 2020**. At this time, a summary of preliminary results of the data analysis undertaken was shared with all participating operators.
- The collection of data was monitored continuously throughout the Program, taking measures to safeguard it via back ups of resulting databases periodically, as well as to comply with the ethics conditions set forth by the **Bioethics Commission** of the **University of Barcelona**.

3.7 Analysing results

All data gathered through the citizen science initiatives rolled out under **SOPHIE**'s **Citizen Science Program** through the tools habilitated towards that end has been shared with those research institutions engaged at its outset, as previously agreed with them. The researchers that volunteered to review and analyse the resulting data were, specifically:

- **Dr**. **Elisa Berdalet** (**Instituto de Ciencias del Mar - CSIC**, Barcelona, Spain) for the **"Mapping *Ostreopsis* spp." initiative**.
- **Dr Mathew White** and **Dr Deborah Cracknell** (**European Centre for Environment and Human Health**, University of Exeter, UK) for the **"Blue spaces & wellbeing" initiative.**

Data collection started effectively in **April 2019** and was carried out until March 2020, when the irruption of the COVID-19 pandemic forced European countries to restrict movement of citizens and tourism operators to shut down their operations. A preliminary analysis of the data gathered was undertaken in **April 2020.**

Fig. 15: A grey seal curiously approaches snorkelers in the Scilly Isles, UK.

4. Impact of SOPHIE's Citizen Science Program. Lessons learned

4.1 Impact and results of SOPHIE's Citizen Science Program

SOPHIE's **"Tourism & Citizen Science" Program** sough to activate **coastal tourism operators** and **citizens, tourists & visitors** of coastal destinations as "*citizen sensors*" that contribute to build knowledge on Oceans and Human Health (OHH) interactions. The Program aimed to test practical approaches to gather and disseminate relevant quality data on OHH through coastal tourism operators, using them as innovative vehicles to contribute to increase interdisciplinary awareness and knowledge on OHH.

The impact and results achieved by SOPHIE's Citizen Science Program in this regard can be gauged by:

- The level of participation and engagement achieved amongst target audiences.
- The contribution of the Program to build knowledge on OHH interactions.
- The contribution of the Program to scientific OHH research.

Engagement & participation

SOPHIE's **Citizen Science Program** had two priority **target audiences**:

- **Target Audience 1:** Coastal tourism operators.
- **Target Audience 2:** Local communities, tourists and visitors of coastal destinations.

The level of engagement and participation in **SOPHIE**'s **"Tourism & Citizen Science" Program** has outperformed the original objectives established:

- Over **295 coastal tourism operators** were reached and took part in training & knowledge exchange sessions addressing Ocean & Human Health interactions.
- A total of **109 coastal tourism operators** signed up to actively partake in the Program, versus an original target of 20.
- 86% of coastal tourism operators that joined the Program have confirmed discussing OHH interactions with their customers over 2019, reaching a potential total client base of over **50,000 visitors**.
- **1,370 persons** have visited the Program's web app **Teamupwithsophie.eu**, which was developed to support education & outreach activities.
- Over **200 citizens** living in **13 different countries** filled in at least one of the surveys connected to the citizen science initiatives.

Considering the above, it can be reasoned that the level of **engagement** and **participation** in the Program has been **very positive**.

It can be argued that achieving this level of success in such a short time (1 year) has been possible due to the collaboration established with the **WILDSEA Europe** network and with **local stakeholders** in coastal destinations. Such collaboration allowed for the swift organization of training sessions in different countries, achieving a good level of

participation that capitalized on existing **trust, networks** and **relationships** carefully weaved by these organizations through the years.

Also, such intensive international outreach generated a **positive geographical spill over** effect, as responses to the citizen science surveys were received from countries, where no previous training or communications effort had been undertaken (such as Germany or France).

However, from the conversations held with tourism operators and the feedback received, it is important to highlight other considerations that might have contributed to the positive level of engagement:

- The citizen science initiatives were presented as an opportunity to add value to their customer experience and to add to their reputation as a responsible tourism operator.
- The quantity of data gathered through the "**Blue spaces and wellbeing**" initiative has been notoriously higher than the one gathered through the "**Mapping Ostreopsis**" initiative. Although this might be simply due to the absence of rare events during 2019 that could be connected to *Ostreopsis* outbreaks, it can also point to a more readily disposition from operators to team up in initiatives that give them the opportunity of engaging their customers and capitalizing the added "customer experience" and "reputational" value implicit in the "**Blue spaces and wellbeing**" initiative.

Contribution to build knowledge on OHH interactions

SOPHIE's **Citizen Science Program** has proved to be an effective means to build knowledge on OHH amongst its target audiences:

- Over **295 tourism operators** participated in training & knowledge exchange sessions, in which the subject of OHH interactions played a central role. Operators attending the training sessions were genuinely interested in the content of the sessions, providing very positive feedback on their participation.
- The results of the "**Blue spaces and wellbeing**" initiative show that people who went on a trip with a tourism operator or guide were significantly more likely to agree that they **learned new things** about the **marine environment** than those who went on their own or with family/friends. It could be argued that, through the Program, building the OHH understanding of operators has had a positive spill over effect that has transferred to their customers.
- Similarly, the videos produced as educational materials for the Program's target audiences have received over **1,540 views** by March 2020.

However, and maybe surprisingly, one of the key findings of the "**Blue spaces and wellbeing**" initiative was that visitors who went on a trip with a tourism operator did not feel that they had learnt much about **how** they could contribute to **protecting** the **marine environment**. This shows that, in spite of the potential to work with coastal tourism operators, there is some limitations to the societal change intended to be triggered. In order to achieve better results, more efforts will have to be made in the future to train operators in communicating the complex interactions between the Ocean and human health, since a single training session is probably not enough to pass

on a large quantity of information and to develop the skills required to inspire **positive environmental change** amongst the general public.

Another potential issue identified was that mostly **company owners** attended the training sessions, and not their **staff**. Staff working for tourism operators is very temporal, moving with the holiday seasons, an only a few key staff remain in a company for years. For that reason, it is key to develop training materials that owners can pass onto staff to learn, which is attractive and has with clear messages. All developed materials should also be available in the local languages for staff to understand and read.

Fig. 16: Small training session at a diving centre in Ithaca, Greece.

<u>Contribution to scientific research</u>

Unfortunately, **SOPHIE**'s **Citizen Science Program** has not succeeded in generating sufficiently enough robust data for OHH researchers to apply it to on-going research, for different reasons.

With regard to the "**Mapping *Ostreopsis*" initiative**, no operators reported any strange algal growths along European coasts or any suspicious symptoms amongst their staff or clients. Authors cannot be sure whether this was due to lack of interest in this initiative, or because no special events were worthy of their particular attention (although when asked about the reasons for no reports, participating operators referred mostly to the latter). In areas already known for *Ostreopsis* growth, 2019 was a year of low growth, with fewer reports than other years, which might explain the lack of sighting reports, as participating tourism operators imply (and as explained under section 4.3 Feedback received from scientists).

This was a clear risk identified when the initiative was being developed, since *Ostreopsis* growths are rare, of short duration, difficult to identify and only happen

during very specific periods of time every year. The fact that no observations were made might be valuable as additional evidence that 2019 has been a year of low recurrence of *Ostreopsis* outbreaks. The value of the initiative might also be found in the availability of a trained network of coastal operators who know about *Ostreopsis* and are prepared to send a good report if rare events are noticed in the future, so that researchers can then check and validate the information, and decide on further actions, if deemed adequate. This initiative might therefore prove valuable to scientists provided there is continuity over time.

With regard to the **"Blue spaces & wellbeing" initiative**, although over 200 responses were received to its underlying surveys, only 100 of those were complete and unfortunately not enough in number for a solid statistical analysis due to many variables. In spite of this, interesting trends could be elucidated from the analysis of data, as informed in **Annex 7.2**. For example, undertaking a coastal & marine activity was generally considered a **very positive experience** for those who engaged in one, and people who conducted the activity with a Tour Guide felt more connected to other people than those who did it on their own or independently with family/friends.

Although this initiative has yielded some interesting and potentially important findings, it is unlikely that it would be published in a peer-reviewed journal, due to the limited numbers of responses available for statistical analysis. A greater number of completed surveys would (i) improve the reliability of existing results and (ii) highlight further as yet unidentified relationships between a number of key variables. Under these circumstances, there could be potential for the study's findings to be considered for submission to a peer-reviewed journal.

It is likely that additional data would have been collected had Europe, and indeed the world, not been struck with the COVID-19 pandemic in March 2020, which has effectively shut down all activities and inter-country movement and shortened the data gathering process of this initiative by at least 2 months. This initiative might therefore also prove valuable provided there is continuity over time.

4.2 Feedback received from tourism operators

Throughout the Program, direct contact has been maintained with the 109 tourism operators taking part in the program at different times. Over 30% of the operators have delivered comprehensive feedback on their participation. The following contributions can be summarized and highlighted:

- **Data reporting for the "Mapping Ostreopsis" initiative.** When asked about the "**Mapping Ostreopsis" initiative**, although no operators reported any signs of algal growths in 2019, all of the respondents explained that the main reason behind no sending data was the fact that they had not seen anything unusual, and not because they had forgotten about the project nor did not care to report. One operator stated that he did not know where to send the report.
- **Engaging customers in the "Blue spaces & wellbeing" initiative.** When asked about the **"Blue spaces & wellbeing" initiative**, and specifically if they had taken any efforts to encourage customers to take part in the associated surveys, 83.3% responded positively (see figure 17).

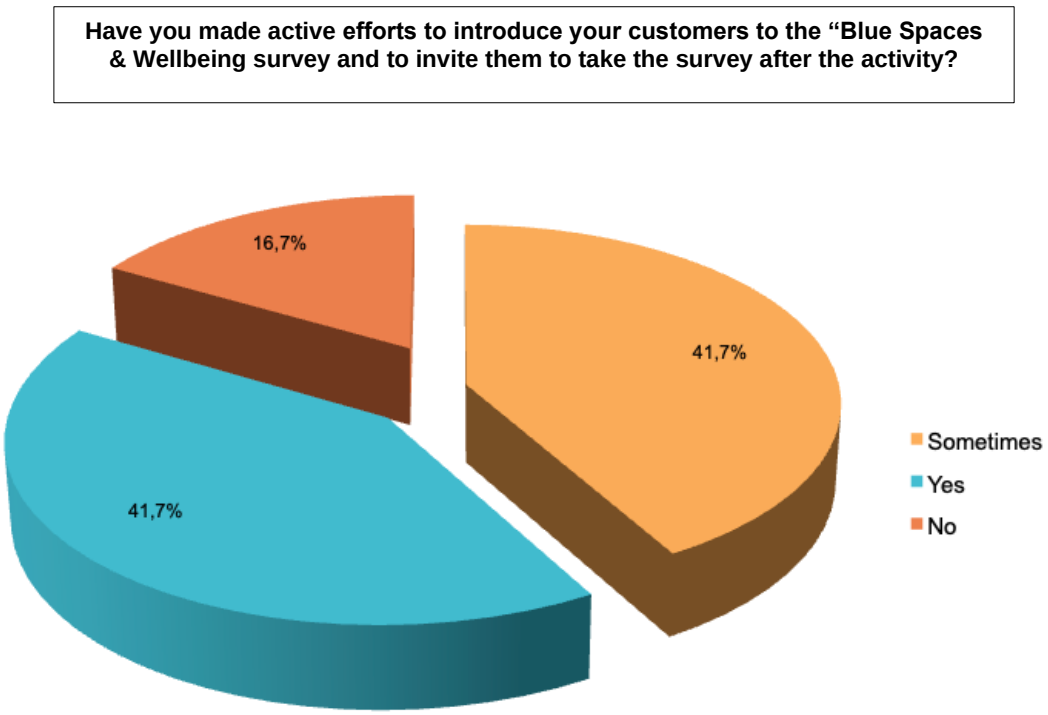


Fig. 17: Answers of tourism operators involved in SOPHIE's "Blue Spaces & Wellbeing" citizen science initiative

- **Lack of time during peak season, main reason not to engage customers.** Those that did not give a positive answer referred to the lack of time during high season to deviate from their core activity. Even so, many of them responded positively to having placed the posters and postcards in visible places in their shop for clients to read.
- **Customers responded positively to information received and showed willingness to contribute to research**. Most of the operators that did encourage customers to participate in the survey felt that customers seemed interested and had conveyed that they would complete the survey at a later stage (72%), which in principle demonstrates a positive disposition to citizen science.
- **Language and connectivity, key barrier deterring customers from responding to survey**. Nearly 12% of operators reported that clients had brought up problems with the language of the survey (available in English, Spanish and Dutch). Also, 8% of operators answered that there were Internet problems at the centre and clients could not log into the survey there and then.
- **Operators, keen to share OHH issues with their customers. 86% of operators** stated that they **did talk to their customers about issues that explain the connections between Ocean and Human health**. Those who didn't highlighted having very little time they had during their activities as their main reason (see figure 18).

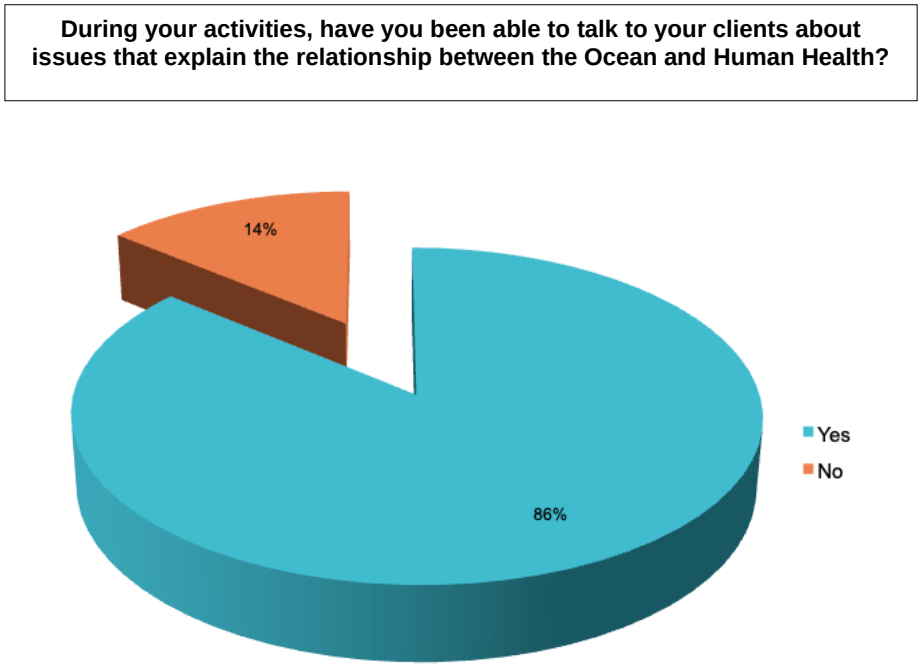


Fig. 18: Answers of tourism operators involved in SOPHIE's "Blue Spaces & Wellbeing" citizen science initiative

- **Education materials valued very positively.** Operators highlighted the training and engagement materials developed as very useful for themselves and to train their team. They mentioned wishing to receive more such materials, in different languages, to be used both for training and for social media purposes, in order to support them when engaging with their clients.
- **Operators' wish: Training materials in local language, an APP that is able to function without Internet connection and a preference for initiatives that can run in the lower season.** When asked about what could have made it easier for them to become more involved in citizen science Initiatives in general, most operators asked for more information to help the brief their team (36%), materials in the local language (31%), to have a downloadable app that can function without internet connection (26%), and to run the initiatives during the lower season (24%).

  The **language barrier** has come forward as a relevant issue. Although the on-line surveys were available in **English**, **Spanish** and **Dutch**, according to the participating operators, many customers declined answering them because they couldn't properly understand the questions. Operators also found it hard to explain the initiative to their foreign customers. Operators suggested that the translation of the surveys and supporting materials into their local language would be helpful both to convey the information onto the rest of their staff and team, as well as to better engage customers.

  The difficulty to follow up with customers to convince them to fill in surveys during the **peak of work** of the high season, which leaves little time for operators to fit in any extra work, was also raised. As discussed, most operators showed a keen interest in partaking in the citizen science initiatives, but they

also referred the difficulties to attend to these during the peak season. In general, operators welcomed any sort of printed material (leaflets, cards, posters, etc.) that they can use at the office/centre to win the attention of customers towards such initiatives.

Finally, another issue brought up by a few operators was the **bad Internet connection** generally available by the coast, where activities run, preventing customers from logging into the survey there and then. Those operators suggested paper forms instead of on-line surveys. Authors are not sure, however, if those paper forms would then be effectively sent to researchers for analysis, or if they would get lost. This form of survey would also make it impossible to ask participants for their e-mail address to send a reminder after one month, due to data protection concerns.

4.3 Feedback received from scientists

The results of the Program in terms of the findings rendered by the analysis of the data gathered has also been discussed with the key researchers engaged in each of the initiatives (namely, Dr Elisa Berdalet, Dr Cracknell and Dr White, see section 3.7). Their contributions are summarized below.

Initiative #1: Mapping *Ostreopsis* spp.

- **Statistical analysis of data results:** No operators reported any strange algal growths or any suspicious symptoms and, therefore, there were no results to evaluate.
- **Overall opinion:** Although we can't know for sure why operators did not report any algal growths, 2019 was a year of low growth for *Ostreopsis* spp., with no reports even in areas well known for important summer blooms. It seems that levels of *Ostreopsis* spp. in 2019 where the same as in previous years, but for unknown reasons they caused no blooms and produced no toxins. This might well explain the lack of reports from operators during SOPHIE's Citizen Science initiative.

  According to Dr. Berdalet *Ostreopsis* spp. is a complicated organism to study. Although it is currently expanding its distribution area, so far it mostly causes occasional, short-lasting blooms in very specific stretches of coast, and only rarely causes symptoms in people. Furthermore, symptoms are very non-specific and easily mistaken for a cold or mild sunstroke. From a preventative and public health management point of view, it is important to learn where and when it can cause massive blooms, and the mechanisms through which this may happen. However, even identifying potential new beaches of distribution of this organism poses an important challenge for researchers. A further problem is the negative connotation of the organism, especially in very touristic areas. Local authorities, tourism businesses and local communities of those areas are generally reluctant to admit that a potentially dangerous microalgae might be visiting their shores, with the negative publicity it might entail for the tourism in the area.

For all these reasons, a citizen science project working with well-trained network of coastal & marine tourism operators is an interesting means to gather information throughout Europe, hinting at new potential locations to carry out deeper scientific studies. In spite of the lack of data received for 2019, the initiative will prove valuable to scientists should there be continuity over several years.

Initiative #2: Blue spaces and wellbeing

- **Statistical analysis of data results:** In total, three surveys were planned for the "**Blue spaces and wellbeing initiative**": a pre-activity survey to establish visitors' expectations and levels of ocean literacy (T1); a post-activity survey to understand the connections between the ocean and human health (T2), and a follow-up survey, four weeks later (T3). The surveys were designed to explore a number of key research questions, such as the impact of an activity/trip on human health and wellbeing, or differences in marine awareness/ocean literacy learning outcomes between those who undertook their activity with a tour operator/guide and those who undertook their activity alone or with family and friends. According to Dr Cracknell, due to insufficient numbers of completed surveys for T1 (N = 13) and T3 (N = 17), most of the data analysis for these two time points focused on 'descriptive' statistics only (e.g. respondent age and gender, motivation for activity, self-rating of ocean literacy/marine awareness). Although insufficient survey responses hindered any meaningful inferential statistical analyses for T1 and T3 surveys, some additional analyses were attempted to identify any potential 'trends' that might become 'significant', if additional data subsequently became available. Regarding the T2 survey, however, there were 95 completed surveys and, although data gaps existed for some questions, more in-depth analyses were possible for surveys collected during this time point. Statistically significant findings emerged for several key questions but, for others, analyses would have benefitted from a greater number of respondents. For instance, some questions had several possible options (e.g. type of activity undertaken) or enabled multiple answers (e.g. animals sighted during trip). While this was not a survey design fault, too few responses for each option (e.g. only two participants went fishing; only one person saw a marine turtle) hampered robust statistical analyses of findings.
- **Relevant findings:** One particularly interesting finding highlighted by Dr Cracknell was the influence that tour operators and guides had on one of the learning outcomes: respondents who went on a trip with a tour operator or guide were significantly more likely to agree that they learned new things about marine life than those who went on their own or with family/friends. Interestingly, Dr Cracknell points out, Kerley *et al*. (2003) found that visitors on guided visits to Addo Elephant National Park, South Africa, saw more species than self-guided tourists. Study authors suggest that this improved their wildlife experience and enhanced the value of biodiversity as an ecotourism resource. Those who went with a tour operator/guide were also significantly more likely to agree that they connected with others on the trip. As social relationships can be important for wellbeing and life satisfaction (Merz & Huxhold 2010), Dr Cracknell explains that these findings suggest that tour operators and guides

may play an important role in facilitating valuable social connections, as well as enhancing ocean literacy outcomes and activity experience.

- According to Dr Cracknell, although some of the results surrounding the relationships between activities and animals or weather should be treated with caution, due to low respondent numbers, collection of these data is nevertheless important. Previous research has found relationships between wildlife (and nature in general), and improved human health and wellbeing. For instance, Curtin (2009) interviewed participants who had taken part in whale and bird-watching trips, and found that the excursions lifted participants' spirits, facilitated contemplation, and elicited feelings of deep joy and happiness. Uyarra *et al*. (2009) found that some coral reef features influenced divers' enjoyment of the coral reefs more than others: fish species richness and number of fish schools, bright reef colour, and healthy coral, contributed most to divers' enjoyment of the reefs. Furthermore, knowing where sightings occur could also be important information for other organisations. For instance, in the UK, the Marine Conservation Society has asked members of the public to report sightings of marine wildlife, such as basking sharks, jellyfish and marine turtles. Citizen science has been used to help track invasive marine species (e.g. crustaceans - Delaney *et al*. 2007) and changes in species' distribution due to climate-driven oceanographic changes (e.g. yellowtail kingfish – Champion *et al*. 2018).
- A greater number of responses for other variables could also provide interesting results, according to Dr Cracknell, For instance, research has found that the presence of litter at the coast can undermine the psychological benefits of coastal visits (Wyles *et al*. 2016). Litter was sighted on over 40% of trips and was mentioned by 16 respondents as one of the things they liked least about their experience. Water quality data is also important. Perceptions of poor water quality can impact on tourists' level of satisfaction (e.g. Lee & Lee 2015) and their willingness to engage with the marine environment (Pendleton *et al*. 2001). The follow-up survey at T3 indicated that a percentage of respondents experienced some illness after their activity. Potentially, given a larger sample, these data could be linked to certain activities (e.g. bathing/surfing – Bradley & Hancock 2003) or locations.
- **Value of the geographical reach of data gathered:** Dr Cracknell felt that it was worth collecting responses from people in different countries and carrying out different activities. For instance, analysis found a statistically significant difference between countries for one of the marine action statements. Although, overall, respondents agreed that they were 'willing to support marine conservation initiatives', those who undertook their activity in the UK (all UK residents) agreed slightly less with this statement than those who undertook their activity in other European countries.

  Regarding collecting information on different activities, she felt that this was also worth including as part of the survey. Although only a small number of respondents undertook some activities (e.g. SUP, n = 2), other activities, such as swimming and diving, were more popular (n = 15 and n = 13, respectively), enabling some tentative analysis to be undertaken. For instance, diving and

snorkelling accounted for 25% of activities undertaken and, although only 19 people undertook these activities, compared with 56 people engaging above water activities, there were some statistically differences between the two groups. As expected, there were differences between animals spotted on above water trips and those encountered underwater. Those participating in above water activities saw more dolphins, seals and seabirds, than those undertaking underwater activities. In contrast, as expected, those on underwater trips encountered more fish and benthic species, such as sea stars, cephalopods, sponges and corals. There was also a difference between the two groups in the type of weather experienced: those undertaking underwater activities were significantly more likely to do so during warm weather than those engaging in above water activities.

- **Overall opinion:** In summary, although the study based on the analysis of the data gathered through the "Blue spaces and wellbeing" citizen science initiative has yielded some interesting and potentially important findings, it is unlikely that it would be published in a peer-reviewed journal, due to the limited numbers of responses available for statistical analysis. A greater number of completed surveys would (i) improve the reliability of existing results and (ii) could highlight further, as yet unidentified, relationships between a number of key variables. Under these circumstances, there could be potential for the study's findings to be considered for submission to a peer-reviewed journal.

4.4 SWOT Analysis

The results achieved by **SOPHIE**'s pilot **"Tourism & Citizen Science" Program** and the feedback received from key stakeholders allows to reflect on the **S**trengths, **W**eaknesses, **O**pportunities and **T**hreats of launching an **OHH citizen science program** linked to **blue tourism** at a broader European scale.

Strengths

- **There is an existing base of motivated coastal & marine tourism operators in Europe that are willing to engage in citizen science.** As sustainable and responsible tourism gain traction as aspirational tourism models, there is a growing base of (eco)tourism operators that are actively integrating environmental and social stewardship as part of their ethos. The great majority of **coastal & marine tourism operators** are small or medium enterprises (SMEs) that are very rooted in their communities and have a deep connection with their destinations. They take pride in their activities and have a strong incentive to conduct their business in a manner that conveys their commitment to their communities. **SOPHIE's Citizen Science Program** has evidenced that tourism operators show a very positive disposition towards partaking in **citizen science initiatives**, especially if they see a clear value-added benefit for them (reputational, enhancing their customers' experience, differentiating themselves from competitors, etc.).

- **Coastal & marine tourism operators offer great potential to be used as opportunistic platforms for scientists to undertake research on OHH interactions.** Coastal & marine tourism operators live and work by the coast all year round and know the area where they conduct their activities very well. They spend most of their time by the coast or at sea, with the potential to become the "eyes" of researchers on the field. **SOPHIE's Citizen Science Program** has evidenced that operators are willing to share information with the scientific community. Working with tourism operators can reduce the burdening of filtering data gathered through citizen science, rendering it more reliable. Because of their familiarity with the marine environment, they have more capacity to assess whether an event is "rare" enough to deviate from normal occurrence and worthy of reporting or not.

  Additionally, tourism operators offer researchers **access** to **thousands of tourists, visitors** and **citizens of coastal communities**, many of whom, as the Program has also shown, are seemingly willing to team up with science when invited to do so by a trusted tourism operator.

- **Engaging coastal & marine tourism operators in citizen science creates synergies between research and Ocean literacy efforts.** Educational efforts invested in engaging coastal & marine tourism operators in citizen science initiatives have contributed to increase their awareness on marine issues, but maybe more importantly also seem to have a positive spill over effect on their customers, as knowledge gained by operators is passed onto them. **SOPHIE's Citizen Science Program** has evidenced that tourism operators and their guides have a positive impact on the learning outcomes of engaging in a coastal or marine activity:

respondents who went on a trip with a tour operator or guide were significantly more likely to agree that they learned new things about marine life than those who went on their own or with family or friends.

Furthermore, education and awareness materials developed for citizen science initiatives reach wider audiences than those originally targeted, generating a positive spill over effect on Ocean literacy amongst the general public.

- **Working through tourism networks has a positive effect on the geographical reach of citizen science initiatives, organically broadening** the **geographical scope** of **OHH research**, **cost-effectively**. **SOPHIE**'s **Citizen Science Program** has evidenced that international citizen science initiatives can successfully contribute to gather data from a broad range of geographies, using digital tools without requiring the physical presence of researchers beyond an initial engagement and training effort, potentially capturing economies of scale if such initiatives a have a long life span. Additionally, the engagement of citizens, visitors and tourists in **SOPHIE's Citizen Science Program** seemed to trigger a multiplier effect, capturing data from citizens and visitors of other coastal destinations where no direct, on site outreach nor training was undertaken. This might point at one of the advantages of working with the tourism sector, namely taking advantage of tourism flows as means to spread the outreach of citizen science initiatives.

  Weaving a network of coastal & marine tourism operators in Europe committed to OHH research could support data gathering from all of Europe, but also support the study of more "sensitive" research areas. Some research issues can be too "sensitive" for the general public to collaborate (e.g. *Ostreopsis* spp.) and can therefore benefit from involving trained, volunteering professionals only.

<u>Weaknesses</u>

- **Short-term citizen science initiatives are most likely to be rendered ineffective in terms of the scientific relevance of the data gathered through their efforts.** As **SOPHIE's Citizen Science Program** has evidenced, citizen science initiatives carried over one year through tourism networks have a low probability of gathering sufficient data to ensure statistical significance. Tourism seasonality plays an important role and must be considered when planning citizen science initiatives. During the peak season, operators are limited in their capacity to attend to the needs of such initiatives; during low season, the level of activity decreases, which also implies a lower potential to capture data. This suggests that extending the length of initiatives is necessary to gather enough, statistically significant data through tourism networks. Engaging and training tourism operators takes time, which also needs to be factored into any initiative.
- **Launching citizen science initiatives requires building a clear case for operators to partake, as well as continuous follow up and networking, which requires mobilizing human and financial resources over time.** In spite of the positive disposition of tourism operators to partake in citizen science initiatives, operators need to see the added value of engaging and investing time in such efforts. Initiatives that align with their ethos and contribute to enhance their reputation and their client's experience are more likely to find support amongst tourism operators. Also, operators need to be motivated and reminded of the initiatives

over time, so as not to lose interest and to keep them amongst their span of priorities. Training efforts need to be sustained over time -acknowledging and addressing the high **rotation of staff** in the tourism sector-, and results shared over time, in order to sustain a sense of **purpose** and **trust**.

With the above in mind, on-line educational and training resources are a must to ensure the cost-effectiveness of the citizen science initiatives. Any of such materials must take into consideration overcoming **language barriers**, as **SOPHIE's Citizen Science Program** has evidenced. For citizen science initiatives with a European scope, materials and data-collection tools should be made available into all EU languages for adequate participation.

- **In spite of the potential of citizen science to connect research and Ocean Literacy efforts, working through tourism operators does not guarantee broad behavioural change on environmental matters. SOPHIE's Citizen Science Program** has shown through its "**Blue spaces and wellbeing**" initiative that while taking part in a marine activity with a tourism operator might contribute to improve awareness of the marine environment amongst citizens, tourists and visitors, those engaging in those activities do not necessarily learn about actions they can take to contribute to a healthy Ocean. While the potential is there for tourist operators to inspire change, additional **training** is needed for operators to develop the **skills** and **knowledge** required to **positively influence behaviour**.
- **Launching citizen science initiatives through tourism networks might bias research towards higher income citizens.** Although the extent of this has not been considered nor addressed by **SOPHIE's Citizen Science Program** (which also relied on local stakeholders to engage citizens), another limitation of working through tourism networks might arise from a bias in social "accessibility" to tourism experiences, as there will be members of society who are not economically privileged enough to partake in guided coastal or marine activities.

<u>Opportunities</u>

- **Citizen science is on the rise as a valuable and accepted tool by scientists to support their research**. Citizen science is slowly but surely being considered by researchers of many disciplines as another valid tool to collect data and gather information for their studies, filtrate results and even to analyse large pools of results. In recent years it has gained momentum also as a means to engage the general public in science, and to increase their interest and knowledge. If well directed and managed, a **citizen science** "**sentinel**" **network of coastal & marine tourism operators** has the potential to create **win-win scenarios** for researchers, tourism operators and their customers.
- **SOPHIE Strategic Research Agenda for Oceans and Human Health has identified "Blue spaces, tourism & wellbeing" as one of the three main target action areas to be addressed in Europe over the next decade.** This involves advancing research to answer fundamental questions, but also addressing capacity building and training needs to increase Ocean Literacy in Europe. Rolling out robust citizen science initiatives through **tourism stakeholders** can potentially support both objectives, advancing **OHH research** while nurturing **Ocean literacy** across **Europe**.

- **Established networks of coastal & marine tourism operators and local NGOs are existing assets that can activate tourism stakeholders without the need to establish new relationships, capitalizing on existing trust.** Through the past decade, the European Union has invested in developing networks to promote transnational cooperation amongst European member states, their business sector, NGOs and civil society. Existing formal and informal networks can contribute to support the uptake of citizen science. The **WILDSEA Europe** network, for example, has been instrumental in activating coastal & marine tourism operators as "**citizen scientists**".

Threats

- **Engaging tourism operators in citizen science initiatives requires time and building and sustaining trust, which can be easily lost.** Launching a **sentinel citizen science network** of **tourism operators** and generating expectations should not be undertaken lightly and should only be attempted with sufficient resources to operate for a minimum period of 5 years, in order to ensure the delivery of sound, cost-effective scientific results. Once operators come on board citizen science initiatives, expectations are created that need to be addressed and fulfilled. If human, technical and financial resources are not allocated to sustain training, networking, providing robust data collection tools and following up with participating operators, as well as to acknowledging their efforts, momentum might be lost, and efforts rendered ineffective.
- While **SOPHIE Citizen Science Program** has not had to address any issues regarding potential **health hazards** associated with engagement in citizen science initiatives, there could be research projects that require exposing tourism stakeholders to health risks. Any European initiative should have the observation of **ethics** implicit in its DNA, and associated risks be clearly identified, evaluated, mitigated and communicated.
- The current **Covid-19 pandemic** has paralyzed tourism activity throughout Europe. While it is still unclear the long-term effects that the pandemic will have in the tourism sector, it has triggered an unprecedented crisis that might lead to the disappearance of many tourism operators across Europe (especially those SMEs lacking strong capital foundations). A sustained tourism crisis could hinder any future efforts geared at channelling citizen science through tourism stakeholders.

Strengths

- Existing base of motivated coastal & marine tourism operators in Europe, willing to engage in citizen science.
- Coastal & marine tourism operators offer great potential to be used as opportunistic platforms for scientists to undertake research on OHH interactions.
- Engaging coastal & marine tourism operators in citizen science creates synergies between research and Ocean literacy efforts.
- Working through blue tourism networks can broaden the geographical scope of OHH research, cost-effectively.

Weaknesses

- Short-term citizen science initiatives most likely to be ineffective in scientific relevance of the data gathered.
- Launching citizen science initiatives requires building a clear case for operators to partake and continuous follow up and networking (mobilizing human and financial resources over time).
- In spite of the potential of citizen science to connect research and Ocean Literacy efforts, working through tourism operators does not guarantee broad behavioural change on environmental matters.
- Launching citizen science initiatives through tourism networks might bias research towards higher income citizens.

Opportunities

- Citizen science on the rise as a valuable and accepted tool by scientists to support their research.
- "Blue spaces, tourism & wellbeing" identified by SOPHIE Strategic Research Agenda for Oceans and Human Health as one of the three main target action areas to be addressed in Europe over the next decade.
- Established networks of coastal & marine tourism operators and local NGOs are existing assets that can activate tourism stakeholders without the need to establish new relationships, capitalizing on existing trust.

Threats

- Engaging tourism operators in citizen science initiatives requires time and building and sustaining trust, which can be easily lost.
- Any European initiative should have the observation of ethics implicit, and associated risks clearly identified, evaluated, mitigated and communicated.
- The current Covid-19 pandemic has triggered an unprecedented crisis that might trigger the bankruptcy of smaller tourism operators across Europe, ceasing to operate.

Fig. 19: Summary of **S**trengths, **W**eaknesses, **O**pportunities and **T**hreats of launching an **OHH Citizen Science Program** linked to **Blue Tourism** at a broader European scale.

5. Conclusions and recommendations

Tourism operators have long been involved in **citizen science** initiatives, mainly for environmental research such as coral reef monitoring, sighting of cetaceans or collection and monitoring of micro-plastics, amongst others, with successful results. **SOPHIE**'s **"Tourism & Citizen Science" Program** wanted to further explore their potential to become allies in advancing the **OHH** agenda, supporting **research** and **raising public awareness** on Ocean and human health interactions through citizen science initiatives. Our results show that they can potentially become such allies.

Building a **sentinel network** of "**blue tourism" operators** in **Europe** to gather **data** on **OHH** through **citizen science** can render clear **benefits**, capitalizing on an existing broad base of **coastal & marine tourism operators** that is willing and able to partake in **citizen science** initiatives, namely:

- Offering an **opportunistic platform** for scientists to undertake research on OHH interactions. Tourism operators spend most of their time by the coast or at sea, with the potential to become the "eyes" of researchers on the field. Additionally, these operators offer researchers access to thousands of tourists, visitors and citizens in coastal communities, who are seemingly willing to team up with science when invited to do so by a trusted tourism operator.
- **Broadening** the **geographical scope** of **long-term OHH research**, **cost-effectively**. International citizen science initiatives successfully contribute to gather data from a broad range of geographies using digital tools, without requiring the physical presence of researchers beyond an initial engagement and training effort, capturing economies of scale.
- **Generating synergies** between **OHH research** and **Ocean literacy efforts**. Educational efforts invested in engaging coastal & marine tourism operators in OHH citizen science initiatives have a positive spill over effect on their customers, as knowledge gained by operators is passed onto them.

However, for such a sentinel network to render results, a number of **critical aspects** need to be properly addressed and managed. The **European Marine Board** has identified a number of factors for successful citizen science. When considering the development of a network to support specific **OHH research** by teaming up with **blue tourism stakeholders** through citizen science initiatives, such factors can be further qualified, amounting to the **critical success factors** for such an effort to render **efficient** and **cost-effective results** in **Europe**:

- **Contribution to science: Connecting to SOPHIE's Strategic Research Agenda for OHH and applying a long-term approach to research through citizen science.** As in any citizen science network, **scientists** should play an **active role** in an **OHH citizen science network** connected to **blue tourism**, ensuring that any initiative promoted and/or undertaken aligns with existing **strategic research priorities** for **OHH**. **SOPHIE**'s Strategic Research Agenda for Oceans and Human Health provides an overarching framework to guide future research in Europe and should be taken as a **guiding reference** to advance **OHH citizen science initiatives** in the **European Union**. In addition, the citizen science initiatives run through such a

sentinel network should have a clear **European added value**, in order to capture and reap the benefits brought by working with **tourism stakeholders**, mainly from the perspective of **cost-effectively broadening** the **geographic reach** of **research**. Local, short-term research initiatives might be more effective applying traditional research methods than using citizen science. However, research efforts requiring long-term data series from different geographical locations can considerably benefit from rolling out citizen science initiatives through blue tourism networks.

In addition, for data to be **statistically significant**, citizen science initiatives in general need to run over periods of time longer than 1 year, allowing the collection of enough data. Setting up citizen science initiatives with tourism operators involves a lot of initial work and applying important financial, human and technological resources (applied to developing training and awareness materials; data collection protocols and tools; building capacity amongst participating operators and following up with them periodically, amongst others). But once up and running, they can continue over several years with little extra effort, collecting data from wide geographical areas over long time spans. The required **duration** of **citizen science initiatives** will logically depend on the type of data targeted and the research question pursued, which will no doubt also influence the quantity of data required to enable robust and meaningful analysis. As previously mentioned, achieving economies of scale is a requisite for citizen science to contribute an added value of cost-effectiveness over traditional research methods. When working with blue tourism stakeholders, we estimate that **capturing** these **economies of scale** requires a time span of **at least 3 years**.

- **Engagement of citizens: Working with blue tourism communities**. Successfully engaging citizens is key to develop citizen science initiatives. When seeking to activate **coastal & marine tourism stakeholders** as "*citizen scientists*", a few factors need to be taken into account:
    - **Building the case for citizen science:** For tourism operators to partake in citizen science initiatives, they have to perceive a clear benefit to their involvement. Whether it is a reputational gain, improving their customer experience or helping to safeguard their "playground", the case for participation should be built into citizen science initiatives and made clear from the outset.
    - **Tourism seasonality:** Any activities geared at supporting engagement of tourism operators (whether it is through information or training sessions) must be planed **off** the **peak tourism season**, when operators have time to invest on issues other than running their business full time. While operators will continue to support running citizen science initiatives during the peak season once engaged, there is a risk that they will limit their dedication to either direct data collection and sharing or customer engagement. When targeting their customers, providing operators with materials to which they can easily refer customers during peak season can help to mitigate this risk. Allowing for data gathering during the **low** and **mid seasons** is also critical to ensure a sufficient flow of data.
    - **Language:** Tourism operators deliver services to a national and international

mix of customers. Providing operators with tools and materials in a broad range of relevant languages is key to support successful engagement of both **operators** and their **customers**.

- **Sustaining momentum:** Periodic **training** and **networking** with tourism operators must be maintained and managed, keeping them interested and engaged to sustain the momentum of citizen science initiatives.
- **Capitalizing existing networks:** Connecting to on-going efforts undertaken by local stakeholders and capitalizing on relationships established through existing tourism networks, such as the **WILDSEA Europe** network – https://wildsea.eu can efficiently and cost-effectively contribute to enhance and sustain engagement.

- **Clear goals: Advancing knowledge of the "blue health effect".** Citizen science, like any volunteering activity, benefits from creating "win-win" scenarios. Developing citizen science initiatives in the realm of the "**blue health effect**" contributes to advance knowledge on the health and wellbeing benefits of exposure to blue environments, supporting the case for coastal & marine tourism. Focusing on the "**benefits**" rather than the "**risks**" of our relationship with the Ocean might be key to **boosting support** for OHH citizen science initiatives amongst the **blue tourism community**.
- **Reliable data: Designing adequate, clear and simple protocols and tools for blue tourism stakeholders.** Appropriate protocols and tools are needed to ensure **data reliability** and **robustness**. Collecting data through blue tourism stakeholders will benefit from deploying tools that can be used **easily** and in **remote** places where no Internet connection is available. Developing citizen science initiatives that capitalize on the awareness that tourism operators have regarding the natural events and conditions of their destinations can benefit from higher data reliability and a reduced data filtering effort.
- **Good communication: Winning the heart of tourism stakeholders by sharing results.** Good communication is key to win the support and engagement of citizen scientists. For an OHH sentinel network of **blue tourism operators** to work effectively by encouraging tourism stakeholders to engage in different initiatives overtime, resources must be allocated to:
  - Developing attractive **supporting OHH materials** that make it **easy** for tourism operators to engage their customers, without requiring elaborate explanations on their side.
  - **Sharing** the **results** of **research** and developing **materials** that allow operators to share such results themselves with their customers as well, building a solid sense of **community**, **purpose** and **achievement**.
- **Improved Ocean literacy: Enhancing awareness and understanding of Ocean and human health interactions.** Enhancing Ocean literacy is one of the added benefits of successful citizen science. Working with blue tourism operators offers a **double dividend**, as efforts invested in their training generates a positive spill over effect over their customers. Given the high rotation of professionals in the tourism sector, to maximize this effect, training materials should be developed online to

make them **easily transferable** to **new staff members**. The fact that online materials can further contribute to sustain awareness amongst citizens beyond their "travel" experience, as well as reaching out to other relevant audiences (beyond those originally targeted through citizen science initiatives) should be taken into consideration and capitalized.

- **A new, emerging success factor: The observance of ethics in citizen science initiatives.** Although in general citizen science volunteers do not seem to be crying out for discussions about ethics, connecting citizen science to OHH research might bring up a wide range of ethical issues needing discussion. What ethical issues arise when citizen scientists are also "patients" reporting their own data? How do we properly communicate and manage risks when collecting data exposes citizen scientists to potential health hazards? How can we foster inclusion and diversity in OHH research when working with blue tourism communities? In addition to such issues, the adoption of the General Data Protection Regulation (GDPR) directive in Europe also calls for a strict observance of data protection that has an impact on citizen science initiatives. Although different initiatives will raise different **ethical issues**, **screening** such initiatives through **independent ethical boards** prior to their development will increase the probability that any potential concerns connected to **OHH citizen science initiatives** are properly **identified** and **addressed**.

SOPHIE's "**OHH Citizen Science & Tourism**" Program has proved that working with the **blue tourism community** as "*citizen sensors*" to build knowledge on **Ocean and human health** has great potential that should be further explored and realized. Building and funding a **sentinel network** of **blue tourism operators** in **Europe** that supports OHH research could be an efficient and cost-effective means towards achieving that potential.

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7. Annexes

7.1 List of operators engaged in SOPHIE's Citizen Science Program

AK Wildlife Cruises (UK)
Albatros Diving (Spain)
Algarve Sun Boat Trips (Portugal)
AloKAYAK (Spain)
Amare Turismo Nautico (Spain)
Amazing Grace Yacht Carter (Ireland)
Anthia Diving Center (Portugal)
Apartamentos Ornis (Spain)
Aquaventures (Ireland)
Atlantic Adventures (UK)
Atlantic Diving (UK)
Awaken Adventures (Ireland)
Baltimore Angling & Wildlife tours (Ireland)
Barca Núria (Spain)
Barrika Surfcamp (Spain)
Basket Islands Eco Marine Tours (Ireland)
Begi Bistan (Spain)Big Blue Diving (Spain)
Bolhas Tours (Portugal)
Bonaona Surf School (Spain)
Buceo Malpica (Spain)
Buceo Wayuu (Spain)
Centro Submarinismo
Subkro (Spain)
Christina Cruise Boat (Greece)
Cornwall Marine Network (UK)
Cornwall Seal Group Research Trust (UK)
Cornwall Waverunner Safaris (UK)
Day Cruise (Greece)
Dingle Surf (Ireland)
Dive Arranmore Charters/Arranmore Holiday Village (Ireland)
Divin' Dec Scuba (Ireland)
Donegal Climbing (Ireland)
Donegal Daytripper (Ireland)
El Rei del Mar (Spain)
Escuela Náutica Arriluz (Spain)
Escuela Náutica As de Guía (Spain)
Estació Nàutica Costa Daurada (Spain)
Fanad lighthouse (Ireland)
Fiskardo Divers (Greece)
Fiskardo Kayaks (Greece)
Getxoport (Spain)
Giroguies (Spain)
Glups Diving (Spain)
Gola Island Outdoor Education (Ireland)
Ionian Star (Greece)
Kayak Basque Country (Spain)

Koru Kayaking (UK)
Let’s Sail (Spain)
Letterfrack Sea Safari (Ireland)
Lizard Adventures (UK)
Maghery Coastal Adventures (Ireland)
Mar Balear (Spain)
Mar Natura (Spain)
Maremasma (Spain)
Marine Discovery Penzance (UK)
Mater (Spain)
Medusa Diving Center (Spain)
Mindfulkit (Spain)
MyCrew (Portugal)
Nauga (Spain)
Náutica Galea (Spain)
Náutica Golfiño S.L. (Spain)
Naviera Nabia (Spain)
Newquay Sea Safaris and Fishing (UK)
Odyssey Outdoor Activities (Greece)
Ozean Experience (Spain)
Palmira Scuba Base Nautica (Spain)
Patronat Turisme Diputació de Tarragona (Spain)
Piragüilla Ocio y Aventura (Spain)
Plàncton Diving (Spain)
Polaris Nautika Eskola (Spain)
Portugal dive (Portugal)
Riu a l’Ebre (Spain)
Rosses snorkellers
Royal Nautic (Portugal)
Scilly Seal Snorkeling (UK)
Seafarer Holidays (Greece)
Sealife Dolphin Watching (Portugal)
Seas the Bay (Ireland)Sirenas Academy (Spain)
SK Kayak (Spain)Solas Ireland (Ireland)
Soller Divers (Spain)
St Martins Watersports (UK)
SUP in a bag (UK)
Tethys Research Institute (Greece)
Tory ferry/Arranmore ferry (Ireland)
Troka Abentura (Spain)
Unisub l’Estartit (Spain)
UR Nomade S.L. (Spain)
Vertente Natural (Portugal)
Walkaboutwest (UK)
Wild Atlantic Adventure Centre (Ireland)
Wilextours (Spain)
Xaloc Diving Center (Spain)

7.2 Results of the preliminary data analysis of the "Blue Spaces & Wellbeing" initiative

By Dr Deborah Cracknell and Dr Mathew White (University of Exeter)

Executive Summary

The SOPHIE Citizen Science Programme planned three surveys to understand the relationship between the ocean and human health: a pre-activity survey to establish visitors' expectations and levels of ocean literacy; a post-activity survey to understand the connections between the ocean and human health, and a follow-up survey, four weeks later. Due to Insufficient numbers of responses for the pre- and follow-up surveys, however, the statistical analyses presented here focuses predominately on the post-activity survey only.

The post-activity survey was complete by 95 female and male visitors, mainly between the ages of 26 and 60. Most activities occurred in late spring or summer, in the UK, Ireland or Spain. Water-based activities were undertaken more frequently than land-based activities and seabirds were spotted on at least half of all trips; other frequent sightings included seals, jellyfish and fish. Generally, water quality was rated as very good and levels of litter were deemed acceptable.

Less than half of respondents used a tour operator/guide; the rest went unaccompanied, choosing to go on their own or with family and friends. Although most visitors who went with a tour operator/guide received some sort of briefing, the amount of information received varied greatly. Statistical analysis found, overall, that respondents from both groups (tour operator vs. unaccompanied) agreed that they learned new things about marine life, that they'd reflected on new ideas about the marine environment, and that they'd observed others who cared about the marine environment. They seemed less sure, however, that they'd learned how they could protect the marine environment. Undertaking the activity was, generally, a very positive experience: people felt happy, close to nature, and that the trip was worthwhile. Many felt a sense of achievement and connection with others. Generally, facilities were good and they felt safe. After the trip they agreed that they were willing to talk to others about marine environmental issues and support conservation initiatives. Although they agreed slightly less that they knew what actions they could personally take to protect the ocean, around two thirds of respondents did state one or more actions they could take, including picking up litter or participating in a beach clean, and/or reducing their use of plastic.

One key area of interest was whether there was a difference between the responses, and visitor profiles, of those who undertook their activity with a tour operator compared with those who went unaccompanied. Overall, statistical analyses revealed few significant differences between the two groups, although those who went with a tour operator were more likely to learn new things about marine life, and connect with others on the trip. There were few inter-country differences in responses, either as an effect of country of residence or country visited.

In summary, findings from this Programme suggest that marine activities and trips can increase ocean literacy and the willingness to undertake new actions to protect the ocean. The activities themselves can improve human wellbeing by making people feel

happy, close to nature and connected with others. While there were few differences in responses between groups, there was evidence to suggest that those who went with a tour operator learned more about marine life and felt more connected to others, than those who were unaccompanied.

<u>Summary of T1 Survey data</u>: Expectations and Ocean Literacy (pre-activity survey)

Descriptives (N = 13)

Nearly half of respondents stated that they hoped that the activity would enable them to have a good time during the holidays and/or learn more about the marine environment. Almost 40% stated that they hoped to undertake some physical activity/exercise. In comparison, only 15% of respondents stated that spending quality time with friends and family was one of their motivations which, interesting, appears in contrast to marine visits generally (see Elliott et al., 2018). Over 75% of people were doing the activity for the first time or had only done the activity a couple of times before. Less than 25% of people had done the activity several times or regularly.

Regarding prior knowledge and experience, overall, participants felt that they only knew a little bit/almost enough about the kinds of animals and plants they might see during the activity or the conservation issues affecting the marine environment. They generally felt that they knew enough about the relationships between the marine environment and human health and well-being, although we cannot be certain which 'relationships' respondents were specifically referring to, i.e. the provision of food and medicines or as restorative environments, or both.

Additional T1 analyses

It was not possible to conduct any inferential statistical analysis of T1 data due to insufficient participant numbers.

<u>Summary of T2 Survey data</u>: Understanding connections between Ocean and Human Health (post-activity survey)

Descriptives (N = 95)

Of the 95 participants who completed the T2 survey; approximately 60% were female (~40% males), and over 75% of respondents were between the ages of 26 and 60.

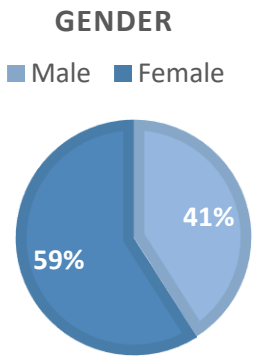

Fig.1 Gender of T2 respondents

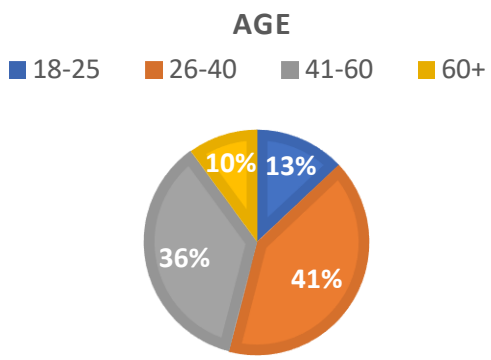

Fig. 2 Age of T2 respondents

Most respondents lived in the UK, Ireland or Spain, and almost 50% lived less than 5 km from the coast (66% - 2/3rds lived within 20 km of the coast). The majority of activities occurred in these three countries, with approximately 75% of respondents undertaking their activity or trip in their country of residence. Interestingly, however, different countries displayed different travel habits. For instance, all respondents living in Spain undertook their activity in Spain, whereas over a third of UK residents chose to go abroad for their activity. All trips undertaken in the UK were by UK residents; no residents in other countries chose the UK for their activity. In contrast, over a third of people who undertook their activity in Spain had travelled from other countries.

The majority of trips (almost 80%) occurred during late spring and over the summer; 20% occurred during the autumn. The weather tended to be warm and sunny, although many people encountered cloudy and windy conditions (<40%). Less than 15% of people experienced cold, wet weather.

Out of 95 participants, 75 stated that they had participated in one of the 17 activities/trips listed in the survey: a total of 13 different activities were undertaken. The activities most frequently mentioned (by at least five respondents) were all sea-based, rather than land-based, activities. Diving and snorkelling accounting for 25% of activities undertaken; boat trips, surfing, coasteering, and swimming were also popular. Over 50% of people saw seabirds during their activity/trip. Other regular sightings included seals, jellyfish, algae, sea stars, crustaceans and large shoals of fish.

Generally, water quality was rated as very good (good-excellent) and, even though over 40% of respondents spotted litter, the quantity was regarded as 'acceptable' (approaching 'good'; M = 2.95).

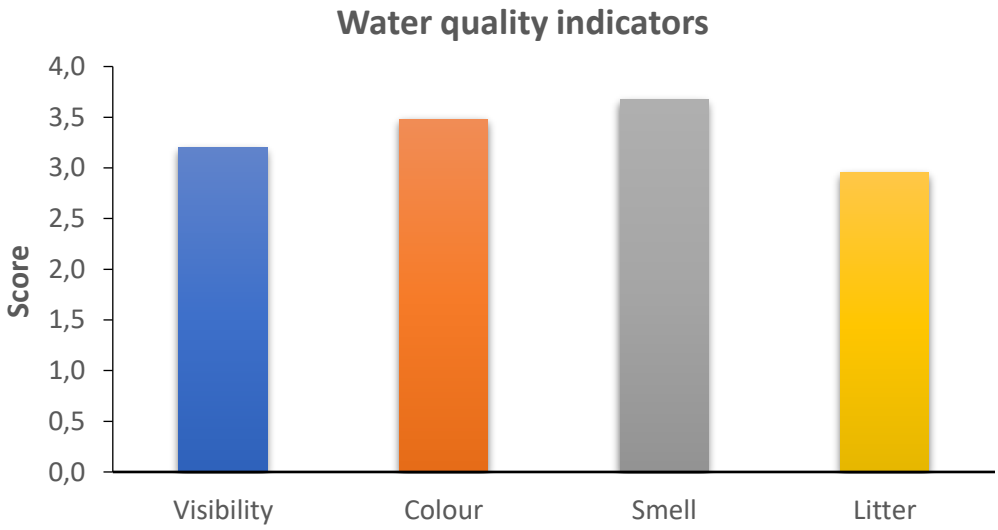

Fig. 3 Water quality indicators

Less than half of respondents used a tour operator/guide (44%); the rest (56%) went on their own or with family and friends (self-guided/unaccompanied). Of those who went with a tour operator/guide almost all received some sort of briefing. Although the means of all three briefing subjects was above the mid-point suggesting the information was 'Enough', the quantity and quality of information received varied

markedly between individuals. Some individuals received 'very little' or 'no information' (~23%), whereas others received 'a lot' or 'a whole lot' (~40%).

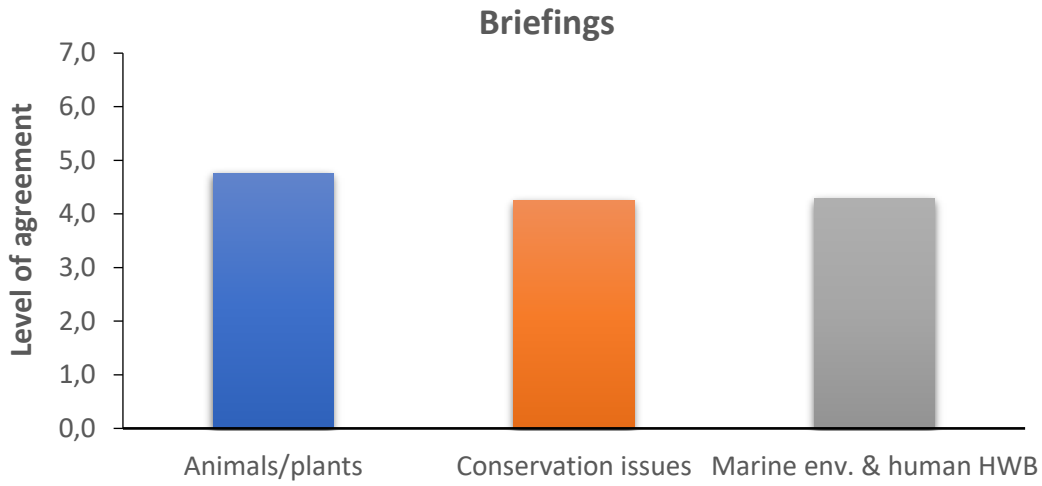

Fig. 4 Quantity of briefing information

With regard to ocean literacy and marine awareness topics, overall, respondents agreed, to some degree, that they learned new things about marine life, that they'd reflected on new ideas about the marine environment, and that they'd observed others who cared about the marine environment. However, they seemed less sure that they'd learned how they could protect the marine environment.

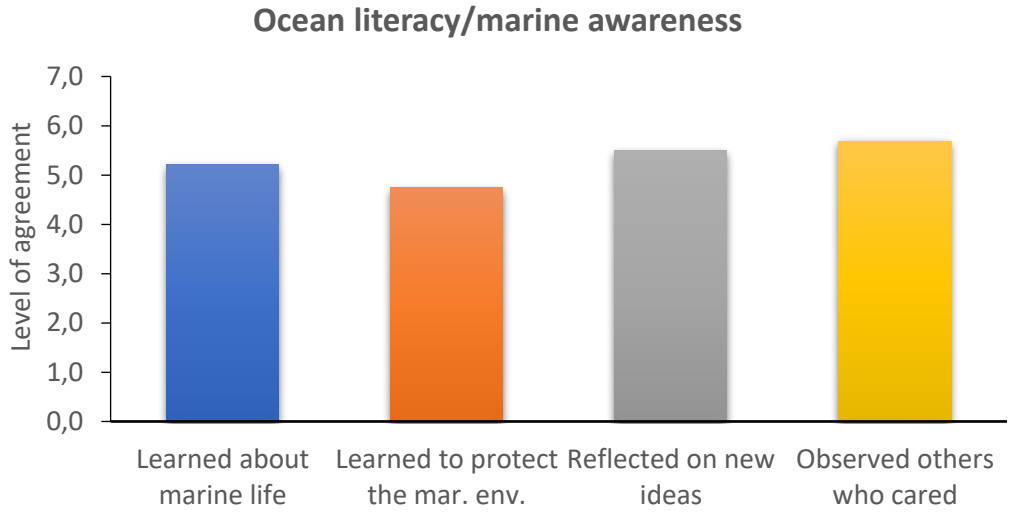

Fig. 5. Level of agreement to ocean literacy/marine awareness statements

Undertaking the activity/trip was generally a very positive experience: people agreed or strongly agreed that the activity made them feel happy and was worthwhile, with many expressing a sense of achievement. They felt close to nature and connected with others on the trip. They generally experienced something pleasantly surprising/unexpected. Overall, they agreed that facilities were good and that they felt safe. Few people felt sick.

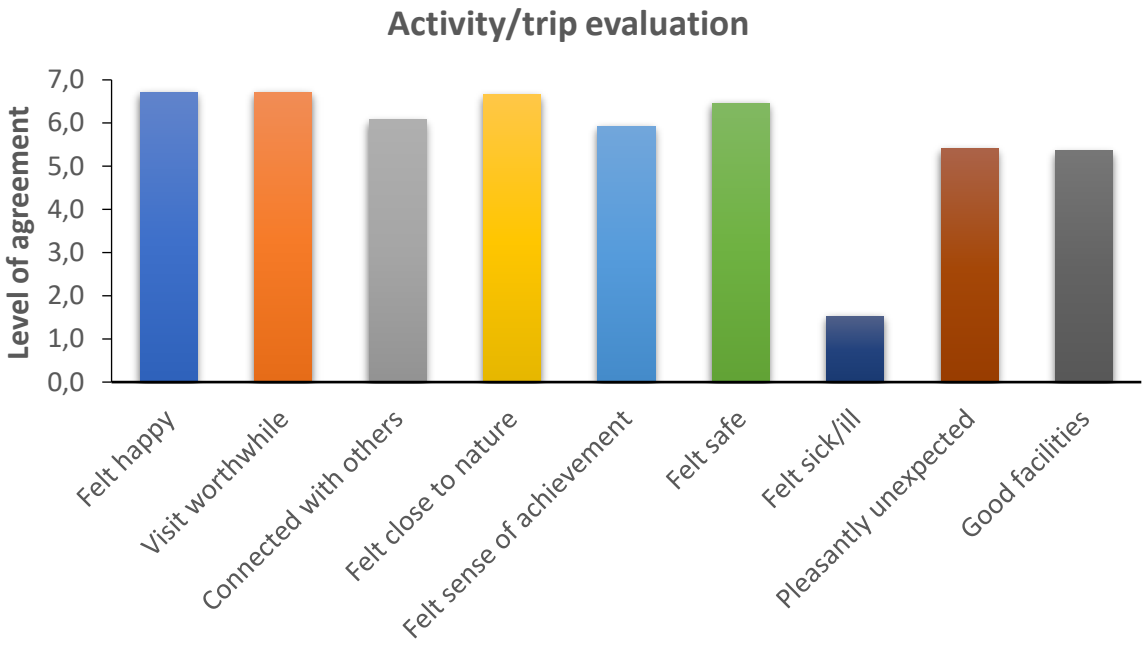

Fig. 6 Activity/trip evaluation

The main things that people liked and enjoyed about their activity or trip included watching marine life and generally being in, on, or by the sea. People also specifically mentioned the sights and sounds of the sea, as well as appreciating the scenery, and generally being outdoors in the fresh air. A number of respondents also mentioned the peace, calm and relaxation they experienced, as well as the aspect of 'being away'.

As for dislikes, people often commented on bad weather, the presence of litter, and things that they found physically challenging (e.g. carrying heavy equipment). Tourism activities, such as motorboats, jet skis, noisy mobile phones and crowds, also negatively impacted on people's enjoyment.

Following the trip, people agreed that they felt willing to talk to others about issues facing the marine environment and were willing to support conservation initiatives. Once again, however, they agreed slightly less that they knew what actions they could personally take to protect the ocean. Nevertheless, over 80% of respondents still agreed, to some degree, that they knew about personal actions they could take to protect the ocean. Around 68% of respondents actually stated one or more actions they could take, including picking up litter or participating in a beach clean, and/or reducing their use of plastic. Approximately 10% of respondents also mentioned raising awareness and educating others. Most agreed that they were likely to undertake these actions within the next four weeks.

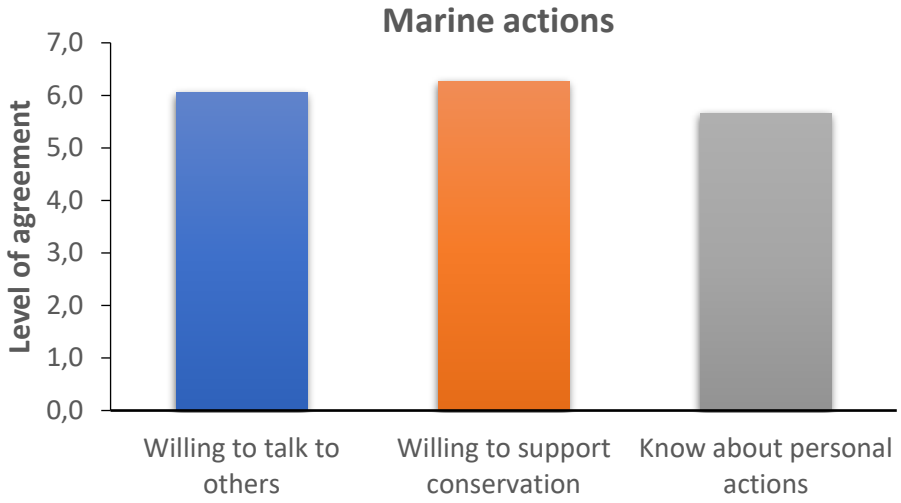

Fig. 7 Level of agreement with marine actions statements

Additional T2 analyses

Marine awareness/ocean literacy; activity evaluation; marine actions

- *Tour operator/Guide vs. On own or with family/friends*

In order to establish whether undertaking an activity or trip with a tour operator/guide, rather than on one's own or with family/friends, influenced marine awareness/ocean literacy, thoughts and feelings about the activity (evaluation), and subsequent intended marine actions, a series of one-way ANOVAs were conducted. Data analysis revealed few significant differences between the two groups. However, respondents who went on a trip with a tour operator/guide were significantly more likely to agree that they learned new things about marine life than those who went on their own or with family/friends, $F(1,93) = 8.350$, $p = .005$.

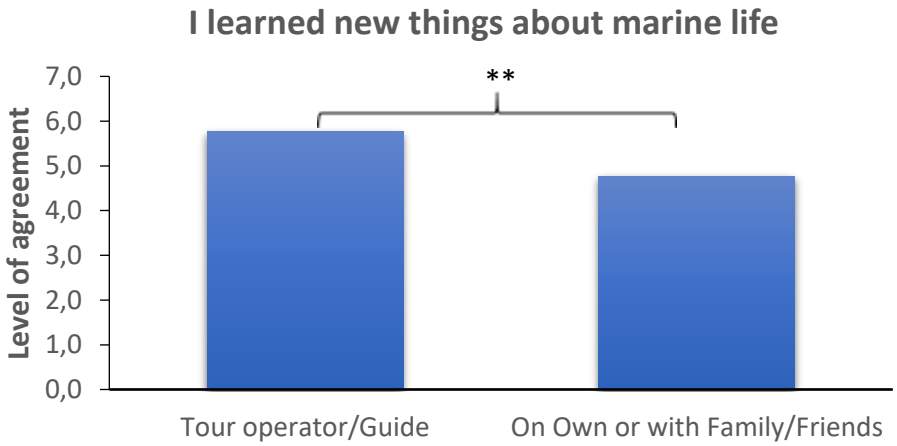

Fig. 8 Differences between groups on ocean literacy/marine awareness statement: I learned new things about marine life

This group were also significantly more likely to agree that they connected with others on the trip than those who went on their own or with family and friends, $F(1,93) = 4.430$, $p = .038$.

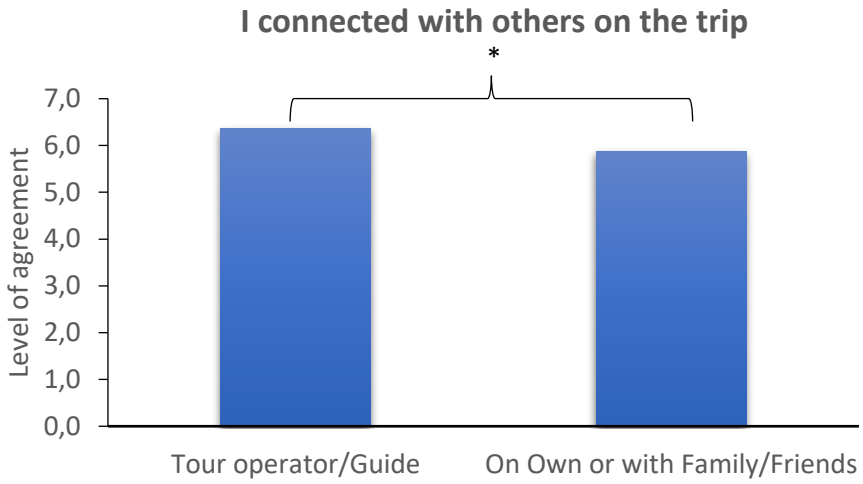

Fig. 9 Differences between groups on ocean literacy/marine awareness statement: I connected with others on the trip

- *Profiles of respondents*

There were no significant differences in age and gender between those who went with a tour operator/guide and those who chose to go alone or with friends and family. However, categorising respondents into three groups - those who went alone, those in a couple or with family/friends, and those in a group - revealed a statistically significant difference between the two groups: people who undertook their activity/trip on their own or with family/friends were less likely to undertake their activity/trip with a tour operator/guide than those in a group, $\chi(2) = 27.319$, $p < .001$.

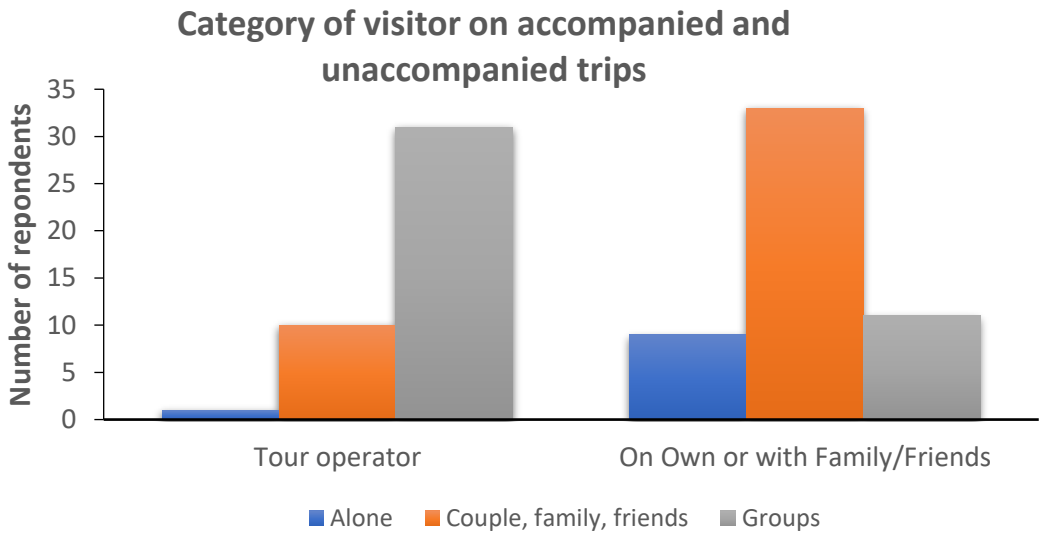

Fig. 10 Visitor profiles: accompanied and unaccompanied trips

Using these groupings to establish any differences between respondents for the marine awareness/ocean literacy, activity evaluation and marine action statements, found few significant differences between the three groups. However, there were statistically significant differences between the groups for two statements: "I observed others who care about the marine environment", $F(2,92) = 3.61$, $p = .031$, and "I connected with others on the trip", $F(2,92) = 4.04$, $p = .021$. Post hoc analysis, using the LSD test, revealed that, for the first statement, those in a 'Group' were significantly more likely to agree with this statement than either those 'Alone' or in a 'Couple/with family or friends'. For the second statement, those who were 'Alone' were significantly less likely to agree with this statement than either those in a 'Couple/with family or friends' or in a 'Group'.

- *Effects of activity*

A total of 75 of the 95 respondents who completed the T2 survey stated that they had undertaken one of the 17 listed activities. Many of these activities were active (e.g. surfing, cycling, climbing), whereas others were more passive (e.g. whale watching). Completion of the nine activity evaluation statements revealed no significant differences as an effect of activity, except for one Statement, "I connected with others on the trip", $F(12,62) = 2.138$, $p = .027$. Although some participants (e.g. those surfing or fishing) agreed quite strongly with this statement, participant numbers varied greatly between activities, impacting on the ability to reliably interpret these findings.

- *Age and Gender differences*

There were no statistically significant age or gender differences in responses to any of the marine awareness, activity evaluation or marine action statements. However, there were two findings that approached significance: (i) there was a tendency for females to more strongly agree than males that they 'felt close to nature', $F(1,93 = 3.893$, $p = .051$, and (ii) 18-25 years olds agreed the most strongly with the marine awareness statement "I observed others who cared about the marine environment", $F(3,91) = 2.573$, $p = .059$.

- *Inter-country differences*

Investigating whether there were any differences in responses as an effect of country visited, (categories: Ireland, Spain, UK, Greece and 'Rest of Europe'), revealed only one significant difference between countries: a statistically significant difference between responses for one item from the marine actions scale: "I am willing to support marine conservation initiatives", $F(4,90) = 2.513$, $p = .047$. Although, overall, respondents agreed that they were willing to support marine conservation initiatives, post hoc comparisons, using the LSD test, revealed that those who undertook their activity in the UK (all UK residents) agreed slightly less with this statement than those who undertook their activity in other countries, such as Spain and Ireland. There were no significant differences as an effect of country for any of the four water quality indicators (visibility, colour, smell, litter); the three briefing items; the four ocean literacy/marine awareness items or the nine activity evaluation items.

With regard to investigating differences in responses as an effect of country of residence, (categories: Ireland, Spain, UK and Rest of Europe/Other') it seemed logical to only explore responses to the marine actions scale, that is, using this scale as an indication of whether certain nationalities were more or less likely than others to undertake marine actions as a result of their experience. Responses to other scales (e.g. water quality, activity evaluation), very much related to the country in which the activity was undertaken. Nevertheless, although this analysis was undertaken, it did not reveal any significant differences as an effect of country of residence.

- *Correlations*

Additional analysis of T2 data revealed strong correlations between many, if not all, of the individual survey items in each of the three scales: marine awareness/ocean literacy; activity evaluation, and marine actions.

- *Activity evaluation statements + weather*

There were a number of point bi-serial correlations between some of the activity evaluation statements and weather conditions. For instance, there was a negative relationship between windy weather and connecting with others ($rpb = -.211$, $p = .041$). It may be reasonable to suggest that this is because windy weather can make having a conversation with someone quite difficult. Interestingly, and potentially less easily explained, is the finding that warm weather was negatively associated with feeling close to nature ($rpb = -.219$, $p = .033$). One possible explanation is that perhaps warm weather (positively associated with sunny conditions, $rpb = .270$, $p = .008$) is in itself usually quite enjoyable to experience and therefore may detract from 'nature' or the activity being undertaken. Alternatively, it is also possible that the weather was actually too warm, making it uncomfortable for some and therefore another potential distraction. In contrast, and intriguingly, cloudy weather was positive correlated with feeling close to nature ($rpb = .202$, $p = .05$). Perhaps cloudy weather (also positively correlated with cold, $rpb = .240$, $p = .048$, wet $rpb = .331$, $p = .001$; and windy, $rpb = .247$, $p = .016$, weather) was more 'challenging', making people feel that they are 'out in the elements' and part of nature.

- *Activity evaluation statements + animals etc. seen on activity/trip*

There were few correlations between activity evaluation statements, and animals and other objects seen during an activity/trip. Seeing colourful fish or spotting cephalopods (e.g. octopus - potentially perceived as cryptic and charismatic) was, however, significantly related to experiencing something pleasantly surprising /unexpected (colourful fish: rpb = .224, p = .029; cephalopods: rpb = .249. p = .015). In contrast, seeing oil was significantly and negatively correlated with how happy a person felt (rpb = -.214, p = .038). Interestingly, there was a positive correlation between experiencing something pleasantly surprising /unexpected and seeing dead animals (rpb = .204, p = .047). Whilst this appears counter-intuitive, perhaps this latter finding reflects a general, overarching interest and curiosity in all things 'nature'.

There were a number of negative associations between certain species of marine life and some of the activity evaluation statements. For instance, seeing sponges, sea stars, corals and crustaceans, was negatively correlated with feeling happy.

As it is possible that some negative animal associations may be due to that fact that some people were above and others below the water surface, further analyses focussed on differences in responses between participants who undertook 'above' water activities and those who undertook 'below' water activities, such as diving and snorkelling. However, as the sub-set of participants who undertook 'below' water activities was relatively small (n = 19), and some of factors investigated (e.g. animals, and also weather) were only experienced by a few respondents, these exploratory findings should be interpreted with caution.

Additional analyses (N = 75): Comparison of participants who undertook above (n = 56) vs. below water activities (n = 19) only

<u>Weather</u>

Approximately 50-60% of respondents undertaking above water activities experienced warm (48.2%) and sunny (58.8%) weather. Around 35-40% experienced windy and cloudy weather (35.7% and 39.3%, respectively). Fewer people experienced cold (16.1%), wet (7.1%) conditions.

In contrast, almost 80% of respondents participating in below water activities tended to undertake their activity during warm and sunny conditions. Around 20% of people experienced windy (15.8%) or cloudy (21.1%) conditions, and only one person had a cold, wet trip.

One-way ANOVA, however, revealed only a statistically significant difference between groups for 'warm' weather with, as mentioned, those undertaking below water activity being significantly more likely to experience their activities/trips during warm weather.

While weather conditions may have been incidental, it is also possible that those undertaking below water activities actively avoided inclement weather conditions due to their potential impact to impact on their activity (e.g. rough boat rides, poor underwater visibility, colder sea temperatures).

<u>Animals</u>

As would be expected, there were a number of statistically significant differences between animals spotted on above water trips and those encountered underwater.

For instance, those participating on above water activities sighted significantly more dolphins, seals and seabirds, than those undertaking underwater activities. In comparison, those on underwater trips encountered more fish (e.g. large, colourful, territorial fish). They also saw more benthic species, such as sea stars, crustaceans, cephalopods, gastropods, sponges and corals.

Marine awareness/ocean literacy; activity evaluation; marine actions statements:

Participants were spilt into three groups: those who undertook 'above' water activities (n = 56), those who undertook 'below' water activities (n = 19), and those who for whom this was not possible to determine (i.e. no activity stated, n = 20). Although additional analyses were undertaken to explore any differences between the responses of the above and below water participants, the numbers of participants who undertook below water activities were low, thus making the following inferential analyses less than robust and potentially problematic to interpret.

A series of one-way ANOVAs found no significant differences in responses between those who undertook underwater activities and those who did not for any of the marine awareness/ocean literacy or marine action statements. However, with regard to the activity evaluation statements, there was one significant difference between the two groups: those who'd participated in 'above' water activities, such as surfing and walking (n = 56) agreed more strongly that they found the trip worthwhile than those who undertook 'below' water activities, such as diving or snorkelling (n = 19), $F(1,73) = 5.896$, $p = .018$. One possible explanation for this may be that diving activities in particular can involve a considerable amount of effort (e.g. setting up and testing of dive equipment, travelling to the dive site, and rinsing the kit after the dive). This effort, often for a relatively short dive, may have resulted in diving being rated as less worthwhile than other activities. Nevertheless, overall, both groups agreed/strongly agreed that the trip was worthwhile.

Interestingly, although not statistically significant, there was a tendency for those who undertook below water activities to disagree slightly less that they felt sick than those who undertook above water activities, $F(1,73) = 3.701$, $p = .058$. It is likely that the lower mean for the above water groups reflects the fact that some of the above water activities were land-based (e.g. cycling, beach/coastal walking). Furthermore, potentially the slightly greater tendency towards feeling sick for those who dived or snorkelled (perhaps as a result of rough sea conditions), contributed to them feeling that the trip was less worthwhile.

- Correlations

In line with analysis of data from all 95 participants who completed the T2 survey, the divers/snorkelers (n = 19) sub-set revealed strong correlations between many of the statements within each of the three scales: marine awareness/ocean literacy; activity evaluation; and marine actions, and many correlations appeared broadly similar between the two above and below water groups. For instance, there were strong correlations for both groups between the item 'I felt happy' and items 'I felt the visit worthwhile', 'I felt close to nature' and ' I felt a sense of achievement'. Interestingly, however, there was only a significant (negative) correlation between the survey items 'I felt sick' and 'I felt safe' for those undertaking below water activities: there was no

significant association between these items for those participants in above water activities.

With regard to correlating activity evaluation items with other aspects of the trip/activity (e.g. weather experienced, animals sighted), there were too few respondents in the below water activities sub-set (already small with only 19 respondents) to run robust statistical analysis; usually only one or two people saw a particular animal or experienced a specific weather condition. In view of this, the following analysis is exploratory and for interest value only, and hence should be viewed with caution.

- *Activity evaluation + weather*

There were no positive correlations between weather and any activity evaluation statements for those undertaking above water activities. However, there were two negative correlations. Intriguingly, warm weather was negatively associated 'I felt close to nature' and 'I felt a sense of achievement': it is not immediately apparent why this might be.

For those undertaking below water activities and trips, there were a number of both positive and negative correlations. For example, sunny weather was positively associated with feeling happy (rpb = .572, p = .010), a sense of achievement (rpb = .533, p = .019), and finding the visit worthwhile (rpb = .509, p = .026), whereas cloudy weather and rain were both negatively correlative with feeling happy (rpb = -.572, p = .010, and rpb = -.813, p < .001, respectively). Cloudy conditions were also negatively associated with feeling a sense of achievement (rpb = -.533, p = .019) and finding the trip worthwhile (rpb = -.509, p = .026). There was a positive relationship between experiencing cold (rpb = .585, p = .009), and cloudy (rpb = .456, p = .050) weather, and feeling sick. As warm weather was negatively correlated with feeling sick, (rpb = -.559, p < .013), perhaps, together, these relationships suggest that more inclement weather could contribute to making below water activities more challenging.

Overall, there appeared a greater number of negative relationships between activity evaluation statements and inclement weather conditions for those participating in below water activities. Potentially, this suggests that those undertaking below water activities and trips are more reliant on 'better weather' (e.g. sunny conditions) for enjoyment of their activity, than those participating in above water activities.

- *Activity evaluation + animals etc. seen on trip*

For those undertaking above water activities, there was a significant positive relationship between spotting dolphins or sunfish, and feeling a sense of achievement. However, while these may appear reasonable associations as, for instance, dolphins are a species that people particularly like (Woods, 2000), overall low numbers of sightings hamper the robust interpretation of results: although dolphins were encountered by approximately 29% of respondents (n =16 out of 56), only one person spotted a sunfish.

<u>Summary of T3 Survey data</u>: Understanding connections between Ocean and Human Health (follow-up survey)

Descriptives (N = 17, i.e. participants who completed both T2 and T3 surveys)

To date, only a small number of respondents (N = 17) completed the follow-up (T3) survey; over 70% of whom were female. Approximately 70% of respondents were between the ages of 26 and 60.

There was some agreement that participants reflected on their trip and that something they had been told during their original trip had stayed with them. There was also slight agreement that they'd tried to learn more about the marine environment since their trip. There was agreement/strong agreement that they were willing to talk to others about issues relating to the marine environment and were willing to support marine conservation initiatives. They only slightly agreed, however, that they knew about new actions that they could take to protect the ocean. This was also evidenced by the uptake of new actions – around a third of participants did not take on a new action to protect the ocean following the activity. Nevertheless, 65% did take on a new action to protect the ocean; approximately the same percentage who indicated in the post-activity survey (T2) that they were likely to take on a new activity in the following four weeks. Of the new activities undertaken following the original trip, over half of respondents indicated that they removed litter and/or plastic from the beach, sea or seabed. Other actions included using less plastic, participating in recycling, and reducing or eliminating harmful household chemicals in the home.

Overall, respondents recalled that the trip made them feel happy, that it was worthwhile and made them feel close to nature. They also recalled that they felt some sense of achievement and connection to others on the trip. They remembered experiencing something pleasantly surprising or unexpected. They felt safe on the trip and thought the facilities were reasonable. Just under 18% of respondents experienced some sort of illness following their trip.

Additional T3 analyses

Overall, too few participants undertook the T3 (follow-up) survey to enable robust additional analysis to be undertaken on T3 survey data. In view of this, findings from T3 surveys should focus on 'descriptives' only.

That said, some exploratory analysis was undertaken of T3 survey data in order identify any potential data trends that may be worth investigating further should sufficient additional data become available at a later time point.

<u>Marine awareness/ocean literacy; activity evaluation; marine actions</u>

It was not possible to undertake additional analysis of the marine awareness/ocean literacy statements, due to the slightly differing wording of the statements for the T2 and T3 (follow up) surveys. However, as the wording of the activity evaluation statements and the marine action statements were the same at both time points, a series of paired t-tests were undertaken. This analysis did not reveal any significant differences between responses for any of these statements.

- *Tour operator/Guide vs On own or with family/friends*

Overall, there were few significant differences between responses for any of the marine awareness, activity evaluation or marine actions statements. There was one significant difference between responses for one marine awareness/ocean literacy statement: those who went with a tour operator/guide were less likely to agree that they 'tried to learn more about the marine environment' since their trip, than those who went on their own or with family and friends, $F(1,15) = 2.69$, $p = .037$. There was also one significant difference between response for one of the activity evaluation statements: those who went with a tour operator/guide felt safer than those who went alone or with family and friends, $F(1,15) = 6.51$, $p = .021$. There were no significant differences for any of the marine action statements.

- *Age differences*

There were no significant differences in responses to those of difference ages for any of the marine awareness and action statements, or the activity evaluation statements. However, as mentioned, only a small sub-set of the original 95 participants, who completed the T2 survey, also completed the follow-up survey at T3.

- *Gender differences*

As before, at T2, there were no significant differences in gender responses to the marine awareness and action statement. There was, however, a significant difference between the two groups in response to the activity evaluation statement 'I felt close to nature'; for this statement, females reported feeling closer to nature than males, $F(1,15) = 1.99$, $p = .045$.

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