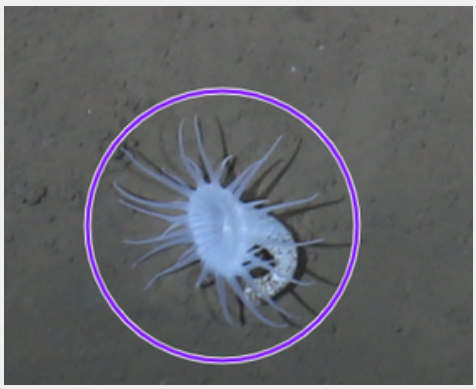
Handbook for Marine Image Analysis for Citizen Science

All you need to know about planning and using annotation - based citizen science in your marine research projects.

Into The Deep



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Into The Deep

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Table of Contents

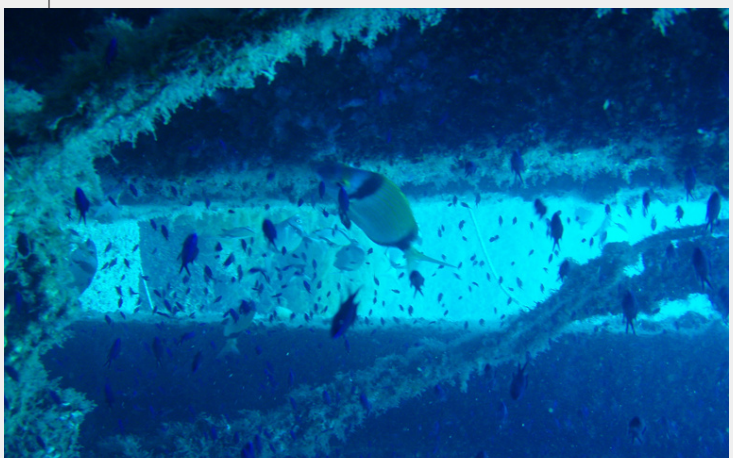


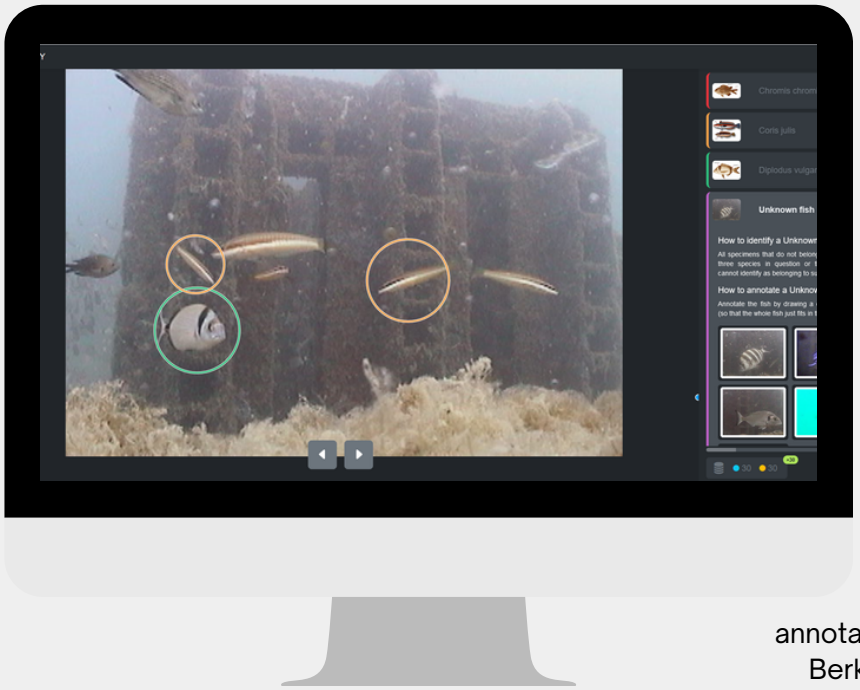
Image courtesy of OBSEA: UPC, Barcelona

Introduction to Into The Deep

Into The Deep makes the world's deep Ocean freely accessible through everyone’s laptops.

First, we spark people’s interest by circulating tailored video-intros via existing adult education pathways, and via social media. This gives anyone open access to short, engaging online courses covering four distinct deep sea marine habitats. Each course details the impact which human behaviour has on the habitat, and how we could change our behaviour to support it.

At the end of each course, we train participants to use Biigle Party. They click through to this web-based tool to make species observations in seafloor images of their chosen habitat. The instructions are clear, and the user collects points when they correctly annotate.



Web-based Citizen Science tool
Biigle Party developed by Bielefeld University makes it possible for everyone to make discoveries in deep Ocean habitats.

Figure 1 Biigle Party being used to annotateNeptune Canada images from the Berkeley Canyon, courtesy of ICM-CSIC

These results feed into real research, and we have various methods to keep participants up to date about their impact on ongoing marine conservation policy and research. Together, expert and volunteer researchers collaborate to protect our valuable marine ecosystems.

Citizen Science: more than just collaboration

Time is running out for our Oceans. **Education and ocean literacy are the most important tools we have to weave respect and understanding of the Oceans' importance into our daily lives as citizens, consumers and workers.** We need people to reconnect with the waters around them, to bring their local and traditional marine knowledge in to climate change research. To make this happen, it is up to all of us to shift our own perspective, to embrace the diversity and potential of collaboration between science and society. It is essential to provide marine learning and participation opportunities that reflect how each of us learns best, that acknowldge the many reasons we have for engaging.

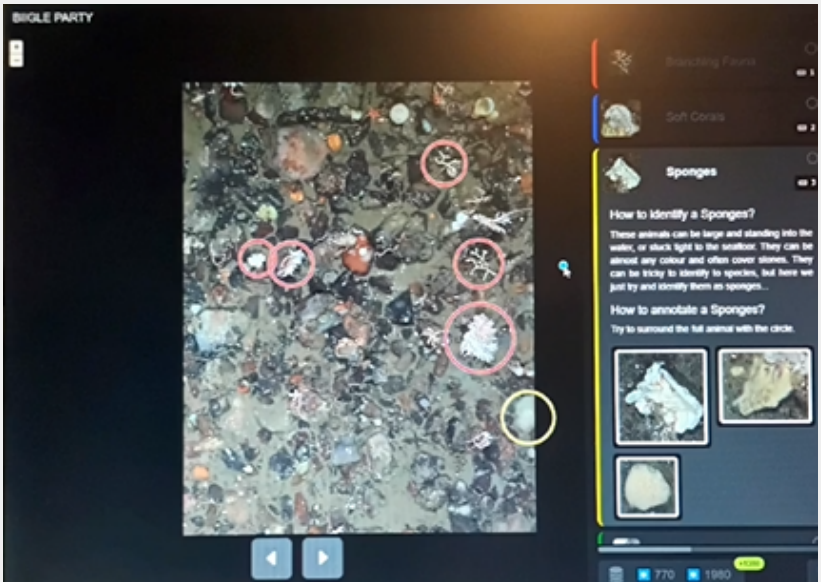
Each of us has a different skill to bring to this challenge and a different motive to connect with the Ocean, and each of us urgently needs to do whatever is in our power to facilitate an emotional and social reconnection, however large or small.

UN Ocean Decade: Challenge 10
Change humanity's relationship with the ocean

Ensure that the multiple values and services of the ocean for human wellbeing, culture, and sustainable development are widely understood, and identify and overcome barriers to behaviour change required for a step change in humanity's relationship with the ocean.

oceandecade.org/challenges

"The future of citizen science is... in shifting the focus from elite science to a reality where data collection, analysis, and interpretation are performed by everyday citizens going about their daily lives in partnership with professional scientists. " Newman et al. 2012



What sort of questions can adult citizen science answer?

At present there is great global interest in many aspects of the functioning of the oceans of the world, and how the biology within these oceans may be changing as a result of global warming. Early in the 2000s public interest in the ‘bleaching’, the death of the algae living in partnership with the animals making up the Great Barrier Reef attracted much interest.

This huge, biodiverse site was well known to many from nature documentaries, diving holiday advertisements and as one of the largest biologically formed structures on the planet, allegedly visible from the International Space Station and orbit. This degradation of the reef was immediately clear when video or still images were compared from the 1990s with those from the 2000s – the coral colours had clearly changed, different types of coral are growing in areas and seaweed was now growing in some places.

Scientists continue to quantify, or measure these changes over time – and indeed recruit citizen scientists to help with this endeavour via the ‘Citizens of the Deep’ project.

The last two decades have seen continued and growing public interest in marine ecosystem change and decline in response to global warming and pollution events, and pressure placed on governments and regulatory bodies by NGOs and the general public to do more to investigate, monitor and maintain these at risk ecosystems.

Gerat Barrier Reef:

Citizen Science For Change Project

https://www.barrierreef.org/what-we-do/reef-trust-partnership/community-reef-protection/citizen-science

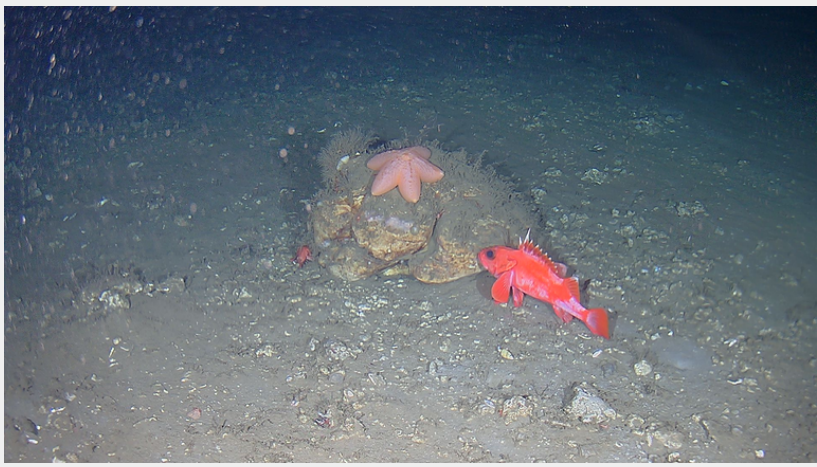
Scientific questions which can be addressed by inspecting still or video images of the seafloor without a huge amount of background knowledge on an area, such as on the photographs taken by divers for the ‘Citizens of the Reef’ project, are perfect for citizen science applications. Questions related to ongoing news stories (oil spills, global warming, seafloor trawling etc) spur an interest in the public which can be usefully utilised by researchers, if suitable questions can be formulated, and interested citizen scientists presented with access to appropriate material.

Questions which can be answered by citizen scientists should be purposeful, straightforward and not obtuse. Those willing to utilize their time to help address research topics posed need to be presented with sensible questions that they can help answer after a brief introduction to a topic (and labelling methodology). In the case of reef monitoring, this may be being shown photographs of pristine and degraded reefs, then being asked to label images from the science data as being either ‘pristine’ or ‘degraded’.

The strength of utilising citizen scientists to assist in such analyses is that many observers may be able to label a potentially huge number of images, or cast different sets of eyes over the same set of images. Certain research questions based on imagery are inappropriate for citizen science studies, such as projects which require a high level of taxonomic knowledge which may only be learnt over many years (such as identifying closely related and similar looking coral reef species in images).

Questions which can be answered by choosing or labelling a few items within an image, or broadly categorizing images (such as ‘degraded’ and ‘undegraded’) are much more suitable, and likely to yield large output results suitable for confident statistical analysis by the researchers running the study after the labelling stage.

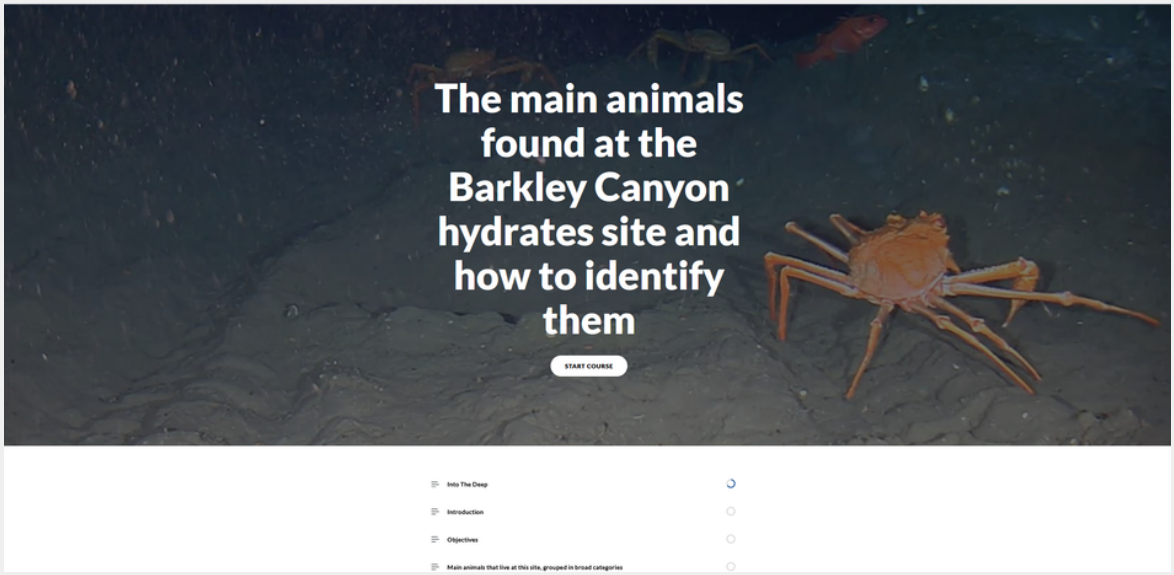
Formulating questions that appeal to potential citizen scientists is also important. If a question is posed that relates to an effort to protect a region or provide useful information to a monitoring organisation this can be satisfying and attractive to some people who may feel interested in taking an active role in science.



It is therefore useful to phrase a research question unambiguously, in such a way as to immediately tell a potential citizen scientist what they are doing and why… such as :

1)“Are areas of the Great Barrier Reef more degraded in 1990 or 2010?”
2)“Does deep sea fishing impact on the number of animals on the seafloor?”
3)“Are there more starfish in a litter abundant canyon than and adjacent, litter free canyon?”

These three questions all clearly show the aim of a piece of research. All three are also questions which can be answered by labelling images collected into contrasting sets of data -(1) reef images from different years, (2) fished and unfished adjacent areas of seafloor, (3) images from littered and unlettered marine canyons.All these questions are also suitable for citizen science projects as the amount of background knowledge needed to help label is low.



Within the ‘Into the Deep’ project we emphasise the need to provide short educational introductions to the regions of interest, so the potential citizen scientist can place his efforts into a larger context, though the example images which can be used for training the citizen scientist, and the tasks which will be asked of them to help answer these questions will be quite straightforward.

For 1) the scientist would likely be shown several images of ‘healthy’ reef and several of ‘degraded’ reef, then shown a number of images they could label. For 2) The potential citizen scientist would be shown images showing what ‘trawled’ and ‘untrawled’ seafloor look like. Then, they could be asked to label further images and ‘trawled’ and ‘untrawled’ and also to mark any animals they see in images.

For 3) the researcher posing the question would already likely be aware of which of two canyons may be litter abundant. The potential citizen scientist would then be asked to label any animals they see in images randomly selected from the two canyon systems. Following labelling the output results from all these studies could be analysed statistically by the researchers posing the study to get a robust answer to the question – particularly if the aid of citizen scientists allowed many images to be labelled.

Image courtesy of Alfred Wegener Institute (AWI), Bremerhaven

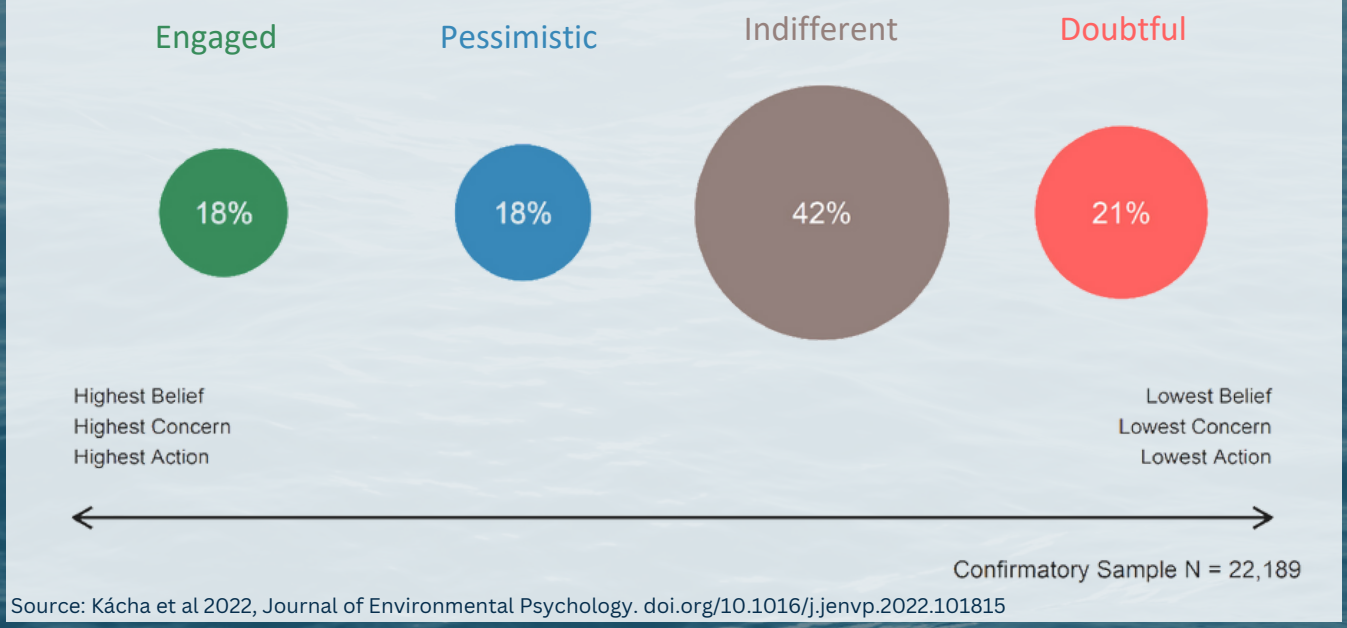
How to prepare adults to engage in participatory science

Into The Deep's mission is to create high-quality, freely accessible learning opportunities, evolving to participatory activities as the learner discovers the importance of deep sea marine biodiversity for their local shores and for global environmental sustainability.

This project is designed to engage informal adult learners (anyone who learns something as a result of their daily work- related, family or leisure activities) and non-formal adult learners (anyone who goes through a programme but isn't evaluated or certfied for their learning). Our learners are unlikely to have had school or further marine education, and it is not necessary to know anything about the four ecosystems before they begin.

Outside of school and formal education systems, our barriers to learning are about more than simply having access to education, or having prior knowledge for certain subjects. As adult learners we have less time, less money, more commitments and demands on our time. We are less likely to seek a purely academic challenge, not relevant to our lives. We are not likely to engage with non-user friendly learning resources, particularly if school experiences were not positive or if we belong to the 9 - 12% of European Citizens with dyslexia and specific learning disorders (source: European Dyslexia Association).

Europe-wide picture of climate-change related attitudes and behaviors

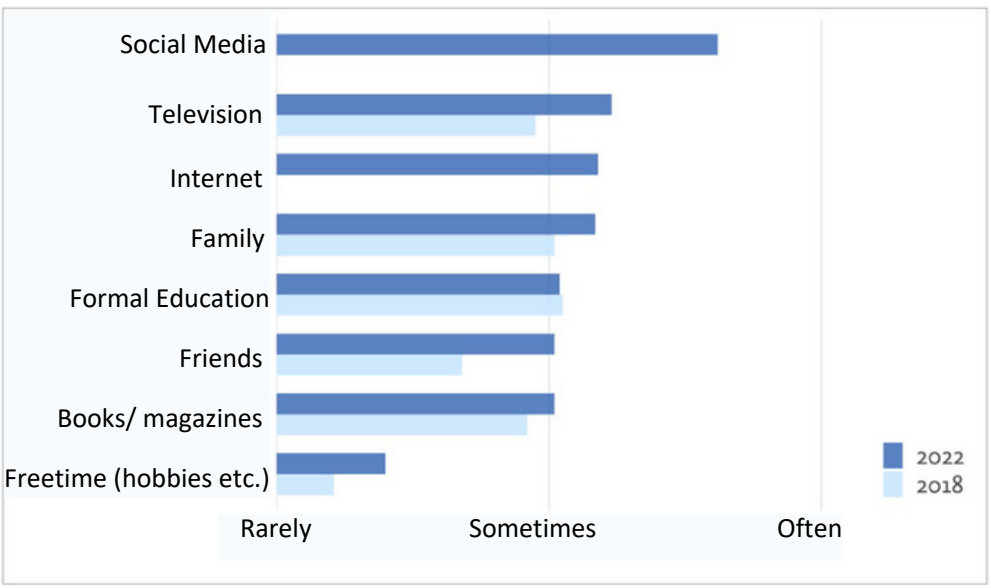


Source: Kácha et al 2022, Journal of Environmental Psychology. doi.org/10.1016/j.jenvp.2022.101815

Why participation is an important part of adult learning

Ingrained habits (car culture), a lack of trust (in the science and/or politics of climate change) to numbness (information overload) have contributed to feeling overwhelmed by climate change and indifferent to changing personal behaviours. As adults, we learn best when we are connected to the issue personally, and when we feel that our contribution will make a difference. Participatory science gives room for adults to grow, evolve and sustain interest.

Frequency of young people's engagement with sustainability in different mediums in 2018 and 2022.



Source: Grund & Brock 2022, Nationales Monitoring, Bildung für nachhaltige Entwicklung
:: Figure 5: Young people's engagement with sustainability over time

Preparing learners for Citizen Science!

1) Which networks should join the call to action to educate local communities? (e.g., NGOs, museums, universities)

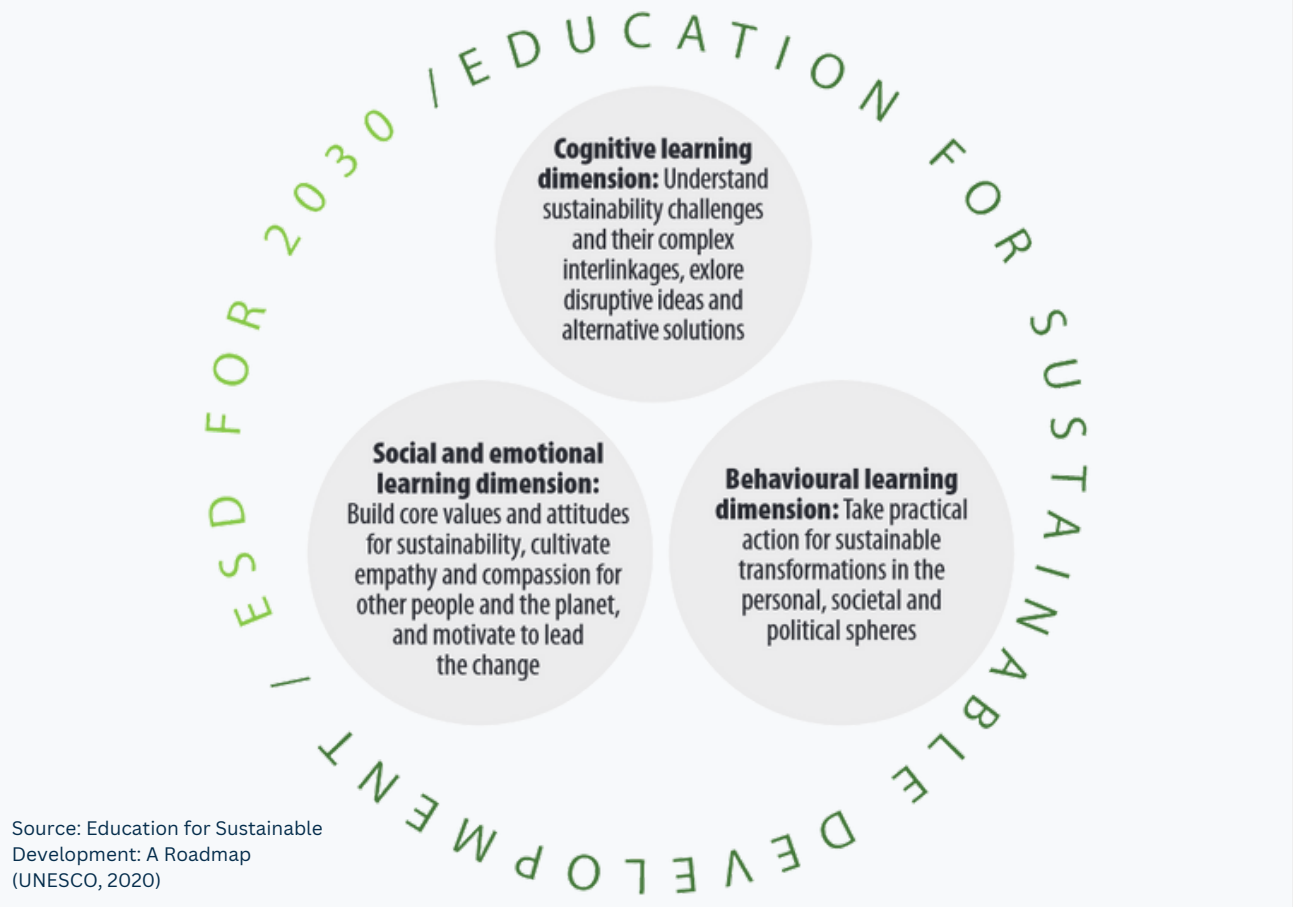
2) How learners should be engaged - what works for their demographic?

3. What do they need to know?

What motivates us to learn as adults?

Outside of formal education systems, we have a more complex relationship with learning new things. Each person's reason for connecting with the Oceans is different, and we must work hard to provide a broad range of ocean literacy opportunities. But the methods and approaches that work will ultimately have a powerful impact on a person's core values, helping them move beyond understanding the Ocean's importance to them, to cultivating empathy and compassion for the Ocean, marine ecosystems and those most impacted by climate change.

UNESCO's Education for Sustainable Development: A Roadmap (UNESCO 2020) say that this social and emotional learning dimension will help us move towards taking practical action, to changing our behaviour for the Ocean we want.



Source: Education for Sustainable Development: A Roadmap (UNESCO, 2020)

How can people without a scientific background play a role in answering scientific questions?

The value of opening your scientific question to the diverse voices of non-scientific participatiory researchers is detailed elsewhere in this Handbook. This chapter is dedicated to practical steps for people without a scientific background to be able to play an active role in helping to answer a scientific question based on marine image or video data.

Firstly, potential citizen scientists need to be be made aware of a research question and motivated by it enough to want to take part in the work. How to build this connection is covered extensively in the final sections of this handbook, but it is important to remember that as adults, we can be motivated to learn by emotional and social connections. These can be difficult to establish, but ultimately have the benefit that the learning can become better embedded into the lifestyle and core values of your citizen scientist.

In practical terms, a connection can be instigated by linking a citizen science research project to the website of a well visited marine institute, for example, or embedding a link to the ongoing research in a news article or well visited blog. These links should then ideally lead the potentially interested citizen scientist to a project page giving more information on the issue of interest, and explaining the aims of a citizen science task within the scope of the project. This website should concisely introduce to topic to the potential scientists, and outline how their active involvement will benefit the scientific task. For many current marine research topics based on imagery, there is likely a huge dataset which can be analysed, a dataset clearly too big for one researcher or a small group to tackle, and this information presented to the potential citizen scientists, so it is clear from the outset that their involvement is actually a requirement, should a statistically valid outcome from the posed question to be reached.

As well as introducing the topic and research question in more detail, the webpage hosting a marine imaging task needs to additionally provide information as to how those with very limited or no experience in a field can actively help. This generally takes the form of showing images with the items of interest (such as animals, litter, geological features etc) clearly shown, so the potential citizen scientist can see whether or not they feel confident that they can identify the items or regions of interest in images, before they take the plunge and join the labelling effort.

At this and every stage of the process it is important to show the value the researchers pose the question place in the potential efforts of citizen scientists, and to present the work as a collegiate and integrated effort to better understand an aspect of marine ecosystem functioning. This is supported by posing research questions which can be addressed straightforwardly by citizen scientists without recourse to ‘google image search’ to verify their efforts, and by clearly presenting example images which show that the task required (such as labelling all animals, trawled seafloor etc) are within the capabilities of the potential citizen scientist.

Although the citizen scientists in imaging based projects will not be carrying out any statistical analysis themselves, it is good practice to explain on the project page how and why the results obtained by the citizen scientist will be utilised. This will further help create and sustain the participant’s connection to and interest in the Ocean, increase their social and emotional connection to specific habitats and further increases the likelihood that they change their behaviour to be more pro-environmental in their daily actions.

Data collection or retrieval

Citizen science can be used to tackle a range of questions on marine ecosystem functioning from marine imaging. Projects can be developed which use archival material, such as imagery collected from particular regions of the seafloor at differing times, for example from several years apart, or from data collected recently, potentially collected with the intention of using in a citizen science project. The main difference in these types of data is that the facility for analysis by non-experts may not be exactly the same.

For example, it is not uncommon for companies interested in surveying areas of the deep sea to film areas of seafloor from 4 or 5 m above the seafloor, either by towed camera or autonomous underwater vehicle. Photographs from these heights can be useful for skilled observers to identify animals or features, but can have quite a low resolution which may make many tasks obtuse, difficult and unsatisfying for untrained citizen scientists. Filming or photographing the seafloor from lower heights reveals less seafloor surface in an image, but does so with a much more higher resolution.

These images are more interesting to citizen scientists, even if the task on which they work is rather routine, as they will get a glimpse at how life gets by in the area, and will develop a more complete mental understanding of an area of seafloor – feeling more involved in the analysis.

Image credit: AWI OFOBS Team

Of course, the scientist running the study may have to design a citizen science project with data they have not had a hand in influencing the collection of, so they will have to keep the drawbacks of the data in mind when setting up a project – perhaps excluding poor quality images , or trying to select images of similar quality for the analysis.

Data quality check

As mentioned in the last section, there can be a great variability in the quality of data which can be available to a researcher for a citizen science project. As with all scientific investigations which aim to compare two or more sets of data (such as the populations of animals in polluted and unpolluted areas of a marine estuary) having images of similar quality is preferred – meaning images taken from roughly the same height above the seafloor, by a vehicle or diver moving at a fixed speed, with similar illumination and similar amounts of sediment in the water, for example.

Illumination can in some cases wash out the detail in an image if the cameras are mounted at a particular angle and the vehicle collecting the images flown at a certain height, or if the seafloor is sloped in a particular way in relation to direction of travel

Image credit: AWI OFOBS Team

Data quality check

It is the role of the citizen science project to select a set of images of comparable quality, and in a suitable number for analysis. Common problems which are seen in marine image data sets aside from variable illumination are images containing too much obscuring sediments to allow analysis of a whole image.

Image credit: AWI OFOBS Team

Another common lighting problem can occur if the light is mounted in such a way that one half of an image is very dark, and the other well illuminated or too bright.

Image credit: AWI OFOBS Team

Data quality check

Very complex images are perhaps too busy for easy use in citizen science projects, with many animals and interactions present.

Image credit: AWI OFOBS Team

Some images are also taken from close proximity to the seafloor and parts of large animals can be cut by the edges of the image. Where this is common in an image set it needs to be clear in the labelling instructions whether the animal (or feature) is marked or not.

Image credit: AWI OFOBS Team

How to upload data

Uploading images and video for a citizen science project will be guided by the particular application being used to develop the study.

Within the context of **Into the Deep** we used the **BIILGE Party** platform developed by Bielefeld University, Germany, to develop our educational and citizen science image based projects. This platform hosts the images that will be used in the project, and provides tools for citizen scientists to use to answer the research question. These tools are simply the availability of labelling tools (basically like a mouse pointer) which can be used to draw a circle around animals or features of interest, or to mark these with a point.

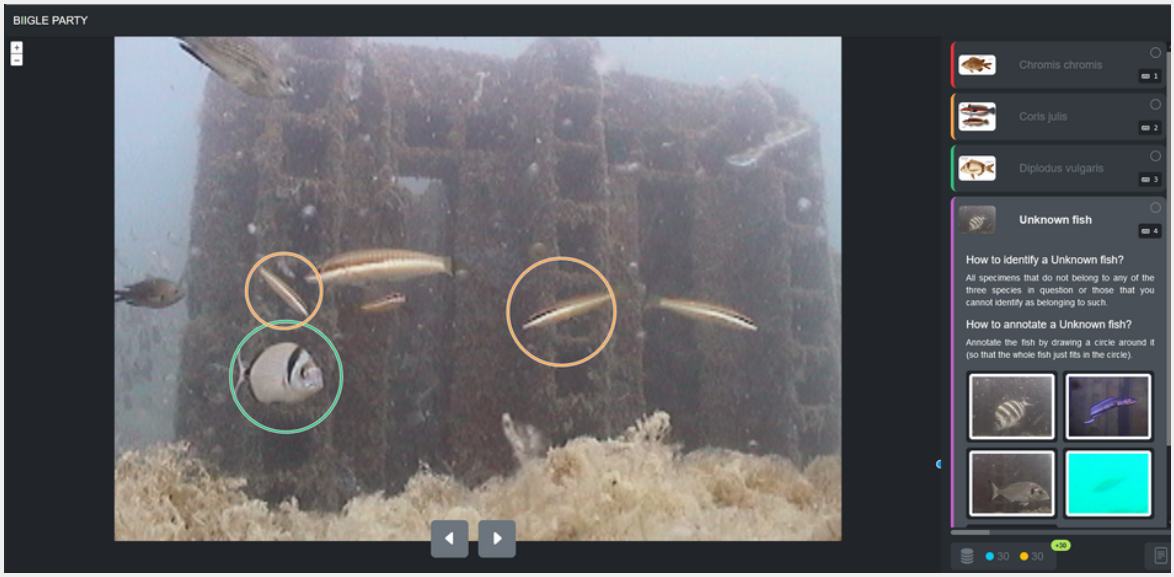


Image credit: Biigle Party

For the upload however, it is important to make any changes needed for an image before uploading. This might mean cutting off the edges, if poorly illuminated, or carrying out any digital correction of illumination etc that might be beneficial.

Some tools, including BIIGLE Party can also access images stored in a location on the web, such as the PANGAEA marine data repository, and therefore the image upload stage might not be necessary. By inspecting a full image resource however, such as the data from a canyon mid-point and canyon edge on PANGAEA, it may well be clear that not every image in the archived dataset is suitable for labelling in a citizen science project (there may be differences in flight height at which images were collected, for example), and therefore it is generally good practice to make a sub selection for.

Benefits of integrating citizen science support into your project

Marine biologists can be highly skilled and adept at using statistics to compare the populations of areas, be these to identify natural geographic or temporal differences, or to gauge the impacts of a pollution event or natural perturbation. This does not mean however that all these skills are needed for the bulk work of labelling a number of images of seafloor to tease out this information.

By providing a sound and straightforward description of the aims of a task, a concise set of training images and the ability to label perhaps up to four animal types or features within an image, citizen scientists can allow a researcher to both greatly increase the number of images which can be examined (more people = more time on a task) as well as carrying out some straightforward quality control (if many people look at the same image, only images where many people make the same label can be added to the output results).

Key to getting significant and useful results from a citizen science project is to:

- Pose a question which is both interesting to the potential citizen scientists (the 'spark' to participation)
- Pose a question broad enough that by either analysing a large number of images or by having very different results from two different regions, that a statistical difference in communities or features could be identified.

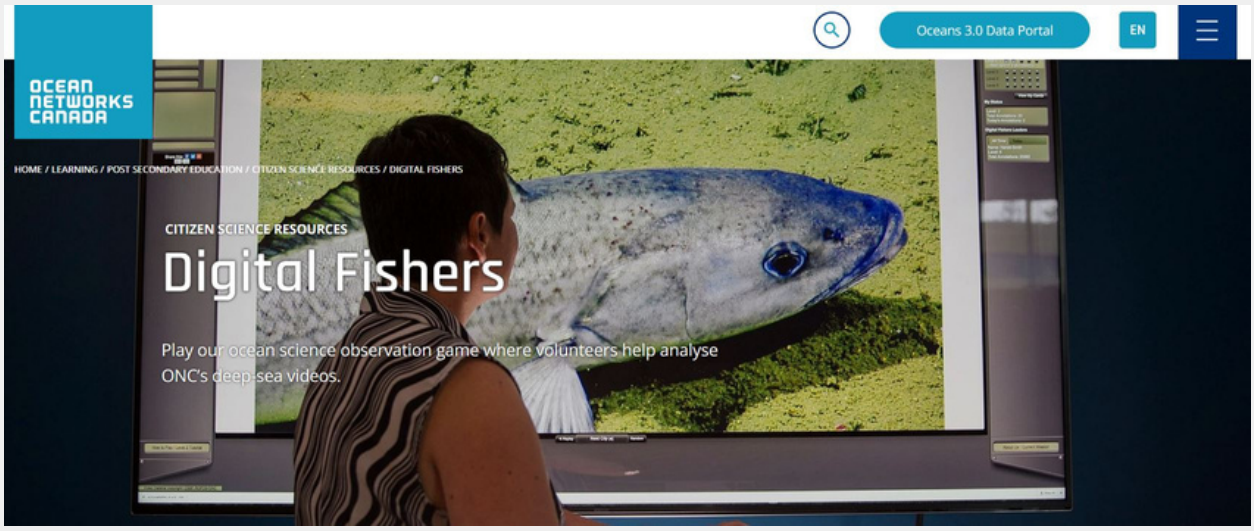
If 100 images randomly selected from a subset of 1000 images are analysed from a polluted and unpolluted area and the numbers of sea cucumbers counted in both areas, and results show than there is a 10% reduction in numbers in the polluted region BUT only one person labelled the images, this is not a strong result. If however 10 people each analysed 100 images randomly selected from the 1000 images from each area again showed a 10% reduction, this result would be much more compelling... as it shows that after repeated random image studies, numbers of sea cucumbers were generally 10% lower in the polluted area. The importance of the 10% is up for the researcher to consider – perhaps the input is minimal, but for a rare species inhabiting only a few locations, perhaps the 10% is of concern – this is the finding to be discussed within the scientific papers or reports to be produced from this citizen science project output.

By posing the straightforward 'Do sea cucumber abundances decrease following a pollution event?' to citizen scientists, and getting them to label animals simply, useful abundance figures can be generated for discussion and consideration.

Running your citizen science project

The duration over which a project should be run is at the discretion of the researcher setting up the project. Short projects, perhaps relating to current, newsworthy events of general interest may perhaps be run quickly, with simple labelling tasks related to news stories on institute webpages or linked in press articles allowing general readers the opportunity to take part in something current – recent examples may be to label animals on images collected from underneath recently moved massive icebergs, or labelling the animals which inhabit the very deepest areas of the ocean, recently imaged from several expeditions. For these rapid studies getting a number of people to make simple observations (i.e. label any fish, any animal) would work well. For slightly more complicated or open ended endeavours, a longer timeframe may be needed to allow sufficient time for a number of citizen scientists to explore a set of images or videos.

The Ocean Networks Canada project has cabled cameras across the Pacific seafloor, as well as hours of images and videos collected via remote operated vehicles. The data from this project is regularly used of citizen science applications, and to gain assistance in labelling animals generally. Researchers can keep an eye on the citizen science labelling efforts and use the data in that case when observations of interest (such as regional or temporal distributions of fish) become apparent. Such long-term citizen science interfaces can train and educate various labellers over a number of years, and is a particularly appropriate route for large infrastructure projects to attempt.



https://www.oceannetworks.ca/learning/post-secondary-education/citizen-science-resources/digital-fishers/

Whether a project is of long or short duration, running the project requires time and resources for a dedicated organiser to upload or link to a project the appropriate image or video data , and make accessible the correct label trees and/or label tools.

Help potential citizen scientists to access your project description, instructions and results by making taking simple steps to make them universially accessible. Read how in The Thalassophile Project Framework for Universally Accessible Marine Science and Conservation Education Resources
https://www.thalassophileproject.org/the-framework

The tool should be associated with a project description and information on why the citizen scientist should get involved and how their input will achieve a particular aim. For effective output, projects should be organised in such a way that if citizen scientists make some annotations, then these are useful, rather than requiring a certain amount of images to be analysed before any input is logged. The majority of the current generation of citizen science platforms are capable of logging even just a few labels made either by a particular IP address, or from a signed in user (depending on project aim and whether or not anonymous users are preferred or an option).

Not sure which citizen science tool is right for you?
The EU Citizen Science site shares ideas for resources, training and much more.
https://eu-citizen.science/

For some projects and platforms, it is possible to keep a record for the citizen scientist on their involvement, i.e. how many labels they may have made, or how their efforts relate to other users. This can increase motivation for some citizen scientists.

The developer of the citizen science project is likely able to have access to information on the numbers of images or videos which have been labelled, how many images may have been labelled by multiple annotators etc. When a sufficient number of annotations have been made they will be able to output the data from the annotation platform for subsequent analysis with a statistical application.

Data analysis

Citizen science annotation systems give output files which can be subsequently analysed using standard statistical applications, or perhaps displayed in graphs or pie charts, if more applicable for the research question being asked and answered by a project.

There are complexities with using citizen scientists in image and video analysis; there will be different levels of concentration exerted by those making annotations – there always is even when a set of comparatively skilled scientists work together on a project. There will be different numbers of images inspected and annotated by the various participants. Some participants will make regular identification errors. By allowing many participants to work on the data, and by keeping the identification tasks quite straightforward, the input of these variabilities on a well designedwell-designed statistical investigation will likely be minimal.

It is however important to keep all the metadata on labelling efforts available. The majority of projects which involve citizen science annotation of marine images have eventual publication of a scientific paper as an aim of the work, and for this it will be important to be able to show interested reviewers the raw output from the image annotation system if needed.

How your project can support (re)connection

- **Find ‘the spark’:** Whether it’s buying fish or going on cruises, everyone has an entry point for interest in the Oceans. Create statements on your project that spark a broad range of possible interests.

- **Learn your local marine identity:** present your idea to local community organisations, libraries, museums, workplaces or schools so that you get useful feedback on what aspects are actually relevant to people. Don’t teach, but actively listen. Broaden your own understanding. Build a picture of your local community’s marine identity and how your project could help this evolve.

- **Connect with non-scientific skill sets and knowledge:** Take time to create a dialogue on how your project idea can adapt to harness the diversity and potential of collaboration between science and society in your region. Do you have local fishing knowledge? Youth into digital initiatives? Cruise fans?

- **Cut through the clutter:** Climate change noise can be off-putting. Your learning and participation initiative must deliver a clear objective, and an easy way for people to see what their impact is and why their agency matters.

- **Be honest about what is and isn’t effective:** Adapt your own project to what works, and keep an open dialogue with your stakeholders - even when the results aren’t as expected - and how the scientific method changes.

- **Don’t leave your community out in the cold:** As a citizen science project leader, you’re responsible for the social and emotional connection between your learners. Keep them updated even after the project finishes. To reduce the workload, team up with a local community organisation that your new network could expand into.

Sustaining Participation

- **Don’t get discouraged!** Remember that it’s normal for most participants to only contribute once to the project, particularly if your initiative is online. Don’t be discouraged, but factor this in to your project plan.

- **It’s social!** Make sure your initiative somehow combines high-quality marine research with building and maintaining social relationships. Particularly in hands-on projects, participants become more dedicated when social bonds are born. A social marine identity can be part of the impact of your project.

- **Analyse the input:** Which datasets see most activity? Is there a certain point where everyone drops off? If it’s time sensitive, are the windows long enough?

- **Keep actively listening:** Before you start, build regular, relevant points in your project where you feasibly collect feedback from participants and use it to adapt your project: an online survey, video call or just invite them to email you. Are they bored? Have their motivations changed? Have they become interested in different aspects of marine ecosystems? Could you adapt to keep them on board? Make sure they know you have listened and adapted where you can.

- **Value and reward:** Even if there is no reward system built into your project, make sure you recognise and reward your participants with certificates, prizes, online workshops - What would encourage them to keep coming back? Make sure frequent contributors regularly get to see their individual contribution as part of the big picture of project results.

- **Remember: Community!** One of the primary motivations for getting involved is a social and emotional connection with marine habitats and with people. Consider asking long-term participants as advocates to recruit more.

- **Formal scientific acknowledgement:** If a group or individuals made a significant contribution to your analysis, consider offering to acknowledge this in any publications and familiarise participants with formal scientific processes.

Communication

Your project is by nature communicative, and having a communication strategy will help you be more effective using limited resources to:

Recruit participants → **Measure impact** → **Disseminate your results** → **Motivate more participants**

Source: Rüfenacht, Simone & Woods, Tim & Agnello, Gaia & Gold, Margaret & Hummer, Philipp & Land-Zandstra, Anne & Sieber, Andrea. (2021). Communication and Dissemination in Citizen Science. 10.1007/978-3-030-58278-4_24.

Throughout this Handbook, we've guided you to ways to co-create your project. Whatever the diverse situations, motivations or backgrounds of the people who support your project, this open dialogue with your participants, and with your wider local society will help you collectively create a clear marine identity, shared goals and core marine values.

Making sure that these dialogues and stakeholder interactions are strategic will help you manage the workload effectively, or allow you to see where you could team up with a local community organisation to collaborate on communications resources.

Communications Resources

NEWSERA Blueprint for #CitSciComm with and for Career Scientists

//eu-citizen.science/

Send us your feedback!

Thanks for reading this and supporting participatory educational methods!

Do you have any comments or questions on this Handbook? Great, it's still in draft form until 01.08.2024, so please email us on

caroline@inter-change.eu

and we'll take a closer look.