# Citizen Science and the Marine Environment: Its Role in Reporting Annual Change of Marine Species

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## Introduction

Increasingly citizen science at a UK and international scale is being focussed on important and topical issues of environmental concern (Earll, et. al. 2023, UNESCO, 2021). Concern about the environment has been one of the main drivers of citizen science in the marine environment from its inception with projects which sought to bring the public's attention and input to species of conservation interest e.g. the basking shark (Earll, 1992) or oil pollution and the beached bird surveys run by the RSPB. The South-West Marine Ecosystem (SWME) programme has, since 2008, been exploring changes in the populations of the wildlife and its management (Earll, Hiscock & Williams 2023). During Covid and subsequently this process has become much more systematic and focussed with the preparation of State of the South West Seas annual reports (Hiscock & Earll, 2023). This short paper explores the role of citizen science in relation to reporting on natural system thematic topics that are covered by SWME and the challenges this poses.

## The South-West Marine Ecosystems Programme – The rational for annual reporting at a regional scale.

How do we get to know about what is happening in the marine environment so that we can act in a timely fashion? The traditional approach in the marine environment, has been driven by both international (OSPAR, ICES) and European initiatives (North Sea Ministerial meetings, The Marine Strategy Framework Directive MSFD) and now the UK Marine Strategy (UKMS). Assessments have been done on a four to six year time scale. Whilst SWME has always been based on an annual conference the focus on *annual* reporting has prompted a clearer view of its rationale: the following reasons seem particularly pertinent:

- Waiting for five to six years to know what is going on is unacceptable
- Reporting is often completed yearly
- The need for early warnings of change is being recognised. The additional 'eyes and ears' of networks of citizen scientists can help provide early warnings
- Our interest is also tempered by an increasing concern about the marine environment
- Most people are keen to communicate and share their work widely
- Annual reporting allows action in a timely way.

The rationale for working at a regional scale has also been important to clarify, and the following key points arise:

- Defra acknowledge that there is a real problem of translating marine status reporting at European/national to a regional ('local') scale
- The issue of translation is particularly problematic in terms of applying appropriate actions
- Most of the people who act operate at a regional or local level
- Reporting at a regional scale provides a higher level of detail (granularity) appropriate to acting

- Regional reporting & communicating engages policy, managers, scientists and citizen scientists.

The SWME communication and reporting process includes:

- Thematic topic webinars with recordings on a YouTube channel, https://www.youtube.com/@southwestmarineecosystems3264/videos
- A one day annual conference covering all the thematic topics
- A state of the seas report which is published in a digital format and can be accessed on the SWME website https://swmecosystems.co.uk/annual-reports and,
- Media work once the report is published
- Publicity for these activities is driven through a mailing system (Mailchimp) run through the SWME website https://swmecosystems.co.uk/; it currently has 1275+ contacts.

The communication and reporting channels make information on these thematic groups widely available in a systematic way. To complement this communication process and build a resilient and sustainable model we have been developing thinking on building social capital. SWME is managed by a steering group comprising some 30+ people covering the thematic topics and key regional institutions and we are developing communities of practice for each thematic topic. Our current community of interest – email contacts – is 1275+.

**What does the SWME Programme cover and what is the role of citizen science**

Thematic topics

The SWME programme covers eleven or twelve thematic topics including natural systems and the management areas that relate to these. The thematic topics covering the natural systems include oceanography, plankton, the seabed and seashore, fish and turtles, marine and coastal birds, seals and cetaceans. These thematic topics are described in more detail below. The management topics include marine planning, MPAs, fisheries, water quality, plastics and sometimes climate change.

This paper will focus on the natural systems and the inputs from citizen science.

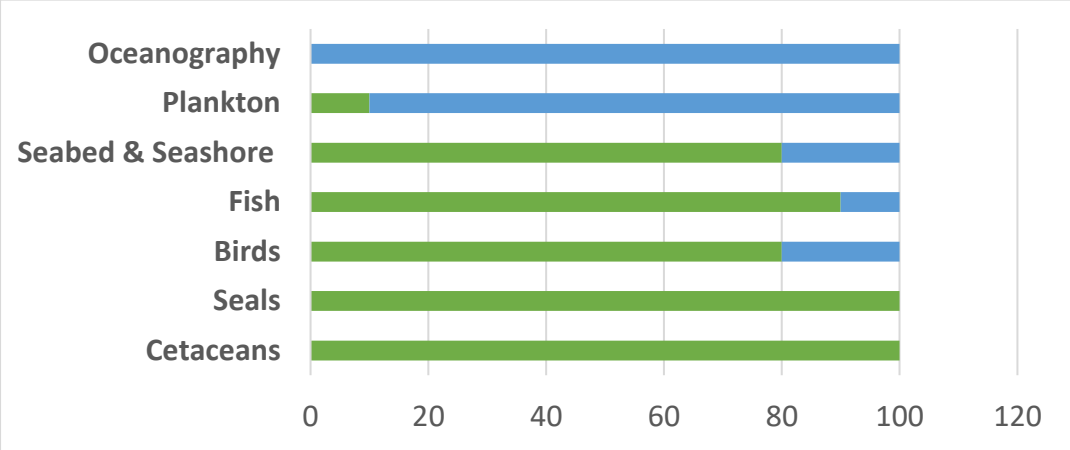


Figure 1. The approximate percentages of sources of information from mainstream science (blue) and citizen science (green) being used in South-West Marine Ecosystems in 2022.

The mix of professional versus citizen science input into SWME

The importance of citizen science in annual reporting in the south-west is illustrated in Figure 1. The *approximate* contributions of citizen and mainstream science are outlined. It is very important to note that this are an initial assessment based on my personal perspective, which will need to be tested over time. The distinction between 'mainstream science' which is undertaken in research institutes and higher education establishments paid for by the Government or through research council, or academic funding and 'citizen science is blurred. Many eNGO employees are highly qualified scientists who don't switch off their scientific rigour when using information from citizen scientists. There are long standing hybrid arrangements such as in the ornithology sector where Government agencies pay for major citizen science initiatives co-ordinated by organisations like BTO and RSPB; the recent *SeaBirds Count* publication is good case in point (Burnell, et.al. 2023)

Asking the question about annual change – was it a normal year?

The one common element to SWME are questions about annual change. Humans are very good at detecting differences. Many professionals and citizens scientists, and the public soon notice when something new or unusual happens. Figure 2 shows a remarkable aggregation of salps off the Scilly Isles which few people have ever seen before. In a similar way there were sightings of over 6000+ great shearwaters, a bird that breeds on the west coast of South Africa, off Lands End in 2023; there have only been recordings of one or two birds before. These two are perfect examples of the additional eyes and ears that citizen science can provide.

It is a given that we understand that natural systems are enormously complex and interact in many ways but nevertheless when extreme or unusual events occur we are able to judge these against our sense of what is normal. In this regard the question common in the SWME context is 'was it a normal year in terms of what you saw?' The SWME reports collate information on these unusual events.

Fig 2. Chains of salps off the Scilly Isles in 2023. Image: David Hamilton

Different types of citizen science

Citizen science is developing and evolving quickly and comes in many different forms including a high level of recognition at national and international levels (UNESCO, 2021).

The citizen science input into the SWME process occurs in a variety of ways; three of these are listed here:

1. *Ad hoc* records gathered from social media, and multiple contacts often using photographs – with no formal citizen science project e.g. the records of fish or seabed species. SWME has two mechanisms for collecting such information either via thematic topic editors or through a monthly prompting process to a network via Paul Naylor.

2. Contributions from Communities of Practice (CoP) collate records from multiple formal sources e.g. the compilation of the SWME marine and coastal bird reports. There is no formal citizen science project as such, but the discussions tap into a wide range of local projects, for example projects collecting annual data on seabird productivity. The SWME webinars also serve to start pulling new information together.

3. Citizen science projects which prompt formal inputs into well developed recording scheme formats. Whilst many of these projects involve bringing recorders together to undertake the work, some of these projects take it further and are often linked to major networks or focussed formal organisations specifically catering for the work. For example: The Cornwall Seal Research Trust, Seasearch, Cornwall Wildlife Trust (CWT) Shoresearch, CWT SeaQuest, CWT Strandings project, MCS Beachwatch, Beached Bird surveys (RSPB).

The common feature that all these approaches have is that they are virtually unfunded by Government, and indeed many are proactively lead by environmental Non Governmental Organisations (eNGOs). Without this leadership by the eNGOs, significant voids would be left in our understanding in relation to annual change.

Another common feature about citizen science is that feedback to contributors is a major part of project procedure and is indeed fundamental to the sustained success of the projects. This requirement lends itself to regular communication of results and annual reporting. In that regard there is a direct contrast with many professional studies where there is no requirement for wider communication.

The degree to which these different projects – especially in category 3 - are recognised by Government and its agencies is highly variable. Why some projects are ‘recognised’ by Government, with their outputs used by Government and its agencies, and others are not is unclear. A clearer set of criteria governing recognition should be made available so that these projects can be recognised more formally, not least in terms of receiving greater funding.

**Thematic topic descriptions in relation to the balance of citizen and mainstream science**

This section elaborates on the *different types* of information that are used for the thematic topics covered by SWME which have been used as the basis for Figure 1. The methodologies used to provide information for SWME vary enormously between each thematic topic. This section is based largely on comments derived from the most recent SWME annual report for 2022. (Hiscock & Earll, Annual report for 2022, published in 2023)

<u>Oceanography</u>

The inputs on oceanography are prepared by Tim Smyth entirely from the mainstream scientific work at PML on the Western Channel Observatory, predominantly focussing on the link between the oceanography of the two long term monitoring stations, inshore (L4) and offshore (E1). This is linked closely with the Met Office assessments of climatology. Wave buoy data on storms both for the year as a whole and over the winter months (October – March) are also used to make links with impacts on other thematic topics.

Plankton

The input to the plankton section is prepared by Angus Atkinson (PML) with the assistance of many of his co-workers in the PML team predominantly focussing on the link between oceanography of the two long term monitoring stations, inshore (L4) and offshore (E1). Overall changes in the composition of the plankton – a new normal - have been a recurring theme over the last few years. Highlights including rare species and major blooms seem in satellite imagery also feature. Jeanette Saunders, who leads a citizen science project, has recently been contributing observations (Facebook page (https://www.facebook.com/SouthDevonJellyfishSurvey/posts) of the gelatinous plankton, including scyphozoans, and hydrozoans (*Physalia* & *Vellela*). In 2023 there was a remarkable bloom of the crystal jellyfish *Aequore*a sp., and there were also remarkable sightings of huge aggregations of salps (Fig 2.)

Whilst studying the plankton is seldom thought of in terms of citizen science it was interesting to note that a recent Porcupine award under the Roger Bamber Research Grant scheme was to Elizabeth Beston for her plankton studies along the Norfolk coast.

Seashore and seabed

Keith Hiscock collates *ad hoc* reports of benthic seashore and seabed species mainly based on a wealth of reports made by divers and people working on the seashore and using social media. The MCS Seasearch and The Cornwall Wildlife Trust Shoresearch project are major citizen science projects in the region and reports come from these sources although not in any formalised way; a community of practice has also been developed in 2024. Although there are a number of professional studies current in any one year in the south-west these are often focussed on very specific objectives, which are reported e.g. Sea grass regeneration projects or work on non-native species like the Pacific oyster. Keith has been keen to emphasize the importance of putting observations in context of the historic record which can be accessed through publications like the Marine Biological Association's Plymouth Marine Fauna. There have been a number of examples of species which whilst being initially noted as rarities, then go on to form more established populations. The spiny lobster *Palinurus elephas* is a good example of such a transition and it has gone on to form the basis of a targeted fishery.

Fishes and Turtles

Doug Herdson collates the records of rare fishes and turtles taking in records from a very wide range *ad hoc* records from divers, commercial fishers, market reports and sports anglers. He has also been assisted with inputs from shark specialist Simon Thomas. This work is not organised in any formal citizen science programme. As with records from the seabed and seashore species the transition of status from rare to common can be seen with some species, the blue fin tuna is a good example. A decade ago (early 2010's) records of bluefin tuna in the south-west were novel and remarkable, as numbers increased various studies were undertaken using anglers and tagging projects, currently (2024) there is a fishery with a quota of 40 tonnes.

In terms of main stream science inputs the highly valuable annual assessments of the smaller pelagic fish species, integrated with assessments of other thematic topics carried out in the twice yearly PELTIC surveys (Pelagic ecosystem survey in the Western Channel and Celtic Sea) lead by Jeroen van der Kooij and Cefas are used in many of the chapter reports.

Stranded turtle records are relatively rare but there are a good networks regionally and nationally for collating these *ad hoc* records. The Environment Record Centre for Cornwall and the Isles of
Scilly (ERCCIS) pulls together inputs from many organisations.

Marine and coastal birds

Alex Banks coordinates the SWME input to this category, with an increasingly strong emphasis on the community of practice as a way of pulling the work of a wide range of organisations together to help compile the SWME reports into a regional perspective. The ornithological community have been the leaders in citizen science for over 50 years and annual reporting on a local and community scale is commonplace in their work. Their developed efforts are exemplified by the recent *Sea Birds Count* project (Burnell,et.al., 2023) a collaboration between national conservation agencies, RSPB, BTO and their citizen science networks involving thousands of people.

Seals

Sue Sayer of the Cornwall Seal Research Trust (CSRT) leads the input on seals to SWME programme. The inputs for the seal section derive from photographic identification records which are subjected to rigorous protocols, with catalogues being compiled for various sites, boat surveys and also input from a community of practice in relation to the wider south-west.

Cetaceans

Duncan Jones (Marine Discovery) and Dan Jarvis (British Divers Marine Life Rescue) bring together the records of the cetaceans. They use a mix of records from all three citizen science methodologies, ad hoc observations, network meetings and organised projects. The context for records of change has been supported by the Cornwall Wildlife Trust's (CWT) Marine Strandings Network programme which was developed in the early 1990's by the pioneer of citizen science and marine natural history Stella Turk (Fig.3). Figure 3 illustrates perfectly how systematic recording that provides a time series can provide a clear context for annual records (Cornwall Wildlife Trust, 2023). Whilst the CWT Marine Strandings Network information is fed into the wider, Government funded UK Cetacean Strandings Investigation Programme (UKCSIP) it has the major virtue of publishing its results annually. This has proved an invaluable source of information to highlight human induced harmful impacts on cetaceans from naval sonar and more recently paired bass trawlers, prompting action. Waiting for five years to untangle such impacts is unacceptable.

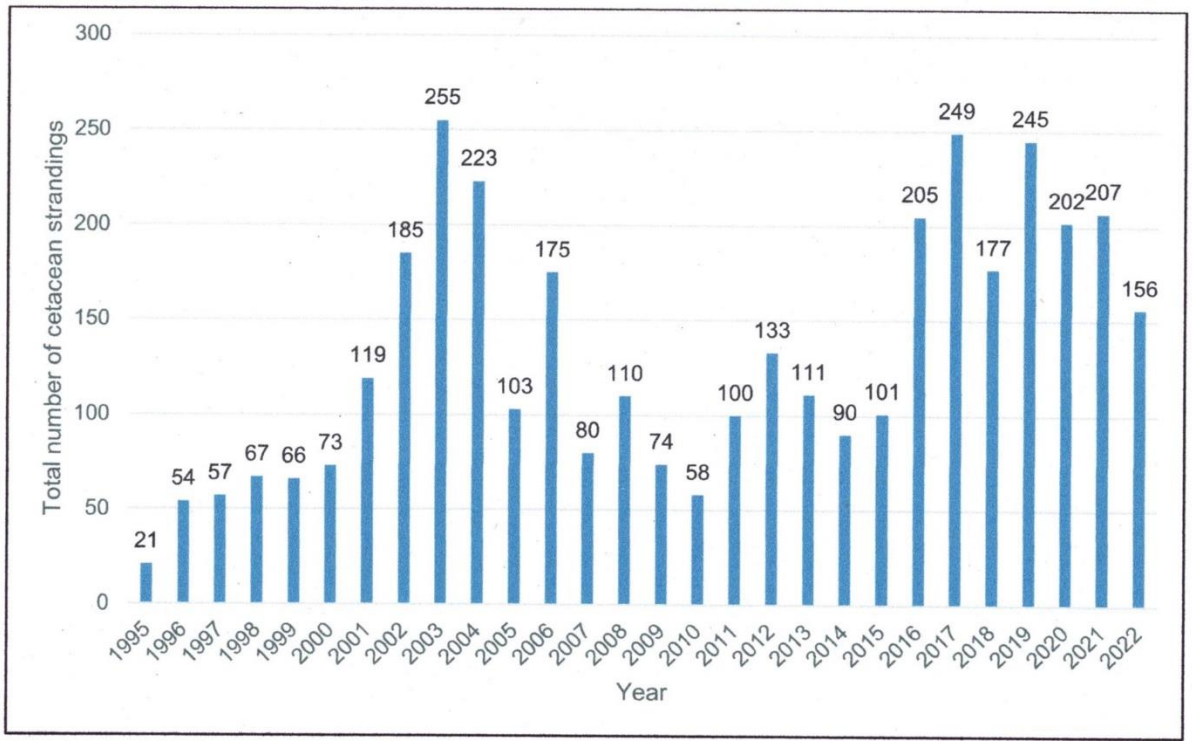


Figure 3. Cetacean strandings in Cornwall (Cornwall Wildlife Trust, 2023)

**Discussion and conclusions**

This short paper describes how citizen science focussed on thematic topics covering the natural systems in the south-west is contributing significantly to both a better understanding of a wide range of marine species, but also to the objective of understanding of how our marine environment is changing.

The extensive networks of citizen scientists in the south-west not only provide 'eyes and ears' in terms of inputs but also fill gaps in government sponsored work on many of the thematic topics. It is also worth noting that in many cases there are no formal, professional annual surveys of many of the thematic groups, and so if there were no citizen science or NGO work being undertaken, there would be *no* information to report on some of these topics.

One of the fundamental features of citizen science is that routine and regular feedback – communication – to participants are built into the procedures and this lends itself to annual reporting. Citizen science procedures then enable year on year reporting (Fig 3) which provides a clear context for assessing change. The communication function of the citizen science process contrasts profoundly with many professional surveys and monitoring, which whilst carried out at considerable expense and with scientific rigour often have little or no commitment to proactive wider communication.

Citizen science is developing fast, assisted by a wide range of digital technologies and in particular the mobile phone and social media. This means inputs from a wide array of sources and *ad hoc* recording is becoming routine and systems need to be in place to accept and verify this information, whilst at the same time allowing easy access to citizen scientists to see and communicate information.

The interaction between thematic topics, the reality of ecosystem function, is becoming an increasingly important aspect of the SWME process and represents a major challenge in terms of communication.

Reporting annual change is in its infancy compared with the more established five or six year formal status reporting procedures. There is need for SWME to communicate its methodologies to a wider audience in a systematic way and work is underway on a report that describes how SWME compiles its assessment. SWME will continue to develop its links with a wide range of citizen science and professional organisations in order to communicate ongoing work more effectively.

One interesting challenge is to explore how the status of species changes with time and how we report this. Species like bluefin tuna and spiny lobster have undergone major changes in their status from being rare to commercially important in less than a decade. Other species like the basking shark have shown a marked decline in terms of routine sightings in the south-west. There is a need in SWME for a more systematic way of reporting such change on an annual basis using status categories.

The SWME model has recently (2024) been piloted in the East Marine Management Organisation (MMO) marine planning region in a project known as East Marine Ecosystems (EASTME). The EASTME project has been funded by Defra through the marine Natural Capital Ecosystem Assessment (mNCEA) programme. The thematic topics covered in SWME have been mirrored in EASTME and it seems likely will be utilised by other regional schemes. A significant addition to the natural system categories in the East MMO Region was a major category on coastal and estuarine (mainly littoral) habitats.

Reporting annual change and timely communication can have many benefits for researchers, managers and policy advisors. Citizen science can play a major part in annual reporting by plugging existing gaps in coverage, however, it needs to be more clearly understood and recognised by Government and its agencies.

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