Education Through Participation: the Role of Citizen Science in Marine Habitat Conservation

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Abstract

The involvement of volunteers in monitoring programs is currently well established in scientific research and is often addressed as "citizens' science". A simple but focused training course, held before participants take action, is crucial to obtain sound and reliable data when volunteers operate in the field. Further to providing validated information, this kind of public engagement has important effects on citizens' environmental awareness, fosters the understanding of scientific issues and has the potential to inform decision making, let alone that difficult communication between Science and Society is a root cause for the under-funding of research. Italian Marine Protected Areas (MPAs) could play a fundamental role in facilitating this process thanks to their institutional environmental education programmes, that is by promoting the involvement of the lay public both in monitoring projects and management decisions. Once engaged in action, volunteers tend to feel more connected with nature, promoting the adoption of correct behaviour and an inclination to protect the marine environment. Here we report on experiences involving the not-for-profit organisation Reef Check Italia onlus and Italian MPAs. These activities have engaged both recreational SCUBA divers and students from different school levels. Such experience have produced validated data on species' distribution and beach pollution, and have concomitantly increased the understanding and awareness about the marine environment in the volunteers. Knowledge of species' distribution and abundance is the first priority in the conservation of biodiversity, as it sets the baseline for the design and implementation of monitoring plans. Empowered to play an active role in the monitoring of evolving habitats, volunteers embody the concept of ocean stewardship and become crucial nodes for further outreach to society.

1. Introduction

As reported by Silvertown "'Science for the People' was a slogan adopted by activists in the 1970 s. 'Science by the people' is a more inclusive aim, and is becoming a distinctly 21st century phenomenon" [1].

From galaxies to atoms, this is the range of scientific fields that are exploiting citizens' competences and availability to optimize the lack of funding and the limit of time that typically characterize the work of many scientists.

The huge experience ripen since the beginning of twenty century by ornithological projects to observe when birds and other animals migrate through an area or how they behave when they are there [2], is now applied to a wide variety of fields to help scientists to collect field data. Researchers now can also ask volunteers to use, if adequately trained, sophisticated equipment and techniques to monitor air

and water quality; to document plants and animals phenology; to solve complex molecular structures; to analyse thousand of photos of unknown galaxies [3]

Nevertheless, despite years of practice, the use of citizen science is still an evolving strategy, which needs to be implemented and organized, a possible deliverable considering the power of internet and social networks.

The loss of biodiversity is a general concern well documented were historical baselines are available [4]. Unfortunately, regarding the marine environment, databases with historical data are very scarce, compromising the efficiency of monitoring programs and conservation measures.

The main task environmental managers have to reach before developing and apply adequate measures of conservation is the detailed knowledge of habitats and species distribution and abundance. In marine environment, the lack of this kind of data is very hard to cover. The development of Marine Protected Areas has restricted the attention on some focal areas but also in these cases species abundance and distribution still remain far to be well defined, weakening monitoring programs.

The fast growth of diving activities all over the world allowed the involvement of recreational divers for marine environmental monitoring since the '90. Examples include surveys of the abundance and distribution in benthic and pelagic communities in Jakarta Bay due to organic pollution from the city of Jakarta [5]; coastal zone management in Australia [6]; North Sea pollution studies [7], and monitoring juvenile lobsters [8]; NOAA's National Marine Sanctuary volunteer programme (www.volunteer.noaa.gov/ocean_sanctuaries.html) focused on the continuous monitoring of US marine parks. In Northern Europe two relevant projects are NELOS (www.biologie.nelos.be) in the Netherlands and Belgium, and SEASEARCH (www.seasearch.org.uk) in the UK. All these projects are well established, and have developed observation protocols appropriate for their target areas and objectives. The potential of this workforce is especially well illustrated in the worldwide programme 'Reef Check' [9]. Recreational divers surveyed over 300 reefs in 31 countries in a global survey that was certainly beyond the resources of conventional scientific projects.

In Italy, Reef Check Italia onlus (www.reefcheckitalia.it), partner of the world wide Reef Check Foundation (www.reefcheck.org), applies protocols for the Coastal Environmental Monitoring (CEM) along Italian coasts, focusing its activity in Marine Protected Areas, mainly promoting the active participation of both recreational divers and students, who have the task to collect data underwater (Underwater Coastal Environment Monitoring, U-CEM) and on the shoreline (Emerged Coastal Environment Monitoring, E-CEM) respectively.

2. Material and methods

The Underwater Coastal Environmental Monitoring (U-CEM) protocol is articulated in three main activities,

- Carry out underwater observations by recreational divers, useful to widen the knowledge about the distribution and the abundance of selected target taxa. In total 39 species are monitored.
- Monitor permanent sites, to be followed seasonally, in order to analyse variations in broad assemblages composition over time.
- Register water temperature vertical profiles and seasonal changes thereof, by collecting both temperature profile data recorded through dive computers carried by recreational divers.

U-CEM has been applied in seven MPAs (fig.1). Here only results from the first activity are reported.

To extend the scope of observation and data collection towards littoral areas, thus permitting and promoting the participation of non-divers and in particular students from primary school to university level, a protocol for intertidal monitoring has been established, the Emerged Coastal Environment Monitoring (E-CEM).

On rocky shores observed items would include marine organisms living at the fringe between shore and water, on sandy beaches they include remains of organisms washed to shore and marine debris. Beach debris includes garbage left behind by beach users, as well as materials – both natural and man-made – washed onto the beach by the waves or transported by rivers. At the moment the CEEM protocol is mainly performed on sandy beaches.

The protocol E-CEM consists in the positioning of a 50x50 cm2 frame, divided in 25 sub-quadrates, along the shoreline and in the recording of the frequency of several categories (fig. 2).

E-CEM has been applied in five MPAs with 30 surveys on nine beaches for a total of more than 500 quadrats (fig. 1)

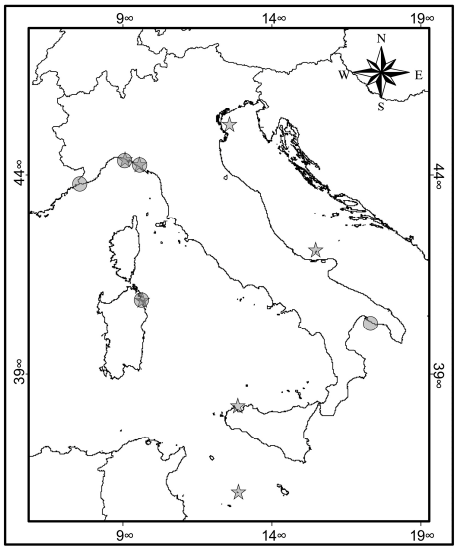

Fig. 1 MPAs where U-CEM (stars) and E-CEM (circles) protocols were applied

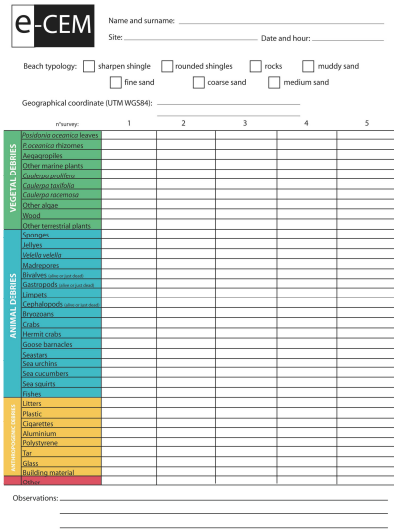

Fig. 2. Data sheet filled by volunteers during beach surveys

3. Results

The census of 39 taxa (presence and abundance) allowed evaluating that the species more easily recognisable by volunteers are gorgonians, *Parazoanthus axinellae* and invasive algae (fig. 3). In five years more than 30 training courses were performed for 350 volunteers and 1400 cards were received on the web.

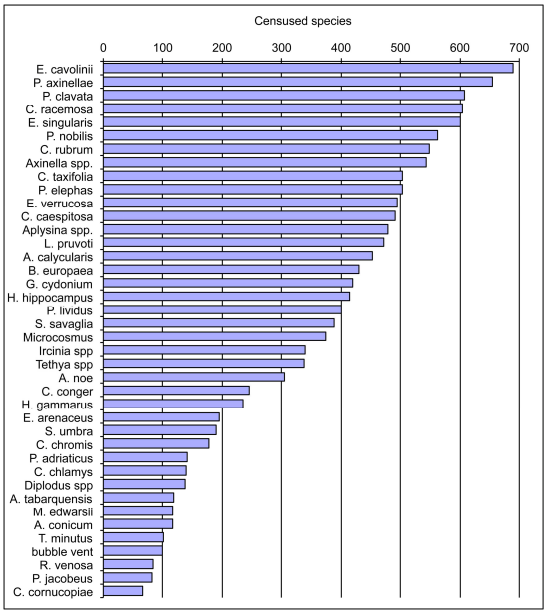

Fig. 3 List of censused taxa and number of surveys received by volunteers

The amount and type of debris that are found vary between the beaches and the period of the year. Nevertheless, among the natural materials the most commonly found are plant remains, especially those of *Posidonia oceanica* (Fig. 4). This can be considered a natural phenomenon that testify the presence of seagrass meadows, which are essential for the conservation of the Mediterranean coastline. The most frequent polluting materials on beaches are plastic, followed by glass and building materials.

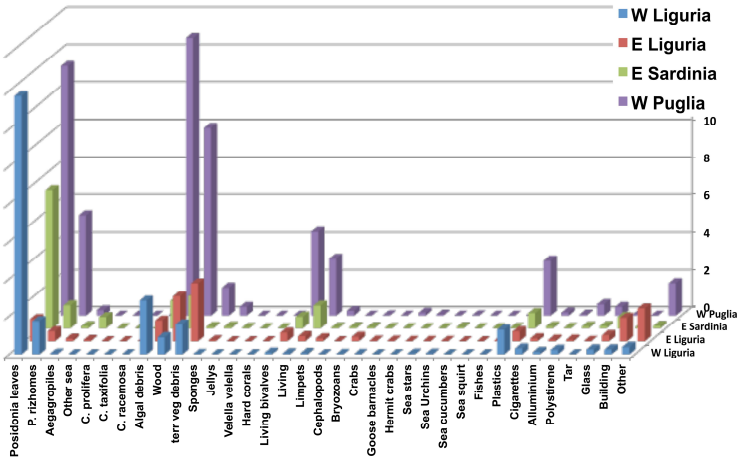

Fig. 4 Frequency (%) of surveyed beached categories.

4. Discussion

In Italy, experiences on environmental volunteerism applied to science are still scarce respect to other countries, where this practice is commonly addressed to several aspects of scientific research, mainly related to monitoring programs. In Italy Environmental Education (EE) is not included in institutional programmes so that the social awareness towards these themes is related to activities promoted by the Ministry of Environment and Territory, by no-profit organizations, by environmentalist associations. Marine Protected Areas are at the moment the most important providers of EE and this is one of the reason why CEM protocol is often realized in this areas.

When looking at learning, it is important to recognise that it is a multifaceted process including cognitive, social and emotional aspects. An interest in learning has to focus not only on the development of cognition but also on social, emotional and moral development itself, as well as on the development of sensory, motorical and physical skills, and the necessary social, cultural and institutional prerequisites for these processes.

U-CEM and E-CEM represent valuable tools to reach these objectives, allowing a direct involvement of volunteers and the possibility for them to observe the effective result of their efforts.

The distribution of marine species is now well delineated for invasive alien algae, for sea fans, for lobsters. They can be considered as flag species, suggesting their importance not only from an ecological point of view but also as a perceptive door where we can knock to communicate science.

Regarding surveys on the beach, the perceptive door may be represented by rubbish. In this case volunteers can feel the problem represented by plastic and other anthropogenic debris [11].

The presence of litter is unattractive, has health and economic impacts on beach users and local communities, and is potentially harmful to marine wildlife through entanglement and ingestion. The very slow rate of degradation of most marine litter items, mainly plastics, together with the continuously growing quantity of the litter and debris disposed, is leading to a gradual, but dramatic increase in the quantities of marine litter in our oceans and world shores [10].

To increase awareness towards these problems it is important to increase information and help people to directly perceive the effect of wrong human behaviour. The most frequent polluting materials on beaches are plastic, followed by glass and building materials. All these materials have very long periods of persistence and result from a wrong human behaviour. The awareness of the people should lead to a rapid reduction of these debris. Thus, the measure of their abundance may be a good thermometer to measure the effectiveness of policies.

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