



European Marine Science Educators Association

# Annual Conference

Hosted by The School of Natural and Environmental Sciences,  
Newcastle University

**2 - 5 October 2018**

**Great North Museum, Newcastle-Upon-Tyne**



<https://conferences.ncl.ac.uk/emsea2018>

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## Citizen science: a successful tool for monitoring biodiversity in Marine Protected Areas

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In the last few decades, anthropogenic activities, introduction of Non-Indigenous Species (NIS, i.e. organisms introduced outside of their natural range), and climate changes, have significantly affected Mediterranean marine biodiversity and ecosystem functioning (1, 2). All that is also true for Marine Protected Areas (MPAs), whose major aim is biodiversity conservation. Therefore, monitoring plans are strongly needed, and the creation of public awareness campaigns might be effective tool to plan management and conservation strategies in MPAs. Since intensive monitoring programs could be very expensive, citizen science, involving citizens in science (including conservation, natural resource and environment), could be a useful tool for gathering data that would otherwise be impossible to collect because of limitations on time and resources (3). Therefore, citizen science may have management, awareness, education and scientific implications. We report the experience of two citizen science projects carried out in MPAs. Precisely, the project "Blue Paths" and the project "*Caulerpa cylindracea*- Egadi Islands".

"Blue Paths", ideated by the Unified School District ISA 2 "2 Giugno" of La Spezia, with the partnership of Marine Parks and Research Centers (CNR-ISMAR and DLTM) aimed at: 1) monitoring the coastal flora and fauna in selected MPAs within the Ligurian and Tyrrhenian Sea, and 2) promoting a scientific literacy in marine science directly involving citizens. Researchers, teachers and volunteers worked together to help school students in the identification of the organisms collected during the surveys. In addition to the high educational value (4), the project had significant scientific fallouts. In particular, a 5 years campaign (2014-2018) carried out at Pianosa Island, in the National Park of Tuscan Archipelago, allowed to record both time series of data and the presence of the NIS *Aplysia dactylomela*, a yellowish-brownish opisthobranch with black rings (5). The project "*Caulerpa cylindracea*- Egadi Islands", sponsored by the STEBICEF Department of the University of Palermo and by the Egadi Islands MPA, aimed at monitoring the spread dynamics of the "sea grape" *C. cylindracea* within the Egadi Islands MPA. The project registered 156 sightings of the alga and allowed to gather useful information on this alga but also on others NIS (6). It also allowed to highlight as the presence of *C. cylindracea*, favoured the settlement of another NIS, the tube-building sabellid *Branchiomma bairdi*. In June 2017, another citizen science project "Aliens in the sea", also sponsored by the STEBICEF Department and aiming at collecting data on 19 marine NIS along the Italian coasts, was launched.

Citizen science is a rigorous process, indistinguishable from conventional science apart from the participation of volunteers. When properly designed, carried out, and evaluated, citizen science can efficiently generate high-quality data, and help to solve problems.

### References

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- 5) Mioni et al., 2018. In: *Book of Abstracts of 49° Meeting SIBM*. 6) Mannino, Balistreri. 2018. *Biodiversit*