UNIVERSITÀ POLITECNICA DELLE MARCHE

Dipartimento di Scienze della Vita e dell'Ambiente DISVA

PHD COURSE IN LIFE AND ENVIRONMENTAL SCIENCES

Report Form for PhD student annual evaluation (XXXVI and XXXVII cycles)

Name of PhD student: Raffaella Bullo

Title of PhD research: PCSI: Plastic Crime Scene Investigation:

The Citizen Science Approach to Microplastic Monitoring Along the Roman Coast & Tevere River

Name of PhD supervisor: Silvia Bianchelli (UNIVPM) - Claudia Gili (SZN).
Research lab name: Biologia ed Ecologia Marina

Cycle:
XXXVI

PhD Curriculum:
Marine biology and ecology

DISVA instrumentation labs/infrastructure eventually involved in the project:
[ ] Actea Mobile Laboratory
[ ] Advanced Instrumentation lab
[ ] Aquarium
[ ] MassSpec lab
[ ] MaSBiC
[ ] Simulation/informatics lab
[ ] Other. Please, indicate: .....

ABSTRACT (1000 characters, including spaces):
The impact of plastic pollution on marine environment has received an important public attention, thanks also to a strong media coverage. The awareness of society is high but mostly runs out on the visibility of macroplastic. Microplastic pollution is emerging as having a negative impact on the environment, ecosystems and marine biodiversity. Microplastic pollution is still underestimated by the public, especially in terms of risk perception. This depends on the lack of information provided to citizens by the scientific world and the media. Recent studies focused on the public perception of microplastics have demonstrated that showing pollution increases knowledge, and influences the perception of risk.
PCSI -Roma aims to assess quantity and quality of microplastics in seawater. For this purpose, the methodology chosen is that of Citizen Science to obtain a large number of data and to maximize the engagement of the civil society in the scientific research.

Part 1. Scientific case of the PhD Research (2 to 3 pages, including figures)

- BACKGROUND & SCIENTIFIC AIMS

Microplastic particles (MPs <5 mm) — mainly fragments, fibers, spheres derived from virgin plastic or cosmetics, from physical and chemical fragmentation, wastewater treatment plants and high coastal urbanization —gained specific worries and attention by numerous scientific publications. MPs can travel great distances from source areas and for decades. As a result, it is now ubiquitous, even in the most remote areas of the world. MPs follow the same fate of macroplastic in causing a long list of harmful physical and chemical effects on marine ecosystems and biota: from sediment plasticization, loss of habitat and healthy ecosystems, toxic additives absorption, until entanglement, intentional and accidental ingestion, bioaccumulation and biomagnification of plastic additives known as endocrine disrupting chemicals. All of these factors increase the menace to present and future biodiversity. Smaller particles mean a higher availability to animals periling the base of the food chain, from phyto- and zooplankton continuing on to top predators, including commercial species consumed by humans.

This PhD project aims to quantify and monitor the presence of microplastics with citizen science approach along beaches and coastal waters. This is the first step of defying new protocols and guidelines that can be used in future for further microplastic monitoring research, also by public administrations, environmental agencies and association, NGOs, schools, tourism operators and general public. The project includes scientific data collected by scientists together with data collected by citizen scientists. It aims to expand the scientific and cultural horizon to plastic pollution awareness: from macroplastic, the most known problem, to microplastic, underestimated and less intelligible to the public. Can this expanded knowledge of volunteers be a pull factor to all stakeholders and stimulate policy action and decision making for plastic impact? Can this new awareness – through doing science – promote different behaviors and actions in the local communities towards preventing, reducing, and substituting single-use plastic? These forms of active participation allow inclusion of a citizenship otherwise excluded (i.e. for social and economic reasons) from the opportunity to know the existence of possible cultural and scientific projects. The awareness of the existence of different prospects, outside the daily limitations, allows people to approach panoramas, cultural and working horizons that are wider than those available in their life. These are fundamental and educational chances especially for young people of school age, for girls and women and for all those who, in conditions of difficulty, are denied to access to the right of knowledge.

WORKPLAN AND RESEARCH ACTIVITIES

WP 1. From the awareness to the action: risk perception and citizen science

Citizen science (CS) has a wide-ranging degree of meaning. One of the most inclusive is the one proposed by Cigliano et al, 2017: "citizen science is scientific research and monitoring projects for which members of the public collaborate with professional scientists to collect, categorize, transcribe, or analyze scientific data, and may also help define the research questions and design, as well as communicate and act on the project's findings." CS is a tool widely used in marine science and has rapidly increased in quantity and quality in the 30 last years. It provides cost – effective means to collect extensive data sets covering vast spatio-temporal scales. This data can be used in scientific research to develop studies at wide spatial (i.e., regional and national scale) and temporal scales, conservation policy and to promote environmental awareness.

Microplastic pollution still needs public perception and risk perception, and this depends upon the information given to citizens. Showing microplastic pollution increases knowledge and influence risk perception.

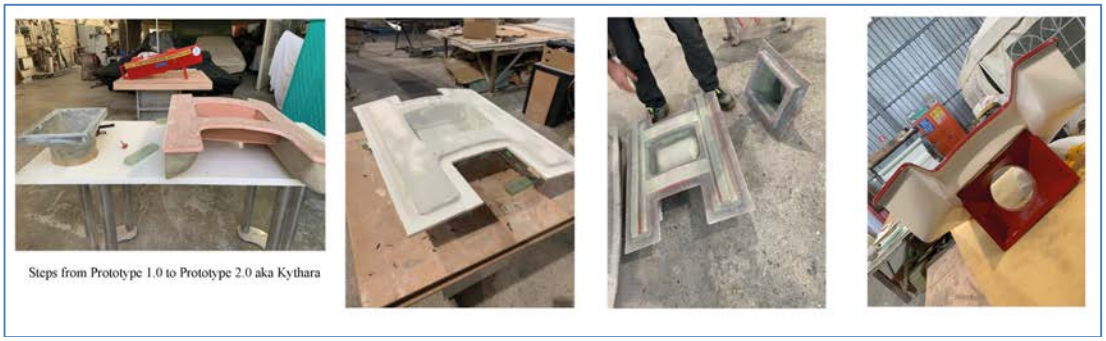
During the next year a survey will be subjected to all the participating citizen scientists at the beginning and at the end of the activities to explore the levels of knowledge and risk perception on microplastic, and in general on scientific processes. This would allow to understand how engagement and communication work and where are the gaps to fill between science and society in the future.

WP 2. A. Building the tool for Citizen Scientists: development and test of the prototype "*Kythara*"

In order to make microplastic sampling accessible to citizen scientists, a prototype (*Kythara*) of a mini-manta has been developed. The idea started from a developed design in 3D of a small catamaran, keeping the proportions of the dimensions to respect the protocols of the manta trawl used in the Marine Strategy Framework Directive. A first prototype 1.0 was therefore built in an artisanal way in wood and fiberglass. On this first development, hydrodynamics, buoyancy and transport tests were carried out to study problems and improvements which were then taken into consideration in the evaluation for the development of the prototype 2.0. In November 2022, the construction of the prototype 2.0 has begun in collaboration with the shipyards CA.NA.FI. srl (Cantieri Navali di Fiumicino) - marine drones' developers, creators and builders (CNR, Marina Militare, etc.). For this step, the chosen building technic is the one of the resin hull described as follow:

1. Project, design and build the positive mannequin: the mannequin was built in PVC foam, modeled by hand. On the PVC mannequin was applied a layer of fiberglass with vinyl-ester resin. Then it was finished with putty.

2. Negative cast: coats of liquid and solid wax were applied on the mannequin, and the wooden constructions of the mold dividers. Subsequently, the gelcoat was applied to the mold and subsequent application of layers of fiberglass.
3. Final positive cast: treatment of the cast with wax, application of gelcoat and application of layers of glass with impregnated divinyl-ester resin and on the product applications of sandwich parts. Hulls and deck coupled with structural sealant. Then finally casted and polished.

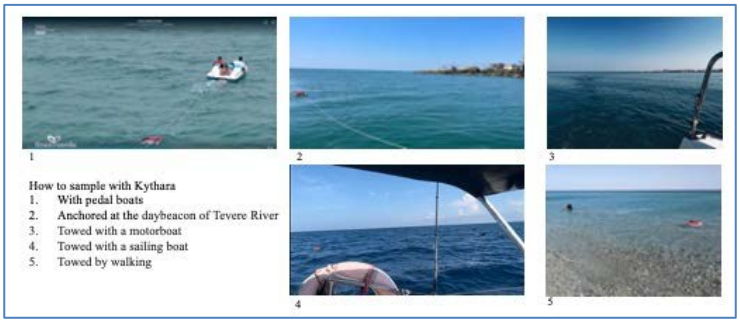


Steps from Prototype 1.0 to Prototype 2.0 aka Kythara

At the stern of the mouth there is a truncated cone filtering net (Ø 20 cm, L 30 cm) with 330µ mesh (according to the guidelines of Marine Strategy Framework Directive). The flowmeter is mounted on the convector. At the tail of the net there is a transparent lexan collecting cup (Ø 5 cm, L 15 cm), with a screw cap with filtering net of 330µ.

Details of the mouth, the stern with the filtering net, the collecting cup and the screw cap.

Kythara allows citizens of all ages to sample microplastics in different ways: swimming, canoeing, pedal boats, surfing, SUP, sailing, walking; it is easy and light to carry (equipped with backpack straps).



B. Validation and Calibration test

On April 2022 in Marine Sicily Center (SZN – Messina), the first tests to relate the filtered volumes of the manta trawl and *Kythara* were carried at same time and condition of navigation. The first results gave a correlation (Volume *Kythara*/Volume Manta trawl) that gained particular interest and to be strengthened (M=0,28). The tests and calibration will continue along the roman coast in winter 2022 - 2023 in collaboration with ARPA Lazio and Dipartimento Scienze Statistiche of Università “La Sapienza” (Rome).

Manta trawl vs. *Kythara*

C. Definition and testing of the sampling procedure with *Kythara*

The first sampling season was carried between June and August 2022 and was dedicated to evaluate the procedure (Statistical analysis in progress). The area on which PCSI works is that one along the Roman coast and the Tevere river. The sampling locations are six: three protected areas (P.A.) and three with anthropogenic impacts (A.I.). From north to south are: Oasi Del WWF di Macchiagrande (P.A.), Isola Sacra (A.I.), Foce di Fiumara Grande (A.I.), Ostia (A.I.), Tenuta Presidenziale di Castelporziano (P.A.), Secche di Tor Paterno (P.A.).

. Sample sites

For each site 25 samples were collected in different conditions: pedal boats (Ostia, Tenuta Presidenziale di Castelporziano), walking (Ostia), sailing (Secche di Tor Paterno), a little motorboat (Isola Sacra e Oasi di Macchiagrande) and anchored at the daybeacon (Foce di Fiumara Grande), for a total of 150 samples. Every sample was carried in 10 minutes time, and for each was registered initial and final latitudes and longitudes (Iphone's compass), initial and final value of the flowmeter (General Oceanic), tracking, average speed and meters traveled (App "Running"- Adidas development). The samples were collected in glass jars with filtered sea water and ethylic alcohol (70%). MPs quantification, qualification and statistical analysis on going.

WP3. Development of the app to collect data for smartphone: planed autumn 2022 – spring 2023 for the third year of PhD.
A smartphone app will be develop to register all the sampling data directly in common devices used by citizen with day and time of sample, georeferencing position, track, meteorological condition, sample methods and all information useful for the project, all the data then will be available in a server.

WP 4. Development of communication plan: planed autumn 2022 – spring 2023 for the second year of sampling
During this year of activities within the territory, important attention to the project was demonstrated by citizens, stakeholders and media. The project has been showed in national ("Linea Verde", Rai Uno https://www.raiplay.it/video/2022/07/Linea-Verde-Estate---Viaggio-tra-le-antiche-terre-del-Lazio---31072022-ff5509a5-1937-4d38-94d4-726ee9032fa7.html) and local media (Canale 10 – Ostia). More contacts are already set for the next year ("Buongiorno Regione – Rai Tre, TG Leonardo, etc.). In parallel PCSI - Roma have participated in local events with direct relationship with public ("Notte Bianca di Fiumicino" with the Municipality of Fiumicino, "Sagra della Seppia di Ostia" organized by Slow Food Roma). In November 2022 activities of environmental engagement in collaboration with Oasi del WWF di Macchiagrande are scheduled in Parco Leonardo, PCSI - Roma will be present in Ferrara (Sealogy - Il Salone Europeo Della Blue Economy) and in Naples "Futuro Remoto" – Città della Scienza.

WP 5 Stakeholder and public engagement

Stakeholders will be mapped and different segments will be identified and quantified. In the first 2 years of the project, public engagement was undertaken directly during the summer season in the beaches as the roman coast is highly frequented at that time, or involve people with interest in participating (fishers, sailing schools, bathing establishments. Extra activities such "*Il gioco delle plastichine*" (Small plastics game) was invented to measure the attention and interest of the topic in children and adults and to strength the continuity of the relationship project - citizens. The success of this game was such high that imposed to reflect on a scientific protocol to plan (October-November 2022) for the engagement of the schools of Fiumicino and Rome (first test and accord 22 – 29 october 2022). The involvement of the environmental associations such WWF Macchiagrande is working since june 2022 for the site. Other associations who work in the roman area (Slow Food Roma, Tevere day, Casa Internazionale delle Donne) are in progress.

The stakeholder engagement was at first institutional to involve the policy – makers from local to national level. The partnership with the Presidency of the Republic was defined in spring 2022 in order to access and to study the coastal waters and beaches of the Riserva Naturale Statale Tenuta di Castelporziano. The patronage of the Fiumicino Municipality and with Assessorato all'Agricoltura, Ambiente e Ciclo dei rifiuti of Rome were defined in June 2022. Accord with Arpa Lazio is next to be closed and accords with Rome Municipality, Assessorato alla Cultura di Roma, Regione Lazio are in progress.

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Part 2. PhD student information on the overall year activity (courses/seminars/schools, mobility periods, participation to conferences)

List of attended courses/seminars/schools

UNIVPM:

1. Introduzione all'ambiente LaTeX per la redazione di documenti scientifici (2020 – 2021).
2. Theory and application of complex networks (2020 – 2021).
3. Elements of Marine Policy(2020 – 2021).
4. Rischio climatico (2020 – 2021).
5. Global change and anthropogenic impacts on marine ecosystems (2020 – 2021).
6. Desing of Research: European projects (2020 – 2021).
7. Technology Transfer and Innovation (2020 – 2021).
8. Dall'impostazione della prova sperimentale alla pubblicazione e valutazione della ricerca - from experimental design to the writing of a scientific paper and research evaluation (2020 – 2021)
9. Microbial-mediated processes in aquatic ecosystems: from basic to applied research toward solving environmental problems (2020 – 2021).
10. Getting Started with R: Environmental Computing (2021 - 2022).
11. Disaster Risk Reduction (2021 - 2022).
12. Complex networks (in corso) (2021 - 2022).

SZN:

1. New perspectives in marine biotechnology (N. 6 Ore)
2. Immersion in molecular biology – basic course (N. 4,5 Ore)
3. Immersion in molecular biology – Advanced Course (N. 7,5 Ore)
4. Experimental design (N. 7 Ore)
5. Scientometric evaluation of young researchers (N. 2 Ore)
6. Use of live animal for scientific purposes: ethics, animal welfare, requirements & management (N. 4 Ore)
7. ECO-EVO-DEVO (n. 11 ore)

Other activities:

1. Citizen Science. The role of citizen science in Horizon Europe. Designing and thinking of citizen science projects. 27 novembre 2020. APRE (1 giorno).
2. "Alla Ricerca Della Cittadinanza Scientifica. Dialoghi tra ricercatori e cittadini per una scienza condivisa e partecipata" - MaCSIS, Master in Comunicazione della Scienza e dell'Innovazione Sostenibile (Università degli Studi di Milano-Bicocca), in collaborazione con Scienza in rete – Le Voci della Scienza. 11 novembre 2021 - (1 giorno).
3. Convegno Nazionale Di Comunicazione Della Scienza Trieste, organizzato da Laboratorio Interdisciplinare per le Scienze Naturali e Umanistiche della Scuola Internazionale di Studi Avanzati di Trieste (SISSA). 17-20 novembre 2021 (4 giorni).
4. Corso "Comunicare la scienza" (3° edizione) organizzato da Università Degli Studi Di Bari Aldo Moro (UNIBA) (48 ore). 16 febbraio – 16 maggio 2022.
5. Progetto Responso 2021 – 2022: attività e presentazioni da attestato (7 giorni in presenza più 90 ore).
6. Attività di divulgazione e dipartimento CAPE SZN da attestato (212 ore più un giorno in presenza).
7. Corso di statistica per ecologia e biologia. Università La Sapienza – Roma, totale 9 crediti (in corso).
8. Notte Bianca di Fiumicino (25 giugno 2022): Invito per Presentazione del progetto PCSI (divulgazione, comunicazione ed engagement) (1 giorno).

List of periods spent abroad

None

List of conferences/workshops attended and of contributions eventually presented

None

Part 3. PhD student information on publications

[13 ottobre 2022]

Student signature

Raffaella Bullo

Firmato digitalmente da Raffaella Bullo
Data: 2022.10.13 20:06:54 +02'00'

Supervisor signature

Silvia Bianchelli

Claudia Gili

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