Partnership for Observation of the Global Ocean (POGO)
Report to SCOR Annual General Meeting 2022

1. Introduction

POGO was established in 1999 by a group of directors of marine research institutions who met to discuss ways in which they could work together more effectively in support of global oceanography, and in particular ocean observations. Members value POGO as a forum in which they can meet their peer-directors at least annually, in well-attended meetings, to discuss matters of common interest.

POGO's vision is to have by 2030, world-wide cooperation for a sustainable, state-of-the-art global ocean observing system that serves the needs of science and society.

POGO's mission is to:

1. Lead innovation and development of the crucial components of the ocean observing system.

2. Identify and contribute to the development of the key skills, capabilities and capacities needed to achieve the vision.

3. Work with governments, foundations and industry, to articulate the benefits to society and required funding to build and sustain the system.

More information on POGO can be found at www.pogo-ocean.org.

2. Collaboration with SCOR

SCOR is the leading international organisation in the marine science arena, and POGO has always enjoyed good relations with it. Examples of joint activities include the following:

- POGO runs jointly with SCOR a Visiting Fellowship programme that enables early-career scientists from developing countries to study for up to three months in a major oceanographic institution of their choice. The programme is now in its 22nd year, and a total of 190 fellowships have been awarded to date (see section 2.1).

- SCOR also runs a Visiting Professorship modelled on the POGO one, and on several occasions the two programmes have complemented one another (for example, in Southern Africa).

- POGO and SCOR have collaborated in assessing capacity development in marine sciences at the global level and coordinate their respective capacity-development programmes. This was conducted initially through a series of workshops convened and funded by SCOR and, since 2015, SCOR and POGO Secretariats have worked on impact evaluation questionnaires sent to past trainees and trainers of their respective and joint programmes. They have analysed the data obtained and published the results in a joint article in *Oceanography* on the SCOR and POGO visiting scientist programmes. In 2022, SCOR along with POGO, the International Oceanographic Data Exchange (IODE) of the Intergovernmental Oceanographic Commission (IOC) of UNESCO, and the International Science Council (ISC) organised a UN Ocean Conference virtual side event on Developing the capacity we need for the ocean we want.

- SCOR established, jointly with POGO, the International Quiet Ocean Experiment (IQOE). This is a programme aimed at the acoustic background in the ocean, including its anthropogenic and natural components. The Science Plan was published in 2015. The Sloan Foundation was instrumental in starting up this initiative, and in providing seed funding for coordination. POGO funded a Working Group to support the IQOE, which was instrumental in getting an Acoustic Essential Ocean Variable (EOV) accepted by GOOS. POGO has been supporting the development of the Acoustic EOV Implementation Plan, which (as of Aug 2022) is in the final stages of internal review before going out for community review. POGO also encouraged its members to consider hosting an International Project Office (IPO) for the programme, which led to the Alfred Wegener Institute recruiting 2 data managers to support IQOE and its Data Working Group in 2019/20. A special issue of ECO Magazine on ocean sound was co-sponsored by SCOR and POGO in 2019, which featured an overview article on IQOE, as well as many contributions from the IQOE community.

- POGO contributed to the establishment, and continues to support the development of the SCOR-SCAR Southern Ocean Observing System (SOOS). For example, POGO provided funding to support a workshop on "Observing and understanding the ocean below the Antarctic sea ice and ice shelves" (OASIIS) in 2016. POGO sponsorship has also recently been approved for the first SOOS Symposium to be held in 2023.

- Both POGO and SCOR have supported the Global Alliance of Continuous Plankton Recorder Surveys (GACS). In 2019, POGO provided support for a Workshop on "eDNA Tools for the CPR Survey" and also for training 2 scientists (from South Africa and Brazil) on "Continuous Plankton Recorder silk analysis methods, from cutting the silk to statistical data analysis and interpretation". Both events were held in Australia in Dec 2019.

2.1. POGO-SCOR Visiting Fellowship

This programme, co-funded by POGO and SCOR and administered by the POGO Secretariat, is designed to promote training and capacity development leading towards a global observation scheme for the ocean. The Programme has been a success for 22 years, with nearly 200 fellowships awarded since 2001 (Figure 1).

The fellowship programme is open to scientists, technicians, postgraduate students (preferably of PhD level) and post-doctoral fellows of developing countries and countries with economies in transition and involved in oceanographic work. The main purpose of the programme is to advance sustained ocean observations and their applications by supporting training in oceanographic observations. Selected fellows are offered the opportunity to visit another oceanographic centre for a short period (1 to 3 months) for training on any aspect of oceanographic observations, analyses, and interpretation.

The POGO-SCOR Visiting Fellowship receives an average of 45 applications every year. The Selection Committee, consisting of 1-2 members of the Secretariat, 1-2 representatives of the SCOR Secretariat and Capacity Development Committee, and 1-2 additional/independent reviewers (usually former host supervisors), evaluates all valid applications considering the quality of the application and applicant CV, relevance of the application to the POGO & SCOR priority areas, and evidence that the training will lead to capacity-building with potential lasting impact on regional observations. The highest-scored applicants are selected according to the budget available, with consideration given to gender and geographical balance, as well as occasionally other factors such as whether the candidate has received POGO or SCOR funding previously.
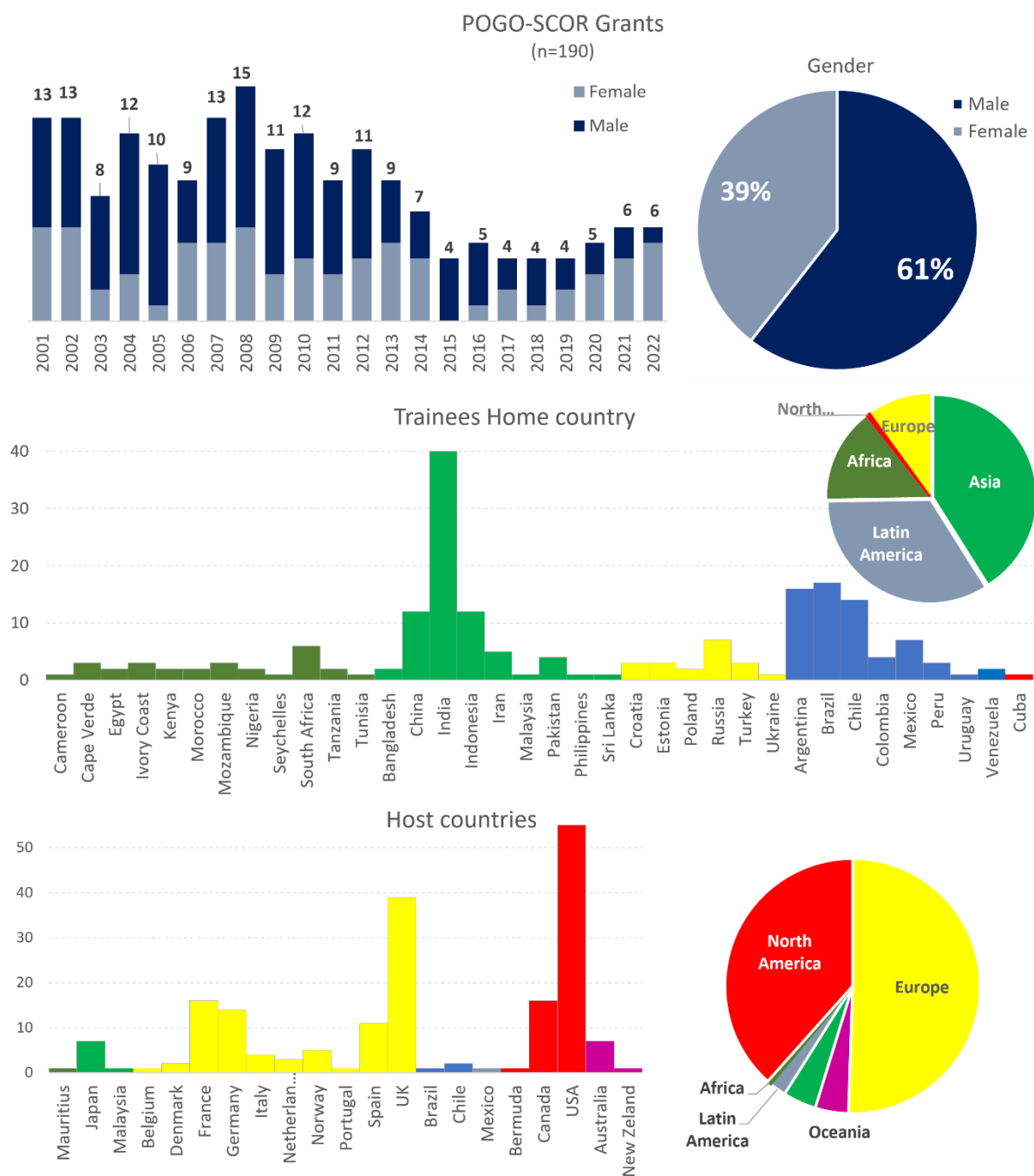
POGO-SCOR Grants (n=190)

Gender

Trainees Home country

Host countries

Fig. 1. Statistics relating to the POGO-SCOR Visiting Fellowships funded since 2001.

In 2022, 29 valid applications (45% female and 55% male) were received from Latin American (41%), African (28%), Asian (28%) and European (3%) candidates. Applicants proposed trainings of one, two or three months in oceanographic centres in Europe (48%), North America (28%), Oceania (10%), Africa (7%), Asia (3%) and Latin America (3%).

The Top 6 candidates for the 2022 Fellowship Programme (Table 1) have been offered and accepted the grant and will start their training between September 2022 and March 2023. Currently, due to COVID international travel restrictions, three of the fellows appointed in previous years are still completing their trainings (Table 1).

Table 1 – POGO-SCOR trainees during the year 2022.

Year	Trainee	Parent institute	Host institute	Training period
2020	Mahi Mankeshwar	Independent researcher, India	Lamont Doherty Earth Observatory, USA	Remote (completed); In person (Aug-Oct 2022)
2021	Dava Amrina	Indonesian Agency for Meteorology, Climatology and Geophysics	Scripps Institution of Oceanography, USA	May-July 2022
2021	María Mendez	Instituto de Biología de Organismos Marinos, Argentina	Universidade de Vigo, Spain	May-Aug 2022
2022	Maria Bravo	National Scientific and Technical Research Council, Argentina	Scripps Institution of Oceanography, USA	Nov 2022 - Jan 2023
2022	Brendon Damini	Federal University of Rio Grande, Brazil	University of East Anglia, UK	Sep-Oct 2022
2022	Isabelle de Oliveira	Federal University of Pernambuco, Brazil	University of Bergen, Norway	Dec 2022 - Feb 2023
2022	Sangeeta Naik	Goa University, India	Cardiff University, UK	Oct-Dec 2022
2022	Anwesha Ghosh	Indian Institute of Science Education and Research Kolkata	Plymouth Marine Laboratory, UK	Mar-Jun 2023
2022	Maya Eria Sinurat	Institut Pertanian Bogor University, Indonesia	Institute of Biophysics Operating Unit, Italy	Sep-Nov 2022

3. Current POGO activities

3.1. Capacity development

Over the last 21 years, POGO has provided training in ocean observations to nearly 1,050 early-career scientists, mostly from developing countries. The main capacity development programmes are:

- The Nippon Foundation-POGO Centre of Excellence, a ten-month graduate-level training programme in observational oceanography, hosted by the AWI since 2013, and previously hosted by BIOS in Bermuda (2008-2012); associated with this is a Regional Training Programme of 2-3 weeks duration, held annually (usually in a developing country);

- A shipboard training programme, which has its origins in the Atlantic Meridional Transect (AMT) Visiting Fellowship on-board a research cruise (initially co-funded by SCOR); the programme, now funded by NF, provides opportunities for any cruise PI to offer a spare berth for training, and POGO provides a "match-making" service between potential fellows and suitable shipboard training opportunities; shipboard training cruises have also been funded through this programme, providing hands-on training to over 20 students each, notably the North-South Atlantic Training transects (NoSoAT, 2015, 2016 and 2022) and South-North Atlantic Training transect (SoNoAT, 2019), on-board the German ice-breaker *RV Polarstern*, and which also comprised a substantial shipboard outreach element;

- The NF-POGO Alumni Network for the Ocean (NANO), which is made up of all the alumni from past NF-POGO training programmes, and offers further support and opportunities for those alumni, ranging from the communication/sharing of training, conference and job opportunities via the NANO website and social media, to the opportunity to publish articles in, and serve on the Editorial Board of the NANO newsletter, to possible involvement in the collaborative NANO global projects;

- The POGO-SCOR Visiting Fellowship Programme (see section 2.1);

- Training Initiatives organised by POGO members, who are successful in applying for partial funding from POGO (those selected for 2022/23 are listed below).

3.2. Projects and Working Groups

3.2.1 Open Access Marine Observation Devices (OpenMODs):

Supported by POGO since 2018-19, this project has the overarching goal "to devise ocean sensors and monitoring devices, globally available to all and not just to a privileged few". The overarching objective of OpenMODs is to realize a prototype of a versatile low-cost ocean observing platform ready to be tested and equipped with a variety of sensors, to consolidate and enlarge the potential user community and to narrow the data and knowledge gaps between "advanced" and "developing" countries. Its potential is not limited to developing countries but it can be advantageous in all those applications that require a high temporal and spatial coverage of observations. The implementation of the prototype has followed three main lines: the platform, the sensors and the communication systems.

Two workshops were held in 2018 and 2019 to assess the state-of-the-art in low-cost ocean observing technology, agree on priority applications and parameters that would need to be measured and on a few "pilot" locations for testing the system, engaging with local stakeholders and so on. Some preliminary ideas for the system design were also discussed, and a [manuscript](#) on the subject has been published.

In 2020, a virtual workshop brought together engineers and technology developers from the participating institutions, to compare, combine and network different viewpoints and expertise and to determine the best solutions for the realization of the low-cost prototype and finalize a technical document as a final plan. It was agreed that the platform should: i) operate (with minimum modifications) as moored system, drifting buoy or manually deployed equipment; ii) mount essential sensors that would operate in dual mode (self-recording or real-time autonomous system), low-cost low-power GPS and communication system to manage and transmit collected data; iii) employ low-cost material; and iv) simplify the assembly process of the system in order to be done on-site by trained non-professional operators or for educational purposes.

In 2021, the OpenMODs prototype consisting of a platform that works either as a moored or drifter, a Temperature-Depth sensor and a communication/transmission device was developed and tested at the National Institute of Oceanography and Applied Geophysics (Italy).

In 2022, the prototype was tested under real conditions by the 10 scholars of the NF-POGO Centre of Excellence in Observational Oceanography at the Alfred Wegener Institute, in Helgoland, Germany. The scholars assembled and connected the device to the gateway, conducted deployment and data retrieval experiments and discussed their observations and results with the developing team in Italy via videoconferencing. The cohort produced a handbook and a video explaining the handling of the probe. The plan now is to implement workshops in the scholars' home countries where the scholars should act as trainers for the handling of the OpenMODs instrument.

3.2.2. WG on Biological Observations and OBON:

This WG, led by POGO member Scripps Institution of Oceanography, has set an agenda for collaboration, and has ensured that POGO is informed on the state of development of ocean biological observing systems. This group has worked on behalf of POGO to partner with other organizations to foster workshops and other activities and works to ensure that POGO is represented in international discussion of ocean biological observing capabilities and systems, with the aim of enabling the community to move from ocean biological observation to ecosystem understanding.

In May 2019 a workshop was held on Machine Learning and Artificial Intelligence (ML/AI) in Biological Oceanographic Observations, funded by the Lounsbery Foundation and hosted by the POGO member institute, Flanders Marine Institute, to educate the POGO community about AI/ML as it is currently being applied in biological oceanography and jump start analysis efforts with new machine learning and artificial intelligence tools. The workshop covered state-of-the-art analysis techniques applied to acoustics, imaging and genomics, and included hands-on tutorials with a focus on data pre-processing and organisation. The

workshop concluded with discussions on the direction of ocean observation in the age of big data. Plans are being discussed for replicating this workshop in the future, possibly in different regions, and also for sharing the tutorials via OceanTeacher.

The residual funds left over from the AI/ML workshop were used for a virtual workshop on eDNA, which was originally to be held jointly with SCOR. Since the workshop did not take place during the financial year for which SCOR had ear-marked the funds, and subsequently COVID-19 made it impossible to hold the workshop in-person in 2020, the workshop was run virtually by POGO in Nov-Dec 2020.

The use of environmental DNA (eDNA) and other omics analyses in studies of marine ecosystems has blossomed. Both scientists and managers hope that the rigorous development of these analyses will allow us to address important science and management questions through our ability to census marine biota across multiple trophic levels with a single sample of DNA. Species of special interest for eDNA observation include those that are commercially important, protected, or invasive. The techniques are also amenable to automation *in situ* and deployment in global observing systems. At this time there are significant challenges to making rapid and major advances in understanding the techniques and their application to decision-making and management related to both analytical methods and strategies for sampling. The UN Decade of Ocean Science for Sustainable Development offers the potential to engage scientists and managers around the world to resolve these challenges and develop an observational strategy that can answer critical questions for each.

Building on the call to action at OceanObs'19 for enhancing biodiversity observations as well as the growing number of organisations fostering omics and eDNA development, this meeting provided an opportunity to envision what a sustainable global 'omics/eDNA monitoring system could look like and (i) promote global coordination among the organisations that are fostering eDNA and 'omics for marine environments, and (ii) coordinate efforts to develop a programme proposal in response to the call for action from the UN Decade of Ocean Science for Sustainable Development.

The WG developed four white papers as starting points for further exploration: 1) Expanding access to critical global marine biological diversity observations, 2) Capacity building for observing, 3) Initiative to make some biological data interoperable, and 4) Create and expand access to inexpensive observing technology for biological observations. These ideas were incorporated into the proposal, which, in June 2021, was approved in the first round of the UN Decade endorsements as a UN Decade of Ocean Science Programme.

The [Ocean Biomolecular Observing Network (OBON)](link) main objectives are build a coastal-to-open ocean multi-omics biodiversity observing system, develop and transfer capacity, enhance marine ecosystem models (including new modelling based on machine learning) by adding biomolecular components and address pressing scientific, management, and policy questions linked to the state and dynamics of life in the ocean. As an endorsed programme, OBON participated in the UN Ocean Decade Project Calls in 2022, and several projects have formally been endorsed by the Decade under the umbrella of OBON, with others still being under review. In June, OBON hosted a UN Ocean Conference virtual side event on [Biomolecular observations in support of conservation and sustainable development](link).

3.2.3. WG on Building CapacIty in Ocean AcidificaTion MoniToring in the Gulf of GuineA (BIOTTA), led by the University of Ghana:

The BIOTTA working group aims to equip graduate students, early career ocean scientists and other marine science professionals in the Gulf of Guinea (GoG) region with skills on sustainable Ocean Acidification data acquisition to expand our understanding of the threats, risks and impacts to marine ecosystems and chart pathways for sustainable management of marine resources at risk to OA in the GoG region. This working group includes POGO members in Cote d'Ivoire, Ghana, Benin and Nigeria and works to bridge national, regional and international data gaps in ocean acidification.

To date, OA monitoring efforts in Africa remain a major challenge with a paucity of data due mainly to the lack of prerequisite skills for carrying out OA measurements. BIOTTA aims to complement global efforts such as the Global Ocean Acidification Observing Network (GOA-ON) and the International Ocean Carbon Coordination Project (IOCCP) by convening a series of virtual regional workshops and webinars to train young and professional scientists in setting up and maintaining OA observation systems in the GoG and other African coastal waters.

The pandemic prevented many of the in-person activities, but BIOTTA participants have been meeting virtually to develop the objectives. Five national focal points were appointed and will coordinate BIOTTA activities at the country level through engaging with scientists and stakeholders to identify OA research and capacity building needs for each country. A BIOTTA stakeholder identification list prepared by the project leads were given to focal points to be used in identifying stakeholders, OA needs and priority in the different countries.

BIOTTA WG went into partnership with The Ocean Foundation, which will provide financial support for OA equipment to participant institutions (in Benin, Cameroon, Cote d'Ivoire, Ghana, Togo and Nigeria) and a training plan for a hybrid training course where stakeholders will learn more about OA monitoring and technicians will learn how to operate the monitoring equipment.

3.2.4. South-East Asia project for General Regional Awareness of Seagrass by Society (SEAGRASS), led by CEMACS, Malaysia:

The Straits of Malacca is the second busiest ocean maritime trade route in the world with a passage of over a thousand ships a day transiting its waterways. Naturally, this brings with it a lot of environmental pressure and risks to existing natural habitats. However, there are still very special pockets of marine habitats that possess high diversities of marine life such as shallow seas, intertidal mudflats, uninhabited islands and seagrass beds. We have chosen the Middle Bank (northern Straits of Malacca) – an area of rich seagrass community to study its changing evolution in an evolving climatic and anthropogenic influence. This area adjacent to the Penang World Heritage Site can be managed as a sustainable expanse of natural sanctuary in a crowded ocean. As the only extensive and established seagrass area in the northern Straits of Malacca, Middle Bank seagrass meadow serves as nursery ground for many commercially important fish and mollusc species. Small-scale fisheries using artisanal fishing gears are also done by local coastal communities at the seagrass meadow as their livelihood.

Apart from physical uses for societal and economic importance, this area is ecologically important, serving as a carbon sink (complementing adjacent mangrove area) to mitigate climate change and offset the state's carbon emission.

The proximity of the Middle Bank to a World Heritage Site will be utilized to drive awareness and education on the value of these marine habitats to the general public. We hope this will encourage the local government and agencies to set up a marine protected area for research, monitoring and education. Awareness and education programmes will be deliberated by the cooperative partners in the project where this may later be promoted to other relevant areas in the region or other areas of the globe.

3.2.5. WG Capacity building for Biochemical obsErvation of AnthropogeniC pollutiOn, tropical traNsitional waters (BEACON), led by the University of Ghana:

BEACON major focus is to build a capacity of interdisciplinary scientists for biochemical pollution monitoring in West Africa. The idea is to establish a network of institutions within the region to share and adopt the best protocols for sampling, laboratory processing and analysis of biochemical data in Sub-Sahara Africa. This region remains to be studied despite its numerous fresh and marine waters, increasing in deteriorating state due to increased human impacts (e.g., pollution) and other climate change and ocean acidification factors.

The BEACON working group aims are to (i) build a capacity of interdisciplinary scientists via the first hybrid workshop, (ii) to adopt standard methods for benthos and chemical tracers such as Hg in benthos and sediment via a Direct Mercury Analyzer for the region, (iii) carry out a preliminary check on benthos and chemical tracer in the sediment brought by participants coupled with practical hands-on experiences in the field and laboratory demonstration in Ghana (iv) develop policy brief on major findings to communicate research results for policy to protect transitional tropical coastal waters and to promote their sustainable usage and management.

BEACON outputs include:

- Creation of Biochemical Observation Network (BON) in West Africa

- Capacity building preparation workshop

- Harmonisation of methods and capacity building workshop for the adoption of benthos sampling and Hg analysis in biota and sediment)

- Online seminar for sharing of results and local species distribution maps for creation of an overall regional map for key pollutant indicator species

- Creation of a Regional Biochemical Data Unit

- Online seminar data generated from the workshop and preparation of concluding report

3.2.6. Citizen Observation of Local Litter in Coastal ECosysTems (COLLECT), led by Flanders Marine Institute, Belgium and University of Ghana:

The project COLLECT aims (i) to demonstrate the potential for acquisition of data by citizen scientists (secondary school students) on the distribution and abundance of coastal debris in African countries, (ii) to assess attitude and awareness shifts in participating students (volunteers) after citizen science interventions and (iii) run a intercalibration exercise for identification of polymer present in samples. This project will be complemented by the knowledge and infrastructure transfer enabled by the POGO member institutions.

Participant institutes in Africa (Benin, Cape Verde, Ivory Coast, Ghana, Morocco and Nigeria) and Asia (Malaysia) provided training to high school students and teachers from 10 schools in total, where they provided not only guidelines for field sampling, but also background information on plastic pollution. Over 300 students (15 to 18 years old) applied standard operating procedures (SOPs) to acquire and sample macro (> 5mm) and microplastics (< 5mm) from sandy beaches, during dry (Oct/21) and wet (Apr/22) seasons.

Surveys were applied before and after the citizen science intervention, to assess shifts in knowledge of the nature and purpose of scientific research and in attitude/awareness towards the environment.

COLLECT outputs include:

- Validation and adaptation of plastic litter sampling standard operating procedures (SOPs) using citizen scientists in African countries;

- Production of datasets that are open and available for a variety of stakeholders;

- Analysis of preliminary information on plastic pollution sources for the targeted study area;

- Evaluation of potential shifts in attitude of participating students towards coastal plastic debris;

- Academic publication in a peer reviewed journal of the results of this case study.

The results obtained in COLLECT will contribute to establish baseline information on coastal plastic debris. In COLLECT, citizen science act as an enabler of open science, by allowing data collected to be freely available to public, academics and regulators. Results will contribute to the identification of hotspots of plastic coastal litter, useful to establish projects on remote sensing and automated techniques for the identification of plastic.

3.2.7. Other initiatives funded by POGO for 2020-21, 2021-22 (delayed) and 2022-23

Working Groups and projects:
- Women in Science: ERIKA (Empowerment /Employment of female researchers in Key Assignments, led by AWI, Germany;
- Action for Sustainable Ocean Acidification Research (ASOAR), led by UK
- Gulf of Mexico Oceanographic and Meteorological Observation Group, led by CICESE, Mexico
- Community-Based Ocean Observing - Identifying the ocean observing requirements and capacity needs of Indigenous peoples and local communities around the Pacific Basin and the pathway for delivery, led by ONC, Canada

Training initiatives:
- Training on subsurface mooring design, recovery and deployment, organised by IOCAS, China;
- Support for SOLAS Summer School;
- Regional training workshop on observing the coastal and marginal seas in the western Indian Ocean including the Arabian/Persian Gulf and the Sea of Oman, organised by IndOOS/IORP, with support from CLIVAR and IMBER/SIBER;
- Training on best practices for biogeochemical ocean observation: instrumentation, operation, quality control, organised by SAMS in the UK;
- Training on principles and applications of Argo and BGC-Argo, organised by the Second Institute of Oceanography, China.