

## Partnership for Observation of the Global Ocean (POGO) Report to SCOR Annual General Meeting 2021

### 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](http://www.pogo-ocean.org).

### Collaboration with SCOR

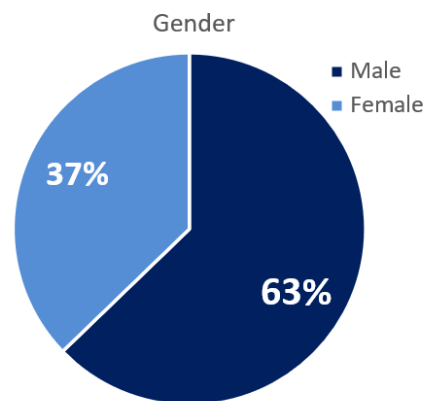
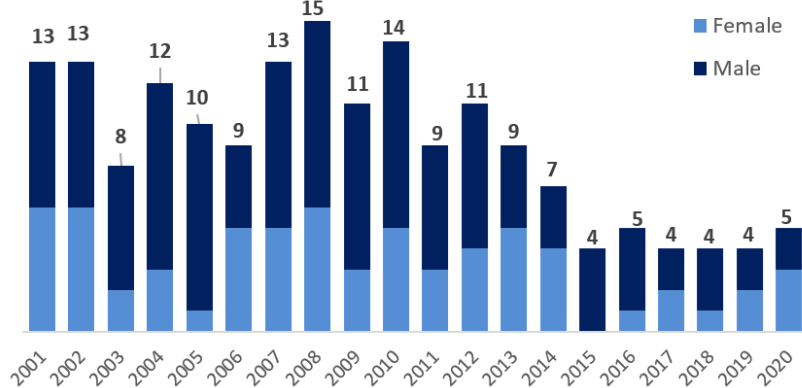
SCOR is the leading international organisation in the marine science arena, and POGO has always enjoyed good relations with it. Examples of joint activities include the following:

- 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 21<sup>st</sup> year, and a total of 180 fellowships have been awarded to date (see statistics on gender, geography etc in Fig. 1). The programme is co-funded by POGO and SCOR and administered by the POGO Secretariat. Candidates are selected by a committee in which both POGO and SCOR are represented.
- 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 building in marine science at the global level and coordinate their respective capacity-building 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.
- 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

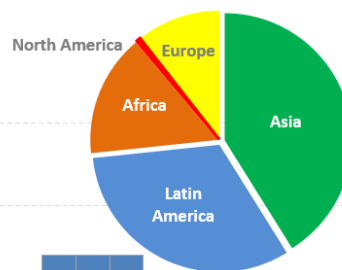
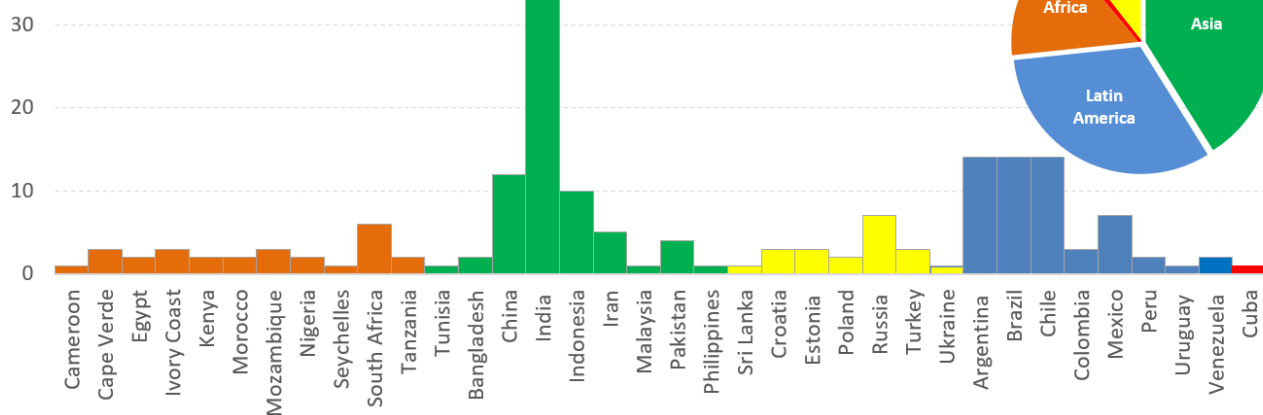
natural components. The Science Plan was published in 2015. The Sloan Foundation was instrumental in starting up this initiative, and in providing seed funding for coordination. POGO funded a Working Group to support the IQOE, which was instrumental in getting an Acoustic Essential Ocean Variable (EOV) accepted by GOOS. POGO has been supporting the development of the Acoustic EOV Implementation Plan, using funds originally allocated to fund a workshop, to contract Ed Urban to lead and coordinate the writing of the Plan. 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.
- Both POGO and SCOR support 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.
- POGO has an interest in contributing to the activities planned under the International Indian Ocean Expedition 50<sup>th</sup> anniversary (IIOE-2), an initiative of SCOR and IOC.

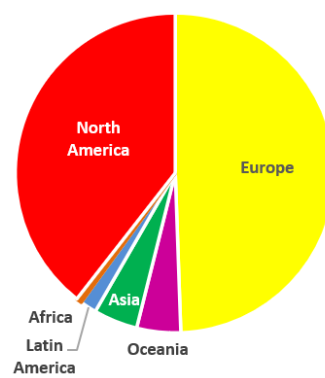
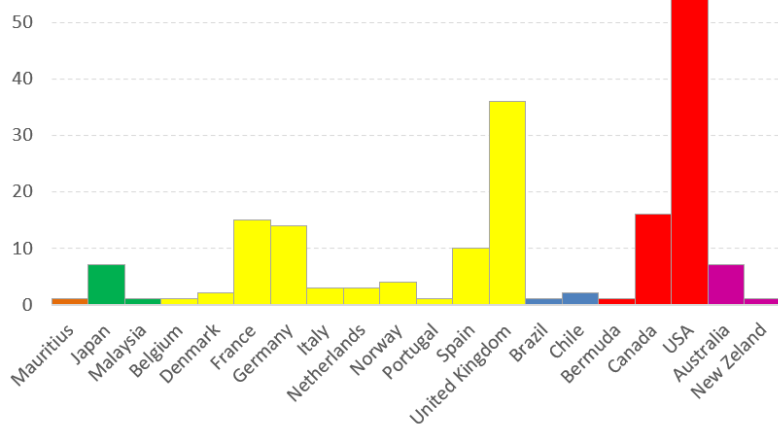
**POGO-SCOR Trainings per year**  
(Total = 180 fellowships)



**Trainees Home country**



**Host countries**



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

## Current POGO activities

### **Capacity development**

Over the last 21 years, POGO has provided training in ocean observations to nearly 1,000 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 and 2016) 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 involving schools in Brazil, Germany, Ireland, Japan and UK;
- 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 (mentioned above);
- Training Initiatives organised by POGO members, who are successful in applying for partial funding from POGO (those selected for 2021/22 are listed below).

### **Projects and Working Groups**

#### *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. The next step was a virtual workshop (Nov 2020) bringing 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.

During the workshop, the project participants agreed that the platform will implement the following functionalities:

- operate with minimum modifications as moored system, drifting buoy or manually deployed equipment;
- mount essential sensors and operate in dual mode as a self-recording system or real-time autonomous system;
- mount a low-cost low-power embedded system to acquire, control, process, store and (in case) transmit data;
- employ low-cost material (e.g. plastic pipes for domestic use for the instrument housing);
- simplify the assembling process of the system in order to be done on-site by trained non-professional operators or for educational purposes.

The sensors are not supposed to substitute the best technological products available on the market. Instead, they are meant to complement/integrate these, by extending the coverage/number and by making them deployable also by trained non-professional operators. The sensor choice will be defined by their performance starting with temperature and pressure sensors. An accurate GPS system is also needed for localization and tracking.

The general idea is that the platform has to be an open and expandable system. Although the implementation on the platform of other sensors for example for the measurement of salinity, chlorophyll, dissolved oxygen, turbidity is not part of this step of the project, it has been considered.

Lastly, the communication system will implement the following functionalities:

- use the most popular low-cost/no transmission cost communication systems;
- enable the timely communication of the relevant data and control flags and its delivery on the web;
- exploit at best the present and future opportunities and facilities offered by the Internet of Things technologies.

The resulting platform will then be tested and used as educational equipment in a conceptual framework of science, technology and practice transfer and dissemination to the local user communities. The prototype potential is not limited to developing countries. It is useful for any infrastructural remote and poorly observed regions and can be advantageous for those applications requiring a dense coverage of timely observations in remote/under-observed sites, especially along coasts.

Priority was given to:

- a platform that will operate in drifter mode which is extremely easy to deploy and perfect for studies associated with search and rescue operations (another need that has emerged). It also constantly guarantees the knowledge of the instrument position. The platform can be easily converted into the moored mode

- temperature and pressure sensors should be low-cost with the idea to replace them rather than calibrate them
- LoRaWAN communications preferably with Bluetooth integration for the in-situ download of the data.

*WG on Biological Observations, led by Scripps Institution of Oceanography:*

This WG 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 proposal for

an “Ocean Molecule Observing Network (OBON)” was submitted to the UN Decade for endorsement in January and endorsed in June 2021.

Other future directions for the POGO Bio Obs WG, and thus for POGO, include (1) inexpensive technologies for biological observing (also linked to OpenMODs topic above), (2) data archaeology for critical marine biodiversity observations, (3) interoperability of marine biological data, and (4) capacity development for biological observing.

*WG on Building Capacity in Ocean Acidification Monitoring in the Gulf of Guinea (BIOTTA), led by the University of Ghana:*

Dotted along the relatively wide continental shelf of the Gulf of Guinea (GoG) are several lagoonal/estuarine systems including adjacent coastal marine waters that provide livelihood benefits, i.e., nutrition and jobs to deprived communities living around them. The productive waters of the GoG support shellfish and a diverse finfish fishery which provide significant income to coastal communities in countries such as Cote d’Ivoire, Ghana, Togo, Benin and Nigeria. Changing ocean pH coupled with other climate and non-climate stressors such as pollution and overfishing present huge threats to the future of the fishery and other marine resources in the region. A lack of skills in the measurement of ocean acidification (OA) forestalls our understanding of species vulnerability to changing pH and puts the fishery and other marine biological resources in the GoG at a greater risk. The BIOTTA working group will equip graduate students, early career ocean scientists and other marine science professionals in the GoG region with skills on sustainable OA 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 hopes to also 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 mainly as a result of 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 BIOTTA working group is working to:

1. Develop a coordinated network for observing OA in the GoG
2. Develop capabilities to undertake analysis of seawater OA parameters using low-cost, readily available and easy-to-use equipment
3. Map OA hotspots in BIOTTA member countries for long-term OA monitoring
4. Initiate sound OA monitoring activities in BIOTTA member countries after successful mapping of hotspots in these countries, making use of OA observation kits developed by GOA-ON and the International Atomic Energy Agency (IAEA)
5. Integrate into global OA observing networks, such as GOA-ON, with the goal to share and make data available to the global ocean observing community.

*WG on Acquisition of Oceanographic Data for Sustainable Resources Management in the Gulf of Guinea, led by NIOMR, Nigeria:*

The initiation of an oceanographic network and a regional databank is a very important project to be embraced by all countries within the West African sub region. Sea surface temperature in the Gulf of Guinea varies at seasonal and inter-annual time scales, and thus may have a strong impact on climate (West African monsoon onset and intensity), precipitation (water resources), and fisheries. The WG aims to obtain data on seawater characteristics up to the 500m isobath within the Gulf of Guinea region. This will provide salient information for physical, chemical, biological and geological description of the water column and sediment characteristics within this region. The main objectives are to collect oceanographic data to complement the completed and ongoing international programs within the Gulf of Guinea region, establish and maintain in-situ long term network of measurements within the Gulf of Guinea, and also incorporate training and local capacity building.

In order to fulfil one of the goals of POGO in building a community of ocean scientists, this WG brings together marine scientists from five African countries within the Gulf of Guinea region (Nigeria, Benin, Togo, Ghana and Côte d'Ivoire), in partnership with oceanographers from GEOMAR, Germany. The main goals are:

- To establish a regional oceanographic databank needed for studies on the analysis and monitoring of ocean and climate conditions within the Gulf of Guinea, their influence on the regional climate, and sustainable management of living and non-living resources (e.g. identification of potential fishing zones)
- To promote regional capacity building through academic/research institutions and shipboard trainings
- To develop and maintain a long-term ocean monitoring network within the Gulf of Guinea region
- To assist governments through research and development in implementing sustainable economic policies on living and non-living resources, which are geared towards sustainable societal livelihood.

Due to COVID, most of the WG activities took place via virtual meetings of the participants. However, NIOMR was successful in organising daily sampling trips during a 1-week period in January, and hosted 6 early-career scientists (funded via NF-POGO shipboard training fellowships) from 4 of the participating African countries for 1 month prior to the cruise and 1 month after the cruise. These were trained by NIOMR in various aspects of shipboard sampling, analysis and data processing.

***Initiatives funded by POGO for 2020-21 (delayed) and 2021-22***

*Working Groups and projects:*

- Women in Science: ERIKA (Empowerment /Employment of female researchers in Key Assignments, led by AWI, Germany;
- Capacity building for Biochemical observation of Anthropogenic pollution, tropical transitional waters (BEACON), led by University of Ghana;
- Establishing long-term seagrass ecosystem observation and development of citizen science, led by CEMACS/USM, Malaysia;



- Svalbard Marine Time Series, led by SAMS, UK.

*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.

*Other:*

- Support for the IOC-UNESCO Ocean Best Practices System Symposium (Sept 2021).