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**INTERGOVERNMENTAL OCEANOGRAPHIC COMMISSION**  
(of UNESCO)

**INFORMATION DOCUMENT**

**GLOBAL OCEAN SCIENCE REPORT:  
PROGRESS, CHALLENGES, PROSPECTS**

Summary. By decision EC-XLVII/6.2 of its Executive Council, the IOC is preparing the Global Ocean Science Report (GOSR) based on a proposal IOC/EC-XLVII/2 Annex 8. The GOSR will assist local and national governments, academic and research institutions, as well as international organizations and donors, in making informed decisions, e.g. on future research investment. It will summarize information about the status of ocean research, investment in research infrastructure and human capacity, as well as potential gaps in marine sciences programmes in need of further investments. It is envisaged to provide an overview on nations' (i) investments, (ii) resources, and (iii) scientific productivity in Ocean Science. It will provide a tool for mapping and evaluating the human and institutional capacity of Member States in terms of marine research, observations and data/information management, as well as a global overview of the main fields of research interest, technological developments, capacity building needs and overall trends. This document provides a progress report of the preparation of the GOSR.

## Background Information

Many international fora (WSSD, Rio+20, UN-ICPOLoS) have identified the need to strengthen marine science capacities of nations in order to advance sustainable ocean management at all levels. At present, there is no global mechanism for assessing and reporting the level of capacity, investments, and needs of nations in ocean science, observation and services. As part of its voluntary commitment to the Rio+20 process, IOC will play a leading role in facilitating the development and implementation of a global strategy to build national and regional capacity in ocean affairs. Consequently a mechanism is required to assess on a regular basis nations' needs and investments on these issues. Thus the Global Ocean Science Report is prepared under the auspices of IOC to fulfil this mandate.

In pursuance to Decision IOC-XXVII/Dec.5.5.2 of the IOC Assembly at its 27<sup>th</sup> session (Paris, 26 June–5 July 2013), an open-ended Intersessional Working Group to further review and improve the Global Ocean Science Report was established (experts from 12 Member States). This working group agreed to frame the GOSR around sustainable development goals and ways science contributes to them. It will address the key aspects to optimize the sustainable use of marine resources, to enable blue growth, and it will further encourage capacity-building and transfer of technology to facilitate international cooperation in coastal and global marine research and management. The GOSR will assist especially developing countries to build appropriate marine scientific research capabilities to address national, regional and global challenges. It is envisaged that the GOSR provides an overview on where and by whom ocean science is conducted, as well as its quality and impact on national and international research strategies. In brief, the GOSR will inform of where the science capacity exists to address the present environmental challenges, as e.g. climatic threats as identified by the IPCC 5th assessment.

The IOC Executive Council accepted the GOSR proposal at its 47th session (Paris, 1–4 July 2014), though no budget was allocated for this effort (Decision EC-XLVII/6.2). Circular letters 2553 and 2560 invited IOC Member States to assess precisely their possibilities to financially support this important project and commit extra-budgetary funds and further to provide information about Ocean Science in their countries by filling in a tailored questionnaire. The questionnaire was designed to obtain objective and detailed responses and it is built with a balanced ratio of direct answers and free text.

## Progress, challenges, prospects – current status of analysis

The preparations of the GOSR have continued during the intersessional period (July 2014–May 2015) with limited resources.

The following section, presenting the activities and analysis conducted until to date, refers to the outline of the report agreed on by the Member States (Box 1).

In December 2014, [IOC Circular Letter 2553](#) invited Member States to financially support the production of the GOSR. Until May 2015 no direct financial commitment was made by any Member States. However in-kind support was received from Republic of Korea (consultant) and Canada (translation of the questionnaire). Also some organizations (ASLO, CIESM, ICES, PICES, etc.) have provided data regarding human research capacity active in the field of ocean science.

In January 2015 a questionnaire, asking for national information on ocean science in IOC Member States was disseminated by [IOC Circular Letter 2560](#). Until May 18 the IOC secretariat received 21 questionnaires filled in by the following Member States: Argentina, Belgium, Chile, China, Colombia, Dominican Republic, Ecuador, Finland, France, Germany, Guinea, Italy, Republic of Korea, Kuwait, Mauritania, Norway, Romania, Russian Federation, Suriname, Thailand, Trinidad and Tobago. Several countries asked for an extension of the deadline for answering the questionnaire, e.g. Canada, USA, Japan, Morocco, Costa Rica, the Netherlands and Spain.

**Box 1.** Outline of the Global Ocean Science Report as agreed on during the 47th Session of the IOC Executive Council by Decision EC-XLVII/6.2.

**1. Introduction**

- 1.1. Rationale
- 1.2. Scope of this report
- 1.3. Methodology

**2. Research investment**

- 2.1. Observations
- 2.2. Fisheries
- 2.3. Other ocean sciences

**3. Research capacity and infrastructure**

- 3.1. Human resources, gender distribution
- 3.2. Facilities/laboratories/field stations
- 3.3. Equipment: e.g. research vessels, ROVs, AUVs
- 3.4. Key time series sampling sites

**4. Research productivity and science impact**

- 4.1. Peer-reviewed publications, e.g. normalized Impact, high quality publications
- 4.2. International collaboration

**5. Oceanographic data and information exchange**

**6. International supporting organizations on ocean science**

- 6.1. Scientific organizations
- 6.2. Fisheries management organizations
- 6.3. The role of International Project Offices

**7. Contribution of marine science to the development of ocean and coastal policies and sustainable development**

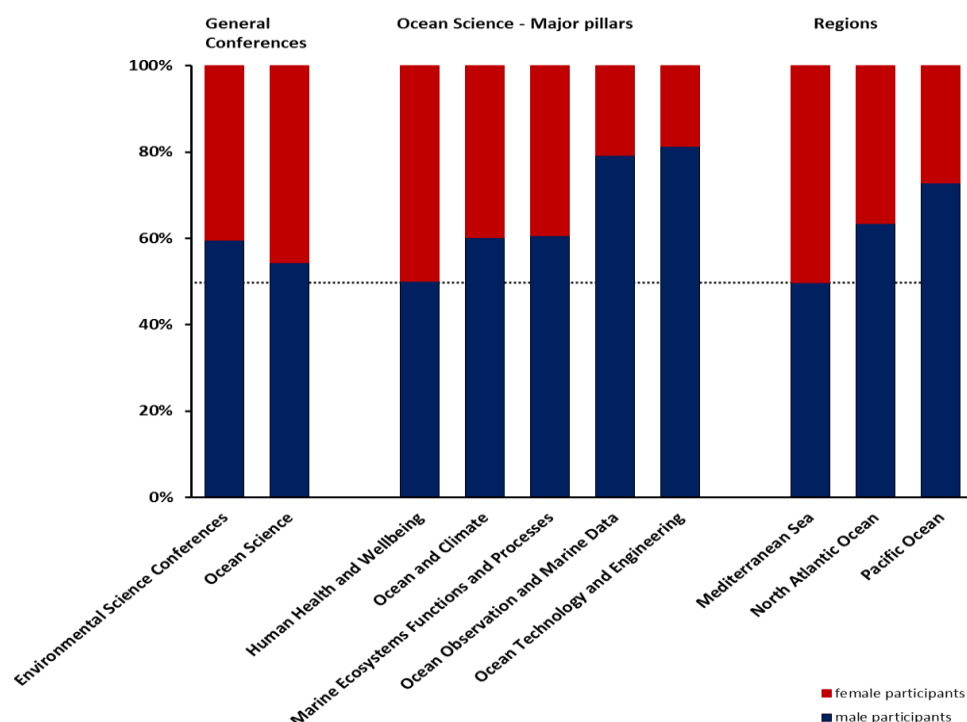
- 7.1. Past examples
- 7.2. Current challenges
- 7.3. Emerging issues

**8. Conclusions**

- 8.1. Gaps in knowledge, research, capacity and technical infrastructure
- 8.2. Findings and opportunities
- 8.3. Capacity building and transfer of technology
- 8.4. Opportunities for international collaboration

The information gathered at this interim stage can serve an analysis of Research investment (Chapter 2), Research capacity and infrastructure (Chapter 3), in particular human resources and the facilities/laboratories/field stations, as well as special equipment available in each nation, and each region respectively. It provides also information on the global contribution of marine science to the development of ocean and coastal management and sustainable development (Chapter 7). Given the geographically clustered responses to the questionnaire the IOC secretariat received so far, there is a possibility to give more detailed regional assessments in the North Atlantic, Europe and North-East Pacific.

In order to complement the data received from Member States, additional information resources were identified for single chapters. An alternative approach to obtain data for Chapter 3 is the identification and classification of participants in terms of gender and affiliation attending selected international conferences/symposia on Environmental Science in general in comparison to Ocean Science, and its eight subsets, according to regions or the previously agreed pillars: Marine Ecosystems Functions and Processes, Ocean and Climate, Ocean Crust and Marine Geohazards, Blue Growth, Ocean Health, Human Health and Wellbeing, Ocean Technology and Engineering, and Ocean observation and Marine Data. The conferences considered within this assessment so far are listed in Table 1. The gender and the country of more than 15.000 participants were identified. Regions addressed in synthesis to date are the Mediterranean Sea (data provided by the Mediterranean Science Commission - CIESM), the North Atlantic Ocean (data provided by the International Council for the Exploration of the Sea – ICES) and the North Pacific Ocean (data provided by North Pacific Marine Science Organization – PICES). The current analysis still misses international conferences discussing topics related to Ocean Crust and Marine Geohazards, as well as Blue Growth. Filling these gaps is part of planned activities for the upcoming months. As Ocean Crust and Marine Geohazards is a highly specialized field of research, there are few international conferences dealing with them compared to other Ocean Science pillars. Further the branch of Blue Growth, apart from fisheries, is a quite recent established investigation topic, so international conferences are still scarce and only have short histories. Conferences focussing on Ocean Health, in particular on marine pollution, were identified and are part of the analysis. Detailed gender information will be presented by country in the final report.



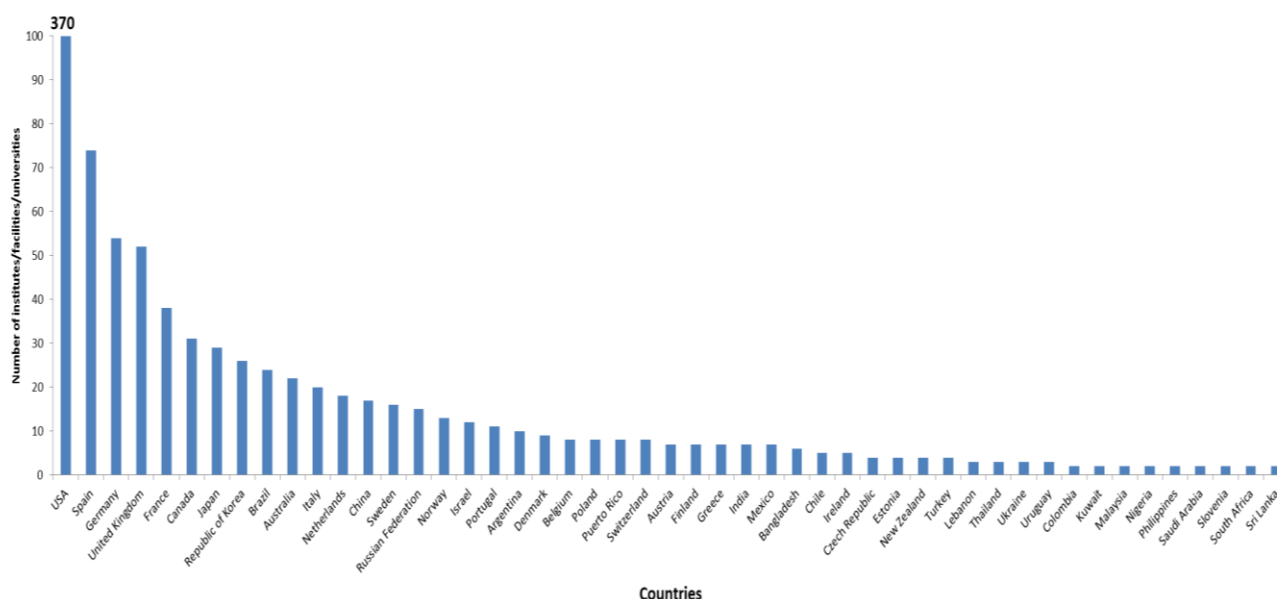
**Figure 1.** Relative proportion (%) of male and female experts attending international scientific conferences/ symposia.

**Table 1. List of international conferences, divided by major focus, illustrating the percentage of male and female participants, the number of participants and countries represented.**

Year	Hosting Country	Conference Name	Male [%]	Female [%]	Number of participants	Number of countries
<b>Environmental Science Conferences</b>						
2012	UK	Planet under Pressure,	59	40	2999	104
<b>Ocean Science</b>						
2013	USA	Aquatic Sciences Meeting	55	45	1879	44
2014	Spain	2nd IORC	56	44	555	70
2015	Spain	Aquatic Sciences Meeting	52	48	2468	62
<b>Ocean Observation and Marine Data</b>						
2009	Italy	OceanOb '09	79	21	637	36
<b>Marine Ecosystems Functions and Processes</b>						
2009	Canada	3rd GLOBEC OSM	72	28	311	34
2010	Argentina	3rd Jellyfish Blooms Symposium	52	48	95	27
2011	Chile	5th Zooplankton Symposium	49	51	297	36
2013	Japan	4th Jellyfish Bloom Symposium	69	31	136	29
2014	Norway	IMBER - Future Ocean	61	39	465	45
<b>Ocean and Climate</b>						
2012	Korea	2nd Effects of CC on the World's Ocean	75	25	362	39
2012	USA	3rd OHCO2W	51	49	538	36
2015	Brazil	3rd Effects of CC on the World's Ocean	54	46	284	38
<b>Human Health and Wellbeing</b>						
2013	France	GEOHAB	55	45	51	21
2014	New Zealand	16th IC Harmful Algae	53	47	394	35
2014	USA	Oceans & Human Health	43	57	87	11
<b>Ocean Health</b>						
2010	China	6th International Conference on Marine Pollution and Ecotoxicology	NA	NA	NA	NA
2013	China	7th International Conference on Marine Pollution and Ecotoxicology	NA	NA	NA	NA
<b>Ocean Technology and Engineering</b>						
2011	Spain	Oceans'11	82	18	403	31
2012	Spain	IC Coastal Engineering	80	20	795	45
<b>Mediterranean Sea</b>						
2010	Italy	CIESM Congress,	50	50	1000	n.a.
2013	France	CIESM Congress,	49	51	1000	n.a.
<b>North Atlantic Ocean</b>						
2012	Norway	ICES Annual Science Conference	67	33	647	31
2013	Iceland	ICES Annual Science Conference	65	35	688	36
2014	Spain	ICES Annual Science Conference	58	42	569	34
<b>Pacific Ocean</b>						
2012	Japan	PICES Annual Meeting	80	20	466	22
2013	Canada	PICES Annual Meeting	67	33	365	11
2014	Korea	PICES Annual Meeting	72	28	365	18

Preliminary results, presented in Fig. 1, illustrate the almost equal distribution of female and male participants in general Ocean Science conferences. Nevertheless, it is obvious that conferences within the various fields of Ocean Science are less equally attended by women and men. There is a stronger representation of men especially in meetings focussing on Ocean Technology and Engineering, and Ocean observation and Marine Data. Differences between the regions indicated equal gender representation of researchers within the field of ocean science in the Mediterranean Sea, while there is a higher proportion of male investigators in the North Atlantic and Pacific Ocean.

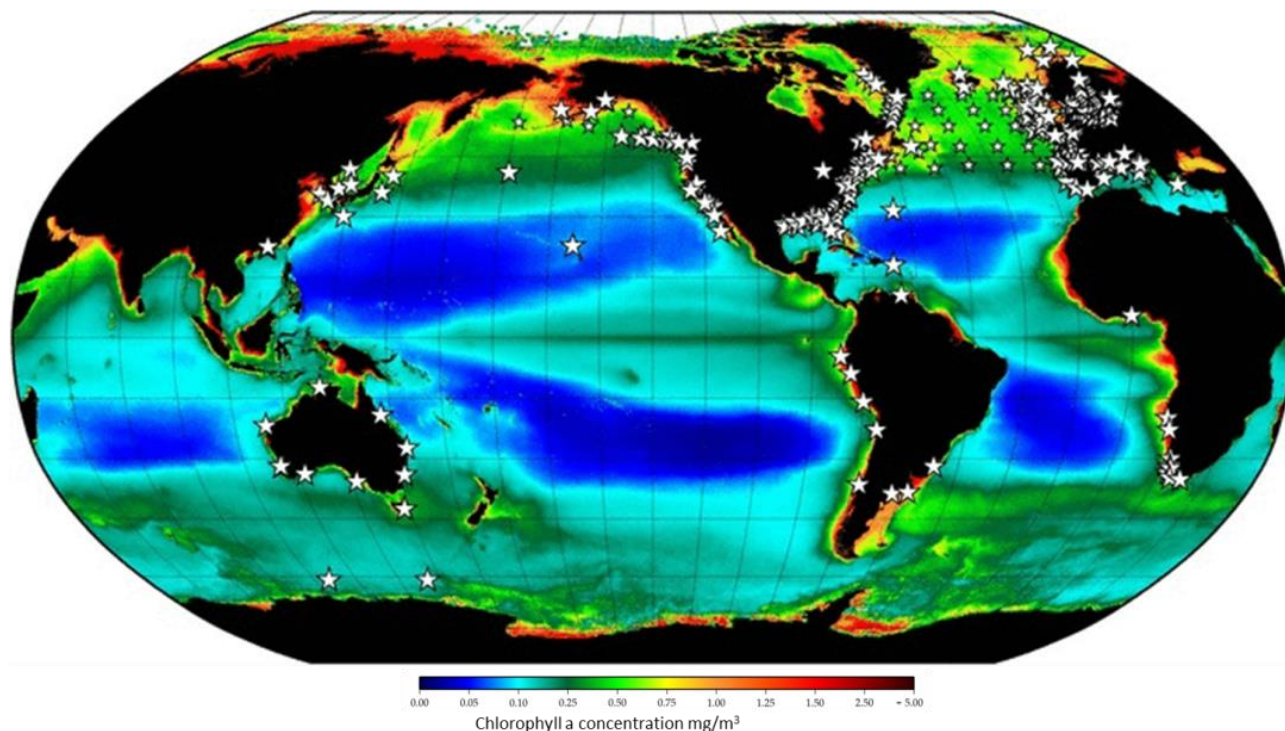
A sub set of these conferences (Third International Symposium on the Ocean in a High CO<sub>2</sub> World, 2012, Monterey, USA; Second International Symposium Effects of Climate Change on the World's Oceans, 2012, Yeosu, Republic of Korea; Third International Symposium Effects of Climate Change on the World's Oceans, 2015, Santos, Brazil; Aquatic Science Meeting ASLO, New Orleans, 2013; Aquatic Science Meeting, 2015, Granada, Spain; OceanObs'09, 2009, Venice, Italy) was further analysed to obtain data on the number of laboratories, universities, institutes investigating in ocean science and presenting their results at international meetings. Preliminary results, shown in Fig. 2 (49 countries with at least two institutes/facilities and universities represented), indicate the different modalities of organization of national scientific schemes and subsequent architecture of science infrastructure (e.g. centralized with some centres of specialized science, spatially equally distributed regional centres). The total number of European institutions is about the same as for the USA.



**Figure 2.** Number of institutes/facilities and universities by country represented at the following list of international conferences (more than two): Third International Symposium on the Ocean in a High CO<sub>2</sub> World, 2012, Monterey, USA; Second International Symposium Effects of Climate Change on the World's Oceans, 2012, Yeosu, Korea; Third International Symposium Effects of Climate Change on the World's Oceans, 2015, Santos, Brazil; Aquatic Science Meeting ASLO, New Orleans, 2013; Aquatic Science Meeting, 2015, Granada, Spain; OceanObs'09, 2009, Venice, Italy.

The information about special equipment like autonomous underwater vehicles (AUV), remotely operated underwater vehicles (ROV) will be partly extracted from the questionnaires. Additional data are provided by the Global Ocean Observing System (GOOS) and other resources, e.g. a report published in 2013 (MREKEP/NERC - James Hunt, Global Inventory of AUV and Glider Technology available for Routine Marine Surveying), for Europe <http://www.eurofleets.eu/lexi/>. An index about research vessels in place, categorized by length, will be presented according to what is provided from the Member States directly, under consideration of previous assessments (e.g. <http://www.researchvessels.org/qryshipinfo.asp>, and <http://www.eurofleets.eu/rvs/> for Europe). The

number and distribution of ship based time-series, measuring a broad suite of parameters, including chemical, physical and biological features, can be obtained from the IOC-led initiative International Group for Marine Ecological Time Series (<http://igmets.net>, Fig. 3).



**Figure 3.** Compilation of more than 300 ship-based marine ecological time series sites (plus about 100 estuarine sites) (©IGMETS).

In order to be able to obtain the information needed to answer the question about research productivity and science impact (Chapter 4), bibliometric analysis of peer-reviewed publications have to be conducted. The GOSR is anticipated to include a list of the following indicators for each country, calculated over the last five years: number of publications, publication growth ratio, specialisation index, average of relative citations, average relative impact factor, highly cited publications (% in top 10% and in top 1%) and the rate of international collaboration. Graphics, including maps of citations scores and positional analysis graphs in terms of output, specialization, the degree of international and regional collaboration, as well as the impact will be used to illustrate the distribution of regional scientific hubs, will further illustrate the assessment. The analysis will be conducted for Ocean Science in general and the eight subsets, according to the previously agreed pillars: Marine Ecosystems Functions and Processes, Ocean and Climate, Ocean Crust and Marine Geohazards, Blue Growth, Ocean Health, Human Health and Wellbeing, Ocean Technology and Engineering, and Ocean observation and Marine Data. Since the here proposed results cannot be solely delivered by the IOC secretariat, a company in charge and experienced with this type of studies has to be contracted. It is important to remark, that in case there is no funding provided either by the IOC regular budget or extra-budgetary funds, the analysis given in Chapter 4 will be incomplete.

The information about how the different Member States carry out the oceanographic data and information exchange (Chapter 5) and about the role of international supporting organizations/project offices within ocean science (Chapter 6) will be mostly retrieved from resources within the IOC and its networks.

Chapter 7 will give detailed information to which extend marine science contributes to the development of ocean and coastal policies and sustainable development in any particular nations and regions. The information used in this part is included in the survey, to be answered by the Member States.



The last part of the publication will summarize the previously presented results and end with some conclusions, highlighting knowledge gaps, research needs, available human capacity and technical infrastructure with respect to ocean science. It will stress the demand for capacity building and transfer of technology, likewise the opportunities for international collaboration to improve these.

### Updated timeframe

The limited financial and in-kind resources available to prepare the Global Ocean Science Report will cause changes on the timeframe previously agreed by the IOC Executive Council at its 47th session in 2014, which are anticipated as follows:

<b>Dates</b>	<b>Actions</b>
<b>June–July 2015</b>	Twenty-eighth session of the IOC Assembly Call to Member States to provide funds for the GOSR
<b>August 2015– January 2015</b>	Analysis of received questionnaires and free of charge resources
<b>September 2015</b>	In case of new financial resources bibliometric analysis carried out.
<b>December 2015</b>	Identifying authors of the individual chapters; forming the editorial board
<b>February–May 2016</b>	Workshops – Lead authors convene drafting the first text elements
<b>June 2016</b>	Discussions by email and teleconferences with the editorial board and experts from Member States Review of the first text elements First draft presented at the 49 <sup>th</sup> Session of the IOC Executive Council
<b>July–September 2016</b>	Writing and improving of text elements Finalize the discussions by email and teleconferences Review of conclusions and recommendations Complete the structure of the report
<b>September– November 2016</b>	Finalizing the report and an executive summary
Presentation at a relevant meeting, December 2016	

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