Ocean Acidification workshop: Developing regional capacity for ocean observations in support of SDG target 14.3

Workshop report
8 – 9 June 2019
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1. Background

The world ocean absorbs up to 30% of the annual emissions of anthropogenic CO$_2$ to the atmosphere, helping to alleviate the impacts of climate change on the planet. However, this comes at a steep ecological cost, as the absorbed CO$_2$ reacts in seawater and results in changing acidity levels in the ocean. The changing acidity is described by a decrease in seawater pH and closely linked shifts in the carbonate chemistry of the waters including the aragonite concentration, which is the main form of calcium carbonate used by key species to form shells and skeletal material (e.g. reef building corals and shelled mollusks). Observations of marine acidity at open ocean and coastal locations have revealed that present-day conditions are often outside pre-industrial bounds.

![Figure 1. Modelled pH ocean acidification observing platforms in West Asia (source: GOA-ON data portal http://portal.goa-on.org/Explorer).](image)

Projections of the future ocean show that ocean acidification affects all areas of the ocean, while consequences for marine species, ecosystems, and their function vary. Over the past 10 years various studies have documented that ocean acidification is directly influencing the recruitment success of coral reefs and also aquaculture production, quality and taste, whilst broadly affecting survival and calcification of a wide range of taxa. Measurements have also shown that chemical alterations particularly affect species at lower trophic levels, and cascading effects within the food web are expected to result in increasingly adverse impacts on coastal economies.
Further, ocean acidification does not affect marine ecosystems in isolation. Multiple environmental stressors can interact with ocean acidification with cumulative effects, such as ocean warming and stratification, de-oxygenation, or extreme events, as well as other anthropogenic perturbations such as overfishing and pollution.

The Gulf of Oman and the northern Arabian sea are the world’s largest oxygen minimum zone, and the Persian Gulf has several extreme environments, all of which will be differently affected by ocean acidification; not much is know about the carbonate chemistry of these seas. However good knowledge, human and technical science capacities to measure the carbonate chemistry and to detect the impacts on marine life are indispensable to adapt at the local level. The shortage of data required from sustained observation and experimentation for vast areas in the West Asia region (Fig. 1) is also reflected in the GOA-ON member list. To date only scientists from six countries in the region in question (Turkey, India, Lebanon, Egypt, Kuwait and Iran) are members of GOA-ON.

The governing board of the RCOWA recognized this knowledge gap and called on the IOC-UNESCO Secretariat to assist in the organization of an ocean acidification workshop. IOC supports this objective, as it believes it would greatly support scientists and stakeholders in the region, in order to establish a joint strategy to observe, mitigate and adapt to ocean acidification, occurring now and in the future.

2. Purpose

The workshop served a diverse range of stakeholders, in particular scientists. The ultimate goal of this workshop was to align and enforce ocean acidification research and monitoring in region of the RCOWA, as well as to foster data collection and experimentation in support of Sustainable Development Goal (SDG) target 14.3: “minimize and address the impacts of ocean acidification, including through enhanced scientific cooperation at all levels”. The workshop addressed the relevance and linkages between SDG target 14.3 and other SDGs, targets and indicators. The workshop was organized around two main pillars, a) Introduction to Ocean Acidification research and observation, SDG indicator 14.3.1, international networks and b) Discussion to identify future priorities and capacity building activities to enforce ocean acidification research and observation in the region.

3. Presentations and Discussions

Many of the participants have not had started with ocean acidification research and observations prior to the workshop, therefore introductory presentations on 8 June 2019 given by Kirsten Isensee (IOC-UNESCO, Programme Specialist) and Katherina Schoo (IOC-UNESCO, Consultant) (preparations were supported by Christina MacGraw, New Zealand, and Andrew Dickson, US) provided background information highlighting:

- Ocean Acidification - What is ocean acidification? Introduction to the threat of ocean acidification to ocean health and resources,
• SDG 14.3 – Ocean acidification in the framework of the UN 2030 Agenda and the role of national statistical agencies as well as National Oceanographic Data Centres,
• Technical capacity—what do we need to measure and how?, including introduction to the GOA-ON in a box,
• Ocean Acidification measurement resources: Presentation of e.g. GOA-ON data portal and Pier2Peer, IAEA resources, status of SDG indicator 14.3.1 online resources and others.

Further, Dr. Abolfazl Saleh and Dr. Maryam Ghaemi presented preliminary results of ocean acidification results in the Persian Gulf.

In addition, participants of the workshop (Annex III) were asked to present quickly the currently existing capacities (human and technical) to measure ocean acidification on the first day. This assessment showed that besides good knowledge and equipment in the Iranian National Institute for Oceanography and Atmospheric Science and some instrumentation in Iraq at the University of Basrah the capacity to report towards the SDG indicator 14.3.1 does not exist.

Most of day 2 therefore was used to identify priorities in order to build and extend human and technical capacities to conduct ocean acidification research and observation (see item 5.).

4. Ocean Acidification research and observation priorities and recommendations for the region of West Asia

Based on group discussions on day one and two of the workshop, the following priorities required in order to increase the capacity were identified.

Current monitoring capacities in the region:

The region’s ocean acidification monitoring and observing programmes are in the early stages of development. The Iranian National Institute for Oceanography and Atmospheric Science maintains the Persian Gulf and Gulf of Oman Oceanographic Monitoring Program, Iran’s Coastal Monitoring Program and a program on Monitoring and Studying Climate Change and Management of Its Effects. The long running environmental monitoring program in Iraq includes the measurement of several carbonate chemistry variables; the measurements are however not explicitly taken for the monitoring of ocean acidification.

Researchers in the region have access to a variety of existing capacities and infrastructure, such as trained experts in chemistry and biology, and laboratories in a variety of coastal research stations and Universities in several regional seas, some of which are equipped with suitable instruments and laboratory equipment for the sampling and analysis of seawater (participants listed for example pH sensors, Alkalinity titrators, spectrophotometers as available in several laboratories), as well as biological samples. The Iranian National Institute for Oceanography and Atmospheric Science hosts the Iranian National Oceanographic Data Centre, which is accredited by the International Oceanographic Data and Information Exchange (IODE) of IOC. The Institute also has a Research Vessel, the Kavoshgar Khalij Fars (Persian Gulf Explorer). The vessel is equipped with laboratories, sampling instruments and in situ measuring devices and suitable for ocean acidification research.
cruises in the regional seas. By pooling these resources, countries in the region may be able to maximize their capacities and advance regional ocean acidification research.

**Main Ocean Acidification Science questions in the region:**

Among the main scientific questions the participants identified of importance for the region were the potential **effects of ocean acidification on mangroves** and other marine ecosystems such as seagrasses and algae; the consequences of ocean acidification on the health, survival and growth of **commercially important species**, including fish and other seafood from fisheries, aquaculture and mariculture, as well as the socio-economic impacts of potential issued with these fisheries for the general population; the **effects of ocean acidification on the existing coral reefs** and the future development of these reefs and the possible damage of coastal and offshore structures due to changes in marine pH. Participants agreed that closer cooperation with stakeholders, such as fishermen, was needed. The workshop participants stressed the need for **carbonate chemistry observations in the region, with adequate spatial and temporal resolution** to enable researchers to determine a baseline against which future changes can be evaluated.

**Capacity needs and priorities:**

The main resources needed in the region are **specific training on seawater sampling and carbonate chemistry analysis**, including technical training on how to use the relevant instruments and sensors. Since not all of the laboratories have the instruments necessary for the measurement of carbonate chemistry, **additional instruments are required**. Participants mentioned that the acquisition and shipping of the certified reference materials necessary for the calibration and standardization of the instruments and samples has proven difficult, and has constrained the research in the region.

Specific trainings identified to be conducted in the upcoming 2 years included:

- Basic and advanced chemical training on how to measure ocean acidification
- Basic (and advanced) biological training on how to set up biological ocean acidification experiments with socioeconomically important species
- Training workshops on how to control and assure the quality of the collected data
- Trainings on how to use the SDG 14.3.1 data portal

**Actions for international/regional collaboration**

The workshop participants expressed a wish for **collaboration with regional and global organizations to create and initiate common efforts in ocean acidification observations and research**. Initially, the development of a **multistakeholder cooperation for ocean acidification research at the national level**, bringing together Universities, Research Institutes and Agencies as well as policy makers within a country was identified as a **high priority**.

At the regional level, the workshop **participants proposed a regional ocean acidification observing network for West Asia**, in the manner of a GOA-ON regional hub. **Regional cooperation should make use of and benefit from** the existing networks and initiatives of the **Regional Education and Research Centre on Oceanography for West Asia (RCOWA)**, the **Regional Organization for the Protection of the Marine Environment (ROPME)**, the **2nd International Indian Ocean Expedition (IIEO-2)**. Furthermore, support from **international and intergovernmental entities**, such as GOA-ON, IOC-UNESCO and the OA-ICC of the IAEA, will facilitate the development of ocean acidification
capacities in the region by providing training to a number of researchers who can then become mentors to others, access to guidelines, manuals, webinars and standard practices of ocean acidification observations and research and organizing workshops in the region. The exchange of expertise and experience with other researchers within the ocean acidification community, through GOA-ON or similar networks, is a resource to further explore.

The workshop participants identified the production of quality data and information on ocean acidification to protect valuable marine ecosystems and sustainably use the marine resources as the main goal of the ocean acidification research in the region. This would enable the region to contribute to the Sustainable Development Goal 14.3. Additionally, the researchers in the region recognized that raising awareness for ocean acidification and the possible consequences was as a goal for the future.
Annex I – Agenda

Day 1 – 8 June 2019

9:00  Welcome  RCOWA Official / Local Official

9:10  Introduction to the workshop: overview of the Agenda and expected outcomes  IOC-UNESCO (Kirsten Isensee & Local representative (tbc)

9:20  Tour de Table  Short introduction by everybody: Name, Organization, Country, Expertise

9:45  What is ocean acidification? Introduction to the threat of ocean acidification to ocean health and resources  IOC-UNESCO

10:30  Break

10:45  SDG 14.3 – Ocean acidification in the framework of the UN 2030 Agenda and the role of national statistical agencies as well as National Oceanographic Data Centres  Kirsten Isensee (IOC-UNESCO)

11:30  Inorganic carbon chemistry in coral reefs and rocky intertidal shores of the northern Persian Gulf: implication for ocean acidification studies  Dr. Saleh

12:00  Mangrove and coastal acidification, case study: Mangrove ecosystems on the northern coasts of the Persian Gulf  Dr. Ghaemi

12:30  Carbonate chemistry of the Persian Gulf and Gulf of Oman (results of Cruise PGE1803, Sep. 2018)  Dr. Saleh

13:00  Lunch break

14:00  Other regional and global ocean acidification science and observation networks – Science cooperation to address policy demands and best practices  Local representatives, Katherina Schoo, Kirsten Isensee (IOC-UNESCO)

14:30  Interactive Afternoon  Short presentations by participants

Discussion questions:
What are key regional concerns related to OA?
Can you address 14.3?
What is missing to observe ocean acidification?
Do you have access to equipment and trained experts?
Do you use open access data centres?
What is necessary increase regional and international collaboration?

17:30  Wrap up
## Day 2 – 9 June 2019

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<thead>
<tr>
<th>Time</th>
<th>Activity</th>
<th>Presenter/Group</th>
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<tr>
<td>9:00</td>
<td>Technical capacity— what do we need to measure and how?, including introduction to the GOA-ON in a box</td>
<td>IOC-UNESCO</td>
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<td>10:00</td>
<td><strong>Ocean Acidification measurement resources:</strong> Presentation of e.g. GOA-ON data portal and Pier2Peer, IAEA resources, status of SDG indicator 14.3.1 online resources and others</td>
<td>Katherina Schoo (IOC-UNESCO)</td>
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<td>10:30</td>
<td>Break</td>
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| 11:00 | **Interactive Session** in Breakout Groups (by specialty and/or subregion) Drafting of a Roadmap: Steps needed to implement a sustained ocean acidification observing network and related science activities in the West Asia Region to achieve target 14.3 by 2030. Questions to focus on:  
  - What existing capacity does your country/region have?  
  - What additional resources does your country/region need?  
  - Monitoring impact – what experimental facilities and OA research programmes do you have?  
  - What partnerships need to be developed?  
  - How can GOA-ON, IOC, IAEA, GOOS and other entities facilitate this work?  
  - How will this work address SDG 14.3? What steps need to be taken to ensure this happens by 2030? | Keeping in mind the results from the discussions on day 1  
Consider the roles of international and intergovernmental entities like GOA-ON, IOC, IAEA, GOOS, and how they can facilitate this |
| 12:30 | Lunch break                                                               |                 |
| 14:00 | Interactive Session – continued                                           |                 |
| 15:30 | Break                                                                     |                 |
| 16:00 | **Presentations** of breakout group findings and results                 | Lead from each group |
| 17:00 | Summary and steps forward – what next?                                   | Kirsten Isensee & RCOWA Secretariat |
| 17:45 | Closing                                                                   |                 |
Annex II - Background material

Background reading

- Sustainable Development Goal (SDG) 14.3.1 Indicator Methodology, with its associated data file, metadata file, metadata explanation
  - All of the files are available online: [http://goa-on.org/resources/sdg_14.3.1_indicator.php](http://goa-on.org/resources/sdg_14.3.1_indicator.php)
  - SDG 14: [https://sustainabledevelopment.un.org/sdg14](https://sustainabledevelopment.un.org/sdg14)
  - IOC-UNESCO Ocean acidification: [https://en.unesco.org/ocean-acidification](https://en.unesco.org/ocean-acidification)

- Global Ocean Acidification Observing Network GOA-ON
  - GOA-ON website: [http://goa-on.org](http://goa-on.org)
  - GOA-ON data portal: [http://portal.goa-on.org/Explorer](http://portal.goa-on.org/Explorer)
  - Resources and additional information: [http://goa-on.org/resources/other.php](http://goa-on.org/resources/other.php)

Additional Resources

- International Oceanographic Data and Information Exchange (IODE) of the IOC
  - Website: [https://www.iode.org/](https://www.iode.org/)
  - Link to online data and information services maintained by the IODE network of National Oceanographic Data Centres (NODCs) datacentres: [https://www.iode.org/index.php?option=com_content&view=article&id=549&Itemid=100357](https://www.iode.org/index.php?option=com_content&view=article&id=549&Itemid=100357)

- Ocean Acidification International Coordination Centre (OA-ICC) of the International Atomic Energy Agency (IAEA)
  - Website: [https://www.iaea.org/services/oa-icc](https://www.iaea.org/services/oa-icc)
  - OA-ICC news stream for up to date information on ocean acidification research: [https://news-oceanacidification-icc.org/](https://news-oceanacidification-icc.org/)
  - Resources [https://www.iaea.org/services/oa-icc/resources](https://www.iaea.org/services/oa-icc/resources)

- International Ocean Carbon Coordination Project IOCCP
  - Website: [http://www.ioccp.org/](http://www.ioccp.org/)
  - List of sensors and instruments developed and used by the ocean carbon research community: [http://www.ioccp.org/index.php/instruments-and-sensors](http://www.ioccp.org/index.php/instruments-and-sensors)

- Best practices guides:
  - Guide to best practices for ocean acidification research and data reporting: [https://www.oceanbestpractices.net/handle/11329/339](https://www.oceanbestpractices.net/handle/11329/339)
Guide to Best Practices for Ocean CO₂ Measurements:

Ocean Acidification Information Exchange (OAIE) is a useful site for asking questions and discussing issues with members of the ocean acidification research community:
https://www.oainfoexchange.or
## Annex III – List of Participants

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