## Annex 1: Survey of existing national capacities across Africa for harmful algal bloom early warning systems that incorporate oxygen measurements

### Background

The Norwegian Agency for Development Cooperation (NORAD) project “Enhancing early warning systems for supporting resilience in Africa: Safeguarding ocean and human health” is leveraging the Intergovernmental Oceanographic Commission of UNESCO's (IOC) expertise and global networks to build capacity in response to Harmful Algal Bloom (HAB)-related threats. It aims to assist the Member States of IOC in establishing standardized systems for ocean observations, data management, early warning, and community notification. The project is intended to result in the creation of sustained systems beyond the project’s lifespan, build interoperability with current national monitoring and disaster preparedness strategies, and contribute to achieving healthier and more resilient coastal communities in Africa.

To facilitate the identification of potential partnerships with African countries for building skills and capacity in ocean observations, ocean data management and the building of HAB early warning systems that integrate environmental correlates, the project team are assisting IOCAFRICA in assessing the current state of national capacity for building and deploying such early warning systems.

### Survey

This survey and the questions contained within are designed to assess the existing national capacity for:

1. Awareness of HAB events and their impacts
2. Observing and monitoring frameworks for the Global Ocean Observation System's (GOOS) Essential Ocean Variables (EOVs) for phytoplankton and oxygen and for monitoring of HABs (including biotoxins)
3. Data management of observations and monitoring data
4. Capacity and infrastructure for supporting early warning systems

The survey is divided into sections corresponding to the elements described above. In completing the survey, Member States are encouraged to collaborate with and utilize the most reliable and authoritative sources in their countries, including national regulating agencies, ocean science institutions, national data coordinators and data agencies that are part of the IODE community. It is recognised that those agencies that might have oversight of ocean observation programs may differ from those that have oversight of HAB monitoring and alert systems and there may be broader engagement by academic institutions in research and associated data collection on phytoplankton, HABs and oxygen.

To assist in facilitating survey responses from multiple agencies within a country, copies of the survey can be completed separately. In these cases, the project team at IOC will compile information collected for each country. Where multiple agencies and individuals have contributed to the one survey response, please provide the details of all contributors in the survey submission so that they can be made aware of the outcomes of the survey, IOCAFRICA and IOC networks and potential further engagement in the project.

Respondents can also access an online version of the survey at the following link, should they prefer to submit their responses digitally : [LINK [FRENCH](https://forms.cloud.microsoft/Pages/ResponsePage.aspx?id=Uq5PHbM5-kuwswIpVrERlMfnGL1GvYFDo6mTTaZWTpRUOUs2QUFRNks5SzMxOEVMVTZaM0M2TTZYMiQlQCN0PWcu) / [ENGLISH](https://forms.cloud.microsoft/Pages/ResponsePage.aspx?id=Uq5PHbM5-kuwswIpVrERlMfnGL1GvYFDo6mTTaZWTpRUNlM0VDI4UlhRNEdGSEE1V1lLM05JODNWUyQlQCN0PWcu)]. The online version of the survey is a direct copy of this pdf, so there is no need to submit both versions of the survey. Where information for responding to a question is not available, please leave the response empty and move onto the next question. Respondents are encouraged to provide the best information available.

For further information on the project and the survey, please contact the Head of the Ocean Science Section, Dr Karen Evans ([k.evans@unesco.org](mailto:k.evans@unesco.org)) with copy to Dr Henrik Enevoldsen, head of the IOC Science and Communication Centre on Harmful Algae (h.enevoldsen@unesco.org).

The project team would appreciate appreciate receiving submissions of the survey no later than **30 November 2025**. Surveys can be submitted to Ms Yun Sun ([y.sun@unesco.org](mailto:y.sun@unesco.org)) with copy to Dr Karen Evans (k.evans@unesco.org).

### Project team

The project team includes members of the Ocean Science Section (OSS), Ocean Observations and Services (OOS), IOCAFRICA and the IOC International Oceanographic Data and information Exchange (IODE).

### Acknowledgements

The project team would like to acknowledge the assistance of the Global Ocean Oxygen Database and Atlas (GO2DAt) Steering Committee and the wider ocean oxygen community via the Global Ocean Oxygen Network (GO2NE) for their assistance in developing the survey.

# **Contributor details**

## Country being reported on

1. **Country:**

## Focal point(s) for HAB monitoring

1. **Full name of focal point (first name, family name):**
2. **Organisation:**
3. **Email:**
4. **OceanExpert ID (www.oceanexpert.net):**
5. **Sector of your institution (Check all that apply)**

* Public sector / Government
* Industry (Including fisheries, aquaculture)
* Private sector
* Intergovernmental Organisation
* Nongovernmental Organisation
* Academic
* Community group
* Other

## Focal point(s) for oxygen monitoring

1. **Full name of focal point (first name, family name):**
2. **Organisation:**
3. **Email:**
4. **OceanExpert ID (www.oceanexpert.net):**
5. **Sector of your institution (Check all that apply)**

* Public sector / Government
* Industry (Including fisheries, aquaculture)
* Private sector
* Intergovernmental Organisation
* Nongovernmental Organisation
* Academic
* Community group
* Other

## Focal point(s) for the Global Ocean Observing System Essential Ocean Variables

1. **Full name of focal point (first name, family name):**
2. **Organisation:**
3. **Email:**
4. **OceanExpert ID (www.oceanexpert.net):**
5. **Sector of your institution (Check all that apply)**

* Public sector / Government
* Industry (Including fisheries, aquaculture)
* Private sector
* Intergovernmental Organisation
* Nongovernmental Organisation
* Academic
* Community group
* Other

# **Knowledge and monitoring**

## HABs

1. **Does your country have dedicated monitoring systems for phytoplankton and biotoxins?**

* Yes
* No
* I do not know

1. **Does your country have a reporting system for HAB events?**

* Yes
* No
* I do not know

1. **Which organization is responsible for HAB monitoring and/or reporting?**
2. **How often do HAB events occur in your country?**

* Never
* Less than once a year
* Once a year
* Twice a year
* More than twice a year
* I do not know

1. **Which sectors are most affected by HAB events in your country? (Check all that apply)**

* Wild capture fisheries
* Aquaculture
* Tourism
* Public health
* Water supply
* Coastal communities’ livelihoods
* I do not know

1. **What are the consequences of HAB events in your country? (Check all that apply)**

* Food safety
* Seafood contamination
* Food security
* Mass mortalities (of any life)
* Decrease in the amount of seafood products at local markets
* Decrease in the amount of seafood products exported to other countries
* Public health
* Foodborne disease
* Waterborne disease
* Respiratory distress
* External irritation (e.g. to the skin, eyes)
* Sociocultural
* Environmental/ecosystem health
* Impacts on the economy

## Ocean Oxygen

1. **Does your country have dedicated monitoring systems for measuring ocean oxygen?**

* Yes
* No
* I do not know

1. **Does your country have a reporting system for low oxygen events?**

* Yes
* No
* I do not know

1. **Which organization is responsible for oxygen monitoring and/or reporting?**
2. **How often do low-oxygen events occur?**

* Never
* Less than once a year
* Once a year
* Seasonally
* Twice a year
* More than twice a year
* I do not know

1. **Which sectors are most affected by low-oxygen events in your country? (Check all that apply)**

* Wild capture fisheries
* Aquaculture
* Tourism
* Public health
* Water supply
* Coastal communities’ livelihoods
* I do not know

1. **What are the consequences of low-oxygen events in your country? (Check all that apply)**

* Food security
* Mass mortalities (of any life)
* Decrease in the amount of seafood products at local markets
* Decrease in the amount of seafood products exported to other countries
* Public health
* Disease associated with low oxygen-induced cyanobacteria blooms
* Disease associated with mass mortalities
* Sociocultural
* Environmental/ecosystem health
* Impacts on the economy

1. **Are the causes of low oxygen conditions known (e.g. excess nutrient input from land, localised upwelling or stratification, ocean warming and marine heatwaves)?**
   * Yes
   * No
   * I do not know

# **Infrastructure and capability**

## Monitoring programmes and observing systems

1. **Does your country have dedicated ocean observing systems for measuring the Global Ocean Observing System Essential Ocean Variables?**

* Yes
* No
* I do not know

1. **Which organization is responsible for your country’s ocean observing system?**
2. **What essential ocean variables of relevance to HAB and low-oxygen events are regularly monitored in your country? (Check all that apply)**

* Sea state
* Ocean surface stress
* Sea ice
* Sea surface height
* Sea surface temperature
* Subsurface temperature
* Surface currents
* Sea surface salinity
* Subsurface salinity
* Oxygen
* Nutrients
* Particulate matter
* Nitrous oxide
* Dissolved organic carbon
* Ocean colour
* Phytoplankton biomass and diversity
* Microbe biomass and diversity
* Zooplankton biomass and diversity
* Fish abundance and distribution
* Sea turtle abundance and distribution
* Seabird abundance and distribution
* Marine mammal abundance and distribution

1. **What infrastructure and capacity for HABs exists in your country?**

Phytoplankton Biotoxins

Dedicated monitoring infrastructure □ □

Dedicated laboratory facilities □ □

Accredited methods □ □

Trained analysts □ □

Dedicated data storage and systems for data exchange □ □

Other scientific and technical support □ □

1. **What is the sampling frequency for phytoplankton related to HABs?**

* Daily
* Weekly
* Bi-weekly to monthly
* Annually
* Irregularly (only when phytoplankton are detected)
* Other

1. **What approaches and technology are routinely used for biotoxin detection? (Check all that apply)**

* In vivo assay (mouse bioassay)
* Elisa
* Receptor binding assay
* HPLC
* LC-MS/MS
* Cell bioassay
* Other

1. **What is the sampling frequency of oxygen measurements?**

* Continuous
* Daily
* Weekly
* Bi-weekly to monthly
* Annually
* Irregularly (e.g. only when algal blooms are detected)
* Other

1. **Does oxygen sampling occur in the open ocean and/or coastal waters?**

Coastal waters Open ocean

Regular sampling □ □

Irregular sampling □ □

None □ □

## Data and data systems

1. **Does your country have dedicated data management and exchange infrastructure for HABs, oxygen measurements and/or the Essential Ocean Variables?**
   * Yes
   * No
   * I do not know
2. **Which organization(s) is (are) responsible for dedicated data management and exchange infrastructure for HABs, oxygen measurements and/or the Essential Ocean Variables?**

**HABs:**

**Oxygen:**

**Essential Ocean Variables:**

1. **How are data on HABs, oxygen and the Essential Ocean Variables stored and shared in your country? (Check all that apply)**

` HABs Oxygen EOVs

Data are stored on computers – only internal access □ □ □

Data are stored on computers – limited/controlled access □ □ □

Data are stored on national databases – limited/controlled access □ □ □

Data are stored on national databases – public access □ □ □

Data are stored on international databases – public access □ □ □

Data are stored on paper archives □ □ □

Data access currently limited, but planned to be made accessible □ □ □

Data is not accessible

I do not know □ □ □

1. **Do you have historical data on phytoplankton related to HABs?**
   * Yes, from the last year
   * Yes, from the last 5 years
   * Yes, from the last 10 years
   * Yes, from more than 10 years
   * No
   * I do not know
2. **Do you have historical data of biotoxin occurrence in seafood?**
   * Yes, from the last year
   * Yes, from the last 5 years
   * Yes, from the last 10 years
   * Yes, from more than 10 years
   * No
   * I do not know
3. **Do you have historical data for ocean oxygen?**
   * Yes, from the last year
   * Yes, from the last 5 years
   * Yes, from the last 10 years
   * Yes, from more than 10 years
   * No
   * I do not know
4. **Do you have historical data for any of the Essential Ocean Variables?**
   * Yes, from the last year
   * Yes, from the last 5 years
   * Yes, from the last 10 years
   * Yes, from more than 10 years
   * No
   * I do not know

# **Reporting and communication**

1. **Who is evaluating and communicating the data produced by monitoring programs and observation systems? (Check all that apply)**

HABs Oxygen EOVs

Local/regional institution and organization □ □ □

Government □ □ □

The private sector □ □ □

Both government and private □ □ □

The scientific community □ □ □

Communities □ □ □

Other (please specify)

1. **What type of products are generated by monitoring programs and observation systems? (Check all that apply)**

HABs Oxygen EOVs

Datasets (including historical) □ □ □

Summary reports (weekly to annual) □ □ □

Press releases □ □ □

Forecasts (weekly or shorter intervals) □ □ □

Management advice □ □ □

Other (please specify)

1. **What is the target audience for products from the monitoring program? (Check all that apply)**

HABs Oxygen EOVs

National policymakers □ □ □

Shellfish producers □ □ □

Shellfish harvesters □ □ □

Other mollusc producers/harvesters □ □ □

Fishers □ □ □

Fish producers □ □ □

Exporters or importers □ □ □

Local communities □ □ □

National scientists and researchers □ □ □

International scientists and researchers □ □ □

The public □ □ □

Associated and other organizations □ □ □

Other (please specify)

1. **Does your country have an early warning or alert system for HABs?**
   * Yes
   * No
   * Not currently but my country is interested in developing an alert system for HABs
   * My country is currently developing an alert systems for HABs
   * I do not know
2. **If your country has an early warning or alert system for HABs is it connected to your country’s monitoring programs and observation systems?**

* Yes, it is directly informed by monitoring programs and observation systems
* No, it is completely separate from monitoring programs and observation systems
* It is in the process of being connected to monitoring programs and observation systems
* I do not know

1. **In the event of a HAB, how is information typically communicated to the public and relevant sectors (e.g., fisheries, health authorities)? (Check all that apply)**
   * Press release/news
   * SMS/email alerts
   * Government website
   * No formal communication

Other (please specify)