Today we still don’t know the distribution of organisms in the world’s oceans, how they change with latitude and depth, and how they are changing with human uses or climate change.
➢ Supports the global Blue Economy: Conserving biodiversity is critical for sustaining development of coastal communities, small islands

➢ Marine biodiversity is a useful proxy for ecosystem services

➢ Monitoring biodiversity is fundamental to managing ecosystem uses and human health and resilience
Global demand for biodiversity change information: Policy Relevant and Accessible Data

On track to exceed target (we expect to achieve the target before its deadline)
On track to achieve target (if we continue on our current trajectory we expect to achieve the target by 2020)
Progress towards target but at an insufficient rate (unless we increase our efforts the target will not be met by its deadline)
No significant overall progress (overall, we are neither moving towards the target nor away from it)
Moving away from target (things are getting worse rather than better).

2011-2020
United Nations Decade on Biodiversity

AICHI BIODIVERSITY TARGETS

SUSTAINABLE DEVELOPMENT GOALS

Intergovernmental Platform on Biodiversity & Ecosystem Services
OBIS – THE Ocean Biogeographic Information System

The reality: in situ surface ocean (upper 20 m) records
2/3 of our knowledge is in the upper layer (5% of the ocean)

How can we make best use of information to detect, report on and respond to biodiversity change?
Community Experiences and Challenges in Best Practices

Frank Muller-Karger
University of South Florida
OCEAN BEST PRACTICES WORKING GROUP
Vision and Goal

Develop a community of practice to understand changes in marine biodiversity

Focus:
- Ocean Observing Systems and networks
- Coastal zones, EEZ, High Seas
- Marine Protected Areas
- Community resilience and the blue economy
Benefits of an MBON

A sustained, integrated and operational MBON will provide information to enhance:

- biosecurity,
- protect ecosystem and public health,
- enable predictive modeling,
- better inform environmental impact assessments,
- allow for adaptive monitoring and
- ecosystem-based management of living marine resources.
Global Ocean Observing System

Biodiversity Observation Network (BON)

GOOS: Essential Ocean Variables
- Focus on EOVs driven by societal needs
  - Global implementation

ESSENTIAL BIODIVERSITY VARIABLES
- Focus on EBVs driven by science questions and other user needs (policy, societal)
  - National and regional implementation

DATA INTEGRATION AND DISSEMINATION
+ other national, international data systems

OTHER DATA PROVIDERS AND USERS
- National Governments and Organizations
- International Organizations
- Non Government Organizations
- Research Institutions
- Citizen Scientists

INTERNATIONAL LINKAGES

GLOBAL OCEAN VARIABLES PROVIDERS AND USERS
- National Governments
- Non Government Organizations
- Agencies
- Institutions
- Citizen Scientists

GLOBAL OCEAN OBSERVING NETWORK
- National — Regional — Global — Thematic

MBON

MBON Data Gateway

MBON Data Gateway

ESSENTIAL CYCLES

OBSERVING LIFE IN THE OCEANS FOR SOCIETAL BENEFIT
- INFORMATION FLOW -
The GEO BON approach in a nutshell

Developing a standard and flexible framework for biodiversity observations

Supporting the development of Biodiversity Observation Networks

Producing Policy Relevant Outputs
Essential Biodiversity Variables are a minimum set of measurements, complementary to one another, that can capture major dimensions of biodiversity change.

- Biological and policy relevance
- Sensitive to change
- Biological, state variables
- Generalizable across realms
- Scalable
- Feasible
Essential Biodiversity Variables:
Complementary species-centered and ecosystem-centered perspectives

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**Essential Biodiversity Variables (EBVs)**

**Species-focused EBV classes**
- Variables measuring an attribute of a collection of organisms grouped primarily by species identity
  - **Genetic Composition**
    - Variables measuring genetic diversity within species
  - **Species Populations**
    - Variables measuring species distribution and abundance
  - **Species Traits**
    - Variables measuring traits of species

**Ecosystem-focused EBV classes**
- Variables measuring an attribute of a collection of organisms grouped primarily by location
  - **Community Composition**
    - Variables measuring the collective diversity of organisms within ecosystems
  - **Ecosystem Structure**
    - Variables measuring structural attributes of ecosystems
  - **Ecosystem Function**
    - Variables measuring functional attributes of ecosystems

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Fernández et al. 2019 in press
## Global Ocean Observing System (GOOS) 
### Essential Ocean Variables (EOVs)

<table>
<thead>
<tr>
<th>PHYSICS</th>
<th>BIOGEOCHEMISTRY</th>
<th>BIOLOGY AND ECOSYSTEMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sea state</td>
<td>Oxygen</td>
<td>Phytoplankton biomass and diversity</td>
</tr>
<tr>
<td>Ocean surface stress</td>
<td>Nutrients</td>
<td>Zooplankton biomass and diversity</td>
</tr>
<tr>
<td>Sea ice</td>
<td>Inorganic carbon</td>
<td>Fish abundance and distribution</td>
</tr>
<tr>
<td>Sea surface height</td>
<td>Transient tracers</td>
<td>Marine turtles, birds, mammals abundance and distribution</td>
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<tr>
<td>Sea surface temperature</td>
<td>Particulate matter</td>
<td>Hard coral cover and composition</td>
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<tr>
<td>Subsurface temperature</td>
<td>Nitrous oxide</td>
<td>Seagrass cover</td>
</tr>
<tr>
<td>Surface currents</td>
<td>Stable carbon isotopes</td>
<td>Macroalgal canopy cover</td>
</tr>
<tr>
<td>Subsurface currents</td>
<td>Dissolved organic carbon</td>
<td>Mangrove cover</td>
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<tr>
<td>Sea surface salinity</td>
<td><strong>Ocean colour (Spec Sheet under development)</strong></td>
<td>Microrganism biomass and diversity (<em>emerging</em>)</td>
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<tr>
<td>Subsurface salinity</td>
<td></td>
<td>Benthic invertebrate abundance and distribution (<em>emerging</em>)</td>
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<tr>
<td>Ocean surface heat flux</td>
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</tbody>
</table>
Each EOV and EBV has many levels of Best Practices, some to develop, and all to document

How to address this in a systematic manner for ocean observers is a challenge
<table>
<thead>
<tr>
<th>EOV Specification sheet</th>
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<tbody>
<tr>
<td><strong>Name of EOV</strong></td>
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<tr>
<td><strong>Sub-Variables</strong></td>
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<td><strong>Derived Products</strong></td>
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<tr>
<td><strong>Supporting Variables</strong></td>
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<tr>
<td><strong>Responsible GOOS Panel</strong></td>
</tr>
<tr>
<td><strong>Societal Drivers/Pressures (see list of Drivers/Pressures at the end of document)</strong></td>
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<tr>
<td><strong>Readiness Level</strong></td>
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<tr>
<td><strong>Scientific questions</strong></td>
</tr>
<tr>
<td><strong>Phenomena addressed (general)</strong></td>
</tr>
</tbody>
</table>

GOOS EOV Spec sheets published here:
http://goosocean.org/index.php?option=com_content&view=article&id=14&Itemid=114
Challenge: Societally-relevant products need linked data pipelines to make **products**

At least 5 pipelines need to be linked:

- Satellite data (space agencies)
- In situ environmental data (NCEI, DataOne, GOOS)
- Genetic (GenBank/NCBI, RefSeq, Gene Home, SRA, etc.)
- Biodiversity (OBIS, GBIF, others)
- Socio-economic data
Best Practice Challenges

• Define observing requirements
  • User needs
  • Expectations from JCOMM for a network (global footprint, etc.)

• Define Best Practices for EOVs and EBVs
  • Develop and deploy practical protocols for biological observations

• Link local and regional groups engaged in biological observations
  • Governance / coordination

• Capacity building:
  • Observers
  • Users / decision-makers

• Develop useful products beyond scientific research

• Develop + deploy practical, useful in situ and remote sensing technologies

• Integrate biological observations into a multidisciplinary observing system

• Sharing, curating, distributing data

• Etc.