# Interagency Ocean Observation Committee (IOOC) Biology- Integrating Core to Essential Variables (Bio-ICE) Task Team

## Scope of Work

July, 7 2020

## Goals and activities of the task team

The goal of this IOOC task team is to advance the integration of biological observations from local, regional and federal sources using best practices to inform national needs and ultimately feed seamlessly into the Global Ocean Observing System, as appropriate. To accomplish this goal the task team will focus on marine mammals and corals, to:

1. Reconcile the IOOS core biological variables with GOOS Essential Ocean Variables (EOVs) and the Group on Earth Observations' Essential Biodiversity Variables (EBVs), identifying where there are clear synergies in terms of spatial and temporal observing requirements and existing observation infrastructure and delivery including best practices/standards.
2. Identify and improve pathways for data flow for observations of these variables from both the Regional Associations and Federal sources into IOOS. Focus will be on identifying and implementing best practices surrounding standardized data collection and delivery adhering to the FAIR[1], and CARE[2] data principles, as appropriate.

## Background and rationale

Several sessions at the Ocean Observations '19 conference produced recommendations related to biological observations. There are seven key recommendations from the conference that this task team seeks to contribute to (Appendix 1).

To ensure the goal of the task team can be achieved within its time frame, efforts will focus on corals and marine mammals, which have complementary essential variables. We have selected these sets of variables because of their importance to multiple stakeholders, as well as offering opportunities to tie-in to several critical U.S. priorities in ocean science. While the team will focus on these two sets of variables, we acknowledge that there are activities looking at other essential variables that could be synergistic with our efforts, such as SCOR Working Group 158: Coordinated Global Research Assessment of Seagrass System (C-GRASS). We will monitor and engage with such groups should the joint undertaking benefit the task team.

[1] Findable, Accessible, Interoperable, Reusable (https://www.go-fair.org/fair-principles/)
[2] Collective Benefit, Authority to Control, Responsibility, Ethics (https://www.gida-global.org/care)

As mentioned, both of these sets of variables are of interest to a range of local, regional, tribal and federal stakeholders, and they are directly responsive under two of the goals of the Sub-Committee for Ocean Science and Technology's (SOST's) Decadal Vision for Ocean Science[3]. Specifically, under Goal one "Understand the Ocean in the Earth System," the acoustic datasets used to assess occurrence, distribution, abundance, phenology, and density of marine mammals, as well as the satellite data sets and/or towed-diver/video surveys used to evaluate spatial coverage and potentially species composition of corals, are relevant to the Harness Big Data section. Additionally, both of these variables are of interest under Goal two "Promote Economic Prosperity." Preserving coral reefs has both ecological benefit (biodiversity maintenance) and economic benefit (provision of critical habitat to larval and juvenile stages of some commercially harvested species and tourism). Coral reefs may provide goods and services worth $375 billion each year, an impressive figure for an environment that covers less than 1 percent of the Earth's surface[4]. For marine mammals, the ecological benefit to nutrient turnover[5,6] supports healthy fish stocks, which has a direct connection to commercial fisheries, and whale-watching/tourism provides a substantial economic benefit. A recent study put the value of the average great whale, based on its various activities, at more than $2 million, and easily over $1 trillion for the current stock of great whales[7].

The activities proposed by the task team for both corals and marine mammals fall clearly under seven of the eight topic areas (and arguably under all eight topic areas) of the recent Ocean Summit on Technology and Partnerships[8]. Both of the selected sets of variables are also relevant to the Presidential Memorandum [9] on "Ocean Mapping of the United States Exclusive Economic Zone and the Shoreline and nearshore of Alaska." Improving our knowledge and the information available on coral species composition, coverage and location responds directly to mapping the seafloor. While the methods used to map the seafloor may impact marine mammals so understanding their occurrence, distribution and abundance is critical to minimizing impacts during the mapping efforts.

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[3] SOST (2018) "Science and Technology for America's Oceans: A Decadal Vision." https://www.whitehouse.gov/wp-content/uploads/2018/11/Science-and-Technology-for-Americas-Oceans-A-Decadal-Vision.pdf

[4] Costanza, R., R. d'Arge, R. de Groot, S. Farber, M. Grasso, B. Hannon, K. Limburg, S. Naeem, R.V. Oneill, J. Paruelo, R.G. Raskin, P. Sutton, M. van den Belt et al. 1997. "The value of the world's ecosystem services and natural capital." Nature 387, 253–260. https://doi.org/10.1038/387253a0

[5] Roman, J., and J.J. McCarthy. 2010. "The Whale Pump: Marine Mammals Enhance Primary Productivity in a Coastal Basin." PLoS ONE 5 (10): e13255. https://doi.org/10.1371/journal.pone.0013255

[6] Roman, J., J.A. Estes, L. Morissette, C. Smith, D. Costa, J.J McCarthy, J. Nation, S. Nicol, A. Pershing, and V. Smetacek. 2014. "Whales as Marine Ecosystem Engineers." Frontiers in Ecology and the Environment 12 (7): 377–85. https://doi.org/10.1890/130220

[7] Chami, R., S. Oztosun, T. Cosimano, and C. Fullenkamp. 2019. "Nature's Solution to Climate Change." Finance and Development 56(4). https://www.imf.org/external/pubs/ft/fandd/2019/12/pdf/natures-solution-to-climate-change-chami.pdf

[8] Ocean Summit on Technology and Partnerships https://www.whitehouse.gov/wp-content/uploads/2019/11/Ocean-ST-Summit-Readout-Final.pdf

[9] Presidential Memorandum on "Ocean Mapping of the United States Exclusive Economic Zone and the Shoreline and nearshore of Alaska." https://www.whitehouse.gov/presidential-actions/memorandum-ocean-mapping-united-states-exclusive-economic-zone-shoreline-nearshore-alaska/

## Anticipated Impact and Deliverables

The task team will leverage existing infrastructure and information to improve the integration of fit-for-purpose marine mammal and coral observations from local, regional and federal sources using standardized best practices. This will inform national needs, feed seamlessly into the Global Ocean Observing System, and provide a roadmap for IOOS to improve delivery of its other core biological variables consistent with national and global requirements. Deliverables include but may not be limited to:

1. Summary of the synergies between core and essential variables for marine mammals and corals in terms of spatial and temporal observing requirements and existing observation infrastructure and delivery.
2. Identification/development and publication of best practices to deliver fit-for-purpose observations and information for these variables, and submission of existing or new materials to the IOC Ocean Best Practices Repository[10].
3. Evaluation report on how well the variables are being implemented (observation to information delivery to meet requirements) as the task team sunsets.

## Timeline and responsibilities

The task team is proposed for the period June 2020 – January 2022. Activities will focus initially around examination of relationships between core and essential (biodiversity and ocean) variables for corals and marine mammals. Identification of common requirements will be prioritized to ascertain best practices and map data pathways/life cycles. The task team will engage with other existing groups with interest in corals and marine mammals including, but not limited to, the IOOS Association and the NOPP Biodiversity Interagency Working Group. One or a series of working meetings will be held to engage with the broader community in discussions and adoption of best practices, and agreement to share data so that ultimately observations and information from these variables will be increased in IOOS (from both regional and federal sources). Timing and location of the working meeting(s) will depend on ongoing activities.

## Resources Required

**Staff and Facilities:** IOOC staff with the assistance of the Consortium for Ocean Leadership (COL) will provide basic logistical support to facilitate meetings, workshops, and conference calls. In addition, we request support from COL to help organize and host the working group meeting(s), as well as IOOC Exec Sec time to support and coordinate the team.

**Budget:** Initial request of up to $50,000 to host, arrange logistics, and provide invitational travel for expert participants to working meeting(s) in late 2021.

[10] Ocean Best Practices Repository. https://www.oceanbestpractices.org/repository/

## Membership/Representation

The task team shall consist of a minimum of three representatives from at least three of the interested IOOC member agencies and will operate with the approval/oversight of the IOOC.

Within the Team, there will be two sub-groups which will focus on each of the variables identified. Each subgroup will have a Chair who will be responsible for ensuring the sub-group is achieving their tasks/deliverables. Two task team Co-Chairs will oversee the progress of the sub-groups, reconcile the activities, and ensure team deliverables are on time. The team Co-Chairs will also be responsible for keeping in close contact with the sub-group Chairs and assist when needed. All officially recognized task team members can vote. Non-voting participants may be invited to help achieve specific task team objectives. (See list of members below).

## Approval Process/Reporting

The IOOC will be the final approval authority for the scope of work and products for this task team.

- The IOOC Co-Chairs will initially review the final scope of work and proposed products and approve them for review by the IOOC.
- During the time the task team is active, any questions and issues that cannot be resolved by internal consensus will be presented to the IOOC for resolution.
- The task team will provide written or verbal updates at IOOC meetings and as needed to the IOOC Co-Chairs.

## Frequency

The frequency of meetings will be as agreed by the group to achieve the activities in a timely manner.

## Sunset Date

Task team will remain constituted until January 31, 2022, unless disbanded sooner or extended.

A review of the Scope of Work will be undertaken after the first six months initially, and then extended as agreed to upon review thereafter, to ensure continuing relevance to IOOC goals.

## Members

| **General Membership** |
|---|
| Gabrielle Canonico (Team Co-Chair) – NOAA |
| Laura Lorenzoni (Team Co-Chair) – NASA |
| Abby Benson – USGS |

| |
|---|
| Brian Melzian – EPA |

### *Sub-Groups*

| **Corals Membership** | **Marine Mammals Membership** |
|---|---|
| Erica Towle – NOAA *(Chair)* | Sam Simmons – MMC *(Chair)* |
| Jennifer Koss – NOAA | Matt Biddle – NOAA (NOS/IOOS) |
| Kaitlyn Brucker – EPA | Jason Gedamke – NOAA (NMFS) |
| William Fisher – EPA | Stacie Hardy – NOAA (NMFS) |
| Susan Jackson – EPA | Maggie Hunter – USGS |
| Katie Lohr – NOAA | Anu Kumar – Navy |
| Juan Luis Torres Perez – NASA | Keith Mullins – NOAA (NMFS) |
| Anderson Mayfield – NOAA | Kim Parsons – NOAA (NMFS) |
| Sarah O'Connor – NOAA | Jim Price – BOEM |
| Debbie Santavy – EPA | Shannon Rankin – NOAA (NMFS) |
| Curt Storlazzi – USGS | Patty Rosel – NOAA (NMFS) |
| Anna Toline – NPS | Heather Spence – DOE |
| Kimberly Yates – USGS | Sofie Van-Parijs – NOAA (NMFS) |
| ***Contributors:*** | Mike Weise – ONR |
| Sarah Bingo – UHawaii | ***Contributors:*** |
| Miguel Figuerola – IOOS Association | Karin Forney – NOAA (NMFS) |
| Frank Muller-Karger – USF | Erin Moreland – NOAA (NMFS) |

*The task team recognizes that it may be prudent to include representatives from NGOs, academia, and the private sector as discussions evolve, and reserve the right to add additional members from those groups ad hoc where practicable.*

# Appendix 1: Ocean Obs '19 Key Recommendations this task team will directly address

Ecosystem Health and Biodiversity session:

- Integrate biological observations into the global observing system as an integral and necessary component of ocean ecosystem science and understanding.
- Advance decadal plans for a fully encompassing global ocean observing system that integrates biology, biodiversity, physical and biogeochemical observations.
- Implement available technologies for biological observing now, maximizing access to biological data and information to quantify, explain, and forecast biodiversity changes.

Integrating Ocean Observations sessions 1 and 3:

- 1c) Make sure we're measuring the same, important EOVs in comparable ways across geographic scales to inform societal, management and scientific needs.
- 3a) Ensure that observing networks contributing to the global ocean observing system provide updated metadata on progress towards full maturity under the FOO, as well as their data to the relevant open and FAIR regional and global databases
- 3b) Report progress towards the desired global ocean observing system through biennial reporting to the United Nations using EOVs as a reporting framework
- 3c) Increase regional & global coordination throughout the next decade, focusing on partnerships & improved communication; observational capacity including improved data sharing; an expanded funding base for sustained observations.

# Biology: Integrating Core to Essential Variables (Bio:ICE) Task Team

Goals and activities of the ***corals*** task team sub group

The goal of the task team is to advance the integration of biological observations from local, regional, and federal sources using best practices to inform national needs and ultimately feed seamlessly into the Global Ocean Observing System, as appropriate. These goals have been initiated at the GOOS EOV level by David Obura et al., (see GOOS EOV hard coral specification sheet hyperlinked below), and this effort will use those efforts as a platform at the U.S. national level, with the ultimate intention of feeding back into the global level. Many of these efforts are being discussed at the Global Coral Reef Monitoring Network (GCRMN) level, and regional level (i.e., AGGRA, Micronesia Challenge, etc.), and as such, it will be important to have input from those bodies. Additionally, there are efforts within the NGO and private sector in this space (i.e., Allen Coral Atlas, etc.), so this effort should also seek to engage those participants. One marker of success of this effort will be improving the understanding of, and accessibility to, tropical hard coral data. To accomplish this goal this task team sub group will focus on tropical shallow-water hard corals to:

1. Reconcile the IOOS core biological variables with essential variables (Essential Biodiversity Variables, EBVs, and Essential Ocean Variables, EOVs), identifying where there are clear synergies in terms of spatial and temporal observing requirements and existing observation infrastructure and delivery including best practices/standards.
2. Identify and improve pathways for data flow for observations of these variables from both the Regional Associations and Federal sources into IOOS. Focus will be on identifying and implementing best practices surrounding standardized data collection and delivery adhering to the FAIR[1], and CARE[2] data principles, as appropriate.

Specifically for corals, step one above involves reconciliation across these variables:

| IOOS Core Variable | GOOS EOV | GEO EBVs (subset) |
|---|---|---|
| Coral species and abundance | Hard coral cover and composition | Species distribution |
| | | Population abundance |
| | | Population structure |
| | | Phenology |
| | | Morphology |
| | | Reproduction |
| | | Taxonomic diversity |

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| | | |
|---|---|---|
| | | Species interactions |
| | | Habitat structure |

**Table 1:** Coral-specific IOOS core, GOOS Essential Ocean, and a subset of GEO Essential Biodiversity Variables. The subset of GEO EBVs listed have been identified based on those that can be derived from methods used to observe IOOS core and GOOS EOVs based on existing monitoring programs.

With reference to the EOV specification sheet, the task team will identify sub variables, derived products and phenomena of interest (Table 2) to federal agencies and IOOS stakeholders, specifying the required temporal and spatial scales for observations, and which methods (Table 2) can be used to deliver at these scales. This will be cross-referenced against U.S. observing systems and programs and updated with other federal programs/systems that are measuring coral species abundance and distribution. The task team recognizes that genetic composition is an EBV class, and has great importance in the field of coral science. The task team does not wish to exclude genetics and 'omics from the discussions of this task team; however, we recognize that reconciling genetic composition would be premature, as the field is exploding and evolving in this area. Therefore, for the purposes of this task team, genetic composition will not be formally reconciled across IOOS, GOOS, and GEO EBVs at this time.

Additionally, the task team recognizes that a major challenge of this group will not necessarily be reconciling indicators, but rather reconciling how to compare those indicators based on the design of the data collection and/or frequency of data collection. For example, a major focus may be reconciling how to compare coral cover data from fixed sites with coral cover data from random sites. The task team anticipates that an outcome of the project may prompt a need for data modeling efforts to facilitate the reconciling.

| **Sub variables**[3] | **Derived products**[4] | **Phenomena to capture**[5] | **Methods** |
|---|---|---|---|
| Hard coral cover | Maps of coral cover, photomosaics | Status, Trends | long term monitoring surveys, |
| Hard coral areal extent | Maps of areal extent, GIS-based tools (i.e., Vulcan coral atlas) | Loss or decline | monitoring, satellites, |
| Hard coral density | data inventories | Status, Trends | monitoring |
| Hard coral diversity | data inventories | Status, Trends | monitoring |
| Hard coral condition | bleaching/disease dashboards | Loss or decline | monitoring |

[3] Sub-variables: components of the EOV that may be measured, derived or inferred from other elements of the observing system and used to estimate the desired EOV.
[4] Derived products: outputs calculated from the EOV and other relevant information, in response to user needs.
[5] Phenomena: is an observable process, event or property measured or derived from one or a combination of EOVs having characteristic spatial and time scale(s) that addresses the GOOS scientific questions

| | | | |
|---|---|---|---|
| Hard coral habitable substrate | GIS-based tools | Loss or decline | monitoring, satellites, |
| Hard coral size classes | data inventories | Recovery Processes | monitoring |
| Complementary variables | data inventories | Disturbance events (bleaching) | monitoring, satellites |

**Table 2:** Initial list of sub-variables, products, phenomena, and methods from the specification sheet/survey. This is to be added to and/or prioritized as part of the task team activities to identify where to focus to complete step two of the goal.

The temporal and spatial scale requirements, existence and use of established[6] best practices or standard operating procedures, data availability, and phenomena of interest and/or products delivered will be used to prioritize engagement with observing systems and programs and the sub group will use this to determine how best to complete step two above.

Specific steps:

1. Review and discuss Table 1 proposed focus on delivering tropical shallow hard coral abundance and distribution and connecting to any EBVs that can also be delivered based on the methods used to deliver the core variables and EOVs.
2. Review and discuss Table 2 (including definition of terms) – identify additional sub-variables, derived products, phenomena of interest and methods used to deliver those.
3. Review and add to the GOOS BioEco survey results for current observing networks and programs monitoring tropical shallow hard coral abundance and distribution, including which methods they are using and whether the data and products are publically accessible or not. Additions may come from agency research programs or stakeholder observations
4. From the Ocean Best Practices website (https://www.oceanbestpractices.org/), BioEco survey results, agency documents and other stakeholder resources, identify any established[7] best practices or standard operating procedures for the methods or for delivery of derived products.
5. Review the sum total of all this information to identify the pathway(s) of data flow for the sub group to focus on and improve (i.e., second step in our goals).

<u>Proposed foci and hence membership:</u>

- Long-term monitoring surveys

[6] By "established" we mean that they have been formally described/written down, and they have been vetted among, and approved by, network members.

[7] Established meaning they have been formally described/written down, and they have been vetted among, and approved by, network members, if coming from an observing network.

- Benthic habitat mapping
- Photomosaic/Structure from Motion
- Co-location of physical and biogeochemical measurements with biological measurements (temperature, carbonate chemistry, etc. as complementary variables)

# Biology: Integrating Core to Essential Variables (Bio:ICE) Task Team

Goals and activities of the ***marine mammal*** task team sub group

The goal of the task team is to advance the integration of biological observations from local, regional and federal sources using best practices to inform national needs and ultimately feed seamlessly into the U.S. Integrated Ocean Observing System (IOOS) and the Global Ocean Observing System, as appropriate. To accomplish this goal this task team sub group will focus on marine mammals to:

1. Reconcile the IOOS core biological variables with essential variables (Essential Biodiversity Variables, EBVs, and Essential Ocean Variables, EOVs), identifying where there are clear synergies in terms of spatial and temporal observing requirements and existing observation infrastructure and delivery including best practices/standards.
2. Identify and improve pathways for data flow for observations of these variables from both the IOOS Regional Associations and Federal sources into IOOS. Focus will be on identifying and implementing best practices surrounding standardized data collection and delivery adhering to the FAIR[1], and CARE[2] data principles, as appropriate.

Specifically for marine mammals step one above involves reconciliation across these variables:

| IOOS Core Variable | GOOS EOV | GEO EBVs |
|---|---|---|
| Species/abundance | Abundance and distribution | Species distribution |
| | | Population abundance |
| | | Population structure |
| | | Phenology |
| | | Body mass |
| | | Natal dispersal distance |
| | | Demographic traits |
| | | Migratory behavior |
| | | Physiological traits |
| | | Species interactions |
| | | Net primary productivity |
| | | Habitat structure |
| | | Ecosystem extent & fragmentation |

**Table 1:** A table of the marine mammal specific IOOS core, GOOS Essential Ocean, and GEO Essential Biodiversity Variables. GEO EBVs have been identified based on those that can be derived from the various methods used to deliver IOOS core and GOOS EOVs. For example, those that can be derived directly (red) or indirectly (orange) from telemetry data.

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[2] Collective Benefit, Authority to Control, Responsibility, Ethics (https://www.gida-global.org/care)

With reference to the EOV specification sheet, the task team will identify sub variables, derived products and phenomena of interest (Table 2) to federal agencies and IOOS stakeholders, specifying the required temporal and spatial scales for observations, and which methods (Table 2) can be used to deliver at these scales. This will be cross-referenced against a list of U.S. observing systems and programs compiled from a recent GOOS Bio Eco panel survey and updated with other federal programs/systems that are measuring marine mammal abundance and distribution.

| **Sub variables**[3] | **Derived products**[4] | **Phenomena**[5] | **Methods** |
|---|---|---|---|
| Species presence/absence | Density | Population status and trends | Line transect surveys (aerial or vessel-based) |
| Age | Hotspots | Distribution shifts | Unoccupied aerial vehicles |
| Sex | Home range | Species diversity | Unoccupied underwater vehicles |
| Count data | Movement patterns | Mass mortalities | Manned ground-based counts/observations |
| Repeated individual presence (tracking/resights) | Utilization distribution (relative occupation of home range) | | Photo-identification |
| | Migration pathways | | Genetics (eDNA) |
| | Habitat maps | | Tracking/telemetry |
| | Population status (increasing, decreasing, stable) | | Passive acoustic monitoring/hydrophones |

**Table 2:** Initial list of sub-variables, products, phenomena, and methods from the specification sheet/survey. This is to be added to and/or prioritized as part of the task team activities to identify where to focus to complete step two of the goal.

The temporal and spatial scale requirements, existence and use of established[6] best practices or standard operating procedures, data availability, and phenomena of interest and/or products delivered will be used to prioritize engagement with observing systems and programs and the sub group will use this to determine how best to complete step two above.

Specific steps:

[3] Sub-variables: components of the EOV that may be measured, derived or inferred from other elements of the observing system and used to estimate the desired EOV.
[4] Derived products: outputs calculated from the EOV and other relevant information, in response to user needs.
[5] Phenomena: is an observable process, event or property measured or derived from one or a combination of EOVs having characteristic spatial and time scale(s) that addresses the GOOS scientific questions
[6] By “established” we mean that they have been formally described/written down, and they have been vetted among, and approved by, network members.

1. Review and discuss Table 1 proposed focus on delivering marine mammal abundance and distribution and connecting to any EBVs that can also be delivered based on the methods used to deliver the core variables and EOVs.
2. Review and discuss Table 2 (including definition of terms) – identify additional sub-variables, derived products, phenomena of interest and methods used to deliver those.
3. Review and add to the GOOS BioEco survey results for current observing networks and programs monitoring marine mammal abundance and distribution, including which methods they are using and whether the data and products are publicly accessible or not. Additions may come from agency research programs or stakeholder observations.
4. Identify which methods to focus on for remaining task team efforts and adjust membership as necessary.
5. From the Ocean Best Practices website (https://www.oceanbestpractices.org/), BioEco survey results, agency documents and other stakeholder resources, identify any established[7] best practices or standard operating procedures for the methods or for delivery of derived products.
6. Review the sum total of all this information to identify the pathway(s) of data flow for the sub group to focus on and improve (i.e. second step in our goals).

Proposed foci and hence membership:

- Line transect surveys: large vessel (including towed passive acoustics), small vessel, and aerial.
- Passive acoustic monitoring.
- Telemetry: hardening and socialization of metadata standards for telemetry data.
- Photo-ID and CMR abundance estimates.

[7] Established meaning they have been formally described/written down, and they have been vetted among, and approved by, network members, if coming from an observing network.