The Global Ocean Observing System

GCOS

Version: 2.0 March 2025

Essential Ocean Variable Specification Sheet

Zooplankton biomass and diversity

Global Ocean Observing System (2024). Essential Ocean Variable Specification Sheet: Zooplankton biomass and diversity. GOOS Reference No; DOI: [to be assigned]

EOV Specification Sheet curated by:

Biology and Ecosystems Panel

The Global Ocean Observing System

GCOS

DETAILED INFORMATION ON HOW TO READ THE SPECIFICATION SHEET CAN BE FOUND IN THIS GUIDE

Background and justification

Zooplankton (drifting animals in the world's oceans) are foundational to marine ecosystems worldwide, linking primary producers (phytoplankton) to higher trophic levels (including marine mammals, seabirds, fish, and invertebrates), directly sustaining fisheries critical for global food security and livelihoods, and supporting endangered and vulnerable marine megafauna. Zooplankton play a pivotal role in regulating the global carbon cycle, contributing to the biological pump that sequesters carbon in the deep ocean, thereby contributing to the mitigation of climate change. They are also critical for nutrient cycling, recycling key elements like nitrogen and phosphorus, which maintain ocean productivity and sustain marine food webs. Their biomass and diversity are sensitive indicators of ocean health, reflecting responses to stressors such as warming, acidification, and deoxygenation, making them essential for tracking ecosystem health and resilience. Zooplankton underpin marine biodiversity and ecosystem services, and monitoring zooplankton is essential for meeting international goals such as SDG 13 (Climate Action) and SDG 14 (Life Below Water). Furthermore, zooplankton data have interdisciplinary utility, supporting climate models, fisheries management, and ecosystem assessments. To effectively use zooplankton as an Essential Ocean Variable, global collaboration is needed to address observational gaps, standardise methods, and build capacity, particularly in understudied regions, with a focus on areas most vulnerable to climate change impacts. Timely action is needed to expand global zooplankton observation coverage, thereby enhancing sustainable ocean management and informing climate policy.

Integration with Global Observation Frameworks

The Global Climate Observing System (GCOS) developed the Essential Climate Variable (ECV) framework to define necessary observations for monitoring Earth's climate (Bojinski et al., 2014). Some EOVs, including ocean physics, biogeochemistry, and biology/ecosystems variables (GCOS, 2022a; GCOS, 2022b), are also ECVs.

The Essential Biodiversity Variables (EBVs) defined and curated by the Group on Earth Observations Biodiversity Observation Network (GEO BON) complement the GOOS biological and ecosystem (BioEco) EOVs (Muller-Karger et al., 2018; Bax et al., 2019). The EOVs represent the basic observations of a particular parameter or process. EBVs are time-series of biodiversity observations across genes, species populations, communities, or ecosystems. Thus, EOVs may be seen as the building blocks for GEO BON EBVs. The EOVs can be used to synthesise the EBVs as time series of BioEco EOV sub-variables at one location, or as time series of gridded, mapped, or modelled EOVs (Jetz et al., 2019).

The GOOS Biology and Ecosystems Panel collaborates with the Physics and Climate and Biogeochemistry Panels to advance EOVs, advocating for the need for biological observations, information management, and applications. GOOS, MBON, GEO BON, and OBIS work together to standardise guidelines and data management for EOVs, EBVs, and ECVs.

Current observing networks and coordination

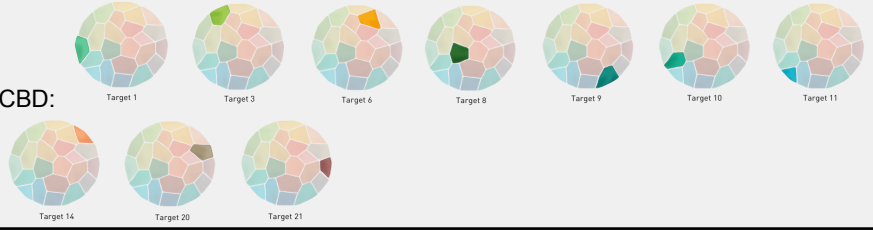
Diverse networks and communities are collecting observations of biology and ecosystems EOVs at different scales and in different regions. An initial baseline survey conducted in 2019/20 identified 203 active, long-term (>5 years) observing programmes systematically sampling marine life. These programmes spanned about 7% of the ocean surface area, mostly concentrated in coastal regions of the United States, Canada, Europe, and Australia (Satterthwaite et al., 2021). This information can be found in the GOOS BioEco Metadata Portal, which is continually updated. To consult the latest information, please visit: https://bioeco.goosocean.org

Contributes to (please click on the symbol for more information):

EBV: 

ECV: 

SDG: 

CBD: 

DRAFT

1. EOV information

ESSENTIAL OCEAN VARIABLE (EOV)	Zooplankton biomass and diversity
DEFINITION	Number and biomass of zooplankton per taxa or total per unit of volume or area of water
EOV SUB-VARIABLES - key measurements that are used to estimate the EOV	**Biomass**, total and/or by taxon, in units of mass (dry mass, wet mass, carbon mass) per unit volume or per unit area of water, and preferably depth-resolved **Abundance** by taxon, in units of number of individuals per unit volume or per unit area of water, and preferably depth-resolved. **Species composition**, relative and/or absolute abundance or biomass of zooplankton taxa within a specific community within a given area and time, preferably depth-resolved.
SUPPORTING VARIABLES - other measurements that are useful to provide scale or context to the sub-variables of the EOV	**Environmental:** sea surface temperature subsurface temperature sea surface salinity subsurface salinity oxygen phytoplankton biomass and diversity
	EOV related: • Functional group • Size class • Life stage • Body size • Body mass (e.g., wet, dry, ash-free, carbon) • Sex • Body composition: Elemental (e.g., C:N ratio), nutritional (e.g., caloric content), and biochemical body composition (e.g., fatty acid content) • Rates measurements (e.g., growth, respiration, ingestion, etc.)

DRAFT

DERIVED PRODUCTS - outputs calculated from the EOV and sub-variables, often in combination with the supporting variables	• Zooplankton biomass and distribution patterns • Zooplankton diversity indices • Size-based indicators of zooplankton assemblages • Functional group indicators of zooplankton assemblages • Zooplankton production (secondary production) • Gross-growth efficiency

DRAFT

2. Phenomena to observe - what we want to observe with this EOV

This section presents examples of priority phenomena for GOOS that can be (partly) characterised by this EOV's sub-variables. This list is not exhaustive but serves to provide general suggestions on how observation efforts can structure their planning and implementation to observe certain phenomena.

The GOOS application area(s) the phenomena are relevant for are depicted as follows: Ocean health 

PHENOMENA TO OBSERVE		Community or population status and trends	Phenological changes	Biogeographical range shifts
PHENOMENA EXTENT	HORIZONTAL	Regional to global	Regional to global	Regional to global
	VERTICAL	Surface to deep sea	Surface to deep sea	Surface to deep sea
	TEMPORAL	Seasonal to decadal	Seasonal to interannual	Interannual to multi-decadal
RESOLUTION TO OBSERVE PHENOMENA	HORIZONTAL	10-100 km	10-100 km	10-100 km
	VERTICAL	10-50 m increments	10-50 m increments	10-50 m increments
	TEMPORAL	Weekly to annual	Weekly to biweekly during critical seasons	Seasonal to annual
SIGNAL TO CAPTURE		Changes in zooplankton community structure, age structure, and biomass, and/or shifts in dominant species.	Changes in seasonal timing of zooplankton biomass peaks, reproduction, or recruitment.	Shift in distribution patterns (both vertical and horizontal) of zooplankton species beyond historical ranges.
SUB-VARIABLES NEEDED TO MEASURE		• Species-specific abundance and biomass • Total zooplankton biomass	• Species and life stage-specific abundance and biomass	• Species-specific abundance and biomass • Vertical and horizontal distribution of key species
SUPPORTING VARIABLES NEEDED		<u>Essential:</u> • Temperature <u>Recommended:</u> • Chlorophyll-a concentrations	<u>Essential:</u> • Temperature profiles (surface to depth) • Photoperiod • Life stage	<u>Essential:</u> • Temperature • Salinity • Dissolved oxygen

DRAFT

	● Salinity ● Nutrient concentrations ● Dissolved oxygen levels ● Ocean stratification indices	● Egg production rates <u>Recommended:</u> ● Chlorophyll-a concentrations ● Moulting rates	<u>Recommended:</u> ● Chlorophyll-a concentrations ● Mixed-layer depth ● Ocean currents (strength, direction) ● Life stage

DRAFT

3. GOOS Observing Specifications or Requirements

This section outlines ideal measurements for an optimal observing system for this Essential Ocean Variable (EOV). It offers guidance on creating a long-term system to observe key phenomena related to the EOV. These values are not mandatory, and no single system is expected to meet all requirements. Instead, the combined efforts of various observing systems should aim to meet these goals. Observations at different scales are also valuable contributions to global ocean observation if shared openly.

EOV	Zooplankton							
PHENOMENA	Community or population status and trends; Phenological changes; Biogeographical range shifts							
EOV SUB-VARIABLE	Zooplankton biomass			**DEFINITION**			Zooplankton biomass refers to the total mass of zooplankton present in a specific volume or area of water, expressed typically in units such mgC m^{-3} (carbon biomass) or gDW m^{-3} (dry weight biomass). It includes total biomass, as well as biomass categorised by taxon, functional group, or size class.	
	Resolution			**Timeliness**	**Uncertainty Measurement**	**Stability**	**Sampling approach**	**References**
	Spatial Horizontal	**Spatial Vertical**	**Temporal**					
IDEAL	Number of replicate samples informed by power analysis and collected	Number of replicate samples informed by power analysis and collected within the	Number of replicate samples informed by power analysis and collected within the	Near-real-time	within uncertainty range for each gear type		Remote sensing: acoustics Ship-based: trawl surveys Ship-based: time series Ship-based: other (optics) Autonomous: sub-surface vehicles	

DRAFT

	within the spatial decorrelati on scale of the data	spatial decorrelation scale of the data to the deepest possible depth	temporal decorrelation scale of the data					
DESIRABLE	10-100 km	10-100 m	Monthly-seasonal	Data availability within 3-6 months of collection				
MINIMUM	>100 km	Depth integrated	Annual	Data availability within 1 year				

EOV SUB-VARIABLE	Zooplankton abundance				**DEFINITION**		Zooplankton abundance refers to the number of individuals of zooplankton present per unit volume or area of water, and is typically expressed as individuals m^{-3} or individuals m^{-2}. It includes total abundance, as well as abundance by species/taxon, functional group, or size class.	
	Resolution			**Timeliness**	**Uncertainty Measurement**	**Stability**	**Sampling approach**	**References**
	Spatial Horizontal	**Spatial Vertical**	**Temporal**					
IDEAL	Number of replicate samples informed	Number of replicate samples informed by	Number of replicate samples informed by	Near-real-time	within uncertainty range for each gear type		Remote sensing: acoustics Ship-based: trawl surveys Ship-based: time series	

DRAFT

	by power analysis and collected within the spatial decorrelation scale of the data	power analysis and collected within the spatial decorrelation scale of the data to the deepest possible depth	power analysis and collected within the temporal decorrelation scale of the data				Ship-based: other Autonomous: sub-surface vehicles	
DESIRABLE	10-100 km	10-100 m	Monthly-seasonal	Data availability within 3-6 months of collection				
MINIMUM	>100 km	Depth integrated	Annual	Data availability within 1 year				

EOV SUB-VARIABLE	Zooplankton species composition	**DEFINITION**	Zooplankton species composition refers to the variety and relative abundance of zooplankton species within a given area and time. It encompasses the taxonomic identification of species present, their proportional contributions to the community structure,

DRAFT

DRAFT

4. Observing approach, platforms and technologies

This table provides examples of approaches and technologies used to collect this EOV to help observe priority phenomena

APPROACH / PLATFORM	Ship-based or moorings: acoustics	Ship-based: surveys	Ship-based: time series
EOV SUB-VARIABLE(S) MEASURED	Abundance Biomass	Abundance Biomass Species composition	Abundance Biomass Species composition
TECHNIQUE / SENSOR TYPE	Multi-frequency (e.g., 200, 120, 38 kHz) hydroacoustics, e.g., EK80, EK60	Net Collections (e.g., Bongo nets, WP2 nets, MOCNESS, Multinet, IKMT, RMT-8, Tucker Trawl) eDNA	Multi-frequency hydroacoustics Net Collections (e.g., Bongo nets, WP2 nets, MOCNESS, Multinet, IKMT, RMT-8, Tucker Trawl) CPR eDNA
SUGGESTED METHODS AND BEST PRACTICES	Calibration of acoustic instruments	Harris et al., 2000 Djurhuus et al., 2018 De Brauwer et al., 2023	Calibration of acoustic instruments Harris et al., 2000 Djurhuus et al., 2018 GO-SHIP CPR De Brauwer et al., 2023
SUPPORTING VARIABLES MEASURED	Some hydroacoustics can also be used to measure current velocity	Some nets have a CTD sensor attached to obtain supporting variables such as temperature, salinity, dissolved oxygen, and fluorescence.	Typically, time series also include CTD deployments and may take other measurements at each station, including nutrient concentrations, chlorophyll-a, primary productivity, etc.

APPROACH / PLATFORM	Ship-based: optical	Autonomous: sub-surface vehicles: acoustics	Autonomous: sub-surface vehicles: optical

DRAFT

EOV SUB-VARIABLE(S) MEASURED	Abundance Biomass Species composition	Abundance Biomass	Abundance Biomass Species composition
TECHNIQUE / SENSOR TYPE	Laser Optical Plankton Counter (LOPC) ISIIS (In Situ Ichthyofauna Imaging System) Underwater Vision Profiler	Glider-borne acoustics sometimes with Kongsberg EK80, or the Acoustic Zooplankton Fish Profiler from ASL.	Glider-borne optical sensors and holographic imaging systems
SUGGESTED METHODS AND BEST PRACTICES	Herman et al., 2004 Cowen et al., 2013 Picheral et al., 2021 Hoving et al., 2019	Reiss et al., 2021 Ohman et al., 2018	Ohman et al., 2018 Picheral et al., 2021
SUPPORTING VARIABLES MEASURED	If sensors are attached, these could also include temperature, salinity, dissolved oxygen, and fluorescence, among others	Gliders are typically outfitted with sensors to measure temperature, salinity and depth, in addition to dissolved oxygen and fluorescence. Other sensors may measure pH.	Gliders are typically outfitted with sensors to measure temperature, salinity and depth, in addition to dissolved oxygen and fluorescence. Other sensors may measure pH.

5. Data and information management

Access to data and information is at the core of an ocean observing system. This section provides essential information on how to contribute data to the GOOS

GOOS approach to data management is aligned with open data and FAIR (Findable, Accessible, Interoperable, Reusable)[1] practices. All EOV data and information is valuable, thus effective data management practices are essential to ensure it remains accessible and (re)usable for future generations.

In this section you will be directed to resources that explain how you can contribute data to global ocean observing and ensure your data and information is accessible, interoperable and sustained. This resource has instructions for different scenarios: an individual submitting data, or existing data centres connecting to the system.

Please follow these practices carefully, as BioEco EOV data FAIRness relies on compliance with these guidelines.

Before proceeding, please note these important points:

1. As a **minimum**, you must ensure information describing your EOV data (i.e. metadata) are visible in the Ocean Data and Information System (ODIS)[2]. Regardless of where the actual data is stored, evidence of its existence must be findable within ODIS.
2. BioEco EOV data is successfully managed if it is discoverable in the **GOOS BioEco Portal.** The BioEco Portal is the central point of access and coordination of BioEco EOV observing programmes. Data visible in ODIS will automatically be visible in the BioEco Portal and vice versa.

3. If data is published to OBIS[3], it will also be visible in ODIS and the BioEco Portal. You do not need to also add it elsewhere, unless there is extra information you would like to include.

The main data management steps are as follow:

1. Become discoverable: ensure the data producers (e.g., organisation, programme, project, etc.) and datasets are visible in ODIS
2. Prepare the required metadata about the data producer and the datasets
3. Publish EOV data (e.g. OBIS)
4. Verify discoverability in ODIS

Not all steps may be relevant for you, but **Step 1 is the minimum required** to ensure your data contributes to EOVs. .

---

[1] Wilkinson et al. 2016 https://doi.org/10.1038/sdata.2016.18
[2] ODIS, part of IOC-UNESCO's International Oceanographic Data and Information Exchange (IODE), is a global federation of data systems sharing interoperable (meta)data about holdings, services, and other resources to enhance cross-domain data accessibility.
[3] OBIS is a global biodiversity database and IOC-UNESCO IODE component, connecting +30 nodes, +1000 institutions, and 99 countries, interoperating with other major biodiversity hubs like GBIF and makes data visible in ODIS as an ODIS node.

TO CONTRIBUTE DATA AND METADATA TO THE GLOBAL OBSERVING SYSTEM, PLEASE GO TO: https://iobis.github.io/eov-data-management/

Figure 2. Map of OBIS Nodes. See https://obis.org/contact/ for a complete list.

Contact the OBIS Secretariat (helpdesk@obis.org) for help setting up your data workflows. To publish BioEco EOV data from systems like NCEI or ERDDAP to OBIS, consider becoming an OBIS node or collaborating with one. The OBIS Secretariat can help guide you through the process of becoming a Node, or connect you with an appropriate OBIS node (Figure 2).

Help Resources

- EOV Metadata Submission tool: https://eovmetadata.obis.org/

ODIS

- General help https://book.odis.org/index.html
- Connecting to ODIS https://book.odis.org/gettingStarted.html
- ODIS Catalogue of Sources: https://catalogue.odis.org/
- Ocean Info Hub: https://oceaninfohub.org/
- Schema.org framework https://schema.org/

OBIS

- OBIS Manual: https://manual.obis.org/
- OBIS YouTube data formatting and publishing videos: https://www.youtube.com/playlist?list=PLIgUwSvpCFS4TS7ZN0fhByj_3EBZ5lXbF
- Darwin Core term reference list: https://dwc.tdwg.org/terms/
- WoRMS taxonomy: https://www.marinespecies.org/
- Spreadsheet template generator https://www.nordatanet.no/aen/template-generator/config%3DDarwin%20Core
- BioData Guide with example code for transforming datasets to DwC: https://ioos.github.io/bio_data_guide/

GOOS BioEco Portal

- Documentation https://iobis.github.io/bioeco-docs/
- Access https://bioeco.goosocean.org/

Zooplankton data products

- COPEPOD
- KRILLBASE
- CPR

References

Background information

Bax, N. et al. 2019. A response to scientific and societal needs for marine biological observations. Frontiers in Marine Science. https://doi.org/10.3389/fmars.2019.00395

Bojinski, S. et al. 2014. The concept of essential climate variables in support of climate research, applications, and policy. Bull. Amer. Meteor. Soc., 95, 1431–1443, doi:https://doi.org/10.1175/BAMS-D-13-00047.1.

GCOS, 2022a. The 2022 GCOS Implementation Plan (GCOS-244). World Meteorological Organization, Geneva. https://library.wmo.int/records/item/58104-the-2022-gcos-implementation-plan-gcos-244.

GCOS, 2022b. The 2022 GCOS ECVs Requirements (GCOS 245). World Meteorological Organization, Geneva. https://library.wmo.int/records/item/58111-the-2022-gcos-ecvs-requirements-gcos-245

Jetz, W. et al. 2019. Essential biodiversity variables for mapping and monitoring species populations. Nature Ecology & Evolution. 3, p. 539–551. Doi: 10.1038/s41559-019-0826-1.

Miloslavich, P et al. 2018. Essential Ocean Variables for sustained observations of marine biodiversity and ecosystems. Global Change Biology. Volume 24, Issue 6. Pages 2416-2433. http://dx.doi.org/10.1111/gcb.14108.

Muller-Karger, F. 2018. Advancing Marine Biological Observations and Data Requirements of the Complementary Essential Ocean Variables (EOVs) and Essential Biodiversity Variables (EBVs) Frameworks. Frontiers in Marine Science. https://doi.org/10.3389/fmars.2018.00211.

Satterthwaite et al. 2021. Establishing the Foundation for the Global Observing System for Marine Life. *Front. Mar. Sci. 8.* https://doi.org/10.3389/fmars.2021.737416

Guides, best practices and methods

Cowen, R. K., Greer, A. T., Guigand, C. M., Hare, J. A., Richardson, D. E., & Walsh, H. J. (2013). Evaluation of the In Situ Ichthyoplankton Imaging System (ISIIS): comparison with the traditional (bongo net) sampler. *Fishery Bulletin*, *111*(1).

Continuous Plankton Recorder survey, Marine Biological Association, Plymouth. Accessible on https://www.cprsurvey.org/ (accessed April 07, 2025).

De Brauwer, M., Clarke, L. J., Chariton, A., Cooper, M. K., de Bruyn, M., Furlan, E., MacDonald, A. J., Rourke, M. L., Sherman, C. D. H., Suter, L., Villacorta-Rath, C., Zaiko, A., & Trujillo-González, A. (2023). Best practice guidelines for environmental DNA biomonitoring in Australia and New Zealand. *Environmental DNA*, 5, 417–423. https://doi.org/10.1002/edn3.395

Demer, D.A.; Berger, L.; Bernasconi, M.; Bethke, E.; Boswell, K.; Chu, D.; Domokos, R. et al. (2015) Calibration of acoustic instruments. ICES Cooperative Research Report No. 326, 133pp. DOI: http://dx.doi.org/10.25607/OBP-185

Djurhuus, A., Pitz, K., Sawaya, N.A., Rojas-Márquez, J., Michaud, B., Montes, E., Muller-Karger, F. and Breitbart, M. (2018), Evaluation of marine zooplankton community structure through environmental DNA metabarcoding. Limnol. Oceanogr. Methods, 16: 209-221. https://doi.org/10.1002/lom3.10237

Harris, R., Wiebe, P., Lenz, J., Skjoldal, H. R., & Huntley, M. (Eds.). (2000). *ICES zooplankton methodology manual*. Elsevier.

Herman, A. W., Beanlands, B., Phillips, E. F. (2004). The next generation of Optical Plankton Counter: the Laser-OPC. *Journal of Plankton Research*, 26:10, 1135–114. https://doi.org/10.1093/plankt/fbh095

Hoving, H.-J., Christiansen, S., Fabrizius, E., Hauss, H., Kiko, R., Linke, P., Neitzel, P., Piatkowski, U., and Körtzinger, A. (2019). The Pelagic In situ Observation System (PELAGIOS) to reveal biodiversity, behavior, and ecology of elusive oceanic fauna. Ocean Sci., 15, 1327–1340, https://doi.org/10.5194/os-15-1327-2019.

Ohman, M.D., Davis, R.E., Sherman, J.T., Grindley, K.R., Whitmore, B.M., Nickels, C.F. and Ellen, J.S. (2019), *Zooglider:* An autonomous vehicle for optical and acoustic sensing of zooplankton. Limnol Oceanogr Methods, 17: 69-86. https://doi.org/10.1002/lom3.10301

Picheral, M., Catalano, C., Brousseau, D., Claustre, H., Coppola, L., Leymarie, E., Coindat, J., Dias, F., Fevre, S., Guidi, L. and Irisson, J.O., Legendre, L., Lombard, F., Mortier, L., Penkerch, C., Rogge, A., Schmechtig, C., Thibault, S.,Tixier, T., Waite, A., Stemmann, L. (2022). The Underwater Vision Profiler 6: an imaging sensor of particle size spectra and plankton, for autonomous and cabled platforms. *Limnology and Oceanography: Methods*, *20*(2), 115-129.

Reiss, C. S., Cossio, A. M., Walsh, J., Cutter, G. R., & Watters, G. M. (2021). Glider-Based estimates of meso-zooplankton biomass density: a fisheries case study on antarctic krill (Euphausia superba) around the northern antarctic peninsula. *Frontiers in Marine Science*, *8*, 604043.

SCOR Working Group 154 (2020) Recommendations for plankton measurements on the GO-SHIP program with relevance to other sea-going expeditions. SCOR Working Group 154 GO-SHIP Report, (Boss, E. et al). Scientific Committee on Oceanic Research, 70pp. DOI: http://dx.doi.org/10.25607/OBP-718

Standards and reference materials

Integrated EOV products and visualisations

Contributors

Leading authors	Kim Bernard, Svenja Halfter
Contributing authors	Elizabeth Lawrence, Ward Appeltans, Pier Luigi Buttigieg, Ana Lara-Lopez

DRAFT

Acronyms and Abbreviations

CBD: Convention on Biological Diversity

EBV: Essential Biodiversity Variables

ECV: Essential Climate Variables

EOV: Essential Ocean Variables

GCOS: Global Climate Observing System

GEO BON: Group on Earth Observations Biodiversity Observation Network

GOOS: Global Ocean Observing System

IOCCP: International Ocean Carbon Coordination Project

MBON: Marine Biodiversity Observation Network

MOCNESS: Multiple Opening-Closing Net and Environmental Sensing System

OBIS: Ocean Biodiversity Information System

ODIS: Ocean Data Information System

OCG: Observation Coordination Group

OOPC:Ocean Observations Physics and Climate Panel

SDG: Sustainable Development Goals

DRAFT

Glossary of terms

Derived products: outputs calculated from the EOV and sub-variables, often in combination with the supporting variables, that contribute to evaluating change in phenomena. For example, evaporation can be determined from sea surface temperature measurements; air-sea fluxes of CO2 can be derived from inorganic carbon EOV; fish stock productivity can be determined from fish abundance.

Indicators: An indicator can be defined as a 'measure based on verifiable data that conveys information about more than just itself'. This means that indicators are purpose dependent - the interpretation or meaning given to the data depends on the purpose or issue of concern. (BIP definition)

Measurement Uncertainty: the parameter, associated with the result of a measurement, that characterises the dispersion of the values that could reasonably be attributed to the measurand (GUM)1. It includes all contributions to the uncertainty, expressed in units of 2 standard deviations, unless stated otherwise

Phenomena: properties (e.g., of a species such as distribution), processes (e.g., of the ocean such as surface ocean heat flux), or events (e.g., such as algal blooms) that have distinct spatial and temporal scales, and when observed, inform evaluations of ocean state and ocean change

Stability: The change in bias over time. Stability is quoted per decade.

Supporting variables: other measurements that are useful to provide scale or context to the sub-variables of the EOV (e.g., pressure measurements to provide information on the depth at which subsurface currents are estimated, sea temperature to understand dissolved inorganic carbon, water turbidity to support estimations of hard coral cover).

Sub-variables: key measurements that are used to estimate the EOV (e.g., counts of individuals to provide an estimate of species abundance (such as fish, mammals, seabirds or turtles), partial pressure of carbon dioxide (pCO_2)to estimate ocean inorganic carbon, or wave height to estimate sea state).

Timeliness: The time expectation for availability of data measured from the data acquisition time.

DRAFT

Appendix - Additional information

A1. Applications

This table provides examples of applications of this EOV, including, contribution to other essential variable frameworks, multilateral environmental agreements, contribution to indicators and GOOS applications

EOV		Zooplankton biomass and diversity
CORRESPONDING ESSENTIAL VARIABLES	ECV	Plankton
	EBV	Genetic composition: Intraspecific genetic diversity, genetic differentiation, effective population size Species populations: Species distributions, species abundances Species traits: Morphology, physiology, phenology, movement, reproduction Community composition: community abundance, taxonomic/phylogenetic diversity, trait diversity, interaction diversity
GLOBAL INDICATORS EOV CAN CONTRIBUTE	**SDG**	SDG 2: Zero hunger 2.3: Increase productivity and incomes of small-scale food producers including fishers SDG 8: Decent work and economic growth - Zooplankton supports growing employment in fisheries and tourism SDG 13: Climate Action 13.3 Zooplankton as early warning signs to raise awareness of climate change SDG 14: Life below water 14.1: Zooplankton as sentinels for marine pollution 14.2: Zooplankton community essential to support a healthy ocean 14.3: Zooplankton as sentinels for ocean acidification, especially pteropods 14.5: Zooplankton essential for ecosystems in protected areas 14.7: Zooplankton community supports fisheries and tourism for Small Island developing States and least developed countries 14.a: Increase scientific knowledge, research and technology for ocean health 14.b: Zooplankton supports small-scale fisheries as a major prey for fish
	CBD	Target 1: Plan and manage all areas to reduce biodiversity loss Target 2: Restore 30% of all degraded ecosystems Target 3: Conserve 30% of land, waters, and seas Target 4: Halt species extinction and protect genetic diversity Target 6: Reduce the introduction of invasive alien species by 50% and minimize their impact Target 8: Minimize the impacts of climate change on biodiversity and build resilience Target 9: Manage wild species sustainably to benefit people Target 10: Enhance biodiversity and sustainability in aquaculture and fisheries Target 14: Integrate biodiversity in decision-making at every level Target 21: Ensure that knowledge is available and accessible to guide biodiversity action

DRAFT

	UN Ocean Decade	Challenge 2: Protect and restore ecosystems and biodiversity Challenge 3: Sustainably nourish the global population Challenge 4: Develop a sustainable, resilient and equitable ocean economy Challenge 7: Sustainably expand the Global Ocean Observing System Challenge 10: Restore society's relationship with the ocean
GOOS APPLICATIONS		

DRAFT

A2. Additional supporting material and literature

Suggested literature

Other material

A3. Readiness level assessment

Essential Ocean Variable Specification Sheet

Sponsored by: