



Global Ocean Observing System



Seagrass Cover and Composition An Essential Ocean Variable

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A series supported by:



In collaboration with:



GOOS Essential Ocean Variables (EOVs)

EOVs make it easier to measure and compare ocean data from all corners of the world!

EOVs focus on **three** main delivery areas:



EOVs are grouped by discipline and are overseen by **three** GOOS expert panels:



EOVs can be described by **three** key elements:



Basic measurements for estimating the main EOV (e.g., counting marine turtles)

Additional measurements offering context (e.g., measuring water temperature for understanding environmental conditions affecting turtles)

Outputs calculated from the sub-variables and other relevant information (e.g., visible changes in turtle population using turtle count and water condition)

GOOS Biology and Ecosystems EOVs

BioEco EOVs are the **minimum set of ocean variables** for biology and ecosystems identified to help understand and forecast marine life.

They provide a **framework for coordinating** ocean observations, ensuring **globally comparable and combinable data**.



If you want to know more about the BioEco EOVs....

Follow the GOOS BioEco EOVI webinar series

All sessions will be recorded and made available

- **Introductory webinar: The GOOS Biology and Ecosystems Essential Ocean Variables (BioEco EOVs) and Data Management**
Thursday, July 10th 2025 | 23:00 – 00:00 UTC+0 [Webinar recording](#)
and Friday, July 11th 2025 | 13:00 – 14:00 UTC+0 [Webinar recording](#)
- **Seagrass cover and composition | Macroalgae canopy cover and composition**
Friday, September 19th 2025 | 13:00 – 14:00 UTC+0 | [More information](#) | [Register here!](#)
- **Coral cover and composition | Microbe biomass and diversity**
Friday, October 10th 2025 | 13:00 – 14:00 UTC+0
- **Phytoplankton biomass and diversity | Zooplankton biomass and diversity**
Thursday, October 16th 2025 | 22:00 – 23:00 UTC+0
- **Sea turtles abundance and distribution | Benthic invertebrates abundance and distribution**
Thursday, November 13th 2025 | 23:00 – 00:00 UTC+0
- **Seabirds abundance and distribution | Marine mammal abundance and distribution**
Friday, November 21st 2025 | 13:00 – 14:00 UTC+0
- **Fish abundance and distribution | Ocean sound**
Friday, December 12th 2025 | 20:00 – 21:00 UTC+0
- **Mangrove cover and composition**
Friday, December 12th 2025 | 13:00 – 14:00 UTC+0

Seagrass Cover and Composition

An Essential Ocean Variable (EOV)

- Feasibility
- Impact
- Low cost
- Replicability



Credit: Ben Jones / Ocean Image Bank

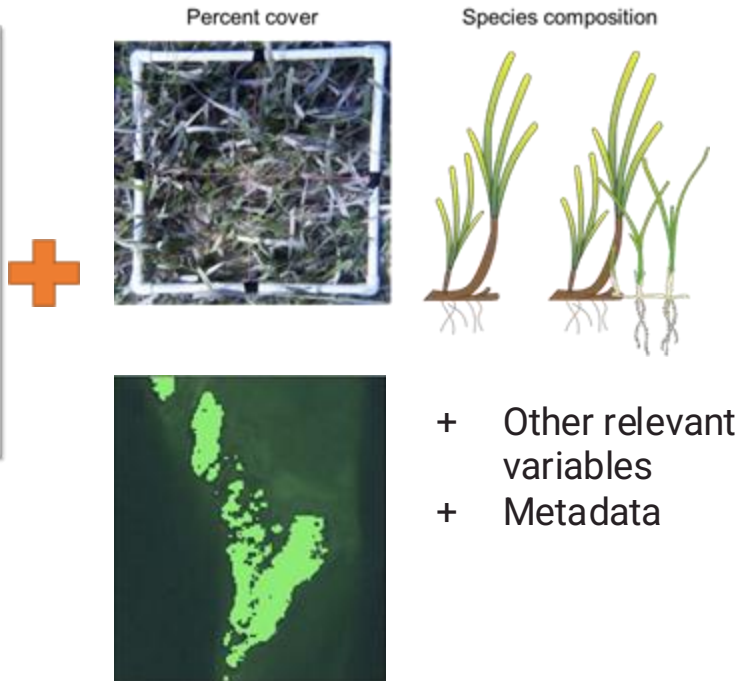
Many benefits of being coordinated

Standardized protocols

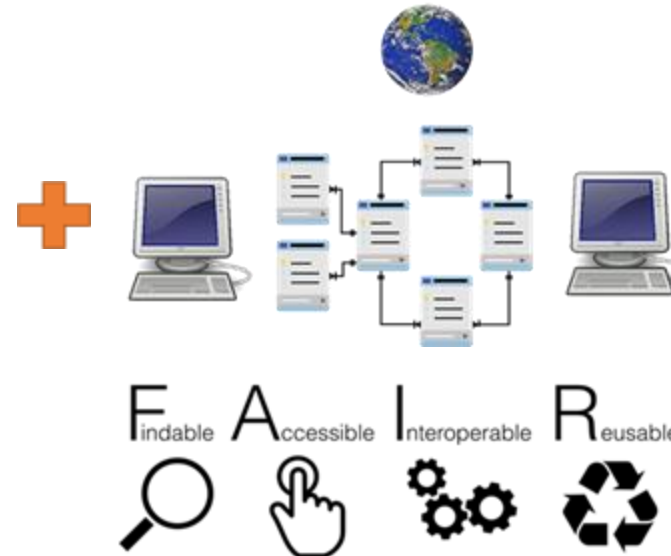


Standardized operating procedures (SOP)

Seagrass EOVS



Shared data system



Products and benefits



Invasive species alert



Seagrass degradation alert



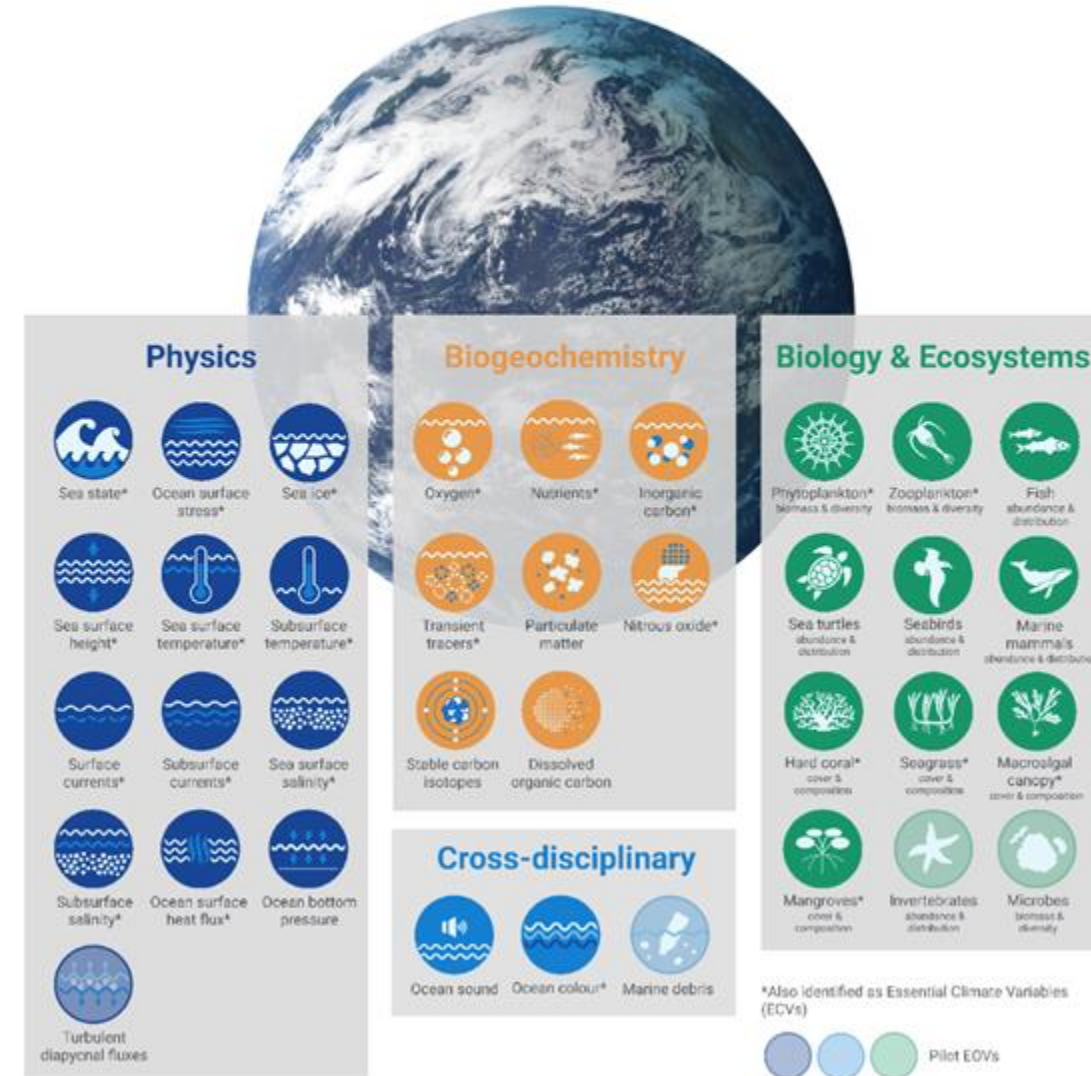
Regional and global science

EOV specification sheet

Provides a common framework for coordination guiding the collection of ocean observations.

A tool to help standardise oceanographic data collection and analysis and contribute information on EOVs to the Global Ocean Observing System.

GOOS EOV Specification Sheet



Essential Ocean Variable (EOV) Specification Sheets

Background & Justification

Defines the societal & scientific drivers, pressures, & applications related to the EOV

Funders and decision makers

SDG

Applications

EOV data informs decision making to meet societal requirements

Research scientists

Phenomena to Observe

Provides examples of processes, events, or ocean properties to observe with the EOV based on societal and scientific drivers

Data Management & Information

Provides guidelines to contribute to open access data repositories that enable global knowledge

Data managers

EOV Observing specifications

Defines the ideal observations of this EOV to capture the phenomena of interest

Observing systems, monitoring programmes, data collectors

Observing approaches

Illustrates sampling approaches to measure the EOV and capture the phenomena

Essential Ocean Variable Specification Sheet

Seagrass cover and composition



Global Ocean Observing System (2025). Essential Ocean Variable Specification Sheet:
Seagrass cover and composition. GOOS Reference No; DOI: [to be assigned]

EOV Specification Sheet curated by:



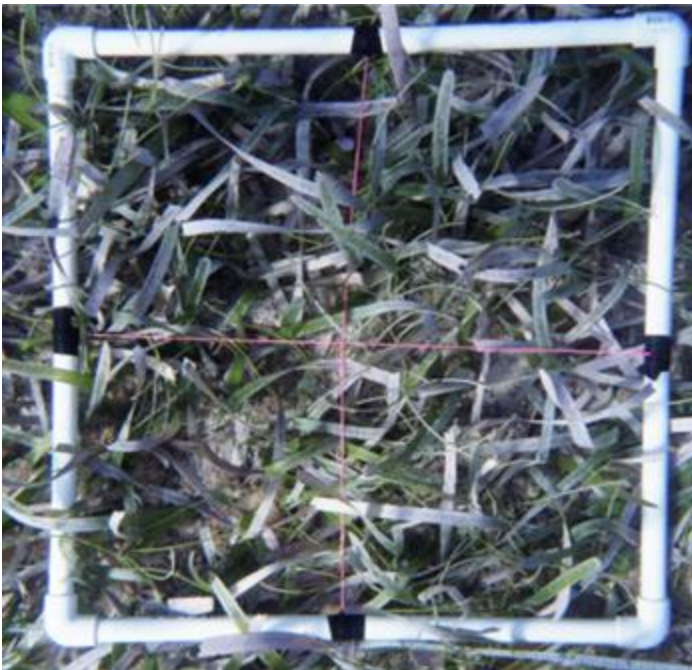
1. EOVS information

ESSENTIAL OCEAN VARIABLE (EOV)	Seagrass cover and composition
DEFINITION	The areal extent, cover, and species composition of the submerged plants that form the foundation of seagrass habitats and ecosystems
EOV SUB-VARIABLES - key measurements that are used to estimate the EOVS	Seagrass percent cover Seagrass species composition Seagrass areal extent
SUPPORTING VARIABLES - other measurements that are useful to provide scale or context to the sub-variables of the EOVS	Environmental: water depth, water clarity, water temperature, salinity, sediment characteristics (grain size distribution, bulk density, organic carbon content), nutrient concentrations (NO ₃ , PO ₄ , etc.), pH, dissolved oxygen concentration, land runoff, fishing pressure, coastal development, tourism pressure, surrounding habitats EOV related: seagrass shoot length, seagrass canopy height, seagrass shoot density, seagrass (above- and/or below-ground) biomass, epiphytic algae cover and/or biomass, seagrass productivity, seagrass elemental nutrient content, seagrass ash rate and seagrass dry weight
DERIVED PRODUCTS - outputs calculated from the EOVS and sub-variables, often in combination with the supporting variables	Global and regional seagrass distribution, seagrass diversity metrics, ecosystem resilience (representing ecosystem state, recovery capacity), carbon storage/sequestration, essential habitat for species of conservation interest, fish, etc

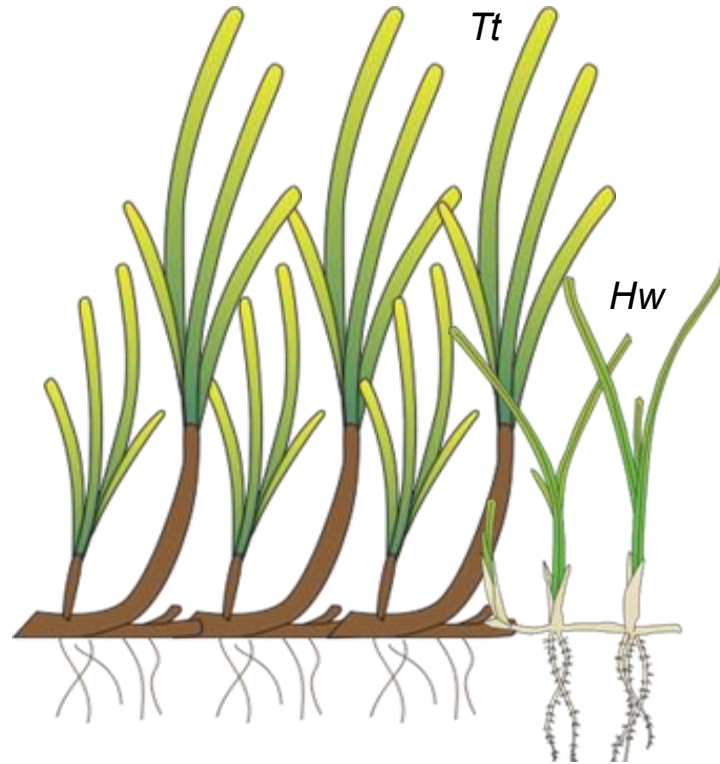
Seagrass EOV Sub-variables

Key measurements that are used to estimate the EOV

Percent cover



Species composition



Areal extent



Duffy, E. et al
Measuring and reporting on seagrass as an Essential Ocean Variable for science and sustainable development.
BioScience (In review)

Seagrass EOV supporting variables

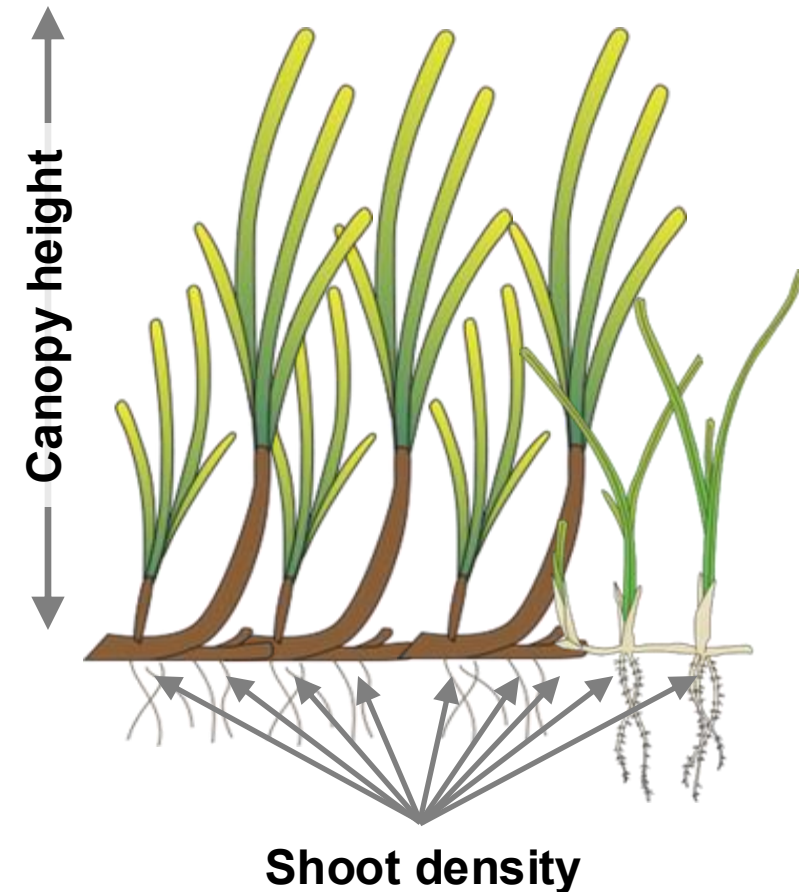
Other measurements that are useful to provide scale or context to the sub-variables of the EOV

Environmental:

water depth, water clarity, water temperature, salinity, sediment characteristics (grain size distribution, bulk density, organic carbon content), nutrient concentrations (NO₃, PO₄, etc.), pH, dissolved oxygen concentration, land runoff, fishing pressure, coastal development, tourism pressure, surrounding habitats

EOV related:

seagrass shoot length, seagrass canopy height, seagrass shoot density, seagrass (above- and/or below-ground) biomass, epiphytic algae cover and/or biomass, seagrass productivity, seagrass elemental nutrient content, seagrass ash rate and seagrass dry weight



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

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

The GOOS application area(s) the phenomena are relevant for are depicted as follows: Climate , ocean health , operational services 

PHENOMENA TO OBSERVE		Habitat status and trends 	Carbon stock and sequestration trends (estimated) 	Changes in species composition 
PHENOMENA EXTENT	HORIZONTAL	local, regional, global	local, regional, global	local, regional, global
	VERTICAL	0 – 100 m	0 – 100 m	0 – 100 m
	TEMPORAL	Seasonal to decadal	Decadal	Weeks to year
RESOLUTION TO OBSERVE PHENOMENA	HORIZONTAL	10 - 1000 m	10 - 1000 m	10 - 1000 m
	VERTICAL	NA	NA	NA
	TEMPORAL	Seasonal to annual	Seasonal to decadal	Seasonal to decadal
SIGNAL TO CAPTURE		>25% change in cover and/or species lost or gained and/or >20% change areal extent	>20% change areal extent and/or >25% change in cover and/or species lost or gained.	species lost or gained
SUB-VARIABLES NEEDED TO MEASURE		percent cover, species composition, areal extent	areal extent, percent cover, species composition	species composition, percent cover, areal extent
SUPPORTING VARIABLES NEEDED		Water clarity	Carbon and emission factors from IPCC (literature-based numbers), Sediment characteristics (esp organic carbon), Carbon sequestration rates from the literature (ref in prep)	

Habitat status and trends

Carbon stock and sequestration trends (estimated)

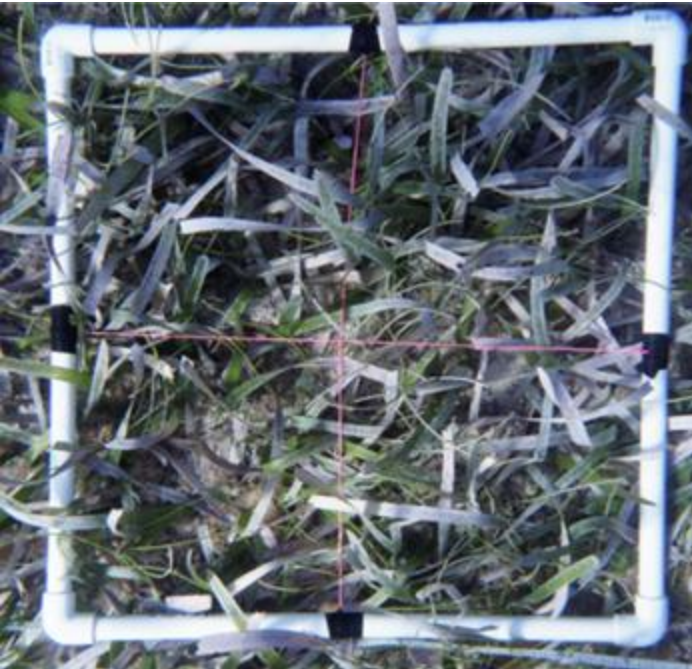
Changes in species composition



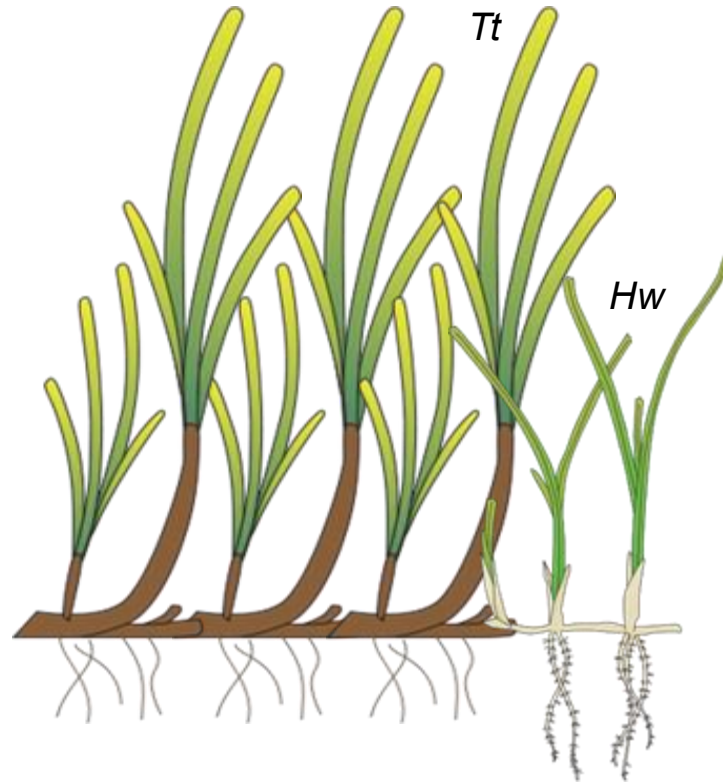
Seagrass EOV Sub-variables

Key measurements that are used to estimate the EOV

Percent cover



Species composition



Areal extent

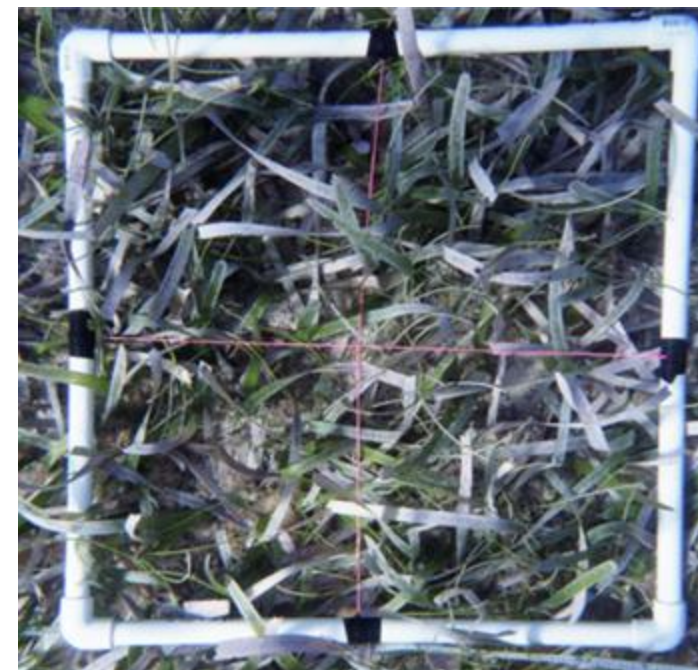


Seagrass percent cover

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 these specifications. 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	Seagrass cover and composition							
PHENOMENA	Habitat status and trends, carbon stock and sequestration trends (estimated), changes in species composition							
EOV SUB-VARIABLE	Seagrass percent cover				DEFINITION		The percent of substrate covered by seagrass plants, measured in a defined sample area (%)	
	Resolution			Timeliness	Uncertainty Measurement	Stability	Sampling approach	References
	Spatial Horizontal	Spatial Vertical	Temporal					
IDEAL	<1 m	NA	Seasonal		<10% cover		In situ measurements in defined areas (e.g. quadrats) estimate the cover of seagrass in total and/or by species, to the nearest % possible (minimum: in Braun-Blanquet categories of seagrass total)	Braun-Blanquet cover categories Fourqurean et al. 2001
DESIRABLE	< 1 m	NA	Annual		10-20% cover			Point counts Protocol Cover and density
MINIMUM	< 5 m	NA	Decadal		10-40% cover			Kenworthy, W.J., et al. 1993.



Seagrass species composition

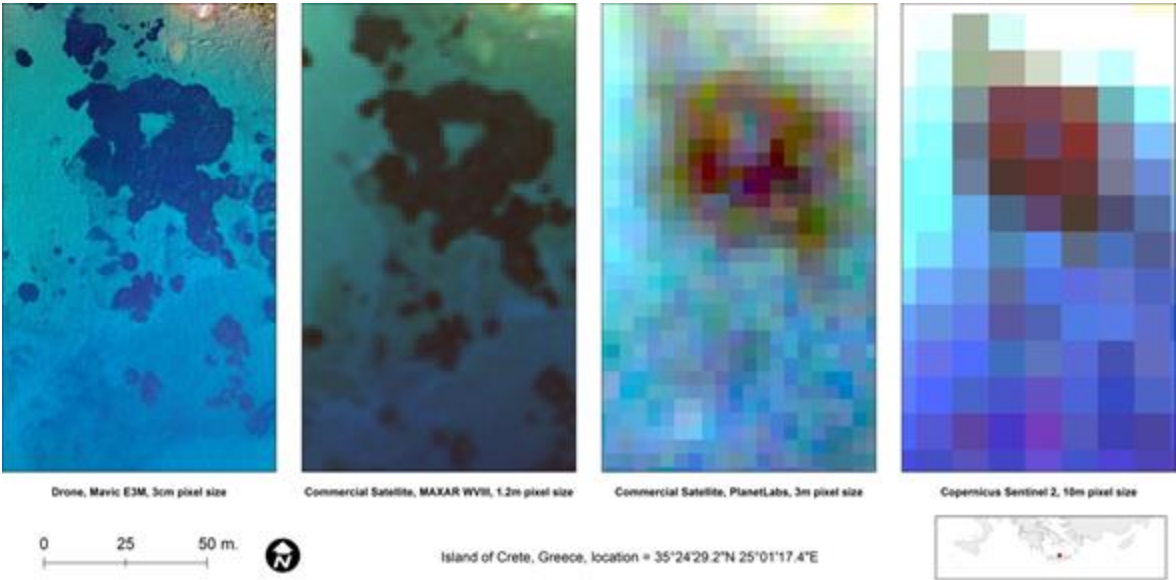
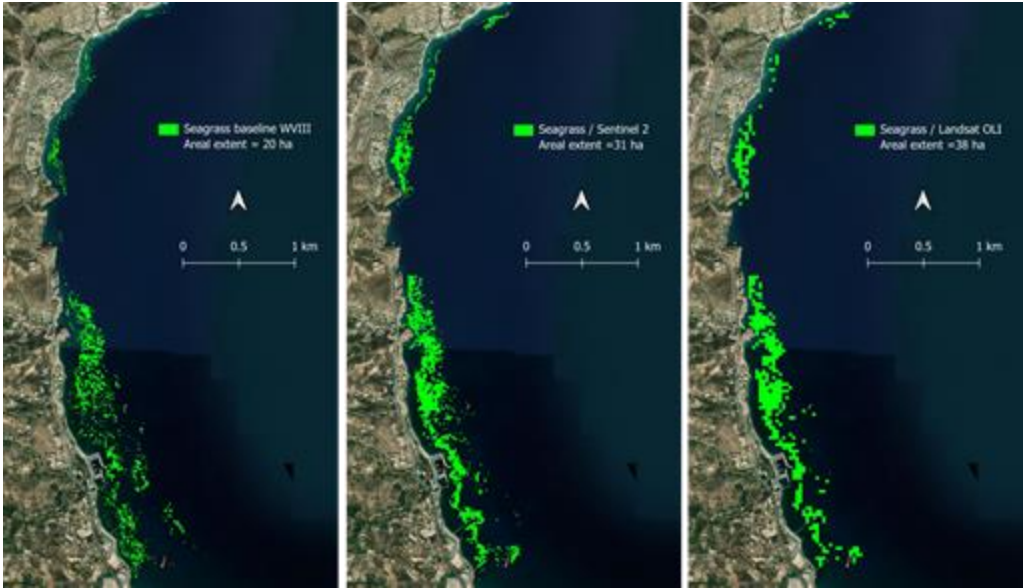
EOV SUB-VARIABLE	Seagrass species composition				DEFINITION		Seagrass species present	
	Resolution			Timelines	Uncertainty Measurement	Stability	Sampling approach	References
	Spatial Horizontal	Spatial Vertical	Temporal					
IDEAL	<1m	NA	Seasonal		ID to species level		Record the presence of a seagrass species and the location. Minimum: closest possible functional/morphological categories)	
DESIRABLE	<1m	NA	Annual					
MINIMUM	<5m	NA	5 year		Functional/ morphological categories			Kilminster et al., 2015

Species composition



Seagrass areal extent

EOV SUB-VARIABLE	Seagrass areal extent				DEFINITION		The horizontal spatial extent of seagrass	
	Resolution			Timeliness	Uncertainty Measurement	Stability	Sampling approach	References
	Spatial Horizontal	Spatial Vertical	Temporal					
IDEAL	<1*1m (pixel size)		Seasonal, and after extreme events. Sample during the same month		5%		Ideal and desirable: Acquire imagery and apply image classification techniques. Minimum: Create polygons of seagrass meadows using GPS-enabled devices (i.e. smartphone, handheld GPS unit) by walking, swimming or using a boat.	
DESIRABLE	<10*10m (pixel size)		Annual, and after extreme events. Sample during the same season.		10%			
MINIMUM	<30*30m (pixel size)		Decadal		+/- 5m radius			



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	Fixed Point: diver survey or other	Fixed Point: diver survey or other	Remote sensing: satellite
EOV SUB-VARIABLE(S) MEASURED	percent cover, species composition	species composition	areal extent
TECHNIQUE / SENSOR TYPE	Quadrat based surveys, incl. drop camera, photoquadrat	Point observation	Satellite observations
SUGGESTED METHODS AND BEST PRACTICES	Kenworthy, W.J., et al. 1993, species composition - SeagrassSpotter.org, Althaus et al., 2015; Kilminster et al., 2015, den Hartog 1970, Pixel classification - Roelfsema et al 2014 Calibration standards - Foden, 2007		Dierssen et al 2021 Poursanidis et al., 2021 Trinh et al., 2023
SUPPORTING VARIABLES MEASURED	water depth		surrounding habitats

APPROACH / PLATFORM	Remote sensing: other	Fixed-point: other	Fixed Point: other
EOV SUB-VARIABLE(S) MEASURED	areal extent	areal extent, percent cover, species composition	areal extent
TECHNIQUE / SENSOR TYPE	aircraft or aerial drone (cameras with optical sensors, RGB, multi-spectral or hyperspectral, bathymetry lidar)	Remotely operated vehicle (camera), including video transects	GPS-enabled devices for seagrass polygon
RECOMMENDED METHODS AND BEST PRACTICES	UNEP 2020	Roelfsema et al 2015a	
SUPPORTING VARIABLES MEASURED	surrounding habitats	surrounding habitats	surrounding habitats

APPROACH / PLATFORM	Remote sensing: acoustics	Ship based: other Fixed point: other	
EOV SUB-VARIABLE(S) MEASURED	areal extent	species composition	
TECHNIQUE / SENSOR TYPE	vessel mounted (sidescan sonars, single- and/or multibeam)	eDNA	
RECOMMENDED METHODS AND BEST PRACTICES			
SUPPORTING VARIABLES MEASURED	water depth		

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 EOVS 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 EOVS 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 EOVS 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 EOVS 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 EOVS observing programmes. Data visible in ODIS will automatically be visible in the BioEco Portal and vice versa.
3. If data is published to OBIS³, 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 EOVS 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.

The power of shared data!!

Seagrass EOVS

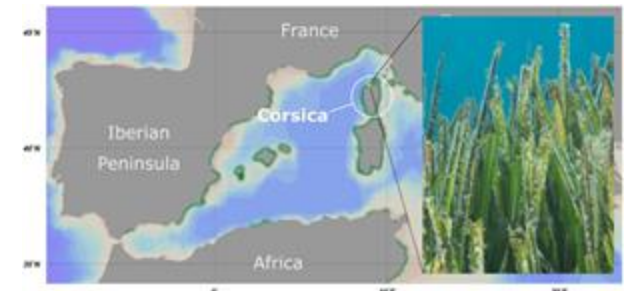


Contributes to:

Essential Climate Variables
Essential Biodiversity Variables
SDG 14
CBD GBF
Climate, UNFCCC
Ramsar
UN Ocean Decade
Ocean Health

Seagrass % cover
Seagrass species composition
Areal extent
+ other variables
+ metadata (e.g. date, GPS coordinates)

Research





OCEAN BIODIVERSITY
INFORMATION SYSTEM

obis.org

world's largest open-
access repository for
standardized marine
biodiversity data



>141,000,000
presence records



>5,700
marine datasets

More than **just**
species occurrences



>181,480,000
measurements



DNA-derived

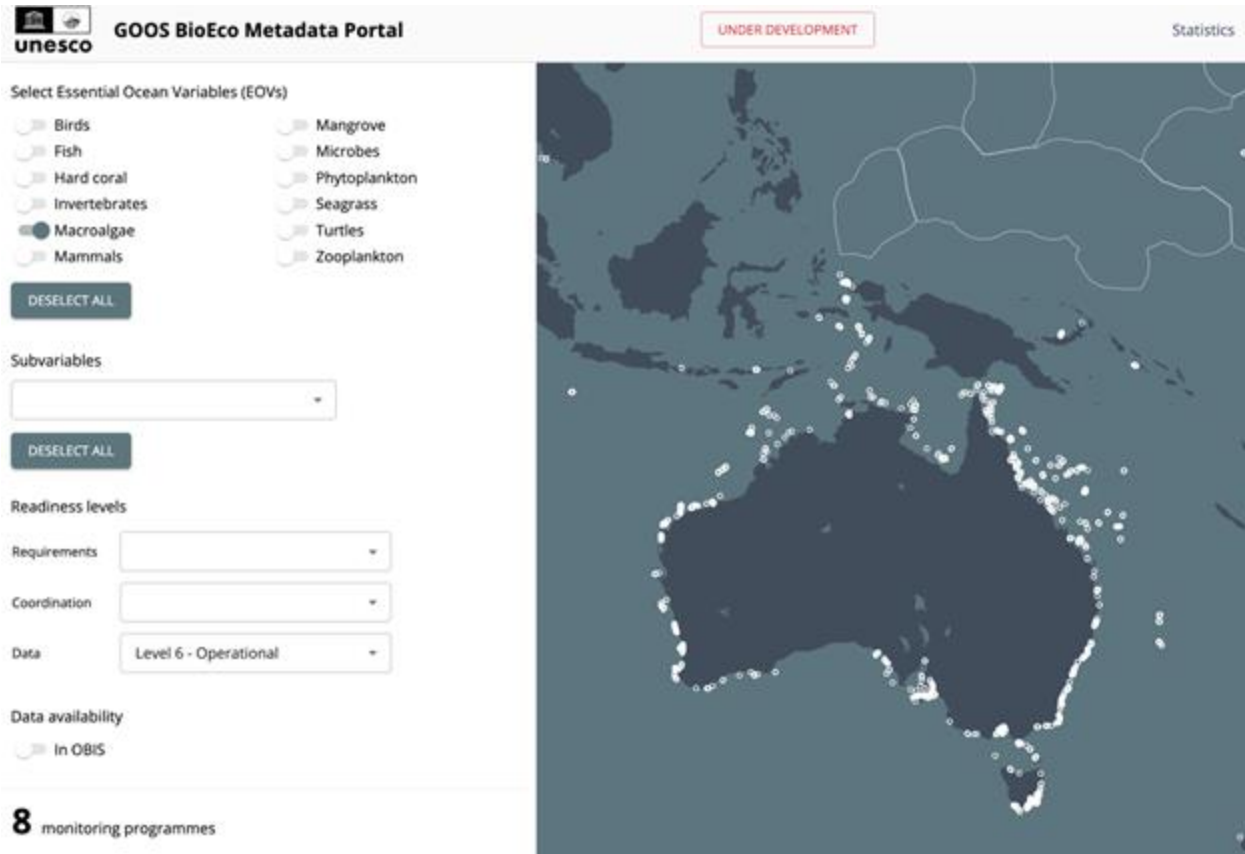


Habitat,
Ecosystems
Abundance

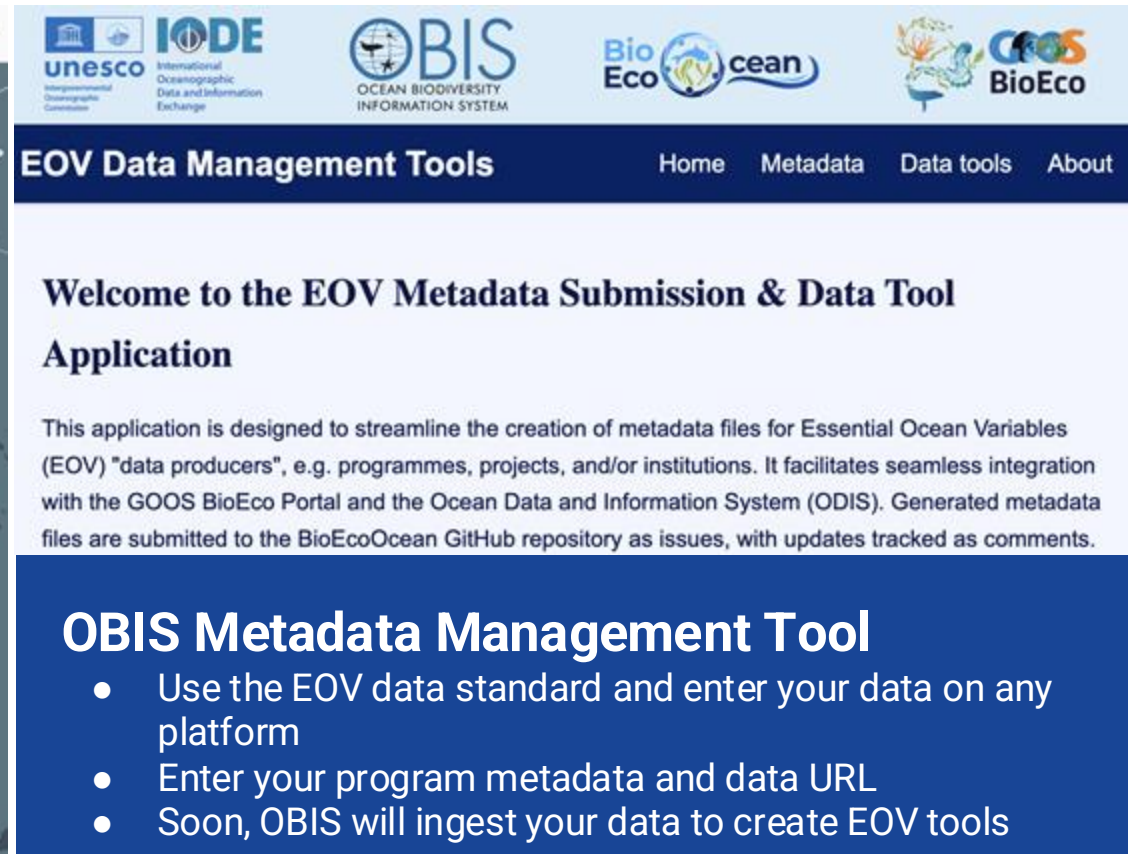


Satellite
Tracking
Image-derived

Implementation: Data Deposition, Management, and Long-Term Vision



The screenshot shows the GOOS BioEco Metadata Portal. At the top, there's a header with the UNESCO logo and the text "GOOS BioEco Metadata Portal". A red box labeled "UNDER DEVELOPMENT" is visible. On the left, there's a sidebar with "Select Essential Ocean Variables (EOVs)" and a list of variables: Birds, Fish, Hard coral, Invertebrates, Macroalgae (selected), Mammals, Mangrove, Microbes, Phytoplankton, Seagrass, Turtles, and Zooplankton. Below this is a "DESELECT ALL" button. Further down, there's a "Subvariables" section with a dropdown menu and another "DESELECT ALL" button. The "Readiness levels" section includes "Requirements", "Coordination", and "Data" (set to "Level 6 - Operational"). The "Data availability" section has a radio button for "In OBIS". At the bottom left, it says "8 monitoring programmes". The main area of the portal displays a map of the world with a focus on the Pacific Ocean, showing numerous data points (white dots) along the coastlines and in the open ocean.



The screenshot shows the EOVS Data Management Tools application. At the top, there's a header with logos for UNESCO, IODE, OBIS, BioEco, and Ocean. Below the header, there's a navigation bar with links: Home, Metadata, Data tools, and About. The main content area has a heading "Welcome to the EOVS Metadata Submission & Data Tool Application". Below this, there's a paragraph: "This application is designed to streamline the creation of metadata files for Essential Ocean Variables (EOV) 'data producers', e.g. programmes, projects, and/or institutions. It facilitates seamless integration with the GOOS BioEco Portal and the Ocean Data and Information System (ODIS). Generated metadata files are submitted to the BioEcoOcean GitHub repository as issues, with updates tracked as comments." Below this paragraph, there's a blue box with the heading "OBIS Metadata Management Tool" and a list of bullet points: "Use the EOVS data standard and enter your data on any platform", "Enter your program metadata and data URL", and "Soon, OBIS will ingest your data to create EOVS tools".

<https://bioeco.goosocean.org/>

<https://eovmetadata.obis.org/>

GOOS BioEco Portal

bioeco.goosocean.org

Interactive map to show:

- **Who** is collecting BioEco EOVS data?
- Where?
- More metadata

Easy to add new entries
with form-based entry-
point:

eovmetadata.obis.org



Moving Forward: Emerging Technologies



Uncrewed Vessel (USV)

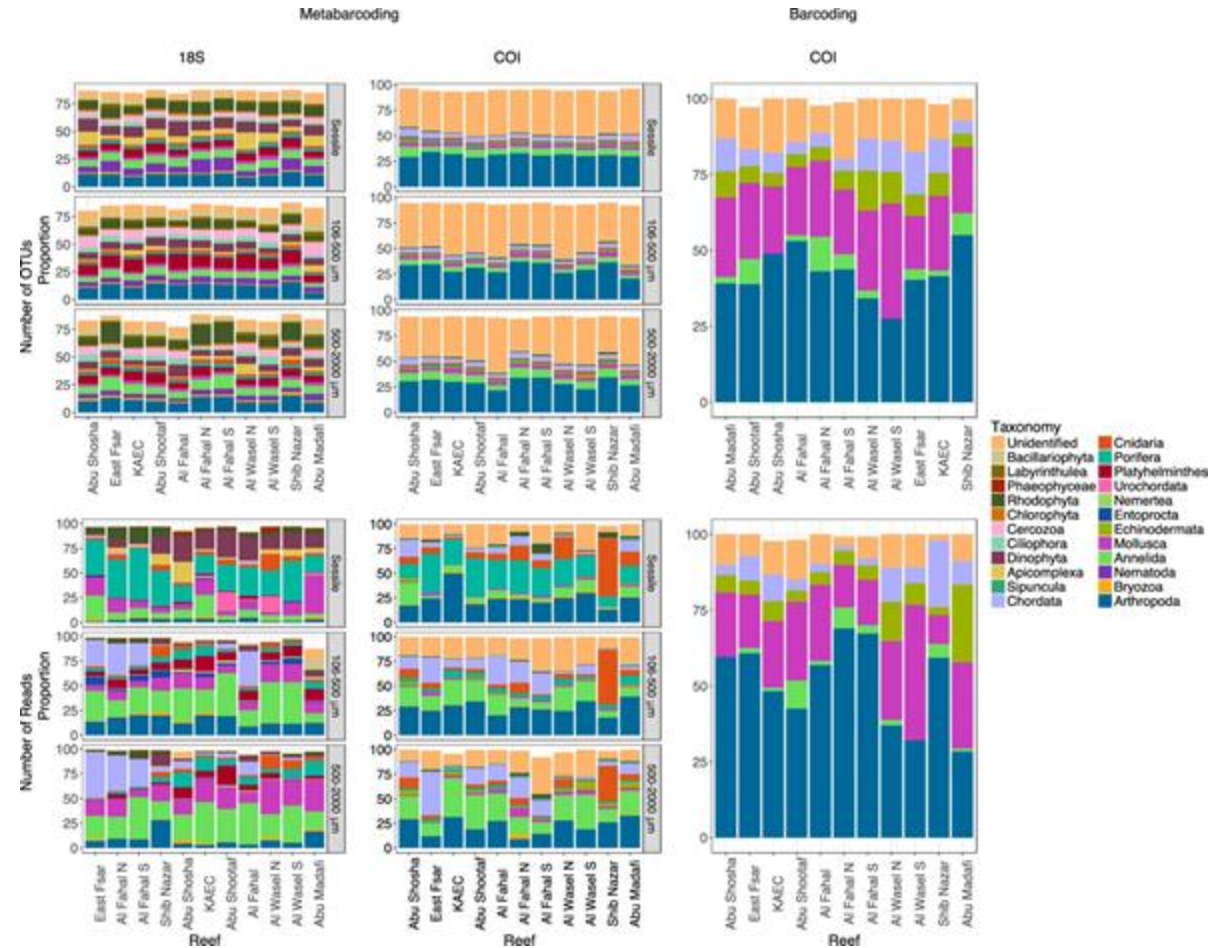


AI-assisted AUV for observations

Moving Forward: Emerging Technologies



**eDNA & Biodiversity using
ARMS**



Way forward!



Follow the EOV

- Clarify questions/hypotheses to decide how to allocate samples in space and time
- Use standardized protocols (SOP)

Publish your data

- Adopt FAIR principles

Enjoy the benefits

- Take advantage of new technologies (eDNA, imaging tools)
- Enjoy increasing availability of seagrass data!

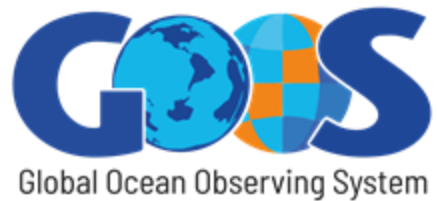
Thanks!

Special thanks for supporting Seagrass EOVS development:



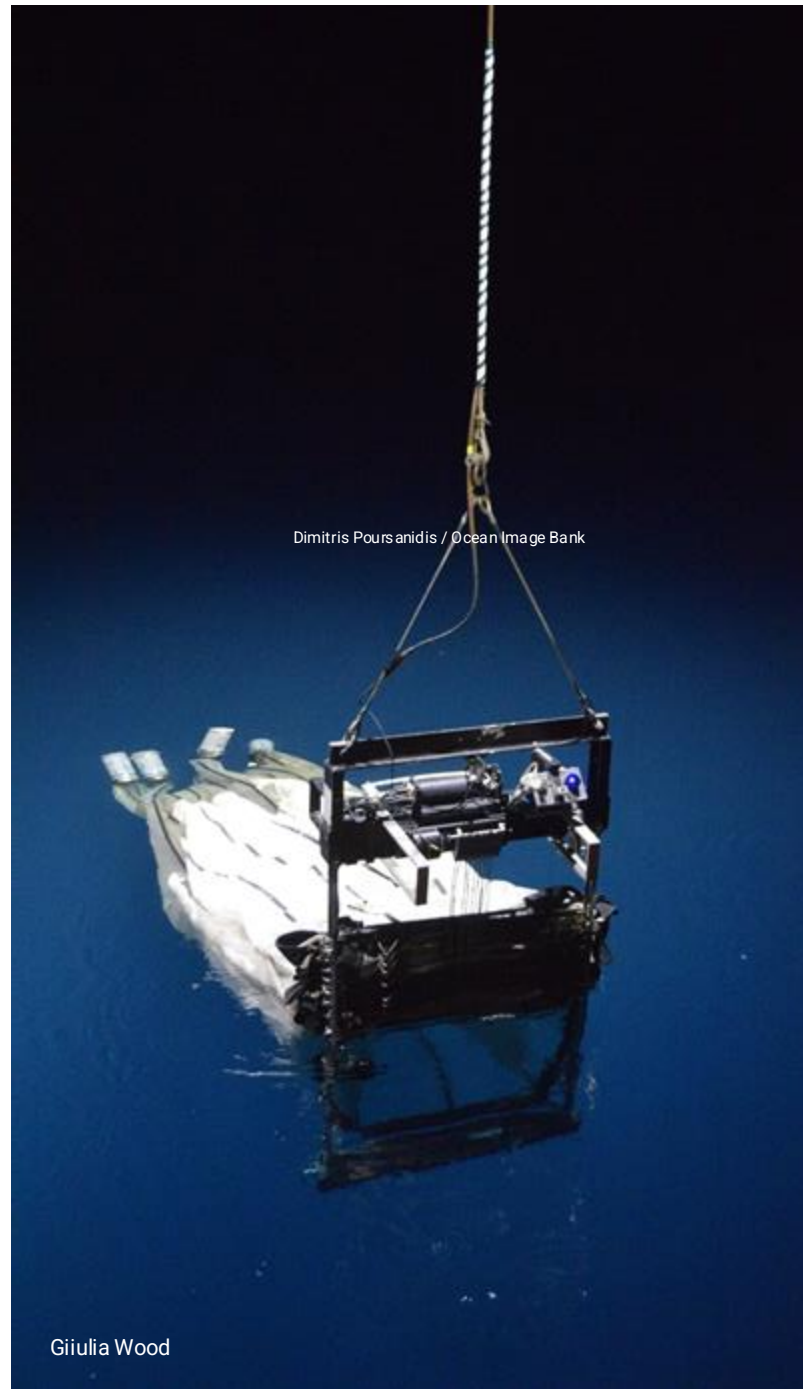
Special thanks for contributing to the GOOS BioEco Panel and sharing GOOS vision:





Thank you

goosocean.org



Dimitris Poursanidis / Ocean Image Bank

Giulia Wood

