

# GOOS webinar

## Seagrass Synergy: Collaborate for Global Observing and Understanding

 27 March 2024 | 15:00 CET



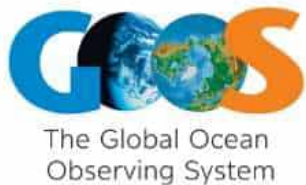
**Emmett Duffy**  
*Smithsonian Institution*



**Lina Mtwana Nordlund**  
*Uppsala University*



Join at  
**slido.com**  
**#1907 922**



# Seagrass



The composite image consists of four panels:

- Diagram (Left):** Compares the structure of Algae and Seagrass. Algae has a stipe, holdfast, and blade. Seagrass has roots, a rhizome, leaves, and a flower.
- Photograph (Middle):** Shows a seagrass plant with its roots and leaves against a blue background.
- World Map (Right):** Shows the global distribution of seagrass species. A legend indicates the number of species per region: 1-2 (lightest green), 3-6 (light green), 7-9 (medium green), 10-11 (darker green), and 12-16 (darkest green). High concentrations are seen in the Mediterranean, the Red Sea, and parts of the Indian and Pacific Oceans.
- Text (Bottom Left):** [ian.umces.edu](http://ian.umces.edu)
- Text (Bottom Right):** Short et al 2007



# Seagrass is important to nature and people



# Seagrass is important to nature and people

Biodiversity

Fisheries

Effective carbon sequestration and storage



# Seagrass is important to nature and people

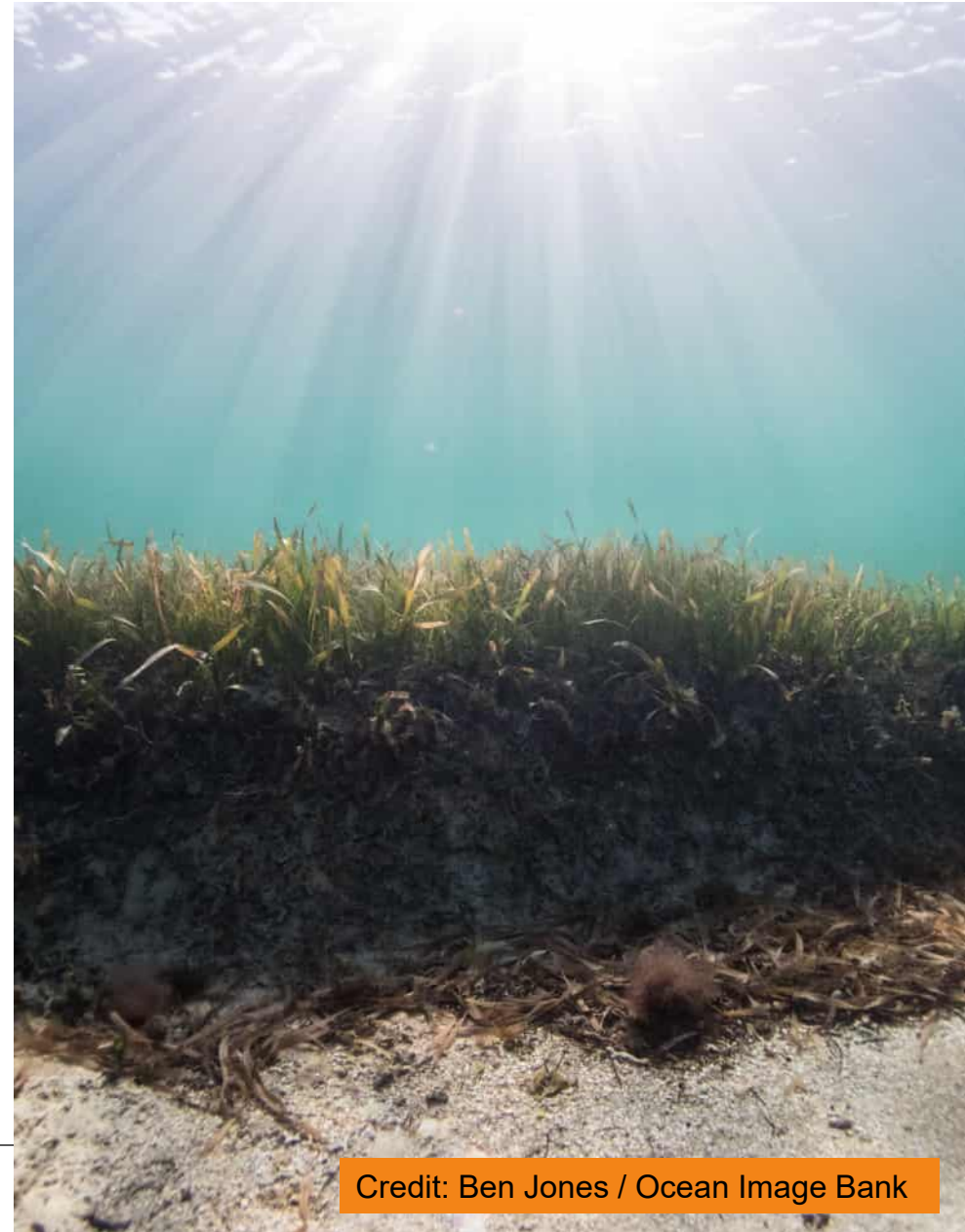
Biodiversity

Fisheries

Effective carbon sequestration and storage

Coastal protection

Improved water quality



Credit: Ben Jones / Ocean Image Bank







Credit: Marcelo Johan Ogata / Ocean Image Bank



# Imagine...

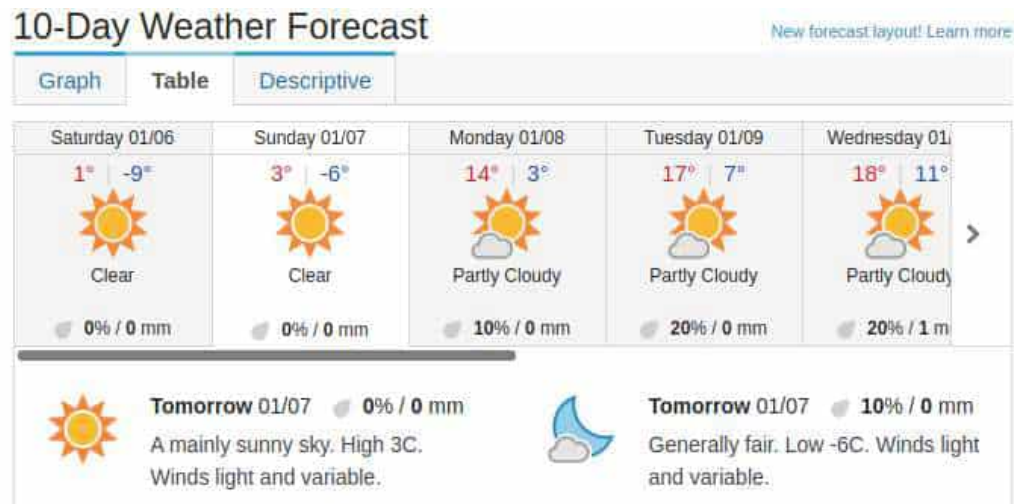
What if...  
...we had comparable  
seagrass data  
around the world?



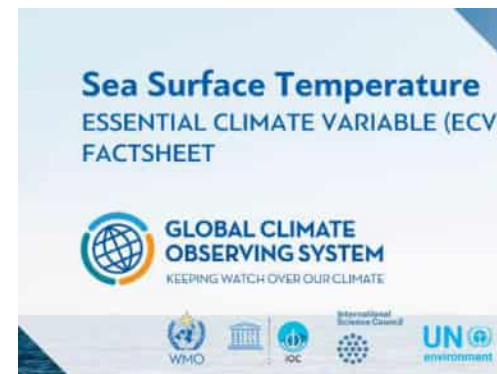
Credit: Ben Jones / Ocean Image Bank

# Essential Variables

## Did you check the weather?



What if we didn't have open temperature data?





# Essential Variables

Measuring everything at all times is just not feasible

Too expensive

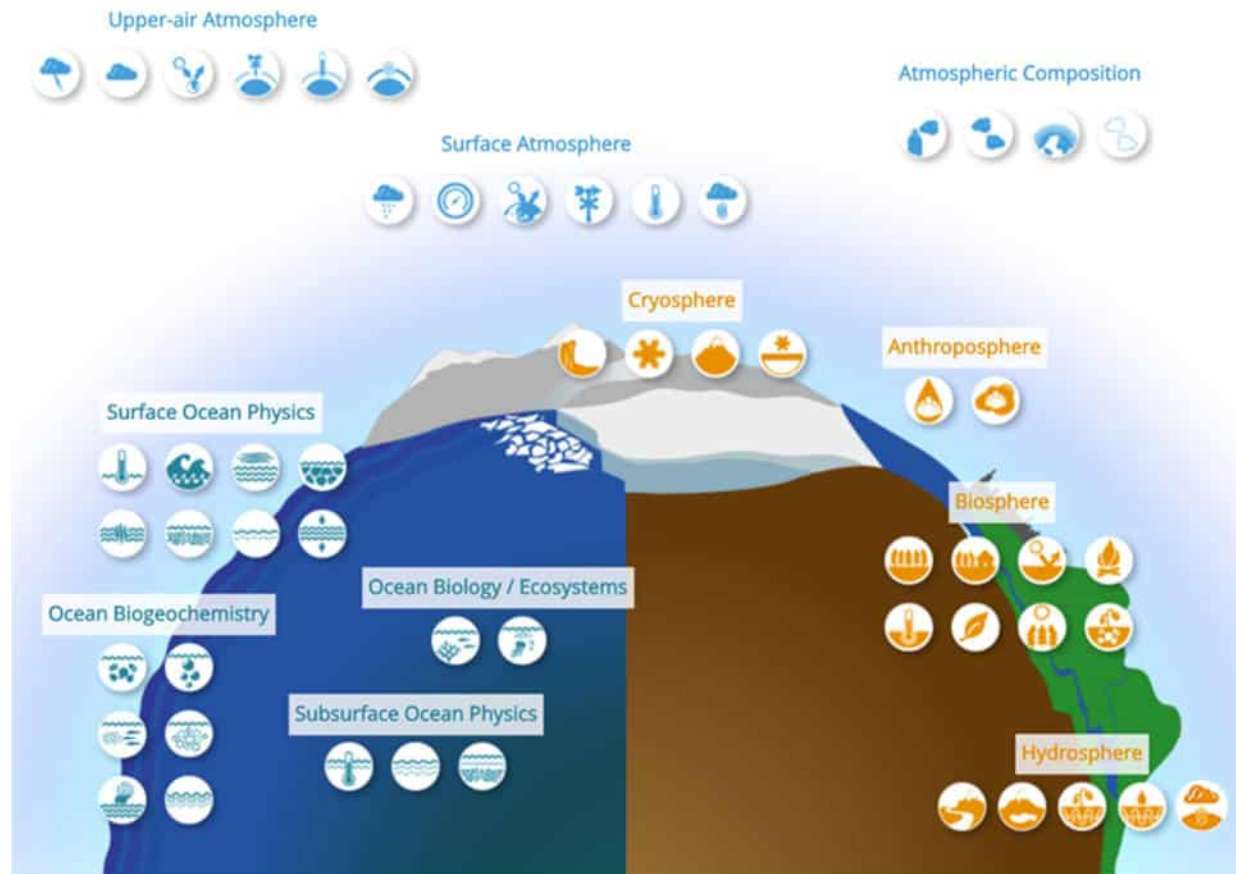
Too time consuming

The Essential Variables are a (representative) selection

Essential **Ocean** Variables

Specific for the ocean

## Essential Climate Variables



# The Global Ocean Observing System (GOOS), IOC-UNESCO

The Essential Ocean Variable (EOV) framework aspires to make a coordinated system by delivering specification sheets instructing which variables to measure and highlighting the importance of transparency of data



The Global Ocean Observing System



**Leading, coordinating and supporting vital ocean observing**

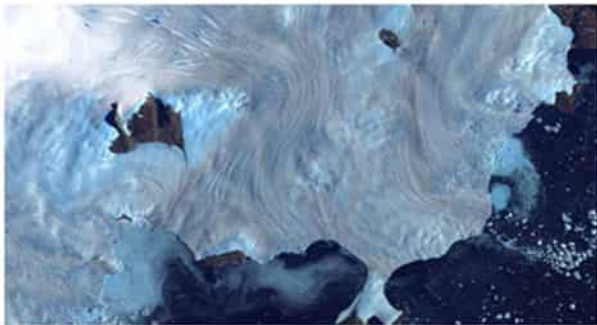
Integrating the system, empowering the community, forming the partnerships.

Sponsored by





# The Global Ocean Observing System (GOOS), IOC-UNESCO



## Physics and climate

Focuses on physical processes and their role in forecasting ocean conditions inc. circulation patterns, interactions with the atmosphere and heat transport and storage.



## Biogeochemistry

Aims to establish the qualitative and quantitative role of the marine carbon and biogeochemistry system and its impact on climate and ocean life.



## Biology and ecosystems

Provides a better, clearer understanding of ocean ecosystems and helps create a fit-for-purpose global biological and ecosystem observation network.

# Biology and Ecosystems



## Seagrass Cover and Composition

### Physics

- Sea state\*
- Ocean surface stress\*
- Sea ice\*
- Sea surface height\*
- Sea surface temperature\*
- Subsurface temperature\*
- Surface currents\*
- Subsurface currents\*
- Sea surface salinity\*
- Subsurface salinity\*
- Ocean surface heat flux\*
- Ocean bottom pressure

### Biogeochemistry

- Oxygen\*
- Nutrients\*
- Inorganic carbon\*
- Transient tracers\*
- Particulate matter
- Nitrous oxide\*
- Stable carbon isotopes
- Dissolved organic carbon

### Cross-disciplinary

- Ocean sound
- Ocean colour\*
- Marine debris

### Biology & ecosystems

- Phytoplankton biomass & diversity\*
- Zooplankton biomass & diversity\*
- Fish abundance & distribution
- Sea turtle abundance & distribution
- Seabird abundance & distribution
- Marine mammal abundance & distribution
- Hard coral cover & composition
- Seagrass cover & composition
- Macroalgal canopy cover & composition
- Mangrove cover & composition
- Microbe biomass & diversity
- Invertebrate abundance & distribution





# Seagrass is an Essential Ocean Variable

Seagrass meadows are excellent ecosystem engineers and promote biodiversity



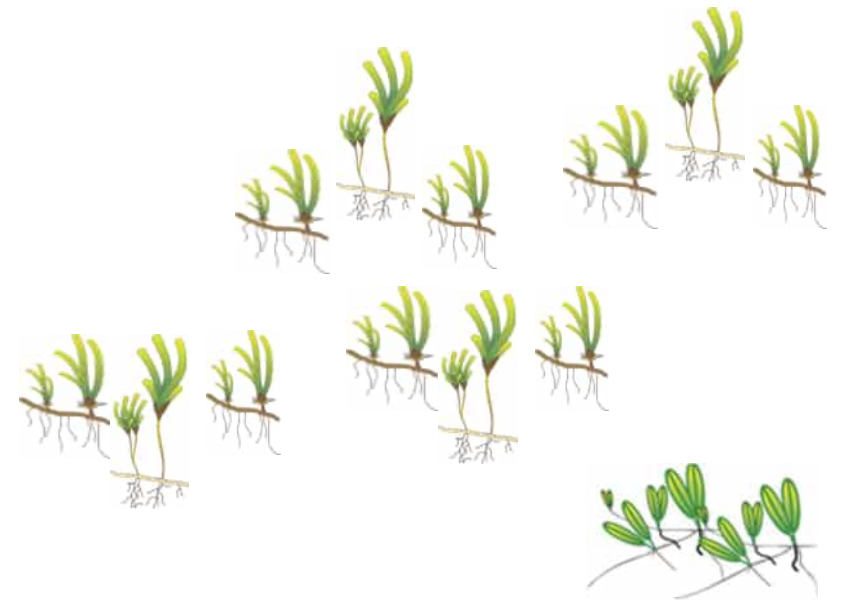
# Seagrass is an Essential Ocean Variable

The Seagrass Essential Ocean Variable is established and under further development  
Led by Emmett Duffy and Lina Mtwana Nordlund + interested stakeholders

Seagrass % cover

Seagrass species composition

+ other recommended variables





slido



**Do you think it is possible to measure seagrass % cover and species composition in your environment and setting?**



① Start presenting to display the poll results on this slide.



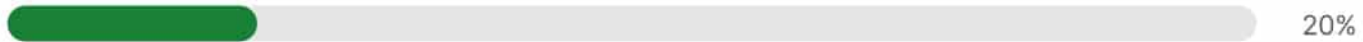
## Do you think it is possible to measure seagrass % cover and species composition in your environment and setting?

Multiple Choice Poll 46 votes 46 participants

Yes, we are already doing it! - 26 votes



Yes, but we not doing it yet - 9 votes



Probably, but it would require additional work - 10 votes



No, I don't think so - 0 votes



I don't know - 1 vote





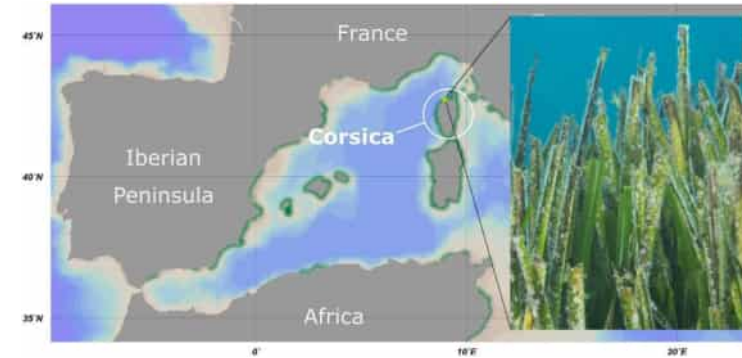
# Imagine...

What if...  
...we had comparable  
seagrass data  
around the world?



Credit: Ben Jones / Ocean Image Bank

# Sustained monitoring All observations



Seagrass % cover  
Seagrass species composition  
+ other variables





# Why Collaborate?

Why not?

- Already established monitoring program...

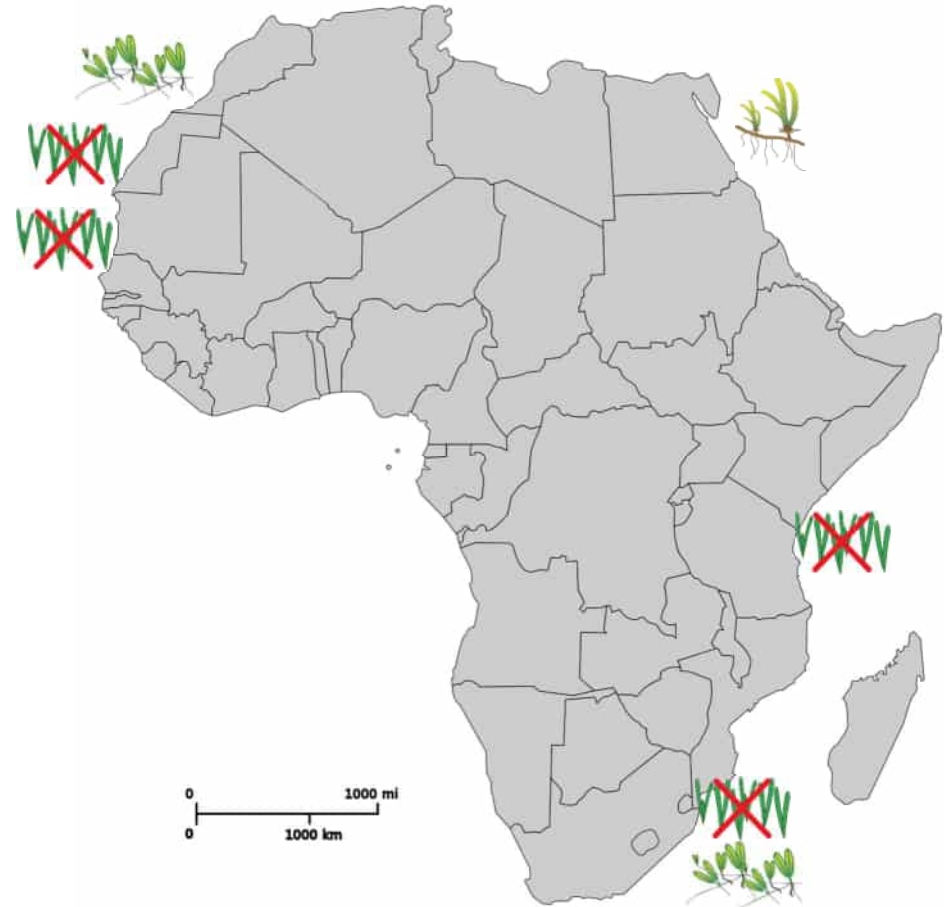
But the benefits!

Sustained monitoring + observations

Early signals

National and regional understanding

Come together as a global community!



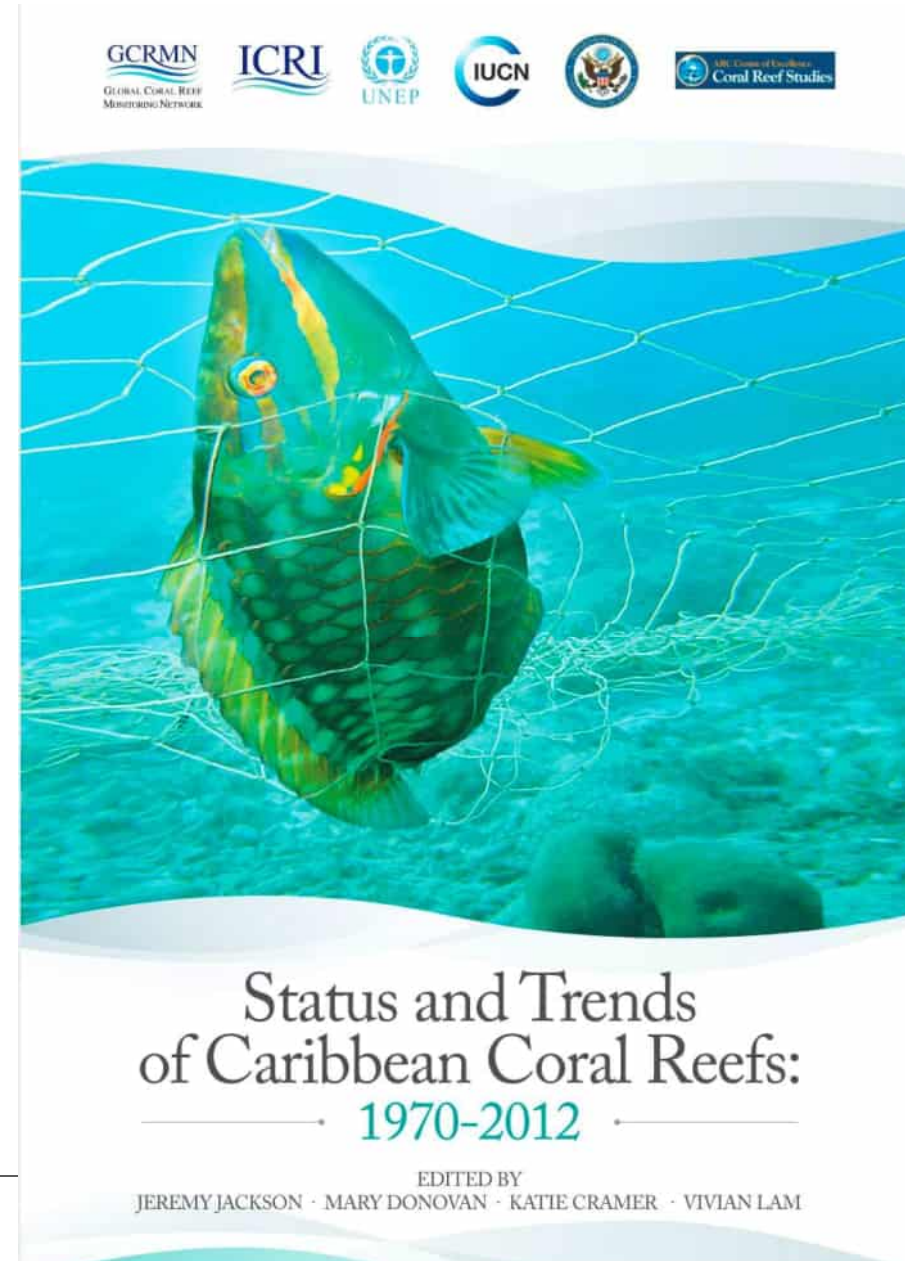
# We need bio-eco standards

“There is an urgent need to develop simple, standardized monitoring protocols to assess in real time the condition of reefs ...

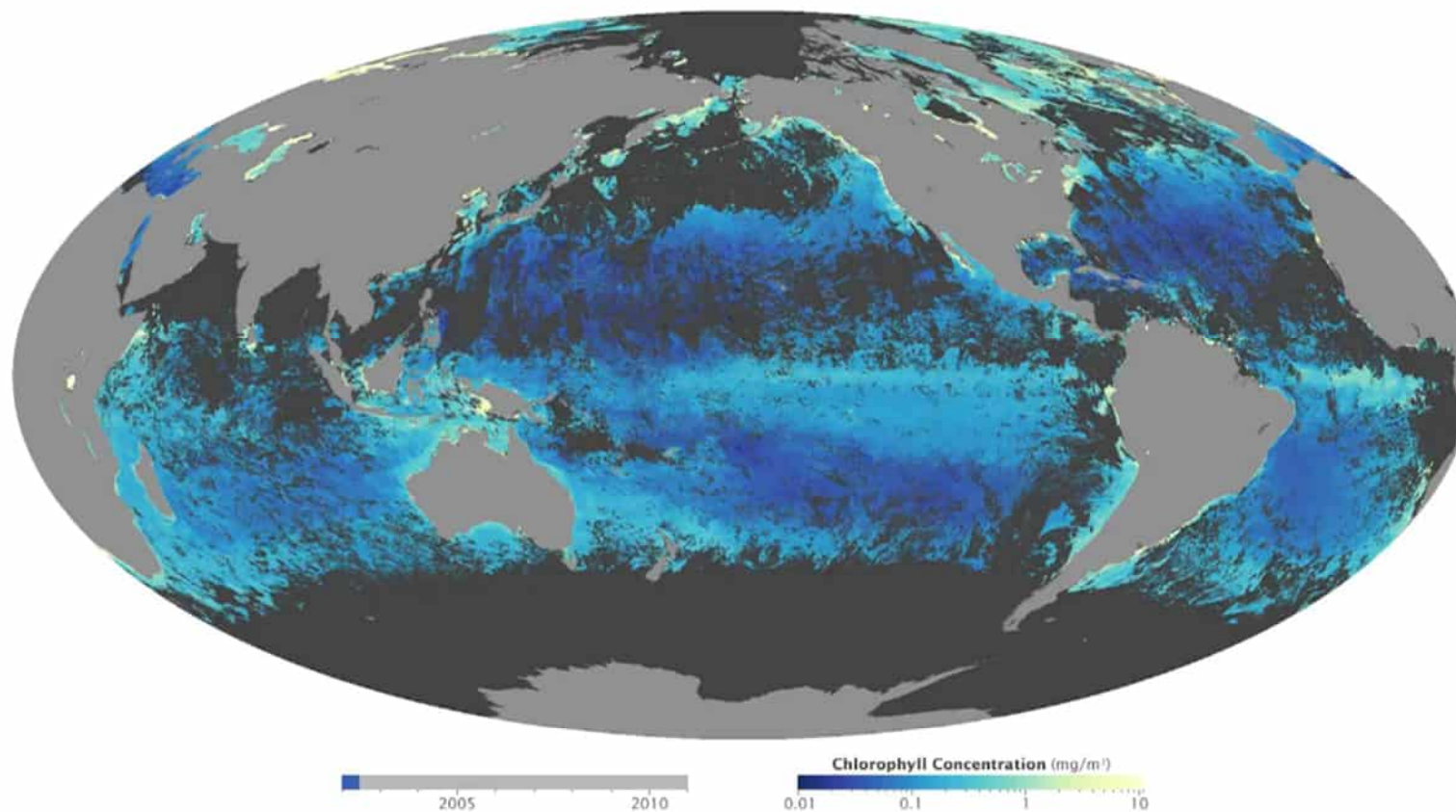
it took nearly two years to begin to use [the data] reliably because of the diversity of metrics, formatting errors, and internal inconsistencies. ***Much of the data was unusable*** because we could not verify locations, depths, and missing metadata. ***The situation is inexcusable and no one should ever have to go through such an exercise again.***”

Jackson et al. 2014

*Status and trends of Caribbean Coral Reefs, 1970-2012*



# Standards revolutionized ocean understanding





# The vision: C-GRASS

*(Coordinated Global Research Assessment of Seagrass Systems)*

A rigorous, dynamic picture of  
global seagrass status and  
trends ...

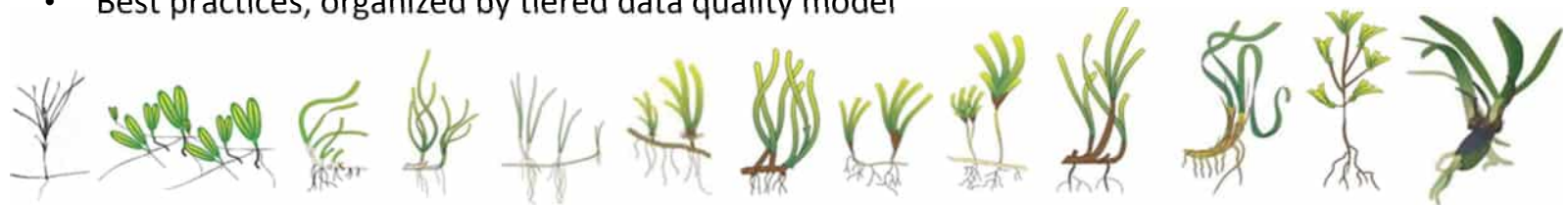
and a global Community  
of Practice that stewards it for  
the public good.



# History of progress on seagrass standards



- **Seagrass networks established, coordinating standardized surveys**
  - Seagrass-Watch (1998)
  - SeagrassNet (2000)
  - Smithsonian MarineGEO (2013)
- **Essential Ocean Variable (EOV) concept developed**
  - Framework for Ocean Observing proposes EOVs (2009)
  - Global Ocean Observing System (GOOS) Biology & Ecosystem panel established (2015)
  - Biological and ecosystem EOVs drafted (2016)
- **Global coordination and consultation around seagrass cover and composition” EOV**
  - Coordinated Global Research Assessment of Seagrass Systems (C-GRASS) funded by SCOR (2019)
  - C-GRASS group proposes seagrass data schema, best practices, Community of Practice
  - Consultations with seagrass community: OceanObs (2019), SeaPlants (2019), ISBW (2022)
- **Proposed global standards for seagrass cover and composition EOV (MS in prep)**
  - Data schema linked to OBIS
  - Best practices, organized by tiered data quality model

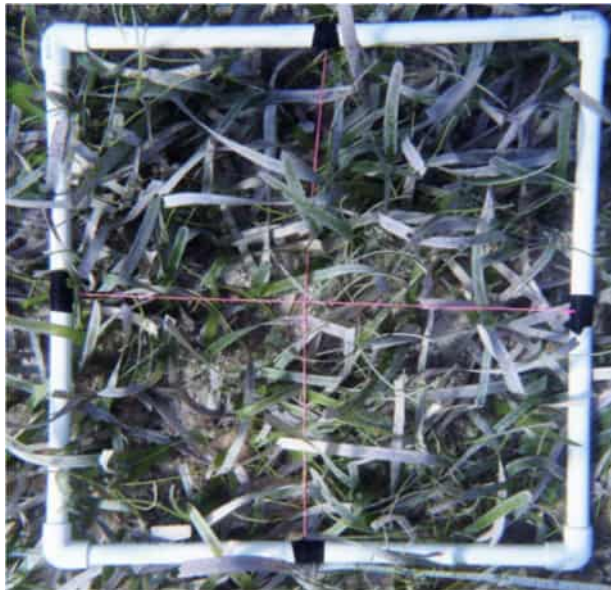


# Seagrass EOV: Minimum requirements

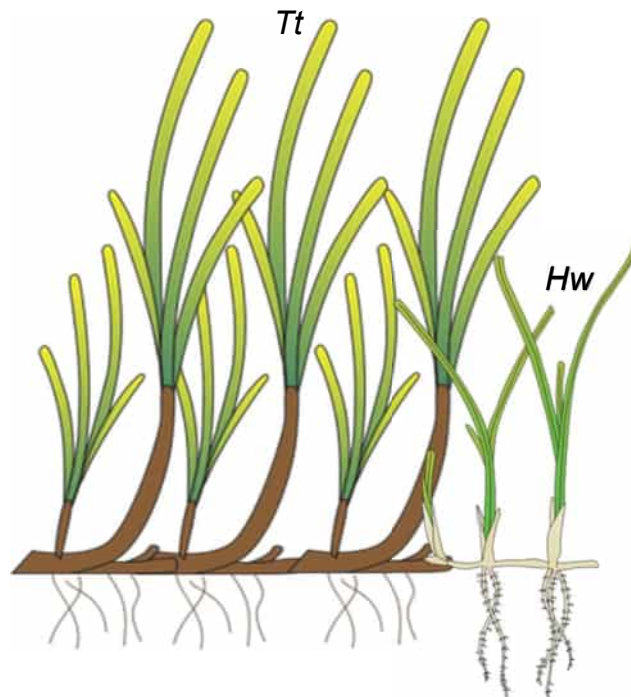
*Quality level 1: Seagrass cover and species composition*



Percent cover



Species composition





# Measuring seagrass EOV: Refinement

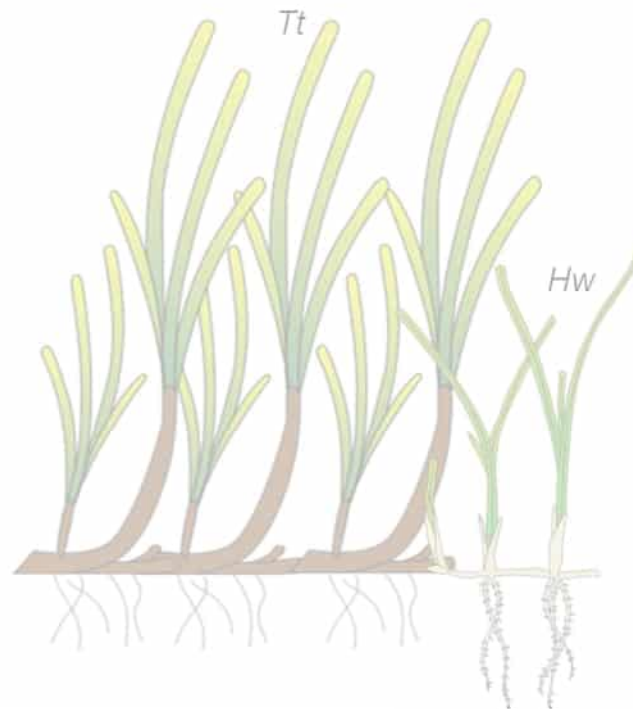
Quality level 2: (+) Seagrass density and canopy height



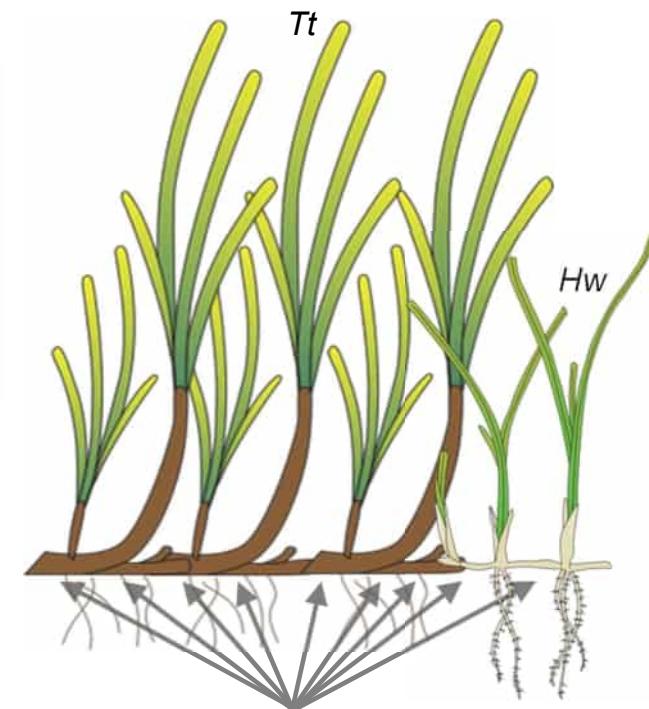
Percent cover



Species composition



Canopy height



Shoot density

# Measuring seagrass EOV: The ecosystem

(+) EOVs for *macroalgae, fishes, invertebrates ...*



# Measuring seagrass EOV: Data quality model

EOV name	Description	Data quality levels
<b>EOV: Seagrass cover and composition</b>	<ul style="list-style-type: none"> <li>Seagrasses are the key indicator of seagrass ecosystem health.</li> <li>Habitat value determined by species, and their three-dimensional growth form</li> </ul>	<ol style="list-style-type: none"> <li><b>Total seagrass cover</b> (%), proportional cover by <b>species</b> or functional group</li> <li>+ Seagrass habitat structure: shoot <b>density</b> and <b>canopy height</b></li> </ol>
<b>EOV: Algal cover and composition (<i>in development</i>)</b>	<ul style="list-style-type: none"> <li>Algae compete with seagrasses and provide food for animals. Algal cover is the aggregated cover of all algal forms.</li> <li>Fleshy, macro and turf algae are competitors of seagrasses.</li> <li>Abundance of algae is sometimes measured destructively as biomass.</li> </ul>	<ol style="list-style-type: none"> <li>Suggested: <b>Total algal cover</b> (%)</li> <li>+ Suggested: cover by <b>functional group</b> (fleshy/macro, micro/filamentous, and calcareous)</li> <li>+ Suggested: <b>Biomass of algae</b></li> </ol>
<b>EOV: Fish abundance and diversity (<i>in development</i>)</b>	<ul style="list-style-type: none"> <li>Fish play many functional roles.</li> <li>Monitoring programs often focus on a subset of families or target species depending on monitoring aims.</li> </ul>	<ul style="list-style-type: none"> <li>Levels not yet assigned. Most basic is <b>abundance of key taxa</b>, most complex is abundance and biomass of all species.</li> </ul>



Adapted from: Obura et al. 2019. *Frontiers in Marine Science* 6: 580.



# How to measure the seagrass EOV?






# Standard seagrass protocols



<https://www.seagrasswatch.org/manuals>



## The MarineGEO Toolkit

The MarineGEO Toolkit is a set of protocols for surveying marine habitats and communities. Our protocols provide a standardized set of measurements for characterizing the health of marine ecosystems and their associated communities. Besides measuring key ecological and biological variables, we provide best practices for site selection, layout, workflow, and data submission. Each protocol contains:

- a PDF document that includes step-by-step methods
- a data entry sheet to print off and bring out into the field
- an excel workbook to use for data submission

MarineGEO follows a standard workflow for protocol development, testing, and revision. The entire workflow is detailed in the MarineGEO Protocol Development and Revision Process (PDF) document.

Select a habitat or community type below to learn more and to download protocol materials.

Coral Reef Habitats

Seagrass Habitats

Oyster Reef

<https://marinegeo.si.edu/research/marinegeo-toolkit>



### Seagrass-Watch Protocols

Source: McKee, L.J., Campbell, S.J., Miller, K.E. & McKee, J.E. (2007) Seagrass-Watch: Manual for Mapping & Monitoring Seagrass Resources. (Seagrass-Watch HQ, Cairns: 114pp [www.seagrasswatch.org/manuals.html](http://www.seagrasswatch.org/manuals.html))

**Site layout**

**Pre-monitoring preparation**

**Make a Timetable**  
Create a timetable of times of departure and arrival back, and what the objective of the day is and what is to be achieved on the day. Give a copy of this to all volunteers involved in advance so they can make their arrangements to get to the site on time. List on this timetable what the volunteers need to bring.

**Have a CONTACT PERSON**  
Arrange to have a reliable contact person to raise the alert if you and the team are not back at a specified or reasonable time.

**Safety**

- Assess the risks before monitoring - check weather, tides, time of day, etc.

### SEAGRASS SPECIES CODES

**Zc**  
*Zostera muelleri* subsp. *capricorni*

- leaf with 3-5 parallel veins
- cross-veins form boxes
- leaf tip smooth and rounded, may be dark point at tip
- rhizome usually brown or yellow in younger parts
- leaf grows straight from rhizome (no stem)

**Ho** *Halophila ovalis*

- 6 or more cross veins
- no hairs on leaf surface
- leaf margins smooth
- leaf 5-20mm long

**Th**  
*Thalassia hemprichii*

- ribbon-like, curved leaves 30-40cm long
- leaf tip rounded, slightly serrated
- short black tannin cells, 1-2mm long, in leaf blade
- thick rhizome with scars between shoots

**Hu**  
*Halodule uninervis*

- trident leaf tip, not rounded
- 1 central vein
- rhizome usually pale, with small black fibres at the nodes
- narrow leaf blades 0.25-1mm wide

**Cr**  
*Cymodocea rotundata*

- rounded leaf tip
- narrow leaf blade (2-4mm wide)
- leaves 7-15 cm long
- 9-15 longitudinal veins
- well developed leaf sheath

**Cs**  
*Cymodocea serrulata*

- serrated leaf tip
- wide leaf blade (5-8mm wide)
- leaves 8-15cm long
- 13-17 longitudinal veins
- robust/strong rhizome

**Si**  
*Syringodium isoetifolium*

- narrow spaghetti-like leaves
- cylindrical in cross section, 1-2mm diameter
- leaves contain air cavities
- leaf tip tapers to a point
- leaves 7-30cm long

**Ea** *Enhalus acoroides*

- very long (>30cm)
- ribbon-like leaves with reviled leaf margins
- thick rhizome with long black bristles and coral-like roots

### SEAGRASS-WATCH MONITORING

ONE OF THESE SHEETS IS TO BE FILLED OUT FOR EACH TRANSECT YOU SURVEY


Observer: \_\_\_\_\_ Date: / /

Location: \_\_\_\_\_

Site code: \_\_\_\_\_ Transect no.: \_\_\_\_\_

Start time: \_\_\_\_\_ End time: \_\_\_\_\_

Comments	% Seagrass coverage	% Seagrass species composition	Canopy height (cm)	% Algae cover	% Epifauna cover



## Manual for Scientific Monitoring of Seagrass Habitat

Worldwide Edition

August 2006

<https://www.seagrassnet.org/>





# Sharing: The seagrass EOVS data schema\*

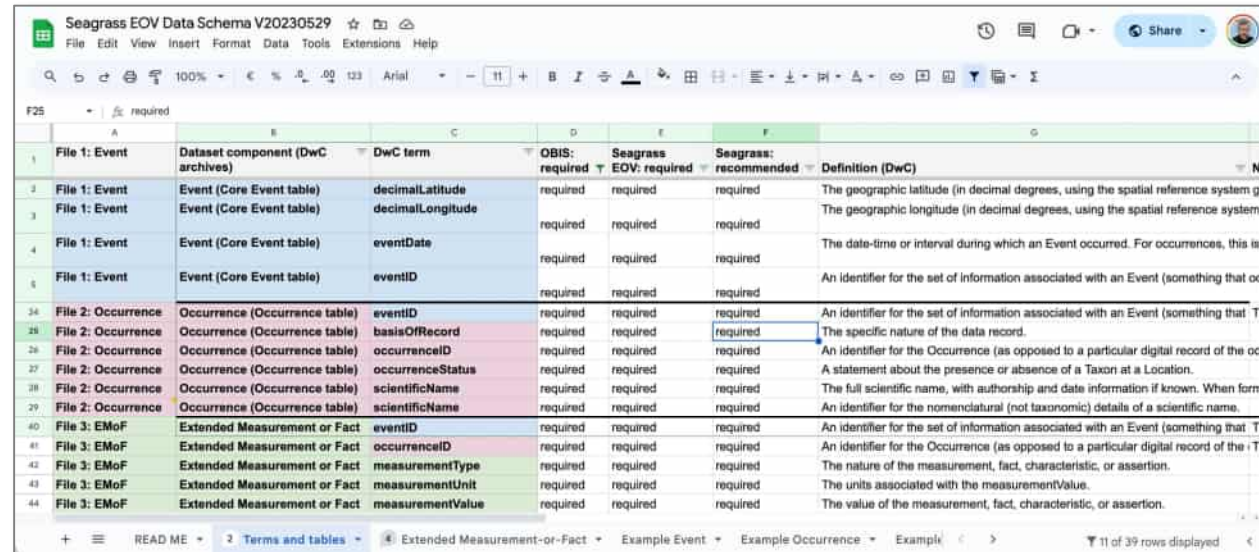
\* *In development*

## Data submission pipeline

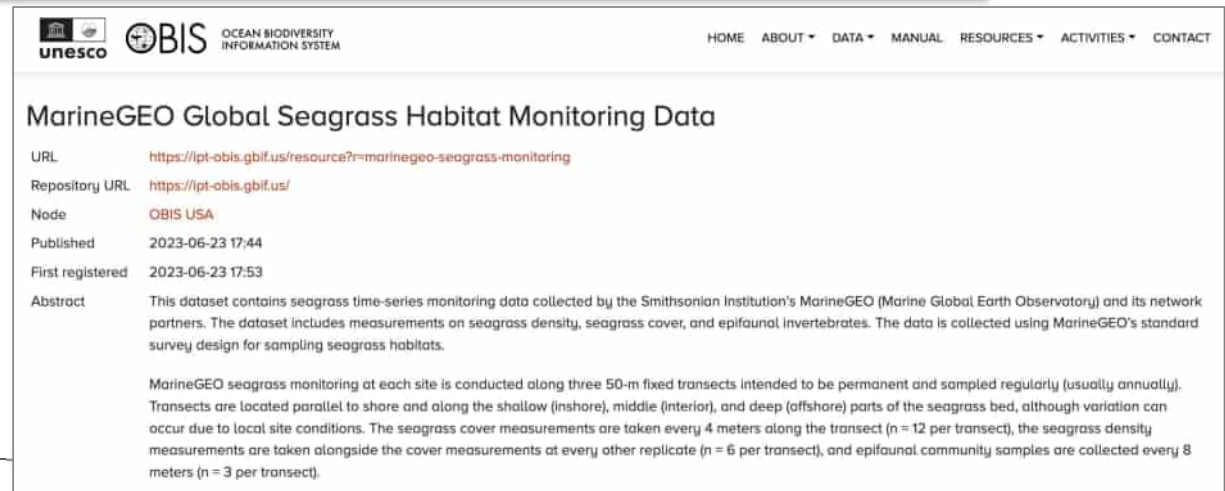
- Field > upload
- DwC-compliant
- Pairs w/ spec sheet
- Supports upload to OBIS

## Components (tabs)

- Read Me
- Terms & tables
- Seagrass EMoF (traits)
- Examples



	A	B	C	D	E	F	G
1	File 1: Event	Dataset component (DwC archives)	DwC term	OBIS: required	Seagrass EOVS: required	Seagrass: recommended	Definition (DwC)
2	File 1: Event	Event (Core Event table)	decimalLatitude	required	required	required	The geographic latitude (in decimal degrees, using the spatial reference system g
3	File 1: Event	Event (Core Event table)	decimalLongitude	required	required	required	The geographic longitude (in decimal degrees, using the spatial reference system
4	File 1: Event	Event (Core Event table)	eventDate	required	required	required	The date-time or interval during which an Event occurred. For occurrences, this is
5	File 1: Event	Event (Core Event table)	eventID	required	required	required	An identifier for the set of information associated with an Event (something that oc
24	File 2: Occurrence	Occurrence (Occurrence table)	eventID	required	required	required	An identifier for the set of information associated with an Event (something that TI
25	File 2: Occurrence	Occurrence (Occurrence table)	basisOfRecord	required	required	required	The specific nature of the data record.
26	File 2: Occurrence	Occurrence (Occurrence table)	occurrenceID	required	required	required	An identifier for the Occurrence (as opposed to a particular digital record of the oc
27	File 2: Occurrence	Occurrence (Occurrence table)	occurrenceStatus	required	required	required	A statement about the presence or absence of a Taxon at a Location.
28	File 2: Occurrence	Occurrence (Occurrence table)	scientificName	required	required	required	The full scientific name, with authorship and date information if known. When form
29	File 2: Occurrence	Occurrence (Occurrence table)	scientificName	required	required	required	An identifier for the nomenclatural (not taxonomic) details of a scientific name.
40	File 3: EMoF	Extended Measurement or Fact	eventID	required	required	required	An identifier for the set of information associated with an Event (something that TI
41	File 3: EMoF	Extended Measurement or Fact	occurrenceID	required	required	required	An identifier for the Occurrence (as opposed to a particular digital record of the TI
42	File 3: EMoF	Extended Measurement or Fact	measurementType	required	required	required	The nature of the measurement, fact, characteristic, or assertion.
43	File 3: EMoF	Extended Measurement or Fact	measurementUnit	required	required	required	The units associated with the measurementValue.
44	File 3: EMoF	Extended Measurement or Fact	measurementValue	required	required	required	The value of the measurement, fact, characteristic, or assertion.

unesco OBIS OCEAN BIODIVERSITY INFORMATION SYSTEM

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## MarineGEO Global Seagrass Habitat Monitoring Data

URL <https://ipt-obis.gbif.us/resource?r=marinegeo-seagrass-monitoring>

Repository URL <https://ipt-obis.gbif.us/>

Node **OBIS USA**

Published 2023-06-23 17:44

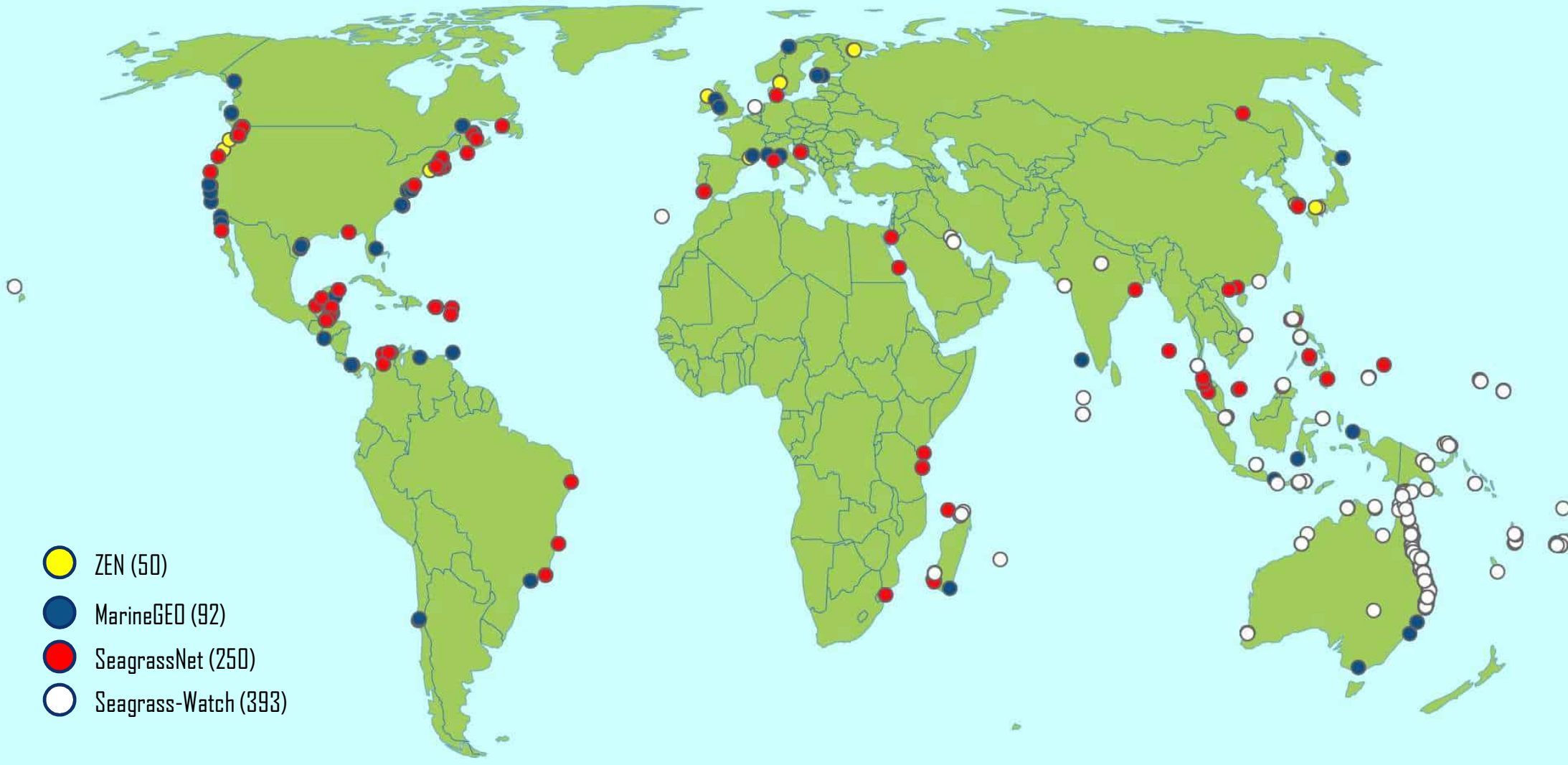
First registered 2023-06-23 17:53

Abstract This dataset contains seagrass time-series monitoring data collected by the Smithsonian Institution's MarineGEO (Marine Global Earth Observatory) and its network partners. The dataset includes measurements on seagrass density, seagrass cover, and epifaunal invertebrates. The data is collected using MarineGEO's standard survey design for sampling seagrass habitats.

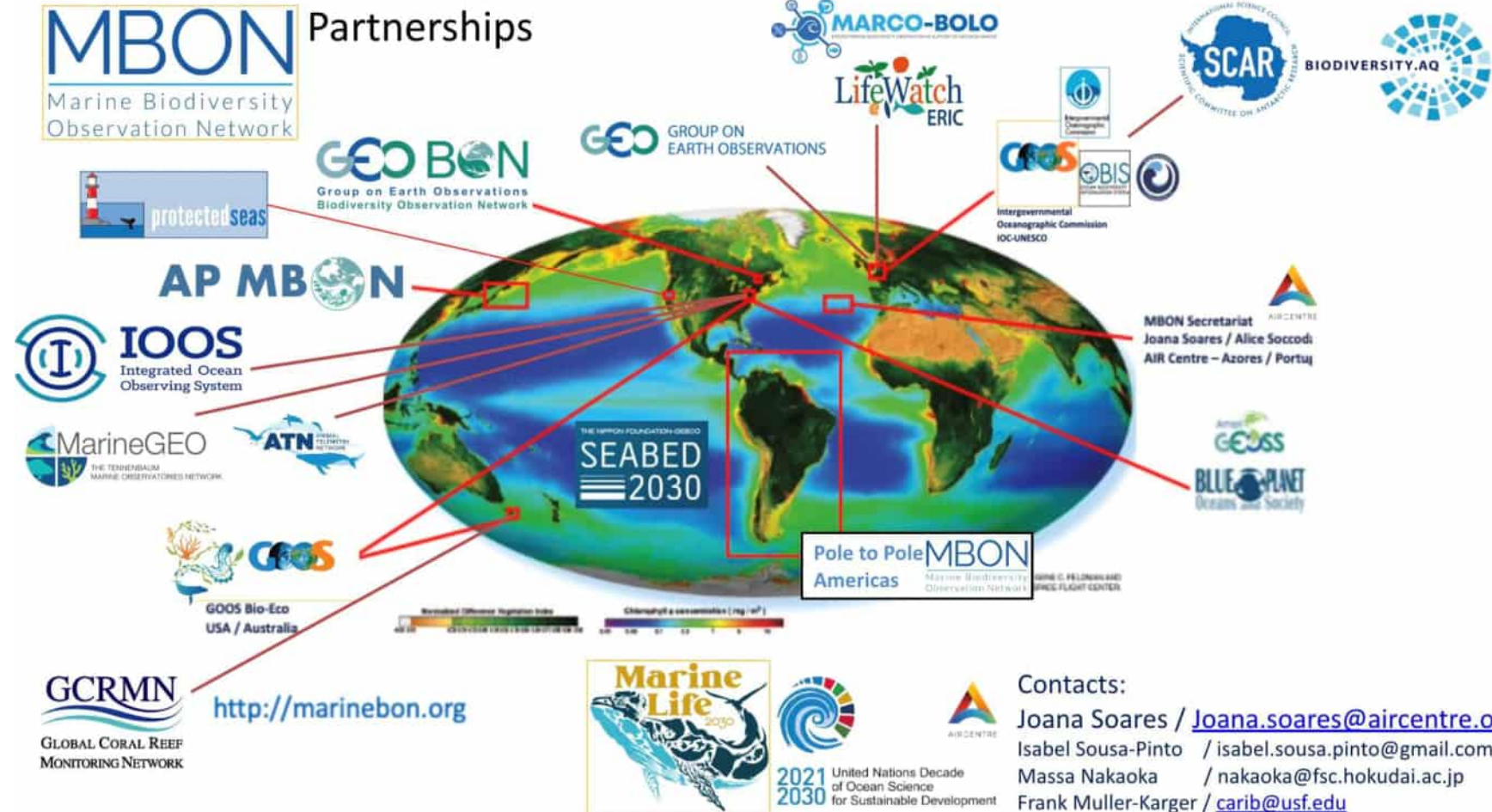
MarineGEO seagrass monitoring at each site is conducted along three 50-m fixed transects intended to be permanent and sampled regularly (usually annually). Transects are located parallel to shore and along the shallow (inshore), middle (interior), and deep (offshore) parts of the seagrass bed, although variation can occur due to local site conditions. The seagrass cover measurements are taken every 4 meters along the transect (n = 12 per transect), the seagrass density measurements are taken alongside the cover measurements at every other replicate (n = 6 per transect), and epifaunal community samples are collected every 8 meters (n = 3 per transect).



# Linking: Network power!



# Linking: *More networks!*



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 Frank Muller-Karger / [carib@usf.edu](mailto:carib@usf.edu)





# Going global: Community science



Seagrass Spotter



<https://seagrassspotter.org/>

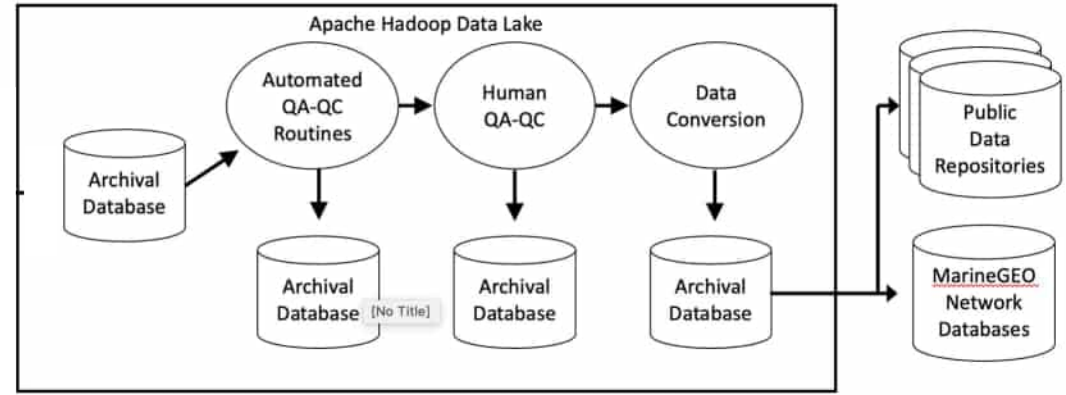


# Pipeline: Standards > Data system > Application

Standardized protocols



Shared data system



Global Science!





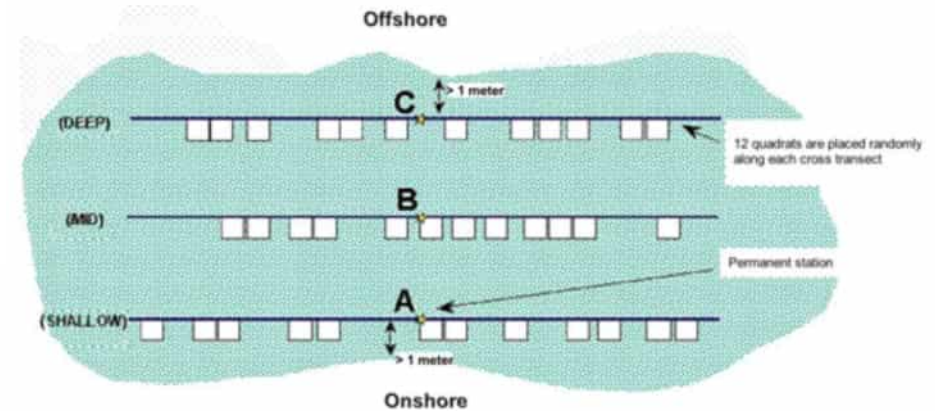
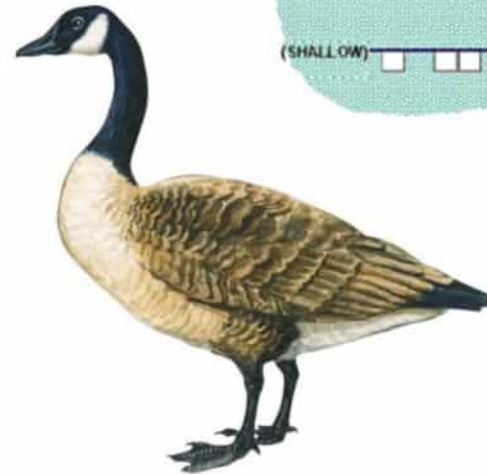
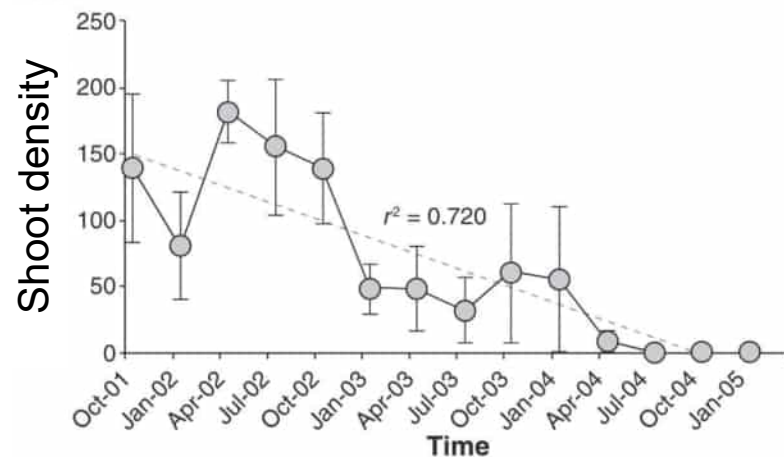
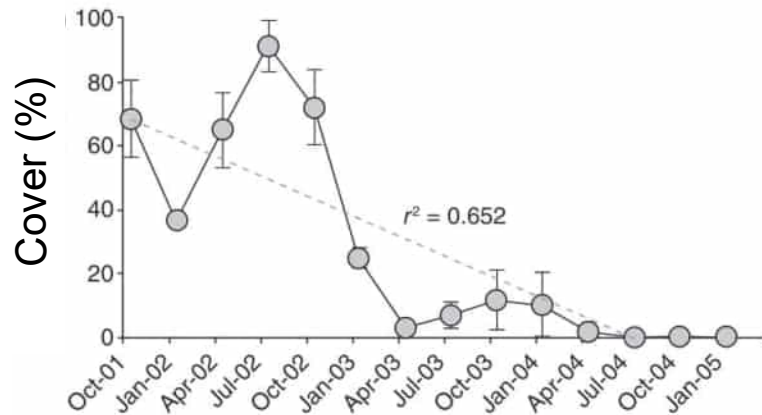
# How can we use this data?





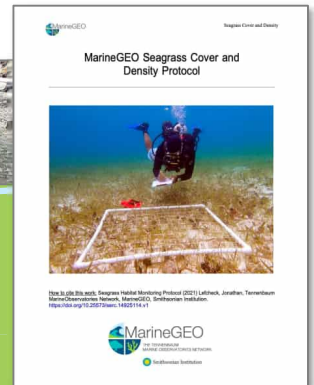
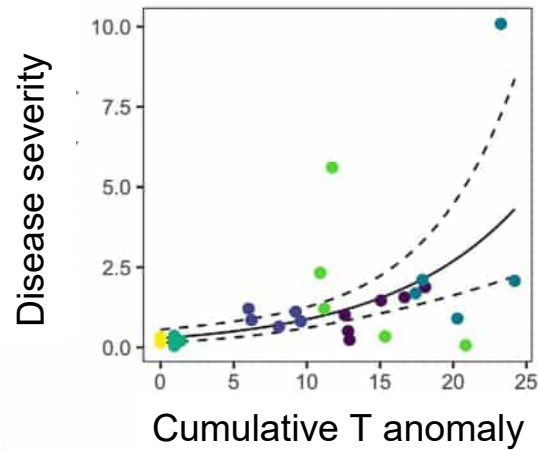
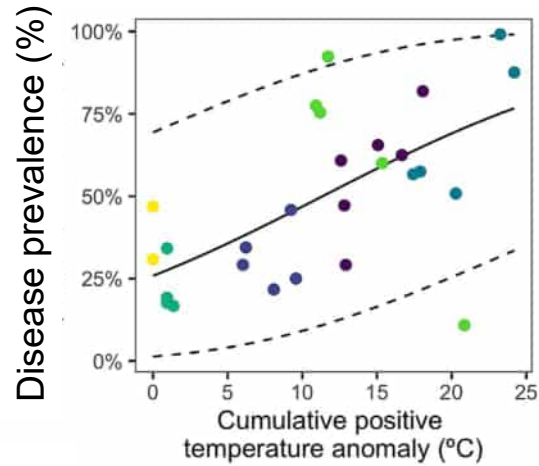
# Results: Geese cause seagrass decline

SeagrassNet standard sampling: New Hampshire, USA, 4 yr



# Results: Warming boosts eelgrass disease

MarineGEO standard sampling: W North America, 30 sites, 3 yr



Aoki et al. 2022. *Limnology and Oceanography* 67:1577-1589.



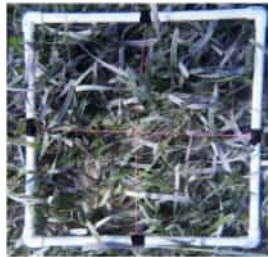
# Go with the flow...

Standardized protocols



Seagrass EOV

Percent cover



Species composition



Shared data system



Products & Benefits!



Invasive species alert



Seagrass degradation alert



Regional and global science





The Global Ocean Observing System

# Thank you!

[goosocean.org](http://goosocean.org)



MarineGEO  
toolkit



SeagrassNet  
manual



Seagrass-Watch  
manual



Seagrass Spotter  
app




slido



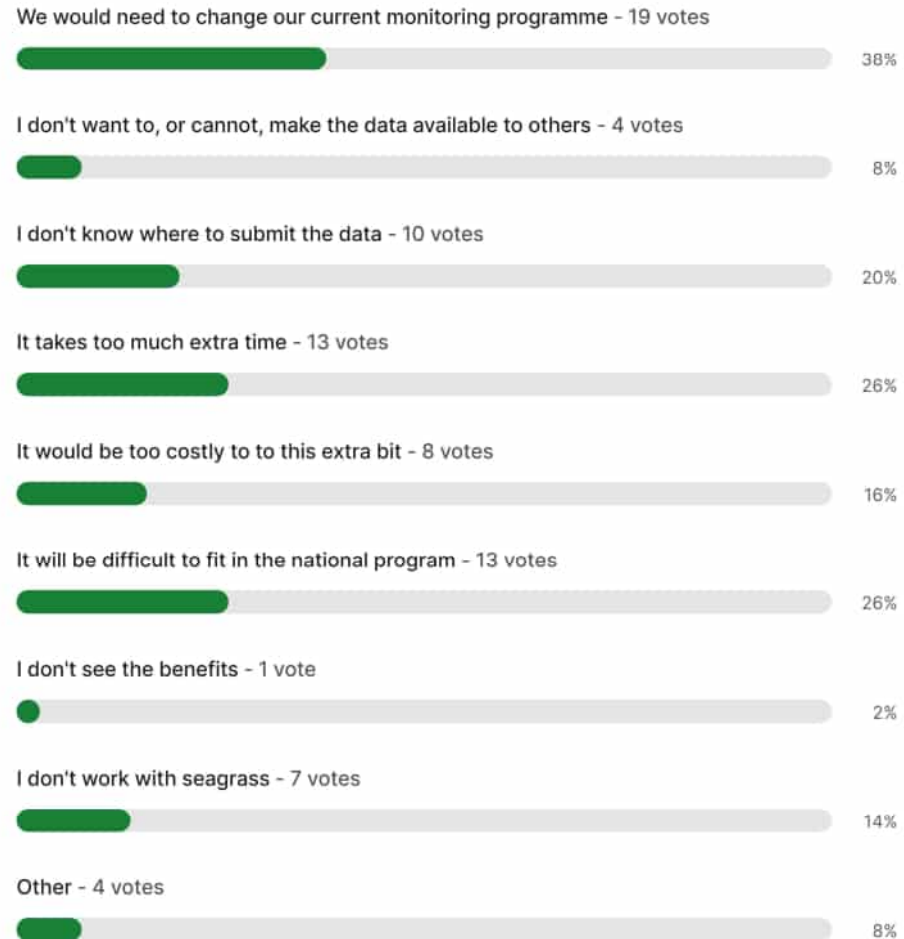
**What are the biggest challenges to achieving globally comparable seagrass data, according to you?**

ⓘ Start presenting to display the poll results on this slide.



 What are the biggest challenges to achieving globally comparable seagrass data, according to you?

Multiple Choice Poll  50 votes  50 participants





# The benefits!

Think positive!

Dream big and bold!

Think about **seagrass**!

**BREAKING  
HEADLINES**



slido



**What do you think is the biggest benefit of globally comparable seagrass data?**



ⓘ Start presenting to display the poll results on this slide.



## What do you think is the biggest benefit of globally comparable seagrass data?

Open text poll  59 responses  49 participants



Anonymous

Track changes globally and locally and enhancing our understanding of carbon cycling



Anonymous

Interpret local results (like variability and temporal trends) in a larger context



Anonymous

Seagrass data is important for marine organisms. And also reduce global sea problems.



Anonymous

Convince local policy makers that their conservation challenges might be shared with others.



Anonymous

We can solve problems much better working together



Anonymous


Global and regional patterns will emerge. So that we don't have a one-size-fits-all view of seagrass in management.








- Anonymous  
Groundtruthing tool
- Anonymous  
Feeding into climate adaptation targets, getting seagrass ecosystems recognised internationally, understanding national, regional and global extent. Huge benefit to this project in many ways
- Anonymous  
Understanding connectivity among local regional and global variations
- Anonymous  
Advantages in monitoring activities and consequent adaptive management plans
- Anonymous  
Use available data to support future proposal for projects in the area.
- Anonymous  
High resolution hyperspectral satellite imagery to map seagrass globally! This may also enable to map and identify threats such as macroalgae , often detrimental to seagrass.
- Anonymous  
Better communicate the importance of seagrass beds and raise awareness about disastrous consequences of their decline and take actions





 Anonymous  
I think it's a good opportunity to have a large-scale view of the global situation of seagrasses.

 Anonymous  
Climate change driven ecosystem shifts and concurrent species movement/displacement

 Anonymous  
To protect coastal marine biodiversity, save the coastal ecosystem interactions between terrestrial and marine components

 Spyros Christofilakos  
Insight for global decision and policy-making

 Anonymous  
Can we compare different groups? Posidonia vs Cymodocea vs Zostera vs Halophila? Different traits, demands, etc ...

 Anonymous  
Solving big problems together and assess the trends compared standard data

 Anonymous  
It will be important to identify trends over time and maybe an early warning system for future changes in the seagrass community.



# Q & A



Biology and Ecosystems Panel

Credit: Dimitris Poursanidis / Ocean Image Bank





The Global Ocean Observing System

# Thank you!

[goosocean.org](http://goosocean.org)



Credit: Ben Jones / Ocean Image Bank