Coastal and Marine Ecological Classification Standard (CMECS) Overview

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CMECS -- The Common Language for Marine Ecosystems

Outline

- Process & Objectives
- Classification vs. Mapping
- *Questions*
- Classification Content
- *Questions*
- Mapping & Implementation
- *More Questions & Discussion*

Partners

- **Federal agencies:** NOAA, EPA, COE, USGS, FWS, NPS, BOEMRE, USDA/NRCS, NASA
- **State agencies:** MA Division of Marine Fisheries, OR Coastal Management Program, SC Department of Natural Resources, TX Parks and Wildlife, California State Coastal Conservancy
- **NGO's:** NatureServe, TNC
- **Academia:** FIU, U. Miami, URI, U. So. Miss., VIMS

People

- Becky Allee, Mark Finkbeiner, Garry Mayer, Chris Moses - NOAA
- Chris Madden, Kathy Goodin, Judy Soule - NatureServe
- Giancarlo Cicchetti – EPA
- Larry Handley – USGS

- +35 Members of the CMECS workgroup
- + Over 100 expert participants in workshops and pilots over the years

Development Timeline

- **Initiated CMECS development (first workshop)** — **1998**
- **Published *Federal Register* notice/open public comment period** — **August, 2010**
- **Closed public comment period (+120 days)** — **December, 2010**
- Review and sort comments; develop response teams — January 2011
- Complete responses to public comments; submit final package to FGDC — September 2011
- Publish comments in *Federal Register* — October 2011
- FGDC endorsement of CMECS — November 2011

Objectives

- Develop a national standard for consistent terminology for coastal and marine ecological features.
- Include biological, geological, physical, and chemical aspects of the seascape.
- Be compatible with existing FGDC standards (wetland, soils, vegetation) and build on other existing systems
- Meet planning, inventory, restoration, monitoring, and protection information needs.

Benefits

- “Uplands to sea floor” continuity
- Common terminology and framework for data from different sources
  - Across scales
  - Across geographic regions
  - Across institutions
- Built on existing classification approaches
- Based on ecological principles
- Responsive but stable
  - Dynamic content standard
  - Expands with knowledge
- Flexibility to meet individual program needs

Before we get too deep…

To an ecologist a classification is:

Comprehensive list of ecological units: *Linnaean approach*

To a mapper a classification is:

List of relevant units that can be discerned with available sensors: *practical approach*

CMECS is a product of the former with an eye toward the latter.

Classification: What is it?

- What factors define the units?
- What values determine the conceptual boundaries between units?
- What are the units called? – common terminology
- What are the rules for identifying the units, and how do I know one when I see it?
- How are the units described?

- *What are the buckets?*

Mapping: Where is it?

- How do I portray the units on a map?
- What if I can't discern the units with a particular technology?
- What happens if two units are coincident in horizontal space?
- How do I deal with units that are temporally variable?

These questions determine how to portray the units, but shouldn't determine how to define them.

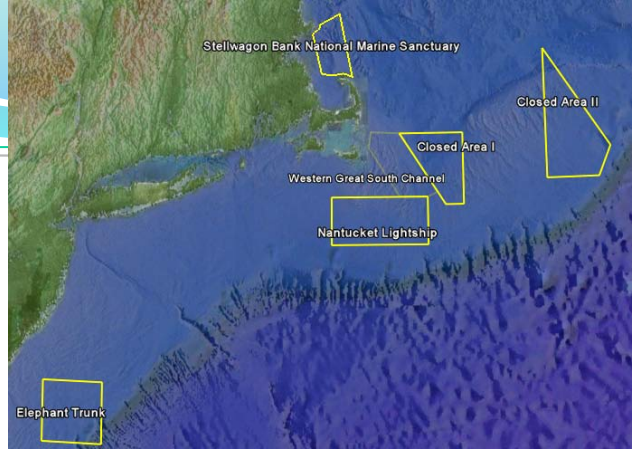
The answers are almost always objective driven.

Condition Assessment: How is it Doing?

- What factors effect the status of the unit across it's range? Area, threats, etc.
- What factors determine the condition of the unit in the field and to what extent?
  - Water quality (contaminants, sediments, hypoxia)
  - Physical disturbance (dredging and fill, storm surge)
  - Invasive species
  - Human induced climate change (bleaching, sea level)
- *As a rule these things help assess the status and condition of a unit but do not define what or where it is.*
- *Watch this space*

Questions?

CMECS Domain



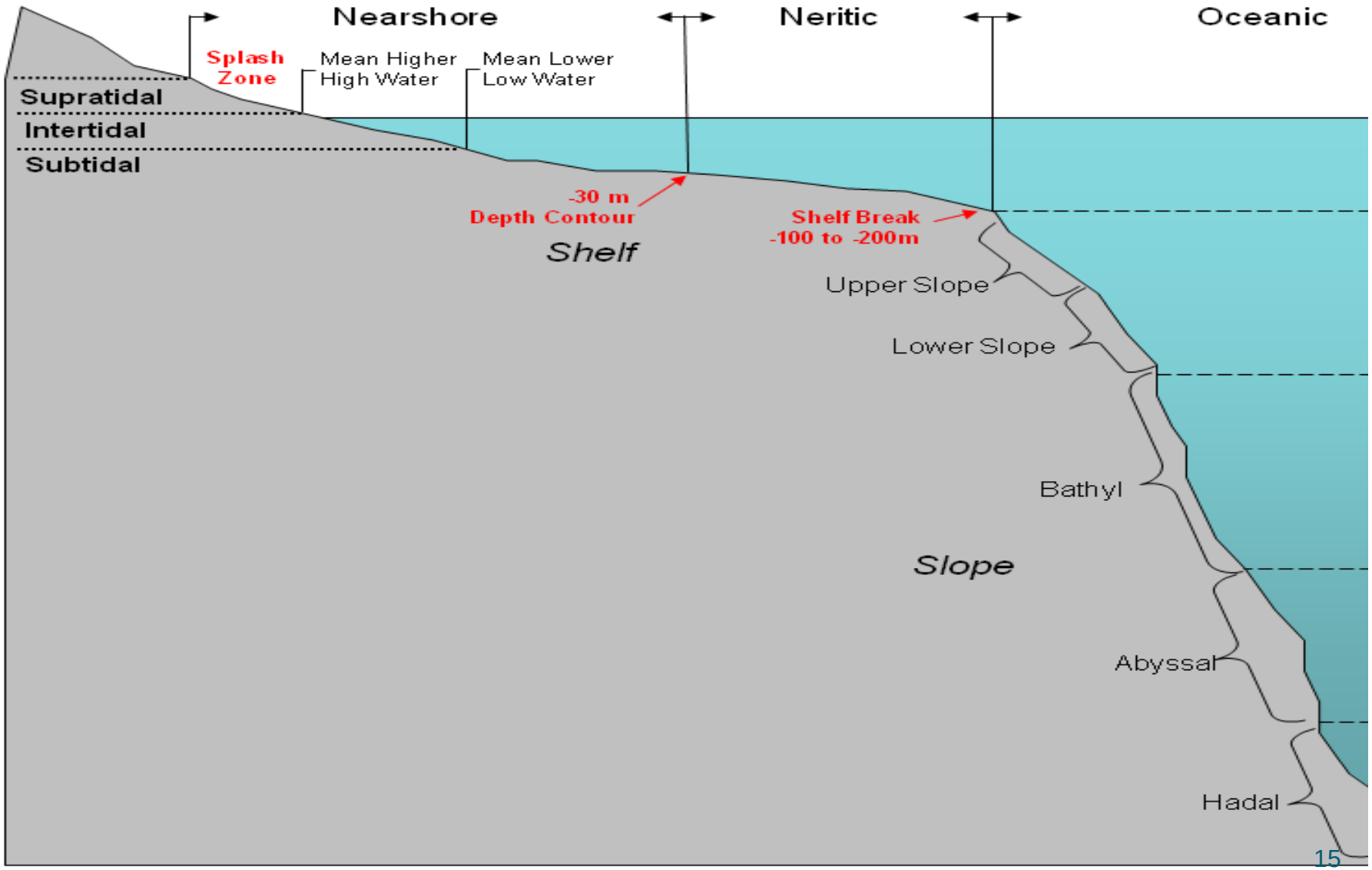
All waters, substrates, benthos and sub-benthos of the coastal marine realm extending:

- **Landward** to tidal splash zone of coasts, intertidal euhaline and brackish wetlands, and waters of Great Lakes
- **Up river/estuary** to head of tide, where tide $\geq$ 0.2 ft (0.06 m) for at least part of month
- **Seaward** to deep ocean, including all continental and ocean waters and bottom

System , Subsystem and Tidal Zone

System	Subsystem	Tidal Zone
Marine	**Nearshore** **Neritic** **Oceanic**	***Supratidal*** ***Intertidal*** ***Subtidal***
Estuarine	**Shallow Water** **Deep Water** **Tidal Riverine** **Shallow Water** **Tidal Riverine** **Deep Water**	
Lacustrine	**Limnetic** **Littoral**	

Marine Subsystems & Tidal Zones



Components

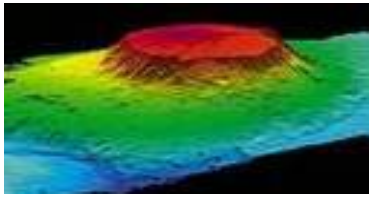
Benthic Biotic Component (BBC)

Composition of biota on seafloor surface

Surface Geology Component (SGC)

Geological composition of surface and near-surface substrates; surface features, including biogenic structures

Geoform Component (GFC)

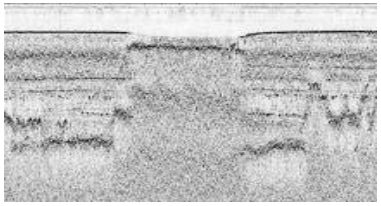


Major geomorphic character or structural character of coast or seafloor

Water Column Component (WCC)

Structure, characteristics, and processes of water column and associated biota

Sub-Benthic Component (SBC)



Character of sediments and soils below substrate surface

Benthic Biotic Component (BBC)

- Describes the biological composition and cover of the coastal and marine benthos
- Hierarchical: Class, Subclass, Biotic Group, Biotope
- Derived from FGDC Wetland Standard Classes and Subclasses – with some modifications

Benthic Biotic Component

Class	Subclass	Biotic Group	Biotope
Faunal Reef Biota			
Coral Reef Biota			
Faunal Bed			
Aquatic Bed	*e.g.*, Macroalgae	**e.g., Kelp Forest**	***e.g., Macrocystis* Community**
Emergent Wetland			
Scrub-shrub Wetland			
Forested Wetland			

CMECS
The Common Language for Marine Ecosystems

Coastal and Marine Ecological Classification Standard

Catalog of units

Benthic Biotic (BBC) Component

Drill down to browse hierarchy. Click link for description.

- Benthic Biotic
  - Aquatic Bed
  - Coral Reef Biota
  - Emergent Wetland
  - Faunal Bed
    - Epifauna
      - Attached Anemones
      - Barnacles
        - Balanus Communities
        - Chthamalus Communities
      - Bryozoans
      - Burrowing Anemones
        - Cerianthus Communities
        - Edwardsia Communities
      - Coral Garden Faunal Bed
      - Crinoids
        - Comanthus Communities
        - Diplocrinus Communities
      - Epifaunal Ophiuroids

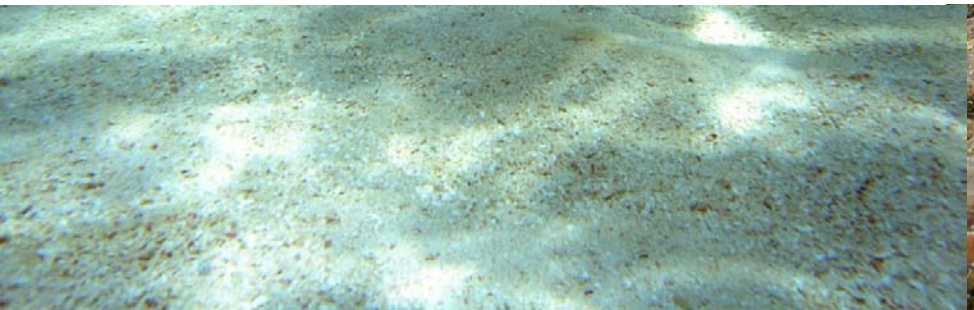
Search for Search

Refine Name Search by Level:

- **Class**
- **Subclass**
- **Biotic Group**
- **Biotope**

Surface Geology Component (SGC)

- Describes the geological composition and environment of the upper layer of the hard substrate and the upper 15 cm of soft substrate as well as the structural (non-living) aspects of biogenic substrates such as coral reefs.
- Hierarchical: Class, Subclass, Group
  - Class: Unconsolidated Substrate
    - Subclass: Fine Unconsolidated Substrate
      - Groups : Sand, Silt, Clay, Fine Mixes, Coarse Mixes
    - Subclass: Coarse Unconsolidated Substrate
      - Groups: Fragments, Shells/Corals



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Coastal and Marine Ecological Classification Standard

Catalog of units

Home | Search/Browse

Surface Geology (SGC) Component

Drill down to browse hierarchy. Click link for description.

- Surface Geology
  - Coral Reef Substrate
  - Faunal Reef Substrate
    - Mollusk Reef Substrate
    - Worm Reef Substrate
  - Rock Substrate
    - Bedrock
    - Pavement
  - Unconsolidated Substrate
    - Coarse Unconsolidated Substrates
      - Fragments
      - Shells/Corals
    - Fine Unconsolidated Substrates
      - Clay
      - Coarse Mixes
      - Fine Mixes
      - Sand
      - Silt

Search for

Search

Refine Name Search by Level:

- Class
- Subclass
- Group
- Biotope

Geoform Component (GFC)

- Describes the major geomorphic or structural characteristics of the coast and seafloor at various scales
- Initial list derived from Greene et al. with modifications
- Three subcomponents:
  - Coastal Region – Ecological regions based on Spalding
  - Physiographic Setting – major components of seafloor geomorphology along the continuum from the spreading center to the coast. (e.g., fracture zone, abyssal plain, continental rise, continental shelf).
  - Geoform - seafloor structures that range in size from 100's of kilometers to less than a meter (e.g., delta, embayment, channel).
    - Anthropogenic (berm, harbor, artificial reef).
    - Coastal
    - Marine

GeoForm (GFC) Component

Drill down to browse hierarchy. Click link for description.

- GFC Physiographic Setting
  - Abyssal plain
  - Basin Floor
  - Borderland
  - Coast
  - Continental/Island Rise
  - Continental/Island Shelf
  - Continental/Island Slope
  - Fracture Zone/Spreading Center
  - Inland/Enclosed Sea
  - Mid-Ocean Ridge
  - Ocean Bank/Plateau
  - Shelf Break
  - Trench

- GFC Geoform
  - Alluvial Fan
  - Apron
  - Aquaculture
  - Artificial Levee
  - Artificial reef
  - Atoll
  - Bank
  - Basin
  - Bay/Embayment/Sound/Bight
  - Beach
  - Berm
  - Boulder Field
  - Channel
  - Dam
  - Delta
  - Depression
  - Dredge Deposit
  - Drilling platform
  - Dune
  - Fan
  - Fish Pond
  - Fjord

Water Column Component (WCC)

- Describes the structures, patterns and processes of the water column

- Three Subcomponents
  - Depth zones
  - Hydroforms and subforms
  - Biotic Groups & Biotopes

- Modifers
  - salinity, temperature, etc.

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Catalogue of Units

Home | Search/Browse

Water Column (WCC) Component

Drill down to browse hierarchy. Click link for description.

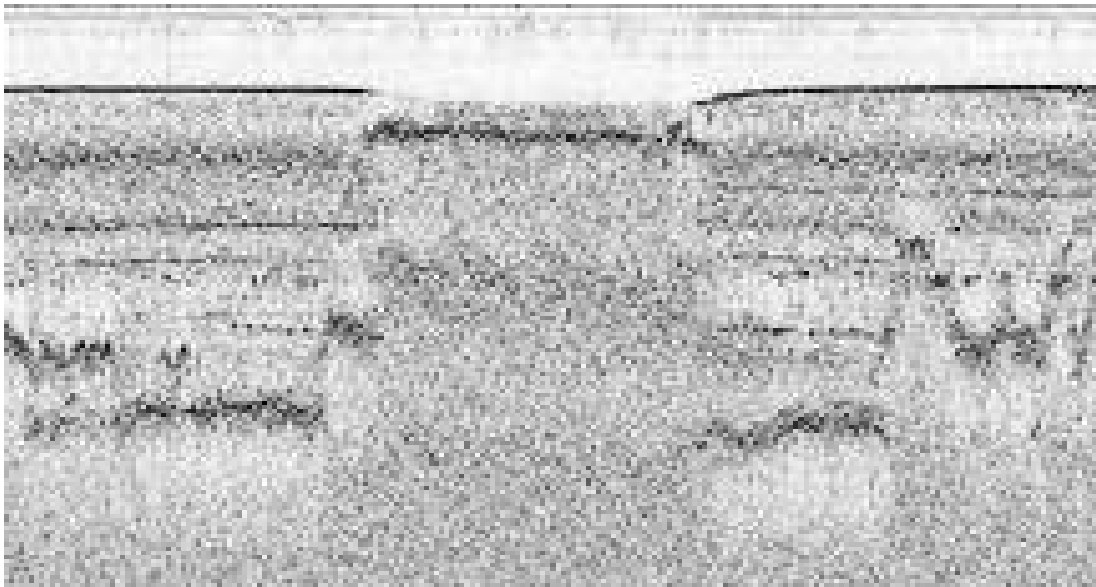
- WCC Depth Zone
  - Marine Nearshore (Subsystem)
    - Marine Nearshore Shallow Zone
    - Marine Nearshore Deep Zone
  - Marine Neritic (Subsystem)
  - Marine Oceanic (Subsystem)
    - Marine Oceanic Epipelagic Zone
    - Marine Oceanic Mesopelagic Zone
    - Marine Oceanic Bathylpelagic Zone
    - Marine Oceanic Abyssopelagic Zone
    - Marine Oceanic Hadalpelagic Zone
  - Estuarine Shallow Water (Subsystem)
  - Estuarine Deep Water (Subsystem)
    - Estuarine Deep Water Shallow Zone
    - Estuarine Deep Water Deep Zone

- WCC Hydroform
  - Current
  - Downwelling
  - Eddy
    - Cold Core Ring
    - Mesoscale eddy
    - Warm Core Ring
  - Frontal Boundary
  - Gyre
    - Recirculation Gyre
    - Subpolar Gyre
    - Subtropical Gyre
  - Horizontal Layer
  - Ice
  - Intrusion
  - Surf Zone
  - Upwelling
  - Water Mass

- WCC Biotic Group
  - Demersal Fish (Schools)
  - Floating Microbial Mat
  - Floating Vascular Vegetation
  - Floating/Drift Macroalgae
  - Jellyfish Aggregations (Smacks)
  - Kelp Forest (Water Surrounding Stipe and Blades)
  - Pelagic Fish (Schools)
  - Phytoplankton Bloom
  - Seagrass Meadow (Water Surrounding Grass Blades)
  - Surf Foam/Surface Foam
  - Vent Community
  - Whale Aggregations (Pods)
  - Zooplankton Aggregation

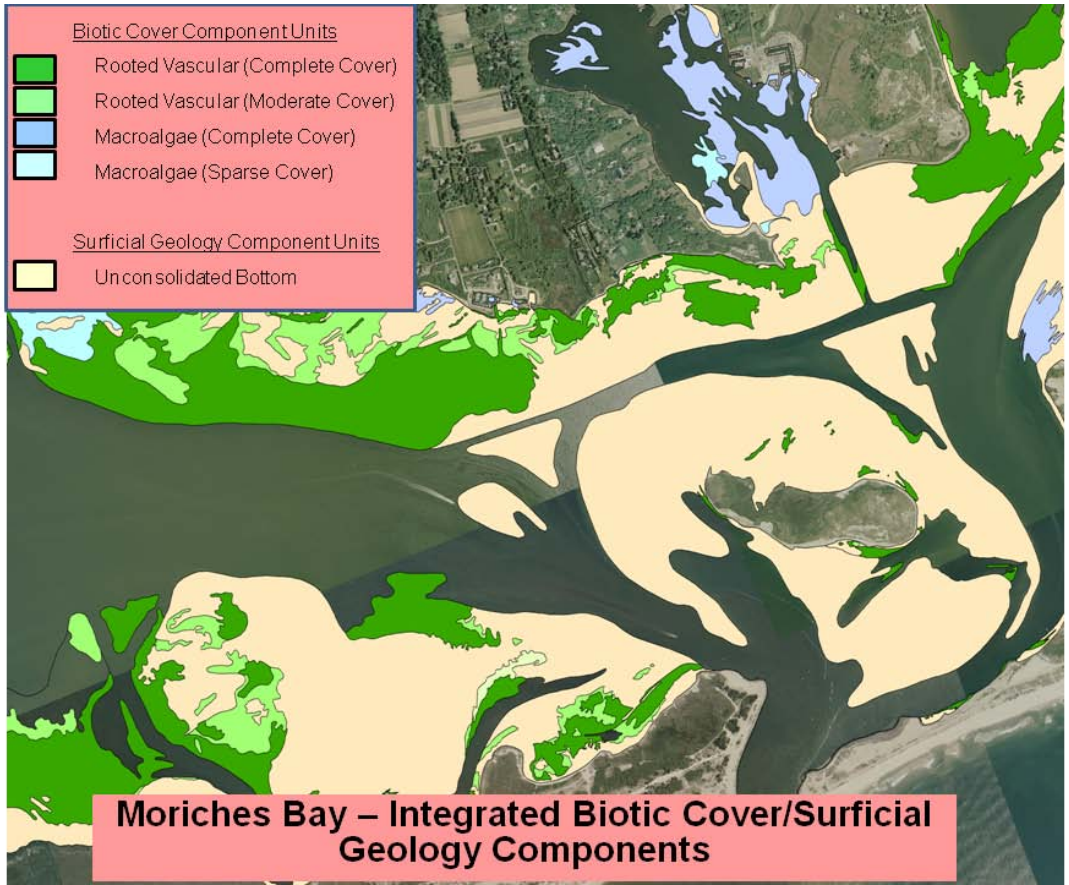
Sub-benthic Component (SBC)

- Describes characteristics of the sediments and soils below the surface with depth
  - Upper 15 cm: Same as SGC.
  - Below 15 cm: Horizontal Soil Layering. Suborders and Great Groups.



Modifiers

- A consistent set of variables used to further describe a standard unit and allow users customize their application of the classification in a standardized way
- Examples:
  - Energy Level
  - Percent Cover
  - Slope
  - Rugosity



Moriches Bay – Integrated Biotic Cover/Surficial Geology Components

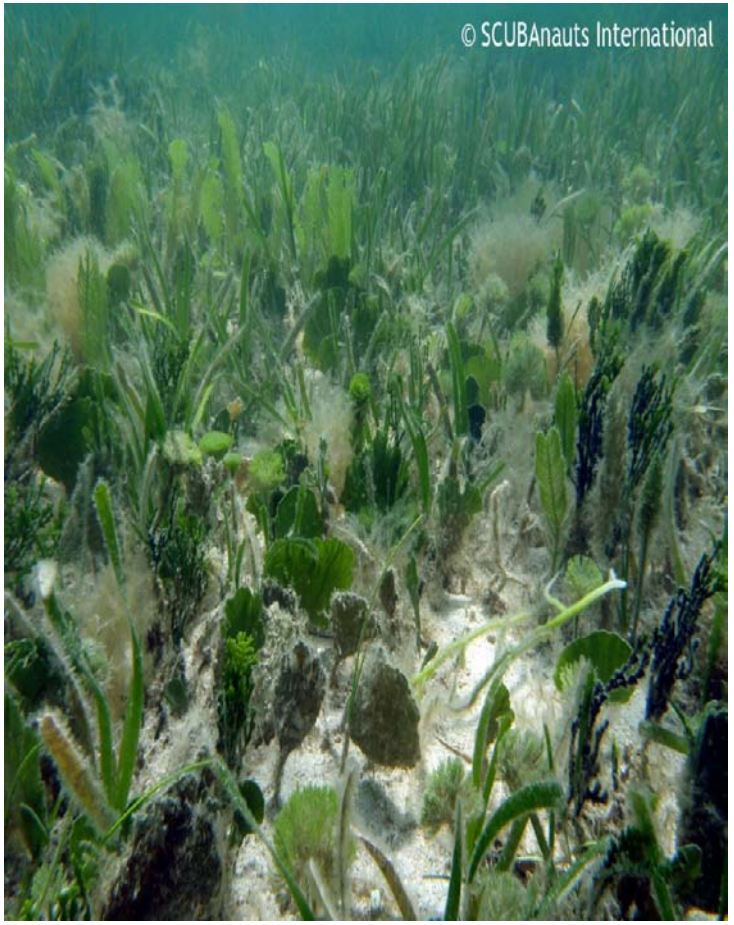
Seagrass Bed Classification

System ,Subsystem ,Tidal Zone
Marine Nearshore Subtidal

Benthic Biotic Component (BBC):
Class: Aquatic Bed
Subclass: Rooted Vascular
Biotic Group: N.A. Atlantic Seagrass Bed
Biotope: *Thalassia Seagrass* Bed
Modifier: Dense

Surface Geology Component (SGC)**:**
Class: Unconsolidated Substrate
Subclass: Fine Unconsolidated Substrate
Group: Sand

Geoform Component (GFC):
Physiographic Setting: Coast
Geoform: Lagoon



(Gulf of Mexico) Image: C. Moses

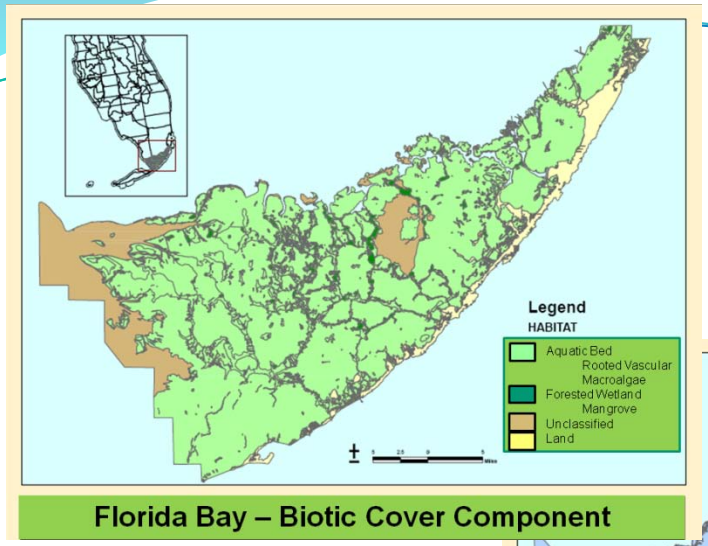
Water Column Component (WCC): *Not used*
Sub-Benthic Component (SBC): *Not used*

Questions?

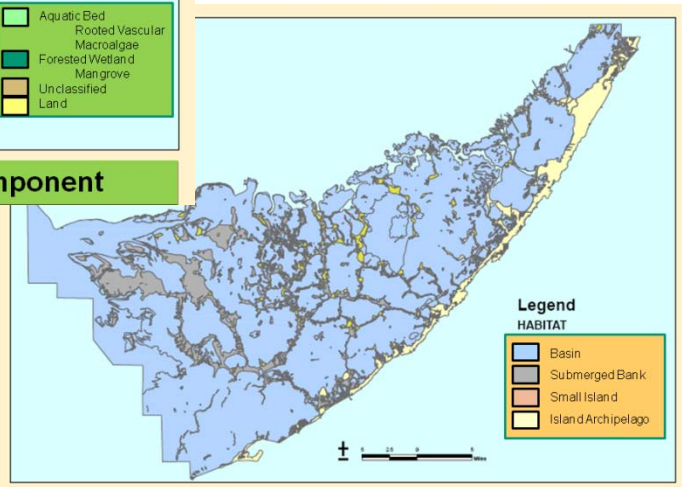
Mapping CMECS

- Driven by user objectives.
- CMECS is technology agnostic. Level of specificity depends on a users objectives and the source data.
- Various components can be mapped alone or together based on user objectives.
- Map scale and geographic scale is user driven. No predefined minimum mapping unit.
- CMECS recognizes spatially and temporally variable units. Frequency of mapped “snapshots” depends on user needs. Modifiers can be used to indicate ephemeral units.

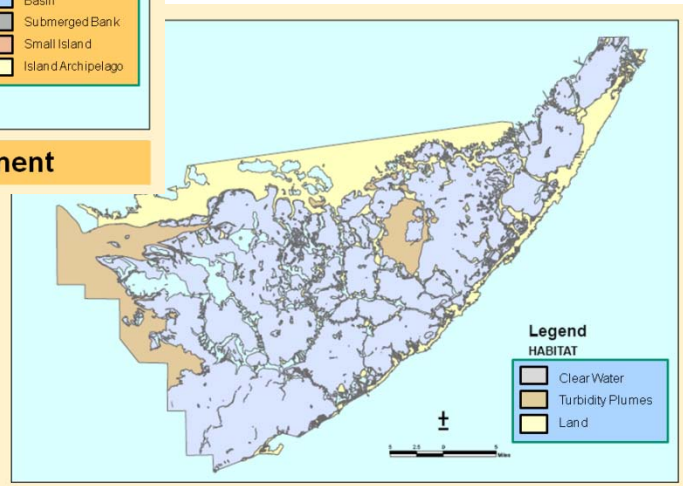
Mapping CMECS



Florida Bay – Biotic Cover Component



Florida Bay – GeoForm Component

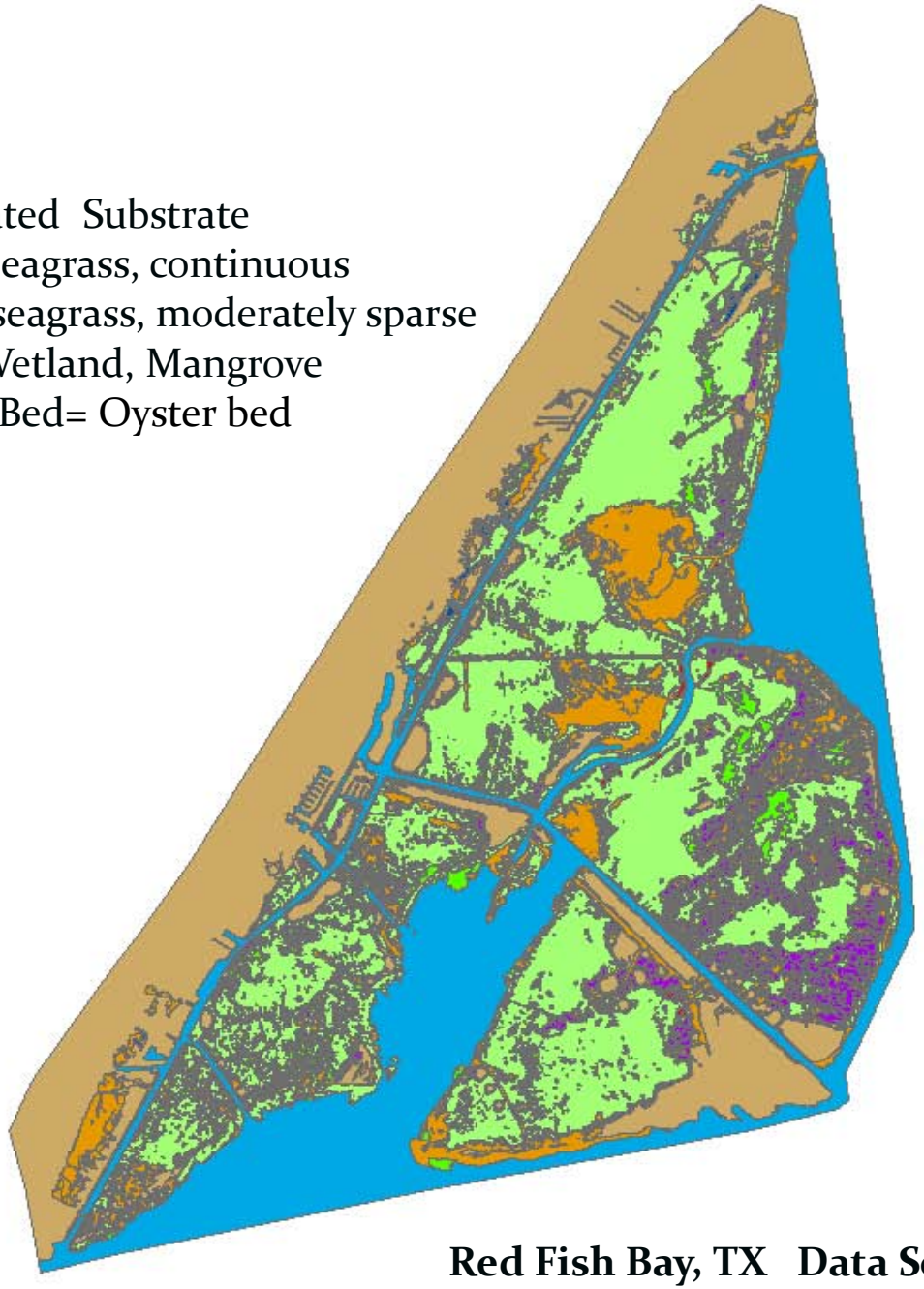


Florida Bay - Water Column

- Develop coverage for each separate component

Applied CMECS units to existing map developed by Florida Marine Research Institute (FMRI, 2002) originally classified using "SCHEME" system.

ES = Estuarine
1 = Subtidal
s:US = Unconsolidated Substrate
b: AB.3.0.0.dens = seagrass, continuous
b: AB.3.0.0.mdsp= seagrass, moderately sparse
b:FO.1 = Forested Wetland, Mangrove
b: FB.1.0b = Oyster Bed= Oyster bed



Red Fish Bay, TX Data Source: Side Scan

CMECS Pilot Projects

12 projects completed and 9 projects underway

- **Where** = Gulf of Mexico, MS, NY, TX, CA, OR, FL, SC, AK, MA, VI, RI, WA, Qeshm Island, Iran

- **Partners** = USGS, California SeaGrant, California State Coastal Conservancy, New York Dept. of State, Univ. of Rhode Island, NEPs, NERRs, Mass. CZM Program, NPS, TNC, BOEMRE, NASA, Texas Dept of Parks and Wildlife, Oregon Dept of Fish and Wildlife,

- **Type of pilot** = 14 projects working from native source data, 6 projects involving cross-walks from other systems, 1 project comparing systems

CMECS Pilot Projects (Cont.)

- **Types of source data** = Aerial imagery, sediment grab sampling, underwater videography, sediment profile imaging, water quality sampling, bathymetry, acoustic backscatter, satellite imagery

- **Four versions of CMECS tested v. I, v. III, and v. 3.1**

- **Focus areas** =
  - BBC/SGC - 6
  - SGC/GFC - 1
  - SGC -1
  - WCC - 2
  - GFC – 1

Redfish Bay, TX Pilot Data
Greens=Seagrass, Yellow=Unconsolidated Sediments, Maroon=Mangroves

CMECS Implementation Issues

- **Limitations of sensors**
  - Let objectives, resources , and available technology help you focus on what components and how far down the hierarchy
- **Integration of the components**
  - CMECS provides a common format
  - As with any GIS project, it's up to the scientists to develop ecologically meaningful overlays of the components
- **Portraying temporally variable units**
  - Let objectives guide the best visualization techniques
- **Annotating heterogeneous polygons**
  - Driven by the minimum mapping unit
  - Guidelines for secondary elements and complexes need testing
- **Crosswalking challenges**
  - New guidelines for qualifying the relationships are on the way

Resources

CMECS Web Site

www.csc.noaa.gov/benthic/cmecs

Standards Document

http://www.fgdc.gov/standards/projects/FGDC-standards-projects/cmecs-folder/cmecs-index-page

CMECS Unit Catalogue

www.cmecscatalogue.org

Contact Information

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Questions?