

An Approach to the Analysis of Video-Based Surveys of Benthic Habitats

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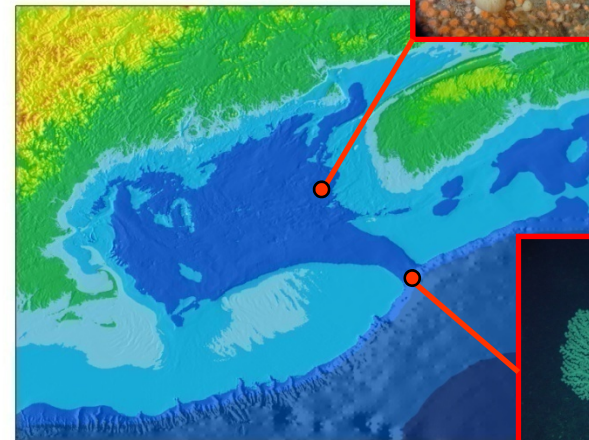
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Fisheries & Oceans, Maritimes

- Ecosystem approach to ocean resource management (Ocean's Act 1997)
- Increased the need to identify and classify benthic marine habitats



Available Technology

- Survey Equipment:

- Towcam
- Campod
- Videograb
- ROV ROPOS

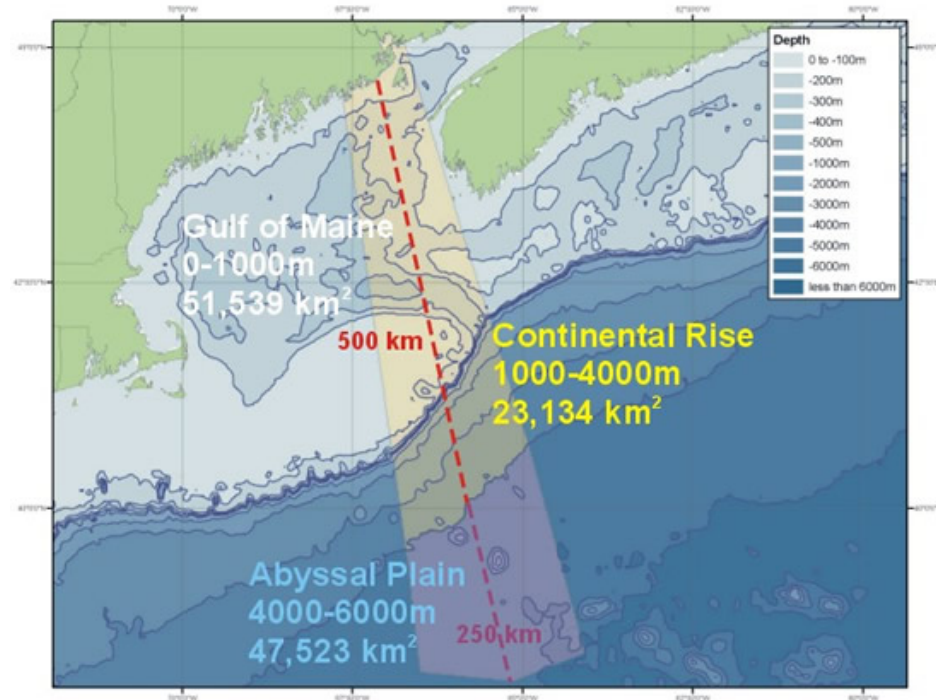
- Semi-Automatic Logging Software:

- ClassAct Mapper
- Class Event
- Carol



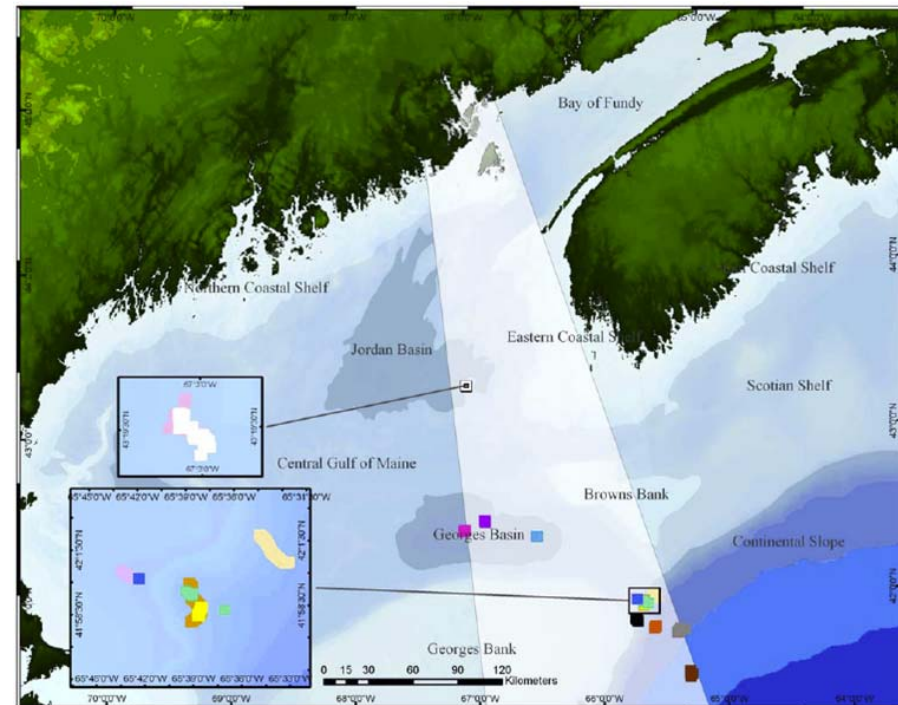
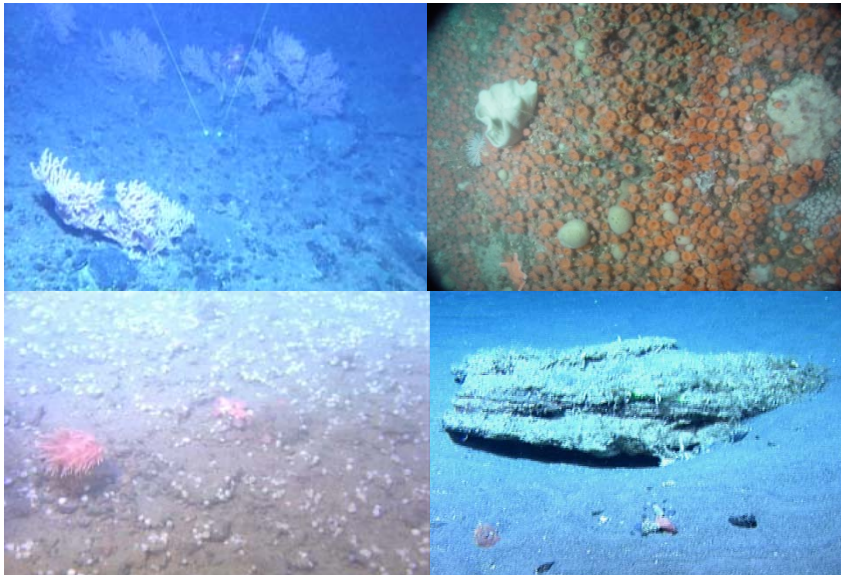
Discovery Corridor Initiative

- Swath of ocean bottom and water column above it
- Encompasses a variety of ecologically inter-linked habitats that may support a range of biodiversity
- Objectives:
 - 1) Maximize known information
 - 2) Serves as a focal point for collaborative study
 - 3) Traverse a variety of habitats

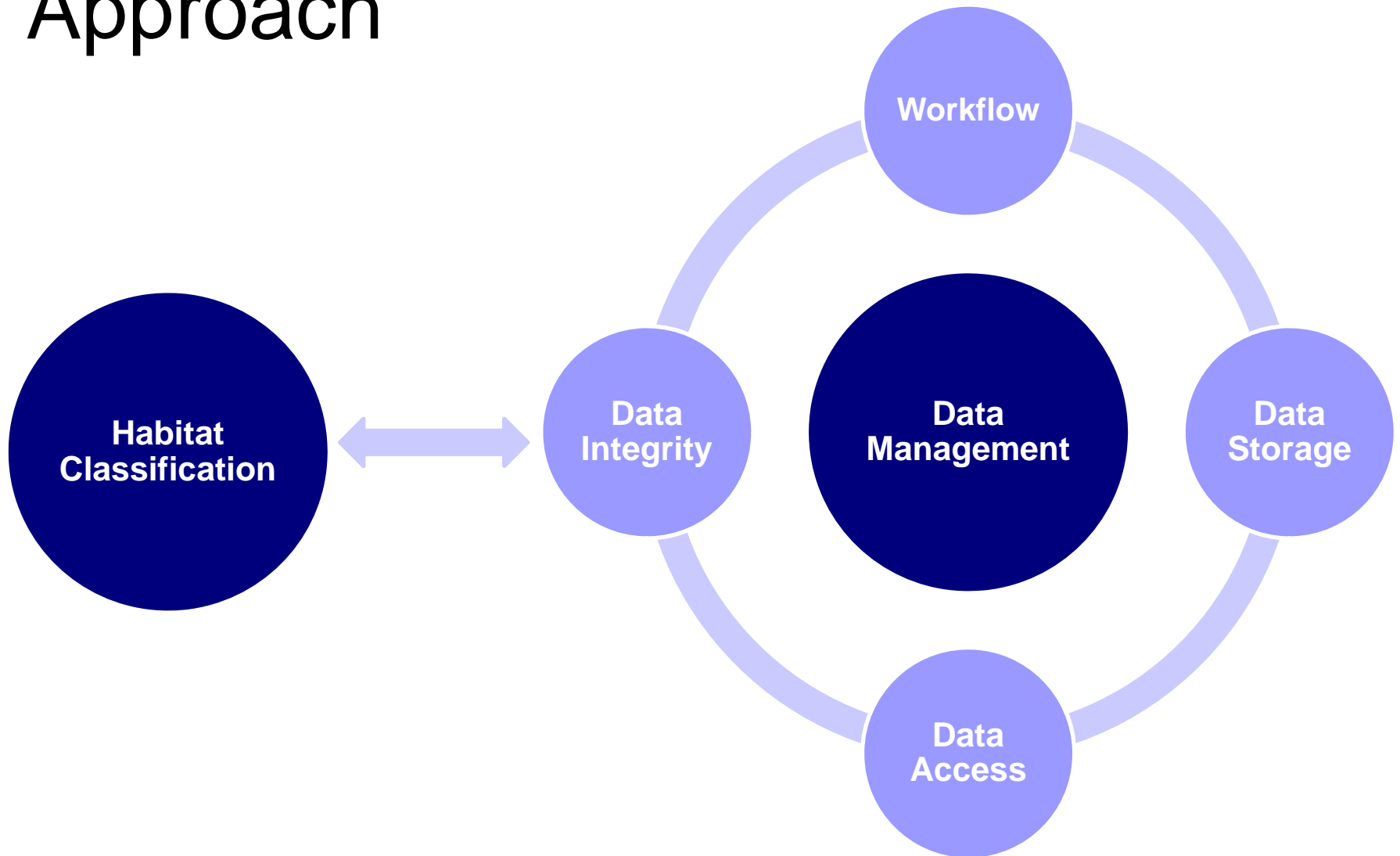


Benthic Surveys

- July 2006
- 15 sites
- ROV ROPOS
- ~120 hrs seafloor video



Considerations to Analysis Approach





Classification Scheme

Adapt a pre-existing classification scheme:

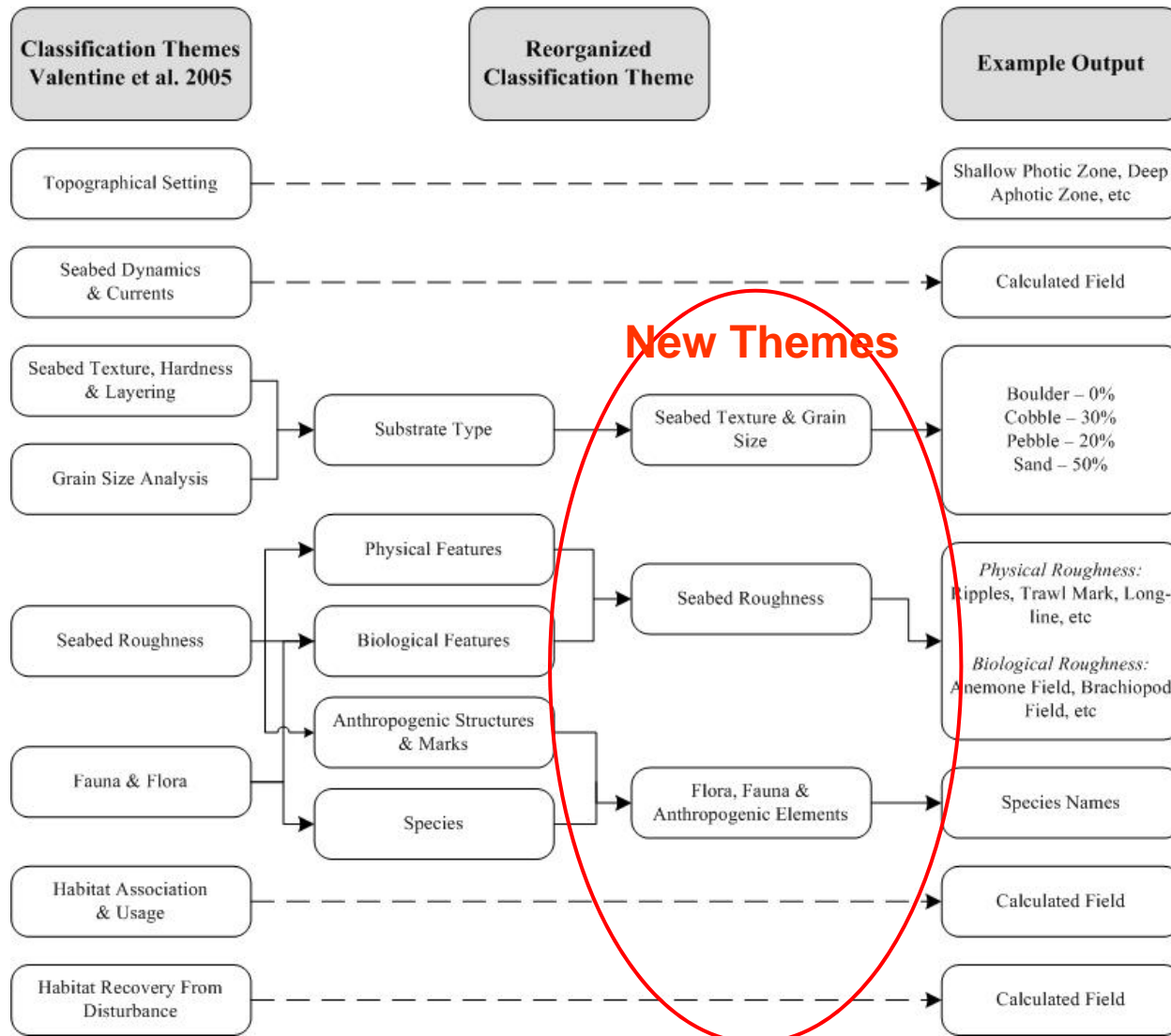
**Classification of Marine Sublittoral Habitats,
with Application to the Northeastern North
America Region**

**Valentine, Todd, Kostylev (2005)
Amer. Fish. Soc. Symp.**

Valentine et al. 2005

- Holistic ecosystem based approach
 - Geological attributes
 - Biological attributes
 - Oceanographical attributes
 - Anthropogenic attributes
- Easily adaptable to a RDBMS
- Habitat descriptors are the base unit, easy migration into GIS

Reorganized Scheme



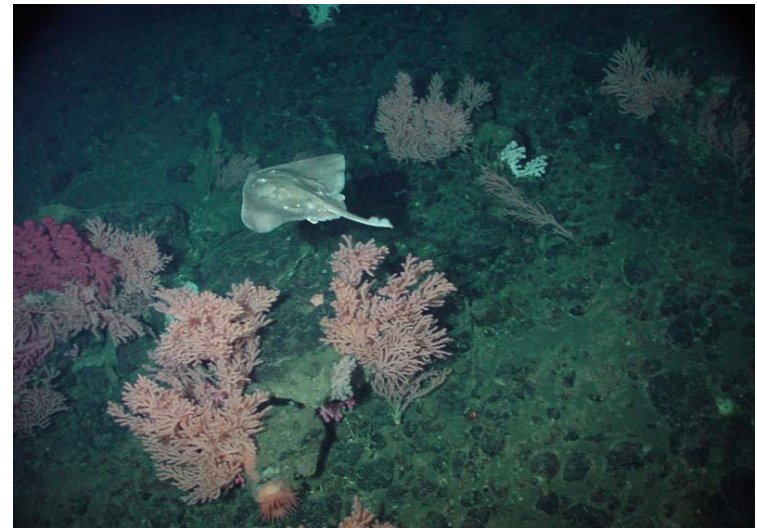
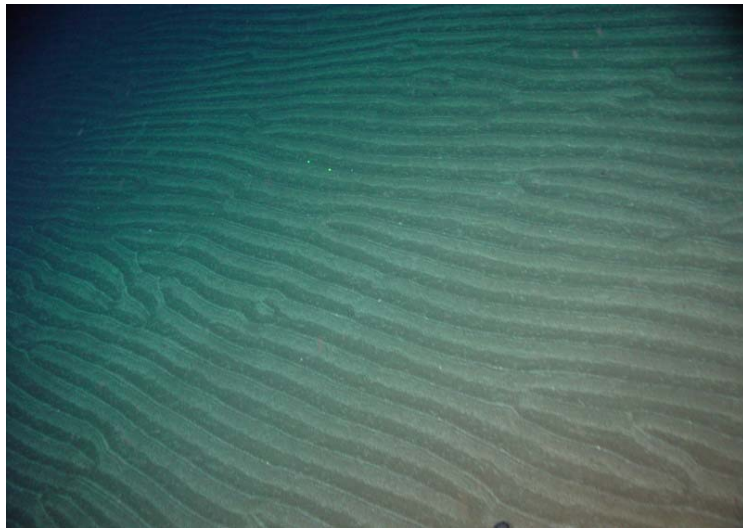
Seabed Texture & Grain Size

- Analysis of visible substrate types
- Based on the Wentworth scale
- Can add substrate types if required (e.g. bedrock outcrop)

Substrate	Size (mm)
Bedrock outcrop	$X > 1000$
Boulder	$X > 256$
Cobble	$64 < X < 256$
Pebble	$4 < X < 64$
Sand	$0.0625 < X < 4$
Fine grained sediment	$0.0625 < X$

Seabed Roughness

- As from Valentine et al. (2005)
- Physical and biological features that contribute to the 3D structure of the seabed surface
- Degree to which features contribute to forming a roughness element depends on its abundance or dominance
- Quantitatively describing feature allows a complexity index to be assigned to the data



Quantitative Descriptions

- Qualitative descriptors linked to quantitative description
- Improves data interpretation

Entry	Descriptor
Ripples	Undulations of non-cohesive sediment. Distance between peaks ~ 5 to 10 cm. Length of ripples > 100 cm (i.e. > largest length dimension of field of view). Visible on m ² scale.
Anemone dominated	> 200 per m ² , 2 distinct size classes: ~1–4 cm dia. and ~10–20 cm dia.
Coral thicket	≥ 0.2–0.5 per m ² , high density aggregations of hard corals consisting mainly of <i>Primnoa</i> sp. and <i>Paragorgia</i> sp.
Bioturbation	Prevalent (> 25% cover) biogenic modifications of the seabed: burrows, mounds, tracks, depressions, on 1–2 m ² scale.

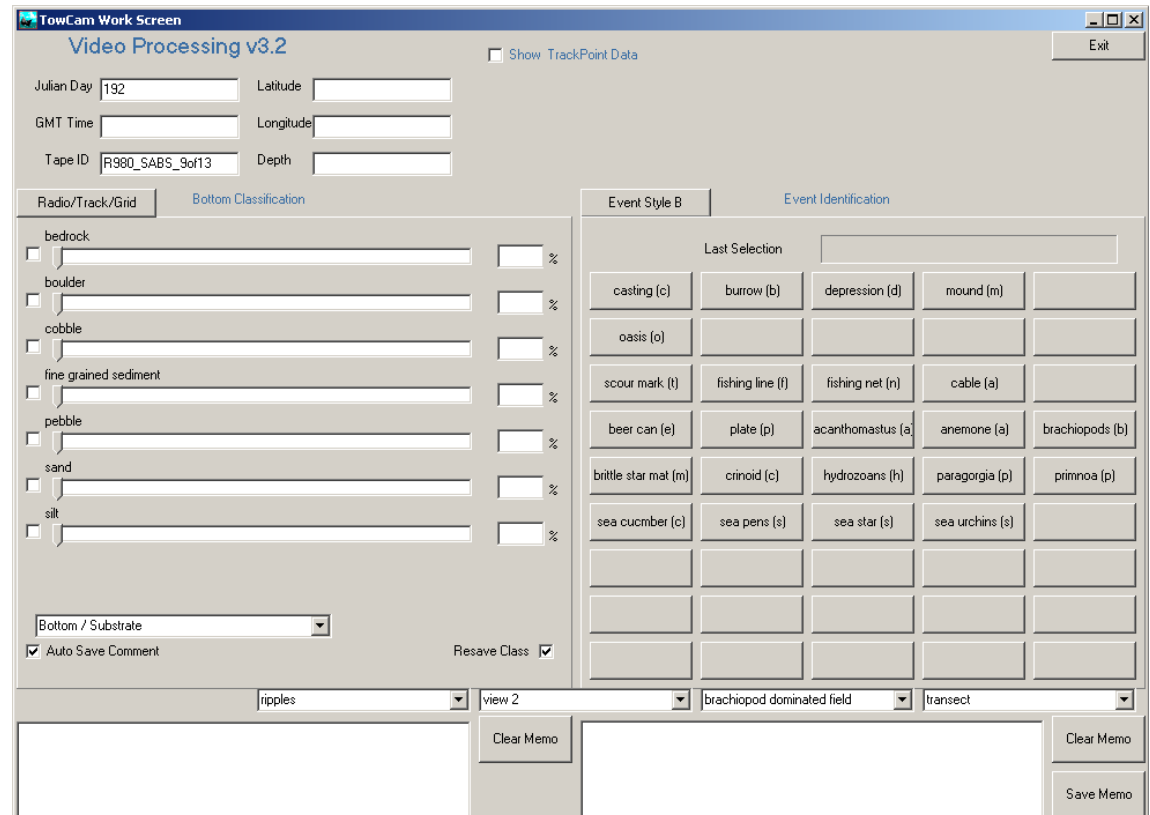
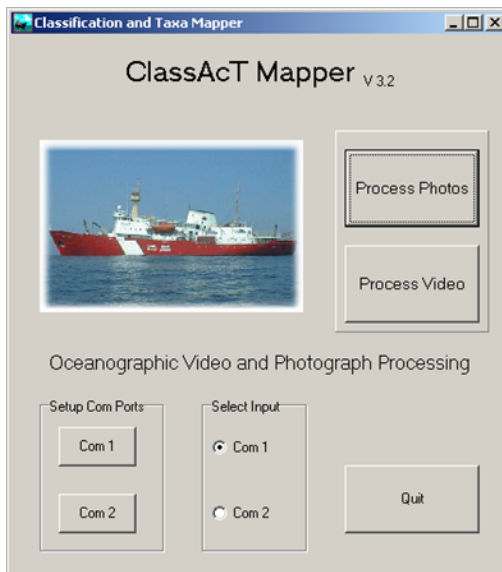
Fauna, Flora & Anthropogenic Elements

- Enumerates biological and anthropogenic features
- Recorded as discrete events
- Do not structure habitat
- Information on species-habitat relationships, stability, susceptibility of habitat, etc



Data Logging

ClassAct Mapper v. 3.2



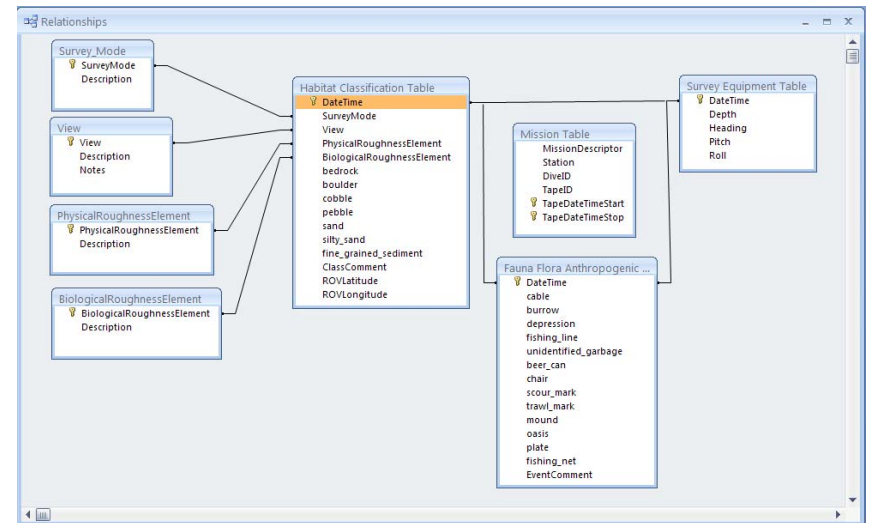
Database

■ Components

1. Attribute tables (4)
 - Habitat entries, spatial, temporal data
2. Attribute definition tables (4)
 - Qualitative and quantitative description of habitat entries

■ Normalized on date-time

■ > 280 000 records from ~ 120 hr

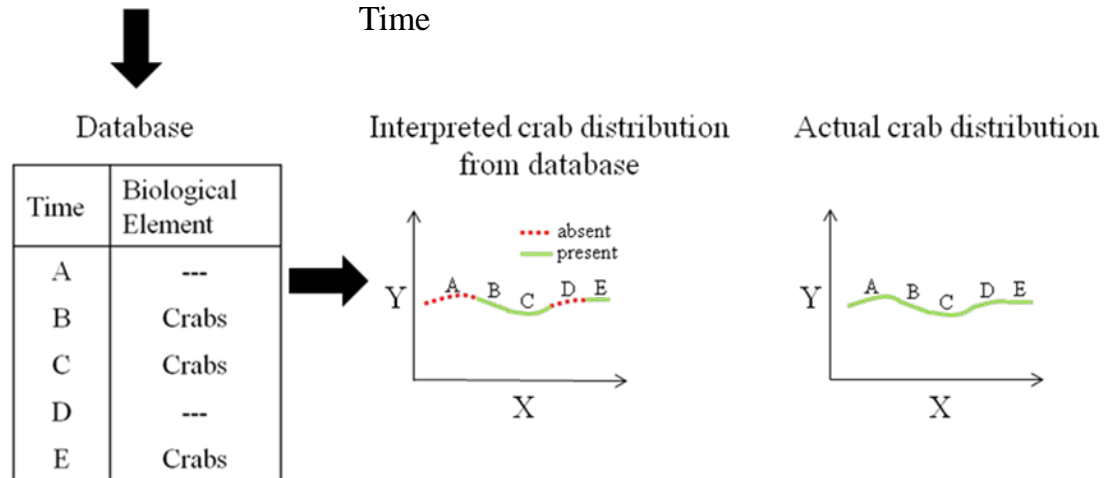
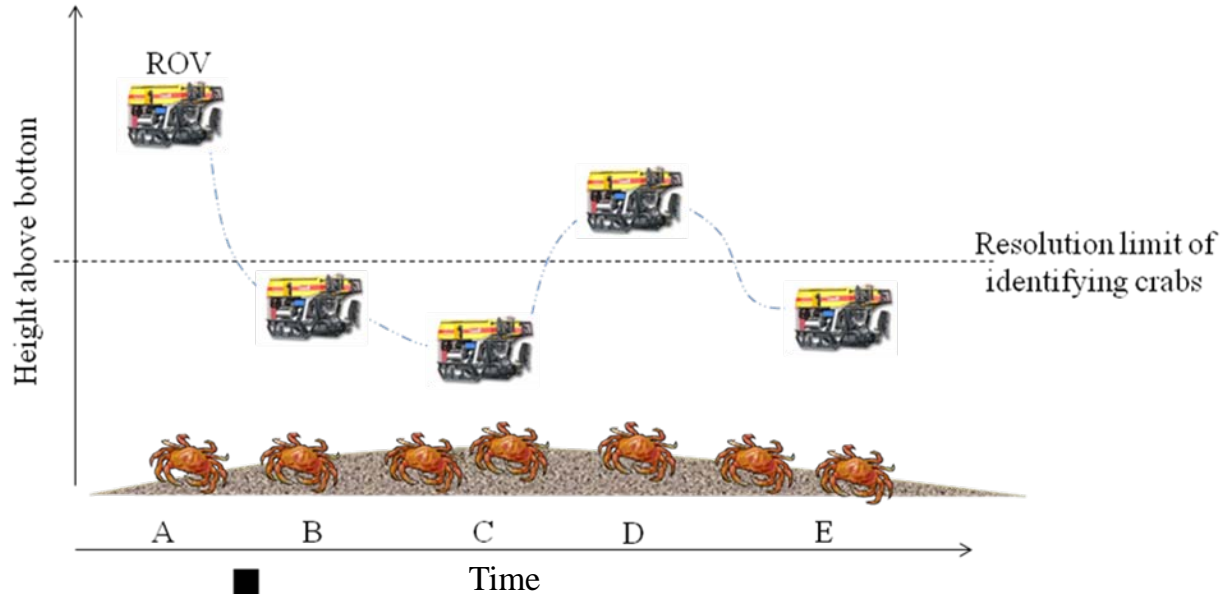


Data Sharing and Interpretation

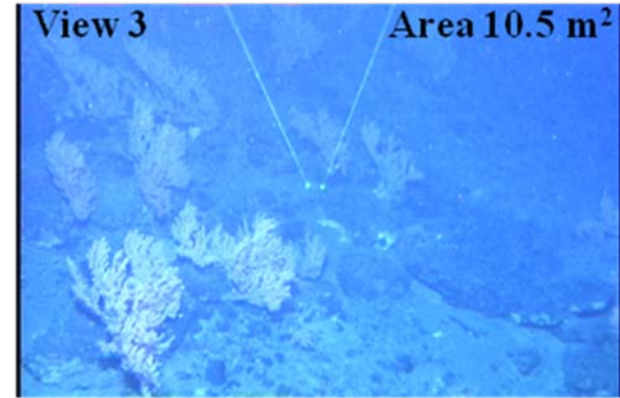
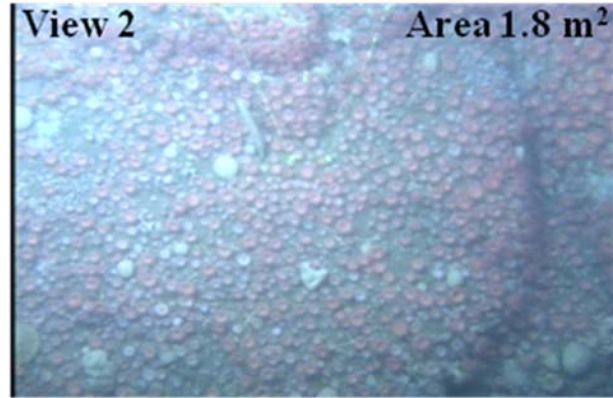
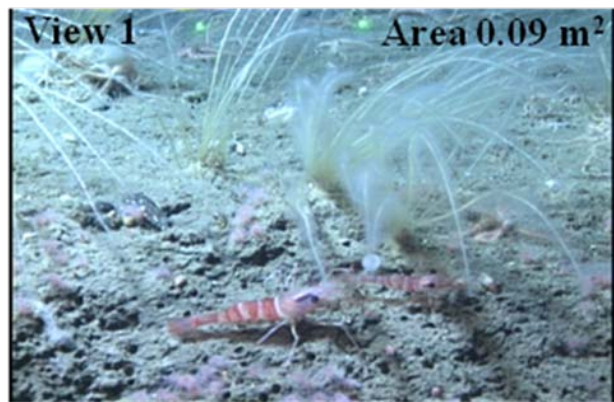
- Meta-analysis, data mining
- Secondary data users
- Potential limitations in datasets
- Metadata not enough to guide data users



View: Sampling Resolution



Resolution Varies



Entry	Lowest limit of object discrimination	Camera Footprint
View 1	< 3 cm	<1 m ²
View 2	3-5 cm	~1-2 m ²
View 3	10-15 cm	≥10 m ²

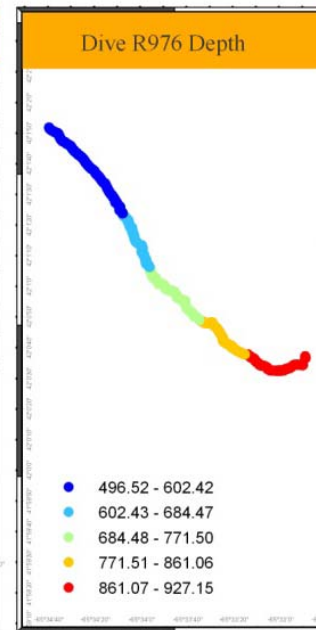
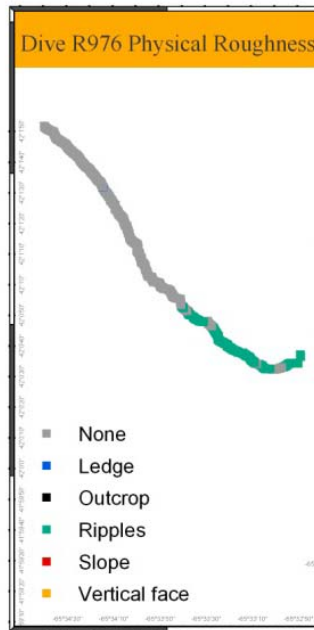
Survey Mode

Entry	Descriptor
Sampling	Taking/removing a physical sample from the environment. Equipment is typically stationary. Directed sampling.
Investigation	In-depth exploration of an area. This is a non-transect mode and the survey instrument is usually relatively stationary (e.g. examining an organism, bedform, etc). Directed sampling.
Transect	Transecting e.g. moving video survey of area. Directed sampling.
Inactive	Equipment is not engaged in scientific activity. Survey equipment is usually relatively stationary. e.g. stopped to check gauges, checking/placing equipment, etc. Non-directed sampling.
Transiting	Moving between sampling sites. Substrate is usually some-what visible. Non-directed sampling.
Off bottom	Equipment off bottom/in water column and substrate is usually not visible. e.g., pulled off due to currents, ship motion, etc. Non-directed sampling.

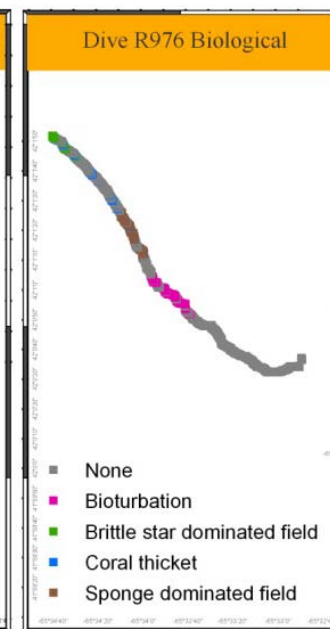
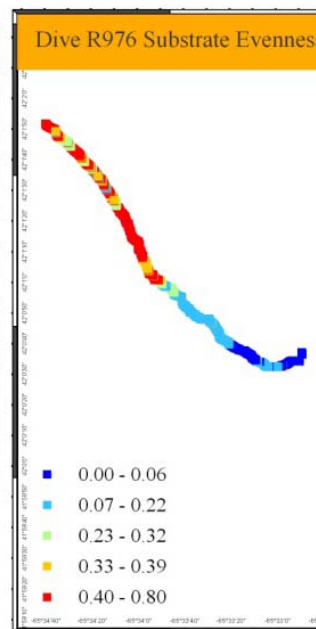
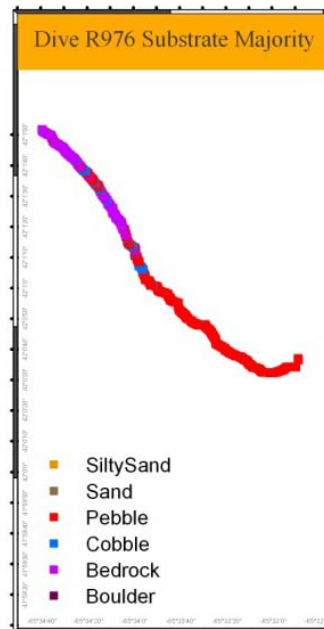
“Secondary Survey Information”

- Data on video quality recorded at the same resolution as habitat attributes
- Improves the value of data in the scientific workflow
- *View* - index of the limit of resolution
- *Survey Mode* - survey technique employed by the equipment

Example



0 0.45 0.9
Kilometers



Conclusions

- Valentine et al. scheme
 - Easily adaptable to environment of interest
 - Easily adaptable to video survey data
- Partly hierarchical scheme easily adaptable to RDBMS and GIS
- Secondary Survey Information improves the scientific workflow and data interpretation, particularly by secondary data users

Acknowledgements

An underwater photograph of a rocky seabed. The scene is filled with various marine organisms. In the upper right, a bright orange sea star is visible. Below it, a large, pinkish-orange sea urchin stands out. The seabed is covered with smaller, similar sea urchins and other small marine life. The lighting is somewhat dim, typical of an underwater environment, highlighting the textures and colors of the organisms.

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An Approach to the Development of a Relational Database and GIS Applicable Scheme for the Analysis of Video-Based Surveys of Benthic Habitats

<http://www.dfo-mpo.gc.ca/libraries-bibliotheques/tech-eng.htm>