

BENTHIC GEOLOGIC HABITAT MAPPING IN SHALLOW LAGOON AND ESTUARINE ENVIRONMENTS

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GEOLOGISTS AND SOIL SCIENTISTS WORKING SIDE BY SIDE: NOT SO CRAZY AFTER ALL!

Low-energy basin
organic silt?

Fluid silt loam?

J. Turrene



BENTHIC GEOLOGIC HABITATS

- What is a habitat?
 - Spatially recognizable area with physical, chemical, and biological characteristics that are distinctly different from surrounding areas.
(Valentine et al., 2005)
- Benthic Geologic Habitat
 - A spatially recognizable area with *geologic characteristics* that are distinctly different from surrounding areas.

BENTHIC GEOLOGIC HABITATS

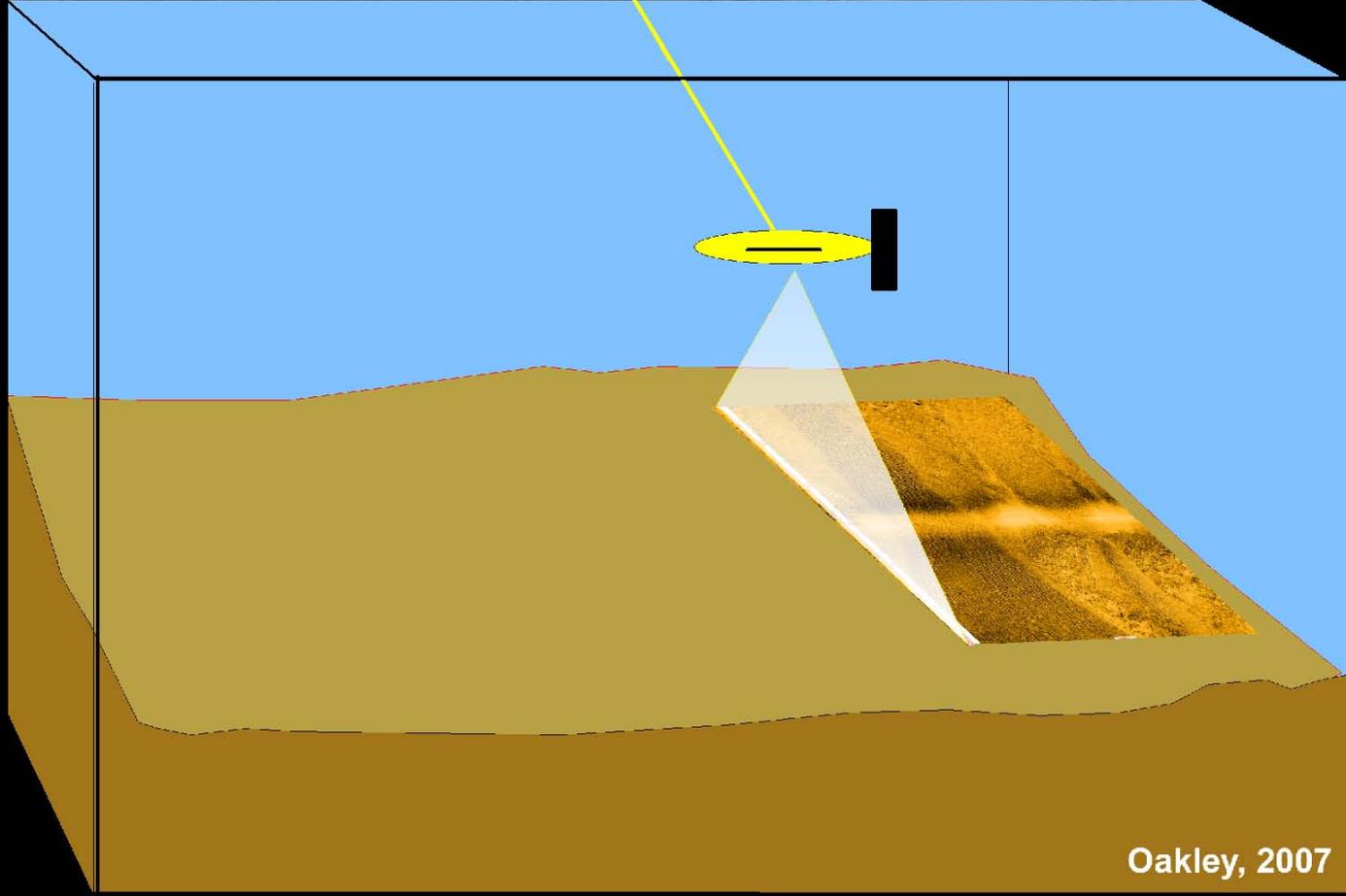
‘Geologic Characteristics’ = Facies

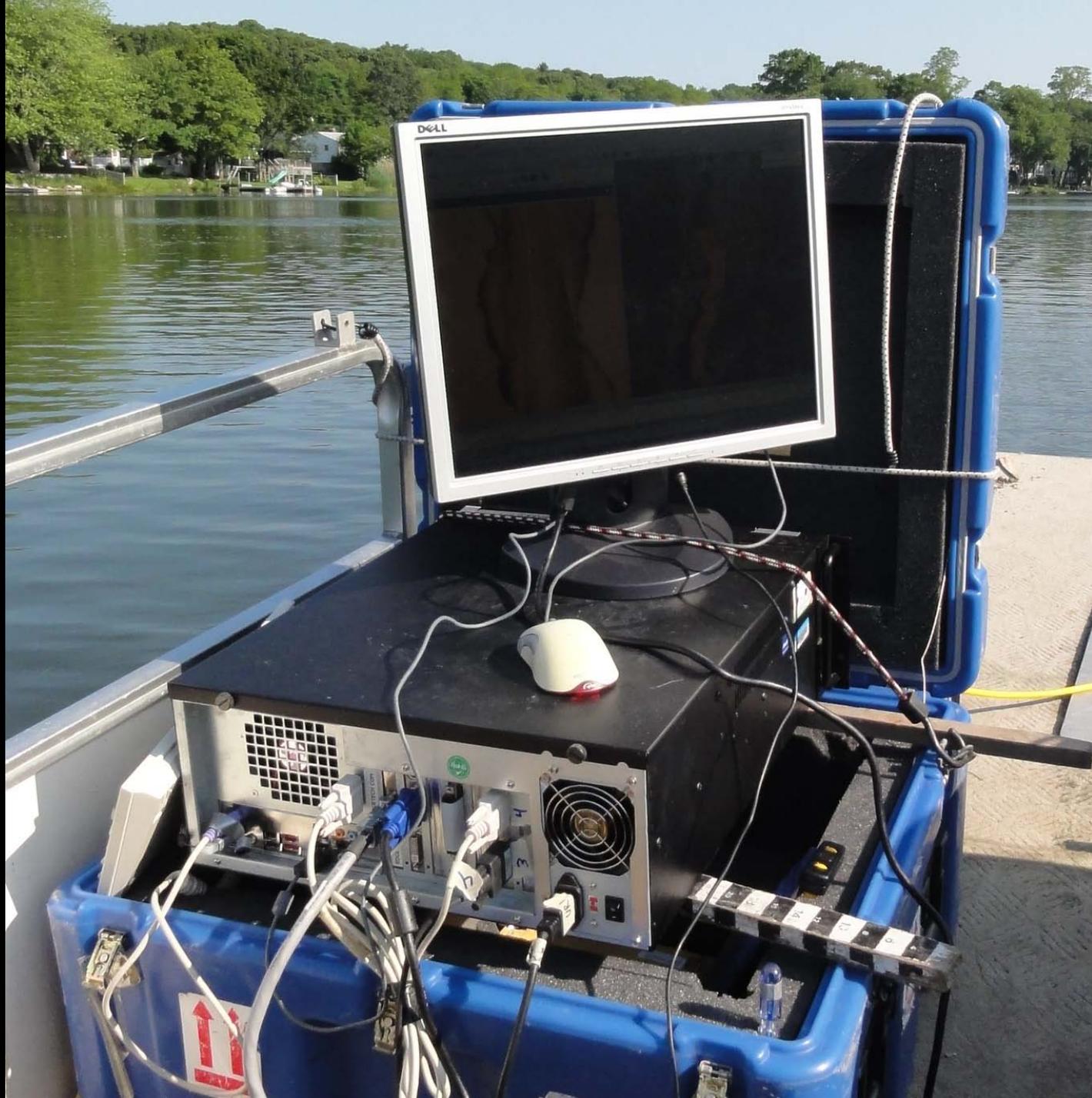
- Particle size, shape, sorting, color, composition and biologic content

The extent of the facies are determined using side scan sonar

Characteristics described from sediment samples, underwater video, etc..

WHAT IS SIDE-SCAN SONAR?







INTERPRETING SIDE-SCAN SONAR DATA

Interpreted based on the texture and intensity of the returning side-scan sonar signal

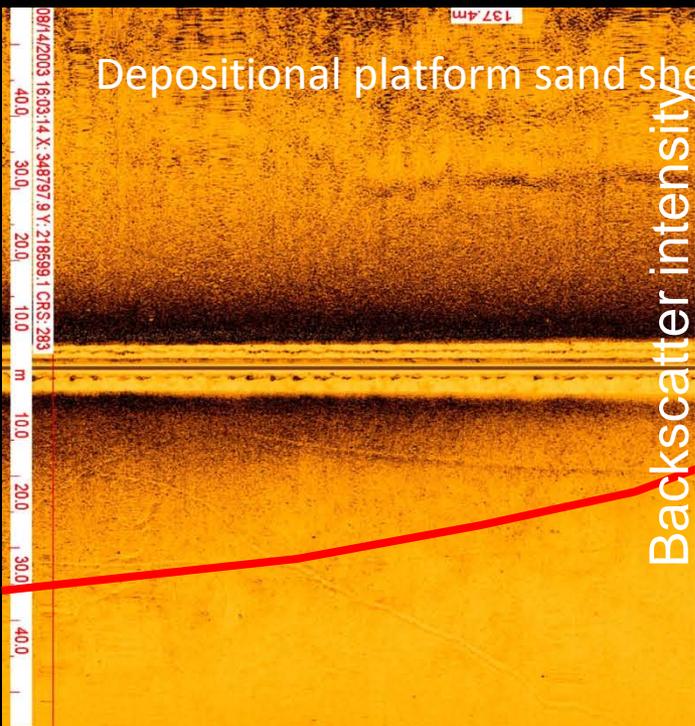
– Intensity

- How light/dark is the image
- Quasi relationship between grainsize and intensity

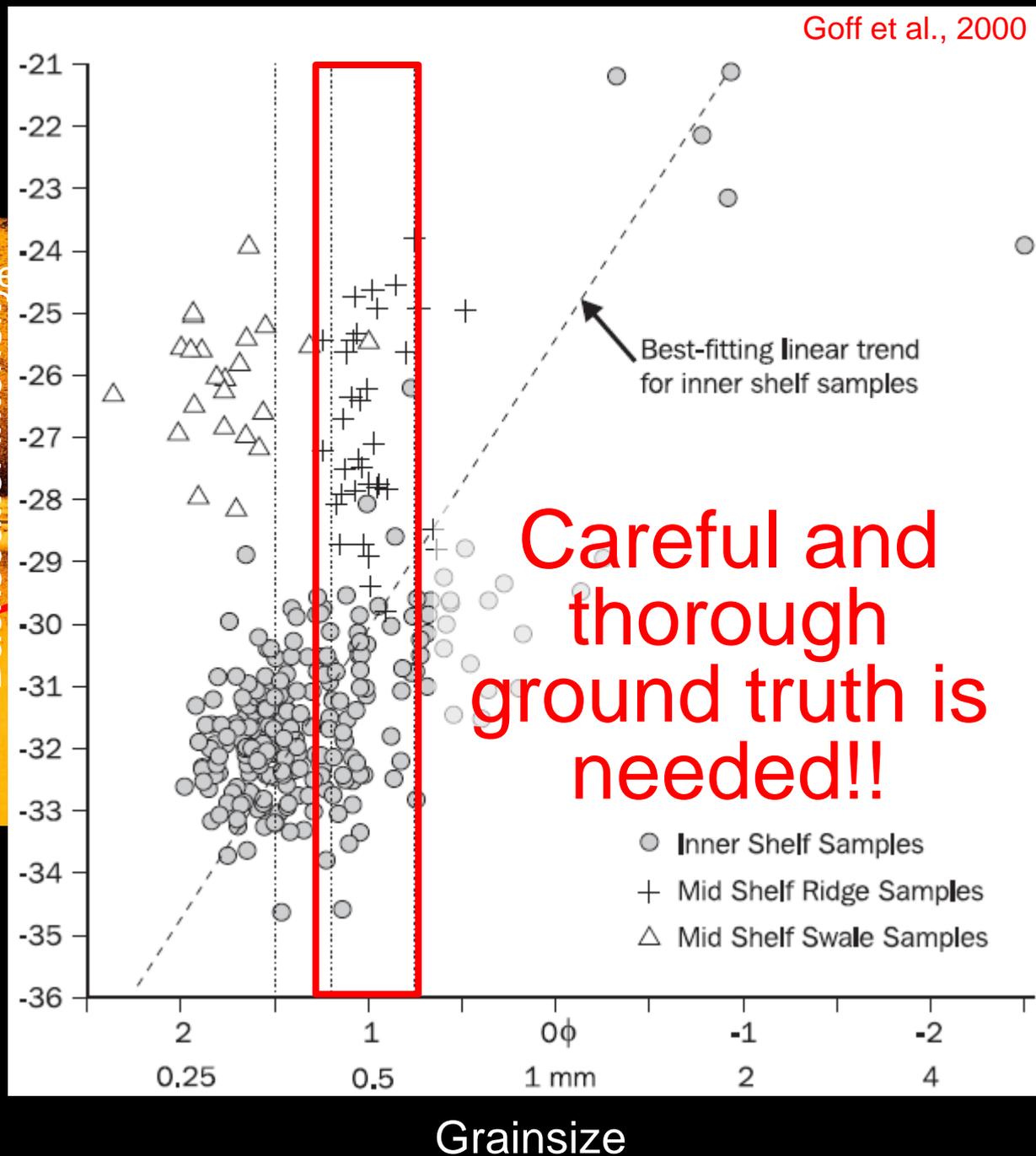
– Texture

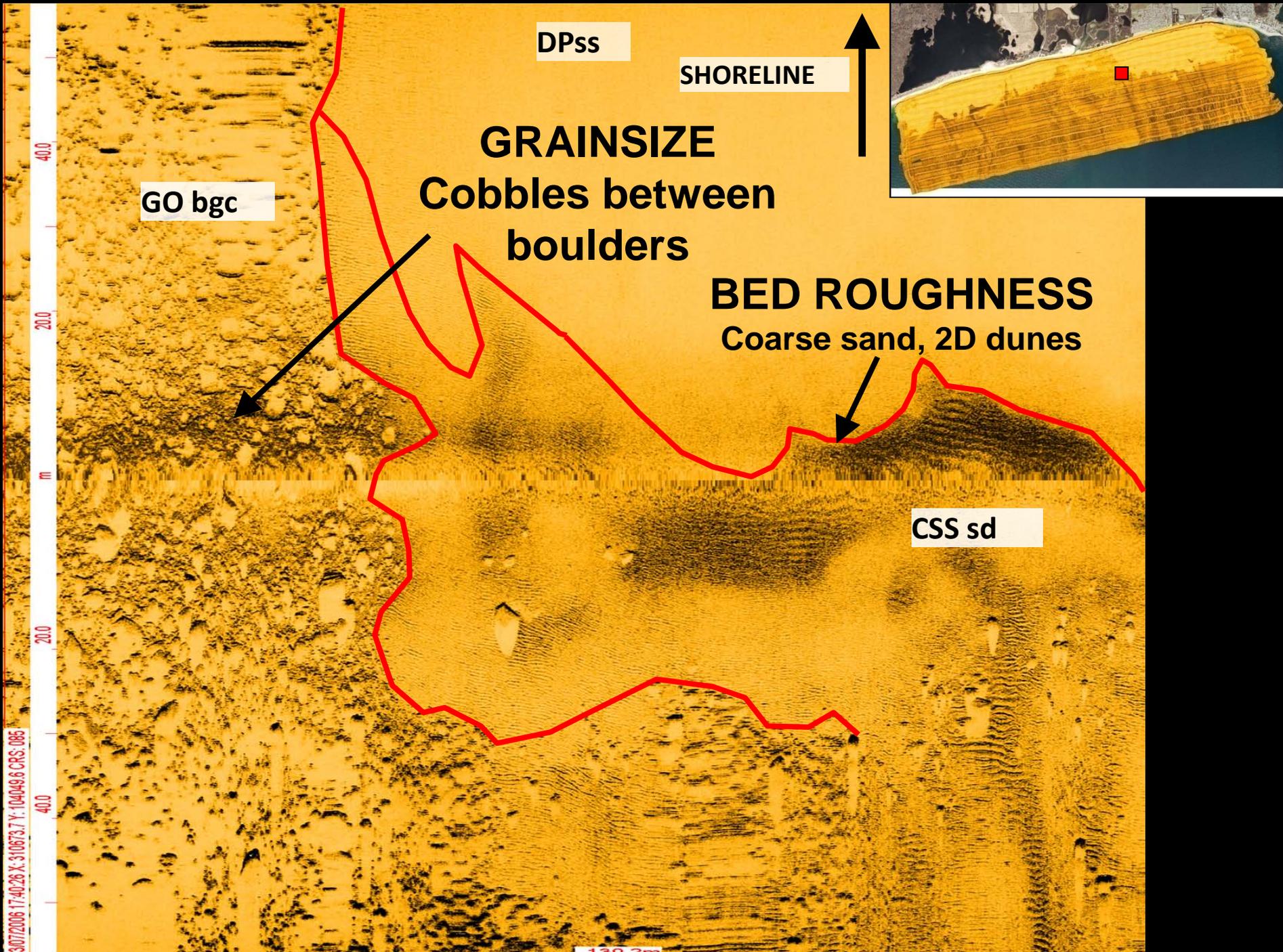
- What is the pattern of the image
- “Geology” (bedforms, boulders etc.)
- “Biology” (Microalgae, SAV)

Intensity of the side-scan signal



“Hard or rough bottoms reflect more energy...”

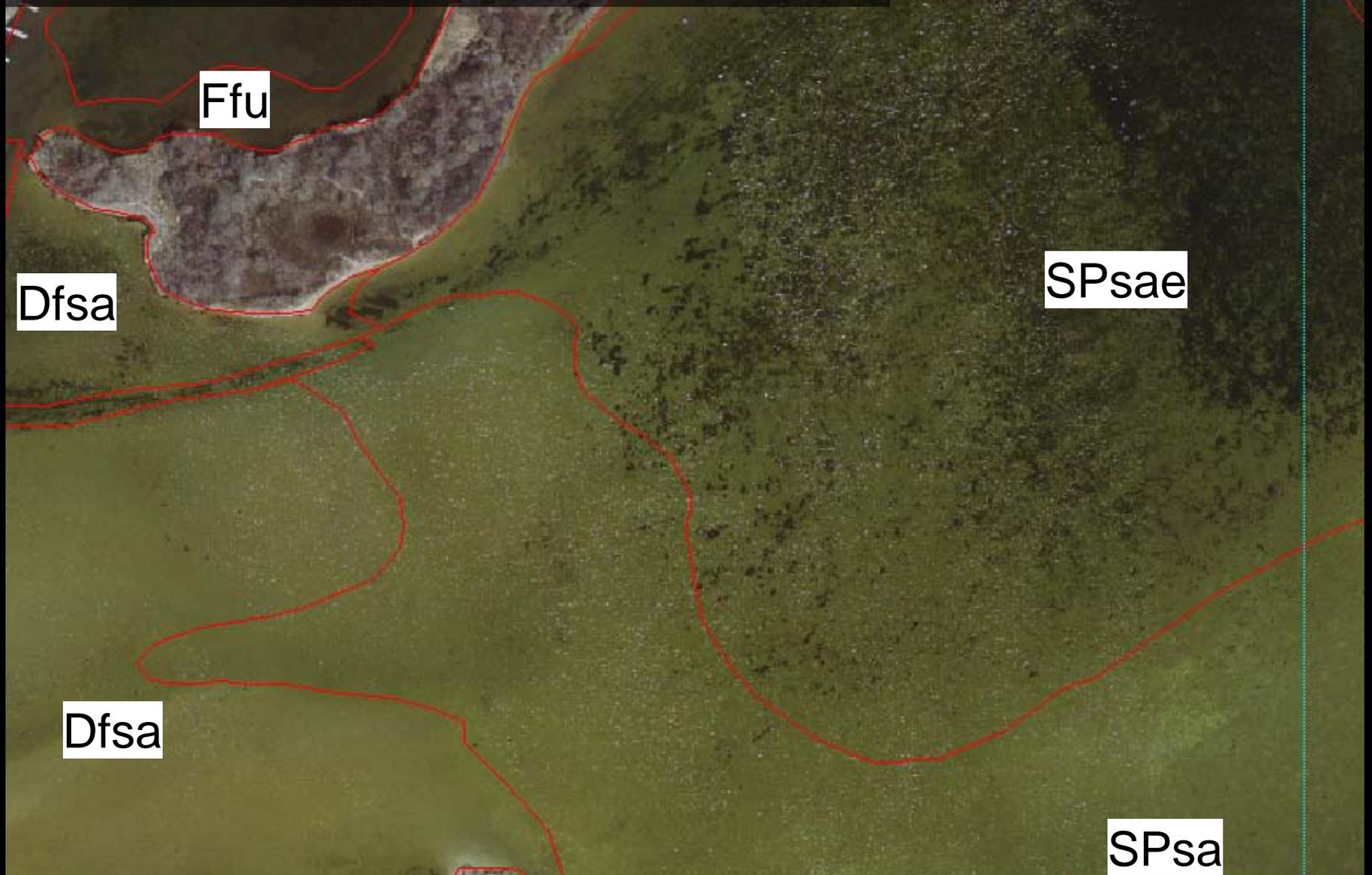




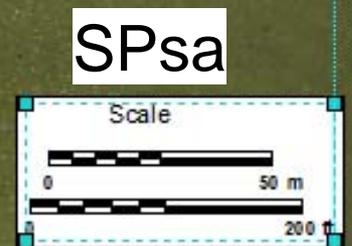
OTHER SOURCES OF IMAGERY

- Aerial imagery serves two purposes:
 - Base map to display data
 - Additional data source for shallow dep. environments
- Digital orthophotographs
- Low-angle oblique photos
- Vertical aerial photos
 - * Know the date of the photos, and low-tide is the best

Digital orthophotography – Green Hill Pond



*Not always a perfect match
If the images are from previous years

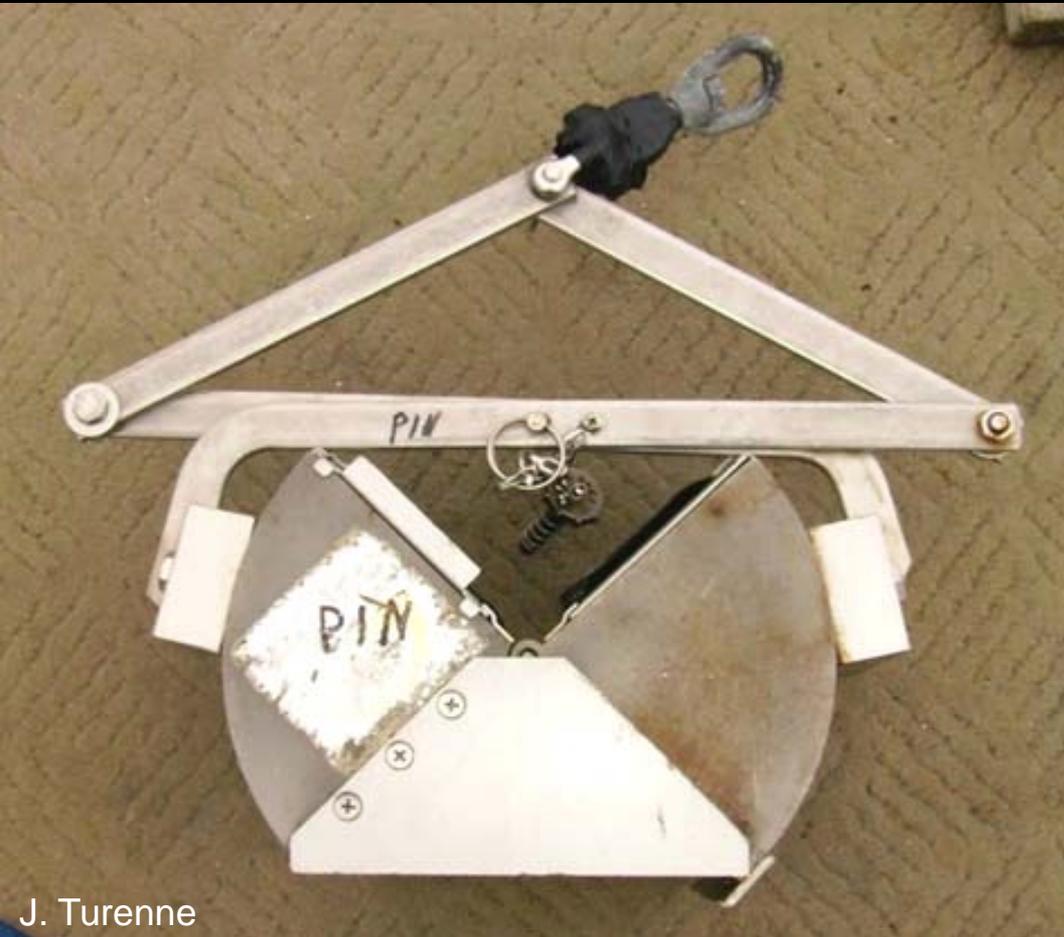


COLLECTING GROUND-TRUTH

- A side-scan only mosaic is not a geologic map!
- Beware 'Automated interpretations'
- Sources of ground-truth data
 - *Surface sediment grab samples*
 - *Underwater video images*
 - Sediment cores
 - SPI Imagery
 - Direct (Diver) Observation

SURFACE GRAB SAMPLERS

“PETITE” PONAR GRAB:
(Mud and Sand)



Orange Peel Grab:
(Sand and Gravel)



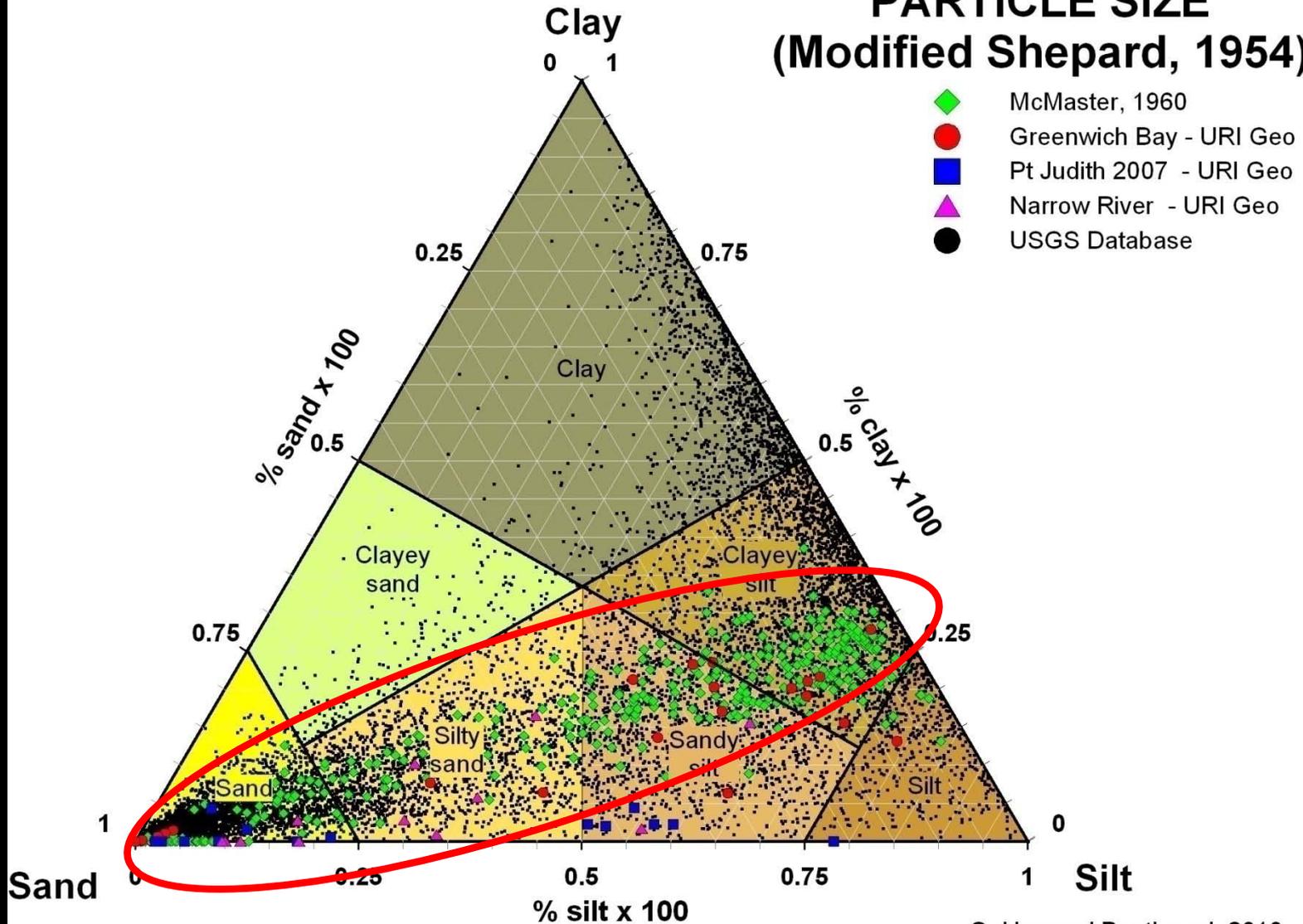
SURFACE GRAB SAMPLE

Upper Pond, Narrow River, RI



CLASSIFYING PARTICLE SIZE: Modified Shepard, 1954

SEDIMENT PARTICLE SIZE (Modified Shepard, 1954)



UNDERWATER VIDEO IMAGERY



SeaViewer
Underwater Video Systems

J. Turenne, Photos

Underwater Laser Pointers

N 41 24. 71383
W071 30. 25328

157 deg
0 mph

12:52:36

5 cm

10-08-08

Low-energy basin silt
w/ burrows

Low-energy basin silt w/ shells
Slipper shells, (*Credula fornicata*)

N 41 24. 71443
W071 30. 21785

353 deg
0 mph

13:14:24

2 cm

10-08-08

DEPOSITIONAL ENVIRONMENTS

- Place where the geologic processes (Water, wind, ice, humans) work to transport and deposit the sediment
- “Where the sediment ends up”
- Some examples in estuaries and lagoons
 - Low-energy basins, Channels, Tidal deltas Etc.

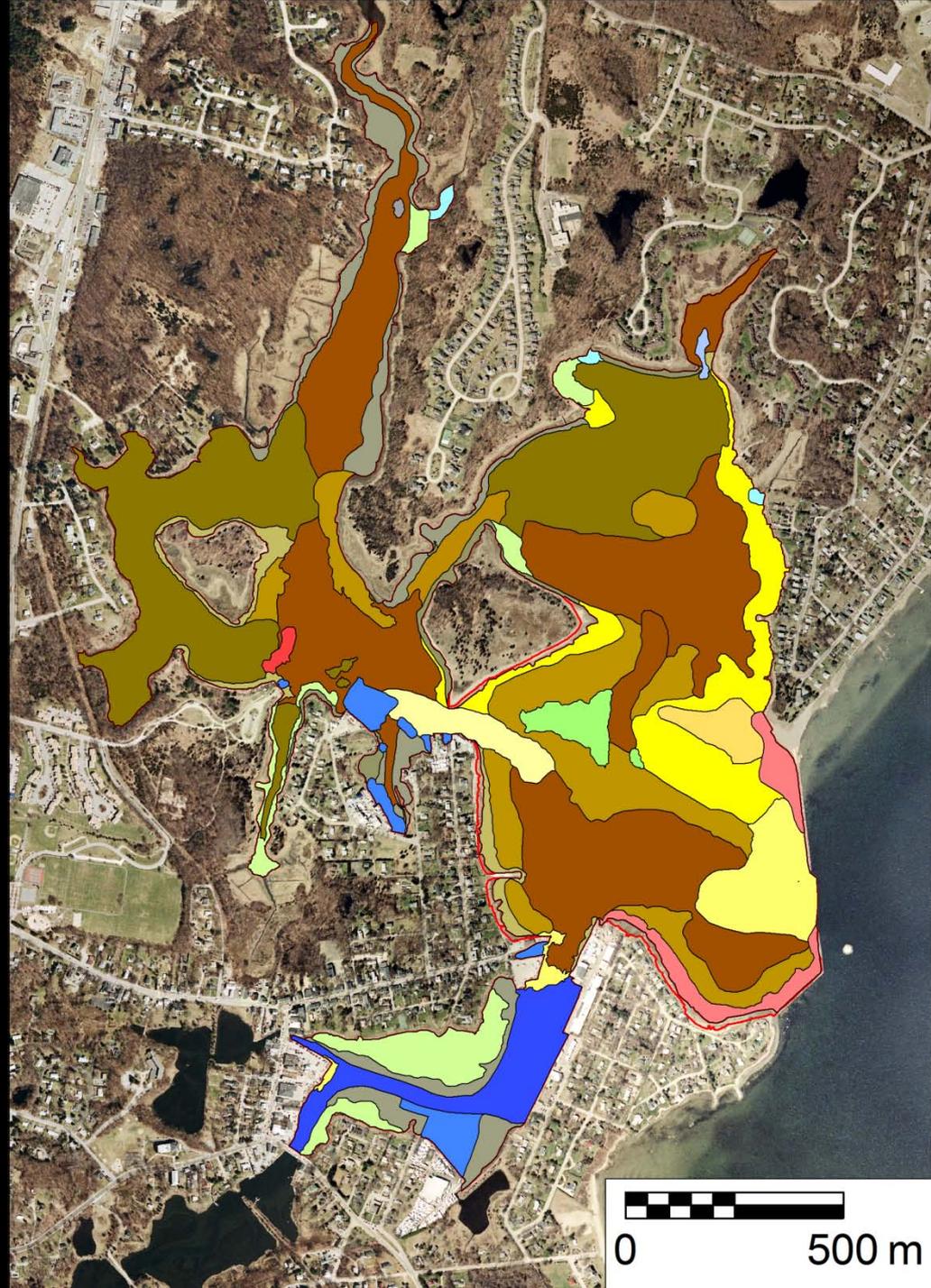
“Benthic Geologic Habitats of Greenwich Bay and Wickford Harbor, Narragansett Bay” (Oakley, Alvarez and Boothroyd, 2011 submitted for publication, J. of Coastal Research)

Stolt et al., 2011 J. of Coastal Research



Interpreting Benthic Geologic Habitats: Wickford Harbor Example

1. Collect and process
Side-scan sonar data
2. Delineate side-scan facies
3. Collect ground – truth data
 - Surface sediment grabs
 - Cores
 - Underwater video
4. Interpret Benthic Geologic
Habitats



WICKFORD HARBOR

Some examples...

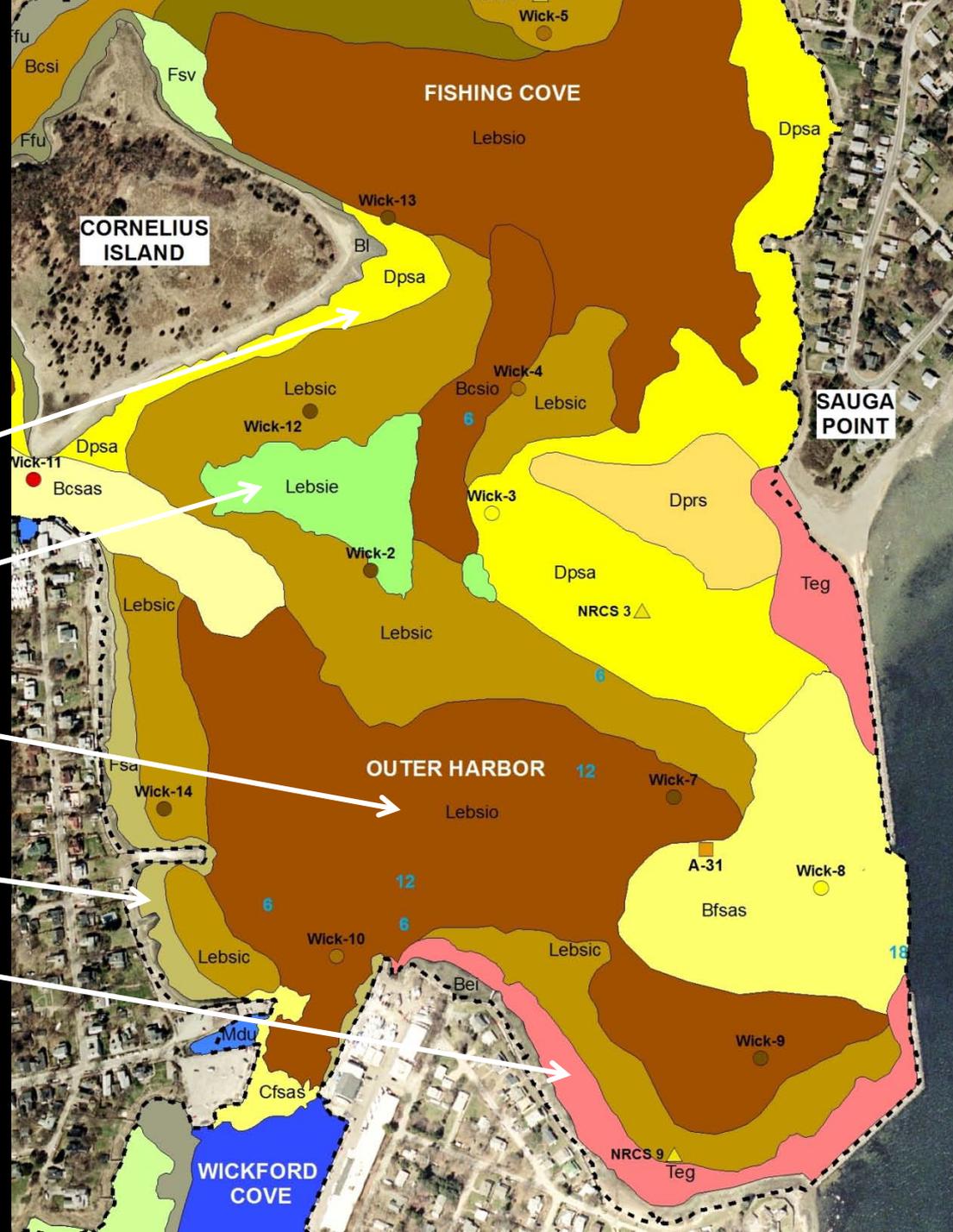
Dpsa – Depositional platform sand sheet

Lebsie – Low-energy basin silt w/ eelgrass

Lebsio – Low-energy basin organic silt

Fsa – Sand Flat

Teg – Gravel erosional terrace



BENTHIC GEOLOGIC HABITATS AND SAS

- Mapping is based on different data sets
- BGH's
 - Side-scan, video, grab samples
- SAS
 - Bathymetry, Soil Descriptions
- Map units are typically similar in extent and distribution

BENTHIC GEOLOGIC HABITATS: WICKFORD, RI



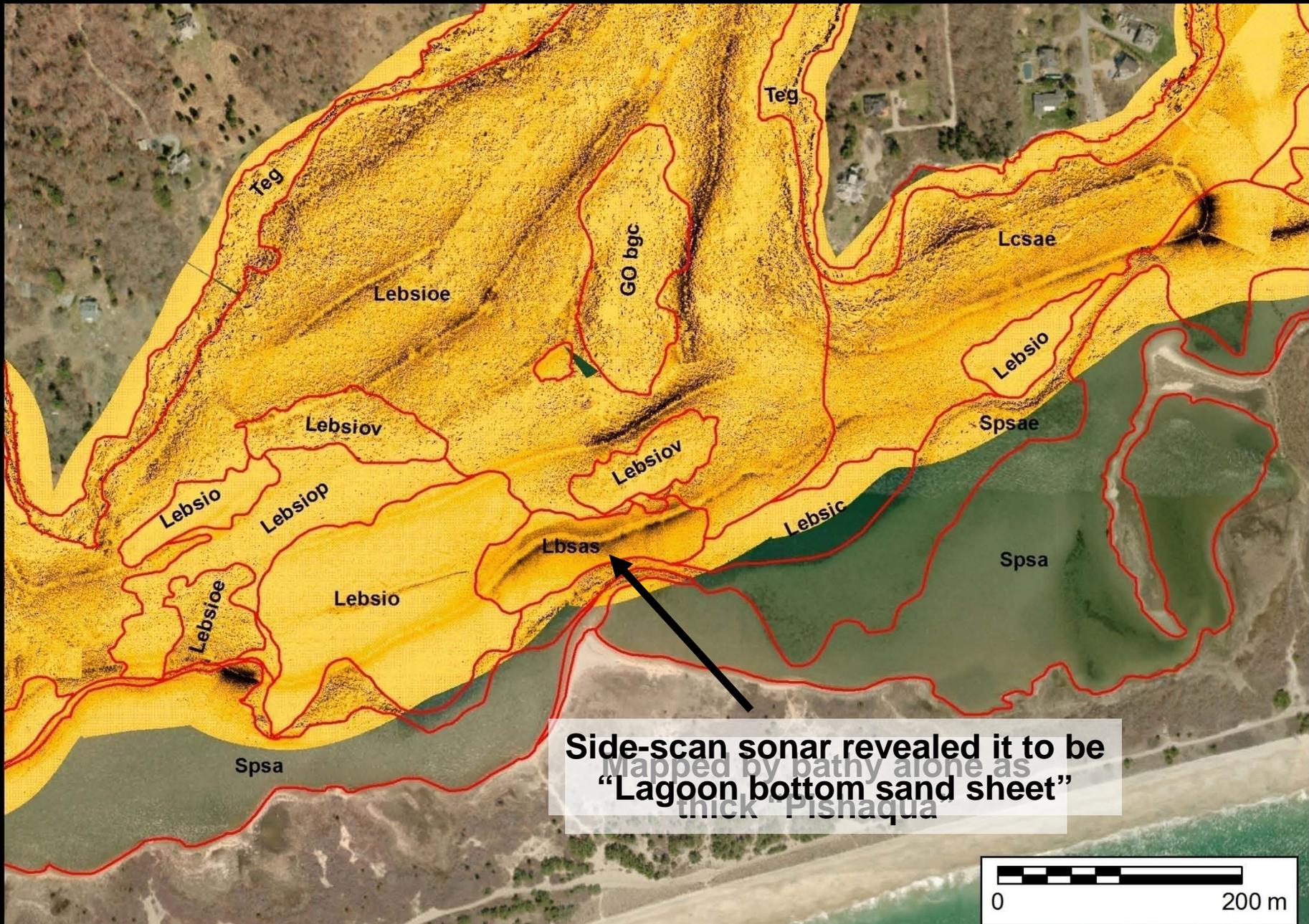
SUBAQUEOUS SOILS: WICKFORD, RI



BENTHIC GEOLOGIC HABITATS AND SAS

- Benefits to SAS mapping
 - Resolution of the data interpreted from side-scan sonar is much higher than SAS data (30cm pixels, < 100m² mmu)
 - Provides a check on the bathymetry driven interpretations
 - Video and grab samples provide some check/additional data on SAS interpretations and presence absence of SAV

Side-Scan Sonar and SAS: Resolution, Resolution, Resolution!



QUESTIONS?

