Pêches et Océans Canada | Fisheries and Oceans Canada

Characterization of the sea floor for benthic ecology: what does it means for benthic ecologists.

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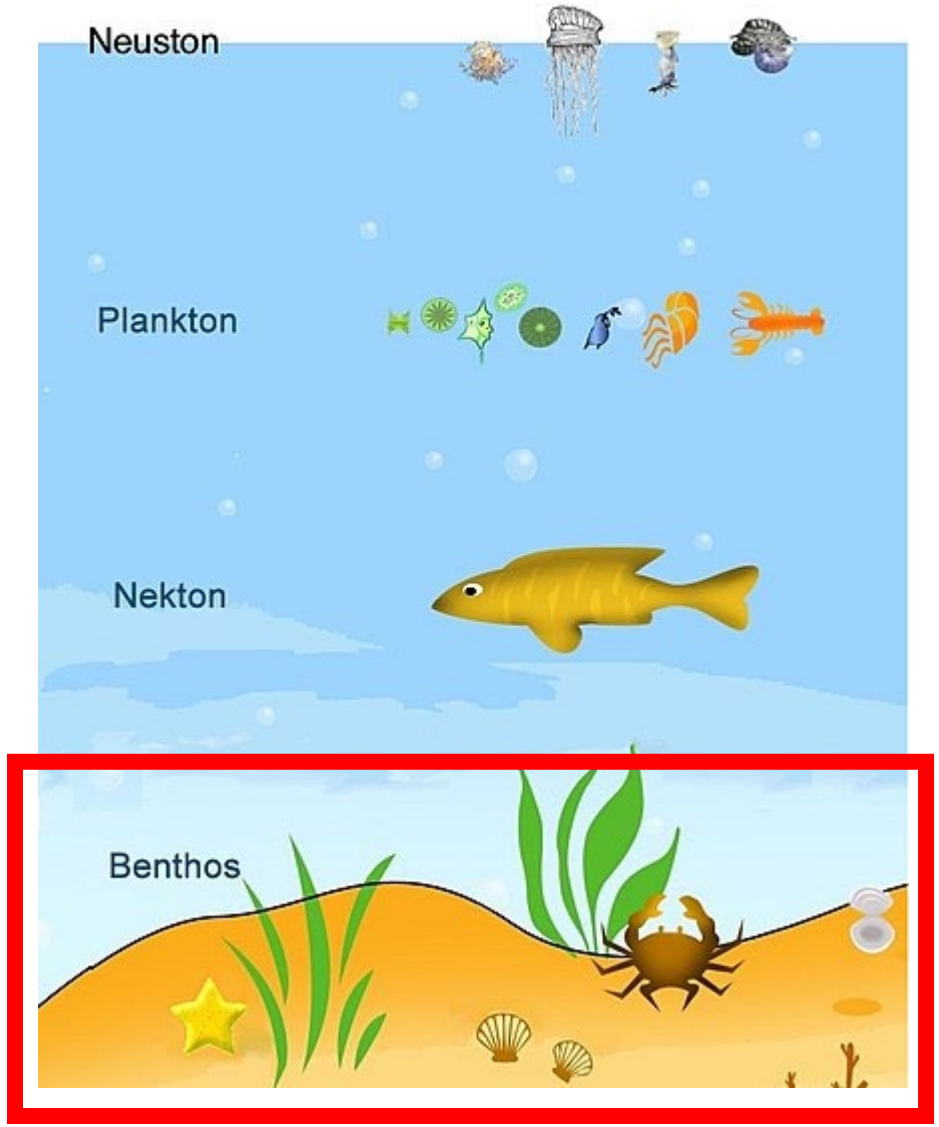
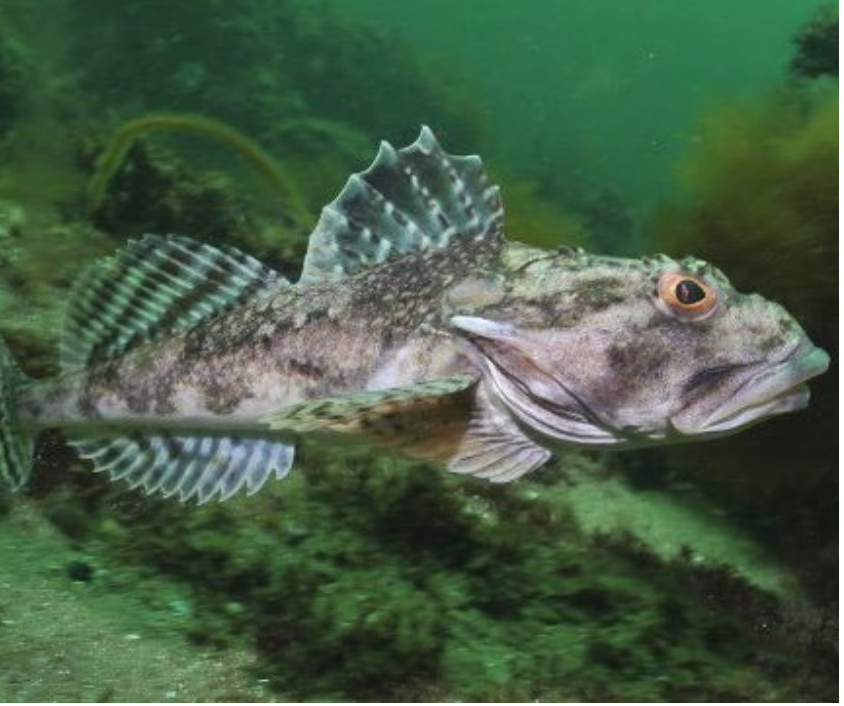
Filippo Ferrario, Jillian Shao, Kathleen MacGregor,

Chris Mckindsey, Yanick Gendreau

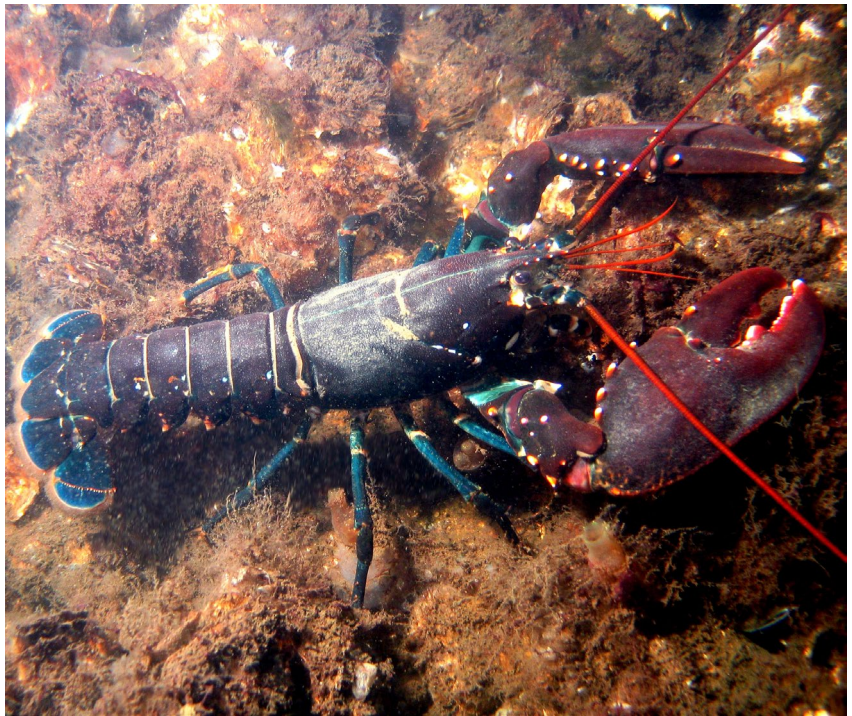
What do we mean with **Benthos**?

The community of organisms that live on, in, or near the bottom (of a sea, lake…)



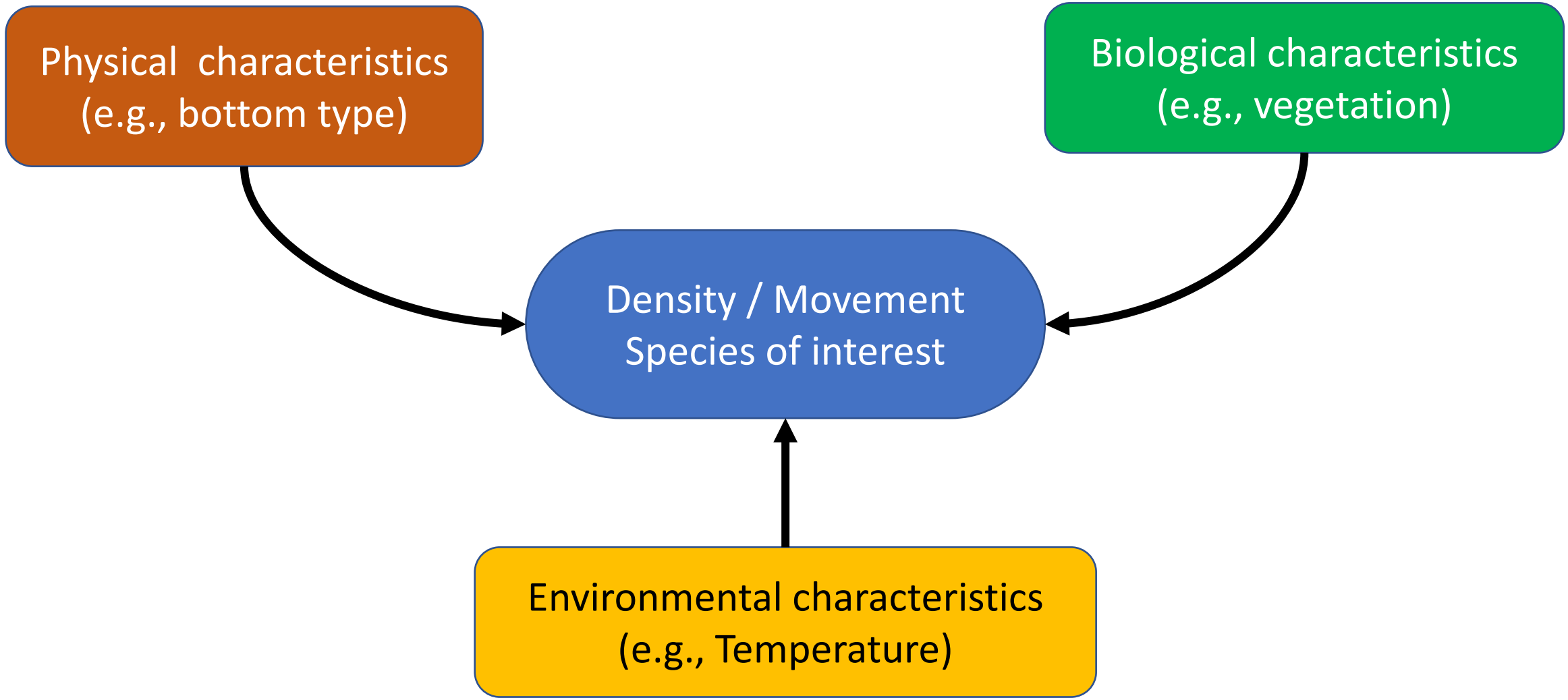



gnu - www.aquaporta



Studying species distribution and Habitat use

Studying species distribution and Habitat use



Studying species distribution and Habitat use

Physical characteristics (e.g., bottom type)

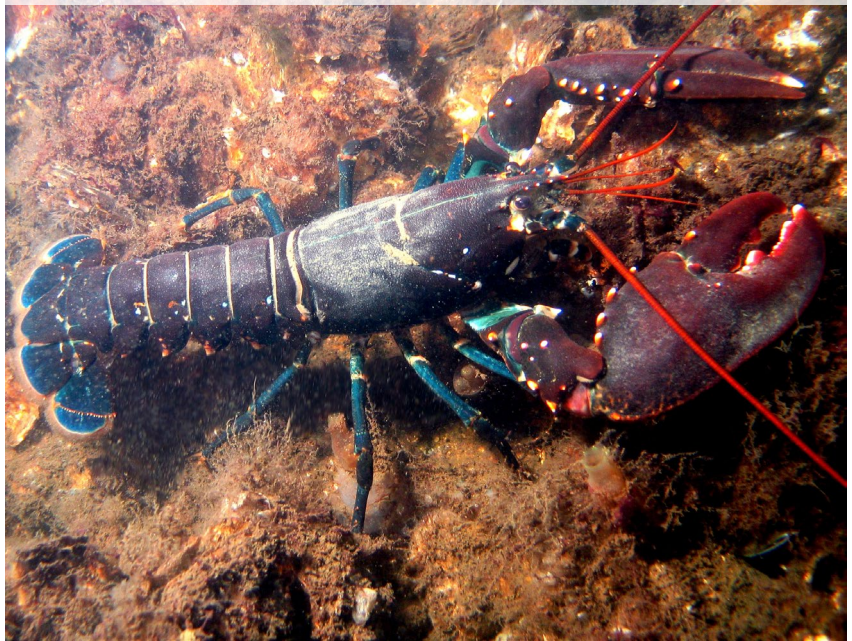
Biological characteristics (e.g., vegetation)

A spatial issue

Movement capabilities

Large (potentially)

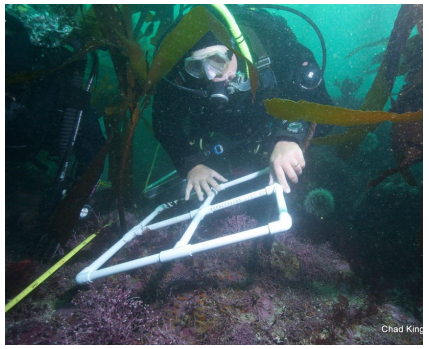
Medium

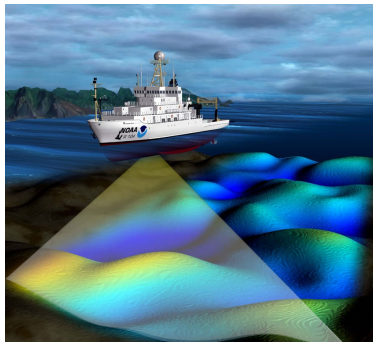


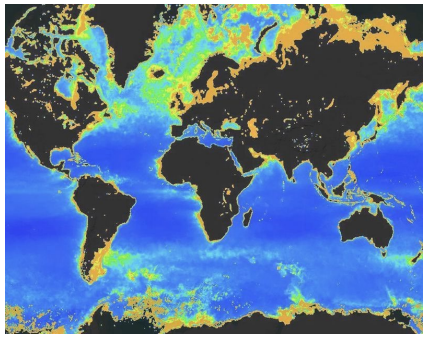
Small

Studying species distribution and Habitat use: Scale matters

Habitat Map detail / resolution

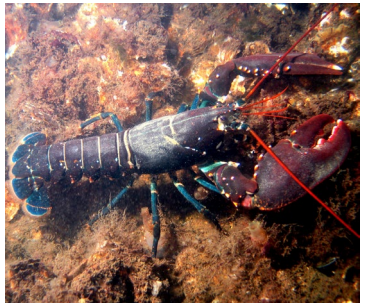






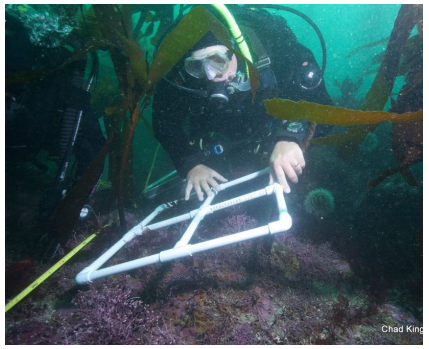
10 m 100 m 1 km 100 km

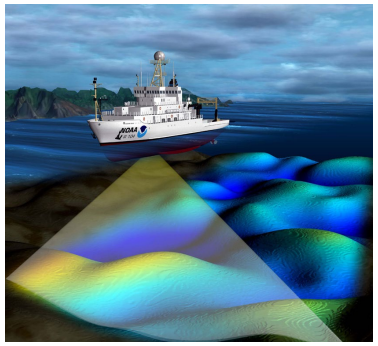
Scale of movement / of maps

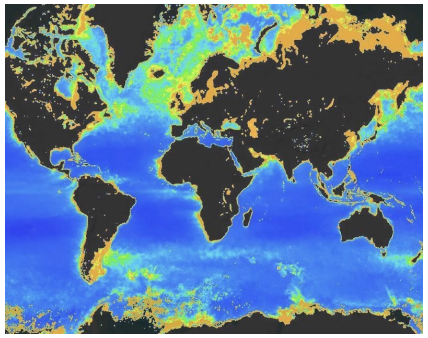


Studying species distribution and Habitat use: Scale matters

Habitat Map detail / resolution





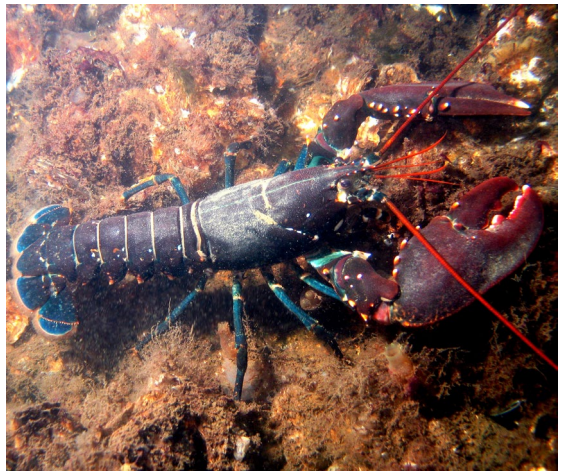


? MAP AVAILABILITY ?

Availability of maps at relevant Scales

Medium Scale

Lobster tracks



Lavoie et al. 2022 (@ IML)

Available Habitat Type:

In vs **Out**

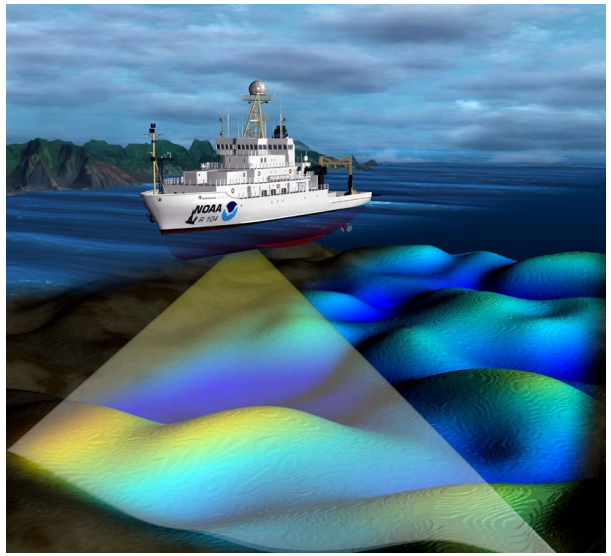
the farm

Availability of maps at relevant Scales

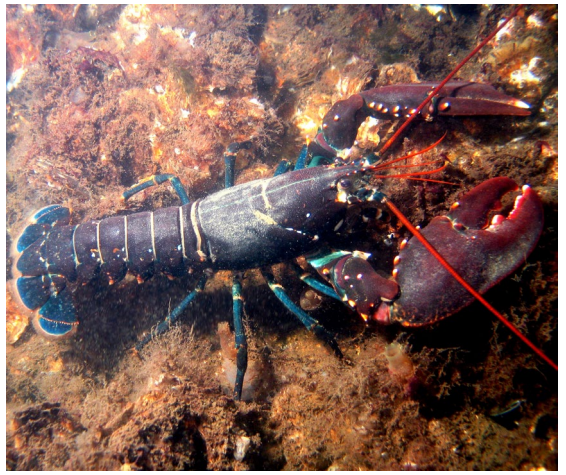
Medium Scale

Desired habitat characteristic :

- Sea floor (e.g., Depth, Slope, Substrate Classification, …)



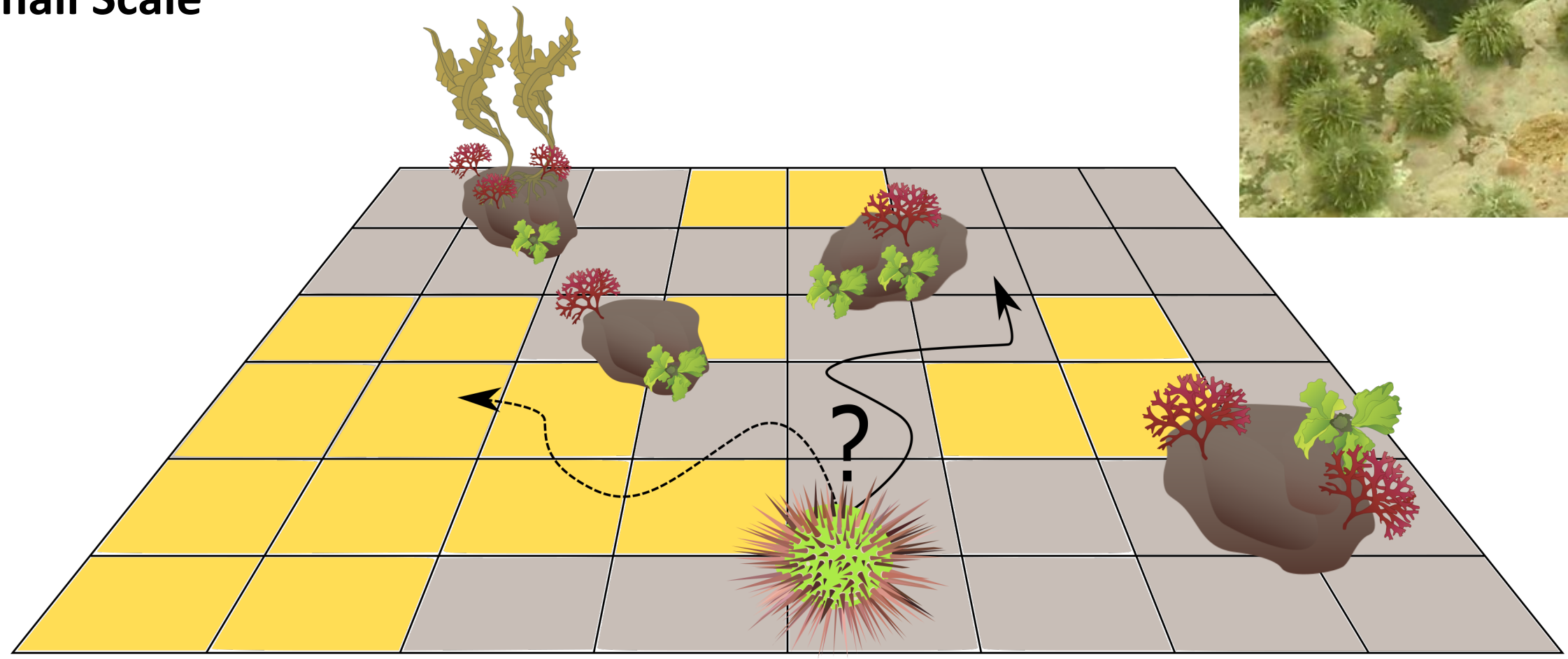
Lobster tracks



Lavoie et al. 2022 (@ IML)

Green sea urchin’s habitat use in heterogeneous habitats

Small Scale



Spatial point patterns analysis

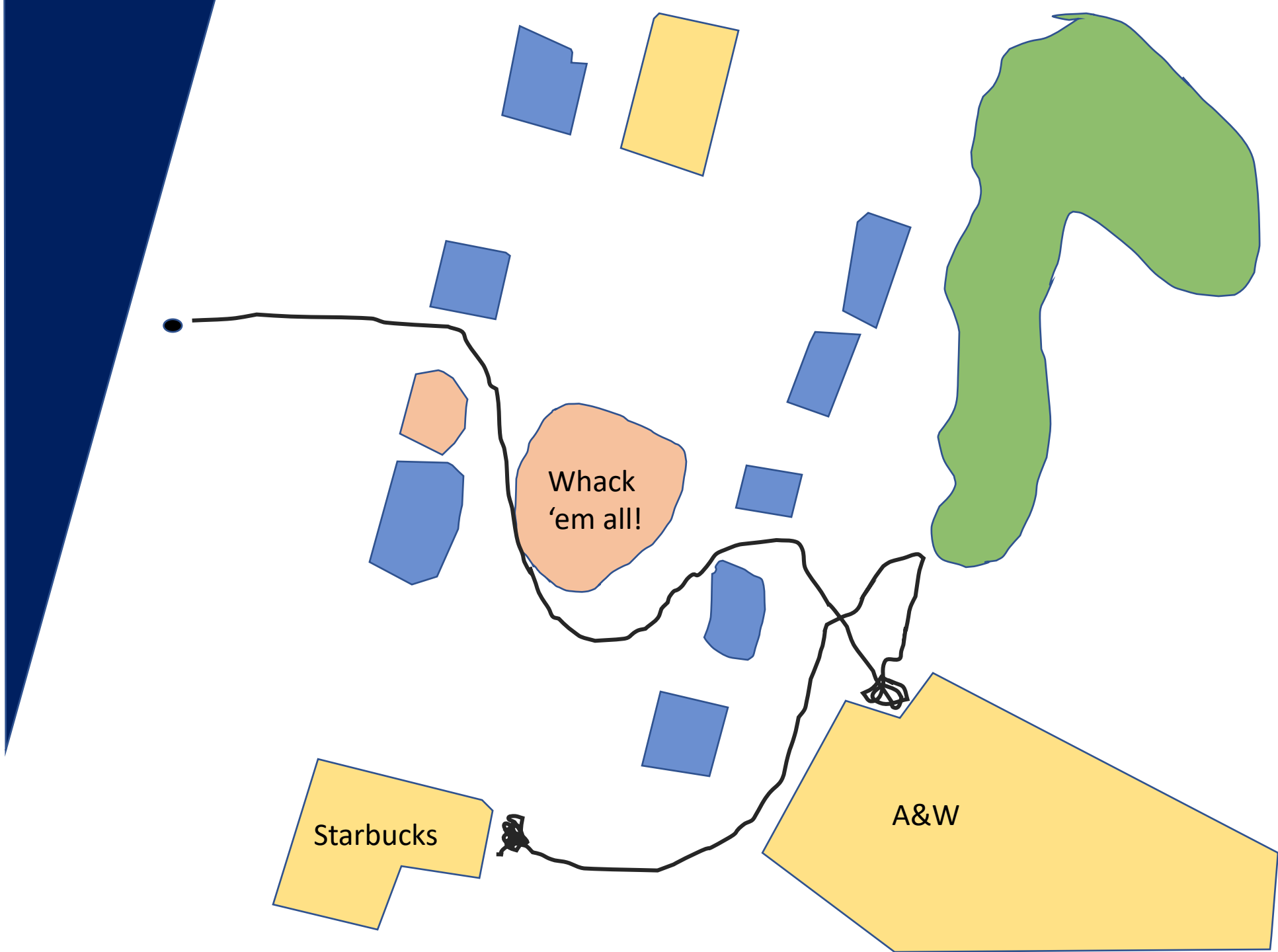
Distribution as proxy for movement

Spatial point patterns analysis

Distribution as proxy for movement

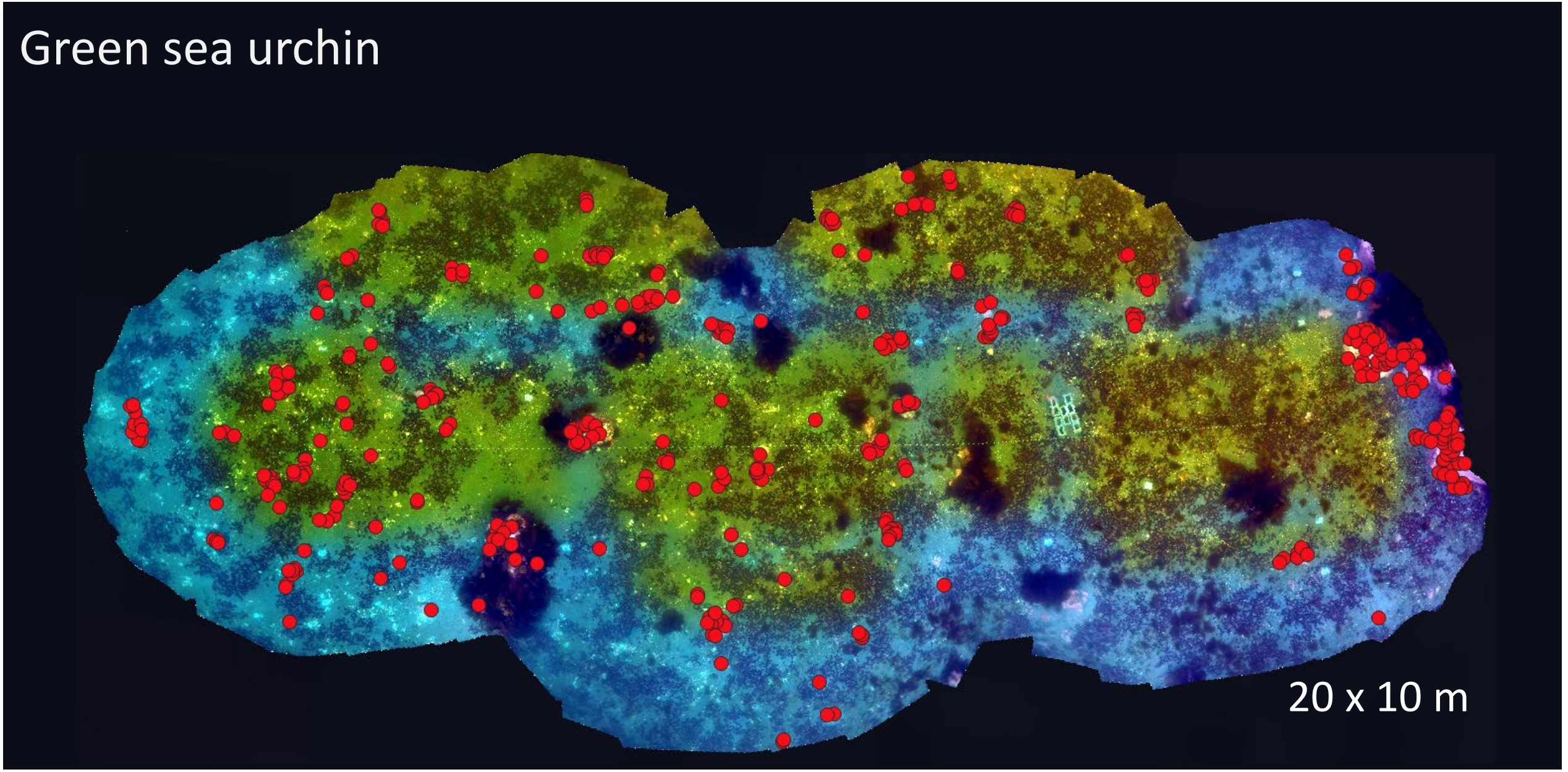
Acoustic Telemetry

Movement tracks related to landscape

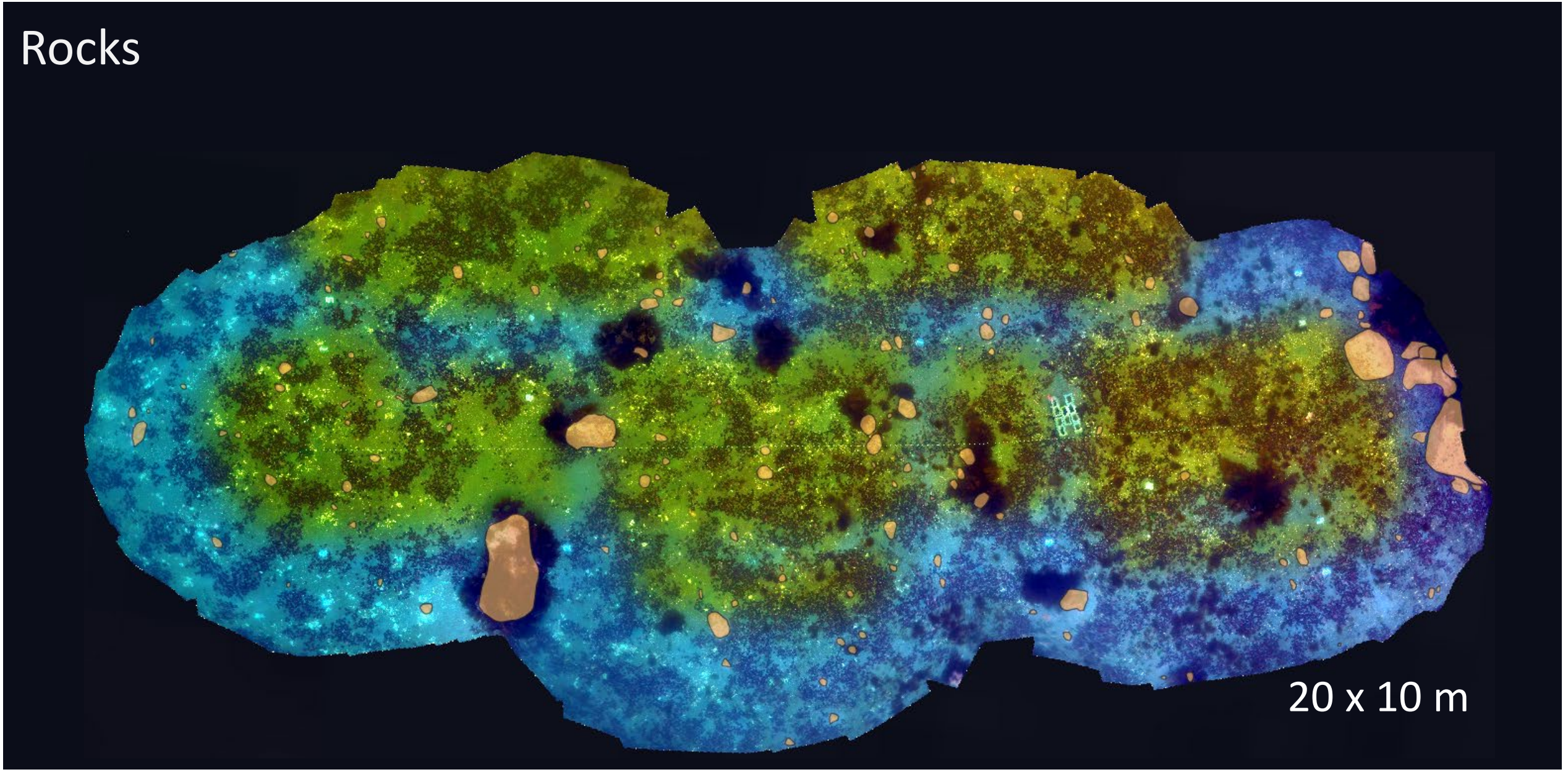


Underwater photomosaics

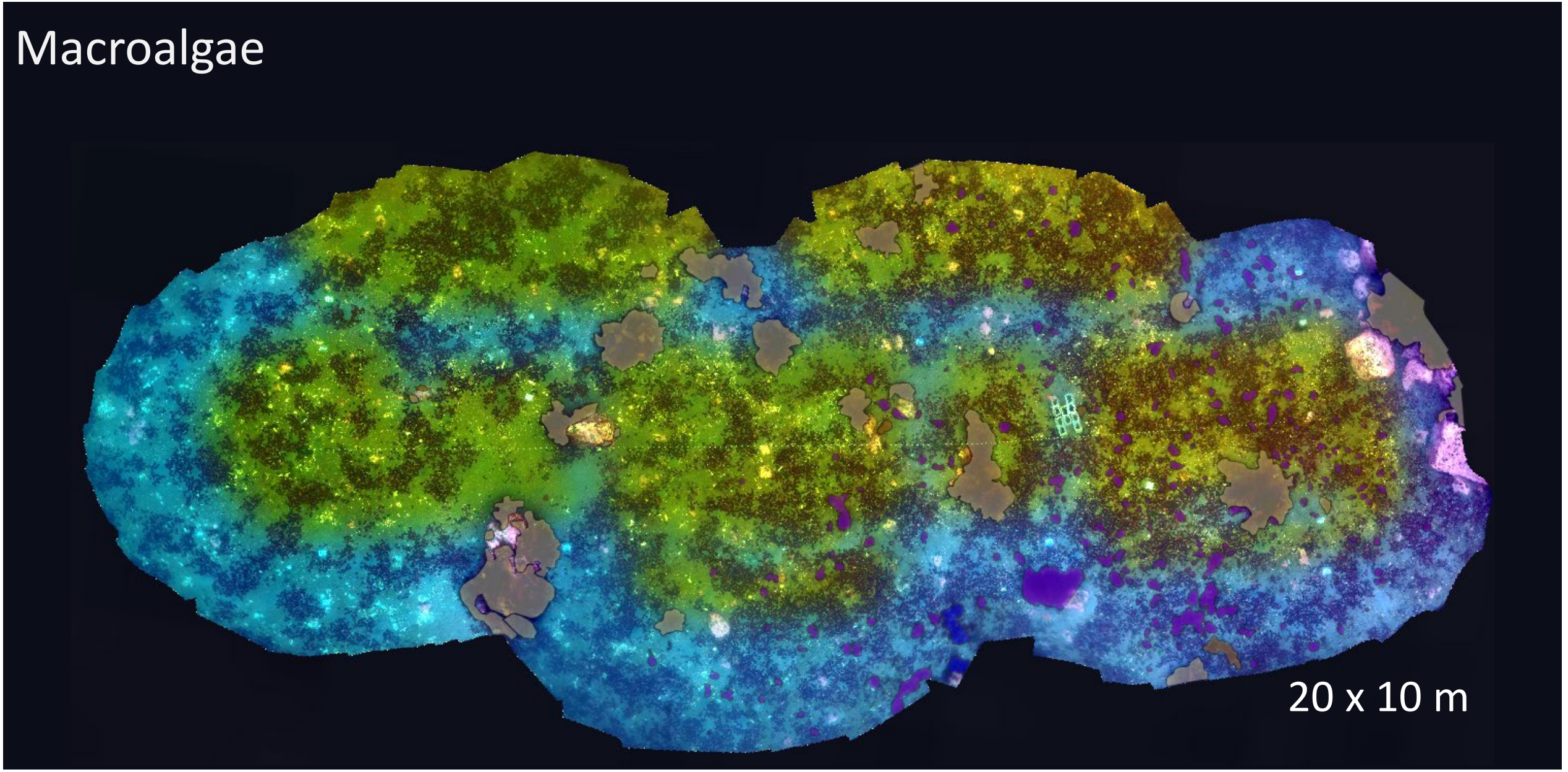
Data rich imagery



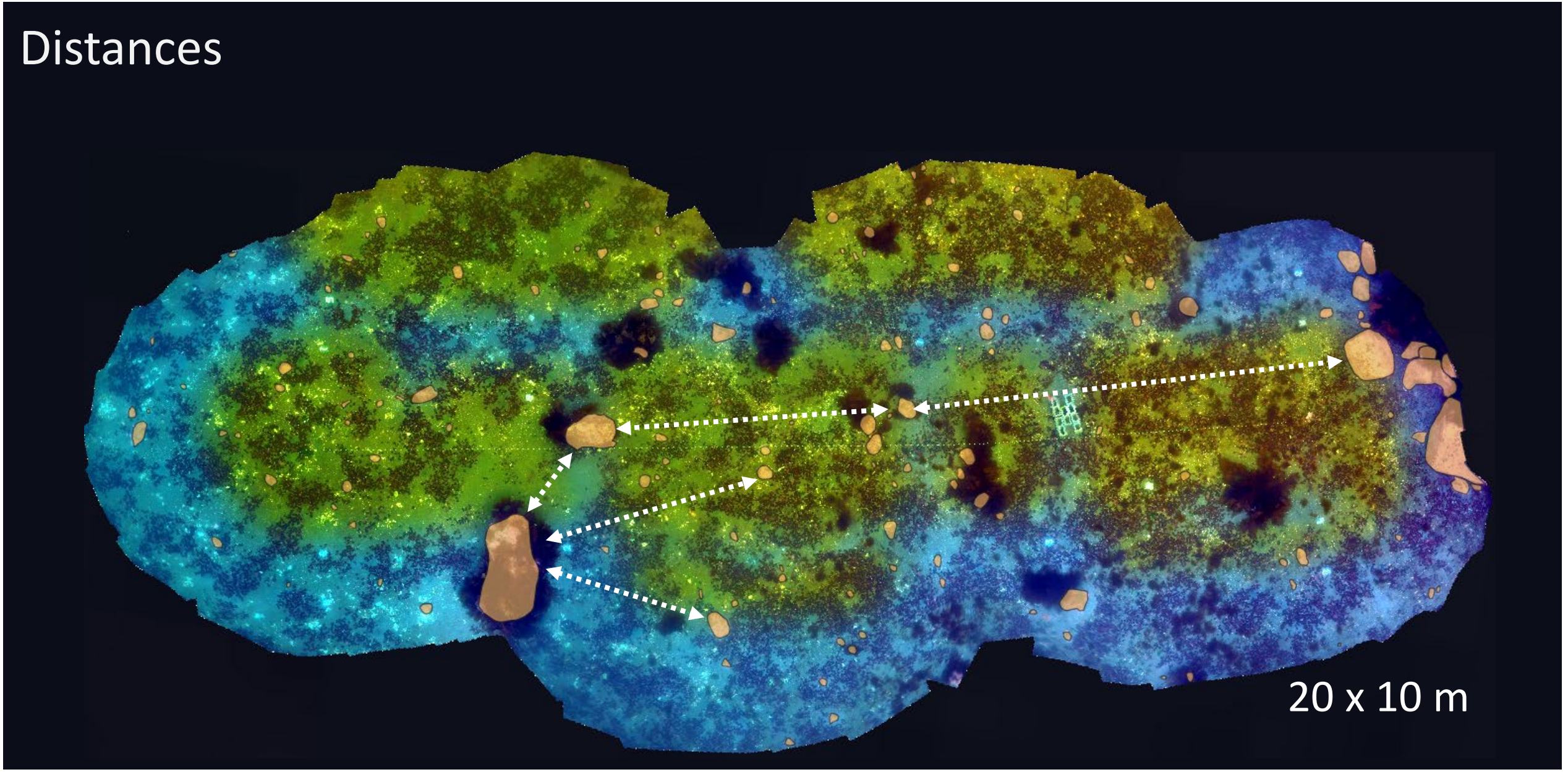
Data rich imagery



Data rich imagery

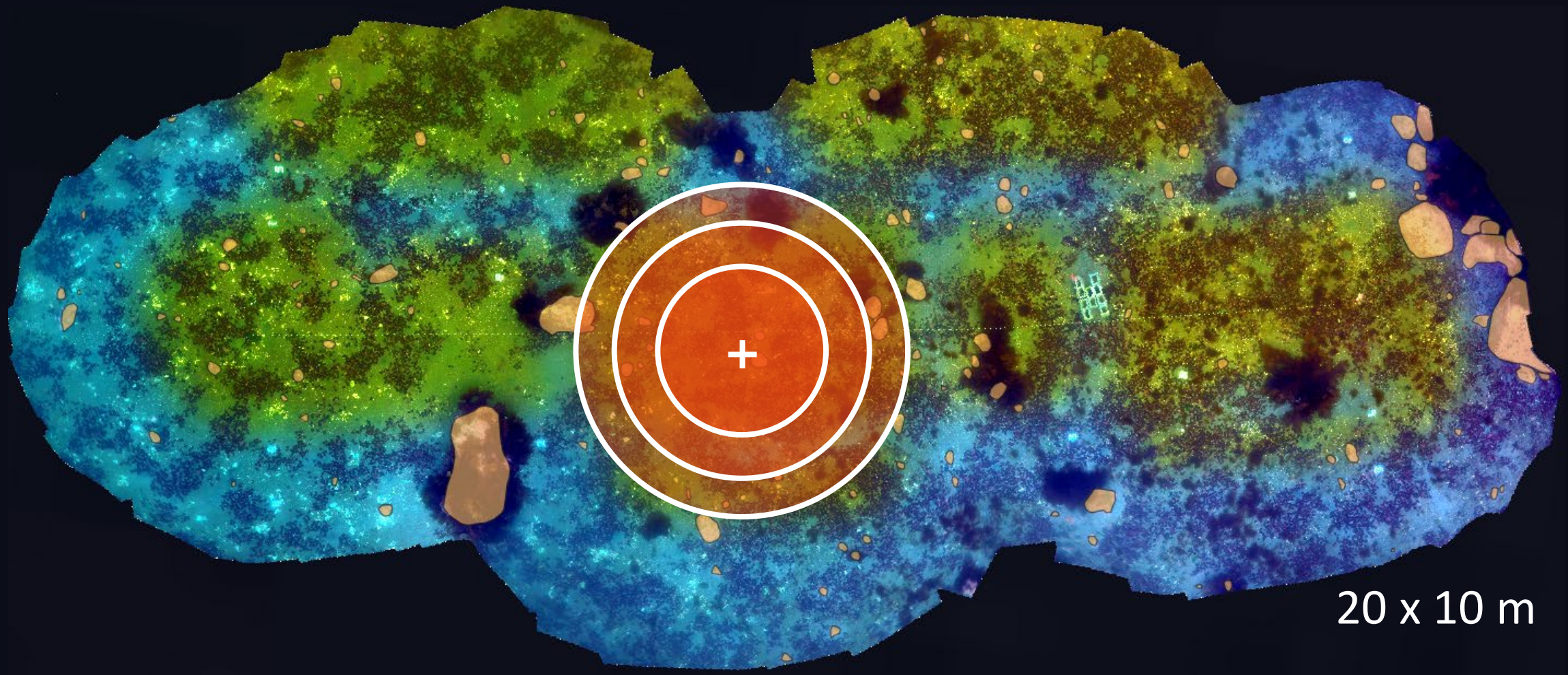


Data rich imagery



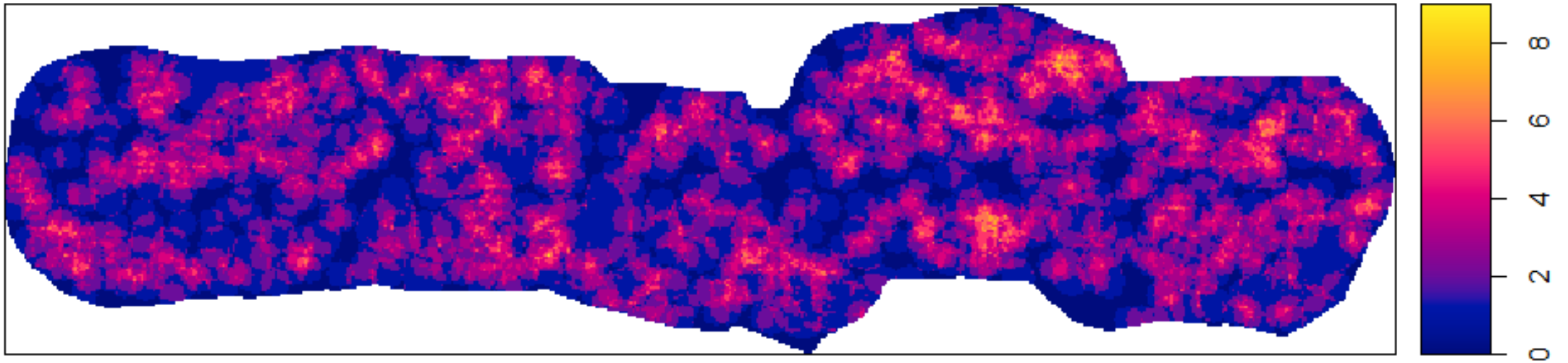
Data rich imagery

Other spatial metrics (e.g., buffers)

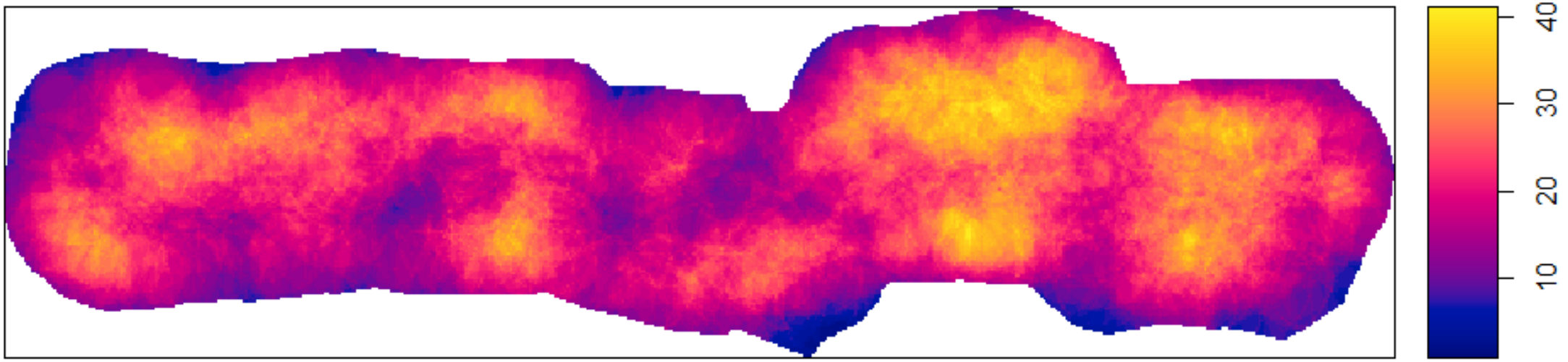


Example : Number of rock patches within buffer of

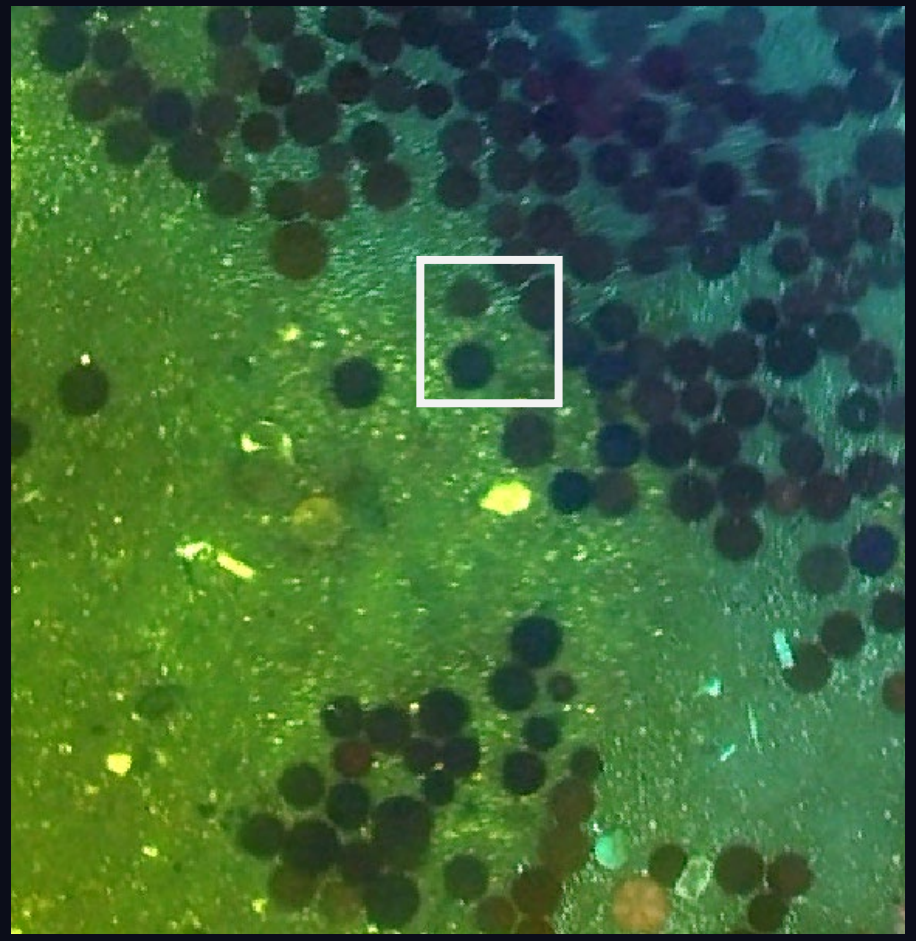
0.5 m



2.0 m



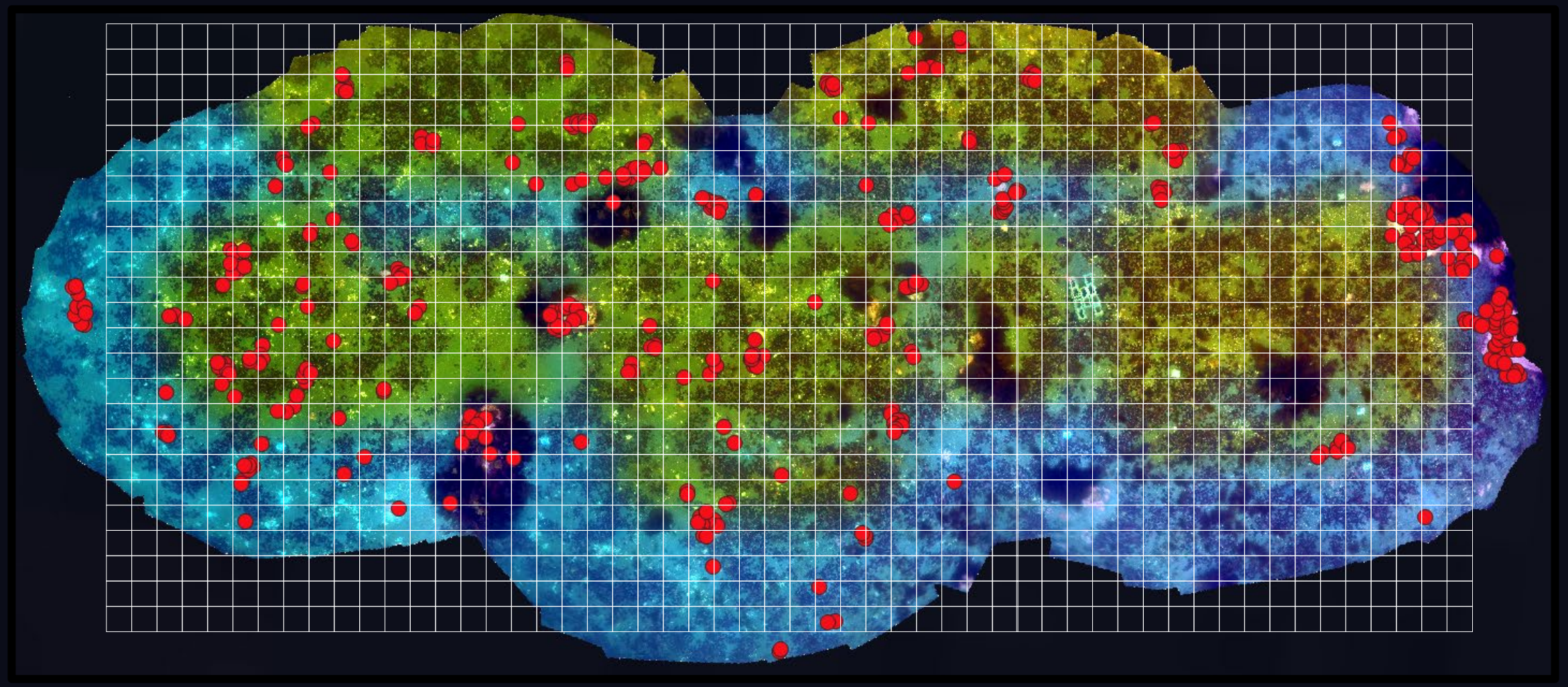
Predictor variables



Sand dollars
density (biotic)

Dead shells
density (abiotic)

Features in a mosaic converted in rasters of variables (densities; % covers)

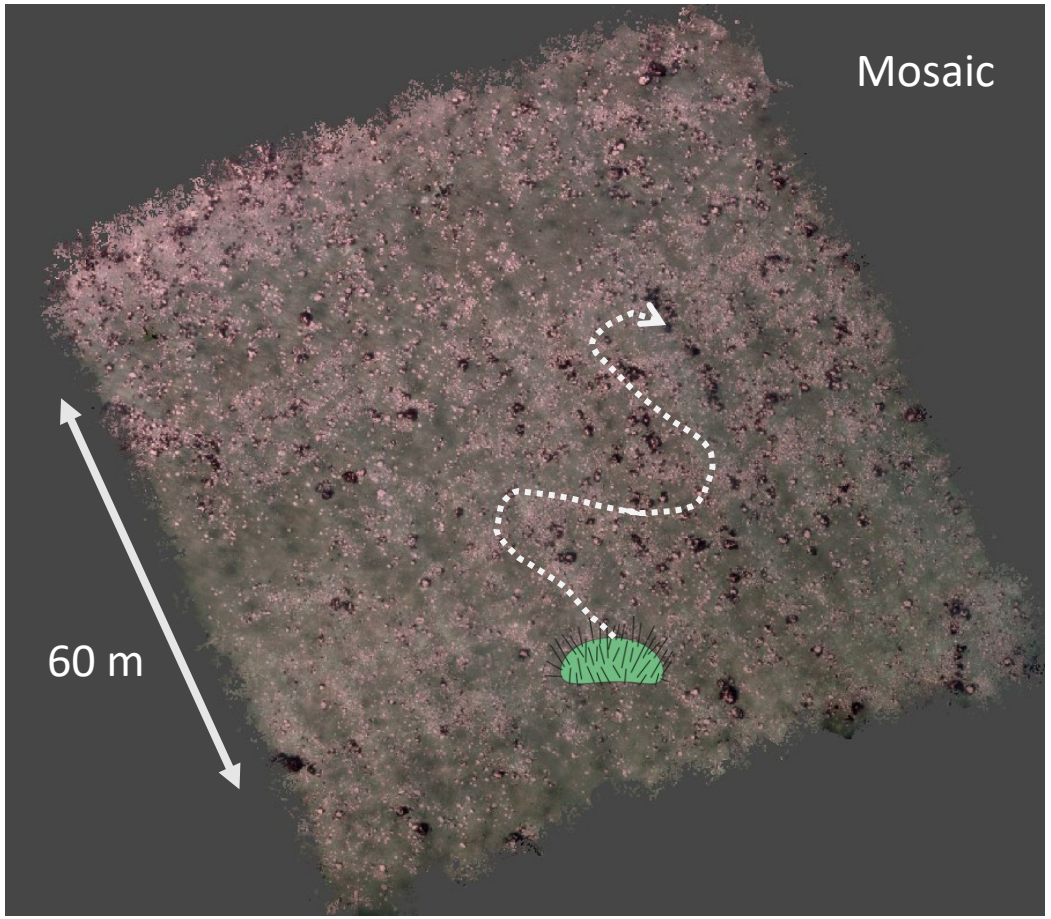


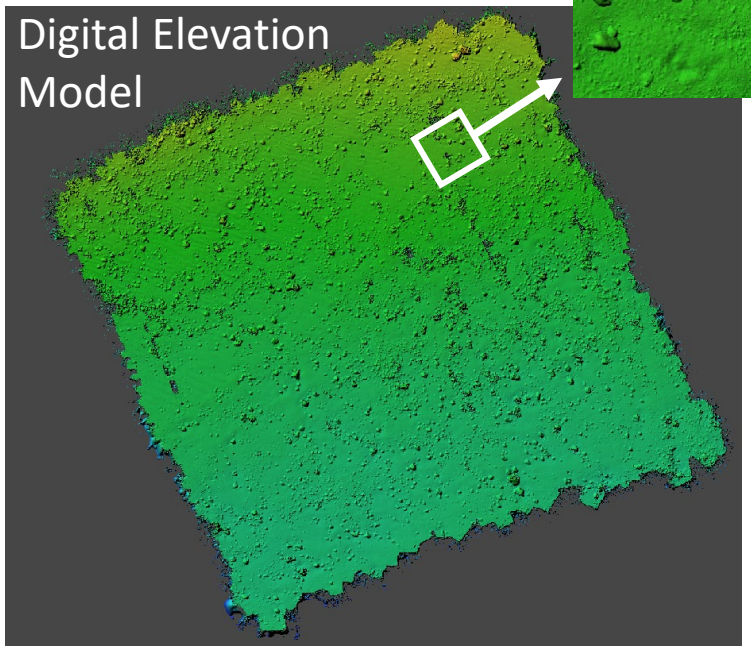
Green sea urchin points → density per pixel

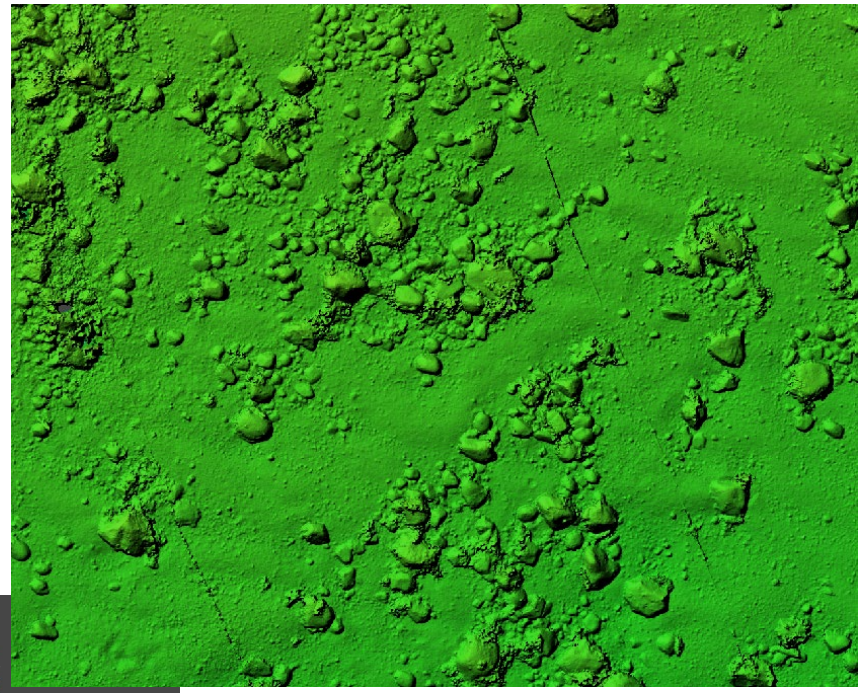
Benthic invertebrates habitat use … Acoustic telemetry

Combine acoustic telemetry with habitat mapping from photomosaicing

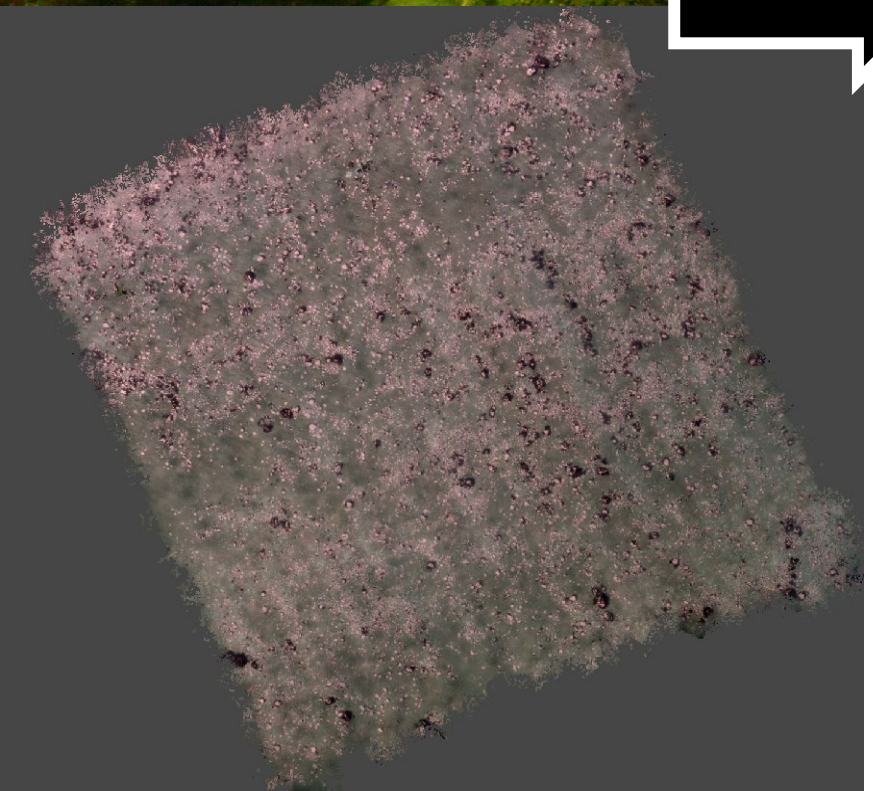
Underwater photos



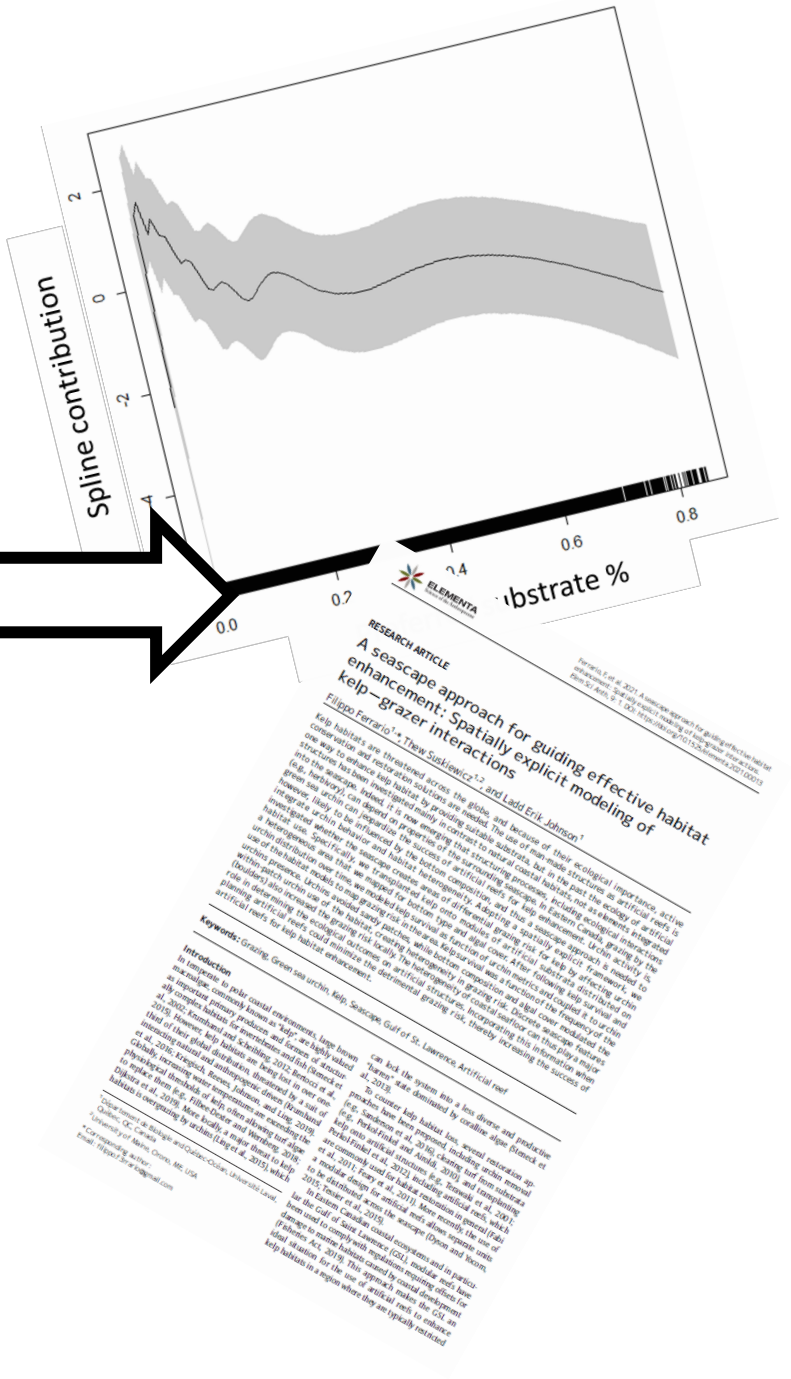




Structural complexity



Data Extraction



RESEARCH ARTICLE

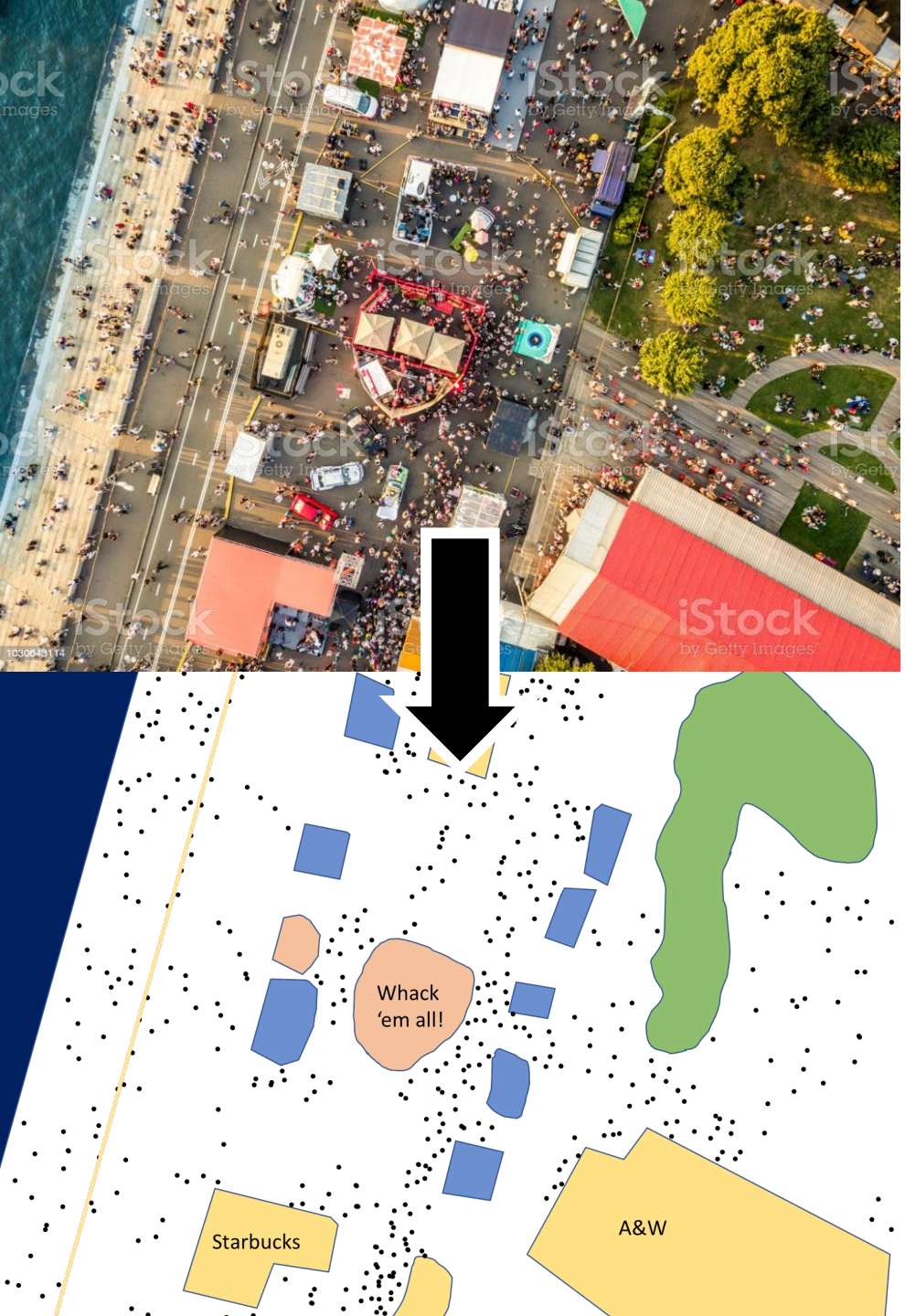
A seascape approach for guiding effective habitat enhancement: Spatially explicit modeling of kelp–grazer interactions

Filippo Ferrario[1]*, Thew Suskiewicz[1,2] and Ladd Erik Johnson[1]

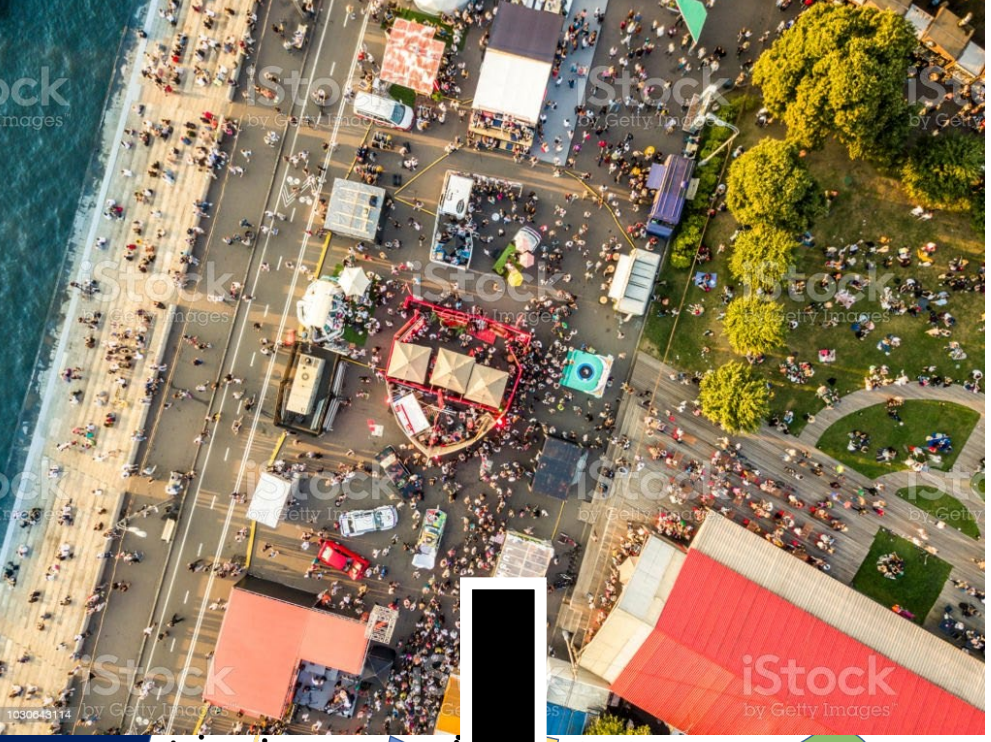
Keywords: Grazing, Green sea urchin, Kelp, Seascape, Gulf of St. Lawrence, Artificial reef

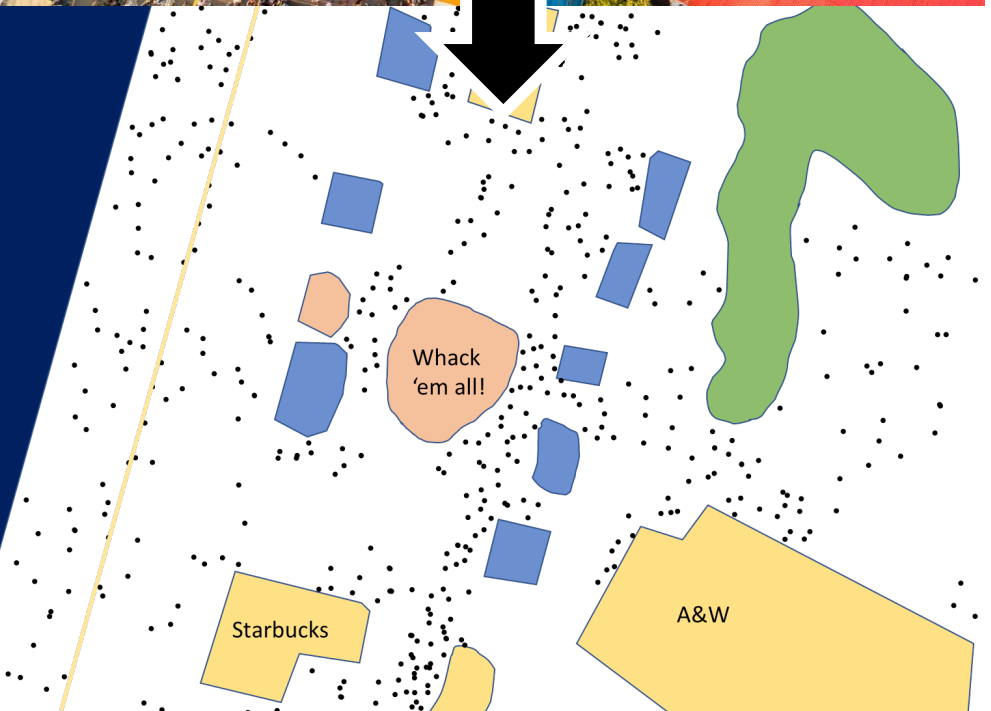
Introduction

Data Extraction



Data Extraction



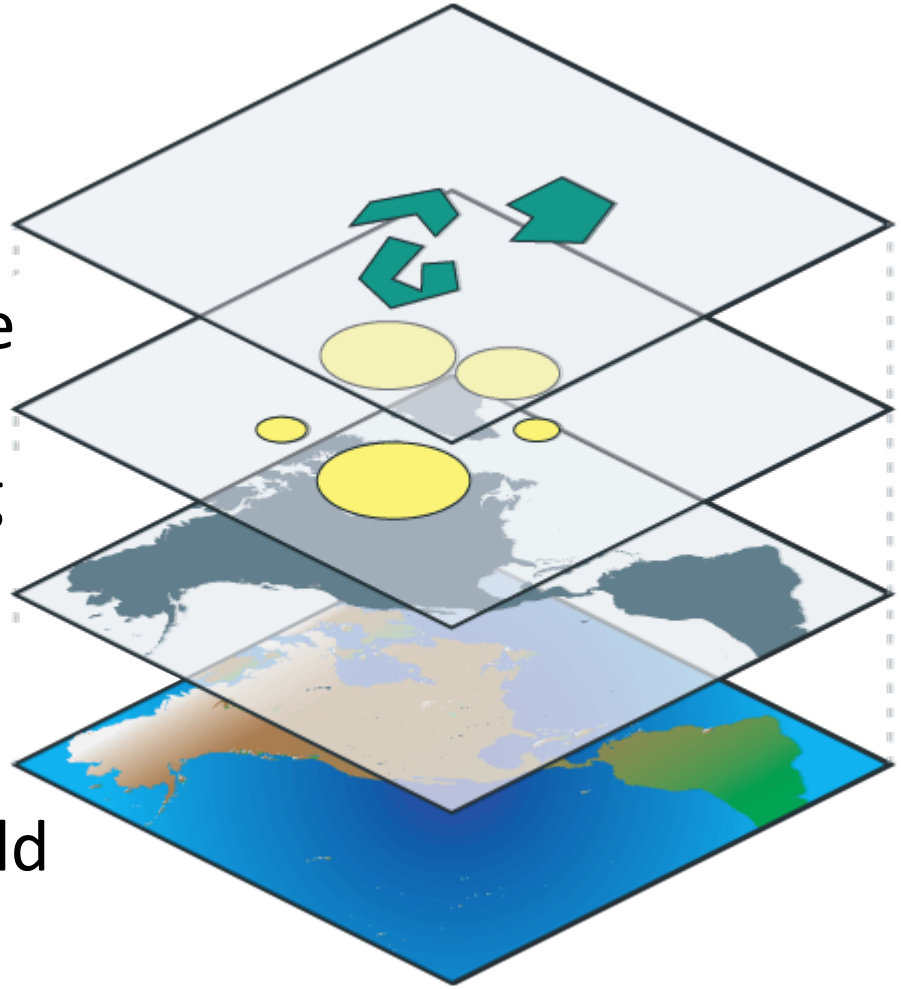


Species

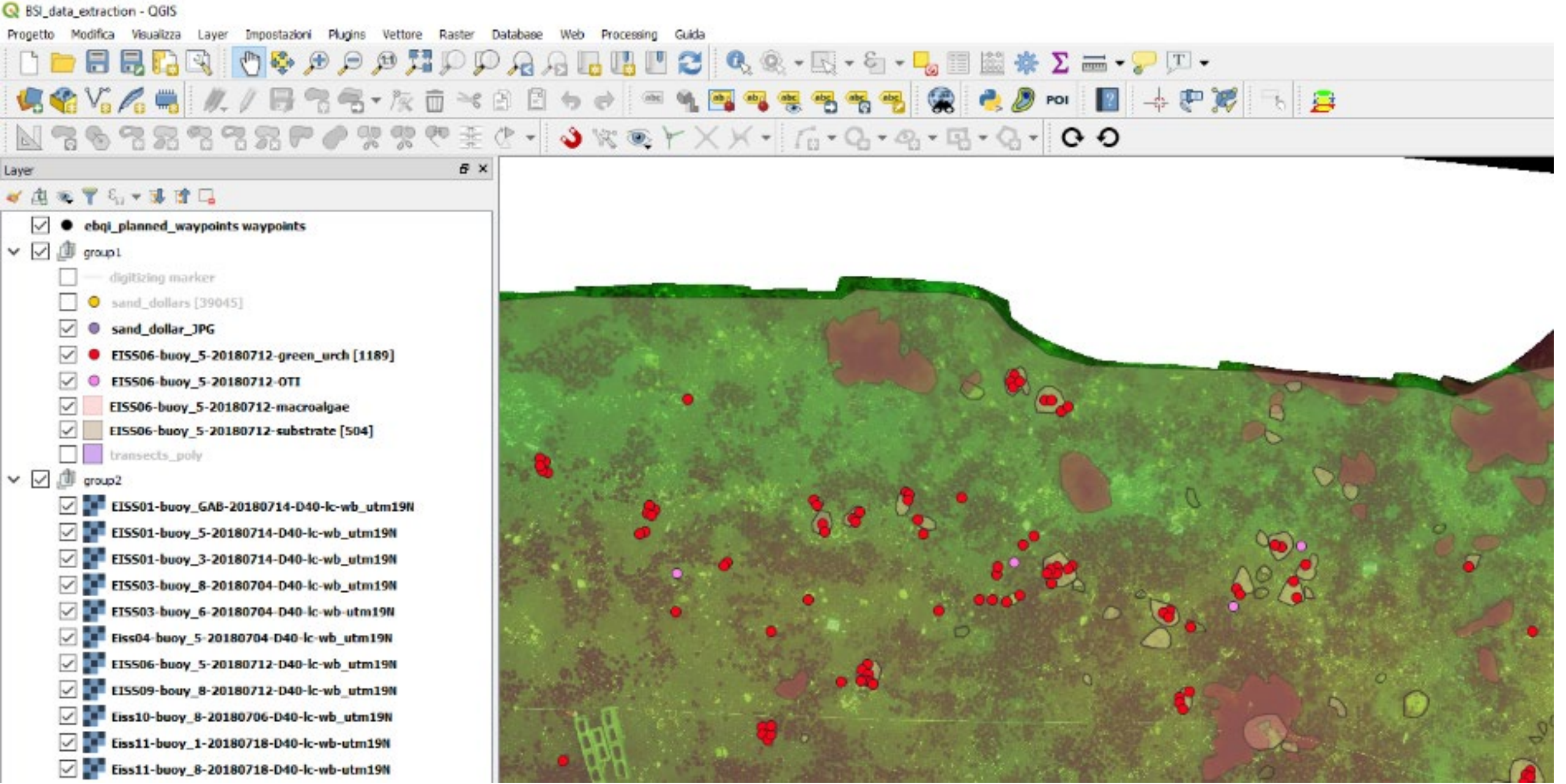
Substrate

Sampling area

Real world

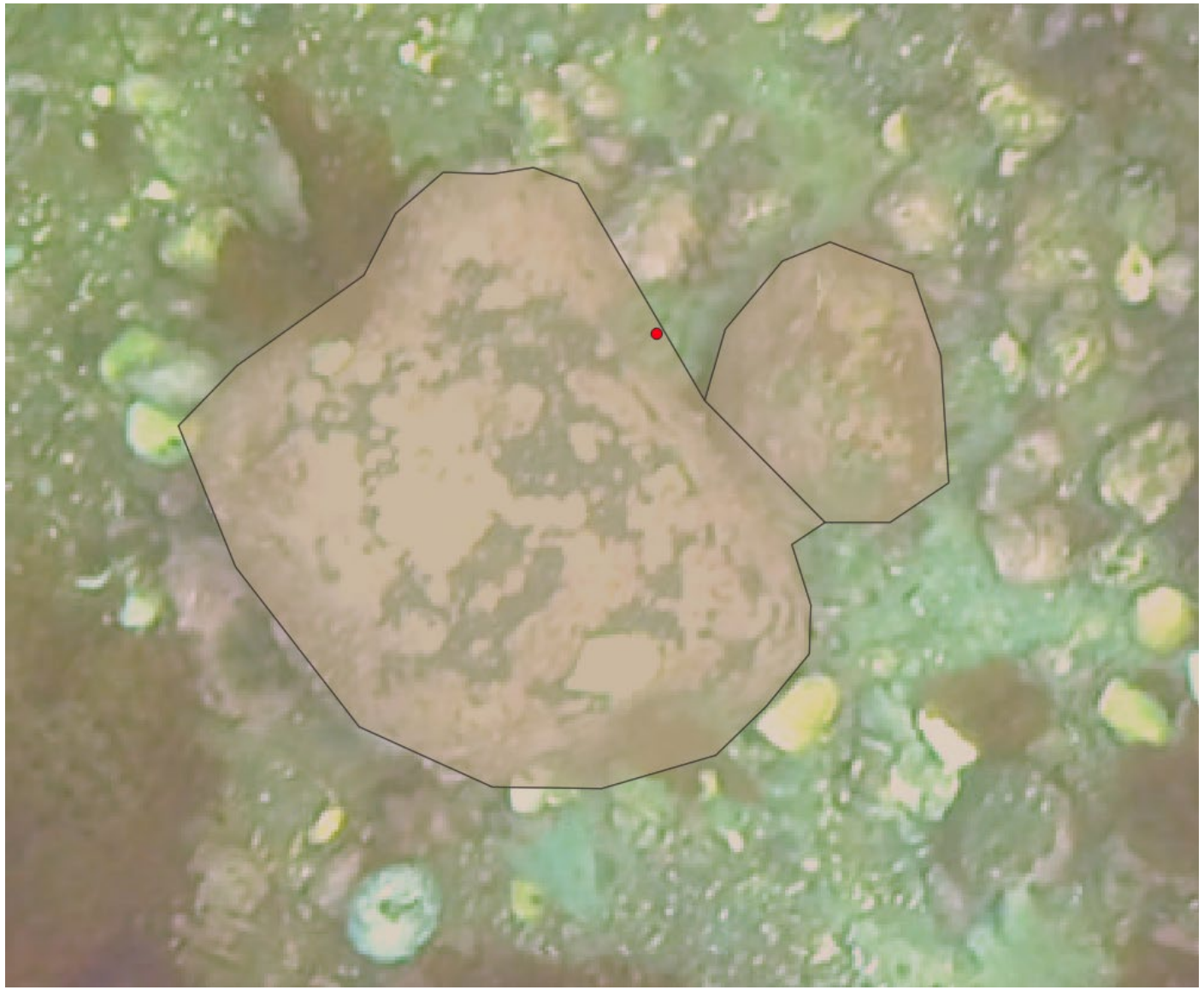


DATA EXTRACTION Manual in a GIS environment



Polygons

- Substrate & Seaweeds
- Position, size & shape

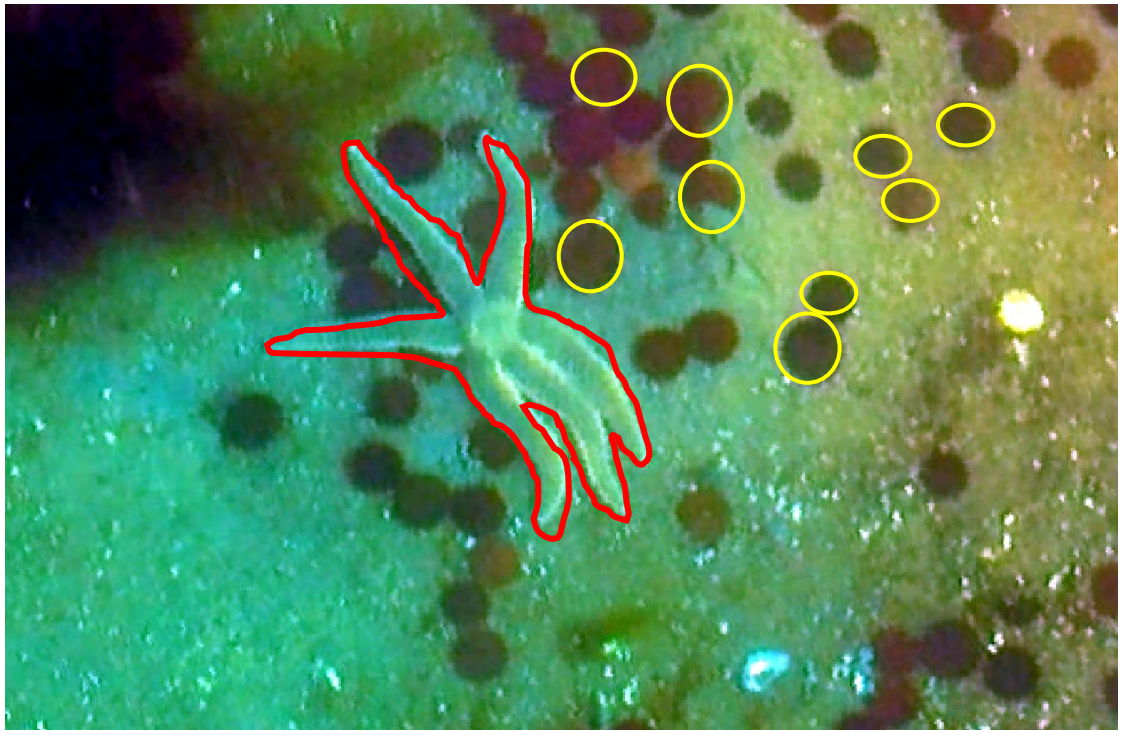


Points

- Animal species
- Only position

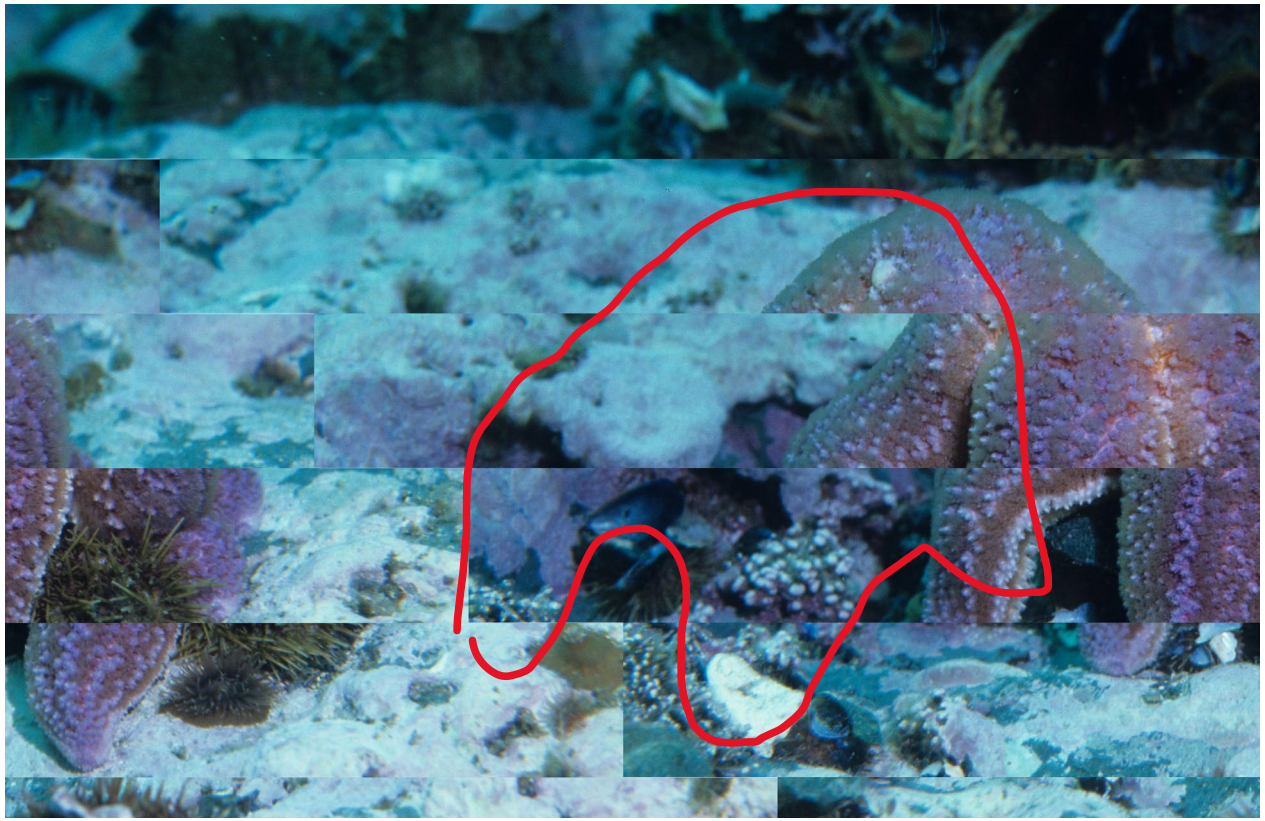
Points

Polygons



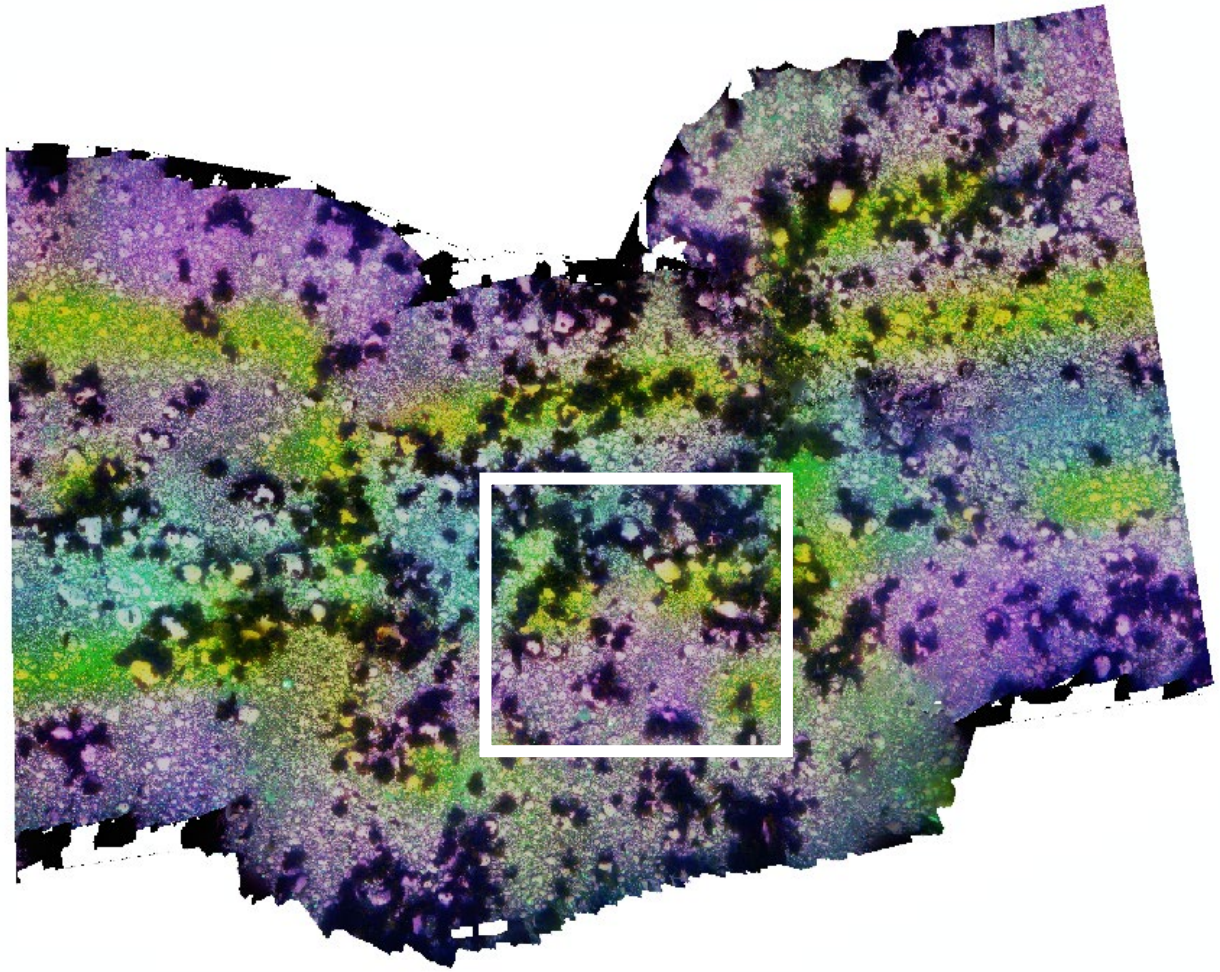
Animals are not points!

Polygon => Shape => Behavior (e.g., feeding), Size,…



Moving towards computer vision & Machine Learning

Pixel Classification
supervised - Maximum likelihood

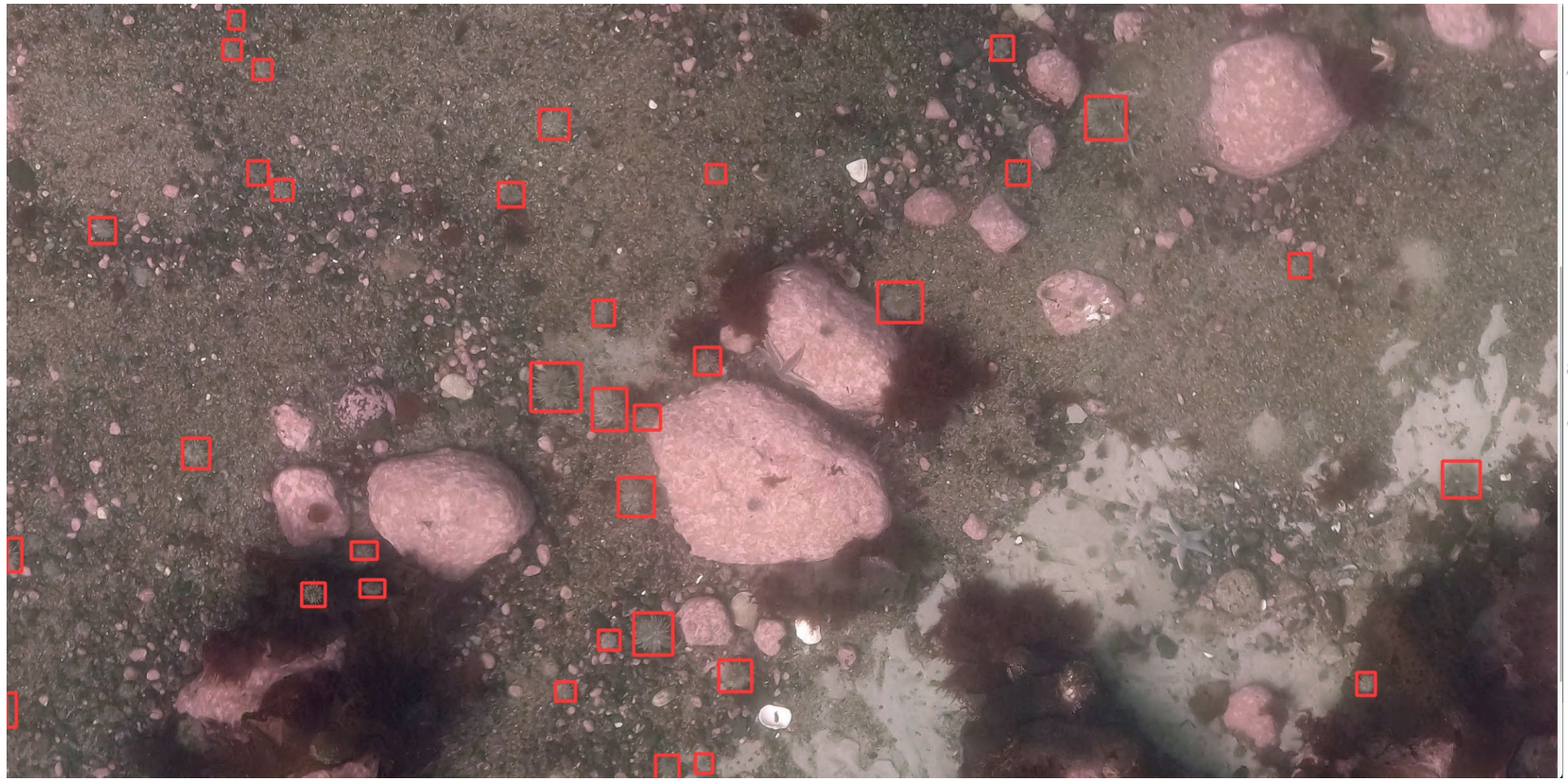


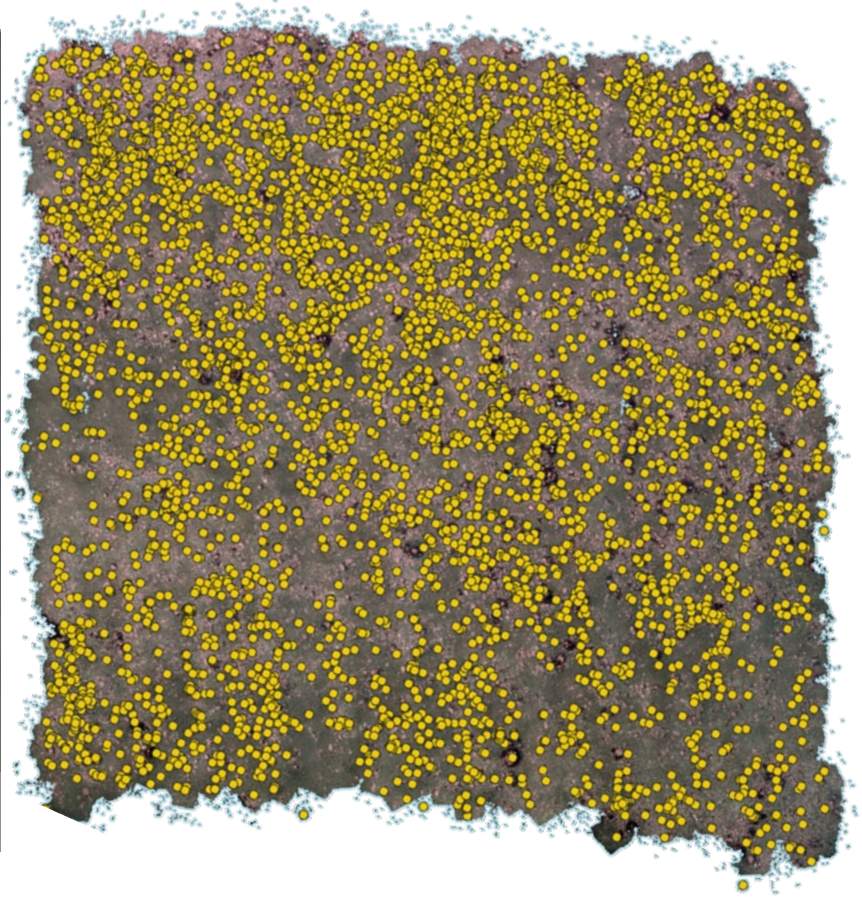
ArcMap - PCI Geomatica – Ecognition

Moving towards computer vision & Machine Learning

Collaboration with CIDCO

Machine Learning model to identify Sea Urchins on photomosaics





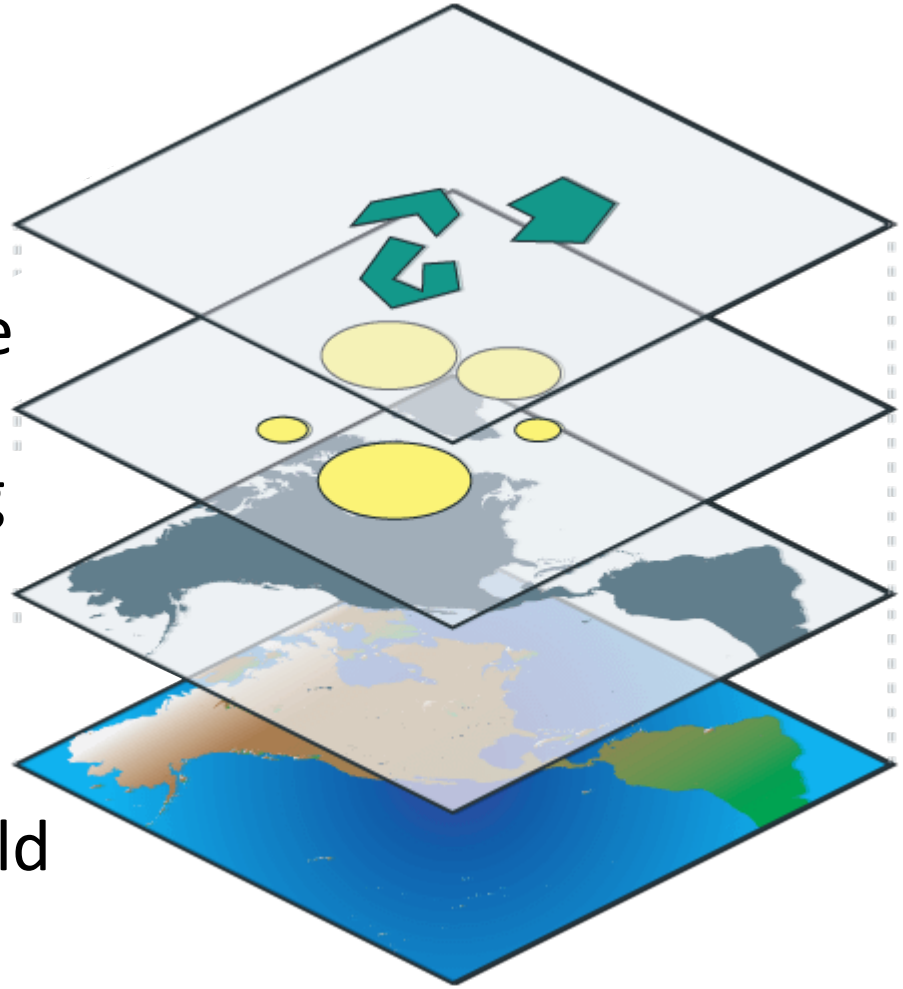
Moving towards computer vision & Machine Learning

ML model for individuals → Species

ML model for substrate → Substrate

Sampling area

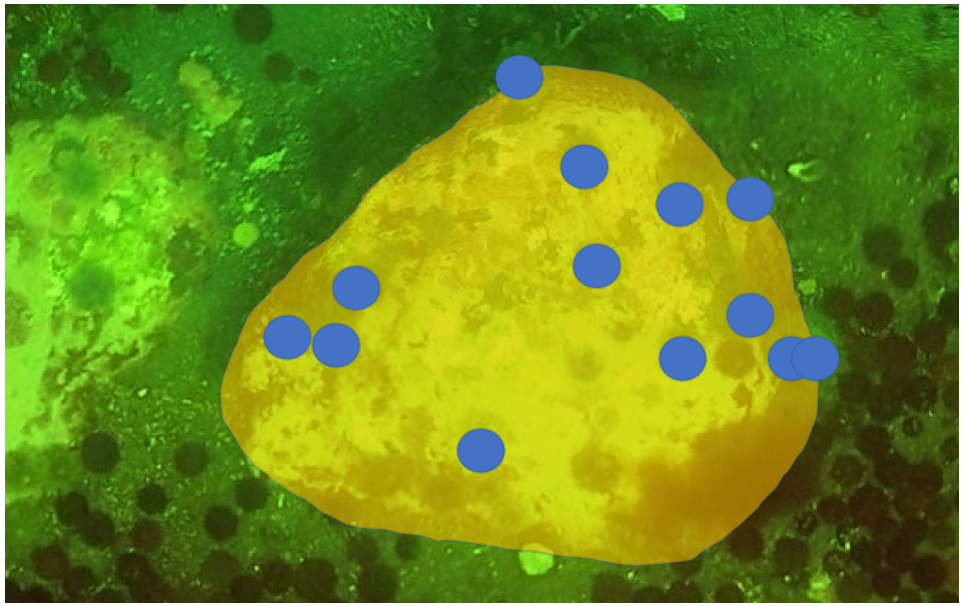
Real world

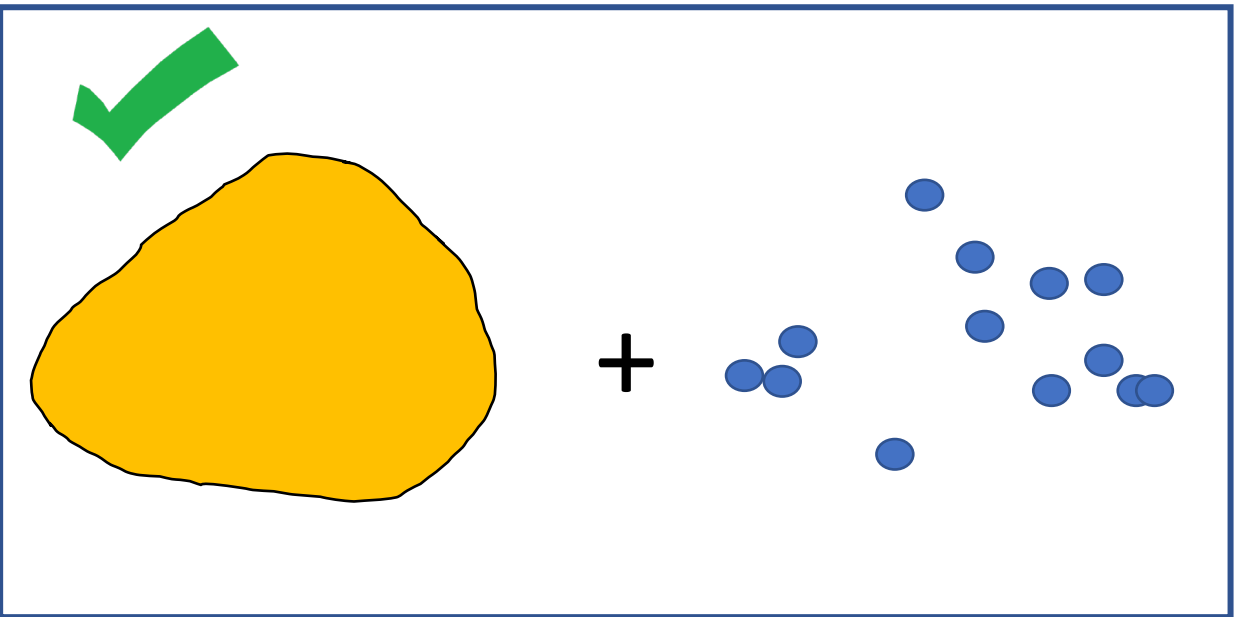


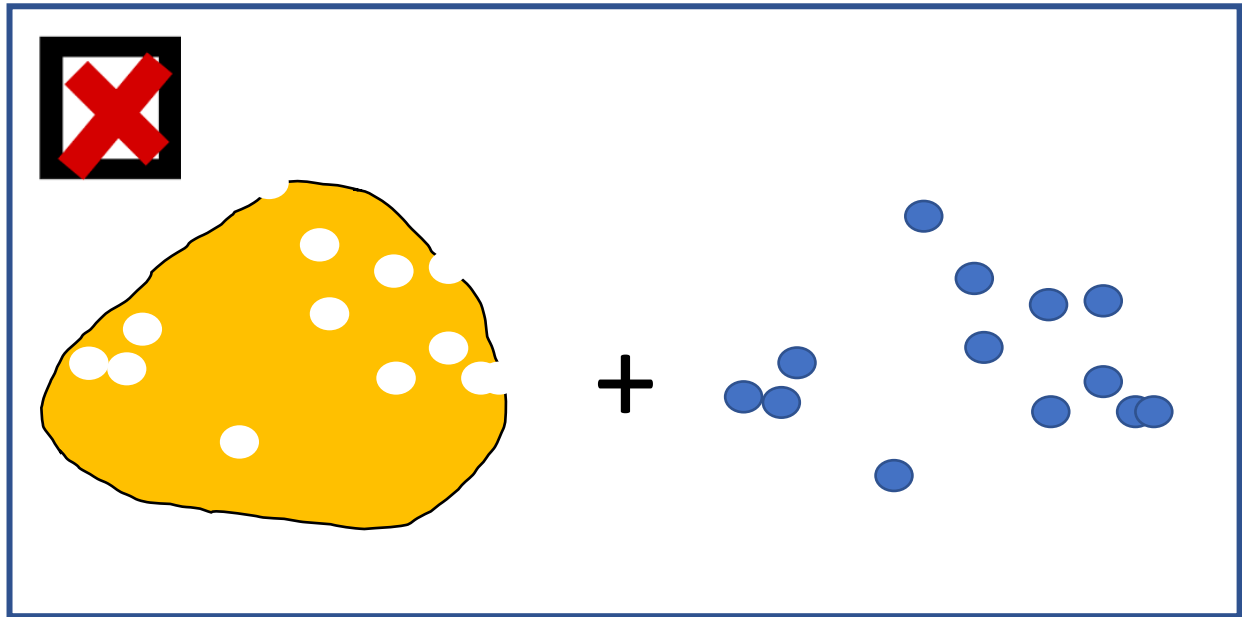
A desired approach that preserve overlay of layers

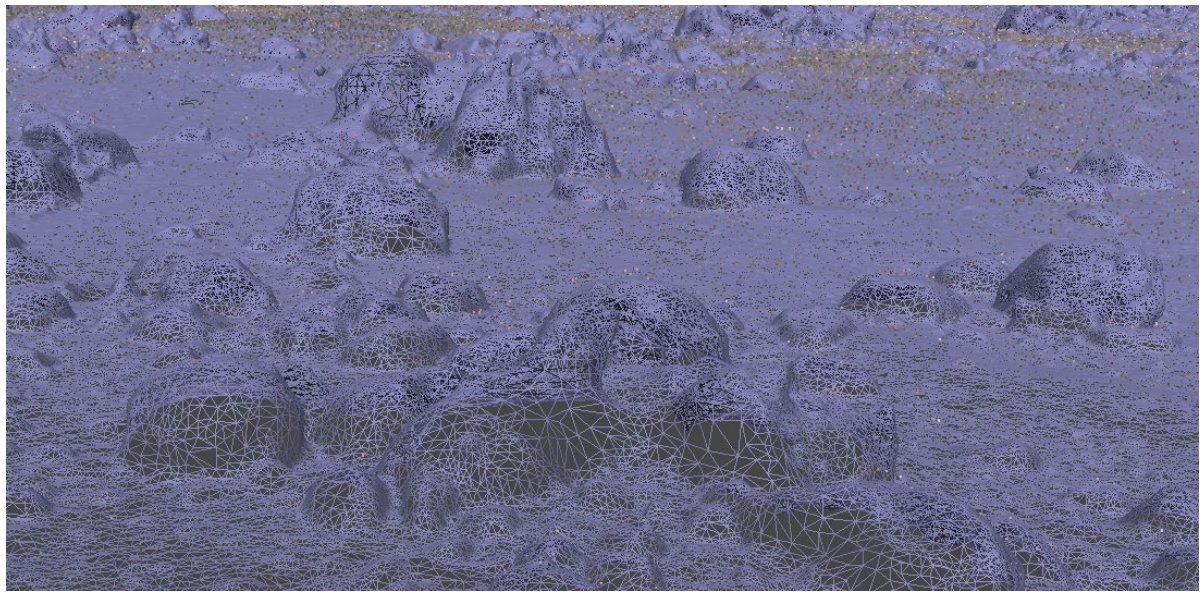
Moving towards computer vision & Machine Learning

A desired approach that
<u>preserve overlay of layers</u>





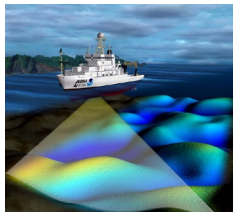


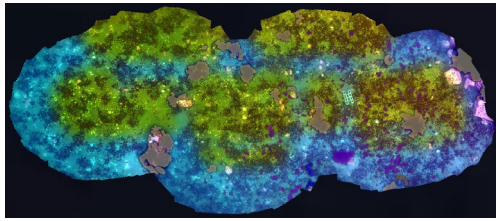


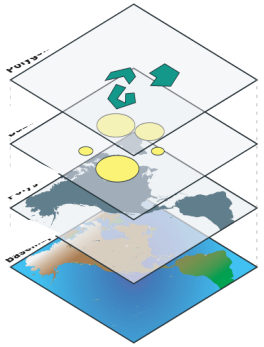
CV/ML to combine 2D and 3D ?

Characterization of the sea floor NEEDS for benthic ecology

- Scale and Map availability
- Substrate type @ medium scale
  ? Multibeam Classification
- Small scale: Image data extraction








Mapping &
Image analysis
Me
You experts

Pêches et Océans Canada

Fisheries and Oceans Canada

Contact us!

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Small and Medium scale Sea Floor Characterization needed