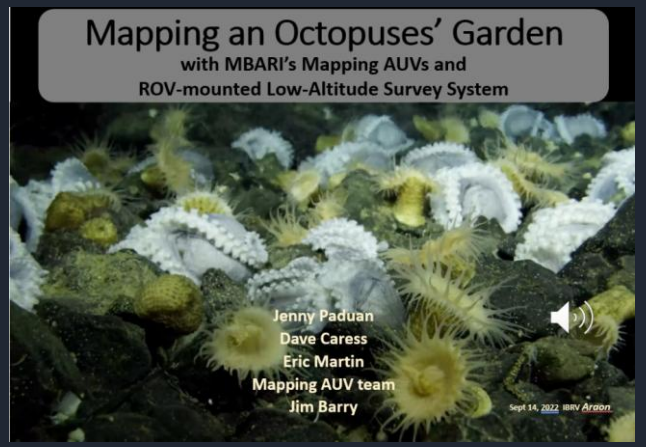
X3D Use Cases

Versar: Geospatial and Digital Solutions

Versar leverages X3D's geospatial capabilities to create interactive environmental analysis tools. Their applications help clients visualize environmental impact assessments, infrastructure planning, and resource management scenarios through intuitive 3D interfaces that integrate multiple data sources into cohesive geospatial visualizations.

MBARI: Mapping of the Seafloor



The Monterey Bay Aquarium Research Institute uses X3D for visualizing complex underwater terrain and biological habitats. Their systems combine bathymetric data, underwater photography, and biological observations into interactive 3D environments that help scientists study marine ecosystems in unprecedented detail.

X3D provides the tools needed to create meaningful interactive visualizations that help stakeholders understand complex spatial relationships

Web3D Consortium: Powering 3D on the Web

Founded in 1995, the Web3D Consortium has been at the forefront of developing open standards for real-time 3D communication on the web for **30 years**.

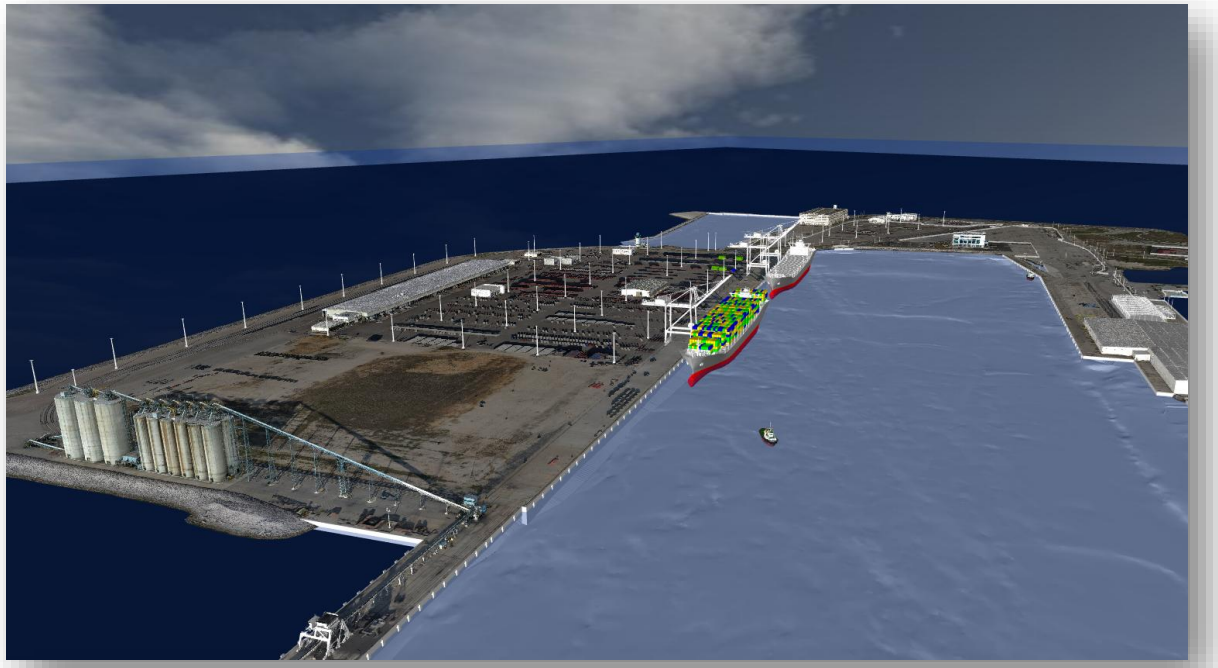
Our mission is to develop and promote royalty-free standards that enable the creation, delivery, and playback of interactive 3D content across various platforms and devices.

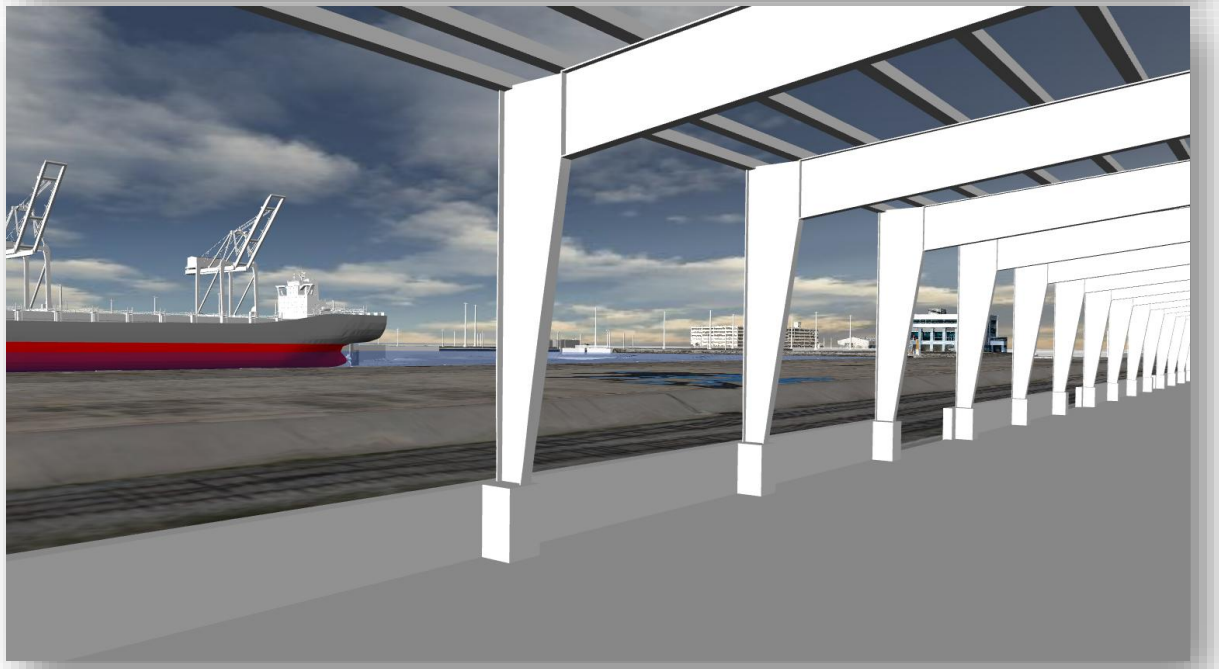
The consortium brings together experts from academia, government, and industry to ensure that 3D technologies remain accessible, interoperable, and future-proof.

VERSAR
GLOBAL SOLUTIONS

- Program and Project Management Company
- Geospatial and Digital Solutions Group
- Partners with:
  - Web3D Consortium
  - Open Geospatial Consortium
  - Naval Post Graduate School
  - Virginia Tech

- Government and DOD Customers
  - Engineering
  - Geospatial
  - Planning
  - Management
  - Consultation
  - Training
  - Products and Services





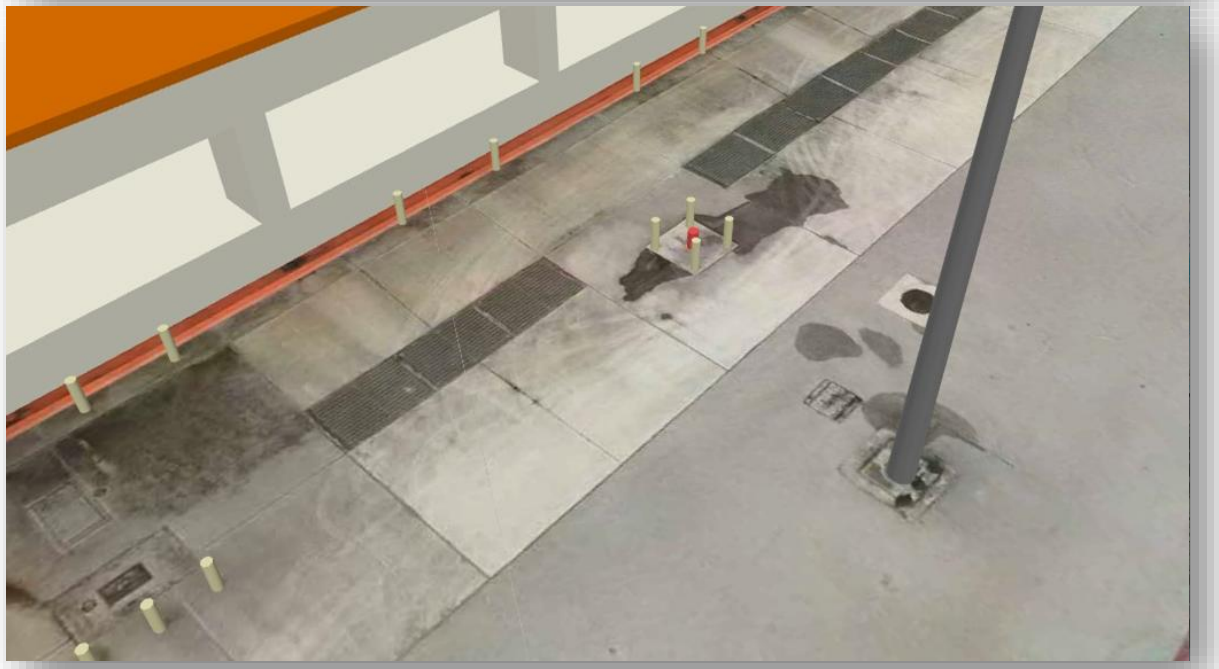
VERSAR
GLOBAL SOLUTIONS

- Information and Connectivity
  - Build on and improve existing data methodologies and pipelines
  - Facilitate creation, interoperability, and access to data

- X3D Virtual Environments and the Internet
  - Non-proprietary solution
  - Implemented and authorized for use by the government
  - Minimal edge computing requirements
  - Access to data regardless of location and software
  - Findable, Accessible, Interoperable, Reusable
  - Efficiency and Standardization

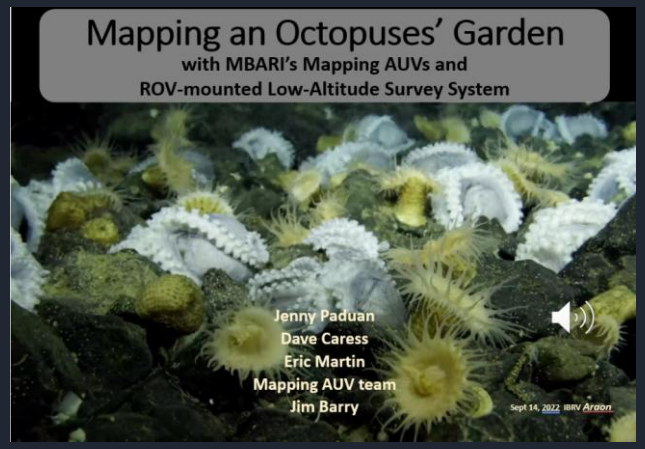
- X3D Capability and Observations
  - Terabytes of data collected or aggregated
  - Conversion and Transformation
  - Gigabytes or Megabytes Rendered and Shared
  - Maintain quality and fidelity of data
  - Data interaction and investigation

- Value to Our Customers
  - Currently being implemented
  - Allows for critical collaboration and decision making
  - Precision
  - Customizable
  - Integrable and relatable
  - Performant
  - Accessible



X3D Geospatial Use Cases

01 MBARI: Mapping an Octopuses' Garden



The Monterey Bay Aquarium Research Institute uses X3D for visualizing complex underwater terrain and biological habitats. Their systems combine bathymetric data, underwater photography, and biological observations into interactive 3D environments that help scientists study marine ecosystems in unprecedented detail.

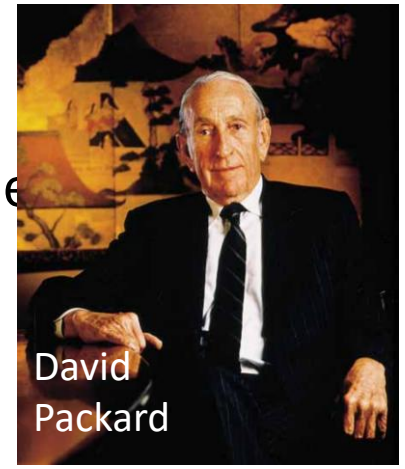
Mapping an Octopuses' Garden

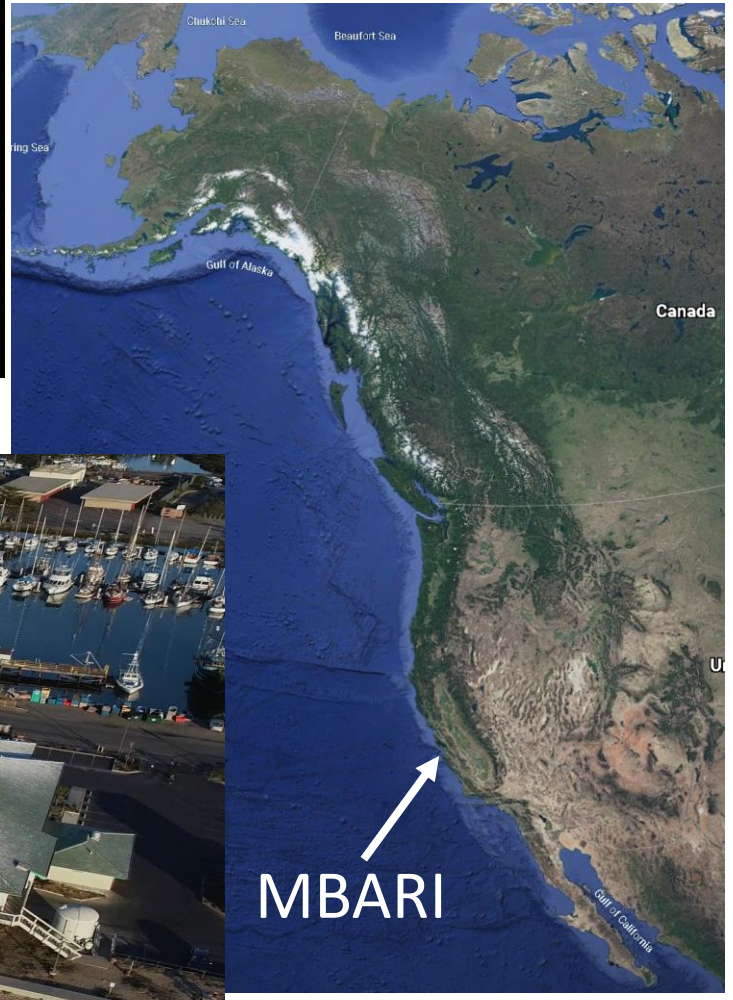
with MBARI's Mapping AUVs and ROV-mounted Low-Altitude Survey System

Monterey Bay Aquarium Research Institute

Founded in 1987

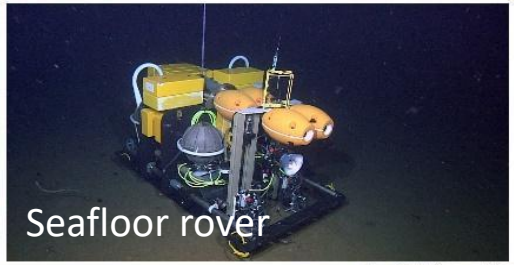
Funding from the David and Lucile Packard Foundation

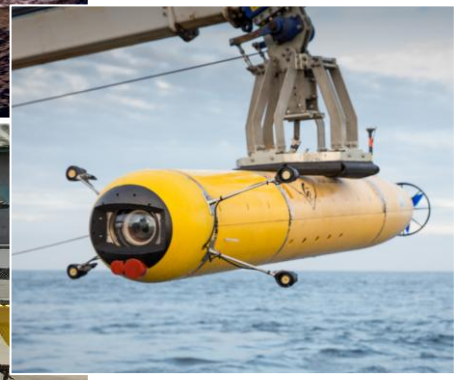





MBARI
Monterey Bay Aquarium
Research Institute

MBARI operates three ships and an array of seagoing robots to study the oceans



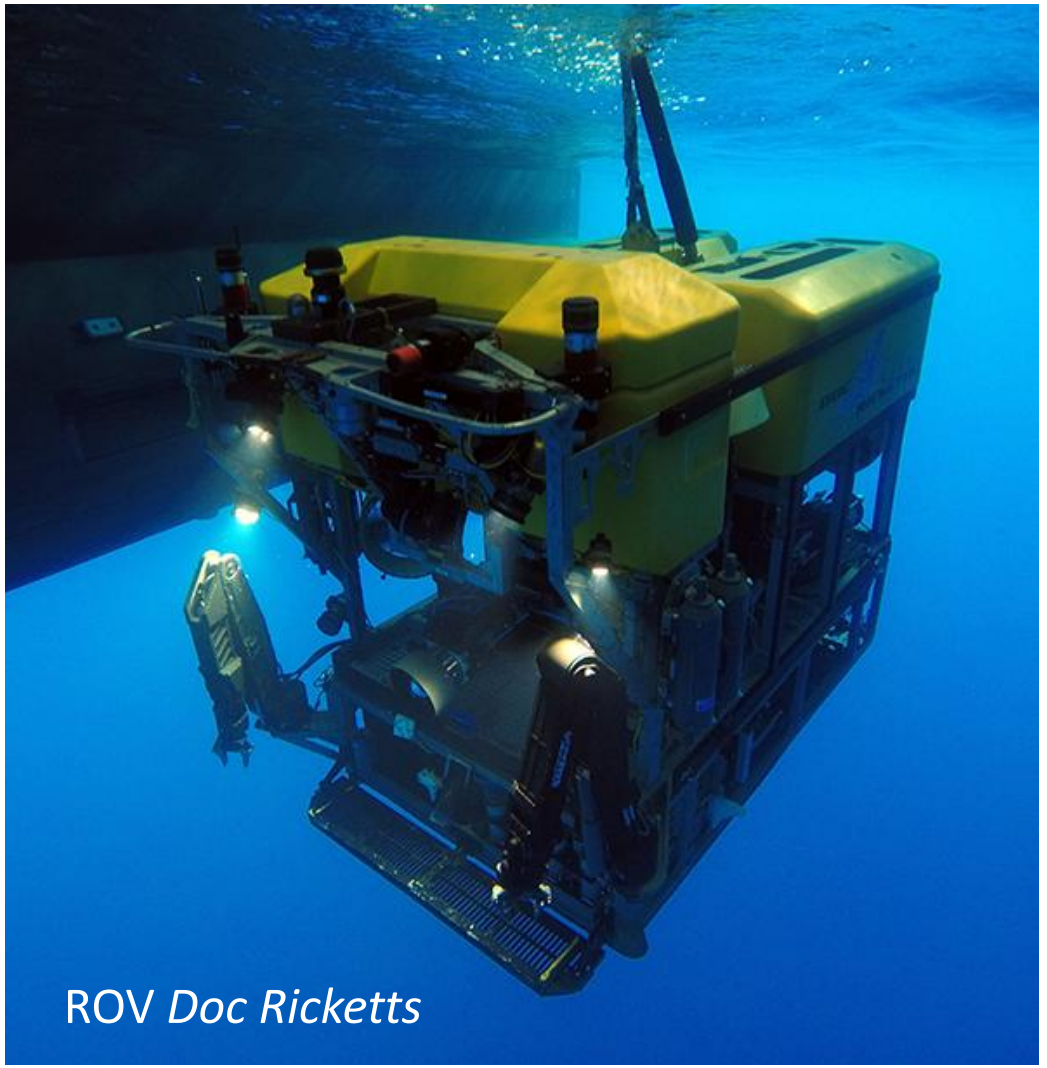


AUV

Autonomous Underwater Vehicle

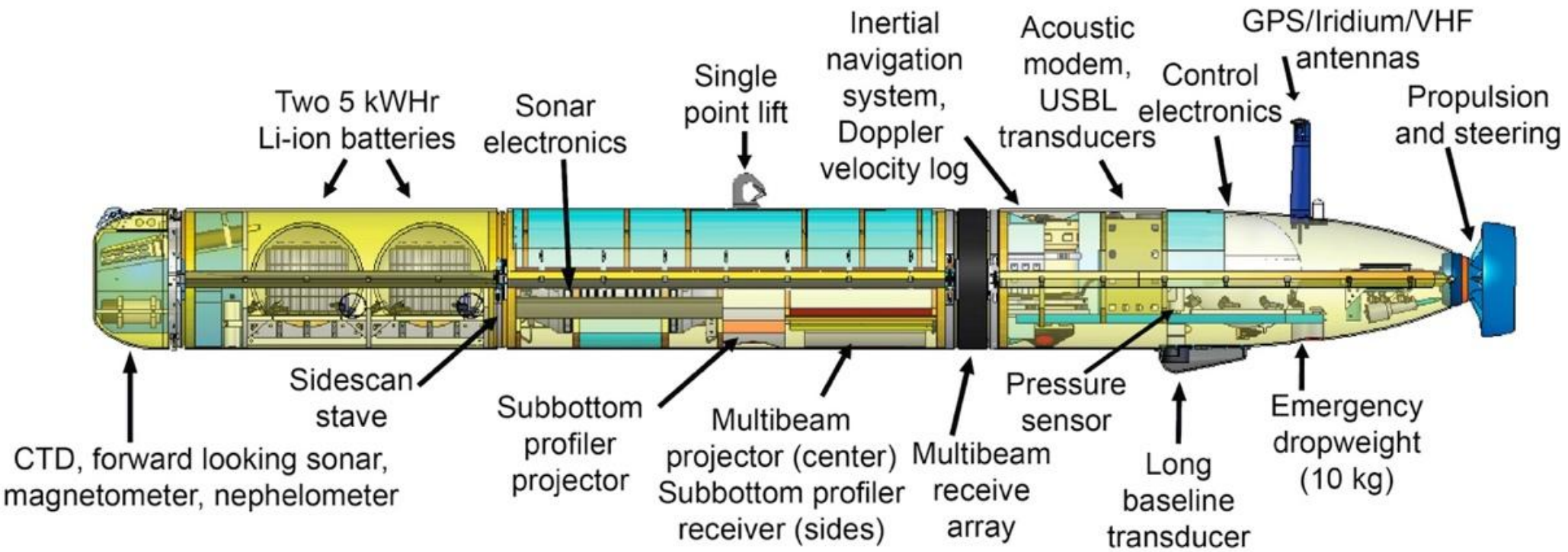
ROV

Remotely-operated vehicle

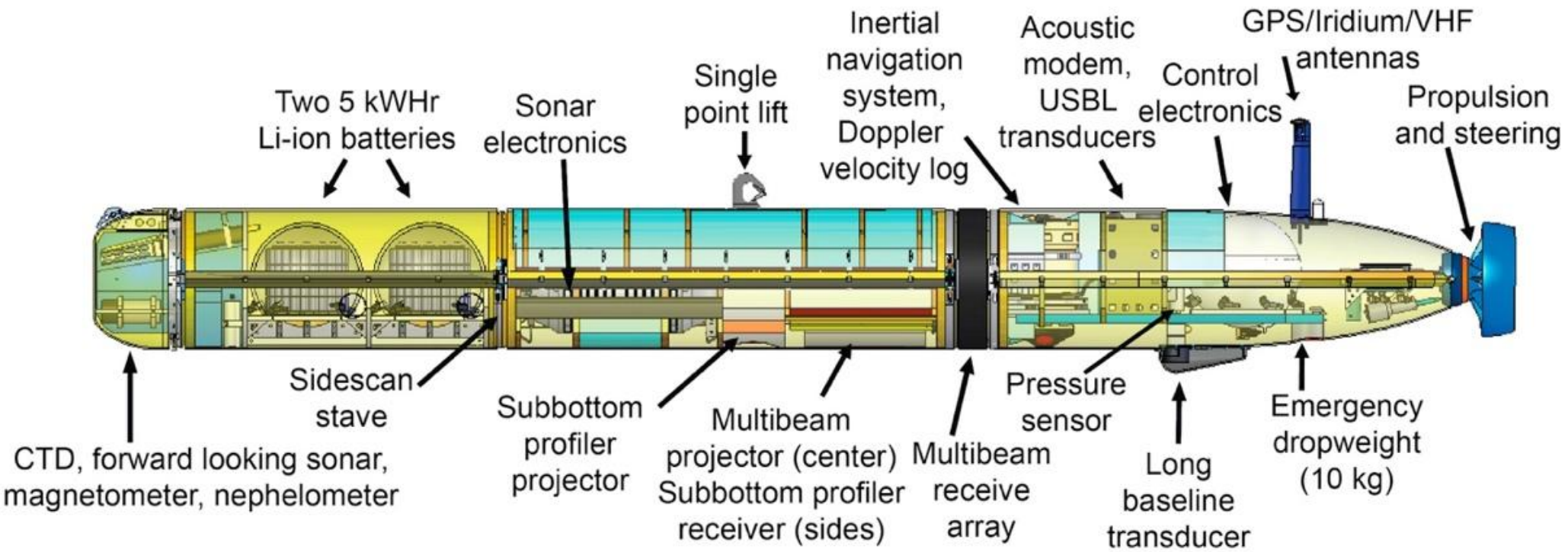


ROV *Doc Ricketts*

Mapping AUV - schematic



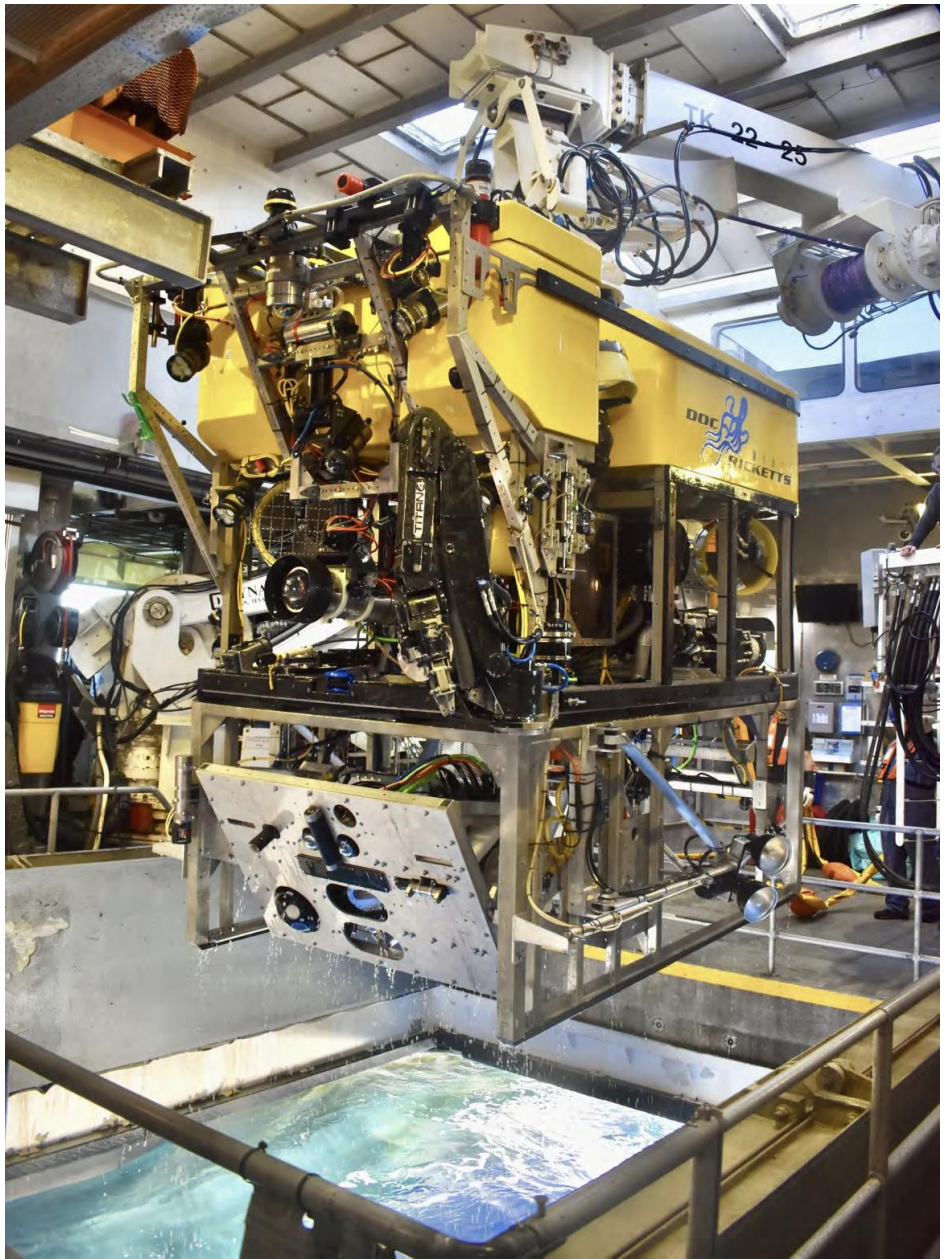
Mapping AUV - schematic



Fly 50 m above the seafloor for 1-m resolution data

Low-altitude survey system (LASS)

ROV *Doc Ricketts*

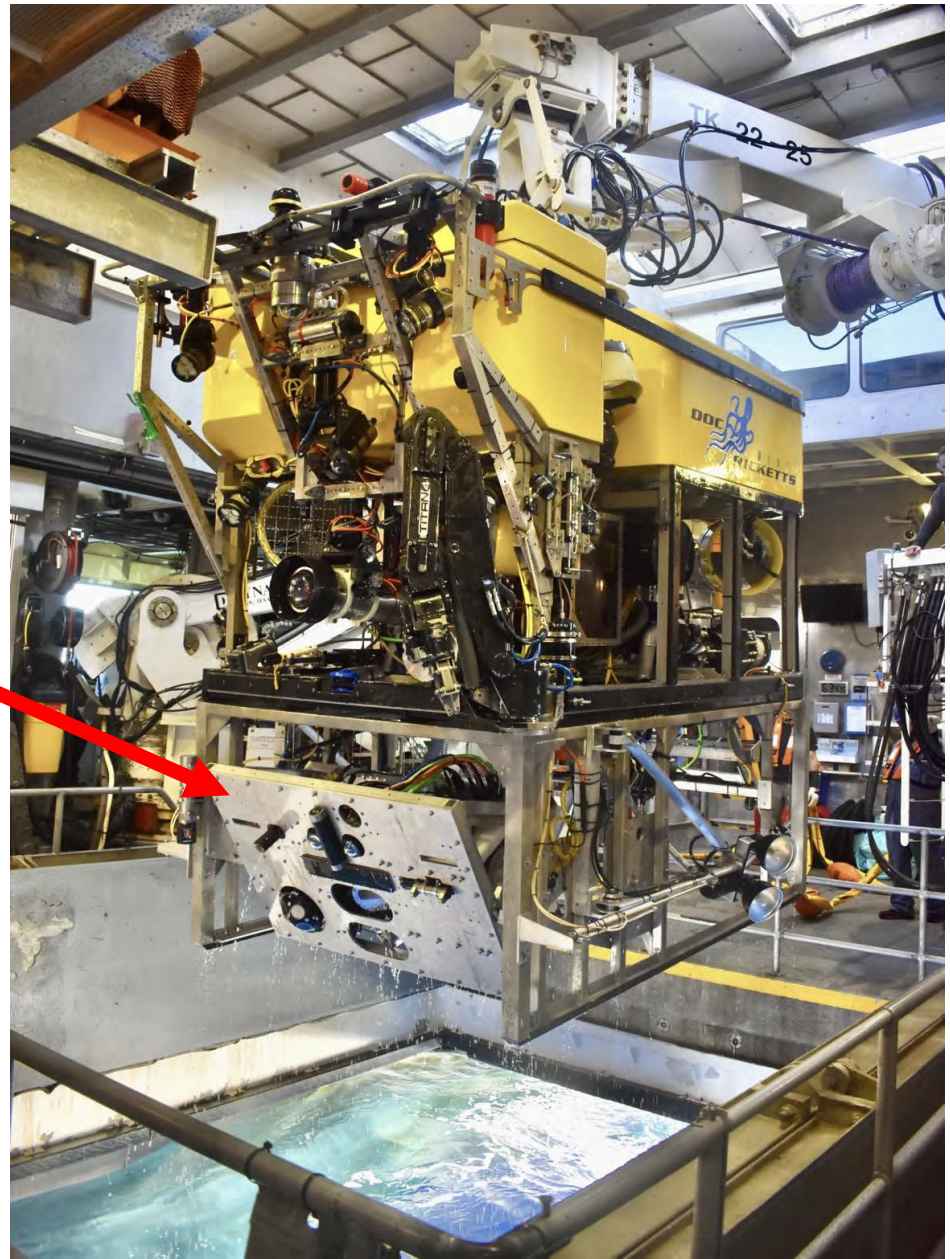


Low-altitude survey system (LASS)

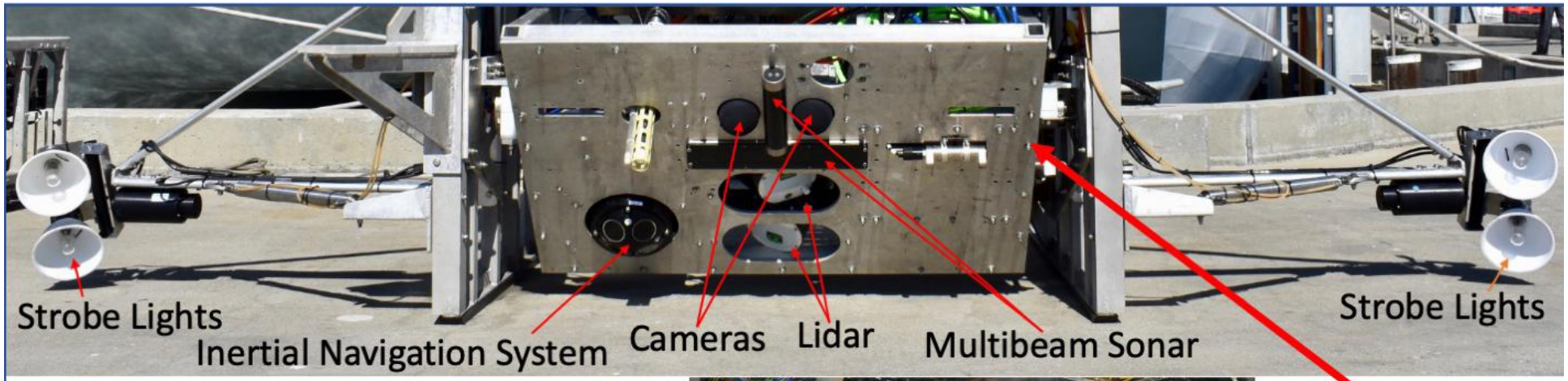
ROV *Doc Ricketts*

LASS toolsled

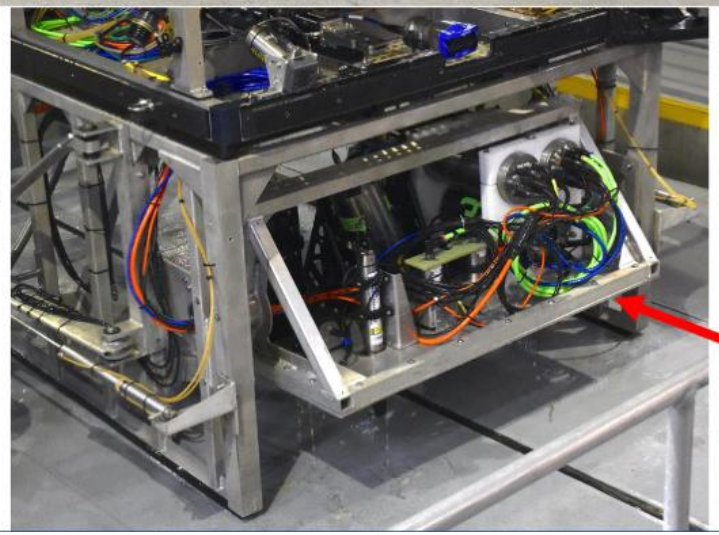
- Flown autonomously
- 3 m above seafloor
- 3 m wide line spacing



Low-altitude survey system: sensors



- Wide Swath Lidar (WiSSL)
- Multibeam sonar
- Stereo color cameras + strobes
- Inertial Navigation System
- Sensor frame and strobes rotate to point at the seafloor regardless of slope



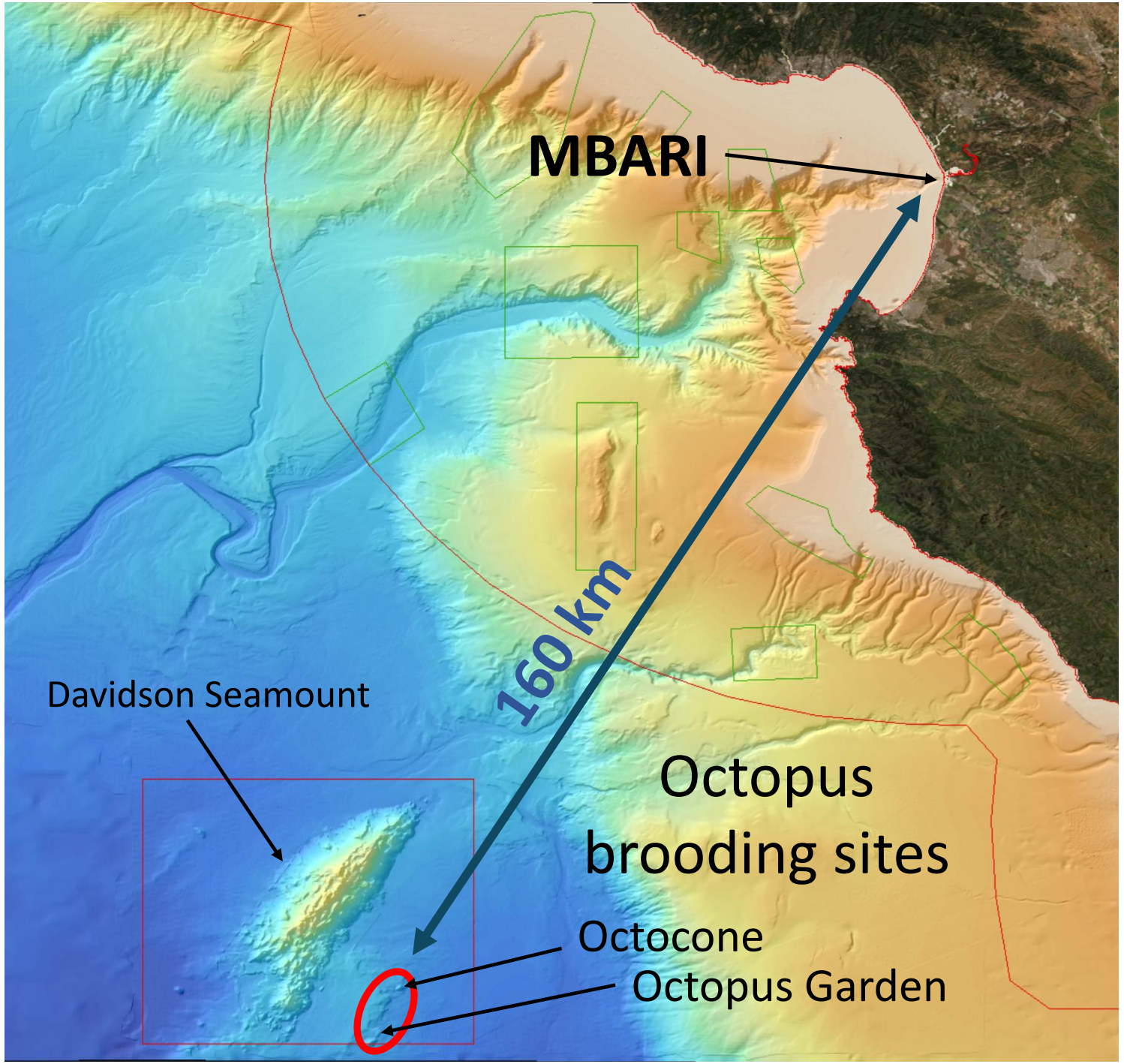
Sensor frame pointing 45° forward

Sensor frame pointing straight down

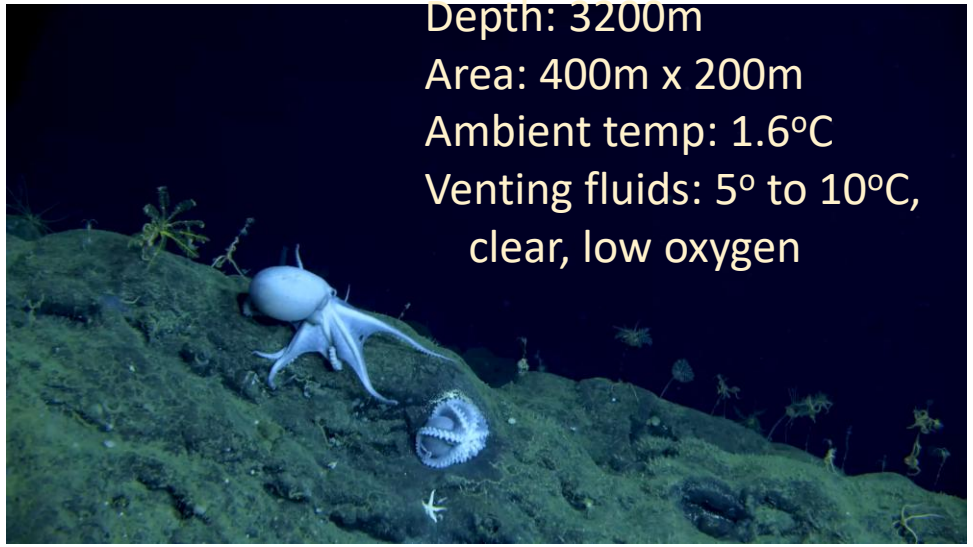
Low-altitude survey system: articulating frame

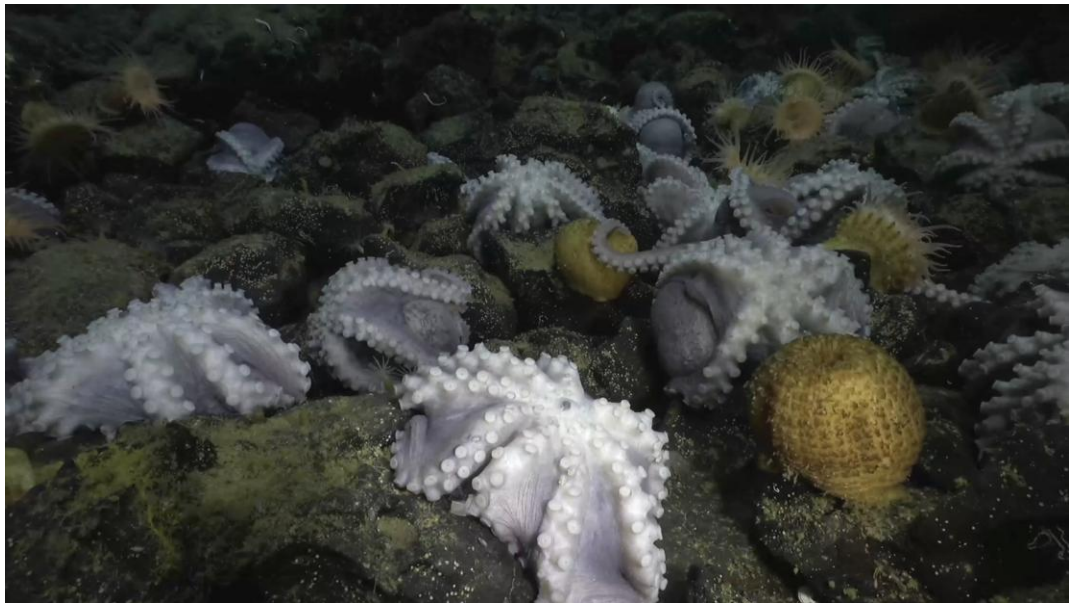
Muusoctopus robustus (a deepwater octopus)

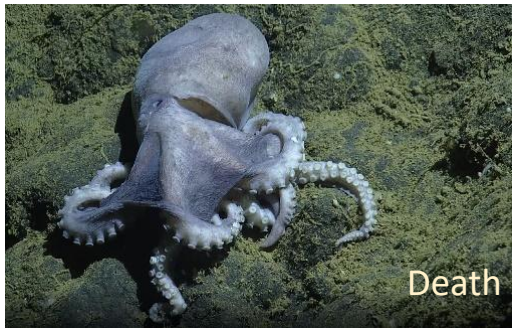
Feeding on a whale-fall


MBARI
160 km
Davidson Seamount
Octopus
brooding sites
Octocone
Octopus Garden

Muusoctopus reproductive biology







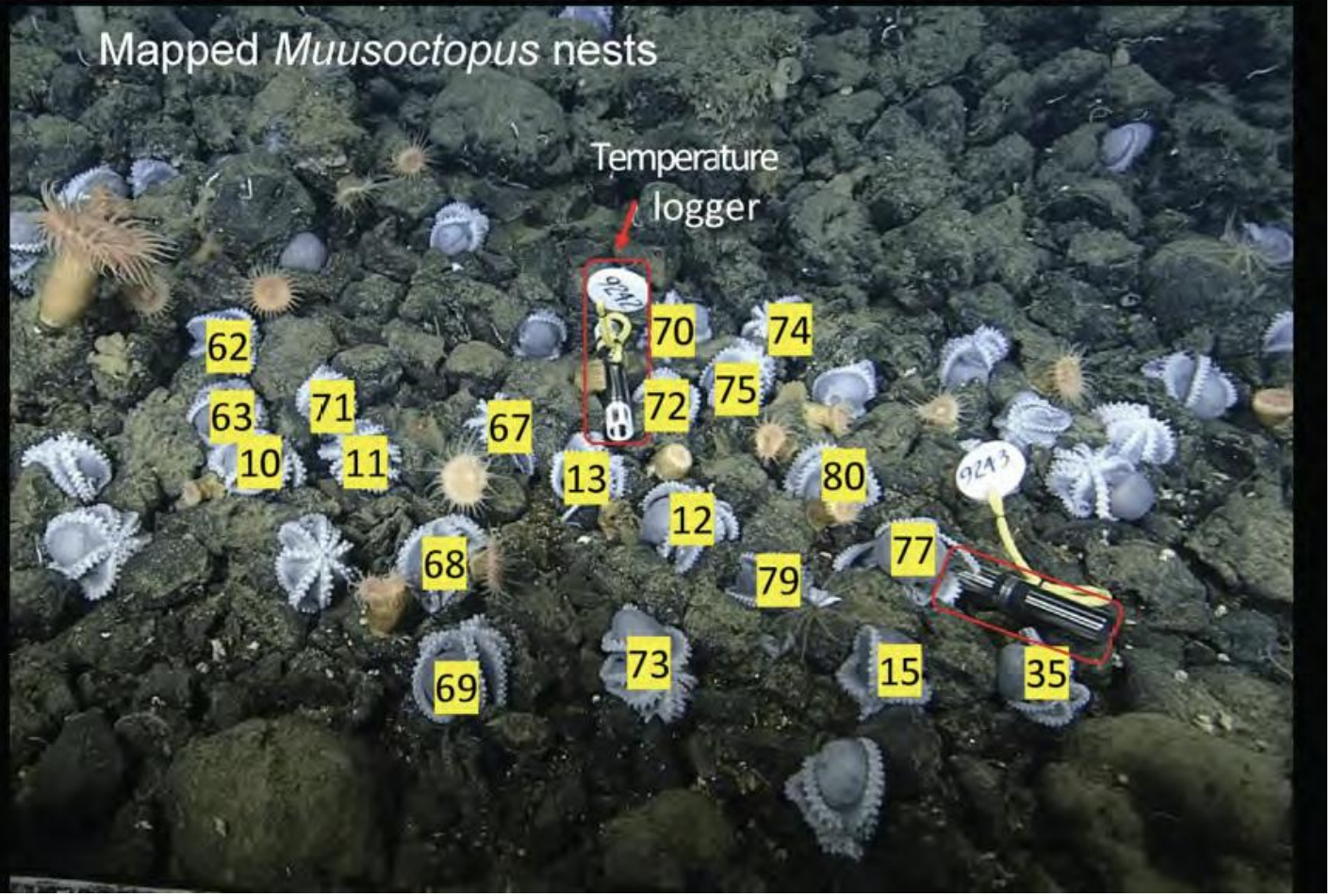
Mapping an Octopuses' Garden

with MBARI's Mapping AUVs and ROV-mounted Low-Altitude Survey System

Muusoctopus reproductive biology

Field program

Revisit marked nests
- Temperature
- Oxygen
- Embryo condition
- Female identity



Questions that can be addressed by our combination of acoustic and optical mapping:

- How many octopuses are there?
- How many are brooding, wandering, or dead?
- How is their distribution related to the shape and character of the seafloor habitat?
- What other animals are there?

Mapping Octopus Garden with the AUVs

From the R/V *Rachel Carson*
February, 2022

Mapping Octopus Garden with the AUVs

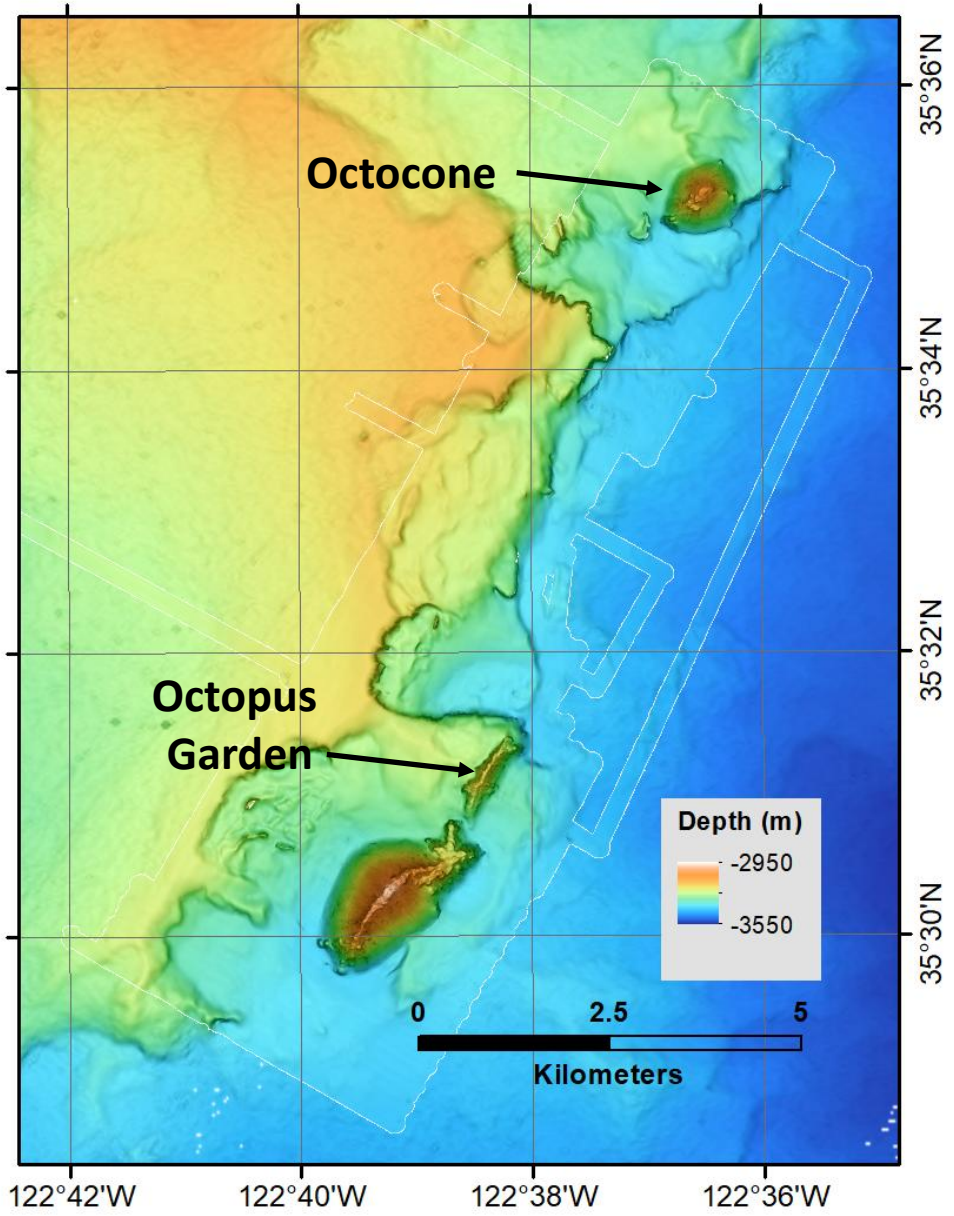
Mapping Octopus Garden with the AUVs

From the R/V *Rachel Carson*
February, 2022

Mapping Octopus Garden with the AUVs

February, 2022

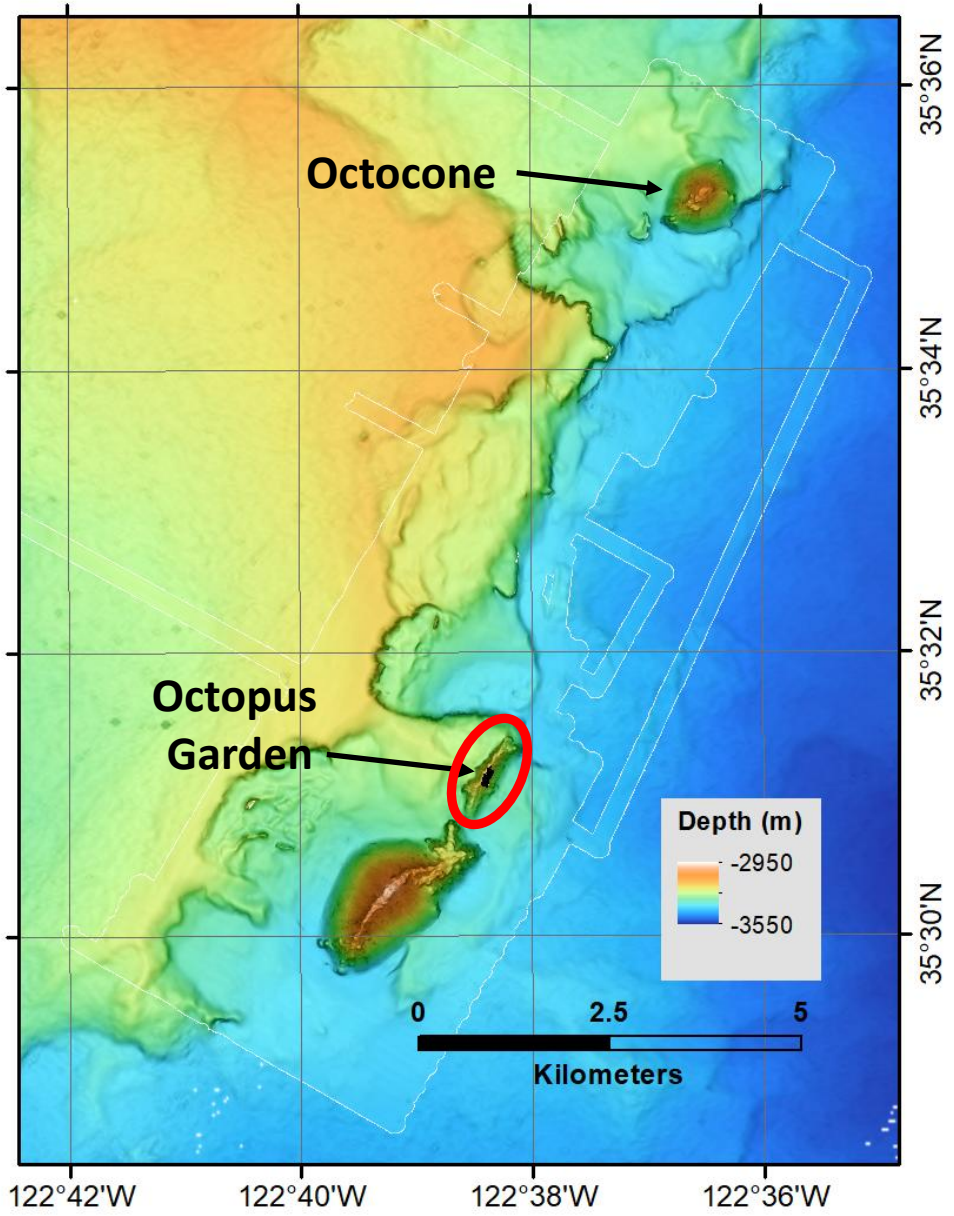
- AUV missions: 6
- Area: 54 km²
- Both brooding sites covered



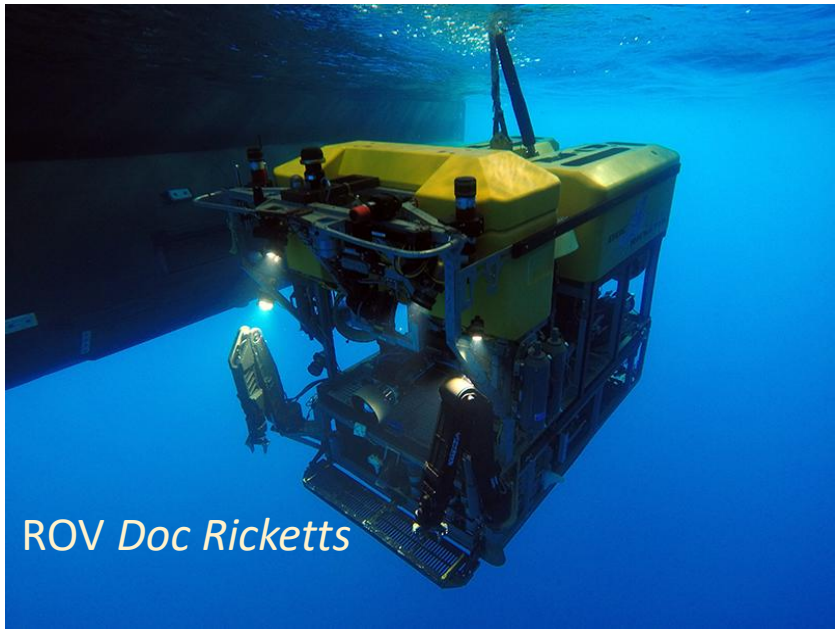
Mapping Octopus Garden with the Low-Altitude Survey System

April, 2021

- LASS missions: 2
- Area: 245 m by ~95 m
- Part of Octopus Garden



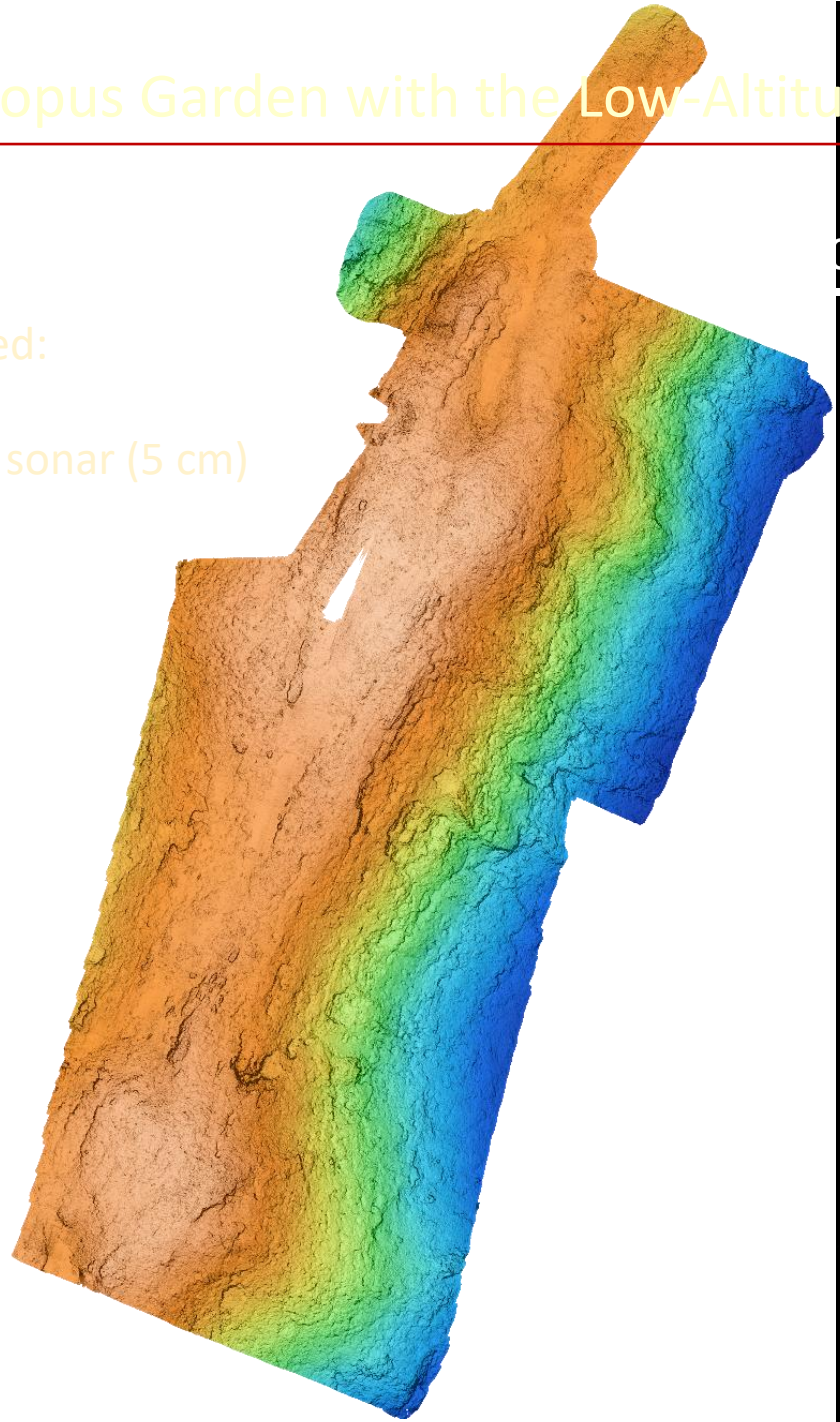
Mapping Octopus Garden with the Low-Altitude Survey System



Mapping Octopus Garden with the Low-Altitude Survey System

Co-navigated:

Multibeam sonar (5 cm)



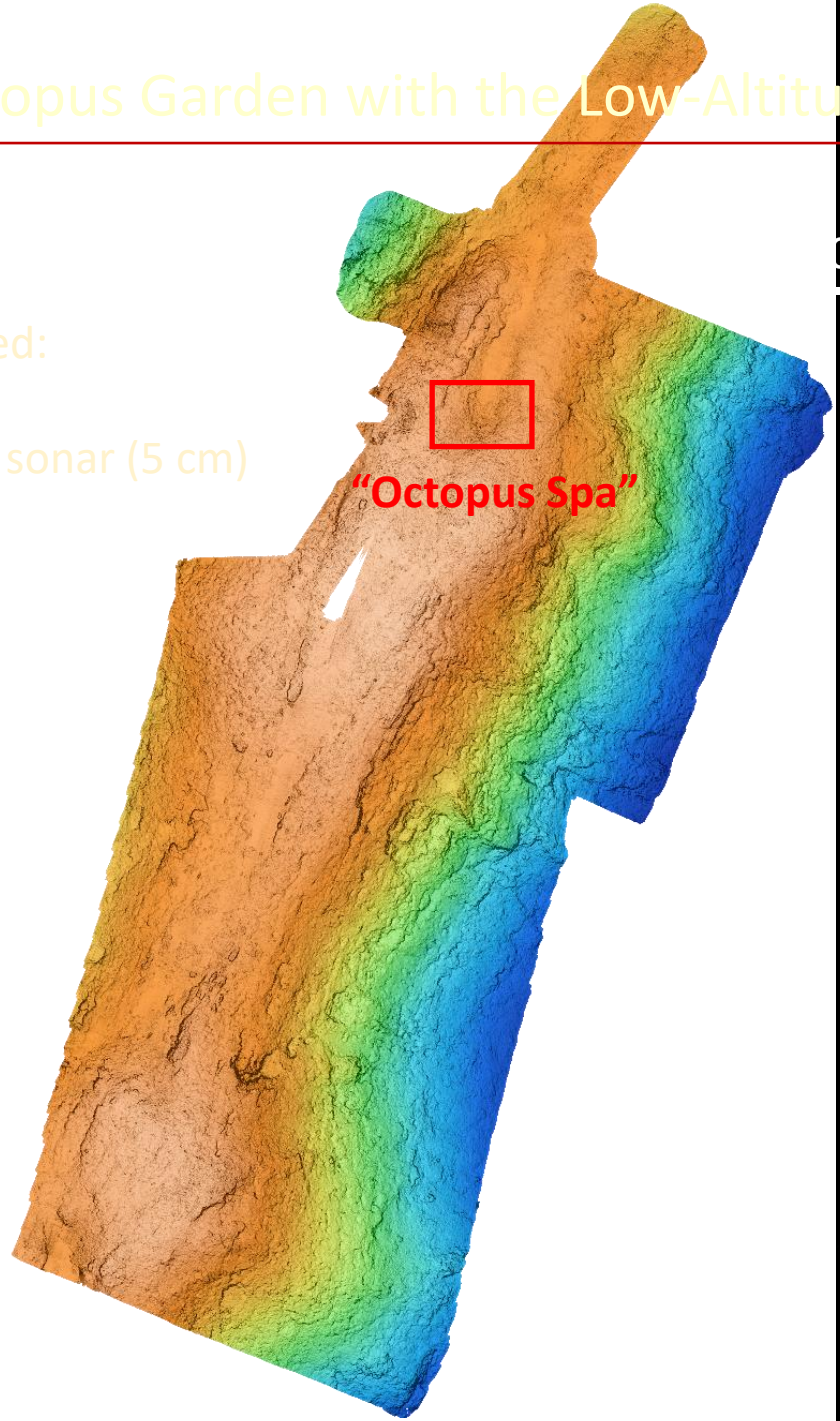
0 meters

Stereo still cameras (2 mm)

Mapping Octopus Garden with the Low-Altitude Survey System

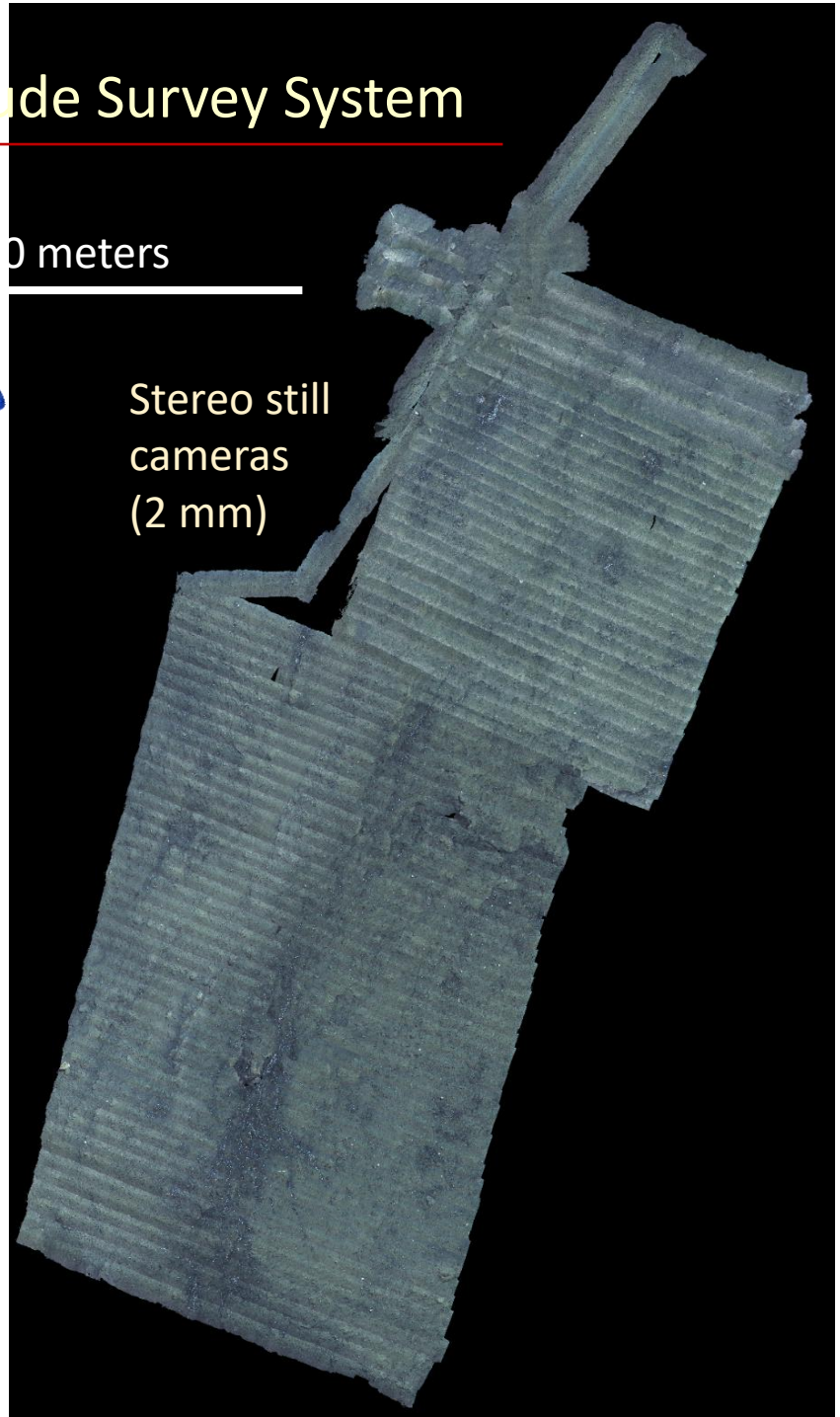
Co-navigated:

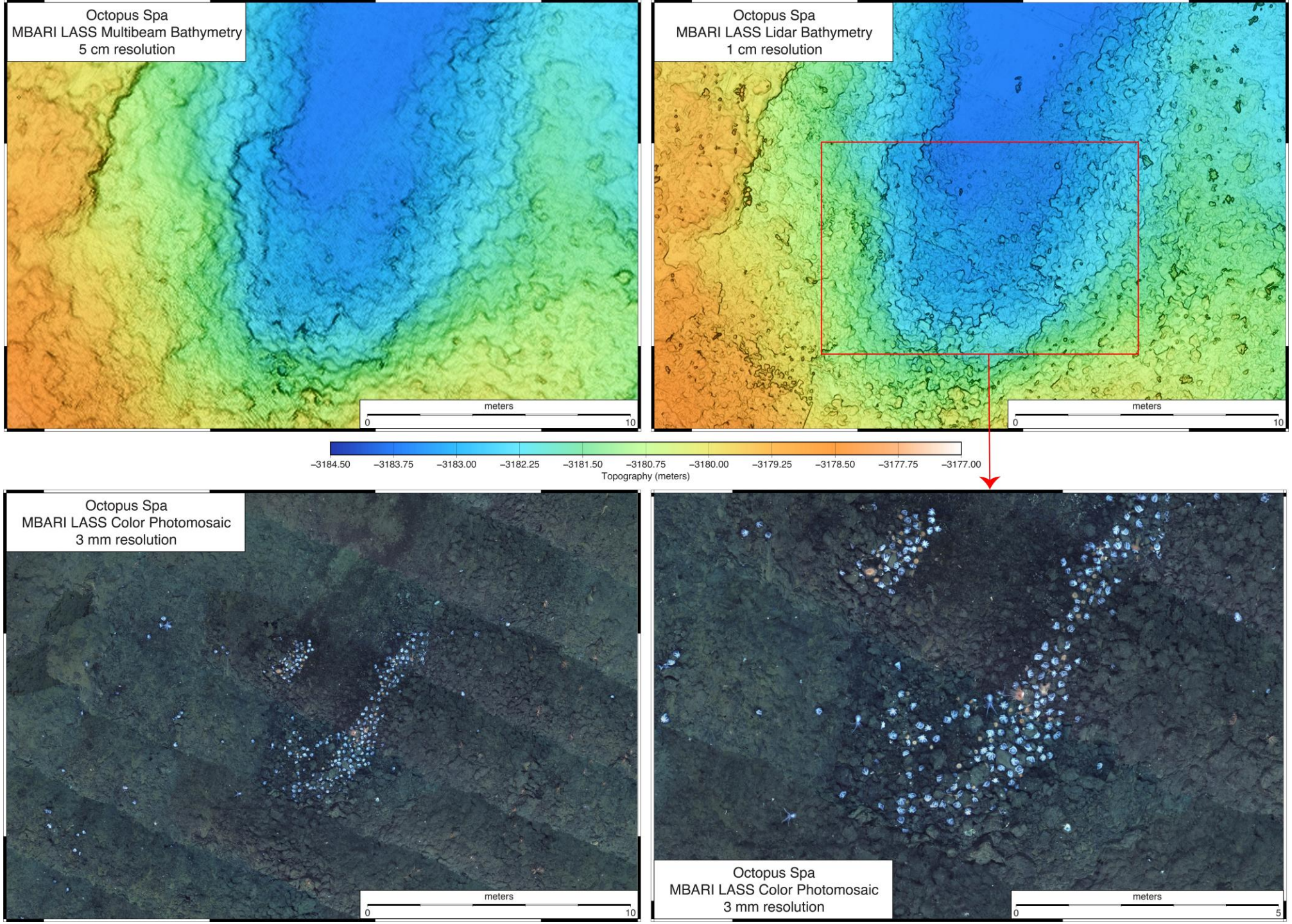
Multibeam sonar (5 cm)



0 meters

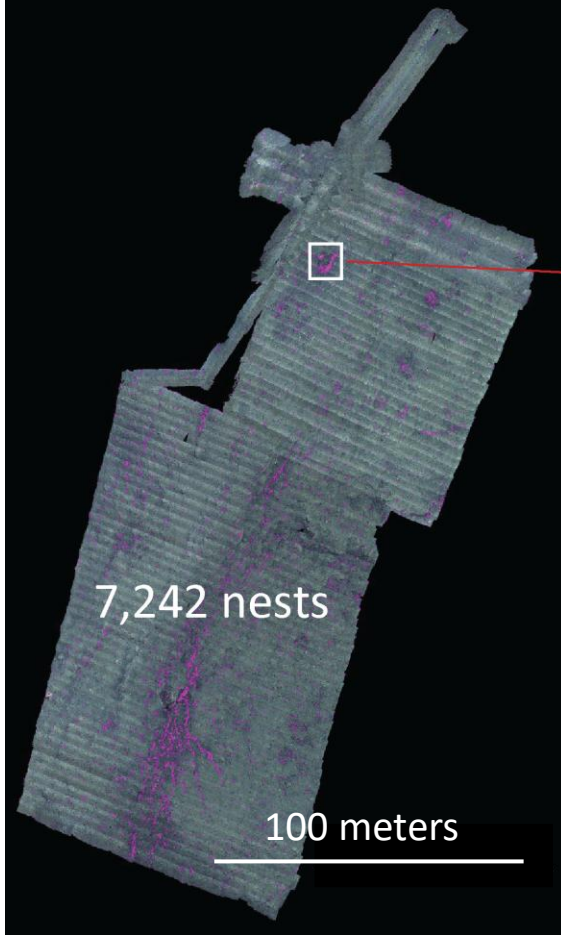
Stereo still cameras (2 mm)



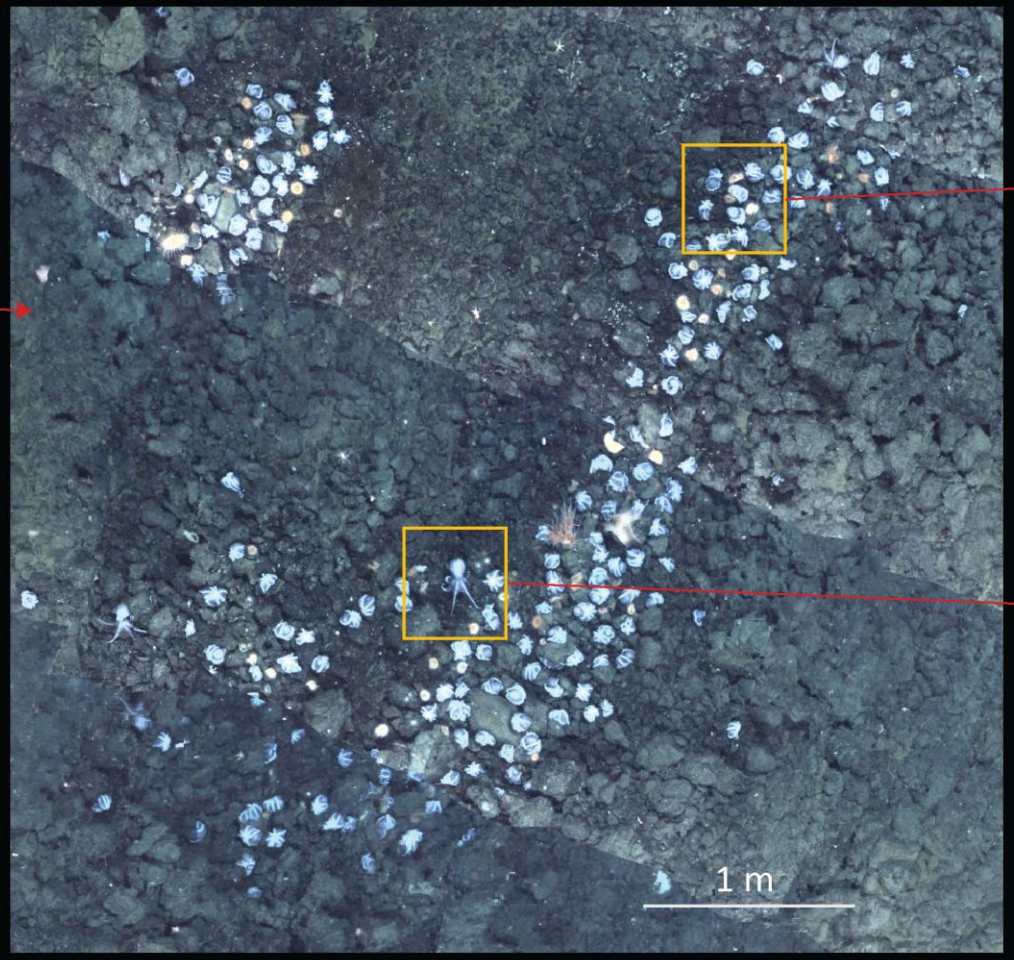

Octopus Spa
MBARI LASS Multibeam Bathymetry
5 cm resolution
meters
0
10
Octopus Spa
MBARI LASS Lidar Bathymetry
1 cm resolution
meters
0
10
−3184.50
−3183.75
−3183.00
−3182.25
−3181.50
−3180.75
−3180.00
−3179.25
−3178.50
−3177.75
−3177.00
Topography (meters)
Octopus Spa
MBARI LASS Color Photomosaic
3 mm resolution
meters
0
10
Octopus Spa
MBARI LASS Color Photomosaic
3 mm resolution
meters
0
5

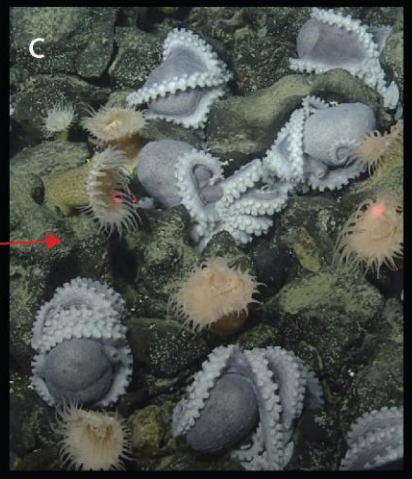
Interpreting the mapping

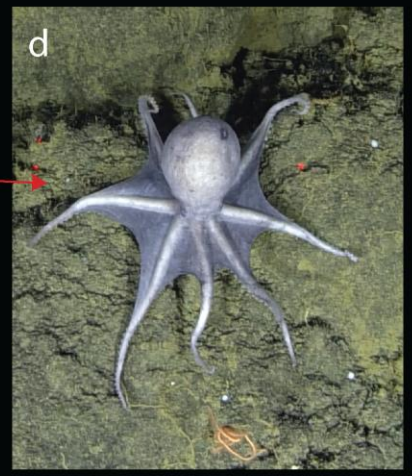
a) LASS photomosaic



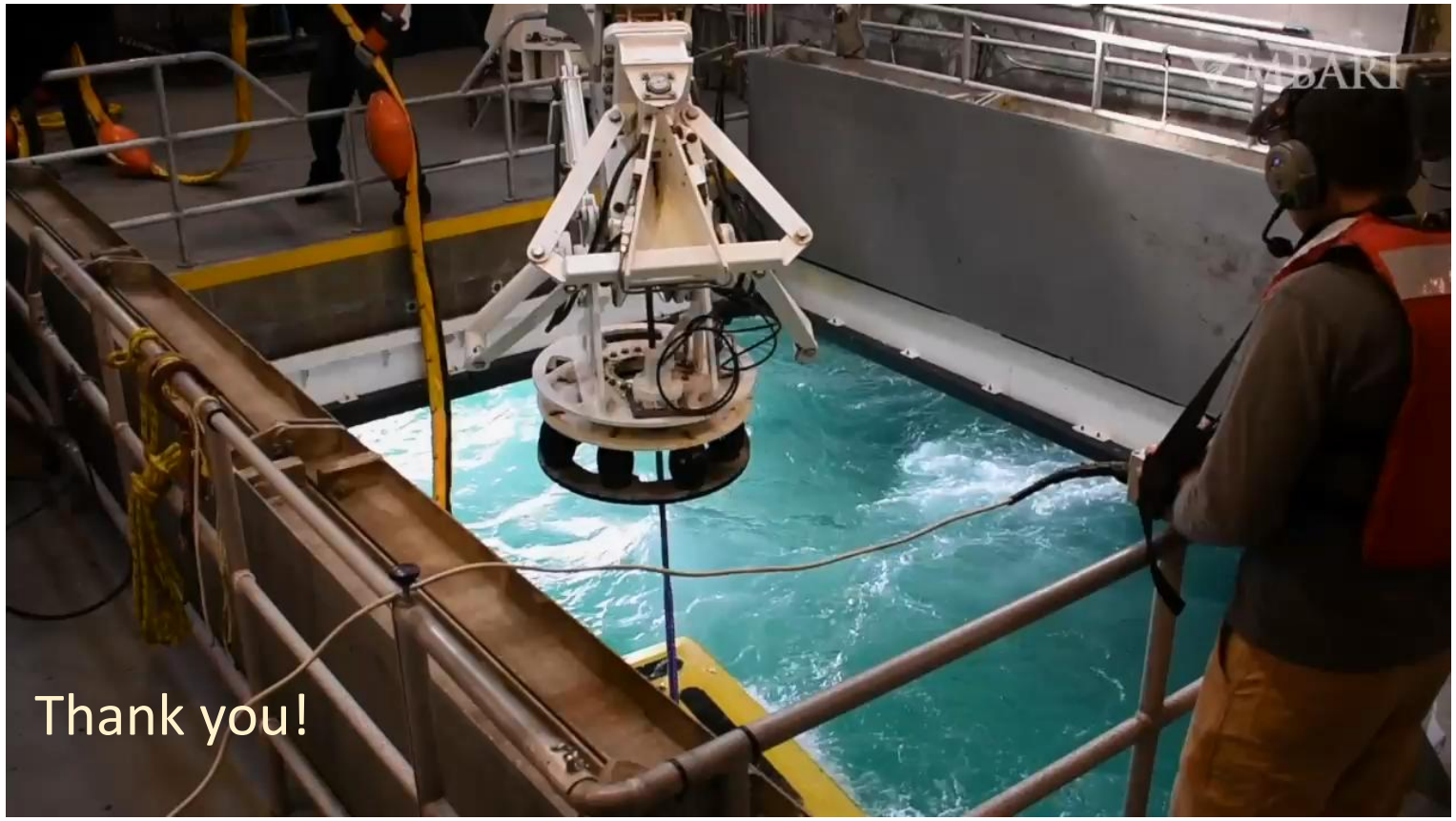
b) Zoom in on photomosaic: individuals brooding and moving





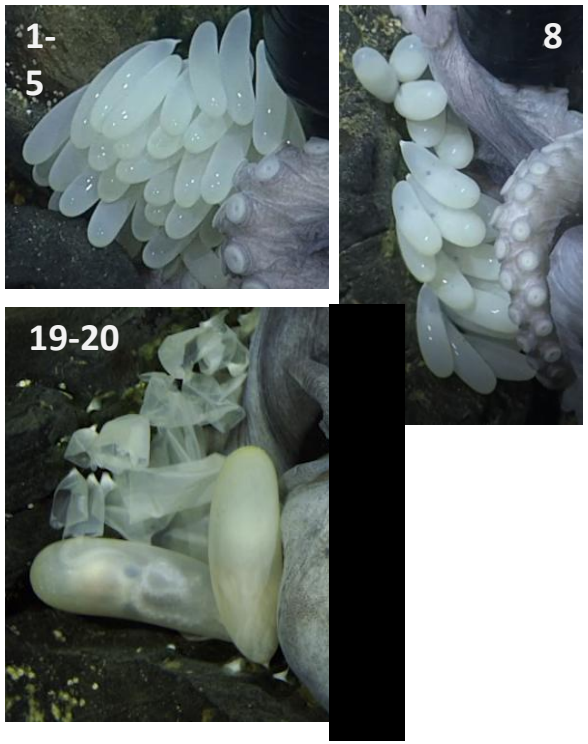


Muusoctopus from ROV video

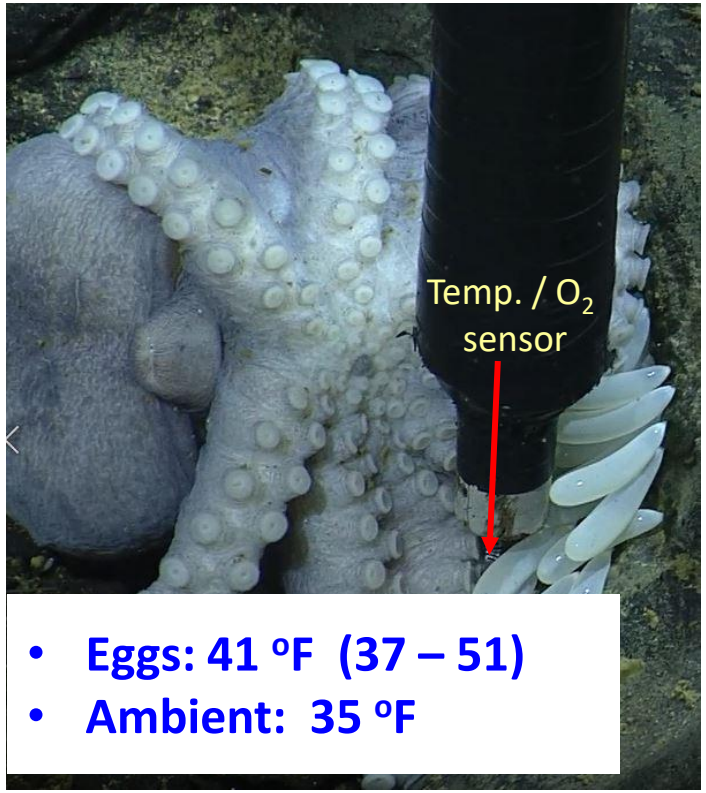

MBARI
Thank you!

Measurements of marked nests

Embyro stage rating



Egg temperature / oxygen



- **Eggs: 41 °F (37 – 51)**
- **Ambient: 35 °F**

Female Turnover

We welcome contributions from developers, researchers, and industry professionals interested in advancing 3D web technologies.

Join Web3D Geospatial Working Group

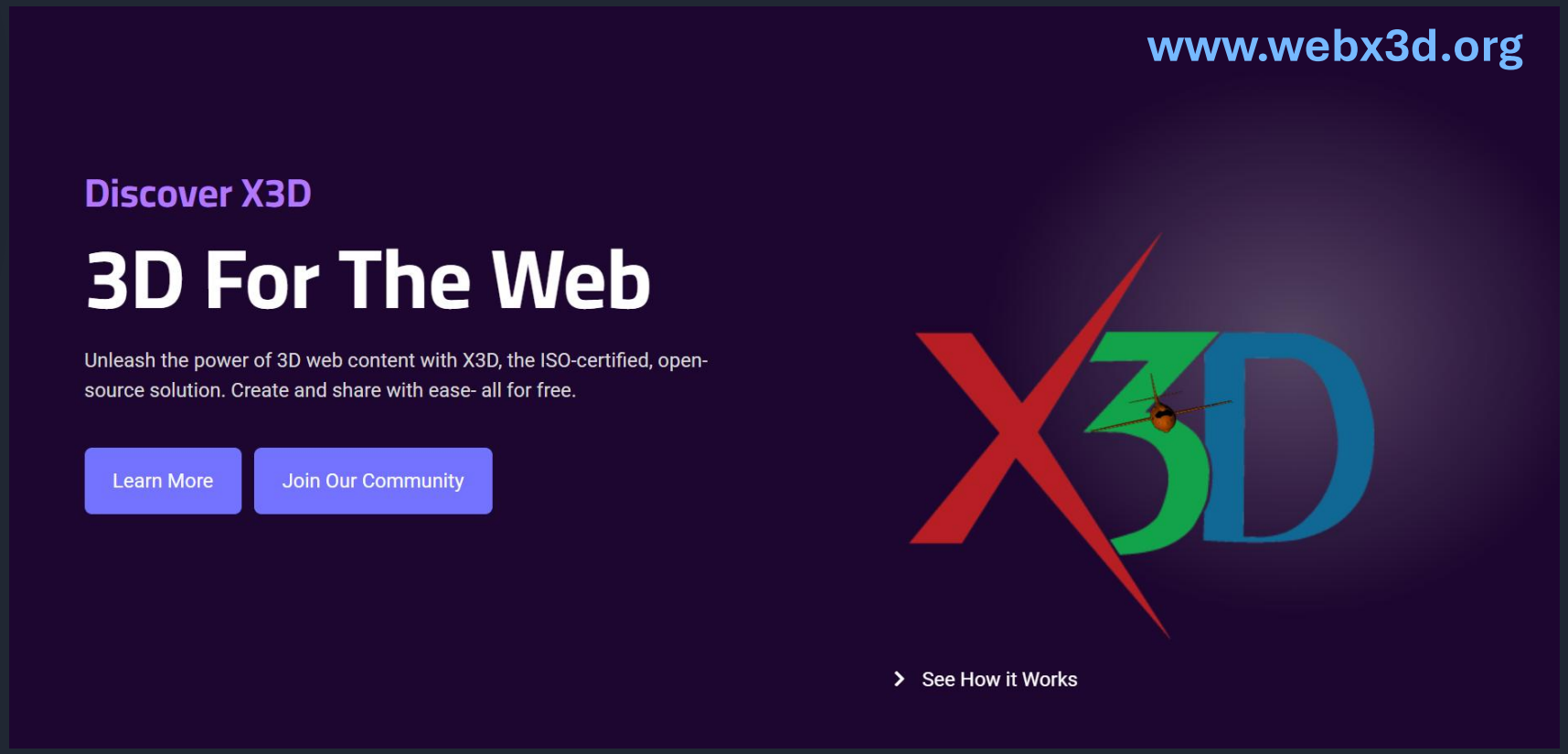
Learn X3D – Resources and Tools

Attend our conferences and webinars

YouTube Channel

Learn X3D – www.webx3d.org

Resources and Tools



web3D CONSORTIUM

Thank You!

www.web3d.org

Join us at www.web3d.org to learn more about X3D standards and how to get involved with the Web3D Consortium. We welcome contributions from developers, researchers, and industry professionals interested in advancing 3D web technologies.