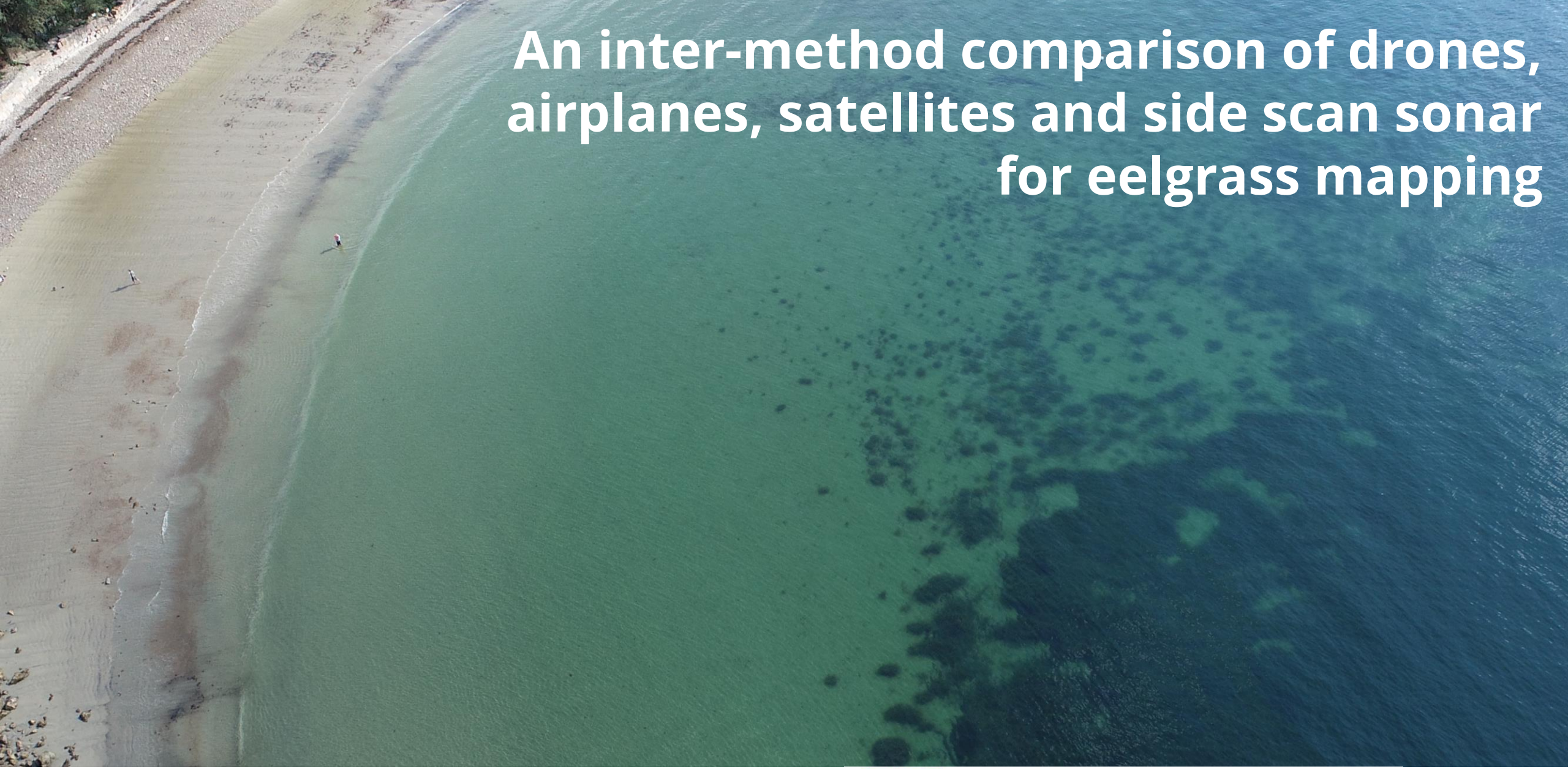
An inter-method comparison of drones, airplanes, satellites and side scan sonar for eelgrass mapping



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Massachusetts Bays
NATIONAL ESTUARY PARTNERSHIP

CZM

The problem

Reliance on remotely-sensed eelgrass data

Low confidence in some portions of the meadow

Inadequate protection → net loss

Questions

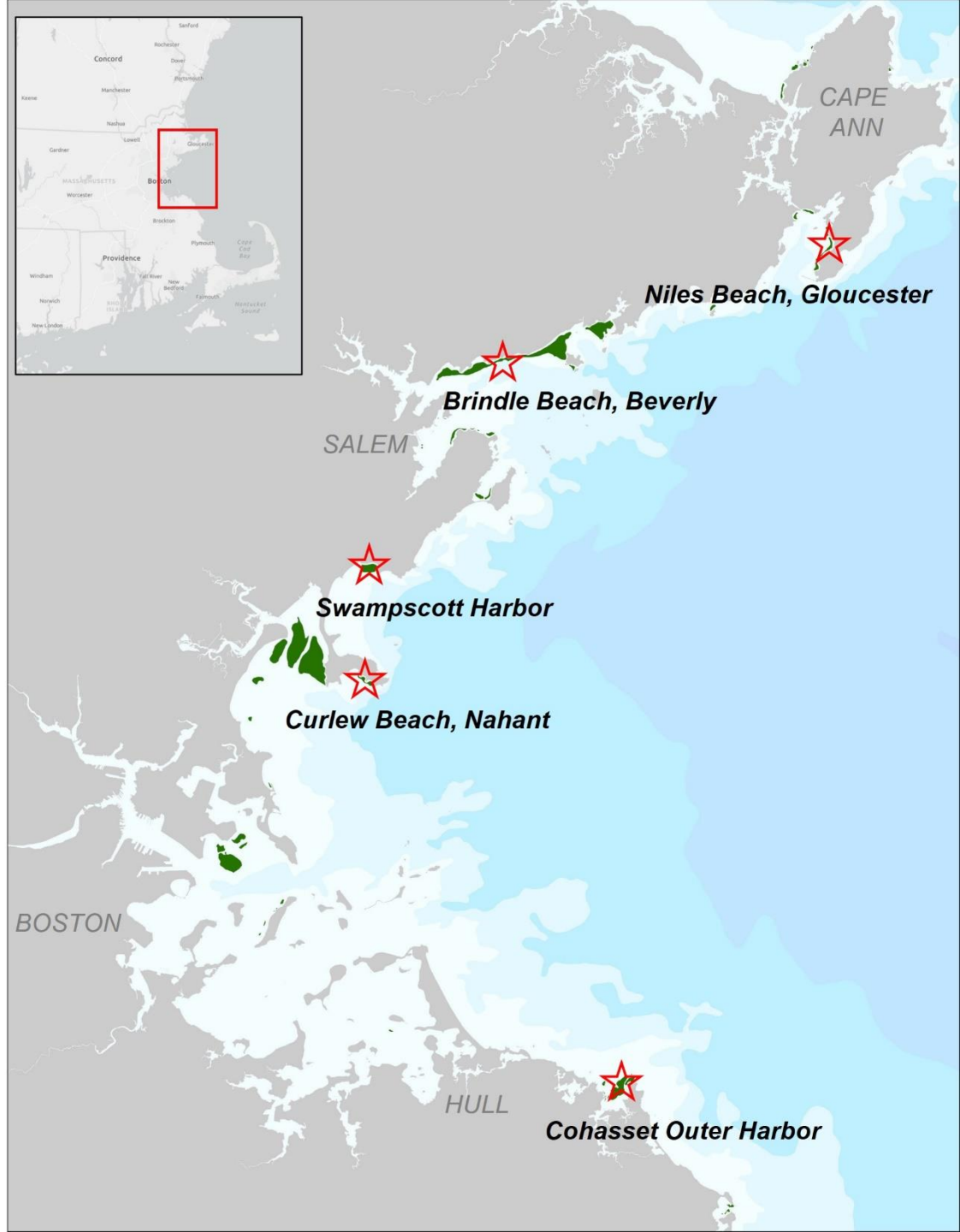
How accurate are eelgrass maps generated from remote sensing imagery?

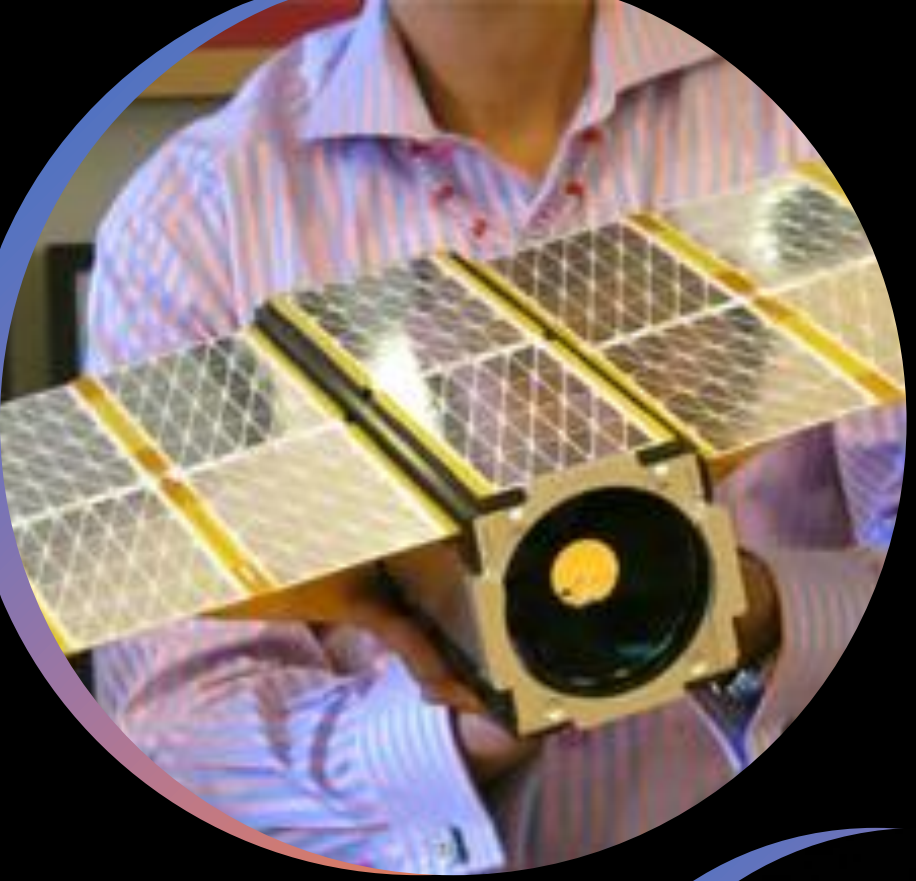
Q1: How does the remotely-sensed edge compare to diver-measured edge

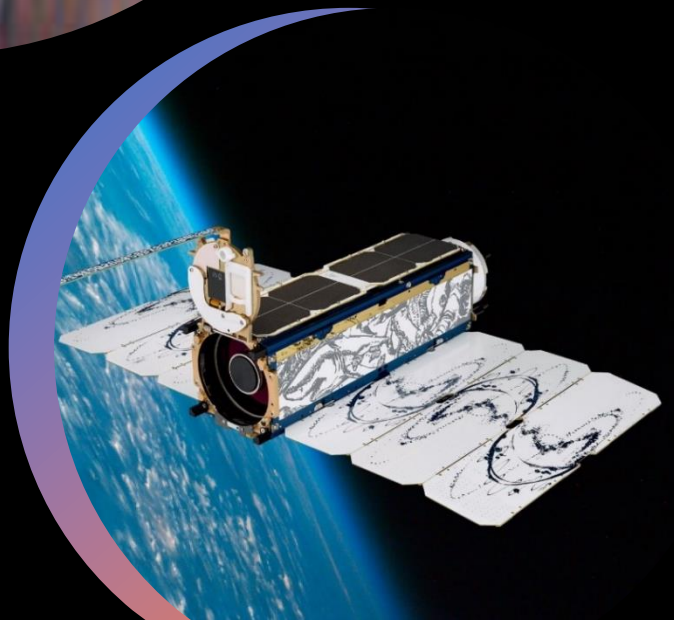
Q2: What are the effects of percent cover, canopy height and patchiness at the edge

Study Design

- *Five sites eastern MA*
- *Acquired semi-synchronous imagery via satellite, airplane, drone and side scan sonar*
- *Underwater photo ground truthing and diver transects*
- *Summer 2022*







Satellite

- Imagery acquired from PLANET SuperDove satellites
- 3 m pixel resolution
- NASA Commercial SmallSat Program

Airplane

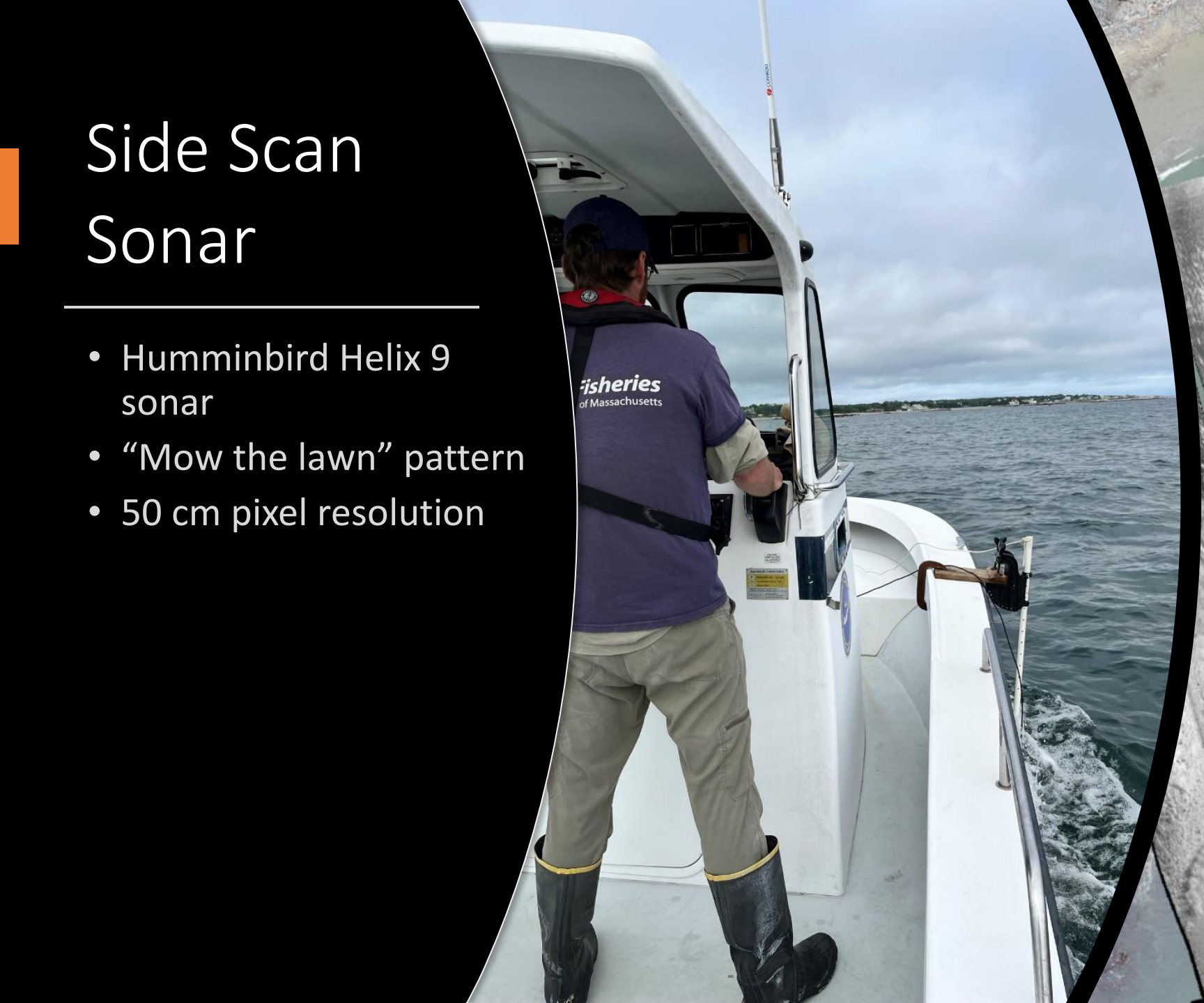
- MassDEP long-term program (1995+)
- 25 cm pixel resolution

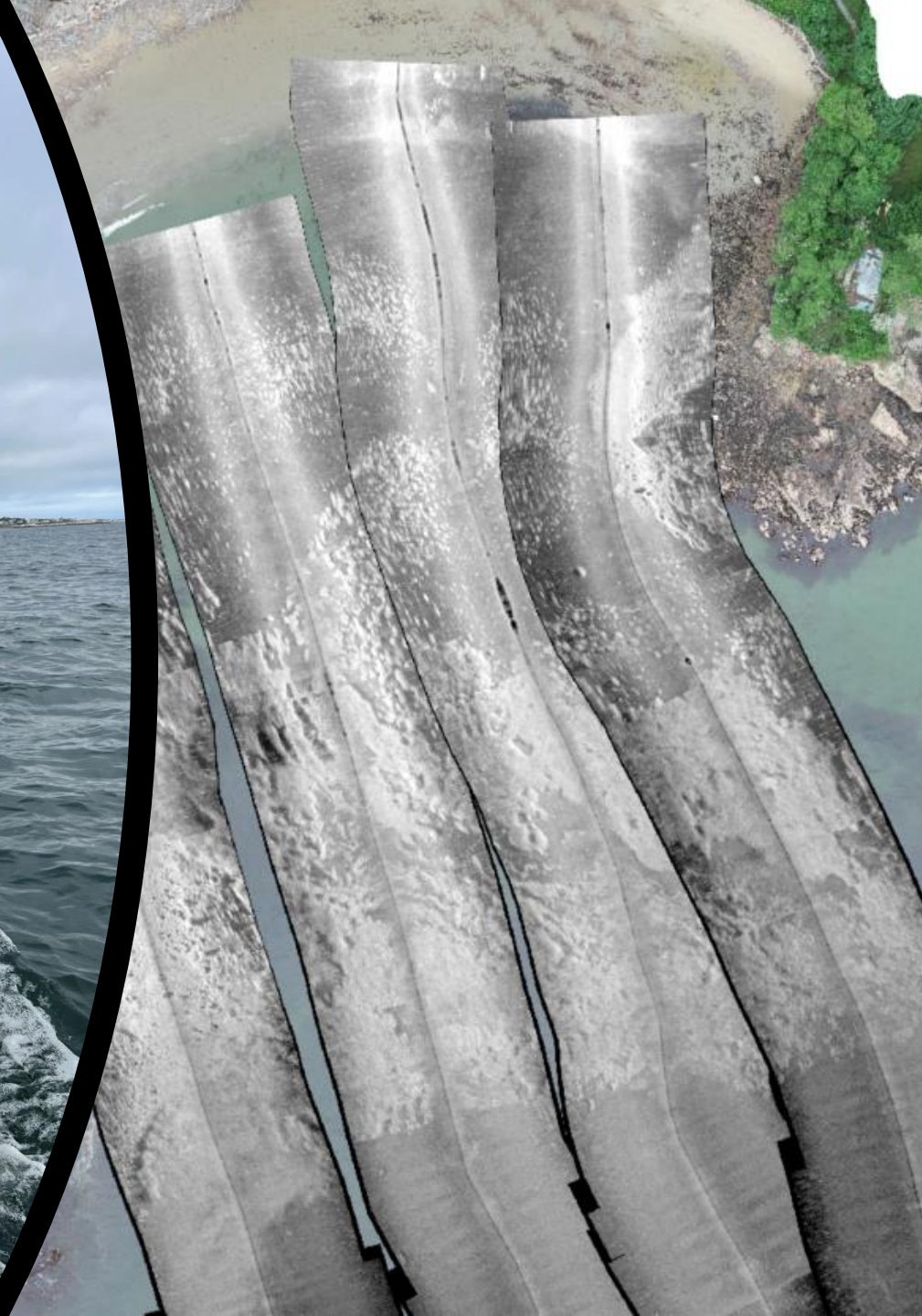
Drone

- DJI Phantom 4 Pro V2
- 3 cm pixel resolution
- Image processing in DroneDeploy

Side Scan Sonar

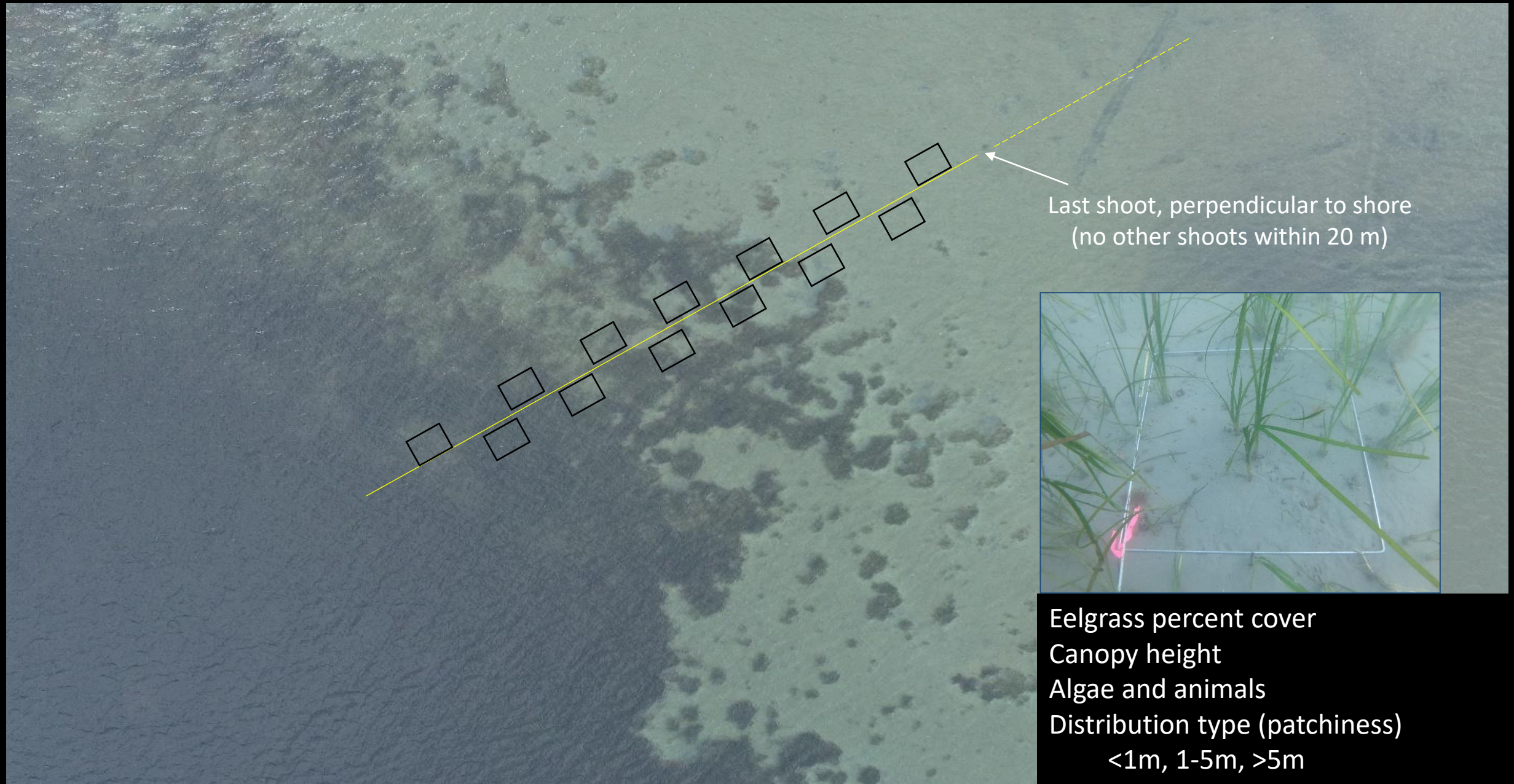
- Humminbird Helix 9 sonar
- “Mow the lawn” pattern
- 50 cm pixel resolution



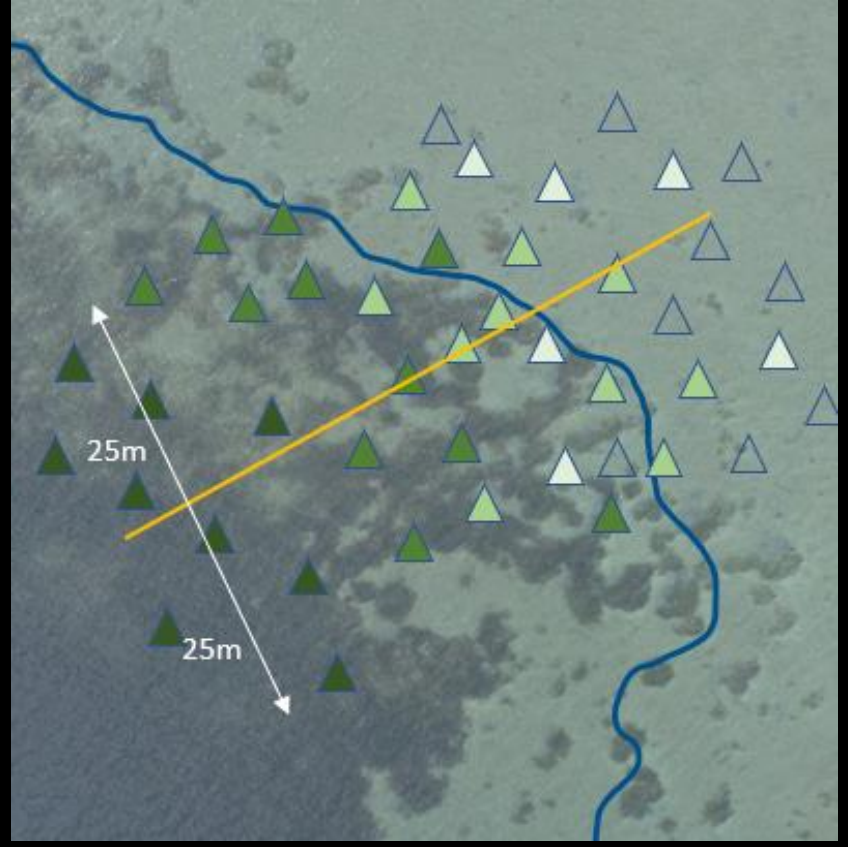


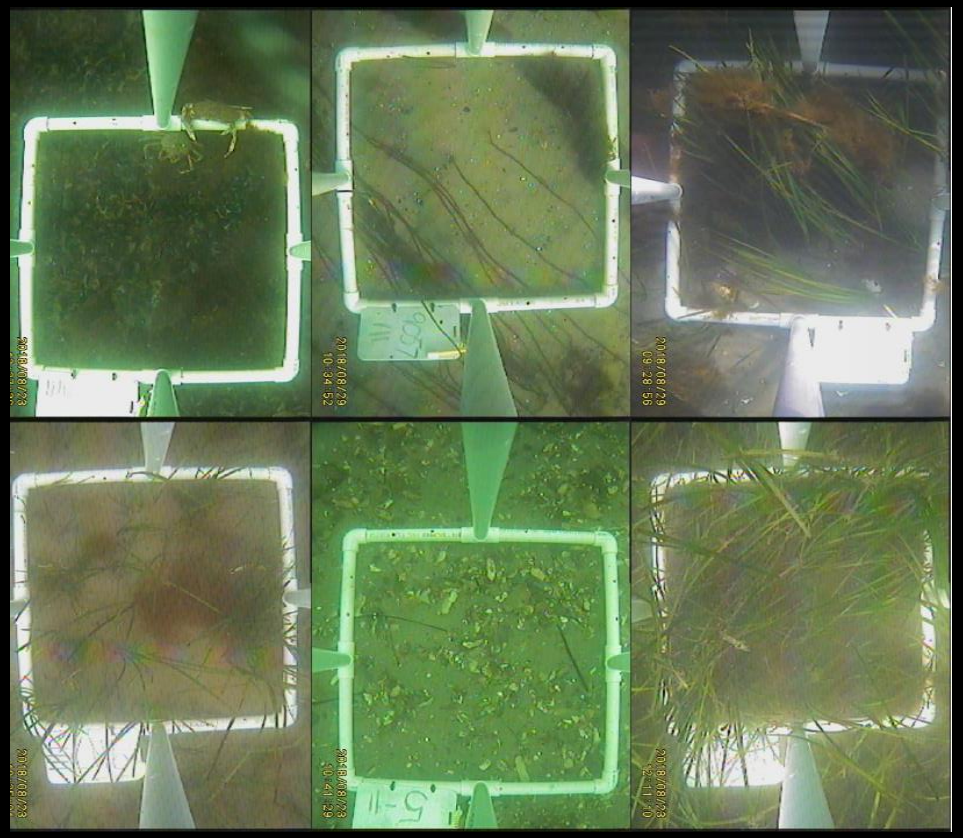
Dive Survey

Two shallow transects, one deep transect per site



Eelgrass percent cover
Canopy height
Algae and animals
Distribution type (patchiness)
<1m, 1-5m, >5m

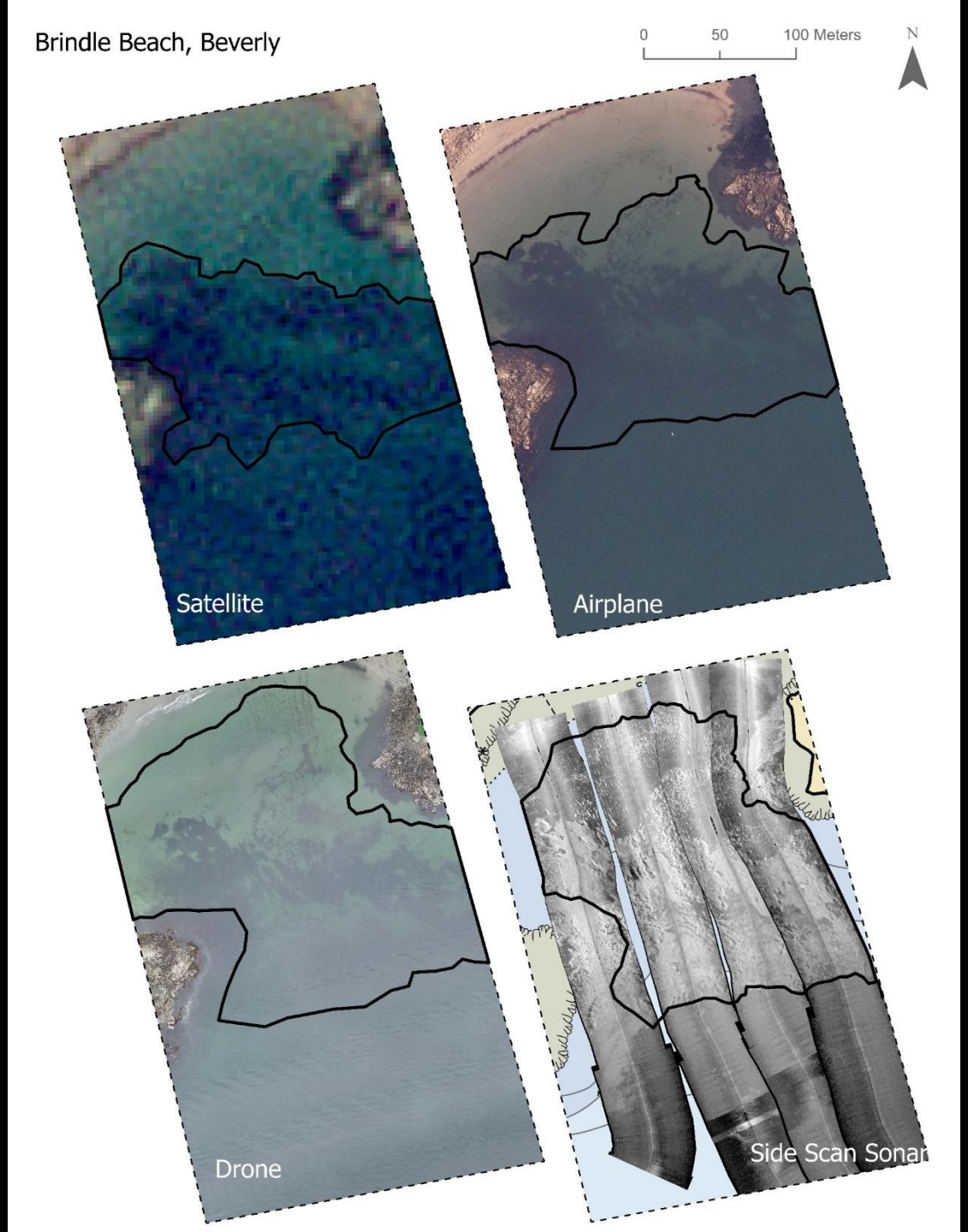




Fine Percent Cover Values
< 1%
1 to < 10%
10 to < 20%
20 to < 30 %
30 to < 40 %
40 to < 50 %
50 to < 60 %
60 to < 70 %
70 to < 80 %
80 to < 90%
90 to 100%

Photo-Groundtruthing

- Randomly sample 30 stations around diver transects
- Eelgrass % cover (CMECS)

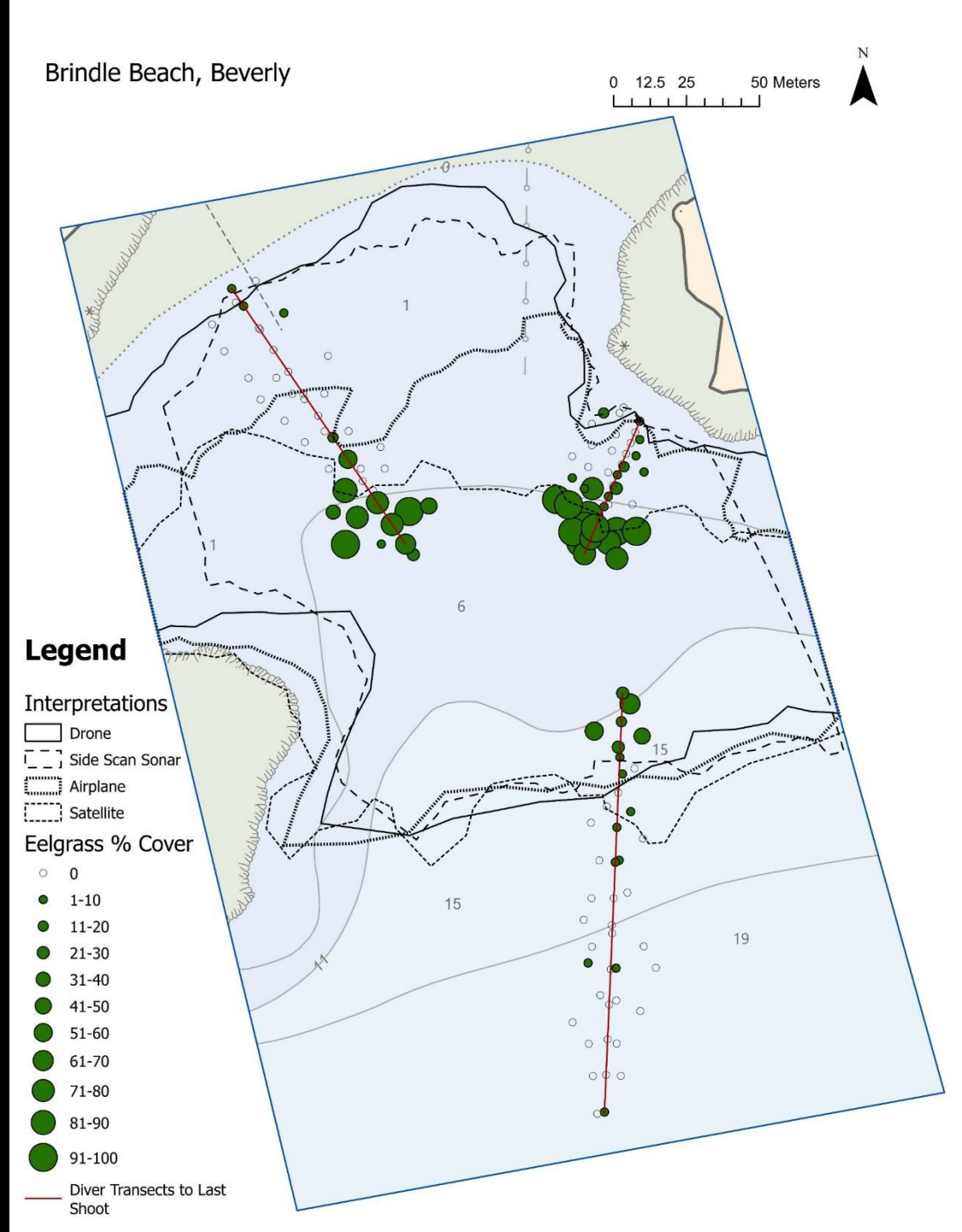


Heads Up manual photointerpretation

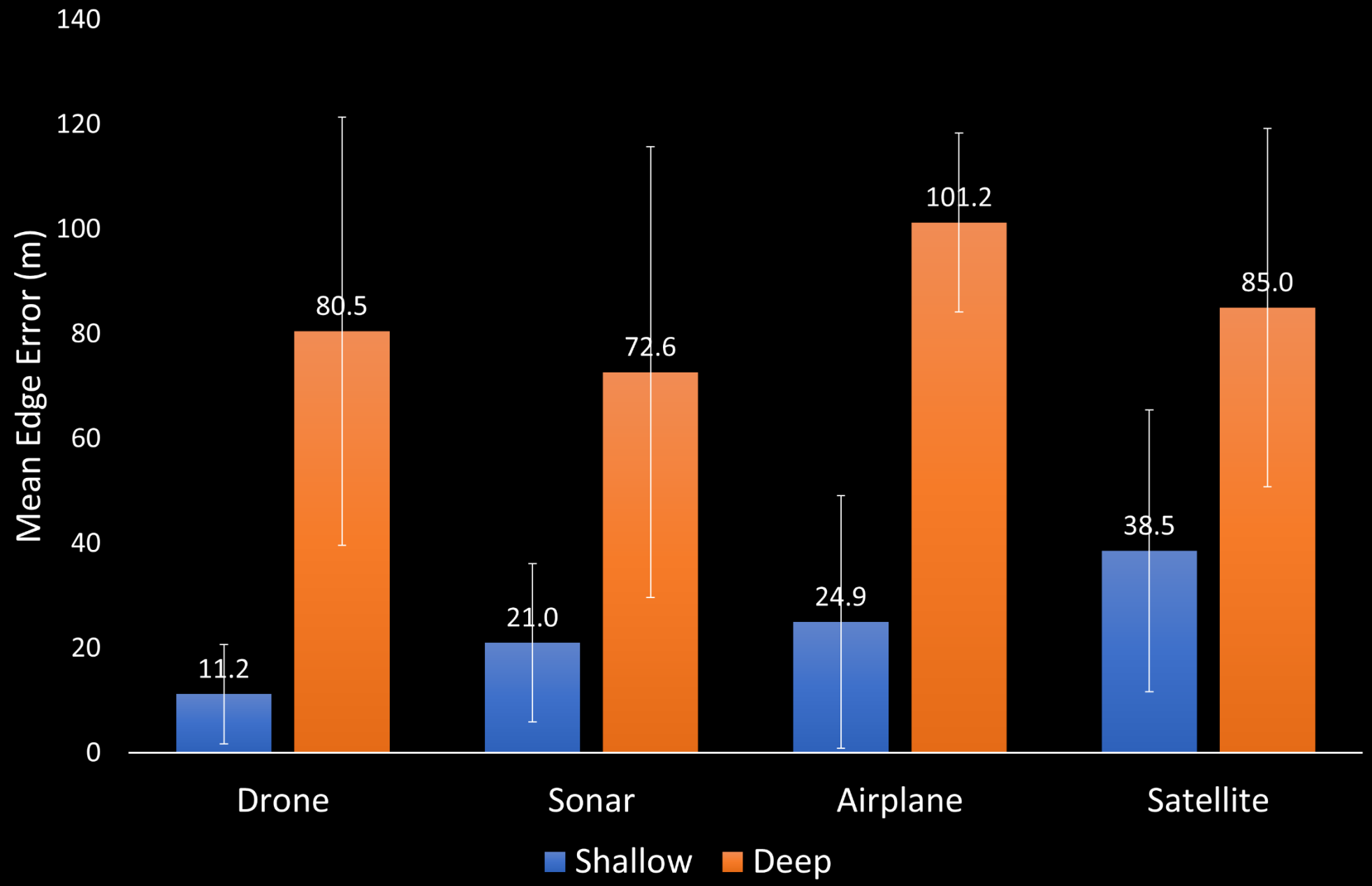
Pre-determined rules (MMU, smoothing, manipulations)

Spatial analysis of

- Edge error
- Eelgrass % cover, canopy height and distribution type
- Accuracy assessment



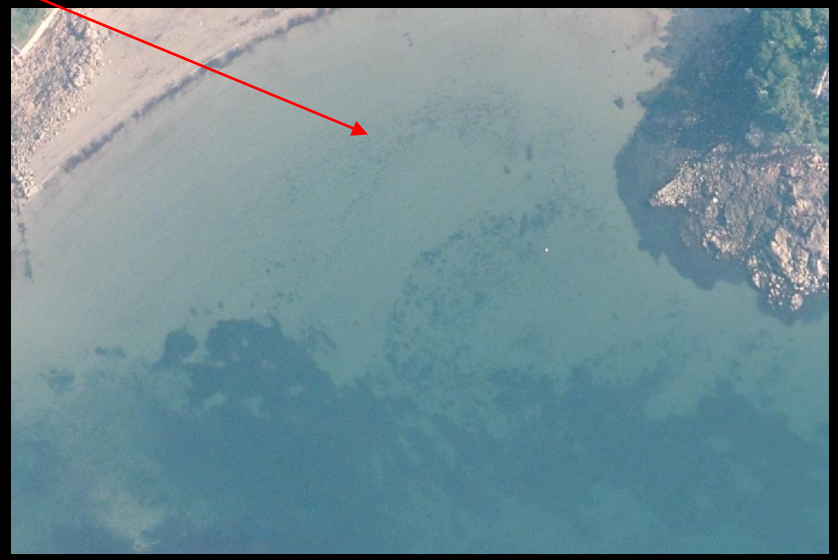
Results: Edge Error



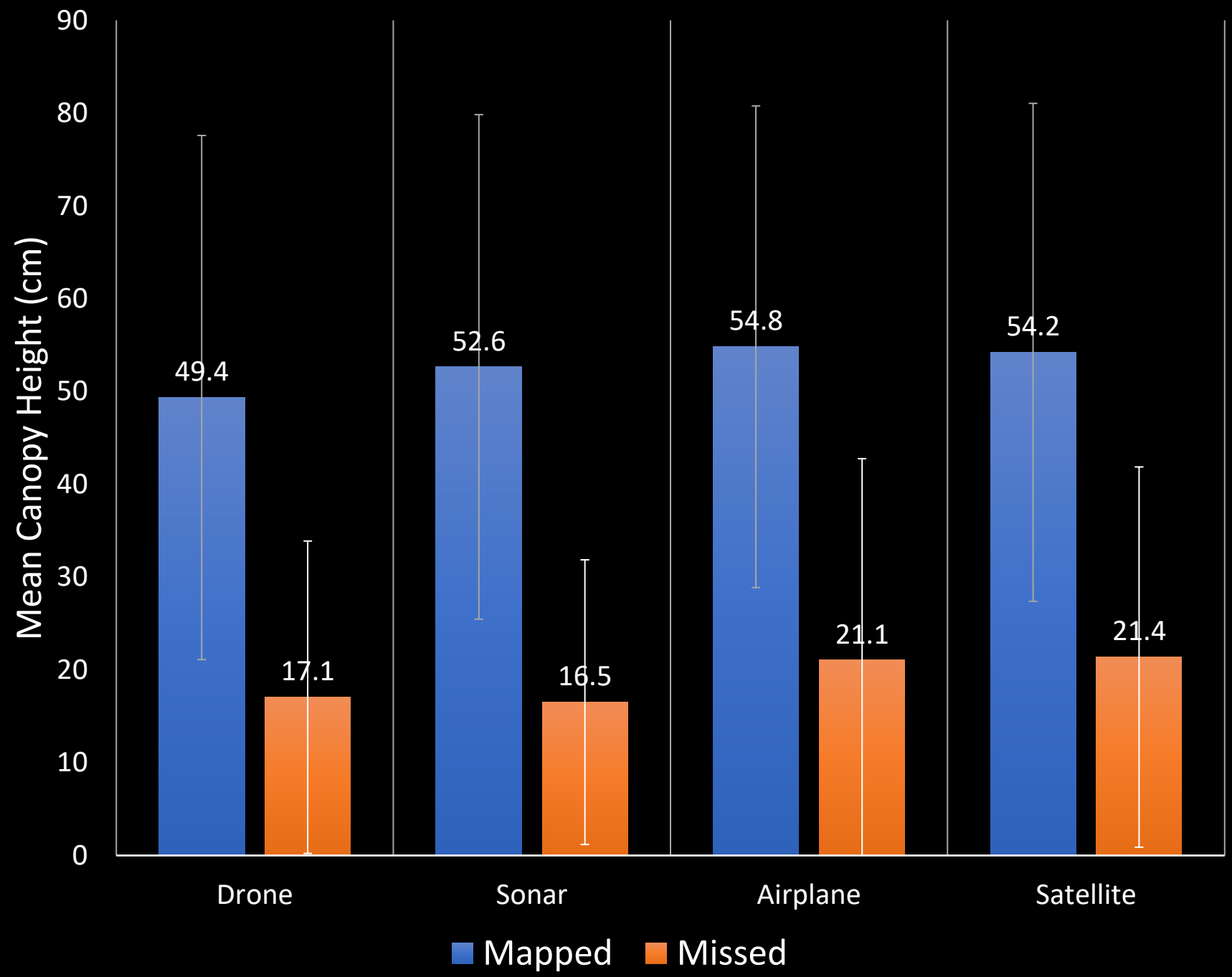
Accuracy Assessment: Percent Cover

	1-10	11-20	21-30	31-40
Drone	79%	92%	96%	91%
Sonar	68%	97%	89%	96%
Airplane	56%	92%	89%	91%
Satellite	60%	85%	85%	87%

Site	Survey	1-10
Gloucester	Drone	86%
	Sonar	90%
	Airplane	86%
	Satellite	90%
Beverly	Drone	64%
	Sonar	59%
	Airplane	50%
	Satellite	18%
Swampscott	Drone	78%
	Sonar	52%
	Airplane	4%
	Satellite	78%
Nahant	Drone	68%
	Sonar	59%
	Airplane	45%
	Satellite	23%
Cohasset	Drone	94%
	Sonar	78%
	Airplane	91%
	Satellite	78%

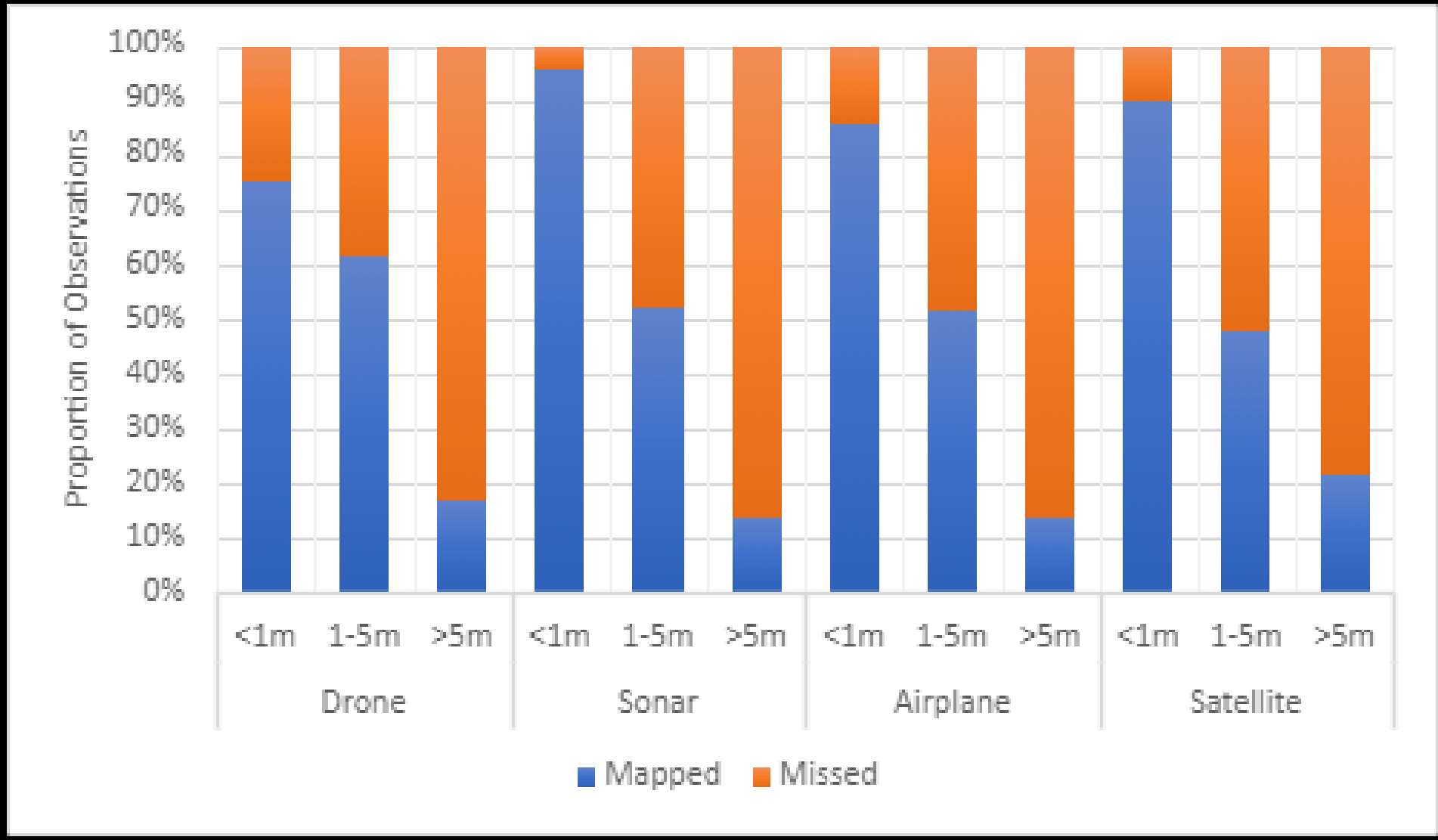


Effects of Canopy Height



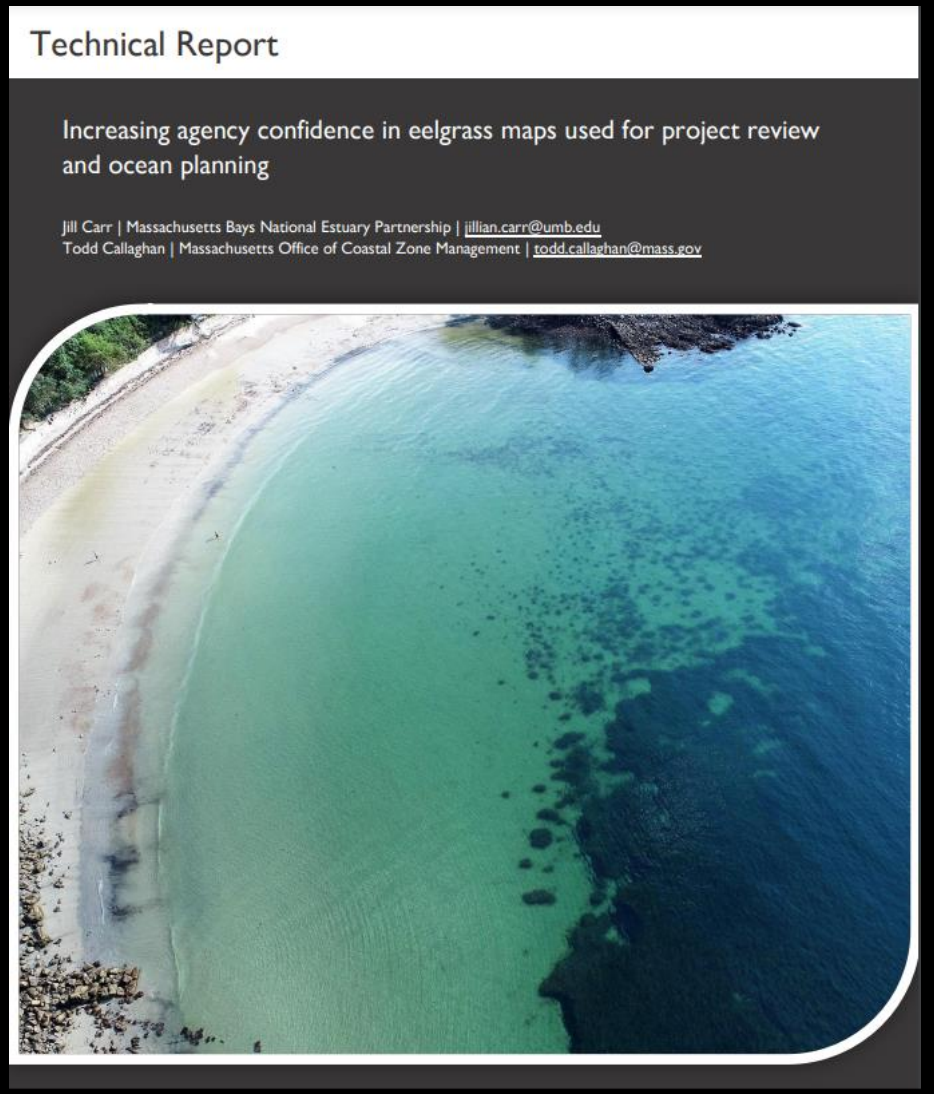
Effects of Distribution Type

Continuous <1 m
Transitional 1-5 m
Patchy >5 m



Management Recommendations

- Apply conservation buffers = mean edge error to protect unmapped edge areas
- Prioritize use of drone and sonar
- Supplement airplane imagery with enhanced edge ground truthing
- Explore use of submeter satellite imagery
- Use edge errors to integrate maps from different methods



Thank you!

Thanks to NOAA for funding

Thanks to our **project partners**: Kate Frew, Forest Schenck and Iris Seto (DMF), Tay Evans and David Hilgeman (MassDEP), Julie Simpson (MIT Sea Grant), Sara Grady and Taylor Czybora (NSRWA), Randall Hughes, Lizzy Sorano and Neida Villanueva-Galarza (NEU Marine Science Center), and Emily Flaherty and Alison Frye (SSCW).

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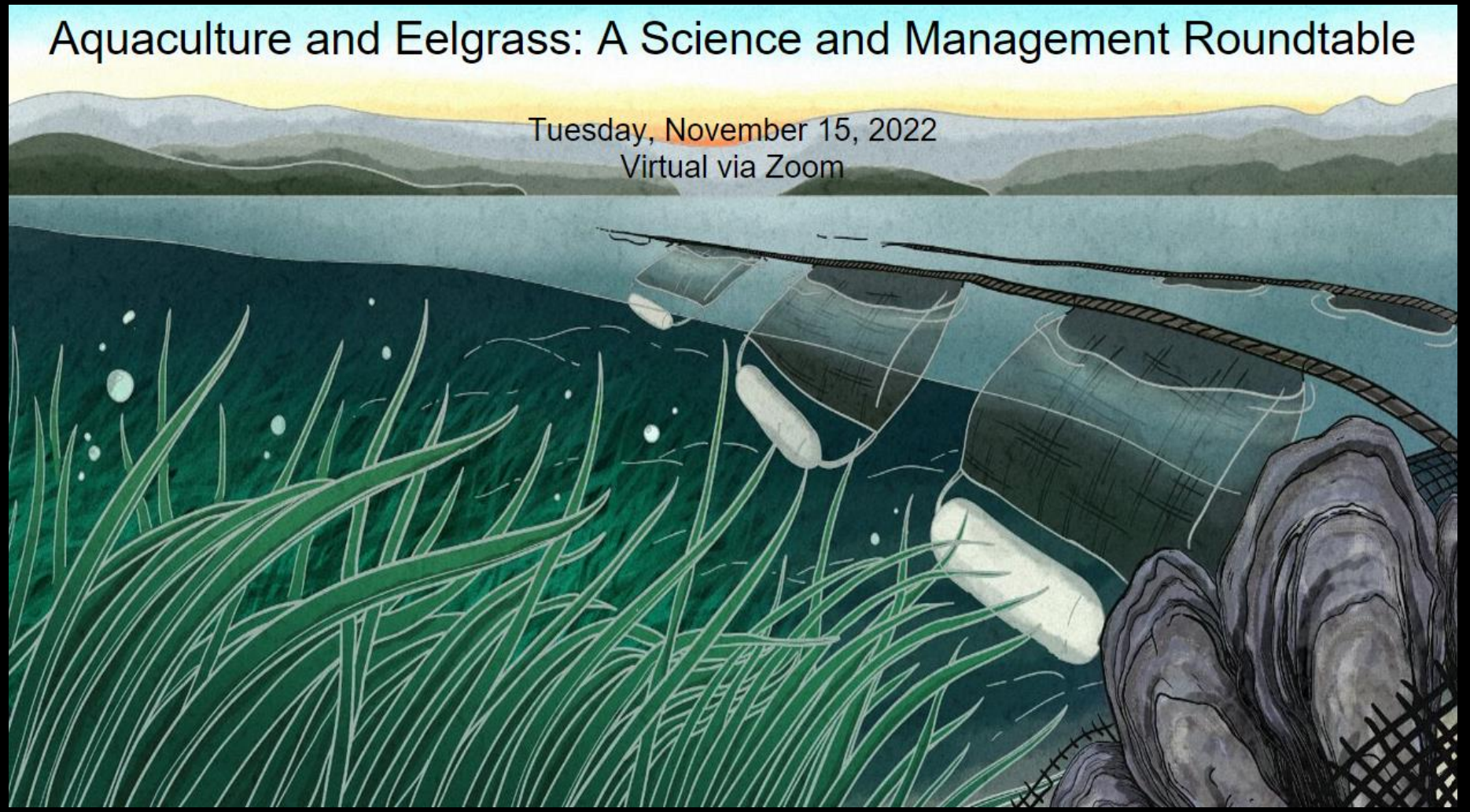
Eelgrass-Aquaculture Interactions



Keynote: Howarth

Paired mgr/sci talks from

- Canada
- Maine
- New Hampshire
- Massachusetts
- Rhode Island
- Connecticut
- NOAA

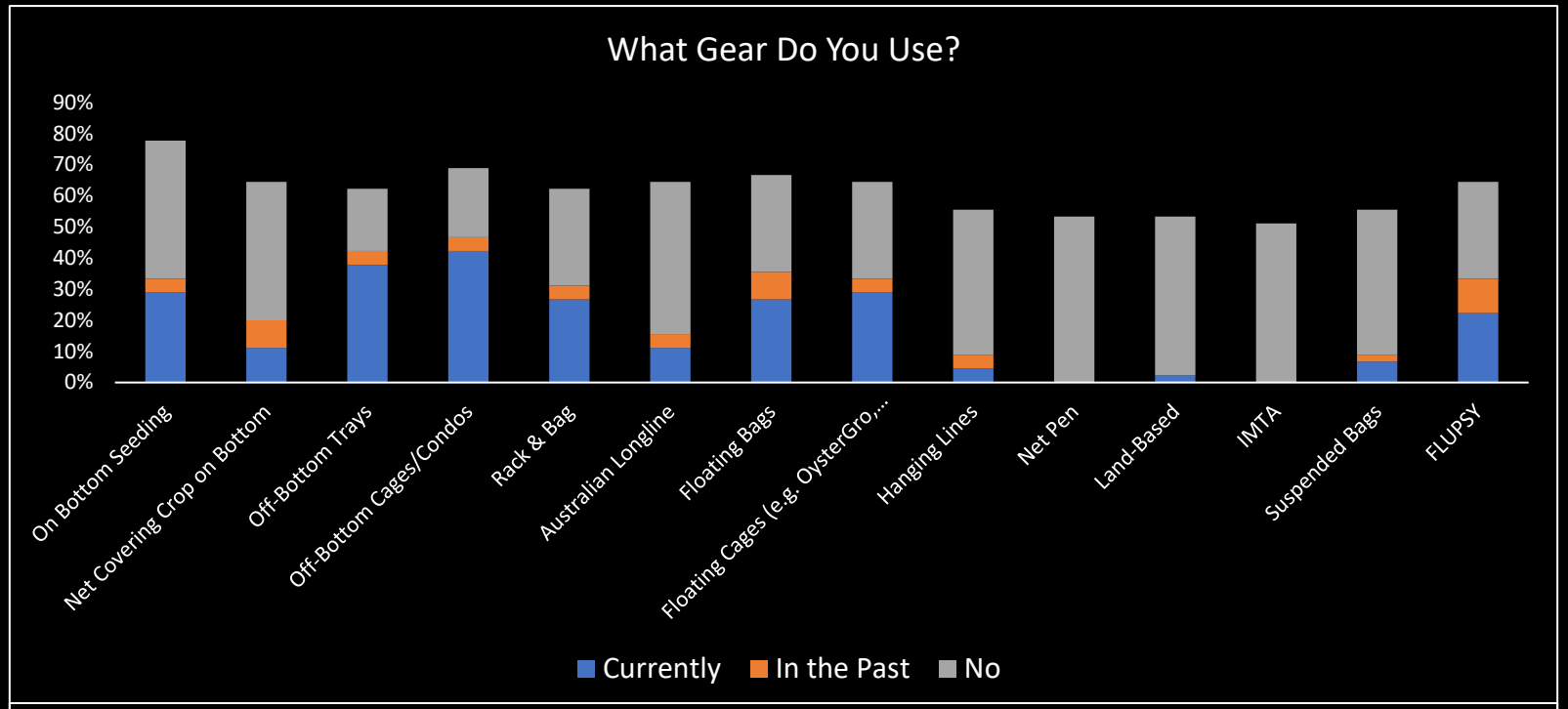
https://www.youtube.com/watch?v=pFJ24PC3faQ

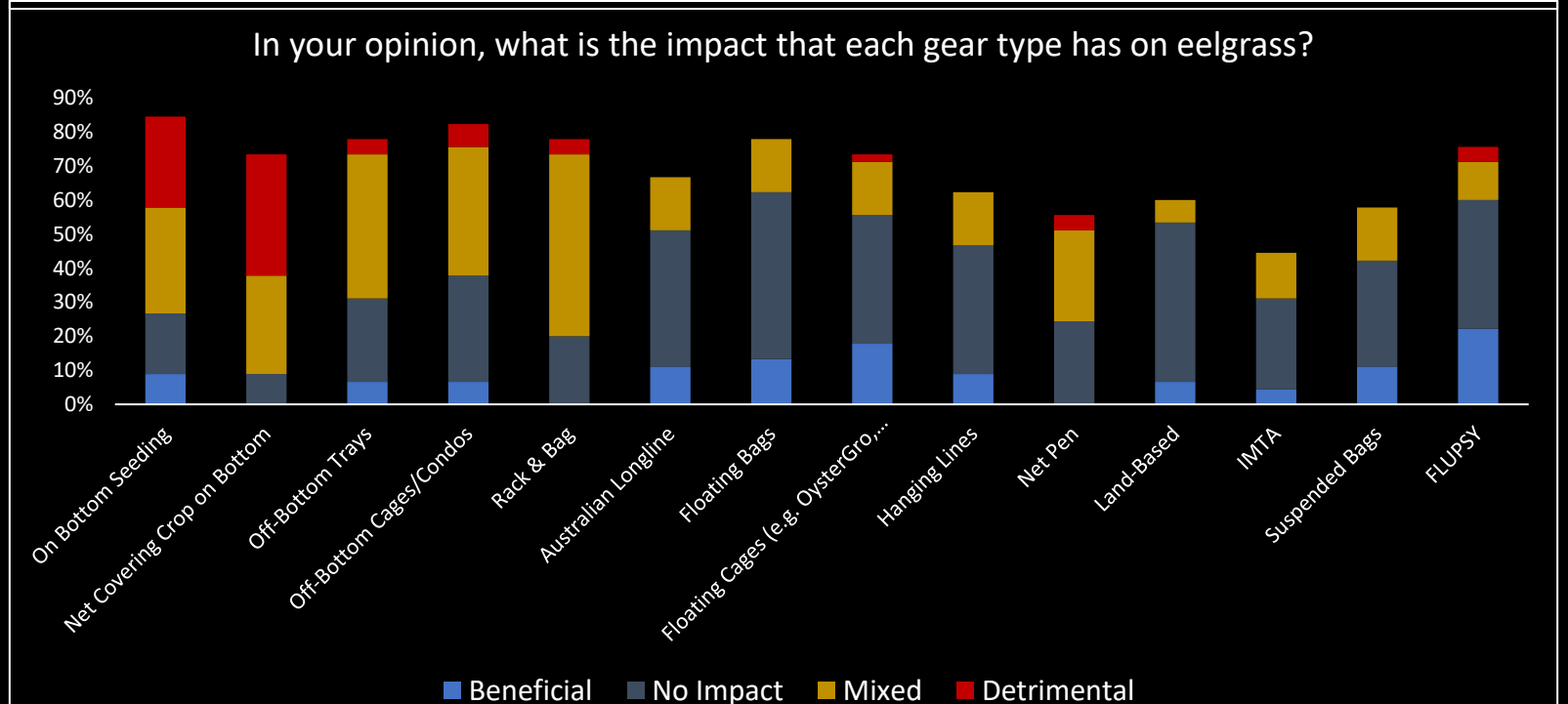
Eelgrass-Aquaculture Interactions

Priority areas for research and management:

- Adjust regulatory stance of expansion of eelgrass into leases
- Quantify impacts (positive and negative) of co-location or near-location
- Infuse adaptability to regulations
- Permit and support research program
- Improve eelgrass mapping and modeling

Jan 2023: Grower survey
45 respondents ME to NC





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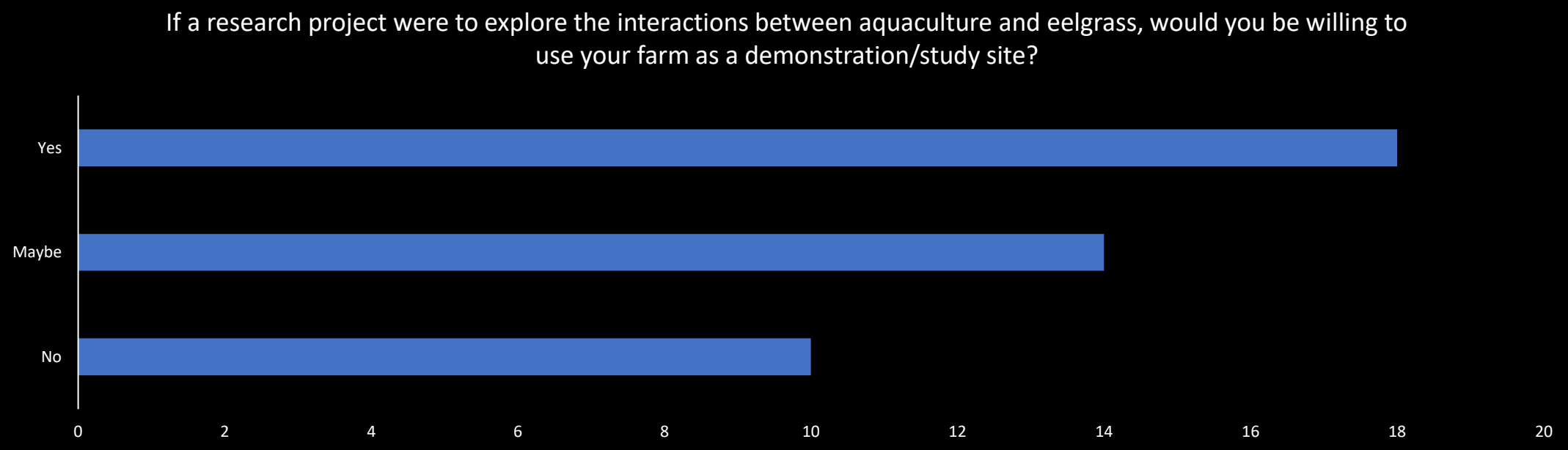

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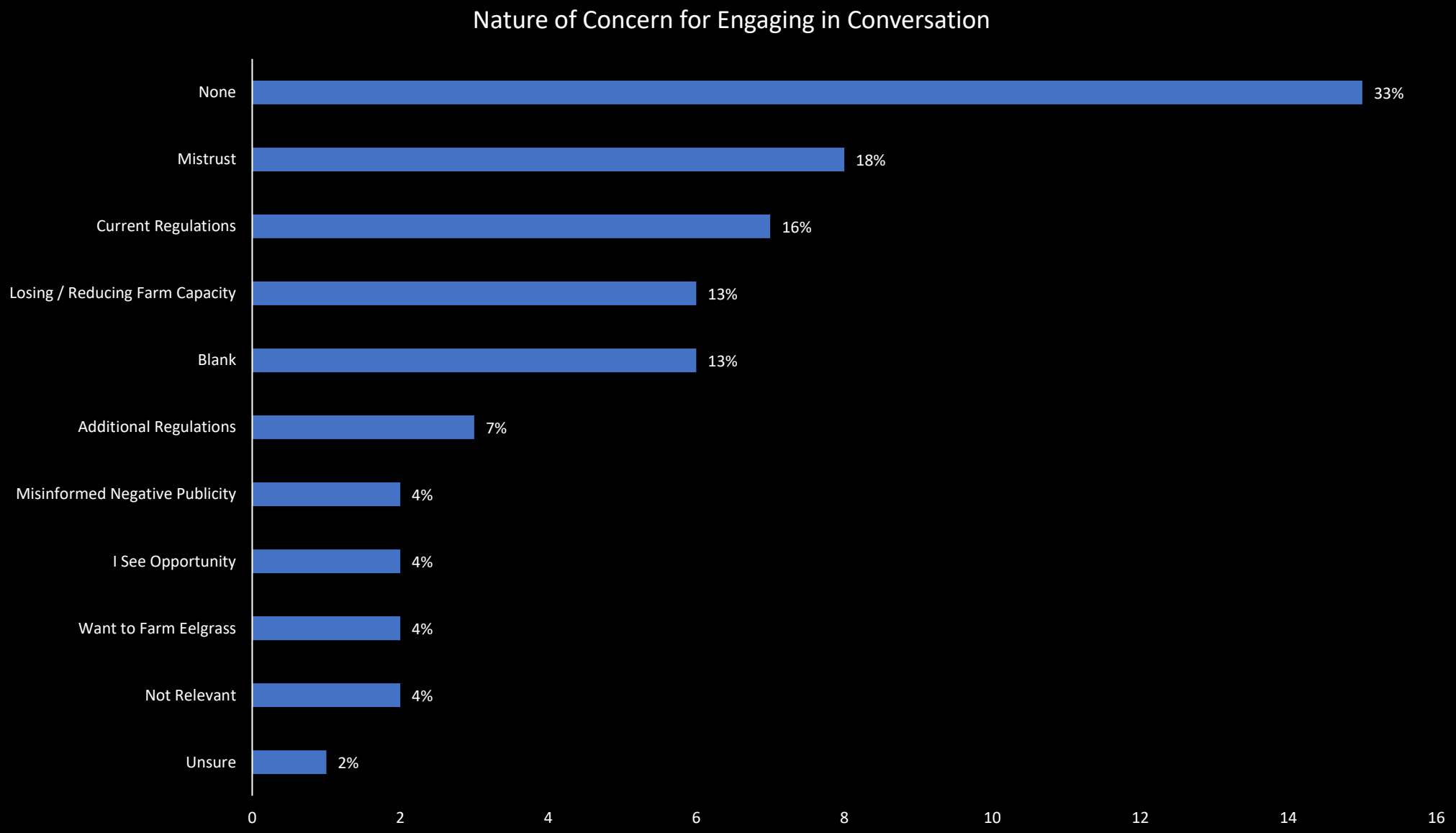
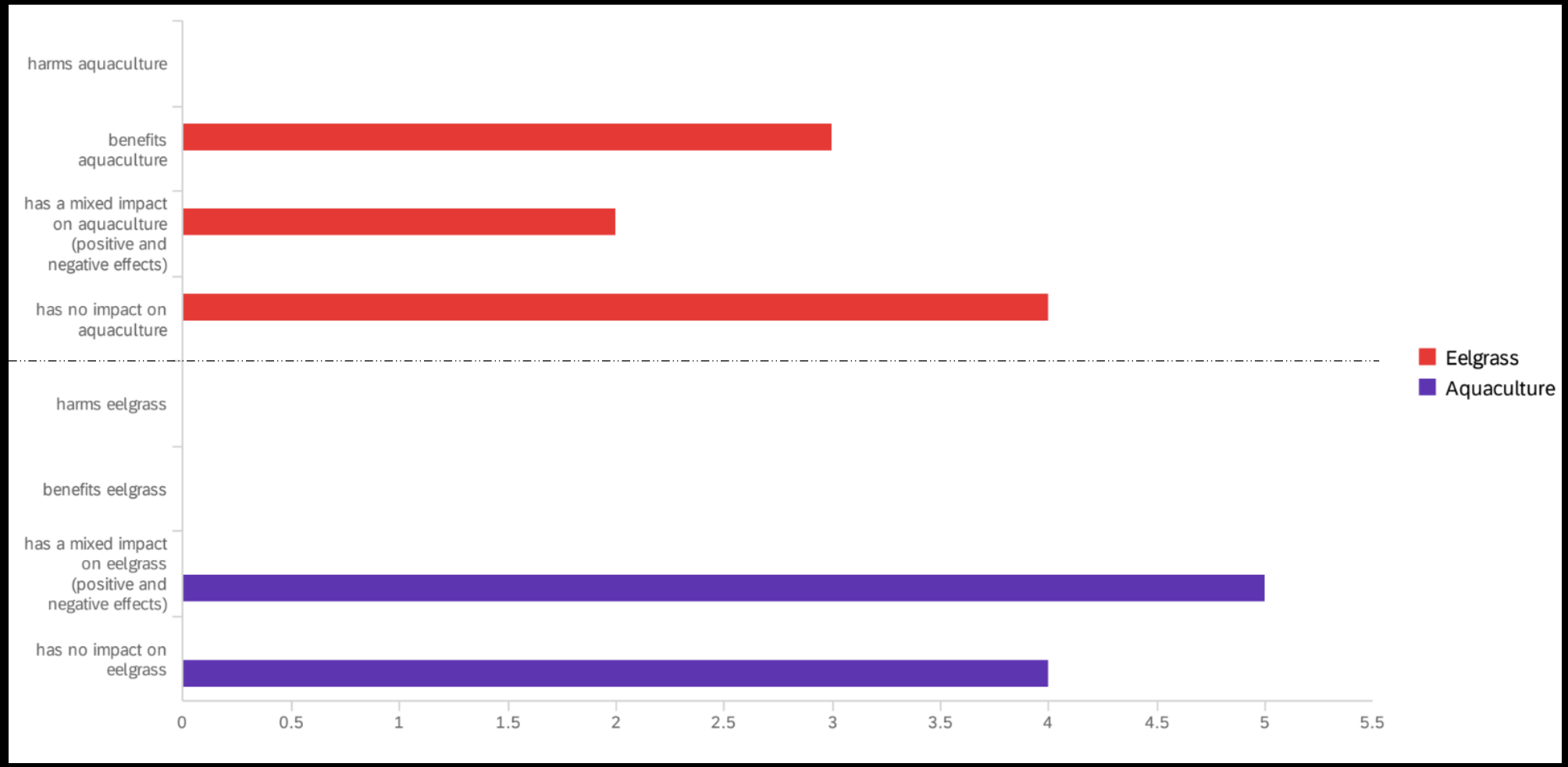


Summer 2023: Municipal survey
18 respondents (MA)



Next steps

- Research development
- Work with towns and state on regulatory barriers

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