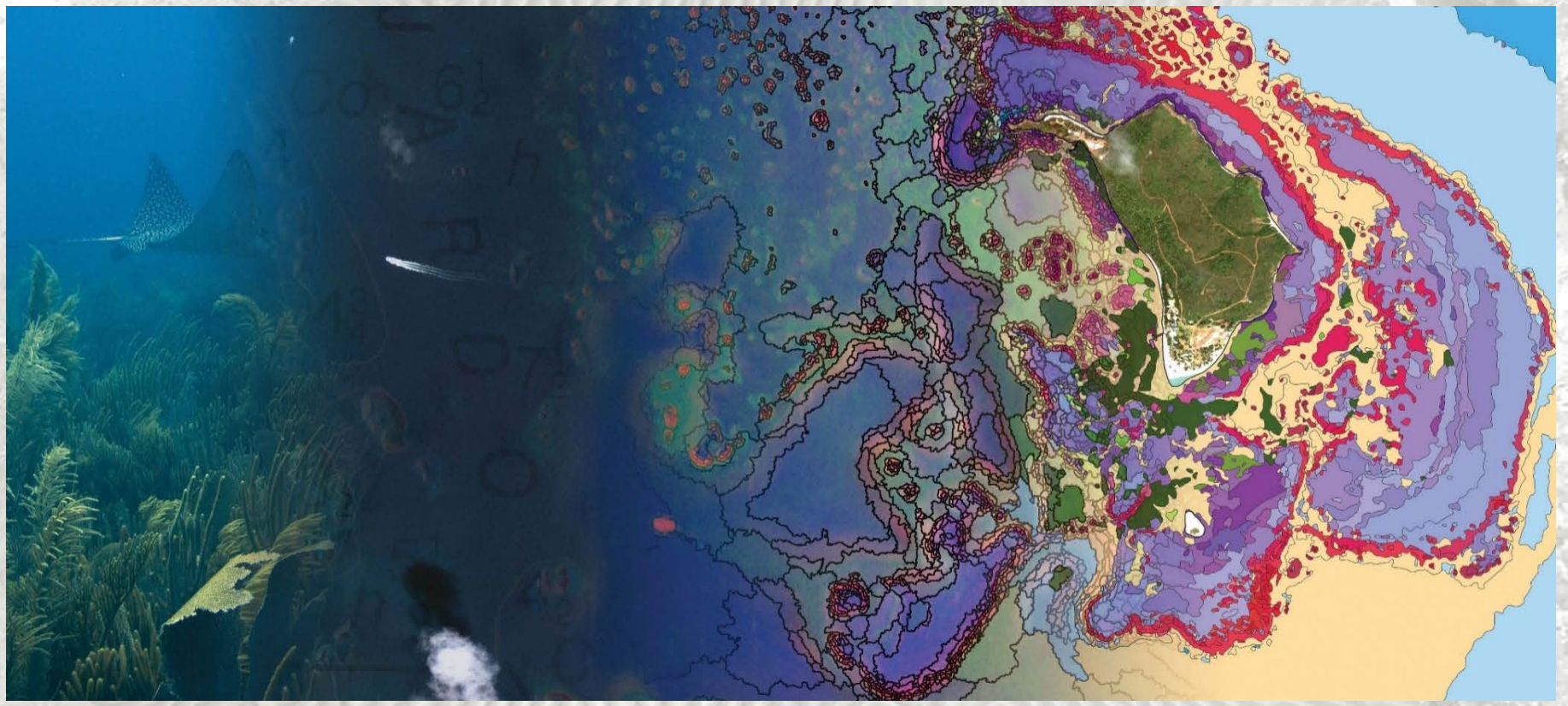

Getting a Good Close-up: Ground Validation for Habitat Mapping in the US Caribbean

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Research Question:

How do we validate and enhance spatial accuracy of benthic habitat maps?

1. Site Selection
2. Collection Methods
3. Recording Biogeographic Data
4. Analyzing The Data: Points and Transects
5. Accuracy Assessment

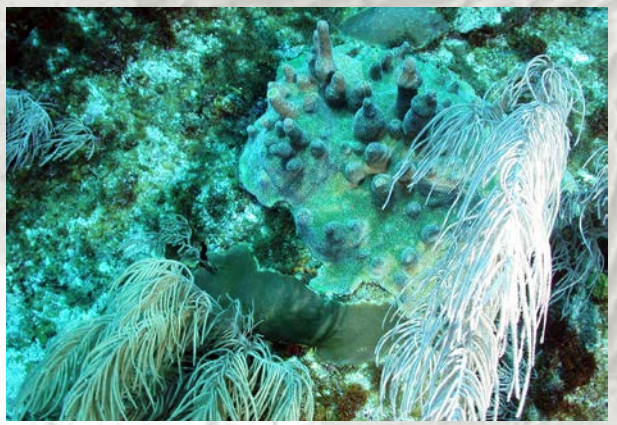
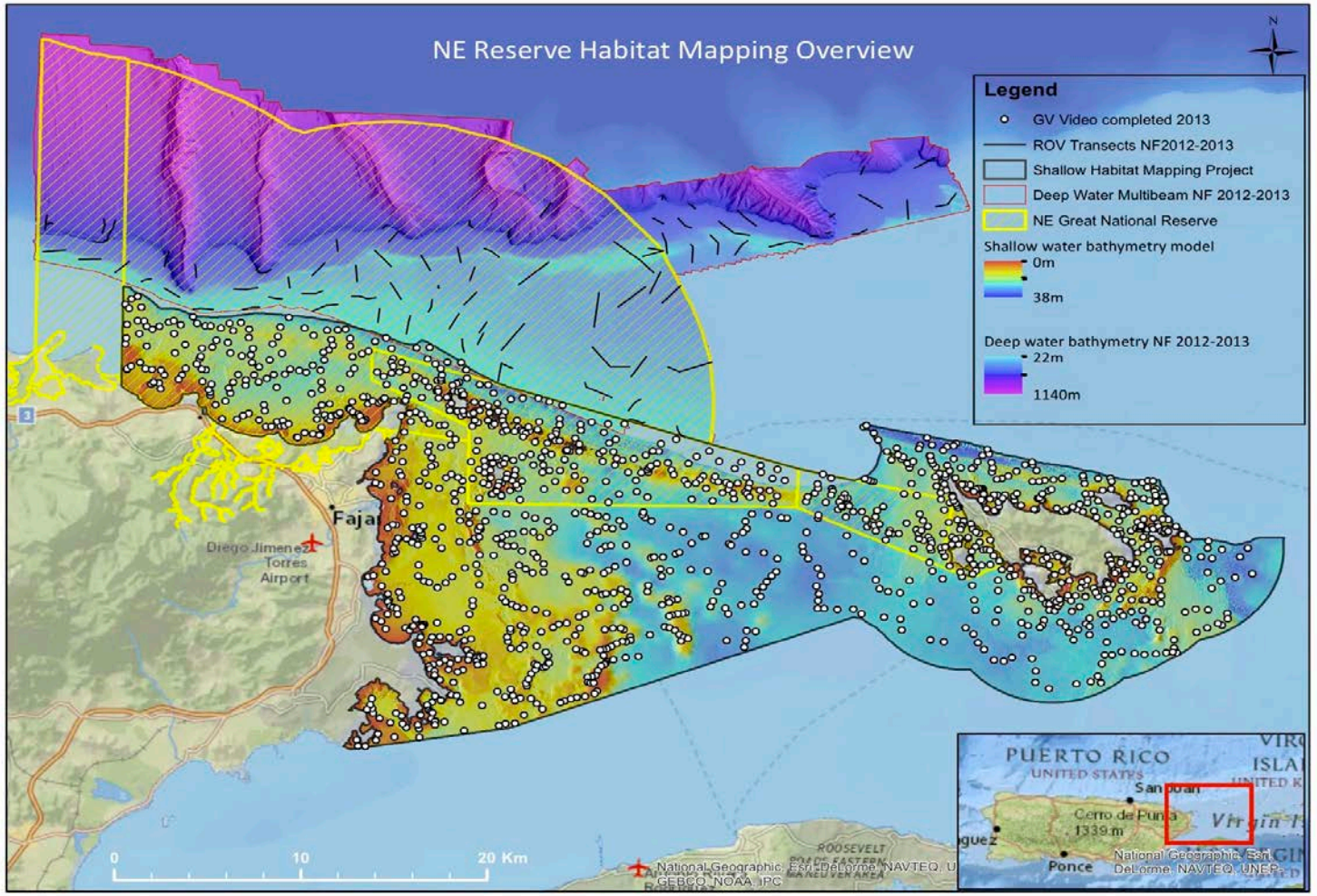


Plate and Octo corals on a patch reef

Coney inside an artificial reef

Red Cushion Sea Star in a seagrass patch

1. Site Selection



Ground Validation site selection for the Northeast Reserves of Puerto Rico

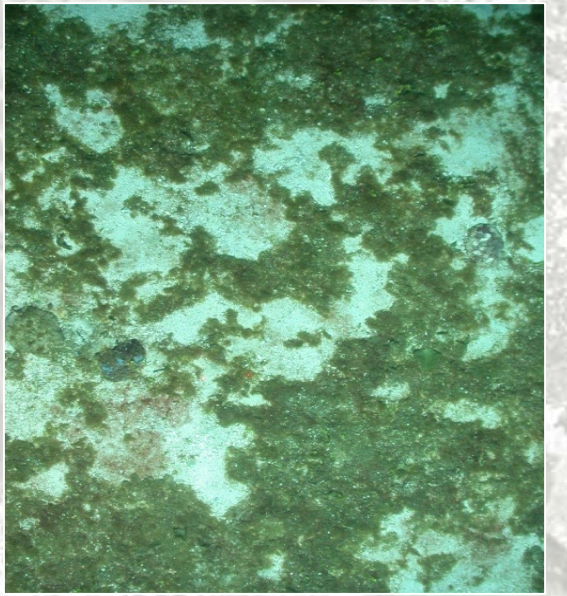
- Develop a draft habitat map with segmentation first
- Estimate samples per day and distance between sites
- Evaluate depth and accessibility of ground truth sites
- Random Sampling (GV) and Stratified Random Sampling (AA)

2. Collection Methods

- What type of depth or environment?
- How is spatial and video data being collected?
- What type of vessel is needed?
- What are the risks and hazards?
- What is the gear and safety equipment?

Plate corals on an aggregate reef

Spur and Groove formations with sand channels



Pavement with macro algae

2.a Snorkel Survey

Snorkel Survey along rocky shoreline with GPS unit towed inside safety buoy

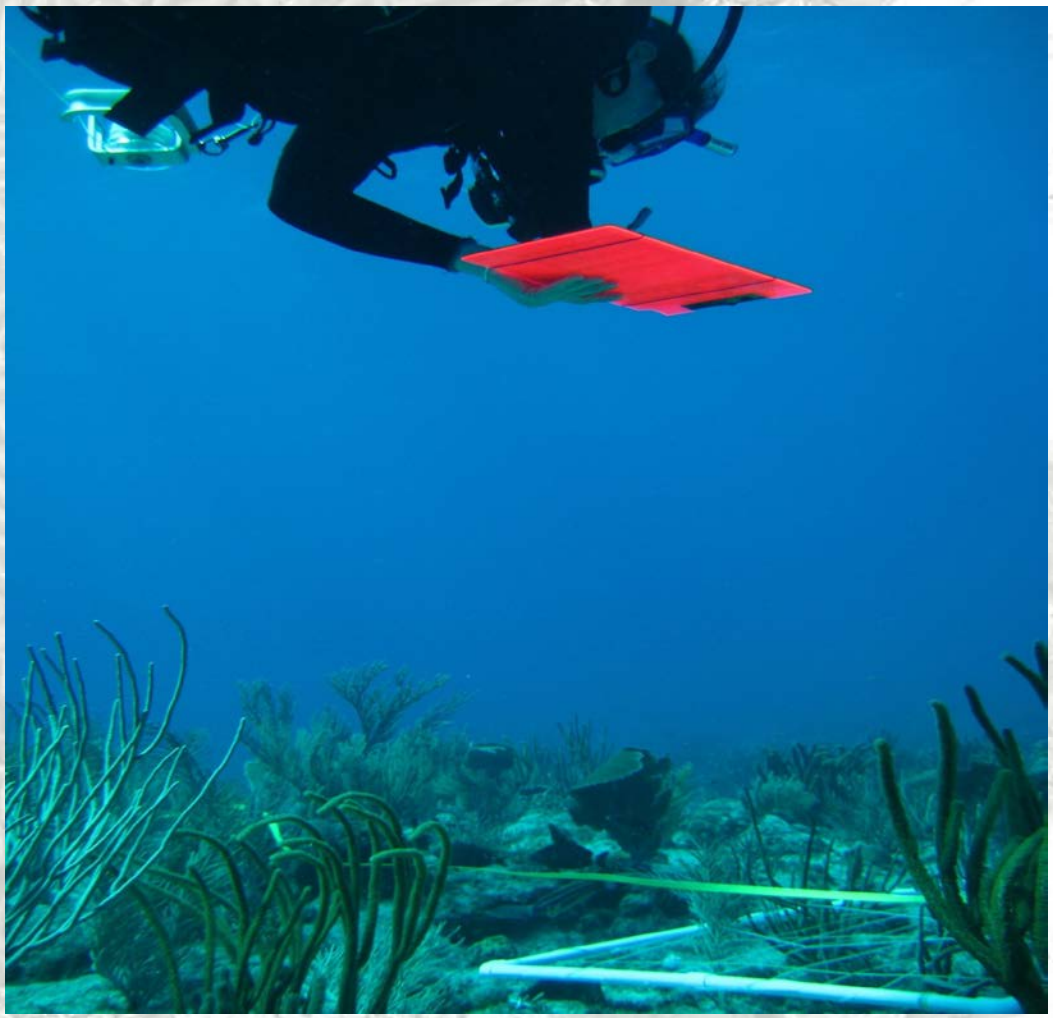
- < 10m depth, areas too difficult to access remotely
- Transect or point data, Waterproof GPS Unit on surface
- Shore based, small vessel, or kayak. 2 person team
- Risk of currents, waves, visibility and weather
- Waterproof GPS, underwater camera, and safety gear

Snorkel survey from kayak with GPS unit inside watertight case onboard

2.b Diver Surveys

- 10m- 30m depth, areas too deep to free dive
- Transect data or grid, GPS towed on surface
- Small or large vessel, team of at least 3 divers
- Risk of currents, visibility, air and pressure limits
- Waterproof datasheets, transect equipment, safety gear

NCRMP divers annotating habitat along transect line



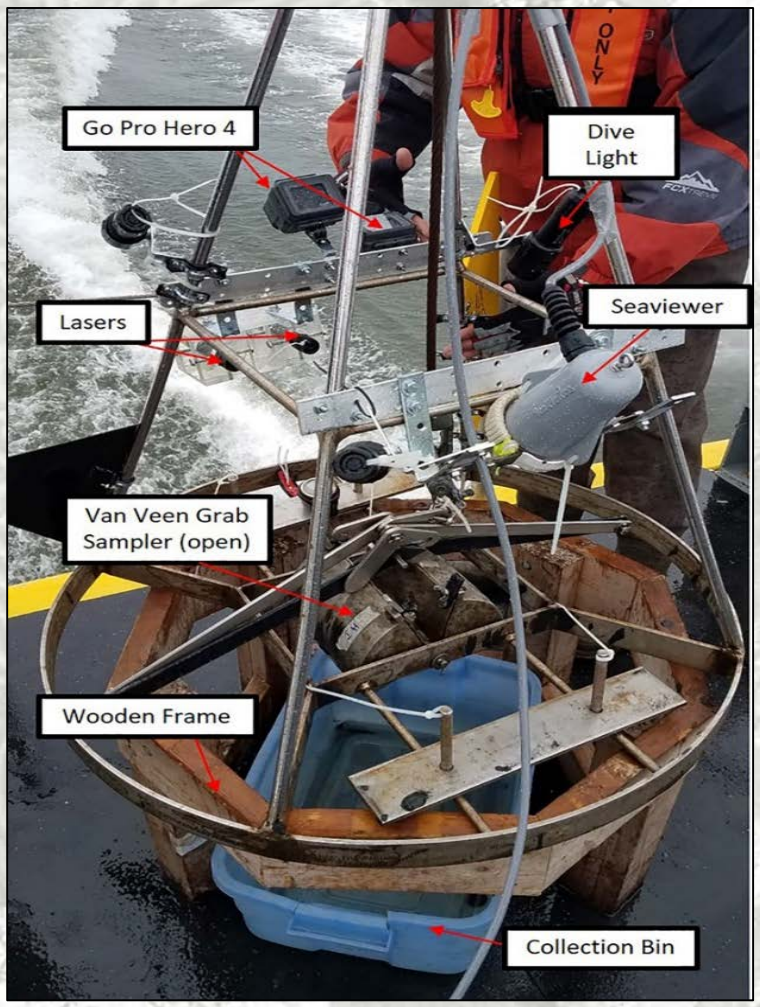
NCRMP diver counting species of benthic flora and fauna inside a 1m grid

2.c Drop Camera

- 10 – 100m depth*, areas too difficult or too deep to snorkel
- Transect or point data, topside GPS unit
- Small or large vessel, team of at least 3
- Risk of entanglement, currents, visibility
- Hand line or downrigger, underwater camera and topside video system

Seaviewer Drop camera on a seagrass bed

Seaviewer drop camera with LED lights and HD GoPro attached



Drop cameras and other accessories mounted to grab sampler

2.d Remotely Operated Vehicles

- 20-100 m depth*, areas too deep for diving or drop camera
- Transect data, USBL and GPS topside for Navigation
- Large vessel with A-Frame or crane, team of at least 5
- Trip/Fall hazards on deck, entanglement, electrocution
- Video/photo, retractable arm and collection bins*

UNCW Phantom S2 ROV with SD video and HD still photo cameras

UNCW Mohawk ROV with retractable arm, HD video and still photo,

3. Recording Biogeographic Data

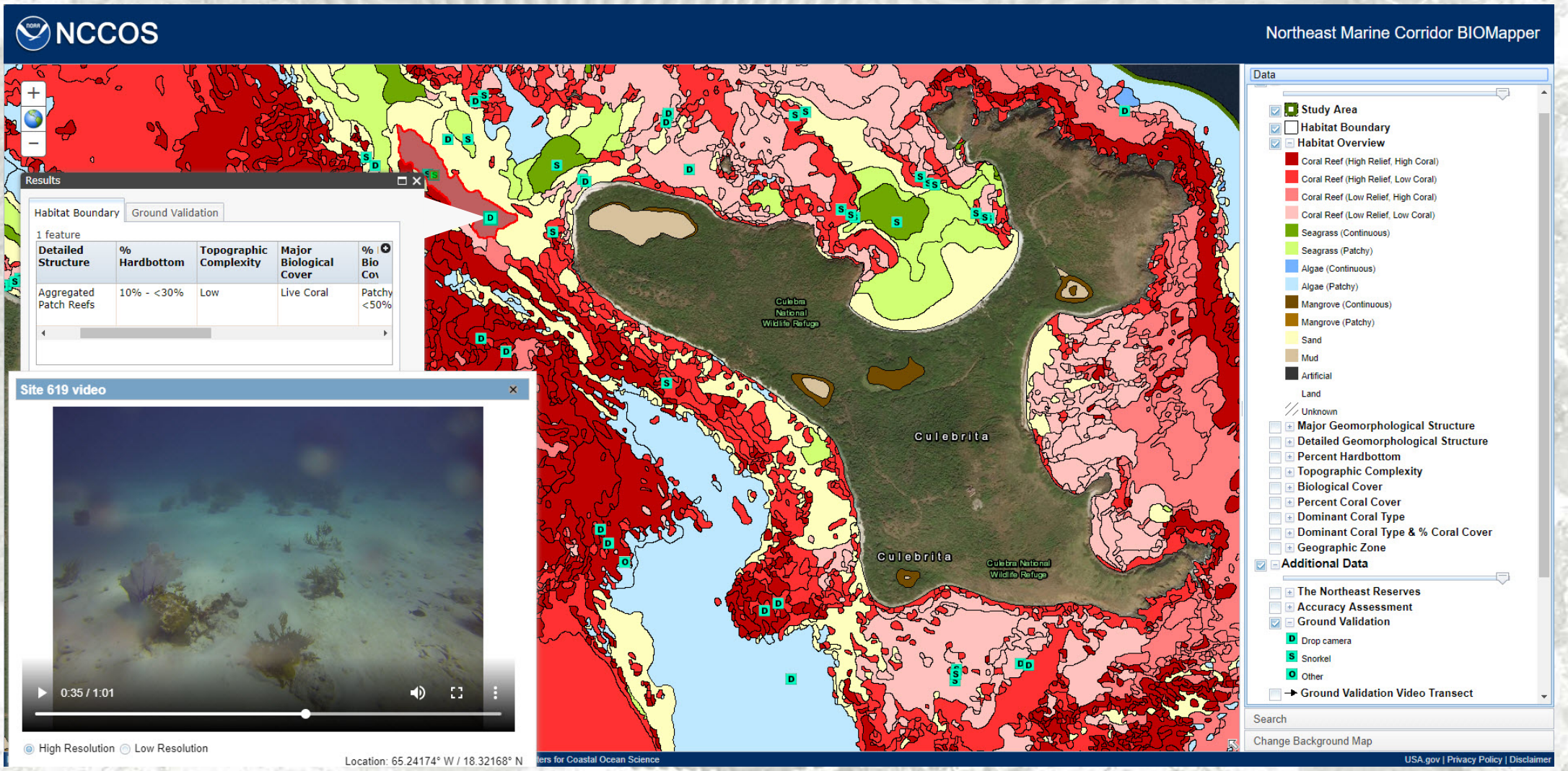
- Calibrate camera clock with GPS unit
- Sync GPS Logging with video start/stop
- Enter annotations into data sheet with habitat classes
- Log time and position of habitats and transitions
- Convert data to GIS shapefiles with annotations table

Pilot (left) and scientist (right) annotating habitat data on an ROV an dive

Logging a drop camera dive on a Trimble GeoXH and topside HDMI video system

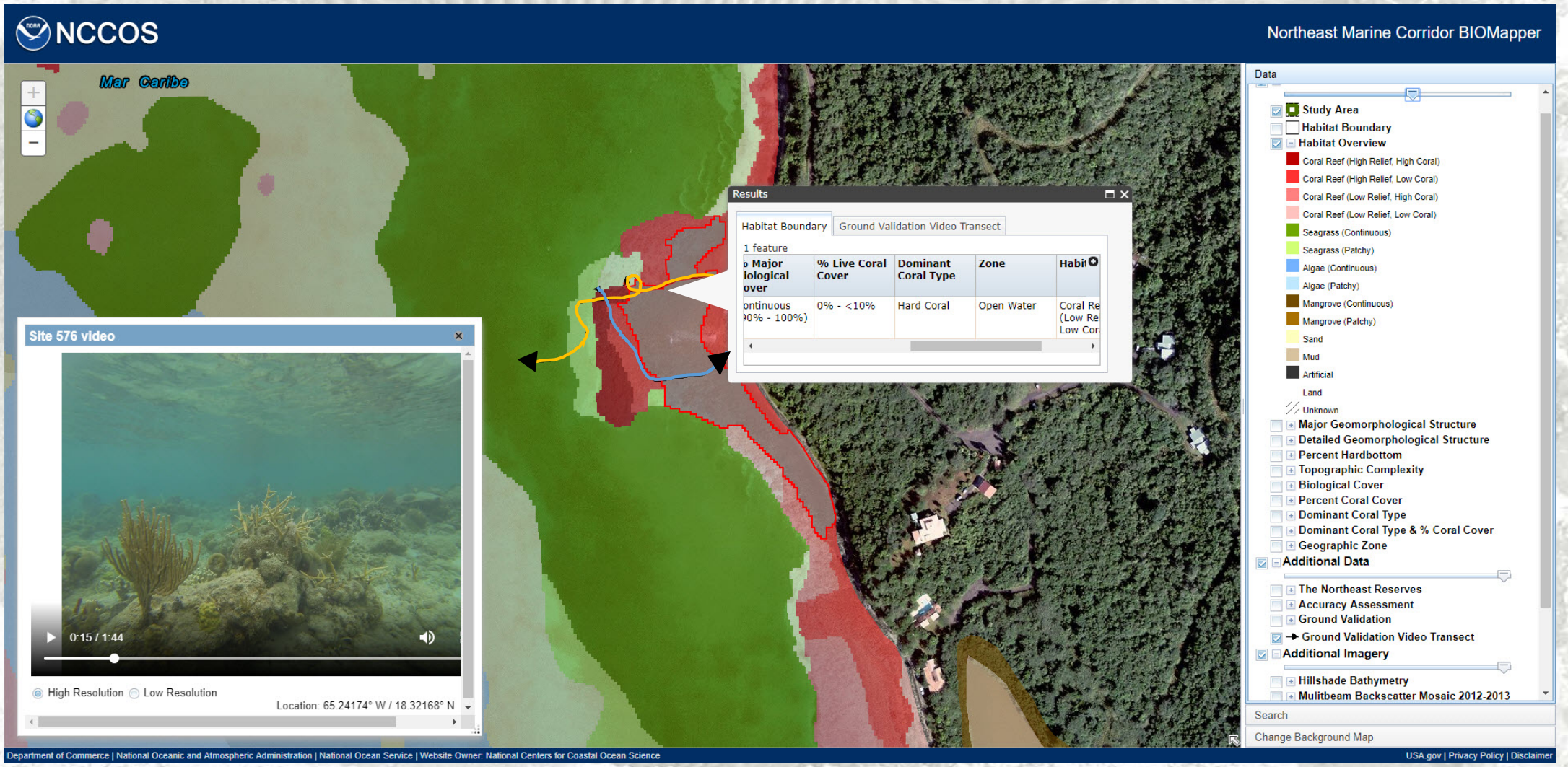
Logging a drop camera dive on a Panosonic Toughbook with a Garmin GPS tracker

4.a Analyzing Data: Points



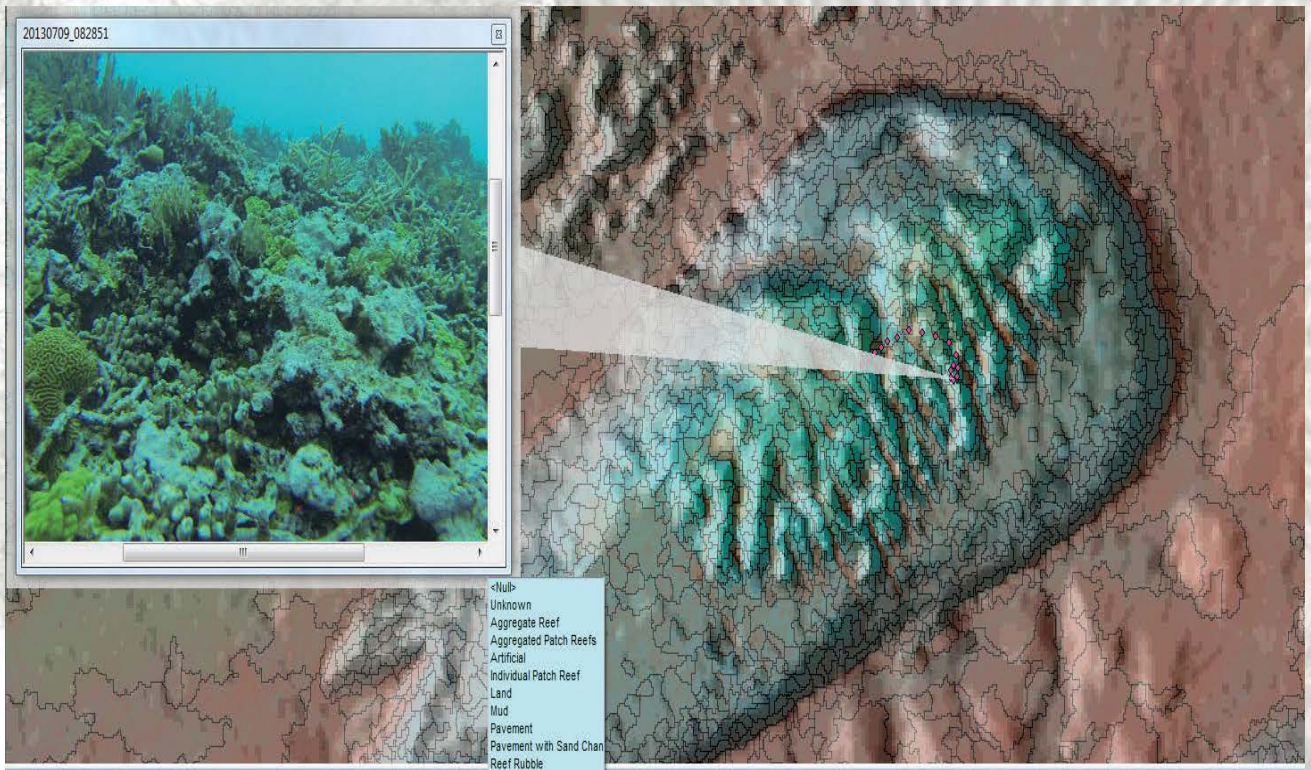
Drop camera point data from the Culebrita National Wildlife Refuge of the Northeast Marine Corridor BIOMapper, PR

4.b Analyzing Data: Transects



Snorkel transit data from the Luis Pena Reserve of the Northeast Marine Corridor BIOMapper, PR

5. Accuracy Assessment



Table

NER_GVpoint_Classification_Domain_Database

Video_ID	Date	Time	ASSESSMENT	M_STRUCT		P_HARD	T_COMPLEX	M_COVER	P_COVER	CO_COVER	P_CORAL	D_CORAL	ACROPORA	FISH/MEGAF	VISIBILITY
749	7/9/2013	08:10:19am	Dropcamera	Coral Reef and Hardbottom	Spur and Groove	70% - <90%	Low	Algae	Patchy (50% - <90%)	No cover	1% - <10%	Scleractinia	No cover	None	Moderate
750	7/9/2013	08:27:55am	Dropcamera	Coral Reef and Hardbottom	Spur and Groove	90% - 100%	High	Live Coral	Patchy (50% - <90%)	Algae	50% - <90%	Scleractinia	AcrCer	None	High
750	7/9/2013	08:27:55am	Dropcamera	Coral Reef and Hardbottom	Spur and Groove	90% - 100%	Moderate	Algae	Patchy (50% - <90%)	Live coral	10% - <50%	Scleractinia	AcrCer	None	High
750	7/9/2013	08:27:55am	Dropcamera	Coral Reef and Hardbottom	Spur and Groove	90% - 100%	High	Live Coral	Patchy (50% - <90%)	Algae	50% - <90%	Scleractinia	AcrCer	None	High
750	7/9/2013	08:27:55am	Unknown	Coral Reef and Hardbottom	Spur and Groove	10% - <30%	Low	Algae	Patchy (10% - <50%)	No cover	1% - <10%	Scleractinia	AcrCer	None	High
750	7/9/2013	08:27:55am	Dropcamera	Coral Reef and Hardbottom	Pavement	90% - 100%	Low	Algae	Patchy (50% - <90%)	Live coral	10% - <50%	Scleractinia	AcrCer	None	High
750	7/9/2013	08:27:55am	Dropcamera	Coral Reef and Hardbottom	Spur and Groove	90% - 100%	High	Live Coral	Patchy (50% - <90%)	Algae	50% - <90%	Scleractinia	AcrCer	None	High
750	7/9/2013	08:27:55am	Unknown	Coral Reef and Hardbottom	Reef Rubble	10% - <30%	Low	Algae	Patchy (10% - <50%)	No cover	1% - <10%	Scleractinia	AcrCer	None	High

Video analysis of accuracy assessment data using ArcGIS

AA (i)

map(j)	Agg Reef	Patch Reef	Sand	Rubble	Seagrass	Pavement	Rhodolith	$n_{.j}$	User's Accuracy (%)
Agg Reef	26				1	2	1	30	87%
Patch Reef		11			2			13	85%
Sand	2	1	51		4	2	4	64	80%
Rubble				5				5	100%
Seagrass	2	2	1		75	2	5	87	86%
Pavement					1	11		12	92%
Rhodolith	2		2		1	2	55	62	89%
$n_{i.}$	32	14	54	5	84	19	65	273	
Producer's Accuracy (%)	81%	79%	94%	100%	89%	58%	85%		

OA = 85.7%

T_e = 0.83

Pr = 1/M where M is number of classes (i.e., 7)

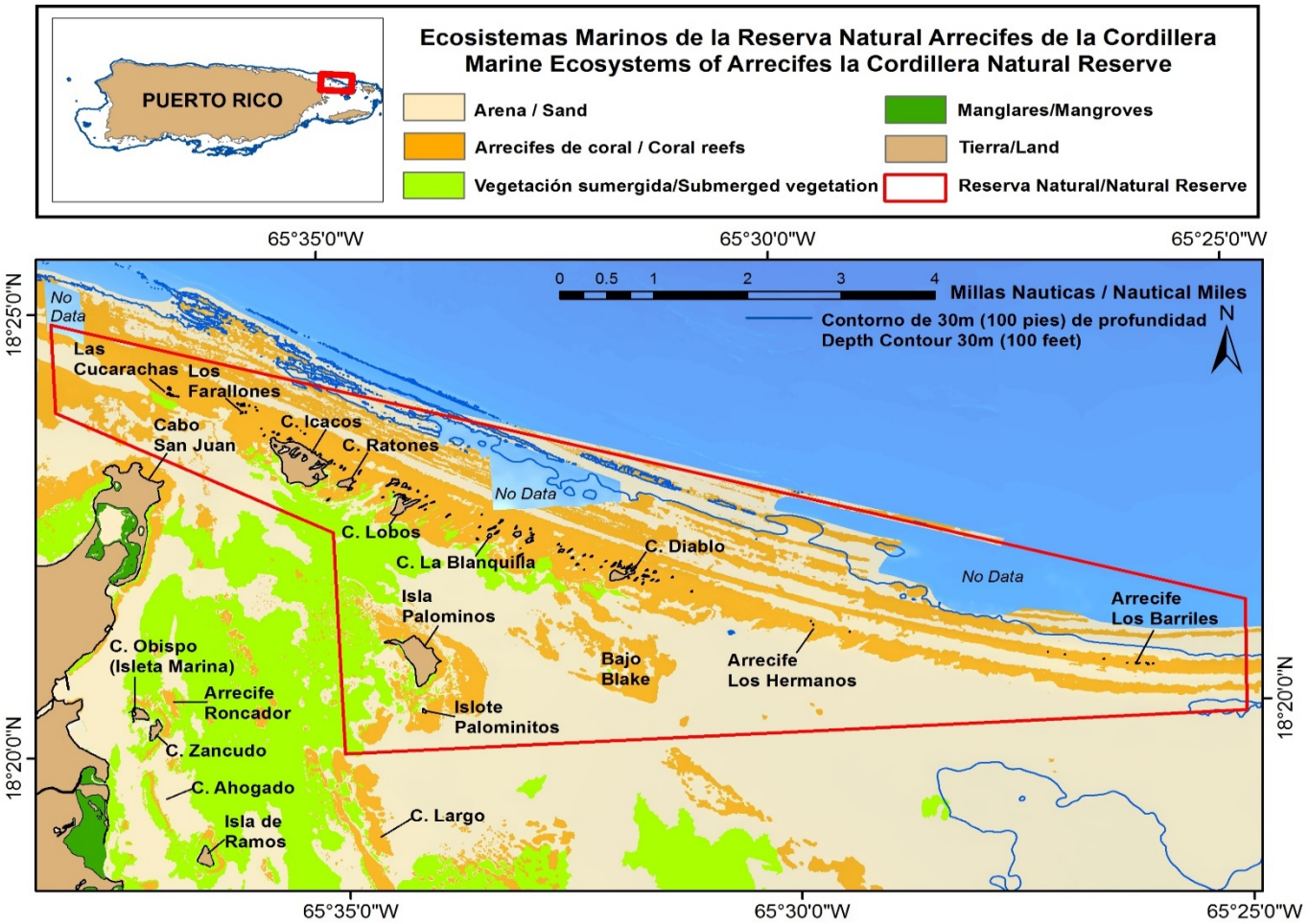
Pr	Tau_e	V(Tau)	CL(Tau)
0.14	0.83	0.00	0.05

Edited Map

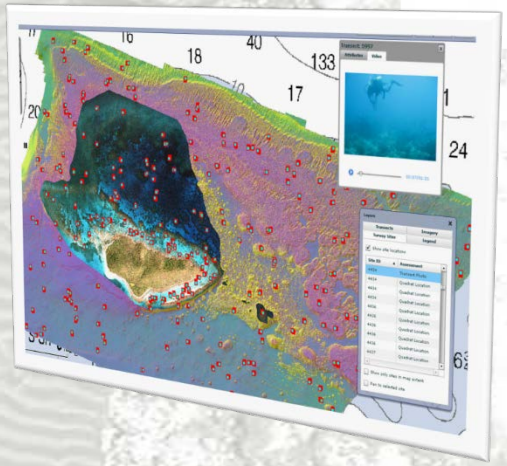
Habitat	Area (sq m)	Proportion
1.00	4519953.98	0.130
2.00	1894597.35	0.054
3.00	9344982.73	0.268
4.00	908714.95	0.026
5.00	6751143.15	0.193
6.00	1150283.35	0.033
7.00	11234223.71	0.322
Total	34895184.27	

A confusion matrix used to calculate the thematic accuracy of the benthic habitat map

Final Products

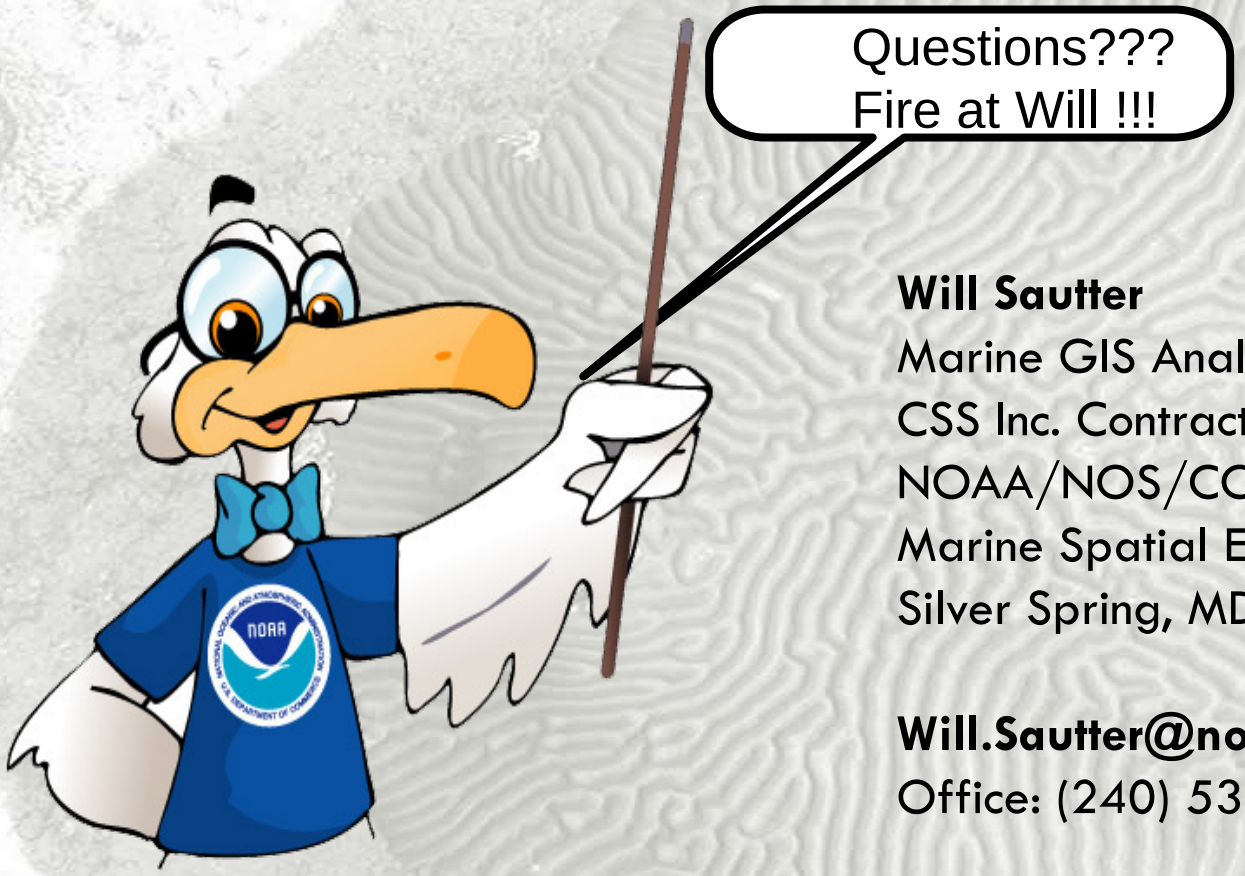


Habitat Map of the la Cordillera Coral Reef Natural Reserve, PR translated to Spanish



NOAA/NCCOS Tech Memos and digital web mapping services (BIOMapper)

NOAA Informational sign at the public boat landing in Fajardo, PR



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Gustav Kagesten

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NOAA MSE Division

NCCOS Habitat Mapping Website
https://products.coastalscience.noaa.gov/collections/benthic/default.aspx

NCCOS BIOmappers web portal
https://maps.coastalscience.noaa.gov/biomapper/biomapper.html