AI for the Belize National Marine Habitat Map: Supporting Marine Spatial Planning and the Development of a Sustainable Blue Economy

Arlene Young

Director

Coastal Zone Management Authority and Institute

GEO Week 2021 Side Event: Biological Earth observations in support of transformative commitments and sustainable development

November 24, 2021



Overview

- Project Team
- Introduction
- Background/Goal
- Activities/Workflows
- Results
- Supporting Marine Spatial Planning and the Development of a Sustainable Blue Economy
- Next Steps/Conclusion

@BZgeo

Project Team

Partnership:
Lead - Coastal Zone Management Authority and Institute, Belize, C.A.

Partner- GRH Consulting, LLC, Alabama, U.S.A.





Arlene Young



Chantalle Samuels



Andria Rosado

Coastal Zone Management Authority and Institute



Robert Griffin



Emil Cherrington

GRH CONSULTING

INTRODUCTION

- Tourism: US$150-$196 million/yr

(snorkeling, diving, sport fishing, etc)



- Fisheries: US$14-$16 million/yr

(lobster, conch, finfish, aquaculture)



- Shoreline Protection: US$231-347 million/yr

(avoided damages via mangroves, coral reefs)

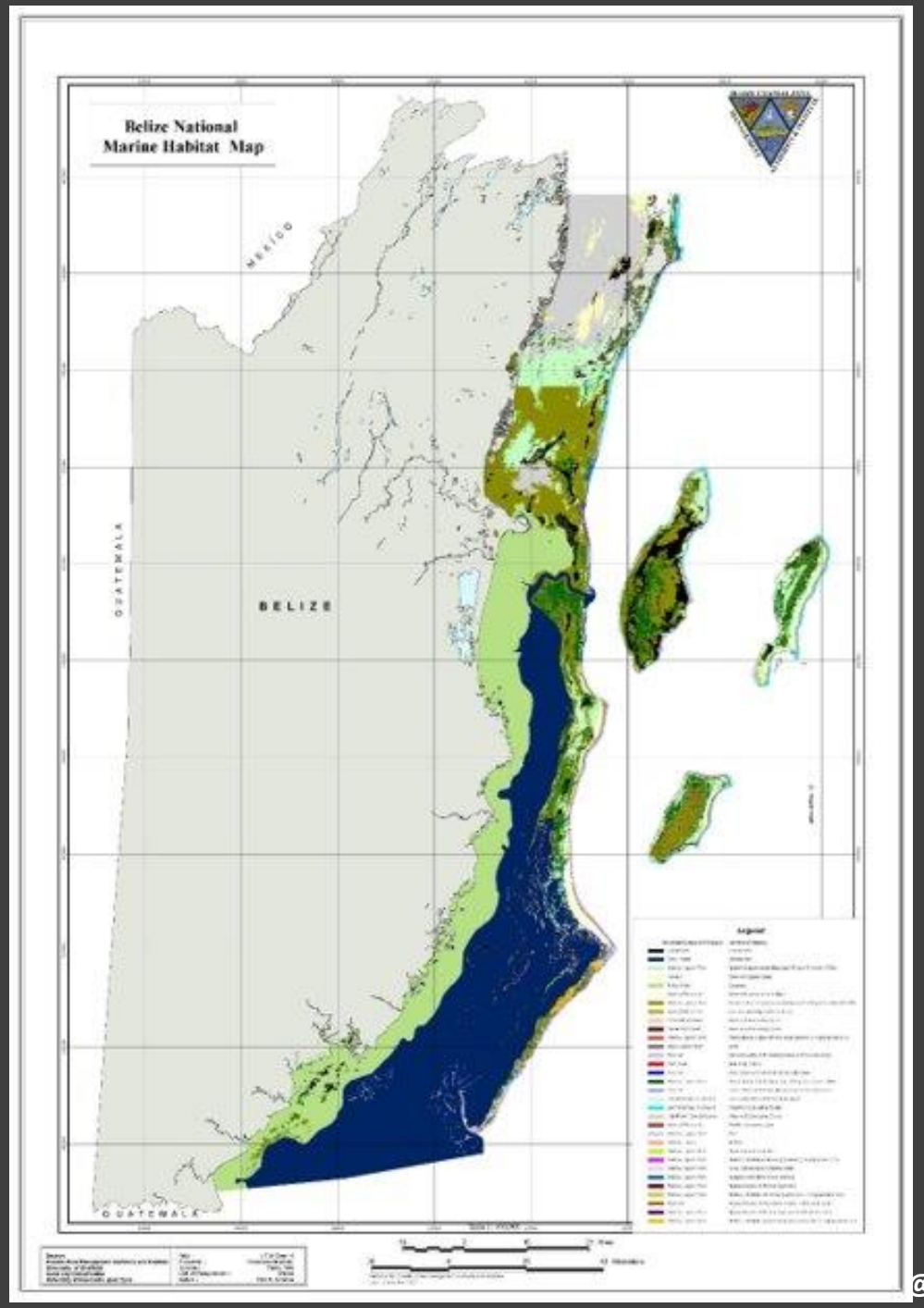


Source: Cooper, E., L. Burke and N. Bood. 2009. "***Coastal Capital of Belize. The Economic Contribution of Belize's Coral Reefs and Mangroves***." Working Paper, World Resources Institute.

Background/Goal

- Background: Belize's National Marine Habitat Map was prepared in 1997

- Goal: *To use Microsoft Azure's cloud computing power in conjunction with field surveys, 3m Planet Scope imagery, supplementary 10m Sentinel-2 imagery, and Machine Learning techniques, to develop an updated, finer-scale version of the National Marine Habitat Map*



@BZgeo

Activities

- Data Collection
- Remote Sensing/Data Processing
- Capacity Building
- Communications and Outreach

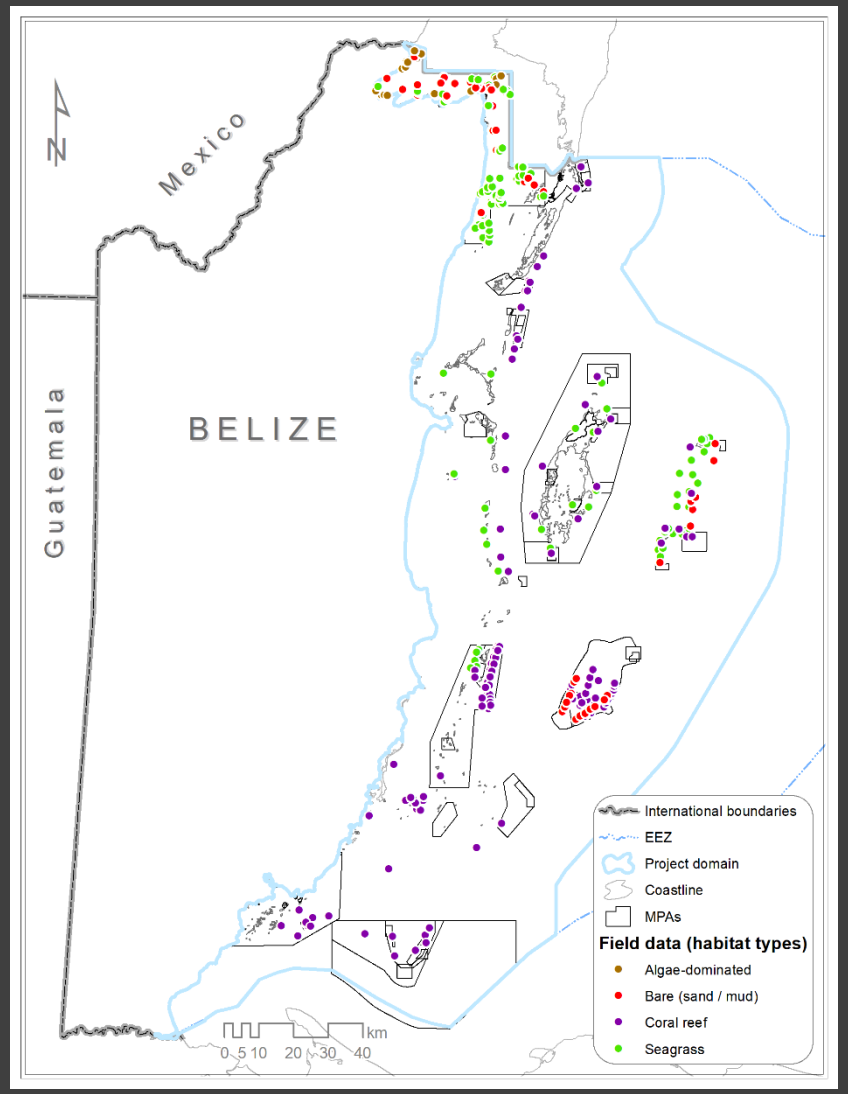
Data Collection



Table 2. Field survey data facilitated for this project.

No.	Org.	Location	Coral	Seagrass	Algae	Bare	Mangrove	Total	Dates collected
1	SACD	Corozal Bay	0	64	0	36	0	**100**	2019
2	SACD	Corozal Bay	0	6	22	2	0	**30**	Aug. 2016
3	CZMAI*	central coast	8	7	0	0	14	**29**	Jun-21
4	CZMAI	central coast	4	5	0	0	0	**9**	Jun-21
5	BAS	Lighthouse Reef**	7	30	0	7	0	**44**	
6	Fisheries Dept.	Ambergris, Caye Caulker, SWCMR, Sapodilla Cayes	23	0	0	0	0	**23**	N/A
7	FOH	Placencia, LBCNP, SWCMR, Gladden Spit	12	0	0		0	**12**	N/A
8	TIDE	Port Honduras***	10	0	0	0	0	**10**	N/A
9	UB-ERI	Turneffe	23	9			5	**37**	N/A
10	WCS	SWCMR, Glovers Reef	75	5	0	14	0	**94**	N/A
TOTAL			**162**	**126**	**22**	**59**	**19**	**388**	

** The initial set of 29 coordinates supplied by the CZMAI were digitized from high resolution satellite imagery and aerial (drone) photography.*
*** The data supplied by BAS included some 8 sites with live coral cover, but only 7 of them had coral cover exceeding 10%.*
**** The geographic domain of the TIDE data also extended outside of the Port Honduras Marine Reserve, to include 2 sites east of the Reserve's boundaries, in the general vicinity of the Sapodilla Cayes.*



@BZgeo

Capacity Building



AI for Earth

GEO BON

BELIZE COASTAL ZONE MANAGEMENT AUTHORITY & INSTITUTE

GRH CONSULTING

"Essential Biodiversity Variables (EBV) on the cloud- Artificial Intelligence (AI) for the Belize National Marine Habitat Map"

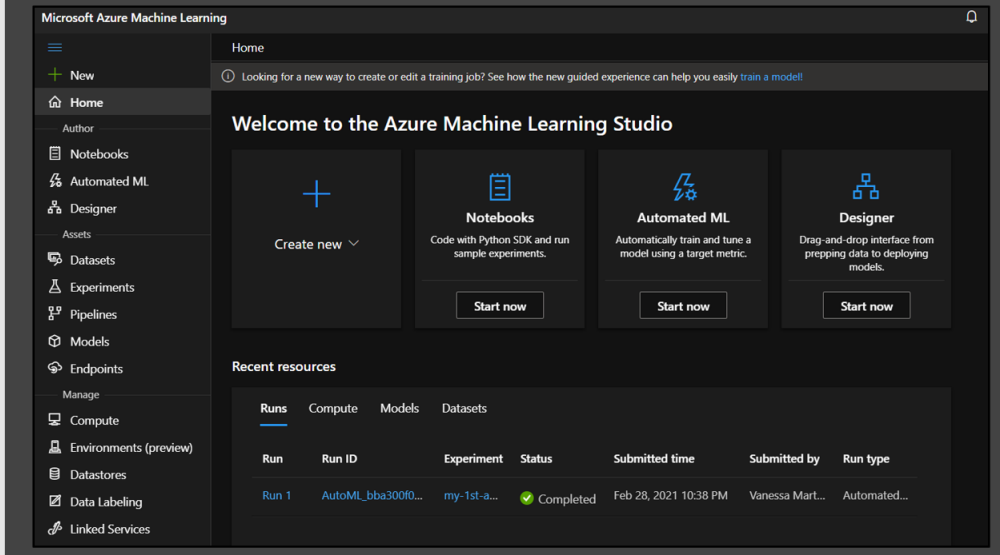
Training Session

Date: July 29, 2021 (9:00 am – 11:00 am CST)

Location: Virtual, via Microsoft Teams. Link to be shared with participants via email

Draft Agenda		
Time	**Items**	**Presenter**
9:00 - 9:10	Opening Remarks	CZMAI
9:10 - 9:20	Welcome and Self Introductions	All
9:20 - 9:30	Overview of the project and Objectives of the training	CZMAI/GRH Consulting
9:30 - 10:30	Presentation/Live Demo	GRH Consulting
10:30 - 11:00	Open Discussions	All
11:00 - 11:30	Closing and next steps	CZMAI/GRH Consulting

Introduction to Microsoft Azure



Machine Learning Studio:

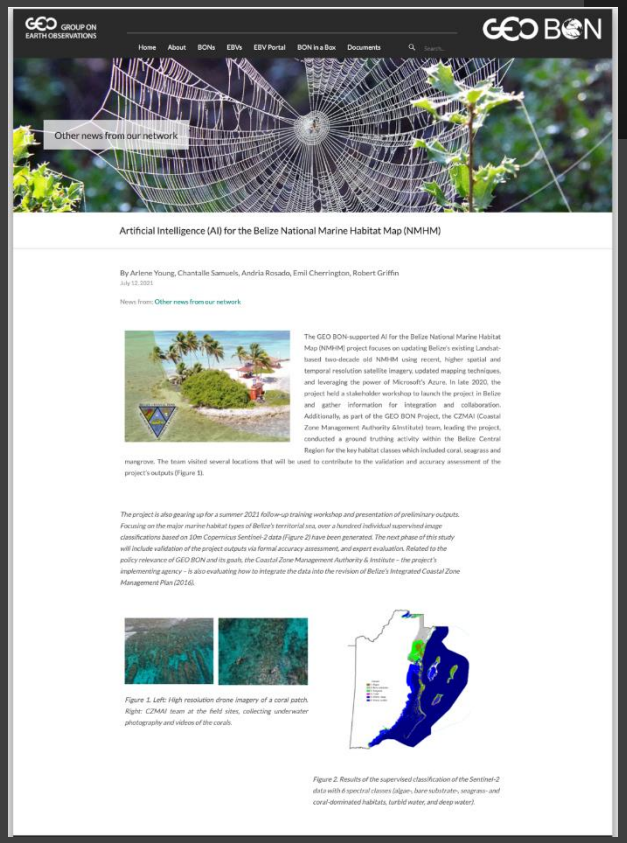
- Geared towards business-focused ML applications
- Cannot currently read geospatial data
- Planetary Computer will have in-house data catalog available for processing through APIs and Azure Storage
  - Currently in private preview

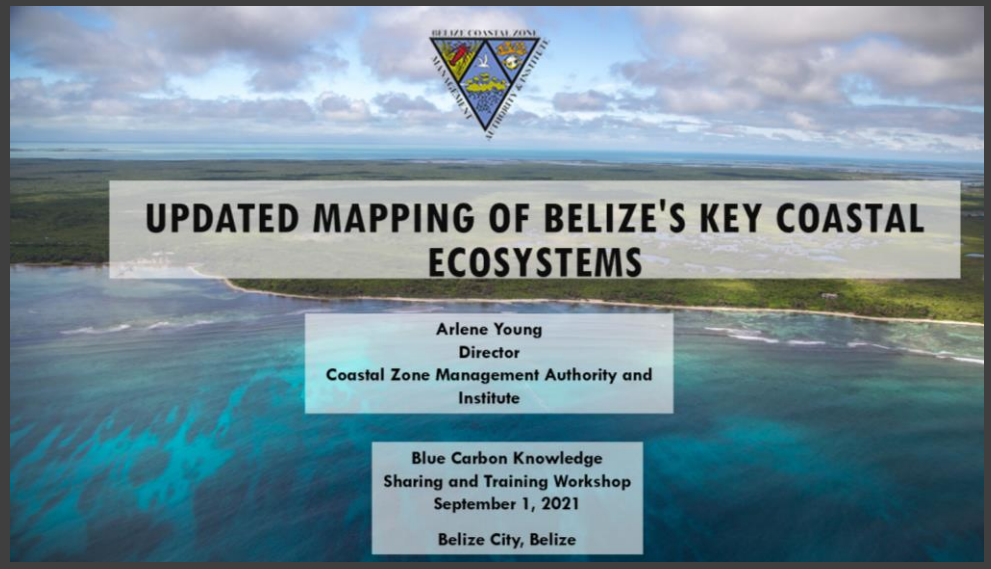
@BZgeo

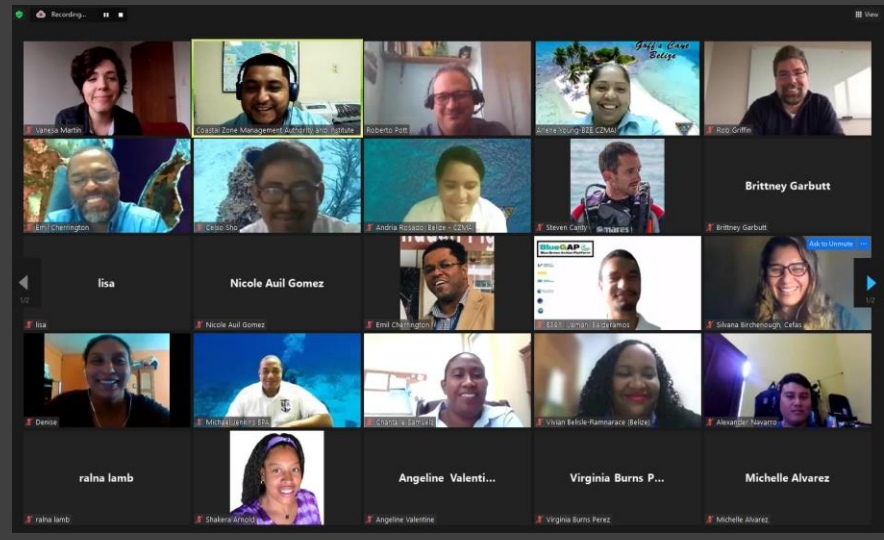
Communications and Outreach





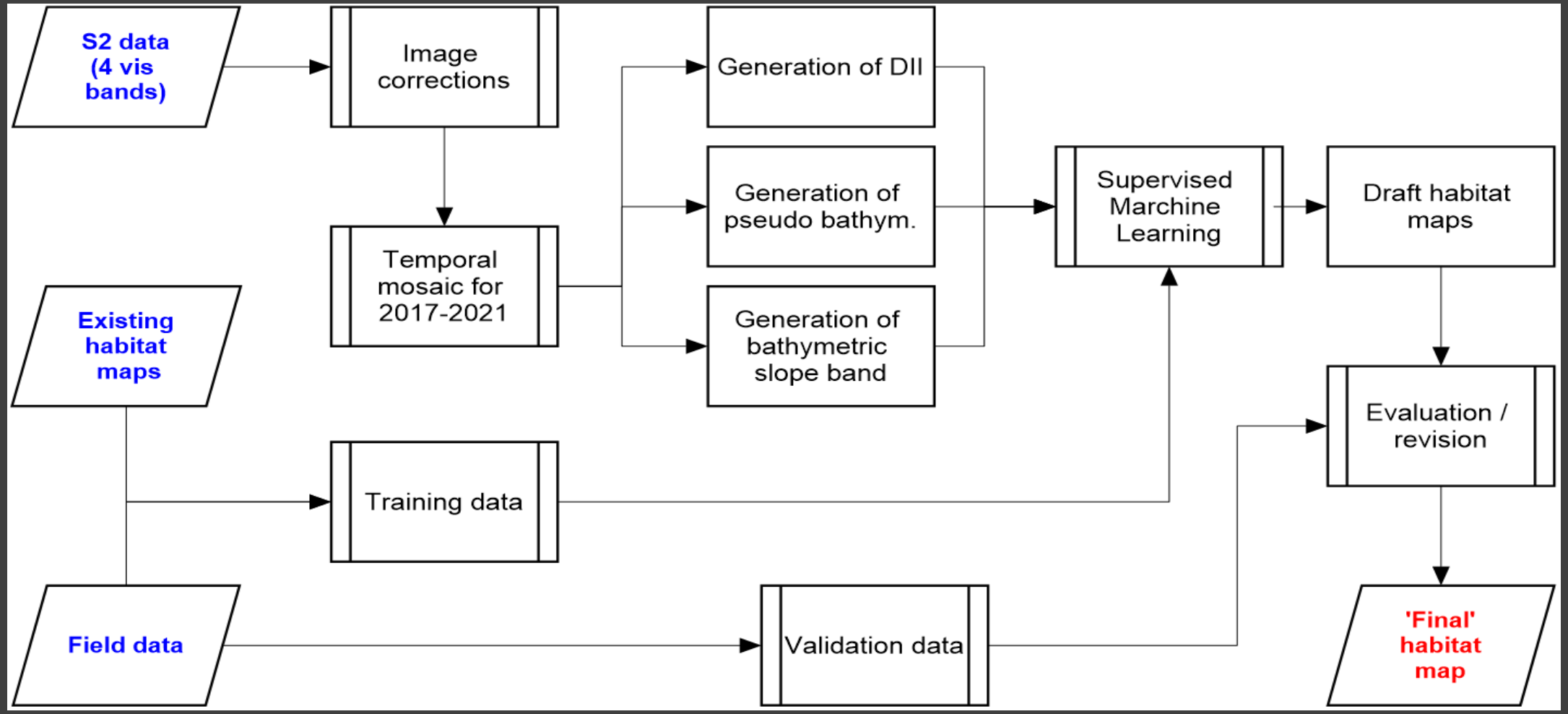






@BZgeo

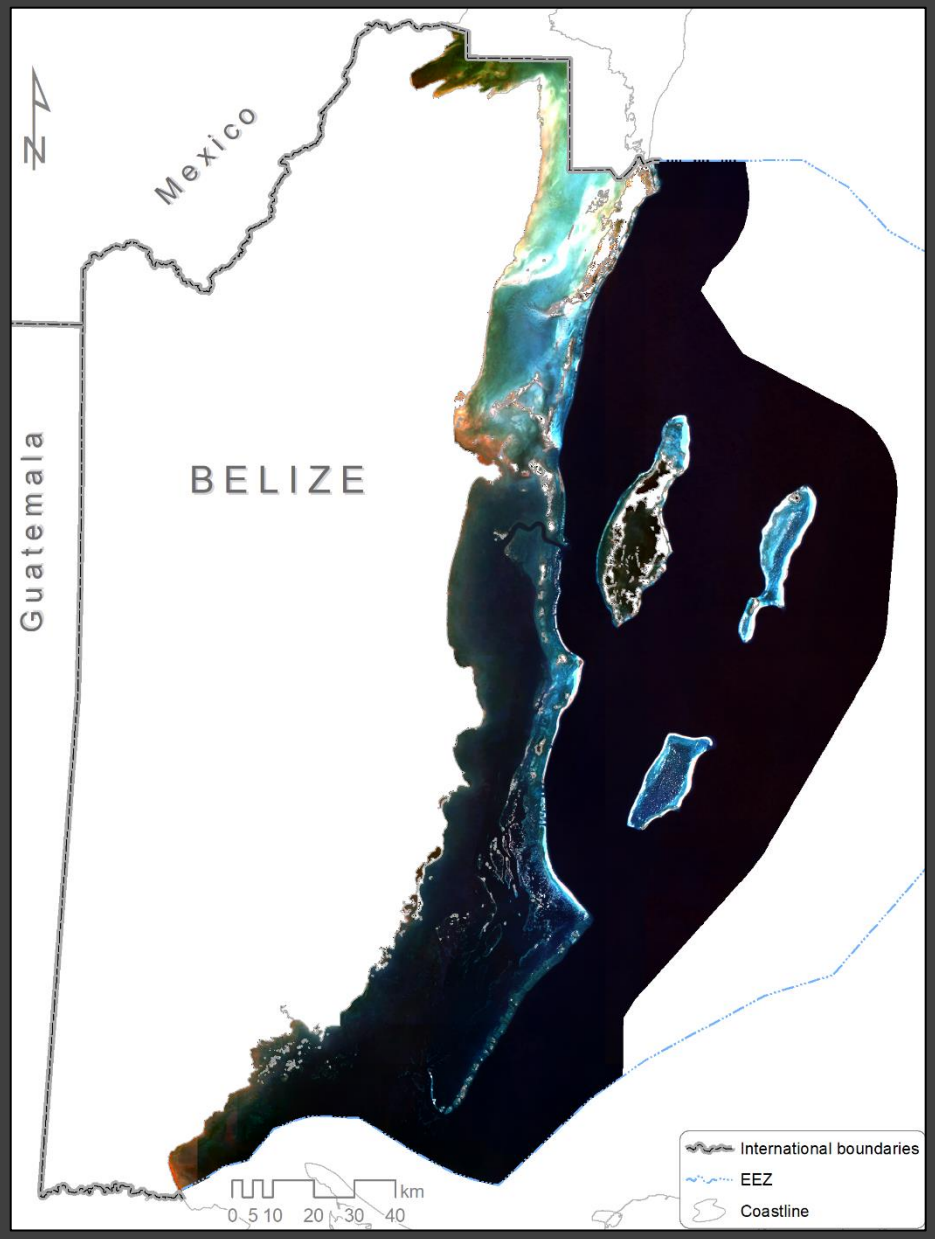
Workflow


S2 data (4 vis bands)
Image corrections
Generation of DII
Generation of pseudo bathym.
Generation of bathymetric slope band
Temporal mosaic for 2017-2021
Supervised Marchine Learning
Draft habitat maps
Existing habitat maps
Evaluation / revision
Training data
Field data
Validation data
'Final' habitat map

Remote Sensing/Data Processing

- A range of satellite data acquired were used as inputs to processing within a virtual machine on Azure including publicly available data from the Copernicus Sentinel-2.

- Additionally, the Sentinel-2 data were acquired from and pre-processed with the Google Earth Engine (GEE) cloud processing platform. Furthermore, higher spatial resolution Planet Scope data (4.77m) from Planet were also acquired and evaluated.



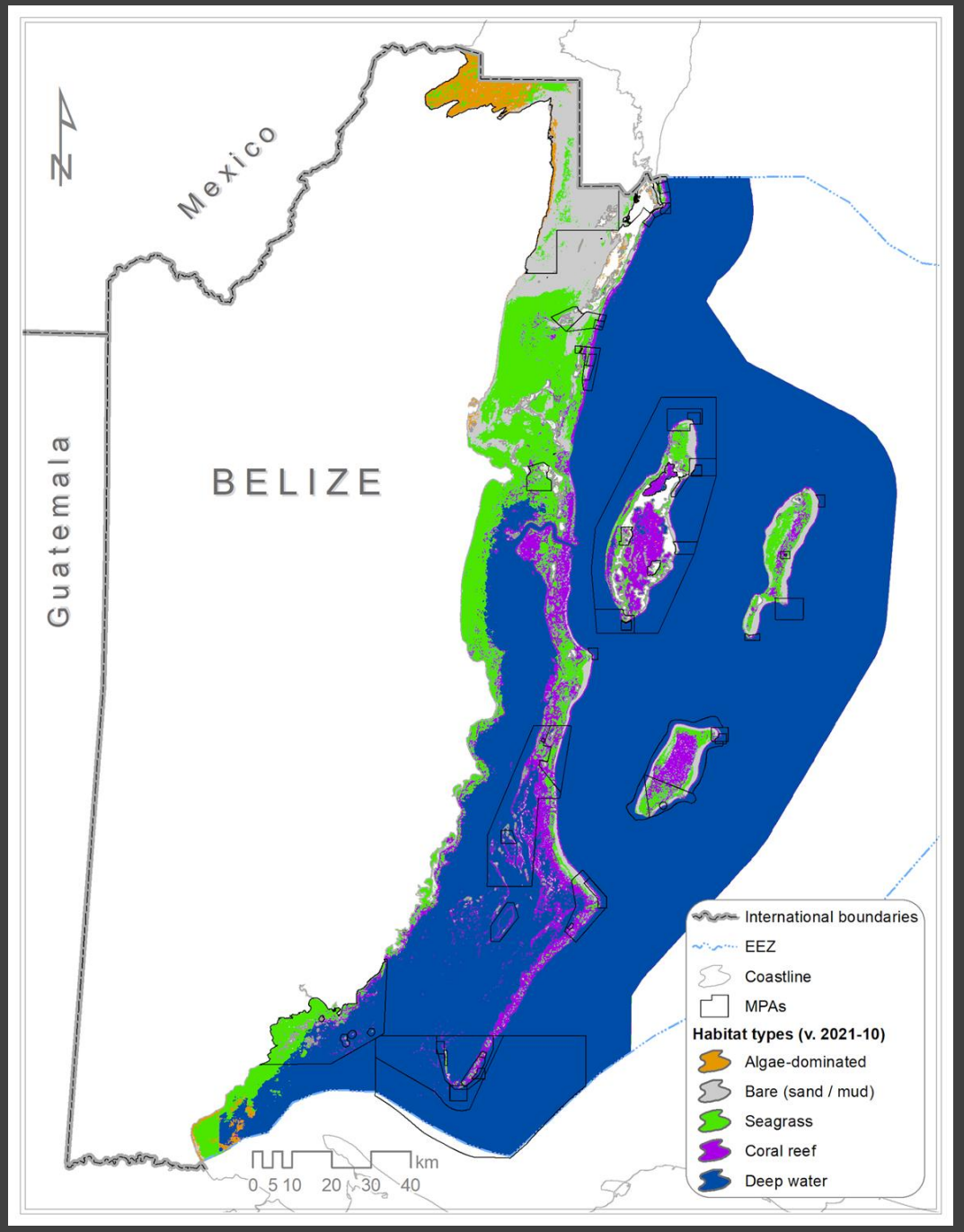


Results

Draft Marine Habitat Map

Table 3. Comparison of the area estimates of the principal marine habitats.

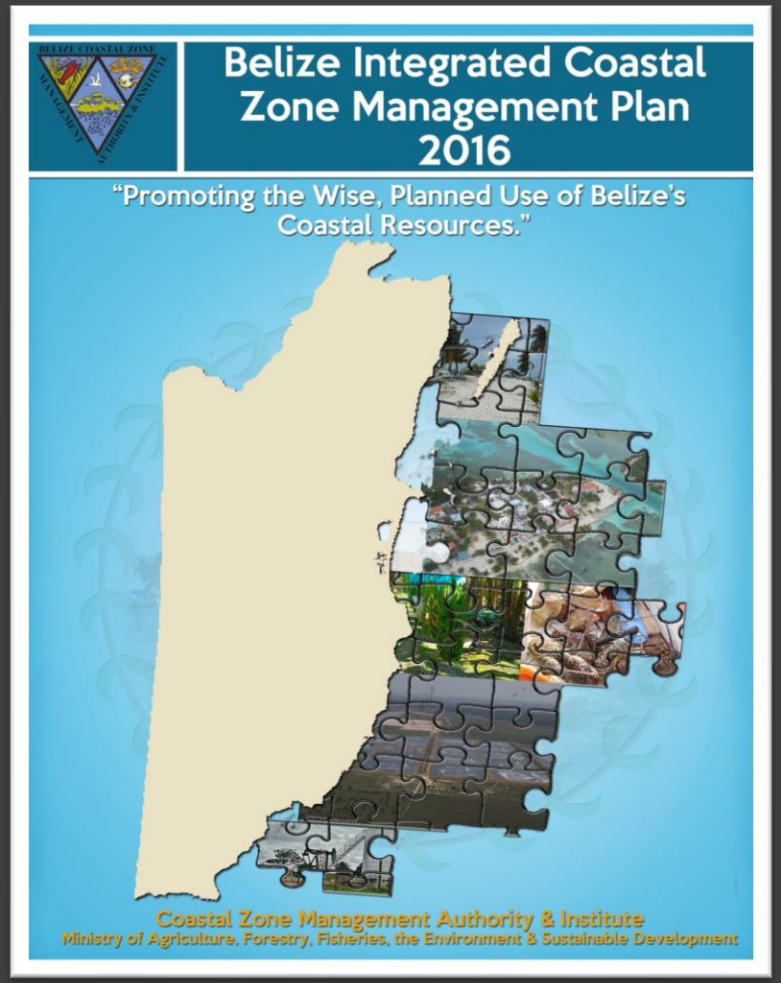
Class	NMHM, v1		NMHM, Oct. 2021 update	
	Area (ha.)	%	Area (ha.)	%
Algae-dominated	3,040	0.3%	36,735	1.8%
Bare substrate-dominated	126,211	13.8%	118,464	5.9%
Seagrass-dominated	417,393	45.7%	229,146	11.3%
Coral-dominated	39,220	4.3%	138,701	6.9%
Deep water	327,292	35.8%	1,501,625	74.2%
TOTAL	**913,156**	**100%**	**2,024,672**	**100%**



Informing Marine Spatial Planning and the development of a Blue Economy

- Update current habitat data layers

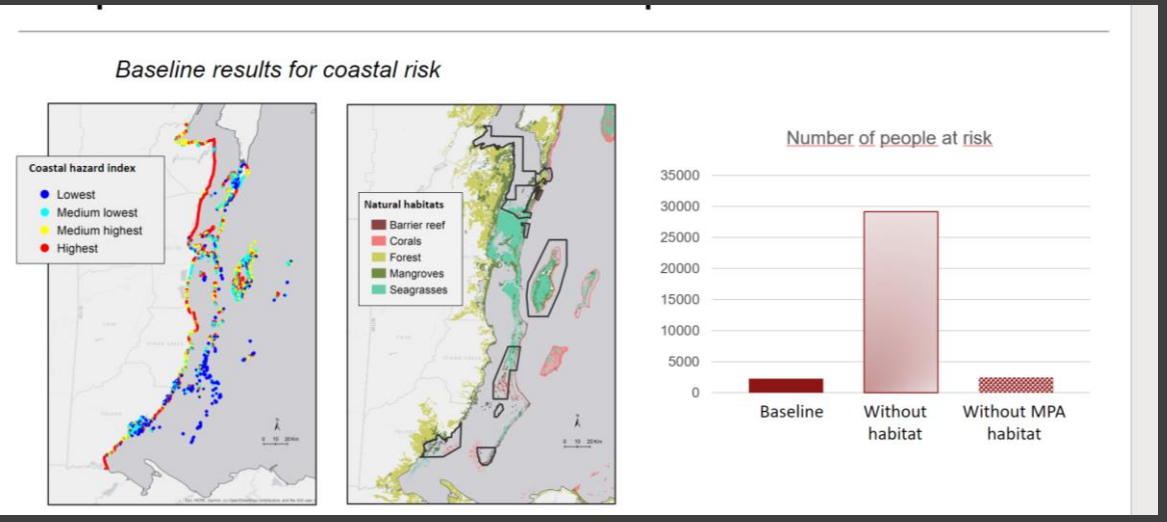
- Update Habitat Risk Assessment (HRA) model: Re-run HRA model using updated human use and habitat layers to produce new HRA risk assessment maps

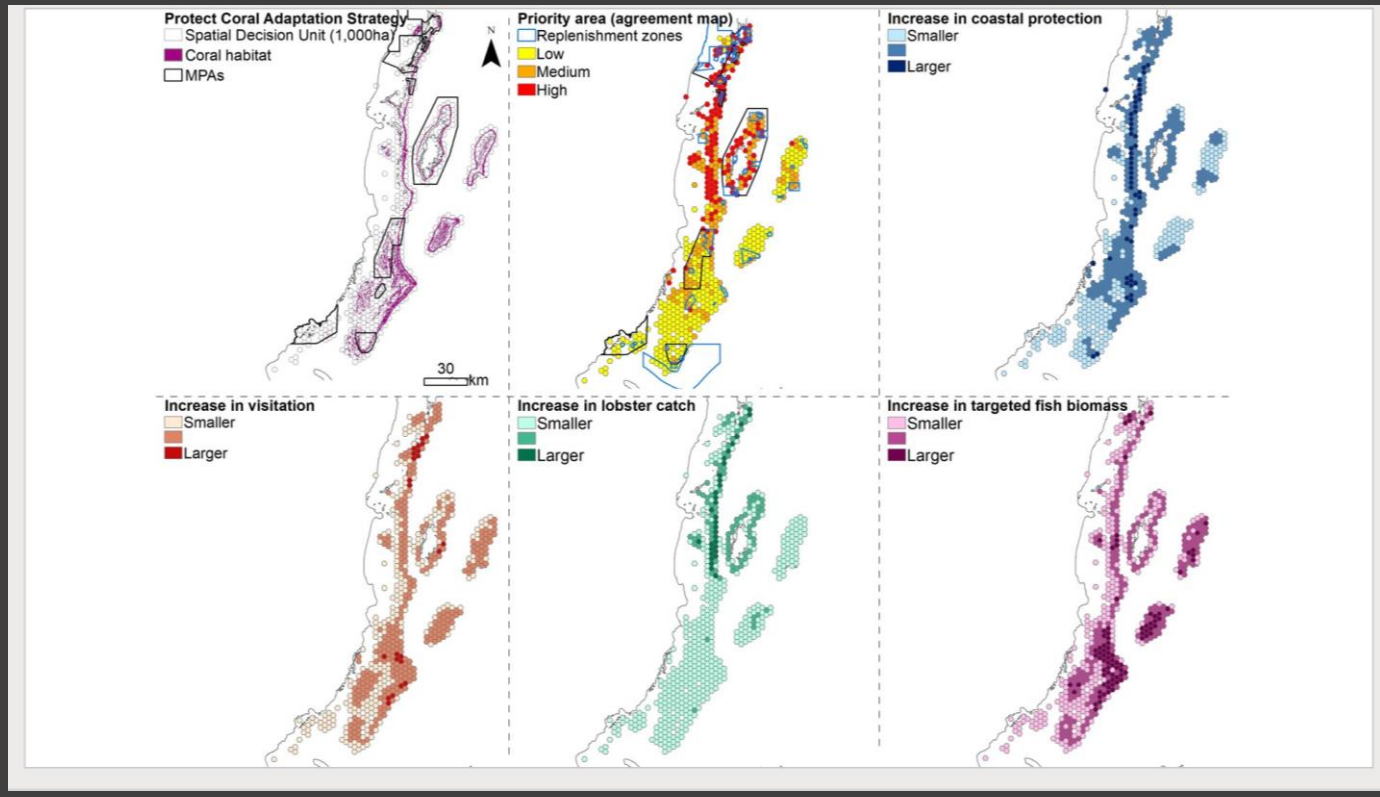




@BZgeo

Adaptation to Climate Change





Conclusion and Next Steps

- Updating based on final processing
- Sharing the final Marine Habitat Map
- Sharing datasets
- Future updating by the CZMAI team

- The final Marine Habitat Map (2021) will provide:
  - Evidence-based data to support policy development and planning in Belize
  - Further identification of Adaptation strategies will inform habitat protection and coastal risk reduction projects and investments
  - Spatial data to support the value and cost of habitat protection and management as well as Belize's ambition and climate change action plan
  - Assess opportunities for the development of Belize's Blue Economy

Coastal Zone Management Authority & Institute

"Leading the sustainable use and planned development of Belize's coastal zone"





THANK YOU!

Mrs. Arlene Young

director@coastalzonebelize.org

www.coastalzonebelize.org

