ENVIRONMENTAL PROTECTION AGENCY MEETING
ECOELÉCTRICA BIOLOGICAL MONITORING PROGRAM
REGION 2 HEADQUARTERS, NY
MAY 22, 2024

EcoEléctrica
A better environment with natural gas

AGENDA

EcoEléctrica Biological Monitoring Program Plan (BMPP)
2019-2024 Update

10:00-10:15 AM	**Greetings & Introductions** **All Attendees**
10:15-10:30 AM	**Regulatory Update 2019-2024** **EcoEléctrica/DNA** Five-year summary: • NPDES Permit renewal process • Water Quality Certificate • Negotiation of Temperature and Residual Chlorine • FWS and NMFS comments

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AGENDA (CONT.)

10:30-11:00 AM **Biological Monitoring**
HJ Reefscaping
Results 2019-2023

- Corals/Sponges
- Seagrasses
- Fishes

11:00-11:30 AM **Water Quality Monitoring**
DNA Environment/UPRM
2020-2023 Water Quality Results

- Continuous Monitoring
- Monthly Monitoring

11:30 AM-12 noon **Outreach Projects**
New Proposal 2024-2029

12:00 noon **Meeting Closure**
All attendees

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INTRODUCTION

EcoEléctrica- Update

Cogeneration Plant

- 545 MW contracted capacity
- Natural gas/propane/fuel oil #2

Desalinization Plant

- 2 MM gallons processed/day
- Water Franchise

LNG Receiving Terminal

- 42 MM Gallon Storage tank
- Pier 1,800 linear ft
- Regasification 279 MM SCFD

Truck Loading Station

Developed and Constructed by Naturgy, Owned by CROWLEY.

Operated by EcoElectrica under an O&MSA.

Two lanes / 24 trucks per day.

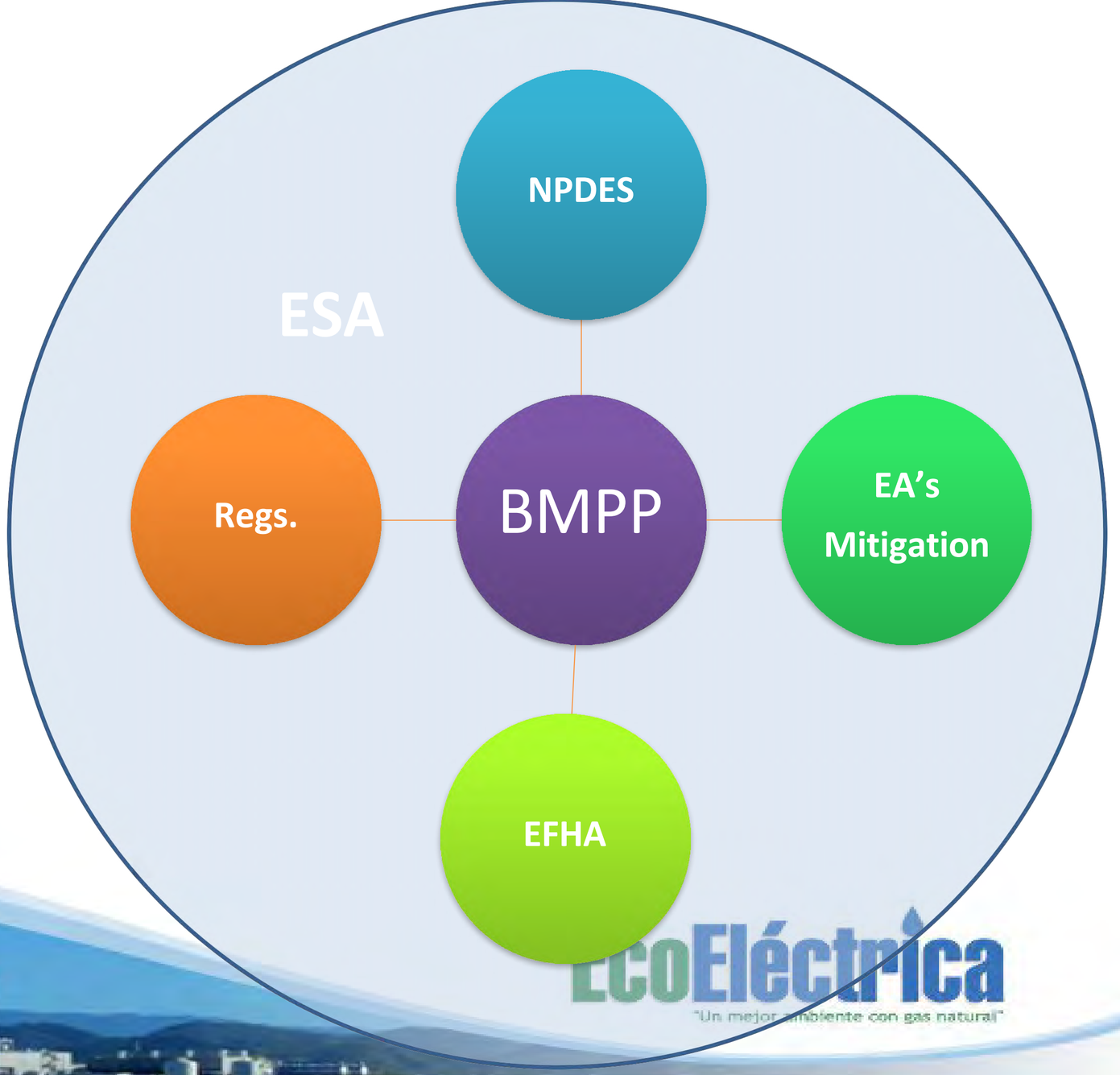
EcoEléctrica produces approximately 17% of PR's electric energy.

Capacity to send out up to 186 MMSCFD natural gas to the neighboring PREPA Costa Sur Power Plant in addition to 93 MMSCFD consumed by the facility. With 21,581 MMBTU LNG Sendout to TLF.

BMPP- 5 YR SUMMARY

Environmental Context- Cooling Water Discharge

Background



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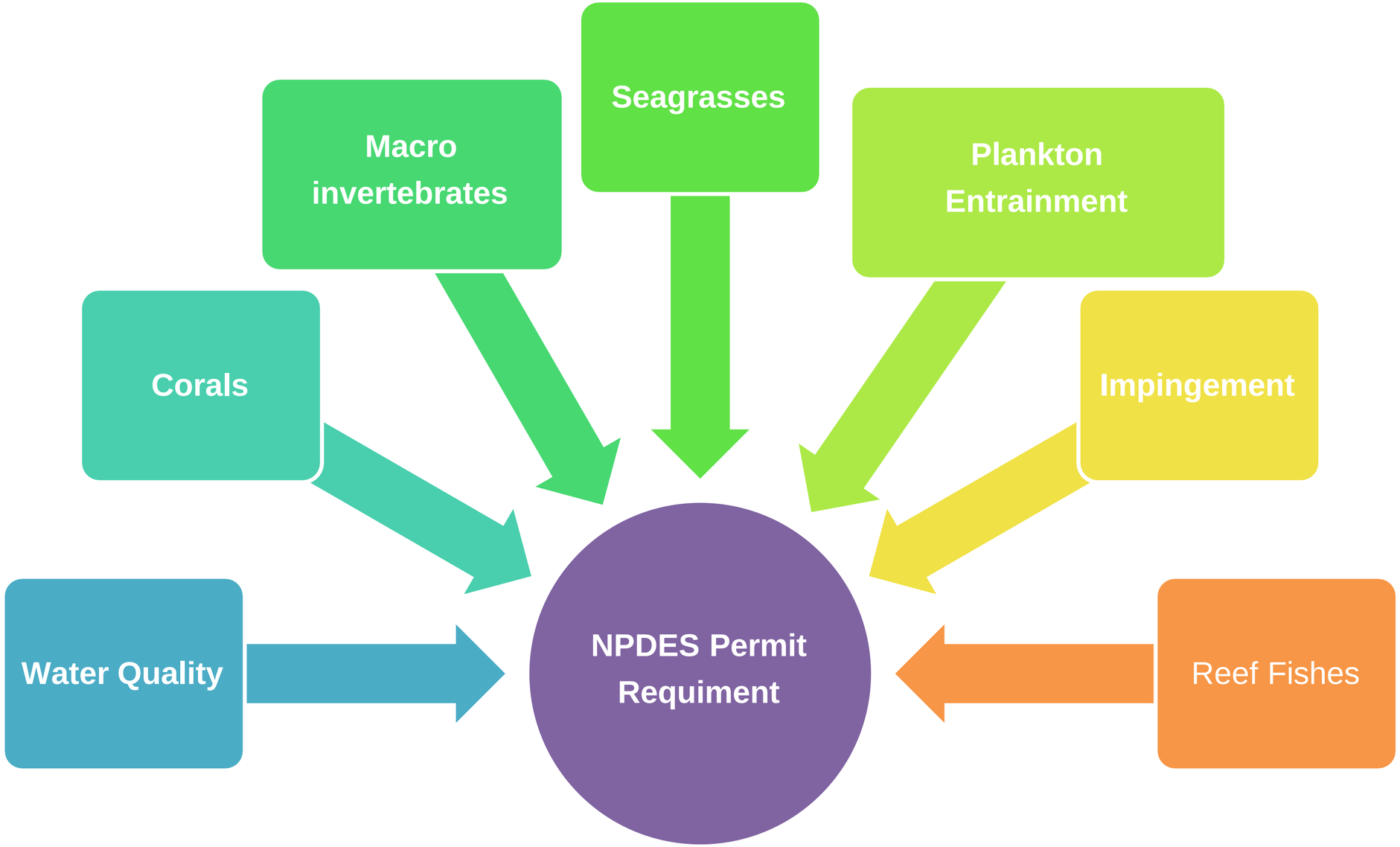
Biological Monitoring Program Elements



REGULATORY UPDATE
2020-2024

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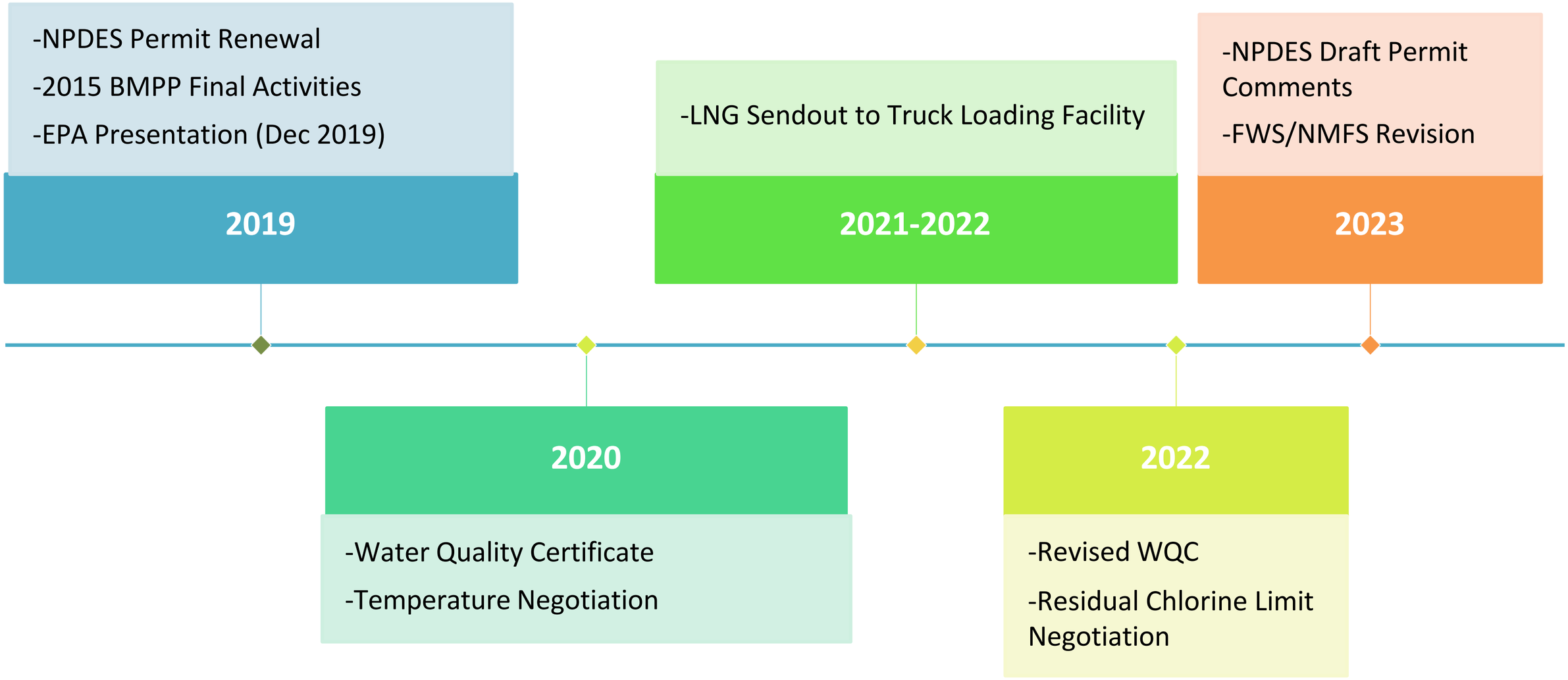
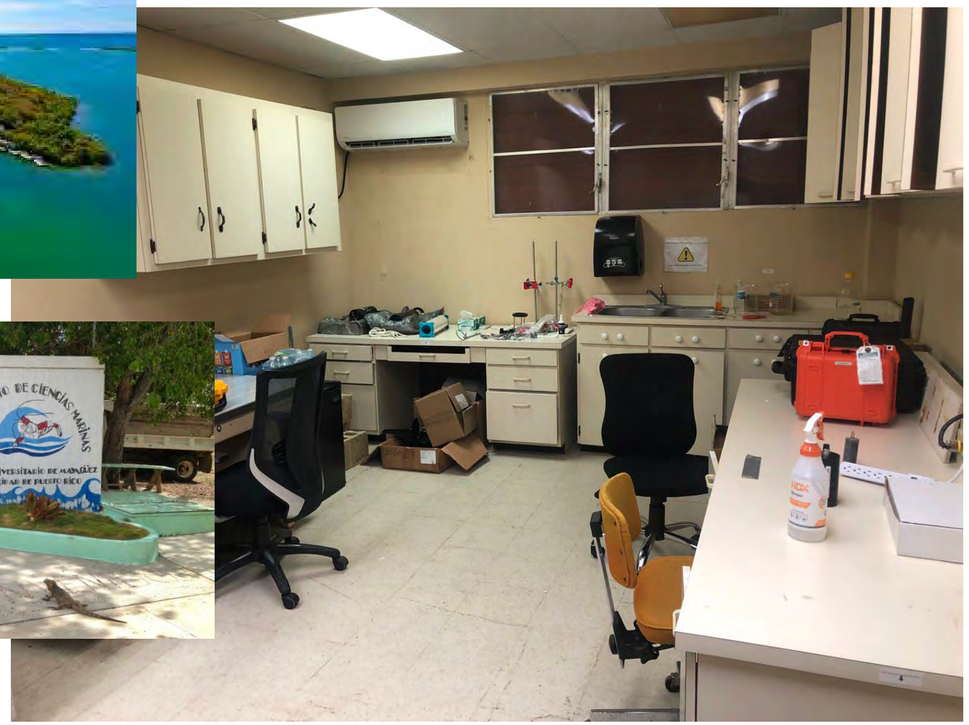
REGULATORY UPDATE



Biological Monitoring Program Plan Technical Staff Update
Water Quality 2020-Date

- **EcoEléctrica MOU with UPRM (2021)**
  - Master's Plan 1 and 2
    - Damaris Negrón- PM
    - Dr. Travis Courtney- TA
    - Leira Centeno
  - Subvention 3-MS students
- CAPEX: $200K+ instruments
- Magueyes Lab Lease- $650/month
- Use of UPRM boats



Leira Centeno- Project Paper

EcoEléctrica Biological Monitoring Project Plan Report: 2022

Leira Centeno Mejías
Department of Marine Sciences
University of Puerto Rico Mayagüez

Introduction

EcoEléctrica is located between Guayanilla Bay and Tallaboa Bay in the southern coast of Puerto Rico and host a diverse array of ecosystems and uses for the island of Puerto Rico (Figure 1). The EcoEléctrica plant includes a 545 mega-watts combined cycle natural gas power plant, a seawater desalination plant, and a marine unloading and storage terminal for liquefied natural gas (EcoEléctrica, 2015). EcoEléctrica imports liquefied natural gas at the pier, stores it in the terminal, and then vaporizes it into natural gas for combustion in one of two combustion turbines attached to a single steam turbine (EcoEléctrica, 2015). A portion of the steam produced is subsequently used in a desalination plant to convert seawater into freshwater (Vicente, 2001, 2008; Otero 2013a, 2013b). To cool the facilities, raw seawater is pumped from near the shoreline of the pier into an 8-cell cooling tower to remove heat from processed wastewater and from the condenser of the steam turbine system. After that, the water is pumped to a cooling tower to remove excess heat before it is discharged through a 51 cm pipe in the outfall (Vicente, 2001, 2008; Otero 2013a, 2013b). The intake is designed with a mesh to protect marine organisms from entering the system, and the outfall includes a diffuser that is designed to return the seawater to the bay at approximately the same temperature as the intake (EcoEléctrica, 2015).

EcoEléctrica's discharge through the outfall is regulated under 40 CFR 125.123- "Criteria and Standards for the National Pollutant Discharge Elimination System (NPDES) Ocean Discharge

1st Student
Subventioned by Industry

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BMPP IMPLEMENTATION
2020-2024

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BMPP Implementation 2020-2024

Study	Details
Coral Study	Coral large scale
	Coral small scale
ESA and Action area	Coral ESA
	Coral ESA additional site (Louis Reef)
	Coral (Transplant site) Cptn Egorov
Seagrass	Seagrasses large scale
Macro invertebrates	Motile macro invertebrates
Fish Survey	Fish survey
Water Quality Monitoring	Monthly
	Continuous

***All Results Within Established Parameters**

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BIOLOGICAL STUDIES

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HJR Reefscaping Team

- Hector Ruiz, Ph.D. (Coral & algae ecology)
- Michelle Scharer, Ph.D. (Fish ecology)
- Antonio Ortiz, Ph.D. (Coral & seagrass ecology)
- Chelsea Harms, Ph.D. (Fish ecology)
- Jose Vargas (Restoration expert)

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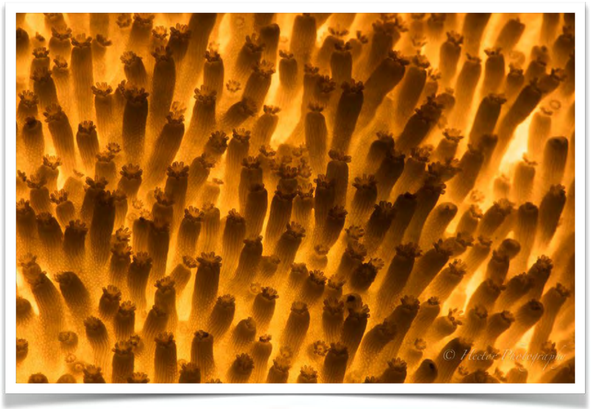
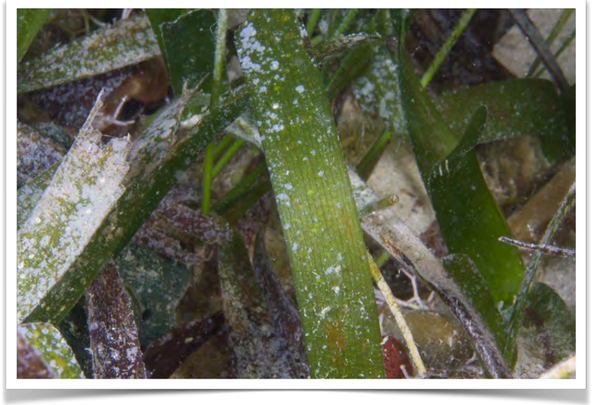
- **Coral reefs**
  - Percent of benthic cover
  - Coral demography
  - Orthomosaics



- **Seagrasses**
  - Percent benthic cover



- **Fishes**
  - Diversity & abundance
  - Nassau grouper recruitment

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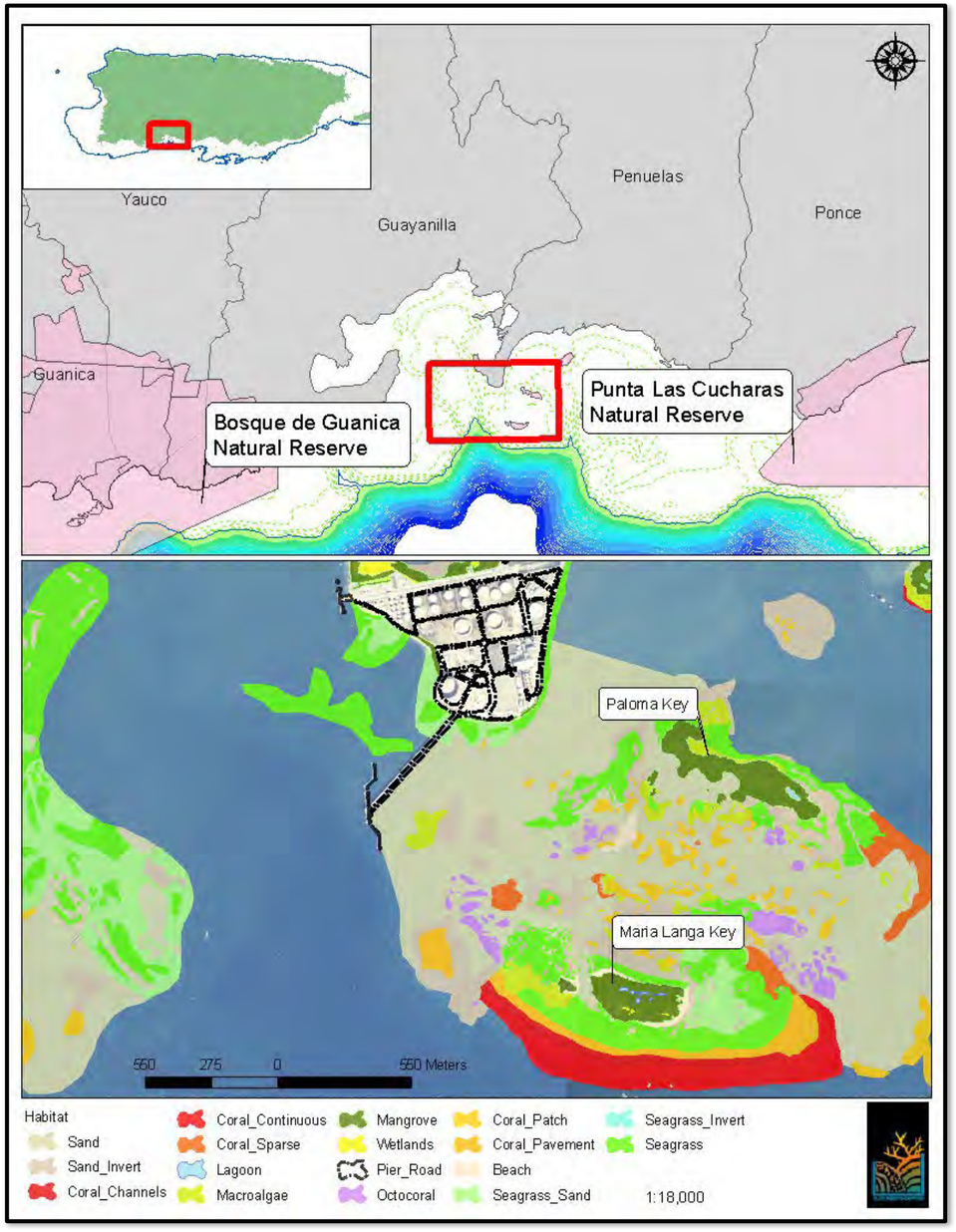
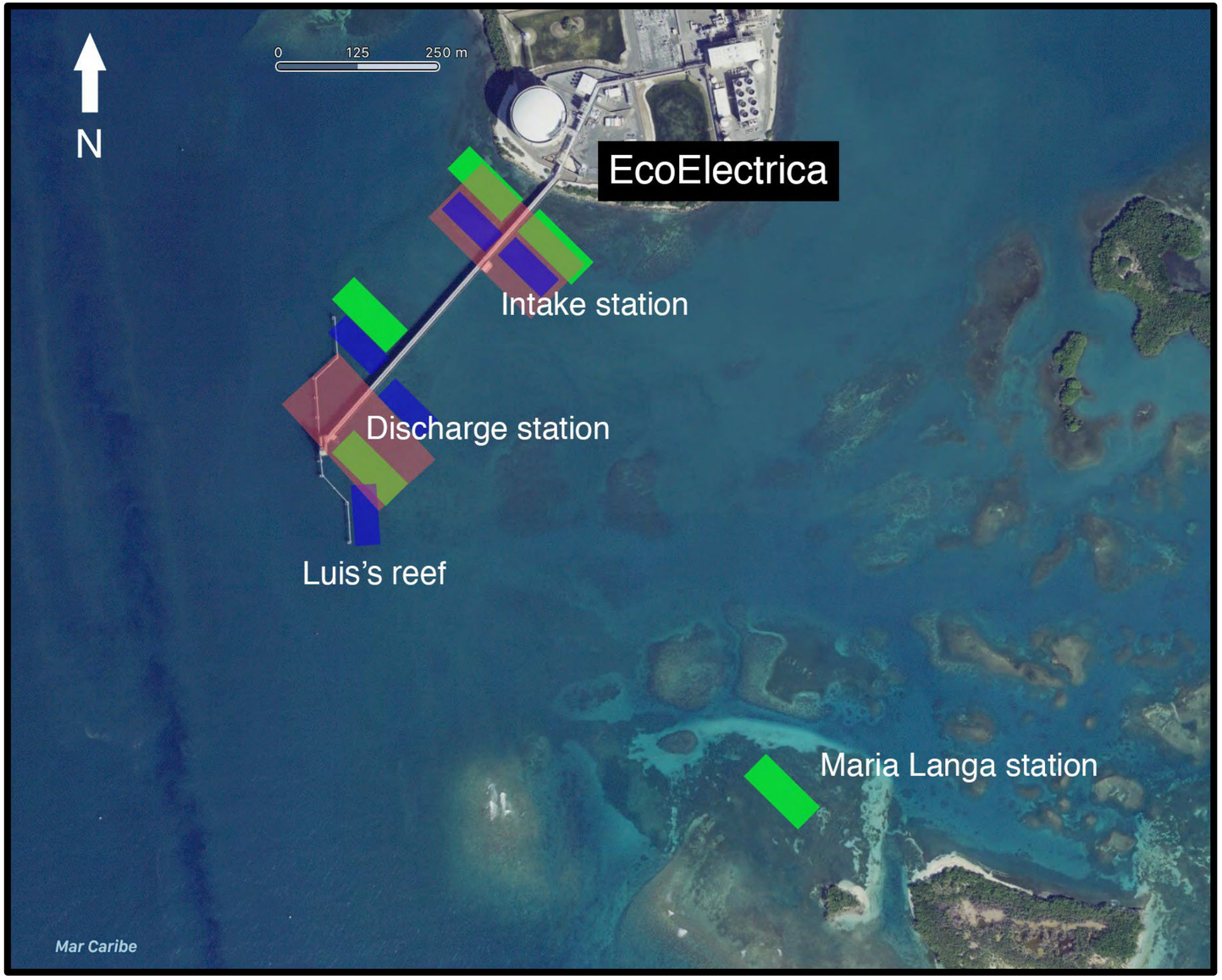
20

Location of Monitoring Stations





Coral reefs

- Benthic cover %
- Coral demography
- Orthomosaic

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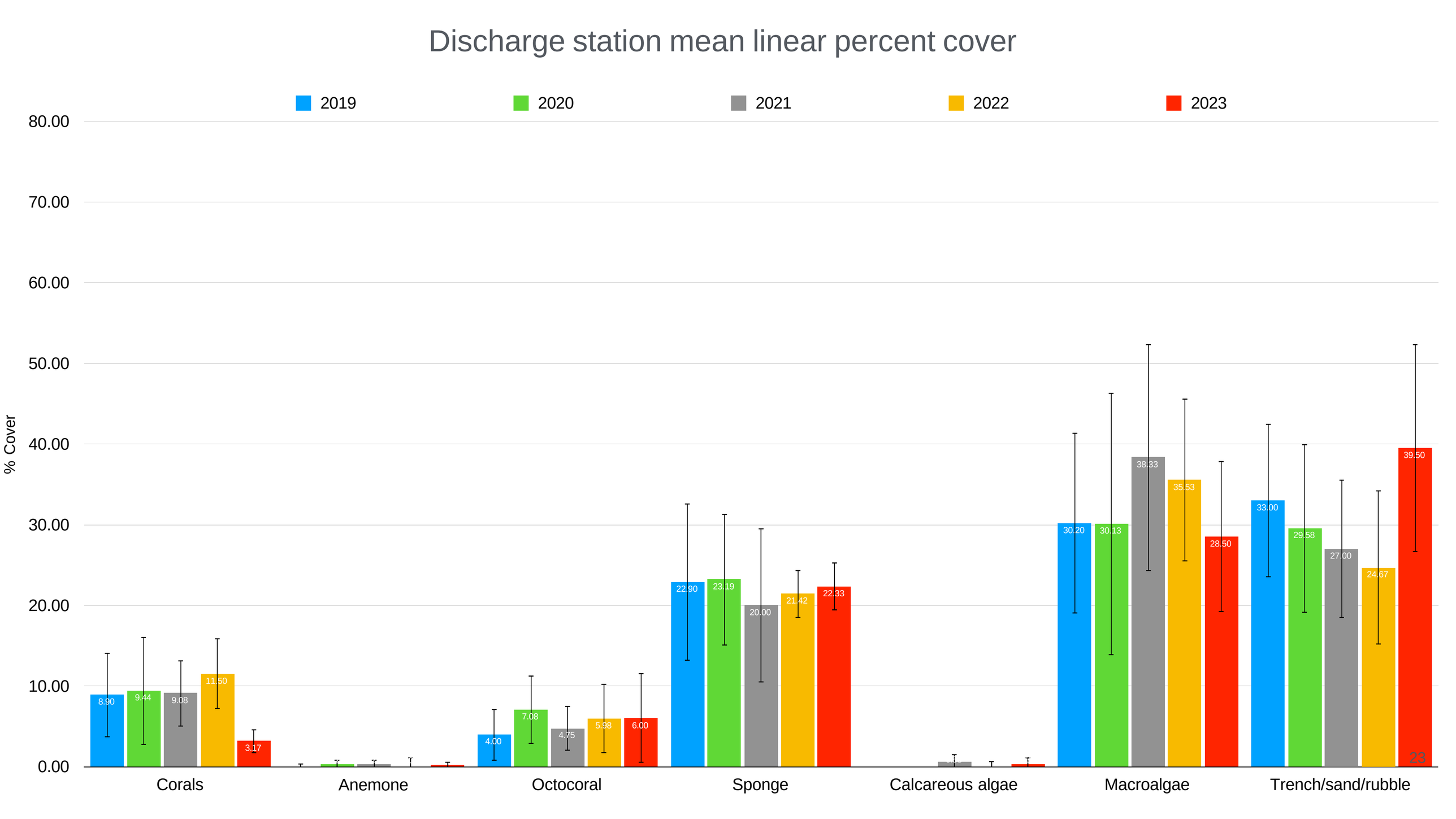
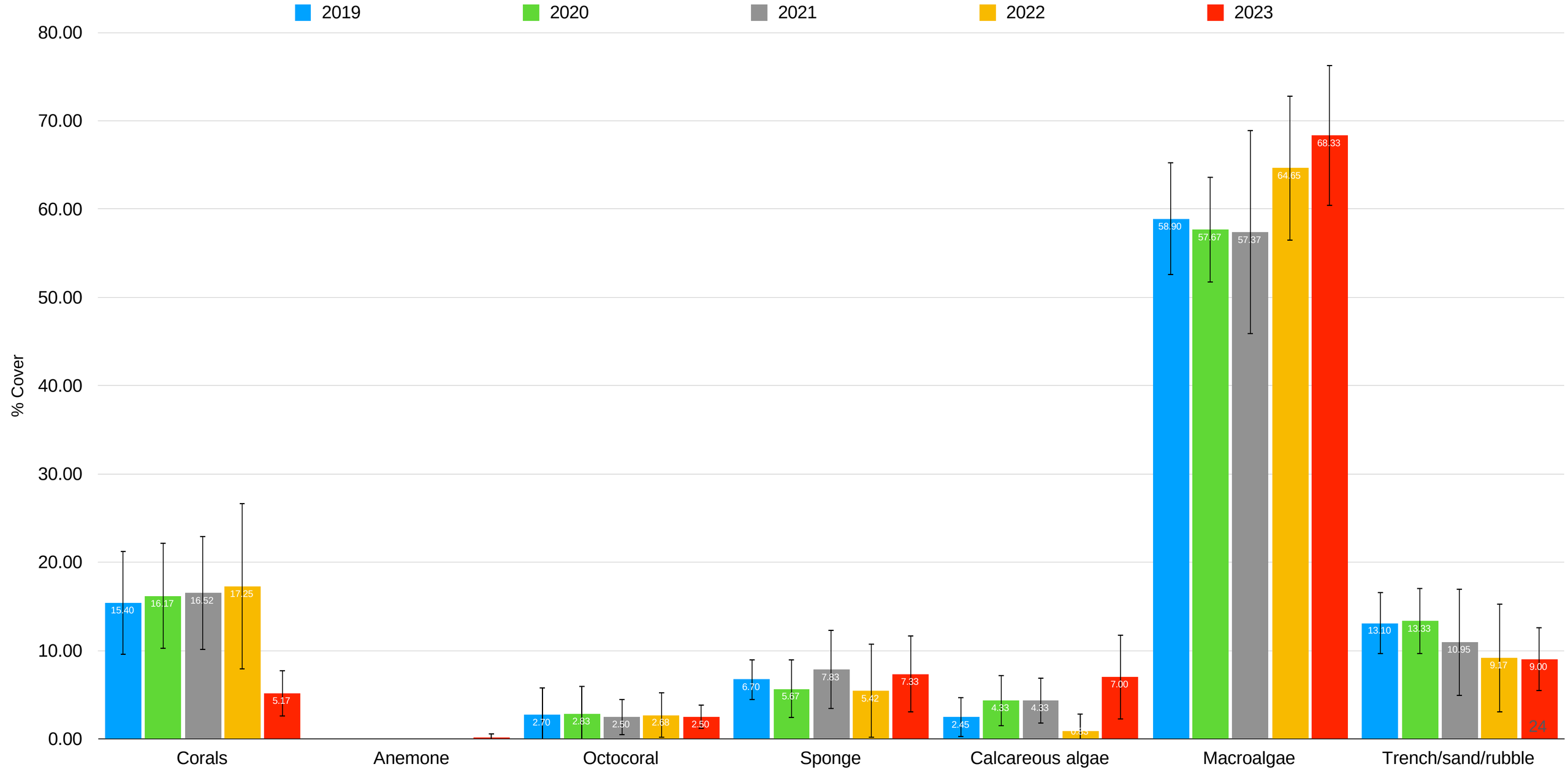
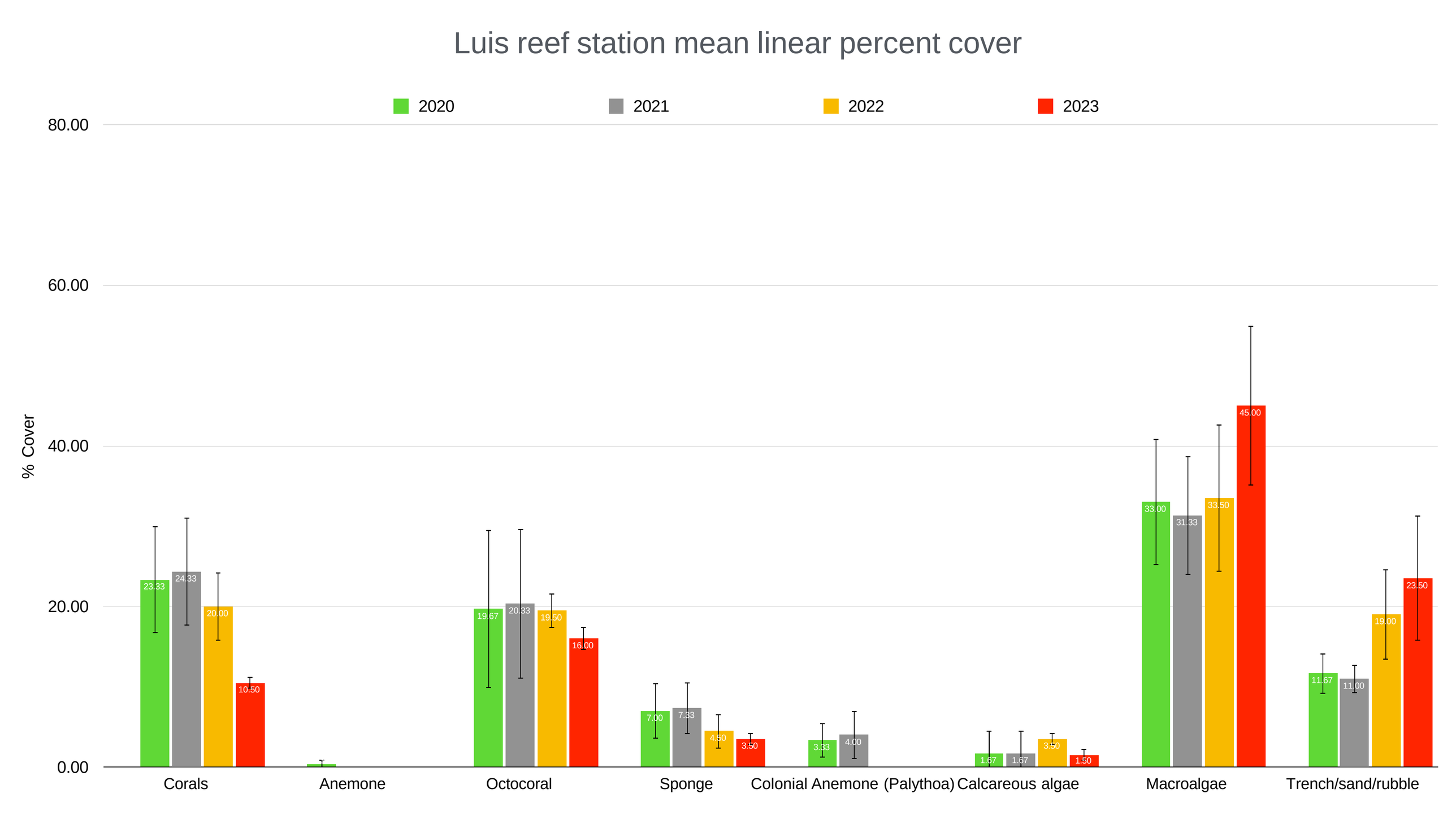
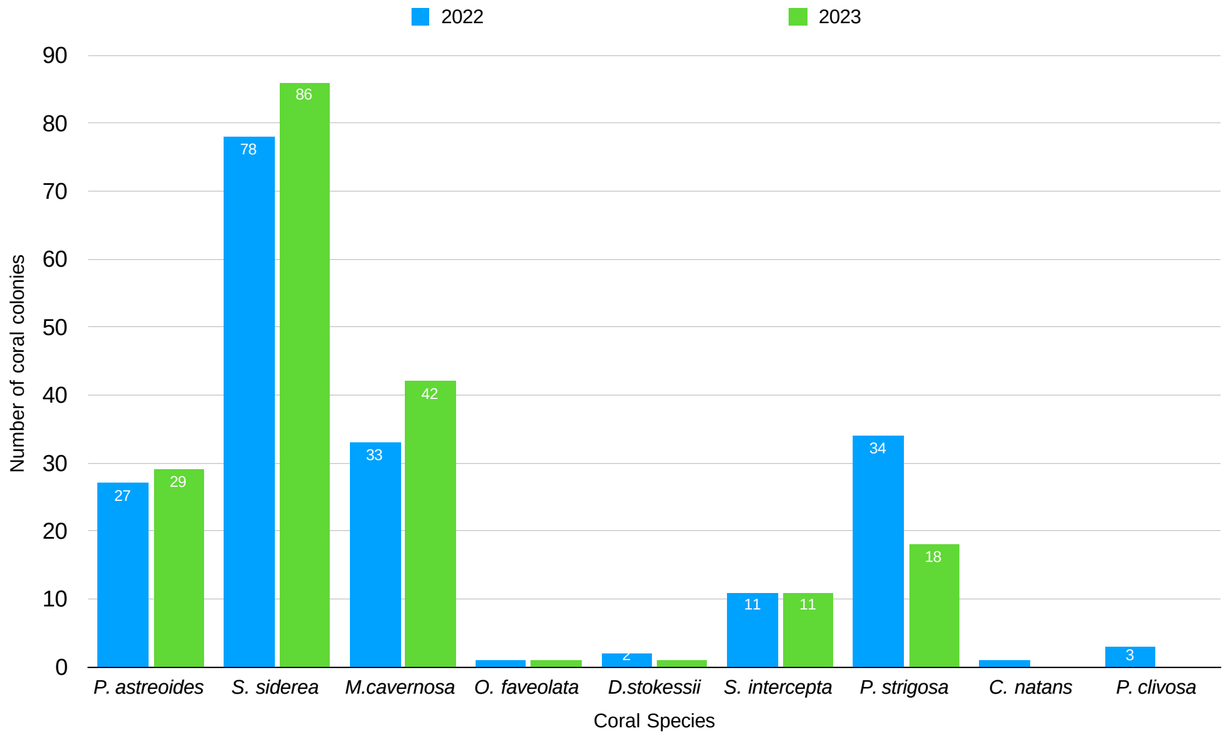
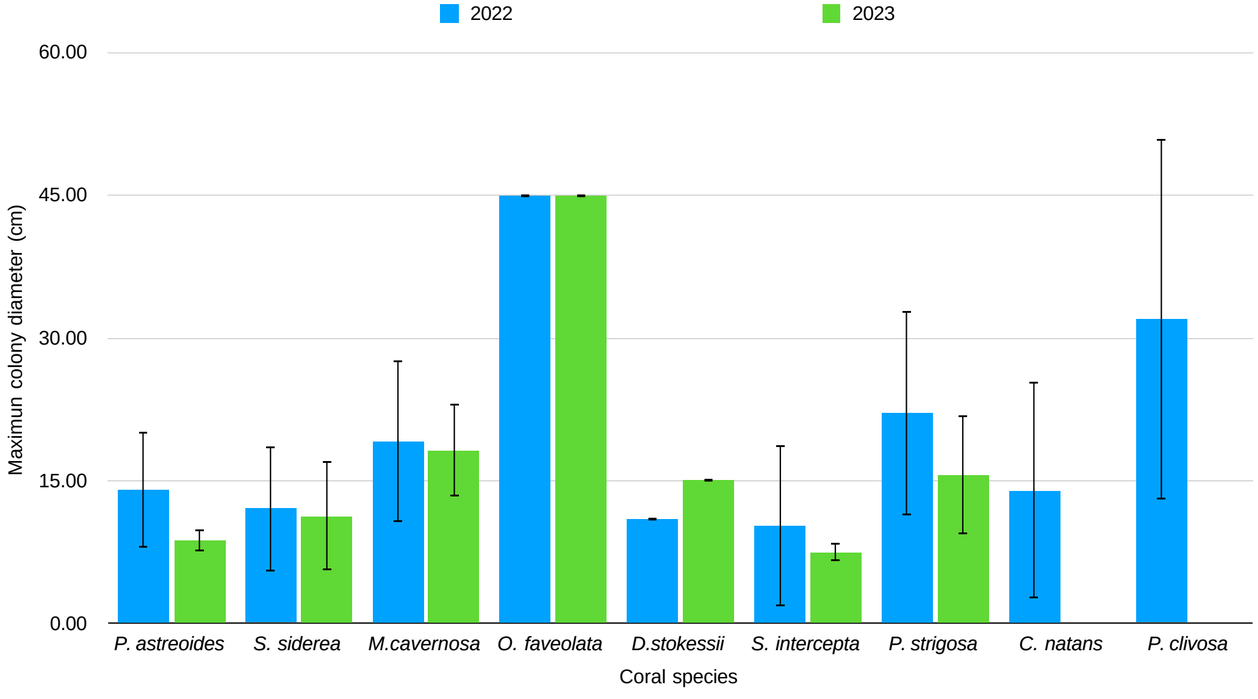

Discharge station mean linear percent cover
2019
2020
2021
2022
2023
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
% Cover
8.90
9.44
9.08
11.50
3.17
4.00
7.08
4.75
5.98
6.00
22.90
23.19
20.00
21.42
22.33
30.20
30.13
38.33
35.53
28.50
33.00
29.58
27.00
24.67
39.50
Corals
Anemone
Octocoral
Sponge
Calcareous algae
Macroalgae
Trench/sand/rubble

Intake station mean linear percent cover




Luis reef station mean linear percent cover
2020
2021
2022
2023
80.00
60.00
40.00
20.00
0.00
% Cover
23.33
24.33
20.00
10.50
19.67
20.33
19.50
16.00
7.00
7.33
4.50
3.50
3.33
4.00
1.67
1.67
3.50
1.50
33.00
31.33
33.50
45.00
11.67
11.00
19.00
23.50
Corals
Anemone
Octocoral
Sponge
Colonial Anemone (Palythoa)
Calcareous algae
Macroalgae
Trench/sand/rubble

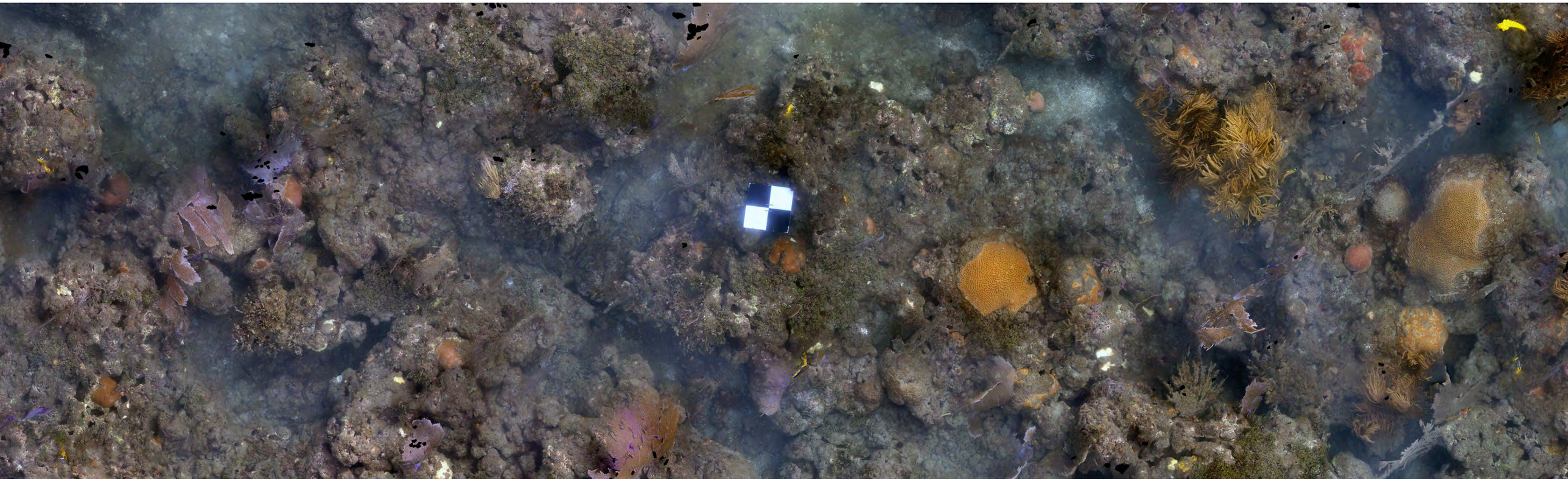




Coral demographic information at the discharge station

- Loss of coral diversity (two species)
- Significant loss of coral colonies of *P. strigosa*
- Apparent increase in # of colonies is due to methodology (partial mortality)
- Loss of large coral colonies (SCTLD)
- Bleached coral colonies:
  - In 2022- 4/191= 2.1%
  - In 2023- 61/186= 32.8%

Orthomosaic of a permanent transect at the Intake station



Egorov restoration site

November 2021

Area of 96 m^2

622 colonies

6.45 col./m^2

10% coral cover

13 species present

April 2022

395 colonies died (63%)

4.1 col./m^2

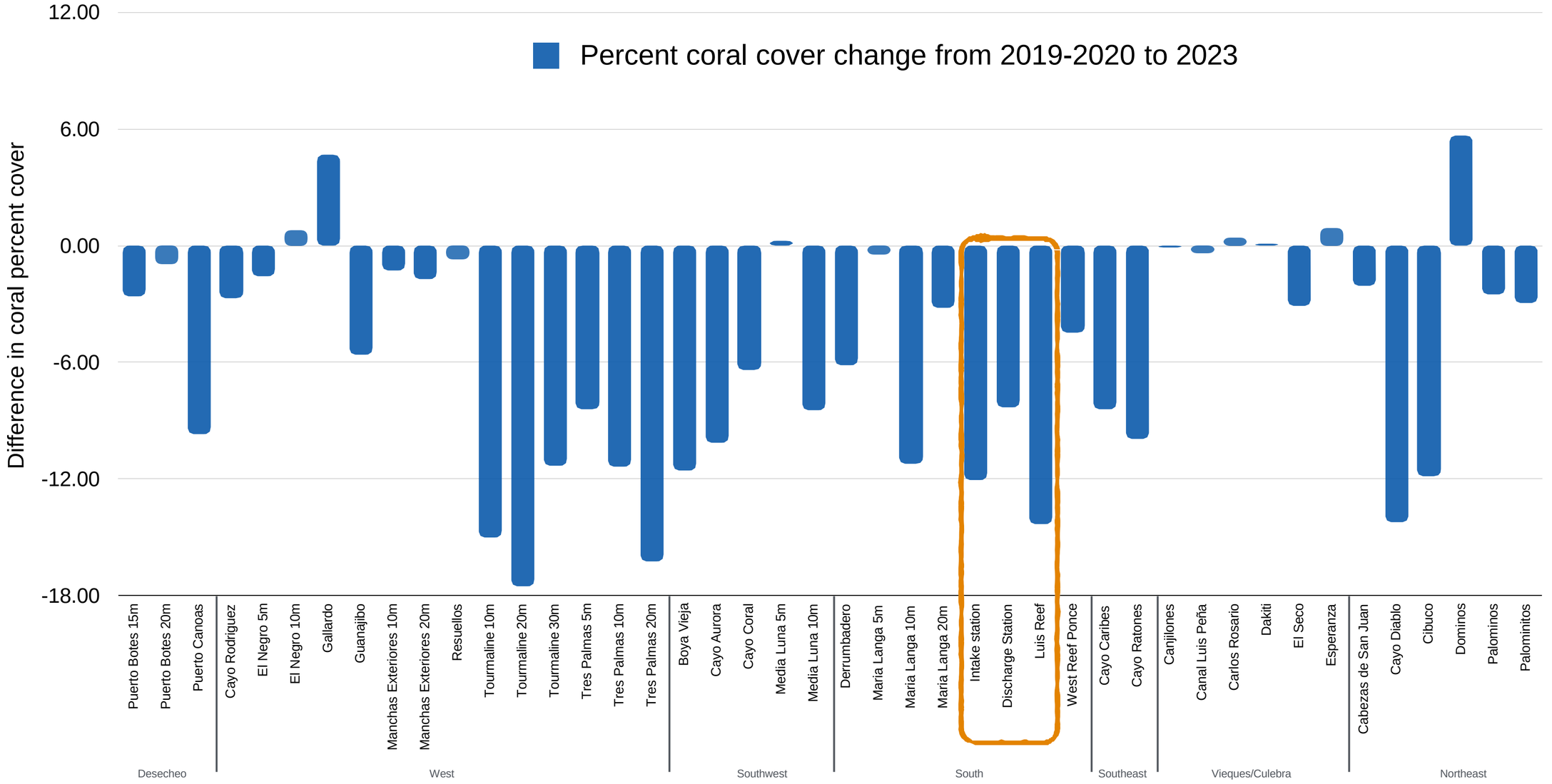
41% live tissue loss

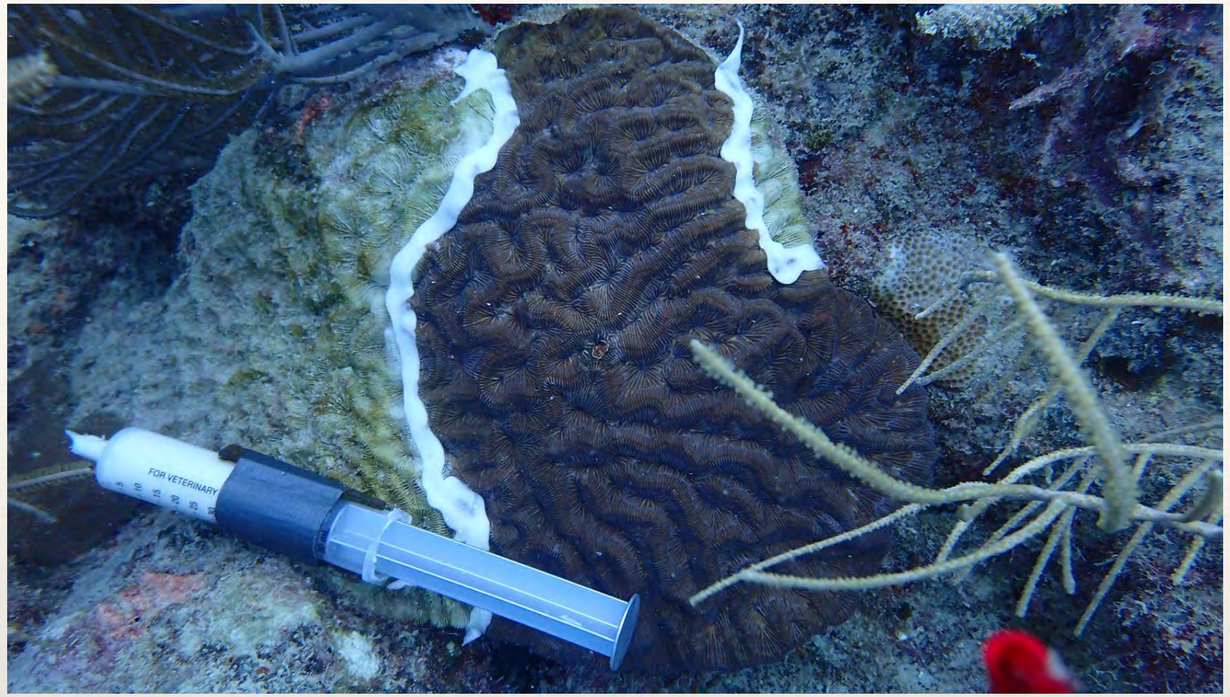
6 % coral cover

7 species affected

4 species gone

Puerto Rico coral reef monitoring program data

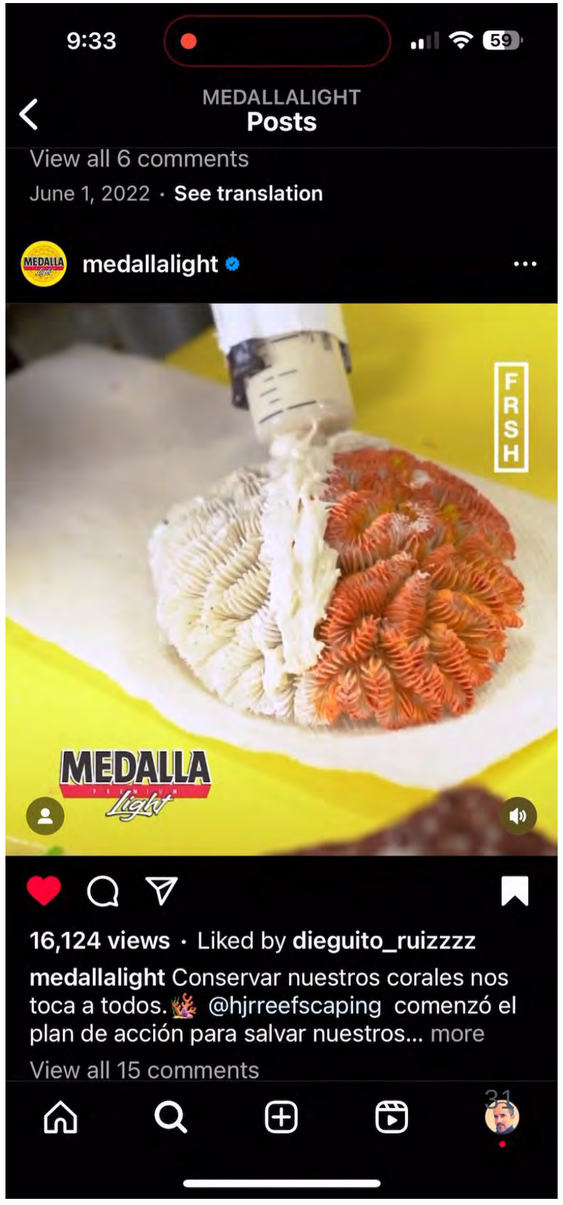



FOR VETERINARY

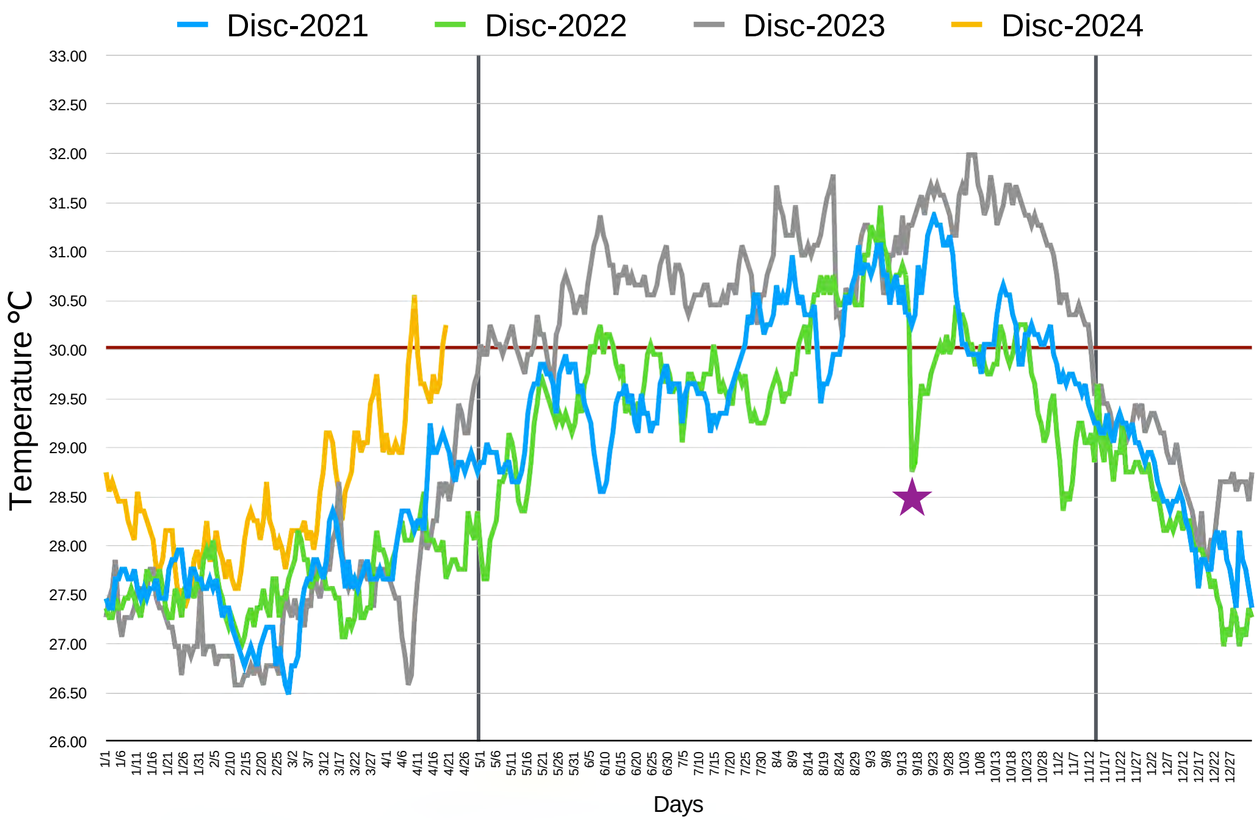
Efforts to save as many colonies as possible

Accomplishments

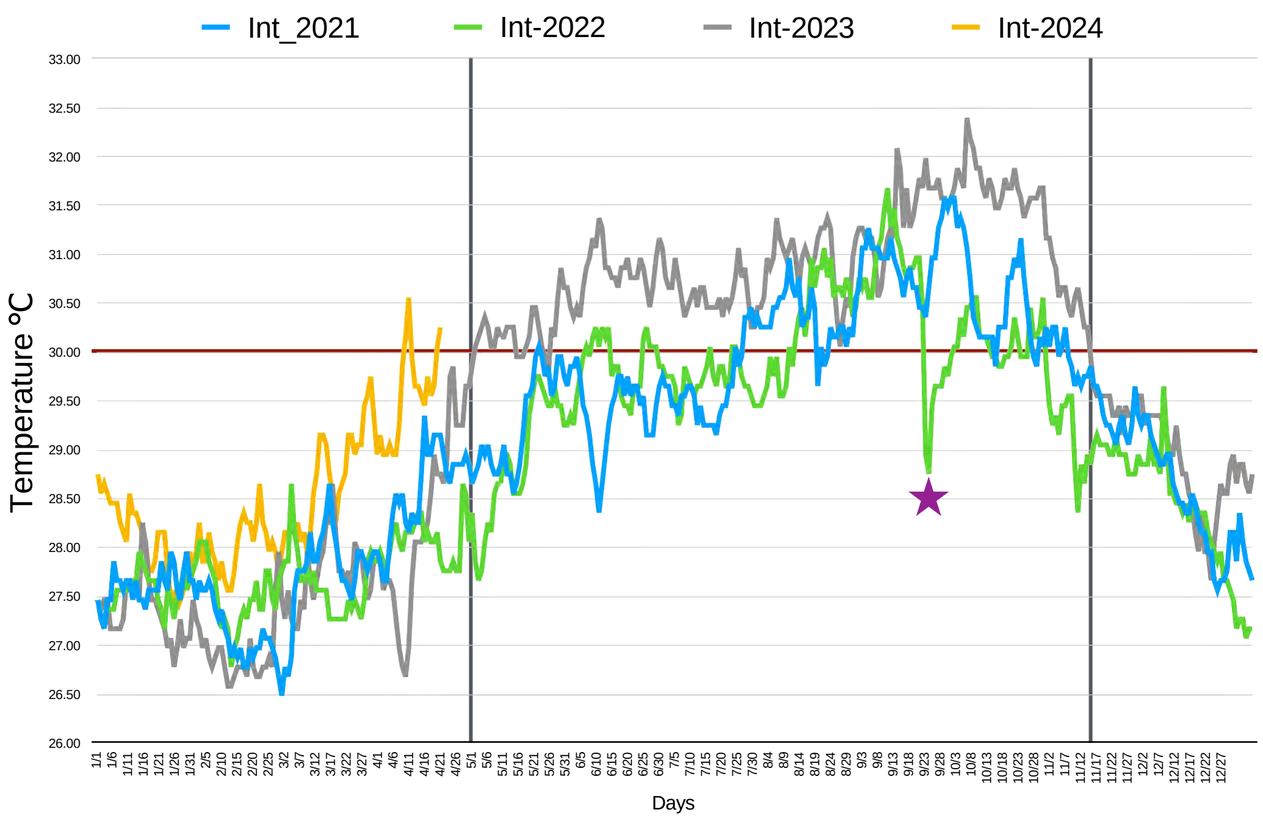
- Collaborative effort between Medalla, HJR Reefscaping, TNC DRNA & EcoElectrica
- Visited 10 sites in southern and western Puerto Rico
- 33 Field work days for treatment and orthophotomosaic (from 03/05/2021)
- Recruited over 120 volunteers with over 31 webinar presentations by Dra. Nilda Jimenez (DNER) and Catalina Morales with support from “Cervecera de Puerto Rico”.
- Approximately **2,697** colonies treated with antibiotic (32% success in Guayanilla area).



Discharge



Intake



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Benthic (Coral) Studies Summary

- Macroalgae is the dominant benthic organism at both stations
- Coral cover is **5.17%** (17.25%) at the Intake
- Coral cover is **3.17%** (11.50%) at the Discharge
- Coral cover is **10.50%** (24.33%) at Luis Reef
- Significant differences in coral cover with 2023, due to SCTLD and bleaching event (heat wave)
- National Coral Reef Monitoring Program's island wide coral cover was 5.20% ±0.41% (2021)

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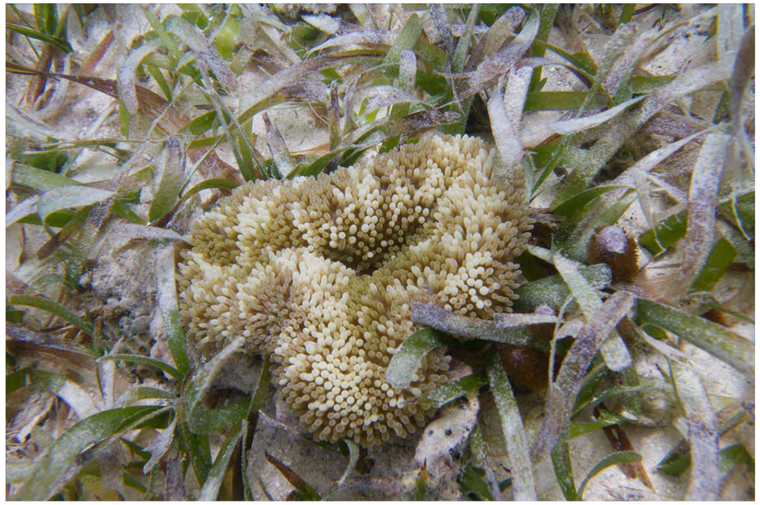
Seagrasses

- Large Scale
- Percent cover



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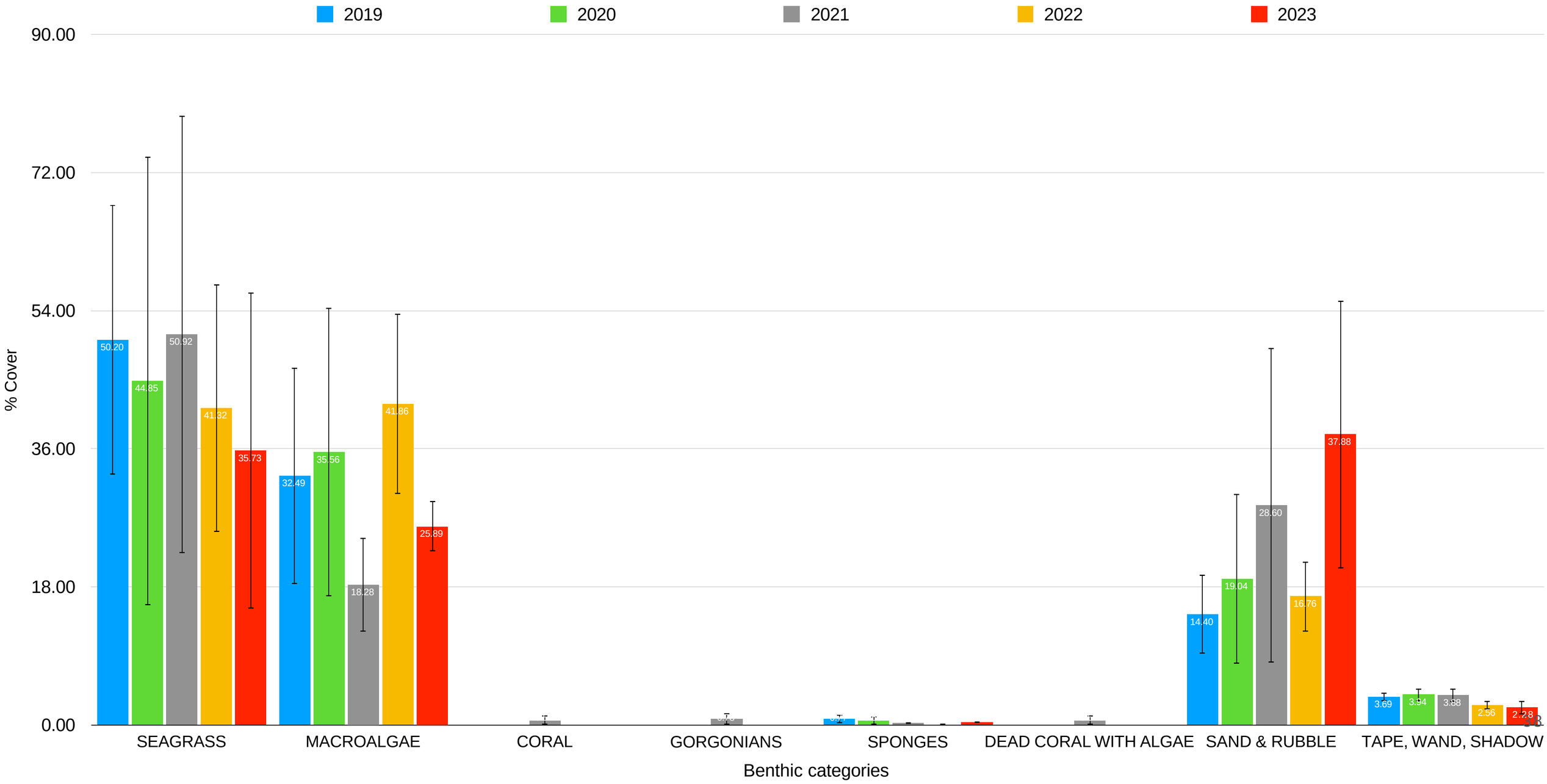
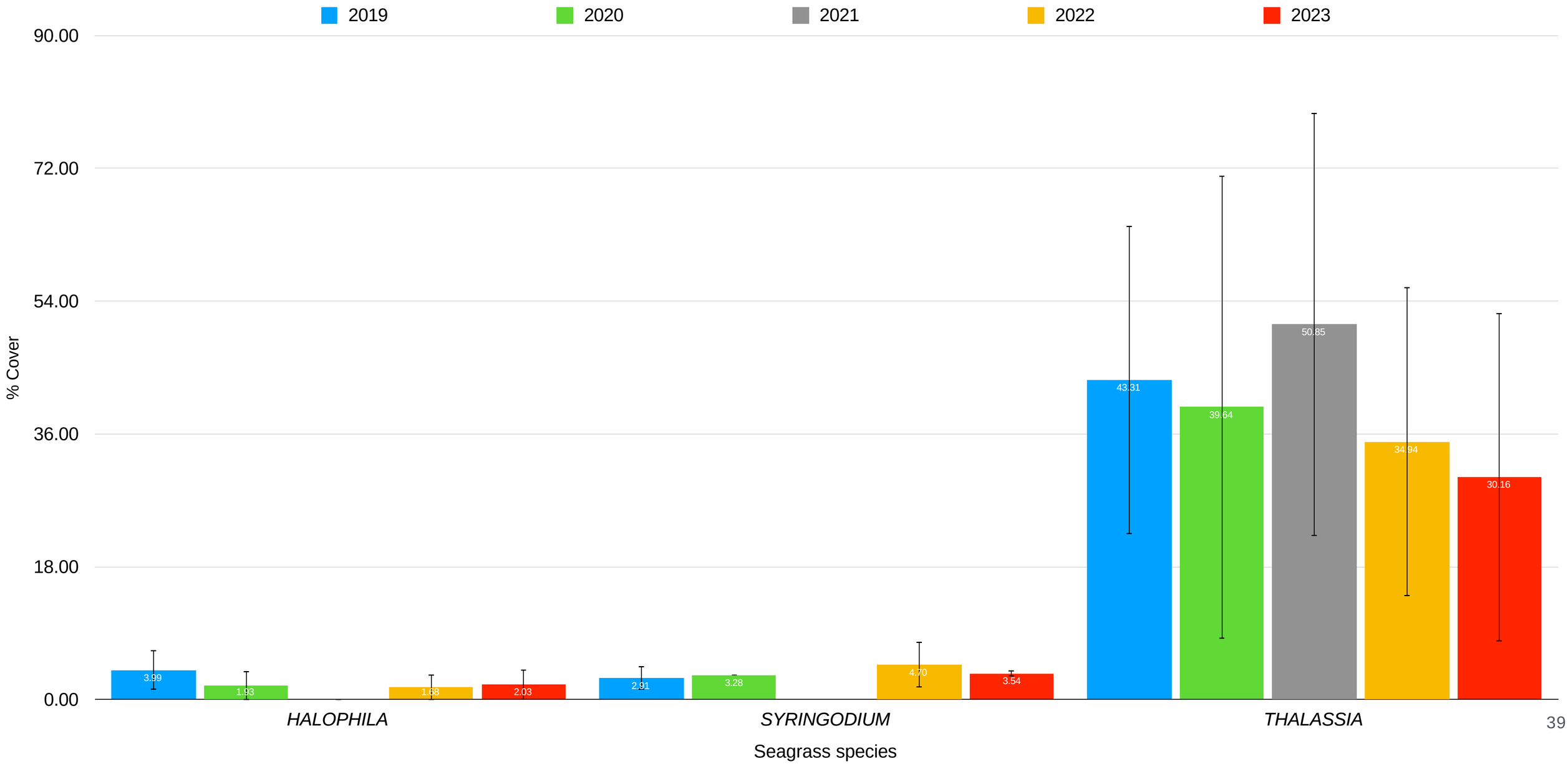
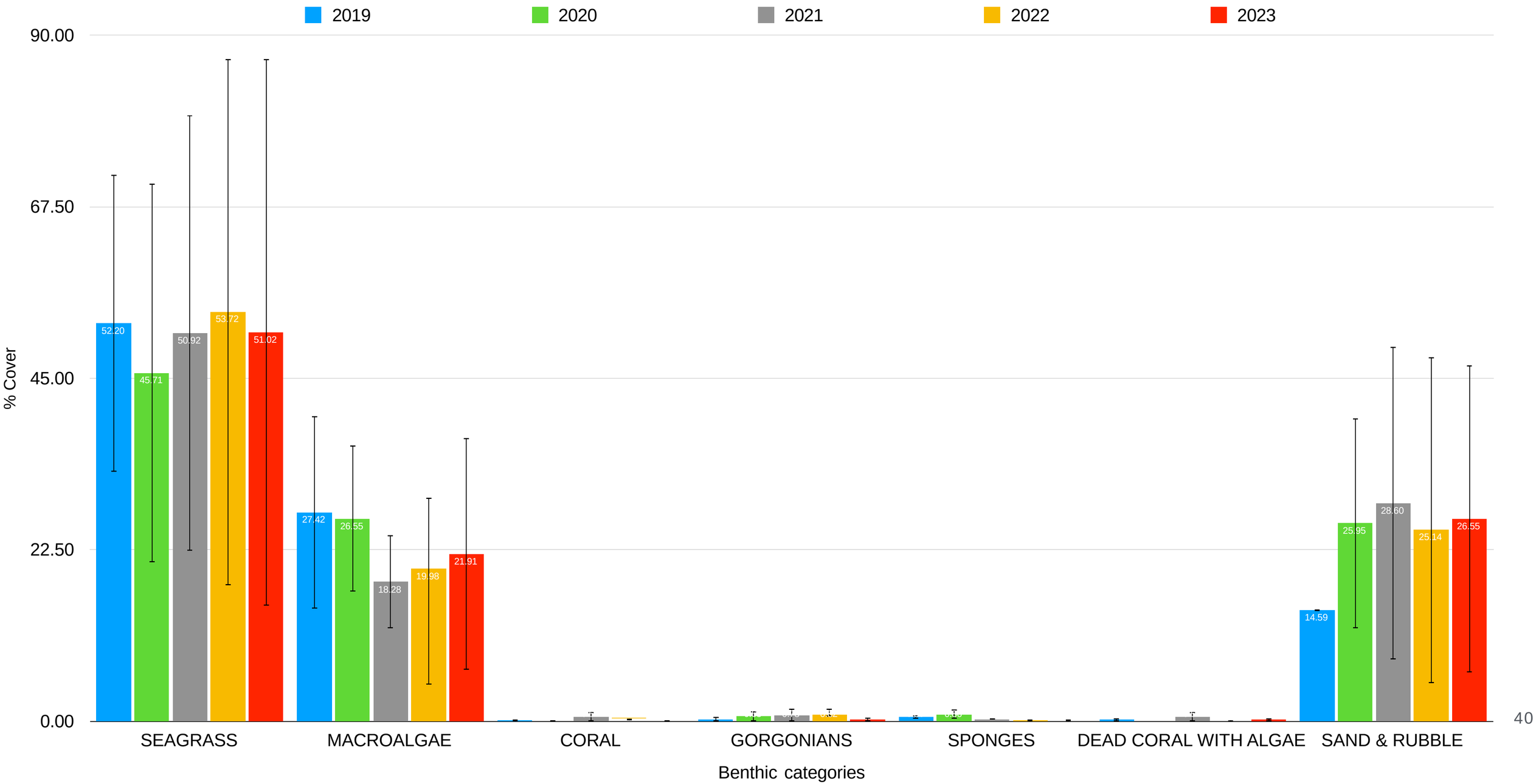
Soft sediment major categories at discharge station



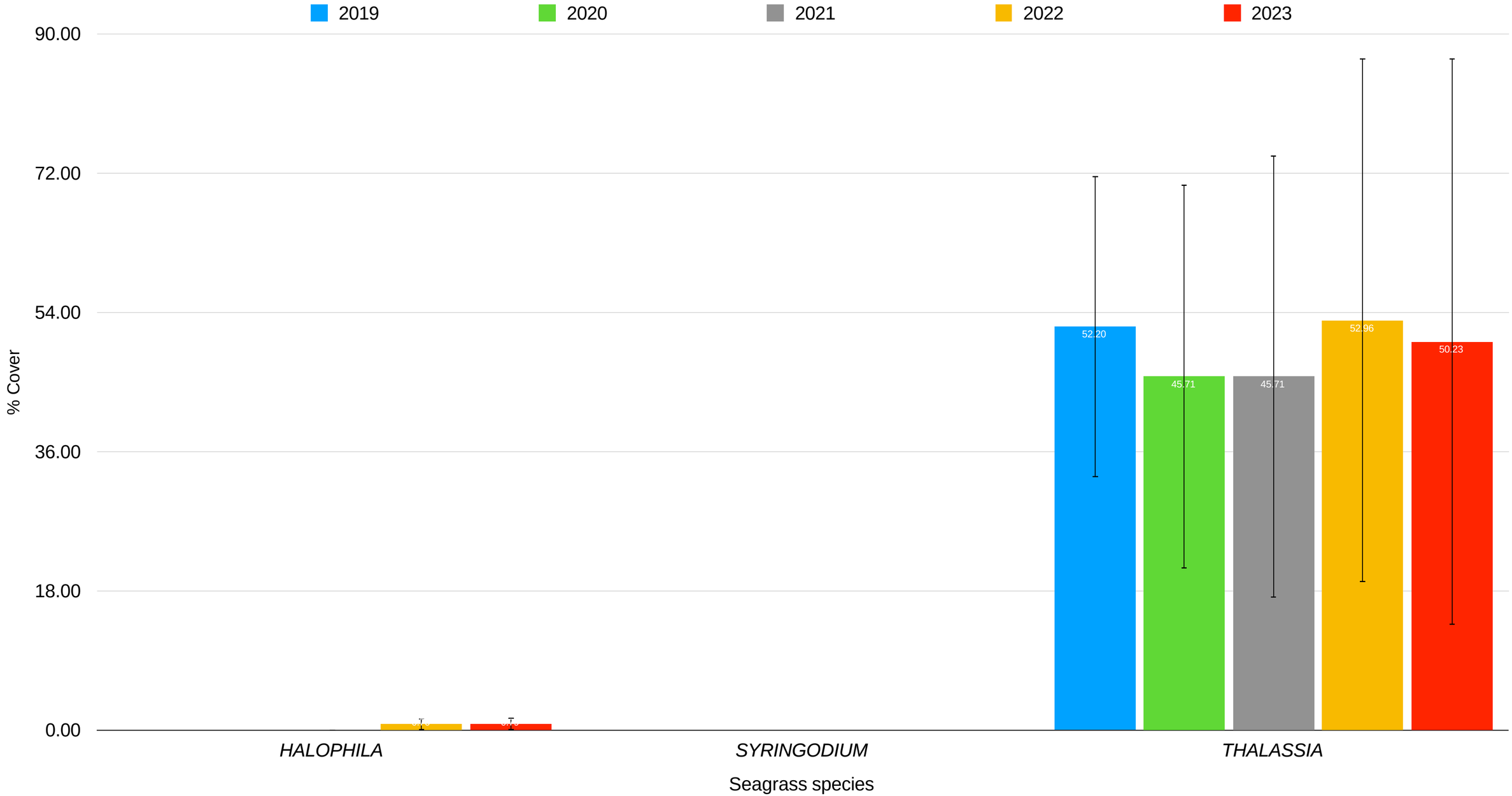
Discharge station seagrass species cover

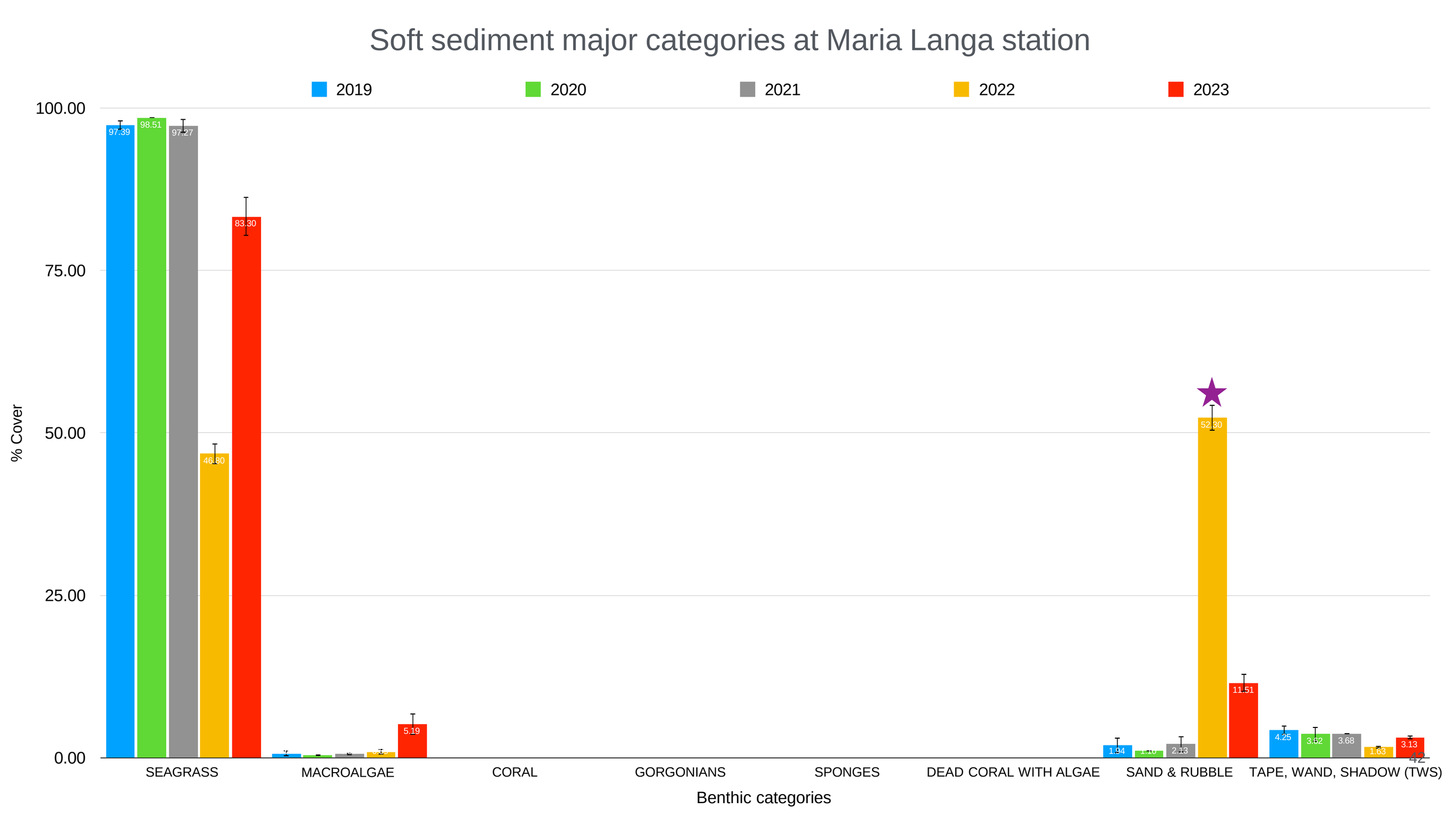


Soft sediment major categories at intake station

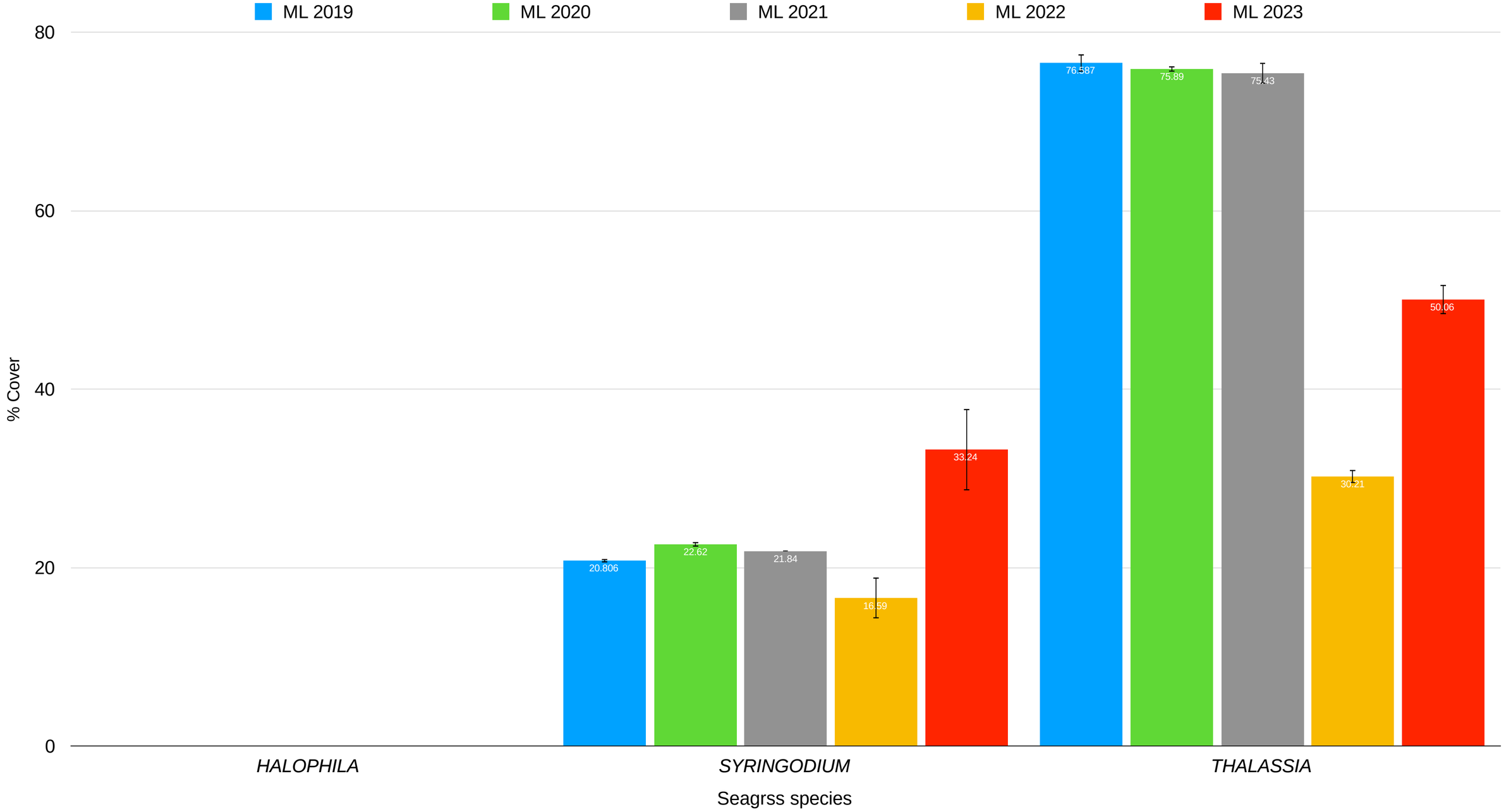


Intake station seagrass species cover




Soft sediment major categories at Maria Langa station
2019
2020
2021
2022
2023
100.00
75.00
50.00
25.00
0.00
% Cover
97.39
98.51
97.27
46.80
83.30
5.19
1.94
2.13
52.30
11.51
4.25
3.62
3.68
1.65
3.13
SEAGRASS
MACROALGAE
CORAL
GORGONIANS
SPONGES
DEAD CORAL WITH ALGAE
SAND & RUBBLE
TAPE, WAND, SHADOW (TWS)
Benthic categories
42

Maria Langa seagrass species cover



Seagrass Studies Summary

- *Thalassia testudinum* is the dominant seagrass specie at all stations
- Seagrass cover is **35.73%** at the Discharge
- Seagrass cover is **51.02%** at the Intake
- Seagrass cover is **83.30%** at Maria Langa
- Significant difference since 2022, triggered by burial after Hurricane Fiona

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Fishes Studies Summary

- At the Discharge and Intake, there was no difference between species richness between 2019 and 2023
  - Discharge 2019: 54 species, 2021: 52 species, 2023: 57 species
  - Intake 2019: 30 species, 2021: 32 species, 2023: 39 species
- From 2019 – 2023, fish species diversity and abundance appear to have remained stable
- The most abundant species are small bodied or juveniles of reef fishes
- A pulse of Nassau grouper (ESA, threatened) recruitment was detected in Guayanilla and the southwest coast of Puerto Rico

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Fish density, ranked

Common Species	Intake	Discharge
Bicolor Damselfish	0.03	0.20
French Grunt	0.02	0.17
Bluehead	0.04	0.13
Dusky Damselfish	0.04	0.12
Beaugregory	0.10	0.04
Ocean Surgeonfish	0.03	0.12
Slippery Dick	0.07	0.04
Redband Parrotfish	0.04	0.01
Schoolmaster	0.03	0.02
Striped Parrotfish	0.02	0.02
Porkfish	0.02	0.01
Bar Jack	0.01	0.02
Sharpnose Puffer	0.00	0.02
Sergeant Major	0.02	0.01
Blue Tang	0.00	0.02
Yellowtail Snapper	0.004	0.02
Graysby	0.01	0.01
Mahogany Snapper	0.01	0.01
Squirrelfish	0.01	0.01
Banded Butterflyfish	0.02	0.00
Stoplight Parrotfish	0.00	0.01
Clown Wrasse	0.01	0.00
Redtail Parrotfish	0.01	0.00

fish/^m2

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Heat Map of Nassau Grouper reports

WATER QUALITY MONITORING
UPRM/DNA

EcoEléctrica

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Water Quality Monitoring Team

Damaris Negron, MS

Juanita Caballeira, Jose Martinez, Leira Centeno, MS

Travis Courtney, PhD

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Water Quality Studies- Context

Sampling Stations

Water Quality Monitoring

Monthly Water Quality Monitoring (MWQM)

Temperature

Turbidity

Photosynthetic Active Radiation

Continuous Water Quality Monitoring (CWQM)

Temperature

Conductivity

pH

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CONTINUOUS WATER QUALITY

Eureka Manta Sonde

Temperature HOBO
(Back Up)

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MONTHLY WATER QUALITY

CTD CAST Away

PAR Meter

C3 Submersible Fluorometer

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MONTHLY MONITORING RESULTS

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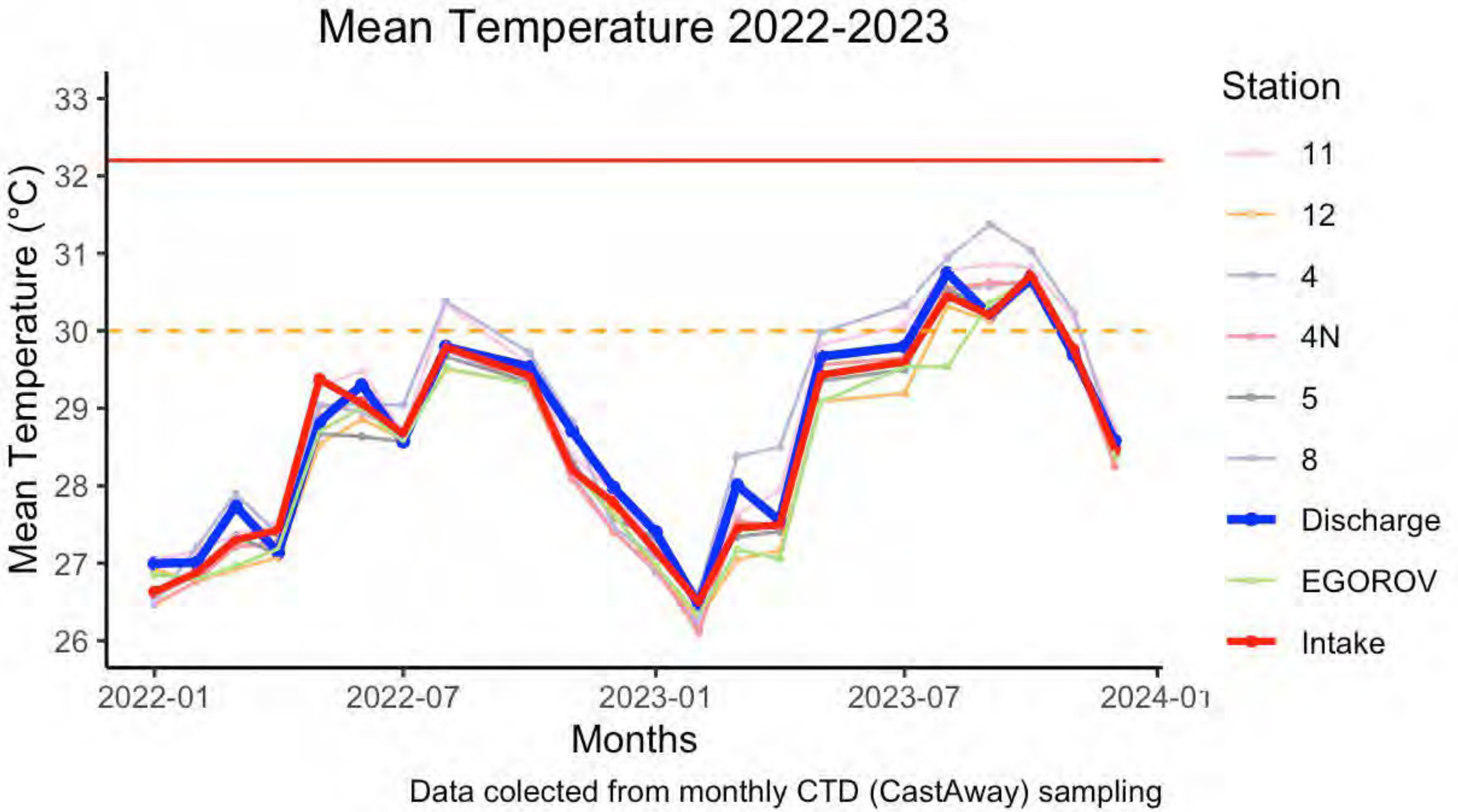
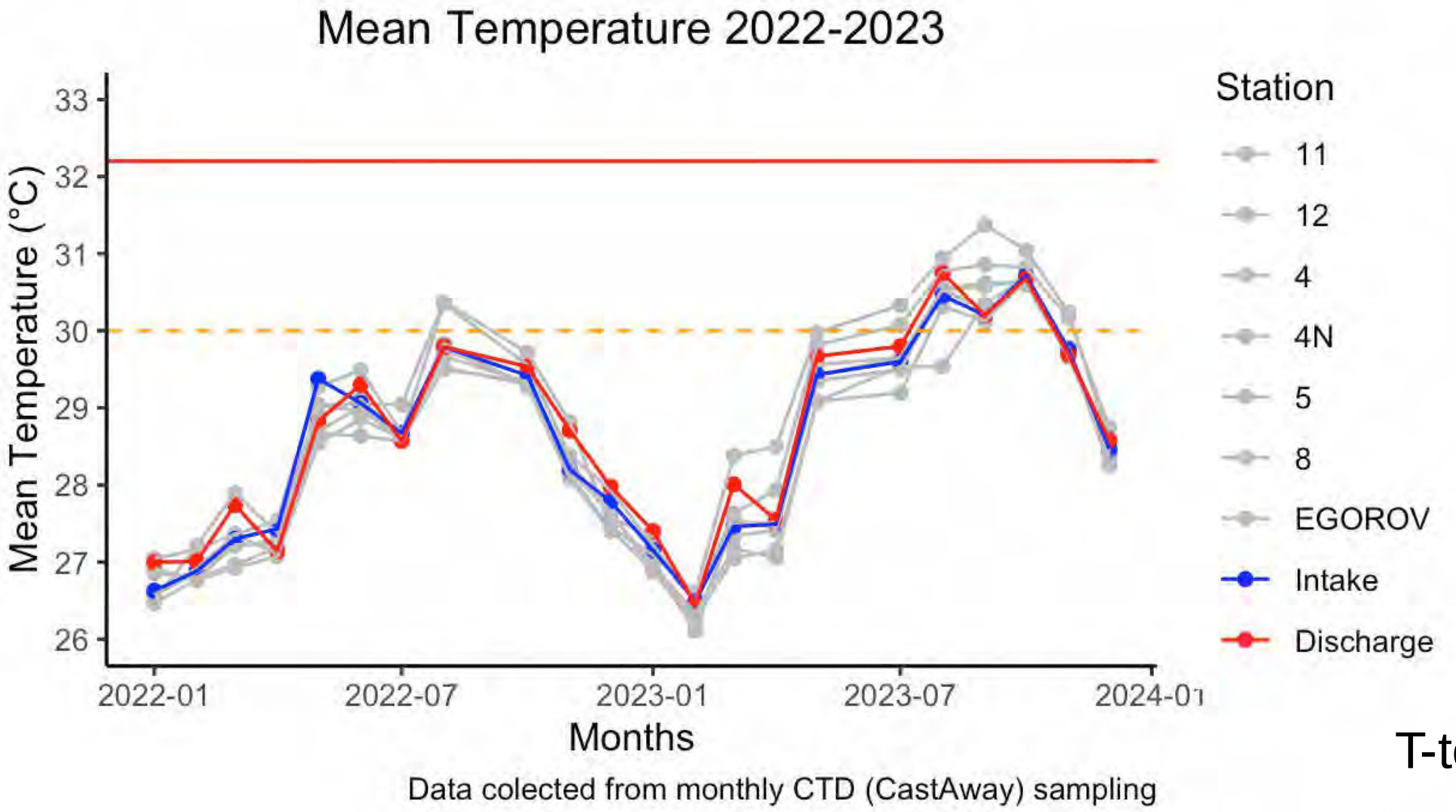
Monthly Monitoring- Temperature



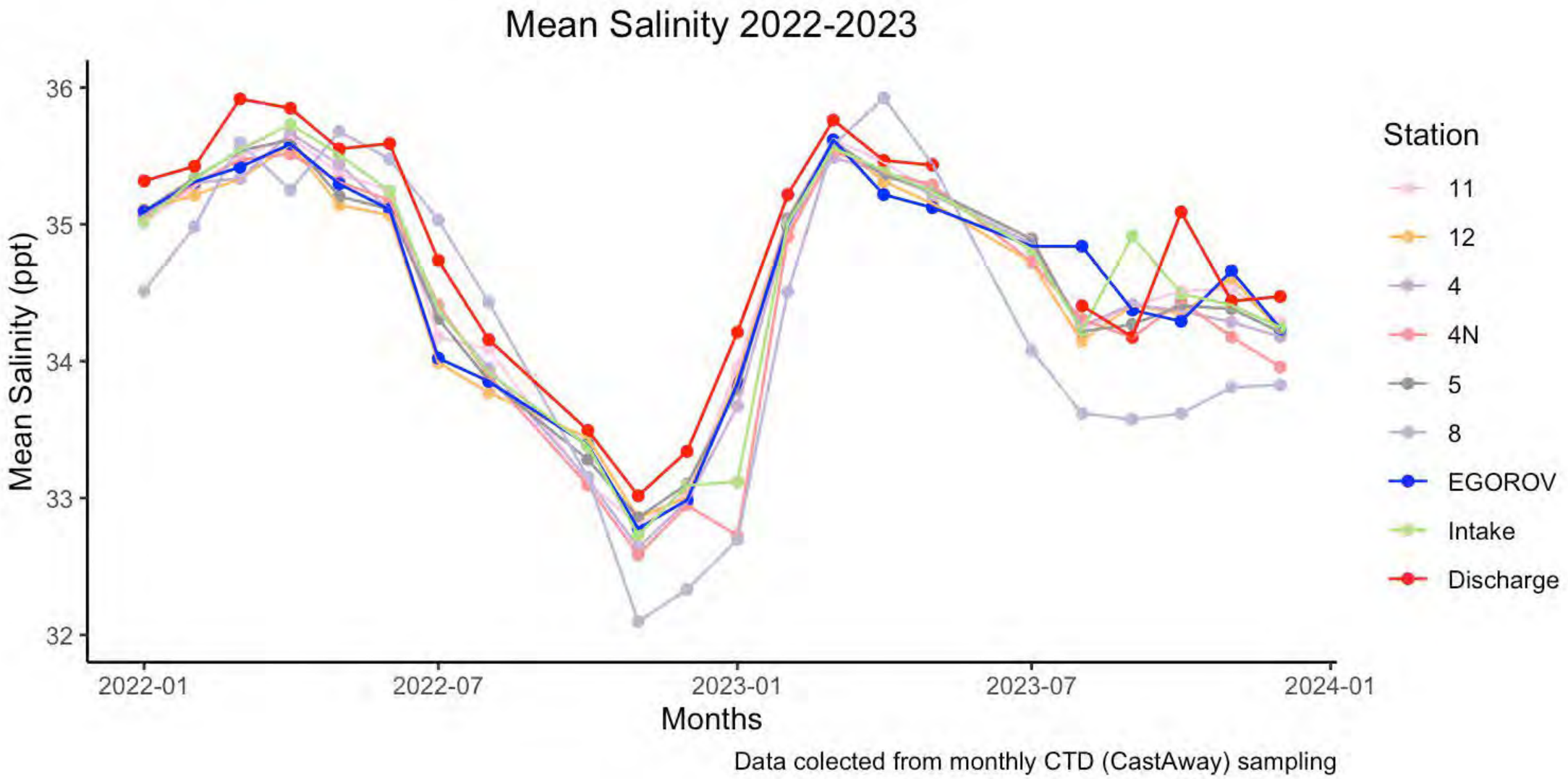
Monthly Monitoring- Temperature



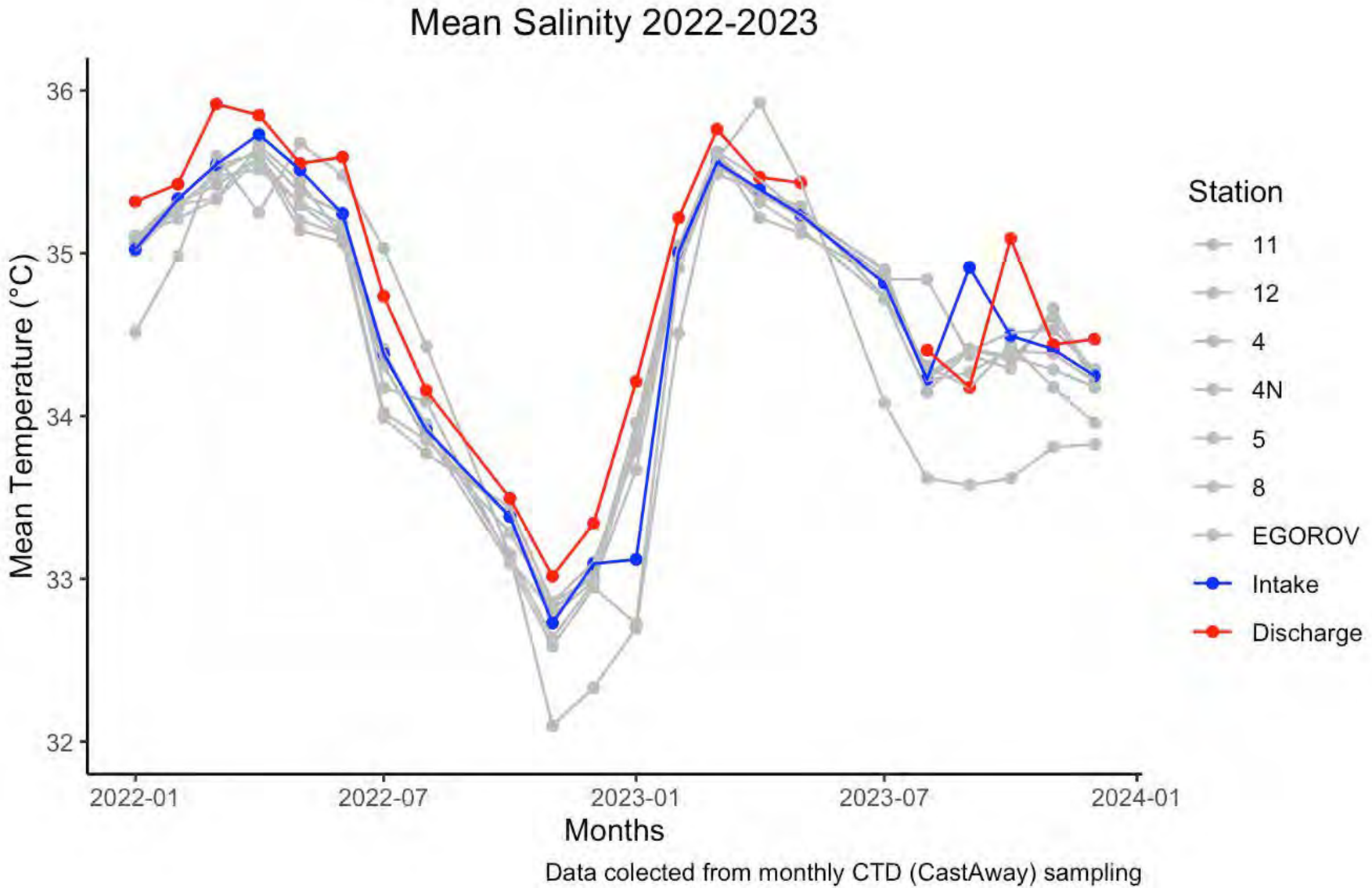
T-test

p-value = 0.763

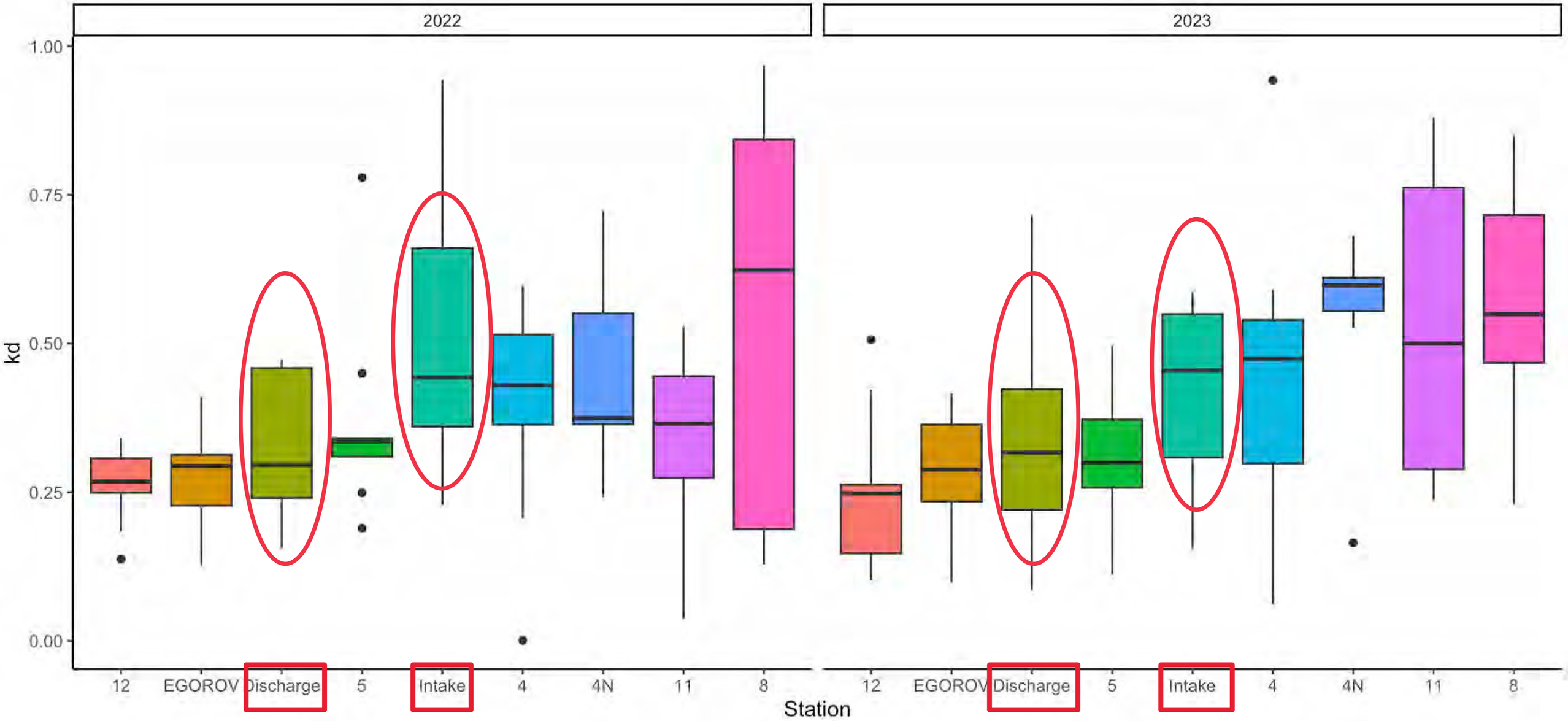
Monthly Monitoring- Salinity



Monthly Monitoring- Salinity

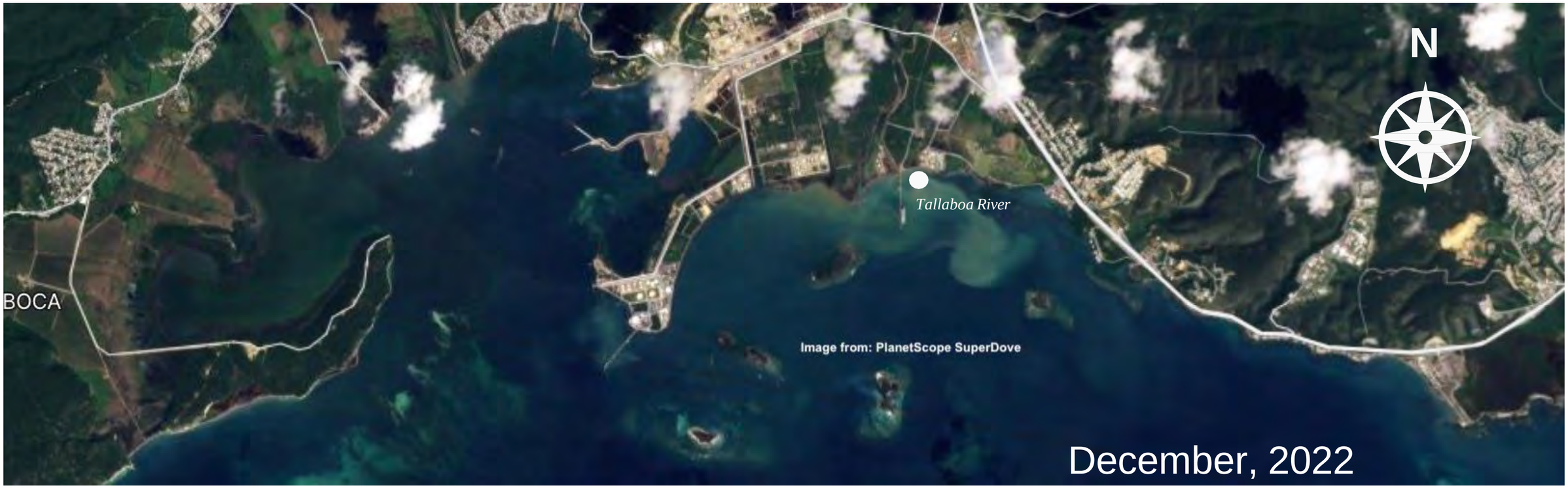


Monthly Monitoring- Photosynthetically Active Radiation (PAR)



Rivers Discharges

Rivers Discharges



CONTINUOUS MONITORING RESULTS

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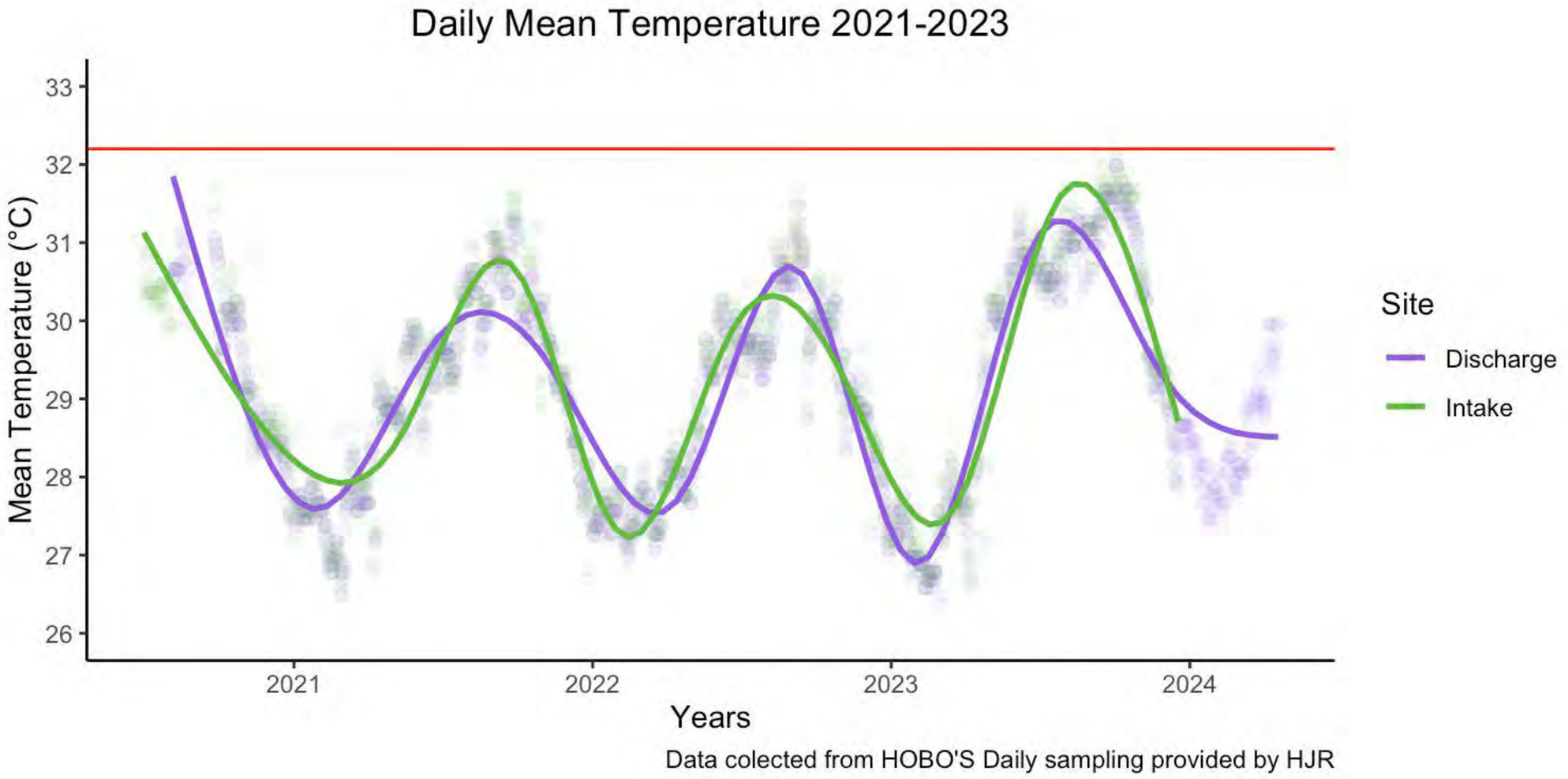
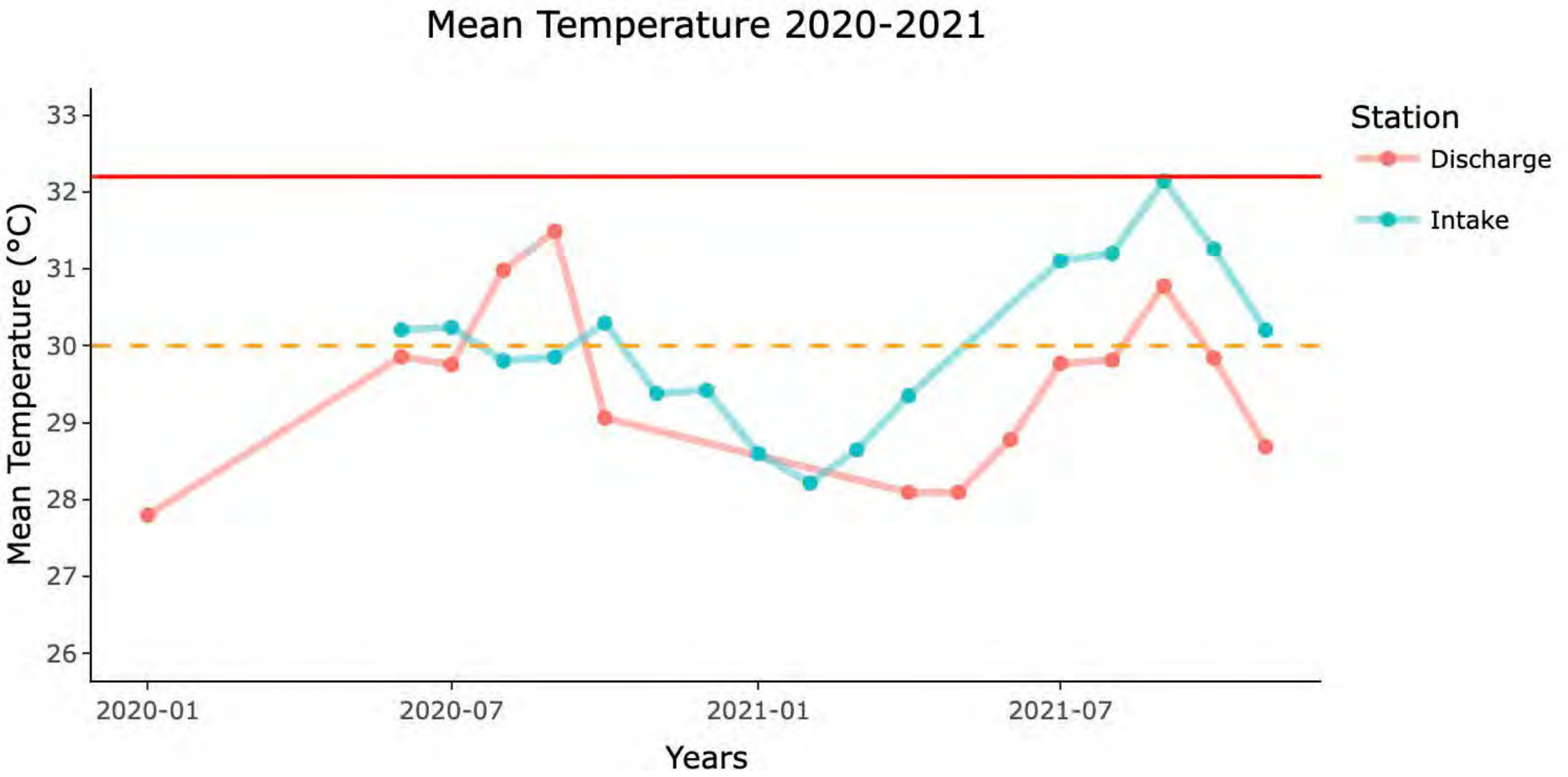
Continuous Temperature: Intake and Discharge



Continuous Temperature: Intake and Discharge



Max Temperature Register

2020-2023

Year	Monitoring	Value	Season	Station	References
2020-2021	Continuous	32.14 •C	Wet / September	Intake	Rodriguez, L. 2021
2021-2023	Continuous	31.67 •C	Wet / October	Intake	HJReefScaping 2024
2022	Monthly	30.91 •C	Wet / October	8	Centeno, 2024
2023	Monthly	31.53 •C	Wet / October	8	Centeno, L 2024

Max temperature Intake and Discharge

Monthly 2022-2023

Station Id.	Max Temperature 2022	Max Temperature 2023	Difference
Intake	29.8 •C August	30.7 •C October	0.9
Discharge	29.8 •C August	30.7 •C August/October	0.9

Conclusions

Temperature

- An overall well mixed vertical distribution was observed.
- 0.9◦C higher 2023 vs. 2022 (0.6◦C higher in 2020!)
- No statistical difference found within stations during monthly monitoring.

Salinity

- Same trend throughout all stations .

PAR

- Within established parameters .

Next steps– Additional sites

ENVIRONMENTAL OUTREACH PROJECTS

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Summary

- **We propose a scalable solution to the glass waste problem on the island, whereby this waste can be converted back to sand and used in construction projects**
  - **Our idea is to use the sand produced for coral reef restoration**
  - **We have approval from DNER to pilot this project in Guanica, PR at our coral nursery**
  - **We are requesting Medalla's support in purchasing the bottle crushing equipment and solar system to power the machine**

ISLA MAR RESEARCH EXPEDITIONS

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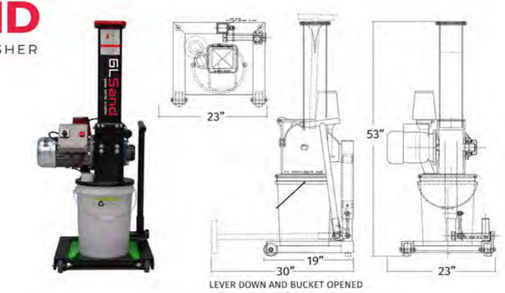
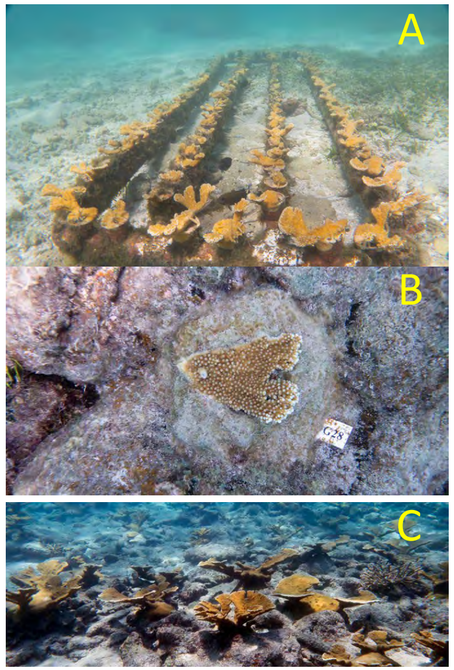
IIJR REEFSCAPING

What do we need?

- Expleco Bottle Crushing Machine with shipping from New Zealand (~$8500 USD + tax)
- Independent solar system to run the machine ($10,000USD)

GLSAND
GLASS CRUSHER





How will we do it?

1. **Medalla glass bottles will be crushed in the machine to make sand**
2. **The sand will be mixed with cement to use for coral restoration.**
3. **Corals from the nursery will be selected for planting (A)**
4. **Small fragments of Elkhorn coral are cemented to the reef using the cement/recycled crushed glass mixture ("outplanting", B) at Cayo Maria Langa in Guayanilla**
5. **They will eventually grow together to create a coral reef structure. These are outplanted Elkhorn corals at our Guanica coral nursery site (C)**

How will we do it?

1. We monitor their growth over time by measuring length, width and height of the corals (D). Some corals planted at Maria Langa have grown significantly since their planting!
2. This outplanting site is the perfect location to test this method because the site itself has been very suitable to promote coral reef growth of outplants. Cayo Maria Langa is part of an on-going environmental project supported by EcoElectrica where mangrove restoration, seagrass monitoring, invasive species removal and coral restoration has taken place (E).

Over 600 colonies outplanted
at Maria Langa, Guayanilla
1,748 bottles crushed
874 pounds of sand

WHAT'S NEXT

Proposed for Next Period

Study	Current Period (2020-2024)	Proposed Next Period (2024-2029)
Coral Large Scale Assessment	Annual	Annual
Coral Small Scale Assessment	Annual	Bi-annual
Endangered Species Act Coral Assessment (Follow up	Annual	Annual
New Coral Reef Louis Reef Assessment (as an additional reference site)	Annual	Annual
Cora Reef Mapping (Ortho mosaic)	Annual	Annual update
Coral transplant site-Egorov	Bi-annual	Once during 5-yr period
Seagrass Large Scale	Annual	Annual
Impingement	Once during the period.	Discontinue
Entrainment	Last completed in 2017	Discontinue
Fish Survey	Annual	Annual
Macro invertebrates	Annual	Annual
HOBO Data Loggers	Annual	Annual
Sea urchin transplant (as coral reef restoration)	None	As needed- TBD
Monthly Water Quality Monitoring	Annual	Annual
Continuous Water Quality Monitoring	Annual	Annual

THANKS!!!!!!

QUESTIONS

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