Regional data sharing workshop with MAR Fish partners
Summary report

Cancún, Mexico

8-9 August 2023

marfish

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Contents

Fulton, S, Rivera, O, & Caamal, J. (2023) Regional data sharing workshop with MAR Fish partners: Summary report. Comunidad y Biodiversidad, Cancún, Mexico

The MAR Fish Project

The MAR Fish Spawning Aggregation Project is a vital conservation initiative focused on safeguarding the marine biodiversity and fisheries resources within the Mesoamerican Reef (MAR) region. The project centers around the protection and management of fish spawning aggregations (FSAs), critical events where numerous fish species gather to reproduce in specific locations. These aggregations play a pivotal role in maintaining healthy fish populations and ecosystem balance.

The MAR region, encompassing the coastal areas of Mexico, Belize, Guatemala, and Honduras, is home to a diverse array of marine life. However, overfishing and habitat degradation have threatened the sustainability of these ecosystems. The MAR Fish Spawning Aggregation Project aims to reverse this trend by employing a multifaceted approach and actions in the four MAR countries in collaboration with fishers, government, academics and civil society organizations.

Key components of the project include scientific research to identify and monitor spawning aggregation sites, community engagement to raise awareness and promote sustainable fishing practices, and the establishment of protected areas to prevent overexploitation during critical reproductive periods for commercial fish. By involving local communities, fishers, researchers, and governmental bodies, the project fosters a collaborative effort to ensure the long-term health of marine environments and the livelihoods they support.

Through these comprehensive efforts, the MAR Fish Spawning Aggregation Project not only contributes to the conservation of marine species but also supports the broader goals of sustainable fisheries management and the overall resilience of the Mesoamerican Reef ecosystem. This initiative stands as a testament to the positive outcomes that can emerge when science, community involvement, and policy converge in the pursuit of environmental preservation.

The MAR Fish project, which began in 2019, has generated significant amounts of information in the four MAR countries. As the project nears its close, Comunidad y Biodiversidad (COBI) was tasked with bringing project partners together for a data sharing workshop where the advances, successes and challenges could be shared and discussed, and next steps planned for the project. The workshop was held in Cancun on the 8th and 9th of August 2023 in Cancun, Mexico with 18 people from 11 organizations who have implemented conservation actions at the MAR Fish project sites.

The Cayman Crown

The Cayman Crown is a site of significant importance to the Mesoamerican Reef. Located in the Gulf of Honduras, it straddles the border between Belize and Guatemala. Previously poorly documented, in 2013 the reef was discovered to have higher than expected coral cover and characteristics consistent with a fish spawning aggregation (FSA) site. Further investigation led to a characterization of site users and a better understanding of the socioeconomic activities (particularly fisheries) that take place at the site.

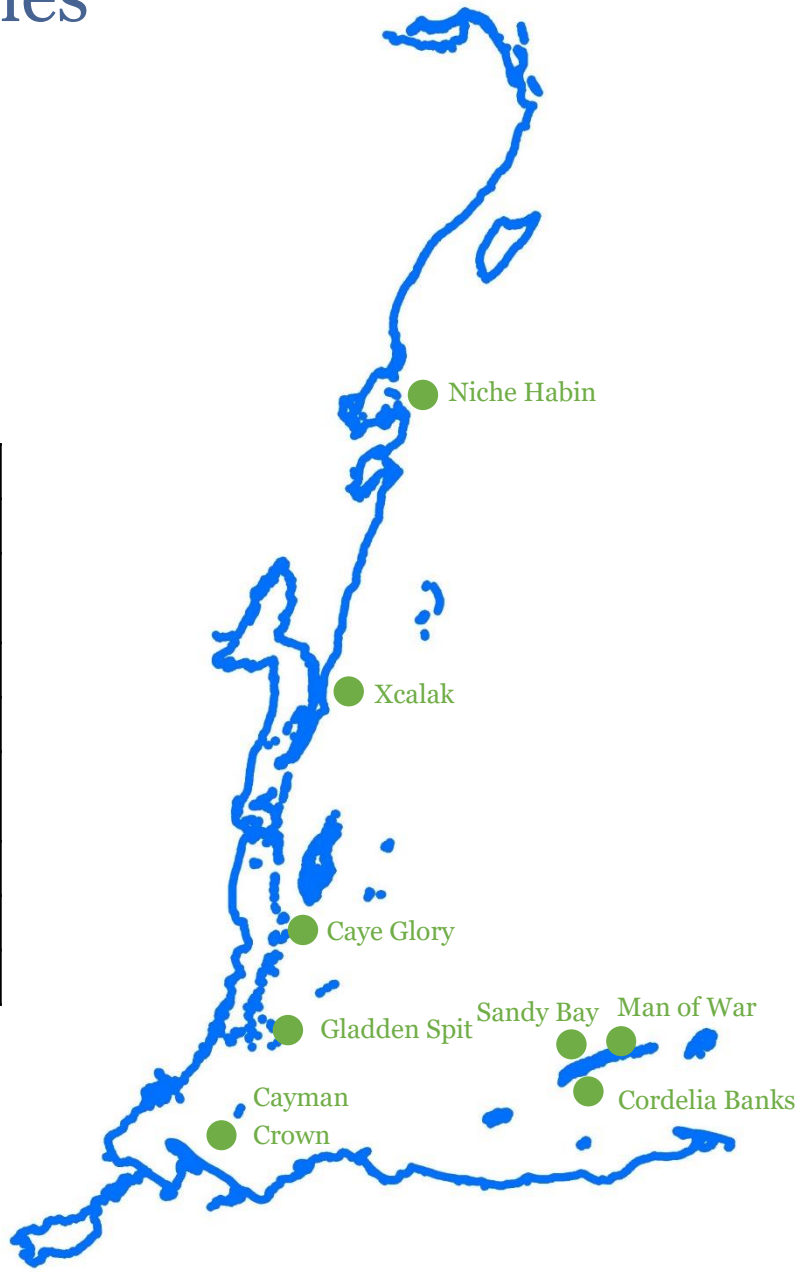
Both Belize and Guatemala have passed legislation to protect the site. Belize expanded the Sapodilla Cayes Marine Reserve in May 2020, and Guatemala created a 10-year temporary closure by Ministerial Agreement in July 2020.

The Cayman Crown sites forms the centre piece of the MAR Fish project with the project dedicating efforts to characterize, monitor and conserve the site across the three countries that share the Gulf of Honduras.

Sentinel site summaries

Before the workshop, a representative from each organization was provided with a template for collecting data at each sentinel site. The following pages provide a summary of each site across the four countries.

Site	Organization	Comments
Punta Allen (Niche Habin)	COBI	
Xcalak (Blanquizal)	COBI	Xcalak replaced Punta Herrero (El Faro) as a sentinel site
Caye Glory (Emily)	BFD	
Gladden Spit	SEA	
Cayman Crown	TIDE/HRI/Funda Eco/CORAL	
Man of War	CORAL	Man of War replaced Texas as a sentinel site
Sandy Bay (Powers Point)	CORAL	
Cordelia Banks	CORAL	



Punta Allen (Niche Habin) - Mexico

Site description
- 12 km from the coast.
- 40 metres deep. Sandy bottom with spur and groove reef between 5 and 10 m high.
- Protected as a fish refuge since 2016.

Achievements and challenges
- Continuity to passive acoustic monitoring and data analysis.
- PCR test to detect Nassau grouper DNA.
- Loss of data for February 2023 acoustics due to hydrophone error.
- Limited visual censuses due to bad weather.
- Well-trained local fisher-led monitoring team.

Species and abundances
- Nassau grouper: 1,300-1,800 fish
- Sizes from 40-90cm
- Courtship, colour changes, spawning.
- Associated species:
  - Horse-eye jack
  - Black grouper
  - Cubera snapper

Monitoring
- Size and abundance estimates.
- Courtship and behavior reporting.
- Acoustic monitoring.
- DNA and eDNA sampling.

Xcalak (Blanquizal) - Mexico

Site description
- 8.5 km from the coast.
- 32 metres deep. Sandy bottom with 10m high spur and groove reef with sandy channels.
- Part of Xcalak National Park. Not fully protected but not fished.

Achievements and challenges
- Continuity to passive acoustic monitoring and data analysis.
- eDNA sampling.
- Collaborations with local researchers in 2023.
- Limited visual censuses due to bad weather.
- eDNA samples still to be analysed.

Species and abundances
- Nassau grouper: 1,000 fish. Sizes from 40-90cm
- Black grouper: 7 fish. Sizes 40-90 cm
- Courtship, colour changes, spawning
- Reports of tiger grouper to the south of the Nassau grouper aggregation

Monitoring
- Size and abundance estimates.
- Courtship and behavior reporting.
- Acoustic monitoring.
- DNA and eDNA sampling.

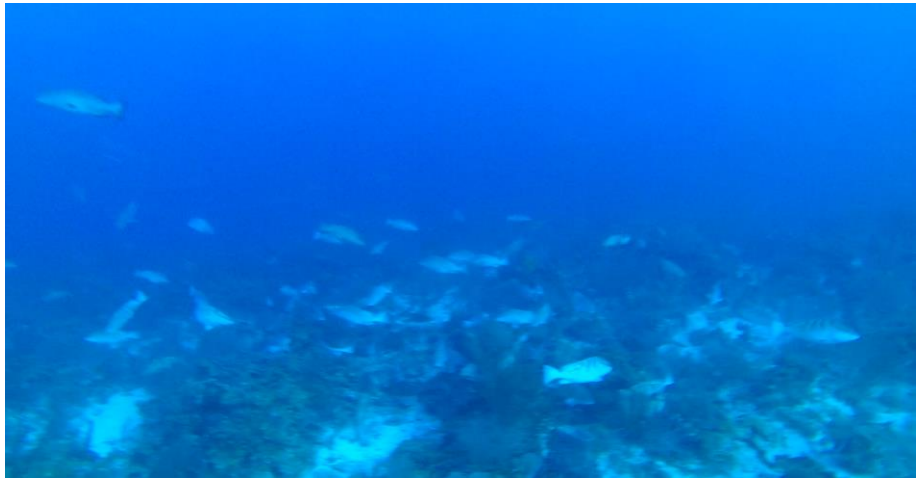
Caye Glory (Emily) - Belize

Site description

- Sharp bend point in the reef, steep drop off.
- Site area coverage – 546 hectares.
- Historically a Nassau grouper spawning site in December/January. Now fully protected.
- Productive grouper fishing spot in 60s – catch: 2 tons per day.
- Watch Jacques Cousteau dive the site in the 1960s - here

Achievements and challenges

- Illegal fishing and a lack of financial resources to conduct patrols.
- The weather during spawning season impacts the ability to get to the site to monitor it.
- 2021 has positive numbers of grouper and snapper species, an increase on abundance in previous years, although peak abundances are low considering long term averages.



Species and Abundance	2019	2020	2021
Nassau grouper	236	33	375
Dog snapper	1278	30	2400
Bar Jack	506	20	100
Horse eye Jack	238	250	250
Black grouper	6	20	2
Yellowmouth grouper	6	16	0
Yellowfin grouper	18	0	0
Tiger grouper	5	0	0

Monitoring

- Underwater visual census.

Gladden Spit and Silk Cayes - Belize

Site description

- A protected marine reserve in the central part of Belize´s Barrier Reef.
- Gladden Spit itself hosts over 25 species of reef fish.
- Whale sharks—who come to feed on the eggs—are known to frequent the area and provide an attraction for tourists.

Achievements and challenges

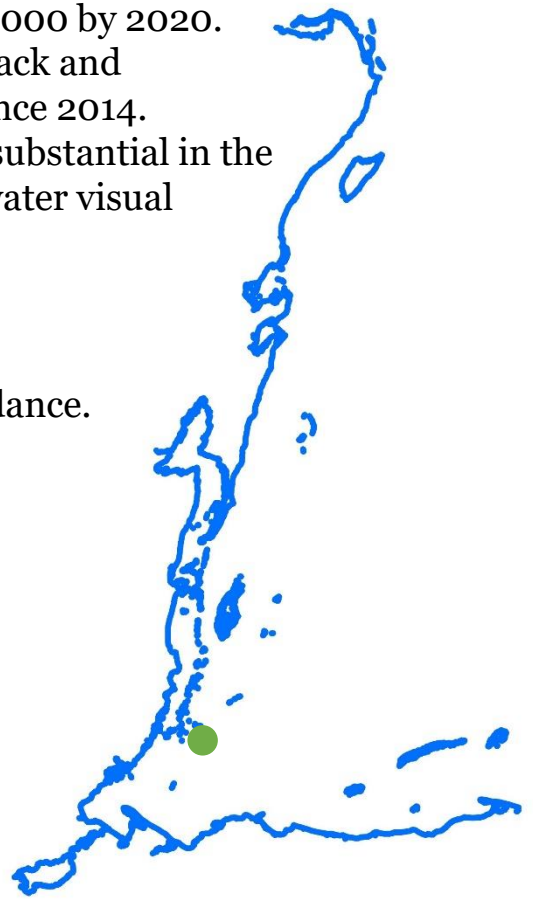
- Data collected from 2003 – 2023 with the exception of 2021 and 2022 (partial).
- Staff turnover has led to lack of continuity.
- Limited community researchers.
- Preliminary analysis of data for 20 years is complete.

Species and abundances

- The site remains an important snapper (dog, mutton and cubera) but the data indicate a drastic decline in the number count of most of the species. There was a peak in 2017 when over 10,000 mutton and cubera snapper were seen, but this had declined to 3,000-4,000 by 2020.
- Grouper abundances (Nassau, black and yellowfin) have been below 50 since 2014.
- Peak count numbers were more substantial in the early years of conducting underwater visual surveys.

Monitoring

- Visual surveys for size and abundance.



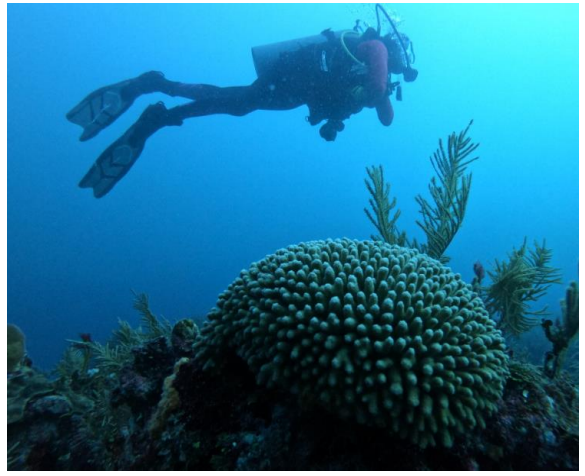
Cayman Crown - Belize

Site description

- Offshore reef located in the Gulf of Honduras, partially within the Sapodilla Cayes Marine Reserve (56km east of Belize's mainland, Punta Gorda Town).
- Habitats: coral framework, coral framework w/algae, individual patch reefs (Purkis, 2021).

Achievements and challenges

- Data confirmed the presence of two multispecies aggregation sites: The Jewel Wall and West Bezel Fisher Marker
- Challenges: COVID-19, Remoteness – 56km east of Belize's mainland, Transboundary in nature (sensitivity of the area) – territorial dispute between Guatemala & Belize, Illegal fishing, Insufficient enforcement data records, e.g., unknown number of illegal gear confiscated and origin.



Species and abundances

- 38 fish species reported (commercial interest)
- Spawning evidence (gravid females, changes in color and bicolor patterns) observed in black, Nassau & tiger groupers

Monitoring

- Exploratory dives (2020)
- Characterization & monitoring trips (since 2021)
- Underwater visual surveys (support from three Community Researchers) that have worked at 10 sites (characterized and monitored).

Cayman Crown - Guatemala

Site description

- High coverage reef zone, spur and groove reefs, with drops of up to 500m, declared as a total restricted area through ministerial agreement 85-2020.

Achievements and challenges

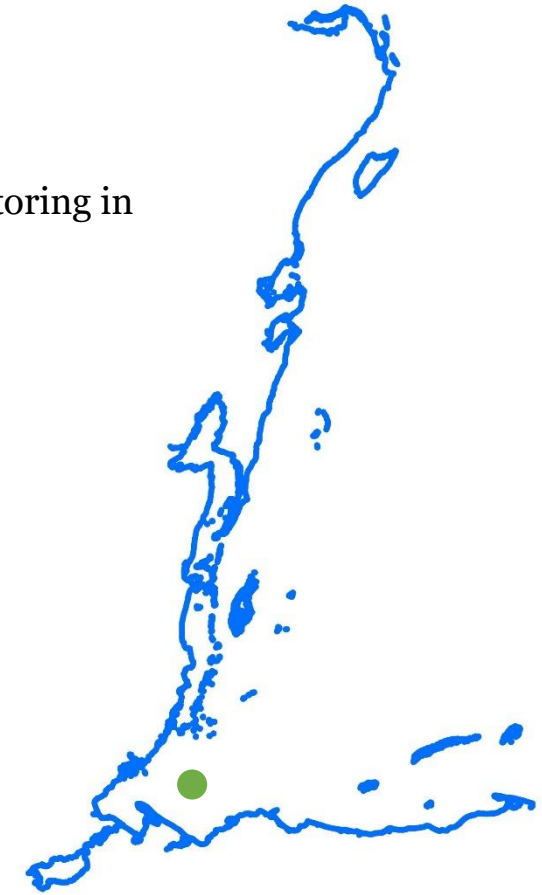
- Hydrographic survey of the area.
- Navigation advisories.
- Development of a diagnosis of the Marine Coastal Zone of the RVSPM and Corona Caiman.
- Governance committee.
- Strengthening dialogue with the fishing sector.
- Economic alternatives and capacity building.

Species and abundances

- 24 species of megafauna:
  - 19 cetaceans
  - 5 species of rays and sharks
- Schoolmaster, dog snapper, Crevalle jack, Bar jack, Atlantic spadefish

Monitoring

- Reproductive aggregation monitoring in collaboration with TIDE (2021).
- Visual surveys.
- Megafauna monitoring.
- On-board observation.
- 30-minute exploratory dives.



Man of War - Honduras

Site description
- Northwest side of the island, max depth ~40m, fore reef with reef mounds and sand patch in the center.
- Original sentinel site was Texas, but preliminary observations did not suggest it was a spawning site, so efforts switched to Man of War.

Achievements and challenges
- The site was characterized, and spawning was confirmed for a small number of tiger grouper.
- The use of dropcams as a tool to characterize sites was challenging due to the conditions and equipment configuration. Hydrophone data was collected but technical challenges had to be overcome for equipment configuration.

Species and abundances
- Tiger grouper 24

Monitoring
- Underwater Visual Census.
- Texas sentinel site is not an FSA - drop cams in 2022 were unsuccessful.

Sandy Bay - Honduras

Site description
- Located in the Northwest end of the island of Roatan, fore reef, with sand bowl in the center; max depth ~40m.

Species and abundances
- Tiger grouper ~250-275
- Black grouper 15

Achievements and challenges
- Successfully monitored three years in a row.
- Preliminary data suggest niomass increasing.

Monitoring
- Underwater visual census.
- Lasers.
- Hydrophone.

Cordelia Banks - Honduras

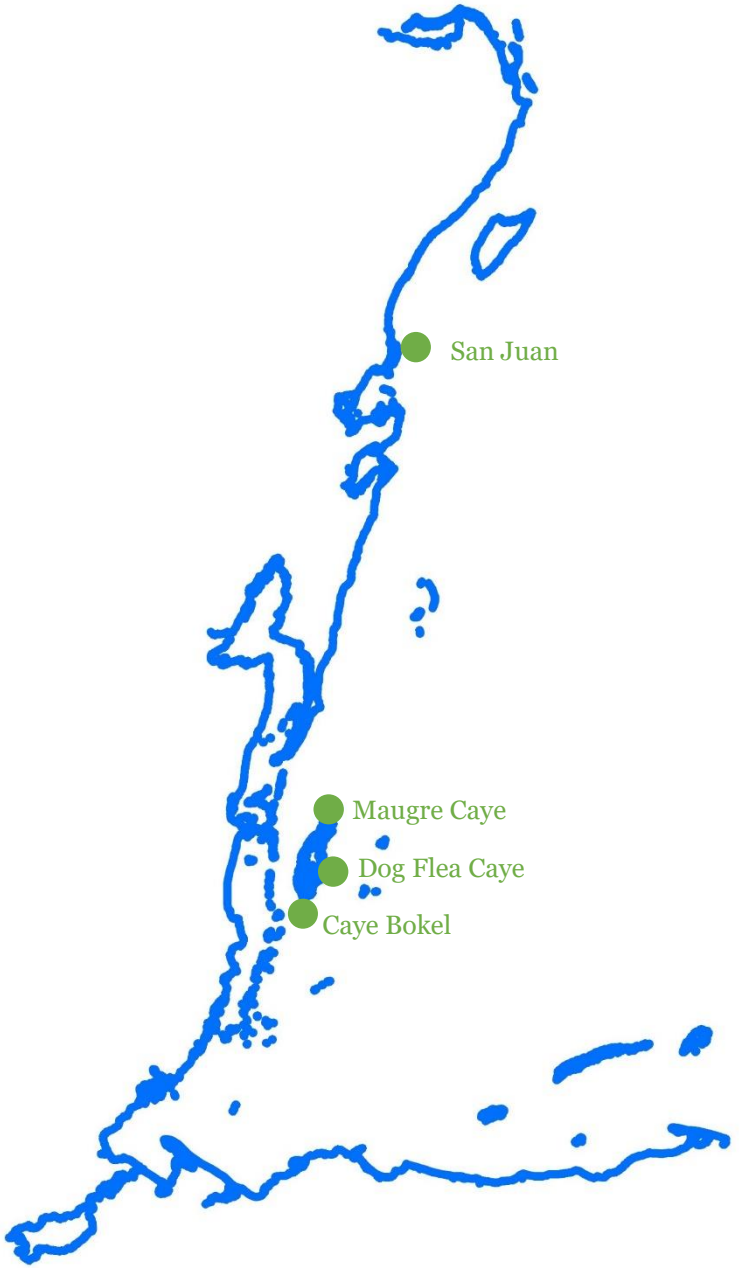
Site description
- South side of the island, fore reef, max depth ~40m, spawning occurs in the water column off the wall.

Species and abundances
- Nassau grouper 250
- Yellowfin grouper 300
- Black grouper 50
- Tiger grouper 100 (spawning in March and April 2023)

Achievements and challenges
- Successfully rediscovered a previously thought extirpated FSA.
- Confirmed spawning for Yellowfin and Nassau in April 2023 and aggregations seen in March.
- Yellowfin and Nassau grouper are found deep and are hard to observe.

Monitoring
- Underwater visual.
- Hydrophone.
- Lasers.

Activities at some additional sites were reported by project partners. These sites are not sentinel sites for the MAR Fish project, although we include the information for reference on the following pages.



San Juan - Mexico

Site description
- 21 km from the coast.
- 36 metres deep. Rocky reef close to drop-off.
- Protected as fish refuge since 2016.

Achievements and challenges
- Continuity to passive acoustic monitoring and data analysis.
- eDNA sampling.
- Limited visual censuses due to bad weather.
- eDNA samples still to be analysed.

Species and abundances
- Nassau grouper: 50-70 fish. Sizes from 50-90cm
- Black grouper: 40 fish. Sizes 40-90 cm
- Courtship, colour changes
- Associated species:
  - Permit
  - Horse-eye jack
  - Dog snapper
  - Barracuda

Monitoring
- Size and abundance estimates.
- Acoustic monitoring.
- DNA and eDNA sampling.

Maugre Caye - Belize

Site description

- Located on the north of the Turneffe Atoll Marine Reserve. It is a fully protected zone within a highly protected zone.
- It is located approximately 300m off the reef crest in a spur and groove system at 25 – 35m depth
- Five main ridges and four channels within the spawning site

Achievements and challenges

- TASA took over site monitoring in 2022, previously monitored by UBERI.

Species and abundances

- Nassau grouper abundance, after falling below 500 individuals from 2016-2022, increased to over 2,000 in 2023.

Monitoring

- 2022-2023 (Dec-Feb) FSA monitoring season included:
  - Underwater Visual Census.
  - Laser Sizing.
  - Passive Acoustics.

Dog Flea Caye- Belize

Site description

- Located on northeast of the Turneffe Atoll Marine Reserve, below Maugre Caye.
- A fully protected zone within a highly protected zone.
- It is located approximately 1km off the reef crest on a very steep slope leading to the drop off which starts at approximately 30m.
- The spawning area has three main ridges.

Achievements and challenges

- TASA took over site monitoring in 2022, previously monitored by UBERI.

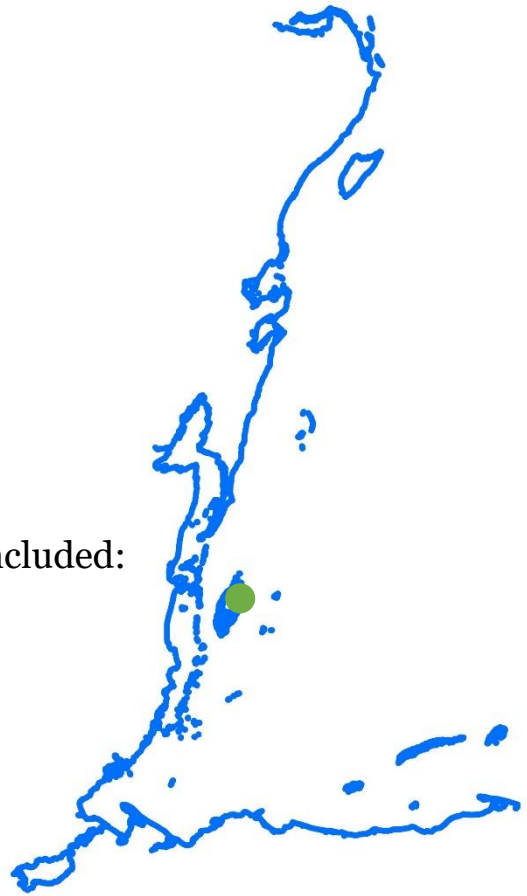
Species and abundances

2023 species and abundance

- Groupers
  - Black – 3
  - Nassau – 5
  - Tiger – 25
  - Yellowfin -4
- Snappers
  - Dog – 2
  - Mahogany – 25
  - Mutton – 8
  - Yellowtail - 280
- Others
  - Bar Jack – 170
  - Horse-eye Jack – 70
  - Permit - 2

Monitoring

- 2023 SPAG monitoring season included:
  - Underwater Visual Census.
  - Laser Sizing.
  - Passive Acoustics.



Caye Bokel- Belize

Site description

- Located on the southernmost point of the Turneffe Atoll Marine Reserve.
- A fully protected zone within a highly protected zone.
- Located approximately 1km off the reef crest on the drop off which starts at approximately 30m.
- The site is known for its strong underwater currents.

Achievements and challenges

- TASA took over site monitoring in 2022, previously monitored by UBERI.

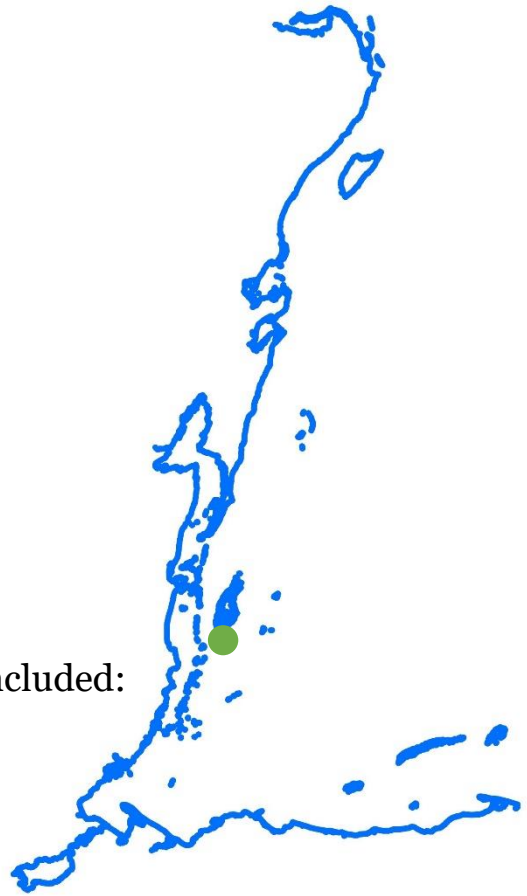
Species and abundances

2023 species and abundance

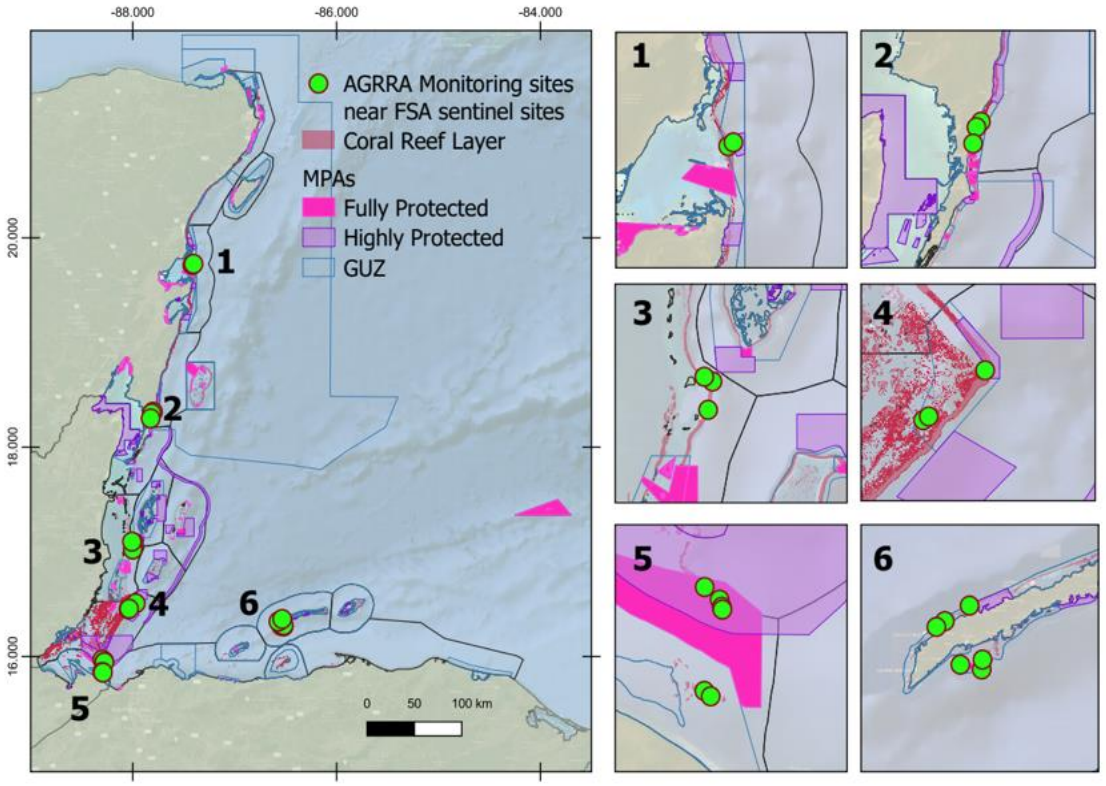
- Groupers
  - Black – 200
  - Nassau – 50
  - Tiger – 400
  - Yellowfin – 60
  - Rock hind - 20
- Snappers
  - Dog – 1500
  - Schoolmaster – 300
  - Mutton – 300
  - Yellowtail – 2800
  - Cubera - 2500
- Others
  - Bar jack – 200
  - Crevalle jack - 600
  - Horse-eye jack – 1200
  - Permit - 600

Monitoring

- 2023 SPAG monitoring season included:
  - Underwater Visual Census.
  - Laser Sizing.
  - Passive Acoustics.



Reef health near sentinel FSAs



FSA sentinel areas:
1) Nichehabin (Punta Allen); 2) Blanquizal (formerly Punta Herrero); 3) Emily (Caye Glory); 4) Gladden Spit; 5) Cayman Crown; 6) Roatan (Cordelia Banks, Power Point, and Man O'War)

The four main AGRRA indicators (commercial and herbivorous fish biomass, live coral cover and macroalgae cover) are being assessed at current and passed HRI monitoring sites across the MAR that are in close proximity to the FSA sites. The evaluation of these indicators will provide information as to whether the protected FSA sites provide reef health benefits in the immediate proximity to the FSAs.

Achievements

- 2020 & 2022- Report Card of the Health of the MAR, a special section focusing on the importance of FSAs, MPAs, fully protected areas and the need to protect our fish.
- 2023 - three AGRRA trainings: 49 new surveyors in all four countries.
- Bleach Watch monitoring / SCTLD monitoring and mitigation strategies.

Challenges

- 2020/2021 pandemic (no traveling, surveyors unavailable).
- Site accessibility due to distance and poor weather.

Visual survey data collection and analysis

Underwater visual censuses are the most widely implemented FSA monitoring technique. A monitoring workshop was held in Cancun in November 2019 to discuss monitoring protocols and techniques. These protocols have been widely implemented during the project.

The pandemic greatly affected monitoring during the 2020 and 2021 snapper spawning season (May-July) and 2021-2022 grouper spawning season (December-March) when no in-field activities could take place, or smaller field teams were used, limiting data collection.

During the workshop participants discussed the challenges in finding and retaining skilled survey divers. Due to the pandemic, the regional training workshop that was planned in Belize 2020 was not completed. This left some organizations with less experience in FSA monitoring with some doubts on protocol implementation, although virtual support by MAR Fish project partners helped alleviate some problems. However, as fish spawn simultaneously across FSA sites, having sufficient trained divers to work at each site was a commonly reported problem. In Honduras, the high number of dive masters working in the tourism sector provides an opportunity to work with skilled divers (important for deep diving), but high turnover and varying availability leads to uncertainty before each monitoring period. In Mexico, COBI has worked closely with the local fishing cooperatives to ensure that there is a pool of survey divers to choose from. In Belize, staff turnover and the time needed to train each diver was also mentioned as a challenge.

The need for regular regional training and refreshers courses, similar to the way HRI and AGRRA train their coral reef survey divers, was recommended. This could include a train-the-trainer program where long-term staff in each country are focal points for local training. Trained divers should commit to be available for a certain time period. Belize will be conducting a national training program in October 2023.

The importance of each diver have a deep knowledge about the FSA site to be monitored was also stressed. Even if a survey diver is well-trained, if they do not know the local conditions, underwater landmarks, currents, or fish behaviour among other factors, it can lead to less effective surveys being conducted.

Divers collecting visual census data on a Nassau grouper spawning aggregation

Visual survey data collection and analysis

The importance of a good boat captain was heavily stressed by several participants. As FSA sites are often found at remote sites, and monitoring occurs during the winter and spring, conditions can be rough. A knowledgeable captain, who knows the site conditions and can assure the safety of the dive team is paramount. Training needs to be provided to captains, but experience is the most important factor.

Although MARFish partners have been provided with laser sighting devices to allow them to get more accurate fish size estimates, few partners are yet to fully implement the technique. Belize has some experience, and CORAL has experimented with the design in Honduras. Partners reported difficulties building the mount and ensuring that the distance between the lasers did not shift during the dive. Virginia Burns, who has experience using laser calipers, provided recommendations on design and calibration. The project still recommends using laser calipers where possible as they are the most effective way to monitor short-term changes in size distribution in the fish stock. Visual size estimations of hundreds or thousands of fish is difficult and although general estimations can be made, they lack sufficient detail to detect short term population changes. After a site is protected, changes to fish sizes are likely to be among the changes detected as protected fish grow. Increased abundance is delayed as fish must first reproduce.

A diver waits to be picked up after a dive

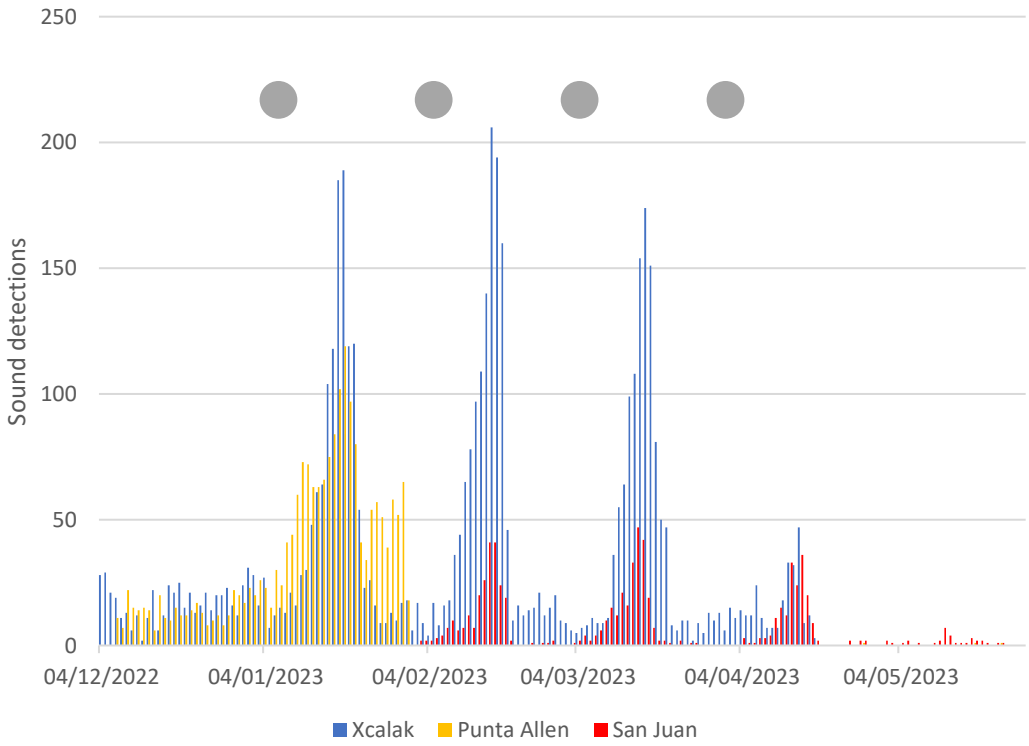
Finally, participants highlighted the ongoing costs of maintaining a monitoring program. SCUBA gear is expensive to purchase and maintain, particularly in the humid Caribbean. Sourcing continuous funding for maintaining equipment is difficult, yet costs can be significant, particularly for compressors and boats. Equipment sharing has been implemented to divide costs, yet as all fish spawn at the same time across the reef, each individual team needs its own equipment in place at the same time. Mechanisms to provide continuous (small) amounts of maintenance funding are required as it is often easier to fundraise for new equipment than to maintain the equipment you already have.

Acoustic data collection and analysis

Acoustic sensors provide a relatively cheap and autonomous way of collecting long-term data at FSA sites. The SNAP hydrophone from Loggerhead Instruments has been deployed in the MAR Fish project, to date at sites in Mexico, Guatemala and Honduras. The Belizean sites will have hydrophones deployed by the 2023-2024 grouper spawning season.

During the workshop, Jacobo Caamal from COBI guided a practical session where he explained the components of the hydrophone, common pitfalls and recommendations for effective deployment. Questions arose regarding how best to deploy the hydrophone (installation structure needed), battery life and how to analyse the information. Jacobo mentioned that Energizer batteries had provided COBI with the best duration, although the manufacturer has begun to recommend Amazon´s own brand.

Data analysis continues to be conducted. COBI will provide support to HRI and CORAL to analyse data with the FADAR algorithm which detects Nassau, black and yellowfin group, as well as red hind. This analysis must be conducted on a high-performance PC. It should be noted that the algorithm was developed by researchers at Florida Atlantic University using grouper sounds from other regions in the Caribbean. Due to erroneous detections occurring in Mexico´s 2020 data, the algorithm was re-trained with MAR data to adapt it to regional sound differences.



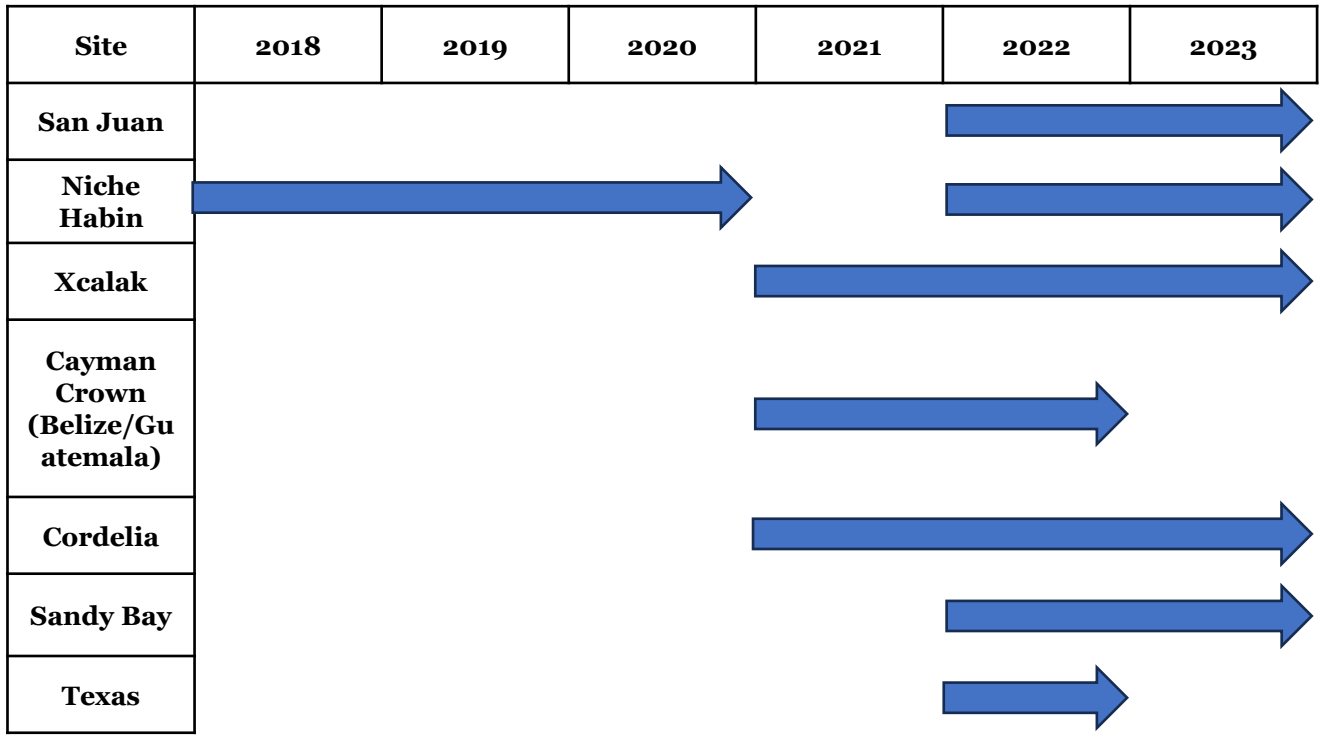
Acoustic data analysed by the FADAR for three sites in Mexico in 2023. Grey circles indicate approximate date of full moon. Unfortunately, the Punta Allen sensor did not record in February and March, however the cyclical abundances for sound detections can be identified during each lunar cycle as the fish arrive to spawn 6-10 days after the full moon during January, February and March. Historically, fishers report groupers spawning in the MAR from December, however MAR Fish partners have not detected spawning that early. Warmer waters are possible delaying spawning until the new year, and also resulting in spawning in the spring months.

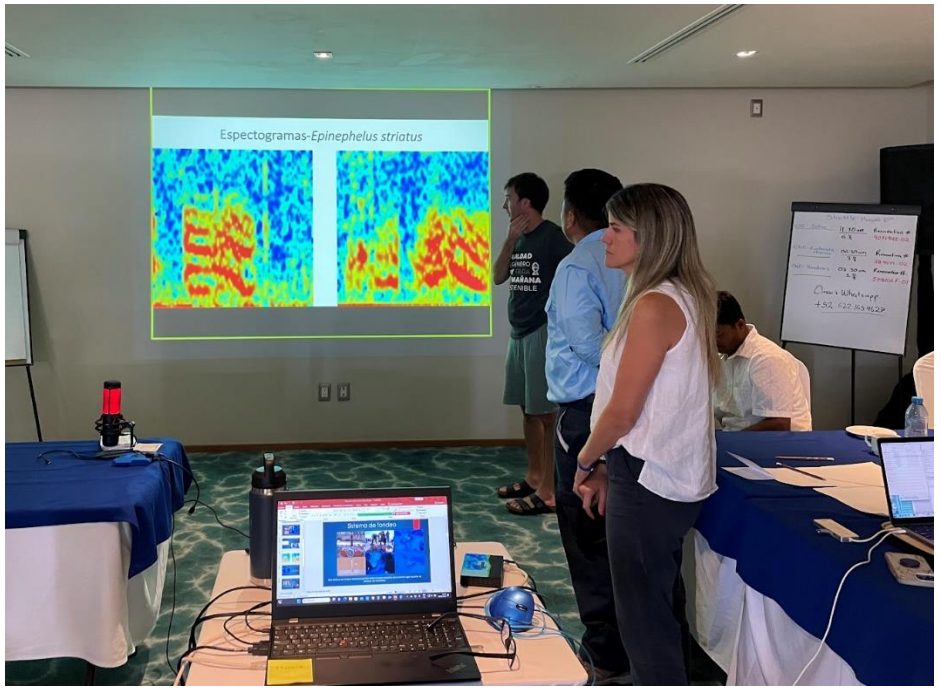
Acoustic data collection and analysis

To date, hydrophones have been deployed in Punta Allen, Xcalak, San Juan in Mexico, Cayman Crown in both Belize and Guatemala, and Cordelia, Sandy Bay and Texas in Honduras. In Gladden Spit and Caye Glory, project partners aim to deploy hydrophones before the end of 2023.

The hydrophones have been installed consistently since 2021/2022 across seven sites, however due to weather conditions and battery life, acoustic data is not collected year-round. Acoustic monitoring is prioritized during the winter months (December through March) to collect grouper sounds.

Years in which acoustic data has been collected at sentinel sites



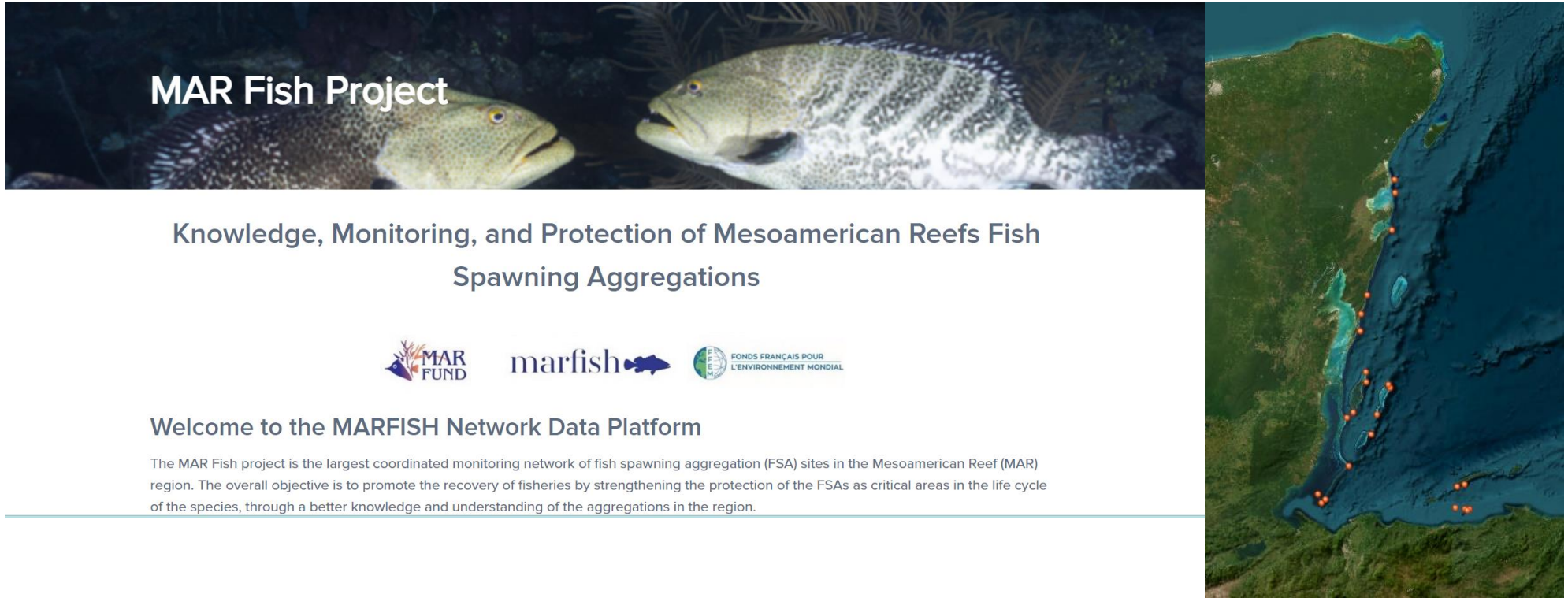


Workshop participants reviewing a Nassau grouper spectrogram registered on a spawning site

Databases and analysis

The MAR Fish database and survey form have been deployed on the AGGRA website. The survey form provides a standardized data entry module for underwater visual census data and automatically updates the online database and visual displays. Test surveys from Mexico, Belize and Honduras have been entered. Some partners have requested support for data entry due to the large number of surveys conducted historically.

In parallel, HRI are currently undertaking their regional coral reef health surveys in the four MAR countries. The surveys include reef sites close to the FSA sites and this data, and historic reef data, will be analysis to evaluate whether reefs close to the FSA sites have additional fish biomass due to their proximity to the FSAs.



Lessons from the Belize Spawning Aggregation Working Group

With support from EDF, Virginia Burns was able to join the workshop and provide a history of the Belize Spawning Aggregation Working Group. The working group was created in 2001 to support Belize´s initiatives to protect its FSA sites, and, despite challenges, the group remains active more than 20 years later, providing a leading example of how to maintain a collective action initiative over time.

As the group is not a legal entity, Virginia stressed the importance of “champions” who can take the lead with projects. The working group was created by several champions, including Janet Gibson who led the group in its early years. These champions position the group as a coordinating body who can bring together diverse stakeholders who are working on FSAs in the country, promoting knowledge exchange. Including fishers was also key to the group's success. Fishers were involved at the onset and although the group as a whole was less active between 2015-2020, two fisher associations have since rejoined the working group following the pandemic, and are active members. Having the fishers onboard was key for moving legislation forwards in the early days of the group, as their support and feedback to their peers is important.

The group maintains a national database of FSA data, in collaboration with the University of Belize, where members periodically send the data. Without dedicated funding, maintaining the database can be challenging. The first country-wide training was held in 2001 and repeated in 2005 and 2012. The group hopes to conduct a fourth national FSA training in late 2023.

The Belize Spawning Aggregation Working Group is an example a national level collective action group with a well-defined goal. Its successful operation for over 20 years should be noted, although the importance of champions should be highlighted as much of its success depends on the time and effort dedicated by key individuals who help move the group forward.

Fishing pressure

All of the FSA sites in this project now have some level of protection, which can vary by jurisdiction. In Mexico, “fish refuge” no take zones, requested by the Punta Allen fishing cooperative protect San Juan and Punta Allen (Niche Habin) FSAs. The Blanquizal site in Xcalak is part of the Xcalak Reefs National Park and while technically not fully protected is not fished by local fishers. There was a low number of traditional fishers who used to access the site, but they have since retired. There is not effective government enforcement, but fishing cooperatives work with the national park authority and other stakeholders to manage the sites.

In Belize, all FSAs are protected yet there is concern around night fishing, particularly from transboundary fishers from neighbouring countries. Enforcement at night can be dangerous for co-managers and the Belize Fisheries Department. BFD hope to acquire a larger vessel to be stationed at FSA sites during spawning periods, but there have been significant budget cuts, limiting operation. In Gladden Spit, concern was also raised by the increasing number of traditional fisher licences. Traditional fisher licences were originally given to fishers who used the sites at the time the sites were protected with the vision of phasing them out as older fishers retire. In 2019 there were only 29 traditional fisher licences in Gladden Spit, but this had increased to 101 in 2023. The reason for this increase is unknown and SEA will look to work with the village council and BFD to identify the true traditional fishers.

Many fishers in the Guatemalan portion of the Cayman Crown remain at odds with the protection of the site. Some want monetary compensation for their opportunity costs, but it is not always clear who traditionally fished in the area. Enforcement is limited, and like in many Latin American countries, the juridical process and the division of responsibilities between the fisheries department, coast guard and other dependencies is not clear, limiting impact. CORAL has also worked to understand the role of Honduran fishers who travel to the area.

In Honduras, while the FSA sites do not have specific spatial protection, they are part of the Roatan Marine Park where snapper and grouper fishing is not allowed at depths less than 60m. CORAL is working with local communities to explore the option of additional spatial protection as well. Due to the location of the sites near many of the Bay Islands main tourism destinations, there are relatively few fishers active at the sites. Tourism and sports-fishing were two topics also discussed during the workshop. Recreational diving on FSAs has been mentioned previously as an alternative activity yet most participants were in agreement that large numbers of recreational divers, on deep, remote sites could both be dangerous and also a potential risk to the fish due to disruptive behaviour. Sport-fishing across the MAR is a great unknown. The economic benefits are large, possibly similar to the commercial fisheries, yet there is very little information across the four countries about what species are being caught and where, and also whether catch and release rules and bag limits are respected. There is also no singular definition of what “sport-fishing” is.

Avoiding institutional amnesia

In 2023, Stuart Fulton published a paper entitled "*Institutional amnesia pushes fish spawning aggregations towards extirpation*" in the journal *People and Nature*. The paper stemmed from the 2020 surveys of 21 people across the MAR as part of the process to create the *Status Report on Fish Spawning Aggregations in the Mesoamerican Reef*. This interviewees regularly reported the population status of the fish at the FSAs that they managed as "unknown", despite data being available often showing alarming declines over decades. For example, at Caye Glory in Belize, fishers were catching 2 tonnes of fish per day in the 1960´s. By the time the site was protected in 2005, only 18 were seen by divers, yet managers interviewed in 2020 reported the tendencies in abundance as "unknown".

The 2023 paper explores why people and institutions report uncertainty using the concept of institutional amnesia. While institutional amnesia is related to the shifting baseline concept popularized by Daniel Pauly (in which individuals compare changes against their own reference points, rather than the true reference points from earlier states), institutional amnesia focuses on the way institutions and organizations manage knowledge and information. Institutional amnesia therefore refers to the tendency of organizations to forget or ignore past events or information that may be relevant or inconvenient to their current goals or beliefs. can prevent an organization from recognizing and addressing problems or challenges that have arisen in the past. It can contribute to a culture of denial or avoidance of difficult issues, and organizations with institutional amnesia are likely to keep trying to periodically replicate solutions that have not worked in the past, or unsuccessfully implement solutions that others have successfully applied.

Institutional amnesia can occur accidentally (information is poorly archived or lost) or deliberately (it is more convenient that we forget something). This publication is the first time the concept has been explored in conservation science. The little research that has been conducted to date has been conducted in the realms of business, government and disaster response, however the conclusions and recommendations are similar. To avoid institutional amnesia, we must:

- Reduce staff turnover to ensure continuity of knowledge and information.
- Increase the participation of local research institutions and local NGOs to create local capacity and avoid brain drain.
- Create narratives to improve story-telling and knowledge transfer within institutions.
- Improve record keeping to allow continuity, data transparency and to hold decision-makers to account.

"While new information technologies have provided us with the ability to store, retrieve, manipulate and communicate more data, faster than ever before, at the same time many of our institutions seem to be losing their memories"

Pollitt, C. (2000). *Institutional amnesia: A paradox of the 'information age'?* Prometheus, 18, 5–16.

Next steps

This section provides a list of recommended next steps and action items.

- Complete data analysis at each site, incorporating the 2023/2024 spawning season for visual and acoustic data. COBI can provide acoustic data analysis support where needed.
- Upload data to the AGRRA database to seed the regional database and gather momentum for its use.
- Conduct a regional training and capacity building process to ensure a pool of FSA survey trained divers who follow the same standards.
- Investigate sport-fishing, its impacts, definition and its impact on fish that form spawning aggregations.
- Fundraise as a region. The MAR is interconnected, and we need to work to conserve all of the region´s FSA sites.
- Continued engagement with fishers, and other site users, must continue to help reduce conflicts and increase participation.

Annex 1 – workshop agenda

Time	Tuesday 8th August 2023	Wednesday 9th August 2023
09:00	Welcome	Review of day 1
09:30	Workshop objectives	
10:00	15 min updates from MARFish partners	Visual census data discussion – achievements and challenges
10:30		
11:00	Coffee break	Coffee break
11:30	15 min updates from MARFish partners	Acoustic sensor data discussion – achievements and challenges
12:00	Database discussion – where are we are and where do we go from here?	
12:30		
13:00	Lunch	Lunch
13:30		
14:00	Focus on Cayman Crown – achievements, challenges and results	What's next? Update on future plans at sentinel sites
14:30		
15:00		How to continue this regional effort
15:30	Coffee break	Coffee break
16:00	MARFish monitoring and evaluation – FFEM indicators	Review of agreements and commitments
16:30		
17:00		Close

Annex 2 – workshop participants

Participant	Organization	Sentinel sites
Stuart Fulton	COBI	Punta Allen (Niche Habin), Xcalak (Blanquizal)
Jacobo Caamal	COBI	Punta Allen (Niche Habin), Xcalak (Blanquizal)
Omar Rivera	COBI	Punta Allen (Niche Habin), Xcalak (Blanquizal)
Melanie McField	HRI	Cayman Crown
Melina Soto	HRI	
Ana Giro	HRI	Cayman Crown
Antonella Rivera	CORAL (virtual)	Man of War, Sandy Bay, Cordelia
Grace Horberry	CORAL/RMP	Man of War, Sandy Bay, Cordelia
Guillermo Galvez	FUNDA ECO	Cayman Crown
Michelle Fernandez	MAR Fund (virtual)	
Cecilia Guerrero	TIDE	Cayman Crown
Elizabeth Avila	SEA	Gladden Spit
Tyrell Reyes	Belize Fisheries Department	Caye Glory (Emily)
Nic Requena	EDF	
Virginia Burns	TASA	
Asad Magaña	TIDE	Cayman Crown
Israel Muñoz	HRI	
Judith Morales	MAR Fund (virtual)	

Annex 3 – workshop photos