NEWSLETTER

Issue 15: December 2022
For period 2021-2022

CONTENTS

OUR GOAL

To determine the success of management measures in enhancing grouper and snapper spawning aggregations for Belize.

OUR WORK

The Belize Spawning Aggregation (SPAG) Working Group is pleased to present our main updates for the past two years. The Working Group is a volunteer-based group made up of a network of organizations involved in managing and monitoring the Nassau Grouper SPAG sites which have been protected since 2003.

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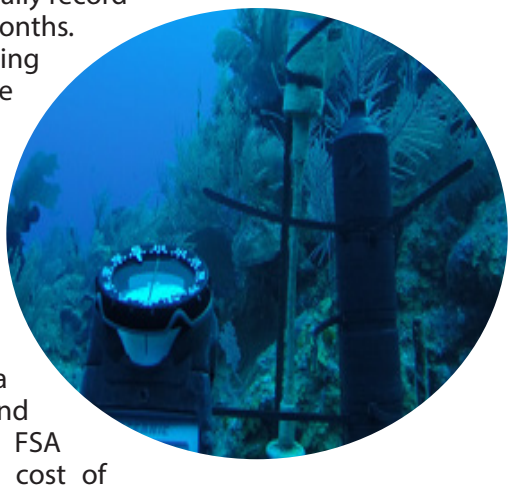
PASSIVE ACOUSTIC MONITORING OF FISH SPAWNING AGGREGATIONS (FSAS) AT GLOVERS REEF ATOLL, BELIZE

Myles Phillips, Wildlife ConservationSociety, Belize Program

Coral reefs are considered the rainforests of the sea, and just like their terrestrial counterparts, are alive with a myriad of sounds produced by fish, marine mammals and other creatures. Many fish are known to produce sounds associated with behaviors, including courtship, competition for food or mates, defensive threat displays, coordination of group behaviors and warning cries when predators are sighted. For example, the Nassau Grouper *Epinephelus striatus* uses specialized muscles in conjunction with the air bladder to produce a variety of deep, grunting calls. Their Courtship-Associated Sounds (CAS) can be used to quantitatively measure the amount of courtship, and presumably spawning activity, at a Fish Spawning Aggregation (FSA) site. These sounds allow scientists to assess patterns of courtship activity across the four months of the spawning season (December to March), and across years (Schärer et al., 2013, 2014).

For these studies, we use specialized acoustic recording devices, known as hydrophones, which can detect sounds underwater with far greater efficacy than the human ear. Logistically they are extremely practical, requiring only one dive for deployment at the FSA site, and another to retrieve them at the end of the spawning season for the species of interest. Once deployed, they can either continuously or periodically record sound information for weeks to months. However, the up-front cost of acquiring a hydrophone can be high, in the range of $3000-$5000 USD. The data also requires a certain level of technical expertise for analysis and interpretation.



WCS has only recently begun to explore the use of this technology to augment our monitoring work at Tiger/Southwest Caye Bank (a Tiger Grouper spawning site) and Northeast Point (a multispecies FSA site). A collaborator covered the cost of analyses of the 2021 data from Northeast Point to inform the filming of a documentary during the 2022 spawning season. These analyses only considered a daily sample during the period 6pm-7pm, when the greatest courtship/spawning activity is expected to occur for Nassau Grouper. It was able to indicate daily patterns of spawning activity during the spawning period (See Figure 1).

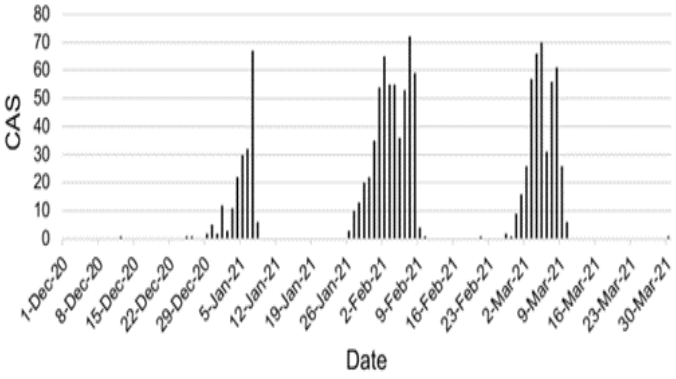


Figure 1: Total counts of courtship associated sounds (CAS) of Epinephelus striatus per day from 18:00AST-19:00AST at Glover's Reef. Sample rate = 44.1kHz, Hann window size = 4096, 0-1kHz visible bandwidth. From Appeldoorn-Sanders, 2021.

An initial assessment of 24 hours of audio on the fourth and fifth day after the full moon in February 2021 detected CAS produced by other grouper species, including Red Hind *Epinephelus guttatus*, Black Grouper *Mycteroperca bonaci* and Yellowfin Grouper *Mycteroperca venenosa*. This evidence supports reports of Northeast Point representing an important multispecies aggregation site for groupers. The greatest number of Nassau Grouper CAS were heard during the February aggregation event, followed by March and then January, with double peaks in the incidence of CAS which suggest the possibility of multiple spawning events in February and March (Appeldoorn, 2021).


Tiger Grouper with Loggerhead DSG-ST in background, Glover's Reef. Photo: M. Phillips/WCS©

Monitoring of CAS is not the only application of acoustic marine monitoring being explored by WCS. Acoustic data analyses from 2021 also revealed several incidents of extended vessel activity within 300m/1000ft (the effective 'listening' range of the DSG-ST) of Northeast Point on multiple occasions. The device recorded several gear shifting "pops" and sudden changes in speed which may be associated with fishing activity (Appeldoorn, 2021). It must be noted that in the 2021 sampling season, neither the Fisheries Department nor WCS Belize were able to travel to this site due to the COVID19 pandemic. In short, this report acts as proof of concept for the use of hydrophones to detect the frequency of unsanctioned vessel activity at FSAs, including illegal fishing, and is currently being used as empirical evidence to support adaptive management efforts for better enforcement of this sensitive area. However, it must be emphasized that hydrophone data does not allow immediate response by enforcement agencies. This information will only be extracted upon retrieval of the device and analysis of the recordings. It will be key for WCS and the rest of the Belize National Spawning Aggregation Working Group to continue efforts to supplement constant enforcement presence by Belize Fisheries Department and the Coast Guard during peak spawning periods for Nassau Grouper.

Hydrophone data collection is ongoing, but WCS lacks in-house capacity to analyse this data. Moreover, there is also limited capacity in-country to do the analysis. As such, organisations using hydrophones will need to rely on partnerships with expert collaborators or pay for expert analysis for the foreseeable future. WCS intends to continue gathering long-term data in order to assess annual variability of calling activity of Nassau Grouper and other commercially important species. This will reveal annual patterns of behavior through the frequency of call types, including the timing of FSAs and the occurrence of spawning events. It is paramount for us to continue annual monitoring at Northeast Point to contribute to this emerging field of study. We are deeply grateful to the many technical collaborators who have variously supported our first steps into this form of monitoring through equipment loans, donations and technical support. These include Michelle Scharer-Umpierre of HJR Reefscaping (Puerto Rico), Timothy Rowell and Ryan Caiillouet of NOAA (USA), the Commonwealth Scientific and Industrial Research Organisation (CSIRO), Casey Sapp of VRTUL and Ana Salceda of BelugaSmile Productions.

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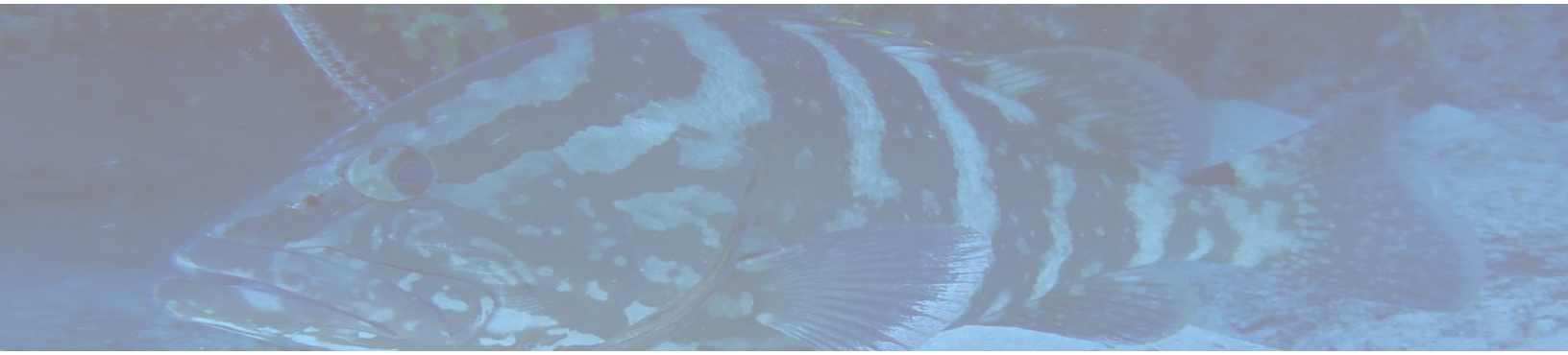

SANDBORE FSAS: A STRONGHOLD FOR NASSAU GROUPER

Dominique Lizama, Belize Audubon Society

Aggregating in the hundreds, thousands or tens of thousands, the critically endangered Nassau grouper (*Epinephelus striatus*) actively spawn in Belize from December to March in water temperatures of approximately 79°F. Historically, fishers targeted this species during the spawning months with some sites having catch rates of up to 1500-1800 fish per boat (Sala etc. al, 2001) and continued unabated until it became protected in 2002. Thereafter fishing still continued albeit limited. As a result, most spawning sites in Belize saw dwindling numbers, further pushing the species to decline. With the region having the same peril, the species was eventually labeled as critically endangered by the IUCN in 2019. Fishing Nassau grouper at Lighthouse Reef Atoll (LHRA) dates back to early 1920s and up to the 1980's, fishermen described congregations of between 20,000 and 30,000 spawning Nassau grouper at the Sandbore site. Since then, there has been significant decline in numbers which is also true nationally for this species by a population decline of more than 80% since the late 1970's, attributed primarily to fishing pressure (Sala etc. al, 2001). As a result of its vulnerability and population threat, the Nassau grouper is a key conservation target for this management zone.

LHRA has been identified as a high priority conservation target for its outstanding fish diversity, based on a combination of the low human impact levels, the near-pristine nature of the reefs, and the connectivity with the open ocean, (Kramer et al., 2002). Specifically at the northern tip of the atoll, off the shelf-edge at the Sandbore spawning aggregation site, which supports a viable population of Nassau groupers, has been actively monitored for 20 years. The viability of this site is attributed to its remote location, seemingly inaccessibility by local fishers especially during the said months when northerlies are blowing and effective enforcement during the closed season. Although Nassau grouper aggregating numbers in LHRA have fluctuated over the years (Paz et al., 2001; Heyman et al., 2002), there has been a steady increase 2013 to 2018.

Maximum count estimates between the hundreds and thousands, peaked in 2018 at an estimated ~4033 (Belize SPAG WG, 2019), when compared to the other national sites. The subsequent years; however, had low recorded numbers or none due to cancellations of dives because severe inclement weather affected monitoring, particularly in 2020-2021 (See Figure 2).

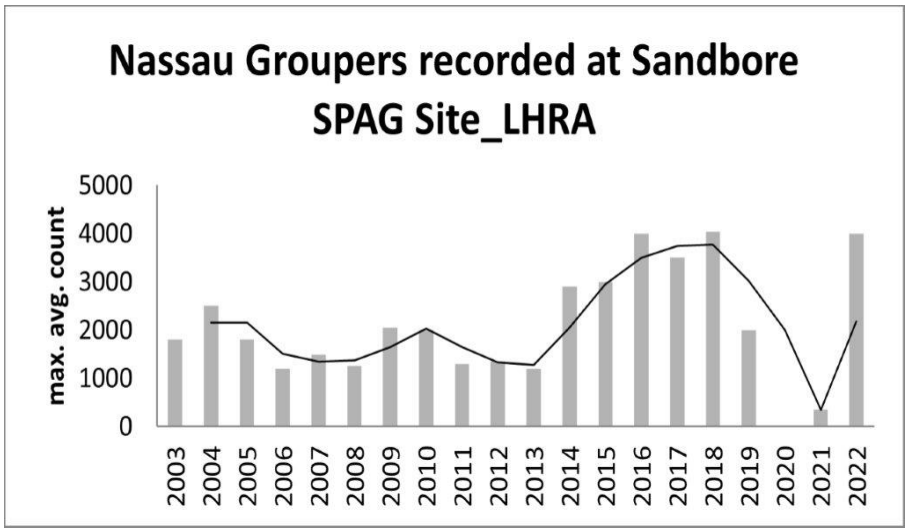

Figure 2 : Maximum average count for Nassau Grouper at Sandbore SPAG site.

Coupled with the unfavorable weather conditions, additional observations by the monitoring team have noted that the "fish ball" was difficult to locate and has been going deeper since 2017, beyond the limits of the divers. A fish finder was installed on the research vessel in 2022 to aid divers in locating the fish ball and to be more effective in their efforts. This resulted in successful findings as the fish count estimates stood at 4000 Nassau groupers. Fish sizing also commenced in 2022 at LHRA to determine more accurate measurements. Additional recommendations for future successful monitoring include the use of more sophisticated monitoring equipment such as a hydrophone.

Although the Sandbore site is outside the two designated Natural Monuments co- managed by BAS, the Belize Coast Guard jointly with BAS provides a surveillance and enforcement presence, with targeted patrols in the area during the full moon spawning period. However, the logistical challenges posed by the distance from Half Moon Caye make it difficult to provide full protection. This makes it particularly vulnerable to illegal transboundary fishing at night, particularly from Honduran boats. Should this persist, BAS will be unable to effectively address these illegal vessels. Patrolling efforts during the period November to March 2018 to 2022 showed that the BAS rangers made 130 patrols in the area. For one year, an increased level of security was added in 2021 by the Belize Coast Guard being posted at Northern Two Caye which is adjacent to Sandbore, but that didn't last very long and the post was abandoned.

The continuous monitoring thus far in tracking the population status of *E. striatus* has shown that Sandbore is a stronghold in Belize for this this critically endangered species.

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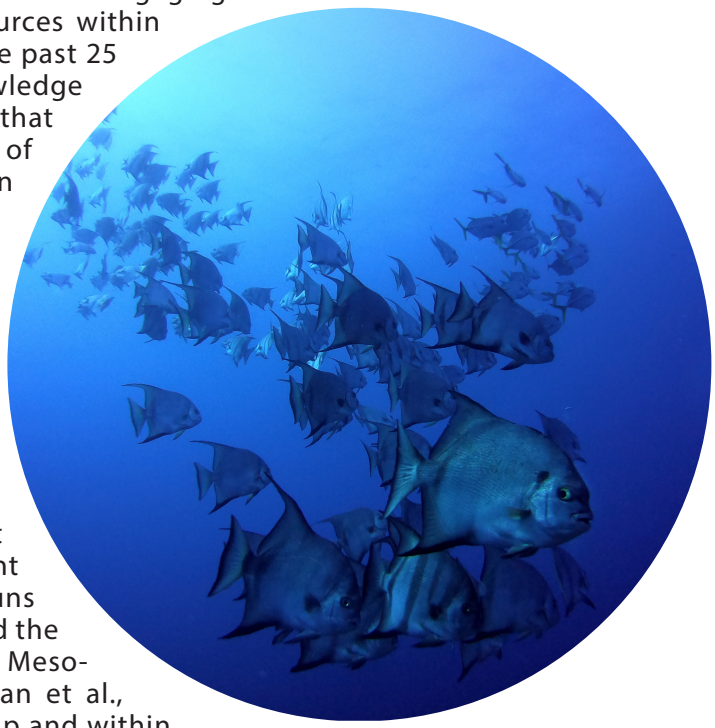
CAYMAN CROWN: A POSSIBLE MULTISPECIES FSAS (A SYNOPSIS)

Cecilia Guerrero, Toldeo Institute for Environment and Development

The Cayman Crown reef has been an area of regional interest since its discovery by Guatemalan fishers in 2013. A transboundary site in nature, lying between Guatemala and Belize, Cayman Crown is located within Conservation Zone IV at the southernmost part of the newly expanded Sapodilla Cayes Marine Reserve (SCMR) in Belize.

Described as an offshore reef area, Cayman Crown is located approximately 56 km east of Punta Gorda Town and 16 km south-southwest of Hunting Caye (Figure 3). Purkis (2021), contracted by the Healthy Reefs Initiative (HRI), characterized the reef through a benthic habitat mapping exercise for the Southern Belize and Guatemala Mesoamerican Reef. The study described the reef as a platform reef with depths to 50 m and habitats primarily composed of coral framework, coral framework with algae and individual patch reefs. Further preliminary assessments suggested a possible multispecies fish spawning aggregation (FSA) at Cayman Crown – a site potentially crucial to the Mesoamerican Reef for its biological connectivity and resiliency of marine resources. However, information needed to guide the effective management and protection of Cayman Crown is lacking.

The Toledo Institute for Development and Environment (TIDE) has been engaging stakeholders in the sustainable management of natural resources within the Maya Mountain Marine Corridor of southern Belize over the past 25 years. Since 2020, TIDE has been working to reduce the knowledge gap of the Cayman Crown reef through a multifunded project that aims to increase the knowledge, protection and management of fish spawning aggregations and replenishment zones within the Mesoamerican region. The project is being implemented in partnership with HRI, and Guatemalan counterpart Foundation for Eco-development and Conservation (FUNDAECO for its acronym in Spanish), to collate crucial ecological and biological baseline data necessary for the establishment of an FSA site at Cayman Crown and to effectively manage the area.



Aggregation of Atlantic spade jack at Cayman Crown during the characterization and monitoring of the site. Photo: TIDE, 2022 ©

Activities led by TIDE under this project included the characterization and monitoring of 10 potential FSA sites at Cayman Crown. This required TIDE's science team to conduct underwater visual surveys on the full moon and subsequent days during the grouper and snapper spawning season that runs from December to June. The underwater visual surveys followed the 'Reef Fish Spawning Aggregation Monitoring Protocol for the Meso-American Reef and the Wider Caribbean, Version 2.0' (Heyman et al., 2004), used by the Belize Spawning Aggregation Working Group and within the Mesoamerican region. The survey captures abundance of target species, sizes estimates and records any spawning behavior.

A recent analysis of the data collected by TIDE between February 2020 and May 2022 confirms the presence of two multispecies aggregation sites: The Jewel Wall and West Bezel Fisher Marker, which support aggregations of mostly jacks with numbers in the hundreds to thousands, snappers in the hundreds and groupers in tens to hundreds. The most sighted species included the Atlantic spade, bar jack, horse eye jack, schoolmaster, rainbow runner, white grunt, bonito, crevalle jack, yellowtail snapper and dog snapper. Additionally, spawning behavior was reported in species of commercial importance, including the black, Nassau, and tiger groupers which displayed color changes and gravid appearance. However, further research and monitoring is required at Cayman Crown to better inform decision-makers in the proper protection and management of the site. With this in mind, TIDE plans to continue working with its partners and local authorities in 2023 to monitor and evaluate potential, confirmed and established FSA sites, as well as implement the SCMR Management Plan 2021-2026, enhance the use of technology in research activities, including the use of acoustic recorders, and obtain co-management of SCMR.

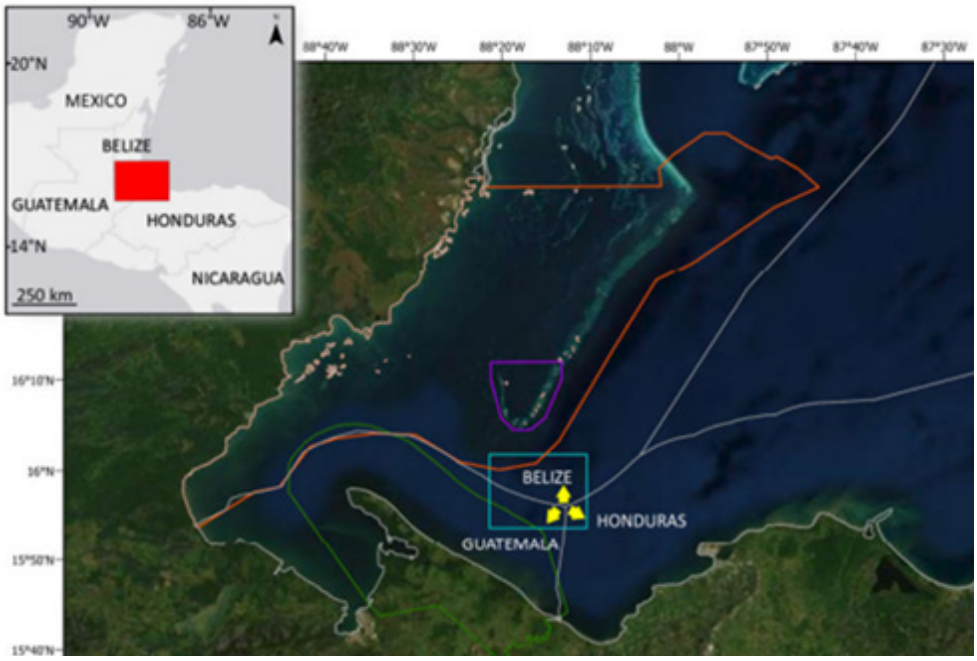


Figure 3: Location of the Cayman Crown reef relative to the Belize and Guatemala coastlines. The Sapodilla Cayes Marine Reserve boundary - prior to expansion in 2020 - is outlined in purple, whilst the location of the Cayman Crown site is delineated in aquamarine. The Southern Barrier Complex of Belize, is outlined in orange (Source Purkis 2021).

BONEFISH AS AN UMBRELLA SPECIES TO INFORM WIDER CONSERVATION IN BELIZE

Dr. Addiel U. Perez and Dr. Aaron James, Bonefish & Tarpon Trust

Recent and ongoing research by Dr. Addiel U. Perez from Bonefish & Tarpon Trust (BTT) has identified a bonefish (Albula vulpes) pre-spawning aggregation (PSA) site, and tracking spawning movements. The PSA site, in northern Ambergris Caye, hosts bonefish that migrate from their home flats throughout the region – from San Pedro and Corozal bay in Belize, Chetumal Bay and Xcalak in Mexico, and beyond. This means that any damage to this important site or harvest of these fish threatens the region's economically important Flats fishery.

Large adult bonefish (*Albula vulpes*) migrate seasonally to pre-spawning aggregation sitesbefore migrating offshore to spawn.

Photo: Dr. Addiel U. Perez ©

Bonefish follow a reproductive process that is a bit different than species that people are more familiar with, like groupers and snappers. Groupers and snappers migrate from their home locations to a spawning site, and spawn at that site. In contrast, bonefish migrate from their home locations to a PSA site, where they tend to form large schools for a few days to a week. To spawn, the bonefish move offshore at night, and dive as deep as 450 feet. They then either return to the PSA site and spawn offshore again the next night, or migrate home. For site identification, PSA characterization, and identification of the spawning area, Dr. Perez is applying the protocol developed by BTT from research on spawning bonefish in The Bahamas, Belize, and the Florida Keys.

As with all BTT's research, this has been a collaborative effort amongst stakeholders, including El Pescador Lodge and Villas, Omar's Freelance Fishing, Blue Bonefish, and resource managers including Hol Chan Marine Reserve and Belize Fisheries Department. As with research and identification of other fish spawning aggregations, the goal of BTT's bonefish work inform education efforts so that the importance of this location is known, and build a strong conservation partnership with stakeholders and resource managers to ensure effective protection of this important location. During the spawning season of 2022-2023, BTT will track bonefish during their offshore migration to spawn.

Why is the flats fishery important?

The flats fishery is one of several types of recreational-sport fishing (RSF) in Belize. The flats fishery is catch-and-release and takes place in Belize's shallow coastal waters (Perez-Cobb et al 2014). This fishery targets bonefish, tarpon (*Megalops atlanticus*), permit (*Trachinotus falcatus*), and snook (*Centropomus spp.*). This fishery supports more than 2,000 direct and indirect jobs and contributes close to BZ $110 million to Belize's economy (Fedler 2013). For these socio-economic reasons, these species are important to be protected and the fishery managed appropriately. To accomplish this, BTT focuses on generating scientific information and building capacities of local stakeholders and resource managers for application to conservation and management of fisheries and protected areas.

Bonefish as an umbrella species in coastal Belize

Bonefish is a good umbrella species because it depends upon the many connected habitats of the coastal habitat mosaic – from shallow mangrove flats to backreef lagoons and offshore waters. Using bonefish as the focal species to justify protection of these habitats provide protection to other species that use the same or a portion of the habitat mosaic used by bonefish. The focus on habitats are important because when habitats are destroyed or degraded, the flats fishery, other fisheries and tourism that depend on habitats will also suffer. The habitats essential to our flats species aren't just where we fish for them, but also include habitats for juveniles, adults migrating to spawn, spawning locations, and feeding and resting areas away from the flats.

Threats to bonefish include dredging of the flats and coastal development, which degrades habitats, and beach fish traps, which catch fish during spawning migrations. Although bonefish captured in beach traps are released, the traps disrupt migrations and cause stress, which reduces spawning success. Given these and the current threats to habitats by coastal development, it is important that essential habitats are identified and protected to ensure the economically and culturally important flats is sustainable.

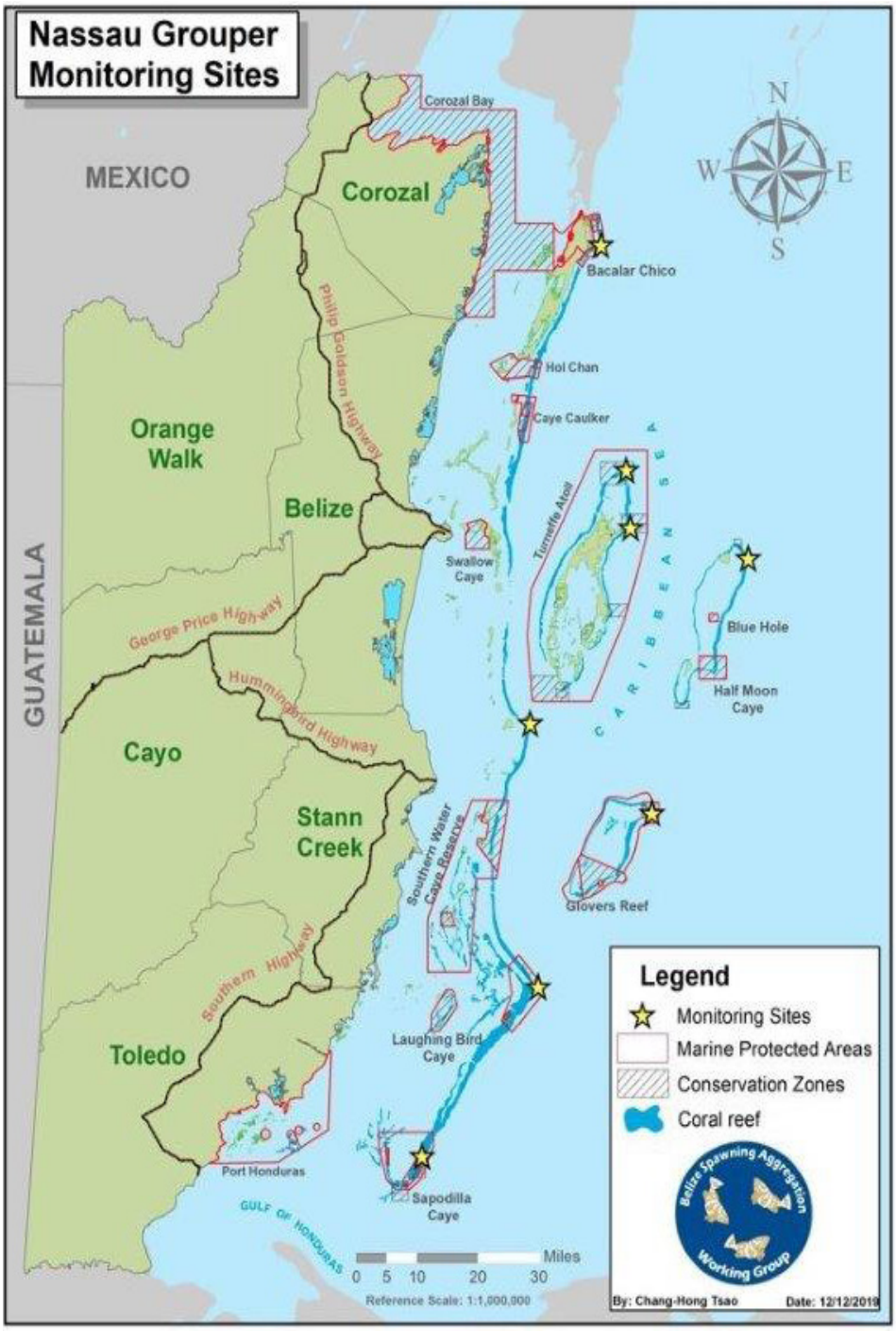
In addition to BTT's work on bonefish, we are also working to identify important home range habitats, pre-spawning aggregation sites and spawning sites for permit and tarpon. As these important habitats are identified, we will continue to share this information with resource managers so that management plans can incorporate these important habitats into comprehensive management.

BTT and long with resource conducting research and training in northern Belize.

Flats fishing in Bacalar Chico Marine Reserve highly depends on healthy coral reefs, seagrass and mangrove habitats.

Active Members of the Belize Spawning Aggregation Working Group

- Belize Fisheries Department
- Belize Audubon Society (BAS)
- Wildlife Conservation Society (WCS)
- Turneffe Atoll Sustainability Association (TASA)
- Coastal Zone Management Authority and Institute (CZMAI)
- Toledo Institute for Development and Environment (TIDE)
- University of Belize -Environmental Research Institute (UB ERI)


Nassau Grouper
Monitoring Sites
MEXICO
GUATEMALA
Corozal Bay
Corozal
Orange Walk
Belize
Cayo
Stann Creek
Toledo
Phillip Goldson Highway
George Price High-way
Hummingbird Highway
Southern Highway
Bacalar Chico
Hol Chan
Caye Caulker
Turneffe Atoll
Swallow Caye
Blue Hole
Half Moon Caye
Glovers Reef
Southern Water Caye Reserve
Laughing Bird Caye
Sapodilla Caye
Port Honduras
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Legend
Monitoring Sites
Marine Protected Areas
Conservation Zones
Coral reef
Belize Spawning Aggregation Working Group
By: Chang-Hong Tsao
Date: 12/12/2019