# Port Honduras Marine Reserve

# Annual Report 2019


Prepared by:
Ryan A. Moore
Contributors:
Heidi Waters, Nigel Gomez, Federico Caal

Manager's Overview

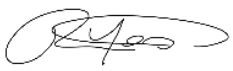
It is with great pleasure to present the Port Honduras Marine Reserve (PHMR) annual report for 2019. This report summarizes the main activities that occurred throughout the year January 2019 - December 2019. The reserve staff has continued with the same dedication and passion in ensuring the successful management of the area and its conservation targets have remained first and foremost.

The field staff conducted a total of 677 patrols within the time period, a significant increase from the previous year. As a result of these patrols, 1 arrest was made with successful prosecution, 1 written warning issued, 12 verbal warnings issued and 16 gill nets and 10 fish traps were removed from within the reserve. Most of the patrols conducted were joint operations with the Belize Coast Guard, and personnel from other protected areas managed by the Toledo Institute for Development and Environment (TIDE). Working relationships with government agencies in 2019 such as the Belize Coast Guard, Belize Fisheries Department, Belize Police Department, Belize Port Authority, Belize Immigration Department and the Belize Forest Department have continued to be improved.

Once again, we would like to express our sincere gratitude to the Belize Fisheries Department, PHMR Advisory Committee, the Belize Coast Guard, OAK-MARFUND, European Union, the Summit Foundation, Overbrook, Gulf Caribbean Fisheries Institute, New England Biolabs and the Protected Areas Conservation Trust. The great work towards the sound management and sustainable use of the marine resources would not have been possible without the financial contribution and commitment from these partners throughout the year.

I must make special mention of PHMR's rangers, Edwin Cabrera, Dervi Williams, Rahjeme Coleman and Allen Garcia for their continued dedicated support and hard work to the conservation and protection of PHMR's natural ecosystems and its marine life. A special thank you must be given to the Belize Coast Guard for their tremendous support throughout 2019 in the enforcement of rules and regulations of the reserve and the security they provided for our staff and resource users. It has been a privilege and a great experience to have worked with you all for 2019 and I look forward to 2020 with great expectations.

Sincerely,



Ryan A. Moore
Marine Manager
Toledo Institute for Development and Environment

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## 0.0 List of Abbreviations

| | | |
|---|---|---|
| PHMR | - | Port Honduras Marine Reserve |
| TIDE | - | Toledo Institute for Development and Environment |
| BFD | - | Belize Fisheries Department |
| BCG | - | Belize Coast Guard |
| SMART | - | Spatial Monitoring and Reporting Tool |
| MPA | - | Marine Protected Area |
| GIS | - | Geographic Information Systems |
| MMMC | - | Maya Mountain Marine Corridor |
| SI | - | Statutory Instrument |
| RZ | - | Replenishment Zone |
| MA | - | Managed Access |
| FWC | - | Fresh Water Cup |

## 1.0 Administration

### 1.1 Staffing for PHMR

**PHMR Enforcement Staff**

| No. | Names | Position |
|---|---|---|
| 1 | Ryan Moore | Marine Manager |
| 2 | Edwin Cabrera | Head Ranger |
| 3 | Dervi Williams | Senior Ranger |
| 4 | Rahjeme Garcia | Ranger |
| 5 | Allen Garcia | Ranger |

**Table 1: Showing PHMR Enforcement Staff**

**PHMR Research Team**

| No. | Names | Position |
|---|---|---|
| 1 | Heidi Waters | Science Director |
| 2 | Anthony Rash | Marine Biologist |
| 3 | Nigel Gomez | Managed Access Coordinator/Research Assistant |

**Table 2: Showing PHMR Research Team**

**Community Researchers and volunteers**

| Names | Names |
|---|---|
| Rushay Figueroa | Daniel Tush |
| James Choc | Eulogio Teul |
| Milton Cohouj | Eeryn Bowden |
| Mauricio Barboza | Genevieve Ramirez |
| Melissa Robinson | Shalini Shal |
| Stavros Bardalez | |
| Gary Zuniga | |
| Tracy Petillo | |
| Amelia Bo | |
| Alejandro Baki | |

**Table 3: Showing Community Researchers and volunteers who assisted in the management of PHMR**

## 2.0 Background of the Port Honduras Marine Reserve

### 2.1 Introduction

The PHMR was declared by the Government of Belize on January 25th 2000. It is actively co-managed by TIDE with the governing authority being the Fisheries Department. PHMR is a semi-estuarine system that covers approximately 160 square miles and is an integral part of the MMMC in southern Belize. The reserve is located just off the coast of Punta Gorda and extends north up to Monkey River Village. PHMR is comprised of coastal wetlands, seabed, mangroves, lagoons, savannahs of Paynes Creek National Park and national lands within the area known as the Port Honduras, with general boundaries being the Rio Grande in the south, Monkey River in the north, the snake cayes in the east and the coastal wetlands in the west. The reserve is rich in biodiversity, containing approximately 138 small mangrove cayes, which provide essential habitat and nursery for juvenile aquatic species. Other critical habitats include sea grass beds, hard bottom communities, and soft bottom communities. A large portion of the reserve is covered by seagrass, which also provides essential habitat and food for juvenile fish species, sea turtles and manatees. Also, within the reserve are fringing reefs, coral patches and coral heads which provide a refuge and food for marine animals.

There are two buffer communities that are located adjacent to the reserve which are Monkey River Village and Punta Negra Village. The residents of each village are mostly commercial fishers, tour guides, or fly-fishing guides who depend on the resources of the reserve for their livelihood.

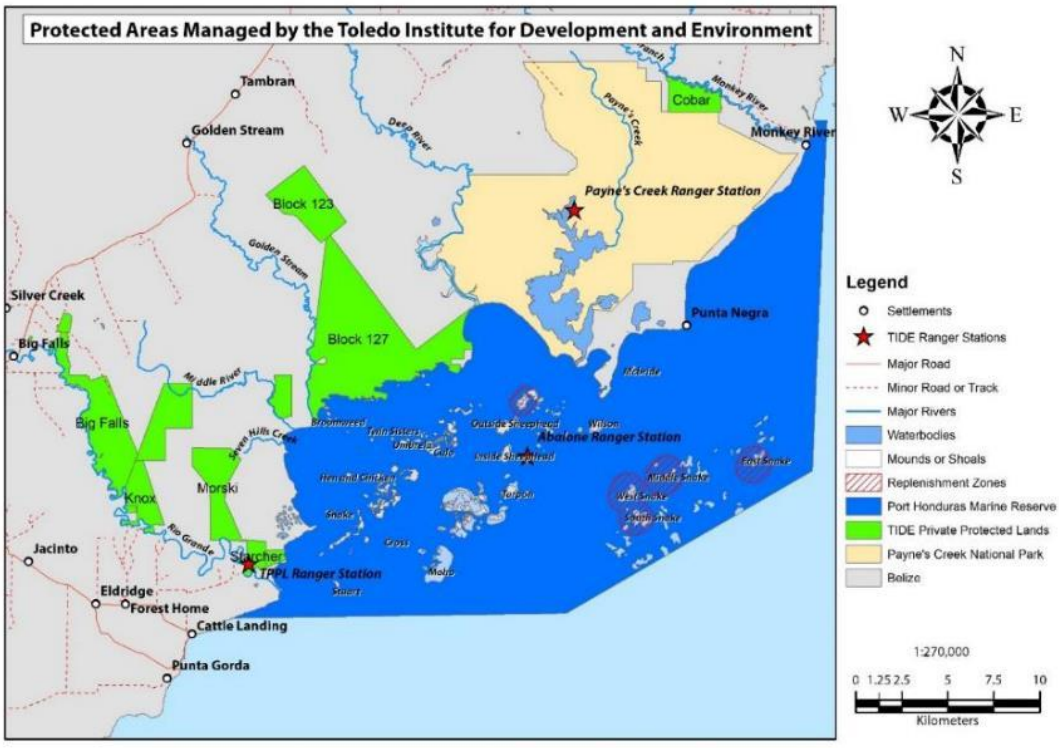



**Figure 1: A map of the protected areas managed by the Toledo Instituted for Development and Environment**

### 2.2 PHMR's Strategic Plan and Goals

**The PHMR management strategy is based on five major goals:**

1. To protect the physical and biological resources of the Port Honduras Marine Reserve
2. To provide education and research
3. To preserve the value of the area for fisheries and other important genetic resources
4. To develop recreational and tourism services that will enhance the economic and social benefits of the area without causing environmental damage
5. To strive for sustainable financing

### 2.3 Zoning Plan and Regulations

Three zones were established for the purpose of the regulation and control of the reserve:

**1. General Use Zone (95% of the Reserve)**

Established to provide opportunities for uses and activities (e.g. fishing for conch, lobster, and finfish) under a stringent monitoring scheme.

**2. Conservation Zone (4% of the Reserve)**

Established to provide an area free from commercial fishing to prevent overexploitation of fishery stock, provide an undisturbed area for recruitment of species, and enhance the value of the area for recreational and tourism activities. These areas are located 0.805-kilometers (half a mile) radius around Wildcane Caye and 0.805-kilometers (half a mile) radius around East, West, and South Snake Cayes.

**3. Preservation Zone (1% of the Reserve)**

Established to provide areas within the marine reserve that is preserved in an entirely natural state and to protect areas of particularly fragile habitat or with threatened or rare species. This area is located 0.805-kilometers (half a mile) radius around Middle Snake Caye.

## 3.0 PHMR Activities Accomplished in 2019

### 3.1 Patrols and Surveillance

A total of 677 patrols were conducted for the period January 2019 to December 2019 (*Appendix 1: Patrol Routes in 2019*). The rangers travelled a distance of ~16,200km and averaged ~1350km per month an increase from last year. This totaled ~1720 hrs at sea patrolling with an average of ~144 hrs per month.


**Figure 2: Showing rangers and the Belize Coast Guard on patrol near Punta Gorda Town**

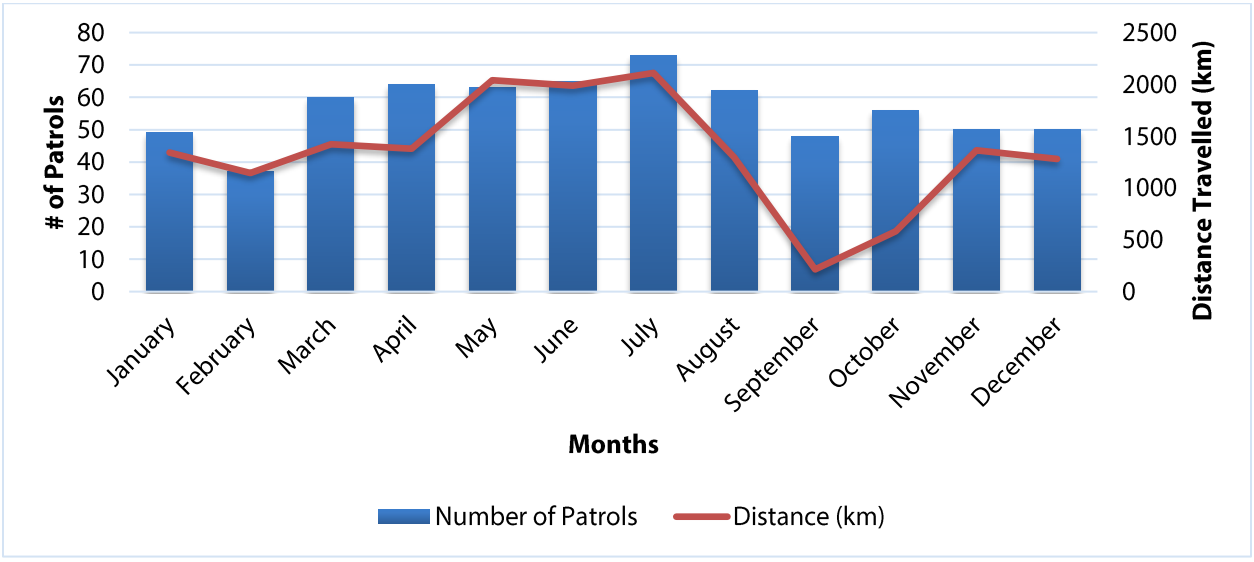



**Figure 3: Showing number of patrols and distance travelled (km) by month in 2019**

An average of 56 patrols were conducted each month focusing on the conservation and preservation zones around the Snake Cayes and the most eastern islands which are the primary habitats for conch and lobster. Other priority areas included the coast leading up to Monkey River Village, the river mouths which empty into PHMR and the conservation zone around Wildcane Caye.

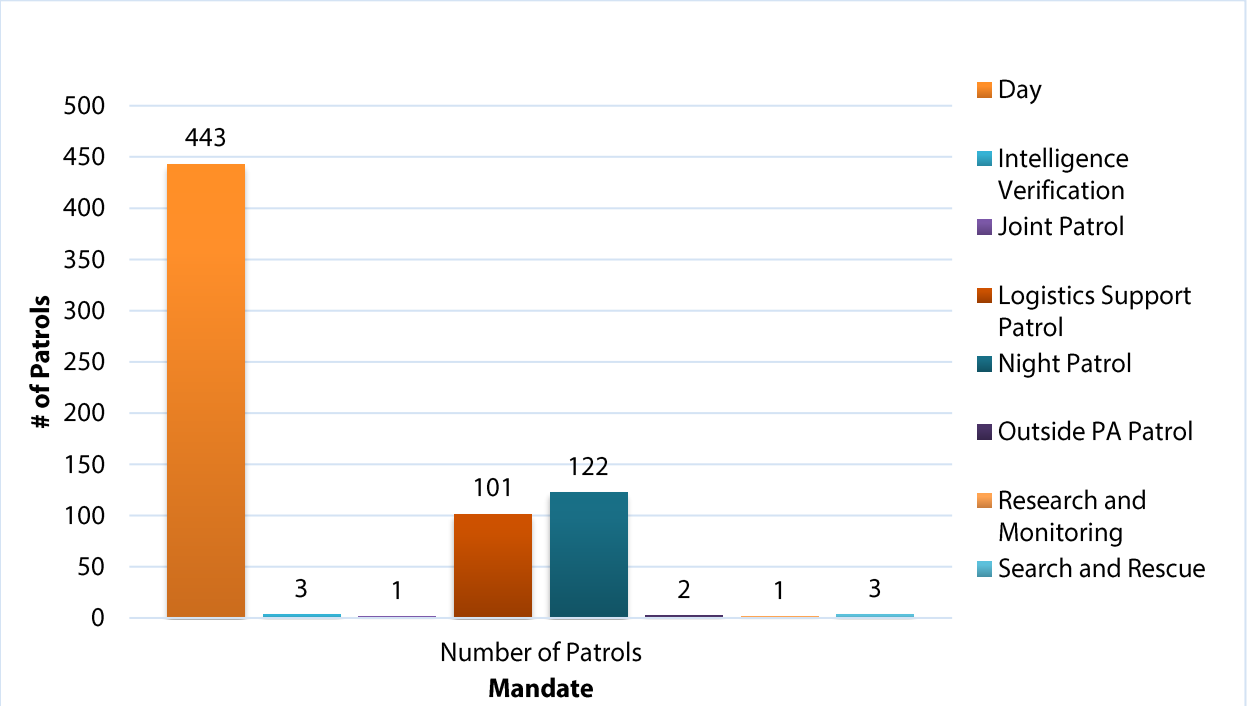



**Figure 4: Showing patrols by mandate for 2019**

Through the assistance of donors, we received 1 new vessel, 1 drone, 2 water tanks, 1 electrical water pump, 1 gas stove which has contributed significantly to enforcement in PHMR. The ranger team will continue to prioritize night time patrols of the PHMR to reduce illegal transboundary infractions by Guatemalans and Hondurans. It has been noted last year with adjustments made to patrol routes that illegal fishing has increased just outside the reserve.

### 3.2 Patrol Infractions for 2019

The patrols in PHMR yielded 33 infractions observed the results of which are as follows: 1 arrest with pending prosecution, 1 written warning issued, 12 verbal warnings issued and 16 gill nets and 10 fish traps were removed from within the reserve.

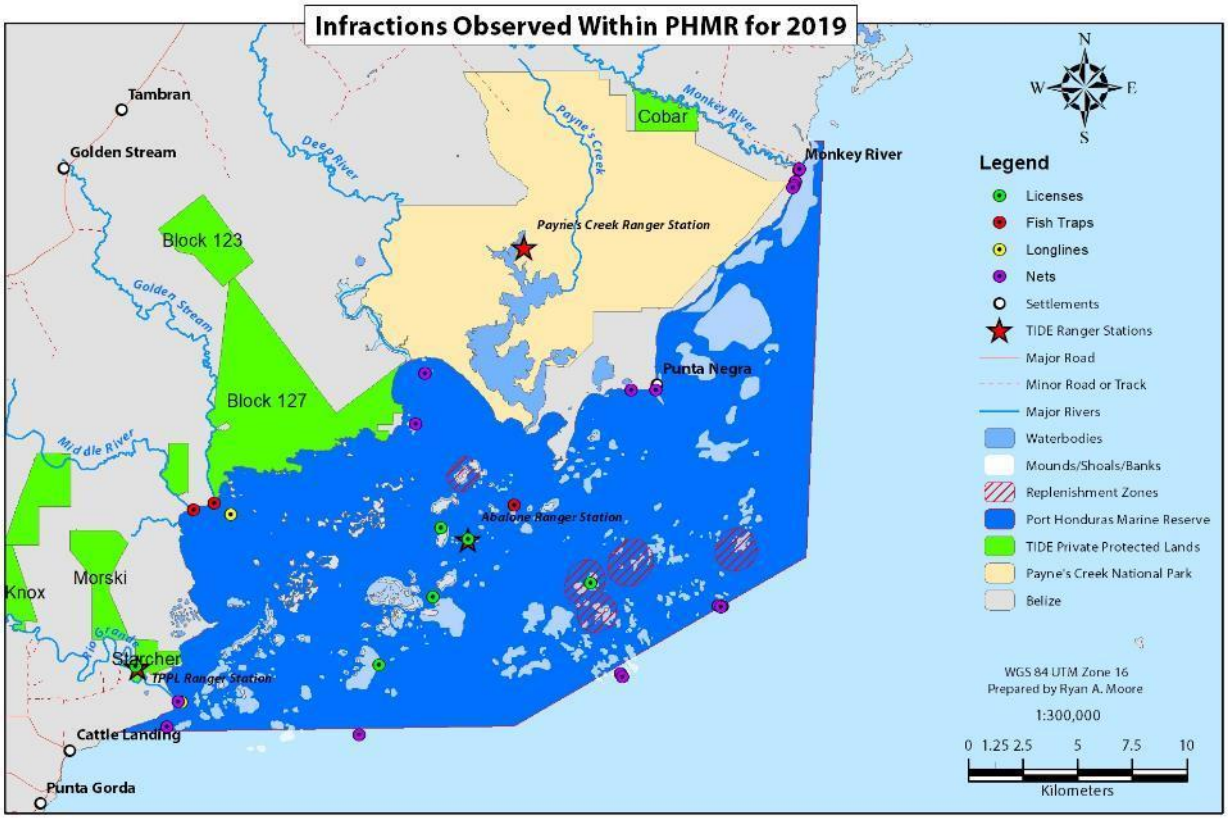



**Figure 5: Showing infractions within PHMR for 2019**

Of the 33 offenses recorded, 19 were from unknown offenders, of the 14 known offenders 3 individuals committed multiple offenses during one event and 1 individual committed different offenses on separate instances. Overall the enforcement team did a wonderful job and will continue to work with these known individuals to increase compliance within the reserve.

**Table 4: Showing details of arrests made in 2019**

| # | Date | Name of Person | Description of Activity | Outcome | Fine/Penalty |
|---|---|---|---|---|---|
| 1 | 28/12/2019 | Marvin Westby | Fishing with gill net that exceeds 100m, Fishing with gill net that has mesh size less than 3 inches, Fishing with restricted gear in a marine reserve, Longlines. | Arrested and charged. | A fine of $305 was imposed for the charge of gill net with mesh size less than 3 inches. The case was settled out of court on the condition that he plead guilty to the charge and forfeit some fishing gear on January 21. |

### 3.3 Advisory Committee Meetings

**Figure 6: Advisory Council meeting held in December for PHMR and PCNP**

For 2019 one Advisory Council meeting was held and was well attended. The meeting was very successful and saw new members present with village council elections being held in Monkey River and elections were held for the Toledo Tour Guides Association. Presentations were given by both MPA managers and feedback was received in addressing issues. Members were informed that the upcoming advisory council will see the election of new membership on TIDE's board.

### 3.4 Maintenance of Patrol Equipment

The upkeep of the patrol equipment such as the regular cleaning of patrol vessel, regular servicing of the outboard engine (engine oil, oil filter change, gear oil change, freshwater wash and re-greasing) were done by rangers; major repairs and any technical problems were done by a mechanic in Punta Gorda Town. The boat continued to have significant issues however during the latter part of the year funding was secured for the purchasing of a new 25ft vessel. We hope that in 2020 this vessel can be put into service in the first month and should see significant savings in fuel consumption due to the size and it being a single engine. Routine maintenance and preventative repairs will be key in ensuring that the vessel remains reliable through the long term.

### 3.5 Infrastructure Maintenance

The upkeep of the ranger station was done by the rangers and personnel from the Belize Coast Guard (BCG) stationed at PHMR. Monitoring and maintenance of solar system was done by rangers. Through a major PACT project, funding was secured for the purchasing of 2 new rotoplas tanks to add to and replace degraded tanks.

**Figure 7: Arial view of Abalone Caye captured by the SwellPro drone and stitched using 3rd party software**

The kitchen was refurbished and dry wall was fitted throughout. This came along well with the new stove which was purchased and we expect that these little improvements can boost morale of the rangers and the BCG.

### 3.6 Trainings Accomplished by PHMR Enforcement Staff

**Figure 8: Rangers utilizing the drone received from the EU Project**

Staff members were given the opportunity to participate in a number of trainings through the year. The team benefited from the communications training with the establishment of a whatsapp group chat, google drive folder to store essential documents and drone handling skills. A manual was created for the Drone to ensure it is accounted for and on how to include the data in our enforcement program.

| # | **Training or Workshop** | **Facilitator** |
|---|---|---|
| 1 | TIDE Communications Training | Sabrina Myvett and Jerry Enriquez |
| 2 | Drone Handling Training | Ricardo Modesta (Swellpro Trainer) |
| 3 | GIS and Drone Training | Belize Forest Department w/ UB Instructor |
| 4 | Advance GIS remote sensing training MODIS | University in Chetumal |
| 5 | Advance SMART Training and New Features of SMART 6 | Wildlife Conservation Society |
| 6 | MPA Managers Workshop | Belize Fisheries Department |
| 7 | Tri-national Marine Wildlife Trade Workshop | Wildlife Conservation Society |

**Table 5: Showing trainings and workshops by PHMR Enforcement Team**

**Figure 9: Manager at Advance SMART training in Glovers Reef Atoll**

**Figure 10: Protected Areas Managers meeting in Belize City**

### 3.7 Training needs for PHMR enforcement staff

| | |
|---|---|
| 1. | Advance Boat and Engine Maintenance Training |
| 2. | MPA Enforcement Training |
| 3. | Fisheries Regulations Training |
| 4. | Case File Preparation Training |
| 5. | Special Constable Training |
| 6. | Mooring, Demarcation Buoy Installation and Cleaning Training |

**Table 6: Showing training needs for PHMR Management Staff**

### 3.8 Partnerships

The PHMR staff continue to work with local and partner organizations, these partners include the Fisheries Department, the Belize Coast Guard, the Police Department, the Belize Defense Force, the Belize Audubon Society, Southern Environmental Association, the University of Belize and the Tour Guide and Fishermen Associations from the buffer communities of the reserve.

**4.0 Communications**

TIDE has developed and implemented a communications strategy for 2019 which continued to be carried out by the Communications involving different members of staff. This year the Marine Manager and the Education and Outreach Coordinator attended a 30-minute radio broadcast highlighting the PHMR. This was also live fed through TIDE's Facebook page. Throughout the year posts highlighting work done in the PHMR was also highlighted on the Facebook page and TIDE continues to attend national radio shows before the Fish Fest to highlight all of TIDE's work. TIDE expects to utilize similar methods in 2020 to continue to keep stakeholders aware of the work TIDE is doing on their behalf and activities relating to the PHMR.

**5.0 Erosion of Abalone Caye**

In 2019 the island did not experience significant erosion and remained stable with only a few gabion baskets succumbing to wave action. TIDE will continue to seek funding to ensure the viability of the key to host our enforcement team due to its strategic location in the reserve.

**Figure 11: Showing Abalone Caye and the seawall Seawall out at Abalone Caye**

## 6.0 Community Education and Outreach

### 6.1 TIDE Freshwater Cup 2019

TIDE promotes primary and secondary schools in the holistic development of children ages 8 -17 from 19 institutions. For this program a total of 606 students were directly involved in the soccer tournament. TIDE collaborated with Ryoko Kumara from JICA and Analee Chuc from OCEANA to sensitize all 19 schools on harmful plastics, marine litter, and their impact on key species and the environment


**Figure 12: Showing Female FWC champions**

For 2019 schools implemented their environmental projects with the help of either teams participating in the program or by joining forces with members of the school's population. Fourteen of the nineteen schools invited their entire school population to contribute efforts and resources to successfully complete their objectives. Principals and teachers ensured that they regularly attended to their projects. The projects implemented by these schools varied in scope. Some did all five R's (Reduce, Reuse, Refuse, Remove and Recycle) of solving the plastic issue, while others concentrated on one or two. Most schools included indoor and outdoor experiences for the children participating. The quantity of plastics removed from the environment was of such outstanding amounts, that education and awareness of its impact came to be another key component of the schools' plans. School children were encouraged to recycle plastics that were collected through their campaigns and to showcase in their classrooms. Education campaigns made students the main actors in the solution of plastic pollution within

their communities. They were directly engaging with their parents and community members for a litter free community.

**Figure 13: Showing freshwater cup female players**

At the end of the FWC tournament, all teams were acknowledged for their team effort in being a part of the success for the 2019 FWC Cup. The four male primary school teams who won their zone games participated in this event in Golden Stream. The four male teams were from Trio Government, Golden Stream Government, San Pedro Columbia R.C. and St. Peter Claver R.C. competing in the final leg of the games.

The four female primary school teams, on the other hand, travelled to San Miguel Football field for their finals. The four female teams were from St. Peter Claver RC, San Miguel RC, Silver Creek RC and Trio Government School. St. Peter Claver Primary School were the overall champions for both Male and Female competitions. The Freshwater Cup tournament was also made a success due to the support of certified officials from the Football Federation of Belize - Referee Department. They ensured that the rules of the games were exercised and travelled to all venues with outreach personnel.

### 6.2 Summer Camp

The theme for 2019 summer camp was "Be the solution for plastic pollution". This year's success was possible with funding from PACT. The camp was at four locations: Punta Gorda, San Marcos and Big Falls. There were 105 campers engaged in fun-filled activities during the month of July. The camp at Punta Gorda had 24 campers, the

camp at Big Falls had 22 campers, the camp at Medina Bank had 39 campers and the camp in Monkey River had 20 campers.

**Figure 14: Showing kids engaging in team building activities during camp**

Each campsite was organized and implemented by four facilitators with one leader at each community. These individuals learnt and taught during summer break to provide an opportunity for young minds to be actively involved in learning and being solution to plastic pollution.

We had the wonderful support of three Japan International Cooperation Agency (JICA) volunteers Ryoko, Roy and Masaki as well as 3 P.O.D. volunteers Michelle, Ray and Raul. The volunteers focused on providing lessons in arts and crafts, team building activities, and other activities which focused on building self-esteem and knowledge on beating plastic pollution. During camp healthy snacks were emphasized and students enjoyed the various fruits and vegetable they were provided.

**Figure 15: Showing kids working on Arts and Craft projects during summer camp**

TIDE continues to ensure that every child living in communities surrounding the three protected areas are engaged positively and are stewards of the environment. Let's continue to be the solution to plastic pollution for a healthy environment.

## 7.0 Managed Access in PHMR

### 7.1 Overview of the Managed Access Program for 2019

Through the European Union project, "Restoring Fisheries in the Mesoamerican Barrier Reef System," and the Environmental Defense Fund; TIDE has continued with Managed Access activities as well as laying the groundwork for a bright future in Managed Access nationally.

**Figure 16: Assortment of commercially targeted fish species out at the Punta Gorda fish market**

### 7.2 Fishing Forums

The fishing forum was held at Marian's Bayview Restaurant and was jointly for Area 4 and Area 5 fishers. This forum saw an increase over previous forums and was well attended. Topics of discussion included the new fisheries bill, recreational fishers, alternative lively hood projects and other issues affecting the Sapodilla Cayes Marine Reserve. To culminate the end of the forum, a small football marathon was held at the Cattle landing Football Field. This activity was well received and saw for positive interactions amongst fisherfolks of different areas.

**Figure 17: Showing Managed Access Fishing Forum in June 2019**

**Figure 18: Showing winners of the football marathon held amongst fishers**

### 7.3 Committee Meetings

One committee meeting was held in March of 2019 which brought fishers from the communities of Punta Gorda, Cattle Landing and Punta Negra. Fishers were engaged and they actively participated and contributed to the meeting. Potential new entrants for both areas were veted by the committee.

**Figure 19: Showing Managed Access Committee meeting in March 2019**

### 7.4 Outreach Activities

The primary strategy for PHMR continues to be 'one on one' house visits however, frequent stops are still being made to the fish market where the dialogue remains vibrant and energetic. For 2019, small community focal group meetings were included in the overall outreach strategy and were held in addition to forums.

**Figure 20: Showing a small focal group meeting that was held in Monkey River with Fisher Folks.**

It was seen that the number of fisher folks were dwindling and some fisher folks never come to forums. In Area 3 the MA coordinator saw firsthand how effective the small community focal group meetings were in those areas and it was implemented for fishers of Area 5. The community based focal group meeting engaged a targeted group of fisher folk and the information obtained from fishers is much more representative of the group due to the chance of individuals having more of an opportunity to voice their opinions.

**Figure 21: Showing the inside of the Punta Gorda fish market**

### 7.5 Other Activities

2019 saw research being conducted by Catie Alves with the title: 'Searching for the win-win: Can community-based fisheries management restore ecological function and improve the livelihoods of Belizean fishers?' Main takeaways included that a majority of fishers surveyed were 41-50 years old, and fishing is 81-100% source of income for most. Most fishers support Managed Access in the long run and think that it's benefitting their livelihoods, and is improving marine resources. These fishers believe that enforcement, and the perceived effectiveness, are big issues and that most fishers perceived that catch has not improved, nor has the time they're spending at sea decreased, under Managed Access. Overall, there is a need to improve empowerment of fisher communities.

## 8.0 Research and Monitoring

Research and monitoring continue to be an integral part in the management effectiveness of the Port Honduras Marine Reserve (PHMR). Monitoring for the year 2019 included lobster surveys, conch surveys, a sea cucumber survey, a coral health survey, reef fish surveys, reef benthic surveys and coral bleaching surveys. Included with this report will be the commercial species, coral health survey and coral bleaching update 2019. A more detailed analysis of the commercial species, coral health and bleaching, reef fish and reef benthic monitoring will be available in the PHMR Biological Report(s) for 2019.

### 8.1 Queen Conch (*Lobatus gigas*)

Annual monitoring of queen conch takes place in Port Honduras Marine Reserve (PHMR) twice each year in July after the conch season closes and in September before the season opens again. Data on population density, maturity and size frequency of queen conch are collected and analyzed. In 2019, the Belize Fisheries Department closed the queen conch fishery on April 30$^{th}$, 2019 due to the realization of the queen conch quota in accordance with Statutory Instrument No. 54 of 2012. Hence, closed season queen conch monitoring was conducted in May 2019.

Since September 2011, 20 sites had been monitored; five in Replenishment Zones (RZs), 11 in the General Use Zone (GUZ) and four outside the reserve (OUT). In 2019, an additional site OUT was added making the total number of conch sites monitored at 21. In this 2019 report, planned RZ expansion sites for conch were included in the analysis in order to capture the effect of establishment of these areas as RZs in the future. The RZ expansion sites would encompass the Snake Cayes in one contiguous area; currently the RZs only encompass a 1-mile radius encircling each Caye. These RZ expansion sites are collectively known as 'Expanded Replenishment Zone' (ERZ) sites with two currently located in the GUZ. The ERZ sites, in addition to the RZs sites, are referred to as the Contiguous RZs. At each site, where possible, belt transects are performed with five 50-meter transect lines laid parallel to one another and at least five meters apart. Two divers on each side search a combined 4-meter width along each line. All conch within each 200 m$^2$ belt transect are counted and conch density, length and lip thickness are measured. At some sites, only three or four were possible due to habitat and depth constraints. The specific number of sites surveyed in each monitoring trip can vary slightly due to weather, resources, and underwater visibility. A map of monitoring sites for each species in each zone in PHMR can be found in the Appendices.

The annual mean conch densities in RZs in 2019 increased 28% from 46 conch per hectare in 2018 to 59 conch per hectare in 2019 **(Fig. 22)**. Mean conch densities at the opening of the season in the RZs were at 86 conch per hectare **(Fig. 23)**. This was a 39% increase from opening of season in the RZs in 2018 and the first year since 2013 that the conch density was above 80 conch per hectare. The annual conch densities in the GUZ slightly decreased to 38 conch per hectare with population values at opening of conch season similar to 2018 levels at 45 conch per

hectare. The OUT sites showed annual conch density similar to levels in 2017-2018 at 15 conch per hectare. The annual conch density in the estimated Contiguous RZ was ~72 conchs per hectare; a 72% increase in population density from 2018 levels at 42 conchs per hectare **(see Fig. 22)**. The increases in conch densities in the RZs and Contiguous RZs was good news. However, for the past 6 years, the conch population has remained below the 88 $ha^{-1}$ minimum density threshold, as determined by the Belize Fishery Department, in all zones and continues to have a negative impact on reproductive success, as the likelihood of conch encountering reproductive mates remains low.

Mean conch shell length in 2019 was similar to 2018 values in all three zones ranging from 19-21 cm; legal shell length as determined by BFD **(Fig. 24)**. The mean shell length since 2009 does not show any major increasing or decreasing trends in the GUZ, RZs or OUT.

The annual mean conch lip thickness (LT) in 2019 was greater in the RZs than in the GUZ at 11 mm and 6 mm, respectively **(Fig. 25)**. Additionally, the Contiguous RZs showed slighter greater LTs than those found in the GUZ. However, these LT annual mean values are still less than literature standards for queen conch fecundity. Additionally, time series analysis shows a general trend toward decreasing lip thickness in the GUZ, RZs and OUT **(see Fig. 25)**. Studies have shown that high fishing (exploitation) rates has typically resulted in an overall decline in the lip thickness of a queen conch population resulting in the harvesting of immature conchs, thus reducing recruitment rates.

The closed seasons, especially in the GUZ, have not yet achieved their intended purpose of increasing abundance to healthy population levels by protecting conch during their reproductive season and thus increasing recruitment rates. This, combined with low mean lip thickness in all zones, indicates poor recruitment via reproduction, with immature adults being predominant. These factors together continue to leave the conch population vulnerable to overexploitation and collapse.

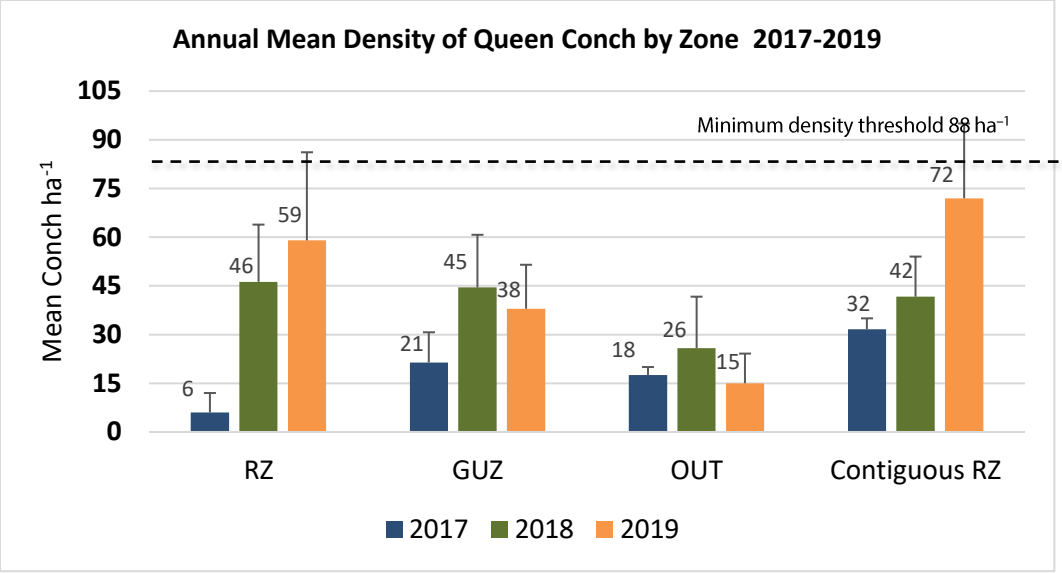



**Figure 22: Annual mean density of queen conch, number of conchs per hectare, observed by zone 2017–2019 [Replenishment Zones (RZ), General Use Zone (GUZ), Outside the Reserve (OUT), Contiguous RZ][+Standard Error Bars].**

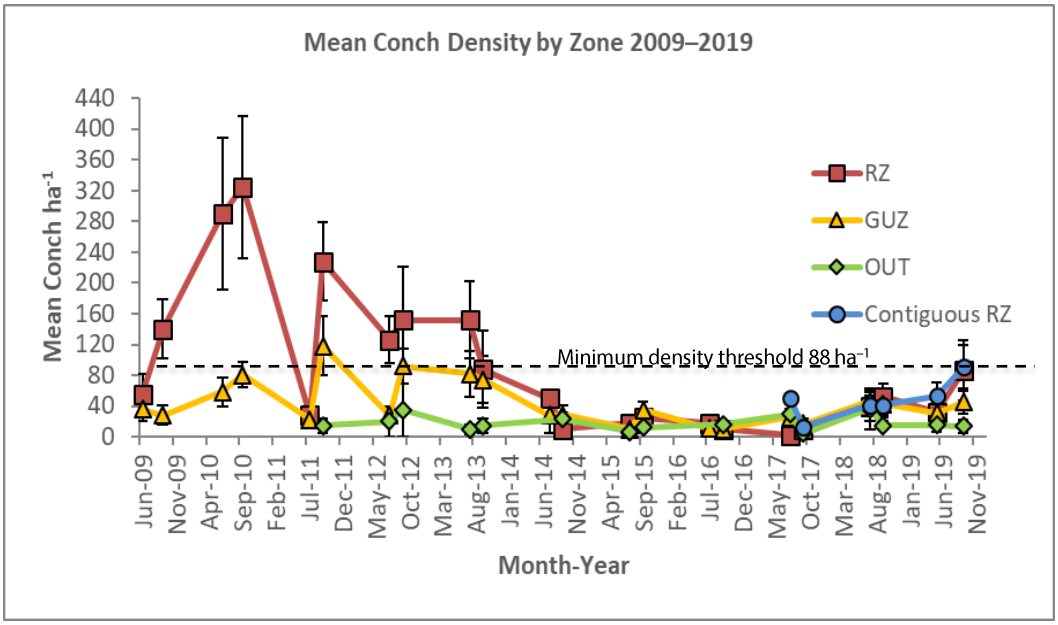



**Figure 23: Mean queen conch density, number of conchs per hectare, observed during pre-season and post-season surveys by zone 2009–2019 [Replenishment Zones (RZ), General Use Zone (GUZ), Outside the Reserve (OUT), Contiguous RZ] [±Standard Error Bars].**

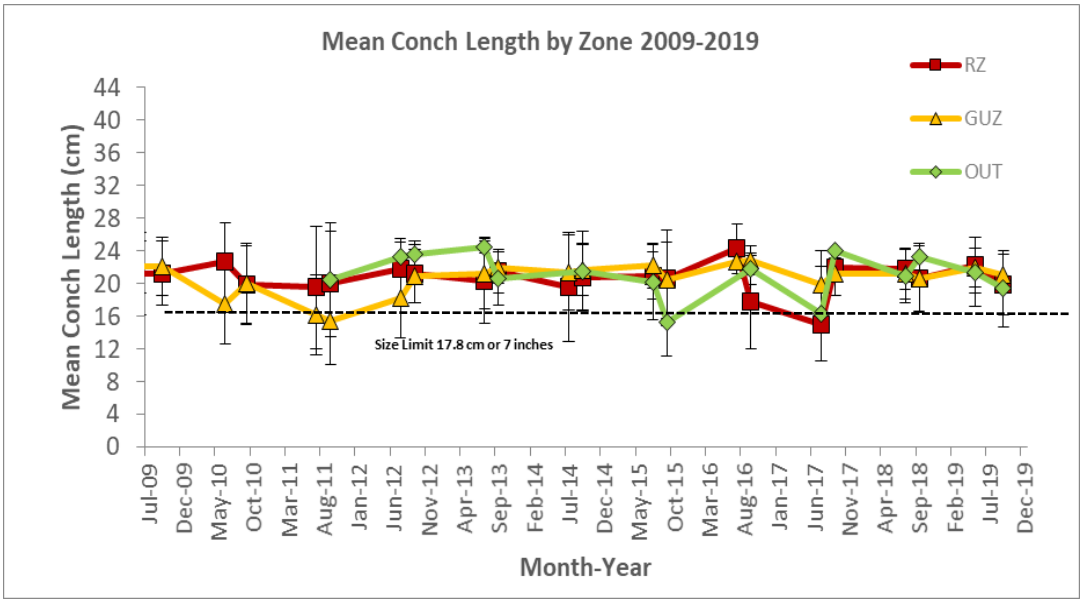



**Figure 24: Mean queen conch shell length (cm) observed during pre-season and post-season surveys by zone 2009–2019 [Replenishment Zones (RZ), General Use Zone (GUZ), Outside the Reserve (OUT)] [±Standard Deviation].**

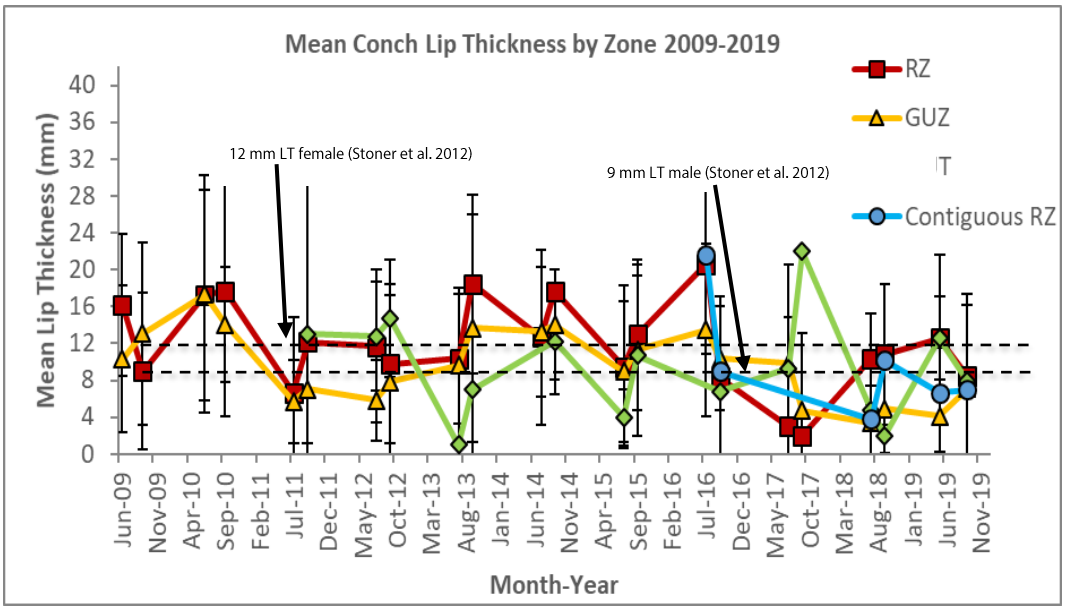



**Figure 25: Mean queen conch lip thickness (mm) observed during pre-season and post-season surveys by zone 2009–2019 [Replenishment Zones (RZ), General Use Zone (GUZ), Outside the Reserve (OUT), Contiguous RZ] [±Standard Deviation].**

### 8.2 Caribbean Spiny Lobster (*Panulirus argus*)

Caribbean spiny lobster (*Panulirus argus*) populations are surveyed at 18 sites within and adjacent to PHMR twice a year, immediately after the closed season begins (15th February), and immediately before it opens (15th June). Sites are located in the RZs (8 sites), GUZ (7 sites), and outside the reserve (3 sites). In 2016, TIDE added four new sights in areas planned for RZ expansion in order to capture the effect of establishment of these areas as RZs in the future. Only three of these sites are currently monitored regularly. These new sites are collectively known as 'Expanded Replenishment Zone' (ERZ) sites with two currently located in the GUZ and one at the outskirt of current RZ zone at Middle Snake Caye. The ERZ sites in addition to the RZs sites are known collectively as the Contiguous RZs. At each site, where possible, either two diver pairs conduct two 30-minute timed swims simultaneously or a 60-minute timed swim is conducted by a single diver pair. For each lobster located, species, gender, maturity (tar spot, eggs) and carapace length are recorded. The number of sites surveyed in each monitoring period and year can vary slightly due to weather, resources, and underwater visibility. Abundance is calculated as the number of lobsters encountered per hour during each timed swim.

In 2019, lobster abundance decreased from 2018 values in both the GUZ and RZs with annual mean lobster abundance at 4 $hr^{-1}$ and 5 $hr^{-1}$, respectively **(Fig. 26).** Though OUT sites are on lobster preferred coral habitat, the lobster abundance was <2 lobster per hour. The planned Contiguous RZ lobster abundance reflected the observed lobster abundances in the RZs in 2017-2019 **(Fig. 27).** These results imply that the lobster population is under more pressure and not being protected enough for steady increases in abundance and reproductive activity and should be closely monitored.

The mean carapace length in the RZs in 2019 increased to ~9 cm at opening of lobster season, similar to GUZ values, with an annual mean carapace length at 8.7 cm **(Fig. 28)**. The GUZ mean carapace length 2017-2019 at opening of season has been steady at ~9 cm. The OUT and Contiguous RZ showed increases in annual mean carapace lengths at 9.0 cm and 8.7 cm, respectively, with Contiguous RZ mean carapace length observed at 10 cm at opening of lobster season 2019, slightly higher than the GUZ and RZs. That being said, mean carapace lengths do not show large fluctuations in size in zones over time with the exception of GUZ 2016, and that anomaly most likely is due to low population size measured that year (n=3).

The gender ratio in the RZs and GUZ between 2009–2019 exhibited a relatively stable male bias (males ~60–70%; females ~20–40%), with the exceptions in 2013, 2016 and 2018 when the gender ratio became more equal. However, these more equal gender ratios seen in the past could have been attributed to the lower abundances in general. In 2019, males were once again more prevalent than females with males 65-70% and females ~25-35% in the RZs, GUZ and OUT **(Fig. 29).** It has been suggested that regular fluctuations in population abundances, size distribution and gender ratio in each zone may be attributed to molting, reproductive and feeding activities [(1)].

Additionally, fluctuations in population abundances has been linked to variations in environmental factors (e.g. sea temperature) [2].

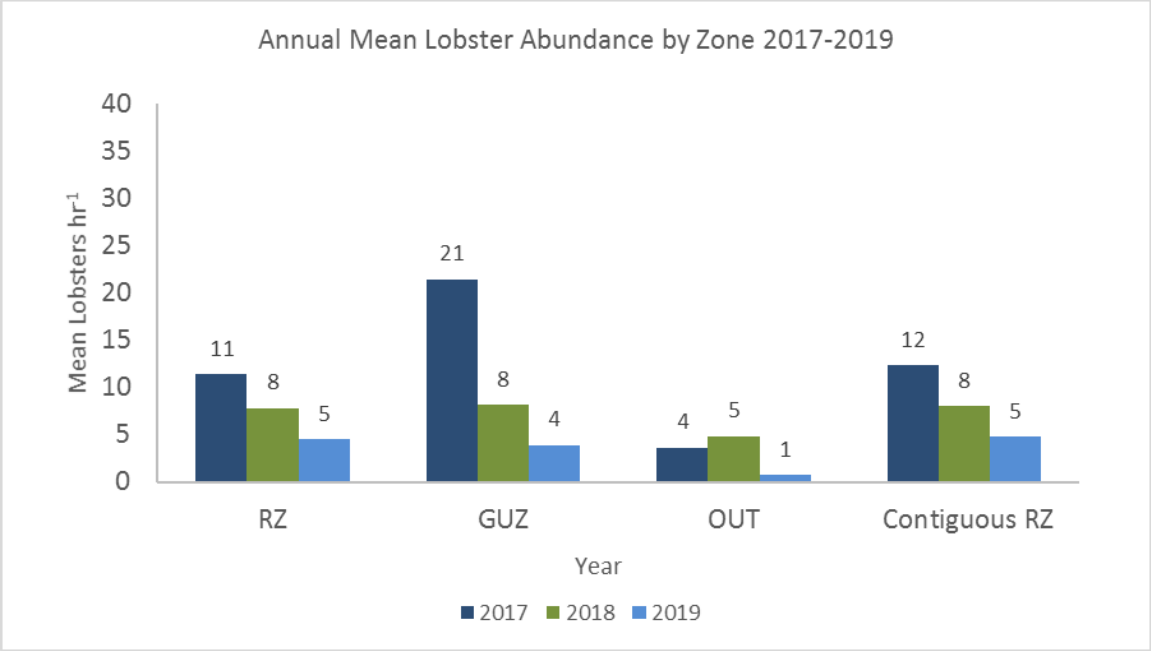



**Figure 26: Annual mean spiny lobster, *Panulirus argus*, abundance (lobster per hour) by zone 2017–2019 [Replenishment Zone (RZ), General Use Zone (GUZ), Outside the Reserve (OUT), Contiguous RZ].**

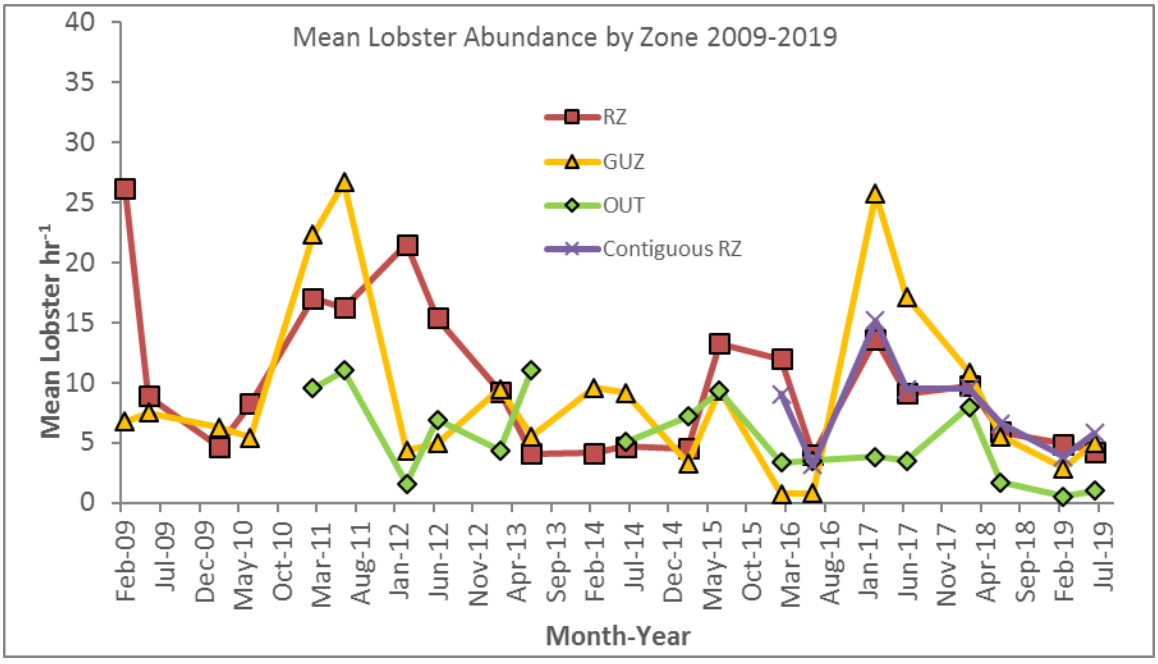



**Figure 27: Mean spiny lobster, *Panulirus argus*, abundance (lobster per hour) observed during pre-season and post-season surveys by zone 2009–2019 [Replenishment Zone (RZ), General Use Zone (GUZ), Outside the Reserve (OUT), Contiguous RZ].**

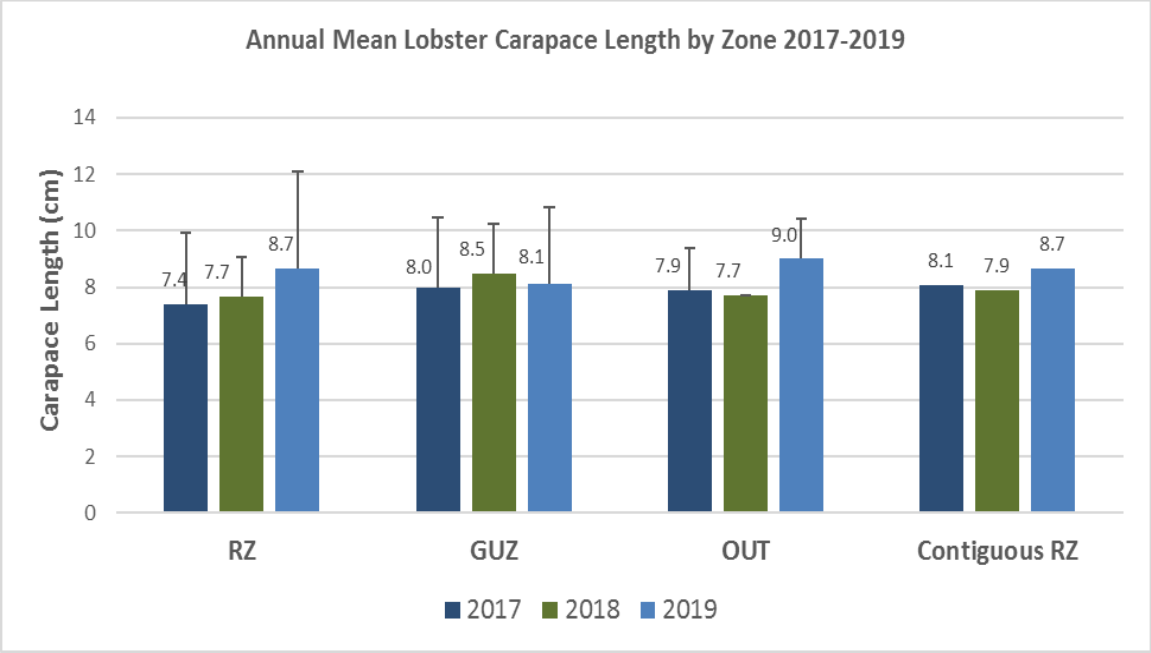



**Figure 28. Annual mean spiny lobster, *Panulirus argus*, carapace length (cm) by zone 2017–2019 [Replenishment Zone (RZ), General Use Zone (GUZ), Outside the Reserve (OUT), Contiguous RZ].**

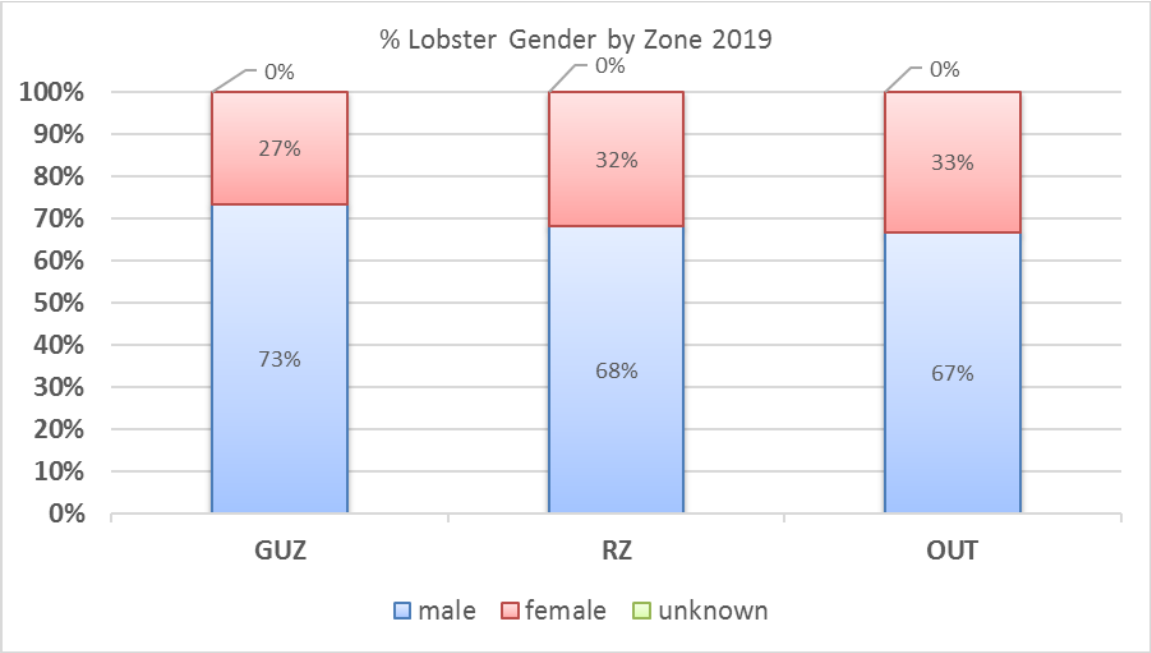



**Figure 29: Percent (%) spiny lobster, Panulirus argus, gender (male, female, unknown) by zone 2019 [Replenishment Zone (RZ), General Use Zone (GUZ), Outside the Reserve (OUT)].**

**8.3 Sea Cucumber (Holothuria mexicana)**

A moratorium on sea cucumber harvesting was enacted by the Belize Fisheries Department in 2017 due to the substantial decrease in sea cucumber population abundances in Belize. Nonetheless, monitoring continued to be conducted for sea cucumber in May of 2019. Sites are located in the RZs (5 sites), GUZ (8 sites), and outside the reserve (3 sites). A 11.28 m line (*calculated as*: area of a circle = $\Pi r^2 \rightarrow 400\ m^2/\Pi = 127.32$; $\sqrt{127.32} = 11.28$ m) is attached to a central pole, and two divers swim the line around the pole in a radar-sweep trajectory covering 400 $m^2$ of habitat. When *H. mexicana* are found, length and width measurements are taken *in situ,* being careful not to touch the specimen as this might cause it to retract. Specimens are then brought up to the boat to be weighed before being returned to their original location. In order to gain population density estimates, the number of *H. mexicana* per hectare is calculated. Mean length and weight are also calculated to determine mean sizes in different management zones.

The sea cucumber mean density decreased significantly since 2012-2013 in both the RZs and GUZ with density by zones <30 per hectare **(Fig. 30)**. The mean sea cucumber density in OUT has been <15 $ha^{-1}$ since monitoring began in 2016 and none were found in that zone during the November 2018 and May 2019 monitoring efforts (Fig. 10). Though a moratorium was placed on harvesting the sea cucumber in 2017, there has been no significant difference (*P*=.81) in mean sea cucumber densities in all zones since it went into effect. Due to the continual low abundance of the sea cucumber population, only one monitoring survey was conducted in 2019.

Since 2011, mean sea cucumber lengths in the RZs and GUZ have ranged from ~17-28 cm with the overall mean and median of the GUZ and RZs 2011-2019 at 22 cm and 23 cm, respectively, showing no outliers in overall mean values **(Fig. 32)**. The annual mean sea cucumber length in the RZs and GUZ increased from 2018 values from 21-24 cm in the RZs and from 21-28 cm in the GUZ **(Fig. 32)**. This was the highest recorded mean sea cumber length in the GUZ since pre-fishery values. Even so, there was no significant difference (*P*=.64) in mean sea cucumber lengths in all zones since the 2017 moratorium.

The mean sea cucumber weight in the GUZ from 2011-2019 ranged from ~304-707 g, with the overall mean of the GUZ at 483 g and RZs at 614 g and the overall median at similar values of ~489 g and ~602 g, respectively **(Fig. 33)**. In 2019, the annual mean sea cucumber weights increased in both the GUZ and RZs from 2018 values to 650 g in the GUZ with the RZs being slightly higher **(Fig. 33)**. Again, though there was a moratorium placed on the sea cucumber, there was no significant difference (*P*=.16) in mean sea cucumber weights in all zones since 2017.

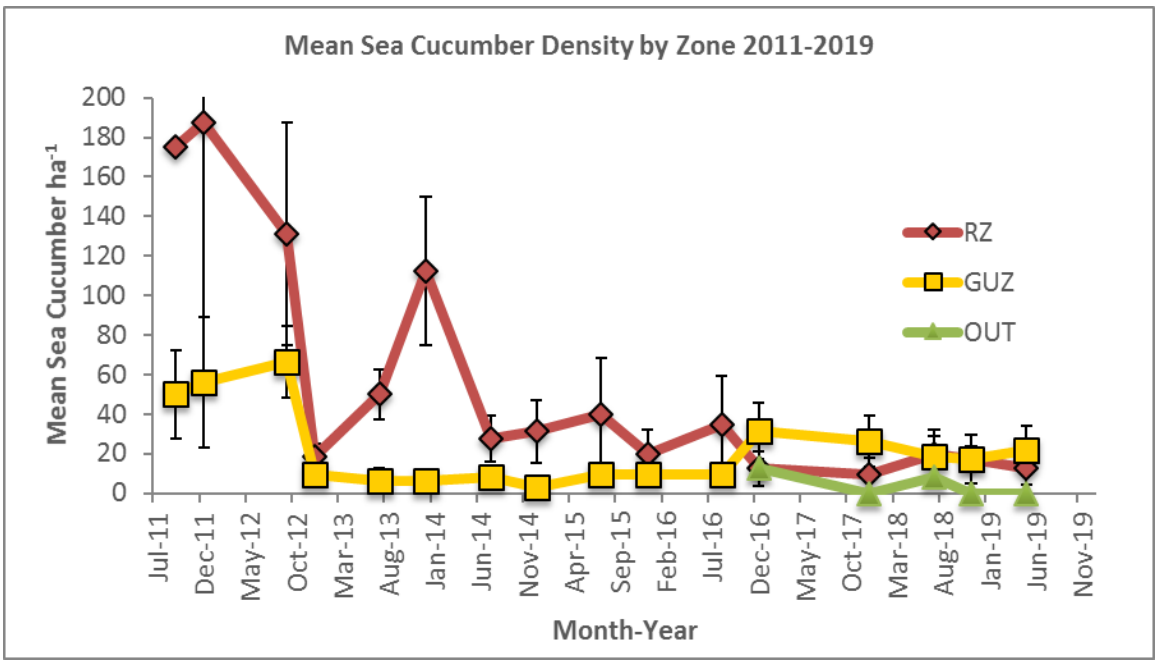



**Figure 30: Mean Sea cucumber, *H. mexicana*, density observed during pre-season and post-season surveys conducted 2011–2019 [Replenishment Zone (RZ), General Use Zone (GUZ), Outside the Reserve (OUT)] [±Standard Error Bars].**

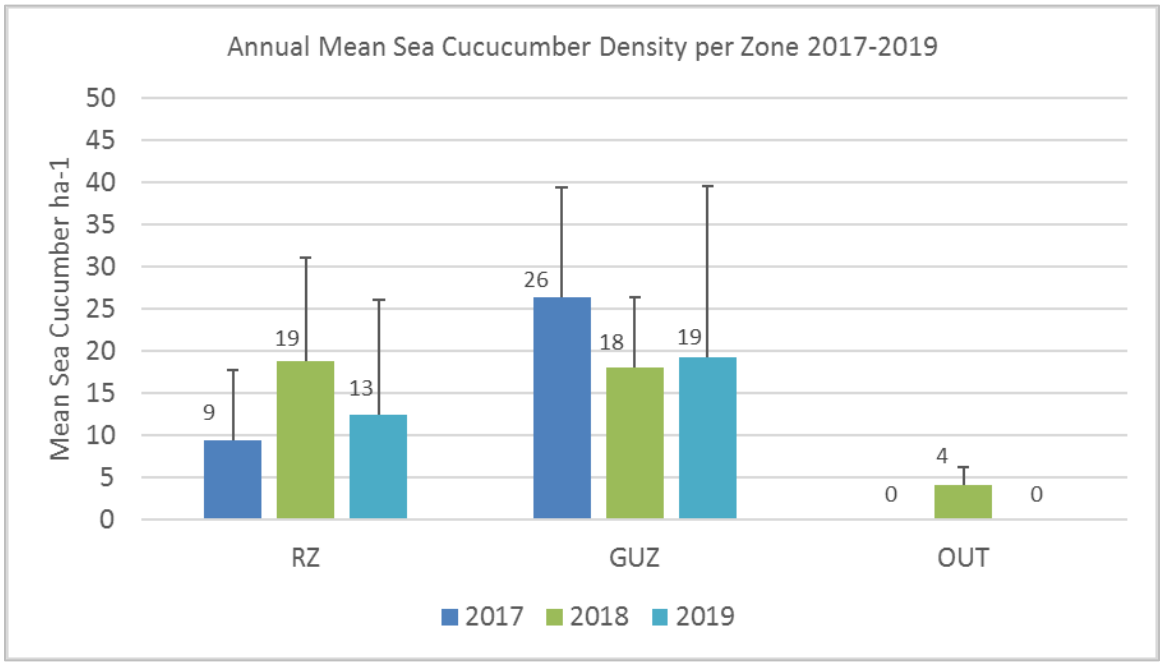



**Figure 31: Annual mean sea cucumber, *H. mexicana*, density per zone 2017–2019 [Replenishment Zone (RZ), General Use Zone (GUZ), Outside the Reserve (OUT)] [±Standard Error Bars].**

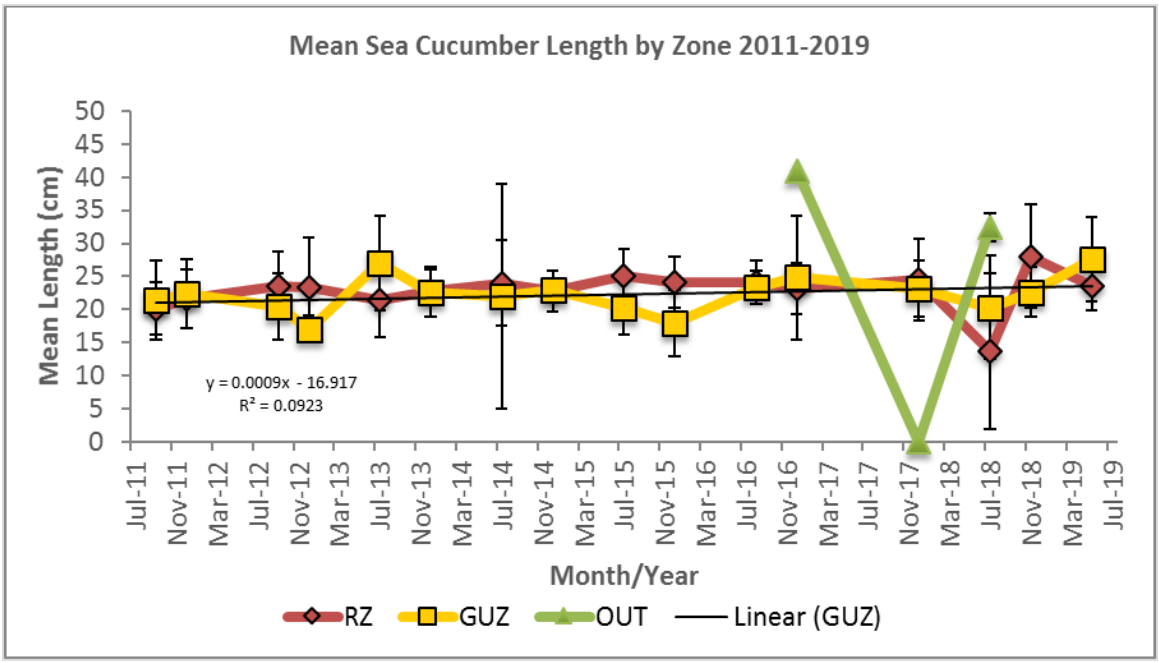



**Figure 32: Mean sea cucumber, *H. mexicana,* length (cm) by zone observed during pre-season and post-season surveys conducted 2011–2019 [Replenishment Zone (RZ), General Use Zone (GUZ)] [±Standard Deviation]. Note: Zero length means (n=0).**

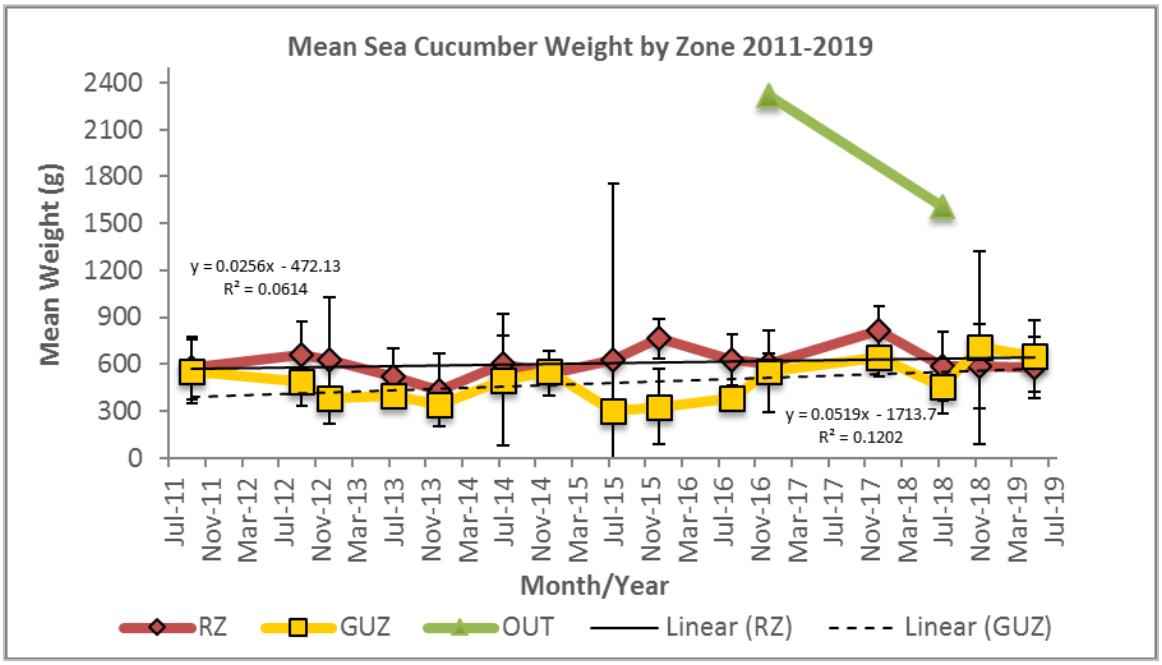



**Figure 33: Mean sea cucumber, *H. mexicana*, weight (g) observed during pre-season and post-season surveys conducted 2011–2018 [Replenishment Zone (RZ), General Use Zone (GUZ), Outside the Reserve (OUT)] [±Standard Deviation].**

## 9.0 Commercial Fishing, Recreational Fishing and Tourism in PHMR

### 9.1 Vessels in PHMR

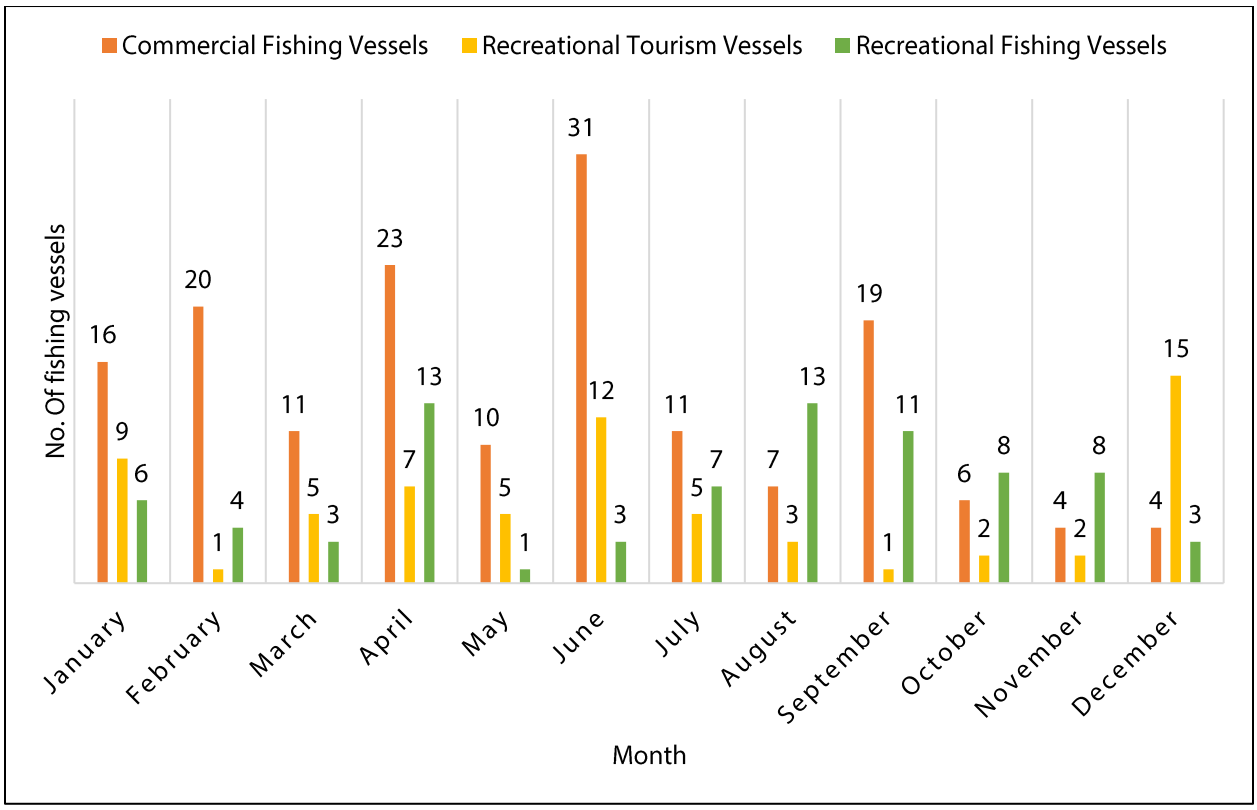



**Figure 34: Showing vessels sighted in PHMR for 2019**

In 2019 the rangers through the Spatial Monitoring and Reporting Tool (SMART) logged over 333 vessels in the reserve. Of these vessels 162 were commercial fishers, 67 were recreational tourism vessels, 80 recreational fishing vessels and 24 other vessels either transiting the area or conducting other activities.

### 9.2 Commercial, Recreational and Tourism Users in PHMR

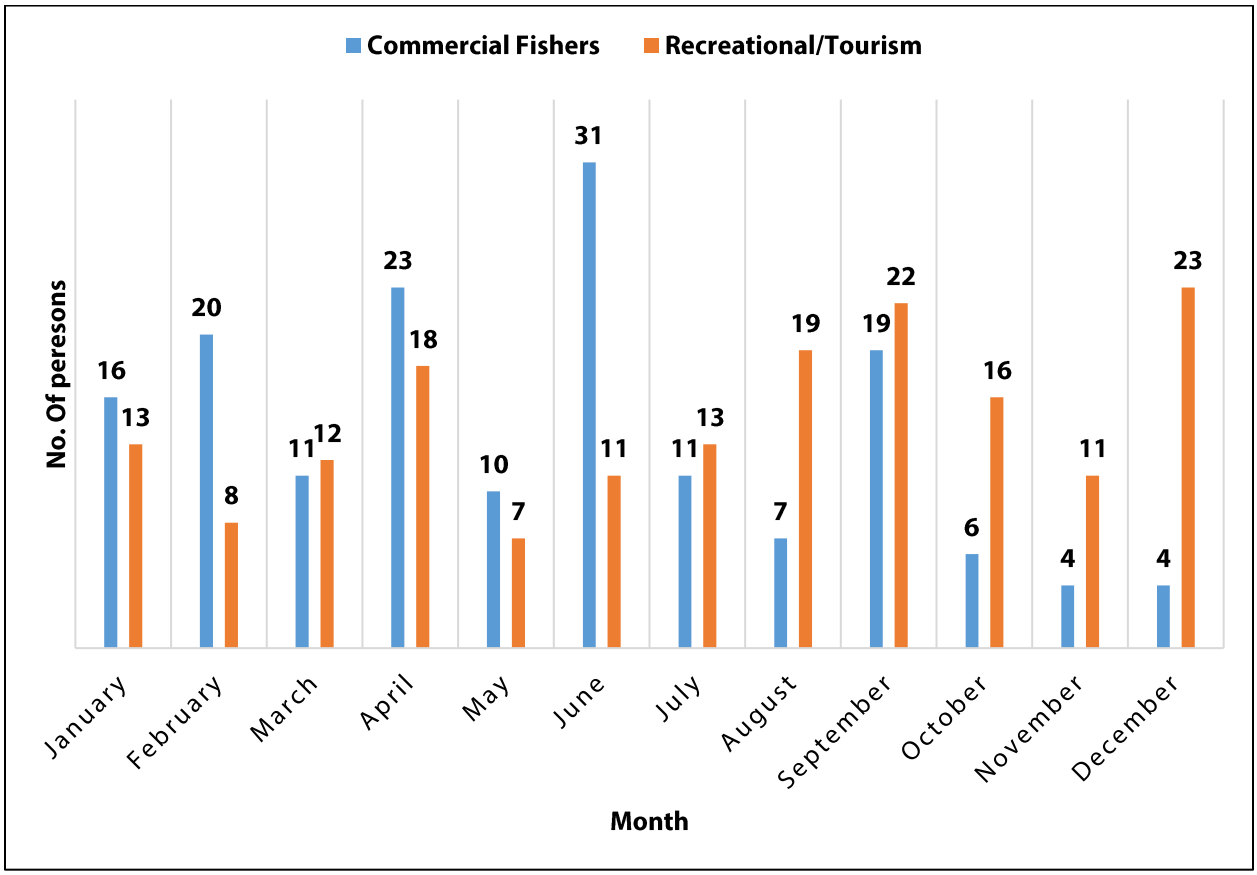



**Figure 35: Showing the commercial and recreational/tourism users by month for 2019**

In 2019 TIDE Port Honduras Marine Reserve enforcement team, through SMART, logged ~162 commercial fishers and ~173 recreational fishers and tourism users in the reserve (Note: *These numbers are approximations due to technical issues with the SMART program*).

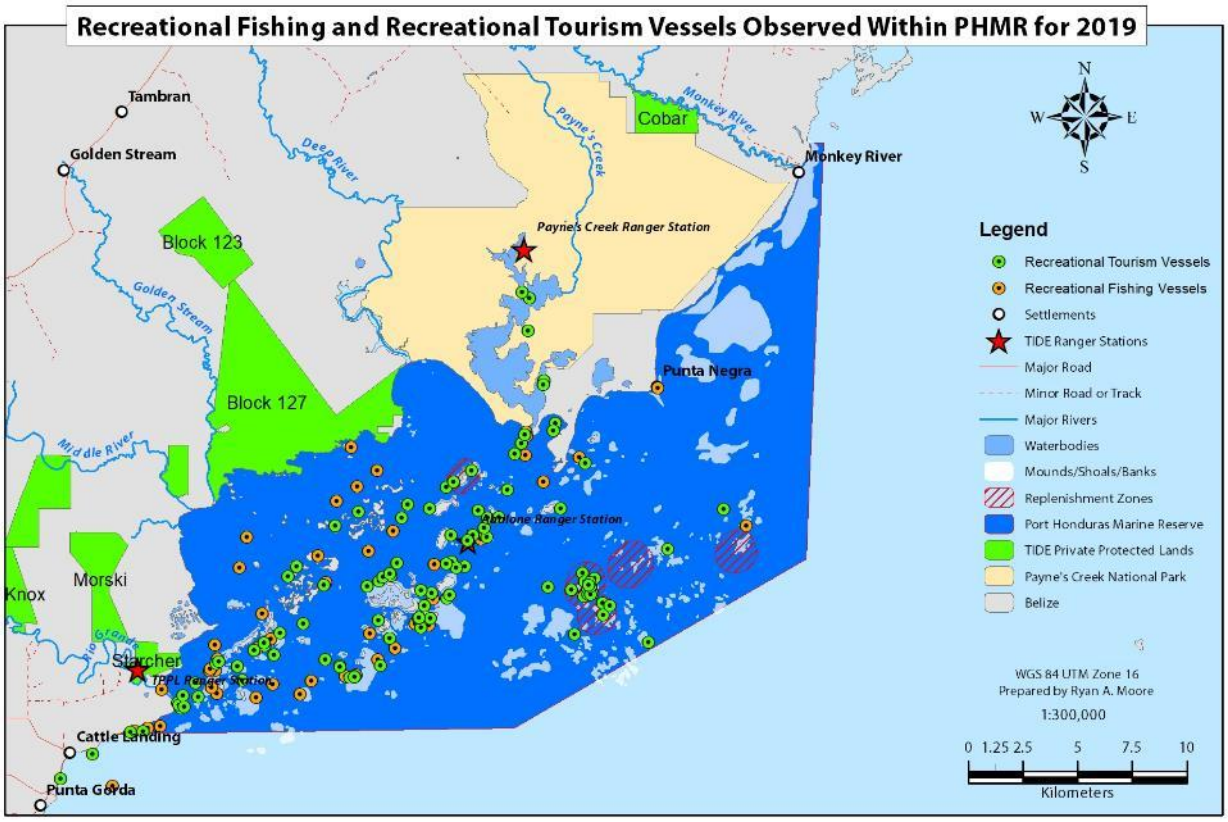



**Figure 36: Showing Recreational and Tourism vessels sighted in the reserve by Rangers and logged using SMART**

The map above shows that a majority of the reserve is being used for both recreational fishing and tourism related activities. Areas north of the reserve shows little to no activity for these types of vessels.

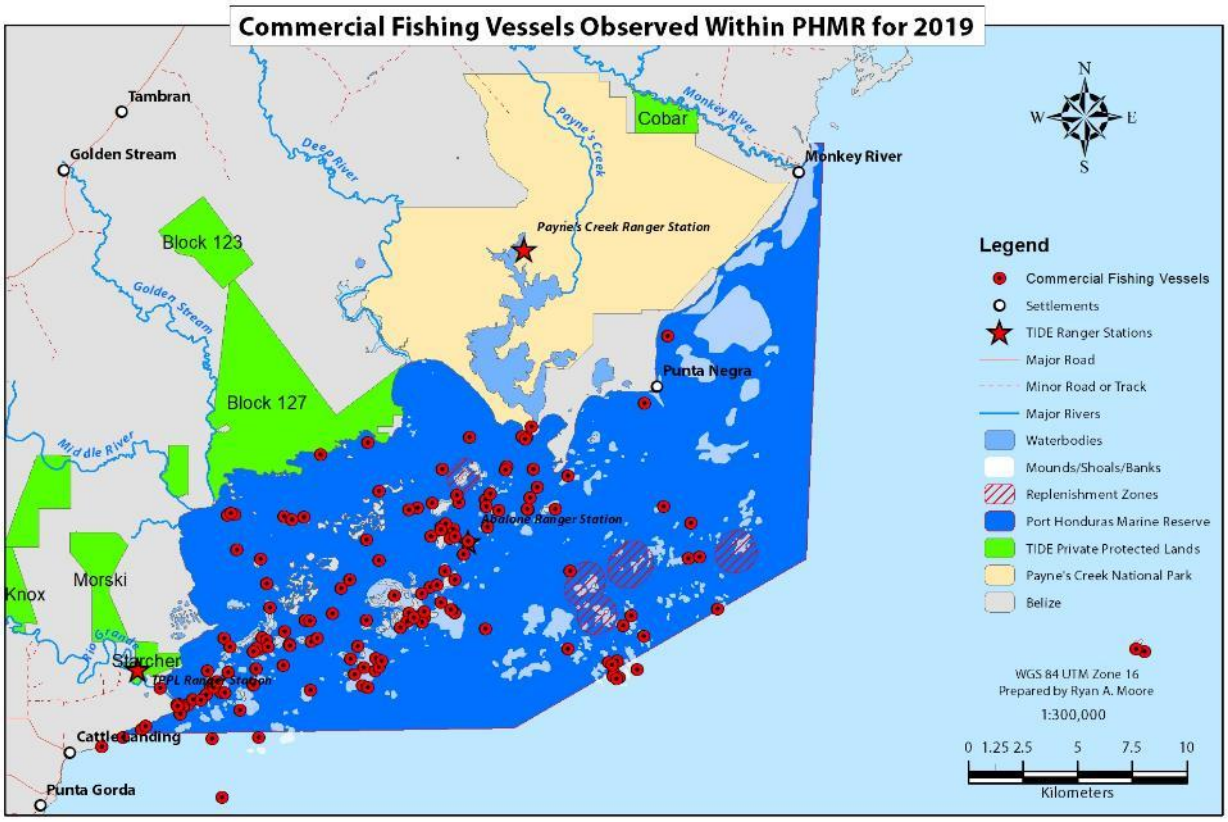



**Figure 37: Showing Commercial fishing vessels in PHMR for 2019**

The map above shows the approximate location for commercial fishers within PHMR (*The gps coordinates is taken at the location of the patrol vessel unless the rangers are directly interacting with the commercial fishers*).

| | | |
|---|---|---|
| Adrian Noralez | Daniel Tillet | Joel Casimiro |
| Akeem Williams | Dennis Usher | John Nunez |
| Alan Bochub | Earl Bowden Jr. | Jorge Alfonzo Williams |
| Alonzo Reymundo | Earl Bowden Sr. | Kenton Galvez |
| Angel Escobar | Edgar Aleman | Yonardo Cus |
| Byron Paiz | Edgar Wagner | Leslie Williams |
| Angel Paiz | Edgar Randas | Lionel Delcid |
| Anna Ramirez | Elder Aleman | Luis Cabrera |
| Anselma Cabrera | Elroy Cuevas | Mainor Melgar |
| Apolonio Westby | Evel Aleman | Martin Reyes |
| Bode | George Ramirez | Marvin Saldivar |
| Carlos Bardarlez | Gerson Coleman | Marvin Westby |
| Carlos Cofias Jr. | Harrison Young | Miguel Bardalez |
| Carlos Ramirez | Humphrey Cofious | Minor Perez |

| | | |
|---|---|---|
| Mynor Melgar | Romulo Aleman | Byron Paiz |
| Mynor Perez | Roy Ramirez | Angel Paiz |
| Narciso Martinez | Suzette Jacobs | Anna Ramirez |
| Oliver Rojas | Walace Bardalez | Anselma Cabrera |
| Omar Westby | Winston Thompson | Apolonio Westby |
| Paula Jacobs | Adrian Noralez | Bode |
| Rafael Ramirez | Akeem Williams | Carlos Bardarlez |
| Ray Arzu | Alan Bochub | Carlos Cofias Jr. |
| Ray Jacobs | Alonzo Reymundo | Carlos Ramirez |
| Rodan Cabrera | Angel Escobar | Daniel Tillet |

**Table 7: Showing commercial fishers sighted in PHMR for 2019**

## 10.0 Recreational Tourist Visitation to Abalone Caye

Overall, the Port Honduras Marine Reserve saw ~1,550 foreign visitors in 2019, this number was derived through ticket sales. A total of 163 individuals, from ten different countries, stopped by the station and received presentations from the rangers.

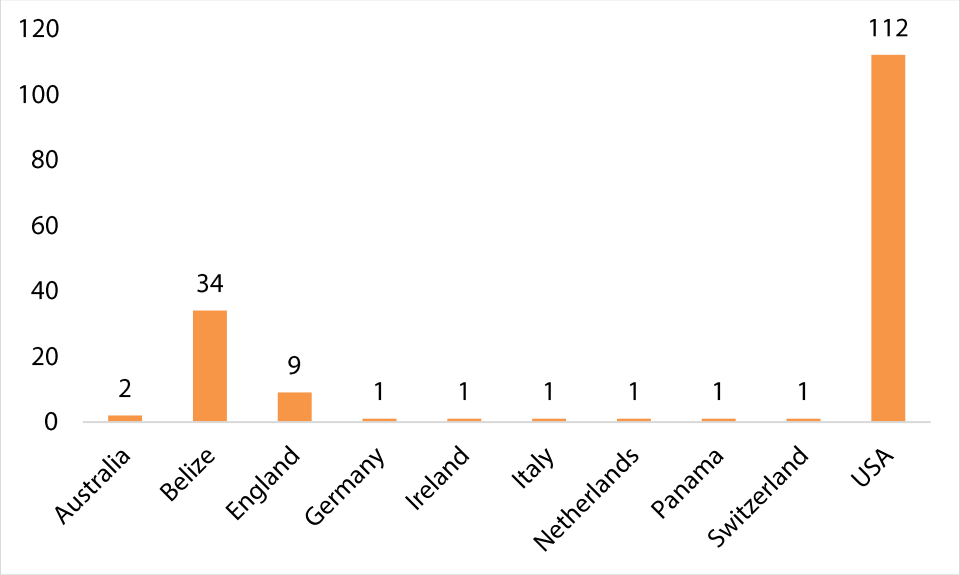



**Figure 38: Showing number and origin of visitors to Abalone Ranger Station**

The USA continues to be our largest source of visitors. There are visitors that venture direct to West Snake Caye or Moho Caye and conduct sport fishing, swimming, snorkeling within the reserve, and do not visit the ranger station so a record of their visit is not recorded in the log book but are captured in the ticket sale record.

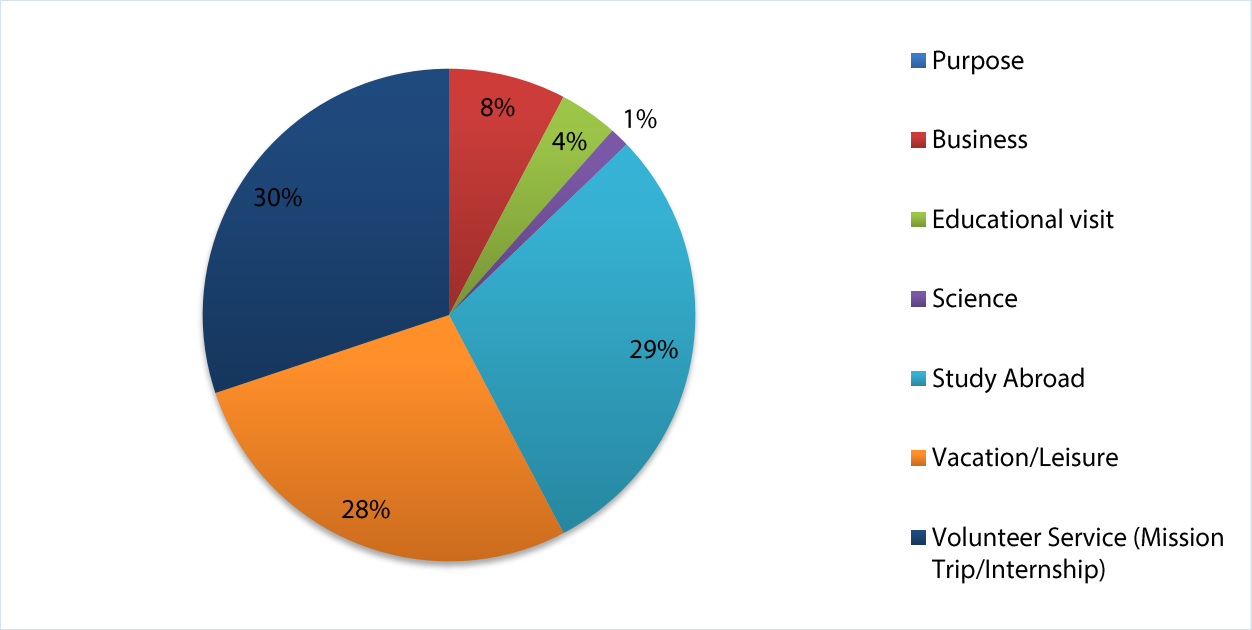



**Figure 39: Showing purpose of visit to Belize**

## 11.0 The TIDE Team

### 11.1 Board of Directors

| | |
|---|---|
| Albert Roches | Retired Public Officer (Public Health) |
| Jeremy Enriquez (Director) | Program Manager, Ecology Project International |
| Alexander Garbutt (Director) | Local Fisherman and Tour Guide in Monkey River |
| Marie Aleman (Vice-Chair) | Entrepreneur/Community Representative |
| Dale Gomez (Director) | PCNP Advisory Council Representative |
| Paula Williams (Director) | PHMR Advisory Council Representative |
| William Tate (Treasurer) | Entrepreneur/Tourism Community Representative |
| Celia Mahung | Executive Director (Ex-Officio) |

### 11.2 TIDE Office Staff

#### 11.2.1 Management Staff

| | |
|---|---|
| Celia Mahung | Executive Director |
| Allan Genus | Program Manager |
| Joe Villafranco | Development Director |
| Stephene Supaul | Operations Manager |
| Heidi Waters | Science Director |
| Ryan Moore | Marine Manager |
| Mario Muschamp | Terrestrial Manager |
| Federico Caal | Environmental Education Officer/ Community Development Officer |
| Jasmine Tzul - Faber | European Union - Project Manager |
| Paul Etienne | Information Technology Officer |
| Nigel Gomez | Managed Access Coordinator |

#### 11.2.2 Administrative Staff

| | |
|---|---|
| Darius Avila | Accountant |
| Kimberly Lawrence | Financial Administrator |
| Alaine Noralez | Accounts Clerk |
| Ishiamae Gomez | Front Desk |

**11.3 PHMR Advisory Committee**

| | |
|---|---|
| Mr. Neville Smith | BTIA/PG Tour Guide Association |
| Mr. Armando Ramirez | Rio Grande Fisherman Cooperative |
| Mr. Daniel Castellanos | Monkey River Village Council/ Fishers Assoc. |
| Hon. Michael Espat | Area Representative |
| Mrs. Paula Jacobs | Chairperson Punta Negra Village Council |
| Mr. Roy Polonio | University of Belize-Toledo Campus |
| Mr. Lyndon Rodney/Victor Vasquez | Fisheries Department-PG |
| Mr. Ashton Mckenzie/Winston Chun | PG Town Council |
| Mr. Leonardo Castro | Monkey River Village Council |
| Mrs. Celia Mahung | Executive Director |
| Mr. Mario Muschamp | Terrestrial Manager |
| Mr. Ryan Moore | Marine Manager |

**11.4 Tide Private Protected Lands Staff**

| | |
|---|---|
| Mario Xi | Head Ranger |
| Santiago Cucul | Ranger |
| Junnalio Ical | Ranger |
| Pedro Shol | Ranger |

**11.5 Payne's Creek National Park Staff**

| | |
|---|---|
| Mario Muschamp | Terrestrial Manager |
| Augustin Sho | Ranger |
| Leonard Williams | Ranger |
| Liberato Pop | Ranger |

**11.6 TIDE Tours Staff**

| | |
|---|---|
| Chalita Salam | Financial Sustainability Manager |
| Caroline Oliver | Project Assistant |
| Martin Ack | Senior Tour Guide |
| Norman A. Williams | Field Officer |

## 12.0 Conclusion and Recommendations:

2019 was a successful year for PHMR however with the addition of new staff a strain was placed on old staff. Processes will be put in place during 2020 to ensure a smooth transition occurs, this was piloted with new staff members however a more guided orientation and evaluation is needed. Overall the team was able to accomplish 112% (600) of planned patrols with 77 more patrols. We saw an increase of over 275 patrols from the previous year and we were able to focus on the primary areas of interest guided by the SMART.

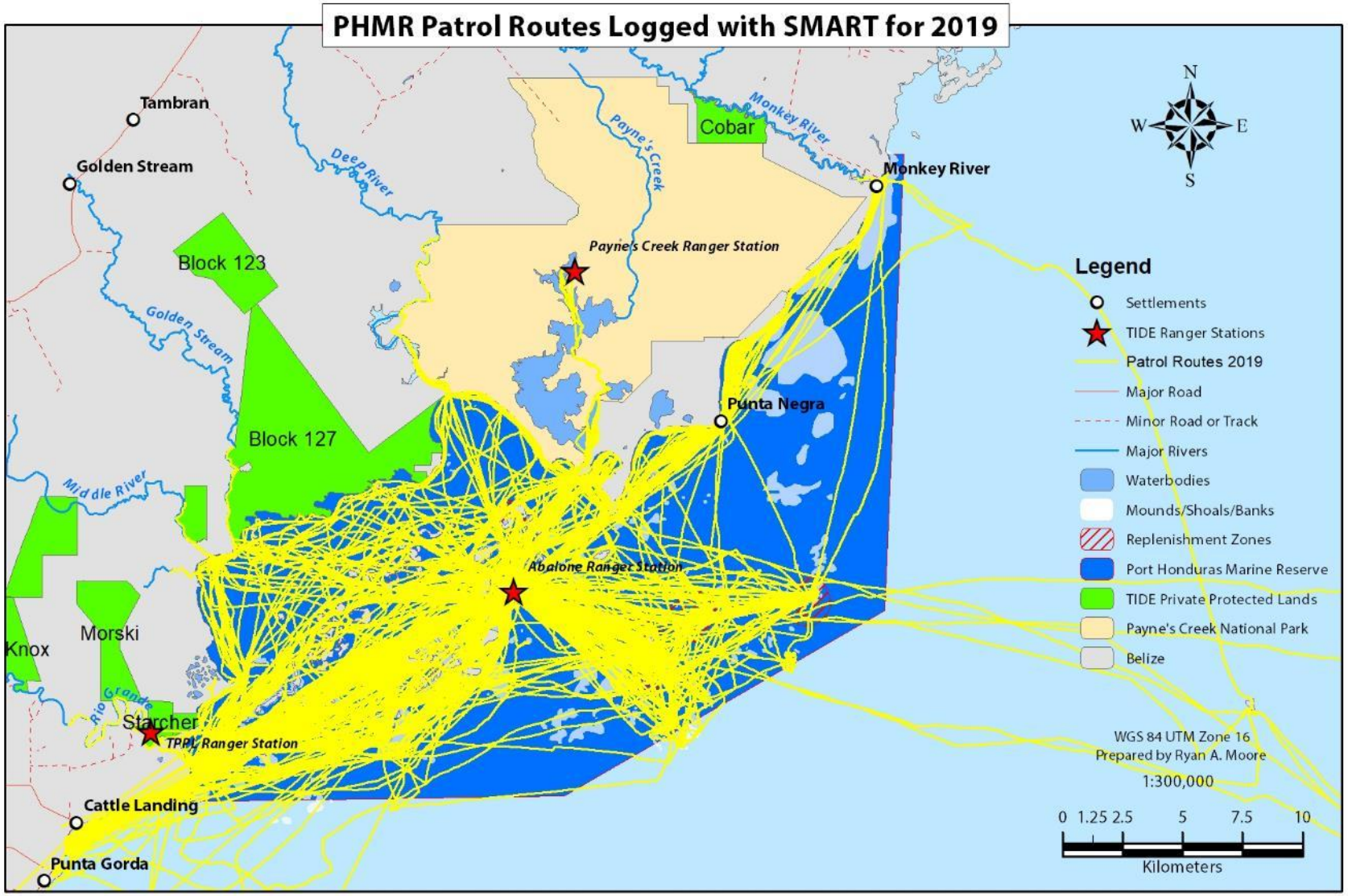
**Recommendations**

- Continue to collect socioeconomic data of the communities adjacent to the MPA to determine level of impact from management of the Reserve.
- Continue to evaluate success derived from activities or trainings that created local jobs to demonstrate MPA´s contribution to the sustainable development in the area as well as identify gaps and opportunities for sustainable livelihood development activities.
- Continue to build staff capacity and Improve in technology to be more cost effective in the management of the protected areas.
- Continue to monitor for new developments in and around the reserve that can pose serious threat to the integrity of the protected area and ensure the Environmental Impact Assessment process is followed for the development and implementation of those projects.
- Increase efficiency and effectiveness guided by the SMART tool through increase documentation of patrol activities and resource user activities.

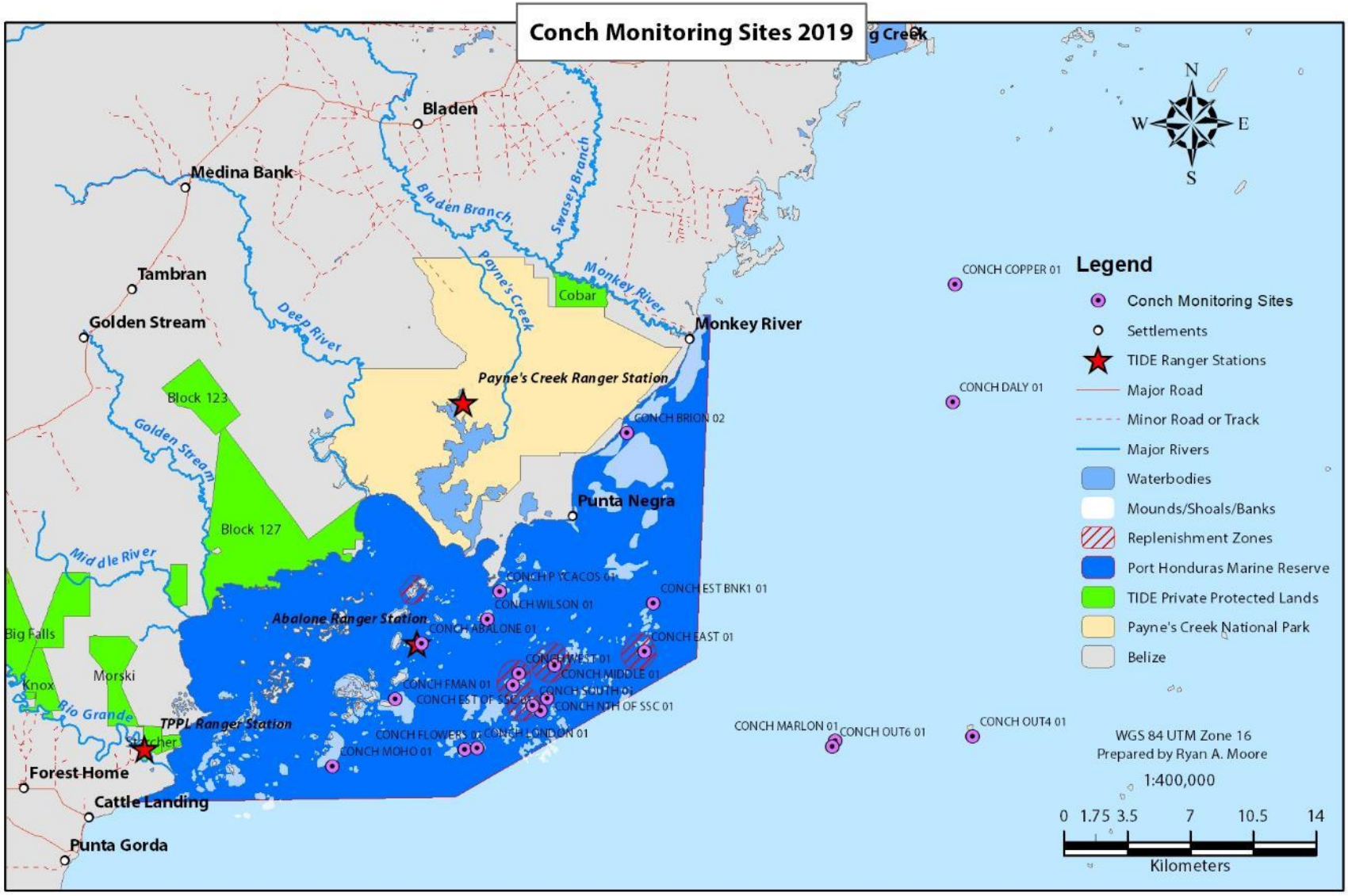
For 2019 tower observations were introduced however it was not continuous, items were ordered for catch sampling and are expected to be received early 2020. The use of SMART in reporting was prevalent and extremely effective in capturing management needs and for 2020 the goal will be to train at least one ranger or member of staff to ensure continuity of the program. With the addition of 2019 data TIDE expects to conduct a comparison to visualize the progress being made in regards to enforcement in PHMR. With that, TIDE would like to express its deepest gratitude to all those who have made the management of PHMR a success in 2019.

## 13.0 Appendix

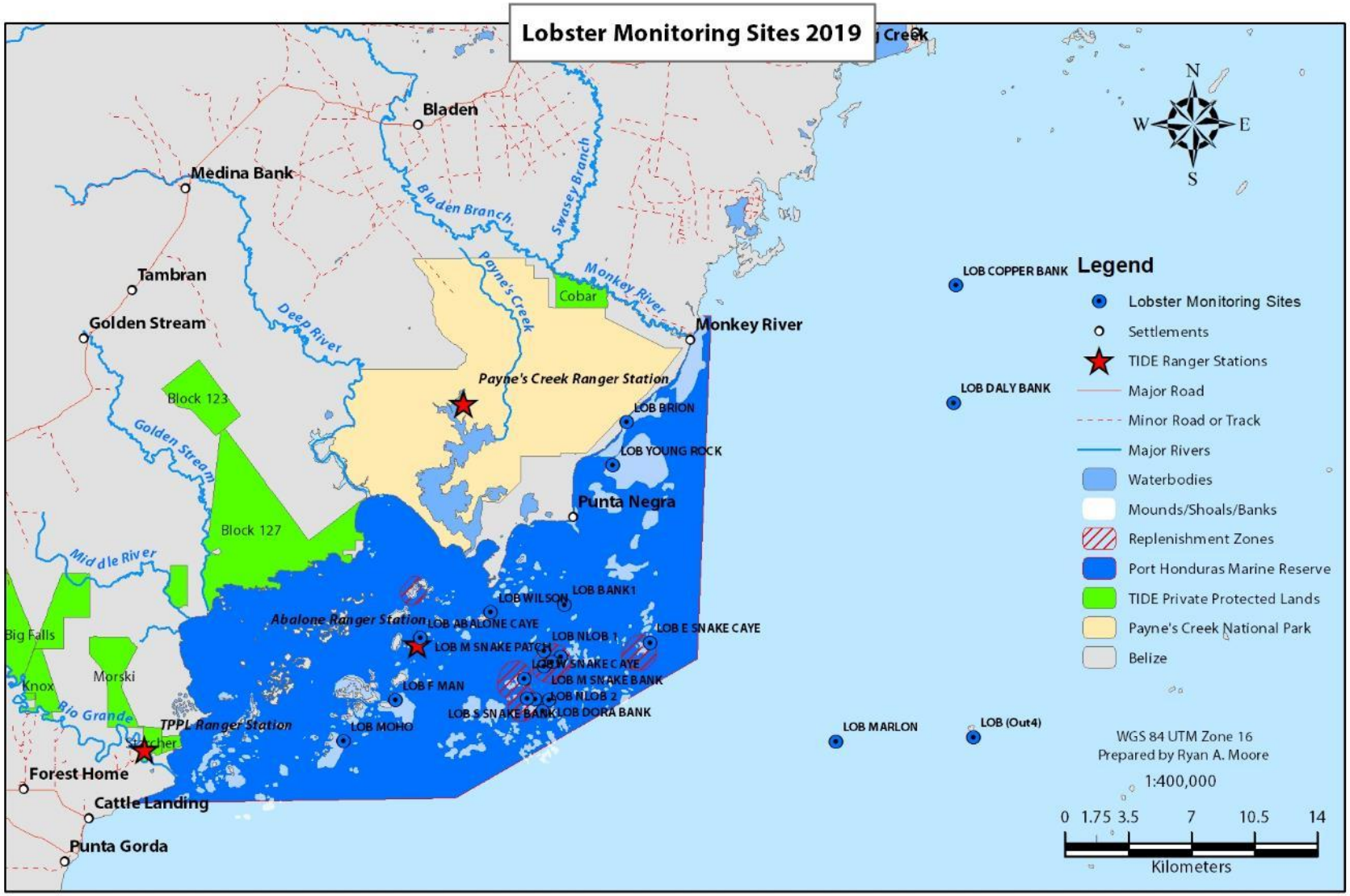
### Appendix 1: Patrol Routes in 2019



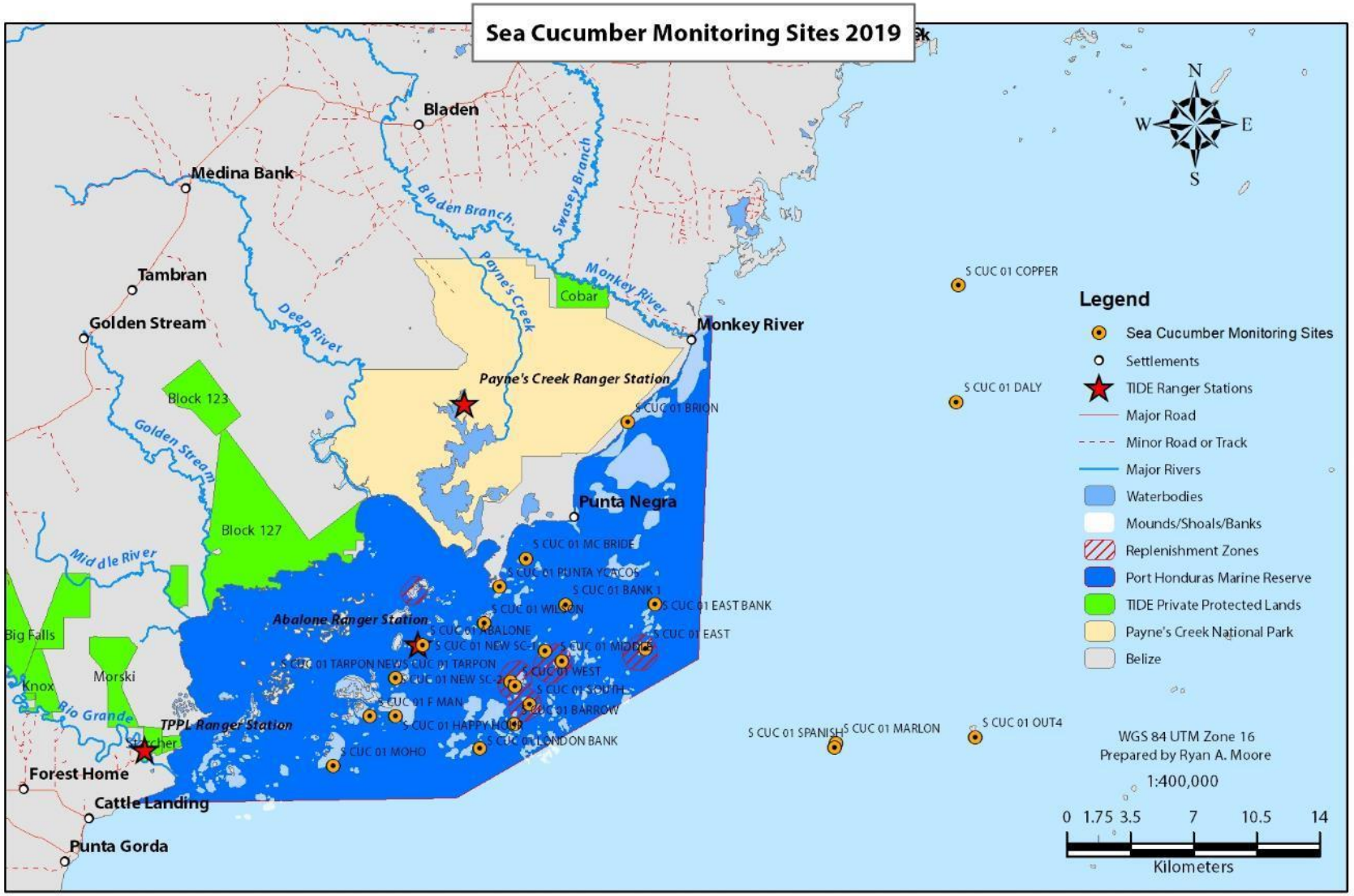
**Appendix 2: Conch Monitoring Sites 2019**



**Appendix 3: Lobster Monitoring Sites 2019**



**Appendix 4: Sea Cucumber Monitoring Sites 2019**



## 14.0 References

(1) MacDiarmid, AB (1991). Seasonal changes in depth distribution, sex ratio and size frequency of spiny lobster *Jasus edwardsii* on a coastal reef in northern New Zealand. *Marine Ecology Progress Series* 70: 129–141.

(2) Davis, GE (1977). Effects of recreational harvest on a spiny lobster *Panulirus argus* population. *Bulletin of Marine Science* 27(2): 223–236.