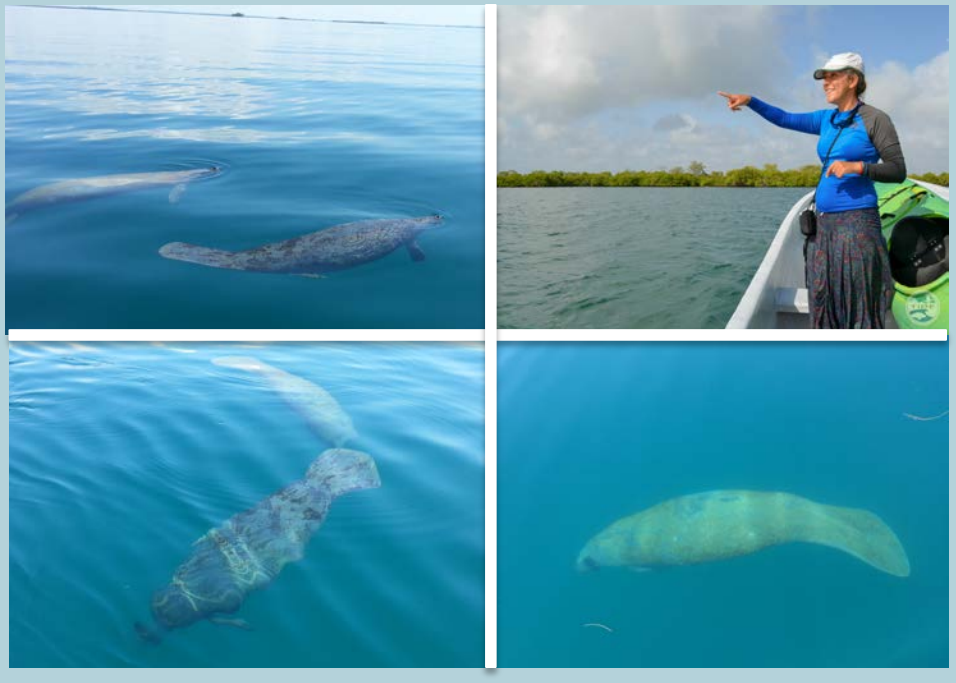
WEST INDIAN MANATEE BASELINE STUDY 2014

TIDE Targeted Research Project:

Baseline Population Study of West Indian Manatee (*trichechus manatus*) in Port Honduras Marine Reserve, Belize

October 2014



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Abstract

Belize has more Antillean manatees (*Trichechus manatus manatus*) than any other country in the Caribbean Sea, yet are currently affected by the same threats in all its distribution. At present, new human activities such as oil exploration and tourism development potentially may occur in PHMR and Payne's Creek National Park (PCNP) in the near future, emphasising the need for a population study in these areas. In order to strengthen the development of management, conservation and monitoring strategies, the main objective of this study is to obtain demographic and ecological information on the manatee population in PHMR, as well as information on the potential areas with more disturbances for these animals inside PHMR. In order to have access to local knowledge, interviews with local communities were arranged before monitoring began to select the best survey areas. Monitoring was mainly conducted using boat surveys, and with kayak surveys, as a non-invasive method in specific areas determined as resting places for manatees. Patrol data on boat movements in PHMR was compared with manatee distribution data to identify areas of greatest risk to manatees from boat strikes and other disturbances to their behaviour. Management recommendations such as full protection zones avoiding manatee hotspots and speed limits were then made to promote more effective conservation of manatees in PHMR and PCNP. Additionally, an initiative to involve the community in manatee conservation was developed. Some PHMR fishers have started to collaborate with TIDE by collecting data on manatee sightings. This information will be critical in promoting awareness of the importance of protecting manatees, and in generating a sense of stewardship among local fishers and tour operators to become conscientious boaters in areas where manatees are founds.

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List of abbreviations

BFD	Belize Fisheries Department
CITES	The Convention on International Trade in Endangered Species of Wild Fauna and Flora
IUCN	International Union for Conservation of Nature
FFWCC	Florida Fish and Wildlife Conservation Commission
LEK	Local Ecological Knowledge
NGO	Non-Governmental Organisation
PCNP	Payne's Creek National Park
PHMR	Port Honduras Marine Reserve
TIDE	Toledo Institute for Development and Environment
TPPL	TIDE Private Protected Lands

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1. INTRODUCTION

Belize is rich in biodiversity and natural resources. It is home to many complex and dynamic ecosystems that support many ecological processes and a variety of marine life and habitats. As a result, there are many areas of ecological importance across the country that have received protective status.

Important tools to protect this high marine biodiversity are Marine Protected Areas (MPAs), of which there are 13 in Belize (BFD, 2014). MPAs are intended to protect marine ecosystems and marine life located within. Some of these MPAs depend exclusively on Belize Fisheries Department (BFD) but others are co-managed by the BFD and non-governmental organizations (NGOs). An example of this co-operation is the Port Honduras Marine Reserve (PHMR) co-managed by the Toledo Institute for Development and Environment (TIDE), and the BFD.

These reserves are home to many endangered species, among which is the West Indian manatee, *Trichechus manatus. T. manatus* is present throughout Belizean coastal areas, occupying seagrass beds, mangroves and coral reefs (Self-Sullivan and Mignucci- Giannoni, 2008). In addition, Belize has a larger population of manatees than any other country in its range (O'Shea and Salisbury, 1991; Quintana-Rizzo and Reynolds, 2010), estimated between 800 and 1000 individuals.

Various initiatives have been developed with the intention of gaining more insight on the status of this species and achieving better conservation and management, particularly in protected areas. However, most of these areas correspond to general use, where only extractive activities are regulated. Specific studies are needed in these areas to establish the necessary recommendations for management and conservation.

2. RATIONALE

The threats facing manatees are similar throughout their range. These threats include habitat loss and degradation, ship strikes, bycatch by fishing gear, pollution, human disturbance, natural disasters and, to a lesser extent, hunting (Quintana-Rizzo y Reynolds, 2010). All these threats are exacerbated by the fact that manatees are large and relatively slow animals with a low reproductive rate (Auil, 1998).

The West Indian manatee is listed as endangered on the IUCN Red List (Self-Sullivan and Mignucci-Giannoni, 2008) and protected by CITES, SPAW protocol and other laws protecting national and international wildlife (Quintana-Rizzo and Reynolds, 2010). Locally, it is listed as an endangered species under Belize's Wildlife Protection Act of 1981, and while number have recovered to a degree in Belize since then, it remains endangered in other areas of the Caribbean (Auil, 1998).

Along the Belize coast, particularly in coastal areas in the center of the country, boat strikes are considered among the greatest of threats to manatees (LaCommare et al. 2008; Auil, 1998). However, in PHMR, boat strikes are far less common, because there are fewer boats. Nevertheless, economic activities in the area (mainly tourism and fishing), remain a threat within the reserve. More recently, proposed oil exploration and drilling in Payne's Creek National Park (PCNP) and PHMR poses a major new potential threat to manatees and other components of the marine environment in the region. Providence Energy Group, (n.d.) are holders of a government-issued concession area spanning large parts of PHMR and significant parts of PCNP. The concession gives Providence Energy rights to explore for petrochemicals for a total of eight years in an area of 1,375 square kilometers in southern Belize. If oil is found, Providence Energy will have exploitation rights over 25 years. While the eight-year deadline passed in 2013, proceedings in the Supreme Court of Belize have since focused on legal technicalities enabling Providence to continue with exploration unabated.

The main technique for finding and tracking oil and natural gas reserves is through seismic reflection profiles. These profiles use intense high-pitched sounds to create an image of the sub-oceanic land topography (Hildebrand, 2005). The impacts of this technique and future extraction may put pressure on ecosystems in the area. Boats and

human pressures will increase, threatening manatees and indirectly seagrass (Short and Wyllye-Eciieverria, 1996), a key staple in the diet of manatees, and influencing its behavior (Marsh et al., 2012; Alves-Stanley et al., 2010). Also, the behavioral audiograms of manatees show that they can hear sounds with frequencies as low as 46 kHZ and they are more sensitive to sounds between 10 kHz and 20 kHz (Gerstein et al. 1999). No contemporary studies show the impact of these acoustic techniques on manatees. However, these effects are documented for marine mammals in general (The Marine Mammals Commission, 2009). Furthermore, negative effects of contamination from oil spills are known from previously recorded cases of dugongs (*Dugong dugon*) in the Persian Gulf (Marsh et al., 2012).

All of this, added to inadvertent captures in fishing gear (gill nets), particularly calves, negatively affect the well-being of manatees (Oliveira de Meirelles, 2008), highlighting the need for an up-to-date population study and an analysis of human impacts on manatees within the reserve. This will help build understanding of the possible responses of this species to future perturbations and will provide a solid knowledge base upon which to build management strategies to increase effectiveness of manatee conservation efforts.

3. STATE OF KNOWLEDGE

3.1. Characteristics of the species *Trichechus manatus*

The West Indian Manatee (*Trichechus manatus*) is a herbivorous marine mammal belonging to the Sirenia order. These animals inhabit rivers, lagoons, estuaries, marine wetlands and shallow coastal waters (Marsh et al., 2012) in Florida, the Greater Antilles, eastern Mexico and Central America, and northern and north-eastern South America (Lefebvre et al., 2001). There are two subspecies, the Florida manatee (*Trichechus manatus latirostris*) and the Antillean manatee (*Trichechus manatus manatus*). The Antillean manatee is a euryhaline species that can only tolerate a narrow temperature range, being limited to water temperatures above 20ºC (Geraci and Lounsbury, 1993). The limiting factors to their distribution are: water temperature, salinity, aquatic vegetation abundance, water depth and human activity (Arroyo et al, 1998.).

Adult manatees can reach lengths of 2.7 to 3 m and weigh between 400-550 kg. Calves are around 1.2 m long and weigh approximately 18 to 45 kg (Reep y Bonde, 2006; Reynold y Odell, 1991). This species has a low reproductive rate and only reaches sexual maturity between ages three to five, when their body reaches around 2.7 m long. Distance between genital and anal openings, rather than body size, is considered the most reliable way to visually differentiate between sexes (Marsh et al., 2012). Furthermore, a female can be distinguished with the naked eye when accompanied by a calf. The calf stays with the mother between one and two years after birth (dependency period) (Reynold & Odell, 1991; Auil, 1998; Marsh et al., 2012).

Sirenia (manatees and dugongs) is the only extant order of herbivorous marine mammals (Marsh et al., 2012). Because of the low energy content of their food, and manatees' low digestive efficiency, they spent between four to eight hours per day feeding (Geraci and Lounsbury, 1993). They eat the equivalent of ten percent of their body weight daily of various species of marine vegetation. They feed on plants and algae and usually target submerged, floating or emergent grasses (UNEP, 1995). Their feeding area is usually restricted to seagrass growing at depths between one and five meters but in most cases, less than two meters (Marsh et al., 2012). The plant species

are usually *Thalassia testudinum, Syringodium filiforme, Halodule wrightii, Rhizophora mangle, Ruppia* sp. and *Panicum* sp. (Auil, 1998; Flores-Cascante et al., 2013).

The most common social association of manatees is mother with calf, although small groups of 2-3 animals may feed or travel together (Quintana Rizzo y Reynolds, 2010). These animals come to the surface to breathe every three to five minutes. Their breathing rate may vary depending on the level of activity, body size, water temperature, depth to which they are and reproductive status (Marsh et al., 2012). Manatees can breathe more often when they are moving and at rest these intervals can be 10 to 15 minutes (Reep & Bonde, 2006; Reynolds & Odell, 1991) coming to be a maximum of 24 min (Marsh et al., 2012.). They are quiet animals that can swim long distances, up to 240 km in 89 days on the coast of Belize and Chetumal Bay (Castelblanco-Martinez et al., 2014). However, unlike the Florida manatee, which migrates with changing temperatures typical in the sub-tropical zone, *T. manatus manatus* does not need to travel because the temperature variation in their home range (tropical zone) is minimal (Arroyo et al. 1998; Morales-Vela et al., 2003; Quintana-Rizzo and Raynolds, 2010). They move around mostly in search of fresh water (Castelblanco-Martinez et al., 2014) and mating partners.

3.2. Area of study

3.2.1 Port Honduras Marine Reserve (PHMR):

PHMR was established in January 2000. The purpose of its establishment was, among others, to end manatee poaching in the region (IUCN, 1997). Since then, PHMR has been administered by TIDE (Toledo Institute for Development and Environment) and regulated by the Belize Fisheries Department (Crabe et al., 2009). TIDE was concerned with environmental and social needs in the area even before the establishment of the reserve (Auil, 1998). PHMR lies on the coastal area of Toledo District, southern Belize, from the mouth of Monkey River it extends approximately 40km south to 8km north of Punta Gorda Town and from the coastline, 25 km east to include the Snake Cayes (Robinson et al. 2004). PHMR covers an area of 414 km^2 composed of mangroves, mud beds, coral reefs and seagrass beds (Robinson et al., 2004; TIDE, 2013), all of which are frequented by manatees. Extensive seagrass meadows cover the

shallow coastal areas and surround an intricate network of mangrove cayes. Thick mangroves cover nearly all of the 138 Cayes within the reserve and border the coastline and estuaries of PHMR. Fringing coral reefs encompass the offshore Snake Cayes and patch reefs are scattered throughout the reserve. Several watersheds empty into PHMR, including Monkey River, Punta Ycacos lagoon, Deep River, Middle River, Golden Stream and Rio Grande.

PHMR is composed of three zones (Fig. 2.1): 95% is a General Use Zone or GUZ (regulated extractive activities allowed), 4% is a Replenishment Zone or RZ (non-extractive activities only) and 1% is a Preservation Zone or PRZ (research activities only). As such, 5% of the reserve is under full protection from extraction.

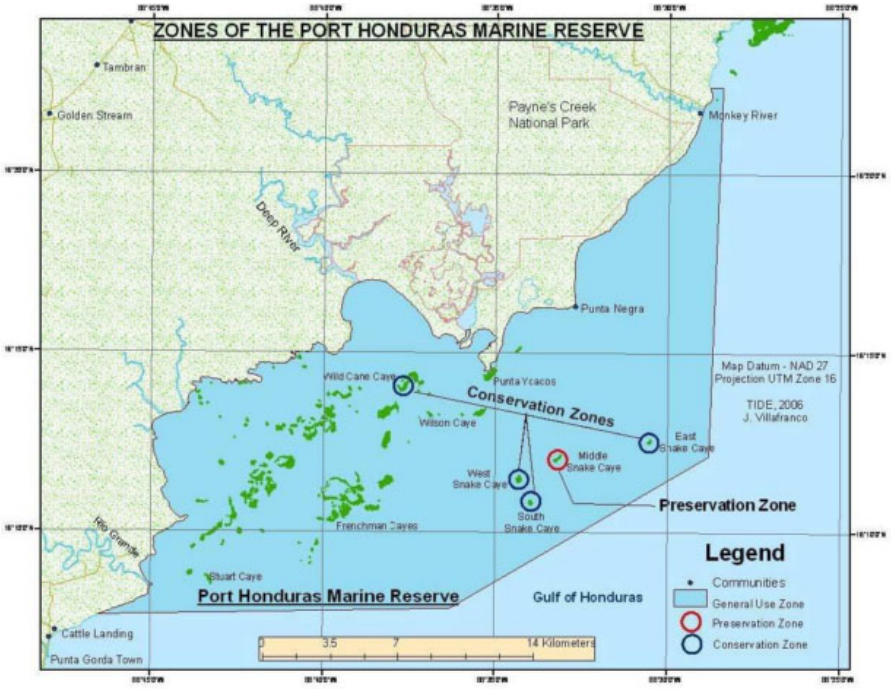

Figure 3.1. Map of the Protected Areas managed by TIDE: Port Honduras Marine Reserve (PHMR), Payne's Creek National Park (PCNP) and TIDE protected Private Lands

3.2.2. Buffer Communities:

There are three communities buffering PHMR: Punta Gorda, Monkey River and Punta Negra Village (see Figure 1). Punta Gorda has approximately 6500 habitants and is located at the southern outside of PHMR. The smallest one is Punta Negra Village with approximately 20 habitants, located in the central part of the mainland coast of PHMR, between Punta Ycacos and Monkey River. Monkey River Village is located at

the northern end of PHMR at the mouth of Monkey River. These communities subsist mainly on the small-scale fisheries economy generated from lobster, conch and finfish, as well as from tourism activities (Coleman and Diamond, 2005).

3.3. Previous studies on *T. manatus* in Belize

While a larger number of studies exist on the subspecies *T. m. latirostris,* greater understanding of the West Indian manatee is currently developing (Marsh et al., 2012). Castelblanco-Martinez (2012) in French Guiana, Jimenez (2005) in Costa Rica or LaCommare et al. (2012) in Belize are examples of that.

Nineteen manatee aerial surveys have been conducted in Belize since 1977. The first was conducted by Bengston & Magor (1979) when 101 individuals were sighted in September 1979. In May 1989, O'Shea and Salisbury sighted 102 during another aerial survey. Between 1994 and 1995, Morales-Vela et al. (2000) conducted three flights in January 1994, May 1994 and January 1995, 266, 207 and 171 manatees were sighted respectively. Subsequently Auil (2004) developed a five-year study; two flights per year (one in the dry season and another one in the rainy season) were performed between 1997 and 2002.A total of between 90 and 338 manatees were sighted during these surveys. These surveys provide information on the distribution and relative abundance, and allow the implementation of management strategies, including the National Plan of Coastal Zone Management (CZMAI, 2012). Furthermore, a new aerial survey was done in May 2014, as part of a regional manatee project (Mexico, Belize, Guatemala) (direct communication with Castelblanco-Martinez, June 2014).

Boat-based surveys have also been conducted in various areas of Belize. This technique is considered an effective and low cost method to monitor manatees (LaCommare et al., 2012).

3.4. Knowledge about manatee in PHMR

Prior to this study, no o studies specific to PHMR manatees had been conducted, however in all aerial surveys conducted in Belize, sightings have been recorded in the reserve, which places it as a zone of constant presence for the species. In 1999, during the aerial survey by CZMAI there were six sightings in the dry season and 13 during the

rainy season recorded in the reserve. Subsequently, the three flights between 1994 and 1995 by Morales-Vela et al. recorded five ten and five manatees respectively. In addition, in March 2003, 16 sightings were recorded within the reserve during another aerial survey (Robinson et al., 2004).

PHMR was included in the evaluation of manatee habitat in the Gulf of Honduras (Romero-Oliva, 2007), in which the relationship between manatee habitat quality and the presence of this species in the Gulf of Honduras was studied.

Local ecological knowledge (LEK) has been widely used as a source of reliable information for the development of research on the ecology of manatees (Sousa et al., 2013). From studies with interviews information on the distribution, abundance in the diet of the manatee even in different areas obtained as well as the threats they face (Franzini et al, 2013; Morales-Vela et al, 2003).

4. OBJECTIVES OF STUDY

Main Objective

The main objective of this study is to obtain demographic and ecological information on the manatee population in the selected survey zones of PHMR and PCNP, as well as information on high-risk zones inside PHMR. This is in order to strengthen the development of management, conservation and monitoring manatee strategies.

Specific objectives

1. Determine spatial distribution, size/age distribution, relative abundance and areas mostly used by *T. manatus* in selected sites of PHMR and PCNP.

2. Determine percentage of calves and group size.

3. When possible, identify individuals based on photo-identification techniques and create a photo database.

4. Analyse boat traffic trends including presence, frequency, distribution, activities engaged in and types of boats in the reserve.

5. Evaluate other possible human and natural factors that may threaten the survival, health, and/or reproduction of manatees.

6. Provide management recommendations to minimise the threats on survivorship and strategies to promote survivorship of manatees in PHMR.

5. METHODOLOGY

5.2. Pre-selection of survey zones

From previous studies on manatees and their presence within the reserve, a first selection of the study areas and the study methodology to follow were established.

First, based on the data and coordinates obtained in the study of Morales-Vela et al. (2000), conducted by plane in January and May 1994 and January 1995, the mouth of Deep River was determined as the first area of study. This area consists of a small bay at the mouth of the river, stretching about 9 km in length along the waterfront (Fig 2, Zone 1). Frenchman Cayes was also selected as a study area (Fig. 2, Zone 2). Second, Robinson et al. (2004), corroborates presence of manatees in the Frenchman Cayes area (Fig 2, Zone 2), and suggests this area as being a resting area for manatees. Third, and taking into account the affinity of manatees for freshwater areas (Quintana-Rizzo and Reynolds, 2010), the wetland part of Payne's Creek National Park is also chosen as a study site to evaluate the abundance of the species in that region. This zone is distinct by way of its complex network of channels and because the water is dark as a result of tannins released by mangrove roots and from the surrounding and underlying soil during the rainy season. Finally, the transect lines where Providence Energy Group proposes to conduct seismic oil exploration are understood to coincide with this area. These proposed seismic transects also coincide with Zone 1. These are therefore priority interest areas, not only due to the recorded presence of individuals but due to the concentrated nature of potential impacts of seismic exploration on this species.

5.3. Interviews and establishment of sampling areas

During the initial weeks of the study period, informal interviews with the fishing communities, park rangers and tour guides, were carried out (Morales-Vela et al., 2003). In Monkey River, seven fishermen and one PHMR ranger were interviewed. In addition, the collaboration and the information provided by the by TIDE rangers working in PHMR, PCNP and TIDE Protected Private Lands (TPPL), was very important for the delimitation of the study areas. During the National Fishers' Forum, held in Punta Gorda on June 5, 2014, informal discussions licensed PHMR fishers took place. Also, once fieldwork was

initiated, contact was maintained with certain fishermen and tour guides, who have expert local knowledge of the reserve. They confirmed the selected areas and recommended focusing search efforts in some locations within them.

These interviews were designed to determine the local ecological knowledge (LEK) of fishers in the region on manatees and their distribution; and to have a first contact with the areas where manatees are observed (Pablo-Rodriguez and Olivera-Gómez, 2012). A map of the reserve was shown where they were able to point out and describe those areas where manatees have been seen (Figure 1). The aim was to be able to estimate the principal zones with manatee presence, the frequency of anecdotal sightings in each zone, whether individuals or groups and if females with calves were present.

In 90% of cases, respondents confirmed Deep River as the main area for spotting manatees. Most fishermen indicated Golden Stream as an important area for the species and only fishermen from Monkey River indicated sightings at the mouth of this river, although they all agreed that the rate was not high. In addition, certain fishermen and PCNP rangers noted PCNP as a significant sighting location. Fishermen from Punta Gorda and TPPL rangers noted the mouth of the Rio Grande as an important sighting area. Also, sightings by the NGO Society for Oceanic Air flight made in May 2014 along the coast of Belize in early May (2014) ratified this information. In addition, some tour guides and rangers who have spent more time working in the reserve reported seeing manatees in Frenchman Lagoon (Fig. 2, Zone 2) and with less frequency in some cays near to this lagoon.

With this information, the zones 1, 2 and 3 (established from the bibliographic information) were maintained. The boundaries of Zone 1 (Deep River) were established from Garrobo Point to Punta Ycacos, including Punta Ycacos Lagoon; Zone 2 (Cayes) was limited as Frenchman Cays, including Frenchman Lagoon, No name Cayes, Barracuda Range and Bob Stuart Rante Cays; and Zone 3 (Payne's Creek) was limited as the entire area of channels within the PCNP. Also, two zones were added: Zone 4, Golden Stream, from about two miles northwest of Pork ‘n Doughboy Point to Garrobo

Point; and Zone 5, Rio Grande, from the southern side of the river mouth to Pork 'n Doughboy Point Point (Figure 2).

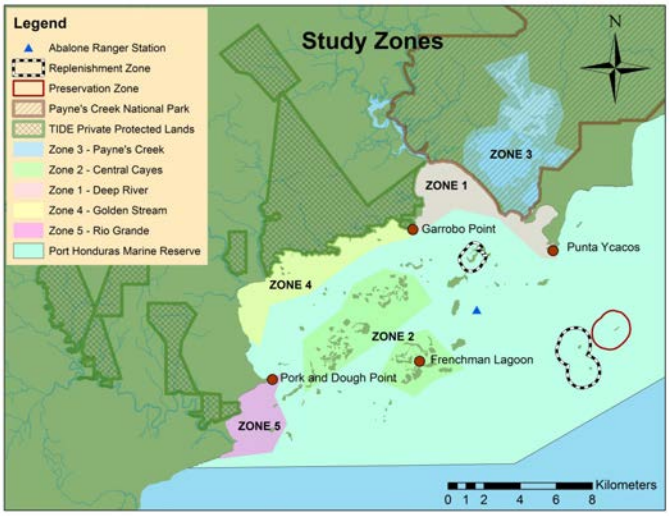

Figure 5.1. Distribution of survey areas in PHMR

5.4. Manatee monitoring

Once all control sites were established, manatee surveys focused on counting individuals and recording locations. Data was collected on total group size, females sighted with calves, age range, presence of, habitat description and behavior. The manatee behaviors were compiled in four categories for this study, due to the high turbidity in the reserve: feeding, resting, moving and socializing.

Table 5.1. Categories of behaviours

Behaviour	Definition
Feeding	Manatee eating seagrass and rests of seagrass floating around
Resting	Submerged manatee, no significant movement except to breathe and no presence of rest of floating vegetation
Moving	Manatee swimming with constant speed and direction
Socializing	A group of more than two manatees adult with interactions between them

Age range was classified into three categories, based on size (Quintana-Rizzo and Reynolds, 2010): Calf ≤ 175 cm; Juveniles / sub-adults, between 176 and 275 cm; and Adults > 275 cm.

Surveys were carried out using direct visual surveillance. Initially, kayaks were used to access survey sites to be as non-invasive as possible. However, given the limitations on visibility angle and speed of kayaks, as well as reduced visibility due to the rainy

season and the possible weather changes, it was soon decided by TIDE to use PHMR patrol and research boats, reserving kayak usage for areas identified as ‘rest areas’ for manatee. For these cases an emergency action plan (Appendix 4) was developed for safety.

Thus, with rangers’ assistance and cooperation, all zones were covered between 1.5 and 3 hours, and at least once by two weeks, and all data concerning individuals or groups, group sizes, behavior of individuals, and geographic locations were recorded. Time and coordinates were recorded at the beginning and end of each survey to calculate time and effort invested (Castelblanco-Martínez, 2012), to estimate the relative abundance.

Zone 1, Deep River, was surveyed from where Deep River bay starts until Punta Ycacos (Fig. 2). The itinerary was conducted covering the coastline, to a distance between 10 and 20 meters from the coast, covering the areas with seagrass presence and where the depth was not more than 4 meters. With TIDE’s patrol vessel, each sighting was documented, recording time, position and individuals characteristics. Habitat was recorded using the datasheet in Annex 3. Manatees were followed long enough to determine whether they were alone or in groups, and attempts made to capture images. A Nikon AW 320 and GoPro attached to a 2 meters bar was used to try to capture images of the ventral part of the animals, seeking to determine the sex. In some cases, researchers entered the water, as permitted under the research permit issued by the Forest Department (Annex 2) and attempted to take pictures for subsequent photo-identification. Any unique markings that could be seen were recorded as a means to identify individuals in future (Annex 4), complementing the photographic information. This occurred on 14 occasions.

Zone 2, Cayes zone, was surveyed in the PHMR patrol vessel with a reduced speed (between 5.5 and 7.5 miles/h). The boat surveys were done navigating between the cayes in a random way, in the shallow areas (no more than 3 meters deep) close to these cayes and included Bob Stuart Caye, Barracuda Range, No Name Caye and others. This itinerary was carried out 14 times. Frenchman Lagoon was surveyed by kayak, covering the internal part of the lagoon. The patrol vessel deployed the kayak

and researcher at the survey start point and time and retrieved them at the end point and time of each survey. This method was used only in this area, due to the sheltered nature of the water by the cayes here, and only rarely, due to limitations of the kayak. In other areas, highly variable weather conditions initially prevented use of the kayak. The kayak survey was done twice.

Zone 3 (Figure 2), wetlands of Payne's Creek National Park was surveyed using partly the same methodology, with adaptations given the greater turbidity in this area. The pictures for the photo-identification were made only from the PCNP patrol vessel. This area was covered 15 times. Due to the high turbidity and the possible problem that it could be for the sighting of individuals, an alternative methodology was used for this area: the evaluation of the presence or absence of individuals. This methodology ultimately was not necessary given the number of sightings in the Zone 3 (See Annex 5).

In the Zones 4 and 5 the support of the TPPL enforcement team was instrumental and the methodology developed in the surveys was the same as in Zone 1. The boat survey was performed 12 times for Zone 4 and 10 times for Zone 5.

Variation in survey durations and times depended on non-related enforcement activities and commitments of the rangers. In addition, and because of the need to combine activities in some of the surveys, more than one of the areas selected for the monitoring were covered, so sampling time was not the same in each area. As can be seen in Figure 3, Payne's Creek is the area with greatest time invested while Rio Grande is the area with shorter monitoring time.

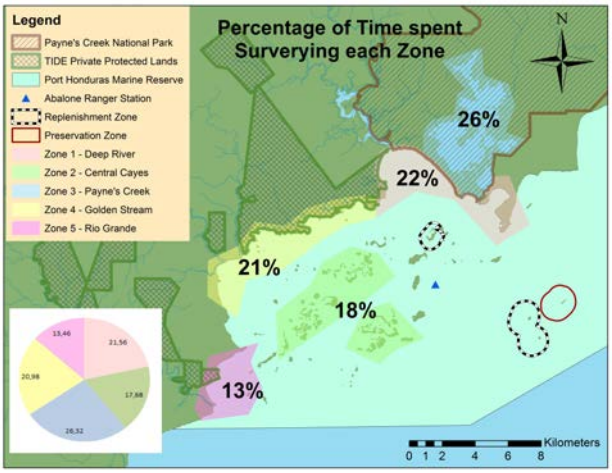

Figure 5.2. Percentage of time spent on monitoring in each one of the selected zones

5.5. Control of human impact

PHMR rangers provided access to the information collected during theirs patrols. These patrols are carried out to monitor and regulate fishing activity in the reserve, both recreational and commercial fishing. GPS points of each boat are taken by the rangers, in addition to the basic characteristics of the vessel and, in the case of fishing, the type of fishing being carried out. The rangers also recorded boat-sighting information during the manatee surveys. This information was useful to determine the areas of greatest influx of boats.

5.6. Photo-identification

During sampling, photographs of manatees were taken from the boat when the manatees were breaching the water surface. A waterproof compact digital camera (Nikon AW120) was used so that it would be possible to take underwater photographs of the manatees underwater. Once the visual contact was established, and all relevant information for the study taken, attempts were made to take photographs of complete individuals, sometimes from the boat and sometimes in the water. From the water it was attempted to capture sharper images of individuals and to better identify them, when water clarity permitted it.

In addition, a GoPro camera, attached to a two-meter PVC pole, was introduced into the water after some manatee sightings to record the submerged zone and take

manatee video. Due to high turbidity, these videos did not yield results useful in determining group size or identifying any individual.

The pictures and videos useful for the photo-ID were selected and edited. Some frames were taken from the videos for the photographic file. This will be carried out using the photo editing software Sony Vega Pro 13.0, which aims to edit and analyze images. This noninvasive technique uses unique patterns of scars and other kinds of markings on the back and the tail fin of the animal to identify the individual. These markings can result from boat strikes, fishing gear or even fungal infections (FFWCC, s.d.).

5.7. Data analysis

All coordinates taken to the location of the sightings were treated with ArcGIS for mapping. Sighting rates by area and rates of manatees sighted per hour in each survey area were calculated; and the total of manatee sighted by the total of survey hours in each area. In addition, the percentages of adults, sub-adults and calves were calculated. Behaviour percentages for each zone are also calculated. The proportions of group sizes and the number of manatees sighted per hour in each monitoring conducted in each of the selected areas were also estimated.

6. RESULTS

64 surveys were conducted during the period 9 June to 4 September 2014, corresponding to a total of 83 hours and 43 minutes of survey time. The average survey duration was 1 hour and 17 minutes, and all were conducted between 6am and 6 pm.

6.1. Relative abundance and spatial distribution

From the 14 boat surveys in Zones 1 and 2 (Deep River and Cayes), 15 in Zone 3 (Payne's Creek), 12 in Zone 4 (Golden Stream) and 10 in Zone 5 (Rio Grande), only in 50% (n=32) of the surveys was least one manatee sighted. During these surveys 112 manatees sightings were done, 91.07% were adults (n=102) and 8.92% calves (n=10).

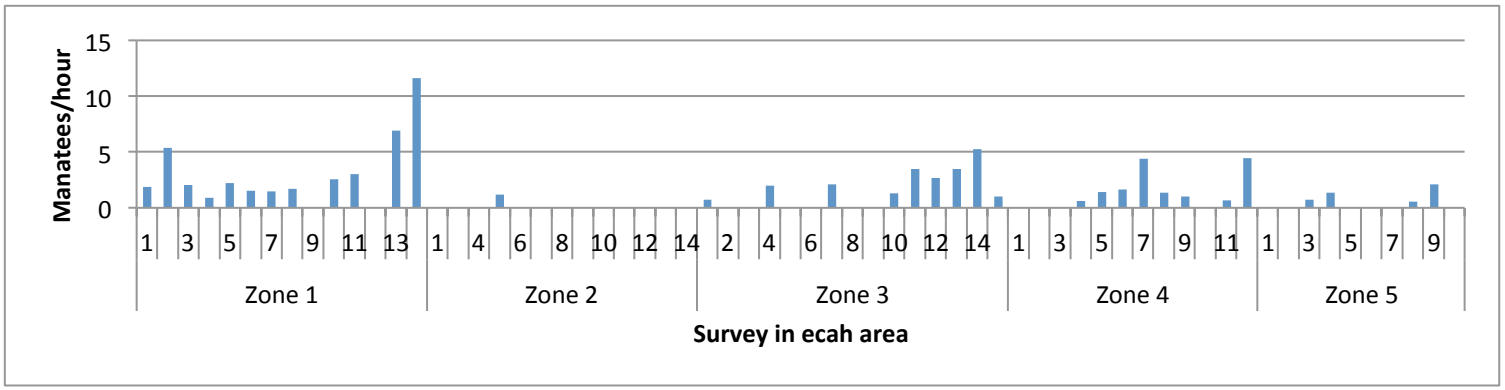

Figure 6.1. Manatees sighted per hour in each survey made in each area

The average relative abundance index in all zones combined is 1.25 manatees per hour of survey time. However this value is different for each area. The highest values of relative abundance were observed in Zones 1 and 3. The maximum difference of these values occurs between zones 1 and 2, the maximum and minimum, respectively.

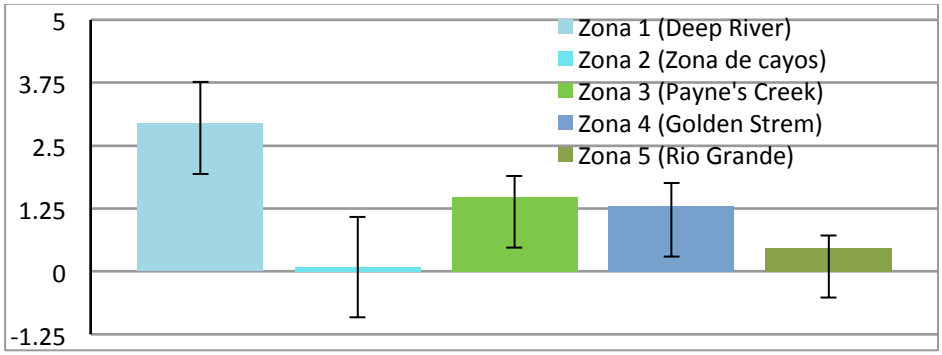

Figure 6.2. Average of manatee sightings/hour/zone and standard error

33.88% of individuals were sighted in Zone 1 (Deep River), 3.30% in Zone 2 (Cayes), 34.71% in Zone 3 (Payne's Creek), 20.66 % in Zone 4 (Golden Stream) and 7.43% in Zone 5 (Rio Grande). However the total hours of survey were not the same in the different zones. In Table 2 the total number of manatees sighted per total number of hours used and the corresponding value of manatees sighted per hour per zone is observed.

Table 6.1. Number of manatee sighted per number of survey hours per zone

Zone	Hours	No. Manatees	Total manatees/h
Deep River	18:03	41	2,27
Frenchman Cays	14:48	1	0,07
Payne's Creek	22:02	39	1,77
Golden Stream	17:34	24	1,37
Rio Grande	11:16	7	0,62
TOTAL	84:43	112	

The kayak surveys in Frenchman Lagoon had a 3 hours and 26 minutes total duration. During these surveys only one sighting was done, one manatee adult resting.

When calculating spatial distribution of groups or individuals, the number of manatees sighted in a "casual" way are included in the data set (n = 9), increasing total of manatees sighted to 121. These sightings occurred in a casual way, outside of the study sampling time, during other activities in the reserve. So the total number of sightings was 78 and the total number of individuals sighted in them was 121. Of the total of individuals sighted, adults comprised 88.42%, 1.98% juveniles and 9.41% calves. From the 12 calves spotted (9.91% of total), seven (58%) were in Payne's Creek, three (30%) were seen in Deep River and in Golden Stream and Rio Grande was spotted one (the 8.3%) in each zone.

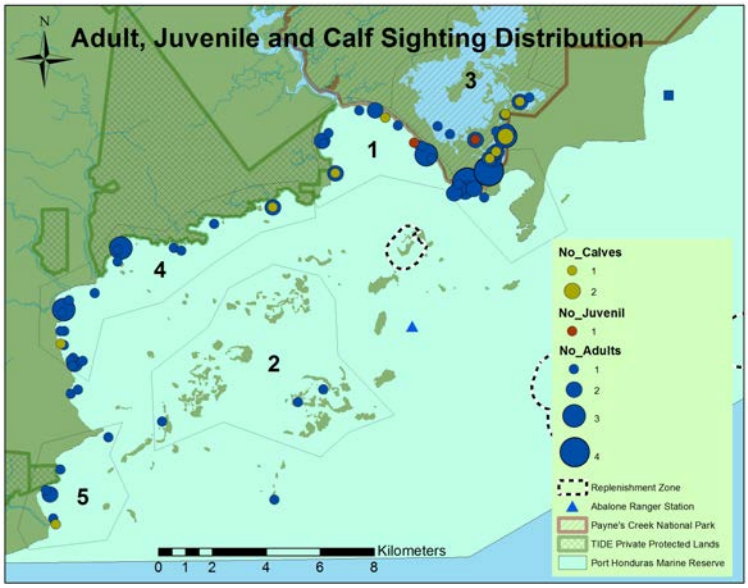

Figure 6.3 Distribution of size groups and individuals' age in PHMR and PCNP

Finally, referring to the group size of the 78 sightings done, in 65.38% of cases an individual alone was sighted (n = 51), in 19.23% (n = 15) of the sightings groups were formed by two individuals, 11.53% (n = 9) of cases were three individuals who formed the group size, in 1.65% (n = 2) were four and only in 0.82% of cases (n = 1) group consisted of five individuals, which is the maximum group size for this study.

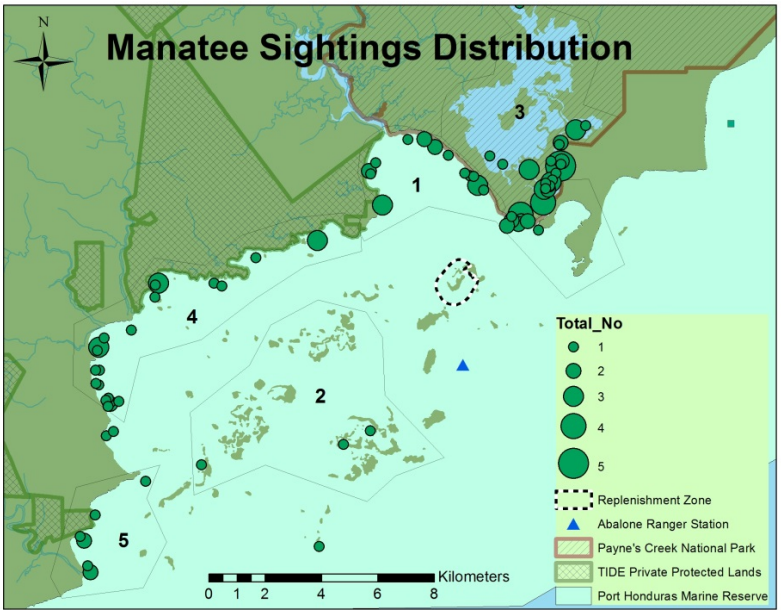

Figure 6.4. Distribution and size of group of manatees sighted in PHMR and PCNP

6.2. Behaviour

The activities carried out by manatees during the sightings were classified into four categories: ‘feeding’, ‘moving’, ‘resting’ or ‘mating’. From the total number of individuals sighted (n=121), 59.40% were feeding, 15.84% were moving, 21.78% were resting and 2.97% were mating.

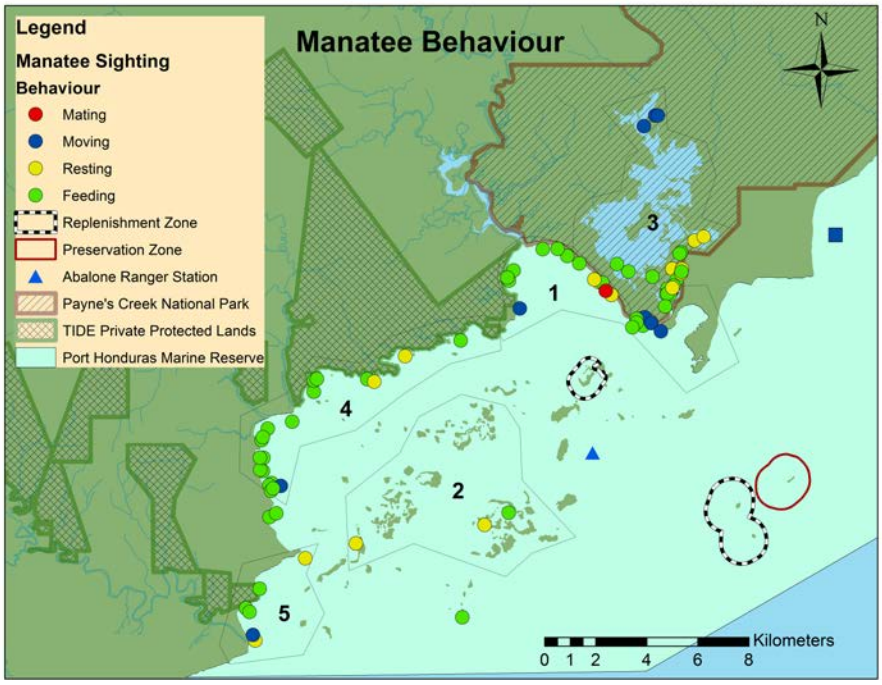

Figure 6.5. Manatee behavior during sightings in different survey zones of PHMR and PCNP

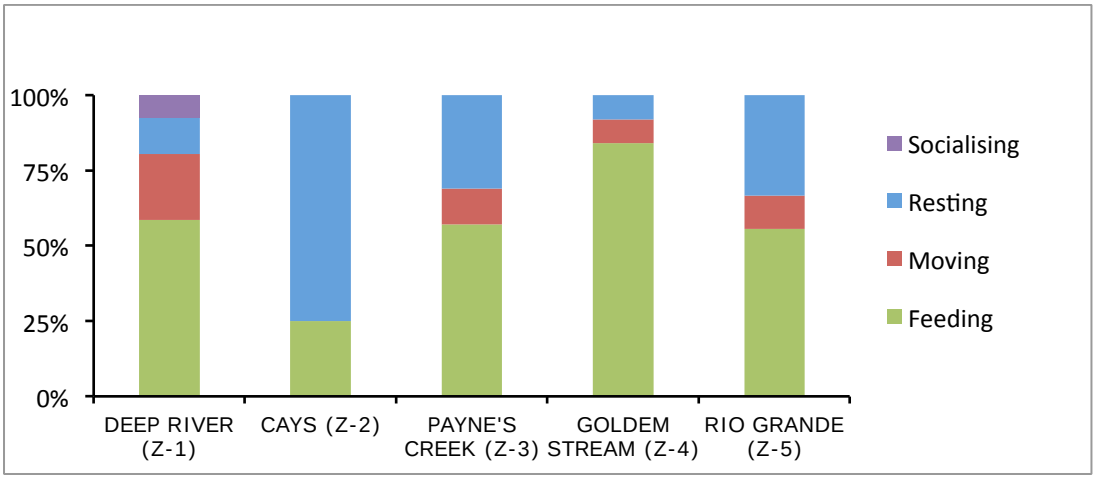

Figure 6.6. Relative proportions of different types of behavior of manatees in each survey zone

In Table 1 the percentage of individuals performing each activity in each area of the total sighted individuals can be observed. As mentioned above, the most frequently observed behavior is feeding, with the largest number of individuals feeding recorded in Deep River (Zone 1) and Payne's Creek (Zone 3). Payne's Creekn (Z-3), also, is a frequented area for resting. Deep River is the area where most individuals were moving, some of them swimming to the Payne's Creek mouth suggesting that these individuals move between zones 1 and 3 consistently, ie, manatees frequently leave Payne's Creek (Z-3) to the mouth of Deep River (Z-1).

Table 6.2. Percentage of total individuals performing different activities in each of the areas

		FEEDING	MOVING	RESTING	MATING
DEEP RIVER	Zone 1	N=24 (19.83%)	N=9 (7.43%)	N=5 (4.13%)	N=3 (2.47%)
CAYS	Zone 2	N=1 (0.82%)	N=0 (0%)	N=3 (2.47%)	N=0 (0%)
PAYNE'S CREEK	Zone 3	N=24 (19.83%)	N=5 (4.13%)	N=13 (10.74%)	N=0 (0%)
GOLDEN STREAM	Zone 4	N=21 (17.35%)	N=2 (1.65%)	N=2 (1.65%)	N=0 (0%)
RIO GRANDE	Zone 5	N=5 (4.13%)	N=1 (0.82%)	N=3 (2.47%)	N=0 (0%)

6.3. Photo-identification

The usefulness of the camera was reduced by the high turbidity of the water due to wet season conditions. In the videos recorded by GoPro no individual were registered under water but with the Nikon one video was made from the boat, making possible to begin the photographic archive.

Three videos and several photographs taken during a survey in Payne's Creek (Z-3) allowed the first photo ID in the reserve. This is a female that has a mark on the back of about 30 cm in length (Figure 8). Although the photographs were taken from the boat and in it was not able to observe the individual's genitals, it was determined as female because the direct contact with its calf at all times. This marking may have been due to natural or anthropogenic causes.

Figure 6.7. Manatee ID number 1. Female adult photo-identified in PCNP with unique marking in the dorsal area

A second manatee was recorded in the reserve by one of the fishermen who collaborated on this project. The video was taken near Moho Cay. In the images the manatee's gender and propeller markings on the back dorsal side can be observed (Figure 11).

Figure 6.8. Manatee ID number 2. Female adult photo-identified close to Moho Cay with mark of a propeller

6.4. Presence of boats

Figure 12 shows the locations of boats that frequent the reserve. Most cases are fishermen' boats. The busiest areas are the mouth of Rio Grande and, in a more dispersed way, the area around the cayes, both areas frequented by fishermen. The rangers do not follow an established pattern during patrols. Areas with higher frequency

of fishing boats are also frequented by park rangers on patrol, seeking to control that illegal activities are not conducted in PHMR.

Some of these cays, as the Frenchman Cays, are used as crossing routes, especially when the sea is rough. Furthermore, the speeds reached by the boats have no limitations, so even if the sightings in that area during this study are low, the probability of impact on manatees is high. This is an important factor to take into account in the recommendations.

The opposite case is Payne's Creek area. The rangers' patrols do not usually cover that area, but equally it is not an area frequented except for sport fishing.

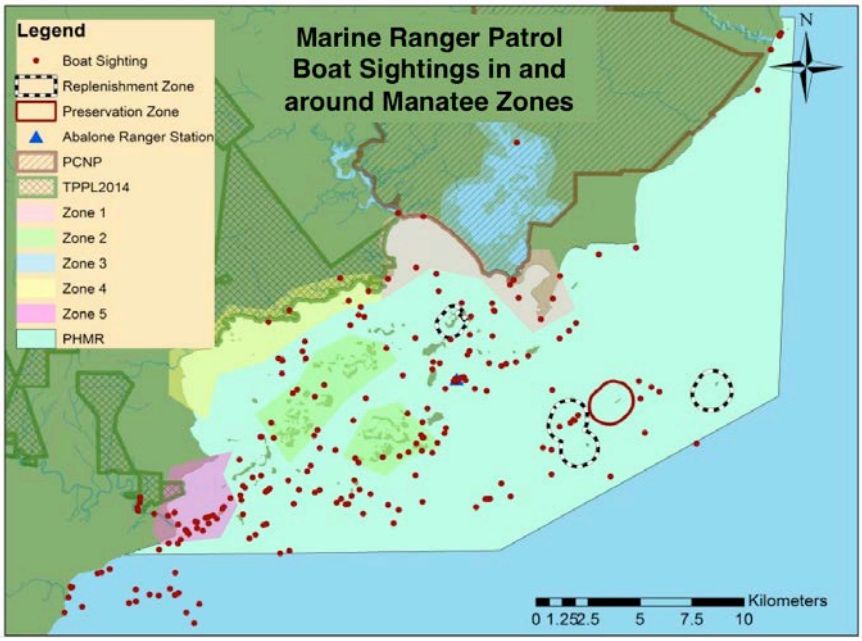

Figure 6.9. GPS coordinates of the boat sighted during the rangers patrol between January and May 2014

7. DISCUSSION

Fieldwork was conducted between June and October. The input of sediment carried by the five major rivers flowing into the reserve during the rainy season causes the water to become turbid, which was the main limitation during the study, particularly for the photo-identification. Photo ID can be used to model manatee population dynamics, calculate population growth rates and provide an integrated measure of regional status (Langtimm et al. 2004). However, as only two individuals could be photo-identified, it was not possible to determine which or how many of those individuals were sighted repeatedly and it has not been possible to estimate of the size of the population in the reserve.

Also during this project, I have been the only person present in all the surveys. The support of the rangers was paramount, however, their presence and experience has not been uniform. This could have influenced the number of sightings by survey and even by area. Likewise, the number of people in each survey has not been constant, however, the persons who did the sightings was usually the same two or three. Moreover, coordination between the various activities of the rangers and this project has limited the duration of the monitoring and has not allowed the project to have a standardized methodology to survey the manatees by hours. Having a specific boat for the surveys could allow higher performance and improved application of the methodology.

Also, the areas selected for monitoring have different characteristics, which suppose a difference in the presence of manatees in each. Zones 1, 4 and 5 exhibit very similar characteristics. They are coastal areas with a high presence of mangrove and freshwater inputs from rivers and streams that flow into the reserve. Zones 1 and 5 are the mouth of two of the largest rivers in the area: Rio Grande and Deep River. Zone 4 has a greater number of waterways but with lower flow, this has also created a variety of small coves in the area. These three areas (Z. 1-4-5) have great presence of seagrass. Zone 5 has greater presence of boats because the mouth of Rio Grande is a good area for fishing, while areas 1 and 4 are hardly frequented by fishermen. Referring to visibility, zone 5 is the one with greater turbidity. In zone 3, as in zone 1, turbidity it is quite high.

Zones 1 and 4 present murky areas and usually clear areas on the north coast of the mouths. Zone 3 can be considered like the coastal zones (Z. 1, 4 and 5) as there the salinity of the water in the wetlands of Payne's Creek is quite low because the confluence of fresh and salt water. The part of the channels presents a much lower salinity which in the main lake, opposite the mouth of the sea. Moreover, this is an area completely surrounded by mangrove, which form channels in the PNPC. The main lagoon of PCNP, where most individuals were sighted, has much seagrass in good condition. Finally, the area with the greatest differences from the rest is Zone 2 (Cayes). This area also has many patches of seagrass and is made up mangrove cays, but the waters are clear and have high salinity. This is also the area with the greatest difference in the index of relative abundance compared to other areas, much less.

About 70% of individuals were spotted in zones 1 and 3. Initially this may be influenced by the fact that both zones are the areas with higher sampling effort invested; however both have a higher rate of relative abundance. This could mean that these areas have the best conditions. Rio Grande (Z-5), similar to the other coastal features, has shown however, a low index of relative abundance. Few individuals and only one calf were spotted in Rio Grande mouth, however the community members revealed that in this zone can be found a large number manatees and even groups of up to 10 individuals. Zone 2 showed that there is less use of the cayes by manatees in PHMR and that manatees are located mainly along the coast. This information coincides with the information yielded by Morales-Vela et al (2000) study during which the increased presence of manatees was observed in the lagoons and coastal habitats.

A percentage of calves over 7% indicates that the population is in good condition (O'Shea y Salisbury, 1991). We cannot determine whether the population is growing or shrinking because there is no previous study to compare, however, a percentage of calves close to 10% is considered positive (O'Shea and Salisbury, 1991) and determines the area as an important point of constant presence of West Indian manatee. In addition, from the 12 calves sighted (9.91% of total), seven (58%) were in Payne's Creek, indicating that the calm waters of Payne's Creek are chosen by mothers to spend much of the calves dependence period. The mother-calf pairs are frequently

sighted in Payne's Creek, probably due to the tranquillity of the area chosen by manatees as places to rest (as seen in Fig. 8). In Zone 3 (PCNP) were located the largest groups, of up to five individuals. However, most of the sightings were solitary individuals as in studies O'Shea and Salisbury (1991) and Morales-Vela et al (2000). This also suggests that the individuals sighted in Payne's Creek and Deep River may be the same moving frequently in and out of PCNP water. During sightings in continuous dates (days 20 and 21 August) 7 individuals were spotted in the lagoon of Payne's Creek and 6 the next day at the mouth of Payne's Creek (Near Deep River), which leads us to consider that individuals sighted in Payne's Creek (Z-3) and Deep River (Z-1) may be the same, moving constantly in and out of the waters of CPNP.

Furthermore, in Figures 6, 7 and 8, a point marked with a square (instead of the usual circle used in other locations) on the coast in front of Punta Negra was observed. This point corresponds to an individual sighted out of the selected areas for the study so it is not included in the analysis of results. This individual, an adult moving in the direction of Monkey River, demonstrates circulation with that area of the reserve (not analyzed in this project) where fishermen confirmed sightings in the region before and during the implementation of this project.

Also, this study represents the establishment of baseline population monitoring of manatees in PHMR, but there are previous data collected by community members. In a particular, Village Farmer collected data in the vicinity of their property in Golden Stream. In addition, local ecological knowledge of fishermen has provided information and assistance in this study, which was of great importance. Hence an awareness activity among community members about the need to conserve this species, an initiative of community collaboration has been started. TIDE could continue collecting manatee data, in areas outside the selected zones within PHMR and during the two distinct seasons. A data sheet like the one used in this study was distributed among the participants in this initiative. Those that have GPS can take the coordinates of the sightings and those without can write a number describing the sighting in the PHMR map printed on the back of the sheet. These data tables are printed on waterproof paper; both fishermen and tour guides can take it in the boat without damage risks.

TIDE has a list of names and phone numbers of these participants, after six months TIDE will contact those who have not reported their data to the NGO, to have the data collected and provided them a new data table for the six months following.

8. CONCLUSIONS

Boat surveys are a cheap and effective method to determine the presence of manatees. Being a low-cost methodology is easier for the NGOs to perform and to continue these studies. Six months have not been enough to define the population size and distribution of the species in the area. Seasonal changes due to the dry season or rainy season influence the behavior of manatees (Spiegelberger and Ganslosser, 2005). These variations between seasons require, at least, an annual study. However, this study allows the establishment of the baseline for further studies.

Zones 1 and 3 are the most important areas in this study. They are the zones with the greatest effort invested which could lead to confusion because they also have the highest number of indivduals sighted, however are the areas with the highest relative abundance. These two areas have been separated during the study, but due to their very similar zones 1 and 3 could be considered as a single area. The high percentage of spotted calves obtained, 9.92%, indicates that the stock is in good condition and with a high rate of reproduction (O'Shea and Salisbury, 1991). Females with calves are associated with fluvial-lagoon systems since, as we can see, the areas mainly chosen for this are Zones 1 and 3 (Deep River and PCNP). In addition the largest group sizes (up to 5 individuals) are found in these areas, determined as the areas with the highest rate of individuals feeding and resting.

The presence of boats is not homogeneous throughout the reserve. Fishing in PHMR is the main resource of the buffer communities so the busiest areas are the fishing ones. In zones 1 (Deep River) and 4 (Golden Stream), therefore, manatees are not very affected because the only coastal fishing zone is Rio Grande. However, Zone 5 (Rio Grande) is used by fishermen with small engines and the users work with slow speeds so the impact on manatee may be minimal. However, this area is highly trafficked because it is located at the southern side of PHMR, close to Punta Gorda. Frenchman Lagoon is also used as a passage channel primarily as shelter on days with rough sea. There are no limitations for the boat speeds so that while the proportion of sightings in this area is relatively low, the risks to manatees that are in this area are greater, upholding the need for management intervention in this area. Even though there are

fewer manatees, each one there has a greater chance of getting injured due to boat strikes than in other areas (see Figure 12).

Regarding proposed new anthropogenic activities, government issued oil exploration concession areas overlap with key areas of manatee sighting. Payne's Creek (Z-3) and Deep River (Z-1) will be primarily affected by increased presence of boat and human impact due to oil exploration, particularly, the zone borders between both concessions so this increase will double (Figure 13). This increase will have direct consequences not only due to increased collisions but the effect of human activities in the area will have an impact on sea grass.

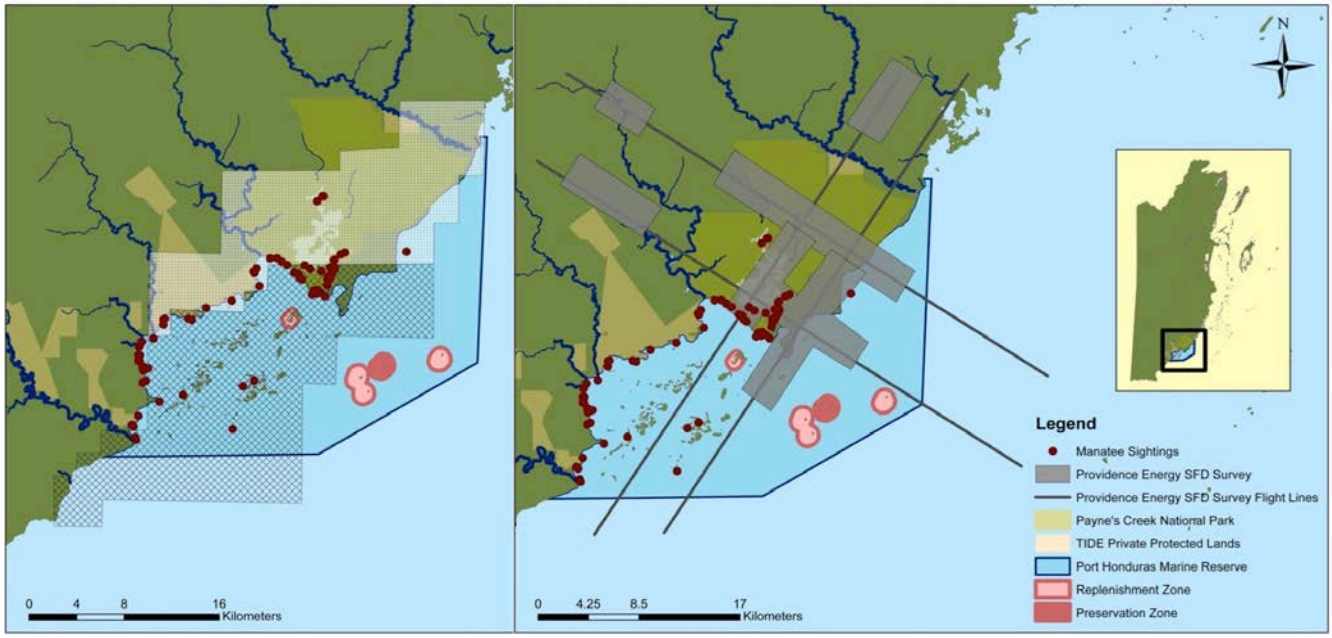

Figure 8.1. USCapital and Providence Energy Group concessions for the exploration of oil resources (on the left) and Aeromagnetic survey lines (on the right) with manatee sighting localizations in PHMR

8.1. Recommendations

There are two types of recommendations in this study: Management recommendations and monitoring recommendations.

Management recommendations

- Limiting the number of boats

Should oil exploitation be initiated, boat traffic is likely to increase considerably, particularly in the convergence areas of both companies with concessions. Limiting the presence could control the impact degree in these areas and could mitigate the impact of these.

- Speed limit in Payne's Creek and Frenchman Lagoon

Maximum speed for boat circulation could reduce disturbance on the species and prevent collisions. Payne's Creek is not a transit area so it is recommended that those who need to circulate in these waters do so under a limit of 10 miles/hr. In the case of Frenchman Lagoon, and because it is a transit zone, the maximum speed will be 13 miles / h.

- New signs of "no wake zones".

"No wake zone" signs are only found in one area of Payne's Creek. It is necessary to relocate these signs since they are in areas where there have not been sightings, or add new ones in addition to the existing ones. It is also important to raise awareness of the importance of respecting those signs and zones so it would be interesting to organize a session with the community and the rangers, explaining that and asking for their cooperation.

- Action Plan for the rehabilitation of injured manatees.

The nearest and only Belizean manatee rehabilitation center is situated in Sarteneja, at the other end of the country. This makes logistics for rehabilitation of manatees in PHMR difficult, as reaction times and swift low stress transport are important in these situations. It is therefore necessary to publish an action plan outlining how to rescue manatees as quickly as possible in the southern Belize region. Wildtracks and CZMAI are working on that (*pers. comm.* Zoe Walker). The actions taken depend on the age of the animal, state or damage, its state of health / injuries, and the environment it is found in, but generally follow these steps:

1. If animal is alive, assign someone immediately to watch it continuously - the primary issue has been people seeing a manatee requiring rescue, and then not finding it again when they return to the location

2. Contact Jamal Galves (607-5038), and copy to Wildtracks, describe situation, send photo if possible - he will then generally assess the situation and make suggestions as to the best way to proceed until he gets there
3. Assist Jamal once he arrives on site.

Catching manatees and handling them without guidance is inadvisable unless people are used to handling them, even if they seem badly injured, as they are potentially dangerous if people have little or no in-water experience with them, and can be harmed by inexperienced handling and / or net use.

- Training in handling manatees

Derived from the need for a protocol for the rehabilitation of manatees it is recommended that a member of TIDE staff be trained in interim care to allow time for experts from Wildtracks or CZMAI to arrive. This person could be one of the rangers of PHMR, or even train all marine rangers for this. Once notified of the injured manatee, they have a boat and the capacity to arrive quickly to a stranding site and act with the necessary knowledge; they could know how to handle them, minimizing hazards to the manatee and for themselves.

- Study of seagrass in PHMR and PCNP

Seagrass is the principal food for manatees and it limits their distribution and permanence in certain areas. TIDE is conducting a comprehensive habitat mapping project to characterize habitats in the reserve. This includes underwater surveys and analysis of many transects at different locations throughout PHMR including seagrass. TIDE must include transect to analyze the state of the seagrass in the zones 1 (Deep River), 3 (Payne's Creek) and 4 (Golden Stream), where the manatee abundance index is highest.

<u>Monitoring recommendations</u>

- Annual surveys

Including the dry season is important because there are variations in the distribution of manatees between the wet and dry seasons. The water provided by the rivers is lower and it does in some cases that manatees swim up the river. Besides rainfall will be lower

so they increase visibility, facilitating sightings. It will be important to include the major rivers that flow into the reserve. Rio Grande, Deep River and Monkey River were determined as sighting points during the interviews.

The rangers have demonstrated great interest in the species throughout the fieldwork and they are perfectly able to continue collecting the necessary information. However, it would be advisable to have a boat specific for the surveys. This would allow longer surveys and at a specific times.

- Sonar

Given the characteristics of the zone 5 and the degree of turbidity during the rainy season, the use of side scan sonar at least in this area is recommended. During this study, there have not been a large number of sightings in that area, however, and as a result of the interview, a large number manatees is usually present in that area so one sonar will allow a better estimate of the number of manatees in Rio Grande and estimate the group sizes.

- Aerial surveys

It will be important keep in contact with Light Hawk and try to have an aerial survey when they are coming to Belize, at the beginning of May.

Also, during this study the Belize Fisheries Department was contacted to request it's collaboration in an aerial survey using their enforcement drones. The idea was dropped due to lack of time for a test study and the low visibility in the reserve. However, during the dry season, and given that BFD is planning to develop its use of the drones, it would be advisable to do a complete aerial study of PHMR, from Rio Grande to Monkey River, including the cayes area.

- Satellite tracking

Telemetry Monitoring allows behavioral observations, associations with conspecifics and periodic evaluations of visual health. These technologies also can alert to inappropriate movements or other issues requiring rescue response. Radio signals sent from the transmitter are received by polar orbiting satellites and analyzed to yield accurate location data on the manatee. Sensors built into the unit give additional data on water

temperature and the manatee's activity. Researchers can access this information daily by computer (Fancy et al. 1988; Save the manatee, n.d.).

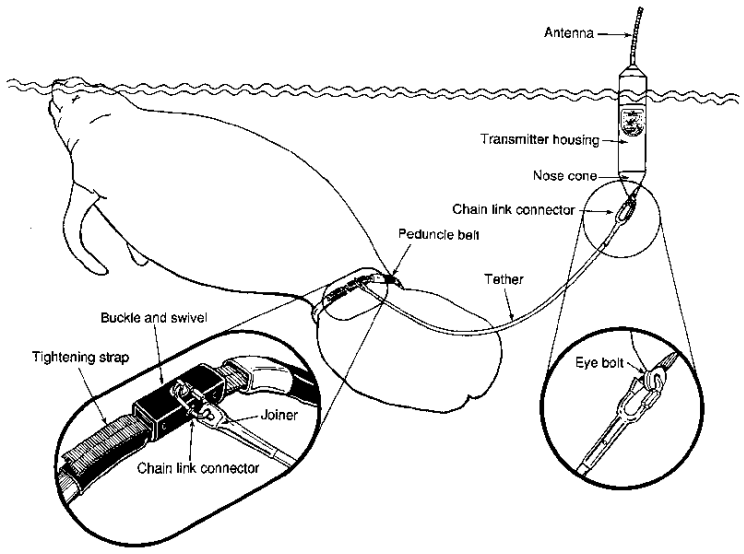

Figure 8.2. Manatee with a transmitter attached to its tail

Such studies require people trained to handle individuals. Catch the animal with a net is needed to attach the transmitter to the tail fin. These people to train could be fishermen of PHMR who are familiar with this species. Also, they could be assisted by the rangers (once these have been previously trained for the work of rehabilitation of manatees).

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Annexes

Annex 1. Questions for the interviews

LOCALIZATION

In which zones have you seen manatee more frequently? (show the map of the reserve)

How many did you see? It was an individual or a group of manatees?

Was there presence of mother with calf?

In which condition was the animal?

What activity was it doing? Feeding, resting, moving…?

FEEDING

What they eat?

Do you know what kind of plant they eat generally? The species?

Where they are usually eating?

Can you identify the grazing traces?

How are these traces?

In which zones of the PHMR have you seen these traces?

Annex 2. Forest Department Permit

FOREST DEPARTMENT

Ministry of Forestry, Fisheries and Sustainable Development
Forest Drive, Belmopan, Belize
Tel: (501) 822-1524 Fax: (501) 822-1523
Email: secretary.fd@ffsd.gov.bz

Please Quote
Ref. No. CD/60/3/14(43)

Transito Gonzalez Medina
Charles Westby Street
Indianville, Punta Gorda
Belize C.A.

August 7th, 2014

SCIENTIFIC COLLECTION/RESEARCH PERMIT
WILDLIFE PROTECTION ACT NO. 14/2000

Permission is hereby granted to the above-named and address to do **Research/Collection** in the country of Belize subject to the following conditions:

1. The permit is:
   a) Valid for Transito Gonzalez Medina and companions as listed below only.
   b) Valid until January 6th, 2015.

2. This permit provides research/collection to be done at: **Port Honduras Marine Reserve and Paynes Creek National Park.**

3. The permit allows the holders to do research entitled: **Baseline population study of West Indian Manatee (Trichechus manatus) in Port Honduras Marine Reserve.**

4. The objective of the research is to: **Obtain demographic and ecological information of the manatee population in Port Honduras Marine Reserve, also information on the potential risk zones inside PHMR and photo indentification.**

5. The permit holder must supply the Forest Department with **both digital and hard copies of final reports at the end of the Project.**

6. This permit may be cancelled at anytime not withstanding condition 1(b) above at the discretion of the Minister of Forestry, Fisheries and Sustainable development.

9. The permit holder shall make provisions to accommodate Forest Department Staff on field trips as Convenient to both parties.

10. Research fee has been paid vide Treasury Receipt No. 1194656 dated. 7th August, 2014

List of companions
Areli Perez
PHMR Rangers
PCNP Rangers

Wilber Sabido
Chief Forest Officer

Cc: CFO
File