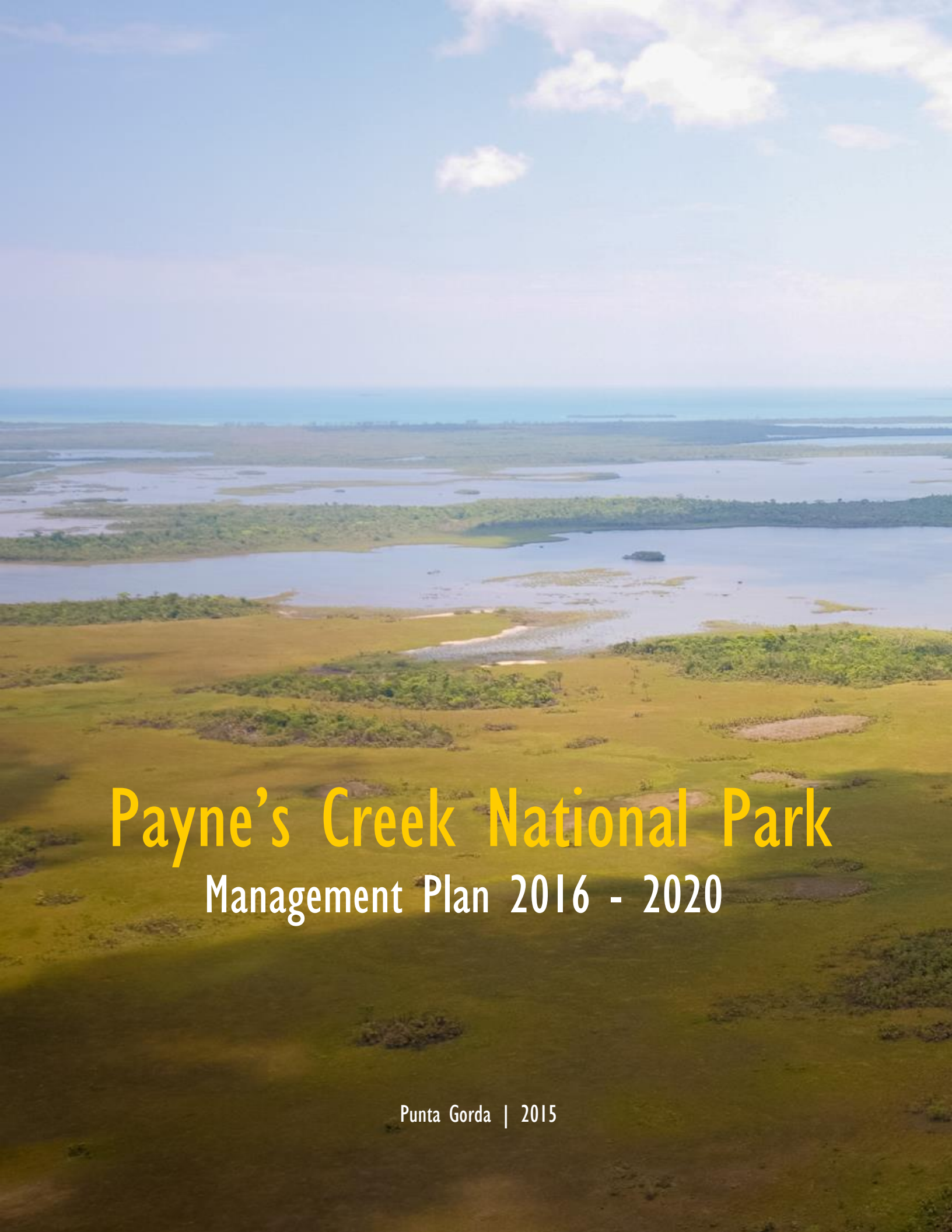

Payne's Creek National Park

Management Plan 2016 - 2020

Punta Gorda | 2015

Cover page

The open savannah of Payne's Creek with Punta Ycacos Lagoon in the background
Photo: Paul Etienne

Back page

Gray fox (*Urocyon cinereoargenteus*)
Photo: Paul Etienne

Maps

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Payne's Creek National Park

Management Plan

2016 - 2020

Prepared by: Toledo Institute for Development and Environment (TIDE) in partnership with the Government of Belize

Financed by: Protected Areas Conservation Trust (PACT)

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Special thanks: Update from the incredibly informative and useful original management plan written in 2006 by Zoe and Paul Walkerof Wildtracks Consultants

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INTRODUCTION

Background and Context

The Payne's Creek National Park (PCNP) is located in the northeastern corner of the Toledo District, the most southerly of Belize's six districts. The PCNP lies just south of the Monkey River, extending southwards to the banks of the Punta Ycacos Lagoon, and delineated by Deep River to the west.

The PCNP started as a local initiative led by the village leaders of Monkey River who wanted to create a nature preserve along the riverbanks, which would have brought the village economic benefits through eco-tourism and agricultural development. The area was declared first as the Monkey River Special Development Area (MRSDA) on 17 October, 1991 (Statutory Instrument (SI) 152 of 1991) under the Land Utilization Act of 1992 following lobbying by the village leaders. The size of the MRSDA was then extended, and eventually, through the assistance of the Forest Planning and Management Project (FPMP), it was declared a National Park on 14 May 1994 (SI 43 of 1994) (Appendix 1), under the National Parks System Act of 1981. The designation was later amended in 2004 (SI 149 of 2004) following realignment of the Park's boundaries (Appendix 2). The realignment led to the inclusion of pine savanna to the west and northwest, excised from Deep River Forest Reserve. It also led to the exclusion of most of the coastal ridges and the Punta Negra Lagoon. The size of the National Park has now increased from 29,420 acres to approximately 37,680 acres of hypersaline, saline, brackish and freshwater wetland habitats, mangroves, broadleaf forest and savanna.

The Toledo Institute for Development and Environment (TIDE) had been managing the PCNP since 1997 until it entered into an official (though not legally binding) co-management agreement with the Forest Department in 2004. This co-management agreement later became enshrined in law under the new National Protected Areas System Act (2015) providing, for the first time, legal recognition of TIDE's management. TIDE is a registered non-governmental organization incorporated in 2000 under the Companies Act, Chapter 206, of the Laws of Belize.

Purpose and Scope of Plan

The current management plan is a revision of the management plan that was created in 2006 by Zoe and Paul Walker of the Wildtracks consultant team. The management plan intends to update all sections, address some of the major gaps in the 2006 plan and integrate issues which have arisen in the interceding decade. Key themes include:

1) Integrating climate change considerations across all relevant sections;
2) Integrating updated information pertaining to fire management and threats
3) Ensuring that social data gathering, particularly gender inclusive, is a key focus over the coming 5 years
4) Reflecting the strong focus on sustainable livelihoods to achieve conservation targets

The management plan update process involves 5 main phases:

1) Review and conduct a gap analysis of 2006 PCNP Management Plan
2) Information gathering from community, private sector, government and managers
3) Drafting of revised management plan
4) Presentation of draft management plan to PCNP advisory committee for feedback
5) Final draft and distribution

The plan details the five main programs of the Park which are:

1) Site Protection
2) Fire Management
3) Alternative Livelihood Development
4) Administrative Capacity Enhancement
5) Research and Monitoring
6) Education and Awareness

These programs and their objectives and activities will be implemented over a five-year period from January 2016 to December 2020.

The current management plan is based on the National Management Plan Framework developed for terrestrial and marine protected areas system of Belize under the mandates of the Forest and Fisheries Department (PACT *et al.*, 2005). The management plan will be

submitted to the Forest Department and the Payne's Creek Advisory Committee for final approval.

DESCRIPTION OF THE PROTECTED AREA

Location

The Payne's Creek National Park is located in southeastern Belize and is centered on latitude 88°35' W and 16°20' N (Figure 2.1). The Park is 37,680 acres and extends north to the Deep River Forest Reserve, east to the Monkey River, the Caribbean Sea and lands on the coast of Devil's Point, Paddy's Bluff and Punta Negra, south to Port Honduras and lands on the coast of Punta Negra, Punta Ycacos and New Haven and west to the bank of the Deep River and Deep River Forest Reserve (S.I. No. 149 of 2004, Schedule I Payne's Creek).

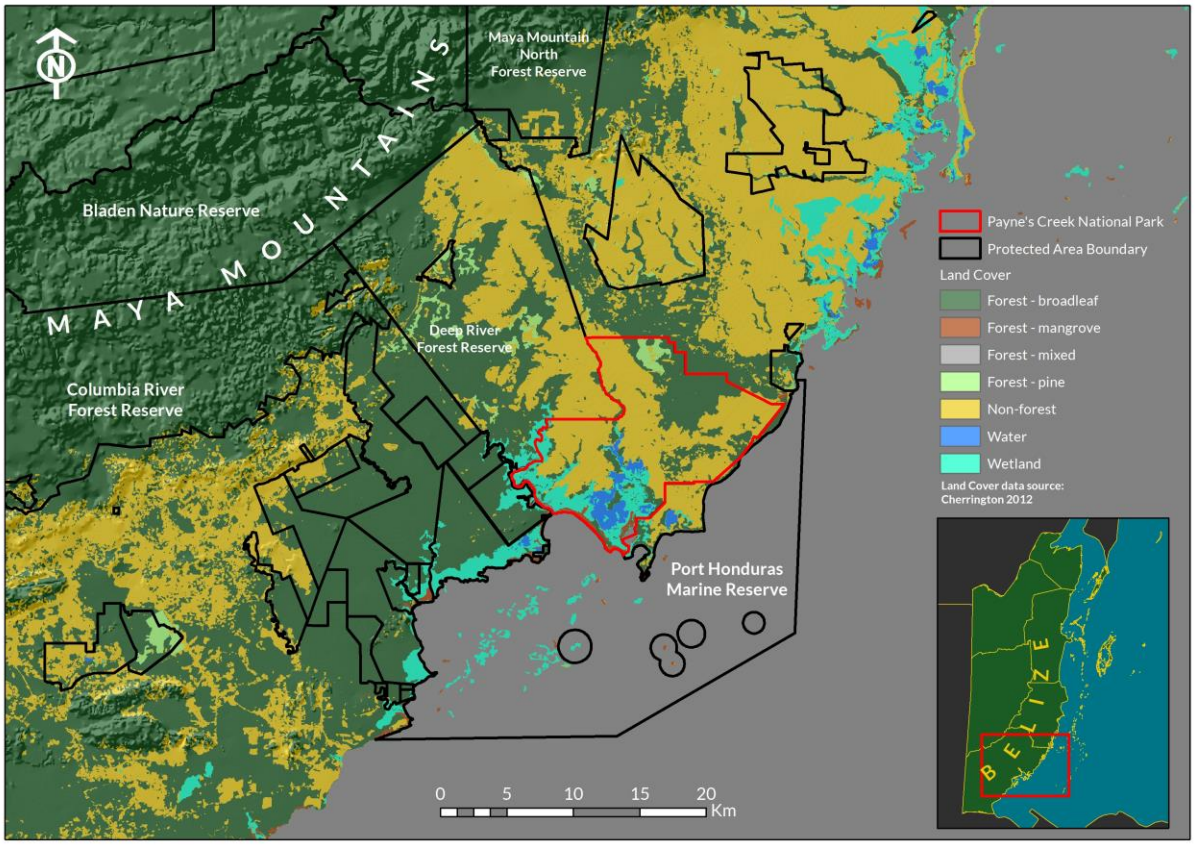

Figure 1. Local and National Location of Payne's Creek National Park

The Payne's Creek National Park is buffered by many communities (official) and settlements (unofficial) including: Punta Gorda Town, Punta Negra Village, Monkey River Village, Bella Vista Village, San Isidro Community, Swasey, Cruce Trio, Trio Village, Bladen Community, Gomez Sawmill and Logging Company, Medina Bank Village, Deep River, Tambran and Golden Stream Village, Independence Village and Placencia Village (Figure 2). Members of these communities at various points, whether constant, seasonal or historical, have made contact with the habitat of PCNP either directly (i.e within) the Park or indirectly through activities outside the Park but which nonetheless impact the Park's eco-system (King, 2005).

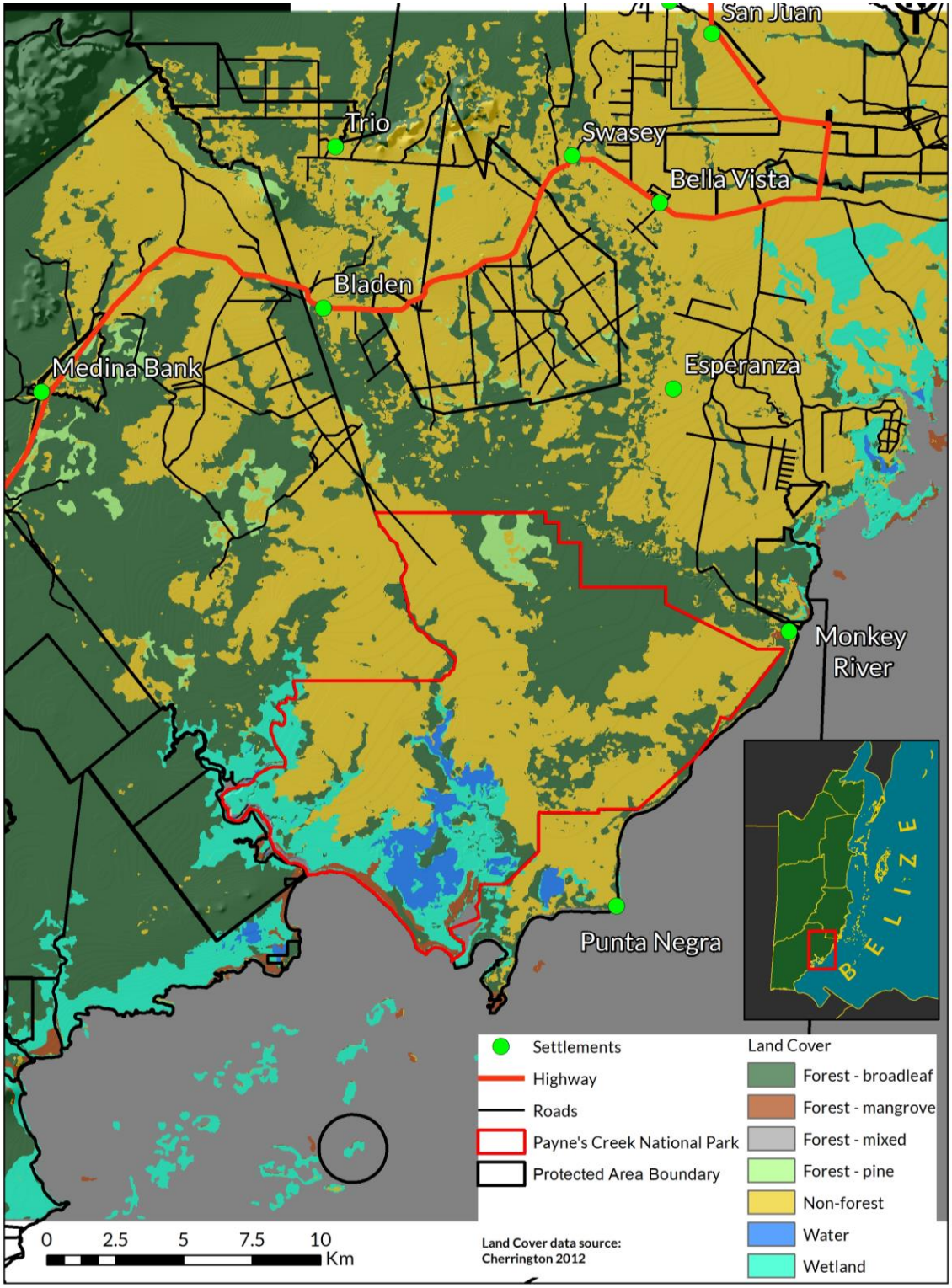

Figure 2. Payne's Creek NP and key buffer communities

There are several entry routes into the PCNP; however, the time of the year is a determining factor. In the dry season (January – June), the park may be accessible by road in a four-wheel vehicle at an exit point off the southern highway, which runs directly into the park. It is also possible to access through Monkey River Village where knowledgeable locals and tour guides can use various trail systems through the riparian forest into the Park. The Park can also be accessed by boat via the Punta Ycacos Lagoon (Figure 2).

Regional Context

Connectivity

In the landscape context, the importance of Payne's Creek lies in its contribution to the Maya Mountain Marine Corridor (MMMC), providing connectivity between the Maya Mountains (terrestrial) and the marine (Gulf of Honduras) ecosystems. The 205,419 ha MMMC, itself a critical component of the regional Mesoamerican Biological Corridor (MBC) and Mesoamerican Barrier Reef System (MBRS) is comprised of eight contiguous protected areas (Figure 2.4), and an additional ninth (Sapodilla Cayes) to the east.

As an area within the larger corridor region (Gulf of Honduras Priority Area) this Park would be linked to the marine areas of Guatemala and Honduras thereby creating a tri-national linkage complex, thus its regional and international importance

National Context

The National Protected Areas System of Belize is comprised of a total of 94 protected areas. The PCNP is one of 16 national parks distributed throughout the country (Meerman, 2005). The PCNP is the third largest national park, the largest park being Chiquibul National Park (265,262 acres)

Legal and Policy Framework

Under the National Protected Areas System Bill (2015), "National park" means any area established as a national park in accordance with the provisions of section 33 for the protection and preservation of natural and scenic values of a national significance for the

benefit and enjoyment of the general public". In order to align the NPAS internationally Belize will manage in accordance with IUCN categories. PCNP is a Category II protected area, classified as a *"large natural or near natural area set aside to protect large-scale ecological processes, along with the complement of species and ecosystems characteristic of the area, which also provide a foundation for environmentally and culturally compatible, spiritual, scientific, educational, recreational, and visitor opportunities"*.

Ministry of Forestry Fisheries and Sustainable Development (MFFSD) is responsible for the administration of this new act and has entered into a comanagement agreement (see box) with TIDE (2015) for the management of PCNP.

PCNP Management Committee

TIDE also works closely with the PCNP Management Committee which provides input on the strategic direction of the park and reviews performance, specifically the completion of management actions outlined in the management plan. Further to this the Management Committee reviews and approves the annual workplans developed by the park management team. The Management Committee also plays a valuable role in the revision of the Management Plan which should be updated each 5 years and reviewed at its midway point. The Committee is comprised of representatives from Monkey River Village, Punta Negra Village, Rio Grande Fishermen's Co-op, Monkey River Tour Guide Association, BTIA (PG), Association for Commercial & Fishers for Sustainability and Empowerment in Monkey River, University of Belize, Deep River Logging Concession, Toledo East Area Representative, Fisheries Department and TIDE (ex-officio), without a right to vote. Observers on the Committee include the Forest Department and the Punta Gorda Town Council

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Co-management in Belize – A brief history (adapted from Young & Horwich 2006)

Enabling legislation: Soon after Belize's independence Belize's new government passed two landmark pieces of legislation – the National Park Systems Act (No. 5, 1981) and the new Wildlife Protection Act (No. 4, 1981). This legislation set the stage for protected areas development in Belize. The National Park System Act provided the legal framework for the establishment of national parks, natural monuments, and wildlife reserves while the Wildlife Protection Act, greatly improved since the 1944 Ordinance, afforded protection to wildlife recognized under Convention on International Trade in Endangered Species (CITIES) and regulated the use and hunting of other species in need of protection. Both of these Acts delegated responsibility for their enforcement to the Forest Department (FD) in the Ministry of Natural Resources.

Audubon Society: Because the FD lacked the capacity, personnel and financial resources (Hartshorn et al. 1984; GoB 2005b) to adequately administer protected areas, the department was unprepared to deal with this new responsibility given to them under the two Acts. Recognizing its limitations, the government approached the Belize Audubon Society (BAS) in 1982 and asked the Society to use its expertise and experience in protected areas management to manage and protect the six major national parks and wildlife sanctuaries (Belesky 2004). This co-management agreement between the government and BAS was formalized and solidified in 1984 with the signing an agreement that gave the Society the authority to collaborate with the FD and the GOB in the "protection and management of areas designated under the Forestry Acts and National Parks and Refuges Acts" as well as to draft management plans for governments approval for the said protected areas. This co-management agreement continued until 1995 when BAS signed a five year tripartite agreement with GOB, and the FD that defined the Society's role in the protection of six protected areas.

National expansion: Through the 1980's and 1990's other NGO's signed similar co-management agreements across the country, from Shipstern in Corozal to Sarstoon-Temash and Payne's Creek in Toledo District. Forest Dept. has signed 26 comanagement agreements representing 54% of the NPAS. Whilst considerable progress remains to be made towards integrating communities into the management of protected areas, comanagement has become a model which can claim considerable plaudits at a regional and international level.

Land Tenure

The Payne's Creek National Park is all national lands. National Lands are those lands excluding forest reserves but including land and part of lands not already granted or that, which may be acquired by the Government of Belize.

Key functions of Protected Area

Apart from its regional connectivity importance the PCNP plays several other important roles:

- Protection of Watersheds
- Protection of Wildlife
- Protection of Cultural Heritage

Protection of Watersheds

One of the founding concepts behind the Maya Mountain Marine Corridor (MMMC) is the protection of watersheds that flow into the Gulf of Honduras, by maintaining water quality necessary for functional and healthy coastal ecosystems. PCNP encompasses the majority of the Payne's Creek watershed also including the Upper and Lower Freshwater Creeks, during annual inundation of the surrounding savanna areas. The origin of Payne's Creek itself lies outside the Park (Figure 3). The entire Payne's Creek watershed is likely to be important for storing freshwater during the wet season before eventual release into the Punta Ycacos lagoon system.

PCNP also provides some protection for the eastern bank of the lower Deep River, with the western bank falling within Deep River Forest Reserve (Walker & Walker, 2005). The Rationalization exercise (Wildtracks, 2013) recommended the inclusion of at least 2 miles of Deep River from the river mouth within Statutory Instrument of either PCNP or PHMR. This would address the under-representation of rivers within the NPAS, strengthening of protected connectivity between freshwater and the reef, representation of riverine mangrove and strengthened ability to address clearance of riparian vegetation for development.

Protection of Wildlife

Payne's Creek National Park provides direct protection for twenty species of international concern (as listed by the IUCN Redbook – www.iucnredlist.org). Two of these twenty species, the goliath grouper and hawksbill turtle, are considered critically endangered, four of these are considered endangered, three are classed as vulnerable, and nine are lower risk/near threatened (Table 1). Two further species (red brocket and spotted eagle ray) are considered 'data deficient' – there being insufficient data to give it a status, and yet considered to be at risk. Two further species have also been included in the list (water opossum and neotropical river otter), due to their proximity to Payne's Creek, and therefore the high probability of them being recorded within the boundaries in the future. Both were recorded from the banks of Monkey River (Walker & Walker, 2005).

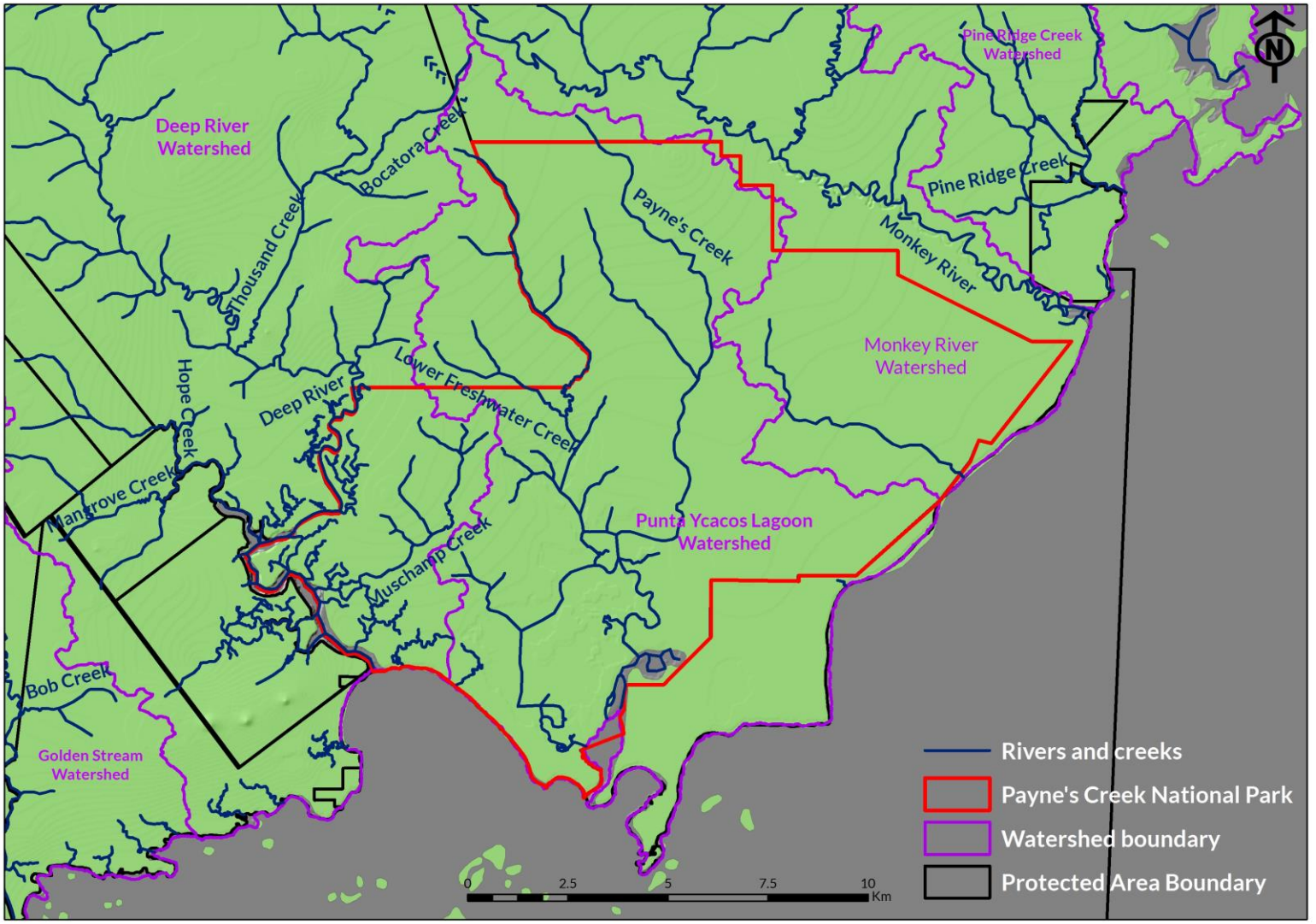


Figure 3. Major Creeks and watershed boundaries of Payne's Creek National Park

Table 1. Species of International Concern (IUCN Redlist) of Payne's Creek National Park

Critically Endangered	*Goliath Grouper*	*Epinephelus itajara**
	Hawksbill Turtle	*Eretmochelys imbricate**
Endangered	Cycad	*Zamia prasina*
	Yucatan Howler	*Alouatta pigra*
	Baird's Tapir	*Tapirus bairdii*
	Yellow-headed Parrot	*Amazona oratrix*
	Yaxnik, Fiddlewood	*Vitex gaumeri*
Vulnerable	West Indian Manatee	*Trichechus manatus**
	Mutton Snapper	*Lutjanus analis**
	Large-leaved Mahogany	*Swietenia macrophylla*
Lower Risk /	Jaguar	*Panthera onca*
Near Threatened	Puma	*Puma concolor*
	Water opossum	*Chironectes minimus***
	Great curassow	*Crax rubra*
	Black rail	*Laterallus jamaicensis*
	Black catbird	*Melanoptila glabirstris*
	Morelet's Crocodile	*Crocodylus moreletii*
	Mexican Giant Musk Turtle	*Staurotypus triporcatus*
	Slider	*Trachemys scripta*
	Cycad, Palmita	*Zamia polymorpha*
Data Deficient	Neotropical river otter	*Lontra longicaudis***
	Red brocket	*Mazama americana*
	Spotted eagle ray	*Aetobatus narinari**
** Species present within Punta Ycacos Lagoon and coastal zone*		
***Species recorded from adjacent Monkey River*		

Source: Walker & Walker, 2005

Also useful for highlighting threatened species is Appendix 1 of CITES (Convention on international Trade in Endangered Species www.cites.org.). This listing reflects concerns over ensuring that international trade in specimens of wild animals and plants does not threaten their survival, and so concentrates more on species that have a commercial value internationally (Table 1).

Table 2 CITES Appendix One Species of Payne's Creek National Park

Mammals	
Alouatta pigra	Yucatan Black Howler Monkey
Lutra longicaudis	Neotropical River Otter
Herpailurus yaguarondi	Jaguarundi
Leopardus pardalis	Ocelot
Leopardus wiedii	Margay
Panthera onca	Jaguar
Trichechus manatus	West Indian Manatee
Tapirus bairdii	Baird's Tapir
Birds	
Jabiru mycteria	Jabiru
Amazona oratrix	Yellow-headed Parrot
Reptiles	
Eretmochelys imbricata	Hawksbill Turtle
Crocodylus moreletii	Morelet's Crocodile
Boa constrictor	Boa Constrictor

Source: Walker & Walker, 2005

The rationalization exercise (2013) called for greater protection for Goliath grouper nursery areas, such as those adjacent to PCNP. This report recommended that protected areas known to protect key populations of this species should be prioritised as a mechanism to maintain the viability of this critically endangered species. In PCNP there could be a realignment of the park boundaries to include all nursery lagoons which are currently excluded and at risk.

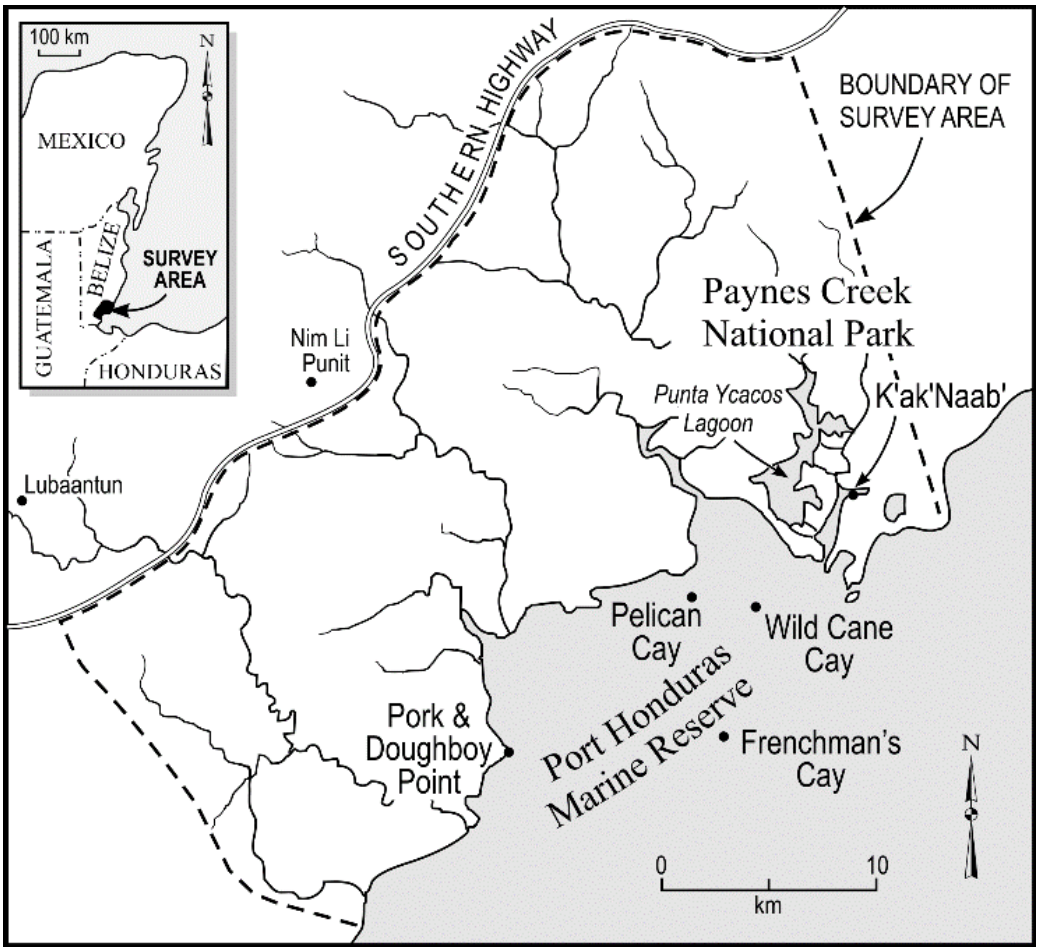
Protection of Cultural Heritage

Archaeological work conducted over the last few years has shown that Punta Ycacos lagoon was once the focus of what may have been a major salt industry. Forty-one Late Classic Maya saltworks (600–900AD) have been identified, including one with the first-known ancient Maya canoe paddle. The discovery of the saltworks indicates that there was extensive production of salt, destined largely for Lubaantun, Num Li Punit and Uxbenca, as well as the inland Peten Maya during their Late Classic peak. These saltworks were later submerged by

the rising seas, which preserved actual food remains at several sites in the Port Honduras, with fish, turtle, and manatee remains being identified (McKillop, 2001).

Payne's Creek and surrounding archaeological sites (by Heather Mckillop)

The Belize Institute of Archaeology manages archaeology throughout Belize, including Paynes Creek National Park and Port Honduras Marine Reserve. Therefore, any plans for development or archaeological research need to be approved by the IA. Professor Heather Mckillop has carried out archaeological survey (search for sites) and excavation of sites in the coastal area between Punta Gorda and Punta Negra (see inset) in what is now PHMR and PCNP since 1982 under permits from the Belize IA.



Significant archaeological sites have been submerged by sea-level rise and hidden from modern view underwater and under mangroves on the cays and coast of Paynes Creek National Park and Port Honduras Marine Reserve. Sea-level rise between 1 and 2 meters since A.D. 900, the end of the Classic period civilization, has been documented by my fieldwork in the coastal area: Radiocarbon dated archaeological sites that are either underwater, in shallow water off cays and the coast, have been reported (McKillop 2002, 2005a, 2005b).

Active sea-level rise is documented by red mangrove peat below the seafloor in Punta Ycacos Lagoon (McKillop et al. 2010).

Three island trading ports dated to the Classic period (A.D. 300-900) and the Postclassic period (A.D. 900-1500) are located in the Port Honduras Marine Reserve and are signficant archaeological sites, notably Wild Cane Cay, Frenchman's Cay, and Green Vine Snake (see McKillop 2002, 2005a). The first two islands are privately-owned and were mapped and excavated with permission of the landowners and permits from the Belize Institute of Archaeology. The third island is govenmrnt owned and was excvated under permit from the Belize Institue of Archaeology. Wild Cane Cay was a major trading port on the sea route around the Yucatan and inland to places north of modern Mexico City, the highlands of Guatemala and Pacific coast, Honduras, and inland to the lowlands of Guatemala and Belize. I have recommended to TIDE and in public talks that Green Vine Snake is worth having as a archaeological and mangrove habitat visitor site, with raised wooden walkways from the natural harbor. Lacking biting insects that are endemic in most of the other cays, Green Vine Snake would be appealing to visitors.

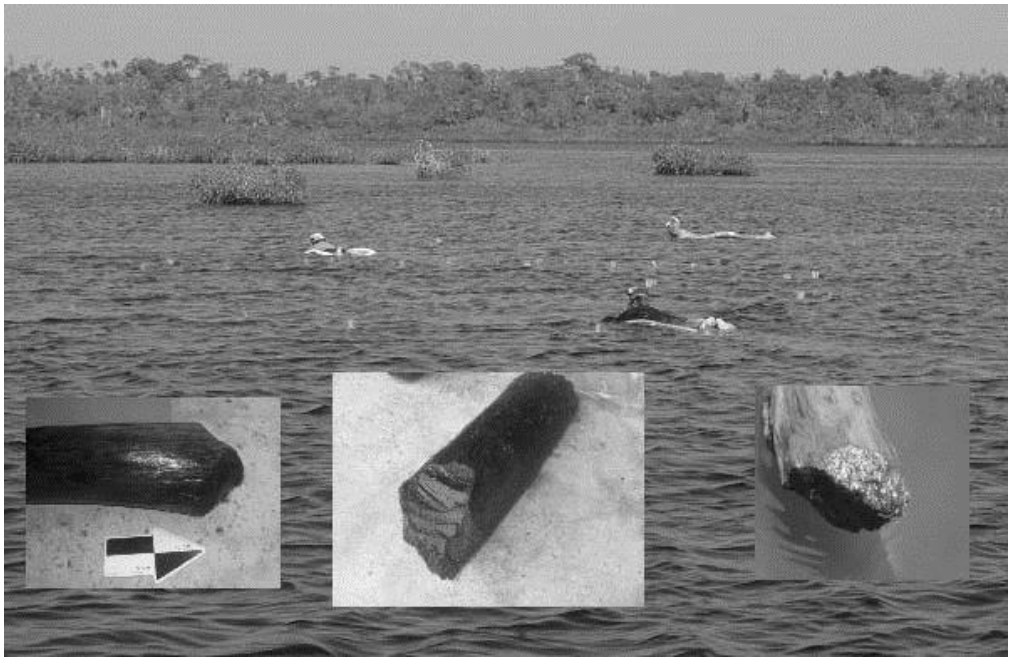
Many of the mangrove cays, including islands with no dry land that are covered by red mangroves, have archaeological sites buried under 0.5 meters of mangrove peat (McKillop 2002). Excavations in the shallow water and mangroves around Wild Cane Cay, Frenchman's Cay, and Pork and Doughboy Point indicated there are intact archaeological deposits that extend at least one meter below the seafloor (McKillop 2005a).

The discovery of preserved wooden architecture and the wooden canoe paddle below the seafloor in Paynes Creek National Park are highly significant finds that are unmatched in the entire ancient Maya world (McKillop 2005b). Wooden buildings and objects do not normally preserve in the tropical landscape of Central America, where stone temples, palaces, and foundations of residences are well-known, including the public archaeological sites of Lubaantun and Nim li punit, in the Toledo District, for example. Since the discovery of the wooden architecture in 2004, my archaeological team with a Belize boat captain, have discovered and mapped thousands of wooden posts and excavated a dozen wooden structures, all below the seafloor in Punta Ycacos Lagoon, a large salt-water system in Paynes Creek National Park.

The underwater sites in PCNP were salt works where brine was evaporated in pots over fires inside wooden buildings constructed along the edge of former hyper-saline waters (Figure 2).

The sites consist of briquetage—the broken pots and vessel supports used to evaporate the brine, as well as water jars, lots of charcoal, and of course, wooden architecture. The wooden buldings are embedded in firm mangrove peat that developed as red mangroves (Rhizophora mangle) kept pace with rising seas during the Holocene.

There were fluctuations in sea-levels, with a lowering of sea level before the Classic period of the Maya (before A.D. 300), which left mangrove peat exposed above the water, providing dry ground for the Paynes Creek Maya salt workers to construct their salt works. Salt is a basic biological necessity that was needed by the growing inland Maya population where salt was scarce. When the Classic period cities, including Lubaantun and Nim li punit, were abandoned c. A.D. 900, the Paynes Creek salt works were abandoned, due to lack of customers.



Inset: Snorkeling archaeologists, with inserts showing wooden posts with sharpened ends discovered in Paynes Creek National Park at salt works dated to the Classic Maya period (A.D. 300-900) (Photos by H.McKillop).

The Paynes Creek salt works are located below the seafloor in Punta Ycacos Lagoon and in the adjacent mangrove flats, with mangroves completely covering many sites. In order to protect the PCNP salt works, the area should not be dredged, and any proposed construction should be subject to an EIA that addresses the archaeological findings and buried and submerged locations of the sites. Virtually nothing is visible. From archaeological survey and excavation so far, sites are concentrated in the lagoons, main channel, and mangroves closer to the sea, althugh there are salt works in Freshwater Creek beyond the Ranger Station. There also are sites on the pine savanah, notably up Muschamp Creek.

Socio-Economic Context

The following is extracted from the Belize Country Poverty Assessment (2010) a comprehensive report commissioned by the Government of Belize and the Caribbean Development Bank (CDB) which is highly relevant and informative to an integrated management approach in PCNP. Toledo's current population is estimated to be around 31,000, just under 10% of the national population. Population growth is slightly below the national average, in contrast to the 1990s, when it was higher. The population density is around 7 persons per km^2 making it easily the most sparsely populated district of the country; its rural population is also the most dispersed being spread between over 50 villages, over a quarter of the total. Toledo's population is exceptionally young with 43% being under the age of 15 compared with 34% nationally. Average household size is much higher: 4.9 persons compared with 3.6 persons nationally. Table 3 provides a summary of key socio-economic indicators for Toledo and compares these to the national average.

The population is ethnically diverse: approximately 2/3rds are Mayan, with the remainder split between Mestizos, Garifuna, Creole and East Indian. While the latter are concentrated on Punta Gorda and other mainly coastal settlements, the Maya dominate the hinterland. The Maya arrived in the area from Guatemala in the late 19th/ early 20th centuries to work in the German run plantations near the border since when they have spread eastward and, latterly to settlements along the Southern Highway. The longest standing inhabitants are however the Creoles and the Garifuna who arrived in late 18th and early 19th centuries. The two most recent population trends have been: (i) the arrival of Mestizos, mostly from Guatemala, who have settled in Punta Gorda, the main centre and in the northern part of the district where they work in plantation agriculture and shrimp farming; (ii) further Mayan immigration from Guatemala. Although Punta Gorda has grown, in common with the rest of the country, there has been no rapid urbanisation, despite a significant increase in its Mayan population due to rural-urban migration.

Agriculture remains the predominant economic driver of the district, followed by a small mining sector and an emerging tourism sector. Agriculture accounts for over 42% of the employed population compared with 16% nationally. As a consequence of the dominance of agriculture, average wages in the district were little over 60% of the national average (2000).

Agriculture is predominantly small scale based on the milpa system, a variant of 'slash and burn' which the Maya have developed over the centuries. The main cash crops are black beans (almost 80% of national production), rice (29%) and corn (7%). Cacao production developed in the early 2000s but declined sharply between 2006 and 2007 due to disease. In general, commercial production is constrained by the relative isolation of the area from the rest of the country, despite the opening of the Southern Highway in 2002. Trade with Guatemala, which has expanded in recent years, may offer greater potential. As a result much cultivation is primarily for subsistence. Livelihoods are supplemented by small scale trading and off-farm work; as noted, there is a small urban rural drift to Punta Gorda.

	Indicator	Toledo	Belize	Ratio
Population	% of population living in rural areas	82	49	1.7
	% Maya	69	11	6.6
	Average household size (persons)	4.9	3.6	1.4
	% aged under 15	43	34	1.3
Poverty	% poor households	46	31	1.5
	% poor population	60	41	1.5
	% indigent households	38	10	3.3
	% indigent population	50	16	3.1
Employment	Unemployment Rate	13	13	1.0
	% employ in agric	42	16	2.6
	% elementary occupations	20	24	0.9
Education	% of population not attending school with no or primary education only	78	67	1.2
	% of head of households with no secondary education	42	19	2.2
Housing	% not owning their dwelling	15	33	0.4
	% of Households with no WC	65	33	2.0
	% of dwellings with no concrete or brick walls	67	51	1.3
	% of households who get drinking water from standpipe, well or river	13	3	3.9
	% of Households who do not use electricity for lighting	35	10	3.5
	% of Households which have 3 or more persons per room	38	9	4.2
Durable goods	% not owning TV	49	19	2.6
	% not owning cellphone	57	26	2.2
	% not owning motor vehicle	80	65	1.2
	% not owning computer	83	73	1.1

Table 3: Socio economic indicators of Toledo (Belize Country Poverty Assessment, 2010).

The combination of restricted markets due to its location, dispersed population and low agricultural productivity, compounded by an absence of local market towns to buy and sell goods, have entrained a limited purchasing power for Toledo's residents, and a generally low level of socio-economic development. Together these have resulted in a very high level of poverty as well as housing (see Table) and health conditions substantially below the national average. In 2002, almost 80% of the population and 67% of households were classified as poor. The levels of indigence were also high: 56% of population and 45% of households. Furthermore, virtually all the high poverty villages in Belize are located in Toledo along with around half those with moderate poverty levels.

Despite intensive development efforts in terms of infrastructure and NGO community development and income generation programmes, poverty in Toledo remains very high - 50% of the population is indigent and 65% are poor – and it remains the poorest district in the country. Yet poverty in Toledo has, unlike the rest of the country, decreased since 2002. Likely reasons are the intensive development efforts, an increase in cocoa cultivation, and more off farm employment opportunities. Additionally, by its very location, Toledo is less connected to the rest of the economy and has thus been less affected by the recession. The district also largely escaped the devastating floods of 2007 and 2008 whereas the 2002 survey took place soon after severe flooding in 2001 which destroyed a large proportion of that year's crop.

Infant mortality (2007) was substantially higher (25 per 1,000 compared with 17 per 1,000 nationally) and the population is at greater risk from malaria and water-borne disease; the proportions of stunted and underweight children were much higher than the national average. Overall, in 2006, most mother and child health indicators in Toledo were worse than the national average. Some improvement is also likely to have occurred over the last 3 years due to the expansion of health facilities in the district. Health issues were not however mentioned with great frequency during the Participatory Poverty Assessments (PPAs).

Education indicators have improved in the last few years due to major efforts to increase the number of schools. As a consequence, examination pass rates show little variation from the

national average as do school enrolment rates (which are low at secondary level in all rural areas). However; the transition rate from primary to secondary was significantly lower (76% as against 86%) while primary (but not secondary) school repetition rates are higher. Additionally, contrary to the national trend, there were substantially more males than females attending secondary school.

The PPAs reveal that many households considered that living standards had changed for the worse and that they felt less secure in terms of shelter, food, water and safety; although others considered that there had been little change. The Village Surveys (undertaken with village leaders) also reveal a contrasting pattern with over twice as many considering that economic conditions had improved as those which considered that they had got worse; the remainder considered that there had been little change. In sharp contrast, only a quarter were generally satisfied with their current situation while over three quarters were dissatisfied. These contrasting views reflect both the variety of opinion within communities, the differences between villages and a general dissatisfaction with government performance as a result of promises not being kept or projects failing. Conversely, there was a greater consensus that education had improved and that, in a number of villages, programmes had led to an increase in community involvement.

The continuing high level of poverty, increased food insecurity, resulting from a growing population unaccompanied by increases in productivity or land supply, and an increase in the price of imported goods has made many resort to coping strategies such as the age-old illegal practice of cross border trade with Guatemala, activities which are now illegal (logging and 'ketch and kill' (hunting) in protected areas), allowing cattle to trespass beyond previously agreed boundaries, as well as more traditional ones such as small scale trade, home production and off-farm work. An increase in alcoholism and drunkenness is also reported. A perceived decrease in water security is paradoxical as many villages have benefited from new water supply systems; yet these often break forcing a return to the use of water from streams and wells.

Previous Government Socioeconomic Development Programmes

Successive governments (colonial and post-independence) have been concerned with the development of Toledo for many years. Since the late 1970s, several major rural development projects (with a total investment of around US$30 million) have been implemented. All those except Community Initiated Agricultural Development Project (CARD) which had only just started, were reviewed in the abovementioned Toledo study. These projects legacy has been limited, with poverty remaining at a very high level despite their objective being to build on the lessons learned from previous largely unsuccessful interventions. The report identifies 4 key reasons for this situation:

1) The geographical situation of Toledo: makes public utilities and public services – water supply, drainage, solid waste management, health clinics, schools - both costly and difficult to maintain. This dispersion increases production costs and reduces competitiveness. Even with the discovery and export of Belizean crude oil, fuel costs remain relatively high. Feeder roads leading from the main arterials are single lane, unsurfaced and often designed for pedestrian rather than vehicle movements thereby restraining agriculture practices from advancing into mechanised self-sufficiency with good access to markets. Road rehabilitation costs are high on a per capita basis and per capital expenditure, with external funding for such activities being slight. Whilst not wholly responsible for the district's low agricultural productivity, the milpa system dictates a transient use of land, making drainage and road construction expensive and cumbersome to plan and manage, and encourages run-off and leaching of nutrients, thus reducing soil fertility.
2) Project design: projects targeted single sectors without appreciating the degree of inter-relationship with other issues. They were also designed with little integration and thought to the cultural fabric of Belize. Projects have also been superimposed on already fragile governance and institutional systems. In doing so, local knowledge has been under-utilized and capacity issues under-estimated. Little attention has been paid on the pace and direction of change which these projects endeavour to make and how these contrast with existing social outlooks and institutional structures. Significantly, there was little attempt to consider the role of women.

3) Sociological issues: in addition to generally under-estimating the importance of social issues in project design, there has been a failure to appreciate the diversity of the cultural landscape and in particular the "tendency to treat communities and groups as homogeneous". This has meant both that projects have experienced resistance, especially where they involved changes to the prevailing small holder/ communal land tenure system, and that much more time and effort is needed to successfully introduce new programmes.
4) Lack of participatory processes: introducing new rural interventions is difficult at the best of times and early projects took little account of participants' attitudes or knowledge. While this has undoubtedly changed, 'participation' has often been cosmetic rather than substantive with little input to the actual design of projects – the most important issue of all. More fundamentally there has been an inability to understand the potential impact of projects in terms of Mayan customs, aspirations, historic cultivation practices, inter-community differences and general belief systems.

Zooming in on PCNP and neighboring Port Honduras Marine Reserve (PHMR) a 2004 report suggested that communities such as Monkey River, Punta Gorda and Punta Negra rely heavily on the availability of the surrounding natural resources to satisfy a major portion of their income. The residents in these areas are looking for alternative economic options that will result in adequate income to meet their daily needs rather than destructive practices and illegal fishing activities (Collins, Port Honduras Marine Reserve - Socio-Economic Assessment Report, 2004).

The major communities buffering the park, Punta Gorda Town, Punta Negra Village, Monkey River Village, Bella Vista Village, Trio and Bladen have a total population of approximately 10,494 people with an almost equal ratio of male to female (Table 4).

Table 4 Population by sex of Payne's Creek National Park Main Buffering Communities

Community	*Male*	*Female*	*Total*
Punta Gorda	2520	2840	5360
Bella Vista	1804	1707	3511
Bladen	248	219	467
Trio	482	418	900
Monkey River	98	98	196

Punta Negra	No data	No data	60
Total	5152	5282	10494

Source: Central Statistical Office, Census 2010

Survey's conducted by TIDE staff and community researchers in 2014 examined relative usage of PCNP by the above mentioned villages (excepting Punta Gorda). Figure 4 highlights that the usage of PCNP on a whole, combining the 5 surveyed villages, are low with just 4% of respondents visiting the park any more than once a week. Only 20% of respondents visit the park more than once a year. These results certainly indicate that, in comparison to other National Parks and Protected Areas, PCNP receives low frequencies of visitation.

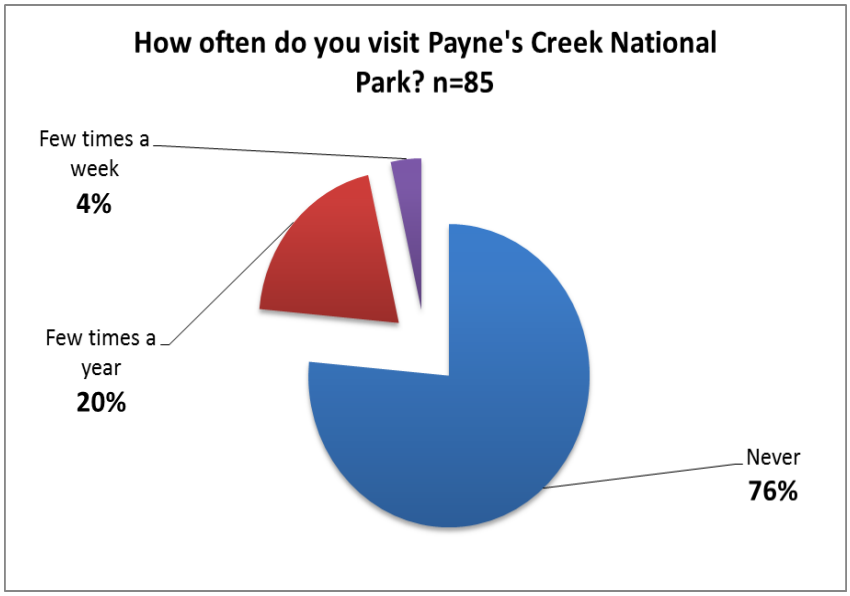


Figure 4. Paynes Creek buffer community visitation levels (2014 community researcher survey). This chart indicates that visitation is generally low, among respondents to the 2014 survey, with just 4% using the park frequently

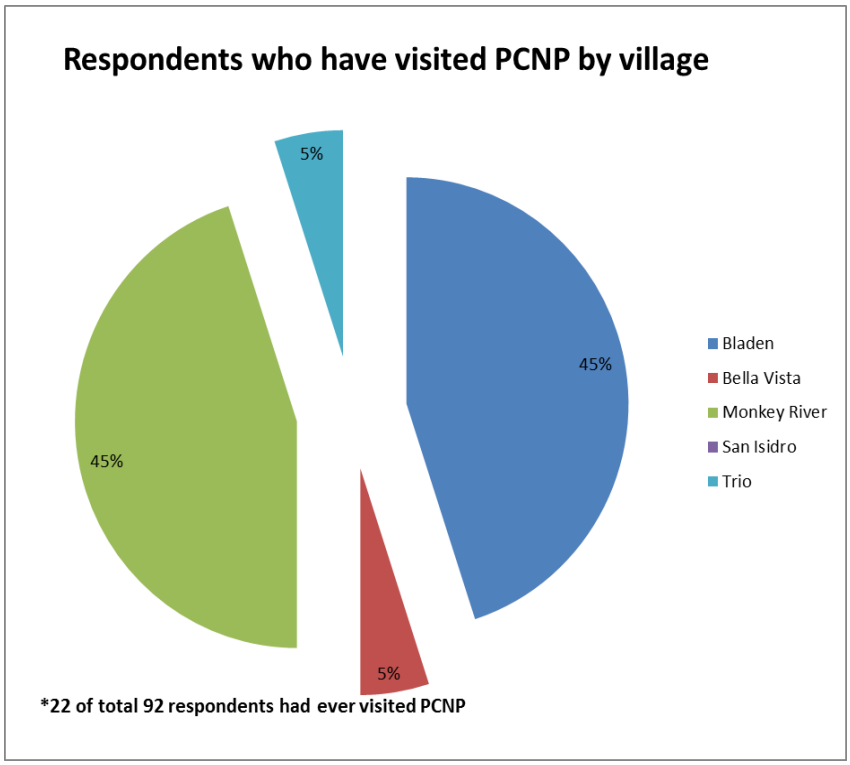


Figure 5. Payne's Creek buffer community visitation by village (2014 Community Researcher Survey). This chart highlights that the key users of the park are Bladen and Monkey River Villages combining at 90% against just 10% for Trio, Bella Vista and San Isidro. It should also be noted that only 22 of the 92 survey respondents had ever visited PCNP.

The results of a socio-economic survey conducted in 2005 (King, 2005) showed that a major source of income for these same communities comes from the use of natural resources in providing tourism services, and for fishing, farming and hunting. At that time, the main sources of income for the residents were from wage labour, small businesses and employment in the public service. The 2014 study did not examine income sources in detail so it is not possible to determine whether dependency on natural resources for employment and income in the PCNP buffer communities has increased or decreased. However, Figure 6 below indicates that a great deal of the respondents (n = 78) still participate in activities which rely on natural resources.

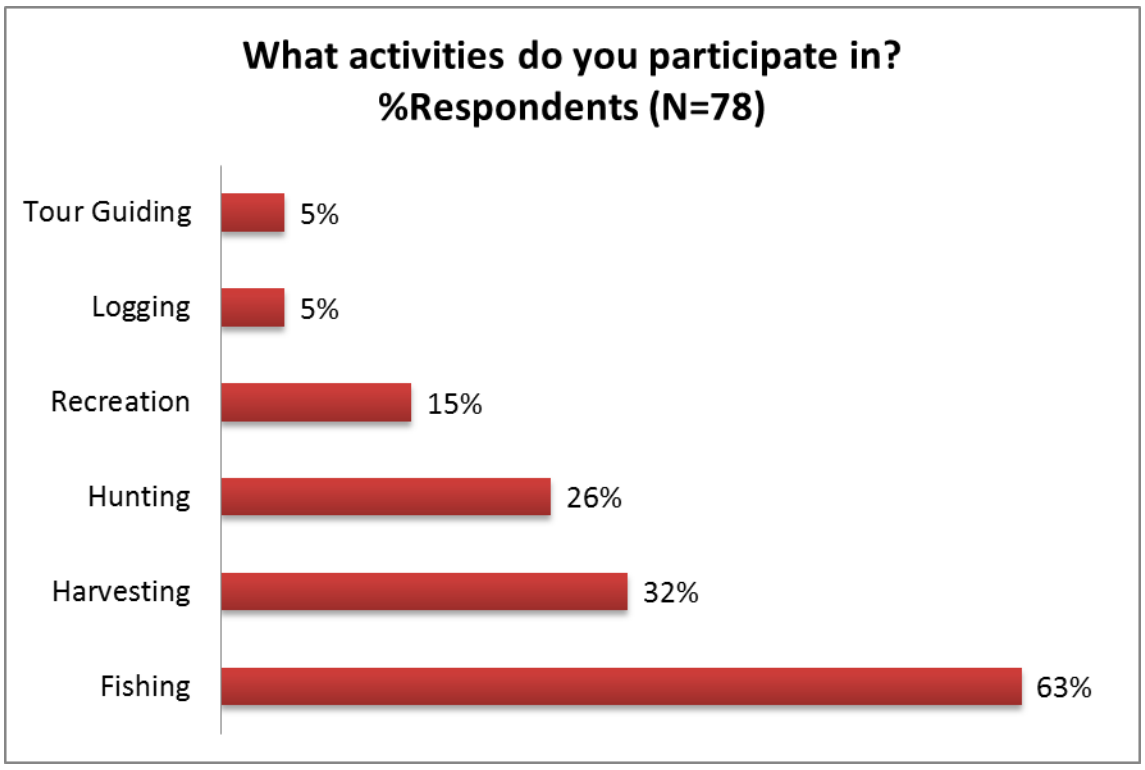


Figure 6. Livelihoods of PCNP buffer communities (2014 Community Researcher Survey). Concerning employment it is clear that healthy natural resources are of critical importance. Future surveys should break this data down further to improve analysis

Education

The Toledo District continues to lag behind the rest of Belize in the quality of education and the results achieved by its students (Ministry of Education, 2014/15). Behind this overall gap there is a clear gender divide in the data. Of particular concern is the gender gap in transition rate from primary to secondary level education which, contrary to all other districts, stands at 88% for male and 76% for female. However, repetition rates for males (7.6%) are much higher than female (3.9%), as are dropout rates which stand at 9.3% for male and 6.5% for female. Vocational and technical education enrolment continues to be more than double for male than female but this gap is decreasing each year. Factors such as pregnancy and traditional gender roles could be influencing these figures. These results have not been broken down by village or sub-district and, for analysis on how education levels are affecting PCNP management, this should be the focus of more in-depth community surveys.

King's 2005 socio-economic survey also indicated that after receiving the minimal primary education, very few young people go on to complete high school, suggesting that the majority of the populace would continue to utilize the natural resources as a means of maintaining their livelihood since jobs requiring high school education will be minimally available to many of them. . This may mean that the communities will continue to interact with the environment in the provision of tourism services such as guiding and sport-fishing, and traditional uses such as hunting, farming, fishing, timber harvesting and other plant products. King then surmised that the buffer communities of PCNP would continue to rely on the parks products and materials for subsistence and commercial purposes. This assumption should be tested specifically through targeted surveys as it is critical in determining a management approach which is responsive to the needs of these communities.

Gender

TIDE's mission is "to engage stakeholders in the sustainable management of natural resources within the Maya Mountain Marine Corridor of southern Belize for the benefit of all." It is increasingly recognized that sustainable resource management requires an understanding of all pertinent social and economic factors of stakeholder communities, including gender (UNDP, 2007). The ways in which people use resources are typically defined by a person's gender (i.e. socially constructed roles and responsibilities). Through the gendered-division of labor, women and men interact with different natural resources and in different ways, and thus have different values, needs, priorities, and dependencies. Therefore, accounting for gender-based differences in resource management is critically important for understanding how conservation programming impacts communities.

Moreover, ensuring that men and women are benefitting equitably, and thus that resources are managed in a productive and sustainable way for all, can lead to improvements in conservation performance, greater social and economic gains, increased cooperation, and higher rates of participation in conservation projects (Agarwal, 2009; Agrawal, 2000; Shandra and London, 2008; Westermann et al., 2005). TIDE is therefore committed to addressing the different needs and priorities of men and women and take additional measures to ensure equitable access to all project information, equal participation throughout all stages of conservation projects and related activities, and equal opportunities

to benefit from all PCNP projects. An important Gender Integration Manual (Luna 2015) has been developed for TIDE to improve the integration of gender into conservation projects. This will also be made available to TIDE's partners.

Physical Environment

Climate

Under the Holdridge Life Zone Classification System, most of the Park falls into the Subtropical Wet zone with a tiny section on the eastern side falling into the Tropical Moist life zone. The rainy season lasts from May to January and the dry season lasts from February to April with the hurricane season lasting from June to November. It should be noted that the timings of these seasons are becoming more unpredictable which will have implications for a variety of management actions (IPCC, 2014).

Hurricane Iris (2001)

One of the most significant and destructive events in living memory was the passing of Hurricane Iris in October 2001, a Category 4 Hurricane which moved west southwest across Payne's Creek with sustained winds in excess of 140 mph. This natural phenomenon is expected to increase under the 2015 predictions for the region by the Intergovernmental Panel on Climate Change (IPCC). Whilst it is not possible to predict precisely when hurricanes will hit PCNP or its buffer communities it is absolutely necessary to prepare site facilities, hurricane shelters and contingency plans.

To provide an indication of the catastrophic damamge than hurricanes can wreak, an aerial survey of the forest impacted by Hurricane Iris was conducted two weeks after the event. This survey found that the northeastern broadleaf forest areas of PCNP were severely affected, lying within 90 to 100% of the destruction belt, with total defoliation, and the majority of standing trees de-limbed (Meerman, 2001; Figure 7). The pine savanna showed less impact, being mapped at 20% damage (along with the herbaceous swamp areas). The creek side vegetation and forested ridges on slightly higher grounds within the savanna areas were mapped at 75% damage level, with many trees down or damaged.

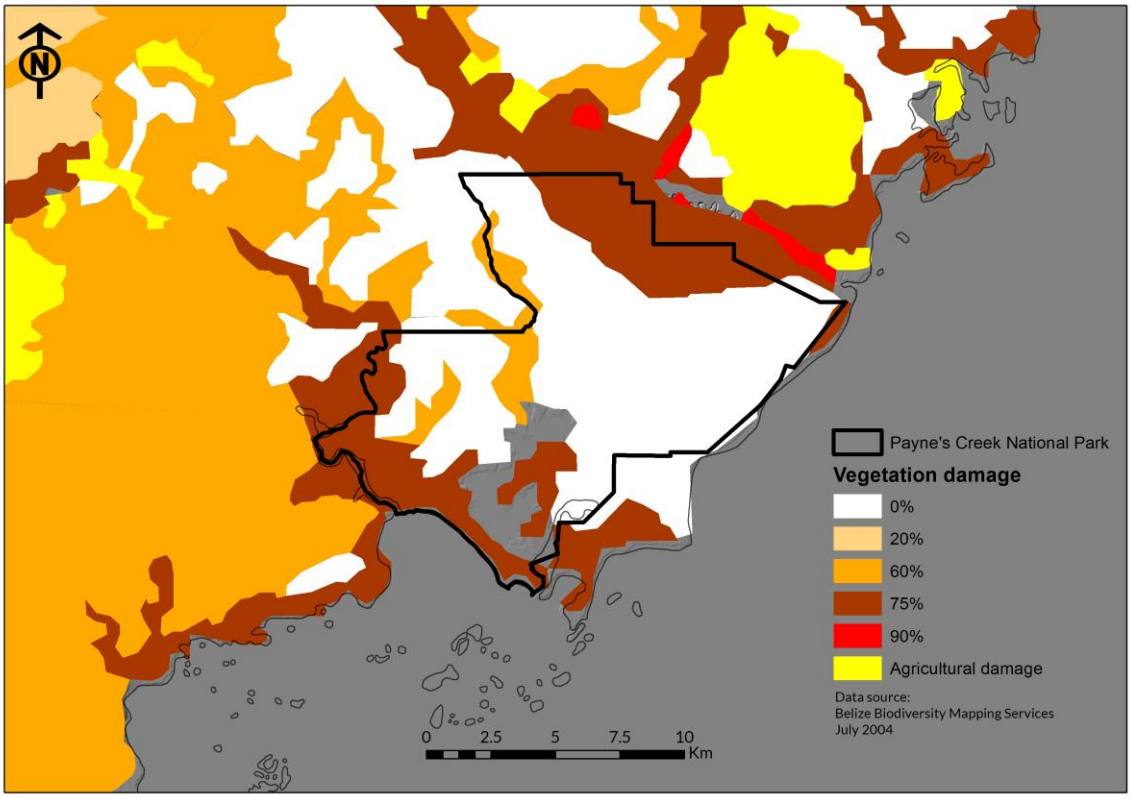


Figure 7. Hurricane Damage within Payne's Creek National Park. The white areas with no damage are the low lying wetlands and savannah grass regions of PCNP

Geology

The rocks that form the surface of the PCNP are of the Toledo Formation of early Tertiary age. These rocks include shales and clays, siltstones, and sandstones. Hot springs occur near the Park in Deep River Forest Reserve, these waters may contribute to some of the creeks that have their origin in the Park (Holland & Ricketts, 2005).

No potentially commercial mineral deposits have been discovered to date in the Park. However, hot springs (epithermal) alterations of sedimentary rocks, such as those seen in the Park, are known to be associated with economic base and precious metal deposits in other parts of the world. Should such epidermal mineral deposits be discovered in southern Belize then the Park area *could be* subject to mineral exploration (Holland & Ricketts, 2005).

Oil

Under contracts issued by the Government of Belize which allocated drilling and exploration rights for the entire territory of Belize the integrity of PCNP and the adjacent PHMR was threatened in 2012/2013 by the prospect of 2 dimensional seismic surveying for presence of hydrocarbons. Providence Energy, the company with the rights for the coastal plains and nearshore shallow coastal region around PCNP was halted before such surveying could proceed by major objections to the quality and comprehensiveness of the Environmental Impact Assessment (EIA) submitted by the National Environmental Advisory Council (NEAC). Providence was unable to address these before litigation against the Government of Belize submitted in 2013 eventually ruled in 2014 that the issuing of a majority of drilling rights had been done illegally. This rendered the permits for many companies, including Providence, null and void.

Whilst this represents a temporary reprieve for PCNP and PHMR, the threat of oil drilling and exploration activities still remains. In Figure 8 the extent of the proposed survey area can be clearly seen. Even more concerning is that the intention of Providence and their particular interest focused in large part on PCNP. It has not been possible to obtain the details on what are the geological characteristics that make PCNP the target of such interest but indicates the need for vigilance and continued investigation.

The impacts of oil exploration and spillage on the flora and fauna and buffer communities are discussed in Section 3, Conservation Planning.

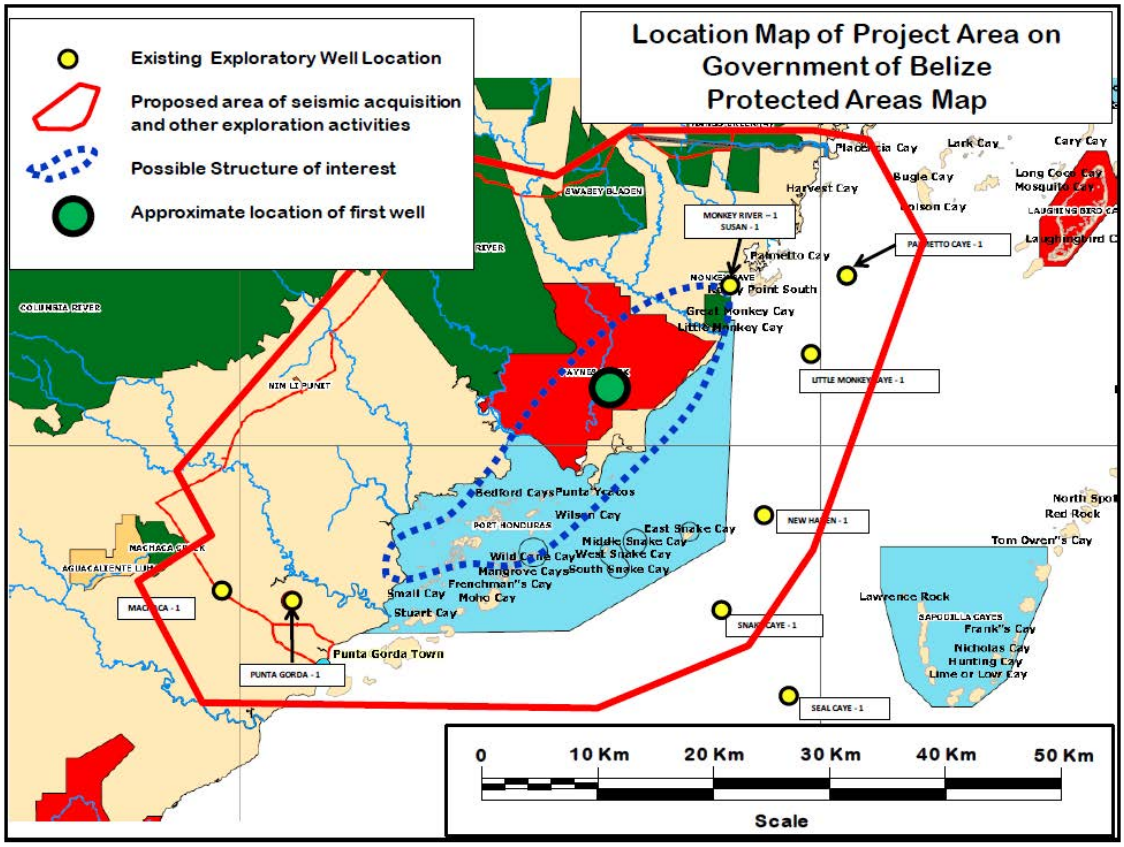


Figure 8. The proposed location of seismic surveying and drilling wells for potential hydrocarbon extraction.

Soils

The Puletan suite of savanna soils are the dominant soil type in the PCNP. These soils are derived from the sedimentary rocks of the Toledo Formation (shales, siltstones and sandstones). These rocks have given rise to a spectrum of soil types ranging from poorly draining clay-rich soils to more sandy-silty soils termed the Puletan suite.

The soils derived from the Toledo Formation are generally poor soils and this factor has a distinct impact on naturally occurring vegetation in the Park (Holland & Ricketts, 2005). The soils are characterized as follows:

1. The soils generally possess very low content of phosphorous, potassium, magnesium and calcium
2. Soil pH is very low (very acidic soils) with pH in the 4.4 to 4.8 range

The erosion of soils by rainwater, occurs both along waterways, e.g. Muschamp Creek, and also on very modest slopes (Holland & Ricketts, 2005).

Hydrology

Within the Payne's Creek National Park, there are no dense drainage patterns and therefore, the water has accumulated to form large wetlands that are important for wading birds and other wetland species. Coupled with the topography of the Park, which can be characterized as flat to very gently rolling coastal plain with topographic relief less than 20 m (the highest point in the park is 18 m), and composition of the soil, the rate of run off is low. The Punta Ycacos Lagoon and Payne's Creek are the two bodies responsible for draining the Ycacos Lagoon watershed whose basin size is 158 km^2 (Heyman, 1996). The Payne's Creek drainage system is seasonally flooded but is liable to become quite low and stagnant in the dry season. The Punta Ycacos Lagoon, experiences large ingression of sea water as a result of high tide creating a brackish environment. The brackish environment favors the growth of mangroves, which cover an approximate land area of 22 km^2. The lagoon contains extensive areas of mud flats, mangrove islands and channels. It is likely that climate change will affect these dynamics in both the short and long term.

The latest IPCC (2014) predictions of the effects of climate change for Belize indicate decreased overall precipitation (up to 30% lower) and increased duration of drought. This is likely to increase the duration of lagoons and creeks stagnation affecting temperature, salinity and dissolved oxygen levels. In parallel, ephemeral lakes, ponds and lagoons will remain wet for a much shorter time period with implications for dependent flora and fauna. There is currently no data to assess this specifically and it remains a key research target (see Research and Monitoring Program).

Ecology

Ecosystems

Five broad ecosystem categories, with a total of 14 ecosystems were identified and mapped within PCNP by Meerman & Sabido (2001; revised 2004). The vegetation component of the biological assessment (Walker & Walker, 2005) identified discrepancies between the extent and location of habitats observed and those indicated in the Belize Ecosystems Map (Meerman & Sabido, 2001). Walker & Walker (2005) focused primarily upon the collection of validated data on vegetation types, mostly from transects, ground truthing point checks, aerial reconnaissance and photography to determine the actual location and extent of the various vegetation types. As a result, an updated ecosystem map for PCNP was generated identifying a total of 17 ecosystems for the Park (Walker &Walker, 2005, Table 2.6, Figure 2.7). A description of each ecosystem is provided in Appendix 3.

Table 5. Ecosystems of Payne's Creek National Park

Legend Code	Ecosystem Name – following UNESCO terminology (Meerman & Sabido, 2001)
7	Tropical Evergreen Broadleaf Lowland Forest over Poor or Sandy Soils
14	Tropical Evergreen Broadleaf Lowland Forest over Alluvium
17	Tropical Evergreen Broadleaf Lowland Swamp Forest: Permanently Waterlogged
17	Tropical Evergreen Broadleaf Lowland Swamp Forest: Somewhat Waterlogged
47	Dwarf Mangrove Scrub
49	Mixed Mangrove Scrub
50	Coastal Fringe *Rhizophora mangle* – Dominated Forest
51	Riverine Mangrove Forest
56	Broad-leaved Lowland Shrubland: Miconia Variant
62	Short-grass Savanna with Needle-leaved Trees
63	Short-grass Savanna with Shrubs
65	Eleocharis Marsh
69	Tropical Littoral Forest and Beach Communities
70	Tropical lowland Reed-Swamp
71	Tropical Lowland Tall Herbaceous Swamp
74	Rooted Underwater Communities of Flowing Water
76	Waterbodies

Legend Code for Ecosystems as described in the Belize Ecosystems Map (Meerman and Sabido, 2001, 2004)

Source: Walker &Walker, 2005

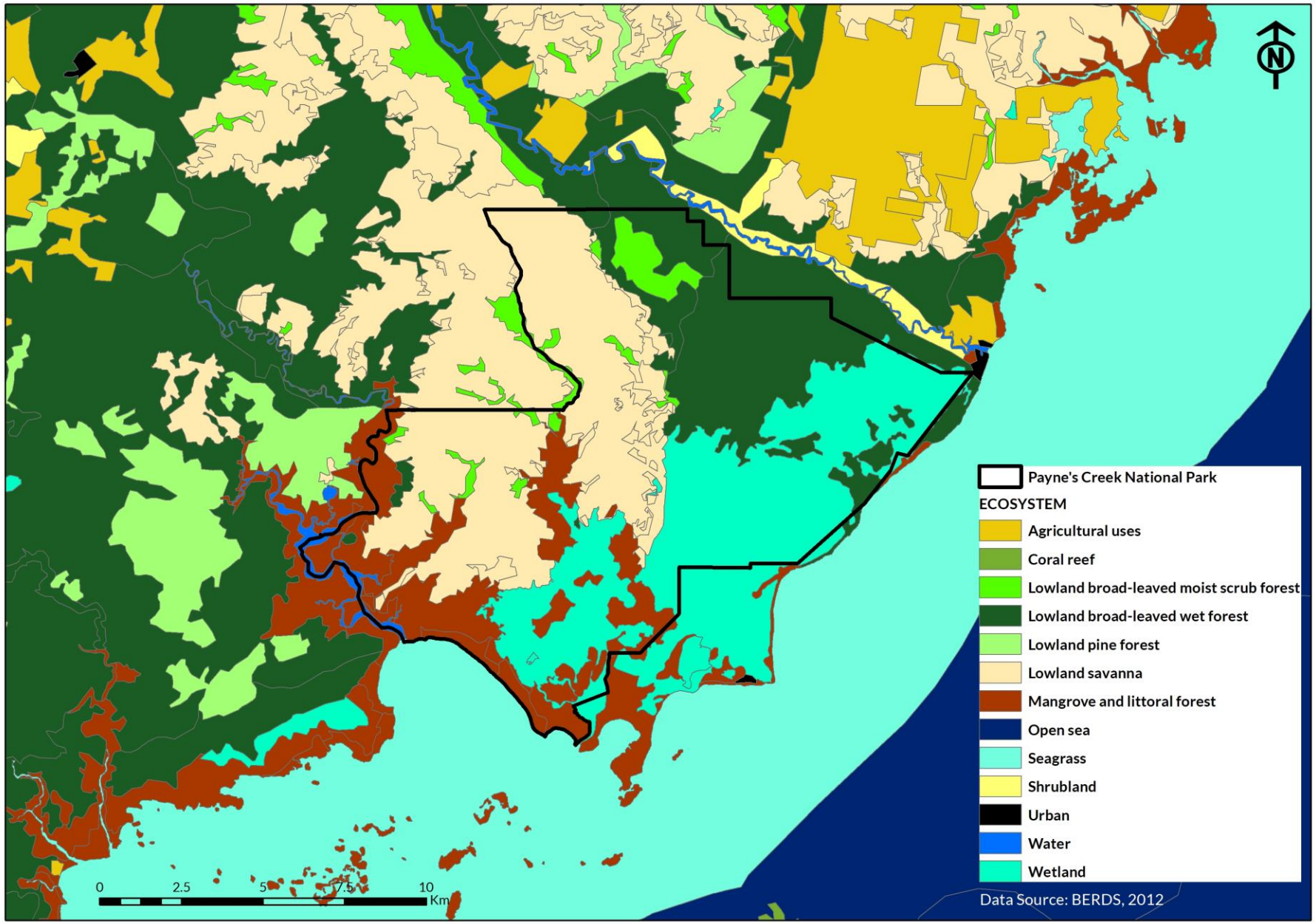


Figure 9. Ecosystem Map of Payne's Creek National Park (Ruscalleda, 2015)

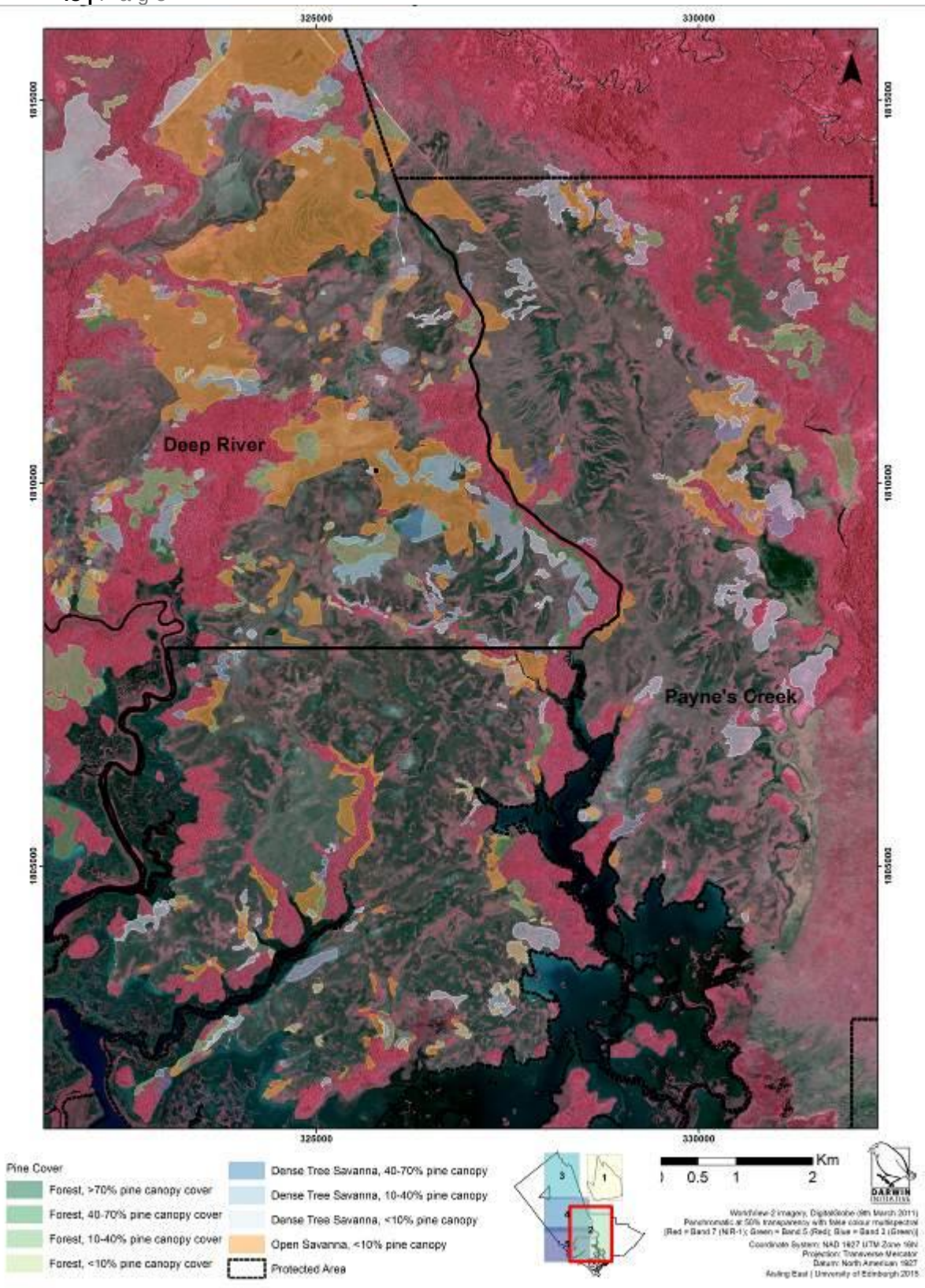


Figure 10: Pine distribution map of PCNP (1:30,000) (Darwin Initiative project, 2015)

Flora

Under the 2012 Darwin Initiative Project, savannah across Belize was assessed and quantified. Savannas were also thought to be species poor, yet this project has found more than 950 plant species in the lowland savanna, or approximately 28% of the nation's flora as recognised by Balick et al. (2000). 380 of these are savanna specialists. Of the 41 vascular plant species reported by Balick et al. (2000) as endemic to Belize 18 (44%) are recorded in the lowland savanna, this highlights their critical importance for the avoidance of extinctions. Whilst some savanna plants are widespread, others (including some endemics) show localized distributions. The following tables highlight some of the contextual characteristics of PCNP and the detailed checklist of species according to the list produced by the Darwin project.

Table 6. Key characteristics of PCNP relating to its status as a vital savannah conservation tool

Characteristic	*Area (km^2)*
Total area of PA	140.53
Dense tree savanna extent	4.1
Forest inclusion	1.61
Open savanna	46.57
Waterlogged savanna (seasonally)	-
Wetland inclusion	0.09
Savanna area	52.38
% of PA that is savanna	37.27

Table 7.: Checklist of savannah plant species derived from 'A checklist of the vascular plants of the lowland savannas of Belize, Central America' Goodwin *et al* (2012). Please check the fieldwork appendix in the Annexes of this management plan for more details of the exact locations these species were recorded and the structural and ecosystem characteristics of each site.

LYCOPODIOPHYTA LYCOPODIACEAE	 *Lycopodiella caroliniana*
PTERIDOPHYTA BLECHNACEAE	 *Blechnum serrulatum*
MAGNOLIOPHYTA AMARYLLIDACEAE APIACEAE APOCYNACEAE ASTERACEAE CONVOLVULACEAE CYPERACEAE DILLENIACEAE ERIOCAULACEAE FABACEAE – CAESALPINIOIDEAE FABACEAE – FABOIDEAE FAGACEAE GENTIANACEAE HYPOXIDACEAE IRIDACEAE LAMIACEAE MALVACEAE MELASTOMATACEAE MENYANTHACEAE MYRTACEAE ONAGRACEAE PASSIFLORACEAE PLANTAGINACEAE	 *Hymenocallis littoralis* *Centella asiatica* *Mandevilla subsagittata* *Metastelma stenomeres* *Tabernaemontana alba* *Wedelia acapulcensis* *Merremia aturensis* *Rhynchospora barbata* *Rhynchospora exaltata* *Scleria interrupta* *Davilla kunthii* *Eriocaulon kinlochii* *Chamaecrista desvauxii* *Chamaecrista kunthiana* *Chamaecrista rotundifolia* *Vigna linearis* *Quercus oleoides* *Schultesia brachyptera* *Curculigo scorzonerifolia* *Alophia silvestris* *Hyptis conferta* *Hyptis lantanifolia* *Hibiscus costatus* *Melochia spicata* *Acisanthera quadrata* *Clidemia strigillosa* *Conostegia icosandra* *Miconia albicans* *Nymphoides indica* *Eugenia trikii* *Psidium salutare* *Ludwigia nervosa* *Passiflora urbaniana* *Benjaminia reflexa*

POLYGALACEAE	*Polygala adenophora* *Polygala longicaulis*
RUBIACEAE	*Coccocypselum herbaceum* *Diodella apiculata*
SALICACEAE	*Casearia sylvestris*
TURNERACEAE	*Turnera curassavica*
VIOLACEAE	*Hybanthus calceolaria*
XYRIDACEAE	*Xyris jupicai*

According to the Walker & Walker (2005) study, a total of 152 plant species were identified (106 to species level), representing 69 families in PCNP (see Appendix 4). The relative abundance of predominant and characteristic species within each ecosystem is also described.

Fauna

Mammals

A total of 28 mammal species were recorded during three survey periods (Walker & Walker, 2005). A full list of mammal species recorded to date for PCNP and their habitat preferences are included in Appendix 5.

Of these 28 species, 6 (just under 22%) are considered to be species of international concern (Table 2.7), with two species (Yucatan howler monkey and Baird's tapir) listed as 'endangered' under the IUCN Red List classification, one as vulnerable (West Indian manatee), whilst three are classified as 'lower risk / near threatened' (jaguar, puma and water opossum – this last being recorded from the adjacent area). There are also two species listed as 'data deficient' - potentially at risk, but for which there is insufficient data on abundance and/or distribution to allow an assessment of viability (Neotropical river otter and red brocket deer).

The Yucatan Black Howler is the only Yucatan endemic mammals species recorded within the area, with a range restricted to Mexico, Belize and Northern Guatemala, though it is possible that further work on small mammals such as rodents and bats may well show the presence of other regional endemics (Walker & Walker, 2005).

Antillean Manatee (*Trichechus manutus spp. manatus*):

The Antillean manatee, the only subspecies of manatee found in Belize, is a subspecies of the West Indian manatee. They are a solitary species that has adapted to live in calm waters away from natural predators, so they have not complex behaviors for predator avoidance (Nowak, 1999). They are seasonal migrants due to oceanic temperature fluctuations, but do not migrate nearly as far as their sister species—the Florida manatee—because water temperatures in the Antillean's tropical home remain relatively constant throughout the year.

The Antillean manatee is found in the tropical and subtropical Western Atlantic Coastal Zone between the Bahamas to Brazil, including the Caribbean Sea and the Gulf of Mexico. The Antillean manatee prefers the calm waters of coastal and riverine systems. They feed on sea grass and rest in mangrove swamps (Deutsch et al., 2008). While the collective West Indian manatee is classified as "vulnerable" by the IUCN Red List, this subspecies is considered "endangered" because the estimated number of mature individuals is less than 2,500 and are expected to decline at a rate of at least 20% over the next 40 years. The species is threatened by habitat loss, loss of sea grass, hunting, pollution, natural disasters, and watercraft collisions (Deutsch et al., 2008). Belize is a critically important habitat for the survival of this species but there has been observed increases of manatee mortality through boat strike. Payne's Creek remains a vital sanctuary and management of boat speed is a vital conservation action.

Table 8. Mammal species of international concern of Payne's Creek National Park

Endangered	
Yucatan Black Howler	*Alouatta pigra*
Baird's Tapir	*Tapirus bairdii*
Antillean Manatee	*Trichecus manatus spp. manatus*
Lower Risk/Near Threatened	
Jaguar	*Panthera onca*
Puma	*Puma concolor*
Water Opossum	*Chironectes minimus*
Data Deficient	
Neotropical River Otter	*Lontra longicaudis*
Red Brocket	*Mazama americana*

Source: Walker & Walker, 2005

Birds

Yellow-headed parrot (*Amazona oratrix*)

A flagship species for PCNP an endemic subspecies to Belize (belizensis), are known to nest within the protected area but are threatened particularly by the increasing frequency of fires that burn not only the savanna grass but also the dead pine trees used for nesting. Sadly, the beauty of these birds and their ability to mimic speech and sounds has also made them popular as pets. Despite the fact that it is listed on Appendix 1 of the Convention of International Trade in Endangered Species (CITES) which makes it illegal to sell or buy wild-collected yellow-headed parrots, trade in the yellow-headed parrot still flourishes.

Fledging parrots are stolen from their nests, in the holes of tree trunks and limbs, by poachers who sell the birds for the pet industry. The yellow-headed parrot is gravely endangered from this activity and from the loss of its natural habitat in the pine savanna. Natural populations have been reduced alarmingly by as much as 90%, highlighting the importance of remaining key habitat such as PCNP for the survival of the species.

To date, a total of 309 bird species have been recorded for PCNP. A comprehensive bird species list is included in Appendix 6. A number of species were highlighted for their status as species of concern (locally, nationally or internationally). These include: one Endangered species (yellow-headed parrot, CITES listed) and three Near Threatened species (great curassow, black rail and black catbird) (IUCN, Red List, 2004). One further CITES species, the jabiru (*Jabiru mycteria*) has also been highlighted.

The riverine mangroves of the Punta Ycacos lagoon system also provide structure for a number of nesting species, including 150 to 200 nesting pairs of white ibis, and individual nests of boat billed herons, bare-throated tiger-herons, pale-vented pigeons, all of which were recorded during the Walker & Walker (2005) assessment. Other waterbirds also frequent the shallow waters or fish in the deeper channels – little blue heron, great blue heron, osprey, anhinga, belted kingfisher and American pigmy kingfisher were all observed feeding.

Reptiles and Amphibians

A total of 41 species of amphibian and reptiles have been recorded for the Park, representing approximately 47% of all the species likely to occur within the Park. The 41 species recorded to date represent 19 families (Walker & Walker, 2005, Table 9).

Table 9. Reptile and Amphibian Families recorded for Payne's Creek National Park

Order Caudata	
Family Plethodontidae	2 species
Order Anura	
Family Leptodactylidae	1 species
Family Bufonidae	2 species
Family Hylidae	5 species
Family Ranidae	1 species
Order Crocodylia	
Family Crocodylidae	1 species
Order Testudines	
Family Kinosternidae	1 species
Family Emydidae	2 species
Order Squamata, Suborder Sauria	
Family Corytophanidae	2 species
Family Iguanidae	2 species
Family Phrynosomatidae	1 species
Family Polychrotidae	2 species
Family Scincidae	2 species
Family Teiidae	3 species
Family Xantusiidae	1 species
Order Squamata, Suborder Serpentes	
Family Boidae	1 species
Family Colubridae	9 species
Family Elapidae	1 species
Family Viperidae	2 species

Source: Walker & Walker, 2005

Fish

A total of 39 fish species were recorded within the PCNP water bodies (Walker & Walker, 2005, Appendix 7). Each of the water bodies within the Park was found to have a distinctive fish fauna, thought to be primarily determined by the salinity of the water and therefore, the fish species represented a combination of freshwater, brackish and saltwater species.

The fish population included many game species particularly permit, but also barracuda, crevalle and horse-eye jacks, snook, goliath grouper, blue stripped grunt, black mutton and

silk snapper. Seasonally, cow-nosed rays (*Rhinoptera bonasus*) congregate for mating in the shallow waters between the months of February and April. Spotted eagle ray and southern stingray are both present within the Punta Ycacos system year round.

A number of species exist on the reef adjacent to nearby cayes, with either juveniles that utilize seagrass and/or coastal mangroves. These include:

Parrotfish	
Scarus croicensis	Striped parrotfish – settle on reef as adults but migrate every day to shallow inshore feeding grounds
Sparisoma aurofrenatum	Redband parrotfish – include seagrass in their diet
Sparisoma chrysopterum	Yellowtail parrotfish does eat seagrass among other things. Lives in seagrass and coral rubble, visits shallow inshore feeding areas.
Sparisoma rubripinne	Yellowtail parrotfish. Lives in shallow coral rubble and seagrass
Snapper	
Lutjanus apodus	Schoolmaster – juveniles often inhabit shallow bays, inlets and mangrove lagoons
Hogfish	
Lachnolaimus maximus	Hogfish. Young settle in shallow water habitats

The goliath grouper (jewfish), listed as critically endangered is thought to be relatively abundant within the lagoon system, though globally, populations are declining significantly.

Past and Present Key Research

Punta Ycacos Salt Works Archaeology

Since 1982, Heather McKillop, Louisiana State University, has been conducting archaeological research in the Port Honduras Marine Reserve. The research area was extended to Payne's Creek National Park, and the discovery and excavation of three salt works in Punta Ycacos Lagoon (McKillop, 2002) provided a better understanding of ancient Maya trade and economy. These salt works are associated with a massive coastal salt industry that produced salt for the inland cities of the Classic Maya period, where salt was

scarce. The salt works are submerged below sea level and associated with the only known wooden architecture in the entire Maya area. Both the wooden buildings and salt works are preserved because of their environmental location in an underwater mangrove peat bog. Transect excavations were conducted at both sites to establish the function of the wooden architecture and revealed an abundance of ceramic vessels used to evaporate brine over fires to make salt, confirming the function of the architecture for workshop salt production. Interestingly the presence of artifacts on the surface of the peat and wooden posts driven into mangrove peat indicated that the mangroves of PCNP were able to keep pace with sea-level rise until sometime after the late classic abandonment (c.950 AD). The archaeology research is still ongoing to further examine the production and distribution of salt from Punta Ycacos salt works.

Savannah Ecosystem Assessment

The results of the savannah Darwin Initiative project 2009 - 2012 which was conducted across the savannahs of Belize yielded some very interesting results for the management of PCNP. From 2009 to 2012 information was collected about the plants and soils of the lowland savannas and a new national mapping of the remaining savanna areas was produced as part of a new National Ecosystems Map and published in 2012. The main objectives were:

- Provide improved and more current savanna vegetation mapping for Belize to support conservation and management
- Conduct baseline taxonomic research and botanical survey of savanna areas
- Enhance the capacity of local institutions to collect and interpret these data for conservation management.

Key products of the project for PCNP included the *'Checklist of the vascular plants of the lowland savannahs of Belize'* which catalogued more than 950 species nationally. The second major output was an improved ecosystem map (see Figure 10) which provided more accuracy and highlighted the importance of PCNP for national savannah conservation.

Biodiversity Assessment of PCNP

This biodiversity assessment was commissioned as part of the Payne's Creek Management Plan Development Project (2005), at the request of TIDE. It comprises a biological assessment of the flora and fauna, providing the baseline on the distribution of different vegetation types, and the distribution and abundance of plant and animal species within the National Park. It was conducted by Walker & Walker in 2005 and still stands as the most comprehensive faunal biodiversity assessment to date, 10 years later. The main objectives were:

- To design a survey to determine the distribution and abundance of plants within the park - the methodology to take into consideration various types of plant communities found within the different vegetation types.
- To review secondary data.
- To design a survey to assess the distribution and abundance of selected types of fauna within the park - the methodology being dependent on the types of organisms being surveyed.
- To include training of community members in survey techniques.

Cultural and Socio-Economic Values

Community and Stakeholder Use

Historically, the PCNP has been used for fishing and hunting, and has also been heavily impacted by commercial logging, prior to the 1990's. The survey conducted by King (2005) and the community researcher survey in 2014 indicated that the use of the park by the buffer communities was not particularly high but there a significant shortcomings of both of these surveys which must be remedied as soon as possible to provide a useful picture of current and potential use and demand for use of PCNP. As such the limited results of the two surveys are presented below but perhaps most importantly, we also provide recommendations for the design of a buffer community use survey which answers the most important questions for the managers of PCNP.

In the socio-economic survey conducted by King (2005) of the five main buffer communities (Punta Gorda Town, Punta Negra Village, Monkey River Village, Bella Vista Village, Trio and Bladen Communities) several stakeholder user groups were identified. These included fisher folks, banana farmers, households, loggers, sport-fishers, tour guides and scientific researchers (King, 2005; Table 9). The survey also indicated the time of the year when the various products were harvested or activities conducted (Table 10). It is highly recommended that when this study is repeated, it is broken down by gender and age group.

Table 10: Community Park Use Indicating User Groupings

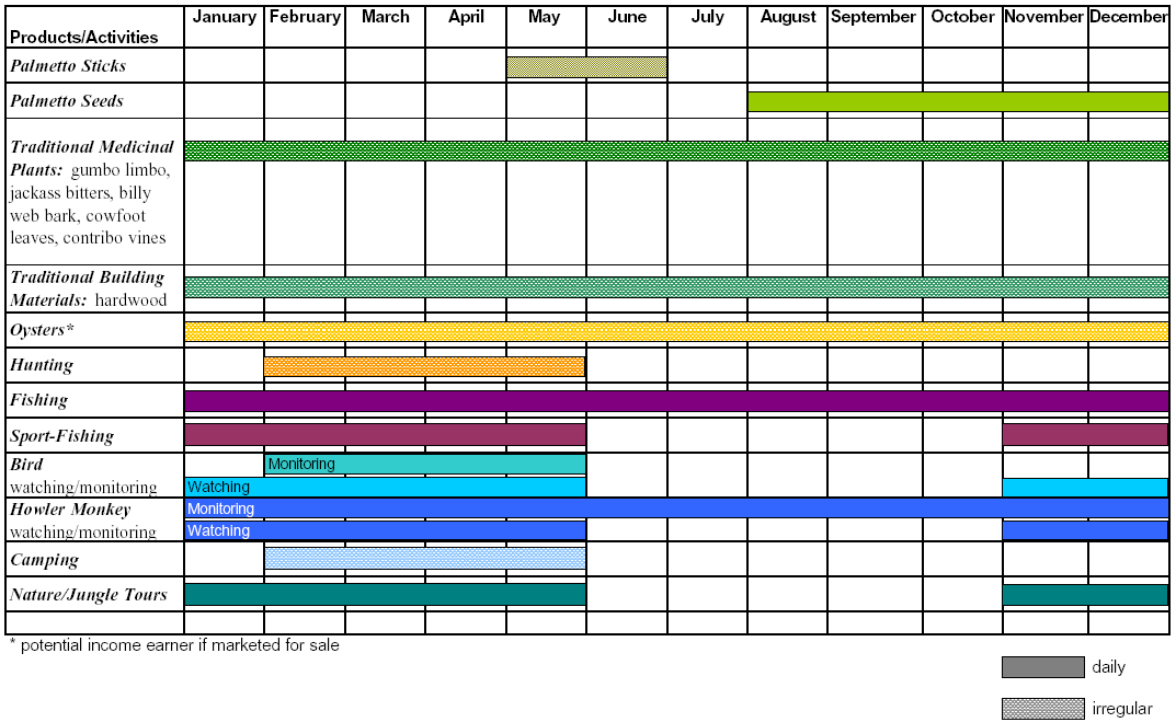
Products/Activities	*Users*	*Purposes*
Palmetto Sticks	Fisher folks	construction of traps for fish and lobster
	Banana Farmers	props for banana trees
Palmetto Seeds	Households (Bladen Community)	commercial export for medicinal and horticulture
Traditional Medicinal Plants	Households	Medicinal
Building Materials (Timber Products)	Households	building materials
	Loggers	commercial production
Oysters	Households	commercial export as food source
Hunting	Households	subsistence and commercial
Fishing	Fisher folks	commercial
	Households	subsistence
Sport-fishing	Sport-fishers	commercial
	Tour guides	commercial
Bird watching	Tour guides	commercial
Bird Monitoring	Scientific Researchers	Scientific
Howler Monkey Watching	Tour guides	commercial
Howler Monkey Monitoring	Scientific Researchers	commercial
Camping	Households	Recreation
	Scientific Researchers	Scientific
Nature/Jungle Tours	Tour guides	commercial

Source: King, 2005

While the survey shows that there are several user groups, it also indicated that many of the residents (89.4%) did not have any products from within the PCNP in their households (King, 2005). This is supported by the 2014 community surveys which found that only 22 out of 92 respondents had ever visited PCNP. King (2005) found that a small percentage (10.6%) said that they utilize a small amount of resources from PCNP for household purposes only.

Products and resources used by the respondents include medicinal plants, timber, game meat, fish, palmetto sticks and seeds. The majority of the respondents (76.2%) estimated that they could earn BZD$100.00 or less per week from the sale of these products.

Payne's Creek National Park
Seasonal Calendar
Indicating Park Use and Dormancy Periods
Communities' Perception



Source: King, 2005

Recreation and Tourism Use

Fly fishing

The Punta Ycacos Lagoon is considered excellent habitat for the elusive permit, with over 200 people using the site annually for fly-fishing (catch and release), making it a significant tourism resource for the area. One of the key users, Monkey River Lodge, has this to say about the lagoon;

"Occasionally you may find groups of permit feeding in the Punta Ycacos Lagoon. Imagine thousands of acres of 18-inch deep water surrounded by miles of savanna, mangroves and

jungle. It's a maze, but the Permit and our guides know how to find their way around. If you go deep enough into the Lagoon, you will come to the Ranger Station, the only sign of man in the entire protected estuary"

Fly-fishing guides are mainly from Punta Gorda Town, Punta Negra Village, Monkey River Village and at times from Placencia Village. The coastal shelf off Southern Belize has a reputation as a global hotspot for fly fishing, particularly of the 'Big Three', tarpon, bonefish and permit. Southern Belize is often coined 'The Permit capital of the world'. There has been considerable investment into enhancing the sustainability of the industry through best practice catch and release workshops and the possible development of a fly fishing guide certification course.

Wildlife tours

The Monkey River Tour Guide Association has also been using and developing the nature trails that run through the riparian forest along the Monkey River and into the protected area, focusing primarily on the Yucatan black howler monkeys.

Organized tours

To enable TIDE to sustain and expand its conservation and development efforts, there was a need to get more people out in the field and also to build a sustainable financing source. *TIDE tours,* was developed in 1999 in order to promote ecotourism in the district and begin building that sustainable financing source for TIDE, managers of PCNP. In 2014 this was supplemented by another tourism arm of TIDE, *Ridge to Reef Expeditions* (R2R). R2R expedition teams pay for the experience of carrying out important field research, education and conservation actions that are making a significant contribution to TIDE's mission: protecting wildlife and its habitats, raising awareness, empowering local communities and sustaining natural resources into future in the Maya Mountain Marine Corridor. All proceeds from R2R expeditions go directly into the management and protection of the protected areas it manages.

TIDE tours runs infrequent tours to PCNP, specifically the "Birding and Camping tour" in which guests stay overnight at the accommodation located near the Ranger Station. R2R has a bigger focus on PCNP, advertising expedition activities including Yellow Head Parrot conservation and monitoring and also Manatee conservation and monitoring. Expedition volunteers stay overnight at the Ranger Station accommodation and interact with the ranger team. R2R is in its beginning stages so it is too early to assess the success of impacts on the PCNP management or fauna and flora. However, care has been taken in the design phase to minimize any negative impact of these expeditions and to maximize the positive impact.

Cultural significance

There are also several sites of cultural significance within the Park that are infrequently utilized for recreational purposes (Table 12, Figure 11). These sites may be included in recreational tours as the popularity and usage of PCNP increases.

Table 12. Sites of Cultural Significance within the Payne's Creek National Park

Regions	*Location*	*Significance*
Monkey River	Parallel to Monkey River Village northwest of PCNP boundaries	Historical transit point for banana and logs to the sea, domestic source, tourism, archaeological (undiscovered Mayan sites), recreation, subsistence fishing
The "Pan" (Pond);	Southwest Punta Negra Village	Domestic source, subsistence fishing, recreation, tourism attraction
Dillwater	Centrally located in relation to present day PCNP	Historic settlement (abandoned), school, farming site, logging site, recreational area
Hot Water Spring	Northwest of PCNP boundaries	Historic site, scientific wonder (water always hot, bad taste)
Fresh Water Creeks	Upper Dillwater Lagoon; branches into Upper and Lower Freshwater Creeks	Domestic source, wildlife water source
Payne's Creek	Northeast of the present day PCNP Ranger Station	Historic Creek named after the original land owner; Mr. Payne, a Canadian who lived in area in the 1800s
Muschamp Creek	Southwest of PCNP Ranger Station	Became part of PCNP after its boundary realignment in 2004; site of an abandoned/crashed airplane, 1900s logging camp
Submerged Mayan Sites	two sites are located within PCNP boundaries to the southeast and southwest of	Production sites for salt for trading during Mayan civilization, 45 sites discovered, 23 sites with wooden architecture, one site

	Dillwater Lagoon	on land-Killer Bee (K'ak Naab – site found with wooden paddle), sites are named after local hunters, fishers and domestic users of the area
Pineapple Grove	Site near Muschamp Creek	Historic hunting site
Clear Water	Site near Muschamp Creek	Historic hunting site

Source (King, 2005)

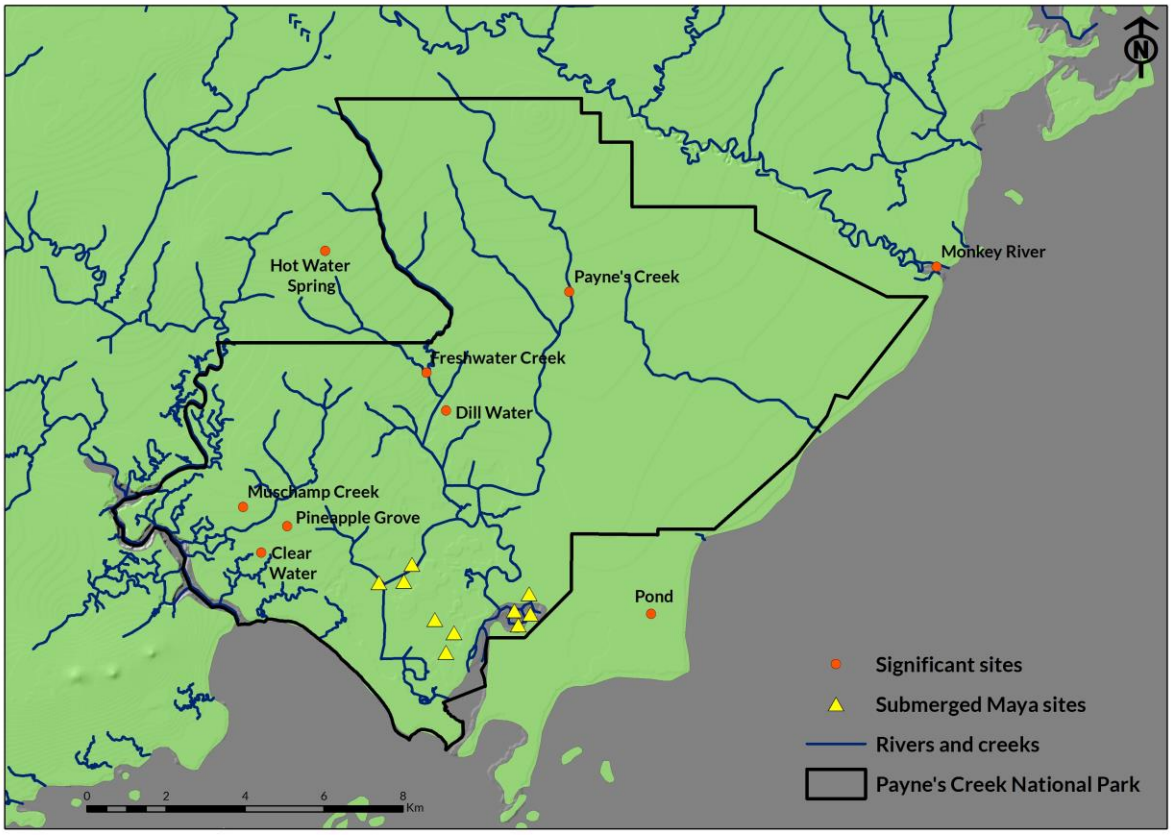


Figure 11: Sites of Cultural Significance in/around Payne's Creek National Park
Source: King, 2005

Other Economic Use

As a National Park, under the recently revised National Protected Area System Bill (2015), extractive use of PCNP is not permitted with essentially only tourism permitted within the park boundaries. However, with management costs of PCNP far exceeding its capacity to generate income and with an uncertain income stream given a continuing heavy reliance on irregular donor funding this situation is under review. As will be discussed in the Conservation Planning section later in this plan (page 72) some of the key threats to PCNP include unsustainable harvesting techniques. Drawing on a series of community meetings

held by TIDE and based on management experience s it was agreed that discussions would begin over the potential change in management category of PCNP to permit sustainable harvesting of timber and non-timber forest products. TIDE has been driving these discussions thanks to the support of a Darwin initiative project 'Conserving pine woodland biodiversity in Belize through community fire management'.

This project intends to conserve and enhance biodiversity and livelihoods in Toledo's pine woodlands by reducing the frequency of intense wildfires. Many wildfires presently result from poor communities striving to meet basic needs (60% of Toledo's rural population have insufficient income to meet basic food requirements). By PA's (including PCNP) adjusting their management to allow sustainable use of pine woodlands, and allowing communities to access the benefits, community members will have a vested interest in managing fire in order to maintain and improve woodland resources. It is thought that by granting long-term exclusive rights to harvest NTFPs within defined concession areas there will be increased stewardship and reduced public/political pressure to convert this endangered ecosystem to agricultural land use.

The main focus of this project will be to determine how to sustainably develop the palmetto (*Acoelorraphe wrightii*), also known as 'popta' seed harvest. Palmetto seed harvest can earn community members $36-$45 /day for 14 weeks a year and compares very favourably with wages of banana plantation workers ($25 /day), and equates to $3,000-$3,900 pppa. Harvest of palmetto is typically a family activity with equal participation of males and females. Presently, the palmetto resource is threatened by unsustainable harvesting practices and wildfire. The intention of TIDE through this project is to ensure sustainable supply to the export market, based in Canada. Under the project, TIDE will create a plan for sustainable extraction from ~7,000-acre zone in PCNP. If it can be demonstrated that the ecological impacts are within limits of acceptable change, the National PA Administrator could approve the plan, enabling ~50 additional community members to extract palmetto palm, providing $147,000-189,000pa to community members and $24,000 pa in royalties to Forest Department. Additional resources, such as pine lumber which is harvested in adjacent sustainable long term concessions, could be harvested within 5-10 years. FD has expressed interest in using this project to inform a possible revision of the National Parks System Act to facilitate community access to resources within national parks.

Educational Use

To date, use of the Park for educational purposes has been limited. TIDE facilitates visits to the park for community members from the 6 buffer communities. This averages around 6 trips per year. There are further visits to the park by visiting researchers and academic institutions, particularly concerning the archaeological site. TIDE employs an education and outreach director who is responsible for such visits. An organizational education strategy has been developed and TIDE has intentions to increase the number of visits to PCNP, particularly for young people from the buffer communities.

Fire

A great deal of the following section has been adapted from the five-year Integrated Fire Management Plan for the Maya Mountain Marine Corridor (MMMC). This plan was developed to bring together stakeholders in fire management and identify concrete management actions for the period 2009 – 2014. TIDE is currently fundraising for the development of the next five year plan, however much of the content of this plan remains relevant.

For thousands of years fire has been an integral component of the ecological dynamics of the Maya Mountain Marine Corridor (MMMC). Historically the primary ignition source has been the indigenous inhabitants of the corridor. After the end of the Late Maya Classic Period, fire regimes were characterized by a much longer fire return period. Colonization by the British, which included the exploitation of the timber resources on the southern coastal plain, marked the beginning of fire regimes with decreasing return periods. While lightning ignition may occur on the hilly areas of the MMMC, it is relatively unknown on the pine savanna ecosystem of the MMMC.

Cultural and socio-economic use of fire

Early human activity in the MMMC including the coastal plains included the use of fire as a cultural tool. In this area there is evidence to suggest that fire was used as a tool for hunting

and for clearing unwanted vegetation. There were also periods where fire was a limited occurrence on the pine savannas of the MMMC. During the period of colonial settlement and development fire continued to be used increasingly as part of hunting practices, the clearing of unwanted vegetation and range management in the grazing of free range livestock. At present fire continues to be used in both mechanized and manual land clearing including the milpa system. While land clearing within the fire- maintained ecosystems is very limited, runaway fires from these agricultural practices often enter the fire adapted ecosystems and in extreme or favorable circumstances may also affect fire sensitive ecosystems.

The burning of vegetation along the shoulders and borders of the Southern Highway has also become a cultural practice in recent years. However it is the use of fire as part of traditional hunting practices, mostly to alter the range of white tailed deer (*Odocoeilus virginiana)* where fire is widely and more frequently used in the fire dependent pine savannah ecosystems of PCNP.

Fire regime

Fire has contributed immensely to the mosaic of ecosystems on the coastal plains of the MMMC and within the PCNP. At varying times of the year, and in varying frequencies, fire has shaped the present day ecosystems of the coastal plains in the MMMC. These coastal plains are dominated by pine savannahs dissected by small creeks draining into the coastal lagoons and rivers and along which narrow bands of gallery forests are found. In those areas where fire has not penetrated, lowland broadleaf forest ranging from seasonally dry to permanently waterlogged serve to break the spread of fire throughout the pine savanna ecosystem of PCNP.

In the last 50 years the development of communication infrastructure and agro-industries on the coastal plains within the MMMC with the attendant increase in human population has had a significant impact in rapidly shortening the fire return period thus accelerating changes in fire influenced ecosystems in the MMMC.

The proliferation of rural communities linked to the paving of the Southern Highway and the establishment of agro industries requiring large pools of workers has rapidly increased

human activity on the SCP which involves a related increase in the use of fire. This rapid increase in population growth has created an increase in illegal hunting related intrusion within the park and an increase in the intrusion of wildfires into the park from surrounding lands.

At present the fire return interval for most of the pine savanna ecosystems on the MMMC is one year and in some cases 6 months. The effects of these progressively shorter fire return periods are reflected in the paucity of pine seedlings in pine stands where seeding and seedling emergence do occur but seedling survival is short lived.

Fire and Natural Disturbance

Fire regimes in PCNP and the structure of vegetation communities have been altered and shaped by a historic cycle of tropical storms including major hurricanes. The last major hurricane to impact the PCNP was the passage of Hurricane Iris in October of 2001 which moved west southwest across Payne's Creek with sustained winds in excess of 140 mph. An assessment of damage two weeks after the event showed that in the belt of destruction with damage of between 90 to 100 %, the northeastern broadleaf forest areas of PCNP were severely affected, with total defoliation, and the majority of standing trees de-limbed (Meerman, 2001). The pine savanna only suffered 20% damage (along with the herbaceous swamp areas). The creek side vegetation and forested ridges on slightly higher grounds within the savanna areas were mapped at 75% damage level, with many trees wind-thrown or damaged. The after effect of these extreme climatic disturbances sometimes cause changes in fuel composition and continuity which may under favorable conditions permit the spread of fire in fire sensitive ecosystems resulting in changes in vegetation especially in the transition zone between fire-dependent ecosystems and fire-sensitive or fire-independent ecosystems (Meyers, 2006). Unfortunately as a result of the effects of global warming, the IPCC's 2014 prediction indicate an increase in the severity and frequency of extreme tropical climatic events.

Most recently around 2000, widespread clusters of mortality in the pine stands on the pine savanna ecosystem of the MMMC, including PCNP, as a result of an unprecedented level of attack by the Southern Pine Beetle severely increased fuel loading in the affected areas. The

passage of Hurricane Iris only served to increase surface fuel loadings as most standing dead pine trees were blown down.

The need for fire management

Natural fires have occurred for millennia over the global landscape thus floral and faunal species have adapted to it. Additionally fires have been used for centuries to achieve different land management objectives. However, too frequent fires or fire exclusion creates inappropriate fire regimes thus causing negative effects to ecosystems and their biodiversity (Myers 2007).

Too frequent fires have caused the displacement of certain animal species, or reduced population in areas where they were otherwise common. Frequent fires also reduce the diversity of plant species especially the understory shrub and herbaceous species. Also forest structure is affected leading towards an even aged structure thus implicating management for silvicultural purposes. At the other side of the spectrum, fire exclusion due to the perceived notion that all fires are bad, have lead to increased fuel load buildup and broadleaf vegetation succession in the long term. The access to areas for management purposes are reduced, silvicultural objectives are hampered and animal and plant species viability is reduced. Thus, whenever a wildfire does occur it has catastrophic effects on the same plant and animal species one is conserving, and management objectives are reversed.

Impacts of fire of key Conservation Targets of PCNP

The MMMC Conservation Action Strategy identifies the pine savanna ecosystem as one of three terrestrial conservation targets because of the threat of wildfires and hunting pressures. The keystone species within the pine savanna ecosystem are Caribbean Pine and the Yellow- Headed Parrot. To a lesser extent the coastal plain broadleaf forest is also impacted by wildfires.

According to Pinelo (2006) the Short Grass Savanna with Shrubs and/or Needle Leaf Trees has been described by WWF as one of the few fragments of relatively well preserved lowland and pre-montane pine forests in Belize and is further categorized as critical/endangered.

An integrated fire management approach is therefore required as a critical component of sustainable management and biodiversity conservation. In addition, the economic losses due to wildfires can be great, in relation to timber and tourism values as well as to agricultural values.

The coastal broadleaf forest is considered a fire sensitive ecosystem where floral and faunal species are not adapted to fire and irreversible changes occur when fire is introduced. In most cases the forest structure and floral species composition changes to an open canopy forest with pioneer species. It takes decades of ecological succession for the area to return to its original state. The effects on fauna are indirect in that rarely species mortality occurs but exodus of species takes place, and other negative effects are on habitat and food availability.

Pine savannahs are considered fire maintained ecosystems in that floral and faunal species over the past years have adapted to fires, thus some species require frequent low intensity fires to perpetuate themselves (Myers 2007). With regards to Caribbean Pine the objective is to create fire return intervals in the pine savanna ecosystem that will permit the establishment of young regeneration and the development of uneven-aged stand structures.

The endemic Yellow Headed Parrot (*Amazona oratrix belizensis*), an Appendix II species in the CITES listing is a nested conservation target embedded in the pine savanna ecosystem of the MMMC. Due to a combination of anthropogenic fires caused by escaped agricultural fires, and hunting practices, their nesting habitat and thus their viability has been seriously jeopardized as they nest in hollow, live and dead trees.

These are almost always the trees that readily burn in wildfires because of their characteristics. Additionally hunting of the Yellow-headed Parrots for the pet trade has drastically reduced their population to around 22 nesting pairs in the PCNP (Muschamp pers. comm.). Fire management within the Pine Savannas must also integrate the life cycle dynamics of the Yellow-headed Parrots in order to enhance the breeding environment of this threatened species.

Fire Management History

Fire Management on the Pine Savannas of the MMMC peaked during the colonial forestry era in the 1950's and 60's. It was based on direct suppression of wildfires based on early detection, extensive fire infrastructure including fire towers, communication links and good roads. However, very little of the infrastructure extended into the pine savannas of what is now PCNP. As for other areas within the pine savanna ecosystem of the MMMC, annual fires characterize the present fire regime. Wildfire detection and suppression efforts by TIDE Park Rangers commenced in 1999, however, limitations in fire suppression equipment and human resources have only permitted the successful suppression of three fires since (Muschamp, 2004). Nevertheless, unlike previous efforts at fire management, fire management efforts within the PCNP have been tempered by the focus on ecosystem management for the benefit of conservation targets.

Fire Laws

The Forest Fire Protection Act empowers the Chief Forest Officer to declare fire protection areas and requires the land owner or lease holder to prepare and execute a forest fire protection plan. This is most likely to be enacted following tropical storm damage which drastically increases fuel load and reduces moisture. Other legislation affecting fire includes the Negligent Use of Fire Act which seeks to restrict damage to person and property (from fire); and finally the Agricultural Fires Act which requires a landholder to construct a fire line around an area where vegetation is being burned as part of land clearing activities, normally related to agriculture development of land. Legislation applicable to protected areas does not specifically mention forest fire management or forest fire protection. It is understood that the management of wildfires or prescribed fires will form part of the forest management plan or protected areas management plan for a given area. Any planned fire ignition in a Forest Reserve or Protected Area requires the approval of the administrator of the NPAS.

The Wildland Fire Management Policy for Belize

In 2009, recognizing that there were; "Abundant, unwanted, and uncontrolled wildland fires that occur in Belize causing damage to the environment, human health, and property.", The Wildland Fire Management Policy for Belize (2009) was developed to serve as the basis for

informing land managers of the best practices to avoid damaging wildfire. The four key strategic objectives are as follows;

• To minimize the inappropriate use of fire in socio-cultural practices including traditional uses;
• To improve the organizational capability of all stakeholders to manage wildland fires
• To strengthen the operational capacity of all stakeholders to manage wildland fires
• To develop adequate fire prevention capability at all levels.

This policy was collaboratively developed amongst the key national stakeholders but unfortunately has not been implemented at a national level. The situation in southern Belize is somewhat different with the regular meetings of the Southern Belize Fire Working Group and the resulting practical collaboration and resource sharing. This remains a model which must be replicated nationally, particularly within the context of the drying and warming climate.

Proposed Fire Regime

The MMMC Conservation Action Strategy indicates that due to the threats, present landscape context and condition, the viability of the pine savanna ecosystem is poor. Wildfires in these protected areas have been an annual occurrence for the past five years (Cherrington, 2008). This should thus be a cause of concern to land managers and an appropriate fire regime that takes into account conservation targets, land management objectives, and the effects of the seasonality and variability of burns should be introduced.

In the Integrated Fire Management Plan (IFMP), it is proposed that a fire return interval between three to five years be introduced to the pine savannas of Payne's Creek National Park. This is based on history, anecdotal evidence, and technical input from local and international expertise (Steve Morrison pers comm.), thus with future monitoring and evaluation, this proposed interval may be changed for specific periods of time and for specific management areas and burn units. The rationale behind the fire return interval is that fire free periods more than five years, and in certain areas more than three years, allow substantial fuel accumulation which leads to high intensity fires. If the fire return interval

goes beyond five years then prescribed fires may also become ineffective in that large diameter hardwood stems may not be killed if the objective is to control broadleaf competition. With fire return intervals less than three years or five years, pine regeneration mortality is almost one hundred percent, thus management for timber production is unsustainable.

Therefore the proposed fire regime is an initial fire free interval of three to five years depending on fuel accumulation, broadleaf competition, pine regeneration and growth, then the introduction of prescribed fires in the different management areas or specific burn units in a return interval of three to five years depending on the accomplishment of the specific objectives.

The objective of fire management in the broad leaved forests is to exclude all fires through a dedicated program of public awareness campaign, fire detection, and fire suppression. As mentioned, this ecosystem is fire sensitive and wildfires lead to irreversible habitat changes.

Management Areas and Burn Units

For ease of fire management the protected areas will be divided into management areas and burn units taking into consideration the ecosystems, its embedded vegetation strata, fire management objectives, existing roads, natural barriers, and other land management zonations. In Figure 12 below the zonation and location of fire management units for PCNP can be seen.

Burn Schedule

The provisional burn schedule is based on the management objective for the specific management area or burn unit. Foremost is the suppression of all wildfires for a three to five year period, then the introduction of prescribed fires to a management area or burn unit every three to five years. After monitoring of levels of fuel accumulation, effects on hardwood and pine regeneration, and mortality, the burn schedule will be adjusted either to a shorter or longer fire return interval. A framework schedule is included in the IFMP that can be adapted to a particular area or unit depending on the objective.

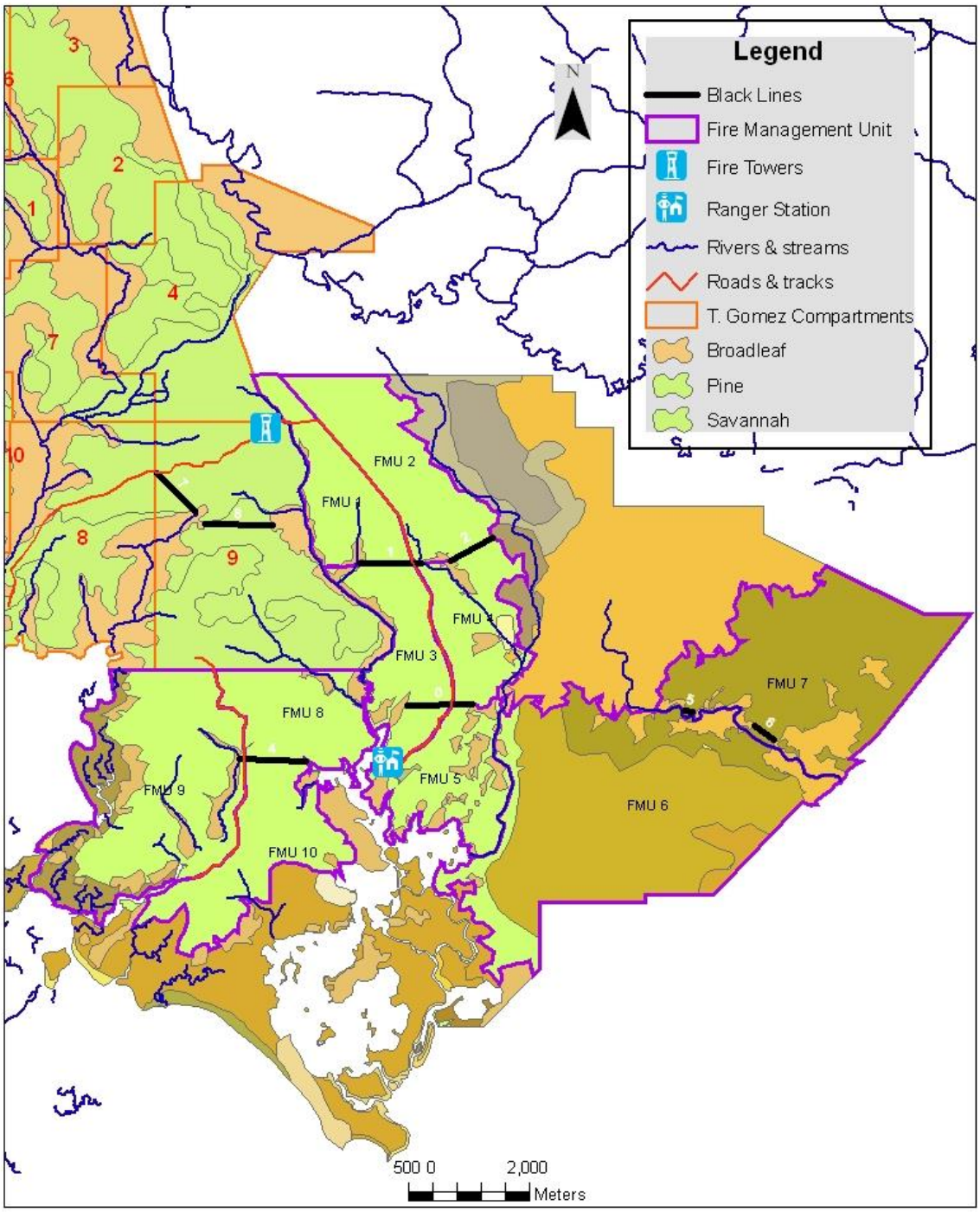


Figure 12: Fire Management Units in the Payne's Creek National Park

Personnel Capacity

At present TIDE's fire management staff includes the PCNP Park Manager and three park rangers. All have taken both a suppression and prescribed fire course (TNC S190), two are qualified 'Burn Boss'. Additionally four staff from the Private Lands Initiative have taken the S190 prescribed fire course. Boosting this capacity further, through the SBFWG, adjacent land managers Thomas Gomez & Sons, Wood Stop, Ya'axché Conservation Trust and community leaders have received the basic S190 fire training and regularly practice and refresh these skills through prescribed fire implementation across the lowland savannah at the beginning of each dry season. This training is ongoing in order to take account for turnover in the staff and leadership amongst these stakeholders.

Equipment

The Southern Belize Fire Working Group has obtained a batch of basic hand tools, and Personal Protective Equipment, such as Nomex shirts, pants, gloves, smoke masks, helmets, bladder bags, Pulaskis (picks), fire rake, shovels, and swatters. These are usually sufficient for a small team of six - ten firefighters to conduct both prescribed burning and direct and indirect attacks on low intensity wildfires. Complementing this, for medium to high intensity fires, equipment including two mobile water tanks (large for tractor, small for ATV), two pumps, hoses and ATV have recently been secured. Heavy machinery is provided by Thomas Gomez & Sons and includes a D7 bulldozer, skidder, tractor and loaders. These equipment are primarily used for Forest Management and harvesting operations but can be made available to the SBFWG for pre-suppression and suppression activities.

Communication and Detection

Fire management in PCNP and its surrounding protected areas requires good and compatible radio telecommunication systems, or improved cellular network coverage for efficient communication between the towers, the ranger station, patrol teams and the sawmill. TIDE had constructed a fire lookout tower in a strategic location of PCNP that provides 360 degrees unhindered view of the landscape. The PCNP tower is located on one of the highest point in the park in an open space with good road access. (See Figure 13). A

similar tower was constructed in DRFR but unfortunately was hit by a wildfire and is currently out of action until it can be repaired.

Both towers if manned simultaneously during the fire season will be able to detect and precisely triangulate smoke and fires to provide an accurate location of the wildfire, while also providing information for quick access by the initial attack suppression crew. It is important that TIDE and Thomas Gomez & Sons, as part of the fire detection and communication system, have in place a map of their fire control area and adjoining lands mounted on a suitable material and with strings attached to make the necessary triangulation for the location of the fire.

An efficient communication and detection plan, coupled with dedicated manning of posts (towers, base) is one of the two most important factors for the successful implementation of the fire management plan. An equipped and dedicated wildfire response team is the other important factor.

The IFMP recommends that TIDE should invest in hiring additional temporary rangers during the fire season to man towers and be part of the wildfire response team, equipped and ready to attack wildfires as soon as reported. In the case of Thomas Gomez & Sons a permanent fire lookout with adequate fire detection training will be required for the fire season. It should be noted that under the conditions of its long term sustained forest management license, TGS is required to keep a trained initial attack crew of at least 6 men.

The towers are to be manned from 8:00 am to 5:00 pm every day during the fire season (February 15th to June 15th), which usually coincides with the dry season. However, it may also be necessary to man fire towers during short burning seasons which occur in November, December, and even January. Therefore with weather observations, the detection period can be changed depending on the advent of an earlier dry season, or an extended dry season.

As mentioned previously, both Ya'axché (Golden Stream CP), and Yong's (Swasey Bladen FR) have a fire lookout tower that if manned simultaneously during the fire season, can effectively detect and report wildfires for their quick suppression.

An important point to remember is that it is best to quickly suppress wildfires as soon as detected and reported, before they escalate into a larger fire with high intensities, as they become more difficult and costly to suppress.

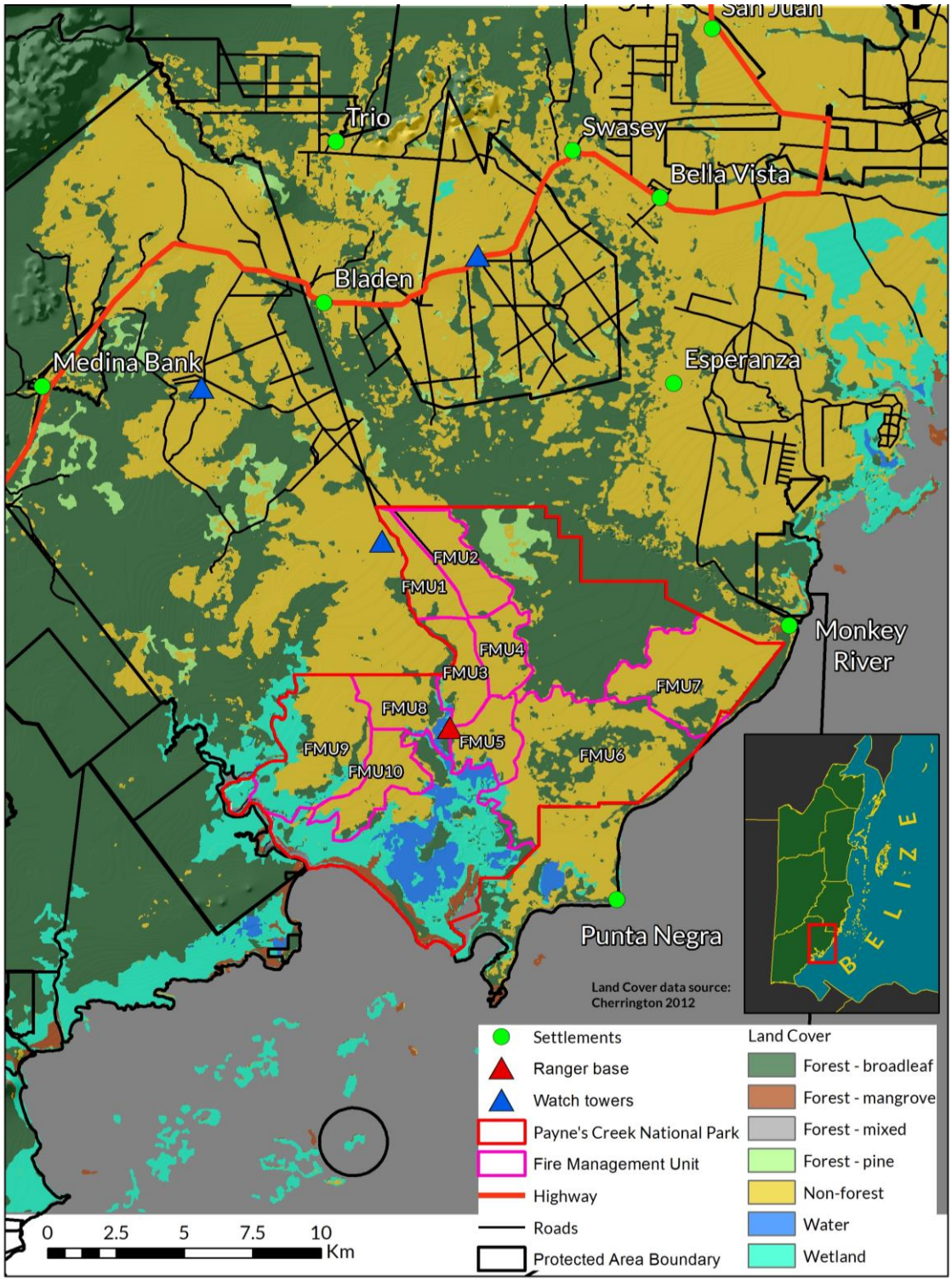


Figure 13: Location of Fire watch towers and Ranger Base relative to landmarks

Weather observation

Weather observation is critical in fire management operations, such as planning and conducting prescribed fires, planning/conducting pre suppression activities, and conducting fire suppression activities during a wildfire. The monitoring of rainfall, temperature, relative humidity, and wind direction are critical in determining if stated land management objectives (reducing hardwood encroachment, increasing regeneration etc) will be met.

PCNP has been collecting weather data since 2004 however there is a need for it to be structured into a dedicated activity especially during the onset of the fire season to determine weather patterns for each year and decide on prescribed burning "windows", as well as determining fire danger ratings during the progress of the fire season. It should be complemented with obtaining daily weather forecasts from Hydromet, the national weather service. Ideally, investing in an automated weather station for ease and fidelity of meteorological recording would be desired. The NASA FIRMS/MODIS satellite imageryand warning system of current "hotspots" that denote fires above 100m^2 in size, is improving and provides a valuable but cheap complement to on the ground monitoring activities.

Fire break preparations

Preparations are conducted before the onset of the fire season and may consist of further subdividing large units (see Figure 12) into manageable areas either by scraping fire breaks with hand tools (machetes, pulaskis, fire rakes) or light machinery (tractor with scrape blade), or doing black lines. The use of light and heavy machinery (plow, grader, bulldozer) is avoided as much as possible in PCNP to prevent scarring of the landscape and the associated impact on the conservation values.

For PCNP, the two main roads, leading in from the north, from the Deep River Forest Reserve, will be black lined annually, to act as a fire break. Additionally, three sections of Fire Management Unit (FMU) 7 will be black lined annually to prevent wildfires south east of Monkey River, crossing vulnerable points along a gallery forest, and burning into FMU 6 (See Figure 12). Three other black lines (No.1, No.2, and No.6) will need to be created and maintained annually. The southern end of Muschamp Creek will need to be strengthened to

act as a division between FMU 5 and 6. These blacklines, along with the existing roads are the basis for creating the FMU. The ranger station is located in FMU 5 (See Figure 12).

Two roads, one leading to Alligator Creek, and the other to Muschamp Creek in PCNP, originate in the DRFR, as well as two proposed blacklines (No. 7 and No. 8). These fall under the jurisdiction of Thomas Gomez & Sons and will be carried out under the SBFWG join activities.

These roads and proposed blacklines are crucial in fire suppression since they would reduce the area that could possibly burn in a wildfire, as well as providing a basis for fire management actions.

In adjacent protect areas, from which wildfire can enter PCNP, The DRFR, as well as the SBFR, contain an impressive forest road system that will be maintained so as to act as fire breaks, compartmentalizing each reserve. No new fire breaks are anticipated to be constructed however, if skidding roads are built, for forest management purposes, then these can be used as fire breaks.

Wildfire Response

Given the adequate implementation of the pre suppression and detection plan, it is expected that response time to wildfires will be short, ensuring that the fires remain small and also the area and negative effects remain relatively small. Nevertheless, the Fire Manager at PCNP and in the DRFR must develop and maintain a plan that outlines actions to be carried out in the event of a wildfire and ensure that the wildfire response teams as well as support personnel are familiar with the relevant parts of the plan.

Phases of Suppression

Suppression activities will be grouped into three activities: initial attack, full blown attack, mop up. The initial attack will occur immediately after the wildfire is reported either by the tower or the patrol team to the base (ranger station) and may consist of a small suppression team with basic hand tools.

If successful in suppressing the wildfire because of response time, the size of the fire, or because of the conditions (vegetation type, time of day, small unit etc.), then no full blown attack with additional personnel and equipment would be needed. Mop up is then carried out to ensure that the fire is completely extinguished. A report is then prepared for review of the lessons learnt, then it is filed.

Suppression Techniques

Fire Suppression will be carried out using various tactics or techniques to either directly or indirectly attack the wildfires. Direct attack will consist of suppressing the fire at the fire line. This will be done either individually or simultaneously cooling (applying water with bladder bags/water tank), or smothering the fire (with fire swatters). Indirect attack corresponds to suppressing the fire away from the fire line usually from a pre-established fire break or a fire line constructed in front of the advancing wildfire. Indirect attacks will be carried out when the fire intensity is high, flame heights are high, or when the burning vegetation impedes access for direct attack.

With the indirect attack, either from a pre-established fire break or a constructed fire line, the fuel between the line and the fire will be ignited and burnt out.

Mop Up

As mentioned previously, mop up is the process of completely encircling the fire perimeter and ensuring all burning material is completely extinguished. Depending on the width of the fire line, or the burnt materials at the fire line, it is recommended to completely extinguish all smoking materials to within 10ft or 20 ft of the fire line.

Community and Stakeholder Participation in Fire Management

Public Outreach Program

TIDE has a public outreach and education program which focuses both on marine and terrestrial environment. This program also provides awareness on the PCNP in regards to its

importance in conservation of biodiversity, and providing connectivity in the MMMC. A brochure has been produced that focuses on the Yellow Head Parrot, and its vulnerability to due to poaching and wildfire. This endeavor must be boosted with other outreach activities such as school programs, and radio talk shows. Furthermore at the beginning of each dry season radio commercials should be broadcast to remind the public to be vigilant against wildfire.

Community Fire Management Program

TIDE and other land manager members of the Southern Fire Working Group have initiated a program to assist communities with basic fire training to enable communities to deal more effectively with wildfire threats to their communities. Through grants secured by both Ya'axché and TIDE, more than 100 community members will be trained in basic fire management under a specifically designed training program which addresses both savannah and broadleaf wildfire and prescribed fire. This considerable cadre of trained community members could also assist in the event of a large fire requiring many fire fighters. The SBFWG members have committed to increasing the cache of fire management equipment to supply this large team. The training of community members would also assist in raising fire awareness in communities and should initiate a continuous dialogue on fire management in communities. The SBFWG intends to increase participation of community fire representatives at the 3 annual meetings of the group.

CONSERVATION PLANNING

Conservation Targets and Threats

The Convention on Biodiversity's Strategic Plan for Biodiversity 2011-2020 consists of 20 targets for 2020, termed the Aichi Targets. Concerning PCNP and this management plan there are some that are particularly relevant.

Target 11: by 2020, at least 17 per cent of terrestrial and inland water, and 10 per cent of coastal and marine areas, especially areas of particular importance for biodiversity and ecosystem services, are conserved through effectively and equitably managed, ecologically representative and well-connected systems of protected areas

and other effective area-based conservation measures, and integrated into the wider landscapes and seascapes.

Target 14: by 2020, ecosystems that provide essential services, including services related to water, and contribute to health, livelihoods and well-being, are restored and safeguarded, taking into account the needs of women, indigenous and local communities, and the poor and vulnerable.

Target 19: by 2020, knowledge, the science base and technologies relating to biodiversity, its values, functioning, status and trends, and the consequences of its loss, are improved, widely shared and transferred, and applied.

Whilst these targets are very broad and are used more frequently to set national level targets and planning, it is also useful to ensure that component management plans of the National Protected Areas System recognize the need to align. Within this management plan we will focus management activities on a limited number of specific subjects such as ecosystems or species. These are known as conservation targets and are chosen to indicate the health of the various ecosystems, represent the target of a particular threat, or are of local, national or international concern. This management plan has addressed local and/or immediate threats to ecosystems and/or species of conservation interest on the local/national level as a first priority(s), and on an international level as a second priority

Identification of Conservation Targets and Threats

The identification of conservation targets and threats is based on information from the previous management plan and an analysis of the results of the various consultants' reports, the knowledge of the Park's staff and various stakeholder consultations.

The following conservation targets were selected/maintained:

Ecosystem Target	Short Grass Savanna with Shrubs and/or Needle Leaf Trees Tropical Evergreen Broadleaf Lowland Forest Freshwater Habitat Estuary Habitat, Including Adjoining Mangrove Habitats
Species Groups	Game Species

Species Targets	Yellow-headed parrot West Indian Manatee

The justification for the selection of the conservation target, along with its principle threat(s) is provided in Table 13.

Table 13. Summary and justification of Conservation Targets

Conservation Target	*Species, Communities or Ecological Systems represented by Target*	*Threat*
Short Grass Savanna with Shrubs and/or Needle Leaf Trees	One of the few fragments of relatively well preserved lowland and pre-montane pine forests (WWF: Belizean pine forest) Conservation status: critical/endangered (WWF Categories)	Invasive cogon grass (*Imperata cylindrical*) is a possible invasive exotic
	<u>Soils</u>, particularly the *Puletan savanna* soils	Fire-induced loss of vegetation cover and hence, erosion (Potential)
	<u>Needleleaf and Palm Tree Species</u>, including, the Caribbean Pine (*Pinus caribaea*) and the Palmetto Palm (*Acoelorraphe wrightii*), which are valued for board-wood production and/or as traditional building materials	Increasing frequency and intensity of fire, following past logging pressures
	<u>Palmetto Palm Seed (*Acoelorraphe wrightii)*</u>, which is valued for export	Fire and illegal extraction Increasing frequency and intensity of fire
	<u>*Traditional Medicinal Plants*</u>, including Gumbo Limbo (*Dendropanax arboreus*), Jackass Bitters (*Neurolaena lobata*), Billiweb Bark *(Sweeetia panamensis),* Cowfoot Leaves (*Bauhinia divaricata*), and Contribo (*Aristolochia trilobata*), which are valued for treatment of chronic ailments	Fire and unmanaged extraction Illegal extraction
		Anthropogenic fire incidence within the Short Grass

Short Grass Savanna contd.	*Sundew and the Palmita Cycad, (Drosera capillaries* and *Zamia polymorpha, respectively)* constitute two species of plants which are regarded as threatened on an international level owing, and have not been specifically identified as threatened on a national level	Savanna ecosystem (Potentially)
	Yellowhead Parrot Juveniles, which are valued for sale to the pet trade	Fire damage to nest sites and direct nest poaching
	Game Species, including the Baird's Tapir (*T. bairdii*), Great Curassow (*Crax rubber*), White-Lipped Peccary (*D. pecari*), Collared Peccary (*T. tajacu*), Red Brocket (*Mazama Americana*), White Tailed Deer (*O. virginianus*), Nine-Banded Armadillo (*Dasypus novemcinctus*), Central American Agouti (*Dasyprocta punctata*) and Paca (*Agouti paca*), one or more of which are known to frequent the Short Grass Savanna, are valued as food	Unmanaged extraction (hunting) Presently Habitat and food loss due to wildfire damage
Tropical Evergreen Broadleaf Lowland Forest	The broadleaf forest to the north lies on the alluvial plain of the Monkey River, and is important particularly for its role in connectivity and maintenance of water quality. It includes the recently mapped permanently waterlogged swamp forest – an ecosystem poorly represented within Belize's current protected areas system.	Land clearance between PCNP and Monkey River, fragmentation of forest ecosystem and decreasing connectivity
	Broadleaf Tree Species, including various species of timber valued as board wood, such as Campeche (*Simira salvadorensis*), Yemeri (*Vochysia hondurensis*), and Manni (*Symphonia globulifera*)	Illegal extraction

Tropical Evergreen contd.	<u>*Traditional Medicinal Plants*</u>, including Gumbo Limbo (*Bursera simaruba*) Jackass Bitters (*Neurolaena lobata*), Billiweb Bark *(Sweeetia panamensis),* Cowfoot Leaves (*Bauhinia divaricata*), and Contribo (*Aristolochia trilobata*), which are valued for treatment of chronic ailments and sale, and therefore may be <u>*potentially*</u> threated by unmanaged extraction.	Illegal extraction (Potentially)
	<u>*Game Species*</u>, including the Baird's Tapir (*T. bairdii*), Great Curassow (*Crax rubber*), White-Lipped Peccary (*D. pecari*), Collared Peccary (*T. tajacu*), Red Brocket (*Mazama Americana*), White Tailed Deer (*O. virginianus*), Nine-Banded Armadillo (*Dasypus novemcinctus*), Central American Agouti (*Dasyprocta punctata*) and Paca (*Agouti paca*), one or more of which are known to frequent the *Tropical Evergreen Broadleaf Lowland Forest* ecosystem, are valued as food.	Unmanaged extraction (Hunting) (Presently) Lack of knowledge regarding boundaries and rules/regulations of Park
	<u>*Howler Monkeys:*</u> constitute one species of wildlife which is regarded as threatened on both international and national levels owing to habitat loss.	Local Timber extraction and hence, habitat loss (Potentially)
Freshwater Habitat	Payne's Creek and Freshwater Creek are both freshwater systems that drain the Payne's Creek watershed, flowing into Punta Ycacos lagoon system. Vital for maintaining flow through the lagoon system, and for controlling water salinity.	Fire induced loss of vegetation cover and hence, erosion-born sedimentation adjacent to and within the park
	<u>*Water Quality*</u>, particularly the water quality of Paynes Creek, Freshwater	Development on lands adjacent to the park

	Creek, Muschamp Creek and the Punta Ycacos Lagoons	
Estuary Habitat, Including Adjoining Mangrove Habitats	The Punta Ycacos Lagoon is a focal point of the protected area.	Development on lands adjacent to the park
	<u>Marine Vertebrates</u>, including the West Indian Manatee (*Trichechus manatus*), the Cow Nosed Ray (*Rhinoptera bonasus*), and the Goliath Grouper (*Epinephelus itajara*), the Hawksbill Turtle (*Eretmocheles imbricate*), and several species of water birds, including White Ibis (*Eudocimus albus*), individual Boat-billed Herons (*Cochlearius cochlearius*), bare-throated Tiger Herons (*Tigrisoma mexicanum*), Pale-vented pigeons (*Columba cayennesis*) and the Black Catbird (*Melanoptila glabirostris*)	Illegal extraction (Potentially) Clearance of mangroves, dredging, sedimentation, changes in water quality, increased boat activity (Potentially)
Game species	The endangered Baird's tapir (*T. bairdii*), near threatened great curassow (*Crax rubber*), white-lipped peccary (*D. pecari*), collared peccary (*T. tajacu*), red brocket deer (*Mazama Americana*), white tailed deer (*O. virginianus*), nine-banded armadillo (*Dasypus novemcinctus*), Central American agouti (*Dasyprocta punctata*), paca (*Agouti paca*)	Illegal extraction (hunting), particularly in the Deep River extension Lack of economic opportunities in area – supplement diet through hunting
Yellow-headed parrot	Whilst this conservation target has been chosen because of specific threats to its viability, protection of this species is primarily through fire management, which will be of benefit to other savannah specialists, such as aplomado falcon (*Falco femoralis*), savannah sparrow (*Passerculus sandwichensis*) and sedge wren (*Cistothorus platensis*), as well as Baird's tapir (*T. bairdii*), puma (*F. concolor*) and jaguar (*P. onca*), white-tailed deer	Increasing frequency of fires (burning of nesting trees) Harvesting of nestlings

	(*O. virginianus*) and collared peccary (*T. tajacu*)	
West Indian Manatee (*Trichechus manatus spp. manatus*)	Listed as a vulnerable species (IUCN Redlist) Considered an ideal umbrella species for the health of seagrass ecosystems, as well as being an early indicator of disturbance through land development and increased boat activities, being the first and most obvious species to stop utilizing the area.	Disturbance through land development Increase in boating activities

Assessment of Conservation Target Viability

Conservation planning requires the ability to assess the status of conservation targets over time, to enable planners to see whether management actions are successful in bringing about the desired changes. Current conservation planning tools therefore seek to describe the status of the conservation targets in a standardized manner, allowing comparison over time. The seven recommended conservation targets have been rated according to their viability within each of the three TNC Viability Criteria – Size, Condition and Landscape Context (Table 14), with justification for the ratings chosen – Very Good, Good, Fair or Poor (Table 15).

Table 14. The Nature Conservancy Viability Criteria

TNC Viability Criteria	
Size	A measure of the target's area or abundance, based on the minimum requirement needed to ensure survival after natural disturbance
Condition	An integrated measure of community composition, structure and biotic interactions (eg. structure, population components etc.)
Landscape Context	An integrated measure of two factors – key elemental processes that sustain the species or ecosystem, and connectivity

Table 15. The Nature Conservancy Viability Rating

TNC Viability Ratings	
Very Good Score 4	Functioning at an ecologically desirable status, and requires little human intervention
Good Score 3.5	Functioning within its range of acceptable variation; may require some human intervention
Fair Score 2.5	Lies outside its range of acceptable variation and requires human intervention. If unchecked, the target will be seriously degraded
Poor Score 1.0	If allowed to remain in the present status, restoration or preventing local extinction will be impossible

Viability Rankings for Conservation Targets

Following an assessment of the conservation targets chosen (Table 16), an overall viability ranking for each target was established, using the TNC 5-S System. Under this system, each viability rating was given a score, and the average then calculated for each conservation target to give an overall viability rating, with the averaged results being ranked.

Score	*Viability Rating*
>=3.75	Very Good
3.0 – 3.74	Good
1.75 – 2.99	Fair
<1.75	Poor

Viability Ratings

Table 16. Viability Rating Assessment of Conservation Targets

Conservation Target: Savannah		
TNC Viability Criteria	TNC Viability Rating	Justification
Size	Good	Whilst extensive areas of Payne's Creek are savannah, much of this is degraded through anthropogenic activities - logging and intense and frequent fires, and little regeneration of pine has occurred.
Condition	Fair	Heavy logging in the past, and the increasing frequency of anthropogenic fires are affecting the condition of the savannah, with fewer pine seedlings reaching maturity, resulting in a shift away from pine savannah to short grass savannah without pine. It is still a viable ecosystem, if fire management continues to be prioritized within Payne's Creek.
Landscape Context	Fair	On a regional level, the pine savannah eco-region is considered endangered / critically endangered. Throughout Belize it is under pressure from pine bark beetle, increased frequency of anthropogenic fire, logging, development, and cattle farming. It is still a viable ecosystem, if fire management is prioritized within Belize

Conservation Target: Broadleaf Forest		
TNC Viability Criteria	TNC Viability Rating	Justification
Size	Good	The area of broadleaf forest within Payne's Creek is probably not large enough to match the minimum dynamic area required should surrounding forest be cleared. It is showing good recovery from extensive hurricane damage,

		so other than preventing human impacts such as logging, it should not require intervention actions.
Condition	Good	The broadleaf forest area has not been exposed to significant anthropogenic impacts (the recent hurricane damage is considered part of the natural cycle for hurricane climax forests such as these).
Landscape Context	Fair	The viability of the broadleaf forest is heavily dependent on its connectivity to the gallery forest that follows the Monkey River eastwards. If this connectivity is interrupted, a number of the species dependant on this ecosystem will no longer have viable populations.

Conservation Target: Freshwater Ecosystem		
TNC Viability Criteria	TNC Viability Rating	Justification
Size	Very Good	The freshwater creeks within Payne's Creek are isolated from other water systems, and as such are defined by natural boundaries. No human intervention is necessary to maintain these ecosystems in their present state.
Condition	Very Good	With ranger patrols in place, there is very little human impact on these creeks, either through fishing or through creek-side land clearance. There is some impact on the creeks that run through the savanna when fires destroy bankside vegetation and cause increased erosion and sedimentation.
Landscape Context	Good	The freshwater creeks of the protected area are isolated from surrounding river systems, so there is no connectivity. However, this is a positive factor, as there are thought to be few creek systems within Belize that are still free of the invasive *Tilapia,* or threatened by development or agriculture. As such, the viability of these creeks at the landscape level is good.

Conservation Target: Estuarine Ecosystem		
TNC Viability Criteria	TNC Viability Rating	Justification

Size	Very Good	A mangrove / brackish ecosystem complex incorporating Punta Ycacos lagoon, with sufficient area and resilience to be able to recover after natural disturbance.
Condition	Very Good	The current condition is Very Good, with few anthropogenic impacts. There are serious concerns about any development impacts that may take place and this rating is at higher risk of changing.
Landscape Context	Good	The estuarine ecosystem receives freshwater from the creeks within PCNP, and marine water from Port Honduras marine reserve. This connectivity is necessary for the health of the lagoon system.

Conservation Target: Yellow-headed Parrot		
TNC Viability Criteria	TNC Viability Rating	Justification
Size	Fair	The population that uses Payne's Creek would not be viable if taken in isolation. Current pressure from increased frequency of anthropogenic fire and nest poaching is further reducing the population viability.
Condition	Fair	At present the population is breeding, but the age structure is presumed to be skewed by the increased frequency of fire and the harvesting of nestlings, both of which have reduced the nesting success. This should be urgently researched.
Landscape Context	Poor	Belize is the last stronghold of this species, and increasing pressures from land use changes, nest poaching, and the increasing frequency of anthropogenic fires throughout its range. Without human intervention, this species is unlikely to recover.

Conservation Target: West Indian Manatee		
TNC Viability Criteria	TNC Viability Rating	Justification
Size	Good	Recovering from past human hunting pressure within the

		area, now that there is continued enforcement presence
Condition	Good	Enforcement is now preventing hunting, age structure presumed to be returning to a natural equilibrium. Mating groups and mother-and-calf pairs seen within the lagoon system
Landscape Context	Good	The Belize population of manatees is in a stage of steady recovery from previous hunting pressure, but there are increasing impacts from development activities (removal of seagrass during dredging activities, sedimentation), accidental deaths in nets set over creek mouths, some hunting and most significantly - boat strikes. Human intervention is required to ensure its survival.

Conservation Target: Game Species		
TNC Viability Criteria	TNC Viability Rating	Justification
Size	Fair	There are indications of relatively heavy hunting pressure within the protected area (particularly in the newly added Deep River Forest Reserve area), however this is currently anecdotal and not measured. Fragmentation of the broadleaf forest corridor along Monkey River outside of the protected area is thought to already be impacting white-lipped peccary populations, with interruption of seasonal migrations, and increasing human population in the area is increasing both hunting and land clearance pressures. These are all affecting game species populations which traverse both inside and out of the protected area.
Condition	Fair	Lack of information to make an accurate estimation of rating however, park staff suggest that the condition is fair. Assessment of hunting pressure should be derived from social surveys
Landscape Context	Fair / Good	The game populations reliant on savannah are rated as good, as there is sufficient contiguous habitat to ensure their continued presence if hunting pressure is reduced/removed. The majority of these species are generalists (such as nine-banded armadillo), so are wide ranging in Belize, though they are thought to be showing a general decline in abundance as more land is developed. For broadleaf forest species, however, viability at the landscape context level is probably best rated as fair, as species like the white-lipped peccary rely on connectivity

		of the broadleaf forest, which is becoming fragmented in the Southern Highway area. White-tailed deer are also the subject of anecdotally intense hunting pressure, potentially for commercial purposes.

The conservation targets for Payne's Creek National Park were then rated based on their overall viability (Table 14). Two ecosystems are considered to have Very Good overall viability in their current status (Freshwater ecosystems and Estuarine lagoon), whilst two are considered to have Good viability (requiring limited human intervention – Broadleaf forest and the West Indian manatee), and three are considered to require greater human intervention, being rated as Fair (Savanna, Game species and the Yellow-headed parrot)

Conservation Target	*Size*	*Condition*	*Landscape Context*	*Overall Viability Rating*
Freshwater ecosystems	Very Good (4)	Very Good (4)	Good (3.5)	Very Good (3.83)
Estuarine Ecosystem	Very Good (4)	Very Good (4)	Good (3.5)	Very Good (3.83)
Broadleaf forest	Good (3.5)	Good (3.5)	Fair (2.5)	Good (3.17)
West Indian Manatee	Good (3.5)	Good (3.5)	Good (3.5)	Good (3.5)
Savanna	Good (3.5)	Fair (2.5)	Fair (2.5)	Fair (2.83)
Game species	Fair (2.5)	Fair (2.5)	Fair (2.5)	Fair (2.5)
Yellow-headed parrot	Fair (2.5)	Fair (2.5)	Poor (1.0)	Fair (2.0)

Overall Viability Rating
Very Good: Viability criteria at or above desired future status
Good: Viability at or above minimum threshold for biological integrity
Fair: Viability criteria at or above a minimum restorable level
Poor: Viability criteria below minimum restorable status (probably unrecoverable)

Table 17. Ratings of Conservation Targets Source: Walker & Walker, 2005

Threats to biodiversity

Having assessed the biodiversity for viability, the threats to biodiversity were identified for the Park. A threat analysis for each conservation target was conducted based on the World Conservation Society Rankings. This threat analysis involved gathering information on the:

1. Threat status (Historical, Present/Active, Potential)
2. Conservation Target affected by the Threat
3. Source of Threat (Direct and Indirect)
4. Area (How much of the conservation target it affects)

Proportion of Area Affected		(adapted from WCS)
Criteria	Score	
Area	4	Will affect throughout >50% of the area
	3	Widespread impact, affecting 26 – 50% of the area
	2	Localized impact, affecting 11 – 25% of the area
	1	Very localized impact, affecting 1 – 10% of the area

5. Severity

Severity Ranking		(adapted from WCS)
Criteria	Score	
Severity	3	Local eradication of target possible
	2	Substantial effect but local eradication unlikely
	1	Measurable effect on density or distribution
	0	None or positive

6. Urgency (Likelihood of threat occurring over the next five years)

Urgency Ranking		(adapted from WCS)
Criteria	Score	
Urgency	3	The threat is occurring now and requires action
	2	The threat could or will happen between 1 – 3 years
	1	The threat could happen between 3 – 10 years
	0	Won't happen in > 10 years

7. Recovery Time (Length of time for target to recover following major disturbance)

Recovery Ranking		(adapted from WCS)
Criteria	Score	
Recovery	3	100+ years or never
	2	11-100 years
	1	1-10 years
	0	Immediate

8. Probability of Threat Occurring (During timeframe of management plan)

Probability Ranking		(adapted from WCS)
Criteria	Score	
Probability	1.00	0.76-1.0
	0.75	0.51-0.75
	0.50	0.26-0.50
	0.25	≤0.25

The total score for each threat was then calculated using the equation:

(Urgency + Recovery) x Severity x Area x Probability

A total of eight threats were identified:

Direct:
- Fire
- Illegal Hunting and Fishing
- Illegal Logging
- Development in Adjacent Areas
- Illegal Extraction of *Acoelorraphe* (palmetto) seeds
- Illegal Extraction of Yellow Headed Parrot Nestlings

Indirect
- Lack of knowledge/awareness of park (benefits, boundaries, regulations)
- Lack of income opportunities for buffer communities

For each of the direct threats, a threat assessment was conducted (Table 18).

Table 18. Threat Assessment for Conservation Targets

Threat 1: Fire		
Increasing frequency of anthropogenic fire within the protected area		
Status	Active	
Target	Savannah	
Source	*Direct:* Hunters from local communities, milpa clearance burning out of control *Indirect*: Lack of economic opportunities in area – supplement diet through hunting Need for reinforcement of importance in managing milpa fires	
Area	4	Almost the entire savannah area (80 to 90%) was impacted by fire in 2005 and 2010
Severity	3	The savannah ecosystem is changing, with local eradication of pine in some areas
Urgency	3	Current threat. If not tackled, the ecosystem will degrade still further
Recovery Time	2	Recovery of the pine element of the savannah will take over ten years, if fire impacts are managed to allow regeneration
Probability of Threat Occurring	1	The threat is occurring increasingly frequently particularly considering climate change driven extended dry seasons

Threat 2: Hunting		
Hunting, particularly within the Deep River extension area		
Status	Active	
Target	Game Species: (White-lipped and collared peccary, white-tailed deer, red brocket deer, paca, agouti, armadillo, great curassow, crested guan, tinamou)	
Source	Direct: Hunters from some local communities, reported to be hunting within the protected area Indirect: Lack of economic opportunities in area – supplement diet through hunting	
Area	2	Primarily focused on white-tailed deer in the savanna
Severity	2	Only anecdotal data available but incidents are reported to be increasing
Urgency	3	Currently occurring
Recovery Time	1	Most game species are still present, so populations should recover over the course of 10 years
Probability of Threat Occurring	1	The threat is occurring at present, and will continue to occur until strategies are implemented to halt it

Threat 3: Development in Adjacent Areas

Impacts from development in adjacent areas – three areas of concern:

1. Punta Ycacos area at mouth of Punta Ycacos Lagoon
2. Headwaters of Freshwater and Payne's Creeks
3. Clearance of broadleaf forest between Payne's Creek National Park and Monkey River

Area 1: Punta Ycacos area at mouth of Punta Ycacos Lagoon

Status	Potential	
Target	Estuarine Ecosystems, Manatees	
Source	Direct: Clearance of mangroves, dredging, sedimentation, changes in water quality, increased boat activity Indirect: Politically supported investment opportunities	
Area	3	Will potentially affect all of Punta Ycacos Lagoon system
Severity	2	Changing water qualities and disturbance levels will alter biodiversity presence in the area. Increased boat traffic threatens manatees
Urgency	1	There are no plans for development in progress
Recovery Time	1	Most game species are still present, so populations should recover over the course of 10 years
Probability of Threat Occurring	0.25	The threat is not occurring at present, but land ownership by private developers holds an ongoing threat

Area 2: Headwaters Payne's Creeks

Status	Potential	
Target	Freshwater Ecosystems	
Source	Direct: Land clearance and changing drainage patterns Indirect: Investment opportunities, local need for more land	
Area	4	Has the potential to affect water quality and flow throughout the entire freshwater target of Payne's Creek
Severity	2	Any change in land use and water flow patterns will have the potential to affect water quality through the entire freshwater target
Urgency	1	No imminent threat
Recovery Time	2	Dependent on level and type of impact -herbicide impact (1-3 yrs), complete clearance of headwater area, may never recover
Probability of Threat Occurring	0	Unlikely to occur, but shouldn't be completely ignored

Area 3: Clearance of broadleaf forest between Payne's Creek National Park and Monkey River

Status	Potential	
Target	Broadleaf Forest	
Source	Direct: Land clearance between PCNP and Monkey River, fragmentation of forest ecosystem and decreasing connectivity Indirect: Community need for more agricultural land, investment opportunities	
Area	2	Impacts will be edge effect and loss of connectivity
Severity	1	There will be change, with edge effect, and increased number of edge species
Urgency	1	Dependent on political climate
Recovery Time	2	Forest structure will only recover if adjacent land returns to broadleaf forest
Probability of Threat Occurring	0	Unlikely to occur within the timescale of the management plan

Threat 4: Harvesting of *Acoelorraphe* within Payne's Creek National Park		
Harvesting of *Acoelorraphe* seeds for export to Canada		
Status	Active	
Target	*Accoelorraphe* (palmetto), a species of the pine savannah	
Source	Direct: Harvesting of seeds by surrounding local communities Indirect: High poverty level in adjacent communities, few employment opportunities	
Area	2	Limited harvesting in ongoing inside the protected area, but it is not thought to be on a large scale – primarily at easy access points
Severity	2	Current harvesting methodology will affect recruitment in the long term, if harvesting is expanded.
Urgency	2	Harvesting is likely to increase as populations increase.
Recovery Time	1	Once harvesting of seed stops, this species will recover relatively quickly – if the parent stock are still standing
Probability of Threat Occurring	0.75	Increasing pressure on surrounding seedstocks outside of the protected area will eventually lead to incursions, as long as the market continues

Threat 5: Theft of Yellow-headed parrot within Payne's Creek National Park		
Theft of Yellow-headed parrot nestlings		
Status	Potential	
Target	Yellow-headed parrot	
Source	Direct: Theft of nestlings by surrounding local communities – currently outside the protected area Indirect: Illegal market for parrot nestlings, High poverty level in adjacent communities, few employment opportunities	
Area	2	Occurring across coastal savannah
Severity	2	With such low populations, any nestling threat is going to have a serious impact on the recruitment and overall viability of the yellow-headed parrots in the area
Urgency	2	The likelihood of even just one nest within the protected area being robbed at some point in the next three years is high, especially for nests within the Deep River extension, where local communities are currently unaware of the new boundaries
Recovery Time	1	If nestling theft were the only threat, recovery would occur after removal of the threat
Probability of Threat Occurring	0.75	Rangers prioritize the identification and patrolling of nest sites during nesting season but the market continues to develop

The resultant total threat scores were ranked (Table 19)

Table 19. Total Threat Scores for the Conservation Targets

Threats	Criteria Ratings					Total threat Score	Ranked Threat *
	Area	Severity	Urgency	Recovery	Probability		
Fire	4	3	3	2	1	60	1
Hunting and Fishing	2	2	3	1	1	16	2
Development in Adjacent Areas: Area 1*	3	2	1	1	0.25	3	5
Harvesting of *A. wrightii*	2	2	2	1	0.75	9	=3
Theft of yellow-headed parrot chicks	2	2	2	1	0.75	9	=3
* Lowest threat score rank = 5							

*As the probability of development in Areas 2 and 3 is considered extremely unlikely over the period of the management plan, these two have not been included within the matrix.

Threats can therefore be ranked as follows:

1) Fire
2) Hunting and Fishing
3) Theft of Yellow-headed Parrot nestlings
4) Harvesting of *A. wrightii*
5) Development in Adjacent Areas

Management Constraints

Based on the experience of the staff, the assessments conducted for this Plan and stakeholder consultations, several management constraints and limitations have been identified for the Park. These include:

Lack of awareness

Specifically, this section covers the potential lack of awareness or knowledge of communities about the aesthetic, ecological and biological benefits of the Park and its regulations.

The results of the 2005 socio-economic survey indicated that, of the five main communities surveyed, half of the respondents (56.2%) did not know about PCNP. Only a third of the sample had any idea of the boundaries, rules and regulations governing PCNP. This lack of awareness also meant that half of the key informants were uncertain of TIDE's management practices and had limited involvement in the protection of the area. The more basic 2014 survey also found that most respondents were unaware who was managing PCNP (only 10% considered TIDE/government as the manager). This highlights a continued lack of understanding of the relevant authority.

The survey also looked at "Recommended Areas for Enhancement of Management Practices" from the local expert's point of view. The local experts interviewed included village leaders, Alcaldes, members of PCNP Management Committee, environmentalists/conservationists, PCNP personnel, tour guides and sport-fishers. Most of the respondents (83.3%) indicated that the awareness program within the communities and schools must be a high priority. The second area of priority as indicated by 66.7% of the respondents was the need for community participation in programs and projects geared at enhancing the sustainable development and use of the Park. Half of the respondents suggested that Education/Training Programs coupled with advocacy for development of economic initiatives must also be given attention.

Diversity increasing complexity

Ethnic

The socio-economic assessment indicated that there are various ethnic and culturally diverse peoples with both vested and historical interests in the Park. The Creole population for example has depended on the PCNP for fishing and tourism related businesses for generations. The Mestizo and Mayans likewise value the PCNP as it provides them with food (game meat and fish). This diversity means that the Park staff and the Environmental Education/Community Outreach staff will have to be ethnically and culturally sensitive to people, understand various cultural and traditional practices and be able to communicate in Creole and Spanish mainly. A small percentage of the residents speak only Kekchi Maya and Mopan Maya.

Gender

As previously outlined, like many protected area managers, TIDE is only beginning to take into account the need to understand gender roles and the way that natural and cultural resources are used by each gender. This management plan seeks to mark the beginning of this change and account for such differences with the ultimate aim of benefitting both the environment and the communities that use them. Cultural diversity of the buffer communities also raises further complexity given that gender roles can differ significantly between and within the villages.

Age

Adding yet further complexity is the need to take into account the different age groups of the buffer communities, which again can significantly influence the way in which resources are used and therefore management actions. Changing dynamics in the movement of young people in and out of these communities, some of which are growing very rapidly, raises very important questions about how the next generation will be using natural resources in and around PCNP.

Socio-economic status of buffer communities

In all the buffer communities, well over a third of the population is involved in private and individual initiatives involving the utilization of natural resources. This may mean that the communities will continue to interact with the environment in the provision of tourism services such as guiding and sport-fishing, and traditional uses such as hunting, farming, fishing, timber harvesting and other plant products. It can be surmised then that people in the buffer communities of the PCNP will continue to rely on the parks products and materials for subsistence and commercial purposes. Likewise, the limited educational achievement in the buffer region may be a concern for compliance with environmental conservation efforts. Results of the survey indicate that even after receiving the minimal primary education very few young people go on to complete high school. It is very likely then, that the majority of the people will continue to utilize the natural resources as a means of maintaining their livelihood since jobs requiring high school education will be minimally available to many of them.

Human and Financial Resources

Currently, the Park is almost completely financed by funding from external donor agencies and does not generate any income of its own. As outlined on P.53 TIDE continues to build sustainable financing sources (R2R, TIDE tours) to supplement the increasing costs of management.

Building community management through incentives is also likely to reduce management costs for comanagers. The ongoing investigations into building palmetto seed harvesting and potential timber harvesting businesses will contribute significantly toward this goal. The assumption here is that if buffer communities are deriving economic income from the effective management of PCNP's ecosystems then they are much more likely to comply with, and enforce, the laws and regulations of its management.

Finally, it is important to note that Protected Areas Conservation Trust (PACT), a key funding source for the NPAS, it undergoing major reforms to its parent legislation. The PACT Act has been amended and passed through cabinet and the House of Representatives to allow for a much more efficient and responsive funding source to maintain ecosystem services. A key component of this reform is the direct annual allocation of PACT funds for core costs, something that was previously not a permitted use of PACT funds. Core cost funding will

now be available for park management staff salaries, which was the major complaint of comanagers leading to this reform.

Accessibility

The PCNP has three principle routes of access. The first of these is the northwestern access road connecting the park to the Southern Highway; the second is the western extent of this same road where it adjoins the Monkey River; and the third is by sea through the Punta Ycacos Lagoon. Currently, there is only one ranger station that is located within the Punta Ycacos Lagoon, therefore, most of the time the other entrances are not being monitored. Secondly, the ranger station is located in a low-lying area and during the rainy season it is difficult to access the higher areas near the Southern Highway entrance due to flooding. It is proposed that a substation be placed near the access point of the Southern Highway entering through Deep River Forest Reserve.

Opportunities for the Management of the Protected Area

Willingness of Stakeholders to Engage Themselves in the Protection of the Park

The majority of the respondents (80%) interviewed in the 2005 socio-economic survey stated that the Park is extremely or fairly important to their livelihood. The respondents indicated that they are likely to participate in pertinent initiatives and are willing and prepared to commit and engage themselves in the management and governance of the PCNP. Respondents felt that their involvement can best be done through community education and active participation in community consultations. This survey was not broken down by gender or age so questions remain as to exactly who in these communities has interest in protection and management.

Since 2005, globally and regionally, the approach towards protected area management has shifted. Given the increasing recurrent costs of management of protected areas and the widespread reliance on donor funding, particularly in Belize, sustainable solutions are needed. Community management of protected areas is emerging as a viable and in many cases far more cost effective option across the region and increasingly in Belize. For community management to be successful there must be clear incentives for conservation and protection by the stakeholder communit(ies). Such incentives can be on grounds of cultural use, economic and social development or purely for their existence value. The most

significant incentive for PCNP buffer communities, in 2015, should be determined by the social surveys discussed in Monitoring & Evaluation (P.127) but based upon previous reports including King (2005) there is considerable interest in the economic benefit through livelihoods that PCNP can provide through tourism or through the potential extractive activities such as palmetto seed and pine harvesting being analysed through the Darwin project discussed on P.56. Essentially, PCNP will be conserved by buffer communities if they perceive that there are benefits that accrue as a result of that conservation.

Other innovative and collaborative approaches could include engaging with buffer community hunters who use fire as a tool for hunting. The reason these fires are so damaging is that they are uncontrolled by hunters who have little interest or technical/resource capacity to manage the fires. A potential option could be to engage those hunters in sustainable, licensed and regulated hunting which takes place in locations that have been recently burned through prescribed fire. This speaks to the intention of TIDE to develop an Integrated Approach to fire management.

Community Researchers

The Community Researcher Program, which was initially geared towards the PHMR, can be expanded to the PCNP to increase the communities' capacity to manage and protect the park's natural resources. The program builds the capacity of, mostly younger, men and women to collect biotic, abiotic and social data from inside the park and its surrounding area. The program has been a genuine success and remains one of the flagship initiatives of TIDE.

The benefits of the program include a) the development of local skills in conservation and sustainable development, increasing employability and opportunity, b) building trust between buffer villages and the science team at TIDE, and simultaneously building community trust in the analysis of the collected data, c) collection of data which can inform park management actions.

Whilst the biotic and abiotic monitoring components of this program have been particularly successful, especially in the marine sector, the social science component needs extensive development in order to collect robust data.

Established Relationship with Local Logging Concession Holder

The PCNP staff has a good relationship with the DRFR concession holder Mr Dale Gomez, who also sits on the PCNP Management Committee. This relationship is very important given that the concession duration is 40 years and fire management is critical to the success of both the concession, and PCNP function. Mr Gomez supports the Park in its endeavour to improve fire management within the Park and participates in the delivery of training to prevent and control fires within the Park. Mr Gomez has been an active and supportive member of the SBFWG since its inception and shares information to support management activities freely with the other members. Mr Gomez also assists the staff by alerting them to illegal hunting in the area as many times the fires are set by hunters who use it as a strategy to catch deer.

Promotion of the park

In order to increase awareness of the Park, TIDE must adopt a structured communications strategy which addresses the different stakeholder groups. To attract tourists it must continue to develop national and international marketing (TIDE tours, R2R) that includes website, social media, radio and television advertisements. For increasing local and national public awareness there is a continued need to professionally develop strategically designed and located signs, posters, brochures, flyers and film documentaries (Spanish and English, possibly Kekchi). These materials must address key management issues of the Park such as fire, climate change, overhunting and nest poaching but must follow the IUCN recommendation to ensure a positive message theme, '*Less loss more love'*. Essentially identification of what people love about PCNP should be sought (through social surveys) and integrated into the strategy.

A structured Environmental Education Strategy for PCNP buffer communities is long overdue and continues to contribute to the general lack of awareness of the location of PCNP, its purpose, its management and its benefits. There is a need for an annual calendar of activities that will provide for schools and other educational organizations from buffer communities to visit PCNP for educational/awareness programs. As outlined frequently in this management plan there is a need to ensure that such communications and outreach take into account the different perspectives of gender and age. The recently developed overarching Environmental Education and Outreach Strategy (2015, annexes) does outline

the core value of gender empowerment but this must be reflected in the activities and equally in the Monitoring and Evaluation of the strategy.

Increase Economic Opportunities for Local Communities

Tourism

Residents of Punta Gorda Town, Monkey River and Punta Negra Villages have received several training sessions geared towards tourism activities such as kayaking, birding, fly-fishing and small business management. The main recommendations of the stakeholder consultations as part of the 2006 management plan were to establish tourist attractions within the PCNP including visitor centre, camping grounds, nature trails and observation platforms for viewing of submerged Mayan Salt Archaeology Sites. The Monkey River Tour Guide Association and the Punta Gorda Tour Guide Association were keen on assisting in the development and establishment of these sites.

Professor Mckillop installed permanent exhibits featuring 3D printed replicas of artifacts from the Underwater Maya project at the Tourism Information Center in Punta Gorda and at the Ranger Station in Paynes Creek National Park, with funding from a Site Preservation Grant from the Archaeologial Institute of America (https://archaeological.org/projects/paynescreekbelize ; McKillop and Sills 2013). The objective of the exhibits, which also include images and text, are to help integrate the significant archaeogical finds in local tourism efforts. In fact, the PCNP Ranger Station exhibit was placed at the request of the marine tour guides, who would benefit from the value-added tourism from including archaeology in fishing, snorkeling and/or birding boat trips to PCNP. An observation platform in the lagoon was initially proposed, but in discussions at a public lecture in 2013 at Garbutt's Marine, an alternative was discussed, which would have a viewing platform (with plexiglass to view artifacts on the seafloor) at the PCNP Ranger Station, or to have a recreated wooden buliding made from the same tree species on land at PCNP. Both could be followed up and would require new funding, approval from the Belize IA, and of course, TIDE and Professor Mckillop's participation.

The consultations held in 2005 also revealed that stakeholders felt that TIDE should advocate for financial and technical assistance that will provide communities with opportunities to access resources for business initiatives such as eco-tourism development projects. Whilst these have been advanced somewhat through the development of TIDE

tours and R2R Expeditions the intervening years since 2005 have highlighted the need to further develop livelihood opportunities for the PCNP buffer communities. The reasons for this would require a specific assessment but have been reflected in the continued slower than expected growth of tourism in the wider Toledo District. Development of Cruise Ship tourism at the newly constructed port at Harvest Caye may change this trend but care must be taken to ensure the development of this type tourism is socially and ecologically sustainable. If not it could bring more problems than it solves.

Forest products

Considering that tourism potential has taken longer than expected to materialize it is sensible to identify and develop alternative livelihood opportunities. As outlined in detail on P.56, TIDE is currently approaching this through the Darwin Initiative project which is seeking specifically to develop palmetto seed harvesting given the existing market shortage and the threat to the growing industry from unsustainable harvesting and fire. Progress towards this is outlined in the management planning section (P.99). Whilst this is unlikely to solve the economic development needs of all communities, in conjunction with other livelihood opportunities developing in sustainable logging, tourism and commercial agriculture, it can demonstrate the need to protect the natural resources present in and around PCNP.

Collaboration

PCNP was established as an integral component of the Maya Mountain Area Corridor initiative for the specific purpose of providing connectivity between the Maya Mountains and Belize's coastal sea. Although an important initiative in principle, the efficacy of the PCNP's role in the corridor is entirely dependent on the continuity of management objectives and actions within the mosaic of parks and reserves of which the corridor is comprised.

The PCNP staff collaborates closely with the PHMR staff to conduct joint patrols within both the Park and the Marine Reserve, and support each other in day-to-day activities such as research, hosting educational groups and community meetings. Through initiatives such as the SBFWG TIDE is also able to share knowledge, plans and concerns with managers of these adjacent PA's. In addition the monthly Interagency meeting facilitated by the Belize Defence Force (BDF) represents another important opportunity to share knowledge of existing and arising threats and request manpower support for patrolling and enforcement activities.

Concerning monitoring, PCNP management staff must continue to play a guiding role in the development of the National Biodiversity Monitoring Plan which will provide a national framework for the monitoring of the biotic and abiotic environment. Once this process is completed opportunities to share data, training and capacity development and strategic planning should be specifically laid out with key local MMMC partners such as Ya'axché and the Southern Environmental Association (SEA). If effective reporting for the MMMC is to be completed, it is critical to take advantage of these partnerships. Furthermore, as is frequently stated in this management plan, there is a critical and overdue need to professionally develop a socio economic monitoring program in order to effectively measure the PCNP management intervention impacts. Currently it is not possible to gain any understanding of the impacts of PCNP on the socio economic status of the five buffer communities.

There is also the opportunity for the PCNP management to establish relationships with other regional organizations. TIDE is already partnering officially with the Tri-national Alliance for the Gulf of Honduras (TRIGOH), Healthy Reefs Initiative (HRI) and Panthera and through these contacts can explore linkages with the regional Mesoamerican Biological Corridor (IUCN) initiative. As a critically important part of this, exchanges with Park and Marine Reserve staff from Belize, Guatemala and Honduras should also be encouraged.

Technology

PCNP management must remain at the forefront of proven technological advances in the field of compliance monitoring. As aforementioned there is a critical need to develop GIS capacity within TIDE's permanent staff in order to conduct assessment of a variety of factors affecting ecosystem services, such as land use change, fire management and monitoring and habitat and ecosystem mapping. Further tools that will be a big part of the future approach at TIDE include the Spatial Monitoring and Reporting Tool (SMART).

SMART is much more than a data collection method. It's a suite of best practices aimed at helping protected area and wildlife managers better monitor, evaluate and adaptively manage patrolling activities. SMART includes a powerful new software application that improves the ability of protected area agencies and other ranger-based programs to combat poaching and other illegal conduct. SMART has been designed by a team of expert software

engineers and conservation scientists who have worked side by side with conservation managers around the world. The SMART team understands the needs of frontline enforcement and recognizes the challenges of protecting wildlife in the face of increasing threats and limited resources. SMART uses the power of information and the importance of accountability to help direct resources to the places they are needed most.

Key benefits of SMART include;

User-friendly features to help managers strategically plan their enforcement operations—including preparation of workplans, evaluation of patrol targets, and more efficient visualization of enforcement coverage and performance
Integration of patrol data with intelligence gathered from a variety of different sources, providing a more complete picture of poaching and the people involved
Tracking of legal and administrative cases resulting from enforcement action
Improved reporting and analysis features for more accurate interpretation of the data
Compatibility with a wide variety of GPS units and data collection devices
User support through extensive training materials, practical guidelines and technical assistance
Affordability—SMART is free to everyone and "open source," meaning that it is not owned by any single organization and can be easily adapted to meet the varied and changing needs of user
A User Forum, which gives users worldwide the chance to suggest improvements and share lessons learned
A business plan and active global SMART community to ensure SMART development is financed and supported over the long term

Camera trapping

The cost of camera taps has fallen significantly as has their memory capacity to hold both photo and video evidence of illegal activities and wildlife. Significantly camera traps can be used to capture images of hunters entering into the park in dry season to set fire. Once the individual has been identified then either a case can be built or a warning delivered.

MANAGEMENT PLANNING

Management and Organizational Background

Payne's Creek National Park (PCNP) is staffed by three rangers and TIDE's Protected Area Manager who is also responsible for the management of PHMR. Rangers conduct patrols to monitor threats to the integrity of the PCNP including hunting, foraging, fishing and wild forest fires. Rangers also play a key role in research and monitoring activities conducted in the PCNP (see Monitoring and Evaluation section P.127) and in maintaining the support of buffer communities through assisting TIDE's Education and Outreach Officer in community outreach and environmental education activities within and around the park.

PCNP field staff are also supported by the TIDE Management Staff, which includes the Executive Director, the Science Director, the Director of Operations and the Development Director.

To assist the staff in carrying out these duties, PCNP is equipped with a ranger station, a fiberglass skiff, an all terrain vehicle, a lawn tractor and two bicycles for patrols. The PCNP ranger station is equipped with a base radio and the rangers have hand held radios to communicate with the neighboring Port Honduras Marine Reserve ranger station and the TIDE headquarters.

The PCNP staff has received training in protected area management, fire management and law enforcement. Rangers and the Protected Area Manager have obtained Special Constable status through training with the Police Training Department.

Management Goal

The main purpose of the Park is the preservation of biodiversity and water quality and the sustainable provision of ecosystem services to surrounding communities. Such ecosystem services include flood buffering, spillover of game species, direct livelihood opportunities (tourism) and a productive nursery for commercially fished species It is important to note that whilst the current status of PCNP as a National Park prohibits extractive activities, the Darwin Initiative Project commencing in 2015 is assessing the viability of sustainable extractive activities which, if ultimately viable, could lead to an application for the revision of the park zonation.

Management Strategies

The PCNP comanaging entity, TIDE, has an approach to conservation that is based on a five-prong approach that includes:

Protected Areas Planning and Management

To protect conservation targets by promoting and leading the planning and management for protected areas in the target area

Promotion of Sustainable Development

Taking a landscape scale – Ridge to Reef approach to conservation and development initiatives that generate opportunities for the residents and lead to the sustainable development of the target area

Research and Monitoring

To maintain the biodiversity and integrity of the ecosystems through continuous research, monitoring and to inform policy change within an adaptive management approach.

Environmental Education and Outreach

To facilitate behavior change toward protection and sustainable use by enhancing the knowledge base on target area's natural resources , processes and human benefit

Institutional Development

Improve TIDE's organizational capacity to accomplish its mission

The management strategy for the Park takes into consideration the five components listed above with the realization that to ensure the long-term ecological integrity of the Park, a balance of all five components must be achieved.

Management Programs and Objectives

The Management Program and Objectives for the Park are based on an analysis of the threats and opportunities identified in the Conservation Planning section.

Six programs have been identified for the Park:
1: Site Protection Program 2: Fire Management Program 3. Alternative Livelihood Development Program 4: Administrative Capacity Enhancement Program 5: Research and Monitoring Program

6: Education and Awareness Program

PROGRAM 1 - Site Protection

Background:

The site protection program focuses on illegal hunting, fishing and logging, extraction and nest destruction of yellow headed parrot chicks and extraction of palmetto seed (*Acoelorraphe wrightii)*. TIDE has addressed some of the issues, raised in the previous management plan surrounding confusion over poorly demarcated boundaries and has cleared the main boundary line with DRFR. Further recommendations of the previous management plan, to launch a campaign amongst the buffer villages of the location and objectives of the park, have also been undertaken. Over the forthcoming 5 years TIDE intends to increase compliance with park rules through increased park surveillance and the development of livelihood opportunities to provide incentives for compliance. Underpinning all programs is the implementation of monitoring and evaluation frameworks. This will ensure that management effectiveness can be measured.

Management Objective: To increase levels of compliance within the park

Monitoring recommendations: Integrate the full use of SMART by the park staff to gather an initial baseline of patrol infractions. This will allow measurement of patrol effort in comparison to incidents enabling more accurate allocation of limited resources. SMART also allows measurements of patrol effort and fuel use by the ranger team.

Management Actions:

Patrolling and enforcement

- Develop an integrated compliance plan which covers PCNP, PHMR and TPPL
- Maintain water based patrols at >150/yr, maintain land based patrols at >50/yr , park management must amend this based upon adaptive management principles and resource availability.

- Conduct at least five multi-agency patrols annually with FD, BDF and Coastguard
- Construction of sub-station at boundary of PCNP/DRFR
- Upgrade PCNP access road to facilitate enforcement and fire management activities
- Install radio repeater system or cellular communications at ranger base and substation
- Install internet at PCNP ranger base
- Integration of SMART system for patrol monitoring and reporting
- Park manager to develop monthly patrol schedule and integrate with other managed PA's

Sustainable extraction

- Formalise and secure licences for sustainable extraction concessions
- Establish a concessionaires committee with TIDE, FD and community

Conservation target protection

- Direct protection of nest trees (fuel clearance)
- Implement specific Yellow Head Parrot nest site patrols during rearing season
- Establish and enforce no-wake zones for manatee protection

Monitoring and evaluation

- Conduct biennial management effectiveness assessments in accordance with monitoring strategy
- Produce annual SMART reports to assess patrol performance

Boundary demarcation and zonation

- Investigate possibility of realigning boundaries to include Deep River southern estuary bank and mangroves and coastal ridges from portion excised in 2004
- If feasible, negotiate terms for re-zoning of park for sustainable extraction activities
- Survey and demarcate potential concession boundaries and revised zonation plan

- Clearing of 3 remaining boundary lines of PCNP (Bladen branch to coastline south of Monkey River, Monkey River to Punta Negra and Lagoon, Deep River to Freshwater creek)
- Install signs at strategic points of the park to inform resource users and land developers

Maintenance and equipment

- Repairs and ongoing maintenance to site infrastructure and equipment
- Procurement of equipment necessary for management activities
- Vehicle maintenance and repair

Advocacy

- Support buffer communities in advocating against unsustainable development which affects the park
- Along with buffer communities, lobby for revised policy and legislation where necessary

PROGRAM 2 - Fire Management Program

Background:

Fire has been identified as a major problem within the Park. The pine savanna has been constantly subjected to anthropogenic fires set primarily by hunters wanting to attract white-tailed deer that feed on the new shoots of grass after a fire. The pine savanna habitats (including both the 'short-grass savanna with needle-leaved trees' and the now largely lost 'tropical evergreen seasonal needle-leaf lowland dense forest') have been continually exposed to anthropogenic fires for several decades at least. Whilst infrequent fires (3-5 yrs) are needed to maintain pine woodlands and prevent succession towards broadleaf forest, annual fires shift the balance towards open, low-density pine savanna, with a relatively species-poor herbaceous layer and very low pine regeneration.

Management Objective: To achieve a fire return interval of between three to five years

Monitoring recommendations: In combination wit h the recommended monitoring of the ecological and regenerative effects of wildfire and prescribed fire on the PCNP savannah it is strongly recommended that TIDE and the PCNP staff build their capacity in GIS mapping of fire history and fire risk modeling. They key is to attempt to recognize the impacts that management interventions have had on biodiversity and sustainable livelihoods.

Management Actions:

Collaboration

- Coordinate three SBFWG meetings per year
- Focus group meetings with community leaders

Community fire management

- Support the devolution of fire authority to community level
- Mapping no-burn zones based on fire risk analysis
- Investigation of feasibility of coordinating hunting with prescribed fire
- Farmers applying best practices in use of agricultural fire
- Community fire officers predicting fire risk based on prevailing weather conditions
- Supporting the development and training of community fire brigades

Fire management

- Conduct wildfire suppression as necessary (TIDE & Community)
- At least 9 members of SBFWG conduct at least 5 prescribed burns in PCNP per year

Equipment

- Procure fire management equipment as necessary (including replacements)

PROGRAM 3 - Alternative Livelihood Development

Background:

The aim of the alternative livelihood development program is to improve economic opportunities that are consistent with the sustainable development of the park for residents of buffering communities. The focus will be on the investigation of sustainable extraction of palmetto seed, also covered in other programs, and pine and also the development of basic infrastructure for the park to accommodate visitors, marketing of the park and site-specific training of park staff and tour guides. Funds generated will be used to offset the management costs for the park.

TIDE's Sustainable development program aims to reduce poverty and the resulting pressure on natural resources. This involves increasing opportunities for sustainable income generation through the development of new products and services that utilise local resources and existing assets sustainably. This approach will also focus on the inclusion of other household members such as women and youth. Three main overarching initiatives have been identified for the coming 5 years of this plan in PCNP;

- Sustainable extraction
- Value adding
- Ecotourism

Management Objective: To develop economic opportunities that create incentives for conservation

Monitoring recommendations: The most pressing need is to gather a comprehensive socio economic baseline from which any positive or negative future trends resulting from management interventions can be assessed. See P.135 for more details on the recommended methodology.

Management Actions:

Sustainable extraction

- Develop business and marketing plans for 3 Small Forest Enterprises

Alternative livelihood opportunities

- Support alternative livelihood development based upon survey results
- Focus on livelihood opportunities that target women

Site infrastructure

- Construct 2 cabanas to build capacity to host student groups
- Construct observation platform at underwater Maya archaeological sites
- Extend boardwalk
- Develop new trails in the park

Support for sustainable financing

- Support the development of new packages and tours through Ridge to Reef and TIDE tours. This should follow the TIDE tours/R2R investment plan.

PROGRAM 4 - Administrative Capacity Enhancement

Background:

The development of the capacity of the staff to manage the park must take priority as the successful implementation of the plan will be dependent upon this objective being met. The focus of this program will be on training of both staff and buffer communities in order to meet the conservation objectives of this management plan.

Management Objective: To improve administrative capacity to manage the Park

Monitoring recommendations: Conducting internal capacity needs assessments will provide an idea of progress in terms of PCNP staff capacity. In addition the introduction of the ranger payscale and advancement scheme will provide an obvious indicator of capacity progress.

Management Actions:

Community management

- Maintain at least 3 meetings of advisory committee
- Develop community fire management training materials
- Train >50 farmers and community leaders in basic fire management
- Build community and NGO/government partner capacity to deliver basic training

Capacity enhancement for park staff

- Improve GIS monitoring capacity
- Develop SMART capacity (field and technical)
- Provide training to at least 20 staff (TIDE, Ya'axché, Forest Dept) in Small Forest Enterprises
- Participate in NTPPAM courses as per capacity needs assessment

Capacity development tools

- Develop standard operating procedures (SOP) manual for ranger team
- Develop and implement tool to conduct biennial assessment of park staff capacity development needs

Performance monitoring

- Implement ranger professional advancement incentive
- Train park management staff in development of performance targets and goal setting

PROGRAM 5 - Research and Monitoring Program

Background:

In 2005, several baseline assessments were conducted for the Park including, biological, hydrological, geological, socio-economic and land use studies. These assessments also identified potential research and monitoring priorities for the Park. 10 years on there is a need to refresh these baselines and develop a comprehensive social and ecological monitoring program. This research and monitoring program for the Park should be focused on providing information that will assist the Park staff in addressing key management issues for the Park and assessing the relative impact park management is having on conservation

targets, biodiversity and the buffer communities. A major challenge for research and monitoring activities will be to provide the continuity and accuracy of long-term studies that are usually required to before conclusions can be made.

It is also important to develop research and monitoring strategies that inform questions about vulnerability and resilience of system components (natural systems and key species) to climate change. Across all the activities below it is critical to determine sensitivity, adaptive capacity, resilience and exposure of system components to projected climate change impacts in order to inform a conceptual framework for climate change adaptation strategies

Management Objective: To create a structured research program that supports the management objectives of the Park and provides income generation through provision of facilities.

Monitoring recommendations: Developing GIS capacity to inform and support long term biodiversity monitoring will advance the program considerably. TIDE should continue to develop long term ecosystem health indicator monitoring in collaboration with Ya'axché to generate landscape level analysis. Likewise water quality monitoring can be expanded into the park to monitor effects of climate change.

Management Actions:

Fire effects

- Measure short term fire effects using photo point monitoring assessment

Long term indicator monitoring

- Collect data on two biodiversity transects as part of long term monitoring program
- Share results with Ya'axche to produce combined report
- Develop protocol for long term bird monitoring point counts

- Conduct monthly water quality monitorgn in PCNP lagoon as part of wider TIDE program

Yellow Head Parrots

- Monitor nests weekly to determine nestling success
- Install video cameras to observe nesting behavior
- Replace old boxes and install at least 5 new boxes per year
- Provide veterinary care for Yellow Head Parrots and nestlings
- Removal of at risk nestlings for captive rearing
- Repair and maintain pre-release enclosure
- Develop baseline and protocol for monitoring of Yellow Head Parrot
-

Endangered floral species

- Establish baseline and protocol for monitoring *Vitex gaumeri* and *Zamia prasina*,

Social monitoring

- Baseline survey of livelihoods in 5 buffer communities
- Baseline survey of perceptions, attitudes and behaviors in 5 buffer communities
- Gender inclusive assessment of interest in Sustainable forest enterprises (SFE's) amongst 5 communities,
- Undertake long term monitoring of changes in attitudes and behaviors (every 5 years) in 5 buffer communities
- Baseline survey of fire knowledge and attitudes in 5 buffer communities
- Evaluate socio-economic costs of palmetto seed harvest

Sustainable extraction monitoring

- Implement palmetto and timber concession monitoring programs if concessions are granted
- Undertake satellite and ground survey of pine and palmetto stocks to inform concession placement

- Establish and monitor 28 permanent sample plots to assess seedling and seed regeneration rates
- Develop baseline and protocol for monitoring of pine harvest
- Develop baseline and protocol for monitoring of palmetto harvest

Collaboration

- Develop collaborative research and monitoring partnerships with other organizations operating in the MMMC
- Develop research partnerships to address identified priority information gaps and conservation targets

PROGRAM 6. Education and awareness

As mentioned previously the TIDE education and outreach messaging must follow the less loss, more love approach recommended by IUCN. The program should feed into the development of, and integrate the results of the social surveys into the adaptive development of the guiding Education Strategy. Awareness, attitudes and behaviours of buffer communities, with data disaggregated by gender, age, linguistic group and village will help considerably with informing PCNP staff and management on the necessary approach towards targeting awareness of the PCNP.

Management Objective: To build awareness of the objectives and importance of the park and its conservation targets, and the benefits they provides on a local, national and international level

Monitoring recommendations: There is a need to set realistic and achievable monitoring targets for this program given its identification as a major weakness in the Education Strategy . A simple start would be setting targets for number of recipients of education and awareness broken down by age group and gender, and recording data annually. 3 year surveys and focus groups could be used to test the transmission of conservation messages identified by TIDE in the strategy.

Management Actions:

Conservation targets

- Develop and distribute materials outlining the laws concerning Yellow Head Parrot
- Develop and broadcast awareness raising public service announcements on national radio on key park threats and conservation targets
- Participate in national radio morning talk show to raise awareness of threats facing Yellow Head Parrot
- Raise awareness of fire risks, laws and best practice

Protected Area Awareness

- Distribute awareness raising materials to communicate protected area laws
- House to house awareness raising visits

Education strategy (M&E)

- Implement TIDE's Education Strategy as it pertains to PCNP and buffer communities
- Implement the monitoring and evaluation recommendations for behavior change outlined in the education strategy

Inclusivity

- Implement targeted education for women and youth

Community integration

- Develop community researcher program and activities in PCNP and buffer communities

Management Zones

The main purpose of PCNP, as per the management category, is the "*protection and preservation of natural and scenic values of national significance for the benefit of the public and the sustainable use of the resources through non-extractive activity"* – mainly tourism. Given the socio-economic situation of buffer communities, the challenge to manage the PCNP successfully lies in its ability to provide an opportunity for the residents to make a sustainable income off the park, historically this has been attempted using non-extractive activities, mainly research and tourism activities. However, tourism has not proven to be the panacea that was hoped for and there is a need, in the context of rapidly expanding populations, for other sustainable livelihood options. In the 2006 management plan the map below was proposed to allow for the development of tourism activities in PCNP. Proceeding as this management plan is being written is the investigation into the social, economic and ecological feasibility of sustainable extractive activities in PCNP. If this study finds that such activities can proceed without negative impact on ecosystem services of the park then TIDE will apply for a re-categorization and zoning plan for the park. These details will be inserted into the management plan when the study is completed. The following are the relevant aspects of the previous zonation which will be transferred in some form to the forthcoming zonation.

Recreational Use Zone

Objective: To promote the recreational and economical value of the area through its enhancement of tourism activities; to increase economic benefits to the communities and the park and to allow for research and education.

Rationale: This zone encompassed the Punta Ycacos Lagoon marine estuary. The Punta Ycacos Lagoon is an important fly-fishing site and contains archaeological areas. If the activities within this area are managed properly, it will enhance the area for tourism, thereby increasing benefits to communities. The lowland broadleaf forested areas used by the Monkey River Tour Guide Association to conduct tours (hiking, bird watching) within the park are also located within this zone. It is hoped that the development of this area for recreational purposes will further enhance the incentive for conservation of PCNP.

Regulations:

- Non-extractive recreational activities allowed such as sight-seeing and kayaking
- A policy of catch and release fishing for all tarpon, bonefish and permit will be applied within the park.
- Tourists (visitors) will be allowed into designated trails and sight seeing areas only, except with special permission from the PCNP manager.
- All visitors must be escorted by a site-specific tour guide.
- All visitors must pay a park entrance fee (National Parks Entry Fees Regulations, SI 74 of 2003) and sign a log book.
- No extraction of any flora or fauna without special permission from the managing authority.
- All fly-fishing boats must register at the park headquarters before entering the Ycacos Lagoon.
- Camping in designated areas only and all campers require permission from the managing body. The management body has the right to limit the number of campers. A separate camping fee will be paid.
- Boats must use marked access where available.
- The lagoon will have a speed limit of 10 knots in navigation channels and a 5 knot (no wake) limit in shallows and flats. Slow speed is encouraged at all times.
- Access to designated archaeological spots requires the permission of the management authority.
- A carrying capacity of 10 tourist boats will be allowed within the lagoon at any one time.

Zonation recommendations

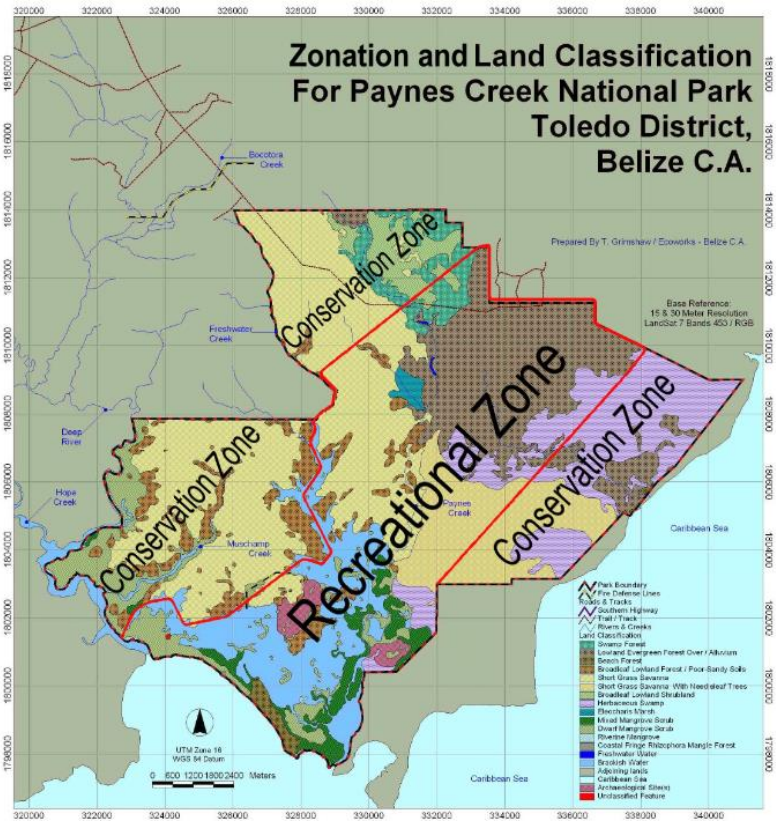
The current zonation plan, developed originally in the 2006 management plan is in need of updating. Through the Darwin Initiative project frequently mentioned throughout this plan, TIDE as the comanagers of PCNP are conducting an in-depth feasibility study into the potential to develop sustainable extraction for the overall improvement of management and conservation target status of PCNP and surrounding savannah protected areas. The target species for extraction, subject to the feasibility study, include palmetto, pine and potentially selected game species. The final report of this study will be presented to the regulatory authority of the National Protected Areas System and, conditional on a positive outcome,

accompanied by a recommendation for a new zonation plan and an amendment to the management category for PCNP.

Zonation compliance

Ensuring that the recreational activities within the lagoon remain low impact will require a collaborative approach with the main fly fishing guides that utilize the area. It is important to support the development of best practices in catch and release fishing. Spot checks may periodically need to be conducted. It is also critically important to ensure that all boats (including those of enforcement authorities) are abiding by the speed limit to avoid boat collisions with the manatees. Boat strike deaths have spiked in recent years and stand as the number one threat to this endangered species and conservation target. Whilst this threat is most serious at a national level, primarily in the Belize River estuary, there is a need to maintain vigilance given the potential increased boat traffic arising from increased tourism activities. Speed limits will also reduce impacts from noise levels and waves impacting the shorelines. Additional signs should also be posted to keep boats out of shallow area. Archaeological sites will have to be closely monitored to ensure non-tampering of sites.

Figure 14. Previous Conservation Zoning Plan for Payne's Creek National Park



General Rules of the Park

- All boats and vehicles entering the park, must check into a designated visitor center and pay an entrance fee per person (National Parks Entry Fees Regulation (SI 74 of 2003)
- All persons with a special permit (including sport fishers, tour operators, researchers, etc.) should abide by the rules within their license agreement.
- No person shall alter any sign, buoy, or notice within the park.
- No person shall have in their possession within the boundary of the park any flora or fauna other than in accordance with this plan.
- No person shall deposit any substance (solid or liquid) within the boundary of the park except in cases allowed by the managing authority.
- Licenses and permits issued are non-transferable.
- Rules of the park are only non-applicable in life threatening situations.
- All existing laws of Belize, in particular the Forest Laws and Fisheries Laws apply.
- All park staff personnel reserve the right to stop, board, and search any vessel and confiscate illegal items.
- All scientific research requires a permit from both the Government Authority responsible and the Managing Authority. The government shall in accordance with sections 5(1) and 7(1) of the National Parks System act process all applications for camping, scientific research and other related activities, and shall grant approval for such applications in consultation with TIDE. Research is allowed with stringent guidelines, based on the research needs of the park and a research fee shall be charged by the Managing Authority.
- All educational activities require coordination and approval from the managing body.
- All educational groups must be escorted by a park guide unless otherwise authorized by management.
- All tourists/visitors/scientists must be escorted by a site-specific tour guide.

Implementation Plan

The following section details the management actions that should be implemented to achieve the conservation of the outlined targets.

Table 20: Five Year Implementation Plan (January 2016 – December 2020)

	Year 1 Jan 2016 - Dec 2016	Year 2 Jan 2017 - Dec 2017	Year 3 Jan 2018 - Dec 2018	Year 4 Jan 2009 - Dec 2019	Year 5 Jan 2010 - Dec 2020
SITE PROTECTION PROGRAM					
Patrolling and Enforcement					
Develop an integrated compliance plan which covers PCNP, PHMR and TPPL	X	X			
Maintain water based patrols at >150/yr	X	X	X	X	X
Maintain land based patrols at >50/yr	X	X	X	X	X
Conduct at least five multi-agency patrols annually with FD, BDF and Coastguard	X	X	X	X	X
Construction of sub-station at boundary of PCNP/DRFR	X	X			
Upgrade PCNP access road to facilitate enforcement and fire management activities	X				X
Develop communications between ranger teams, bases and substations	X				
Install internet at PCNP ranger base	X				
Integration and implementation of SMART system for patrol monitoring and reporting	X	X	X	X	X
Park manager to develop monthly patrol schedule and integrate with other managed PA's	X	X	X	X	X
Sustainable extraction (contingent on zonation approval)					

Formalise and secure licences for sustainable extraction concessions		X	X		
Establish a concessionaires committee with TIDE, FD and community		X			
Conservation target protection					
Direct protection of nest trees (fuel clearance)	X	X	X	X	X
Implement specific Yellow Head Parrot nest site patrols during rearing season	X	X	X	X	X
Establish and enforce no-wake zones for manatee protection		X			
Monitoring and evaluation					
Conduct biennial management effectiveness assessments in accordance with monitoring strategy			X		X
Produce annual SMART reports to assess patrol performance	X	X	X	X	X
Boundary demarcation and zonation					
Investigate possibility of realigning boundaries to include Deep River southern estuary bank and mangroves and coastal ridges from portion excised in 2004		X			
If feasible, negotiate terms for re-zoning of park for sustainable extraction activities		X	X		
Survey and demarcate potential concession boundaries and revised zonation plan			X		
Clearing of 3 remaining boundary lines of PCNP (Bladen branch	X	X			

to coastline south of Monkey River, Monkey River to Punta Negra and Lagoon, Deep River to Freshwater creek)					
Install signs at strategic points of the park to inform resource users and land developers	X	X			
Maintenance and equipment					
Repairs and ongoing maintenance to site infrastructure and equipment	X	X	X	X	X
Procurement of equipment necessary for management activities	X	X	X	X	X
Vehicle maintenance and repair	X	X	X	X	X
Advocacy					
Support buffer communities in advocating against unsustainable development which affects the park	X	X	X	X	X
FIRE MANAGEMENT PROGRAM					
Collaboration					
Coordinate three SBFWG meetings per year	X	X	X	X	X
Focus group meetings with community leaders	X	X	X	X	X
Community fire management					
Support the devolution of fire authority to community level	X	X			
Fire management					
Conduct wildfire suppression as necessary (TIDE & Community)	X	X	X	X	X

At least 9 members of SBFWG conduct at least 5 prescribed burns in PCNP per year	X	X	X	X	X
Equipment					
Procure fire management equipment as necessary (including replacements)	X	X	X	X	X
ALTERNATIVE LIVELIHOOD DEVELOPMENT PROGRAM					
Sustainable extraction					
Develop business and marketing plans for 3 SFE's	X	X			
Alternative livelihood opportunities					
Support alternative livelihood development based upon survey results		X	X	X	
Focus on livelihood opportunities that target women	X	X	X	X	X
Site infrastructure					
Construct 2 cabanas to build capacity to host student groups	X	X			
Construct observation platform at underwater Maya archaeological sites			X		
Extend boardwalk			X		
Develop new trails in the park		X	X	X	
Support for sustainable financing					
Support the development of new packages and tours through Ridge to Reef and TIDE tours	X	X	X	X	X
ADMINISTRATIVE CAPACITY ENHANCEMENT PROGRAM					

Community management					
Maintain at least 3 meetings of advisory committee	X	X	X	X	X
Develop community fire management training materials	X	X			
Train >50 farmers and community leaders in basic fire management	X	X	X		
Build community and NGO/government partner capacity to deliver basic training	X	X	X		
Capacity enhancement for park staff					
Improve GIS monitoring capacity	X	X	X	X	X
Develop SMART capacity (field and technical)	X	X			
Provide training to at least 20 staff (TIDE, Ya'axché, Forest Dept) in Sustainable Financing Enterprises	X	X			
Participate in NTPPAM courses as per capacity needs assessment	X	X	X	X	X
Capacity development tools					
Develop standard operating procedures (SOP) manual for ranger team			X		
Develop and implement tool to conduct biennial assessment of park staff capacity development needs	X		X		X
Performance monitoring					
Implement ranger professional advancement incentive	X	X	X	X	X
Train park management staff in development of performance targets and goal setting	X				
RESEARCH AND MONITORING PROGRAM					
Fire effects					
Measure short term fire effects using photo point monitoring assessment	X	X	X	X	X

Long term indicator monitoring					
Collect data on two biodiversity transects monthly as part of long term monitoring program	X	X	X	X	X
Share results with Ya'axche to produce combined biennial report	X		X		X
Develop protocol for long term bird monitoring point counts	X	X			
Conduct monthly water quality monitoring in PCNP lagoon as part of wider TIDE program	X	X	X	X	X
Yellow Head Parrots					
Monitor nests weekly to determine nestling success	X	X	X	X	X
Install video cameras to observe nesting behavior	X				
Replace old boxes and install at least 5 new boxes per year	X	X	X	X	X
Provide veterinary care for Yellow Head Parrots and nestlings	X	X	X	X	X
Removal of at risk nestlings for captive rearing	X	X	X	X	X
Repair and maintain pre-release enclosure	X				
Develop baseline and protocol for monitoring of Yellow Head Parrot	X				
Endangered floral species					
Establish baseline and protocol for monitoring *Vitex gaumeri* and *Zamia prasina*,		X	X		

Social monitoring					
Baseline survey of livelihoods in 5 buffer communities	X	X			
Baseline survey of perceptions, attitudes and behaviors in 5 buffer communities	X	X			
Gender inclusive assessment of interest in Sustainable forest enterprises (SFE's) amongst 5 communities,	X	X			
Undertake long term monitoring of changes in attitudes and behaviors (every 5 years) in 5 buffer communities			X		
Baseline survey of fire knowledge and attitudes in 5 buffer communities	X	X			
Evaluate socio-economic costs of palmetto seed harvest		X			
Sustainable extraction monitoring					
Implement palmetto and timber concession monitoring programs if concessions are granted			X	X	X
Undertake satellite and ground survey of pine and palmetto stocks to inform concession placement	X				
Establish and monitor 28 permanent sample plots to assess seedling and seed regeneration rates		X	X	X	X
Develop baseline and protocol for monitoring of pine harvest				X	X
Develop baseline and protocol for monitoring of palmetto harvest		X	X	X	X
Collaboration					
Develop collaborative research and monitoring partnerships with other organizations operating in the MMMC	X	X	X	X	X

Develop research partnerships to address identified priority information gaps and conservation targets	X	X	X	X	X
EDUCATION AND AWARENESS PROGRAM					
Conservation targets					
Develop and distribute materials outlining the laws concerning Yellow Head Parrot	X		X		X
Develop and broadcast awareness raising public service announcements on national radio on key park threats and conservation targets	X	X	X	X	X
Participate in national radio morning talk show to raise awareness of threats facing Yellow Head Parrot	X	X			
Raise awareness of fire risks, laws and best practice	X	X	X	X	X
Protected Area Awareness					
Distribute awareness raising materials to communicate protected area laws	X	X	X	X	X
House to house awareness raising visits	X	X	X	X	X
Education strategy (M&E)					
Implement TIDE's Education Strategy as it pertains to PCNP and buffer communities	X	X	X	X	X
Implement the monitoring and evaluation recommendations for behavior change outlined in the education strategy	X	X	X	X	X
Inclusivity					
Implement targeted education for women and youth	X	X	X	X	X
Community integration					
Develop community researcher program and activities in PCNP and buffer communities	X	X	X	X	X

Financing

Economic sustainability of protected areas is paramount to their permanence, function and achievement of the goals for which they have been designated. During the formative years of protected area development, donor institutions have participated in the financing of both the capital (non-recurrent) and operating (recurrent) cost of conservation. Recent trends however indicate that donors are shifting their funding strategies to address non-recurrent expense, while encouraging protected areas to develop recurrent sources revenues with which to meet routine expenditures for salaries and maintenance. TIDE has made great strides toward this goal with the development initially of TIDE tours and most recently through one of its programs, R2R. R2R is showing early signs of promise in providing a reliable contributing source to the overall financing needs of PCNP. Furthermore, the development of R2R activities has significant benefits for buffer communities who are involved in various ways either employed as staff, tour operators, supplies vendors or through the increase in local spending by the visitors. In the pilot phase of R2R in 2014/2015 this amounted to an estimated BZ$39k. As mentioned earlier in this plan, community management through economic incentive can drastically reduce the annual costs of PCNP and should also remain a component of the multi-faceted financing strategy for PCNP.

Attracting academic tourism partnerships

The conservation zoning scheme can be further capitalized on to build an important revenue stream for the PCNP from tropical study courses and programs, in being able to provide access to teachers, students and researchers interested in learning or developing field methods for resource management. This will also be facilitated and channeled through R2R and will require marketing efforts to specific university departments with interests in the type of wildlife extent within the park. TIDE can also develop Tropical Studies training that would attract foreign students who want to earn school credits. These training courses can either be advertised through a number of University contacts in Belize of through advertisement on the web. Developing a formal training course with a university would be ideal since TIDE could then forecast income stream and more properly plan activities.

User Fees

The National Parks (Entry Fees) Regulations, 2003 (SI 74 of 2003) made it possible for entrance fees to be collected for the PCNP. TIDE can collect $2.00 per Belizean and $10.00 per non-Belizean who enters the Park. Children under twelve (12) years of age and senior Belizean citizens over the age of sixty-five (65) years are exempted from paying the prescribed entry fees. This is an income source that should be investigated given the opportunities presented by cruise ship tourism development at Harvest Caye, less than 15kn north of Monkey River. If cruise ship tourism can be developed inside PCNP without negative impact to the conservation targets and subject to an impact assessment and the development of guiding carrying capacity recommendations, it could be a valuable income source for the park. It is recommended that this be investigated as a sustainable income generating source.

Museum for Archaeological artifacts

The PCNP is unique in relation to its submerged archaeological sites located within the Ycacos lagoon. With proper development and management, these sites can serve as a major attraction for the park and a revenue generator. It is recommended that discussions be held with the Department of Archaeology and long term researcher, Professor Mckillop, to illustrate the park management team's interest in playing a vital role in preserving these archaeological sites and showcasing them locally. This can further complement the sustainable financing activities of R2R and the ancillary community tourism industry and small scale enterprises. It is important to note the contribution of Professor Mckillop in donating 3D replicas of the discovered artifacts along with accompanying interpretation.

The PCNP Ranger Station exhibit was placed at the request of the marine tour guides, who would benefit from the value-added tourism from including archaeology in fishing, snorkeling and/or birding boat trips to PCNP. An observation platform in the lagoon was initially proposed, but in discussions at a public lecture in 2013 at Garbutt's Marine, an alternative was discussed, which would have a viewing platform (with plexiglass to view artifacts on the seafloor) at the PCNP Ranger Station, or to have a recreated wooden buliding made from the same tree species on land at PCNP. Both could be followed up and would require new

funding, approval from the Belize IA, and of course, TIDE and Professor Mckillop's participation. See https://archaeological.org/projects/paynescreekbelize for more details and some images of the proposals.

Monitoring and Evaluation

There are two categories of monitoring:

- Monitoring success of strategy implementation (have we carried out the strategies developed during our conservation planning?)
- Monitoring effectiveness of the strategy (have the strategies we've implemented been successful in tackling the threat?)

Both are important, providing feedback on how the management implementation process is proceeding, and how successful the strategies are, allowing flexibility, with the adaptation of strategies to suit new circumstances. A monitoring plan for each objective will have to be developed with specific indicators to measure effectiveness. This may include pre and post surveys to be able to detect a change. The PCNP staff develops an annual work plan each year and it is suggested that the annual work plan be evaluated on a monthly basis. The PCNP Management Committee should also be presented with a report every six months on the progress of the implementation of the work plan. Other stakeholders, communities and NGOs should also be provided with information on the status of the work plan.

Management effectiveness assessment

It is proposed here that management effectiveness reviews can be conducted internally provided the following monitoring methodologies in this section are implemented. Such reviews should take place biennially and do not need to be exhaustive. More in depth reviews, possibly independent could be conducted at 5 year intervals. Valuable lessons can be drawn from the Healthy Reefs Initiative Eco audit (http://www.healthyreefs.org/ecoaudit/FullEcoAuditIndicators.pdf) which is conducted every two years. Simple annual trends can be identified using SMART (which can also has plug-ins which can be adapted to gather social and ecological data) and can provide much needed information to feed into annual adaptive management strategies.

Biodiversity Monitoring

TIDE, as managers of PCNP, intend to fulfill the role of the park within the NPAS by addressing some of the main priorities of the NPAS Rationalization (2013).

Table 21. The potential for the results from PCNP biodiversity monitoring data for indicating the success of meeting priorities listed in the NPAS Rationalization Report.

National Priorities (NPAS Rationalization Report)	Biodiversity Monitoring Indicators
Maintain health of key ecosystems (including Pine Savannah, Wetland and Tropical Evergreen Broadleaf Forest)	Bird species diversity Presence of priority bird and mammal species Bird and mammal indicator species proportions
Maintain a habitat that supports the migratory species	Bird migration route health indicator species proportions
Support the regeneration of key ecosystems affected by hurricane iris	Bird species diversity Presence of priority bird and mammal species

Results from the biodiversity monitoring data serve not only as indicators of the effective management occurring within the boundaries of PCNP, but also the success of a number of programs aiming to target specific threats to priority species. For example, education about hunting and fishing closed seasons, park boundary locations, outreach schemes for riparian reforestation and alternative livelihoods.

Biodiversity Monitoring Program

Monitoring of the birds and large mammals in PCNP has been carried out by the PCNP ranger team since 2008. It involves carrying out repeated surveys across a set of sites using standardised methods and protocols that allow changes to be measured through time. Ultimately this acts as a tool for developing and adapting species and site protection/management. The data derived from the monitoring activities has a range of uses.

This includes measuring the impact of threats, such as a) land use change, b) providing summary information on the state of nature and how it is changing, c) measuring the efficacy of conservation actions for species or sites (Gregory and Strien, 2010). In this way, the biodiversity monitoring data should help to evaluate PCNP management effectiveness.

Indicator Species

Birds can act as good indicators of biodiversity as they are sensitive to environmental change and are relatively easy to survey compared to other types of animals, giving realistic count data based on direct evidence (Gregory and Strien, 2010). The presence of certain mammal species in an area can also provide important information about ecosystem health in terms of its condition, prey availability and levels of hunting pressure.

So far, monitoring has focused on recording the presence of all bird and mammal species in order to calculate a biodiversity baseline against which future changes can be assessed. This biodiversity baseline was also deemed a necessary prerequisite for the effective management of the Southern Biological Corridor proposed in the NPAS Rationalisation Report. As of August 2014, data is being collected concerning a set target species list which has been classified into six indicator groups. These classifications are based on those made by Hoffman (2013) and adapted to the extra species in our list according to the knowledge of the TIDE rangers. The relative proportion of detected species belonging to each different indicator group can help when drawing conclusions from monitoring results. For example, an increase in the relative proportion of 'Disturbed forest indicators' might indicate habitat degradation. PCNP rangers are fully responsible for the entry of this data.

Common Name	*Code*	*Common Name*	*Code*
American Redstart	M	Aplomado Falcon	P
Barn Swallow	M	Black and White Warbler	M
Black Throated Bobwhite	P	Black-faced Antthrush	F
Black-throated Green Warbler	M	Blackburnian Warbler	M
Blue Gray Gnatcatcher	P	Bronzed Cowbird	D
Brown Hooded Parrot	F	Chestnut-Sided Warbler	M

Common Yellowthroat	M	Crested Guan	G
Dickcissel	D	Fork Tail Flycatcher	P
Golden Winged Warbler	F	Grace's Warbler	P
Great Curassow	G	Great Tinamou	G
Grey-breasted Martin	M	Hooded Warbler	M
Jabiru Stork	W	Keel-Billed Toucan	F
Kentucky Warbler	F	Little Tinamou	G
Louisiana Waterthrush	W	Magnolia Warbler	M
Mealy Parrot	F	Northern Waterthrush	W
Painted Bunting	D	Peregrine Falcon	M
Plain Chachalaca	D	Prothonotary Warbler	W
Purple Martin	M	Scissortail Flycatcher	P
Sedge Wren	P	Slaty Breasted Tinamou	F
Swainson's Warbler	F	Swallow-tailed Kite	M
Tody Motmot	F	Tree Swallow	M
White-tailed Kite	P	Wood Thrush	M
Worm-Eating Warbler	F	Yellow Headed Parrot	P
Yellow-rumped Warbler	M	Yellow-throated Warbler	M

Table 22.. Target bird species list with indicator group codes. Refer to Table 19 (below) for corresponding indicator group names and definitions

Code	*Indicator Group*	*Description*
M	Migration route health indicator	Migrant species
D	Disturbed forest indicator	Species found in human impacted or cleared forest
F	Forest health indicator	Species that thrive only in primary or undisturbed secondary forest
G	Game species	Species hunted regularly
W	Wetland health indicator	Species strongly associated with wetland habitats
P	Pine-savanna health indicator	Species associated with pine savanna habitats

Table 23: Indicator group names and definitions

The target species list was put in place to ensure clearer and more reliable data and is based around a list drafted through a collaboration between TIDE and Ya'axché Conservation Trust (Ya'axché), adapted based on the knowledge of TIDE's rangers of species presence within PCNP and TIDE's other managed protected areas. It is hoped that as of 2014, due to the similarities in the target species list, data collection methodology, database structure and data entry methodology between TIDE and Ya'axché, biodiversity data can be shared and combined between the two organisations. This should enable an approach to management that reflects the connectivity of TIDE and Ya'axché's protected areas, forming the Southern Biological Corridor (NPAS, 2013).

Methods

In PCNP there are two transects which should be each be visited once a month. These two transects are part of a total of 7 monitored by TIDE's rangers across the MMMC. Their locations were chosen based on accessibility during the wet season and their representation

of the conservation target ecosystem types listed in the MMMC Conservation Action Strategy. Detailed methods for the biodiversity monitoring can be found in TIDE's annual biodiversity report (2015) which contains analysis of transect data between 2009 and 2012. There are plans to analyse 2013 – 2015 data in early 2016. For the purposes of this management plan an overview of the methodology is outlined below.

For birds, line transects are 1000m in length with stations every 200m from which bird point counts are carried out. Birds are detected directly by either sight or sound. During one transect visit 5 bird point counts are carried out, one at each station. Each point count follows the same methodology; stand at the station in silence for 10 minutes, recording every bird species either seen or heard, the number of individuals, the bearing and the estimated distance from the transect.

Mammals are recorded mostly based on indirect cues such as tracks, scat, scratch marks and smell whilst walking along the transect between the bird stations. Monitoring occurs mostly at dawn (to coincide with the dawn chorus for birds), however on occasion it will be carried out at dusk. For each transect visit, rangers estimate and record the weather, ground condition, trail cover and what time they began monitoring.

Common Name	*Code*	*Common Name*	*Code*
Howler Monkey	F	Jaguar	F
Red Brocket Deer	F	Ocelot	F
Puma	F	Baird's Tapir	W
Margay	F	Jaguarundi	D
Neotropical River Otter	W	White-Lipped Peccary	F
Paca	G	Grey Fox	P
White Tailed Deer	G	Collared Peccary	G
Agouti	G	Nine-Banded Armadillo	G

Table 24. Mammal species and indicator groups

Socio Economic Monitoring

As of 2015 there is no formal socioeconomic monitoring program in place for PCNP. Social assessments have historically been undertaken as a result of projects, when funding has been available or for a particular purpose such as a management plan. Perhaps because of this there is a major gap in the information needed by PCNP managers to make long term decisions. There is a critical need to design an appropriate long-term monitoring program for the buffer communities of PCNP, many of which are shared by PHMR, and to initially gather the baseline data from which it will be possible to identify trends and ultimately the relative success of management interventions and a key component of management effectiveness. The following outlines the recommendations for the development of such a program and is reflected in the management activities to ensure it is part of the plans for the forthcoming five years.

Cultural and Socioeconomic Values of Management Area

There is an intimate link between how people use natural resources and their socioeconomic background. Understanding the socioeconomic dimensions of protected area buffer communities is essential for assessing, predicting, and managing the use of the protected area and the resources it aims to conserve.

To balance sustainable use and resource protection, protected area managers need to know:

1. The status of resource conditions and threats to biodiversity
2. The people that use and affect resource conditions, including the patterns in resource use, and perceptions of the change in resource conditions, as well as protected area management (rules, regulation, awareness, etc.)

Limitations of previous socioeconomic assessments

In 2014, a survey was conducted in PCNP buffer communities internally by TIDE and utilizing the Community Researchers in the data collection. Unfortunately the questionnaire had a number of limitations and information quality can be considerably improved to better inform

management decisions. Key considerations for improvement include the following; Survey questions were not clearly worded, often scaled incorrectly, and contained leading questions. Surveys also failed to record the sex of survey respondents, critical in moving forward with the incorporation of a gender perspective.

Recommendations

Tips for designing questionnaires

- Set goals and objectives for the survey. What is the overall purpose for the assessment? Knowing what purpose the socioeconomic is serving will determine how complex the survey will be.
- Use clear and simple syntax
- Use close-ended questions (a few open-ended questions are also appropriate) including yes/no, agree/disagree scales, other scaled questions (3-pt, 5-pt, 7-pt, and 10-pt scales), range of answers, multiple-choice answers
- Avoid leading questions:
    - Leading: what kinds of problems are there between hunters and [other users] of the protected area?
    - Not leading: what kinds of interactions are there between hunters and [other users] of the protected area?
    - Leading: do people fish here very often?
    - Not leading: how often do people fish here?
- Use indirect questions for sensitive issues such as income or illegal resource extraction (e.g. do you collect yellow-headed parrots? Do you know if yellow-headed parrots are illegally collected in your community?
- Be realistic about what informants know. Do not ask them to define terms or ask them explicitly about rules and regulations.
- Gather in-depth answers to questions regarding resource use (when, what, where, how, why): when do you hunt/fish? How often do you hunt/fish? Where do you go hunting/fishing? What kind of fishing/hunting do you do? What do you hunt/fish? Why do you hunt/fish (subsistence, commercial, recreation, etc.)?
- How often surveys are conducted will depend on time and capacity of staff members,

as well as financial resources.

Table 25. Key sections to include for survey improvement:

Parameter	*Details*
Resource use patterns	Who uses resources? What resources? In what capacity? Timing and seasonality Location of resource use
Perceived impact of the protected area	People's perceptions regarding the changes in resource conditions in or near the protected area (do people feel conditions are getting better or worse?)
Protected area benefits and distribution of benefits	How people perceive the benefits of the protected are and how they are distributed among the community
Risk perception, resource dependency, and conservation attitudes	Provides information that on how likely people are to support conservation initiatives, how sensitive people are to resource changes, and the likelihood of engaging in illegal activities.
Awareness of rules and regulations	Determines how well the managing organization is raising awareness within communities
Enforcement	How do people perceive enforcement? Do they feel it's effective? Do they support enforcement?
Community participation	Determines the level of involvement and reach of participatory processes within communities, including the PA planning process, monitoring, trainings, and various conservation projects.

Communication and access to information	How do people access information (online, TV, radio, etc.)? Capturing this information can reveal how people access or receive information about the conservation initiative
Demographic Section	Ethnicity, caste, and religious background Income/household economic status Age and gender Education Social status (membership in formal and informal organizations?)

Respect stakeholders and communities

It is also important to respect stakeholders and communities by recognizing their knowledge, time, and customs. Surveyors and interviewers should minimize disruptions of communities' daily activities by selecting times of the day that convenient for stakeholders and limit the time it takes to survey them. Generally, interviews and surveys should take around 30 minutes and not exceed one hour, depending on the cultural customs.

Gender bias

It is easy for women to be excluded in field data collection, a result of the time and location selected to interview women, and assessment teams that are dominated by men. Gender bias can also be a problem when cultural norms make it difficult for women to talk to outsiders. Some ways to overcome this bias include:

- Talk specifically with women as a separate stakeholder group
- Include women on the assessment team (female enumerators)
- Include a gender specialist in budgeting to address gender-based issues hat can arrive during data collection

Test survey instruments

Remember to beta-test survey instruments with a few community members or field staff and conduct preliminary analysis after the first community is surveyed. By testing survey instruments, the team can them clarify any discrepancies and problems that may arise through additional questionnaires or by modifying questions. Indications of problems include:

- Respondents are having difficulties answering;
- Respondents frequently respond 'I don't know';
- Respondents are giving answers that do not make sense;
- Too many are contradictions between the quantitative and qualitative data

It may not always be possible to modify the survey after the data has begun to be collected. In this case, additional data can be collected through the use of interviews or focus groups to help clarify any issues.

Validate findings

Remember to validate survey findings by holding small discussions with key stakeholders, presenting results to stakeholders or other interest groups, or presenting results at community meetings.

Long term monitoring of Fire Effects

There are a host of post wildfire/prescribed burn effects to monitor, such as % mortality of pine regeneration, pole size timber, mature pine trees, and broadleaf trees, as well as scorch, char, and growth increment. Through the park's research and monitoring programme, a continuous monitoring can be implemented.

The first step would be to establish a line sampling transect both through wildfire and prescribed burnt areas to record its immediate effects preferably a day after and then three months after, as a post burn effect.

A more long term monitoring and evaluation of effects of wildfires and prescribed burns could be implemented via the establishment of four permanent demonstration plots. Two would be established in the Short- grass savanna with Needle leaved Trees(pine thickets), while the other two would be established in the Short-grass Savanna with Shrubs ecosystem. A treatment would consist of two subplots whereby fire suppression took place or was simulated in one subplot, whilst the other would act as the control. Similarly in the prescribed burning treatment, one would be established in the pine thickets and the other in the open short grass savanna with shrubs. It would include a control, and treated plot where a prescribed fire was allowed.

Target viability

Both the PCNP CAP process (2006), and the MMMC CAP process (2008) recognize that the savanna ecosystem and the Yellow- headed Parrot landscape context, condition, and viability were fair to poor. Thus coupled with an effective fire management plan, a dedicated monitoring and evaluation would lead to the enhanced viability of the conservation targets.

Research

The Monitoring and Evaluation abovementioned would provide a sound, simple, and inexpensive process to obtain much needed data on the effects of fire management actions. These would tie in with the overall Biodiversity Research Programme that TIDE conducts on its management areas that will further enhance its conservation and management capability.

Indicators to measure success

As mentioned in the MMMC strategy, the incidences of wildfires, area burnt, and the percentage of pine regeneration are all indicators of success. Additionally an increased number of Yellow - headed Parrot breeding pairs, and nesting sites would demonstrate the effectiveness of the fire management plan for this key conservation target, coupled with an effective site protection plan.

Education and outreach impact monitoring

The main objective of TIDE's environmental education program is to change behaviors in target groups and stakeholders. The literature review section of this strategy covers the various theories for behavior change and describes the influencing factors that contribute to changes in behavior. An important component of a monitoring and evaluation system is measuring for changes toward environmentally friendly behaviors. Behaviour change is related to, but unique from creating awareness, instilling knowledge or altering attitudes. Behavior change is defined as 'altering voluntary actions of an individual or a community. Many individuals or communities face significant barriers that limit their ability to make changes in behavior. Understanding these barriers and devising strategies to overcome them can strengthen the program for PCNP and positively contribute to the park users and buffer communities changes in behavior.

Measuring the effectiveness of strategies for overcoming barriers can be assessed through an evaluation that specifically measures for changes in behavior. However, behavior changes are slow to occur and it can be several years before they are noticeable or common in target communities or user groups. Factors such as frequency, duration and intensity should also be considered in assessing behavior.

The Education Strategy developed by TIDE has specific recommendations for measuring the effect of such strategies and the impact of the Education Strategy itself. It is a key management activity to implement these recommendations for the PCNP users and buffer communities.

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