

Report For: TIDE

Payne's Creek National Park

Biodiversity Assessment



Draft Final Report

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Biodiversity Assessment of Payne's Creek National Park

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Introduction

This biodiversity assessment was commissioned as part of the Payne's Creek Management Plan Development Project, at the request of Toledo Institute for Development and Environment. It covers Activity 2.1 under Objective 2 of the Project - 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.

Training of community members in the survey and assessment techniques used is an integral component within the project, as this will provide the outline for continued biodiversity monitoring, and a baseline against which effectiveness of conservation management strategies can be measured.

Goal and Objectives of the Payne's Creek National Park Management Plan Development Project

The main goal of the project is to revise and finalize the draft management plan for Payne's Creek National Park, with the ultimate objective being increased protection of the Park thereby supporting the conservation of the adjoining ecosystems, namely the Gulf of Honduras.

The overall objectives are as follows:

1. To gather and evaluate existing information regarding Payne's Creek National Park and its buffer communities
2. To establish baseline data for Payne's Creek National Park on biological, physical, social, economic and governance factors
3. To use the above information to revise the current draft management plan for Payne's Creek National Park in a participatory format

Objectives of the Biodiversity Assessment of Payne's Creek National Park

This document focuses on one aspect of one of these objectives – the biological assessment (flora and fauna) for Objective 2: Activities 2.1.

Objective 2: To establish baseline data for Payne's Creek National Park on biological factors

Activities:

2.1 Biological Assessment (flora and fauna)

Flora

- 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 include training of community members in survey techniques

Fauna

- 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.

Other deliverables generated from the biodiversity assessment were:

To produce a biodiversity assessment that:

- gives sufficient data to allow informed future management
- gives sufficient baseline to allow future monitoring of biodiversity
- gives improved mapping of ecosystems within the protected area, and identification of key species for each ecosystem
- contributes to the Belize Biodiversity Information System

After an initial site visit on 9th March, and a more in-depth survey between 23rd and 27th April, the majority of the fieldwork took place between 10th and 15th May, 2005, based from the Payne's Creek Rangers Station. A team of ten took part in the fieldwork, including participants from park staff, local communities, and interns from the Centre for Employment Training in Punta Gorda:

Paul and Zoe Walker	(Consultants)
Mario Muschamp	(Park Manager)
Brent Young	(Community Participant, Monkey River)
George Myvette	(Community Participant, Punta Negra)
Jeovanni Williams	(Intern, Centre for Employment Training)
Kenan Santino	(Intern, Centre for Employment Training)
Elizabeth Kiralis	(Intern, Centre for Employment Training)
Tyrell Borland	(Intern, Centre for Employment Training)

The team also included Mr. Augustin Howe, who assisted with plant identifications.

Acknowledgments:

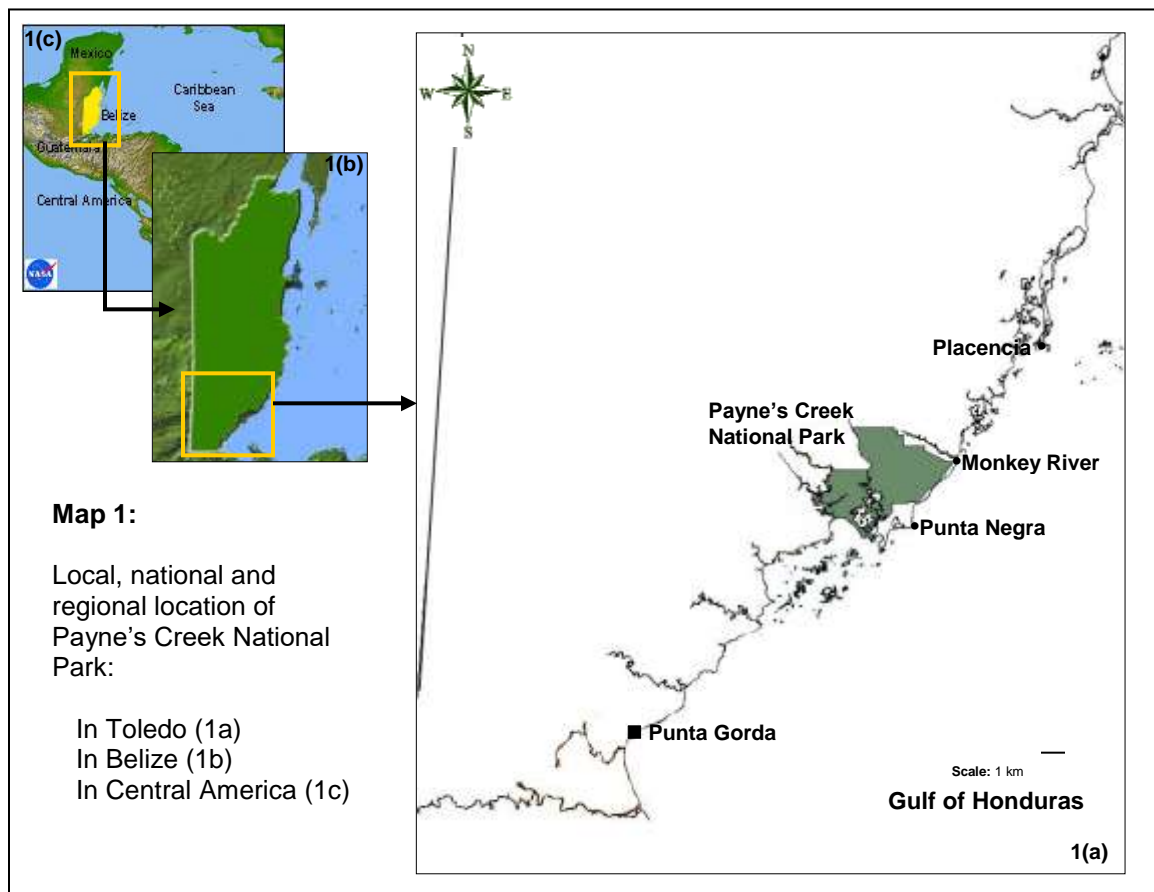
Many thanks go especially to Mario Muschamp, Park Manager of Payne's Creek National Park, for his constant assistance and sharing of knowledge, and to the rest of the TIDE staff. Thanks also go to the community participants and interns who took part in the training opportunities and provided willing assistance with the field work.

Acknowledgments also go to the following for their input:

Nicole Auil, Wildlife Trust
Angela Gall
Augustin Howe
H. Lee Jones
Lizandro Quiroz, Wildlife Officer, Forest Department
Natalie Rosado, Forest Officer, National Parks Management Programme, Forest Department

1. Background

Payne's Creek National Park (PCNP) is situated in Toledo District, the most southerly of Belize's six districts. The National Park lies just south of the Monkey River, extending southwards to the banks of Punta Ycacos Lagoon, and delineated by Deep River to the west (Map 1). The National Park was declared as a protected area in May 1994 (SI 43 of 1994), under the National Parks System Act. The designation was then later amended in 2004 (SI 149 of 2004) following realignment of the protected area boundaries. The original National Park was designated to protect approximately 37,680 acres of hypersaline, saline, brackish and freshwater wetland habitats, mangroves, broadleaf forest and savanna, and wildlife. It was also designated to protect distinctive physical features - the extensive sequence of coastal ridges and intervening pond systems formed from sediment discharged from Monkey River (Zisman, 1996), and the Punta Ycacos Lagoon system itself. The realignment led to the inclusion of pine savanna to the west and north west, excised from Deep River Forest Reserve. It also led to the exclusion of most of the coastal ridges, Punta Negra lagoon, and Punta Ycacos Lagoon itself (N. Rosado. pers, com.).



The ecosystems of PCNP, a matrix of broadleaf forest, short grass and pine savannah, herbaceous and mangrove swamps, is thought to shelter a representative array of Belize's mammals, including jaguar, ocelot, margay, jaguarundi, white-lipped peccary, paca, Baird's tapir, white tailed deer, red brocket deer and the Yucatan black howler monkey. Deep River, adjacent to the protected area, has been highlighted for its local importance for the West Indian manatee (Auil, pers. comm.), which also frequents Punta Ycacos Lagoon itself. The lagoon system itself provides a congregation site for cow-nosed rays, and mangrove cayes provide the structure for a

nesting colony of White Ibis. Fringing mangrove offering nesting sites for bare-throated tiger herons and other wading birds. The critically endangered hawksbill turtle has been recorded nesting on the beaches adjacent to the protected area, near Punta Negra. The protected area is also home and wintering grounds for just under 300 species of birds, including the yellow-headed parrot, jabiru stork, muscovy duck and the aplomado falcon.

Within the protected area's boundaries, archaeologists have uncovered inundated ancient Maya sites in Punta Ycacos, which has led to increased recognition of the area for its archaeological importance, with ongoing archaeological research into the sites, believed to be involved in salt manufacture (Brian Woodye, pers. com.). These sites were recently excavated and evidence shows that some date back to 1300 B.C. TIDE has been working with Louisiana State University to ensure that the integrity of these sites remains protected.

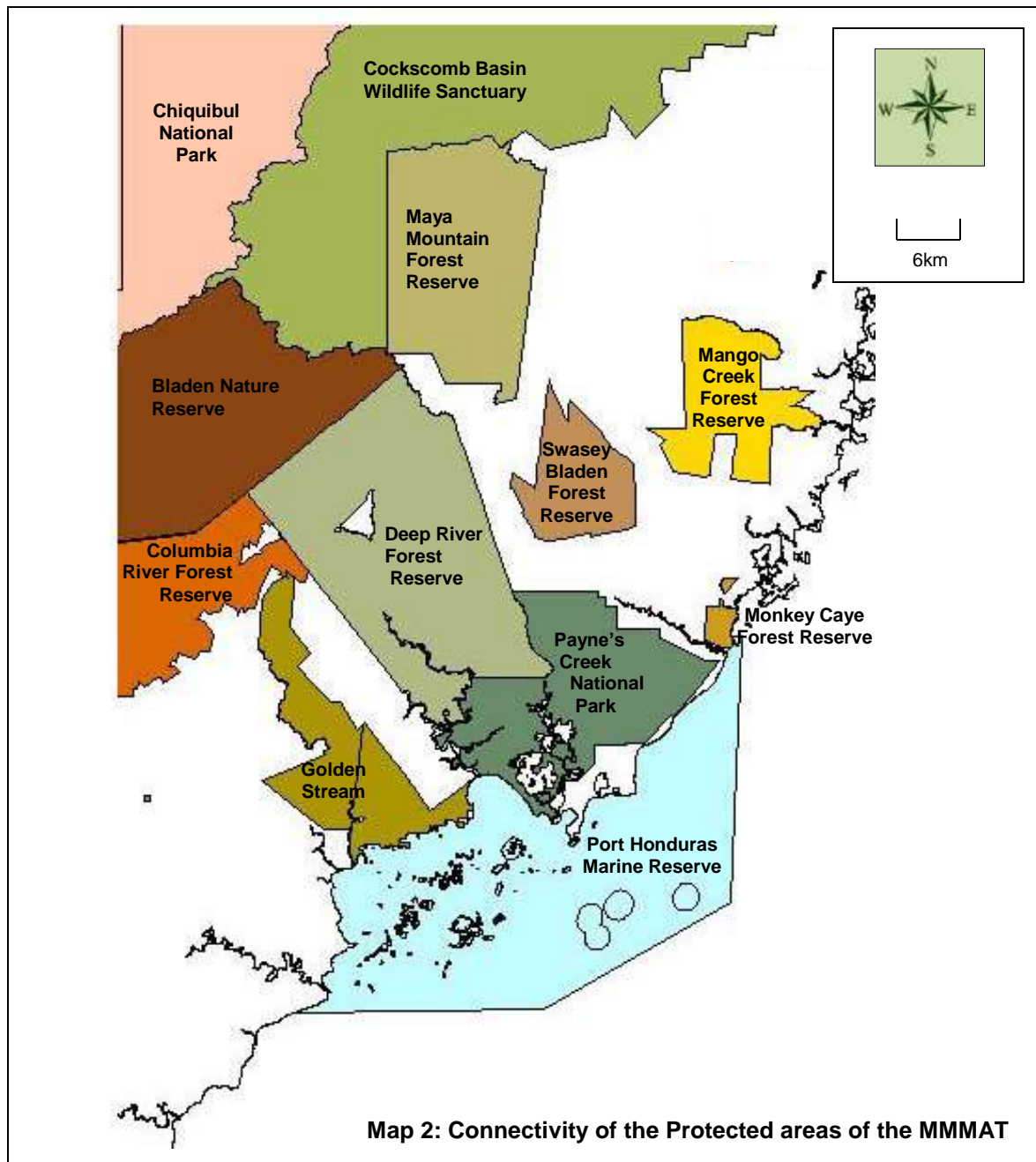
Adjacent communities include Monkey River (pop. approx. 170) and Punta Negra, with Bladen, Bella Vista and Independence also noted as impacting communities. Punta Gorda (pop. approx. 4,300) lies 30km to the southwest, whilst northeast is the tourism-based town of Placencia (pop. approx. 365) (CSO, 2000). Traditionally, the park has been used in the past for fishing and hunting, and has also been heavily impacted by commercial logging prior to the 1990's, particularly during the dry season. The income of the communities adjacent to PCNP (Monkey River Village, Punta Negra Village and Punta Gorda) is generally low, and despite large agricultural areas (banana, mango and citrus farms, there is little infrastructure in the area to support much employment. With the support and encouragement of TIDE, some community members are now using the protected area in a more sustainable way, for world-class fly-fishing tours - the Punta Ycacos Lagoon is considered excellent habitat for the elusive permit, for example, with 200+ people using the site annually for fly fishing, making it a significant tourism resource for the area (Muschamp, pers com.). Local guides also use 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. This species has also been the target of research activities within the protected area and adjacent riverside forest (Pavelka et. al. 2003)

In 2004, a co-management Memorandum of Understanding was signed between TIDE and the Ministry of Natural Resources. In an effort to ensure community participation, the Paynes Creek National Park Interim Committee has been formed, including representatives of each of the stakeholder communities (Monkey River Village, Punta Negra Village and Punta Gorda Town), and government representatives, to ensure a balanced management structure that can be supported at all levels. The Interim Committee is involved in all decision making for the park, with every change in management requiring the approval of a majority of the committee.

2. Conservation Importance of Payne's Creek National Park

2.1 Connectivity

In the landscape context, the importance of Payne's Creek lies in its contribution to the Maya Mountain Area Corridor, providing connectivity between the matrix of different ecosystems of the Maya Mountains and the Gulf of Honduras, maintaining the inter-relations between them, and preventing fragmentation. Comprised of eight contiguous protected areas (Map 2), and an additional ninth (Sapodilla Cayes) to the east, the 205,419 hectare MMMAT provides representation of the dominant geophysical features of the region – the Maya Mountains rising to the west (a sequence of volcanic and metamorphic sediments, with granite intrusions), with rivers flowing down to the flat coastal plain, then on to the marine environment of the Gulf of Honduras.



In broad terms, the Maya Mountain Area Corridor covers seven of the target areas identified under the MMMAT Site Conservation Plan:

- upland forest
- coastal plain pine savanna
- coastal broadleaf forest
- riparian forest
- aquatic communities
- estuaries and shallow nearshore communities
- coral reef

Payne's Creek National Park provides part of the interface between the terrestrial and marine components of the MMMAT, and is situated on Pleistocene deposits of clay and recent alluvium of the coastal plain, with elements of coastal plain pine savanna, riparian forest (following the alluvial area of the Monkey River) and estuarine ecosystems. Payne's Creek itself is an interesting example of a freshwater creek system originating within the coastal plain area.

This connectivity is already under threat, with development along the Southern Highway and settlements along the river systems (particularly the Monkey River). This is thought by local community members be interrupting the seasonal migration of white-lipped peccary from the coastal plains to the mountains, with the associated movement of jaguars. This movement is reportedly no longer being seen (Muschamp, pers. comm.).

MMMAT Vision Statement

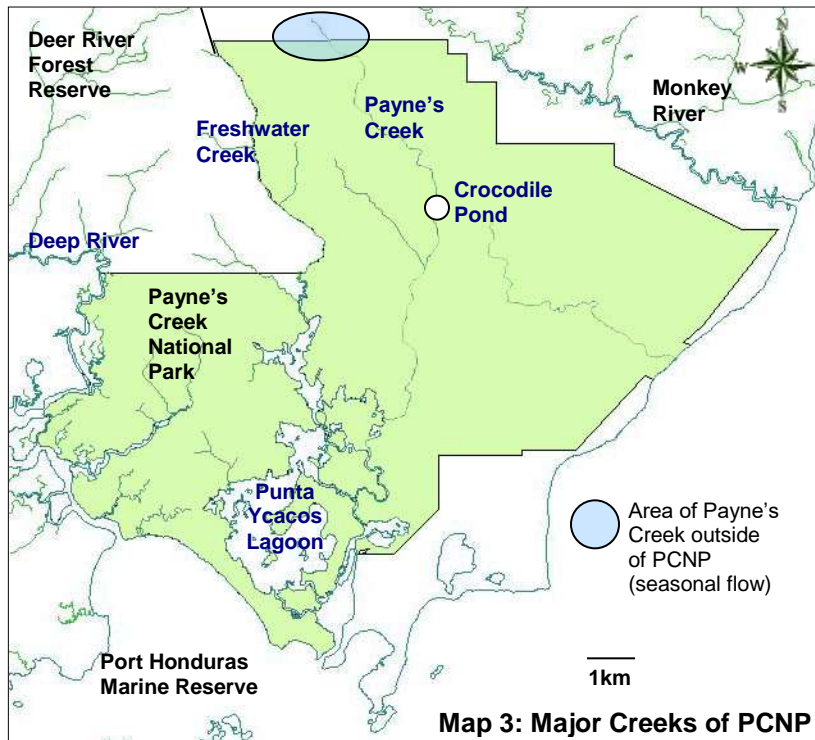
With proper management, the MMMAT will continue to function as an integrated matrix of ecosystem types. Rare and common species will continue to find refuge within the array of habitats contained within the MMMAT. Healthy watersheds will provide abundant clean water to maintain a healthy and productive coastal zone that fulfills human needs. Wildlife corridors will connect the mountains with habitats in the coastal plains to facilitate healthy populations of game and non-game species.

Alliances with large and small farm owners will reduce runoff of chemicals and sedimentation from soils being used for agriculture. Better planning of upland human activities and careful management of threats in the coastal zone will provide for more pristine estuarine, nearshore communities, and coral reefs, thereby supporting viable fisheries and ecotourism development. Residents from surrounding communities will act as stewards of the entire area to monitor, assess and protect the quality of the site. Further economic development will prove compatible with biodiversity conservation.

MMMAT will continue to be a place of economic and environmental renewal of national importance to Belize and international importance to the greater Gulf of Honduras.

2.2 Protection of Watersheds

One of the main concepts behind the MMMAT is the protection of watersheds that flow into the Gulf of Honduras, ensuring the water qualities that are essential for the survival of the coral reef. Payne's Creek National Park encompasses the majority of the Payne's Creek watershed (which also includes the Upper and Lower Freshwater Creeks (Griffith, 2000), based on annual inundation of the surrounding savanna areas. The origin of Payne's Creek lies outside the



protected area, to the north (Map 3). The whole Payne's Creek area appears to be important for storing freshwater during the wet season, releasing it into the Punta Ycacos lagoon system. The protected area also provides some protection for the eastern bank of the lower Deep River, with the western bank being within Deep River Forest Reserve, and therefore afforded some measure of protection from development. The middle reaches of the river, however, are impacted by human development, particularly where the river is crossed by the Southern Highway.

2.2 Protection of Wildlife

Payne's Creek National Park provides direct protection for fifteen species of international concern (as listed by the IUCN Redbook – www.iucnredlist.org) – four of these are considered endangered, one is classed as vulnerable, and ten are lower risk / near threatened (Table 1). One further species (red brocket) is considered 'data deficient' – there being insufficient data to give it a status, and yet it is considered to be at risk.

A further five species of concern have been recorded in Punta Ycacos Lagoon, though strictly speaking, following the realignment, these are no longer found within the protected area boundary. With the adjacent presence of Payne's Creek National Park and Port Honduras Marine Reserve, however, the lagoon system can be considered to be afforded some protection. Two of these five species, the goliath grouper and hawksbill turtle, are considered critically endangered; a further two (the West Indian manatee and the mutton snapper) are considered 'vulnerable', and the spotted eagle ray, 'data deficient'.

Two more 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.

For the purposes of this report, all twenty three will be considered as of highlighted species of importance in the context of the Payne's Creek National Park Biodiversity Assessment.

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

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. Twenty species fall under this category, including the five cat species. The ocelot, margay jaguarundi, jabiru and boa constrictor are the only six of these CITES listed species that do not occur also on the IUCN Redlist (Table 2).

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

Twenty species fall under this category, including the five cat species. The ocelot, margay jaguarundi, jabiru and boa constrictor are the only six of these CITES listed species that do not occur also on the IUCN Redlist (Table 2).

2.4 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. (McKillip, 2001).

Payne's Creek National Park, as defined by the original SI (S43 of 1994), gave protection to these archaeological sites, but the realignment may have removed some or all of these sites from within the protected area boundaries. This will need to be investigated during the management planning process.

3. Historical Impacts that have shaped Payne's Creek National Park

3.1 Logging

Both the broadleaf forest and pine savanna of the Payne's Creek area have been selectively logged since 1925, with particularly heavy logging pressure during the 1950's and 1960's (Zisman 1996, M. Muschamp, pers. com.). Salvage logging of hardwoods reportedly took place in NE PCNP in 2001 / 2002, east of Paynes Creek after the impacts of Hurricane Iris. Mr. Gomez currently holds a logging concession, and is logging pine to the north of PCNP – possibly overlapping the area now included in NW PCNP under the re-alignment of the boundaries (Muschamp, pers. comm.).

It is not possible to fully separate the impacts from past logging of pines from the impacts of fire. It is very clear, however, from examination of historical accounts (Wright, A.C., et al, 1959) that the density and extent of pines within the PCNP and surrounding savannas is now dramatically reduced from past levels – the result of combined impacts of logging and fire. In selectively removing the largest trees for timber, the effects of intermittent fires are greatly exacerbated – since these would be the same trees that would have been the best parent trees for re-seeding. Notably, logging of larger pines inevitably reduces future nesting opportunities for Yellow-Headed Parrots, since these would be the same trees to suffer limb-loss as they age – thereby creating nest-sites for the parrots and some raptors.

It is evident that extraction rates in the southern coastal plain for pine are not sustainable in an ongoing process – but could be in perhaps 20-year cycles, with adequate control of anthropogenic fires.

3.2 Fire

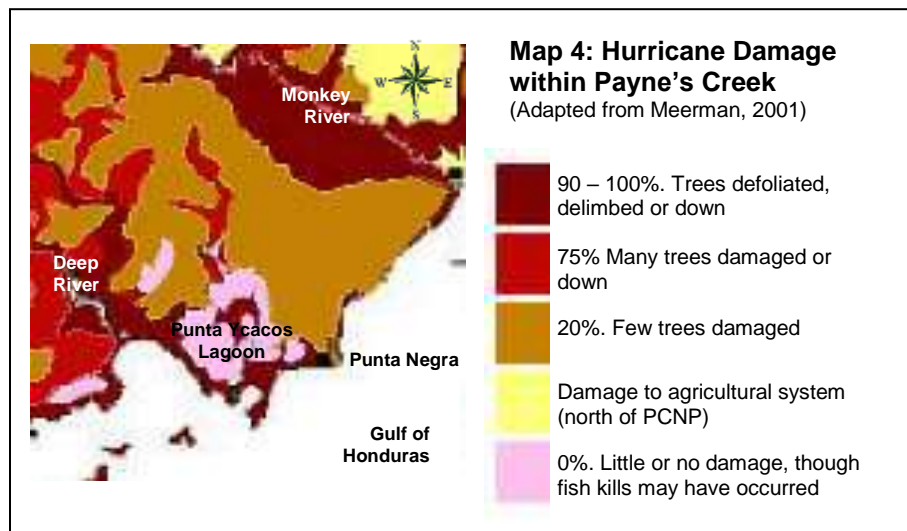
The pine savanna has also been constantly subjected to anthropogenic fires (Wright et. al., 1959, TIDE, 2002), set primarily by hunters wanting to attract white-tailed deer. The last major fire occurred in 2002, fuelled partly by the dead wood accumulated following Hurricane Iris, however current fire activity within the area may be even more extensive in terms of acres affected (pers. obs. April, 2005). 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 (Wright, et al, 1959). Whilst lightning strike fires are common in the upper elevations in Belize,

they are generally considered rare in tropical lowlands (Middleton et al, 1997). Fire in the tropical lowland forests is traditionally considered to be of anthropogenic origin (Janzen, 1986; Meerman, pers comm.; Walker, pers. obs). Whilst infrequent fires (in 7-15 year cycles) may be needed to maintain pine woodlands and prevent succession towards broadleaf forest, more frequent fires (3-7 years) shift the balance towards open, low-density pine savanna, with a relatively species-poor herbaceous layer (Myers et al, 2002). With more frequent fires this system quickly degenerates to open short-grass savanna (Meerman & Sabido, 2001). The near devastating impacts of frequent anthropogenic fire on the soils of PCNP are discussed in detail within the Geology Report (Holland & Ricketts, 2005) prepared for TIDE, along with the implications for the regeneration of impacted vegetation.

3.3 Hurricanes

The National Park was severely impacted by Hurricane Iris, which made landfall near Independence on 8th October 2001, moving west southwest across Payne's Creek with sustained winds in excess of 140mph, and causing major devastation to the area. An aerial survey of the impacted forest was conducted two weeks after the event to assess ecosystem susceptibility and percentage impact was then mapped from extrapolation of ecosystem mapping and photographs of the area (Meerman, 2001, Map 4). The northeastern broadleaf forest areas of Payne's Creek were severely affected by the hurricane, lying within the 90 to 100% destruction belt, with total defoliation, and the majority of standing trees delimbed. The pine savanna showed less impact, being mapped at 20% damage (along with the herbaceous swamp areas), as following past logging activities and fires, the savanna has few standing trees, being primarily open grassland used to annual inundation / drought cycles.

The creek side vegetation and forested ridges on slightly higher grounds within the savanna areas were mapped at a 75% damage level, with many trees down or damaged.



The 2001 assessment of ecosystem damage in Paynes Creek National Park from Hurricane Iris (Meerman, 2001) was largely accurate. The tall herbaceous swamp community has evidently now fully recovered from the impacts of that storm event, showing no remaining signs of damage. Whilst, within the open short-grass savanna with needle-leaved trees, most of the larger and older pines that had escaped past logging activities were toppled or partially de-limbed by Hurricane Iris, it is clear that the impacts of the storm to this system are overshadowed by the impacts of past logging and especially fires. Adequate young trees survived the hurricane to re-seed those areas still harbouring pines, and in the absence of the 2002 and 2005 fires good regeneration would be taking place. Whilst all of the broadleaf forest ecosystems of PCNP were decimated by Hurricane Iris (and at least two areas subsequently burnt over in 2002 (Muschamp,

pers com.)) regeneration is proceeding rapidly. Palms generally resist tropical storm and hurricane force winds better than broadleaved trees, and provide some protection to forests where they are especially dense. In areas rich in cohune and royal palms, more of the understory tree stock survived the storm, and are now re-establishing a new canopy reaching 5-8m in height. Whilst the majority of the taller trees (some in excess of 30m) were toppled or de-limbed by the storm, quite a lot are re-sprouting from snapped trunks 15-20m above ground. The regenerating forest therefore largely has a stratified structure, with a new low canopy developing, with surviving broadleaved trees and palms standing overhead. Especially in areas that survived the 2002 fire, it is clear that the broadleaved forest maintains a good species richness, which is rapidly re-establishing an open understory and vertical stratification.

Photograph 1: Post-hurricane image of tropical forest of Payne's Creek immediately following Hurricane Iris, 2001. (Meerman, 2001)



Photograph 2: Regenerating tropical forest adjacent to Payne's Creek, 2005 (Z. Walker)



3.4 Oil Exploration

Oil exploration took place in the 1950's, and again during the mid 1970's, with seismic lines passing close to the Payne's Creek Rangers Station. Whilst the oil exploration roads have left fading scars on the landscape, especially across the coastal pine savanna, the extent of the impact on the biodiversity has been relatively small – there has been increased accessibility to hunters during the dry seasons, with the opening of the main oil exploration access road, which has led to increased hunting of the Deep River Forest Reserve. This includes the area now annexed to Payne's Creek to the west, bordered by Deep River.

3.5 Commercial harvesting of plants

Harvesting of plants has also been a past impact, with orchid collection by Guatemalans for commercial purposes during 1997/1998. More recently, there has been an expanding harvesting of *Acoelorrhaphes wrightii* seeds for export, particularly by people of the Bladen community. This potentially sustainable resource is unfortunately being harvested by some in an unsustainable manner, with palms being cut down to access the seeds, and this, coupled with recent fires during early 2005 is now encouraging people to enter the protected area to access the *Acoelorrhaphes*. Whilst there is some gathering for seeds for germination elsewhere in Belize (eg. Teakettle Enterprises, Box 1), the large scale harvesting seen in Toledo is destined for Canada, where the oil is extracted for use in herbal remedy trade, as in the example (Box 1).

Full Spectrum Saw Palmetto

Function:

Trophic Full Spectrum Saw Palmetto is a remarkable progression in prostate support formulations. Saw Palmetto Berries contain an oil with a variety of fatty acids and phytosterols, its fat soluble extract has been shown to prevent and treat benign prostatic hypertrophy (BPH) or enlarged prostate.

Characteristics:

Trophic Full Spectrum Saw Palmetto, is nature and science in harmony. Fresh freeze-drying of wildcrafted Saw Palmetto Berry and Stinging Nettle Root maintains the biologically active constituents for highest potency and action. This process provides phytochemicals and enzymes not present in standardized or conventional air dried herbs. Combining this with the standardized Saw Palmetto Berry Extract and Pygeum Africanum yields a full spectrum product with the scientific research of standardized active ingredients.

www.trophic.net

Box 1

3.5 Fishing

Fishing within the lagoon has been a traditional activity for the more established communities of the area (especially Monkey River and Punta Negra), though there now appears to be general respect locally for the protected area boundaries (Muschamp, pers. com.). This is less true with the members of the immigrant/seasonal communities such as Trio, with Central American seasonal agricultural workers having little knowledge either of the conservation laws of Belize, or the location of protected areas. With the realignment of the boundary, continued enforcement of no fishing regulations will come into question.

Fly fishing is an active sport within the Punta Ycacos lagoon system, with a developing tourism market focusing on the permit in particular. Tour guides have been well trained to protect their resource, and Payne's Creek may well have been able to use the management of access in the

future as a move towards sustainability. However, as with the local fishing, the realignment of the boundary to exclude the lagoon will cause problems if such as sustainability option was put into place, and will not allow regulation of use to exclude tour guides who are not considered to be using the resource sustainably.

4. Review of Current Situation – Areas of Concern

4.1 Park boundaries

Perhaps the most apparent problem faced by the protected area at present is the lack of awareness of the exact location of the new boundaries following realignment, not just within the local communities, but also within the TIDE organization itself, and the Payne's Creek National Park staff. This identifies the need for a programme to define and demarcate the boundaries, raising awareness in the local communities of their new location.

Two specific areas of concern are highlighted – the first is Punta Ycacos lagoon, which appears to now lie outside the new Park boundaries, yet is not protected by inclusion in Port Honduras Marine Reserve. It would appear crucial to the objectives of the protected area to resolve the status of the lagoon, and lobby for its inclusion under Paynes Creek National Park, Port Honduras Marine Reserve, or possibly as an Archaeological Reserve in its own right. Without some form of protection, however, there will be the potential for conflict in the future.

The second is the new extension to the National Park, annexed from Deep River Forest Reserve. This area was being logged as recently as April 2005, with both park staff and logging concession holders unaware of the new location of the park boundaries. This is obviously also a potential area of conflict.

4.2 Watershed protection

Whilst the majority of Freshwater Creek and Payne's Creek are within the protected area, there is a substantial portion of the watershed that lies outside, to the west. This is of particular importance with the annual flooding regime of the savannah, as any pollutant activities within this watershed will have the ability to contaminate the creeks during floods, drain into Punta Ycacos, and from there, the Gulf of Honduras. At present, Freshwater Creek is protected by Deep River Forest Reserve. Payne's Creek, however drains from the area to the north. Land use change in this area may alter water flows and water quality, so should be monitored closely.

Of perhaps greater concern is the mouth of Punta Ycacos lagoon itself, where dereservation has made lagoon-side land available for development. With rumours of dredging of canals, filling of inundation areas, construction and increased boat traffic, a move towards development of the area – even clearance of the riverine mangrove – could alter the water quality significantly, with increased turbidity, sedimentation, pollutant run-off. Coupled with contamination from increased boat activity, this may well have an adverse effect on the aquatic biodiversity of the area, including the permit and the West Indian manatee.

4.3 Harvesting of *Acoelorrhaphes wrightii*

Whilst harvesting of palmetto seeds (*Acoelorrhaphes wrightii*) is becoming an industry in the area, with financial benefits to a number of local communities, the harvesting methods are not always sustainable, with some trees being chopped down in entirety to allow harvesting of the seeds. At present (April, 2005), there has been no evidence of seeds being harvested within the protected area, though the pressure for seeds is likely to increase, resulting in a need for greater wardening presence. On the positive side, the seed harvesters are seeing the devastation the savannah fires have on the palmetto harvest, and are now more aware of the need to control use of fire.

4.4 Hunting

The lack of awareness of the realigned boundaries will cause some conflict with the hunting members of local communities, as to date they have been accessing Deep River Forest Reserve for both fishing and hunting. Now that part of Deep River Forest Reserve has been appended to Paynes Creek, there will be increased enforcement of no-hunting regulations in an area that local communities perceive as open to them (despite Forest Reserve legislation). This therefore has to be resolved with care if TIDE and Payne's Creek are to retain support at community level, without compromising biodiversity protection.

4.5 Boat Activity

With increased use of Punta Ycacos for fly-fishing, and the potential increase in boat activity following realignment of the boundaries, boat activity impacts may well increase, with impacts from wash effect on the shorelines, on the mangroves, and potential boat collisions with manatees. Increased signage may be necessary – if Punta Ycacos returns to TIDE management.

5. General Field Methods

The conservation importance of an area is typically determined through an assessment of its biodiversity, achieved through recording the species presence, species distribution, condition and /or relative abundance of key species. Where a good baseline exists, a biodiversity assessment can concentrate on the latter, looking at species densities and abundance in different ecosystems, or comparisons with other areas of Belize or the region. In the situation, however, where little or no baseline data exists, as is the case for Payne's Creek National Park, the primary biodiversity assessment requirement is for data on species presence and distributions, to provide a baseline for future work on abundance.

The vegetation component of the current biological assessment of the Payne's Creek National Park focused largely upon the collection of validated data on vegetation types, from transects, ground-truthing point checks, aerial reconnaissance and photography, to determine the actual vegetation types, their location, and extent, and to generate an updated ecosystem map for PCNP. Predominant and / or characteristic species of flora, and relative abundances associated with each habitat were identified and listed where possible. The three primary objectives for the vegetation survey were to ensure that ecosystem mapping for the protected area was as accurate as possible, to provide a species list for each ecosystem type, with key species identified, and to assess the relative hurricane damage to the different ecosystems.

The major vertebrate groups were surveyed, with particular attention paid to mammals, reptiles, amphibians and fish – a comprehensive bird species list has already been generated for the area, so less field time was given to this group. Different survey techniques were employed for each of these vertebrate groups, dependant on the individual requirements. .

Three field visits to the area provided the data for the biodiversity assessment. During these visits, much of Payne's Creek was accessed, by vehicle, boat, or by foot. Also important in the data collection were discussions with protected area staff, community members and fishermen.

For highlighting threatened species of international concern, two sources were used. The first is the IUCN Red List, considered the most authoritative source in terms of species status. Species listed under Appendix One of the Convention of International Trade in Endangered Species are also mentioned, though this listing is not considered as valid as the IUCN red list for highlighting threatened species of international concern, as it is more concerned with internationally traded species.

6. Ecosystems of Payne's Creek

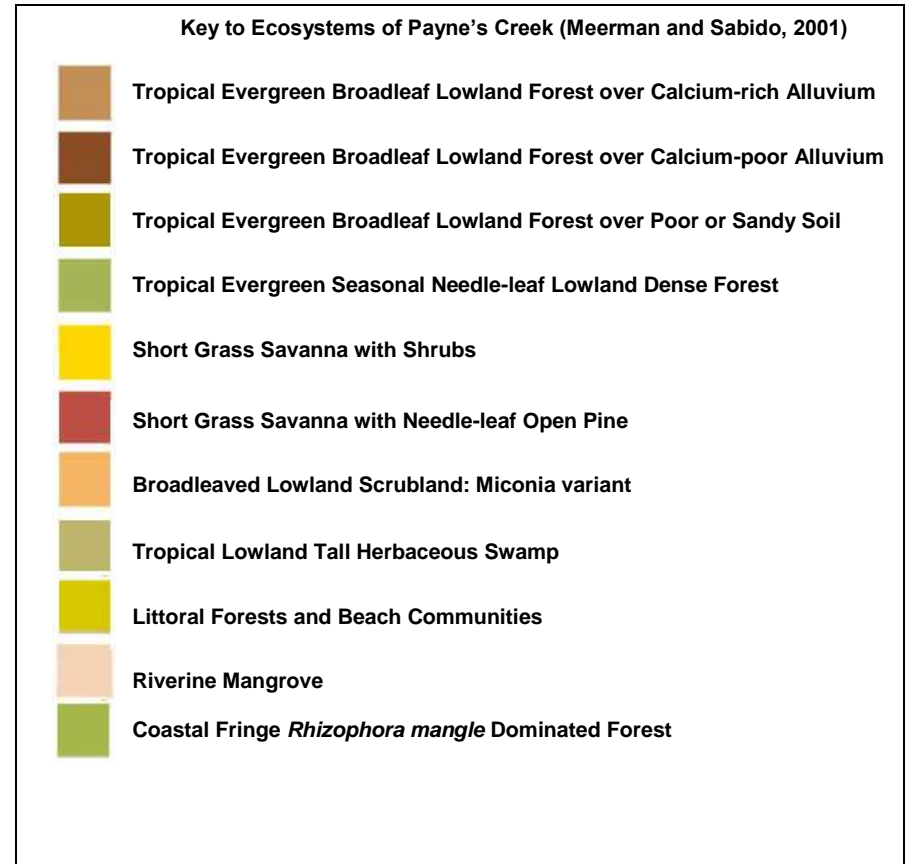
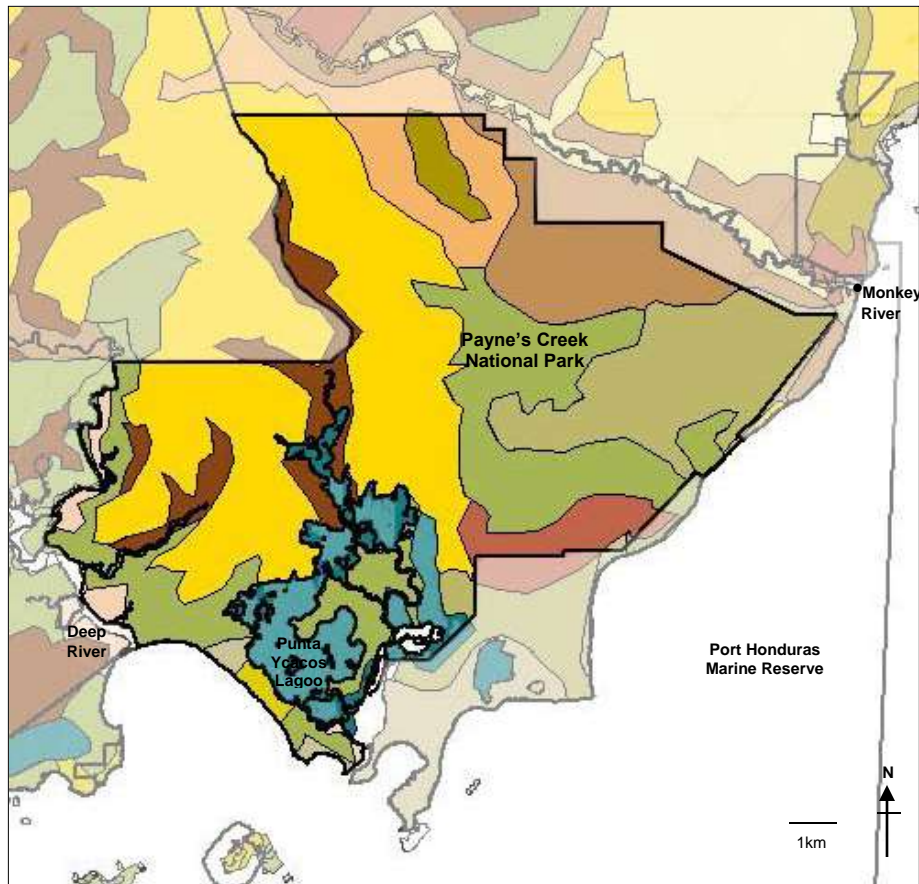
Five broad ecosystem categories, with a total of fourteen ecosystems were identified and mapped within Payne's Creek National park by Meerman & Sabido, (2001; revised 2004; Map 5). These are listed below in a nested table of predominant vegetation types (Table 3)

Ecosystem Category	Ecosystem
Saline wetlands	Brackish / saline lake
	Caribbean mangrove forest: mixed mangrove scrub
	Caribbean mangrove forest: coastal fringe mangrove
	Caribbean mangrove forest: riverine mangrove
Coastal ridge	Tropical coastal vegetation on recent sediments
Freshwater / low-salinity wetlands	Tropical lowland tall herbaceous swamp
Broad-leaved forest	Tropical evergreen broad-leaved alluvial forest on calcareous soils
	Tropical evergreen broadleaf lowland forest, over calcareous soils
	Tropical evergreen broad-leaved lowland forest on poor or sandy soils
	Tropical evergreen broad leaved alluvial forest
Savanna with / without pines	Tropical evergreen seasonal needle-leaved forest
	Short-grass savanna with shrubs
	Short grass savanna with scattered needle-leaved trees
Shrublands	Evergreen broad-leaved lowland shrubland, Miconia variant

A preliminary site visit by boat to Payne's Creek was undertaken on 9th March '05 allowing an overview of the following habitats:

1. Brackish / saline lake
2. Caribbean mangrove forest: mixed mangrove scrub
3. Caribbean mangrove forest: coastal fringe mangrove
4. Tropical coastal vegetation on recent sediments
5. Tropical evergreen broad-leaved lowland forest on poor or sandy soils
6. Short-grass savanna with shrubs

Significant discrepancies were evident between the extent and location of habitats observed during this preliminary visit, and those indicated in the Belize Ecosystems Map (Meerman & Sabido, 2001). In particular, the mapping of Tropical evergreen broad-leaved lowland forest on poor or sandy soils (Meerman & Sabido, 2001) significantly exaggerates its actual extent along the northern limits of Ycacos Lagoon and along the sides of the creek heading northwards. The definition of dry ground and seasonally inundated land within the 1:50,000 OS map more accurately represents the area and extent of the broad-leaved forest habitat in this area.



Map 5: Ecosystems of Payne's Creek, as mapped under the Central American Ecosystem Map (Belize)

(Meerman and Sabido, 2001; updated 2004)

Examination of existing satellite photographic coverage of the area, information gathered from the aerial survey, and the detail of the 1:50,000 OS Map indicates additional mapping errors within the Belize Ecosystems Map, specifically in the distinction and delineation of the boundaries between the following habitats:

- Tropical evergreen broad-leaved alluvial forest on calcareous soils
- Tropical evergreen broad leaved alluvial forest
- Tropical evergreen seasonal needle-leaved forest
- Evergreen broad-leaved lowland shrubland, *Miconia* variant
- Short-grass savanna with shrubs

The vegetation component of the current biological assessment of the Payne's Creek National Park focused largely 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, and to generate an updated ecosystem map for PCNP. Predominant and / or characteristic species of flora, and relative abundances associated with each habitat were identified and listed where possible.

Site-specific data on the plant species of the Park was determined to be limited and largely anecdotal. The impacts of Hurricane Iris have been mapped (Meerman, 2001), and the effects of selected tree species studied (Pavelka, & Behie, 2005).

In order to address the primary data deficiencies for management planning, the botanical work of this assessment includes two components:

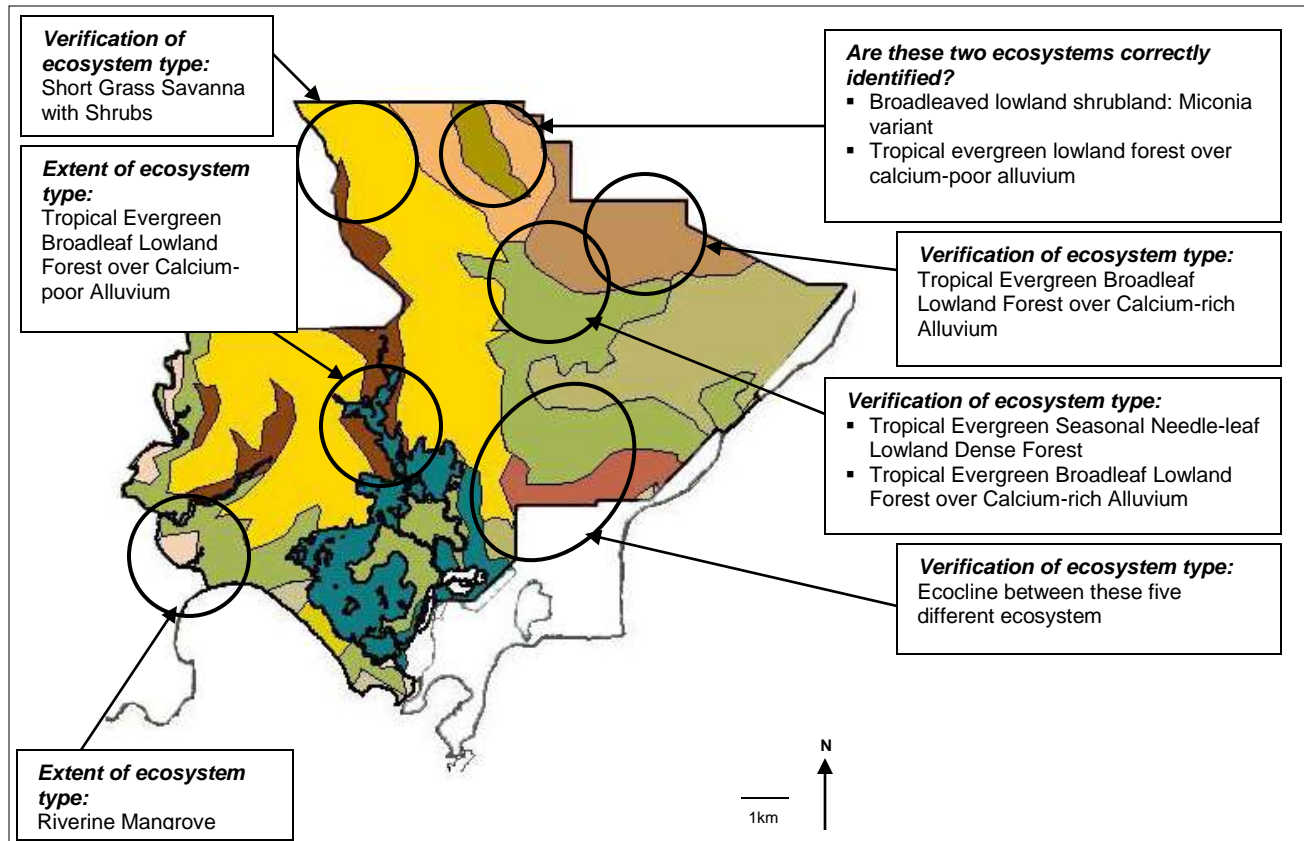
- Validation and re-mapping of ecosystems
- Identification and examination of relative abundance of predominant plants within the ecosystems

Methods

Preliminary site visits to each of the main habitat types were used to ground-truth existing ecosystem mapping (Meerman & Sabido, 2001 & 2004), identify principal discrepancies, and develop preliminary lists of predominant plant species for each ecosystem. A satellite image was then used to evaluate course-scale discrepancies. A low level (generally 400-600 feet a.s.l.) aerial reconnaissance, involving a series of parallel, photographically supported transects was then conducted to provide a broad overview of the extent of ecosystems at a finer scale. Resultant data was then used to re-evaluate the existing ecosystem map, and identify the locations for line transects and point stops where further ground-truthing would be required (Map 6).

Line transects were conducted within the seven selected highlighted ecosystems, and across identified ecoclines, noting habitat structure, predominant species, relative abundance, and drainage characteristics. Additional data was recorded on hurricane damage, and subsequent regeneration. Point stops, recording the same data as in the line transects, were conducted to provide additional and broader coverage within the survey time available.

Plant identification in the field was undertaken by Paul Walker and Augustine Howe, with additional local names being provided by community participants. Additional identifications from photographic records were made using web-based identification guides.



Map 6: Ecosystem areas highlighted for further investigation

(Adapted from: Meerman and Sabido, 2001; updated 2004)

Results

It has been established that the current ecosystems map is not adequate for management purposes in defining the ecosystems and their extents. Under this survey, two previously identified ecosystems have been discounted:

- 'Tropical evergreen broadleaf lowland forest on calcareous soils' – because there are no calcareous soils within PCNP, and because the ground-truthing of the current project did not recognize justification for separating the tract mapped by Meerman & Sabido (in the NW of the Park) as being significantly different from the presently mapped 'tropical evergreen lowland forest over poor or sandy soils.
- 'Tropical evergreen seasonal needle-leaved forest' – whilst this ecosystem probably occurred within PCNP in relatively recent history, the impacts of past logging and anthropogenic fires have dramatically reduced the density of pines and occurrence of associated broadleaf trees, such that the system is now more accurately described as 'short-grass savanna with needle-leaved trees'. Effective fire management within the Park should however result in the re-establishment of the denser needle-leaved forest over time.

Six additional ecosystems have been added to those now known to occur within PCNP, though there are significant problems fitting some of these within the accepted UNESCO terminology and characterizations in current use. In some instances the classification terminology appears appropriate, but the ecosystem characterization differs significantly. In these instances, the

classification is used, but asterisked and given explanatory notations. The six additional ecosystems that have been identified in this survey are:

- Tropical evergreen broadleaf lowland forest over alluvium (14*)
- Tropical evergreen broadleaf lowland swamp forest: permanently waterlogged (17)
- Tropical evergreen broadleaf lowland swamp forest: somewhat waterlogged (17*)
- Dwarf mangrove scrub (49)
- Eleocharis mash (65)
- Tropical lowland reed-swamp (70)
- Rooted underwater communities of flowing water (74)

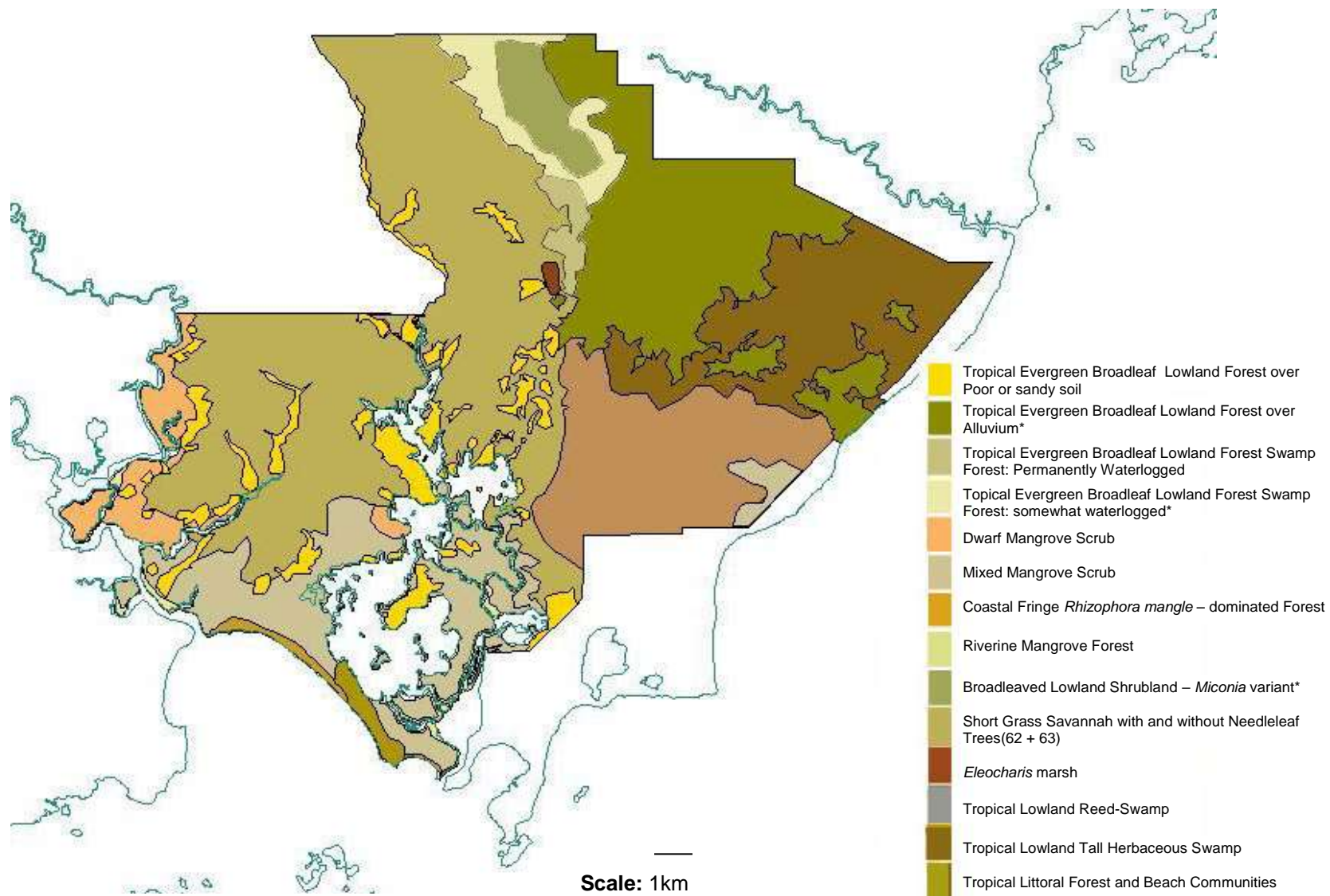
NB. Numbers refer to the Legend Code designated by the Belize Ecosystem Map (Meerman and Sabido, 2001).

* Indicates where UNESCO classification terminology and ecosystems characterization do not adequately fit the ecosystems and where explanatory notations are provided

As noted above, some ecosystem types do not adequately fall within the structural and species composition definitions of UNESCO terminology, so explanations are provided. Extensive data was collected on ecosystem definition and extent, and used to generate the updated and refined ecosystem map (Map 7).

A total of 152 plant species were identified (106 to species level), representing 69 families. Identification concentrated upon trees and predominant shrubs, with limited coverage of herbaceous plants and grasses. Maximizing upon most effective use of available time, abundance data was collected in the form of relative abundance of predominant and characteristic species within each ecosystem, rather than through more structured species counts. This policy decision was further justified by the observed clumped distributions of several common species which would render data from a relatively small number of abundance measurements almost meaningless in terms of representing overall ecosystems.

Table 4: Ecosystems Identified and Mapped within Paynes Creek National Park (Walker, 2005)	
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* The forest in the NE of PCNP was identified (Meerman & Sabido) as Ecosystem 14 – over calcium rich alluvium. Whilst the forest structure and composition fits this habitat, the soils are not Ca-rich (Holland, 2005), but the forest is radically different from that described on calcium-poor alluvium (15) (now named Tropical Evergreen broadleaved alluvial forest)
17	Tropical Evergreen Broadleaf Lowland Swamp Forest: Permanently Waterlogged
17*	Tropical Evergreen Broadleaf Lowland Swamp Forest: Somewhat Waterlogged* The forest in the north of PCNP and east of the savanna was identified (Wright, et al, 1959) as being 'High Marsh Forest' – equating to Ecosystem 17. The forest structure and composition generally fits for this ecosystem, though the northern majority of the tract is not permanently waterlogged. This area had been erroneously mapped (Meerman & Sabido) as being Ecosystem 56.
47	Dwarf Mangrove Scrub
49	Mixed Mangrove Scrub
50	Coastal Fringe <i>Rhizophora mangle</i> – Dominated Forest
51	Riverine Mangrove Forest
56*	Broad-leaved Lowland Shrubland: Miconia Variant* This is perhaps the 'closest fit' – applying UNESCO terminology to an area identified by Wright et al as 'Transitional Low Broadleaf Forest and Shrubland: poor in lime-loving species'. It had been mapped (Meerman & Sabido) in the area now identified as 17*. Species composition is generally compatible, but the rainfall of PCNP is significantly higher than that prescribed for 56, and the stands of <i>Acoelorrhaphe wrightii</i> are significantly taller than typical for 56.
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)	
* Indicates where UNESCO classification terminology and ecosystems characterization do not adequately fit the ecosystems and where explanatory notations are provided	



Map 7: Ecosystems of Payne's Creek, Walker, 2005

Ecosystems of Paynes Creek National Park

▪ **Tropical Evergreen Broadleaf Lowland Forest over Poor or Sandy Soils**

Within PCNP this ecosystem is most prevalent along the upper water-courses: along the banks of Freshwater Creek and Muschamp Creek. Prior to Hurricane Iris, the canopy would have been quite broken and generally not more than 15-20m, with a dense understory. Characteristic species include *Byrsonima bucidifolia*, *Chrysobalanus icaco*, *Chrysophyllum mexicanum*, *Coccoloba* sp., *Curatella americana*, *Davilla* sp., *Dicranopteris pectinata*, *Eugenia* sp., *Miconia* spp., *Vochysia hondurensis* and *Xylopia frutescens*. Where fires have penetrated from adjacent savannas, *Byrsonima bucidifolia*, *Byrsonima crassifolia* and *Pinus caribaea* become established. Now recovering from the impacts of Hurricane Iris, much of this ecosystem is now a dense understory up to 6-7m high, with *Vochysia hondurensis* and *Pinus caribaea* being the tallest trees standing overhead. A high percentage of the *Vochysia hondurensis* were snapped off below the crown, but have since resprouted; a significant percentage of the medium-sized pines in this system withstood the storm.

Legend Code from Belize Ecosystem Map: 7

▪ **Tropical Evergreen Broadleaf Lowland Forest over Alluvium***

The forest in the NE of PCNP, extending westwards from Monkey River, was identified (Meerman & Sabido) as Tropical Evergreen Broadleaf Lowland Forest over Calcium-Rich Alluvium (Ecosystem 14). However, the soils in this locality bear very low traces of calcium (Holland & Ricketts, 2005), and cannot therefore be described otherwise. The forest structure and species composition largely correspond to this ecosystem, and differ very considerably from the potential alternative: Tropical Evergreen Broadleaf Lowland Forest over calcium-poor alluvium (15). For this reason, and in an attempt to largely remain within the UNESCO terminology, it therefore is proposed that this forest be referred to as simply Tropical Evergreen Broadleaf Lowland Forest over Alluvium.

Characteristic species include: *Acacia collinsii*, *Andira inermis*, *Ardisia* sp., *Attalea cohune*, *Bactris major*, *Bursera simaruba*, *Calophyllum brasiliense*, *Cassia grandis*, *Cecropia peltata*, *Ceiba pentandra*, *Cordia bicolor*, *Costus* sp., *Desmoncus orthacanthos*, *Dioscorea* sp., *Ficus* spp., *Guazuma ulmifolia*, *Inga affinis*, *Lacmellea standleyi* (?), *Lonchocarpus guatemalensis*, *Luehea seemannii* (?), *Pachira aquatica*, *Philodendron* spp., *Piper amalago*, *Pterocarpus officinalis*, *Quararibea funebris*, *Roystonea regia*, *Sapium* sp., *Spondias mombin*, *Spondias radlkoferi*, *Stemmadenia donnell-smithii*, *Swietenia macrophylla*, *Syngonium* sp., *Tabebuia rosea*, *Tabernaemontana alba*, *Trophis racemosa*, *Virola koschnyi*, and *Zanthoxylum* sp. In wetter depressions, and adjacent to the tall herbaceous swamp to the west, *Ficus insipida* (?) *Pterocarpus officinalis*, *Roystonea regia* are particularly common. Prior to Hurricane Iris, many of the taller trees reached 30m or more in height, though few of this stature now remain. As noted elsewhere, palms withstand storm force winds generally better than broadleaf trees – such that *Attalea cohune* and *Roystonea regia* now make up a very significant portion of the taller trees.

Regeneration from the impacts of the Hurricane is good, such that a stratified forest structure is again being achieved, with a surprisingly open understory. As prime habitat for black howler monkeys, this ecosystem had been increasingly used for tourism - and indeed still is as the trails are largely re-opened, the forest still being aesthetically pleasing, and with the howler monkeys still in residence.

*Legend Code from Belize Ecosystem Map: 14**

- **Tropical Evergreen Broadleaf Lowland Forest over Calcium-Poor Alluvium**

As described by Meerman & Sabido (2005), this ecosystem comprises low scrubby forests in depressions where creeks cross short-grass savanna. Tracts of this ecosystem can be seen dotted across the savannas on either side of the upper reaches of Freshwater Creek. Species include *Acoelorrhaphe wrightii*, *Acacia collinsii*, *Coccoloba* sp., *Miconia* spp., *Voychysia hondurensis* and *Xylopia frutescens*. Within PCNP this system is generally confined to quite narrow depressions, has an open structure, and is generally up to 5m in height. In several areas it has been exposed to savanna fires – which tend to kill the *Coccoloba* sp. and *Voychysia hondurensis*, *Voychysia hondurensis*, and thereby leaving remnants more typical of 'short-grass savanna with shrubs'.

Legend Code from Belize Ecosystem Map: 15

- **Tropical Evergreen Broadleaf Lowland Swamp Forest: Permanently Waterlogged**

This ecosystem was identified along the track to the Crocodile Pond on Paynes Creek, stretching from close to the edge of the Eleocharis marsh up to and along the banks of Paynes Creek itself. The ground is generally waterlogged, with hog-wallow relief evident over large areas. The forest had been tall prior to Hurricane Iris, probably reaching 30m in height. Individual specimens of *Ceiba pentandra* still stand, snapped off approximately 20m above ground – with a diameter at that height in excess of 1m. There is considerable species overlap with the alluvial forest to the east. Identified species include: *Acacia collinsii*, *Alibertia edulis*, *Andira inermis*, *Ardisia* sp., *Attalea cohune*, *Bactris major*, *Bursera simaruba*, *Calathea* sp., *Cassipourea guianensis*, *Cecropia peltata*, *Ceiba pentandra*, *Coccoloba* sp., *Dialium guianense*, *Dendropanax arboreus*, *Desmoncus orthacanthos*, *Faramea* sp., *Ficus* spp., *Guazuma ulmifolia*, *Heliconia latispatha*, *Hamelia rovirosae* (?), *Hirtella racemosa*, *Inga* sp., *Licania hypoleuca*, *Lonchocarpus guatemalensis*, *Machaerium* sp., *Morinda panamensis*, *Mouriri* sp., *Luehea seemannii* (?), *Pachira aquatica*, *Philodendron* spp., *Protium* sp., *Psychotria poeppigiana*, *Pterocarpus officinalis*, *Roystonea regia*, *Simarouba glauca*, *Spondias radlkoferi*, *Stemmadenia donnell-smithii*, *Syngonium* sp., *Terminalia amazonia*, *Trichospermum grewiifolium*, *Trophis racemosa*, *Virola koschnyi*, *Virola multiflora*, *Vochysia hondurensis* and *Zuelania guidonia*.

Legend Code from Belize Ecosystem Map: 17

- **Tropical Evergreen Broadleaf Lowland Swamp Forest: Somewhat Waterlogged***

The forest in the north of PCNP and east of the savanna was identified (Wright, et al, 1959) as being 'High Marsh Forest' – equating to Ecosystem 17. The forest structure and composition generally fits for this ecosystem, though the northern majority of the tract is not permanently waterlogged. This area had been erroneously mapped (Meerman & Sabido) as being 'broad-leaved lowland shrubland: *Miconia* variant'. The habitat extends northwards from the permanently waterlogged swamp forest described above, appears to have a slightly lower species richness, generally with somewhat smaller diameter trees that appear to have reached 25+m in height – slightly lower than that in the more waterlogged areas. The ground lacks hog-wallow relief, and it is debatable whether the term swamp forest is really correct: again it is almost a case of best fit in trying to apply UNESCO terminology and descriptions to a rather different ecosystem. Subjective observations are that the soil nutrient level, and organic content, is rather lower in this tract than in the obviously waterlogged swamp forest immediately to the south.

*Legend Code from Belize Ecosystem Map: 17**

- **Dwarf Mangrove Scrub**

Extensive tracts of this ecosystem occur in PCNP, particularly west of Ycacos Lagoon. The coastal mudflats support an almost monoculture of stunted red mangrove, *Rhizophora mangle*, with a very even canopy at 1-1.2m above ground. In some areas these mudflats are a few centimeters below water level, in other a few centimetres above. On the 'inland' edge, this ecosystem often grades into a rather taller 'mixed mangrove scrub'.

Legend Code from Belize Ecosystem Map: 47

- **Mixed Mangrove Scrub**

In PCNP this ecosystem is often found in a relatively narrow belt between stands of 'riverine mangrove forest' and the 'dwarf mangrove scrub' mudflats. It typically includes all three mangrove species: *Avicennia germinans*, *Laguncularia racemosa* and *Rhizophora mangle*, along with the mangrove associate *Conocarpus erectus*. The canopy is generally broken and uneven in PCNP, reaching 3-4m. It occurs on soils that are marginally less waterlogged than those within the dwarf mangrove scrub, and where periods of inundation are significantly shorter.

Legend Code from Belize Ecosystem Map: 49

- **Coastal Fringe *Rhizophora mangle* – Dominated Forest**

The best examples of this ecosystem can be seen along sections of the coastline west of the entrance to Ycacos Lagoon. Whilst many of the taller red mangroves were snapped off by Hurricane Iris, it is clear that some had stood as high as 10m or more. Regeneration is taking place, with significant new growth. The stilt roots of coastal fringe red mangrove, extending out into the shallow waters play a critical role in breaking the force of storm surge during tropical storm events, trapping sediments and thereby reducing erosion run-off, and providing nursery grounds for a broad variety of fish species.

Legend Code from Belize Ecosystem Map: 50

- **Riverine Mangrove Forest**

Dominated by tall *Rhizophora mangle* often standing 10m-20m tall, this ecosystem can be structurally very similar to Coastal Fringe, though the stilt roots rarely project far out into the watercourse. The system is said to be rather more nutrient rich than other mangrove ecosystems, because of the deposition of riparian alluvium. Typically, a rather deeper aggregation of dead leaf and branch material is seen in this ecosystem than in other mangrove systems. Within Paynes Creek, riverine mangrove forest typically stretches 5-10m back from the watercourse, and then tends to grade into lower mixed mangrove scrub.

Legend Code from Belize Ecosystem Map: 51

- **Broad-leaved Lowland Shrubland: *Miconia* Variant***

This is perhaps the 'closest fit' – applying UNESCO terminology to an ecosystem identified by Wright et al as 'Transitional Low Broadleaf Forest and Shrubland: poor in lime-loving species'. The habitat occupies an area of approximately 800 acres in the northern portion of

PCNP. It had been erroneously mapped (Meerman & Sabido) in the area now identified as 17*. Species composition is generally compatible with that defined for this ecosystem, but the rainfall of PCNP is significantly higher than that prescribed for 56, and the stands of *Acoelorrhaphe wrightii* are significantly taller than typical for 56. Species identified within the tract within PCNP include: *Acoelorrhaphe wrightii*, *Bactris major*, *Byrsonima bucidifolia*, *Cassipourea guianensis*, *Cecropia peltata*, *Ceiba pentandra*, *Chrysobalanus icaco*, *Clusia* sp., *Coccoloba* sp., *Cochlospermum vitifolium*, *Davilla* sp., *Desmoncus orthacanthos*, *Hirtella americana*, *Ilex guianensis*, *Inga* sp., *Matayba* sp., *Miconia affinis*, *Miconia argentea*, *Miconia* spp., *Neurolaena lobata*, *Palicourea* sp., *Passiflora foetida*, *Pithocellobium* sp., *Scleria bracteata*, *Sideroxylon* sp., *Sloanea* sp., *Symphonia globulifera*, *Tabernaemontana alba*, *Terminalia amazonia*, *Vismia macrophylla*, *Vochysia hondurensis* and *Xylopia frutescens*. In PCNP this is a very patchy ecosystem, with dense stands of *Acoelorrhaphe wrightii* standing 8-10m high, low dense *Miconia* shrubs and taller (usually hurricane-damaged) specimens of *Terminalia amazonia* and *Vochysia hondurensis* widely spaced throughout the system.

*Legend Code from Belize Ecosystem Map: 56**

- **Short-grass Savanna with Needle-leaved Trees**

Occurring on very nutrient-deficient soils over an impermeable clay subsoil, this system experiences extremes in terms of water regime: lacking vertical drainage these flat to gently rolling landscapes in PCNP become very waterlogged and frequently inundated during the wetter months, and extremely parched during the dry season. A few siliceous graminoid species form the bulk of the ground cover, with occasional vines such as *Passiflora urbaniana*. *Pinus caribaea* is dotted sparsely across portions of the system, with indications (Wright, et al, 1959; per obs, 2005) that densities have been severely reduced by the combined impacts of logging and fire. Woody thickets of *Acoelorrhaphe wrightii*, *Byrsonima crassifolia*, *Chrysobalanus icaco*, *Hirtella americana*, and *Quercus* sp. are scattered across the landscape.

Legend Code from Belize Ecosystem Map: 62

- **Short-grass Savanna with Shrubs**

In PCNP this ecosystem is very similar to that described above, but lacks the *Pinus caribaea*. It is in fact quite possible that this is in fact a degraded example of that ecosystem: historical records (Wright, et al, 1959) indicate that pines occurred far more extensively in these southern and western savannas of Paynes Creek than is now the case. Unsustainable logging and anthropogenic fires (Meerman, 2001) are the likely causes of localized extirpation of pines in this savanna system.

Legend Code from Belize Ecosystem Map: 63

- **Eleocharis Marsh**

A relatively large example of this ecosystem is located SW of the swamp forest west of the Crocodile Pond, in a low-lying depression bordered to the north and west by short-grass savanna. An *Eleocharis* sp. occurs almost monospecifically in this system, standing 0.4 – 0.6m tall. Smaller patches occur in similar situations across the savannas, but are generally too small to map.

Legend Code from Belize Ecosystem Map: 65

- **Tropical Littoral Forest and Beach Communities**

Found along portions of the coastline west of the mouth of Ycacos Lagoon, and often immediately behind a narrow strip of fringing mangrove, this ecosystem includes tall specimens (up to 22m) of *Pouteria campechiana*, *Manilkara zapota* and *Metopium brownei*. Understory species include *Chrysobalanus icaco*, *Coccoloba uvifera*, *Hymenocallis littoralis*, *Myrica cerifera* and *Myrmecophila tibicinis*. Interestingly, whereas it is not uncommon to have the palm *Thrinax radiata* as a common component of littoral forests elsewhere in Belize, here *Acoelorrhaphe wrightii* evidently fills this niche. Normally associated with freshwater swamplands, the ability of *Acoelorrhaphe wrightii* to occur on the coastal beaches is presumed to be possible because of the very high rainfall of Toledo continually flushing the salts out of the soil, even close to the sea itself. The occurrence of *Acoelorrhaphe wrightii* has not been observed in littoral forests elsewhere by this author.

Legend Code from Belize Ecosystem Map: 69

- **Tropical lowland Reed-Swamp**

This is perhaps the most appropriate UNESCO classification for a relatively small freshwater peat-based marsh now crossed by the re-aligned eastern boundary of PCNP, east of Ycacos Lagoon. One of the most dominant plants here is *Sagittaria lancifolia* – a water plantain with a tuberous root that enables rapid regeneration after fire. The diminutive red sundew, *Drosera capillaries*, was also recorded in this system.

Legend Code from Belize Ecosystem Map: 70

- **Tropical Lowland Tall Herbaceous Swamp**

An extensive area of this ecosystem extends from close to the eastern limit of PCNP westwards to merge into the short-grass savannas. Covering an estimated area of over 4,000 acres, this seasonally inundated system is dominated by tall graminoids and the Maranthaceae *Thalia geniculata* – with a largely unbroken canopy up to 2m in height. This area had previously been erroneously mapped (Wright, et al) as being 'high marsh forest' – an error more recently corrected (Meerman & Sabido) as being tall herbaceous swamp. To the western extent of this system, *Thalia geniculata* becomes sparse and then absent, as the system grades into the short grass savanna.

Legend Code from Belize Ecosystem Map: 71

- **Rooted Underwater Communities of Flowing Water**

This system was noted along portions of Paynes Creek, and is reportedly quite extensive within the Crocodile Pond. *Nymphaea* water lilies were observed in this system.

Legend Code from Belize Ecosystem Map: 74

- **Waterbodies**

Most examples of these habitats have been excised from PCNP by the recent re-alignment of the boundaries.

Legend Code from Belize Ecosystem Map: 76

7. Flora of Payne's Creek

A full list of plants identified within Payne's Creek is in Appendix One

8. Fauna of Payne's Creek

8.1 Mammal Fauna of Payne's Creek

Mammals were recorded opportunistically throughout the three survey periods, from sightings, tracks, calls, and from local reports. Bats were recorded in two locations (the pine savanna (UTM E 328 638; N 1805 994) and the forest at Payne's Creek (UTM E 331 243; N 1811 213) using an acoustic recorder, set on both nights to record bat vocalizations from 6:00pm to 6:00am. However, rain on both nights gave indecipherable results.

Results

There is very little specific baseline data available in the literature on mammals of Payne's Creek - of the provisional list of thirty-one mammal species anticipated to be present in the Payne's Creek area from reviewing past data, species presence in adjacent areas (NARMAP, 1995), and regional species distribution maps (Reid, 1997) a total of twenty-seven mammal species were recorded during the survey periods. Four of these were observed directly by the survey crew (Virginia opossum, nine-banded armadillo, Yucatan black howler monkey and grey fox), four were recorded from their tracks (Baird's tapir, white-tailed deer, northern raccoon and jaguar), one species was heard (Yucatan black howler), and park staff confirmed the presence of another sixteen species seen within the protected area. Three species (water opossum, Neotropical river otter and silky anteater) were recorded as present in adjacent areas of similar habitats and therefore considered likely to occur within the protected area.

Of these 26 species, 6 (just under 24%) are considered to be species of international concern (Table 5), 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).

Table 5: Mammal Species of International Concern of PCNP	
Endangered	
Yucatan Black Howler	<i>Alouatta pigra</i>
Baird's Tapir	<i>Tapirus bairdii</i>
Vulnerable	
West Indian Manatee	<i>Manatus trichechus</i>
Lower Risk/Near Threatened	
Jaguar	<i>Panthera onca</i>
Puma	<i>Puma concolor</i>
Water Opossum	<i>Chironectes minimus</i>
Data Deficient	
Neotropical River Otter	<i>Lontra longicaudis</i>
Red Brocket	<i>Mazama americana</i>
IUCN Red List, 2004	

Three of the non-Redlist species (jaguarundi, ocelot and margay) are listed in Appendix One of the Convention of International Trade in Endangered Species:

The Yucatan black howler is the only Yucatan endemic mammal 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.

Some species show distinct habitat preferences – the Yucatan howler monkey, for example is largely restricted to the broadleaf forest adjacent to the forested river-edge vegetation, whilst white-tailed deer were the most abundant species recorded from the pine

savanna, with two adults being seen near the Ranger's Station, and a further two being observed during the aerial reconnaissance flight. A complete list of mammal species recorded to date for Payne's Creek National Park and their habitat preferences is included in Appendix 2.

Punta Ycacos Lagoon, whilst apparently not now being within the boundaries of the protected area, is known to provide shelter for the Port Honduras West Indian manatee population, with observations of both mating groups and mothers with calves. Dolphins are also reported to enter the lagoon occasionally during high water, but the identification of the species is unknown (M. Muschamp, pers. com.).

Didelphidae (Opossums)

Two species of Didelphidae have been recorded for Payne's Creek National Park (Virginia opossum and grey four-eyed opossum), and one (water opossum) from an adjacent area considered close enough and similar enough to suggest that this species will be present within the Park:

Virginia opossum	<i>Didelphis virginiana</i>
Gray four-eyed opossum	<i>Philander opossum</i>
Water opossum	<i>Chironectes minimus</i>

Both *D. virginiana* and *P. opossum* are observed most commonly within the savanna areas (*D. virginiana*, often associated with human habitation, was recorded from the Payne's Creek Rangers Station), though a dead cat-kill specimen was also recorded from the broadleaf forest. The water opossum (*C. minimus*) is only ever found in association with creeks and rivers. It is known from Monkey River, but is also expected to also occur by Payne's Creek.

The common opossum and smaller mouse opossums (Mexican, Alston's and Robinson's mouse opossums, and the Central American woolly opossum) may also occur within the national park, but haven't been recorded to date.

Edentata (Anteaters and Armadillos)

Two species of anteater are recorded for Payne's Creek:

Northern tamandua	<i>Tamandua mexicana</i>
Silky anteater	<i>Cyclopes didactylus</i>

T. mexicana is considered to be relatively common in the area, and has been seen by Payne's Creek rangers within the broadleaf forest areas. *C. didactylus* has been recorded adjacent to the protected area, (from broadleaf forest contiguous with the Park, both near Monkey River village area and Punta Negra), so it is considered probable that it also occurs here.

One species of armadillo has been recorded within Payne's Creek National Park:

Nine-banded armadillo	<i>Dasypus novemcinctus</i>
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Cebidae (New World Monkeys)

Whilst two species of primates were initially noted from the literature review, only one species appears to be present within the protected area, being heard during broadleaf forest transects:

Yucatan black howler	<i>Alouatta pigra</i>
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The second, the Central American spider monkey (*Ateles geoffroyi*), has not been observed by Payne's Creek park staff within the protected area, so has been removed from the species list. It is thought to occur further west, in the broadleaf forest of the Maya Mountains.

Black howler monkeys, endemic to a small area of the Yucatan Peninsula, Belize and the Peten, were decimated by a yellow fever epidemic in 1956/57 that swept through the *Alouatta* population throughout most of Belize. With increasing habitat fragmentation and loss, it has recently been upgraded to Endangered in the IUCN Redbook. Healthy populations of this species have been found historically (pre-Hurricane Iris) within the broadleaf forest belt that follows the Monkey River, in the northern portion of the protected area. Research work from 2000 to 2001 showed that between four and eight groups of howler monkeys, each with a home range of between 0.5ha to 3.0 ha, were present within the 52 hectare broadleaf forest study site running south from Monkey River into Payne's Creek National Park. The total of 53 individuals, at an approximate density of 102 individuals/km², This is considered a healthy density, primarily due to the forested area remaining relatively undisturbed by land clearance. More recently, continuing work from 2001 to 2004 has shown that the damage caused by Hurricane Iris in 2001, has resulted in a 35% loss of howler food trees which, together with losses in the monkey population itself as a direct result of the hurricane, has caused a major reduction in howler monkey population numbers to an estimated density of between 40 and 60 individuals/km², and social disorganisation within the troops in the area. Predictions from the study are that the population has not yet stabilized, and numbers will still continue to fall (Pavelka, 2005, Pavelka, 2004, Pavelka, 2003).

Sciuridae (Squirrels)

Two species of squirrels are reported to be present within the protected area by the rangers, though only one is indicated to be present from the range maps (Reid, 1997):

Deppe's Squirrel	<i>Sciurus deppei</i>
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Throughout Belize, this species appears to show a preference for cohune dominated areas of the broadleaf forest (pers. obs.). The second species, described as 'large and dark', or 'black' (Muschamp, pers. com.) may be the Variegated Squirrel (*Sciurus variegatoides*), which has been recorded from Chiquibul and Columbia Forest areas (Matola, 1992; Rodgers et. al, 1991, Matola 1989), though this will need verification before it can be added to the species list.

Rodentia (Rodents)

There has been no research to date into the small rodent species present within the protected area, but three larger rodent species are known to occur:

Erethizontidae:	Mexican Porcupine	<i>Coendou mexicanus</i>
Dasyproctidae:	Central American Agouti	<i>Dasyprocta punctata</i>
Agoutidae:	Paca	<i>Agouti paca</i>

C. mexicanus has been recorded from the broadleaf forest ecosystems by the rangers, as has *D. punctata*. The paca (*A. paca*) is found more frequently along the stream edges of upper Payne's Creek and Freshwater Creek, and on the banks of Deep River (Muschamp, pers. com.). Hunting pressure, particularly in the newly annexed Deep River area, where hunting is a regular occurrence, is thought to be keeping numbers below their optimum levels.

Carnivora (Carnivores)

Six species of non-Felidae carnivores were recorded from Payne's Creek National Park:

Canidae:	Grey fox	<i>Urocyon cinereoargenteus</i>
Procyonidae:	Northern raccoon	<i>Procyon lotor</i>
	White-nosed coati	<i>Nasua narica</i>
	Kinkajou	<i>Potos flavus</i>
Mustelidae:	Tayra	<i>Eira barbara</i>
	Neotropical river otter	<i>Lutra longicaudis</i>

U. cinereoargenteus is most often observed on the savannah, and was recorded by the rangers station. Fresh tracks of *P. lotor* were recorded from the lagoon edge by the station dock, and reports suggest that both these species are abundant within the area.

N. narica and *P. flavus* are both most frequently encountered in broadleaf forests, as confirmed by sightings reported by the rangers. It is hard to estimate from these reports how these two species have fared following the hurricane damage of 2001, though with the general improvement in the condition of the forest, it is thought that the coati, at least, will recover relatively quickly.

Of the two mustelids, only one, the tayra (*E. barbara*), has been recorded by rangers within the protected area. The Neotropical river otter (*L. longicaudis*) has been reported from Monkey River and Punta Negra lagoon, so is thought likely to occur on the banks of Deep river, and on Payne's Creek itself.

All five of the cat species found in Belize are present within Payne's Creek:

Felidae:	Jaguar	<i>Panthera onca</i>
	Puma	<i>Puma concolor</i>
	Ocelot	<i>Leopardus pardalis</i>
	Margay	<i>Leopardus wiedii</i>
	Jaguarundi	<i>Herpailurus yaguarondi</i>

Tracks of *P. onca* were recorded from the broadleaf forest areas, and rangers reported sightings on both the pine savannah and coastline. *P. concolor* is also known to frequent the savannas and forest, and *L. pardalis* has been recorded from broadleaf forest and the edge of the savanna. The two smallest cats (*L. wiedii* and *H. yaguarondi*), however, have only ever been recorded from the broadleaf forest areas (Muschamp, pers. com.).

Tapiridae (Tapir)

Baird's tapir (*Tapirus bairdii*) is the largest herbivore present in the coastal plain, and tends to be associated with the creeks, freshwater inundation areas and riverside, where this species grazes on the herbaceous vegetation. Whilst shy and infrequently seen, its tracks were recorded both on the savannah and in the broadleaf forest areas. It is listed as an endangered species (IUCN Redlist), but is thought to be relatively widespread in Belize, where it is seldom hunted (however, there were reports of a recent tapir carcass north-west of the protected area, with indications that it had been killed for the meat (Muschamp, pers. com.)). The main threat to this species is the increasing destruction of the habitat, with the protection of significant tracts of unfragmented riparian vegetation and other suitable habitat being a priority for its continued survival. Whilst this vegetation lies primarily outside the protected area, Payne's Creek is able to provide protection through being contiguous with the riparian forest, and through the efforts of TIDE and the Monkey River community in protecting the forest belt between Paynes Creek and Monkey River, and through the economic value for tourism.

Tayassuidae (Peccaries)

Two peccary species are recorded from Payne's Creek:

Collared Peccary	<i>Tayassu tajacu</i>
White-lipped Peccary	<i>Dicotyles pecari</i>

The *T. tajacu* has been reported from both broadleaf forest and short grass savanna, where it lives in small herds. Whilst there is some hunting pressure within the newly annexed area to the west (formerly part of Deep River Forest Reserve), Payne's Creek is able to play a role in the overall protection of this species. The larger *D. pecari*, however, travels in much larger herds, and requires large areas of unfragmented broadleaf forest. Currently, there is sufficient broadleaf forest in the overall area to maintain white-lipped peccary, though fragmentation of forest habitat in the area of the Southern Highway is already changing the seasonal movement patterns of this species. As fragmentation increases, it is possible that, combined with hunting pressure, this species may not be able to maintain a viable population in the coastal area in the future. Payne's Creek alone does not have sufficient broadleaf forest to ensure the survival of this species.

Cervidae (Deer)

Two deer species are present in the protected area:

White-tailed deer	<i>Odocoileus virginianus</i>
Red brocket	<i>Mazama americana</i>

The larger of the two, *O. virginianus*, is favoured by hunters, and comes under intense pressure during dry season. It prefers the savannah ecosystems, and is lured to newly burnt areas for ash and new shoots, encouraging hunters to set fires throughout the coastal plain. Four individuals were seen during the survey, congregating in pairs by water holes on the savannah in the peak of dry season. The smaller *M. americana* is a forest species, rarely venturing into the open areas, so is confined to the northern, broadleaf forest areas of Payne's Creek.

Trichechidae (Manatees)

Belize is particularly important in having the largest population of West Indian Manatees (*Trichechus manatus*) in Central America. This large aquatic mammal is highly threatened, being listed as 'vulnerable' by IUCN, with an estimated population of less than 1,000 individuals in Belize (Auil, pers. com.). Port Honduras (including Deep River and Punta Ycacos lagoon) has been highlighted as one of six areas that has been found to be consistently important to manatees, with the availability of freshwater, seagrass and sheltered areas. This is despite pressure on the manatee population in the area prior to the designation of the Port Honduras Marine Reserve - reports showed the presence of eleven manatee slaughter sites, with the carcasses of a total of thirty-five animals in 1995. In 1996, a further nine carcasses were found in the Deep River area, with one further slaughtered calf discovered in 1998. Reasons cited for this slaughter included tradition and poverty, lack of active enforcement, and the location of a market in Livingstone, across the border (Auil, 1998).

Since the declaration of Port Honduras Marine Reserve in, and the active enforcement presence of Fisheries and TIDE rangers, the species is no longer under pressure from hunters in this area. Manatees are known to congregate both in the Deep River, and in Punta Ycacos lagoon, with both mother-and-calf and mating herd congregations (Muschamp, pers. com.) – with the dereservation of the lagoon system, there are concerns on the impact any potential development may have, this species relying on good water quality, low boat activity, and minimal disturbance. It is therefore highlighted as a species of particular concern in the Deep River / Payne's Creek area.

8.2 Birds of Payne's Creek

A total of 309 bird species have been recorded to date for Payne's Creek National Park. With the presence of a comprehensive bird species list, and input from a professional ornithologist resident in the general area, a decision was made to survey birds opportunistically rather than taking the form of an in-depth survey, concentrating on verification of species on the current list. During the survey period, a number of species were highlighted for their status as species of concern (either locally, nationally or internationally), with one Endangered species (yellow-headed parrot) and three Near Threatened (great curassow, black rail and black catbird) (IUCN, Red List, 2004). One CITES species, the jabiru (*Jabiru mycteria*) has also been highlighted.

The riverine mangroves of the Punta Ycacos lagoon system 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 (Muschamp, pers. com.), all of which were recorded during the 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.

Of the birds that inhabit the pine savanna, the yellow-headed parrot is by far the most threatened, being internationally recognized as Endangered (IUCN redlist, listed by Birdlife International as Globally Endangered), following a very rapid 90% population decline throughout its range since the 1970's, to an estimated 7,000 individuals in 1994. In the last ten years alone, the population is thought to have declined by 68%, and significant rates of decline are expected in the future with increased habitat destruction for development, increased man-made fires over the pine savanna areas, and the theft of nestlings for the pet trade (Birdlife, 2004). Fortunately, the rate of decline of this species has not been as severe in Belize as in other parts of its range, and Belize is now the last remaining stronghold. Restricted to pine savanna of Mexico, Belize and northern Honduras, yellow-headed parrots 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.

This threat also faces other savanna species – such as the fork-tailed flycatcher, black-throated bobwhite, sedge wren, savanna and rusty sparrows – species that nest low down within the grass layer. The endemic sub-species of the sedge wren (*Cistothorus platensis russelli*) is only found in seasonally wet grasslands of northern Toledo / central Stann Creek, and on the highest peaks of Mountain Pine Ridge – with such a small range, Payne's Creek, with its healthy population, will be critical to the long-term protection of this sub-species, with fire management being a major requirement for the focus of management activities.

Of the three Near Threatened species recorded within Payne's Creek National Park (Table 6), the black rail is probably the most locally rare – it has only been recorded in Belize five times (Jones, 2003), one of these being at Payne's Creek. The black catbird is associated with mangrove ecosystems, and can be expected to be present adjacent to the lagoon. This Yucatan endemic is more common in the north, but its range appears to be slowly extending southwards, with a record from Monkey River (Jones, 2003). It is therefore considered probable that this species is present within the protected area. The third near threatened species, the great curassow, inhabits the broadleaf forest to the north.

Endangered	Yellow-headed Parrot	<i>Amazona oratrix</i>
Lower Risk / Near Threatened	Great curassow	<i>Crax rubra</i>
	Black rail	<i>Laterallus jamaicensis</i>
	Black catbird	<i>Melanoptila glabirstris</i>

The Central American population of the jabiru stork, listed in CITES Appendix One, is thought to be genetically isolated from that of South America, resulting in a limited gene pool available for viability. Whilst individuals have been recorded feeding from pools within the savannah, no nests have been reported from within Payne's Creek, the nearest being listed from Mango Farm in the 1980's, to the north of Monkey River (Barnhill et. al. 2005). With the increasing number of shrimp farms, and changes in jabiru migration patterns, it is possible that this species is now nesting more in the southern savannahs, though the recent increase in anthropogenic fires will not encourage it to continue doing so.

8.3 Amphibians and Reptiles of Payne's Creek

No formal herpetofaunal species list had previously been generated for PCNP. A review of known distributions and habitat preferences of amphibians and reptiles indicated a potential herpetofauna of approximately 88 species (excluding marine turtles), with potential for up to a further 17 species whose ranges could extend into the general vicinity.

Visual Encounter Transects were utilized as the primary survey technique for the herpetofauna, augmented with additional data collected during vegetation ground-truthing transects. Surveys were conducted within each of the main habitat types: broadleaf forest (in various stages of succession), shrubland, savanna (with and without pines), herbaceous swamps and mangrove wetlands. Training was provided to the community participants in the methodology of conducting surveys, search technique, handling of (non-venomous) herpetofauna, and use of identification keys and guides. Timed (1 hour) diurnal and nocturnal VE Transects were implemented in the broadleaf forest habitat, to provide training in the estimation of abundance.

Results

A total of 10 amphibian species (including 2 salamanders) were recorded during the surveys, with one additional species being reported by PCNP Staff (M. Muschamp, pers com); 1 crocodylian was observed along with 3 freshwater turtles, 12 lizard species (and 1 additional reported by Park Staff), and 3 species of snake (with a further 10 species having been previously observed by Park Staff).

Thus a total of 30 species were recorded during the surveys, an additional 11 species reliably identified from past sightings from Park staff – giving a total species list to date of 41, or approximately 47% of all the species likely to occur there. The 41 species recorded to date represent 19 families (Table 3). Marine turtles are not included the survey, as known nesting sites in the area do not lie within the Park; the recent exclusion of Ycacos Lagoon (in the re-alignment of the boundaries) means that the likely occurrence of the Hawksbill Turtle in that system does not qualify it as occurring within the Park.

It is clear from the surveys, and supported by the preliminary species list, that Paynes Creek supports a rich herpetofaunal community. As one would expect, this comprises the broad array of lowland species, and lacks those restricted to the higher elevations of the Maya Mountains to the west.

Of the amphibians, of note was the observation of 3 salamanders (of 2 species) within a single transect in the broadleaf forest adjacent to Monkey River. Whilst that nocturnal survey was undertaken on an existing trail just outside the Park, it was within 100m of the boundary, in contiguous habitat, and is therefore considered representative of that habitat within the Park (where trails are absent). Salamanders are not commonly encountered in most parts of Belize (Lee, 2000; Walker, per. obs.), the observation of 3 specimens in 1 hour is indicative of the very humid conditions and suitable habitat. The observation of the veined treefrog (*Phrynohyas venulosa*) adjacent to Paynes Creek represents a range extension for this species – not previously recorded this far southeast in Belize (Lee, 2000; Stuart, et al, 2004). None of the

amphibians recorded at PCNP, or likely to occur there, is currently considered of conservation concern (all being rated as of Least Concern, IUCN (2004)). With the exception of the salamanders and the one Eleutherodactylid that is likely to occur there, all can be considered lowland generalists occurring across a relatively broad array of habitats in Belize.

PCNP harbours a relatively diverse reptile fauna. Of note was the observation of *Corytophanes critatus* – indicating that the broadleaf forest ecosystems have retained their reptile fauna despite the ravages of Hurricane Iris in 2001. *Cnemidophorus maslini* is relatively common in the open habitats of PCNP, including around the Ranger Station. This is a particularly interesting species, with three disjunct populations in Belize – of which that in the PCNP / Monkey River area is one. It is parthenogenetic – all individuals being female, which reproduce asexually. The occurrence of *Ctenosaura similis* (Muschamp, pers com.) represents a range extension for this species, not previously recorded this far southeast in Belize. Whilst the conservation status of Neotropical reptiles is less poorly known than that of amphibians (Walker, pers obs), 3 species of conservation concern have been recorded there. *Crocodylus moreletii*, *Staurotypus triporcatus* and *Trachemys scripta* all being classified as Lower Risk (IUCN, 2004). All three of these species were recorded within Paynes Creek itself (Table 8).

The endangered Central American River Turtle or Hicatee (*Dermatemys mawii*) was not recorded in the survey, and is reported as being absent from the Park (Muschamp, pers comm.), despite the presence of suitable habitat within the known range for this species. Extirpated from much of its range in Mexico and Guatemala (as a result of hunting pressure), this species is also in decline in Belize, and is considered likely to be elevated to the status of Critically Endangered in the near future. It is quite likely that this species occurred historically within PCNP, and was extirpated by hunting from neighbouring communities in the way it has throughout much of its range.

Table 7: Reptile and Amphibian Families recorded from Payne Creek National Park, May, 2005

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

Table 8: Reptile Species of International Concern (IUCN: Red list 2005) of Payne's Creek (Including Punta Ycacos Lagoon system)

Critically Endangered	Hawksbill Turtle	<i>Eretmochelys imbricate</i> *
Lower Risk / Near Threatened	Morelet's Crocodile	<i>Crocodylus moreletii</i>
	Mexican Giant Musk Turtle	<i>Staurotypus triporcatus</i>
	Slider	<i>Trachemys scripta</i>

* Species present within Punta Ycacos Lagoon and coastal zone

8.4 Fish Fauna of Payne's Creek

Knowledge of the marine and freshwater species of the area is good, with background data on both the Port Honduras Marine Reserve (TIDE), and from an in-depth study of the fish fauna of the adjacent Monkey River (Esselman, 2001). An initial provisional list of 35 species has been generated, and it is expected that the biodiversity assessment will build upon this, developing greater knowledge on the distribution of these species within the protected area.

Whilst the Statutory Instrument appears to define Payne's Creek National Park as the land component alone, the waterbodies are considered an integral part of the project area for the biodiversity assessment. Three areas were selected for investigation during the biodiversity assessment:

- Freshwater Creek
- Punta Ycacos Lagoon system
- Payne's Creek

Fish were also identified from drying roadside ruts on the pine savanna, in harsh conditions with virtually no water. With its impermeable clay subsoil, the savanna floods during wet season, with water overflowing the Freshwater and Payne's Creek systems, allowing fish fauna to spread into the coastal plain, then isolating fish populations in small pools as the water retreats with the onset of dry season.

Each of these water bodies was found to have a distinctive fish fauna, thought to be primarily determined by the salinity of the water. Within the main Punta Ycacos system, the salinity was found to increase from Freshwater Creek to the entrance to the Bay of Honduras, a salinity gradient that appeared to affect species distributions within the lagoon.

Knowledge of the fish species present in Punta Ycacos appeared to be extensive, so effort was concentrated on upper Payne's Creek, where sampling has not previously taken place. The creek originates within the broadleaf forest just north of the protected area, and meanders southwards to drain into Punta Ycacos. At the sampling point (UTM E 331 151; N 1811 198), the creek is approximately 2.5m wide and less than 1m deep, with a range of aquatic plants, including water lilies. The broadleaved forest through which the creek runs has been heavily damaged by Hurricane Iris, with an estimated 90% canopy loss. This damage has resulted in tree falls across much of the length of the creek, and an increase in logs and branches within the creek itself providing increased shelter for many species.

Methods ranged from presence/absence surveys (Freshwater Creek, and a nocturnal survey of Payne's Creek), use of hook and line, trapping with a fine mesh box net (Payne's Creek), and recording local knowledge of fish from park staff and fishermen. Identification was through use of a dichotomous key (Greenfield and Thomerson, 1997).

Results

A total of 39 fish species were recorded within the waterbodies associated with Payne's Creek National Park, either directly or through reports from park staff and local fishermen. The species assemblage for Punta Ycacos was composed primarily of marine species such as snook and barracuda. Salinity decreased moving northeast-wards through the system towards Freshwater Creek, with a gradient ranging from a specific gravity of 1.026 to 1.016 (34.5ppt to 21.3 ppt) from the mouth of the lagoon to the most northerly sample point within Freshwater Creek (UTM E 3327162; N 1807344).

Some species showed a greater range of salt tolerance whilst others appeared to be limited to areas of a certain salinity. White mullet, for example, are known locally for only being present

near the mouth of the lagoon, in waters with a higher salinity, whereas the blue-eyed cichlid was only found in the areas of lower salinity, not being recorded within the main lagoon system (though was interestingly recorded at the mouth of the Monkey River).

Payne's Creek itself, another tributary that flows into the lagoon, proved to have a varied species composition, with both a high diversity and high densities of the most common species observed (particularly *Cichlasoma salvini*, *Hyphessobrycon compressus*, *Poecilia mexicana*, *Xiphophorus helleri*). The water at this sampling point, approximately 8 to 9km north of the creek mouth, had a specific gravity of 1.000 (0ppt), reflected by the fish assemblage of saline intolerant species. Of particular note was the absence of *Cichlasoma maculicauda*, so abundant in the more saline water conditions of Freshwater Creek (and in fact even recorded from the mouth of Monkey River), and the possible presence of *Rivulus marmoratus* (to be confirmed). *Cichlasoma spilurum* another of the cichlid species present within the protected area, was observed in both Freshwater and Payne's Creeks, appearing to be widespread throughout the area.

Punta Ycacos Lagoon is well known within Toledo District for its game fish population – particularly permit, but also barracuda, crevalle and horse-eye jacks, snook, jewfish, blue-striped 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.

Also investigated was the possibility of reef fish use of the abundant seagrass beds directly offshore from the southern shoreline of Paynes Creek. A number of species were highlighted as existing on reef adjacent to nearby cayes, with either juveniles that utilized seagrass and / or coastal mangroves. These included:

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 cotal 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

Of the marine fish, three are of international concern (Table 9). The goliath grouper (jewfish), listed as critically endangered is thought to be relatively abundant within the lagoon system, though globally, populations are declining significantly.

Table 9: Fish Species of International Concern (IUCN: Red list 2005) of Payne's Creek (Including Punta Ycacos Lagoon system)		
Critically Endangered	Goliath Grouper	<i>Epinephelus itajara</i> *
Vulnerable	Mutton Snapper	<i>Lutjanus analis</i> *
Data Deficient	Spotted eagle ray	<i>Aetobatus narinari</i> *
* Species present within Punta Ycacos Lagoon and coastal zone		

Overall, the fish surveys, combined with input from park staff and local fishermen, generated a relatively comprehensive species list for the water bodies of Payne's Creek – a combination of freshwater, brackish and saltwater species. Most surprising was the presence of two fish species in a drying ephemeral pool in a wheel rut on the pine savanna (UTM 03227100, 1813450). These have been identified as *Cichlasoma octofasciatum* (also recorded from Payne's Creek) and *Gambusia yucatana*.

9. Conservation Planning

As it is difficult to address all conservation issues associated with the maintenance of biodiversity within Payne's Creek as a whole, it is generally considered more effective to focus management activities on a limited number of specific subjects such as an ecosystem or species – these are known as conservation targets. These targets are chosen to indicate the health of the various ecosystems, represent the target of a particular threat, or are of national or international concern.

9.1 Identification of Conservation Targets

Recommendations have been made for the identification of major conservation targets - the ecosystems and species chosen to be the focus of conservation planning efforts within the protected area. It is generally considered easiest to work with between six and eight targets, trying to ensure that they are representative of the biodiversity of the protected area and of the main threats impacting the biodiversity. For Payne's Creek, seven recommended targets have been selected (Table 10, 11), though target selection should always remain flexible, so the management planning team at TIDE may feel the need to change targets during the planning process.

Whilst the current focus may be on these targets, it should also be recognized that adaptive management is key in ensuring that should new priority conservation targets arise, they are not ignored in favour of those chosen in the management plan. It should also always be borne in mind that these targets represent not just themselves, but have been chosen because they also represent the overall biodiversity of the protected area.

Table 10: Recommended conservation targets for Paynes Creek National Park	
<i>Ecosystem Targets</i>	Savannah
	Broadleaf Forest
	Freshwater Ecosystem
	Estuarine Ecosystem
<i>Species Groupings:</i>	Game Species
<i>Species Targets:</i>	Yellow-headed Parrot
	West Indian Manatee

Conservation Target	Justification for Target Selection	Species, Communities or Ecological Systems represented by Target
Savanna	Highlighted as one of the few fragments of relatively well preserved lowland and pre-montane pine forests (WWF: Belizean pine forest). Under the WWF categories, it is given the conservation status critical / endangered. Threatened by increasing frequency and intensity of fire, following past logging pressures. Payne's Creek has not yet affected by pine bark beetle, but it has been recorded nearby. Invasive cogon grass (<i>Imperata cylindrical</i>) is a possible invasive exotic (Muschamp, pers. com.).	This covers short grass savannah through to pine savannah. Species that frequent this ecosystem group include three mammal species of international concern (IUCN red-listed): one endangered species (Baird's tapir (<i>T. bairdii</i>), two species classed as lower risk / near threatened (puma (<i>Felis concolor</i>) and jaguar (<i>Panthera onca</i>). White-tailed deer (<i>Odocoileus virginianus</i>) and collared peccary (<i>Tayassu tajacu</i>) are also represented by this conservation target. It is also important habitat for pine savanna specialist birds such as the endangered yellow headed parrot (<i>Amazona oratrix</i> - covered as a separate target), jabiru (<i>Jabiru mycteria</i>), aplomado falcon (<i>Falco femoralis</i>), savannah sparrow (<i>Passerculus sandwichensis</i>) and sedge wren (<i>Cistothorus platensis</i>).
Broadleaf 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	Several IUCN red-listed and CITES listed species are restricted to the broadleaf forest – the Endangered Yucatan black howler (<i>Alouatta pigra</i>), the CITES listed ocelot (<i>Leopardus pardalis</i>), margay (<i>Leopardus wiedii</i>) and jaguarundi (<i>Herpailurus yaguarundi</i>). The near threatened jaguar (<i>Panthera onca</i>) and great curassow (<i>Crax ruber</i>) are also found in this habitat, as are a number of species presently considered non-threatened – white-lipped and collared peccaries (<i>Dicotyles pecari</i> and <i>Tayassu tajacu</i>).
Freshwater ecosystems	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.	Payne's Creek is used by several bird species of concern such as muscovy duck and agami heron. It also provides habitat for the near threatened Morelet's crocodile (<i>Crocodylus moreletii</i>) and the slider (<i>Trachemys scripta</i>). It has a healthy freshwater fish fauna. It is expected that the Near Threatened Water Opossum (<i>Chironectes minimus</i>) and the Neotropical river otter (<i>Lontra longicaudis</i>) will also occur here.

Table 11: Identification of Conservation Targets (continued)		
Conservation Target	Justification for Target Selection	Species, Communities or Ecological Systems represented by Target
Estuarine Lagoon	Whilst Punta Ycacos lagoon is thought to be outside the Payne's Creek realigned boundaries, it should be included as a conservation target, as it is a focal point of the protected area.	The lagoon system has been highlighted as important for the protection of extensive estuarine mangrove areas (Zisman, 1992), particularly important as a fish nursery for the reefs of the Port Honduras area, and also as a congregating area for cow-nosed rays (<i>Rhinoptera bonasus</i>) and the vulnerable West Indian manatees (<i>Trichechus manatus</i>). The critically endangered goliath grouper (<i>Epinephelus itajara</i>) and hawksbill turtle (<i>Eretmochelys imbricate</i>) and vulnerable mutton snapper (<i>Lutjanus analis</i>) have also been recorded here. The mangroves also support a number of nesting waterbirds – a nesting colony of between 150 and 200 pairs of white ibis (<i>Eudocimus albus</i>), individual nests of boat-billed herons (<i>Cochlearius cochlearius</i>), bare-throated tiger-herons (<i>Tigrisoma mexicanum</i>) and pale-vented pigeons (<i>Columba cayennensis</i>). It is thought that the near threatened black catbird (<i>Melanoptila glabirostris</i>), a mangrove associate, is extending its range southwards into this area (Jones, pers. com.; Muscamp, pers. com).
Game species	Game species span both broadleaf forest and savanna ecosystems, but face similar threats. White-lipped peccary (<i>D. pecari</i>) in particular is a species of concern within Belize with increasing habitat fragmentation and hunting pressure.	The endangered Baird's tapir (<i>T. bairdii</i>), near threatened great curassow (<i>Crax rubber</i>), white-lipped peccary (<i>D. pecari</i>), collared peccary (<i>T. tajacu</i>), red brocket deer (<i>Mazama americana</i>), white tailed deer (<i>O. virginianus</i>), nine-banded armadillo (<i>Dasyprocta novemcinctus</i>), Central American agouti (<i>Dasyprocta punctata</i>), paca (<i>Agouti paca</i>) are all under pressure from hunting. Whilst some are restricted to broadleaf forest, and others prefer the open savannah, the actions to mitigate this common threat are the same.
Yellow-headed parrot	This species is listed as Endangered in the IUCN Redbook, and Globally Endangered by Birdlife. It has faced massive declines over the past twenty years, and is further threatened by the increasing frequency of fires (burning nesting trees) and the harvesting of nestlings. Nine nests have been identified within Payne's Creek, though at least one of these is known to have been destroyed by fire in 2005.	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 (<i>Falco femoralis</i>), savannah sparrow (<i>Passerculus sandwichensis</i>) and sedge wren (<i>Cistothorus platensis</i>), as well as Baird's tapir (<i>T. bairdii</i>), puma (<i>F. concolor</i>) and jaguar (<i>P. onca</i>), white-tailed deer (<i>O. virginianus</i>) and collared peccary (<i>T. tajacu</i>)

Table 11: Identification of Conservation Targets (continued)		
Conservation Target	Justification for Target Selection	Species, Communities or Ecological Systems represented by Target
West Indian Manatee	The manatee (<i>Trichechus manatus</i>) is listed as a vulnerable species (IUCN redlist), and is chosen as a conservation target due to the potential threats it may be facing with the realignment of the protected area boundaries, which no longer assures protection for the lagoon system.	Whilst this conservation target has been chosen because of specific threats it faces, it is 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.

9.2 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 identified during the planning exercise are therefore rated according to their viability within each of the three TNC Viability Criteria – Size, Condition and Landscape Context (Table 12), with justification for the ratings chosen – Very Good, Good, Fair or Poor (Table 13).

Table 12: 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 13: TNC Viability Ratings	
Very Good:	Functioning at an ecologically desirable status, and requires little human intervention
Good:	Functioning within its range of acceptable variation; may require some human intervention
Fair:	Lies outside its range of acceptable variation and requires human intervention. If unchecked, the target will be seriously degraded
Poor:	If allowed to remain in the present status, restoration or preventing local extinction will be impossible

Looking at each of the recommended conservation targets in turn, the following broad ratings were assigned. These are recommended ratings and may well become more defined or change during discussion of the management planning team, as more information becomes available for assessing the 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 is reducing 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 is prioritized within Payne's Creek.
Landscape Context	Fair	On a regional level, the pine savannah ecoregion 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 the wardening currently 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 <i>Tilapia</i> , 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 now that the protected area boundaries have been realigned, so this rating may well change within the management plan periodic reviews.
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. The rating is not Very Good, as Punta Ycacos lagoon is no longer included within the protected area, so this connectivity may be affected

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). 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 within the protected area.
Condition	Fair / Good	Not enough information to make an accurate estimation of rating. Suggest this should be discussed with community members and park staff in greater detail
Landscape Context	Fair / Good	The game populations reliant on savannah are probably rated as good, as there is sufficient contiguous habitat to ensure their continued presence if hunting pressure is removed. The majority of these species are generalists (such as white-tailed deer and 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.

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 the harvesting of nestlings 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
Landscape Context	Poor	Belize is the last stronghold of this species, and increasing pressures from land use changes, the theft of nestlings, and the increasing frequency of anthropogenic fires started by anthropogenic causes 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), increased boat traffic, accidental deaths in nets set over creek mouths, and still some hunting, so human intervention is required to ensure its survival.

Viability Rankings for Conservation Targets

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

Viability Rating	Score
Very Good	4
Good	3.5
Fair	2.5
Poor	1.0

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

With this information we can place the recommended conservation targets for Payne’s Creek in order of viability. 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 (Table 14).

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)				

For each conservation target we set a recommended goal, with relevant indicators that can be monitored over time to assess whether that goal has been met (Table 15).

Table 15: Viability Rating Goals			
Conservation Target	Current Rating	Goal	Justification and Indicator
Freshwater ecosystems	Very Good	Very Good	Goal: Very Good. To maintain the freshwater ecosystem in its current condition or better
			Potential Monitoring Indicators: Fish populations (abundance and diversity) and water quality (sampled annually at specific survey points on both creeks). Annual monitoring of land use in headwater areas of both creeks.
Estuarine Ecosystem	Very Good	Very Good	Goal: Very Good. To maintain the estuarine ecosystem in its current condition or better. To return the lagoon system to protected status
			Potential Monitoring Indicators: Land use adjacent to lagoon (eg. disturbance / removal of mangroves in non-protected areas), permit populations (annual feedback from fly-fishing tou guides), manatee presence / absence
Broadleaf forest	Good	Good	Goal: Good. To maintain the broadleaf forest in its current condition or better, and ensure continued connectivity within MMMAT
			Potential Monitoring Indicators: Continued absence of anthropogenic impacts
West Indian Manatee	Good	Very Good	Goal: Very Good. To ensure the continued, undisturbed presence of manatees within Punta Ycacos lagoon. To support initiative for the continued recovery of manatee populations in the Port Honduras area
			Potential Monitoring Indicators: West Indian Manatee presence within Punta Ycacos lagoon and Deep River (through instigating report procedure)
Savannah	Fair	Good	Goal: Good. To improve the viability of the savannah
			Potential Monitoring Indicators: Fire frequency; density of pine seedlings and saplings
Game species	Fair	Good	Goal: Good. To improve the viability of game species through enforcement, and ensuring continued connectivity of broadleaf forest within MMMAT
			Potential Monitoring Indicators: white-lipped peccary sightings, white tailed deer sightings, signs of hunting activity
Yellow-headed parrot	Fair	Good	Goal: Good. To improve the viability of the Yellow-headed parrot
			Potential Monitoring Indicators: Number of nests within Payne's Creek, number of nests disturbed (through harvesting of nestlings / fire),

- Urgency:** What is the likelihood of the threat occurring over the next five years? This is ranked on a scale of:

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

- Recovery Time:** How long will it take the target to recover following major disturbance? This is ranked on a scale of:

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

- Probability of the Threat Occuring:** What is the probability of the threat occurring during the timeframe of the management plan? This is ranked on a scale of:

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

- Management Actions:** What management actions can be used to reduce or eliminate the threat?

Threat 1: Fire		
Increasing frequency of anthropogenic fire within the protected area		
Status	Active	
Target	Savannah	
Source	Direct: Hunters from all 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
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
Management Actions	Developing and implementing a fire management programme, increased vigilance against hunters in the savannah dry season, fire management training for local communities involved in milpa farming	

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 all local communities, reported to be hunting within the protected area, particularly in the Deep River extension Indirect: Lack of economic opportunities in area – supplement diet through hunting	
Area	2	Primarily focused on white-tailed deer in the savanna in the Deep River realignment area (but needs more input...*)
Severity	1	Partially reflecting low awareness of new park boundaries following realignment, easy access across savannas from north, and also indicative of safety problems of tackling armed hunters at night
Urgency	3	Currently occurring, partially reflecting low awareness of new park boundaries following realignment
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
Management Actions	Delineation and demarcation of protected area boundaries in areas of conflict, increase in prioritization of wardening effort. Facilitate increase in economic opportunities to local communities, reducing requirement for hunting.	

Threat 3: Development in Adjacent Areas		
Impacts from development in adjacent areas – three areas of concern: <ol style="list-style-type: none"> 1. Dereserved 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: Dereserved 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
Urgency	2	There are plans fore 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	0.75	The threat is occurring at present, and will continue to occur until strategies are implemented to halt it
Management Actions	Close liaison with property developer to ensure environmentally sound planning, in-depth review of any EIA produced, and close liaison with DoE	
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 ithroughout 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
Management Actions	Monitor land ownership / land use change in the headwaters area; monitor water quality	
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	Dependant 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
Management Actions	Monitor land ownership / land use change in the broadleaf forest area adjacent to Paynes Creek National Park; Facilitate community protection of broadleaf forest near Monkey River; If feasible, acquire land to form connectivity between Paynes Creek and Monkey River	

Threat 4: Logging		
Logging, particularly within the Deep River extension area		
Status	Active	
Target	Needleleaf Forest	
Source	Direct: Local timber concessions overlapping newly defined Deep River extension to Payne's Creek Indirect: Market for pine wood	
Area	1	How widespread is the logging?
Severity	2	The pine savannah shows the signs of past removal of pine, but the characteristic species are still present
Urgency	3	Currently occurring, as Deep River extension I included within a logging concession. Partially reflecting low awareness of new park boundaries following realignment
Recovery Time	2	
Probability of Threat Occurring	0.75	Is logging still going on within the protected area? (Needs more input...*)
Management Actions	Delineation and demarcation of protected area boundaries in areas of conflict; assess the Deep River extension in terms of impact of current logging; work with logging concession holder towards an agreement re. Deep River extension; increase in prioritization of wardening effort.	

Threat 5: Harvesting of <i>Acoelorrhaphe</i> within Payne's creek National Park		
Harvesting of <i>Acoelorrhaphe</i> seeds for export to Canada		
Status	Potential (Active?)	
Target	<i>Accoelorrhaphe</i> , a species of the pine savannah	
Source	Direct: Harvesting of seeds by surrounding local communities (particularly Buena Vista) – currently outside the protected area Indirect: High poverty level in adjacent communities, few employment opportunities	
Area	1	If harvesting starts inside the protected area, it is not thought to be on a large scale – primarily at easy access points
Severity	1	Whilst this will not apparently be affected within the 5-year period of the management plan (if harvested properly), harvesting will affect recruitment in the long term
Urgency	2	Rating is dependent on whether harvesting is currently occurring or not. (Needs more input...*)
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
Management Actions	Delineation and demarcation of protected area boundaries in areas of conflict; increase in prioritization of wardening effort.	

Threat 6: 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	(Needs more input...*)
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	0.25	This is low, as wardening activities prioritise the identification and wardening of nest sites during nesting season
Management Actions	Continuing the prioritization of identification and wardening of nesting areas, increased public awareness, liaison with PFB Yellow-headed parrot programme, define boundaries in Deep River extension and spread awareness.	

All ratings should be reviewed by management planning team, as this is the technical overview, and doesn't incorporate local conditions. For those with an * , we feel more local knowledge is needed to rate this, but have made a 'best option' estimate.

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

$$(\text{Urgency} + \text{Recovery}) \times \text{Severity} \times \text{Area} \times \text{Probability}$$

...and the resultant total threat scores are ranked.

Threats	Criteria Ratings					Total threat Score	Ranked Threat*
	Area	Severity	Urgency	Recovery	Probability		
Fire	4	3	3	2	1	60	6
Hunting and Fishing	2	1	3	1	1	8	5
Development in Adjacent Areas: Area 1*	3	2	2	2	0.75	18	4
Logging	1	2	3	2	0.75	7.5	3
Harvesting of <i>A. wrightii</i>	1	1	2	1	0.75	2.25	1
Theft of yellow-headed parrot chicks	2	2	2	1	0.25	3	2

* **Lowest threat score rank = 1**

*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:

- Fire
- Hunting and Fishing
- Development in Adjacent Area
- Logging
- Theft of Yellow-headed Parrot nestlings
- Harvesting of *Acoellorraphe* seeds

10. Management Recommendations

The three highest priority management recommendations for Payne's Creek National Park are:

1. Mapping and clearly delineating the boundaries on the ground of the new Deep River extension, and ensuring that staff and stakeholders are aware of location
2. Ensuring some form of protective status for Punta Ycacos lagoon system
3. Fire Management

Recommendations developed under conservation planning

Fire

1. Developing and implementing a fire management programme (this appears to be well under way, with the work that Mario Muschamp has been doing).
2. Fire awareness and fire management training for local communities involved in milpa farming and hunting

Hunting

3. Increased vigilance against hunters in the savannah dry season, especially in the Deep River extension
4. Delineation and demarcation of protected area boundaries in areas of conflict
5. Facilitate increase in economic opportunities to local communities, reducing requirement for hunting.

Development in Adjacent Areas

6. Develop close liaison with property developer to ensure environmentally sound planning
7. In-depth review of any EIA produced, and close liaison with DoE on points of concern
8. Monitor land ownership / land use change in the headwaters area, and the broadleaf forest area adjacent to Paynes Creek National Park;

Maintain Forest Connectivity

9. Facilitate and encourage community protection of broadleaf forest near Monkey River;
10. If feasible, and not in conflict with Monkey River, acquire land to form connectivity between Paynes Creek and Monkey River

Logging

11. Work with logging concession holder towards an agreement re. Deep River extension;
12. Delineation and demarcation of protected area boundaries in areas of conflict;

13. Assess the Deep River extension in terms of impact of current logging;

Yellow-headed Parrots

14. Continuing the prioritization of identification and wardening of nesting areas,
15. Increased public awareness,
16. Liaison with PFB Yellow-headed parrot programme, and with other organizations promoting conservation of this species (BAS etc.)

11. Biodiversity Monitoring Recommendations

Why monitor, what to monitor, where to monitor it, and when to monitor it...these are the questions that need to be asked when designing a monitoring programme for a protected area. Monitoring allows protected area managers to see patterns and changes in biodiversity over time – and also gives a means of measuring success of conservation strategies.

Developing a 'measures of success' monitoring programme for conservation targets is relatively straight forward using the Wildlife Conservation Society Living Landscape Programme (Sanderson et. al., 2002).

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.

Both strategy monitoring programmes can be developed in the same way, with a monitoring system based on the Wildlife Conservation Society Living Landscapes Programme. For example, for the conservation objective:

'Maintain Yellow-headed Parrot population at or above the current levels'

1. Choose the threat to be monitored
2. Develop a target condition that you want to achieve for that threat
3. Decide what you need to monitor to see if you are reaching your target
4. Decide how you are going to monitor
5. Designate an indicator that you can use to measure whether your strategy has been successful

It is assumed that positive changes in the threat reflect success of the implementation of the strategy, or the effectiveness of the strategy.

Monitoring Success of Strategy Implementation

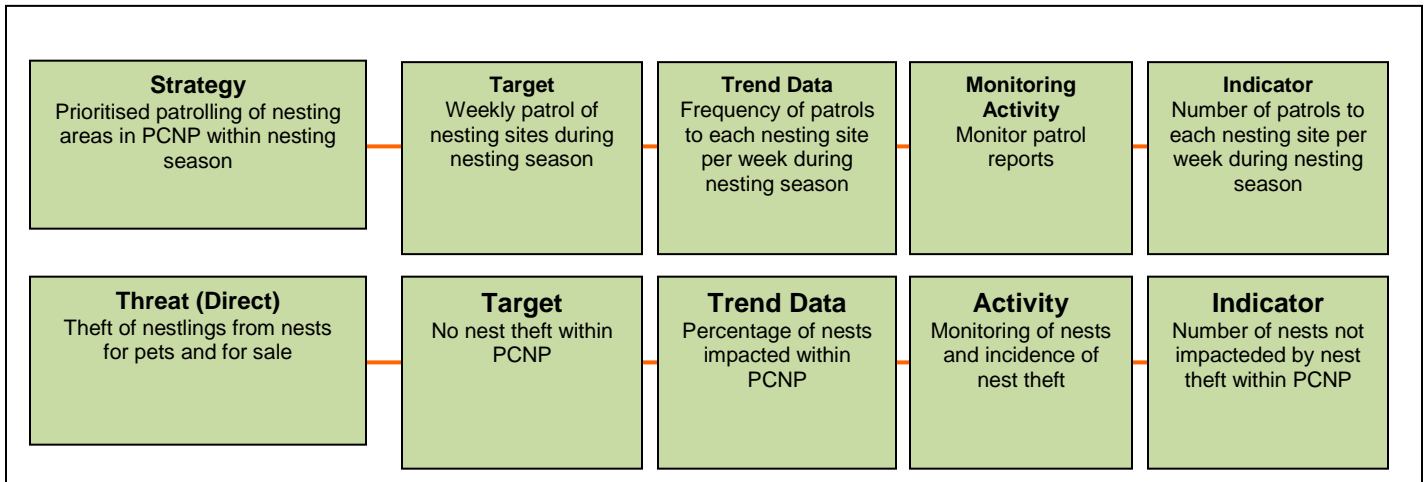
For this example, a priority strategy has been chosen (‘maintain Yellow-headed Parrot populations at or above current levels’), an identified direct threat (‘theft of Yellow-headed Parrot nestlings’), and an associated action (Prioritised patrolling of nesting areas in PCNP within nesting season).

The target is to increase the number of patrols in the critical areas to an average of once per week per nesting site during nesting season, over the management plan period, to ensure that no nestlings are removed from nests. The baseline is the current status – the number of patrols that currently visit the nest sites per unit of time (in this case, per week during nesting season), and the number of nest thefts recorded.

Indicators are identified – measures that can be compared to the baseline, to see if the strategy and associated actions have been implemented successfully. For this strategy, we have two indicators:

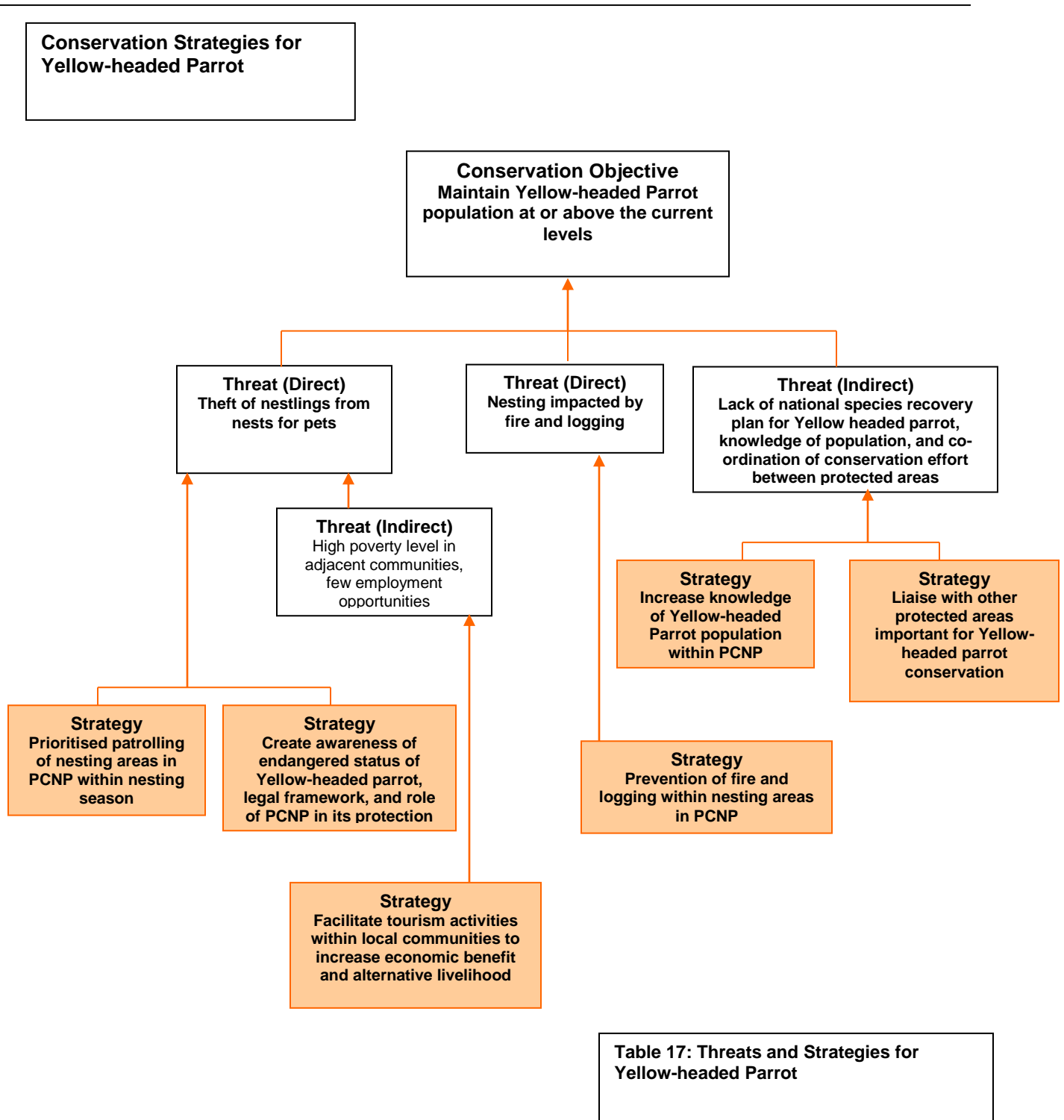
1. The number of patrols per unit time – to tell us if the strategy has been implemented (monitored by looking at the patrol reports (in planning patrol report layout, ensure that they contain the information needed for monitoring. In this case, for example, the date, and the areas visited)).
2. The percentage of nests impacted by theft of nestlings – to tell us if the strategy has been successful.

This monitoring framework can be summarized as follows:

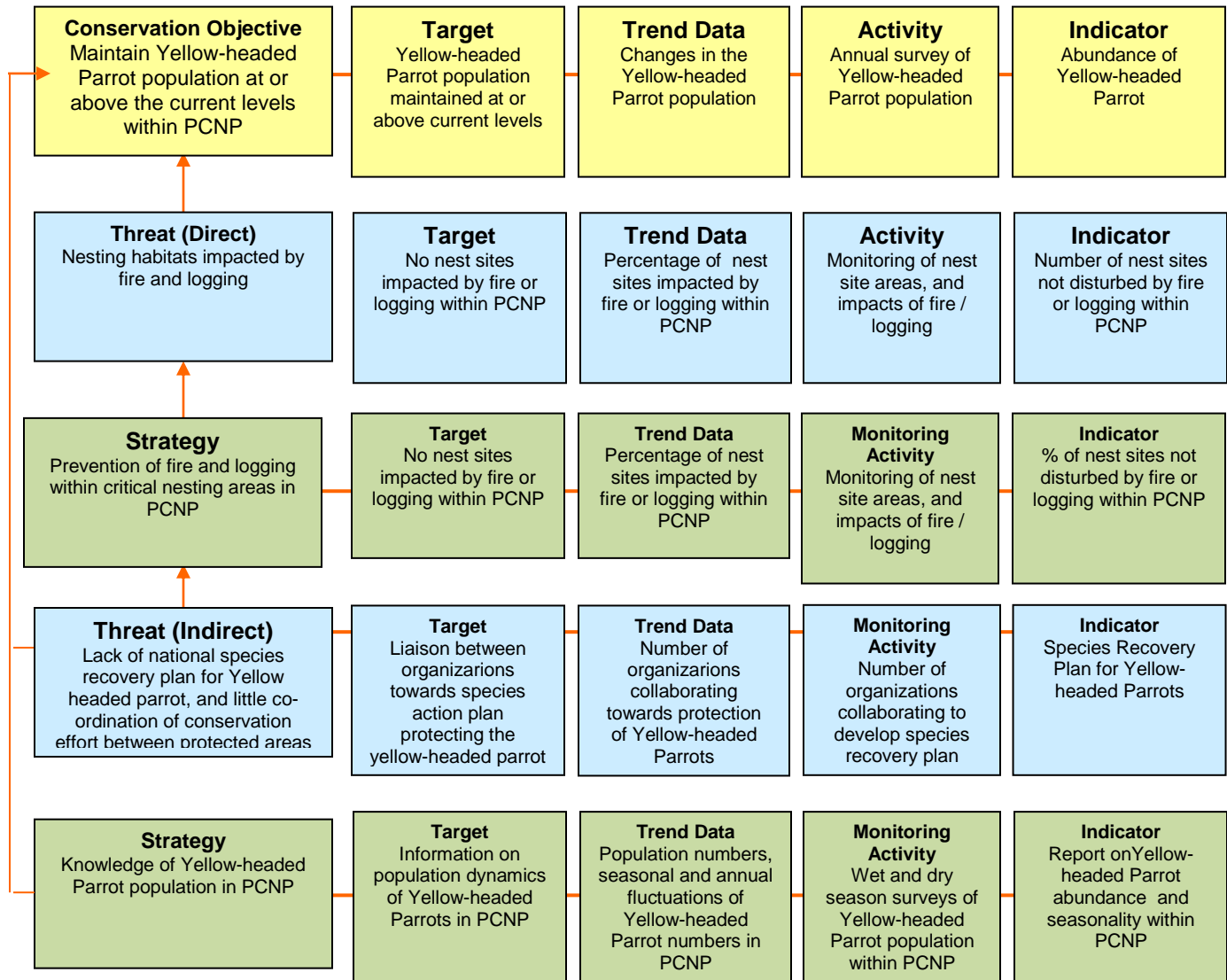


If the conservation status is reviewed at the end of the nesting season, or end of the year, and patrol reports show that each critical area was visited every week during the nesting season, but two nests were impacted by theft of nestlings during the nesting season, then there has been some degree of success, but the target has not been reached. The annual operational plan may then need to be reviewed and the frequency of patrols increased, to ensure the success of the strategy. In this way, monitoring can feed directly back into management.

Following the Yellow-headed Parrot example through:

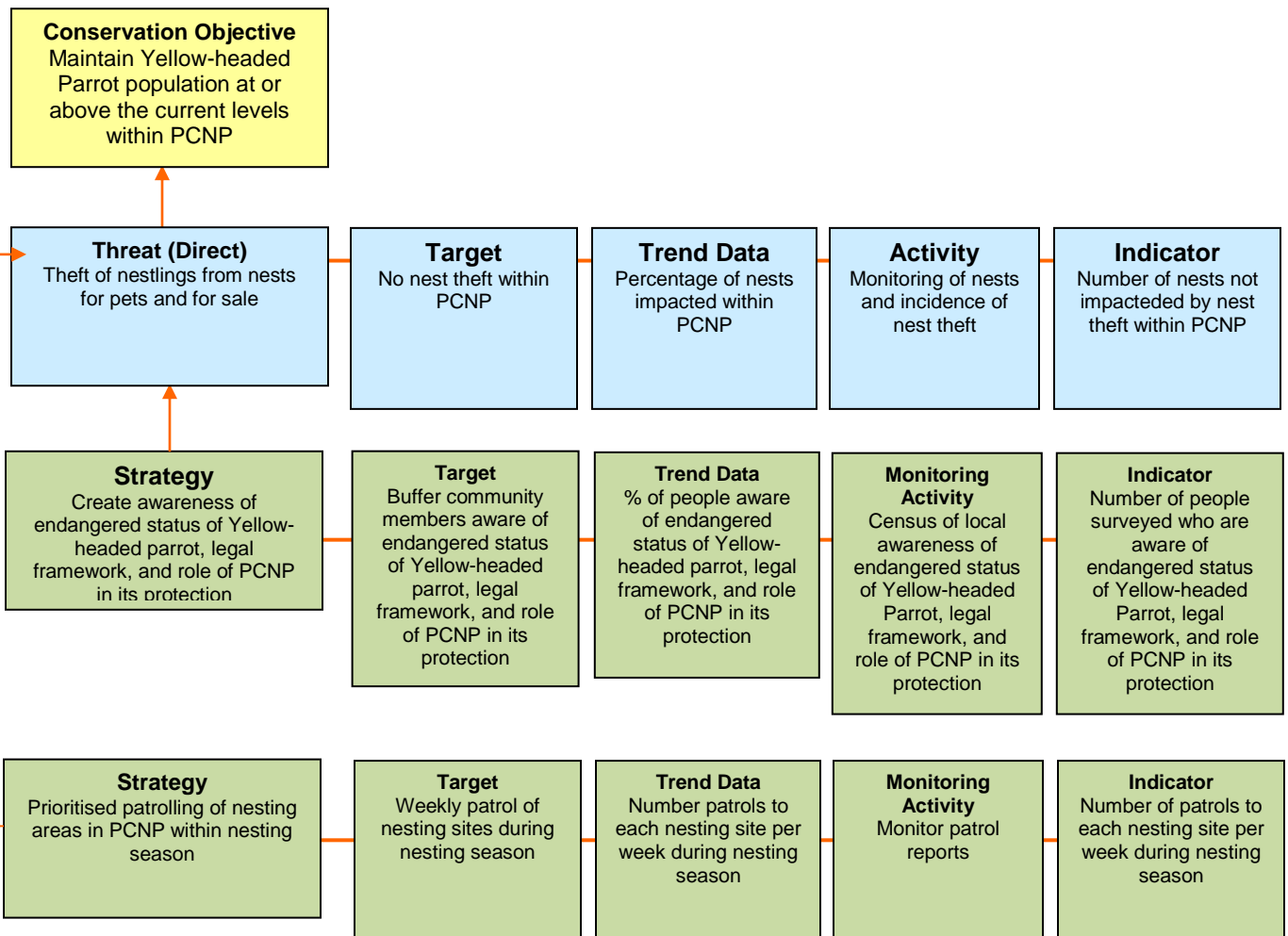


Monitoring Framework – Yellow-headed Parrot



Box 2(a): Monitoring framework for Yellow-headed Parrots (after WCS, Living Landscapes Programme)

Monitoring Framework – Yellow-headed Parrot (cont.)



Box 2(b): Monitoring framework for Yellow-headed Parrots (cont.)
(after WCS, Living Landscapes Programme)

This framework can be developed for each conservation target in turn, giving a range of indicators to choose from for incorporation into the monitoring programme. Not all indicators are cost effective or feasible, so some may not be used. Others may appear several times, for more than one conservation target, and can therefore be flagged as being particularly cost effective.

At the end of the day, a conservation planning monitoring programme will indicate whether the management of the natural resources has been successful over the time period of the management plan, whilst also allowing the management plan itself to be adaptive to ensure as effective an implementation as possible.

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Appendices:

Appendix One: Plant Species of Payne's Creek National Park

Appendix Two: Mammal Species of Payne's Creek National Park

Appendix Three: Bird Species of Payne's Creek National Park

Appendix Four: Reptile and Amphibian Species of Payne's Creek National Park

Appendix Five: Fish Species of Payne's Creek National Park

Appendix One: Plant Species of Paynes Creek National Park

Family	Species	Common name
Adiantaceae	<i>Acrostichum aureum</i>	Mangrove fern
Alismataceae	<i>Sagittaria lancifolia</i>	White-flowered water plantain
Anacardiaceae	<i>Metopium brownei</i>	Black Poisonwood, Chechem
	<i>Spondias mombin</i>	Hogplum
	<i>Spondias radlkoferi</i>	Hogplum
Annonaceae	<i>Annona scleroderma</i>	Wild annona, cowsop (?)
	<i>Xylopia frutescens</i>	Polewood
Apocynaceae	<i>Lacmellea standleyi</i> (?)	Milk Tree
	<i>Stemmadenia donnell-smithii</i>	Cojeton
	<i>Tabernaemontana alba</i>	Dog balls
Aquifoliaceae	<i>Ilex guianensis</i>	Birdberry
	<i>Ilex sp.</i>	
Araceae	<i>Philodendron spp.</i>	Philodendron
	<i>Philodendron tripartitum</i>	Three-lobed philodendron
	<i>Syngonium sp.</i>	
Araliaceae	<i>Dendropanax arboreus</i>	Mano de lion, White Chaca
Arecaceae	<i>Acoelorrhaphe wrightii</i>	Tasiste
	<i>Attalea cohune</i>	Cohune
	<i>Bactris major</i>	Pokenoboy - black fruit
	<i>Cocos nucifera</i>	Coconut
	<i>Desmoncus orthacanthos</i>	Bayal, basket tie tie, stay-a-while
	<i>Roystonea regia</i>	Royal palm, Cabbage palm
Asteraceae	<i>Neurolaena lobata</i>	Jackass bitters
Bignoniaceae	<i>Crescentia cujete</i>	Calabash
	<i>Paragonia pyramidata</i>	liana
	<i>Tabebuia rosea</i>	Mayflower
Bixaceae	<i>Cochlospermum vitifolium</i>	wild cotton, (yellow) cotton flower

Appendix One: Plant Species of Paynes Creek National Park (cont...2)

Family	Species	Common name
Bombacaceae	<i>Ceiba pentandra</i>	Ceiba / cotton tree
	<i>Ochroma pyramidale</i>	Balsa, polack
	<i>Pachira aquatica</i>	Provision bark, Santo domingo
	<i>Quararibea funebris</i>	Batidos
Boraginaceae	<i>Cordia bicolor</i>	"Fiddlewood"
	<i>Cordia sp.</i>	Cordia
Bromeliaceae	<i>Tillandsia spp.</i>	Air-plants
Burseraceae	<i>Bursera simaruba</i>	Gumbo limbo
	<i>Protium sp.</i>	
Cecropiaceae	<i>Cecropia peltata</i>	Trumpet, Warumo
Chrysobalanaceae	<i>Chrysobalanus icaco</i>	Cocoplum
	<i>Hirtella americana</i>	Pigeon plum
	<i>Hirtella racemosa</i>	Wild pigeon plum
	<i>Licania hypoleuca</i>	Red pigeon plum
Clusiaceae	<i>Calophyllum brasiliense</i>	Santa maria
	<i>Clusia sp.</i>	
	<i>Garcinia sp.</i>	
	<i>Symphonia globulifera</i>	Waika chew-stick
	<i>Vismia camparaguey</i>	Wild annato
	<i>Vismia macrophylla</i>	Ringworm tree
Combretaceae	<i>Conocarpus erecta</i>	Buttonwood
	<i>Laguncularia racemosa</i>	White Mangrove
	<i>Terminalia amazonia</i>	Nargusta
Convolvulaceae	<i>Ipomoea sp.</i>	Ipomoea
Costaceae	<i>Costus sp.</i>	Costus
Cyperaceae	<i>Cyperus sp.</i>	
	<i>Eleocharis sp.</i>	Freshwater reed
	<i>Rhynchospora cephalotes</i>	Armadillo grass
	<i>Scleria bracteata</i>	Cutting grass

Appendix One: Plant Species of Paynes Creek National Park (cont....3)

Family	Species	Common name
Dennstaedtiaceae	<i>Pteridium caudatum</i>	Pteridium, Bracken
Dilleniaceae	<i>Curatella americana</i> <i>Davilla sp.</i> <i>Tetracera sp.</i>	Yaha, Sandpaper tree
Dioscoreaceae	<i>Dioscorea sp.</i>	Chiny yam
Droseraceae	<i>Drosera capillaris</i>	Red sundew
Elaeocarpaceae	<i>Sloanea sp.</i>	
Erythroxylaceae	<i>Erythroxylum sp.</i>	Erythroxylum
Euphorbiaceae	<i>Sapium sp.</i>	
Fabaceae		
Caesalpinioideae	<i>Cassia grandis</i> <i>Dialium guianense</i>	Bukut, Stinking toe Ironwood
Mimosoideae	<i>Acacia collinsii</i> <i>Inga affinis</i> <i>Inga cocleensis</i> <i>Inga sp.</i> <i>Mimosa pellita</i> <i>Mimosa pudica</i> <i>Mimosa tarda</i> <i>Pithocellobium sp.</i>	Subin Bri-bri Inga Inga Sensible weed (pink - flowered) Sensitive weed Sensible weed
Papilionoideae	<i>Andira inermis</i> <i>Lonchocarpus guatemalensis</i> <i>Machaerium sp.</i> <i>Mucuna sp.</i> <i>Pachyrhizus sp.</i> <i>Pterocarpus officinalis</i>	Bastard cabbage bark, carbon Dogwood, Turtle-bone Tiger claw Deer eye, horse eye vine Kaway
Fagaceae	<i>Quercus sp.</i>	Oak

Appendix One: Plant Species of Paynes Creek National Park (cont...4)

Family	Species	Common name
Flacourtiaceae	<i>Zuelania guidonia</i>	John Crow Wood, Tamai
Gleicheniaceae	<i>Dicranopteris pectinata</i>	Tiger fern
Heliconiaceae	<i>Heliconia bourgaeana</i>	Waha leaf
	<i>Heliconia latispatha</i>	Platanillo
	<i>Heliconia sp.</i>	Heliconia
Lauraceae	<i>Nectandra sp.</i>	Laurel
Loganiaceae	<i>Strychnos sp.</i>	Chicoloro
Malpighiaceae	<i>Byrsonima bucidifolia</i>	Craboo
	<i>Byrsonima crassifolia</i>	Sacpa, Nancen
Malvaceae	<i>Malvaviscus arboreus</i>	Turk's cap hibiscus
Marantaceae	<i>Calathea sp.</i>	
	<i>Thalia geniculata</i>	
Melastomaceae	<i>Miconia affinis</i>	Chigger nuts
	<i>Miconia argentea</i>	White Maya
	<i>Miconia lacera</i>	Chigger nuts
	<i>Miconia spp.</i>	Miconia
	<i>Mouriri sp.</i>	
Meliaceae	<i>Guarea sp.</i>	
	<i>Swietenia macrophylla</i>	Mahogany
	<i>Trichilia sp.</i>	
Moraceae	<i>Ficus insipida</i> (?)	Wild fig (long leafed)
	<i>Ficus sp.</i>	Fig
	<i>Trophis racemosa</i>	Yaxox, Red breadnut, White ramon
Myricaceae	<i>Myrica cerifera</i>	
Myristicaceae	<i>Viola koschnyi</i>	Banak
	<i>Viola multiflora</i>	Bastard banak, white banak

Appendix One: Plant Species of Paynes Creek National Park (cont....5)

Family	Species	Common name
Myrsinaceae	<i>Ardisia sp.</i>	
Myrtaceae	<i>Eugenia capuli</i> <i>Eugenia sp.</i>	Eugenia Eugenia
Nyctaginaceae	<i>Pisonia aculeata</i>	Tiger claw
Nymphaeaceae	<i>Nymphaea sp.</i>	Water lily
Orchidaceae	<i>Bletia purpurea</i> <i>Myrmecophila tibicinis</i>	Pink terrestrial orchid cow-horn orchid
Passifloraceae	<i>Passiflora biflora</i> <i>Passiflora foetida</i> <i>Passiflora urbaniana</i>	Granadillo Passionflower
Pinaceae	<i>Pinus caribaea</i>	Caribbean pine
Piperaceae	<i>Piper amalago</i> <i>Piper sp.</i>	Cordonzillo
Poaceae	<i>Gynerium sagittatum</i>	Dumb cane
Polygonaceae	<i>Coccoloba belizensis</i> <i>Coccoloba sp.</i> <i>Coccoloba uvifera</i>	Bob Coccoloba Sea-grape
Rhizophoraceae	<i>Cassipourea guianensis</i> <i>Rhizophora mangle</i>	Bastard waterwood Red Mangrove
Rubiaceae	<i>Alibertia edulis</i> <i>Amaioua corymbosa</i> <i>Faramea sp.</i> <i>Guettarda combsii</i> <i>Hamelia rovirosae</i> (?) <i>Morinda panamensis</i> <i>Palicourea sp.</i> <i>Psychotria poeppigiana</i>	Wild guava Wild coffee Glassy wood Yellow-wood Hot lips

Appendix One: Plant Species of Paynes Creek National Park (cont....6)

Family	Species	Common name
Rutaceae	<i>Zanthoxylum sp.</i>	Prickly yellow
Sapindaceae	<i>Cupania sp.</i> <i>Matayba sp.</i>	Cupania
Sapotaceae	<i>Chrysophyllum mexicanum</i> <i>Manilkara zapota</i> <i>Pouteria campechiana</i> <i>Sideroxylon sp.</i>	Chiceh Sapote Mammee cerillo
Selaginellaceae	<i>Selaginella sp.</i>	Selaginella
Simaroubaceae	<i>Simarouba glauca</i>	Negrito
Solanaceae		
Sterculiaceae	<i>Guazuma ulmifolia</i>	Bay cedar, pixoy
Tiliaceae	<i>Luehea seemannii</i> (?) <i>Trichospermum grewiifolium</i>	Copper-leaf Luehea Balsa wood, makapal
Ulmaceae	<i>Trema sp.</i>	Trema
Verbenaceae	<i>Avicennia germinans</i> <i>Vitex gaumeri</i>	Black Mangrove Yaxnik
Vochysiaceae	<i>Vochysia hondurensis</i>	Yemeri, San Juan
Zamiaceae	<i>Zamia polymorpha</i>	Palmita, Cycad

Appendix Two: Mammal Species of Payne's Creek National Park			
Species		Record	Broad Ecosystem Association
Didelphimorpha			
Didelphidae			
Virginia opossum	<i>Didelphis virginiana</i>	Seen	Pine savanna, Broadleaf Forest
Grey four eyed opossum	<i>Philander opossum</i>	PCNP Staff	Pine savanna
Water opossum*	<i>Chironectes minimus</i>	PCNP Staff	Mario - seen on Monkey River
Edentata			
Myrmecophagidae			
Northern tamandua	<i>Tamandua mexicana</i>	PCNP Staff	Broadleaf forest
Silky anteater*	<i>Cyclopes didactylus</i>	PCNP Staff	Broadleaf forest
Dasypodidae			
Nine banded armadillo	<i>Dasypus novemcinctus</i>	PCNP Staff	Broadleaf forest, Pine Savanna
Chiroptera			
White-lined sac winged bat*		Seen	Monkey River
Primates			
Cebidae			
Yucatan Black Howler	<i>Alouatta pigra</i>	Heard	Broadleaf Forest
Rodentia			
Sciuridae			
Deppes Squirrel	<i>Sciurus deppei</i>	PCNP Staff	Broadleaf Forest
Erethizontidae			
Mexican porcupine	<i>Coendou mexicanus</i>	PCNP Staff	Broadleaf forest, Pine Savanna
Dasyproctidae			
Central American Agouti	<i>Dasyprocta puntata</i>	PCNP Staff	Broadleaf Forest
Agoutidae			
Paca	<i>Agouti paca</i>	PCNP Staff	Along creek edges
Carnivora			
Canidae			
Grey Fox	<i>Urocyon cinereoargenteus</i>	Seen	Pine savanna
Procyonidae			
Northern racoon	<i>Procyon lotor</i>	Tracks	On creek, river and lagoon margins
White-nosed coati	<i>Nasua narica</i>	PCNP Staff	Broadleaf Forest
Kinkajou	<i>Potos flavus</i>	PCNP Staff	Broadleaf Fores, along river edge
Mustelidae			
Tayra	<i>Eira barbara</i>	PCNP Staff	Broadleaf forest, Pine Savanna
Neotropical River otter	<i>Lutra longicaudis</i>	PCNP Staff	Monkey River and Punta Negra creeks
Felidae			
Ocelot	<i>Leopardus pardalis</i>	PCNP Staff	Broadleaf Forest and edge of savanna
Margay	<i>Leopardus weidii</i>	PCNP Staff	Broadleaf forest (3 see in 5 years)
Jaguaroundi	<i>Herpailurus yagouarundi</i>	PCNP Staff	Broadleaf forest
Puma	<i>Puma concolor</i>	PCNP Staff	Broadleaf forest, Pine Savanna
Jaguar	<i>Panthera onca</i>	Tracks	Broadleaf forest, Pine Savanna and seen on coast
*Observed in Adjacent Areas			

Appendix Two: Mammal Species of Payne's Creek National Park (continued)			
Species		Record	Broad Ecosystem Association
<i>Perissodactyla</i>			
<i>Tapiridae</i>			
Baird's Tapir	<i>Tapirus bairdii</i>	Tracks	Pine Savanna, Broadleaf forest, creek edges
<i>Artiodactyla</i>			
<i>Tayassuidae</i>			
Collared Peccay	<i>Tayassu tajacu</i>	PCNP Staff	Broadleaf forest, Pine Savanna
White-lipped Peccary	<i>Dicotyles pecari</i>	PCNP Staff	Broadleaf forest - seen in large droves
<i>Cervidae</i>			
White tailed deer	<i>Odocoileus virginianus</i>	Seen	Pine Savanna, Broadleaf forest
Red brocket deer	<i>Mazama americana</i>	PCNP Staff	Broadleaf forest
West Indian Manatee	<i>Manatus trichechus</i>	PCNP Staff	Punta Ycacos Lagoon
*Observed in Adjacent Areas			

Bird Species of Paynes Creek National Park				
Species		Status	Habitats	Endemism
Great Tinamou	<i>Tinamus major</i>	fP	BFL	
Little Tinamou	<i>Crypturellus soui</i>	fP	SC	
Thicket Tinamou	<i>Crypturellus cinnamomeus</i>		BFL, SC	
Least Grebe	<i>Tachybaptus dominicus</i>	IP	WL, LA	
Pied-billed Grebe	<i>Podilymbus podiceps</i>	IP	WL, LA	
American White Pelican	<i>Pelecanus erythrorhynchos</i>	IW	LA, BE	
Brown Pelican	<i>Pelecanus occidentalis</i>	vV	MF, BE, OC	
Neotropic Cormorant	<i>Phalacrocorax brasilianus</i>	cP	LA	
Double-crested Cormorant	<i>Phalacrocorax auritus</i>	uV	MF, BE	
Anhinga	<i>Anhinga anhinga</i>	fP	LA	
Magnificent Frigatebird	<i>Fregata magnificens</i>	vV	O	
Least Bittern	<i>Ixobrychus exilis</i>	rP	WL	
Bare-throated Tiger-Heron	<i>Tigrisoma mexicanum</i>	uP	WL, LA	
Great Blue Heron	<i>Ardea herodias</i>	cV	WL, LA	
Great Egret	<i>Ardea alba</i>	cV	WL, LA	
Snowy Egret	<i>Egretta thula</i>	cV	WL, LA	
Little Blue Heron	<i>Egretta caerulea</i>	cV	WL, LA	
Tricolored Heron	<i>Egretta tricolor</i>	fV	MF, LA, BE	
Cattle Egret	<i>Bubulcus ibis</i>	vW	SC	
Green Heron	<i>Butorides virescens</i>	cV	LA	
Agami Heron	<i>Agamia agami</i>	rV	LA	
Black-crowned Night-Heron	<i>Nycticorax nycticorax</i>	uW	LA	
Yellow-crowned Night-Heron	<i>Nyctanassa violacea</i>	cP	LA	
Boat-billed Heron	<i>Cochlearius cochlearius</i>	IP	LA	
White Ibis	<i>Eudocimus albus</i>	fP	MF, LA, BE	
Scarlet Ibis	<i>Eudocimus ruber</i>	X	MF, LA	
Roseate Spoonbill	<i>Platalea ajaja</i>	rV	LA, BE	
Jabiru	<i>Jabiru mycteria</i>	rV	LA, BE	
Wood Stork	<i>Mycteria americana</i>	uV	LA	
Black Vulture	<i>Coragyps atratus</i>	vP	SA, AG, BE	
Turkey Vulture	<i>Cathartes aura</i>	vP	SA, O	
Lesser Yellow-headed Vulture	<i>Cathartes burrovianus</i>	fP	SA, AG, BE	
King Vulture	<i>Sarcoramphus papa</i>	uP	BFL	
Muscovy Duck	<i>Cairina moschata</i>	uP	LA	
Black-bellied Whistling-Duck	<i>Dendrocygna autumnalis</i>	IW	WL, LA	
Blue-winged Teal	<i>Anas discors</i>	cW	WL, LA	

<p>Status Legend</p> <p>v = very common c = common f = fairly common u = uncommon o = occasional l = local</p> <p>Regional Endemics Legend (L. Jones)</p> <p>MA Middle America Endemic NMA Northern Middle America Endemic</p>	<p>Habitat Preferences within PCNP Legend (Adapted from Jones and Vallely, 2001)</p> <p>BFL Lowland broadleaf forest PFL Lowland pine forest SC Scrub, low second growth SA Savanna WL Wetland habitats with emergent vegetation LA Lagoons, ponds, rivers, streams O Overhead/aerial</p>	<p>Status Legend</p> <p>P = permanent resident S = seasonal resident V = visitor T = transient (migrant) W = winter resident X = one or two records only</p>
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Acknowledgments to: Lee Jones and Mario Muschamp

Bird Species of Paynes Creek National Park (continued)				
Species		Status	Habitats	Endemism
Osprey	<i>Pandion haliaetus</i>	fV	LA,O	
Gray-headed Kite	<i>Leptodon cayanensis</i>	uP	BFL	
Swallow-tailed Kite	<i>Elanoides forficatus</i>	fS	BFL,O	
White-tailed Kite*	<i>Elanus leucurus</i>	fP	WL,SC	
Snail Kite	<i>Rostrhamus sociabilis</i>	oV	WL, LA	
Plumbeous Kite	<i>Ictinia plumbea</i>	uS	BFL,O	
Bicolored Hawk	<i>Accipiter bicolor</i>	rP	BFM, BFL	
White Hawk	<i>Leucopternis albicollis</i>	IP	BFL,O	
Gray Hawk	<i>Asturina nitida</i>	fP	BFL,SC,O	
Common Black-Hawk	<i>Buteogallus anthracinus</i>	fP	SC,O	
Great Black-Hawk	<i>Buteogallus urubitinga</i>	uP	BFM,BFL,O	
Roadside Hawk	<i>Buteo magnirostris</i>	cP	SC,SA,O	
Short-tailed Hawk	<i>Buteo brachyurus</i>	fP	BFM,BFL,O	
Red-tailed Hawk	<i>Buteo jamaicensis</i>	X	O	
White-tailed Hawk	<i>Buteo albicaudatus</i>	IP	AG, SA	
Black Hawk-Eagle	<i>Spizaetus tyrannus</i>	uP	BFM,BFL,O	
Barred Forest-Falcon	<i>Micrastur ruficollis</i>	IP	BFM,BFL	
Collared Forest-Falcon	<i>Micrastur semitorquatus</i>	fP	BFM,BFL	
Laughing Falcon	<i>Herpetotheres cachinnans</i>	fP	PW,SC,SA	
Northern Harrier	<i>Circus cyaneus</i>	oW	WL,LA	
American Kestrel	<i>Falco sparverius</i>	uW	SA	
Merlin	<i>Falco columbarius</i>	uW	LA,BE	
Aplomado Falcon	<i>Falco femoralis</i>	IP	SA	
Bat Falcon*	<i>Falco rufigularis</i>	fP	SC,O	
Peregrine Falcon	<i>Falco peregrinus</i>	uW	LA,O	
Plain Chachalaca	<i>Ortalis vetula</i>	cP	BFL,BFM,SC	
Crested Guan	<i>Penelope purpurascens</i>	uP	BFM,BFL	
Great Curassow	<i>Crax rubra</i>	uP	BFM,BFL	
Black-throated Bobwhite	<i>Colinus nigrogularis</i>	fP	PW,SA	NMA
Ruddy Crake	<i>Laterallus ruber</i>	cP	SC	MA
Gray-breasted Crake	<i>Laterallus exilis</i>	IP	AG, WL	
Clapper Rail	<i>Rallus longirostris</i>	uP	MF	
Gray-necked Wood-Rail	<i>Aramides cajanea</i>	fP	WL	
Uniform Crake	<i>Amaurolimnas concolor</i>	rP	BFL	
Sora	<i>Porzana carolina</i>	IW	WL	
Sungrebe	<i>Heliornis fulica</i>	uP	LA	

Status	Habitat Preferences within PCNP	
<p>Legend</p> <p>v = very common c = common f = fairly common u = uncommon o = occasional l = local</p> <p>Regional Endemics</p> <p>Legend (L. Jones)</p> <p>MA Middle America Endemic NMA Northern Middle America Endemic</p>	<p>P = permanent resident S = seasonal resident V = visitor T = transient (migrant) W = winter resident X = one or two records only</p>	<p>Legend (Adapted from Jones and Vallely, 2001)</p> <p>BFL Lowland broadleaf forest PFL Lowland pine forest SC Scrub, low second growth SA Savanna WL Wetland habitats with emergent vegetation LA Lagoons, ponds, rivers, streams O Overhead/aerial</p>

Bird Species of Paynes Creek National Park (continued)				
Species		Status	Habitats	Endemism
American Coot	<i>Fulica americana</i>	IW	WL, LA	
Limpkin	<i>Aramus guarana</i>	cP	WL,LA	
Black-necked Stilt	<i>Himantopus mexicanus</i>	fW	WL, BE	
Black-bellied Plover	<i>Pluvialis squatarola</i>	uT	BE	
Killdeer	<i>Charadrius vociferus</i>	fW	AG, WL	
Spotted Sandpiper	<i>Actitis macularia</i>	cW	LA	
Short-billed Dowitcher	<i>Limnodromus griseus</i>	uW	WL	
Greater Yellowlegs	<i>Tringa melanoleuca</i>	uW	WL,BE	
Solitary Sandpiper	<i>Tringa solitaria</i>	uW	WL,BE	
Whimbrel	<i>Numenius phaeopus</i>	oT	BE	
Least Sandpiper	<i>Calidris minutilla</i>	fW	WL, BE	
Pectoral Sandpiper	<i>Calidris melanotos</i>	uT	WL, BE	
Wilson's Snipe	<i>Gallinago delicata</i>	uW	WL	
Caspian Tern	<i>Sterna caspia</i>	oT	LA, BE	
Royal Tern	<i>Sterna maxima</i>	cV	BE, OC	
Pale-vented Pigeon	<i>Columba cayennensis</i>	cP	BFL,PW,SC	
Red-billed Pigeon	<i>Columba flavirostris</i>	oV	BFL,PW	MA
Short-billed Pigeon	<i>Columba nigrirostris</i>	fP	BFM,BFL	
Common Ground-Dove	<i>Columbina passerina</i>	oV	SA, AG	
Ruddy Ground-Dove	<i>Columbina talpacoti</i>	vP	SC	
Plain-breasted Ground-Dove	<i>Columbina minuta</i>	cP	SA, AG	
Blue Ground-Dove	<i>Claravis pretiosa</i>	fP	BFM,BFL	
White-tipped Dove	<i>Leptotila verreauxi</i>	uP	BFM,BFL	
Gray-fronted Dove	<i>Leptotila rufaxilla</i>	cP	BFM, BFL	
Gray-chested Dove	<i>Leptotila cassini</i>	cP	BFM,BFL	
Ruddy Quail-Dove	<i>Geotrygon montana</i>	uP	BFM,BFL	
Olive-throated Parakeet	<i>Aratinga nana</i>	vP	BFM,BFL,SC	MA
Brown-hooded Parrot	<i>Pionopsitta haematotis</i>	cP	BFM,BF	
White-crowned Parrot	<i>Pionus senilis</i>	cP	BFM,BFL	MA
White-fronted Parrot	<i>Amazona albifrons</i>		BFL,SA	MA
Red-lored Parrot	<i>Amazona autumnalis</i>	vP	BFL	
Yellow-headed Parrot	<i>Amazona oratrix</i>	cP	PW	*
Yellow-billed Cuckoo	<i>Coccyzus americanus</i>	fT	BFM, BFL, PFL	
Squirrel Cuckoo	<i>Piaya cayana</i>	cP	BFM,BFL	
Striped Cuckoo	<i>Tapera naevia</i>	uP	SC	
Groove-billed Ani	<i>Crotophaga sulcirostris</i>	vP	SC	

<p>Status</p> <p>Legend</p> <p>v = very common c = common f = fairly common u = uncommon o = occasional l = local</p> <p>Regional Endemics</p> <p>Legend (L. Jones)</p> <p>MA Middle America Endemic NMA Northern Middle America Endemic</p>	<p>P = permanent resident S = seasonal resident V = visitor T = transient (migrant) W = winter resident X = one or two records only</p>	<p>Habitat Preferences within PCNP</p> <p>Legend (Adapted from Jones and Vallely, 2001)</p> <p>BFL Lowland broadleaf forest PFL Lowland pine forest SC Scrub, low second growth SA Savanna WL Wetland habitats with emergent vegetation LA Lagoons, ponds, rivers, streams O Overhead/aerial</p>
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Bird Species of Paynes Creek National Park (continued)				
Species		Status	Habitats	Endemism
Vermiculated Screech-Owl	<i>Otus guatemalae</i>	uP	BFM, BFL	
Barn Owl	<i>Tyto alba</i>	uP	WL	
Spectacled Owl	<i>Pulsatrix perspicillata</i>	rP	BFM,BFL	
Mottled Owl	<i>Ciccaba virgata</i>	cP	BFM.BFL	
Lesser Nighthawk	<i>Chordeiles acutipennis</i>	fW	SA,O	
Common Nighthawk	<i>Chordeiles minor</i>	IS	SA,O	
Common Pauraque	<i>Nyctidromus albicollis</i>	cP	BFM, BFL, SA, SC	
Northern Potoo	<i>Nyctibius jamaicensis</i>	uP	SA, AG	
Vaux's Swift	<i>Chaetura vauxi</i>	fP	O	
Lesser Swallow-tailed Swift	<i>Panyptila cayennensis</i>	fP	O	
Long-billed Hermit	<i>Phaethornis longirostris</i>	cP	BFM, BFL, SC	
Little Hermit	<i>Phaethornis longuemareus</i>	cP	BFM, BFL	
White-necked Jacobin	<i>Florisuga mellivora</i>	fP	BFM.BFL,LA	
Green-breasted Mango	<i>Anthracothorax prevostii</i>	fP	SC	
Canivet's Emerald	<i>Chlorostilbon canivetii</i>	fP	PFM, PFL, SA SC	NMA
Ruby-throated Emerald	<i>Archilochus colubris</i>	fT	SC	
White-bellied Emerald*	<i>Amazilia candida</i>	cP	BFM,BFL	MA
Rufous-tailed Hummingbird	<i>Amazilia tzacatl</i>	vP	SC,SA	
Cinnamon Hummingbird	<i>Amazilia rutila</i>	IP	MF, AG	
Black-headed Trogon	<i>Trogon melanocephalus</i>	cP	BFL.BFM,PW	MA
Violaceous Trogon	<i>Trogon violaceus</i>	cP	BFM,BFL	
Slaty-tailed Trogon	<i>Trogon massena</i>	fP	BFM, BFL	
Blue-crowned Motmot	<i>Momotus momota</i>	cP	BFM,BFL	
Ringed Kingfisher	<i>Ceryle torquata</i>	fP	LA	
Belted Kingfisher	<i>Ceryle alcyon</i>	cW	LA	
Amazon Kingfisher	<i>Chloroceryle amazona</i>	uP	LA	
Green Kingfisher	<i>Chloroceryle americana</i>	cP	LA	
American Pygmy Kingfisher	<i>Chloroceryle aenea</i>	fP	LA	
White-necked Puffbird	<i>Notharchus macrorhynchos</i>	rP	SC	
White-whiskered Puffbird	<i>Malacoptila panamensis</i>	IP	BFM,BFL	
Rufous-tailed Jacamar	<i>Galbula ruficauda</i>	fP	BFM,BFL	
Collared Aracari	<i>Pteroglossus torquatus</i>	cP	BFM,BFL	
Keel-billed Toucan	<i>Ramphastos sulfuratus</i>	cP	BFM,BFL	
Black-cheeked Woodpecker	<i>Melanerpes pucherani</i>	fP	BFM,BFL	
Golden-fronted Woodpecker	<i>Melanerpes aurifrons</i>	cP	SC	
Yellow-bellied Sapsucker*	<i>Sphyrapicus varius</i>	uW	BFM,BFL	

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Bird Species of Paynes Creek National Park (continued)				
Species		Status	Habitats	Endemism
Ladder-backed Woodpecker*	<i>Picoides scalaris</i>	fP	PFL	
Smoky-brown Woodpecker	<i>Veniliornis fumigatus</i>	fP	BFM,BFL	
Golden-olive Woodpecker	<i>Piculus rubiginosus</i>	fP	BFM,BFL	
Chestnut-colored Woodpecker	<i>Celeus castaneus</i>	uP	BFM,BFL	MA
Lineated Woodpecker	<i>Dryocopus lineatus</i>	cP	BFM,BFL	
Pale-billed Woodpecker	<i>Campephilus guatemalensis</i>	cP	BFM,BFL	MA
Rufous-breasted Spinetail	<i>Synallaxis erythrothorax</i>	fP	SC	NMA
Buff-throated Foliage-gleaner	<i>Automolus ochrolaemus</i>	fP	BFM,BFL	
Plain Xenops	<i>Xenops minutus</i>	fP	BFM,BFL	
Tawny-winged Woodcreeper	<i>Dendrocincla anabatina</i>	fP	BFM,BFL	MA
Ruddy Woodcreeper*	<i>Dendrocincla homochroa</i>	uP	BFM,BFL	
Wedge-billed Woodcreeper	<i>Glyphorhynchus spiurus</i>	fP	BFM, BFL	
Olivaceous Woodcreeper*	<i>Sittasomus griseicapillus</i>	fP	BFM,BFL	
Northern Barred-Woodcreeper	<i>Dendrocolaptes sanctithomae</i>	fP	BFM, BFL, PFL	
Ivory-billed Woodcreeper	<i>Xiphorhynchus flavigaster</i>	cP	BFM,BFL	MA
Streak-headed Woodcreeper	<i>Lepidocolaptes souleyetii</i>	uP	BFM, BFL, PFM, PFL	
Great Antshrike	<i>Taraba major</i>	fP	SC	
Barred Antshrike	<i>Thamnophilus doliatus</i>	cP	SC	
Western Slaty-Antshrike	<i>Thamnophilus atrinucha</i>	fP	BFL	
Dot-winged Antwren	<i>Microrhopias quixensis</i>	cP	BFL	
Dusky Antbird*	<i>Cercomacra tyrannina</i>	cP	SC	
Black-faced Antthrush	<i>Formicarius analis</i>	cP	BFM,BFL	
Yellow-bellied Tyrannulet	<i>Ornithion semiflavum</i>	fP	BFM,BFL	MA
Greenish Elaenia	<i>Myiopagis viridicata</i>	fP	BFM,BFL	
Yellow-bellied Elaenia	<i>Elaenia flavogaster</i>	vP	PW,SA	
Ochre-bellied Flycatcher	<i>Mionectes oleagineus</i>	cP	BFM, BFL, PFM	
Sepia-capped Flycatcher	<i>Leptopogon amaurocephalus</i>	IP	BFM,BFL	
Northern Bentbill*	<i>Oncostoma cinereigulare</i>	fP	BFM,BFL	MA
Slate-headed Tody-Flycatcher*	<i>Poecilotriccus sylvia</i>	uP	SC	
Common Tody-Flycatcher	<i>Todirostrum cinereum</i>	cP	SC,SA	
Northern Beardless-Tyrannulet	<i>Camptostoma imberbe</i>	fP	PFL, SC, SA	
Yellow-olive Flycatcher	<i>Tolmomyias sulphurescens</i>	cP	BFM,BFL	
Stub-tailed Spadebill	<i>Platyrinchus canrominus</i>	fP	BFM,BFL	MA
Royal Flycatcher	<i>Onychorhynchus coronatus</i>	uP	BFM,BFL	
Sulphur-rumped Flycatcher	<i>Myiobius sulphureipygius</i>	IP	BFM,BFL	
Eastern Wood-Pewee	<i>Contopus virens</i>	vT	BFM,BFL	

<p>Status Legend</p> <p>v = very common c = common f = fairly common u = uncommon o = occasional l = local</p> <p>Regional Endemics Legend (L. Jones)</p> <p>MA Middle America Endemic NMA Northern Middle America Endemic</p>	<p>Habitat Preferences within PCNP Legend (Adapted from Jones and Vallely, 2001)</p> <p>BFL Lowland broadleaf forest PFL Lowland pine forest SC Scrub, low second growth SA Savanna WL Wetland habitats with emergent vegetation LA Lagoons, ponds, rivers, streams O Overhead/aerial</p>
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Bird Species of Paynes Creek National Park (continued)				
Species		Status	Habitats	Endemism
Tropical Pewee	<i>Contopus cinereus</i>	fP	BFL	
Yellow-bellied Flycatcher	<i>Empidonax flaviventris</i>	cW	BFL	
Vermilion Flycatcher	<i>Pyrocephalus rubinus</i>	fP	SA,SC	
Bright-rumped Attila	<i>Attila spadiceus</i>	cP	BFL	
Rufous Mourner	<i>Rhytipterna holerythra</i>	IP	BFL	
Least Flycatcher	<i>Empidonax minimus</i>	fW	SC	
Acadian Flycatcher	<i>Empidonax virescens</i>	uT	SC	
Alder Flycatcher	<i>Empidonax alorum</i>	uT	SC	
Willow Flycatcher	<i>Empidonax traillii</i>	ft	SC	
Olive-sided Flycatcher	<i>Contopus cooperi</i>	uT	BFL, PFL	
Dusky-capped Flycatcher	<i>Myiarchus tuberculifer</i>	cP	BFL	
Great Crested Flycatcher	<i>Myiarchus crinitus</i>	fW	BFL, PFL	
Brown-crested Flycatcher	<i>Myiarchus tyrannulus</i>	cS	BFL,PW	
Great Kiskadee	<i>Pitangus sulphuratus</i>	vP	SC	
Boat-billed Flycatcher	<i>Megarynchus pitangua</i>	cP	BFL	
Social Flycatcher	<i>Myiozetetes similis</i>	vP	SC	
Sulphur-bellied Flycatcher*	<i>Myiodynastes luteiventris</i>	cS	BFL	
Tropical Kingbird	<i>Tyrannus melancholicus</i>	vP	PW,SA	
Couch's Kingbird	<i>Tyrannus couchii</i>	cP	PW,SA	
Eastern Kingbird	<i>Tyrannus tyrannus</i>	vT	BFL	
Scissor-tailed Flycatcher	<i>Tyrannus forficatus</i>	uW	AG	
Fork-tailed Flycatcher	<i>Tyrannus savanna</i>	cP	SA, AG	
Thrush-like Schiffornis	<i>Schiffornis turdinus</i>	cP	BFL	
Cinnamon Becard	<i>Pachyramphus cinnamomeus</i>	IP	BFL	
Rose-throated Becard	<i>Pachyramphus aglaiae</i>	uP	PFM, PFL	
Masked Tityra	<i>Tityra semifasciata</i>	cP	BFL	
Black-crowned Tityra	<i>Tityra inquisitor</i>	fP	BFL	
White-collared Manakin	<i>Manacus candei</i>	cP	BFL	MA
Red-capped Manakin*	<i>Pipra mentalis</i>	cP	BFL	
White-eyed Vireo	<i>Vireo griseus</i>	cW	SC	
Mangrove Vireo*	<i>Vireo pallens</i>	cP	SC	MA
Yellow-throated Vireo	<i>Vireo flavifrons</i>	fW	BFL	
Red-eyed Vireo	<i>Vireo olivaceus</i>	vT	BFL	
Yellow-green Vireo	<i>Vireo flavoviridis</i>	cS	BFL	
Yucatan Vireo	<i>Vireo magister</i>	IP	MF	NMA
Tawny-crowned Greenlet	<i>Hylophilus ochraceiceps</i>	IP	BFL	

<p>Status Legend</p> <p>v = very common c = common f = fairly common u = uncommon o = occasional l = local</p> <p>Regional Endemics Legend (L. Jones)</p> <p>MA Middle America Endemic NMA Northern Middle America Endemic</p>	<p>Habitat Preferences within PCNP Legend (Adapted from Jones and Vallely, 2001)</p> <p>BFL Lowland broadleaf forest PFL Lowland pine forest SC Scrub, low second growth SA Savanna WL Wetland habitats with emergent vegetation LA Lagoons, ponds, rivers, streams O Overhead/aerial</p>
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Bird Species of Paynes Creek National Park (continued)				
Species		Status	Habitats	Endemism
Lesser Greenlet	<i>Hylophilus decurtatus</i>	vP	BFM,BFL	
Brown Jay	<i>Cyanocorax morio</i>	vP	BFL,PW	MA
Purple Martin	<i>Progne subis</i>	vT	O	
Gray-breasted Martin	<i>Progne chalybea</i>	cS	O	
Tree Swallow	<i>Tachycineta albilinea</i>	fW	WL, LA	
Mangrove Swallow	<i>Tachycineta albilinea</i>	cP	LA	
Northern Rough-winged Swallow	<i>Stelgidopteryx serripennis</i>	cW	BFM,BFL	
Barn Swallow	<i>Hirundo rustica</i>	vT	SA	
Spot-breasted Wren	<i>Thryothorus maculipectus</i>	vP	BFM,BFL	MA
House Wren	<i>Troglodytes aedon</i>	fP	SC	
Sedge Wren	<i>Cistothorus platensis</i>	fP	SA	*
White-breasted Wood-Wren	<i>Henicorhina leucosticta</i>	cP	BFM,BFL	
Nightingale Wren	<i>Microcerculus philomela</i>	IP	BFM, BFL	NMA
Long-billed Gnatwren	<i>Ramphocaenus melanurus</i>	cP	BFM,BFL	
Blue-gray Gnatcatcher	<i>Polioptila caerulea</i>	cP	PW	
Tropical Gnatcatcher	<i>Polioptila plumbea</i>	fP	BFM,BFL	
Swainson's Thrush	<i>Catharus ustulatus</i>	fT	BFM,BFL	
Wood Thrush	<i>Hylocichla mustelina</i>	cW	BFM,BFL	
Clay-colored Robin	<i>Turdus grayi</i>	cP	BFL,SC	
Gray Catbird	<i>Dumetella carolinensis</i>	cW	BFM,BFL	
Black Catbird	<i>Melanoptila glabrirostris</i>	X	MF	NMA
Tropical Mockingbird	<i>Mimus gilvus</i>	cP	SA,AG	
Northern Parula	<i>Parula americana</i>	oW	PFL, MF	
Golden-winged Warbler	<i>Vermivora chrysoptera</i>			
Blue-winged Warbler	<i>Vermivora pinus</i>	fW	BFL,SC	
Bay-breasted Warbler	<i>Dendroica castanea</i>	uT	BFL	
Blackburnian Warbler	<i>Dendroica fusca</i>	fT	BFL	
Tennessee Warbler	<i>Vermivora peregrina</i>	cT	BFM,BFL,SC	
Yellow Warbler	<i>Dendroica petechia</i>	cW	SC	
Chestnut-sided Warbler	<i>Dendroica pensylvanica</i>	cW	BFM,BFL,SC	
Magnolia Warbler	<i>Dendroica magnolia</i>	cW	BFM,BFL,SC	
Yellow-rumped Warbler	<i>Dendroica coronata</i>	uW	PW,SA	
Black-throated Green Warbler	<i>Dendroica virens</i>	fW	PW,SC	
Yellow-throated Warbler	<i>Dendroica dominica</i>	cW	BFL,PW	
Grace's Warbler*	<i>Dendroica graciae</i>	cP	PW	
Black-and-white Warbler	<i>Mniotilta varia</i>	cW	BFM,BFL	

<p>Status</p> <p>Legend</p> <p>v = very common c = common f = fairly common u = uncommon o = occasional l = local</p> <p>Regional Endemics</p> <p>Legend (L. Jones)</p> <p>MA Middle America Endemic NMA Northern Middle America Endemic</p>	<p>P = permanent resident S = seasonal resident V = visitor T = transient (migrant) W = winter resident X = one or two records only</p>	<p>Habitat Preferences within PCNP</p> <p>Legend (Adapted from Jones and Vallely, 2001)</p> <p>BFL Lowland broadleaf forest PFL Lowland pine forest SC Scrub, low second growth SA Savanna WL Wetland habitats with emergent vegetation LA Lagoons, ponds, rivers, streams O Overhead/aerial</p>
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Bird Species of Paynes Creek National Park (continued)				
Species		Status	Habitats	Endemism
American Redstart	<i>Setophaga ruticilla</i>	cW	BFM,BFL	
Prothonotary Warbler	<i>Protonotaria citrea</i>	cT	BFL,LA	
Worm-eating Warbler	<i>Helmitheros vermivorus</i>	fW	BFM,BFL	
Ovenbird	<i>Seiurus aurocapilla</i>	cW	BFM,BFL	
Northern Waterthrush	<i>Seiurus noveboracensis</i>	cW	LA	
Louisiana Waterthrush	<i>Seiurus motacilla</i>	uW	LA	
Kentucky Warbler	<i>Oporornis formosus</i>	cW	BFM,BFL	
Common Yellowthroat	<i>Geothlypis trichas</i>	cW	SC	
Gray-crowned Yellowthroat	<i>Geothlypis poliocephala</i>	cP	PW,SA	MA
Hooded Warbler	<i>Wilsonia citrina</i>	cW	BFM,BFL	
Yellow-breasted Chat	<i>Icteria virens</i>	fW	SC	
Gray-throated Chat	<i>Granatellus sallaei</i>	IP	BFL	NMA
Gray-headed Tanager	<i>Eucometis penicillata</i>	fP	BFM,BFL	
Red-crowned Ant-Tanager	<i>Habia rubica</i>	uP	BFM, BFL	
Red-throated Ant-Tanager	<i>Habia fuscicauda</i>	cP	BFM,BFL	
Hepatic Tanager*	<i>Piranga flava</i>	cP	PW	
Summer Tanager	<i>Piranga rubra</i>	cW	BFM,BFL	
Scarlet Tanager	<i>Piranga olivacea</i>	cT	BFM,BFL	
Crimson-collared Tanager	<i>Ramphocelus sanguinolentus</i>	fP	SC	MA
Passerini's Tanager	<i>Ramphocelus passerinii</i>	cP	SC	MA
Blue-gray Tanager	<i>Thraupis episcopus</i>	vP	BFL,PW	
Yellow-winged Tanager	<i>Thraupis abbas</i>	cP	BFM,BFL	MA
Scrub Euphonia	<i>Euphonia affinis</i>	fP	SC,SA	MA
Yellow-throated Euphonia	<i>Euphonia hirundinacea</i>	cP	BFM,BFL	MA
Olive-backed Euphonia	<i>Euphonia gouldi</i>	cP	BFM,BFL	MA
Golden-hooded Tanager	<i>Tangara larvata</i>	fP	BFL,PW	
Red-legged Honeycreeper	<i>Cyanerpes cyaneus</i>	cP	BFM,BFL	
Blue-black Grassquit	<i>Volatinia jacarina</i>	vP	SC	
Variable Seedeater	<i>Sporophila americana</i>	vP	SC,SA	
White-collared Seedeater	<i>Sporophila torqueola</i>	vP	SC,SA	MA
Thick-billed Seed-Finch	<i>Oryzoborus funereus</i>	cP	PW,SC,SA	
Orange-billed Sparrow	<i>Arremon aurantirostris</i>	cP	BFM,BFL	
Green-backed Sparrow	<i>Arremonops chloronotus</i>	cP	BFL,SC	NMA
Rusty Sparrow*	<i>Aimophila rufescens</i>	cP	PW	MA
Lark Sparrow	<i>Chondestes grammacus</i>	X	SA, Ag	
Clay-colored Sparrow	<i>Spizella pallida</i>	x	SC	
Chipping Sparrow	<i>Spizella passerina</i>	fP	PFL	

Status Legend	Habitat Preferences within PCNP Legend (Adapted from Jones and Valley, 2001)
v = very common	BFL Lowland broadleaf forest
c = common	PFL Lowland pine forest
f = fairly common	SC Scrub, low second growth
u = uncommon	SA Savanna
o = occasional	WL Wetland habitats with emergent vegetation
l = local	LA Lagoons, ponds, rivers, streams
Regional Endemics Legend (L. Jones)	O Overhead/aerial
MA Middle America Endemic	
NMA Northern Middle America Endemic	

Bird Species of Paynes Creek National Park (continued)				
Species		Status	Habitats	Endemism
Savannah Sparrow	<i>Passerculus sandwichensis</i>	X	AG	
Grasshopper Sparrow*	<i>Ammodramus savannarum</i>	cP	SA	
Grayish Saltator	<i>Saltator coerulescens</i>	cP	SC	
Buff-throated Saltator	<i>Saltator maximus</i>	cP	BFL	
Black-headed Saltator	<i>Saltator atriceps</i>	cP	BFL	MA
Black-faced Grosbeak	<i>Caryothraustes polioaster</i>	cP	BFM,BFL	MA
Blue Grosbeak	<i>Passerina caerulea</i>	fW	SC, WL	
Rose-breasted Grosbeak	<i>Pheucticus ludovicianus</i>	cT	BFM,BFL	
Blue-black Grosbeak	<i>Cyanocopsa cyanooides</i>	cP	BFM,BFL	
Indigo Bunting	<i>Passerina cyanea</i>	cW	SC	
Dickcissel	<i>Spiza Americana</i>	cT	SC,WL	
Eastern Meadowlark*	<i>Sturnella magna</i>	cP	SA, AG	
Melodious Blackbird	<i>Dives dives</i>	vP	SC	MA
Great-tailed Grackle	<i>Quiscalus mexicanus</i>	vP	SC	
Black-cowled Oriole	<i>Icterus prothemelas</i>	cP	BFL,PW,SA	MA
Orchard Oriole	<i>Icterus spurius</i>	cW	SC	
Yellow-backed Oriole	<i>Icterus chrysater</i>	fP	PW	
Yellow-tailed Oriole	<i>Icterus mesomelas</i>	uP	SC,LA	
Baltimore Oriole	<i>Icterus galbula</i>	cW	BFM,BFL	
Yellow-billed Cacique	<i>Amblycercus holosericeus</i>	uP	BFL,PW	
Montezuma Oropendola	<i>Psarocolius Montezuma</i>	vP	BFL	MA

<p>Status Legend</p> <p>v = very common c = common f = fairly common u = uncommon o = occasional l = local</p> <p>Regional Endemics Legend (L. Jones)</p> <p>MA Middle America Endemic NMA Northern Middle America Endemic</p>	<p>P = permanent resident S = seasonal resident V = visitor T = transient (migrant) W = winter resident X = one or two records only</p>	<p>Habitat Preferences within PCNP Legend (Adapted from Jones and Vallely, 2001)</p> <p>BFL Lowland broadleaf forest PFL Lowland pine forest SC Scrub, low second growth SA Savanna WL Wetland habitats with emergent vegetation LA Lagoons, ponds, rivers, streams O Overhead/aerial</p>
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Appendix Four: Reptile and Amphibian Species of Payne's Creek National Park				
Species		Survey Record	Staff	*Pot. Record
Plethodontidae				
<i>Bolitoglossa mexicana</i>	Mexican Mushroomtongue Salamander	x		
<i>Bolitoglossa rufescens</i>	Northern Banana Salamander	x		
Rhinophrynidae				
<i>Rhinophrynus dorsalis</i>	Burrowing Toad			x
Leptodactylidae				
<i>Eleutherodactylus loki (rhodopis)</i>	Polymorphic Robber Rainfrog			x
<i>Leptodactylus fragilis (labialis)</i>	White-lipped Frog			x
<i>Leptodactylus melanonotus</i>	Sabinal Frog	x		
Bufonidae				
<i>Bufo marinus</i>	Cane Toad	x		
<i>Bufo valliceps</i>	Gulf Coast Toad	x		
Hylidae				
<i>Agalychnis callidryas</i>	Red-eyed Treefrog		x	
<i>Hyla loquax</i>	Mahogany Treefrog			x
<i>Hyla microcephala</i>	Yellow Treefrog	x		
<i>Hyla picta</i>	Painted Treefrog			x
<i>Phrynohyas venulosa</i>	Veined Treefrog	x		
<i>Scinax staufferi</i>	Stauffer's Treefrog	x		
<i>Smilisca baudinii</i>	Common Mexican Treefrog	x		
Microhylidae				
<i>Gastrophryne elegans</i>	Elegant Narrowmouth Frog			x
Ranidae				
<i>Rana berlandieri</i>	Rio Grande Leopard Frog	x		
<i>Rana vaillanti (palmipes)</i>	Rainforest Frog			x
Crocodylidae				
<i>Crocodylus moreletii</i>	Morelet's Crocodile	x		
Chelydridae				
<i>Chelydra serpentina</i>	Snapping Turtle			x
Kinosternidae				
<i>Staurotypus triporcatus</i>	Mexican Giant Musk Turtle			x
<i>Kinosternon leucostomum</i>	White-lipped Mud Turtle	x		
Emydidae				
<i>Rhinoclemmys areolata</i>	Furrowed Turtle	x		
<i>Trachemys scripta</i>	Slider	x		
Eublepharidae				
<i>Coleonyx elegans</i>	Yucatan Banded Gecko			x
Gekkonidae				
<i>Sphaerodactylus glaucus</i>	Dwarf Gecko			x
<i>Sphaerodactylus millepunctatus</i>	Spotted Dwarf Gecko			x
<i>Hemidactylus frenatus</i>	House Gecko			x
Corytophanidae				
<i>Basiliscus vittatus</i>	Brown Basilisk	x		
<i>Corytophanes cristatus</i>	Smoothhead Helmeted Basilisk	x		
<i>Corytophanes hernandezii</i>	Hernandez's Helmeted Basilisk			x
<i>Laemantus longipes</i>	Eastern Casquehead Iguana			x

Appendix Four: Reptile and Amphibian Species of Payne's Creek National Park (continued)				
Species		Survey Record	Staff	*Pot. Record
Iguanidae				
<i>Ctenosaura similis</i>	Black Iguana		x	
<i>Iguana iguana</i>	Green Iguana	x		
Phrynosomatidae				
<i>Sceloporus variabilis</i>	Rosebelly Lizard	x		
Polychrotidae				
<i>Anolis biporcatus</i>	Neotropical Green Anole			x
<i>Anolis capito</i>	Bighead Anole			x
<i>Anolis lemurinus</i>	Ghost Anole	x		
<i>Anolis pentaprion</i>	Lichen Anole			x
<i>Anolis rodriguezii</i>	Smooth Anole			x
<i>Anolis sagrei</i>	Brown Anole			x
<i>Anolis sericeus</i>	Silky Anole	x		
<i>Anolis tropidonotus</i>	Greater Scaly Anole			x
<i>Anolis uniformis</i>	Lesser Scaly Anole			x
Scincidae				
<i>Eumeces sumichrasti</i>	Sumichrast's Skink			x
<i>Mabuya unimarginata</i>	Central American Mabuya	x		
<i>Sphenomorphus cherriei</i>	Brown Forest Skink	x		
Teiidae				
<i>Ameiva festiva</i>	Middle American Ameiva	x		
<i>Ameiva undulata</i>	Rainbow Ameiva	x		
<i>Cnemidophorus maslini</i>	Maslin's Whiptail	x		
Xantusiidae				
<i>Lepidophyma flavimaculatum</i>	Yellow-spotted Night Lizard	x		
Boidae				
<i>Boa constrictor</i>	Boa Constrictor		x	
Colubridae				
<i>Adelphicus quadrivirgatus</i>	Middle American Earth Snake			x
<i>Amastridium veliferum</i>	Rustyhead Snake			x
<i>Coniophanes fissidens</i>	White-lipped Spotbelly Snake			x
<i>Coniophanes imperialis</i>	Black-striped Snake	x		
<i>Dryadophis melanolomus</i>	Lizard Eater			x
<i>Drymarchon corais</i>	Indigo Snake	x		
<i>Drymobius margaritiferus</i>	Speckled Racer		x	
<i>Imantodes cenchoa</i>	Blunthead Tree Snake			x
<i>Lampropeltis triangulum</i>	Milk Snake		x	
<i>Leptodeira frenata</i>	Rain Forest Cat-eyed Snake		x	
<i>Leptodeira septentrionalis</i>	Northern Cat-eyed Snake		x	
<i>Leptophis ahaetulla</i>	Parrot Snake	x		
<i>Leptophis mexicanus</i>	Mexican Parrot Snake			x
<i>Ninia diademata</i>	Ringneck Coffee Snake			x
<i>Ninia sebae</i>	Redback Coffee Snake			x
<i>Oxybelis aeneus</i>	Mexican Vine Snake			x
<i>Oxyrhopus petola</i>	Calico False Coral Snake			x
<i>Pseustes poecilonotus</i>	Puffing Snake			x
<i>Rhadinaea decorata</i>	Adorned Graceful Brown Snake			x

Appendix Four: Reptile and Amphibian Species of Payne's Creek National Park (continued)				
Species		Survey Record	Staff	*Pot. Record
Colubridae (continued)				
<i>Scaphiodontophis annulatus</i>	Guatemalan Neckband Snake			x
<i>Senticolis triaspis</i>	Peninsular Rat Snake			x
<i>Sibon nebulata</i>	Cloudy Snail Sucker			x
<i>Sibon sanniola</i>	Pygmy Snail Sucker			x
<i>Sibon sartorii</i>	Terrestrial Snail Sucker			x
<i>Spilotes pullatus</i>	Tiger Tree Snake		x	
<i>Stenorrhina degenhardtii</i>	Degenhardt's Scorpion-eating Snake			x
<i>Thamnophis proximus</i>	Western Ribbon Snake			x
<i>Tretanorhinus nigroluteus</i>	Orangebelly Swamp Snake			x
<i>Urotheca elapoides</i>	False Coral Snake			x
<i>Xenodon rhabdocephalus</i>	False Fer-De-Lance			x
Elapidae				
<i>Micrurus hippocrepis</i>	Maya Coral Snake			x
Viperidae				
<i>Atropoides nummifer</i>	Jumping Pitviper			x
<i>Bothrops asper</i>	Fer-de-Lance		x	
<i>Crotalus durissus</i>	Neotropical Rattlesnake		x	
<i>Porthidium nasutum</i>	Rainforest Hognose Pitviper			x
Survey Record: Recorded during biodiversity assessment				
Staff: Reported to be present in the Payne's Creek area by the Park Staff				
*Potential Records: Based on known geographic ranges and habitat				

Appendix Five: Fish Species of Payne's Creek National Park				
	Presence recorded by park staff			

x	Observed during biodiversity assessment			
Species		Punta Ycacos	Freshwater Creek	Payne's Creek
Megalopidae Tarpon				
<i>Megalops atlanticus</i>	Tarpon		x	
Characidae Characins				
<i>Astyanax aeneus</i>	Central tetra			x
<i>Hyphessobrycon compressus</i>	Mayan tetra			x
Pimelodidae Pimelodid Catfish				
<i>Rhamdia guatemalena</i>	Guatemalan chulin			x
Belonidae Needlefish				
<i>Strongylura notata</i>	Redfin needlefish	x	x	
Rivulidae				
<i>Rivulus marmotus</i>	Mangrove rivulus			?
Poeciliidae Livebearers				
<i>Belonesox belizanus</i>	Pike killifish	x	x	x
<i>Gambusia luma</i>	Sleek mosquitofish			x
<i>Gambusia yucatanana</i>	Southern Yucatan mosquitofish			
<i>Heterandria bimaculata</i>	Twospot livebearer			x
<i>Poecilia mexicana</i>	Shortfin Molly			x
<i>Xiphophorus helleri</i>	Green swordtail			x
Synbranchidae Swamp Eels				
<i>Ophisternon aenigmaticum</i>	Obscure swamp eel	x		
Centropomidae Snooks				
<i>Centropomus sp?</i>	Snook			
Serranidae Sea Basses				
<i>Epinephelus itajara</i>	Goliath grouper			
Carangidae Jacks				
<i>Caranax latus</i>	Horse-eye jack	x		
<i>Caranax crysos</i>	Crevalle jack			
<i>Trachinotus falcatus</i>	Permit			
Lutjanidae Snappers				
<i>Lutjanus griseus</i>	Gray snapper			
<i>Lutjanus apodus</i>	Schoolmaster Snapper	x		
<i>Lutjanus analis</i>	Mutton Snapper			
<i>Lutjanus synagris</i>	Lane snapper			
Appendix Five: Fish Species of Payne's Creek National Park (continued)				
	Presence recorded by park staff			
x	Observed during biodiversity assessment			
Species		Punta	Freshwater	Payne's

		Ycacos	Creek	Creek
Gerridae	Mojarras			
<i>Gerres cinereus</i>	Yellowfin mojarra	x		
Haemulidae	Grunts			
<i>Haemulon plumieri</i>	White Grunt	x		
<i>Haemulon sciurus</i>	Blue-striped Grunt	x		
<i>Pomadasys crocro</i>	Burro Grunt	x		
Cichlidae	Cichlids			
<i>Cichlasoma maculicauda</i>	Blackbelt cichlid		x	
<i>Cichlasoma meeki</i>	Firemouth cichlid			x
<i>Cichlasoma octofasciatum</i>	Jack Dempsey			x
<i>Cichlasoma robertsoni</i>	False firemouth cichlid			
<i>Cichlasoma salvini</i>	Yellowbelly cichlid			x
<i>Cichlasoma spilurum</i>	Blue-eye cichlid		x	x
Mugilidae	Mulletts			
<i>Mugil curema</i>	White mullet			
Dasyatidae	Stingrays			
<i>Dasyatis americana</i>	Southern stingray	x		
Eleotridae	Sleepers			
<i>Gobiomorus dormitor</i>	Bigmouth sleeper			
Myliobatidae	Eagle Rays			
<i>Aetobatus narinari</i>	Spotted eagle ray			
Sphyraenidae	Barracuda			
<i>Sphyraena barracuda</i>	Great Barracuda			
Tetraodontidae	Pufferfish			
<i>Sphoeroides testudineus</i>	Checkered Pufferfish			
Rhinopteridae	Cow-nosed Rays			
<i>Rhinoptera bonasus</i>	Cow-nosed Ray	x		