BELIZE TROPICAL FOREST STUDIES
P.O.Box 208
Belmopan, Belize.

MONKEY RIVER SPECIAL DEVELOPMENT AREA

BIODIVERSITY STUDY

Presented to:

BELIZE ENTERPRISE FOR SUSTAINED TECHNOLOGY
(B.E.S.T)

1995

MONKEY RIVER SPECIAL DEVELOPMENT AREA, BIODIVERSITY STUDY.
TABLE OF CONTENTS

Appendix 1.

List of maps.

Map 1. Monkey River Special Development Area, development plan.
The original SDA is indicated in the north east of the extended SDA. This original SDA is identical to the current biodiversity study area.
Map 2. The watershed of the Monkey River; showing its main tributaries
Map 3. The watershed of the Pine Ridge Creek in relation to the MRSDA (1991)
Map 4. The Monkey River Special Development Area (1991) with the local sites mentioned in the text
Map 5. The changes in a random section of the channel of the Monkey River 1956-1995
Map 6. Areas in the MRSDA (1991) visited during the biodiversity study August 1995
Map 7. Natural vegetation map, sheet 2 (Wright et al, 1959)
Map 8. Provisional Sheet #27, Survey Department, Belize 1952
Map 9. Landsystems in the MRSDA (1991) (King et al, 1986)
Map 10. Vegetation map of the MRSDA (1991) (Meerman, 1995)
Map 11. Crocodile survey
Map 12. Howler Monkey observations

Appendix 2.

List with pictures and figures.

Appendix 3.

Species lists.

Vegetation list	8	sheets
Odonata list	2	sheets
Lepidoptera list	5	sheets
Marine invertebrate list	2	sheets
Fish list	3	sheets
Herpetology list	1	sheet
Bird list	6	sheets
Mammal list	2	sheets

EXECUTIVE SUMMARY

Introduction

In 1991, in attempt to revitalize the village, community leaders of Monkey River village proposed to the Government of Belize that the area around Monkey River be declared a "Nature Preserve". In response to this request, on October 17, 1991, the Minister of Natural Resources declared a 6700 ha (16,800 acre) Special Development Area (SDA) at Monkey River, which in 1993 was expanded (map 1).

In 1994, Belize Enterprise for Sustained Technology (B.E.S.T.) submitted a proposal for a "Program of Eco-Tourism Development and Conservation Area Management for the Village of Monkey River" to the Conservation Development Fund of the NARMAP project. One of the project objectives was the implementation of a bio-diversity project. On July 3rd, 1995, Belize Tropical Forest Studies was subcontracted to carry out the Biodiversity study in the Monkey River SDA. Fieldwork for the study started on July 28, 1995 and lasted through the month of August 1995.

In the B.E.S.T. proposal to NARMAP of 1994, the project area to be covered by the Biodiversity study was described as identical of the original SDA as declared in 1991.

The Biodiversity study team was selected on the basis of multi-diciplinary knowledge, ample experience with Belizean Flora and Fauna and Belizean nationality or Belize residency to assure that their personal knowledge gained would remain in Belize. Additional assistance was received from the Association for the Protection of Monkey River (APMR) and from Raleigh International.

General Biodiversity

In general, insect surveys, in this case presented by a Odonata and a Lepidoptera survey, give the best indication as to the Biodiversity of an area (Brown, 1991). But also based on the findings of the other disciplines it was concluded that compared to other areas in Belize, biodiversity was moderately high but with few unique components.

Special species

In spite of the moderate Biodiversity in the area, a number of species occur that although they may not be especially rare or threatened, are special enough to draw special attention.

The flagship species of the project is with no doubt the Black Howler Monkey *Alouatta pigra*. There occurs a healthy Howler Monkey Population in Monkey River, although densities appear lower than in the Community Baboon Sanctuary along the Belize River.

Another flagship species is the Green Iguana *Iguana iguana*. Although under a certain amount of hunting pressure, Iguana's are very common, mainly along the Monkey River itself and are easily observed.

Crocodiles also draw attention. The population in the project area appears healthy but could not be properly sampled outside the dry season. All identifiable crocodiles turned out to be Morelets Crocodiles *Crocodylus moreletii*. The presence of the American Crocodile *Crocodylus acutus* in the area is expected but could not be confirmed. If this species would be confirmed for this area, it would constitute a management priority.

A third reptile that could easily serve as one of Monkey River's flagship species is the Rainbow Racerunner *Cnemidophorus lemniscatus*. This spectacular lizard is very common in the village of Monkey River itself and was not previously recorded from Belize. This is one of the few species that is really unique to the Monkey River Area.

If a bird had to be added to the list of flagship species, it should be the Montezuma Oropendola *Psarocollius montezuma*. This species is very common and conspicuous in the Monkey River area and their nesting colonies are of touristic interest.

There appears to be a healthy population of large cats (Jaguars and Pumas) which is probably the result of a healthy prey base.

Tourism

The project area has a high tourist potential. The pittoresque village of Monkey River is strategically located on a sandy beach, at the mouth of an "unspoiled" river with a coral reef nearby. There is a lot of nature which includes some spectacular species and the people are friendly.
The ecotourism potential is tremendous but this resource is just starting to being tapped. There are some excellent guides in the village but product marketing and management are still problematic. There also appears to be a lack of understanding on the mechanisms of tourism, both on a national scale and on an international scale. There is some serious potential for degradation of the resource, mostly as a result of external influences.

Pressures on the ecosystem

To the casual observer the environment of Monkey River appears healthy and pristine. The reverse is true.

There is serious potential for degradation of the ecosystem as a result of external influences. There is an increasing hunting pressure mainly caused by people from outside the area. At present the effects of this pressure appear minimal but unless this pressure is put under control, serious depletion of wildlife in the area can be expected.

The environment most seriously under pressure is the aquatic environment. Overfishing, caused both by residents and non-residents already had noticeable effects on the population of some target species. But the most serious threat comes from pollution caused by agricultural developments upstream. The most visible effect is that the coral reef in the direct vicinity of the village is already dying. Although effects on other organisms may be assumed, such effects are much less visible on the short term.

Recommendations

Monkey River village is economically largely dependent on a healthy river system and a healthy marine environment. It is important to activate the people of Monkey River village and to make them more assertive when it concerns the environment of their river and village. Because this environment is their only asset for the future.

A monitoring program, preferably implemented by the people of Monkey River should be established to monitoring the quality of the river water including sediment load and the presence of agrochemicals.

Hotspots for these monitoring activities are formed by the mouths of the Monkey River, the Pine Ridge Creek and the reefs around Little Monkey Caye and Great Monkey Caye.
Environmental education should be undertaken in Monkey River school and other community bodies to acquaint such persons with the full continuum of the marine system, its function, its fragility, and its interdependence.

The Association for the Preservation of Monkey River should be revitalized and hold more frequent meetings, ascribing to a set of goals and working together with conservation NGO's in Belize.

Closing the area for hunting does not appear acceptable for the moment. It is recommended that closed seasons during the reproductive seasons of the various game species are installed and implemented. Also certain sections of the SDA or even entire habitats may be declared closed to hunting permanetly or seasonally. The pine savanna (Fire-induced shrubland of the plains) which serves as a refugium during rainy season would be a first candidate for this.

Management of the Green Iguana population could consist of closing down for hunting one or two nesting beaches along the river. Destructive hunting techniques like burning the vegetation should be prevented.

A management plan focussing on the protection of the wildlife in the area should put heavy emphasis on the pressures from outside. Patrol and warden activities should also be centered along access routes.

The crocodile population in Payne's Creek should be protected from too intensive touristic attention. A survey of the Crocodiles of Payne's Creek is deemed essential for the management and conservation of this population. This survey should take place during the dry season. This crocodile study has highest priority.

The current tourist trails on the south side of the River lack any "direction". Development of these trails should focus on any attractions, no matter how small, that can be found along the trails. The forest north of the Road holds attractive possibilities for complementary trails.

INTRODUCTION.

History of the MRSDA

Until about forty years ago, the village of Monkey River had a sizeable population of well over a thousand residents and Monkey River village was then Monkey River Town. The economy of Monkey River Town was based on a thriving Banana Industry but after the collapse of this industry people started moving away and presently the village has a population of about 250 people (William Anderson pers.comm.)(pict. 1,2).

In 1991, in attempt to revitalize the village, community leaders proposed to the Government of Belize that the area around Monkey River be declared a "Nature Preserve". The justification for such a declaration was to protect and preserve the natural resources of Monkey River that residents depend on for their livelihood, and to stimulate job opportunities and economic diversification through tourism and agricultural development.

In response to this request, on October 17, 1991, the Minister of Natural Resources declared a 6700 ha (16,800 acre) Special Development Area (SDA) at Monkey River. Later it was decided that the area covered by the declaration was too small if the SDA programma was to take on a wider role. And in early 1993 the SDA was officially expanded to include the community of Punta Negra (map 1). The expanded SDA also contains the Payne's Creek Wildlife Sanctuary and a section of the Deep River Forest Reserve.

In 1992, the Belize Center for Environmental Studies drafted a management plan (for the original SDA)(BCES, 1992). This management plan gives a basic description of the area (including a mammal and a bird list) and gives a timetable for the development of the SDA, including eco-tourism development.

In 1994, Belize Enterprise for Sustained Technology (B.E.S.T.) submitted a proposal for a "Program of Eco-Tourism Development and Conservation Area Management for the Village of Monkey River" to the Conservation Development Fund of the NARMAP project. One of the project objectives was the implementation of a bio-diversity project.
On July 3rd, 1995, B.E.S.T. subcontracted Belize Tropical Forest Studies to carry out the Biodiversity study in the Monkey River SDA. Fieldwork for the study started on July 28, 1995. The resulting report was submitted in September 1995.

Boundaries of the study area

The B.E.S.T. proposal to NARMAP of 1994 described the project area as identical of the original SDA as declared in 1991. Given time and monetary restrictions, the actual project area of the Biodiversity study was not expanded to include the new, expanded SDA. The map 1 of the Monkey River SDA also indicates the original SDA.

Biodiversity study team

In composing the team for the Monkey River Biodiversity study the following considerations were taken into account.
1) to contain costs and to reduce logistic problems, the team needed to be small.
2) to reach the first goal, the specialists needed to be multi-diciplinary.
3) the specialists needed to have ample experience with Belizean Flora and Fauna.
4) the specialists needed to be Belizeans or Belize residents to assure that their personal knowledge gained on this exercise would remain in Belize and therefore available for future projects.

The resulting team of specialists was thus composed:

Jan C. Meerman. Belize Tropical Forest Studies, Cayo district, Belize.
Team leader, Also covering the fields of vegetation, reptiles, amphibians and Lepidoptera.

Tineke Boomsma. Belize Tropical Forest Studies, Cayo district, Belize.
Covering physical environment, Odonata and Lepidoptera.

Bader Hassan. Emerald Valley Lodge, Steadfast Village, Stann Creek district, Belize.
Covering mammals and hunting issues.

Ellen M. McRae. CariSearch Ltd., Caye Caulker, Belize.
Covering birds, fishes and marine invertebrates.

During the field work, substantial logistic assistance, was received from the Association for the Protection of Monkey River. Both head warden David Linares and assistant Warden Barry Young accompanied the team on several trips. Two additional local assistants, Eloy Cuevas and Santiago Cuevas, were attracted to assist in logistics such as transport by boat, to act as bush guides and to supply biological information. In all cases it was attempted to create a two-way lane of information, providing training in Biodiversity studies from one end and conveying vast local knowledge from the other end.

During field period III field assistance was received from the Raleigh International team residing in Monkey River at that moment. The Raleigh International team consisted of:

Project manager Alex Page and venturers Mary Halls, Nicola Marsh, Sultan bin Ashoor, Chee Meng Or, Steven Classy, Steven Raw, Madeline Dykes, Rebecca Taber, Catherine Handyside, Matthew Symons, Maureen McCrovern and Alastair Masters.

Many additional residents provided information that benefited the Biodiversity study. These informants include: William Anderson, Clive Garbutt, Marva Garbutt, Lloyd Williams, Alexander Garbutt, Melvin Coleman, Daniel Castellanos, Avington Garbutt and Enid Coleman.

Acknowledgements

Belize Tropical Forest Studies is first of all grateful to the villagers of Monkey River who assisted the team throughout the fieldwork. Special mention deserves the instant service provided when anyone of the team needed to be ferried across the river, no matter what time of day. Enna's Hotel and restaurant provided the team with comfortable lodgings and wholesome meals, which are important ingredients of any fieldstudy. The Association for the Protection of Monkey River made the Association's skiff available for the team and both head warden David Linares and assistant Warden Barry Young accompanied the team on the various trips. Eloy Cuevas and Santiago Cuevas provided friendship and masses of information.

Belize Tropical Forest Studies also wishes to thank B.E.S.T. and B.E.S.T. project officer Vijay Krishnarayan for support during the whole project. B.E.S.T. also provided fish traps and a fish net. The Belize Center for Environmental Studies assisted in putting its extensive library to the disposal of the project. Will Heyman of BCES/TNC provided background information on the marine habitat. We discussed crocodiles with Christian Bech from TCC (Mango) farm.

Raleigh International provided recent 1:50.000 maps of the project area and the venturers Alex Page, Mary Halls, Nicola Marsh, Sultan bin Ashoor, Chee Meng Or, Steven Classy, Steven Raw, Madeline Dykes, Rebecca Taber, Catherine Handyside, Matthew Symons, Maureen McCrovern and Alastair Masters emptied butterfly traps, dragged beach seines, measured crocodiles and performed many other tedious but important tasks.

The Conservation department of the Ministry of Natural Resources and the Fisheries department provided the necessary permits and the Forest Department was helpful in locating an extensive series of black and white aerial photographs of the project area. The Forest Management and Planning project loaned 10 Butterfly traps to the project.

MATERIALS AND METHODS

Fieldvisits

Field period I:
July 28, Overflight by part of field team of Monkey River SDA with Javiers Flying Service. Pictures were developed for use in the field and in the final report.

Field period II:
August 1,2 and 3. First field work of part of field team with emphasis on Howler Monkeys, entomology, botany and herpetology. Preparation of logistics for Field period III. Meet with Alex Page from Raleigh International and discuss with him the involvement of Raleigh venturers that reside in Monkey River.

Meet with Assistant Warden Barry Young from the Association for the Protection of Monkey River. Unfortunately, our arrangements through Raleigh were unsuccessful and head warden David Linares is absent during this visit. Mr. Young takes the team up river to see some of the trails and to Little Monkey Cay for a first Bird survey.

Field period III:
August 8,9,10,11,12 and 13. Entire field team resides in Enna's Hotel in Monkey River town. Full scale Biodiversity research focussing on the aquatic survey, mammal survey, insect survey and floristic survey. As a rule the four team members operated independently. David Linares, Eloy Cuevas and Santiago Cuevas served as guides and also served as recipients of Biodiversity study training. The entire team of Raleigh venturers assist with the various aspects of the study. The boat of the Association of the Protection of Monkey River was used throughout the field period while an extra boat was hired in the village for three field days. Apart of actual fieldwork, many residents of Monkey River Town were interviewed as to aspects of hunting and fishing. The high water levels in the river, streams, lagoons and even in the forest hampered some surveys (especially aquatic- and crocodile-surveys) but the actual weather was dry during most of the field period and the field time could be used to the fullest.

Field period IV: August 18. Canceled due to unexpected flood levels of the Monkey River.

Field period V: August 26, 27 and 28. In which 2 night surveys were conducted along the Monkey River and along the various coastal creeks. Transportation and guidance was provided by Eloy Cuevas. By day, the northern Savanna and a few forest trails were checked for tracks. U.V. lighting for moths. The weather during this field period was rainy. Increasing rain and threatening floods prevented extension of this field period.

Equipment

Specific equipment used is described under every discipline. Additionally, the team was equipped with a Trimble Ensign GPS. Fishtraps were received on loan from B.E.S.T. and 10 Butterfly traps were received on loan from the Forest Planning and Management Project.

ENVIRONMENTAL DESCRIPTION OF THE STUDY AREA

T.Boomsma

Watersheds (maps 2,3,4)

Monkey River

The two main tributaries of the Monkey River are the Bladen Branch and the Swasey Branch; the Trio, another major river, drains in the Bladen Branch. According to LIC data produced from their GIS, the planar area of the Monkey River watershed is 1275 km^2 (Lee et al, 1995).

The Bladen starts at an elevation of approx. 900-1000 m. The drop of the headwaters of the Bladen is steep, losing up to 800 m in less than 5 km of horizontal distance. The main Bladen loses elevation less rapidly. The bedrock of the Bladen watershed consists of the Bladen Volcanic Member northwest of the main channel and of limestone at and southeast of the main channel. The upper Bladen has an asymmetrical drainage system, with only a few seasonal streams in limestone which will contribute subsurface water to the Bladen during the rainy season.

The Swasey Branch drains the western basin of the Cockscomb Basin Wildlife Reserve (CBWS). The Swasey drains the steep metamorphic hill slopes of this basin that steeply descend to the fringing slopes between 100-200 m elevation from the Main Divide at 800 m and more. The bedrock of the basin consists of granite and metamorphic sedimentary rocks.

From the point where the Bladen and the Swasey pass out from the Maya Mountains, they flow through Quaternary alluvial fans towards their confluence at Branch Mouth (pict. 3). From there on to the village of Monkey River the river is called Monkey River (12,5 km in straight line).

Granite and metasedimentary rocks are much less pervious to water than limestone, but the metasediments appear to be more pervious than granite. Soils from granite appear to be more erodible than those of limestone and metasediments (King et al. 1989). The headwaters of the Swasey and the Bladen which are situated in the Maya Mountains comprise approx. half of the total watershed and receive an average of 2540 to 4000 mm of rain (Hartshorn et al 1984, Wright et al. 1958). The coastal plains receives less rain, Monkey River village receives an annual average between 2032-2540 mm (Hartshorn 1984). These figures do not seem high for a tropical country. But 90 % of the rain falls during the rainy season which lasts from May through January with a peak in July (King et al., 1986). Also most rain falls in short periods, outbursts of a 50-100 mm a day are not rare. Since the headwaters of the river are situated in mountainous area with bedrock consisting for the greatest part of granite, volcanic rock and metamorphic sediments the runoff is considerable and flooding of the rivers after heavy rains are normal events.

The sediment load of the river can be considerable, but no exact figures are available about the extent and origin of the sediment load. Observations made during the overflight of July 28, 1995

indicate make it probable that most of the sediments are being picked up after the river has entered the lowlands. The streambed of the lower Bladen and the lower Swasey are situated in a thick layer of alluvial sediments which are partly eroded during the flooding. This erosion is directed sideways but also downwards; deepening the channel of the river and stirring up the sediments. When the discharge starts to decline the bed is built back up by the deposition of alluvium (Strahler and Strahler, 1978). Another source of sediment load are the large scale agricultural developments like the extensive banana plantations in Red Bank and Cow Pen on the Swasey, and the banana plantations on the Bladen.

In most agricultural development the prescribed 66 feet river reserve is rarely respected and preserved as was seen during the reconnaissance flight over TCC Farm which is neighboring north of the study area (pict. 4). Bad soil management will increase the sediment load of the surface run off from these extensive plantations. No exact figures are available in what extent the large scale agricultural developments contribute to the sediment load of rivers.

The Bladen and the Swasey River are highly dynamic rivers with sudden changes in the discharge levels after heavy rains in their catchment basin. Figures of the Bladen gauging station, upstream of Melvin's bank, reveal an average daily flow of 1,2-1,8 m depth. The average discharge is 16-20 m^3 and the annual stage range between a low flow of 0,7 m and high flow of 4,6 m (1992/93). Similar discharges were recorded for the Swasey Branch with a recorded annual stage range from 1,1 to 2,2 m in 1992/93. The combined Monkey River flow is expected to be a daily average of around 35-40 m^3. (Lee et al., 1995).
The lower courses of the Bladen and the Swasey are characterized by a meandering pattern through the alluvial sediments of the alluvial fans which form the Central Coastal Plain (King et al. 1993). These fans were formed in the Quaternary period when the Maya Mountains were uplifted, resulting in a sudden increase in sediment load of the draining rivers. Currently these alluvial fans are being eroded by rivers like the Bladen, the Swasey and the Monkey River.

The meandering Monkey River has changed its course many times, a process that is still continuing. Map 5. shows the different courses of the river found on aerial pictures dating from 1956 (Series BH4/March 1956) and as seen during an aerial reconnaissance flight on July 28th, 1995. See pict. 5,6.

The Monkey River is a lowland river with natural levees of approx. 1,5 m near the Branch Mouth and almost no levees near the village of Monkey River. During the dry season the waterlevel in the river is low and many sandbars are visible along the riverbanks. During floods, the water will inundate large parts of the surrounding land, depositing silt and dissolved minerals over large surfaces. The coarsest sediments will be deposited closest to the river, thus building up the natural levees which are not well developed in this part of the drainage system. The finer sediments are deposited further away where the current is decreasing, in this way creating a system of slightly higher grounds with coarser sediments and lower swampy areas with a more clayey substrate. The meandering pattern of the river is changing constantly: bends in the river are cut off and what were slight bends in the course are getting more pronounced. This dynamic system results in a varied habitat of backswamps, oxbow lakes, higher grounds and sandbars and beaches. Other features are the little seasonal streams, like the Forest Creek and other unnamed

creeks, that are responsible for the drainage of the inundated land after the floods. The natural levees are blocking the water from a direct backflow to the river, so the floodwater is collected in these creeks many of which drain away from the main river.

The sediment load of the Monkey River and to a lesser extent of the Pine Ridge Creek is carried southward by littoral drift. This was clearly visible during field visit #I which was carried out immediately after a period of heavy rain during on July 28, 1995. See pict. 7. The mixing of fresh riverwater and seawater causes turbulency in the water which will, in combination with the sea-current, prevent the finest particles to settle, but the larger sand particles will be deposited. Along the coast a system of sandy beachridges has been developed and on these high grounds the village of Monkey River was established. This system of beach ridges of various ages divided by low lying areas, stretches southward from the village to Guanacaste creek and further. The sandy ridges are cut through by the Alligator Cree, Guanacaste Creek and many other small creeks most of which are not projected on the 1993 1:50,000 topographic map (fig. 8). These creeks drain the savanna west of the beach ridges. After heavy rains the discharge of the creeks is large enough to overflow and cut through these ridges but during the dry season the creeks are again blocked by the sand deposited by the sea and the flow of the creeks stagnates.

According to the inhabitants of Monkey River village, flooding of the Monkey River is not a problem in the village. The excess of water is dispersed over the forest and the savanna and rarely reaches the village.

Pine Ridge Creek

Although the Pine Ridge Creek is only partly inside the MRSDA, it will be discussed briefly since the water that is drained by this creek directly affects the marine environment of the MRSDA. The Pine Ridge Creek drains approx 50 km^2 situated between the Sennis Creek in the north, the Swasey in the west and the Monkey River in the south (map 3). The total watershed is on the old alluvial fans of the Puletan Plain land system (King et al. 1986). At present half of this land is converted into mango and citrus plantations. Especially the citrus plantation is characterized by the presence of numerous drains, ditches and channels to avoid waterlogging after heavy rains. The approx. annual rainfall in this area is between 2032 and 2540 mm (Hartshorn et al, 1984).

The natural vegetation consisted of fire-induced open Pine savanna, with transitional low broadleaf forest along the several tributaries of the Pine Ridge Creek.

Land use.

Based on LIC, GIS tables of land-use surveyed between 1989/92, the Monkey River and its two major tributaries contain 2769 ha (around 2,2 %) of agricultural land; mostly banana but also mango, milpa, annual crops, pasture and citrus. Urban land-use totals 76 ha (Lee et al, 1995). The majority of the agriculture activities take place in the low Maya Mountains foothill valleys and the coastal plain. The most extensive banana plantation is at Cowpen on the Swasey. The headwaters of the Swasey are partially protected by the CBWS, and will remain forested. However, there have been plans to build a hydro-electric plant in the Swasey at the point where the river passes out the Cockscomb basin. This hydro plant was supposed to generate energy for shrimp farms and shrimp processing plants on the coastal plains. These potential plans will have a major impact on the CBWS, agricultural activities and the riparian forests along the Swasey and the Monkey River.

Early this century people lived up and down the Monkey River, cultivating milpas for a thriving banana industry. This industry collapsed in the early 1940's due to diseases in the bananas. Since then milpa farming has been decreasing with only a few milpas active at present.

Half of the watershed area of the Pine Ridge Creek is in use as mango and citrus plantation by the Toledo Citrus Company farm. The extensive artificial drainage system of especially the citrus plantation undoubtedly increases the flux in discharge of the Pine Ridge Creek.

Agricultural pollution.

Modern agriculture can represent a significant source of environmental pollution. Poor soil management can result in high sediment content run-off; fertilizers and the use of herbicides and pesticides can affect the water quality and subsequently affect neighboring habitats such as the coral reef.

Although the discussion of the impact of the agricultural practices was not within the scope of this study, it will be briefly discussed because evidence was found indicating that the environment of the study area was affected by agricultural practices outside the area.

Pesticides.
The Toledo Citrus Company farm (TCC farm) is located at the junction of the Swasey and the Bladen Branch, north of the study area. This area is mainly drained by the Pine Ridge Creek, of which the lower reaches form part of the northern boundary of the MRSDA. Due to the predominantly north-south littoral drift along the coast, the water of the Pine Ridge Creek and its pollutants will move southward parallel to the coast, thus affecting the coastal waters of the MRSDA and the marine environment of Port Honduras.

The TCC farm is located on the Puletan Plain Land system (map #, King et al, 1986). The Puletan Plain land system is a plain of old alluvial fans dating from the Quaternary. The soil is mostly sandy with a very compact subsoil. The soil is heavily leached and thus very low in chemical fertility. The physical fertility is impeded by the presence of the very compact subsoil that causes severe draught in the dry season and waterlogging during the rainy season. The sandy soil has a very low adsorption complex to bind the applied nutrients.

To avoid waterlogging which could severely damage the citrus crop, all citrus trees are on raised cambers. The extensive system of drains and channels has to remove excessive water as soon as possible. Although the Puletan Plain land system is fairly flat, erosion of the soil (in the channels but also the bare topsoil between the citrus trees through sheet flow), does occur to some extend (pict. 9).

According to Hall (1994), conditions at the TCC farm are conducive to the transport of pesticides by sediment transport as result of the soil type. Although Hall considers most pesticides of non-threatening to the Barrier Reef 35 km from the coast, they definitely have a potentially impact on the patch reef found near Little and Great Monkey Caye, respectively 2,5 and 1,2 km from the mouth of the Pine Ridge Creek. Regarding the direction of the littoral drift, the pesticides might also reach the Reef of Port Honduras (25 km south of the Pine Ridge Creek).

Hall (1994) expects the citrus plantations to be minor pesticide contaminant sources because pesticides are only applied in low doses since the citrus is grown for juice-extraction and not for sale as fresh fruit. Hall expects that most pesticides will be sufficiently diluted by riverwater and seawater before they reach the main reef, but patch reef as close to the source as Little and Great Monkey Caye might get infected.

The banana plantations of Cow Pen and Red Bank are the largest in the Monkey River watershed; they are situated approx. 70 river km from the coast. Banana farming is more intensive than citrus farming, with far greater inputs of agro-chemicals. Although no exact figures are available about the amount of chemicals applied in these farms, the high amount of rainfall and the erodibility of the soil make it likely that this area is a major source of contamination (Hall, 1994).

Fertilizers.

Fertilizers, perhaps more so then pesticides, are recognized as important sources of pollution to water courses. The majority of the fertilizers used are the NPK fertilizers. Concern about the effects of nitrogen and phosphorous upon coral reefs has been growing recently (Hall, 1994). No exact information about the form and amount of nitrogen and phosphorus that reaches the reef is available in Belize. But during the fieldwork carried out in the MRSDA it was observed that the quality of the patch reef at Little and Great Monkey Caye was in a deplorable state. This will be further discussed under the marine section of this report.

Hall (1994) estimated the losses of nitrogen from citrus farms on Pine Ridge Soils in excess of 70 kg per hectare per annum (p.h.p.a.), the losses from phosphorus for the same soil type at 15 kg p.h.p.a.
The total area in cultivation by the TCC farm is approx. 2500 ha mixed mango and citrus farm (Topographic maps 39 and 40, 1993).

Hall (1994) estimated the losses of nitrogen from the Cowpen banana farms on alluvial soils of 80-90 p.h.p.a. not unlikely; the losses for phosphorus was estimated on 5 kg p.h.p.a. or less. Hall also estimated the banana plantation at Cow Pen to 1821 ha.

Sedimentation and improved run off.

The presence of large scale agriculture developments will increase the mobilization of soils to the coastal marine environment. The problems in the case of the TCC farm are probably more the results of the mechanical improvement of the surface run off rather than the change in interception capacity caused by the removal of the original vegetation type.

The sedimentation on coral reefs and seagrass beds will put these ecosystems under increased stress. The stress imposed by sedimentation will have an impact on corals but to what extent is depending on the species of coral, the duration of sedimentation, the increase in turbidity and other factors. The different coral species have a large difference in the ability to reject sediments. Hodgson (1993) found that with increased sedimentation live coral cover declined drastically as did species diversity. He argues that corals can grow in turbid water, and those waters exposed to sedimentation, but that death occurs when sediment deposition exceeds the clearance rate.

The improved run off will also lead to a more pronounced drop in salinity on the reef during periods with heavy rain fall. And this alone may present a serious problem for the coral community.

VEGETATION

J.C.Meerman

Introduction

Attempts to give a description of the vegetation of the Monkey River area have appeared in several publications. Wright et al. (1959) produced a vegetation map and classification for the whole country of Belize. Unfortunately, as far as the Monkey River area is concerned, the map includes some curious mistakes (Wet Savanna misidentified as Bribri-Provision Bark forest), possibly as a result of printing errors (map. 7). The BCES study (1992) produced a vegetation map of the original Monkey River SDA based on satellite imagery which was largely correct but lacked a description of the vegetation types indicated. More recently Iremonger & Brokaw (1995) produced a new vegetation classification and accompanying vegetation map (in prep.). Unfortunately, the misidentifications have multiplied here (e.g. Wet Savanna now misidentified as Pine Savanna). These mistakes are probably the result of a lack of ground-truthing. The most accurate vegetation maps available for the area are, remarkably enough, the old "Provisional Sheets" (nr. 27, 1952)(map 8). Finally, King et al. (1986) produced land system maps accompanied with an indication of vegetation types present in the land systems recognized (map 9).

A new vegetation map of the project area was produced as part of the current Biodiversity study (map. 10) and is based on:
- an extensive set of detailed black and white aerial photographs (Series BH4/March 1956) that were available at the Forest Department,
- color aerial pictures taken during an overflight in Field period I (July 28, 1995),
- existing literature as mentioned above,
- field reconnaissance during field periods II-V.

As far as possible the nomenclature of the different vegetation types is adapted to that of Iremonger & Brokaw (1995), but unfortunately certain vegetation types could not be fitted in their classification.

A limited amount of specimens were collected for later identification but no herbarium specimens were taken. Most species were identified in the field. Identification and other consulted literature includes: Aguilar, 1994., Ames & Correll, 1985., Brokaw et al. 1990., Catling & Catling, 1988., Croat, 1978., Dwyer & Spellman, 1981., Killip, 1936., Mickel, 1979., Roosmalen, 1985., Standley & Record, 1936.

A total of 9 different vegetation types with 5 subtypes were recognized during the current study, several of which are clearly related. The vegetation types of the Monkey River area all have in common that they are on flat, low lying lands which are subject to seasonal flooding by waters from the Bladen and Swasey drainage systems. This common aspect explains many similarities between the various vegetation types.

Certain vegetation types in the area, especially the littoral strip and the high forest on various places along the river, haven been historically affected by human activity. Past level of occupation was much higher than the present level and various introduced species are reminders of past residential and/or agricultural activities. Such species include ornamentals such as: *Caladium bicolor, Cordyline fruticosa*, and *Sanseveria trifasciata* and fruit trees such as Breadfruit; *Atrocarpus altilis*, Papaya *Carica papaya*, Oranges and Limes; *Citrus spp.*, Coconut; *Cocos nucifera*, Mango; *Mangifera indica*, Banana and Plantain; *Musa spp.* and Black berry; *Syszgium cumini*.

The various vegetation types identified are:

1. Lowland broadleaf forest which is split up in:
- **1a. Lowland broadleaf wet forest over moderately lime-rich alluvium.**
- **1b. Riparian seasonal swamp forest.**

2. Mixed scrubland.
3. Low swamp forest
4. Littoral forest/Coastal beach sand scrubs.
5. Seasonally waterlogged scrubs.
6. Fire-induced shrubland of the plains.
7. Lowland needle-leaf moist dense forest over poor soils.
8. Mangrove forests which are split in:
- **8a. Riverine mangrove forest.**
- **8b. Coastal fringe *Rhizophora mangle*-dominated forest**.
- **8c. Dwarf mangrove scrub.**

9. Wet savanna.
These various vegetation types are indicated on map 10.

Description of vegetation types

The vegetation type numbers used in the classifications of Wright (1959) and Iremonger & Brokaw (1995) are put between brackets behind every vegetation type. Vegetation types without such numbers do not fit in their classifications.

1. Lowland broadleaf forest (pict. 10)
Is the dominating vegetation type present in the study area. This vegetation type can be split up into 2 different types which differ little in species composition but are clearly different when height, age and density are taken into consideration. Both occur mixed and on the map they are not distinguished. The reason why this vegetation type is being split up in two is also that certain other groups of organisms (notably birds and insects) appear to distinguish between the two.

1a. Lowland broadleaf wet forest over moderately lime-rich alluvium. (Wright 5, Iremonger & Brokaw 2)
Tall, species rich, lowland forest. Many species reach impressive girths. Canopy broken, Many large emergents. Generalizing, this type is situated primarily on the "Toledo Swamps" landsystem as identified by King et al. (1986)(map 9). Characteristic species include Cohune; *Attalea cohune*, "Bay-Cedar", Santa Maria; *Calophyllum brasiliense*, Rubber; *Castilla elastica*, Kapok; *Ceiba pentandra*, Figs; *Ficus spp.*, Bongo Wood; *Grias cauliflora*, Locust; *Hymenea coubaril*, Bri-bri; *Inga edulis*, Kaway; *Pterocarpus officinalis*, Royal Palm; *Roystonea oleraceae*, Quamwood; *Schizolobium parahybum*, Hogplum; *Spondias mombin*, Waika-chewstick; *Symphonia globulifera*, Nargusta; *Terminalia amazonia*, Banak; *Virola koschnyi*, Yemeri; *Vochysia hondurensis* and Melastomaceae. A conspicuous under story palm is the Warree Cohune *Astrocaryum mexicanum*, which is absent from the other forest types. The palm like *Cordulovica utilis* occurs in low numbers. Herbacecous undergrowth is characterized by many Araceae and Maranthaceae. *Dieffenbachia seguine* and a low Maranthaceae (*Ctenanthe sp.*?) are common.

1b. Riparian seasonal swamp forest. (Wright 20, Iremonger & Brokaw 33)
This forest type is lower but otherwise very similar to the previous. It is induced by frequent disturbance and as such occurs mainly in a wide strip along the Monkey Rivier and thereby falls within King's (1986) "Toledo Floodplain" landsystem. Human activity such as clearing land for milpa's mimics the destruction caused by the river and causes a similar secondary forest. The vegetation along the access road also falls within this category. Vegetation density is high and although the canopy is broken, there are few large emergent trees. Typical species include: Cohune; *Attalea cohune*, Pokenoboy: *Bactris sp*., Santa Maria; *Calophyllum brasiliense*, Bokut: *Cassia grandis*, Trumpet: *Cecropia peltata*, Kapok; *Ceiba pentandra*, Cocoplum; *Chrysobalanus icaco*, Basket tie-tie; *Demonchus schippii*, Tubroos; *Enterolobium cyclocarpum*, Amate; *Ficus glabrata*., Bombo Wood; *Grias cauliflora*, Bri-bri; *Inga edulis*, Balsa; *Ochroma lagopus*, Kaway; *Pterocarpus officinalis*, Provision tree; *Pachira aquatica*, Turtle-bone; *Pithecellobium recordi*, Royal Palm; *Roystonea oleraceae*, *Thevetia ahouai*, Yemeri; *Vochysia hondurensis*, Polewood; *Xylopia frutescens* and some

Melastomaceae. The herbaeceous layer includes: Bamboo; *Bambusa vulgaris*, Dumb-cane; *Gynerium saggitatum*, *Heliconia latispatha*, and *Montricardia arborescens*. Warree bush; *Dieffenbachia seguine* and many Araceaeous vines dominate the ondergrowth.

Highly conspicuous are the large numbers of Willows *Salix chilensis* that grow, often in pure stands, on recently disturbed banks of the river. Towards the river mouth, Blue Moho; *Hibiscus tiliaceus*, and Raccoon tie-tie *Dalbergia ecastophylum.* form dense stands.

2. Mixed scrubland.

Various low broadleaf vegetation type are lumped in this vegetation type #2. Previous descriptions (BCES, 1982., Iremonger & Brokaw, 1995., Wright, 1959) all struggled with this section and the 1952 provisional map even left the area blank. The whole area is very complex, patchy and doubtfully different from the previous vegetation type. Most of it has very dense shrubby vegetation, with a grassy undergrowth. Numerous emergent Royal Palms; *Roystonea oleraceae* occur. Other species include: Santa Maria; *Calophylum brasiliense,* Raccoon tie-tie; *Dalbergia ecastophylum,* Basket Tie-tie; *Desmonchus schippii,* Provision Tree; *Pachira aquatica,* Kaway; *Pterocarpus officinalis,* Melastomaceae and Cut-grass; *Scleria bracteata*. Some patches contain dense *Acoelorrhape wrightii.* Comparing the 1956 aerial photographs with pictures taken during the July 28, 1995 overflight, revealed that in 1956 the area was not properly distinguishable from the former forest type. Now the forest is much lower with many open (wet?) savanna like patches. It is possible that sections of this "vegetation type" may in be Guamil or secondary growth following past cultivation (pict. 4). According to the landsystem map of King et al. (1986) this "vegetation type" is situated on a more complex soiltype than the other forest types.

3. Low swamp forest (pict. 12)

This forest types combines characteristics of vegetation types 1a,1b and 4. It occurs behind the Littoral forest belt south of the mouth of Monkey River and on isolated patches within the wet savanna. The transition from Littoral forest to this Low swamp forest is very gradual, but the transition from this type to the wet savanna, can be very abrupt and is often marked with a belt of Red mangrove; *Rhizophora mangle*. Typical species include: Palmetto; *Acoelorraphe wrightii*, Gumbo-limbo; *Bursera simaruba,* Santa Maria; *Calophyllum brasiliense,* Sea-grape; *Coccoloba uvifera*, Coco-plum; *Chrysobalanus icaco*, Raccoon tie-tie; *Dalbergia ecastophylum*, Basket Tie-tie; *Desmonchus schippii,* Provision tree; *Pachira aquatica*, Kaway; *Pterocarpus officinalis* and some Melastomaceae. Along Creeks that drain water from the wet savanna, Royal Palms; *Roystonea oleraceae* are sometimes present.

The herb layer is dominated by species such as Tiger-bush; *Acrostychum aureum*, *Blechum serrulatulum,* Cut-grass; *Scleria bracteata,* and *Montricardia arborescens*.

4. Littoral forest/Coastal beach sand scrubs. (Wright 32, Iremonger & Brokaw 28)(pict. 12)

Littoral forests are found in a narrow coastal strip on recent dune-sands. The "dunes" around Monkey River are barely elevated and not very conspicuous. Several ridges of various ages often

occur and with increasing age of these ridges, the accompanying vegetation gradually merges with the following vegetation types.

Key species of this habitat include Sea-grape; *Coccoloba uvifera*, Coco-plum; *Chrysobalanus icaco* and Coconut; *Cocos nucifera*. Other species present are: Palmetto; *Acoelorraphe wrightii*, Cashew; Anacardium occidentale, Black Mangrove; *Avicennia germinans*, Buttonwood; *Conocarpus erecta*, White Mangrove; *Laguncularia racemosa* and Tea-box; *Myrica cerifera*. Salt water Palmetto; *Thrinax radiata* occurs only at English Town. Herbaceous vegetation includes Pinwing; *Bromelia pinguin*, Sea-Bean; *Canavalia maritima*, Dumb Cane; *Gynerium saggitatum*, Lilly; *Hymenocalis latifolia* and *Ipomoea pes-capre*. The Horn-Orchid; *Myrmecophylla brysiana*, is common.

5. Seasonally waterlogged scrubs. (Wright 15, Iremonger & Brokaw 41)
In the extreme west of the study area, there is a transition to a very wet, low scrub forest. This vegetation type was not visited but deducted from the 1956 aerial photographs, the July 28, 1995 overflight, and from information provided by Santiago Cuevas. Likely species include Palmetto; *Acoelorrhape wrightii*, Pokenoboy; *Bactris sp.*, Cocoplum; *Chrysobalanus icaco, Miconia spp*., Provision tree; *Pachira aquatica*, *Motriocardia arborescens* and Polewood; *Xylopia frutescens*. (Not represented in the vegetation lists of appendix 3).

6. Fire-induced shrubland of the plains (Pine-Savanna). (Wright 19, Iremonger & Brokaw 42)
This is a type of open Pine-savanne with a grassy vegetation and clumps of Palmetto; *Acoelorrhape wrightii*, Craboo; *Byrsonima crassifolia*, Cocoplum; *Chrysobalanus icaco*, Yaha; *Curatela americana*, Oaks; *Quercus spp.*, Polewood; *Xylopia frutescens* and a few Pines; *Pinus caribaea* and several low Melastomacea shrubs. Low vegetation can be covered with the parasitic *Cassytha filiformis.* Annual fires prevent this vegetation type from reverting to Broad-leaf forest. This vegetation type occurs only along the extreme northern edge of the project area.

7. Lowland needle-leaf moist dense forest over poor soils. (Iremonger & Brokaw 14)
This vegetation types does not actually occur in the researched section of the Monkey River SDA, but there is a small patch just outside the SDA along the Pine-Ridge Creek on the northern boundary of the research area.
Vegetation is dense. Species include: Palmetto; *Acoelorrhaphe wrightii*, Cashew; *Anacardium occidentale*, Craboo; *Byrsonima crassifolia*, Cocoplum; *Chrysobalanus icaco*, Teabox; *Myrica cerifera*, Pine; *Pinus caribaea*, Oak; *Quercus sp.*, Yemeri; *Vochysia hondurensis*, Polewood; *Xylopia frutescens*, Various *Miconia spp.* and other Melastomaceae, Cut-grass; *Scleria bracteata* is very prominent in the undergrowth.
This habitat is the only habitat in the area with abundant epiphytes: *Cattopis berteroniana, Tillandsia bulbosa*, *Tillandsia streptophylla* among the Bromeliads and *Brassavola nodosa*, *Epidendrum nocturnum and Galeandra batemanii* among the orchids.

8. Mangroves.

This vegetation type is characterized by the dominating presence of Red Mangrove *Rhizophora mangle*. Three distinctly different types of mangrove vegetation can be recognized (picture #).

8a. Riverine mangrove forest. (Iremonger & Brokaw 37)

This vegetation type is very rare in the study area. It occurs only along Black Creek. Especially the west-side of the creek has very tall Red Mangrove; *Rhizophora mangle*. Behind the Red Mangrove fringe there is a narrow belt with White Mangrove; *Laguncularia racemosa*, the Mangrove Fern; *Acrostychum aureum* and the vine *Rhabdadenia paludosa.*

8b. Coastal fringe *Rhizophora mangle*-dominated forest. (Iremonger & Brokaw 36)

Occurs coastally, in a narrow strip between the mouth of Pine-ridge creek and English Town and then from English town south towards the mouth of Monkey River. Virtually pure stand of Red Mangrove; *Rhizophora mangle.* This type occurs also on both Monkey Cayes. Little Monkey Caye is covered with a pure stand of tall Red Mangrove while Great Monkey Caye has a virtually pure stand of shrubby, medium sized Red Mangrove. Only on the extreme eastern tip of Great Monkey Caye there is a patch with more varied vegetatation including *Spartina* grass, Sea side Moho *Thespesia populnea*, Button Wood *Conocarpus erecta*, White Mangrove *Laguncularia racemosa* and Coconut *Cocos nucifera.*

8c. Dwarf mangrove scrub. (Iremonger & Browaw 43)

Occurs in two sections along the Pine-ridge creek. Virtually pure stands of Red Mangrove; *Rhizophora mangle*. Very open vegetation type on mudflats with vegetation usually lower than 1.5 m., higher along the creeks.

9. Wet savanna. (pict. 12,13,14)
This vegetation type occurs in two distinctive patches. The first section is a patch with a virtually pure stand of Reed; *Phragmitis australis*, just west of Black Creek.

The most important section of wet savanna occupies about one quarter of the whole project area. Most visitors will not notice this habitat but it is very dominating when seen from the air (picture 14). Also one of the forest trails has access to this vegetation type. Access to this vegetation type from the beach through the low swamp forest (vegetation type #3) is extremely difficult.

The whole area is characterized by very wet conditions during the rainy season. There is actually a band of open water in the north-west section of this savanna (picture 14). Several seasonal creeks drain water from the Wet Savanna, through the Low Swamp Forest and the Littoral Forest to the sea. The wetter areas in the north are dominated by pure stands of Waha leaf; *Thalia geniculata*. More towards the south, Tiger-bush; *Acrostychum aureum, Montricardia arborescens*, Reed; *Pragmitis australis, Typha dominguensis*, and some shruby vegetation such as Raccoon tie-tie; *Dalberigia ecastophylum* may occur, as well as isolated trees such as Royal Palm; *Roystonea oleraceae*.

During the dry season the whole section is prone to fire (started by hunters) and the edges of the high forest towards the north bear the scars of these fires. Comparison between the 1956 aerial pictures and the pictures taken during the July 28, overflight show clearly that the forest edge is slowly receding, probably as a result of these fires.

Discussion and conclusions

Several vegetation types occur in the project area. Although some habitats appear completely different (for example: Lowland broadleaf forest versus Wet Savanna, or Fire induced shrubland versus Mangrove forest), they all have in common that they are on flat, low lying lands which are subject to seasonal flooding by waters from the Bladen and Swasey drainage systems. And in spite of many obvious differences, this common aspect explains many similarities between the various vegetation types. Certain plants, such as Cocoplum *Chrysobalanus icaco* are virtually omnipresent. A plant like Provision tree *Pachyra aquatica* is nearly so.

One of the major vegetation types found inside the project area (wet savanna with monospecific stands of *Thalia geniculata*) is not recognized as distinct in the existing literature and may be rare within the Belizean context. With the knowledge available at this time, it has to be concluded that none of the other vegetation types found in the project area are particularly rare or unique in Belize and all vegetation types have in common that they are well presented within the various protected areas of Belize (Iremonger & Brokaw, 1995).

The undergrowth of the forests within the project area are dominated by Aroids, while ferns and/or palms are scarce. In this aspect the forests of the project area differ from areas such as Tapir Mountain Nature Reserve and the Upper Mullins River Basin (Meerman & Boomsma, 1994., Rivero, 1994).

The trees of the broadleaf forests in the project area contain a number of species that are usually associated with limestone derived soils (Kapok *Ceiba pentandra*, Hogplum *Spondias mombin* Mahogany *Swietenia macrophylla*) but there are also many species that are usually associated with poorer acidic soils (Polewood *Xylopia frutescens*, Can't be helped *Vismia ferruginea*, Yemeri *Vochysia hondurensis*, the Melastomaceae). The presence of the former can be explained by lime deposited with river sediments. The presence of the second groups on soils which are neither clearly acidic nor clearly poor (apart from the Pine Ridge areas), may possibly be explained by the fact that the soils within the project area may not be poor in nutrients as such but that physical characteristics (waterlogging) prevents the vegetation from utilizing these nutrients.

Forest fires play an important role in maintaining certain savanna like habitats. This process can be natural but within Belize many savanna fires are deliberately caused by people. Often by hunters who hope to lure Deer to areas of new, fresh growth. But in many cases these fires are caused by negligence or just plain malice. While maintaining certain habitats, fire also destroys habitat. Savannas constantly increase in size because the forest edges are slowly being eaten away by the fire. comparing the aerial pictures of 1956 with recent pictures clearly demonstrates this, especially in the case of the wet savanna. Also isolated, tall trees deep in the wet savanna are reminders of the forest that was there, only a few decades ago, before the savanna took over. It appears important to the author that this process of "savananization" is reversed which can only be achieved by an active policy of fire-prevention.

ODONATA.

T.Boomsma

Introduction

Since they are often quite large and active by day, most people are familiar with the adults of dragonflies (Anisoptera) and damselflies (Zygoptera). What most people don not know is that the immature stages of the Odonata (dragonflies and damselflies), the so-called larvae, spend their entire life in the water. Actually, of its total lifespan, a dragonfly or damselfly spends most of its time as a larva and therefore in the water. An adult can normally lives a few weeks to a few months but the time it spends as a larva may be anything between a few months to even a few years.

The larvae of some species are able to live in different kinds of waterbodies, varying from large roadpuddles to the standing backwaters of rivers. In general larvae of these species have a take less than a year to reach maturity. Other species are limited to a more specific habitat, such as the larvae of gomphid dragonflies which inhabit the mudbanks in the Monkey River. Larvae of these more specialized species may take up to three years to reach maturity.

The species composition of Odonata can give the researcher information about the different habitats found in an area: the presence or absence of certain species is an indicator of (mostly physical) characters of the different kinds of waterbodies found in the study area.

When a larvae is fully grown, it crawls up out of the water, usually on a plant stem or rock, and undergoes the final molt or metamorphosis. The newly emerged adult is not yet fully colored and is still very soft. It takes a few weeks before the color pattern is fully developed. Meanwhile the reproductive organs also mature. During this period when the dragonflies and damselflies are still immature, they are called tenerals. The tenerals spend their time away from the water in habitats like the forest and grassy areas. During this Odonata survey in the Monkey River SDA, thousands of teneral *Erythrodiplax fervida* were found in the grassy area bordering the access road to Monkey River village.
Only when mature, the individuals will return to the water to reproduce. The males hang around near the water waiting for the arrival of the females. For this reason the majority of the individuals seen near the water are males; the females only come to the water to mate and lay her eggs. After that she will leave the water and return to other habitats to feed. The majority of individuals found along the trails and road away from water are teneral and female dragonflies and damselflies.

Some species of dragonflies are on the wing for only a few months each year, whereas other may be seen throughout the year. In general August is good month to sample adult Odonata in Belize with most of the seasonal Odonata potentially present. As collecting adult Odonata can be difficult, the collecting and rearing of larvae is another method that can be used to gather information about the Odonata fauna. But for collecting of the larvae of the longer lived gomphids, the months of March and April are better since the adults emerge during these

months. The gomphid larvae collected in the Monkey River during this study all belonged to the 1st and 2nd year cohort meaning that these larvae had another 1 or 2 year to go to complete their life cycle. No 3rd year cohort larvae were found which was not surprising since full grown larvae emerge before the rainy season starts.

Materials and methods.

The survey on odonata was carried out during 3 field visits: Field visit II (1-3 August), Field visit III (8-13 August), and Field visit V (26-27 August 1995).
Adult dragonflies and damselflies were observed in the field and if necessary (or possible) caught using a standard butterfly net. The areas sampled were:
- the main course of the Monkey River
- the small seasonal creeks in the riparian forest
- the swamps in the riparian forest
- the access road to the village of Monkey River
- the village
- the mangrove forest
- the wet savanna
- the pine savanna (Fire induced shrubland of the plains)

After identification individuals were released or if identification was tentative the individuals were preserved in acetone. This treatment with acetone preserves the colors of the specimens; the color pattern is often an important characteristic for identification.

Larvae were caught by using a dipnet. The net was used to take samples of detritus and mud from the bottom of the Monkey River and the Forest Creek. The sample was searched and larvae present were collected. The larvae of Gomphidae were identified up to genus level, counted and measured. Afterwards the larvae were released in a comparable habitat.

The salinity of the different waters were tested with a salinity tester DIST 4, Hanna instruments.

Identification literature includes: Calvert, 1908., Belle, 1992., Williams, 1923., Garrison, 1994a., Bick & Bick, 1995., Gonzalez-Soriano, 1992., Garrison, 1994b., Williamson, 1923., Ris, 1930., May, 1979., May., Donnnely,1965, and Borror, 1942.

Selected Odonata habitats.

Monkey River.

The Monkey River is a highly dynamic river which receives the majority of its water from the Bladen Branch and the Swasey Branch. These watersheds are situated on the eastside of the Main Divide of the Maya Mountains. With the prevailing winds coming from the northeast to the southeast, these watersheds catch large amounts of rain. Since there are no rain gauge stations present in the Maya Mountains no exact figures about the rainfall are available but estimates run from 2540-3048 mm (Hartshorn et al., 1984) to 3000-4000 mm (Wright et al, 1958). The rainfall is unevenly spread over the year, the dry season from February through May results in a low runoff of the Monkey River. This time of the year large sandbanks are exposed with small backwaters which have a muddy substrate, covered with detritus. These sites are favored by many Odonata larvae. The main river, with its substrate of coarse shifting sand, offers less opportunities for the larvae.

Other good habitats for the Odonata are the backwaters and the oxbow lakes formed by the Monkey River. These standing waters are lined with grasses and sedges; also some herbs grow in the water. The larvae can cling on the roots and submerged stems of this vegetation, while the upper parts of the plants offer the adult dragonflies and damselflies places to perch and in the case of damselflies to deposit eggs. Since the water in these habitats is not, or barely, flowing one might expect an Odonata fauna typical for small lakes and ponds. Although occasional passers by from other habitats may occur.

The seasonal flooding of the surrounding forest by the Monkey River during the rainy season results in the presence of seasonal creeks and swamps in the forest. One of these creeks is discussed under "Forest Creek". These temporary creeks showed to be poor in aquatic fauna, only few organism were caught. As a result these seasonal streams have little carrying capacity for a substantial Odonata fauna.

The water of the Monkey River near its mouth had a conductivity of 0,1 ppt (11 August 1995), further upstream the water was completely fresh.

Forest Creek.

The largest part of the watershed of the Pine Ridge Creek, of which the Forest Creek is part of, originates in the Pine Savanna north of the study area. The Forest Creek starts in the riverine forest just north of the Monkey River. The headwaters of this tributary are not indicated on the topographical map 1:50,000 but are indicated on map 3. This tributary is fed by local rainwater originating in the forest and Pine savanna. During flooding of the Monkey River, the whole area floods including the forest where this Forest Creek originates. At this stage the creek carries water from the Monkey River to sea. It takes 1 to 2 days before the water in the stream is back in its bedding. This event washes everything from detritus, mud and many lifeforms away from this little creek. Apparently the larvae which manage to live in this creek have developed mechanisms to cope with these harsh circumstances.

The substrate of the Forest Creek consisted of solid clay, with some accumulations of detritus at places where it could be trapped by roots and stems of plants and trees. The creek was faintly meandering. The steep banks are 50-70 cm above the bottom of the creek. The undergrowth vegetation surrounding the creek, was very open. Some grasses, Cohune palm and royal palm seedlings and small shrubs were bordering the creek, offering a perch for the Odonata. The creek was running through the Cohune forest with few open spots in the canopy, apart from where the road crosses the creek, present (picture 15).

According to Eloy Cuevas, the headwaters of this creek dry up during the dry season. More downstream small pools with standing water might be present but during a long dry season these might dry up as well.

During the fieldvisit on 21 August 1995, a large flooding of the Monkey River was observed. The bridge over the Forest Creek was still above water but the whole forest floor adjacent to the creek was covered with ± 10 cm of water. During the fieldvisit of 26 and 27 of August, the waterlevel was down to what might be assumed normal rainy season level and was very slowly flowing.
The water in the Forest Creek was completely fresh.

Payne's Creek.
The Payne's Creek drains the area starting south of Bladen Branch. The Payne's Creek was visited where it flows through Lowland Broadleaf Forest; at at least 2 places the creek widens up and forms an open area where the canopy is not closed over the creek (picture 22). During the dry season, while long stretches of the Payne's Creek will dry up, these small lakes will keep water (E. Cuevas, pers com).
J.C. Meerman observed on 9th of August 1995 great activity of dragonflies in particularly *Perithemis* and *Micrathyria spp.* but due to the inaccessibility of the area no individuals could be caught for further identification.
The water in the Payne's Creek was slow flowing at the point where it widens and the water was fresh.

Littoral forest.
South of the village a short transect line running east-west had been cut by the Raleigh International expedition June-August 1995. This transect line runs for approx. 500 m, starting from the beach just south of the cabanas (map 6). The transect crosses the old beach ridges and the low grounds between these ridges. A similar system of beach ridges and low grounds is present just south of the village where deserted house lots are present. At the site of the transect line no recent habitation had occurred, resulting in a natural vegetation pattern.

The low grounds between the ridges were filled with water. Remarkable was the increasing depth of these low grounds. Starting with 20 cm water in the gully closest to the sea, the last gully before the savanna, was 60-80 cm deep.
The substrate of the low grounds was sand with a layer of half decomposed leaflitter on top, this leaflitter was thinnest in the low grounds near the sea. During the dry season these low grounds

will become dry and the organic material will decompose as result of the presence of oxygen. Towards the west the low grounds will retain water and a layer of peat accumulates.

Most Odonata were observed at the end of the transect where the canopy of the littoral forest became more broken. At the time of the visit (August 2, 1995) all water was fresh.

Pine savanna.

In the Pine savanna, close to the entrance road, two shallow seasonal ponds were located. Each had no more than 25 cm of water. These ponds were rainfed and exist because of the presence of an impermeable layer of clay in the underground. These ponds are out of reach of normal floodwaters of the Monkey River. Thin grass vegetation lined the ponds. Some flap (algae) was present in the water, as a sign of eutrophic conditions. Since the soils of the savanna are heavily leached and so very poor in nutrients, this excess of nutrients causing the algae growth must originate in the adjacent citrus plantation where fertilizers are applied.
Due to the seasonal status of the ponds, the Odonata fauna here is limited to typical colonizers.

Results.

Of the adult Odonata a total of 43 species were observed and/or collected. The Zygoptera (damselflies) counted 16 species and the Anisoptera (dragonflies) 27 species (Appendix 3). Comparing this result with other Odonata surveys conducted in the country is difficult. The influence of seasonality, the duration of the survey, the variety of habitats in the study area, all influence the number of species that may be found in an area.

Based on the author's subjective experience the results of this study for the Monkey River Special Development Area were excellent. Since a number of Odonata species are seasonal a follow-up survey during the dry season would probably reveal a number of additional species. Boomsma and Dunkle (in press) recorded a total of 175 Odonata species, 67 Zygoptera and 108 Anisoptera for Belize. During this survey 2 additional species for the country were found but both species could not be identified to species level. For further identification other specialists will be consulted. There is a definite possibility that both species may be new to science. Besides these two "new" species the following species constitute new records for the Toledo district: *Lestes tenuatus, L. tikalus, Telebasis collopistes, T. salva, Coryphaeschna apeora, Triacanthagyna caribbea* and *Erythemis attala*.

Eight larvae of Phyllocycla spp were collected; 4 belonging to the 1st year cohort and 4 belonging to the 2nd year cohort.
Three larvae of Phyllogomphoides spp were collected, all belonging to the 2nd year cohort. These larvae were found at the last station where larvae were collected at UTM 182900-33600.
Four larvae of Libellulidae larvae were collected in the Monkey River at different locations.

Good sampling sites proved to be the access road and Monkey River village with 18 and 12 species respectively. Most species present here used the open area to feed (duskdwellers, *Tramea* spp, *Pantala flavescens* , *Coryphaeshna* spp) or to mature (*Erythrodiplax fervida* and *E. umbrata*).

The Mangrove forest had only a few species. Only a few Odonata species can bread in brackish or saline water, one of these is the Caribbean Yellowface (*Neoerythromma cultellatum*) (Boomsma, own records).

The habitats which had the most specialized Odonata were the Monkey River and the Forest Creek. Although the Monkey River did not reveal many species at this time of the year, one gomphid was seen flying over the river and representatives of 2 genera of Gomphidae were collected from the muddy substrate of the banks of the river. All gomphid larvae collected belonged to the 1st and 2nd year cohort.
The Forest Creek scored high with 13 species, 9 of which were damselflies. Of these only the 2 *Argia* spp and the unidentified Coenagrionidae occurred in notable numbers. Although 3 species of *Telebasis* were seen near the stream, it is doubtful if they can reproduce in this stream since they prefer standing water.

The behavior of *Telebasis salva* in the U.S.A. was studied by Robinson & Frye (1986), males will abandon a habitat if he did not mate the first day there. Also, females probably oviposit at different habitats on different days, thus improving the chances that at least some eggs will survive. The presence of *Telebasis* along the Forest Creek has to be viewed in this light.

Most species were encountered in low numbers, 12 species were observed from only 1 individual. Other species like *Coryphaeschna* spp, *Gynacantha nervosa, Erythrodiplax fervida, E. umbrata* and *Pantala flavescens* were more abundant.

Some notes on Odonata.

Dragonflies and damselflies will stay unobserved most of the times by most of the villagers and by the regular tourist. Sometimes people mention they have seen red and green dragonflies or they have seen a huge one. But Belize has more to offer than just red, green and huge ones.

Although it will be hard for local tourguides to recognize all the different species, it is not hard to observe dragonflies and damselflies in the field. Even though exact identification of every species may be impossible different species can be distinguished by their size and behavior.

For the most obvious and conspicuous species a short description follows.

Pseudostigma aberrans is one of the damselflies known under the common name of "helicopter damselflies". Anyone who has seen a helicopter damselfly will not easily forget the view. These giant damselflies, with total lengths up to 13 cm, move gracefully through the vegetation looking for spiders hanging in their webs. While hovering in front of the webs the spiders are caught by the damselflies. The helicopter damselflies breed in waterfilled treeholes or other small waterbodies, but not in a stream or pond. These waterfilled treeholes are called phytotelmata. Since it can be expected that these phytotelmata dry up during the dry season, the life cycle of the larvae of these giant damselflies must be completed during the rainy season. The adult damselfly will survive the dry season and will start laying eggs after the first rains have filled the treeholes again.

Gomphidae are dragonflies with an interesting lifecycle. Most Gomphidae larvae need 2 to 3 years to complete their life cycle (Boomsma, own records.). The larvae are not active hunters but in general are sit and wait predators. They can hardly compete with more aggressive larvae of other species when they occur in the same habitat. But not many other Odonata larvae can live under the same harsh conditions as the gomphid larvae do: most gomphid larvae live in fast flowing stream and rivers, a very dynamic habitat with periodically shifting sands and mud and a small foodsupply. Gomphid larvae **can** survive in conditions with standing water and plenty of food available, but under these conditions other larvae can survive as well and will outcompete the gomphid larvae (laboratory observations Boomsma). A consequence of the long life cycle of the larvae is that gomphid larvae will not survive in seasonal streams. An attempt in collecting larvae resulted in the catch of two genera of gomphid larvae in the Monkey River but none in the Forest Creek. According to Eloy Cuevas this creek dries up in April and May over most of its length, thus eliminating all larvae present in the creek.
Starting as early as March, adult gomphids emerge and spend the first time of their life away from the water. Therefor no last instar larvae belonging to the 3rd year cohort were found. After the first rains they start to reproduce and they can be observed perching on and flying over the sandbanks.

Duskdwellers is a common name for the dragonflies that can be seen feeding in the open during the last half hour before nightfall. They can occur in large clouds of many dozens, mainly belonging to the genera *Gynacantha* and *Triacanthagyna*. Large groups of these dragonflies were seen in the village of Monkey River, most of the times flying high around the buildings and

trees. They often fed in a small area a few meters in diameter while prey lasted, suddenly they could leave that area looking for new prey. As sudden as they appeared, they disappear to spend the night and most of the day in the forest and other dense vegetation.
While walking through the forest at several occasions duskdwellers were disturbed and caught. Near the village of Monkey River a very fresh teneral *Triacanthagyna caribbea*, was caught. A female *Triacanthagyna satyrus* was caught near the Forest Creek where she was inserting eggs in the muddy bank of the creek, a 30 cm away from the water. A teneral female *Gynacantha* sp, was caught while she was flying low through the forest.
A *Triacanthagyna septima* was disturbed in the littoral forest and could be closely observed to make identification possible.
The observations made during this survey makes it possible to indicate the habitat where these duskdwellers reproduce. The larvae have a relatively short life cycle, so they are able to reproduce in seasonal waterbodies like the flooded area behind the village, the flooded savanna or the swamps in the forest. Also the Forest Creek seems to be a suitable habitat. The females insert the eggs with in mud, not far away from the water.
Duskdwellers are common in most places in the country, they are easily observed in open areas where they come to feed. But they are hard to catch and it is not always possible to identify them.

Hetaerina titia.
The common name for the *Hetaerina* genus is Rubyspot. All *Hetaerina spp* have a smaller or larger red spot at the base of the wings. With *Hetaerina titia* this red spot is obscured by the smoky black color of the wings which can extend all the way to the tip of the wings. *Hetaerina titia* is the most common and widespread *Hetaerina* in the lowland rivers and streams. Both males and females perch on tips of twigs, their flight is a little erratic but they have the tendency to return to the same perch. This species can easily be observed from the little bridge over the Forest Creek.

A little damselfly was found in the tributary of the Forest Creek. Up to now this damselfly could not be identified. It is definitely a new record for the country and possibly even an undescribed species. This damselfly is very inconspicuous: the very thin abdomen is dark with an orange tip, the head and body are dark with blue and green markings. In this way it was perfectly camouflaged in the dark forest where it resembled the little lightspots on the water. Most individuals were observed sitting on the vegetation along the creek. When disturbed the animals flew very inconspicuously to other spots and consequently disappeared from view.
This species was only found along the Forest Creek. Apparently it is fully adapted to survive the dynamics of this creek where other damselflies will not survive. On the other hand, when this habitat will be developed (cq. the forest cut down and the creek exposed to light: in this way transforming this heterotrophic into an autotrophic system) other Odonata and other insects will be able to colonize this creek and thus outcompeting this species. To study the biology of this damselfly and also to establish the size and distribution of its population, an additional survey in another season is needed.

Discussion and conclusions

During a 2 year sampling period in the Shipstern Nature Reserve, Corozal district, 14 species of damselflies and 41 species of dragonflies were collected (Boomsma, 1993). All species were related to standing waterbodies. Seven of the damselflies species and 21 species of dragonflies were found in both Shipstern and the MRSDA. It is expected that the overlap in composition between these two habitats will be much larger when additional surveys can be carried out in the MRSDA. This assumption is based on the extensive areas of standing waters present in both locations.

A short 2 day sampling trip to the Bladen Nature Reserve at First Hill in 1993 revealed 15 damselflies and 10 dragonflies (Boomsma, 1994). The majority of the damselflies collected here were related to flowing waters. Six of the 10 dragonflies were related to the standing waters of the inundated land near the foothills of the Bladen Reserve. Here the Bladen Branch is a fast flowing river in hilly area, and with a limestone substrate.
The damselflies found during the August 1995 study in the MRSDA are related to slow flowing or standing waters; the species composition shows little overlap with the 1993 Bladen survey. Only 5 species of damselflies, of which 1 species is limited to phytothelmata and not to open water, were found in both habitats. The damselflies encountered in both locations are strongly related to slow flowing or standing waters. Also 5 species of dragonflies were found in both habitats; they are also strongly related to the seasonally swampy areas in the lowlands caused by the flooding of the river and the impeded drainage of the areas.

Conclusion is that the Odonata fauna of the MRSDA is strongly related to slow flowing and standing waters. Most species encountered during the August 1995 study are common to very common in the country of Belize. Species diversity is moderately high but species composition (with the exception of the two unidentified species) does not appear to be special.

INSECTS: LEPIDOPTERA (BUTTERFLIES AND MOTHS)

J.C.Meerman

Introduction

More than any other group of organisms, butterflies (Lepidoptera; Diurnia) form good indicators for the biological value and integrity of a certain area. A good Lepidoptera species-list not only can tell the researcher whether the sampled area is dry scrubland, rainforest, secondary growth, pasture or whatever, but also in which state the habitat is (pristine/deteriorated).

Most adult lepidoptera utilize liquid foodsources such as nectar, rotting fruit, excreta, treesap etc. and can be very dependant on certain micro-habitats. The larvae, on the other hand, are usually herbivorous and in most cases restricted to very few plant species within one or a few families or even genera. Even within the few suitable foodplants, usually just a few parts of these plants, growth-stages or microhabitat conditions, are utilized.

The link with the flora and all other factors combined, makes Lepidoptera extremely useful Biodiversity / bio-integrity indicators. Even more importantly (at least compared with other insect groups), butterflies are easily sampled and identified, making continuous or repeated surveys easier and cheaper. Carrying out a Lepidoptera survey in Monkey River was therefore a logical step. The composition of the butterfly (Lepidoptera; Diurnia) fauna of Belize is getting reasonably well known (Boomsma & Meerman, 1993., Boomsma & Measey, 1992., Davis, 1928., Meerman, 1992., Meerman & Boomsma, 1992, 1993a,b, 1994a,b, Meerman & Williams, 1995., Ross, 1964). There is also a small collection in Central Farm (Cayo district). At present the best sampled areas in Belize are the Shipstern Nature Reserve in the Corozal district (Meerman & Boomsma, 1993), Caracol and the Slate Creek Preserve, both in the Cayo district.

Materials and methods

Lepidoptera were sampled using conventional methods. The most obvious way to collect butterflies is catching them with a butterfly net. This method was extensively used. Virtually every day during most field periods throughout August 1995, collecting trips were made. Most butterflies caught were released after positive identification. Specimens that could not be identified on the spot were stored in small paper envelopes for identification later in the camp. Specimens that posed some identification problem even at that stage, were then conserved and stored for later reference.

Another important method we used to catch butterflies, was trapping them in "fruit traps". During field period III: August 9,10,11 and 12, a total of 18 fruit traps were employed. The traps were of the common design, 25 cm diameter and 80 cm high. The bottom lid slightly larger than the diameter of the top part. The traps were divided into groups of 6 and spread over three areas. One set of traps was arranged along the road, in a very wet section of the forest

(Riparian Seasonal Swamp Forest), close to the village, The second set was arranged also along the road in a dryer section of the same vegetation type. Set number three was employed on the open Pine-savanna (Fire-induced shrubland of the plains).

Bottom lid of the traps were generally positioned at a height of about 1 m. The traps were baited with overripe banana's and mangoes. Approximately four times a day, from 08.00 - 16.00h, the traps were checked and their contents examined.

Many butterfly data were collected by mere observation. Not always it is possible to physically catch a butterfly, and in many cases it is not necessary either. This method, however, can only be used with species that are easy and positively to identify while they are on the wing.

Sphingidae and Saturniidae data were collected using a 12 V., 15 W. ultraviolet light (fluorescent tube). The light was permanently fixed against a white screen on a east facing, wall of the generator building in Monkey River village (picture 16) and operated on two nights around new moon (August 26 and 27) during field period V. Light-trapping moths during field period III was not possible due to adverse moonlight condition. Full moon conditions affect light trapping results negatively.

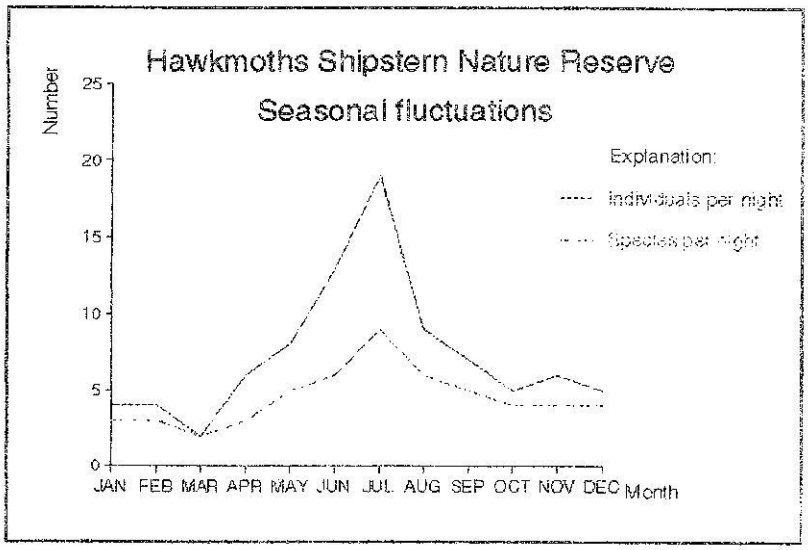
Identification literature used includes: D'Abrera, 1981-1994., DeVries, 1987., Janzen, 1982., Lemaire, 1973 and Tyler et al. 1994.

Results

Sphingidae

The best time of the year to sample Hawkmoths (Sphingidae) diversity is early in the rainy season (fig. 1). For this reason, there were high hopes during this survey. A list was compiled consisting of 23 species (appendix 3). No less than 78 specimens belonging to 22 species were collected from the light trap (one species was caught by day). This is an average of 39 specimens and 15.5 species per night (over 2 nights only, so sample size is small.

An identical sampling carried out virtually simultaneous (August 17-29) at the **Belize Tropical Forest Studies** headquarters in Slate Creek Preserve, Cayo district, resulted in an average of 24 specimens and 11 species per night (sample size 7 nights). The results over 3 years of sampling at the Shipstern Nature Reserve in the Corozal district revealed an average of 9 specimens and 6 species per night for this time of year (fig. 1). Results of the current survey at Monkey River, even though sampling size was small, indicates a high richness/diversity for this particular group of insects in this area.



One species *Eumorpha labruscae* appears rare in Belize, but otherwise, the species composition did not contain any real surprises.

Saturniidae

Based on own experience, Saturniidae or silkmoths are most common towards the very end of the rainy season and generally, August is not the best month to sample this group. Nevertheless, the extremely limited amount of 3 specimens belonging to 3 different species that we observed was somewhat surprising (appendix 3). An identical sampling carried out

virtually simultaneous (August 17-29) at the **Belize Tropical Forest Studies** headquarters in Slate Creek Preserve, Cayo district, resulted in an average of 18 specimens and 6 species per night (sample size 7 nights).

Lepidoptera, Diurnia

73 species of day-flying Butterflies belonging to the three major families (Papilionidae, Pieridae and Nymphalidae) were observed/collected during the survey. Additionally, 6 Lycaenidae, 6 Riodinidae and 23 Hesperidae were collected bringing the total to 108 species (appendix 3).

To my experience, many Papilionidae are more prevalent at the end of the dry season. But August is usually a good month to sample the other families. This seasonality reflects itself in the current species list. For example; of the Papilionidae representatives of the genera *Eurytides* and *Protographium* were completely absent. But nevertheless, a total number of 10 Papilionidae species was observed. The only special species in this list is *Battus lycidas* of which several specimens and a pupa were observed on August 2, during field period II. *B.lycidas* appears to occur on isolated localities and only a very limited number of records from Belize have come to my attention.

A very large number of the species observed are associated with disturbed/secondary growth habitats. This is not surprising judging the large areas of disturbed habitat constantly being created by the meandering of the Monkey River. And this large number of species associated with disturbed/secondary growth habitats can be seen as a natural phenomenon. Although, human agricultural activities and also the herbaceous vegetation along the access road add to the amount of disturbed habitat available. The number of "high forest" species encountered in the Monkey River area was lower than usual in forested habitats (Meerman, 1992., Meerman & Boomsma, 1994., Meerman & Williams, 1995).

Migrations

Butterfly migrations are a well documented phenomenon. But in most cases, cause, origin and destination of flocks of migrating butterflies are still a mystery.

On August 1, 1995, during field period II, a strong migration involving several butterfly species was noted. This migration was already noted along the Hummingbird Highway in the Cayo and Belize districts. It was very obvious along the Southern Highway (at least to the junction with the Monkey River Road). Also in Monkey River village this migration was noted. All butterflies were moving in a straight line in a south, to southeasterly direction. Arriving at the beach, the movement was continued across the water. Fishermen reported large numbers of butterflies near the barrier reef, 35 km offshore. No doubt the butterflies were crossing the bay and heading for Guatemala/Honduras (100 - 180 km over water depending on landing site). Although it is obviously not clear how and if the migration continued from there. According to Monkey River village residents, this movement started in the last week of July.

Species involved in the migration include:
Anteos maerula (large numbers), *Aphrissa boisduvalli* (large numbers), *Aphrissa statira* (moderate numbers), *Marpesia chiron* (low numbers), *Marpesia petreus* (low numbers), *Eunica alcmena* (low numbers), *Historis odius* (low numbers) and *Historis acheronta* (large numbers). Especially the last four species are remarkable because they are not usually know to migrate. Williams (1930) did note that both *Historis spp.* sometimes migrate but that there was no evidence of them setting out across wide expanses of water. The current observation proves that this crossing of wide expanses of water can occur after all.

This migration continued unabated for several days but on August 11, numbers ceased and on August 12 there was no longer any migration in evidence.

It is difficult to give an estimate of the numbers of butterflies involved in the migration. Most butterflies appeared in small flocks. But on average, on a random 50 m wide front, anywhere between 5 and 10 butterflies a minute could be seen passing. Over this same 50 m wide front, between 3,000 and 6,000 butterflies would pass daily. The migration lasted at least 11 days which makes 33,000 - 66,000 butterflies in total. The total width of the migration path is unknown but must have been tens of kilometers wide. Anywhere between 10 and 50 million butterflies may have been on the move during this period.

A second migration of Lepidoptera was noticed during field period V. On the night of 26/27 August 1995, 8 individuals of the moth *Urania fulgens* appeared on the screen behind the U.V. light. This moth is not known to be a resident in Belize and mass migrations have not been reported before from this country.

U.fulgens is a day-flying moth. It is medium sized, black with metalic green bands and long tails on the hindwings. The moths are quite spectacular to see and could easily be mistaken for a Swallowtail- (Papilionid) butterfly. Since they are normally diurnal it is uncommon for this species to be attracted to light (Smith, 1992). In it's larval stage, this moth feeds on *Omphalea*

spp. (Euphorbiaceae), none of which ever have been reported from Belize (Dwyer & Spellman, 1981). The moth is known to have reproductive populations in Veracruz, Mexico, down to the pacific side to Guatemala and El Salvador. Then there is a gap in distribution and reproductive populations have again been reported from Costa Rica en Panama (Smith, 1992).

The second night of using the U.V., only one additional *U.fulgens* came to the light. But both on August 27 and August 28, moths were seen passing by day. In the following days, migrating *U.fulgens* were seen on Caye Caulker (McRae, pers.comm.), in San Antonio (Cayo district), San Ignacio, Belmopan), along the entire Western Highway, Belize City and in San Pedro Ambergris Caye. This migration followed a "compass" north direction but was far less spectacular than the butterfly migration earlier the same month. Numbers were lower, and most individuals were keeping close to the ground. Their high speed and direct movement made them only obvious when crossing rivers and/or roads.

Until September 7, 1995 there was a constant flow of *U.fulgens*, all flying straight north. Numbers were low. In a front 50 m wide, moths passed through at a rate of about one individual/minute. But the front appeared country wide and between 1 and 2 million moths **a day** may have passed through Belize.

The migration changed character around September 8, 1995 and direction of the migration appeared to be reversed. Data from Monkey River in that period are unfortunately lacking.

Discussion and conclusions

In general the number of species observed during this survey was fairly large (based on substantial personal experience) but not exceptional. The species composition held few surprises.

Even though large tracts of "high" forest are present the species composition is strongly skewed towards species adapted to disturbed/secondary growth habitats. This observation can be linked to the strong meandering character of the Monkey River which maintains large areas of dynamic, disturbed habitat in the area. Noteworthy in this aspect is the apparent lack (or at least rarity) of butterflies of the subfamily Ithomiinae (During the month of August they were common near the **Belize Tropical Forest Studies** headquarters in the Cayo district). Ithomiinae are typical components of most Neotropical "rain forest" communities and although some species can occur in disturbed habitats, the special conditions in Monkey River do not seem to be favorable for these and other typical forest butterflies.

In general the species composition of the Monkey River area butterfly fauna (and reflecting on other groups of organisms as explained earlier) indicates a moderately high Biodiversity with a low level of "uniqueness".

The migrations observed were of high scientific interest but have little or no relation with the Biodiversity of the Monkey River Area.

The butterfly fauna of Monkey River is of some touristic importance. Even though there may be few exclusive species, many are colorful or otherwise attractive. And to most visiting tourists they will be new anyhow. Especially the entrance road lined with flowering herbs is a good habitat to view and even photograph butterflies (pict. 17).

AQUATIC SURVEYS

Ellen M McRae

Methods

Itinerary

DAY 1 (8 AUG 1995) - Arrival 15.00h, walk in town & on beach. Fish traps set in a blind-creek in the village

DAY 2 (9 Aug) - Early morning departure for distal portion of Monkey River SDA (upper Monkey River). Fish traps yield catch.

DAY 3 (10 Aug) - Fish traps run. Northern coastal sampling, including Little Monkey Caye, Great Monkey Caye and associated coral reef, Black Creek, Pine Ridge Creek and associated mangrove and needle leaf/pine savannah habitat, and the coastal littoral forest of English Town (once inhabited). Piscine surveys conducted. Sampling for fish with beach seine (unsuccessful) and snorkling (successful). Fish traps run in the village.

DAY 4 (11 Aug) - Southern coastal sampling, including littoral creeks (Alligator, Moho, Tarpon and Guanacaste Creeks). Both creek and adjacent seashore were sampled by beach seine and dip net, as well as visual ID. Fish traps set at mouth of Black Creek; halfway up Black Creek; at the southwestern tip of Little Monkey Caye; and in and Alligator Creek. Castnet samples were taken at the Pelican feeding ground immediately outside and to the north of the mouth of Monkey River. Principally piscine surveys.

DAY 5 (12 Aug) - Proximal upriver fish sampling, including quiet blind creeks, as well as on river sandbanks. Methods included beach seine (unsuccessful due to speed of current speed and lack of shoreline in quiet areas) and castnet (successful with larger mesh; unsuccessful with smaller mesh as too many holes).

DAY 6 (13 Aug) - Avian survey on proximal section of Monkey River road (0545-0910). Departure.

Materials Piscine Surveys (pict. 18,19)
1) Minnow traps (total length 40 cm; diameter 19 cm; funnel diameter 4 cm) set 3 nights, 2 days at Monkey River Creek in town. Bait ranged from fish to johnny-cake. Also, set for several hours at the following: the Mouth of Black Creek; Little Monkey Caye and two of the littoral creeks (Alligator Creek, Tarpon Creek).

2) A cut-down seach seine (length 7.6 m; mesh size, 8 mm) was used at a variety of locations, including Oyster Bank (a deep mangrove pool at the top of Black Creek); the mangroves at Great Monkey Caye; and Monkey River (unsuccessful, due to water depth, speed of current and/or presence of cover (mangrove roots)). Successful locations included Alligator Creek, Tarpon Creek and Guanacaste Creek (inside creek mouths) and also onshore (all locations where water depth was manageable and a beach was present upon which to haul the net)(pict. 18).

3) An 8-ft castnet of the variety known as "sprat net" was thrown by Eloy Cuevas in several areas, including: North-side MR mouth; several Monkey River Stations.

4) A dipnet 35 cm was used by Jan Meerman, particularly in Alligator, Tarpon and Guanacaste Creeks. This method was also used by Tineke Boomsma to catch aquatic insect larvae; at least one fish was captured incidentally in this way.

5) A mask and snorkle were employed by Ellen McRae in several locations to view fish in situ (Pine Ridge Creek freshwater dwarf mangrove roots); south side Great Monkey Caye (marine mangroves); east side Great Monkey Caye (Coral Reef/Seagrass) and the mouth of Pine Ridge Creek (Shoalgrass/sparse Turtlegrass). In the latter an area of deposition of molluscan and other shells yielded a list of invertebrates.

6) Some fish were viewed from the surface by the experienced fishing guide Eloy Cuevas.

7) Some species were reportewd by members of the community but not actually observed during this survey.

8) A few instances of dead fish washed up on shore or found floating were recorded.

Primary identification and literature sources: Augusta, 1994., Meerman, 1993., Colin, 1978., FAO, 1977., Greenfield & Thomerson., Human et al. 1992., Kaplan, 1988., McRae, (in press)., Murphy, 1980., Stokes, 1980 and Warmke & Abbott, 1961.

Freshwater techniques

All nets used (except dipnets, which are limited to surface or very shallow waters) had a mesh size of $\geq$ 8 mm (beach seine). However, many species were likely able to escape this gear. Such species as Gobiids, Blenniids, small Poeciliids, Cyprinidontids etc are small enough to slip through the mesh of the "spratnet" used by our team during Monkey River samples. However, this net was able to effectively collect an assortment of larger river species. Castnet samples were collected by Eloy Cuevas.

The beach seine was able to collect Mexican tetras (billums) as small as 20 mm in length in the southern beach creek-mouths. However, this sampling device was nonfunctional in the Monkey River milieu, with its fast current in the main river, and lack of beaches in the quiet backwater areas that seemed to be richest in fish. The beach seine was operated by a variety of people, including Eloy Cuevas, Jan Meerman, Ellen McRae, and a selection of people from Raleigh International (picture 18).

The "dipnets" were actually either:

a) a butterfly net, utilised essentially (and rather effectively) by Jan Meerman to pluck surface-swimming fishes from the water with considerable speed to avoid escapement; or

b) an aquatic insect-larvae collecting net, employed by scraping under substrate (primarily mud and leaf-detritus) in slow, shallow (< 20-30 cm) water. One such sample, in a shallow rainforest stream yielded a tiny Pimelodid catfish; another, an unknown species which escaped before I had an opportunity to examine it. This device was wielded by Tineke Boomsma.

Traps were metal cylinders with entry funnel 4 cm in diameter. This seemingly would have been an effective mechanism for sampling of the smaller species; indeed this was the case in the blind creek near the village. However, the Monkey River traps collected nothing, as did the traps set in the southern creek mouths, and the one in Black Creek. The possibilities are as follows:

a) the baits selected (fried fish; dead catfish) did not appeal to fish in the area sampled.
b) the targetted fish species may move (or feed) primarily during crepuscular hours or night (i.e., before and after our traps were placed in creeks and Monkey River).

Snorkeling was an effective method of observing fish; however, it was unworkable in black tannin-waters (such as Black Creek and the littoral creek-mouths of Alligator, Tarpon and Guanacaste Creek), or in the sediment-laden, swiftly-flowing Monkey River). It was most effective in the freshwater mangrove community at Pine Ridge Creek.

When fish rose to the surface and could be identified, direct surface observation supplemented other sampling methods. Often, however, these sightings could not be fully identified.

Marine techniques

Snorkeling proved to be the most effective method of sampling the coral reef area at Station 4. The relatively clear (vis apprx 2-3 m, 3-4 m under the apprx 0.5 m freshwater floating on the surface) water afforded sufficient visibility to identify all larger fish in the area. Gobies, blennies and other tiny species could not be sampled due to the limited visibility.

Visibility in mangroves at station 5 was poor ($\pm$ 1 m; fresh and saltwater mixing); fish (except Grey Snappers) could generally not be approached closely enough for positive identification. Additionally, attempts to employ the beach seine at that station were unsuccessful. There was too much easily-available cover for the myriads of baitfishes to seek, and they easily evaded the slowly-walked net. A castnet attempt was equally unsuccessfull.

The 2 traps set in marine stations were fruitful, yielding one fish each.

Dipnets were ineffectual in marine systems, where a) most organisms do not lurk near the surface; b) much coastal water, especially downstream from river plumes, is too turbid to see anything.

Castnets were very effective in this turbid coastal water some distance ($\leq$ 100 m) from shore. Alongshore, the beach seine proved very effective for sampling fish, some as small as 23 mm. Undoubtedly, however, there was escapement by larger, more active species, who could outswim the combined speed of the current and the steady walking pace of the person holding the stake on the end of the net.

Resource use surveys

Several villagers were interviewed regarding use of fish resources. Through this medium a general picture appeared regarding the use of these resources by persons originating from inside and outside the Monkey River SDA (1991) area.

Persons consulted to obtain this information include: Eloy Cuevas, David Linares, Clive Garbutt, Marva Garbutt, Lloyd Williams, Alexander Garbutt, Melvin Coleman, Daniel Castellanos, Avington Garbutt, Enid Coleman and Santiago Cuevas.

Results

Biodiversity Surveys

Results of the fish and marine invertebrate surveys are presented in appendix 3. Scientific names also appear therein. These presentations are arranged according to the major habitats. Though time was insufficient to cover in detail all habitat types, an overview of the SDA was gained.

A total of 54 fish species were sighted, trapped or in some way observed. Of these, 26 were observed over the coral reef or in other situations of seawater. Twenty were noted in or near the confluence of fresh and salt water; and 8 in Monkey River, Pine Ridge Creek or Black Creek.

Resource use

The most lucrative fishery for Monkey River residents is that for the Spiny Lobster (*Panulirus argus*). There are two principal methods of fishing for this species: traps and diving. None of this fishing occurs in Monkey River SDA (1991) waters. Traps are set in 5-6 fathoms of water $\geq$ 4 km offshore and pulled up manually. They are large boxes made of palmetto strips; but here their similarity to the Northern Shelf Lagoon lobster fishery ends. Three sizes of traps are in general use: 48 " (122 cm) X 30 "(76.2 cm); 40" (101.6 cm) X 30", and an undisclosed smaller size. They are designed with an entry "funnel" on top of the trap (as opposed to on the front in the Northern trapezoidal-shaped lobster trap). Cement is placed in the bottom to weight the traps, making them extremely heavy. No hydraulic gear is used. This method is reported to have originated in Honduras and was imported to Monkey River by a Honduran boat.

Catch per unit effort (CPUE) is reported to be higher for traps than for diving; however, as one fisherman put it, since diving is done more frequently than trap hauls, the total actual catch from diving by those fisherment who do both is greater than for traps. The lobster fishery is reportedly declining.

Spearfishing for lobsters is very uncommon; most catch by divers is from hookstick. Scalefish are primarily caught by hook and line.

The most important fisheries occurring within MRSDA areas are:

a) trolling for Barracuda over coral reef areas such as those near Great and Little Monkey Cayes. Some fishermen report that there is not sufficient of these fish over the reefs to support a commercial fishery.

b) throwing castnets for bait to accommodate a multispecies reeffish effort, located principally in two areas east of the SDA. One of these is a series of banks an estimated 7-8 mi offshore, targetting such reef-based species as Mutton Snapper (*Lutjanus analis*) among others during their spawning season. The more productive site is a series of banks located 3-4 km behind the Barrier Reef, principally yielding Yellowtail Snapper (*Ocyuris chrysurus*).

The bait fishery is certainly not being overutilised; driving through some longshore areas, Scaled Sardines (*Harengula jaguana*), Anchovies (*Anchoa sp.*) and others actually jumped into the boat. A phenomenon not observed off (for example) Caye Caulker or Ambergris Caye.

c) a controversial gillnet fishery, targetting seasonal species such as sharks, Snook (*Centropomus sp.*), Mackerel (*Scomberomorus sp.*) and other species. Nets are set in a variety of locations, depending upon target species. The shark fishery does not take place in SDA waters. However, mackerel (fished 4-6 km offshore over grass) and especially snook (fished along the beach, net set at right angles to the beach) are within the confines of the SDA. Nets are set at night and retrieved the morning. The gillnet fisherman interviewed stated that all targetted species were declining. He attributed this to the fact that there are more fishermen all the time.

Most fishermen not participating in the gillnet fishery are convinced that it is negatively affecting fish populations. One of the men who participates in this fishery was interviewed. He defended his right to fish in this fashion in defiance of the majority opinion of the village. This gillnet, pronounced typical by the fisherman, measured some 200m X 5 m, with a 4" mesh. This fisherman also participated in seasonal hook & line fisheries.

d) spearfishing by farmworkers, most of whom are reportedly Central American immigrants, in Monkey River; principally for home use. Target species include: Tuba (*Cichlisoma synspilum*), Snook (*Centropomus sp*), Machaca (*Brycon guatamalensis*), Tarpon (*Megalops atlanticus*), and various catfish species.

There ia a mixture of opinion over whether this effort (principally on weekends) is detrimental to the fishery. Most fishermen believe there is a problem with Guatamalans, Hondurans etc. coming from their respective countries to use marine resources; however most of this effort is conducted South of Monkey River SDA, in Port Honduras, an area also utilised by Monkey River fishermen, both commercial and sport. So competition is experienced by the Monkey River fishermen over these resources.

e) a variety of sportfishing efforts, principally centred around Monkey River.

> 1) occasional sportfishing for amusement and/or supplemental food resource by members of Monkey River Village. This targets principally Tuba and Crana (*Cichlosoma urophthalmus*), which some say occur in the same numbers as in previous years, but others claim they have declined.
>
> 2) professional guided sportfishing efforts, principally originating from Placencia. During high tourism season (Christmas through Easter) as many as 10 boats from Placensia utilise Monkey River for sportfishing trips. Principal target species is Tarpon (*Megalops atlanticus*).

Only one guide from Monkey River has his National Tourguide License; his work is principally in the area of sportfish guiding, although his knowledge of birds is substantial. At least one other guide is attempting to obtain his license, although his primary specialty seems to be bird/rainforest guiding. It is recommended that more Monkey River persons interested in guiding apply for their National License as soon as possible through the Placencia Tourguide Association.

Problems perceived by Monkey River residents

1) Gillnet fishing at and near the mouth of Monkey River is perceived to be severely impacting fishery resources.

2) Foreigners fishing in area (principally Port Honduras).

3) A combination of increased sedimentation (from deforestation) and reduced water flow (due to water taken by farms for irrigation) are perceived by some fishermen to have raised the level of the Monkey River Bar rapidly in recent years. (These effects are of course accentuated in a drought year such as 1995)

4) Agrochemicals such as pesticides and fertilisers have been deposited into Monkey River and Pine Ridge Creek by large Banana/Citrus operations upstream. At times even pesticide drums, etc are found floating down Monkey River and pass into the sea. This has severe public health implications for residents of Monkey River village, not to mention for the surrounding environment.

5) The Tuba has been noted to decline this year. Some attribute it to the farmworkers spearing of river fish; others, to the drought.

Interestingly, the condition of the nearshore reef was not noted by any of the interviewees as a cause for concern.

Discussion and conclusions

The fish assemblages of the various habitats of the Monkey River SDA are not by any means considered to have been sampled in their entirety by this brief effort. However, a brief overview of fish biodiversity reveals a few interesting features:

1) a moderately diverse freshwater ichthyofauna. A list of 28 species was obtained for freshwater and brackish habitats. This compares with 71 for the Manatee SDA fish fauna (Angusta, 1994). Possible reasons for this include:

a) the Manatee SDA data was assembled over a period of several weeks (Augusta, 1994). The present survey contained a freshwater survey element of approximately 2.5 days. This actually speaks rather well for the MRSDA fish fauna.

b) the Manatee SDA is substantially composed of large quiet-water areas (lagoons, backwaters). There was a trend toward catches in the present survey occurring principally in blind creeks and backwaters. However this could have been an artifact of sampling bias. During this time of year the Monkey River is muddy and swift-moving and could not be sampled using normal techniques.

Meerman (1993) reports a list of only 26 species for the Shipstern Lagoon system. Comparativly, Monkey River's appears more substantial.

One feature of note in the MRSDA collections: the complete absence of members of the family Cyprinodontidae. At this point, there exists no proposed explanation for this. The other surveys in other areas all contain a component of Cyprinodontids. Perhaps a more intensive survey would reveal this family.

2) an apparently depauperate marine ichtyofauna, especially in comparison with that of nearby (approx 21 km) West Snake Caye, (examined briefly by this author in April, 1995). This may be in part due to the poor condition of many coral colonies, especially of *Montastrea annularis*. A treatment of this habitat follows. However, it must be stated that it was surprising to find any coral growing so close to river outfalls, largely due to low salinity levels in combination with high sediment loads.

The most severe threat to the piscine fauna of the Monkey River SDA appears to be related to the effluent originating from large-scale agriculture located upstream. A monitoring scheme would be necessary to confirm this hypothesis.

A second threat originates with the use of gillnets, especially in the vicinity of beaches and rivermouths.

The Coral Reef System--Great Monkey Caye

An area of coral reef occupied seabottom offshore the northeastern and eastern sections of Great Monkey Caye (GMC). The area sampled (by mask, fins & snorkle) was approximately 2 m in depth, with a substantial freshwater layer overlying seawater to depth of apprx 0.5 m. This strongly obscured visibility, requiring constant dives to observe benthic and reef-associated organisms. Corals and other invertebrates noted in the reef area are indicated in appendix 3. Coral consisted of small to medium colonies growing sporadically over a rubble/seagrass pavement. The most striking features included:

1) a depauperate fish fauna compared with West Snake Caye
(15 vs 21 species). An additional reef-associated species was found washed up on the beach at Monkey River Village, leading to the supposition that that species may also occur at the GMC reef. There were remarkable numbers of Grey Angelfishes, a closely aggregated group of 12 individuals was observed.

2) while coral species composition was not recorded at West Snake Caye, the general impression was of a reef subjected to physical damage (probably of natural origin) in the past and regenerating nicely. The GMC reef not only contained few large colonies; the colonies of the common reef-building species *Montastrea annularis* were extensively bleached and looked poorly-off. Several *Siderastrea radians* colonies appeared of an unnatural colour, leading to a general impression of ill-health.

A second coral reef is located off the eastern shore of Little Monkey Caye. Time was too short to investigate the condition of this reef; however, it needs to be addressed after viewing the condition of the coral off Great Monkey Caye.

A reef in a situation such as the GMC reef is living in a marginal situation. Reef corals ordinarily require stable salinity, along with clear, non-turbid waters. Examples exist in the literarure of reefs subjected to siltation stress--and their subsequent demise (eg, Cortes & Risk, 1985). However, although excessive siltation is reportedly a problem in the MRSDA watersheds, it is unlikely to be the primary causative agent of this reef's degraded condition. No evidence of silt-coating overlie coral colonies.

Along with increased sediment loads from intensive farming comes infusions of nutrients from fertilisers used on growing fields. As coral reefs evolved in a low-nutrient ecosystem, these excessive nutrients upset existing narural balances, often resulting in algal mats growing over the top of healthy living coral. This is currently in progress along the Northern Belize Barrier Reef (pers. obs.). However, the coral community at GMC shows no evidence of this "reef eutrophication". Possibly an influence described in some work along Australia's reef --that of excessive nutrients retarding reef-based processes-- may be occurring. However, the greatest likelihood is the hypothesis that agrichemical biocide infusions from large-scale agribusiness located upstream are severely affecting the coral condition at GMC. This hypothesis needs to be confirmed or denied by means of exhaustive tests of water and tissue for detection of these chemicals.

The banana industry is known to utilise an array of potent biocides ranging from herbicides through fungicides and insecticides (Usher & Pulver, 1994). This as well as citrus is inputting chemicals via irrigation water into drainage ditches that flow directly into Pine Ridge Creek (Cuevas, pers. comm). Another potential chemical imbalance problem is that created by extensive irrigation, serving to remove toxic elements such as Selenium with runoff. This was reported in California in the early 1990's--with devastating results to local bird populations (Williams et al, 1991; Ohlendorf et al, 1989). These may also bioaccumulate in other organisms, such as coral, whose filter-feeding techniques could result in distressed coral conditions.

REPTILES AND AMPHIBIANS

J.C.Meerman

Introduction

For the purposes of this study, special attention was paid to a selected number of reptile species, namely Crocodiles and Iguana's. Species which are important in commercial, touristic and conservation aspects.

Materials and methods

Amphibians are virtually impossible to sample outside their breeding season. And sampling efforts usually focus on breeding sites which in most cases are temporary ponds. Best results are usually obtained directly after the first heavy rains of the rainy season (mostly in June-July) and as a rule there are a very limited number of prime sampling days each season. After this period breeding activity ceases and sampling quickly becomes less effective. As such, the expectations for sampling Amphibians in the Monkey River SDA were not high. An additional problem was constituted by the vast areas that get flooded in the area with the result that there are few areas where breeding activity gets concentrated.

Sampling therefore was opportunistic. In several cases species were identified by their calls, which was very effective for species that were calling from high in trees or between dense vegetation.

Many species of reptiles and especially snakes occur naturally in low densities and it usually takes many years of residence in a certain area to get to know the true extend of reptilian diversity. Road kills can sometimes be the most effective way of expanding a species list (Meerman, 1993).

Drift fences combined with pitfall traps are usually considered effective methods catching some ground dwelling reptiles and amphibians (Heyer et al, 1994), but this technique is time consuming and very selective in the species that can be sampled in this way. Also the repeated inundation of the forests during the surveys made this method not suitable for our purposes.
Again, taking into account the time available, and purposes of the current Biodiversity study, most data were gathered in a opportunist way (with the exception of the main target species).

On August 9, a day trek was undertaken to Payne's Creek for the special purpose of finding Crocodiles. Nightly surveys for the same purpose, and using a 4.5 V halogen head lamp, were undertaken on August 26 and 27, restricting itself to the Monkey River, a small section of the Bladen, and to the most important coastal creeks. Attempts were made to catch Crocodiles for identification, using a metal snare attached to the end of a long bamboo pole. Small Crocodiles were caught by hand. This survey took place just after new moon. Surveys during full moon are usually less sucessful since the moonlight interferes with the light from the headlamp.

Identification literature was mainly Henderson & Hoevers (1975), Meerman (1992), Meyer (1993) and Stuart (1963).

Results

A total of 7 amphibians and 16 reptiles were recorded (Appendix 3). An additional 5 reptile species are listed whose presence was recorded by informants of listed in literature.

This result is not impressive but extensive attention was paid to a selected number of species. 7 species require some extra attention:

Selected species

Glass Frog

Glass frogs, *Hyalinobatrachium fleischmanni*, are tiny green frogs with a transparent ventral surface. They are nocturnal, and the call of the males is a bird-like "peep", usually vocalized in a chorus of many males along a stream.

One of the surprises of the August 26 night survey was the large number of Glass Frogs that was heard vocalizing. Glass Frogs are known from several locations in the Cayo and Toledo districts (Meyer & Farneti-Foster, in press), but have never been reported from elevations this low and so near to sea. Most frogs were heard along the short section of the lower Bladen that was surveyed (see Crocodile section) but some choruses were heard further down the Monkey River approximately up to UTM 163.365/18.124.

Hickatee

Mol, 1986 did not list Monkey River among the sites where the freshwater turtle *Dermatemys mawei,* or Hickatee occurred. Inhabitants of Monkey River confirmed this statement.

Sea Turtles

The presence of Sea turtles in the area was not actively researched. Informants from Monkey River village indicated that there are no turtles nesting within the survey area.

This absence of turtles is confirmed by Smith (Smith et al., 1992 and pers. comm.). The nearest nesting beach appears to be near Punta Negra, just south of the survey area. Loggerhead, Green and Hawksbill Sea Turtles have been reported nesting from this area. Within the larger MRSDA this nesting beach has a special status (map 1) limiting subdivision size to 4 acres per parcel, 1000 ft minimum beach frontage/lot, a 200 ft construction set back from L.W.M. and a maximum of 20% beach vegetation clearance.

The beaches of Monkey River have potential as turtle nesting beaches but considering the amount of people that used to live in Monkey River village, this resident turtle population must have been exterminated generations ago (Smith, pers. comm.).

Smith (Pers. comm.), indicated that as recent as 1990, residents of Monkey River village were still actively fishing (with nets) for Sea Turtles. The interviews in the village did not reveal whether this fishery is still practiced today.

Rainbow Racerunner

The documented distribution of the Rainbow Racerunner *Cnemidophorus lemniscatus* is from Guatemala through Central America, south to Columbia and Northern Brazil. The occurence of the Rainbow Racerunner in Belize was predicted by Campbell and Vannini (1989) but never confirmed. The discovery of this species in Monkey River was therefore somewhat exciting.

New Reptiles and Amphibians for the Belize list are constantly being discovered. Henderson & Hoevers (1975) listed 28 Amphibians and 106 Reptiles for Belize, while the most up-to-date list (Meerman, in press), lists 39 Amphibians and 114 Reptiles, an increase of 19 species or 14% in a period of 20 years.

But in this case the discovery of the Rainbow Racerunner is more than just another new species. The Rainbow Racerunner is easy the most beautiful lizard in Belize! The females bear conspicuous dark longitudinal stripes. The cheeks, throat and sides are bright yellowish green (picture 20). The males which reach 30 cm in length (including tail) are usually a bit larger than the females and are even brighter colored. Back and head are bright green, the sides are yellowish green with small yellow spots. Throat, lower jaw and front legs are sky-blue (picture 21).

The Rainbow Racerunner is very common in Monkey River village and although lightning fast, is easy to see. Most villagers know it as "Shake Hand". This curious name is easily explained after observing the animals for a short while. The lizards inhabit edges of open sandy area's. They stay on the ground hidden between low vegetation and rubbish. When approached, they rush of to a next hiding place. But after a short distance they usually stop and look over their shoulders to observe the intruder. While they sit and look, they lift one foreleg and shake this vigorously. They dart of again, stop and "shake hand" again. Every time they stop somewhere, they show this curious behavior.

Actually, this hand shaking has a social function. These lizards occur in high densities and have complex societies. An adult, dominant, male will have a territory which overlaps with the territories of several females and possibly some immature males. Every time a lizard moves around, he or she will have to maintain and even defend this territory. Waving a foreleg is just a way to draw attention from other lizards and send signals to them. By varying the intensity of the "shake", different sorts of messages can be conveyed. When a lizard is chased and has to run for his life, it will risk entering neighboring territories. It uses then a special hand shake to pacify angry neighbors.

Al this can be seen right in the village. And for interesting tourist these lizards can be quite an attraction. We have not seen any Racerunners in English Town but they are common in Monkey River village itself and along the beach going south.

Green Iguana

Next to the Black Howler Monkeys, Green Iguanas *Iguana iguana,* are one of the main attractions of every Monkey River trip. Especially the large (up to 6 kg.), orange-brown males, form a spectacular sight with their prehistoric appearance. Young iguana's and smaller females are green and gave the species it's name. Green Iguanas are vegetarians and they like the leaves of Trumpet or *Cecropia* trees. Young Trumpet trees can sometimes get completely defoliated by them. Iguanas are especially easy to spot in the Trumpet trees which have a very open crown. But most of all Iguanas like the foliage of Fig trees. Every large Fig tree along the Monkey River houses at least a few large Green Iguanas. Sometimes when passing under such a tree, an Iguana tries to get away from the danger that people obviously present to him by jumping straight into the river. They have been known to miscalculate their jump and land straight in the boat passing under them which can be a scary experience for the unaware passengers.

Green Iguanas are locally called "Bamboo Chicken" which refers to the taste of the meat and to the large amount of eggs they produce. Green Iguanas are hunted during the dry season when the females come down to lay their eggs in sandbanks along the river. It is in this season that Iguana's get hunted. This hunting is mostly taking advantage of the opportunity. While the females are in their nesting hole they are easy to catch. Both the eggs and the female get eaten. Outside the breeding season, Iguanas of both sexes are occasionally hunted with the aid of a shotgun.

According to the villagers of Monkey River, the amount of Iguana hunting has increased dramatically in recent years. Workers from the TCC farm and from Cow Pen (mostly Central American Immigrants), cycle down to the river (they find access through a bulldozer trail that was created while extracting a large Yemeri-tree) and stay as long as it takes to collect 100 Iguanas or more. Sometimes this means they have to camp along the river. To facilitate the Iguana hunt these hunters set fire to the dense vegetation on overgrown sandbanks. The nesting holes are then easier to find and easier to access.

In spite of this heavy pressure, the Iguana population still appears strong. During the field surveys it was not uncommon to see several Iguana's of various size classes in a single tree. Early in the morning when the Iguana's exposed themselves to warm up in the early sun, was the best time to see Iguanas. Later during the heat of the day, they were less visible.

The weakest point in the reproduction of the Green Iguana is that they need sandy spots to lay their eggs. During the dry season females will lay their eggs and females will travel long distances to reach good laying spots. This egg laying is timed so that the hatchlings emerge with the onset of the rainy season. Clutch size varies from 6 - 70 eggs and depends on the size of the female, but the average amount is about 40 (Werner, 1991). Especially where sandy spots are scarce, female Iguanas have to compete for laying sites. At that moment they are very vulnerable for predation. Every predator from Raccoon to Jaguar will come and take advantage of this seasonal supply of easy meat. People will also find these laying sites and over-harvesting can quickly decimate local populations.

The eggs take 3 months to hatch. Since egglaying takes place around March (Pers Obs., March 1995 Hopkins, Stann Creek district, Belize). Young Iguanas can be expected to emerge around

June/July. The number of juveniles that emerge successfully can be an indication of the health of a population. If there are few young there is not enough recruitment and the population will dwindle.

During a night survey along the Monkey River on August 26th, young green Iguanas were found to be very numerous. Everywhere, in low vegetation, Willows standing in the water of the flooded river, in Dumb Cane, overhanging branches of Bri-bri trees, young, sleeping, 1st year, but also a few 2nd year Iguanas could be seen. So it appears that enough females and their clutches escaped human/animal predation.

Iguana's were also seen near the coastal creeks south of Monkey River village (such as Guanacaste Creek).

Crocodiles (*Crocodylus moreletii* Morelets Crocodile and *Crocodylus acutus* American Crocodile)

Many residents claimed a high Crocodile density in the area. Crocodiles are of certain Conservation and Touristic interest, so a thorough Crocodile survey seemed warranted. Mr. Christian Bech, manager at TCC (Mango) Farm, informed us of a large concentration of Crocodiles in a pool along Payne's Creek (map 11, picture 22). According to him, the Crocodiles present there belonged to the species *C.acutus*. If true, this location would be of great conservation importance taking into account the precarious situation of this species (Meerman, in press).
Both species can be difficult to distinguish and especially young animals can be reliably identified only after checking scalation and certain measurements (Meerman, 1992). See also fig.2.

Unfortunately, Crocodile surveys are difficult to carry out during the rainy season. Especially in a wet area such as the Monkey River SDA. During the rainy season, virtually the entire region (including the swampy forest) becomes potential Crocodile habitat. This expansion of the habitat results in a dispersal of the animals and consequently, they become difficult to locate.

During the dry season, on the other hand, the entire population concentrates in a few favorable areas and consequently, the animals become easier to monitor.

On August 9, a day trek was undertaken to Payne's Creek. Having arrived there, the water level was very high, partly submerging some vegetation on the banks. The vegetation on the banks was very dense (pict. 22). No Crocodiles were in evidence. It was concluded that a night survey from the banks would be of little use, since only small portions of the creek would be visible. Using a boat would be the only option. Unfortunately, most sections of the Payne's Creek are not navigable and the only option would be to carry an inflatable to the site. Even then with the large areas of submerged forest nearby, the chances of getting a good impression of the Crocodile population here would be slim. Reluctantly, it was decided that properly surveying Payne's Creek was not possible during the Rainy season.

On August 11, by day, a small (± 60 cm) Crocodile was seen in the mouth of Alligator Creek, one of the creeks draining water from the wet savanna through the littoral forest to the sea. The animal was active by day and not shy, nevertheless, it could not be caught and although it appeared to be a regular *C.moreletii,* identification remains uncertain.

Also on August 11, a similar sized Crocodile was seen at the mouth of Guanacaste Creek which constitutes the boundary of our survey area. The animal was very shy and could not be approached.

A nightly survey was undertaken just after new moon, on August 26, restricting itself to the Monkey River and to a small section of the Bladen. Weather was variable with frequent heavy showers. Water level was high, flooding most sand banks and creating difficulties to penetrate Crocodile habitat.

In spite of the difficult conditions, no less than 10 Crocodiles were encountered on this trip. All crocodiles were seen between on the upper Monkey River and the lower section of the Bladen or between UTM points 163.330/18.140 and 163.378/18.117

1) 20.40h. At UTM 163.365/18.124. Wide snouted crocodile, typical *C.moreletii*, size ± 1.5 m.. Hanging on to branches in very fast flowing water. Slipped through the snare and escaped.
2+3) 22.00h. UTM 163.344/18.133: 2 juveniles ± 60 cm. Hiding behind sandbank in submerged spiny vegetation. Could be approached close enough to get a good view but due to dense vegetation capture attempts by hand and or by snare were unsuccessful.
4+5) 23.00h. Slightly west of previous location: 2 crocodiles. One ± 60 cm, other possibly larger. Hiding in submerged spiny vegetation behind flooded sandbank. Impossible to approach.
6) 23.45h. Crocodile at junction of Swasey and Bladen UTM 163.337/18.138. Very shy. Eye shine only. Eyes wide apart. Probably large animal (> 2m).
7) 12.00h. Small Crocodile lying on the north bank, a little up the Bladen UTM 163.330/18.140. Caught by hand (picture 23). Released after measuring. Rows of scales on the underside of the tail interrupted by smaller scales.

Standard measurements (Meerman, 1992):
Total length 690 mm
TL 19 mm, TW 21 mm
L 65 mm, W 39 mm
L/W = 1.67, TL<TW.

8) Back on Monkey River, 00.46h, single small Crocodile. Caught by hand. Released after measuring. Rows of scales on the underside of the tail interrupted by smaller scales.

Standard measurements (Meerman, 1992):
Total length 720 mm
TL 20 mm, TW 22 mm
L 66 mm, W 41 mm
L/W = 1.61, TL<TW.

9) Approx. UTM 163.372/18.120, ± 13.00h, Wide snouted Crocodile, ± 1.7 m. Too big to attempt capture.
10) Approx. UTM 163.378/18.117, ± 13.30h. Eye-shine.

The Crocodiles seen close enough on this trip, clearly belonged to the species *C.moreletii*. The capture and subsequent measurements of the two immature individuals confirm this identification.

A second nightly survey was undertaken on August 27. This time surveying Pine Ridge Creek, Black Creek and the coastal creeks south of Monkey River village. The weather was bad with intermittent rain. No Crocodiles were seen.

Unfortunately it has to be concluded that the possible presence of *C.acutus* could not be confirmed. Any research in this direction should be conducted during the dry season.

Discussion and conclusions

Green Iguanas are still common around the Monkey River. Although there appears to be a heavy hunting pressure from outside the area, the population appears healthy.

Definitely, Iguana ranching as propagated by the Belize Zoo seems futile in the case of Monkey River. The natural recruitment would outnumber even the most intensive ranching effort. However, this is no reason for complacency. There appears to be a heavy human pressure on the Green Iguana population of Monkey River and this pressure may be increasing. It would make sense to install protective measures to prevent that finally, ranching of Green Iguana's does become the only option to save the species.

Even without completely closing the hunt for Iguanas and their eggs, a very positive management measure could be the closing down for hunting one or two nesting beaches along the river. The active meandering of the river will probably change the size and the quality of the individual beaches from year to year. And therefore, every season it should be decided which beaches are to be closed for hunting. Vigorous patrolling and possibly fencing the beach with barbed wire (to make a clear signal for human intruders) are of highest importance in this scenario. Destructive hunting techniques like burning the vegetation should be prevented.

Crocodiles appear plentiful but may be sensitive to disturbance. Nesting sites, which include some of the higher sandbanks along the Monkey River, Bladen and Swasey, should be protected. The Payne's Creek warrants further investigations. Tour guides from Monkey River Village have indicated the desire to use this population for visitation by their tours. On occasions groups have camped out near the creek. Care should be taken not to disturb any nesting activity during these tours. Crocodiles can be very sensitive to disturbance of their nesting sites, increased human activity draws attention of Raccoons and other predators to the nests and thirdly, female crocodiles guard their nest and are known to defend it which may lead to potentially dangerous situations.

There are no active nesting beaches of any Sea Turtle within the Monkey River study area.

BIRD SURVEY

Ellen McRae

Methods

Itinerary
DAY 1 (8 AUG 1995) - Arrival 15.00h.; walk in town & on beach.

DAY 2 (9 Aug) - Early morning departure for distal portion of Monkey River SDA (upper Monkey River). Point count stations upriver of trails. Walk along proximal portion of Payne's Creek Trail; point counts taken.

DAY 3 (10 Aug) Northern coastal sampling, including Little Monkey Caye, Great Monkey Caye, Black Creek, Pine Ridge Creek and associated mangrove and needle forest/pine savanna habitat, and the coastal littoral forest of English Town (once inhabited).

DAY 4 (11 Aug) - southern coastal sampling, including Alligator, Moho, Tarpon, and Guanacaste Creeks; also, littoral forest around Alligator Creek.

DAY 5 (12 Aug) - Proximal upriver fish sampling. Also bird surveys.

DAY 6 (13 Aug) - Avian survey on proximal section of Monkey River road (0545-0910). Departure.

Primary resource material for bird species identification included: Peterson & Chalif, 1973; Robins, et al, 1966; Howell, SNG & S Webb, 1995; Garcia et al, 1994; Coffey & Coffey, date unknown [tape].

Techniques
1. A series of 10-minute point counts, entailing both visual and auditory detection methods (no tape recordings used), at selected points along the following:

a) Monkey River
b) Payne's Creek Trail (to Guanacaste Creek)
c) Black Creek
d) Pine Ridge Creek
e) 2 Needle forest/pine savanna ground stations, reached along Pine Ridge Creek.
f) Monkey River Road, from landing to apprx.
2 km westward.
g) 2 different tall littoral forest stations; at English Town and Alligator Creek.

2. Point count measurements by paces on land; approximate measured length of 1 pace = 75 cm. Stations were somewhat randomly selected along the river. GPS positions were taken by Jan Meerman.

Observations noted en route between selected point count stations. When on land, these locations were noted by paces. On river, they were usually not noted.

3. Slow circumnavigation of the Crown Reserve Little Monkey Caye. Although individual birds were counted, a detailed analysis of the number of nests was beyond the scope of this survey.

4. Circumnavigation of Great Monkey Caye.

5. A walk through the needle leaf forest at Pine Ridge Creek.

6. Incidental bird sightings reported by other survey team members, from a variety of habitats, including broadleaf forest and guamil (along road).

7. Incidental species not observed by team but reported by residents of Monkey River Village.

8. Sightings reported by BCES (1992) research team not observed by this team.

Results

Biodiversity Surveys

Results of the surveys are presented according to habitat in appendix 3. Though time was insufficient to cover in detail all habitat types for birds, an overview of the SDA was gained.

A total of 129 bird species were detected, using point counts, general opportunistic observations, and voice identification. This compares with 45 species for the previous survey (BCES, 1992), 11 of which were not sighted by this survey. This creates a total of 140 species observed to date; a number which will surely increase with continued research. Many species utilising the SDA's habitats seasonally could not be viewed as they will not arrive until Sept-Nov.

One day of river and TRF sampling (roughly equivalent to the treatment that could be expected from a tour group directed at birding) yielded 70 species. This would be enhanced by tape-recordings of birdsongs, which might serve to attract thicket-dwelling species not ordinarily seen to a tourist group. This would certainly be a good day for most birding tourists.

The trail sampled was Payne's Creek Trail--one of 5 hunting trails recut to promote tourist visitation. Habitat here ranged from guamil to high forest.The section walked was from Monkey River to the upper reaches of the Guanacaste Creek (approximately 1/2 way to a Crocodile Pond at Upper Payne's Creek.). Twelve species were observed only in this habitat. These are: Great Tinamou; Great Curassow; Black-cheeked Woodpecker; Chestnut-coloured Woodpecker; Tawney-winged Woodcreeper; Ruddy Woodcreeper; Olivaceous Woodcreeper; Slaty Antshrike; Dusky Antbird; White-throated Spadebill; Southern House-wren; Grey-headed Tanager.

One half-day of observations along the road (early to mid- secondary growth), in addition to some reports of incidental sightings by other team members, produced a list of 71 species, 8 of which were not reported elsewhere. These included: Ruddy Crake; White-tipped Dove; Violet Sabrewing; White-necked Jacobin; Violaceous Trogon; Pale-billed Woodpecker; Buff-throated Saltator; Blue-black Grassquit. Habitat along this road included reed marsh with wamil.

Two days along coastal (mangrove, cayes, sandy beach including that near the village, littoral forest, and creek-mouth habitats produced 64 species, (one of these deposited in the wrackline by sea action). Nine species (White Ibis; Osprey; Whimbrel; Semipalmated Sandpiper; Royal Tern; Sandwich Tern; Yucatan Vireo; Yellow Warbler and Mangrove Warbler; Cerulean Warbler) were found exclusively in coastal habitat. One of these (an immature Cerulean Warbler--recognisable by bluegreen feathers on the head with yellow wash ventrally, white tailspots and wingbars) was washed up in tidal wrack, after having evidently dropped into the sea during migration.

Finally, a morning and afternoon in Pine savanna/Needle leaf forest habitat showed 29 species, 6 (Yucatan Bobwhite; Yellowhead Parrot; White-bellied Emerald; Northern Bentbill; Dusky-capped Flycatcher; and Thick-billed Seed-Finch) of which only occurred there.

On the other side of the spectrum, the species occurring over the most broad range of habitats was the Spot-breasted Wren.

Resource use surveys

Several villagers were interviewed regarding use of avian resources. Through this medium a general picture appeared regarding the use of these resources by persons originating from within and without the Monkey River SDA area. Persons consulted to obtain this information include: Eloy Cuevas, David Linares, Clive Garbutt, Marva Garbutt, Lloyd Williams, Alexander Garbutt, Melvin Coleman, Daniel Castellanos, Avington Garbutt, Enid Coleman, Santiago Cuevas.

Three major use categories for birds were identified. These included: food; pets; and tourism. Of these, the lowest impact and the potentially most lucritive is the latter. As a non-extracive activity, tourism offers a means of re-utilising a bird or nesting colony over again instead of shooting or collecting juveniles. At least two guides in the village are studying birds with the intent to guide birds to at least some extent. One has his National Tourguide License; the other is applying. This is a use on the increase in the Monkey River area.

One tourguide, specializing in birds, has stated that the greatest attractions to tourists in his experience are herons and egrets, the larger kingfishers, Montezuma Oropendolas, and the general diversity of bird species along the Monkey River. Additionally, the nesting colony at Little Monkey Caye draws interest. At least one guide from Placencia brings persons to Monkey River for bird observation.

The most traditional use is hunting for food. Species hunted most frequently by residents of Monkey River include the Great Curassow (*Crax rubra*) and the Crested Guan (*Penelope purpurascens*). Curassow feathers were noted in the yards of some people. Occasionally smaller birds are taken, including Plain Chachalaca (*Ortalis vetula*), Muscovy Ducks (*Cairina moschata*), Quail (*Colinus nigrogularis*) and the odd pigeon (*Columba sp*). However, several interviewees ventilated as how they didn't bother with smaller birds, and used their expensive shells exclusively for the larger two species. The fact that this was possible indicates that there is apparently no difficulty in locating these when the need or desire strikes. Nonetheless, at least the Crested Guans

were sufficiently cautious to avoid detection by members of this survey team. Great Curassows were observed on one occasion only.

The persons from outside the area who most use the resource in this area are farmworkers on the large citrus/banana plantations located at TTC farm and CowPen. Roads have apparently been cut into the forest by farm personnel to facilitate their use of the area.

The pet trade targets Red-lored Parrot (*Amazona autumnalis*); Yellowhead Parrot (*A. ochrocephala*); and Aztec Parakeets (*Aratinga nana*). All young are generally removed from nests during a raid; this results in the aging of parrot populations, and inevitable decline in numbers. The Yellowhead Parrot (*A.oratrix*) was once common but is now reduced in numbers.

Discussion and conclusions

The birds of Monkey River SDA were observed by point counts along Monkey River, the road, and along the section of Payne's Creek Trail between Monkey River and Guanacaste Creek (215 min total). Other birds were noted between point counts. Birds were either observed directly or heard and identified by voice. No mistnetting was conducted.
This is in contrast with other avifauna surveys in the southern-coastal area (eg, Robins, 1990, for Stann Creek District).
A prior list for Monkey River did not describe methods (BCES, 1992). However, some comparisons can be made.

As might be expected, species numbers for this survey are lower than the mist-net effort by Robins (of considerably longer duration (early Jan-late Feb). Undoubtedly mist-netting would reveal a considerable number of secretive deep-forest species, indicated by this survey in numbers of forest birds identified by voice during the Payne's Creek Trail walk.

Numbers of species noted indicate in the short time available that the area contains a relatively rich avifauna. Many aspects of the observed avifauna were deemed to be of value in pursuing a course of environmentally and culturally sensitive tourism.

1) A moderately rich avifauna, containing sufficient diversity of species to attract birding tourists.

2) Large numbers of certain highly visible species with showy habits that attract general natural history buffs to heighten their interest in birds. These species include:

a) Montezuma Oropendola -- a large, colourful blackbird forming spectacular colonial nesting sites in large trees. At least two such nesting colonies are located close to one another (quite possibly they are connected) on *Ceiba petandra* trees within easy visual reach of tourists travelling up the Monkey River. Their GPS data is recorded elsewhere in this chapter. Another colony, located along the access road on two adjacent Royal Palms, is sufficiently remarkable to warrant notice from even advanced birders.

b) Yellowhead Parrot -- This large, vociferous parrot has become rare in recent years due to depredations by the pet trade. This is because the species is large and learns to mimic human sound easily. A few were observed immediately North of the SDA in Pine Savannah habitat.

It is likely, given the number of Royal Palms (In Monkey river, Yellow heads breed in rotting Royal Palms; Eloy Cuevas, pers. com.) within the SDA that Yellowheads nest within the area, and, with appropriate protection from pet seekers, will constitute an important attraction to high-grade tourism. Hopefully they will assume a higher value as tourist attractions in the wild than as pets in a cage.

c) White-collared Manakin -- Though these birds are very small, their noisy leks (meeting-places for male birds, where considerable wing-snapping and darting around takes place. Brown, 1990). The noticeable "whirrr" of their wings in flight points out their location to the experienced guide (which profession is
growing in Monkey River). There were considerable numbers of these along the Payne's Creek Trail leading to the Crocodile Ponds; at least three were noted.

d) Keel-billed Toucan -- In addition to being the National Bird of Belize,this species for many people exemplifies the "Tropical Rainforest Experience". Along Payne's Creek Trail, considerable numbers were heard calling to one another; a hogplum tree utilised by a pair for nesting is opportunely placed along Monkey River for easy viewing.

Detailed information regarding the locations of these nesting/breeding sites appear in the following Section.

3) The Crown Reserve-status nesting colony is actively used by several species for breeding, as well as a night roost for a large number of Short-billed Pigeons. At the time of the survey, Great Egrets were nesting.

This breeding colony is accessible, highly visible and must be considered an attraction for tourism.

Bird species of conservation (*) or other significance

Least Grebe: Sighted by the previous team, this species is listed by Garcia et al (1994) as uncommon in SDA habitats.

Anhinga: This species was sighted several times, in several habitats. It is reported to breed on Little Monkey Caye in springtime (Cuevas, pers. comm). Garcia et al (1994) list it as uncommon in Southern hardwood forests. One was sighted a short distance up the Bladen Branch from Monkey River.

Bare-throated Tiger Heron: Listed as uncommon in Southern Hardwood forests by Garcia et al (1994), this species is common along the Monkey River. At least two nests were sighted, one of them low enough for easy tourist viewing.

*Muscovy Duck: Listed as threatened/endangered by Garcia et al (1994), one of this species was sighted by EC beating a hasty retreat as we approached it along Monkey River. This is no surprise, as this is one of the species reported to be hunted by SDA residents. It is recommended that special attention be awarded this species within the proposed reserve framework.

Great Black Hawk: This species was encountered several times along Monkey River and along the Southern creeks. It is not listed in Garcia et al as occurring coastally; however, in southern Belize, many species not ordinarily associated with coastal avifauna appear along the coast. Some birds normally associated with inland broadleaf forests were mistnetted in mangroves by Robins et al (1990).

Collared Forest Falcon & Aplomado Falcon: These uncommon (Garcia et al, 1994) falcons were sighted (former) and reported by the previous survey team (latter) in the SDA. They are a treat for birding tourists.

Great Curassow & Crested Guan: These species are legal to hunt in Belize; however, throughout their lowland range in Belize, they are listed as uncommon by Garcia et al (1994). The people of the village stated that these were the two most commonly hunted bird species for food; yet only one curassow was sighted, and no guans. It is recommended that these species also be protected in at least some portion of the Monkey River Forest.

Black-throated Bobwhite: An individual was flushed in Pine savanna habitat. This species is listed as uncommon (Garcia et al, 1994).

Sungrebe: Several were sighted along Monkey River, including an individual with 3 chicks. Listed as uncommon in Southern hardwood areas by Garcia et al (1994).

Collared Plover: This species is listed as accidental in Belize (Garcia et al , 1994). It was reported by the previous survey team (BCES, 1992).

Semipalmated Sandpiper: Listed as rare in coastal areas by Garcia et al (1994), a small group of this species was sighted on a sandy beach south of Monkey River Village in the vicinity of Alligator Creek.

Pale-vented Pigeon: This species is listed as common in lowland savannah; however, it has been sighted in Placencia and Monkey River in mangroves on the coast. Garcia et al (1994) do not record the species in Mangrove forest and coastal beach vegetation.

Short-billed Pigeon: Again, Garcia et al (1994) do not list this species as occurring in coastal areas; however, a large flock of these (and probably also some of the preceeding species) spends every night on Little Monkey Caye--possibly as a mechanism to avoid predation by raccoons, which are reported as commonly seen in coastal mangroves. Several hundred of these Pigeons sleep on the Caye, then disperse into the mangroves (and possibly points further inland) to feed.

White-winged Dove: The pigeon colony utilising Little Monkey Caye for night roosting was identified by a previous survey team (BCES, 1992) as white-winged doves. This survey team observed none of this species; instead, large numbers of Short-billed Pigeons were observed. The early-morning expedition to Pine Ridge Creek revealed considerable numbers of Pale-vented Pigeons mixed in with the Short-bills.

*Yellowhead Parrot: The species is listed as common in coastal savannah; however, the pet trade is reducing numbers in the wild. Garcia et al (19940 list the species as of conservation significance.

White-necked Jacobin: This species was repoerted feeding in the *Heliconia*s by the roadside by Tineke Boomsma. It is listed as uncommon in Garcia et al (1994); it is a showy, large species of hummingbird.

Keel-billed Toucan: One of Belize's premier "charismatic megafauna", the National Bird is listed by Garcia et al (1994) as uncommon in Southern Hardwood forests; several of the species were heard and one seen along Monkey River, where a hogplum tree reportedly hosts a nest in the spring.

Rufous-breasted Spinetail: This species is listed as uncommon in Southern hardwoods; it was common along Monkey River.

Slaty Antshrike: A good look at this individual ascertained its presence in the Monkey River Forest along Payne's Creek Trail. Although Garcia et al (1994) list the species as accidental, Howell & Webb (1995) report it as uncommon to fairly common in Southern Belize.

*Yucatan Vireo: This species is listed as uncommon in Garcia et al (1994). Howell & Webb's (1995) distribution map show it to be a Caribbean Yucatan coastal endemic, whose distribution does not reach to Southern Belize; however, a thriving population on West Snake Caye shows this not to be the case (McRae, unpub data). A few were heard in mangrove and littoral forest on the coast and on Great Monkey Caye. The species was recommended as requiring attention in the coastal zone (McRae, 1995).

*Cerulean Warbler: Unfortunately the only individual seen of this species was dead; apparently a casualty of migration. The species is an early migrant. The specimen has been kept for reference. Cerulean warblers are listed as of conservation significance due to a long-term decline of breeding birds, (Sauer & Droege, 1989). They are listed as uncommon in southern hardwood forests by Garcia et al (1994).

*Prothonotary Warbler: Listed as uncommon in Garcia et al (1994), one individual of this species was observed along the road. The species was flagged for conservation significance in Belize by McRae (1995) due to a narrow winter distribution (the Caribbean coast of Central America), which renders them more susceptible to extinction (Reed, 1989); the species has also experienced a 4 % decline since the past 10 years (Sauer & Droege, 1989).

Grey-headed Tanager: The species is listed as uncommon by Garcia et al, 1994). Two were observed at antswarms along the Payne's Creek Trail.

Scarlet-rumped Tanager: A brilliant, showy species listed in Garcia et al (1994) as uncommon; however, several were seen along Monkey River.Attraction for tourists.

Bird Nesting Areas of Interest to High-Grade Natural History-based Tourism

The following bird nesting areas were considered notable and of considerable interest to the tourist targetting Belize's avifauna or general nature study:

1) Little Monkey Caye (UTM 163.422/18.105).
This is a small, relatively high (approximately 8m) Red Mangrove caye (in early fruiting stage during visit). Current nesting includes Great Egrets (unfledged young, although nests were too high for a view of the chicks). Late juvenile, and breeder Brown Pelicans were also around. Brood sounds (the scraping noises made by juvenile birds) were continuous.

On the morning of August 10, 1995, 21 Brown Pelicans were observed, most of them were perched on the southeast side of the island. Most Great Egret activity was centred on the western end of the Caye. More than 25 of these were noted 10 Aug; $\geq$ 18 more were roosting on the mangroves directly across from the island (around the mouth of Black Creek). Four Anhingas were perched at treetop level in the Great Egret area. This species is reported to nest at LMC commencing around May. a few are still routinely sighted at the Caye. Yellow-crowned Night Herons are also reputed to nest on LMC; however, no time-frame was reported.

On 12 Aug a disturbance was noted at LMC in the afternoon. Birds were continually rising and taking to the air in the South-central portion of the Caye. Eloy Cuevas reported that fishermen utilise this island to soak new lobster traps prior to setting them. This is obviously a strong disturbance factor and should be curtailed. There exists considerable area away from nesting birds to soak lobster traps.

In view of the large amount of input from large-scale agriculture located upstream, long-term information regarding brood success and monitoring numbers of individuals of Great Egrets and other nesters at LMC is essential for determining the amount if any of impact from these sources. It is known that a) many species of birds are susceptible to accumulation of pesticides (eg, Murphy, 1980); b) that Selenium and other soil constituents may concentrate in irrigation runoff to toxic levels, causing death and deformation of chicks; thereby reducing considerably brood success (Bildstein et al, 1991; Williams et al, 1991; Ohlendorf et al, 1989).

2. Montezuma Oropendola nesting colonies: These occurred in two notable (and visible) locations within the research area.

a) Two *Ceiba petandra* trees along the northern bank of Monkey River containing: appprox 70-80 nests. UTM 163.387/18.111

approx 10 nests UTM 163.384/18.114

These were so close as to be probably related.

b) Two adjacent Royal Palms along the access Road:

UTM 163.405/18.106

These colonies are highly attractive to tourists, even if they are not specifically interested in birds. The Oropendola's large size, distinctive colouration, large numbers and humourous aspects of their behaviour combine to produce a strongly positive experience for tourist visitors.

The use of Royal Palms for nesting in Oropendolas has not been seen before by this author. Every previous viewed nesting tree in Belize or eastern Guatemala has been *Ceiba*.

3) Bare-throated Tiger Heron

This large, heavy-billed and attractive member of the heron family nests along Monkey River. A minimum of two nests were in use (late fledglings). The nest positions are known to the local guides; however, GPS was not taken for them. One nest in particular is positioned low in the tree for easy viewing.

Guides should not approach these nest too closely when carrying tourists. Lingering in the area while people attempt close-up shots is dangerous to eggs,which require warmth and protection from the parent bird, and to chicks, which may panic and possibly fall into the river or be eaten by predators before their parents return. A slow pass at approximately 10-20 m should offer opportunities for photography while reducing disturbance impact. Tourists should be warned to be quiet and not shout, laugh or talk loud or move suddenly within 50 m of such a nest.

4) White-collared Manakin

Tiny but attractively coloured and quite distinctively noisy, these birds form leks (aggregations of male birds where considerable jumping from twig to twig and wing-snapping takes place in an attempt to attract females) which can be heard from a surprising distance (Brown, 1990). Several areas were encountered along Payne's Creek Trail and along Monkey River which were presumed to be leks due to the volume of wing snaps and rolls emitted from surrounding forest. Several males were observed along Payne's Creek Trail.

a: Along Monkey River 163.368/18.123
b: Approximately 830 m toward Monkey River along the Payne's Creek trail.
c: Approximately 1 km riverward from the previous lek next to a stream (without current) that was waded.

Studies of leks in the Monkey River Forest should be undertaken with an eye to ascertaining their tolerance of visitation among other attributes.

MAMMALS

Bader Hassan & Jan C. Meerman

Introduction and methods

The planning of the Mammal survey as component of the Monkey River Biodiversity Study 1995, was dictated by:
- the limited amount of time available for this study.
- the main purpose of the study which is to supply information for the proposed Ecotourism activities in which the community of Monkey River intends to get involved.

Taking these considerations into account an approach was chosen which
- ignored smaller mammals such as small rodents and bats which have less touristic potential, and are difficult to sample without using extensive and varied trapping techniques.
- focusses on the larger mammals and to identify these by
    a) looking for tracks, and
    b) interviewing local hunters.

A questionnaire was developed but later it was decided to use this questionnaire only as a general guideline for the interviewer. Approaching the individual hunters with this questionnaire might have made them cautious as to the intentions of the interview. As a result they would have provided the interviewer with "safe" answers which would have had no relation to actual events. For the same reasons it was decided not to include any names of the interviewed hunters in the report.

It has to be stressed that the interviewer himself is an experienced and well known hunter. The knowledge gained over decades of hunting for various types of game in various habitats, was essential for this type of survey. Also the fact that the interviewer was a hunter himself installed faith with the interviewed hunters and increased the output of information.

Field surveys focussing on the mammal population in the Monkey River SDA was limited to three of the five field periods:
Field period II: August 1,2 and 3. Which was a general reconnaissance of the area. Some trails were visited with guidance from Assistant Warden Barry Young from the Association for the protection of Monkey River and limited attention was paid tracks and to the Black Howler Monkeys.

Field period III: August 8,9,10,11,12 and 13. In which the main bulk of the survey took place. By day as many trails (both tourist trails and hunting trails) as possible were traversed looking for tracks and other mammal signs. Some trails were visited twice in order to get an idea of the amount of animal traffic that had taken place between both surveys. During those trips guidance was provided by David Linarez and Santiago Cuevas, both from Monkey River Town. In the evenings, socializing with the men of the village provided the interviewer with complementary information.

Field period V: August 26, 27 and 28. In which 2 night surveys were conducted along the Monkey River and along the various coastal creeks. Both surveys started at 19.00h and ended around 01.00h next morning. Transportation and guidance was provided by Eloy Cuevas. By day, the northern Savanna and a few forest trails were checked for tracks. The weather during this field period was rainy. Increasing rain and threatening floods prevented extension of this field period.

Results

The field surveys were significantly affected by the frequent rainfall and numerous floodings. Fieldvisit # 4, actually had to be cancelled because of high water and fieldvisit #5 was cut short by rising water levels. For the mammal survey, however, these inconveniences had positive side affects. Roadsides and trails were muddy and animal tracks were consequently easy to read.

During a single night survey by outboard powered skiff along the Monkey River, on August 26, an astonishing amount of Mammals was viewed. Astonishing also because the noise of the outboard engine may be expected to have scared of the majority of animals present in the area. Also heavy rain frequently impeded visibility. The mammals seen included Opossum sp., Wateropossum, Paca, Kinkajou and even a Puma.

Also based on tracks and other signs found (scrapes, scratches, faeces, smells etc.), and on information provided by the local hunters it was concluded that the forest on both sides of the Monkey River is very rich in game and the game density is definitely above average in the general Belizean context (B.Hassan, personal experience).

The showpiece of Monkey River is the Black Howler Monkey, which is always in evidence either audibly or visibly, and reaches high densities on both sides of the Monkey River.

The frequently returning floods during the rainy season put a certain stress on the terrestrial mammal fauna of the Monkey River area. Isolated patches or ridges with higher ground are of great importance as refugia during floods. It appears that the higher grounds of the Pine savanna in the north and just north of the project area are very important in this aspect. This was amply demonstrated during fieldvisit V, which took place just after the waters of the August 20-22 flood subsided. The savanna along the Monkey River entrance road was found to be littered with tracks of various animals such as Opossum, Armadillo (pict. 24), Paca, Gray Fox, Raccoon, Jaguarundi, Ocelot, Puma, Collared Peccary and White-tailed Deer. A number of these animals don't usually reside in this habitat and obviously only took refuge there while the forest was flooded.

The species seen, tracked and/or reported are presented in Appendix 3.

Hunting, result of interviews

The hunters of Monkey River hunt a wide array of game. Most hunted species are permitted game animals in the Wildlife Protection Act of 1981. By law, White-tailed Deer and Red Brocket Deer (Antelope) have a closed season which lasts from the first day of July to the thirtieth of September every year. Using headlamps or other artificial lights to facilitate hunting is prohibited (Wildlife Protection Regulations S.R. & O, 1945 #131 section 8).

Species hunted by the inhabitants of Monkey River include:
Paca, Agouti, Collared Peccary, White-lipped Peccary, White-tailed Deer, Red Brocket Deer among the mammals and Iguana, Slider Turtle, Crested Guan and Great Currasow are among the Birds and Reptiles that are hunted frequently (See Bird and Reptile sections respectively).
Most hunters claimed to hunt for subsistence and recreational purposes. In the past some hunters from the village used to hunt commercially, but presently none of the hunters in the village practice commercial hunting.

The amount of hunters in Monkey River village is limited. Of the approximately 250 villagers, only 5 are to be considered serious hunters. And even they rarely hunt more than 2 or 3 times per month. But all men that still farm some plots along the river, carry their shotgun along at all times, just in case anything worth-while comes within range. All these hunters have hunted from youth and learned to hunt from their relatives. Some of the younger men in the village also hunt but their hunting is more recreational than intensive, preferring to hunt along the road and directly along the river.

One hunter uses dogs when he goes hunting and all practice night-time hunting with the aid of a headlamp. No closed seasons for any of the hunted species are taken into consideration.

The animals most frequently taken are Paca and Collared Peccary and these are mostly taken directly along the Monkey River.

Most hunters recall good hunting areas in the upper Bladen (presently the Bladen Nature Reserve) and along the Trio but usually they consider these areas too far to be really interesting. Also these areas have now been invaded by hunters from the various communities of Central American immigrants which have sprouted up in the area over the past decade.

Hunters from these immigrant communities, in this case predominantly those located in TCC farm and the Banana Farms (Cow Pen), also enter the area close to the Monkey River. Most hunters from Monkey River have the feeling that they compete for their game and also that these immigrants hunt indiscriminately.

The team definitely found traces of higher hunting pressure on the north side of the river. There was a higher incidence of spent shotgun shells and hunting trails were more frequent. This higher

pressure compared with the area south of the river is undoubtedly caused by hunters from outside the area that have access by road but, lacking boats, are unable to cross the river (at least during the rainy season).

The people of Monkey River village want Ecotourism development, which was the main reason why they wanted the area reserved. But there are mixed feelings in the village about closing the area for hunting. About half of the interviewed people are in favor. But at the same time they don't see why they themselves should stop hunting, after all, there is enough game. Closed for other hunters yes, but most Monkey River village hunters will not accept that they can not continue hunting. Closed seasons, or smaller closed areas might be an option.

Many hunters, even though without giving up their hunting practices are now looking towards ecotourism as an additional source of income. They definitely feel that their hunting experience gives them a competitive edge as jungle guides.

Selected species

Black Howler Monkey

The Black Howler Monkey or "Baboon", is a species with a very limited range. It occurs only in south-eastern Mexico, northern Guatemala and in Belize. Due to it's limited distribution is has to be considered a very vulnerable species. Although reliable documentation is lacking (McCarthy, Pers. comm.), various sources (Emmons & McCarthy, in press; Horwich et al. in press; Wynne, 1995) report that the populations of this species were severely affected by a yellow fever epidemic in 1956-7. As a result, Howler Monkey's were decimated or disappeared altogether in many parts of Belize. Currently many populations seem to be recovering and they were even reintroduced into the Cockscomb Basin (Horwich et al. In press).

On a whole, the Black Howler Monkey appears to be a relatively adaptable species. As long as they are not hunted, they can tolerate human presence and they can even adapt to secondary growth forest types. They are mostly frugi- and foli-vorous and although a wide variety of fruits and leaves is accepted, the Fig tree (*Ficus spp.*) appears high on the list of favorites. Available food sources probably influence group size and home range size.

Howler Monkeys are the showpiece of Monkey River. They are the only wild mammal in the area that visitors will almost certainly see or at least hear. The local Howler population is spread over the entire Broadleaf forest of the study area within the Monkey River SDA. They even have been recorded from the Red Mangrove Fringe along Black Creek and during field period III, one group was heard calling from the swamp forest just behind English Town.

The amount of Black Howler Monkeys within the area is difficult to estimate without elaborate censusing techniques. Approximate location of groups that were heard vocalizing or actually seen during the field periods is noted down on map 12. Since groups don't vocalize all the time and silent groups can be missed easily, we assume that we were able to count more or less only half of the troupes present in any given area. With this assumption, we estimated a density of ±2 groups per km¨. This figure is in agreement with the brief census of Wynne (1995) in Monkey River who counted 6 groups in an area of approximately 3 km¨. Assuming there is about 43 km¨ suitable Howler Habitat within the current study area of the Monkey River SDA, there may be as many as 90 groups of Howlers in the entire study area.

Notable was the large number of individuals per group. In one group, close to the road in Riparian forest dominated by Kaway and Provision tree, I counted no less than 13 individuals. Once we saw a single Howler sitting in a *Cecropia* tree amidst secondary growth but all other groups seen counted between 4 - 8 individuals. This high number of individuals per group is contradictory to the situation in the Community Baboon Sanctuary (CBS) in the Belize District were groups are never larger than 10 individuals. For Monkey River, Wynne (1995) estimated the average number of individuals per group to be 7. A figure that concurs with our findings. Using this average group size, the total number of Howler Monkeys within the study area can be estimated to be between 500 and 700 individuals. This average density concurs with the figures given by Arita, Robinson & Redford (1990), who indicate a "normal" density of 12 Black Howler Monkeys/km¨.

Based on these figures, the density of Howler Monkeys in Monkey River appears to be lower than at the CBS where group density may be as high as 10 groups per km¨ (Horwich, R.H. & J. Lyon, 1990). This high density at the CBS may be caused by the fact that the groups there have to live on a relatively narrow strip of riverine forest while at Monkey River, the groups can spread over a much larger area. Fig trees that probably constitute one of the main food sources in the area are in Monkey River not just found along the river but widespread throughout the forest.

Spider Monkey

The local name for the Spider Monkey is "Monkey". The name Monkey River, therefore, would imply a presence of Spider Monkeys. But currently there are no Spider Monkeys to be found in the entire area. Older residents claim that there never have been any Spider Monkeys near Monkey River at all. The closest populations of "Monkeys" that they know of are "up in the hills" (Upper Bladen and Trio).

Paca

Paca's are Belize's largest rodent weighing 4 to 8 kg. In favorable habitats they can reach high densities (27.5 animals/km¨ according to Arita, Robinson & Redford, 1990). Paca's give birth to only one young at a time and so, although females may give birth twice a year, reproduction rates are low. But since the young are born well developed, survival rate is high.

Because of their relative abundancy, large size and high quality meat, the Paca or Gibnut is one of the preferred and probably most commonly taken game species in the Monkey River area.

Most Paca's are taken at night, using headlamps and the forest around Monkey River supplies the most of them. Hunters claim their numbers, at least along the Monkey River have increased during past decades. Probably as a result of the depopulation of Monkey River Town with the resulting decrease of hunters.

Based on figures provided by the hunters of Monkey River village, the number of animals taken by them on an annual basis is anywhere between 120 and 180. Although this figure probably includes animals taken outside the study area (along lower Bladen and lower Swasey). The number of animals taken by outsiders can not be quantified.

Robinson and Redford (1991) estimate the potential sustainable harvest of Paca's to be 1.3 animals/km¨. For the ±50km¨ of suitable habitat within the study area this translates to 65 animals. It may, therefore, appear that the numbers taken are above sustainable use. Nevertheless, hunters claim that Paca's actually have become more numerous and also the large number of tracks found by the team definitely indicate a healthy Paca population in the area. Quite possibly, the Paca density in the Monkey River area is higher than would be expected based on the figures of Arita, Robinson & Redford (1990).

Agouti

Contrary to the Paca, Agouti's are diurnal. Although they are considerably smaller than Pacas, Agouti's usually occur in somewhat lower densities. Arita, Robinson & Redford (1990) give a figure of 19.7 animals/km¨. Track records seem to confirm this situation for the Monkey River area.

The meat of the Agouti or "Rabbit" is very lean compared to that of the Paca. The larger size and tastier meat of the Paca makes the latter a much more preferred game than the Agouti. And with the abundance of Paca, most hunters don't bother with going after Agouti. Most Agouti's are, therefore, taken opportunistically while hunting for more desirable game. The meat of Agouti is sometimes marketed as Gibnut, which may lead to some confusion.

White-tailed Deer

White-tailed Deer, or simply "Deer" are not strictly forest animals. They are most common on the savannas and in and along forest edges. This species is also a preferred game species. They are hunted day and night, mostly on the savanna after this has been set to fire. Deer come to lick the ashes or eat the young grass shoots. According to the hunters of Monkey River, the best area to hunt this animal is around Dill Water, in the Savanna west of the Study Area. This area needs to be reached by boat through Deep River which is a long distance and, therefore, expensive. Also the area is now (during the dry season) accessible by road which has resulted in a great influx from hunters from all over the region. Most hunters from Monkey River claim, that as a result of this, the overall Deer population has gone down.

Red Brocket Deer

This small deer which is locally called "Antelope" is contrary to the White-tailed Deer mostly a forest species. Commonly taken by hunters from Monkey River. The best populations appear to be in the forest around Monkey River. Densities of this species can be relatively high (10.5 animals/km¨ according to Arita, Robinson & Redford, 1990).

White-lipped Peccaries

White-lipped Peccaries or "Warree" are mostly frugivorous and live in large herds of as many as 100 individuals. Consequently they need vast areas to forage and are very sensitive to forest fragmentation. Densities are usually rather low: 4.9 individuals/km¨ (Arita, Robinson & Redford, 1990). Based on these figures, the minimum area needed by a single herd of 100 Warrees may be as big as 20 km¨. In other words, the whole research area is theoretically just big enough for two of such herds. Practically this figures may be too optimistic, since the amount of forest north of the Monkey River (which, during high water, is isolated by the river) is too limited to support a Warree population full time.

Warree tracks were found to be relatively common in the area of Monkey River. Tracks were found mostly in the area between Payne's Creek and Guanacaste Creek.

Local hunters distinguish between the normal "Warree" and the "Cross Warree". They recognize that both belong to the same species but the "Cross Warree" is a generally more aggressive type. Herds consist either of normal "Warree's" or of "Cross Warree's". Possibly the temperament of the herd depends on the amount of young they have to defend or even on the amount of experience they have with people.

As a result of the ecological characteristics of this species the opportunities for sustained hunting are relatively low. Robinson & Redford give a potential annual harvest of 4.5 kg/km¨ translating into 0.8 animals/km¨ annually.

Collared Peccaries

Collared Peccaries are smaller than their larger cousin the Warree. They also live in smaller herds and thrive in the secondary growth habitats. Consequently they are less vulnerable to changes in the habitat. Densities can be relatively high (11.9 animals/km¨ (Arita, Robinson & Redford, 1990). They are frugivorous but generally they prefer seeds above the actual fruits. Ecologically they are seed destructors rather than seed dispersers.

Collared Peccaries are one of the preferred and most commonly taken game animals. Hunters claim their numbers, at least along the Monkey River have increased during past decades. This increase is probably a result of the depopulation of Monkey River Town with the resulting decrease of hunters and the decrease of agricultural activities along the River.

Robinson & Redford (1991) claim that the Collared Peccary has a high production and is one of the animals with best perspectives for sustainable hunting. The annual harvest per km¨, may be as high as 42.2 kg annually, translating into 2.4 animals/km¨.

Tapir

Tapirs are becoming increasingly rare throughout their range. Habitat destruction and overhunting are generally blamed for declining populations. In Belize it has been found that Tapirs are probably more threatened by hunting than by habitat destruction (Fragoso, 1991). Within the study area, fresh tracks of Tapir or "Mountain Cow" were found on both sides of the Monkey River. The population did not appear overly high, however. Tapirs prefer disturbed riverine habitat (Fragoso, 1991) and the whole Monkey River area (including the wet savanna) with its mosaic of vegetation in different stages of regeneration appears ideal habitat for Tapirs. Fragoso (1991) sampled a 60 m wide strip along the Upper Macal in the Cayo district and found a density of 13.3 Tapirs/km¨. This very high density was probably caused by the fact that only a very narrow strip of prime habitat along the river was sampled, ignoring the area further away from the river which likely also formed part of the sampled animals' homeranges. Tapir density in Barro Colorado Island in Panama is reported to be 0.6 animals/km¨ (Terwilliger, 1978), while Arita, Robinson & Redford (1990) indicate an "average" density of 0.5 animals/km¨. Exact figures of the Monkey River research area are not available but appear to be lower than any of the above figures. Hunters from Monkey River claim they don't hunt Tapir. They are too big to carry for long distances, but mostly because the meat is not preferred. The relative scarcity of tracks, though, may be an indication of a certain amount of hunting pressure.

Jaguar

Jaguars are one of the top predators of the Neotropical Forests. As such they are naturally rare. Arita, Robinson & Redford (1990) estimate an average density of only 0.1 animal/km¨. Rabinowitz & Nottingham (1986) who did study in Belize came to an even more conservative estimate of 0.07 animal/km¨. Based on these data, the entire Study Area might be expected to support between 3 and 4 adult Jaguars.

Based on numerous tracks, scratches and scrapes found, there appears to be a strong population of Jaguars in the area. And the above mentioned density is most likely reached. This strong population is no doubt the result of a strong prey-base. In the past there used to be several conflicts involving Jaguars. But since the total collapse of the livestock industry that once thrived on the banks of Monkey River, these conflicts have come to a halt. The last reported conflict involved a Jaguar that six years ago, took a dog near the beach on the south side of the village. The Jaguar was killed from the porch of the nearest house.

One hunter stated he used to hunt Jaguars for the skins while there still was a market but that this practice as come to a halt all together.

Puma

Most hunters interviewed reported "Red Tigers" but stated they were less common than Jaguars. Although Puma tracks can be difficult to distinguish from those of Jaguar, tracks probably belonging to Puma were found near the entrance road on the Northern Pine Savanna and on one of the forest trails just north of the Monkey River. One individual was actually seen during a night survey on August 26. The animal was standing on a small open spot on the north bank of the river, and betrayed himself by the yellowish eye-shine reflecting in the headlamp. It was not until the animal turned around and afforded us a full lateral view, that we recognized it for what it was.
Puma's are generally considered Deer hunters and therefore, they are probably more in evidence on the savanna's.

Manatee

There were no Manatee sightings on any of the field trips we made. Local informants indicated that they were not common in the area. Sometimes they would swim a way up the Monkey River. These events usually taking place towards the end of the dry season, around May.

Discussion and conclusions

The mammal population within the research area appears healthy. The large number of tracks from Puma and Jaguar and even the sighting of a Puma indicate a healthy prey base. And the area certainly counts among the richest of the country as far as mammal density goes.

Hunting by the residents of Monkey River village focusses principally on Paca and Peccary. White-tailed Deer and Brocket Deer are also hunted whenever the opportunity arises. The number of Paca taken annually may be substantial but the population of this species appears healthy and based on the little information available, the hunting of this species appears sustainable. Based on information provided by the hunters themselves it appears that the hunting of White-tailed Deer (although mostly taking place outside the study area) is not sustainable and that this population is declining.

Closing the area for hunting does not appear acceptable for the moment. Also the game density is high enough to allow hunting but it is recommended that closed seasons during the reproductive seasons of the various game species are installed and implemented. Also certain sections of the SDA or even entire habitats may be declared closed to hunting permanently or seasonally. The pine savanna (Fire-induced shrublands of the plains) which serves as a refugium during rainy season would be a first candidate for this.

With the current number of inhabitants of Monkey River village and more importantly, the declining number of serious hunters, the human pressure on the mammal population of the area appears small and sustainable. However, there is growing pressure from outside the area, notably from laborers of the Mango and Banana plantations nearby. Their impact is hard to assess and even harder to control.

A management plan focussing on the protection of the wildlife in the area should put heavy emphasis on this pressure from outside. Patrol and warden activities should also be centered along access routes.

RECOMMENDATIONS

Environment

Monkey River village is economically largely dependent on a healthy river system and a healthy marine environment. Unfortunately, the village is at the end of the watershed of the Bladen, Swasey, Monkey River and the Pine Ridge Creek and so are largely depended on how other people deal with the environment upstream. At the moment the people of Monkey River village have the feeling that the environment is changing: anecdotal evidence related to us by several villagers indicates that in the past, Monkey River was plagued by large hordes of Bottl'ass flies (Black-flies, Simulidae) but that this plague has now virtually completely disappeared. Most villages assume that the disappearance of the Bottl'ass flies is a result of pesticide use in the banana farms and although they enjoy the eradication of this particular plague, they also sense that this means there is something wrong. Also, the pesticide containers that come floating down the River and the decrease in certain fish species, creates an uneasy feeling. But most residents accept all this as simple facts of life and do not realize that something has to be done and actually can be done.

It is important to activate the people of Monkey River village and to make them more assertive when it concerns the environment of their river and village. Because this environment is their only asset for the future.

The people of Monkey River should press the right authorities in establishing a monitoring program for the quality of the river water including sediment load and if possible the presence of agrochemicals.

This monitoring program should be implemented by the people of Monkey River village to enlarge their environmental awareness and to make them more critical to activities undertaken by individuals or companies in the watershed of the Monkey River.

Hotspots for these monitoring activities are formed by the mouths of the Monkey River, the Pine Ridge Creek and the reefs around Little Monkey Caye and Great Monkey Caye.

Reasons for the severe coral bleaching observed needs to be investigated.

Products of such monitoring should be systematically presented to the Ministry of Tourism and the Environment, the Ministry of Agriculture and Cabinet attended by a petition signed by villagers containing any documented amounts of pollutant, dates of these and an action-oriented letter asking that decisive steps be taken by Government to induce agriculture interests to reduce documented inputs.

Environmental education should be undertaken in Monkey River school and other community bodies to acquaint such persons with the full continuum of the marine system, its function, its fragility, and its interdependence. Teachers may contact Mr. Alexander Lacadio or Mr. Jeffrey Zuniga to initiate contact with an active school environmental club that spans at least two Districts (Toledo and Stann Creek). These teachers have recently completed a Marine Life Workshop at

Caye Caulker during which they initiated action plans to train other teachers to teach marine science in an interesting and exciting fashion (McRae, pers. obs).

Activities in the area by large-scale foreign interests, such as large developments and/or more large banana/citrus plantations should be monitored. The north side of the river is already under higher pressure and increased activities here could be detrimental to the wildlife of the entire area.

Management

The Association for the Preservation of Monkey River should be revitalized and hold more frequent meetings, ascribing to a set of goals and working together with conservation NGO's in Belize.

An adapted management plan of the SDA should be developed.

Wardens of the Association for the preservation of Monkey River should pursue training and seek contact with their colleagues in other protected areas in Belize.

Wardens have to be trained to carry out educational tasks at schools.

Closing the area for hunting does not appear acceptable for the moment. It is recommended that closed seasons during the reproductive seasons of the various game species are installed and implemented. Also certain sections of the SDA or even entire habitats may be declared closed to hunting permanently or seasonally. The pine savanna which serves as a refugium during rainy season would be a first candidate for this.

Management of the Green Iguana population could consist of closing down for hunting one or two nesting beaches along the river. The active meandering of the river will probably change the size and the quality of the individual beaches from year to year. And therefore, every season it should be decided which beaches are to be closed for hunting. Vigorous patrolling and possibly fencing the beach with barbed wire (to make a clear signal for human intruders) are of highest importance in this scenario. Destructive hunting techniques like burning the vegetation should be prevented.

A management plan focussing on the protection of the wildlife in the area should put heavy emphasis on this pressure from outside. Patrol and warden activities should also be centered along access routes.

Patrolling should focus on:

- stopping the pet trade in parrots.
- the prevention of disturbance and poaching on protected nesting beaches for Iguana's and Crocodiles.
- the prevention of hunting during closed seasons.
- the prevention of hunting in areas closed for hunting.
- the protection of bird colonies.

- the prevention of deliberate burning of the savannas.
- any activity that could affect the environment.

Gillnetting activities need to be controlled, as research and monitoring in nearby Port Honduras has proven beyond a doubt their propensity for diminishing fish populations (Heyman, pers.comm.).

The crocodile population in Payne's Creek should be protected from too intensive touristic attention.

The current habit of placing lobster traps to soak in the mangroves just below nesting and/or roosting birds on Little Monkey Caye should be discouraged.

Research

Mainly the crocodile survey and the fish surveys suffered from the high water conditions encountered during the present Biodiversity study. A repeat of the current study during the dry season from February through May, focussing on these two groups would undoubtedly improve the amount of base line data for these groups. Surveys during the winter months would add many migratory birds to the list.

A survey of the Crocodiles of Payne's Creek is deemed essential for the management and conservation of this population. Again, this survey should take place during the dry season. Off all possible studies in the area this crocodile study has highest priority.

Detailed studies should be undertaken of the sequential nesting aspect of Little Monkey Caye. Numbers of nests, times of nesting activities for each species, rate of success of broods, and degree of interaction between species are some of the data needed.

Research should be attempted to establish reproductive seasons in certain game species. Results of such a survey could be used in the management of these game species.

Tourism.

The presence of a coral reef so close to Monkey River Village constitutes a considerable bonus to the attractiveness of the area to ecotourism. However, it is in such a degraded condition that it will eventually become unable to support even the marginal life that it currently does. Tourguides and other people in Monkey River with an interest in tourism should be made aware of this potential faith of this important asset.

The current tourist trails on the south side of the River may not cover the needs of all tourists. These old hunting trails may be too difficult for people not used to walking in the jungle.
Most of these trails also lack any "direction". Development of these trails should focus on any attractions, no matter how small, that can be found along the trails. Such attractions could also include old habitation sites and the signs left by users of the area (such as dorey-making but also buttress roots, cut to supply bowls and trays).
The forest north of the Road, is higher and dryer than the majority of the forest south of the river. This area would be very attractive for tourist trails. There is also easy access from the road. We highly recommend constructing some trails in this area.

An effort should be spearheaded by APMR to distribute tourguide licensing information to aspiring (or practicing) tourguides in the Village. This should facilitate use of these guide's services.

A small monochrome directory of Monkey River's tourguides could be produced. These can be distributed by BTB and (with purchased membership by APMR) in BTIA at international trade shows, if desired.

The turn-off from the Southern Highway to Monkey River should be sign posted. Existing tourist interests (Hotel, Tourguides) could join forces and invest in this small project.

There exists a useful guide to promotion of community based ecotourism projects (Pedersen, 1995).

Literature.

Aguilar,J.M.C. 1994. Guia practica para los Arboles mas comunes de Tikal, Peten, Guatemala. Centro de Estudios Conservacionistas, Guatemala.

Ames,O. & D.S.Correll. 1985. Orchids of Guatemala and Belize. (Reprint). General Publishing Company, Toronto. 779 pp.

Arita,H.T., Robinson,J.G. & K.H.Redford. 1990. Rarity in Neotropical Forest Mammals and its ecological correlates. Conservation Biology 4(2): 181-192.

Augusta,C. 1994. Fishes of the Manatee Special Development Area. Unpubl.ms. 21 pp + maps.

BCES. 1992. Management plan, Monkey River Special Development Area, Belize Center for Environmental Studies. Submitted to USAID.

Belle,J. 1992. Studies on ultimate instar larvae of neotropical Gomphidae, with the descrition of *Tibiagomphus* gen.nov. (Anisoptera). Odonatologica 21(1):1-24.

Bick,G.H. & J.C.Bick. 1995. A review of the genus *Telebasis*, with description of eight new species (Zygoptera:Coenagrionidae). Odonatologica 24(1): 11-44

Bildstein,K.L., G.T.Bancroft, P.J.Dugan, D.H.Gordon, R.M.Erwin, E.Nol, L.X.Payne & S.E.Senner. 1991. Approaches to the conservation of coastal wetlands in the Western Hemisphere. Wils.Bull. 103(2): 218-254.

Boomsma,T. 1993. Dragonflies and damselflies of the Shipstern Reserve. Occasional Papers of the Belize Natural History Society Vol. 2: pp 54-58.

Boomsma,T. 1994. Odonata. In: The Nature Conservancy. 1994. Bladen Nature Reserve, a rapid ecological assessment.

Boomsma,T. and S.W. Dunkle. In press. Odonata of Belize. Odonatologica.

Boomsma,T. & G.J.Measey. 1992. Cockscomb Basin Wildlife Sanctuary, Lepidoptera & Odonata Survey, January 1992. Unpubl. report. 29 pp.

Boomsma,T. & J.C.Meerman. 1993. Butterflies of Caracol. Unp. report. 12 pp.

Borror,D.J. 1942. A revision of the Libelluline genus *Erythrodiplax* (Odonata). Contr. in Zool. and Ent. Ohio State Univ. No. 4: XV + 286 pp.

Brokaw,N.V.L. & Mallory, E.P. & P.W.Alcorn. 1990. Trees of Rio Bravo. Programme For Belize, Belize City. 234 pp + appendix.

Brown,J. 1990. Manakins--snap, crackle, pop. In: Horwich,R. & J.Lyon (eds). A Belizean Rain Forest Orang Utan Press, Gays Mills, WI. pp 255-258.

Brown,jr. K.S. 1991. Insects as indicators. In: Collins,N.M. & J.A.Thomas (eds.) The conservation of insects and their habitats. Academic press, London. 350-404.

Calvert,P.P. 1908. Odonata. Biologia Cent.-am. (Neuroptera), pp. 17-420.

Campbell,J.A. & J.P.Vannini. 1989. Distribution of amphibians and reptiles in Guatemala and Belize. Proceedings of the Western Foundation of Vertebrate Zoology 4(1):0-21.

Catling,P.M. & V.R. Catling. 1988. Lista Comentada de las Orquideas de Belice. Orquidea (Mex.) 11:63-102.

Coffey jr.,B.B. & L.Coffey. Songs of Mexican Birds, Tinamous through Wrens (Tape).

Colin,P.L. 1978. Caribbean Reef Invertebrates and plants. TFH Publications, Neptune City, NJ. 512 pp.

Croat,T.B. 1978. Flora of Barro Colorado Island. Stanford University Press, Stanford. 943 pp.

D'Abrera,B. 1981. Butterflies of the neotropical region. Part I. E.W.Classey, Faringdon. 172 pp.

D'Abrera,B. 1984. Butterflies of the neotropical region. part II. Hill House, Ferny Creek. Pp. 174-384.

D'Abrera,B. 1988. Butterflies of the neotropical region. Part V. Hill House, Black Rock. Pp. 680-877.

D'Abrera,B. 1987. Butterflies of the neotropical region. Part III. Hill House, Black Rock. Pp. 386-525.

D'Abrera,B. 1987. Butterflies of the Neotropical region. Part IV. Hill House, Black Rock. Pp 528-678.

D'Abrera,B. 1994. Butterflies of the neotropical region. Part VI. Hill House, Black Rock. Pp. 878-1096.

Davis,F.L. 1928. Notes on the Butterflies of British Honduras. Old Royalty Book Publishers, London. 102 pp.

DeVries,P.J. 1987. The Butterflies of Costa Rica. Princeton University Press. Princeton NJ. 327 pp.

Donnelly,T.W. 1965. A new species of *Ischnura* from Guatemala, with revisionary notes on related North and Central American Damselflies (Odonata: Coenagrionidae). Florida Entomologist 48(1): 57-63.

Dwyer,D. & D.L.Spellman. 1981. A list of Dicotyledoneae of Belize. Rhodora 83(834): 161-236.

Emmons,K.M. & TJ.McCarthy (In Press). Other Mammals of the Cockscomb Basin. In: Cockscomb Basin Wildlife Sanctuary. Producciones de la Hamaca/ Orang-Utan Press. Caye Caulker, Belize & Gay Mills, WI, USA.

FAO, 1977. Fish Identification sheets. Crinidae, Blennidae, Clinidae, Clupeidae, Engraulididae, Gobiidae, Sequindae.

Fincke,O.M. 1992. Behavioural ecology of the Giant Damselflies of Barro Colarado Island, Panama in: D. Quintero and A. Aiello, *Insects of Panama and Mesoamerica*. Oxford University Press, Oxford. pp 102-113.

Fragoso,J.M.V. 1991. The effects of hunting on Tapirs in Belize. In: Robinson, J.G. & K.H.Redford (eds.). 1991. Neotropical wildlife use and conservation. University of Chicago Press, Chicago. pp. 154-162.

Garcia,J., S.Matola, M.Meadows & C.Wright. 1994. A Checklist of the Birds of Belize. World Wildlife Fund US. 35 pp.

Garrison,R.W. 1994. *Telebasis boomsmae* spec. nov., a new damselfly from Belize (Zygoptera: Coenagrionidae). Odonatologica 23(3): 277-282.

Garrison,R.W. 1994. A synopsis of the genus *Argia* of the United States with keys and descriptions of new species, *Argia sabino, A. leonorae,* and *A. pima* (Odonata:Coenagrionidae). Trans. of the Am. Ent. Soc. 120 No. 4, pp. 287-368.

Gonzalez-Soriano,E. 1992. *Protoneura rojiza* spec. nov., a new damselfly from Mexico (Zygopter: Protoneuridae). Odonatologica 21(4): 489-493.

Greenfield,D.W. & Thomerson. A guide to the inland fishes of Belize. Draft unpubl.ms. 82 pp.

Hall,M. 1994. Assessment of the potential risks from agriculture on the coastal area of the Stann Creek District. Master thesis. Imperial College of science, technology and medicine. Centre for environmental technology, University of London.

Hartshorn,G., L.Nicolait, L.Hartshorn, G.Bevier, R.Brightman, J.Cal, A.Cawich, W.Davidson, R.DuBois, C.Dyer, J.Gibson, W.Hawley, J.Leonard, R.Nicolait, D.Weyer, H.White, C.Wright.

1984. Belize Country Environmental Profile. Robert Nicolait & Associates Ltd., Belize City, Belize. 151 pp.

Henderson,R.W. & L.G.Hoevers. 1975. A Checklist and key to the Amphibians and Reptiles of Belize, Central America. Milwaukee Public Museum, Contributions in Biology and Geology Nr. 5. 63pp.

Heyer,W.R.,Donnely,M.A., McDiarmid,R.W., Hayek,L.C. & M.S.Foster (Eds.) 1994. Measuring and Monitoring Biological Diversity, Standard Methods for Amphibians. Smithsonian Institution Press, Washington. 364 pp.
Hodgson,G. 1993. Sedimentation damage to reef corals in Global Aspects of Coral reefs- Health, hazard and history. June 10th and 11th, 1993. University of Miami, Rosentiel School of Marine and Atmospheric Science.

Horwich,R.H., Koontz,F., Saqui,E., Saqui,H., Pop,E., Silver,S., Ostro,L. & J.Lumb. (in press). Reintroduction of Black Howler Monkeys into the Cockscomb Basin. In: Cockscomb Basin Wildlife Sanctuary. Producciones de la Hamaca/ Orang-Utan Press. Caye Caulker, Belize & Gay Mills, WI, USA.

Horwich,R.H. & J.Lyon. 1990. A Belizean Rain Forest. Orang-utan Press, Gay Mills, Wisconsin. 420 pp.

Howell,S.N.G. & S.Webb. 1995. A guide to the birds of Mexico and Northern Central America. Oxford University Press. 851 pp.

Humann,P. & N.DeLoach. 1992. Reef Creature Identification. Vaughan Press, Orlando FL. 320 pp.

Iremonger,S. & N.Brokaw. 1995. Vegetation classification for Belize. Report, Programme For Belize. 20 pp.

Janzen,D.H. 1982. Guia para la identificacion de mariposas nocturnas de la familia Saturnidae del Parque Nacional Santa Rosa, Guanacaste, Costa Rica. Brenesia 19/20:255-299.

Kaplan,E.H. (Ed.) 1988. Southeastern and Caribbean Seashores. Peterson Field Guide Series, Houghton Mifflin, Boston. 425 pp.

Killip,E.P. 1936. Passifloraceae of the Mayan region. Carnegie Inst. Washington Pub. 461. Maya Botany: Miscellaneous papers XIII: 299-328

King,R.B., I.C.Baillie, P.G.Bissett, R.J.Grimble, M.S.Johnson & G.L.Silva. 1986. Land resource survey of Toledo district, Belize. Land Resources Development Centre, Surbiton, England. 63 pp. 125 pp. appendixes + maps.

King,R.B., J.B.Pratt, M.P.Warner & S.A.Zisman. 1993. Agricultural development prospects in Belize. NRI Bulletin 48. 159 pp.

King,R.B., I.C.Baille, J.R.Dunsmore, R.J.Grimble, M.S.Johnson, J.B.Williams & A.C.S.Wright. 1989. Land resource assessment of Stann Creek district, Belize. ODNRI bulletin. 262 pp + maps.

Lee,M.D., J.D.Stednick & D.M.Gilbert. 1995. Environmental water quality monitoring program. Draft report to NARMAP/USAID/GOB.

Lemaire,C. 1973. Revision du genre Automeris Hubner et des genres voisins. Biogeographie, ethologie, morphologie, taxonomie (lep. Attacidae). Mem. Mus. Nat. d'Hist. Nat. 422 pp + 49 pl.

Marshall,J.W. 1995. Dory mekkin di fade weh. School for International Training Report. 40 pp.

May,M.L. The *Lestes* of Mexico and Central America, manuscript.

May.M.L. 1979. Lista preliminar de nombre y clava para identificar los Odonata (Caballitos) de la Isla de Barro Colorado. Cuadernos de Ciencias No. 1, Smithsonian Tropical Research Inst. and La Editorial Universitaria, Panama. Pp. 1-52.

McRae,E. (in press). Birds. In: Dotherow,M. (ed.) The state of the coastal zone of Belize. BCZMU.

Meerman,J.C. 1992. The Status of crocodiles in the eastern Corozal district. Occasional Papers of the Belize Natural History Society 1(1): 1-5.

Meerman,J.C. 1992. Lepidoptera of Las Quevas and Puente Natural, Chiquibul forest, Cayo district, Belize; 13-19 July 1992. Unpublished report. 8 pp.

Meerman,J.C. 1993. Fish of the Shipstern Nature Reserve. Occasional Papers of the Belize Natural History Society. 2(8): 61-64.

Meerman,J.C. Crocodiles. State of the Coastal Zone Report. GEF/UNDP Coastal Zone Management Project - Belize. In Press.

Meerman,J.C. Checklist - herpetology of Belize. In: Belize Country Environmental Profile. In press.

Meerman,J.C. & T.Boomsma. 1992. Lepidoptera of the Macal river between Kinloch's camp and the Guacamallo bridge. In: B.W.Miller (ed.) Prelimimary report for Belize Electricity Board hydro-electric project enviromental impact assessment. pp. 19-31.

Meerman,J.C. & T.Boomsma. 1993. Biodiversity of the Shipstern Nature Reserve. Occasional Papers of the Belize Natural History Society. 2(1-11): 1-85.

Meerman,J.C. & T.Boomsma. 1993. Butterflies of the Hidden Valley Inn area. Unpublished report. 6pp.

Meerman,J.C. & T.Boomsma, 1994. Biological survey, Tapir Mountain Nature Reserve, Cayo District, Belize. Belize Tropical Forest Studies Publication #1. 27 pp.

Meerman,J.C. & T.Boomsma. 1994. Upper Mullins river basin environmental review. Forest Management and Planning Programme. Internal Report Series vol. 7,#03. 16 pp.

Meerman,J.C. & G.Williams. (1995). The January-February 1995 Maya Mountains Divide Expedition. Belize Tropical Forest Studies Publication #3. 45 pp. 7 App.

Meyer,J.R. 1993. Calls of Common Belizean Frogs and Toads. Privately produced tape.

Meyer,J.R. & C.Farneti Foster. A guide to the frogs and toads of Belize. In Press.

Mickel,J.T. 1979. How to know the ferns and fern allies. Wm. C. Brown Company Publishers, Dubuque, Iowa. 229 pp.

Mol,D. 1986. The distribution, status, and level of exploitation of the freshwater turtle *Dermatemys mawei* in Belize, Central America. Biological Conservation 35: 87-96.

Murphy,S.D. 1980. Pesticides. In: Doull,J., C.D.Klaassen & M.O.Amdur.(eds.) Toxicology, the basic science of poisons. MacMillan Pub. NY. pp 357-408.

Ohlendorf,H.M., R.L.Hothem & D.Welsh. 1991. Nest success, cause specific failure and hatchability of aquatic birds and Selenium contaminated Kesterson reservoir. Condor. 91(4): 787-796.

Pedersen,A. 1995. Promotion of community-based ecotourism in the Maya Forest. Management Systems International. 104 pp.

Peterson,R.T. & E.L.Chalif. 1973. A field guide to Mexican birds. Peterson Field Guide Series, Houghton Mifflin Co. 298 pp.

Rabinowitz,A.R. & B.G.Nottingham. 1986. Ecology and behaviour of the Jaguar (Panthera onca) in Belize, Central America. Journal of Zoology 210: 149-159.

Reed,J.M. 1989. A system for ranking conservation priorities for Neotropical migrant birds based on relative susceptibility to extinction. Proc.Manomet Symp.Neotr.Migr.Birds. pp 524-536.

Ris,F. 1930. A revision of the libelluline genus *Perithemis* (Odonata). Misc. Publ. Mus. Zool. Univ. Michigan, No. 21:1-50, 7 pl.

Rivero,R.E. 1994. Preliminary survey of Ferns and Epiphytes of Manatee Forest Reserve, Stan Creek, Belize. Forest Management and Planning publications. 11 pp.

Roosmalen,M.G.M. van. 1985. Fruits of the Guianan Flora. Institute of Systematic Botany Utrecht University, Utrecht. 483 pp.

Robins,C. et al. 1990. Informal Report to participants: Use of forest and angricultural habitats by birds wintering in Belize. Jan-Feb. 1990. 15 pp.

Robins,C., B.Bruun & H.S.Zim. 1966. The birds of North America. Golden Press. Western Press NY. 340 pp.

Robinson,J.V. and B.L. Frye. 1986. Survivorship, mating and activity pattern of adult *Telebasis salva* (Hagen) (Zygoptera:Coenagrionidae). *Odonatologica* 15(2): 211-217.

Robinson,J.G. & K.H.Redford. 1991. Sustainable harvest of Neotropical Forest Animals. In: Robinson, J.G. & K.H.Redford (eds.). 1991. Neotropical wildlife use and conservation. University of Chicago Press, Chicago. pp. 415-429.

Ross,G.N. 1964. An annotated list of Butterflies collected in British Honduras in 1961. Journal of the Lepidopterists' Society 18(1): 11-26.

Sauer,J.R. & S.Droege. 1989. Geographic patterns in population trends of Neotropical migrants in North America. Proc.Manomet Symp.Neotr.Migr.Birds. pp. 26-42.

Smith,G.W., K.L.Eckert & J.P.Gibson. 1992. WIDECAST sea turtle recovery action plan for Belize. CEP Technical report no. 18. UNEP Caribbean Environment Programme, Kingston, Jamaica. 86 pp.

Smith,N.G. 1992. Reproductive behaviour and ecology of *Urania (Lepidoptera: Uraniidae)* moths and of their larval food plants, *Omphalea spp. (Euphorbiaceae)*. In: Quintero,D. & A.Aiello (eds.). Insects of Panama and Mesoamerica. Oxford University Press. Oxford. 692 pp.

Stokes,J. 1980. Handguide to the Coral Reef Fishes of the Caribbean. W.M.Collins & Sons Ltd. Singapore. 160 pp.

Strahler,A.N. & A.H.Strahler. 1978. Modern Physical Geography. John Wiley & Sons. NY. 502 pp.

Stuart,L.C. 1963. A Checklist of the Herpetofauna of Guatemala. Misc. Publ. Mus. Zool., Univ. Michigan # 122. 150 pp.

Survey Department, Belize. 1952. Provisional sheet #27.

Terwilliger,V.J. 1978. Natural History of Baird's Tapir on Barro Colorado Island, Panama Canal Zone. Biotropica 10(3): 211-220.

Tyler,H., K.S.Brown & K.Wilson, 1994. Swallowtail Butterflies of the Americas. Scientific publishers, Gainesville, Florida, USA. 376 pp.

Usher,W. & E.Pulver. 1994. Evaluation of pesticide and fertilizer usage in bananas and potential risk to the environment. NARMAP 92 pp.

Warmke & R.T.Abbot. 1961. Caribbean Seashells. Dover Publications NY. 348 pp.

Werner,D.I. 1991. The rational use of Green Iguanas. In: Robinson,J.G. & K.H.Redford (eds.). 1991. Neotropical wildlife use and conservation. University of Chicago Press, Chicago. pp. 181-201.

Williams,M.L., R.L.Hothem & H.M.Ohlendorf. 1991. Recruitment failure in American Avocets and Black-necked Stilts nesting in Kesterson Reservoir, California. 1984-5. Condor 91(4): 797-802.

Williams,C.B. 1930. The migration of butterflies. Oliver & Boyd, Edinburgh & London. xi+473 pp.

Williamson,E.B., 1923. Notes on the genus *Erythemis*. With a description of a new species (Odonata). Misc. Publ. Mus. Zool. Univ. Mich. No. 11: 1-22, 1 pl.

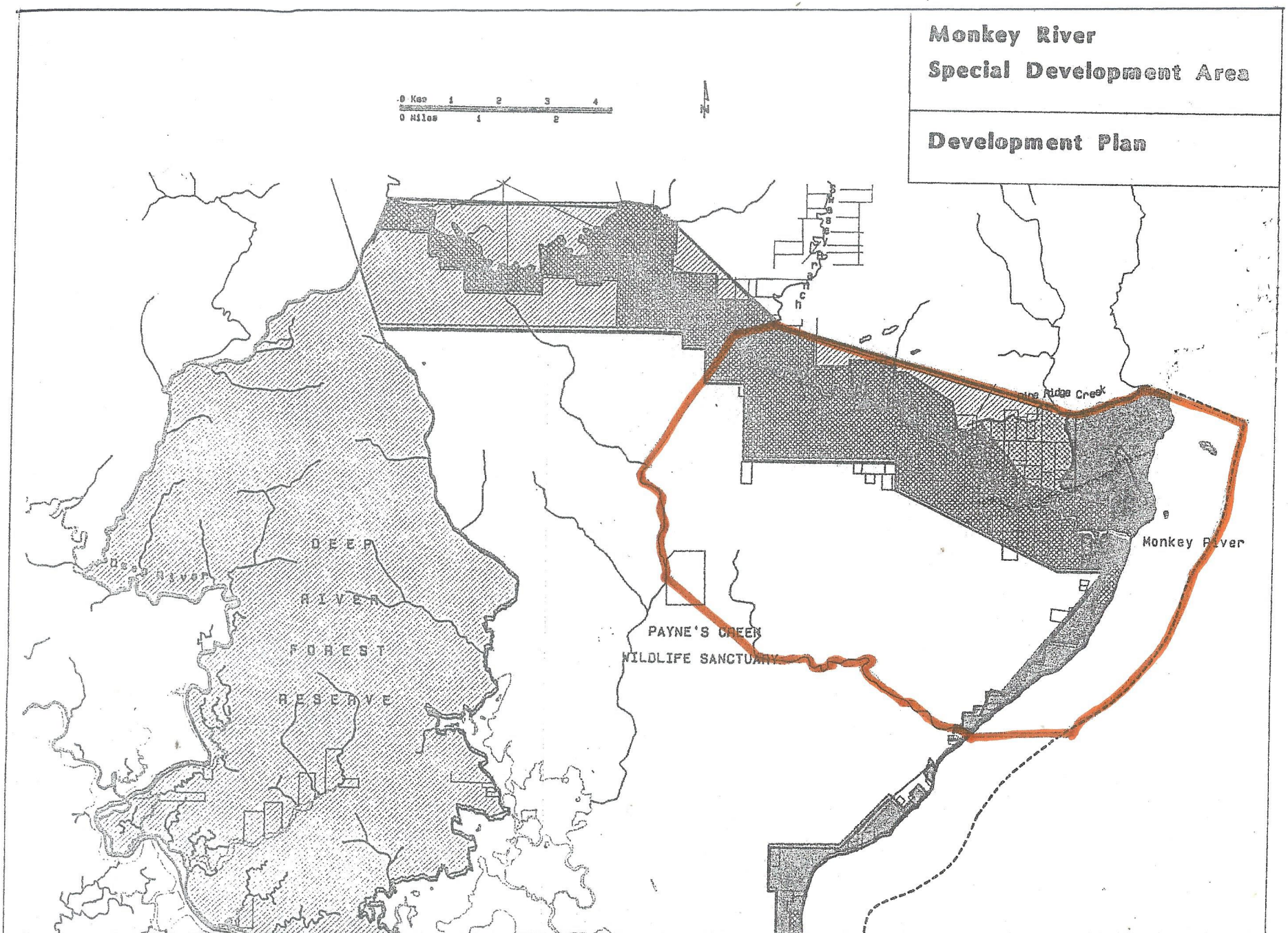
Williamson,E.B. 1923. Notes of American species of *Triacanthagyna* and *Gynacantha*. Mus.Zool.Michigan. Misc.Publ. 9. 80 pp.

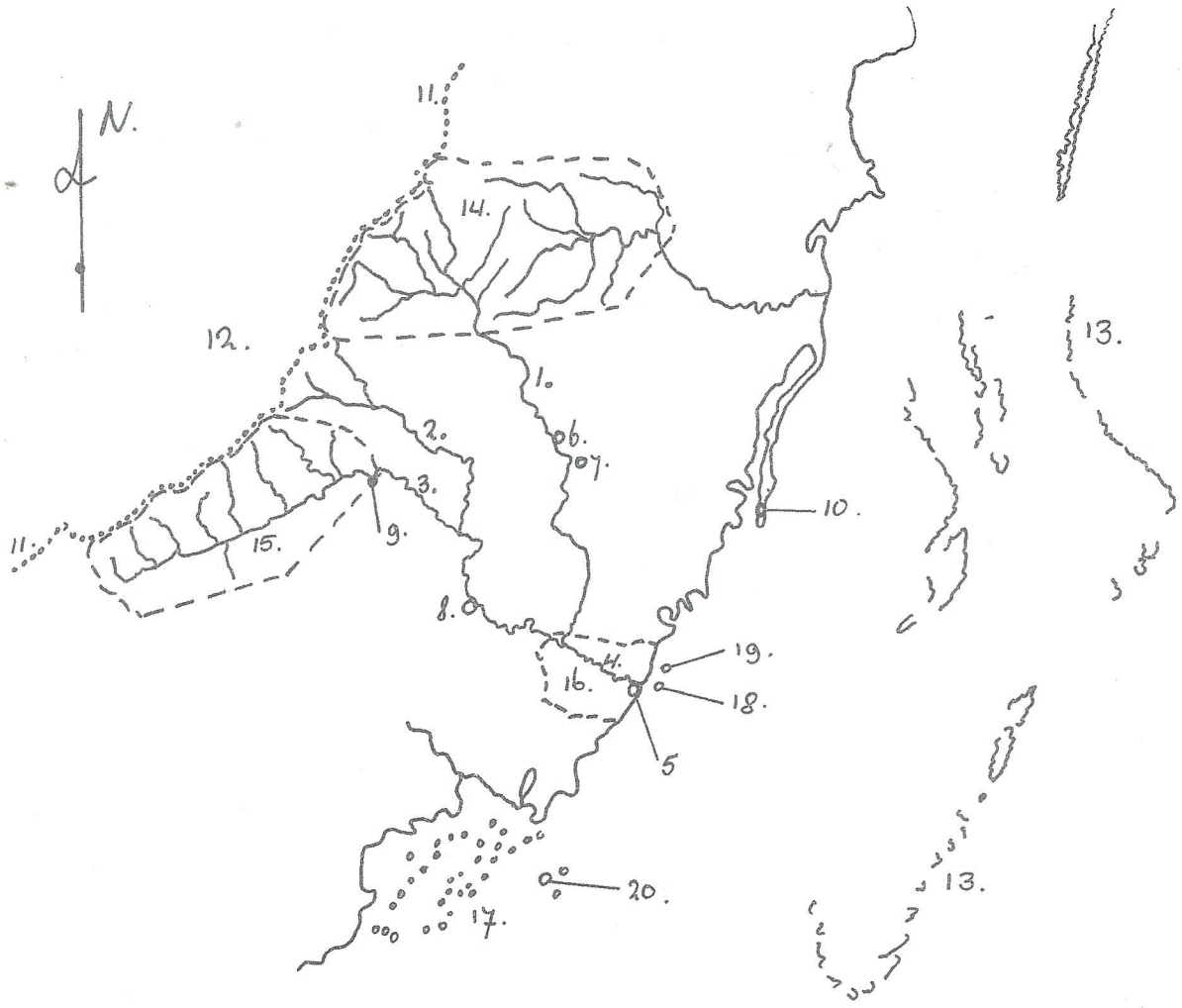
Wright,A.C.S., D.H.Romney, R.H.Arbuckle & V.E.Vial. 1959. Land in British Honduras. Colonial Res.Publ. No 24. Her Majesty's Stationary Office, London. 327 pp. + maps.

Wynne,A. 1995. A census and survey of research on the Black Howler Monkey (Alouatta pigra). School for International Training Report. 29 pp.

Appendix 1.

List of maps.

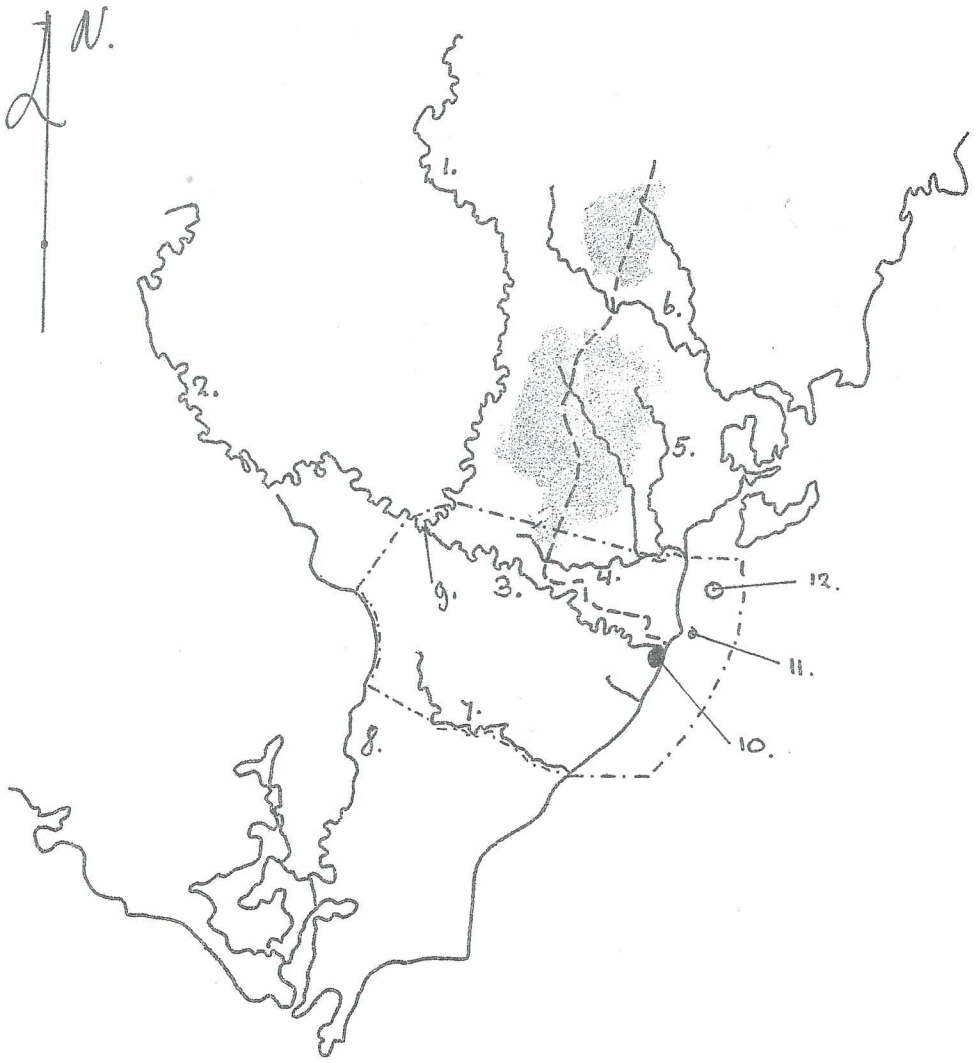

Monkey River
Special Development Area
Development Plan
0 Kms 1 2 3 4
0 Miles 1 2
N
DEEP
RIVER
FOREST
RESERVE
Deep River
PAYNE'S CREEK
WILDLIFE SANCTUARY
Monkey River



Map 2. The watershed of the Monkey River; showing its main tributaries.

Scale 1:750,000

1 Swasey Branch
2 Trio
3 Bladen Branch
4 Monkey River
5 Monkey River village
6 Red Bank
7 Cow Pen
8 Melvin's Bank
9 First Hill
10 Placencia
11 Main Divide
12 Maya Mountains
13 Barrier Reef
14 Cockscomb Basin Wildlife Sanctuary
15 Bladen Nature Reserve
16 Monkey River Special Development Area 1991
17 Port Honduras
18 Little Monkey Caye
19 Great Monkey Caye
20 West Snake Caye



Map 3. The watershed of the Pine Ridge Creek in relation to the Monkey River Special Development Area (1991).

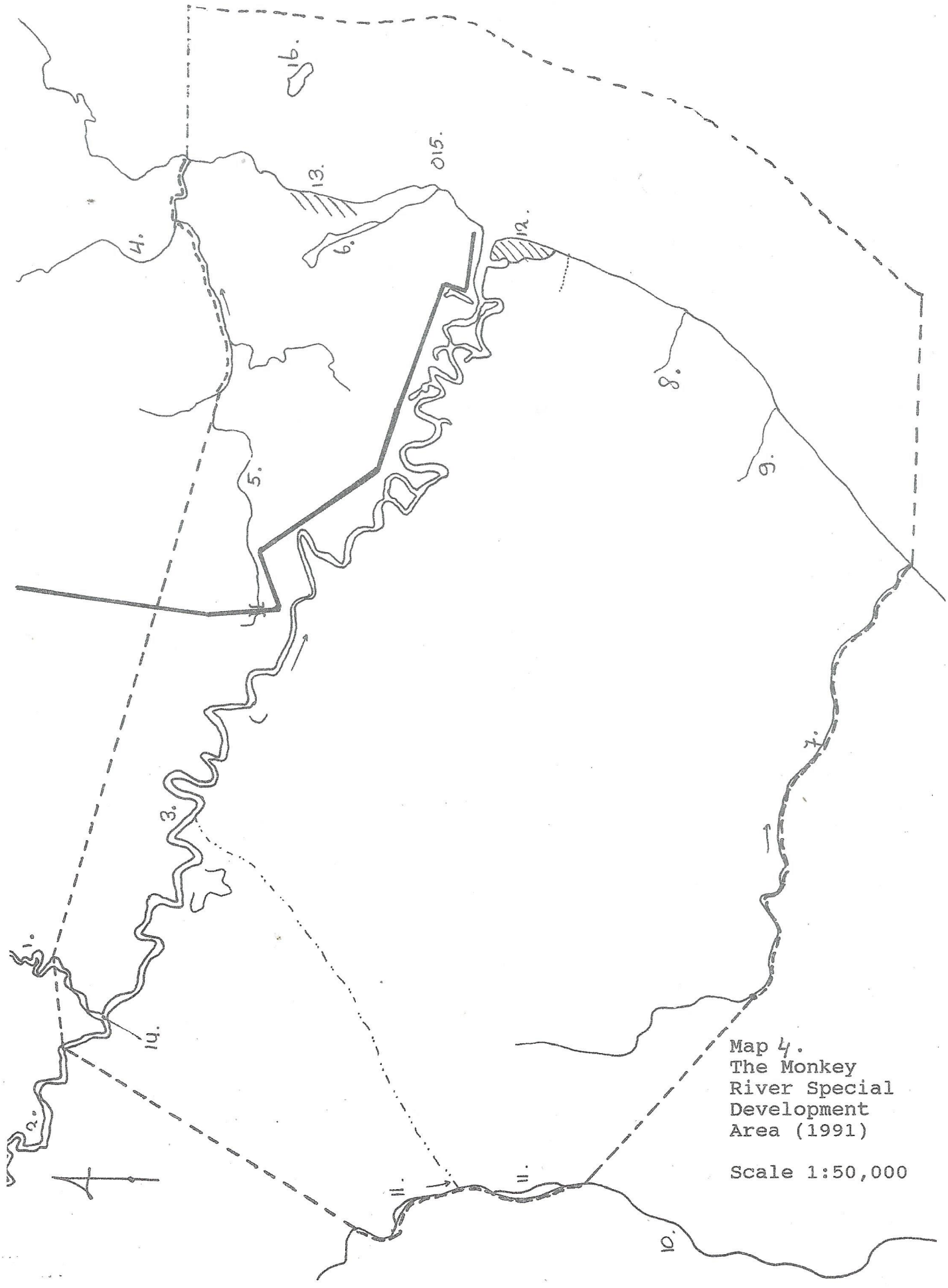
Scale 1:250,000

1 Swasey Branch
2 Bladen Branch
3 Monkey River
4 Forest Creek
5 Pine Ridge Creek
6 Sennis Creek
7 Guanacaste Creek
8 Payne's Creek
9 Branch Mouth
10 Monkey River village
11 Little Monkey Caye
12 Great Monkey Caye

------ road

-.-.-.-.- MRSDA 1991

Toledo Citrus Company



Map 4.
The Monkey River Special Development Area (1991)

Scale 1:50,000

Key to map 4. The Monkey River Special Development Area (1991)

Scale 1:50,000

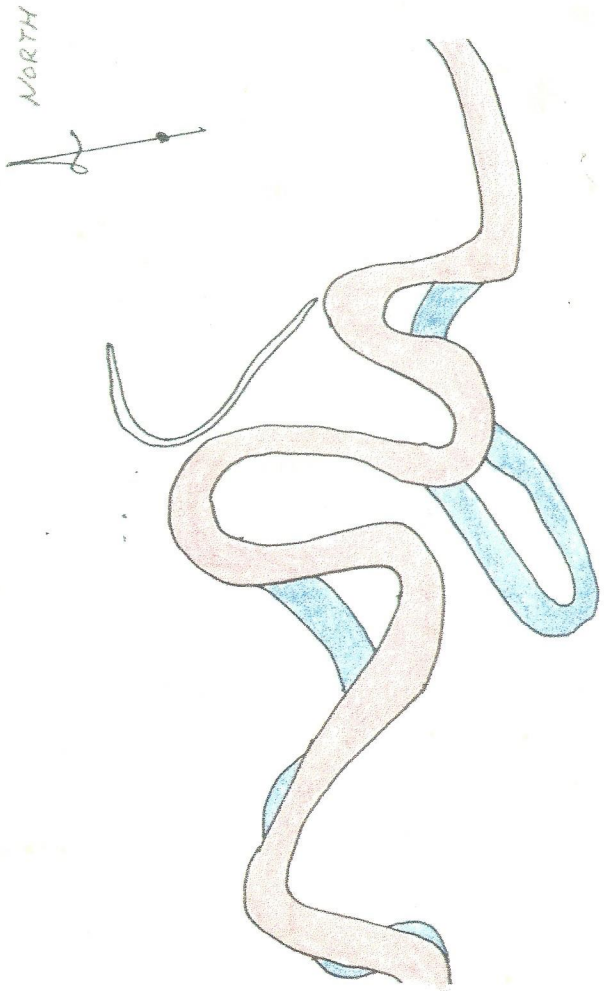
1 Swasey Branch
2 Bladen Branch
3 Monkey River
4 Pine Ridge Creek
5 Forest Creek
6 Black Creek
7 Guanacaste Creek
8 Alligator Creek
9 Tarpon Creek
10 Payne's Creek
11 Crocodile Pond in the Payne's Creek
12 Monkey River village
13 English Town
14 Branch Mouth
15 Little Monkey Caye
16 Great Monkey Caye

------- Monkey River Special Development Area (1991) boundaries

road

..... transect line cut by the Raleigh International Expedition 1995

-.-.-.-.- approx. allignment of the Payne's Creek trail

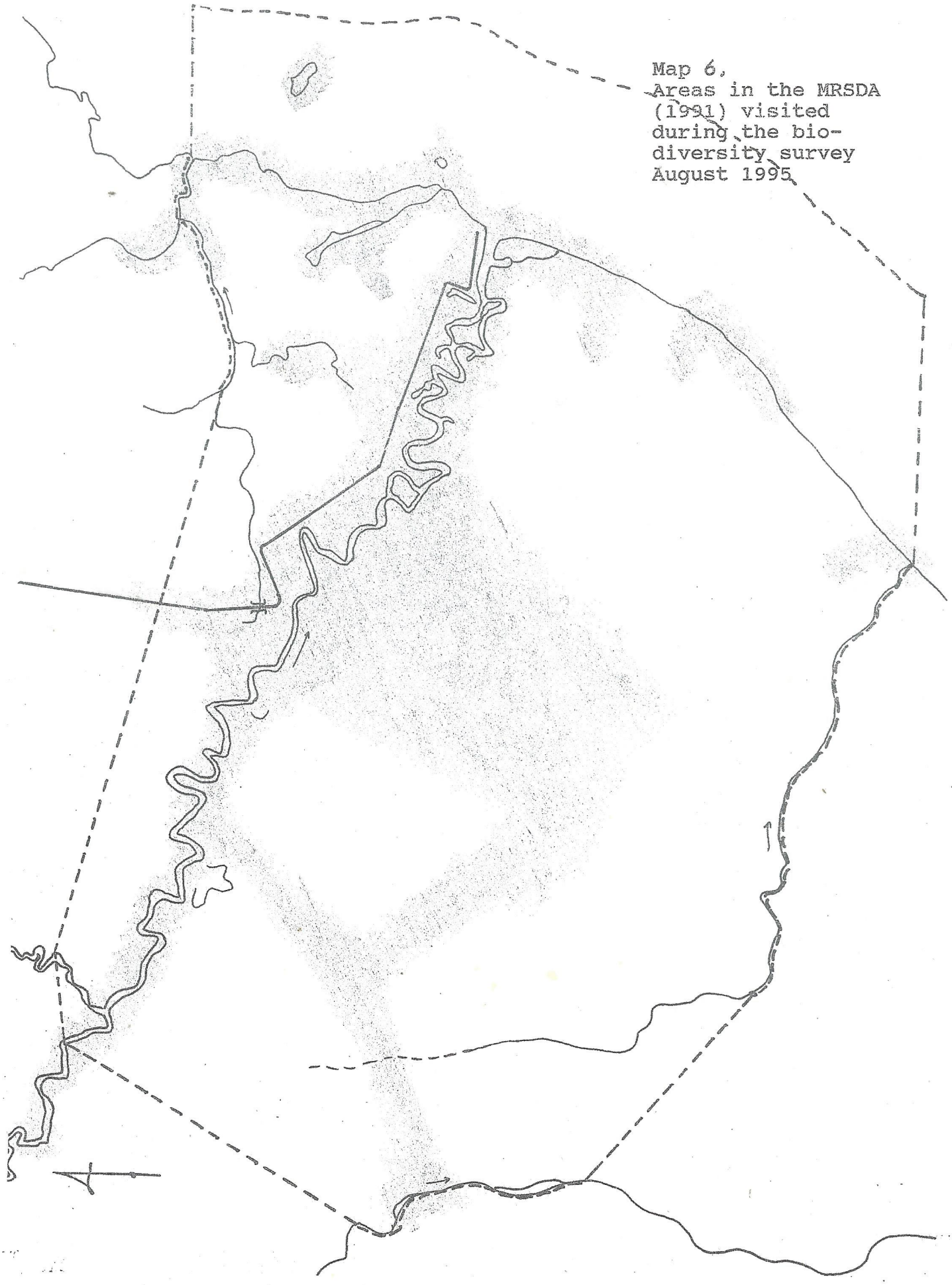


Map 5. The changes in a random section of the channel of the Monkey River 1956-1995.

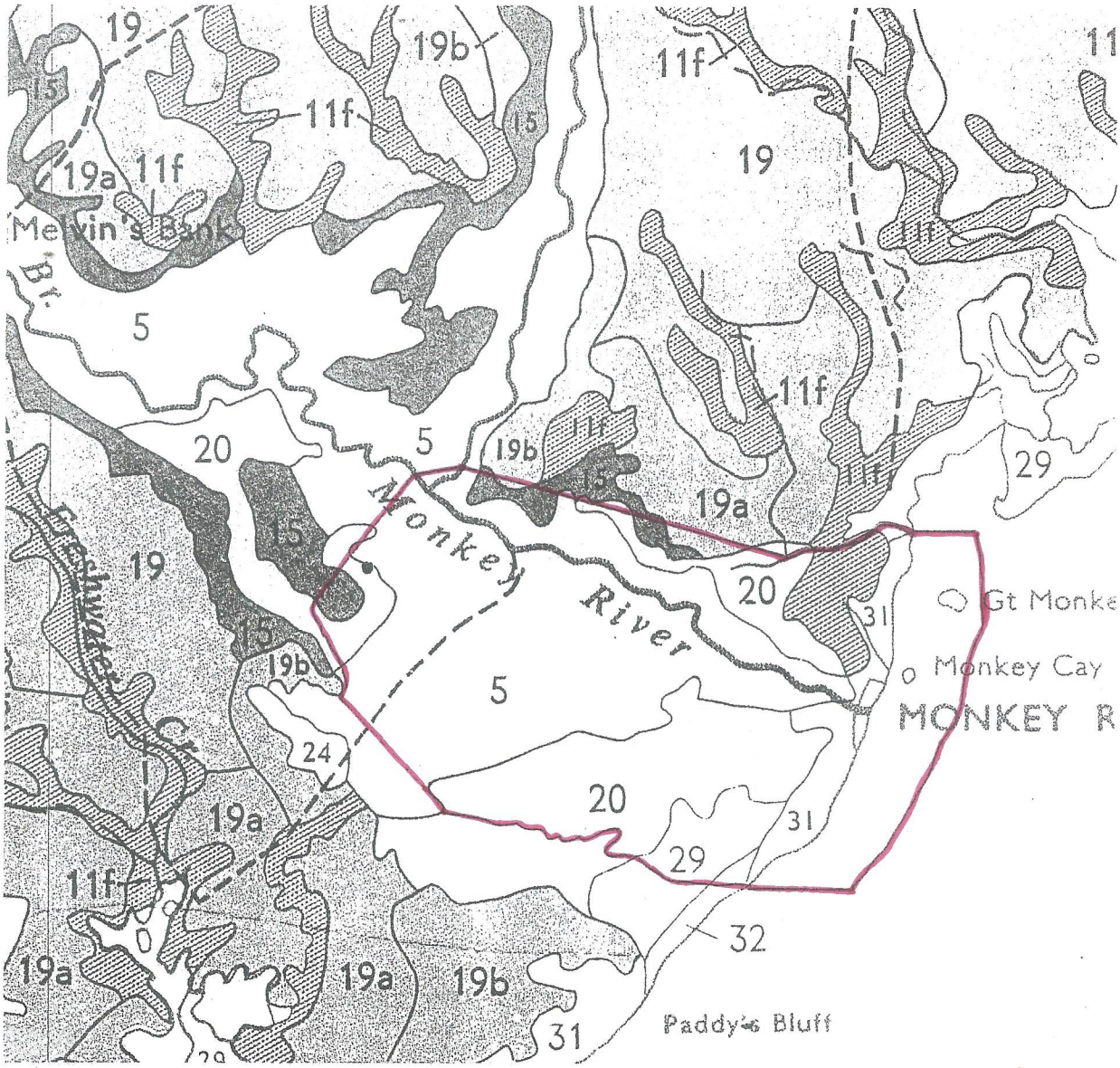
Scale approx. 1:5,000

channel according to aerial picture BH4/March 1956, sheet 043

channel according to observations during the an overflight July 1995



Map 6.
Areas in the MRSDA (1991) visited during the bio-diversity survey August 1995



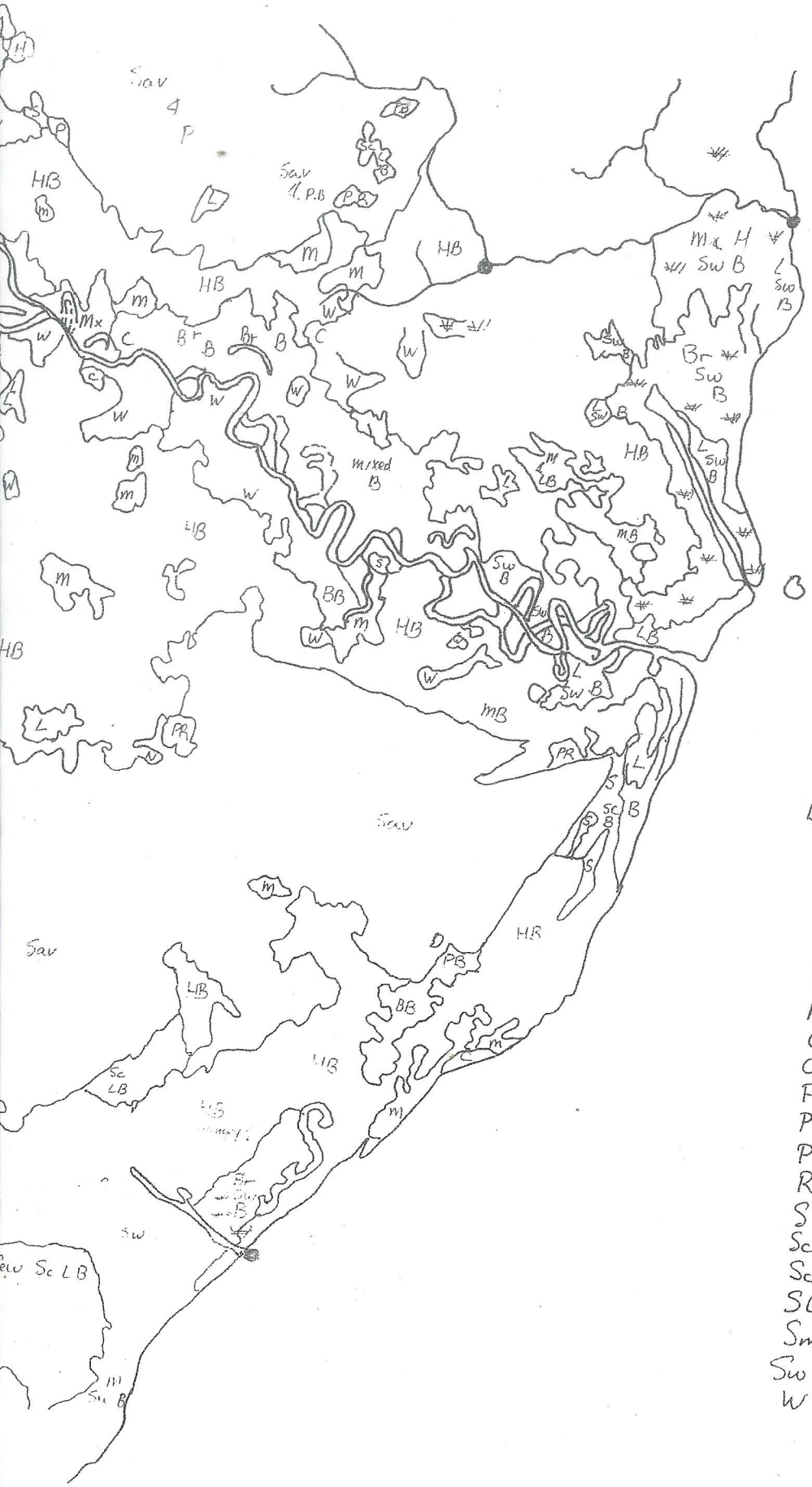
Map 7. Natural vegetation map, sheet 2 (Wright et al, 1959)

MRSDA (1991) boundary

Scale 1:50,000

Legend:

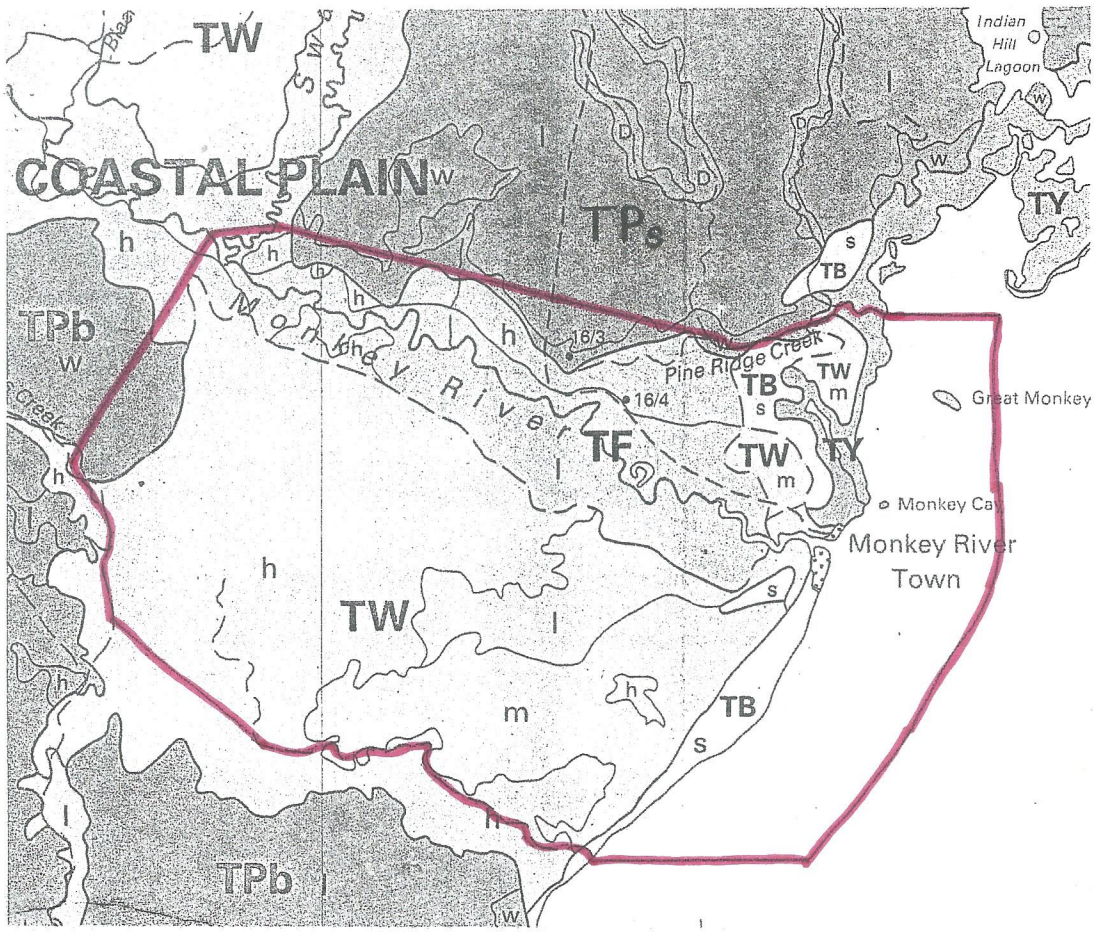
5	Cohune-Quamwood forest
11f	Negrito-Cockspur-Botan palm forest
15	Black and white maya
19a	Sedges
19b	Palmetto palm scrubs
20	Bribri-Provision Bark assemblage
29	Buttonwood-Red Mangrove-White Mangrove assemblage
31	Red Mangrove-White Mangrove association
32	Tea box-Cocoplum forest



MAP 8.
Provisional Sheet #
Survey Department - Be
1952.

SCALE N 1: 39.304

B = Bush
BB = Broken Bush.
BPR = Broken Pine Ridge
BR = Broken Ridge
C = cultivation.
H or HB = High Bush.
L or LB = Low Bush
LL = low lying
M or MB = Medium Bush
Mang = Mangrove
OB = Open Bush.
OW = Open Water.
P or Pas = Pasture
PB = Pine Bush
PR = Pine Ridge
R = Reeds
S or Sav = Savannah
Sc or Scattd = Scattered.
Scr = Scrub
Sl = Slight
Sm = Small
Sw B = Swamp Bush.
W = wamil.



Map 9. Landsystems in the Monkey Area Special Development Area (1991) (King et al, 1986)

——— Boundary Monkey River Special Development Area.

TW Toledo swamps: h,m and l.

TF Toledo Floodplains: h high floodplain bench levee
l backswamps and low levees

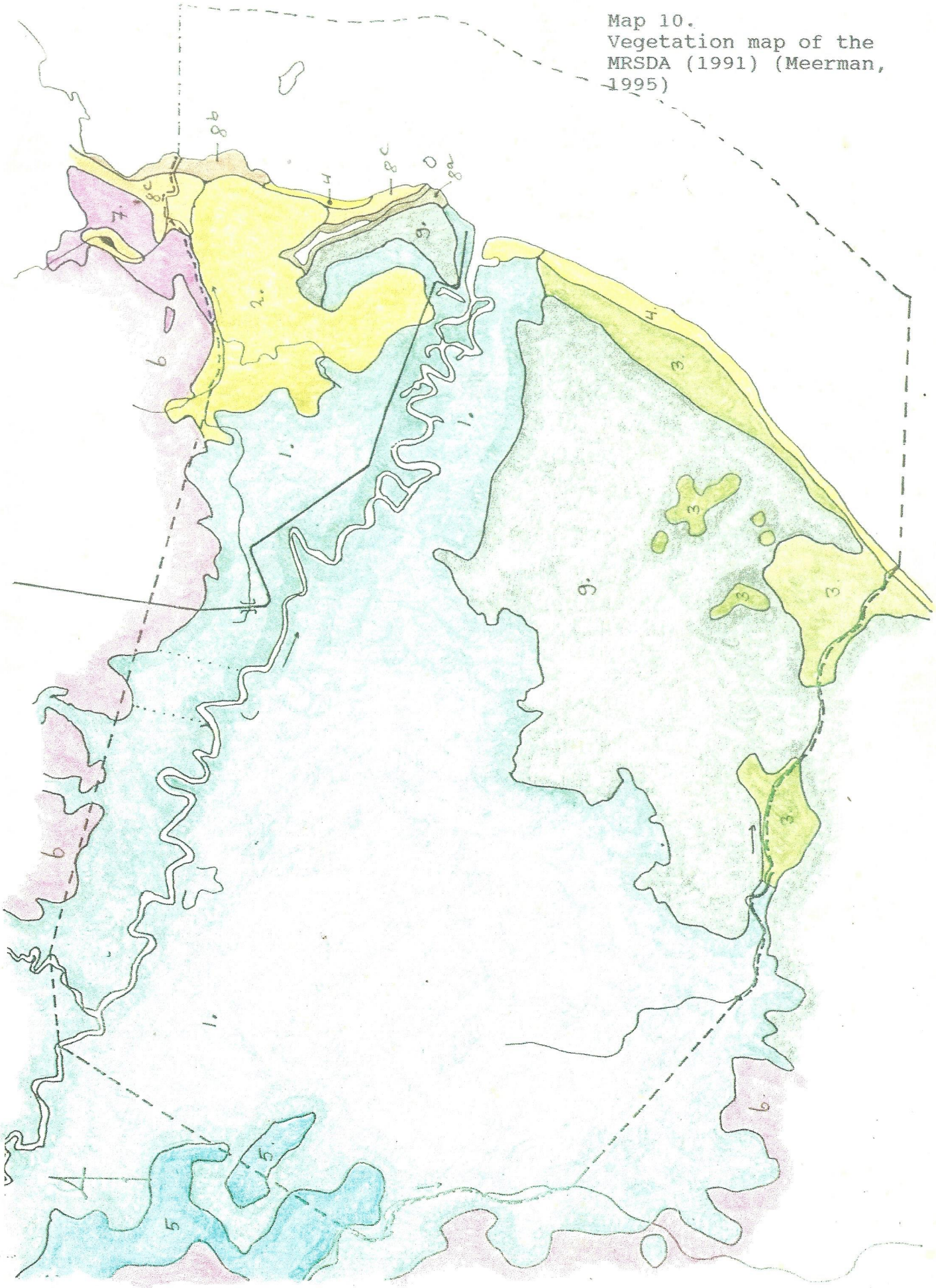
TB Toledo Strand Plain: s strand plain

TY Toledo saline swamps

TPb Puletan Plain, Bladen subsuite: w accumulation of alluvial wash

TPs Puletan Plain, Savannah subsuite: l poorly drained plain
w accumulation of alluvial wash

Map 10.
Vegetation map of the MRSDA (1991) (Meerman, 1995)



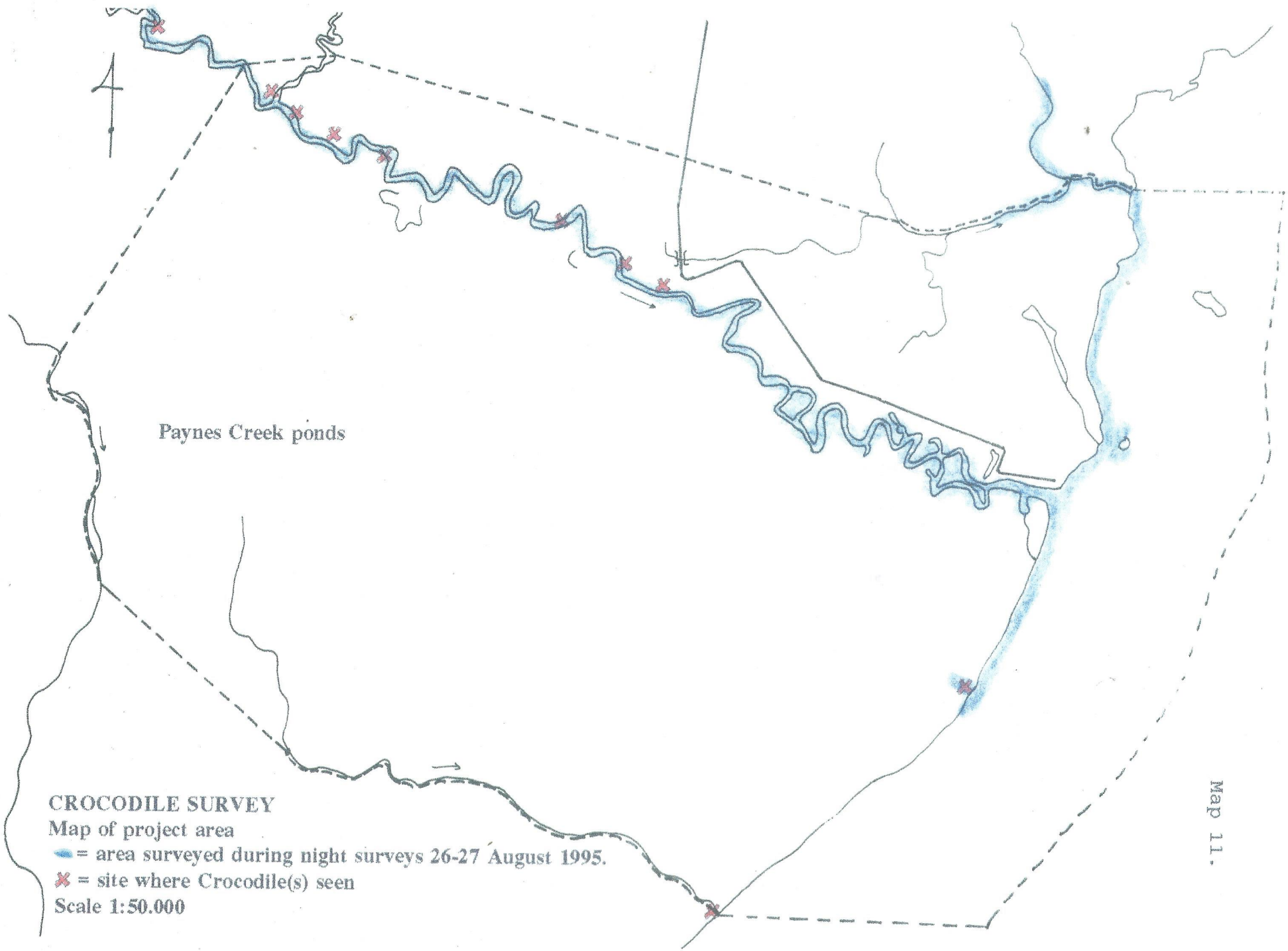
Key to map 10.

Vegetation map of the MRSDA (1991) (Meerman, 1995)

Scale 1:50,000

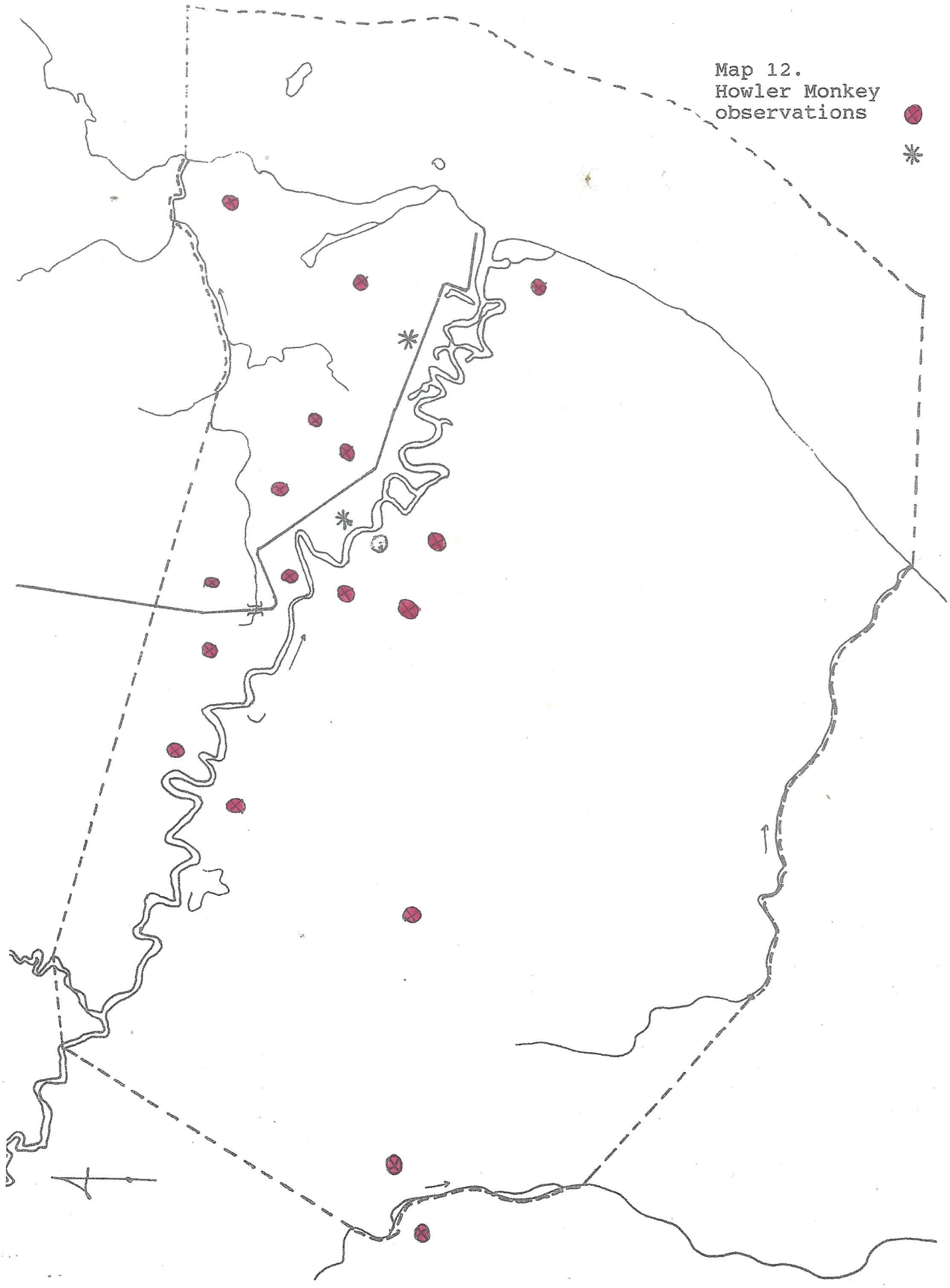
Legend:

1	Lowland Broadleaf Forest
2	Mixed Scrubland
3	Low Swamp Forest
4	Littoral Forest/Coastal Beach Sand Scrubs
5	Seasonally Waterlogged Scrubs
6	Fire-induced Shrubland of the Plains
7	Lowland Needle-leaf Moist Dense Forest over poor soils
8a	Riverine Mangrove Forest
8b	Coastal Fringe *Rhizophora mangle* dominated Forest
8c	Dwarf Mangrove Scrub
9	Wet Savanna



CROCODILE SURVEY
Map of project area
= area surveyed during night surveys 26-27 August 1995.
= site where Crocodile(s) seen
Scale 1:50.000

Map 11.


Map 12.
Howler Monkey
observations

Appendix 2.

List with pictures and figures.

Pict. 1 Monkey River village, seen from the air

Pict. 2 The beach of Monkey River village

Pict. 3 Branch Mouth, the confluence of the Swasey and the Bladen Branch

Pict. 4 The Toledo Citrus Company farm east of the Swasey Branch

Pict. 5 The position of the channel of the Monkey River in 1956

Pict. 6 The position of the channel of the Monkey River in 1995

Pict. 7 The mouth of the Monkey River. Note the Wet Savanna in the background, the heavy sediment load of the Monkey River and the tannin laden waters discharged by Black Creek

Pict. 8 The Guanacaste Creek meandering through the beach

Pict. 9 Drainage channels in the TCC farm, with erosion of the banks of the channel visible

Pict. 10 Vegetation type 1a- Lowland Broadleaf Wet Forest over moderately lime-rich alluvium- from the air. Notice the broken canopy

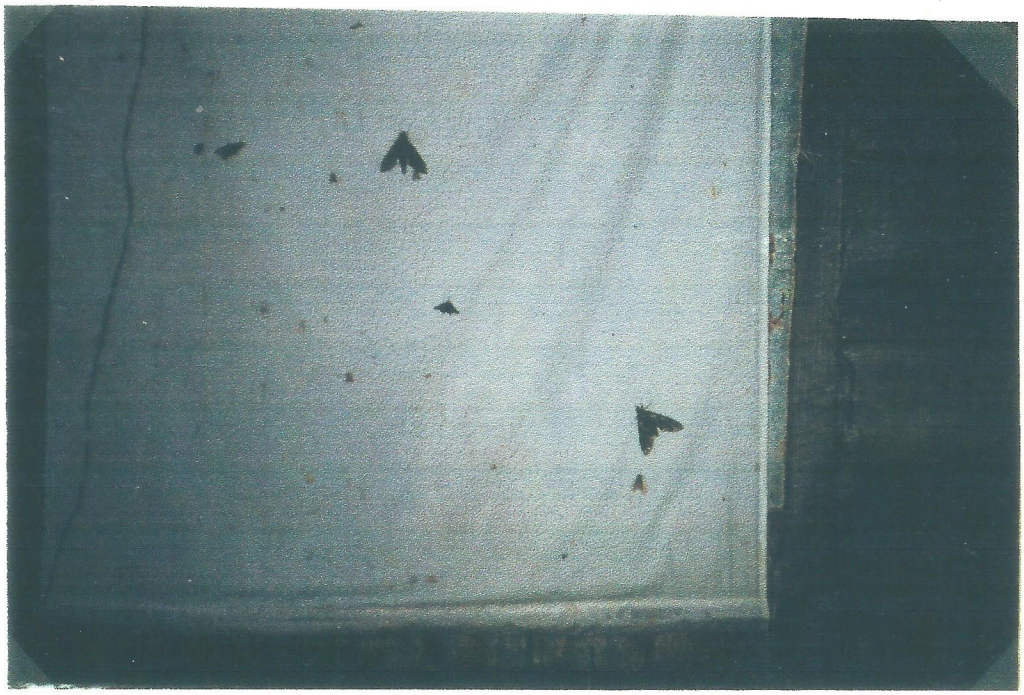
Pict. 11 Vegetation type 2- Mixed Scrubland- in the lower left corner

Pict. 12 Vegetation types 3- Low Swamp Forest-,12- Littoral Forest/Coastal Beach Sand Scrubs- and 9- Wet Savanna- from the air

Pict. 13 Black Creek from the air. Showing vegetation type 8a- Riverine Mangrove-, 8c- Dwarf Mangrove Forest-, 9- Wet Savanna

Pict. 14 Vegetation type 9- Wet Savanna- from the air, in the background the Monkey River and the TCC farm. Notice the inundated section of the Wet Savanna

Pict. 15 The Forest Creek



Pict. 16 Moth-trapping, using an ultra-violet light

Pict. 17 The access road to the village

Pict. 18 Operating the beach seine net

Pict. 19 Eloy Cuevas and Ellen McRae observing the catch

Pict. 20 Female Rainbow Racerunner *Cnemidophorus lemniscatus*

Pict. 21 Male Rainbow Racerunner *Cnemidophorus lemniscatus*

Pict. 22 Crocodile Pond in the Payne's Creek from the air

Pict. 23 Eloy Cuevas observing a young *Crocodylus moreletii*

Pict. 24 Tracks of the Nine-banded Armadillo

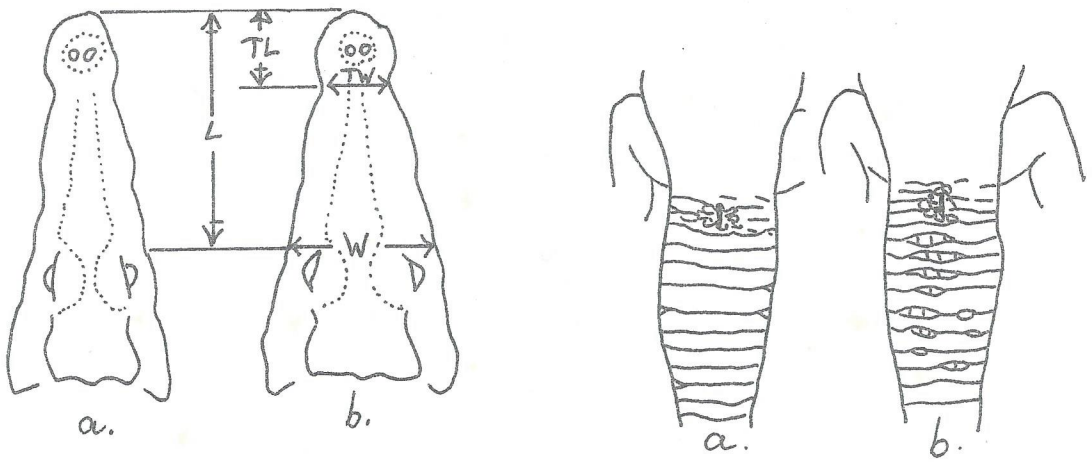


Fig. 2 Headshape and scalation of *Crocodylus acutus (a)* and *Crocodylus moreletii* (b)

Appendix 3.

Species lists.

Vegetation list	8	sheets
Odonata list	2	sheets
Lepidoptera list	5	sheets
Marine invertebrate list	2	sheets
Fish list	3	sheets
Herpetology list	1	sheet
Bird list	6	sheets
Mammal list	2	sheets

Vegetation list, Monkey River SDA

	HABITAT AND VEGETATION TYPE		High forest	River forest	Mixed scrub	Low Swamp	Littoral forest	Pine savanna	Mangroves	Wet savanna
	SPECIES	LOCAL NAME	Type 1a	Type 1b	Type 2	Type 3	Type 4	Types 6&7	Type 8a-c	Type 9
AGAVACEAE										
	*Cordyline fruticosa**			O						
	*Sanseveria trifasciata**						O			
ANACARDIACEAE										
	*Anacardium occidentale**	Cashew					O	O		
	*Mangifera indica**	Mango		O			O			
	*Spondias cytherea**	Golden Plum					O			
	Spondias mombin	Hogplum	O	O						
ANNONACEAE										
	Annona reticulata	Anona	O	O						
	Xylopia frutescens	Polewood				O		O		
APOCYNACEAE										
	Allamanda cathartica			O	O	O	O			
	*Catharanthus roseus**						O			
	Rhabdadenia paludosa					O	O	O	O	
	Tabernaemontana arborea	Cojoton (large fruit)	O			O				
	Tabernaemontana chrysocarpa	Cojoton	O							
ARACEAE										
	Anthurium pentaphyllum			O						
	Anthurium bakeri		O							
	*Caladium bicolor**	Caladium					O			
	Diefenbachia seguina	Warree bush	O	O						
	*Diefenbachia picta**						O			
	Monstera sp. A.						O			
	Monstera sp.B			O						
	Montricardia arborescens		O							O
	Philodendron radiatum (?)			O						
	Philodendron hoffmanii (?)									
	Philodendron sp. B.			O						
	Philodendron sp. C.			O						
	Philodendron sp. D.									
	Philodendron sp. E									
	Philodendron sp. F.									
	Spatiphyllum blandum		O	O						
	Syngonium podophylum		O							

O=Observed, * = Species of introduced origin, usually artifacts of past habitation

Vegetation list, Monkey River SDA

	HABITAT AND VEGETATION TYPE		High forest	River forest	Mixed scrub	Low Swamp	Littoral forest	Pine savanna	Mangroves	Wet savanna
	SPECIES	LOCAL NAME	Type 1a	Type 1b	Type 2	Type 3	Type 4	Types 6&7	Type 8a-c	Type 9
	Syngonium angustatum			O						
	Syngonium sp. A.						O			
	Syngonium sp. B.			O						
	Syngonium sp. C.			O						
	Zanthedescia spatyphyllum		O	O						
ARISTOLOCHIACEAE										
	Aristolochia schippii		O	O						
	Aristolochia trilobata					O			O	
ASCLEPIADACEAE										
	Sarcostemma clausum			O						
AVICENNIACEAE										
	Avicennia germinans	Black mangrove					O			
BIGNONIACEAE										
	Amphitecna latifolia	Wild Calabash				O	O			
BOMBACACEAE										
	Ceiba pentandra Kapok	Cotton Tree	O	O						
	Ochroma lagopus Balsa	Polak		O						
	Pachira aquatica	Provision bark	O	O	O	O	O			
BORAGINACEAE										
	Argusia gnaphalodes						O			
BROMELIACEAE										
	Achmaea bracteata		O							
	Achmaea sp.							O		
	Ananas comosus	Pineapple					O			
	Bromelia pinguin	Pingwing					O			
	Catopis berteroniana	Air plant						O		
	Tillandsia bulbosa	Air plant						O		
	Tillandsia nr. multicaulis	Air plant	O							
	Tillandsia streptophylla	Air plant						O		
BURSERACEAE										
	Bursera simaruba	Gumbo Limbo	O	O		O	O			
CACTACEAE										
	Selenicereus sp.	Snake cactus		O						
CAPPARIDACEAE										
	Cleome viscosa						O			

O=Observed, * = Species of introduced origin, usually artifacts of past habitation

Vegetation list, Monkey River SDA

	HABITAT AND VEGETATION TYPE		High forest	River forest	Mixed scrub	Low Swamp	Littoral forest	Pine savanna	Mangroves	Wet savanna
	SPECIES	LOCAL NAME	Type 1a	Type 1b	Type 2	Type 3	Type 4	Types 6&7	Type 8a-c	Type 9
CARICACEAE										
	*Carica papaya**	Papaya		O						
CASUARINACEAE										
	*Casuarina equisetifolia**	Australian Pine					O			
CHRYSOBALANACEAE										
	Chrysobalanus icaco	Cocoplum		O	O	O	O	O	O	
	*Couepia polandra**	Monkey Cap					O			
COMPOSITAE										
	Ageratum sp.						O			
	Neurolaena lobata	Jackass Bitters		O						
	Wedelia trilobata						O			
COMBRETACEAE										
	Conocarpus erecta	Buttonwood					O		O	
	Laguncularia racemosa	White Mangrove				O	O		O	
	Terminalia amazonia	Nargusta	O	O						
CONVOLVULACEAE										
	Ipomoea pes-caprae						O			
CUCURBITACEAE										
	Anguria sp. (three lobed)		O							
CYCLANTHACEAE										
	Cordulovica utilis	Panama Hat Palm	O							
CYCADACEAE										
	Zamia loddigesii							O		
CYPERACEAE										
	Cyperus giganteus			O						
DILLENIACEAE										
	Curatella americana	Yaha						O		
DIOSCOREACEAE										
	Dioscorea sp.	Wild Yam		O			O			
EUPHORBIACEAE										
	*Manihot esculenta**	Cassava		O			O			
FAGACEAE										
	Quercus sp.	Oak						O		
GRAMINEAE										
	Bambusa vulgaris	Bamboo		O						

O=Observed, * = Species of introduced origin, usually artifacts of past habitation

Vegetation list, Monkey River SDA

	HABITAT AND VEGETATION TYPE		High forest	River forest	Mixed scrub	Low Swamp	Littoral forest	Pine savanna	Mangroves	Wet savanna
	SPECIES	LOCAL NAME	Type 1a	Type 1b	Type 2	Type 3	Type 4	Types 6&7	Type 8a-c	Type 9
	Cenchrus sp.	Bur-bur					O			
	Gynerium sagittatum	Dumb Cane		O	O		O			
	Phragmitis australis Reed			O						O
	*Saccharum sp.**	Sugar Cane		O			O			
	Scleria bracteata	Cut grass	O		O		O			
	Spartina sp.								O	
	Typha dominguensis			O		O	O			O
GUTTIFERAE										
	Calophylum brasiliense	Santa Maria		O	O	O	O			
	Symphonia globulifera	Waika Chewstick	O							
	Vismia ferruginea	Can't be helped		O				O		
LAURACEAE										
	Cassytha filiformis Parasite							O		
	*Persea americana** Advocado	Pear		O			O			
LECYTHIDACEAE										
	Grias cauliflora	Bombo wood	O	O		O	O			
LEGUMINOSAE - CAESALPINOIDEAE										
	Cassia grandis	Bokut		O						
	Cassia nr alata			O						
	Cassia occidentalis						O			
	Hymenaea coubaril	Locust	O							
	Schizolobium parahybum	Quamwood	O	O						
LEGUMINOSAE - MIMOSOIDEAE										
	Acacia sp.	Cockspur	O	O						
	Enterolobium cyclocarpum	Guanacaste		O						
	Inga edulis	Bri-bri		O		O	O			
	Inga sp.			O	O					
	Lysiloma bahamiense						O			
	Mimosa pudica	Sensitive plant					O			
	Mimosaceae, low spiny shrub	Prickle		O						
	Pithecellobium sp.						O	O		
	Pithecelobium recordi	Turtlebone	O	O						
LEGUMINOSACEAE - PAPILIONOIDEAE										
	Abrus precatorius	John Crow Bead					O			
	Canavalia maritima Seaside Bean						O			

O=Observed, * = Species of introduced origin, usually artifacts of past habitation

Vegetation list, Monkey River SDA

	HABITAT AND VEGETATION TYPE		High forest	River forest	Mixed scrub	Low Swamp	Littoral forest	Pine savanna	Mangroves	Wet savanna
	SPECIES	LOCAL NAME	Type 1a	Type 1b	Type 2	Type 3	Type 4	Types 6&7	Type 8a-c	Type 9
	Crotalis sp.						O			
	Dalbergia ecastophylum	Racoon Tie tie			O	O	O		O	
	Erythrina sp.		O							
	Gliceridia sepium	Madre Cacao						O		
	Machaerium sp.		O			O				
	Pterocarpus officinalis	Kaway	O	O	O	O	O			
LORANTHACEAE										
	Phoradendron ?	Scorn-e-groun					O			
MALPIGHIACEAE										
	Byrsonima crassifolia	Craboo					O	O		
MALVACEAE										
	Hibiscus tiliaceus	Blue Moho		O	O		O			
	Thespesia populnea	Sea side Moho							O	
MARANTHACEAE										
	Calathea (allonia?)	Waha leaf		O						
	Ctenanthe ?		O							
	Thalia geniculata	Waha Leaf								O
MELASTOMACEAE										
	Melastomaceae	Pigeon feed	O	O						
	Melastomaceae			O		O	O	O		
	Miconia amplexans			O						
	Miconia habrolepis	Red Maya	O							
	Tococca (coriaceae?)						O	O		
MELIACEAE										
	(Trichilia pallida?)	Carbon	O							
	Swietenia macrophylla	Mahogany		O			O			
MENISPERMACEAE										
	Cissampelos pareira			O						
MORACEAE										
	*Artocarpus altilis**	Breadfruit		O			O			
	Castilla elastica	Wild rubber		O						
	Cecropia peltata	Trumpet	O	O		O	O	O		
	Ficus glabrata	Amate		O						
	Ficus sp.		O	O						
	Ficus sp.						O			

O=Observed, * = Species of introduced origin, usually artifacts of past habitation

Vegetation list, Monkey River SDA

	HABITAT AND VEGETATION TYPE		High forest	River forest	Mixed scrub	Low Swamp	Littoral forest	Pine savanna	Mangroves	Wet savanna
	SPECIES	LOCAL NAME	Type 1a	Type 1b	Type 2	Type 3	Type 4	Types 6&7	Type 8a-c	Type 9
	Ficus sp.	Matapalo	O							
MUSACEAE										
	Heliconia latispatha		O	O	O					
	Heliconia sp.			O						
	*Musa sp.**	Banana/Plantain		O			O			
MYRICACEAE										
	Myrica cerifera	Tea Box				O	O	O	O	
MYRTACEAE										
	*Eucalyptus sp.**	Eucalyptus					O			
	*Psidium guajava**	Guava					O			
	*Syszgium cumini**	Blackberry		O			O			
MYRISTICACEAE										
	Virola koschnyi	Banak	O	O						
OLACACEAE										
	Ximenia americana	Hog-plum					O			
ORCHIDACEAE										
	Brassavola nodosa						O	O		
	Catasetum integerrimum						O			
	Epidendrum nocturnum					O		O		
	Galeandra batemanii							O		
	Gongora sp.		O			O				
	Myrmecophylla brysiana	Horn Orchid			O	O	O	O	O	
	Vanilla sp. Leaf narrow, lanceolate,glabrous			O		O				
	Vanilla sp. Leaf ovate, hirsute		O							
PALMAE										
	Acoelorraphe wrightii	Palmetto		O	O	O	O	O		O
	Astrocaryum mexicanum	Warree Cohune	O							
	Attalea cohune	Cohune	O	O						
	Bactris trichophylla	Pokenoboy	O	O	O	O				
	Chameodora sp.		O	O						
	*Cocos nucifera**	Coconut		O		O	O		O	
	Desmoncus schippii	Basket tie-tie		O	O	O	O			O
	Geonoma sp. Fish-tail Palm		O							
	Roystonea oleraceae	Cabage Palm	O	O	O					
	Thrinax radiata	Saltwater Palmetto					O			

O=Observed, * = Species of introduced origin, usually artifacts of past habitation

Vegetation list, Monkey River SDA

	HABITAT AND VEGETATION TYPE		High forest	River forest	Mixed scrub	Low Swamp	Littoral forest	Pine savanna	Mangroves	Wet savanna
	SPECIES	LOCAL NAME	Type 1a	Type 1b	Type 2	Type 3	Type 4	Types 6&7	Type 8a-c	Type 9
PANDANACEAE										
	*Pandanus (veitchii?)** Screw Pine						O			
PASSIFLORACEAE										
	Passiflora biflora			O		O				O
	Passiflora foetida var. gossypiifolia			O						
	Passiflora foetida var. mayarum						O			O
	Passiflora oerstedii						O			
	Passiflora rovirosae		O							
	Passiflora serratifolia			O						
	Passiflora urbaniana							O		
PINACEAE										
	Pinus caribaea Honduran Pine	Pine						O		
PIPERACEAE										
	Peperomia sp.		O							
	Piper sp.	Cordoncillo		O		O	O			
PTERYDOPHYTA - FERNS										
	Acrostychum aureum	Tigerbush				O	O		O	O
	Adiantum petiolatum			O						
	Blechum serrulatum					O	O		O	O
	Lomariopsis recurvata			O						
	Lomariopsis sp.			O						
	Lygodium sp.			O						
	Polypodium polypodioides		O							
	Polypodium nr. astrolepis			O			O			
	Tectaria incisa			O						
	Tectaria sp.			O						
	Thelypteris hispidula			O						
	Vittaria sp.		O				O			
POLYGONACEAE										
	Coccoloba belizensis	Wild grape		O						
	Coccoloba schiedeana		O	O		O				
	Coccoloba uvifera	Seagrape				O	O			
RHIZOPHORACEAE										
	Rhizophora mangle Red Mangrove	Red Mangrove				O			O	O

O=Observed, * = Species of introduced origin, usually artifacts of past habitation

Vegetation list, Monkey River SDA

	HABITAT AND VEGETATION TYPE	High forest	River forest	Mixed scrub	Low Swamp	Littoral forest	Pine savanna	Mangroves	Wet savanna
	SPECIES LOCAL NAME	Type 1a	Type 1b	Type 2	Type 3	Type 4	Types 6&7	Type 8a-c	Type 9
RUBIACEAE									
	Cephaelis tomentosa Hot-lips	O			O	O	O		
	Rubiaceae mauve	O							
	Rubiaceae white		O						
RUTACEAE									
	*Citrus sp.** Citrus		O			O			
	Zanthoxylum sp. Prickly yellow		O		O				
SALICACEAE									
	Salix chilensis Willow		O						
SIMAROUBACEAE									
	Simarouba glauca Negrito		O						
SMILACACEAE									
	Smilax sp.				O	O	O		
TILIACEAE									
	Luhea seemanni Yellow leaf Bay Cedar	O	O						
	Trichospermum campbellii Narrow-leaf Moho		O	O					
	Unidentifiable Black Bay Cedar	O	O						
VERBENACEAE									
	Stachytarpheta jamaicensis						O		
	Stachytarpheta sp.					O			
VITACEAE									
	Vitis tiliaefolia Water tie-tie		O	O					
VOCHYSIACEAE									
	Vochysia hondurensis Yemeri	O	O				O		
ZINGIBERACEAE									
	Costus sp.	O	O		O	O			
	Renealmia sp.	O							
UNKNOWN IDENTITY									
	Cachito	O	O						
	Tzultzul	O							
	Cachito II						O		

O=Observed, * = Species of introduced origin, usually artifacts of past habitation

Odonata list, Monkey River SDA.

HABITAT AND VEGETATION TYPE	High forest	Monkey River	Forest creek	Forest swamp	Access Road	M.R.village	Littoral forest	Pine savanna	Magroves	Wet savanna
SPECIES	Type 1a	Type 1b	Type 1b	Type 1b	Type 1b	Type 4	Type 4	Types 6&7	Type 8a-c	Type 9
ZYGOPTERA - DAMSELFLIES										
CALOPTERYGIDAE - BROAD-WINGED DAMSELS										
Hetaerina titia Smoky Rubyspot		O	O		O					
LESTIDAE - SPREADWINGS										
Lestes tenuatus			O							
Lestes tikalus								O		
PSEUDOSTIGMATIDAE - HELICOPTER DAMSELFLIES										
Pseudostigma aberans				O						
PROTONEURIDAE										
Neoneura amelia		O	O	O	O					
COENAGRIONIDAE - POND DAMSELS										
Argia frequentula			O							
Argia oculata			O	O						
Ischnura hastata							O	O		
Ischnura posita					O					
Ischnura ramburi		O						O		
Leptobasis vacillans				O						
Neoerythromma cultellatum Caribbean Yellowface									O	
Telebasis collopistes			O							
Telebasis digiticollis			O	O			O			O
Telebasis salva			O							
Coenagrionidae unid.			O							
ANISOPTERA - DRAGONFLIES										
AESHNIDAE - DARNERS										
Coryphaeschna apeora					O					
Coryphaeschna viriditas					O					
Gynacantha nervosa						O				
Gynacantha sp.			O							
Triacanthagyna caribbea							O			
Triacanthagyna satyrus?			O							
Triacanthagyna septima							O			

O=Observed and/or collected, L=Larvae collected

Odonata list, Monkey River SDA.

HABITAT AND VEGETATION TYPE	High forest	Monkey River	Forest creek	Forest swamp	Access Road	M.R.village	Littoral forest	Pine savanna	Magroves	Wet savanna
SPECIES	Type 1a	Type 1b	Type 1b	Type 1b	Type 1b	Type 4	Type 4	Types 6&7	Type 8a-c	Type 9
GOMPHIDAE - CLUBTAILS										
Phyllocycla sp.		L								
Phyllogomphoides sp.		L								
Gomphidae sp.		O								
LIBELLULIDAE - SKIMMERS										
Anatya normalis					O					
Cannaphila insularis					O					
Dythemis multipunctata					O					
Dythemis sterilis				O	O	O	O			
Erythemis attala					O			O		
Erythemis haematogastra				O			O			O
Erythemis vesiculosa					O	O		O		
Erythrodiplax fervida		O		O	O	O	O	O		
Erythrodiplax funerea						O				
Erythrodiplax fusca		O			O					
Erythrodiplax umbrata					O	O		O		
Micrathyria didyma	?					O	O			O
Micrathyria hagenii						O				
Orthemis ferruginea					O	O		O		O
Orthemis levis			O							
Pantala flavescens					O	O		O	O	O
Perithemis domitia	?		O	O			O			
Tramea abdominalis					O	O				O
Tramea calverti					O	O				O

O=Observed and/or collected, L=Larvae collected

Lepidoptera list, Monkey River SDA

	HABITAT & VEGETATION TYPE	High forest	River forest	Low swamp	Littoral forest	Pine savanna	Mangroves	Wet savanna
	SPECIES	Type 1a	Type 1b	Type 3	Type 4	Types 6&7	Type 8a-c	Type 9
PAPILIONIDAE - SWALLOWTAILS								
	Battus lycidas	O						
	Battus polydamas Gold Rim Butterfly		O	O	O		O	
	Mimoides phaon		O					
	Papilio anchisiades Red-spotted Swallowtail		O					
	Papilio androgeus Queen Swallowtail		O					
	Papilio cresphontes Giant Swallowtail				O			
	Papilio thoas King Swallowtail		O					
	Papilio thoas/cresphontes		O		O		O	
	Parides erithalion		O	O	O		O	
	Parides sesostris	O						
PIERIDAE - SULFURS AND WHITES								
	Anteos maerula Yellow Brimstone		O	O	O	O	O	O
	Aphrissa boisduvalli		O	O	O	O	O	O
	Aphrissa statira Migrant Sulfur		O	O	O	O	O	O
	Appias drusilla Tropical White		O	O	O			
	Ascia monuste Great Southern White				O			
	Eurema albula		O					
	Eurema daira Barred Sulfur		O					
	Eurema dina Bush Sulfur		O					
	Eurema nise Blacktip Sulfur		O		O			
	Eurema proterpia Tailed Orange		O					
	Phoebis argante Apricot Sulfur		O					
	Phoebis philea Orange-Barred Sulfur		O					
	Phoebis sennae Cloudless Sulfur		O		O			
NYMPHALIDAE								
CHARAXINAE - GOATWEED BUTTERFLIES								
	Archaeoprepona demophon		O		O			
	Memphis morvus	O						
	Prepona omphale		O					
	Zaretis ellops		O					
NYMPHALINAE - BRUSHFOOTED BUTTERFLIES								
	Adelpha basiloides		O		O			
	Adelpha cytherea		O					
	Adelpha iphiclus		O	O				

O=Observed and/or collected.
U.V. light trap results are represented quantitatively

Lepidoptera list, Monkey River SDA

	HABITAT & VEGETATION TYPE	High forest	River forest	Low swamp	Littoral forest	Pine savanna	Mangroves	Wet savanna
	SPECIES	Type 1a	Type 1b	Type 3	Type 4	Types 6&7	Type 8a-c	Type 9
	Anartia fatima Brown Peacock		O		O			
	Anartia jatrophae White Peacock		O		O			
	Callicore texa					O		
	Catenophele numilia		O		O			
	Colubura dirce		O					
	Dynamine mylitta		O					
	Eunica alcmena		O	O	O		O	
	Euptoieta hegesia Mexican Fritillary				O	O		O
	Hamadryas amphinome Red Cracker		O					
	Hamadryas februa Gray Cracker		O					
	Hamadryas feronia Blue Cracker		O					
	Historis acheronta	O	O	O	O	O	O	O
	Historis odius Stinky Leaf Wing		O	O	O		O	
	Junonia evarete Buckeye		O		O	O		O
	Marpesia chiron Banded Dagger Wing	O	O	O	O		O	
	Marpesia petreus Red Dagger Wing	O	O	O	O			
	Mestra amymone Noseburn Wanderer		O					
	Myscelia ethusa Blue Wave				O			
	Pyrrhogyra neaerea		O					
	Smyrna blomfildia		O					
	Temenis laothoe		O					
HELICONIINAE - PASSIONFLOWER BUTTERFLIES								
	Agraulis vanillae Gulf Fritillary				O	O		
	Dryadula phaetusa Banded Orange					O		
	Dryas iulia Orange Longwing		O	O	O			
	Eueides aliphera		O					
	Eueides isabella Isabella Tiger		O		O			
	Heliconius charitonius Zebra Long Wing		O	O	O			
	Heliconius erato Red Passion-Flower Butterfly		O	O				
	Heliconius ismenius		O					
MELITAEINAE - CHECKERSPORTS AND CRESCENTS								
	Chlosyne lacinia Giant Patch		O					
	Thessalia theona Mexican Checkerspot		O					

O=Observed and/or collected.
U.V. light trap results are represented quantitatively

Lepidoptera list, Monkey River SDA

	HABITAT & VEGETATION TYPE	High forest	River forest	Low swamp	Littoral forest	Pine savanna	Mangroves	Wet savanna
	SPECIES	Type 1a	Type 1b	Type 3	Type 4	Types 6&7	Type 8a-c	Type 9
DANAINAE - MILKWEED BUTTERFLIES								
	Danaus erissimus Soldier		O					
	Danaus gilippus Queen		O		O			
	Lycorea cleobaea Large Tiger		O					
MORPHINAE - MORPHO'S								
	Morpho peleides	O	O	O	O		O	
BRASSOLINAE - OWL BUTTERFLIES								
	Caligo eurilochus	O						
	Caligo memnon		O	O	O			
	Caligo uranus	O						
	Opsiphanes cassina		O	O				
SATYRINAE - NYMPHS AND SATYRS								
	Cissia hermes Southern Satyr		O		O			
	Cissia ocirrhoe		O	O	O			
	Cissia usitata				O			
	Pierella luna	O						
	Taygetis andromeda	O	O					
LYCAENIDAE - HAIRSTREAKS, COPPERS AND BLUE BUTTERFLIES								
	Allosmaitia nr. pion		O					
	Arawacus sp.		O					
	Calycopis isobeon		O		O			
	Ministrymon sp.				O			
	Thecla marsyas		O		O			
	Thecla nr. bitias		O					
RIODINIDAE - METALMARKS								
	Calydna lusca					O		
	Charis gynaea				O			
	Emesis vulpina		O					
	Juditha molpe		O					
	Leucochimona vestalis							
	Lymnas pixe		O					
HESPERIIDAE - SKIPPERS								
	Antigonus nr. nearchus		O					
	Atrytone nr. mazai		O					
	Callimormus nr. saturnus		O		O			

O=Observed and/or collected.
U.V. light trap results are represented quantitatively

Lepidoptera list, Monkey River SDA

	HABITAT & VEGETATION TYPE	High forest	River forest	Low swamp	Littoral forest	Pine savanna	Mangroves	Wet savanna
	SPECIES	Type 1a	Type 1b	Type 3	Type 4	Types 6&7	Type 8a-c	Type 9
	Discophellus lama		O					
	Heliopetes arsalte		O					
	Lerodea eufala		O					
	Mylon nr. pulcherius		O					
	Nascus phocus				O			
	Nastra sp.		O		O			
	Pachus loxus		O					
	Panoquina ocola		O					
	Pellicia costimaculata		O					
	Polythrix octomaculata		O					
	Proteides mercurius		O					
	Pyrgus communis				O			
	Pyrgus oileus		O		O			
	Staphylus/Bolla sp.		O		O			
	Synapte nr. salenus		O					
	Timocharis trifasciata		O					
	Typhedanus nr. undulatus		O					
	Urbanus dorantes		O					
	Urbanus sp.		O					
	Xeophanus trixus		O					
SATURNIIDAE - SILKMOTHS								
	Automeris metzli				1			
	Automeris zozine				1			
	Hylesia nr. dalina				1			
SPHINGIDAE - HAWKMOTHS								
	Aellopos titan	O						
	Agrius cingulatus				3			
	Callionima parce				1			
	Cocytius antaeus				2			
	Cocytius duponchel				10			
	Enyo lugubris				11			
	Enyo ocypete				4			
	Erinnyis ello				1			
	Erinnyis oenotrus				5			
	Erynnis oenotrus				1			

O=Observed and/or collected.
U.V. light trap results are represented quantitatively

Lepidoptera list, Monkey River SDA

	HABITAT & VEGETATION TYPE	High forest	River forest	Low swamp	Littoral forest	Pine savanna	Mangroves	Wet savanna
	SPECIES	Type 1a	Type 1b	Type 3	Type 4	Types 6&7	Type 8a-c	Type 9
	Eumorpha anchemolus				1			
	Eumorpha labruscae				1			
	Eumorpha triangulum				1			
	Isognathus rimosa				2			
	Pachylia ficus				16		O	
	Pachylioides resumens				1			
	Perigonia lusca				2			
	Phryxus caicus				3			
	Protambulyx strigilis				2			
	Xylophanes ceratomioides				1			
	Xylophanes chiron				5			
	Xylophanes pluto				3			
	Xylophanes tersa				2			
URANIDAE								
	Urania fulgens				9+O			
CASTNIIDAE								
	Castnia sp.	O						
NOCTUIDAE - NOCTUID MOTHS								
	Ascelapha odorata Black Witch	O	O	O	O			

O=Observed and/or collected.
U.V. light trap results are represented quantitatively

Marine invertebrate list, Monkey River SDA

	HABITAT	Monkey	Littoral	Black	Pine R.	Monkey	Coral	Beach &
	SPECIES	River	Creeks	Creek	Creek	Cayes	Reef	Coastal
PHYLUM PORIFERA								
CLASS DEMOSPONGIAE								
	Aplysina fulva? Green Rope Sponge						occ.	
	Siphonodictyon corraliphagum Variable boring Sponge						occ. on coral, yellow	
PHYLUM CNIDARIA								
CLASS HYDROZOA								
	Millepora squarrosa Encrusting Fire Coral						common on seafans	
	Millepora alcicornis Branching Fire Coral						common	
CLASS SCYPHOZOA								
	Carybdea alata Sea Wasp		two		one			
CLASS ANTHOZOA, ALCORNARIA								
	Gorgonia ventalina Sea Fan						common	
	Plexaura flexuosa Tan bushy soft Coral						common (white)	
	Pseudopterogorgia acerosa Smooth Sea Feather						common	
CLASS ANTHOZOA, ZOOANTHARIA, SCLERACTINEA								
	Acropora palmata Elkhorn Coral						few,young	
	Acropora cervicornis Staghorn Coral						short	
	Diploria sp. Brain Coral						few,small	
	Montastrea annularis Boulder Coral						bleached	
	Manicina areolata Common Rose Coral						dead	
	Porites asteroides Small Pore Coral						unc. small	
	Siderastrea radians "Dimple" Coral						common (bleached)	
CLASS ANTHOZOA, ZOOANTHERIA, CORALLIMORPHARIA								
	Ricordea florida Florida False Coral						1 colony	
CLASS ANTHOZOA, ZOOANTHERIA, ZOANTHIDIA								
	Zoanthus sociatus Green Colonial Anemone						1 colony	
PHYLUM ANNELIDA, SERPULIDAE								
	Spirobranchia giganteus Christmas Tree Worm						one	
PHYLUM MOLLUSCA, GASTROPODA								
	Bulla striata Striated Bubble							common
	Cerithium sp.							common
	Neritina virginea Virgin Nerite							occ.
	Limpet unid.							one
	Snail unid.							one

V=Viewed by snorkeling,
T=Trap, S=Beach Seine.

Marine invertebrate list, Monkey River SDA

	HABITAT	Monkey	Littoral	Black	Pine R.	Monkey	Coral	Beach &
	SPECIES	River	Creeks	Creek	Creek	Cayes	Reef	Coastal
PHYLUM MOLLUSCA, PELECYPODA								
	Arca ibricata Mossy Ark							common
	Anomia simplex Jingle Shell							shells
	Chiona cancellata Cross-barred Venus							shells
	Donax variabilis Coquina							shell
	Anodontia alba Butter Lucine							common
	Macoma sp. A							shell
	Macoma sp. B							shell
	Tagelus divisus Purplish Tagelus							S
	Tivella mactroides Trigonel tivella							common
	Divaricella quadrisulcata Cross-hatched Lucine							shells
	Lucina pectinata Jamaica Lucine							common
	Tellina caribbea Caribbean Tellin							shell
	Trachycardium muricatum Yellow Cockle							common
	Chione interpurpura Mottled Venus							shell
	Glycomeris pectinata Comb Bittersweet							shell
PHYLUM ARTHROPODA, CRUSTACEA								
MALACOSTRACA, DECAPODA								
	*Macrobrachium sp. "*Freshwater Lobster"		V, one					
	Hippolytidae A. Shrimp	T, one						
	Hippolytidae B. Shrimp	T, one						
	Pennaeidae (antennae 3x body lg)		S					
	Anomura Hermit Crab		S, one					
	Hippa or *Emerita* sp. Mole Crab		shells					
	Callinectes sp. Blue Crab		S, one					
	Cardisoma guanhumi Great Land Crab		V, holes					
	Ocypoda quadrata Ghost Crab		common					
	Uca sp. Fiddler Crab		Colony					
PHYLUM ECHINODERMATA								
ASTEROIDEA								
	Oreaster reticulata Cushion Seastar						V, occ.	
ECHINOIDEA								
	Lytechinus variegatus Green Urchin						V, one	
	Echinometra viridis Reef Urchin						V, one	

V=Viewed by snorkeling,
T=Trap, S=Beach Seine.

Fish list, Monkey River SDA.

		HABITAT	Monkey	Littoral	Black	Pine R.	Monkey	Coral	Beach
	SPECIES	LOCAL NAME	River	Creeks	Creek	Creek	Keys	Reef	&Coastal
DASYATIDAE - STINGRAYS									
	Unidentified	Stingray				O			
MEGALOPIDAE - TARPONS									
	Megalops atlanticus	Tarpon		O	O				
CLUPEIDAE - HERRINGS									
	Harengula jaguana Scaled Sardine								C
	Chirocentrodon bleekerianus Dogtooth Herring								C
ENGRAULIDIDAE - ANCHOVIES									
	Anchoa spinnifer. Anchoa								C
CHARACIDAE - CHARACINS									
	Astyanax fasciatus Banded (Mexican) Tetra	Billum	T	S		V			
	Brycon guatemalensis Machaca	Machaca	C						
	Hyphessobrycon compressus Blackfin Tetra					V			
	Unidentified Characin					V			
ARIIDAE - SEA CATFISHES									
	Cathorops sp . Sea Catfish		T						
PIMELOIDAE - CATFISHES									
	Rhamdia guatemalensis Stream Catfish		D (in forest stream)						
BELONIDAE - NEEDLEFISHES									
	Strongylura notata Redfin Needlefish		C						
	Strongylura sp. (unid. juvenile)					O			
POEDILIIDAE - LIVEBEARERS									
	Belonesox belizanus Pike Livebearer			D					
	Gambusia luma	Poopsie				D			
	Poecilia mexicana Shortfin Molly			S					
	Poecillia orri Mangrove Molly		D	D					
	Unident. juv. Poeciliid			S					
ANTHERINDAE - SILVERSIDES									
	Melaniris sp. Silverside						V		
SYNBRANCHIDAE - SWAMP-EELS									
	Ophisteron aenigmaticum Mud-Eel		T						
CENTROPOMIDAE - SNOOKS									
	Centropomus undecimalis Snook	Snook	C			O			
SERRANIDAE - SEABASSES									
	Serranus tigrinus Harlequin Bass							V	

O=Observerd from surface, V=Viewed by snorkeling,
T=Trap, S=Beach Seine, C=Castnet, D=Dipnet, R=Reported

Fish list, Monkey River SDA.

		HABITAT	Monkey	Littoral	Black	Pine R.	Monkey	Coral	Beach
	SPECIES	LOCAL NAME	River	Creeks	Creek	Creek	Keys	Reef	&Coastal
CARANGIDAE - JACKS									
	Oligoplites saurus Leatherjacket								S
	Trachynotus falcatus Permit	Permit				S			S
	Unident. Juv. Jack								S
LUTJANIDAE - SNAPPERS									
	Lutjanus apodus Schoolmaster							V	
	Lutjanus griseus Gray Snapper					V	V		
	Lutjanus jocu Dog Snapper					V			
	Lutjanus synagris Lane Snapper				T				
GERREIDAE - MOJARRAS									
	Eugerres sp.	Stonebass	C						
HAEMULIDAE - GRUNTS									
	Haemulon macrostomum Spanish Grunt							V	
	Haemulon plumieri White Grunt							V	
	Anisotremus virgicus Porkfish							V	
SPARIDAE - PORGIES									
	Calamus sp. Porgy							V	
SCAIENIDAE - DRUMS									
	Bairdiella ronchus Ground Croaker								S
	Stellefer sp. Stardrum								S
POMACANTHIDAE - ANGELFISHES									
	Pomacanthus arcuatus Grey Angelfish							V	
POMACENTRIDAE - DAMSELFISHES									
	Eupomacentrus dorsopunicans Dusky Damselfish							V	
CICHLIDAE - CICHLIDS									
	Cichlasoma maculicauda Blackbelt Cichlid					V			
	Cichlasoma sysnspillum	Tuba				V			
	Cichlasoma uropthalmus	Crana'	T,C	S	O	V			
	Cichlasoma sp.					O			
LABRIDAE - WRASSES									
	Halichoeres bivittatus Slippery Dick						T	V	
SCARIDAE - PARROTFISHES									
	Sparisoma chrysopterum Redtail Parrotfish							V	
	Sparisoma rubripinne Yellowtail Parrotfish							V	
	Scarus croicensus Striped Parrotfish							V	

O=Observerd from surface, V=Viewed by snorkeling,
T=Trap, S=Beach Seine, C=Castnet, D=Dipnet, R=Reported

Fish list, Monkey River SDA.

		HABITAT	Monkey	Littoral	Black	Pine R.	Monkey	Coral	Beach
	SPECIES	LOCAL NAME	River	Creeks	Creek	Creek	Keys	Reef	&Coastal
MUGILIDAE - MULLETS									
	Mugil curema White Mullet	Mullet	C						
	Unident. Mugilid					O			
POLYMNEMIDAE - THREADFINS									
	Polydactylus sp. Threadfin								S
SPHYRAENIDAE - BARRACUDAS									
	Sphyraena baracuda Great Barracuda	Barracuda	R					R	
ELEOTRIDIDAE - SLEEPERS									
	Eliotris sp. Jewel (Sleeper)		T						
ACANTHURIDAE - SURGEONFISHES									
	Acanthurus caeruleus Blue Tang							V	
	Acanthurus chirurgis Doctorfish							V	
OSTRACIIDAE - BOXFISHES									
	Lactrophrys bicaudais Spotted Trunkfish								O

O=Observerd from surface, V=Viewed by snorkeling,
T=Trap, S=Beach Seine, C=Castnet, D=Dipnet, R=Reported

Amphibian and Reptile list, Monkey River SDA.

	HABITAT AND VEGETATION TYPE		High forest	River forest	Low swamp	Littoral forest	Pine savanna	Mangroves	Wet savanna
	SPECIES	LOCAL NAME	Type 1a	Type 1b	Type 3	Type 4	Types 6&7	Type 8a-c	Type 9
AMPHIBIA									
ANURA - FROGS AND TOADS									
	Bufo marinus Giant Toad	Toad				O			
	Bufo valiceps Gulf coast Toad	Toad		O	O				
	Hyalinobatrachium fleischmanni Glass Frog			H					
	Hyla microcephala Yellow Tree Frog			H					
	Leptodactylus melanonotus Black-backed Frog		H	H	H	H			H
	Rana vailanti Rainforest Frog	Spring chicken	O	O					
	Smilisca baudini Mexican Tree Frog			O	H	H			
REPTILIA									
TESTUDINES - TURTLES									
	Caretta caretta Loggerhead Sea Turtle	Logga	S, see text						
	Chelonia mydas Green Sea Turtle	Turtle	S, see text						
	Eretmochelys imbircata Hawksbill Sea Turtle		S, see text						
	Chrysemys scripta Neotropical Slider Turtle	Bocatora		O	O	O			
	Kinosternon acutum	Swanka	O	O			O		
	Rhinoclemys areolata	Black belly	R, without location						
CROCODYLIA - CROCODILES									
	Crocodylus acutus American Crocodile	Aligator	Reported from Paynes Creek						
	Crocodylus moreletii Morelets Crocodile	Aligator		O		O			
IGUANIDAE - IGUANAS									
	Anolis lemurinus			O	O				
	Anolis sagrei							O	
	Anolis uniformis		O	O					
	Basilicus vittatus	Cock Lizard	O	O		O	O	O	O
	Corytophanes cristatus	Old Man Lizard	BH						
	Iguana iguana Green Iguana	Green iguana	O	O		O		R	
SCINCIDAE - SKINKS									
	Unidentified specimen						O		
TEIIDAE - TEID LIZARDS									
	Cnemidophorus lemniscatus Rainbow Racerunner	Shake Hand				O			
SERPENTES - SNAKES									
	Boa Constrictor Boa	Wowla		O		O			
	Oxybelus anaeus Gray Vine Snake	Tie-tie snake		O					
	Spilotus pullatus Spotted Rat Snake	Bocotora clapansaya	BH						
	Tretanorhinus nigroluteus	Black Water Snake		O					
	Bothrops asper Fer-de-lance	Tommygoff		R					

O=Observed, H=Heard (sound i.d.), R=Reported by Monkey River village residents, BH = Reported B.Hassan, S=Smith et al. 1992.

Bird List, Monkey River SDA

	HABITAT AND VEGETATION TYPE		High forest	River forest	Mixed scrub	Village	Littoral forest	Pine savanna	Mangroves	Monkey keys	Wet savanna
	SPECIES	LOCAL NAME	Type 1a	Type 1b	Type 2	Type 4	Type 4	Types 6&7	Type 8a-c	Type 8b	Type 9
TINAMIDAE - TINAMOUS											
	Tinamus major Great Tinamou	Blue-footed Partridge	BH								
PODICIPEDIDAE - GREBES											
	Tachybaptus dominicus Least Grebe	Diving dopper		R							
PELECANIDAE -PELICANS											
	Pelecanus occidentalis Brown Pelican	Pelikin				O				O	
PHALACROCORACIDAE - CORMORANTS											
	Phalacrocorax auritus Double-crested Cormorant	Shag				O				O	
	Phalacrocorax brasilianus Neotropic Cormorant	Shag				O					
ANHINGIDAE - ANHINGAS											
	Anhinga anhinga Anhinga	Shag		O						O	
FREGATIDAE - FRIGATEBIRDS											
	Fregata magnificens Magnifficent Frigate Bird	Man o' War				O	O			O	
AREIDAE - HERONS											
	Ardea herodias Great Blue Heron	Full Pot		O							
	Bubulcus ibis Cattle Egret	Gaulin		O							
	Butorides virescens Green Heron	Poor Joe					O		O		
	Egretta alba Great Egret	Gaulin		O		O			O	O	
	Egretta caerulea Little Blue Heron	Blue Gaulin		O		O			O	O	
	Egretta tricolor Tricolored Heron	Crabcatcher ?	BCES, without location								
	Nycticorax nycticorax Black-crowned Night-Heron		BCES, without location								
	Nycticorax violaceus Yellow-crowned Night-Heron	Crabcatcher		O		O	O		O	O	
	Tigrisoma mexicanum Bare-throated Tiger-Heron	Barking Gaulin		O							
THRESKIORNITHIDAE - IBISES AND SPOONBILLS											
	Eudocimus albus White Ibis	White Curlew							O	JM	
ANATIDAE - SWANS, GEESE AND DUCKS											
	Cairina moschata Muscovy Duck			EC							
	Dendrocygna autumnalis Black-bellied Whistling-Duck			O				O	O		
CATHARTIDAE - NEW WORLD VULTURES											
	Cathartes aura Turkey Vulture	John Crow		O	O	O	O	O	O	O	O
	Cathartes burrovianus Lesser Yellow-headed Vulture	John Crow	BCES, without location								
	Coragyps atratus Black Vulture	John Crow		O							
	Sarcoramphus papa King Vulture	King John Crow		O							
ACCIPITRIDAE - KITES, HAWKS, EAGLES AND ALLIES											
	Buteo magnirostris Roadside Hawk	Chicken Hawk		O	O		O				

O=observerd, H=heard (sound i.d.), BH=Reported by B.Hassan, EC=Reported by E.Cuevas,
JM=Reported by J.Meerman, TB=Reported by T.Boomsma, BCES=BCES report 1992

Bird List, Monkey River SDA

	HABITAT AND VEGETATION TYPE		High forest	River forest	Mixed scrub	Village	Littoral forest	Pine savanna	Mangroves	Monkey keys	Wet savanna
	SPECIES	LOCAL NAME	Type 1a	Type 1b	Type 2	Type 4	Type 4	Types 6&7	Type 8a-c	Type 8b	Type 9
	Buteo nitidus Gray Hawk			O							
	Buteogallus anthracinus Common Black Hawk	Crab Hawk				O	O	O	O		
	Buteogallus urubitinga Great Black Hawk	Crab Hawk		O			O				
	Pandion haliaetus Osprey	Billy Hawk		O			O		O		
FALCONIDAE - FALCONS AND ALLIES											
	Falco femoralis Aplomado Falcon		BCES, without location								
	Falco rufigularis Bat Falcon	Lion Hawk				JM		O			
	Herpetotheres cachinnans Laughing Falcon	Guaco				O					
	Micrastur semitorquatus Collared Forest Falcon			O		H					
CRACIDAE - CHACHALACAS, GUANS AND CURASSOWS											
	Crax rubra Great Curassow	Curassow	JM								
	Ortalis vetula Plain Chachalaca	Cocicro		O	O			O			
	Penelope purpurascens Crested Guan	Quam	EC								
PHASANIDAE - TURKEYS AND QUAIL											
	Colinus nigrogularis Yucatan Bobwhite							O			
RALLIDAE - RAILS, GALLINULES AND ALLIES											
	Aramides cajanea Grey-necked Woodrail	Top-na-Chick		O	O	O					
	Laterallus ruber Ruddy Crake	Dodging Bull		O	O						
HELIORNITHIDAE - FINFOOTS											
	Heliornis fulica Sungrebe	Diving dopper (falsely)		O							
ARAMIDAE - LIMPKINS											
	Aramus guarauna Limpkin	Clucking hen		O		O					
CHARADRIIDAE - PLOVERS											
	Charadrius collaris Collared Plover		BCES, without location								
SCOLOPACIDAE - SANDPIPERS AND ALLIES											
	Actitis macularia Spotted Sandpiper	Shaky-batty				O	O				
	Calidris pusilla Semipalmated Sandpiper					O	O				
	Numenius phaeopus Whimbrel					O	O				
LARIDAE - GULLS, TERNS AND SKIMMERS											
	Sterna maxima Royal Tern	Large Seagull				O					
	Sterna sandvicencis Sandwich Tern	Sea Gull				O					
COLUMBIDAE - PIGEONS AND DOVES											
	Claravis pretiosa Blue Ground-Dove	Turtle Dove		O							
	Columba cayennensis Pale-vented Pigeon	Red Mangrove Pigeon						O	O		
	Columba flavirostris Red-billed Pigeon		H								

O=observerd, H=heard (sound i.d.), BH=Reported by B.Hassan, EC=Reported by E.Cuevas,
JM=Reported by J.Meerman, TB=Reported by T.Boomsma, BCES=BCES report 1992

Bird List, Monkey River SDA

	HABITAT AND VEGETATION TYPE		High forest	River forest	Mixed scrub	Village	Littoral forest	Pine savanna	Mangroves	Monkey keys	Wet savanna
	SPECIES	LOCAL NAME	Type 1a	Type 1b	Type 2	Type 4	Type 4	Types 6&7	Type 8a-c	Type 8b	Type 9
	Columba nigrirostris Short-billed Pigeon	Tres pe-sos Son		O	O		O		O	O	
	Leptotila verreauxi White-tipped Dove			O				O			
	Zenaida asiatica White-winged Dove									BCES	
PSITTACIDAE - NEW WORLD PARROTS											
	Amazona albifrons White-fronted Parrot			O							
	Amazona autumnalis Red-lored Parrot			O	O						
	Amazona oratrix Yellow-headed Parrot	Yellow-head						O			
	Aratinga astec Aztec Parakeet	Keetie				O		O	O		
CUCULIDAE - CUCKOOS											
	Crotophaga sulcirostris Groove-billed Ani	Cow-boy	BCES, without location								
	Piaya cayana Squirrel Cuckoo	Pe-Quam		O				O			
STRIGIDAE - TYPICAL OWLS											
	Glaucidium brasilianum Ferruginous Pigmy Owl			O							
CAPRIMULGIDAE - NIGHTHAWKS AND NIGHTJARS											
	Nyctidromus albicollis Pauraque	Who-you				O					
APODIDAE - SWIFTS											
	Chaetura sp. Cimney/Vaux Swift			O							
TROCHILIDAE - HUMMINGBIRDS											
	Amazilia candida White-bellied Emerald							O			
	Amazilia rutila Cinnamon Hummingbird			O	O			O			
	Amazilia tzacatl Rufous-tailed Hummingbird					O					
	Campylopterus hemileucurus Violet Sabrewing			O							
	Florisuga mellivora White-necked Jacobin			TB							
	Phaethornis superciliosus Long-tailed Hermit		BH	O							
	Pygmornis longuemarcus Little Hermit		O	O							
TROGONIDAE - TROGONS											
	Trogon massena Slaty-tailed Trogon		O	O							
	Trogon melanocephalus Black-headed Trogon	Ramatutu		O	O		O	O	O		
	Trogon violaceus Violaceous Trogon			BH							
ALCEDINIDAE - KINGFISHERS											
	Ceryle alcyon Belted Kingfisher	Kingfisher	BCES, without location								
	Ceryle torquata Ringed Kingfisher	Kingfisher		O							
	Chloroceryle aenea Pygmy Kingfisher	Kingfisher		O							
	Chloroceryle amazona Amazon Kingfisher	Kingfisher		O							
	Chloroceryle americana Green Kingfisher	Kingfisher		O							

O=observerd, H=heard (sound i.d.), BH=Reported by B.Hassan, EC=Reported by E.Cuevas, JM=Reported by J.Meerman, TB=Reported by T.Boomsma, BCES=BCES report 1992

Bird List, Monkey River SDA

	HABITAT AND VEGETATION TYPE		High forest	River forest	Mixed scrub	Village	Littoral forest	Pine savanna	Mangroves	Monkey keys	Wet savanna
	SPECIES	LOCAL NAME	Type 1a	Type 1b	Type 2	Type 4	Type 4	Types 6&7	Type 8a-c	Type 8b	Type 9
GALBULIDAE - JACAMARS											
	Galbula ruficauda Rufous-tailed Jacamar		BCES, without location								
RHAMPHASTIDAE - TOUCANS											
	Pteroglossus torquatus Collared Aracari	Phyllis		O							
	Ramphastos sulfuratus Keel-billed Toucan	Billbird	O	O							
PICIDAE - PICULETS AND WOODPECKERS											
	Campephilus guatemalensis Pale-billed Woodpecker	Father Red-cap		O							
	Celeus castaneus Chestnut-coloured Woodpecker		O								
	Centurus aurifrons Golden-fronted Woodpecker	Carpenter		O				O	O		
	Centurus pucherani Black-cheeked Woodpecker			O							
	Dryocopus lineatus Lineated Woodpecker			O		O					
	Veniliornis fumigatus Smokey-brown Woodpecker			O							
FURNARIDAE - OVENBIRDS											
	Synallaxis erythrothorax Rufous-breasted Spinetail			H	H						
	Xenops minutus Plain Xenops			O							
DENDROCOLAPTIDAE - WOODCREEPERS											
	Dendrocincla anabatina Tawny-winged Woodcreeper			O							
	Dendrocincla homochroa Ruddy Woodcreeper			O							
	Sittasomus griseicapillus Olivaceous Woodcreeper			O							
FORMICARIDAE - ANTBIRDS											
	Cercomacra tyrannina Dusky Antbird		O								
	Formicarius moniliger Black-faced Anttrush		O	O							
	Thamnophilus doliatus Barred Antshrike			O	O				O		
	Thamnophilus punctatus Slaty Antshrike			O							
TYRANNIDAE - TYRANT FLYCATCHERS											
	Attila spadiceus Bright-rumped Attila			H							
	Elaenia flavogaster Yellow-bellied Elaenia			O				O	O		
	Megarynchus pitangua Boat-billed Flycatcher				O			O			
	Myiarchus tuberculifer Dusky-capped Flycatcher							O			
	Myiodynastes luteiventris Sulphur-bellied Flycatcher			O							
	Myiozetetes similis Social Flycatcher	Kiskadee		O	O			O	O		
	Oncostoma cinereigulare Northern Bentbill							O			
	Pitangus sulphuratus Great Kiskadee			O	O	O		O	0		
	Platyrhynchus cancrominus Stub-tailed Spadebill		O								
	Sayornis nigricans Black Phoebe		BCES, without location								

O=observerd, H=heard (sound i.d.), BH=Reported by B.Hassan, EC=Reported by E.Cuevas, JM=Reported by J.Meerman, TB=Reported by T.Boomsma, BCES=BCES report 1992

Bird List, Monkey River SDA

	HABITAT AND VEGETATION TYPE		High forest	River forest	Mixed scrub	Village	Littoral forest	Pine savanna	Mangroves	Monkey keys	Wet savanna
	SPECIES	LOCAL NAME	Type 1a	Type 1b	Type 2	Type 4	Type 4	Types 6&7	Type 8a-c	Type 8b	Type 9
	Tyrannus melancholicus Tropical Kingbird			O	O		O	O	O		
	Tyrannus savanna Fork-tailed Flycatcher							JM			
COTINGIDAE - COTINGAS											
	Schiffornis turdinus Trushlike Mourner		O	O							
	Tityra semifasciata Masked Tityra	White Woodpecker		O			O				
PIPRIDAE - MANAKINS											
	Manacus candei White-colared Manakin	Cohune popper	O	O							
HIRUNDINIDAE - SWALLOWS											
	Progne subis Purple Martin					O		O	O		
	Tachycineta albilinea Mangrove Swallow			O		O		O	O		
CORVIDAE - JAYS AND CROWS											
	Cyanocorax morio Brown Jay	Piam piam		O		O	O		H		
TROGLODYTIDAE - WRENS											
	Thryothorus maculipectus Spot-breasted Wren	Katy-yu-baby-di-cry	H	H	H			H	H		
	Troglodytes musculus Southern House-Wren			O							
VIREONIDAE - VIREOS											
	Hylophilus decurtatus Lesser Greenlet			O							
	Vireo magister Yucatan Vireo						O		O	O	
	Vireo pallens Mangrove Vireo			O	O			O	O		
PARULINAE - WOOD WARBLERS											
	Dendroica cerulea Cerulean Warbler						dead in wrack				
	Dendroica p. bryanti Mangrove Warbler									H	
	Dendroica petechia Yellow Warbler						O				
	Protonotaria citrea Prothonotary Warbler			O							
THRAUPINAE - TANAGERS											
	Cyanerpes cyaneus Red-legged Honeycreeper			O							
	Eucometis penicillata Gray-headed Tanager		O								
	Habia fuscicauda Red-throated Ant-Tanager		O	O							
	Phlogothraupis sanguinolenta Crimson-collared Tanager			EC							
	Rhamphocelus passerinii Scarlet-rumped Tanager			O							
	Thraupis episcopus Blue-Gray Tanager	Bluebird		O		O					
CARDINALINAE - GROSBEAKS AND BUNTINGS											
	Saltator atriceps Black-headed Saltator		O	O	O						
	Saltator maximus Buff-throated Saltator			O							

O=observerd, H=heard (sound i.d.), BH=Reported by B.Hassan, EC=Reported by E.Cuevas,
JM=Reported by J.Meerman, TB=Reported by T.Boomsma, BCES=BCES report 1992

Bird List, Monkey River SDA

	HABITAT AND VEGETATION TYPE		High forest	River forest	Mixed scrub	Village	Littoral forest	Pine savanna	Mangroves	Monkey keys	Wet savanna
	SPECIES	LOCAL NAME	Type 1a	Type 1b	Type 2	Type 4	Type 4	Types 6&7	Type 8a-c	Type 8b	Type 9
EMBERIZINAE - BRUSHFINCHES, SEEDEATERS, SPARROWS AND ALLIES											
	Oryzoborus funereus Thick-billed Seedfinch							O			
	Sporophila aurita Variable Seedeater			O							
	Sporophila torqueola White-collared Seedeater	Grassy bird		O		O					
	Volatinia jacarina Blue-black Grasquit			O							
ICTERIDAE - AMERICAN BLACKBIRDS AND ORIOLES											
	Amblycercus holocericeus Yellow-billed Cacique		O	O	O			O	O		
	Dives dives Melodious Blackbird			O		O	O				
	Icterus chrysater Yellow-backed Oriole	Banana Bird		O							
	Icterus dominicensis Black-cowled Oriole	Banana Bird		O							
	Icterus mesomelas Yellow-tailed Oriole	Banana Bird		O							
	Psarocolius montezuma Montezuma Oropendula	Yellow tail		O	O	O			O		
	Quiscalus mexicanus Great-tailed Grackle	Blackbird				O					

O=observerd, H=heard (sound i.d.), BH=Reported by B.Hassan, EC=Reported by E.Cuevas, JM=Reported by J.Meerman, TB=Reported by T.Boomsma, BCES=BCES report 1992

Mammal list, Monkey River SDA.

	HABTAT AND VEGETATION TYPE		High forest	River forest	Low swamp	Littoral forest	Pine savanna	Mangroves	Wet savanna
	SPECIES	LOCAL NAME	Type 1a	Type 1b	Type 3	Type 4	Types 6&7	Type 8a-c	Type 9
MARSUPIALA - MARSUPIALS									
Didelphidae - Opossums									
	Didelphis sp. Opossum (sp.?)	Possum	T	O		T	T		
	Chironectus minimus Wateropossum	Waterpossum		O					
	Philander opossum Gray Four-eyed Opossum	Four-eyes		R		R			
	Mouse Opossum (sp?)			R		R			
CHIROPTERA - BATS									
Noctilionidae - Bulldog Bats									
	Noctilio leporinus Fishing Bat	Bat		O					
PRIMATES - MONKEYS									
Cebidae - Monkeys									
	Alouatta pigra Mexican Black Howler Monkey	Baboon	O	O	R	R		R	
EDENTATA EDENTATES									
Myrmecophagidae - Anteaters									
	Tamandua mexicana Northern Tamandua	Antsbear	R	O		R		O	
Dasypodidae - Aramandillos									
	Dasypus novemcinctus Nine Banded Armadillo	Armadilly	T	T	T	T	T		
RODENTIA - RODENTS									
Sciuridae - Squirrels									
	Sciurius yucatenensis Yucatan Squirrel	Squirrel	O	R		R	R		
	Sciurius deppei Deppe's Squirrel	Squirrel	R						
Erethizontidae - Porcupines									
	Coendou mexicanus Mexican Hairy Porcupine	Porcupine	R	R		R			
Dasyproctidae - Cavimorph Rodents									
	Dasyprocta punctata Central American Agouti	Rabbit	T	T		R			
	Agouti paca Paca	Gibnut	T	T	T		T		
CETACEAE - PORPOISES, WHALES									
Delphinidae - Dolphins									
	Tursiops trunctatus Atlantic bottle-nosed dolphin	Papas	R, Inside the reef						
	Stenella frontalis Spotted Dolphin	Papas	R, Outside the reef only						

O=Observed during fieldwork, T=Tracks (or other traces) found,
R=Reported by Monkey River village residents

Mammal list, Monkey River SDA.

	HABTAT AND VEGETATION TYPE		High forest	River forest	Low swamp	Littoral forest	Pine savanna	Mangroves	Wet savanna
	SPECIES	LOCAL NAME	Type 1a	Type 1b	Type 3	Type 4	Types 6&7	Type 8a-c	Type 9
CARNIVORA - CARNIVORES									
Canidae - Dogs									
	Urocyon cinereoargenteus Gray Fox	Fox				R	O		
Procyonidae - Raccoon Family									
	Potos flavus Kinkajou	Nightwalker	R	O					
	Procyon lotor Northern Raccoon	Racoon	R	R	T	T	T	T	T
	Nasua narica White-nosed Coati	Quash	T	T		T	R		R
Mustelidae - Weasel Family									
	Eira barbara Tayra	Bushdog		O		R			
	Conepatus semistriatus Striped Hog-nosed Skunk	Polecat		R					
	Lutra longicaudis Southern River Otter	Waterdog		R					
	Mustella frenata Long-tailed Weasel	Weasel		R		R			
Felidae - Cats									
	Panthera onca Jaguar	Tiger	T	T		R	T		
	Herpailurus yagouaroundi Jaguarundi	Halari	R	R		R	T		
	Leopardus pardalis Ocelot	Tigercat	T	T			T		
	Leopardalus wiedii Margay	Tigercat	T	R					
	Puma concolor Puma	Red Tiger	T	O		R	T		R
SIRENIA - SEA COWS									
Trichechidae - Manatees									
	Trichechus manatus Manatee	Manantee	R, Inside the reef, sometimes up the river, usually around May						
PERISSODACTYLA - ODD TOED UNGULATES									
Tapiridae - Tapirs									
	Tapirus bairdii Central American Tapir	Mountain Cow	T	T			T		T
ARTIODACTYLA - EVEN TOED UNGULATES									
Tayassuidae - Peccaries									
	Tayassu tajacu Collared Peccary	Peccary	T	T			T		
	Tayassu pecari White-lipped Peccary	Warree	T	T					
Cervidae - Deer									
	Mazama americana Red Brocket Deer	Antelope	T	T		T			
	Odocoileus virginianus White-tailed Deer	Deer	T	T		T	T		T

O=Observed during fieldwork, T=Tracks (or other traces) found,
R=Reported by Monkey River village residents