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Cover: Marine turtle, *Dermochelys coriacea* nesting near Kamwatta Beach, Shell Beach, Guyana. Photo Tom Hollowell, Smithsonian Institution.

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1. The Effect of Birding on Local and Migrant waterfoul populations along the coast of Guyana

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INTRODUCTION

In Guyana, the richness and diversity of plant and animal life permeates every square inch of this land, from the mountain peaks to the tide pools of the seashore. Species diversity has been over the past ten years, the focal point of many studies (Wildlife Survey conducted by Iwokrama and EPA - August – December 2001). Much work has been completed in the interiors of Guyana, discovering, evaluating and cataloguing new and current species of fauna and flora. As researchers expand on the boundaries of their study areas, moving deeper into the hinterland, species along the heavily populated coastline are being overlooked. Over the years, much work has been compiled on the diversity of plant, fish, reptile, amphibian and more specifically mammalian species in the hinterland; however, little work has been compiled on the diversity native to and visiting our shoreline.

The study of the class Aves is termed Ornithology and is a diverse and complex science, incorporating branches of ecology, geology, etc. Birds are by far one of the most diverse classes in the animal kingdom, owing their success to several adaptations over the course of evolution. The class Aves is divided into two super orders: Ratite and Carinate. The class comprises of over 8600 species distributed among 27 living orders (4 ratite and 23 carinate). Ratite orders are composed of those flightless birds such as ostriches, rheas, emus and kiwis. Carinate birds include all those birds with a keeled sternum.

Of the 27 orders, 20 are found in Guyana. Of these 20 orders, 9 are shore birds (Prince et al, 1997). Both migrant and native shore bird species occupy important ecological niches, serve as important biological control agents and act as dispersers. Because of their importance in the ecosystem and their declining population numbers, the conservation and or protection of some species is vital for the promotion of a healthy and long living ecosystem. However, several factors have both directly and indirectly contributed to the decline in the numbers and diversity of shorebirds over the past years. The majority of these factors are anthropogenic activities, which have increased in prominence as the years progressed. Habitat destruction and pollution, pollution of food supplies, and over harvesting have all played significant roles in the decline of diversity and numbers of shorebirds in certain locations. One such anthropogenic activity, which has a direct impact on these statistics, is known in local circles as "birding".

WHAT IS "BIRDING"?

This pastime has been practiced for as much as fifty years and is enjoyed by young and old alike. In years gone by it was a tradition passed down from elders, siblings and shared between friends. The practice involves killing flocks of birds with a length of stiff wire. A short length of stick (between 12 – 20 inches) is inserted up to the half way to three quarter mark into the sand or mud depending in the composition of the feeding area of the birds. A length of stiff wire (40-50 feet) is attached to the stick about 6 inches off the surface of the sand or mud. All of the wire except for 5–8 feet is submerged in the top inch of the sand or mud at a right angle to the horizon. The free end of the wire is held in the hands of the "birder", who crouches to keep the wire in constant contact with the sand or

mud. When a flock of birds skims the surface of the sand or mud close enough, the wire is pulled taunt by the "birder" cutting into the flock.

The tension of the wire removes heads, wings and sometimes the feet of the bird, in the process killing the bird. The birds are collected, skinned, cleaned and the meat roasted, curried, or fried and eaten. An experienced birder may collect as many as 130 birds during the low tide period every day. Given this number it is evident that the quantity of birds taken each year is alarming, and, this therefore has serious implications for bird populations.

TARGETED SPECIES

"Birding" usually occurs during the period of August to October, although in some areas the practice continues year round. The bird groups usually targeted by "birders" include Ibises (Ibidae), Spurwings (Parridae), Plovers (Oedicnemidae), Sandpipers (Scolopacidae), Terns (Laridae), Water thrushes (Parulidae) and Egrets (Ardeidae). Most recently one member of the family Threskiornithidae, The Scarlet ibis (*Eudocimus rubber*) has also come under threat for its tender meat.

If this practice is allowed to continue unchecked coupled with the destruction and pollution of feeding grounds, several species may become too few in number or disappear before we can properly catalogue the diversity of our shore birds

ACKNOWLEDGEMENTS

Special thanks are extended to the person who laid the seed of this project in my head, Dr. Graham Watkins. Thanks are also extended to the following persons who gave to me guidance, encouragement and aid in many forms when I most needed it - Mr. Phillip Da Silva, Mr. and Mrs. Terry Bayney, Ryan Mc Kinnon, Waldike Prince, Class of 2002 – Biology. Finally to those people who aided me in many ways when I most needed them - Samantha James, Terry Bayney, Mr. Calvin Bernard, Damien Fernandes, Desmond Nicholson, Keith David and Nazir Khan.

Special Thanks are also extended to Ms. Chan Chal Prashad and Mr. Vijay Datadin - GIS, Iwokrama; for the preparation of all local maps presented in this report.

LITERATURE REVIEW

In order to accurately acquire and document the information need for this study, several key questions had to be first answered. One of which was "What are waterfowl?" The Ramsar Convention (The Ramsar Convention on Wetlands Importance Especially as Waterfowl Habitat, 1990) defines waterfowl as species of birds that are ecologically dependent upon wetlands for their survival. These species include groups from several families:

- loons or divers – Gaviidae
- grebes – Podicipedidae
- cormorants – Phalacrocoracidae
- pelicans – Pelecanidae
- herons, bitterns, storks, ibises, spoonbills – Ciconiiformes
- swans, geese, ducks – Anatidae
- wetland related raptors – Accipitriformes and Falconiformes
- cranes – Gruidae
- shorebirds and waders – Charadriidae; and
- terns – Sternidae.

However, in 1994 this list was updated to include all species of the following families: Gaviidae, Podicipedidae, Pelecanidae, Phalacrocoracidae, Anhingidae, Areidae, Balaenicipitidae, Scopidae, Ciconiidae, Threskiornithidae, Phoenicopteridae, Anhimidae, Anatidae, Pedionomidae, Gruidae, Asrmidae, Rallidae, Heliornithidae, Eurypgidae, Jacanidae, Rostratulidae, Dromadidae, Hematopodidae, Ibidorhynchidae, Recurvirostridae, Burhinidae, Glareolidae, Charadriidae, Scolopacidae, Thinocoridae, Laridae and Rhynchopidae. (Rose, P.M. and

Scott, D.A. ; Waterfowl Population Estimates, Wetlands International,1997).

The sequence and nomenclature of species within families was reviewed and treated by Silbey and Monroe (1990,1993), and O' Donnel and Fjeldsa (1993). The traditional sequence of families by Morony et al, (1975) was retained.

Of the thirty-two families of waterfowl identified, twelve (12) are found along the coastland of Guyana. Many of these bird species migrate from the Northern, Western and Eastern United Stated for the winter season (Prince et al, 1993). Millions of shorebirds make the annual 2000-mile journey from North America to winter in South America (O'Reilly and Wingfield, 1995). Migratory routes of shorebirds follow three main flyways: The Atlantic Flyway, The Pacific Flyway and The Central Flyway (Fig. 1) Shorebirds appearing on the coast of Guyana utilize the Atlantic and Central Flyways for their migration (W.W. Cook,1985) These migratory paths are influenced by winds and geography. Shorebirds are thought to have an internal compass for directional orientation which may be influenced by the sun, moon, position of stars, polarized light, magnetism, wind, photoperiod, or even olfactory cues (Kerlinger, 1995). Upon arrival at their destination they have usually exhausted their stored supply of body fat and are in need of refueling.

The beaches on the coastland of South America provide the ideal wetland conditions for these birds (Meyers and Meyers, 1979). The wetlands on the South American coast provide mangrove forests for shelter and breeding, and mudflats, sandy beaches and open fishing areas for foraging. Shorebirds are found mainly on the seashore between the low and high water marks feeding on a variety of small invertebrates, clams, snails, larvae and insects (Robert and McNeil, 1989). Due to the diversity of food supplies in the same wetland, large mixed flocks of shorebirds are usually observed.

It is for this specific reason that shorebirds migrate. At the onset of winter in the north, food becomes scarce; thus these birds set out in large flocks on an incredible migration to areas of abundant food supplies.

Despite the fact that millions of these birds set out on the migration, thousands die enroute due to predators and anthropogenic activities such as hunting. However all is not safe once they reach their feeding grounds. Due to the ever increasing presence of humans and their activities in wetlands and on beaches, the birds are slowly being pushed out of their habitats. This loss of habitat decreases food availability causing the birds to work harder to survive (Howe, 1989). Often times the feeding areas of the shorebirds are heavily polluted by solid and agricultural wastes that the food supply for the birds can no longer be accessed by them. In addition to loss of habitat, certain shorebirds also face predators; one of which is man himself. In certain circles, shorebirds are a gourmet treat for local diners as well as being good sport for "hunters" (Morrison, 1994). Surveys indicate a decline in the population numbers worldwide of Semipalmated sandpipers, Least sandpipers, Short-billed Dowicher, Red knots and Black-Bellied plovers (Morrison, 1994).

It should be noted that "Birders" on Guyana target all these birds with the sole exception of the Red Knot for their meat. The practice of " birding" has been in existence for over fifty years, and despite the laws protecting these birds during the closed season, they are still targeted during this time.

In 1973, the Government of Guyana passed a Wild Birds Protection Act which stated,

" Everyone who knowingly wounds, or, kills any wild bird specified in the First Schedule, or exposes or offers for sale or exports or attempts to export from Guyana, any wild bird or part of any wild bird captured or killed after any commencement of this act shall be liable to a fine of GY $75 for each wild bird or part thereof in respect of which the offence is committed." (Chapter 71:07, September 30,1919,3,18 of 1962). The first schedule being birds absolutely protected. For shorebirds this list includes Flamingoes, Frigate birds, Grebes, Herons, Kingfishers, Pelicans, Petrels, Rails and Crakes, Spurwings and Storks (Cap.71:07, pg. 6).

" Everyone who,
Knowingly captures, wounds, or, kills any wild birds specified in the Second Schedule during the closed season,
or;
Exposes or offers for sale, or, purchases any wild

bird recently captured or killed during the closed season; shall be liable to a fine of GY $75 for each wild bird in respect of which the offence is committed " (Chapter 71:07,6,18 of 1962, pg, 4.).

The Second Schedule being a list of wild birds protected during the closed season. Shorebirds referenced on this list include ducks, ibises, spoonbills, Spurwings, storks and thick-kneed plovers. (Cap.71: 07, O. in C., 5/11/1934; 39/1947. pg.7).

Closed seasons defined in the third schedule of this act (Cap.71: 07, O. in C., 5/11/1934; 39/1947. pg.7) designate the closed season for:

Ibises as – 1 st January to 1 st August in each year.

Ducks – 1 st April to 30 th September in each year

Other wild birds – 1 st April to 1 st August in each year.

With reference to the above stated information, the act further states, *"Any offence under this Act committed on the sea coast may be investigated by any magistrate in any county in which the accused person is found."* ((Cap.71: 07, Chapter 71:07, September 30,1919, 2 of 11).

Figure 1. Migratory routes of shorebirds follow three main flyways: The Atlantic Flyway, The Pacific Flyway and The Central Flyway.

OBJECTIVES AND JUSTIFICATION

Initially the main objective of this study was to produce a complete Shorebird survey for the coast of Guyana. However some time into the study the practice of "birding" came to light. From that moment the main focus of this study was to highlight the practice of "birding" as well as to determine what are the long and short term effects that this practice has on local and migrant shorebird populations.

Additionally, secondary studies were conducted to determine what species of birds and in what quantities were being targeted and killed by "birders". This study was based on observations, questionnaires and previous research.

Finally a waterfowl survey was compiled for the coast of Guyana from Darthmouth, Essequibo to Corriverton, Berbice. This survey was compiled based on observations recorded at designated study sites distributed along this stretch of the coast.

METHODOLOGY/ EXPERIMENTAL DESIGN

The procedure followed to obtain as accurate data as possible is presented in five steps:

In order to accurately identify what bird species were being targeted by the practice of "birding" several months were spent familiarizing oneself with the physical appearance, nesting patterns, feeding relationships and the vocalizations of birds present on the seashore.

Beaches were chosen within 3 – 5 miles of each other along the coast of Guyana from Dartmouth (Essequibo) to Corriverton (Berbice) as study sites. The study sites in which the practice was common were noted and mapped.

Questionnaires were distributed to at least two (2) persons at each study site. These were collected upon completion or on a subsequent visit to the site. The questionnaires were then analyzed to determine which of the study sites required heavy scrutiny in subsequent visits.

Field visits were conducted at low (¾ rising and low) tide to collect a detailed account of the bird species frequenting the shores. A 100m transect was set up parallel to the horizon and the entire beach mapped into 5 –6 zones. All bird life found in each zone was accurately identified and recorded along with their population numbers (using point counts – Reed et al, 1983) respective of their zones. (Potts et al, 1986) The zones were classified according to standards set by Lands and Surveys as well as their distance from the nearest man made barrier. Below is an example of how the zones were categorized:

APPENDIX 1

ZONE	DESCRIPTION
A	Vegetation preceding first man-made barrier running parallel to the horizon.
B	First man- made barrier parallel to the horizon.
C	Vegetation proceeding the first man-made barrier parallel to the horizon
D	Sand /Silt
E	Mud
F	Water Level

Interviews were conducted with at least four persons (2 adults, 2 youths) as well as questionnaires were completed at each shoreline visited to determine if the practice of "birding" occurred on that particular shoreline.

Through observations, interviews, and, postmortems it was determined exactly which species of shorebirds are being targeted by the "birders" and in what seasons they are being targeted.

Figure 2 Illustration showing "birders" unrolling wire used to kill birds.

Figure 3 "Birder" attaching wire to a short stick and fixing it into the ground. The wire is submerged in the top inch of the mud.

Figure 4 Illustration showing the result of "birding".

RESULTS

SHOREBIRD SURVEY

Upon completion of the bird surveys, investigation of all study sites, interviews and research a grand total of 23417* shore birds were observed (* indicates individual birds and not pairs). The classification of shorebirds was based on standards set by P.M. Rose and D.A Scott in 1994. This number comprised of 32 individual species and 12 orders. Of the 32 individual species 20 are listed as being migrant species (Snyder, 1966).

The list of the shorebirds observed along the coast of Guyana is represented in Table 2.

TARGETED SPECIES.

Of the 32 individual species identified, 18 are targeted in both closed and open season by "birders". These species include: Least sandpipers, Spotted sandpipers, Semipalmated sandpipers, Solitary sandpipers, Sanderlings, Short-billed Dowicher, Whimbrels, Greater and Lesser yellowlegs, Ruddy Turnstone, Semipalmated plovers, Collared plovers, Snowy egrets and Glossy ibis. Below is a precise list of the birds identified as the targeted species.

Table 1. Table showing all Shorebird species targeted by "birders" along the Coast of Guyana.

COMMON NAME	FAMILY	SCIENTIFIC NAME
Solitary Sandpiper	Scolopacidae	*Tringa solitaria*
Lesser Yellowlegs	Scolopacidae	*Tringa flavipes*
Greater Yellowlegs	Scolopacidae	*Tringa melanoleuca*
Spotted Sandpiper	Scolopacidae	*Actitis malcularia*
Ruddy Turnstone	Scolopacidae	*Arenaria interpres*
Least Sandpiper	Scolopacidae	*Calidris minutilla*
Semipalmated Sandpiper	Scolopacidae	*Calidris pusilla*
Sanderling	Scolopacidae	*Calidris alba*
Whimbrel	Scolopacidae	*Numenius phaeopus*
Dowicher	Scolopacidae	*Limnodromus griseus*
Semipalmated Plover	Charadriidae	*Charadrius semipalmatus*
Collared Plover	Charadriidae	*Charadrius collaris*
Great Egret	Ardeidae	*Casmerodius albus*
Snowy Egret	Ardeidae	*Egretta thula*
Little Blue Heron	Ardeidae	*Florida caerulea*
Cattle Egret	Ardeidae	*Bubulcus ibis*
Scarlet Ibis	Threskiornithidae	*Eudocimus ruber*
Glossy Ibis	Threskiornithidae	*Plegadis falcinellus*

Table 2. List of Migratory and Local Coastal bird species observed along Sample areas.

COMMON NAME	FAMILY	SCIENTIFIC NAME	INDIVIDUALS
Solitary Sandpiper	Scolopacidae	*Tringa solitaria*	423
Lesser Yellowlegs	Scolopacidae	*Tringa flavipes*	122
Greater Yellowlegs	Scolopacidae	*Tringa melanoleuca*	252
Spotted Sandpiper	Scolopacidae	*Actitis malcularia*	1802
Ruddy Turnstone	Scolopacidae	*Arenaria interpres*	1531
Least Sandpiper	Scolopacidae	*Calidris minutilla*	6465
Semipalmated Sandpiper	Scolopacidae	*Calidris pusilla*	990
Sanderling	Scolopacidae	*Calidris alba*	398
Whimbrel	Scolopacidae	*Numenius phaeopus*	118
Dowicher	Scolopacidae	*Limnodromus griseus*	73
American Oystercatcher	Haematopodidae	*Haematopus palliatus*	3
Black-Bellied Plover	Charadriidae	*Pulvialis squatarola*	122
Semipalmated Plover	Charadriidae	*Charadrius semipalmatus*	1264
Collared Plover	Charadriidae	*Charadrius collaris*	242
Large-Billed Terns	Laridae	*Phaetusa simplex*	83
Common tern	Laridae	*Sterna hirundo*	387
Yellow-Billed Tern	Laridae	*Sterna superciliaris*	30
Least Tern	Laridae	*Sterna albifrons*	551
Black Skimmer	Rynchopidae	*Rynchops nigra*	549
Magnificent Frigatebird	Fregatidae	*Fregata magnificens*	2335
Great Blue Heron	Ardeidae	*Ardea herodias*	23
White-Necked Heron	Ardeidae	*Ardea cocoi*	102
Great Egret	Ardeidae	*Casmerodius albus*	637
Snowy Egret	Ardeidae	*Egretta thula*	1448
Little Blue Heron	Ardeidae	*Florida caerulea*	463
Tricoloured Heron	Ardeidae	*Hydranassa tricolor*	12
Striated Heron	Ardeidae	*Butorides striatus*	2
Cattle Egret	Ardeidae	*Bubulcus ibis*	1071
Black-Crowned Night Heron	Ardeidae	*Nycticorax nycticorax*	188
Scarlet Ibis	Threskiornithidae	*Eudocimus ruber*	80
Glossy Ibis	Threskiornithidae	*Plegadis falcinellus*	143
Wattled Jacana	Jacanidae	*Jacana jacana*	208
Everglade Kite	Accipitridae	*Rostrhamus sociabilis*	40
Crane Hawk	Accipitridae	*Geranospiza caerulescens*	23
Osprey	Pandionidae	*Pandion haliaetus*	72
Crested Caracara	Falconidae	*Polyborus plancus*	62

SAMPLE AREAS POSITIVE FOR "BIRDING"

A total of 55 beaches were sampled ranging from Dartmouth (Essequibo) to Corriverton (Berbice). Of the 55 beaches sampled, the practice of "birding" was prevalent in 40 (72% of the beaches sampled) (See Table 3). In each of these locations, it was observed that the shoreline consisted of almost 75% mud in proportion to sand or silt. This data is consistent with the fact that most shorebird species forage for food in shallow mud rich in invertebrate life (Robert and Mc Neil, 1989).

When analyzed, the "mud" was found to be a combination of very fine silt and mud. This environment provided the best habitat for the micro and macro invertebrate life such as the polychaete and oligochaete worms, insect larvae and aquatic insects on which the birds feed. Below is a depiction of the basic plan of the study sites in which most (90%) of the shorebirds were observed. It should also be noted that this is also the basic plan of all the study sites in which "birding" occurred.

ZONE	DESCRIPTION	LENGTH(feet)
A	Short shrubs, grasses and marshy land with numerous water pools	250 – 300
B	Man-made barrier/structure—Usually a seawall or grouping of boulders	30 – 45
C	Mangrove forests or small grouping of mangroves or tall trees.	50 – 75
D	Sand / loose silt	10 – 30
E	Fine silt and mud	400 - 650
F	Water mark	-

KILLING METHODS AND JUSTIFICATION

When interviewed, 165 (75%) out of a total of 220 persons admitted to killing birds along the seashore. The main method of killing the birds was by using the wire method as described in the introduction. All of the persons who indicated that they had killed birds on the seashore stated that they used this method to kill and maim the birds. A small percentage (9%) also indicated that they used nets to capture the larger birds.

Of the total number of persons who admitted to killing these shorebirds, 117 (70.9%) indicated that they killed for food alone, whereas, 48 (29%) persons indicated that they killed both for food and for the sport of the kill.

OPEN MARKETS

When the interviews were conducted, it was discovered that five of the study sites (Suddie, Kitty, Triumph/BV, Mahaica, and Corriverton) actually had open markets for these shorebirds. The term open market refers to a particular stall, stand or premises in which these birds are sold; either in pieces or whole. In Truimph and Mahaica stall owners stated that in the seasons in which the birds were in abundance they were usually sold at a cost of $ 200 per dozen birds or $200 for every three pounds. However, when the birds are not abundant, consumers will pay between $500 - $1000 per dozen. Stall owners stated that the most popular birds are the Sandpipers and Plovers; however, in recent years there has been an increased demand for such birds as the Little Blue Heron and other Egrets. It should be noted, however, that there is only a small percentage of the population that actually purchases these birds from markets, and thus the markets remain small. Those members of the population that indulge in the consummation of these shorebirds are mainly limited to those individuals who execute the act of " birding", and their families.

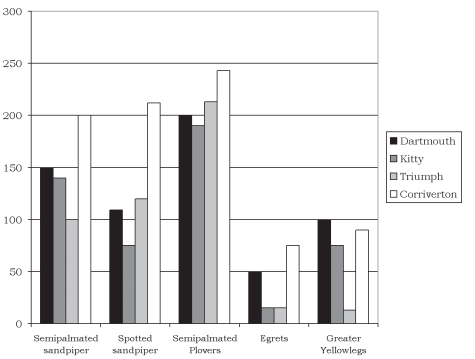

Figure 5. Bar chart showing quantities of popular targeted shorebirds usually sold daily when the birds are abundant on the beaches.

Despite the fact that 165 persons admitted to indulging in the practice, 173 (78.6%) admitted to knowing about the practice and stated that they had indulged in it as children. However despite the fact that 173 persons (78.6%) admitted to knowing of the practice, only one person indicated that they were aware of an open and closed season on certain birds. Alarmingly, none of the persons interviewed indicated that they were aware of the fact that it was illegal to kill certain species of shorebirds and that there liable to be fined for killing and of these protected bird species.

BIRDING SEASONS

All of the "birders" interviewed indicated that they were two seasons in which they usually kill these birds. Season one was during August to December each year, and, Season two was during the period of March to July each year.

Of the 165 "birders" interviewed all admitted to catching the birds during the period of August to December, however almost 145 also admitted to killing birds after December and during seasons designated as closed seasons.

Table 3. Table showing study sites in which "birding" was prevalent and those having open markets.

LOCATION	BIRDING	OPEN MARKET
Darthmouth	No	No
Anna Regina	No	No
Suddie	Yes	Yes
Parika	No	No
Philadelphia	No	No
Dan Heuvel	No	No
Zeelugt	No	No
Zeeburg	Yes	No
Metenmeer Zorg	No	No
Uigtlugt	No	No
La Jalousie	No	No
Ruimzigt	Yes	No
Anna Catherina	No	No
Blankenburg	No	No
Hague	No	No
Vergenougen	No	No
Lenora	No	No
Kitty	Yes	Yes
Turkeyn	Yes	No
Goedforwagting	Yes	No
Le Resouvenier	Yes	No
Triumph/BV	Yes	Yes
Lusignan	Yes	No
Haslington	Yes	No
Victoria	Yes	No
Hope Beach/ Anns Grove	Yes	No
Enmore	Yes	No
Mosquito Hall	Yes	No
Mahaica	Yes	Yes
Columbia	Yes	No
Glazier's Lust	Yes	No
Carlton Hall	Yes	No

LOCATION	BIRDING	OPEN MARKET
Bushy Park	Yes	No
Yorkshire Hall	Yes	No
Calcutta	No	No
Mahaicony	Yes	No
Abarry	Yes	No
Foulis	Yes	No
Golden Fleece	Yes	No
Hope	Yes	No
Seafield	Yes	No
Brittania	Yes	No
Hopetown	Yes	No
Bath	Yes	No
Zeelust	Yes	No
D'Edward	Yes	No
Rosignol	Yes	No
Blairmonth	Yes	No
Rose Hall	Yes	No
New Amsterdam	Yes	No
Eversham	Yes	No
Leeds	Yes	No
Benab	Yes	No
Corriverton	Yes	Yes

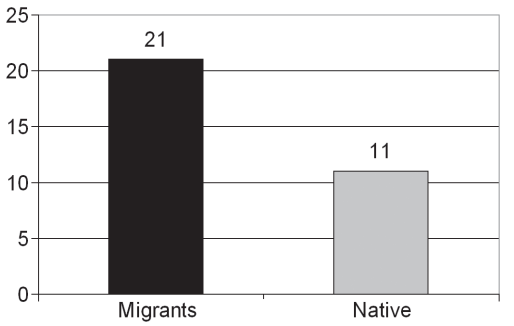

Figure 6. Bar Graph sowing the number of migrant verses native species of shorebirds observed along the study sites.

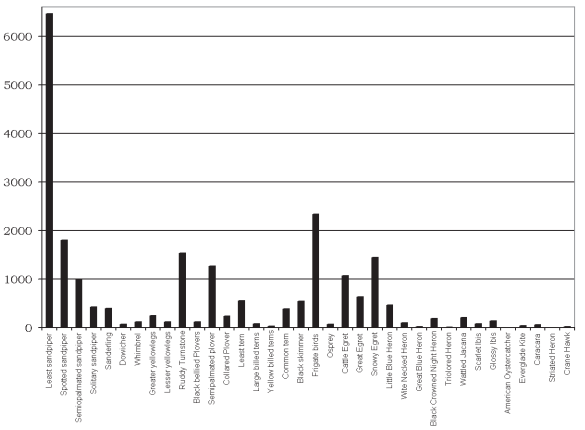

Figure 7. Bar chart showing quantity of individual birds sighted in study sites.

DISCUSSION

The data collected from the study sites along the coast clearly show that there is an amazing diversity of bird life frequenting our shorelines. This collection includes both migratory and native bird life. Clearly, the population numbers of certain species of these shorebirds warrants a closer inspection by the Environmental Protection Agency. Many of the species targeted are legally protected by the Wild Birds Protection Act of 1973. These bird species include members of the family Ardeidae (Herons or gaulins, egrets and allies), Frigatidae (Magnificent Frigatebirds), Jacanidae (Jacanas and Spur-wings) and Phoenicopteridae (Flamingoes) , which are all absolutely protected. This means that they cannot be killed, maimed or captured for sale or consumption. These bird species protected by the act in closed seasons include members of the family Anatidae (Ducks and Geese), Threskiornithidae (Ibises), and Jacanidae (Jacanas / Spur-wings).

The closed seasons defined in the third schedule of this act (Cap.71: 07, O. in C., 5/11/1934; 39/1947. pg.7) designate the closed season for:

Ibises as – 1 st January to 1 st August in each year.

Ducks – 1 st April to 30 th September in each year

Other wild birds – 1 st April to 1 st August in each year.

It should be noted that an exception applies to the closed season for ducks. Ducks may be removed in any manner convenient from rice fields and their vicinity at any point in the year.

In Guyana the law does not protect species most targeted by “birders”. However in other areas of the world from which these birds migrate (e.g. Chesapeake Bay, Western United States, Canada and The Great Salt Lake) conservationists and Wild bird Protection Groups have put certain legislation into motion for their protection. Specifically conservation groups have designated safe areas or sanctuaries where these birds congregate to feed or breed. These steps were put in place when P. M Rose and D.A Scott of Wetlands International in 1994 observed that the population numbers of certain species of shorebirds were at an all time low. Upon careful investigations it was discovered that this was the case in many other stopover, breeding and foraging sites of these birds. Investigators from Wetlands International, The U.S Fish and Wildlife Service and other state wildlife protection agencies joined in the search for the reason of this sudden decline.

In 1997, they compiled their information and efforts to give the much needed boost to the legislation process which would place a ban on the removal of shorebirds, eggs or nests from beaches identified as stopover sites, foraging and breeding sites along the coastline. In addition to the laws governing the act, severe fines or jail sentences were imposed on anyone caught removing any part of the natural vegetation of the area, eggs, nests or individual birds from the beaches when occupied by the bird populations.

The legislation implemented in these areas worldwide was designed not only to protect the bird population but also to keep the populations at a healthy number. By also imposing bands on littering along the beaches, legislators and conservationists also protected the food supply and natural ecosystems of the birds. The bird species found in Guyana protected under this legislation include the Spotted Sandpiper, Semipalmated Sandpiper, Least Sandpiper, Whimbrels, Greater and Lesser Yellowlegs, Ruddy Turnstones, Dowichers, Semipalmated Plovers, Collared Plovers, Black Bellied Plovers, Least Terns, Common Terns, Large-Billed Terns, and The American Oystercatcher.

Migratory shorebirds not only face threats from hunters but they also face the threats of pollution of their habitats and natural wetlands from agricultural runoff, loss of wetlands due to development for agriculture, disease, bad weather and disturbance at stopover sites by humans, vehicles or dogs. Often times the threats posed by disturbances at stopover sites cause

the migration flocks to continue to the next programmed stopover site (which may be hundreds of miles away) without much needed food or rest.

Sadly the situation is no different in Guyana. Shorebirds are under constant threat from "birders" upon their arrival on the beaches; they face pollution of their habitat, destruction of rest areas by humans harvesting mangroves, and, drainage of "wetlands" for agricultural land. The harvesting of mangroves for firewood and struts is widespread along the coast of Guyana. Despite the fact that mangrove forests serves as roosting and breeding sites for thousands of birds, the strong branches and at times the entire tree are indiscriminately harvested. This practice was observed in Darthmouth, Parika, Ruimzeight, Kitty, Victoria, Anns Grove, Mahaica, Abary, and, Leeds. Unfortunately all of the study sites in which this practice occurred also supported large populations of egrets, herons, jacanas, and raptors in the affected mangrove forests. Villagers are unaware of the large-scale disturbance they cause when they enter the mangrove forests. In their haste to harvest the mangroves, they are unaware of the fact that they displace countless birds, which happen to be nesting in the trees, as well as disturbing the birds nesting in neighbouring trees. Frequently this frenzy of human activities deters the birds from returning to that particular nesting site.

This is most unfortunate since there are already so few suitable nesting sites for these birds. Despite the fact that the government has placed restrictions on the harvesting of mangroves in selected areas, there are very few enforcers of the law along the coast. When the issue of birding arises, this scenario again presents itself. It is an undisputed fact that there are laws protecting certain species of shorebirds from being hunted, killed, maimed, or, captured for sale or human consumption; however, are there enough human resources to enforce and upkeep these laws? Clearly, in Guyana there are not adequate human resources to fulfill this demand.

Does the government need to employ patrol officers or do the conservation and environmental groups of the country need to employ tactics to inform and educate those in violation of these laws? Or, is it simply that the Wild Birds Protection Act needs to be re-evaluated to exclude present protected species or to include species threatened by the various anthropogenic activities highlighted in this report? Theses are questions that can only be answered by those policy and law makers who are in a position to inject real change and ensure that possible solutions are evaluated, and it plausible, executed and maintained for as long as the problem persists or until more plausible solutions present themselves.

The idea of employing "patrol officers" to curtail the problem of birding and overharvesting of mangroves which serve as nesting sites for thousands of shorebirds, may not be the most efficient means of putting a halt to these practices. The answer may in fact lie in the education system. It obvious at every study site that the villagers and "birders" were not aware that they were breaking the law. Many of the adults interviewed lacked formal education, or were limited in the level of education they were exposed to. This is the seed of "birding" as well as overharvesting of mangroves. None of the persons interviewed were even aware that there was a Wild Bird Protection Act, and that the contents of this act prevented the hunting, killing, maiming, or, capturing of many of the species of targeted birds. Again when asked about the harvesting the mangroves, the reply was always the same. All persons interviewed were not aware that the removal or destruction of these forests was in violation of the laws of Guyana. Few were aware that the law protected certain mangrove forests such as those on Shell Beach and along the Demerara River. They however, concluded by stating that they did not think that all mangroves, even the ones with nesting colonies of birds were included in this Protection Act. When asked about the Forestry Act protecting mangroves, all but one was aware that the Forestry Act even included mangroves as forests.

This is an alarming figure, and an even more alarming setback for the general public. In any estimation it appears that the Government of Guyana, The Forestry Commission, The Environmental Protection Agency, or any other concerned environmental/ conservation organization need to take a careful look at how

those people most affected by their legislation and "solutions" to remedy current problems are affected by these changes. In addition to the evaluation of those affected, these organizations also need to take a closer look at how the legislation implemented is received by the residents in the areas of concern. Is the correct information reaching those most in need of it, do the legislators need to broadcast their plans to a wider audience, or are we simply not investing enough resources and effort into educating the ones we most need to reach?

RECOMMENDATIONS

The information presented in this report has highlighted several threats humans pose to migrant and native shorebird populations. The roots, seed and stems of the problem have also been identified, however, it is hoped that further work is undertaken to determine the full extent to which these and other problems occur along the coast. Further research will not only be able to determine the full extent of damage caused by these problems in all regions along the coast; but it will also provide a more comprehensive and complete guide to all native and migrant shorebirds along the Guyana coast.

In addition to further research, it is hoped that the government or those organizations responsible for educating the public take a more hands on approach when dealing with the public and those individuals most affected by the changes outlined in these new plans.

Another careful survey needs to be undertaken by the Forestry Commission in order to determine exactly what mangrove forests are harvested by humans, and exactly which of those forests provide a sanctuary for bird life.

It is also important to undertake studies to determine exactly what species of birds inhabit these mangroves. Once this is determined, the relevant steps should be taken to have those areas which support large healthy populations declared bird sanctuaries protected by law.

REFERENCES

TEXT REFERENCES

Botton, M.L, Loveland, R.E., and Jacobsen, T.R. 1994. Site Selection of Migratory Shorebirds in Delaware Bay and its Relationship to Beach Characteristics and Abundance of Horse shoe Crab (Limulus polyhemus) eggs. Auk.111(3).

Burger, J.1984. Abiotic factors Affecting Migrant Shorebirds. In: Shorebirds Migration and Foraging Behavior (J. Burger and B. Olla, eds.). Plenum Press, New York.

Day, S., 1992. Migration. New scientist 135, S12'92, 4 page insert.

De Schauensee, R.M. and W.H. Phelps, Jr. 1995. A Guide to the Birds of Venezuela. Princeton University Press. U.S.A.

Elphick, J., 1995. Atlas of Bird Migration: Tracing the Great Journeys of the World's Birds. Random House, New York.

Erckmann, W.J. 1983. The Evolution of Polyandry in Shorebirds: An Evaluation of Hypothesis In: Social Behaviour of Female vertebrates. (Wasser, S.K.,ed). New York Academic Press, N.Y.

Gould, J.L., 1995. Constant Compass Calibration. New Scientist.

Helmers,D.L., 1992. Shorebird Management Manual. Western Hemisphere Shorebird reserve Network, Manomet,Ma.

Hinds, W., 2001. Checklist of Birds on Almond Beach. Guyana Marine Turtle Conservation Society, Georgetown Guyana.

Howe,M.A., P.H. Geissler, and B.A. Harrington. 1989. Population Trends of North American Shorebirds based on the International Shorebird Survey, Biological Conservation.

Johnsgard, P., 1981. The Plovers, Sandpipers, and Snipes of the World. University of Nebraska Press, Lincoln, NE.

Kerlinger, P., 1995. How Birds Migrate. Stackpole Books, Mechanicsburg, PA.

Kerlinger, P., 1995. Night Flight. Natural History. P 67 - 68

Meyers, J.P. and L.P. Meyers, 1979. Shorebirds of Coastal Buenos Aires Province, Argentina. Ibis. 121: 186 - 200

Morris, A., 1996. Shorebirds: Beautiful Beachcombers. North Woods Press, Inc. Minocqua, WI.

Morrison, R.I., 1994. Shorebird Population Status and Trends in Canada. In: Bird Trends. A Report on results of National and Regional Ornithological Surveys in Canada. Environment Canada. 3: 1 – 20.

O'Reilly, K. and Wingfield, J.C., 1995. Spring and Autumn Migration in Arctic Shorebirds: Same Distance, Different Strategies. American Zoologists. 35.

Page, G.W. and R.E. Gill, 1994. Shorebirds in Western North America: late 1800's to late 1900's. Studies in Avian Biology. 15: 147 – 160.

Pfister, C., B.A. Harrington, and M. Lavine, 1992. The Impact of Human Disturbance on Shorebirds at a Migration Staging Area. Biological Conservation. 60: 115 – 126.

Prince, W., C. Bernard et al., 1997. Report of Shorebird Survey to Almond Beach. Small Grants Programme Proposal for Management of Natural Resources. Dept. of Biology, university of Guyana.

Robert, M. and R. Mc Neil, 1989. Comparative Day and night Feeding Strategies of Shorebird Species in a Tropical Environment. Ibis 131: 69 – 79.

Robinson, S.K., 1995. Regional Forest Fragmentation and the Nesting Success of migratory Birds. Science. Pp 1987 –90.

Rose, P.M and D.A Scott, 1997. Waterfowl Population Estimates, Second Edition. Wetlands International Publ. 44, Wageningen, Netherlands.

Skagen, S.K. and Knopf, 1994. Migrating Shorebirds and Habitat Dynamics at a Prairie Wetland Complex. Wilson Bulletin. 106: 91 – 105.

Snyder, D.E., 1966. The Birds Of Guyana. Xxx Publishers.

Watson, G.E., 1966. Seabirds of the Tropical Atlantic Ocean. Smithsonian Press. Washington, D.C.

INTERNET REFERENCES

http://www.staste.nj.us/drbc/shorebiords/trend.htm
http://www.newton.dep.anl.gov/natbltn/700 – 799/nb728.htm
http://www.com/CommercialSt/ tmcnish/Ardea_herodias.jpg
http://www sofia.usgs.gov/.../kids/images/critters/whiteheron.jpg
http://www-boone.fnal.gov/cgi-bin/ kasper/birds/pics?6
http://www.flmnh.ufl.edu/NATSCI/NIMAGES/ORNITH/GALLERY/HERONGWP.JP
http://www.redpath-museum.mcgill.ca/ .../greatblueheron.htm
http://www.manitobanature.ca/birder
http://www.dcr.state.va.us/ dnh/bushmill.htm
http://www.florida-everglades.com/ birds.htm
http://vwww.cws-scf.ec.gc.ca/ hww-fap/eng_ind.html
http://www.flmnh.ufl.edu/NATSCI/NIMAGES/ORNITH/GALLERY/HERONGB2.JP
http://www.avesint.com/ costarica.html
http://www.swr.ucsd.edu/hcd/biota.htm
http://www.smithsonianmag.si.edu/ .../sep97/

egrets_jpg.html
http://www.selcga.org/act_wetland_protect.shtml
http://www.amazonian-fish.co.uk/ images/egrets.jpg
http://wwwpacific.fws.gov/sandiego/southbay.html
http://www.caleuche.com/River/ Images/Egrets.jpg
http://www.rep.org/al/al_index.htm
http://www.geocities.com/observesat/photo10.htm
http://www.accessatlanta.com/.../image/ birds/fullsize/egrets.jpg
http://migratorybirds.fws.gov/shrbird/shrbird.html

SOURCE REFERENCES

Schedule 1-IV, Legal Supplement; The Official Gazette, 29 th September, 1999., The Laws of Guyana.

Wild birds Protection Act, Laws of Guyana, Legal Supplement., Chapter 71:07., Schedule 1-3.

2. Reproductive Patterns of Insectivorous and Frugivorous Bats At CEIBA Biological Station and Iwokrama Forest

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Prepared for the Center for the Study of Biological Diversity

SUMMARY

Bat species make up more than half of the mammalian diversity in Guyana. They play a vital role in the ecological systems of the forest such as pollination and seed dispersal of key plant species and as such can be used as a tool for monitoring disturbances. The value and important functions bats perform in the forest makes it necessary to learn more about these animals and to make sure that vial populations are maintained to ensure the continued health of the forest.

Over a 12-month period (1999 – 2000) an inventory of and reproductive data was collected on the bats at the CEIBA Biological Station. This study aimed at looking at the reproductive pattern in bats from the CEIBA Biological Station and compares it to available data from the Iwokrama Forest. Data was collected with the use of mist nets at CEIBA and field notebooks lodged at the Centre for the Study of Biological Diversity and the Iwokrama International Centre for Rain Forest Conservation and Development. This project also provided the opportunity to introduce and train biology students from the University of Guyana in bat biology.

During the study, literature reviews indicated that bats might follow one of four reproductive cycles – seasonal monestry, seasonal polyestry, aseasonal polyestry and bimodal polyestry. These cycles are dependent on many factors the most important being food. 30 species of bats were netted during the course of the study. 11 species were insectivores and 12 frugivores. Analysis shows that frugivorous bats tend to follow a bimodal cycle while insectivores may follow either of two cycles' seasonal monestry or seasonal polyestry. There are indications that frugivores give birth in the months of March- April and July –August at CEIBA but no definitive trend could be detected for insectivores. The gaps in the data for the Iwokrama Forest makes it difficult to compare the two locations and it is hoped that with more data there will be a better picture for understanding bat reproduction.

INTRODUCTION

Bats are the only mammals that can truly fly and represents the second largest order of mammals with about 900 species (Emmons, 1990; Nowak, 1994). Bat species richness is highest in the tropics, and in particular the Neotropics (Emmons, 1995, Voss and Emmons, 1996). Until recently the bat fauna of Guyana has been poorly documented and only a small number of collections, miscellaneous records and reviews of specimens are available (Smith and Kerry, 1996; Lim et al, 1999; Lim and Engstrom, 2001). Thus compared to neighboring countries, there are no comparable summaries available.

Bats play a vital ecological role in forests as well as provide useful and beneficial services to humans. Bats disperse seeds and pollinate flowers of many important forest plants. Fujita and Tuttle (1991) estimated that at least 443 products useful to people, from 163 plant species, rely to some extent on flying fox bats for pollination or seed dispersal in the Old World Tropics. These include timber products such as balsa; fruits such as avocado (*Persea americana*), bananas (*Musa acuminata*), guavas (*Psidium guajava*), mangoes (*Mangifera indica*); nuts such as cashews (*Anacardium occidentale*); and fibers such as manila (*Musa*

textilis). For some plants, bats may be the only vertebrates capable of dispersing their seeds, thus bats play a "keystone" role in the structuring of forest communities (Nowak, 1994). As dispersers of "pioneer" species like *Cecropia, Solanum* and *Piper*, bats also play an important role in the regeneration of cleared areas (Nowak, 1994). For example *Carollia perspicillata* eats up to 35 fruits of the genus *Piper* per night, dispersing some 350-2500 seeds, dispersed per night per individual. Insectivorous bats such as the Vespertilionids may depress populations of mosquitoes (Nowak, 1994). Bats may also be indicators of different levels of habitat destruction. Communities that include many species of phyllostomid bats have been suggest an undisturbed primary rainforest (Fenton et al, 1992). In view of their roles in tropical rainforest it is vital that ecologically viable bat populations are maintained.

Despite the evidence that support the importance of the role bats play in the sustaining the forest, forestry managers do not incorporate monitoring bats into their management programs. Thus, completely neglecting the evolutionary and ecological relationship between bats and plants (Ochoa, 1992). The forest plays an important role in the economic sector of many countries including Guyana and the implication of reduction of bat populations or extinction must be considered when thinking of conservation and forest management. Thus the increase of knowledge and awareness of the value of bats would be needed for the formulation and implementation of future programs that aim to conserve tropical forests and its associated interactions.

A healthy population of any animal is key to the continued health of the forest. This study was designed to firstly document the species of bats that can be found at the CEIBA Biological Center and secondly to look at the reproductive patterns that bats exhibit at that location and compare these patterns to areas of Guyana where data are available. The project was also geared to continue the process of training young biologists in the methods of surveying and identifying of bats. In Guyana there are few people familiar with the bat fauna thus it becomes important to provide training for interested persons so that there will be increased expertise in this field.

METHODS

STUDY SITE

The CEIBA Biological Centre (CEIBA) is located on the Linden-Soedyke Highway (N 06°29′35″ W 058°13′17″) approximately 33 km from Georgetown the capital of Guyana. CEIBA is in the sandy belt region of Guyana, which extends approximately 200 km from the coast southwards (ter Steege, 1993) hence this soil type mainly determines its vegetation. The lower end of the study site is situated near a swamp and the vegetation on this end is dictated by this condition. The swamp forest is dominated by Mora (*Mora excelsa*). The swamp forest has two sources of water the Yaracabra Creek running through the station on the western section and on the eastern end an underground spring, which give rise to a small creek. Wallaba (*Eperua falcata*) once dominated the dry upland vegetation, however, this species has been harvested the area is now dominated by the legume Dakama (*Dimorphandra conjugata*). CEIBA experiences an average mean temperature of 27 °C and an average monthly rainfall of 227 ml (Hydrometrological Department, 2001).

METHODOLOGY

Bats were captured by mist nets, which is one of the best methods of capture (Wilson et al, 1996). Nets were deployed along trails in the under story of the forest, in clearings and along and across black water streams in and around the research station. The nets were set in five different micro-habitats classified as dry upland forest, swamp forest, human altered habitat with buildings, secondary growth and forest streams as a means of maximizing the diversity and abundance of the species caught.

During each sampling evening, approximately 10 nets of dimension 2.6m x 12m and 2.6m x 6 m were used. Nets were opened between 1800 and 1830 and closed at approximately 2300. They were checked every 30 – 45 min. for animals. After removal, bats were identified (using a key developed by Lim and Engstrom, 2001) and weight, forearm length; sex and reproductive information were taken. The bats were then released. Marking of the bats captured was tried using water paint but the markings were not permanent so this was discontinued. Netting was done every two weeks from 27 February 1999 to 26 February 2000.

The reproductive status of females was judged by the distention of the adbomen or by palpating the abdominal area to detect presence or absence of an embryo (B.K. Lim, pers. Comm.; Fleming et al, 1972; Petit, 1997). Small embryos will however be passed over due to size and distention possibly misjudged after feeding (Fleming et al, 1972). Lactating females were judged by lightly palpating the pectoral region for milk exudates (B.K. Lim, pers comm,). Pregnant females not lactating were considered to be pre-lactating; while non-pregnant females with enlarged nipples and not lactating were considered to be post-lactating. No data were collected for males as testes position is labile for many species and great faith cannot be placed in this as a means of judging reproductive status (Fleming et al, 1972; Petit, 1997)

Voucher specimens were collected to represent the species present within the area and when identification was in doubt. Only alcoholic specimens were prepared. After tissues were taken the specimen was injected with 10% formalin and placed in it for fixation. The fixed specimens were then removed from the formalin and placed in water over night to remove as much of the fixative before storing in 70 % ethanol. The tissues samples collected were stored in 95% ethanol. Information collected on the specimens include, date collected, location, total length, tail length, length of left hind-foot, length of ear and tragus, length of forearm, and weight. Taxonomic verifications were done by the Royal Ontario Museum (ROM) Ontario, Canada.

Reproductive data necessary for comparison were gathered from the Centre for the Study of Biological Diversity (CSDB) where copies of field notebooks for scientific expeditions are stored. Information collected includes species identification, locality of species collection, date, sex and reproductive data. The data used for comparison were from the Iwokrama Forest collected during the faunal surveys during 1997.

RESULTS

SPECIES RECORDS

I sampled bats for a total of 15, 795 m^2 hours [net length (m) x net width (m) x time (h)]. During the research thirty species representing five families were captured from five microhabitats at CEIBA. Twenty-four species have been positively identified from specimens collected. The positive identification of *Lionycteris spurrell* remains uncertain, as there are no specimens for this species. The family Phyllostomidae was the largest represented family with 28 species from the 6 subfamilies. The family Emballonuridae was represented by four species and the families Noctilionidae and Molossidae were represented by one species captured near the Madewini Bridge along the Linden-Soedyke Highway.

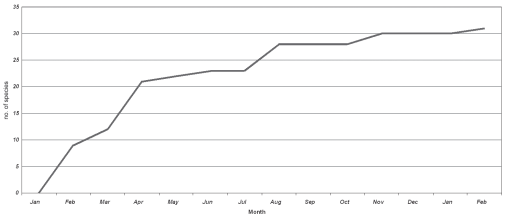


Figure 1. Species accumulation curve at CEIBA

Looking at the total area of CEIBA (12 acres) into consideration the number of species captured is considered high. The species diversity was estimated at 43 species for the area using Choa's Estimator

$$S^* = S_{obs} + (a^2 / 2b)$$

S_{obs} – number of species observed
a – number of singletons
b – number of doubletons

During a more recent one-week (October, 2000) stint of collecting by the Royal Ontario Museum at CEIBA 12 new species were collected for the area bring the species count to 42 and adding two new families Mormoopidae and Vespertilionidae. Despite this conservative estimate of species diversity its expected that the species count for CEIBA will raise beyond the estimated number as the species captured during the study were low flying and the levels above the reach of the ground nets are always under sampled (Karr, 1981) and as such the diversity of bats is expected to rise especially with the sample of the canopy.

SPECIES HABITAT DISTRIBUTION

The area around CEIBA was divided into five microhabitats: dry upland forest (mainly Dacama), swamp forest (Mora), forest creeks, secondary growth and human altered habitat (mainly dwelling area). The phyllostomid bats were captured mainly in the secondary growth, dry upland and swamp forest. Some were caught over the forest creeks. *Desmodus rotundus* was the only species caught in human altered habitat. The Emballonurids were mostly caught over the forest creeks except *Saccopteryx bilineata*, which was caught in the dry upland forest. Both the Noctilionidae and Molossidae were caught over the forest creek.

Table 1. List of species at the CEIBA Biological Station and their habitat distribution

TAXONOMIC CLASSIFICATION	HABITAT CAPTURED
Family Emballonuridae	
Rhynchonycteris naso	Over the Yarakabra and Madewini Creeks
Peropteryx leucoptera	Over spring
Peropteryx marcotis	Over spring
Saccopteryx bilineata	Dry upland forest
Family Noctilionidae	
Noctilio leporainus	Over the Madewini Creek
Family Phyllostomidae	
Sub-family Phyllostominae	
Micronycteris nicefori	Swamp Forest
Mimon crenulatum	Dry upland forest
Phyllostomus hastatus	Swamp forest
Tonatia saurophila	Swamp forest
Tonatia silvicola	Swamp forest
Tonatia brasilense	Swamp forest
Sub-family Lonchophyllinae	
Lionycteris spurrelli	Swamp forest
Lonchophylla thomasi	Swamp forest

Sub-family Glossophaginae	
Glossophaga soricina	Swamp forest, secondary forest
Choeroniscus minor	Swamp forest
Sub-family Carollinae	
Carollia brevicauda	Dry upland forest, swamp forest, secondary forest
Carollia perspicillata	Dry upland forest, swamp forest, creeks secondary forest, spring
Rhinophylla pumilio	Swamp forest, dry upland forest
Sub-family Stenodermatinae	
Sturnira lilium	Over spring
Artibeus cinereus	Dry upland forest, swamp forest, secondary forest
Artibeus sp	Dry upland forest, swamp forest
Artibeus obscurus	Secondary
Artibeus planirostris	Dry upland forest, secondary forest
Artibeus lituratus	Swamp forest, dry upland forest, secondary forest
Artibeus concolor	Swamp forest
Platyrrhinus helleri	Swamp forest, dry upland forest
Platyrrhinus brachycephala	Swamp forest, dry upland forest
Mesophylla maconnelli	Swamp forest
Sub-family Desmodontinae	
Desmodus rotundus	Human altered habitat, Mora Swamp, Spring
Family Molossidae	
Molossus molossus	Over Madewini Creek

DATA COLLECTION

Reviews of field notes yielded data from mammal trips conducted by the ROM beginning 1994 to 1999 to various areas in south and central Guyana. The areas visited included Gunn's Strip – South Rupununi, Surama - North Rupununi, Tropenbos Field Station - Mabura Highway and several sites within the Iwokrama Forest. Analysis was done only on data collected from the Iwokrama Forest localities from 1997 to 1999.

REPRODUCTION

Table 2. Breakdown of reproducing females captured or collected from CEIBA and Iwokrama Forest.

	CEIBA		Iwokrama Forest	
	Frugivores	Insectivores	Frugivores	Insectivores
Total Reproducing Female	**81**	**15**	**164**	**16**
Pregnant	46	15	115	12
Lactating	13	0	43	4
Pregnant and Lactating	4	0	1	0
Pregnant and Pre-lactating	7	0	0	0
Postlactating	11	0	0	0
Swollen Uterus	0	0	1	0
Swollen Uterus and Lactating	0	0	4	0
Inactive Females	**54**	**11**	**261**	**58**

Table 2 shows the breakdown of the reproducing females captured at CEIBA and collected from the Iwokrama Forest (see Figures 1 and 2 for graphical representation). Females were categorized as either being inactive, pregnant, lactating, pregnant and lactating, pregnant and pre-lactating or post-lactating accordingly. Only females collected for specimens were data on swollen uterus available. Four neonates were caught during periods of netting. Neonates are considered developed enough to hang by themselves a few hours after birth and are left in the roost when females are foraging (Handley et al, 1991). Neonates caught indicate that they were only recently born from the time of capture.

Reproductive data were collected at CEIBA throughout the year except for the months of September and October 1999. At the time netting began some species were already in varying stages of pregnancy. The data from CSBD are limited to the time frame in which specimens were collected. These were the months of March-April and October-November of 1997. There is the need to full gaps in the data for the remaining months.

In order to define any patterns species were placed into feeding guilds (Appendix 2; e.g. Engstrom and Lim, in press). The major guilds were frugivores and insectivores. Other food guilds identified were nectarivores, omnivores and sanguivores, however, their sample sizes were too small to give consideration during the process of analysis.

DISCUSSION

Bats in the Neotropics are known to follow four possible breeding cycles seasonal monestry - only one breeding season per year, aseasonal polyestry – continuous breeding year round, seasonal polyestry – breeding for most of the year but there is a period of inactivity and bimodal polyestry – two breeding seasons per year (Wilson, 1973; Racy, 1982; Gannon and Willig 1992). Bonaccorso 1979 only acknowledges three of these cycles seasonal monestry, aseasonal polyestry, and seasonal polyestry. It is suggested that these cycles are dependent in some way on abiotic factors such as:

1. Food availability for the young when they are weaned.
2. Rainfall (Wilson 1979, Gannon 1992, Racy 1982).

It is very important that juvenile bats are weaned at periods of high fruit productivity or a boom in the insect population for after that the chances of survival decrease. Rainfall greatly influences the phenology of plants (Racy 1982), this would mean that the period and amount in which rainfalls would affect flowering, fruiting abundance and the responding boom in insect populations. As such bats adjust their reproductive cycles to give birth with these seasons of abundance (Gannon and Willig, 1992).

Wilson (1973) defined the reproductive cycles and identified some of the species that may follow such cycles. He indicated that *Desmodus rotundus* would follow the aseasonal polyestrous cycle due to the year round availability of food, species of the genera *Artibeus, Carollia and Glossophaga* appears to follow bimodal polyestrous cycles using the two major periods of when food resources are plentiful to reproduce, species like *Noctilio leporinus* and *Saccopteryx bilineata* would follow the seasonal monestry making use of the major period of resources availability to reproduce and species like *Myotis nigricans* would follow the seasonal polyestrous cycles reproducing throughout the year with a break during the long stressful dry season when there is a reduction in food resources.

Gannon and Willig (1992) suggested that some form of polyestry is indicated by simultaneous lactation and pregnancy. *Carollia perspicillata* and *Artibeus lituratus* were the only species caught that were pregnant and lactating, although pregnant and pre-lactating

females of *Artibeus cinereus* and *Rhinophylla pumilio* were also caught. In order to establish complete reproductive histories and base reproductive patterns reproducing females would have to be recaptured at least twice within the breeding season (Handley et al, 1991). To achieve this goal a more permanent tagging system would have to put in place with continuous monitoring.

For frugivorous bats bimodal polyestry appears to be the cycle most favored. There were indications of birthing peaks between the months of March to April, and July to August, and a break within the months of October and November since this is a stress period (Wilson, 1973). As can be seen from Figure 3 there is no deviation from the proposed pattern at CEIBA. Figure 4 does shows some indication that the same trend is being followed within the Iwokrama Forest but the lack of data for the months of June to August makes it difficult to prediction how much. Of the four months sampled, October and November also showed high peaks. At CEIBA the November sample showed little reproductive activity.

Insectivorous bats appear to follow either of two cycles: seasonal monoestrous or seasonal polyestrous. From Figures 5 and 6, it is clear that no inferences can be made due to the gaps in the data. This gap is made more obvious as many insectivorous bats are difficult species to sample. At CEIBA, there were peaks observed in April and November what this may mean is difficult to tell without more data.

Looking at the variations between Iwokrama Forest and CEIBA during the time frame the data was collected it was noted that there was a low catch rate of reproducing frugivorous females at CEIBA from the month of November. Sampling for the months of September and October would reinforce the belief that this period is expected to be very taxing as there are few trees that fruit and any births observed would be from individuals out of synchrony with the main cycles. The high peaks that were observed during the months of October and November in the Iwokrama Forest are suggested to have occurred because the El Niño cycle. It is also suggested that during periods of high stress caused by extreme dryness some species of plants reproduce as a means of survival (D. Cassells, pers. comm). This phenomenon may have prompted this unexpected period of reproduction within the bats.

CONCLUSION

Food is the obvious factor that affects reproducing bats when it comes to the survival of the mother and young. The reproductive periods of frugivores are much more restricted as their cycle is linked to the production of fruits during the two rainy seasons. Insectivores are not so restricted as they have to an extent a year round supply of food though there is a lull during the long dry season.

Reviewing the available reproductive data there are large gaps that needs to be filled to complete the patterns. Physical observations would provide present day trends but the data collected during past expeditions would help to give a complete view of what the trends were like and the changes that have occurred over the years.

REFERENCES

Bonaccorso, F.J. (1979) Foraging and Reproductive Ecology in a Panamanian Bat Community. Bulletin Florida State Museum Volume 24 No. 4

Emmons, L.H (1990) Neotropical Rainforest Mammals: A Field Guide. The University of Chicago Press, Chicago and London

Emmon, L.H (1995) Mammals of Rainforest Canopies. Pp 199-223, in Forest Canopies. Lowman, MD. And Nadkarni, N.M (Eds) Academic Press, San Diedo, CA.

Engstrom, M.D. and Lim, B.K. (In press) Conservation and Diversity of the Mammals from Guyana. In Ecología y Conservacíon de los Mamíferos de latino America (G.Y. Cabellos and J. Simonetti, Eds) Fondo de Cultura Economica, Mexico, D F.

Fenton, M.B; Acharya, I; Audet, D; Hickey, M.B.C.; Merriman, C.; Obrist, M.K.; Syme, D.M. (1992) Phyllostomid Bats (Chiroptera) as Indicators of Habitat Disruption in the Neotropics. Biotropica 24: 440-446

Fleming, T.H.; Hooper, E.T.; Wilson, D.E. (1972) Three Central American Bat Communities: Structure, Reproductive cycles and Movement patterns. Ecology Volume 53 No. 4

Fujita, M.S. and M.D. Tuttle. (1991) Flying foxes (Chiroptera: Pteropodidae): threatened animals of key economic importance. Conservation Biology 5:455-63

Gannon, M.R. and Willig, M.R. (1992) Bat Reproduction in the Luquillo Experimental Forest of Puerto Rico. The Southwestern Naturalist Volume 37 No. 4

Handley, Jr, C.O.; Wilson, D.E.; Gradner, A.L. (Eds) (1991) Demography and Natural History of the Common Fruit Bat, Artibeus jamaicensis, on Barro Colorado Island, Panama. Smithsonian Contribution to Zoology # 511

Karr, J.R. (1981) Surveying Birds in Tropics. Studies in Avian Biology 6 Pg 548-553. Estimating the Number of Terrestrial Birds. ED. Ralph, C.J. and Scott, S.M. Coopers Ornithological Society.

Lim, B.K.; Engstrom, M.D.; Timm, R.M.; Anderson, R.P.; Watson, L.C. (1999) First Records of 10 Bat Species in Guyana and Comments on Diversity of Bats in Iwokrama Forest. Acta Chiropterologica 1:179-190.

Lim, B.K and Engstrom, M.D. (2001) Species Diversity of Bats (Mammalia:Chiroptera) in Iwokrama Forest, Guyana, and the Guianan Subregion: Implications for Conservation. Biodiversity and Conservation 10: 613-657.

Nowak, R.M. (1994) Walker's Bats of the World. The John Hopkins University Press, Baltimore and London.

Ochoa, J.G. (1992) Venezuela's Bats: A Case for Conservation. BATS Volume 10 No. 3 Pages 10-13

Petit, S. (1997) The diet and reproductive schedule of Leptonycteris curasoae curasoae and Glossophaga longirostris elongate (Chiroptera: Glossophaginae) on Curacao. Biotropica 29(2): 214 - 223

Racy, P.A. (1982) Ecology of Bats Reproduction. In Ecology of Bats. Kunz, T.H. (Ed) Plenum Press. New York and London

Smith, P.G. and Kerry, S.M. (1996) The Iwokrama Rain Forest Programme for Sustainable Development: how much of Guyana's bat (Chiroptera) diversity does it encompass? Biodiversity and Conservation 5: 921-941

Ter Steege, H and Persaud, C.A. (1991) The phenology of Guyanese timber species: a compliation of a century of observations. Vegetatio 95: 177-198

Voss, R.S. and Emmons, L.H. (1996) Mammalian Diversity in Neotropical Lowland Rainforest: A preliminary Assessment. Bulletin of the American Museum of Natural History, 230:1-115

Wilson, D.E. 1973 Reproduction in Neotropical Bats. Periodicum Biologorum Volume 75 (1)

Wilson, D.E.; Cole, F.R.; Nichols, J.D; Rudram, R.; Foster, M.S. 1996 Measuring and Monitoring Biological Diversity. Standard Methods for Mammals. Smithsonian Institution Press. Washington and London.

Encarta.msn.com/index/conciseindex/0f/oof90000.htm

www.crfg.org/pubs/ff/guava.htlm

Encarta.msn.com/find/concise.asp

APPENDIX I

Updated Species List of the CEIBA Biological Research Station

Collected by the Burton Lim and Mark Engstrom (Royal Ontario Museum) and Deirdre Jafferally (Iwokrama)

FAMILY EMBALLONURIDAE
Cyttarops alecto
Rhynchonycteris naso
Peropteryx leucoptera
Peropteryx macrotis
Saccopteryx bilineata
Saccopteryx leptura

FAMILY NOCTILIONIDAE
*Noctilio leporainus**

FAMILY MORMOOPIDAE
Pteronotus parnelli*

FAMILY PHYLLOSTOMIDAE
SUBFAMLY PHYLLOSTOMINAE
Micronyteris nicefori
Micronycteris daviesi
Micronycteris homezi
Mimon crenulatum
Phyllostomus hastatus
Phylloderma stenops
Tonatia saurophila
Tonatia silvicola
Tonatia brasilense

SUBFAMILY LONCHOPHYLLINAE
*Lionycteris spurrelli**?***
Lonchophylla thomasi

SUBFAMILY GLOSSOPHAGINAE
Glossophaga soricina
Choeroniscus minor

SUBFAMILY CAROLLIINAE
Carollia brevicauda
Carollia perspicillata
Rhinophylla pumilio

SUBFAMILY STENODERMATINAE
Sturnira lilium
Artibeus cinereus
Artibeus obscurus
Artibeus plairostris
Artibeus lituratus
Artibeus concolor
Artibeus gnomus
Artibeus glaucus
Platyrrhinus helleri
Platyrrhinus brachycephalus
Mesophylla maconnelli

SUBFAMILY DESMODONTINAE
Desmodus rotundus

FAMILY VESPERTILIONIDAE
Eptesicus furinalis
*Myotis albescens**
Myotis riparius

FAMILY MOLOSSIDAE
*Molossus molossus**
Molossus sp.

* - Species were caught at the Madewini Bridge

APPENDIX II

Bat Feeding Guilds

Insectivores

Rhynchonycteris naso
Peropteryx leucoptera
Peropteryx macrotis
Saccopteryx bilineata
Micronyteris nicefori
Mimon crenulatum
Tonatia saurophila
Tonatia silvicola
Tonatia brasilense
Myotis sp.
Molossus molossus

Nectarivores

Glossophaga soricina
*Lionycteris spurrelli***?**
Lonchophylla thomasi
Choeroniscus minor

Picivores

Noctilio leporainus

Frugivores

Carollia brevicauda
Carollia perspicillata
Rhinophylla pumilio
Sturnira lilium
Artibeus cinereus
Artibeus obscurus
Artibeus planirostris
Artibeus lituratus
Artibeus concolor
Platyrrhinus helleri
Platyrrhinus brachycephalus
Mesophylla maconnelli

APPENDIX III

During the period of the project students from the University of Guyana accompanied me on a number of trips to the CEIBA Biological Research Station. The main objectives for having the students were to provide them with field experience in survey techniques in bat capture, data collecting and methods of preparation of scientific specimens. The students that accompanied me from the third year biology class were

1. Damian Fernandes
2. Shevon Lewis and
3. Wiltshire Hinds.

Christopher Chin and Deokie Arjoon also accompanied me on a few trips. While working at the Station students from secondary schools namely St Roses, St Joseph and North Georgetown Secondary on a short ecology program were also given the opportunity to participate in netting activities.

Capturing Techniques

While assisting me the students were instructed on how to set up mist nets and the best places to set the net to have maximum capture. They were instructed in the methods of preparation even though they did not prepare any specimen. Specimens were collected only if necessary and it was easier to transport the live specimen hence the inability to prepare skin specimens.

Species Identification

In terms of species identifications students were introduced to a species key that was developed by Burton Lim for the mammal species of Guyana as a means to identify bat species. Some of the easier characteristics to help in quick identification were also pointed out. Overall the students were enthusiastic and had a great time. They were quite disappointed when the project came to an end and that they had not been able to come on as many trips as they like due to conflicting schedules. In all the experience was rewarding, as they were able to take those skills to their present jobs.

APPENDIX IV

List of Specimens collected during the project

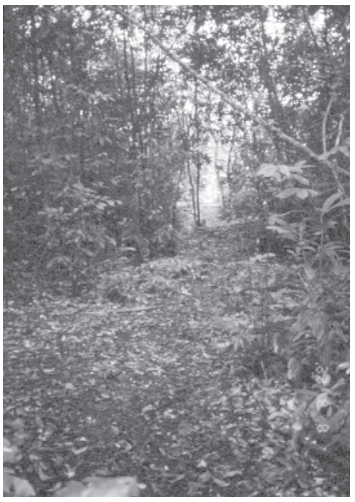
Specimens were exported to the Royal Ontario Museum to authenticate identification and are to be returned to the CSBD.

Field #	*Species*	Sex	Preparation	Reproductive Data
DJ 103	*Carollia perspicillata*	F	ALC	no emb
DJ 104	*Carollia perspicillata*	F	ALC	no emb
DJ 105	*Mimon crenulatum*	F	ALC	no emb
DJ 106	*Peropteryx leucoptera*	F	ALC	no emb
DJ 107	*Mesophylla macconnelli*	F	ALC	ova- 15mm
DJ 108	*Artibeus cinereus*	M	ALC	
DJ 109	*Platyrrhinus brachycephalus*	F	ALC	ova - 22 mm
DJ 110	*Carollia perpsicillata*	M	ALC	
DJ 111	*Glossophaga soricina*	M	ALC	
DJ 112	*Molossus molossus*	M	ALC	
DJ 113	*Molossus molossus*	F	ALC	ova - 15 mm
DJ 114	*Rhynconycteris naso*	M	ALC	
DJ 115	*Rhynconycteris naso*	F	ALC	no emb
DJ 116	*Noctilio leporinus*	F	ALC	ova - 34 mm
DJ 117	*Artibeus obscurus*	F	ALC	ova - 15 mm
DJ 118	*Artibeus lituratus*	M	ALC	
DJ 119	*Artibeus lituratus*	F	ALC	no emb
DJ 120	*Carollia perspicillata*	M	ALC	
DJ 121	*Desmodus rotundus*	F	ALC	lactating, ova = 12 mm
DJ 122	*Platyrrhinus helleri*	M	ALC	
DJ 123	*Glossophaga soricina*	M	ALC	
DJ 124	*Peropteryx leucoptera*	F	ALC	no emb
DJ 125	*Tonatia silvicola*	M	ALC	t = 13*9
DJ 126	*Carollia perspicillata*	M	ALC	
DJ 127	*Carollia perspicillata*	F	ALC	no emb
DJ 128	*Carollia perspicillata*	F	ALC	no emb
DJ 129	*Rhinophylla pumilio*	F	ALC	no emb
DJ 130	*Carollia perspicillata*	M	ALC	
DJ 131	*Peropteryx leucoptera*	F	ALC	no emb
DJ 132	*Phyllostomus hastatus*	M	ALC	
DJ 133	*Choeroniscus minor*	F	ALC	ova = 14 mm
DJ 134	*Artibeus obscurus*	M	ALC	
DJ 135	*Mesophylla macconnelli*	F	ALC	emb = 17
DJ 136	*Lonchophylla thomasi*	M	ALC	
DJ 137	*Sturnira lilium*	M	ALC	
DJ 138	*Lonchophylla thomasi*	F	ALC	emb - 13
DJ 139	*Peropteryx marcotis*	F	ALC	no emb
DJ 140	*Tonatia brasiliense*	M	ALC	
DJ 141	*Micronycteris nicefori*	F	ALC	no emb
DJ 142	*Artibeus concolor*	F	ALC	no emb, lactating
DJ 159	*Saccopteryx bilineata*	M	ALC	T = 3 * 2
DJ 160	*Tonatia saurophila*	F	ALC	Swollen uterus
DJ 161	*Tonatia brasiliense*	M	ALC	T = 6 * 4
DJ 162	*Tonatia saurophila*	F	ALC	Swollen uterus
DJ 176	*Artibeus Sp.*	M	ALC	T = 6*4

TL	LT	LHF	LE/TR	FA	Wt	Date	Remarks
66	7	11	13/7	40	13	99/2/27	broken forearm cause for collection
55	9	11	14/9	38	16	99/3/6	tibia - 16, died in the nets
83	33	9	20/7	51	12.6	99/3/6	
68	9	7	11/4	41	5.5	99/3/6	
42		8	14/6	30	7.4	99/3/6	
43		8	12/6	38	11	99/3/6	
51		9	13/5	42	18.6	99/3/6	
60	9	11	12/6	39	15.8	99/4/2	tibia - 19
56	6	9	9/4	34	7.9	99/4/2	
101	36	8	10/4	41	16	99/4/2	
95	35	7	9/4	38	12	99/4/2	
55	15	6	10/4	38	3.8	99/4/2	caught over the Madawini Creek by the road
52	12	7	10/4	36	3.4	99/4/2	caught over the Madawini Creek by the road
111	2	25	23/7	81	> 30 g	99/4/2	caught over the Madawini Creek by the road
73		12	16/8	61	> 30 g	99/4/2	
85		16	20/6	68	> 30 g	99/4/2	
85		14	18/6	70	> 30	99/4/2	
70	10	13	16/7	41	15.4	99/4/2	has a rusty brown color
72		14	16/8	57	33	99/4/17	missing two digits on left foot, caught over the bathing spring
51	8	9	12/5	40	12.8	99/5/8	
46	12	8	10/4	38	7.7	99/5/8	
58	21	8	12/5	41	6	99/5/8	
100	8	14	32/12	56	33	99/5/8	
51	7	12	16/6	41	12.4	99/5/8	
54	7	12	16/6	41	12	99/5/8	
49		11	14/6	41	12.3	99/5/8	
40	8	9	12/4	33	8.5	99/5/8	
54	15	11	14/6	40	13	99/5/8	
55	21	7	13/4	43	5.5	99/5/29	caught over bathing spring, 18:45 hrs
111	10	17	29/11	85	72	99/5/29	caught over bathing spring, 20:50 hrs.
68		7	8/3	36	9.6	99/6/26	picture, tissue
72		13	19/7	60	30	99/6/26	tissue taken
46	5	5	7/3	31	8.5	99/8/7	tissue taken
53		7	11/4	30	6.2	99/8/7	tissue taken
60	7	10	12/5	41	18	99/8/7	tissue taken
59	11	7	12/5	32	8.2	99/8/7	tissue taken
55	10	7	10/3	42	4.2	99/8/28	
66	9	7	19/8	35	10	99/8/28	tissue taken
59		11	16/5	39	7.5	99/8/28	tissue taken
60	16	11	7/4	47	18.7	99/8/28	tissue taken
68	18	11	13/5	47	7.6	99/11/20	tissue taken
95	9	15	30/10	56	25.5	99/11/20	tissue taken
63	23	9	24/8	36	9.7	99/11/20	tissue taken
108		13	31/10	59	27.5	99/11/20	tissue taken
56		10	12/5	38	12.5	00/02/26	tissue taken

APPENDIX V

Habitats and Bats of the CEIBA Biological Station



Dry Upland Forest

Secondary Forest

Human Altered Environs

Mora Swamp Forest

Spring

Yaracabra Creek

Mimon crenulatum (hairy nosed bat)

Platyrrhinus helleri (white-lined fruit bat)

Lonchophylla thomasi
(spear nosed long
tongued bat)

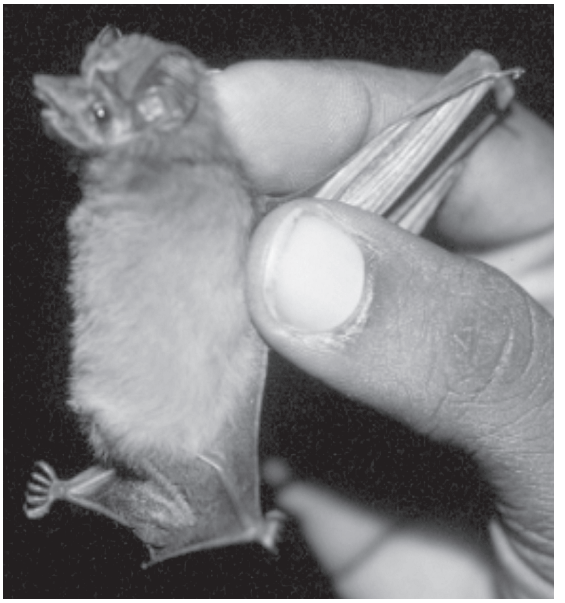
Artibeus sp.
(fruit-eating bat)

Desmodus rotundus (common vampire bat)

Phyllostomus hastatus (spear nosed bat)

Rhinophylla pumilio (little fruit bat)

Sturnira lilium (yellow-shouldered bat)



Peropteryx marcotis (doglike sac-winged bat)

Choeroniscus minor (long nosed, long tongued bat)

(Pictures of habitats by D. Jafferally, pictures of bats by Dr. G. Bourne)

APPENDIX VI

Reproductive Data from Ceiba Biological Station

Species	Date	Reproductive Data
Carollia perspicillata	24-Jul-99	carrying infant
Carollia perspicillata	24-Jul-99	Carrying infant
Carollia perspicillata	6-Mar-99	Carrying neonate ~ 35 mm
Carollia perspicillata	27-Feb-99	Lactating
Artibeus cinereus	27-Feb-99	Lactating
Artibeus cinereus	27-Feb-99	lactating
Carollia perspicillata	2-Apr-99	Lactating
Artibeus cinereus	2-Apr-99	Lactating
Carollia perspicillata	17-Apr-99	Lactating
Carollia perspicillata	28-Aug-99	Lactating
Artibeus planirostris	28-Aug-99	Lactating
Carollia perspicillata	28-Aug-99	Lactating
Artibeus concolor	28-Aug-99	no ova, Lactating
Desmodus rotundus	17-Apr-99	ova = 12 mm, lactating
Lonchophylla thomasi	7-Aug-99	Ova = 13
Mesophylla maconnelli	6-Mar-99	ova = 15 mm
Molossus molossus	2-Apr-99	ova = 15 mm
Artibeus obscurus	2-Apr-99	ova = 15 mm
Platyrrhinus brachycephalus	6-Mar-99	Ova = 22 mm
Noctilio leporainus	2-Apr-99	ova = 34 mm
Mesophylla maconnelli	7-Aug-99	ova= 17
Choeroniscus minor	26-Jun-99	ova=14 mm
Carollia perspicillata	6-Mar-99	Post-lactating
Carollia perspicillata	6-Mar-99	Post-lactating
Carollia perspicillata	6-Mar-99	Post-lactating
Carollia perspicillata	17-Apr-99	Post-lactating
Artibeus cinereus	17-Apr-99	Post-lactating
Carollia brevicauda	17-Apr-99	Post-lactating
Carollia perspicillata	7-Aug-99	Post-lactating
Carollia perspicillata	7-Aug-99	Post-lactating
Carollia brevicauda	7-Aug-99	Post-lactating
Carollia perspicillata	28-Aug-99	Post-lactating
Carollia perspicillata	27-Feb-99	Post-Lactating
Platyrrhinus helleri	27-Feb-99	pregnant
Platyrrhinus helleri	27-Feb-99	pregnant
Platyrrhinus helleri	27-Feb-99	pregnant
Artibeus planirostris	27-Feb-99	pregnant
Carollia perspicillata	6-Mar-99	pregnant
Carollia brevicauda	6-Mar-99	Pregnant
Carollia perspicillata	6-Mar-99	pregnant
Carollia perspicillata	6-Mar-99	Pregnant
Platyrrhinus helleri	6-Mar-99	Pregnant
Carollia perspicillata	6-Mar-99	pregnant
Rhinophylla pumilio	6-Mar-99	pregnant
Carollia perspicillata	6-Mar-99	Pregnant
Carollia perspicillata	6-Mar-99	Pregnant
Carollia perspicillata	6-Mar-99	Pregnant
Carollia brevicauda	2-Apr-99	Pregnant
Rhinophylla pumilio	2-Apr-99	Pregnant
Rhynchonycteris naso	2-Apr-99	Pregnant
Rhinophylla pumilio	2-Apr-99	Pregnant
Rhynchonycteris naso	2-Apr-99	Pregnant
Tonatia silvicola	17-Apr-99	Pregnant
Tonatia silvicola	17-Apr-99	Pregnant

Species	Date	Reproductive Data
Artibeus cinereus	17-Apr-99	pregnant
Glossophaga soricina	17-Apr-99	pregnant
Artibeus planirostris	17-Apr-99	Pregnant
Mimon crenulatum	8-May-99	Pregnant
Carollia brevicauda	8-May-99	Pregnant
Carollia perspicillata	8-May-99	Pregnant
Tonatia silvicola	8-May-99	Pregnant
Carollia perspicillata	8-May-99	Pregnant
Carollia perspicillata	8-May-99	Pregnant
Carollia perspicillata	26-Jun-99	pregnant
Carollia perspicillata	10-Jul-99	Pregnant
Carollia brevicauda	24-Jul-99	Pregnant
Carollia brevicauda	24-Jul-99	Pregnant
Desmodus rotundus	24-Jul-99	Pregnant
Carollia perspicillata	7-Aug-99	Pregnant
Mimon crenulatum	7-Aug-99	Pregnant
Carollia perspicillata	7-Aug-99	Pregnant
Artibeus cinereus	28-Aug-99	pregnant
Glossophaga soricina	28-Aug-99	Pregnant
Carollia perspicillata	28-Aug-99	Pregnant
Carollia perspicillata	28-Aug-99	pregnant
Carollia perspicillata	28-Aug-99	Pregnant
Rhynchonycteris naso	20-Nov-99	Pregnant
Lonchophylla thomasi	20-Nov-99	Pregnant
Carollia brevicauda	4-Dec-99	Pregnant
Tonatia silvicola	4-Dec-99	Pregnant
Peropteryx leucoptera	4-Dec-99	Pregnant
Choeroniscus godmani	12-Feb-00	Pregnant
Lonchophylla thomasi	26-Feb-00	pregnant
Tonatia silvicola	26-Feb-00	pregnant
Platyrrhinus helleri	26-Feb-00	pregnant
Carollia perspicillata	26-Feb-00	pregnant
Carollia perspicillata	26-Feb-00	pregnant
Carollia perspicillata	26-Feb-00	Pregnant
Carollia perspicillata	26-Feb-00	Pregnant
Carollia perspicillata	26-Feb-00	Pregnant
Rhinophylla pumilio	26-Feb-00	Pregnant
Carollia perspicillata	6-Mar-99	Pregnant and Lactating
Artibeus lituratus	17-Apr-99	pregnant and lactating
Carollia perspicillata	8-May-99	Pregnant and Lactating
Artibeus lituratus	8-May-99	Pregnant and lactating
Carollia perspicillata	8-May-99	Pregnant and Pre-lactating
Carollia perspicillata	26-Jun-99	Pregnant and Pre-lactating
Rhinophylla pumilio	26-Jun-99	Pregnant and Pre-lactating
Artibeus cinereus	26-Jun-99	Pregnant and Pre-lactating
Rhinophylla pumilio	26-Jun-99	Pregnant and Pre-lactating
Carollia perspicillata	10-Jul-99	pregnant and pre-lactating
Tonatia saurophila	26-Feb-00	pregnant, mammary tissue present
Carollia perspicillata	26-Feb-00	Pregnant, mammary tissue present
Carollia perspicillata	26-Feb-00	Pregnant, pre-lactating
Tonatia saurophila	20-Nov-99	Swollen uterus
Tonatia saurophila	20-Nov-99	Swollen uterus

APPENDIX VII

Reproductive Data from Iwokrama Forest and South Guyana

Species	Date	Location
Artibeus obscurus	17-Jul-94	5 km SE Surama
Sturnira lilium	18-Jul-94	5 km SE Surama
Artibeus concolor	18-Jul-94	5 km SE Surama
Artibeus planirostris	18-Jul-94	5 km SE Surama
Artibeus lituratus	19-Jul-94	5 km SE Surama
Sturnira lilium	19-Jul-94	5 km SE Surama
Rhinophylla pumilio	20-Jul-94	5 km SE Surama
Artibeus planirostris	20-Jul-94	5 km SE Surama
Artibeus cinereus	22-Jul-94	5 km SE Surama
Artibeus cinereus	22-Jul-94	5 km SE Surama
Artibeus cinereus	22-Jul-94	5 km SE Surama
Artibeus cinereus	22-Jul-94	5 km SE Surama
Artibeus cinereus	22-Jul-94	5 km SE Surama
Carollia perspicillata	22-Jul-94	5 km SE Surama
Artibeus obscurus	23-Jul-94	5 km SE Surama
Artibeus lituratus	24-Jul-94	5 km SE Surama
Sturnira lilium	24-Jul-94	5 km SE Surama
Carollia brevicauda	24-Jul-94	5 km SE Surama
Sturnira lilium	25-Jul-94	5 km SE Surama
Artibeus obscurus	25-Jul-94	5 km SE Surama
Artibeus obscurus	25-Jul-94	5 km SE Surama
Artibeus obscurus	25-Jul-94	5 km SE Surama
Artibeus lituratus	25-Jul-94	5 km SE Surama
Artibeus obscurus	25-Jul-94	5 km SE Surama
Artibeus lituratus	25-Jul-94	5 km SE Surama
Rhinophylla pumilio	25-Jul-94	5 km SE Surama
Artibeus cinereus	26-Jul-94	5 km SE Surama
Rhinophylla pumilio	26-Jul-94	5 km SE Surama
Lonchophylla thomasi	26-Jul-94	5 km SE Surama
Artibeus obscurus	26-Jul-94	5 km SE Surama
Artibeus obscurus	26-Jul-94	5 km SE Surama
Artibeus planirostris	26-Jul-94	5 km SE Surama
Artibeus concolor	28-Jul-94	5 km SE Surama
Artibeus concolor	28-Jul-94	5 km SE Surama
Platyrrhinus helleri	29-Jul-94	5 km SE Surama
Rhinophylla pumilio	29-Jul-94	5 km SE Surama
Carollia perspicillata	29-Jul-94	5 km SE Surama
Sturnira lilium	29-Jul-94	5 km SE Surama
Artibeus concolor	29-Jul-94	5 km SE Surama
Artibeus obscurus	29-Jul-94	5 km SE Surama
Artibeus cinereus	30-Jul-94	5 km SE Surama
Sturnira lilium	30-Jul-94	5 km SE Surama
Sturnira lilium	30-Jul-94	5 km SE Surama
Artibeus obscurus	30-Jul-94	5 km SE Surama
Carollia perspicillata	6-Aug-94	Tropenbos 20 km SSE Mabura Hills
Artibeus lituratus	6-Aug-94	Tropenbos 20 km SSE Mabura Hills
Artibeus lituratus	6-Aug-94	Tropenbos 20 km SSE Mabura Hills
Artibeus obscurus	6-Aug-94	Tropenbos 20 km SSE Mabura Hills
Artibeus obscurus	6-Aug-94	Tropenbos 20 km SSE Mabura Hills
Artibeus lituratus	6-Aug-94	Tropenbos 20 km SSE Mabura Hills
Artibeus concolor	6-Aug-94	Tropenbos 20 km SSE Mabura Hills
Mimon crenulatum	6-Aug-94	Tropenbos 20 km SSE Mabura Hills

Species	Date	Location
Tonatia saurophila	6-Aug-94	Tropenbos 20 km SSE Mabura Hills
Artibeus lituratus	7-Aug-94	Tropenbos 20 km SSE Mabura Hills
Artibeus lituratus	7-Aug-94	Tropenbos 20 km SSE Mabura Hills
Artibeus concolor	7-Aug-94	Tropenbos 20 km SSE Mabura Hills
Tonatia silvicola	7-Aug-94	Tropenbos 20 km SSE Mabura Hills
Artibeus concolor	7-Aug-94	Tropenbos 20 km SSE Mabura Hills
Carollia brevicauda	7-Aug-94	Tropenbos 20 km SSE Mabura Hills
Carollia perspicillata	7-Aug-94	Tropenbos 20 km SSE Mabura Hills
Artibeus lituratus	8-Aug-94	Tropenbos 20 km SSE Mabura Hills
Artibeus lituratus	8-Aug-94	Tropenbos 20 km SSE Mabura Hills
Artibeus lituratus	8-Aug-94	Tropenbos 20 km SSE Mabura Hills
Artibeus obscurus	8-Aug-94	Tropenbos 20 km SSE Mabura Hills
Artibeus lituratus	9-Aug-94	Tropenbos 20 km SSE Mabura Hills
Desmodus rotundus	9-Aug-94	Tropenbos 20 km SSE Mabura Hills
Artibeus lituratus	10-Aug-94	Tropenbos 20 km SSE Mabura Hills
Desmodus rotundus	11-Aug-94	Tropenbos 20 km SSE Mabura Hills
Saccopteryx bilineata	11-Aug-94	Tropenbos 20 km SSE Mabura Hills
Artibeus concolor	11-Aug-94	Tropenbos 20 km SSE Mabura Hills
Artibeus obscurus	11-Aug-94	Tropenbos 20 km SSE Mabura Hills
Tonatia silvicola	11-Aug-94	Tropenbos 20 km SSE Mabura Hills
Glossophiga soricina	12-Aug-94	Tropenbos 20 km SSE Mabura Hills
Glossophiga soricina	12-Aug-94	Tropenbos 20 km SSE Mabura Hills
Artibeus obscurus	13-Aug-94	Tropenbos 20 km SSE Mabura Hills
Artibeus obscurus	13-Aug-94	Tropenbos 20 km SSE Mabura Hills
Artibeus obscurus	13-Aug-94	Tropenbos 20 km SSE Mabura Hills
Artibeus obscurus	14-Aug-94	Tropenbos 20 km SSE Mabura Hills
Artibeus obscurus	14-Aug-94	Mabura Hills
Carollia perspicillata	14-Aug-94	Mabura Hills
Carollia perspicillata	14-Aug-94	Mabura Hills
Carollia perspicillata	14-Aug-94	Mabura Hills
Molossus molossus	14-Aug-94	Mabura Hills
Molossus molossus	14-Aug-94	Mabura Hills
Molossus molossus	14-Aug-94	Mabura Hills
Molossus molossus	14-Aug-94	Mabura Hills
Molossus molossus	14-Aug-94	Mabura Hills
Molossus molossus	14-Aug-94	Mabura Hills
Molossus molossus	14-Aug-94	Mabura Hills
Molossus molossus	14-Aug-94	Mabura Hills
Molossus molossus	14-Aug-94	Mabura Hills
Carollia perspicillata	5-Jul-95	Iwokrama 25 km SSW Kurupukari
Tonatia silvicola	6-Jul-95	Iwokrama 25 km SSW Kurupukari
Rhinophylla pumilio	12-Jul-95	Iwokrama 25 km SSW Kurupukari
Tonatia silvicola	12-Jul-95	Iwokrama 25 km SSW Kurupukari
Tonatia silvicola	15-Jul-95	Iwokrama 25 km SSW Kurupukari
Tonatia silvicola	18-Jul-95	Iwokrama 25 km SSW Kurupukari
Tonatia silvicola	19-Jul-95	Iwokrama 25 km SSW Kurupukari
Tonatia silvicola	19-Jul-95	Iwokrama 25 km SSW Kurupukari
Carollia perspicillata	26-Oct-96	Gunn's strip
Carollia perspicillata	26-Oct-96	Gunn's strip
Carollia perspicillata	26-Oct-96	Gunn's strip
Molossus molossus	26-Oct-96	Gunn's strip
Carollia perspicillata	28-Oct-96	Chodikar R. 55 km Sw Gunn's
Carollia perspicillata	28-Oct-96	Chodikar R. 55 km Sw Gunn's
Lonchophylla thomasi	29-Oct-96	Chodikar R. 55 km Sw Gunn's
Lonchophylla thomasi	29-Oct-96	Chodikar R. 55 km Sw Gunn's
Noctilio liporinus	2-Nov-96	Chodikar R. 55 km Sw Gunn's
Artibeus planirostris	3-Nov-96	Chodikar R. 55 km Sw Gunn's
Artibeus obscurus	4-Nov-96	Chodikar R. 55 km Sw Gunn's
Rhinophylla pumilio	9-Nov-96	Kamoa R 50 km SWW Gunn's
Rhinophylla pumilio	11-Nov-96	Kamoa R 50 km SWW Gunn's
Noctilio liporinus	18-Nov-96	7 km from Gunn's

Species	Date	Location
Sturnira lilium	21-Nov-96	Gunn's strip
Sturnira lilium	21-Nov-96	Gunn's strip
Sturnira lilium	21-Nov-96	Gunn's strip
Sturnira lilium	22-Nov-96	Gunn's strip
Carollia perspicillata	9-Mar-97	Pakatau Mountain
Carollia perspicillata	9-Mar-97	Pakatau Mountain
Carollia brevicauda	10-Mar-97	Pakatau Mountain
Carollia perspicillata	10-Mar-97	Pakatau Mountain
Mesophylla maconnelli	12-Mar-97	Pakatau Mountain
Tonatia silvicola	13-Mar-97	Pakatau Mountain
Artibeus lituratus	13-Mar-97	Pakatau Mountain
Tonatia saurophila	14-Mar-97	Pakatau Mountain
Artibeus lituratus	14-Mar-97	Pakatau Mountain
Platyrrhinus helleri	14-Mar-97	Pakatau Mountain
Rhinophylla pumilio	18-Mar-97	Giaconda Camp
Artibeus concolor	18-Mar-97	Giaconda Camp
Artibeus lituratus	18-Mar-97	Giaconda Camp
Carollia perspicillata	18-Mar-97	Giaconda Camp
Carollia perspicillata	18-Mar-97	Giaconda Camp
Artibeus concolor	19-Mar-97	Giaconda Camp
Artibeus planirostris	19-Mar-97	Giaconda Camp
Artibeus planirostris	19-Mar-97	Giaconda Camp
Artibeus lituratus	19-Mar-97	Giaconda Camp
Carollia perspicillata	19-Mar-97	Giaconda Camp
Rhinophylla pumilio	19-Mar-97	Giaconda Camp
Rhinophylla pumilio	19-Mar-97	Giaconda Camp
Rhinophylla pumilio	19-Mar-97	Giaconda Camp
Artibeus lituratus	20-Mar-97	Giaconda Camp
Artibeus concolor	20-Mar-97	Giaconda Camp
Artibeus planirostris	20-Mar-97	Giaconda Camp
Tonatia silvicola	20-Mar-97	Giaconda Camp
Tonatia silvicola	20-Mar-97	Giaconda Camp
Rhinophylla pumilio	20-Mar-97	Giaconda Camp
Rhinophylla pumilio	20-Mar-97	Giaconda Camp
Carollia perspicillata	20-Mar-97	Giaconda Camp
Carollia perspicillata	20-Mar-97	Giaconda Camp
Artibeus cinereus	22-Mar-97	Giaconda Camp
Mesophylla maconnelli	22-Mar-97	Giaconda Camp
Rhinophylla pumilio	23-Mar-97	Giaconda Camp
Rhinophylla pumilio	23-Mar-97	Giaconda Camp
Artibeus obscurus	23-Mar-97	Giaconda Camp
Artibeus cinereus	23-Mar-97	Giaconda Camp
Mesophylla maconnelli	24-Mar-97	Giaconda Camp
Artibeus lituratus	24-Mar-97	Giaconda Camp
Artibeus lituratus	24-Mar-97	Giaconda Camp
Artibeus lituratus	25-Mar-97	Giaconda Camp
Artibeus concolor	25-Mar-97	Giaconda Camp
Artibeus concolor	25-Mar-97	Giaconda Camp
Artibeus concolor	25-Mar-97	Giaconda Camp
Rhinophylla pumilio	26-Mar-97	Giaconda Camp
Artibeus concolor	26-Mar-97	Giaconda Camp
Artibeus obscurus	26-Mar-97	Giaconda Camp
Artibeus obscurus	26-Mar-97	Giaconda Camp
Artibeus lituratus	26-Mar-97	Giaconda Camp
Artibeus lituratus	27-Mar-97	Giaconda Camp
Artibeus planirostris	27-Mar-97	Giaconda Camp
Artibeus obscurus	27-Mar-97	Giaconda Camp
Tonatia saurophila	27-Mar-97	Giaconda Camp
Artibeus obscurus	28-Mar-97	Giaconda Camp
Artibeus cinereus	30-Mar-97	Burro Burro R 25 Km WNW Kurupukari
Tonatia saurophila	31-Mar-97	Burro Burro R 25 Km WNW Kurupukari

Species	Date	Location
Artibeus obscurus	31-Mar-97	Burro Burro R 25 Km WNW Kurupukari
Artibeus lituratus	31-Mar-97	Burro Burro R 25 Km WNW Kurupukari
Artibeus lituratus	31-Mar-97	Burro Burro R 25 Km WNW Kurupukari
Artibeus concolor	31-Mar-97	Burro Burro R 25 Km WNW Kurupukari
Artibeus Sp.	1-Apr-97	Burro Burro R 25 Km WNW Kurupukari
Artibeus planirostris	1-Apr-97	Burro Burro R 25 Km WNW Kurupukari
Artibeus obscurus	2-Apr-97	Burro Burro R 25 Km WNW Kurupukari
Artibeus planirostris	2-Apr-97	Burro Burro R 25 Km WNW Kurupukari
Artibeus planirostris	2-Apr-97	Burro Burro R 25 Km WNW Kurupukari
Artibeus planirostris	3-Apr-97	Burro Burro R 25 Km WNW Kurupukari
Artibeus concolor	5-Apr-97	Burro Burro R 25 Km WNW Kurupukari
Artibeus concolor	5-Apr-97	Burro Burro R 25 Km WNW Kurupukari
Rhinophylla pumilio	6-Apr-97	Burro Burro R 25 Km WNW Kurupukari
Rhynchonycteris naso	7-Apr-97	Burro Burro R 25 Km WNW Kurupukari
Artibeus obscurus	7-Apr-97	Burro Burro R 25 Km WNW Kurupukari
Artibeus concolor	7-Apr-97	Burro Burro R 25 Km WNW Kurupukari
Mesophylla maconnelli	7-Apr-97	Burro Burro R 25 Km WNW Kurupukari
Artibeus concolor	7-Apr-97	Burro Burro R 25 Km WNW Kurupukari
Artibeus concolor	7-Apr-97	Burro Burro R 25 Km WNW Kurupukari
Rhinophylla pumilio	8-Apr-97	Burro Burro R 25 Km WNW Kurupukari
Artibeus concolor	8-Apr-97	Burro Burro R 25 Km WNW Kurupukari
Rhinophylla pumilio	8-Apr-97	Burro Burro R 25 Km WNW Kurupukari
Tonatia saurophila	10-Apr-97	Burro Burro R 25 Km WNW Kurupukari
Artibeus Sp.	10-Apr-97	Burro Burro R 25 Km WNW Kurupukari
Artibeus Sp.	12-Apr-97	Iwokrama Field Station
Artibeus lituratus	12-Apr-97	Iwokrama Field Station
Artibeus lituratus	12-Apr-97	Iwokrama Field Station
Artibeus obscurus	12-Apr-97	Iwokrama Field Station
Artibeus concolor	12-Apr-97	Iwokrama Field Station
Artibeus concolor	12-Apr-97	Iwokrama Field Station
Artibeus planirostris	12-Apr-97	Iwokrama Field Station
Rhinophylla pumilio	3-Oct-97	38 Mile Camp 35 km Sw Kurupukari
Rhinophylla pumilio	3-Oct-97	38 Mile Camp 35 km Sw Kurupukari
Carollia perspicillata	3-Oct-97	38 Mile Camp 35 km Sw Kurupukari
Glossophiga soricina	3-Oct-97	38 Mile Camp 35 km Sw Kurupukari
Lonchophylla thomasi	4-Oct-97	38 Mile Camp 35 km Sw Kurupukari
Artibeus lituratus	4-Oct-97	38 Mile Camp 35 km Sw Kurupukari
Rhinophylla pumilio	5-Oct-97	38 Mile Camp 35 km Sw Kurupukari
Carollia perspicillata	6-Oct-97	38 Mile Camp 35 km Sw Kurupukari
Carollia perspicillata	6-Oct-97	38 Mile Camp 35 km Sw Kurupukari
Rhinophylla pumilio	6-Oct-97	38 Mile Camp 35 km Sw Kurupukari
Rhinophylla pumilio	6-Oct-97	38 Mile Camp 35 km Sw Kurupukari
Artibeus lituratus	6-Oct-97	38 Mile Camp 35 km Sw Kurupukari
Artibeus planirostris	6-Oct-97	38 Mile Camp 35 km Sw Kurupukari
Artibeus planirostris	7-Oct-97	38 Mile Camp 35 km Sw Kurupukari
Carollia perspicillata	7-Oct-97	38 Mile Camp 35 km Sw Kurupukari
Platyrrhinus helleri	9-Oct-97	CowFly Camp 40 km Sw Kurupukari
Rhinophylla pumilio	9-Oct-97	CowFly Camp 40 km Sw Kurupukari
Rhinophylla pumilio	9-Oct-97	CowFly Camp 40 km Sw Kurupukari
Rhinophylla pumilio	9-Oct-97	CowFly Camp 40 km Sw Kurupukari
Lonchophylla thomasi	10-Oct-97	CowFly Camp 40 km Sw Kurupukari
Artibeus planirostris	10-Oct-97	CowFly Camp 40 km Sw Kurupukari
Lionycteris spurelli	11-Oct-97	CowFly Camp 40 km Sw Kurupukari
Artibeus lituratus	11-Oct-97	CowFly Camp 40 km Sw Kurupukari
Saccopteryx bilineata	12-Oct-97	CowFly Camp 40 km Sw Kurupukari
Lionycteris spurelli	13-Oct-97	CowFly Camp 40 km Sw Kurupukari
Artibeus planirostris	13-Oct-97	CowFly Camp 40 km Sw Kurupukari
Artibeus planirostris	13-Oct-97	CowFly Camp 40 km Sw Kurupukari
Artibeus planirostris	13-Oct-97	CowFly Camp 40 km Sw Kurupukari
Sturnira lilium	13-Oct-97	CowFly Camp 40 km Sw Kurupukari
Artibeus cinereus	14-Oct-97	CowFly Camp 40 km Sw Kurupukari

Species	Date	Location
Artibeus lituratus	14-Oct-97	CowFly Camp 40 km Sw Kurupukari
Artibeus planirostris	14-Oct-97	CowFly Camp 40 km Sw Kurupukari
Artibeus planirostris	14-Oct-97	CowFly Camp 40 km Sw Kurupukari
Artibeus planirostris	14-Oct-97	CowFly Camp 40 km Sw Kurupukari
Artibeus lituratus	14-Oct-97	CowFly Camp 40 km Sw Kurupukari
Artibeus lituratus	14-Oct-97	CowFly Camp 40 km Sw Kurupukari
Artibeus lituratus	14-Oct-97	CowFly Camp 40 km Sw Kurupukari
Artibeus cinereus	14-Oct-97	CowFly Camp 40 km Sw Kurupukari
Artibeus lituratus	14-Oct-97	CowFly Camp 40 km Sw Kurupukari
Glossophiga soricina	15-Oct-97	CowFly Camp 40 km Sw Kurupukari
Lionycteris spurelli	15-Oct-97	CowFly Camp 40 km Sw Kurupukari
Platyrrhinus helleri	15-Oct-97	CowFly Camp 40 km Sw Kurupukari
Artibeus lituratus	15-Oct-97	CowFly Camp 40 km Sw Kurupukari
Artibeus cinereus	15-Oct-97	CowFly Camp 40 km Sw Kurupukari
Platyrrhinus helleri	16-Oct-97	CowFly Camp 40 km Sw Kurupukari
Rhinophylla pumilio	18-Oct-97	CowFly Camp 40 km Sw Kurupukari
Carollia perspicillata	20-Oct-97	Gorge Camp 40 km SSW Kurupukari
Carollia brevicauda	20-Oct-97	Gorge Camp 40 km SSW Kurupukari
Artibeus planirostris	20-Oct-97	Gorge Camp 40 km SSW Kurupukari
Artibeus planirostris	20-Oct-97	Gorge Camp 40 km SSW Kurupukari
Artibeus lituratus	21-Oct-97	Gorge Camp 40 km SSW Kurupukari
Artibeus lituratus	21-Oct-97	Gorge Camp 40 km SSW Kurupukari
Artibeus planirostris	21-Oct-97	Gorge Camp 40 km SSW Kurupukari
Carollia perspicillata	22-Oct-97	Gorge Camp 40 km SSW Kurupukari
Platyrrhinus helleri	22-Oct-97	Gorge Camp 40 km SSW Kurupukari
Artibeus planirostris	22-Oct-97	Gorge Camp 40 km SSW Kurupukari
Artibeus planirostris	22-Oct-97	Gorge Camp 40 km SSW Kurupukari
Artibeus lituratus	22-Oct-97	Gorge Camp 40 km SSW Kurupukari
Artibeus lituratus	23-Oct-97	Gorge Camp 40 km SSW Kurupukari
Carollia brevicauda	23-Oct-97	Gorge Camp 40 km SSW Kurupukari
Artibeus concolor	24-Oct-97	Gorge Camp 40 km SSW Kurupukari
Artibeus obscurus	24-Oct-97	Gorge Camp 40 km SSW Kurupukari
Artibeus planirostris	24-Oct-97	Gorge Camp 40 km SSW Kurupukari
Artibeus lituratus	31-Oct-97	Turtle Mountain 10 km NW Kurupukari
Artibeus planirostris	31-Oct-97	Turtle Mountain 10 km NW Kurupukari
Artibeus lituratus	1-Nov-97	Turtle Mountain 10 km NW Kurupukari
Mimon crenulatum	1-Nov-97	Turtle Mountain 10 km NW Kurupukari
Rhynchonycteris naso	2-Nov-97	Turtle Mountain 10 km NW Kurupukari
Rhynchonycteris naso	2-Nov-97	Turtle Mountain 10 km NW Kurupukari
Rhynchonycteris naso	2-Nov-97	Turtle Mountain 10 km NW Kurupukari
Artibeus lituratus	2-Nov-97	Turtle Mountain 10 km NW Kurupukari
Artibeus lituratus	2-Nov-97	Turtle Mountain 10 km NW Kurupukari
Artibeus lituratus	2-Nov-97	Turtle Mountain 10 km NW Kurupukari
Artibeus lituratus	2-Nov-97	Turtle Mountain 10 km NW Kurupukari
Artibeus obscurus	3-Nov-97	Turtle Mountain 10 km NW Kurupukari
Molossus molossus	7-Nov-97	Iwokrama Field Station
Molossus molossus	7-Nov-97	Iwokrama Field Station
Artibeus lituratus	11-Nov-97	S Falls 50 km WSW Kurupukari
Artibeus lituratus	12-Nov-97	S Falls 50 km WSW Kurupukari
Artibeus lituratus	12-Nov-97	S Falls 50 km WSW Kurupukari
Artibeus lituratus	13-Nov-97	S Falls 50 km WSW Kurupukari
Artibeus concolor	14-Nov-97	S Falls 50 km WSW Kurupukari
Molossus molossus	14-Nov-97	S Falls 50 km WSW Kurupukari
Artibeus planirostris	14-Nov-97	S Falls 50 km WSW Kurupukari
Artibeus lituratus	15-Nov-97	S Falls 50 km WSW Kurupukari
Artibeus lituratus	16-Nov-97	Pakatau Falls
Artibeus lituratus	17-Nov-97	Pakatau Falls
Artibeus lituratus	18-Nov-97	Pakatau Falls
Artibeus obscurus	18-Nov-97	Pakatau Falls
Carollia perspicillata	18-Nov-97	Pakatau Falls
Artibeus lituratus	18-Nov-97	Pakatau Falls

Species	Date	Location
Artibeus lituratus	18-Nov-97	Pakatau Falls
Artibeus lituratus	19-Nov-97	Pakatau Falls
Artibeus lituratus	19-Nov-97	Pakatau Falls
Rhinophylla pumilio	19-Nov-97	Pakatau Falls
Artibeus concolor	20-Nov-97	Pakatau Falls
Lonchophylla thomasi	20-Nov-97	Pakatau Falls
Artibeus lituratus	20-Nov-97	Pakatau Falls
Artibeus lituratus	20-Nov-97	Pakatau Falls
Noctilio liporinus	21-Nov-97	Siparuni River
Mimon crenulatum	11-Oct-99	Kabukalli Landing
Artibeus cinereus	12-Oct-99	Kabukalli Landing
Carollia perspicillata	12-Oct-99	Kabukalli Landing
Rhynchonycteris naso	13-Oct-99	Kabukalli Landing
Artibeus cinereus	15-Oct-99	Kabukalli Landing
Artibeus Sp.	16-Oct-99	Kabukalli Landing
Artibeus cinereus	17-Oct-99	Kabukalli Landing
Artibeus lituratus	18-Oct-99	Kabukalli Landing
Artibeus Sp.	18-Oct-99	Kabukalli Landing
Mimon crenulatum	18-Oct-99	Kabukalli Landing
Carollia perspicillata	21-Oct-99	Sand stone
Rhinophylla pumilio	21-Oct-99	Sand stone
Carollia brevicauda	22-Oct-99	Sand stone
Artibeus lituratus	22-Oct-99	Sand stone
Rhinophylla pumilio	22-Oct-99	Sand stone
Rhinophylla pumilio	22-Oct-99	Sand stone
Artibeus obscurus	19-Oct-99	Sand stone
Rhinophylla pumilio	23-Oct-99	Sand stone
Artibeus lituratus	23-Oct-99	Sand stone
Lionycteris spurelli	23-Oct-99	Sand stone
Platyrrhinus helleri	24-Oct-99	Sand stone
Artibeus Sp.	24-Oct-99	Sand stone
Artibeus lituratus	24-Oct-99	Sand stone
Artibeus Sp.	24-Oct-99	Sand stone
Lonchophylla thomasi	24-Oct-99	Sand stone
Lonchophylla thomasi	25-Oct-99	Sand stone
Lonchophylla thomasi	25-Oct-99	Sand stone
Carollia perspicillata	25-Oct-99	Sand stone
Artibeus planirostris	25-Oct-99	Sand stone
Tonatia silvicola	26-Oct-99	Sand stone
Carollia brevicauda	27-Oct-99	Sand stone
Artibeus planirostris	27-Oct-99	Sand stone
Artibeus lituratus	27-Oct-99	Sand stone
Artibeus lituratus	27-Oct-99	Sand stone
Carollia perspicillata	28-Oct-99	Sand stone
Phyllostomus hastatus	29-Oct-99	Sand stone
Artibeus planirostris	29-Oct-99	Sand stone
Artibeus concolor	29-Oct-99	Sand stone
Artibeus Sp.	29-Oct-99	Sand stone
Carollia perspicillata	2-Nov-99	Mt Daniel Cutline
Carollia perspicillata	2-Nov-99	Mt Daniel Cutline
Carollia perspicillata	2-Nov-99	Mt Daniel Cutline
Carollia brevicauda	2-Nov-99	Mt Daniel Cutline
Artibeus obscurus	2-Nov-99	Mt Daniel Cutline
Rhinophylla pumilio	3-Nov-99	Mt Daniel Cutline
Artibeus Sp.	3-Nov-99	Mt Daniel Cutline
Artibeus lituratus	3-Nov-99	Mt Daniel Cutline
Artibeus lituratus	3-Nov-99	Mt Daniel Cutline
Carollia brevicauda	4-Nov-99	Mt Daniel Cutline
Rhinophylla pumilio	4-Nov-99	Mt Daniel Cutline
Artibeus Sp.	4-Nov-99	Mt Daniel Cutline
Artibeus Sp.	4-Nov-99	Mt Daniel Cutline

Species	Date	Location
Artibeus Sp.	4-Nov-99	Mt Daniel Cutline
Artibeus Sp.	4-Nov-99	Mt Daniel Cutline
Artibeus Sp.	4-Nov-99	Mt Daniel Cutline
Artibeus Sp.	5-Nov-99	Mt Daniel Cutline
Artibeus planirostris	5-Nov-99	Mt Daniel Cutline
Artibeus planirostris	5-Nov-99	Mt Daniel Cutline
Carollia perspicillata	8-Nov-99	Iwokrama Field Station
Carollia perspicillata	8-Nov-99	Iwokrama Field Station
Platyrrhinus helleri	8-Nov-99	Iwokrama Field Station
Platyrrhinus helleri	8-Nov-99	Iwokrama Field Station
Molossus molossus	9-Nov-99	Iwokrama Field Station
Tonatia silvicola	9-Nov-99	Iwokrama Field Station
Molossus molossus	9-Nov-99	Iwokrama Field Station
Molossus molossus	9-Nov-99	Iwokrama Field Station
Phyllostomus hastatus	9-Nov-99	Iwokrama Field Station
Artibeus Sp.	9-Nov-99	Iwokrama Field Station
Platyrrhinus helleri	9-Nov-99	Iwokrama Field Station
Molossus molossus	9-Nov-99	Iwokrama Field Station
Molossus molossus	9-Nov-99	Iwokrama Field Station
Molossus molossus	10-Nov-99	Iwokrama Field Station
Molossus molossus	10-Nov-99	Iwokrama Field Station
Artibeus Sp.	11-Nov-99	Iwokrama Field Station
Tonatia silvicola	12-Nov-99	Iwokrama Field Station
Rhinophylla pumilio	12-Nov-99	Iwokrama Field Station
Carollia perspicillata	12-Nov-99	Giaconda Camp
Rhinophylla pumilio	12-Nov-99	Giaconda Camp
Artibeus lituratus	12-Nov-99	Giaconda Camp
Carollia perspicillata	2-Feb-99	Dubulay Ranch
Molossus molossus	2-Feb-99	Dubulay Ranch
Sturnira lilium	2-Feb-99	Dubulay Ranch
Desmodus rotundus	2-Feb-99	Dubulay Ranch
Phyllostomus hastatus	2-Feb-99	Dubulay Ranch
Carollia perspicillata	2-Feb-99	Dubulay Ranch
Artibeus cinereus	5-Feb-99	Dubulay Ranch
Platyrrhinus helleri	4-Feb-99	Dubulay Ranch

APPENDIX VIII

Reproductive Species Account

Species	Date	Location	Condition
Artibeus cinereus	22-Jul-94	5 km SE Surama	9
Artibeus cinereus	22-Jul-94	5 km SE Surama	10
Artibeus cinereus	22-Jul-94	5 km SE Surama	4
Artibeus cinereus	22-Jul-94	5 km SE Surama	25
Artibeus cinereus	22-Jul-94	5 km SE Surama	Lactating
Artibeus cinereus	26-Jul-94	5 km SE Surama	8
Artibeus cinereus	30-Jul-94	5 km SE Surama	16
Artibeus cinereus	22-Mar-97	Giaconda Camp	7
Artibeus cinereus	23-Mar-97	Giaconda Camp	5
Artibeus cinereus	30-Mar-97	Burro Burro R 25 Km WNW Kurupukari	11
Artibeus cinereus	14-Oct-97	CowFly Camp 40 km Sw Kurupukari	23
Artibeus cinereus	14-Oct-97	CowFly Camp 40 km Sw Kurupukari	25
Artibeus cinereus	15-Oct-97	CowFly Camp 40 km Sw Kurupukari	14
Artibeus cinereus	5-Feb-99	Dubulay Ranch	pregnant
Artibeus cinereus	27-Feb-99	CEIBA	Lactating
Artibeus cinereus	27-Feb-99	CEIBA	lactating
Artibeus cinereus	2-Apr-99	CEIBA	Lactating
Artibeus cinereus	17-Apr-99	CEIBA	Post-lactating
Artibeus cinereus	26-Jun-99	CEIBA	Pregnant and Pre-lactating
Artibeus cinereus	28-Aug-99	CEIBA	Pregnant
Artibeus cinereus	12-Oct-99	Kabukalli Landing	Lactating
Artibeus cinereus	15-Oct-99	Kabukalli Landing	9
Artibeus cinereus	17-Oct-99	Kabukalli Landing	25
Artibeus concolor	18-Jul-94	5 km SE Surama	15
Artibeus concolor	28-Jul-94	5 km SE Surama	9
Artibeus concolor	28-Jul-94	5 km SE Surama	4
Artibeus concolor	29-Jul-94	5 km SE Surama	Lactating
Artibeus concolor	6-Aug-94	Tropenbos 20 km SSE Mabura Hills	3
Artibeus concolor	7-Aug-94	Tropenbos 20 km SSE Mabura Hills	9
Artibeus concolor	7-Aug-94	Tropenbos 20 km SSE Mabura Hills	4
Artibeus concolor	11-Aug-94	Tropenbos 20 km SSE Mabura Hills	9
Artibeus concolor	18-Mar-97	Giaconda Camp	Lactating
Artibeus concolor	19-Mar-97	Giaconda Camp	11
Artibeus concolor	20-Mar-97	Giaconda Camp	Swollen uterus, lactating
Artibeus concolor	25-Mar-97	Giaconda Camp	29
Artibeus concolor	25-Mar-97	Giaconda Camp	Lactating
Artibeus concolor	25-Mar-97	Giaconda Camp	19
Artibeus concolor	26-Mar-97	Giaconda Camp	23
Artibeus concolor	31-Mar-97	Burro Burro R 25 Km WNW Kurupukari	27
Artibeus concolor	5-Apr-97	Burro Burro R 25 Km WNW Kurupukari	12
Artibeus concolor	5-Apr-97	Burro Burro R 25 Km WNW Kurupukari	27
Artibeus concolor	7-Apr-97	Burro Burro R 25 Km WNW Kurupukari	Lactating
Artibeus concolor	7-Apr-97	Burro Burro R 25 Km WNW Kurupukari	17
Artibeus concolor	7-Apr-97	Burro Burro R 25 Km WNW Kurupukari	16
Artibeus concolor	8-Apr-97	Burro Burro R 25 Km WNW Kurupukari	Lactating
Artibeus concolor	12-Apr-97	Iwokrama Field Station	30
Artibeus concolor	12-Apr-97	Iwokrama Field Station	25
Artibeus concolor	24-Oct-97	Gorge Camp 40 km SSW Kurupukari	19
Artibeus concolor	14-Nov-97	S Falls 50 km WSW Kurupukari	30
Artibeus concolor	20-Nov-97	Pakatau Falls	22
Artibeus concolor	28-Aug-99	CEIBA	no ova, Lactating
Artibeus concolor	29-Oct-99	Sand stone	10
Artibeus lituratus	19-Jul-94	5 km SE Surama	Lactating

Species	Date	Location	Condition
Artibeus lituratus	24-Jul-94	5 km SE Surama	Lactating
Artibeus lituratus	25-Jul-94	5 km SE Surama	4
Artibeus lituratus	25-Jul-94	5 km SE Surama	28
Artibeus lituratus	6-Aug-94	Tropenbos 20 km SSE Mabura Hills	20
Artibeus lituratus	6-Aug-94	Tropenbos 20 km SSE Mabura Hills	13
Artibeus lituratus	6-Aug-94	Tropenbos 20 km SSE Mabura Hills	22
Artibeus lituratus	7-Aug-94	Tropenbos 20 km SSE Mabura Hills	19
Artibeus lituratus	7-Aug-94	Tropenbos 20 km SSE Mabura Hills	23
Artibeus lituratus	8-Aug-94	Tropenbos 20 km SSE Mabura Hills	30
Artibeus lituratus	8-Aug-94	Tropenbos 20 km SSE Mabura Hills	25
Artibeus lituratus	8-Aug-94	Tropenbos 20 km SSE Mabura Hills	11
Artibeus lituratus	9-Aug-94	Tropenbos 20 km SSE Mabura Hills	18
Artibeus lituratus	10-Aug-94	Tropenbos 20 km SSE Mabura Hills	15
Artibeus lituratus	13-Mar-97	Pakatau Mountain	33
Artibeus lituratus	14-Mar-97	Pakatau Mountain	46
Artibeus lituratus	18-Mar-97	Giaconda Camp	swollen uterus, lactating
Artibeus lituratus	19-Mar-97	Giaconda Camp	42
Artibeus lituratus	20-Mar-97	Giaconda Camp	swollen uterus
Artibeus lituratus	24-Mar-97	Giaconda Camp	swollen uterus, lactating
Artibeus lituratus	24-Mar-97	Giaconda Camp	Lactating
Artibeus lituratus	25-Mar-97	Giaconda Camp	Lactating
Artibeus lituratus	26-Mar-97	Giaconda Camp	Lactating
Artibeus lituratus	27-Mar-97	Giaconda Camp	50
Artibeus lituratus	31-Mar-97	Burro Burro R 25 Km WNW Kurupukari	Lactating
Artibeus lituratus	31-Mar-97	Burro Burro R 25 Km WNW Kurupukari	Lactating
Artibeus lituratus	12-Apr-97	Iwokrama Field Station	Lactating
Artibeus lituratus	12-Apr-97	Iwokrama Field Station	Lactating
Artibeus lituratus	4-Oct-97	38 Mile Camp 35 km Sw Kurupukari	50
Artibeus lituratus	6-Oct-97	38 Mile Camp 35 km Sw Kurupukari	35
Artibeus lituratus	11-Oct-97	CowFly Camp 40 km Sw Kurupukari	34
Artibeus lituratus	14-Oct-97	CowFly Camp 40 km Sw Kurupukari	Lactating
Artibeus lituratus	14-Oct-97	CowFly Camp 40 km Sw Kurupukari	40
Artibeus lituratus	14-Oct-97	CowFly Camp 40 km Sw Kurupukari	45
Artibeus lituratus	14-Oct-97	CowFly Camp 40 km Sw Kurupukari	34
Artibeus lituratus	14-Oct-97	CowFly Camp 40 km Sw Kurupukari	27
Artibeus lituratus	15-Oct-97	CowFly Camp 40 km Sw Kurupukari	39
Artibeus lituratus	21-Oct-97	Gorge Camp 40 km SSW Kurupukari	Lactating
Artibeus lituratus	21-Oct-97	Gorge Camp 40 km SSW Kurupukari	35
Artibeus lituratus	22-Oct-97	Gorge Camp 40 km SSW Kurupukari	34
Artibeus lituratus	23-Oct-97	Gorge Camp 40 km SSW Kurupukari	33
Artibeus lituratus	31-Oct-97	Turtle Mountain 10 km NW Kurupukari	43
Artibeus lituratus	1-Nov-97	Turtle Mountain 10 km NW Kurupukari	53
Artibeus lituratus	2-Nov-97	Turtle Mountain 10 km NW Kurupukari	49
Artibeus lituratus	2-Nov-97	Turtle Mountain 10 km NW Kurupukari	43
Artibeus lituratus	2-Nov-97	Turtle Mountain 10 km NW Kurupukari	43
Artibeus lituratus	2-Nov-97	Turtle Mountain 10 km NW Kurupukari	33
Artibeus lituratus	11-Nov-97	S Falls 50 km WSW Kurupukari	Lactating
Artibeus lituratus	12-Nov-97	S Falls 50 km WSW Kurupukari	Lactating
Artibeus lituratus	12-Nov-97	S Falls 50 km WSW Kurupukari	Lactating
Artibeus lituratus	13-Nov-97	S Falls 50 km WSW Kurupukari	Lactating
Artibeus lituratus	15-Nov-97	S Falls 50 km WSW Kurupukari	Lactating
Artibeus lituratus	16-Nov-97	Pakatau Falls	Lactating
Artibeus lituratus	17-Nov-97	Pakatau Falls	Lactating
Artibeus lituratus	18-Nov-97	Pakatau Falls	Lactating
Artibeus lituratus	18-Nov-97	Pakatau Falls	44
Artibeus lituratus	18-Nov-97	Pakatau Falls	Lactating
Artibeus lituratus	19-Nov-97	Pakatau Falls	Lactating
Artibeus lituratus	19-Nov-97	Pakatau Falls	Lactating
Artibeus lituratus	20-Nov-97	Pakatau Falls	Lactating
Artibeus lituratus	20-Nov-97	Pakatau Falls	Lactating
Artibeus lituratus	17-Apr-99	CEIBA	pregnant and lactating

Species	Date	Location	Condition
Artibeus lituratus	8-May-99	CEIBA	Pregnant and lactating
Artibeus lituratus	18-Oct-99	Kabukalli Landing	pregnant
Artibeus lituratus	22-Oct-99	Sand stone	Lactating
Artibeus lituratus	23-Oct-99	Sand stone	Lactating
Artibeus lituratus	24-Oct-99	Sand stone	Lactating
Artibeus lituratus	27-Oct-99	Sand stone	Lactating
Artibeus lituratus	27-Oct-99	Sand stone	Lactating
Artibeus lituratus	3-Nov-99	Mt Daniel Cutline	Lactating
Artibeus lituratus	3-Nov-99	Mt Daniel Cutline	42
Artibeus lituratus	12-Nov-99	Giaconda Camp	28
Artibeus obscurus	17-Jul-94	5 km SE Surama	Lactating
Artibeus obscurus	23-Jul-94	5 km SE Surama	30
Artibeus obscurus	25-Jul-94	5 km SE Surama	14
Artibeus obscurus	25-Jul-94	5 km SE Surama	18
Artibeus obscurus	25-Jul-94	5 km SE Surama	21
Artibeus obscurus	25-Jul-94	5 km SE Surama	8
Artibeus obscurus	26-Jul-94	5 km SE Surama	10
Artibeus obscurus	26-Jul-94	5 km SE Surama	6
Artibeus obscurus	29-Jul-94	5 km SE Surama	29
Artibeus obscurus	30-Jul-94	5 km SE Surama	Lactating
Artibeus obscurus	6-Aug-94	Tropenbos 20 km SSE Mabura Hills	16
Artibeus obscurus	6-Aug-94	Tropenbos 20 km SSE Mabura Hills	26
Artibeus obscurus	8-Aug-94	Tropenbos 20 km SSE Mabura Hills	26
Artibeus obscurus	11-Aug-94	Tropenbos 20 km SSE Mabura Hills	18
Artibeus obscurus	13-Aug-94	Tropenbos 20 km SSE Mabura Hills	5
Artibeus obscurus	13-Aug-94	Tropenbos 20 km SSE Mabura Hills	19
Artibeus obscurus	13-Aug-94	Tropenbos 20 km SSE Mabura Hills	13
Artibeus obscurus	14-Aug-94	Mabura Hills	16
Artibeus obscurus	14-Aug-94	Tropenbos 20 km SSE Mabura Hills	17
Artibeus obscurus	4-Nov-96	Chodikar R. 55 km Sw Gunn's	31
Artibeus obscurus	23-Mar-97	Giaconda Camp	Lactating
Artibeus obscurus	26-Mar-97	Giaconda Camp	38
Artibeus obscurus	26-Mar-97	Giaconda Camp	26
Artibeus obscurus	27-Mar-97	Giaconda Camp	23
Artibeus obscurus	28-Mar-97	Giaconda Camp	Lactating
Artibeus obscurus	31-Mar-97	Burro Burro R 25 Km WNW Kurupukari	13
Artibeus obscurus	2-Apr-97	Burro Burro R 25 Km WNW Kurupukari	23
Artibeus obscurus	7-Apr-97	Burro Burro R 25 Km WNW Kurupukari	Lactating
Artibeus obscurus	12-Apr-97	Iwokrama Field Station	25
Artibeus obscurus	24-Oct-97	Gorge Camp 40 km SSW Kurupukari	31
Artibeus obscurus	3-Nov-97	Turtle Mountain 10 km NW Kurupukari	29
Artibeus obscurus	18-Nov-97	Pakatau Falls	Lactating
Artibeus obscurus	2-Apr-99	CEIBA	15
Artibeus obscurus	19-Oct-99	Sand stone	Lactating
Artibeus obscurus	2-Nov-99	Mt Daniel Cutline	Lactating
Artibeus planirostris	18-Jul-94	5 km SE Surama	Lactating
Artibeus planirostris	20-Jul-94	5 km SE Surama	Lactating
Artibeus planirostris	26-Jul-94	5 km SE Surama	25
Artibeus planirostris	3-Nov-96	Chodikar R. 55 km Sw Gunn's	30
Artibeus planirostris	19-Mar-97	Giaconda Camp	Lactating
Artibeus planirostris	19-Mar-97	Giaconda Camp	Lactating
Artibeus planirostris	20-Mar-97	Giaconda Camp	46
Artibeus planirostris	27-Mar-97	Giaconda Camp	39
Artibeus planirostris	1-Apr-97	Burro Burro R 25 Km WNW Kurupukari	8
Artibeus planirostris	2-Apr-97	Burro Burro R 25 Km WNW Kurupukari	Lactating
Artibeus planirostris	2-Apr-97	Burro Burro R 25 Km WNW Kurupukari	Lactating
Artibeus planirostris	3-Apr-97	Burro Burro R 25 Km WNW Kurupukari	Lactating
Artibeus planirostris	12-Apr-97	Iwokrama Field Station	Lactating
Artibeus planirostris	6-Oct-97	38 Mile Camp 35 km Sw Kurupukari	32
Artibeus planirostris	7-Oct-97	38 Mile Camp 35 km Sw Kurupukari	40
Artibeus planirostris	10-Oct-97	CowFly Camp 40 km Sw Kurupukari	38

Species	Date	Location	Condition
Artibeus planirostris	13-Oct-97	CowFly Camp 40 km Sw Kurupukari	25
Artibeus planirostris	13-Oct-97	CowFly Camp 40 km Sw Kurupukari	35
Artibeus planirostris	13-Oct-97	CowFly Camp 40 km Sw Kurupukari	42
Artibeus planirostris	14-Oct-97	CowFly Camp 40 km Sw Kurupukari	38
Artibeus planirostris	14-Oct-97	CowFly Camp 40 km Sw Kurupukari	40
Artibeus planirostris	14-Oct-97	CowFly Camp 40 km Sw Kurupukari	37
Artibeus planirostris	20-Oct-97	Gorge Camp 40 km SSW Kurupukari	39
Artibeus planirostris	20-Oct-97	Gorge Camp 40 km SSW Kurupukari	Lactating
Artibeus planirostris	21-Oct-97	Gorge Camp 40 km SSW Kurupukari	40
Artibeus planirostris	22-Oct-97	Gorge Camp 40 km SSW Kurupukari	32
Artibeus planirostris	22-Oct-97	Gorge Camp 40 km SSW Kurupukari	40, lactating
Artibeus planirostris	24-Oct-97	Gorge Camp 40 km SSW Kurupukari	46
Artibeus planirostris	31-Oct-97	Turtle Mountain 10 km NW Kurupukari	45
Artibeus planirostris	14-Nov-97	S Falls 50 km WSW Kurupukari	42
Artibeus planirostris	27-Feb-99	CEIBA	pregnant
Artibeus planirostris	17-Apr-99	CEIBA	Pregnant
Artibeus planirostris	28-Aug-99	CEIBA	Lactating
Artibeus planirostris	25-Oct-99	Sand stone	Lactating
Artibeus planirostris	27-Oct-99	Sand stone	Lactating
Artibeus planirostris	29-Oct-99	Sand stone	7, lactating
Artibeus planirostris	5-Nov-99	Mt Daniel Cutline	8
Artibeus planirostris	5-Nov-99	Mt Daniel Cutline	25
Artibeus Sp.	1-Apr-97	Burro Burro R 25 Km WNW Kurupukari	12
Artibeus Sp.	10-Apr-97	Burro Burro R 25 Km WNW Kurupukari	Lactating
Artibeus Sp.	12-Apr-97	Iwokrama Field Station	34
Artibeus Sp.	16-Oct-99	Kabukalli Landing	21
Artibeus Sp.	18-Oct-99	Kabukalli Landing	30
Artibeus Sp.	24-Oct-99	Sand stone	Lactating
Artibeus Sp.	24-Oct-99	Sand stone	10, lactating
Artibeus Sp.	29-Oct-99	Sand stone	11
Artibeus Sp.	3-Nov-99	Mt Daniel Cutline	Lactating
Artibeus Sp.	4-Nov-99	Mt Daniel Cutline	24
Artibeus Sp.	4-Nov-99	Mt Daniel Cutline	Lactating
Artibeus Sp.	4-Nov-99	Mt Daniel Cutline	Lactating
Artibeus Sp.	4-Nov-99	Mt Daniel Cutline	Lactating
Artibeus Sp.	4-Nov-99	Mt Daniel Cutline	Lactating
Artibeus Sp.	5-Nov-99	Mt Daniel Cutline	6, lactating
Artibeus Sp.	9-Nov-99	Iwokrama Field Station	15
Artibeus Sp.	11-Nov-99	Iwokrama Field Station	Lactating
Carollia brevicauda	24-Jul-94	5 km SE Surama	16
Carollia brevicauda	7-Aug-94	Tropenbos 20 km SSE Mabura Hills	Lactating
Carollia brevicauda	10-Mar-97	Pakatau Mountain	23
Carollia brevicauda	20-Oct-97	Gorge Camp 40 km SSW Kurupukari	27
Carollia brevicauda	23-Oct-97	Gorge Camp 40 km SSW Kurupukari	15
Carollia brevicauda	6-Mar-99	CEIBA	Pregnant
Carollia brevicauda	6-Mar-99	CEIBA	no emb
Carollia brevicauda	2-Apr-99	CEIBA	Pregnant
Carollia brevicauda	17-Apr-99	CEIBA	Post-lactating
Carollia brevicauda	8-May-99	CEIBA	Pregnant
Carollia brevicauda	24-Jul-99	CEIBA	Pregnant
Carollia brevicauda	24-Jul-99	CEIBA	Pregnant
Carollia brevicauda	7-Aug-99	CEIBA	Post-lactating
Carollia brevicauda	22-Oct-99	Sand stone	14
Carollia brevicauda	27-Oct-99	Sand stone	16
Carollia brevicauda	2-Nov-99	Mt Daniel Cutline	Lactating
Carollia brevicauda	4-Nov-99	Mt Daniel Cutline	Lactating
Carollia brevicauda	4-Dec-99	CEIBA	Pregnant
Carollia perspicillata	22-Jul-94	5 km SE Surama	9
Carollia perspicillata	29-Jul-94	5 km SE Surama	14
Carollia perspicillata	6-Aug-94	Tropenbos 20 km SSE Mabura Hills	15
Carollia perspicillata	7-Aug-94	Tropenbos 20 km SSE Mabura Hills	5

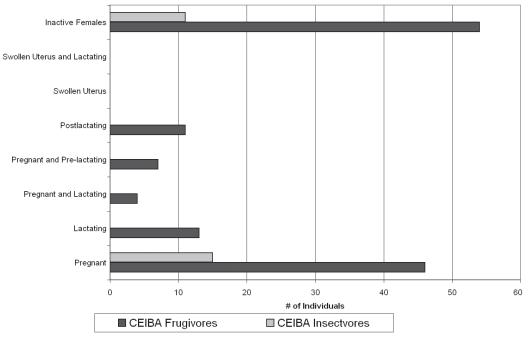
Species	Date	Location	Condition
Carollia perspicillata	14-Aug-94	Mabura Hills	9
Carollia perspicillata	14-Aug-94	Mabura Hills	10
Carollia perspicillata	14-Aug-94	Mabura Hills	10
Carollia perspicillata	5-Jul-95	Iwokrama 25 km SSW Kurupukari	13
Carollia perspicillata	26-Oct-96	Gunn's strip	Lactating
Carollia perspicillata	26-Oct-96	Gunn's strip	Lactating
Carollia perspicillata	26-Oct-96	Gunn's strip	Lactating
Carollia perspicillata	28-Oct-96	Chodikar R. 55 km Sw Gunn's	27
Carollia perspicillata	28-Oct-96	Chodikar R. 55 km Sw Gunn's	15
Carollia perspicillata	9-Mar-97	Pakatau Mountain	29
Carollia perspicillata	9-Mar-97	Pakatau Mountain	9
Carollia perspicillata	10-Mar-97	Pakatau Mountain	24
Carollia perspicillata	18-Mar-97	Giaconda Camp	25
Carollia perspicillata	18-Mar-97	Giaconda Camp	32
Carollia perspicillata	19-Mar-97	Giaconda Camp	35
Carollia perspicillata	20-Mar-97	Giaconda Camp	25
Carollia perspicillata	20-Mar-97	Giaconda Camp	36
Carollia perspicillata	3-Oct-97	38 Mile Camp 35 km Sw Kurupukari	16
Carollia perspicillata	6-Oct-97	38 Mile Camp 35 km Sw Kurupukari	22
Carollia perspicillata	6-Oct-97	38 Mile Camp 35 km Sw Kurupukari	25
Carollia perspicillata	7-Oct-97	38 Mile Camp 35 km Sw Kurupukari	22
Carollia perspicillata	20-Oct-97	Gorge Camp 40 km SSW Kurupukari	24
Carollia perspicillata	22-Oct-97	Gorge Camp 40 km SSW Kurupukari	15
Carollia perspicillata	18-Nov-97	Pakatau Falls	5
Carollia perspicillata	2-Feb-99	Dubulay Ranch	pregnant
Carollia perspicillata	2-Feb-99	Dubulay Ranch	24
Carollia perspicillata	27-Feb-99	CEIBA	Post-Lactating
Carollia perspicillata	27-Feb-99	CEIBA	Lactating
Carollia perspicillata	6-Mar-99	CEIBA	pregnant
Carollia perspicillata	6-Mar-99	CEIBA	Post-lactating
Carollia perspicillata	6-Mar-99	CEIBA	Post-lactating
Carollia perspicillata	6-Mar-99	CEIBA	Post-lactating
Carollia perspicillata	6-Mar-99	CEIBA	pregnant
Carollia perspicillata	6-Mar-99	CEIBA	Carrying neonate ~ 35 mm
Carollia perspicillata	6-Mar-99	CEIBA	Pregnant
Carollia perspicillata	6-Mar-99	CEIBA	pregnant
Carollia perspicillata	6-Mar-99	CEIBA	Pregnant and Lactating
Carollia perspicillata	6-Mar-99	CEIBA	Pregnant
Carollia perspicillata	6-Mar-99	CEIBA	Pregnant
Carollia perspicillata	6-Mar-99	CEIBA	Pregnant
Carollia perspicillata	2-Apr-99	CEIBA	Lactating
Carollia perspicillata	17-Apr-99	CEIBA	Post-lactating
Carollia perspicillata	17-Apr-99	CEIBA	Lactating
Carollia perspicillata	8-May-99	CEIBA	Pregnant
Carollia perspicillata	8-May-99	CEIBA	Pregnant
Carollia perspicillata	8-May-99	CEIBA	Pregnant and Lactating
Carollia perspicillata	8-May-99	CEIBA	Pregnant and Post-lactating
Carollia perspicillata	8-May-99	CEIBA	Pregnant
Carollia perspicillata	26-Jun-99	CEIBA	Pregnant and Post-lactating
Carollia perspicillata	26-Jun-99	CEIBA	pregnant
Carollia perspicillata	10-Jul-99	CEIBA	pregnant and post-lactating
Carollia perspicillata	10-Jul-99	CEIBA	Pregnant
Carollia perspicillata	24-Jul-99	CEIBA	carrying infant
Carollia perspicillata	24-Jul-99	CEIBA	Carrying infant
Carollia perspicillata	7-Aug-99	CEIBA	Pregnant
Carollia perspicillata	7-Aug-99	CEIBA	Post-lactating
Carollia perspicillata	7-Aug-99	CEIBA	Post-lactating
Carollia perspicillata	7-Aug-99	CEIBA	Pregnant
Carollia perspicillata	28-Aug-99	CEIBA	Lactating
Carollia perspicillata	28-Aug-99	CEIBA	Post-lactating
Carollia perspicillata	28-Aug-99	CEIBA	Pregnant

Species	Date	Location	Condition
Carollia perspicillata	28-Aug-99	CEIBA	pregnant
Carollia perspicillata	28-Aug-99	CEIBA	Lactating
Carollia perspicillata	28-Aug-99	CEIBA	Pregnant
Carollia perspicillata	12-Oct-99	Kabukalli Landing	22
Carollia perspicillata	21-Oct-99	Sand stone	Lactating
Carollia perspicillata	25-Oct-99	Sand stone	Lactating
Carollia perspicillata	28-Oct-99	Sand stone	Lactating
Carollia perspicillata	2-Nov-99	Mt Daniel Cutline	Lactating
Carollia perspicillata	2-Nov-99	Mt Daniel Cutline	Lactating
Carollia perspicillata	2-Nov-99	Mt Daniel Cutline	Lactating
Carollia perspicillata	8-Nov-99	Iwokrama Field Station	Lactating
Carollia perspicillata	8-Nov-99	Iwokrama Field Station	Lactating
Carollia perspicillata	12-Nov-99	Giaconda Camp	Lactating
Carollia perspicillata	26-Feb-00	CEIBA	pregnant
Carollia perspicillata	26-Feb-00	CEIBA	pregnant
Carollia perspicillata	26-Feb-00	CEIBA	Pregnant
Carollia perspicillata	26-Feb-00	CEIBA	Pregnant
Carollia perspicillata	26-Feb-00	CEIBA	Pregnant, pre-lactating
Carollia perspicillata	26-Feb-00	CEIBA	Pregnant
Carollia perspicillata	26-Feb-00	CEIBA	Pregnant
Choeroniscus godmani	26-Jun-99	CEIBA	ova=14 mm
Choeroniscus godmani	12-Feb-00	CEIBA	Pregnant
Desmodus rotundus	9-Aug-94	Tropenbos 20 km SSE Mabura Hills	28
Desmodus rotundus	11-Aug-94	Tropenbos 20 km SSE Mabura Hills	Lactating
Desmodus rotundus	2-Feb-99	Dubulay Ranch	Lactating
Desmodus rotundus	17-Apr-99	CEIBA	ova = 12 mm, lactating
Desmodus rotundus	24-Jul-99	CEIBA	Pregnant
Glossophaga soricina	17-Apr-99	CEIBA	pregnant
Glossophaga soricina	28-Aug-99	CEIBA	Pregnant
Glossophiga soricina	12-Aug-94	Tropenbos 20 km SSE Mabura Hills	17
Glossophiga soricina	12-Aug-94	Tropenbos 20 km SSE Mabura Hills	16
Glossophiga soricina	3-Oct-97	38 Mile Camp 35 km Sw Kurupukari	13
Glossophiga soricina	15-Oct-97	CowFly Camp 40 km Sw Kurupukari	21
Lionycteris spurelli	11-Oct-97	CowFly Camp 40 km Sw Kurupukari	10
Lionycteris spurelli	13-Oct-97	CowFly Camp 40 km Sw Kurupukari	24
Lionycteris spurelli	15-Oct-97	CowFly Camp 40 km Sw Kurupukari	Lactating
Lionycteris spurelli	23-Oct-99	Sand stone	10
Lonchophylla thomasi	26-Jul-94	5 km SE Surama	11
Lonchophylla thomasi	29-Oct-96	Chodikar R. 55 km Sw Gunn's	11
Lonchophylla thomasi	29-Oct-96	Chodikar R. 55 km Sw Gunn's	20
Lonchophylla thomasi	4-Oct-97	38 Mile Camp 35 km Sw Kurupukari	20
Lonchophylla thomasi	10-Oct-97	CowFly Camp 40 km Sw Kurupukari	22
Lonchophylla thomasi	20-Nov-97	Pakatau Falls	Lactating
Lonchophylla thomasi	7-Aug-99	CEIBA	Ova = 13
Lonchophylla thomasi	24-Oct-99	Sand stone	Lactating
Lonchophylla thomasi	25-Oct-99	Sand stone	20
Lonchophylla thomasi	25-Oct-99	Sand stone	21
Lonchophylla thomasi	20-Nov-99	CEIBA	Pregnant
Lonchophylla thomasi	26-Feb-00	CEIBA	pregnant
Mesophylla maconnelli	12-Mar-97	Pakatau Mountain	21
Mesophylla maconnelli	22-Mar-97	Giaconda Camp	swollen uterus, lactating
Mesophylla maconnelli	24-Mar-97	Giaconda Camp	34
Mesophylla maconnelli	7-Apr-97	Burro Burro R 25 Km WNW Kurupukari	26
Mesophylla maconnelli	6-Mar-99	CEIBA	ova = 15 mm
Mesophylla maconnelli	7-Aug-99	CEIBA	ova= 17
Mimon crenulatum	6-Aug-94	Tropenbos 20 km SSE Mabura Hills	23
Mimon crenulatum	1-Nov-97	Turtle Mountain 10 km NW Kurupukari	Lactating
Mimon crenulatum	8-May-99	CEIBA	Pregnant
Mimon crenulatum	7-Aug-99	CEIBA	Pregnant
Mimon crenulatum	11-Oct-99	Kabukalli Landing	Lactating
Mimon crenulatum	18-Oct-99	Kabukalli Landing	Lactating

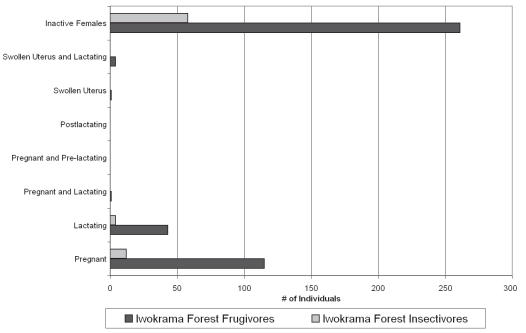
Species	Date	Location	Condition
Molossus molossus	14-Aug-94	Mabura Hills	17
Molossus molossus	14-Aug-94	Mabura Hills	5
Molossus molossus	14-Aug-94	Mabura Hills	15
Molossus molossus	14-Aug-94	Mabura Hills	13
Molossus molossus	14-Aug-94	Mabura Hills	15
Molossus molossus	14-Aug-94	Mabura Hills	Lactating
Molossus molossus	14-Aug-94	Mabura Hills	Lactating
Molossus molossus	14-Aug-94	Mabura Hills	13
Molossus molossus	14-Aug-94	Mabura Hills	25
Molossus molossus	26-Oct-96	Gunn's strip	Lactating
Molossus molossus	7-Nov-97	Iwokrama Field Station	12
Molossus molossus	7-Nov-97	Iwokrama Field Station	34
Molossus molossus	14-Nov-97	S Falls 50 km WSW Kurupukari	Lactating
Molossus molossus	2-Feb-99	Dubulay Ranch	15
Molossus molossus	2-Apr-99	CEIBA	ova = 15 mm
Molossus molossus	9-Nov-99	Iwokrama Field Station	Lactating
Molossus molossus	9-Nov-99	Iwokrama Field Station	Lactating
Molossus molossus	9-Nov-99	Iwokrama Field Station	Lactating
Molossus molossus	9-Nov-99	Iwokrama Field Station	25
Molossus molossus	9-Nov-99	Iwokrama Field Station	Lactating
Molossus molossus	10-Nov-99	Iwokrama Field Station	Lactating
Molossus molossus	10-Nov-99	Iwokrama Field Station	swollen uterus, lactating
Noctilio leporainus	2-Apr-99	CEIBA	ova = 34 mm
Noctilio liporinus	2-Nov-96	Chodikar R. 55 km Sw Gunn's	Lactating
Noctilio liporinus	18-Nov-96	7 km from Gunn's	Lactating
Noctilio liporinus	21-Nov-97	Siparuni River	Lactating
Peropteryx leucoptera	4-Dec-99	CEIBA	Pregnant
Phyllostomus hastatus	2-Feb-99	Dubulay Ranch	22
Phyllostomus hastatus	29-Oct-99	Sand stone	Lactating
Phyllostomus hastatus	9-Nov-99	Iwokrama Field Station	swollen uterus
Platyrrhinus helleri	29-Jul-94	5 km SE Surama	24
Platyrrhinus helleri	14-Mar-97	Pakatau Mountain	9
Platyrrhinus helleri	9-Oct-97	CowFly Camp 40 km Sw Kurupukari	17
Platyrrhinus helleri	15-Oct-97	CowFly Camp 40 km Sw Kurupukari	29
Platyrrhinus helleri	16-Oct-97	CowFly Camp 40 km Sw Kurupukari	24
Platyrrhinus helleri	22-Oct-97	Gorge Camp 40 km SSW Kurupukari	28
Platyrrhinus helleri	4-Feb-99	Dubulay Ranch	pregnant
Platyrrhinus helleri	27-Feb-99	CEIBA	pregnant
Platyrrhinus helleri	27-Feb-99	CEIBA	pregnant
Platyrrhinus helleri	27-Feb-99	CEIBA	pregnant
Platyrrhinus helleri	6-Mar-99	CEIBA	Pregnant
Platyrrhinus helleri	6-Mar-99	CEIBA	Ova = 22 mm
Platyrrhinus helleri	24-Oct-99	Sand stone	5, lactating
Platyrrhinus helleri	8-Nov-99	Iwokrama Field Station	Lactating
Platyrrhinus helleri	8-Nov-99	Iwokrama Field Station	Lactating
Platyrrhinus helleri	9-Nov-99	Iwokrama Field Station	Lactating
Platyrrhinus helleri	26-Feb-00	CEIBA	pregnant
Rhinophylla pumilio	20-Jul-94	5 km SE Surama	4
Rhinophylla pumilio	25-Jul-94	5 km SE Surama	4
Rhinophylla pumilio	26-Jul-94	5 km SE Surama	15
Rhinophylla pumilio	29-Jul-94	5 km SE Surama	8 and lactating
Rhinophylla pumilio	12-Jul-95	Iwokrama 25 km SSW Kurupukari	12
Rhinophylla pumilio	9-Nov-96	Kamoa R 50 km SWW Gunn's	32
Rhinophylla pumilio	11-Nov-96	Kamoa R 50 km SWW Gunn's	Lactating
Rhinophylla pumilio	18-Mar-97	Giaconda Camp	22
Rhinophylla pumilio	19-Mar-97	Giaconda Camp	Lactating
Rhinophylla pumilio	19-Mar-97	Giaconda Camp	28
Rhinophylla pumilio	19-Mar-97	Giaconda Camp	22
Rhinophylla pumilio	20-Mar-97	Giaconda Camp	21
Rhinophylla pumilio	20-Mar-97	Giaconda Camp	24
Rhinophylla pumilio	23-Mar-97	Giaconda Camp	28

Species	Date	Location	Condition
Rhinophylla pumilio	23-Mar-97	Giaconda Camp	18
Rhinophylla pumilio	26-Mar-97	Giaconda Camp	Lactating
Rhinophylla pumilio	6-Apr-97	Burro Burro R 25 Km WNW Kurupukari	Lactating
Rhinophylla pumilio	8-Apr-97	Burro Burro R 25 Km WNW Kurupukari	13
Rhinophylla pumilio	8-Apr-97	Burro Burro R 25 Km WNW Kurupukari	Lactating
Rhinophylla pumilio	3-Oct-97	38 Mile Camp 35 km Sw Kurupukari	22
Rhinophylla pumilio	3-Oct-97	38 Mile Camp 35 km Sw Kurupukari	29
Rhinophylla pumilio	5-Oct-97	38 Mile Camp 35 km Sw Kurupukari	Lactating
Rhinophylla pumilio	6-Oct-97	38 Mile Camp 35 km Sw Kurupukari	26
Rhinophylla pumilio	6-Oct-97	38 Mile Camp 35 km Sw Kurupukari	18
Rhinophylla pumilio	9-Oct-97	CowFly Camp 40 km Sw Kurupukari	31
Rhinophylla pumilio	9-Oct-97	CowFly Camp 40 km Sw Kurupukari	26
Rhinophylla pumilio	9-Oct-97	CowFly Camp 40 km Sw Kurupukari	17
Rhinophylla pumilio	18-Oct-97	CowFly Camp 40 km Sw Kurupukari	23
Rhinophylla pumilio	19-Nov-97	Pakatau Falls	30
Rhinophylla pumilio	6-Mar-99	CEIBA	pregnant
Rhinophylla pumilio	2-Apr-99	CEIBA	Pregnant
Rhinophylla pumilio	2-Apr-99	CEIBA	Pregnant
Rhinophylla pumilio	26-Jun-99	CEIBA	Pregnant and Pre-lactating
Rhinophylla pumilio	26-Jun-99	CEIBA	Pregnant and Pre-lactating
Rhinophylla pumilio	21-Oct-99	Sand stone	16
Rhinophylla pumilio	22-Oct-99	Sand stone	6
Rhinophylla pumilio	22-Oct-99	Sand stone	21
Rhinophylla pumilio	23-Oct-99	Sand stone	24
Rhinophylla pumilio	3-Nov-99	Mt Daniel Cutline	40, lactating
Rhinophylla pumilio	4-Nov-99	Mt Daniel Cutline	Lactating
Rhinophylla pumilio	12-Nov-99	Giaconda Camp	16
Rhinophylla pumilio	12-Nov-99	Iwokrama Field Station	20
Rhinophylla pumilio	26-Feb-00	CEIBA	Pregnant
Rhynchonycteris naso	7-Apr-97	Burro Burro R 25 Km WNW Kurupukari	12
Rhynchonycteris naso	2-Nov-97	Turtle Mountain 10 km NW Kurupukari	11
Rhynchonycteris naso	2-Nov-97	Turtle Mountain 10 km NW Kurupukari	18
Rhynchonycteris naso	2-Nov-97	Turtle Mountain 10 km NW Kurupukari	18
Rhynchonycteris naso	2-Apr-99	CEIBA	Pregnant
Rhynchonycteris naso	2-Apr-99	CEIBA	Pregnant
Rhynchonycteris naso	13-Oct-99	Kabukalli Landing	8
Rhynchonycteris naso	20-Nov-99	CEIBA	Pregnant
Saccopteryx bilineata	11-Aug-94	Tropenbos 20 km SSE Mabura Hills	Lactating
Saccopteryx bilineata	12-Oct-97	CowFly Camp 40 km Sw Kurupukari	13
Sturnira lilium	18-Jul-94	5 km SE Surama	Lactating
Sturnira lilium	19-Jul-94	5 km SE Surama	Lactating
Sturnira lilium	24-Jul-94	5 km SE Surama	Lactating
Sturnira lilium	25-Jul-94	5 km SE Surama	Lactating
Sturnira lilium	29-Jul-94	5 km SE Surama	6
Sturnira lilium	30-Jul-94	5 km SE Surama	7
Sturnira lilium	30-Jul-94	5 km SE Surama	7
Sturnira lilium	21-Nov-96	Gunn's strip	21
Sturnira lilium	21-Nov-96	Gunn's strip	12
Sturnira lilium	21-Nov-96	Gunn's strip	Lactating
Sturnira lilium	22-Nov-96	Gunn's strip	Lactating
Sturnira lilium	13-Oct-97	CowFly Camp 40 km Sw Kurupukari	11
Sturnira lilium	2-Feb-99	Dubulay Ranch	Lactating
Tonatia saurophila	6-Aug-94	Tropenbos 20 km SSE Mabura Hills	19
Tonatia saurophila	14-Mar-97	Pakatau Mountain	30
Tonatia saurophila	27-Mar-97	Giaconda Camp	Lactating
Tonatia saurophila	31-Mar-97	Burro Burro R 25 Km WNW Kurupukari	Lactating
Tonatia saurophila	10-Apr-97	Burro Burro R 25 Km WNW Kurupukari	16
Tonatia saurophila	20-Nov-99	CEIBA	Swollen uterus
Tonatia saurophila	20-Nov-99	CEIBA	Swollen uterus
Tonatia saurophila	26-Feb-00	CEIBA	Pregnant
Tonatia silvicola	7-Aug-94	Tropenbos 20 km SSE Mabura Hills	17

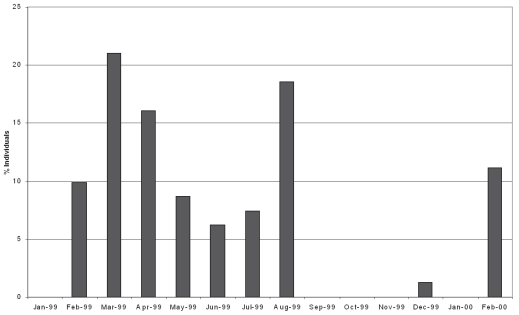
Species	Date	Location	Condition
Tonatia silvicola	11-Aug-94	Tropenbos 20 km SSE Mabura Hills	17
Tonatia silvicola	6-Jul-95	Iwokrama 25 km SSW Kurupukari	19
Tonatia silvicola	12-Jul-95	Iwokrama 25 km SSW Kurupukari	22
Tonatia silvicola	15-Jul-95	Iwokrama 25 km SSW Kurupukari	15
Tonatia silvicola	18-Jul-95	Iwokrama 25 km SSW Kurupukari	13
Tonatia silvicola	19-Jul-95	Iwokrama 25 km SSW Kurupukari	15
Tonatia silvicola	19-Jul-95	Iwokrama 25 km SSW Kurupukari	15
Tonatia silvicola	13-Mar-97	Pakatau Mountain	34
Tonatia silvicola	20-Mar-97	Giaconda Camp	30
Tonatia silvicola	20-Mar-97	Giaconda Camp	43
Tonatia silvicola	17-Apr-99	CEIBA	Pregnant
Tonatia silvicola	17-Apr-99	CEIBA	Pregnant
Tonatia silvicola	8-May-99	CEIBA	Pregnant
Tonatia silvicola	26-Oct-99	Sand stone	Lactating
Tonatia silvicola	9-Nov-99	Iwokrama Field Station	Lactating
Tonatia silvicola	12-Nov-99	Iwokrama Field Station	Lactating
Tonatia silvicola	4-Dec-99	CEIBA	Pregnant
Tonatia silvicola	26-Feb-00	CEIBA	pregnant



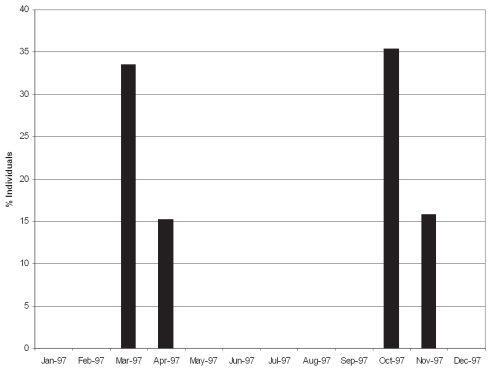
Graph 1. Reproductive Breakdown of bats at CEIBA



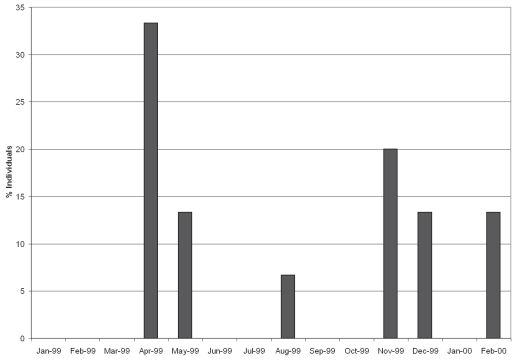
Graph 2. Reproductive Breakdown of Bats from Iwokrama Forest



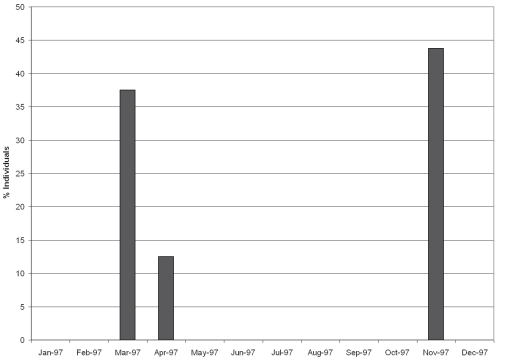
Graph 3. Reproductive Trend of Frugivorous Bats from CEIBA Biological Center



Graph 4. Reproductive Trends of Frugivorous Bats from the Iwokrama Forest



Graph 5. Reproductive Trend of Insectivorous Bats from CEIBA Biological Center



Graph 6. Reproductive Trends of Insectivorous Bats from the Iwokrama Forest

3. A Preliminary Survey Of the Herpetofauna of Lori Beach, Shell Beach, Guyana. May 27th – July 9th 2002

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ABSTRACT

Coastal zones contain some of the world's most productive ecosystems with rich biological diversity (Environmental Protection Agency - Guyana, 2001). At the heart of the Guiana Shield, Guyana have natural resources, which are considered extremely valuable such as 271 species of herpetofauna. Amphibians and reptiles, collectively known as herpetofauna, are noticeable components of many ecosystems and are important indicators of the health and dynamics of a habitat. As coasts are becoming more inhabited as the years go by there is greater need to determine what is there and for good management practices to be implemented.

There are a number of areas in Guyana that are important as wildlife sanctuaries. One such area is Shell Beach. Shell Beach is a unique ecosystem where four of the eight sea turtles nest. However little is known about the other herpetofauna of the area. Hence this research aims to document the other herpetofauna of the area specifically Lori Beach. Two other beaches, however – Almond Beach and Kamwatta Beach were also sampled.

Shell Beach is also an immediate tourist attraction, which can boost the economy of Guyana, thus proper management planning must be implemented in order to benefit the community, the tourists and Guyana. For the effective management of the area informed decision needs to be made by the collection of reliable data, which this research aims to provide.

Pitfall traps with drift fences along with Visual Encounter Surveys (VES) were selected as primary sampling techniques because they have proven by others to be the most efficient and effective method of sampling species within a limited amount of time. The Mark/Recapture Method and Opportunistic Collecting were also employed as secondary sampling techniques.

By creating a species list we can begin to find ways to create proper management of the area, specifically for the longevity of the herpetofauna. We can also deduce the impact on herpetological resources by the community and answer if ecological gaps can be filled and by what species. Moreover, we can determine the impact of the current clearing of the land on herpetofauna by comparative studies using transects.

Pitfall traps with drift net fences along with VES successfully collected 848 individuals of lizards, snakes and frogs. While opportunistic collecting produced three different species of snakes and six different species of frogs. Over a 6-week study along Lori Beach a total of 15 species of herpetofauna, other than the turtles, were observed.

INTRODUCTION

Throughout the world, coastal zones have historically been among the most heavily exploited areas, which contain some of the planet's most productive ecosystems with rich biodiversity (Environmental Protection Agency - Guyana, 2001).

The coastal zone can be loosely defined as both the area of land subjected to marine influences and the area of the sea subjected to land influences (United Nations Environment Programmes, 2000). A more strict definition divides the coastal zone into three main

components: the sea, the beach and the land behind the beach (United Nations Environment Programmes, 2000). This research uses the latter as the definition of Coastal Zone. As with all environmental systems, there are no clearly defined and universally accepted boundaries to the coastal zone (United Nations Environmental Programmes, 2000) therefore a definition of how long this distance is may vary according to each country.

The coastal zone is not an isolated system; it is a highly sensitive area, where a number of ecosystems exist in a state of balance. The three sub-systems interact in many ways and the boundaries between them fluctuate. It is a complex environment, and the health of one ecosystem is intimately tied to the health of the other ecosystems in the area, sometimes impacting areas apart from the coastal system.

Coastal zones are highly productive environments, which combines forestry and farming opportunities on fertile coastal lands. They are in great demand for economic and industrial development providing foci for trade and settlement having easy routes by land or water for population movements (Natural Resource Institute, 2000). In recent years coastal zones have become highly attractive venues for tourism and recreational purposes (Natural Resource Institute, 2000). Due to these uses of the coastal zones, there is increased pressure on the natural resources that supports the social and economic systems associated with these zones.

Pressures from human habitation and economic development are common in the coastal areas of the world. There are indications from around the world that many coastal areas are approaching the point where natural productivity falls, ecological systems collapse, and social, industrial and tourism outputs are declining (Natural Resource Institute, 2000). The management of such an area is of necessity an integrated and multidisciplinary effort (Natural Resource Institute, 2000).

According to the Noordwijk Guidelines for Integrated Management (1993) approximately half of the total world populations live in coastal zones in coastal countries today (Environmental Protection Agency – Guyana, 2001). In the Wider Caribbean and elsewhere, the coastal zone is integral to social and economic life, and has been so ever since the first settlers arrived there. An estimated 40% of the human population in the Wider Caribbean region resides within two kilometers of the coast (Environmental Protection Agency – Guyana, 2001).

Figure 1. The three main components of the coastal zone

Guyana's coastal plain occupies approximately 7% of the total area of the country and extends along the entire 400km of the Atlantic Coast, varying in width from 16km to 64km, extending to maximum of 3.1km at some areas (Environmental Protection Agency – Guyana, 2001). Much of the coastal plain is approximately 0.5 to 1 meter below sea level. The shore zone consists of both natural and man made sea defenses such as mud banks, mangrove belts and sand flats, all of which serve to protect the coast from flooding. The majority of the population (approximately 90%), along with the economic and administrative activities, is concentrated on the coast (Environmental Protection Agency – Guyana, 2001). The area actually lies several feet below sea level at high tide, having been reclaimed in order to take advantage of the enormously rich alluvial soil of the Amazon (Environmental Protection Agency – Guyana, 2001).

IMPORTANCE OF HERPETOFAUNA

The Guiana Shield is continuous with the Amazon Basin representing one of the remaining forested areas of the world. Tropical areas have a special role in the conservation of biodiversity. They are the home of 70% of the world's plants and animals — more than 13 million distinct species (Anonymous, 1996). At the geographic heart of the Guiana Shield, Guyana has natural resources that are considered extremely valuable (World Resource Institute, 1996). Guyana has over 1000 species of terrestrial vertebrates – approximately 271 herptofauna, 137 reptiles (8 families of snakes and 6 families of lizards (Smithsonian Institution, 2001) and 105 amphibians (World Resource Institute, 1996).

Amphibians and reptiles are noticeable components of many ecosystems. Reptiles are important elements of forest ecosystems as secondary consumers and prey items for large predators, yet basic information regarding their utilization of forest habitat is poorly known (Vitt et al, 1999).

Reptiles are sensitive to pesticides (Hall, 1980) due to their low metabolic rates and relatively simple enzyme systems. Walker and Ronis (1989) considered lizards and other reptiles might not be able to detoxify complex chemical compounds such as pesticides, which they have acquired from contaminated invertebrate prey (Lambert, 1997). Lambert (1993 and 1997) thought that residues, especially of persistent pesticides (organochlorines) are stored in the body's fat and accumulate over the years.

Lizards are themselves a food resource for a range of predators and therefore represent an important link in the food chain between invertebrate prey and predators such as birds and mammals. Reptiles such as caimans are important in the ecological food chain as top predators. Lizard residue loads will therefore give an indication of pesticide levels entering the food chains (Lambert, 1997). This idea links reptiles, as bioindicators of pesticide contamination, (Lambert, 1987) as a very important component in the ecosystem. They are therefore an important component of the natural habitats, and are valuable in any exercise of monitoring the effects of pesticides on faunal diversity (Lambert, 1997).

Snakes form a valuable and irreplaceable part of nature's ecological balance. Some primarily feeding on rodents, snakes act as nature's 'pest' control. Snakes keep rodent populations in check, thereby limiting the damage rodent overpopulation would cause (Anonymous, 2001). Snakes are used as a population control medium, which is an important link in the ecological food chain (University of Georgia, 2001). Studying snake population dynamics gives land managers guidance in how management practices affect snake populations. Snake population dynamics provide insight into subtle environmental changes stemming from land management (University of Georgia, 2001).

The Neotropical realm is by far the richest, housing close to half of the world's amphibian species. Different organisms are tolerant of different levels of toxins, and by monitoring which species are present and which have disappeared, a measure of environmental health can be estimated and probed using more sensitive, directed, quantitative techniques (Ball State University, 2000).

Amphibians have a number of characteristics that make them good

bioindicators. They have thin skin that is permeable to water and much of the grunge that occurs in water (Ball State University, 2000). They are more sensitive to these changes because of their very complex, "amphibious" life cycle, which takes place both in water and on land (Central European Salamander Year, 1999). Most amphibians spend part of their lives as eggs and larvae in water, and part of their lives as adults on land. Thus, the presence of amphibians indicates good quality aquatic and terrestrial habitats. If either of these habitats is missing or severely compromised, amphibians will be absent.

As an aside, extrapolating data from amphibians to humans has a long history. For decades, amphibians have been used to probe questions in both development biology and neurobiology; the assumption being that because, like us, amphibians are vertebrates, the results from amphibian studies will be applicable to humans (Ball State University, 2000).

Amphibians also play a crucial role in proper functioning of ecosystems. They are an important part of the ecological balance of many habitats and are one of the most important links in the food chains and energy transfer within ecosystems (Central European Salamander Year, 1999).

Locally lizards and frogs are major vertebrate biomass components of many areas, which are important in the regulation of insect prey and in as prey for other vertebrates. Several reptiles of Guyana such as the large boids (*Boa constrictor* and *Eunectes murinus*) and the Caimans (specifically the Black Caiman, *Melanosuchus niger*) can be used for eco-touristic development since they are considered endangered globally but are locally common. Reptiles are also important as sources of subsistence food for people here in Guyana or as potential concerns of medical problems such as the Elapids and Viperids (Hammond et al, 1999).

HERPETOLOGICAL RESEARCH IN GUYANA

There are a number of areas in Guyana that are important in the formation of wildlife sanctuary. Within recent times there has been an increase in the attempts of conducting research into Guyana's faunal diversity (MARII East Inc, 2001). There is still a general paucity of information relating to wildlife and endemism in Guyana (MARII East Inc, 2001). This dearth of information applies as much to general Guyana as it does for the study area of this project.

In the past there has been numerous attempts to document the herpetofaunal species throughout Guyana. Several collections and surveys were conducted at various regions in Guyana according to the University of Guyana Biological Diversity Center:

In 1992 Charles J. Cole from the American Museum of Natural History collected Boidae, Colubridae, Elapidae, Leptotyphlopidae and Typhlopidae (area unknown).

From February - March of 1992 Charles J. Cole from the American Museum of Natural History collected Teiidae, Gymnophthalmidae, Bufonidae, Leptodactylidae, Gekkonidae, Polychrotidae and Tropiduridae in the North Rupununi Savannas (Jouri, Yupakari, Simoni Area, Karanambo).

From March – April of 1993 Charles J. Cole from the American Museum of Natural History collected Hylidae, Bufonidae, Leptodactylidae, Microhylidae, Gekkonidae, Gymnophthalmidae, Polychrotidae, Teiidae and Tropiduridae in Aishalton, Southern Rupununi Savanna.

In March 1994 Charles J. Cole from the American Museum of Natural History collected Hylidae, Bufonidae, Leptodactylidae, Microhylidae, Gekkonidae, Teiidae, Boidae and Colubridae on Dubulay Ranch in Berbice River.

In August 1995 Charles J. Cole from the American Museum of Natural History collected Colubridae, Typhlopidae,

Leptotyphlopidae and Colubridae (area unknown).

In July 1996 Dr. Godfrey R. Bourne, University of Missouri collected several species of snakes from the family Boidae, Colubridae, Elapidae and Viperidae (area unknown).

In 1997 Charles J. Cole from the American Museum of Natural History made collection of Bufonidae, Hylidae, Leptodactylidae, Gekkonidae, Polychrotidae, Teiidae, Gymnophthalmidae, Amphisbaenidae, Leptotyphlopidae, Colubridae, and Typhlopidae in Aishalton, Rupununi Savanna.

From February – March 1997 Charles J. Cole from the American Museum of Natural History collected Bufonidae, Hylidae, Leptodactylidae, Gekkonidae, Gymnophthalmidae, Polychrotidae, Teiidae, Tropiduridae, Colubridae, Elapidae, Leptotyphlopidae and Viperidae in Kwakwani on the Berbice River.

From February -March 1998 Charles J. Cole from the American Museum of Natural History collected Aniliidae, Boidae, T. teguixin and Colubridae along the Magdalen's Creek Camp near the NW bank of Konawaruk River.

From March 1998 Charles J. Cole from the American Museum of Natural History collected Bufonidae, Hylidae, Leptodactylidae, Ranidae, Gekkonidae, Gymnophthalmidae, Polychrotidae, Teiidae, Tropiduridae, Aniliidae and Colubridae at Magdalen's Creek Camp, Konawaruk River.

From May-July 1998 Brice Noonan from the University of Texas traveled in the Mazaruni, Rupununi and Potaro area, making several collections from the families Viperidae, Colubridae, Boidae and Elapidae.

In June 1999 Robert Reynolds et al from the USGS Patuxent Wildlife Research Center collected Leptotyphlopidae and Colubridae at Baramita in the NW District.

From October - November 2000, Royal Ontario Museum of Canada collected Amphibians from the families Caeciliidae, Microhylidae, Bufonidae, Leptodactylidae and Hylidae; and Reptiles from the families Teiidae and Colubridae at Mount Ayangana. Observing Bothrops spp. at the Kwatse River and Melanosuchus niger at the Pong River.

In 1992, 1994, 1997 and 1999 Iwokrama International Centre made collection at Burro burro, Base Camp, Kabocalli, Maipuri, Muri Scrub, Pakatau Creek, Third Camp, Tiger Camp, Kurupukari, Cowfly and Three Miles in the Iwokrama Forest, Region 8, Guyana.

JUSTIFICATION AND OBJECTIVES OF THE RESEARCH

Guyana has remarkable biodiversity, which is unique to the world because the majority of its natural resources remain 'undiscovered' (ter Steege *et al,* 2000). Despite the number of collections and surveys carried out in various parts of Guyana, mostly inland, there is still a lack of sufficient data on its herpetofauna, especially on reptiles due mainly to a lack of herpetologists, financial supports, accessibility to areas, lack of surveys along the coast and an unwillingness to survey the more dangerous species such as snakes.

Guyana is a country with little industrial development but with rich natural resources, which can provide for the development of the country and its people. Its coasts are becoming more inhabited as the years go by, having approximately 90% of the population. This causes greater need to determine what is there and ways to protect it through good management practices before species decline increases.

However, it is at crossroads where utilization, conservation and preservation of its natural resources are concerned (ter Steege *et al*, 2000). Shell Beach is no exception to this. While having a rich biodiversity where four out

of the eight sea turtle species nest yearly, little is known about the other herpetofauna. Its rich natural resources provide an immediate tourist attraction site, which can boost the economy of Guyana. Thus proper management planning must be in place in order to benefit the animals, the community, the tourists and the country.

For effective management, informed decisions need to be made, and in order to make informed decision the necessary data need to be collected. This research aims to provide the data necessary to make such decisions by creating a preliminary species list which will help in deducing management plans for the area as it relates to herpetofaunal populations, determine the pressure on herpetofaunal resources by the inhabitants of the area, compare the impact of clearing of the land at an undisturbed and disturbed locality on the herpetofauna and deduce if different species are found in different areas, relaying if ecological gaps can be filled and by what species.

Even though turtles were not the main focus of this research, there are several references made to them due mainly to probable management plans that can relate to them.

LIMITATIONS

Traps along transects only caught smaller species of frogs and lizards such as the Leptodactylidae and Teiidae but not larger ones.

Along Transect C a jaguar (*Panthera onca*) was seen which limited the searching time along that specific transect due to the observer's fear.

Only one person checking the lines limited the number and perhaps type of species sighted.

Mosquito population increased drastically due to the rainy season, hence the times for checking traps/VES was limited.

Heavy rains created swamps in the forests thus traps could not be set there.

Lines A and C were placed in an undisturbed area where vegetation was thick at various stages thus limiting the number of species sighted, so population occurrence cannot be exactly calculated.

Limited funds and equipment.

Short duration/period for study.

Lack of willingness to share information on work previously done on herpetofauna.

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SITE SELECTION AND METHODOLOGY

HISTORY OF STUDY AREA (SHELL BEACH)

(Information taken from the Guyana Marine Turtles Conservation Society website: http://www.gmtc.org.gy/shell|_beach.html)

Shell Beach is a 100-mile long stretch of beach along Guyana's coastline between the mouths of the Pomeroon and Waini Rivers and is bordered by the Atlantic Ocean and mangrove forests. Various points along the beach have names but the two significant ones under permanent habitation are Almond and Gwennie Beaches. Around 150 inhabitants, compared to less than 5 10 years ago, presently occupy Almond Beach. Residents are mainly Arawak Indians from Moruca, Warraus from Morawhanna, and others from Mabaruma and the Pomeroon. While not a formally established community, some residents do have leases for the land. The infrastructure includes a school and two churches. Recently, Government assistance has been forthcoming and has resulted in funding for the school. Gwennie Beach, with over 180 inhabitants, is a transient, disorganized settlement with no established structures, and the people have a high dependency on turtles, jaguars and birds for food.

DESCRIPTION OF SPECIFIC STUDY AREA (LORI BEACH)

Lori Beach, which is a section of the 100-mile long Shell Beach, is situated approximately 26-30 miles from the Waini River and is found between Kamwatta and Annette Beach. The length of Lori Beach is approximately 3 miles or 4.8 km. A Turtle Conservation Camp was built at Lori Beach and was the main site for this research. The Conservation Camp was built in late February of 2002. The more visible vegetation surrounding the Conservation Camp consists mainly of Almond (*Terminalia catappa*), Noni (*Morindra citrifolia*), Black Mangrove (*Avicennia germinans*), White Mangrove (*Laguncularia racemosa*), Red Mangrove (*Rhizophora mangle*), Coconut (*Cocos nucifera*), Papaya (*Carica papaya*) and Cassava (*Manihot esculenta*) while *Ipomea pes-caprae* was spread mostly from the highest tide mark inward on the beach.

JUSTIFICATION OF METHOD

Pitfall traps with drift fences along with Visual Encounter Surveys (VES) were selected as primary sampling techniques because they have been proven by others (e.g Imler, 1945; Gloyd, 1947; Woodbury, 1951, 1953; Hurlbert, 1969; Gibbons, 1970; Gibbons and Bennett, 1974; Briese and Smith, 1974; Randolph *et al,* 1976; Collins and Wilbur, 1979; Bennett *et al.,* 1980; Brown, 1981; Wygoda, 1981; Gibbons and Semlitsch, 1981) to be the most efficient and effective method in collecting species data within a limited amount of time. The terrestrial drift fence and pitfall trap technique has been used for many years for field sampling a variety of vertebrate and invertebrate species (Gibbons and Semlitsch, 1981).

Drift fences and pitfall traps are commonly used to trap amphibians and reptiles in order to assess species distribution and compile species lists (Friend, 1984; Bury and Corn, 1987). Drift fences with pitfall traps yield large amount of data on numbers (often total population sizes), seasonality, migration patterns, diversity, and distribution patterns of many animals (Gibbons and Semlitsch, 1981).

Materials such as aluminum flashing and plastic sheeting (Dodd and Scott, 1994), of some predefined length and height is erected to serve as a barrier to redirect ground-traveling individuals into an open container(s) buried to the rim in the ground (Thompson *et al.*, 1998). A part of the material is placed below the surface of the ground. This has the advantage of preventing small animals from passing under or through the fence (Gibbons and Semlitsch, 1981). In 1994, Dodd and Scott deduced that

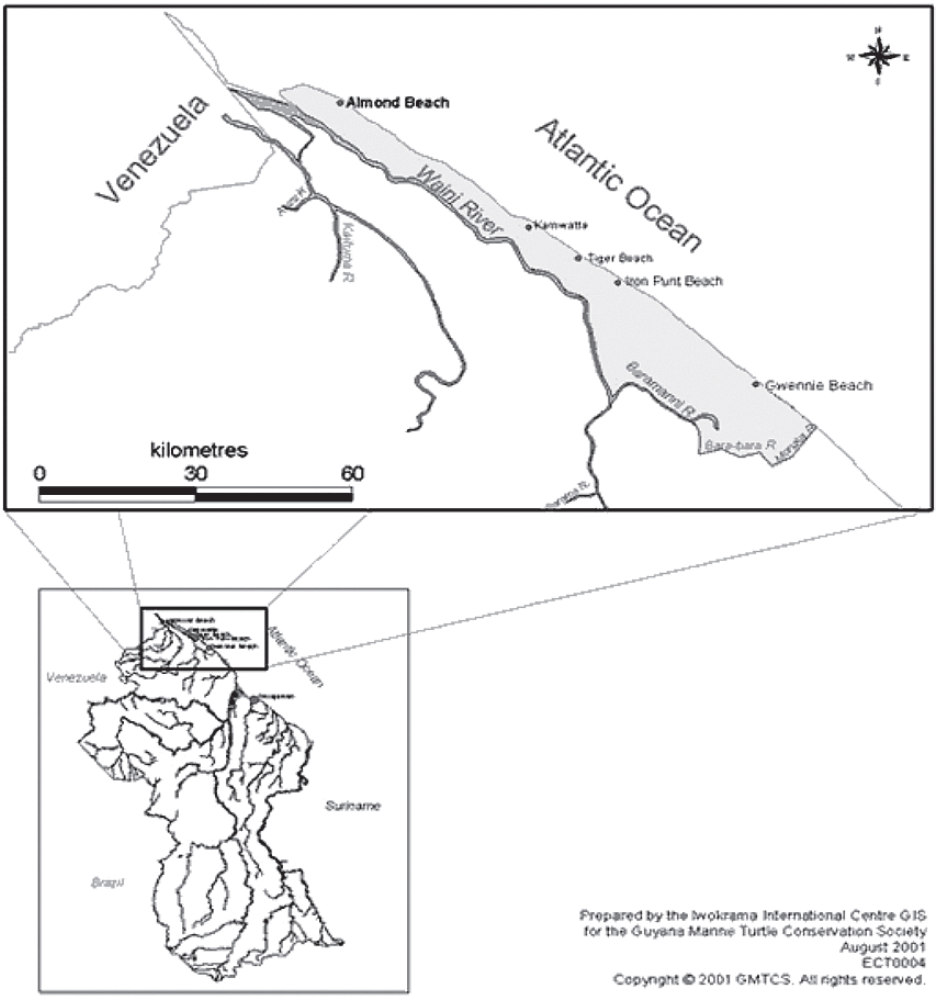

Figure 2. Map of Shell Beach, showing several areas along the beach

hard plastic buckets…have the capacity to make the most effective containers (pitfalls) because they are resistant to collapse and moisture induced deterioration (Thompson *et al.*, 1998).

Drift fences with pitfall traps yield a wealth of biological information, often providing ecological perspectives that could be obtained in no other manner (Gibbons and Semlitsch, 1981). Although the time and effort put into drift fence construction, maintenance, and operation are high; data accumulation is often superior to any other form of collecting for a wide variety of terrestrial animals (Gibbons and Semlitsch, 1981).

Visual Encounter Surveys (VES) are most commonly used in amphibian and reptile survey and census technique (Heyer *et al.*, 1994). This can be used to determine the species richness of an area, to compile a list and to estimate relative abundances of species in the area. In addition, this technique is sensitive to differences in habitat types (Heyer *et al.*, 1994). There are different types of designs such as randomized-walk, quadrats, and transect.

Randomized-walk involves walking a randomly chosen distance at a randomly chosen compass direction repeatedly. Quadrats are square sampling areas (or varying size) placed at randomly selected sites within a study area; the quadrats are exhaustively checked for amphibians and reptiles, and then these numbers are used to estimate total numbers within the entire study area. Transects are straight lines that can be set up permanently, data is then collected by walking down the line and counting all amphibians and reptiles seen on either side of the line (Heyer *et al.*, 1994). VES is an appropriate technique for both inventory and monitoring studies (Heyer *et al*., 1994).

In this research pitfall traps with drift net fences focused more on terrestrial animals while Visual Encounter Survey (VES) concentrated on semi arboreal – arboreal species hence obtaining maximum data as possible.

METHODS

Three 100m transects (A, B and C) were cut along the beach from the highest tide mark through the forest up to an area where little flooding occurred.

Line B passed through the 'Conservation Camp' while the other lines, A & C, branched 200m on either side of Line B. Line B showed a marked degree of disturbance while lines A & C did not.

DESCRIPTION OF TRANSECTS/LINES

Line A – Vegetation was covering approximately 90% of the ground. Vegetation started from the beach with the *Ipomea pes-caprae* followed by Noni (*Morindra citrifolia*) then Papaya (*Carica papaya*) then by *Rhizophora mangle*, which bordered the forest leading to more swampy areas.

Line B – This area was 90% exposed with sparse vegetation consisting of *Ipomea pes-caprae,* Papaya (*Carica papaya*), Coconut (*Cocos nucifera*), Almond (*Terminalia catappa)* and Mangroves *(Avicennia germinans* and *Rhizophora mangle*), which bordered the forest. 85 –100m inwards Noni (*Morindra citrifolia*) borders the edge of the swampy region. This area showed a great level of disturbance due to the clearing of the land for the building of the Turtle Conservation Camp.

Line C – Vegetation along this line is similar to Line A beginning with *Ipomea pes-caprae* by the beach followed by several Coconut trees (*Cocos nucifera*), Papaya (*Carica papaya*), Cassava (*Manihot esculenta*), Silk Cotton Tree (*Ceiba pentandra*) and then mangrove forest (*Avicennia germinans* and *Rhizophora mangle*).

Terrestrial drift fence and pitfall trap techniques were used for field sampling. Approximately 15cm high Aluminum flashing was erected as the drift fence with 2 ½ liter plastic buckets as pitfall traps. 2cm of the Aluminum flashing was buried under ground to prevent small animals from passing under or through the fence. Each drift fence was 3.048m (10ft) in length and a bucket was placed at each end of each fence (figure 6).

Pitfall traps were made by digging a hole in the ground large enough to place the 2.5 liter bucket. The buckets were placed in the hole up to its rim. Buckets had several small holes in the bottom to prevent water from accumulating when it rained thus preventing the species trapped from drowning.

Six terrestrial drift fences/pitfall traps were placed 15m apart alternately along each line – at 15m, 30m, 45m, 60m, 75m and 90m – using letters and numbers for demarcation, for example A1, A2, A3, etc. (figure 8).

Traps were checked at 6am, 8am, 10am, 1pm, 3pm and 6pm daily for 32 days in the order of Line B-A-C for approximately ½ hr - 1 hr. Specimens that were caught in the traps were marked with red paint and released, employing the mark/recapture method. For every new species caught at least one specimen was taken for collection and further identification purposes.

The above was also coupled with Visual Encounter Surveys (VES). VES was done by walking along the three-100m lines looking for animals that could not be caught in the pitfall

traps. This allowed for maximum species seen and identified along transect hence producing a better survey of the herpetofaunal diversity at the location. VES concentrated more on semi-arboreal/arboreal species and was performed simultaneously with the pitfall trap checks. Some reptiles and amphibian species are difficult to encounter so opportunistic collecting was employed. To further assess the area for herpetofauna, questionnaires were also employed.

Specimens collected were placed in a 1:10 ratio of formalin and water then wrapped in gauze and packed in containers, which were later transferred to Georgetown for further identification and preservation.

Figure 3. Lori Beach

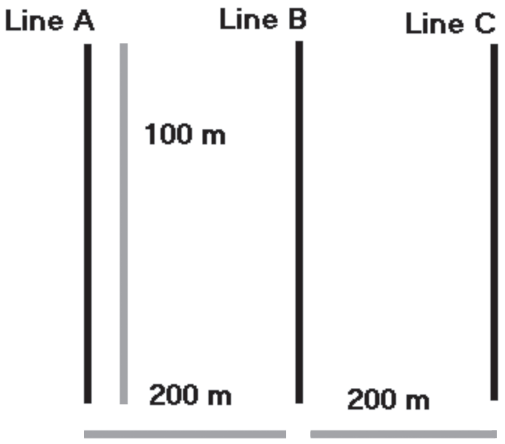

Figure 4. Layout of the transects

Figure 5. Transect A

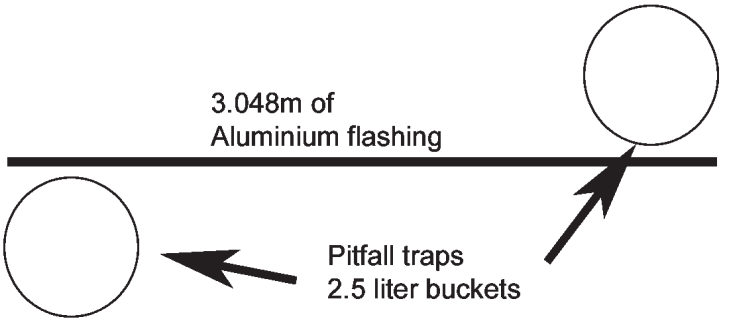

Figure 6. Layout of the Pitfall Trap with Drift net fences

Figure 7. Pitfall Trap with Drift Fences

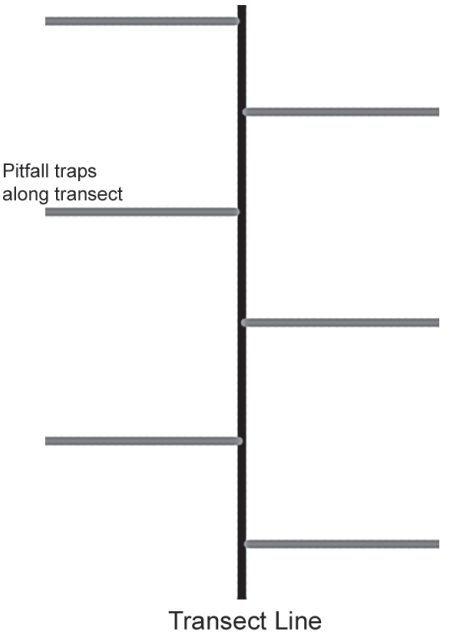

Figure 8. Representation of the six alternating pitfall traps along each transect

Figure 9. Pitfall Trap along Transect

RESULTS

LIST OF HERPETOFAUNA COLLECTED AND OBSERVED

A total of 15 species of herpetofauna were caught and documented for Lori Beach, Almond Beach and Kamwatta Beach. Most of the work was conducted along Lori Beach where three species of giant sea turtles were observed. The following table, which acts as a list, illustrates the species of herpetofauna documented.

Table 1. A list of all the herpetofauna observed.

Common Name	Family	Scientific Name
Lizards:		
-	Teiidae	***Ameiva ameiva***
-	Teiidae	***Cnemidophorus gramivagus***
Green Iguana	Polychrotidae	***Iguana iguana***
Ganga sacka gecko	Gekkonidae	***Thecadactylus rapicauda***
-	Gekkonidae	***Gonatodes humeralis***
Frogs:		
-	Hylidae	***Scinax ruber***
-	Hylidae	***Hyla sp.***
Paradox frog	Psuedidae	***Pseudis paradoxa***
- (Escaped - >1cm)	Leptodactylidae	***Leptodactylus sp.***
-	Leptodactylidae	***Leptodactylus sp.***
Toad	Bufonidae	***Bufo marinus***
Snakes:		
Labaria	Viperidae	***Bothrops atrox***
Blind Snake	Leptotyphlopidae	***Leptotyphlops sp.***
Water Snake	Colubridae	***Liophis cobella***
Tiger Snake	Colubridae	***Drymarchon corais***
Turtles:		
Leatherback Turtle	Dermochelyidae	***Dermochelys coriacea***
Green Turtle	Cheloniidae	***Chelonia mydas***
Hawksbill Turtle	Cheloniidae	***Eretmochelys imbricata***

Pitfall traps with drift fences caught mostly lizards while VES noted mostly frogs, snakes and turtles. Opportunistic Collection caught most of the snakes except for the *Leptotyphlops* sp. and most of the frogs, except for a *Leptodactylus* sp. and two species of lizards, especially *Iguana iguana* and *Thecadactylus rapicauada.*

Cnemidophorus gramivagus was noted as the most abundant herpetofauna at the disturbed area of Line B. *Ameiva ameiva* was the second highest species observed and was found mostly along the forest edge of Lines A and C. *Bufo marinus* and *Scinax ruber* were the most abundant for the frog species at Lori Beach specifically. However *Bufo marinus*, if inclusive of Almond Beach, would be the most copious of the frog species. *Liophis cobella* was the most abundant for the snake species.

Table 2. Summary of the Type, Population Number, Method Used and Area where each species of Herpetofauna was found. Population numbers for the turtles are not available since official numbers have not been released. However the three species of turtles noted was observed along the beach during night patrolling with the wardens.

Species Name	Population Number Observed	Method Used	Area Found
Ameiva ameiva	124 (68/56)	VES/ Trap	Lori
Cnemidophorus gramivagus	709 (363/346)	VES/ Trap	Lori
Iguana iguana	8 (2/3/3)	VES/ Trap/ Random	Lori & Kamwatta
Thecadactylus rapicauda	1	Random	Lori
Gonatodes humeralis	1	VES	Lori
Scinax rubber	16 (2/14)	VES/Random	Lori
Hyla sp.	6	Random	Lori & Almond
Pseudis paradoxa	1	Random	Almond
Leptodactylus sp.	1	Random	Kamwatta (escaped)
Leptodactylus sp.	1	Trap	Lori
Bufo marinus	53 – 18 at Lori, 35 at Almond	VES/ Random	Lori & Almond
Bothrops atrox	1	Random	Lori
Leptotyphlops sp.	1	Random	Lori
Liophis cobella	3	Random	Lori
Drymarchon corais	1	Random	Lori
Dermochelys coriacea	-	Random	Lori
Chelonia mydas	-	Random	Lori
Eretmochelys imbricata	-	Random	Lori

In addition to the surveys conducted as part of this study, several species were also noted through previous work done and questionnaires.

Species	Reference
Tegu – *Tupinambis negropunctatus*	Tom Hollowell
Mud turtle – *Kinosternon scorpioides*	Tom Hollowell
Boa Constictor – *Boa constrictor*	Questionnaire
Caiman – possibly *Caiman crocodilus*	Questionnaire
Anaconda - *Eunectes murinus*	Questionnaire
Olive Ridley Turtle - *Lepidochelys olivacea*	Questionnaire
Wood slave lizard: looks somewhat like a lizard with long green crest, dark brown or sometimes dark green	Queationnaire
Frog: yellow-green with white strips on dorsal	Questionnaire
'Yamaraka' snake: brown snake with red-yellowish ventral	Questionnaire
Gama gecko: similar to *Thecadactylus rapicauda* but bigger	Questionnaire
Yellow tail racer snake / Cam-a-Cari	Questionnaire

The various methods used encountered a number of individuals as well as species. VES was overall the highest producer of individuals observed yet the species richness was limited compared to Random Collection, which produced the least individuals but the highest species diversity. Pitfall Traps with drift fences produced the second highest number of individuals however species richness was low since this caught mostly lizards.

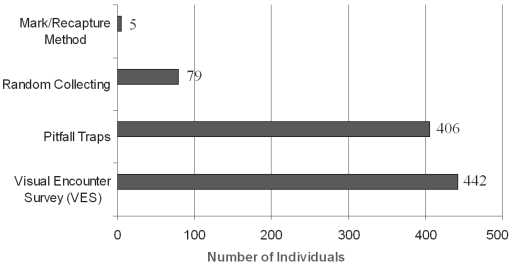

Chart 1. Comparison of various methods used during the research

RECAPTURES

Recaptures yielded mostly *Cnemidophorus gramivagus* species along Transect B. Five recaptures were noted.

Table 3. Representation of the total number of recapture, their position on each transect and type of species.

Day	Trap	Amount	Species
11	B5	1	***C. gramivagus***
16	B2	1	***C. gramivagus***
17	B2	1	***C. gramivagus***
21	C2	1	***C. gramivagus***
28	B1	1	***C. gramivagus***
Total	-	5	-

Ameiva ameiva and *Cnemidophorus gramivagus* were the most abundant of the lizards and of the herpetofauna overall. *Ameiva ameiva* was mostly abundant along the undisturbed areas of Transect A and C as depicted by the Charts 2 and 3. *Ameiva ameiva* was concentrated along lines which were considered undisturbed.

Table 4. Representation of the number of *Ameiva ameiva* found in various traps along each Transect.

Traps	A	B	C	Total
1	11	1	4	16
2	3	0	2	5
3	5	1	7	13
4	3	2	10	15
5	2	2	2	6
6	1	0	0	1
Total	25	6	25	56

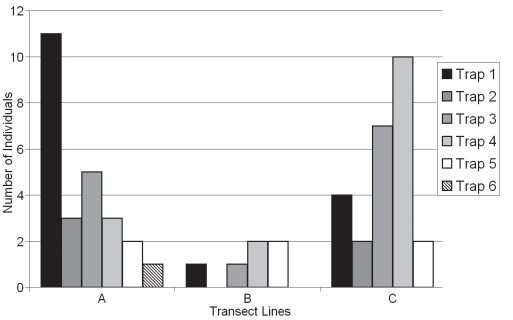

Chart 2. Number of *Ameiva ameiva* found along each transect of the research

Table 5. Representation of the number of *Cnemidophorus gramivagus* found in various traps along each Transect.

Traps	A	B	C	Total
1	9	17	9	35
2	11	26	13	50
3	39	40	35	114
4	13	33	21	67
5	18	45	8	71
6	6	3	0	9
Total	96	164	86	346

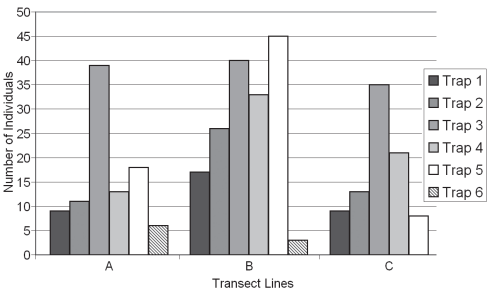

Chart 3. Number of *Cnemidophorus gramivagus* found at each transects.

Table 6. A Summary of the Number of *Cnemidophorus gramivagus* and *Ameiva ameiva* species encountered in the Pitfall traps and VES for 32 days.

Days	*Ameiva ameiva*		Total	*Cnemidophorus gramivagus*		Total
	Traps	VES		Traps	VES	
1	9	16	25	34	0	34
2	3	4	7	21	3	24
3	0	0	0	4	0	4
4	3	1	4	20	18	38
5	0	0	0	10	15	25
6	0	0	0	3	16	19
7	5	5	10	12	25	37
8	1	3	4	2	6	8
9	5	3	8	34	14	48
10	0	0	0	0	1	1
11	3	0	3	6	13	19
12	4	2	6	9	18	27
13	0	0	0	0	0	0
14	0	1	1	17	26	43
15	0	1	1	3	6	9
16	2	2	4	13	18	31
17	1	1	2	5	6	11
18	1	0	1	5	3	8
19	0	0	0	1	3	4
20	0	0	0	2	0	2
21	1	0	1	6	11	17
22	5	4	9	27	13	40
23	3	1	4	13	23	36
24	1	1	2	12	9	21
25	0	0	0	7	12	19
26	1	4	5	10	17	27
27	0	0	0	1	5	6
28	1	2	3	22	29	51
29	0	0	0	3	12	15
30	0	2	2	3	8	11
31	1	1	2	11	5	16
32	6	14	20	30	28	58
Total	56	68	124	346	363	709

Transects A and C are similar in vegetation type as well as biogeography. They are both undisturbed when compare to Transect B where the Conservation Camp is located. According to the table and chart Lines A and C have almost the same number individuals while Lines B and C have the same number of species.

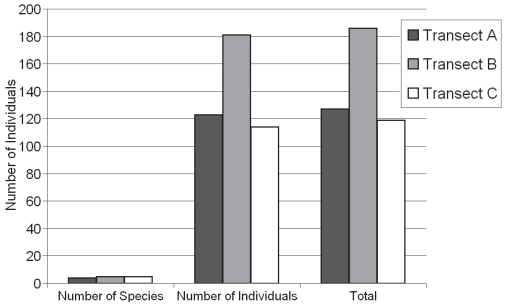

Chart 4. Comparison of Transect Lines giving details as to the number of species, number of individuals and overall total along each line.

A comparison of the traps showed that Trap 3, which consisted entirely of lizard species has the highest number of individual for Line B. Equality in the number of species was seen along Trap 2, 4, 5 and 6.

Table 7. Comparison of trap yields along all the transects

Traps	# Species	# Individuals
1	2	51
2	3	56
3	2	127
4	3	84
5	3	78
6	3	11

DISCUSSION

Tropical faunas, like that of Shell Beach, are important to understand the ecological makeup of Guyana and hence South America. Surveying along Lori, Almond and Kamwatta beach yielded 15 species of herpetofauna excluding turtles. A total of 13 of these were from Lori Beach while it was noted with inclusion of references and questionnaires that 29 species was observed occurring along Shell Beach (Lori, Almond and Kamwatta Beach).

COMPARISON AND IMPROVEMENTS IN TECHNIQUES

From the various methods used it was deduced that Visual Encounter Survey (VES) yielded more species richness and abundance than compared to pitfall traps with drift fence. This was due to pitfall traps collecting mainly species of lizards, one species of snake (*Leptotyphlops* sp.) and one species of frog (*Leptodactylus* sp.) which were considered relatively small and did not possess any suction-like appendages such as the toe pads on the Hylidae or Gekkonidae with which they can use to climb out of the buckets. Pitfall traps with coverlids or deeper buckets will be effective in trapping species that are relatively larger and able to cling to the walls of the buckets.

Species richness was noted along Lines B and C while species abundance was apparent at Line B. Line C caught the only snake (*Leptotyphlops* sp.) and frog (Leptodactylus sp.) species encountered in the traps. This could be due largely to the topography of the area as well as the ecological requirements. *Leptotyphlops* sp. lives among leaf litter burrowing for their prey. Line C had a small hill or raised area with relatively high level of leaf litter where trap C5 was situated. This was the trap in which the snake was found. Fifteen meters away trap C6 was located where the *Leptodactylus* frog was found. Directly after trap C6 the swampy region began.

The period in which this research was carried out was noted as the 'rainy season' where the forests were flooded creating swamps due to the heavy rains. Herpetofauna are particularly sensitive to weather changes particularly temperature and precipitation (Zug, 1993). Reptiles and amphibians are ectoderms, that is, they obtain their body heat from the external environment. This has major implications for any survey technique, in that weather conditions may greatly affect the activity and therefore the catch ability of reptiles and amphibians. Lizards and snakes may move two or three days after rains depending on ambient temperate (Vogt and Hime, 1982).

Since snakes are ectoderms they require environments, which can provide heat from the external environment to raise their body temperature. The forest floor where they usually are found could not provide this medium due to the heavy rains which created swamps hence drier land was sought. It was usually after a period of rain that snakes were sighted along the disturbed transect and Conservation Camp, enabling us to catch them. This could be explained by the migration of the species onto

drier land from the flooded forests.

Migration onto drier land is closely tied to foraging. It was observed that several small rodents such as mice were caught in the traps. This could be another explanation as to the sighting of the snakes along Line B and around the Conservation Camp.

It was noted as well that on sunny days as compared to rainy/stormy days the catchability of reptiles were more. This is due largely to their ectoderm nature.

Frogs such as *Scinax ruber* and *Hyla sp.* were randomly caught usually in very moist areas such as in the kitchen, between cups, next to the sink, etc. This could be because frogs being amphibious require water to keep their homeostasis functioning properly. At Almond Beach *Bufo marinus* were seen mostly at nights in large numbers sitting next to a pond while at Lori Beach they were seen mostly by the beachfront and were little in number as compared to Almond. One postulation is that due to the flooded forests at the back they do not require to migrate but may do so because of foraging requirements since mosquitoes, dragonflies, etc were noted mostly along the beachfront. Due to their moisture need (thin, moist skin which desiccates easily) frogs such as the *Pseudis paradoxa* found in the pond at Almond Beach was easily caught.

Lizards have proven themselves to be almost ideal organisms for ecological studies. Because they are ectotherms, they are often abundant, making them relatively easy to locate, observe, and capture. Lizards were found mostly along beaches.

Ameiva ameiva was found in abundance next to the forest edge at Trap 4, 5 and 6, especially on Transect A and C. This was considered unusual since they were noted as active forager who ran in open areas. But noting their foraging habits it was less surprising to find them there. *Ameiva ameiva* are insectivores. Next to the forest edge where those traps were located there were hundreds of mosquitoes flocking the area. The flooded forest created a sustainable breeding area for these mosquitoes hence the vast numbers.

Thermoregulation is intertwined to foraging behaviours. *Cnemidophorus gramivagus* is considered a more active forager than *Ameiva ameiva*, which may explain their sight frequency. They were considered the most abundant species noted, especially along Line B. Their foraging behaviour is related to their ecology where being so active leads to being easily seen by predators. It is probably more hazardous in terms of attracting the attention of potential predators, foraging widely can be advantageous in increasing contacts with potential prey. In order to prevent this they bask in the sun regularly to raise their body's temperature, which allows them to have 'flight' energy in order to escape from predators as well as assisting in the catching of their prey.

Gonatodes humeralis was found approximately 5m away from Line A on a branch. This could be due to several reasons. Some lizards do not bask as often as others due to the habitat in which they live. If they are very difficult to see (camouflage) as *Gonatodes humeralis* was, they may not require to have such as high level of activity since they may be sit-and-wait predators. Mosquitoes were also abundant hence *G. humeralis* may not need to leave the forest in order to forage. Another reason was that since most geckos are nocturnal it might have been resting when caught.

The location difference of each species may provide insight in the need to avoid a high level of competition. Times of activity of most lizards are relatively consistent from day to day and change more or less regularly with the weather. At 10:00 hours on sunny days there was increase activity among the lizard species, followed by 13:00 hours. One postulation as to why this is so may be linked with ecothermy where when reptiles do not get the required body temperature their heat rate drops considerably hence the lizards become immobile until the heat from the surrounding environment reflects itself onto the lizard's body. The timing of activity should be considered in future studies involving the catching of lizard species.

Transect B was considered a disturbed area as compared to Transect A and C due to the abundance of coconut, which is usually found in secondary regenerating areas. Transect B ran through the Conservation Camp which was cleared of most of the underlying vegetation of

Ipomea pes-caprae.

Transect B yielded more individuals due to it being a disturbed area where drier land was easily exposed. This assisted lizards and snakes, being reptiles, in their ectothermy and foraging habits. Five of the six snakes were found around the conservation camp with the exception being the *Leptotyphlops* sp., which was found at Line C. Line A and C were similar in geography and vegetation illuminating approximately 90% of the geography found along Lori Beach.

Trap 3 yielded more individuals while Traps 2, 4, 5 and 6 yielded species abundance hence being species richer than Trap 3. This might be due to migration from the forested area to drier lands of the 'beach'. When migration would occur species would fall into traps of 4, 5 and 6. Trap 4 at Line B deduced a great number of individuals due to it being next to a small papaya tree, which offered shade to lizards when body temperature goes too high.

Testing of the colour of the buckets to see which produced the more probable number was not done but this is recommended to see whether or not colour play a significant role in the trapping of these species.

According to the questionnaires, herpetofauna such as snakes and frogs are usually seen on rainy days which may largely be due to migration from the flooded forests and for foraging. Lizards are usually more abundant in the dry season. Asking if there has been a decline in the type and population of species most could not say since herpetofauna other than the turtles were not focused on. However, it was noted that there was a decline from last year by one person because before the rainy season started the forested area at the back was burnt so deaths of frogs, lizards and snakes were probable. Snakes were mostly seen at the starting of the season in early February and March. It was also noted that at Almond Beach the number of frog species and population remained unchanged according to one interviewee.

IMPACT OF CLEARING OF LAND ON HERPETOFAUNA

Clearing of the land is done for several reasons: to create the conservation camp making it a more livable area, for farming and to keep the mosquito population down. Clearing of the land drastically increased the number of lizards, frogs and snakes sighted. This can be due to the need to bask (ectoderms) and to forage for food, which has moved to drier area such as rodents and insects. Line B caught more individuals than the other transects (A & C) because it is believed that being disturbed it has more probability of enabling herpetofauna, especially the reptiles a chance to bask.

HUMAN IMPACT ON HERPETOFAUNAL RESOURCES

Human impacts on the herpetofaunal resources are limited in terms of consumptions. Lizards and frogs are left untouched for the most part. However snake species are killed whether they are venomous or not due largely to a lack of knowledge as to which is harmful or harmless. However snakes such as the labaria (Bothrop atrox), Boa constrictors and Eunectes murinus are well known as either being harmful or harmless. Snakes of the family Colubridae are unsure according to the locals as to whether they are poisonous or not. Turtles are drastically impacted upon for food as compared to the other herps in some areas along Shell Beach as well as in the surrounding communities. Turtle meat and eggs are sold in markets and/or being killed if caught in fishing nets sometimes. A majority of the people that were interviewed paid little attention to herpetofauna other than the turtles and snakes largely due to the focus of their career or that it can harm them in some way. Snakes such as *Drymarchon corais* and lizards such as *Iguana iguana* are caught for the local and international wildlife trade.

MANAGEMENT PLANS

Pressure on resources is limited to snakes and turtles mostly and will be focused on to a great degree in the management plans for the area. In order for sustainable use and conservation of herpetofauna effective management plans need to be in place.

Education awareness programmes need to be in places which includes not only the children but also the adults. The Guyana Marine Turtle Conservation Society has a foundation programme where during the May – July Period school children from the surrounding villages visit Shell Beach to learn more about the turtles and the fauna and flora of Guyana. This gives them a first hand experience of how endangered the turtles are as well as helping to implement the mind-set that slaughtering of turtles needs to be drastically reduced. Even though this is a good programme most of the information rarely reaches the adults and more specifically the businessmen and women who use and sell turtle meat and eggs. In order for more effective awareness adults need to be included.

It is recommended to bring not only students but adults as well from the village/ community that usually poach, sell or invest some amount of time/money into turtle meat and eggs such as shop owners, hunters themselves, etc to give them an insight of GMTCS' objectives and why there is a need for protection and conservation of the turtles, snakes and lizards which are being utilized in one way or another. An education programme similar to that of the Children's programme should be created but with focus of the importance of herpetofauna to the area where they live, to Guyana and to the World. Programme outline should always try to relate to the environment in which they live, making it more intimate and hence more comprehensive.

Communities need to be apart of the management plan. Community interaction in any conservation work is very important, leading to the success or failure of a programme. There should be a more intimate interaction with the Almond Beach community and the turtle-patrolling programme. Interaction with the community will offer several benefits: the community will gain income from visiting persons while ensuring that persons who are turtle poaching are deterred. If those in the community believe that the turtle project is helping to ensure an income by selling their crafts, etc, they will ensure that people wishing to do otherwise will be stopped. Interaction with the community can be achieved by having visitors spend from a half day or several days, depending on their duration of stay, at Almond Beach then taking them to view the turtles at the Conservation beach (Lori, Kamwatta, etc). Upon these visit to the community one can build awareness of the local herpetofauna found there and can compare it to the herpetofauna diversity at the Conservation Area.

Upon conducting questionnaires for my research it was noticed that many are unable to say why there is a need to conserve/preserve the turtles and other herpetofauna. Iwokrama International Centre has developed a ranger-training programme, which can be utilized and adapted according to Shell Beach's requirements of providing information on the fauna and flora of the area to the community, the tourists/visitors and the whole of Guyana enabling conservation or at least sustainable utilization of the resources. Sea turtles are usually seen during the nights but during the day lizards, snakes and even frogs are very noticeable components. Nature walks and trails during the day and night should be created and implemented to help in creating awareness. This would most likely be done during the 'dry season' since the mosquito population are too annoying to visitors and residents.

While education is the main focus of the sustainability of the herpetofauna, Government must implement rules and regulations for offenders.

CAN ECOLOGICAL GAPS BE FILLED?

This preliminary research is unable to supply sufficient data to say if ecological gaps can be filled and by what species, especially from the frogs and snakes data. However it can be postulated from analyzing the population numbers that in a disturbed area *Cnemidophorus gramivagus* will flourish considerably than *Ameiva ameiva* due to the ability to actively forage hence increasing prey. Ameiva ameiva may decrease drastically from the inability to keep up with the competition.

RECOMMENDATIONS

GENERAL RECOMMENDATIONS

Continued work on this research for longer duration

Survey during dry season

Survey into undisturbed forest and burnt mangrove forest. This will yield a variation of data, illuminating the recovery of the forest/area through comparative studies as well as deduce the effects of 'Slash and Burn' on herpetofaunal species.

Deeper buckets to enable the catching of bigger species of herps.

Buckets with coverlids

Survey along Almond Beach to see the types of herpetofauna and effects of the community on herps.

Development of management plans to involve herpetofauna in eco-tourism along Shell Beach.

Testing of the colour of buckets to see whether colour play a significant role in the trapping of these species.

RECOMMENDED METHOD

Four 1km transects (A, B, C & D) are cut in an area suitable for walking and little flooding. Two of these lines (A & B) run parallel to each other while C & D dissect A & B (shaped like tic-tac-toe game). Each line is approximately ½ km apart. Ribbon markers shall be placed every 50km starting from the end of the beach inwards.

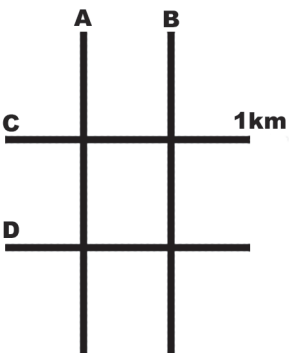

Figure 10. Diagram for transects A-D

Terrestrial drift fence and pitfall trap techniques are used for field sampling. Approximately 15cm high Aluminum flashings will be erected as the drift fence with 5 liters plastic buckets as pitfall traps. 2cm of the Aluminum flashing will be buried under ground to prevent small animals from passing under or through the fence. Each drift fence will be 10ft or 3.048m in length and two buckets are placed at the end of each fence.

5 of these assemblage traps will be placed approximately 200m apart on each line, each having a number demarcating them such as 1,2,3, etc. totaling to 20 pitfall traps on 4km lines. Buckets will have several small holes in the bottom to prevent specimen from drowning if it rains.

Traps were checked thrice daily - at 8:00am, at 1:00pm and at 5:30pm for 8 –10 weeks.

Specimens in the bucket shall be identified when possible and marked with paint using a colour code. If identification in the field is difficult, specimen shall be collected using a long forceps/tong to collect poisonous species and hands (garden gloves are recommended) for non-poisonous species and photographs shall be taken of all species.

The above is also coupled with Visual Encounter Surveys (VES), allowing for maximum species seen and identified along transect. VES shall concentrate more on semi-arboreal/arboreal species. VES will be done according to transect lines at 5am, 10am, 3pm and 8pm respectively i.e. at 5am Line A will be checked, at 10am Line B will be checked etc and this will alternate everyday giving approximately 10 – 15 surveys being completed for each line.

Specimens collected will be placed in 10% formalin then wrapped in gauze and packed in containers, which will later be transferred to Georgetown for further identification and preservation in 95% alcohol. Much more information can be obtained from an animal that has been captured than can be obtained from an animal that has simply been seen.

RECOMMENDED PITFALL TRAP MECHANISM

Pitfall traps are recommended to have lids on or to increase the size of the buckets from 2.5 liters to 5 liters. This will prevent species such as Hylidae frogs and larger snakes from escaping. However with this mechanism it is advisable that there is regular checking of the traps since species may run the risk of overheating eventually leading to death.

Two circles (similar to the diameter of the mouth of the buckets) are cut from material similar to the drift fences, preferably Aluminum flashing since this may be sturdier. One of the circles is required to be smaller in diameter than the other.

Two holes are drilled in the center of each circular lid and a piece of rope tied from one lid to the other, with a space similar to the depth of the bucket.

One circle is placed at the top of the bucket acting as a lid while the other is placed inside the bucket acting as a lever to assist in closing the lid.

As the animal falls into the bucket, it lands on the lid inside the bucket lowering it to the bottom, which then pulls on the string drawing the top lid closed.

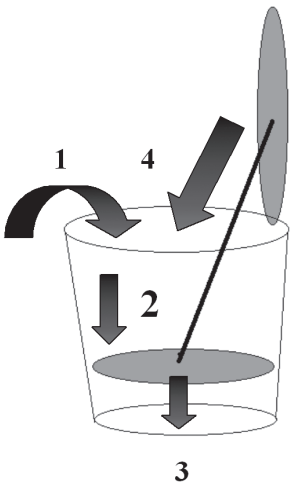

Figure 11. Diagram of the Proposed Pitfall Trap Mechanism

REFERENCES

Anonymous, World Resource Institute, *Policy Overview: Forests and Guyana's National Interest*, 1996, http://www.wri.org/wri/biodiv/guyana/101-pwp.html.

Arjoon, Annette, Guyana Marine Turtle Conservation Society (GMTCS). Email: gmtcs@networksgy.net

A SEED Europe, *The Ecological Importance of Forests*; Netherlands, 2001, http://www.gn.apc.org/reforestingscotland/hosted/branch/index.htm.

Ball State University, *Investigating A Malady In Frogs*; Muncie, IN, 2000, http://www.bsu.edu/alumni/alumnus/nov/faculty.html

Blomberg, Simon and Richard Shine, *Reptiles*, Department of Anatomical Sciences, University of Queensland, St. Lucia, Australia.

Canadian International Development Agency; *Forestry Issues: Deforestation: Tropical Forests in Decline*; 2001, http://www.rcfa-cfan.org/english/issues.12-2.html.

Central European Salamander Year, 1999, http://www.geocities.com/RainForest/Canopy/2190/salaman.html.

Cole, Charles J, *et al*; *Unisexual Lizards of the Genus Gymnophthalmus (Reptilia: Teiidae) in the Neoptropics: Genetics, Origin and Sytstematics*, 1990, American Museum of Natural History, New York.

Corn, Paul Stephen *et al, Management of Amphibians, Reptiles and Small Mammals in North America*, 1988, Rocky Mountain Forest, United States Department of Agriculture.

Environmental Protection Agency (Guyana), *Coastal Zone Management*, 2001, http://www.sdnp.org.gy/epa/iczm/index.html.

Food and Agriculture Organization (FAO) of the United Nations; *State of the World's Forests*, 1999, http://www.fao.org/forestry/fo/sofo/sofo99/pdf/sofo_e/I-1-en.pdf.

Gibbons, Whitfield *et al*, *Perceptions of Species Abundance, Distribution and Diversity: Lessons from Four Decades of Sampling on a Government-Managed Reserve*, 1997, Savannah River Ecology, University of Georgia, U.S.A.

Gibbons, Whitfield; *Terrestrial Drift fences with Pitfall Traps: An effective Technique for Quantitative Sampling of Animal Population*, 1981, Savannah River Ecology, South Carolina, U.S.A.

Gillespie M.Sc., Graeme; *Factors influencing reptile community composition in the forests of Buton Island*; 2001, http://www.opwan.com/.

Guyana Marine Turtles Society 2001, http://www.gmtcs.org.gy/shell_beach.html.

Guyana Marine Turtle Conservation Society (GMTCS), *Map and description of Shell Beach Area*, 2002, http://www.gmtcs.org.gy/shell_beach.html.

Hammond, D. et al, *Iwokrama Amphibian and Reptile Surveys*, 1999, Iwokrama, Guyana.

Heyer, W.R, *Reptiles and Amphibians: Measuring and monitoring biological diversity: standard methods for amphibians*. Smithsonian Institution Press, Washington, DC, 1994.

Hollowell, Tom, Biological Diversity of the Guianas Program, Department of Botany, MRC 166, Smithsonian Institution, Washington DC 20560-0166. Email: *hollowell.tom@nmnh.si.edu*

InterKnowledge Corps, *Guyana: General Information*, 1996 –1997, http://www.geographia.com/guyana/geninfo.html

Lambert, Michael R.K., Environmental Sciences Department, 1997, Natural Resources Institute, University of Greenwich, United Kingdom.

Leetz, Thomas, *Snakes…as a hobby*, 1991, T.F.H. Publications Inc., U.S.A.

MARII East Inc, *EIA Bonasika Mine Development*, Wharf Complex, Access Road, Mine site, Guyana Industrial Minerals Incorporated, 2001

Mehrtens, John M., *Living Snakes of the World in Colour*, 1987, Sterling Publishing Co. Inc., New York, U.S.A.

Natural Resource Institute, *Coastal Zone Management*, 2000, http://www.nri.org/work/coastalzonemanagement.htm

Pictures for this research, *Michelle Kalamandeen*, 2002, untamedsoul@hotmail.com

Rainforest Action Network, *Rates of Rainforest loss: A rainforest fact sheets*; 1995-2001, http://www.ran.org/info_centre/factsheets/04b.html.

Shmael, Safraz W., *National Development Strategy (NDS) of Guyana*; 1996, http://

www.guyana.org/NDS/chap.30.htm.

Smithsonian Institution, *Preliminary Checklist of the Herpetofauna of Guyana*, 2001, The Biological Diversity of the Guianas Program (BDG), http://www.mnh.si.edu/biodiversity/bdg/guyherps.html.

Smithsonian Insitution, *The Biological Diversity of the Guianas Programme (BDG)*, 2001, http://www.si.edu/

Stafford, Peter J., *Pythons and Boas*; 1986, T.F.H Publications Inc., U.S.A.

Strojny, Carol A., *Survey of Iron County Reptiles and Amphibians*, 2001, http://www.im.nbs.gov/naamp3/papers/14ss.html.

Sutherland, William J.; *Ecological Census Techniques: A Handbook*; 1996, Cambridge University Press.

Sutherland, William, *Why Census,* School of Biological Sciences, University of East Anlia, Nowich.

Ter Steege, Hans *et al*; *Plant Diversity in Guyana: Implications for a National Protected Areas Strategy*, 2000, http://www.bio.uu.nl/~boev/staff/personal/htsteege/plantdiv/index.html.

The University of Georgia, *Pit Tag Fact Sheet*, 2001, Savannah River Ecology Laboratory, http://www.uga.edu/srel/pittag.htm.

Thompson, William L., White Gary C., Gowan Charles, *Monitoring Vertebrate Populations*; 1998, Academic Press.

United Nations Environment Programmes (UNEP) – Caribbean Environment Programme, *Coastal Zone Management*, 2000, http://www.cep.unep.org/issues/czm.html

Vitt, L. et al, *The impact of individual tree harvesting on thermal environments of lizards in Amazonian rain forest*. 1998, Conservation Biology.

Vott and Hine, 1982 - *Monitoring Vertebrate Populations*; 1998, Academic Press.

World Resources Institute, *Policy Overview: Forests and Guyana's National Interest*, 1996, http://www.wri.org/wri/biodiv/guyana/101-pwp.html.

Zug, 1993 - *Monitoring Vertebrate Populations*; 1998, Academic Press.

APPENDIX 1
Fauna and Flora at Shell Beach

BUTTERFLIES

Common Name	**Scientific Name**
Blue Morpho	***Morpho menelaus***
-	***Eurema sp***
-	***Euedes sp.***
-	***Euptichia sp.***
-	***Parides sp.***
Monarch	***Danaus plexipus***

CRABS

Common Name	Scientific Name
Fiddler Crab	***Uca rapax***
Bundari Crab	***Cardisoma guanhumi***
Tree Crab	***Aratus pisonii***
Ghost Crab	***Ocypode quadrata***

OTHER INVERTEBRATES

Common Name	Class	Order	Family	Scientific Name
Sand Wasp	Insecta	Hymenoptera	Mutsillidae	-
Centipede	Chilopoda	-	-	-
Millipede	Diplopoda	-	-	-
Scorpion	Arachnida	Scorpionida	-	-
Spider	Arachnida	Araneae	Arachnidae	-
Bug	Insecta	Heteroptera	Pentatomidae	-
Lady Bug	Insecta	Coleoptera	Coccinellidae	-
Flies	Insecta	Diptera	-	-
Tarantula	Arachnida	Araneae	Arachnidae	***Avicularia sp. /***
Grasshopper	Insecta	Orthoptera	-	***Thelpusa sp.***
Field Cricket	Insecta	Orthoptera	Gryllidae	-
Roach	Insecta	Blattodea	-	-
Dragonfly	Insecta	Odonata	-	-
Bees	Insecta	Hymenoptera	-	-
Mosquito	Insecta	Diptera	-	-
Parcel Ant/	Insecta	Hymenoptera	Formicidae	-
Machoui Ant				***Atta sp.***
Coconut Worm	Insecta	-	-	-

PRIMATES *

Common Name	Family	SubFamily	Scientific Name
Brown Capuchins	Cebidae	Cebinae	***Cebus apella***
Weepers or Wedge-capped Capuchins	Cebidae	Cebinae	***Cebus olivaceus / C. nigrivittatus***
Red Howlers	Cebidae	Alouattinae	***Alouatta seniculus***
Squirrel Monkeys	Cebidae	Cebinae	***Saimiri sciureus***

*Note: It was observed, usually between 6am to 9am, at Lines A and B, Lori Beach that the Brown Capuchins, Weepers and Squirrel monkeys all forage together at the edge of the Mangrove/Almond forest. One theory postulated by Dr. Donna Shephard of the Calgary/ Guyana Zoo is that the Brown Capuchins usually have very strong jaws and teeth, which enables them to obtain food from hard-shelled fruits. Knowing this the Weepers would collect the leftover materials from these fruits hence increasing their dietary variety and opportunities. The Squirrel Monkeys are allowed to accompany the groups because they are extremely hypersensitive and can alert the others of impending danger while consuming the raw materials from the fruit.

OTHER MAMMALS

Common Name	Family	Scientific Name
Southern Tamandua/Anteater	Myrmecophagidae	***Tamandua tetradactyla***
Agouti	Dasyproctidae	***Dasyprocta agouti***
Coati	Procyonidae	***Nasua nasua***
Jaguar	Felidae	***Panthera onca***
Deer	Cervidae	**-**
Rat	Muridae	**-**
Porcupine	Erethizontidae	**-**
Porpoises	Platanistidae	***Inia geoffrensis***

BIRDS

Common Name	Family	Scientific Name
Scarlet Ibis	Threskiornithidae	***Eudocimus ruber***
Frigate Bird	Fregatidae	***Fregata magnificens***
Flamingoes	Phoenicopteridae	***Phoenicopterus ruber***
Muscovy Ducks	Anatidae	***Cairina moschata***
Osprey	Accipitridae	***Pandion haliaetus***
Caracara	Falconidae	***Caracara plancus***
Sea Goose/ Brown Booby	Sulidae	***Sula leucogaster***
Sea Gull/ Brown Pelican	Pelecanidae	***Pelecanus occidentalis***
Hummingbird	Trochilidae	-
Johnny Crows/ Black Vultures	Cathartidae	***Coragyps atratus***

FISHES

Common Name	Scientific Name
Spring Cuirass	***Cathorops spixii***
Jewfish	***Epinephelus itajara***
Banga Mary	***Macrodon ancylodon***
Catfish	***Bagre marinus / Arius grandicossis***
Patwa	-
Four –Eye Fish	***Anableps anableps***
Gillbacker	***Arius herzbergii***
Red Snapper	***Lutjanus campechanus***
Couvalli	***Caranx hippos***
Hassar	***Hoplosternum sp. / Callichythes sp.***
Huri	***Hoplias malabaricus***
Yarrow	***Erythirnus erythirnus***
Cassie	***Pimelodus blochii/ridgidus*** group
Grey Snapper	***Cynoscion ocoupa***

Trout	***Cynoscion virescens***
String Ray/ Tengrie	***Dasyatis guttata***
Cuffum	***Megaolops ottonticus***
Sea Patwa	***Diapterus rhombeus/ Caitipa mojarra***
Pacu	-
Kokwari	***Hexanematichthys proops***
Quamina	-
Pargee	***Lobotes surinamensis***
Cuma Cuma Fish/ Black Cuirass	-

*Note: Upon conducting an interview with Mr. Daniel James, Turtle Warden from Moruca, Mrs. Violet James, Turtle Warden/ Cook from Almond Beach and Mr. Dennis Gonsalves, Turtle Warden from Moruca it was noted that fishes such as the Banga Mary (Macrodon ancylodon), Spring Cuirass/ Madamango Sea Catfish (Cathorops spixii), Catfish (Bagre marinus / Arius grandicossis), Grey Snapper (Cynoscion ocoupa), Cuma Cuma Fish/ Black Cuirass, Red Snapper (Lutjanus campechanus) and Gillbacker (Arius herzbergii) were mostly used for personal consumption by the Almond Beach community. Individuals living along the Shell Beach area for personal consumption also caught these fishes. Techniques used were drift nets or seines.

Hassar (Hoplosternum sp. / Callichythes sp.) is caught by many in the community (Almond Beach) to sell due to the marketing opportunities of the fish. Hassar is worth approximately $200.00 Guyanese per pound. Traffickers or hawkers, as they are locally called, would buy the catch at Mabaruma from the locals, reselling it in Georgetown or Kaituma. Salting then drying preserves the fishes for transportation from Shell Beach to Mabaruma.

Fishes such as Spring Cuirass/ Madamango Sea Catfish (Cathorops spixii), Cuma Cuma Fish/ Black Cuirass and Gillbacker (Arius herzbergii) are the most abundant among the fishes and can be sold for $60.00 - 70.00 Guyanese per pound. Along with interviews, visiting fishing boats was also used to obtain the above data on fishes.

PLANTS *

Common Name	**Family**	**Scientific Name**
-	Caesalpeniaceae	***Caesalpinia bonduc*** (L.) Roxb.
-	Papilioniaceae	***Canavalia rosea*** (Swartz) DC
White Mangrove		***Laguncularia racemosa****
-	Malvaceae	***Thespesia populnea****
-	-	***Cuscuta umbellata****
Red Mangrove	Rhizophoraceae	***Rhizophora mangle*** (L.)
Black Mangrove	Verbenaceae	***Avicennia germinans*** (L.) Stein
-	Aizoaceae	***Sesuvium portulacastum*** (L.)
-	Convolvulaceae	***Ipomea pes-caprae*** (L.) R. Brown
-	Vitaceae	***Cissus verticillatus***
Coconut	Palmae	***Cocos nucifera***
Papaya	Caricaceae	***Carica papaya***
Cecropia/ Congo Pong	Cecropiaceae	***Cecropia sp.***
Cassava	Euphoriaceae	***Manihot esculenta***
Almond	Combretaceae	***Terminalia catappa***
Noni	Rubiaceae	***Morinda citrifolia***
-	Cucurbitaceae	***Cucurbita moschata***
-	Malvaceae	***Hibiscus pernambucensis***
-	Euphorbiaceae	***Jatropha gossypiifolia***
-	Cyperaceae	***Cyperus spp.***
Silk Cotton Tree	-	***Ceiba pentandra***

* Tom Hollowell