


Preliminary Report
December 2013

SOUTH RUPUNUNI BIODIVERSITY ASSESSMENT TEAM (BAT) EXPEDITION

October 22 – November 7, 2013

A Collaboration of:
WWF-Guianas
Global Wildlife Conservation


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ACKNOWLEDGEMENTS

WWF Guianas and the entire Biodiversity Assessment Team (BAT) are sincerely grateful to all the organisations, communities, individuals and enterprises who played a role in preparing for and carrying out the BAT expedition. Our deepest gratitude is extended to the Toshaos, village councils, and people of the Deep South and South-Central Rupununi, and especially the villages of Potarinau, Sawariwau, Karaudarnau, Parabara and Shulinab for allowing us to visit their spectacular region and study their diverse landscapes and rich resources. We wish to thank the members of South Rupununi District Toshaos Council and the South Central People's Development Association (SCPDA), and particularly Nicholas “Sparrow” Fredericks, for their assistances throughout the preparation and expedition.

We are especially grateful to Guyana’s Environmental Protection Agency (EPA), particularly Dr. Indarjit Ramdass and Ms. Diana Fernandes for assisting us throughout the permitting process. We also thank the Ministry of Amerindian Affairs (MoAA), especially Minister Pauline Sukhai, Besham Ramsaywack, and Sharon Hicks for granting permits.

We express gratitude to the University of Guyana’s Biology and Agriculture Departments and School for Earth and Environmental Sciences for identifying and allowing students to participate in the BAT expedition. Those seven students, energetic and enthusiastic participants in the expedition, have now returned to their departments with vastly increased field experience and research skills. We particularly appreciate the support of the Department of Biology and the Centre for the Study of Biological Diversity, especially the Dean, Dr. Ansari, H. Sambhu, Kaslyn Holder, and Elford Liverpool for loaning survey equipment and for their assistance in efficiently processing the specimens for further study.

Thanks also to the Iwokrama International Centre for loaning their camera traps and Conservation International Guyana, especially Curtis Bernard and Rene Edwards and the Lethem office for their technical and logistical assistance.

The BAT is extremely grateful to the administrative and finance staff of WWF Guianas and Global Wildlife Conservation (GWC), and especially Tonia Newton, who worked tirelessly to keep funds flowing throughout the survey’s logistically challenging preparations. Thanks also to Dale De Mendonca, for assistance during preparations and for safely transporting the BAT and all their gear around Georgetown and Charles “Charlo” Hendricks, for expert bush driving and sage advice that opened up the hidden treasures of the Rupununi. The drivers of all the trucks and boats were patient with our unusual pursuits and schedules, and got us there and back safely. We had well prepared campsites, excellent and plentiful food (Fayonne overseeing it all!) and good weather (for the most part) and it all contributed to an outstanding expedition.

Patricia “Miss Pat” Fredericks knows and is known in every corner of the Rupununi. Without her rich history, deep understanding, extensive contacts, and sage council-on-everything this expedition would have had a much bumpier road.

We thank Ana Denman and Chris Jameson of GWC for their assistance with logistics and payments.

Lastly, WWF Guianas would like to acknowledge the dedication and hard work of the entire team: the lead researchers, research assistants, and field guides. Their enthusiasm, expertise and teamwork during the entire expedition led to its successful outcome.

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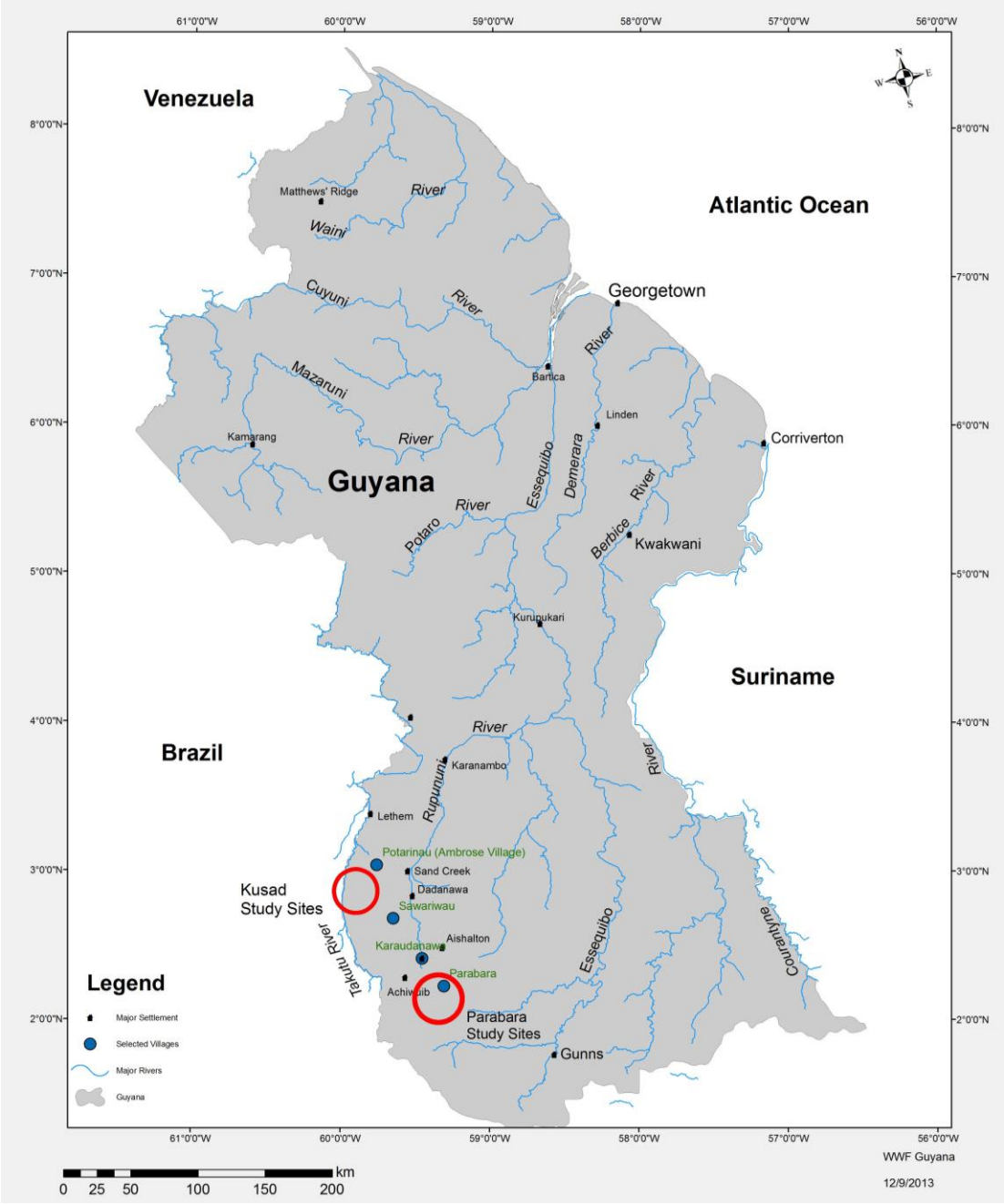

INTRODUCTION TO THE SOUTH RUPUNUNI BIODIVERSITY ASSESSMENT TEAM (BAT) SURVEY

The Rupununi Savannah is one of Guyana's most unique and diverse ecosystems and among the last great wilderness areas on Earth. It is home to over 9000 species, including over 2000 vertebrates and many species that are highly endangered globally (Hollowell and Reynolds, 2005; DIREN, 2006; Conservation International, 2003; Funk et al., 2007). This high diversity is the result of mixing of Amazonian and Guiana Shield fauna; extremely diverse and closely packed habitats; and marked seasonal variability, including extensive flooding. The Rupununi Savannah has been the home to and source of livelihood for indigenous peoples for millennia, as well as dozens of cattle ranches beginning in the late 19th century. Until recently the region's ecosystems have been protected by its isolation. Increasing interest in the region for gold mining, petroleum extraction, and large-scale agriculture is beginning to threaten the spectacular wildlife and natural habitats of the Rupununi.

The Rupununi Savannah is divided into two near equally sized parts by the Kanuku Mountains – the North and South Rupununi. Despite a reportedly high diversity and unique species composition, biological data, particularly from the southern Rupununi are still lacking (Watkins et al. 2010). As pressure to "develop" the region increases, it is essential to have a strong baseline of species and habitat information for the Southern Rupununi in order to make sound management and conservation decisions.

Project Objectives
World Wildlife Fund-Guianas (WWF Guianas) and Global Wildlife Conservation (GWC) carried out the Southern Rupununi Biodiversity Assessment Team (BAT) expedition to get a snapshot of the region's diversity, collecting data on seven taxonomic groups (mammals, birds, reptiles, amphibians, fish, insects and plants) as well as water quality and natural resource use. This information establishes a baseline that we hope will be used by all stakeholders, including the Government of Guyana, the University of Guyana (UG), NGOs, local communities and businesses to make informed decisions about sustainable management of the Rupununi's resources.

Survey Sites
The Southern Rupununi BAT survey was carried out in two under-sampled areas of the Rupununi Savannah. The survey focused on both freshwater and terrestrial habitats within savannah, savannah-forest and riverine ecosystems. The areas visited included a number of distinct savannah types; forests, including rainforest, dry and riparian forest; bush islands and wetlands; and creeks, rivers, and lakes.

1) **Site 1: Kusad Mountain.** Base camp at N2.81245 W59.8666, 125 m elevation.
23-29 October 2013. In and around the forested Kusad Mountains about 40 miles south southeast from Lethem in an area drained by the Skabunk and Sawariwau Rivers, tributaries of the Takatu and very close to a series of wetlands that in flood merge the Takutu (Amazon) and Rupununi (Essequibo) watersheds. Kusad Mountain is a rocky mountain surrounded by savannah. Principal habitat types surveyed included savannah, bush islands, gallery forests, creeks, rivers and rocky outcrops.

2) Site 2: **Parabara**. Base Camp at N2.18201 W59.33704, 245 m elevation. October 30-November 5, 2014. The second site was situated approximately 10 km north of the Parabara area in savannah beside gallery forest bordering the creek named Bototo Wau as far south as you can travel by road in the Rupununi and west of the Marudi Mountains. In this area the savannah is beginning to give way to rainforest, patches of forest in savannah become patches of savannah in forest. There are still bush islands and riverine forests along creeks but among blocks of rainforest. The creeks here flow into the Kuyuwini, a tributary of the Essequibo.

Team and Collaborations

The BAT was comprised of Guyanese and international scientists who have expertise in the detection and identification of plants, birds, reptiles and amphibians, large and small mammals, fishes, aquatic beetles, katydids, and ants, as well as expertise in measuring water quality. The BAT also included a training component; seven UG undergraduates and 13 local community residents participated in the surveys and at the conclusion of the fieldwork a series of training workshops were offered to UG students in Georgetown. The BAT survey methods utilized internationally recognized sampling protocols and undertook limited specimen collection for future identification and/or archival purposes, both local and foreign. The BAT survey also included a study of natural resource use by local people in the four communities adjacent to the study sites; Potarinau, Sawariwau, Karaudanawa, and Parabara.

The BAT survey was initiated by WWF Guianas, Guyana Office, with the close collaboration of GWC, the South Central Peoples Development Association, and the UG. Other partners include Conservation International Guyana and Panthera.

Project Outputs

The project's outputs will include biodiversity data on the species and habitats of the area to be published in a scientific report covering all taxonomic groups listed (scheduled to be published in late 2014), publications in peer-reviewed scientific journals, as well as presentations which were held in all the adjacent local communities in the South Rupununi and to stakeholders in Georgetown.

The BAT expedition also compiled data on the use and value of biodiversity to the local communities in the area of the taxonomic assessments.

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SUMMARY OF PRELIMINARY BAT RESULTS

The South Rupununi Biodiversity Assessment Team (BAT) survey revealed a high diversity of species living in the wide range of habitat types in the area. The local Wapishana people are dependent on the species and habitats of this region, using them for food, medicines, building supplies, and in cultural practices. These species and ecosystems are also valuable for the people of Guyana and the world, as they help regulate climate, filter and clean freshwater resources, keep the ecosystem in balance, and provide innumerable ecological services for all of us.

At the Kusad Site (Site 1), the BAT surveyed savannah, rocky outcrops, bush islands, gallery forests, rivers and creeks. The savannahs were mostly open, hot and dry areas shaped by frequent and regular fires. Common trees of the savannah included *Curatella Americana* (Sandpaper Tree) and *Byrsonima verbascifolia,* which is used by the local people as an anti-malaria and anti-diarrhea cure. The bush islands consist of small patches of forest often elevated and rocky within the savannah with trees often not higher than 10 m. Rocky outcrops form an important part of the savannah, examples include Kusad Mountain, Saddle Mountain, and Shiriri Mountain. The rocky outcrops and mountains are among the most vulnerable of vegetation types, as they are unique in the regional context. Large parts of the savannah are drainage systems of the larger rivers (Takatu, Ireng, Rupununi) with rivers bordered by gallery forests, providing habitats for many other organisms (ants, mammals, birds, etc.). At the Parabara Site (Site 2), the BAT surveyed savannah, bush islands (not rocky), gallery forest, and rainforest (bush), rivers and creeks.

A preliminary count of the number of plant species documented during the BAT survey is 241 species, including 70 species of herbs, grasses and trees from the savannah, 25 species of trees from the bush islands, 29 species of trees from the rocky outcrops, 100 species of trees from the gallery forests, and 41 species of trees from the rainforest (bush). Two 0.5 ha plots revealed over 80 unique species of trees (approx. 83) with approx. 43 species from the Bush at Parabara Village and 61 species in the bush within the savannah near Camp 2.

The water beetle community of the South Rupununi is extremely diverse, likely due to high habitat diversity, with 139 species in 64 genera (tentative) of water beetles of which at least 3 genera and 10 species are new to science. Diversity of ants is also high, with over 150 ant species, many likely new records for Guyana and species new to science (yet to be confirmed). The ant species differed between the Kusad and Parabara sites.

The BAT bird team documented 302 species and noted low overlap among sites, which indicates a very high regional diversity. Some notable species recorded included the Red Siskin (IUCN Endangered) and several rare species including the Glossy-backed Becard and Short-billed Honeycreeper. With these interesting species, the South Rupununi region has high potential for birdwatching tourism.

Reptiles and amphibians were especially abundant and diverse during the BAT survey, despite the dry conditions. 34 species of reptiles and 25 species of amphibians were recorded, with sightings of Green Anaconda, Emerald and Amazon Tree Boas, Red footed tortoise, Three-striped poison dart frog and the uncommonly seen but deadly, Bushmaster (*Lachesis muta*). Potentially, one new record of frog for Guyana may have been found, *Leptodactylus* cf. *myersi*,

and also one potentially new species or possibly and extension of *Allobates spumaponens.*

At Kusad Mountain, 21 species of bats and 2 species of rats were recorded. Similar species numbers were found at the Parabara site, with 22 species of bats and 1 species of rats. However, the species were different at the two sites, resulting in overall high diversity of small mammals, for a total of 36 species. The most interesting species caught was the Orinoco sword-nosed bat (*Lonchorhina orinocensis*), which represents the first record in Guyana and a distributional range extension of approximately 700 km.

Camera traps were put out at both sites to record large and medium sized mammals. They will be picked up at the end of November thus camera trap results are not yet available. The BAT also recorded signs of many large mammals including Jaguar, Tapir, Giant armadillo, Giant anteater, White lipped peccary, Red Brocket deer, Agouti, Labba, Savannah Fox, Collared peccary, 9-banded armadillo and Tayra (Haka tiger), which indicates a diverse and healthy mammal fauna.

Water quality was measured at 9 water bodies at each BAT Site. Parameters measured included temperature (^{o}C), pH, dissolved oxygen (mg/L), conductivity (μS/cm), turbidity (NTU), nutrients (mg/L), and metals (mg/L). Preliminary analyses indicate good water quality at all water bodies except a few located close to areas with human presence (where the turbidity levels exceeded 100 NTU). The low pH values of the sampled waters (5.03-7.96) indicate that they are slightly acidic which is characteristic of rivers and creeks of Guyana. The dissolved oxygen values ranged from 1.11 to 7.84 mg/L with the lower values generally found in the ponds and isolated/stagnant small creeks.

At least 145 fish species from 28 families were recorded during the BAT survey. Fish diversity from both areas (Kusad and Parabara) was relatively high, with the Parabara/Kuyuwini sites being exceptional for fish abundance. Detailed comparison with other regions of Guyana must await definitive identification of certain taxa as endemics to either the Kuyuwini/Essequibo or Takutu/Rupununi basins. But both regions will undoubtedly reveal that some species are new to science.

The Natural Resource Use workshops conducted in Potarinau, Sawariwau, Karaudarnau and Parabara Villages revealed to the local residents the value of their resources, the rate at which these resources were being depleted and the necessity to take immediate steps in managing these resources. In all of the communities it was found that little or nothing is being done to conserve their Natural Resources that they depend on for everyday life. Residents also pay very little attention to sustainable use of their resources although they are aware that these resources are being depleted.

It is recommended that results from this Assessment be shared with the Village Councils of these communities so that they can use it to assist in formulating Village rules for the management of their Resources. These communities should also be encouraged to seek assistance from Agencies and NGOs to assist in developing and implementing Resource Use Development Plans.

PRELIMINARY REPORTS BY TAXA/GROUP

Plants

Edwin Pos, Isaac Johnson, Zola Narine, Frank Johnny, Alcidio Isaacs and Magnus Raymond

Summary

From October 24 - November 5 an extensive study has been done regarding the plant-diversity of South West Guyana, as part of a large multi-taxa survey carried out in cooperation with the World Wildlife Fund (WWF) Guyana and the Global Wildlife Conservation (GWC). The survey took place within the Rupununi Savannah area on two main sites: 1) Kusad Mountain area and 2) the Parabara area. Four main vegetation types were sampled: savannah, bush islands, rocky outcrops and gallery forests. In addition, two 0.5-hectare plots were set up in the Parabara region (South-West Guyana). Sampling main vegetation types yielded a recording of 102 species in the Kusad region of which 57 were trees or treelets, 17 were bushes, woody herbs and climbers, 12 were grasses, sedges and rushes and 16 belonged to herbaceous species. For the Parabara region, a total number of 175 species were collected (including species from the plots). Results from the plots show that there is a high regional diversity in tree community composition, as only 17 out of 39 and 54 in respectively the first and second plot species co-occurred in both plots.

Introduction

Plants constitute a significant part of all biomass on our planet and as primary producers they play an important part of any ecosystem (terrestrial and aquatic). In addition, floral diversity is not only important in maintaining ecosystem functioning on a biological level but also plays an important role in many cultures and local populations. Communities often find many uses of plants; in medicinal, ornamental, religious or other practices (e.g. Johnston, 1997). Hence, plants constitute a large part of any culture. And although (vascular) plants are well distributed over the whole world, the Neotropics have always been on the focus of attention regarding plant diversity, and with good reason. Looking at the Neotropics alone, it provides a habitat for more than 90,000 species of seed plants (approximately >35% of the world's species) (Antonelli & Sanmartín 2011). Just recently, using an unprecedented large-scale dataset ter Steege et al. (2013) estimated that the Amazon region (including the Guiana shield) should harbor approximately an incredible 16,000 species of trees, indicating the vast diversity of plant life that can be found within this extensive area. The floristic composition of South West Guyana is partly well-known (Jansen-Jacobs & ter Steege 2000), however, there are still large parts that have not been studied yet. Therefore, from October 24 - November 5 an extensive study has been done regarding the plant-diversity of South West Guyana, as part of large multi-taxa survey carried out in cooperation with the WWF Guianas and the GWC. The survey took place within the South Rupununi Savannah area. Covering approximately 13,000 km^2 it is the largest savannah area of the country (Daniel & Hons 1984). Basecamps were located on two sites specifically: 1) The Kusad Mountain and 2) The Parabara Savannah (which is the southern most part of the greater Rupununi Savannah area).

Methodology

The area of the Rupununi Savannah can be subdivided into four main vegetation types (Jansen-Jacobs & ter Steege 2000): savannah, bush islands, gallery forests and rocky outcrops. There is a

fifth vegetation type, namely ponds and marshes but as these were not sampled within this study they will not be mentioned further on. Bush islands are the small patches of forest that can be found scattered over the savannah, ranging from small to larger sizes with trees often not growing taller than 10 meters. Gallery forests are the forests that grow on riverbanks and often can be seen from as far as they form a distinct line of trees across the horizon. Rocky outgroups in the South Western Guyana savannah area are classified within this study as being the mountainous areas such as Kusad Mountain itself, Shiriri Mountain or Saddle Mountain. To provide a detailed and thorough inventory, sampling was conducted in each main vegetation type. Two main methods of sampling were used:

Sampling of vegetation types
Sampling within each vegetation type at both sites was conducted as follows: each member of the team walked in a straight line through the vegetation, sampling all unique species. As plants tend to show clustering patterns as a result of dispersal limitation, sampling in a straight line is expected to allow collection of more species than when sampling randomly through an area. Sampling in this way offers the possibility of collecting more unique species in one area, with the advantage being that it is not necessary to set up plots or specific areas to be sampled. However, this technique does not give any information on community composition, as information regarding the number of individuals for each species is not recorded. At the first site (the Kusad mountain area) all main vegetation types except a bush island were sampled. Due to a lack of time and means of transportation no bush island could be reached. At the Parabara site the same vegetation types were sampled to provide the necessary data to make comparisons between the Kusad region and the Parabara region, except for rocky outcrops. Due to a lack of rocky outcrops within a reasonablevicinity, this vegetation type could not be sampled.

Sampling Plots
The setting up of plots has the obvious disadvantage of being extremely laborious, setting up a 1.0 hectare plot can take one team of approximately 4-6 people roughly one day to complete. Sampling the plot then might take the same team another full day. However, there are some distinct advantages, mainly that, in contrast with the previously mentioned method, this actually does give information regarding community composition. Due to a lack of time, it was chosen to use 0.5-hectare plots instead of 1.0-hectare plots. These still give a great deal of information but take less time to set up and to sample (roughly 1 day in total for 1 plot with a team of 4-6 people). Within the plot-area, each individual tree of 10 centimeter in diameter at breast height (DBH; standardized at 1.30 meter from the forest floor) was measured, photographed, sampled if possible and identified if possible. Due to a lack of time no plots were laid out at the first site (Kusad Mountain).

Plot locations
Plot locations were established in undisturbed high forest standing on mixed soils. The first plot near Parabara was located in the continuous rain forest lying south of the village. Directly adjacent to the village are a number of plantations. To avoid edge effects of these plantations, a 30 minute walk past these plantations was taken into account. The second plot was set up in the gallery forest near the basecamp of the Parabara Savannah, intersected by a small creek. In total two 0.5 hectare plots were established and inventoried (see Table 1 for plot data).

Table 1. Plant plot data for the two plots at the Parabara site (Site 2).

Plot Code	Country	Region	Size (hect.)	Forest Type	Latitude	Longitude
GR_PB01	Guyana	Parabara_Bush	0.5	Continuous forest	2.084917	-59.236233
GR_PB02	Guyana	Parabara_Savannah	0.5	Gallery Forest	2.175495	-59.337144

Plot Structure
All plots were established with a main transect line of 125 meters with 20 x 20 m blocks on both sides of the lines. Such rectangular plots are better suited for small teams and are quicker to establish. The main line was established using poles with flagging tape set up every 20 meters. Along the main line from each 20 m. pole a second pole was placed 20 meters perpendicular to the main line on a fixed distance, thus creating the subplots of 20 x 20 m each. Within each subplot, all trees of 10 cm in Diameter at Breast Height (DBH; standardized to 1.30 meters up from the forest floor) was flagged and inventoried. Part of the team flagged trees, moving up through the subplots starting from the lower left corner. Other team members then moved through the same subplots, identifying and sampling all flagged trees.

Identifying
All individual trees with a DBH of 10 cm and above were pre-identified in the field as much as possible, with the help of the entire team (especially Mr. Isaac Johnson). Samples were taken of unique species for each plot, i.e. species that were not earlier collected within the specific plot. All samples will be taken to the University of Utrecht for identification and further processing. Duplicates will be returned to the Centre for the Study of Biological Diversity in the Department of Biology at the University of Guyana.

Processing collected material
All collections of both methods were photographed both in the field and shortly before pressing and pickling. Descriptions of all collections were made in situ and a collection was made per species, pressed in the field and later pickled in ethanol at the base camp to ensure preservation for a prolonged period of time.

Preliminary Results

In total, a combined number of 277 species (tentative) were recorded at both sites, belonging to a total number of 54 families and 98 genera (tentative). These numbers are to be considered an estimate and will need to be revised, as a number of specimens have no proper identification so far. It is therefore most likely that, specifically, the numbers of family and genera will increase when definitive identification has been done.

<u>Sampling the four main vegetation types</u>

Site 1: Kusad Mountain
During the surveys, a total number of 102 species (tentative) were recorded, of which 57 were

trees or treelets, 17 were bushes, woody herbs and climbers, 12 were grasses, sedges and rushes and 16 belonged to herbaceous species. During these surveys a combined total of 102 specimens were collected, of which 50 were collected on the savannah, 29 on Kusad Mountain (i.e. rocky outcrop) and 23 along the gallery forest of the Takatu River.

Site 2: Parabara savannah
In addition to the sampling of vegetation types, two 0.5-hectare plots were laid out in the Parabara region. A total combined number of 175 species (tentative) were recorded during these surveys (including the plots), of which 149 were trees or treelets, 4 bushes, woody herbs and climbers, 2 grasses, sedges and rushes and 20 herbaceous species. The sampling efforts yielded a total of 149 collections for the Parabara site.

Tree Diversity
A total number of 446 individual trees ≥ 10 cm DBH were recorded. Based on positive identification and morphospecies these belonged to 30 identified families, 49 identified genera and 76 different species. Sampling the plot near Parabara over the Kuyuwini River (hereafter referred to with the plot code GR_PB01) resulted in recording a total of 248 individuals belonging to 39 species. In contrast, the plot near the Parabara base camp (GR_PB02) yielded a recording of 198 individuals belonging to 54 species. Fisher's alpha was calculated to compare the two plots in terms of community composition: i.e. the number of species and the number of individuals belonging to these species. Fisher's alpha is a widely used biodiversity index, which is relatively independent of sample size and describes the relation between the number of species and their abundance within a sample (Fisher *et al.* 1943). Fisher's alpha showed that the plot near Parabara base camp in the gallery forest was nearly twice as rich (Fisher's alpha of 24.46 vs. 13.00 for the plot in the continuous rain forest near Parabara village). Of all species recorded in both plots, only 17 species co-occurred in both plots, indicating high regional diversity.

The most common species by far was Uridan, or *Pithecellobium collinum* (Mimosoideae), with a combined number of 61 individuals, while it was only found in the GR_PB01 plot. It is followed by the Manicole palm (*Euterpe stenophylla*; Palmae, 45 individuals), the Kokorite palm (*Attaleu regia*; Palmae, 39), Itikiboraballi (*Swartzia laevicarpa,* Fabaceae*,* 29), the Sweetheart tree (*Talisia elephantipes*; Sapindaceae, 25), Bartaballi (*Ecclinusa sanguinolenta;* Sapotaceae, 21), Wina kakaralli (*Lecythis corrugata;* Lecythidaceae, 17), Kurokai (*Protium sagotianum*; Burseraceae, 15), the Kuffiballi (*Guarea pubescens*; Meliaceae, 14), Kokoritiballi (*Pouteria clura*; Sapotaceae, 10) and the Kamahora (*Pouteria venosa*; Sapotaceae, 10). All other species had less than 10 individuals. Of all 76 species, 33 were only represented by a single individual (see Figure 2).

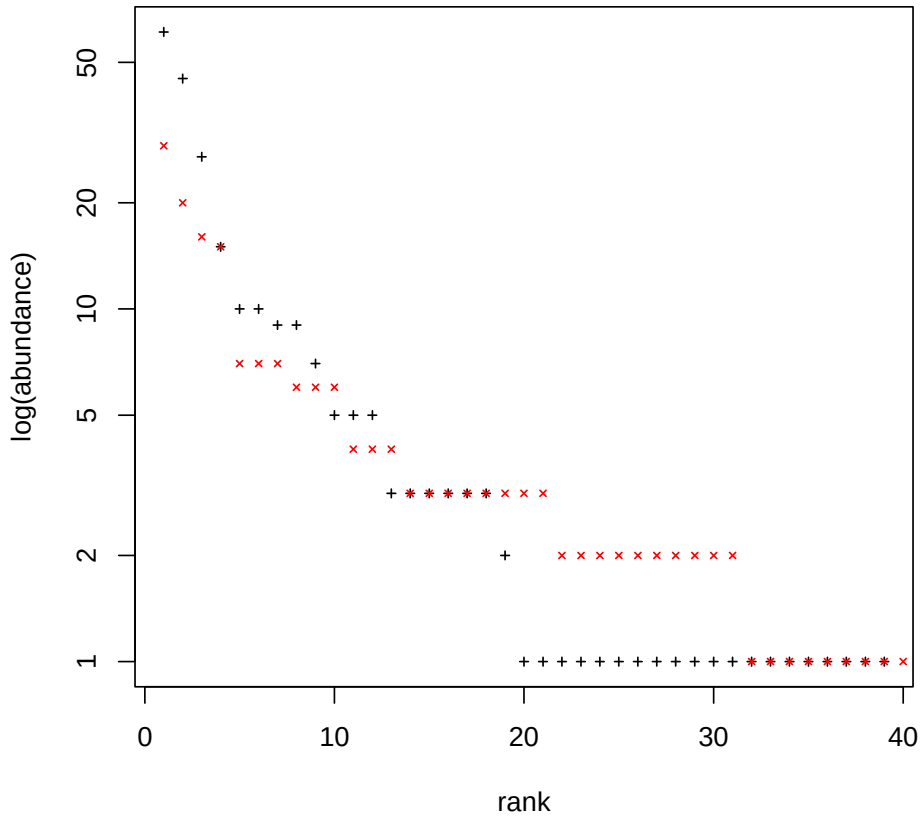

Figure 1. Rank Abundance curve for the two 0.5 hectare plots. Shown in black is the GR_PB01 plot near Parabara village, red indicates the GR_PB02 plot near the Parabara basecamp. Both curves show the distinct pattern of a few dominant species and many singletons (i.e. species occuring only with 1 individual).

Recommendations

To be able to gain a better insight in the community composition and structure of forests in the South Rupununi and the surrounding areas more sampling surveys should be considered. This would lead to the inclusion of many more species, for all main vegetation types. Although this survey sampled a relatively large number of species considering the limited amount of time, there is still much to be discovered. More plots should be laid out in the surrounding areas to get a detailed and high-resolution view of species diversity. With this information we will be able to gain more understanding of gradients in species diversity and turnover of species diversity over larger geographical scales. This information is vital for making informed decisions regarding conservation practices.

These initial results have shown that the South West part of the Rupununi Savannah is a highly diverse area, both in terms of habitats and occuring species. The two plots, which were recorded during this survey, showed that there is high regional diversity even within relatively short distances. Earlier studies have already indicated that especially the rocky outcrops such as Kusad

Mountain and Saddle Mountain are unique habitats with in the interior of Guyana and deserve special attention regarding conservation practices (Jansen-Jacobs & Steege 2000). Overall, this survey showed that there is much to be discovered and worth protecting in the South-West Rupununi Savannah.

Acknowledgements
We would like to thank the Wapishana community for assistance and permission to work in their area. We would also like to thank WWF Guianas and GWC for making this Biodiversity Assessment possible.

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Ants

Jackson Helms, Leeanne E. Alonso, and Sampson Isaacs

Introduction

Ants (Insecta: Hymenoptera: Formicidae) are diverse and abundant and occupy most terrestrial habitats. Over 12,000 ant species have been described (Bolton et al. 2006). High abundance and nearly global distribution make ants one of the most prominent groups of land animals. Through their interactions with other organisms—as predators, herbivores and mutualists—ants achieve high ecological importance and contribute to many ecosystem processes such as seed dispersal, decomposition and soil turnover. Ecological importance, numerical dominance, ease of sampling and sensitivity to environmental conditions (Kaspari and Majer 2000) make ants ideal organisms for biomonitoring programs (Agosti et al. 2000).

Like the Guiana Shield in general, the ant fauna of Guyana is diverse but poorly known. Previous surveys have found approximately 450 species and suggest that hundreds more remain to be discovered (Kempf 1972; LaPolla et al. 2007). Our surveys here in the southern Rupununi—the first in the area—are an important step in mapping Guyana's ant diversity.

Brief Methods and Study Sites

During approximately two weeks of surveying in the southern Rupununi we collected ants through hand collecting, sugar baits, pitfall traps and leaf litter sampling. In hand collecting we manually search for ants on the ground, on vegetation, in soil, under rocks and logs, in rotting wood, and inside hollow twigs and plants. We hand collected at different habitat types within a site—lowland dry forest, upland dry forest, savannah and riparian forest at Kusad; and savannah, morichal, riparian forest, bush islands and lowland rainforest at Parabara.

For bait traps we placed large plastic vials with cotton soaked in sugar solution on the ground and collected them after 1-2 hours. We bait trapped at riparian forest, dry forest and tall grass savannah in Kusad.

In pitfall trapping we placed traps every 10 meters along a 200 meter transect and collected the traps after 48-72 hours. Each trap is a plastic cup buried with its lip level with the ground and filled with soap solution. We did one transect in tall grass savannah at Kusad (elevation 135 m) for 72 hours, and one in shortgrass savannah at Parabara for 48 hours (elevation 240 m).

For litter sampling we used the Winkler method adopted from the Ants of the Leaf Litter Protocol (Agosti et al. 2000). We created 200 meter transects and collected leaf litter from a square meter plot every 10 meters. The leaf litter from each plot was sifted and hung in a Winkler trap for 48 hours. We ran three Winkler transects: one in lowland dry forest at Kusad (135-180 m elevation); one in higher dry forest at Kusad (475 m elevation); and one in lowland rainforest at Parabara (250 m elevation). We supplemented the standardized transects with targeted litter collections from each site—two from lowland dry forest at Kusad, one each at night and during the day in higher dry forest at Kusad, one from a bush island at Parabara, and one from a gallery forest at Parabara.

General Impressions

We collected at least 150 ant species, belonging to 31 genera and 9 subfamilies. These results are based on tentative identifications of hand-collected specimens. The numbers will rise as we process pitfall and litter samples and properly identify our hand collected specimens. Species differed between the two sites and among habitats within each site. Both sites had high diversity, with 25 hand collected genera from 7 subfamilies at Kusad and 27 genera from 9 subfamilies at Parabara. High species richness and species turnover result in high regional diversity. Further processing of specimens will allow more detailed comparisons of diversity and composition. Overall we found a highly diverse and intact ant fauna in the southern Rupununi, indicating large blocks of high quality habitat and high habitat diversity.

Interesting Species

This is one of few ant surveys conducted in Guyana and the first for the areas of Kusad and Parabara. All observations therefore represent new range records.

We found several species of army ants (Ecitoninae), including *Eciton burchellii* and *E. hamatum* at Parabara and *Labidus* sp. at both sites. Army ants play an important role as top predators in these ecosystems, and their nomadic hunting lifestyle and massive colonies require large territories. The presence of several species indicates large blocks of intact habitat, as well as the presence of adequate prey species.

The presence of many arboreal (e.g. *Camponotus* sp., *Cephalotes* sp., *Daceton armigerum*, *Pseudomyrmex* sp.), leaf litter (e.g. *Apterostigma* sp., *Cyphomyrmex* sp., *Strumigenys* sp., *Trachymyrmex* sp.), and specialized predatory (*Hypoponera* sp., *Leptogenys* sp., *Odontomachus* sp., *Pachycondyla* sp.) species is typical of healthy diverse forests. Likewise, the bullet ant (*Paraponera clavata*), which we collected in Parabara, requires fairly large blocks of rainforest. The grasslands had healthy ant faunas as well, with Dolichoderine species like *Dorymyrmex* sp., leaf-cutters (*Atta* sp.), *Ectatomma* sp., and several Ponerines.

We collected many ants living in specialized ant plants. Among the ant plants we found (*Cordia nodosa*, *Cecropia* sp., *Hirtella* sp., and several Melastomataceae species) we collected ants such as *Allomerus* sp., *Azteca* sp., *Crematogaster* sp. and *Pseudomyrmex* sp., indicating intact ant-plant symbioses.

Conservation Recommendations

Further sampling of Kusad and Parabara will reveal many more species than we found in our two week survey. Likewise, sampling during different times of year may reveal seasonal changes in ant activity.

The southern Rupununi is characterized by high habitat heterogeneity, with blocks of savannah and forest of different size. Sampling in different habitat patches (e.g. rocky outcrops other than Kusad) should reveal how ant communities respond to changes in habitat size and landscape structure. This information can be incorporated into monitoring programs to guide management decisions about the use of fire, maintenance of bush islands, and agricultural practices—all stated priorities of the Wapichan people (Gomes and Wilson 2012). Such monitoring of southern Rupununi ant communities may help local communities recognize and respond to future environmental and land use changes.

Acknowledgements
We thank the Wapishana community for assistance and permission to work in their land.

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Table 2. Preliminary checklist of ant genera of the South Rupununi Savannah, Guyana.

Subfamily	Genus	Kusad	Parabara
Cerapachyinae	*Cerapachys*	N	Y
Dolichoderinae	*Azteca*	Y	Y
	Dolichoderus	Y	Y
	Dorymyrmex	Y	Y
	Tapinoma	Y	N
	Technomyrmex	Y	Y
Ecitoninae	*Eciton*	N	Y
	Labidus	Y	Y
Ectatomminae	*Ectatomma*	Y	Y
Formicinae	*Brachymyrmex*	Y	N
	Camponotus	Y	Y
	Gigantiops	Y	Y
	Nylanderia	Y	Y
Myrmicinae	*Allomerus*	N	Y
	Apterostigma	N	Y
	Atta	Y	Y
	Cephalotes	Y	Y
	Crematogaster	Y	Y
	Cyphomyrmex	Y	Y
	Daceton	Y	N
	Pheidole	Y	Y
	Solenopsis	Y	Y
	Strumigenys	N	Y
	Trachymyrmex	Y	Y
	Wasmannia	Y	N
Paraponerinae	*Paraponera*	N	Y
Ponerinae	*Hypoponera*	Y	Y
	Leptogenys	Y	Y
	Odontomachus	Y	Y
	Pachycondyla	Y	Y
Pseudomyrmecinae	*Pseudomyrmex*	Y	Y

Aquatic Beetles

Andrew Short, *Shari Salisbury*, & *Timothy Isaacs*

Introduction

Aquatic beetles are a diverse guild of aquatic insects that occur in a broad range of habitats including streams, lakes, and waterfalls. There are an estimated 18,000 species of aquatic beetles worldwide (Jäch & Balke 2008). These species are distributed across approximately 20 beetle families in four primary lineages: Myxophaga, Hydradephaga, aquatic Staphyliniformia (Hydrophiloidea and Hydraenidae) and the Dryopoidae (or aquatic Byrroids). Members of Myxophaga are small beetles that feed largely on algae as larvae and adults. The Hydradephaga (including the diving and whirligig beetles) are largely predators as adults and larvae; the aquatic Staphyliniformia are largely predators as larvae but scavengers as adults; the dryopoids are largely scavengers or eat algae as both larvae and adults (Short 2013).

Aquatic insects (including some groups of aquatic beetles) are often used as effective indicators of water quality in freshwater systems. This is largely due to their varying response to ecological perturbations such as increasing sediment load, nutrient inputs, and loss of canopy cover. Aquatic beetle communities are also effectively used to discriminate among different types of aquatic habitat (e.g. between lotic and lentic; rock outcrops, substrate, etc.).

Aquatic beetles in Guyana are very poorly known. There has been some limited prior collecting, notably by Smithsonian researchers in 1983 (Takutu Mountains), 1994, and 1995 (both north Rupununi area). There are no known records of aquatic beetles from the South Rupununi. By comparison, neighboring Venezuela and Suriname have received significantly more attention in recent years, and been the subject of numerous survey efforts (e.g. Short & Kadosoe 2011, Short 2013). Still, the entire regional fauna is understudied and many new species are being discovered and remain to be described.

Methods

We collected aquatic beetles in the vicinity of both Kusad Mountains and Parabara base camps. We employed a variety of mostly "active" collecting techniques. Active techniques, which include methods where beetles are collected in their habitat, are preferred as they allow gathering of ecological and water quality data as well as the specimens. We also used one "passive" method, UV lights, to assess diversity.

Traps and other passive methods. During two nights at the Kusad Mountain Camp, and three nights at Parabara Camp, we collected in the evening hours until approximately 10 p.m. at a UV light mounted on a white sheet erected near the center of each camp. Several dung traps were set out at Parabara camp for two days, but no terrestrial hydrophiloid specimens were found.

Active methods. Most collecting in marshes, ponds, and stream pools was done with aquatic dip nets. The nets are swept through marginal detritus, vegetation, and open water and the contents subsequently placed on screens over white tubs to extract the beetles. A small strainer was used to collect insects that are not active swimmers but float on the water's surface when disturbed. Leaf-packs and submerged logs were examined in flowing streams. At one hygropetric surface in

the Kusad Mountains, the rock was scrubbed with a brush into an aquatic net held downstream.

The majority of aquatic beetles are less than 5 mm, although some are significantly larger (50 mm). These small specimens require examination under a microscope for species identification, thus I collected and preserved samples of these insects from both camps to study in the laboratory for processing.

Results

Summary of Habitats: Kusad. The Kusad study region had a broad range of aquatic habitats. Lotic habitats included a large river (Takatu River), several medium creeks (e.g. Kato Wao) and numerous small creeks, both forested and in the open savannah. Most of these had rocky or mud substrates. Five large "lakes" and marshes that were detached from streams were also investigated. These ranged from less than 0.5m to more than 2 meters in depth, and all were without canopy cover. One stream near base camp flowed over a large rocky expanse, forming large areas of hygropetric habitat.

Summary of Habitats: Parabara. The Parabara vicinity had several large rivers, including the Kuyuwini (though this was not sampled), and numerous small creeks and streams. In contrast to the Kusad site, nearly all these streams were in densely forested riparian zones and had a predominately sandy substrate. Several marshes areas were sampled in small savannah patches, but these were almost always draining into creeks and thus not as isolated. Several forested ponds with thick layers of detritus substrate were also sampled.

Summary of Taxa. A preliminary review of samples suggests we collected a total of 148 species of aquatic beetles in 11 families. Both the Kusad and Parabara sites had similar levels of species richness, with an estimated 112 and 102 species respectively. Our results also suggest a fair amount of dissimilarity between sites, which dozens of species present at only one of the two study sites.

Taxa & Habitats of Note. As with prior expeditions in the Guiana Shield region (e.g. Short, 2013), the hygropetric habitats at the Kusad site had the most "unusual" species. This includes two species of the family Torridincolidae, which are both likely new to science. This is the first record of the family for Guyana. Several species of the rare hydrophilid genus *Tobochares* and dytiscid genus *Fontidessus* were also found at this site, and both may represent new species.

Conservation Recommendations

The study region has an exceptionally high level of species richness for aquatic beetles. As one comparison, more species were recorded here than during the Southwestern Suriname RAP survey, despite that more sites were visited and more collecting methods were used on that trip (Short and Kadosoe, 2011). This is likely due to two factors: first, the region is relatively undisturbed. While there are visible human impacts to aquatic habitats at some collection sites, these seem to be discrete and limited. Most habitats in which we collected were pristine or nearly so. Second, there is a very high diversity of habitats in the region, each with distinctive aquatic beetle communities. For example, both the open savannah habitats around Kusad and the interior forests around Parabara village hosted large communities of aquatic beetles, but had very little in common. Thus, by possessing a large number of habitats with distinct and intact communities, the area as a whole yields a very diverse species assemblage. As a consequence, conservation

efforts should focus on maintaining integrity of the habitat mosaic that exists is the southern Rupununi region.

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Table 3. Preliminary List of Aquatic Beetles from the South Rupununi.

	Kusad	Parabara	Total
Dryopidae			
Pelonomus	-	2	2
Dryops	-	1	1
	Kusad	**Parabara**	**Total**
Dytiscidae			
Agaporamorphus	1	1	1
Amarodytes	1	1	1
Anodocheilus	2	2	3
Bidesonotus	1	2	3
Bidessodes	2	1	2
Celina	3	2	3
Copelatus	5	6	7
Derovatellus	1	1	1
Desmopachria	4	4	5
Fontidessus	2	-	2
Hydaticus	2	2	3
Hydrodessus	-	2	2
Hydrovatus	1	1	1
Hypodessus	1	-	1
Laccodytes	-	1	1
Laccomimus	2	1	2
Laccophilus	5	5	6
Liodessus	1	1	1
Megadytes	3	1	3
Neobidessus	2	2	3
Pachydrus	1	1	1
Queda	1	-	1
Rhantus	1	-	1
Thermonectus	1	4	4
Vatellus	2	3	3

	Kusad	Parabara	Total
Dryopidae			
Pelonomus	-	2	2
Dryops	-	1	1
Elmidae			
Mixed genera (4+)	5	6	7
Stegoelmis	-	1	1
Epimetopidae			
Epimetopus	1	-	1
Gyrinidae			
Gyretes	2	3	3
Gyrinus	-	1	3
Hydraenidae			
Hydraena	2	2	2
Hydrochidae			
Hydrochus	3	3	3
Hydrophilidae			
Anaceana	1	1	1
Berosus	5	2	5
Chasmogenus	2	2	3
Derallus	2	3	3
Enochrus	4	3	4
Gen Nov. 1	1	1	1
Gen Nov. 2	1	1	1
Globulosis	1	-	1
Helobata	1	-	1
Helochares	4	4	4
Hemiosus	1	-	1
Hydrobiomorpha	2	1	2
Hydrophilus	1	1	1
Notionotus	1	1	1
Oocyclus	3	-	3
Paracymus	2	2	3
Phaenonotum	1	1	2
Phaenostoma	1	1	1
Tobochares	2	-	2
Tropisternus	4	4	6
Lutrochidae			
Lutrochus	-	1	1
Noteridae			
Hydrocanthus	3	3	4
Mesonoterus	1	-	1
Notomicrus	2	2	2
Pronoterus	1	-	1
Siolius	1	1	1
Suphis	1	-	1
Suphisellus	3	4	5
Torridincolidae			
Claudiella	2	-	2

	Kusad	Parabara	Total
Dryopidae			
Pelonomus	-	2	2
Dryops	-	1	1
TOTAL	**112**	**102**	**148**

Reptiles and Amphibians

Andrew Snyder and Meshach Pierre

Introduction

Reptiles and amphibians are important components of Neotropical forests and savannahs. While the knowledge of Guiana Shield herpetofauna is increasing rapidly, no previous surveys to these sites have ever been conducted. This area is high priority because of its high diversity of habitats and low levels of human activity. For reptiles and amphibians, species diversity is related to habitat diversity, with many species showing strict habitat requirements. Reptiles and amphibians are appropriate for rapid assessment study due to their limited dispersal, intermediate positions in food webs, varying life history strategies, and modes and timing of dispersal. They are often species-rich and tolerant to varying degrees of environmental stress, making them valuable indicators of ecosystem health.

Methods and Study Sites

We surveyed amphibians and reptiles for six nights each at Kusad Mountain (24-29 October 2013) and at the Parabara area (October 31-November 5). Due to the availability of transportation to a variety of sites and habitats, opportunistic surveys were conducted during the day and night to maximize species diversity. Opportunistic surveys involve actively searching for reptiles and amphibians over large areas in suitable habitat and are effective for sampling species richness.

Reptiles and amphibians were captured manually once observed. Each specimen was assigned a field number, and corresponding locality data, preliminary identification, and general descriptions of habitat were noted. When possible, specimens were photographed prior to euthanasia. Specimens were anesthetized and fixed using 10% formol, and tissue samples were collected and stored in 95% ethanol.

Kusad Mountain is an isolated, dry forest mountain surrounded by the Rupununi Savannah. Surveys were conducted around the base camp, in and around two small savannahs located within the mountain at 545m elevation, and at a nearby pond.

Our survey site at the Parabara area contained a variety of suitable habitats. This unique area contained savannah, tropical gallery forests, bush islands, and lowland tropical rainforest. Long walks at night targeted both savannah and gallery forest. The contiguous tropical rainforest habitat was surveyed near Parabara Village both during the day and night.

General Impression of Each Site

Overall, 34 species of reptiles and 26 species of amphibians were observed at both of our sites. During our surveys at Kusad Mountain, a total of 11 species of amphibians were recorded, all being Anurans (Hylidae, Bufonidae). A total of 25 species of reptiles were recorded with 13 species being snakes (Viperidae, Boidae, Elapidae, Colubridae, Typhlopidae), one species of tortoise (Testudinidae), and 11 species of lizards (Gekkonidae, Sphaerodactylidae, Teiidae, Polychrotidae, Scincidae, Tropiduridae). In the Parabara area, a total of 19 species of amphibians were observed from 7 families (Leptodactylidae, Hylidae, Dendrobatidae, Aromabatidae,

Bufonidae, Craugastoridae, Allophrynidae, Pipidae) and 18 different species of reptiles were observed from 11 families (Alligatoridae, Chelonidae, Colubridae, Boidae, Viperidae, Sphaerodactylidae, Tropiduridae, Teiidae, Polychrotidae, Scincidae, Iguanidae).

For reptiles and amphibians community composition, species diversity is related to habitat diversity. The dry forests of Kusad Mountain and overall lack of rain during the surveys are responsible for the lower diversity of amphibians compared to the Parabara area, where the wet tropical forests supported greater richness.

Interesting Species

Of the 60 species of reptiles and amphibians recorded from both survey sites, nine are currently included on CITES. The Black caiman (*Melanosuchus niger*) is currently included in Appendix I and II of CITES. The gold tegu (*Tupinambis teguixin*), emerald tree boa (*Corallus caninus*), Amazon tree boa (*Corallus hortulanus*), green anaconda (*Eunectes murinus)*, red-footed tortoise (*Chelonoidis carbonaria*), and two species of frogs (*Ameerega trivitatta* and *Allobates femoralis*) are included in Appendix II of CITES, while the Neotropical rattlesnake (*Crotalus durissus*) is included in Appendix III of CITES. Additionally, the IUCN Red List classifies the black caiman (*Melanosuchus niger*) as Conservation Dependent and the red-footed tortoise (*Chelonoidis carbonaria*) as Vulnerable.

Additionally, at Kusad Mountain, one individual of the frog identified preliminarily as *Leptodactylus* cf. *myersi,* was found, and may represent a new record for Guyana. In Parabara Village, two individuals identified as *Allobates* sp. require laboratory work in order to determine whether they are a range extension of *Allobates spumaponens* or potentially even a new species.

Conservation Recommendations for Each Site

Before anything else, the first recommendation is to maintain the integrity of the undisturbed forests and stream habitats within and around Kusad Mountain and the Parabara area. The results of this short dry season survey represent only a fraction of the herpetofauna of these areas. More extensive sampling is required, including during the wet season, in order to reflect more accurately the species richness at these sites. Medium to large-bodied reptiles such as the caimans, turtles, and tortoises are frequent food sources for certain Amerindian groups. It was noted that fewer of these species than expected were observed, especially around Parabara Village. There needs to be specific studies monitoring the current abundance of these species and possibly input a sustainable management plan.

Also, further water-quality monitoring with herpetofaunal surveys should take place during the wet and dry seasons in Parabara Village along streams and rivers associated with small-scale mining. Due to their moist, permeable skin and biphasic lifestyle, amphibians are especially sensitive to environmental contamination.

Acknowledgements

We thank Charles Hutchinson (World Wildlife Fund-Guianas), Aiesha Williams (World Wildlife Fund-Guianas), Edward Gomes (Potarinau Village), and Elvis Thompson (Parabara Village) for assisting field investigation and specimen collection.

Table 4. Amphibians recorded during the October 2013 BAT survey of Kusad Mountain and Parabara area, Guyana.

Taxa	Kusad Mountain	Parabara Area
ORDER ANURA		
Family Allophrynidae		
Allophryne ruthveni		**X**
Family Aromobatidae		
Allobates femoralis		**X**
Allobates sp.		**X**
Family Bufonidae:		
Rhaebo guttatus		**X**
Rhinella marina	**X**	**X**
Rhinella martyi		**X**
Rhinella merianae		**X**
Family Craugastoridae		
Pristimantis cf. chiastonotus		**X**
Family Dendrobatidae		
Ameerega trivittata		**X**
Family Hylidae		
Dendropsophus minutus	**X**	
Hypsiboas boans		**X**
Hypsiboas crepitans	**X**	**x**
Hypsiboas cf. multifasciatus		
Lysapsus laevis	**X**	**X**
Osteocephalus leprieurii		**X**
Osteocephalus taurinus		**X**
Phyllomedusa bicolor	**X**	**X**
Family Leptodactylidae		
Adenomera sp.	**X**	
Leptodactylus fuscus	**X**	**X**
Leptodactylus cf. myersi	**X**	
Leptodactylus mystaceus		**X**

Leptodactylus pentadactylus	**X**	
Leptodactylus petersi		**X**
Leptodactylus sp.	**X**	
Family Pipidae		
Pipa pipa		**X**
Family Ranidae		
Lithobates palmipes	**X**	
Total: 26	**11**	**19**

Table 5. Reptiles recorded during the October 2013 BAT survey of Kusad Mountain and Parabara area, Guyana.

Taxa	Kusad Mountain	Parabara Area
ORDER CROCODYLIA		
Family Alligatoridae		
Melanosuchus niger		**X**
ORDER TESTUDINES		
Family Testudinidae		
Chelonoidis carbonaria	**X**	
ORDER SQUAMATA		
Family Gekkonidae		
Hemidactylus palaichthus	**X**	
Thecadactylus rapicauda	**X**	
Family Polychrotidae		
Anolis auratus	**X**	**X**
Anolis planiceps	**X**	**X**
Family Scincidae		
Mabuya nigropunctata	**X**	**X**
Family Sphaerodactylidae		
Gonatodes humeralis	**X**	**X**
Pseudogonatodes guianensis	**X**	
Family Teiidae		
Ameiva ameiva	**X**	**X**
Cnemidophorus lemniscatus	**X**	
Kentropyx calcaratus		**X**
Tupinambis teguixin	**X**	**X**

Family Tropiduridae		
Plica umbra		**X**
Tropidurus hispidus	**X**	
Uranoscodon superciliosus		**X**
Family Boidae		
Corallus caninus		**X**
Corallus hortulanus	**X**	
Eunectes murinus	**X**	
Family Elapidae		
Micrurus hemprichii	**X**	
Family Colubridae		
Chironius fuscus		**X**
Chironius exoletus	**X**	**X**
Dipsas catesbyi		**X**
Helicops angulatus	**X**	
Leptodeira annulata	**X**	
Mastigodryas boddaerti	**X**	
Oxybelis aeneus	**X**	**X**
Oxybelis fulgidis		**X**
Pseudoboa coronata	**X**	
Pseudoboa neuwideii	**X**	
Family Typhlopidae		
Typhlops sp.	**X**	
Family Viperidae		
Bothrops atrox	**X**	
Crotalus durissus	**X**	**X**
Lachesis muta		**X**
Total: 34	**25**	**18**

Birds

Brian J. O'Shea, Asaph Wilson, and Jonathan Wrights

Introduction

Birds are ideal subjects for rapid biodiversity assessments because most species are diurnal and easy to identify relative to other groups of organisms. A variety of resources exist to facilitate their identification by both sight and sound; nevertheless, the ecology and distribution of many tropical species are still poorly known. Data from rapid assessments can therefore contribute valuable information to inform conservation planning. Bird surveys also present outstanding opportunities to introduce students to ornithological field research.

This report presents preliminary findings from ornithology surveys conducted under the auspices of the South Rupununi Biodiversity Assessment Team (BAT), a group of scientists, students and community representatives that surveyed two localities in the southern Rupununi savannah of Guyana from 23 October – 6 November 2013.

Study Sites and Methods

Study Sites. Our surveys were based from two main camps – Kusad Mountain (23-30 October) and Parabara savanna (31 October – 6 November). Due to limited accessibility of habitats around the Kusad camp, we also surveyed opportunistically along a walking trail up the mountain itself on 26-27 October; at a large marsh in the savannah roughly 7 km from the camp on 28 October; and very briefly at dawn along the Takutu River on 29 October (this latter survey was terminated by heavy rain shortly after dawn, forcing us to return to camp). Habitats at Kusad were a mix of forest and savannah, the latter ranging from dry to flooded; near the camp itself, the savannah was moderately wet with fairly dense stands of the dominant savannah tree (*Curatella americana*) and long (>1m) grass. Waterways in the savannah were characterized by conspicuous linear stands of the Moriche or Ité palm (*Mauritia flexuosa*). Aside from a few small clearings, the entire mountain was covered by tall forest; on the lower slopes, this forest was quite dry on very rocky ground, with few large trees, whereas at higher elevations it was more humid, with a more substantial soil layer and somewhat larger stature and structural complexity.

The Parabara site was located in a large patch of savannah with many "bush islands" of varying size; the camp itself was situated near a tongue of riparian forest. From this camp, we were able to walk long distances across the savannah and along the road linking Parabara village with Karaudarnau and other settlements. Accordingly, most of our observations were made within a 5-km radius around the camp, although we did spend one day in and around the village of Parabara itself, roughly 11 km by road from the camp. Habitat in Parabara village was a mixture of mostly overgrown agricultural clearings and tall rainforest typical of the region.

Field Methods. We used a variety of methods to survey the avifauna. Our primary method was casual observation of birds while walking along roads and trails, or across the savannah itself, noting all species of birds seen and heard. We were active mainly during the first 2-3 hours of daylight, after which bird activity tapered off dramatically, especially in savannah, where it reached a near-standstill by mid-day. We also used mist nets at both sites – five at Kusad, and

eleven at Parabara – these nets were set in forest around each camp. We only opened nets when we were available to check them, which was not every day, since we often spent entire days and nights away from the camp; furthermore, because we were typically afield during the early mornings, we usually opened nets only from mid-morning into the afternoon, when birds were less active. Birds captured in the nets were either collected or released. Specimens were prepared as study skins to be deposited at the National Museum of Natural History in Washington, DC, and at the Centre for the Study of Biological Diversity at the University of Guyana. Birds were also documented by sound recording, using a Marantz PMD-661 digital recorder and a Sennheiser ME-62 microphone. We made four recordings of the dawn soundscape using a stereo microphone pair (Sennheiser MKH-20 and MKH-30). Recordings typically ran for approximately two hours, beginning 30-45 minutes before sunrise. Two such recordings were made from each site; one from a patch of savannah near the top of Kusad Mountain; another from a marsh in the savannah roughly 7 km from the Kusad camp; and two from the savannah in Parabara, 3-5 km from the camp. All recordings are deposited at the Macaulay Library at the Cornell Lab of Ornithology, Ithaca, NY, USA. These recordings serve to document a substantial proportion of the bird species recorded during the survey.

Results

Species totals. Our preliminary species list totals 306 species. We recorded 150 species at Kusad, both on the mountain and in the surrounding savannahs, and 137 species around the Parabara savannah camp. During one morning and early afternoon around Parabara village, we recorded 159 species, 82 of which were not observed elsewhere. Of the 150 species observed at Kusad, 62 were recorded only there. Whereas the savannah avifauna of the two localities overlapped broadly, the forest avifauna at Kusad was distinctly different from that found around Parabara village. The Parabara village avifauna was typical of the lowland rainforest of the Guiana Shield, featuring high diversity and many species assemblages typical of such forest (e.g. army ant-following antbirds and mixed-species foraging flocks); these were almost entirely absent from Kusad, where the avifauna was more similar to that found in the gallery forests of the surrounding savannas. Despite this, an interesting subset of the Guianan lowland forest avifauna was present in tall forest at Kusad, particularly at higher elevations (e.g., Guianan Puffbird *Notharchus macrorhynchos* and Capuchinbird *Perissocephalus tricolor*). Our high species total reflects the exceptional diversity of habitats in the southern Rupununi relative to other areas of the Guiana Shield.

Interesting species. From Kusad, we obtained one specimen each of Undulated Tinamou (*Crypturellus undulatus*) and Pearly-vented Tody-Tyrant (*Hemitriccus margaritaceiventer*). The tinamou represents a taxon (*C. u. simplex*) that is poorly represented in collections; ours is the first specimen from Guyana taken in modern times. The tody-tyrant was not previously known to occur in the southern Rupununi; indeed it is known from only one other locality in Guyana (Mt. Holitipu).

From the Parabara savannah camp, we recorded Ocellated Crake (*Micropygia schomburgkii*), a poorly-known savanna specialist. From Parabara village, we observed one pair each of Glossy-backed Becard (*Pachyramphus surinamus*) and Short-billed Honeycreeper (*Cyanerpes nitidus*), both of which are low-density species whose distributions in the Guiana Shield are poorly known. At Parabara village we also heard Crimson Fruitcrow (*Haematoderus militaris*), a rare

and spectacular cotinga endemic to the Guiana Shield and highly sought by birdwatchers. Finally, we encountered several groups of Red Siskin (*Carduelis cucullata*), a critically endangered species whose population in the Rupununi was only recently discovered.

Discussion and Recommendations

Relative to other areas of the Guiana Shield, the south Rupununi harbors a high diversity of birds due to the presence of several habitat types including lowland rainforest, wet and dry savannah, dry hill forest, and gallery forest, all in close proximity. Unlike areas dominated by a mix of terra firme and riparian forests, which typically share up to 90% of species between them, many species in the southern Rupununi are restricted to particular habitats or forest types, as evidenced by the low overlap between the forest avifaunas of Kusad and Parabara, as well as the presence of savannah species that do not occur in forested regions of the Guiana Shield. The savannah avifauna is vulnerable to the widespread practice of burning, which occurs throughout the dry season across much of the Rupununi. Although many savannah species are ecological generalists that can be common in human-dominated landscapes, a handful of them are restricted to particular habitats in the savannah and are vulnerable to local extinction.

Overall, the southern Rupununi presents an opportunity for community-based habitat management to ensure the maintenance of high bird diversity, which could provide livelihoods for residents through tourism. Protecting bird habitats would also improve quality of life by sustaining populations of species that control crop pests and provide food for people. Management of habitats should include reducing the frequency and extent of fires, limiting hunting of game birds (particularly during their breeding seasons), and protecting forest habitats and water quality along rivers throughout the region.

Table 6. Preliminary list of birds of the South Rupununi.

Scientific name	English name	Kusad	Parabara	Parabara village
Tinamidae				
Tinamus major	Great Tinamou		X	
Crypturellus cinereus	Cinereous Tinamou		X	
Crypturellus soui	Little Tinamou		X	
Crypturellus undulatus	Undulated Tinamou	X		
Crypturellus variegatus	Variegated Tinamou		X	
Anatidae				
Cairina moschata	Muscovy Duck	X		
Cracidae				
Ortalis motmot	Variable Chachalaca	X	X	
Penelope marail	Marail Guan		X	
Penelope jacquacu	Spix's Guan		X	
Crax alector	Black Curassow		X	
Odontophoridae				
Colinus cristatus	Crested Bobwhite	X		
Odontophorus gujanensis	Marbled Wood-Quail		X	
Ardeidae				
Tigrisoma lineatum	Rufescent Tiger-Heron	X	X	X
Butorides striata	Striated Heron	X		
Bubulcus ibis	Cattle Egret	X		
Ardea cocoi	Cocoi Heron			X
Ardea alba	Great Egret	X		
Egretta caerulea	Little Blue Heron			X
Threskiornithidae				
Mesembrinibis cayennensis	Green Ibis			X
Theristicus caudatus	Buff-necked Ibis	X		
Ciconiidae				
Jabiru mycteria	Jabiru	X		
Cathartidae				
Cathartes aura	Turkey Vulture	X	X	
Cathartes burrovianus	Lesser Yellow-headed Vulture	X		

Cathartes melambrotus	Greater Yellow-headed Vulture	X	X	
Coragyps atratus	Black Vulture	X	X	
Sarcoramphus papa	King Vulture	X	X	
Accipitridae				
Gampsonyx swainsonii	Pearl Kite	X		
Ictinia plumbea	Plumbeous Kite			X
Geranospiza caerulescens	Crane Hawk	X		
Pseudastur albicollis	White Hawk	X		
Buteogallus urubitinga	Great Black-Hawk	X		
Buteogallus meridionalis	Savanna Hawk	X	X	
Busarellus nigricollis	Black-collared Hawk	X		
Buteo magnirostris	Roadside Hawk	X	X	X
Buteo nitidus	Gray Hawk	X		X
Buteo brachyurus	Short-tailed Hawk	X		
Buteo albicaudatus	White-tailed Hawk		X	
Spizaetus tyrannus	Black Hawk-Eagle		X	
Spizaetus ornatus	Ornate Hawk-Eagle	X		
Rallidae				
Micropygia schomburgkii	Ocellated Crake		X	
Aramides cajanea	Gray-necked Wood-Rail	X	X	
Porzana albicollis	Ash-throated Crake		X	
Heliornithidae				
Heliornis fulica	Sungrebe			X
Eurypygidae				
Eurypyga helias	Sunbittern	X	X	X
Charadriidae				
Vanellus chilensis	Southern Lapwing		X	
Burhinidae				
Burhinus bistriatus	Double-striped Thick-knee		X	
Scolopacidae				
Calidris fuscicollis	White-rumped Sandpiper		X	
Jacanidae				

Jacana jacana	Wattled Jacana	X		
Columbidae				
Columbina passerina	Common Ground-Dove	X	X	X
Columbina minuta	Plain-breasted Ground-Dove	X		
Patagioenas speciosa	Scaled Pigeon		X	
Patagioenas cayennensis	Pale-vented Pigeon	X	X	
Patagioenas plumbea	Plumbeous Pigeon		X	X
Patagioenas subvinacea	Ruddy Pigeon			X
Zenaida auriculata	Eared Dove	X		
Leptotila verreauxi	White-tipped Dove	X	X	
Leptotila rufaxilla	Gray-fronted Dove		X	
Falconidae				
Daptrius ater	Black Caracara			X
Caracara plancus	Southern Caracara	X	X	
Milvago chimachima	Yellow-headed Caracara	X	X	
Herpetotheres cachinnans	Laughing Falcon	X		
Micrastur ruficollis	Barred Forest-Falcon	X		
Micrastur mirandollei	Slaty-backed Forest-Falcon		X	X
Micrastur semitorquatus	Collared Forest-Falcon			X
Falco sparverius	American Kestrel	X		
Falco rufigularis	Bat Falcon	X	X	X
Falco femoralis	Aplomado Falcon	X		
Psittacidae				
Ara ararauna	Blue-and-yellow Macaw	X	X	
Ara macao	Scarlet Macaw		X	X
Ara chloropterus	Red-and-green Macaw		X	X
Orthopsittaca manilata	Red-bellied Macaw	X	X	
Diopsittaca nobilis	Red-shouldered Macaw	X	X	
Aratinga leucophthalmus	White-eyed Parakeet			X
Aratinga pertinax	Brown-throated Parakeet	X	X	
Pyrrhura picta	Painted Parakeet			X
Brotogeris chrysopterus	Golden-winged Parakeet		X	X
Touit purpuratus	Sapphire-rumped Parrotlet			X
Gypopsitta caica	Caica Parrot			X
Pionus menstruus	Blue-headed Parrot		X	X
Pionus fuscus	Dusky Parrot		X	X
Amazona ochrocephala	Yellow-crowned Parrot		X	
Amazona amazonica	Orange-winged Parrot		X	X

Deroptyus accipitrinus	Red-fan Parrot			X
Cuculidae				
Piaya cayana	Squirrel Cuckoo	X	X	X
Crotophaga ani	Smooth-billed Ani	X	X	X
Tapera naevia	Striped Cuckoo	X		
Strigidae				
Megascops choliba	Tropical Screech-Owl	X	X	
Lophostrix cristata	Crested Owl			X
Pulsatrix perspicillata	Spectacled Owl	X		X
Bubo virginianus	Great Horned Owl	X		
Glaucidium hardyi	Amazonian Pygmy-Owl		X	X
Glaucidium brasilianum	Ferruginous Pygmy-Owl	X	X	
Athene cunicularia	Burrowing Owl	X		
Nyctibiidae				
Nyctibius griseus	Common Potoo	X	X	
Caprimulgidae				
Lurocalis semitorquatus	Short-tailed Nighthawk			X
Chordeiles pusillus	Least Nighthawk		X	
Chordeiles acutipennis	Lesser Nighthawk	X		
Podager nacunda	Nacunda Nighthawk	X		
Nyctidromus albicollis	Common Pauraque	X	X	X
Antrostomus rufus	Rufous Nightjar		X	
Caprimulgus cayennensis	White-tailed Nightjar	X		
Caprimulgus nigrescens	Blackish Nightjar		X	
Apodidae				
Chaetura spinicaudus	Band-rumped Swift			X
Chaetura chapmani	Chapman's Swift			X
Chaetura brachyura	Short-tailed Swift	X		X
Tachornis squamata	Fork-tailed Palm-Swift	X	X	X
Trochilidae				
Phaethornis ruber	Reddish Hermit		X	X
Phaethornis augusti	Sooty-capped Hermit	X		
Phaethornis bourcieri	Straight-billed Hermit			X
Phaethornis superciliosus	Long-tailed Hermit	X		X
Campylopterus largipennis	Gray-breasted Sabrewing			X

Florisuga mellivora	White-necked Jacobin			X
Anthracothorax nigricollis	Black-throated Mango	X		
Topaza pella	Crimson Topaz			X
Chlorostilbon mellisugus	Blue-tailed Emerald	X		
Hylocharis cyanus	White-chinned Sapphire			X
Polytmus sp.	White-tailed/Green-tailed Goldenthroat		X	
Amazilia sp.	Versicolored/White-chested Emerald	X		
Amazilia fimbriata	Glittering-throated Emerald	X		
Heliomaster longirostris	Long-billed Starthroat	X		X
Trogonidae				
Trogon viridis	Green-backed Trogon	X	X	X
Trogon violaceus	Guianan Trogon			X
Trogon melanurus	Black-tailed Trogon		X	X
Alcedinidae				
Megaceryle torquata	Ringed Kingfisher			X
Chloroceryle amazona	Amazon Kingfisher			X
Chloroceryle americana	Green Kingfisher			X
Chloroceryle inda	Green-and-rufous Kingfisher	X		
Chloroceryle aenea	American Pygmy Kingfisher			X
Momotidae				
Momotus momota	Amazonian Motmot	X	X	
Galbulidae				
Galbula albirostris	Yellow-billed Jacamar			X
Galbula galbula	Green-tailed Jacamar	X		
Galbula dea	Paradise Jacamar		X	X
Bucconidae				
Notharchus macrorhynchos	Guianan Puffbird	X		
Bucco tamatia	Spotted Puffbird		X	
Monasa atra	Black Nunbird	X		X
Chelidoptera tenebrosa	Swallow-winged Puffbird	X	X	X
Capitonidae				
Capito niger	Black-spotted Barbet			X
Ramphastidae				

Ramphastos tucanus	White-throated Toucan	X	X	X
Ramphastos vitellinus	Channel-billed Toucan	X	X	X
Pteroglossus viridis	Green Aracari			X
Picidae				
Picumnus exilis	Golden-spangled Piculet			X
Melanerpes cruentatus	Yellow-tufted Woodpecker			X
Celeus undatus	Waved Woodpecker			X
Celeus flavus	Cream-colored Woodpecker			X
Celeus torquatus	Ringed Woodpecker		X	
Dryocopus lineatus	Lineated Woodpecker	X	X	X
Campephilus melanoleucos	Crimson-crested Woodpecker	X	X	X
Campephilus rubricollis	Red-necked Woodpecker	X	X	X
Furnariidae				
Furnarius leucopus	Pale-legged Hornero	X		
Synallaxis albescens	Pale-breasted Spinetail	X		
Philydor pyrrhodes	Cinnamon-rumped Foliage-gleaner			X
Automolus ochrolaemus	Buff-throated Foliage-gleaner		X	X
Automolus infuscatus	Olive-backed Foliage-gleaner			X
Xenops minutus	Plain Xenops			X
Dendrocincla fuliginosa	Plain-brown Woodcreeper		X	X
Glyphorhynchus spirurus	Wedge-billed Woodcreeper		X	X
Dendrocolaptes certhia	Amazonian Barred-Woodcreeper		X	X
Xiphorhynchus obsoletus	Striped Woodcreeper			X
Xiphorhynchus guttatus	Buff-throated Woodcreeper	X	X	X
Thamnophilidae				
Cymbilaimus lineatus	Fasciated Antshrike		X	
Sakesphorus canadensis	Black-crested Antshrike	X	X	
Thamnophilus doliatus	Barred Antshrike	X		
Thamnophilus murinus	Mouse-colored Antshrike		X	X
Thamnophilus punctatus	Northern Slaty-Antshrike	X	X	
Thamnophilus amazonicus	Amazonian Antshrike			X
Thamnomanes caesius	Cinereous Antshrike			X
Myrmotherula brachyura	Pygmy Antwren			X
Myrmotherula surinamensis	Guianan Streaked-Antwren			X
Isleria guttata	Rufous-bellied Antwren			X
Myrmotherula axillaris	White-flanked Antwren		X	X
Herpsilochmus sticturus	Spot-tailed Antwren		X	X

Herpsilochmus rufimarginatus	Rufous-winged Antwren	X		
Microrhopias quixensis	Dot-winged Antwren			X
Formicivora grisea	White-fringed Antwren	X	X	
Cercomacra cinerascens	Gray Antbird			X
Cercomacra tyrannina	Dusky Antbird	X		X
Myrmoborus leucophrys	White-browed Antbird		X	X
Hypocnemis cantator	Guianan Warbling-Antbird		X	X
Hypocnemoides melanopogon	Black-chinned Antbird			X
Percnostola rufifrons	Black-headed Antbird		X	X
Myrmeciza ferruginea	Ferruginous-backed Antbird		X	X
Pithys albifrons	White-plumed Antbird			X
Gymnopithys rufigula	Rufous-throated Antbird			X
Formicariidae				
Formicarius analis	Black-faced Antthrush			X
Grallariidae				
Myrmothera campanisona	Thrush-like Antpitta		X	X
Conopophagidae				
Conopophaga aurita	Chestnut-belted Gnateater			X
Tyrannidae				
Tyrannulus elatus	Yellow-crowned Tyrannulet			X
Myiopagis gaimardii	Forest Elaenia	X	X	X
Myiopagis flavivertex	Yellow-crowned Elaenia			X
Myiopagis viridicata	Greenish Elaenia	X		
Elaenia flavogaster	Yellow-bellied Elaenia	X	X	
Elaenia cristata	Plain-crested Elaenia	X	X	
Ornithion inerme	White-lored Tyrannulet			X
Camptostoma obsoletum	Southern Beardless-Tyrannulet	X		X
Phaeomyias murina	Mouse-colored Tyrannulet	X		
Corythopis torquatus	Ringed Antpipit			X
Zimmerius acer	Guianan Tyrannulet	X	X	
Mionectes macconnelli	McConnell's Flycatcher	X		X
Sublegatus cf. modestus	Scrub-Flycatcher sp.	X		
Lophotriccus vitiosus	Double-banded Pygmy-Tyrant		X	X
Atalotriccus pilaris	Pale-eyed Pygmy-Tyrant	X		
Hemitriccus margaritaceiventer	Pearly-vented Tody-Tyrant	X		

Poecilotriccus sylvia	Slate-headed Tody-Flycatcher	X		
Todirostrum cinereum	Common Tody-Flycatcher		X	X
Todirostrum pictum	Painted Tody-Flycatcher		X	
Tolmomyias sulphurescens	Yellow-olive Flycatcher	X	X	
Tolmomyias assimilis	Yellow-margined Flycatcher			X
Tolmomyias poliocephalus	Gray-crowned Flycatcher			X
Tolmomyias flaviventris	Yellow-breasted Flycatcher	X	X	
Pyrocephalus rubinus	Vermilion Flycatcher	X		
Arundinicola leucocephala	White-headed Marsh-Tyrant	X		
Legatus leucophaius	Piratic Flycatcher		X	X
Myiozetetes cayanensis	Rusty-margined Flycatcher	X	X	X
Pitangus sulphuratus	Great Kiskadee	X	X	X
Conopias parvus	Yellow-throated Flycatcher		X	X
Myiodynastes maculatus	Streaked Flycatcher	X		
Megarynchus pitangua	Boat-billed Flycatcher	X	X	
Tyrannopsis sulphurea	Sulphury Flycatcher		X	
Tyrannus albogularis	White-throated Kingbird	X		
Tyrannus melancholicus	Tropical Kingbird	X	X	X
Tyrannus savana	Fork-tailed Flycatcher	X	X	
Rhytipterna simplex	Grayish Mourner		X	X
Sirystes sibilator	Sirystes			X
Myiarchus tuberculifer	Dusky-capped Flycatcher	X	X	
Myiarchus tyrannulus	Brown-crested Flycatcher	X		
Ramphotrigon ruficauda	Rufous-tailed Flatbill		X	X
Attila cinnamomeus	Cinnamon Attila			X
Attila spadiceus	Bright-rumped Attila	X	X	X
Cotingidae				
Phoenicircus carnifex	Guianan Red-Cotinga			X
Cotinga cayana	Spangled Cotinga			X
Lipaugus vociferans	Screaming Piha	X	X	X
Xipholena punicea	Pompadour Cotinga			X
Querula purpurata	Purple-throated Fruitcrow			X
Haematoderus militaris	Crimson Fruitcrow			X
Perissocephalus tricolor	Capuchinbird	X		
Pipridae				
Tyranneutes virescens	Tiny Tyrant-Manakin			X
Lepidothrix serena	White-fronted Manakin		X	
Manacus manacus	White-bearded Manakin			X
Chiroxiphia pareola	Blue-backed Manakin	X		

Xenopipo atronitens	Black Manakin		X	
Pipra pipra	White-crowned Manakin		X	X
Pipra erythrocephala	Golden-headed Manakin		X	X
Tityridae				
Schiffornis turdina	Thrush-like Schiffornis			X
Pachyramphus polychopterus	White-winged Becard	X		
Pachyramphus surinamus	Glossy-backed Becard			X
Vireonidae				
Cyclarhis gujanensis	Rufous-browed Peppershrike	X		
Vireo olivaceus	Red-eyed Vireo	X	X	
Hylophilus thoracicus	Lemon-chested Greenlet		X	X
Hylophilus pectoralis	Ashy-headed Greenlet	X		
Hylophilus muscicapinus	Buff-cheeked Greenlet			X
Hylophilus ochraceiceps	Tawny-crowned Greenlet			X
Corvidae				
Cyanocorax cayanus	Cayenne Jay	X		
Hirundinidae				
Tachycineta albiventer	White-winged Swallow	X		
Progne chalybea	Gray-breasted Martin	X	X	X
Atticora fasciata	White-banded Swallow			X
Stelgidopteryx ruficollis	Southern Rough-winged Swallow		X	X
Hirundo rustica	Barn Swallow	X	X	
Troglodytidae				
Troglodytes aedon	House Wren	X		
Campylorhynchus griseus	Bicolored Wren	X	X	
Thryothorus coraya	Coraya Wren			X
Thryothorus leucotis	Buff-breasted Wren	X		
Polioptilidae				
Ramphocaenus melanurus	Long-billed Gnatwren		X	X
Polioptila plumbea	Tropical Gnatcatcher	X		
Turdidae				
Turdus leucomelas	Pale-breasted Thrush	X	X	
Turdus fumigatus	Cocoa Thrush			X

Turdus nudigenis	Bare-eyed Thrush	X		
Turdus albicollis	White-necked Thrush	X	X	
Mimidae				
Mimus gilvus	Tropical Mockingbird	X		
Motacillidae				
Anthus lutescens	Yellowish Pipit	X	X	
Thraupidae				
Tachyphonus surinamus	Fulvous-crested Tanager			X
Tachyphonus phoeniceus	Red-shouldered Tanager		X	
Ramphocelus carbo	Silver-beaked Tanager	X		X
Thraupis episcopus	Blue-gray Tanager	X	X	X
Thraupis palmarum	Palm Tanager	X	X	X
Tangara velia	Opal-rumped Tanager			X
Tangara cayana	Burnished-buff Tanager	X		
Dacnis cayana	Blue Dacnis		X	
Cyanerpes nitidus	Short-billed Honeycreeper			X
Cyanerpes cyaneus	Red-legged Honeycreeper			X
Coereba flaveola	Bananaquit	X	X	X
Emberizidae				
Ammodramus humeralis	Grassland Sparrow	X	X	
Emberizoides herbicola	Wedge-tailed Grass-Finch		X	
Sporophila plumbea	Plumbeous Seedeater	X		
Sporophila nigricollis	Yellow-bellied Seedeater	X		
Sporophila minuta	Ruddy-breasted Seedeater	X	X	
Oryzoborus angolensis	Chestnut-bellied Seed-Finch			X
Cardinalidae				
Saltator grossus	Slate-colored Grosbeak			X
Saltator maximus	Buff-throated Saltator			X
Saltator coerulescens	Grayish Saltator	X		
Cyanocompsa cyanoides	Blue-black Grosbeak			X
Parulidae				
Parula pitiayumi	Tropical Parula	X	X	
Geothlypis aequinoctialis	Masked Yellowthroat	X		
Basileuterus culicivorus	Golden-crowned Warbler	X		
Phaeothlypis flaveolus	Flavescent Warbler	X		

Icteridae				
Psarocolius viridis	Green Oropendola		X	X
Psarocolius decumanus	Crested Oropendola			X
Cacicus cela	Yellow-rumped Cacique		X	X
Cacicus haemorrhous	Red-rumped Cacique			X
Icterus cayanensis	Epaulet Oriole		X	
Icterus nigrogularis	Yellow Oriole	X		
Molothrus oryzivorus	Giant Cowbird			X
Sturnella magna	Eastern Meadowlark	X	X	
Fringillidae				
Carduelis cucullata	Red Siskin			
Euphonia finschi	Finsch's Euphonia	X		
Euphonia violacea	Violaceus Euphonia			X
Euphonia cayennensis	Golden-sided Euphonia			X
Total number	**306**	**150**	**137**	**159**

Small Mammals

Burton K. Lim, Chetwynd Osborne, and Abraham Ignace

Introduction

Small mammals are loosely defined as species less than 1 kg in body mass, such as all bats and most rodents and opossums. In lowland tropical areas of South America, this group typically accounts for over half of the mammalian species diversity. There are 222 species of mammals known from Guyana, of which almost 80% are bats, rats, and opossums.

These small mammals are important for conservation because many are seed dispersers and flower pollinators responsible for ecosystem regeneration. Others are primary predators of insects and keep in check these populations that may otherwise do damage to vegetation. Because of their high species diversity, relative abundance, and relative ease of capture, bats in particular are a good taxonomic group for the rapid assessment of biodiversity.

This was the first survey of small mammals in the Kusad Mountain and Parabara areas of the South Rupununi in Guyana. It was conducted from October 23 to November 4, 2013.

Methods

Survey methods for small mammals included the use of Sherman live traps set on the ground and in trees to sample both terrestrial and arboreal rats, mice, and mouse opossums. Line transects were placed in both forest and savannah habitats with traps set approximately 5 metres apart. Larger opossums were targeted with Tomahawk live traps that were strategically set on the ground near large trees with vines leading up to the crowns to increase the chances of encountering animals. There were a total of 1,713 Sherman trap-nights and 20 Tomahawk trap-nights. Traps were checked each morning.

For bats, mist nets were set in the forest understory and at the savannah interface, typically in pairs with a short 6 m mist net set perpendicular to a long 12 m mist net. A triple-high canopy system was used to stack 3 nets on top of each other and set in the savannah at the edge of the forest. Nets were typically opened from 6-10 p.m. and checked on a regular basis approximately every hour. There were a total of 184 net-nights and 11 canopy net-nights.

Voucher specimens will be prepared as dried skins with skulls and skeletons, or as whole animals fixed in 10% formalin with long-term storage in 70% ethanol. These different preparation types maximize the examination of both osteological morphology and soft anatomy. Tissue samples of liver, heart, kidney, and spleen were frozen in liquid nitrogen with long-term storage in a –80 ^{o}C ultra-cold freezer for molecular study. A reference collection will be deposited at the University of Guyana's Centre for the Study of Biological Diversity and the Royal Ontario Museum as documentation of the biodiversity of mammals in the Rupununi savannah and available for research to the international community.

Study Sites

Two primary study sites were surveyed for small mammals. The first site was located in the isolated forested Kusad Mountain area (N2.81245 W59.8666, 125 m elevation) and was surveyed for 6 nights from October 23-28. Three trap lines were set with one about 200 m along a trail in the forest that led to a dry, rocky creek bed with the headwaters originating at the approximately 500 m summit. A second trap line of 100 m was set in the adjacent savanna. The third trap line was 300 m in length and wound its way from the creek beside the camp, through forest and a small patch of forest before ending in an abandoned banana field. Most mist nets were set in the forest than in the savannah.

The second site was situated approximately 10 km north of the Parabara area in savannah beside gallery forest bordering the creek named Bototo Wau (N2.18201 W59.33704, 245 m elevation). It was surveyed for 5 nights from October 31 to November 4. Two trap lines of 100 m were set in savannah on either side of the gallery forest following the wet course of palm trees. There were no trails in the gallery forest but three trap lines of 200-300 m of length were set. Because of the absence of trails, most mist nets were set in the savannah than in the forest.

Results

A total of 36 species were represented by 257 individuals of small mammals. This included 33 species of bats represented by 248 individuals and 3 species of rats documented by 9 individuals. All rats were prepared as voucher specimens to document the small mammal diversity but 75 of the commoner bats were released unharmed.

The short-tailed fruit bat (*Carollia perspicillata*) was the most abundant species caught. It is a primary seed disperser of the colonizing shrub *Piper* that is commonly found in forest gaps or the edge of open areas in savannah. This bat represented about 25% of the total captures in mist nets and was almost 3 times as common as the next species (*Artibeus cinereus*), which is another fruit-eating bat. The next three commonest species belong in the same genus (*Artibeus*) and are all fig specialists. Ten of the bat species were caught only once.

At 9 individuals, the trap success rate of Sherman and Tomahawk traps was low, as is usually typical in lowland areas of the Guiana Shield. It took on average 190 traps to catch one rodent. No opossums were captured and only 1 tegu lizard was caught in the Tomahawk traps. Interestingly, 2 species of the terrestrial spiny rat (*Proechimys*) were caught in the forests of the Kusad Mountain area, whereas 1 species of the short-tailed cane mouse (*Zygodontomys brevicauda*) was caught in the savannas of the Parabara area.

For bats, the Kusad Mountain area documented 21 species represented by 126 individuals and the Parabara area documented 23 species represented by 122 individuals. There were 11 species of bats that were caught at both sites, whereas 10 species were caught in only the Kusad Mountain area and 12 species were caught in only the Parabara area.

Interesting Species

The most interesting species caught was the Orinoco sword-nosed bat (*Lonchorhina orinocensis*), which represents the first record in Guyana and a distributional range extension of approximately 700 km. This species was previously known from the savannahs of Venezuela

and Colombia. It is listed as vulnerable on the IUCN Red List of Threatened Species because of declining populations and threatened habitats. Sword-nosed bats are insectivorous species.

Another savannah endemic species (*Glossophaga longirostris,* nectar-feeding bat) was caught at the Kusad Mountain area. The short-tailed cane mouse (*Zygodontomys brevicauda*) also occurs in only savanna habitats. All other species of small mammals caught are also commonly found in typical lowland rainforest of Guyana.

A notable observation was the increasing species accumulation on a daily basis except for the last night, which was affected by rain and the nets were closed early at 8:30 p.m. Not surprisingly considering the short duration, this indicates that the survey at each site was not complete.

Conservation Recommendations

There was a distinction in small mammal diversity between the Kusad Mountain area and the Parabara area. About half of the species were not recorded at the other site, which suggests a difference between the isolated forest within savannah habitat of Kusad and the savannah within gallery forest habitat of Parabara. Coupled with the rising species accumulation curve, this suggests that more surveying is required to better understand the biodiversity of the savannas.

The first documentation of the Orinoco sword-nosed bat in Guyana indicates that there is undiscovered species diversity to be found in the South Rupununi. However, the savannahs of Venezuela and Colombia are different with more exposed rocky outcrops and caves where this species roosts. Its habitat requirements in Guyana need to be studied to reassess the conservation status of this vulnerable species.

Table 7. Preliminary Checklist of Small Mammals from the South Rupununi, Guyana

Species	Kusad	Parabara	Total
BATS:			
Carollia perspicillata	40	37	77
Artibeus cinereus	21	7	28
Artibeus lituratus	0	21	21
Artibeus planirostris	11	8	19
Artibeus gnomus	0	13	13
Phyllostomus discolor	5	5	10
Glossophaga soricina	9	0	9
Phyllostomus elongatus	6	1	7
Sturnira lilium	4	3	7
Glossophaga longirostris	6	0	6
Phyllostomus hastatus	2	4	6
Trachops cirrhosus	6	0	6
Artibeus concolor	0	4	4
Desmodus rotundus	4	0	4

Lophostoma silvicolum	1	2	3
Micronycteris megalotis	2	1	3
Rhinophylla pumilio	0	3	3
Choeroniscus minor	0	2	2
Micronycteris minuta	1	1	2
Mimon crenulatum	0	2	2
Molossus molossus	0	2	2
Myotis riparius	1	1	2
Saccopteryx bilineata	2	0	2
Ametrida centurio	0	1	1
Artibeus obscurus	0	1	1
Carollia brevicauda	1	0	1
Eptesicus furinalis	1	0	1
Lonchorhina orinocensis	1	0	1
Mesophylla macconnelli	0	1	1
Phylloderma stenops	0	1	1
Pteronotus parnellii	1	0	1
Saccopteryx leptura	1	0	1
Uroderma bilobatum	0	1	1
Total	**126**	**122**	**248**
RODENTS:			
Proechimys cuvieri	3	0	3
Proechimys guyannensis	4	0	4
Zygodontomys brevicauda	0	2	2
Total	**7**	**2**	**9**

Large Mammals

Evi A.D. Paemelaere, Diana Fernandes, Leroy Ignacio, and Angelbert Johnny

Introduction

Large mammals constitute a major source of protein in the Rupununi Region of Guyana, where communities still live a mostly traditional lifestyle of fishing and hunting. More recently, an additional role of mammals in local livelihoods has emerged. As the (eco-) tourism sector in the Region started growing in the 90's larger mammals have become one of the main attractions for international visitors to the Rupununi. Considering hunting often drives depletion or even local extinction of mammalian populations (Peres 1990, Redford 1992, Cullen Jr et al. 2000, Hill et al. 2003), understanding the diversity and monitoring of these species is essential for both traditional and modern local livelihoods. Importantly, monitoring of large mammal species can also serve as a tool for assessing overall ecosystem function integrity. Particularly the larger species require large areas and large quantities of food, and they reproduce slowly, thus rendering them particularly sensitive to hunting and other disturbances by humans (Purvis et al. 2000, Brashares 2003, Cardillo et al. 2004).

Large mammal camera trap surveys were conducted in the North and South Rupununi savannahs in 2011 and 2012 (Paemelaere and Payán Garrido 2012, Payán et al. 2013). In addition, non-volant mammal surveys have been conducted in the Kanuku Mountains (M. Hallett, Pers. Comm.). Primate surveys, on the other hand, have mostly focused on the northern half of the country only as far south as Iwokrama (Sussman and Phillips-Conroy 1995, Lehman et al. 2006). Together with local knowledge of hunters and tourist guides, the diversity of larger mammals in the general area is well known. These studies indicated that the Rupununi Region remains a stronghold for some threatened species, such as giant anteater (*Myrmecophaga tridactyla*), Brazilian tapir (*Tapirus terrestris*), and jaguar (*Panthera onca*). Nevertheless, the Rupununi has a highly diverse habitat, and still much research is needed to fully understand the spatial variability in species distribution and the potential effects of hunting on mammals. Furthermore, some of the more elusive species have not, or only rarely, shown up in camera trap studies or sightings by locals. These include for example giant armadillo (*Priodontes maximus*), bush dog (*Speothos venaticus*), oncilla (*Leopardus tigrinus*), and badger (*Galictis vittata*); species that are generally poorly known.

Kusad Mountain is a forested island of about 50 km^2 amid savannah. The surrounding villages of Potarinau, Sawariwau and Katoonarib hunt and farm on Kusad, each in their own section. The combined population of the villages is about 1600 individuals. These villages have fewer hunting areas available than most others Amerindian communities, which are located mostly at the savannah-forest edge. Nevertheless, hunting may still be sustainable, considering the large proportion of fish and livestock in people's diet. The Parabara area includes a savannah island surrounded by continuous forest and gallery forests. In the Parabara area, a similar sized human population uses the land, but due to the extensive forest, this pressure may be spatially diluted. The villagers of the South Rupununi are definitely aware of their potential impact on wildlife, and they produced a land-use management proposal (DTC 2012). Kusad Mountain is thought of as a link in a wildlife corridor from Brazil to the Kanukus (N. Fredericks, Pers. Comm.), and the Parabara area is part of the proposed Karaodaz Conserved Area. The management proposal not

only refers to hunting locations (sinks) but also to protected breeding populations (sources): "Protect hunting and multiplying grounds and wildlife sites in mountain areas". Our study of large mammals at Kusad and Parabara offers a reference for future studies on the diversity and abundance of larger mammals important in local livelihoods and in assessing conservation value of the areas.

Methods

We used camera traps (Cuddeback Capture) for detection of mammals > 1kg. For these larger land vertebrates, camera trapping is considered the best method for surveying (Rowcliffe *et al.* 2008, Diaz-Pulido & Payán 2011). Photographs from the motion-triggered cameras provide information on the species and its time and location of activity. We set one camera per station along existing walking trails with 450-600 m straight line distance between stations. Sites with wildlife trails or creek beds along the trails were given preference. During camera trapping we opportunistically recorded animal tracks and live sightings of terrestrial mammals and monkeys.

Kusad Mountain – We set 20 camera trap stations along existing trails along the northeastern section of Kusad Mountain (Figure 1). The first trail gave walking access to two farm houses, one of which was recently abandoned. This trail started at the mountain foot and went up a steep rocky hill along a creek in the valley below. The trail crossed creeks three times before reaching a small savannah area and climbing further through forest to the top. The second trail continued through forest from the top down the other side of the mountain. The last part of the trail was very steep and rocky and no additional cameras were set here. The third trail ran along the mountain foot of the same peak, passing through savannah between this peak and a smaller somewhat isolated hill to the north of Kusad. In a cave at the start of the trail, two cameras were set up to cover different angles of the large chamber.

Parabara area – Here, we set 19 stations along two trails that were cut in August 2012 (Figure 2). One trail started in the isolated savannah by Parabara, passing through forest fingers along creeks into the forest towards Hungry Mountain, which continues to the Amazon. The other trail branched off to the south-east towards another unnamed mountain.

Data analysis

Independent photographs from camera traps will be identified to species and considered as single occurrences for estimating relative abundance of species sensu O'Brien (2003). To assess completeness of the survey rarefaction curves will be produced with EstimateS (Colwell 2006). Additionally, species richness and diversity will be estimated. Provided a sufficient number of photographs is available of uniquely identifiable species, such as jaguars and ocelots, populations densities will be calculated (Karanth *et al.* 2002, Wallace *et al.* 2003), using closed populations models in CAPTURE (Otis *et al.* 1978, White *et al.* 1982, Rextad & Burnham 1991).

Results

Camera traps will be collected at the end of November 2013. Preliminary results can be reported based on tracks and live sightings. The number of live sightings was very low at both locations.

Kusad

Savannah fox (*Cerdocyon thous*) were observed by the team on several occasions. No other verifiable sightings of terrestrial mammals were recorded for this site. Howler monkeys (*Alouatta seniculus*) could be heard daily, but were never seen. The pungent scent of spider monkeys (*Ateles paniscus*) was noticeable along the trail, but we did not observe any individuals. Along the trail, the density of wildlife trails appeared to increase as we approached the top, where the habitat was less rocky and hills were less steep. We found one seemingly active burrow of a giant armadillo there. Multiple sites with tracks of collared peccary (*Pecari tayacu*) and one with white-lipped peccary (*Tayassu pecari*) were seen before the rocky creek outcrop. Beyond the outcrop, several small creeks were crossed and in the mud alongside the creeks we detected tracks of red brocket deer (*Mazama americana*), Brazilian tapir (*Tapirus terrestris*), agouti ('acury'; *Dasyprocta leporina*), and paca ('labba'; *Cuniculus paca*). One track of giant anteater (*Myrmecophaga tridactyla*) was seen near the top. In the savannah, we noticed prints of brocket deer, tapir, and paca in a dense bush near a dried up water source. Old scat of jaguar was found along the savannah trail and in two separate caves. We also recorded a scrape mark of a giant anteater on the trunk of a caimbe tree (*Curatella americana*) along this trail.

Parabara

Live sightings in the Parabara area included a savannah fox and a red brocket deer along the main road to the village, and a labba on the camera trap trail at night. A kinkajou (*Potos flavus*) was heard by the team. Some team members reported a sighting of capuchin monkeys (*Cebus sp*.) near the camp and golden hand tamarins (*Saguinus midas*) by Parabara village. Howler monkeys could be heard in the distance, but were not observed during the survey. Tracks along the forest trail were limited in contrast to the rather high density of wildlife trails, which appeared to be mostly armadillo (*Dasypus* sp.) trails. Scratch marks of armadillo were common. In the savannah-forest edge, we detected many more tracks and signs of mammals, including feeding spots of labba, scrape marks and scat of jaguar, and tracks of tapir and red brocket deer. Along the vehicle road to Parabara in the continuous forest we found tracks of jaguar, deer and agouti.

Discussion

Preliminary results indicated the presence of some disturbance sensitive species at both sites. Tapir and white lipped peccary are particularly sensitive to hunting (Bodmer 1995, Peres 2000). White lipped peccaries were recently re-listed to endangered (Altrichter et al. 2012). Because these animals live in large social groups in very large territories, they are not always easy to detect. They were recorded by cameras in the eastern Kanukus (Sanderson & Ignacio 2002), but not in a recent study in the western Kanukus (M. Hallett, Pers. Comm), or in the north or south savannahs (Paemelaere & Payán Garrido 2012, Payán et al. 2013). Other disturbance sensitive species detected included the jaguar and giant armadillo. As top predator, requiring large amounts of habitat with large quantities of prey, the jaguar offers a good proxy for overall wildlife density and ecosystem integrity (Purvis et al. 2000, Carbone and Gittleman 2002, Crooks 2002, Sanderson et al. 2002, Cardillo et al. 2004, Cardillo et al. 2005), particularly in areas where no domestic livestock is available as an alternative food source, as was the case in the Parabara area. These preliminary results thus hint at sustainable hunting pressure in both

areas.

At Kusad, tracks were mostly seen at the forest-savannah edge by the mountain foot and in the open forest near the top of the mountain. Similarly, in Parabara, tracks were most commonly seen at the savannah-forest edge. Our guides informed us that few trees are fruiting in the forest at this time, leaving the ité palm (*Mauritius flexuosa*), which lines the savannah creeks, as the major food source, thus mobilizing animals into these areas. This may also partially explain the low number of monkey sightings, and prevents us from any inferences on the effects of isolation of forest at Kusad or hunting pressure on monkeys in the Parabara area based on this single, short-term survey.

Because the trails were mostly covered in thick leaf litter, or rocks, rendering quantitative tracking difficult, and leading us to collect tracks opportunistically with special focus on the muddy areas along creeks and sandy trails in the savannahs. Tracks also tend to be biased towards ungulates and the largest mammals. The species list based on tracks is thus far from complete and does not provide information on abundance of the detected species. The camera trap photographs will provide quantitative data on diversity and abundance from which we will be able to draw more detailed conclusions on the status of the areas and from which we can make conservation recommendations.

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Table 8. Overview of species detected through opportunistic recordings of tracks in comparison with species detected elsewhere.

Scientific name	**Local Name**	**Preliminary Results based on tracks**		**North/South**	**East**	**West**
Rodentia						
Proechimys sp	Spiny rat sp				x	x
Sciurus aestuans	Guaianan squirrel					x
Myoprocta exilis	Green Acouchy				x	x
Dasyprocta leporina	Agouti (Acuri)	x	x	x	x	x
Cuniculus paca	Paca (Labba)	x	x	x	x	x
Hydrochoerus hydrochaeris	Capybara			x	x	
Marsupialia						
Didelphis marsupialis	Common opossum			x	x	x
Philander opossum	Grey 4-eyed opossum				x	x
Xenarthra						
Dasypus novemcinctus	9-banded armadillo (Capache/Ayce)	x	x	x	x	x
Dasypus kappleri	Great long-nosed armadillo				x	
Priodontes maximus	Giant armadillo	x	x		x	x
Tamandua tetradactyla	Tamandua			x	x	x
Myrmecophaga tridactyla	Giant anteater	x		x		x
Artiodactyla						
Mazama americana	Red brocket deer (Bush deer)	x	x	x	x	x
Mazama	Grey brocket				x	x

gouazoubira	deer					
Odocoileus virginianus	White-tailed deer	x		x	x	
Pecari tajacu	Collared peccari	x	x	x	x	x
Tayassu pecari	White-lipped peccary	x			x	x
Perissodactyla						
Tapirus terrestris	Tapir (Bush cow)	x	x	x	x	x
Carnivora						
Cerdocyon thous	Savanna fox	x	x	x	x	
Speothos venaticus	Bush dog				x	
Nasua nasua	Coati			x	x	x
Procyon cancrivorus	Crab-eating raccoon			x		
Eira barbara	Tayra			x	x	x
Gallictis vittata	Grison				x	x
Leopardus tigrinus	Oncilla			x	x	
Leopardus wiedii	Margay			x	x	
Leopardus pardalis	Ocelot (Labba tiger)			x	x	
Puma yaguoaroundi	Jaguarundi				x	
Puma concolor	Puma (Deer tiger)			x	x	
Panthera onca	Jaguar (Tiger)	x	x	x	x	

Water Quality

Denise Simmons and Nelanie La Cruz

Introduction

It has been noted that the Rupununi savannah is a unique and diverse ecosystem within Guyana that includes many species that are endangered globally. Despite this, there is a lack of scientific information in the Southern Rupununi, and while the region has been relatively protected by its isolation, there is increasing interest in the area.

A Biodiversity Assessment Team (BAT) expedition to the Southern Rupununi was executed during the period from October 23 to November 5, 2013 and a water quality survey was a component of the biodiversity assessment.

Water is an invaluable natural resource. Water is used for numerous purposes by humans and it supports diverse aquatic species. An assessment of water quality is important not only because it provides an indication of the status (in terms of the physical and chemical characteristics) of the water bodies, but it also provides information for the researchers conducting the surveys of aquatic taxonomic groups since physical and chemical characteristics govern the development of aquatic biotic in surface waters (Meybeck and Helmer 1996).

The waters, creeks and wetlands of the Southern Rupununi are used by the indigenous peoples for domestic purposes, including drinking and food preparation, among others; as such, a water quality assessment identifies whether the waters are safe for this purposes. Moreover, this water quality survey contributes to the limited baseline data available that should be considered in the establishment of water quality standards for surface waters in Guyana and the management of water resources.

Study sites

The water quality survey was conducted in the Kusad Mountains over the period from October 24 to 29, 2013 and from October 31 to November 5, 2013 in the Parabara area. The water bodies surveyed included savannah and forest creeks, savannah ponds and a marsh, and tributaries of the Takatu and Kuyuwini Rivers. A total of eighteen sample sites/water bodies were targeted with a total of fifty-one sample locations.

There were nine sample sites in the Kusad Mountains area. Sampling was conducted at 26 locations at the sampling sites as indicated below:

- Takatu River at Lukanani landing - 1 location;
- Mokorowau – 3 locations;
- Black Huri Lake (Suzukarishii) – 4 locations;
- Ants Creek (Zaidowau) – 4 locations;
- Small Sand Creek (Katowau) – 7 locations;
- Dadawau – 2 locations;
- Matobanwau – 1 location;
- Tarayara Creek – 3 locations; and

- Cocosabana Lake (Tawro Lake) – 1 location.

In addition to the Takatu River, the sample sites in the Kusad Mountains area consisted of creeks in the savannah (Ants Creek, Small Sand Creek and Dadawau), forests creeks, sampled at the lower parts of the mountains (Mokorowau and Tarayara Creek) and ponds (Black Huri Lake and Cocosabana Lake).

In the Parabara area, there were nine sample sites, from which there were 25 locations at which sampling was conducted as indicated below:

- Mushaiwau – 3 locations;
- Wiriwiriwau – 2 locations;
- Kuyuwini River – 6 locations;
- Marudi Creek (mouth) – 1 location;
- Lmy Creek – 1 location;
- Tiger head Creek - Kohmara Fitho – 1 location;
- Unnamed creek - Old man's farm, Henry's mouth – 1 location;
- Bototowau – 5 locations; and
- unnamed creek – 5 locations.

In addition to the Kuyuwini River, the sample sites in the Parabara area consisted of creeks in gallery forests (Mushaiway, Wiriwiriwau, Bototowau), a marsh, and tributaries of the Kuyuwini River (Marudi Creek, Lmy Creek, Tiger head Creek).

Methods

The physical and chemical characteristics of the waters in the survey sites were assessed through the measurement of the following physical and chemical parameters: temperature, pH, dissolved oxygen, conductivity, total dissolved solids (TDS), turbidity, oxygen demand, nutrients and metals. A Hach portable multi-parameter meter was used to measure temperature, pH, dissolved oxygen, conductivity and TDS in the field. Turbidity was also measured in the field using a Hach portable turbidimeter. At selected sites, water samples were collected and stored for the analysis of oxygen demand, nutrient and metal to be conducted at a later date in the laboratory; these samples were acidified and stored at temperatures below 4 ^{o}C.

Preliminary Results

The pH of the sampled waters in the Southern Rupununi ranged from 5.03-7.96. In the Kusad Mountains and Parabara area, the pH of the sampled water ranged from 5.03 to 7.96 and 5.46 to 6.46, respectively. In the study sites, the ponds and the isolated/stagnant parts of small creeks had the lower pH values, while the rivers had the higher values. The dissolved oxygen values for the two study sites ranged from 1.11 to 7.84 mg/L, with the dissolved oxygen ranging from 1.51 to 7.84 mg/L in the Kusad Mountains and from 1.11 to 6.36 mg/L in the Parabara area. The lower values were generally found in the ponds and isolated/stagnant small creeks. The highest dissolved oxygen reading of 7.84 mg/L was in the Kusad Mountains area where the water was in free fall over some rocks. The highest dissolved oxygen reading in the Parabara area (6.36 mg/L) was the mouth of the Marudi Creek. The conductivity of the sampled waters ranged from 4.49 to 68.10 µS/cm. Turbidity of the waters sampled ranged from 0.54 to 154.00 NTU; in the Kusad

Mountains and Parabara areas the measured turbidity ranged from 1.69 to 129.00 NTU and from 0.54 to 154.00 NTU, respectively. The lowest turbidity values were associated with the pond and marsh and isolated/stagnant parts of small creeks. The water bodies with the highest turbidity levels in both study sites were those where there was human activity, namely the Cocosabana Lake and the mouth of the Marudi Creek. In fact, if the turbidity levels for these two water bodies are discounted, then the highest turbidity values measured in the Kusad Mountains and Parabara areas would have been in Takatu and Kuyuwini Rivers, respectively.

Preliminary Discussion and Recommendations

The preliminary results of the water quality survey indicate that except for a few water bodies, most of the water bodies are free from intensive anthropogenic disturbance. The low pH values of the sampled waters indicate that they are slightly acidic which is characteristic of rivers and creeks of Guyana. The isolated sections of small creeks and ponds and marshes had low levels of dissolved water due to the fact that they were lentic and in some instances had high inputs of leaf litter. Most of the small creeks, ponds and marsh were clear (with turbidity levels of < 12 NTU). Of significance were the high turbidity levels measured in two water bodies that were possibly due to the proximity to human activity; there was a livestock farm in the vicinity of the Cocosabana Lake and mining activities occurring in the upper reaches of the Marudi Creek. Given the limited water quality information available on the Southern Rupununi, this survey has provided valuable information. Importantly, it provides scientific information that could be used by the indigenous peoples of the South Rupununi in the management of their waters, creeks and wetlands as articulated in their plan for the case of Wapichan territory in Guyana (DTC 2012).

Notwithstanding the useful information contain herein from this survey, one can only pronounce on the health of the water bodies at one point in time. Therefore, it is recommended that this water quality survey be repeated in the dry season and also extended to the wet season to observe the seasonal variations in parameters. In fact, this survey could form the basis for the establishment of a water quality monitoring system that would provide information to detect trends in water quality and identify the cause(s) of the trends/changes. In addition, in light of the threat of mining, there should be an assessment of the mercury levels in the water, sediment, and fish of the Kuyuwini River, in particular. These water quality data will be compared to the other limited water quality information available for the same or other water bodies of the Southern Rupununi in an effort to detect commonalities.

Acknowledgments

We thank our two local guides, Paul Francis (resident of Potarinau) and Alcido Isaacs (resident Karaudarnaua) for assistance with water quality sampling.

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Table 9. Water Quality Measurements for Kusad Mountains.

Sample Point Location #	Collection site ID	Name of water body	Location of sampling point	Description of sampling point	Date	Time	Weather condition	Temp (°C)	pH	DO (mg/L)	DO (% sat)	Cond (uS/cm)	TDS (mg/L) as NaCl	Turb (NTU)	Remarks
1	GY-131024-001-KM	Takatu River at Lukanani landing	N02° 50.155' W 059° 59.429'	River, fast current, above rapids	24-Oct-13	8:00	sunny	29.0	7.12	6.65	87.7			25.20	
2	GY-131024-002-KM	Mokorowau, upstream of camp at Kusad Mountains	N02° 48.720' W59° 52.004'	Creek, clear water, overhanging vegetation	24-Oct-13	15:57	sunny	28.4	6.90	7.01		54.70	26.20	9.18	
3	GY-131024-003-KM	Mokorowau, further upstream of camp at Kusad Mountains	N02° 48.566' W59° 51.908'	Creek, clear water, flowing over rocks at the bottom of a sloping rock	24-Oct-13	16:40	sunny	27.1	7.63	7.65	99.1	60.00	28.70	6.76	
4	GY-131025-004-KM	Black Huri Lake (Suzukarishii)	N02° 49.747' W059° 48.320'	Lake that contained rooted vegetation	25-Oct-13	7:00	sunny	29.3	5.03	5.32	70.3	6.00	3.45	1.69	
5	GY-131025-005-KM		N02° 49.767' W059° 48.259'		25-Oct-13	7:35	sunny	29.9	5.21	5.12	68.7	5.02	2.30	3.92	
6	GY-131025-006-KM		N02° 49.889' W059° 48.295'		25-Oct-13	8:10	sunny	30.5	5.55	6.36	85.5	4.49	2.03	2.51	
7	GY-131025-007-KM		N02° 49.865' W059° 48.354'		25-Oct-13	8:40	sunny	30.6	5.60	6.41	87.0	5.45	2.49	1.71	
8	GY-131025-008-KM	Ants Creek (Zaidowau)	N02° 49.736' W059° 48.557'	Creek, almost stagnant, moss in water, ite palms lining the creek	25-Oct-13	10:20	sunny	28.9	5.44	2.74	37.0	11.41	5.82	6.89	Creek was disconnected from downstream section

Sample Point Location #	Collection site ID	Name of water body	Location of sampling point	Description of sampling point	Date	Time	Weather condition	Temp (°C)	pH	DO (mg/L)	DO (% sat)	Cond (uS/cm)	TDS (mg/L) as NaCl	Turb (NTU)	Remarks
9	GY-131025-009-KM	Ants Creek (Zaidowau), downstream	N02° 49.863' W059° 48.632'	Creek, almost stagnant, moss and moca moca vegetation in the water, Ite palms lining creek	25-Oct-13	11:03	sunny	34.0	5.89	4.83	69.9	13.57	6.19	4.32	
10	GY-131026-010-KM	Small Sand Creek (Katowau), at Saddle Mountain crossing	N02° 53.437' W059° 51.043'	Creek, almost stagnant, downstream of water flowing over rock in the water	26-Oct-13	8:12	sunny	30.5	6.68	6.47	87.1	17.50	8.11	19.99	
11	GY-131026-011-KM		N02° 53.419' W059° 51.087'	Creek, flowing, downstream of point GY-131026-010-KM	26-Oct-13	8:42	sunny	30.7	6.67	6.50	87.8	17.40	8.11	19.50	
12	GY-131026-012-KM		N02° 53.426' W059° 51.142'	Creek, flowing, downstream of water flowing over rocks and downstream of sample point GY-131026-011-KM	26-Oct-13	9:15	sunny		6.96	7.21	98.8	17.35	8.06	18.60	
13	GY-131026-013-KM		N02° 53.400' W059° 51.066'	Creek, flowing, upstream of actual rocks and sample point GY-131026-010-KM	26-Oct-13	10:55	sunny	31.8	6.77	6.52	90.5	19.24	9.96	19.40	

Sample Point Location #	Collection site ID	Name of water body	Location of sampling point	Description of sampling point	Date	Time	Weather condition	Temp (°C)	pH	DO (mg/L)	DO (% sat)	Cond (uS/cm)	TDS (mg/L) as NaCl	Turb (NTU)	Remarks
14	GY-131026-014-KM	Small Sand Creek (Katowau) upstream of Saddle Mountain crossing at Kodowidpau downstream	N02° 52.499' W059° 49.828'	Creek, fast current, downstream of water flowing over a rock in the creek	26-Oct-13	11:20	sunny	32.4	6.79	6.76	95.2	20.97	9.77	22.40	
15	GY-131026-015-KM	Small Sand Creek (Katowau) upstream of Saddle Mountain crossing at Kodowidpau upstream	N02° 52.468' W059° 49.808'	Creek, fast current, upstream of a rock outcrop in the creek	26-Oct-13	12:50	sunny	34.4	6.70	6.60		17.64	8.22	22.20	
	GY-131027-016-KM	Takatu River at Lukanani landing	N 02° 50.152' W 059° 59.442'	River, fast current, above rapids, water at lower level than sample GY-131024-001-KM and aquatic vegetation visible	27-Oct-13	8:45	sunny	30.4	6.78	6.41	86.4	31.80	14.89	22.00	

Sample Point Location #	Collection site ID	Name of water body	Location of sampling point	Description of sampling point	Date	Time	Weather condition	Temp (°C)	pH	DO (mg/L)	DO (% sat)	Cond (uS/cm)	TDS (mg/L) as NaCl	Turb (NTU)	Remarks
16	GY-131027-017-KM	Dadawau	N02° 50.571' W059° 59.102'	Creek flowing to Takatu River, clear water, flowing slowly, down stream of a vehicle (rock) crossing in the creek, moca moca vegetation in creek	27-Oct-13	10:15	sunny	29.1	6.27	4.89	65.4	14.32	6.65	3.04	
17	GY-131027-018-KM		N02° 50.545' W059° 59.108'	Creek flowing to Takatu River, clear water, appeared stangnant, upstream of a vehicle (rock) crossing in the creek, moca moca vegetation in creek	27-Oct-13	10:40	sunny	28.6	6.14	3.64	48.5	14.86	6.90	1.92	
18	GY-131027-019-KM	Matobanwau near discharge into Takatu River	N02° 50.042' W059° 59.432'	Creek flowing to Takatu River, steep sides, overhanging vegetation, leaf litter in water, steep sides	27-Oct-13	11:30	sunny	32.2	7.01	6.80	95.2	24.60	11.46	21.00	

Sample Point Location #	Collection site ID	Name of water body	Location of sampling point	Description of sampling point	Date	Time	Weather condition	Temp (°C)	pH	DO (mg/L)	DO (% sat)	Cond (uS/cm)	TDS (mg/L) as NaCl	Turb (NTU)	Remarks
	GY-131027-020-KM	Mokorowau, sample as sample point GY-131024-003-KM			27-Oct-13	15:38	sunny	27.4	7.96	7.84	100.8	52.90	24.80	7.38	
19	GY-131027-021-KM	Mokorowau, upstream of sample point GY-131027-020-KM	N 02° 48.539' W 059° 51.907'	Nearly isolated pool in lip of sloping rock	27-Oct-13	16:00	sunny	25.6	7.13	7.56	95.0	51.10	24.20	7.97	
	GY-131027-022-KM	Mokorowau, sample as sample point GY-131024-002-KM	N02° 48.596' W059° 51.948'		27-Oct-13	16:40	sunny	27.1	7.06	7.02	90.2	53.70	25.20	8.13	
20	GY-131028-023-KM	Tarayara Creek	N 02° 47.408' W 059° 54.007'	Creek, steep sides, water clear, overhanging vegetation, leaf litter, water flowing very slowly, shalllow	28-Oct-13	8:54	sunny	26.5	5.93	2.47	31.3	67.50	31.70	14.40	
21	GY-131028-024-KM		N 02° 47.417' W 059° 54.042'	Creek, steep sides, water brown, overhanging vegetation, leaf litter, water flowing very slowly, almost stgnant	28-Oct-13	9:20	sunny	25.9	6.29	1.51	19.0	64.40	30.30	16.80	

Sample Point Location #	Collection site ID	Name of water body	Location of sampling point	Description of sampling point	Date	Time	Weather condition	Temp (°C)	pH	DO (mg/L)	DO (% sat)	Cond (uS/cm)	TDS (mg/L) as NaCl	Turb (NTU)	Remarks
22	GY-131028-025-KM		N 02° 47.430' W 059° 54.063'	Creek, steep sides,water brown, overhanging vegetation, leaf litter, water flowing very slowly	28-Oct-13	9:42	sunny	26.0	6.40	3.84	48.0	68.10	32.00	11.30	
23	GY-131028-026-KM	Cocosabana Lake (Tawro Lake)	N 02° 51.197' W 059° 55.337'	Lake containing standing vegetation, water murky	28-Oct-13	10:36	sunny	29.5	6.61	3.50	46.6	26.00	12.22	129.00	pigs were in the lake, lake was next to a holding pen for livestock
24	GY-131028-027-KM	Small Sand Creek (Katowau) downstream of Saddle Mountain crossing at Masorode	N 02° 53.714' W 059° 51.351'	Creek, flowing, downstream of water flowing over rocks (rapids) and downstream of sample point GY-131026-011-KM	28-Oct-13	12:03	sunny	31.6	6.81	6.83	95.1	21.92	10.22	17.20	
25	GY-131028-028-KM	Ants Creek (Zaidowau), downstream of sample point GY-131025-009-KM	N 02° 49.806' W 059° 48.614'	Creek, almost stagnant, moca moca vegetation in the water, Ite palms lining creek	28-Oct-13	17:25	sun was beginning to set	29.8	5.88	3.46	46.5	14.88	6.91	3.96	

Sample Point Location #	Collection site ID	Name of water body	Location of sampling point	Description of sampling point	Date	Time	Weather condition	Temp (°C)	pH	DO (mg/L)	DO (% sat)	Cond (uS/cm)	TDS (mg/L) as NaCl	Turb (NTU)	Remarks
26	GY-131028-029-KM	Ants Creek (Zaidowau), downstream of sample point GY-131023-028-KM	N 02° 50.764' W 059° 49.255'	Creek, almost stagnant, moca moca vegetation in the water, Ite palms lining creek	28-Oct-13	17:45	sun was beginning to set	27.9	6.20	5.13	66.8	27.80	12.54	5.55	

Table 10. Water Quality Measurements for Parabara area.

Sample Point Location #	Collection site ID	Name of water body	Location of sampling point	Description of sampling point	Date	Time	Weather condition	Temp (°C)	pH	DO (mg/L)	DO (% sat)	Cond (uS/cm)	TDS (mg/L) as NaCl	Turb (NTU)	Remarks
1	GY-131031-001-PB	Mushaiwau	N 02° 09.564' W059° 17.557'	Creek, water flowing fairly quickly around a rock in the water, upstream of bridge crossing creek	31-Oct-13	9:25	sunny	24.9	6.22	5.63	71.0	19.86	9.24	24.2	Gallery forested area - forest vegetation lining creek
2	GY-131031-002-PB		N 02° 09.591' W 059° 17.539'	Creek, water flowing fairly quickly, overhanging vegetation, upstream of Kamudi Creek (Packbywau)	31-Oct-13	10:00	sunny	24.9	6.27	5.76	72.0	21.76	10.14	21.2	Gallery forested area - forest vegetation lining creek
3	GY-131031-003-PB		N 02° 09.562' W059° 17.567'	Creek water flowing fairly quickly, downstream of bridge crossing creek	31-Oct-13	10:45	sunny	25.2	6.12	5.74	72.0	19.64	9.14	18.8	Gallery forested area - forest vegetation lining creek

Sample Point Location #	Collection site ID	Name of water body	Location of sampling point	Description of sampling point	Date	Time	Weather condition	Temp (°C)	pH	DO (mg/L)	DO (% sat)	Cond (uS/cm)	TDS (mg/L) as NaCl	Turb (NTU)	Remarks
4	GY-131031-004-PB	Wiriwiriwau	N 02° 09.050' W 059° 16.252'	Creek, water flowing fairly quickly, overhanging vegetation, upstream of bridge crossing creek	31-Oct-13	12:05	sunny	24.8	6.15	6.14	76.9	20.09	9.35	18.4	Gallery forested area - forest vegetation lining creek
5	GY-131031-005-PB		N 02° 09.069' W 059° 16.262'	Creek, water flowing fairly quickly, overhanging vegetation, downstream of bridge crossing creek	31-Oct-13	12:22	sunny	24.8	6.16	6.18	77.4	19.63	9.14	18.8	Gallery forested area - forest vegetation lining creek
6	GY-131101-006-PB	Kuyuwini River	N 02° 05.763' W 059° 14.458'	River, rapid current, at landing on the left bank of river	1-Nov-13	9:20	sunny	31.5	6.35	5.73	72.4			28.9	Forested area - forest vegetation lining river
7	GY-131101-007-PB	Marudi Creek (mouth)	N 02° 04.725' W 059° 11.198'	Creek, water flowing slowly, overhanging vegetation, water is murky and has high sediment load	1-Nov-13	11:35	sunny	24.7	6.46	6.36	79.6	25.30	11.79	154	Forested area - forest vegetation lining Creek. Mining is being done in the creek

Sample Point Location #	Collection site ID	Name of water body	Location of sampling point	Description of sampling point	Date	Time	Weather condition	Temp (°C)	pH	DO (mg/L)	DO (% sat)	Cond (uS/cm)	TDS (mg/L) as NaCl	Turb (NTU)	Remarks
8	GY-131101-008-PB	Kuyuwini River, downstream of Marudi Creek		River, rapid current	1-Nov-13		sunny	26.3	6.36	5.66	72.5	19.69	9.17	32.7	Forested area - forest vegetation lining river
9	GY-131101-009-PB	Kuyuwini River, downstream of sample point GY-131101-008-PB	N 02° 04.541' W 059°11.131'	River, rapid current	1-Nov-13	12:20	sunny	29.3	6.41	5.77	76.2	18.53	8.62	27.3	Forested area - forest vegetation lining river
10	GY-131101-010-PB	Lmy Creek, upstream of Marudi Creek	N 02° 04.575' W 059°11.514'	Creek, water flowing slowly, overhanging vegetation	1-Nov-13	13:05	sunny	26.3	6.21	5.35	69.2			27.0	Forested area - forest vegetation lining creek
11	GY-131101-011-PB	Kuyuwini River, upstream of Lmy Creek	N 02° 04.649' W 059° 11.974'	River, rapid current	1-Nov-13	13:45	sunny	27.0	6.34	5.45	71.3			39.4	Forested area - forest vegetation lining river
12	GY-131101-012-PB	Tiger head Creek - Kohmara Fitho, upstream of sample point GY-131101-011-PB	N 02° 04.703' W 059°13.282'	Creek, water flowing slowly, overhanging vegetation	1-Nov-13	14:40	sunny	25.0	6.08	5.34	68.5			32.6	Forested area - forest vegetation lining creek

Sample Point Location #	Collection site ID	Name of water body	Location of sampling point	Description of sampling point	Date	Time	Weather condition	Temp (°C)	pH	DO (mg/L)	DO (% sat)	Cond (uS/cm)	TDS (mg/L) as NaCl	Turb (NTU)	Remarks
13	GY-131101-013-PB	Kuyuwini River, upstream of Tiger head Creek	N 02° 05.088' W 059° 13.317'	River, rapid current	1-Nov-13	15:00	sunny	29.1	6.34	5.45	70.5			32.0	Forested area - forest vegetation lining river
14	GY-131102-014-PB	Kuyuwini River, upstream of landing	N 02° 05.906' W 059° 14.931'	River, rapid current	2-Nov-13	8:49	sunny	25.9	6.37	5.74	72.5	21.90	20.2	23.9	Forested area - forest vegetation lining river
15	GY-131102-015-PB	Unnamed creek - Old man's farm, Henry's mouth, upstream of point GY-131102-014-PB	N 02° 05.273' W 059° 15.204'	Creek, water flowing slowly, overhanging vegetation, leaf litter in the water	2-Nov-13	9:06	sunny	24.0	6.02	1.11	13.6	35.40	16.55	35.8	Forested area - forest vegetation lining creek
16	GY-131103-016-PB	Bototowau	N 02° 05.271' W 059° 15.205'	Creek, water clear and flowing, overhanging vegetation, litter visible at bottom of creek	3-Nov-13	9:45	sunny	24.5	6.05	6.16	77.1	12.64	5.86	8.26	Gallery forested area - forest vegetation lining creek

Sample Point Location #	Collection site ID	Name of water body	Location of sampling point	Description of sampling point	Date	Time	Weather condition	Temp (°C)	pH	DO (mg/L)	DO (% sat)	Cond (uS/cm)	TDS (mg/L) as NaCl	Turb (NTU)	Remarks
17	GY-131103-017-PB	Bototowau, upstream of sample point GY-131103-016-PB	N 02° 10.880' W 059° 20.314'	Creek, water clear and flowing, overhanging vegetation, litter visible at bottom of creek	3-Nov-13	10:10	sunny	24.6	5.90	5.48	68.2	14.01	6.49	10.9	Gallery forested area - forest vegetation lining creek
18	GY-131103-018-PB	Bototowau, upstream of sample point GY-131103-017-PB and upstream of the bridge crossing the creek	N 02° 10.878' W 059° 20.296'	Creek, water clear and flowing, overhanging vegetation, litter visible at bottom of creek	3-Nov-13	10:35	sunny		6.08	5.38	67.2	13.15	6.11	11.8	Gallery forested area - forest vegetation lining creek
19	GY-131103-019-PB	Bototowau, upstream of sample point GY-131103-018-PB	N 02° 10.935' W 059° 20.327'	Creek, water clear and flowing, overhanging vegetation, litter visible at bottom of creek	3-Nov-13	10:57	sunny	24.8	6.06	6.18	77.3	13.38	6.21	11.2	Gallery forested area - forest vegetation lining creek
20	GY-131103-020-PB	unnamed creek	N 02° 10.809' W 059° 20.271'	Creek, water clear and flowing, overhanging vegetation	3-Nov-13	11:25	sunny	25.2	5.84	6.30	79.0	9.65	4.49	3.51	Gallery forested area - forest vegetation lining creek

Sample Point Location #	Collection site ID	Name of water body	Location of sampling point	Description of sampling point	Date	Time	Weather condition	Temp (°C)	pH	DO (mg/L)	DO (% sat)	Cond (uS/cm)	TDS (mg/L) as NaCl	Turb (NTU)	Remarks
21	GY-131104-021-PB	unnamed creek, marsh	N 02° 10.905' W 059° 20.548'	marsh, standing vegetation present, water clear	4-Nov-13	9:30	cloudy	26.2	5.59	1.43	18.3	10.49	4.85	0.65	At edge of gallery forested area
22	GY-131104-022-PB				4-Nov-13		cloudy	26.1	5.65	2.36	30.4	9.14	4.21	0.61	At edge of gallery forested area
23	GY-131104-023-PB				4-Nov-13		cloudy	26.7	5.58	2.89	37.1	8.59	3.94	0.54	At edge of gallery forested area
24	GY-131104-024-PB	unnamed creek, downstream of marsh	N 02° 10.930' W 059° 20.486'	Creek, clear water, water flowing, overhanging vegetation, moss visible near bottom, water clear	4-Nov-13	10:11	cloudy	25.9	5.60	4.67	59.8	8.85	4.08	2.89	At edge of gallery forested area
25	GY-131104-025-PB	Bototowau, upstream of sample point GY-131103-019-PB	N 02° 11.315' W 059° 20.644'	Creek, water almost stagnant, at a fishing poind, overhanging vegetation	4-Nov-13	11:00	cloudy	25.1	5.46	2.75	34.6	10.61	4.90	4.54	Gallery forested area - forest vegetation lining creek; fishing area

Fishes

Donald Taphorn, Matthew Kolmann, Liana Kalicharan and Maxi Ignace

Introduction

From October 20 to November 7, 2013 a team of researchers from the Royal Ontario Museum (ROM, M. Kolmann, D. Taphorn), the University of Toronto (M. Kolmann), the University of Guyana (UG, Liana Kalicharan) and a local resident who served as guide and assistant (Maxi Ignace) was hosted by WWF-Guianas, Global Wildlife Conservation and the Guyana Environmental Protection Commission in a collaborative survey with other zoologists to catalogue the biodiversity of the watershed and tributaries of the southern Rupununi Savannah region, Guyana. Collections were performed under the EPA collection permit # 102113 BR033 and will be exported to the Royal Ontario Museum under EPA export permit 111413 SP:09 for further study and definitive identification. Habitats surveyed were usually located near forest/savannah borders and included savannah and forest streams, savannah ponds and marshes, gallery forest creeks and main tributary rivers of the upper Kuyuwini and Rupununi River drainages (Essequibo Basin) and tributaries of the Takutu River (Amazon Basin).

The Rupununi wetlands region is particularly interesting from evolutionary and biogeographical standpoints as it represents a potential avenue of species exchange between Essequibo and Amazon basins during torrential rainy seasons. Extensive flooding of the savannahs between the Takutu and Rupununi basins is thought to promote this potential route of species transfer and gene flow. As such, fishes provide a fascinating system in which to examine the history of faunal crossover and interaction in a complex geological and hydrological region. We can infer the evolutionary history and seek to reconcile biological and geological patterns in species distributions by examining the genetic history and population connectivity of fish communities in these regions (bio- and phylo- geography). These methods (phylogenetics, population genetics) also provide researchers insight into community structure and niche dynamics, explaining why some taxa are found in sympatry (where two or more closely related species coexist), while other taxa may be broadly distributed across drainages and are the sole representative of that clade in a region. Since the very few river drainages in Guyana that have been surveyed for fishes, such as the Potaro or Mazaruni Rivers, express a high degree of endemism, it is imperative that the ichthyologically unexplored regions be examined in order to catalogue local fish biodiversity, most notably in the face of increasing severe habitat degradation from gold mining and other human developments.

Methodology

Several sampling methods were used depending on the habitat and hydrological conditions at the discretion of the research team. The primary method of fishing used is seine netting, whereby a small meshed (usually 1/8 inch for this study) net is pulled by two workers through shallow (waist to chest deep) water while fish are corralled to the middle of the net. Secondarily, small meshed gillnets (1/2 to 2 inch) were deployed in deeper water, targeting medium sized fishes. These nets were typically set in the

evening, over the time period in which crepuscular, diurnal and nocturnal fishes are moving. Gillnets are monofilament of varying mesh sizes and primarily entangle fishes. Rod and reel, handlines with hooks and cut bait, and a small trot-line were also used to target larger species of fish. Locations were selected by the researchers according to the ease in which these areas could be sampled (eg. in areas shallow enough to deploy a seine) and with consideration towards habitat complexity. These sites are listed below. An electric fish finder was also utilized to localize the electronic signals produced by these unique fishes, which transforms electric discharges into audible sound. Fishes were then manually separated from the sampling gear and placed in buckets until all gear was retrieved from the habitat. Fishes were then anesthetized with a clove oil and ethanol solution, which numb the fish and eventually asphyxiate the animals. Once euthanasia was complete, specimens were hand-sorted and tentatively identified to species when possible. Fishes were "tissued" and tagged with a unique catalogue label. "Tissuing" involves removing either a fin clip or a section of muscle tissue from the right side of the fish and preserving the sample in ethanol. These samples are necessary for DNA extraction methods in later analyses for bar-code identification, population genetics, phylogenetic, or other molecular studies. It is of critical importance that these tissue samples are matched with the preserved, catalogued, and identified specimen from which they were collected in order to positively match the genetic material to the physical animal. We generally attempted to tissue at least 5 specimens of a given species from each locality. In this way we capture both the taxonomic and genetic diversity of a given habitat or locality. All specimens were preserved in a 15 to 35% formaldehyde solution for later cataloguing and taxonomic confirmation.

Collecting Sites

KUSAD MOUNTAIN AREA

GUY13-01. Oct. 23, 2013. Sandy creek at Kusad Mountain. Collectors: Taphorn, D. GPS 02° 48 718'N 059° 52 000'W.

GUY13-02. Oct. 23, 2013. Mokorowau Creek at Kusad Mountain. Collectors: Taphorn, D., Kolmann, M., Ignace, M., Kalicharan, L. GPS 02° 48 718'N 059° 52 000'W.

GUY13-03. Oct. 24, 2013. Takutu River at Lukunani Falls. Collectors: Taphorn, D., Kolmann, M., Ignace, M. GPS 02° 50 158'N 059° 59 426'W.

GUY13-04. Oct. 24, 2013. Small stream feeding into Takutu River. Collectors: Taphorn, D.
GPS 02° 50 563'N 059° 59 113'W.

GUY13-05. Oct. 25, 2013. Black Huri Lake, west of Kusad. Collectors: Taphorn, D., Kolmann, M., Ignace, M., Kalicharan, L. GPS 02° 49 786'N 059° 48 355'W.

GUY13-06. Oct. 25, 2013. Ant Creek, west of Kusad. Collectors: Taphorn, D., Kolmann, M., Ignace, M., Kalicharan, L. GPS 02° 49 749'N 059° 48 537'W.

GUY13-07. Oct. 26, 2013. Sand Creek upstream of Katorwau River. Collectors: Taphorn, D., Kolmann, M., Ignace, M., Kalicharan, L. GPS 02° 53 417'N 059° 51 031'W.

GUY13-08. Oct. 26, 2013. Katorwau River crossing, in Kodowidpao. Collectors: Taphorn, D., Kolmann, M., Ignace, M., Kalicharan, L. GPS 02° 52 494'N 059° 49 837'W.

GUY13-09. Oct. 26, 2013. Upstream Katorwau River. Collectors: Taphorn, D., Kolmann, M., Ignace, M., Kalicharan, L. GPS 02° 52 494'N 059° 49 837'W.

GUY13-10. Oct. 27, 2013. Marsh west of Takutu River. Collectors: Taphorn, D. GPS 02° 52 204'N 059° 55 003'W.

GUY13-11. Oct. 27, 2013. Takutu River at Lukunani Falls. Collectors: Taphorn, D., Kolmann, M., Ignace, M., Kalicharan, L. GPS 02° 50 142'N 059° 59 423'W.

GUY13-12. Oct. 27, 2013. Small stream feeding into Takutu River. Collectors: Taphorn, D., Kolmann, M., Ignace, M., Kalicharan, L. GPS 02° 50 557'N 059° 59 118'W.

GUY13-13. Oct. 28, 2013. Tarayara Creek. Collectors: Taphorn, D., Kolmann, M., Ignace, M., Kalicharan, L GPS 02° 47 350'N 059° 54 035'W.

GUY13-14. Oct. 28, 2013. Cattle pond near ranch, west of Kusad. Collectors: Taphorn, D., Kolmann, M., Ignace, M., Kalicharan, L. GPS 02° 51 197'N 059° 55 340'W.

GUY13-15. Oct. 28, 2013. Downstream Katorwau River. Collectors: Taphorn, D., Kolmann, M., Ignace, M., Kalicharan, L. GPS 02° 53 719'N 059° 51 339'W.

PARABARA REGION

GUY13-16. Oct. 31, 2013. Moshiwuau Creek. Collectors: Taphorn, D., Kolmann, M., Ignace, M., Kalicharan, L. GPS 02° 09 559'N 059° 17 558'W.

GUY13-17. Nov. 01, 2013. Marudi Creek, off the Kuyuwini River, downstream of Parabara. Collectors: Taphorn, D., Kolmann, M., Ignace, M., Kalicharan, L. GPS: 02° 09 558'N 059° 17 560'W.

GUY13-18. Nov. 01, 2013. Lmy Creek, off the Kuyuwini River, downstream of Parabara. Collectors: Taphorn, D., Kolmann, M., Ignace, M., Kalicharan, L. GPS 02° 09 558'N 059° 17 560'W.

GUY13-19. Nov. 01, 2013. Jaguar Creek, off the Kuyuwini River, downstream of

Parabara. Collectors: Taphorn, D., Kolmann, M., Ignace, M., Kalicharan, L. GPS 02° 04 643'N 059° 11 981'W.

GUY13-20. Nov. 01, 2013. Tigerhead Creek, off the Kuyuwini, downstream of Parabara. Collectors: Taphorn, D., Kolmann, M., Ignace, M., Kalicharan, L. GPS 02° 04 716'N 059° 13 265'W.

GUY13-21. Nov. 01, 2013. Kuyuwini River, downstream of Parabara (gillnet set along river). Collectors: Taphorn, D., Kolmann, M., Ignace, M., Kalicharan, L. GPS 02° 53 719'N 059° 51 339'W.

GUY13-22. Nov. 03, 2013. Bototowau Creek (draining into marsh). Collectors: Taphorn, D., Kolmann, M., Kalicharan, L. GPS 02° 10.905'N 059° 20.547'.
GUY13-23. Nov. 04, 2013. Kuyuwini River upstream of Parabara (gillnet set along river). Collectors: Taphorn, D., Kolmann, M., Ignace, M., Kalicharan, L. GPS 02° 53 719'N 059° 51 339'W.
GUY13-24. Nov. 05, 2013. Baboon Creek (Rupununi drainage). Collectors: Taphorn, D., Kolmann, M., Ignace, M., Kalicharan, L. GPS 02° 05.662'N 059° 14.408'W.

Preliminary Results

Approximately 4301 preserved specimens and 894 tissue samples were taken from a variety of species (see Table 11), representing the faunal diversity of each locality. These specimens were transported to the ichthyological collections at the Royal Ontario Museum in Toronto, Canada. There, further examination by experts specializing in the systematics and evolutionary history of particular groups of interest (notably loricariid catfishes, cichlids, gymnotiform knifefishes, and anostomids) will be conducted to obtain more definitive identifications, and identify possibly new species. Several specimens have already tentatively been identified as new species, endemics, or rare. Holotypes and paratypes of these specimens will be stored in the Center for the Study of Biological Diversity at the University of Guyana once these new specimens are examined and described.

Discussion

Collections were obtained from 24 localities spanning the Rupununi, Takutu, and Kuyuwini basins (15 from the Kusad area, 9 from the Parabara area). The expedition collected about 150 species in 28 families with the potential of more species being identified upon closer examination. Fish diversity from both areas (Kusad and Parabara) was relatively high, with the Parabara/Kuyuwini sites being exceptional for fish abundance. Detailed comparison with other regions of Guyana must await definitive identification of certain taxa as endemics to either the Kuyuwini/Essequibo or Takutu/Rupununi basins. But both regions will undoubtedly reveal that some species are new to science. All locality records are important documentation of the fish diversity of Guyana, especially in the face of anthropogenic development (mining, deforestation, expanding human population).

Some of the species collected in Kusad and Parabara regions may be new to science, e.g. *Aphyocharax* "slender," *Odontostilbe* cf. *gracilis*, *Characidium* sp, "*Rivulus*" sp, *Gymnotus* sp, *Geophagus* "takutu," *Ancistrus* sp "net," *Ancistrus* sp "white dots," and *Loricaria* sp. Tissue samples and whole specimens of these taxa, as well as several other species, were collected from both regions. Further work at the Royal Ontario Museum, specifically the use of DNA assays, will allow comparison of specimens of purportedly similar ancestry, but from the two major drainages samples (Amazon and Essequibo). Potential differences in the molecular hereditary material from there taxa will hopefully reveal whether genetic differences among these unique individuals might warrant specific taxonomic recognition.

Implications for conservation

Our first impression of the fish faunas in both regions visited is that they are well conserved. Although the creek by the Cassava farm in the Kusad region had very few fishes, and very low diversity, perhaps as a result of previous poisoning by local fishermen. This practice is still a fairly common practice and reduces the abundance and diversity of fishes in the streams affected for months, or even years. The Kuyuwini River had impressive fish abundance, of the small and medium sized fishes our gear can capture. Reports from local inhabitants indicated that the fishery for the Aimara (*Hoplias aimara*) is still active and productive. As a top predator, this species is susceptible to overfishing. It would also be expected to accumulate mercury released from gold mining activities.

Preliminary recommendations

As the incidence of gold mining activities increases, local inhabitants and their principal food fishes should be monitored for the accumulation of mercury.

Poisoning of streams should be discouraged because of lasting negative effects of the total removal of the fish population. Locals informed us that migrating fish will avoid poisoned streams for several years after they have been fished out.

Ornamental fishes are common in both regions, and could support a local industry for export. One major limitation for the development is the lack of inexpensive transport for the fishes collected.

Table 11. Preliminary List of fish species recorded during the South Rupununi BAT Survey.

Station	Date	Order	Family	Genus	Species
Kusad Mountain - Site 1					
GUY13-01	23-10-2013	Characiformes	Lebiasinidae	*Pyrrhulina*	*filamentosa*
GUY13-02	23-10-2013	Characiformes	Lebiasinidae	*Pyrrhulina*	*filamentosa*
GUY13-02		Characiformes	Characidae	*Astyanax*	*rupununi*
GUY13-02		Siluriformes	Pimelodidae	*Rhamdia*	*quelen*
GUY13-02		Siluriformes	Heptapteridae	*Pimelodella*	Sp
GUY13-02		Siluriformes	Trichomycteridae	*Trichomycterus*	Sp
GUY13-03	24-10-2013	Characiformes	Ctenoluciidae	*Boulengerella*	*cuvieri*
GUY13-03		Characiformes	Anostomidae	*Leporinus*	Sp
GUY13-03		Characiformes	Anostomidae	*Leporinus*	*granti*
GUY13-03		Characiformes	Hemiodontidae	*Hemiodus*	*unimaculatus*
GUY13-03		Perciformes	Cichlidae	*Guianacara*	*dacrya*
GUY13-03		Siluriformes	Loricariidae	*Hypostomus*	*hemiurus*
GUY13-03		Characiformes	Curimatidae	*Curimata*	Sp
GUY13-03		Siluriformes	Loricariidae	*Peckoltia*	*braueri*
GUY13-03		Siluriformes	Loricariidae	*Rineloricaria*	*fallax*
GUY13-03		Siluriformes	Heptapteridae	*Imparfinnis*	Sp
GUY13-03		Characiformes	Characidae	*Exodon*	*paradoxus*
GUY13-03		Siluriformes	Loricariidae	*Parotocinlus*	*britskii*
GUY13-03		Characiformes	Parodontidae	*Parodon*	Sp
GUY13-03		Characiformes	Crenuchidae	*Characidium*	*hasemani*
GUY13-03		Characiformes	Serrasalmidae	*Myleus*	Sp
GUY13-03		Perciformes	Cichlidae	*Geophagus*	*takutu*

Station	Date	Order	Family	Genus	Species
GUY13-03		Characiformes	Characidae	*Aphyocharax*	*erythurus*
GUY13-03		Characiformes	Characidae	*Hemigrammus*	*Levis*
GUY13-03		Characiformes	Characidae	*Hemigrammus*	Sp
GUY13-03		Characiformes	Curimatidae	*Cyphocharax*	*spilurus*
GUY13-03		Characiformes	Characidae	*Moenkhausia*	*copei*
GUY13-03		Characiformes	Characidae	*Jupiaba*	*polylepis*
GUY13-03		Characiformes	Characidae	*Jupiaba*	Sp
GUY13-03		Siluriformes	Loricariidae	*Hypostomus*	*makushi*
GUY13-03		Characiformes	Characidae	*Moenkhausia*	*lepidura*
GUY13-03		Characiformes	Characidae	*Ctenobrycon*	*spilurus*
GUY13-03		Siluriformes	Trichomycteridae	*Vandellia*	*Sp*
GUY13-03		Characiformes	Characidae	*Bryconamericus*	*hyphessus*
GUY13-03		Characiformes	Characidae	*Microschemobrycon*	Sp
GUY13-03		Characiformes	Characidae	*Creagrutus*	Sp
GUY13-03		Tetraodontiformes	Tetraodontidae	*Colomesus*	*psittacus*
GUY13-03		Characiformes	Serrasalmidae	*Pygopristis*	*denticulatus*
GUY13-04	24-10-2013	Gymnotiformes	Hypopomidae	*Hypopygus*	Sp
GUY13-05	25-10-2014	Characiformes	Characidae	*Parapristella*	*georgei*
GUY13-05		Characiformes	Lebiasinidae	*Nannostomus*	Sp
GUY13-05		Anguilliformes	Synbranchidae	*Synbranchus*	*marmoratus*
GUY13-06	25-10-2014	Characiformes	Lebiasinidae	*Nannostomus*	Sp
GUY13-06		Characiformes	Lebiasinidae	*Pyrrhulina*	*filamentosa*
GUY13-06		Characiformes	Characidae	*Hyphessobrycon*	*minor*
GUY13-06		Characiformes	Characidae	*Hemigrammus*	*stictus*
GUY13-06		Characiformes	Characidae	*Hemigrammus*	*belotti*

Station	Date	Order	Family	Genus	Species
GUY13-06		Perciformes	Cichlidae	*Apistogramma*	*steindachneri*
GUY13-06		Perciformes	Cichlidae	*Cichlasoma*	*amazonarum*
GUY13-06		Perciformes	Cichlidae	*Acaronia*	*nassa*
GUY13-06		Perciformes	Cichlidae	*Crenicichla*	*alta*
GUY13-06		Perciformes	Cichlidae	*Crenicichla*	*regani*
GUY13-06		Perciformes	Cichlidae	*Mesonauta*	*guyanae*
GUY13-06		Characiformes	Erythrinidae	*Erythrinus*	*erythrinus*
GUY13-06		Characiformes	Erythrinidae	*Hoploerythrinus*	*unitaeniatus*
GUY13-06		Characiformes	Erythrinidae	*Hoplias*	*malabaricus*
GUY13-06		Siluriformes	Callichthyidae	*Hoplosternum*	*thoracatum*
GUY13-06		Siluriformes	Auchenipteridae	*Trachelyopterus*	*galeatus*
GUY13-06		Gymnotiformes	Hypopomidae	*Hypopygus*	Sp
GUY13-06		Gymnotiformes	Hypopomidae	*Brachyhypopomus*	Sp
GUY13-06		Gymnotiformes	Gymnotidae	*Gymnotus*	Sp
GUY13-06		Gymnotiformes	Sternopygidae	*Eigenmannia*	*virescens*
GUY13-06		Characiformes	Characidae	*Bryconops*	*affinis*
GUY13-06		Characiformes	Characidae	*Gnathocharax*	*steindachneri*
GUY13-06		Characiformes	Characidae	*Aphyocharax*	*erythurus*
GUY13-06		Characiformes	Characidae	*Odontostilbe*	*gracilis*
GUY13-06		Characiformes	Characidae	*Phenacogaster*	Sp
GUY13-06		Characiformes	Characidae	*Moenkhausia*	*oligolepis*
GUY13-06		Characiformes	Characidae	*Moenkhausia*	*copei group*
GUY13-06		Characiformes	Characidae	*Parapristella*	*georgei*
GUY13-06		Characiformes	Characidae	*Ctenobrycon*	*spilurus*
GUY13-06		Characiformes	Characidae	*Poptella*	sp 2
GUY13-06		Characiformes	Characidae	*Astyanax*	*rupununi*
GUY13-06		Characiformes	Curimatidae	*Curimatella*	*immaculata*
GUY13-06		Characiformes	Curimatidae	*Cyphocharax*	*spilurus*

Station	Date	Order	Family	Genus	Species
GUY13-06		Characiformes	Serrasalmidae	*Serrasalmus*	*rhombeus*
GUY13-07	26-10-2013	Characiformes	Ctenoluciidae	*Boulengerella*	*Cuvieri*
GUY13-07		Characiformes	Hemiodontidae	*Bivibranchia*	Sp
GUY13-07		Characiformes	Hemiodontidae	*Hemiodus*	Sp
GUY13-07		Pleuronectiformes	Achiridae	*Hypoclinemus*	*mantelis*
GUY13-07		Characiformes	Anostomidae	*Leporinus*	*granti*
GUY13-07		Perciformes	Cichlidae	*Guianacara*	*dacrya*
GUY13-07		Perciformes	Cichlidae	*Geophagus*	Sp
GUY13-07		Perciformes	Cichlidae	*Cichlasoma*	*amazonarum*
GUY13-07		Perciformes	Cichlidae	*Apistogramma*	*steindachneri*
GUY13-07		Characiformes	Curimatidae	*Cyphocharax*	*spilurus*
GUY13-07		Characiformes	Characidae	*Bryconops*	*alburnoides*
GUY13-07		Characiformes	Characidae	*Bryconamericus*	Sp
GUY13-07		Characiformes	Characidae	*Characidae*	Sp
GUY13-07		Characiformes	Characidae	*Aphyocharax*	*erythurus*
GUY13-07		Characiformes	Characidae	*Jupiaba*	*polylepis*
GUY13-07		Characiformes	Characidae	*Jupiaba*	Sp
GUY13-07		Siluriformes	Loricariidae	*Hypostomus*	*squalinus*
GUY13-08	26-10-2013	Characiformes	Hemiodontidae	*Hemiodus*	Sp
GUY13-08		Characiformes	Hemiodontidae	*Hemiodus*	*unimaculatus*
GUY13-08		Characiformes	Hemiodontidae	*Bivibranchia*	Sp
GUY13-08		Perciformes	Cichlidae	*Mesonauta*	*guyanae*
GUY13-08		Perciformes	Cichlidae	*Guianacara*	*dacrya*
GUY13-08		Perciformes	Cichlidae	*Geophagus*	*takutu*
GUY13-08		Perciformes	Cichlidae	*Caquetaia*	*spectabilis*
GUY13-08		Perciformes	Cichlidae	*Cichlidae juvenile*	Sp

Station	Date	Order	Family	Genus	Species
GUY13-08		Characiformes	Anostomidae	*Leporinus*	*granti*
GUY13-08		Characiformes	Ctenoluciidae	*Boulengerella*	*cuvieri*
GUY13-08		Characiformes	Lebiasinidae	*Nannostomus*	Sp
GUY13-08		Characiformes	Lebiasinidae	*Pyrrhulina*	*filamentosa*
GUY13-08		Characiformes	Serrasalmidae	*Serrasalmus*	*rhombeus*
GUY13-08		Characiformes	Characidae	*Bryconops*	*alburnoides*
GUY13-08		Characiformes	Characidae	*Aphyocharax*	*erythurus*
GUY13-08		Characiformes	Characidae	*Hemigrammus*	*levis*
GUY13-08		Characiformes	Characidae	*Hemigrammus*	*microstomus*
GUY13-08		Characiformes	Characidae	*Hemigrammus*	Sp
GUY13-08		Characiformes	Characidae	*Parapristella*	*georgei*
GUY13-08		Characiformes	Characidae	*Odontostilbe*	*gracilis*
GUY13-08		Characiformes	Characidae	*Moenkhausia*	*copei group*
GUY13-08		Characiformes	Characidae	*Moenkhausia*	*lepidura*
GUY13-08		Characiformes	Characidae	*Ctenobrycon*	Sp
GUY13-08		Characiformes	Characidae	*Phenacogaster*	Sp
GUY13-08		Characiformes	Characidae	*Bryconamericus*	*hyphessus*
GUY13-08		Characiformes	Characidae	*Jupiaba*	*polylepis*
GUY13-08		Characiformes	Characidae	*Jupiaba*	sp 1
GUY13-08		Characiformes	Curimatidae	*Cyphocharax*	*spilurus*
GUY13-08		Siluriformes	Loricariidae	*Parotocinlus*	*britskii*
GUY13-08		Characiformes	Crenuchidae	*Characidium*	*hasemani*
GUY13-09	26-10-2013	Perciformes	Cichlidae	*Geophagus*	*takutu*
GUY13-09		Perciformes	Cichlidae	*Mesonauta*	*guyanae*
GUY13-09		Siluriformes	Heptapteridae	*Rhamdia*	*quelen*
GUY13-09		Characiformes	Prochilodontide	*Prochilodus*	*nigricans*
GUY13-09		Perciformes	Cichlidae	*Caquetaia*	*spectabilis*
GUY13-09		Perciformes	Cichlidae	*Guianacara*	*dacrya*

Station	Date	Order	Family	Genus	Species
GUY13-09		Characiformes	Parodontidae	*Parodon*	*guyanensis*
GUY13-09		Perciformes	Cichlidae	*Crenicichla*	*cf. alta*
GUY13-09		Characiformes	Erythrinidae	*Hoplias*	*malabaricus*
GUY13-09		Siluriformes	Heptapteridae	*Pimelodella*	Sp
GUY13-09		Siluriformes	Cetopsidae	*Cetopsis*	Sp
GUY13-09		Characiformes	Anostomidae	*Leporinus*	*granti*
GUY13-09		Characiformes	Hemiodontidae	*Hemiodus*	*unimaculatus*
GUY13-09		Characiformes	Hemiodontidae	*Bivibranchia*	Sp
GUY13-10	27-10-2013	Characiformes	Lebiasinidae	*Copella*	*nattereri*
GUY13-10		Perciformes	Cichlidae	*Apistogramma*	*steindachneri*
GUY13-10		Characiformes	Characidae	*Parapristella*	*georgei*
GUY13-11	27-10-2013	Characiformes	Anostomidae	*Leporinus*	*nigrotaeniatus*
GUY13-11		Characiformes	Hemiodontidae	*Argonectes*	*longiceps*
GUY13-11		Characiformes	Characidae	*Exodon*	*paradoxus*
GUY13-11		Perciformes	Cichlidae	*Geophagus*	*takutu*
GUY13-11		Characiformes	Anostomidae	*Leporinus*	*granti*
GUY13-11		Characiformes	Serrasalmidae	*Serrasalmus*	*rhombeus*
GUY13-11		Characiformes	Anostomidae	*Leporellus*	*vittatus*
GUY13-11		Siluriformes	Heptapteridae	*Heptapterid*	Sp
GUY13-11		Siluriformes	Heptapteridae	*Pimelodus*	*blochii group*
GUY13-11		Characiformes	Characidae	*Cynopotamus*	Sp
GUY13-11		Characiformes	Hemiodontidae	*Hemiodus*	*unimaculatus*
GUY13-11		Siluriformes	Loricariidae	*Hypostomus*	*squalinus*
GUY13-11		Siluriformes	Doradidae	*Leptodoras*	Sp
GUY13-11		Characiformes	Serrasalmidae	*Prosomyleus*	*rubripinnis*
GUY13-11		Gymnotiformes	Sternopygidae	*Porotergus*	Sp
GUY13-11		Siluriformes	Loricariidae	*Peckoltia*	*sabagi*

Station	Date	Order	Family	Genus	Species
GUY13-11		Characiformes	Curimatidae	*Curimata*	*cyprinoides*
GUY13-11		Siluriformes	Doradidae	*Doras*	Sp
GUY13-11		Characiformes	Characidae	*Tetragonopterus*	*chalceus*
GUY13-11		Siluriformes	Loricariidae	*Peckoltia*	*braueri*
GUY13-11		Siluriformes	Loricariidae	*Loricaria*	Sp
GUY13-12	27-10-2012	Siluriformes	Loricariidae	*Rineloricaria*	Sp
GUY13-12		Gymnotiformes	Sternopygidae	*Eigenmannia*	*virescens*
GUY13-12		Perciformes	Cichlidae	*Crenicichla*	*regani*
GUY13-12		Perciformes	Cichlidae	*Guianacara*	*dacrya*
GUY13-12		Perciformes	Cichlidae	*Mesonauta*	*guyanae*
GUY13-12		Characiformes	Acestrorhyncidae	*Acestrorhynchus*	*microlepis*
GUY13-12		Characiformes	Lebiasinidae	*Nannostomus*	sp 1
GUY13-12		Characiformes	Lebiasinidae	*Nannostomus*	sp 2
GUY13-12		Characiformes	Lebiasinidae	*Copella*	*nattereri*
GUY13-12		Characiformes	Characidae	*Hyphessobrycon*	*minor*
GUY13-12		Characiformes	Characidae	*Hemigrammus*	*bellotti*
GUY13-12		Characiformes	Characidae	*Hemigrammus*	*stictus*
GUY13-12		Characiformes	Characidae	*Hemigrammus*	*Levis*
GUY13-12		Characiformes	Characidae	*Hemigrammus*	Sp
GUY13-12		Characiformes	Characidae	*Bryconops*	*affinis*
GUY13-12		Characiformes	Characidae	*Parapristella*	*georgei*
GUY13-12		Characiformes	Characidae	*Moenkhausia*	*collettei*
GUY13-12		Characiformes	Chilodontidae	*Chilodus*	*punctatus*
GUY13-12		Characiformes	Curimatidae	*Curimatella*	*immaculata*
GUY13-12		Characiformes	Curimatidae	*Cyphocharax*	*spilurus*
GUY13-12		Gymnotiformes	Sternopygidae	*Eigenmannia*	*virescens*
GUY13-13	28-10-2013	Characiformes	Lebiasinidae	*Pyrrhulina*	*filamentosa*

Station	Date	Order	Family	Genus	Species
GUY13-13		Characiformes	Characidae	*Hemigrammus*	*bellotti*
GUY13-13		Characiformes	Erythrinidae	*Hoploerythrinus*	*unitaeniatus*
GUY13-13		Siluriformes	Callichthyidae	*Callichthyes*	*callichthyes*
GUY13-14	28-10-2013	Characiformes	Characidae	*Hyphessobrycon*	*minor*
GUY13-14		Gymnotiformes	Hypopomidae	*Brachyhypopomus*	Sp
GUY13-14		Characiformes	Lebiasinidae	*Nannostomus*	Sp
GUY13-14		Characiformes	Characidae	*Parapristella*	*georgei*
GUY13-14		Perciformes	Cichlidae	*Apistogramma*	*steindachneri*
GUY13-14		Perciformes	Cichlidae	*Crenicichla*	*alta*
GUY13-14		Characiformes	Erythrinidae	*Hoplias*	*malabaricus*
GUY13-15	28-10-2013	Perciformes	Cichlidae	*Crenicichla*	*lugubris*
GUY13-15		Perciformes	Cichlidae	*Mesonauta*	*guyanae*
GUY13-15		Perciformes	Cichlidae	*Guianacara*	*dacrya*
GUY13-15		Perciformes	Cichlidae	*Geophagus*	*takutu*
GUY13-15		Perciformes	Cichlidae	*Satanoperca*	Sp
GUY13-15		Characiformes	Hemiodontidae	*Bivibranchia*	sp
GUY13-15		Characiformes	Characidae	*Bryconamericus*	*cf orinocensis*
GUY13-15		Characiformes	Characidae	*Bryconamericus*	*hyphessus*
GUY13-15		Characiformes	Characidae	*Aphyocharax*	*erythurus*
GUY13-15		Characiformes	Characidae	*Microschemobrycon*	sp
GUY13-15		Characiformes	Characidae	*Phenacogaster*	sp
GUY13-15		Characiformes	Characidae	*Bryconops*	*alburnoides*
GUY13-15		Characiformes	Characidae	*Bryconops*	*caudomaculatus*
GUY13-15		Characiformes	Characidae	*Jupiaba*	*polylepis*
GUY13-15		Characiformes	Characidae	*Jupiaba*	sp
GUY13-15		Characiformes	Characidae	*Moenkhausia*	*copei group*
GUY13-15		Characiformes	Characidae	*Moenkhausia*	*collettei*

Station	Date	Order	Family	Genus	Species
GUY13-15		Characiformes	Characidae	*Parapristella*	*georgei*
GUY13-15		Characiformes	Characidae	*Hemigrammus*	*levis*
GUY13-15		Characiformes	Characidae	*Hemigrammus*	sp
GUY13-15		Characiformes	Characidae	*Odontostilbe*	*gracilis*
GUY13-15		Characiformes	Serrasalmidae	*Pristobrycon*	sp
GUY13-15		Characiformes	Serrasalmidae	*Pygocentrus*	*nattereri*
GUY13-15		Characiformes	Curimatidae	*Cyphocharax*	*spilurus*
GUY13-15		Characiformes	Curimatidae	*Curimatella*	*immaculata*
GUY13-15		Characiformes	Hemiodontidae	*Hemiodus*	*unimaculatus*
GUY13-15		Characiformes	Hemiodontidae	*Hemiodus*	sp
GUY13-15		Characiformes	Anostomidae	*Leporinus*	*granti*
GUY13-15		Characiformes	Erythrinidae	*Hoplias*	*malabaricus*
GUY13-15		Characiformes	Acestrorhynchidae	*Acestrorhynchus*	*microlepis*
GUY13-15		Siluriformes	Auchenipteridae	*Trachelyopterus*	*galeatus*
GUY13-15		Siluriformes	Cetopsidae	*Cetopsis*	sp
GUY13-15		Siluriformes	Loricariidae	*Parotocinlus*	*britskii*
GUY13-15		Siluriformes	Loricariidae	*Hypostomus*	*taphorni*
GUY13-15		Siluriformes	Loricariidae	*Peckoltia*	*braueri*
GUY13-15		Siluriformes	Loricariidae	*Peckoltia*	*sabagi*
GUY13-15		Siluriformes	Loricariidae	*Leporacanthicus*	sp
GUY13-15		Siluriformes	Loricariidae	*Loricaria*	sp
GUY13-15		Siluriformes	Loricariidae	*Rineloricaria*	sp
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GUY13-16	31-10-2013	Characiformes	Lebiasinidae	*Nannostomus*	sp
GUY13-16		Characiformes	Characidae	*Moenkhausia*	*copei group*
GUY13-16		Characiformes	Characidae	*Moenkhausia*	*lepidura group*
GUY13-16		Characiformes	Curimatidae	*Cyphocharax*	*spilurus*
GUY13-16		Characiformes	Anostomidae	*Leporinus*	*friderici group*

Station	Date	Order	Family	Genus	Species
GUY13-16		Perciformes	Cichlidae	*Crenicichla*	*alta*
GUY13-16		Perciformes	Cichlidae	*Guianacara*	*dacrya*
GUY13-16		Characiformes	Characidae	*Bryconops*	*affinis*
GUY13-16		Characiformes	Erythrinidae	*Hoploerythrinus*	*unitaeniatus*
GUY13-16		Siluriformes	Loricariidae	*Rineloricaria*	sp
GUY13-16		Characiformes	Characidae	*Moenkhausia*	*oligolepis*
GUY13-16		Characiformes	Characidae	*Aphyocharax*	sp
GUY13-16		Siluriformes	Loricariidae	*Ancistrus*	*"net"*
GUY13-16		Siluriformes	Loricariidae	*Ancistrus*	*"white dot"*
GUY13-16		Siluriformes	Loricariidae	*Hypostomus*	*hemiurus*
GUY13-16		Characiformes	Parodontidae	*Apareiodon*	sp
GUY13-16		Characiformes	Crenuchidae	*Characidium*	*steindachneri*
GUY13-16		Characiformes	Characidae	*Phenacogaster*	sp
GUY13-16		Characiformes	Crenuchidae	*Melanocharacidium*	sp
GUY13-16		Characiformes	Characidae	*Bryconops*	*affinis*
GUY13-16		Characiformes	Characidae	*Hemigrammus*	*bellotti*
GUY13-16		Characiformes	Lebiasinidae	*Pyrrhulina*	*filamentosa*
GUY13-16		Characiformes	Acestrorhynchidae	*Acestrorhynchus*	*falcatus*
GUY13-16		Gymnotiformes	Rhamphichthyidae	*Gymnorhamphichthys*	*hypostomus*
GUY13-16		Characiformes	Hypopomidae	*Brachyhypopomus*	sp
GUY13-16		Gymnotiformes	Sternopygidae	*Eigenmannia*	*virescens*
GUY13-16		Characiformes	Characidae	*Jupiaba*	sp
GUY13-16		Siluriformes	Auchenipteridae	*Trachelyopterus*	*galeatus*
GUY13-16		Siluriformes	Heptapteridae	*Rhamdia*	*quelen*
GUY13-16		Gymnotiformes	Sternopygidae	*Sternopygus*	*macrurus*
GUY13-17	1-11-2013	Characiformes	Characidae	*Hyphessobrycon*	sp
GUY13-17		Siluriformes	Heptapteridae	*Pimelodella*	sp
GUY13-17		Characiformes	Characidae	*Aphyocharax*	sp

Station	Date	Order	Family	Genus	Species
GUY13-17		Characiformes	Characidae	*Phenacogaster*	sp
GUY13-17		Characiformes	Lebiasinidae	*Pyrrhulina*	*filamentosa*
GUY13-17		Characiformes	Characidae	*Odontostilbe*	*gracilis*
GUY13-17		Characiformes	Characidae	*Odontostilbe*	*cf gracilis*
GUY13-17		Characiformes	Curimatidae	*Cyphocharax*	sp
GUY13-17		Characiformes	Crenuchidae	*Characidium*	sp
GUY13-17		Characiformes	Anostomidae	*Anostomus*	*anostomus*
GUY13-17		Characiformes	Characidae	*Jupiaba*	sp
GUY13-17		Characiformes	Characidae	*Moenkhausia*	*copei* group
GUY13-17		Characiformes	Characidae	*Moenkhausia*	*lepidura* group
GUY13-17		Characiformes	Characidae	*Moenkhausia*	*oligolepis*
GUY13-17		Siluriformes	Trichomycteridae	*Ochmacanthus*	*alternus*
GUY13-17		Siluriformes	Callichthyidae	*Corydoras*	Sp
GUY13-17		Characiformes	Erythrinidae	*Hoplias*	*malabaricus*
GUY13-18	1-11-2013	Characiformes	Characidae	*Bryconops*	Sp
GUY13-18		Characiformes	Characidae	*Moenkhausia*	*lepidura* group
GUY13-18		Characiformes	Characidae	*Moenkhausia*	*copei* group
GUY13-18		Characiformes	Characidae	*Hyphessobrycon*	*minor*
GUY13-18		Characiformes	Characidae	*Aphyocharax*	*erythurus*
GUY13-18		Characiformes	Curimatidae	*Cyphocharax*	*spilurus*
GUY13-18		Characiformes	Characidae	*Jupiaba*	*sp*
GUY13-18		Characiformes	Chalceidae	*Chalceus*	*microlepidotus*
GUY13-18		Characiformes	Crenuchidae	*Characidium*	*steindachneri*
GUY13-18		Characiformes	Lebiasinidae	*Nannostomus*	sp
GUY13-18		Perciformes	Cichlidae	*Apistogramma*	sp
GUY13-19	1-11-2013	Characiformes	Characidae	*Hyphessobrycon*	*minor*
GUY13-19		Characiformes	Characidae	*Hemigrammus*	*ocellifer*
GUY13-19		Characiformes	Characidae	*Moenkhausia*	*copei group*

Station	Date	Order	Family	Genus	Species
GUY13-19		Characiformes	Characidae	*Moenkhausia*	*lepidura group*
GUY13-19		Characiformes	Characidae	*Bryconops*	*affinis*
GUY13-19		Characiformes	Characidae	*Phenacogaster*	sp
GUY13-19		Characiformes	Crenuchidae	*Characidium*	*steindachneri*
GUY13-20	1-11-2013	Perciformes	Cichlidae	*Crenicichla*	*lenticulata*
GUY13-20		Perciformes	Cichlidae	*Crenicichla*	*lugubris*
GUY13-20		Perciformes	Cichlidae	*Crenicichla*	*alta*
GUY13-20		Perciformes	Cichlidae	*Guianacara*	*dacrya*
GUY13-20		Perciformes	Cichlidae	*Apistogramma*	*steindachneri*
GUY13-20		Siluriformes	Heptapteridae	*Pimelodella*	Sp
GUY13-20		Characiformes	Characidae	*Bryconops*	Sp
GUY13-20		Characiformes	Characidae	*Aphyocharax*	*erythurus*
GUY13-20		Characiformes	Characidae	*Poptella*	Sp
GUY13-20		Characiformes	Characidae	*Moenkhausia*	*lepidura group*
GUY13-20		Characiformes	Characidae	*Moenkhausia*	*copei group*
GUY13-20		Characiformes	Characidae	*Hyphessobrycon*	*minor*
GUY13-20		Characiformes	Characidae	*Hyphessobrycon*	*vorderwinckleri*
GUY13-20		Characiformes	Characidae	*Jupiaba*	*Sp*
GUY13-20		Characiformes	Lebiasinidae	*Nannostomus*	*Sp*
GUY13-20		Characiformes	Acestrorhynchidae	*Acestrorhynchus*	*falcatus*
GUY13-20		Characiformes	Acestrorhynchidae	*Acestrorhynchus*	*microlepis*
GUY13-20		Characiformes	Erythrinidae	*Hoplias*	*malabaricus*
GUY13-20		Siluriformes	Trichomycteridae	*Trichomycterus*	sp
GUY13-20		Characiformes	Curimatidae	*Cyphocharax*	*spilurus*
GUY13-20		Characiformes	Crenuchidae	*Characidium*	*steindachneri*
GUY13-20		Characiformes	Lebiasinidae	*Pyrrhulina*	*filamentosa*
GUY13-21	1-11-2013	Characiformes	Serrasalmidae	*Serrasalmus*	*rhombeus*
GUY13-21		Gymnotiformes	Sternopygidae	*Eigenmannia*	cf *macrops*

Station	Date	Order	Family	Genus	Species
GUY13-21		Siluriformes	Pimelodidae	*Pimelodus*	*ornatus*
GUY13-21		Siluriformes	Heptapteridae	*Pimelodella*	sp
GUY13-21		Characiformes	Anostomidae	*Leporinus*	*friderici group*
GUY13-21		Siluriformes	Loricariidae	*Hypostomus*	*sp*
GUY13-21		Siluriformes	Loricariidae	*Hypostomus*	*taphorni*
GUY13-21		Siluriformes	Pimelodidae	*Pimelodus*	*blochii group*
GUY13-21		Characiformes	Auchenipteridae	*Ageneiosus*	*inermis*
GUY13-21		Siluriformes	Doradidae	*Doras*	sp
GUY13-21		Siluriformes	Doradidae	*Leptodoras*	sp
GUY13-21		Characiformes	Curimatidae	*Cyphocharax*	*spilurus*
GUY13-21		Characiformes	Curimatidae	*Curimatella*	*immaculata*
GUY13-21		Characiformes	Curimatidae	*Psectrogaster*	sp
GUY13-21		Characiformes	Characidae	*Cynopotamus*	Sp
GUY13-21		Characiformes	Characidae	*Charax*	Sp
GUY13-21		Characiformes	Acestrorhynchidae	*Acestrorhynchus*	*falcatus*
GUY13-21		Characiformes	Acestrorhynchidae	*Acestrorhynchus*	*microlepis*
GUY13-21		Characiformes	Acestrorhynchidae	*Acestrorhynchus*	*Sp*
GUY13-21		Characiformes	Characidae	*Poptella*	*Sp*
GUY13-21		Characiformes	Triporthidae	*Triportheus*	*Sp*
GUY13-21		Characiformes	Characidae	*Jupiaba*	*polylepis*
GUY13-21		Characiformes	Hemiodontidae	*Hemiodus*	*Sp*
GUY13-21		Perciformes	Cichlidae	*Guianacara*	*dacrya*
GUY13-21		Characiformes	Serrasalmidae	*Prosomyleus*	*rubripinnis*
GUY13-21		Characiformes	Characidae	*Moenkhausia*	*lepidura group*
GUY13-21		Perciformes	Cichlidae	*Aequidens*	Sp
GUY13-21		Characiformes	Chalceidae	*Chalceus*	*microlepidotus*
GUY13-21		Characiformes	Characidae	*Bryconops*	*affinis*
GUY13-21		Characiformes	Anostomidae	*Anostomus*	*anostomus*

Station	Date	Order	Family	Genus	Species
GUY13-22	3-11-2013	Characiformes	Lebiasinidae	*Nannostomus*	Sp
GUY13-22		Characiformes	Characidae	*Hemigrammus*	*vorderwinckleri*
GUY13-22		Characiformes	Characidae	*Hemigrammus*	*belotti*
GUY13-23	4-11-2013	Characiformes	Serrasalmidae	*Serrasalmus*	*rhombeus*
GUY13-23		Characiformes	Acestrorhynchidae	*Acestrorhynchus*	*falcatus*
GUY13-23		Characiformes	Acestrorhynchidae	*Acestrorhynchus*	*microlepis*
GUY13-23		Siluriformes	Auchenipteridae	*Ageneiosus*	*inermis*
GUY13-23		Characiformes	Chilodontidae	*Caenotropus*	Sp
GUY13-23		Characiformes	Prochilodontidae	*Prochilodus*	*rubrotaeniatus*
GUY13-23		Siluriformes	Pimelodidae	*Pimelodus*	*blochii group*
GUY13-23		Siluriformes	Pimelodidae	*Pimelodus*	*ornatus*
GUY13-23		Siluriformes	Heptapteridae	*Pimelodella*	Sp
GUY13-23		Characiformes	Characidae	*Bryconops*	*caudomaculatus*
GUY13-23		Characiformes	Characidae	*Moenkhausia*	*lepidura group*
GUY13-23		Siluriformes	Doradidae	*Doras*	Sp
GUY13-23		Characiformes	Hemiodontidae	*Hemiodus*	*unimaculatus*
GUY13-23		Characiformes	Hemiodontidae	*Hemiodus*	Sp
GUY13-23		Characiformes	Curimatidae	*Cyphocharax*	*Spilurus*
GUY13-23		Perciformes	Cichlidae	*Crenicichla*	*lenticulata*
GUY13-23		Perciformes	Cichlidae	*Crenicichla*	*Lugubris*
GUY13-23		Perciformes	Cichlidae	*Crenicichla*	*Alta*
GUY13-23		Perciformes	Cichlidae	*Guianacara*	*Dacrya*
GUY13-23		Characiformes	Hemiodontidae	*Hemiodus*	*unimaculatus*
GUY13-23		Characiformes	Anostomidae	*Leporinus*	*friderici group*
GUY13-23		Characiformes	Anostomidae	*Leporinus*	*nigrotaeniatus*
GUY13-23		Characiformes	Anostomidae	*Leporinus*	sp
GUY13-23		Characiformes	Chalceidae	*Chalceus*	*macrolepidotus*
GUY13-23		Characiformes	Triporthidae	*Triportheus*	sp

Station	Date	Order	Family	Genus	Species
GUY13-23		Characiformes	Characidae	*Roeboides*	*thurni*
GUY13-23		Characiformes	Characidae	*Cynopotamus*	*essequibensis*
GUY13-23		Siluriformes	Loricariidae	*Hypostomus*	*hemiurus*
GUY13-23		Siluriformes	Loricariidae	*Hypostomus*	*taphorni*
GUY13-23		Siluriformes	Auchenipteridae	*Pseudoplatystoma*	*fasciatum*
GUY13-23		Characiformes	Characidae	*Moenkhausia*	sp
GUY13-23		Siluriformes	Auchenipteridae	*Tatia*	sp
GUY13-23		Characiformes	Serrasalmidae	*Prosomyleus*	*rubripinnis*
GUY13-23		Characiformes	Characidae	*Poptella*	sp
GUY13-23		Characiformes	Erythrinidae	*Hoplias*	*aimara*
GUY13-23		Characiformes	Erythrinidae	*Hoplias*	*malabaricus*
GUY13-24	5-11-2013	Characiformes	Characidae	*Hemigrammus*	*unilineatus*
GUY13-24		Perciformes	Cichlidae	*Crenicichla*	*alta*
GUY13-24		Characiformes	Acestrorhynchidae	*Acestrorhynchus*	sp
GUY13-24		Characiformes	Characidae	*Moenkhausia*	*oligolepis group*
GUY13-24		Characiformes	Characidae	*Phenacogaster*	sp
GUY13-24		Characiformes	Erythrinidae	*Hoplias*	*malabaricus*
GUY13-24		Characiformes	Lebiasinidae	*Pyrrhulina*	*filamentosa*
GUY13-24		Characiformes	Characidae	*Astyanax*	*rupununi*
GUY13-24		Siluriformes	Trichomycteridae	*Trichomycterus*	sp
GUY13-24		Siluriformes	Loricariidae	*Ancistrus*	*"net"*
GUY13-24		Cyprinodontiformes	Rivulidae	*Rivulus*	sp

Natural Resource Use Assessment

Patricia Fredericks and Cedric Buckley

Introduction

The Rupununi Savannah is a home to and a source of livelihood for some 5,000 indigenous people. Until recently, the region has been protected by its isolation. With improving accessibility, beginning with a road from Georgetown 20 years ago, a bridge across the Takatu River to Brazil in the past five years, and the promise of the paving of the road from the Lethem (Brazil border) to Linden over the coming five years there is increasing interest in the region for gold mining, petroleum extraction, and large-scale agriculture. These developments are already threatening the spectacular wildlife and natural habitats of the Rupununi, as well as traditional ways of life of the communities.

As the pressure to rapidly 'develop' the region increases, it is essential for communities to recognize the natural resources on which they depend and to have good baseline data.

The purpose of the Resource Use Assessment is to provide insights into critical resources used by the residents of the villages neighboring the BAT sites namely Potarinau, Sawariwau, Karaudarnau and Parabara and the parameters influencing natural resource access and use; to identify potentially unsustainable activities and conflicts; and to initiate thinking about potential resource management interventions.

This will inform the people of the South Rupununi and National Policy makers in instituting management interventions, even at a village level, that would promote sustainable use of their natural resources.

Methodology Used

This RUA was done using a participatory methodology and in workshop format with members of each of the four communities over a period of three days in each. There were facilitated discussions divided by gender and age groups which identified critical resources used. Critical resources were categorized as those used for food, shelter or business and all scarce resources were identified. Participants also discussed how these resources were linked to their traditions and culture and finally potential management interventions.

Study Sites (Potarinau, Sawariwau and Karaudarnau Villages)

Workshops were conducted in Potarinau from Oct 22 – 24, Sawariwau on Oct 25, 27, 28 and Karaudarnau from Nov 4-6 2013. Very similar resources were identified as important in each of these communities. Potarinau and Sawariwau interact with and use the resources of the Kusad Mountain whilst Karaudarnau accesses resources associated with the Parabara area. These villages are made up largely of indigenous persons of the Wapishana tribe. Resources used for food included the following animals and birds: labba (*Coniculus paca*), bush and savannah deer (*Mazama americana* and *Odocoileus virginianus*), tapir (*Tapirus terrestris*), armadillo (*Pridontes maximas*), caiman, powis (*Crax alector*), Wisisi ducks (*Dendrocygna autumnalis*), parrots and macaws. A large

number of fish were also identified. The fruits of the Ité (*Mauritia flexuosa*) and Turu Palms were also identified as critical to the diet of these communities. Resources used for shelter were identified as Ité and Kokerite leaves also Red Wood, White and Black Cedar, Purple Heart (*Peltoygne* sp.) and other wood such as the Wichabai used for fences. Resources used for business were identified as gold, cedar, Mucru, Ité Palm (*Mauritia flexuosa*), Cotton Plant, Bow Wood, and some animals, including deer and tapir which are sold once there was enough to satisfy family needs. The Towa Towa bird (*Oryzoborus angolensis*) was identified by the village of Karaudarnau as being important for business (the pet trade). Critical resources that were identified as scarce because of overharvesting or habitat loss were all those listed for food with emphasis on the armadillo. The Red Wood, Cedar and Bow Wood were also listed here.

Observations of these sites

In Potarinau and Sawariwau "Bush Islands" were identified as crucial to the resident's since they use this habitat for their farmlands. Some farming is also done on Kusad Mountain, with at least two families farming there.

Study Site (Parabara Village)

The workshop was conducted in this village from Oct 31 – Nov 2 2013. This community is made up of Wai Wais and Wapishanas. The names of some resources are referred to in the Wai Wai language.

In this village which is situated along the right bank of the Kuyuwini River the resources are still very much intact but are being threatened by the influx of persons into the area to engage in gold mining The main resources identified for food were fish (Lukunani (*Cichla ocellaris*), Haimara (*Hoplias aimara*), Tiger Fish, and others); animals (Tapir, Labba (*Coniculus paca*), Agouti (*Dasyprocto spp.),* Armadillo (*Priodontes maximas*), Peccary (*Tayassuidae spp.)* and Spider Monkey (*Cebidae Paniscus*). Birds identified for food were the Powis, Pigeon, Macaw, and Toucan. For shelter, all timber species, Wokoyo, were identified along with leaves of the Manicole Palm, Nibi, Wood Bark (Watab). For business, the Ite Palm, Bead Tree, Arrow Tree, Kaiku Tree (used to make axe handles) and gold. Weyu, used for firewood, and Boat Wood (Pite) were listed as crucial to the lives of the residents. Resources identified as being scarce were Himara, Lukunanai and Houri fish, Water Cedar, Bow Wood, Turu Fruit, Tapir, Spider Monkey and tree used for boards (Kukwa).

Observation of this Site

On the completion of this workshop it was obvious that the residents of this community were awakened to the value of their resources, the rate at which these resources were being depleted and the necessity to take immediate steps to manage these resources.

General Observations and Recommendations

In all of these communities it was found that little or nothing is being done to conserve the natural resources that they depend on in their daily life. Residents pay very little attention to sustainable use of their resources, even though they are aware that these resources are being depleted.

It is recommended that results from this assessment be shared with the village councils of these communities so that they can use it to assist in formulating Village rules for the management of their resources. These communities should also be encouraged to seek assistance from agencies and NGO's to assist in developing and implementing Resource Use Development Plans.

Author's Note: *The methodology used during this Resource Use Assessment was developed by a team from Conservation International Guyana (Patricia Fredericks included) and used previously with the Wai Wai Community of Kanashen.*