Brownsberg Nature Park

ECOLOGICAL RESEARCH & MONITORING PROGRAM 2001-2006

Kelly A. Fitzgerald

Bart P. E. De Dijn

Sutrisno Mitro

1 September 2002

STINASU - Foundation for Nature Conservation in Suriname
Research Department of STINASU, Stichting Natuurbehoud Suriname
Cornelis Jongbawstraat 14, P.O. Box 12252, Paramaribo, SURINAME
Phone (597) 427102 / 427103 Fax (597) 421850
Email research@stinasu.sr and stinasu@sr.net
WWW http://www.stinasu.sr

Acknowledgements

We would like to acknowledge and thank the following persons:

- **Pierre-Michel Forget** from the Museum National D'Histoire Naturelle (Paris) for providing critical feedback since the first draft of this document was prepared, and for the promotion of Brownsberg as a research site.
- **Paul Ouboter and Shamita Sahdew** from the National Zoological Collection of Suriname for preparing the water quality monitoring protocol, for inputs on wildlife monitoring, and for the initiation of baseline studies on water quality, amphibians, and fishes.
- **Henk Reichart** from WWF and the Oceanic Society for inputs on wildlife monitoring and climatological monitoring.
- **Otte Ottema and Marchal Lingaard**, the ornithologists at STINASU, for help with the bird study aspect of the wildlife monitoring protocol, and for the initiation of a baseline study of the Brownsberg bird fauna.
- **Pieter Teunissen** for detailed information about the flora and fauna of Brownsberg.
- **Kenneth Tjon** from the Center for Agricultural Research in Suriname for inputs on vegetation monitoring, mapping and GIS.
- **Sue Boinski** from the University of Florida for inputs on monkey population monitoring.
- **Frank van der Lugt** from the University of Suriname for doing a field survey for the development of the water quality monitoring protocol.
- **Helen Hiwat and Anil Gangadin** from the National Zoological Collection of Suriname for inputs on assessing the insect biodiversity in the Park.
- **Marga Werkhoven and Usha Raghoenandan** from the National Herbarium of Suriname for inputs on vegetation monitoring.
- **John de Bruin** for assisting with the technicalities of herpetofauna monitoring.
- **John Perrine** from the University of California at Berkeley for providing inputs on the study of carnivores.
- **Jim Sanderson** from the Center for Applied Biodiversity Science at Washington, D.C. for training in the surveying of nocturnal mammals and for the donation of trap cameras.
- **Scott Mori** from the New York Botanical Garden for providing information on Lecythidaceae and the vegetation of the Park.
- **Burton Lim and Mark Engstrom** from the Royal Ontario Museum for providing training and information on bats surveying, and for a preliminary survey of the bats of the Park.
- **Francois Catzeflis** from the University of Montpellier for providing training and information on small mammal surveying, and for a preliminary survey of the rodents and marsupials of the Park.
- **Tim Paine** from the University of Louisiana for assisting with the development and initiation of vegetation monitoring in the Park.

Summary

Brownsberg Nature Park was established in 1970 and is Suriname's first and only national park. Since its creation, the Park has become one of the most popular nature recreation areas in Suriname. It is an excellent bird-watching area. It has unique habitats, such as moss forest, as well as endemic plant species. It also harbors a very diverse wildlife.

STINASU—the Foundation for Nature Conservation in Suriname—has been successful in promoting the Park as a recreation destination. The promotion of research and nature education in the Park, however, has been under-emphasized. For the sustainable management of the Park and its biodiversity, it is mandatory that an ecological research and monitoring program be implemented. This program must yield up-to-date information upon which management decisions can be based.

Equally critical—perhaps more so since it seeks to foster nature conservation in all of Suriname—is that opportunities be created at Brownsberg Nature Park for Surinamers to learn about nature. The Park hosted 17,000 mostly Surinamese visitors in the year 2001, which is equivalent to more than four percent of the total population of Suriname. Currently, it is the most popular nature destination in the country. It consequently offers unique opportunities for effective nature education, exposure to nature research, and the nation-wide promotion of love and respect for nature.

On-the-job training of Surinamers in ecological research can be undertaken at the Park, in conjunction with facilitation of research and monitoring by national and international research teams. This will yield skilled personnel and critical information. The Park can become a place where monitoring techniques can be learned, and where studies on the sustainable use of the rainforest can be initiated. By exposing visitors to these techniques, studies and their results, the Park will effectively become a "rainforest school". Easy access and good facilities make it an attractive place to observe and learn.

The research and monitoring program for the Park will serve to:

1. Assess the "health" of the Park's ecosystems and the conservation status of the Park,
2. Locate the flora, fauna, and ecological phenomena for the purpose of visitor education,
3. Expand the potential of the Park as a site for nature study, and
4. Strengthen scientific research across the Guayanas Region, e.g. by sharing methodologies, information and human resources.

The practical objective of this research and monitoring program is to develop and implement an ecological monitoring protocol for the Brownsberg Nature Park, and, while doing so, develop the human capacity at STINASU by means of on-the-job training. The protocol includes the monitoring of climate and hydrology, water quality, vegetation, as well as wildlife. The construction of a Park Research Station facility is included in this program.

Samenvatting

Het Brownsberg Natuurpark werd in 1970 ingesteld en is Suriname's eerste en enige nationale park. Al kort na de instelling werd het Park een van de populairste gebieden voor natuur-recreatie in Suriname. Het gebied is een goede plek voor vogelaars. Het heeft unieke habitats, zoals mosbos, en herbergt endemische planten. Het is een toevluchtsoord voor vele wilde diersoorten.

STINASU – de Stichting voor Natuurbehoud in Suriname – heeft het Park met succes gepromoot als een ontspanningsoord. Aan de bevordering van onderzoek en educatie in het Park is echter veel minder aandacht besteed. Het is broodnodig voor het duurzame beheer van het Park en van haar biodiversiteit dat er een ecologisch onderzoeks- en monitoringsprogramma wordt uitgevoerd. Dit programma moet gegevens opleveren die kunnen dienen als basis voor beslissingen in relatie tot het beheer van het Park.

Minstens zo belangrijk – misschien zelfs belangrijker omdat het een gevoel voor behoud van de natuur moet kweken bij alle surinamers – is dat er te Brownberg mogelijkheden worden gecreeerd om over de natuur te leren. 17,000 mensen bezochten het Park in 2001; de meeste daarvan waren Surinamers, wat overeen komt met meer dan vier procent van de totale Surinaamse bevolking. De Brownsberg is tegenwoordig de populairste natuurplek van het land. Dit zijn haast ideale omstandigheden om het Park te benutten voor effectieve natuureducatie, voor het blootstellen van bezoekers aan natuuronderzoek, en voor de landelijke promotie van de liefde voor de natuur en van natuurbehoud.

Het Park biedt ook de mogelijkheid om jonge Surinamers "on-the-job" op te leiden tot ecologische onderzoekers, parallell en gekoppeld aan het faciliteren van onderzoek en monitoring door binnen- en buitenlandse onderzoeksteams. Zo verkrijg je goed opgeleide mensen en essentiele informatie. Het Park kan een plaats worden waar men ecologische technieken kan leren en waar studies naar de duurzame benutting van het regenwoud kunnen aanvangen. Door bezoekers bloot te stellen aan zulke technieken en aan onderzoeksresultaten zal het Park een "regenwoud-school" worden. Vanwege de goede bereikbaarheid en infrastructuur is het Park de plek bij uitstek om te observeren en leren.

Met het onderzoeks- en monitoringsprogramma wordt geoogd:

1. De diagnose van de "gezondheid" van de ecosystemen van het Park, en de bepaling van de status van het Park als plek voor natuurbescherming,
2. Het localiseren van floristische en faunistische elementen en van ecologische verschijnselen, dit voor de educatie van bezoekers,
3. De vergroting van de potentie van het Park als een locatie voor natuurstudie, en
4. Het ondersteunen van wetenschappelijke onderzoek in de Guayanas, o.a. door uitwisseling van info over methodes, van resultaten en van mensen.

Het practische doel van het onderzoeks- en monitoringsprogramma is om een protocol voor ecologische monitoring te Brownsberg te ontwikkelen en uit te voeren, en om simultaan de expertise bij STINASU te vergroten door on-the-job opleiding. Het protocol omvat monitoring van klimaat en hydrologie, van waterkwaliteit, van vegetatie, en van wildsoorten. De bouw van een onderzoeksstation is een integraal deel van het hier gepresenteerde programma.

Table of Contents

List of Appendices

Introduction

STINASU (the Foundation for Nature Conservation in Suriname) is a semi-governmental organization that is managing protected areas in Suriname. STINASU's founding statement is to 1) facilitate scientific research in the reserves, 2) engage in nature education and conservation awareness activities, and 3) develop nature tourism as a means to finance nature conservation. Brownsberg Nature Park was created in 1970 and is Suriname's only national park. As a Park, it serves as a private wildlands park belonging to STINASU and is not a strict, government-controlled nature reserve. Since its creation, the Park has become one of the most popular nature recreation areas in Suriname. It has earned an international reputation as being an excellent bird-watching area.

In the Brownsberg Nature Park Management Plan (Reichart 1991), the three guiding directives of STINASU are re-iterated as the guiding directives for the Park. The Park has traditionally been strong in promoting itself as a recreation and tourist destination. The promotion of nature education and scientific research, however, has been sporadic and under-emphasized. If the Park is to serve as a center for research and education, it is important that the biological diversity of the Park be maintained. The Park management must recognize "the importance of collecting data in a scientifically reputable manner so that [the data] can be used to address current and future management issues" (Fancy 2000). As of February 2001, STINASU created a Research and Monitoring Division for Brownsberg Nature Park, employing a full-time Research Coordinator to develop and manage research and monitoring activities specific to the Park.

In order to promote sustainable management of the Park and its biodiversity, it is absolutely critical that the Park creates and implements an ecological monitoring program in order to begin collecting and updating baseline data on the Park's ecological composition, status, and health. An additional motivating component of this program is the provision of educational and experiential opportunities in research to Park visitors and the general Surinamese population in order to promote nature conservation. Monitoring programs must first document the initial or baseline conditions of both natural areas and adjacent human-altered landscapes (Kremen et al. 1994). Different types of baseline data are needed to assess the impact of projects and management through time on both biodiversity and patterns of human disturbance.

This Ecological Monitoring Plan outlines methodology and protocol for 1) the collection of baseline data on the climate, water quality, vegetation, and wildlife for the period of one year and 2) the on-going monitoring of these Park qualities over a five year period. This Plan will be reassessed upon completion of the fifth year of monitoring, revised, and continued.

Background and History

Brownsberg Nature Park is located northwest of the Brokopondo Reservoir, in the northeastern part of Suriname, about 90 km south of the capital city of Paramaribo (i.e. about 100 km south of the Atlantic coastline). It is named after one of the first gold miners who worked in the area during the early 20th century, the American Mr. Brown (Reichart 1991). In the 1950s, the bauxite company SURALCO explored the hill that has a bauxite cap, but the company was not interested in exploitation at that time. The 8,400 hectares of the northern and central part of the hill was subsequently given to STINASU in a long-term lease as a Nature Park. The location just below the northeastern high point of the plateau where buildings were set up by SURALCO has been used ever since by STINASU to accommodate day visitors and overnight guests. In 2001, STINASU obtained clearance from the Minister of Natural Resources to proceed with the acquisition of an additional 4,800 hectares of the Brownsberg hill range. This "new" area encompasses the southern part of the hill range and is contiguous with the current Park. On the other hand, 1,000 hectares of the "old" Park will become a zone where gold mining by inhabitants of the village of Brownsweg will be permitted. This is a lowland area that is, in fact, already heavily impacted by gold mining.

Thus, the current Nature Park's encompasses some 12,200 hectares, i.e. most of the Brownsberg hill, a 500-meter high tabletop range. The Park straddles a long and narrow crescent-shape laterite plateau that is a watershed divide between the Suriname and Saramacca river systems. The Park is dominated by seasonal evergreen rainforest and is characterized by heavily forested, steep slopes and gullies on all sides of the Plateau. Much of the Park is rugged terrain with the soil on the slopes being held in place by the root structure of the vegetation.

Although there are traces of pre-Columbian activities at the Brownsberg range (Reichart 1991), no native Amerindian settlements remain at or near it. At the time of the creation of the Brokopondo Reservoir (better known as the Brokopondo Lake) in the mid 1960s, thousands of Maroons left their flooding villages. Hundreds soon resettled at the foot of the Brownsberg, near the newly formed lake. The settlement there was called Brownsweg. In recent years, Brownsweg has become a large village with a busy "small-scale" gold mining industry. Villagers hunt and log near and occasionally in the Park, and gold miners have been mining within the Park boundaries.

Biogeographically, the Brownsberg hill range, including the Park, is an important area because it contains floral and faunal elements usually found only deeper in the interior, particularly on hills and ranges farther south in the country. The upper slopes and valleys of the Plateau are refuges and potential centers of endemism, harboring species not usually seen in the surrounding lowlands, most probably because the topographic relief has resulted in divergent humid environments. The rapidly rising slopes contain a number of different habitat zones, thereby enhancing the biological diversity of the area. Some animal species with specific feeding or nesting behaviors, which require that they occasionally migrate some distance to other habitats, need only move a short vertical distance on the Brownsberg. These aspects

of the Brownsberg—especially the wide range of altitudinal zones of tropical habitats—have hardly been studied, and the research of these habitats must be given priority.

Biological explorations of the Park and research there have been limited. A team of the Carnegie Museum (Pittsburgh) has collected bats and small mammals during 1971-73 in the Park (Engstrom pers. comm.). Tjon Lim Sang and van de Wiel (1980) have studied the vegetation along the upper reaches of some small creeks. Some plants new to science were discovered in the Park (Webster and Armbruster 1982, 1991; Prance 1986). Held (1984) has studied the ecology of some of the larger game bird species in the Park. The wildlife, vegetation, and water quality should be monitored on a regular basis because noticeable changes in the population densities, community composition, or quality can be harbingers of possible, not yet discovered problems, such as environmental deterioration, over-harvesting, or disease.

Although formerly a pristine rainforest area, the Park is increasingly affected and threatened by human activities, principally gold mining, logging, and tourism. Parts of the Park have already been seriously damaged. The precise extent of the damage remains unclear, such as the impact on wild flora and fauna. It is obvious that an ecological monitoring program urgently needs to be implemented in Brownsberg Nature Park. The small size, easy accessibility, and obvious damage in some areas make it a good location for undertaking a pilot ecological monitoring program, and learn from the results thereof. At Brownsberg, important lessons are to be learned about nature conservation as well as the responses of wildlife and biodiversity to human activities such as forest clearing, hunting and tourism. Lessons learned from research and monitoring at Brownsberg will be of great value for monitoring and management of other natural and protected areas.

During the early nineties, the first management plan for the Park was drafted (Reichart 1991) for the next five years. This plan has been implemented over a much longer period (ongoing). Research and monitoring prescriptions that were featured in the original management plan have only been implemented starting in 2001 when the Brownsberg Research and Monitoring Division became operational. The research and monitoring plan outlined here represents an expansion and update of the 1991 prescriptions in the form of a focused and fundable program. The implementation of this program has already started, particularly the wildlife monitoring part, using STINASU funds and funds obtained via the U.S. Peace Corps. WWF-GFECP (the Guayanas program of WWF) also plans to financially support the program, starting late 2002. Volunteers, interns and researchers have already been generously offering and providing their support in kind (refer to Acknowledgements).

Purpose and Objectives

STINASU's founding statement says that it is to assist in the development and promotion of scientific research, nature education, and recreation in the protected areas. The Park Management Plan (Reichart 1991) itself states that in order to attain the goals delineated in its statutes, STINASU will "stimulate, coordinate, and (jointly) finance scientific exploration and develop already existing nature reserves by 1) initiating and maintaining contracts with international conservation organizations, 2) obtaining financial and technical support from above-mentioned organizations, and 3) programming and conducting scientific research in the reserves, and making the results of such research available through publications."

STINASU realizes that that it should generate basic data on the state of the environment and biological diversity in these areas. Data needs to be updated regularly, interpreted, and lead to tangible scientific, educational, and recreational outputs. For the sustainable management of the protected areas and their biodiversity, it is critical that ecological monitoring programs be implemented which will yield up-to-date information upon which management decisions can be based.

Equally critical to the implementation of a monitoring program is the creation of educational and experiential opportunities in ecological research to Brownsberg Nature Park visitors. In the year 2001, Brownsberg hosted 17,000 visitors, most of who were Surinamese, thereby representing about four percent of the total Surinamese population. Because of this, Brownsberg offers unique opportunities for effective nature education, exposure to nature research, and the nationwide promotion of love and respect for nature. Thus, a second critical component of this program is the creation of opportunities at Brownsberg for Park visitors to learn about nature and the impact of man on nature, by getting exposed to the results of the on-going research.

The on-the-job training of Surinamese staff in the Park is also of critical importance, in conjunction with the facilitation of research and monitoring by national and international research teams. Training and the exposure to research will yield skilled and well-informed personnel. The Park should become a site where research and monitoring techniques can be tested and learned, and where studies of the sustainable use of the rainforest can be initiated. The information obtained from these studies would allow the Park to function as a "rainforest school", not just for park personnel, but also for students and other visitors. Easy access and good facilities make it an attractive place to observe, learn, and begin to investigate.

In order to assist with the achievement of this goal, an Ecological Monitoring Program for Brownsberg Nature Park was initiated in January 2001. According to Gibbs et al. (1999), the general purpose of monitoring is "to develop a scientifically defensible estimation of the status and trends in [natural] resources and to determine whether management practices are sustaining those resources or should be changed". The purpose of the Brownsberg Nature Park Ecological Research and Monitoring Program is four-fold:

1) To assess and monitor ecosystem health and evaluate the conservation status of the Park. This implies establishing baseline data for the Park's vegetation, wildlife, and water quality by collecting one year's worth of data. Subsequent monitoring efforts need to be continued over the long-term.
2) To locate the flora, fauna, and ecological phenomena for the purpose of promoting visitor education. Additionally, this monitoring program will utilize and integrate visitor, Park staff, and biologist input and information.
3) To expand the scientific and economic potential of Brownsberg Nature Park as a site for international ecological research. This will fulfill the guiding principles of STINASU and the Park and to generate monetary returns to feed back into STINASU, the Park, and the Research Program.
4) To strengthen the scientific research network of the Guayanas Region by promoting research at Brownsberg that involves both national and international participants. To achieve this, an exchange of information and of human resources between the countries will be instrumental.

The primary objectives of this monitoring program are 1) to develop and implement an ecological monitoring protocol for the Park and 2) to develop and provide training programs for STINASU staff, with an emphasis on developing their skills in ecological monitoring and research.

The following section of Methodology outlines a protocol for 1) the collection of baseline data on the climate and hydrology, water quality, vegetation, and wildlife for the period of one year and 2) the on-going monitoring of these Park qualities over a five year period. This Plan will be adjusted yearly and fully reassessed upon completion of the fifth year of monitoring.

Research Station

One of the immediate goals of this Ecological Research and Monitoring program is to create a world-class tropical rainforest research station at Brownsberg Nature Park. World-renowned tropical forest research stations can be found in Costa Rica (La Selva, Monte Verde), Venezuela (Rancho Grande), Panama (Barro Colorado Island), and Peru (Manu). Currently, efforts are being pursued to create a strong research program for the Guayanas Region (e.g. the Guiana Shield), with French Guiana and Guyana seeking to collaborate with Suriname in standardizing protocols, systematizing data management, and working towards the exchange of both information and researchers. A research station established in Brownsberg Nature Park would serve as a critical piece in strengthening the research efforts both within tropical forests and the Guayanas Region.

In order to fulfill the four-fold purpose of the Park's Ecological Research and Monitoring Program, and particularly to promote and expand the commercial and economic potential of Brownsberg Nature Park as a site for international ecological research, STINASU seeks to construct a fully functional research station at the Park. The facility will be designed to accommodate up to twenty researchers, both national and international, at one time. This facility is intended to support small groups and individual researchers who choose to stay for either a limited time or for the long-term. The core infrastructure will include basic sleeping and cooking facilities as well as laboratory facilities. Currently, an assessment of a potential location for this research station is underway at the Park, with important considerations being road access and access control, a year-round reliable water supply, electrical power, proximity to research plots and transects, and some degree of separation from Park guest facilities. The site of preference is located by the Telesur Transmission Station (see map located in **Appendix A**). For the time being, one of the old guest facilities, "The Ark", is being used as a research station. This building is, however, not well suited to serve as such because of its design and location.

Additionally, at least two satellite field stations will be constructed. The purpose of these stations will be to provide over-night shelter at remote research locations within the Park, and their design will be a simple hammock shelter with kitchen facilities and an outhouse. The plan is to locate the field stations in watersheds on the east and west side of the plateau, situated near permanent research plots that are to be established.

Finally, in order to promote visitor education, a Research Division information office should be constructed in the Park Headquarters area. This office will provide a space for the dissemination of research findings to Park visitors, promote education, encourage visitor involvement in the Park's research and monitoring program, and facilitate interaction between researchers and Park guests. As of May 2002, the Park initiated construction of such an office.

Methodology

The essence of a monitoring program is *not* the testing of cutting-edge biological hypotheses, but rather the documentation of environment, flora, and fauna, as well as the detection of changes in ecological phenomena. Monitoring the same sites over time is an effective method of program implementation to serve such intent. Since access to nearly 80% of the Park is severely restricted due to rugged terrain and limited trail and road infrastructure, it seems realistic to focus sampling efforts where access permits, and to increase sampling intensity in areas of special interest (for instance, moss forests and altitudinal gradients). A system of permanent plots and transects that are revisited over time is well-suited for detecting changes and trends, although it is not necessary to visit all of the selected sites every year, as the sites can be sampled on a rotation schedule over the years (e.g. for vegetation and botanical studies). This is important to bear in mind with unforeseen changes in funding or staff availability.

The Park has a number of habitat types. A preliminary habitat classification is provided in **Appendix B**. In order to conduct ecological monitoring activities in all of these habitat types, this program advocates the establishment of a network system of permanent research transects and plots to supplement the existing network of trails and roads. Research transects, visitor trails, and permanent points will all be utilized in the monitoring effort. Included in **Appendix C** is a list of the current trails and transects, and a description of their location and habitat types.

Research Transect and Plot Development

1. Several permanent transects will be established throughout the Park. A minimum of 4 pairs of 1500-meter transects will be created through the Park, including the areas around Rondwandeling, Mazaroni Falls, Witi Creek, and the Jeep Trail. These transects will serve as “research only” trails and be off-limits to non-research Park visitors. Transect location will attempt to target areas of both high and low visitor use, in order to evaluate community and visitor impact on the flora and fauna populations in the Park. These transects will also attempt to transverse an elevational range along the Plateau slopes, top, and base. At least one transect will target unique habitats, such as the moss forest, which should also be monitored.
2. More emphasis, however, will be placed on opening up transects in the southern region of the Park, away from the concentration of tourists. It is recommended that most of the region south of the Telesur Transmission Station be designated and managed as a research zone with only low-impact tourism permitted. This southern region extends for another 10 km along the plateau of the Brownsberg range.
3. Along selected transects, permanent research plots will be created. These research plots will be used to study and

classify the Park's habitats and vegetation, to evaluate the unique qualities of the habitats of the Park, to monitor nesting bird populations, to study insect biodiversity, and to conduct abiotic (e.g. soil) mapping.

4. Other monitoring and research efforts that should be implemented but that are not necessarily within the scope of this project are: 1) the establishment of research transects and/ or plots in the scarred gold-mining areas in the Park in order to monitor ecosystem recovery, and 2) the establishment of a canopy observation platform, which can be integrated into a canopy walkway for both international research attraction and eco-tourism promotion. Additionally, portable canopy observation platforms can be integrated into this program for the purpose of studying canopy flora and fauna (Nadkami 1988). In the disturbed and impacted areas, erosion, water quality, tree succession, habitat classification, and wildlife survey monitoring should all be carried out. These damaged sites are not only important sites for scientific research but can also provide sites for visitor education activities and/ or eco-volunteer habitat rehabilitation programs.
5. Additionally, permanent points, including Telesur, the Tapir outlook, and the Mazaronitop outlook, may be used to monitor animal populations. The points that have been identified here are vistas that provide an unimpeded view of the forest canopy that extends from the Plateau, down the slopes, and across the lowland regions. In addition, these points offer an excellent position from which to observe bird species that utilize the above-canopy space as well as edge habitats.

- Responsibility for work: Park Research Coordinator

The research and monitoring program will be ongoing and long-term and will be re-assessed every five years. It has already begun in March 2001, with the initiation of the collection of one year's worth of ecological baseline data. Baseline data collection will continue well into 2003, and during the remaining years of this program, until it is evaluated in 2006, the data collection will technically be ecological monitoring. Future monitoring data on the Park will be compared with the baseline data so that trends can be determined.

Landres et al. (1988) recommend two approaches to ecological monitoring efforts. The first is the species-based approach that is used when a particular species or group of species is of concern. Data is collected on population density, dispersion, reproductive output, and food and habitat requirements. The second is a community-based approach that is used when the quality or integrity of a habitat community is of concern. Data is collected on the attributes of community structure and on processes like the nutrient cycle, primary and secondary production, and the factors regulating these

processes. There are four components to the Brownsberg monitoring protocol. These are: 1) climatological and hydrological, 2) water quality, 3) vegetation, and 4) wildlife monitoring. Therefore, this ecological monitoring program seeks to integrate both species-based and community- based approaches by monitoring a wide breadth of elements.

Climatological/ Hydrological monitoring

1. Because the easterly Trade Winds and presumably also the Brokopondo Reservoir, located along the entire eastern edge of the Park, have an effect on the Park's climate, the climatological factors should be examined along the gradient from the lake, to the Plateau, to the lee-side of the plateau. A weather station will be (re)-established on the Plateau, ideally at the Telesur Transmission Station that is located about 4 kilometers south of the Park Headquarters complex, which is the proposed locality of the new research station.
2. Ad hoc climatological measurements and short-term monitoring will take place in other areas within the Park. For example, sampling will be conducted on the slopes of the Brownsberg hill range in order to monitor the climatological changes that are expected to occur along an east-west gradient from lakeside to lee-side. Climatological measurements will also be made within moss forest and non-moss forest types in order to determine the limiting factors governing the presence of moss forest. One option for the ad hoc monitoring is to purchase data loggers suitable for gathering data on specific factors and to utilize scaffolding within the various forest regions of the Park in which climatological monitoring is conducted.
3. Factors to record: minimum and maximum daily temperature; humidity; rain and fog precipitation, and solar radiation.
4. One goal of this aspect of the monitoring is to design models that can provide estimated measures of interests, such as evapo-transpiration rates and evapo-transpiration stress relative to habitat type and stratum. Meteorological Services of Suriname can provide data interpretation and analysis services. Additionally, most of the meteorological monitoring equipment comes with data analysis and interpretation software.
5. In addition to climatological factors, it is recommended that hydrological studies be incorporated into this aspect of the monitoring program. The Brownsberg range acts as a watershed for the surrounding lowlands, and the water catchment and discharge surely varies considerably in function of the wet and dry season, as well as with global climate fluctuations, such as El Niño (ENSO). A suggested protocol to monitor changes in water discharge and flow at

the Park in order to make extrapolations to and comparisons with fish densities, global climate change, and water quality, is to install weirs at selected creeks along the eastern and western slopes of the Plateau. At these weirs automated hydrological recorders (dataloggers) can be installed.

6. There is a concern about safety and protection of weather and hydrological stations, and thus, the need to locate them in an area where there is a permanent presence of Park personnel.

- Time/ Personnel Requirements: One Climatological Monitoring Supervisor and one Technical to collect data and conduct interpretation and analysis. Either predominantly non-automated data collection by 2 persons, for up to 5 hours per day, 7 days a week, or predominantly automated data collection by 2 persons, 1-3 days a week.
- Responsibility for work: Park Research Coordinator, Climatological Monitoring Supervisor, Technical Assistants
- Contacts: World Meteorological Organization, Meteorological Services of Suriname

Water quality monitoring

One of the main reasons for local and foreign tourists to visit the Brownsberg area is the crystal-clear brooklets and waterfalls. For tourism, it is important to keep these streams as clean as they are or formerly were. Water quality is also important for the safety of drinking water and for the impact it may have on freshwater aquatic life. Therefore, it is critical that water quality monitoring is incorporated into this ecological monitoring program.

Tourist facilities, including housing, recreational facilities, and trails are created in several areas. The housing and recreational facilities are located on the plateau (at an altitude of about 500-m) and include five houses for tourists and several for personnel. During most of the year, rain is sufficient to supply water for drinking and other purposes. This water is stored in several concrete tanks. From here it is pumped to a water tower to create adequate pressure to the distribution system, which supplies all houses and toilet groups with water. During the long dry season between September and December, a shortage of water may occur. In this case, water is pumped from a reservoir located in the upper reaches of the creek than feeds the Leo- and Irene Falls. The water from the taps and showers goes straight into the soil a short distance from the houses. The water from the toilets is drained to septic tanks.

Considering the water supply and sewage system described above, the following concerns arise:

- Accidental pollution of water reservoirs with coliform and other bacteria or toxins from other organisms.
- Accidental pollution of dammed reservoirs with bacteria or pollutants.
- Leakage of septic tanks to nearby creeks.

Also in areas outside the lodging areas, especially along trails and at waterfalls, tourism may cause water quality problems in the following manners:

- Pollution of creeks with litter, nutrients, and coliform bacteria.
- Increased turbidity due to erosion in picnic sites.

Since the late 1980's, a new gold rush started in Suriname, mostly inflicted the east of the country—the so-called Greenstone Belt. This area includes the Brownsberg region where gold mining also occurred during gold rush. For several reasons, it seems to be very difficult to control the borders of the Nature Park and to evict miners that have already entered the Park. Consequently, mining activities occurred and still occur in the area below and north of Irene Falls and the area of Witi Creek. It involves small- to medium-scale mining in which mercury is used for amalgamation of the gold. Streams affected by gold mining are therefore polluted by mercury. Sometimes the values of other heavy metals have increased because of the stirring-up of the soil.

In review of the water quality problems that may occur, a monitoring program should focus on three areas of concern:

1) Drinking water. Apart from some general water quality parameters, this part of the program should focus on bacterial pollution.
   - Localities: The water reservoir above Leo Falls and all the reservoirs near the guesthouses.

2) Pollution of creeks caused by tourists and tourist facilities. This part of the monitoring will focus mainly on general water quality parameters, including nutrients.
   - Localities: Leo- and Irene Falls, Kumbu Falls, Mazaroni Falls, Witi Creek, other streams below the Plateau, and a control site.

3) Pollution of creeks caused by gold mining. The focus will be on mercury pollution and increased turbidity, but also most of the general water parameters will be measured.
   - Localities: Streams located near areas impacted by gold-mining activities.

It is proposed to start with a baseline survey which will identify problem localities and parameters that are really significant, in order to reduce the costs for the actual monitoring. Hired, experienced water quality experts can best carry out the baseline survey. As soon as the results of the baseline survey are available, a draft monitoring program can be

developed by them for further execution by STINASU. STINASU personnel will have to be trained in water quality sampling and analysis. Preferably, one or two STINASU employees that will be involved in the actual monitoring activities should accompany the experts during sampling and analyses in the field during the baseline survey.

The baseline survey will include all localities and parameters of possible concern. The following 16 localities and 18 parameters are suggested:

Parameter	Rainwater	Reservoir Leo Falls	Reservoirs houses	Upstream Leo Falls	Leo Falls	Irene Falls	Upstream Kumbu Falls	Kumbu Falls	Mazaroni Falls	Witi Creek Upstream	Witi Creek Swimming Pool	Witi Creek Mainstream	Brokopondo Lake	Stream below plateau	Stream below plateau	Verjari Creek
Temperature	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
PH	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Conductivity	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Dissolved oxygen	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Turbidity	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Alkalinity	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Hardness	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Chloride	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Nitrate		■	■	■	■	■	■	■	■	■	■	■		■	■	■
Phosphate, ortho		■	■	■	■	■	■	■	■	■	■	■		■	■	■
Phosphate, total		■	■	■	■	■	■	■	■	■	■	■		■	■	■
BOD		■	■	■	■	■				■	■	■		■	■	
COD		■	■	■	■	■				■	■	■		■	■	
Ecoli/coliform bact.		■	■	■	■	■				■	■			■	■	
Fe		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Al		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Hg	■	■								■		■	■			■
Pb		■												■	■	

The baseline survey measurements will be taken during all four seasons, yet twice during the longer seasons, and therefore, a total of six times during the year.

For the execution of the baseline survey, the following additional facilities are needed:

- a rainwater container
- electro-chemical water quality meters
- a boat at Brokopondo Lake

- a trail to upper Witi Creek
- alternative trails to creeks below the Plateau

It is advised to proceed to purchase the equipment that is eventually needed for the monitoring that will be done by STINASU.

The monitoring program will be developed based on the results of the baseline survey, which will determine the localities and parameters per locality to include, and the frequency of measurement. For the budget, it is supposed that the monitoring program will include about half of the measurements of the baseline survey.

- Considerations:

1. In the rainy season, sampling should be conducted in the morning, before the rains, in order to avoid the increase water turbidity that follows the rains.
2. In every creek, 2 sampling points will be designated to rule out sampling error.
3. Consider collaborating with the Ministry of Public Works to develop a riverine computer model of the Park's watershed, as many employees in the Ministry have completed training in this.

- Time/ Personnel Requirements: For the first year of baseline survey, one water quality expert is required for 164 man-days and two technical assistants are required for 96 man-days each. During the following years when the monitoring program is implemented, the personnel requirements are as follows: one Water Quality Monitoring Supervisor and one Technical Assistant. At minimum, two persons are required for two weeks during both the short dry and short rainy seasons, and for four weeks during the long dry and long rainy seasons. This allows for field sampling and analyses, as well as data management and report writing.
- Responsibility for work: Park Research Coordinator, Water Quality Monitoring Supervisor, Technical Assistants
- Contacts: Paul Ouboter (National Zoological Collection of Suriname), Frank van der Lugt (University of Suriname), Ministry of Public Works

Vegetation monitoring

The basic vegetation of Brownsberg Nature Park can be categorized as seasonal evergreen forest, yet several plant communities can be seen within a fairly short distance because of changes in elevation and varying soil conditions. No habitat classification map has been completed for the Park. In the 1970s and 1980s, some researchers had identified and marked over 500 trees along the Park's roads and trails, and began monitoring the

phenology of these individual trees. While the work ceased in the early 1980s, the Park still has the original data and many of the marked trees are still identifiable.

The recommendations for implementing vegetation monitoring in the Park are as follows:

1. As of May 2002, tree phenology monitoring was re-initiated in the Park. Trees were marked and identified along the trails; in addition, the trees used in the original tree phenology monitoring effort of the 1970s and 1980s have been re-marked and their identifications checked. Presently, more than 500 individual trees of about 150 species are marked and available for phenology study. Located in **Appendix D** is a list of the tree species that are currently marked. As new trails, research transects, and research plots are established, additional trees should be identified and marked, and thus made available for phenology monitoring. Emphasis has been placed on the trees of importance to keystone mammal species that are monitored within the 'Wildlife Monitoring' aspect of this protocol. Many of these trees themselves serve as keystone species that provide food for the wildlife communities (Terborgh 1986). At least every two to four weeks, the individual trees should be examined, and the amount of fruit and flowers on these quantified. Included in **Appendix E** is a detailed protocol for tree phenology monitoring and in **Appendix F** is a data form. The appended protocol does not relate to leaf fall and the formation of new leaves. Vegetative tree phenology monitoring is nevertheless also important to add to the protocol. Fruiting or flowering trees can be utilized as sampling points for "sit and watch" fauna surveys.

- Patterns of flowering, fruiting, and leaf fall and formation that are derived from tree phenology monitoring will be tested for correlations with habitat types, dispersal mechanisms, and phylogeny. In addition, correlations will be examined between these patterns and the distribution of wildlife.

2. One-hectare (100mx100m) research plots, or similar, smaller plots (e.g. 0.1 or 0.01 ha) will be established along elevational gradients and in a variety of habitats within the Park, including the unique ones like moss forest. One-hectare plots provide sufficient information to study the botanical diversity and dynamics of most tropical forests (Dallmeier and Comiskey 1996); they have been used for botanical diversity studies in Guyana (Ek 1997). Once plot boundaries are delineated and marked, a plot can be divided into smaller quadrants. Within a plot, trees with a DBH (Diameter at Breast Height) of 1 or 5 cm or greater should be marked and identified. The main focus must be on monitoring temporal changes in forest structure and

dynamics as well as on vegetation diversity and composition, including that of the understory (regenerating) species to better understand which saplings of which climax species are regenerating in the various plots. These plots can also be established in the old gold mining sites and used to monitor ecosystem recovery. Additionally, this technique can be used to study the various habitat types more in-depth (see below). Refer to "Methodology for Establishing Biodiversity Plots" (Dallmeier and Comiskey 1996) in **Appendix F** for the standard methodology of plot establishment of forest dynamics measurements. The degree of plant endemism can be investigated through the data from these plots. One-hectare plots, as well as other standardized plots, will enable data about the Brownsberg forest to be compared with other forests worldwide, to analyze habitat associations for flora species, and differences in tree diversity and forest composition between different regions.

3. Records from the National Herbarium have been compiled into an initial list of the plant species of the Park. Currently, there are over 900 plant species known to occur in the Park; the most current list has been included in **Appendix G**. This list will be continually augmented through opportunistic collecting as well as through standardized plot studies.
4. Develop a habitat classification map for the Park by utilizing satellite imagery and field reconnaissance techniques. This effort can be coordinated with the standardized plot studies. To assist with the habitat classification and the research transect development and monitoring, as well as the other monitoring efforts, Geographical Information Systems (GIS) mapping equipment and programs should be purchased for the Research and Monitoring Division in Brownsberg Nature Park. A grant for GIS training, software, and hardware was submitted to the U.S. Fish and Wildlife Service in May 2002. GIS is a crucial component of Park monitoring programs and will substantially raise the quality and nature of the Park monitoring and management programs.
5. In order to quantify litter, fruit, and flower biomass, and to provide a good indication of the seasonal and spatial distribution of food resources, a series of litter traps will be established, following a standard methodology to be provided and tested in the field by Dr. Pierre-Michel Forget. Litter traps will need to be checked bi-weekly, and their contents dried, weighed, and identified. We expect the first litter traps to be installed and serviced by October 2002.
6. In March 2001, STINASU, through the efforts of volunteers, re-created an Orchid Garden within the Park. The Garden has a collection of the numerous orchid species that can be found throughout the Park. From July till September 2002, a

scientific orchid collection of the Brownsberg consisting of more than 100 species has been created by Mr. Jan den Held. The mounted plants in this "live" collection must be properly installed in a permanent structure. Efforts should be made to photograph the orchids when they are flowering.

7. Create a field guide to the vegetation of the Park. This production can be structured along the basis of a book created for the Ducke Reserve in the central Amazon of Brazil (Ribeiro 1999). This book will provide documentation of the flora of the reserve, a dichotomous species key, descriptions, and photographs and descriptions of the bark, flowers, leaves, and fruit.
8. Aerial surveys of the Park should be conducted bi-annually. The primary purpose of these flight surveys will be to obtain photographic documentation of the Park to assist with the monitoring of habitat degradation as related to gold mining and forest clearing (e.g. logging) around and within the Park. Additionally, these aerial surveys can service Park management and law enforcement by aiding in the monitoring of gold-mining activities that intermittently pervade the Park.

- Time/ Personnel Requirements: One Vegetation Monitoring Supervisor with one Technical Assistant. At minimum, two persons required 5 days per week, up to 8 hours per day. This is inclusive of both the monitoring and the data entry and management.
- Responsibility for work: Park Research Coordinator, Vegetation Monitoring Supervisor, Technical Assistants, Park Tree-spotters
- Contacts: Pieter Teunissen (Independent Researcher), Kenneth Tjon (CELOS/ NARENA), Marga Werkhoven and Usha Ragoenandan (National Herbarium of Suriname), Olaf Banki and Marjon Jansen-Jacobs (Netherlands Herbarium, Utrecht Division), Tim Paine (University of Louisiana)

Wildlife monitoring

The Park Management Plan includes detailed species lists for amphibians, reptiles, fish, birds, and mammals. Updated and revised lists for the herpetofauna, mammals, and birds are located in the **Appendix (H-J)**. Fauna population monitoring is, in many ways, the primary focus of this monitoring protocol. Its implementation will require the efforts of biologists, interns, volunteers, visitors, and Park staff. It should be required that Park Guards, who are responsible for the patrol of the Park and its boundaries, be trained in this protocol.

The question of "What to monitor?" is always a difficult one. Gibbs et al. (1999) make the following recommendations for answering this question. A useful indicator to monitor is "some attribute that is reflective of environmental conditions that extend beyond its own measurement, that provides an early warning of a change in the system, that directly indicate a cause of a change rather than simply the existence of one, and that represents broad changes in a resource of concern". Umbrella species (the habitat of these species hosts many other associated species) and Keystone species (these species have strong interactive effects with other species and thereby generate effects that are large relative to the abundance of the keystone species) are useful indicators for monitoring. These two categories of animals can often be used as indicators for monitoring efforts. An indicator species is an organism whose characteristics (e.g. presence or absence, activity, population density, dispersion, reproductive success) are used as an index of attributes too difficult, inconvenient, or expensive to measure for other species or environmental conditions of interest (Landres et al. 1988). Finally, monitoring efforts should focus on indicators that 1) represent the community by interacting with a wide variety of species and responding to a variety of environmental components, 2) are easily detectable in the environment with minimum sampling effort, and 3) contribute greatly to unique components of the system. By definition, however, indicators may bear no direct or simple cause and effect relationship to the factor or factors of interest (Landres et al. 1988), and therefore, should be selected carefully and interpreted cautiously. A guiding directive of using indicators in a monitoring program is to select indicators that collectively represent multiple levels of organization (i.e. populations, species, communities, ecosystems, and landscapes) from different structural, compositional, and functional perspectives (Kremen et al. 1994).

For the purpose of this monitoring program, several "Animal Focal Groups" have been identified and selected. These are: birds (incl. game birds), game animals, monkeys, amphibians, reptiles (herpetofauna), large terrestrial carnivores, bats, small nonvolant mammals, fish, insects and arthropods in general, and butterflies. Each of these focal groups will be discussed in further detail below with respect to the monitoring protocol methodologies.

In order to conduct monitoring activities on these selected taxa, either the Park's core research team or specialized research groups that we do not assume are a part of the core team will be responsible for the implementation. The Park's core research team will oversee the following methodologies:

- Transect walking in order to monitor populations and distributions of game animals (incl. birds), and monkeys,

- Pitfall trapping to inventory and monitor populations of amphibians, small nonvolant mammals, and macro-invertebrates,
- Photo-trapping to monitor large terrestrial carnivores and nocturnal mammal species.

For a broader or more in-depth study of target taxa, such as birds and amphibians, and for the study of additional taxa such as bats, smaller arthropods, and butterflies, help from outside specialists will be required. We expect specialized studies, including the personnel and finances to undertake them, to come largely from sources outside of STINASU (and thus not included in the budget below).

One notable consideration is that it would be advantageous to create a pocket bird and mammal guide for visitor and staff use. This field guide would provide color plates and descriptions of the key bird and mammal species.

i. Time/ Personnel Requirements: One Wildlife Monitoring Supervisor and two Technical Assistants, with considerable input from temporary research assistants. At minimum, two people required 7 days per week, up to 8 hours per day. This is inclusive of both the monitoring and the data entry and management.
ii. Responsibility for work: Park Research Coordinator, Wildlife Monitoring Supervisor, Technical Assistants, Park Guards

- Contacts: Bart de Dijn (STINASU Research Director), Paul Ouboter (National Zoological Collection of Suriname, Herpetologist), Otte Ottema (STINASU Ornithologist), Sue Boinski (University of Florida, Primatologist), John de Bruin (Independent Herpetologist), Mark Engstrom (Royal Ontario Museum), Francois Catzeflis (University of Montpellier), James Sanderson (IUCN/ Conservation International), John Perrine (University of California at Berkeley), the Bronx Zoo, US Zoological Society, Wildlife Conservation Society, Jan Mol (National Zoological Collection of Suriname/ CELOS), Phillip de Vries (Independent researcher), Helen Hiwat (National Zoological Collection of Suriname)

Methods to be implemented by the Core Park Research Team

Transect Walking

In order to monitor game animals, game birds, and monkeys, as well as snakes and two highly conspicuous amphibian species

(*Epipedobates trivittatus* and *Atelopus spumarius*), a diurnal transect walking methodology will be implemented.

We intend to calculate population densities of these target taxa, using Leopold's method (i.e. calculation of density based on perpendicular distance to transect of animals sighted) or similar methods (as done by Simmen et al. 2001 for primates). Thus separate estimates may be obtained for different transects and different parts of the Park. This, however, may not be strictly possible for several of the target taxa because of their great mobility. Also, transect counts may, in many cases, reflect activity rather than density. It will be attempted to estimate density or activity during discrete seasons (i.e. rainy season vs. dry season). We expect this to be possible only for those taxa that are very abundant or active during at least one season.

The intent is to monitor the trails and transects in the Park at least 2 to 3 weeks of every month, with the goal of accumulating a minimum of 50km of transect monitoring every month. Monitoring must occur during the first 4 hours after sunrise, and opportunistically, during the 3 hours before sunset. A standard pace of 2-3 km/ hr will be used during transect monitoring. A detailed list of the species within each of these focal groups is provided in **Appendix K**. A sample Monitoring Schedule is provided in **Appendix L**. As these transects and trails are walked, any animal that is identified in one of the Focal Groups will be recorded.

The reasoning and focus of monitoring the selected animal groups in this manner are as follows:

1. Game animals: Key species of game animals to be monitored include, but are not limited to: peccaries, agouti, deer, tapir, etc. Generally, any large mammal species (i.e. larger than *Myoprocta acouchy*) can be included as a 'game species'. Since residents of the nearby villages hunt these species, it is important to monitor the presence, numbers, behavior, and habitat use of these species. Behavior is notable as it can provide an indication of the degree of human impact and quality of habitat. Identifying the habitat that the various species are utilizing is important in designating and managing critical habitat for these species. All game animals seen or heard should be recorded. As well, notes should be made about feces, cadavers, tracks, etc. that are encountered. Tracking stations should be established along some of the permanent research transects and be regularly monitored. For example, along the Plateau road (Mazaroniweg), Witi Creek Trail, and Transect 3, there are some good tracking station locations where there are semi-permanent mud holes or sandy patches. These sites should be regularly visited, and any tracks located there recorded.

2. Game birds: A general quantitative monitoring of game birds will take place within the realm of this transect walking methodology. The selected game bird species that will be the focus of the general monitoring efforts are the gray-winged trumpeter, the black curassow, the five species of tinamou, and the two species of guan. It should be noted that it will be difficult for biologists who are not trained in field ornithology to document the species *heard*.
3. Monkeys: All eight species of monkeys found in Suriname can be found in Brownsberg Nature Park. It should be noted that a particular emphasis should be placed on monitoring the howler monkeys, spider monkeys, and brown capuchins, as these are especially targeted game species. Because some of these species succumb to hunting pressure and because monkeys are considered high profile and even keystone species, it is important to monitor these. Again, since members of the nearby community occasionally hunt several of these species, it is important to monitor the presence, numbers, behavior, and habitat use of these species. Sue Boinski of the University of Florida emphasizes that the observation of monkey behavior itself is a strong indicator of the degree of human impact and quality of habitat. For example, the terrestrial predator alarm (TPA) vocalization is a robust and acoustically distinctive anti-predation vocal response that is present in many mammal and bird species; it can offer useful information on the relative well-being and stress levels of animals (Boinski et al. 1999). Efforts should be made to identify the trees that the monkeys are utilizing and the fruits (or other items) that the monkeys are eating. Identifying the habitat that the various species are utilizing is important in designating and managing critical habitat for these species. Refer to Stoner (1994) for an alternative protocol to determine monkey densities.
4. Herpetofauna: In assessing and monitoring the entirety of the Park's biodiversity, a special focus should be the herpetofauna found in the Brownsberg vicinity. Through transect walking, data will be collected on two species of amphibians which are highly conspicuous and easily identifiable (*Atelopus spumarius* and *Epipedobates trivittatus*) and any snakes, turtles/ tortoises, and caimans that are encountered.

Two wildlife data collection forms have been created. Both forms are located in **Appendices M-P**. One is a standard "Wildlife Monitoring" data form (accompanied by an information guide and methodology sheet) to be specifically used by the Brownsberg research team, assistants, and Park guards who will be trained in this protocol. The second is a Wildlife Observation Form

(accompanied by an information sheet for visitors that details the monitoring program) that is targeted towards Park visitor use, with the purpose of not only gathering and categorizing additional wildlife observation data, but also promoting visitor education. Both data forms seek to record the following information:

- Date of monitoring effort,
- Observer(s)/ data recorder(s) name or initials,
- Transect name,
- Time of day that monitoring began and ended,
- Weather conditions,
- Time of sighting,
- Marker distance code (corresponds with trails and distance in meters),
- Distance (perpendicular at ground level) of animal from trail
- Stratum / height above the ground where animal was located
- Species scientific name,
- Total number of animals in group,
- Number of males and females within group, if known,
- Number of young in group, if present,
- General behavior of animal(s),
- General (physical) description of animal(s),
- Habitat classification type,
- Comments, such as notes about feces, tracks, and cadavers that are encountered and information about what was collected (i.e. feces, tissue samples, fruits, seeds, etc.) and where it was found.

Again, it should be emphasized that Park guards, who are responsible for patrolling the boundaries and the less accessible regions of the Park, will be trained in the Wildlife Monitoring protocol and be required to participate in this effort.

Lastly, this methodology is predominantly a diurnal transect effort. It is important, however, to implement night surveys in order to survey nocturnal wildlife, such as the felids, opossums, and kinkajous. It is recommended to implement night surveys, and to conduct these on a variety of trails and transects at least one time per week. Leo Falls Trail, Mazaroniweg, Jeep Trail, and Mazaronitop Trail are ideal transects on which to conduct night surveys; they are ideal in that they offer relatively flat (and therefore safe) terrain which transverses several habitat types. The standard protocol is to stop every 100m, listen, and scan the entire area—from ground to canopy—with a spotlight.

Pitfall Trapping

In order to survey and monitor small nonvolant mammals and amphibians, as well as larger invertebrates, pitfall trapping will be implemented throughout the Park. The aim of this survey is to obtain a species inventory of the target taxa. In terms of data

analysis, this means that these data will also be analyzed using rarefaction methods (e.g. species-effort curves and estimation of asymptotic species richness). It is obvious that this method represents the initial stages of monitoring and will only yield information on general faunal composition in the Brownsberg area.

The reasoning and focus of monitoring these selected groups in this manner is as follows:

1. Small nonvolant mammals: Our current knowledge of this fauna is very poor. In April of 2002, Francois Catzeflis of the University of Montpellier and Mark Engstrom of the Royal Ontario Museum helped to initiate a survey of small mammals in the Park, using pitfall traps, Sherman traps, BTS traps, and Tomahawk traps. Upon their recommendation, pitfall trapping can be used to continue to survey and monitor the small mammal populations in the Park; they have pledged to assist STINASU in the identification and cataloging of the specimens that are collected therein.
2. Amphibians: Globally, amphibian populations are declining, and, therefore, it is important to monitor the amphibian species found at Brownsberg. While data will be collected on two of the amphibian species, *Atelopus spumarius* and *Epipedobates trivittatus,* through the transect walking, pitfall trapping is a proven methodology to inventory ground dwelling amphibian species. It should be noted that it would be most effective to implement in-depth amphibian surveys during the wet seasons, during the night (i.e. with transect walking), and after heavy rains.
3. Invertebrates: The National Zoological Collection of Suriname has expressed interest in processing invertebrate specimens from the pitfall traps in order to continue with their on-going effort to catalogue the Park's invertebrate biodiversity.

This said, a typical pitfall trap line consists of 11 five-gallon buckets, placed into the earth up to the rim, spaced 10m apart, and connected by a 30-40cm high drift fence. The total line is 100m in length. The goal is to establish a series of 6 trap lines in various regions or habitats in the Park (e.g. 2 along Jeep Trail, 2 along Witi Creek trail, and 2 along Mazaroniweg). To maintain the traps, ensure that at least 2cm and no more than 5cm of water remain in the bottom of the bucket.

Every morning, the pitfall traps must be checked, preferably by 8 AM, and all specimens collected. If not, the specimens will spoil. If it is known that a field technician will be unable to check the pitfall traps the following day, the buckets either must be covered with their lids or branches and twigs must be placed inside, providing small mammals with an escape mechanism.

Collected small mammal specimens will be processed in the following manner. 1) Dry by brushing with cornmeal. 2) Identify, if

possible, to species. 3) Record the following data: identification number (see below), species, collection location, date, total length, tail length + tuft length, hind foot length + nail/ claw length, ear length, weight (if possible), sex, and whether or not the female is pregnant or lactating. Next, a small incision must be made in the lower abdomen, and a couple miniscule incisions made in the stomach. A Royal Ontario Museum tag will be tied around the ankle once the identification number is recorded next to the data, and the specimen will be placed in formaldehyde solution. Every 6 months, all the specimens will be sent to the Royal Ontario Museum (c/o Mark Engstrom, Senior Curator of Mammals) for identification and processing. In order to prepare for shipment, the specimens must be removed from the formaldehyde, and individually wrapped in gauze (or cheesecloth) and triple bagged.

The amphibians that are collected will be identified, photographed, and released. Data recorded about these will be: species, date, location, and, if necessary, snout-to-vent length measurements. If possible, a photograph will be made of each species in order to compile an irrefutable database for the Park's amphibians.

Invertebrate specimens will also be collected. Specimens will be placed in formaldehyde solution and shipped to the National Zoological Collection of Suriname for identification and cataloging.

If the capture rate significantly declines (i.e. <4 small mammals a week, for a single 100m drift fence), this is an indication that the local population is being over-captured. It is recommended that the trap lines be run continuously for one month, and closed for two months in order to allow the community to recover from removal sampling. Thereby, at least 2 trap lines can be run at a time, while the others remain closed.

Photo-trapping

In order to most effectively monitor both large terrestrial carnivores, particularly felids, and shy or nocturnal mammal species, photo-trapping surveys will be used. This technique will essentially be used as an inventory tool for these elusive animals. Since the camera also records the time of observation, the data obtained can also be used to assess the daily activity pattern, at least for some of the more common species photographed. A minimum of 10 of CamTrakker© cameras (Conservation International 2001) will be obtained for this effort. These 10 cameras will be established equidistant in selected 10-km^2 sites. Every 6 months, the cameras will be relocated to other sites in order to more fully survey the Park's habitats. This has the implicit goal of determining which habitats the predators are utilizing and determining density of populations. Data obtained will include species, date, time, and location, and possibly the sex and identity (determined by distinguishing markings or scars) of the individuals.

Target taxa for in-depth study by outside specialists

Birds

With respect to bird monitoring, there are three methodologies, both qualitative and quantitative, that will be incorporated into this wildlife-monitoring program.

1. A general qualitative survey of the Park conducted monthly (or bi-monthly) by a professional ornithologist; this survey provides a general inventory of where different bird species are located throughout the Park. Repeated bird surveys have in fact already been implemented, independently of this research plan, by Otte Ottema of STINASU. The survey results need to be evaluated. If the existing data is inadequate, surveys may need to be repeated. An in-depth bird survey of the Park should be completed at least *every two months*, while every month is preferable. Methodology includes walking the various trails and transects and recording the birds heard and seen. Selected permanent vista points (i.e. Tapir outlook, Mazaronitop outlook, and Telesur), should be monitored for bird activity during this survey. Additionally, targeted observations of canopy species need to be undertaken at suitable point locations (places with an open sub-canopy, e.g. at roads). Abundantly fruiting or flowering trees also need to be monitored opportunistically; this will help with obtaining records of hummingbird and manakin species. The netting of birds must be considered in order to obtain adequate records of foliage gleaners and leaf tossers. This survey provides a general inventory of where different bird species are located throughout the Park. *Given the specialization of bird studies, this aspect of monitoring should be delegated to a specialist, and in this case, to an experienced ornithologist (with years of field experience in the Guayanas Region or at least other Amazonian regions).*
2. A more in-depth quantitative study will be conducted using transect and point count methods; this effort will focus primarily on comparisons between habitats and use-zones within the Park. To provide the bird monitoring with more quantitative data about bird populations in the Park and habitat utilization, this second methodology has to be implemented at least quarterly in the Park. It is advantageous, given that time and human resources are limited, to utilize transect counts (moving along trails at a constant speed, stopping only when necessary to identify species) as well as point counts along the trails (5-10 minute

counts by a static observer; every bird within 25-50 meters is recorded; counts at random or at regular intervals). Point counts may only be strictly possible and required for assessing the canopy fauna. Canopy bird counting involves an observer lying on the ground, looking upward (focusing on movement in the canopy). In addition to quantitative information about the number of birds sighted, additional data will be collected on habitat and strata utilization. A data form for point counts has been created; it is included in **Appendices Q-R**. *Given the specialization of bird counts, this aspect of monitoring should be delegated to a specialist, and in this case, to an experienced ornithologist.*

3. Upon further consultation with a STINASU ornithologist, a methodology is being developed to map bird territories for endemic and rare species which nest in the Park. Within the permanent research plots, it is recommended that a Bird Territory Mapping study be initiated. While this monitoring program does not specifically target nesting birds, the Park should aim to incorporate this element of monitoring and research into the Park-wide research and monitoring efforts. An additional data form has been created for this methodology; it is included in **Appendix S**. *This aspect of monitoring will need to be carried out under the guidance of an experienced ornithologist.*
4. Additionally, mixed species flocks will have to be recorded in sufficient detail. The previous methodologies are expected to fail in this respect, since generally only the approximate size of the flock and some of the lead or most conspicuous member species will be recorded. This is insufficient, since mixed species flocks may contain tens of bird species (many inconspicuous). Such flocks are difficult to observe because they often move rapidly, and because a single flock may simultaneously occupy all forest strata. The adequate assessment and monitoring of mixed flocks is important because most of the bird individuals in any Neotropical forest block may be members of such flocks. Investigating them will require specialized methods, as well as time and energy in the field of a specialized team of researchers. An adequate method might be to follow the flocks opportunistically as soon as they are encountered along transects. *This aspect of monitoring will need to be carried out by an experienced ornithologist.*

Bats

Bats are critical in terms of seed dispersal and pollination, for example of Walaba (*Eperua* sp.) and Kankantri (*Ceiba pentandra*), and contribute significantly to the Park's biodiversity. In April 2002, the Royal Ontario Museum initiated a bat survey in

the Park. The survey team conducted an intensive 2-week study utilizing mist-netting techniques at both the ground level and in the canopy. Preliminary results reveal that the survey is incomplete, in terms of the amount of species and individuals recorded. Therefore, it is recommended to conduct additional bat surveys, both to complete an inventory of the bat populations in the Park and to monitor the health of the populations over time. It is recommended that bat surveys be conducted 2 weeks of every year. It is necessary to invite a specialized research team to the Park to conduct this sampling.

Fishes

No specific methodology has been developed yet for monitoring fish populations in the Park for two reasons. Firstly, the water quality monitoring data will provide a qualification of the health of the riparian ecosystems. Secondly, the required methodology for monitoring fishes is technical and requires an expert to implement. The National Zoological Collection of Suriname, however, may be interested to develop a suitable methodology for the Park, and has already initiated an inventory of the fish fauna of the Park and neighbouring areas (Saramacca River system). Data on fishes can certainly feedback into the general wildlife monitoring effort in the Park.

Invertebrates

The National Zoological Collection of Suriname (NZCS) is interested in collecting the insects that are obtained in the pitfall traps. Additionally, from April 2001 through April 2002, it carried out an insect biodiversity inventory, comparing different habitats in the Park. Any invertebrate monitoring effort in the Park must come from NZCS or other specialized research groups since this is a very specialized field of study. It is recommended, however, that the Bureau of Public Health be asked to conduct a study on malaria vectors in the Park lowlands. This is important as the Park intends to establish over-night facilities near the lakeside and visitor safety must be considered.

Butterflies

Our knowledge of this fauna is currently poor, but it is important, primarily in the interests of tourism promotion, to inventory and monitor the species of butterflies, and to document where and when they are seen. This is a specialized field of study that must be initiated by a specialized research group.

Applications for Monitoring

Through these stated monitoring efforts, we seek to gain a holistic understanding of the Park's ecosystem. By integrating the data and results of wildlife, vegetation, habitat, water quality, and climate, a greater picture emerges, providing insight into the ecosystem health and quality of the Park. This monitoring program will provide information that will be fed directly back into Park management. Given that this program is long-term and ongoing, adaptive Park management is going to become a crucial partner in the overall effort.

Another aspect of this program is to incorporate the monitoring of interactive processes and the results thereof into the effort. By studying such processes as leaf litter fall (via litter traps) and the cycles of leaves, flowers, and fruits and by examining the interactive aspects of frugivory and pollination within the forest community, results can be obtained which are indicative of fruit and seed set and dispersal, as well as seedling growth and succession. Early and ongoing monitoring can reveal warning signs of stress and unbalance in the ecosystem, which may be able to be remedied through adaptive management. For example, the fruits that are not being eaten on the forest floor serve as an indicator of the absence of key animals or processes.

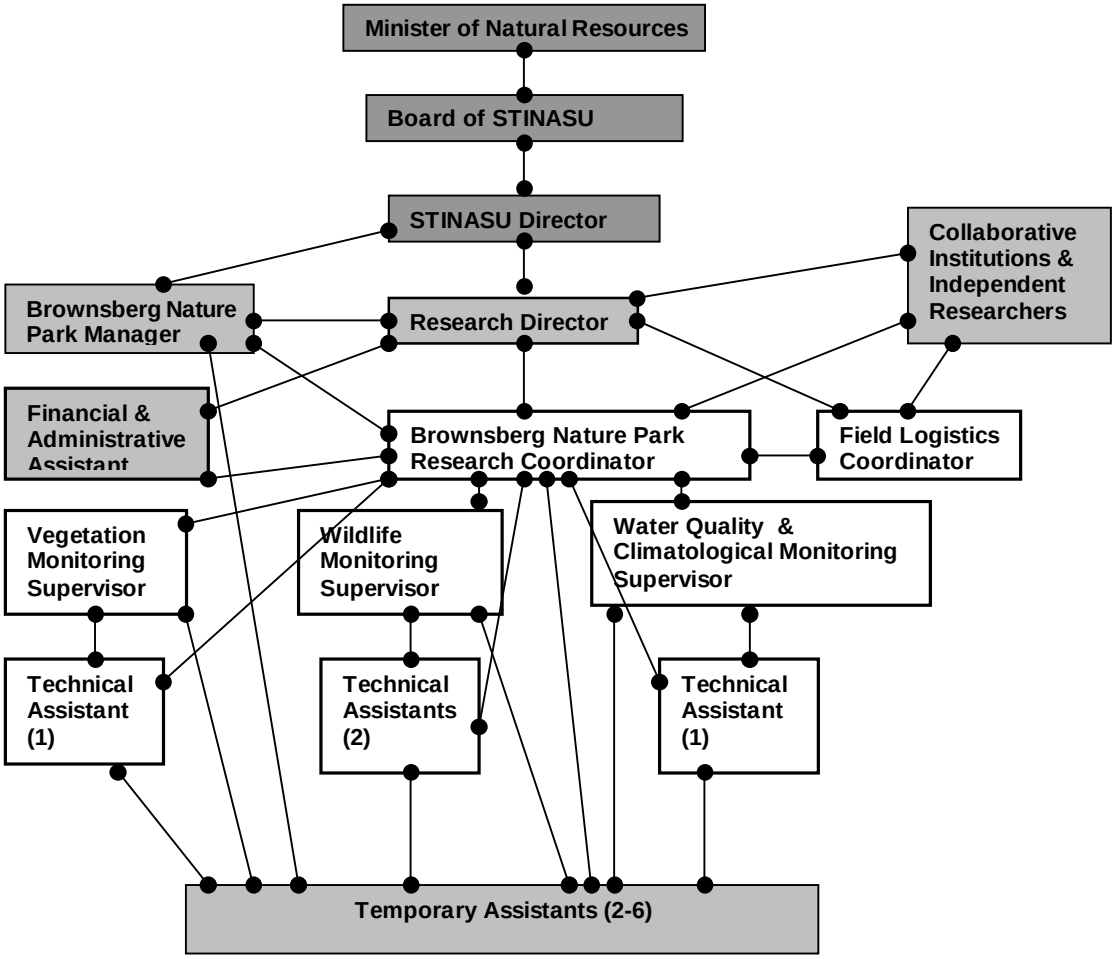
With this in mind, efforts should be made to extend the ecological monitoring and research efforts to evaluate ecosystem and landscape level interactions, resource use impact and sustainability, visitor and community impact on ecosystem health in high-use areas and along the borders, and ecosystem recovery in disturbed areas. Brownsberg Nature Park is an ideal location to study the effects of human activities on ecological phenomena and biodiversity. The Park is affected by a number of legal and illegal human activities, including tourism, hunting, forest clearance, and gold-mining. Additionally, the Park is in a geographic position that is increasingly influenced by surrounding land-use and land-interest pressures. In the light of these circumstances, it is important to work with Park management, local cummunities and government agencies to strive to increase protection of the Park and surrounding areas. The Park is placed in a scientifically valuable position as a critical area to study the trends of how and to what degree ecological phenomena and biodiversity are influenced by a variety of human activities. This broadens our investigations in scope and importance.

As the program is expanded and becomes more comprehensive in scope, and as more data and information is collected and interpreted, it is absolutely critical that this information is disseminated to other researchers, and importantly, to Park visitors. Creating a Research and Monitoring Division Information Center in the Park would be an ideal place to display information about the program and the researchers, and to provide interpretive and educational material about the data that is being collected through the program. For example, a pamphlet called "What kinds of wildlife you can see where and when" can be created by utilizing and interpreting the wildlife monitoring data. In addition, an interpretive guide can be produced that points out to visitors signs of ecosystem health (or disease) in the Park.

Organizational Structure of Research and Monitoring Division

The organizational structure for the Brownsberg Nature Park Research and Monitoring Division is represented in the flow diagram. Duties for the various job positions are as follows:

- Research Director: Promotes, coordinates, and advises research and monitoring activities in all the protected areas managed by STINASU, including the nature reserves and the Brownsberg Nature Park.
- Financial and Administrative Assistant: Acts as the city liaison for the Park's Research and Monitoring Division. Coordinates logistics of researcher transport, accommodation, equipment, etc. Assists with budgeting and report writing. Manages Research Department funds.
- Brownsberg Nature Park Research Coordinator: Coordinates and advises research and monitoring activities in Brownsberg Nature Park.
- Field Logistics Coordinator: Coordinates the field logistics of housing, research locations, technical and equipment support, and ad hoc advice for researchers from STINASU, collaborative institutions, and independent organizations.
- Supervisors: Responsible for carrying out their respective monitoring protocols. Coordinate technical assistant activities. Manage data, conduct analysis, and write reports.
- Technical Assistants: Trained in field monitoring protocol and assist with data collection and analysis. Must have an educational and career background in biological science.
- Temporary Research Assistants: Volunteers, interns, and field guides will serve as temporary research assistants.


Minister of Natural Resources
Board of STINASU
STINASU Director
Collaborative Institutions & Independent Researchers
Brownsberg Nature Park Manager
Research Director
Financial & Administrative Assistant
Brownsberg Nature Park Research Coordinator
Field Logistics Coordinator
Vegetation Monitoring Supervisor
Wildlife Monitoring Supervisor
Water Quality & Climatological Monitoring Supervisor
Technical Assistant (1)
Technical Assistants (2)
Technical Assistant (1)
Temporary Assistants (2-6)

Training Programs for Staff and Field Technicians

It is important to develop a Training Program component for the Ecological Monitoring Program. Training will be targeted towards training Park Guards, Park Field Workers, and assorted student interns and eco-volunteers in specific aspects of the monitoring program, most notably the Wildlife Monitoring.

Park Guards are required to patrol the Park and its borders daily. Park Field Workers perform duties assigned to them by the Park manager, and, according to the Management Plan, are available to assist researchers. The Plan recommends that, during the low season, the Field Workers accompany the Guards on patrol in order to become more familiar with the entire Park and to record biological and ecological observations. All Park employees should be taught some basic skills in ecology and wildlife recognition. Two Park employees had been selected to undergo a 1-month intensive training in Tree Spotting. This training was concluded successfully in August 2002, and is a valuable investment. Follow-up training is required.

Another critical component of this Monitoring Program will be labor and monetary assistance provided through student interns and eco-volunteers. STINASU should utilize this valuable resource of available and eager workers who often can bring in additional funding. A useful project would be to invite secondary school and university students from Suriname to volunteer for the monitoring program during school vacations. While the training would be intensive and not very profitable in terms of data collection and continuity, this would provide crucial educational outreach and field skill experience to potential field biologists in Suriname.

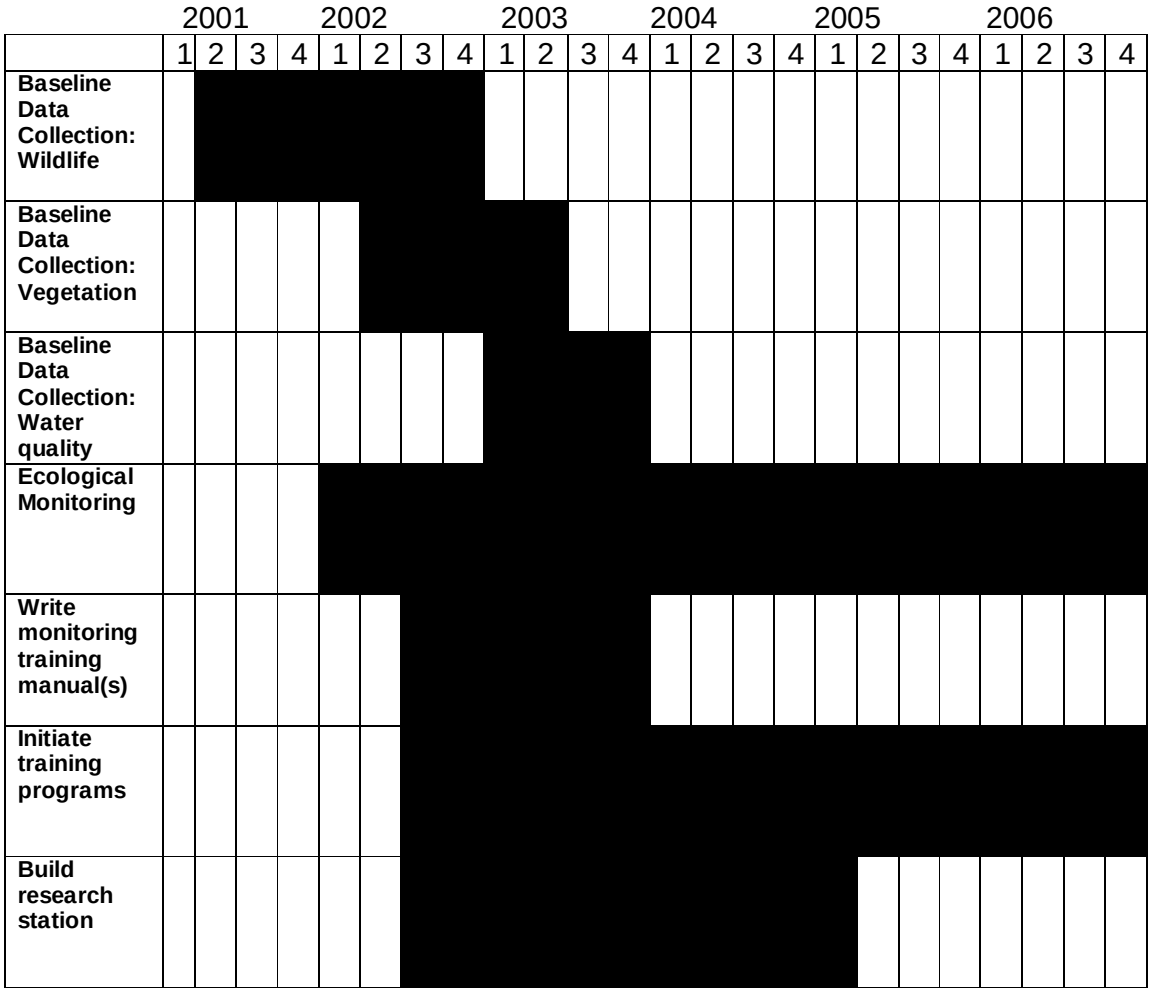
Guidelines for the Training Program are as follows:

- Park History and Goals
- Important features of the Park
- Field safety
- Communications
- Data recording and field journal maintenance
- Navigation
- Human impacts on natural ecosystems
- Conservation biology and nature conservation
- Ecology
    - Basic plant and animal taxonomy
    - Use of dichotomous keys to identify commonly seen plants, amphibians, reptiles, birds, and mammals
    - Basic wildlife management field techniques
    - Field identification of plants, especially trees, shrubs, and herbs commonly used by locals
    - Recognition of animal tracks
    - Collecting and preserving biological specimens
    - Habitat type classification and identification
    - Monitoring of water quality
    - Introduction to climatology and hydrology

Time Frame

Project Duration:
Baseline Data Collection: April 2001-December 2002 (1 year)
Ecological Monitoring: April 2002-December 2006 (4 years)
Plan Assessment: December 2006

Timeline for Ecological Research and Monitoring Program 2001-2006



Budget and Budget Notes

This Ecological Monitoring Program in designed as a permanent and on-going program. This Protocol offers a comprehensive plan that incorporates one year of baseline studies and inventories with ecological monitoring studies to follow in the years after the baseline studies. Additionally, this protocol has identified other projects that will be implemented by STINASU either alone or in collaboration with independent researchers or associated institutions.

The implementation of this Ecological Monitoring Program in Brownsberg Nature Park requires the establishment of infrastructure, the acquisition of equipment, the increase in the labor capacity of the Research Department, and, thus, a relatively large budget. As this is not only a new program, but also a program that is directed by an entirely new Research Department, the needs are great. Firstly, given the comprehensiveness of this monitoring program that encompasses wildlife, vegetation, water quality, hydrological, and climatological studies and monitoring, the program has a necessarily extensive need, for a wide-range of equipment and supplies as well as human resources. Also, in order to accommodate researchers and to achieve one of the four primary goals of this program, which is to strengthen scientific research in the Guayanas Region, it is critical that STINASU establish a well-equipped scientific research station at Brownsberg Nature Park. The research site and station at Brownsberg would thus become an essential part of any regional research network of the Guayanas Region.

The Ecological Monitoring Program has already been initiated, that is to the extent possible with existing resources. In 2001, the program operated mostly using STINASU funds and personnel, in addition using interns and volunteers recruited by STINASU. Some additional funds were obtained via the US Peace Corps in 2002. The University of Suriname initiated baseline studies (water quality, amphibians, invertebrates), and so did foreign guest researchers (bats, rodents and other mammals). These brought in most of the personnel, equipment, and additional funds required for work in their field of expertise. Core activities described in the Brownsberg Research and Monitoring Program have thus already been initiated, and specialized baseline studies and inventories are already being implemented by independent researchers and collaborative organizations. It is critical that the program gets more direct financial support so that the core staff can continue its activities and that the research work of others at the Park is properly facilitated. It is obvious that the Park needs to rapidly develop its research infrastructure and equipment base in response to these developments and needs.

BUDGET 2002 –2006 (in American Dollars)

ITEMS	Y1 2002	Y2 2003	Y3 2004	Y4 2005	Y5 2006	TOTAL
1. Personnel	**$52,600**	**$60,800**	**$52,600**	**$52,600**	**$52,600**	**$271,200**
2. Housing Facility	**$48,500**	**$45,000**	**$35,000**	**$12,000**	**$2,000**	**$142,500**
3. Communications	**$2,400**	**$700**	**$700**	**$1,100**	**$1,100**	**$6,000**
4. Transport	**$13,100**	**$21,450**	**$6,750**	**$3,750**	**$2,750**	**$47,800**
5. Field Equipment/ Materials	**$26,700**	**$13,600**	**$24,760**	**$10,410**	**$9,010**	**$96,480**
6. Fuel/ Lubricants	**$5,150**	**$9,000**	**$11,500**	**$12,000**	**$12,000**	**$49,650**
7. Office Supplies	**$5,500**	**$2,500**	**$6,500**	**$3,500**	**$6,000**	**$24,000**
8. Overhead (5%)	**$7,698**	**$7,653**	**$6,891**	**$4,768**	**$4,273**	**$31,882**
9. Contingencies (5%)	**$7,698**	**$7,653**	**$6,891**	**$4,768**	**$4,273**	**$31,882**
GRAND TOTAL	**$169,345**	**$168,355**	**$151,591**	**$104,896**	**$94,006**	**$701,393**

Budget Details

ITEMS	Y1 2002	Y2 2003	Y3 2004	Y4 2005	Y5 2006	TOTAL
1. Personnel (note: "mm" is "man months")	**$52,600**	**$60,800**	**$52,600**	**$52,600**	**$52,600**	**$271,200**
STINASU & Park Director (management fee)	$2,400	$2,400	$2,400	$2,400	$2,400	$12,000
Research Director (1x4mm/y)	$4,000	$4,000	$4,000	$4,000	$4,000	$20,000
Park Research Coordinator (1x12mm/y)	$8,400	$8,400	$8,400	$8,400	$8,400	$42,000
Field Supervisors (3x12mm/y)	$18,000	$18,000	$18,000	$18,000	$18,000	$90,000
Technical Assistants (4x12mm/y)	$14,400	$14,400	$14,400	$14,400	$14,400	$72,000
Administrative Assistant (1x4mm/y)	$1,200	$1,200	$1,200	$1,200	$1,200	$6,000
Logistics Coordinator (1x12mm/y)	$4,200	$4,200	$4,200	$4,200	$4,200	$21,000
Water quality expert (164 man-days)	$0	$8,200	$0	$0	$0	$8,200
Training water quality sampling (12 man-days)	$0	$600	$0	$0	$0	$600
2. Housing Facility	**$48,500**	**$45,000**	**$35,000**	**$12,000**	**$2,000**	**$142,500**
Research Station construction	-	-	-	-	-	-
>Main station	$40,000	$40,000	$0	$0	$0	$80,000
>Laboratory	$0	$0	$30,000	$0	$0	$30,000
>Station furnishings	$5,000	$5,000	$5,000	$10,000	$0	$25,000
>Refrigerator	$1,500	$0	$0	$0	$0	$1,500
>Drying cabinet	$500	$0	$0	$0	$0	$500
>Generator (gasoline 120-140 V)	$1,500	$0	$0	$0	$0	$1,500
Field Satellite Stations (2)	$0	$0	$0	$2,000	$2,000	$4,000
3. Communications	**$2,400**	**$700**	**$700**	**$1,100**	**$1,100**	**$6,000**
Telephone fees	$500	$500	$500	$500	$500	$2,500
Email & Internet	$200	$200	$200	$200	$200	$1,000
Port-a-phone radios (4) & charger	$1,700	$0	$0	$400	$400	$2,500
4. Transport	**$13,100**	**$21,450**	**$6,750**	**$3,750**	**$2,750**	**$47,800**
1 4WD Pick-up (purchase + maintenance)	$12,000	$12,000	$6,000	$2,000	$2,000	$34,000
Additional 4WD vehicle rental (24 days)	$0	$1,800	$0	$0	$0	$1,800
1 Boat	$0	$5,000	$0	$1,000	$0	$6,000
1 Outboard engine (25 hp)	$0	$2,000	$100	$100	$100	$2,300
2 Mountain bikes	$500	$50	$50	$50	$50	$700
Air transport (2 times/ year)	$600	$600	$600	$600	$600	$3,000
5. Field Equipment/ Materials	**$26,700**	**$13,600**	**$24,760**	**$10,410**	**$9,010**	**$96,480**
1 Laptop computer	$1,700	$0	$200	$1,700	$0	$3,600
1 Digital camera	$1,000	$0	$100	$0	$0	$1,100
4 GPS units	$1,000	$0	$0	$0	$0	$1,000
4 Binoculars (10x35, waterproof)	$2,000	$0	$0	$0	$0	$2,000
1 Infrared binocular	$600	$0	$0	$0	$0	$600
1 Video + 1 sound recorder	$1,500	$0	$0	$0	$0	$1,500
4 Hand-held tape recorders	$400	$0	$0	$0	$0	$400

ITEMS	Y1 2002	Y2 2003	Y3 2004	Y4 2005	Y5 2006	TOTAL
1 Water pump	$1,500	$0	$0	$0	$0	$1,500
3 Microscopes	$0	$0	$8,000	$250	$250	$8,500
1 Chainsaw	$2,500	$200	$500	$200	$500	$3,900
1 Balance	$0	$0	$1,000	$0	$0	$1,000
2 Gas burners	$0	$0	$500	$0	$0	$500
1 Heating plate	$0	$0	$300	$0	$0	$6,300
General lab supplies	$0	$0	$4,000	$1,000	$1,000	$6,000
General camping gear	$1,000	$100	$100	$500	$100	$7,800
General field supplies	$2,500	$1,500	$1,500	$1,500	$1,500	$8,500
Climatological Station & peripherals	$10,000	$100	$500	$100	$500	$11,200
Water quality equipment	-	-	-	-	-	-
>pH/ ISE meter & accessories	$0	$750	$0	$0	$0	$750
>pH probe (spare)	$0	$250	$0	$0	$0	$250
>Cl probe	$0	$450	$0	$0	$0	$450
>Conductivity/ dissolved oxygen meter & acc.	$0	$2,000	$0	$0	$0	$2,000
>Turbidity meter & accessories	$0	$640	$0	$0	$0	$640
>Colorimeter & accessories	$0	$1,100	$0	$0	$0	$1,100
>Digital Titrator	$0	$150	$0	$0	$0	$150
>Replacement of broken equipment	$0	$0	$1,500	$1,500	$1,500	$4,500
>Glass & plastic ware	$0	$350	$0	$0	$0	$350
>Sample bottles	$0	$200	$0	$0	$0	$200
Chemicals	$1,000	$500	$1,500	$1,000	$1,000	$5,000
Generator	$0	$0	$1,500	$100	$100	$1,700
Refrigerator	$0	$0	$1,000	$0	$0	$1,000
Rental of 2nd colorimeter (96 days)	$0	$960	$0	$0	$0	$960
External lab analysis	-	-	-	-	-	-
>60 BOD ($25/ sample)	$0	$1,500	$750	$750	$750	$3,750
>60 COD ($10/ sample)	$0	$600	$300	$300	$300	$1,500
>54 E. coli/ coliform ($20/ sample)	$0	$1,080	$540	$540	$540	$2,700
>36 Hg ($20/ sample)	$0	$720	$720	$720	$720	$2,880
>18 Pb ($25 sample)	$0	$450	$250	$250	$250	$1,200
6. Fuel/ Lubricants	**$5,150**	**$9,000**	**$11,500**	**$12,000**	**$12,000**	**$49,650**
Car fuel	$2,000	$2,000	$2,000	$2,000	$2,000	$10,000
Mixed fuel	$2,500	$6,000	$8,000	$8,000	$8,000	$32,500
Natural gas	$300	$300	$500	$500	$500	$2,100
Kerosene	$0	$0	$0	$500	$500	$1,000
Lubricants	$350	$700	$1,000	$1,000	$1,000	$4,050
7. Office Costs	**$5,500**	**$2,500**	**$6,500**	**$3,500**	**$6,000**	**$24,000**
Computers	$2,000	$0	$2,000	$0	$2,000	$6,000
Computer peripherals (scanner, printer, etc.)	$1,000	$0	$1,000	$0	$500	$2,500
Photocopies & special prints	$500	$500	$500	$500	$500	$2,500
Publishing	$0	$0	$1,000	$1,000	$1,000	$3,000
Books & Periodicals	$1,000	$1,000	$1,000	$1,000	$1,000	$5,000
General supplies	$1,000	$1,000	$1,000	$1,000	$1,000	$5,000
SUBTOTAL	**$153,950**	**$153,050**	**$137,810**	**$95,360**	**$85,460**	**$637,630**
8. Overhead (5%)	**$7,698**	**$7,653**	**$6,891**	**$4,768**	**$4,273**	**$31,882**
9. Contingencies (5%)	**$7,698**	**$7,653**	**$6,891**	**$4,768**	**$4,273**	**$31,882**
GRAND TOTAL	**$169,345**	**$168,355**	**$151,591**	**$104,896**	**$94,006**	**$701,393**

Evaluation of Program

It is critical for any project to incorporate an evaluatory and monitoring process in order to determine the effectiveness of the program itself and to provide on-going opportunities to improve both the strategy and methodology of the program. We have identified several factors through which to gauge the effectiveness of this Ecological Monitoring Program. These are listed in the following table.

What to monitor?	Things to check	Monitoring Process	Responsibility	Time Period
Administrative needs	Quality of summary reports	Summary reports of data for all aspects of monitoring	Research Coordinator, Admin. Asst., Supervisors	Monthly
Roles & responsibilities	Work schedules, work quality, performance	- Daily logs - Team meetings - Observation	Research Coordinator, Supervisors	-Daily -Weekly -Daily
Visitor participation	Quantity of visitors participating in monitoring efforts, interest/ enthusiasm	Visitor surveys, interviews, Wildlife Observation Form returns	Supervisors	Daily/ weekly
Visitor education	Transfer of monitoring results into visitor education programs/ opportunities	Visitor surveys, interviews, development of educational materials/ displays	Research Coordinator, Supervisors	Monthly
Staff participation	Quantity of staff participating in monitoring efforts, interest/ enthusiasm	Interviews, observations, staff meetings	Research Coordinator	Daily/ weekly
Staff education	Provision of training programs to staff in ecological monitoring, transfer of results into staff education programs/ opportunities	Interviews, meetings, observations, quantity of staff participating in training and education workshops	Research Coordinator, Supervisors	Monthly
Baseline data development	Accumulation of data for all aspects of monitoring program	Reports, summaries	Research Coordinator, Admin. Asst., Supervisors	Monthly
Team interest & motivation	Level of interest, enthusiasm, & motivation for monitoring team members	Meetings, observation	Research Coordinator, Admin, Asst., Supervisors	Daily, weekly

We will use the guidelines provided in the above table to monitor this program. By utilizing this process, we can evaluate the effectiveness of the program and make necessary improvements in a timely manner.

References

Berry, P. E., J. A. Steyermark, and B. K. Holst (1995) Flora of the Venezuelan Guayana: Vol. 1. Missouri Botanical Garden: St. Louis, Missouri.

Boinski, S. (2001) "Collated Ralieghvallen Fruit Codes: April 2001". Raleighvallen Capuchin Quantitative Data Coding Format. Unpublished manuscript.

Boinski, S., T.S. Gross, and J.K. Davis (1999) "Terrestrial Predator Alarm Vocalizations are a Valid Monitor of Stress in Captive Brown Capuchins (*Cebus apella*)". Zoo Biology. 18: 295-312.

Bubberman, F. and J. Janssen (1970) Brownsberg Natuurpark, historie, landschap. Medeling no. 1. STINASU, reprint of SURALCO magazine, no. 2 (Augustus 1970). 19 pp.

Conservation International (2001) RAP™ Training Manual for RAP™ Guyana 2001: So many species, so little time. Rapid Assessment Program; Center for Applied Biodiversity Science; Conservation International: Washington, D.C.

Cremers, G, A. Mori, C. Gracie, J. J. de Granville, M. Hoff, and J. D. Mitchell (1997) Guide to the Vascular Plants of Central French Guiana: Part 1: Pteridophytes, Gymnosperms, and Monocotyledons. New York Botanical Garden: New York.

Dallmeier, F. (1992). "Long-term monitoring of biological diversity in tropical forest areas." Methods for establishment and inventory of permanent plots. MAB Digest Series, 11. UNESCO. Paris.

Dallmeier, F. and J. A. Comiskey. (1996). "From the forest to the user: a methodology update." Manu: The biodiversity of southeastern Peru; la biodiversidad del sureste del Peru (Wilson, D. and A. Sandoval, Eds.). Smithsonian Institution Press. Washington, DC. Pp. 41-56.

Ek, R. C. (1997) Botanical Diversity in the Tropical Rain Forest of Guyana. Tropenbos-Guyana Series 4. The Tropenbos Foundation: Wageningen, the Netherlands. Pp. 46-47, 207-213.

Fancy, S. G. (2000) "Guidance for the design of sampling schemes for inventory and monitoring of biological resources in national parks". U.S. National Park Service Inventory and Monitoring Program. http://www.nature.nps.gov/sfancy

Gibbs, J. P., H. L. Snell, and C. E. Causton (1999) "Effective monitoring for adaptive wildlife management: lessons from the Galapagos Islands". J. of Wildlife Management. 63(4):1055-1065.

Held, M. M. (1984) Ecologisch onderzoek aan enkele bejaagde bosvogels in Suriname. Instit. voor de Opleiding van Leraren, Paramaribo. 102 pp.

Hoop, C. (1991) Verdronken land, Verdwenen dorpen: De transmigratie van Saramaccaners in Suriname 1958-1964. Uitgeverij Bewustzijn: Alkmaar, the Netherlands.

Jongman, R. H. G., C. J. F. Ter Braak, and O. F. R. van Tongeren. (1995) Data Analysis in Community and Landscape Ecology. Cambridge University Press: United Kingdom.

Kluyver, H. N. (1975) De vogels van de Brownsberg. Natuurgids serie B, No. 3. 94 pp.

Kremen, C., A.M. Merelender, and D.D. Murphy (1994) "Ecological Monitoring: A Vital Need for Integrated Conservation and Development Programs in the Tropics". Conservation Biology. 8(2): 388-397.

Landres, P. B., J. Verner, and J.W. Thomas (1988) "Ecological Uses of Vertebrate Indicator Species: A Critique". Conservation Biology. 2(4): 316-328.

Lovejoy, T. E. and G. T. Prance (Eds.) (1985) Key Environments: Amazonia. IUCN. Pergamon Press: Oxford, England. Pp. 110-145.

Nadkami, N. (1998) "Use of Portable Platform for Observations of Tropical Forest Canopy Animals". Biotropica. 20(4): 350-351.

Prance, G. T. (1986) "New taxa of Chrysobalanaceae for the flora of the Guianas. Studies on the flora of the Guianas, 19". Koninkl. Nederl. akademie van wetenschappen, proceed. 89(1):111-116.

Reichart, H. A. (1991) Brownsberg Nature Park Management Plan 1991-1995. STINASU: Paramaribo, Suriname.

Ribeiro, J. E. L. da S. et al. (1999) Flora de Reserva Ducke: Guia de identificacao das plantas vasculares de uma floresta de terra-firme na Amazonia Central. INPA-DFID. Midas Printing Ltd., Brazil.

Schulz, J.P. (1960). Ecological studies on rain forest in Northern Suriname. In: De Hulster, I.A., & Lanjouw, J. (eds.). The vegetation of Suriname. Van Eedenfonds, Amsterdam & Dienst 's Lands Bosbeheer, Paramaribo.

Simmen, B., C. Julliot, F. Bayart, and E. Pages-Feuillade (2001) "Diet and population densities of the primate community in relation to fruit supplies." In: F. Bongers, P. Charles-Dominique, P.M. Forget, and M. Thery (Eds.).Nouragues: Dynamics and Plant-Animal Interactions in a Neotropical

Rainforest. Kluwer Academic Publishers: Dordrecht, the Netherlands. Chapter 8. Pp. 90-101.

Steege, Hans ter (2000) Plant Diversity in Guyana: With recommendations for a National Protected Area Strategy. Tropenbos Series 18. The Tropenbos Foundation: Wageningen, the Netherlands.

Stoner, K.E. (1994) “Population Density of the Mantled Howler Monkey (*Alouatta palliata*) at La Selva Biological Reserve, Costa Rica: A New Technique to Analyze Census Data. Biotropica. 26(3): 332-340.

Sutherland, W. J. (2000) The Conservation Handbook: Research, Management, and Policy. Blackwell Science, Ltd.: London.

Terborgh, J. (1986) “Keystone plant research in the tropical forest”. In: Conservation Biology. Pp. 330-344. Ed. M.E. Soule. Sinauer Associates.

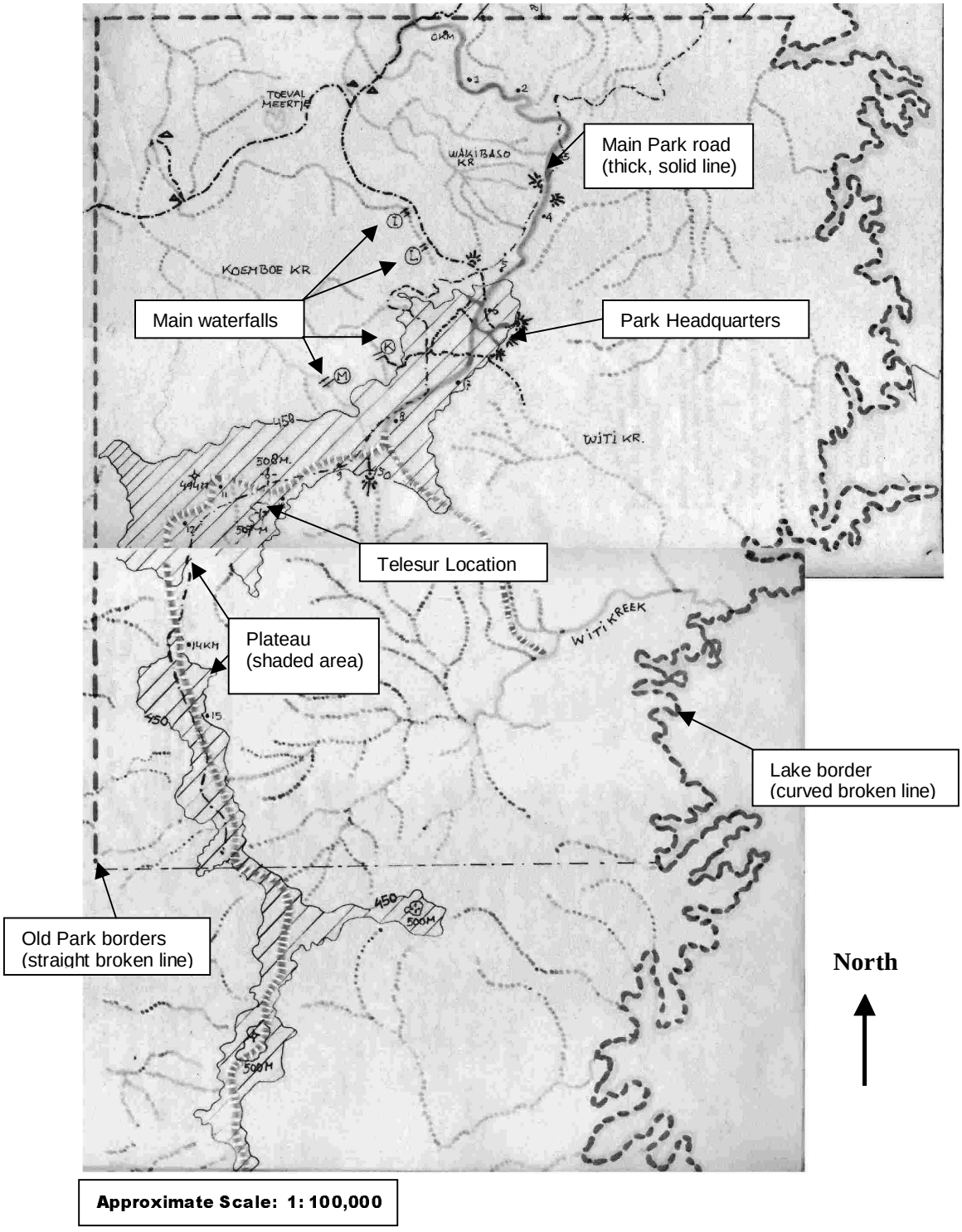
Tjon Lim Sang and I. van de Wiel (1980) De vegetatie langs watervallen en kreken in het natuurpark de Brownsberg in Suriname. Doctoral Thesis, Instit. System. Botany, Utrecht University. 46 pp.

Webster, G. L. and W. S. Armbruster (1982) "An unusual new species of *Dalechampia* (Euphorbiaceae) for Suriname". Botany. 7(4): 484-488.

---------- (1991) "A synopsis of Neotropical species of *Dalechampia* (Euphorbiaceae)." Botan. J. of the Linnean Soc. 105: 137-177.

APPENDICES

APPENDIX A: Provisional map of Brownsberg Nature Park



APPENDIX B: Park Habitat Types

Please note that the habitat classification below is preliminary and serves to illustrate the variety and variability of habitats at the Brownsberg Nature Park

Code	Habitat Type	Technical Description

The following are considered to be true habitat types occuring at Brownsberg, meaning that they appear to be distinct and mutually exclusive in the area.

HF **High Forest** **Mesophytic, high rainforest on well-drained soil**

This is a predominantly thin-leaved, very diverse primary forest with 3-5 stories that occurs on well-drained, deeper soils of a loamy-sandy nature. The forest canopy, generally about 25-40 m, is usually closed and relatively continuous, with many broad-crowned trees. Some emergent trees, with crowns that fan-out across the canopy, reach heights of 45-65 m. The tree girth tends to be large and buttress roots are common. The understory is sparse and open and is dominated by trees with slender crowns that approach 15 m in height. The herb layer is very open. This forest type is found primarily on the Plateau slopes and in certain patches on the Plateau, particularly where the soil is deeper and well drained. It may be the most common forest type at Brownsberg. Some of the larger trees found here are: kankantri (*Ceiba pentandra*), kwatapatu (*Lecythis davisii*), ingipipa (*Couratari* spp.), dyadidya (*Sclerolobium bidentata*), djoebotri (*Pouteria* spp.), and gronfolo (*Qualea coerula*). The herb layer consists primarily of dicot saplings and seedlings, often of Rubiaceae and Piperaceae, and some broad-leaved forest grasses. Although palms are common in the understorey of such forest in lowland areas, they often are not at Brownsberg: palms tend to be rare on the plateau as well as the slopes. Lianas are common in this forest type; very large lianas (stem diameter > 10 cm) are also present, and are an indicator of the great stability of the habitat.

HP **High, Palm-dominated Forest** **Mesophytic, high rainforest on well-drained soil with palm-dominated understory**

This is a special High Forest type, with palms present at high densities in the understory. Thus, this type of primary forest is characterized by an understory of palms within a forest type of same stature and presumably a similar floristic composition as the High Forest. The dominance of palms in the understorey can be defined as such: the leaves of different mature palm individuals tend to touch one another and immature palms constitute most of the vegetation cover below breast height. Palm-dominated forest on well-drained soil occurs locally at Brownsberg. The distinction between this forest type and the previous may be artificial, as there are many degrees to which palms can dominate the understory. In cases where the arborescent palm *Astrocarium sciophylum* (bugrumaka) is the dominant understory species, the distinction would appear to be justified; it may not be justified in the case of *Astrocarium paramaca* (paramaka), which is not arborescent and usually less dominant. Light levels below a bugrumaka understory are exceedingly low, as is the number of herbs and tree saplings. De Granville (pers. comm.) regards forest with many mature bugrumaka as very old, stable forest.

HC **High Closed Forest** **Mesophytic, high rainforest on well-drained soil with dense understory**

This is a High Forest type with an exceptionally dense understorey. Whether or not this is a distinct primary forest type is uncertain. It may essentially be a more dynamic type of High Forest, characterized by higher treefall rates and more light gaps. It occurs locally at Brownsberg on well-drained soil. It may also simply be an

"edge" or transitional forest type, occurring where a high and low forest type meet, or bordering an area with much recent treefall. This remains to be investigated further.

HM High Marsh Forest — Mixed meso-hydrophytic, high rainforest on seasonally badly-drained soil

This is a special High Forest type on soil that inundates during the rainy season. The vegetation is generally thin-leaved, but it may also contain some thicker leaved hydrophytic trees. This primary forest type is widespread at Brownberg; it is found along creeks, and is often restricted to some 5 to 20 m on either side of creek systems, which is where the soils become periodically inundated and, therefore, badly drained on a seasonal basis. Thus, there are lots of high roots, stilt roots, and air roots. The understory is characterized by thick undergrowth that is dominated by Piperaceae species, as well as by palulu (*Ravenala guianensis)* and grasses. Maripa palms *(Attalea maripa)* and tasi palms (*Geonoma baculifera)* are indicator species.

SW Swamp Forest — Hydrophytic, low rainforest on perennially badly-drained soil

The canopy of this forest type is typically one or two stories reaching a height of 15-25 m. Lianas and epiphytes are not common, but stilt roots on trees are. This type of forest is commonly encountered in the lowlands and occasionally on top of the Plateau where the laterite cap has a depression in which a thick peat-like layer was laid down. The soils are usually composed of heavy clays and litter. It is found in the lowest and wettest parts of depressions where the soil is completely inundated during the rainy seasons, and fully saturated with water all year long (but dry during times when there is a strong El Nino effect). The dominant vegetation here consists of arborescent palms, tree ferns (Cyatheaceae), and warimbo (Marantaceae). The pina palm *(Euterpe oleracea)* is the indicator species par excellence that is always present and usually dominant. This palm is multi-stemmed and should not be confused with the single-stemmed *Euterpe precatoria* that occurs in well-drained forest.

SA Savanna Forest — Xerophytic, low forest on exceedingly well-drained soil

The tree canopy is lower than that of High Forest (less than 20-30 m) and the understory is dense. The tree girth is generally small; most of the forest trees are thin-stemmed treelets. The forest looks impoverished and most trees are stunted. The leaves tend to be thick and leathery. This forest type is widespread on top of the Plateau where the laterite cap is near the surface and where there is only a thin layer of humus. It also occurs locally on similar soils at much lower elevations, e.g. on ridges that extend into the lowlands. The substrate is mostly blackish gravel or lateritic boulders and plates that are highly permeable and have a poor water retention capacity. There is a rapid run-off of rainwater and the soil dries out quickly, especially during the dry season. Because the nutrient-poor, shallow soil hinders tree growth, the canopy is not closed, and therefore much light penetrates to the forest floor, contributing to the dense understory. The dominant tree species are: hevea (*Hevea guianensis*), busi amandra (*Terminalia dichotoma*), and several gujave species (Myrtaceae). Palms are generally absent from the understory.

LF Liana Forest — Mesophytic, low forest with a liana-dominated canopy

This forest type is especially noteworthy for the absence of stories and the liana canopy that rarely exceeds 10-15 m. Tall trees occur, but they are widely separated from one another; therefore, the canopy is not continuous. Trees either have difficulty becoming established or are readily tipped over because they are overgrown by heavy masses of lianas. This forest type may be edaphic (i.e. limited

by soil conditions), at least at Brownsberg, where it is found locally in areas with shallow, rocky, lateritic soil (and also sometimes in creek valleys) that provide bad rooting conditions and poor footholds for trees. Elsewhere in Suriname, similar liana-dominated forest patches may also be found on "normal" soils, and are assumed to reflect localised, persistent disturbance. This vegetation type is dominated by liana and vine species in the following families: Leguminosae, Bignoniaceae, Malpigiaceae, Dilleniaceae, and Menispermaceae.

BT **Bamboo Thicket** **Low, mesophytic thicket dominated by woody grasses**

This is the only essentially non-forest habitat type at the Brownsberg. The vegetation is composed almost exclusively of bamboo (woody) grasses. The grasses form a single dense, impenetrable layer of some 2 to 5 m height. Isolated mature trees, usually of low stature (10 to 25 m) may occur in the thicket. There are virtually no tree seedlings or saplings in the thicket. This habitat type would seem to occur where large forest patches have been severely disturbed. Bamboo thickets are considered successional when they occur along rivers, but their status in upland areas, such as at Brownsberg, is not well understood. The disturbance leading to the long-term estabishment of bamboo thickets in Brownberg is mining; elsewhere in Suriname, disturbance by pre-Columbian Amerindians would seem to have resulted in large bamboo patches.

The following are not considered to be true habitat types, but complementary aspects that can be found in one or more of the habitat types listed above

m **Moss Aspect** **Rainforest in high humidity areas**

Located along the eastern edges of the Plateau, where clouds and mists linger. Due to the high humidity there during much of the day, the trees are covered with a thick layer of moss. Moss not only covers much of the bark of trees, but also the upper side of older leaves. Typically, moss growth hangs down from horizontal branches and twigs, and covers most stilt roots and liana stems. The forest thus has the appearance of a "moss" or cloud forest habitat. It occurs in combination with some of the forest habitat types described above, such as High Closed Forest. It is very typical of the Brownsberg plateau and similar plateaus in Suriname (e.g. at the Nassau and Lely ranges).

s **Secondary Aspect** **Forest in disturbed areas & gaps**

Located along the roadsides, in areas recovering from relatively small-scale disturbance (e.g. selective logging, low-impact mining), and in areas with recent treefall. The tree canopy, if present, is closed and very uniform, and reaches a maximum height of 20-30 m. A closed canopy is lacking when trees or branches have fallen very recently, and have resulted in a new forest clearing or "gap". Larger recent clearings tend to be dominated by fast-growing herbs and shrubs (e.g. Melastomataceae), and are overtaken by fast-growing trees within one or two years. Man-made gaps may remain herby or shrubby for prolonged periods when the soil was compacted by heavy rolling equipment. The dominant trees usually are busipapaja (*Cecropia* spp.) and *Pourouma* spp., which are accompanied and succeeded by pangapanga (*Palicourea guianensis*), swit'bonki (*Inga* spp.), various Melastomataceae, and other softwood trees. Because of the high light penetration, the understory is very dense in recent gaps and very difficult to pass through. Since secondary forest is a natural succession of stages that are characteristic of the recovery and maturation of rainforest, it occurs in combination with several of the forest types described above.

APPENDIX C: Descriptive List of the Park's Trails and Transects

Trail/ Transect	Vegetation	Notes	Length (km)	Elevation Change
Irene Falls-Leo Falls	Savanna Forest, High Forest, Marsh Forest, seconday aspect	Begin at Picnic Place.	2.1	-300m
Mazaronitop	Savanna Forest, moss aspect, secondary aspect		0.7	+10m
Jeep Trail	Savanna Forest, High Forest, Bamboo Thicket, moss aspect	Begin at Mazaroniweg 2.6	4.6	-300m
Mazaroni Road	Savanna Forest, High Forest, Swamp Forest, secondary aspect, moss aspect	Plateau road	3.0	0
Telesur Road	Savanna Forest, High Forest, moss aspect, secondary aspect	Begins at Mazaroniweg 3.0	1.5	0
Mazaroni Falls	Savanna Forest, High Forest, Marsh Forest	Begins at Mazaroniweg 3.0	1.0	-250m
Witi Creek	Savanna Forest, Marsh Forest, High Forest, Swamp Forest		3.8	-450m
Rondwandeling	Savanna Forest, High Forest, moss aspect, secondary aspect	Circuit trail; roundtrip	2.6	0
Kumbu Falls-	Savanna Forest, High Forest, Marsh Forest	Trail shared w/ Rondwandeling	2.2	-150m
Transect 1	Marsh Forest, High Forest	Begins at Witi Creek trail 0.3km	1.0	-50m
Transect 2	Savanna Forest, Marsh Forest	Begins at Rondwandeling 1.3 km	1.0	-100,
Transect 3	Savanna Forest, High Forest, Marsh Forest, Swamp Forest	Begins at slope south of Tapir guesthouse	1.8	-300m
Points	**Vegetation**	**Notes**		
Mazaronitop	Savanna Forest, secondary aspect	Overlook at end of Mazaronitop trail		
Telesur Kampu	High Forest, secondary aspect	Clearing at the end of Telesur Road		

APPENDIX D: List of the Tree Species Used in the Phenology Monitoring

The following is a list of the tree species that are the focus of the Park's tree phenology monitoring effort. Over 500 individual trees of approximately 150 species have been identified and marked as a part of this effort.

Family	Genus	Species
Anacardiaceae	Anacardium	spruceanum
Anacardiaceae	Sp	indet
Anacardiaceae	Spondias	mombin
Anacardiaceae	Tapirira	sp
Annonaceae	Anaxagorea	doliocharpa
Annonaceae	Annona	sp
Annonaceae	Dugetia	sp
Annonaceae	Fusaea	longifolia
Annonaceae	Sp	indet
Annonaceae	Unonopsis	rufescens
Annonaceae	Xylopia	sp1
Annonaceae	Xylopia	sp2
Apocynaceae	Aspidiosperma	marcgravianum
Apocynaceae	Bonafousia	undulata
Apocynaceae	Geissospermum	sericeum
Apocynaceae	Geissospermum	sp
Apocynaceae	Macoubea	guianensis
Apocynaceae	Parahancornia	fasiculata
Araceae	Iriartea	exorhiza
Araliaceae	Dendropanax	sp
Araliaceae	Schefflera	morotoni
Arecaceae	Astrocaryum	sp
Arecaceae	Attalea	maripa
Arecaceae	Oenocarpus	baccaba
Bignoniaceae	Jacaranda	sp
Bignoniaceae	Tabebuia	capitata
Bignoniaceae	Tabebuia	serratifolia
Bignoniaceae	Tabebuia	sp
Bombacaceae	Eriotheca	surinamensis
Boraginaceae	Cordia	sp
Burseraceae	Protium	polybotryum
Burseraceae	Protium	sp
Burseraceae	Sp	indet
Burseraceae	Trattinickia	burserifolia
Caesalpinoidae	Eperua	falcata
Caesalpinoidae	Eperua	sp
Caesalpinoidae	Sclerolobium	melinoii
Celastraceae	Goupia	glabra
Chrysobalanaceae	Licania	macrophylla
Chrysobalanaceae	Licania	sp
Clusiaceae	Clusia	grandiflora
Clusiaceae	Rheedia	acuminata
Clusiaceae	Sp	indet
Clusiaceae	Symphonia	glaucescens
Clusiaceae	Tovomita	choisyana
Clusiaceae	Tovomita	sp
Clusiaceae	Vismia	guianensis
Clusiaceae	Vismia	sp
Combretaceae	Buchenavia	sp
Combretaceae	Buchenavia	tetraphylla
Combretaceae	Terminalia	amazonia
Combretaceae	Terminalia	dichotoma
Ebenaceae	Diospyros	sp
Elaeocarpaceae	Sloanea	guianensis
Elaeocarpaceae	Sloanea	sp
Euphorbiaceae	Amanoa	guianensis
Euphorbiaceae	Chaetocarpus	schomburgkianus
Euphorbiaceae	Croton	schiedeanus
Euphorbiaceae	Drypetes	variablis
Euphorbiaceae	Hyeronima	alchorneoides var alchorneoides
Euphorbiaceae	Micranda	brownsbergensis
Euphorbiaceae	Pausandra	martinii
Euphorbiaceae	Sapium	glandulosum
Euphorbiaceae	Sp	indet
Fixed	Mistake	to be
Flacourtaceae	Banara	guianensis
Flacourtaceae	Carpotroche	surinamensis
Flacourtaceae	Casearia	sp
Flacourtaceae	Laetia	procera
Humiriaceae	Sacoglottis	cydonioides
Lauraceae	Nectandra	sp
Lauraceae	Ocotea	rubra
Lauraceae	Ocotea	sp
Lauraceae	Sp	indet
Lecythidaceae	Corythophora	labriculata
Lecythidaceae	Couratari	fagifolia
Lecythidaceae	Couratari	guianensis
Lecythidaceae	Couratari	sp
Lecythidaceae	Couratari	stellata
Lecythidaceae	Eschweilera	collina
Lecythidaceae	Eschweilera	coriacea
Lecythidaceae	Eschweilera	pedicellata
Lecythidaceae	Eschweilera	sp
Lecythidaceae	Lecythis	corrugata
Lecythidaceae	Lecythis	idatimon

Family	Genus	Species	Family	Genus	Species
Lecythidaceae	Lecythis	zabucajo	Papilionoidae	Platymiscum	trinitans
Lecythidaceae	Sp	indet	Papilionoidae	Sp	indet
Malphigiaceae	Byrsonima	laevigata	Papilionoidae	Swartzia	amshoffiana
Malphigiaceae	Byrsonima	sp	Papilionoidae	Swartzia	arborescens
Melastomataceae	Bellucia	grossularoides	Papilionoidae	Swartzia	benthamina
Meliaceae	Carapa	procera	Papilionoidae	Swartzia	longicarpa
Meliaceae	Carapa	sp	Papilionoidae	Swartzia	schomburgkii
Meliaceae	Carapa	sp	Papilionoidae	Swartzia	sp
Meliaceae	Cedrela	odorata	Papilionoidae	Vatairea	guianensis
Meliaceae	Guarea	glabra	Quiinaceae	Lacunaria	crenata
Meliaceae	Guarea	pubescens	Rubiaceae	Palicourea	sp
Meliaceae	Trichilia	quadrijuga	Rutaceae	Ticorea	pedicellata
Mimosoidae	Enterolobium	schomburgkii	Rutaceae	Zanthoxylum	rhoifolium
Mimosoidae	Enterolobium	sp	Sapindaceae	Cupania	scrobiculata
Mimosoidae	Inga	alba	Sapindaceae	Talisia	megaphylla
Mimosoidae	Inga	leiocalyina	Sapindaceae	Talisia	microphylla
Mimosoidae	Inga	sp	Sapindaceae	Talisia	sp
Mimosoidae	Parkia	sp	Sapotaceae	Chrysophyllum	cuneatifolium
Mimosoidae	Piptadenia	suaveolens	Sapotaceae	Ecclinusa	guianensis
Mimosoidae	Pithecellobium	jupunba	Sapotaceae	Manilkara	bidentata
Mimosoidae	Pithecellobium	pedicellare	Sapotaceae	Micropholis	guianensis
Mimosoidae	Sp	indet	Sapotaceae	Pouteria	guianensis
Moraceae	Bagassa	tiliaefolia	Sapotaceae	Pouteria	melanopoda
Moraceae	Brosimum	parinaroides	Sapotaceae	Pouteria	sp
Moraceae	Brosimum	rubescens	Sapotaceae	Pouteria	speciosa
Moraceae	Cecropia	sp	Sapotaceae	Sp	indet
Moraceae	Cecropia	sp	Simaroubaceae	Simaba	guianensis
Moraceae	Ficus	guianensis	Simaroubaceae	Simarouba	amara
Moraceae	Ficus	nymphaefolia	Sterculiaceae	Sterculia	excelsa
Moraceae	Ficus	sp	Sterculiaceae	Sterculia	pruriens
Moraceae	Maquira	sclerophylla	Tiliaceae	Apeiba	glabra
Moraceae	Pourouma	sp	Tiliaceae	Apeiba	petuomo
Moraceae	Sp	indet	Tiliaceae	Apeiba	sp
Myristicaceae	Iryanthera	sagotiana	Tiliaceae	Luheopsis	sp
Myristicaceae	Iryanthera	sp	Tiliaceae	Sp	indet
Myristicaceae	Sp	indet	Vochysiaceae	Erisma	uncinatum
Myrtaceae	Calycorectes	bergii	Vochysiaceae	Qualea	caerulea
Myrtaceae	Eugenia	sp	Vochysiaceae	Qualea	rosea
Myrtaceae	Myrcia	sp	Vochysiaceae	Ruizterania	albiflora
Myrtaceae	Sp	indet	Vochysiaceae	Vochysia	sp
Nyctaginaceae	Guapira	sp			
Nyctaginaceae	Sp	indet			
Nyctaginaceae	Torrubia	sp			
Olacaceae	Heisteria	cauliflora			
Olacaceae	Minquartia	guianensis			
Olacaceae	Sp	indet			
Papilionoidae	Bocoa	prouacensis			
Papilionoidae	Diplotropis	purpurea			
Papilionoidae	Dipteryx	sp			

APPENDIX E: Tree Phenology Monitoring Protocol and Data Sheet

Tree Phenology Protocol for Vegetation Monitoring Program
Brownsberg Nature Park, Suriname
Prepared by C. E. Timothy Paine
25 June 2002

Overview:

The goal of tree phenology monitoring is to determine patterns of flowering and fruiting. In order to accomplish this, a variety of trees have been identified and marked, and will be repeatedly observed. This tree phenology monitoring program supplements and is coordinated with the pre-existing Wildlife Monitoring Program, but is run as an independent program.

Individual trees that are marked must be mature, healthy individuals, whose trunk is within 5m of a trail. Trees should be of canopy or emergent stature, but significant sub-canopy trees will also be included. Additionally, the crown should not be obscured by lianas, so as to simplify observations. As of July 2002, over 500 individuals were marked, with a maximum of five individuals per species. Most of the individuals selected and marked were at least 100 meters from conspecifics.

Species identities were determined as well as possible, though some family and genus classifications remain indeterminate and uncertain, and thus must be re-checked. Resources used for determination include:

- Boggan, J, V. Funk, C. Kelloff, M. Hoff, G. Cremers, and C. Feuillet (1997) Checklist of the Plants of the Guianas (Guyana, Suriname, French Guiana). Second edition. Smithsonian Institution: Washington, D.C.
- Gentry, A. H. (1993) A Field Guide to the Families and Genera of the Woody Plants of Northwest South America (Columbia, Ecuador, Peru) with supplementary notes on herbaceous taxa. University of Chicago Press: Chicago.
- Polak, A. M. (1992) Major Timber Trees of Guyana: A Field Guide. Tropenbos Series 2. The Tropenbos Foundation: Wagenwingen, the Netherlands.
- van Roosmalen, Marc G. V. (1985) Fruits of the Guianan Flora. Institute of Systematic Botany: Utrecht, the Netherlands.
- van Roosmalen, Marc G. V. (Unpublished manuscript) Lecythidaceae of the Guianan Shield.
- van Roosmalen, Marc G. V., F. van Troon, B. Hoffman, and M. Plotkin (Unpublished manuscript) Lianas and Scandent Shrubs of Suriname.

It is recommended that collections be made of all species, at least of fallen leaves and, preferably, fertile material. Specimens will be compared against the collection of the National Herbarium of Suriname whenever necessary.

Trails included in this monitoring effort are Mazaronitop, Rondwandeling, Jeep Trail, Mazaroniweg (i.e. the Plateau Road), Mazaroni Fall, Irene Fall, Telesur road, Witi Creek, and Kumbu Fall. Trees have been marked in nearly every habitat type found in the Park, including Mountain Savannah Forest, Swamp Forest, and Upland Rainforest.

Data collection:

Tree phenology monitoring will preferrably be conducted at least twice a month (approximately every forthnight). Phenology data can be recorded simultaneously with the wildlife monitoring transect walking effort. The following data will be collected:

- For each species:
  Family, Genus, Species, Species Code (i.e. 4-letter code unique to each species), Common Names (both English and Surinamese), Slash Notes, Leaf Notes, Flower Notes, Fruit Notes, Photos of Slash/Leaf/Flower/Fruit, Mating System.
- For each individual:
  Family, Genus, Species, Species Code, Tree Number, Trail and Distance Code, Location along trail (i.e. is the tree located on the right or left side of the path?), UTM Coordinates, ID Confidence (i.e. with what degree of confidence has the tree been correctly identified to Species/ Genus/ Family?), and Notes.
- For each observation:
  Date, Time of observation, Tree Number, Species Code, D.B.H., Height, Presence of Flowers and/or Fruit, Quantities of Flowers and/or Fruit, Notes.

Estimates of fruit and flower abundance should be made if possible, but if this is too time consuming, the presence of fruits and flowers will be recorded. Observations should be made with binoculars, with the observer scanning the entire visible part of the crown. The percentage of the crown that is visible should also be estimated in order to extrapolate the number of fruits present on the tree overall. For example, if 15 fruits are visible on the 20% of the crown that is visible, then estimate that there are 75 fruits in all. (15 fruit/ 20%) x 100% = 75 fruits. In order to correct for imprecision bias, the quantity of fruit/flowers will be lumped into categories differing by an order of magnitude. A $\log_{10}$ scale (i.e. 10; 100; 1,000; 10,000) will be used, so that any over- or under-estimations are made consistent. To continue this example, this tree would be recorded as having 100 fruits.

Dense inflorescences and infructescences (e.g. Moraceae, Mimosoidea) are to be counted as one flower or fruit. Efforts should be made to exclude immature fruits, flower buds, or old, rotting fruit. Also, efforts should be made to count fruits and flowers only on the focal tree, and not on any epiphytes, lianas, or neighboring trees. To simplify observations, a descriptive list of the fruit of each focal species will be provided to the data recorded.

Diameter at breast height (d.b.h.) should be measured once per year. Measurements should be taken on the uphill side of the tree (if on a slope) and strictly at 1.3 meters above ground level, regardless of the presence of buttresses.

Tree height should also be recorded once per year using a clinometer. From a distance of 15-20m from the base of the tree, the clinometer is used to determine the angle from the level of the observer to the top of tree and to the bottom of the tree. The sum of these two measurements (read from the dial of the clinometer) gives the height of the tree in meters. If the base of the tree is above the level of the observer (i.e. the tree is uphill from the observer), these two measurements should be subtracted and not summed. Tree height is measured to the topmost branches of the crown.

Tree Phenology Data Sheet:

Trail: _____ Date: _____ Observer(s): _____

Tree #	Genus	Species	Location	r/l-side	Fruits	Flowers	Time	Comments

APPENDIX F: Methodology for Establishing Biodiversity Plots

The following include some information additional to that listed in *Dallmeier 1992* on the methodology for establishing biodiversity plots. It is also based on *Dallmeier and Comiskey 1996*.

Plot Selection and Establishment

Selection of the plot site is crucial to the value of the research and should be based on the following criteria:

- The area should contain species representative and endemic to the ecosystem.
- Common or dominant species should be represented.
- The plot must be located within one vegetation type to give true representation of the area's diversity.

The botanist, aided by cartographic information, remote sensing photographs, and field verification techniques such as vegetation transects, must help determine the initial location of the plot. The use of Modified Whittaker Plots (0.1 ha), or many smaller plots (e.g. 0.01 ha), can greatly enhance the evaluation process. One-hectare plots provide sufficient information to study the dynamics of most tropical forests. Larger areas are required to analyze the spatial distributions of the trees and the dynamics of individual species, but this increases your monetary and time investments. The results from a one-hectare plot may also be used to decide whether a larger plot size, such as a 50-hectare plot, is necessary to elucidate the dynamics of the forest.

The forest plots are established according to Dallmeier (1992). At most new sites, professional survey or topography teams delineate a one-hectare plot (100 x 100 meters) and divide it into 25 quadrants, each 20 x 20 meters in size. The quadrants may be further divided into 16 sub-quadrants, each 5 x 5 meters. Close supervision is needed to ensure the least amount of disturbance to the vegetation as possible when the plots are set. The survey team also takes level measurements at each of the quadrant corners, producing a detailed topographic map of the plot. Exact coordinates are determined with the aid of a GPS. The boundaries of the quadrants are demarcated with string, to be removed later, making orientation easier within the plot.

Field Measurements

Tree tagging and identification begin after the corner stakes of the quadrants are set and the strings tied. The process includes locating, measuring, marking, and mapping all trees with a diameter at breast height (DBH) of 10 cm (4 cm at the dry forest site in the Virgin Islands). Diameter tape is used to measure DBH, avoiding any protrusions on the trunk. When trees below 10 cm are included in the census, they are measured with calipers. An average from three caliper readings is recorded, and a note is made of the measurement methods. Where multiple stems occur on a censused tree, all individual stem diameters of 1 cm are measured. The point of measurement is marked using paint. Trees are tagged with an aluminum

label facing toward the base line of the plot and set with a nail 30 cm above the point of measurement. The nails thus serve as general guides for future measurements.

Trees are tagged with an individual number consisting of a sequence of three double digits. Using (01-24-09) as an example, the first pair of numbers (01) identifies the one-hectare plot within the selected area in which the tree is located, while the second pair (24) identifies the 20 x 20-meter quadrant. The last pair (09) identifies an individual tree within the quadrant. No other tree receives this number. In each quadrant the tree numbers start at one and continue until the last tree is labeled.

Equipment requirements:

- 2 DBH tapes
- 10 cans of red spray paint per hectare
- 800 aluminum an 2" nails
- 25 data sheets

Mapping Methods

Two mapping methods are used by MAB. A team of three people works together in quadrant mapping. Two stand at ends of the quadrant baseline, while the third moves to each tree being measured. Electronic range finders measure the distance to the nearest 0.5-m from the tree to two adjacent corners. The A and B values recorded are later used, along with the diameter, to calculate the exact position of the tree. Where a smaller minimum DBH is used, as in the Virgin Islands Biosphere Reserve, trees are mapped by sub-quadrants. This provides a faster, more reliable method for mapping the increased number of qualifying trees. Again, string is used to demarcate the boundaries of the sub-quadrants. A field worker can then visually locate the positions of the trees and record them on pre-printed girded forms by walking around the sub-quadrant and gradually closing in on the center. This method is very accurate in the small sub-quadrants and allows one person to map up to 200 stems per day.

Equipment requirements:

- Data sheets
- 50 meter measuring tapes or electronic range finder
- 2 DBH tapes

Voucher Specimen Collection

Voucher specimens of the tree species occurring in the plot are valuable for further study of forest biodiversity. A minimum of five herbarium specimens is always collected; most are sterile. The botanists collect and identify the specimens, assisted by two or three experienced tree climbers who go after the more inaccessible samples. Field specimens are held together with flagging tape labeled with the tree number. The samples are sorted at the base camp, trimmed, and placed between absorbent paper. The tree number, as well as the botanist's collection number, identify the samples, which are stacked and bundled, placed in plastic bags, and preserved with a

solution of 50% ethanol so that they will not decompose during the trip to the herbarium.

On arrival at the herbarium, the samples are placed in dryers separated by corrugated plates. They should be fully dry within two days, at which point they are sent to specialists for initial identification and confirmation of their field identification. The final stage of the process is to mount and make high-resolution photocopies of the specimens.

Data Management

Data collected in the field can be entered into the *Biodiversity Monitoring Database (BioMon)*. BioMon enables users to efficiently manage the complex spatial and temporal data collected and to prepare a preliminary analysis. In addition, it facilitates the process of field verification by producing maps of the individual tree locations.

BioMon System Requirements:

- Windows 95/ 98 or Windows NT
- 16 megabytes RAM
- 5 megabytes or disk space with additional space required for data
- 640 x 480 monitor

References

Dallmeier, F. (1992). "Long-term monitoring of biological diversity in tropical forest areas." *Methods for establishment and inventory of permanent plots.* MAB Digest Series, 11. UNESCO. Paris.

Dallmeier, F. and J. A. Comiskey. (1996). "From the forest to the user: a methodology update." *Manu: The biodiversity of southeastern Peru; la biodiversidad del sureste del Peru* (Wilson, D. and A. Sandoval, Eds.). Smithsonian Institution Press. Washington, DC. Pp. 41-56.

APPENDIX G: Brownsberg Nature Park's Flora Species

Family	Genus	Species
Acanthaceae	Aphelandra	scabra
Acanthaceae	Aphelandra	tetragona
Acanthaceae	Blechum	pyrimidatum
Acanthaceae	Drejera	boliviensis
Acanthaceae	Justicia	calycinus
Acanthaceae	Justicia	cayennense
Acanthaceae	Mendoncia	aspera
Acanthaceae	Ruellia	rubra
Acanthaceae	Teliostachya	alopecuriodea
Anacardiaceae	Anacardium	spruceanum
Anacardiaceae	Loxopterygium	sagotii
Anacardiaceae	Sp	indet
Anacardiaceae	Spondias	mombin
Anacardiaceae	Tapirira	guianensis
Anacardiaceae	Tapirira	sp
Anacardiaceae	Thyrsodium	guianense
Annonaceae	Anaxagorea	doliocharpa
Annonaceae	Annona	sp
Annonaceae	Cymbopetalum	brasilense
Annonaceae	Dugetia	calycina
Annonaceae	Dugetia	inconspicua
Annonaceae	Dugetia	pycnastera
Annonaceae	Dugetia	sp
Annonaceae	Dugetia	surinamensis
Annonaceae	Fusaea	longifolia
Annonaceae	Guatteria	punctata
Annonaceae	Guatteria	sp
Annonaceae	Rollinia	exsucca
Annonaceae	Sp	indet
Annonaceae	Unonopsis	rufescens
Annonaceae	Xylopia	cf sericea
Annonaceae	Xylopia	frutescens
Annonaceae	Xylopia	sp1
Annonaceae	Xylopia	sp2
Annonaceeae	Guatteria	scandens
Apocynaceae	Aspidiosperma	album
Apocynaceae	Aspidiosperma	kunthiana
Apocynaceae	Aspidiosperma	marcgravianum
Apocynaceae	Aspidiosperma	oblongum
Apocynaceae	Aspidiosperma	vargasii
Apocynaceae	Bonafousia	albiflora
Apocynaceae	Bonafousia	undulata
Apocynaceae	Forsteronia	acouci
Apocynaceae	Geissospermum	sericeum
Apocynaceae	Geissospermum	sp
Apocynaceae	Himatanthus	articulatus
Apocynaceae	Lacmellea	aculeata
Apocynaceae	Macoubea	guianensis
Apocynaceae	Odontadenia	nitida
Apocynaceae	Odontadenia	perrotetii
Apocynaceae	Parahancornia	fasiculata
Apocynaceae	Rauvolfia	paraensis
Apocynaceae	Stenosolen	heterophyllus
Aquifoliaceae	Sp	indet
Araceae	Anthurium	pentaphyllum
Araceae	Anthurium	rubrinervium
Araceae	Dieffenbachia	seguina
Araceae	Dracontium	asperum
Araceae	Heteropsis	flexuosa
Araceae	Monstera	adansonii
Araceae	Monstera	obliqua
Araceae	Philodendron	insigne
Araceae	Philodendron	linnaei
Araceae	Philodendron	megalophyllum
Araceae	Philodendron	pedatum
Araceae	Philodendron	rudgeanum
Araceae	Philodendron	scandens
Araceae	Philodendron	sect. pteromiscium
Araceae	Philodendron	sphalerum
Araceae	Philodendron	splitgerberi
Araceae	Philodendron	surinamense
Araceae	Sp	indet
Araceae	Spathiphyllum	sp
Araceae	Syngonium	podophyllum
Araceae	Syngonium	sp
Araceae	Xanthosoma	sp
Araliaceae	Dendropanax	sp
Araliaceae	Schefflera	morotoni
Araliaceae	Schefflera	paraënsis
Araliaceae	Sp	indet
Arecaceae	Astrocaryum	paramaca
Arecaceae	Astrocaryum	sciophyllum
Arecaceae	Astrocaryum	sp
Arecaceae	Attalea	maripa
Arecaceae	Bactris	simplicifrons
Arecaceae	Calopogonium	muconoides
Arecaceae	Clathrotropis	brachypetala
Arecaceae	Euterpe	oleracea
Arecaceae	Geonoma	stricta
Arecaceae	Iriartea	exorhiza
Arecaceae	Mauritia	flexuosa
Arecaceae	Oenocarpus	baccaba
Asteraceae	Bidens	pilosa

Family	Genus	Species
Asteraceae	Bidens	synapiifolia
Asteraceae	Cyanthillium	cinereum
Asteraceae	Emilia	sonchifolia
Asteraceae	Erichitis	hieracifolia
Asteraceae	Hebeclinium	macrophyllum
Asteraceae	Mikania	parviflora
Asteraceae	Mikania	psilostachya
Asteraceae	Neuroleana	lobata
Asteraceae	Rolandra	fruticosa
Asteraceae	Sp	indet
Asteraceae	Wullfia	baccata
Balanophoraceae	Helosis	cayennensis
Begoniaceae	Begonia	glabra
Bignoniaceae	Arrabidea	candicans
Bignoniaceae	Arrabidea	fanshawei
Bignoniaceae	Arrabidea	patellifera
Bignoniaceae	Distictella	magnoliifolia
Bignoniaceae	Jacaranda	copaia
Bignoniaceae	Jacaranda	obtusifolia
Bignoniaceae	Jacaranda	rhombifolia
Bignoniaceae	Jacaranda	sp
Bignoniaceae	Lundia	densiflora
Bignoniaceae	Lundia	erionema
Bignoniaceae	Memora	flavida
Bignoniaceae	Memora	sp
Bignoniaceae	Mussatia	prieurei
Bignoniaceae	Neonotoma	variablis
Bignoniaceae	Parabignonia	steyermarkii
Bignoniaceae	Paragonia	pyrimidata
Bignoniaceae	Pithecoctenium	cruciferum
Bignoniaceae	Sp	indet
Bignoniaceae	Stizophyllum	riparium
Bignoniaceae	Stizophyllum	sp
Bignoniaceae	Tabebuia	capitata
Bignoniaceae	Tabebuia	inmpetiginosa
Bignoniaceae	Tabebuia	serratifolia
Bignoniaceae	Tabebuia	sp
Bignoniaceae	Tanaecium	sp nov
Bignoniaceae	Tynanthus	pubescens
Bignoniaceae	Tynanthus	sp nov a
Bignoniaceae	Tynanthus	sp nov b
Bignoniaceae	Xylophragma	seemanianum
Bombacaceae	Eriotheca	surinamensis
Bombacaceae	Quararibea	duckei
Bombacaceae	Quararibea	turbinata
Boraginaceae	Cordia	alliodora
Boraginaceae	Cordia	nodosa
Boraginaceae	Cordia	panicularis
Boraginaceae	Cordia	polycephala
Boraginaceae	Cordia	sagotii or lomatoloba
Boraginaceae	Cordia	schomburgkii
Boraginaceae	Cordia	sp
Boraginaceae	Cordia	tetrandra
Boraginaceae	Tournefortia	ulei
Bromeliaceae	Achmea	sp
Bromeliaceae	Catopsis	berteroniana
Bromeliaceae	Racinaea	spiculosa
Burmaniaceae	Burmannia	bicolor
Burseraceae	Protium	plagiocarpum
Burseraceae	Protium	polybotryum
Burseraceae	Protium	sp
Burseraceae	Protium	tenuifolia
Burseraceae	Sp	indet
Burseraceae	Tetragastis	altissima
Burseraceae	Trattinickia	burserifolia
Burseraceae	Trattinickia	lawrancei
Caesalpinoidae	Bauhinia	eilertsii
Caesalpinoidae	Bauhinia	sp
Caesalpinoidae	Bauhinia	surinamensis
Caesalpinoidae	Bocoa	prouacensis
Caesalpinoidae	Copaifera	guianensis
Caesalpinoidae	Copaifera	reticulata
Caesalpinoidae	Crudia	aromatica
Caesalpinoidae	Crudia	sp
Caesalpinoidae	Dialium	guianense
Caesalpinoidae	Dicorynia	guianensis
Caesalpinoidae	Dimorphandra	sp
Caesalpinoidae	Eperua	falcata
Caesalpinoidae	Eperua	sp
Caesalpinoidae	Macrolobium	bifolium
Caesalpinoidae	Martinodendron	parviflorum
Caesalpinoidae	Peltogyne	pubenscens
Caesalpinoidae	Sclerolobium	albifolium
Caesalpinoidae	Sclerolobium	melinoii
Caesalpinoidae	Sclerolobium	micropetalum
Caesalpinoidae	Sclerolobium	sp
Caesalpinoidae	Senna	chrysocarpa
Caesalpinoidae	Voucapoua	americana
Capparidaceae	Capparis	maroniensis
Caricaceae	Jacaratia	spinosa
Caryophyllaceae	Drymaria	cordata
Celastraceae	Goupia	glabra
Celastraceae	Maytenus	sp
Celastraceae	Sp	indet
Chrysobalanaceae	Couepia	guianensis
Chrysobalanaceae	Couepia	versicolor
Chrysobalanaceae	Excellodendron	barbatum

Family	Genus	Species	Family	Genus	Species
Chrysobalanaceae	Hirtella	bicornis	Convulvulaceae	Merremia	macrocalyx
Chrysobalanaceae	Hirtella	cf triandra	Cucurbitaceae	Cayaponia	rigida
Chrysobalanaceae	Hirtella	margae	Cucurbitaceae	Cf Gurania	spinulosa
Chrysobalanaceae	Hirtella	paniculata	Cucurbitaceae	Gurania	subumbellata
Chrysobalanaceae	Licania	canescens	Cucurbitaceae	Psiguria	sp
Chrysobalanaceae	Licania	cf apetala	Cucurbitaceae	Selysia	prunifera
Chrysobalanaceae	Licania	heteromorpha	Cucurbitaceae	Sp	indet
Chrysobalanaceae	Licania	hypoleuca	Cyatheaceae	Cyathea	oblonga
Chrysobalanaceae	Licania	licaniiflora	Cyatheaceae	Cyathea	spectabilis
Chrysobalanaceae	Licania	macrophylla	Cyatheaceae	Cyathea	surinamensis
Chrysobalanaceae	Licania	majuscula	Cyatheaceae	Metaxya	rostrata
Chrysobalanaceae	Licania	ovalifolia	Cyatheaceae	Sp	indet
Chrysobalanaceae	Licania	robusta	Cyclanthaceae	Asplundia	cf glandulosa
Chrysobalanaceae	Licania	sp	Cyclanthaceae	Asplundia	sp
Chrysobalanaceae	Parinari	campestris	Cyclanthaceae	Dicranopygium	pygmaeum
Chrysobalanaceae	Parinari	excelsa	Cyclanthaceae	Stelestylis	surinamensis
Chrysobalanaceae	Sp	indet	Cyclanthaceae	Thoracocarpus	bissectus
Clusiaceae	Caraipa	punctulata	Cyperaceae	Becquerelia	cymosa
Clusiaceae	Caraipa	richardiana	Cyperaceae	Bisbokeleria	longifolia
Clusiaceae	Clusia	grandiflora	Cyperaceae	Bisbokeleria	microcephala
Clusiaceae	Clusia	nemorosa	Cyperaceae	Calyptrocarya	glomerulata
Clusiaceae	Clusia	pana-panari	Cyperaceae	Cyperus	simplex
Clusiaceae	Clusia	platystigma	Cyperaceae	Diplasia	karataefolia
Clusiaceae	Clusia	sp	Cyperaceae	Hypolytrum	pulchrum
Clusiaceae	Rheedia	acuminata	Cyperaceae	Rhyncospora	holoschoenoides
Clusiaceae	Rheedia	benthamina	Cyperaceae	Rhyncospora	montana
Clusiaceae	Sp	indet	Cyperaceae	Scleria	sp
Clusiaceae	Symphonia	globulifera	Cyperaceae	Scleria	stipularis
Clusiaceae	Tovomita	choisyana	Denn. =?	Lonchitis	hirsuta
Clusiaceae	Tovomita	schomburgkii	Dichapetalaceae	Dichapetalum	pedunculatum
Clusiaceae	Tovomita	secunda	Dichapetalaceae	Dichapetalum	rugosum
Clusiaceae	Tovomita	sp	Dichapetalaceae	Tapura	capitulifera
Clusiaceae	Vismia	guianensis	Dichapetalaceae	Tapura	guianensis
Clusiaceae	Vismia	latifolia	Dillenaceae	Davilla	alata
Clusiaceae	Vismia	ramuliflora	Dillenaceae	Davilla	kunthii
Clusiaceae	Vismia	sp	Dillenaceae	Davilla	sp
Combretaceae	Buchenavia	sp	Dillenaceae	Doliocarpus	brevipedicelatus
Combretaceae	Buchenavia	tetraphylla	Dillenaceae	Doliocarpus	major
Combretaceae	Combretum	laxum	Dillenaceae	Pinzona	coriacea
Combretaceae	Terminalia	amazonia	Ebenaceae	Diospyros	aff. pseudoxylopia
Combretaceae	Terminalia	dichotoma	Ebenaceae	Diospyros	martinii
Combretaceae	Terminalia	lucida	Ebenaceae	Diospyros	sp
Connaraceae	Cnestidium	guianense	Elaeocarpaceae	Sloanea	acutiflora
Convulvulaceae	Aniseia	martinicensis	Elaeocarpaceae	Sloanea	dentata
Convulvulaceae	Bonamia	maripoides	Elaeocarpaceae	Sloanea	grandiflora
Convulvulaceae	Dicranostyles	cf passifloroides	Elaeocarpaceae	Sloanea	guianensis
Convulvulaceae	Dicranostyles	guianensis	Elaeocarpaceae	Sloanea	sp
Convulvulaceae	Maripa	glabra	Euphorbiaceae	Acalypha	diversifolia
Convulvulaceae	Maripa	scandens	Euphorbiaceae	Amanoa	guianensis

Family	Genus	Species
Euphorbiaceae	Chaetocarpus	schomburgkianus
Euphorbiaceae	Conceveiba	guianensis
Euphorbiaceae	Croton	marourensis
Euphorbiaceae	Croton	schiedeanus
Euphorbiaceae	Croton	trinitatus
Euphorbiaceae	Dalechampia	cf parvibracteata
Euphorbiaceae	Dalechampia	cissifolia
Euphorbiaceae	Drypetes	variablis
Euphorbiaceae	Euphorbia	sp
Euphorbiaceae	Hevea	guianensis
Euphorbiaceae	Hyeronima	alchorneoides var alchorneoides
Euphorbiaceae	Mabea	piriri
Euphorbiaceae	Mabea	speciosa var speciosa
Euphorbiaceae	Maprounea	guianensis
Euphorbiaceae	Margaritaria	nobilis
Euphorbiaceae	Micranda	brownsbergensis
Euphorbiaceae	Pausandra	martinii
Euphorbiaceae	Pera	bicolor
Euphorbiaceae	Phyllanthus	caribaeus
Euphorbiaceae	Phyllanthus	urinaria
Euphorbiaceae	Sapium	glandulosum
Euphorbiaceae	Sp	indet
Euphorbiaceae	Tragia	lessertiana
Euphorbiacecae	Pluknetia	polyadenia
Fixed	Mistake	to be
Flacourtaceae	Banara	guianensis
Flacourtaceae	Carpotroche	surinamensis
Flacourtaceae	Casearia	arborea
Flacourtaceae	Casearia	combayensis
Flacourtaceae	Casearia	guianensis
Flacourtaceae	Casearia	javitensis
Flacourtaceae	Casearia	sp
Flacourtaceae	Casearia	ulmifolia
Flacourtaceae	Lacistema	aggregatum
Flacourtaceae	Lacistema	grandifolium?
Flacourtaceae	Laetia	procera
Gentianaceae	Irlbachia	alata
Gentianaceae	Irlbachia	purpurascens
Gesneriaceae	Besleria	laxiflora
Gesneriaceae	Codonanthe	calcarata
Gesneriaceae	Columnea	calotricha
Gesneriaceae	Drymonia	coccinea
Gesneriaceae	Paradrymonia	campostyla
Gleicheniaceae	Gleichenia	remota
Gnetaceae	Gnetum	nodiflorum
Gnetaceae	Gnetum	urens
Graminae	Ichnanthus	pallens
Graminae	Ichnanthus	panicoides
Graminae	Olyra	latifolia
Graminae	Olyra	micrantha
Graminae	Olyra	obliquifolia
Graminae	Oplismenus	hirtellus
Graminae	Oplismenus	oblonga
Graminae	Panicum	pilosum
Graminae	Pharus	latifolius
Graminae	Pharus	parvifolius
Graminae	Streptogyne	americana
Grammit. =?	Cochlidium	linearifolium
Hernandiaceae	Sparratanthelium	uncigerum
Hippocrataceae	Cheiloclimum	cognatum
Hippocrataceae	Salacia	cordata
Hippocrataceae	Salicia	multiflora
Hippocrataceae	Sp	indet
Humiriaceae	Sacoglottis	cydonioides
Humiriaceae	Sacoglottis	guianensis
Hymenophyll.	Trichomanes	botryoides
Hymenophyll.	Trichomanes	diversifrons
Hymenophyll.	Trichomanes	pinnatum
Hymenophyll.	Trichomanes	rigidum
Hymenophyll.	Trichomanes	trollii
Icacinaceae	Dendrobangia	boliviana
Icacinaceae	Leretia	cordata
Labiatae	Hyptis	atrorubens
Labiatae	Hyptis	lanceolata
Lauraceae	Aniba	jenmanii
Lauraceae	Aniba	kappleri
Lauraceae	Aniba	panurensis
Lauraceae	Aniba	riparia
Lauraceae	Endlicheria	endlicheriopsis
Lauraceae	Licaria	debilis
Lauraceae	Licaria	martiniana
Lauraceae	Licaria	sp
Lauraceae	Nectandra	cissiflora
Lauraceae	Nectandra	reticulata
Lauraceae	Nectandra	sp
Lauraceae	Ocotea	aff. schomburgkii
Lauraceae	Ocotea	caniculata
Lauraceae	Ocotea	cf floribunda
Lauraceae	Ocotea	indirectineuria
Lauraceae	Ocotea	petalanthera
Lauraceae	Ocotea	puberula
Lauraceae	Ocotea	rubra
Lauraceae	Ocotea	sp
Lauraceae	Ocotea	splendens
Lauraceae	Rhodostemonodaphne	kunthiana

Family	Genus	Species	Family	Genus	Species
Lauraceae	Sp	indet	Melastomataceae	Adelobotrys	ciliata
Lecythidaceae	Corythophora	labriculata	Melastomataceae	Bellucia	grossularoides
Lecythidaceae	Couratari	cf gloriosa	Melastomataceae	Cf Henrietella	sp
Lecythidaceae	Couratari	fagifolia	Melastomataceae	Cf Macrocentrum	fruticosum
Lecythidaceae	Couratari	guianensis	Melastomataceae	Clidemia	conglomerata
Lecythidaceae	Couratari	sp	Melastomataceae	Clidemia	hirta
Lecythidaceae	Couratari	stellata	Melastomataceae	Ernestia	rubra
Lecythidaceae	Eschweilera	collina	Melastomataceae	Henrietella	flavescens
Lecythidaceae	Eschweilera	coriacea	Melastomataceae	Henrietella	succosa
Lecythidaceae	Eschweilera	pedicellata	Melastomataceae	Loreya	mespiloides
Lecythidaceae	Eschweilera	simiorum	Melastomataceae	Miconia	aschridyoides
Lecythidaceae	Eschweilera	sp	Melastomataceae	Miconia	ceramicarpa
Lecythidaceae	Gustavia	angusta	Melastomataceae	Miconia	chrysophylla
Lecythidaceae	Gustavia	hexapetala	Melastomataceae	Miconia	guianensis
Lecythidaceae	Gustavia	sp	Melastomataceae	Miconia	kappleri
Lecythidaceae	Lecythis	chartacea	Melastomataceae	Miconia	laterifolia
Lecythidaceae	Lecythis	corrugata	Melastomataceae	Miconia	mirabilis
Lecythidaceae	Lecythis	idatimon	Melastomataceae	Miconia	nervosa
Lecythidaceae	Lecythis	zabucajo	Melastomataceae	Miconia	prasina
Lecythidaceae	Sp	indet	Melastomataceae	Miconia	pteropoda
Loganiaceae	Antonia	ovata	Melastomataceae	Miconia	sp
Loganiaceae	Strychnos	melinoniana	Melastomataceae	Miconia	tschudyoides
Loganiaceae	Strychnos	tomentosa	Melastomataceae	Mouriri	acutiflora
Loranthaceae	Oryctanthus	florulentus	Melastomataceae	Mouriri	callocarpa
Loranthaceae	Phoradendron	pulleanum	Melastomataceae	Nepsera	aquatica
Lycopodiaceae	Lycopodiella	cernua	Melastomataceae	Pterolepis	glomerata
Malphigiaceae	Banisteriopsis	lucida	Melastomataceae	Sp	indet
Malphigiaceae	Byrsonima	aerugo	Melastomataceae	Tibouchina	sp
Malphigiaceae	Byrsonima	crassifolia	Melastomataceae	Topobea	parasitica
Malphigiaceae	Byrsonima	densa	Meliaceae	Carapa	procera
Malphigiaceae	Byrsonima	laevigata	Meliaceae	Carapa	sp
Malphigiaceae	Byrsonima	sp	Meliaceae	Cedrela	odorata
Malphigiaceae	Hiraea	affinis	Meliaceae	Guarea	glabra
Malphigiaceae	Hiraea	propinqua	Meliaceae	Guarea	grandifolia
Malphigiaceae	Jubelina	rosea	Meliaceae	Guarea	guara
Malphigiaceae	Mascagnia	leucanthele	Meliaceae	Guarea	kunthiana
Malphigiaceae	Sp	indet	Meliaceae	Guarea	macrophylla
Malphigiaceae	Stigmaphyllon	sinuatum	meliaceae	Guarea	pubescens
Malphigiaceae	Tetrapteris	styloptera	Meliaceae	Guarea	sp
Malvaceae	Pavonia	fruticosa	Meliaceae	Trichilia	micrantha
Malvaceae	Sida	sp	Meliaceae	Trichilia	quadrijuga
Marantaceae	Calathea	elliptica	Menispermaceae	Abuta	barbarta
Marantaceae	Ischnosiphon	arouma	Menispermaceae	Abuta	candollei
Marantaceae	Ischnosiphon	obliquus	Menispermaceae	Cissampelos	andromorpha
Marantaceae	Maranta	divericata	Menispermaceae	Orthomene	schomburgkii
Marantaceae	Maranta	humilis	Menispermaceae	Sp	indet
Maratt =?	Danaea	simplicifolia	Mimosoidae	Acacia	tenuifolia
Marcgraviaceae	Souroubea	guyanansis	Mimosoidae	Calliandra	cf tergemia
Melastomataceae	Aciotis	purpurascens	Mimosoidae	Enterolobium	schomburgkii

Family	Genus	Species	Family	Genus	Species
Mimosoidae	Enterolobium	sp	Myristicaceae	Iryanthera	sagotiana
Mimosoidae	Inga	alba	Myristicaceae	Iryanthera	sp
Mimosoidae	Inga	capitata	myristicaceae	sp	indet
Mimosoidae	Inga	leiocalyina	Myristicaceae	Virola	michelli
Mimosoidae	Inga	marginata	Myristicaceae	Virola	sebifera
Mimosoidae	Inga	paraensis	Myrsinaceae	Cybianthus	resinosus
Mimosoidae	Inga	pezizifera	Myrsinaceae	Stylogyne	spruceana
Mimosoidae	Inga	rubignosa	Myrsinaceae	Weigeltia	cf microbotrys
Mimosoidae	Inga	sp	Myrtaceae	Calycopus	sp
Mimosoidae	Inga	stipularis	Myrtaceae	Calycorectes	bergii
Mimosoidae	Inga	thibaudiana	Myrtaceae	Calyptranthes	sp
Mimosoidae	Inga	virgultosa	Myrtaceae	Calyptranthes	speciosa
Mimosoidae	Leucaena	leucocephala	Myrtaceae	Campomanesia	aromatica
Mimosoidae	Parkia	nitida	Myrtaceae	Eugenia	brownsbergii
Mimosoidae	Parkia	sp	Myrtaceae	Eugenia	cf florida
Mimosoidae	Parkia	ulei	Myrtaceae	Eugenia	coffeifolia
Mimosoidae	Piptadenia	suaveolens	Myrtaceae	Eugenia	cupulata
Mimosoidae	Pithecellobium	jupunba	Myrtaceae	Eugenia	ligustrina
Mimosoidae	Pithecellobium	pedicellare	Myrtaceae	Eugenia	patrisii
Mimosoidae	Sp	indet	Myrtaceae	Eugenia	sp
Mimosoidae	Stryphnodendron	pulcherimum	Myrtaceae	Myrcia	amazonica
Monimiaceae	Mollinedia	grazielae	Myrtaceae	Myrcia	decorticans
Monimiaceae	Mollinedia	laurina	Myrtaceae	Myrcia	deflexa
Monimiaceae	Siparuna	cuspidata	Myrtaceae	Myrcia	sp
Monimiaceae	Siparuna	decipiens	Myrtaceae	Myrcia	tomentosa
Monimiaceae	Siparuna	guianensis	Myrtaceae	Sp	indet
Moraceae	Bagassa	tiliaefolia	Nyctaginaceae	Guapira	eggersiana
Moraceae	Brosimum	acutifolium	Nyctaginaceae	Guapira	sp
Moraceae	Brosimum	guianense	Nyctaginaceae	Sp	indet
Moraceae	Brosimum	parinaroides	Nyctaginaceae	Torrubia	sp
Moraceae	Brosimum	rubescens	Ochnaceae	Ouratea	angulata
Moraceae	Cecropia	sp	Ochnaceae	Ouratea	gigantophylla
Moraceae	cecropia	sp	Olacaceae	Chaunochiton	kappleri
Moraceae	Ficus	albert-smithii	Olacaceae	Heisteria	cauliflora
Moraceae	Ficus	broadwayi	Olacaceae	Heisteria	densifrons
Moraceae	Ficus	citrifolia	Olacaceae	Heisteria	ovata
Moraceae	Ficus	guianensis	Olacaceae	Minquartia	guianensis
Moraceae	Ficus	maxima	Olacaceae	Sp	indet
Moraceae	Ficus	nymphaefolia	Onagraceae	Ludwigia	erecta
Moraceae	Ficus	sp	Onagraceae	Ludwigia	octovalvis
Moraceae	Maquira	sclerophylla	Opiliaceae	Agonandra	sylvatica
Moraceae	Naucleopsis	guianensis	Orchidaceae	Aulizia	clavata
Moraceae	Pourouma	sp	Orchidaceae	Beloglottis	costaricensis
Moraceae	Pourouma	villosa	Orchidaceae	Brassia	sp
Moraceae	Pseudolmedia	laevis	Orchidaceae	Caluera	surinamensis
Moraceae	Sp	indet	Orchidaceae	Campylocentrum	micranthum
Moraceae	Trymatococcus	oligandrus	Orchidaceae	Catasetum	deltoideum
Musaceae	Heliconia	acuminata	Orchidaceae	Cf Erythrodes	sp
Musaceae	Heliconia	spatho-circinata	Orchidaceae	Cf Macradenia	sp

Family	Genus	Species	Family	Genus	Species
Orchidaceae	Cheiradenia	imthurnii	Orchidaceae	Pleurothallis	discoidea
Orchidaceae	Chondrorrhychna	lactea	Orchidaceae	Pleurothallis	foliata
Orchidaceae	Cryptarrhena	lunata	Orchidaceae	Pleurothallis	polygonoides
Orchidaceae	Cyclopogon	elatus	Orchidaceae	Pleurothallis	prinosa
Orchidaceae	Dichaea	muricata	Orchidaceae	Pleurothallis	seriata
Orchidaceae	Dichaea	sp	Orchidaceae	Pleurothallis	sp
Orchidaceae	Dipteranthus	sp	Orchidaceae	Pleurothallis	suspensa
Orchidaceae	Elleanthes	caravata	Orchidaceae	Psgmorchis	pusilla
Orchidaceae	Elleanthes	cephalotus	Orchidaceae	Quekettia	vermeuleniana
Orchidaceae	Elleanthes	linifolius	Orchidaceae	Scaphyglottis	cf dunstervillei
Orchidaceae	Elleanthes	sp	Orchidaceae	Scaphyglottis	modesta
Orchidaceae	Encyclia	diurna	Orchidaceae	Scaphyglottis	prolifera
Orchidaceae	Epidendrum	racemosum	Orchidaceae	Scaphyglottis	violaceum
Orchidaceae	Epidendrum	secundum	Orchidaceae	Sobralia	cf suaveolens
Orchidaceae	Epidendrum	sp	Orchidaceae	Sobralia	macrophylla
Orchidaceae	Epidendrum	ungiculatum	Orchidaceae	Stelis	cf aprica
Orchidaceae	Gongora	quinquenervis	Orchidaceae	Stelis	sp
Orchidaceae	Hormidium	fragrans	Orchidaceae	Trichosalpinyx	memor
Orchidaceae	Hormidium	pygmaeum	Orchidaceae	Trichosalpinyx	orbicularis
Orchidaceae	Kegeliella	houtteana	Orchidaceae	Trigonidium	acuminatum
Orchidaceae	Lepanthes	cf helicocephala	Orchidaceae	Trisetella	triglochin
Orchidaceae	Lepanthes	ruscifolia	Orchidaceae	Xylobium	foveatum
Orchidaceae	Lepanthes	sp	Papilionoidae	Andira	sp
Orchidaceae	Lockhartia	imbricata	Papilionoidae	Cf Platymiscum	ulei
Orchidaceae	Masdevallia	guttulata	Papilionoidae	Clitoria	javitensis
Orchidaceae	Maxillaria	brunnea	Papilionoidae	Clitoria	pendens
Orchidaceae	Maxillaria	camaridii	Papilionoidae	Clitoria	sagotii
Orchidaceae	Maxillaria	cf jenischiana	Papilionoidae	Dalbergia	monetaria
Orchidaceae	Maxillaria	desvauxiana	Papilionoidae	Desmodium	adscendens
Orchidaceae	Maxillaria	discolor	Papilionoidae	Desmodium	axillare
Orchidaceae	Maxillaria	reichenheimiana	Papilionoidae	Desmodium	barbatum
Orchidaceae	Maxillaria	rufescens	Papilionoidae	Desmodium	heterophyllum
Orchidaceae	Maxillaria	sp	Papilionoidae	Desmodium	wijdlerianum
Orchidaceae	Maxillaria	splendens	Papilionoidae	Dioclea	elliptica
Orchidaceae	Maxillaria	stenophylla	Papilionoidae	Dioclea	huberi
Orchidaceae	Notylia	sagittifera	Papilionoidae	Dioclea	macrocarpa
Orchidaceae	Octomeria	brevifolia	Papilionoidae	Diplotropis	purpurea
Orchidaceae	Octomeria	grandiflora	Papilionoidae	Dipteryx	sp
Orchidaceae	Oncidium	aff baueri	Papilionoidae	Dypterix	odorata
Orchidaceae	Ornithocephalus	gladiatus	Papilionoidae	Machaerium	angustifolium
Orchidaceae	Paphinia	cristata	Papilionoidae	Machaerium	floribundum
Orchidaceae	Pelexia	callifera	Papilionoidae	Machaerium	macrophyllum
Orchidaceae	Platystele	ovalifolia	Papilionoidae	Ormosia	paraensis
Orchidaceae	Platystele	stenostachya	Papilionoidae	Platymiscum	trinitans
Orchidaceae	Pleurothallis	aristata	Papilionoidae	Poecilanthe	effusa
Orchidaceae	Pleurothallis	barbulata	Papilionoidae	Sp	indet
Orchidaceae	Pleurothallis	cf consimilis	Papilionoidae	Swartzia	amshoffiana
Orchidaceae	Pleurothallis	ciliolata	Papilionoidae	Swartzia	arborescens
Orchidaceae	Pleurothallis	diffusiflora	Papilionoidae	Swartzia	benthamina

Family	Genus	Species	Family	Genus	Species
Papilionoidae	Swartzia	brachyrachis	Polypodiaceae	Lindsaea	sp
Papilionoidae	Swartzia	laevicarpa	Polypodiaceae	Offersia	cervina
Papilionoidae	Swartzia	longicarpa	Polypodiaceae	Oleandra	articulata
Papilionoidae	Swartzia	panacoco	Polypodiaceae	Polybotrya	fractiserialis
Papilionoidae	Swartzia	schomburgkii	Polypodiaceae	Polypodium	dissimile
Papilionoidae	Swartzia	sp	Polypodiaceae	Polypodium	phyllitidis
Papilionoidae	Tephrosia	purpurea	Polypodiaceae	Pteris	biaurita
Papilionoidae	Vatairea	guianensis	Polypodiaceae	Tectaria	incisa
Papilionoidae	Vatairea	paraensis	Polypodiaceae	Tectaria	plantaginea
Papilionoidae	Zornia	sp	Polypodiaceae	Tectaria	trifoliata
Passifloraceae	Passiflora	coccinea	Polypodiaceae	Thelypteris	glandulosa
Passifloraceae	Passiflora	foetida	Polypodiaceae	Thelypteris	hispidula
Passifloraceae	Passiflora	garckei	Quiinaceae	Lacunaria	crenata
Passifloraceae	Passiflora	glandulosa	Quiinaceae	Quiinia	aff. parvifolia
Passifloraceae	Passiflora	laurifolia	Quiinaceae	Quiinia	integrifolia
Passifloraceae	Passiflora	sp	Rhamnaceae	Gouania	blanchetiana
Passifloraceae	Passiflora	vespertilio	Rosaceae	Prunus	myrtifolia
Phytolaccaceae	Phytolacca	rivinoides	Rubiaceae	Amaioua	guianensis
Piperaceae	Piper	aequale	Rubiaceae	Borreria	capitata
Piperaceae	Piper	alatabaccum	Rubiaceae	Borreria	laevis
Piperaceae	Piper	arboreum	Rubiaceae	Borreria	latifolia
Piperaceae	Piper	hispidum	Rubiaceae	Capirona	decorticans
Piperaceae	Piper	obliquum	Rubiaceae	Capironia	surinamensis
Piperaceae	Piper	obtusifolia	Rubiaceae	Coussarea	microcarpa
Piperaceae	Piper	poiteanum	Rubiaceae	Coussarea	paniculata
Polygalaceae	Barnhartia	floribunda	Rubiaceae	Coussarea	racemosa
Polygalaceae	Moutabea	guianensis	Rubiaceae	Coussarea	sp
Polygalaceae	Moutabea	longifolia	Rubiaceae	Diodia	acimifolia
Polygalaceae	Polygala	sp	Rubiaceae	Diodia	sp
Polygalaceae	Polygala	variablis	Rubiaceae	Duroia	longiflora
Polygalaceae	Securidaca	pubescens	Rubiaceae	Faramea	irwinii
Polygalaceae	Securidaca	uniflora	Rubiaceae	Faramea	multiflora
Polygonaceae	Coccoloba	ascendens	Rubiaceae	Faramea	sp
Polygonaceae	Coccoloba	parinensis	Rubiaceae	Fernandusa	paraensis
Polygonaceae	Sp	indet	Rubiaceae	Fernandusa	rudgeoides
Polypodiaceae	Adantium	fuliginosum	Rubiaceae	Fernandusa	sp
Polypodiaceae	Adantium	glaucescens	Rubiaceae	Gonzalagunia	dicocca
Polypodiaceae	Adantium	macrophyllum	Rubiaceae	Gonzalagunia	sp
Polypodiaceae	Adantium	phyllitidis	Rubiaceae	Gonzalagunia	spicata
Polypodiaceae	Adantium	pulverulentum	Rubiaceae	Guettarda	spruceana
Polypodiaceae	Adantium	sp	Rubiaceae	Hillia	illustris
Polypodiaceae	Blechnum	volubile	Rubiaceae	Ixora	graciliflora
Polypodiaceae	Bolbitis	semipinnatifida	Rubiaceae	Ixora	surinamensis
Polypodiaceae	Cyclodium	inerme	Rubiaceae	Morinda	brachycalyx
Polypodiaceae	Diplasium	cristatum	Rubiaceae	Pagamea	guianensis
Polypodiaceae	Hemidictyum	marginatum	Rubiaceae	Palicourea	croceoides
Polypodiaceae	Lindsaea	dubia	Rubiaceae	Palicourea	crocera
Polypodiaceae	Lindsaea	lancea	Rubiaceae	Palicourea	guianensis
Polypodiaceae	Lindsaea	reniformis	Rubiaceae	Palicourea	sp

Family	Genus	Species	Family	Genus	Species
Rubiaceae	Posoqueria	latifolia	Sapotaceae	Pouteria	egregia
Rubiaceae	Psychotria	acuminata	Sapotaceae	Pouteria	engleri
Rubiaceae	Psychotria	capitata	Sapotaceae	Pouteria	filipes
Rubiaceae	Psychotria	cf muscosa	Sapotaceae	Pouteria	guianensis
Rubiaceae	Psychotria	deflexa	Sapotaceae	Pouteria	melanopoda
Rubiaceae	Psychotria	erecta	Sapotaceae	Pouteria	reticulata
Rubiaceae	Psychotria	hoffmannseggian	Sapotaceae	Pouteria	sp
Rubiaceae	Psychotria	iodotricha	Sapotaceae	Pouteria	speciosa
Rubiaceae	Psychotria	mapouroides	Sapotaceae	Pouteria	trigonosperma
Rubiaceae	Psychotria	moroidea	Sapotaceae	Pradosia	surinamensis
Rubiaceae	Psychotria	racemosa	Sapotaceae	Sarcaulis	brasilensis
Rubiaceae	Psychotria	sp	Sapotaceae	Sp	indet
Rubiaceae	Psychotria	trichophoroides	Scropulariaceae	Achetaria	ocimoides
Rubiaceae	Ronabea	latifolia	Scropulariaceae	Lindernia	crustacea
Rubiaceae	Sabicea	aspera	Selaginellaceae	Selaginella	parkeri
Rubiaceae	Sipanea	biflora	Simaroubaceae	Picramnia	guianensis
Rubiaceae	Sipanea	pratensis	Simaroubaceae	Picramnia	latifolia
Rubiaceae	Sipanea	staheli	Simaroubaceae	Simaba	guianensis
Rubiaceae	Uncaria	guianensis	Simaroubaceae	Simarouba	amara
Rutaceae	Sp	indet	Siymplococaeae	Symplocos	guianensis
Rutaceae	Ticorea	pedicellata	Smilacaceae	Smilax	cf megalophylla
Rutaceae	Zanthoxylum	cf flavum	Smilacaceae	Smilax	schomburgkiana
Rutaceae	Zanthoxylum	rhoifolium	Smilacaceae	Smilax	syphilitica
Sapindaceae	Cupania	hirsuta	Solanaceae	Brunfelsia	guianensis
Sapindaceae	Cupania	scrobiculata	Solanaceae	Cestrum	cf latifolium
Sapindaceae	Matabaya	opaca	Solanaceae	Lycianthes	pauciflorum
Sapindaceae	Paullinia	acuminata	Solanaceae	Markea	cf longiflora
Sapindaceae	Paullinia	cf latifolia	Solanaceae	Solanum	leucocarpon
Sapindaceae	Serjania	oblongifolia	Solanaceae	Solanum	paludosum
Sapindaceae	Sp	indet	Solanaceae	Solanum	rugosum
Sapindaceae	Talisia	hemidasya	Solanaceae	Solanum	sp
Sapindaceae	Talisia	megaphylla	Solanaceae	Solanum	subinerme
Sapindaceae	Talisia	microphylla	Solanaceae	Sp	indet
Sapindaceae	Talisia	pedicellaris	Sterculiaceae	Bytnerria	benensis
Sapindaceae	Talisia	praealta	Sterculiaceae	Guazuma	ulmifolia
Sapindaceae	Talisia	sp	Sterculiaceae	Sterculia	excelsa
Sapindaceae	Talisia	sylvatica	Sterculiaceae	Sterculia	pruriens
Sapindaceae	Toloucia	patentinervis	Styracaceae	Styrax	aff fanshaweii
Sapindaceae	Toloucia	pulvinata	Theaceae	Gordonia	fruticosa
Sapindaceae	Urvillea	ulmacea	Theophrastaceae	Clavija	lancifolia
Sapindaceae	Vouarana	guianensis	Thunbergiaceae	Mendoncia	hoffmannseggiana
Sapotaceae	Chrysophyllum	cuneatifolium	Tiliaceae	Apeiba	glabra
Sapotaceae	Ecclinusa	guianensis	Tiliaceae	Apeiba	intermedia
Sapotaceae	Ecclinusa	prieurii	Tiliaceae	Apeiba	petuomo
Sapotaceae	Manilkara	bidentata	Tiliaceae	Apeiba	sp
Sapotaceae	Micropholis	guianensis	Tiliaceae	Luheopsis	sp
Sapotaceae	Pouteria	bangii	Tiliaceae	Sp	indet
Sapotaceae	Pouteria	cuspidata ssp robusta	Trigoniaceae	Trigonia	laevis
			Triuridaceae	Sciaphila	albescens

Family	Genus	Species	Family	Genus	Species
Turneraceae	Turnera	rupestris	Vitaceae	Cissus	sicyoides
Ulmaceae	Celtis	iguanea	Vitaceae	Cissus	sp
Ulmaceae	Trema	micrantha	Vochysiaceae	Erisma	uncinatum
Urticaceae	Pilea	pubescens	Vochysiaceae	Qualea	caerulea
Urticaceae	Urera	caracasana	Vochysiaceae	Qualea	dinizii
Verbenaceae	Cithaexylum	macrophyllum	Vochysiaceae	Qualea	rosea
Verbenaceae	Cithaexylum	spinulosum	Vochysiaceae	Ruizterania	albiflora
Verbenaceae	Lantana	camara	Vochysiaceae	Vochysia	costata
Verbenaceae	Lippia	alba	Vochysiaceae	Vochysia	guianensis
Verbenaceae	Petrea	bracteata	Vochysiaceae	Vochysia	sp
Verbenaceae	Stachytarpheta	cayennensis	Vochysiaceae	Vochysia	surinamensis
Verbenaceae	Vitex	compressa	Zingiberaceae	Costus	claviger
Violaceae	Amphirrox	surinamensis	Zingiberaceae	Costus	scaber?
Violaceae	Paypayrola	longifolia	Zingiberaceae	Renealmia	sp
Violaceae	Rinorea	cf pubiflora			
Violaceae	Rinorea	riana			
Violaceae	Rinorea	sp			

APPENDIX H: Brownsberg Nature Park's Mammal Species

This checklist has been assembled from collections made by the Carnegie Museum in the period 1974-1980, from data provided by Dr. Ouboter of the University of Suriname, from collections made by Dr. Mark Engstrom and Mr. Burton Lim of the Royal Ontario Museum and Dr. Francois Catzeflis of the University of Montpelier during 2002, and data provided by the Park's Wildlife Monitoring Program. Sranan Tongo names for animals were obtained from the "Woordenlijst Sranan Nederlands English" (Anon. 1980a). These data are current to May 2002.

U = residency unconfirmed; ROM = collected by Royal Ontario Museum in 2002
c = common; r = rare; d = diurnal; n = nocturnal

SPECIES	ENGLISH	SRANAN TONGO	.REMARKS
Order Marsupialia	(marsupials)	(awari)	
Family Didephidae	(marsupials)		
Caluromys philander	woolly opossum		U
Didelphis marsupialis	common opossum	foto/dagu/busi-awari	ROM
Gracilinamns emilae	gracile mouse opossum		ROM
Marmosa murina	murina mouse opossum	busmoismoisi	ROM
Marmosops sp.	slender mouse opossum		ROM
Metachirus nudicaudatus	brown 4-eyed opossum	froktu-awari	ROM
Philander opossum	gray 4-eyed opossum	fo-ai-awari	
Order Chiroptera	(bats)	(fremusu)	
Family Emballonuridae	(sheath-tailed bats)		
Saccopteryx bilineata	black 2-lined sac-winged bat		ROM
Saccopteryx leptura	brown 2-lined sac-winged bat		ROM
Family Mormoopidae	*(leaf-chinned and mustached bats)*		
Pteronotus gymnonotus	naked-back leaf-chinned bat		ROM
Pteronotus parnellii	common leaf-chinned bat		ROM
Family Phyllostomidae: Sub-family Phyllostominae		(spear-nosed bats)	
Chrotopterus auritus	wooly false vampire bat		ROM
Glyphonycteris daviesi	Davies' big-eared bat		ROM
Micronycteris hirsuta	hairy big-eared bat		ROM
Micronycteris homezi	Homez's big-eared bat		ROM
Micronycteris minuta			
Micronycteris megalotis	little big-eared bat		
Micronycteris sylvestris			
Mimon crenulatum	hairy-nosed bat		ROM
Phylloderma stenops			
Phyllostomus discolor	flower-eating bat		ROM
Phyllostomus elongates	brown spear-nosed bat		ROM
Phyllostomus hastatus	greater-spear-nosed bat		ROM
Phyllostomus latifolius	red spear-nosed bat		ROM
Tonatia bidens			
Tonatia carrikeri	white-bellied round-eared bat		ROM
Tonatia saurophila	striped round-eared bat		ROM
Tonatia schulzi	warty round-eared bat		ROM
Tonatia silvicola	forest round-eared bat		ROM
Trachops cirrhosus	frog-eating bat		ROM
Trinycteris nicefori	Nicefori's big-eared bat		ROM

Family Phyllostomidae: Sub-family Lonchophyllinae	(spear-nosed long-tongue bats)		
Lionycteris spurrelli	Spurrell's nectar-feeding bat		ROM
Lonchophylla thomasi	Thomas' nectar-feeding bat		ROM
Family Phyllostomidae: Sub-family Glossophaginae	(long-tongue bats)		
Anoura caudifer	tailless long-nosed bat		
Anoura sp.	hairy-legged nectar-feeding bat		ROM
Choeroniscus minor	long-nosed nectar-feeding bat		ROM
Glossophaga soricina	common nectar-feeding bat		ROM
Family Phyllostomidae: Sub-family Carolliinae	(short-tailed little fruit bats)		
Carollia brevicauda	silky short-tailed fruit bat		ROM
Carollia perspicillata	Seba's short-tailed fruit bat		ROM
Rhinophylla pumilio	little fruit bat		ROM
Family Phyllostomidae: Sub-family Stenodermatinae	(fruit bats)		
Ametrida centurio	little white-shouldered bat		ROM
Artibeus cinereus	pygmy fruit bat		
Artibeus concolor	medium fruit-eating bat		ROM
Artibeus jamaicensis			
Artibeus lituratus	greater fruit-eating bat		ROM
Artibeus obscurus	sooty fruit-eating bat		ROM
Artibeus planirostris	larger fruit-eating bat		ROM
Artibeus sp.	small fruit-eating bat		ROM
Chiroderma villosum	greater big-eyed bat		ROM
Chiroderma trinitatum	small big-eyed bat		ROM
Platyrrhinus helleri	Heller's broad-nosed OR white-lined bat		
Platyrrhinus sp.	lesser white-lined bat		ROM
Sturnira lilium	small yellow-shouldered bat		ROM
Sturnira tildae	greater yellow-shouldered bat		ROM
Uroderma bilobatum	common tent-making bat		ROM
Vampyressa caraccioli	greater white-lined bat		ROM
Vampyressa pusilla	yellow-eared bat		ROM
FamilyThyropteridae		(sucker footed bats)	
Thyroptera tricolor	disc-winged bat		ROM
Family Vespertilionidae		(vespertilionid bats)	
Eptesicus brasiliensis			
Eptesicus chiriquinus	big black bat		ROM
Eptesicus furinalis	big brown bat		ROM
Myotis riparius	red myotis		ROM
Family Molossidae		(free-tailed bats)	
Molossus ater	black free-tailed bat		ROM
Molossus molossus	common free-tailed bat		ROM
Order Primates	(monkeys)	(yapiyapi)	
Family Cebidae			
Alouatta seniculus	red howler monkey	babun	c, d
Ateles paniscus	spider monkey	kwata	c, d
Cebus apella	brown capuchin	keskesi	c, d
Cebus olivaceus	gray capuchin	bergi-keskesi	r, d
Chiropotes santanas	brown-bearded saki	bias	r, d
Pithecia pithecia	white-faced saki	wanaku	r, d
Saimiri sciureus	squirrel monkey	monkimonki	r, d
Family Callitrichidae			
Saguinas midas	golden-handed tamarin	saguwenke	c, d
Order Edentata	(edentates)		
Family Myrmecophagidae	(anteaters)		
Cyclopes didactylus	pygmy anteater	likanu	r, n
Tamandua tetradactyla	southern tamandua	mirafroiti	r, d

Family Bradypodidae	(3-toed sloths)	(loiri)	
Bradypus tridactylus	pale-throated 3-toed sloth	sonloiri	r, d
Family Choloepidae	(2-toed sloths)	(loiri)	
Chloepus didactylus	southern 2-toed sloth	skapuloiri, tofingaloiri	r, d
Family Dasypodidae	(armadillos)	(kapasi)	
Dasypus kappleri	great long-nosed armadillo	makakapasi	c, n
Dasypus novemcinctus	9-banded armadillo	lontutere	c, n
Priodontes giganteus	giant armadillo	granmankapasi	U
Order Carnivora	(carnivores)		
Family Procyonidae	(raccoons)		
Nasua nasua	South American coati	kwaskwasi	c, d, n
Potos flavus	kinkajou	netikeskesi	c, n
Family Mustelidae	(weasels)		
Eira barbara	tayra	aira	r, d, n
Family Felidae	(cats)		
Herpailurus yagouaroundi	jaguarundi	blaka-tigrikati	r, d, n
Leopardus pardalis	ocelot	heititigrikati	r, n
Leopardus tigrinus	oncilla	tigrikati	U
Leopardus wiedii	margay	tigrikati	r, n
Pathera onca	jaguar	pakiratigri, penitigri	r, d, n
Puma concolor	puma	reditigri	r, n
Order Perissodactyla	(odd-toed ungulates)		
Family Tapiridae	(tapirs)	(bofru)	
Tapirus terrestris	tapir	bofru	r, n
Order Artiodactyla	(even-toed ungulates)		
Family Tayassuidae	(peccaries)		
Tayassu pecari	white-lipped peccary	pingo	c, d
Tayassu tajacu	collared peccary	pakira	c, d
Family Cervidae	(deer)	(dia)	
Mazama americana	red brocket deer	redidia, pranasidia	c, d, n
Mazama gouazoubira	brown brocket deer	kuriaku, busikrabita	c, d, n
Order Rodentia	(rodents)		
Family Sciuridae	(squirrels)		
Sciurus aestunas	Guiana tree squirrel	bonboni, letyan	
Sciurillus pusillus	Neotropical pygmy squirrel		
Family Sigmodontinae: Sub-family Oryzomyini	(rice rats)		
Neacomys guianae	spiny mouse		
Neacomys paracou	Paracou spiny mouse		ROM
Neacomys sp.	spiny mouse		ROM
Oecomys auyantepui	Auyantepui aboreal rice rat		ROM
Oecomys bicolor	bicolored arboreal rice rat		ROM
Oecomys sp.	arboreal rice rat		ROM
Oryzomys capito	terrestrial rice rat		
Oryzomys concolor	arboreal rice rat		
Oryzomys macconnelli	Macconnelli's terrestrial rice rat		ROM
Oryzomys megacephalus	common rice rat		ROM
Oryzomys sp.	rice rat		ROM
Family Sigmodontinae: Sub-family Incertae Sedis (Uncertain sub-family)	(climbing rats)		
Rhipidomys nitella	climbing rat		ROM
Family Echimyidae: Sub-family Eumysopinae	(spiny rats)		
Proechimys cuvieri	Cuvier's spiny rat		ROM
Proechimys guyannensis	Guyana spiny rat	maka-alata	ROM
Proechimys sp.	spiny rat	alata	ROM

Family Echimyidae: Sub-family Incertae Sedis (Uncertain sub-family)			
Mesomys hispidus	spiny tree rat		ROM
Family Hydrochaeridae	(capybaras)		
Hydrochaeris hydrochaeris	capybara	kapuwa, watra-agu	r, d
Family Dasyproctidae	(agoutis)		
Dasyprocta leporine	red-rumped agouti	konkoni	c, d
Myoprocta acouchy	red acouchy	mambula	c, d
Family Agoutidae	(pacas)		
Agouti paca	paca	hei	c, n
Family Erethizontodae	(new world porcupines)		
Coendou prehensilis	tree porcupine	gindyamaka, agidya	r

8 Orders (1 bat)
26 Families (6 bats)
9 Sub-families (5 bats)
73 Genera (29 bats)
116 Species (57 bats)

APPENDIX I: Brownsberg Nature Park's Bird Species

This list has been compiled through the efforts of the STINASU ornithologist, Otte Ottema, and is current to March 2002.

Status Code:
C : Common, usually seen within a day
N : Not commmon, usually seen within a week
R : Rare, difficult to find
? : Recorded by trustworthy ornithologist, but confirmation deemed necessary

Common name	Scientific name	Status
TINAMIDAE		
Great Tinamou	Tinamos major	N
Cinereous Tinamou	Crypturellus cinereus	N
Little Tinamou	Crypturellus soui	N
Variegated Tinamou	Crypturellus variegatus	C
Red-legged Tinamou	Crypturellus erythropus	R
ANHINGIDAE		
Anhinga	Anhinga anhinga	R
CATHARTIDAE		
King Vulture	Sarcoramphus papa	N
Turkey Vulture	Cathartes aura	?
Greater yellow-headed Vulture	Cathartes melambrotus	C
ACCIPITRIDAE		
Swallow-tailed Kite	Elanoides forficatus	C
Grey-headed Kite	Leptodon cayanensis	R
Double-toothed Kite	Harpagus bidentatus	R
Plumbeous Kite	Ictinia plumbea	C
Gray-bellied Hawk	Accipiter poliogaster	R
White-tailed Hawk	Buteo albicaudatus	N
Short-tailed Hawk	Buteo brachyurus	N
Gray Hawk	Buteo nitidus	R
Broad-winged Hawk	Buteo platypterus	R
White Hawk	Leucopternis albicollis	N
Black-faced Hawk	Leucopternis melanops	R
Great Black Hawk	Buteogallus urubitinga	N
Harpy Eagle	Harpia harpjia	R
Black-and-white Hawk-Eagle	Spizatur melanoleucus	R
Ornate Hawk-Eagle	Spizaetus ornatus	R
Black Hawk-Eagle	Spizaetus tyrannus	R
PANDIONIDAE		
Osprey	Pandion haliaetus	R
FALCONIDAE		
Laughing Falcon	Herpetotheres cachinnans	?
Slaty-backed Forest-Falcon	Micrastur mirandollei	R
Barred Forest-Falcon	Micrastur ruficollis	C
Lined Forest-Falcon	Micrastur gilvicollis	C
Black Caracara	Daptrius ater	R
Red-throated Caracara	Daptrius americanus	C
Yellow-headed Caracara	Milvago chimachima	?
Bat Falcon	Falco rufigularis	N

CRACIDAE		
Little Chachalaca	Ortalis motmot	N
Marail Guan	Penelope marai	R
Spix's guan	Penelope jacquacu	N
Common Piping-Guan	Pipile pipile	R
Black Curassow	Crax alector	N
PHASIANIDAE		
Marbled Woodquail	Odontophorus gujanensis	C
PSOPHIIDAE		
Gray-winged Trumpeter	Psophia crepitans	N
RALLIDAE		
Grey-necked Wood-Rail	Aramides cajanea	R
Russet-crowned Crake	Laterallus viridis	C
EURYPYGIDAE		
Sunbittern	Eurypyga helias	?
SCOLOPACIDAE		
Solitary Sandpiper	Tringa solitaria	?
Spotted Sandpiper	Actitis macularia	C
COLUMBIDAE		
Scaled Pigeon	Columba speciosa	N
Pale-vented Pigeon	Columba cayannensis	R
Ruddy Pigeon	Columba subvinacea	C
Plumbeous Pigeon	Columba plumbea	N
White-tipped Dove	Leptotila verreauxi	?
Gray-fronted Dove	Leptotila rufaxilla	C
Ruddy Qual-Dove	Geotrygon montana	N
Violaceous Qual-Dove	Geotrygon violacae	?
PSITTACIDAE		
Blue-and-yellow Macaw	Ara ararauna	R
Scarlet Macaw	Ara macao	?
Red-and-green Macaw	Ara chloroptera	R
Painted Parakeet	Phyrrhura picta	C
White-eyed Parakeet	Aratinga leucophtalmus	R
Brown-throated parakeet	Aratinga Pertinax	R
Golden-winged Parakeet	Brotogeris chrysopterus	C
Lilac-tailed Parrotlet	Touit batavica	R
Sapphire-rumped Parrotlet	Touit purpurata	R
Black-headed Parrot	Pionites melanocephala	R
Caica Parrot	Pionopsitta caica	R
Blue-headed Parrot	Pionus menstruus	C
Dusky Parrot	Pionus fuscus	N
Blue-cheeked Parrot	Amazona dufresniana	R
Yellow-headed Parrot	Amazona ochrocephala	R
Orange-winged Parrot	Amazona amazonica	N
Mealy Parrot	Amazona farinosa	R
Red fan Parrot	Deroptyus accipitrinus	N
CUCULIDAE		
Squirrel Cuckoo	Piaya cayana	C
Black-bellied Cuckoo	Piaya melanogaster	R

Smooth-billed Ani	Crotophaga ani	R
STRIGIDAE		
Tropical screech-Owl	Otus choliba	R
Tawny-bellied Screech-Owl	Otus watsonii	N
Crested Owl	Lophostrix cristata	R
Spectacled Owl	Pulsatrix perspicillata	R
Black-banded Owl	Ciccaba huhula	R
Mottled Owl	Ciccaba virgata	R
NYCTIBIIDAE		
Common Potoo	Nystibius griseus	R
CAPRIMULGIDAE		
Semi-collared Nightjar	Lurocalis semitorquatis	N
Pauraque	Nyctidromus albicollis	R
Blackish Nightjar	Caprimulgus nigrescens	C
APODIDAE		
Chapman Swift	Chaetura chapmani	R
Band-rumped Swift	Chaetura spinicauda	C
Sick's Swift	Chaetura sicki	R
Short-tailed swift	Chaetura brachyura	C
Lesser Swallow-tailed Swift	Panyptila cayennensis	N
Fork-tailed Palm-Swift	Reinarda squamata	R
TROCHILIDAE		
Rufous-breasted Hermit	Glaucis hirsuta	N
Long-tailed Hermit	Phaetornis superciliosus	C
Great-billed Hermit	Pheatornis malaris	R
Little Hermit	Phaetornis longuemareus	R
Straight-billed Hermit	Phaetornis bourcieri	N
Reddish Hermit	Phaetornis ruber	N
Gray-breasted Sabrewing	Campylopterus largipennis	N
White-necked Jacobin	Florisuga mellivora	N
Brown violetear	Colibri delphinae	R
Black-throated Mango	Anthracothorax nigricollis	N
Tufted Coquette	Lophornis ornata	R
Blue-chinned Sapphire	Chlorestes notatus	R
Fork-tailed Woodnymph	Thalurania furcata	C
Rufous-throated Sapphire	Hylocharis sapphirina	R
White-chinned Sapphire	Hylochris cyanus	C
Green-tailed Goldenthroat	Polytmus theresia	R
Glittering-throated Emerald	Amazilia fimbriata	R
Crimson topaz	Topaza pella	R
Black-eared Fairy	Heliotrix aurita	N
TROGONIDAE		
Black-tailed Trogon	Trogon melanurus	R
White-tailed Trogon	Trogon viridis	C
Collared Trogon	Trogon collaris	C
Black-throated Trogon	Trogon rufus	R
Violacious Trogon	Trogon violaceus	N
ALCEDINIDAE		
Ringed Kingfisher	Ceryle torquata	C
Green Kingfisher	Chloroceryle americana	R
Pygmy Kingfisher	Chloroceryle aenea	R

MOMOTIDAE		
Blue-crowned Motmot	Momotus momota	C
GALBULIDAE		
Yellow-billed Jacamar	Galbula albirostris	N
Bronzy Jacamar	Galbula leucogastra	R
Paradise Jacamar	Galbula dea	N
Great Jacamar	Jacamerops aurea	R
BUCCONIDAE		
White-necked Puffbird	Notarchus macrorhynchus	R
Pied Puffbird	Notarchus tectus	R
White-chested Puffbird	Malacoptila mystacalis	R
Collared Puffbird	Bucco capensis	R
Black Nunbird	Monasa atra	N
Swallow-Wing	Chelidoptera tenebrosa	N
CAPITONIDAE		
Black-spotted Barbet	Capito niger	N
RAMPHASTIDAE		
Black-necked Aracari	Pteroglossus aracari	C
Green Aracari	Pteroglossus viridis	N
Guianan Toucanet	Selenidera culik	C
Red-billed Toucan	Ramphastos tucanus	C
Channel-billed Toucan	Ramphastos vitellinus	N
PICIDAE		
Golden-spangled Piculet	Picumnus exilis	R
Golden-olive Woodpecker	Piculus rubiginosus	C
Yellow-throated Woodpecker	Piculus flavigula	C
Golden-green Woodpecker	Piculus chrysochloros	R
Chestnut Woodpecker	Celeus elegans	N
Waved Woodpecker	Celeus undatus	C
Ringed woodpecker	Celeus torquatus	R
Lineated Woodpecker	Dryocopus lineatus	R
Golden-collared Woodpecker	Veniliores cassini	N
Crimson-crested Woodpecker	Campephilus melanoleucos	N
Red-necked Woodpecker	Campephilus rubricollis	C
DENDROCOLAPTIDAE		
Plain-brown Woodcreeper	Dendrocincla fuliginosa	N
White-chinned Woodcreeper	Dendrocincla merula	?
Wedge-billed Woodcreeper	Glyphorynchus spirurus	C
Red-billed Woodcreeper	Hylexetastes perroti	R
Black-banded Woodcreeper	Dendrocolaptes picumnus	N
Barred Woodcreeper	Dendrocolaptes certhia	N
Chestnut-rumped Woodcreeper	Xiphorhynchus pardalotus	C
Buff-throated Woodcreeper	Xiphorhynchus guttatus	C
Lineated Woodcreeper	Lepidocolaptes albolineatus	R
Curve-billed Scythebill	Campyloramphus procurvoides	R
FURNARIIDAE		
Pale-breasted Spinetail	Synallaxis albescens	N
Mc Connell's Spinetail	Synallaxis macconnelli	R
Ruddy spinetail	Synallaxis rutilans	R
Rufous-rumped Foll.-Gleaner	Philydor erythrocercus	C
Rufous-tailed Foliage-gleaner	Philydor ruficaudatus	N
Olive-backed Foll.-Gleaner	Automolus infuscatus	R

Ruddy Foliage-Gleaner	Automolus rubiginosus	R
Buff-throated Foll.-Gleaner	Automolus ochroleamus	R
Plain Xenops	Xenops minutos	N
Tawny-throated Leafscraper	Sclerurus mexicanus	?
Black-tailed Leafscraper	Sclerurus caudacutus	?
Short-billed Leafscraper	Sclerurus rufigulares	?
THAMNOPHILIDAE		
Fasciated Antshrike	Cymbilaimus lineatus	N
Great Antshrike	Taraba mayor	C
Black-crested Antshrike	Sakesphorus Canadensis	C
Band-tailed Antshrike	Sakesphorus melanothorax	R
Black-throated Antshrike	Frederickena viridis	R
Mouse-colored Antshrike	Thamnophilus murinus	C
Slaty Antshrike	Thamnophilus punctatus	N
Amazonian Antshrike	Thamnophilus amazonicus	N
Spot-winged Antshrike	Pygiptila stellaris	R
Dusky-throated Antshrike	Thamnomanes ardesiacus	N
Cinereous Antshrike	Thamnomanes caesius	C
Pygmy Antwren	Myrmotherula brachyura	N
Streaked Antwren	Mymotherula surinamensis	N
Rufous-bellied Antwren	Myrmotherula guttata	R
Brown-bellied Antwren	Myrmotherula gutturales	N
White-flanked Antwren	Myrmotherula axillaris	C
Long-winged Antwren	Myrmotherula longipennis	N
Gray Antwren	Myrmotherula menettriesii	N
Spot-tailed Antwren	Herpsilochmus sticturus	R
Todd's Antwren	Herpsilochmus stictocephalus	C
Ash-winged Antwren	Teranura spodioptila	R
Gray Antbird	Cercomacra cinerascens	C
Dusky Antbird	Cercomacra tyrannina	C
White-browed Antbird	Myrmoborus leucophrys	R
Warbling Antbird	Hypocnemis cantator	C
Black-chinned Antbird	Hypocnemoides melanopogos	R
Black-headed Antbird	Percnostola rufifrons	C
Spot-winged Antbird	Percnostola leucostigma	R
Silvered Antbird	Sclateria naevia	R
Ferruginous-backed Antbird	Myrmeciza ferruginea	C
Black-throated Antbird	Myrmeciza atrothorax	R
White-plumed Antbird	Pithys albifrons	N
Rufous-throated Antbird	Gymnopithys rufigula	N
Spot-backed Antbird	Hylophylax naevia	N
Scale-backed Antbird	Hylophylax poecilonota	R
Wing-banded Antbird	Myrmornis torquata	R
FORMICARIIDAE		
Rufous-capped Antthrush	Formicarius colma	R
Black-faced Anttrush	Formicarius analis	C
Variegated Antpitta	Grallaria varia	R
Spotted-Antpitta	Hylopezus macularia	C
Thrush-Like Antpitta	Myrmothera campanisona	C
CONOPOPHAGIDAE		
Chestnut-belted Gnateater	Conopophaga aurita	R
COTINGIDAE		
Spangled Cotinga	Cotinga cayana	N
Purple-breasted Cotinga	Cotinga continga	R

Pompadour Cotinga	Xipholena punicea	N
Dusky Purpletuft	Iodopleura fusca	R
Screaming Piha	Lipaugus vociferans	C
Black-capped Becard	Pachyramphus marginatus	R
Pink-throated Becard	Platypsaris minor	N
Black-tailed Tityra	Tityra cayana	N
Crimson Fruitcrow	Heamatoderus militares	R
Purple-throated Fruitcrow	Querula purpurata	C
Capuchinbird	Perissocephalus tricolor	N
White Bellbird	Procnias alba	N
Guinian Red Cotinga	Phoenicircus carnifex	R

PIPRIDAE

Golden-headed Manakin	Pipra erythrocephala	C
White-crowned Manakin	Pipra pipra	N
Blue-backed Manakin	Chiroxiphia pareola	?
White-fronted Manakin	Pipra serena	N
White-throated Manakin	Corapipo guturalis	N
White-bearded Manakin	Manacus manacus	N
Tiny Tyrant Manakin	Tyranneutes virescens	C
Wing-barred Manakin	Piprites chloris	R
Thrush-like Manakin	Schiffornis turdinus	C

TYRANNIDAE

Long-tailed Tyrant	Colonia colonus	N
Tropical Kingbird	Tyrannus melancholicus	C
Piratic Flycatcher	Legatus leucophaius	C
Dusky-chested Flycatcher	Tyrannopsis luteiventris	R
White-ringed Flycatcher	Conopias parva	N
Boat-billed Flycatcher	Megarynchus pitangua	N
Rusty-margined Flycatcher	Myiozetetes cayanensis	C
Great Kiskadee	Pitangus sulphuratus	C
Lesser Kiskadee	Pitangus lictor	R
Bright-rumped Atlla	Atilla spadiceus	C
Cinereous Mourner	Laniocera hypopyrrha	R
Grayish Mourner	Rhytipterna simplex	C
Short-crested Flycatcher	Myarchus ferox	R
Dusky-capped Flycatcher	Myarchus tuberculifer	R
White-throated Pewee	Contopus albogularis	N
Olive-sided Flycatcher	Contopus borealis	R
Euler's Flycatcher	Empidonax eulery	R
Ruddy-tailed Flycatcher	Terenotriccus erythrurus	N
Sulphur-rumped Flycatcher	Myiobius barbatus	N
Royal flycatcher	Onychorhynchus coronatus	?
White-crested Spadebill	Platyrinchus platyrhynnchos	R
Golden-crowned Spadebill	Platyrinchus coronatus	R
Cinnamon-crested Spadebill	Platyrinchus saturatus	R
Rufous-tailed Flatbill	Ramphotrigon ruficauda	?
White-eyed Tody-Tyrant	Hemitriccus zosterops	R
Double-banded Pygmy-Tyrant	Lophotriccus vitiosus	R
Helmeted Pygmy-Tyrant	Lophotriccus galeatus	C
Short-tailed Pygmy-Tyrant	Myiornis ecaudatus	R
Yellow-bellied Elaenia	Elaenia flavogaster	R
Small-billed Elaenia	Elaenia parvirostris	?
Forest Elaenia	Myiopagis gaimardii	R
Yellow-crowned Elaenia	Myiopagis flavivertex	R
Mouse-coloured Tyrannulet	Phaeomyias murina	N
Southern Beardless-Tyrannulet	Camptostoma obseletum	N

Slender-footed Tyranulet	Tyranniscus gracilipes	N
Yellow-crowned Tyrannulet	Tyrannulus elatus	R
White-lored Tyrannulet	Ornithion inerme	R
Sepia-capped Flycatcher	Leptogon amaurocephalus	R
Ochre-bellied Flycatcher	Pipromorpha oleoginea	N
Mc Connell's Flycatcher	Pipromorpha macconnelii	N
Ringed Antpipit	Corythopis torquata	R
OXYRUNCIDAE		
Sharpbill	Oxyruncus cristatus	N
HIRUNDINIDAE		
White-winged Swallow	Tachycineta albiventer	N
Brown-chested martin	Progne tapera	R
Gray-breasted Martin	Progne chalybea	C
Barn Swallow	Hirundo rustica	N
TROGLODYTIDAE		
Coraya Wren	Thryothorus coraya	C
Buff-breasted Wren	Thryothorus leucotis	R
White-breasted wood Wren	Henicorhina leucosticta	C
Wing-banded Wren	Microcerculus bambla	R
Musician Wren	Cyphorhinus arada	N
TURDIDAE		
Pale-breasted Trush	Turdus leucomelas	N
White-necked Trush	Turdus albicollis	C
SYLVIIDAE		
Collared Gnatwren	Microbates collaris	R
Long-billed Gnatwren	Ramphocaenus melanurus	N
Guianan Gnatcatcher	Polioptila guianensis	?
Tropical Gnatcatcher	Polioptila plumbea	C
VIREONIDAE		
Rufous-browed Peppershrike	Cyclarhis gujanensis	C
Slaty-capped Shrike-Vireo	Smaragdolanius leucotus	R
Red-eyed Vireo	Vireo olivaceus	C
Lemon-chested Greenlet	Hylophilus thoracicus	R
Buff-cheeked Greenlet	Hylophilus muscicapinus	C
Tawny-crowned Greenlet	Hylophilus ochraceiceps	N
PARULINAE		
Tropical Parula	Parula pitiayumi	N
Rose-breasted Chat	Granatellus pelzelni	R
American Redstart	Setophaga ruticilla	R
River Warbler	Basileuturus rivularis	R
THRAUPINAE		
Swallow Tanager	Tersina viridis	R
Purple Honeycreeper	Cyanerpes caeruleus	C
Red-legged Honeycreeper	Cyanerpes cyaneus	C
Short-billed Honeycreeper	Cyanerpes nitida	R
Green Honeycreeper	Chlorophanes spiza	C
Blue Dacnis	Dacnis cayana	C
Black-faced Dacnis	Dacnis lineata	R
Blue-hooded Euphonia	Euphonia musica	R
White-vented Euphonia	Euphonia minuta	R

Finsch's Euphonia	Euphonia finschi	R
Violaceous Euphonia	Euphonia violacea	C
Golden-sided Euphonia	Euphonia cayennensis	N
Golden-bellied Euphonia	Euphonia chrysopasta	R
Opal-rumped Tanager	Tangara velia	R
Paradise Tanager	Tangara chilensis	R
Spotted Tanager	Tangara punctata	R
Turquoise Tanager	Tangara mexicana	R
Bay-headed Tanager	Tangara gyrola	C
Blue-gray Tanager	Thraupis episcopus	C
Palm Tanager	Thraupis palmarum	C
Silver-beaked Tanager	Ramphocelus carbo	C
Highland Hepatic Tanager	Piranga lutea haemalea	N
Blue-backed Tanager	Cyanicterus cyanicterus	R
Fulvous-shrike-Tanager	Lanio fulvus	N
White-shouldered Tanager	Tachyphonus luctuosus	R
Flame-crested Tanager	Tachyphonus cristatus	N
Fulvous-crested Tanager	Tachyphonus surinamus	C
Guira Tanager	Hemithraupis guira	R
Yellow-backed Tanager	Hemithraupis flavicollis	R
Red-billed Tanager	Lamprospiza melanoleuca	N
Magpie Tanager	Cissopis leveriana	?
COEREBINAE		
Bananaquit	Coereba flaveola	C
ICTERINAE		
Giant Cowbird	Scaphidura oryzovora	R
Crested Oropendola	Psarocolius decumanus	N
Green Oropendola	Psarocolius viridis	C
Yellow-rumped Cacique	Cacicus cela	R
Red-rumped Cacique	Cacicus haemorrhous	C
CARDINALINAE		
Blue-black Grosbeak	Cyanocompsa cyanoides	N
Buff-throated Saltator	Saltator maximus	R
Red-and-black Grosbeak	Periporphyrus erythromelas	N
Slate-colored Grosbeak	Pitylus grossus	N
Yellow-green Grosbeak	Caryothraustes canadensis	N
EMBERIZINAE		
Pectoral Sparrow	Arremon taciturnus	C
Variable Seedeater	Sporophila americana	R
Lined Seedeater	Sporophila lineola	R
Chestnut-bellied Seedeater	Sporophila cataneiventris	R

APPENDIX J: Brownsberg Nature Park's Herpetofauna Species

The following list has been compiled from various publications about Brownsberg Nature Park, from recorded sighting by visiting biologists, and particularly from the Park's Wildlife Monitoring Program. The original data are on file at the Nature Conservation Department of the Suriname Forest Service, at the Zoological Collection of the University of Suriname, or at the Park's Research and Monitoring Division Office. Most Sranan Tongo names for animals were obtained from a publication called "Woordenlijst Sranan Nederlands English" (Anon., 1980a). Up to the moment, very little research has been conducted on amphibians in the Park. These data are current to May 2002.

c=common
d=usually seen during daytime
n=usually seen during nighttime
p=poisonous snake species
r=rare
W=observed in Park's Wildlife Monitoring Program

TAXON	ENGLISH	SRANAN	REMARKS
CLASS AMPHIBIA			
Order Gymnophiona			
Family Rhinatrematidae			
Rhina bivittatum	worm salamander		r
Order Anura			
Family Pipidae	(toads)		
Pipa pipa	Surinam toad		d
Family Dendrobatidae	(true frogs)		
Epipedobates trivittatus			c, d, W
Colostethus spp.			c, d
Family Bufonidae	(true toads)		
Atelopus cf. spumarius			c, d, W
Atelopus pulcher			c, d
Bufo guttatus			W
Bufo margaritafer			W
Bufo marinus	giant toad		c, n
Bufo typhonius	toad		c, n
Family Hylidae	(tree frogs)		
Hyla spp.			c, n
Phyllomedusa hypochondrialis			c
Family Leptodactylidae	(whistling frogs)		
Ceratophrys cornuta			W
Leptodactylus bolivianus			W
Leptodactylus mystaceus	whistling frog		c, n
Leptodactylus rhodomystax			W

CLASS REPTILIA

Order Testudines			
***Suborder Cryptodira**			
Family Emydidae	(common freshwater turtles)		
Rhinoclemmys punctularia	Guiana wood turtle	arakaka	c
Family Kinosternidae	(mud turtles)		
Kinosternon scorpoides	scorpion mud turtle		c
Family Testudinidae	(land tortoises)		
Geochelone carbonaria	red-footed tortoise	sabana sekrepatu	c, W
Geochelone dentifulata	yellow-footed tortoise	busi sekrepatu	c, W
****Suborder Pleurodira***	(side-necked turtles)		
Family Chelidae	(side-necked turtles)		
Phrynops nasutus	common toad-headed turtle		n
Phrynops gibbus	South American keel-backed side-necked turtle		n
Platymys platycephala	flat-headed flat-shelled turtle		n, W
Order Squamata			
***Suborder Sauria**	(lizards)		
Family Gekkonidae	(gekkos)		
Coleodactylus amazonicus			c, d
Gonatodes humeralis			c, d
Gonatodes annularis			d
Hemidactylus mabouia			n
Thecadactylus rapicauda			c, n
Family Iguanidae	(iguanas)		
Anolis chrysolepis			c,d
Anolis fuscoauratus			d
Iguana iguana	iguana		c, d
Plica plica			c, d
Plica umbra			c, d
Urocentron azureum			r, d
Family Scindidae			
Mabuya mabouya			c, d
Family Teiidae	(tejus)		
Alopoglossus angulatus			c, d
Ameiva ameiva			c, d
Arthrosaura kockii			d
Cercosaura ocellata			r
Kentopyx calcaratus			c, d
Leposoma guianense			c, d
Neusticurus bicarinatus			c, d
Neusticurus rudis			c, d
Tretioscincus agilis			r, d
Tupinambis nigropunctatus		sapakara	c, d
***Suborder Amphisbaenia**			
Family Amphisbaenidae			
Amphisbaena fuliginosa			n
***Suborder Serpentes**			
Family Boidae	(constrictors)		
Boa constrictor	boa constrictor	dagwesneki	r, W
Epicrateus cenchris	rainbow boa	egron aboma, regenboog boa	W
Corallus caninus	emerald boa	groene boomboa, akada	r, W
Corallus enhydris	boa	ingisneki, takroetite	W
Eunectes murinus	anaconda	boma	W

Family Colubridae			
Atractus badius	false coral snake	faja-sneki	W
Chironius carinatus		reditere	W
Chironius fuscus		ingibangi	W
Chironius multiventris			W
Chironius scurrulus			W
Chironius sp.			W
Dipsas catesbyi			W
Erythrolampus aesculapii	false coral snake	krarasneki	c, W
Liophis typhlus		popokaisneki	W
Mastigodryas boddaerti		alatasneki, alataman	W
Oxybelis aeneus	vine snake	busiswipi, titesneki	W
Oxybelis argenteus	vine snake	busiswipi, titesneki	W
Oxyrhopus formosus			r, W
Philodryas olfersii			
Pseustes poecilonotus		brokobaka, trangabaka	W
Pseustes sulphureus		brokobaka, trangabaka	W
Siphlophis cervinus			r, W
Tantilla melanocephala			W
Xenodon rhabdocephalus		todosneki	W
Family Leptotyphlopidae	(thread snakes)		
Leptotyphlops tenella	worm snake		c, W
Family Crotalidae	(vipers)		
Lachesis muta	bushmaster	makasneki	p, W
Bothrops atrox	fer-de-lance	owrukuku, labaria	p, W
Bothrops bilineatus	green tree viper	popokaisneki, papegaaislang	p, W
Bothrops brazili	Brazilian fer-de-lance	busi-owrukuku	p, r, W
Family Elapidae	(coral snakes)		
Micrurus hemprichii	coral snake	krarasneki	p, W
Micrurus lemniscatus diutus		krarasneki	p, W
Micrurus psyches	coral snake	blaka-krarasneki	p
Order Crocodilia			
Family Alligatoridae			
Paleosuchus trigonatus	smooth-fronted cayman	wigkopkaaiman	W

32 species of snakes, excluding 5 unidentified Colubrids observed in the field

APPENDIX K: Wildlife Species List for Monitoring

Scientific Name	English Name	Sranan Name
Monkeys		
Aloutta seniculous	red howler monkey	babun
Ateles paniscus paniscus	spider monkey	kwata
Cebus apella apella	brown capuchin	keskesi
Cebus olivaceus	Wedge-capped Capuchin	bergi keskesi
Chiropotes santanas chiropotes	brown-bearded saki	bisa/ baard saki
Pithecia pithecia	white-faced saki	wanaku
Saguines midas midas	red-handed tamarin	saguwenke/ sanguwijntje
Saimiri sciureus sciureus	squirrel monkey	monkimonki
Other mammals		
Agouti paca	paca	hei
Bradypus tridactylus	pale-throated 3-toed sloth	sonloiri
Choloepus didactylus	2-toed sloth	skapuloiri
Coendou prehensilis	Brazilian tree porcupine	djiendjamaka
Cyclopes didactylus	pygmy anteater	likanu
Dasypus kappleri	great long-nosed armadillo	maka kapasi
Dasypus novemcinctus	long-nosed 9-band armadillo	dikidiki/ gewone kapasi
Dasyprocta agouti	agouti	konkoni
Didelphis marsupialis	common opossum	dagu-awari
Eira barbada	tayra	aira
Felis concolor	puma	redi-tigri/ puma
Felis pardalis	ocelot	tigri-kati
Felis tigrina	little spotted cat/ oncilla	tigri-kati
Felis wiedii	margay	
Herpailurus yagouaroundi	jaguarundi	blaka tigri-kati/ busi-kati
Hydrochaeris hydrochaeris	capybara	kapuwa
Mazama americana	red-brocket deer	redi-dia/ prasara-dia/ groot boshert
Mazama gouazoubira	brown-brocket deer	kuriaku
Metachirus nudicaudatus	brown 4-eyed opossum	froktu-awari/ bruine opossum
Myoprocta acouchy	reddish acouchy	mambula
Nasua nasua	coati	kwaskwasi/ neusbeer
Panthera onca	jaguar	pakira tigri/ peni-tigri
Potos flavus	kinkajou	neti-keskesi
Priodontes maximus	giant armadillo	granman kapasi
Tamandua tetradactyla	collared anteater/ southern tamandu	mirafroiti/ miereneter
Tayassu pecari	white-lipped peccary	pingo
Tayassu tajacu	collared peccary	pakira
Tapirus terrestris	tapir	bofru
Game birds		
Crax alector	black currasow	powisi
Crypturellus cinereus	cinerous tinamou	anamu
Crypturellus erythropus	red-legged tinamou	redifutu-anamu
Crypturellus soui	little tinamou	pikin-anamu/ ston-anamu
Crypturellus undulatus	undulated tinamou	tokoro
Crypturellus variegatus	variegated tinamou	tigri-anamu/ redi-anamu
Ortalis motmot	little chachalaca	wakago
Odontophorus guianensis	marbled wood quail	
Penelope jacquacu	spix' s guan	busikrakun/ marai
Penelope marai	marai guan	marai
Psophia crepitans	gray-winged trumpeter	kamikami
Tinamos major	great tinamou	mamafowru-anamu
Other birds		
Procnias alba	white bellbird	gonge
Herpetofauna		
Atelopus spumarius	poison arrow frog	dendrobates/okopipi
Epipedodates trivattus	poison arrow frog	dendrobates/okopipi
All snakes,turtles, tortoises, caimans		

APPENDIX L: Sample Schedule for Wildlife Monitoring

The requirements for the Wildlife Monitoring Program at Brownsberg Nature Park are as follows: Every trail and transect must be monitored a minimum of one time per week. Monitoring should begin by 7.30 AM, unless inclement weather conditions prohibit it, and it should occur through the duration of the first 4 hours after sunrise. Night monitoring should be conducted at least once per week on selected trails (i.e. Leo Falls, Rondwandeling, Mazaroniweg to Telesur, Jeep Trail, and possibly Witi Creek). Night surveys should be conducted while the moon is not full, when there is minimal rain drip, and during the first 4 hours after sunset.

A weekly monitoring schedule will be implemented for the wildlife survey field teams. An example one-month schedule is as follows:

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
Mazaronitop (1.4 km total)	Witi Creek (7.6 km total)	Rondwandeling/ Kumbu Falls (4.6 km total)	PM: Leo Falls (2.6 km total)	Jeep Trail (14.4 km total)	Irene Falls/ Leo Falls (5.2 km total)	Mazaroni Falls/ Telesur (11.0 km total)
Mazaronitop (1.4 km total)	Witi Creek (7.6 km total)	Rondwandeling/ Kumbu Falls (4.6 km total)	PM: Rondwandeling (2.6 km total)	Jeep Trail (14.4 km total)	Irene Falls/ Leo Falls (5.2 km total)	Mazaroni Falls/ Telesur (11.0 km total)
Mazaronitop (1.4 km total)	Witi Creek (7.6 km total)	Rondwandeling/ Kumbu Falls (4.6 km total)	PM: Mazaroniweg/ Telesur (9.0 km total)	Jeep Trail (14.4 km total)	Irene Falls/ Leo Falls (5.2 km total)	Mazaroni Falls/ Telesur (11.0 km total)
Mazaronitop (1.4 km total)	Witi Creek (7.6 km total)	Rondwandeling/ Kumbu Falls (4.6 km total)	PM: Jeep Trail (14.4 km total)	Jeep Trail (14.4 km total)	Irene Falls/ Leo Falls (5.2 km total)	Mazaroni Falls/ Telesur (11.0 km total)

APPENDIX M: Wildlife Monitoring Data Sheets (English and Dutch Versions)

Transect Monitoring of Wildlife: Brownsberg Nature Park

Date: ___/___/___	**Observer(s):** _____	**Transect:** _____	**Time Beg:** _____	**Time End:** _____
Weather: sunny rainy light rain misty foggy windy _____				

Time	Path/ KM	Species	#	Sex	# Young	Behavior	Description	Habitat	Comments
	Path: km:			M: F:					
	Path: km:			M: F:					
	Path: km:			M: F:					
	Path: km:			M: F:					
	Path: km:			M: F:					
	Path: km:			M: F:					
	Path: km:			M: F:					
	Path: km:			M: F:					
	Path: km:			M: F:					
	Path: km:			M: F:					
	Path: km:			M: F:					

Gegevens Wilde Dieren: Brownsberg Natuurpark

Datum: ___/___/___	**Observator(s):** ____________	**Transect:** ________________	**Beg. Tijd:** _______	**Eind Tijd:** __________
Weer zonnig regen weinig regen nevelig mistig winderig _____________________________				

Tijd	**Pad/ KM**	**Soort**	**#**	**Geslacht**	**#Jongen**	**Gedrag**	**Beschrijving**	**Omgeving**	**Opmerking**
	Pad: km:			Mnl.: Vrl.:					
	Pad: km:			Mnl.: Vrl.:					
	Pad: km:			Mnl.: Vrl.:					
	Pad: km:			Mnl.: Vrl.:					
	Pad: km:			Mnl.: Vrl.:					
	Pad: km:			Mnl.: Vrl.:					
	Pad: km:			Mnl.: Vrl.:					
	Pad: km:			Mnl.: Vrl.:					
	Pad: km:			Mnl.: Vrl.:					
	Pad: km:			Mnl.: Vrl.:					
	Pad: km:			Mnl.: Vrl.:					
	Pad: km:			Mnl.: Vrl.:					

APPENDIX N: Wildlife Monitoring Data Sheet Guide and Methodology

Field Title	Explanation of Field
❖ Date:	day/ month/ year of transect monitoring
❖ Observers:	Initials of observer(s); preferably, 3 initials per person
❖ Transect:	Name of transect (i.e. trail, transect, or road). (*See below*).
❖ Beg. Time:	Time at beginning of walking transect; 24-hour time
❖ End Time:	Time at end of transect (upon completion); 24-hour time
❖ Weather:	Circle best description(s) of weather conditions at time of transect monitoring; more than one can be circled; note in comment space changes of condition over monitoring time. (*See below*).
❖ Time:	Time of day for specific wildlife observation, given in 24-hour time.
❖ Path/ km:	Use the first previous trail/ road distance marker code (i.e. within the 100-m length, use that code for that section regardless if the nearest location is the next trail marker)—Path: initials for transect/ trail/ road; km: kilometer distance. (*See below*).
❖ Species:	Species name of wildlife observed. Any language is acceptable *as long as species identification is clear.* Refer to Wildlife Species List for Monitoring.
❖ #/ Amount:	Total number of animals within species group
❖ Sex:	Sex of animal observed; "M" for male, "F" for female; provide number for each sex designation; note only if known.
❖ # Young:	Does the animal have offspring with it? If so, how many?
❖ Behavior:	What is the animal doing? Eating, sleeping, foraging, etc. Additionally, note the response of the animal to the observer.
❖ Description:	Provide a physical description of animal, noting in particular unique markings or injuries, as well as taking careful notes when there is a questionable identification that will need to be verified upon return to office. Include notes about length, size, and weight, particularly for larger vertebrates.
❖ Habitat:	Provide code for habitat type. Refer to Park Habitat Types list.
❖ Stratum:	Record the vertical distance of the animal's position relative to ground level, and name the statum (above the canopy, canopy, mid-story, understory, or ground).
❖ Horizontal distance:	Record the horizontal distance of the animal relative to the transect.
❖ Comments:	Any additional comments particular to observation of animal (e.g. questionable identification, particulars of behavior or health, etc.) Also make note of the size of the offspring, relative to the size of the adult, if present. Include comments about what the animal is eating, with effort to identify the correct fruit/ tree/ seed species. Make note of what has been collected and how it is labeled in the archives/ museum.

Abbreviations for Transects/ Trails/ Roads/ Places

WK—Witi Kreek (Creek)
IV—Ireneval (Falls)
LV—Leoval (Falls)
IV/LV—Ireneval/ Leoval shared trail
MT—Mazaronitop
KV—Koemboeval (Falls)
RW—Rondwandeling
KV/RW—Koemboeval/ Rondwandeling shared trail
MV—Mazaronival
TE—Telesur road
MW—Mazaroniweg (Plateau road)
AKP—Agwago Kun Pasi
JT—Jeep Trail

NOTES ABOUT WEATHER CATEGORIES

The official meteorological designations of foggy/ mist and misty/ nevelig . . .

- Foggy/ Mist indicates <1km visibility; dense clouds on/ near ground
- Misty/ Nevelig indicated >1km visibility, light clouds on/ near ground

APPENDIX O: Park Visitor Wildlife Observation Form (English and Dutch Versions)

Wildlife Observation Reporting Form
Brownsberg Nature Park

Name: _____ Phone #: _____ Email: _____
Please use this form to report sighting of significant or unusual wildlife (such as jaguars, pumas, eagles, monkeys, deer, pingo, rare birds, etc.) or any animal that is injured or acting strangely.

Wildlife observed: _____

Sighting date: Day: ____ Month: ____ Year: ____ Time of sighting: _____ am pm

Location (trail/ road distance marker): _____

Weather conditions: clear rainy mostly cloudy partly cloudy windy foggy

Please describe the animal, including any distinguishing marks: _____

_____

Please describe the animal's behavior (i.e. eating something, acting strangely, injured, etc):_____

Did the animal have any offspring with it? If so, how many and what size? _____

Other information: _____

Thank you for taking the time to complete this form. The valuable information you have provided will help us preserve and protect the wildlife in Brownsberg Nature Park.

Wilde Dieren Registratie Formulier
Brownsberg Natuurpark

Naam: _____ Telefoon #: _____ Email: _____
Gaarne dit formulier invullen bij het zien van bijzondere dieren of niet-alledaagse wilde dieren (jaguars, pumas, roofvogels, apen, herten, pingos, zeldzame vogels, etc.).

Dier soort: _____

Datum observatie: Dag: ____ Mnd.: ____ Jaar: ____ Observatie tijd: _____ vm/ nm

Plaats (pad of weg afstand): _____

Weeromstandingheden: droog regen veel wolken weinig wolken windig mistig

Beschrijf het dier, inclusief bijzondere kenmerken: _____

_____

Beschrijf het gedrag van het dier, (z.a. iets eten, vreemd gedrag, gewond zijn): _____

_____

Zijn er jongen? Hoeveel en hoe groot? _____

Andere informatie: _____

Dank u voor uw medewerking. De belangrijke informatie die u hebt verstrekt stelt ons beter in staat aan natuurbehoud en -bescherming te doen in het Brownsberg Natuurpark.

APPENDIX P: Visitor Information Sheets about Park's Research and Monitoring Program (English and Dutch versions)

Visitor Information about Wildlife Observation Forms

WHO ARE WE?

STINASU has recently created a Research and Monitoring Department for Brownsberg Nature Park. Our team consists of a core group of research biologists and field technicians, with supporting assistance from national and international student interns, volunteers, and research scientists.

WHAT DO WE DO?

Our mission is both to evaluate and monitor the ecosystem health and quality of the Park and to locate the flora, fauna, and ecological phenomena in the Park for the purpose of promoting education and research here. We initiate and coordinate a wide variety of research and monitoring activities here in the Park, including identifying and cataloging tree species, observing and recording wildlife, surveying bird populations, documenting weather patterns, monitoring water quality in the Park's creeks, and studying the habitat use and needs of game animals. All of this is a necessary part of managing the Park's natural resources for we must gain a better understanding of the nature and condition of the Park's resources. It is very important to gain a better understanding of which species inhabit the Park, and determine how many of each species there are or how active they are, and what they eat.

HOW CAN YOU HELP US?

Part of our monitoring program seeks to involve YOU—the Park visitor. Whenever you walk the trails and observe an animal, you can provide our monitoring program with valuable information. Take a few Wildlife Observation Forms with you as you walk the trails in the park, and when you see an animal that you can positively identify, record as much information on the card as possible, and return it to the Park office or to the Research Center which is located in the Ark. Please note that all of our Park trails and roads are labeled with distance markers every 100 to 200 meters. These are 10cm by 10cm yellow signs posted on the trees and flagged with blue tape. When you observe an animal, please note the code (the code on the sign) nearest to the location of the sighting.

THANK YOU !

Informatie voor Bezoekers over Wilde Dieren Registratie Formulieren

WIE ZIJN WIJ?

STINASU heeft recentelijk een onderzoeks- en monitoringsteam ingesteld voor het Brownsberg Natuurpark. Ons team bestaat uit een groep onderzoekers, biologen, en veldpersoneel, met assistentie van nationale en internationale studenten, vrijwilligers, en onderzoekers.

WAT DOEN WIJ?

Ons doel is de ecologische kwaliteit en gezondheid van het Park te evalueren en te monitoren. We doen dat momenteel door de flora, fauna, en ecologische verschijnselen in het Park te localiseren. Het is nodig te onderzoeken en monitoren om een goed en adequaat beheer uit te voeren binnen het Park. Wij doen dit ook om natuureducatie en -onderzoek te bevorderen in Suriname. Wij initieren en coordineren een gamma aan onderzoeks- en monitoringsactiviteiten in het Park, waaronder de indentificatie en het catalogiseren van bomen, alsook het observeren en vastleggen van klimatologische data. Het monitoren van de waterkwaliteit in het Park staat ook op het programma. We bestuderen het woongebied en gedrag van jachtwildsoorten. Het is belangrijk om een beter inzicht te hebben in de flora en fauna van het Park: deze te indentificeren, na te gaan hoeveel van elk soort er voorkomt of hoe actief ze zijn, en na te gaan wat ze eten.

HOE KUNNEN JULLIE ONS HELPEN?

Een onderdeel van ons monitoringsprogramma is dat wij ook parkbezoekers erbij betrekken. Tijdens een bezoek aan een van de watervallen of paden kan je informatie opschrijven bij het zien van dieren. Je kan terecht bij het beheerderskantoor en ook bij het Onderzoek Centrum in de Ark voor meer informatie hieromtrent. Er zijn speciale formulieren ontworpen die je van ons kan meekrijgen als je gaat wandelen. Vul die zo volledig mogelijk in! Bij beeindiging van je bezoek zouden wij graag de ingevulde formulieren terug willen hebben, voor zover je natuurlijk wat bijzonders tegenkwam tijdens je wandeling (a.u.b. duidelijk aangeven welk pad je hebt gevolgd). Voor het gemak zijn alle paden voorzien van blauwe markeerlinten om de 100 of 200 meter. Er zijn ook gele markeerplaten van 10 bij 10 cm op bomen gespijkerd met een codering die het pad en de afstand aangeeft t.o.v. vaste punten. Wanneer je iets waarneemt, noteer dan de letter- en cijfercode van de dichtsbijzijnde markeerplaat.

Wij danken u bij voorbaat voor uw medewerking.

APPENDIX Q: Bird Point Counts Data Sheet

Bird Point Count Data Sheet: Brownsberg Nature Park

Date: ___/___/____	**Observer(s): _____**	**Transect: _____**	
Weather: sunny rainy light rain misty foggy windy _____			

				Horizontal Dist.						Vertical Strata						
				SEEN		HEARD										
Marker Code	**Time (15 min)**	**Species**	**Est. #**	**<10m**	**10-50m**	**<10m**	**10-50m**	**50-500m**	**>500m**	**Above canopy**	**Canopy**	**Mid-story**	**Understory**	**Ground**	**Habitat**	**Behavior/ Comments**

APPENDIX R: Bird Point Count Protocol

The Bird Point Count Protocol will be implemented on a trial basis at Brownsberg Nature Park. Initially, only the following trails/ transects will be targeted for the implementation of this protocol: Ireneval/ Leoval, Transect 2, and Rondwandeling. Once a clearer estimate of the time requirements is obtained and the protocol is refined, it is expected that the bird point counts will be expanded to other trails, and eventually, to other reserves under STINASU management.

This protocol integrates both line count observation and point count observation techniques. It is agreed that an experienced ornithologist will walk the trails in the morning or evening hours, and upon sighting or hearing a bird, will stop and begin a 5-15 minute point count at that location. Upon completing the point count, the ornithologist will continue on the trail until the next bird is recorded. This method may have to be modified considerably in function of the results of trail applications. A modification already under consideration is to restrict point counts to the canopy, meaning that canopy birds will be recorded using this method, while the birds occurring in lower stata will be assessed using a transect count method.

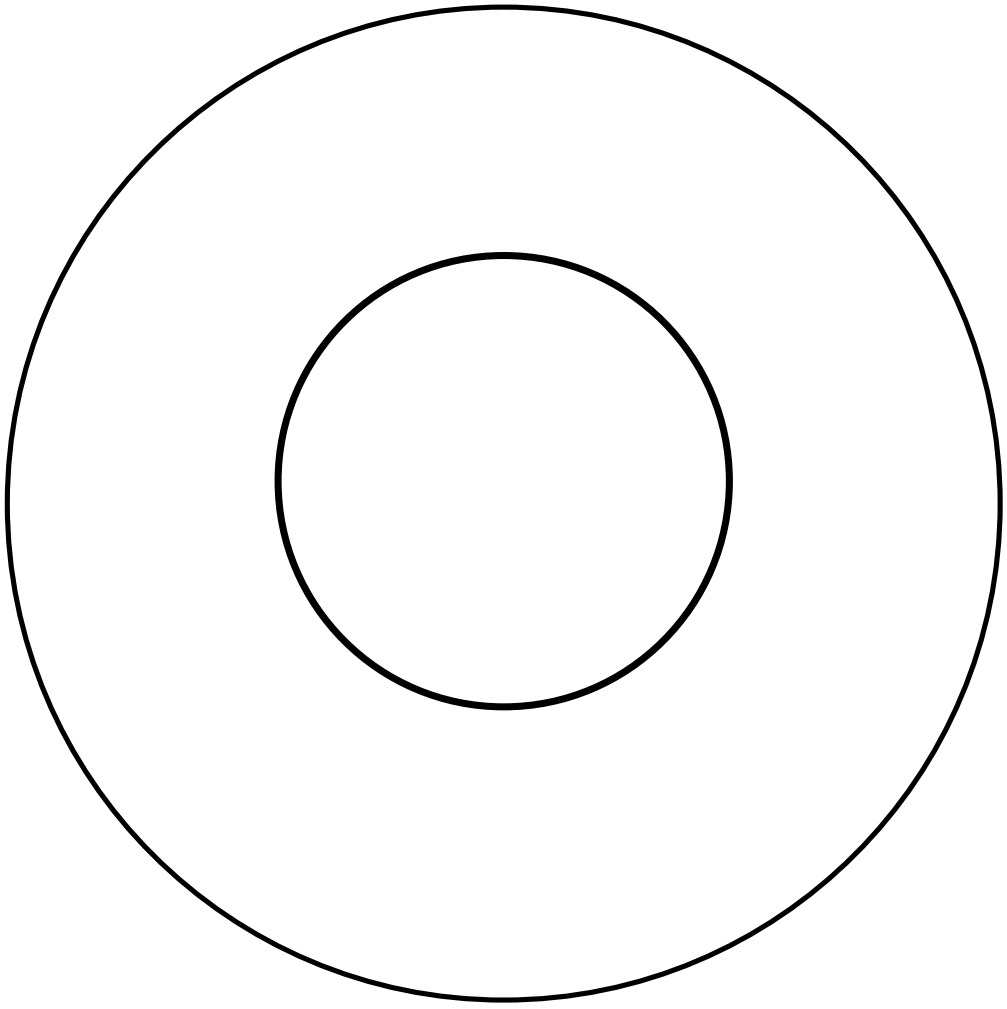
A data sheet has been developed specifically for this protocol. Guidelines for filling out the data sheet are as follows:

- Date: Standard day/ month/ year
- Observer(s): Names or initials of the data recorders and observers participating in the point count
- Transect: Name of trail or transect being monitored
- Weather: Circle or describe in the space provided, the weather conditions at the beginning and during the monitoring period
- Marker code: This is the trail distance marker code that demarcates the location of the point count observation. Generally, any space between a 100-m section of trail is designated by the preceding trail marker (i.e. the one closer to the trail head). For instance, if a point count is conducted between markers WK 0.5 and WK 0.6, the marker code given is WK 0.5.
- Time: This is the time, given in 24-hour time, at the beginning of a point count. In parentheses, indicated the amount of time spent, in minutes, at this point station.
- Species: Indicate the species of bird observed at this point location. Preferably, use the scientific name, but utilizing the common English name is sufficient.
- Est. #: Estimate the number of individuals of this particular species sighted or heard at this point location.
- Horizontal Distance: If a bird is seen, estimate if the bird was observed 10m or 10-50m from the transect/ trail. If the bird is heard, estimate if the bird is observed <10m, 10-50m, 50-500m, or >500m from the trail.
- Vertical Stratum: Estimate the stratum that the particular bird(s) of this particular species are utilizing: Above the canopy, canopy, mid-story, understory, or ground.
- Habitat: Utilizing the habitat guidelines available at the Brownsberg Research Station, designate the habitat type of the point count location. These data can be obtained after the fact.
- Behavior/ Comments: Include a description of the behavior of the bird species, as well as any other additional, relevant comments.

APPENDIX S: Bird Territory Mapping Data Sheet

BIRD TERRITORY MAPPING DATA FORM

Date: ___/___/___ **Observer(s): _____**
Transect: _____ **Point: _____**
Time Beg: _____ **Time End: _____**
Species: _____

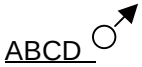


Codes for Mapping of Bird Territories

Species ABCD in song

Species ABCD in song; if exact location known, indicate with an arrow and a point

Species ABCD in song; if exact location not known, indicate the observer's position with an arrow and an "X"

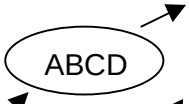


Male of species ABCD calling

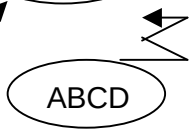
Male of species ABCD repeatedly giving alarm calls or non-song vocalizations associated with territoriality

Various Superscripts:

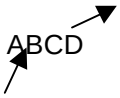
f—carrying food
m—carrying nest material
E—in an occupied nest with ___ number of eggs
N—in an occupied nest with ___ number of nestlings
*P—parent is incubating eggs or warming young
juv—juvenile or fledgling
fam—juvenile with parents in attendance



In flight after it was perched



Circling above the forest



In flight only

Notes about mapping and data recording

- The inner circle designates a 25m radius and the outer circle designates a 50m radius.
- A different code should be used for each species—use the 4-letter code (first 2 letters of genus and species).
- Each point's map should later be transferred to the master maps for each individual species at the point. Label these according to each consecutive visit.
- Territories can then be drawn around clusters.