# THE BIODIVERSITY OF THE UPPER IMBANG-CALIBAN WATERSHED, NORTH NEGROS FOREST RESERVE, NEGROS OCCIDENTAL, PHILIPPINES

TECHNICAL PUBLICATION OF THE NEGROS RAINFOREST CONSERVATION PROJECT: A COLLABORATIVE INITIATIVE BETWEEN THE NEGROS FORESTS AND ECOLOGICAL FOUNDATION, INC AND CORAL CAY CONSERVATION

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Front Cover Image: Philippine Montane Forest by Alexia Tamblyn

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## ii. Executive Summary


- This report mainly outlines the empirical findings of the science survey program that was conducted in the Upper Imbang-Caliban watershed area of the North Negros Forest Reserve during the course of a 12-month period between February 2002 and January 2003. This forms part of the ongoing work of the Negros Rainforest Conservation Project and represents part of the first ever, detailed study of the biodiversity of this area.

- Vegetation surveys are in progress using six permanent survey plots (PSPs) within three major forest habitat types of the NNFR. The PSPs have been established according to standard biodiversity assessment methods for tropical forests. Thus far, nearly fifteen thousand tree specimens have been tagged and one hundred and twenty morphological types identified. Clear differences in community composition have been noted between habitat types, and they also harbour in excess of fifty non-timber forest products used locally.

- Bird surveys have been completed both by observation (MacKinnon lists) and by mist netting in several locations within the watershed area. These have identified 98 species from 35 families, of which 69% were endemic to the Philippines. These records increase the overall inventory for the project area to 137 species, with local community composition reflecting habitat type.

- Mist netting surveys for Chiropterans recorded a total of twelve bat species, eight Megachiropterans and four Microchiropterans. The species identified included a number of vulnerable and threatened species, such as the Philippine pygmy fruitbat and the Little golden-mantled flying fox.

- Amphibian and reptile species were sampled using a quadrat based visual encounter survey method across a range of habitat types. Only preliminary surveys were conducted in order to test the survey approach. Only nine species from five families were recorded.

- The presence/absence and relative distribution of non-volant mammals was recorded via observation and live capture (trap lines) survey methods. Almost 70% of non-volant species known to exist on Negros Island were recorded in the watershed study area. This included species such as the endangered Visayan warty pig and Visayan spotted deer.

- Invertebrate research work has focused on butterfly surveys which have been undertaken on all six PSPs using walking transect counts with point counts and baited traps. In excess of 46 species from 7 families have been recorded and nearly 80% of these species are endemic to the Philippines.

- During the course of 2002 the NRCP has initiated a scholarship progamme for Negrenese volunteers and continued to develop and implement a number of natural environment education and awareness initiatives with NFEFI.

- The significance of the findings of the faunal and floral research are discussed and a series of recommendations for future work are proposed.

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# 1. Introduction

## 1.1. The Negros Rainforest Conservation Project (NRCP)

The Negros Rainforest Conservation Project (NRCP) is a joint programme of co-operative research, education and training between the Negros Forests and Ecological Foundation Inc. (NFEFI) and Coral Cay Conservation (CCC). The NRCP is based in the Tropical Montane Cloud Forests of the North Negros Forest Reserve (NNFR), in Negros Occidental, Negros, Philippines (See Turner *et al.*, 2001).

## 1.2. Background

The moist forests of the Philippines, including the NNFR (Figure 1.1), are the eighth most vulnerable forest ecoregion in the world (WWF 2001). The NNFR is the largest remaining area of wet evergreen rainforest on Negros and in the central Philippines. It is of clear importance to the survival of many critically endangered species found only within the Negros-Panay Faunal region, the most threatened of the Philippines' 5 faunal regions (Heaney & Regalado 1998).

The Philippines is a mega-biodiversity hotspot and has higher percentages of endemism than any other biogeographic province in the whole of the Indo-Malayan Realm. Over 57% of species in the major faunal and floral groups occur nowhere else in the world (Oliver & Heaney 1996). Birdlife International currently identifies Negros Island as an Endemic Bird Area (EBA) and the NNFR as an International Bird Area (IBA) (Stattersfield *et al.*, 1998).

Figure 1.1. The southern portion of the North Negros Forest Reserve, with the track leading to the Upper Imbang-Caliban watershed area.

However, the Philippines also has one of the highest rates of tropical forest loss, declining from 70% to 18% cover in the last 100 years and Negros Island only has 4% of its original forest cover (Turner *et al.*, 2001). Approximately 60% of endemic Philippine flora are now extinct. This poses a great threat to many endemic vertebrate species such as threatened hornbills (*Penelopides panini* and *Aceros waldeni*), the endangered (WCSP 1997) Philippine spotted deer (*Cervus alfredi*), and the Philippine warty pig (*Sus cebifrons*). The latter two species have been extirpated from 95% of their former range (Cox 1987) having once been common throughout the West Visayas but are now extinct on the islands of Cebu, Guimaras and Masbate. Their status and distribution on Negros is very poorly known and information is urgently needed for effective conservation and management.

In addition to harbouring immense biological diversity, the NNFR is also a source of vital ecosystem goods and services. For example, it provides many non-timber forest products (NTFPs) such as Rattan and Bamboo, and also protects six vital watersheds for the north Negros area, providing a clean and controlled supply of water to the provincial capital and other areas. Large scale flooding as a result of deforestation is becoming more common, and consequently has huge social and economic costs. The case to preserve the remaining forested watersheds for environmental and socio-economic reasons is clear. The Foundation for the Philippine Environment (FPE) has therefore stressed the need to develop strategies to preserve and sustain the NNFR and its stakeholder communities.

The integrated importance of the social, economic and ecological values of the NNFR are now beginning to be recognised on international, national and local scales. The Department of the Environment and Natural Resources (DENR), and the Philippine National Biodiversity Strategy and Action Plan (NBSAP) have identified the need to conserve the forest resources via use of the collective efforts of empowered, self-reliant Filipinos (DENR/UNEP 1997). However, they lack the resources for effective implementation. NFEFI has assumed this role for Negros and is dedicated to protecting, conserving and restoring the Negros environment in order to safeguard the sustainable use of its resources for future generations. It is widely acknowledged that areas of Negros are biologically poorly known and further field studies should be completed in order to provide adequate baseline data to develop appropriate conservation strategies (Evans *et al.*, 1993; Collar *et a*l., 1999). In 1998 NFEFI asked CCC to assist in the provision of resources for the production of a sustainable management plan for the NNFR consequently resulting in the establishment of the NRCP.

Figure 1.2. The Negros Rainforest Conservation Project base, located in Sitio Campuestohan within the NNFR.

The NRCP conducts its conservation work from a field centre located in the village of Campuestohan (Figure 1.2), on the southwest the perimeter of the NNFR. A program of biodiversity surveys and monitoring work has been established within the Municipalities of Talisay and Murcia (Figure 1.3), Province of Negros Occidental. This will provide ecological data, in order to make recommendations towards the sustainable management of the NNFR, and provide information for the co-operative development of environmental awareness and education initiatives. The ecological survey work undertaken by the NRCP has been designed for the collection of reliable quantitative and qualitative data by non-expert trained volunteers.

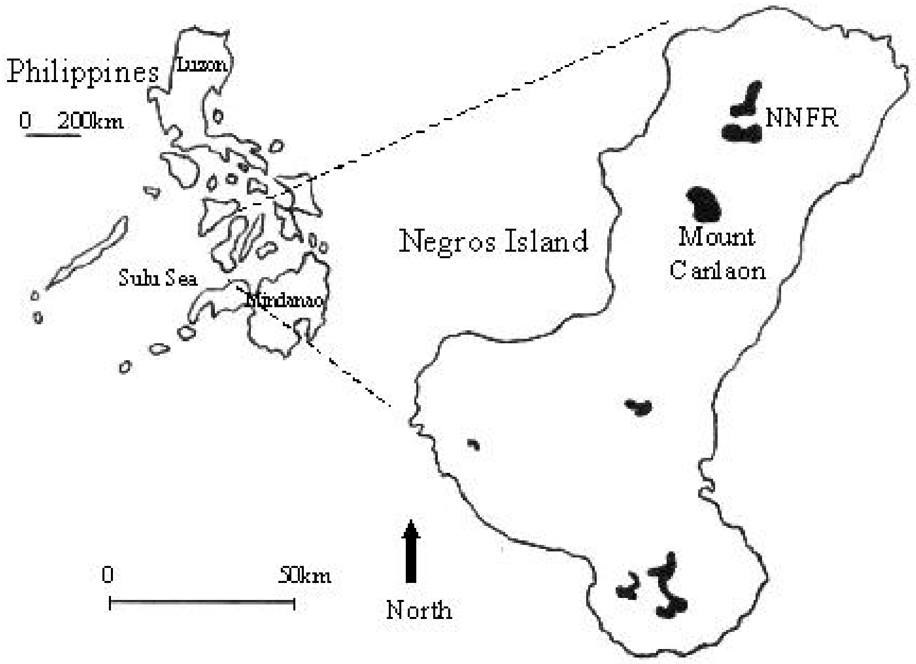


Figure 1.3. The remaining forest patches of Negros Island and the location of the North Negros Forest Reserve (NNFR) within Negros Island, Philippines.

### 1.3. Volunteer Training

The vast majority of survey work completed by CCC is undertaken by volunteers, thus efficient and effective training is a vital component of any volunteer programme in order to allow participants to quickly gain the required identification and survey skills that allow them to collect accurate and useful data. CCC uses an intensive one-week training programme (*The CCC Skills Development Programme*) that has been constantly refined since the late 1990s. The programme is designed to provide volunteers, who may have no biological knowledge, with the skills necessary to collect useful and reliable data. The primary aim of the lectures and practical tasks during this one-week programme is to train volunteers to use specialised field equipment and give them the ability to discern the specific identification characteristics and relevant biological attributes of the species that they will encounter during their terrestrial surveys.

The training programme is co-ordinated by the Project Scientist (PS) and Science Officer (SO) and involves lectures, seminars, practical field based learning and evening audio-visual presentations. Volunteers are also encouraged to practise survey techniques and utilise identification guides to ensure a thorough understanding of the information provided in the lectures. An important component of the training schedule is a series of testing procedures to ensure that each volunteer has reached a minimum acceptable standard.

The volunteer’s data collection abilities are further validated in the field and survey techniques are applied that require minimal expertise yet permit the collection of accurate ecological data. Volunteers work under the guidance of professional practitioners (NRCP staff) to ensure, via continuous monitoring, stringent survey standards are maintained and thus more technically demanding surveys can be completed, such as tree species inventories and vertebrate surveys.

Whilst the use of volunteers may be questioned with regard to expertise in data collection it is acknowledged that conservation biologists have long used “non-professional” volunteers to collect information needed to make informed decisions concerning resources they are trying to protect (Bildstein 1998). There is also a growing body of literature supporting the use of trained volunteers in baseline ecological monitoring work where resources are limited (e.g. Mumby *et al.*, 1995; McLaren & Cadman 1999; Turner & Cadbury 2002).

The NRCP undertakes rapid biodiversity assessments of major faunal groups (focussing on birds, mammals, reptiles, amphibians and insects) in conjunction with long-term vegetation monitoring, working with local research collaborators. The botanical inventories, for example, have been co-ordinated with the botany department of the Philippines National Museum using the internationally recognised permanent sample plot technique. These allow spatio-temporal comparisons of the species composition of different forest habitats.

### 1.4. Collection Permit

The NRCP operates under a Wildlife Gratuitous Permit (GP) as issued by the DENR to NFEFI, authorising the same to collect certain biological specimens for research/scientific purposes. All collection activities undertaken by the NRCP adhere strictly to the terms and conditions of the above mentioned GP, and the NRCP only collects specimens for preservation when strictly necessary for taxonomic identification and conservation purposes.

The current permit allows the NRCP to make collections from the major faunal and floral groups (as detailed below):

Most major faunal groups include: Avians, Mammals, Reptiles, Amphibians, & Invertebrates.

Most major floral groups include: Angiosperms, Gymnosperms, Filicinophyta & Bryophyta.

### 1.4. Aims and objectives of the NRCP

The current aims and objectives of the NRCP are outlined as follows:

- To obtain base-line quantitative data on the biodiversity of the fauna and flora of the NNFR, to create resource maps and an environmental database for the region.

- To conduct complimentary field based research into the habitat requirements and ecology of the species currently included in the NFEFI captive breeding programme, the objective of which is to produce guidelines for effective forest management to aid in-situ conservation of specific species.
- To provide suitable education materials and programmes to improve environmental awareness amongst local communities, to offer training opportunities to host country counterparts in biodiversity assessment & management and to provide non-destructive alternative livelihood opportunities through the development of eco-tourism and sustainable forestry practices.
- To produce integrated community-driven management plans for the conservation, restoration and sustainable use of biodiversity in the region.

The results of the baseline survey work will contribute vital information to the development of sustainable management recommendations for this area of the NNFR, with the potential to combine the work of the NRCP with other data sources and develop a management plan for the whole NNFR. All results and reports produced by the NRCP will be submitted to NFEFI who will facilitate their dissemination and outputs therein to the local municipalities and will include the findings in its community education projects.

### 1.5. Report Outline

This report attempts to provide an initial characterisation of the biodiversity of the Upper Imbang-Caliban Watershed of the NNFR. The ecological survey work has concentrated in specific forest habitat types during a twelve-month period (February 2002 – January 2003) in order to develop reliable species inventory and distribution information for major faunal and floral groups.

The report initially focuses on the vegetation assessments completed within three different forest habitat types, comparing species compositions and the presence of non-timber forest products. Within these same habitat areas (and additional sites), separate chapters detail the community composition of six different faunal groups (birds, volant mammals, reptiles & amphibians, invertebrates and non-volant mammals). In the final chapter (Discussion & Conclusions), the findings of this research are related to existing knowledge, and future research and conservation recommendations are proposed.

# 2. Vegetation

## 2.1. Introduction

Wet tropical forests in mountainous portions of Southeast Asia can be divided into four primary elevationally based habitat types. These include lowland, montane, mossy and sub-alpine environments and are determined by local annual temperature and precipitation. Dipterocarpaceae families dominate lowland forests, which grade into montane forest consisting mainly of Fagaceae (oak), Lauraceae (cinnamon), Myrtaceae (myrtles), and Theaceae (camellias) families. Mossy or upper montane forests are mainly alum tree relatives (Symplocaceae) and Myrsinaceae (ardisias). The sub-alpine level is predominately inhabited by Ericaceaea (heather, heath), Myricaceae (bayberries) and sub-alpine scrub. Most families show pronounced mid elevation peaks in species richness (Heaney 2001).

This broad outline of the primary forest habitats is generally consistent throughout Southeast Asia and Philippines, however, the species of each family present at each level varies depending upon abiotic and country specifics. The Philippines harbours an exceptional array of floral species, yet due to changes in the pattern of resource use the natural environment has been extensively exploited. Subsequently 60% of the endemic Philippine flora is now thought to be extinct. Nevertheless it is estimated that there are still some 8000 species of flowering plants, of which over 3000 are tree species that can attain a diameter at breast height of 30cm or more.

Despite the acknowledged diversity of the flora at a national scale, limited efforts have been undertaken to document the vegetation within the major islands of the Philippines. On Negros, only three areas of rainforest remain and one is the NNFR. The NNFR is dense and complex rainforest that represents the second largest remaining fragment of wet evergreen rainforest of the central Philippine Islands. The original vegetation was primarily forest, however, due to anthropogenic disturbances only 9900ha virgin forest remains in a mosaic of areas at different levels of disturbance.

The reserve is composed of two major fragments of old growth forest that are bedded into half craters of two extinct volcanoes, Mount Mandalagan and Mount Silsay. The Nasacob Corridor, comprised of second growth forest, connects the two halves. Tributaries from both craters meet in the Nasacob corridor to form the Malogo River, the most abundant and pristine water source for the island of Negros. Secondary forest stands on previously logged land, providing a stunning diversity of habitats mainly due to the elevational gradient. Low lying valleys harbour majestic dipterocarp forests while species rich submontane Oak-Laurel forests are present in the submontane zone. Higher up, large areas of mossy forest provide habitats for a multitude of lichens, mosses and other epiphytes thriving in the mist of the cloud level. Also situated within the NNFR are unique habitats created by hot springs, sulphur springs and temporary inundated bogs (Hamann *et al.*, 1996).

The moist forest habitats of the NNFR are disproportionately valuable from a conservation perspective (Hamann *et al.*, 1999) and provide an important refuge for a large number of rare and endemic floral and faunal species. Vast areas of the NNFR have been destroyed and replaced by cultivated fields or tall tropical grasslands thus reducing the old growth forest from 80,500ha to an estimated 9800ha (Hamann & Curio 1999).

The forests of the NNFR have been exploited over a long period of time with the levels of species extraction varying both spatially and temporally. The habitat was originally sub-montane dipterocarp forest dominated by red & white Lauan (*Shorea* species), Philippine Mahogany (hardwood)), and Almasiga (softwood). Species extracted from the forests have varied over time due to availability and demand. Lauan species were primarily taken followed by the large softwood Almasiga trees, palms, rattan and trees ferns. Other species exploited include Tangili, Almon, Danlugan, and additional species for charcoal. Kaingin or slash and burn agricultural techniques used by local communities have also contributed to the forest degradation.

Limited vegetation work has been undertaken in the NNFR. A study by Hamann *et al.* (1996) undertook floral surveys within the vicinity of sitio Patag, identifying the structure and composition of the transition zone between lowland and lower montane forest. This work was limited in geographical scope and in timescale, thus more extensive studies to assess the vegetation community composition and species distribution (and how this relates to faunal distribution) are required to allow effective conservation management recommendations to be made.

For the current research, three different habitat types within the NNFR have been selected for surveying. Each site is at a different stage in logging history; Mawa is old-growth forest that was selectively legally logged for dipterocarps 38 years ago. It is now depauperate in hardwood dipterocarp species, but still has big Almasiga trees and was not exploited for charcoal, mosses, tree ferns or palms. Aeroplano is described as secondary, intermediately disturbed forest, which was legally logged for dipterocarps, and then illegally logged for other species 14 years ago. The Dam is secondary re-growth forest, which was legally logged for dipterocarps, illegally logged for other species with commercial value, and then indiscriminately cut for charcoal production, resulting in complete exploitation of this area of forest. Exploitation stopped and re-growth began 14 years ago .

*2.1.1. Aims*

The aims of the vegetation study were therefore to assess the vegetation composition (tree species) of the three forest habitats in which the NRCP was working and to compare and contrast them. A secondary aim was to assess the presence of NTFPs.

## 2.2. Methods

*2.2.1 Transect Establishment*

The NRCP has established six permanent sample plots (PSPs) within the montane rainforest of the NNFR according to standard biodiversity assessment methods for tropical forests (Stork & Davies 1996). The standard baseline transect survey technique utilises 1ha PSPs (Dallmeier 1992). These have been established as three parallel pairs of permanently marked strip transects (500m x 20m), with one pair situated in each of the three habitat types (disturbed, secondary & old growth forest) to be monitored in the study. Each of the PSPs has been adjusted for uneven terrain via slope correction (Dallmeier 1992) and has been subdivided into 25 sub-quadrats (20m x 20m). This is the standard area unit for stand parameters (see Hamann *et al.*, 1999, Alder & Synnott, 1992), such as detailed tree inventory work (tagging, & identification).

The NRCP team has completed establishment of the six permanent sample plots (PSPs) each enclosing an area of one hectare (500m x 20m transect lines), with 20m sampling intervals, in three different forest types (old growth, secondary (selectively logged) and re-growth forest). In excess of 15000 individual trees (2000-3000 per PSP) have been tagged with unique identifier codes and measured (Diameter at Breast Height [DBH]) within these six plots. A summary of the PSP establishment is given in Table 2.1.

Table 2.1. Summary of the Permanent Sample Plot (PSP) locations within the NNFR. Further details are given by Turner *et al*. (2001).

| Name | PSP Code | Forest Type | Date of Establishment | Grid reference | Altitude (m) |
|---|---|---|---|---|---|
| Dam | E | Secondary | April 1999 | N10°39'38 E123°09'47 | 950m |
| Dam | F | Secondary | April 1999 | N10°39'38 E123°09'36 | 950m |
| Aeroplano | C | Disturbed Old Growth | August 1999 | N10°40'17 E123°09'53 | 1100m |
| Aeroplano | D | Disturbed Old Growth | August 1999 | N10°40'13 E123°09'58 | 1100m |
| Mawa | G | Old Growth | February 2000 | N10°38'47 E123°10'00 | 1400m |
| Mawa | H | Old Growth | February 2000 | N10°38'48 E123°10'02 | 1400m |

The size of the NRCP forest PSPs, and the inventory survey protocols have been chosen in accordance with those used in the Philippine Plant Inventory Project (Madulid 1996; Pipoly & Madulid 1998) and to provide results that are comparable to other sites both locally and nationally (Hamann *et al.*, 1999). They are also comparable to protocols implemented internationally (Dallmeier 1992; Alder & Synnott 1992). The 1ha plot size (with 20m x 20m subdivisions) is accepted as the standard design for forest inventory work and survey plots (Dallmeier 1992, Alder & Synnott, 1992).

Within each sub-quadrat of each PSP, all trees with a 10cm DBH or greater, have been measured and tagged with aluminium tree tags. This has been completed in order to conform to standard forest inventory methods (Pendry & Proctor 1997; Hamann *et al.*, 1999; Dallmeier 1992). Also the three tallest trees in each 20m sub-quadrat are being measured for total height using clinometer methodology (Alder & Synnott 1992).

*2.2.2. Morpho-Species Identification*

All tree species were identified initially by local guides and thus attributed local names. Prior to this a validation study of local guides identification skills was completed within standard 20m x 20m quadrats to ensure consistency of identification between different guides. Whilst botanical samples are being sent for taxonomic identification (see section 2.2.3), local names give a reliable indication of morpho-species richness and diversity. Local names were also translated to scientific names using Madulid (2001).

*2.2.3 Botanical Sampling*

The collection of botanical specimens from each of the PSPs has recently been initiated (2001), and previously only pilot studies had been completed by Maribel Agoo (National Museum of Philippines, Manila) and Dr. Peter Wilkie (Royal Botanic Gardens, Edinburgh).

Botanical samples have been taken from tagged trees to enable species identification of all tagged trees within each PSP, and thus generate a complete botanical inventory (species composition) for each PSP within each forest habitat type (see Hamann *et al.*, 1999). Thus far only a limited number of specimens have been collected, collated, dried and pressed according to standard field methods (Bridson & Forman 1992; Davies & Jermy 1996) at the NRCP. Samples have thus far been sent to Manila for further taxonomic work. Samples have been collected in triplicate, as done for previous studies (Hamann *et al.*, 1999), enabling samples to be sent to research collaborators for identification and a reference collection to be maintained at the NRCP/Bacolod Office.

Each PSP was also being systematically surveyed throughout the year for all species in fruit and/or flower. Each PSP is walked once a month, and every tagged tree in fruit or flower recorded, with notes regarding their colour and size. This data will then be combined with the species identification data in order to improve understanding of the phenology of the different forest types.

*2.2.4. NTFP Inventory*

Non-Timber Forest Products (NTFP) can be broadly defined as all biological materials other than timber that are extracted from forests for human use (Mitchell 2002). One PSP from each of the three habitat types (Table 2.1) was surveyed in detail by Mitchell (2002) for the presence of floral species used as NTFPs. The PSP transects were surveyed methodically with a local community member, walking in a zigzag fashion through the PSP identifying the NTFP species present in each quadrat. In order to be thorough and to cross check the informant information the three PSPs were each surveyed twice, once with each ampuestohan informant. The presence and abundance of each species was recorded.

*2.2.5. Analysis*

The following community metrics were calculated: Species richness; Pielou's eveness (j), where j=H`(observed)/H`$_{max}$, and H`$_{max}$ is the maximum possible diversity which would be achieved if all species were equally abundant. H` is derived from the Shannon-Weiner diversity index: $H=\sum(P_i * \text{Log}_e(P_i))$ where $P_i$ is the number of individuals of the *i*th species as a proportion of the total number of individuals of all species (Carr 1996).

Patterns in community composition were assessed using PRIMER (Plymouth Routines in Multivariate Ecological Research) (Clarke & Warwick, 1994a). Community (species abundance) data were double-square root-transformed to reduce the influence of dominant and rare species. The Bray-Curtis similarity measure was then calculated between every permutation of sample pairs (Clarke & Warwick 1994b). The relationship between the forest types is displayed using a non-metric multidimensional scaling (NMDS) ordination (Figure 2.1) and a hierarchical agglomerate clustering technique (Figure 2.2) (Clarke & Green 1988).

## 2.3. Results

*2.3.1. Botanical Inventory*

Nearly fifteen thousand individual trees (DBH≥10cm) have been permanently tagged within the six survey plots. One hundred and twenty morphological types of trees have been identified (which is likely to increase as scientific identifications are confirmed) and preliminary analysis has revealed that the overall species richness and Shannon-Wiener diversity (Begon *et al.*, 1990) is higher in the disturbed old-growth forest (95 species, diversity index = 21.57) and secondary forest (92 species, diversity index = 20.63) than the old growth forest (72 species, diversity index = 12.54). The two old-growth areas also have a more even distribution of species in comparison to the secondary forest, and all forest areas demonstrated high diversity but low abundance of individual species (Table 2.2).

Table 2.2. Species diversity and equitability for the three forest types surveyed within the NNFR.

| | Forest Type<br>Old growth | Secondary (disturbed) | Secondary (regrowth) |
|---|---|---|---|
| 1) Species richness | 75 | 95 | 92 |
| 2) Diversity index | 12.54 | 21.57 | 20.63 |
| 3) Equitability index | 0.167 | 0.227 | 0.224 |

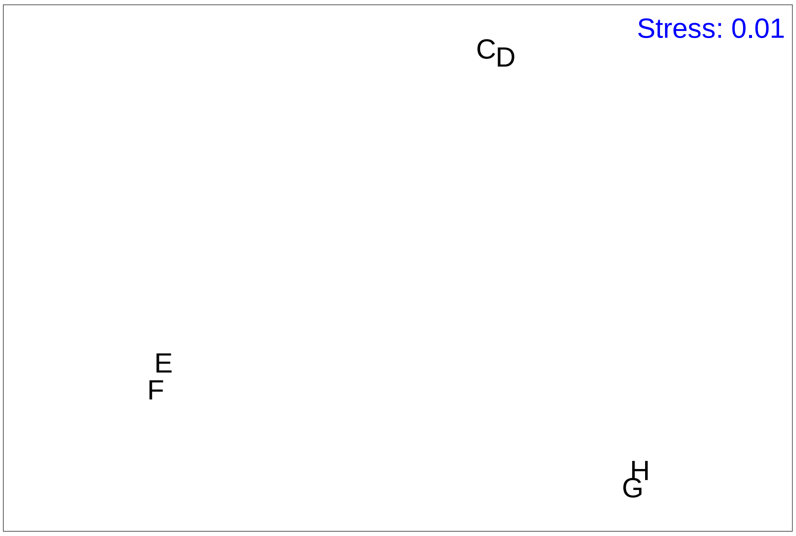


Figure 2.1. NMDS ordination of the six forest permanent sample plots within the NNFR. Where: C & D = disturbed old-growth forest; E & F = Secondary forest; G & H = Old-growth forest.

The aggregate species inventory scores (Table 2.3) illustrate that whilst the different forest habitat types demonstrate some similarities in terms of species present and their relative abundance, with species such as *Mimosa pudica* (Fabaceae) being equally common across all habitats. However the habitat types were more different than similar as illustrated by the NMDS and Cluster analyses.

The NMDS and Cluster demonstrate clear similarities between the pairs of sample plots located in the same forest type, indicating similar community composition. The relatively low stress value of the NMDS (<0.1) also demonstrates good separation of the three forest types, indicating that they differ substantially in their relative compositions.

The Cluster also confirms that the four old-growth forest plots are more similar to each other than to the secondary forest plots that are dominated by pioneer species (e.g. *Euphorbiaceae*). However, there is evidence that old-growth species, such as *Palaquium* species and *Agathis philippinensis* are re-growing at these sites. The disturbed old-growth and old-growth forest plots are also very different from each other in their species composition (Figure 2.1) with the latter being dominated by palm species, which have incidentally been completely removed from the secondary forest.

Table 2.3. Combined floristic compositions of the three forest habitat types surveyed (based on aggregate PSP inventory scores).

| **Morphotype** | **Scientific Species Name** | **Family** | **Eroplano** | **Dam** | **Mawa** |
|---|---|---|---|---|---|
| Adgaw | Premna odorata Blco. | Verbenaceae | 1 | 2 | 4 |
| Agboy | Mussaenda philippinensis Merr. | Rubiaceae | 2 | 0 | 0 |
| Ahos-ahos | Cyperus rotundus L. | Cyperaceae | 1 | 3 | 0 |
| Alagasi | Leucosyke capitellata (Poir.) Wedd. | Urticaceae | 55 | 6 | 29 |
| Alingatong | Dendrocnide meyeniana (Walp.) | Urticaceae | 8 | 0 | 0 |
| Almaciga | Agathis philippinensis Warb. | Araucaceae | 6 | 43 | 32 |
| Alom-alom | | | 5 | 0 | 0 |
| Andalamai | | | 0 | 1 | 0 |
| Angab | | | 2 | 2 | 0 |
| Avocado | Persea americana Mill. | Lauraceae | 7 | 20 | 25 |
| Aya | Amaranthus spinosus L. | Amaranthaceae | 0 | 13 | 0 |
| Bagilumboy | Syzygium bordenii (Merr.) Merr. | Myrtaceae | 1 | 0 | 0 |
| Bagobahi | Lagerstroemia pyriformis Koehne forma pyriformis | Lythraceae | 171 | 70 | 340 |
| Bago-binlud | | | 29 | 3 | 42 |
| Bagotambis | Syzygium merrittianum (C.B. Rob.) Merr. | | 14 | 38 | 48 |
| Bahay-bahay | | | 0 | 0 | 1 |
| Bakan | Sterculia oblongata R.Br. | Sterculiaceae | 8 | 82 | 60 |
| Bakhaw | Rhizophora apiculata Bl. | Rhizophoraceae | 0 | 4 | 0 |
| Bala-baga | | | 0 | 1 | 3 |
| Bangkal | Nauclea elmeri Merr. | Rubiaceae | 20 | 144 | 1 |
| Banhotan | | | 1 | 11 | 0 |
| Baticuling | Litsea glutinosa (Lour.) C.B. Rob. | Lauraceae | 2 | 180 | 0 |
| Batwan | | | 36 | 7 | 62 |
| Bayanti | Mallotus paniculatus (Lam.) Muell.-Arg. | Euphorbiaceae | 7 | 4 | 18 |
| Binunga | Macaranga tanarius (L.) Muell. Arg. | Euphorbiaceae | 25 | 98 | 95 |
| Biri | Ficus guyeri Elm. var. guyeri | Moraceae | 1 | 0 | 1 |
| Bita | Alstonia scholaris (L.) R.Br. var. scholaris | Apocynaceae | 51 | 3 | 7 |
| Bukaw-bukaw | | | 88 | 123 | 34 |
| bulo-batwan | | | 0 | 2 | 0 |
| Bulongkadios | Vanieria cochinchinensis Lour. | Moraceae | 2 | 10 | 0 |
| Bulukang | | | 16 | 773 | 3 |
| Bunsilak | Elaeocarpus calomala (Blco.) Merr. | Elaeocarpaceae | 148 | 26 | 102 |
| Buntot-tae | Ficus spp. | | 29 | 24 | 69 |
| Dalakit | Ficus benjamina L. | Moraceae | 83 | 102 | 34 |
| Dalamay | | | 153 | 87 | 27 |
| Dalamo | Laportea interrupta (L.) Chew | Urticaceae | 1 | 9 | 0 |
| Dao | Dracontomelon dao (Blco.) Merr. & Rolfe | Anacardiaceae | 74 | 1 | 1 |
| Dead tree | | | 58 | 3 | 1 |
| Dugo-an | Myristica philippensis Lam. | Myristicaceae | 17 | 0 | 0 |
| Enato | | | 3 | 0 | 1 |
| Gatasan | Daemonorops mollis (Blco.) Merr. | Arecaceae | 22 | 69 | 64 |
| Giant Tree Fern | | | 7 | 2 | 22 |
| Gisok-gisok | Hopea philippinensis Dyer | Dipterocarpaceae | 118 | 151 | 59 |
| Gulo-ginabot | | | 26 | 0 | 0 |
| Habon | | | 676 | 682 | 750 |
| Hagimit | Ficus minahassae (Teijsm. & de Vr.) Miq. | Moraceae | 9 | 0 | 0 |
| Hamindang | Macaranga bicolor Muell.-Arg. | Euphorbiaceae | 59 | 19 | 37 |
| Harras | Garcinia ituman Merr. | Cluasiaceae | 4 | 0 | 0 |
| Harras I | | | 7 | 1 | 0 |

| Morphotype | Scientific Species Name | Family | Eroplano | Dam | Mawa |
|---|---|---|---|---|---|
| Harras II | | | 7 | 106 | 3 |
| Hublas | Tristaniopsis decorticata (Merr.) Wils. & Waterh. | Myrtaceae | 11 | 78 | 35 |
| Kagay | Whitfordiodendron scandens Elm. | Fabaceae | 25 | 97 | 3 |
| Kaldemon | Atalantia disticha (Blco.) Merr. | Rutaceae | 38 | 72 | 139 |
| Kaningag | Cinnamomum celebicum Koord. | Lauraceae | 3 | 0 | 6 |
| Kape-kape | | | 74 | 16 | 59 |
| Katmon | Dillenia philippinensis Rolfe var. philippinensis | Dilleniaceae | 66 | 29 | 6 |
| Labnog | Ficus sp. | Moraceae | 0 | 54 | 75 |
| Langka | Artocarpus heterophyllus Lamk. | Moraceae | 23 | 33 | 53 |
| Lanipga | Terminalia copelandii Elm. | Combretaceae | 4 | 2 | 0 |
| Lauan | Shorea spp. | Dipterocarpaceae | 0 | 6 | 0 |
| Lunok | Ficus virgata Reinw. ex Bl. var. virgata | Moraceae | 122 | 29 | 30 |
| Morpho 1 | | | 2 | 0 | 0 |
| Morpho 2 | | | 0 | 1 | 0 |
| Morpho 3 | | | 41 | 132 | 22 |
| Morpho 4 | | | 6 | 1 | 1 |
| Mahogany | Sweitenia mahogani Jacq. | Meliaceae | 2 | 4 | 0 |
| Makang | | | 0 | 1 | 0 |
| Malabahi | Memecylon paniculatum Jack | Melastomataceae | 0 | 1 | 0 |
| Malabako | | | 4 | 20 | 48 |
| Mala-batwan | | | 140 | 93 | 3 |
| Malabayabas | | | 0 | 0 | 3 |
| Malabita | | | 54 | 52 | 169 |
| Malagasi | | | 86 | 107 | 136 |
| Mala-iba | Melia azidarach L. | Meliaceae | 0 | 0 | 4 |
| Mala-istiwitis | | | 4 | 25 | 7 |
| Malakadyos | Beilschmiedia cairocan Vid. | Lauraceae | 0 | 0 | 1 |
| Malapaho | Manigifera altissima Blco. | Anacardiaceae | 0 | 0 | 3 |
| Malapinya | Magnolia candolei (Bl.) Keng var. angatensis (Blco.) | Magnoliaceae | 4 | 0 | 0 |
| Malaumo | | | 3 | 0 | 2 |
| Mamalasi | | | 0 | 1 | 0 |
| Manitga | | | 38 | 234 | 5 |
| Mulato | Intsia bijuga (Colebr.) Kuntze | Fabaceae | 0 | 2 | 0 |
| Nato | Palaquium luzoniense (F-Vill.) Vid. | Sapotaceae | 0 | 1 | 0 |
| Ngala-ngala | Horsfieldia ardisiifolia (A.DC.) Warb. | Myristicaceae | 28 | 6 | 17 |
| Oblas | | | 37 | 147 | 31 |
| Odling | Cynometra ramiflora L. var. ramiflora | Fabaceae | 6 | 0 | 0 |
| Odlling Red | | | 1 | 0 | 2 |
| Odling White | | | 35 | 131 | 89 |
| Olo-anagas | | | 73 | 12 | 76 |
| Pagut-dong | | | 26 | 5 | 23 |
| Pajong Pajong | | | 122 | 191 | 164 |
| Palm tree | | | 0 | 1 | 0 |
| Palomaria | Leucaena leucocephala (Lam.) de Wit | Fabaceae | 5 | 0 | 0 |
| Pangi-pangi | | | 183 | 97 | 926 |
| Panubol | | | 126 | 140 | 78 |
| Pitogo | Cycas circinalis L. | Cycadaceae | 0 | 2 | 0 |
| Pulo pine tree | | | 6 | 0 | 0 |
| Pulo pinya | | | 148 | 145 | 51 |
| Red lauan | Shorea negrosensis Foxw. | Dipterocarpaceae | 0 | 5 | 1 |
| Sagi-sagi | | | 9 | 1 | 28 |
| Sagu-sahis | | | 4 | 3 | 16 |
| Salibadbad | | | 4 | 0 | 0 |

| Morphotype | Scientific Species Name | Family | Eroplano | Dam | Mawa |
|---|---|---|---|---|---|
| Salong-salong | Vatica mangachapoi Blanco ssp. mangachapoi | Dipterocarpaceae | 1 | 0 | 0 |
| Solu-santol | | | 52 | 0 | 0 |
| Tamboyog | | | 5 | 6 | 0 |
| Taulay | | | 21 | 149 | 28 |
| Tibig | Ficus nota (Blco.) Merr. | Moraceae | 6 | 9 | 4 |
| Tubog | Ficus benguetensis Merr. | Moraceae | 1 | 0 | 0 |
| Tulo-tul-an | | | 42 | 24 | 1 |
| Tungaw-tungaw | Melastoma affine D. Don | Melastomataceae | 9 | 0 | 0 |
| Tu-og | Bischofia javanica Bl. | Euphorbiaceae | 1 | 2 | 0 |
| Turog-turog | Mimosa pudica L. | Fabaceae | 114 | 276 | 152 |
| Ulo-istiwitis | | | 248 | 388 | 242 |
| Unidentified | | | 66 | 37 | 6 |
| White lauan | Shorea contorta Vid. | Dipterocarpaceae | 30 | 195 | 25 |
| Yapping | | | 0 | 23 | 13 |
| Yating-yating | | | 1 | 0 | 0 |

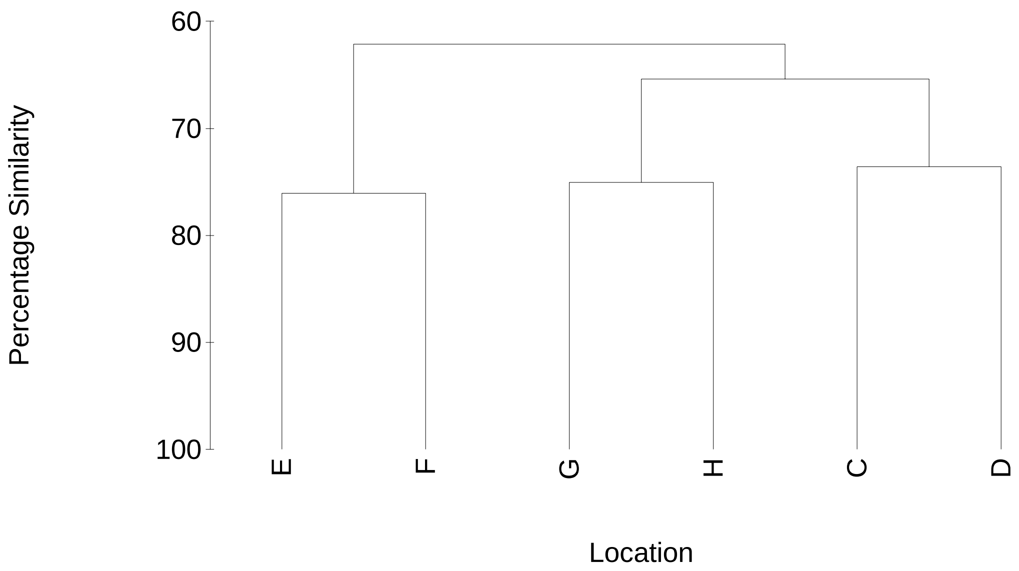


Figure 2.2. Dendrogram of forest community composition at the six forest permanent sample plots within the NNFR, calculated using group-average linking of Bray-Curtis similarities (calculated from √√-transformed data). Where: C & D = disturbed Old-growth forest; E & F = Secondary forest; G & H = Old-growth forest.

### *2.3.2 Fruit & Flower Surveys*
Fruiting and flowering surveys have been completed for a 12 month period however, the data will be analysed and summarised in a later report, once combined with full species inventory data for each of the PSPs, and distribution and habitat use data of selected faunal groups.

### *2.3.3. Non-Timber Forest Products (NTFP)*
A total of 52 NTFPs were identified across the three PSPs surveyed (Table 2.4). These have a range of uses from medicinal, food, social and environmental (see Mitchell 2002 for further details).

Table 2.4. NTFP species identified within 3 PSPs by local community members (from Mitchell (2002) with permission).

| **Species** | Transect C | | Transect F | | Transect G | |
|---|---|---|---|---|---|---|
| | Number of quadrats where species were found by each informant | | | | | |
| | **NV** | **SS** | **NV** | **SS** | **NV** | **SS** |
| *Agathis philippensis* | 1 | - | 6 | 11 | 15 | 9 |
| *Alocasia macrorhizos* | 3 | 4 | - | - | - | 1 |
| *Alocasia sp.* | - | - | - | 7 | - | 1 |
| *Alpina paradoxa* | 17 | - | 1 | - | - | - |
| *Alstonia sp.* | - | - | - | - | - | 4 |
| *Amomum sp.* | 12 | 3 | - | 7 | 9 | 2 |
| *Arisaema sp.* | 4 | - | - | - | 7 | - |
| *Asplenium* | 16 | 5 | 3 | 1 | - | 2 |
| *Artocarpus heterophyllus* | - | - | 1 | - | - | - |
| *Artocarpus odoratissimus* | - | - | 1 | 3 | - | - |
| *Atalantia sp.* | - | - | - | 1 | - | - |
| *Bambusa* | 11 | 4 | 3 | 7 | 15 | 12 |
| *Begonia sp.* | 2 | 2 | - | - | 1 | 1 |
| *Breynia sp.* | - | - | 1 | - | 1 | - |
| *Calamus* | 14 | 16 | 2 | - | 4 | 1 |
| *Calamus merillii* | 2 | 2 | 1 | 1 | - | - |
| *Canarium sp.* | - | 2 | 4 | 8 | 7 | 4 |
| *Cinnamomum mercadoi* | 13 | 4 | 1 | 1 | 3 | 1 |
| *Coffea sp.* | 1 | 1 | - | 1 | - | - |
| *Cissus sp. 2* | - | - | - | - | - | 1 |
| *Curculigo sp.* | - | - | 14 | 2 | - | - |
| *Cyathea* | 5 | 12 | 7 | 10 | 8 | 15 |
| *Cynometra ramiflora* | - | - | - | - | - | 1 |
| *Daemonorops mollis* | 12 | - | - | 2 | - | 4 |
| *Dillenia philippensis* | - | 3 | 1 | 1 | - | - |
| *Dioscarea sp.* | - | 2 | - | 4 | - | 4 |
| *Diplazium esculentum* | 2 | - | - | 3 | - | - |
| Fern | 5 | 5 | 13 | 7 | 7 | 7 |
| *Ficus septica* | 13 | - | 1 | - | 11 | - |
| *Flagellaria indica* | - | - | 1 | 3 | 2 | - |
| *Garcinia binucao* | - | 1 | 2 | 7 | - | 3 |
| *Homalanthus rotundifolius* | - | - | - | 2 | - | - |
| *Hoya sp.* | - | 4 | - | 3 | 4 | 6 |
| *Intsia sp.* | 1 | 1 | - | - | - | - |
| *Justicia sp.* | - | - | - | 2 | - | - |
| *Leea sp.* | - | 1 | - | - | - | - |
| *Medinilla sp.* | 8 | 6 | 3 | 5 | - | - |
| Moss | 13 | 9 | 2 | 5 | - | 9 |
| Orchidaceae | 21 | 13 | 8 | 6 | 9 | 17 |
| Palmae | 16 | 7 | 12 | 10 | 15 | 17 |
| Pandanaceae | 16 | 9 | 6 | 4 | 15 | 1 |
| *Persea americana* | - | - | 2 | - | - | - |
| *Philodendron sp. 1* | - | - | 1 | 1 | - | - |
| *Philodendron sp. 2* | - | - | 3 | 3 | - | - |
| *Phragmites karka* | - | - | 2 | 1 | - | - |

| Species | Transect C | | Transect F | | Transect G | |
|---|---|---|---|---|---|---|
| | Number of quadrats where species were found by each informant | | | | | |
| | **NV** | **SS** | **NV** | **SS** | **NV** | **SS** |
| *Pinus sp.* | - | - | - | - | 3 | 1 |
| *Piper sp.* 1 | 1 | - | - | 1 | - | - |
| *Piper sp.* 2 | - | 1 | - | - | - | - |
| *Piper sp.* 3 | 18 | 8 | 6 | 6 | 15 | 19 |
| *Pothos sp.* | - | - | - | 6 | 4 | 7 |
| *Raphidophora sp.* | 8 | - | - | - | - | - |
| *Stachytarpheta jamaicensis* | - | - | - | 3 | - | - |
| **Total Number of Species** | **26** | **25** | **28** | **35** | **21** | **26** |

NV/SS – initials of community informants.

## 2.4. Discussion

The inventory work completed across all PSPs illustrates a diverse array of at least 120 morpho-types present within the study areas. This total is higher than the number of species identified by Hamann *et al*. (1999) in a single 1ha plot in a different region of the NNFR. This may be a combined function of the current study only working to a morhpo-type level and assessing more than one habitat type. It is probable that species richness may change since names used by local guides can refer to either one species (e.g. Olongas) or a group of species (e.g. Bunsilak, of which Olongas is one species). Testing of local guides has sort to minimise this probable variation in taxonomic focus of local names employed (which appear to vary slightly between villages). However, it is premature to give more detailed inference from the data until species level identifications have been completed for all PSPs. This will also permit an assessment of accuracy and taxonomic focus of local names used.

It is apparent that those surveyed are more diverse than the one studied by Hamann *et al*. (1999) and are comparable to other areas of Southeast Asia where the number of species per hectare is typically between 100 and 150 (Whitmore 1995). The PSP sites are at higher elevation (by 2-500m) than the area studied by Hamann *et al*. (1999), and as diversity generally declines with altitude (Pipoly & Madulid 1998) these results suggests that the vegetation of this area is particularly diverse.

At a species level, tree ferns and palms were the most dominant groups within each PSP, accounting for between 11 and 19% of individuals recorded. All other species contributed no more than 7% individually to the composition of any PSP, except for *Vanieria cochinchinensis* (Moraceae), which accounted for over 12% of all species encountered at the Dam PSPs. Additionally, there was also a high prevalence of Dipterocarpacaeae species (e.g. *Hopea philippinensis* and *Shorea contorta*) at the Dam PSPs. This family is both important in ecological and economic terms, and their regeneration and higher numbers at the Dam sites may partly reflect the lower altitude of the sites since there are more common in lowland forests (Whitmore 1984).

The empirical outputs of the completed PSP inventories will not only provide a valuable baseline of vegetation community structure, and how this relates to faunal diversities and distributions, but may also aid restoration efforts. Comparison of species frequencies on different plots (within different forest types) might help to decide which species are useful for reforestation projects. For example, a species that occurs in scattered patches in an old growth plot, but forms high frequency populations on the logged site (e.g. Moraceae *sp*.), is likely to be a pioneer species. Such species are generally tolerant of drought and intense sun, and may be used to establish new plantations by open field planting. Such results will only transpire once the scientific inventory has been completed but could ultimately aid the restoration initiatives of NFEFI for the Upper Imbang-Caliban watershed (Turner *et al.*, 2001).

# 3. Birds

## 3.1. Introduction

The avian diversity of the Philippines is of global importance with 33% of the 576 recorded species existing only in this cluster of islands. BirdLife International has designated 9 areas of the Philippines as Endemic Bird Areas (EBA); an area encompassing the overlapping breeding ranges of restricted range bird species, and some as Important Bird Areas (IBA) including Negros (Stattersfield *et al.*, 1998). The EBA which covers the central Philippine islands (EBA 152), was listed as one of the worlds 11 highest-ranking in terms of biological importance and threat level (Brooks *et al.*, 1992).

The Philippines currently has the highest proportion of restricted range and threatened species worldwide (Stattersfield *et al.*, 1998). It is estimated that 80% of bird species are forest dependent (Collar *et al.*, 1999) and nearly half of the endemic bird species are threatened by deforestation (Brooks *et al.*, 1997). Other causes of decline are attributable to hunting and growing pet trade (WCSP 1997). Such problems are prevalent across most of the major islands in the Philippines, including Negros Island.

Negros supports more than 190 species of avifauna of which approximately 100 are thought to be forest dependent. Restricted range species are consequently under serious threat by further loss and fragmentation of the forests. Due to excessive hunting in the NNFR, larger birds are scarce, including hornbills and fruit pigeons (Haribon 2002). Many of these species are endangered and endemic with a staggering 59 species found on Negros endemic to the Philippines and 9 are further restricted to the Negros-Panay faunal region (Brooks *et al.*, 1991). Such species include the endangered Visayan flowerpecker (*Dicaaeum retrocinctum*) found in the NNFR, as well as the Negros bleeding-heart (*Ptilinopus arcanus)* whose status is critical (Kennedy *et al.*, 2000).

The avifauna of Negros appears to have been well studied over the last 60 years (see Brookes *et al* 1992 for review) however knowledge of Philippine birds and their habitats is far from complete. Limited studies have been published on the species of the NNFR and those which have were either limited in duration (Brookes *et al.*, 1992) or in ecological and geographical scope (Hamann & Curio 1999). Species inventory work is of great importance, however, such spatially non-specific studies provide limited information for applied conservation recommendations within a multiple stakeholder environment (Turner *et al.*, 2002a).

The ongoing work of the NRCP has developed a detailed inventory of species present within the Upper Imbang-Caliban watershed area of the NNFR (Turner *et al*., 2001; Turner *et al*., 2002c), however, such observations indicate that habitat preferences and spatial distriburions vary between species and species groups. Yet the status and distribution of the species within the different forest habitat types of the project area of the NNFR is currently very poorly known. Thus, information is urgently needed for the effective conservation and management of the reserve.

### *3.1.1. Aims*

The avifaunal research work had two major aims:

- Update the ongoing bird species inventory for the study watershed;
- Compare and contrast the community composition of the major forest habitat types studied.

## 3.2. MacKinnon Lists

*3.2.1. Methods*

The bird fauna of the NNFR was surveyed by observation using Mackinnon lists (Mackinnon & Phillips 1993). The observer makes a list of species sighted by recording each new species until a predetermined number of species is reached. Based on preliminary surveys, the list length was set at the advised minimum of 10 species (Bibby *et al.*, 1998). A species can only be recorded once on each list but may be recorded on subsequent lists. Surveys should be repeated until at least 25 lists are completed at each survey location. Such data then permits the calculation of species discovery curves and an index of relative abundance or detectability (Bibby *et al.*, 1998; Turner *et al.*, 2002b).

Lists were compiled at 11 survey locations within the NNFR but were predominantly focussed on three major habitat types (Table 3.1) which were surveyed throughout the duration of the study period. Occasionally the 10 species could not be recorded in a single visit; in these cases the site was revisited later in the day or the following day to complete the list.

*3.2.2. MacKinnon List Analysis*

Species discovery curves were calculated for each survey location by replacing surveyor effort with the number of lists and plotting this against the cumulative total number of species.

An Index of Relative Detectability (IRD) rather than abundance was calculated for each species calculating the proportion of lists on which it appears at each location, and thus the index can vary between 0 (species not recorded) and 1 (species recorded on every list). The term “index of relative detectability” has been used here, rather than the standard “index of relative abundance”, as the frequency of a species occurring on a list is dependent on several factors, of which abundance is only one.

Species diversity metrics were then calculated from the IRDs. Three measures of local diversity were calculated for each survey location and these included: Total number of species (S), Shannon-Weiner diversity $H=\sum(P_i*\text{Log}_e(P_i))$ where $P_i$ is the number of individuals of the *i*th species as a proportion of the total number of all *i*th species, and Pielou’s eveness $J=H/\text{Log}_e S$ (Carr 1996).

Further patterns in community composition were assessed using PRIMER (Clarke & Warwick, 1994a). The Bray-Curtis similarity measure was then calculated (from IRD data) between every permutation of sample pairs (Clarke & Warwick 1994b). The relationship between survey sites was analysed using a Non-metric MultiDimensional Scaling (NMDS) ordination and a hierarchical agglomerate clustering technique (Clarke & Green 1988).

Table 3.1. Locations of Mackinnon List and mist net surveys.

| Location code | Location | Location code | Location |
|---|---|---|---|
| 1 | Bamboo Platform | 7 | Caliban River |
| 2 | NRCP garden | 9 | Road to Concepcion |
| 3 | Dam | 10 | James’ Farm |
| 4 | Aeroplano | 11 | Valley North |
| 5 | Mawa | 12 | NFEFI Staff House |
| 6 | Crater | | |

Site 8 was omitted part way through the survey period.

### *3.2.2. Results*

The Mackinnon lists completed during 2002 at all locations identified 98 species from 35 families (Table 3.3), of which 68 (69%) were endemic to the Philippines. These records increase the overall inventory for the project area to 137 species recorded since 2001, with 80 (58%) of these endemic (Appendix 1). Species discovery curves (Figure 3.1) indicate a similar rate of discovery at all survey sites, with only the Dam, Mawa and Aeroplano reaching discernable plateaus. The total number of lists completed at each location is given in Table 3.2.

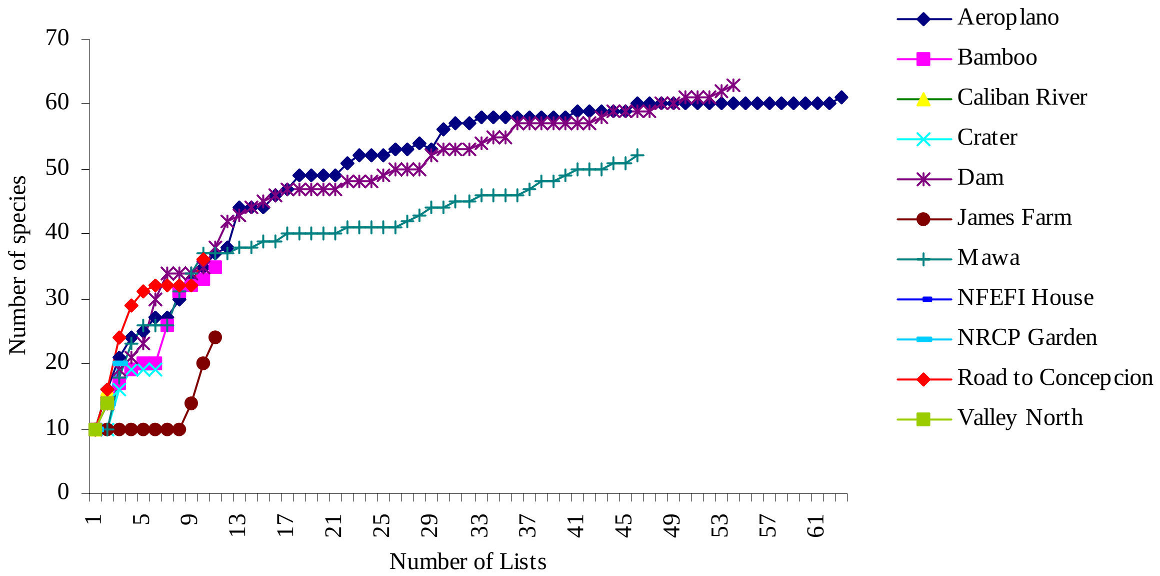


Figure 3.1. Bird species accumulation curves for MacKinnon Lists (for list with 10 species)

Table 3.2. Number of Mackinnon lists (>ten species) completed at each location

| Location | Number of lists |
|---|---|
| Bamboo Platform | 10 |
| NRCP garden | 3 |
| Dam | 50 |
| Aeroplano | 59 |
| Mawa | 43 |
| Crater | 3 |
| Caliban River | 2 |
| Road to Concepcion | 8 |
| James Farm | 10 |
| Valley North | 2 |
| NFEFI Staff House | 1 |

Table 3.3. Species IRD value by species and list location.

| Family | *Genus/ Species* | Common Name | Bamboo Platform | NRCP Garden | Dam | Aeroplano | Mawa | Crater | Caliban River | Road to Conception | James' farm | Valley North | NFEFI House |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Accipitridae | *Pernis celebensis steeri* | Barred honeybuzzard | 0.10 | 0.67 | 0.00 | 0.00 | 0.00 | 0.00 | 0.50 | 0.00 | 0.00 | 0.00 | 0.00 |
| Accipitridae | *Haliaetus Indus intermedius* | Brahminy kite | 0.10 | 0.00 | 0.00 | 0.00 | 0.12 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.00 |
| Accipitridae | *Accipeter soloensis* | Chinese goshawk | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.50 | 0.00 |
| Accipitridae | *Spilornis cheela holospilus* | Crested serpent-eagle | 0.10 | 0.00 | 0.00 | 0.00 | 0.16 | 0.00 | 0.00 | 0.13 | 0.00 | 0.00 | 0.00 |
| Accipitridae | *Pernis celebensis* | Oriental honey buzzard | 0.10 | 0.00 | 0.10 | 0.05 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Accipitridae | *Accipeter trivirgats extimus* | Crested goshawk | 0.00 | 0.00 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 |
| Accipitridae | *Spizaetus philippinesis* | Philippine hawk eagle | 0.00 | 0.00 | 0.00 | 0.08 | 0.05 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Falconidae | *Falco peregrinus ernesti* | Peregrine falcon | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.05 |
| Phasianidae | *Gallus gallus* | Red junglefowl | 0.00 | 0.00 | 0.00 | 0.00 | 0.12 | 0.67 | 0.50 | 0.00 | 0.00 | 0.00 | 0.00 |
| Columbidae | *Phapitreron leucotis* | White-eared brown dove | 0.10 | 0.00 | 0.00 | 0.00 | 0.19 | 0.67 | 0.50 | 0.00 | 0.00 | 0.50 | 0.00 |
| Columbidae | *Ptilinopus leclancheri* | Black-chinned fruit dove | 0.00 | 0.00 | 0.00 | 0.00 | 0.05 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Columbidae | *Ducula poliocephala* | Pink-bellied imperial pigeon | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Columbidae | *Ducula aenea* | Green imperial pigeon | 0.00 | 0.00 | 0.00 | 0.00 | 0.19 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Columbidae | *Columba vitiensis* | Metallic pigeon | 0.00 | 0.00 | 0.00 | 0.00 | 0.07 | 0.33 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Columbidae | *Macropygia Phasianella tenuirostris* | Reddish cuckoo-dove | 0.20 | 0.33 | 0.01 | 0.00 | 0.14 | 0.00 | 0.00 | 0.13 | 0.00 | 0.50 | 0.00 |
| Columbidae | *Steptopelia chinensis tigrina* | Spotted dove | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0.00 | 0.00 | 0.13 | 0.00 | 0.00 | 0.00 |
| Cuculidae | *Cuculus saturatus* | Oriental cuckoo | 0.00 | 0.00 | 0.00 | 0.00 | 0.07 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Cuculidae | *Cuculus micropterus* | Indian cuckoo | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.13 | 0.00 | 0.00 | 0.00 |
| Cuculidae | *Centropus v. viridis* | Philippine coucal | 0.40 | 0.67 | 0.01 | 0.00 | 0.21 | 0.00 | 0.00 | 0.25 | 0.03 | 0.50 | 1.00 |
| Strigidae | *Ninox scutulata* | Brown hawk owl | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Strigidae | *Ninox philippensis centralis* | Philippine hawk-owl | 0.00 | 0.00 | 0.00 | 0.00 | 0.26 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.00 |

| Family | Genus/ Species | Common Name | Bamboo Platform | NRCP Garden | Dam | Aeroplano | Mawa | Crater | Caliban River | Road to Conception | James' farm | Valley North | NFEFI House |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Podargidae | *Batrachostomus septimus* | Philippine frogmouth | 0.00 | 0.00 | 0.00 | 0.00 | 0.07 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Apodidae | *Collocalia vanikorensis amelis* | Island swiftlett | 0.20 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.25 | 0.00 | 0.00 | 0.00 |
| Apodidae | *Collocalia mearnsi* | Philippine swiftlet | 0.40 | 0.67 | 0.01 | 0.00 | 0.05 | 0.00 | 0.00 | 0.13 | 0.00 | 0.00 | 0.00 |
| Apodidae | *Collocalia esculenta marginata* | Glossy swiftlet | 1.00 | 0.67 | 0.01 | 0.00 | 0.14 | 0.67 | 1.00 | 0.63 | 0.06 | 1.00 | 1.00 |
| Apodidae | *Collocalia troglodytes* | Pygmy swiftlet | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0.00 | 0.00 | 0.13 | 0.00 | 0.00 | 0.00 |
| Apodidae | *Mearnsia picina* | Philippine needletail | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Apodidae | *Hirunapus celebensis* | Purple needletail | 0.40 | 0.67 | 0.00 | 0.00 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.00 |
| Apodidae | *Apus affinis* | House swift | 0.10 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Coraciidae | *Eurystomus orientalis cyanocollis* | Dollar bird | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Alcedinidae | *Hacyon chloris collaris* | White-collared Kingfisher | 0.00 | 0.33 | 0.01 | 0.00 | 0.05 | 0.00 | 0.00 | 0.13 | 0.00 | 0.00 | 0.00 |
| Alcedinidae | Actenoides lindsayi | Spotted wood kingfisher | 0.00 | 0.00 | 0.00 | 0.04 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Meropidae | *Merops p.philippinus* | Blue-tailed bee-eater | 0.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.13 | 0.00 | 0.00 | 0.00 |
| Bucerotidae | *Penelopides p. panini* | Tarictic hornbill | 0.00 | 0.00 | 0.15 | 0.00 | 0.19 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Picidae | *Dendrocopos m. maculatus* | Pygmy woodpecker | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Picidae | *Dryocopus javanensis philippinensis* | White-bellied woodpecker | 0.00 | 0.00 | 0.00 | 0.00 | 0.51 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hirundinidae | *Hirundo rustica gutturalis* | Barn swallow | 0.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.25 | 0.00 | 0.00 | 0.00 |
| Hirundinidae | *Hirundo tahitica javanica* | Pacific swallow | 0.10 | 0.05 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Campephagidae | *Coracina striata* | Bar-bellied cuckoo-shrike | 0.00 | 0.00 | 0.00 | 0.00 | 0.05 | 0.33 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Campephagidae | *Lalage nigra* | Pied triller | 0.00 | 0.00 | 0.00 | 0.00 | 0.05 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

| Family | *Genus/ Species* | Common Name | Bamboo Platform | NRCP Garden | Dam | Aeroplano | Mawa | Crater | Caliban River | Road to Conception | James' farm | Valley North | NFEFI House |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Campephagidae | *Pericrocotus flammeus novus* | Scarlet minivet | 0.00 | 0.00 | 0.00 | 0.00 | 0.12 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Pycnonotidae | *Pyconotus g.goiavier* | Yellow-vented bulbul | 0.40 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.00 |
| Pycnonotidae | *Hypsipetes philippinius guimarasensis* | Philippine bulbul | 0.90 | 0.00 | 0.00 | 0.00 | 0.70 | 0.00 | 0.50 | 0.63 | 0.06 | 1.00 | 0.00 |
| Pycnonotidae | *Hypsipetes everetti* | Yellowish bulbul | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.50 | 0.00 | 0.00 | 0.00 | 0.00 |
| Dicruridae | *Dicrurus balicassius mirabilis* | Balicassiao | 0.30 | 0.00 | 0.00 | 0.00 | 0.60 | 0.00 | 0.50 | 0.00 | 0.00 | 0.00 | 0.00 |
| Oriolidae | *Oriolus chinensis* | Black-naped oriole | 0.00 | 0.00 | 0.00 | 0.00 | 0.05 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Corvidae | *Corvus macrorhynchos philippinus* | Large-billed crow | 0.10 | 0.00 | 0.00 | 0.00 | 0.00 | 0.33 | 0.00 | 0.25 | 0.00 | 0.00 | 0.00 |
| Corvidae | *Corvus enca* | Slender-Billed crow | 0.10 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Paridae | *Parus elegans albescens* | Elegant tit | 0.20 | 0.00 | 0.00 | 0.00 | 0.35 | 0.00 | 1.00 | 0.13 | 0.01 | 0.50 | 0.00 |
| Sittidae | *Sitta rontalis* | Velvet-fronted nuthatch | 0.00 | 0.00 | 0.00 | 0.00 | 0.42 | 0.33 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Rhabdornithdae | *Rhabdornis mystacalis* | Stripe-headed rhabdornis | 0.00 | 0.00 | 0.00 | 0.00 | 0.09 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Turdidae | *Brachypteryx Montana brunneiceps* | White-browed shortwing | 0.00 | 0.00 | 0.00 | 0.00 | 0.16 | 0.67 | 0.00 | 0.00 | 0.00 | 0.50 | 0.00 |
| Turdidae | *Saxicola caprata randi* | Pied bushchat | 0.10 | 0.00 | 0.00 | 0.00 | 0.00 | 0.33 | 0.00 | 0.75 | 0.08 | 0.00 | 0.00 |
| Turdidae | *Zoothera andromedae* | Sunda ground thrush | 0.00 | 0.00 | 0.04 | 0.05 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Turdidae | *Turdus poliocephalus nigrorum* | Island thrush | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 1.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Sylviidae | *Phyllscopus borealis* | Arctic warbler | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Sylviidae | *Phylloscopus c.cebuensis* | Lemon-throated leaf-warbler | 0.00 | 0.00 | 0.00 | 0.00 | 0.05 | 0.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 |
| Sylviidae | *Phylloscopus olivaceus* | Philippine leaf warbler | 0.00 | 0.00 | 0.00 | 0.00 | 0.09 | 0.00 | 0.00 | 0.13 | 0.00 | 0.50 | 0.00 |
| Sylviidae | *Phylloscopus trivirgatus nigrorum* | Mountain leaf-warbler | 0.00 | 0.00 | 0.00 | 0.00 | 0.07 | 0.67 | 0.00 | 0.13 | 0.01 | 0.00 | 0.00 |

| Family | *Genus/ Species* | Common Name | Bamboo Platform | NRCP Garden | Dam | Aeroplano | Mawa | Crater | Caliban River | Road to Conception | James' farm | Valley North | NFEFI House |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sylviidae | *Megalurus timoriesis tweedalei* | Tawny grassbird | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.50 | 0.05 | 0.00 | 0.00 |
| Sylviidae | *Megalurus palustris forbesi* | Striated grassbird | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.63 | 0.00 | 0.00 | 0.00 |
| Sylviidae | *Orthotomus canasteiceps rabori* | Philippine tailorbird | 0.10 | 0.00 | 0.00 | 0.00 | 0.40 | 0.00 | 0.50 | 0.00 | 0.00 | 0.50 | 0.00 |
| Muscicapidae | *Rhinomyias ruficauda* | White-throated jungle-flycatcher | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Muscicapidae | *Eumyias p. panayensis* | Mountain verditer flycatcher | 0.00 | 0.00 | 0.00 | 0.00 | 0.47 | 0.00 | 0.00 | 0.13 | 0.01 | 0.00 | 0.00 |
| Muscicapidae | *Ficedula narcissina* | Narcissus flycatcher | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Muscicapidae | *Ficedula hyperythra* | Snowy-browed flycatcher | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0.00 | 0.00 | 0.13 | 0.00 | 0.00 | 0.00 |
| Muscicapidae | *Ficedula westermanni rabori* | Little pied flycatcher | 0.00 | 0.00 | 0.00 | 0.00 | 0.07 | 0.00 | 0.00 | 0.13 | 0.01 | 0.00 | 0.00 |
| Muscicapidae | *Cyanoptila cyanomelana* | Blue and white flycatcher | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Muscicapidae | *Culicapa heianthea panayensis* | Citrine Canary-flycatcher | 0.00 | 0.00 | 0.00 | 0.00 | 0.28 | 0.67 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Muscicapidae | *Rhipidura javanica nigriorquis* | Pied fantail | 0.10 | 0.00 | 0.00 | 0.00 | 0.02 | 0.00 | 0.00 | 0.25 | 0.00 | 0.00 | 0.00 |
| Muscicapidae | *Rhipidura cyaniceps albiventris* | Blue-headed fantail | 0.00 | 0.00 | 0.00 | 0.00 | 0.74 | 0.33 | 1.00 | 0.13 | 0.01 | 1.00 | 0.00 |
| Pachycephalidae | Pachycephala albiventris | Green-backed whistler | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Pachycephalidae | Pachycephala homeyeri | White-vented whistler | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Motacillidae | *Motacilla cinerea robusta* | Grey wagtail | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.50 | 0.00 | 0.00 | 0.00 | 0.00 |
| Motacillidae | *Anthus novaeseelandiae lugubris* | Richard's pipit | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.25 | 0.00 | 0.00 | 0.00 |
| Motacillidae | *Anthus h. hodgsoni* | Olive tree-pipit | 0.00 | 0.00 | 0.00 | 0.00 | 0.05 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Artamidae | *Artamus l.leucorhynchus* | White-breasted wood swallow | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.00 |
| Laniidae | *Lanius schach nasutus* | Long-tailed Shrike | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0.33 | 0.00 | 0.63 | 0.06 | 0.00 | 0.00 |

| Family | Genus/ Species | Common Name | Bamboo Platform | NRCP Garden | Dam | Aeroplano | Mawa | Crater | Caliban River | Road to Conception | James' farm | Valley North | NFEFI House |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Laniidae | *Lanius cristatus lucionensis* | Brown shrike | 0.50 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.25 | 0.03 | 0.00 | 1.00 |
| Sturnidae | *Sarcops calvus melanonotus* | Coleto | 0.90 | 0.00 | 0.00 | 0.00 | 0.44 | 0.33 | 0.00 | 0.00 | 0.00 | 0.00 | 1.00 |
| Sturnidae | *Acridotheres c. cristatellus* | Crested myna | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Nectariniidae | Anthreptes malacensis | Plain-throated sunbird | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Nectariniidae | *Nectaria j. jujularis* | Olive-backed sunbird | 0.60 | 0.00 | 0.00 | 0.00 | 0.02 | 0.00 | 0.50 | 0.25 | 0.03 | 0.00 | 0.00 |
| Nectariniidae | *Aethopyga siparaja magnifica* | Crimson sunbird | 0.20 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.50 | 0.00 | 0.00 | 0.00 | 0.00 |
| Dicaeidae | *Dicaeum bicolor viridissiumum* | Bicolored flowerpecker | 0.20 | 0.00 | 0.00 | 0.00 | 0.09 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Dicaeidae | *Dicaeum australe haematostictum* | Red-keeled flowerpecker | 0.10 | 0.00 | 0.00 | 0.00 | 0.05 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Dicaeidae | *Dicaeum trigonostygma dorsale* | Orange-bellied flowerpecker | 0.00 | 0.00 | 0.00 | 0.00 | 0.30 | 0.67 | 0.50 | 0.13 | 0.01 | 0.00 | 1.00 |
| Dicaeidae | *Dicaeum pygmaeum* | Pygmy flowerpecker | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Zosteropidae | *Zosterops everetti* | Everett's white-eye | 0.00 | 0.00 | 0.00 | 0.00 | 0.05 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Zosteropidae | *Zosterops n. nigrorum* | Yellowish white-eye | 0.60 | 0.00 | 0.00 | 0.00 | 0.12 | 0.67 | 0.50 | 0.13 | 0.01 | 1.00 | 0.00 |
| Zosteropidae | *Zosterops montanus pectoralis* | Mountain white-eye | 0.20 | 0.00 | 0.00 | 0.00 | 0.77 | 1.00 | 1.00 | 0.50 | 0.05 | 1.00 | 0.00 |
| Ploceidae | *Passer montanus saturatus* | Eurasian tree sparrow | 0.20 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.50 | 0.00 | 0.00 | 0.00 |
| Estrildidae | *Lonchura leucogastra manueli* | White-bellied munia | 0.10 | 0.00 | 0.00 | 0.00 | 0.02 | 0.00 | 0.00 | 0.25 | 0.00 | 0.00 | 0.00 |
| Estrildidae | *Lonchura punctulata cabanisi* | Scaly-breasted munia | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.50 | 0.00 | 0.00 | 0.00 |
| Estrildidae | *Lonchura malacca jagori* | Chestnut munia | 0.20 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.38 | 0.00 | 0.00 | 0.00 |

The IRD scores varied between species and location (Table 3.3) with few species common at several locations, e.g. Reddish cuckoo-dove (*Macropygia Phasianella tenuirostris)*, Glossy swiflet (*Collocalia esculenta marginata*) and Yellowish white-eye (*Zosterops n. nigrorum*). Many species were relatively rare within the study areas being recorded at low frequency and at limited locations, e.g. Snowy-browed flycatcher (*Ficedula hyperythra*) and Mountain leaf-warbler (*Phylloscopus trivirgatus nigrorum).* Several species appeared to be restricted to particular habitat types on being located at single survey locations. The following species were only recorded in the old-growth forest of Mawa: Philippine frogmouth (*Batrachostomus septimus*), Pygmy woodpecker (*Dendrocopos m. maculatus*), Pied triller (*Lalage nigra*) and White-vented whistler (*Pachycephala homeyeri*).

Comparison of community metrics for each survey location (Table 3.4) summarises the differences between sites in terms of overall species richness and relative diversity of the avian communities. The three main forested survey sites (Dam, Aeroplano and Mawa) are the most species rich and diverse.

Table 3.4. Bird community metrics for each survey location.

| | Location | Species Richness | Shannon-Weiner Diversity | Pielou's Eveness |
|---|---|---|---|---|
| 1 | Bamboo Platform | 34 | 14.39 | 0.92 |
| 2 | NRCP Garden | 20 | 8.25 | 0.97 |
| 3 | Dam | 62 | 27.00 | 0.84 |
| 4 | Aeroplano | 58 | 24.81 | 0.86 |
| 5 | Mawa | 66 | 28.61 | 0.85 |
| 6 | Crater | 18 | 7.38 | 0.97 |
| 7 | Caliban River | 16 | 6.51 | 0.98 |
| 9 | Road to Concepcion | 36 | 15.20 | 0.94 |
| 10 | James (ML) Farm | 23 | 16.16 | 0.98 |
| 11 | Valley North | 14 | 5.65 | 0.98 |
| 12 | NFEFI Staff House | 10 | 3.91 | 1.00 |

Further patterns in community composition were elucidated using multivariate ordination (Figure 3.2) and clustering techniques (Figure 3.3). The low stress value of the NMDS (Figure 3.2) indicates a good spread of data with some clustering of the survey sites apparent. This is further illustrated by the cluster analysis (Figure 3.3).

The NMDS suggests that community composition differs most distinctly between the forested and non-forested sites. The cluster reinforces this observation, more clearly indicating the dissimilarity between forested and non-forested sites (Figure 3.2: blue circle - non-forest; red circle - forest-edge; green circle- forest), however, it also illustrates the high level of similarity in community composition between the 3 main forested sites (>75%). Interestingly the secondary forest site (Dam) is very similar to the old-growth forest sites (Mawa & Aeroplano). These analyses collectively suggest that the bird communities do vary with some significance both in species composition and relative abundance between the survey sites.

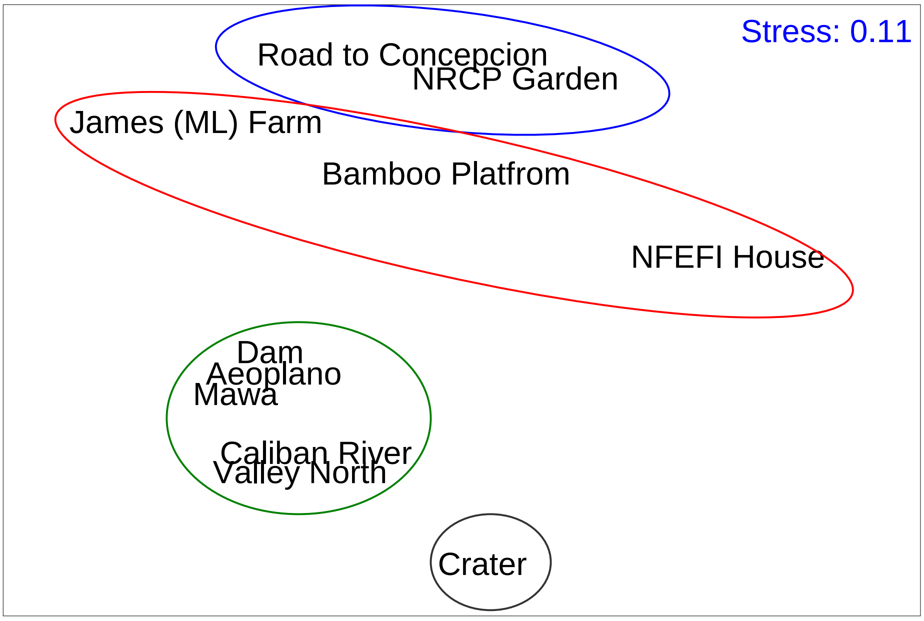


Figure 3.2. NMDS ordination of IRD values for each survey location. Blue circle - non-forest; red circle - forest-edge; green circle – forest; black circle – mossy forest.

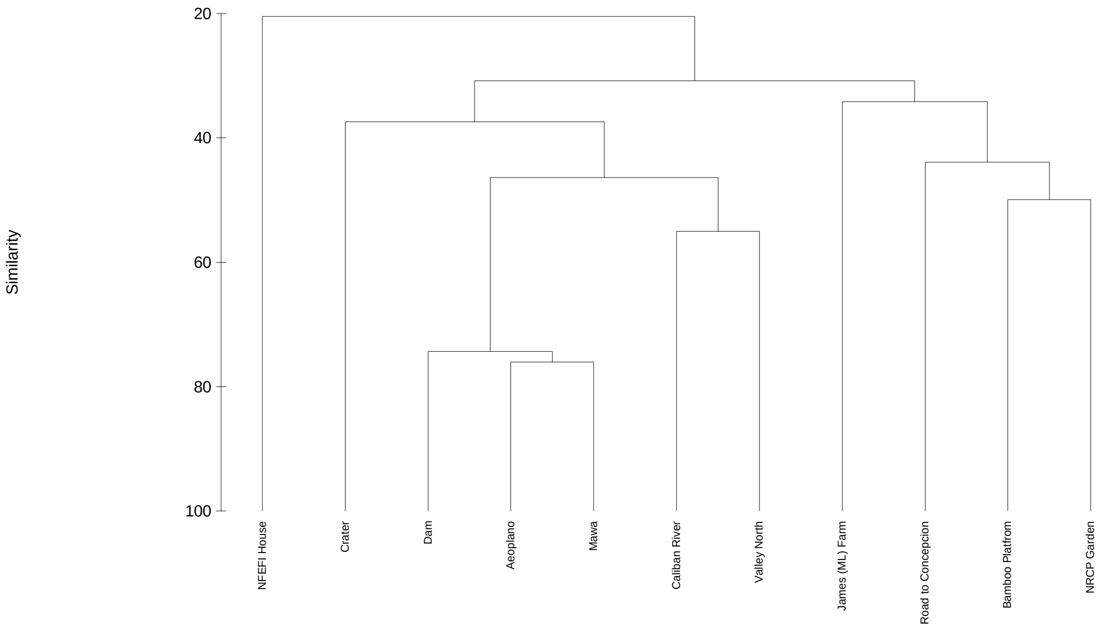


Figure 3.3. Dendrogram of bird community composition calculated using group-average linking of Bray-Curtis similarities and labelled according to survey location name.

## 3.3. Mist Netting

*3.3.1. Methods*

Standard mist netting techniques were employed (Bibby *et al.*, 1998) to survey the less conspicuous species that may not have been detected using the Mackinnon list method. Nets were established using bamboo poles and ropes tied vertically from tree branches. Mist nets (38mm mesh, Avinet, USA) were attached in different combinations (each 6m in length), at 6 locations within the study area (Table 3.1. & 3.5.). These locations were selected for their accessibility, areas of high bird activity and where species that could not be identified had been sighted.

Nets were opened between 0530 hours and 0630 hours and closed at approximately 1000 hours. Afternoon opening times were 1600 hours to 1830 hours. Occasionally nets were kept open throughout the day. These times were dependent upon weather conditions i.e. recording in heavy rain was avoided. Nets were checked between every 30 minutes to every 2 hours dependent upon previous bird activity. Net records were kept, recording species caught, time, date, location and basic morphology data, following the approach of Turner *et al*., (2002b).

*3.3.2. Results*

Due to the limited number of mist net surveys undertaken a brief summary of the species captured is presented (Table 3.5) with additional morphological data presented separately (Table 3.6). These surveys only contributed one additional species not recorded on the MacKinnon lists (White-browed shortwing *Brachypteryx Montana brunneiceps*). Capture rates were not high at any locations (Table 3.7).

Table 3.5. Numbers of birds caught in mist nets at different survey locations*.

| Species | Location | | | | | | Total |
|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | |
| Blue-headed fantail | 1 | - | - | - | 1 | - | 2 |
| Brown shrike | 5 | - | - | - | - | - | 5 |
| Glossy swiftlet | - | 2 | - | - | - | - | 2 |
| Mountain verditer flycatcher | - | - | - | - | 1 | 1 | 2 |
| Mountain white-eye | - | - | 1 | - | | 1 | 2 |
| Orange-bellied flowerpecker | - | - | - | - | 1 | - | 1 |
| Philippine bulbul | - | - | - | 1 | - | - | 1 |
| Philippine hawk-owl | - | - | - | - | - | 1 | 1 |
| Pied fantail | 1 | - | - | - | - | - | 1 |
| Snowy-browed flycatcher | | - | - | - | 1 | 1 | 2 |
| Spotted wood kingfisher | 1 | - | - | - | | - | 1 |
| Sunda ground thrush | | - | - | - | 1 | - | 1 |
| White-bellied munia | 1 | - | - | - | - | - | 1 |
| White-browed shortwing | | - | - | 1 | - | 1 | 2 |
| White-eared brown-dove | 1 | - | - | - | - | - | 1 |
| White-vented whistler | | - | - | 2 | - | - | 2 |
| Yellowish white-eye | 1 | - | - | - | - | - | 1 |
| Total | 11 | 2 | 1 | 4 | 5 | 5 | |

*1: Bamboo platform; 2: NRCP Garden; 3: Dam; 4: Aeroplano; 5: Mawa; 6: Crater;

Table 3.6. Average morphological data of species caught during mist netting surveys.

| | Count | Bill | Tarsus | Wing | Tail | Total length | Weight |
|---|---|---|---|---|---|---|---|
| Blue-headed fantail | 2 | 11.90 | 17.15 | 80.50 | 84.80 | 175.60 | 15.50 |
| Brown shrike | 5 | 16.56 | 27.28 | 88.20 | 87.38 | 210.60 | 29.20 |
| Glossy swiftlet | 2 | 4.35 | 8.70 | 93.90 | 32.75 | 84.10 | 5.50 |
| Mountain verditer flycatcher | 2 | 15.05 | 18.85 | 78.65 | 61.20 | 147.95 | 21.00 |
| Mountain white-eye | 2 | 13.00 | 17.00 | 59.00 | 32.00 | 69.00 | 13.00 |
| Orange-bellied flowerpecker | 1 | 11.30 | 10.50 | 51.00 | 22.40 | - | 7.50 |
| Philippine bulbul | 1 | 21.50 | 20.50 | 102.50 | 98.20 | 339.00 | - |
| Pied fantail | 1 | 11.50 | 15.10 | 75.20 | 99.60 | 175.00 | 16.00 |
| Snowy-browed flycatcher | 2 | 10.20 | 19.00 | 61.50 | 42.40 | 110.95 | 11.00 |
| Spotted wood kingfisher | 1 | 49.00 | 15.50 | 107.20 | 81.00 | 110.00 | 70.00 |
| Sunda ground thrush | 1 | 28.45 | 32.70 | 117.10 | 80.40 | 218.60 | 87.00 |
| White-bellied munia | 1 | 9.70 | 18.00 | 50.40 | 41.10 | 92.60 | 13.00 |
| White-browed shortwing | 2 | 13.10 | 31.60 | 55.35 | 45.00 | 137.85 | 20.00 |
| White-eared brown-dove | 1 | 16.00 | 24.60 | 115.70 | 85.70 | 225.00 | 85.00 |
| White-vented whistler | 2 | 13.55 | 24.35 | 86.05 | 69.20 | 161.65 | 25.50 |
| Yellowish white-eye | 1 | 10.30 | - | 53.00 | 39.10 | 94.20 | - |

Table 3.7. Birds captured per 100 net-effort units during mist-net survey (1 net-effort unit = 1 hour per square metre of net).

| Location code: | NRCP Garden | Dam | Aeroplano | Mawa | Crater | Caliban River |
|---|---|---|---|---|---|---|
| Blue-headed fantail | 0.14 | 0.07 | - | - | - | - |
| Brown shrike | 0.69 | - | - | - | - | - |
| Glossy swiftlet | - | - | - | - | - | 1.71 |
| Mountain verditer flycatcher | - | 0.07 | 0.07 | - | - | - |
| Mountain white-eye | - | - | 0.07 | - | 0.66 | - |
| Orange-bellied flowerpecker | - | 0.07 | - | - | - | - |
| Philippine bulbul | - | - | - | 0.11 | - | - |
| Philippine hawk-owl | - | - | 0.07 | - | - | - |
| Pied fantail | 0.14 | - | - | - | - | - |
| Snowy-browed flycatcher | - | 0.07 | 0.07 | - | - | - |
| Spotted wood kingfisher | 0.14 | - | - | - | - | - |
| Sunda ground thrush | - | 0.07 | - | - | - | - |
| White-bellied munia | 0.14 | - | - | - | - | - |
| White-browed shortwing | - | - | 0.07 | 0.11 | - | - |
| White-eared brown-dove | 0.14 | - | - | - | - | - |
| White-vented whistler | - | - | - | 0.23 | - | - |
| Yellowish white-eye | 0.14 | - | - | - | - | - |

### 3.4. Discussion

The data presented here is only preliminary but serves to illustrate that the NNFR supports a very diverse avifauna with over half the species recorded dependent on forest habitat, and many of which restricted range and threatened species. Over 20% of the Philippine avifaunal species have been located within the NNFR, and nearly half of all species previously documented on Negros Island. Perhaps more importantly, from a biodiversity conservation perspective, is the significant proportions of these species which are endemic to the Philippines, or further restricted within the Philippines.

To date the NRCP has located 137 bird species within the NNFR, which is greater than previous studies (Brooks *et al.*, 1992; Hamann & Curio 1999). Such a detailed avian inventory is clearly a function of surveyor effort, but it serves to illustrate the value of long-term studies when attempting to generate species inventories. The surveys also reinforce the ecological importance of the NNFR for both endemic and IUCN Red Listed species, consolidating earlier work (Brooks *et al.*, 1992; Hamann & Curio 1999; Turner *et al*., 2002c).

Bird species diversity is largely explained by habitat diversity, as illustrated by the multivariate analysis (Figures 3.2 & 3.3). The NNFR not only supports species solely dependent on forest such as the Pink-bellie imperial pigeon (*D. poliocephala*) and the Snowy-browed flycatcher (*Ficedula hyperythra*) but also species with less specific habitat requirements, such as the White-collared kingfisher (*H. chloris*) and the Barn swallow (*Hirundo rustica gutturalis*). The NNFR also appears to represent one of the few remaining refuges on Negros for many forest species that are limited in their ecological and/or altitudinal range and thus cannot be supported by the other habitat types remaining on Negros. The endangered Visayan flowerpecker (*D. haematostictum*) is generally restricted to forest below 750m (Collar *et al*., 1999) and observations generally support this, with no individuals recorded above 800m.

With regard to other threatened species, the only confirmed hornbill sighting was of the Visayan tarictic hornbill (*P. p. panini)*, seen on several occasions in all forest types, and an unconfirmed sighting of Walden's Hornbill (*A. waldeni)* in old-growth forest (Mawa). Both species have previously been recorded in the NNFR (Hamann & Curio 1999) but are restricted to the Western Visayas, (Stattersfield *et al*., 1998) and are dependent on tall forest below 1200m.

There is an acknowledged abundance of forage trees for both hornbill species within the NNFR (Hamann & Curio 1999) however tree size may limit their distribution due to nest hole requirements. Perhaps the greatest threat is the widely reported hunting (Hamann & Curio 1997, Collar *et al*. 1999). During the current survey the research team were aware of hunters in all forest types but there has been limited assessment of this threat. Despite this, the NNFR has recently been recognised as one of three 'key sites' for remnant populations of *A. waldeni* (Collar *et al*., 1999) and thus is globally important for this critically endangered species.

Also of interest are the species that were not recorded by this study but listed by Brooks *et al*. (1992) as forest-dependent. These include species common to lowland areas such as the Pompadour green-pigeon (*T. pompadora*) and the Nicobar pigeon (*C. nicobarica*) and species that may be altitudinally restricted, such as the White-throated jungle-flycatcher (*R. albigularis*) and the Lovely sunbird (*A. shelleyi*). Clearly many of the species are known to be uncommon or rare and some species such as the kingfishers and pittas may well have been missed since they are difficult to locate. More importantly, some of the restricted range species listed as endangered or critically endangered may be extinct. This is postulated since the Negros fruit-dove (*P. arcanus*) was last seen in 1953, the Ashy-breasted flycatcher (*M. randi*) in 1970, and the Celestial monarch (*H. coelestis*) in 1959 (Stattersfield *et al*. 1998, Paguntalan *et al.* 2001). It is also suggested that the Philippine cockatoo (*C. haematuropygia*) may also be extinct (Paguntalan *et al.* 2001).

It is suggested that areas such as the NNFR should be given legal protection under the National Integrated Protected Area System (NIPAS) (Collar *et al*. 1999). The current study reinforces this recommendation on two counts. Firstly, the inventory data clearly demonstrates the importance of the area for Philippine avifauna, and secondly, the results indicate that the study area within the NNFR supports similar species richness to that of Mount Canlaon, which was recommended for protective status by Brooks *et al.* (1992) and now forms part of the NIPAS.

The lack of historical data for the NNFR means it is difficult to comment on the status of particular species, and only limited insight into temporal changes in the diversity of the NNFR avifauna can be deduced. Additionally, it is also imperative that survey effort is increased in a spatial context (since only a limited habitat types have been assessed) and that data (diversity, abundance, distribution) is related to habitat (or forest) type if effective conservation management strategies are to be proposed and implemented at a local level.

# 4. Bats

## 4.1. Introduction

Bats (Chiropterans) often make up a large proportion of the mammalian diversity of forest habitats and this is particularly the case for the Philippines, which has one of the richest mammal faunas in the world. At least 180 mammal species have been recorded, of which 110 are endemic (Heaney 1993; Heaney *et al.*, 1997). The Chiropterans are the most diverse order of mammals in the Philippines with 25 Megachiropteran and 48 Microchiropteran species (Heaney & Regalado 1998) and approximately 40% of these are endemic (Heaney 1986). However, it is also recognised that the Philippines Megachiropteran fauna contains a high percentage of threatened taxa as a result of large-scale deforestation and hunting (Mickleburgh *et al.*, 1992). The status of the Microchiropteran fauna is still poorly known (Heaney 1993) despite the identification of many endemic species (Ingle & Heaney 1992).

Consequently, the Chiropterans are also recognised as probably the most poorly known mammalian order in the Philippines (Ingle & Heaney 1992). Forest habitats have been identified as particularly important for bats and a priority for conservation efforts on a global scale (Mickleburgh *et al.*, 2002), and the Philippines archipelago (and island groups there-in) represents an excellent, if depressing case. The loss of tropical forest and other associated anthropogenic threats (e.g. hunting) posed to endemic biodiversity have been well documented (Oliver & Heaney 1996; Heaney & Regalado 1998), however, this in combination with the high (endemic) species richness and a rate of species discovery which is amoungst the highest in the world (Heaney *et al.*, 1997) equates to an urgent need for conservation action.

Unfortunately an acknowledged Achilles heel is a lack of information (Oliver & Heaney 1996; Heaney & Regalado 1998; Turner *et al.*, 2002c). With regard to Chiropterans, whilst new species have recently been discovered, there are concerns that several species may now be threatened and possibly extinct (Ingle & Heaney 1992). Heaney and Heideman (1987) reported that it has not been possible to estimate the number of species of bats in the Philippines that are extinct or endangered because of a lack of basic surveying information, and they suggested that faunal surveys were needed in nearly all parts of the country. More specifically, Mickleburgh *et al*. (1992) stressed (as one of twenty priority global projects) the urgent need to survey the Negros Island area which was ranked eighth highest in the world for Megachiropteran diversity and was listed sixteenth globally for requiring the establishment of protected areas for world fruit bat conservation.

Negros Island is the most threatened of the Philippines' five faunal regions (Heaney & Regalado 1998). There are at least 42 species of bat thought to be present within this area of which, approximately 25% are known to be endemic to the Philippines (Heaney *et al.*, 1998). The major threats to bats already mentioned are echoed on Negros (Heaney & Regalado 1998). This has doubtlessly affected resident bat populations due to their requirement for forest habitat that provides both food and roosting sites. Additionally, the restricted areas of forested habitat are still susceptible to local hunting pressure.

Whilst habitat preservation would appear a priority (Turner *et al.*, 2002a) there is a general lack of information regarding the distribution, status, and ecology of many species in this area and thus detailed surveys of the bats of the NNFR or remaining forested areas are required in order to underpin future conservation action.

Research interest and knowledge of Chiropterans in the Philippines has been steadily increasing (see Heaney & Heideman 1987; Heideman & Heaney 1989; Heaney 1991; Ingle & Heaney 1992; Utzurrum 1992; Heaney 1993; Heaney *et al.*, 1998) but very little of this has given any focus to the Negros-Panay Faunal Region. That which has; has tended to be more generalist work on patterns of species richness (Heaney 1993), elevational zonation (Heaney *et al.*, 1989) and the role of fruits bats in seed dispersal in sub-montane rainforest (Hamann & Curio 1999). Little work has focused on diversity, distributions and status of species in relation to montane forest habitat types and there is a clear need to survey areas of remaining habitat that may still support significant bat populations, endemic or otherwise, and thus assess their conservation importance.

*4.1.1. Aims*

The principle aim of the research on this group was to complete an inventory of the megachiropteran species, and to assess their relative abundance and distribution between the different survey locations (habitat types).

## 4.2. Methods

*4.2.1. Mist Netting*

Mist-nets (38mm mesh, 6m x 2.6m) were used within 6 locations, representing both forested and non-forested habitats within the study area of the NNFR (Table 4.1 & 2.1)**.**

To maximise capture efficiency, nets were established across likely flight-paths such as clearings, along ridges, or by water (Heaney *et al.*, 1989), in a variety of combinations, such as ‘Z’ and ‘T’ formations (Kunz *et al.*, 1996), and at heights ranging from 1m to 10m above the ground. High nets were operated on a pulley system, and when possible were complemented by a low net positioned on the same pulley system (following Ingle 1993). Generally, nets were opened before dusk and closed anytime up to midnight, depending on weather and personnel.

Bats captured were identified using Ingle and Heaney (1992), sexed by observation of genitalia and nipples, and aged (to adult or juvenile) by assessment of the ossification of the joints of the digits of the wing. Forearm length was measured using dial callipers, and weight using spring balances. When new species were encountered, ear, hind-foot and total length were also recorded.

For each survey night, the location, weather conditions and time the nets were operational was noted. As nets were open for variable lengths of time, net-effort for each location was calculated as hours per square-metre of net.

## 4.3. Results

A total of twelve Chiropteran species were recorded across the survey locations, of which eight were Megachiropteran and four were Microchiropteran species (Table 4.1). Of the 361 bats captured during the general mist-net survey, only a small proportion (<5%) were Microchiropterans. The most diverse areas were the forested survey sites (Table 4.2) with all Microchiropteran species being located at these sites. Morphological data was recorded for each species (Tables 4.3-4.6).

Table 4.1. Summary of Megachiropteran and Microchiropteran species found during the surveys within NNFR.

| Sub-Order | Family | Species | Common name | NRCP Garden | Dam | Aeroplano | Mawa | Crater | James Farm |
|---|---|---|---|---|---|---|---|---|---|
| Megachiropteran | Pteropodidae | *Cynopterus brachyotis* | Common short-nosed fruit bat | 24 | 40 | 37 | 2 | 5 | 24 |
| Megachiropteran | Pteropodidae | *Haplonycteris fischeri* | Philippine pygmy fruit bat | - | 29 | 55 | 17 | 18 | - |
| Megachiropteran | Pteropodidae | *Haplonycteris whiteheadi* | Harpy fruit bat | - | - | - | - | 1 | - |
| Megachiropteran | Pteropodidae | *Macroglossus minimus* | Dagger-toothed flower bat | 31 | 25 | 4 | 2 | 1 | 7 |
| Megachiropteran | Pteropodidae | *Ptenochirus jagori* | Musky fruit bat | - | 3 | 6 | - | - | - |
| Megachiropteran | Pteropodidae | *Pteropus hypomelanus* | Common island flying fox | 1 | - | - | - | - | - |
| Megachiropteran | Pteropodidae | *Pteropus pumilus* | Little golden mantled flying fox | 1 | - | - | - | - | |
| gMegachiropteran | Pteropodidae | *Rousettus amplexicaudatus* | Common rousette | 1 | 3 | 3 | 6 | - | |
| Microchiropteran | Rhinolophidae | *Rhinolophus arcuatus* | Arcuate horseshoe bat | | 1 | 1 | | | |
| Microchiropteran | Rhinolophidae | *Rhinolophus virgo* | Yellow-faced horseshoe bat | - | 1 | 12 | - | - | |
| Microchiropteran | Vespertilionidae | *Myotis macrotarsus* | Philippine large-footed myotis | | - | 1 | - | - | 1 |
| Microchiropteran | Vespertilionidae | *Pipistrellus spp.* | Pipistrelle | - | 1 | - | - | - | |

Table 4.2. Bats captured per 100 net-effort units during mist-net survey (1 net-effort unit = 1 hour per square metre of net).

| Location code: | NRCP Garden | Dam | Aeroplano | Mawa | Crater | James Farm |
|---|---|---|---|---|---|---|
| Net-effort units: | 1418.6 | 10084.2 | 9115.9 | 4281.1 | 1314.5 | 1888.7 |
| *Cynopterus brachyotis* | 1.69 | 0.40 | 0.41 | 0.05 | 0.38 | 1.27 |
| *Haplonycteris fischeri* | - | 0.29 | 0.60 | 0.40 | 1.37 | - |
| *Haplonycteris whiteheadi* | - | - | - | - | 0.08 | - |
| *Macroglossus minimus* | 2.19 | 0.25 | 0.04 | 0.05 | 0.08 | 0.37 |
| *Ptenochirus jagori* | - | 0.01 | 0.07 | - | - | - |
| *Pteropus hypomelanus* | 0.07 | - | - | - | - | - |
| *Pteropus pumilus* | 0.07 | - | - | - | - | - |
| *Rousettus amplexicaudatus* | 0.07 | - | - | - | - | - |
| *Rhinolophus arcuatus* | - | 0.03 | 0.03 | 0.14 | - | - |
| *Rhinolophus virgo* | - | 0.01 | 0.13 | - | - | - |
| *Myotis macrotarsus* | - | - | - | - | - | - |
| *Pipistrellus spp.* | - | 0.01 | - | - | - | - |
| Total | 4.09 | 1 | 1.28 | 0.64 | 1.91 | 1.64 |

Table 4.3. Megachiropteran adult morphological data.

| Species | | Adult Female | | | | | | Adult Male | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Mass (g) | Body length (mm) | Forearm (mm) | Hind foot (mm) | Tail (mm) | Ear (mm) | Mass (g) | Body Length (mm) | Forearm (mm) | Hind foot (mm) | Tail (mm) | Ear (mm) |
| *Cynopterus brachyotis* | range | 18-50 | 65.5-104.7 | 50-68.5 | 9.8-15.6 | 2.2-9 | 8.8-19.2 | 17-45 | 78.4-103.9 | 50.1-68.8 | 8.5-16.2 | 1.5-7.4 | 8.1-24 |
| | mean (sd) | 34.98 (5.25) | 91.84 (7.88) | 64.23 (3.65) | 12.58 (1.38) | 5.46 (1.9) | 13.717 (2.38) | 33.93 (6.13) | 88.66 | 62.45 (3.3) | 12.48 (1.61) | 5.15 (1.89) | 13.83 (2.89) |
| | n | 38 | 29 | 39 | 29 | 23 | 30 | 47 | 37 | 50 | 46 | 23 | 46 |
| *Haplonycteris fischeri* | range | 11-125 | 54.7 -84.5 | 43.5-82.5 | 7-14 | | 6.3-13 | 17-125 | 6.9-13.4 | 61.2 -78.1 | 31 -52.1 | | 7.9-12.9 |
| | mean (sd) | 23.01 | 72.25 (5.46) | 49.95 (5.33) | 9.98 (1.58) | - | 10.17 (1.62) | 23.61 (18.3) | 69.50 (3.51) | 48.64 (3.48) | 10.34 (1.57) | - | 10.18 (1.25) |
| | n | 48 | 45 | 49 | 49 | | 49 | 33 | 33 | 33 | 33 | | 33 |
| *Macroglossus minimus* | range | 16 -24 | 55.2- 73.6 | 41.5 -48 | 8.2- 14 | | 9- 14.6 | 17.5- 34 | 65.2 -85.4 | 42-64.6 | 11.1 -14.7 | 0-6.5 | 9.1-14.6 |
| | mean (sd) | 19.27 (2.12) | 66.79 (4.95) | 44.18 (1.44) | 11.15 (`1.63) | - | 12.56 (1.91) | 21.7 (3.55) | 70.87 (6.42) | 46.3 (4.62) | 11.28 (1.32) | 2.167 (3.75) | 12.88 (1.52) |
| | n | 22 | 12 | 22 | 15 | | 15 | 20 | 13 | 20 | 14 | 3 | 14 |
| *Ptenochirus* | range | 90-107 | 117.5-150.7 | 84.1-93 | 17.4-17.8 | 6.1-9.1 | 12.5-18.2 | 80-93 | 109.5-135.4 | 82-89.3 | 15.2-19.9 | 3.7-12.3 | 16.5-17.6 |
| *Jagori* | mean (sd) | 98.5 (12.02) | 134.1 (23.48) | 88.55 (6.29) | 17.6 (0.28) | 7.6 (2.12) | 15.35 (4.03) | 88.92 (6.53) | 122.08 (8.74) | 86.40 (2.87) | 18.38 (2.07) | 8.93 (3.51) | 17.02 (0.38) |
| | n | 2 | 2 | 2 | 2 | 2 | 2 | 6 | 6 | 6 | 6 | 6 | 6 |

Table 4.4. Microchiropteran adult morphological data.

| Species | | Adult Female | | | | | | Adult Male | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Mass (g) | Body length (mm) | Forearm (mm) | Hindfoot (mm) | Tail (mm) | Ear (mm) | Mass (g) | Body Length (mm) | Forearm (mm) | Hindfoot (mm) | Tail (mm) | Ear (mm) |
| *Hipposideros* | range | | | | | | | | | | | | |
| *Ater* | mean (sd) | - | - | - | - | - | - | 6 | 40.9 | 40.9 | 7 | 29.7 | 15.5 |
| | n | | | | | | | 1 | 1 | 1 | 1 | 1 | 1 |
| *Rhinolophus* | range | 6-13 | 49.2-51.8 | 45.1-50 | 6.3-9.3 | 13-23 | 15-17 | 8-15 | 46.9-50 | 47-50.4 | 6.8-17.8 | 3.7-24.6 | 9.9-21.5 |
| *Arcuatus* | mean (sd) | 10.5 (3.11) | 50.33 (1.33) | 47.73 (2.01) | 7.83 (1.23) | 18.48 (4.14) | 16.13 (0.94) | 11.19 (2.53) | 50.34 (2.42) | 49.05 (1.49) | 10.08 (3.4) | 17.48 (6.73) | 16.85 (4.17) |
| | n | 4 | 3 | 4 | 4 | 4 | 4 | 8 | 6 | 8 | 8 | 8 | 8 |
| *Rhinolophus* | range | 6-18 | 33.9-52.8 | 37.8-41.3 | 4.4-8 | 9-29.9 | 9-16.8 | 6-14 | 30.5-63 | 37.2-40.5 | 6-7.2 | 16-21 | 10-16.4 |
| *Virgo* | mean (sd) | 12.88 | 42.63 (6.55) | 39.83 (1.25) | 6.63 (1.09) | 17.16 (4.18) | 12.45 (2.79) | 8.71 (3.04) | 42.09 (9.73) | 38.9 (1.09) | 6.63 (0.41) | 19 (2.16) | 14.81 (1.95) |
| | n | 8 | 6 | 8 | 8 | 8 | 8 | 7 | 8 | 9 | 9 | 9 | 9 |
| *Pipistrellus* | range | | | | | | | | | | | | |
| *spp.* | mean (sd) | - | - | - | - | - | - | 4 | 49.5 | 32.5 | 6.3 | 30.9 | 12.1 |
| | n | | | | | | | 1 | 1 | 1 | 1 | 1 | 1 |

Table 4.5. Megachiropteran juvenile morphological data.

| Species | | Juvenile Female | | | | | | Juvenile Male | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Mass (g) | Body length (mm) | Forearm (mm) | Hind foot (mm) | Tail (mm) | Ear (mm) | Mass (g) | Body Length (mm) | Forearm (mm) | Hind foot (mm) | Tail (mm) | Ear (mm) |
| *Cynopterus* | range | 25-42 | 80.2-93.6 | 58-64.5 | 12-12.6 | 4.2-6 | 11.8-16.4 | 9-38 | 71.6 -96.1 | 54.3-66.6 | 8.4-14.8 | 2-7.9 | 10-16.5 |
| *Brachyotis* | mean (sd) | 30.94 (5.71) | 87.55 (5.98) | 62.39 (2.16) | 12.3 (0.3) | 5.1 (1.27) | 13.83 (2.03) | 28.55 (4.89) | 86.64 (6.10) | 62.17 (2.99) | 12.23 (1.37) | 4.23 (2.02) | 13.99 (1.65) |
| | n | 8 | 4 | 8 | 3 | 2 | 4 | 31 | 26 | 34 | 29 | 25 | 29 |
| *Haplonycteris* | range | 19.17 (1.6) | 66.56 (5.91) | 48.25 (1.32) | 10.85 (1.39) | | 10.98 (0.96) | 11-22 | 63.8-75.8 | 46.1 -52.7 | 7.8- 11.4 | | 8.8 -13 |
| *Fischeri* | mean (sd) | 17-21 | 60-73.1 | 46.9-50 | 9-12.6 | - | 10-12.2 | 18.29 (3) | 68.94 (3.59) | 49.38 (1.81) | 9.95 (0.93) | - | 11.17 (1.27) |
| | n | 6 | 5 | 6 | 6 | | 5 | 24 | 24 | 24 | 24 | | 24 |
| *Macroglossus* | range | 7-20 | 59.4-68.4 | 40- 44.2 | 10-12.2 | | 12-15.2 | 11-20 | 54.6-75.6 | 36.9-88 | 9.9-13 | 0-4.6 | 11.5-14.4 |
| *Minimus* | mean (sd) | 15 (4.17) | 67.14 (5.89) | 42.83 (1.66) | 11.18 (0.85) | - | 13.43 (1.51) | 15.09 (3.08) | 65.2 (8.10) | 45.76 (11.54) | 10.91 (0.95) | 2.3 (3.25) | 13.03 (1) |
| | n | 8 | 5 | 9 | 6 | | 6 | 16 | 7 | 16 | 8 | 2 | 8 |
| *Ptenochirus jagori* | range | | | | | | | | | | | | |
| | mean (sd) | 69 | 125.5 | 82.5 | 19 | 8 | 20.6 | 77 | 114.7 | 86.4 | 16.9 | 9.9 | 17.6 |
| | n | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| *Pteropus* | range | | | | | | | 115-160 | 131.8-170 | 91-109 | 30.9-33.5 | 0 | 14.5-25.5 |
| *Pumilus* | mean (sd) | - | - | - | - | - | - | 137.5 (31.82) | 150.9 (27.01) | 100 (12.73) | 32.2 (1.84) | 0 | 20 (7.78) |
| | n | | | | | | | 2 | 2 | 2 | 2 | 2 | 2 |

Table 4.6. Microchiropteran juvenile morphological data.

| Species | | Juvenile Female | | | | | | Juvenile Male | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Mass (g) | Body length (mm) | Forearm (mm) | Hind foot (mm) | Tail (mm) | Ear (mm) | Mass (g) | Body Length (mm) | Forearm (mm) | Hind foot (mm) | Tail (mm) | Ear (mm) |
| *Rhinolophus* | range | | | | | | | 4-6 | 38.8- 44.8 | 37.6-39.9 | 4.1-7.5 | 18-21 | 14.5-16.5 |
| *virgo* | mean (sd) | 5 | | 42.2 | 6.6 | 18.1 | 15.1 | 5.67 (1.35) | 42.37 (3.39) | 38.93 (1.19) | 6.13 (1.8) | 19.43 (1.5) | 15.5 (1) |
| | n | 1 | 0 | 1 | 1 | 1 | 1 | 3 | 3 | 3 | 3 | 3 | 3 |
| *Myotis* | range | | | | | | | | | | | | |
| *macrotarsus* | mean (sd) | - | - | - | - | - | - | 25 | 67 | 46.3 | 8.5 | - | 46.3 |
| | n | | | | | | | 1 | 1 | 1 | 1 | | 1 |

### 4.4. Discussion

Twelve of the 73 species known to exist in the Philippines (Heaney *et al.*, 1998) have been recorded, representing over 15% of the Philippine bat fauna. However, this only represents 29% of the 41 species known to occur on Negros (Heaney *et al.*, 1998). The comparatively low numbers of species encountered may be explained by the limited numbered of areas (habitat types) surveyed and the survey techniques employed.

The majority of the recordings consist of fruit bats, in particular, the Common short-nosed fruit bat (*Cynopterus brachyotis),* Dagger-toothed flower bat *(Macroglossus minimus)* and Philippine pygmy fruit bat (*Haplonycteris fischeri).* The prevalence of megachiropterans is probably a facet of the survey method employed, since microchiropterans are known to be able to detect and avoid mist-nets and thus tunnel trap methodologies are recommended for sampling this group (Sedlock 2001). The capture of the Philippine pygmy fruit bat (*Haplonycteris fischeri)* is potentially very important since this species has declined in recent years and is listed as vulnerable (Heaney *et al.*, 1998). It is also known to prefer primary forest and rarely found in secondary forest, as confirmed by the results presented.

With regard to other species that were encountered, they included both threatened and endemic species. The Little golden-mantled flying fox *(Pteropus pumilus)* is rare and endemic to the Philippines and well known to frequent islands where it is usually associated with primary and well-developed secondary forest (Heaney *et al.*, 1989) and uncommon to rare on larger islands (Heideman & Heaney 1989; Utzurrum 1992). Catch data suggests that densities are quite low although it has been hypothesized that this species forages high in the canopy and therefore it may be more abundant than current catch data suggests (Mickleburgh *et al,* 1992). The presence of this species within the reserve is very encouraging as it is considered globally vulnerable by the IUCN and is fourth on the conservation priority list for Philippine fruit bats (Mickleburgh *et al.*, 1992).

Another species captured in low numbers was the Common island flying fox (*Pteropus hypomelanus)* which is also endemic to the Philippines. However, the species is known to fly high above normal netting reach and thus it may be more abundant than the catch-rates suggest. Of the microchiropterans, the Pallid Large-footed myotis (*Myotis macrotarsus)* is an uncommon species that is dependant upon caves to roost in (Heaney *et al.*, 1998) and is currently listed as near-threatened (Mickleburgh *et al.*, 1992).

One species not recorded in this study, is the Philippine tube-nosed fruit bat *(Nyctimene rabori).* This bat species is classified as IUCN critically endangered, being rare or uncommon in all known sites, and facing extinction on Negros (Heaney *et al.*, 1998). It has previously been recorded in the NNFR (Turner *et al.*, 2002a; Turner 2002) but not during this survey period.

The overall results demonstrate that even within the restricted geographic area surveyed by the NRCP, the habitats of the NNFR support a comparatively diverse and important bat fauna both on local and national scales. Further surveys over a greater number of habitat types (e.g. riparian forest; mossy forest) which is planned for 2003-04 (Turner & Raines 2003) using a greater range of methods will doubtlessly record yet more species and records of the Philippine tube-nosed fruit bat would even make it a globally important site.

# 5. Reptiles &Amphibians

## 5.1. Introduction

The spectacular and diverse array of Philippine amphibians and reptiles (herpetiles) is extremely rich in species number, taxonomic diversity and percentage endemism. Of the 101 identified species of amphibians and 258 species of reptiles more than 77% and 65% respectively are believed to be Philippine endemics. In addition to this there are numerous undescribed species, which when identified, are estimated to increase species numbers by 10-20% (Brown *et al.,* 2001a).

Edward Harrison Taylor conducted the first comprehensive review of Philippine herpetiles in 1915 (Taylor 1915), however it has been the last decade that has seen the most dramatic increase in knowledge of this group. The rapid progress of recent research work means that much of the current literature, available species summaries and diagnostic keys are out of date. Current research on Philippine herpetofauna has concentrated on classification and recognition of the country's diversity, including, species descriptions, re-descriptions and classifications of species boundaries.

Few specimens of the montane herpetile species have been collected and limited information is available. Recent work over the last 3 years has increased species knowledge and resulted in new species identifications (Alcala & Brown 1998) however little work has been focussed on spatially specific accounts such as habitat dependencies, estimations of population size or distribution (see Brown 2001a for review).

Herpetiles are especially vulnerable to habitat change due to their permeable skins, dual life mode and limited dispersal capabilities (Hampson 2001). Within rainforest ecosystems exist important microhabitats. Herpetiles are often found near rocks and debris, and in overhanging vegetation within streamside locations. Trees are also favourable environments, with reptiles and amphibians commonly found on trunks, in branches, under bark and in the canopies. Epiphytes such as aerial ferns, pandans, moss mats and orchids are also regular haunts of such organisms.

The herpetile populations of the NNFR are virtually unknown and may have been seriously imperilled due to the massive loss of forest habitat. Direct impacts on the populations have included over-hunting and extensive exploitation for food and trade (Brown *et al.,* 2001a). Indirect impacts such as subsistence farming and subsequent habitat modification have also shaped and reduced herpetile species numbers. The Negros cave frog (*Platymantis speleaus*) is an island endemic and is classified by IUCN as Rare. Habitat loss and degradation is thought to be the main cause of their decline, however few specimens have been discovered and consequently there is a huge void in the information available on this species as is true of many Philippine herpetiles.

Biological pollution from exotic introduced species also poses a serious threat to herpetile communities. A number of Asian and American species have established breeding populations and rapidly spread. Middle American cane toads (*Bufo Marinius*) and Taiwanese bullfrogs (*Hoplobatrachus rugubus*) are two such species who through rapid generation times, voracious dietary habits and invasive abilities are seriously destabilising the syntopic populations of the Philippine herpetofaunal endemics (Brown *et al.,* 2001a).

Various specific studies have been completed on Negros Island, much of which was completed during the middle to the end of the last century. Two recent studies were conducted on the south of the island in Negros Oriental (Dolino 2002 & Tiempo *et al.*, 2001) however very little has been published on the herpetofauna of the NNFR. There consequently continues to be numerous undescribed amphibians and reptiles and huge gaps in the knowledge surrounding many aspects of basic population, behavioural, and reproductive biology (Brown *et al.*, 2001a). Studies spatially detailing species abundance and distribution will identify the conservation status of valuable species, which will benefit both the herpetile populations and the local communities. There is a great need for the collection of basic population and demographic data to enable informed, effective, and biologically sound management plans and recommendations to be made for the herpetiles of the NNFR.

*5.1.1. Aims*

The principle aim of the surveys was to quantify the diversity of species within the Dam, Aeroplano and Mawa survey sites and thus complete some of the first herpetological research in this area.

## 5.2. Methods

*5.2.1. Quadrat Visual Encounter Survey (QVES)*

The quadrat method has been shown to be one of the most effective herpetofaunal sampling techniques (Jaeger & Inger 1994). Four observers intensively search a quadrat, which measured 20m by 20m. Each observer begins at one of the four corners of each quadrat and moves at the same velocity in a clockwise direction. This synchronised movement should prevent most of the individual reptiles and amphibians from exiting the quadrat before capture. The four observers should consist of a mix of staff and volunteers. Each quadrat should be searched for 15 minutes ensuring that all microhabitats are investigated on the forest floor and above (without the need for tree climbing).

Each individual encountered was captured by hand (gloved), identified, measured to the nearest 0.1mm with callipers, weighed on a Pesola spring scale to the nearest 0.25g, marked, and immediately released at the point of capture. Substrate and height at which individuals were encountered was also recorded. Where identification could not be determined, dorsal and ventral photographs were taken.

Herpetile surveys were only started two-thirds of the way through the survey period and the initial lack of taxonomic support has hampered progress. Consequently, only summary results are presented, detailing species encountered, or known to be present.

## 5.3. Results

The reptile and amphibian species known to be present within the study areas are presented in Tables 5.1 and 5.2. These species were encountered across a combination of the survey sites. Whilst they do not accurately represent the diversity of species encountered, since many individuals caught or sighted have yet to be identified to species level (due to lack of taxonomic support), they do represent confirmed species identifications.

Table 5.1. Reptiles located within the Upper Imbang-Caliban watershed.

| Taxon | Recorded | Ecological status+ |
|---|---|---|
| **Lizards** | | |
| Family Agamide | | |
| *Draco spilopterus* (Common flying lizard) | *S | Common |
| | | |
| Family Gekkonidae | | |
| *Cosymbotus platyurus* (Flat-bodied house gecko) | *S | Common |
| *Hemidactylus frenatus* (Common House gecko) | *S | Common |
| | | |
| **Snakes** | | |
| Family Pythonidae | | |
| *Python reticlatus* (Reticulated python) | R | Common |

*captured; S: sighted; R: reported by locals. +Derived from Tiempo *et al*., (2001).

Table 5.2. Amphibians located within the Upper Imbang-Caliban watershed.

| Taxon | Recorded | Ecological status+ |
|---|---|---|
| Family Ranidae | | |
| *Occidosyga laevis* (Common puddle frog) | *S | Common |
| *Rana erythraea* (Green pond frog) | *S | Common |
| *Rana magna* (Giant Philippine frog) | *S | Common |
| *Platymantis dorsalis* (Common forest ground frog) | *S | Endemic, common |
| | | |
| Family Rhacophoridae | | |
| *Polypedates leucomystax* (Common tree frog) | *S | Common |

*captured; S: sighted. +Derived from Tiempo *et al*., (2001).

## 5.4. Discussion

It is impossible to draw any firm conclusions from the results with such a limited data set, however, the initial surveys demonstrate there is a clear need to conduct more rigorous diversity, distrbution and abundance surveys using QVES and similar transect based methods in order to complete a detailed inventory of the amphibian and reptile species present within the watershed area. This would perhaps follow the approach of Brown *et al.* (2001b).

Despite the limited empirical data, the time spent completing surveys (with species sighted but not identified) revealed that the herptofauna is more diverse than that represented in the results.

The NRCP workplan for 2003 (Turner & Raines 2003) will aim to continue the survey work on a more rigorous basis and within a greater number of habitat types within the study area. This will hopefully give a more accurate assessement of the herpetile communities present.

# 6. Invertebrates

## 6.1. Introduction

Invertebrates, particularly insects dominate terrestrial ecosystems and constitute the majority of all described species. Short generation times produce rapid population responses to a wide range of biotic and abiotic environments making them vitally important for ecological study (Lewis *et al*, 1998). This group consequently also has the ability to illuminate patterns and processes of biological diversity, which may be of benefit to conservation (DeVries *et al.*, 1999).

Within the Insecta class, Lepidopterans, in particular butterflies often serve as a good ‘flagship’ species for biodiversity inventories (Lawton *et al.*, 1998). Rainforest butterflies are highly stenotopic, habitat specific and often endemic (Spitzer *et al.*, 1996). They are closely linked to the diversity and health of their habitats either through the dependence of the larval stages on host plants or via the role of the adults as pollinators. They also respond rapidly to forest disturbance, and thus can be useful indicators of the effects of tropical forest disturbance (Hill & Hamer 1998; Kremen 1992). Butterflies are a suitable group for ecological studies; they are relatively large, conspicuous in comparison to other invertebrates, mostly diurnal, their taxonomy is relatively well known, and there are some data on their geographic distributions and for some species on their life history (Hill *et al.*, 1992; Beccaloni & Gaston 1995; Spitzer *et al.*, 1993). Consequently, as a result of the close links between butterfly diversity and health of their habitats, butterflies have been suggested as potential bioindicators of ecological change in tropical regions (Gilbert 1984; Spitzer *et al.*, 1997; Blau 1980; Ghazoul 1997).

Indeed, the biodiversity of butterflies is linked to their ecosystem by influencing nutrient cycling, plant population dynamics, and predator-prey population dynamics (Hammond & Miller 1998). Butterflies are also very sensitive to changes in temperature, humidity, and light levels, parameters often affected by habitat disturbance (Wood & Gillman 1998). Furthermore the response of butterfly communities to temperature, humidity and light levels is of one of the most rapid and conspicuous (Wood & Gillman 1998), again making butterflies useful indicators species.

Little research has been published on Philippine butterflies except for a national inventory (Baltazar 1991) which does not contain descriptions or photographs, only taxonomic data and geographic distributions. Many species and sub species are continuing to be discovered and identified, and their geographic distributions changed. As butterflies of many areas of the Philippines have not been studied, the inventory is far from complete and new species and sub-species continue to be discovered, and distributions changed. CCC have consequently been undertaking a pioneering inventory of the butterflies in the NNFR as part of the NRCP for the past two years (Turner *et al.*, 2001). This represents the only published and widely available research on Lepidopterans in the NNFR. A species inventory has been developed illustrating that tropical butterfly assemblages of the NNFR are particularly diverse and abundant (Turner *et al.*, 2002), preliminary assessment of species distributions between habitats have been made (Slade 2001), and field keys have been developed (Cummings *et al.*, 2002).

It is important that this work continues since montane ecosystems can be viewed as 'habitat islands' effectively isolated by lowlands, and thus distinct and limited in size. They are also distinct due to specific climatic conditions. Spitzer *et al.* (1993) suggest that these factors may result in the evolution of efficient specialists that are able to establish abundant populations, but not disperse over a large area. A decrease in the area of such ecosystems could thus lead to an irreversible loss of biodiversity.

*6.1.1 Aims*

The principle aim of the research was to initially characterise the distribution and diversity of the butterfly fauna within three major forest habitat types within the project watershed area.

## 6.2. Methods

Distribution and diversity assessments were undertaken using a combination of live trapping and observation based survey techniques within the PSPs (as detailed in Table 2.1).

*6.2.1. Feeding Traps*

Within each PSP 10 feeding traps were baited with over-ripe banana and hung from vegetation with the base of the trap at least 1m above ground level. Traps were spaced every 50m with 10 traps set at any survey location. Traps were set for a period of 48hrs, and checked every 12hrs.

On checking the traps, individuals were identified to species level where possible, or voucher specimens taken for new species (see below). All relevant data was recorded i.e. location, habitat type, duration of surveys, method of survey, and specimen details.

*6.2.2. Transect Walks*

The transect walk method with non-random point counts was used to investigate butterfly spatial distribution, diversity and abundance at the different survey sites. The use of such transects also meant that a wide variety of habitats and microclimates (streams, canopy gaps, different aspects, etc.) were surveyed (Hill 1999).

Two straight-line transects within the PSPs were used to prevent observers from straying from the transect. Observation stations were marked every 60m (9 stations in total) for the point counts. Butterflies were surveyed along the transects using methods similar to those described for butterflies in temperate regions by Pollard (1977), and used in previous studies of tropical forest butterflies (Hamer *et al.*, 1997; Hill 1997; Hill *et al.*, 1995; Spitzer *et al.*, 1993, Slade 2001), thus, allowing this study to be compared with diversity studies from other areas.

To ensure a constant duration of observation for each transect walk, a constant speed of 3 minutes per 50m was maintained. During the walk butterflies were observed within an imaginary box around the observer (5m each side, 5m ahead and 5m above). Similarly, at each observation station binoculars were used to record butterflies observed during a 10 minute period within a 10m radius, and at all heights from the ground, in an attempt to include higher flying butterflies. These distances are similar to those used in other tropical butterfly studies (Spitzer *et al.*, 1993; Hill *et al.*, 1995; Hamer *et al.*, 1997). Thus, any differences in butterfly diversity between sites was not due to differences in visibility, because recording is restricted to within 10m of the stations and within 5m of transects (Hamer *et al.*, 1997).

Butterflies that could not be identified to species or genus on the wing were, where possible, caught, and released immediately after identification. During such pauses the timer was stopped. However, if netting was not possible because the butterfly was, for example, flying too high or too fast, it was omitted from the study.

Peak butterfly density was noted to occur around the middle of the day (Hill *et al.*, 1995; Pollard, 1977; Pollard 1988; Walpole 1999). Transect counts were therefore only conducted between 1000hrs and 1500hrs, and only when the weather was good (i.e. sunny, and no rain), as temperature/irradiance differences are known to affect butterfly flight (Pollard & Yates, 1993; Willott *et al.*, 2000). The direction the transects were walked was alternated for each transect to minimise any differences due to time of day, and in an attempt to ensure equivalent conditions.

Each transect was walked four times during each 4 day survey period. Walpole & Sheldon (1999) noted low densities of butterflies beneath the canopy, and concluded that to obtain a sizeable sample, repeated counts were needed along the transect. Hamer *et al.*, (1997) note that although the degree of movement by individuals should not alter the probability of encountering a species, in the absence of sufficient sampling the higher variance for non-sedentary species can lead to possible errors in estimates of relative abundance.

*6.2.3. Identification of Butterfly Species*

The production of a species inventory in advance of transect sampling was essential to familiarise volunteers with the species likely to be encountered during sampling (Hamer *et al.*, 1997; Walpole & Sheldon 1999). A reference collection was been built up by the NRCP. Any butterflies not already in the collection were caught, pinned, photographed, and given a type specimen code. All butterflies were collected under a Wildlife Gratuitous Permit, issued to NFEFI by the Department of the Environment and Natural Resources. Butterflies were caught using English kite nets and killed by pinching the thorax, as killing agents such as ammonia, caused discoloration of the scales and damaged the wings whilst in the killing jar (Slade 2001). Pinning and preservation followed Dickson (1992). A type specimen of both a male and female of each species was caught, pinned and photographed where possible.

Taxonomic identification was based on Cummings and Slade (2002). Identification was also conducted using descriptions given by D'Abrera (1982, 1985, 1990) and Tsukada (1981, 1982*a*, 1982*b*, 1985, 1991). Sub-species were identified using Baltazar (1991).

*6.2.3. Analysis*

Since species counts were only resumed part-way through the survey period, in addition to a general species inventory (Table 6.1), species distributions have been analysed on a presence/absence basis. Data were reduced by ordination using a correlation-based principal components analysis (PCA) in PRIMER (rather than covariance-based PCA). Correlation-based PCA ensures all axes have comparable scales and thus differing scales of measurement will not influence the resultant ordination (Carr 1996).

### 6.3. Results

The NRCP have collected and identified 46 butterfly species and sub-species from 7 families (Table 6.1) and nearly 80% of the species identified are endemic to the Philippines. It is also apparent that a number of the species have restricted geographic distributions within the Philippines (Table 6.1).

There were also differences in butterfly richness between the different survey sites as illustrated by the ordination of species presence (Figure 6.1; Table 6.2).

Table 6.1. Summary accounts of the butterfly species located at the survey sites.

| Family | Species | Distribution |
|---|---|---|
| **Satyridae** | *Mycalesis georgi canlaon* | Philippines |
| | *Mycalesis ita teatus* | Philippines |
| | *Mycalesis perseus caesonia* | Asia |
| | *Melanitis leda leda* | Asia |
| | *Melanitis boisduvalia boisduvalia* | Philippines |
| | *Melanitis atrax cajetana* | Philippines |
| | *Lethe chandica byzaccus* | Asia |
| | *Ptychandra leucogyne* | Philippines |
| | *Ypthima stellera stellera* | Philippines |
| | *Acrophtalmia yamashitai* | Visayans |
| | *Zethera musides* | Visayans |
| | *Elymnias sausoni* | Cebu, Negros |
| | *Ragadia luzonia negrosensis* | Philippines |
| | *Faunis phaon carfinia* | Philippines |
| | *Amathusia phidippus pollicaris* | Asia |
| | *Discophora ogina pulchra* | Philippines |
| **Pieridae** | *Eurema hecabe hecabe* | China & Philippines |
| | *Catopsilia pomona pomona* | Asia |
| | *Appias phoebe montana* | Philippines |
| | *Cepora boisduvalia novum* | Philippines |
| | *Delias henningia henningia* | Philippines & Borneo |
| | *Delias hyparete panayensis* | Asia |
| **Papilionidae** | *Papilio rumanzovia* | Philippines (exc. Palawan) |
| | *Papilio hystapes* | Philippines (exc. Palawan) |
| | *Troides rhadamantus* | Philippines (exc. Palawan) |
| | *Atrophaneura semperi baglantis* | Philippines |
| | *Graphium eurypylus gordion* | SE Asia |
| | *Graphium sarpedon sarpedon* | Asia |
| **Nymphalidae** | *Lexias satrapes amlana* | Philippines |
| | *Tanaecia howarthii* | Negros |
| | *Charaxes amycus negrosensis* | Philippines |
| | *Cyrestis maenalis negros* | SE Asia |
| | *Rhinopalpa polynice panayana* | SE Asia |
| | *Junonia almana almana* | Asia |
| | *Junonia hedonia ida* | SE Asia |
| | *Limenitis jumaloni jumaloni* | Negros & Sibuyan |
| | *Hypolimnas anomala anomala* | SE Asia |
| | *Hypolimnas bolina philippensis* | Australia, SE Asia |
| **Danaidae** | *Euploea mulciber kochi* | SE Asia |
| | *Ideopsis gaura canlaonii* | SE Asia |
| | *Parantica luzonensis luzonensis* | SE Asia |
| | *Parantica vitrina oenone* | Philippines |
| **Lycaenidae** | *Lampides boeticus* | Asia & Africa |
| | *Zizina otis oriens* | Asia |
| | *Jamides alecto manilana* | Asia |
| **Hesperidae** | *Odontoptilum spp* | Asia |

Clasification and distribution based on: D'Abrera (1982); D'Abrera (1985); D'Abrera (1990); Tsukada & Nishiyama (1982); Tsukada (1981); Tsukada (1982); Tsukada (1985); Tsukada & Azumino (1991); and Slade (2001).

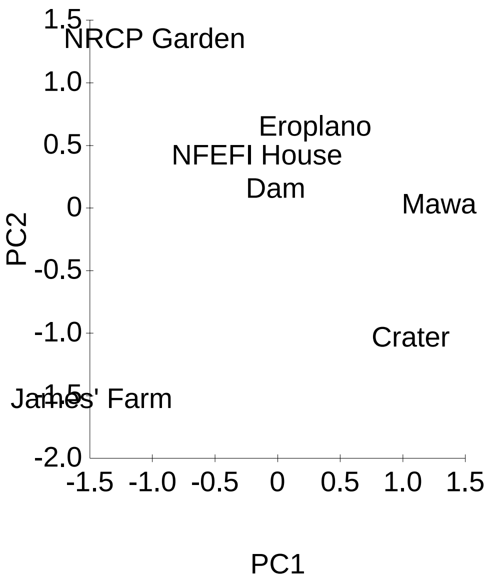


Figure 6.1. Correlation-based PCA (by sample site, log-transformed) of the butterfly data.

The PCA demonstrates clear separation between the different survey sites indicating a different faunal composition at each. The Dam, Eroplano and the NFEFI House sites were most similar to each other, and with regard to the main forest sites, the Dam and Eroplano were more similar each other than to Mawa.

Sample scores along the first two axes of the PCA on log-transformed species data, for each season and the cumulative percentage variation explained by the first five axes for each season is given in Table 6.2. Over half the variation in the data set is explained by the first two axes.

Table 6.2. Eigenvalues of the correlation-based PCA of the butterfly data.

| PC | Eigenvalues | %Variation | Cum.%Variation |
|---|---|---|---|
| 1 | 1.01 | 26.3 | 26.3 |
| 2 | 0.97 | 25.4 | 51.7 |
| 3 | 0.73 | 18.9 | 70.6 |
| 4 | 0.60 | 15.6 | 86.2 |
| 5 | 0.27 | 7.1 | 93.4 |

## 6.4. Discussion

The non-quantitative dataset demonstrates that the watershed supports a high diversity of species, and community composition varies with habitat type (survey location). This supports the earlier work of Slade (2001). Importantly, from a biodiversity conservation perspective, significant proportions of these species are endemic to the Philippines or more restricted geographic ranges within the Philippines. Thus, this area of the NNFR appears to represent one of the few remaining refuges on Negros for many forest species that are limited in their ecological range and thus cannot be supported by the other habitat types remaining on Negros.

# 7. Non Volant Mammals

## 7.1. Introduction

A most spectacular radiation of non-volant mammals is seen in the Philippines with a diverse and species rich fauna consisting of more than 100 native and 5 introduced species. Unfortunately the Philippines is also widely recognised as having the most extensively endangered mammalian fauna of the world (Heaney 2001).

An index of faunal endangerment developed by Heaney (1993), calculated through the ranking of the degree of threat to specific species identified the Greater Negros–Panay faunal region as the most critical region with 8 native species threatened to a significant degree. Negros Island harbours 54 mammalian species within 6 families. Non-volant species represent 5 of the families consisting of Insectivora, Primates, Rodentia, Carniviora and Artiodactyla (Table 7.1). Negros is an oceanic island that is geologically young and therefore it's mammalian fauna is not very diverse relative to other areas of the Philippines (Heaney 2001) and thus these 5 families only include 13 species consisting of 18% of the total Philippine non-volant faunal species. Many of these species are mainly forest dependent and due to the islands geological history are consequently both unique and highly endangered. However, the threat posed by many non-native species known to be present has yet to be quantified.

Table 7.1. Non -volant mammal fauna of Negros Island.

| Order | Family | Species | Status | Distribution |
|---|---|---|---|---|
| Insectivora | Soricidae | *Crocidura negrina* | Rare+ | Negros endemic |
| | Soricidae | *Suncus murinus* | Common* | Non native |
| Primate | Cercopithecidae | *Macaca fascicularis* | Common* | Native |
| Rodentia | Muridae | *Apomys* sp. A | Threatened* | Negros-Panay endemic |
| | Muridae | *Mus musculus* | Common* | Non-native |
| | Muridae | *Rattus argentiventer* | Common* | Non-native |
| | Muridae | *Rattus exulans* | Common* | Non-native |
| | Muridae | *Rattus tanezumi* | Common * | Non-native |
| Carnivora | Felidae | *Prionailurus bengalensis* | Vulnerable+ | Native |
| | Viverridae | *Paradoxurus hermaphroditus* | Common* | Native |
| | Viverridae | *Viverra tangalunga* | Common* | Native |
| Artiodactyla | Suidae | *Sus cebifrons* | Endangered+ | Negros-Panay endemic |
| | Cervidae | *Cervus alfredi* | Endangered+ | Philippine endemic |

* Heaney 1998 + WCSP 1997.

Within the NNFR traces of the extremely rare Visayan warty pig (*Sus cebifrons*) and the Philippine spotted deer (*Cervus alfredi*), the most endangered deer in the world, have been discovered. Long tailed macaques (*Macaca fascicularis*), the only primate found on the island, are common however as with many species of frugivore, populations are becoming severely bottlenecked. The rare and endemic Negros shrew (*Crocidura negrina)* is heavily restricted due to habitat destruction but due to lack of survey work its presence and distribution in the NNFR is unknown (Turner *et al*., 2002a).

Little data has been published on the habitat selection, relative abundance, or life histories of the small mammals. The number of threatened species is proportional to the degree of deforestation of the region and most species require primary forest for survival (Heaney 1993). The remarkable depauperate level of information available on these species in conjunction with the pressures on their habitat and populations, presents an extreme threat to the mammalian species of the Negros-Panay faunal region.

*7.1.1. Aims*

The principle aim of the research on this group was to complete an inventory of the non-volant species present within the study watershed, and to assess their relative abundance and distribution between the different survey locations (habitat types).

## 7.2. Methods

Small mammals were trapped using Sherman live traps (2x2.5x6.5”), and medium-sized mammals trapped using cage traps. Traps were set up in ‘trap lines’ following the approaches of Heideman *et al.* (1987) and Heaney *et al.* (1989). Traps were stationed in lines of 10 Sherman and 3 cages along 60m transects with at least 5m spacing between each trap. Three trap lines were established (with at least 10m separation between lines) at each survey site (Table 2.1). It was ensured that the traps were wholly within the habitat type being surveyed. Each trap location was marked with a small piece of ribbon/raffia (or similar) tied to a branch above (1m) the trap.

Traps were placed on the ground under suitable cover and alongside natural objects such as fallen trees, logs or branches or under low shrubs. Each trap was baited with peanut butter and oat mix (or similar) and dry bedding material (dry grass, cotton wool, shredded paper etc) was also placed in the nest box. Traps were covered with foliage inorder to minimise rain penetration and reduce risk of hypothermia in capture animals. Traps were set for a minimum of 3 mornings and 3 nights, being left open during the intervening periods. Traps were checked at least twice a day, re-baited as needed, and damp bedding replaced. All trap lines were established in areas where no other surveys are being undertaken to minimise disturbance and enhance capture probability.

On checking a closed or triggered trap, the contents were emptied into a clear plastic bag. Identification to species level using locally developed keys (Maunder & Turner 2003), age and sex were determined where possible. Biometric measurements and additional notes including site, date, trap location, and comments on breeding condition, health, or recapture were also taken before release. For medium sized species (e.g. civets) biometrics were not taken due to risk to field personnel, individuals were identified and then released.

*7.2.1. Analysis*

Since species counts were only resumed part-way through the survey period, in addition to a general species inventory (Table 7.2), species distributions have been analysed on a presence/absence basis. Data were summarised by ordination using a correlation-based principal components analysis (PCA) in PRIMER (rather than covariance-based PCA). Correlation-based PCA ensures all axes have comparable scales and thus differing scales of measurement will not influence the resultant ordination (Carr 1996).

## 7.3. Results

The preliminary inventory of mammals (Table 7.2) already indicates that the study watershed area is a key site for the endangered mammal fauna of the Philippines, yet this is far from the definitive inventory. The Visayan Spotted Deer and Visayan Warty Pig; two of the most endangered animals in the world are known to be present in the area. Whilst the latter have been sighted, the former have been heard and their presence reported by locals.

The observation and live trapping work has also located Long-tailed macaques (*Macaca fascicularis*) close to the NRCP research centre and within the Dam survey sites between December and July. Two sites have been identified as being particularly important: Baldusa Falls and Hiyang-Hiyang. Common palm civets (*Paradoxurus hermaphroditus*), Malay civets (*Viverra tangalunga*) and an array of small mammals (Table 7.2) are also known to be active in all areas surveyed, however, the small mammal fauna is dominated by non-native species such as the Asian house shrew (*Suncus murinus*), the Oriental house rat (*Rattus tanezumi*), and the Polynesian rat (*Rattus exulans*).

Table 7.2. Preliminary inventory of non-volant mammal species located within the NNFR.

| Family/Species | Recorded | Status | Geographical distribution | Endemic species |
|---|---|---|---|---|
| Cervidae | | | | |
| Visayan Spotted Deer (*Cervus alfredi*) | R | Endangered | Negros-Panay | yes |
| Suidae | | | | |
| Visayan Warty Pig (*Sus cebifrons*) | S, R | Endangered | Negros-Panay | yes |
| Soricidae | | | | |
| *Asian house shrew (*Suncus murinus*) | C | Common | Asia | no |
| Muridae | | | | |
| *Oriental house rat (*Rattus tanezumi*) | C | Common | Asia -Pacific | no |
| *Polynesian rat (*Rattus exulans*) | C | Common | Asia -Pacific | no |
| *House mouse (*Mus musculus*) | C | Common | Global | no |
| Cercopithecidae | | | | |
| Long-tailed macaque (*Macaca fascicularis*) | S | Common | Southeast Asia | no |
| Viverridae | | | | |
| *Common palm civet (*Paradoxurus hermaphroditus*) | C | Common | Asia | no |
| *Malay civet (*Viverra tangalunga*) | C | Common | Southeast Asia | no |

Status from WCSP (1997); Geographical distribution from Heaney *et al* (1998).
C: captured; S: sighted; R: reported by locals.

PCA ordination on presence/absence data for all species recorded (Table 7.2) revealed no significant separation of survey sites (except the Crater) since most species have been record at all sites surveyed. The crater was separated since no Soricidae or Cercopithecidae species have been located at this site. The only other species contributing significant variation between sites is *Cervus alfredi* which has only be heard or reported to be present at the Crater, Aeroplano and Mawa. Cross comparison with non-volant mammals expected to be present in the study area (Table 7.1) reveals that only *Crocidura negrina, Prionailurus bengalensis,* and *Rattus argentiventer* have not thus far been located within the study area.

## 7.4. Discussion

The area of the NNFR studied supports a high proportion of the Negros non-volant mammal fauna. However, more in depth and spatial explicit studies are needed to assess relative distributions, abundances, and the possible presence of *Crocidura negrina, Prionailurus bengalensis,* and *Rattus argentiventer*.

# 8. Awareness & Education

## 8.1. Scholarships

NFEFI and CCC have been running a scholarship at the NRCP since early 2002. The aim of the scholarship scheme is to enhance local capacity in order to ensure a longer-term sustainability for the NRCP and associated initiatives. In order to encourage maximum participation by host-country nationals, Filipino citizens wishing to participate are heavily subsidized through fees paid by non-Filipino participating volunteers.

To date, the NRCP has supported, on average 1-2 Negrenese scholars each month for the past 12 months. These scholars have either been trainees with NFEFI, volunteers with other local NGOs or students at Negros State College of Agriculture. Each scholar attended the CCC Skills Development Progamme and spent a minimum of one week in the field completing biodiversity surveys. This programme will continue and expand during 2003.

Figure 8.1. An NRCP Scholarship student aetting up a butterfly feeding trap within the forest edge of the NNFR.

## 8.2. Community Training and Information Exchange

Throughout 2002, the NRCP has continued to involve community members from Sitio Campuestohan in all aspects of the conservation work undertaken. This participatory approach has encompassed formalised training of mountain guides, attendance of the CCC Skills Development Progamme, forest walks and assisting CCC staff with field surveys.


Figure 8.2. An ‘Open Day’ at the NRCP.

### 8.3. Forest Camps/Seminars

The NRCP has hosted a series of one day and weekend ‘forest camps’ for local students in order that they can ‘experience’ the NNFR first hand and contribute to the work of the NRCP under the guidance of the NRCP staff and volunteers.

Figure 8.2. Local students learning how to Mist Net under the guidance of the NRCP Project Scientist.

## 8.4. Schools Education

The NRCP in conjunction with NFEFI recently began (early 2003) a programme of talks at local schools within the project watershed area, explaining the work of CCC, NFEFI and the NRCP. It is intended that these will continue throughout 2003.

# 9. Discussion & Conclusions

## 9.1. Biodiversity Status of the Imbang-Caliban Watershed

Hamann (2002) stated that the NNFR is a biodiversity hotspot at risk. Whilst this current report makes no detailed assessment of the threats to the NNFR, it does confirm that the Upper Imbang-Caliban watershed area of the NNFR is indeed a biodiversity hotspot. The findings presented further support the growing body of literature (Appendix 1) that collectively underlines the biological importance of the NNFR.

This perhaps best highlighted by the range of faunal and floral groups studied by the NRCP. For example, the butterfly species data indicates that approximately 84% of the species caught were endemic to the Philippines and over 35% were endemic to the Visayan region. These results are similar to those of Slade (2001) and based on the data collected by these studies, the NNFR may be one of the most important sites in the Philippines for butterfly conservation. The Philippines has already been identified as a 'critical' area for butterfly conservation, Baltazar (1991) found that 44% of the butterflies occurring in the Philippines were endemic.

The biodiversity importance of the NNFR is further supported by the results of the bird survey work that reinforces the findings of earlier studies (Brooks *et al.*, 1992; Dickinson *et al.*, 1991; Turner *et al.,* 2002a). These collectively stress the importance of the NNFR as a vital tract of montane forest habitat on which many avian species depend. Birdlife International identified the NNFR as part of an Endemic Bird Area [EBA] and in terms of biodiversity conservation it has been classified as ‘priority critical’ (Stattersfield *et al.*, 1996). The continuing outputs of the NRCP surveys (presented in this report) reinforce this status with respect to the number of overall species, number of endemic species and numbers of endangered species, including species such as the Tarictic hornbill (*Penelopides panini panini*) and the Flame templed babbler (*Stachyris speciosa*), recorded with in the survey areas of the NRCP.

The findings of the other vertebrate survey work of the NRCP also serve to underline the biological importance of this area of the NNFR. Over 75% of the Negros non-volant mammal fauna and almost 30% of the volant mammal fauna has been located within the watershed area. These include a number of Visayan endemic and endangered species such as the Philippine warty pig (*Sus cebifrons*). *S. cebifrons* has been extirpated from over 95% of its former range in the Visayan region, and it is already extinct or close to extinction on four of the six islands on which it occurs. This area may therefore represent one of the last remaining habitat strongholds for this species.

The relative composition and distribution of many of the faunal communities clearly relates to vegetation/habitat. This is perhaps best illustrated by the bird results. With reference to the forest habitats surveyed, it is apparent that they are more diverse than the area of the NNFR (near Sitio Patag) studied by Hamann *et al*. (1999). The inventory work completed across all PSPs illustrates a diverse array of at least 120 morpho-types present within the study areas. The PSPs in the current study are also comparable to other areas of Southeast Asia where the number of species per hectare is typically between 100 and 150 (Whitmore 1995). The PSP sites are also at higher elevation (by 2-500m) than the area studied by Hamann *et al*. (1999), and as diversity generally declines with altitude (Pipoly & Madulid 1998) these results suggests that the vegetation of this area is particularly diverse.

In addition to the relative high species diversity, there was also a high prevalence of important ecological and economic species at certain sites, such as Dipterocarpacaeae species (e.g. *Hopea philippinensis* and *Shorea contorta*) at the Dam PSPs. This stresses not only the potential conservation value of the area but also the ability for natural ecological recovery. Additionally, the possible identification of pioneer species, which will only transpire once the scientific inventory has been completed, could ultimately aid the forest restoration initiatives of NFEFI for the Upper Imbang-Caliban watershed (Turner *et al.,* 2001).

The important results of this study should be put into geographical and ecological context. Only a small area of the NNFR is encompassed by the NRCP and in relation to the forested habitat only two of the three major habitat types identified by Hamann (2002) have been surveyed. Many other habitat types (e.g. Mossy forest; Riparian forest; Forest edge etc) were not extensively assessed. Therefore, it is probable that the findings still significantly under-represent the biodiversity of the faunal and floral groups studied.

Whilst the current study did not explicitly evaluate threats, general observations indicate that many threats still exist. Hunting is still prevalent and has been widely reported in the NNFR (Hamann & Curio 1997, Collar *et al*. 1999). Interviews with local community members during the current study suggest that actual timber extraction is now minimal by virtue of economic species having already been removed from accessible areas. However, there is still evidence of non-timber resource extraction of species such as rattan and bamboo. One of the greatest threats is probably posed by localised clearance of the lower forest (below 1000m) by *Kaingin* (slash and burn agriculture). This occurs in the ecological zone where many of the threatened and endemic species (and sub-species) are at the limits of their known ecological and altitudinal range. In addition there is also increasing ‘tourist trekking traffic’ along certain trails within the watershed area. The impact of these activities should ideally be assessed and minimised, and such steps have already been proposed by the NRCP (see Appendix 2).

The NRCP aims to catalyse the conservation of the NNFR which will ultimately only be achieved through the implementation of a number of tools. Firstly, the empirical results may aid the petition process for designation of the NNFR as a protected area but this only forms one part of an integrated approach. A second key element is environmental awareness work that is required to underpin effective conservation strategies (Oliver & Heaney 1996, WCSP 1997, Paresce 2000), and this is being addressed by the NRCP at a local scale.

Thirdly, there is perhaps an obvious need to develop conservation strategies that also reconcile the needs of local communities. Therefore, strategies should embrace all relevant stakeholders and thus permit an integrative conservation process. The NRCP already engages stakeholders at the most local level within Sitio Campuestohan but such engagement should expand to other communities.

The ultimate goal of the NRCP is to produce integrated community-driven management plans for the conservation, restoration and sustainable use of biodiversity in the region. The results of the baseline survey work completed thus far and the ongoing education work will hopefully contribute vital information to the development of these management recommendations but clearly more information is required to underpin the sustainable management of this area of the NNFR (Turner *et al*., 2001).

Therefore, in conjunction with developing applied strategies it is also imperative that biodiversity survey effort is increased and that data (diversity, abundance, distribution) is related to habitat (or forest) type if effective conservation management strategies are to be proposed and implemented. The NRCP must also strive to combine its data and information with other data sources from NGOs and LGUs. This will ultimately permit the development of effective conservation decision support tools (e.g. GIS) but in order to achieve this goal, this report makes a number of recommendations.

## 9.2. Recommendations

In light of the findings presented in this report, the NRCP makes the following recommendations in order for the aims of the NRCP to be fully achieved.

1. The biodiversity survey work of the NRCP should continue, expanding its spatial extent and habitat coverage. This should strive to encompass all representative forested and non-forested habitat types of the upper watershed within the NNFR boundary.

2. The NRCP should seek to develop a collaborate partnership through NFEFI/CCC with the Provincial Environment Management Office (Bacolod City) in order to utilise recently available satellite habitat mapping data (and other digital datasets) in order to develop an environmental GIS for the watershed area.

3. The NRCP should seek and support (in-kind) further research collaborations both nationally and internationally.

4. The ongoing environmental education and awareness work of the NRCP should be continued and expanded in its geographic scope within the project watershed.

5. A stakeholder anaylsis to assess local stakeholder needs and values of the forested environment within the project area should be completed by an appropriate local agency (e.g. NFEFI).

6. The outputs of the NRCP should be disseminated by NFEFI to relevant government sectors (e.g. PEMO, DENR) and NGOs (e.g. Haribon, FPE).

7. Funding should be sort to enable the NRCP to enhance local capacity to complete further biodiversity surveys within other areas of the NNFR via participatory biodiversity monitoring and evaluations schemes which will engage local stakeholders (communities, LGUs etc).

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# 11. Appendix 1

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# 12. Appendix 2

**Ecotourism and the NNFR: Recommendations for a structured implementation**
*(Adapted from original text by James Sawyer and Alexia Tamblyn)*

## 12.1. Introduction

Ecotourism creates an enhanced environmental awareness and concern for the environment and thus encourages participants to protect the environment. It is a form of tourism that is usually wildlife based and careful of the environment so that it ultimately benefits nature conservation, and has therefore been proposed as one mechanism for achieving conservation goals, particularly in tropical forests. The true route of ecotourism comes from environmental education, protection and enhancement; these must all be sustainable in the long term.

## 12.2. The North Negros Forest Reserve

Some areas of the NNFR have achieved success in maintaining, protecting and enhancing the forest for the enjoyment of all. There does exist areas of outstanding beauty which are slowly being degraded by mountaineers and day trippers alike. The threats to such areas can be seen as the following:

- Overpopulation of campsite areas
- Poor trail walking
- No guiding
- Lack of adherence to minimum impact camping
- Poor personal sanitation and waste disposal
- High risk of accidents due to un-preparedness and drunkenness

A good example of all of these was the activities of Holy Week in 2002. The crater site within the Imbang-Caliban watershed saw the visitation of over 150 individuals of assorted mountaineering ability. At the same time Baldusa falls saw a lesser number of people. Many individuals were drunk, had they injured themselves they would have precipitated a complicated and protracted rescue from difficult terrain. This would have put unfair, undue and dangerous pressure on agencies and individuals working in these areas (Namely NFEFI, NRCP and the villagers of Campuestohan) who would have been expected to respond.

The crater site was visited a week later for science survey work by NRCP and the site that met them appalled all present. Rubbish littered the site and sanitation was unacceptable. Bearing in mind the crater is the fringe of the range of critically endangered animals such as the Visayan Warty Pig and Visayan Spotted Deer this behavior is unforgivable by the individuals involved. The problems clearly were caused by poor stewardship, lack of policing of environmental factors and a massive overpopulation of one single site.

## 12.3. Ecotourism and the NNFR

Currently NFEFI ask that all visitors who enter the NNFR via the Imbang – Caliban watershed pay to hire a guide for all the reasons detailed above. In 2002 not one group has hired a local guide. This arguably due to machismo on the part of mountaineering groups and a lack of information and policing at the entry point to the watershed.

It is for the aforementioned reasons that a structure for those visiting the NNFR is required to prevent damage to a globally important area. Misguided tourism is as bad as illegal logging and hunting and potentially more destructive. Aside from more specific details, the plan should encompass the following main aims:

- Effective policing of rules
- Revenue generation for all involved
- Enhancement of the NNFR
- Good quality guiding
- Education
- Protection of all of the reserve

### 12.4. Specific Considerations For The Creation Of A Structured Ecotourism Plan

*12.4.1. Minimum Impact Concepts*

- Good quality, sustainable ecotourism means low numbers and higher per capita contributions. While this may exclude some groups, the pricing system could be tiered and could include higher rates for foreign visitors.
- Each site and the reserve in general will have a carrying capacity. This capacity needs to be carefully decided and policed. For example the crater site can only environmentally accommodate three trekking groups due to the lack of suitable sanitation areas. Each area must be considered individually with should scientific input.
- The concept of 'leave nothing but footprints, take nothing but photos', guides are needed to prevent the degradation of trails, sites and the taking of items from the forest.
- Guides need to be trained in all aspects of minimum impact trekking and be empowered to police this approach.

*12.4.2. Monitoring*

- All popular entrance points to the NNFR should be controlled by a type of toll booth to collect revenues and allocate official guides.
- Revenues must be properly accounted and receipts issued
- Those refusing a guide should be refused entry
- Those with poor records of behavior should be reused entry (a monthly list of those reported by guides should be circulated to all booths
- Recording of relevant ID should ensure better policing
- Skill level of mountaineer should not allow for refusals of guides. Guides should be compulsory
- Authority needs to be given to guides and ecotourism workers to prevent entry

*12.4.3. Revenue*

- It is important that local people are trained and employed as guides as this helps to protect the forest.
- At least one guide per five individuals is acceptable.
- Guides obviously need to be paid a wage for their work
- Revenue should be put aside for future enhancement projects
- Revenue should be used to enhance entry points with relevant facilities

*12.4.5. Alternative Incomes*

- Additional projects could be offered at entry points for a charge. An example would be an encouragement to pay to plant a tree in a reforestation area.
- An education and presentation center detailing the following.
    1. Forest animals
    2. Philippine natural history and treasures
    3. Local crafts for sale
    4. T Shirts and tourist material
    5. Organic products for sale
    6. Sensitive camping grounds at entry
    7. First aid post and rescue equipment store
    8. Rubbish collection point
    9. Cable Car rides

*12.4.6. Training*

Guide training is clearly essential to the whole process. Attached is a recommended schedule of guide training.

**12.5. Environmental Education**

- This can be done in part by guides in the forest of the clients so require.
- Regular weekend lectures at specified times should be held at entry points in relevant languages
- Workshops and forest camps for young people of differing ages
- Reforestation schemes including school visits
- Sponsorship initiatives- Volunteers at NRCP/NFEFI, nest boxes
- Newsletters on achievements
- Mountaineering courses for those wishing to begin mountaineering
- Forest survival courses

Trails – Baldosa, Caliban, Crater, Imbang, nursery bird hide, educational trails – medicinal plants, forest products, jungle survival, birding trails

**12.6. Routes and Sites**

It is important to note that other areas could be made available in the future depending on initial success.

*12.6.1. Crater Site*

This site should only hold three groups at any one time regardless of demand due to sanitation requirements and sensitivity of its location to important wildlife. Certain areas of the trail need to be improved.

*12.6.2. Baldusa Falls*

Handlines and handrails are requires to make this trail safe. The site can sustain many day trippers.

*12.6.3. Imbang River and Falls*

A smaller site than Baldusa but less taxing physically. Would support a smaller number of visitors.

*12.6.4. Nursery Bird Hide*
A simple walk and one that could include bird talks

*12.6.5. Other suggested walks available*
Educational Walks
Bird and Nature trails of varying length and difficulty
Medicinal plants

**12.7. Concluding Remarks**
The NNFR has the potential to provide good quality ecotourism and protect the NNFR whilst providing incomes for impoverished upland people. A solid well policed and sensible plan would not only work and provide revenue for all but would also set a great example to other municipalities, islands and countries. It goes without saying that such an achievement would provide excellent financial and political capitol.

As the NNFR already receives many visitors, a poorly implemented policy would lead to further degradation of the forest and impoverishment of those attempting to protect such a resource. The NNFR is truly a global treasure and thus needs to be treated accordingly. Respect, maturity and education will ensure good stewardship for future generations.

**12.8. Recommended training programme for ecotourism guiding in the NNFR**

The training of guides for work in the NNFR for ecotourism purposes should essentially offer value for money on all counts. Experience has proven that ecotourism only works where guiding is of a high informative nature and clients feel safe whilst not impacting upon the environment to visit.

The training modules below relate to the most important aspects of operating in such an environment.

MODULE 1
CONSERVATION AND ECOLOGY
- Importance of global conservation and how the guides fit into this
- Concepts of endangered status and endemism
- Basic rainforest ecology
- Deforestation- Causes and consequences

MODULE 2
FOREST ECOLOGY AND WATERSHEDS
- Why is the NNFR important, threats
- The global status of the NNFR and tropical rainforests
- NNFR developments- NFEFI activities, NRCP etc.
- Biogeography of the Philippines
- Animals of the forest- Common, Latin, local names and ID
- Plants of the forest- Common, Latin, local names and ID

MODULE 3
FIRST AID

- Basic first aid concepts
- Basic physiology (Pulse/RR/BP/AVPU/Skin coloration)
- A to E assessments
- CPR and resuscitation
- Splinting
- Bleeding and general wound care
- Bites
- Burns
- Eyes and ears
- Blisters
- Sprains
- Bandaging and dressings
- Dehydration and exhaustion
- Heat and cold
- Allergies
- Neck injuries
- Practice exercises

MODULE 4
ADVANCED FIRST AID AND RESCUE

- Search techniques and procedures
- Initiating and organizing help
- Casualty maintenance
- Evacuations
- Packaging of casualties
- Considerations of the group
- Radio procedure and mobile phone use
- Procedures for tropical storms
- Practice exercises

MODULE 5
MOUNTAIN SKILLS

- Ropework
- General group management
- Group management in dangerous environments
- Navigation

MODULE 6
CAMPING SKILLS
**To be taught alongside the concept of minimum impact**

- Stoves
- Campsite selection
- Tents
- Water
- Rubbish

- Cooking
- Cleaning
- Sanitation
- Hygiene
- Trail maintenance

Each module should have both a theory and practical assessment where applicable to ensure that information is understood and will be used.
Guides should be assessed annually so as to maintain a level of quality consistent with the initial aims of the training.
Shortfalls should lead to retraining of relevant issues.
Handouts should be produced in Illongo as well as English.