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NEGROS RAINFOREST CONSERVATION PROJECT: PAST, PRESENT & FUTURE

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ABSTRACT

The Negros Rainforest Conservation Project (NRCP) is a joint program of collaborative research, education, and training between the Negros Forests and Ecological Foundation, Inc. (NFEFI) and Coral Cay Conservation (CCC). The project is situated in the North Negros Forest Reserve (NNFR), Negros Occidental, the Philippines. The primary scientific objectives of the project are to collect biodiversity inventory data and to conduct complementary ecological research on species involved in the NFEFI species recovery program to aid in-situ conservation initiatives. The project utilizes trained volunteers to collect baseline biodiversity data in order to increase the understanding of the ecological dynamics and community composition of the different forest types within a restricted area of the NNFR.

This paper presents an overview of the work of the NRCP and reports on the preliminary inventory and census data compiled by the project. These results do not only begin to confirm that the NNFR is an important biodiversity hotspot with a huge diversity of endemic and endangered species, but also underline the data gathering capacity of the NRCP. These initial empirical results and integrated approach of the NRCP are utilized to outline how this information could quantitatively underpin the conservation objectives of NFEFI, and contribute to the development of an integrated, community-driven conservation and sustainable management of the biodiversity of the NNFR.

The Forests of Negros

The Philippines has one of the highest rates of tropical forest loss, declining from 70% to 18% cover in the last 100 years (ESSC 1999, DENR/UNEP 1997). On Negros Island under 5% of the original forest cover remains intact (Heaney

& Regalado 1998). Such whole scale loss means that approximately 60% of endemic Philippine flora is now extinct (Roque *et al*, 2000). As a result, the moist forests of the Philippines are now classified as the eighth most vulnerable forest ecoregion in the world (WWF 2001). Such rapid loss of tropical forest habitat has serious implications for the terrestrial biodiversity of the Philippines. Over 57% of species in the major faunal groups occur nowhere else in the world (Oliver & Heaney 1996) and many of these have restricted ranges within the Philippines. The remaining forested habitat is of critical importance to all groups, but particularly the birds, with over 80% of threatened Philippine bird species dependent on the remaining tropical moist forests (Collar *et al*, 1999). With much of the remaining tropical forest cover restricted to small montane areas, it is now apparent that even low levels of deforestation can seriously threaten montane faunas of restricted distribution (Brooks *et al*, 1999). The area covered by the Negros Rainforest Conservation Project is the largest remaining area of wet evergreen rain forest on Negros (Hamann *et al*, 1999), and the second largest in the West Visayan Faunal region that including Negros, Panay, Guimaras, and Masbate. It also falls into the IUCN category of the highest conservation priority (Dinerstein 1995).

The NNFR represents one of these montane areas. It is considered to be of importance to the survival of many critically endangered endemic and restricted range species found only within the Negros-Panay Faunal region, the most threatened of the Philippines' five faunal regions (Heaney & Regalado 1998). These endemic species include threatened birds such as the critically endangered Walden's Hornbill (*Aceros waldeni*) and the endangered Visayan Tarictic Hornbill (*Penelopides panini*). The mammal fauna includes the endangered Philippine spotted deer (*Cervus alfredi*) and the critically endangered Philippine warty pig (*Sus cebifrons*)

(WCSP 1997). Both species have been extirpated from 95% of their former range (Cox 1987), having once been common throughout the West Visayas. *C. alfredi* is considered to be extinct on the islands of Cebu, Guimaras, and Masbate (Oliver *et al*, 1992). As their status and distribution on Negros is uncertain, census information is urgently needed for effective conservation and management.

Current Knowledge and Needs

In addition to harboring immense biological diversity, these montane forests are also a source of vital ecosystem goods and services. For example, they are a potential source of many non-timber forest products (NTFPs) such as rattan and bamboo (DENR/UNEP 1997). They protect vital watersheds (Penafiel 1994), providing a clean and controlled supply of water to the provincial capital of Bacolod and other areas. These benefits are beginning to be recognized at international, national, and local scales (Heaney 1993; Heaney & Regalado 1998; WWF 2001).

The best strategy for effective conservation, whether by inclusion in the National Integrated Protected Area System (NIPAS), or via stakeholder management, or a combination, is still unclear. But what is recognized is that the adoption of any or all of these approaches will require spatially referenced ecological data in order to guide effective conservation management of diverse forest habitats (Alder & Synnott 1992; DENR/UNEP 1997). However, one of the greatest problems has been the paucity of accurate and current information on the wildlife and forests of the Philippines (Heaney & Regalado 1998) that can provide a baseline inventory to underpin future conservation strategies.

It can be argued that such information exists in one form or another since the fauna and flora of Negros Island are well studied in comparison to other areas of the Philippines (Angel Alcala pers. comm). Unfortunately this is only for particular groups such as mammals (Heaney *et al*, 1989; Heideman *et al*, 1987), herpetiles (Brown & Alcala 1986), and avians (Brooks *et al*, 1992), with such work being completed with differing levels of inclusiveness in a limited range of habitat types. On the other hand, the montane areas of the Philippines, which now represent the majority of the remaining forest fragments, have hardly been explored (Ashton 1993). These include the montane forest areas of Negros. To date, only a limited number of short studies on an equally limited number of taxonomic groups have been published (Hamann *et al*, 1999; Hamann & Curio 1999; Heindl & Curio 1999; Heideman *et al*, 1987; Brooks *et al*, 1992). This has resulted in a patchy array of detailed studies with many gaps in current knowledge regarding forest community compositions and wildlife diversity and distribution. A more comprehensive survey of the differing forest types and the mosaic of natural and anthropogenically affected habitats that are known to exist in the NNFR should be completed before any conservation management or restoration strategies can be effectively planned.

This paper broadly reviews the ecological survey work undertaken by the NRCP; however, it does not attempt to offer a complete and detailed analysis of the inventory data. Such data will be presented in subsequent technical publications.

The Negros Rainforest Conservation Project

In response to the need for ecological information

crucial in making informed decisions regarding the sustainable management of the NNFR, the Negros Forests and Ecological Foundation Incorporated (NFEFI) has asked Coral Cay Conservation (CCC) to assist in the provision of resources in undertaking baseline biodiversity surveys. This cooperation has resulted in the establishment of the Negros Rainforest Conservation Project (NRCP) in 1999. Oliver and Heaney (1996) have recognized the need for locally based conservation initiatives and stressed the importance of not becoming dependent on international assistance. Cognizant of this sentiment, NRCP has realized this goal through its partnership program with CCC. In this arrangement, CCC supports NFEFI's use of trained volunteers in undertaking the ecological inventory and census work.

Primarily, the ecological survey work will gather baseline quantitative data on the biodiversity of the fauna and flora of the North Negros Forest Reserve in order to create resource maps and an environmental database for the region. A major part of this survey work is a complementary field-based research into the habitat requirements and ecology of the endemic species currently included in the NFEFI captive breeding program whose objective is to produce guidelines for effective forest management to aid *in-situ* conservation of specific species. In addition, this survey aims to generate suitable education materials to be used in inculcating environmental awareness among local communities and in designing training programs in biodiversity assessment & management for host country's counterparts. Finally, data from this survey will be used to formulate an integrated, community-driven management plan for the conservation, restoration, and sustainable use of biodiversity in the region.

At the international level, such work will contribute to global efforts such as the Tropical Montane Cloud Forest initiative (Aldrich 2000). At the national level, it will contribute to the National Biodiversity Strategy and Action Plan, which includes inventories of flora and fauna as well as mapping of biodiversity rich areas not covered by NIPAS or declared protected areas. At the local level, the project will provide NFEFI and Local Government Units (LGUs) vital ecological data for conservation management in the NNFR. The information will also be available for the development of education initiatives, and training in biodiversity assessment and management.

Data Collection Methods

Volunteers - 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. In undertaking this project, NRCP uses volunteers (local and international) who are trained by experienced graduate and postgraduate ecologists. The training includes an intensive and comprehensive one-week course in field monitoring techniques. Volunteers are expected to achieve a minimum basic standard of competence before undertaking any fieldwork. While the use of volunteers may be questioned with regard to expertise in data collection, the fact that conservation biologists have long used "non-professional" volunteers to collect much of the information needed to make informed decisions concerning resources they are trying to protect is widely acknowledged (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 (Fore *et al*, 2001; Rosenburg *et al*, 1998; Mumby *et al*, 1995; Darwall *et al*, 1996; McLaren & Cadman 1999).

In addition to training and supervision, the NRCP also uses survey techniques that require minimal expertise yet permit the collection of accurate ecological data. For example, bird surveys are completed both by mist netting (Bibby *et al*, 1998) which allows accurate identification of each specimen and by the use of observation techniques such as Mackinnon lists (Mackinnon & Philips 1993). The Mackinnon list method can be used to generate diversity and relative abundance data, and is useful for more inexperienced observers (e.g. volunteers) as time can be spent identifying individuals without distorting the results (Sutherland 2000). However, tropical forest surveys are often synonymous with a high demand on research resources and technical expertise for surveys on lesser-known taxa, particularly some insect groups (Willott *et al*, 2000). Such issues can be partially ameliorated by using, for example, readily sampled groups such as butterflies, because they are relatively easy to record and identify (Kremen 1994), and can be used as an effective "umbrella group" for biodiversity conservation (New 1997).

Tree Species Inventory - Vegetation survey work has been undertaken using six permanent sample plots which have been established within three forest types of the NNFR (in close proximity to the village of Campuestohan 10° 39'N, 123° 08'E, on the southwest perimeter of the NNFR) to enable comparisons of community composition of the different forest types and species distributions within them. The plots have been permanently established in parallel pairs, in each of three different forested areas: (1) *Lightly disturbed old-growth forest* - selectively legally logged for dipterocarps 35 years ago; (2) *Heavily disturbed old-growth forest* - forest, legally logged for dipterocarps, and illegally logged for other species with commercial value 11 years ago; (3) *Secondary forest* - on a clear-cut site, where regrowth began 11 years ago.

Based on international standard methodology for tree inventory work, one-hectare plots (500m x 20m) subdivided into 25 quadrats of (20m x 20m) were used (Hamann *et al*, 1999, Alder & Synnott, 1992; Dallmeier 1992; Madulid 1996; Pipoly & Madulid 1998). Subsequently, all specimens of ≥10cm dbh (diameter at breast height) were permanently tagged and identified with local names by local guides. Botanical samples were also collected and sent for species identification at the Philippine National Museum, Manila and Royal Botanic Gardens, Edinburgh.

Vertebrate Surveys - The vertebrate faunal surveys initially focussed on birds and mammals. The bird surveys were undertaken using Mackinnon lists (as discussed) and by point counts (Bibby *et al*, 1998; Stork & Davies 1996; Gibbons *et al*, 1996). These survey methods are ideal for rough terrain and dense vegetation where conditions make transect walking difficult (Bibby *et al*, 1992). The data produced are semi-quantitative and allow limited comparisons. Point counts allow easier identification of species which are often difficult to see because of the dense vegetation. For this reason, this method is best carried out by trained volunteers (Stork & Davies 1996).

With the guidance of NRCP staff, assessment of bird and bat diversity was conducted through observation work and by mist netting. Nets were established where capture efficiency was likely to be maximized (in clearings, along ridges or by water), following the approach of previous studies (Heaney *et al*, 1989). For mammal inventories the project used live traps following the trap line methodology of Heaney *et al* (1989) and Heideman *et al* (1987). In addition to the trap lines, the project used visual encounter surveys and species signs (e.g. tracks) according to the basic census techniques of Rabinowitz (1997).

Invertebrate Surveys - Regular butterfly surveys have been undertaken within the three forest types to investigate butterfly diversity, spatial distribution, and relative abundance. The project used the transect walk method with non-random point counts (Walpole & Sheldon 1999; Pollard, 1977), as used in previous studies of tropical forest butterflies (Hamer *et al*, 1997; Hill, 1999). As with the bird surveys, this survey method is ideal for rough terrain and dense vegetation. Baited traps (Ausden 1997) have also been used on each plot since this type of survey is particularly useful for surveying the guild of fruit-feeding butterflies. A type specimen of each species has been collected and identified to sub-species level using D'Abrera (1982; 1985; 1990), Tsukada (1981; 1982; 1985; 1991) and Baltazar (1991). These specimens are stored at the NFEFI for use in generating a photographic field guide that will aid future volunteer training as well as for educational purposes.

PRELIMINARY CENSUS AND INVENTORY RESULTS

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 but this is likely to increase as scientific identifications are confirmed. Preliminary analysis revealed that the overall species richness and Simpson's diversity (Begon *et al*, 1990) are higher in the disturbed old-growth forest (95 species, diversity index = 21.57) and secondary forest (92 species, diversity index = 20.63) than in 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.

As the evaluation of species composition showed clear differences between the different forest types, further 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 was displayed using a non-metric multidimensional scaling (NMDS) ordination (Figure 1) and a hierarchical agglomerate clustering technique (Figure 2) (Clarke & Green 1988).

The NMDS and Cluster demonstrated 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 demonstrated good separation of the three forest types, indicating that they differ substantially in their relative compositions. The Cluster also confirmed 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 were also found to be very different from each other in their species composition (Figure 1) with the latter being dominated by palm species which have been completely removed from the secondary forest.

Vertebrate Surveys - Over 200 hours of observation by 90 volunteers have resulted in the identification of 123 bird species from 33 avian families. This figure represents

approximately 20% of all species (572 in total) known to occur in the Philippines (Kennedy *et al*, 2000) and 1% of global bird species. Over 30% of all species identified within the NNFR are endemic to the Philippines, with sub-species endemic to the Negros-Panay faunal region. Nine of the species recorded in the NNFR are IUCN Red Listed (Table 1). Five of the Red Listed species identified, including the Visayan Flowerpecker (*Dicaeum haematostictum*), the Flame-templed Babbler (*Stachyris speciosa*), and the Visayan Tarictic Hornbill *(Penelopides panini)*, are restricted to the Negros-Panay Faunal region (Stattersfield *et al*, 1998).

The preliminary inventory of mammals (Table 2) already indicates that the NNFR is a key site for the endangered mammal fauna of the Philippines, yet this is far from being a 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 NNFR. So far only deer tracks have been located, although there have been frequent sightings of pig activity, and of the pigs themselves, throughout the areas being studied.

With the use of mist-netting, the majority of the recordings consist of fruit bats, in particular, *Cynopterus brachyotis* and *Haplonycteris fischeri*. Another species, *Nyctimene rabori*, previously thought only to occur in Southern Negros, being restricted to undisturbed, primary, lowland forest, has been caught in the secondary forest near the NRCP research center. Rare or uncommon in all known sites, and facing extinction on Negros, this bat species is classified as IUCN critically endangered (Heaney, 1998).

The observation and live trapping work have also located Long-tailed macaques (*Macaca fascicularis*) close to the research center and within the 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 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*).

Invertebrate Surveys - The NRCP has collected and identified 38 butterfly species and sub-species from 7 families (Figure 3) 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 (Figure 4). There were also differences in butterfly diversity, richness, and abundance between the three forest types, with the secondary forest displaying higher species richness but lower abundance and reduced species diversity (Simpson's diversity (Begon *et al*, 1990)) than the old-growth sites.

DISCUSSION

The data presented here are still preliminary but they serve to illustrate the value of the NRCP data collection process and capacity. To date the NRCP has located 123 bird species within the NNFR, which is greater than previous studies (Brooks *et al*, 1992; Hamann & Curio 1999), and will contribute to the first detailed avian inventory of this area. The surveys also reinforce the ecological importance of the NNFR for both endemic and IUCN Red Listed species, confirming the findings of earlier works (Brooks *et al*, 1992; Hamann & Curio 1999; Heindl & Curio 1999; Heideman *et al*, 1987). They also present the first records for several species from different faunal groups, such as the Philippine Hawk-eagle (*Spizaetus philippensis*) and the Philippine tube-nosed fruit bat (*Nyctimene rabori*).

Clearly, the inventory total is a function of surveyor effort, but it serves to illustrate the value of long-term studies when attempting to generate species inventories.

Detailed inventory and census work represent the first step in the conservation management process since ecologically sound forest management, whether for conservation alone or in conjunction with sustainable resource use, will only be successful if the dynamic behavior of the systems can be adequately characterized and predicted (Alder & Synnott 1992). Permanent sample plot studies used in combination with baseline faunal surveys for all major habitat types have provided us with an opportunity to assess ecological patterns and changes along spatial and temporal dimensions. Therefore, they have a central role in many aspects of tropical forest research, conservation, and management. For example, the empirical outputs of the completed permanent sample plot inventories will not only provide a valuable baseline for vegetation community structure and how this relates to faunal diversities and distributions, but will also aid reforestation efforts.

Comparison of species frequencies on different plots (within different forest types) might help conservationists 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 over site (e.g. *Euphorbiaceae sp.*), is likely to be a pioneer species. Because such species is generally tolerant of drought and intense sun, it may be used to establish new plantations by open field planting. Results of this sort are only possible to achieve when the scientific inventory will have been completed, and only then will it become possible to plan restoration initiatives for areas such as the NFEFI and the Upper Imbang-Caliban watershed.

Acquisition of detailed ecological inventory data also forms part of the resource profiling process that is a necessary step for designating protected areas (Carlo Custodio [PAWB] pers com.). However, detailed conservation planning requires rapid ecological assessments of many other locations within the NNFR in order to adequately characterize the spatial distribution and abundance of species and habitats in relation to environmental gradients. This requires time and the staff's ability to work at appropriate spatial scales.

The project's unique participatory model utilizing trained volunteers represents an opportunity to increase both the spatial and temporal scales in undertaking such inventory work. With this model, it will be possible not only to evaluate the composition of the fauna and flora in differing forest types, but also to monitor change over time, thus accomplishing major research goals with minimal resources. Too often, conservation research is restricted by available resources such as funding, logistical constraints of working in remote forest fragments, and availability of personnel that can spend adequate time in the field in order to achieve research objectives. However, the participatory model of operation of the NRCP offers one possible solution to sustaining such field based research initiatives.

However, it is important to acknowledge the technical constraints presented by the use of volunteer (novice) labor when collecting scientific data. The NRCP has always used internationally recognized and published survey methods (for major faunal and floral groups), but in order to make these methods workable, reliable and provide data in a format that is usable, they have to be adapted for volunteers and local community members. Thus, a situation- specific development of

methods is necessary if accurate and scientifically robust information is to be gained and recognized by peers. Although the perceptive accuracy of data collection may be enhanced through the use of appropriate methods and training, there is still a need to validate any data collection process (MacLaren & Cadman 1999). To this end, the NRCP is currently undertaking a study to validate the data collected by the volunteers who used observation techniques.

While the research lessons continue to be learned, one outcome of the project is clear. The NRCP would not have been sustained for this long without research collaboration and continued local support. Local NGO support, community involvement, and the willingness of local and international researchers to contribute to the project provide the foundation on which the day-to-day research is completed. While the social, political, and economic reasoning for such involvement is well rehearsed, the scientific value of the participatory exchange of knowledge cannot be overstressed in an area that is biologically poorly known and documented, at least in a scientific sense. The inventory and census data are only an initial step while the task of conserving and restoring the forests of the NNFR and Negros is vast. There is a need to look at alternative mechanisms by which to achieve conservation goals and it is now acknowledged that volunteers will play increasingly important roles in wildlife conservation wherever their efforts can be coupled with those of professional practitioners in the field (Bildstein 1998). The NRCP is by no means a panacea but through partnership and collaboration, and the continued involvement of volunteers and local communities, it offers a mechanism through which to make small steps in the right direction and assist in sustaining the resources of the NNFR.

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Table1. Threatened bird species located within the NNFR

SPECIES	STATUS	GEOGRAPHICAL DISTRIBUTION	ALTITUDINAL RANGE	FOREST TYPE	ENDEMIC
White-winged Cuckoo-shrike (*Coracina ostenta*)*	vulnerable	Negros-Panay	<2000	2	yes
Visayan Flowerpecker (*Dicaeum haematostictum*)*	endangeed	Negros-Panay	<1000	2	yes
Flame-templed Babbler (*Stachyris speciosa*)*	endangered	Negros-Panay	<1000	1	yes
Negros Bleeding-heart (*Gallicolumba keayi*)*	critical	Negros-Panay	<1200	2	yes
Visayan Tarictic Hornbill (*Penelopides panini*)*	critical	Negros-Panay	<1500	3	yes
Rufous-lored Kingfisher (*Penelopides panini*)*	endangered	Philippines	<1000	3	yes
Blue-naped Parrot (*Tanygnathus lucionensis*)	endangered	Philipines	<1000	1	yes
Philippine Hawk-Eagle (*Spizaetus philippensis*)*	vulnerable	Philippines	<2000	2	yes
Java Sparrow (*Padda oryzivora*)	vulnerable	Wider S.E. Asia	<1000	3	no

*dependent on tropical forest habitat, 1 Status from WCSP (1997), 2Geographical distribution and Altitudinal range from Kennedy et al (2000), 3Forest Types: 1) Old growth; 2) Secondary (intermediately disturbed); 3) Secondary regrowth

Table 2. Preliminary inventory of mammal species located within the NNFR. Status from WCSP (1997) and Geographical distribution from Heaney *et al* (1998).

Family	Species	Status	Geographic distribution	Endemic
Cervidae	Visayan Spotted Deer (*Cervus alfredi*)	endangered	Negros-Panay Faunal Region	yes
Suidae	Visayan Warty Pig (*Sus cebifrons*)	endangered	Negros-Panay Faunal Region	yes
Pteropodidae	Philippine dwarf fruit bat (*Haplonycteris fischeri*)	vulnerable	Philippines	yes
	Philippine tube-nosed fruit bat (*Nyctimene rabori*)	endangered	Cebu, Negros, Sibuyan	yes
	Harpy fruit bat (*Harpyionycteris whiteheadi*)	common	Philippines	yes
	Common short-nosed fruit bat (*Cynopterus brachyotis*)	common	Southeast Asia	no
	Musky fruit bat (*Pterochirus jagori*)	common	Philippines	yes
	Lesser long-tongued nectar bat (*Macroglossus minimus*)	common	Southeast Asia	no
Megadermatidae	Common Asian ghost bat (*Megaderma spasma*)	common	Southeast Asia	no
Rhinolophidae	Yellow-faced horseshoe bat (*Rhinolophidae virgo*)	common	Philippines	no
Soricidae	Asian house shrew (*Suncus murinus*)	common	Asia	no
	Oriental house rat (*Rattus tanezumi*)	common	Asia-Pacific	no
	Polynesian rat (*Rattus exulans*)	common	Asia-Pacific	no
	House mouse (*Mus musculus*)	common	Global	no
Cercopithecidae	Long-tailed macaque (*Macaca fascicularis*)	common	Southeast Asia	no
Viverridae	Common palm civet (*Paradoxurus hermaphroditus*)	common	Asia	no
	Malay civet (*Viverra tangalunga*)	common	Southeast Asia	no

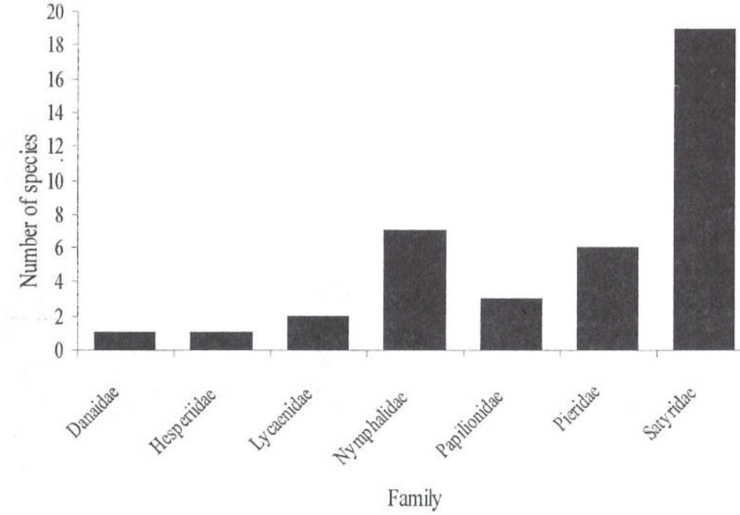

Figure 1. Frequency distribution of butterfly species within families located within the NNFR.

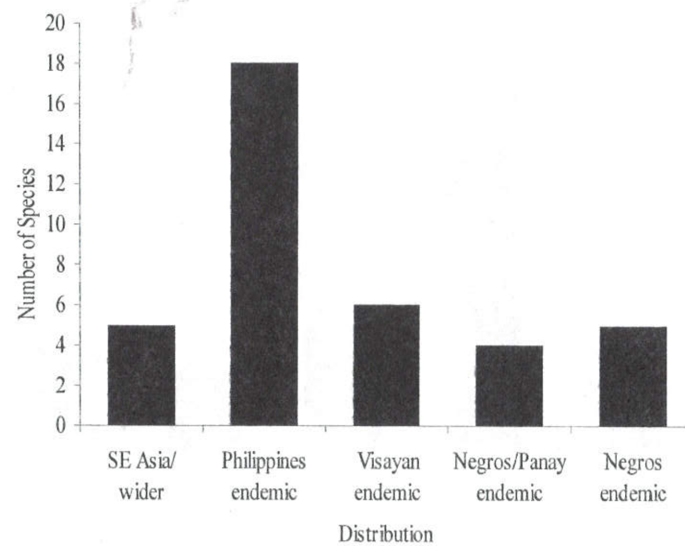

Figure 2. Classification of species identified according to their endemicity/geiographical distribution

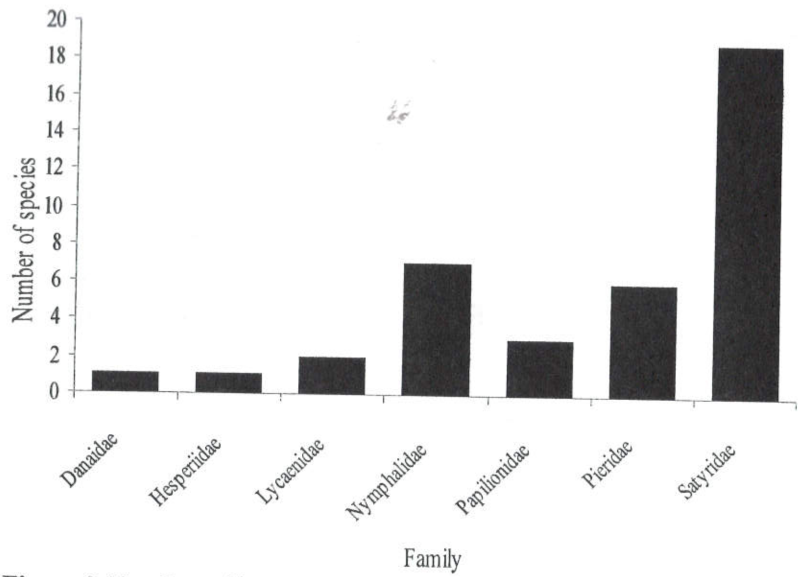

Figure 3. Number of butterfly species by family identified within the NNFR

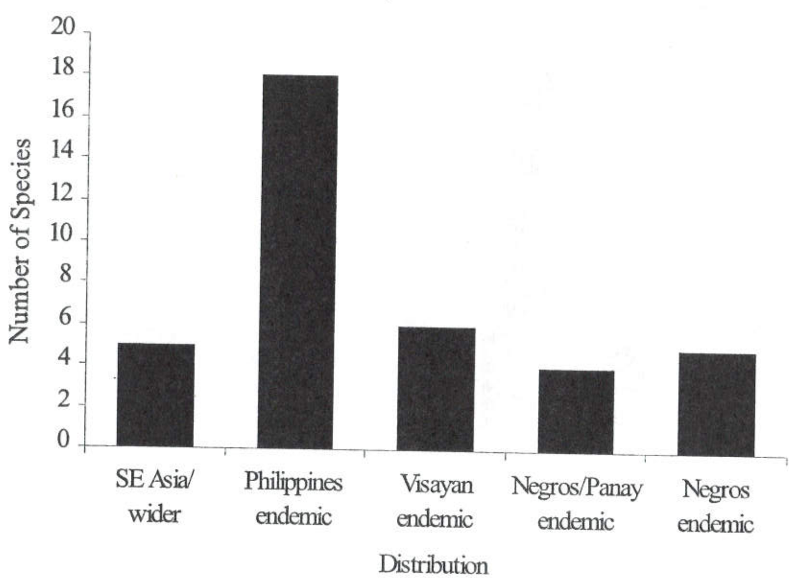

Figure 4. Classification of species identified according to their geographical range

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