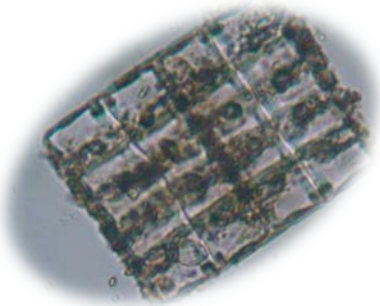

NAUJAN LAKE NATIONAL PARK SITE ASSESSMENT

AND

PROFILE UPDATING

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FOREWORD

The Naujan Lake is the fifth largest lake in the Philippines. It was declared as a national park on March 27, 1956 by virtue of Presidential Proclamation No. 282 signed by President Ramon Magsaysay, with an area of 21,655 hectares. However, due to Proclamation No. 793 signed by President Carlos P. Garcia which reduced the area of the park to only 1,966 hectares, human settlements and agricultural lands increased rapidly. The Proclamation No. 355 signed by President Ferdinand E. Marcos restored the original total area of the park.

The lake is a representative of a wetland habitat, and supports vulnerable, endangered or critically endangered species, and a population of migratory birds and was declared as the 1008th RAMSAR site worldwide and the second RAMSAR site in the Philippines. However, lands surrounding the lake which used to be covered a lush forest was cleared for various human activities.

Management plan for Naujan Lake National Park was established in 1997 with the help of Southeast Asian Regional Center for Graduate Study and Research in Agriculture (SEARCA). Nevertheless, the management plan was not well implemented and there is still a rapidly increasing human population in areas surrounding the lake and conversions of the natural park into agricultural lands. Thus, the NLNP (Naujan lake National Park) is in need of a new site assessment and area profiling.

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EXECUTIVE SUMMARY

This report, *Naujan Lake National Park Site Assessment and Profile Updating,* is a long overdue site assessment and profile updating of Naujan Lake National Park (NLNP). Naujan Lake is the fifth largest lake in the Philippines. The water in the lake comes from numerous mountain streams and springs. Naujan Lake was established as a National Park on March 27, 1956 via Presidential Proclamation No. 262 signed by President Ramon Magsaysay who designated 21,655 hectares for the park. The lake is a representative of a wetland habitat, and supports vulnerable, endangered or critically endangered species, and a population of migratory birds, including large numbers of waterfowls and ducks. The lake and its watershed bound the protected area. The Naujan Lake supports. The lake was given Ramsar site status in 1999 because of the presence of significant numbers of wetland bird species. Due to increasing human population, settlements and agricultural lands have also been expanding rapidly.

PHYSICAL AND GEO-POLITICAL CHARACTERISTICS

The Naujan Lake National Park (NLNP) lies on the north-east portion of Mindoro Island, approximately 34 kilometers south of Calapan City, the provincial capital of Oriental Mindoro. It is located in an area that encompasses the towns of Victoria, Naujan, Pola and Socorro. Victoria represents the largest portion of the watershed (64%) that drains to the lake and eventually northward to the town of Naujan (21%). Other rivers, creeks or streams that drain to the watershed come from Sablayan (1%), Pola (5%) and Socorro (8%).

Based on the legal land classification, 57% of the watershed is alienable and disposable while 43% is forestland. About 17,880 ha are devoted to agriculture. This is composed of annual and perennial crops. The rest of the area could be classified as forested (35% or 10,167 ha), marshland (2% or 616 ha), built up (0.1% or 20 ha), or grassland (0.1% or 17 ha). It has a high elevation of 580 masl at the southern tip of the watershed near the boundary of Sablayan. The lowest elevation is recorded at 20masl.

PLANTS

The plant species recorded by Gruezo (2010b) in the entire national park and lake watershed zone of 36,425 hectares was 613 species (72% indigenous, 13% exotics) in 433 genera and 105 families of vascular plants. The floral diversity is composed of 46 fern species, 43 grasses, 147 herbs, 67 shrubs, 50 vines, 34 lianas, 91 medium-sized trees, and 31 large trees. Gruezo (2010b) also recognized 8 vegetation types: (i) second-growth dipterocarp, interspersed with large parcels of coconut-banana-citrus plantations and small swidden farms, (ii) secondary broadleafed forest, (iii) brushland, (iv) parang (savannah) type, (v) riparian, (vi) marshland, (vii) beach forest, and (viii) mangrove swamp forest. In the present survey, we only recognize 4 types of natural vegetation: (i) secondary forest, (ii) parang vegetation, (iii) freshwater swamp forest, and (iv) marshes. We also include the cultivated areas for coconut, citrus, banana, rice, and other crops. In all the six sites surveyed, we recorded a total of 319 species of vascular plants belonging to 88 families. At least two species, *Randia mindorensis* Elmer [Rubiaceae] and *Saurauia mindorensis* Merr. [Actinidiaceae], are endemic to Mindoro Island; 37 species in all are endemic to the

Philippines. Sites 3 and 4 have the highest average plant diversity and number of species per plot (24.5-26 species). Both sites are on the eastern side of the lake. The sites with lowest biodiversity indices and lowest average number of species per plot are Site 1 (1.545, 16.2 species) on the western side of the lake, and Site 5 (1.694, 16.6 species) on the southeastern side.

Fourteen (14) species are included in the DENR Administrative Order No. 2007-01, *The National List of Threatened Philippine Plants and their Categories* (Fernando *et al.* 2008) and in the *2012 IUCN Red List of Threatened Species* (Table 4). Four species are in the Critically endangered (CR) category, two in the Endangered (EN) category, and seven in the Vulnerable (VU) category.

TERRESTRIAL VERTEBRATES

Relatively high diversity index values were computed for all the six sites sampled in Naujan Lake National Park, ranging 3.03 to 3.68. The recent survey recorded a total of 159 terrestrial vertebrates. This total consists of 105 species of birds (Tables 3), 21 species of mammals (Table 4), and 33 species of reptiles and amphibians. At least 40 species or 25% of the total terrestrial vertebrates recorded (Figure 2) are classified as endemic to the Philippines (23 species of birds, four mammals, and 13 reptiles and amphibians). These 40 endemic vertebrates are further subdivided to 32 Philippine endemic species, five restricted to only two or three islands (Range-restricted), and three Mindoro Island endemics.

Seventy one species of terrestrial vertebrates were recorded in this lake and marshland (44% of total vertebrates recorded), comprising of 48 species of birds, eight mammals, and 15 reptiles and amphibians. The threatened Philippine duck (*Anas luzonica*) is a resident species of the lake as well as the migratory duck, Tufted duck (*Aythya fuligula*) which is a regular visitor of the lake.

Second-growth forests have the highest species diversity with 118 species, translating to almost 75% of total terrestrial vertebrates documented for the whole Naujan Lake National Park. This total constitutes 75 species of birds, 19 mammals, and 24 species of reptiles and frogs. Roughly 78% (31 species) of the total number of endemic species are also present in this habitat type. All three Mindoro endemics recorded for the whole national park were found in this habitat type as well.

A total of 89 species of terrestrial vertebrates were recorded in agricultural areas, consisting of 59 species of birds, 11 mammals, and 19 reptiles and frogs. Most notably the Mindoro endemic frog *H. mangyanum* and Range-restricted bat *P. pumilus* were recorded. There were also seven species recorded that are classified as threatened species. It is interesting to note that these seven threatened species can persist in highly degraded areas such as plantations and human habitations.

A total of 14 species of terrestrial vertebrates recorded in this survey for Naujan Lake are classified as Threatened Species either by IUCN, DENR, or CITES (Convention on International Trade of Endangered Species of Flora and Fauna), consisting of six species of birds, two mammals, four frogs, and two reptiles. It is also interesting to note that more

than 2000 individuals of Whiskered Tern (*Chlidonias hybridus*) were counted during this survey.

AQUATIC VERTEBRATES AND MACROINVERTEBRATES

Most fish species recorded in Naujan Lake are migratory. They live primarily in marine environments but frequently visit freshwater ecosystems and stay, but return to the sea when they become sexually mature. Twenty five species were documented. Alarmingly, eleven introduced species are now present in the lake. A Philippine endemic, *Leiopotherapon plumbeus* (Ayungin), considered an introduced species in the lake was also recorded by the present survey which confirmed the first record by the SEARCA study in 1997.

The present study first documented the presence of *Carrasius* sp. which the locals call Tawes (a local name usually associated with *Barbonymus gonionotus*), and *Cyprinus carpio carpio* which may have been introduced into the lake just recently. Surprisingly, the 1997 SEARCA survey has no record of the two species. This is also the first time that *Tilapia zillii* is reported as well as the presence of two poeciliids, *Poecilia reticulata* and *P. sphenops*.

Fifteen tributaries of Naujan Lake were surveyed. Twenty two species were recorded in Butas River. Nineteen species were recorded from the different tributaries of Naujan Lake (Table 3). Three species are common in all the surveyed tributaries, one native, *Giuris margaritacea*; and two introduced species, *Poecilia reticulata* and *P. sphenops*.

Eighteen of the 29 species recorded from Naujan Lake National Park are species of economic importance. Based on IUCN Red List Category, *Stenogobius* sp. is listed as Critically Endangered (CR). An island endemic, *Puntius hemictenus* is listed as Vulnerable (VU) as well as *Cyprinus carpio carpio.* But the category of *C. carpio carpio* is based on its current status in its natural habitat. Majority of the species listed is Not Evaluated (NE), Least Concern (LC) or have Deficient Data (DD).

The present study was able to record twelve macroinvertebrates composed mainly of 5 gastropods, two bivalves, one crab species, and 4 species of shrimps. Banded file snake has been recorded in Naujan Lake for the first time.

TERRESTRIAL INSECTS AND THEIR RELATIVES

This report is the first record of arthropods being surveyed in Naujan Lake National Park. It summarizes the results of the survey of existing diurnal, soil-litter, ground-dwelling, and nocturnal arthropods, in terms of species richness, diversity, evenness and dominance in the six sampling sites (i.e., Banbanin (Site 1), Montelago (Site 2), Tagbakin (Site 3), Calubasanhon (Site 4), Mabini (Site 5) and Happy Valley (Site 6) of Naujan Lake National Park.

Among the six stations, soil-litter and pitfall traps sampling results showed that Happy Valley has the highest diversity indices (2.69 for the soil-litter and 3.41 for pitfall

traps) while both techniques showed different sites with low number of species richness. The lowest result for soil litter sampling was Montelago (1.12) but for the pitfall traps sampling it was Banbanin (1.76). For the sweep net, the results showed that Calubasanhon (7.63) has the highest species richness while Happy Valley (4.21) has the lowest value. UV light trap sampling results showed that Banbanin (17.86) has the highest value while Tagbakin has the lowest result.

In terms of average number of individuals, Calubasanhon was the highest for the sweep net, Happy Valley for soil-litter sampling and pitfall traps, and Montelago for the light trap sampling.

The presence of high number of tramp species of ants in areas surrounding the Naujan Lake National Park indicate that the area is highly disturbed and the area is near or with human habitants. *Troides rhadamantus* and *Papilio rumanzovia* were frequently observed in Montelago. Both butterflies are threatened and strictly protected, and in fact, *Troides* spp. are among those listed in CITES Appendix II.

WATER QUALITY AND MICROBIAL DIVERSITY

The physico-chemical properties of the lake water collected in near-shore stations of Naujan Lake were determined *in situ* and *ex-situ*. The salinity of lake waters was measured. Turbidity of lake water is caused by suspended organic and inorganic nutrients. The turbidity varied from 3-56 NTU for the 7 lake water samples analyzed. Excessive nitrate concentrations in lake waters encourage the rapid growth and proliferation of phytoplankton that alter water quality. The total nitrates of the 7 lake water samples ranged from 0.087 to 0.152 mg/L, which is almost 10-fold lower than those reported in 1997 for the 3 near-shore stations of Naujan Lake (1.30 to 1.80 mg/L). The low concentration of phosphorus in the lake water sample indicated less agricultural run-off and may be contributed by the wastewater or washings from the community living around the lake.

The results of the DO (Dissolved oxygen) indicated a better lake water quality than that reported 14 years ago. BOD (Biological oxygen demand) is lower compared to the result 14 years ago. The iron concentrations obtained from Taybungan Falls indicate that the water is safe for drinking.

The total heterotrophic count provided information on the number of bacteria present in the lake water samples. The total heterotrophic count of lake waters from Naujan Lake ranged from 8.50 to 196.0 x 10^3 CFU/mL with Tagbakin and Taybungan Falls, with the lowest and highest counts, respectively. Lake water from Butas yielded the lowest total coliforms of 220 MPN/100 mL and Singulan and Taybungan Falls the highest total coliforms of ≥2400 MPN/mL. The total fecal coliform count is highest in lake water obtained from Singulan and lowest in lake water from Butas.

Presence of inorganic nutrients such as nitrogen as nitrates and phosphorus supports the growth of phytoplankton in Naujan Lake. A total of 21 genera of phytoplankton were

identified in the Naujan Lake.

SOCIO-CULTURAL AND ECONOMIC CONDITIONS

Naujan Lake National Park is surrounded by four municipalities –Naujan, Pola, Socorro, and Victoria. In terms of distribution, Naujan's total population comprised 12 % of the provincial population's total while the four barangays shared .99%; Victoria's population comprised 4% while its nine barangays shared 1.55%; Socorro's population had 5% while its eight barangays shared 1.4%; and Pola's population comprised almost 6% but its two barangays only shared 0.62 %. Naujan has the highest population growth rate from 2000 to 2007, at 1.07 per thousand population; slightly higher than the provincial growth rate at 1.06. Three Mangyan tribes are present and residing within the boundaries of NLNP.

The migration pattern of the Naujan Lake National Park is categorized based on the respondent's origin: within the municipality, within the province, within Mindoro island, within the MIMAROPA region, or coming from another place.

Most of the respondents harvest wood within their community for fuel wood and mostly used for cooking. Sixty-five percent (65%) comes from wood. Other fuel/energy sources used by the respondents were LPG, electricity, charcoal and kerosene.

The province of Oriental Mindoro has 18 educational districts; three of these are in Naujan, 1 in Socorro and 1 in Victoria. A total of 482 public schools (both elementary and secondary) are found in Oriental Mindoro; 17% of these are within Naujan, 5% within Socorro, and 6.4% within Victoria. Private schools (both elementary and high school) totaled to 116; 19 of these are within NLNP municipalities.

A relatively high number of day care centers and workers in the four municipalities of NLNP. However, the number of social workers are very low; none in Socorro.

For the last three years (2008-2010), there has been a steady decrease in the birth rate, total death rate is relatively stable, as well as for maternal deaths. Respiratory-related diseases (AURI, Pneumonia, and Bronchitis) are the leading morbidity causes among the general population and among infants. Among the leading mortality causes for the general population were heart-related disease and cerebrovascular accidents. Leading infant mortality causes in the province were severe pneumonia and bronchial asthma. At least 10% of pre-schoolers are underweight. Twenty-eight barangays were positive for Schistosomiasis.

Majority of housing units found in four municipalities were made of wood, cogon, nipa, bamboo, and anahaw. All municipalities within NLNP have electricity and their own water district or water systems. Water facility types present were community water systems, deep wells, artesan wells, shallow wells, natural bodies of water (rivers, lake, springs), bottled water, and tanker truck (delivered water). Sources of water come from surface water such as rivers and the Naujan Lake, and from ground water. All communication services are available within the four municipalities. Transportation services and road networks are present and connect to several barangays.

Fifty percent of the respondents do not own the land where they reside while the rest of the respondents at least own a parcel of land. A total of 16 crops were identified as being grown and cultivated by the respondents. About 41.4% of the respondents raise domesticated animals.

At least nine types of resource utilization practiced by NLNP residents were identified as threats to the lake by the 330 respondents. Only a small proportion of the respondents view the lake as a livelihood source, indicating that food source derived from the lake is at the subsistence level. Garbage disposal along rivers, creeks, and lake shore is still practiced 23 (7%) of the 330 respondents.

GOVERNANCE AND INSTITUTIONAL ARRANGEMENTS

At present, NLNP is under the management of Naujan Lake National Park – Protected Area Management Board (NLNP-PAMB). Plans, programs and projects in the park are put into practice. National and local policies governing and/or affecting the park are implemented. There are at eight concerns that were obtained for NLNP: (i) species introduction, (ii) destructive fishing method, (iii) encroachment to designated fish sanctuary, (iv) land cover change, (v) denuded riparian forest, (vi) siltation and sedimentation, (vii) diversion and damming of rivers and streams for irrigation, (viii) weal implementation of existing laws and regulation, and (ix) proposed diminution of Naujan Lake National Park.

1. INTRODUCTION

1.1 HISTORICAL BACKGROUND

Naujan Lake is the fifth largest lake in the Philippines. It is located at 13°10′N 121°20′E, in the northeastern side of Oriental Mindoro, Mindoro Island. The lake is bounded by four municipalities, Naujan in the north, Victoria in the west, Socorro in the south, and Pola in the east. The lake is volcanic in origin, which extends about 14 km from north to south and 7 km from east to west. The water in the lake comes from numerous mountain streams and springs. The outlet is the Butas River, about 20 km at the Northern portion that connects it to the sea (Tablas Strait). Its eastern part is steep but to the west the land rises gradually.

Naujan Lake was established as a National Park on March 27, 1956 via Presidential Proclamation No. 262 signed by President Ramon Magsaysay who designated 21,655 hectares for the park. The total area includes the lake itself and the surrounding watershed which extends to the coastal area of Pola bay. However, on September 21, 1961, President Carlos P. Garcia signed Presidential Proclamation No. 793 which reduced the total area of the Park from its original size to only 1,966 hectares which only covers the lake waters and its marshy areas. As a result, the once publicly owned areas were privatized and established into human settlements and agricultural lands among others. Then again on January 28, 1968, Presidential Proclamation No. 355 signed by President Ferdinand E. Marcos rescinded Presidential Proclamation No. 793 and restored the original total area of the park.

In 1992 under Republic Act 7586 known as the National Integrated Protected Areas System Act (NIPAS Act), automatically designated it as Naujan Lake National Park (NLNP) and in 1995, DENR Region IV through its PASA (Protected Area Suitability Assessment) report categorized NLNP as a “protected landscape/seascape” and that the existing boundaries be modified excluding some portions of Pola and Socorro.

In 1997, a development and sustainable protected area management plan for NLNP was established through the efforts of SEAMEO Regional Center for Graduate Study and Research in Agriculture (SEARCA), the Protected Areas and Wildlife Bureau (PAWB) of the Department of Environment and Natural Resources (DENR), the Department of Environment and Natural Resources – Region IV (DENR-IV), and the Naujan Lake National Park Protected Area Management Board (NLNP-PAMB). The established plan supports the boundaries modified by the PASA.

The lake is a representative of a wetland habitat, and supports vulnerable, endangered or critically endangered species, and a population of migratory birds. In December 11, 1999, the lake was declared as the 1008th RAMSAR site worldwide and the second RAMSAR site in the Philippines.

The lake and its watershed bound the protected area. However, more than 70% of the land surrounding the lake which used to be a lush forest was converted into settlements and agricultural lands. Due to increase in human population, settlements and agricultural lands increased rapidly. As a result, new boundaries for the park are being proposed.

Furthermore, the last assessment of the area was 10 years ago hence a reassessment of the NLNP is long overdue.

1.2 BIO-GEOGRAPHICAL BACKGROUND

Mindoro Island is the seventh largest island in the Philippines with an area of 10,572 km^2. It is located southwest of Luzon Island, northeast of Palawan Island and northwest of Panay Island between 13^0 32' 21.1224" and 12^0 12' 40.2487" North latitude and 120^0 56' 15" and 121^0 10' 5.5664" East longitude (Zwiefelhofer, 2012). It is one of the six major Pleistocene islands with a total area of 10,460 km^2 (Heaney, 1985; Peterson et al., 2000). It is divided by a mountain range with two peaks: Mt. Halcon, the highest and standing at 2,597 masl found in the northeast portion and Mt. Baco in the south standing at 2,498 masl (Linis, 2009). The island has a two weather types: dry and rainy season, with an average of 26 -32^0 C in temperature, leading to a large diversity of flora and fauna.

There are ten conservation sites that have been identified in the island: (1) Mt. Calavite Wildlife Sanctuary, (2) Puerto Galera, (3) Mt. Halcon, (4) Naujan Lake National Park, (5) Iglit-Baco Mountains, (6) Siburan, (7) Malpalon, (8) Bogbog, Bongabong and Mt. Hitding, (9) Mt. Hinunduang, and (10) Apo Reef Marine Natural Park (Mallari et al., 2001). These conservation sites support an array of vegetation types as well as fauna endemics.

The mountains and forested areas are important biodiversity conservation sites in the island. They are important in the conservation of restricted-island bird endemics such as the Mindoro Imperial-pigeon (*Ducula mindorensis*) and Mindoro Scops-owl (*Otus mindorensis*). A few species of mammals (*Maxomys* sp., *Apomys gracilirostris* and the critically endangered, *Bubalus mindorensis*) were discovered in the area. The island is also the type locality of the Mindoro tree frog, *Philautus schumakeri. Euploea tobleri mangyan,* a threatened butterfly species is only found in the mountains of Mindoro. It is also a tribal territory of Iraya Mangyan, Alangan, Batangan, Hinunuo, Mayan and Bangan tribes (Mallari et al., 2001).

The Naujan Lake supports large numbers of waterfowls and ducks. The threatened Philippine duck (*Anas luzonica*) is a resident species of the lake as well as the migratory duck, Tufted duck (*Aythya fuligula*) which is a regular visitor of the lake. It is also the type locality of the Philippine crocodile, *Crocodylus mindorensis* which is an endangered species and believed to be extinct.

In overall, the floristic, faunistic and geological composition of the island is very unique that it is considered as ninth largest biogeographic zone in the Philippines, in terms of land area covered and with high level of biodiversity and endemism.

2. FRAMEWORK FOR SITE ASSESSMENT AND PROFILE UPDATING

2.1 RATIONALE

The Naujan Lake National Park (NLNP) lies on the north-east portion of Mindoro Island, approximately 34 kilometers south of Calapan City, the provincial capital of Oriental Mindoro. The park sits within the boundaries of four municipalities, Naujan from the north, Pola in the east, Victoria from the west, and Socorro at the south. The lake, with about 11,000 hectares covered with freshwater, is probably of volcanic and tectonic origin (Davies, 1991 as cited by the NLNP Management Manual) that created uplifts which gave rise to cones and hills in the eastern portion of the lake. The western portion of the lake became more or less a broad alluvial basin, which was then filled with river flow and precipitation that became trapped due to the hills and cones that resulted from the uplift. Currently, the water of the lake exits to the sea via its lone outlet, the Butas River, which is situated in the northwestern portion.

Naujan Lake was first declared as a national park on March 27, 1956 by virtue of Presidential Proclamation No. 282 signed by President Ramon Magsaysay, with an area of 21,655 hectares. It is currently designated as a Protected Landscape/Seascape under the National Integrated Protected Areas System (NIPAS) and a management plan was prepared in 2001 with the assistance of the Protected Areas and Wildlife Bureau (PAWB) and the Southeast Asian Regional Center for Graduate and Research in Agriculture (SEARCA). The lake was given Ramsar site status in 1999 because of the presence of significant numbers of wetland bird species. It is also included as one the Important Bird Areas (IBA) in the Philippines (Mallari et al., 2001).

The ground work for the creation of the management plan of Naujan Lake started in 1997, which was spearheaded by SEARCA. From their results, SEARCA documented at least six habitat types: (1) *Parang* (i.e grassland-brushland type), (2) remnant old-growth lowland dipterocarp forest, (3) mixed mangrove and swamp-beach forest, (4) marshland, (5) connected matrix of second-growth and riparian forest, fruit plantations, rice fields, and swiddens, and (6) the freshwater lake itself. A total of 613 species of vascular plant species, representing 433 genera and 105 families, was documented within the park. The floral diversity comprised of 46 fern species, 43 grasses, 147 herbs, 67 shrubs, 50 vines, 34 lianas, 91 medium-sized trees, and 31 large trees. On the other hand, at least 98 species of terrestrial vertebrates (wildlife) were documented during the 1997 SEARCA resource profiling, constituting 68 species of birds, 13 mammals, 12 reptiles, and five amphibians. Notable among the wildlife documented is the presence of approximately 12,000 individuals of the wintering Tufted Ducks (*Aythya fuligula*). Only 14 species of fish were documented in the lake, five of which are migratory fishes. Socio-economic profiling of SEARCA in 2000 revealed that the human population residing within the park is about 187,300. Much of the development within the park is devoted to fishing, planting rice, fruits (mainly citrus), sugarcane, coconut, and other cash crops.

At least 14 years have passed since the resource profiling for the creation of the first management plan of NLNP was initiated. The information generated from the 1997 resource

profiling may no longer be considered as an accurate description of the current conditions of the park, which have no doubt undergone extensive changes since that time due to population changes, agricultural developments, extent of fishery activities, and other land-use expansions and introductions. There is a need to revisit the status of the baseline environmental and socio-economic conditions that prevails within the park.

2.2 OBJECTIVES

The objectives of the new resource profiling are as follows:

(1) To generate up-to-date inventory of environmental conditions of NLNP which will include habitat types present, florisitic diversity, terrestrial vertebrates diversity, fish and other aquatic organisms, arthropod diversity. This will also include current conservation status and degree of utilization.
(2) To document the socio-economic profile, prevailing land use practices, and current governance and institutional management set-up of NLNP.
(3) To compare the status of environmental and socio-economic conditions between the 1997 SEARCA resource profiling and this current profiling.
(4) To document the extent of environmental and socio-economic modifications that has ensued since the 1997 SEARCA resource profiling.
(5) To provide applicable data-backed (based from this new resource profiling) recommendation/s which will be needed for the review of the current management plan of NLNP.

2.3 TOOLS AND METHODOLOGIES

Sampling Sites. Figure 2.3.1 shows the seven sampling sites surveyed by flora, terrestrial vertebrates and terrestrial arthropods.

Site 1 : Barangay Bambanin
Site 2 : Barangay Montelago
Site 3 : Barangay Tagbakin
Site 4 : Barangay Mabuhay 2
Site 5 : Barangay Calubasanhon
Site 6 : Barangay Happy Valley
Site 7 : Lake (this area was surveyed for avifauna)

2.3.1 VEGETATION

The main goal of the vegetation survey is to characterize the vegetation types and create an inventory of all plants found at the study area.

A list of all vascular plant species that occur within the study area will be prepared. Overall floristic diversity observation will be made to complete a list of plants in the study area. Vegetation type structural data will also be collected which will be used to develop

descriptions of the vegetation within the study area. Also, the presence of any rare, threatened or endangered plant species will be noted and documented.

The objectives of this baseline vegetation study are the following:

- To identify the different vegetation types found in the study area
- To develop vegetation type maps based from the data collected
- To describe quantitatively each vegetation type based on the species richness, diversity, relative abundance, species composition, vegetation cover and community structure
- To develop a comprehensive list of plant species found in the study area
- To identify critical habitat areas based on the presence of Rare, Threatened and Endangered species and other species concern

Sampling Sites. Figure 2.3.2 and Table 2.3.1 shows the sampling sites and plots for the vegetation survey of NLNP. Table 2.3.2 shows the different land use present in Naujan Lake National Park.

Vegetation Cover and Species Composition. Vegetation cover and species frequency were collected for each vegetation types. The data were used for describing the different vegetation types or plant associations. Sample plots were established throughout each of the vegetation types.

The line-intercept technique was used for estimating underground vegetation in a forest as well as in grassland. In the quadrant method several plots are laid out, while in this method, several lines can be run through the plant community. Plant species that intercept each line were identified, counted, and measured.

All plant species found in the study area were identified and documented. For species identification, the plants were identified up to the species level.

Useful Plants. Ethno-botanical species were identified based on the field observations. Also, uses of these plant species were as additional information for future use of the data.

Rare, Threatened or Endangered Species. All Rare, Threatened or Endangered species observed during the course of the field survey were documented and noted for each sampling location.

Alien Plant Species. The presence of alien plant species was recorded.

2.3.2 TERRESTRIAL VERTEBRATES

Sampling sites *(see Figure 2.3.1)*

2.3.2.1 Birds

Data collected during bird surveys were used to determine species composition, richness and abundance, habitat preference, and to document the presence of Rare or Endemic bird species. Photographic and GPS records were taken.

Sampling included the following methods:

Transect Survey. Bird surveys were conducted in representative habitat types within the park boundaries. Based from the SEARCA Management Manual, six habitat types are present in NLNP: (1) Parang (grassland-brushland vegetation), (2) Old-growth Lowland Dipterocarp Forest (remnant), (3) Mixed Mangrove and Swamp-Beach Forest, (4) Marshland, (5) Mosaic of Second-growth forest and agricultural lands, (6) freshwater lake.

Two kinds of bird transect surveys were employed:

Transect Walk. This transect type was employed in the following habitat types: Parang, old-growth lowland dipterocarp forest, mixed mangrove and swamp-beach forest, second-growth forest-agricultural lands mosaics. Whenever possible, a 2-kilometer transect line was established in these habitat types. Nevertheless, transect lengths were determined by the extent of habitat type. Each habitat type was sampled at least three times. Transect survey was conducted 06:00 and 10:00, and between 15:00 to 18:00. Because of topographic and vegetative barriers, it was not possible to walk linear transects; therefore, a meandering path was followed within the habitat/vegetation type. Observations on the type of activities being conducted and time were noted. Photo documentation was conducted if possible. In dense terrain (forested or along stream courses), point transects were used. The observer walked from point to point (100 meters apart). At each point the observer stopped (for 5 minutes), listened and observed birds within 50 meters. One thousand (1,000) meter transects were used in more dense habitats.

Transect Cruise. This transect type was employed on Marshland and freshwater lake habitats. This method used motorized boat to perform the transect counts. Since marshlands in Naujan Lake are situated along lake shore, a single transect cruise covered the two habitat types enumerated. Transect Cruise lines were established within the periphery of the lake; at least a two-kilometer transect line was established.

Data recording. All data were recorded on the standard Data Form. A separate data form was used for each transect. Data collected included: species, number of individuals, habitat, food, and reproductive status. GPS readings were made along the transect line, and were downloaded to a map to show the exact transect path.

Mist Nets. In capturing birds mist nets were used. This method determined what species were present and used to gather specific information of captured species (weight,

condition, etc.). The nets were located in an area where there was a high likelihood of bird capture. Sampling was conducted between 6 am and 9 am (morning) and 3 pm to 6 pm (afternoon), and the nets were checked every 15 minutes.

Captured birds were held in cloth bags. Data (weight, measurements, species, and a photographic record) collected on individuals caught in mist nets were recorded. Individuals were marked to show that they have been captured. After data recording, the bird was released at the site of capture. Birds that are inadvertently killed by capture were properly preserved or disposed of onsite. All data were recorded on the appropriate Data Form.

2.3.2.2 Mammals

Mammal surveys determined species composition, richness and abundance, habitat preference, and documented the presence of Rare or Endemic mammal species. Photgraphic and GPS records were taken.

Sampling included the following methods:

Non-volant mammal trapping. This followed field methods employed in previous surveys of small non-volant mammals in the Philippines (Heaney et al., 1989, 1999; Rickart et al., 1991, 1993). Victor rat traps, Museum Special snap traps, and National live-traps were used to capture these small mammals. For trapping on the ground surface, traps were placed in various suitable situations, including: under root tangles, in front of burrow entrances, along runways, and on top of fallen logs; traps were placed 5-15m apart. Traps were baited with either live earthworms or with fried coconut coated with peanut butter. For above-ground trapping, Museum specials were set on horizontal branches of trees, crisscrossing vines of climbing pandans (*Freycinetia*) and climbing bamboos (*Dinochloa*), or overhanging lianas. Traps were checked each morning, soon after dawn and late each afternoon, and occasionally in the late afternoon and evening.

Trapping stations or trap-lines were established at each elevation band, with each elevation band representing distinct habitat types. A minimum of 150 traps were set for each habitat type each day and were maintained for at least three days. Trapping effort was determined.

Bat sampling. Mist nets were used to sample this group. The final locations of mist nets were randomly determined in the field (in areas with highest likelihood for bat capture). These locations included marshlands, forest edges and openings, stream courses and riparian zones. A total number of nets to be used were determined in the field. Mist nets were set up between 16:00 and 20:00. Nets were checked every 15 minutes.

Ethnozoologic Survey (Consultation with Local Villagers). Another way to obtain indirect information is to interview people in the region. Color plates showing pictures of animals will be shown to the local populace so they can identify the types of species they have observed in the area. This information can supplement the wildlife surveys and provide information on the type of wildlife species present, the type that are hunted, and the hunting method. More communications with local villagers may be needed to gather

additional information on rare animals present in the general area. These surveys are especially useful to gather local information on large mammal species, including primates, pigs, and deers.

2.3.2.3 Reptiles and Amphibians

Reptile and amphibian were surveyed to determine species composition, richness and abundance, habitat preference, and to document the presence of Rare or Endemic species. Photographic and GPS records were taken.

Site Targeted Species. Reptiles and amphibians were searched in the selected sampling locations in each habitat. The search techniques included simply walking through the area noting any species sightings; or searching key habitat areas (under stones, logs, bushes, burrows, and under the leaf litter of trees, shrubs and bushes) to find species. The goal of the site targeted surveys was to identify representative reptile and amphibian species within each habitat/vegetation type.

Stream Transects. The transect technique was used in aquatic and riparian habitats. When surveying stream reptiles and amphibians, transects used typically linear areas set up either parallel or perpendicular to the stream, including stream channel, bank or both. One transect was located along each stream course in the wildlife study area. Transect length varied according to site conditions. Transect location was marked on the field map.

Ethnozoologic Survey (Consultation with Local Villagers). This methodology was utilized for gathering information on reptiles and amphibians.

2.3.3 AQUATIC VERTEBRATES AND MACROINVERTEBRATES

Sampling sites *(Figures 2.3.3.1 and 2.3.3.2).* Thirteen sampling points were selected for Naujan Lake, ten of which are located near and on the shore and three were located at the mid central portion (Figure 2.3.3.1). Three sites were also designated for Butas River based largely on type of vegetation. The heavy current in the river prevented the team from thoroughly exploring the length of the river located inside the boundary of the national park.

Fifteen tributaries of Naujan Lake were surveyed (Figure 2.3.3.2). Selection of sampling sites was based primarily on accessibility to ensure the safety of the survey team. Habitat types include the riffles (rapids), pool area and cataracts. Areas from least disturbed to highly disturbed locations were also selected as sampling sites. Also, areas with and without canopy cover were also considered during the sampling regimen. Coordinates of Macatoc River were also gathered for the purpose of mapping since the survey team was not able to conduct survey in the river due to high water level after days of heavy rain.

2.3.3.1 Fish survey

The survey was done on almost the same time of the day in which samples were collected to minimize temporal biases. Multiple sampling techniques which include both active and passive gears were employed in the survey for each sampling technique. Geo-coordinates of different sampling areas were obtained and recorded for generation of maps.

The following gears/methods for different biota were used in conducting aquatic survey in Naujan Lake National Park:

Seine net. Seine net of '*sinamay*' (1.2 mm x 1.2 mm) mesh standardized at 3.0 m wide x 10 m and 1.5 m long was used.

Cast nets. These were circular nets that were heavily weighted along the perimeter and were thrown over fish. These were used on the limnetic zone to catch larger fish.

Hand nets. Rectangular or D-shaped hand nets were used to collect small fishes along the shore and under vegetation. These were used to collect the fish stunned during electro-fishing.

Electrofisher. Low voltage backpack electrofishing device was used. Fishes in close proximity were stunned and were collected using hand net.

Traps. Baited and non-baited traps were used in this methodology. Fish was allowed to passively enter the trap and were trapped inside.

Hook-and-line. Hook-and-line method was used with earthworm as bait. This method was very effective in luring gobies and eleotrids inhabiting rocky portion of the lake.

All fish species that will be caught regardless of collection method were counted and initial identification were recorded. Most of the captured fish were released alive back into the water. Fishes that were collected were used as voucher specimens and brought to the laboratory for accurate identification.

2.3.3.2. Ethno-ichthyological survey

Fisherman Interview. Fishermen were interviewed to determine if the collection represents the total species catch in the Lake. Indigenous knowledge were obtained from the locals that can be used in catching fish.

Landing/ Fish port area. Landing areas were visited to give a complete picture on the species being caught in Naujan Lake.

2.3.3.3. Documentation and identification of freshwater fishes

Field documentation of collected fish samples and fish species identification in the field and laboratory were facilitated by using several fish identification materials including books and

field guides (Herre 1953, Conlu 1986, Vidthayanon 2007). Fish identification were done through standard morphometric measurements given in FishBase (1995), as noted in other systematic reviews and taxonomic references (Collete 1999, Tan & Lim 2002, Reyes et al. 2003, Larson 2005, Chen & Tan 2005). Morphometric data were recorded for cataloguing and data encoding. Taxonomic nomenclature followed the current systematic status presented in FishBase (Froese and Pauly 2007). The collected voucher specimens were deposited in UPLB Museum of Natural History and were compared with the existing literature and Pisces collection for further taxonomic analysis and proper identification.

2.3.3.4 Aquatic macroinvertebrates

Collections were obtained using hand-net sampling, manual picking under the stones, under the leaves and other coarse particulate organic matter, by digging in littoral fringe and by using emergence traps.

Benthic macroinvertebrates identification and abundance. Macroinvertebrate samples were obtained from sampling areas with three stations each using multiple sampling techniques/methods through a 30m transect line. Samples were washed through sieve of mesh size 0.2mm to reduce the bulk, and organisms were sorted out alive and fixed in 5% formalin, preserved in ethyl alcohol and transported to laboratory for proper identification. Bigger organisms were sorted out while smaller ones were identified under a dissecting microscope. For detailed identification, a compound microscope and available key of Pinder (1978), Durand and Leveque (1981), Bouchard (2004), Freitag and Jäch (2007), Freitag and Jäch (2007), and Braasch and Freitag (2008) were used. The abundance of macroinvertebrates in a square meter area were calculated following Jhingran *et al.* (1989) as follows N = n/A: where, N= Number of macro-invertebrates in a square meter; n= number of macroinvertebrates per sample, A = area in square meter.

Data of the physico-chemical factors and macroinvertebrate abundance were subjected to correlation. The macroinvertebrate taxa count of each family (species) were averaged and used to estimate the abundance of individual species in meter square. The dominance (%) of each of the major macroinvertebrate groups were calculated out of the total macroinvertebrates and were demonstrated using simple bar graphs.

2.3.4 TERRESTRIAL INSECTS AND THEIR RELATIVES

The goal of the studies on terrestrial insects and their relatives (spiders, scorpions, mites, millipedes, centipedes and etc.) was to obtain baseline data on insect species that occur on the site, species richness, relative abundance, and density.

The survey also identified rare, threatened, and/or endangered species, as well as, disease-carrying vectors and/or agricultural species.

The following are the sampling methods:

2.3.4.1 Sweeping

Foliage-dwelling Arthropods. Foliage dwelling arthropods were sampled along a two-kilometers transect line in six pre-established stations (Table 1). Each transect line was divided into four sampling points or plots with an interval of 500 m. Arthropods were collected with an insect net in 40 bi-directional sweeps (=80 sweeps) at each sampling point and were preserved directly in a jar with 95% ethanol.

2.3.4.2. Soil and leaf-litter sampling

Soil-leaf litter inhabiting Arthropods. Soil-inhabiting arthropods were sampled within the same sampling points or plots (Table 1) for the foiiage-dwelling arthropods. Approximately, two liters of mixed soil and leaf-litter sample were gathered from the sampling points and placed in plastic bags. These soil-leaf litter samples were run in portable Berlese-Tullgren funnels for 24 hours to extract the inhabiting arthropods.

2.3.4.3. Light trap

Nocturnal Arthropods. Nocturnal arthropods were sampled from each monitoring station using UV-light trap. The UV-light trap is an ultraviolet lamp set up with framed plastic sheets and catching galvanized iron funnel with a jar of 95% ethanol. Most of the light traps, with an exposure time of six hours (1800H to 2400H) except in Montelago (12 hours), were set up within the range of the transects.

2.3.4.4. Butterfly Monitoring

Butterflies were monitored through spot identification. Numbers of individuals spotted were counted. Butterflies that cannot be identified in the field were collected by means of an insect net and brought to the laboratory for proper identification. Lewis (1973) and other references were consulted for this purpose. Updated nomenclature of the butterflies was also counterchecked using Baltazar's (1991) and Treadaway's (1995) inventory.

2.3.4.5. Ant diversity Monitoring

Ants were baited using sugar solution. Ten (10) baits were put in each plot. A 30 minute waiting time were set in each plot. After 30 minutes, baits were then gathered and were put inside a plastic container. Ants were sorted and identified in the laboratory.

2.3.4.6. Laboratory Processing

Sorting of samples, identification of specimens and counting were done in the laboratory under compound and dissecting microscopes. When necessary, slide mounts were prepared as in the case of most mites. Counting was facilitated by a hand counter. Identification was done using available identification keys.

2.3.5 WATER QUALITY AND MICROBIAL DIVERSITY

This study generally aimed to determine the water quality and assess the bacterial and phytoplankton diversity of Lake Naujan, Oriental Mindoro.

Specifically, the study also aimed to,

1. determine the physical and chemical properties of the water of Lake Naujan,
2. assess the microbial diversity and abundance in the lake water,
3. identify bacteria and phytoplanktons using conventional morpho-cultural, biochemical and physiological methods,
4. correlate microbial diversity with the dynamic environmental conditions, and
5. deposit the pure cultures to the Microbial Culture Collection of the Museum of Natural History, UP Los Baños.

Sampling Sites. For water quality and microbial diversity assessment, seven (7) near-shore sampling sites/stations (Table 2.3.5.1, Figure 2.3.5.1 and Figure 2.3.5.2), or those ≥5 meters deep, were determined for Naujan Lake, Oriental Mindoro. Likewise, criteria for selection of sampling stations were determined based on those set by the project team assessing the biodiversity profile of Naujan Lake.

2.3.5.1. Field measurements and sampling

Field measurements and sampling were conducted using standard and modified procedures. Coordinates of sampling site were determined using a global positioning system (GPS) (Etrex). Samples were collected using a glass water sampler (300 mL) at selected near-shore sites/stations (with ≥ 5 meter depth) at surface, subsurface and near the sediments levels and placed in sterile water containers (approximately 2 L) and stored in an ice box prior to analysis.

2.3.5.2. Physical analyses of lake water samples

Physical properties of the lake water which include light intensity, pH, temperature, salinity and turbidity were measured accordingly. A digital light meter, LX-1330B, was used to measure light intensity and values were reported in *lux* (illuminance unit) which is equivalent to 4.1×10^{-7} W/cm^2. The pH was measured using a portable pH pen (pH 600, Milwaukee, Mauritius) and pH paper (Ajax Finechem, Australia). A mercurial thermometer was used to measure surface temperatures by direct immersion and measurements were reported in °C. Salinity, or salt concentration (ppt) was measured using a hand-held refractometer (RHS10/ATC) by direct application of the solution on the main prism. Turbidity of the samples was measured using a nephelometric turbidimeter and measurements were expressed in NTU or nephelometric turbidity unit.

2.3.5.3. Chemical analyses of lake water sample.

Initial dissolved oxygen (DO) of water samples were measured *in situ* using modified Winkler, Full Bottle method (Annex A). Samples were collected using BOD bottles (300 mL)

from near sediment to surface; added with reagents, manganous sulfate (MnSO4), alkaline iodide-azide solution, concentrated sulfuric acid, starch solution and immediately titrated using sodium thiosulfate to the first disappearance of the blue color. The DO (mg/L) was calculated from the volume of the titrant used (0.0375 N Na2S2O3), wherein each mL of the titrant is equivalent to 1 mg DO when the entire bottle contents (300 mL) were titrated.

The biological oxygen demand of the water samples in 5-day incubation (BOD5) and the presence and concentration of inorganic nutrients such as total nitrate (mg/L) and total phosphorus (mg/L) were determined using standard chemical analyses procedures. Samples were analyzed in the Analytical Service Laboratory (ASL) of the Institute of Chemistry (IC), University of the Philippines Los Baños (UPLB).

2.3.5.4. Most Probable Number (MPN) of Coliforms

Lake water samples were subjected to bacteriological analysis using the MPN technique to determine the potability or suitability of water for drinking and cooking. The MPN technique utilizes a "multiple dilution to extinction" approach, valuable in estimating population of bacteria in samples with very low counts. Presence of coliforms particularly the indicator organism, *Escherichia coli* was also determined.

2.3.5.5. Total bacterial counts

The magnitude and diversity of the population of bacteria, particularly the coliforms, at each sampling site were determined. For heterotrophic bacteria, a 10^{-3} (1:1000) to 10^{-5} (1:100,000) dilutions of the samples were prepared using peptone water (0.1%). A 1-mL aliquot was pour-plated in Plate Count Agar (PCA) and Levine Eosin Methylene Blue (EMB), for total aerobic count and coliform count, respectively. Plates were incubated at 28°C for 3-5 days till growth was observed.

2.3.5.6. Identification of purified bacterial isolates

Identification of representative pure bacterial isolates was done using standard cultural, morphological, biochemical and physiological tests. Cultural observations were made for bacterial growth in culture medium. Colony size, margin, elevation, color or pigment produced and texture were noted. Morphological characterizations were made after Gram-staining the purified bacterial isolates. Gram-reaction, formation, and size of the cells were noted and served as basis for further biochemical characterization. Preliminary biochemical characterizations were examined using catalase reaction, oxygen requirement, hydrolysis of starch and liquefaction of gelatin. Differential and/or specific tests were also conducted to determine the species of bacterial genera obtained. These tests were done following standard procedures described. Physiological tests were used to confirm identity of the bacteria.

Identified bacterial isolates were maintained in Nutrient Agar slants and kept at 4°C and deposited at the Microbial Culture Collection of the UPLB Museum of Natural History for further characterization and assays and assignment of accession numbers.

2.3.5.7. Total plankton counts

A hand-over-hand technique using plankton net was used to collect samples at a depth of about 1 foot below the surface of designated sampling sites. Samples were collected in a clean sterile container and preserved with borax-buffered formalin and/or Gram-iodine solution. The plankton density and distribution was measured using Sedgewick-rafter tray. For each site, the number of plankton species, total number of individuals and density of organism were determined. The number of planktons per mL of water sample collected was calculated using the following formula:

$$\text{Cells/mL} = \frac{(\Sigma C)\ (1000\ \text{mm}^3)\ (Vc)}{(L)\ (D)\ (W)\ (S)\ (Vt)}$$

Where:

ΣC = number of organisms counted
Vc = volume of concentrated water samples + preservative
L = length of each strip in mm (50.0 mm)
D = depth of the strip in mm (1.0 mm)
W = width of the strip in mm measured using a calibrated ocular micrometer (1.0 mm) S = number of strips counted Vt = total volume of collected water samples

2.3.6 SOCIO-ECONOMIC PROFILE

Survey, key informant interview and focus group discussions were used in gathering the primary data collection. A two-stage sampling procedure was adopted. First stages, 50% of the coastal barangays were randomly identified for the survey. All coastal puroks and sitio of the chosen barangays were surveyed 100%.

2.3.6.1. Survey Questionnare

A survey questionnaire was used to determine the following information: level of subsistence or traditional use of Naujan lake by the local community; presence of religious, spiritual, historical significance; presence of species of high social or economic value; recognition by community of any ecosystem functions of the Lake that contribute significantly socially or economically to the well-being of the community; utilization of Naujaun Lake resources for economic purposes by the community; position of landowner with regards to being managed for conservation; communities' support (or lack) for management of the area for conservation and other purposes.

2.3.6.2. Key informant interview.

Local and national government officials stationed in the area, officers of people's organizations, personnel of non-government organizations, and other people who could

provide valuable information to substantiate the survey findings were interviewed during the survey.

2.3.6.3. Focus group discussion (FGD)

For coastal barangays not covered by the survey, a FGD with relevant sectors was done.

2.3.6.4. Secondary data gathering

To augment primary data analysis, secondary data were gathered from municipal, barangay and DENR-PAMB records. Maps, census data, CLUPs, and barangay profiles were examined. Reports from various agencies and thesis manuscripts were reviewed.

The following secondary data were gathered:

1. Size or area of the barangay and the municipality
2. Population – size, gender, number of households, average family size, population and gender per age class, and density; growth rate, birth rate, migration rate, origin of migrants and reason for migration
3. Health – morbidity and mortality rates, leading causes of death, disease and sicknesses, maternal death, child mortality, presence of health agencies and health programs, presence and types of toilets, and waste disposal system
4. Education – gender-based literacy rate by level, incidence of drop-out by gender, distribution of schools, student to teacher ratio, and learning support facilities available
5. Income and livelihood – employment rate by gender, sources of income, income classes, farm and house assets
6. Institutions and services – types of formal and informal organizations and service provided, religious institutions, transport and communication facilities or networks available on site, water and electricity agencies
7. Land use and land cover extent

2.3.7 GIS MAPPING AND PHOTODOCUMENTATION

A GPS using longitude/latitude (degrees, minutes, and seconds) was used to record all sampling points, transect locations, transect tracks, trapping locations, and specific locations. Sampling locations and observations were placed onto project maps and into the project GIS data base. Photographs were taken of all sample sites/transects. Photos were taken of species captured.

Listed herein are the types of maps that were generated from this baseline survey:

1. Geopolitical map
2. Human population map (for year 2000 and 2011)
3. Land-use map (for year 2000 and 2011)
4. Habitat/Vegetation map

5. Location of threatened, range-restricted, and congregatory species, and roosting/nesting areas Critical Habitats for biodiversity
6. Areas of high fish diversity
7. Location/s of fish nurseries
8. Areas with significant levels of elemental, inorganic and organic nutrients
9. Areas with significant levels of microbial (especially coliforms) and plankton diversity
10. Water quality map
11. Areas of high resource extraction

2.3.8 RARE SPECIES AND CRITICAL HABITATS

The presence or absence of Rare Species and Critical Habitats was determined. Species with IUCN Redbook ratings of CR, EN, NT, VU and those that are included in the Philippine protected species list were considered Rare species.

Critical Habitat Areas. All possible Critical habitats were identified and descriptions were provided. Critical habitat areas were mapped and characterized.

Rare Species. All Rare species observed and collected during the field survey were noted and documented.

2.3.9 DATA ANALYSES

Biological indices were computed for each representative site.

Species richness. Species richness (D) was determined by the number of species present in a community.

Diversity index. Diversity index was computed following the Shannon Index: $H' = -\Sigma [(ni/N) \ln (ni/N)]$ where; n is the proportion of individuals found in the ith species and ln is the natural logarithm.

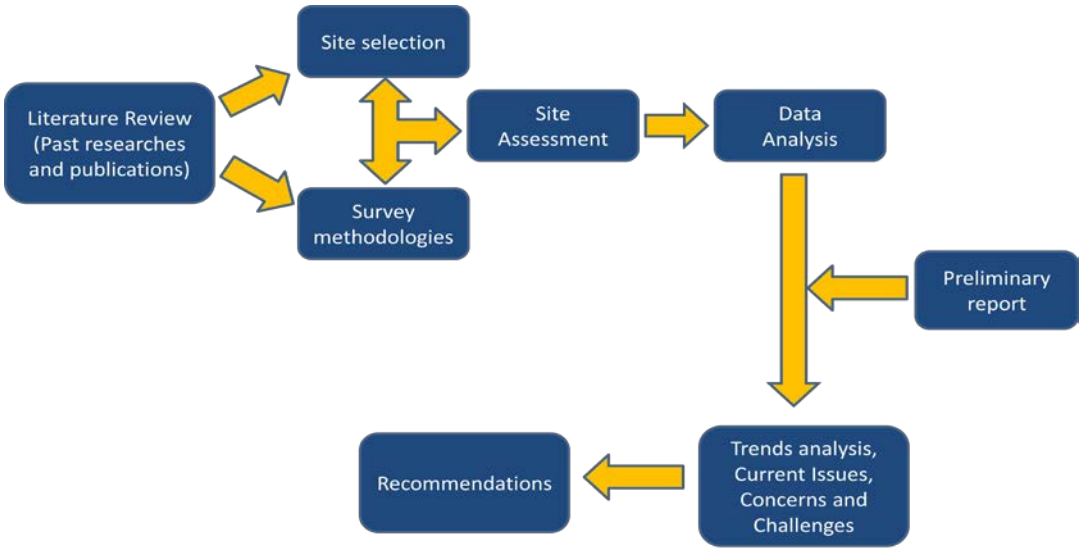
Evenness index. Pielou's Evenness Index (*e*) use the Shannon's Diversity Index were computed as: $e = H'/\log S$ where; S = total number of species.

Dominance index. Species dominance was computed using the Simpson's Dominance Index formula: $c = \Sigma [ni (ni-1)/ N(N-2)]$ where; *n*i is the number of individuals in the *i*th species and N is the total number of individuals.

Fish Density. The number of individual species per unit area, or the fish density, was calculated. Similarity (Cs) between communities using Sørensen similarity index (Smith and Smith 2004) which is based on species composition will also be computed using the formula: $Sim = 2\Sigma nc/\Sigma n1+\Sigma n2$ where; nc= common species between sites, n1 = the species of site 1 and, n2 = the species of site 2.

Statistical analysis. SPSS-version 13.1 (Statistical Package for Social Sciences) was used.

2.4 ANALYSIS FRAMEWORK



3. PROFILE OF NAUJAN LAKE NATIONAL PARK

3.1 PHYSICAL AND GEO-POLITICAL CHARACTERISTICS

The discussion that follows describes the Naujan Lake National Park in terms of geopolitical and biophysical characteristics that were based primarily from secondary sources. The descriptions relate to location, administrative boundaries, legal land classification, land cover, geology, soils, topography and slope.

The extent and distribution of the different chatacteristics were expressed according to the watershed encompassing the Park. The watershed was delineated using GIS and derived from the digital elevation model (DEM) of SRTM (Shuttle Radar Topography Mission).

Location. The Park is located in Oriental Mindoro in the towns of Victoria, Naujan, Pola and Socorro (Figure 3.1.1).

Administrative boundaries. Figure 3.1.2 shows the various administrative boundaries of the Park, to wit: Proclamation 282, PASA, and PAMB with estimated areas (in hectares) of 14,422, 5,255, and 6,628 respectively. These are values net of the estimated area of the lake which is set at 8,125 ha. The watershed has a total area of 37,028 ha or a net area of 28,903 ha.

Victoria represents the largest portion of the watershed (64%) that drains to the lake and eventually northward to the town of Naujan (21%). Other LGUs belonging to the watershed include Sablayan (1%), Pola (5%) and Socorro (8%)[1].

[1] The source data categorizes 1% or about 323 ha as lake.

Legal land classification. Based on the legal land classification, 57% of the watershed is alienable and disposable while 43% is forestland. This amounts to 16,256 ha and 12,377 ha respectively (see Figure 3.1.3).

Land cover *(Figure 3.1.4).* The land cover from 2003 shows that 62% or about 17,880 ha are devoted to agriculture which are located mostly on the western portion of the lake. This is composed of annual and perennial crops. On the other hand, the souhwest and northeast portions are forested (35% or 10,167 ha). The rest of the area are marshland (2% or 616 ha), built up (0.1% or 20 ha), grassland (0.1% or 17 ha)[2].

Geology *(Figure 3.1.5).* The geology of the Park is composed of recent formation (43% or 12,559 ha), pliocene-pleistocene (34% or 9,791), pliocene-quaternary (12% or 3,574), neogene (5% or neogene), sedimentary and rocks (4% or 1,178 ha)[3].

Soils *(Figure 3.1.6).* In terms of soils, 39% (or 11,167 ha) belong to the Luisiana clay loam series. Other series in the watershed include San Miguel silt loam (23% or 6,778 ha), San Manuel loam (12.1% or 3,484 ha), Undifferentiated mountain soils (11.7% or 3,389), Bulacan clay loam (7% or 1,936 ha), and San Manuel sandy loam (1% or 392 ha)[4].

Topography and Slope *(Figure 3.1.7 and 3.1.8).* The Park is has a high elevation of 580 masl at the southern tip of the wateshed near the boundary of Sablayan. The lowest elevation is recorded at 20masl (Figure 3.1.4). The slope is generally flat with sloping portions in the northeast and south (Figure 3.1.5).
Figure 3.1.4. Land cover of NLNP.

3.2 BIOLOGICAL RESOURCES

3.2.1 PLANTS

The vegetation and flora of the Naujan Lake National Park have only recently been described by Gruezo (2009, 2010a, b), although these were based on actual field surveys led by SEARCA and undertaken in November 1996. Previous to these papers no comprehensive floristic account of the area has ever been published. About eight types of vegetation were recognized by Gruezo (2010b), *viz.* (i) second-growth dipterocarp, interspersed with large parcels of coconut-banana-citrus plantations and small swidden farms, (ii) secondary broadleafed forest, (iii) brushland, (iv) parang (savannah) type, (v) riparian, (vi) marshland, (vii) beach forest, and (viii) mangrove swamp forest. These, however, were not adequately described or differentiated from each other in any of the three Gruezo papers. The plant species recorded by Gruezo (2010b) in the entire national park and lake watershed zone of 36,425 hectares was 613 species (72% indigenous, 13% exotics) in 433 genera and 105 families of vascular plants.

Vegetation types. In the present survey based on the six sites sampled, we recognize only four natural vegetation types, plus the cultivated areas for coconut, citrus, banana, rice, and other crops. Two of the natural vegetation types are successional stages or degraded states

[2] The source data categorize 1% or about 204 ha as water.
[3] Based on source data, 1% or about 350 ha are categorized as lake and reported as No Data.
[4] Based on source data, 6% or about 1,748 ha are categorized as lake and reported as No Data.

from a lowland evergreen rain forest that may sometimes overlap with one another; one represents small remnants of freshwater swamp forest; and the other, marshes, a type of wetland vegetation on the lakeshore. No beach forest and mangrove swamp forest were documented in this particular survey as these are already outside the actual boundaries of the park.

The natural vegetation types and cultivated areas occur in a mosaic across the lake and surrounding landscape from water level at the lake up to 273 m elevation on the top of a hill on the northern end of the lake.

1. ***Secondary forest.*** This vegetation includes small remnants and regrowth of degraded typical lowland evergreen rain forests (Fernando *et al.* 2008) that have been previously logged or subjected to *kaingin* (swidden farming). This may include some species of palms (Figure 3.2.1.1), *Ficus,* and isolated large trees *Artocarpus*, *Pometia* (Figure 3.2.1.2), *Sterculia,* and the dipterocarps *Shorea contorta* and *Shorea guiso*. In the Naujan Lake area, this vegetation type is found in Sites 2, 3, 4, and 6 covering a mere 1.42% of all the sites (Table 3.2.1.1).

2. ***Parang vegetation*.** The *parang* vegetation is a mixture of grassland (tall coarse grasses) and small woody vegetation (dense thicket of shrubby growth and scattered individuals of trees) (Whitford 1906; Brown 1919; Richards 1952). It also includes the 'brushland' type of Gruezo (2010a, b) and is sometimes referred to in the literature as 'thicket', 'scrub', 'scrubland', or 'shrubland'. This vegetation represents a more highly degraded stage of what previously was a lowland evergreen rain forest. In the Naujan Lake area, this vegetation type is found in all sites surveyed, except Site 1, covering nearly 21% of all sites (Table 3.2.1.2). It consists predominantly of the grasses *Imperata cylindrica* and *Saccharum spontaneum*. Trees include fast-growing representatives of plant families such as Euphorbiaceae *(Macaranga, Mallotus)* (Figure 3.2.1.3) and Moracae *(Ficus).* The *parang* is one of the characteristic and extensive secondary vegetation types in the Philippines.

3. ***Freshwater swamp forest.*** This type (Fernando *et al.* 2008) is now represented only by very small remnants, and includes, in part, the 'riparian forest', described by Gruezo (2010). The typical tree species in this vegetation include *Nauclea orientalis, Barringtonia racemosa,* and *Terminalia copelandii* (Figure 3.2.1.4). These areas may sometimes be inundated in the rainy season when water overflows from the lake or nearby rivers and creeks. Some remnants of this type occur on drier soils just behind the marshes that may be flooded at certain times of the year or only occasionally, or in areas along the freshwater rivers not otherwise occupied by mangroves. This vegetation type is found in Site 1 (northern side) and Site

4. ***Marshes****.* These are wetland areas along the lakeshore that are continually inundated in water. The vegetation often consists of soft-stemmed plants, usually sedges (Cyperaceae) (Figure 3.2.1.5), grasses (Poaceae), and *Eichhornia crassipes* and *Monochoria* (Pontederiaceae) (Figure 3.2.1.6). In the Naujan Lake area, this vegetation type is found more commonly occurring on the western side of the lake, mainly in Site 1; some also occur in Sites 4, 5, and 6

5. ***Cultivated areas.*** These are areas long converted from a natural vegetation type into rice paddies and crop plantations for coconut (Figure 3.2.1.7), citrus (Figure 3.2.1.8), banana, root crops, or various combinations of these crops (Figure 3.2.1.9). In the Naujan Lake National Park, the cultivated areas occur throughout; they cover nearly two-thirds or about 62.3% of all the sites.

***Flora and species diversity*.** In all the six sites surveyed, we recorded a total of 319 species of vascular plants belonging to 88 families (Table 3.2.1.3). At least two species, *Randia mindorensis* Elmer [Rubiaceae] (Figure 3.2.1.10) and *Saurauia mindorensis* Merr. [Actinidiaceae], are endemic to Mindoro Island; 37 species in all are endemic to the Philippines. The plant families represented with most number of species in the lake park include Poaceae (grasses, including rice, sugar cane, and weeds) 27 species; Fabaceae (legumes, including cultivated species and weeds) 24 species; Moraceae (mostly figs) 21 species; Malvaceae 15 species; Euphorbiaceae 12 species; and Asteraceae 11 species. This clearly indicates that the flora of the lake park is mainly of pioneer species (characteristic of disturbed sites) and of cultivated species

Fourteen (14) species are included in the DENR Administrative Order No. 2007-01, *The National List of Threatened Philippine Plants and their Categories* (Fernando *et al.* 2008) and in the *2012 IUCN Red List of Threatened Species* (Table 3.2.1.4). Four species are in the Critically endangered (CR) category, two in the Endangered (EN) category, and seven in the Vulnerable (VU) category. All of these species occur in the remnant forest secondary forest.

The sites with the highest plant biodiversity are Sites 3 and 4 with a mean Shannon's Index of 2.53 and 2.457 respectively (Table 3.2.1.5). The highest average number of species per plot (24.5-26 species) were also recorded in these two sites. Both sites are on the eastern side of the lake. The sites with lowest biodiversity indices and lowest average number of species per plot are Site 1 (1.545, 16.2 species) on the western side of the lake, and Site 5 (1.694, 16.6 species) on the southeastern side.

3.2.2 TERRESTRIAL VERTEBRATES

Species Diversity and Endemism. From a 15-day survey of Naujan Lake National Park, encompassing seven sampling sites and three habitat types (lake and marshland, second-growth forest, and predominantly agricultural cultivations), a total of 159 terrestrial vertebrates were recorded (Figure 3.2.2.1). This total comprised of 105 species of birds (Tables 3.2.2.1), 21 species of mammals (Table 3.2.2.2), and 33 species of reptiles and amphibians (Table 3.2.2.3). Two species of mammals captured are new records for Mindoro Island: the Hairy-winged bat (*Harpiocephalus harpia*) and Orange-fingered Myotis (*Myotis rufopictus*) (Heaney et al 1998).

At least 40 species or 25% of the total terrestrial vertebrates recorded (Figure 3.2.2.2) are classified as endemic to the Philippines (23 species of birds, four mammals, and 13 reptiles and amphibians). These 40 endemic vertebrates are further subdivided: 32 species are Philippine endemic, five species are restricted to only two or three islands (Range-restricted), and three species are Mindoro Island endemics. The Mindoro endemics

are: Black-hooded Coucal (*Centropus steeri*), Scarlet-collared Flowerpecker (*Dicaeum retrocintum*), and the Mindoro Variable-backed Frog (*Hylarana mangyanum*).

Among the five range-restricted vertebrates, Ashy Ground-Thrush (*Zoothera cinerea*) is found only in Mindoro and Luzon Island; the Little golden-mantled flying fox (*Pteropus pumilus*) is found only in Mindoro and Western Visayas; the Lowland striped shrew-rat *(Chrotomys mindorensis*) is restricted to Mindoro and Southern Tagalog region of Luzon Island; the Northern Short-headed Snake *(Oligodon ancorus*) is found only on Mindoro and Luzon Island; and the Quadra's Flying Lizard (*Draco quadrasi*) is restricted to Mindoro, Romblon, Tablas, and Sibuyan islands.

In addition, at least seven subspecies species of birds captured are Mindoro endemic as well. These are: Colasisi (*Loriculus philippensis*), Philippine Coucal (*Centropus viridis*), White-bellied Woodpecker (*Dryocopus javensis*), Philippine Bulbul (*Hypsipetes philippinus*), Tawny Grassbird *(Megalurus timoriensis*), Mangrove Blue Flycatcher *(Cyornis rufigastra*), and Green-backed Whistler (*Pachycephala albiventris*).

Species Diversity per Habitat Type. Three major habitat types were identified within Naujan Lake National Park: (1) lake and marshland, (2) second-growth forest, and (3) agricultural areas. Lake and marshland habitat comprised mostly of reed beds and ricefield edges along the lake periphery. This habitat type is concentrated mostly along the entire western portion of the lake, and near Subaan River (Sites 1 and 7). Second growth forest within Naujan Lake comprised mostly of early to mid regenerating forest and scrub/parang vegetation. This habitat type, in small isolated areas, is found in Barangays Montelago (Naujan municipality), Mabuhay Dos and Batong Dalig (Socorro municipality) (Sites 2, 4, and 6, repspectively). In Brgy. Montelago, tall mature trees were evident as emergents. Agricultural areas, from plantations, ricefields, open fallow fields, human habitations dominate the rest of Naujan Lake terrestrial landscape (Sites 3 and 5).

Lake and Marshland- Sites 1 and 7. Seventy one species of terrestrial vertebrates were recorded in this habitat type (44% of total vertebrates recorded), comprising of 48 species of birds (Table 3.2.2.4), eight mammals (Table 3.2.2.5), and 15 reptiles and amphibians (Table 3.2.2.6). All 16 species of migratory birds are found in this habitat type including the threatened Philippine Duck (*Anas luzonica*). High numbers of Tufted Duck *(Aythya fuligula*), reaching as high as 3,500 individuals, were also observed. At least seven species observed are classified as endemics, with one species, the Lowland striped shrew-rat (*C. mindorensis*) listed as restricted to Mindoro and Southern Luzon. This endemic murid rodent was captured in tall reed beds near the lake periphery. Half of the total alien and introduced species (5 species) were also found in this habitat type, comprising of three murid rodents (*Rattus* spp. And *Suncus*), and two amphibians (*Rhinella marinus* and *Hylarana erythraea*). Virtually all of these alien and introduced species were found along edges of ricefields and reed beds. On the other hand, a total of three species recorded in this habitat type is classified as threatened species by the International Union for the Conservation of Nature (IUCN, 2010) and Department of Environment and Natural Resources (DENR Administrative Order 2004-15). These were: Philippine Duck (*A. luzonica*), Monitor Lizard (*Varanus salvator*), and Reticulated Python (*Python reticulatus*).

Second-growth Forest- Sites 2, 4, and 6. This habitat has the highest species diversity with 118 species, translating to almost 75% of total terrestrial vertebrates documented for the whole Naujan Lake National Park. This total constitutes 75 species of birds, 19 mammals, and 24 species of reptiles and frogs. Roughly 78% (31 species) of the total number of endemic species are also present in this habitat type. All three Mindoro endemics recorded for the whole national park were found in this habitat type as well. Furthermore, the isolated areas of secondary forest harbors 10 of the 14 threatened species documented for the whole park. This constitutes: four species of birds (*Spizaetus philippensis*- Philippine Hawk-Eagle, *C. steeri, Z. cinerea*, and *D. retrocintum),* two mammals (*P. pumilus* and *Macaca fascicularis*- Long tailed Macaque), two reptiles (*Hydrosaurus pustulatus*- Philippine Sailfin Lizard, and *V. salvator*- Monitor Lizard) and two frogs (Luzon Fanged Frog- *Limnonectes macrocephala*, and *H. mangyanum*). On the other hand, 90% of the total alien and introduced species were found in this habitat type, comprising of six mammals and three frogs.

Agricultural Areas- Sites 3 & 5. A total of 89 species of terrestrial vertebrates were recorded in this habitat type, comprising of 59 species of birds, 11 mammals, and 19 reptiles and frogs. A modest 55% of the total endemic species were also recorded, most notably the Mindoro endemic frog *H. mangyanum* and Range-restricted bat *P. pumilus.* There were also seven species recorded that are classified as threatened species. It is interesting to note that these seven threatened species can persist in highly degraded areas such as plantation and human habitations. These threatened species include one bird, Indigo-banded Kingfisher (*Alcedo cyanopecta*); one mammal, Little golden-mantled flying fox (*P. pumilus*); two reptiles (*H. pustulatus* and *V. salvator*); and three frogs, Truncate-toed Chorus Frog (*Kaloula conjuncta*), Luzon Fanged Frog (*Limnonectes macrocephala*), and Mindoro Variable-backed Frog (*H. mangyanum*). A total of five alien and introduced species were documented in this habitat type.

Diversity Indices for Birds. A relatively high Diversity Index values were computed for all the six sites sampled in Naujan Lake National Park, with range of 3.03 to 3.68 (Tables 3.2.2.7-3.2.2.12). Sites with the highest indices were Site 2 (in Brgy. Montelago) with 3.67, and Site 6 (in Brgy. Batong Dalig) with 3.68. This is followed by Sites 3 (in Brgy. Tagbakin) with 3.58, and Site 5 (in Brgy. Calubasanhon) with 3.43. Sites with the lowest Diversity Indices were Sites 1 (western portion of Naujan Lake) with 3.03, and Site 4 (Brgy. Mabuhay Dos) with 3.43. The sites with the highest indices have also the highest species richness (Site 2- 55 species, Site 6 with 56 species), and these sites are also situated in second-growth forest. It is interesting to note that a relatively high Diversity Indices were computed for agricultural sites (Sites 3 and 5) despite the degraded state of the habitat. On the whole, Sites 2 to 6 had almost similar Diversity Index values (3.43 to 3.68), reflecting a highly diverse and relatively abundant bird community.

Evenness Indices for all sites were roughly the same for Sites 2-6, ranging from 0.89 to 0.93; Site 1 had the lowest Evenness Index with 0.83. The relatively high Evenness Indices for Sites 2-6 indicates that the population of each bird species counted for these sites are more or less evenly distributed such that numerical dominance is not attributed to only a few species (i.e. 2 to 3 species). This is further reinforced in the low Dominance Index values for all the sites, which ranged from 0.03 to 0.08.

Threatened Species. A total of 14 species recorded in this survey for Naujan Lake are classified as Threatened Species either by IUCN, DENR, or CITES (Convention on International Trade of Endangered Species) (Figure 3.2.2.3), comprising of six species of birds, two mammals, four frogs, and two reptiles. The total threatened list is further subdivided into- one species with Critically Endangered (CR) status: Black-hooded Coucal (*Centropus steeri*); one Endangered (EN): Mindoro Variable-backed Frog (*Hylarana mangyanum)*; five Vulnerable (VU): Philippine Hawk-Eagle (*Spizaetus philippensis*), Philippine Duck (*Anas luzonica*), Ashy Ground Thrush (*Zoothera cinerea*), Scarlet-collared Flowerpecker (*Dicaeum retrocintum*), and Philippine Sailfin Lizard (*Hydrosaurus pustulatus*); three Near-Threatened: Indigo-banded Kingfisher (*Alcedo cyanopecta*), Little golden-mantled flying fox (*Pteropus pumilus*), and Luzon Fanged Frog (*Limnonectes macrocephalus*); one Data Deficient (DD): Truncate-toed Chorus Frog (*Kaloula conjuncta*); one CITES Appendix II: Long-tailed Macaque (*Macaca fascicularis*); two DENR DAO 2004-15 threatened species: Monitor Lizard (*Varanus salvator*) and Reticulated Python (*Python reticulatus*).

The secondary forests in Sites 2, 4, and 6 (Brgys. Montelago, Mabuhay Dos, and Batong Dalig, respectively), had the highest concentration of threatened species, having 10 of the 14 threatened species recorded for the whole park. The agricultural area sampling sites 3 and 5 (Brgy. Tagbakin and Calubasanhon, respectively) harbored seven threatened species indicating that these species, despite their relative rarity can persist in degraded habitats. On the other hand, their presence in human-associated habitats (e.g. plantations, residences) increases the risks of population decline most probably due to hunting and habitat loss. The lake periphery and marshlands contained at least three threatened species. A majority of the threatened species found in agricultural areas and wetland habitats are relatively common (e.g. *Varanus salvator* and *Pythoin reticulatus*).

Enumerated below are the observation accounts of the 14 threatened species recorded during the survey.

Critically Endangered

Black-hooded Coucal (*Centropus steeri*)

This Mindoro Endemic bird was observed on three occasions. One individual was observed in the second growth forest of Site 2 (Brgy. Batong Dalig) skulking among dense undergrowth and overhanging vines, some 15 meters from the trail. Two individuals were observed on separate occasions in a relatively mature second growth forest in Site 6 (Brgy. Montelago), both of which among dense undergrowth with bamboo thickets and vines. This species was previously recorded within Naujan Lake in the early 1980s at the Multiple-use Forest Research Center (MUFRC) Experimental Forest, which lies to the south of the lake. This locality is an logging concession, which, according to DENR staff accounts, was mostly covered by secondary growth of dipterocarp forest and scrubland during the 1980s (Collar at al., 1999; Mallari et al., 2001).

Endangered

Mindoro Variable-backed Frog (*Hylarana mangyanum*)

Two individuals of this Mindoro Endemic frog were captured in Site 3 (Brgy. Tagbakin) and Site 6 (Brgy. Batong Dalig); both were captured in small creeks underneath

isolated patches of early second growth. Based on this survey's capture record, this frog is apparently rare despite intensive search along streams and creeks. This species is most probably found in streams that is situated in relatively more intact and mature forest.

Vulnerable

Philippine Hawk-Eagle (*Spizaetus philippensis*)

This raptor was only sighted once, hovering along the lake shore in Site 2 (Brgy. Montelago). It is highly possible that this species nest within Brgy. Montelago as this locality has relatively tall and mature second-growth forest. This species has not been recorded previously in Naujan Lake.

Philippine Duck (*Anas luzonica*)

This wetland bird was sighted several times along the entire periphery of the lake, and about 100 meters inland from the lake shore. A total of 22 individuals were counted. Three individuals in Site 1 (Sitio Banbanin), flying over rice fields and marshland; 15 individuals along the western periphery of the lake; and four individuals along marshy areas near the mouth of Subaan River. Surveys in 1997 indicated that this species was rare, with less than five individuals sighted (Ticsay and Ledesma, 1998). In December 2000, 12 individuals were counted (Collar at al., 1999; Mallari et al., 2001). It appears that Lake Naujan does not large congregations of this species, and only holds small isolated populations.

Ashy Ground-Thrush (*Zoothera cinerea*)

A total of three individuals of this Luzon and Mindoro endemic forest bird. All three individuals were recorded in the forested sampling sites (2, 4 & 6), in barangays Montelago, Mabuhay Dos, and Batong Dalig. Previous records were from Tarugin, Naujan back in the 1970s (Collar at al., 1999; Mallari et al., 2001).

Scarlet-collared Flowerpecker (*Dicaeum retrocintum*)

At least five individuals of this diminutive bird were recorded in Sites 2 (Brgy. Montelago, and 4 (Brgy. Mabuhay Dos). Virtually all birds were sighted along forest edges in early second growth. Previous records were from MUFRC Experimental Forest in the 1990s (Collar at al., 1999; Mallari et al., 2001). This species was not recorded during the 1997 survey.

Philippine Sailfin Lizard (*Hydrosaurus pustulatus*)

One individual of this large agamid lizard was observed along a small creek in Brgy. Montelago. Interviews with local guides indicate that this lizard may not be present within the immediate vicinity lake although (particularly on river mouths), although it is highly likely that they are present further inland along rivers.

Near-Threatened

Indigo-banded Kingfisher (*Alcedo cyanopecta*)

One individual was sighted in Brgy. Tagbakin (Site 3), along a small creek underneath dense foliage of early riparian forest growth. Due to its small size and secretive behavior, it is highly likely that this species is also present in other sites around the lake, particularly in forested areas.

Little golden-mantled flying fox (*Pteropus pumilus*)

A total of five individuals were netted in three different sites around Naujan Lake: Site 2 (Brgy. Montelago- 1 individual), Site 3 (Brgy. Tagbakin- 1 individual), and Site 5 (Brgy. Calubasanhon- 3 individuals). The majority of the captures of this range-restricted fruit bat were from agricultural areas and early second growth/scrub type vegetation, all of which were captured along semi-exposed ridgetops and hills. This species was not recorded during the 1997 survey.

Luzon Fanged Frog (*Limnonectes macrocephalus*)

Five individuals of this Luzon and Mindoro endemic frog were captured in small streams in Sites 3 (Brgy. Tagbakin), 5 (Brgy. Calubasanhon), and 6 (Brgy. Batong Dalig). All captured individuals were taken from streams underneath either dense second-growth or scrub vegetation. This species is probably common especially along the entire length of rivers and streams surrounding Naujan Lake. This species was commonly sighted during the 1997 survey.

Data Deficient

Truncate-toed Chorus Frog (*Kaloula conjuncta*)

One individual of this diminutive frog was captured in Site 3 (Brgy. Tagbakin) inside a tree hole near a creek that is situated along dense early-growth riparian forest. Its secretive behavior makes it quite hard to observe and document this species.

CITES Appendix II

Long-tailed Macaque (*Macaca fascicularis*)

Individuals of this primate were observed in small numbers (1-4 individuals) in Sites 2 (Brgy. Montelago), 4 (Brgy. Mabuhay Dos), and 6 (Brgy. Batong Dalig). All individuals were observed in forested habitats. Records from the 1997 survey were from Brgy. Maria Concepcion and Brgy. Bugtong-na-Toog in Socorro Municipality, Brgy. Montelago in Naujan Municipality, and Brgy. Matulatula in Pola Muncipality.

DENR DAO 2004-15 List of threatened species

Monitor Lizard (*Varanus salvator*)

The northern Philippine population of *V. salvator* is considered threatened by DENR. This large lizard was observed in all sampling sites, from secondary growth forest, scrub vegetation, plantations, reed beds, marshland, to human habitations.

Reticulated Python (*Python reticulatus*)

Based from herpetofaunal census and interviews with local guides, this large snake was also documented in all sampling sites.

Alien and Introduced Species. A total of 10 species documented are classified as alien and introduced (Figure 3.2.2.4). These are: Eurasian Sparrow (*Passer montanus*), Asian House Shrew (*Suncus murinus*), House mouse (*Mus musculus*), Ricefield Rat (*Rattus argentiventer*), Polynesian rat (*R. exulans*), Common brown rat (*R. norvegicus*), Oriental house rat (*R. tanezumi*), Marine Toad (*Rhinella marina*), Chorus Frog (*Kaloula pulchra*), and the Common Green Frog (*Hylarana erythraea*). In most respects, most of these are also considered as pest, particularly the rodents (*Rattus* spp.), and cause damages on agricultural crops and

residences. Practically all of these alien and introduced species are present in all habitat types; they are also most numerous in secondary forests sites (9 out of 10 species present), indicating successful colonization and could lead to displacement of native and endemic species. Five alien and introduced species were recorded both on agricultural areas and lake and marshland areas.

Migratory, Congregatory, and other Wetland Birds. From the avifaunal census, a total of 27 species are strongly associated with wetland habitats. This total comprised of the families Ardeidae (egrets, herons, and bitterns) with eight species; Anatidae (Ducks) with three species; Accipitridae (hawks and eagles) with one species; Rallidae (rails) with eight species; Charadriidae (plovers) with one species; Sternidae (terns) with three species; Sylviidae (Old World warblers) with two species; and Motacillidae (wagtails) with one species.

Roughly 90% of the wetland associated birds (24 species) documented are congregatory, meaning these birds form large colonies. This survey generated 15 new records of congregatory birds as the book "*Key Conservation Sites in the Philippines"* (Mallari et al., 2001) listed only 14 species present in Naujan Lake.

Naujan Lake National park has been declared as a Ramsar site in 1999 mainly due to the presence of at least 10,000 individuals of wintering Tufted Ducks. The population of this species in Naujan Lake is estimated to be at least 1% of the global population threshold, a criteria for inclusion as a Ramsar site. During this survey (conducted late October), close to 2000 individuals were counted. It is believed that this number will increase during the months of January and February.

It is interesting to note that at more than 2000 individuals of Whiskered Tern (*Chlidonias hybridus*) were counted during this survey. Based from "*Key Conservation Sites in the Philippines"* (Mallari et al., 2001), the 1% threshold global population for this species is 1000 individuals. As such, the basis for inclusion of Naujan Lake as a Ramsar, previously justified by the presence of 10,000 plus individuals of Tufted Ducks, should also include the presence of of more than 1% global population of Whiskered Tern counted in Naujan Lake.

3.2.3 AQUATIC VERTEBRATES AND MACROINVERTEBRATES

3.2.3.1 Naujan Lake and Butas River Fish Fauna

Naujan Lake. Majority of the species recorded in Naujan Lake was migratory species wherein they live primarily in marine environment but frequently visit freshwater ecosystems and stay, but return to the sea when they become sexually mature. Some species just enter freshwater ecosystem in pursuit of possible prey, and leave.

Twenty fish species (Table 3.2.3.1.1) were documented that include eleven migratory species: *Chanos chanos* (Bangus*)*, *Anguilla marmorata* (Igat), *Liza macrolepis* (Banak), *Caranx sexfasciatus* (Simbad), *Ambassis urotaenia* (Langaray), *Mesopristes cancellatus* (Bagaong), *Scatophagus argus* (Kitang), *Redigobius tambujon* (Biya), *Glossogobius celebius* (Biyang bato), *Glossogobius giuris* (Biyang puti) and *Awaous*

melanocephalus (Biyang sunog). Another migratory species but found to be a new island record; *Stenogobius* sp. which the locals call Bukatot was also caught and recorded.

Alarmingly, eleven introduced species are now present in the lake. These include *Anabas testudineus* (Puyo), *Channa striata* (Dalag), *Carassius* sp. (locals call Tawes), *Cyprinus carpio carpio* (Karpa), *Oreochromis niloticus niloticus* (Tilapia), *Tilapia zillii* (locals call Bruce Lee), *Trichopodus pectoralis* (Pla-salit), *Trichopodus trichopterus* (Gourami), *Poecilia reticulata* (Isdang kanal) and *Poecilia sphenops* (Wild molly). A Philippine endemic, *Leiopotherapon plumbeus* (Ayungin) which we considered an introduced species in the lake was also recorded by the present survey which confirmed the first record of which by the SEARCA study in 1997.

Note: [1]Drainage

The present study first documented the presence of *Carrasius* sp. which the locals call Tawes (a local name usually associated with *Barbonymus gonionotus*), and *Cyprinus carpio carpio* which may have been introduced in the lake just recently. Surprisingly, the 1997 SEARCA survey has no record of the two species. This is also the first time that *Tilapia zillii* is reported as well as the presence of two poeciliids species, *Poecilia reticulata* and *P. sphenops*.

Butas River. Twenty two species were recorded in the Butas River where its species composition is almost similar to that of Naujan Lake (Sim= 89.36) except for the presence of *Anabas testudineus, Redigobius tambujon, Cyprinus carpio carpio* and *Carassius* sp. and the absence of *Hypseleotris cyprinoides* (locals call Lomog) in the latter. High similarity is due to the fact that Butas River serves as corridor connecting a marine environment and a freshwater ecosystem as Naujan Lake. Keeping the river free from obstruction will ensure the regular ascends of migratory species.

River tributaries. Fifteen tributaries of Naujan Lake were surveyed. Selection of sampling sites was based primarily on accessibility to ensure the safety of the survey team. Habitat types include the riffles (rapids), pool area and cataracts. Areas from least disturbed to highly disturbed locations were also selected as sampling sites. Also, areas with and without canopy cover were also considered during the sampling regimen. Coordinates of Macatoc River were also gathered for the purpose of mapping since the survey team was not able to conduct survey in the river due to high water level after days of heavy rain.

Nineteen species were recorded from the different tributaries of Naujan Lake (Table 3.2.3.1.2). Three species are common in all the surveyed tributaries, one native, *Giuris margaritacea*; and two introduced species, *Poecilia reticulata* and *P. sphenops*. New island records include an eleotrid, *Eleotris melanosoma* (Urabog) and a pipefish, *Microphis* sp.

Eighteen of the twenty nine species recorded from Naujan Lake National Park (Table 3.2.3.1.3) are species of economic importance that include *Ambassis urotaenia, Anguilla marmorata, Caranx sexfasciatus, Chanos chanos, Channa striata, Oreochromis niloticus niloticus, Tilapia zillii, Clarias batrachus, Carssius* sp., *Cyprinus carpio carpio, Glossogobius celebius, G. giuris, Liza macrolepis, Trichopodus pectoralis, T. trichopterus, Scatophagus argus, Leiopotherapon plumbeus,* and *Leiopotherapon plumbeus.* Other recorded species

though commercially less significant plays important role in the ecosystem. Small fish serves as food for larger organisms.

Based on IUCN Red List Category, *Stenogobius* sp. is listed as Critically Endangered (CR). An island endemic, *Puntius hemictenus* is listed as Vulnerable (VU) as well as *Cyprinus carpio carpio.* But the category of *C. carpio carpio* is based on its current status in its natural habitat. Majority of the species listed is Not Evaluated (NE), Least Concern (LC) or have Deficient Data (DD).

3.2.3.2 Macroinvertebrates

Fourteen years after the SEARCA study which recorded 5 macroinvertebrates, the present study was able to record twelve (Table 3.2.3.1.4) composed mainly of 5 gastropods namely, *Vivipara* sp., *Melanoides* sp., *Thiara scabra, Thiara granifera,* and an introduced species, *Pomacea canaliculata*. Two bivalves were also recorded that include *Anodonta* sp. and *Corbicula manilensis*. One crab species, *Mindoron* sp. and 4 species of shrimps: *Macrobrachium lar, Macrobrachium* sp., *Atyopsis* sp. and *Caridina* sp. were included in the collected specimens. The specimens will be sent to Dr. Jose Christopher E. Mendoza of the Systematics and Ecology Laboratory, Department of Biological Sciences, National University of Singapore for accurate identification up to species level.

Note: [1]This listing does not include groups belonging to Class Insecta since other component study covered that assemblage.

3.2.3.4 Other Aquatic Fauna

Scientific Name: *Acrochordus granulatus*
English Name: Banded file snake, Wart snake
Local Name: Duhol

Banded file snake has been recorded in Taal Lake and Laguna de Bay, but this is only the first time being documented in Naujan Lake. It is not impossible that this species has been recorded in Naujan Lake since like the other two lakes; it is connected to a marine environment via its lone outlet, the Butas River. This water snake is not poisonous and poses no threat to humans. Three specimens were noted but only one was collected since the other two were already dead and swollen.

3.2.4 TERRESTRIAL INSECTS AND THEIR RELATIVES

This report is the first record of arthropods from in Naujan Lake National Park. It summarizes the results of the survey of existing diurnal arthropods, soil-litter microarthropods, ground-dwelling arthropods, and nocturnal arthropods, in terms of species richness, diversity, evenness and dominance in the six sampling sites (see Figure 2.3.4.1 – 2.3.4.6) of Naujan Lake National Park.

Species Richness. Table 3.2.4.1 and Figures 3.2.4.1 – 3.2.4.4 summarizes the species richness of arthropods in six stations around Naujan Lake National Park using various sampling techniques. Using sweep net sampling, the average number of species was highest in Calubasanhon. Foliage-dwelling insects showed the following Trends: Calubasanhon > Banbanin > Montelago > Mabuhay 2 > Tagbakin > Happy Valley. For soil-litter sampling, the Trends was Happy Valley > Banbanin > Tagbakin > Calubasanhon > Mabuhay 2 > Montelago; while for pitfall traps, it was Happy Valley > Calubasanhon > Tagbakin > Montelago > Mabuhay 2 > Banbanin, and for the UV light trap, it was Banbanin > Mabuhay 2 > Calubasanhon > Happy Valley > Montelago > Tagbakin.

Trendss in species richness can be attributed to the diversity of vegetation that can be found in each area. Any factor that affects the vegetation, may directly or indirectly affect the arthropod faunal components of the area since these arthropods are dependent on plants for their food, habitat etc. Among the six stations, soil-litter sampling and pitfall trap results showed that Happy Valley has the highest number of species (2.69 for the soil-litter and 3.41 for pitfall traps) while both techniques showed different sites with low values for species richness. Montelago (1.12) has the lowest result for soil litter sampling; Banbanin (1.76) for the pitfall traps sampling. For sweep net sampling, results showed that Calubasanhon (7.63) has the highest species richness while Happy Valley (4.21) has the lowest. UV light trap results showed that Banbanin (17.86) has the highest value while Tagbakin has the lowest result.

The high number of soil and ground dwelling arthropod species in Happy Valley is due to the rich organic matter substrate for soil-litter microarthropods. However, Happy Valley has the lowest species richness using sweep net sampling. Foliage-dwelling arthropods are dependent on plants for their food. Happy Valley is mainly composed of fruit trees or plantation crops (rambutan, banana, coconut, citrus, mango, etc.*),* some grasses and vines. The areas that are found under the canopy of fruit trees were almost clear and have homogeneous vegetation, thus, the results showed that species of foliage-dwelling arthropods were low in the area. For UV light trap sampling, Happy Valley has high species richness on the average.

Even though Calubasanhon is mostly composed of citrus plantation mixed with fruit trees and grasses, the results showed that foliage-dwelling arthropods were rich in the area. The results may be attributed to the richness of lower canopy vegetation especially grasses and vines. Also, the presence of secondary forest at the ridge of the area is able to provide other resources for the arthropods. Ground-dwelling and nocturnal arthropod species in the area was also fairly high.

The area of Banbanin showed a high species richness for nocturnal arthropods. Nocturnal arthropods are active during night time and they can only detect UV light. The result may be attributed to the fact that the area is almost open. Orchards and rice fields were in reach of the UV light. Also, the light trap was running from 6PM - 6AM unlike in the other areas which were only from 6PM -12MN. However, with regard to ground-dwelling arthropods, Banbanin has the lowest result. This was due to heavy rains that had occurred

during the time of sampling. For soil-dwelling arthropods, Banbanin showed a high species richness.

In general, Mabuhay 2 has low species richness in most of the sampling techniques used except UV light trap even though it has old growth trees present in the area. The species present in the light trap were those that can be found mostly in ricefields. The results show that Mabuhay 2 was totally disturbed. In addition, areas surrounding the old growth trees were converted to agricultural lands such as citrus and coconut plantation and ricefields.

Both Montelago and Tagbakin exhibited low number of species richness, the former has the lowest result in soil-litter sampling and the former has the lowest result in UV light trap sampling. Montelago's results may be attributed to limited availability of decaying organic matter or decomposing plant litters while in Tagbakin, the place where the UV light trap was set-up is a homogeneous area (citrus plantation)

Furthermore, the dominance of a few pestiferous species such as psyllids (Psyllidae) and leafhoppers (Cicadellidae) indicates that there is a high degree of disturbance and shows a less stable ecosystem. On the other hand, agricultural insect species such as *Nephotettix, Aphis,* delphacids, lygaeids, among others were collected. These species are associated with agricultural crops such as rice. Beneficial insects such as parasitic wasps, damselflies and dragonflies as well as spiders were also present in the area. Their presence is worth noting since they help reduce populations of pests. The diversity of soil-litter arthropods is affected by the presence of man-made ecosystems and almost homogeneous habitat.

Total Population. In terms of arthropod abundance (average number of individuals) (Table 3.2.4.1 and figures 3.2.4.5 – 3.2.4.8), Calubasanhon was the highest for sweep net, Happy Valley for soil-litter sampling and pitfall traps, and Montelago for light trap. The Trends in abundance for sweep net sampling was Calubasanhon > Tagbakin > Banbanin > Montelago > Mabuhay 2 > Happy Valley; for soil-litter sampling: Happy Valley > Calubasanhon > Banbanin > Tagbakin > Montelago > Mabuhay 2; for pitfall traps: Tagbakin > Happy Valley > Calubasanhon > Banbanin > Tagbakin > Montelago, and for light trap: Montelago > Banbanin > Mabuhay 2 > Tagbakin > Calubasanhon > Happy Valley.

The mixed vegetation at Calubasanhon provides the foliage-dwelling insects with their food and habitat. Furthermore, the dependence of foliage-dwelling arthropods on its host plants was observed in the three stations. The high population data on Calubasanhon can be attributed mainly to the dominance of leafhoppes (Cicadellidae), katydids (Tettigoniidae), short-horned grasshoppers (Acrididae), fruit or vinegar flies (Drosophilidae), spiders (Tetragnathidae) and ants [Formicidae (*Tapinoma melanocephalum)]* that forage and seek refuge on grasses. An average of 132.75 individuals was collected from the Calubasanhon area which has the highest number of individuals among the six pre-established stations followed by Tagbakin with 104, Banbanin with 70, Montelago with 66.5, Mabuhay 2 with 47, and Happy Valley with 27.

The heavy rain during the activity night in Banbanin resulted to the poor results of the pitfall traps. Some of the pitfall traps were swept away by flood-waters and others were flooded. Tagbakin has the highest number of individuals among the six pre-established stations with 170. This was due to the high number of ants (Formicidae) that were trapped.

Leaf litter of fruit trees in Happy Valley provides a rich and moist litter substrate resulting to a high number of soil litter arthropods. In addition, nocturnal arthropods were most abundant in Montelago. This was due to the high number of midges (Chironomidae) that were trapped. Also, the UV light trap was set-up for 6 hours near the lake which is a good habitat for midges.

In sweep net sampling, short-horned grasshoppers (Order Orthoptera: Family Acrididae), spiders (Order Araneae: Families Araniedae, Salticidae and Tetragnathidae), different species of ants (Order Hymenoptera: Family Formicidae), leafhoppers (Order Hemiptera: Family Cicadellidae), milkweed or seed bugs (Order Hemiptera: Family Lygaeidae), vinegar or fruit flies (Order Diptera: Family Drosophilidae), scuttle flies (Order Diptera: Family Phoridae), leaf beetles (Order Coleoptera: Family Chrysomelidae), and snout moths (Order Lepidoptera: Family Pyralidae) were the most abundant group of arthropods collected. Most grasshoppers prefer dry open habitats with lots of grasses and other short plants, although some species live in forests or jungles. Their large numbers in Banbanin, Montelago, and Calubasanhon showed that the said area is abundant in terms of their food and that the area provides them favorable habitat. Similarly, the presence of vast numbers of spiders in the six sampling stations indicates that food is present in the said areas. Spiders are a good biological control agents for pestiferous insects; their high population would be helpful in controlling insect pests in agricultural areas. Ants live in a wide range of ecological niches and feed on different types of food. Their abundance in the sweep-net sampling suggests that ants could also be herbivores or they are present in such habitats because food is abundant. Vinegar or fruit flies were also abundant in the six sampling stations because the areas are mixed plantations of fruit trees that are very suitable as habitat for these flies. Vinegar or fruit flies feed on rotten fruits or other fermented food material. The presence of mixed vegetation in six sampling areas provide a suitable habitat for leafhoppers, seed bugs, scuttle flies, leaf beetles, snout moths, and other foliage-dwelling arthropods.

The large population of soil mites (Acari), springtails (Collembola), short-winged mold beetles (Pselaphidae), and rove beetles (Staphylinidae) indicates that the areas around the Naujan Lake National Park are able to provide a rich soil substrate for detritivorous arthropods.

Pitfall traps were mostly dominated by ants (Formicidae), next were the short-winged mold beetles (Pselaphidae) and rove beetles (Staphylinidae) and collembolans (Entomobryidae). The results suggest that ground-dwelling arthropods can thrive in areas around Naujan Lake National Park. Isopods, sap feeding beetles (Nitidulidae), earwigs (Forficulidae), millipedes (Class Diplopoda), earthworm (Phylum Annelida), and other ground-dwelling arthropods were also trapped during sampling.

Non-biting midges (Chironomidae) were collected in large numbers in the areas of Banbanin, Montelago and Tagbakin. The UV light trap was able to collect a total of 528,178 individuals. Non-biting midges can be found thriving in aquatic or semi-aquatic habitats. The larval stage is an important part of macro zoobenthos of most freshwater ecosystems. However, this group of arthropods is being associated with low biodiversity ecosystems or polluted waters because they are able to survive in such environment.

The differences in values among six stations may be attributed to the variations in vegetation of the six monitoring stations and weather conditions during sampling period.

Species Diversity and Evenness. Table 3.2.4.2 - 3.2.4.3 and figures 3.2.4.9 - 3.2.4.16 summarizes the diversity indices and evenness of the six stations. The results showed that Banbanin had the highest diversity index both for canopy or foliage arthropods (1.86) and soil litter microarthropods (1.62). For pitfall traps, Tagbakin (1.24) had the highest diversity index while Happy Valley (0.72) was the highest using UV light trap. In terms of evenness, Banbanin was the highest for sweep net sampling with 0.075; for detritivorous arthropods, Montelago was the highest with 0.0.61; for pitfall trap, Montelago and Calubasanhon were the highest with 0.0225, and for light trap, there is a large variation in communities between species. For foliage arthropods, both the diversity and evenness indices have the same Trends: Banbanin > Happy Valley > Mabuhay 2> Montelago > Calubasanhon> Tagbakin. The Trends in diversity index of soil-litter arthropods was Banbanin > Happy Valley > Tagbakin > Calubasanhon > Mabuhay 2 > Montelago. Evenness indices for detritivorous arthropods had the following Trends: Montelago > Mabuhay 2 > Calubasanhon = Happy Valley > Tagbakin > Banbanin. The diversity indeces of pitfall traps was Calubasanhon > Tagbakin > Montelago > Happy Valley > Mabuhay 2 > Banbanin while the evenness was Montelago > Tagbakin > Banbanin > Mabuhay 2 = Calubasanhon = Happy Valley. The diversity indices of nocturnal arthropods was Happy Valley > Calubasanhon > Banbanin > Mabuhay 2 > Banbanin > Montelago. Evenness indices for nocturnal arthropods was zero (0).

Reckoning the aforementioned values in terms of computed species diversity indices (H), Banbanin is overall the most diverse area for all types of sampling. In general, the results of the diversity indeces and evenness range are very low. Diversity indeces and evenness range should be between 1.5 to 3.5. The results showed that the overall environment or habitat surrounding the Naujan Lake National Park is homogeneous and does not provide a good habitat for a unique species to thrive. It is also worth noting that the result of the UV light trap showed a very large variation of species diversity between the six sampling stations. The result may be attributed to the large population of non-biting midges that can be found thriving in the lake. However, the presence of a great number of hawk moths (Sphingidae) and other moths, and wild honeybees and stingless bees (Apidae) observed in the white cloth light trap indicates that the area abounds with pollinating species of arthropods. This shows that the area is dominated by flowering plants specifically fruit bearing plants.

Threatened species. Good environmental indicators of vegetation disturbance are those that are endemic and forest-dwelling arthropod species. These would be damselflies, walking sticks, butterflies, and fireflies which unfortunately were not well represented in the collections of the six sites. However, among them, it was only in Montelago that both

Troides rhadamantus and *Papilio rumanzovia* (Figure 3.2.4.17) were frequently observed. Both butterflies are threatened and strictly protected. They are listed in appendix II of CITES. In addition, walking sticks were only observed in Montelago.

Ant Diversity Monitoring. Ants serve as a good biological indicator of disturbed and undisturbed areas. They dominate the forest ecosystem, top predators for their size, food for many animals, help improve soil quality and are able to speed up the nutrient cycle of the ecosystem where they are present. The ant groups that are collected and observed were mainly those that are considered as tramp species, those species that are being spread throughout the world by human activities like *Tapinoma melanocephalum, Dolichoderus thoracicus, Solenopsis geminata, Monomorium floricola, Anoplolepis gracilipes, Oecophylla smaragdina, Crematogaster* sp.*, Pheidole* sp., *Paratrechina* sp.*, Coptosoma* sp., *Technomyrmex* sp., and *Tetramorium* sp. Both *Oecophylla* and *Dolichoderus* ants can thrive in disturbed areas as well as forest edges. Table 3.2.4.4 summarizes all the ants that have been observed in six sampling sites around the Naujan Lake National Park.

The presence of high number of tramp species of ants in areas surrounding the Naujan Lake National Park indicate that the area is highly disturbed and the area is near or with human habitants. Furthermore, other areas or stations tend to provide the needs of the highly aggressive and stinging ants. Their presence showed that the area is disturbed and have homogenous vegetation.

3.2.5 WATER QUALITY AND MICROBIAL DIVERSITY

3.2.5.1 Analyses of the Physico-Chemical Properties of Naujan Lake Water

The physico-chemical properties of the lake water collected in near-shore stations of Naujan Lake were determined *in situ* and *ex-situ*. Physical parameters were determined in situ except for turbidity which was analyzed using a nephelometric turbidimeter at UPLB ASL-IC. Likewise, chemical analyses for the determination of concentration of nitrates and phosphorus and BOD5 were determined by UPLB ASL-IC while initial DO was determined *in situ*. Results of the analyses done are summarized in Table 3.2.5.1.1.

***Light and temperature*.** Nearly all energy that drives and controls the metabolism of freshwater ecosystems is derived from solar energy, which is converted biochemically via photosynthesis to potential chemical energy (Wetzel and Likens, 1990). Absorption and dissipation of solar energy as heat determine the lake temperatures and its consequent effect on nutrient cycling and the biota. For the 7 near-shore stations, temperature ranges from 26-32 °C, warmer than 24°C as reported in 1997. However, values reported reflect only temperatures of surface (till 1 foot from the surface) lake water and limited to subsurface lake water due to the absence of subsurface temperature measuring device.

***pH and salinity*.** The alkalinity or acidity of water, or pH of lake water is a measure of the dissolution and concentration of certain gases in water such as CO2 which markedly affect properties of water. This also determines suitability of water to support growth of its habitat and the amount of treatment needed to restore aptness. pH of lake waters from 8

to 8.3 which is insignificantly different from those in 1997 which ranges from 7.40 to 8.5 for the 3 near-shore stations reported. The lethal effect of acids appears when < 5.5 and alkalines near pH 9.5, although the tolerances of most organisms are considerably more restricted within these pH extremes (Wetzel and Likens, 1990).

The salinity of lake waters was measured. However, no values were detected indirectly indicating absence of major cations such as calcium, magnesium, sodium and potassium and major anions such as the carbonates, sulfates and chloride that constitute over 99% of the total salinity. These results are the reasons why no further analysis of the ions was done for the samples collected.

Turbidity. Turbidity of lake water is caused by suspended organic and inorganic nutrients. This may include silt, carbonate particles, planktons and other organisms. The turbidity varied from 3-56 NTU for the 7 lake water samples analyzed. The lowest, 3 NTU and the highest, 56 NTU were reported for samples collected at near-shore stations, Singulan and Subaan, respectively. Interestingly, the two stations are less than 20 meters away from each other. Probably, the highest turbidity in the Subaan station was due to the Typhoon Ramon aftermath. There were submerged banana trees along the near-shore station lined with marshland and/or swamps.

However, the turbidity of the lake waters reported does not accurately provide the concentration of the suspended materials due to varying particulates size and refractive characteristics. Nonetheless, the measurements are very useful for the evaluation of presence of microorganisms in the lakes (Baker *et al*., 1985).

***Presence of Nitrogen and Phosphorus*.** Nitrogen and phosphorus are major cellular components of organisms. Concentrations of nitrogen and phosphorus compounds can regulate or limit the productivity of organisms in freshwater ecosystem (Wetzel and Likens, 1990).

Nitrogen, N2, may occur in the environment and may take part in many biochemical reactions as organic nitrogen, ammonia nitrogen (NH4-N), nitrite nitrogen (NO2-N) and nitrate nitrogen (NO3-N) in the form of nitrates, is important in the control of freshwater ecosystems (Bronmark and Hansson, 1998). Nitrate concentrations indicate wastewater loading, agricultural runoff and ground water input (Morris, 1980). Excessive nitrate concentrations in lake waters encourage the rapid growth and proliferation of phytoplanktons that alter water quality. Nitrates are released to lake water from chemical fertilizers used in agricultural areas. Presence of excessive nitrate concentrations in water used for drinking may pose an immediate and serious health threat to infants ≤3 months of age. The nitrate ions react with blood hemoglobin, reducing the blood's ability to carry oxygen; this produces a disease called blue baby or methemoglobinemia.

The total nitrates of the 7 lake waters analyzed ranged from 0.087 to 0.152 mg/L, which is almost 10-fold lower than those reported in 1997 for the 3 near-shore stations of Naujan Lake (1.30 to 1.80 mg/L). Reduction in the nitrate contamination of lake water from agricultural areas surrounding the lake may be attributed to the strict implementation of Naujan Lake National Park Management Programs.

Phosphorus, P, like nitrogen, is an essential nutrient for growth of phytoplanktons and the eutrophication of lakes or degradation of lake water quality. Unlike nitrogen, presence of phosphorus in drinking water has little effect on health. Phosphorus are released to the lake water from sewage or from agricultural runoff containing fertilizers and animal or human wastes. Phosphates, $PO4^{-3}$, the inorganic form of phosphorus, common ingredients of detergents. But even with the ban on phosphate-based detergents, the amount of phosphorus occurring in water from other sources poses a significant environmental problem.

The total phosphorus of the 7 lake water samples ranged from 0.034 to 0.172 mg/L. The low concentration of phosphorus in the lake water sample analyzed indicated less agricultural run-off and may be contributed by the wastewater or washings from the community living around the lake.

Dissolved Oxygen (DO). The concentration of oxygen dissolved in water provides valuable information on the on-going biological and biochemical reactions and a measure of the environmental factors affecting aquatic life. However, DO is affected by temperature, pressure and concentrations of various ions (Wetzel, 1983).

The DO of the 7 lake water samples varied from 6.5 to 8.7 mg/L. This value range is almost 2 mg/L higher than those reported in 1997 for the 3 near-shore stations of Naujan Lake. These results indicated a better lake water quality than that reported 14 years ago.

Biological Oxygen Demand (BOD). Microorganisms present in lake water utilize the oxygen dissolved (DO) in water in order to metabolize organic materials. If the oxygen is not replenished either through naturally or artificial means, the DO level decreases. The need for oxygen is called the biological oxygen demand (BOD). The more organic material there is in water, the higher the BOD required by the microorganisms. BOD is considered as the measure of the amount of organic pollution in lakes and thus, the measure of the strength of sewage.

The BOD determined for the 7 lake water samples incubated at 20°C for 5 days ranged from 2.10 -5.07 mg/L. The values of which are lower than those reported in 1997 for Naujan Lake with an average of 5.65 mg/L.

Presence of Iron. The iron concentration of water sample obtained at Taybungan Falls was analyzed. Analysis of the sample was done in order to determine if the observed reddish brown discoloration of the water is due to high iron deposits. The iron concentration was determined as 0.85 ppm or 0.85 mg/L. Iron is seldom found at concentration greater than 10 mg/L. However, as little as 0.3 mg/L can cause water to turn reddish brown color.

As per DENR AO No. 26-A Series of 1994, maximum level of 1 mg/L of iron is considered standard for water to be safe for drinking or consumption.

3.2.5.2 Total Heterotrophic, Coliform and Fecal Coliform Counts of Naujan Lake Water

The total coliform and fecal coliforms counts of the 7 lake waters were determined using the Most Probable Number or MPN technique (5-tube set-up of 3 dilutions). Table 3.2.5.2.1 summarizes the total heterotrophic count, total coliform and total coliform counts for the 7 lake water samples of Naujan Lake.

The total heterotrophic count provided information on the number of bacteria present in the lake water samples. However, the species composition and relative numbers of heterotrophic bacteria is not the focus of the study due to time and resources limitations. Nevertheless, the coliforms that were present in the lake water samples were identified to determine the potential health hazard of the contaminated water. The total heterotrophic count of lake waters from Naujan Lake ranged from 8.50 to 196.0 x 10^3 CFU/mL with Tagbakin and Taybungan Falls, with the lowest and highest counts, respectively. The high heterotrophic count of water from Taybungan Falls may be due to the presence of high iron deposition that supports the growth of the bacteria.

Lake water from Butas yielded the lowest total coliform count of 220 MPN/100 mL and Singulan and Taybungan Falls the highest total coliform count of ≥2400 MPN/mL. Butas, being the biggest outlet and inlet of water in Naujan Lake, yielded the lowest total coliform count probably due to limited presence of dissolved organic or particulate matter that supports the growth of the bacteria particularly that of the coliforms. Presence of high total coliform counts at Singulan and Taybungan Falls probably due to the community inhabiting the shorelines and the various activities along the shorelines that harbor boats and other water vessels.

Water from streams and lakes that contain multitudes of autotrophs and saprophytic heterotrophs is potable as long as pathogens for humans are lacking. The presence of intestinal pathogens such as those that cause typhoid fever, cholera and bacillary dysentery are of prime concern (Benson, 2002). Human and animal fecal materials are usually carried away by water in sewage systems of households and agricultural or animal farms and released into rivers and lakes. This poses great health hazards and requires routine water examination. Presence of non-pathogenic intestinal Escherichia coli or Streptococcus faecalis indicates presence of fecal materials or fecal contamination of the water since these bacteria are not normally present in the water.

The total fecal coliform count is highest in lake water obtained from Singulan and lowest in lake water from Butas. Bacteria such as *E. coli*, *Enterobacter* sp., *Pseudomonas aeruginosa*, *Alcaligenes faecalis* and *Salmonella* sp. were isolated and characterized from the lake water samples analyzed. Presence of these bacteria indicated presence of fecal wastes in the lake water that poses health hazard if lake waters are used and consumed.

3.2.5.3 Phytoplankton Density of Naujan Lake Water

Phytoplankton density indicates presence of inorganic nutrients and considered indicators of water quality. These free-floating algae are considered autotrophic organisms that support themselves by converting inorganic materials into organic matter using energy from the sun. Presence of inorganic nutrients such as nitrogen as nitrates and phosphorus supports the growth of phytoplanktons in Naujan Lake. A total of 21 genera of phytoplankton were identified in the Naujan Lake (Table 3.2.5.3.1). Phytoplankton of genera *Oedogonium* and *Ulothrix* showed dominance during the sampling at stations Butas and Malayas.

In the 1997 report on the phytoplankton density of Naujan Lake waters, there were a total of 29 genera of phytoplankton identified. Interestingly, there were some genera reported then that were no longer observed in the samples collected in October, 2011. This may be due to decrease in the inorganic nutrients of the lake water that no longer support the growth of the phytoplanktons. Changes in the physical properties such as temperature and pH may also adversely affect the growth of these phytoplanktons.

3.3 SOCIO-CULTURAL AND ECONOMIC CONDITIONS

3.3.1 Demographic Characteristics

Population size, gender, distribution, and growth rate. Naujan Lake National Park is surrounded by four municipalities –Naujan, Pola, Socorro, and Victoria. From the ridges down to the coasts, a total of 24 barangays are confined in the declared protected area of Lake Naujan. Five barangays are from the Municipality of Naujan – Montelago, Bayani, Laguna, Dao, and San Pedro. Nine are from the Municipality of Victoria – Merit, Bambanin, Duongan, Malabo, Urdaneta, San Narciso, Pakyas, Leido, and Canaan while eight are from the Municipality of Socorro – Pasi I, Pasi II, Happy Valley, BatongDalig, Lapog, Mabuhay I, Mabuhay II, and Subaan. Two are from the Municipality of Pola – Matula-tula and Tagbakin.

Table 3.3.1.1 shows the population by gender of these barangays, distribution, and growth rate by municipality. Based on the NSO report of 2007, the estimated population of the 24 barangays found within the NLNP was 33,529 (Table 3.3.1.1). Males outnumbered females (17,475 or 52% versus 16,054 or 48%) (Figure 3.3.1.1). Among the 24 barangays within the NLNP, Matula tula of the municipality of Pola had the biggest population, at 3,004, while Merit of Victoria had the lowest population, at 629. Only seven of the 24 barangays had population less than 1,000 while 17 barangays had more than 1,000 population, two of which had more than 2,000 people.

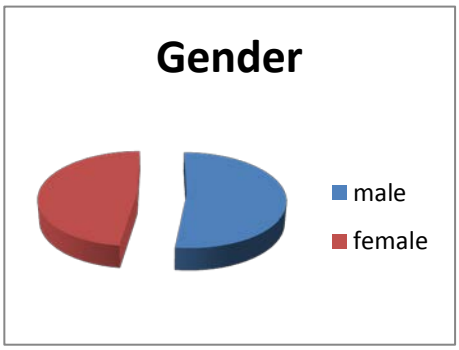


Figure 3.3.1.1. Gender distribution of NLNP residents

In terms of distribution, Naujan's total population comprised 12 % of the provincial population's total while the four barangays shared .99%; Victoria's population comprised 4% while its nine barangays shared 1.55%; Socorro's population

had 5% while its eight barangays shared 1.4%; and Pola's population comprised almost 6% but its two barangays only shared 0.62 %.

Naujan has the highest population growth rate for the period 2000-2007, at 1.07 per thousand population; slightly higher than the provincial growth rate at 1.06. The other three municipalities registered lower than 1 per thousand population growth rate, the lowest of which was that of Pola at 0.3. Overall, the population growth rate is low, a sharp improvement of the growth rate registered in 2000. Back then, it was the municipality of Victoria which had close to 4% population growth, approximately 63% higher than the provincial rate and 57% higher than that of Naujan's rate for the same period. For all four municipalities, the population growth rate declined tremendously, with a range of difference between 1.15 to 3.37 % for the period 2000-2007. Victoria registered the highest decline for the period, with a decrease of more than three percent.

This implies that while the population of the province increased for the period 2000-2007, it has increased at a moderate pace of 1.06%. Municipality-wise, population steadily increased for Naujan (moderate growth rate at 1.07%) and Pola (very slow growth at 0.3%) but the reverse occurred for Victoria (with a growth rate of 0.65%) and Socorro (at 0.32%). Actual population for these latter municipalities decreased by 4,365 persons for Victoria and 1,148 persons for Socorro for the period 2000 to 2007. It can be inferred that the growth rate in these two municipalities could be attributed less to natural increase (birth rate) but by high migration rate. It is also most likely that the increase in the population of the two other municipalities may have also been brought in-migration.

Population density. Table 3.3.1.2 also shows the population density of the barangays and the provincial and municipal data for purposes of comparison.

Oriental Mindoro had a population density of 1.69 persons per hectare. Of the four municipalities, only Victoria had a lower density than the provincial figure. For the aggregate land area of the 24 barangays, the population density of the Park stood at two persons per hectare. The range of population density in all 24 barangays was 9.65 (Pasi II of Socorro) to 0.48 persons per ha (Duongan of Victoria). This could be attributed to the land area covered by these barangays. Pasi II has the smallest area while Duongan has the biggest land in NLNP.

When compared to the municipal population density, the five barangays of Naujan posted the highest density at 2.61 persons per ha (Table 3.3.1.2). This is much higher than the estimated population density of Naujan municipality, at 1.72. The lowest aggregated population density was that of the eight barangays of Victoria, at 1.62; yet this is higher than the recorded 1.5 per ha population density of the town. The two barangays of Pola (2.4 persons per ha) and the nine barangays of Socorro (2.07 per ha) had a much lower population density than their respective municipal estimate (Pola- 2.51 and Socorro – 2.54).

Age structure and dependency ratio. Table 3.3.1.3 shows the NLNP population by age group according to the 2007 NSO report on population. As shown in Figure 3.3.1.2, the age structure of NLNP residents is negatively skewed, or considered young, with a higher proportion of the population in the lower age categories, i.e, those between 0 to 14 years

old. The highest percentage of residents in the NLNP belonged to the 0 - 4 years age group with a population of 5,005 (14.93%). It is followed by the 10 – 14 and 5 - 9 years age groups with a population of 4,988 (14.88%) and 4,983 (14.86%), respectively. The combined population for those below 15 years of age is 14,976 or 45% of the total NLNP residents. Elderly population or those above 64 years of age totaled 1,026 or 3%. Of this proportion, people aged 80 years old and above numbered 143 (0.43%). The mean age group of NLNP is the 20 -24 years category.

The Park is considered rural in character (the rural areas of the four municipalities ranged between 77-94%, with Naujan having the most number of rural barangays and Socorro with the least). Like most rural areas, young people are expected to contribute to the household's income or labor requirement. Thus, when they reach 15 years old, they are assumed to engage in productive work. In the NLNP, those in the productive age (15-64 years) comprised 52% of the total Park population while dependents (below 15 years and over 64 years) constituted 48%. This implies a dependency ratio of close to 1:1, or that each adult has to support one vulnerable person. The burden is lessened when young household members (those within the 10-14 years class) are fully or partially participating in the activities of the household, farm or family enterprise. Their labor is largely unpaid or underpaid; nevertheless, their participation reduces the burden to the adult members of the household.

Having a young population is an advantage to rural communities as this is most suitable for the labor demands of farming, fishing, and other agricultural activities that dominate rural life. This also implies a high proportion of sexually active population (ages 15- 39 years), at more than a third of the NLNP population (35%), and high fertility potential which will push the population level to modest growth each year.

Household size. Table 3.3.1.4 summarizes the household population and household size of each barangay. Matula Tula has the highest number of households, at 714. This is followed by Subaan with 479 households. Both Matula tula and Subaan had population that surpassed the 2,000 mark. The barangay with the least number of households is Batong Dalig with only 191 households.

According to the CBMS report on population (2008), the size of a household in a barangay ranges from four to five members (although there are no supporting figures from the barangays in Victoria). The household size is presumed to be the same with the other barangays. This data indicates that the family system in NLNP is nuclear, i.e., the occupants of the household are the parents and their children, resembling modern homes.

To further describe the demographic characteristics of the NLNP, a survey was done to describe the following: migration pattern, place of origin, previous residence, year of migration, reasons for migrating, manner of migration, and place of origin of father and mother.

Migration Pattern. The migration pattern of the Naujan Lake National Park is categorized based on the respondent's origin: within the municipality, within the province, within Mindoro island, within the MIMAROPA region, or coming from another place (Figure 3.3.1.3).

Figure 3.3.1.4 and Table 3.3.1.5 show that most of the respondents (57%) were born in the same municipality where they are currently residing – the municipalities of Naujan, Pola, Socorro, and Victoria. Almost a quarter (23%) came from other areas outside of the MIMAROPA region. These respondents came from other parts of Luzon, or from Visayas and Mindanao. Migration within the same province is also common, constituting the third largest bulk of respondents, at 16%. Migration from within the same island and the region comprised the least share of the respondents, at less than 5% when combined.

More than half of the respondents (55%) came from the same place where they were born or did not have a previous residence (Figure 3.3.1.5 and Table 3.3.1.6). The second largest bulk of respondents (29%) had lived outside of the region or from other places in the Philippines. It is followed by those who resided from the same province but migrated to the barangay where they are currently living (12%). Only a few (1%) of the respondents indicated that they previously resided within the region. Results indicate that migration has indeed taken place and consistent to the results shown in Table 3.3.1.5 that about a quarter came outside of the region.

Half of the respondents (50%) indicated that they had not come from elsewhere. The second largest bulk of respondents (34%) migrated 11 years ago or earlier, followed by those who migrated about six to 10 years ago (7%). About 6% of the respondents migrated only two to five years ago while the rest just came within 2011 (3%) (Table 3.3.1.7 and Figure 3.3.1.6).

As shown in Figure 3.3.1.7 and Table 3.3.1.8, there are many reasons for migration but the major one is the need for employment or income. About 21% of the respondents migrated for socio-economic reasons. Marriage and family considerations followed, with 14% and 13%, respectively. Others came due to land availability (3%). Consistent with the earlier figures, the largest bulk of respondents (49%) did not state any reason because they are not migrants at all.

Figure 3.3.1.8 and Table 3.3.1.9 show the manner of migration of NLNP respondents. Migration in the municipalities is done with the family in tow (35%). Other manners are marriage (8%) and by scouting the area without bringing the family yet (6%).

Figures 3.3.1.9 and 3.3.1.10 and Table 3.3.1.10 show the place of origin of parents of the NLNP respondents. Majority of the respondents' parents came from outside the MIMAROPA region (51% for the father; 46% for the mother). Parents who came from within the same municipality where the respondents are currently residing accounted for 26% (for fathers) and 30% (for mothers). Those whose parents came from within the province ranked third (11% for fathers; 13% for mothers), followed by those with parents who came from within the region (10% for fathers; 9% for mothers). Only a few indicated that their parents came from other province of Mindoro.

All these figures indicate that migration rate in the NLNP is high, either because their parents brought them there or the respondents moved to this place in 2000 or earlier years. The perception that the Park is a common land and whose access is not well guarded must have encouraged migration as this is sought mainly for socio-economic reasons. Given the

vast resources of the Park, the suitability of many areas for agriculture, the relative proximity of this area to other parts of Luzon and other islands, and the ease in transport make the NLNP vulnerable to migrants. As shown consistently in Tables 3.3.1.5, 3.3.1.6, and 3.3.1.10, and Figures 3.3.1.4, 3.3.1.5, 3.3.1.9, and 3.3.1.10, migrants from outside the MIMAROPA region dominate and must have been attracted to the Park's natural endowments.

Tenure status of land *(Table 3.3.1.11 – 3.3.1.13).* Fifty-six percent (185) of the 330 respondents do not own the land they are residing within NLNP. On the other hand, at least 45% of the respondents own one or two parcels of land within the park. Of these land owners, 27% of them own at least 1 hectare, whereas 18% own land of more than one hectare, with 11 respondents owning land up to 3 or 4 hectares. A quarter of the 330 respondents (83) are classified as tenants, whereas 17% are actual owners.

3.3.2. Cultural profile

As of 2009, at least three Mangyan tribes are present and residing within the boundaries of Naujan Lake National Park (Table 3.3.1.14). These are the Alangan, Hanunoo, and the Tadyawan. A total of 8,158 Mangyan members are currently residing within the four municipalities where NLNP is located (Table 3.3.1.15). More or less, there is equal distribution of males and females among the Mangyan households.

Resource use and practices *(Table 3.3.1.16 – 3.3.1.25).* A total of 97% of the respondents harvest wood within their community for fuel wood. Almost all of these fuel wood is used for cooking (96%), and used very frequently. In fact, it is also heavily used during cooking for big occasions such as birthdays, weddings, graduation parties, etc. In addition, 98% the respondents mothers utilize fuelwood. Majority of the type of fuelwood comes from wood (65%), whereas 24% are derived from charcoal; bamboo and coconut husks are also used to a limited extent. Thirty-one percent of the respondents indicated that a *kaing* of fuelwood takes about 4 to 7 days to be consumed, while 23% of the respondents takes about less than three days. On the other hand, 18% of the respondents takes about less than a month to consume one sack of fuelwood, while 11% take them at least a month of more. Almost half of the respondents who use fuelwood (40%) revealed that it was windy in their residences, resulting heightened burning of fuelwood and thereby leading more of its consumption.

Other fuel/energy sources used by the respondents were: Liquified Petroleum Gas (LPG), electricity, charcoal, and kerosene. At least 32% of the respondents use electricity, while 17% use charcoal; very few percentage use LPG and kerosene.

3.3.3. Basic services and social indicators

Education (Table 3.3.1.26 - 3.3.1.28). The province of Oriental Mindoro has 18 educational districts, three of these are in Naujan, 1 in Socorro and 1 in Victoria. A total of 482 public schools (both elementary and secondary) are found in Oriental Mindoro; 17% of these are within Naujan, 5% within Socorro, and 6.4% within Victoria. Private schools (both

elementary and high school) totaled to 116; 19 of these are within NLNP municiplaities. In terms of pre-elementary schools, there are more government-owned compared with private schools. According to Oriental Mindoro Facts and Figures (2010), there is only one tertiary school (vocational and colleges) in the province (government-owned), however, the data from different municipalities (Naujan, Socorro and Victoria) comprise 4 government-owned tertiary school. A large majority of students of in Oriental Mindoro goes to elementary level, with 66.55%. Naujan has the highest number of enrollees among the four municipalities surrounding Naujan Lake. In the provinicial level, elementary level has higher participation and graduation rate than secondary level. On the other hand, secondary level has higher cohort survival, scool leavers and completion rate compared to elementary level. Data for Pola is not available.

Social Welfare Services (Table 3.3.1.29). A relatively high number of day care centers and workers are concentrated within the municipalities of Naujan, Pola, Victoria, and Socorro (180 and 182, respectively). On the other hand, the number of social workers is low; there is no social worker in the municipality of Socorro.

Health (Table 3.3.1.30 – 3.3.1.36). For the last three years (2008-2010), there has been a steady decrease in the birth rate . Total death rate is relatively stable, ranging from 3.3 to 4.0 %, as well as for maternal deaths (0.4 to 0.5%). Respiratory-related diseases (AURI, Pneumonia, and Bronchitis) are the leading morbidity causes among the general population and among infants. Among the leading mortality causes for the general population were heart-related disease and cerebrovascular accidents. Leading infant mortality causes for the province were severe pneumonia and bronchial asthma. Infant morbidity and mortality causes data were not available for the four NLNP municipalities. At least 10% of pre-schoolers are underweight.

Housing (Table 3.3.1.37). Within the four municipalities covered by NLNP, majority of the roofing and outer wall materials were from wood, cogon, nipa, bamboo, and anahaw. These materials are also the most utilized for the whole province. Concrete and galvanized iron is relatively rare within the four municipalities covered by NLNP.

Water supply (Table 3.3.1.38 - 3.3.1.39). All municipalities within NLNP have their own water district or water systems. Water facility types present were community water systems, deep wells, artesan wells, shallow wells, natural bodies of water (rivers, lake, springs), bottled water, and tanker truck (delivered water). Sources of water comes from surface water such as rivers and the Naujan Lake, and from ground water. There are at least two watershed areas near or within NLNP: the Mag-asawang Tubig Watershed in Victoria, and the Pola Watershed.

1. Potential Water Sources
    a. Surface Water (rivers, streams, lakes) are available in the main river of Oriental Mindoro and in the vast Naujan Lake
    b. Groundwater

2. Watershed Areas
    a. Mag-asawang Tubif Watershed (Victoria)

b. Pola Watershed (Socorro)

Power supply (Table 3.3.1.40 - 3.3.1.43). Practically all households in the four municipalities have electricity. Three of the four sources of electricity that service within park households are operational: Agrekko Rental, Dulangan Mini-Hydro, and Global Business Holdings. On the other hand, maximum power demand further exceeds the total dependable capacity of these three sources of electricity- 28 MW (peak load) vs. 21.1 MW.

Communication services. All sources of communication are available within the four municipalities. There are five local newspapers that reach the park residents, aside from the two national newspapers (Inquirer and Star). Post offices are also present, as well telegraphic services. All cellular phone services are available and have signals all throughout the park. Telephone companies (land line) are present, most of which are found in Calapan. Internet service providers are mostly concentrated in Calapan City, although Smart Communications is present in Naujan and Victoria. There are two radio stations within the park, in Naujan and Voctoria, Cable television network are also established within the four municipalities.

1. Newspapers (Coverage- Or. Mindoro and Southern Tagalog)
    a. Island Sentinel
    b. Mahalta News Update
    c. Island Observer
    d. Mindoro Bulletin
    e. Mindoro Weekly Reporter

2. Post Office – 15

3. Telegraphic Services
    a. Telegraphic transfer office – 4
    b. Office handling social telegraph – 10

4. Wireless Service Providers

Municipality	No. of cellcites		
	SMART Communications	GLOBE Telecom	DIGITEL (SunCellular)
Naujan	3	-	1
Pola	1	-	-
Socorro	1	-	-
Victoria	-	1	1
Oriental Mindoro	24	6	5

Source: Oriental Mindoro Facts and Figures, 2010

5. Telephone Companies (landline)

    a. Calapan Telephone Systems, Inc. – Calapan City, Puerto Galera, Victoria, Socorro, Pinamalayan, Bungabong, Roxas

b. Globe Telecom – Calapan City, Puerto Galera, Naujan, Victoriam Socorro, Pinamalayan, Bungabong, Roxas

6. Internet Service Providers

a. Calapan Telephone Systems, Inc. - Calapan City, Pinamalayan, Bongabong
b. Dalcan Technologies - Calapan City, Puerto Galera
c. Smart Communications - Calapan City, Puerto Galera, Naujan, Victoria, Pinamalayan
d. Globe Telecom - Calapan City

7. Radio Station and Cable TV Networks by Municipality

Municipality	FM Radio Station	Cable Television Network
Naujan	1	1
Pola	-	1
Socorro	-	2
Victoria	1	1
Oriental Mindoro	7	18

Source: Oriental Mindoro Facts and Figures, 2010

Transportation services. Transportation services and road networks are varied and have wide access within the park. Provincial and municipal roads are present and connect to several baranggays; national roads serve as connection between the four municipalities within the park. There are also existing airports and sea ports, concentrated mostly in Calapan City and are within easy access from the four municipalities within the park.

FACILITIES	NUMBER
- Roads (as of 200)	
• National Roads (KM)	299.14
• Concrete – 188.47 km; Gravel – 62.69 km; Asphalt – 117.98	
• Provincial Roads (KM)	897.285
• Concrete – 335.877 km; Gravel – 546.957 km; Earth – 14.431 km; Asphalt – 0.020 km	
- Bridges (number)	
• National	93
• Provincial	95
- Land Transportation	
1.0 Registered vehicles	29,659
2.0 License issued	15,296
3.0 Total collection from fines on law enforcement (PhP)	2,008,450.00
- Airports	2
(i) Existing airports (Calapan, Pinamalayan)	
(ii) Aircraft movements	1,034

• Private/commercial aircraft landed (Calapan)	35
• Government including military craft	
- Sea Ports	
• National Ports (Calapan, Roxas, Bansud)	3
• Municipal ports (2 in Puerto Galera; 1 each in Calapan, Pinamalayan, Mansalay, Bulalacao, Bansud, Bungabong, and Pola	9
- RO-RO vessels	24
- Fast Craft	2
- Shipping company	8
- Ship calls	17,458
- Passengers	
• Disembarked	2,507,461
• Embarked	2,32,460
- Cargo (MT)	
▪ Inbound	904,959
▪ Outbound	844,017

Source: LTO, PPA, Civil Aviation Authority, PEO, DPWH 2010

Poverty and income

1. Municipal level small area estimates of poverty incidence, poverty gap, and severity (Computations based on the 2000 Census, FIES, and LFS figures)

Municipality	Poverty Incidence	Poverty Gap	Poverty Severity
Naujan	0.6227	0.2319	0.1108
Pola	0.6807	0.2712	0.1355
Socorro	0.6167	0.2310	0.1108
Victoria	0.5193	0.1776	0.0800

Source: Oriental Mindoro Facts and Figures, 2010

2. Annual Per Capita Poverty Threshold, Poverty Incidence, Magnitude of Poor Families and Population by Province, MIMAROPA

Region/Province	Annual Per capita Poverty Treshold (in PhP)	Poverty Incidence (%)		Magnitude of Poor Families (No.)	Magnitude of Poor Population (No.)
		Families	Population		
Region IV-B	15,769	27.6	35.0	162,610	980,542
Occidental Mindoro	16,169	25.4	36.3	23,551	160,562
Oriental Mindoro	16,480	26.0	32.8	45,876	279,343
Marinduque	15,911	28.6	34.9	15,853	88,406
Romblon	16,877	43.0	54.0	31,285	178,583
Palawan	14,038	24.0	29.5	46,045	273,648

Source: NSCB, 2008

3. Annual Per Capita Food Threshold, Poverty Incidence, Magnitude of Poor Families and Population by Province, MIMAROPA

Region/Province	Annual Per capita Food Threshold (in PhP)	Subsistence Incidence (%)		Magnitude of Subsistence Families (No.)	Magnitude of Subsistence Population (No.)
		Families	Population		
Region IV-B	10,978	10.5	14.8	62,151	413,876
Occidental Mindoro	11,348	9.1	14.8	8,482	65,405
Oriental Mindoro	11,546	9.2	13.3	16,300	112,831
Marinduque	11,113	10.5	14.6	5,793	37,012
Romblon	11,680	16.5	22.9	11,987	75,878
Palawan	9,784	10.2	13.2	19,589	122,749

Source: NSCB, 2008

4. Average Family Income, Expenditure and Savings of Families, MIMAROPA; 2009

Incomes	-	141,000
Expenditure	-	121,000
Savings	-	21,000

Source: NSO, 2009 FIES

Livelihood and income sources (Table 3.3.1.44 - 3.3.1.52). Fifty-six percent (185) of the 330 respondents do not own the land they are residing within NLNP. On the other hand, at least 45% of the respondents own one or two parcels of land within the park. Of these land owners, 27% of them own at least 1 hectare, whereas 18% own land of more than one hectare, with 11 respondents owning land up to 3 or 4 hectares. A quarter of the 330 respondents (83) are classified as tenants, whereas 17% are actual owners.

A total of 16 crops were identified as being grown and cultivated by the respondents within NLNP. Twenty eight percent of the respondents grow only rice; only a very small percentage practice multiple cropping. The respondents harvest these crops for home use, sold in market, to pay debts, or all of these.

About 41.4 % of the respondents raise domesticated animals, from carabaos, chicken, cows, ducks, goats and pigs. Majority of these raise chickens and pigs.

Fuelwood collection is practiced by 97% of the respondents; bamboo harvesting is practiced by only seven respondents. It is revealed that 95% of these forest products were taken just around the community, and only 4% were obtained in adjacent forest.

Threats to NLNP. At least nine types of resource utilization practiced by NLNP residents were identified as threats to the lake by the 330 respondents (Table 3.3.1.53). These were application of both chemical and organic fertilizers, fishing, washing of clothes, garbage disposal, boat riding, taking a bath within lake periphery, hauling of sand from lake periphery, and utilization of lake and rivers for ricefield irrigation. Of these, it was seen that

four types of threats (fertilizers, fishing, washing, bathing) were practiced by majority of the respondents (ranging from 61% to 72% of the respondents).

An overwhelming majority of the respondents identified food source as the main benefit derived from the lake (65%) (Table 3.3.1.54). This benefit comes in the form of fishing, shellfish collection, and irrigation. Only a small proportion of the respondents view the lake as a livelihood source, indicating that food source derived from the lake is at the subsistence level. It is interesting to note that 44 of the respondents derive no benefit from the lake. Most probably, these respondents have jobs elsewhere and are not active resource-users of the lake.

More than half of the respondents (52.5%) burn their garbages as a means of disposal (Table 3.3.1.55). On the other hand, at least 39% of the respondents use shallow pit as means of garbage disposal. Garbage disposal along rivers, creeks, and lake shore is still practiced 23 (7%) of the 330 respondents.

3.4 GOVERNANCE AND INSTITUTIONAL ARRANGEMENTS

Purpose:

1. Identify the advantages to be gained from the lake and its impact on the state of the lake and the lives of the people depending on it.
2. Develop a method for managing the lake thru community participation programs concerning Naujan Lake and its surrounding environment.

Stakeholder profile

FGD Number	Barangay	No. of Male	No. of Female	Total Number	Ethnic Group	Composition
1	Bambanin	9	1	10	Tagalog	Fruit farmers, charcoal makers, powersaw user,fishermen
2	Malamig	5	5	10	Tagalog	Rice farmers and fishermen
3	Concepcion	22	13	35	Mangyan	Charcoal makers, fruit and crop farmers, farm cleaner

Current Management Structure and Capabilities of the PA management

- Facilitation and coordination of PAMB remains with the DENR and this is done primarily by the designated Parks Superintendent assisted by three other staff of the CENR Office of Socorro
- Active participation of all stakeholders of the NLNP is needed for holistic and integrative approach. However, the stakeholders are not all represented in the

PAMB either because they were not organized or their representatives have not updated them on the agreements made in the PAMB or that the PAMB failed to conduct aggressive IEC.

Policies regarding the Lake

Working Arrangement and Relationships between the PAMB, LGUs and other relevant and concerned stakeholders

- The participants from the three barangays namely, Bambanin, Malamig and Concepcion are not aware of PAMB, its function and its members. Whenever asked about the PAMB, they shook their heads and looked at each other showing confusion about what was asked.
- Few had known about the programs on NLNP; most of those who knew were officers of the barangay
- Residents have not heard of PAMB and have not felt their activities regarding stewardship of the lake.

Plans, programs and projects in the area related to environment and natural resources management.

- There are park rangers (bantay lawa) to protect the lake. However, they do not conduct surprise inspections on the fishermen.
- There are programs in place such as the use of Furadan, crops from the DENR (Dept. of Environment and Natural Resources), and solar dryers from the DA (Department of Agriculture). The Mangyans also use the basketball court to dry their crops. During Fajardo's term, the DA handed out coconut seedlings.
- About 80% of households have septic tanks in place to reduce disposal of human waste in the lake. There are still many residents who do not have lavatories and throw their waste directly in the lake in spite of having public CR's particularly in Barangay Malamig.
- Each household has a dumpster. However, non-biodegradable wastes such as plastic are being burned.
- The municipal government plans to promote eco-tourism in the area by improving the falls.
- Barangay Bambanin would like to have an information drive on proper planting and a cleaning program. They also wanted to implement the no electric fishing in the lake and stop the cutting of trees for charcoal making.
- A tree planting project for 100 hectares of land is currently planned with the help of Mang Cenon (Dating Daan leader) in support of the National reening Program.
- Cropping or pruning of grasses/shrubs to clear roads is usually conducted.

National and local policies governing and/ or affecting the project site

- Fishing within the fish sanctuary is prohibited
- Electric fishing is prohibited because it affects fish growth and most fishermen complied with the regulation. Also, fishing through the use of bayakos is prohibited because it catches large number and different kind of fishes that leads to extinction.
- Use of fishnets with small holes, fish pens and cages are prohibited.
- Tree cutting and harvesting of tambo and Buri are prohibited.

- In 1980, duck raisers were banned.
- Proper disposal of garbage is implemented through ordinance.

Opportunities

- Mangium, Tokyo (wild) and Cocolumber are often planted and were harvested to be sold for lumber.
- The Department of Health (DOH) is able to provide prophylaxes for Schistosomiasis.

4. SITUATIONAL ANALYSIS

4.1 TRENDS AND CHANGES

4.1.1 Terrestrial vertebrates

From literature review, one major publication on survey of vertebrate wildlife of Naujan Lake was found, the "*Faunal Inventory of Naujan Lake National Park and its adjacent Watershed, Oriental Mindoro, Philippines"* (Ticsay and Ledesma, 1998). This publication was a result of the 1997 resource profiling spearheaded by SEARCA for the formulation of the management plan of Naujan lake National Park.

Ticsay and Ledesma (1998) documented a total of 98 terrestrial vertebrates in Naujan Lake. From their list, this total comprised of 68 species of birds, 13 mammals, 12 reptiles and five amphibians. This survey generated a 62% increase, or an additional 61 species, in the total number of terrestrial vertebrate species currently present in Naujan Lake National Park. A total of 37 species of birds were added to the current avifaunal species present in the park (Table 4.1.1); 15 bird species recorded by Ticsay and Ledesma (1998) were missed by the current survey.

Some of the notable birds missed were the Mindoro Scops-Owl (*Otus mindorensis*), recorded in Brgy. Alcate, Victoria Muncipality, and Mindoro Tarictic (*Penelopides mindorensis*), recorded in Brgy. Maria Concepcion and Brgy. Bugtong-na-Toog in Socorro Municipality, Brgy. Montelago in Naujan Municipality, and Brgy. Matulatula in Pola Muncipality. . Ecological record of the Mindoro Scops Owl indicates that this species is restricted to high elevations, usually above 1200 meters above sea level (masl). From Ticsay and Ledesma (1998), based on their sampling localities, there is no indication that they surveyed localities above the listed elevation for Mindoro Scops Owl, nor is there any locality within the park that exceeds 500 masl. From this evidence, there is reason to believe that Ticsay and Ledesma's record is probably erroneous. It is highly possible that the bird they recorded was the Philippine Hawk-Owl (*Ninox philippensis*), which is almost similar in size with Mindoro Scops Owl and is present at lower elevations. Ticsay and Ledesma's record of the Mindoro Tarictic were based from ethnobiological survey; they apparently did not record this bird during transect or capture in mistnets. This current survey visited Brgys. Montelago and Matulala (Site 2 and part of Site 3, respectively), and did not record this species; interviews with local guides all throughout the sampling localities did not indicate that this species was present as well. It is highly likely that it is still present in Brgy. Maria Concepcion and Brgy. Bugtong-na-Toog in Socorro Municipality, although it not certain what is the ecological status of those localities (whether forests are still present).

At least 10 species of mammals were additionally recorded during this current survey (Table 4.1.2). Ticsay and Ledesma (1998) did not record any insectivorous bats during their survey; this current survey captured five species (*Rhinolophus, Hipposideros, Myotis,* and *Harpiocephalus spp.*). This current survey also documented two additional species of fruit bats, *Eonycteris spelaea* and *Pteropus pumilus.* All of these bats are quite difficult to capture, and often require numerous number of mist nets to facilitate a high probability of capture. In addition, one of the three additional murid rodents recorded in this current survey, *Chrotomys mindorensis*, was captured only once using earthworm baits. From research elsewhere (Balete et al., 2008), this rodent is usually captured using earthworm baits. Ticsay and Ledesma (1998) did not employ earthworm-bait trapping, which could be they reason they did not record this endemic murid rodent. It is interesting to note that the previous survey documented three large mammals, Philippine brown deer (*Cervus mariannus*), Philippine warty pig (*Sus philippensis*), and the Tamaraw (*Bubalis mindorensis*). Ticsay and Ledesma (1998) record of the former was from a captive deer held in a house in Barangay Naujan South, Naujan Municipality. It was not indicated whether this deer was taken within the park boundaries. The last two were from ethnobiological interviews. Record of the Philippine warty pig was from Socorro municipality; no locality was listed for the Tamaraw. This current survey, whether from actual observations or from interviews, yielded no indication that these large mammals are still present within the park boundaries.

Twenty species of reptiles and amphibians that was recorded in this current survey were not documented by Ticsay and Ledesma (1998) (Table 4.1.3); four species, all snakes, were missed out by this current survey. These were: the Common Rat Snake (*Elaphe erythrura*), Common Wolf Snake (*Lycodon aulicus*), Barred Coral Snake (*Calliophis calligaster*), and the Pit Viper (*Trimeresurus flavomaculatus*). Eight species of frogs were not recorded from the previous survey, including the threatened *Hylarana mangyanum* and *Kaloula conjcunta.* In addition, eleven species of lizards were also new records for the park, including all three species of agamids (i.e. *Draco, Bronchocoela,* and *Hydrosaurus*), two species of gekkonids, and one species of scincid lizards. The Malayan Freshwater Turtle (*Coura amboinensis*) was also not documented from the previous survey.

4.1.2 Aquatic vertebrates and macroinvertebrates

SEARCA Survey (1997). The SEARCA survey listed fourteen fish species that include only five migratory species. The listing (Table 4.1.4) was a product of a rapid site assessment which failed to cover most migratory species of the lake.

The presence of *Caranx ignobilis* (Maliputo) and *Gobiopterus lacustris* (Dulong) in Naujan Lake as reported in the study of SEARCA is highly contested since it was the first time the two were documented in the lake. There is a high possibility that the former is actually C*aranx sexfasciatus* (Talakitok) whereas the latter is fry of *Glossogobius giuris* (Biyang puti) which is very abundant in the lake. There was no earlier record of their occurrence in the lake and the current MNH UPLB survey was not able to catch either of the two. But without actually examining the specimen, remarks are just opinion of the team.

Three introduced species were recorded by SEARCA that include *Clarias batrachus* (Hito), *Oreochromis niloticus niloticus* (Tilapia) and *Trichopodus pectoralis* (Pla-salit). *Leiopotherapon plumbeus* was first documented by the SEARCA survey which, although a

Philippine endemic is more likely an introduced species in Lake Naujan but the mode of introduction, when and by whom are unknown since there is no available literature.

MNH UPLB Survey (2011). The present survey was able to record twenty nine species belonging to twenty six genera comprising seventeen families of primary and secondary freshwater fishes. Primary freshwater fishes are those species that have evolved in freshwater environment but now living in freshwater and no longer tolerant to saline environment while secondary freshwater fishes are those species of marine origin which are now confined to freshwater and are tolerant of sea water for a short period of time (Mercene, 1997).

4.1.3 Water quality and microbial diversity

This survey for water quality and microbial diversity of the lake revealed that there is an increase in light, temperature, ph, salinity and turbidity (Table 4.1.5). The decrease in the presence of nitrates, phosphorus and BOD may be attributed to the strict implementation of Naujan Lake National Park Management Programs and less use of insecticides or pesticides. Iron deposition in water was not tested in 1997, the result of this survey showed a low concentration, thus, the water is potable for drinking and other consumptions.

The presence of coliforms was not tested in 1997, this survey isolated *E. coli*, *Enterobacter* sp., *Pseudomonas aeruginosa*, *Alcaligenes faecalis* and *Salmonella* sp., the presence of these bacteria indicated presence of fecal wastes in the lake water that poses health hazard if lake waters are used and consumed.

Phytoplankton diversity was compared from the previous survey. Only 21 genera were collected compared to 29 genera collected in 1997. The decrease in diversity may be attributed to the decrease in the inorganic nutrients of the lake water that no longer support the growth of the phytoplanktons and changes in the physical properties such as temperature and pH may also adversely affect the growth of these phytoplanktons.

4.2 CURRENT ISSUES, CONCERNS AND CHALLENGES

4.2.1 Conservation and biodiversity

Species introduction. Table 4.1.6 summarizes the introduced species documented in Naujan Lake National Park and the year of introduction to the Philippines. Four of the listed species belong to the top twenty introduced species (reported by Casal (2007) generated in 2006 from FishBase) with undesirable impacts to nations where they have been introduced and therefore considered as Invasive Alien Species (IAS). These include *Clarias batrachus, Cyprinus carpio carpio, Oreochromis niloticus niloticus and Poecilia reticulata*. Introduced species compete with available space and resources, thus will in most cases outcompete the native inhabitants of a particular ecosystem. A form of biological pollution, they may interbreed with native species that can result in hybridization. Some may even be carrier of parasites and diseases.

Paitan, scientifically known as *Puntius hemictenus* was once a dominant species in Naujan Lake but with the introduction of other cyprinids like *Cyprinus carpio carpio* and *Carassius* sp., for fishery purposes, this species was displaced and can now only be found in some tributaries of the lake. Other species that was displaced by introduced species include *Redigobius tambujon* which suffer the same fate of *P. hemictenus* and now only present in river tributaries.

The ecological niche of *P. hemictenus* was invaded by the two introduced cyprinid species and because of their relatively small size compared to that of *C. carpio carpio* and *Carassius* sp., they were displaced to river tributaries. Other introduced species that competed to available space and resources includes *Oreochromis niloticus biloticus, Tilapia zillii, Poecilia reticulata* and *P. sphenops.* The feeding habit of all the introduced species is summarized in Table 4.1.7. The feeding habit will give one an idea as to what particular niche a species occupies in an ecosystem.

Many introduced species are beneficial in the economic point of view since they can be a source of income for ordinary fishermen but they altered tremendously the natural species to species interaction, the ecological structure as well as the flow of energy due to modification of the natural food chains.

Destructive fishing method. The use of electric device to catch fish is still widespread in the area especially at night as reported by the local residents and confirmed by this study. Some have tried using direct current from the power lines of local power distributor, as confessed by two electrofishers we interviewed, majority uses series of truck batteries as many as 8, while some uses simple motorcycle battery to capture fishery resources which abound in the lake and its river tributaries.

Section 88 of Republic Act 8550 prohibits the use of electricity to catch fish or any fishery species in Philippine waters but this provision is often violated, just like in the case of NLNP. The mere possession of this device as stated in the law shall be punishable by imprisonment from 6 months up to 2 years, and if caught using the device shall be punishable by 5 to 10 years of imprisonment.

The reason for the prohibition is the numerous effects it causes both to the operator and to target and non-target organisms. One of the appalling effects which are very evident was the physical deformities observed in some of the fish samples we caught. Small fishes and juveniles are more prone to dreadful effect of this device which may disrupt their reproductive and physiological growth.

Less destructive active and passive fishing gears observed in Naujan Lake National Park are given as ANNEX B.

Encroachment to designated fish sanctuary. Some fishermen though aware of the presence of fish sanctuaries still encroach and fish in those areas. Monitoring of activities as agreed upon in one of the PAMB resolutions was left to different barangays surrounding the Lake but more often than not, they are not doing their part. Some even think that these sanctuaries actually prevent them from harvesting what they rightly own.

During the conduct of our study, we saw ourselves how local residents disregard the existing sanctuaries despite the presence of buoys that demarcate the area. On our last day, we observed eleven boats as early as 7:00 o'clock fishing way inside the sanctuary in Brgy. Duongan, Victoria. A day before that, we saw 5 fishing boats. We talked to the two fishermen and asked them if they are aware that the area is a no fishing zone and they answered yes. When asked why they're fishing if they know that, they answered that nobody keeps watch over the area. Without properly informing the public about their importance, these sanctuaries will be challenged and breached by local fishermen.

Land cover change. The primary forest cover of the area has remarkably declined through time. This was replaced with secondary forest and agroforestry areas planted mainly with citrus and coconut. Rice fields are now a common sight in once densely forested areas. Only remnants of old forests remain on hard to reach places such as on precipice and mountain ridges. Land cover change is brought about by population pressure. Populations surrounding and within the national park is increasing. With the increasing population, more houses are being built that needed raw materials, more farms being developed, and other structures for recreation such as basketball court and play grounds are being paved.

Denuded Riparian Forest. Riparian forests which hold soil through their root systems to strengthen river banks and prevent erosion are still present but only to areas far from human habitation. Section 16 of PD 705 or the Forestry Code of the Philippines provides that at least 20 meters wide facing lakes shall be retained for environmental protection. Retention means non-removal of existing land cover (forested areas) 20 meters facing lakes which no longer exist in the case of Naujan Lake. Furthermore, Article 51 of PD 1067 or the Water Code of the Philippines provides "*that the banks of rivers and streams and the shore of the seas, and throughout their entire length and within a zone of three (3) meters in urban areas, twenty (20) meters in agricultural areas and forty (40) meters in forest areas, along their margins, are subject to the easement of public use in the interest of recreation, navigation, floatage, fishing and salvage xxx*".

Removal of trees along river banks is still common inside the national park. During the conduct of our study, we saw freshly cut trees to be used for charcoal making. Local officials admitted that they couldn't lift a hand to castigate the violators since according to them the areas where they cut the trees are private lands, although very much within the national park.

Siltation and Sedimentation. During heavy rains, loose soil particles will be washed out and carried to rivers and ultimately reached the shores of lakes and seas. In the case of NLNP, the absence of riparian forest leads to unstable river banks causing it to collapse with the soil particles deposited to mouth of the rivers making that portion shallower after every heavy rain. Soils from bare lands will also be washed out by rain and also ended on the shore of the lake.

Diversion and damming of rivers and streams for irrigation. Damming of rivers not only alters the natural hydrologic regime of the lotic ecosystem but also prohibits the upstream migration of wandering species. Diversion of rivers to irrigate rice fields exposes

the water to chemical contaminants via the chemicals and fertilizers being sprayed and applied to them. The nearness of these rice fields to Naujan Lake poses threat to aquatic organisms of the lake. Chemicals and fertilizers ultimately find its way to contaminate the water of the late which endanger not only the organizing thriving in the lake but to the consuming public and the fishermen themselves. Bioaccumulation of these hazardous chemicals will lead to biomagnifications which detrimental to humans.

Weak implementation of existing laws and regulation. The Philippines has many laws that pertain to environmental protection and species conservation aside from the numerous international conventions, treaties and protocols the country is a signatory to. There should be persons assigned to scrutinize land titles the landowners have in order to determine whether these people are legitimate owners. Because of the different events that transpired from the original proclamation to diminution of the national park and the reinstatement of the original boundaries of the national park; some residents assert to have acquired the land legally and those claims should be examined thoroughly.

The limited number of personnel and the absence of park rangers to monitor illegal activities hamper all efforts to protect the national park. The uncooperative attitude of some local leaders worsens the difficulty of implementing existing policies as well as the residents themselves who deliberately violate these laws.

Proposed diminution of Naujan Lake National Park. House Bill 3251 sponsored by Congressman Rodolfo G. Valencia, now pending in Congress, once approved will set aside more or less 8,000 ha from the Naujan Lake National Park. Once adopted, it will be categorized as a Protected Landscape/ Seascape whereby under the NIPAS Act, it will give opportunities to recreation as well as tourism. This act will further expose the area to myriad of stresses which will compromise the ecological integrity of the national park thereby affecting the stability as well as the numerous functions and services it provides.

4.2.2. Interviews with local community

Condition of Lake Naujan and its surrounding environment. In the past, the lake was teeming with fish but has now decreased. This includes fishes such as Tilapia, Banak, Also, and Panagat. Also included are fish species that have disappeared from the lake such as Banglis, Simbad and small shrimp. Giant Gourami is also gone because they are eaten by Ayungin which also eats the eggs of Tilapia. Currently, there are more non-native fish species and tawis in the lake. On the other hand, there are no fish cages and fish pens found in the lake. Previously, the water on the lake is potable but is now classified as Class C water.

There are no swimming activities in the lake since there are many underwater plants (damoro) and other plants such as waterlily, kikiro and katubanya. However, the lake shoreline is used for laundry (detergents: Tide, Champion, Downy) and bathing. There are piggeries around it but they have a septic tank. Ducks are not raised around the lake because it was banned in 1980.

Garbage was observed around the lake such as sachets of shampoo and fish parts. In addition, chemical and organic fertilizer and pesticide runoff from surrounding farms flow into the river.

Fish numbers are influenced by seasonal variation. They are only observed in some portions of the lake because some areas do not have places to lay eggs. This is especially true in Bambanin. Leido is the only area where fish can lay their eggs.

Barangay Malamig wanted to have more types of fish but they are limited by their skills and knowledge to do it. While the Bureau of Fisheries and Aquatic Resources (BFAR) have been seeding the lake with fingerlings, this project has not yet reached the barangay. Small fishponds are used to hatch tilapia eggs but hatching is not allowed in the lake because tilapia is an invasive species.

Returning pregnant fish to the water is a way to ensure that their numbers remain. However, they are not returned to the water because it would decrease the fishermen's catch and pregnant fish are considered very tasty.

Migration along the lake shore. The inhabitants of Lake Naujan are increasing and a number of the immigrants come from Bicol and Laguna. They migrate to Lake Naujan because it is similar with where they come from which also has a lake and to escape from trouble. Aside from this, they have relatives and friends in Lake Naujan who encourage them to transfer. Areas that have seen a significant increase are Malabo, Leido, San Narciso, Duongan at Urdaneta. The migration remains unchecked because it is not prohibited by any authority. Residents also do not restrain the influx of new comers because they are cautious with people.

The increase of inhabitants started during President Cory Aquino's term when many people who went to the mountains came down to live along the lake shore.
In 1992-1994, many families from Bicol transferred to Barangay Malamig. They were enticed by their relatives with the promise of a good livelihood in farming and fishing.

Benefits from the Lake. Handicrafts using waterlilies, fishing, transportation (banca), lake resources (dalag, hito, shell) and irrigation are some of the advantages from the pond.

Boatman. The boatmen have not yet formed themselves into an association. There are 15 boatmen from five villages. The owners of the ferry boats (banca) are only those with the capacity to buy them. The ferry boat pier is located in Pasi. Each "sitio" has an assigned banca – the place where you ride the banca going out is also where you return. The pier establishment has a business permit and charges Php5.00 for the passengers. The fare for the banca is Php60.00 per trip for long trips while for short trips it is Php40.00 per trip. The trips only take place on Thursdays to Sundays but there daily trips by the fish dealers

There are villages that only use their bancas for fishing and not for passengers. In Barangay Malamig, some bancas are motor driven while others are just paddled by the fishermen. Fishemen using powered bancas fish further away in consideration to the fishermen who only use paddles.

Fishing. Floating drums are used as a boundary for the fish sanctuary (Duongan, Leido and Malamig) where fishing is prohibited. However, there are still some who fish in this area. Use of fine mesh nets are prohibited in the lake.

Problems regarding fishing have been encountered in the lake. This includes the capture and jailing of fishermen using electric rods in Barangay Malabo. A fight also broke out between spear fishermen and those that use the "tibog" method. Fishermen using the "bukot" or "bayakos" who can catch ~300 kg of fish are not being arrested because they are allegedly supported by somebody in authority.

***Other Benefits*.** The lake has only a few visitors. Tourists rarely visit the lake and only students conducting research are more often encountered. Those that visit the lake only stay for about 2 hours. In 2010, American bird watchers visited the lake. There is also a hotspring located in Montelago.

Environmental problems

- Quarrying in the rivers is still rampant that cause dilation of the rivers.
- Insecticides, pesticides or herbicides run-offs are still observed in the river.
- High floods occurred in 1994 and December 2010.

Health problems

- Dengue, Malaria and Hepa B (10 was reported dead).
- Schistosomiasis

5. RECOMMENDATIONS

Set aside portion of the lake as fish sanctuary (ANNEX A). The fish sanctuary being proposed by SEARCA (1997) should be implemented instead of the current set-up. The present study found the proposed area as the most ideal site since most migratory species were caught and observed in this area where lush vegetations were also observed. This can be used as nursing ground for most of the species, migratory or native inhabitants of the lake. A buffer zone of about 50 meters should be situated after the sanctuary to ensure that no encroachment will happen in the restricted zone.

Strict implementation of existing laws and policies. LGU should do their part in ensuring the proposed sanctuary is free from any human activities. Also, use of high-voltage electro-shocking device must be stopped since this poses threat and may impair development of juveniles. Loggers, though small scale should be apprehended since no logging should be done in NLNP for it is a national park.

Restoration of riparian forest. Planting of trees must be prioritized to stabilize river banks to minimize siltation during heavy rains. Forty meters on both sides of every tributary should be planted with forest trees as prescribed in Article 51 of PD 1067. Also, 20 meters facing Naujan Lake should be allotted for forest restoration as prescribed in Section 16 of PD

705 or the Forestry Code of the Philippines to be planted by indigenous plant species present in NLNP.

Proper waste disposal. Dumping of household waste as well as human excreta to bodies of water should be discouraged to maintain clean supply of water.

Long term monitoring of aquatic environment. To determine the population dynamics of aquatic vertebrates of the lake, longer monitoring must be done wherein decline in fishery catch as well as the migration pattern and spawning behavior of migratory species could also be established. Water quality monitoring should also be given emphasis.

Halt to diminution of Naujan Lake National Park. Reduction of the current size of NLNP will expose the park more to exploitation. Unabated encroachment to the park and surrounding area will likely happen.

Relocation of residents from the National Park. If the new delineation of NLNP will happen, money should be poured in to buy titled properties inside the national park. Proceeds from sales should also be used for the rehabilitation of the watershed area. Also, boundaries of NLNP should be properly demarcated and if possible part of the proceeds should be used for fencing of the national park and hiring of forest rangers to monitor the entire area.

Inclusion of Butas River as part of Naujan Lake National Park. Since Butas River serves as important corridor connecting Naujan Lake to Tablas Straight, this should be made part of NLNP to ensure the seasonal ascends of migratory species to the lake.

Creation of Naujan Lake Conservation Authority (NLCA). This body once instituted should focus on preserving the ecological integrity of NLNP including Butas River. Construction of fish cages should not be allowed and introduction of exotic species should be discouraged to maintain ecological balance.

6. CONCLUSION

Naujan Lake National Park is home to many species both terrestrial and aquatic. A number of species endemic to the island of Mindoro can also be found here. As signatory to international conventions and treaties, the Philippines maintain its image as a country protecting the environment, though most of the efforts were done by the private sectors with little support from the government. Naujan Lake in 1999 was included as one of the RAMSAR sites recognizing it as wetlands of international importance.

The limited personnel to monitor various activities inside the national park impede the strict implementation of existing laws and policies. But despite this inadequacy and the lack of policing power of the interim PAMB, they are very successful of not allowing construction of fish cages but little success in controlling further construction of buildings and other structures within the area. Currently, Naujan Lake is the only lake in the Philippines that does not have existing fish cages, a proof that this can also be done in other lakes of the Philippines.

The delineation of the National Park will have an irreversible impact on its biodiversity. This move can be justified if there will be buy-outs of existing properties in areas that will be retained. This will ensure that the re-delineated area will be free from human activities. The rising pressure brought about by increasing population will reach its limit eventually leading to further encroachment to least disturbed areas.

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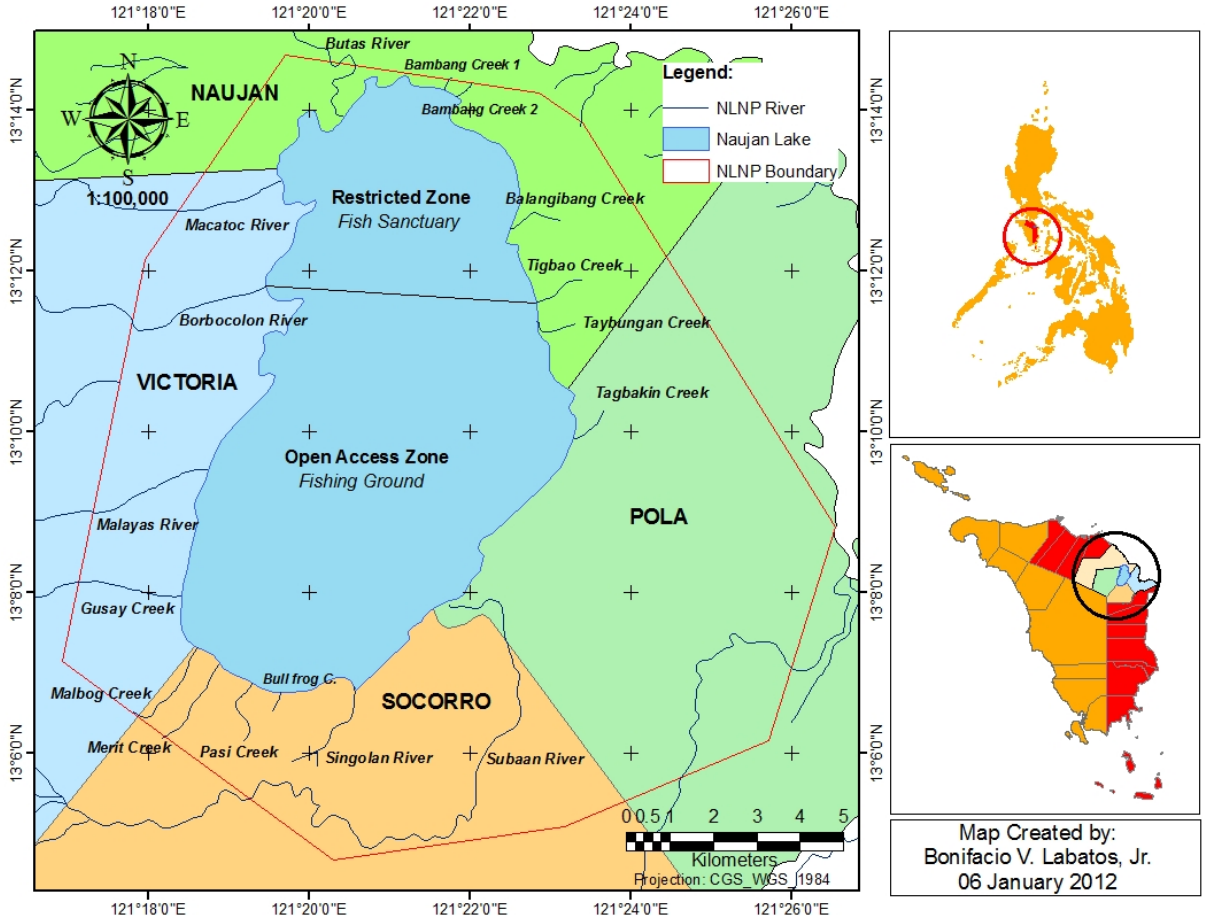
8. ANNEXES

ANNEX A. Proposed Fish Sanctuary for Naujan Lake.



ANNEX B. Fishing Gears

a. Spear fishing (Pana) for large fish

b. Gill net (Pante) for small to large fish

c. Hook-and-line (Kawil)

f. Trap for Dalag

d. Series of traps (Bubo) for shrimp

e. Series of traps (Patanga) for Tilapia

g. Series of traps (Skylab) for shrimp

h. Solitary trap (Bubo) for shrimp

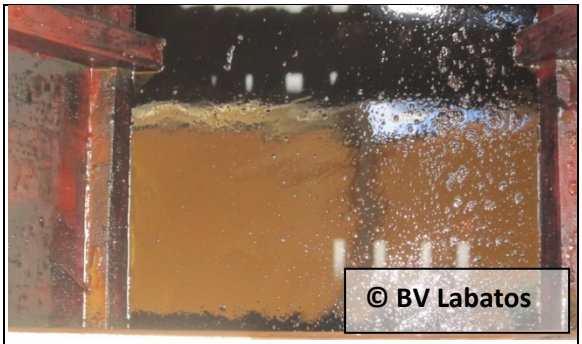
ANNEX C. Threats

a. Washing of clothes

b. Landcover change

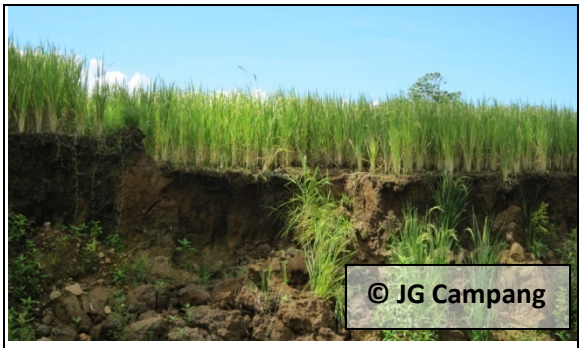
c. Pesticide/fertilizer application


d. Diversion of streams for irrigation



e. Oil leaks from motorized bancas

f. Collapsed of rice paddy (Tigbao Creek)



g. Soil erosion (Tigbao Creek)

h. Households waste (Merit Creek)

m. surface water traversing rice farm areas

n. Siltation after heavy rain

o. Cutting of trees from the National Park

p. Damming of river for irrigation (Subaan River)

q. Siltation after heavy rain (Subaan River)

r. Siltation after heavy rain (Malayas River)

s. Fishing on declared fish sanctuary

t. Rampant violation to no fish zone area (Duongan, Victoria)

ANNEX D. List of arthropods collected from NLNP, Oriental Mindoro, October 2011.

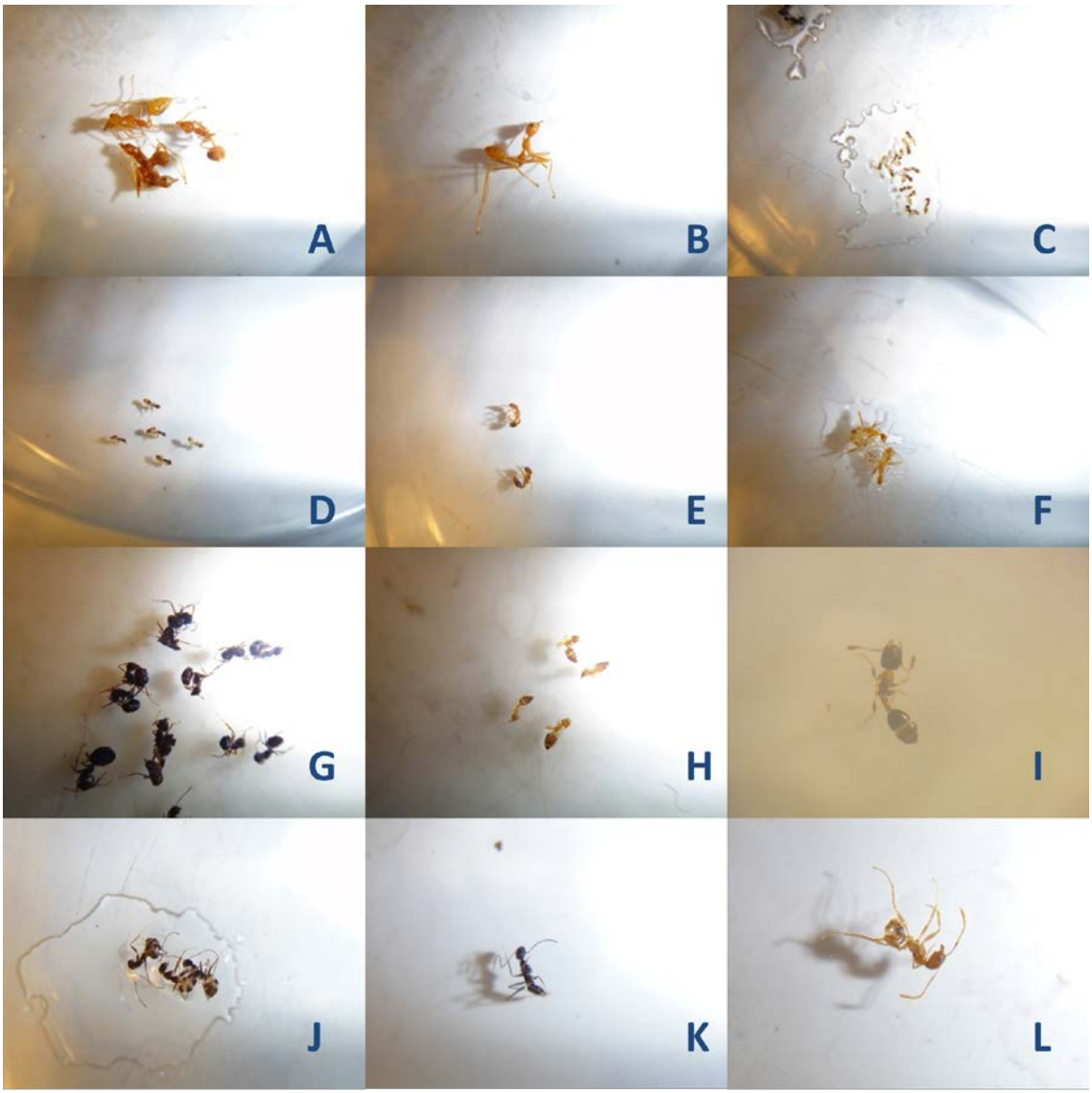
	SPECIES (Family)	REMARKS
1	Acanthosomatidae	Plant feeders, some are pests of cultivated plants.
2	Achipteridae	Soil mites
3	Acrididae	Many are important pests of cultivated plants.
4	Agaonidae	Pollinators
5	Alydidae	Plant feeders, some are pests of cultivated plants.
6	Anthicidae	Common on flowers and folliage as well as on the ground. Larvae feed chiefly on vegetable detritus.
7	Anthomyzidae	Common on grasses and low vegetation, especially in marshy areas.

8	Anthribidae	Usually found on dead twigs and branches, under bark, or on fungi (generally woody fungi
9	Aphrophoridae	Plant feeders, some are pests of cultivated plants.
10	Apidae	Pollinators
11	Araneae	Predators
12	Araneidae	Predators
13	Arctiidae	Adults are pollinators. Larvae often seriously damage trees and shrubs; they spin silk over the foliage, skeletonizing the leaves as they feed, and may form a web over foliage of entire branches.
14	Ascidae	Predators
15	Blattidae	Most are nocturnals, usually are found near the ground, and hide under bark, logs or stones during the day. Some are detrivores and with economic and medical significance (carriers of diseases, etc.).
16	Blephariceridae	Larval stage is filter feeders, adults are predatory (female) and feed on nectars (male).
17	Bombyliidae	Pollinators
18	Bostrichidae	Wood-boring and stored product pests
19	Braconidae	Parasites of immatures or, rerely, adult stages of variuos insects. Mostly attacking pestiferous insects.
20	Brenthidae	Xylophagous (wood eating)
21	Calliphoridae	With medical and veterinary significance (carrier of diseases,etc)
22	Carabidae	Predators and some are pests
23	Cantharidae	Predators, especially on aphids.
24	Cerambycidae	Wood-boring (pest of forest trees)
25	Ceratopogonidae	Found in semi- or aquatic habitats. Blood suckers and some species are vectors of diseases.
26	Cercopidae	Plant feeders, some are pests of cultivated plants.
27	Chalcididae	Parasitoids and hyperparasitoids.
28	Chironomidae	Good biological indicator of presence or absence of pollutants.
29	Chrysididae	Parasitic and cleptoparasitic wasps
30	Chrysomelidae	Plant feeders, some are pests of cultivated plants.
31	Chrysopidae	Pollinators and predatory
32	Cicadellidae	Plant feeders, some are pests of cultivated plants.
33	Cicindelidae	Predatory
34	Coccinellidae	Predators of insect pests
35	Colobathristidae	Plant feeders, some are pests of cultivated plants.
36	Corixidae	Aquatic insects. Feeds on aquatic plants.
37	Cucujidae	Predatory, ectoparasitoids or parasitic.
38	Culicidae	Blood suckers and vectors of diseases
39	Curculionidae	Plant feeders, some are pests of cultivated plants.
40	Delphacidae	Plant feeders, some are pests of cultivated plants.
41	Derbidae	Plant feeders, some are pests of cultivated plants.
42	Diapriidae	Parasitoids and hyperparasitoids.
43	Diopsidae	Found on low-lying vegetation in humid areas, often near streams and rivers, where they feed on fungi and bacteria on decaying vegetation.
44	Dolichopodidae	Found both in terrestrial and aquatic habitats. Adults are predatory.

45	Drosophilidae	Nuisance and pests. Breed in rotting materials and infests ripe fruits.
46	Dryinidae	Larvae are parasitoids on other insects.
47	Dytiscidae	Found in semi- or aquatic habitats. Predatory.
48	Elateridae	Plant feeders, some are pests of cultivated plants.
49	Encyrtidae	Parasitoids on other insects
50	Entomobryidae	Detrivoures
51	Erotylidae	Some are pollinators and some species are pests.
52	Eucharitidae	Parasitic wasps
53	Forficulidae	Predatory
54	Formicidae	Predatory
55	Fulgoridae	Plant feeders, some are pests of cultivated plants.
56	Gelechiidae	Larvae are pests, adults are pollinators
57	Geometridae	Larvae are pests, adults are pollinators
58	Glaceriidae	Larvae are pests, adults are pollinators
59	Gryllidae	Omnivorous scavengers who feed on organic materials, as well as decaying plant material, fungi, and some seedling plants. Food source of other organisms.
60	Hebridae	Semiaquatic insects that live among moss or ponds with an abundance of vegetation, in which they prey on small arthropods.
61	Helodidae	Larvae aquatic and miceophagous, adults terrestrial and pollinators.
62	Hesperiidae	Larvae are pests, adults are pollinators
63	Heteroceridae	Semi-aquatic. Adults and larvae feed on zooplankton, diatoms and algae.
64	Histeriidae	Predatory
65	Hydrophilidae	The larvae are predatory while the adults may be vegetarians or predators in addition to scavenging.
66	Hydropsychidae	Indicator species for presence of water pollutants.
67	Ichneumonidae	Parasitoids and hyperparasitoids.
68	Isotomidae	Found in soil and leaf litters. Decomposers.
69	Issidae	Plant feeders, some are pests of cultivated plants.
70	Lagriidae	Decomposers and herbivores.
71	Lampyridae	Good biological indicator of disturbed environment.
72	Largidae	Plant feeders, some are pests of cultivated plants.
73	Lathridiidae	Usually found on foliage, in rotten wood, under logs, bark of dead trees as well as in fungi and nests of social Hymenoptera, birds and mammals.
74	Leiodidae	Generally feed on fungi in rotting plant or animal material. Some species are common in birds' nests and mammal dens.
75	Libellulidae	Predatory
76	Limnichiidae	Larvae are pests, adults are pollinators
77	Spider- Linyphiidae	Predatory
78	Lycaenidae	Larvae are pests, adults are pollinators
79	Lycidae	Larvae predatory, adults pollinators.
80	Spider- Lycosidae	Predatory
81	Lygaeidae	Plant feeders, some are pests of cultivated plants.
82	Lymantriidae	Larvae are pests, adults are pollinators
83	Machaerotidae	Plant feeders, some are pests of cultivated plants.

84	Mantidae	Predatory
85	Mantispidae	Predatory
86	Meenoplidae	Plant feeders, some are pests of cultivated plants.
87	Mesoviilidae	Aquatic insects, scavengers.
88	Micropezidae	Larvae are phytophagous or saprophagous. Adults predacious on other insects or attarcted to decaying matters.
89	Millipede	Decomposers or predatory
90	Miridae	Plant feeders, some are pests of cultivated plants.
91	Mordelliidae	Plant feeders, some are pests of cultivated plants.
92	Mycetophilidae	Generally found in the damp habitats favoured by their host fungi and sometimes form dense swarms.
93	Neanuridae	Found in soil and leaf litters. Decomposers.
94	Nitidulidae	Feed mainly on decaying vegetable matter, over-ripe fruit, and sap. Few pest species.
95	Noctuidae	Larvae are pests, adults are pollinators
96	Noteridae	Adults and larvae aquatic and carnivorous.
97	Notodontidae	Larvae are pests, adults are pollinators
98	Notonectidae	Larvae are pests, adults are pollinators
99	Oribatidae	Predatory
100	Otitidae	Herbivorous or saprophagous.
101	Spiders- Oxyopidae	Predatory
102	Pasalidae	Found in rotten logs.
103	Pentatomidae	Plant feeders, some are pests of cultivated plants.
104	Perlidae	Good biological indicators of water ecosystem. Sensitive to changes in environment. Adults and laravae are predatory.
105	Phoridae	Feed on decaying organic matter. Transport various disease-causing organisms to food material.
106	Pieridae	Larvae are pests, adults are pollinators
107	Pipunculidae	Parasitoids.
108	Plataspidae	Plant feeders, some are pests of cultivated plants.
109	Platycnemididae	Predatory
110	Platypodidae	Agent in initiating dead wood decomposition
111	Proctotrupidae	Parasitic wasps
112	Pselaphidae	Decomposers
113	Pseudoscorpion	Predatory
114	Psocidae	Found in bark of trees.
115	Psychodidae	Nuisance and pests. Some species are blood-suckers and transmits diseases.
116	Pterophoridae	Larvae are pests, adults are pollinators
117	Pygidicranidae	Predatory
118	Pyralidae	Larvae are pests, adults are pollinators
119	Pyrrhocoridae	Plant feeders, some are pests of cultivated plants.
120	Reduviidae	Predatory
121	Rhipiphoridae	Parasitoids
122	Ricaniidae	Plant feeders, some are pests of cultivated plants.
123	Spiders- Salticidae	Predatory

124	Sarcophagidae	Nuisance and carrier of diseases.
125	Scarabaeidae	Scavengers, decomposers and some are pests of culticated plants.
126	Scelionidae	Parasitoid wasps
127	Sciaridae	Found in moist environments, they are known to be a pest of mushroom farms and are commonly found in household plant pots
128	Scolytidae	Decomposers and pests of forest trees
129	Simuliidae	Females are blood suckers and vectors of diseases. Males are pollinators.
130	Sphecidae	Predatory and pollinators.
131	Sphingidae	Larvae are pests, adults are pollinators
132	Spider- Aranaeidae	Predatory
133	Spider- Tetragnathidae	Predatory
134	Spider-Lycosidae	Predatory
135	Spider-Opilionidae	Predatory
136	Spider-Salticidae	Predatory
137	Spider-Tetragnathidae	Predatory
138	Staphylinidae	Predatory and decomposers.
139	Stephanidae	Parasitoids
140	Tabanidae	Considered as pest for th bites that many inflict but are pollinators.
141	Tachinidae	Parasitoids and parasitic
142	Tenebrionidae	Pests of stored products, others served as food of other organisms
143	Tephritidae	Pests of fruit trees
144	Termitidae	Can cause damage on buildings, decomposers
145	Spiders- Tetragnathidae	Predatory
146	Tetrigidae	Plant feeders, some are pests of cultivated plants.
147	Tettigoniidae	Plant feeders, some are pests of cultivated plants.
148	Tingidae	Plant feeders, some are pests of cultivated plants.
149	Tipulidae	Predatory and pollinators.
150	Tortricidae	Larvae are pests, adults are pollinators
151	Uropodidae	Scavengerrss and decomposers.
152	Veliidae	Found in aquatic habitats and predatory
153	Xylophagidae	Saprophagous (feed on rotten logs)
154	Yponomeutidae	Larvae are pests, adults are pollinators



Annex E. Ants collected around Naujan Lake National Park. A-B) *Oecophylla smaragdina,* **C-D)** *Tapinoma melanocephalum,* **E)** *Tetramorium* sp., **F)** *Anoplolepis gracilipes*, **G)** *Dolichoderus thoracicus,* **H)** *Crematogaster* sp., **I)** *Monomorium floricola,* **J)** *Paratrichina longicornis,* **K)** *Technomyrmex* sp., **L)** *Pheidole* sp.

Annex F. Some insects collected and observed in six sites. A) Long-horned grasshopper (Orthoptera), B) Short-horned grasshopper (Orthoptera), C) Rice stink bug (Hemiptera), D) Pyrrhocorid bug (Hemiptera), E) *Apis* (honeybee) (Hymenoptera), F) Click beetle (Coleoptera), G) Scarab beetle (Coleoptera), H) Lady beetle (Coeloptera), I) Moth (Lepidoptera), J) Sphinx moth (Lepidoptera), K) Moth (Lepidoptera), L) Geometrid moth (Orthoptera), M) Arctiid moth (Lepidoptera), N) Moth (Lepidoptera), O) Moth

Annex G. Some insects collected and observed in six sites. A) Walking sticks (*Lonchodiodes* sp., Phasmatodea), B) Dragonfly (Odonata), C-H) Damselflies (Odonata), I) Firefly (Coleoptera), E) Scarab or June beetle (Coleoptera), F) Male ant (Hymenoptera), G) Wasp (Hymenoptera), H) Cockroach (Blattodea), I) Assasin bug (Hemiptera), J) Leafhopper (Hemiptera).

Annex H. Dissolved Oxygen Concentration

I. Reagents

1. Manganous sulfate solution: Dissolve 480g $MnSO_4 \cdot 4H_2O$ in distilled water and dilute to 1 liter.
2. Alkaline iodide-azide solution: Dissolve 500g KOH and 150g KI in distilled water and dilute to 1 liter. To this solution, add 10g of sodium azide dissolved in 40 ml of distilled water.
3. Sulfuric acid: concentrated
4. Starch solution: Prepare an emulsion of 10g soluble starch in a beaker with a small quantity of distilled water. Put this emulsion into 1 liter of boiling water, allow to boil for a few minutes and let settle for overnight. Use the clear supernate. Preserve by adding 5 mL/L of chloroform and store in a 10°C refrigerator.
5. Sodium thiosulfate stock solution, 0.75N: Dissolve 186.15g $Na_2S_2O_3 \cdot 5H_2O$ in boiled and cooled distilles water and dilute to 1 liter. Preserves by adding chloroform.
6. Sodium thiosulfate standard titrant, 0.0375N: Dilute 50 mL of stock solution to 1 liter. Preserve by adding 5 mL of chloroform.

II. Procedure

1 Fill BOD bottle with 300 mL samples; run over 2-3 times if possible-do not bubble in.
2 Add 2 mL of manganous sulfate solution followed by alkaline iodideazide solution well below the surface of the liquid; stopper with care to exclude air bubbles and mix well by inverting the bottle several times. When the precipitate settles, leaving a clear supernatant, shake again.
3 When settling has produced at least 200 mL of clear supernatant, carefully remove the stopper and immediately add 2 mL of concentrated sulfuric acid by allowing the acid to run down the neck of the bottle, re-stopper, and mix by gentle inversion until the iodine is uniformly distributed throughout the bottle. Complete the analysis within 45 minutes.
4 Transfer the entire bottle contents by inversion into 500 mL wide mouth flask and titrate with 0.0375N sodium thiosulfate solution to pale straw color.
5 Add 1-2 mL starch solution and continue to titrate to the first disappearance of the blue color.

III. Calculation

1. If the normality of the sodium thiosulfate is exactly 0.0375, each mL of the titrant is equivalent to 1 mg DO when the entire bottle contents are titrated.

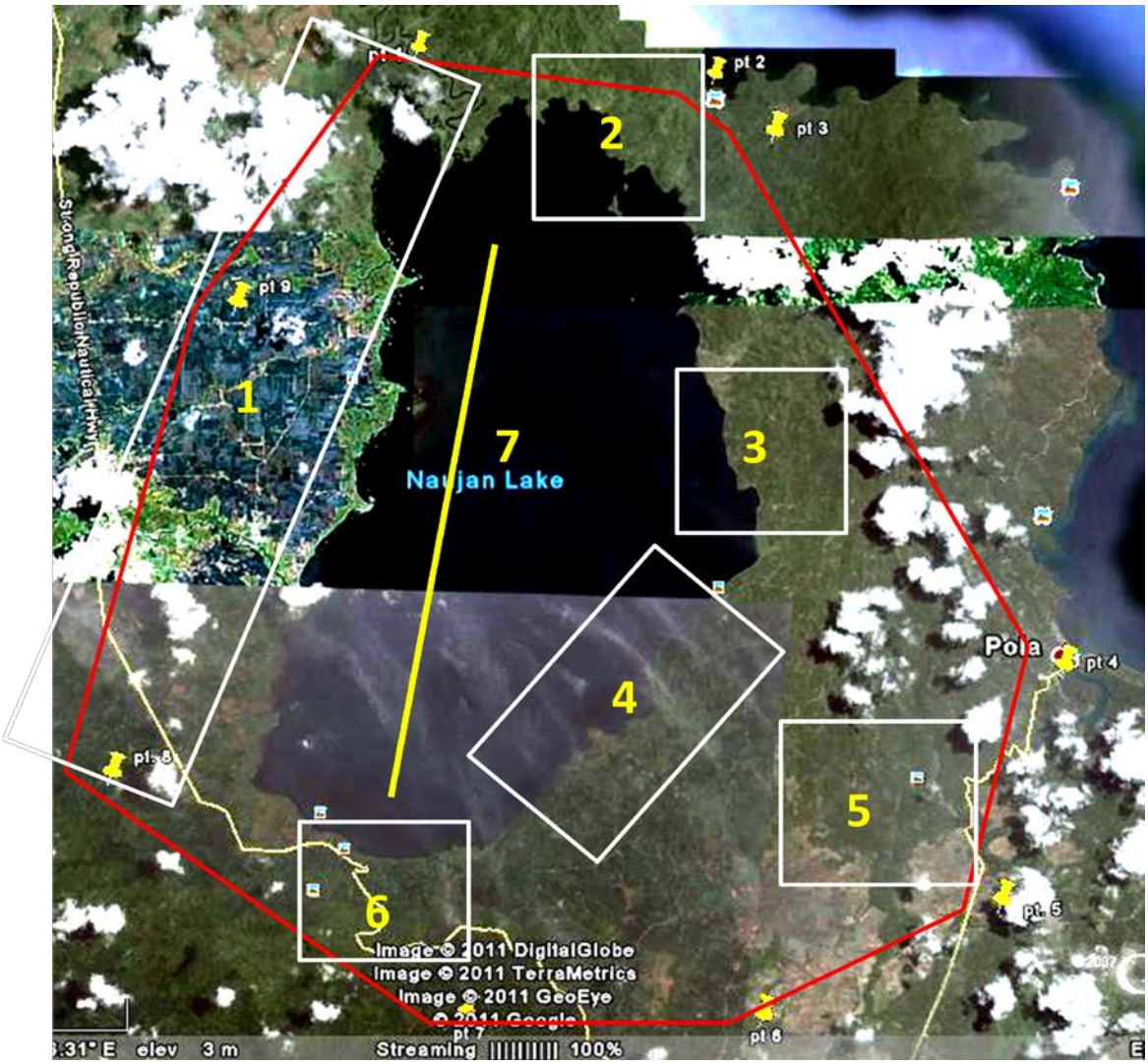


Figure 2.3.1. Sampling sites for flora, terrestrial vertebrates, and terrestrial arthropods.

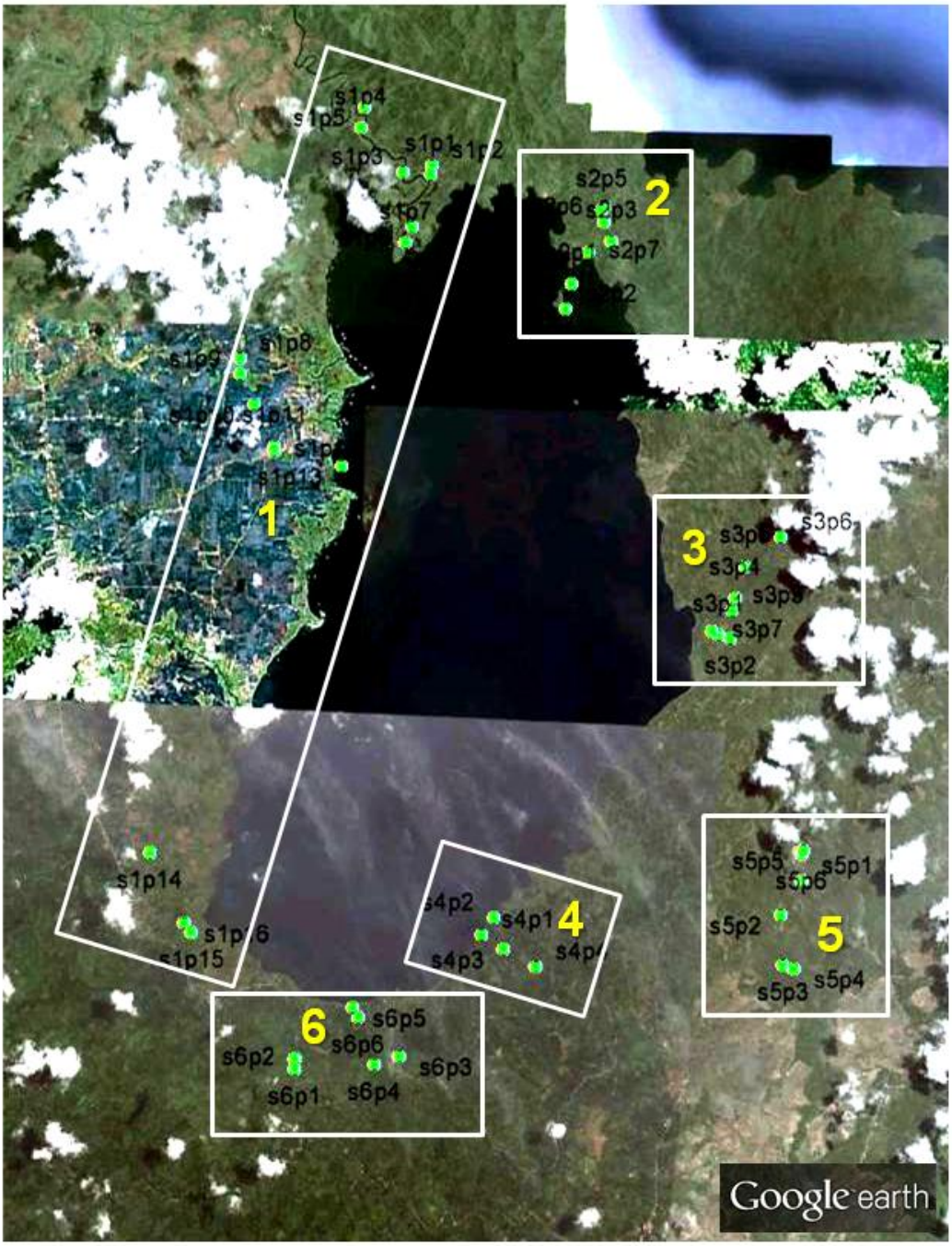


Figure 2.3.2. Location of the six sites and sampling plots for the Naujan Lake National Park botanical survey.

Table 2.3.1. The location of sites and plots for the vegetation survey of Naujan Lake National Park.

Location	General description	Corner 1 coordinates	Map datum	WGS 84	Elevation
Site 1					
Plot 1	marsh / swamp with shrubs and trees	N 13˚07'12.0" E 121˚18'02.9"	Line 1-2 bearing	due N	9 m
Plot 2	shrubs near rice field, hill side, creek side	N 13˚14'25.1" E 121˚20'27.9"	Line 1-2 bearing	N20˚E	2 m
Plot 3	beside Butas River, buri & bangkal vegetation (offset 50m N45˚E)	N 13˚14'21.0" E 121˚20'09.6"	Line 1-2 bearing	N50˚W	4 m
Plot 4	residential	N 13˚14'45.3" E 121˚19'42.7"	Line 1-2 bearing	N20˚W	10 m
Plot 5	in between rice field	N 13˚14'57.1" E 121˚19'44.6"	Line 1-2 bearing	N45˚E	11 m
Plot 6	near Butas River outlet (offset 70m S45˚E)	N 13˚13'50.1" E 121˚20'16.3"	Line 1-2 bearing	N50˚E	18 m
Plot 7	near Butas River outlet (offset 30m due E)	N 13˚13'40.9" E 121˚20'12.3"	Line 1-2 bearing	N45˚W	7 m
Plot 8	beside feeder road, rice field	N 13˚12'32.9" E 121˚18'29.7"	Line 1-2 bearing	due N	15 m
Plot 9	in between rice field, tract of forest	N 13˚12'23.9" E 121˚18'30.2"	Line 1-2 bearing	due E	11 m
Plot 10	in between rice field, beside feeder road, tract of grassland	N 13˚12'07.0" E 121˚18'39.4"	Line 1-2 bearing	Luzon Philippines due E	11 m
Plot 11	tract of forest near rice field, near creek	N 13˚11'43.6" E 121˚18'52.9"	Line 1-2 bearing	Luzon Philippines N45˚W	11 m
Plot 12	tract of forest near rice field, residential area, creek	N 13˚11'41.1" E 121˚18'52.7"	Line 1-2 bearing	Luzon Philippines N45˚W	11 m
Plot 13	planted Mambog and Bangkal in between rice field	N 13˚11'33.4" E 121˚19'35.5"	Line 1-2 bearing	Luzon Philippines due W	11 m
Plot 14	shrubland near rice field, creek, and beside feeder road	N 13˚07'51.3" E 121˚17'40.4"	Line 1-2 bearing	Luzon Philippines due S	11 m

Plot 15	small tract of forest near swamp and pit land	N 13˚07'06.9" E 121˚18'07.5"	Line 1-2 bearing	due E	7 m
Plot 16	marshland/swamp with shrubs and trees	N 13˚07'12.0" E 121˚18'02.9"	Line 1-2 bearing	due N	9 m
Site 2					
Plot 1	small forested island	N 13˚13'20.0" E 121˚21'57.6"	Line 1-2 bearing	N45˚W	24 m
Plot 2	island with coconut, citrus plantation, forested area, few houses	N 13˚13'05.9" E 121˚21'54.2"	Line 1-2 bearing	due S	14 m
Plot 3	hill, with coconut, citrus, banana plantation, shrub area with big trees	N 13˚13'44.5" E 121˚22'22.0"	Line 1-2 bearing	S50˚W	82 m
Plot 4	hill, ridge, forested	N 13˚14'03.5" E 121˚22'17.2"	Line 1-2 bearing	N45˚W	254 m
Plot 5	top of the hill, big trees	N 13˚14'01.8" E 121˚22'15.2"	Line 1-2 bearing	S50˚E	273 m
Plot 6	ridge, hill, forested	N 13˚13'55.3" E 121˚22'16.9"	Line 1-2 bearing	N55˚E	210 m
Plot 7	lake side, near small creek	N 13˚13'38.2" E 121˚22'07.9"	Line 1-2 bearing	due W	9 m
Site 3					
Plot 1	tract of forest, near creek	N 13˚10'03.4" E 121˚23'35.1"	Line 1-2 bearing	due W	29 m
Plot 2	tract of forest, near creek/ riparian	N 13˚10'01.8" E 121˚23'42.5"	Line 1-2 bearing	N45˚E	53 m
Plot 3	citrus (kalamansi) plantation	N 13˚10'17.6" E 121˚43'.2"	Line 1-2 bearing	due N	73 m
Plot 4	riparian, shrubs and forest vegetation	N 13˚10'24.5" E 121˚23'45.0"	Line 1-2 bearing	N10˚W	98 m
Plot 5	coconut plantation	N 13˚10'42.8" E 121˚23'50.5"	Line 1-2 bearing	N30˚W	155 m

Plot 6	remaining dipterocarps, coconut and citrus plantation	N 13˚10'59.7" E 121˚24'12.0"	Line 1-2 bearing	S30˚E	256 m
Plot 7	riparian	N 13˚10'05.4" E 121˚23'31.1"	Line 1-2 bearing	N45˚E	28 m
Site 4					
Plot 1	lakeside, ridge side, forested	N 13˚07'10.0" E 121˚21'10.5"	Line 1-2 bearing	S10˚E	9 m
Plot 2	lakeside, ridge side, forested	N 13˚07'19.9" E 121˚21'17.9"	Line 1-2 bearing	N55˚E	7 m
Plot 3	citrus plantation	N 13˚07'02.2" E 121˚21'24.5"	Line 1-2 bearing	S45˚W	40 m
Plot 4	agroforestry area	N 13˚07'45.8" E 121˚24'30.9"	Line 1-2 bearing	N30˚W	28 m
Site 5					
Plot 1	agroforestry area	N 13˚07'45.8" E 121˚24'30.9"	Line 1-2 bearing	N30˚W	162 m
Plot 2	coconut plantation, agroforestry area	N 13˚07'26.1" E 121˚24'18.5"	Line 1-2 bearing	S 05˚E	120 m
Plot 3	agroforestry area	N 13˚06'57.6" E 121˚24'20.6"	Line 1-2 bearing	S50˚E	94 m
Plot 4	agroforestry area	N 13˚06'55.7" E 121˚24'27.7"	Line 1-2 bearing	S20˚W	78 m
Plot 5	forested area, ridge side, near citrus plantation	N 13˚08'02.9" E 121˚24'31.7"	Line 1-2 bearing	N20˚W	140 m
Plot 6	citrus (kalamansi) plantation	N 13˚08'01.0" E 121˚24'30.7"	Line 1-2 bearing	S50˚E	142 m
Site 6					
Plot 1	scrubland, invasion , parang	N 13˚05'51.7" E 121˚19'15.0"	Line 1-2 bearing	S12˚E	97 m
Plot 2	grassland beside shrubs	N 13˚05'57.4" E 121˚19'14.9"	Line 1-2 bearing	N11˚E	74 m

Plot 3	forested, hill, near agroforestry area	N 13˚06'00.3" E 121˚20'20.6"	Line 1-2 bearing	N10˚W	53 m
Plot 4	citrus plantation near creek	N 13˚05'55.1" E 121˚20'05.0"	Line 1-2 bearing	due E	32 m
Plot 5	lake side, residential area, shrubs	N 13˚06'26.7" E 121˚19'50.5"	Line 1-2 bearing	N40˚W	26 m
Plot 6	agroforestry area, citrus plantation, beside feeder road	N 13˚06'21.3" E 121˚19'54.0"	Line 1-2 bearing	due N	55 m

Table 2.3.2. Land use in the Naujan Lake National Park (area in hectare).

	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Total	Percentage (%) of all sites
Forest	-	27	15	34	-	78	154	1.42
Scrub	-	260	455	279	509	760	2263	20.96
Marsh	825	-	-	85	41	49	1000	9.26
Coconut	-	354	445	552	1163	403	2917	27.02
Ricefield	1925	55	44	292	869	125	3310	30.67
Citrus	-	62	283	139	-	47	531	4.92
Residential	-	-	-	295	201	121	617	5.71
Total	2750	758	1242	1676	2783	1583	10792	

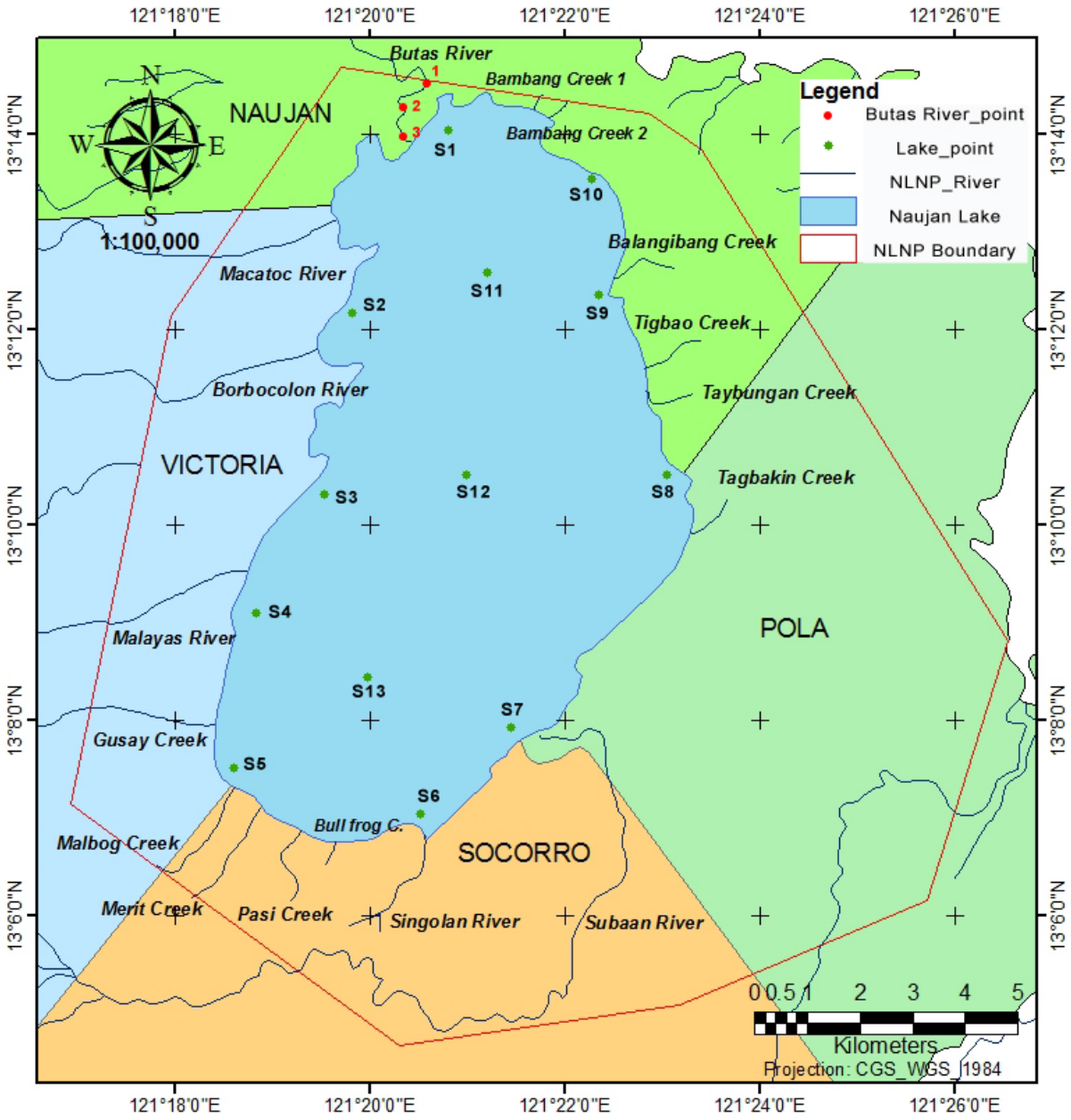


Figure 2.3.3.1. Sampling points for Naujan Lake and Butas River.

Figure 2.3.3.2. Sampling sites for each tributary of Naujan Lake National Park

Table 2.3.4.1. Arthropod pre-established stations.

Transect Line (Site)	Geographical Location	Description
1	Plot 1: 13°07'01.6" N 121°18'15.5" E Elev: 15 m Plot 2: 13°06'51.3" N 121°18'22.9" E Elev: 15 m Plot 3: 13°06'44.6" N 121°18'33.2" E Elev: 15 m Plot 4: 13°06'39.1" N 121°18'39.9" E Elev: 20 m	The monitoring station is located in Brgy. Banbanin (Figure 2.3.4.1). The habitat condition is marshland mixed with ricefield.
2	Plot 1: 13°13'37.7" N 121°22'12.9" E Elev: 22 m Plot 2: 13°13'47.3" N 121°22'22.0" E Elev: 100 m Plot 3: 13°13'48.2" N 121°22'13.1" E Elev: 100 m Plot 4: 13°13'44.9" N 121°22'03.7" E Elev: 138 m	The monitoring station is located in Brgy. Montelago (Figure 2.3.4.2). Vegetation includes a mixed of citrus-coconut plantation and patches of secondary growth forest. Also, a few meters from the lake.
3	Plot 1: 13°09'59.6" N 121°23'26.0" E Elev: 11 m Plot 2: 13°10'10.2" N 121°23'35.1" E Elev: 70 m Plot 3: 13°10'12.3" N 121°23'45.4" E Elev: 120 m Plot 4: 13°10'17.2" N 121°23'41.8" E	The monitoring station is located in Brgy. Tagbakin (Figure 2.3.4.3) The habitat is a mosaic of agricultural areas, mostly citrus and rambutan and secondary growth forest that has been slowly converted to citrus plantation.

	Elev: 70 m	
4	Plot 1: 13°07'11.4” N 121°21'08.7” E Elev: 24 m Plot 2: 13°07'21.7” N 121°21'10.2” E Elev: 20 m Plot 3: 13°07'29.4” N 121°21'13.5” E Elev: 21 m Plot 4: 13°07'22.6” N 121°21'28.7” E Elev: 31 m	The monitoring station is located in Brgy. Mabuhay 2 (Figure 2.3.4.4). The habitat type is a mixture of old and secondary forest, scrubland, grassland and agricultural land (coconut trees, citrus plantation and ricefield)
5	Plot 1: 13°08'05.8” N 121°24'21.7” E Elev: 148 m Plot 2: 13°08'17.6” N 121°24'19.7” E Elev: 142 m Plot 3: 13°08'28.7” N 121°24'10.6” E Elev: 146 m Plot 4: 13°08'43.5” N 121°24'04.1” E Elev: 154 m	The monitoring station is located in Brgy. Calubasanhon (Figure 2.3.4.5), which is an agricultural area. The dominant habitat type are citrus and coconut plantation and along a ridge with secondary forest growth.
6	Plot 1: 13°06'03.0” N 121°19'06.6” E Elev: 82 m Plot 2: 13°06'16.4” N 121°19'06.3” E Elev: 64 m Plot 3: 13°06'28.2” N 121°19'08.4” E Elev: 16 m Plot 4: 13°06'35.6” N 121°18'59.8” E Elev: 14 m	The habitat at the monitoring station in Brgy. Happy Valley (Figure 2.3.4.6) is mainly composed of fruit trees (e.g. rambutan, citrus, santol, mango, banana, coconut, etc.), grasses and vines.

Figure 2.3.4.1. Transect Line 1 (Site 1) – Brgy. Bambanin, A) Plot 1, B) Plot 2, C) Plot 3, D) Plot 4.

Figure 2.3.4.2. Transect Line 2 (Site 2) – Brgy, Montelago, A) Plot 1, B) Plot 2, C) Plot 3 D) Plot 4.

Figure 2.3.4.3. Transect Line 3 (Site 3) – Brgy. Tagbakin, Plot 1, B) Plot 2, C) Plot 3, D) Plot 4.

Figure 2.3.4.4. Transect Line 4 (Site 4) – Brgy. Mabinay 2, A) Plot 1, B) Plot 2, C) Plot 3, D) Plot 4.

Figure 2.3.4.5. Transect Line 5 (Site 5) – Brgy. Calubasanhon, A) Plot 1, B) Plot 2, C) Plot 3, D) Plot 4.

Figure 2.3.4.6. Transect Line 6 (Site 6) – Brgy. Happy Valley, A) Plot 1, B) Plot 2, C) Plot 3, D) Plot 4.

Table 2.3.5.1. Description and Coordinates of Sampling Sites of Water of Naujan Lake, Oriental Mindoro, October, 2011.

Sampling Code	Sampling Sites/Stations	Coordinates Latitude (°N)	Longitude (°E)	Accuracy (m)	Elevation (m)	Description
NL1	Singulan	13° 06' 42.2"	121° 20' 26.6"	3	5	Near ricefield
NL2	Subaan	13° 07' 54.2"	121° 21' 31.3"	3	7	Near ricefield
NL3	Tagbakin	13° 09' 53.6"	121° 23' 14.7"	3	12	Near creek/ ricefield
NL4	Taybungan	13° 11' 19.6"	121° 22' 43.3"	3	11	Near creek/ ricefield
NL5	Butas	13° 13' 43.9"	121° 20' 08.1"	3	13	Near grassland/ river
NL6	Malayas	13° 09' 22.8"	121° 18' 58.4"	3	12	Near Marshland / ricefield
NL7	Taybungan Falls	13° 10' 17.2"	121° 23' 41.8"	3	49	Falls

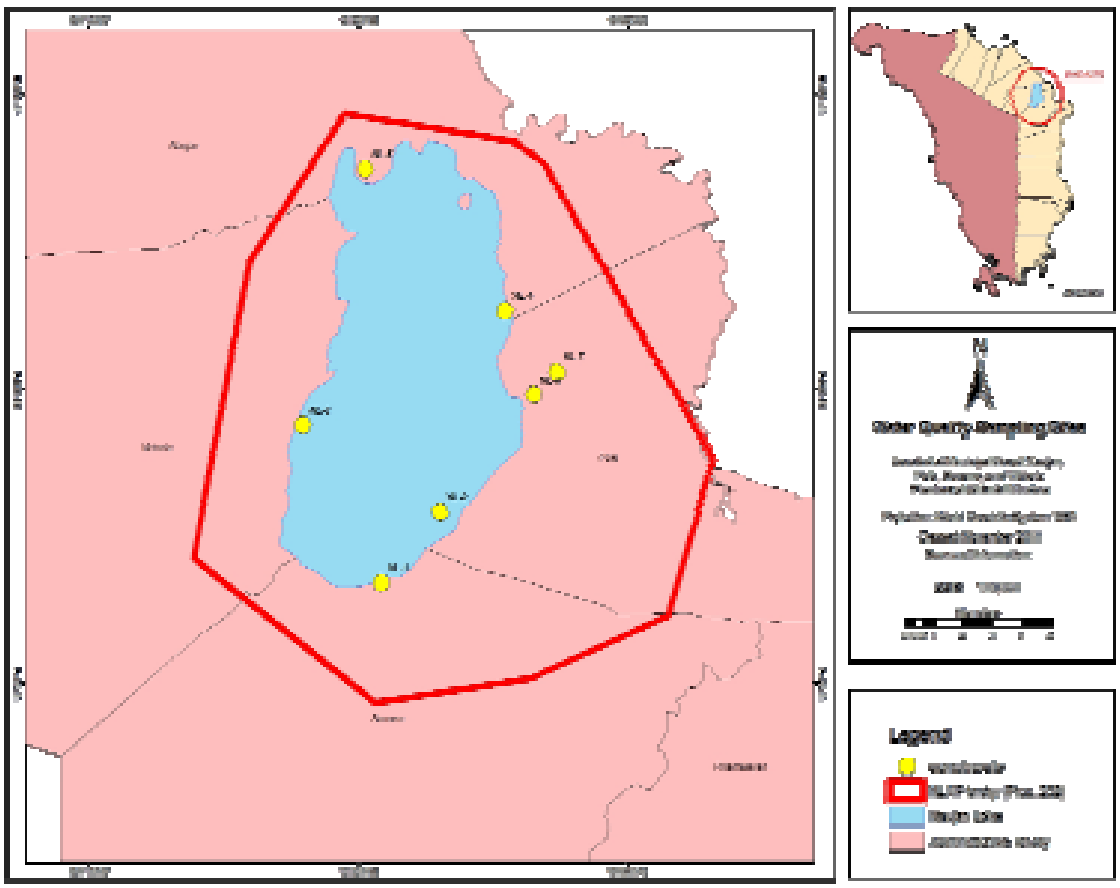
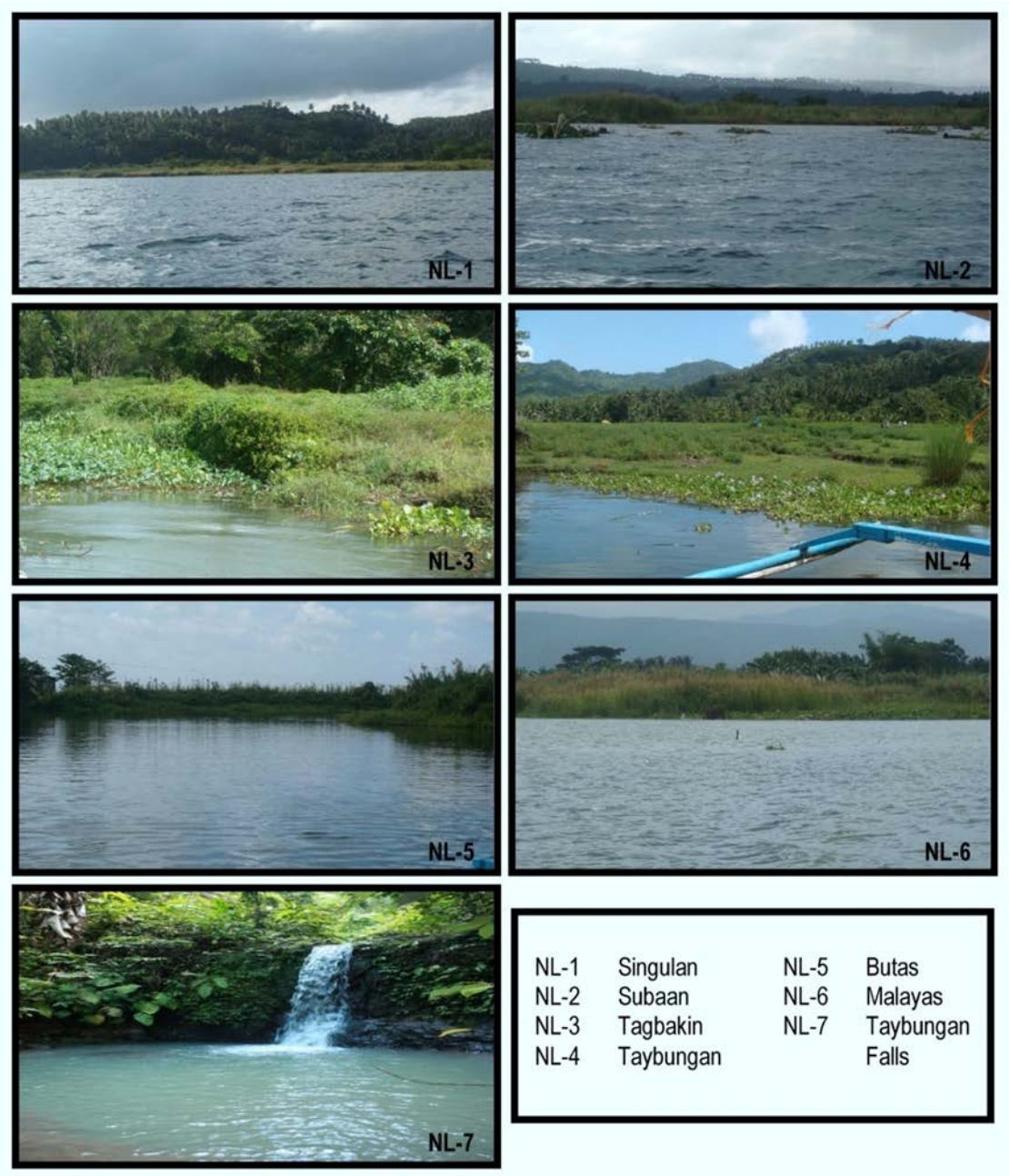


Figure 2.3.5.1. Profile of Sampling Sites for Water Quality and Microbial Diversity Assessment of Naujan Lake (NL), Oriental Mindoro, October, 2011. (Map courtesy of Dr. Nathaniel C. Bantayan and Mr. Milben M. Bragais, 2011)

Figure 2.3.5.2. Photograph of sampling sites of lake water at Naujan Lake, Oriental Mindoro, October, 2011. (Photo credits: NL-1 to NL-6 by MAP De Leon and NL7 by SA Yap)



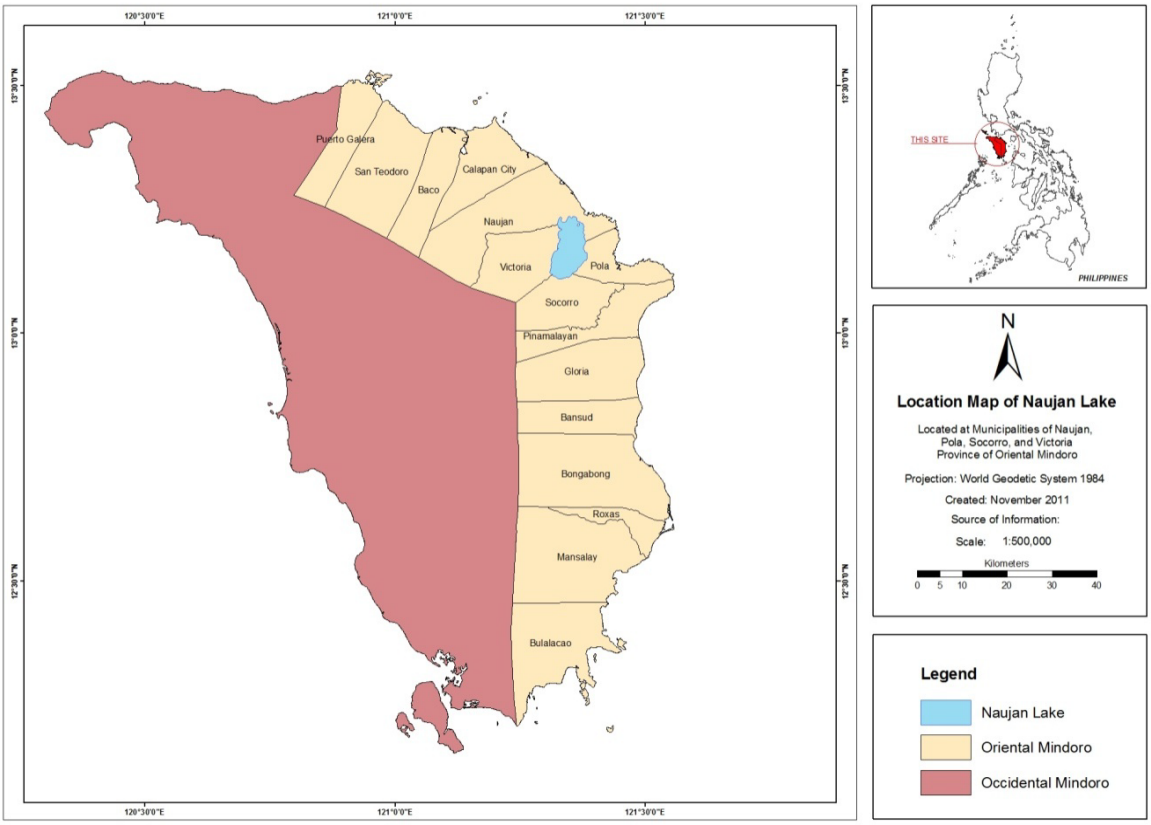


Figure 3.1.1. Vicinity Map of NLNP.

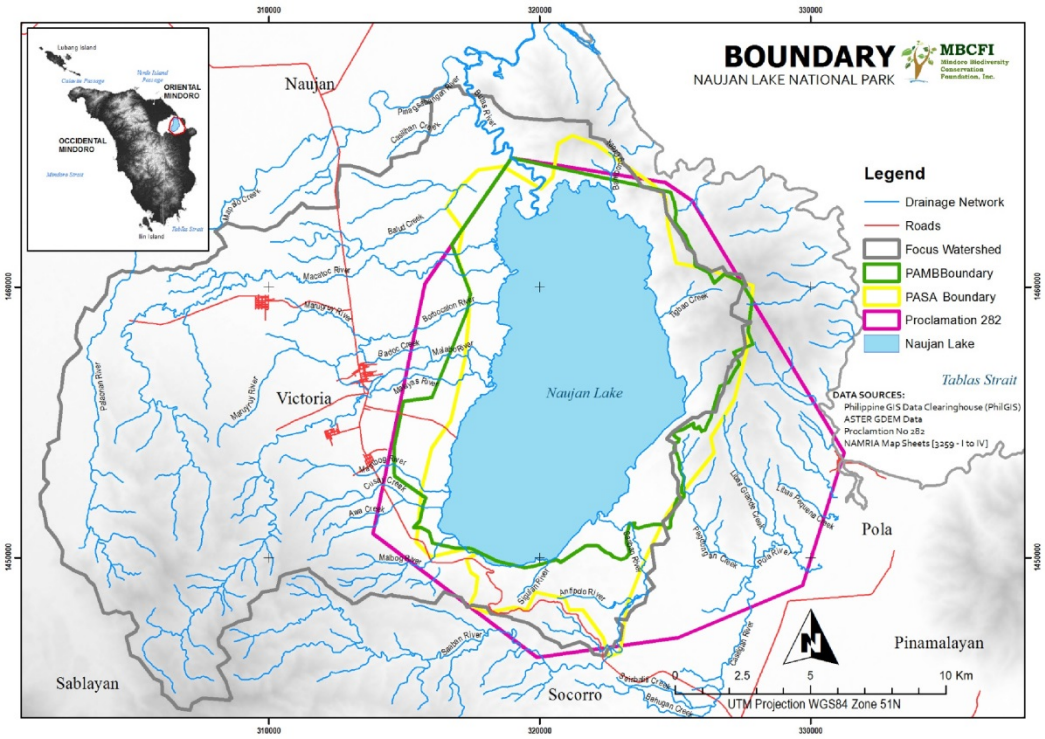


Figure 3.1.2. Boundaries of NLNP.

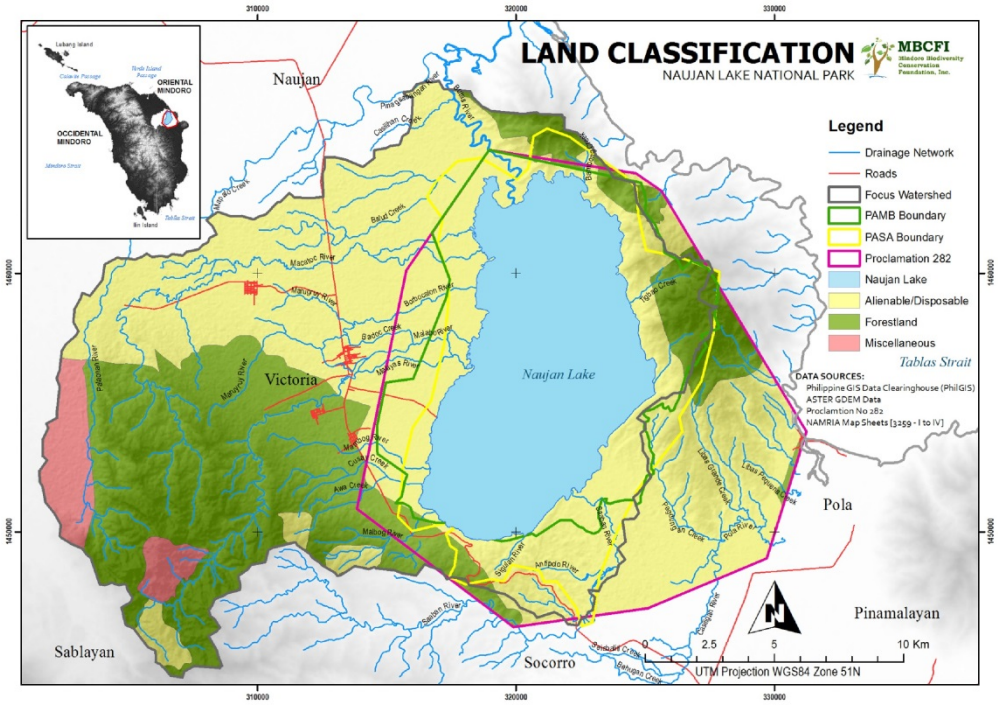


Figure 3.1.3. Land classification of NLNP

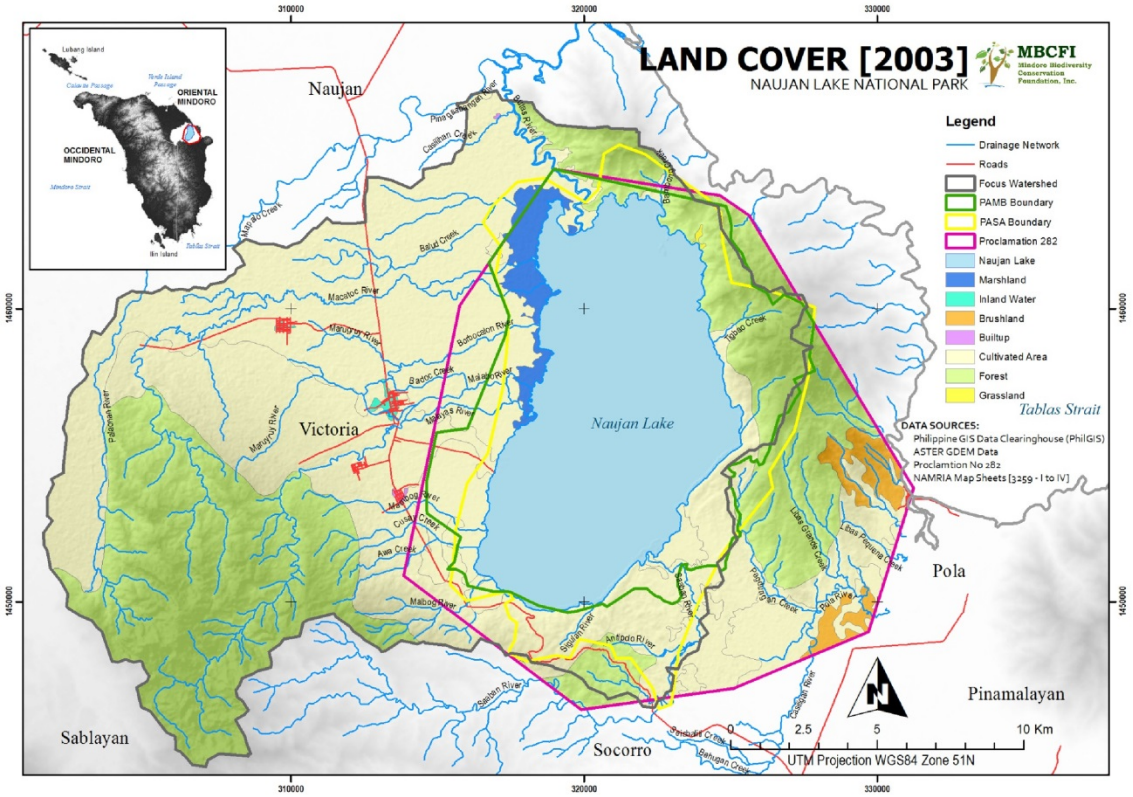


Figure 3.1.4. Land cover of NLNP.

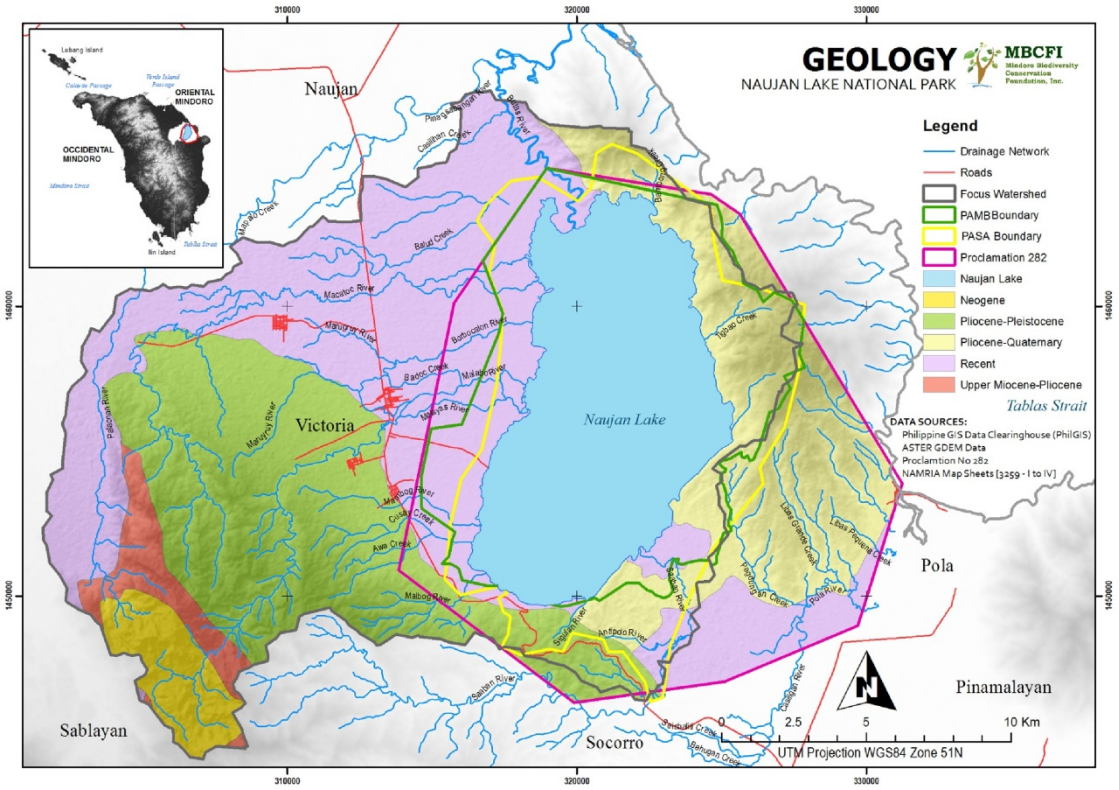


Figure 3.1.5. Geological characteristics of NLNP.

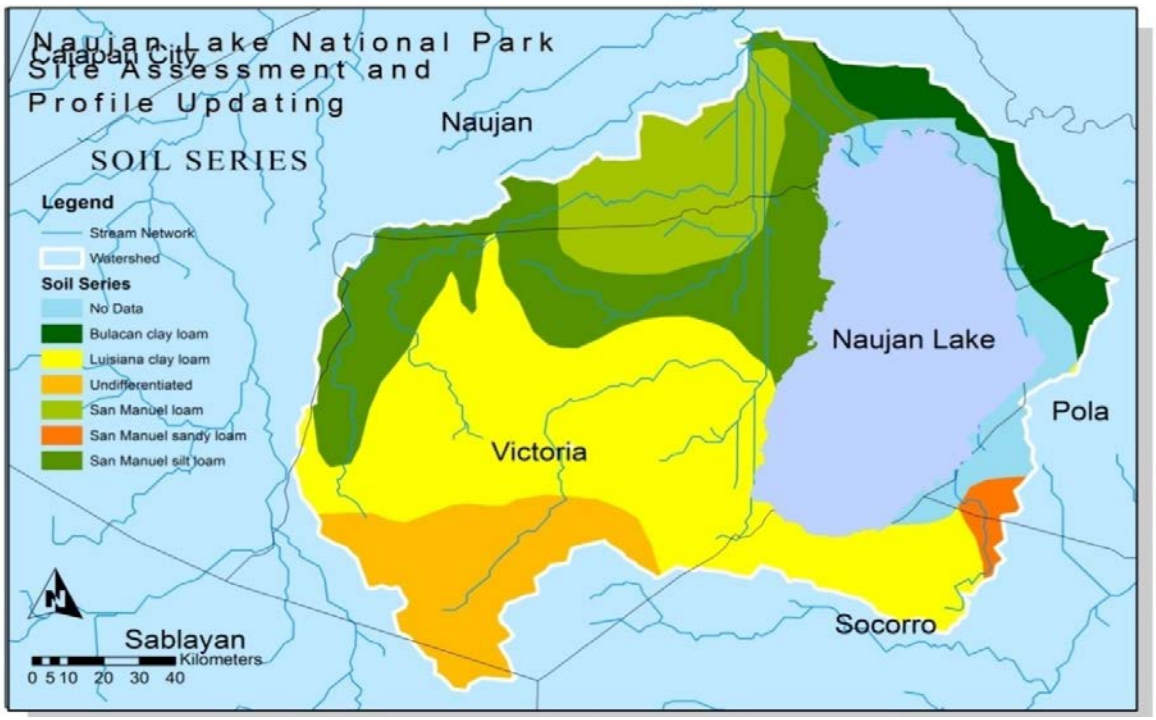


Figure 3.1.6. Soil series of NLNP.

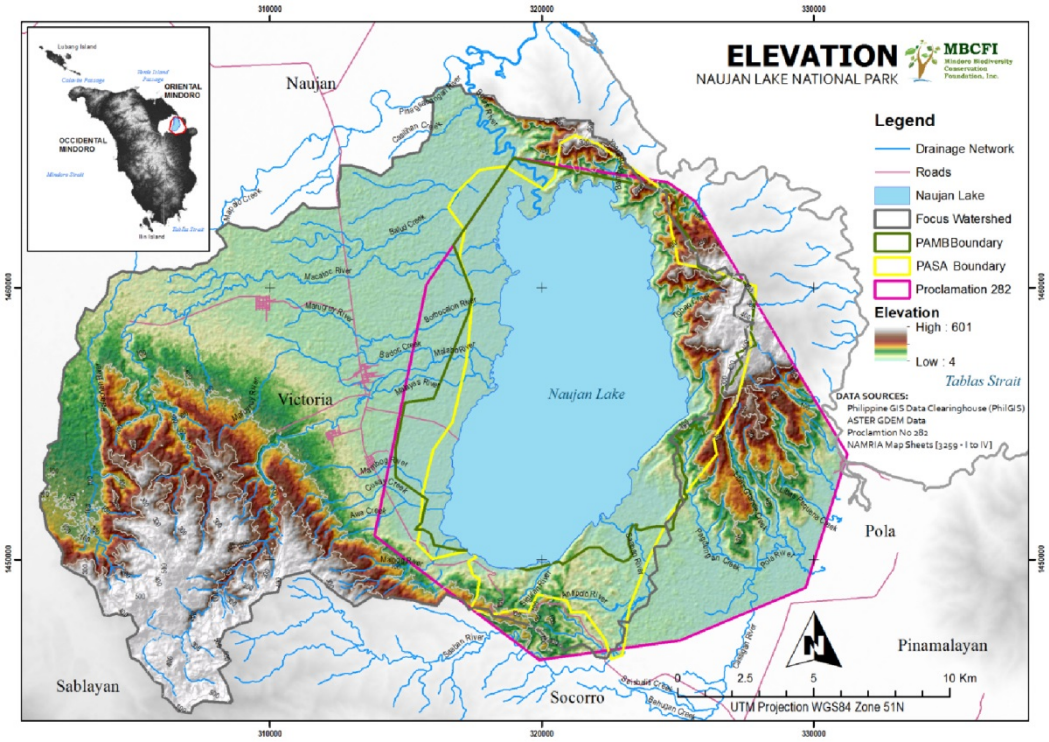


Figure 3.1.7. Elevation of NLNP.

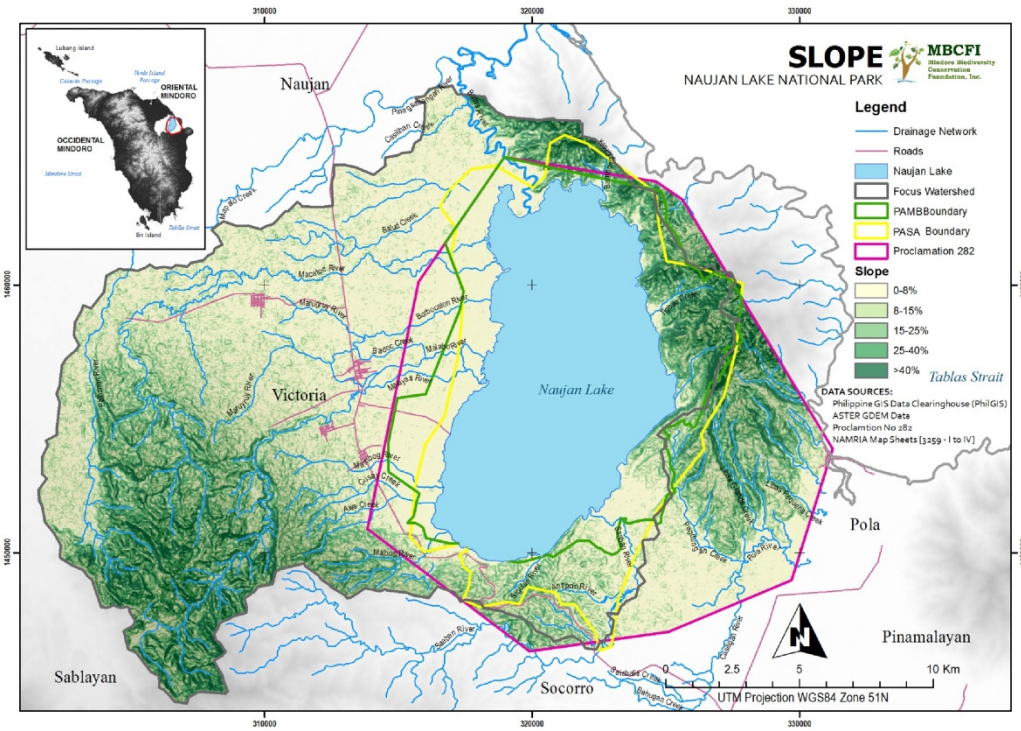


Figure 3.1.8. Slope of NLNP.

Figure 3.2.1.1. *Arenga tremula* (Blanco) Becc. [Arecaceae] and *Artocarpus blancoi* (Elmer) Merr. [Moraceae] in secondary forest in Site 3.

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Figure 3.2.1.2. *Pometia pinnata* Forst. & Forst.f. [Sapindaceae] with tree crown arching over a small river in Site 3.

Figure 3.2.1.3. *Mallotus mollissimus* (Geisel.) Airy Shaw [Euphorbiaceae] is a common fast growing tree species in the *parang vegetation.*

Figure 3.2.1.4. *Terminalia copelandii* Elmer [Combretaceae] in a small remnant freshwater swamp forest on the northern side of Site 1.

Figure 3.2.1.5. *Cyperus imbricatus* Retz. [Cyperaceae] (lower right hand side of photo) among other sedges and grasses in the marsh in Site 1.

Figure 3.2.1.6. *Monochoria hastata* (L.) Solms [Pontederiaceae], a common component of 11 the wetland area along the lakeshore in Site 1.

Figure 3.2.1.7. A coconut [*Cocos nucifera* L.] plantation in Site 3

Figure 3.2.1.8. A mix of banana, coconut, citrus, and root crops in Site 5.

Figure 3.2.1.9. A mix of banana, coconut, citrus, and root crops in Site 5.

Figure 3.2.1.10. *Randia mindorensis* Elmer [Rubiaceae] is one of two species of Mindoro-endemic plant species recorded from the lake park.

Table 3.2.1.3. Annotated checklist of the vascular plants of Naujan Lake National Park.

	Species name	Family	Conservation status / Endemicity / Ecology
1	*Acalypha amentacea* Roxb.	Euphorbiaceae	
2	*Adenanthera intermedia* Merr.	Fabacaeae	
3	*Aeschynomene indica L.*	Fabaceae	Common in the marshes and rice paddies
4	**Ageratum conyzoides* (L.) L.	Asteraceae	Weed; native of Neotropics
5	*Aglaia argentea* Blume	Meliaceae	
6	*Aglaonema commutatum* Schott	Araceae	
7	*Aglaonema commutatum* Schott var. *maculatum* (J.D.Hook.) Nicolson	Araceae	
8	*Ailanthus integrifolia* Lamk.	Simaroubaceae	
9	*Alangium javanicum (*Blume) Wangerin	Cornaceae	
10	*Allophyllus cobbe* (L.) Raeusch.	Sapindaceae	
11	*Alocasia macrorhizos* (L.) G.Don	Araceae	
12	*Alpinia elegans* (Presl) K.Schum.	Zingiberaceae	
13	*Alstonia macrophylla* Wall. ex G.Don.	Apocynaceae	
14	*Alstonia scholaris* (L.) R.Br.	Apocynaceae	
15	*Alternanthera* sp.	Amaranthaceae	
16	*Alysicarpus vaginalis* (L.) DC.	Fabaceae	Common weed
17	*Amorphophallus paeoniifolius* (Dennst.) Nicolson	Araceae	
18	*Amphineuron terminans* (J.Sm. ex Hook.) Holttum	Thelypteridaceae	
19	**Ananas comosus* (L.) Merr.	Bromeliaceae	Pineapple; Native of South America; cultivated
20	*Antidesma bunius* (L.) Spreng	Phyllanthaceae	
21	*Antidesma montanum* Blume	Phyllanthaceae	
22	*Arcangelisia flava* (L.) Merr.	Menispermaceae	
23	*Arenga pinnata* (Wurmb) Merr.	Arecaceae	
24	*Arenga tremula* (Blanco) Becc.	Arecaceae	Endemic to the Philippines
25	*Aristolochia tagala* Cham.	Aristolochiaceae	
26	*Artocarpus altilis* (Park.) Fosb.	Moraceae	Cultivated for its edible fruits
27	*Artocarpus blancoi* (Elmer) Merr.	Moraceae	Endemic to the Philippines
28	*Artocarpus heterophyllus* Lamk.	Moraceae	Cultivated for its edible fruits
29	*Artocarpus odoratissimus* Blanco	Moraceae	Cultivated for its edible fruits
30	*Artocarpus ovatus* Blanco	Moraceae	Endemic to the Philippines
31	*Artocarpus xanthocarpus* Merr.	Moraceae	
32	**Axonopus compressus* (Sw.) P.Beauv.	Poaceae	Native of tropical America; cult. as lawn grass; occurs as a weed
33	*Bambusa blumeana* J.A. & J.H.Schultes	Poaceae	Cultivated
34	**Bambusa dolichomerithalla* Hayata	Poaceae	Native of Taiwan; Cultivated as ornamental
35	*Barringtonia acutangula* (L.) Gaertn.	Lecythidaceae	
36	*Barringtonia pterita* Merr.	Lecythidaceae	
37	*Barringtonia racemosa* (L.) Blume	Lecythidaceae	
38	*Bauhinia cumingiana* (Benth.) Vill.	Fabaceae	
39	*Bauhinia integrifolia* Roxb.	Fabaceae	
40	*Beilschmiedia glomerata* Merr.	Lauraceae	
41	*Blechum pyramidatum* (Lam.) Urb.	Acanthaceae	
42	*Blumea balsamifera* L.	Asteraceae	

43	*Brachiaria* sp. [Synonym: *Urochloa* sp.]	Poaceae	
44	*Breynia vitis-idaea* (Burm.f.) C.E.C.Fischer	Phyllanthaceae	
45	*Buchanania arborescens* (Blume) Blume	Anacardiaceae	
46	*Caesalpinia latisiliqua* (Cav.) Hattink [Synonym: *Mezoneuron latisiliquum* (Cav.) Merr.]	Fabaceae	
47	*Calamus merrillii* Becc.	Arecaceae	
48	*Calamus ornatus* Blume ex Schult. & Schult.f.	Arecaceae	
49	**Calopogonium mucunoides* Desv.	Fabaceae	Native of Tropical America; common weed
50	*Cananga odorata* (Lam.) Hook.f. & Thomson	Annonaceae	
51	*Canarium asperum* Benth	Burseraceae	
52	*Canarium hirsutum* Willd.	Burseraceae	
53	*Canavalia* sp.	Fabaceae	
54	*Canthium monstrosum* (A.Rich.) Merr.	Rubiaceae	
55	**Capsicum frutescens* L.	Solanaceae	Native of Tropical America; naturalized and cultivated
56	*Carica papaya* L.	Caricaceae	Cultivated for its edible fruits
57	*Centella asiatica* (L.) Urb.	Apiaceae	
58	**Centrosema pubescens* Benth.	Fabaceae	Native of South America; common weed in cultivated fields
59	*Chionanthus coriaceus* (S.Vidal) Yuen P. Yang & S.Y. Lu [Synonym: *Linociera phanerophlebia* Merr.]	Oleaceae	
60	*Chionanthus remotinervius* (Merr.) Kiew [Synonym: *Linociera remotinervia* Merr.]	Oleaceae	Endemic to the Philippines; Critically endangered (CR) (DENR DAO 2007-01)
61	*Chisocheton cumingianus* (C.DC.) Harms	Meliaceae	
62	*Chisocheton pentandrus* (Blanco) Merr.	Meliaceae	
63	*Christella dentata* (Forsst.) Holttum	Thelypteridaceae	
64	**Chromolaena odorata* (L.) R.M. King & H.Rob.	Asteraceae	Native of the Neotropics; Common weed
65	**Chrysophyllum cainito* L.	Sapotaceae	Native of the West Indies and Central America; cultivated
66	*Chrysopogon aciculatus* (Retz.) Trin.	Poaceae	Common weed
67	*Citrofortunella microcarpa* (Bunge) Wijnands	Rutaceae	'kalamansi', cult, in plantations
68	*Citrus reticulata* Blanco	Rutaceae	
69	**Cleome rutidosperma* DC.	Capparidaceae	Native of W tropical Africa; common weed
70	*Clerodendrum minahassae* Teijsm & Binn.	Verbenaceae	
71	*Cocos nucifera* L.	Arecaceae	Coconut; cult. in plantations
72	*Codiaeum variegatum* (L.) Blume	Euphorbiaceae	Cultivated as ornamental plant
73	**Coffea canephora* Pierre ex A.Froehner [Synonym: *Coffea robusta* L.Linden]	Rubiaceae	Native of West Africa; cultivated in plantations and home gardens
74	*Colocasia esculenta* (L.) Schott	Araceae	Cultivated as vegetable
75	*Colona serratifolia* Cav.	Malvaceae	
76	*Commelina diffusa* N.L.Burman	Commelinaceae	
77	*Cordia dichotoma* G.Forst.	Boraginaceae	
78	*Corypha utan* Lamk.	Arecaceae	
79	*Costus speciosus* (Koem ex. Retz) SM.	Costaceae	
80	*Cratoxylum sumatranum* (Jack) Blume	Clusiaceae	
81	*Crotolaria* sp.	Fabaceae	
82	*Cryptocarya laevigata* Blume [Synonym: *Cryptocarya trinervia* Elmer]	Lauraceae	
83	*Cucurbita maxima* Duchesne	Cucurbitaceae	Cultivated
84	**Cuphea hyssopifolia* Kunth	Lythraceae	Native of Central America; Cultivated as ornamental

85	*Curcuma domestica* Valeton	Zingiberaceae	Cultivated
86	*Cyanthillium cinereum* (L.) H.Rob. [Synonym: *Vernonia cinerea* (L.) Less.]	Asteraceae	
87	*Cyanthillium patulum* (Aiton) H.Rob. [Synonym: *Vernonia patula* (Dryand.) Merr.]	Asteraceae	
88	*Cyathula prostrata* (L.) Blume	Amaranthaceae	
89	**Cynodon dactylon* (L.) Pers.	Poaceae	Native of Africa; widely cultivated as lawn grass
90	*Cyperus compactus* Retz.	Cyperaceae	
91	**Cyperus cyperoides* (L.) Kuntze	Cyperaceae	Native of Africa; common weed
92	*Cyperus distans* L.f.	Cyperaceae	
93	*Cyperus imbricatus* Retz.	Cyperaceae	
94	*Cyperus iria* L.	Cyperaceae	
95	*Cyperus kyllingia* Endl.	Cyperaceae	
96	**Cyperus rotundus* L.	Cyperaceae	Native of Africa to India; common weed
97	*Dacryodes* sp.	Burseraceae	
98	*Dendrocnide densiflora* (C.B.Rob.) Chew	Urticaceae	Endemic to the Philippines
99	*Dendrocnide subclausa* (C.B.Rob.) Chew	Urticaceae	Endemic to the Philippines
100	*Derris philippinensis* Merr.	Fabaceae	Endemic to the Philippines
101	*Desmodium styracifolium* (Osbeck) Merr.	Fabaceae	Common roadside weed
102	*Desmodium triflorum* (L.) DC.	Fabaceae	
103	*Dichanthium* sp.	Poaceae	
104	*Dillenia philippinensis* Rolfe	Dilleniaceae	Endemic to the Philippines; OWS LR/lc (DENR DAO 2007-01
105	*Dimorphocalyx* sp.	Euphorbiaceae	
106	*Dinochloa diffusa* (Blanco) Merr.	Poaceae	
107	*Dioscorea flabellifolia* Prain & Burkill	Dioscoreaceae	Endemic to the Philippines
108	*Dioscorea pentaphylla* L.	Dioscoreaceae	
109	*Diospyros mindanaensis* Merr.	Ebenaceae	Vulnerable (VU) (DENR DAO 2007-01)
110	*Diospyros philippinensis* A.DC.	Ebenaceae	Endangered (EN) (DENR DAO 2007-01)
111	*Diplazium esculentum* (Retz.) Sw.	Woodsiaceae	Edible fern
112	*Diplodiscus paniculatus* Turcz.	Malvaceae	Endemic to the Philippines
113	*Dipterocarpus kerrii* King	Dipterocarpaceae	Vulnerable (VU) (IUCN 2006)
114	*Dolichandrone spathacea* (L.f.) Seem.	Bignoniaceae	
115	*Donax cannaeformis* (Forst.f.) Rolfe	Maranthaceae	
116	**Dracaena fragrans* (L.) Ker Gawl.	Asparagaceae	Native of Africa; cultivated as an ornamental
117	*Dracontomelon dao* (Blanco) Merr. & Rolfe	Anacardiaceae	Vulnerable (VU) (DENR DAO 2007-01)
118	*Dracontomelon edule* (Blanco) Skeels	Anacardiaceae	Endemic to the Philippines; Vulnerable (VU) (DENR DAO 2007-01)
119	*Drypetes maquilingensis* (Merr.) Pax & K.Hoffm.	Putranjivaceae	Native of Sumatra and Borneo; cultivated as edible fruit tree
120	**Durio zibethinus* Murr.	Malvaceae	
121	*Dysoxylum arborescens* (Blume) Miq.	Meliaceae	
122	*Dysoxylum gaudichaudianum* (A.Juss.) Miq.	Meliaceae	
123	*Echinochloa colona* (L.) Link	Poaceae	

124	*Echinochloa crus-galli* (L.) P.Beauv.	Poaceae	Common weed
125	*Eclipta prostrata* (L.) L.	Asteraceae	
126	*Eichhornia crassipes* (Mart.) Solms	Pontederiaceae	Native of N South America; an invasive species in water courses
127	*Elathostema podophyllum* Wedd.	Urticaceae	Endemic to the Philippines
128	*Elathostema* sp.	Urticaceae	
129	**Elephantopus tomentosus* L.	Asteraceae	Native of Tropical America; Common weed
130	*Eleusine indica* L.	Poaceae	Common weed
131	*Endocomia macrocoma* (Miq.) de Wilde ssp. *prainii* (King) de Wilde	Myristicaceae	
132	*Epipremnum pinnatum* (L.) Engl.	Araceae	
133	*Erythrina variegata* L.	Fabaceae	
134	*Ficus ampelas* Burm.f.	Moraceae	
135	*Ficus callosa* Willd.	Moraceae	
136	*Ficus forstenii* Miq.	Moraceae	
137	*Ficus gul* Lauterb. & K.Schum.	Moraceae	
138	*Ficus heteropoda* Miq.	Moraceae	
139	*Ficus irisana* Elm.	Moraceae	
140	*Ficus magnoliifolia* Blume	Moraceae	
141	*Ficus nota* (Blanco) Merr.	Moraceae	
142	*Ficus pseudopalma* Blanco	Moraceae	Endemic to the Philippines
143	*Ficus ruficaulis* Merr.	Moraceae	
144	*Ficus septica* Burm.f.	Moraceae	
145	*Ficus* sp.	Moraceae	
146	*Ficus subulata* Blume	Moraceae	
147	*Ficus ulmifolia* Lam.	Moraceae	
148	*Ficus variegata* Blume	Moraceae	
149	*Flagellaria indica* L.	Flagellariaceae	
150	*Gigantochloa aspera* (Rumph.) Kurz	Poaceae	Cultivated bamboo
151	**Gliricidia sepium* (Jacq.) Kunth ex Walp.	Fabaceae	Native of Mexico; naturalized in Philippines; usually planted as fence
152	*Glochidion album* (Blanco) Boerl.	Phyllanthaceae	
153	*Glochidion mindorense* C.B.Rob.	Phyllanthaceae	
154	*Glycosmis cyanocarpa* (Blume) Spreng var. platyphylla (Merr.) Stone [Synonym: *Glycosmis platyphylla* Merr.]	Rutaceae	Endemic to the Philippines
155	**Gmelina aborea* Roxb.	Lamiaceae	Native of Pakistan, India, to Myanmar; cult. in plantations for wood or as reforestation species
156	*Gnetum gnemon* L.	Gnetaceae	
157	*Gomphandra luzoniensis* (Merr.) Merr.	Stemonuraceae	
158	*Grewia multiflora* Juss.	Malvaceae	
159	*Guioa koelreuteria* (Blanco) Merr.	Sapindaceae	
160	*Habenaria* sp.	Orchidaceae	
161	*Heterospathe elata* Scheff.	Arecaceae	
162	**Hippeastrum reticulatum* (L'Her.) Herbert	Amaryllidaceae	Native of Brazil; cultivated as ornamental
163	*Homalomena philippinensis* Engl.	Araceae	Endemic to the Philippines
164	*Hydnocarpus subfalcata* Merr.	Flacourtiaceae	
165	*Hyptis brevipes* Poit.	Lamiaceae	
166	*Ichnocarpus volubilis* Merr.	Apocynaceae	
167	*Imperata cylindrica* (L.) P.Beauv.	Poaceae	Often forming dense colonies

			in open areas, tending to be weedy
168	*Ipomoea aquatica* Forssk.	Convolvulaceae	
169	**Ipomoea batatas* (L.) Lam.	Convolvulaceae	Native of Mexico; naturalized in Philippines; cultivated as root crop
170	**Ipomoea triloba* L.	Convolvulaceae	Native of Tropical America; common weed
171	*Isachne globosa* (Thunb.) Kuntze.	Poaceae	
172	**Jatropha curcas* L.	Euphorbiaceae	Native of Mexico; cultivated and naturalized
173	*Kleinhovia hospita* L.	Malvaceae	
174	*Knema glomerata* (Blanco) Merr.	Myristicaceae	
175	*Koordersiodendron pinnatum* (Blanco) Merr.	Anacardiaceae	Vulnerable (VU) (DENR DAO 2007-01)
176	*Lagerstroemia speciosa* (L.) Pers.	Lythraceae	
177	*Lansium domesticum* Corr.	Meliaceae	Cultivated for its edible fruits
178	**Lantana camara* L.	Verbenaceae	Native of West Indies; common invasive weed
179	*Leea aequata* L.	Leeaceae	
180	*Leea guineensis* G. Don	Leeaceae	
181	*Lepisanthes rubiginosa* (Roxb.) Leenh.	Sapindaceae	
182	**Leucaena leucocephala* (Lam) de Wit	Fabaceae	Native of Tropical America; naturalized in the Philippines
183	*Leucosyke aspera* C.B.Rob.	Urticaceae	Endemic to the Philippines
184	*Leucosyke capitellata* (Poir.) Wedd.	Urticaceae	
185	*Leptochloa chinensis* (L.) Nees	Poaceae	Usually in wet places along or near streams
186	*Litsea ampla* Merr.	Lauraceae	
187	*Litsea glutinosa* (Lour.) C.B.Rob.	Lauraceae	
188	*Litsea leytensis* Merr.	Lauraceae	Endemic to the Philippines; Endangered (EN) (DENR DAO 2007-01)
189	*Livistona rotundifolia* (Lam.) Mart.	Arecaceae	
190	*Ludwigia adscendens* (L.) H.Hara	Onagraceae	Common in wet paddies or near streams
191	*Lunasia amara* Blanco	Rutaceae	
192	*Lygodium circinatum* (Burm.) Sw.	Schizaeaceae	
193	*Macaranga bicolor* Muell.-Arg.	Euphorbiaceae	
194	*Macaranga cumingii* (Baill.) Muell.-Arg.	Euphorbiaceae	
195	*Macaranga grandifolia* (Blanco) Merr.	Euphorbiaceae	
196	*Macaranga tanarius* (L.) Muell.-Arg.	Euphorbiaceae	
197	*Mallotus mollissimus* (Geisel.) Airy Shaw	Euphorbiaceae	
198	*Mangifera altissima* Blanco	Anacardiaceae	Vulnerable (VU) (DENR DAO 2007-01)
199	**Mangifera indica* L.	Anacardiaceae	Native of Indo-Burma region; naturalized and widely cultivated
200	**Manihot esculenta* Crantz	Euphorbiaceae	Native of South America; widely cultivated as root crop
201	*Melanolepis multiglandulosa* (Reinw. ex Blume) Rchb.f. & Zoll.	Euphorbiaceae	
202	*Melastoma malabathricum* (L.) Smith	Melastomataceae	
203	*Melochia umbellata* (Houtt) Stapf.	Malvaceae	
204	*Memecylon sp.*	Melastomataceae	
205	*Merremia peltata* (L.) Merr.	Convolvulaceae	
206	**Mikania cordata* (Burm.f.) B.L.Rob.	Asteraceae	Native of Tropical America; naturalized in the Philippines
207	*Milletia* sp.	Fabaceae	
208	**Mimosa pudica* L.	Fabaceae	Native of South America; naturalized in the Philippines
209	*Mischocarpus sundaicus* Blume	Sapindaceae	

210	*Mitragyna diversifolia* (Wall. ex G.Don) Havil. [Synonym: *Mitragyna rotundifolia* (Roxb.) Kuntze]	Rubiaceae	
211	*Monochoria hastata* (L.) Solms	Pontederiaceae	Common in open wetlands
212	*Monochoria vaginalis* (Burm.) Kunth	Pontederiaceae	Common in seasonally inundated or water-logged, open areas
213	*Murdannia nudiflora* (L.) Brenan	Commelinaceae	
214	*Musa errans* L. var. *botoan* Teodoro	Musaceae	Cultivated
215	*Musa sapientum* L. var. *cinerea* Blanco	Musaceae	Cultivated
216	*Musa sapientum* L. var. *compressa* Blaco	Musaceae	Cultivated
217	*Musa sapientum* L. var. *inarnibal* Teodoro	Musaceae	Cultivated
218	*Mussaenda philippica* A.Rich.	Rubiaceae	
219	*Myristica cagayanensis* Merr.	Myristicaceae	
220	*Myristica philippensis* Lam.	Myristicaceae	Endemic to the Philippines; OWS LR/nt (DENR DAO 2007-01)
221	*Nauclea orientalis* (L.) L.	Rubiaceae	
222	*Neotrewia cumingii* (Muell.-Arg.) Pax & K.Hoffm.	Euphorbiaceae	
223	*Nephelium ramboutan-ake* (Labill.) Leenh.	Sapindaceae	
224	*Nephrolepis biserrata* (Sw.) Schott	Oleandraceae	
225	*Olax imbricata* Roxb.	Olacaceae	
226	*Oplismenus compositus* (L.) P.Beauv.	Poaceae	
227	*Oplismenus hirtellus* (L.) Beauv.	Poaceae	
228	*Oryza sativa* L.	Poaceae	Rice plant, Commonly cultivated
229	*Osmoxylon pulcherrimum* Vidal ex Fern.-Vill.	Araliaceae	Endemic to the Philippines
230	*Palaquium glabrum* Merr.	Sapotaceae	Endemic to the Philippines
231	*Pandanus* sp.	Pandanaceae	
232	*Panicum maximum* Jacq.	Poaceae	Cultivated for forage purposes, often escaping as weed
233	*Haplostichanthus lanceolata* (Vidal) Heusden [Synonym: *Papualthia reticulata* (Elmer) Merr.]	Annonaceae	Endemic to the Philippines
234	*Paspalidium* sp.	Poaceae	
235	**Paspalum conjugatum* P.J.Bergius	Poaceae	Native of Tropical America; naturalized in the Philippines
236	*Paspalum distichum* L.	Poaceae	In marshes, swamps
237	**Passiflora foetida* L.	Passifloraceae	Native of Tropical America; naturalized in the Philippines
238	*Pennisetum purpureum* Schumach.	Poaceae	Cultivated for forage purposes, often escaping as weed
239	*Pericampilus glaucus* (Lamk.) Merr.	Menispermaceae	
240	**Persea americana* Mill.	Lauraceae	Native of tropical America; Cultivated for its edible fruits.
241	*Phaeanthus ebracteolatus* (C.Presl) Merr. [Synonym: *Phaeanthus nigrescens* Elmer]	Annonaceae	Endemic to the Philippines
242	*Phragmites vallatoria* (Pluk. ex L.) Veldk. [Synonym: *Phragmites australis* (Cav.) Trin. ex Steud.]	Poaceae	Often forming dense thickets along lake margins
243	*Phyllanthus amarus* Schumach. & Thonn. [Synonym: *Phyllanthus niruri* L.]	Phyllanthaceae	
244	*Physalis minima* L.	Solanaceae	
245	*Pinanga insignis* Becc.	Arecaceae	
246	*Pipturus arborescens* (Link) C.B.Rob.	Urticaceae	
247	*Planchonella nitida* (Blume) Dubard	Sapotaceae	
248	*Poikilospermum suaveolens* (Blume) Merr.	Cecropiaceae	
249	*Polygonum barbatum* L.	Polygonaceae	
250	*Pometia pinnata* Forst. & Forst.f. [Synonym: *Lucuma nervosa* A.DC.]	Sapotaceae	

251	**Pouteria campechiana* A.DC. [Synonym: *Lucuma nervosa* A.DC.]	Sapotaceae	Native of Mexico & Central America; cult. for edible fruits
252	*Pouteria macrantha* (Merr.) Baehni	Sapotaceae	
253	*Premna congesta* Merr.	Lamiaceae	Endemic to the Philippines
254	*Prunus spicata* Kalkm.	Rosaceae	
255	**Pseudelephantopus spicatus* (B.Juss. ex Aubl.) Rohr ex Gleason	Asteraceae	Native of South America; naturalized in the Philippines
256	**Psidium guajava* L.	Myrtaceae	Native of tropical America; naturalized in the Philippines
257	*Pteris ensiformis* Burm.f.	Pteridaceae	
258	*Pteris tripartita* Sw.	Pteridaceae	
259	*Pterocarpus indicus* Willd.	Fabaceae	Critically endangered (CR) (DENR DAO 2007-01)
260	*Pterocymbium tinctorium* (Blanco) Merr. [Synonym: *Pterocymbium macrocrater* Warb.]	Malvaceae	
261	*Pterospermum diversifolium* Blume	Malvaceae	
262	*Pterospermum celebicum* Miq. [Synonym: *Pterospermum niveum* Vidal]	Malvaceae	
263	*Pueraria lobata* (Willd.) Ohwi	Fabaceae	
264	*Pueraria phaseoloides* (Roxb.) Benth.	Fabaceae	
265	*Randia mindorensis* Elmer	Rubiaceae	Endemic to Mindoro Island
266	*Rourea minor* (Gaertn.) Leenh.	Connaraceae	
267	*Saccharum spontaneum* L.	Poaceae	Gregarious, almost exclusively occupying large areas
268	**Saccharum officinarum* L.	Poaceae	Sugar cane; extensively cultivated as major crop plant
269	*Sandoricum koetjape* (Burm.f.) Merr.	Meliaceae	Cultivated for its dibble fruits
270	*Saurauia mindorensis* Merr.	Actinidiaceae	Endemic to Mindoro Island
271	*Schefflera odorata* (Blanco) Merr. & Rolfe	Araliaceae	
272	*Scleria scrobiculata* Nees & Meyen	Cyperaceae	
273	**Scoparia dulcis* L.	Scrophulariaceae	Native of tropical America; naturalized in the Philippines; common weed
274	*Scurrula atropurpurea* (Blume) Danser	Loranthaceae	
275	*Selaginella plana* (Desv. ex Poir.) Hieron.	Selaginellaceae	
276	*Semecarpus cuneiformis* Blanco	Anacardiaceae	
277	*Senna timoriensis* (DC.) H.S.Irwin & Barneby	Fabaceae	
278	*Shorea contorta* Vidal	Dipterocarpaceae	Endemic to the Philippines; Vulnerable (VU) (DENR DAO 2007-01)
279	*Shorea guiso* (Blanco) Blume	Dipterocarpaceae	Critically endangered (CR) (IUCN 2006)
280	*Siphonodon celastrineus* Griff.	Celastraceae	
281	*Smilax bracteata* Presl.	Similacaceae	
282	*Solanum biflorum* Lour.	Solanaceae	
283	*Spermacoce articularis* L.f. [Synonym: *Borreria articularis* (L.f.) F.N.Will.]	Rubiaceae	
284	*Sphaerostephanos unitatus* (L.) Holttum	Thelypteridaceae	
285	*Sporobolus indicus* (L.) R.Br.	Poaceae	
286	**Stachytarpheta jamaicensis* (L.) Vahl V	Verbenaceae	Native of tropical America; naturalized in the Philippines; common weed
287	*Stenochlaena palustris* (Burm.) Bedd	Polypodiaceae	
288	*Sterculia macrophylla* Vent.	Malvaceae	
289	*Sterculia oblongata* R.Br.	Malvaceae	
290	*Sterculia rubiginosa* Vent. var. *setistipulata* (Merr.) Tantra	Malvaceae	
291	*Strombosia philippinensis* (Baill.) Rolfe	Olacaceae	

292	**Swietenia macrophylla* King	Meliaceae	Native of Tropical Africa; widely used for reforestation; cult. for timber
293	**Synedrella nodiflora* (L.) Gaertn.	Asteraceae	Native of tropical America; naturalized in the Philippines; common weed
294	**Syngonium podophyllum* Schott	Araceae	Native of tropical America; naturalized cultivated in the Philippines
295	*Syzygium curranii* (C.B.Rob.) Merr.	Myrtaceae	Endemic to the Philippines
296	*Syzygium simile* (Merr.) Merr.	Myrtaceae	Endemic to the Philippines
297	*Tabernaemontana* sp.	Apocynaceae	
298	*Tabernaemontana sphaerocarpa* Blume [Synonym: *Pagiantha sphaerocarpa* (Blume) Margr.]	Apocynaceae	
299	*Talipariti tiliaceum* (L.) Fryxell	Malvaceae	
300	**Tamaridus indica* L.	Fabaceae	Native of Africa & India; widely cultivated for its edible fruits
301	*Terminalia catappa* L.	Combretaceae	
302	*Terminalia copelandii* Elmer	Combretaceae	
303	*Tetrastigma loheri* Gagnep.	Vitaceae	Endemic to the Philippines
304	*Thalictroides* sp.	Pteridaceae	
305	*Tinomiscum petiolare* J.D.Hook. & Thoms.	Menispermaceae	
306	*Trema orientalis* (L.) Blume	Cannabaceae	
307	*Trichosanthes quinquangulata* A.Gray	Cucurbitaceae	Endemic to the Philippines
308	*Trigonachras cuspidata* Radlk.	Sapindaceae	Endemic to the Philippines
309	*Triumfetta rhomboidea* Jacq.	Malvaceae	
310	*Urena lobata* L.	Malvaceae	
311	*Uvaria sorsogonensis* C.Presl.	Annonaceae	Endemic to the Philippines
312	*Vigna* sp.	Fabaceae	
313	*Vitex glabrata* R.Br.	Lamiaceae	
314	*Voacanga globosa* (Blanco) Merr.	Apocynaceae	Endemic to the Philippines
315	*Wedelia biflora* (L.) DC.	Asteraceae	
316	*Wrightia pubescens* R.Br. ssp. *laniti* (Blanco) Ngan	Apocynaceae	
317	*Xanthosoma sagittifolium* (L.) Schott [Synonym: *Xanthosoma violaceum* Schott]	Araceae	
318	*Zehneria indica* (Lour.) Keraudren [Synonym: *Melothria indica* L.]	Cucurbitaceae	
319	*Zingiber zerumbet* (L.) Sm.	Zingiberaceae	

Table 3.2.1.4. Threatened plants in the Naujan Lake National Park.

	Species name	Family	Threatened category
1	*Shorea guiso* (Blanco) Blume	Dipterocarpaceae	Critically endangered (CR) (IUCN 2012)
2	*Shorea contorta* Vidal	Dipterocarpaceae	Critically endangered (CR) (IUCN 2012); Vulnerable (VU) (DENR DAO 2007-01)
3	*Dipterocarpus kerrii* King	Dipterocarpaceae	Critically endangered (CR) (IUCN 2012)
4	*Chionanthus remotinervius* (Merr.) Kiew [Synonym: *Linociera remotinervia* Merr.]	Oleaceae	Critically endangered (CR) (DENR DAO 2007-01)
5	*Pterocarpus indicus* Willd.	Fabaceae	Critically endangered (CR) (DENR DAO 2007-01); Vulnerable (VU) (IUCN 2012)
6	*Litsea leytensis* Merr.	Lauraceae	Endangered (EN) (DENR DAO 2007-01); Vulnerable (VU) (IUCN

			2012)
7	*Diospyros philippinensis* A.DC.	Ebenaceae	Endangered (EN) (DENR DAO 2007-01), (IUCN 2012)
8	*Dillenia philippinensis* Rolfe	Dilleniaceae	OWS LR/lc (DENR DAO 2007-01); Vulnerable (VU) (IUCN 2012)
9	*Myristica philippensis* Lam.	Myristicaceae	OWS LR/nt (DENR DAO 2007-01); Vulnerable (VU) (IUCN 2012)
10	*Diospyros mindanaensis* Merr.	Ebenaceae	Vulnerable (VU) (DENR DAO 2007-01)
11	*Dracontomelon dao* (Blanco) Merr. & Rolfe	Anacardiaceae	Vulnerable (VU) (DENR DAO 2007-01)
12	*Dracontomelon edule* (Blanco) Skeels	Anacardiaceae	Vulnerable (VU) (DENR DAO 2007-01)
13	*Koordersiodendron pinnatum* (Blanco) Merr.	Anacardiaceae	Vulnerable (VU) (DENR DAO 2007-01)
14	*Mangifera altissima* Blanco	Anacardiaceae	Vulnerable (VU) (DENR DAO 2007-01), (IUCN 2012)

DENR DAO 2007-01: DENR Administrative Order No. 2007-01, *The National List of Threatened Philippine Plants and their Categories.* 2012 *IUCN Red List of Threatened Species.* http://www.iucnredlist.org

Table 3.2.1.5. Biodiversity (Shannon's) Index and species richness for all sites and plots.

	Site 1		Site 2		Site 3	
	Index	No. of Species	Index	No. of Species	Index	No. of Species
1	0.07193	13	2.78047	31	3.1017	44
2	2.79575	25	1.02958	29	2.18874	22
3	1.56623	7	2.80845	34	2.06126	14
4	1.97588	22	2.82217	23	2.61818	14
5	3.26505	18	2.50329	22	1.97586	14
6	1.65188	7	1.12765	28	3.04349	45
7	1.00727	4	2.40698	27	2.72399	29
8	2.71168	23	-	-	-	-
9	2.24358	18	-	-	-	-
10	2.73155	26	-	-	-	-
11	1.00153	12	-	-	-	-
12	2.68724	21	-	-	-	-
13	0.80643	4	-	-	-	-
14	2.31273	18	-	-	-	-
15	2.54553	26	-	-	-	-
16	1.88859	14	-	-	-	-
Ave.	1.545	16.2	2.211	27.7	2.530	26

	Site 4		Site 5		Site 6	
	Index	No. of Species	Index	No. of Species	Index	No. of Species
1	3.04798	42	1.06548	20	1.8774	17
2	2.94154	28	1.93083	16	2.38972	16
3	1.501	12	2.11337	22	1.78361	31
4	2.33979	16	2.28083	13	1.96686	12
5	-	-	1.47578	22	2.52786	26
6	-	-	1.30207	7	1.64747	14
7	-	-	-	-	-	-
8	-	-	-	-	-	-
9	-	-	-	-	-	-
10	-	-	-	-	-	-
11	-	-	-	-	-	-
12	-	-	-	-	-	-
13	-	-	-	-	-	-
14	-	-	-	-	-	-
15	-	-	-	-	-	-
16	-	-	-	-	-	-
Ave.	2.457	24.5	1.694	16.6	2.032	19.3

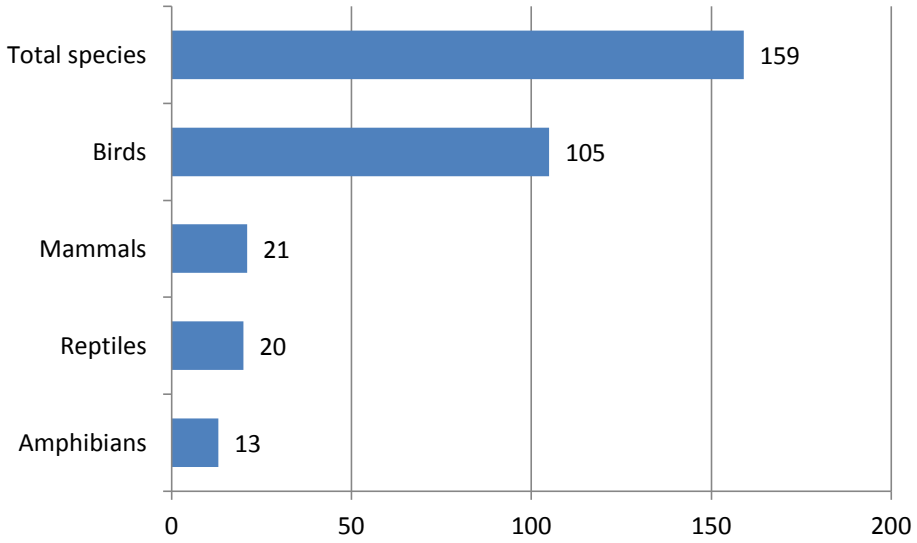


Figure 3.2.2.1. Total diversity of terrestrial vertebrates recorded in Naujan Lake National Park, October 16-29, 2011.

Table 3.2.2.1. Birds recorded from Naujan Lake National Park, October 16-29, 2011.

	Family ARDEIDAE												
1	*Ardea cinerea*	Grey Heron							4	3	7	migrant	Least concern (LC)
2	*Ardea purpurea*	Purple Heron	3						1	2	6	resident	LC
3	*Egretta alba*	Great Egret	7					4	14	18	43	migrant	LC
4	*Egretta intermedia*	Intermediate Egret	7				5	1	1	3	17	migrant	LC
5	*Egretta garzetta*	Little Egret	8								8	migrant	LC
6	*Bubulcus ibis*	Cattle Egret	5								5	migrant/ resident	LC
7	*Ixobrychus cinnamomeus*	Cinnamon Bittern	2						2	1	5	resident	LC
8	*Ixobrychus sinensis*	Yellow Bittern	4						1	6	11	resident	LC
	Family ANATIDAE												
9	*Dendrocygna arcuata*	Wandering Whistling-Duck	6					4	10		20	resident	LC
10	*Anas luzonica*	Philippine Duck	3					4	11	4	22	Philippine Endemic	IUCN threat status:VULNERABLE
11	*Aythya fuligula*	Tufted Duck							1905		1905	migrant	Naujan Lake population, reaching 12,000 individuals during peak of migration, meets the 1% threshold for Important Bird Area Status
	Family ACCIPITRIDAE												
12	*Pandion haliaeetus*	Osprey	1						1	1	3	migrant	LC
13	*Haliastur indus*	Brahminy Kite	1	1	1	1	1			1	6	resident	LC
14	*Accipiter virgatus*	Besra		1							1	resident	LC
15	*Spilornis holospilus*	Crested Serpent-Eagle		1	1		1				3	Philippine Endemic	LC
16	*Spizaetus philippensis*	Philippine Hawk-Eagle		1							1	Philippine Endemic	IUCN threat status:VULNERABLE
	Family PHASIANIDAE												
17	*Gallus gallus*	Red Junglefowl		3			1				4	resident	LC
	Family TURNICIDAE												

18	*Turnix suscitator*	Barred Buttonquail			3								3	resident	LC	
	Family RALLIDAE															
19	*Gallirallus philippensis*	Buff-Banded Rail			2								2	resident	LC	
20	*Gallirallus striatus*	Slaty-breasted Rail	1	1							1		3	resident	LC	
21	*Gallirallus torquatus*	Barred Rail				1							1	resident	LC	
22	*Porzana cinerea*	White-browed Crake	2						1	1			4	resident	LC	
23	*Amaurornis olivacea*	Plain Bush-Hen		1		1							2	Philippine Endemic	LC	
24	*Amaurornis phoenicurus*	White-breasted Waterhen	1	1	2			1					5	resident	LC	
25	*Gallinula chloropus*	Common Moorhen	1									1	2	migrant/ resident	LC	
26	*Fulica atra*	Eurasian Coot								2			2	migrant	LC	
	Family CHARADRIIDAE															
27	*Charadrius dubius*	Little Ringed-Plover							1				1	migrant/ resident	LC	
	Family STERNIDAE															
28	*Sterna bergii*	Great Crested Tern								11			11	resident	LC	
29	*Sterna sumatrana*	Black-naped Tern							14				14	resident	LC	
30	*Chlidonias hybridus*	Whiskered Tern	67						1049	929	219		2264	migrant		
	Family COLUMBIDAE															
31	*Treron pompadora*	Pompadour Green-Pigeon		2	3								5	resident		
32	*Treron vernans*	Pink-necked Green-Pigeon	2			2		3					7	resident		
33	*Phapitreron leucotis*	White-eared Brown-Dove		8	4	3	6	6			1		28	Philippine Endemic		
34	*Ducula aenea*	Green Imperial-Pigeon		1									1	resident		
35	*Macropygia tenuirostris*	Reddish Cuckoo-Dove		5	6	2		4					17	Philippine Endemic		
36	*Streptopelia bitorquata*	Island Collared-Dove				3							3	resident		
37	*Streptopelia tranquebarica*	Red Turtle-Dove			3			5					8	resident		

38	*Streptopelia chinensis*	Spotted Dove	3	2	2	3	12	5			27	resident
39	*Geopelia striata*	Zebra Dove	3		8	5	13	8		1	38	resident
40	*Chalcopaps indica*	Common Emerald Dove		4	3	2	4	3			16	resident
	Family PSITTACIDAE											
41	*Loriculus philippensis*	Colasisi		2	7	5		2			16	Philippine Endemic; subspecies endemic to Mindoro
	Family CUCULIDAE											
42	*Cacomantis merulinus*	Plaintive Cuckoo		5	3	2					10	resident
43	*Cacomantis variolosus*	Brush Cuckoo		6		1	3	2			12	resident
44	*Eudynamys scolopacea*	Common Koel						3			3	resident
45	*Centropus steeri*	Black-hooded Coucal		1				2			3	Mindoro Endemic
46	*Centropus bengalensis*	Lesser Coucal	4	3	5	3	5				20	resident
47	*Centropus viridis*	Philippine Coucal		1	1	1					3	Philippine Endemic; subspecies endemic to Mindoro
	Family CAPRIMULGIDAE											
48	*Eurostopodus macrotis*	Great Eared Nightjar	4	4	4						12	resident
49	*Caprimulgus affinis*	Savannah Nightjar		5	6	6	7	6			30	resident
	Family APODIDAE											
50	*Collocalia esculenta*	Glossy Swiftlet	16	10	17	21	18	16		24	122	resident
51	*Collocalia troglodytes*	Pygmy swiftlet		15	15	15	16	17			78	Philippine Endemic
52	*Hirundapus celebensis*	Purple Needletail			2						2	resident
	Family ALCEDINIDAE											
53	*Alcedo athis*	Common Kingfisher	1					2	1		4	migrant

54	*Alcedo cyanopecta*	Indigo-banded Kingfisher			1							1	Philippine Endemic
55	*Halcyon smyrnensis*	White-throated Kingfisher		2	3	3		2				10	resident
56	*Halcyon chloris*	White-collared Kingfisher	3	2	5	6	8	6				30	resident
	Family MEROPIDAE												
57	*Merops viridis*	Blue-throated Kingfisher					4					4	resident
58	*Merops philippinus*	Blue-tailed Bee-eater	2		5							7	resident
	Family CAPITONIDAE												
59	*Megalaima haemacephala*	Coppersmith Barbet		1								1	resident
	Family PICIDAE												
60	*Dendrocopus maculatus*	Philippine Pygmy Woodpecker		3	4	3	3	4				17	Philippine Endemic
61	*Dryocopus javensis*	White-bellied Woodpecker		1		1		1				3	Subspecies endemic to Mindoro
	Family PITTIDAE												
62	*Pitta eryrthrogaster*	Red-bellied Pitta				1		1				2	resident
63	*Pitta sordida*	Hooded Pitta		1	1							2	resident
	Family HIRUNDINIDAE												
64	*Hirundo rustica*	Barn Swallow		7	14		19		3	7	67	117	migrant
65	*Hirundo tahitica*	Pacific Swallow	22	9	17	19	22	16	4	6	85	200	resident
	Family CAMPEPHAGIDAE												
66	*Lalage melanoleuca*	Black-and-white Triller		1								1	Philippine Endemic
67	*Lalage nigra*	Pied Triller			1	2		2				5	resident
	Family PYCNONOTIDAE												
68	*Pycnonotus goiavier*	Yellow-vented Bulbul	31	7	24	24	28	21				135	resident

69	*Hypsipetes philippinus*	Philippine Bulbul		19	12	17	11	25				84	Philippine Endemic; subspecies endemic to Mindoro
	Family DICRURIDAE												
70	*Dicrurus balicassius*	Balicassiao		13		3		14				30	Philippine Endemic
	Family ORIOLIDAE												
71	*Oriolus chinensis*	Black-naped Oriole	3	5	7	5	7	7				34	resident
	Family CORVIDAE												
72	*Corvus macrorhynchos*	Large-billed Crow		4		4	10	4	20			42	resident
	Family PARIDAE												
73	*Parus elegans*	Elegant Tit		3	2	3	2	3				13	Philippine Endemic
	Family TURDIDAE												
74	*Copsychus saularis*	Oriental Magpie-Robin			3	3		3				9	resident
75	*Saxicola caprata*	Pied Chat					4	4				8	resident
76	*Zoothera cinerea*	Ashy-Ground Thrush		1		1		1				3	Philippine Endemic
	Family SYLVIIDAE												
77	*Gerygone sulphurea*	Golden-bellied Flyeater	2		5	3	5	3				18	resident
78	*Phylloscopus borealis*	Arctic Warbler		3	3	4	9	4				23	migrant
79	*Acrocephalus stentoreus*	Clamorous Reed-Warbler	22							1	6	29	resident
80	*Megalurus timoriensis*	Tawny Grassbird	5		7		13	8			3	36	Subspecies endemic to Mindoro
81	*Megalurus palustris*	Striated Grassbird	9	3	8	8	11	9	1		1	50	resident
82	*Locustella ochotensis*	Middendorf's Grasshopper Warbler	12						1		2	15	migrant
83	*Cisticola exilis*	Bright-capped Cisticola					3					3	resident
84	*Cisticola juncidis*	Zitting Cisticola			2		2	3				7	resident
	Family MUSCICAPIDAE												
85	*Muscicapa griseisticta*	Grey-streaked					3					3	migrant

		Flycatcher										
86	*Cyornis rufigastra*	Mangrove Blue Flycatcher		2		2		2			6	Subspecies endemic to Mindoro
87	*Rhipidura javanica*	Pied Fantail		4	8	6	8	5			31	resident
88	*Hypothymis azurea*	Black-naped Monarch		2	1	1		3			7	resident
	Family PACHYCEPHALIDAE											
89	*Pachycephala albiventris*	Green-backed Whistler		8	3	7					18	Philippine endemic; Subspecies endemic to Mindoro
	Family MOTACILLIDAE											
90	*Motacilla cinerea*	Grey Wagtail	3	2	3		2	2		2	14	migrant
	Family LANIIDAE											
91	*Lanius schach*	Long-tailed Shrike			8	7	8	5			28	resident
92	*Lanius cristatus*	Brown Shrike	8	5		17	16	7			53	migrant
	Family STURNIDAE											
93	*Aplonis panayensis*	Asian Glossy Starling					11				11	resident
94	*Sarcops calvus*	Coleto		7	3	4	4	5			23	Philippine Endemic
	Family NECTARINIIDAE											
95	*Nectarinia jugularis*	Olive-backed Sunbird	1		5		7	12			25	resident
96	*Nectarinia sperata*	Purple-throated Sunbird		3	2	3	3	2			13	resident
97	*Aethopyga shelleyi*	Lovely Sunbird		2		2		3			7	Philippine Endemic
	Family DICAEIDAE											
98	*Dicaeum bicolor*	Bicolored Flowerpecker		5	3	4	3	3			18	Philippine Endemic
99	*Dicaeum retrocinctum*	Scarlet-collared Flowerpecker		3		2					5	Mindoro Endemic
100	*Dicaeum trigonostigma*	Orange-bellied Flowerpecker		2				3			5	resident

101	*Dicaeum pygmaeum*	Pygmy Flowerpecker		4		3	2					9	Philippine Endemic
	Family PLOCEIDAE												
102	*Passer montanus*	Eurasian Sparrow	13		11		12	11				47	Introduced
	Family ESTRILDIDAE												
103	*Lonchura leucogastra*	White-bellied Munia	11					14		10	15	50	Resident
104	*Lonchura punctulata*	Scaly-breasted Munia					8					8	Resident
105	*Lonchura malacca*	Chestnut Munia	17					13		50	20	100	Resident

TOTAL INDIVIDUALS COUNTED	316	218	269	245	332	324	1107	2969	486	6259
TOTAL SPECIES	39	55	50	48	39	56	13	21	23	105
TOTAL PHILIPPINE ENDEMIC SPECIES	1	19	13	16	8	13	1	1	2	21
TOTAL MIGRATORY SPECIES	10	3	3	1	4	5	6	8	9	18
TOTAL MINDORO ENDEMIC SPECIES	0	2	0	1	0	1	0	0	0	2
TOTAL MINDORO ENDEMIC SUBSPECIES	1	6	5	6	2	5	0	0	1	7
TOTAL THREATENED SPECIES	1	3	1	2	0	2	1	1	1	6

Table 3.2.2.2. Mammals recorded from Naujan Lake National Park, October 16-29, 2011.

	Species	Common Name	Sites and Captures						Total Captures	Residency Status	Conservation Status*	Remarks
			1	2	3	4	5	6				
FLYING MAMMALS												
	Family PTEROPODIDAE											
1	*Cynopterus brachyotis*	Common short-nosed fruit bat	19	32	61	93	49	144	398	Native	Abundant and geographically widespread; stable population	
2	*Eonycteris spelaea*	Common nectar bat				1		1	2	Native	Stable and common, usually found in high numbers near caves	
3	*Macroglossus minimus*	Dagger-toothed flower bat		78	7	77	41	28	231	Native	Abundant and widespread	
4	*Ptenochirus jagori*	Musky fruit bat	7	37	15	67	51	14	191	Philippine endemic	Population large and generally stable and widespread	
5	*Pteropus pumilus*	Little golden-mantled flying fox		1	1		3		5	Philippine endemic; restricted to Mindoro, Visayas and Mindanao	IUCN threat status: NEAR-THREATENED; CITES Appendix II	
6	*Rousettus amplexicaudatus*	Common rousette	1		2	8			11	Native	Locally abundant and generally stable; usually found in high numbers near caves	
	Family RHINOLOPHIDAE											

7	*Hipposideros bicolor*	Bicolored roundleaf bat		1		1	Native	Unknown	A poorly-known bat, identification of the lone specimen captured is tentative
8	*Hipposideros diadema*	Diadem's roundleaf bat	1			1	Native	Widespread and common	
9	*Rhinolophus arcuatus*	Arcuate horseshoe bat			2	2	Native	Widespread and common	A species complex; Mindoro population could represent a distinct species
	Family VESPERTILIONIDAE								
10	*Harpiocephalus harpia*	Hairy-winged bat			1	1	Native	Geographically widespread; Poorly known; Philippine records suggest it is probably dependent on forest	New record for Mindoro Island
11	*Myotis rufopictus*	Orange-fingered myotis	1			1	Philippine endemic	Poorly known; previous records suggest it is probably dependent on forest	New record for Mindoro Island
NON FLYING MAMMALS									
	Family CERCOPITHECIDAE								

12	*Macaca fascicularis*	Long-tailed macaque		observed		observed		observed		Native	CITES Appendix II	Hunted in Naujan Lake
		Family SORICIDAE										
13	*Suncus murinus*	Asian house shrew	1	2		1	1		5	Alien	Geographically widespread and invasive	Considered as pest
		Family MURIDAE										
14	*Chrotomys mindorensis*	Lowland striped shrew-rat	1						1	Philippine endemic; endemic to Mindoro and Souther Tagalog region of Luzon Island	Usually widespread in forest but also present in cultivated areas	
15	*Mus musculus*	House mouse				1	2		3	Alien	Geographically widespread and invasive; usually associated with households	Considered as pest
16	*Rattus argentiventer*	Rice-field rat		2		1			3	Alien	Geographically widespread and invasive	Considered as pest
17	*Rattus exulans*	Polynesian rat		2	2			2	6	Alien	Geographically widespread and invasive	Considered as pest
18	*Rattus norvegicus*	Common brown rat	3	2	2	2	4	1	14	Alien	Geographically widespread and invasive; usually associated with households	Considered as pest

19	*Rattus tanezumi*	Oriental house rat	4	7	4	6	6	2	29	Alien	Geographically widespread and invasive	Considered as pest
	Family VIVERRIDAE											
20	*Paradoxurus hermaphroditus*	Palm civet	observed	observed	observed	observed	observed	observed	observed	Native	Geographically widespread	
21	*Viverra tagalunga*	Malay civet		observed		observed		observed		Native	Geographically widespread; usually associated with forest	
TOTAL NUMBER OF INDIVIDUALS CAPTURED			36	163	94	259	158	195	905			
TOTAL NUMBER OF SPECIES			7	12	9	15	10	12	21			
TOTAL NATIVE/RESIDENT SPECIES			4	7	6	10	6	9	15			
TOTAL PHILIPPINE ENDEMICS			1	2	2	2	2	1	4			
TOTAL RANGE-RESTRICTED SPECIES			1	1	1	0	1	0	2			
TOTAL THREATENED SPECIES			0	2	1	1	1	1	2			
TOTAL INTRODUCED/ALIEN SPECIES			3	5	3	5	4	3	6			

Table 3.2.2.3. Frogs and reptiles recorded from Naujan Lake National Park, October 16-29, 2011.

	Species	Common Name	Sites and Captures						Total Captures	Residency Status	Conservation Status*
			1	2	3	4	5	6			
AMPHIBIANS											
		Family BUFONIDAE									
1	*Rhinella marina*	Giant South American Toad	Observed	Observed	Observed	Observed	Observed	Observed		Alien/Introduced	Least Concern (LC); Invasive
		Family MICROHYLIDAE									
2	*Kaloula conjuncta*	Truncate-toed Chorus Frog			1				1	Philippine Endemic	IUCN Threat Status: DATA DEFICIENT
3	*Kaloula pulchra*	Chorus Frog				1		2	3	Alien/ Introduced	LC; Invasive
		Family DICROGLOSSIDAE									
4	*Fejervarya cancrivora*	Asian Brackish Frog				1	2	1	4	Native	LC
5	*Fejervarya vittigera*	Common Pond Frog	1			1			2	Native	LC
6	*Limnonectes macrocephalus*	Luzon Fanged Frog			1		1	3	5	Philippine Endemic	IUCN Threat Status: NEAR-THREATENED
7	*Limnonectes woodworthi*	Woodworth's Fanged Frog	5			4		5	14	Philippine Endemic	LC
8	*Occidozyga laevis*	Puddle Frog	1				2	2	5	Native	LC
		Family CERATOBATRACHIDAE									
9	*Platymantis corrugatus*	Black-masked Ground Frog		1			11		12	Philippine Endemic	LC
		Family RANIDAE									
10	*Hylarana erythraea*	Common Green Frog	7					1	8	Alien/Introduced	LC; Invasive
11	*Hylarana mangyanum*				1			1	2	Mindoro Endemic	IUCN Threat Status: ENDANGERED
		Family RHACOPHORIDAE									

12	*Polypedates leucomystax*	Common Tree Frog		1	3	2		9	15	Native	LC
13	*Rhacophorous pardalis*	Gliding Tree Frog						1	1	Native	LC
REPTILES											
		Family EMYDIDAE									
1	*Coura amboinensis*	Malayan Freshwater Turtle						4	4	Native	LC
		Family GEKKONIDAE									
2	*Cosymbotus platyurus*	Flat-bodied house Gecko	2		4		3		7	Native	LC
3	*Gehyra multilata*	Tender-skinned House Gecko	3		6		4		13	Native	LC
4	*Gekko gekko*	Tokay Narrow-disked Gecko	1	1	2	1	1	1	7	Native	LC
5	*Gekko mindorensis*	Mindoro Narrow-disked Gecko			10	2	2		14	Philippine Endemic	LC
6	*Hemidactylus frenatus*	Common House Gecko	2		3		6		11	Native	LC
		Family AGAMIDAE									
7	*Bronchocela cristatella*	Green Crested Lizard		1				2	3	Native	LC
8	*Draco quadrasi*	Quadra's Flying Lizard		1	2		2	1	6	Restricted to Mindoro, Romblon, Sibuyan, and Semirara	LC
9	*Hydrosaurus pustulatus*	Philippine Sailfin Lizard		Observed						Philippine Endemic	IUCN Threat Status: VULNERABLE
		Family SCINCIDAE									
10	*Eutropis multicarinata*	Two-striped Mabouya		1	1	2	1	1	6	Native	LC
11	*Eutropis multifasciata*	Common Mabouya	1	1	1	Observed	Observed	1	4	Native	LC
12	*Sphenomorphus cumingi*	Cuming's Sphenomorphus		1				1	2	Philippine Endemic	LC
		Family VARANIDAE									

13	*Varanus marmoratus*	Monitor Lizard	1	Observed	Observed	Observed	Observed	Observed	1	Philippine Endemic	DAO 2004-15 Threat Status: VULNERABLE
		Family ACROCHORDIDAE									
14	*Acrochordus granulatus*	Small Warty Snake	1						1	Native	LC
		Family BOIDAE									
15	*Python reticulatus*	Reticulated Python	Observed	Observed	1	Observed	Observed	Observed	1	Native	DAO 2004-15 Threat Status: OTHER THREATENED SPECIES
		Family COLUBRIDAE									
16	*Dendralaphis pictus*	Common Bronze-back Snake					1		1	Native	LC
17	*Oligodon ancorus*	Northern Short-headed Snake						1	1	Restricted to Luzon and Mindoro	LC
18	*Zaocys luzonensis*	Smooth-scaled Mountain Snake						1	1	Philippine Endemic	LC
		Family ELAPIDAE									
19	*Naja philippinensis*	Philippine Common Cobra	Observed					Observed		Philippine Endemic	LC
20	*Opiophagus hannah*	King Cobra	Observed					Observed		Native	LC
TOTAL NUMBER OF INDIVIDUALS CAPTURED			25	22	36	14	36	38	155		
TOTAL NUMBER OF SPECIES			15	12	15	12	16	23	33		

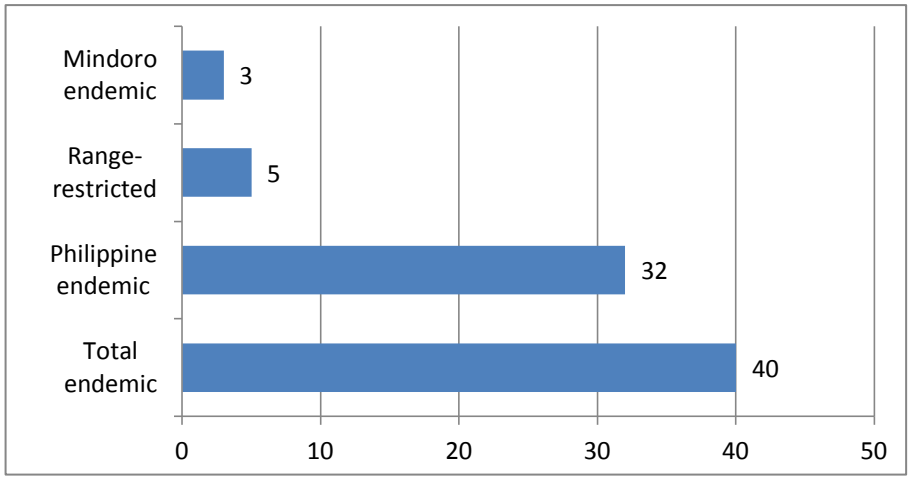


Figure 3.2.2.2. Levels of endemism of terrestrial vertebrates recorded in Naujan lake National Park, October 16-29, 2011.

Table 3.2.2.4. Diversity, endemism, residency, and conservation status of birds recorded in Naujan Lake National Park, October 16-29, 2011.

Habitat type	Sites			
	2,4 & 6	3 & 5	1 and Lake periphery	All sites
	Second growth forest and scrub vegetation with scattered cultivated/ plantation areas	Predominantly cultivated and plantation areas with minimal scrub and early second growth forest cover	Marsh, reed beds, and along the periphery of the Lake	N/A
Species Richness	75	59	48	105
Philippine Endemics	19	13	2	21
Migratory Species	5	4	16	18
Mindoro Endemics	2	0	0	2
Subspecies endemic to Mindoro	7	4	1	7
Threatened Species	4	1	1	6

Table 3.2.2.5. Diversity, endemism, residency, and conservation status of mammals recorded in Naujan Lake National Park, October 16-29, 2011.

Habitat type	Sites			
	2,4 & 6	3 & 5	1	All sites
	Second growth forest and scrub vegetation with scattered cultivated/ plantation areas	Predominantly cultivated and plantation areas with minimal scrub and early second growth forest cover	Marsh and reed beds	N/A
Species Richness	19	11	8	21
Philippine Endemics	3	2	2	4
Range-restricted	1	1	1	2
Threatened Species	2	1	0	2
Native Species	13	7	5	15
Alien/Introduced Species	6	4	3	6

Table 3.2.2.6. Diversity, endemism, residency, and conservation status of frogs and reptiles recorded in Naujan Lake National Park, October 16-29, 2011.

Habitat type	Sites			
	2,4 & 6	3 & 5	1	All sites
	Second growth forest and scrub vegetation with scattered cultivated/ plantation areas	Predominantly cultivated and plantation areas with minimal scrub and early second growth forest cover	Marsh and reed beds	N/A
Species Richness	24	19	15	33
Philippine Endemics	9	7	3	13
Mindoro Endemic	1	1	0	1
Threatened Species	3	5	2	6
Native Species	21	18	13	30
Alien Species	3	1	2	3

Table 3.2.2.7. Bird diversity indices values for Site 1, Brgy. Banbanin, Victoria Municipality, Naujan Lake National Park, October 16-29, 2011.

			Index Computation		
Species	Common Name	Number	ni/N	$(ni/N)^2$	ln(ni/N)(ni/N)
Chlidonias hybridus	Whiskered Tern	67	0.21203	0.04495	-0.32886
Pycnonotus goiavier	Yellow-vented Bulbul	31	0.09810	0.00962	-0.22777
Acrocephalus stentoreus	Clamorous Reed-Warbler	22	0.06962	0.00485	-0.18552
Hirundo tahitica	Pacific Swallow	22	0.06962	0.00485	-0.18552
Lonchura malacca	Chestnut Munia	17	0.05380	0.00289	-0.15722
Collocalia esculenta	Glossy Swiftlet	16	0.05063	0.00256	-0.15105
Passer montanus	Eurasian Sparrow	13	0.04114	0.00169	-0.13127
Lochustella ochotensis	Middendorff's Grasshopper-Warbler	12	0.03797	0.00144	-0.12421
Lonchura leucogastra	White-bellied Munia	11	0.03481	0.00121	-0.11689
Megalurus palustris	Striated Grassbird	9	0.02848	0.00081	-0.10135
Lanius cristatus	Brown Shrike	8	0.02532	0.00064	-0.09307
Egretta garzetta	Little Egret	8	0.02532	0.00064	-0.09307
Egretta alba	Great Egret	7	0.02215	0.00049	-0.08440
Egretta intermedia	Intermediate Egret	7	0.02215	0.00049	-0.08440
Dendrocygna arcuata	Wandering Whistling Duck	6	0.01899	0.00036	-0.07527
Bubulcus ibis	Cattle Egret	5	0.01582	0.00025	-0.06561
Megalurus timoriensis	Tawny Grassbird	5	0.01582	0.00025	-0.06561
Ixobrychus sinensis	Yellow Bittern	4	0.01266	0.00016	-0.05531
Eurostopodus macrotis	Great Eared Nightjar	4	0.01266	0.00016	-0.05531
Centropus bengalensis	Lesser Coucal	4	0.01266	0.00016	-0.05531
Halcyon chloris	White-collared Kingfisher	3	0.00949	0.00009	-0.04421
Geopelia striata	Zebra Dove	3	0.00949	0.00009	-0.04421
Ardea purpurea	Purple Heron	3	0.00949	0.00009	-0.04421
Anas luzonica	Philippine Duck	3	0.00949	0.00009	-0.04421
Streptopelia chinensis	Spotted Dove	3	0.00949	0.00009	-0.04421
Oriolus chinensis	Black-naped Oriole	3	0.00949	0.00009	-0.04421
Motacilla cinerea	Grey Wagtail	3	0.00949	0.00009	-0.04421
Treron vernans	Pink-necked Green-Pigeon	2	0.00633	0.00004	-0.03204
Merops philippinus	Blue-tailed Bee-eater	2	0.00633	0.00004	-0.03204
Ixobrychus cinnamomeus	Cinnamon Bittern	2	0.00633	0.00004	-0.03204
Porzana cinerea	White-browed Crake	2	0.00633	0.00004	-0.03204
Gerygone sulphurea	Golden-bellied Flyeater	2	0.00633	0.00004	-0.03204
Alcedo athis	Common Kingfisher	1	0.00316	0.00001	-0.01821
Pandion haliaeetus	Osprey	1	0.00316	0.00001	-0.01821
Haliastur indus	Brahminy Kite	1	0.00316	0.00001	-0.01821
Gallirallus striatus	Slaty-breasted Rail	1	0.00316	0.00001	-0.01821
Amaurornis phoenicurus	White-breasted Waterhen	1	0.00316	0.00001	-0.01821
Gallinula chloropus	Common Moorhen	1	0.00316	0.00001	-0.01821
Nectarinia jugularis	Olived-backed Sunbrid	1	0.00316	0.00001	-0.01821
TOTAL NO. INDIVIDUALS (N)		316		0.07939	-3.03419
NO. OF SPECIES		39			

Species Diversity Index (H')	3.03419
Hmax	3.66356
Eveness Index (e)	0.82821
Dominance Index	0.07939

Table 3.2.2.8. Bird diversity indices values for Site 2, Brgy. Montelago, Naujan Municipality, Naujan Lake National Park, October 16-29, 2011.

			Index Computation		
Species	Common Name	Number	ni/N	$(ni/N)^2$	ln(ni/N)(ni/N)
Hypsipetes philippinus	Philippine Bulbul	19	0.08716	0.00760	-0.21267
Collocalia troglodytes	Pygmy Swiftlet	15	0.06881	0.00473	-0.18416
Dicrurus balicassius	Balicassiao	13	0.05963	0.00356	-0.16814
Collocalia esculenta	Glossy Swiftlet	10	0.04587	0.00210	-0.14137
Hirundo tahitica	Pacific Swallow	9	0.04128	0.00170	-0.13158
Phapitreron leucotis	White-eared Brown Dove	8	0.03670	0.00135	-0.12129
Pachycephala albiventris	Green-backed Whistler	8	0.03670	0.00135	-0.12129
Hirundo rustica	Barn Swallow	7	0.03211	0.00103	-0.11041
Pycnonotus goiavier	Yellow-vented Bulbul	7	0.03211	0.00103	-0.11041
Sarcops calvus	Coleto	7	0.03211	0.00103	-0.11041
Cacomantis variolosus	Brush Cuckoo	6	0.02752	0.00076	-0.09888
Lanius cristatus	Brown Shrike	5	0.02294	0.00053	-0.08658
Macropygia phasianella	Reddish Cuckoo-Dove	5	0.02294	0.00053	-0.08658
Cacomantis merulinus	Plaintive Cuckoo	5	0.02294	0.00053	-0.08658
Caprimulgus affinis	Savannah Nightjar	5	0.02294	0.00053	-0.08658
Oriolus chinensis	Black-naped Oriole	5	0.02294	0.00053	-0.08658
Dicaeum bicolor	Bicolored Flowerpecker	5	0.02294	0.00053	-0.08658
Rhipidura javanica	Pied Fantail	4	0.01835	0.00034	-0.07336
Chalcopaps indica	Common Emerald Dove	4	0.01835	0.00034	-0.07336
Eurostopodus macrotis	Great-eared Nightjar	4	0.01835	0.00034	-0.07336
Corvus macrorhynchos	Large-billed Crow	4	0.01835	0.00034	-0.07336
Dicaeum pygmaeum	Pygmy Flowerpecker	4	0.01835	0.00034	-0.07336
Gallus gallus	Red Junglefowl	3	0.01376	0.00019	-0.05898
Centropus bengalensis	Lesser Coucal	3	0.01376	0.00019	-0.05898
Dendrocopus maculatus	Philippine Pygmy Woodpecker	3	0.01376	0.00019	-0.05898
Parus elegans	Elegant Tit	3	0.01376	0.00019	-0.05898
Phylloscoopus borealis	Arctic Warbler	3	0.01376	0.00019	-0.05898
Megalurus palustris	Striated Grassbird	3	0.01376	0.00019	-0.05898
Nectarinia sperata	Purple-throated Sunbird	3	0.01376	0.00019	-0.05898
Dicaeum retrocinctum	Purple-throated Sunbird	3	0.01376	0.00019	-0.05898
Halcyon chloris	White-collared Kingfisher	2	0.00917	0.00008	-0.04304
Hypothymis azurea	Black-naped Monarch	2	0.00917	0.00008	-0.04304
Treron pompadora	Pompadour Green Pigeon	2	0.00917	0.00008	-0.04304
Streptopelia chinensis	Spotted Dove	2	0.00917	0.00008	-0.04304
Loriculus philippensis	Colasisi	2	0.00917	0.00008	-0.04304
Halcyon smyrnensis	White-throated Kingfisher	2	0.00917	0.00008	-0.04304
Cyornis rufigastra	Mangrove Blue Flycatcher	2	0.00917	0.00008	-0.04304
Motacilla cinerea	Grey Wagtail	2	0.00917	0.00008	-0.04304
Aethopyga shelleyi	Lovely Sunbird	2	0.00917	0.00008	-0.04304
Dicaeum trigonostigma	Orange-bellied Flowerpecker	2	0.00917	0.00008	-0.04304
Haliastur indus	Brahminy Kite	1	0.00459	0.00002	-0.02470
Spilornis cheela	Crested Serpent Eagle	1	0.00459	0.00002	-0.02470
Spizaetus philippensis	Philippine Hawk-Eagle	1	0.00459	0.00002	-0.02470
Accipiter virgatus	Besra	1	0.00459	0.00002	-0.02470
Gallirallus striatus	Slaty-breasted Rail	1	0.00459	0.00002	-0.02470
Amaurornis olivaceus	Plain Bush-hen	1	0.00459	0.00002	-0.02470
Amaurornis phoenicurus	White-breasted Waterhen	1	0.00459	0.00002	-0.02470
Ducula aenea	Green Imperial Pigeon	1	0.00459	0.00002	-0.02470
Centropus steeri	Black-hooded Coucal	1	0.00459	0.00002	-0.02470

Centropus viridis	Philippine Coucal	1	0.00459	0.00002	-0.02470
Megalaima haemacephala	Coppersmith Barbet	1	0.00459	0.00002	-0.02470
Dryocopus javensis	White-bellied Woodpecker	1	0.00459	0.00002	-0.02470
Pitta sordida	Hooded Pitta	1	0.00459	0.00002	-0.02470
Lalage melanoleuca	Black-and-white Triller	1	0.00459	0.00002	-0.02470
Zoothera cinerea	Ashy Ground-Thrush	1	0.00459	0.00002	-0.02470
TOTAL NO. INDIVIDUALS (N)		218		0.03375	-3.66966
NO. OF SPECIES		55			

Species Diversity Index (H')	3.66966
Hmax	4.00733
Eveness Index (e)	0.91574
Dominance Index	0.03375

Table 3.2.2.9. Bird diversity indices values for Site 3, Brgy. Tagbakin, Pola Municipality, Naujan Lake National Park, October 16-29, 2011.

			Index Computation		
Species	Common Name	Number	ni/N	$(ni/N)^2$	ln(ni/N)(ni/N)
Pycnonotus goiavier	Yellow-vented Bulbul	24	0.08922	0.00796	-0.21561
Collocalia esculenta	Glossy Swiftlet	17	0.06320	0.00399	-0.17452
Hirundo tahitica	Pacific Swallow	17	0.06320	0.00399	-0.17452
Collocalia troglodytes	Pygmy Swiftlet	15	0.05576	0.00311	-0.16097
Hirundo rustica	Barn Swallow	14	0.05204	0.00271	-0.15383
Hypsipetes philippinus	Philippine Bulbul	12	0.04461	0.00199	-0.13873
Passer montanus	Eurasian Sparrow	11	0.04089	0.00167	-0.13072
Geopelia striata	Zebra Dove	8	0.02974	0.00088	-0.10454
Megalurus palustris	Striated Grassbird	8	0.02974	0.00088	-0.10454
Rhipidura javanica	Pied Fantail	8	0.02974	0.00088	-0.10454
Lanius schach	Long-tailed Shrike	8	0.02974	0.00088	-0.10454
Oriolus chinensis	Black-naped Oriole	7	0.02602	0.00068	-0.09495
Loriculus philippensis	Colasisi	7	0.02602	0.00068	-0.09495
Megalurus timoriensis	Tawny Grassbird	7	0.02602	0.00068	-0.09495
Macropygia phasianella	Reddish Cuckoo-Dove	6	0.02230	0.00050	-0.08482
Caprimulgus affinis	Savannah Nightjar	6	0.02230	0.00050	-0.08482
Halcyon chloris	White collared Kingfisher	5	0.01859	0.00035	-0.07408
Centropus bengalensis	Lesser Coucal	5	0.01859	0.00035	-0.07408
Merops philippinus	Blue-tailed Bee-eater	5	0.01859	0.00035	-0.07408
Gerygone sulphurea	Golden-bellied Flyeater	5	0.01859	0.00035	-0.07408
Nectarinia jugularis	Olive-backed sunbird	5	0.01859	0.00035	-0.07408
Phapitreron leucotis	White-eared Brown-Dove	4	0.01487	0.00022	-0.06258
Eurostopodus macrotis	Great-eared Nightjar	4	0.01487	0.00022	-0.06258
Dendrocopus maculatus	Philippine Pygmy Woodpecker	4	0.01487	0.00022	-0.06258
Pachycephala albiventris	Green-backed Whistler	3	0.01115	0.00012	-0.05014
Sarcops calvus	Coleto	3	0.01115	0.00012	-0.05014
Turnix suscitator	Barred Buttonquail	3	0.01115	0.00012	-0.05014
Treron pompadora	Pompadour Green Pigeon	3	0.01115	0.00012	-0.05014

Streptopelia tranquebarica	Red Turtle-Dove	3	0.01115	0.00012	-0.05014
Chalcopaps indica	Common Emerald Dove	3	0.01115	0.00012	-0.05014
Cacomantis merulinus	Plaintive Cuckoo	3	0.01115	0.00012	-0.05014
Halycon smyrnensis	White-throated Kingfisher	3	0.01115	0.00012	-0.05014
Copsychus saularis	Oriental Magpie Robin	3	0.01115	0.00012	-0.05014
Phylloscopus borealis	Arctic Warbler	3	0.01115	0.00012	-0.05014
Motacilla cinerea	Grey Wagtail	3	0.01115	0.00012	-0.05014
Dicaeum bicolor	Bicolored flowerpecker	3	0.01115	0.00012	-0.05014
Gallirallus philippensis	Buff-banded Rail	2	0.00743	0.00006	-0.03644
Amaurornis phoenicurus	White-breasted Waterhen	2	0.00743	0.00006	-0.03644
Streptopelia chinensis	Spotted Dove	2	0.00743	0.00006	-0.03644
Hirundapus celebensis	Purple Needletail	2	0.00743	0.00006	-0.03644
Parus elegans	Elegant Tit	2	0.00743	0.00006	-0.03644
Cisticola juncidis	Zitting Cisticola	2	0.00743	0.00006	-0.03644
Nectarinia sperata	Purple-throated Sunbird	2	0.00743	0.00006	-0.03644
Haliastur indus	Brahminy Kite	1	0.00372	0.00001	-0.02080
Spilornis cheela	Crested Serpent Eagle	1	0.00372	0.00001	-0.02080
Centropus viridis	Philippine Coucal	1	0.00372	0.00001	-0.02080
Alcedo cyanopecta	Indigo-banded Kingfisher	1	0.00372	0.00001	-0.02080
Pitta sordida	Hooded Pitta	1	0.00372	0.00001	-0.02080
Lalage nigra	Pied Triller	1	0.00372	0.00001	-0.02080
Hypothymis azurea	Black-naped Monarch	1	0.00372	0.00001	-0.02080
TOTAL NO. INDIVIDUALS (N)		269		0.03636	-3.58208
NO. OF SPECIES		50			

Species Diversity Index (H')	3.58208
Hmax	3.91202
Eveness Index (e)	0.91566
Dominance Index	0.03636

Table 3.2.2.10. Bird diversity indices values for Site 4, Brgy. Mabuhay Dos, Socorro Municipality, Naujan Lake National Park, October 16-29, 2011.

Pycnonotus goiavier	Yellow-vented Bulbul	24	0.09796	0.00960	-0.22758
Collocalia esculenta	Glossy Swiftlet	21	0.08571	0.00735	-0.21058
Hirundo tahitica	Pacific Swallow	19	0.07755	0.00601	-0.19828
Hypsipetes philippinus	Philippine Bulbul	17	0.06939	0.00481	-0.18513
Lanius cristatus	Brown Shrike	17	0.06939	0.00481	-0.18513
Collocalia troglodytes	Pygmy Swiftlet	15	0.06122	0.00375	-0.17101
Megalurus palustris	Striated Grassbird	8	0.03265	0.00107	-0.11173
Pachycephala albiventris	Green-backed Whistler	7	0.02857	0.00082	-0.10158
Lanius schach	Long-tailed Shrike	7	0.02857	0.00082	-0.10158
Halcyon chloris	White-collared Kingfisher	6	0.02449	0.00060	-0.09084
Rhipidura javanica	Pied Fantail	6	0.02449	0.00060	-0.09084
Caprimulgus affinis	Savannah Nightjar	6	0.02449	0.00060	-0.09084
Geopelia striata	Zebra Dove	5	0.02041	0.00042	-0.07942

Loriculus philippensis	Colasisi	5	0.02041	0.00042	-0.07942
Oriolus chinensis	Black-naped Oriole	5	0.02041	0.00042	-0.07942
Phylloscopus borealis	Arctic Warbler	4	0.01633	0.00027	-0.06718
Corvus macrorhynchos	Large-billed Crow	4	0.01633	0.00027	-0.06718
Sarcops calvus	Coleto	4	0.01633	0.00027	-0.06718
Dicaeum bicolor	Bicolored Flowerpecker	4	0.01633	0.00027	-0.06718
Copsychus saularis	Oriental Magpie-Robin	3	0.01224	0.00015	-0.05391
Phapitreron leucotis	White-eared Brown-Dove	3	0.01224	0.00015	-0.05391
Streptopelia bitorquata	Island Collared-Dove	3	0.01224	0.00015	-0.05391
Streptopelia chinensis	Spotted Dove	3	0.01224	0.00015	-0.05391
Centropus bengalensis	Lesser Coucal	3	0.01224	0.00015	-0.05391
Halcyon smyrnensis	White-throated Kingfisher	3	0.01224	0.00015	-0.05391
Dendrocopus maculatus	Philippine Pygmy Woodpecker	3	0.01224	0.00015	-0.05391
Dicrurus balicassius	Balicassiao	3	0.01224	0.00015	-0.05391
Parus elegans	Elegant Tit	3	0.01224	0.00015	-0.05391
Gerygone sulphurea	Golden-bellied Flyeater	3	0.01224	0.00015	-0.05391
Nectarinia sperata	Purple-throated Sunbird	3	0.01224	0.00015	-0.05391
Dicaeum pygmaeum	Pygmy Flowerpecker	3	0.01224	0.00015	-0.05391
Cacomantis merulinus	Plaintive Cuckoo	2	0.00816	0.00007	-0.03925
Treron vernans	Pink-necked Green Pigeon	2	0.00816	0.00007	-0.03925
Macropygia phasianella	Reddish Cuckoo-Dove	2	0.00816	0.00007	-0.03925
Chalcopaps indica	Common Emerald Dove	2	0.00816	0.00007	-0.03925
Lalage nigra	Pied Triller	2	0.00816	0.00007	-0.03925
Cyornis rufigastra	Mangrove Blue Flycatcher	2	0.00816	0.00007	-0.03925
Aethopyga shelleyi	Lovely Sunbird	2	0.00816	0.00007	-0.03925
Dicaeum retrocinctum	Scarlet-collared Flowerpecker	2	0.00816	0.00007	-0.03925
Cacomantis variolosus	Brush Cuckoo	1	0.00408	0.00002	-0.02245
Haliastur indus	Brahminy Kite	1	0.00408	0.00002	-0.02245
Gallirallus torquatus	Barred Rail	1	0.00408	0.00002	-0.02245
Amaurornis olivaceus	Plain Bush-hen	1	0.00408	0.00002	-0.02245
Centropus viridis	Philippine Coucal	1	0.00408	0.00002	-0.02245
Dryocopus javensis	White-bellied Woodpecker	1	0.00408	0.00002	-0.02245
Pitta erythrogaster	Red-bellied Pitta	1	0.00408	0.00002	-0.02245
Zoothera cinerea	Ashy Ground-thrush	1	0.00408	0.00002	-0.02245
Hypothymis azurea	Black-naped Monarch	1	0.00408	0.00002	-0.02245
TOTAL NO. INDIVIDUALS (N)		245		0.04563	-3.43516
NO. OF SPECIES		48			

Species Diversity Index (H')	3.43516
Hmax	3.87120
Eveness Index (e)	0.88736
Dominance Index	0.04563

Table 3.2.2.11. Bird diversity indices values for Site 5, Brgy. Calubasanhon, Pola Municipality, Naujan Lake National Park, October 16-29, 2011.

			Index Computation		
Species	Common Name	Number	ni/N	$(ni/N)^2$	ln(ni/N)(ni/N)
Pycnonotus goiavier	Yellow-vented Bulbul	28	0.08434	0.00711	-0.20856
Hirundo tahitica	Pacific Swallow	22	0.06627	0.00439	-0.17985
Hirundo rustica	Barn Swallow	19	0.05723	0.00328	-0.16371
Collocalia esculenta	Glossy Swiftlet	18	0.05422	0.00294	-0.15803
Lanius cristatus	Brown Shrike	16	0.04819	0.00232	-0.14615
Collocalia troglodytes	Pygmy Swiftlet	16	0.04819	0.00232	-0.14615
Geopelia striata	Zebra Dove	13	0.03916	0.00153	-0.12687
Megalurus timoriensis	Tawny Grassbird	13	0.03916	0.00153	-0.12687
Streptopelia chinensis	Spotted Dove	12	0.03614	0.00131	-0.12001
Passer montanus	Eurasian Sparrow	12	0.03614	0.00131	-0.12001
Hypsipetes philippinus	Philippine Bulbul	11	0.03313	0.00110	-0.11289
Megalurus palustris	Striated Grassbird	11	0.03313	0.00110	-0.11289
Aplonis panayensis	Asian Glossy Starling	11	0.03313	0.00110	-0.11289
Corvus macrorhnchos	Large-billed Crow	10	0.03012	0.00091	-0.10550
Phylloscopus borealis	Arctic Warbler	9	0.02711	0.00073	-0.09780
Rhipidura javanica	Pied Fantail	8	0.02410	0.00058	-0.08978
Halcyon chloris	White-collared Kingfisher	8	0.02410	0.00058	-0.08978
Lanius schach	Long-tailed Shrike	8	0.02410	0.00058	-0.08978
Lonchura punctulata	Scaly-breasted Munia	8	0.02410	0.00058	-0.08978
Caprimulgus affinis	Savannah Nightjar	7	0.02108	0.00044	-0.08137
Oriolus chinensis	Black-naped Oriole	7	0.02108	0.00044	-0.08137
Nectarinia jugularis	Olive-backed Sunbird	7	0.02108	0.00044	-0.08137
Phapitreron leucotis	White-eared Brown-Dove	6	0.01807	0.00033	-0.07253
Centropus bengalensis	Lesser Coucal	5	0.01506	0.00023	-0.06319
Gerygone sulphurea	Golden-bellied Flyeater	5	0.01506	0.00023	-0.06319
Sarcops calvus	Coleto	4	0.01205	0.00015	-0.05324
Chalcopaps inidica	Common Emerald Dove	4	0.01205	0.00015	-0.05324
Merops viridis	Blue-throated Bee-eater	4	0.01205	0.00015	-0.05324
Saxicola caprata	Pied Chat	4	0.01205	0.00015	-0.05324
Cacomantis variolosus	Brush Cuckoo	3	0.00904	0.00008	-0.04253
Muscicapa griseisticta	Grey-streaked Flycatcher	3	0.00904	0.00008	-0.04253
Dendrocopus maculatus	Philippine Pygmy Woodpecker	3	0.00904	0.00008	-0.04253
Cisticola exilis	Bright-capped Cisticola	3	0.00904	0.00008	-0.04253
Nectarinia sperata	Purple-throared Sunbird	3	0.00904	0.00008	-0.04253
Dicaeum bicolor	Bicolored Flowerpecker	3	0.00904	0.00008	-0.04253
Parus elegans	Elegant Tit	2	0.00602	0.00004	-0.03080
Cisticola juncidis	Zitting Cisticola	2	0.00602	0.00004	-0.03080
Motacilla cinerea	Grey Wagtail	2	0.00602	0.00004	-0.03080
Dicaeum pygmaeum	Pygmy Flowerpecker	2	0.00602	0.00004	-0.03080
TOTAL NO. INDIVIDUALS (N)		332		0.03863	-3.43162
NO. OF SPECIES		39			

Species Diversity Index (H')	3.43162
Hmax	3.66356
Eveness Index (e)	0.93669
Dominance Index	0.03863

Table 3.2.2.12. Bird diversity indices values for Site 6, Brgy. Batong Dalig, Socorro Municipality, Naujan Lake National Park, October 16-29, 2011.

			Index Computation		
Species	Common Name	Number	ni/N	$(ni/N)^2$	ln(ni/N)(ni/N)
Hypsipetes philippinus	Philippine Bulbul	25	0.07716	0.00595	-0.19767
Pycnonotus goiavier	Yellow-vented Bulbul	21	0.06481	0.00420	-0.17735
Collocalia troglodytes	Pygmy Swiftlet	17	0.05247	0.00275	-0.15465
Collocalia esculenta	Glossy Swiftlet	16	0.04938	0.00244	-0.14855
Hirundo tahitica	Pacific Swallow	16	0.04938	0.00244	-0.14855
Dicrurus balicassius	Balicassiao	14	0.04321	0.00187	-0.13575
Lonchura leucogastra	White-bellied Munia	14	0.04321	0.00187	-0.13575
Lonchura malacca	Chestnut Munia	13	0.04012	0.00161	-0.12903
Nectarinia jugularis	Olive-backed Sunbird	12	0.03704	0.00137	-0.12207
Passer montanus	Eurasian Sparrow	11	0.03395	0.00115	-0.11485
Megalurus palustris	Striated Grassbird	9	0.02778	0.00077	-0.09954
Megalurus timoriensis	Tawny Grassbird	8	0.02469	0.00061	-0.09139
Geopelia striata	Zebra Dove	8	0.02469	0.00061	-0.09139
Lanius cristatus	Brown Shrike	7	0.02160	0.00047	-0.08285
Oriolus chinensis	Black-naped Oriole	7	0.02160	0.00047	-0.08285
Halcyon chloris	White-collared Kingfisher	6	0.01852	0.00034	-0.07387
Phapitreron leucotis	White-eared Brown-Dove	6	0.01852	0.00034	-0.07387
Caprimulgus affinis	Savannah Nightjar	6	0.01852	0.00034	-0.07387
Rhipidura javanica	Pied Fantail	5	0.01543	0.00024	-0.06437
Egretta intermedia	Intermediate Egret	5	0.01543	0.00024	-0.06437
Streptopelia tranquebarica	Red Turtle-Dove	5	0.01543	0.00024	-0.06437
Streptopelia chinensis	Spotted Dove	5	0.01543	0.00024	-0.06437
Lanius schach	Long-tailed Shrike	5	0.01543	0.00024	-0.06437
Sarcops calvus	Coleto	5	0.01543	0.00024	-0.06437
Phylloscopus borealis	Arctic Warbler	4	0.01235	0.00015	-0.05425
Corvus macrorhynchos	Large-billed Crow	4	0.01235	0.00015	-0.05425
Macropygia phasianella	Reddish Cuckoo-Dove	4	0.01235	0.00015	-0.05425
Dendrocopus maculatus	Philippine Pygmy Woodpecker	4	0.01235	0.00015	-0.05425
Saxicola caprata	Pied Chat	4	0.01235	0.00015	-0.05425
Treron vernans	Pink-necked Green Pigeon	3	0.00926	0.00009	-0.04335
Chalcopaps indica	Common Emerald Dove	3	0.00926	0.00009	-0.04335
Eudynamys scolopacea	Common Koel	3	0.00926	0.00009	-0.04335
Parus elegans	Elegant Tit	3	0.00926	0.00009	-0.04335
Copsychus saularis	Oriental Magpie-Robin	3	0.00926	0.00009	-0.04335
Gerygone sulphurea	Golden-bellied Flyeater	3	0.00926	0.00009	-0.04335
Cisticola juncidis	Zitting Cisticola	3	0.00926	0.00009	-0.04335

Hypothymis azurea	Black-naped Monarch	3	0.00926	0.00009	-0.04335
Aethopyga shelleyi	Lovely Sunbird	3	0.00926	0.00009	-0.04335
Dicaeum bicolor	Bicolored Flowerpecker	3	0.00926	0.00009	-0.04335
Dicaeum trigonostigma	Orange-bellied Flowerpecker	3	0.00926	0.00009	-0.04335
Cacomantis variolosus	Brush Cuckoo	2	0.00617	0.00004	-0.03140
Centropus steeri	Black-hooded Coucal	2	0.00617	0.00004	-0.03140
Loriculus philippensis	Colasisi	2	0.00617	0.00004	-0.03140
Halcyon smyrnensis	White-throated Kingfisher	2	0.00617	0.00004	-0.03140
Alcedo athis	Common Kingfisher	2	0.00617	0.00004	-0.03140
Lalage nigra	Pied Triller	2	0.00617	0.00004	-0.03140
Cyornis rufigastra	Mangrove Blue Flycatcher	2	0.00617	0.00004	-0.03140
Motacilla cinerea	Grey Wagtail	2	0.00617	0.00004	-0.03140
Nectarinia sperata	Purple-throated Sunbird	2	0.00617	0.00004	-0.03140
Amaurornis phoenicurus	White-breasted Waterhen	1	0.00309	0.00001	-0.01784
Spilornis cheela	Crested Serpent Eagle	1	0.00309	0.00001	-0.01784
Haliastur indus	Brahminy Kite	1	0.00309	0.00001	-0.01784
Gallus gallus	Red Junglefowl	1	0.00309	0.00001	-0.01784
Dryocopus javensis	White-bellied Woodpecker	1	0.00309	0.00001	-0.01784
Pitta erythrogaster	Red-bellied Pitta	1	0.00309	0.00001	-0.01784
Zoothera cinerea	Ashy Ground Thrush	1	0.00309	0.00001	-0.01784
TOTAL NO. INDIVIDUALS (N)		324		0.03315	-3.67578
NO. OF SPECIES		56			

Species Diversity Index (H')	3.67578
Hmax	4.02535
Eveness Index (e)	0.91316
Dominance Index	0.03315

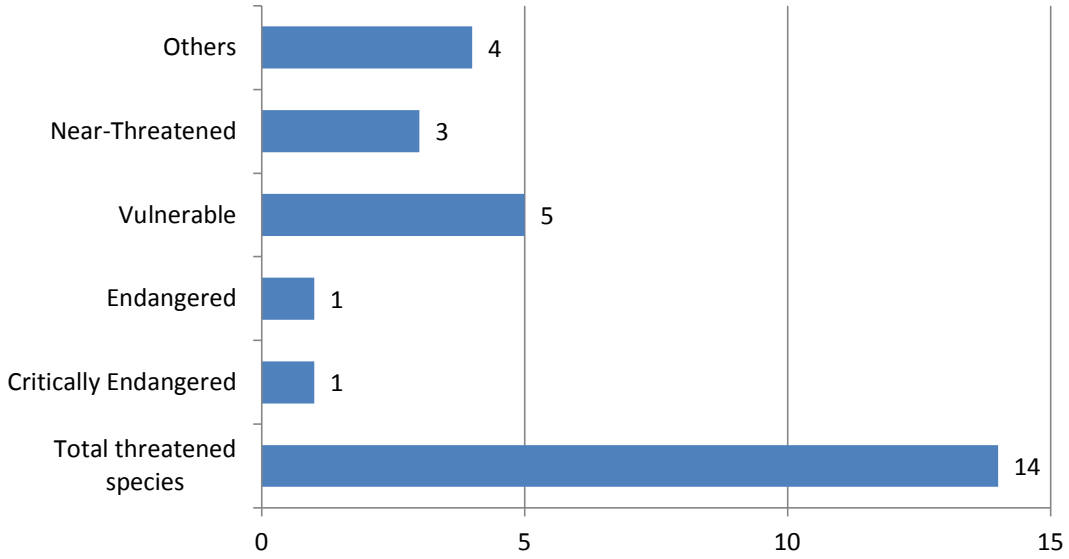


Figure 3.2.2.3. Classification of threatened terrestrial vertebrates recorded in Naujan lake National Park, October 16-29, 2011.

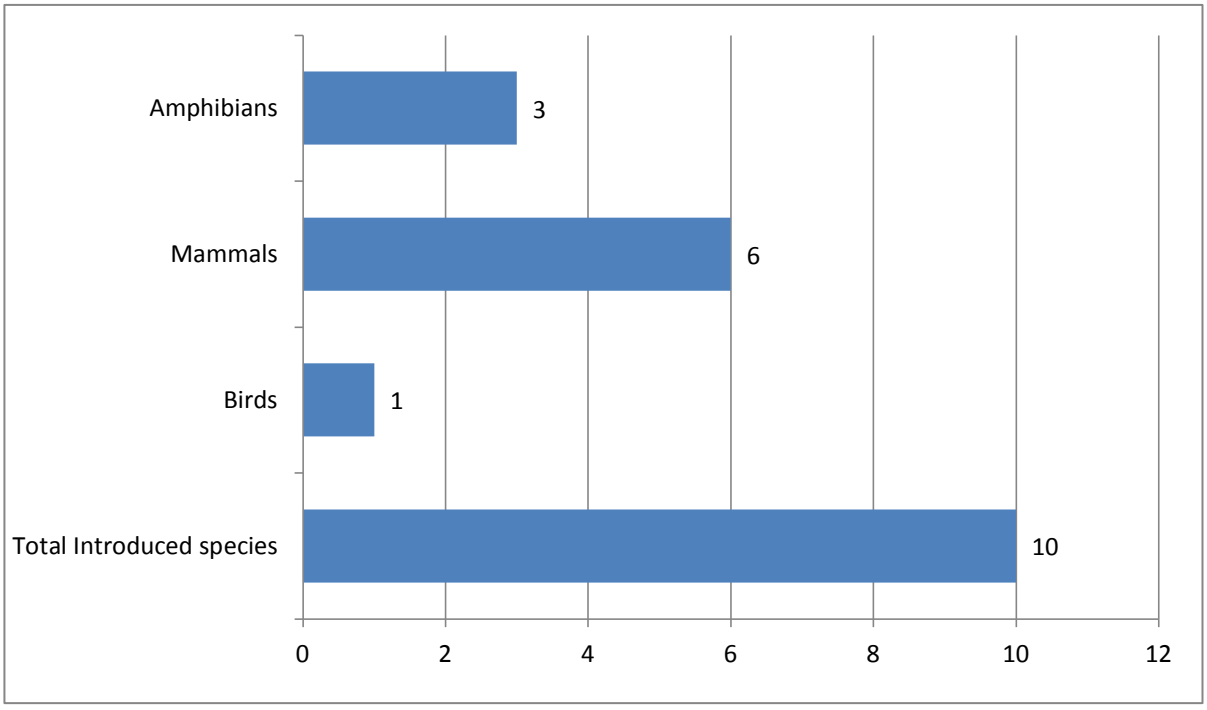


Figure 3.2.2.4. Distribution of alien and introduced terrestrial vertebrates by taxa recorded in Naujan lake National Park, October 16-29, 2011.

Table 3.2.3.1.1. Species recorded in Naujan Lake and Butas River by this study.

SCIENTIFIC NAME	Naujan Lake	Butas River[1]
Chanos chanos	+	+
Anguilla marmorata	+	+
Clarias batrachus	+	+
Liza macrolepis	+	+
Caranx sexfasciatus	+	+
Ambassis urotaenia	+	+
Mesopristes cancellatus	+	+
Channa striata	+	+
Anabas testudineus	+	-
Scatophagus argus	+	+
Redigobius tambujon	+	-
Giuris margaritacea	+	+
Hypseleotris cyprinoides	-	+
Glossogobius giuris	+	+
Glossogobius celebius	+	+
Awaous melanocephalus	+	+
Poecilia reticulata	+	+
Poecilia sphenops	+	+
Oreochromis niloticus niloticus	+	+
Tilapia zillii	+	+
Leiopotherapon plumbeus	+	+
Stenogobius sp.	+	+
Trichopodus pectoralis	+	+
Trichopodus trichopterus	+	+
Cyprinus carpio carpio	+	-
Carassius sp.	+	-
TOTAL	25	22

Table 3.2.3.1.2. Fishes collected from tributaries of Naujan Lake.

SCIENTIFIC NAME	Borbocolon River	Malayas River	Gusay Creek	Malbog Creek	Merit Creek	Pasi Creek	Bullfrog Creek	Singolan River	Subaan River	Tagbakin Creek	Taybungan Creek	Tigbao Creek	Balangibang Creek	Bambang Creek 1	Bambang Creek 2
Ambassis urotaenia	-	-	+	-	-	-	-	-	+	-	-	-	-	-	-
Anguilla marmorata	-	-	-	+	-	-	-	-	-	-	-	+	-	-	-
Channa striata	+	-	-	+	-	+	+	+	-	-	-	-	+	-	+
Oreochromis niloticus niloticus	+	+	+	+	-	-	-	-	+	-	-	-	-	-	-
Tilapia zillii	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-
Clarias batrachus	+	-	+	+	+	+	-	+	+	+	+	+	+	+	+
Puntius hemictenus	-	-	+	+	+	+	+	+	+	+	+	+	+	+	+
Eleotris melanosoma	-	-	-	-	-	+	-	-	-	+	+	-	+	-	-
Giuris margaritacea	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Awaous melanocephalus	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-
Glossogobius celebius	-	+	+	+	+	+	+	+	+	-	+	+	+	-	-
G. giuris	-	+	-	+	+	+	+	+	-	-	+	+	+	-	-
Redigobius tambujon	-	-	+	+	+	-	+	-	-	-	-	-	-	+	+
Trichopodus pectoralis	-	+	-	-	-	-	-	-	+	-	-	-	-	-	-
T. trichopterus	+	+	-	+	+	+	-	+	+	-	-	-	-	+	-
Poecilia reticulata	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
P. sphenops	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Microphis sp.	-	+	-	-	-	-	-	-	+	-	-	-	-	-	-
Leiopotherapon plumbeus	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL	7	10	9	12	8	10	8	10	11	6	8	8	9	8	7

Table 3.2.3.1.3. Conservation category and importance of fishes recorded from Naujan Lake National Park.

FAMILY	SCIENTIFIC NAME	IUCN Red List Category[1]	Importance[2]
Ambassidae	*Ambassis urotaenia*	LC	C/E
Anabantidae	*Anabas testudineus*	DD	E
Anguillidae	*Anguilla marmorata*	NE	C/E
Carangidae	*Caranx sexfasciatus*	LC	C/E
Chanidae	*Chanos chanos*	NE	C/E
Channidae	*Channa striata*	LC	C/E
Cichlidae	*Oreochromis niloticus niloticus*	LC	C/E
	Tilapia zillii	LC	C/E
Clariidae	*Clarias batrachus*	LC	C/E
	Carassius sp.	NE	C/E
Cyprinidae	*Cyprinus carpio carpio*	VU*	C/E
	Puntius hemictenus	VU	E
	Eleotris melanosoma	LC	E
Eleotridae	*Giuris margaritacea*	NE	E
	Hypseleotris cyprinoides	NE	E
	Awaous melanocephalus	NE	E
	Glossogobius celebius	NE	C/E
Gobiidae	*G. giuris*	NE	C/E
	Redigobius tambujon	NE	E
	Stenogobius sp.	CR	E
Mugilidae	*Liza macrolepis*	NE	C/E
Osphronemidae	*Trichopodus pectoralis*	NE	C/E
	T. trichopterus	NE	C/E
Poeciliidae	*Poecilia reticulata*	NE	E
	P. sphenops	NE	E
Scatophagidae	*Scatophagus argus*	LC	C/E
Syngnathidae	*Microphis* sp.	NE	E
Teraponidae	*Leiopotherapon plumbeus*	NE	C/E
	Mesopristes cancellatus	NE	C/E

[1]IUCN Red List Category (CR- Critically Endangered, VU- Vulnerable, LC- Least Concern, NE- Not Evaluated, DD- Data Deficient); [2]Importance (C- Commercially, E- Ecologically, no or little commercial value); * in their natural habitat

Table 3.2.3.1.4. Macroinvertebrates[1] recorded from Naujan Lake National Park (NLNP).

	SCIENTIFIC NAME	SEARCA Survey (1997)	Current Survey (2011)
Gastropods	*Vivipara* sp.	+	+
	Melanoides sp.	+	+
	Thiara scabra	+	+
	Thiara granifera	+	+
	Pomacea canaliculata	-	+
Bivalves	*Anodonta* sp.	-	+
	Corbicula manilensis	+	+
Crab	*Mindoron* sp.	-	+
Shrimps	*Marcrobrachium lar*	-	+
	Macrobrachium sp.	-	+
	Atyopsis sp.	-	+
	Caridina sp.	-	+
TOTAL		5	12

Table 3.2.4.1. Number of arthropod species (S) and number of individuals (N) for the different sampling sites surrounding the Naujan Lake National Park using various sampling techniques.

PLOTS	SITE 1		SITE 2		SITE 3		SITE 4		SITE 5		SITE 6	
	S	N	S	N	S	N	S	N	S	N	S	N
Sweep Net Sampling												
1	30	60	38	88	17	95	37	97	35	145	16	20
2	22	42	28	106	31	156	13	16	38	120	18	40
3	31	109	18	39	25	53	17	35	35	130	8	13
4	31	69	16	33	21	112	19	40	45	136	17	35
Average	28.5	70	25	66.5	23.5	104	21.5	47	38.25	132.75	14.75	27
Soil- Leaf Litter Sampling												
1	11	28	4	13	3	7	7	7	7	13	13	141
2	7	21	4	17	5	17	2	12	7	11	16	115
3	8	25	3	7	14	25	2	2	13	106	9	60
4	7	22	4	12	6	12	2	4	1	7	14	55

Average	8.25	24	3.75	12.25	7	15.25	3.25	6.25	7	34.25	13	92.75
Pitfall traps												
1	14	45	7	21	13	29	10	26	13	41	13	53
2	0	0	6	18	8	18	10	239	10	17	14	37
3	3	19	9	18	8	17	7	49	7	12	20	101
4	11	30	7	17	9	18	8	366	10	35	12	45
Average	7	23.5	7.25	18.5	9.5	20.5	8.75	170	10	26.25	14.75	59
UV light trap												
	146	3358	104	528178	56	1497	127	1924	90	717	55	370

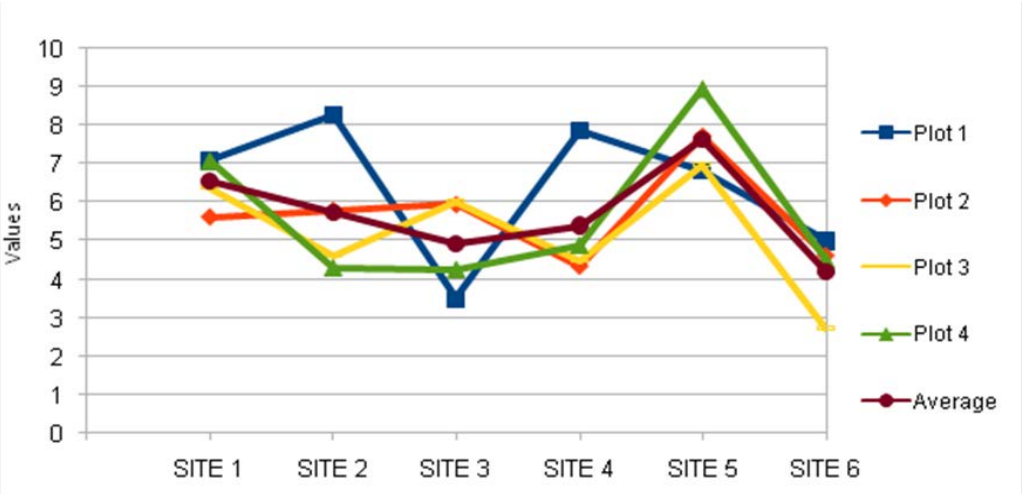


Figure 3.2.4.1. Trends in arthropod species richness around Naujan Lake National Park using sweep net sampling.

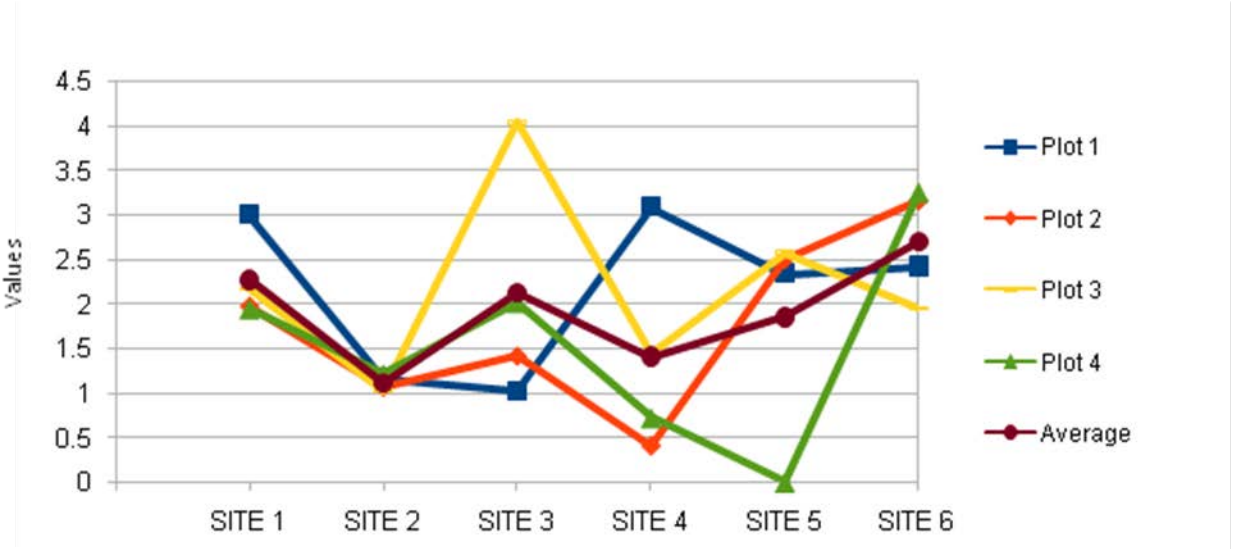


Figure 3.2.4.2. Trends in arthropod species richness around Naujan Lake National Park using soil-litter sampling.

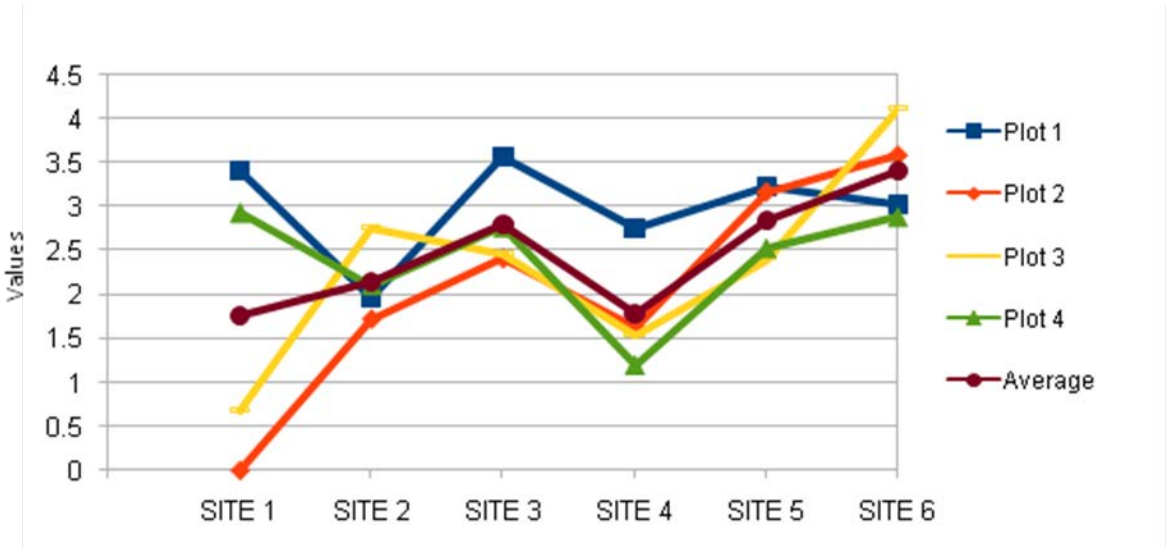


Figure 3.2.4.3. Trends in arthropod species richness around Naujan Lake National Park using pitfall trap.

Figure 3.2.4.4. Trends in arthropod species richness around Naujan Lake National Park using UV light trap sampling.

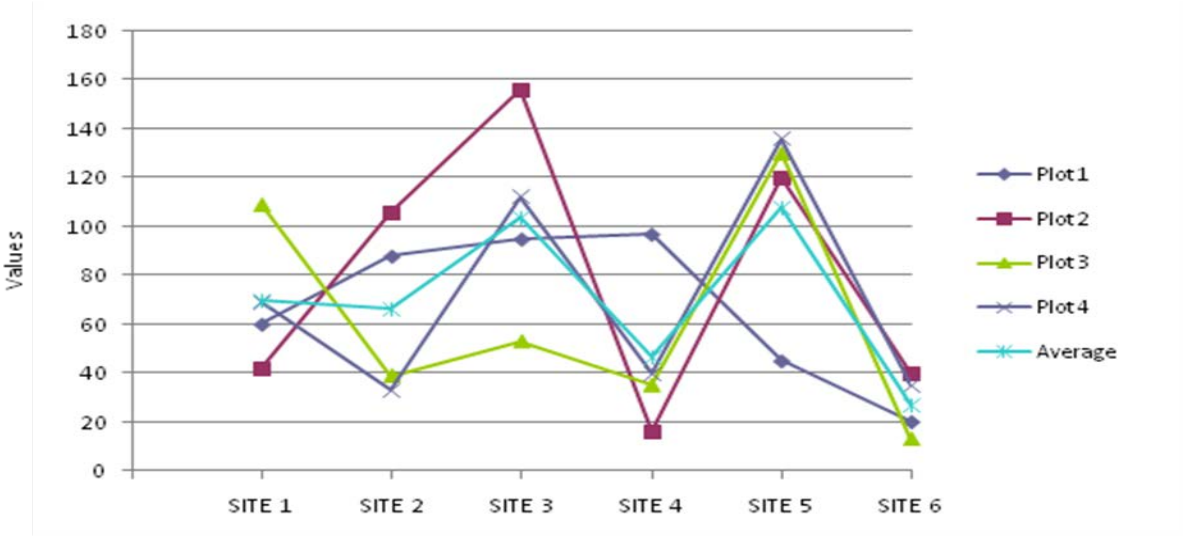


Figure 3.2.4.5. Trends in arthropod individuals around Naujan Lake National Park using sweep net sampling.

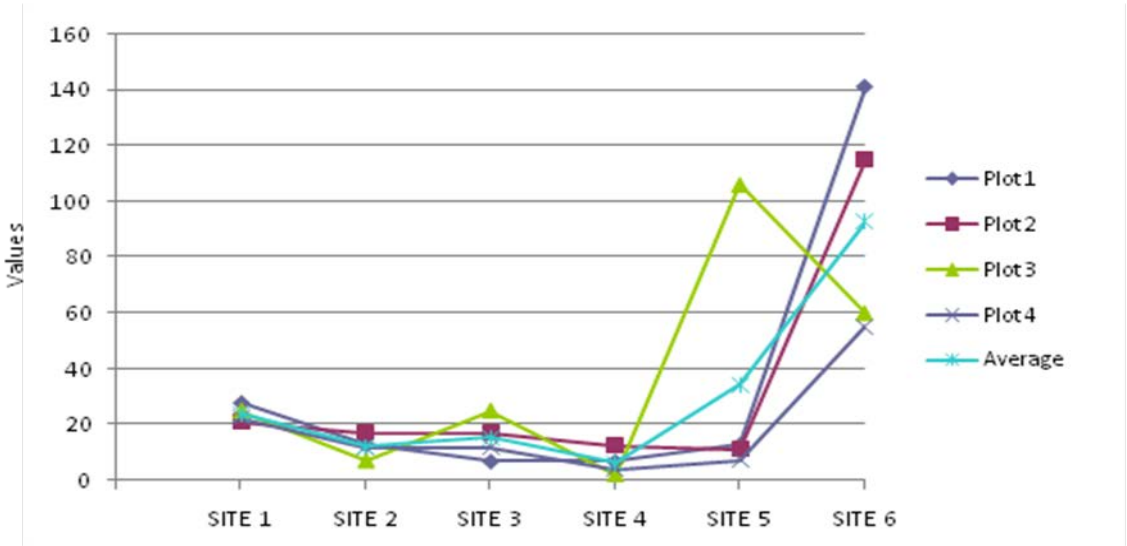


Figure 3.2.4.6. Trends in arthropod individuals around Naujan Lake National Park.

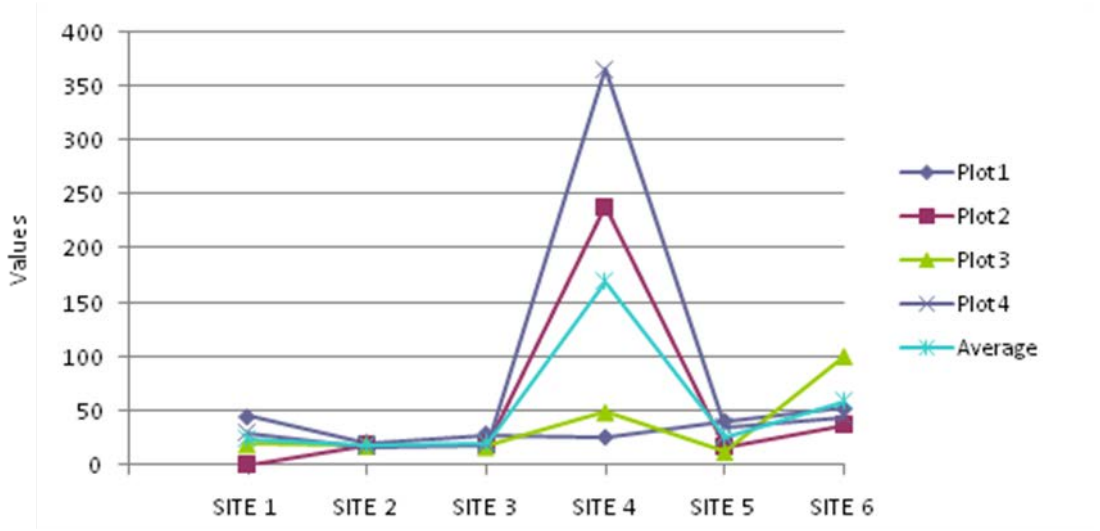


Figure 3.2.4.7. Trends in arthropod individuals around Naujan Lake National Park using pitfall trap sampling.

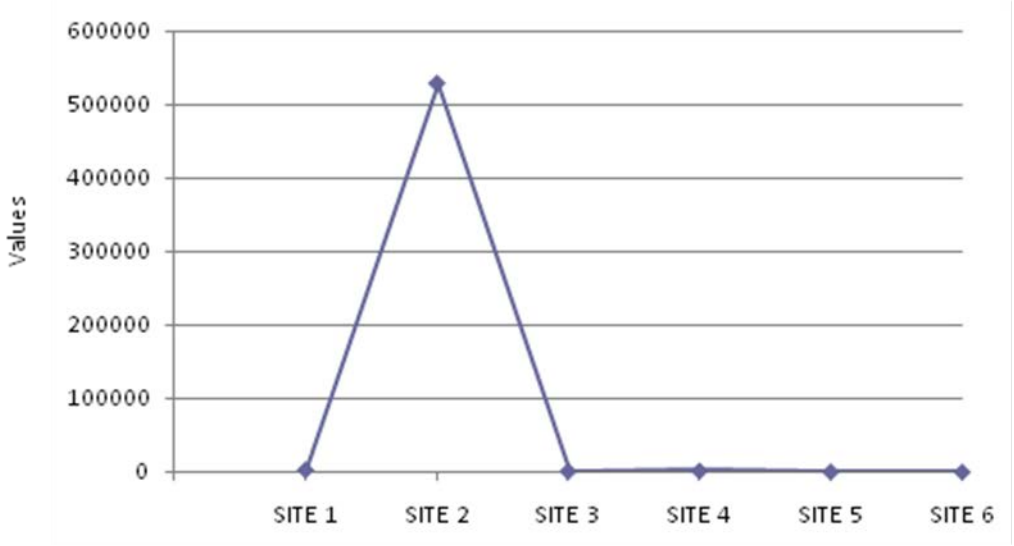


Figure 3.2.4.8. Trend in arthropod individuals around Naujan Lake National Park.

Table 3.2.4.2. Arthropod species diversity (H) values for the different sampling sites surrounding the Naujan Lake National Park using various sampling techniques.

PLOTS	SITE 1	SITE 2	SITE 3	SITE 4	SITE 5	SITE 6
Sweep Net Sampling						
1	2.92	1.61	0.77	1.4	1.08	2.1
2	1.92	1.08	0.94	2.17	1.25	1.6
3	1.14	1.55	1.72	1.66	1.13	1.58
4	1.49	1.61	0.87	1.47	1.31	1.5
Average	1.8675	1.4625	1.075	1.675	1.1925	1.695
Soil- Leaf Litter Sampling						
1	1.59	0.27	0.96	1.95	1.69	1.27
2	1.62	0.8	1.26	0.64	1.09	1.32
3	1.8	1.08	1.29	0.69	1.78	1.25
4	1.46	0.57	1.56	0.69	0	1.7
Average	1.6175	0.68	1.2675	0.9925	1.14	1.385
Pitfall traps						
1	1.06	1.01	1.51	1.25	1.18	0.97
2	0	0.96	0.68	0.23	1.67	1.37
3	0.46	1.44	1.33	0.56	1.45	0.88
4	1.23	1.17	1.44	1.13	1.02	1.01
Average	0.6875	1.145	1.24	0.7925	1.33	1.0575
UV light trap						
	0.3	0	0.25	0.27	0.72	0.73

Table 3.2.4.3. Arthropod species evenness index (e) values for the different sampling sites the Naujan Lake National Park using various sampling techniques.

PLOTS	SITE 1	SITE 2	SITE 3	SITE 4	SITE 5	SITE 6
Sweep Net Sampling						
1	0.08	0.01	0	0.02	0	0.06
2	0.01	0.01	0	0.06	0.01	0.01
3	0.01	0.02	0.01	0.02	0	0.05
4	0.2	0.02	0	0.03	0.01	0.03
Average	0.075	0.015	0.0025	0.0325	0.005	0.0375
Soil- Leaf Litter Sampling						
1	0.32	0.86	0.43	0.14	0.23	0.47
2	0.26	0.54	0.36	0.56	0.07	0.37
3	0.19	0.34	0.3	0.5	0.25	0.46
4	0.32	0.71	0.25	0.5	1	0.25
Average	0.2725	0.6125	0.335	0.425	0.3875	0.3875
Pitfall traps						
1	0.01	0.02	0.02	0.01	0	0
2	0	0.02	0	0	0.03	0.01
3	0	0.03	0.03	0	0.05	0
4	0.01	0.02	0.03	0	0.01	0
Average	0.005	0.0225	0.02	0.0025	0.0225	0.0025
UV Light trap						
	0	0	0	0	0	0

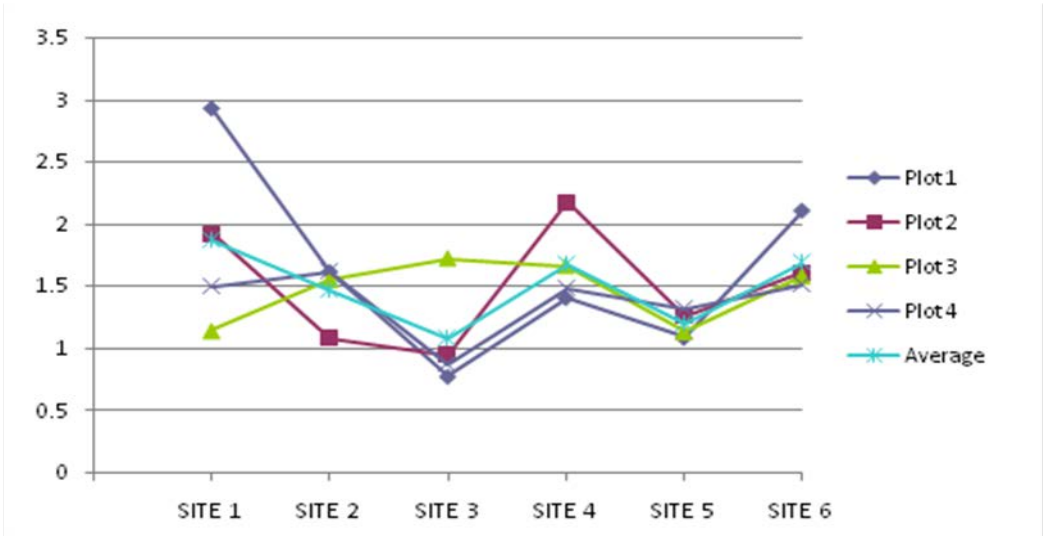


Figure 3.2.4.9. Trends in species diversity indices around Naujan Lake National Park using sweep net sampling.

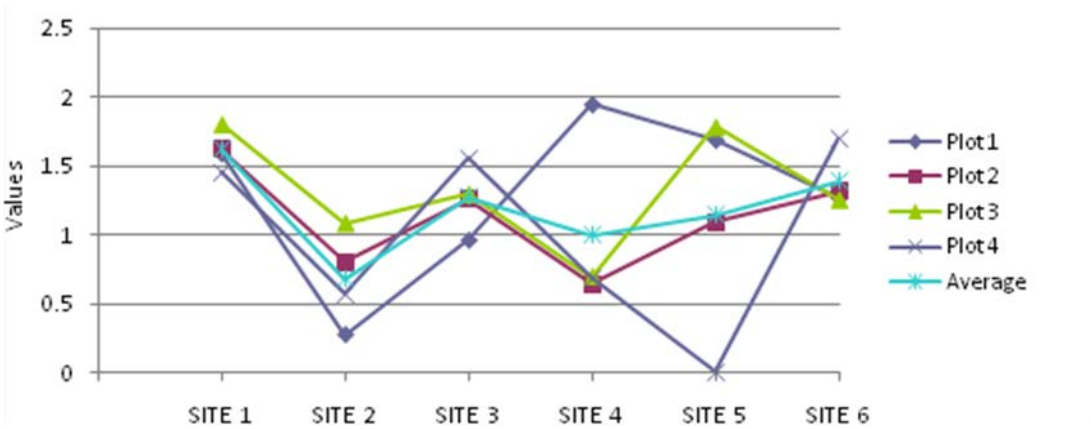


Figure 3.2.4.10. Trends in species diversity indices around Naujan Lake National Park using soil-litter sampling.

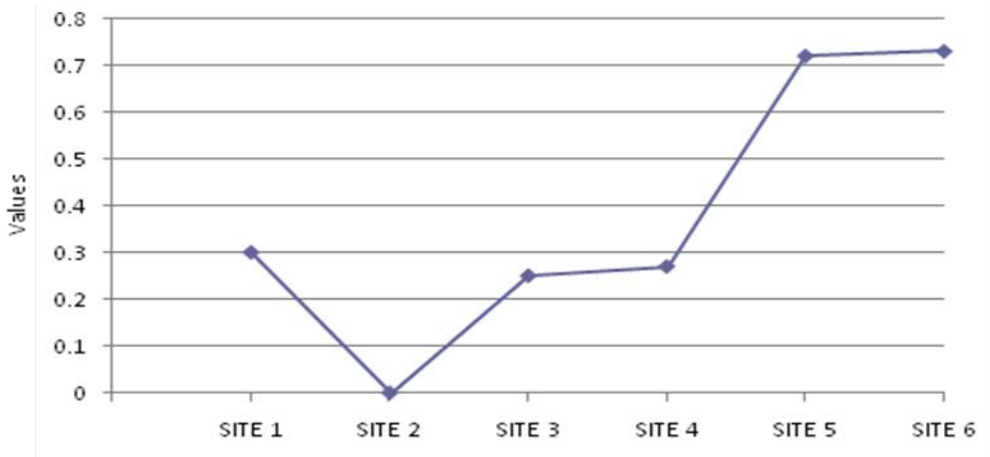


Figure 3.2.4.12. Trends in species diversity indices around Naujan Lake National Park using UV light trap sampling.

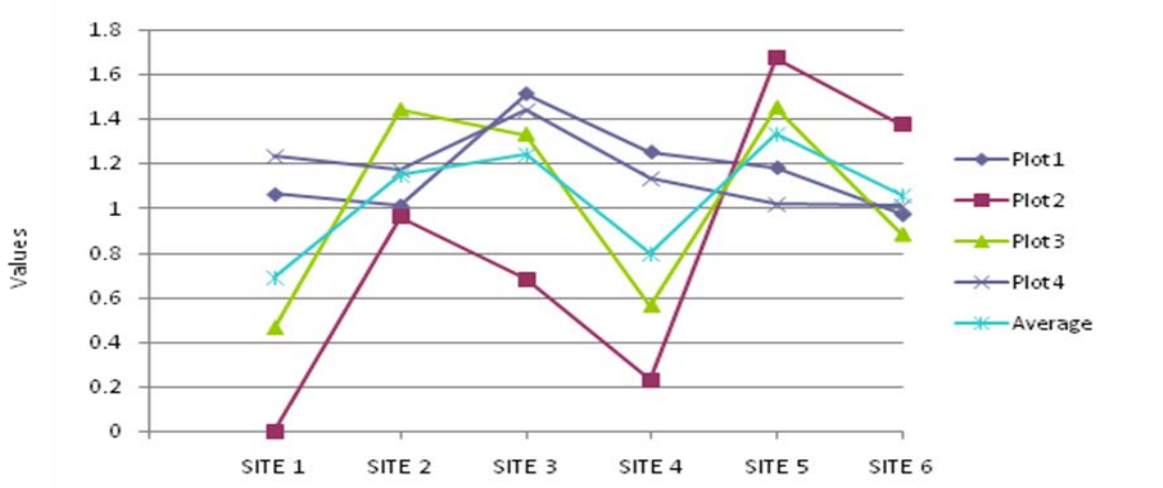


Figure 3.2.4.11. Trends in species diversity indices around Naujan Lake National Park using pitfall trap sampling.

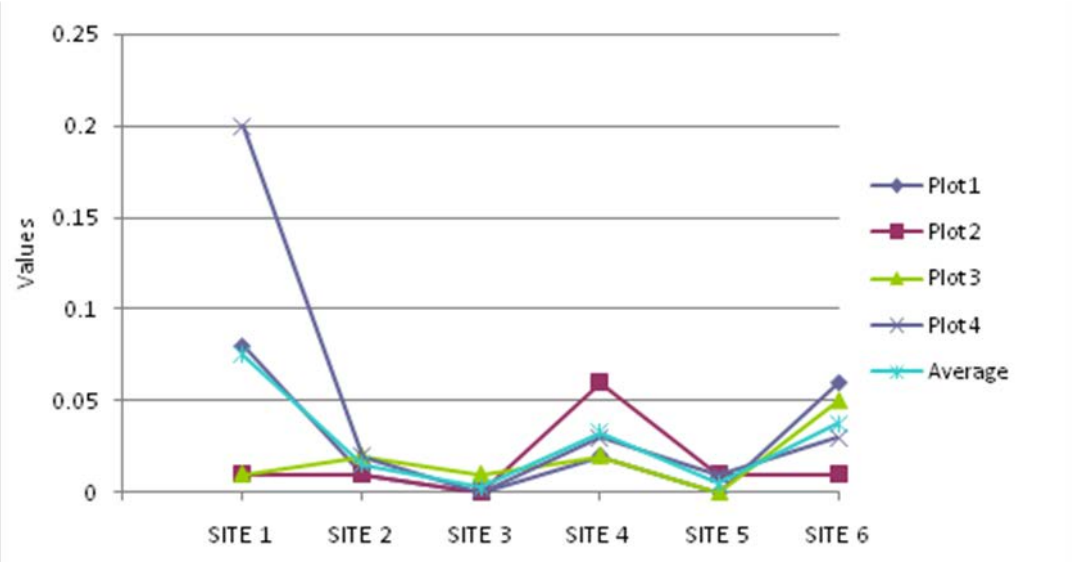


Figure 3.2.4.13. Trends in species evenness indices around Naujan Lake National Park using sweep net sampling.

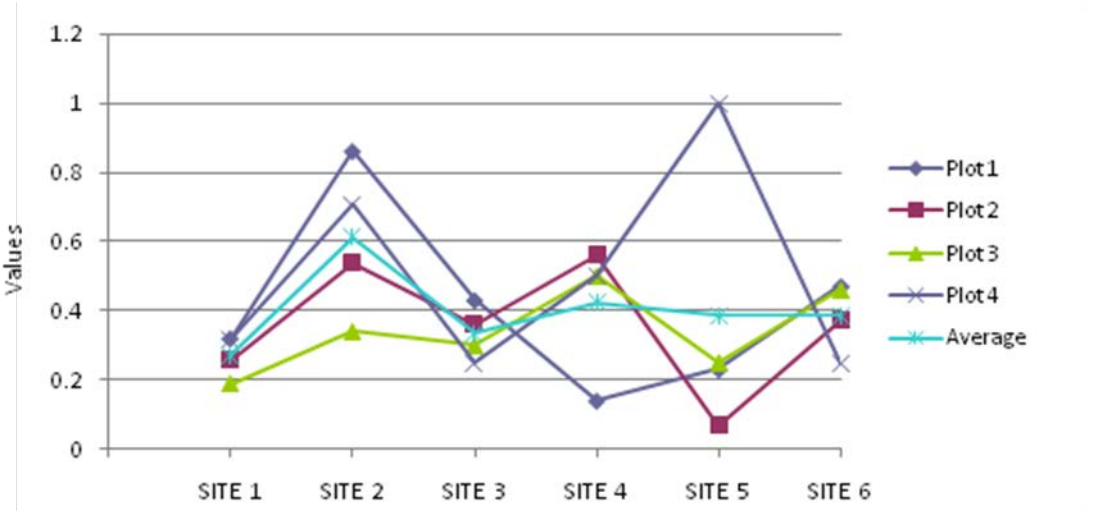


Figure 3.2.4.14. Trends in species evenness indices around Naujan Lake National Park using soil-litter sampling.

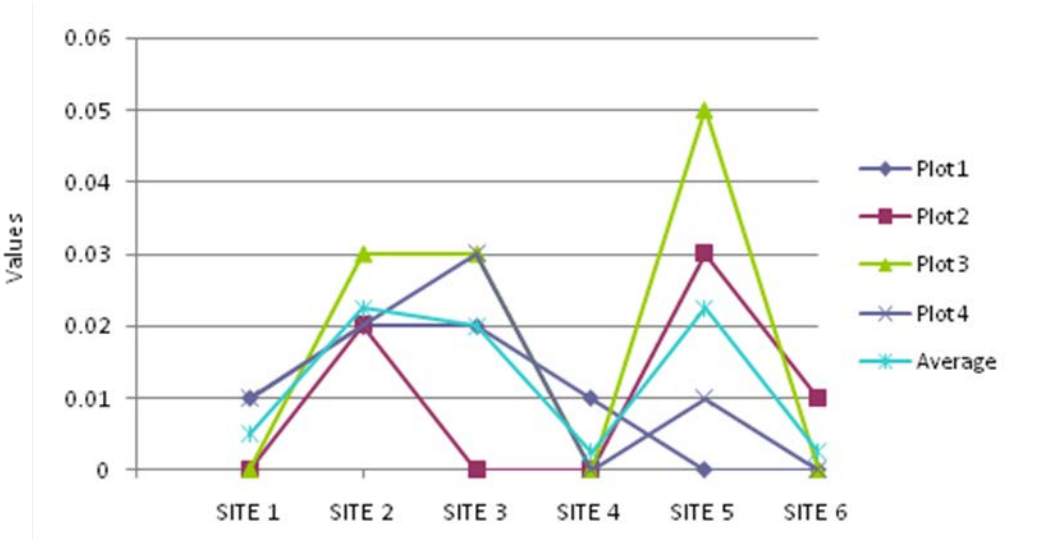


Figure 3.2.4.15. Trends in species evenness indices around Naujan Lake National Park using pitfall trap sampling.

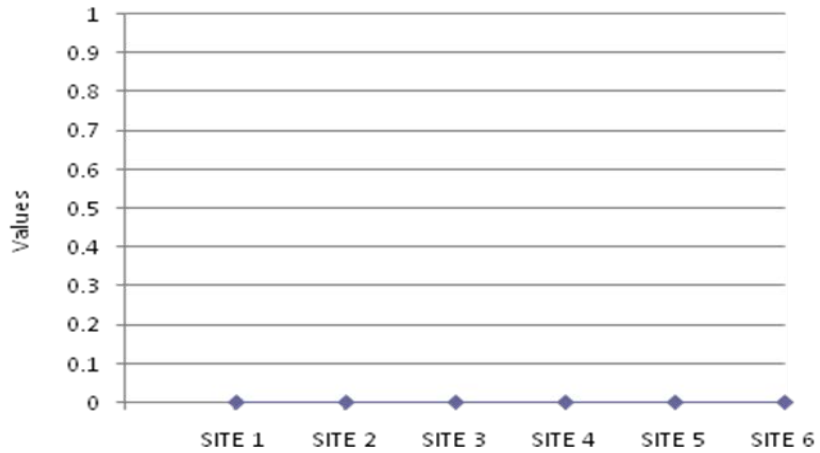


Figure 3.2.4.16. Trends in species evenness indices around Naujan Lake National Park using UV light trap sampling.

Papilio rumanzovia

Idea leuconoe

Pieris rapae

Eurema hecabe

Figure 3.2.4.17. Some butterflies found in the six sampling sites.

Table 3.2.4.4. Presence (x) or absence (0) of ant species in different sampling station around Naujan Lake National Park.

ANT SPECIES	SITE 1	SITE 2	SITE 3	SITE 4	SITE 5	SITE 6
Anoplolepis gracilipes	X	X	X	X	X	X
Crematogaster sp.	X	X	X	X	X	X
Coptosoma sp.	X	X	0	0	X	X
Dolichoderus thoracicus	X	X	X	X	X	X
Monomorium floricola	X	0	X	X	X	0
Myrmecina sp.	X	0	0	0	0	0
Odontomachus sp.	0	0	0	0	0	X
Oecophylla smaragdina	X	X	0	0	X	0
Paratrechina longicornis	X	X	0	0	0	X
Pheidole sp.	X	X	X	X	X	X

Solenopsis geminata	0	0	X	X	X	X
Tapinoma melanocephalum	X	X	X	X	X	X
Technomyrmex sp.	X	X	0	X	X	X
Tetramorium sp.	X	0	0	X	X	0

Table 3.2.5.1.1. Physico-chemical parameters for Naujan Lake near-shore stations, Oriental Mindoro, October, 2011.

	Unit	Sampling Sites / Stations						
		Singulan (NL-1)	Subaan (NL-2)	Tagbakin (NL-3)	Taybungan (NL-4)	Butas(NL-5)	Malayas (NL-6)	Taybungan Falls (NL-7)
Light Intensity	lux	0.80	0.70	0.70	1.30	1.20	1.70	ND
Temperature	°C	30	30	30	32	32	32	29
pH		8.3	8.0	8.2	8.0	8.0	8.1	8.2
Salinity	ppt	0	0	0	0	0	0	ND
Dissolved Oxygen	mg/L	6.5	8.5	7.6	8.3	7.7	7.4	8.7
Turbidity	NTU	5	56	13	11	3	27	7
Total phosphorus	mg/L	0.051	0.109	0.076	0.171	0.034	0.098	0.172
Total nitrates	mg/L	0.123	0.152	0.098	0.101	0.087	0.130	0.102
Iron	ppm	ND	ND	ND	ND	ND	ND	0.85
BOD (5 days 20°C)	mg/L	3.09	5.07	4.08	4.33	3.96	3.84	2.10

Note : Turbidity, Total Phosphorus, Total Nitrates and BOD5 were analyzed by the Analytical Service Laboratory of the Institute of Chemistry, University of the Philippines Los Baños Iron was analyzed by the Central Analytical Services Laboratory of the National Institute of Molecular Biology and Biotechnology, University of the Philippines Los Baños Limit of detection (LOD) for total phosphorus and nitrate is 0.012 and 0.004 mg/mL, respectively Depth, Light Intensity, Temperature, pH, Salinity and Dissolved Oxygen were analyzed *in situ* or immediately after samples were collected ND – not detected

Table 3.2.5.2.1. Total Coliform, Fecal Coliform and Heterotrophic Bacterial Counts of Lake Water from Near-shore Stations of Naujan Lake, Oriental Mindoro, 2011.

Sampling Code	Sampling Sites/Stations	Total Heterotrophic Count (CFU/mL x 10_3)	Total Coliform MPN/100 mL	Total Fecal Coliform MPN/100 mL	Bacteria Present
NL1	Singulan	68.30	≥2400	350	*Escherichia coli* *Enterobacter* sp. *Pseudomonas aeruginosa*
NL2	Subaan	25.50	540	33	*Escherichia coli* *Enterobacter* sp.
NL3	Tagbakin	8.50	1600	170	*Escherichia coli* *Pseudomonas aeruginosa*
NL4	Taybungan	85.00	540	26	*Escherichia coli*

NL5	Butas	34.00	220	17	*Shigella* sp. *Pseudomonas aeruginosa* *Escherichia coli* *Alcaligenes faecalis* *Pseudomonas aeruginosa*
NL6	Malayas	32.70	350	21	*Shigella* sp. *Escherichia coli* *Pseudomonas aeruginosa*

Table 3.2.5.3.1. Average phytoplankton density (units/m^3 x10^3) of lake water sampling stations in Naujan Lake, Oriental Mindoro, October, 2011.

Class/Genus	Stations							TOTAL
	Singulan (NL-1)	Subaan (NL-2)	Tagbakin (NL-3)	Taybungan (NL-4)	Butas (NL-5)	Malayas (NL-6)	Taybungan Falls (NL-1)	
Cyanophyceae								
Anabaena	-	-	6800	800	400	3600	-	11600
Agmenellum	400	400	-	-	-	-	-	800
Anacystis	-	-	400	-	-	-	-	400
Chlorophyceae								
Ankistrodesmus	1200	1600	-	400	1200	1600	2400	8400
Botryococcus	-	-	-	4400	-	1200	-	5600
Oedogonium	-	400	400	-	274000	11200	-	286000
Oocystis	-	-	-	400	800	1200	-	2400
Pediastrum	-	-	-	-	800	-	-	800
Phytoconis	1200	-	-	-	3600	400	-	5200
Scendesmus	-	-	2000	-	400	-	-	7600
Sphaerocystis	-	-	400	-	-	800	400	1600
Tetraedron	-	-	400	800	-	-	400	1600
Tetraspora	-	-	-	-	-	-	800	800
Ulothrix	4000	6800	-	1600	36400	41200	23200	113200
Chrysophycophyceae								
Diatoma	-	-	-	400	-	800	-	1200
Fragillaria	-	-	-	-	-	400	400	800
Stephanodiscus	-	-	400	-	-	-	-	400
Surirella	-	-	4000	-	-	800	1200	6000
Synedra	800	800	-	-	-	-	-	1600
Tabellaria	-	-	1200	1200	-	-		2400
TOTAL	7600	10000	16000	10000	317600	61200	28800	

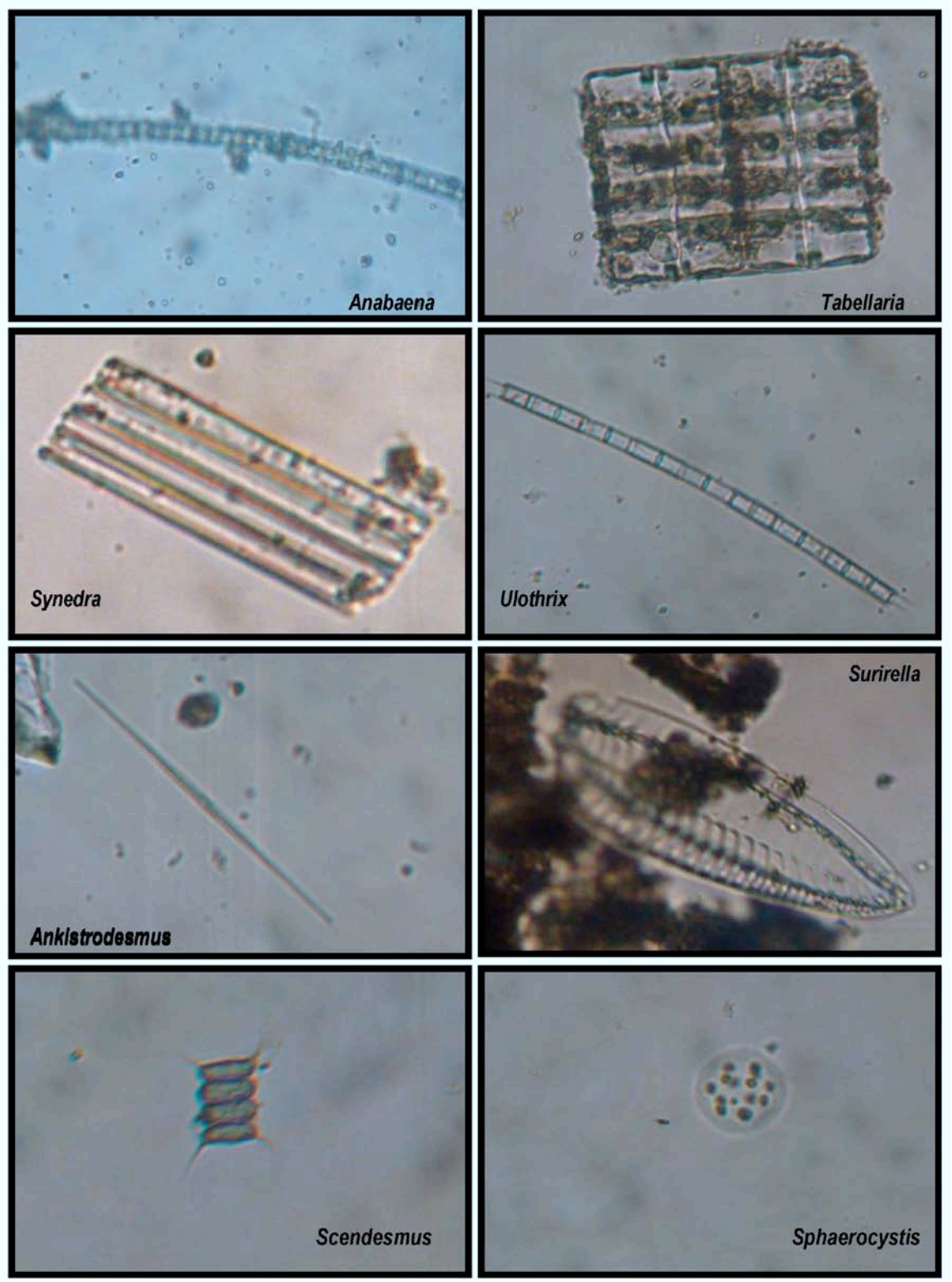


Figure 3.2.5.3.1. Photograph of Phytoplanktons of Lake Water, Naujan Lake (NL), Oriental Mindoro, October, 2011. (Photo credits by MP De Leon, 2011)

Table 3.3.1.1. NLNP barangay population by gender and growth rate, 2000- 2007.
Source: NSO 2007 Census of Population

Municipality	Barangay	Population, 2007 (% distribution)	Male	(%)	Female	(%)	Growth Rate (%) 2000 (population in '000*)	2007
Oriental Mindoro		735,769 (100)					2.46 (667)	1.06
Naujan		90,629 (12.32)					2.22 (79.4)	1.07
	Montelago	1,863	968	52	895	48		
	Bayani	1,941	1,008	51.9	933	48.1		
	Laguna	1,343	702	52.3	641	47.7		
	Dao	1,103	592	53.7	511	46.3		
	San Pedro	1,016	523	51.5	493	48.5		
Total	5 barangays	7,266 (.99)	3,793	52.2	3,473	47.8		
Victoria		32,635 (4.4)					3.92 (37)	0.65
	Merit	629	354	56.3	275	43.7		
	Bambanin	1,022	498	48.7	524	51.3		
	Duongan	1,138	608	53.4	530	46.6		
	Malabo	1,902	1,016	53.4	886	46.6		
	Urdaneta	1,366	743	54.4	623	45.6		
	San Narciso	1,305	696	53.3	609	46.7		
	Pakyas	1,800	935	51.9	865	48.1		
	Leido	1,457	755	51.8	702	48.2		
	Canaan	800	389	48.6	411	51.4		
Total	9 barangays	11,419 (1.55)	5,994	52.5	5,425	47.5		
Socorro		38,052 (5.18)					1.81 (39.2)	0.32
	Pasi I	817	422	51.7	395	48.3		
	Pasi II	965	508	52.6	457	47.4		
	Happy Valley	847	422	49.8	425	50.2		
	Batong Dalig	961	475	49.4	486	50.57		
	Lapog	1,792	923	3	869	48.5		
	Mabuhay I	941	507	51.5	434	46.12		
	Mabuhay II	1,867	982	53.8	885	47.4		
	Subaan	2,096	1,065	8	1,031	49.2		
				52.6				
				50.8				
Total	8 barangays	10,286 (1.4)	5,304	51.6	4,982	48.4		
Pola		42,932 (5.83)					1.97 (31.7)	0.30
	Tagbakin	1,554	803	51.7	751	48.3		
	Matula Tula	3,004	1,581	52.6	1,423	47.4		
Total	2 barangays	4,558 (.62)	2,384	52.3	2,174	47.7		
Overall Total	24 barangays	33,529 (4.55)	17,47 5	52.1	16,054	47.9		

Table 3.3.1.2. Comparative population density of provincial, municipal, and NLNP barangays.

AREA	LAND AREA IN HECTARES	POPULATION (2007)	DENSITY - 2007 (PERSONS/HECTARE)	DENSITY - 2007 (PERSONS/SQ KM)
Oriental Mindoro	*436,472.00*	*735,769*	*1.69*	*168.57*
Naujan	*52,800.00*	*90,629*	*1.72*	*171.65*
Montelago	712.65	1,863	2.61	261.29
Bayani	292.17	1,941	6.64	664.72
Laguna	772.69	1,343	1.74	173.74
Dao	422.28	1,103	2.61	261.37
San Pedro	582.75	1,016	1.74	174.27
Total (5 barangays)	2782.54	7266	2.61	261
Percent of total to municipal total	5.27	8.02	-	-
Average	556.508	1453.2	3.07	307
Victoria	*28,600.00*	*32,635*	*1.50*	*150.11*
Merit	346.00	629	1.82	181.79
Bambanin	546.00	1,022	1.87	187.18
Duongan	2,361.00	1,138	0.48	48.20
Malabo	487.00	1,902	3.91	390.55
Urdaneta	649.00	1,366	2.10	210.48
San Narciso	870.00	1,305	1.50	150.00
Pakyas	599.00	1,800	3.01	300.50
Leido	1,071.00	1,457	1.36	136.04
Canaan	135.00	800	5.93	592.59
Total (9 barangays)	7064	11419	1.62	162
Percent of total to municipal total	24.7	34.99	-	-
Average	784.89	1268.78	2.44	244
Socorro	*14,940.00*	*38,052*	*2.54*	*254.47*
Pasi I	273.78	817	2.99	299.27
Pasi II	100.44	965	9.65	965.00
Happy Valley	1,593.19	847	0.53	53.17
BatongDalig	238.03	961	4.04	403.78
Lapog	520.26	1,792	3.45	344.62
Mabuhay I	708.72	941	1.33	132.91
Mabuhay II	677.13	1,867	2.76	275.78
Subaan	854.85	2,096	2.45	245.15
Total (8 barangays)	4966.40	10,286	2.07	207
Percent of total to municipal	33.24	27.03	-	-

total				
Average	620.80	1285.75	3.40	340
Pola	*13,020.00*	*42,932*	*2.51*	*250.65*
Tagbakin	670.75	1,554	2.32	231.68
Matula Tula	1,226.73	3,004	2.45	244.82
Total (2 barangays)	1897.48	4558	2.40	240
Percent of total to municipal total	14.57	10.62	-	-
Average	948.74	2279	2.385	238
Overall total (24 barangays)	16710.42	33,529	2.0	200

Source: Adapted from NSO 2007 Census of Population

Table 3.3.1.3. Age distribution of NLNP population by gender.

AGE GROUP	POPULATION		TOTAL	Percentage (%)
	MALE	FEMALE		
0 – 4	2,524	2,481	5,005	14.93
5 – 9	2,516	2,467	4,983	14.86
10 – 14	2,583	2,405	4,988	14.88
15 – 19	1,852	1,428	3,280	9.78
20 – 24	1,125	1,020	2,145	6.4
25–29	1,244	1,043	2,287	6.82
30 – 34	1,129	949	2,078	6.2
35 – 39	1,071	884	1,955	5.83
40 – 44	885	769	1,654	4.93
45 – 49	760	726	1,486	4.43
50 – 54	609	565	1,174	3.5
55 – 59	448	415	863	2.57
60 – 64	303	302	605	1.8
65 – 69	186	200	386	1.15
70 – 74	132	188	320	0.95
75 – 79	70	107	177	0.54
80 and over	38	105	143	0.43
Total	17,475	16,054	33,529	100

Source: NSO, 2007

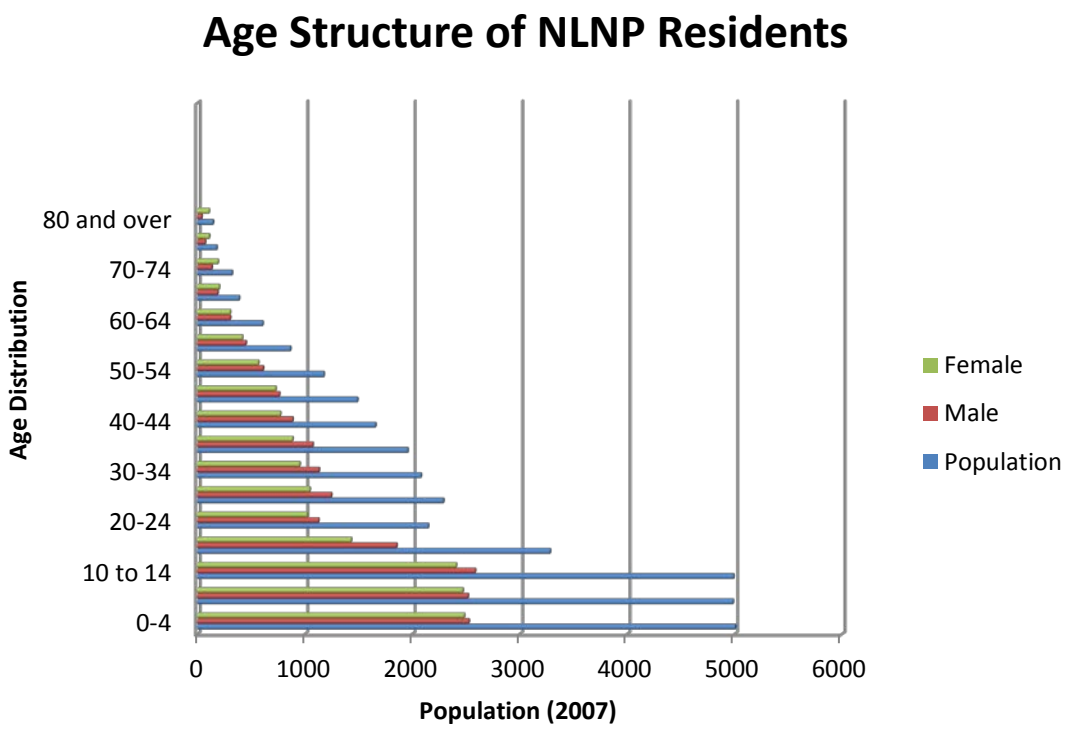


Figure 3.3.1.2. Age structure of NLNP residents.

Table 3.3.1.4. NLNP household population by barangay.

BARANGAY	POPULATION	NUMBER OF HOUSEHOLDS	ESTIMATED NUMBER OF FAMILY MEMBERS/HOUSEHOLD
Matula Tula	3004	714	4
Subaan	2096	479	4
Bayani	1941	383	5
Malabo	1902	313	-
Mabuhay II	1867	364	4
Montelago	1863	393	4
Pakyas	1800	459	-
Lapog	1792	383	4
Tagbakin	1554	300	4
Leido	1457	358	-
Urdaneta	1366	298	-
Laguna	1343	294	4
San Narciso	1305	328	-
Duongan	1138	232	-
Dao	1103	250	4
Bambanin	1022	266	-
San Pedro	1016	229	5
Pasi II	965	224	4
BatongDalig	961	191	5
Mabuhay I	941	209	4
Happy Valley	847	197	5

Pasi I	817	196	4
Canaan	800	174	-
Merit	629	133	-
Total	33529	7361	4 - 5

Source: CBMS, 2008

Within the municipality – migrants originating from the Municipalities of Naujan, Pola, Socorro, and Victoria

Within the province – migrants originating from the Province of Oriental Mindoro

Within the Island – migrants originating from the Provinces of Oriental and Occidental Provinces

Within the Region – migrants originating from Region IV-B or MIMAROPA

From other places – migrants coming from the other parts of the Philippines

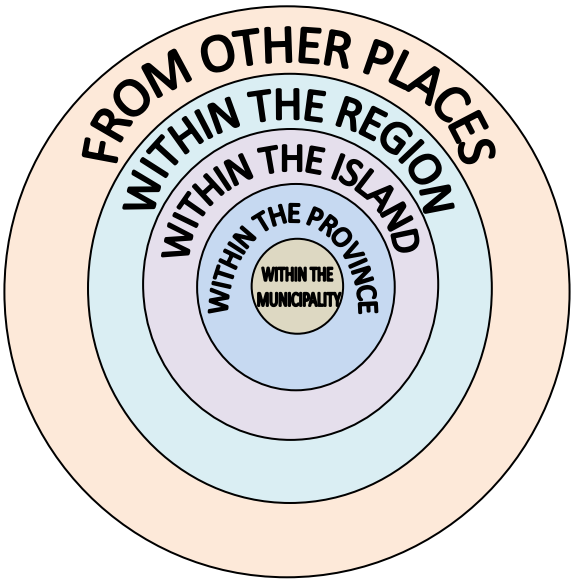


Figure 3.3.1.3. Migration pattern of NLNP respondents.

Table 3.3.1.5. Origin of migrants of the NLNP.

PLACE OF ORIGIN	FREQUENCY	PERCENTAGE (%)
Within the same municipality	187	56.7
Within the same province	52	15.8
Within the island	10	3.0
Within the region	6	1.8
From other places	75	22.7
Total	330	100

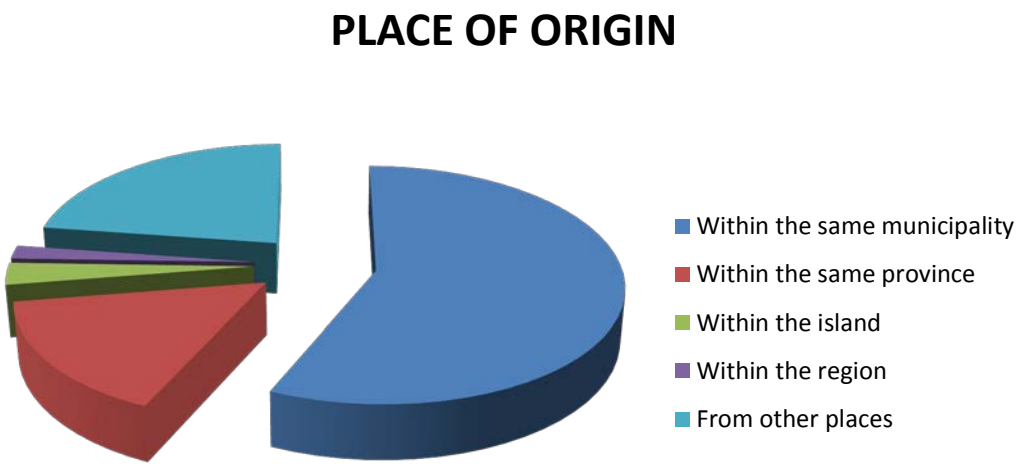


Figure 3.3.1.4. Origin of migrants of the NLNP

Table 3.3.1.6. Previous residence of NLNP respondents.

PREVIOUS RESIDENCE	FREQUENCY	PERCENTAGE (%)
Within the same municipality	20	6.1
Within the same province	41	12.4
Within the island	9	2.7
Within the region	4	1.2
From other places	96	29.1
Did not have a previous residence	160	48.5
Total	330	100

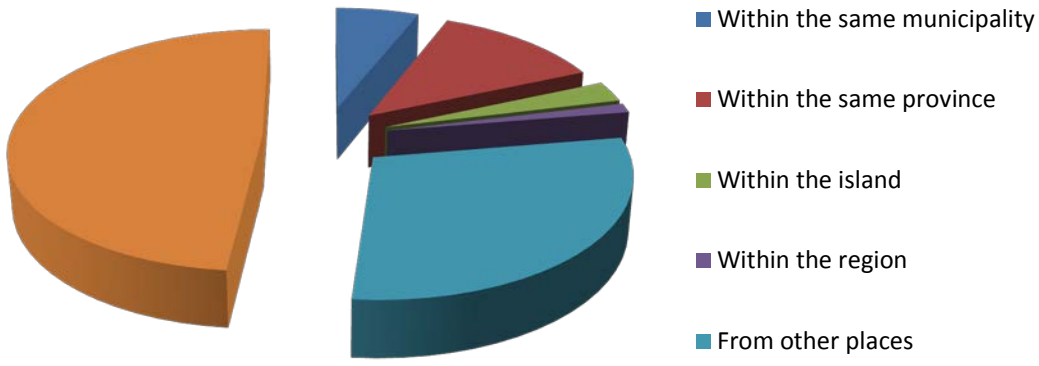


Figure 3.3.1.5. Previous residence of the NLNP residents

Table 3.3.1.7. Year of migration of NLNP residents.

YEAR OF MIGRATION	FREQUENCY	PERCENTAGE (%)
Present year (2011)	9	2.7
2-5 years ago	20	6.1
6-10 years ago	24	7.3
≥ 11 years ago	111	33.6
Original residents/did not migrate	116	50.3
Total	330	100

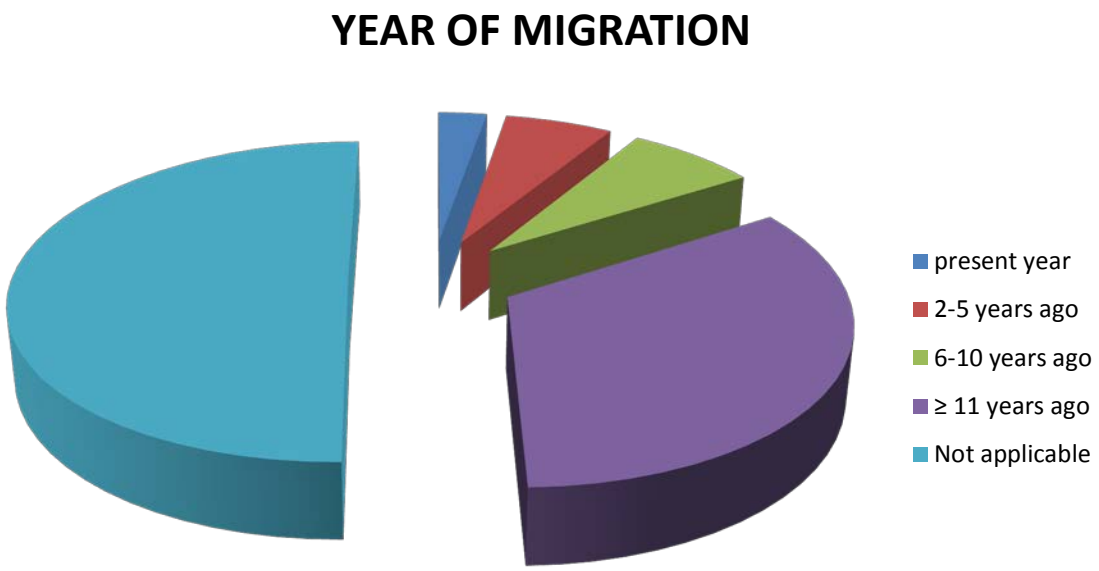


Figure 3.3.1.6. Year of migration of NLNP residents

Table 3.3.1.8. Reasons for migration of NLNP residents.

REASONS FOR MIGRATING	FREQUENCY	PERCENTAGE (%)
Socio-economic reasons	68	20.6
Family Decision	43	13.1
Land Availability	9	2.7
Marriage or family-related	48	14.5
Original residents/did not migrate	162	49.1
Total	330	100

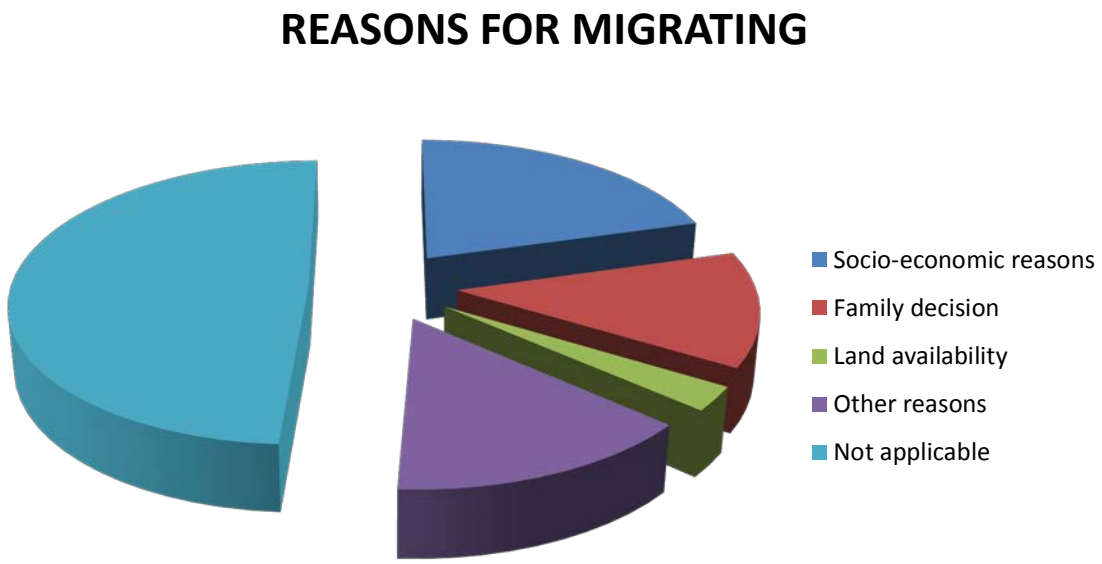


Figure 3.3.1.7. Reasons for migration of NLNP residents.

Table 3.3.1.9. Manner of migration of NLNP respondents

MANNER OF MIGRATION	FREQUENCY	PERCENTAGE (%)
Went ahead of the family	19	5.8
With family	115	34.8
With another family	1	0.3
With several families	1	0.3
Marriage or family-related	27	8.2
Original residents/did not migrate	167	50.6
Total	330	100

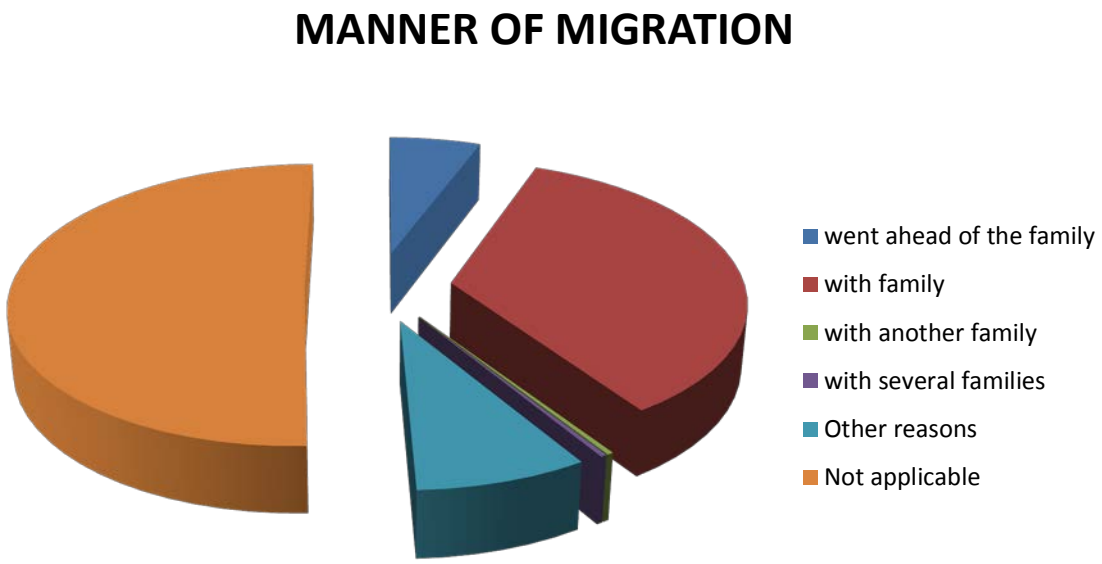
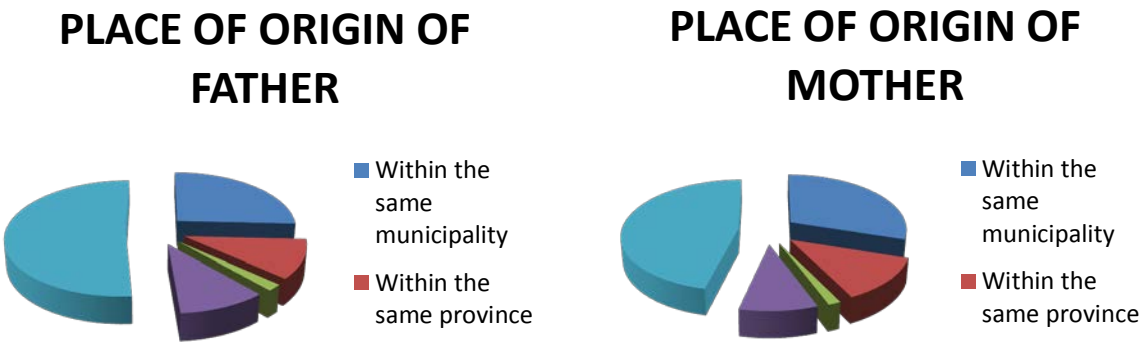


Figure 3.3.1.8. Manner of migration of NLNP respondents.

Table 3.3.1.10. Place of origin of parents of NLNP respondents.

PLACE OF ORIGIN OF FATHER	FREQUENCY		PERCENTAGE (%)	
	FATHER	MOTHER	FATHER	MOTHER
Within the same municipality	85	99	25.8	30
Within the same province	36	42	10.9	12.7
Within the island	6	5	1.8	1.5
Within the region	34	31	10.3	9.4
From other places	169	153	51.2	46.4
Total	330	330	100	100



Figures 3.3.1.9 and 3.3.1.10. Place of origin of parents of the NLNP respondents

Table 3.3.1.11. Number of land parcels of NLNP respondents.

Number of land parcels	Frequency	Percentage (%)
None	185	56
one	36	41
Two	9	3
Total	330	100

Table 3.3.1.12. Size of land parcels of NLNP respondents.

Size of land parcels	Frequency	Percentage (%)
≤ 1 ha	89	27
>1-2 has	40	12
3 has	7	2
4 has	4	1
≥ 5 has	9	3
No land	181	55
Total	330	100

Table 3.3.1.13. Tenure status of land parcels of NLNP respondents.

Tenure status of land parcels	Frequency	Percentage (%)
Tenant	83	25
Lease	1	0.4
Owner	56	17
Others or not mentioned	190	57.6
Total	330	100

Table 3.3.1.14. Mangyan tribes by municipality.

Municipality	Tribes
Naujan	Alangan, Tadyawan
Pola	Tadyawan
Socorro	Tadyawan
Victoria	Alangan, Tadyawan, Hanunoo

Source: Mangyan Mission, 2009; NCIP, 2009

Table 3.3.1.15. Mangyan household by sex, 2008.

Municipality	Number of Mangyan Households		
	Total	Male	Female
Naujan	4,654	2,395	2,259
Pola	782	438	344
Socorro	1,222	646	576
Victoria	1,500	803	697
Oriental Mindoro	48,105	25,014	23,091

Source: CBMS Survey, 2008

Table 3.3.1.16. Fuel dependence of mother of the NLNP residents.

Fuel Dependent	Frequency	Percentage (%)
Yes	322	98
No	8	2
Total	330	100

Table 3.3.1.17. Uses of fuelwood of NLNP residents.

Uses of fuelwood	Frequency	Percentage (%)
Used for cooking	316	96
Used for lighting	0	0
Others (e.g. heating houses esp during the cold months)	14	4
Total	330	100

Table 3.3.1.18. Frequency of fuelwood use of NLNP residents.

Frequency of fuelwood use	Frequency	Percentage (%)
Very frequently	294	89
Frequently	3	1
Moderately	10	3
Rarely	6	2
Do not use fuelwood	17	5
Total	330	100

Table 3.3.1.19. Type of fuelwood used by NLNP residents.

Type of fuelwood used	Frequency	Percentage (%)
Wood	216	65
Bamboo	11	3
Charcoal	78	24
Others (coconut husks, leaves, etc.)	3	1
Do not use fuelwood, they use LPG, electric stove, kerosene, etc.	22	7
Total	330	100

Table 3.3.1.20. One kaing of fuelwood consumed by NLNP residents.

One kaing of fuelwood consumed	Frequency	Percentage (%)
≤ 3 days	75	23
> 4 days - 1 week	101	31
> 1 week	33	10
Do not use fuelwood	121	36
Total	330	100

Table 3.3.1.21. One sack of fuelwood (charcoal) consumed by NLNP residents.

One sack of fuelwood (charcoal)	Frequency	Percentage (%)
< one month	60	18
one month	26	8
> one month	10	3
Use wood instead of charcoal	234	71
Total	330	100

Table 3.3.1.22. Other fuel/energy sources of NLNP residents.

Other fuel/energy sources	Frequency	Percentage (%)
LPG	9	3
Electricity	106	32
Charcoal	57	17
Kerosene	23	7
LPG and electricity	9	3
No electricity /no other source of fuel	126	3
Total	330	100

Table 3.3.1.23. Fuelwood consumers of NLNP residents.

Fuelwood consumers	Frequency	Percentage (%)
Male	57	17
Female	165	50
Children	1	0.3
Both male and female	101	30.7
All three	3	1
Do not rely on fuelwood per se	3	1
Total	330	100

Table 3.3.1.24. Windy in the cooking area of NLNP residents?

Windy in the cooking area	Frequency	Percentage (%)
Yes	134	40
No	170	52
Do not rely on fuelwood per se	26	8
Total	330	100

Table 3.3.1.25. Is fuelwood used in cooking for some occasions by NLNP residents?

Is fuelwood used in cooking for some occassions?	Frequency	Percentage (%)
Yes	256	78
No	12	4
Does not cook for large occasions	62	18
Total	330	100

Table 3.3.1.26. Education facilities (SY 2010-2011)

Facilities	Provincial*	Naujan	Socorro	Victoria	Pola
Educational Districts	18	3	1	1	No available data
Public Elementary Schools	413	74	22	26	
National High Schools	69	11	3	5	
Private Elementary Schools	47	5	3	3	
Private Secondary Schools	36	2	2	4	
Public Pre-Elementary Schools	247	67	22	3	
Private Pre-Elementary Schools	45	4	4	1	
Gov't Owned Tertiary (Vocational/Technical And Colleges)	1	1	2	1	

* *Source: Oriental Mindoro Facts and Figures, 2010*

Table 3.3.1.27. Enrollment in Government Schools by Level of Education (SY 2010-2011)

Educational Level	Provincial*	Naujan	Socorro	Victoria	Pola
Pre-elementary	12,832	1,701	571	1,059	No available data
Elementary	109,487	16,763	1,788	7,672	
Secondary	42,197	9,701	1,399	3,821	

* *Source: Oriental Mindoro Facts and Figures, 2010*

Table 3.3.1.28. Performing Indicators in Public Elementary and Secondary Schools, SY 2010-2011

Performing Indicators	Province	
	Public Elementary Schools	Public Secondary Schools
Participation Rate	81.63	47.91
Cohort Survival Rate	60.68	63.44
School Leavers Rate	10.03	14.1
Graduation Rate	98.01	94.19
Completion Rate	59.60	60.27

Source: Oriental Mindoro Facts and Figures, 2010

Table 3.3.1.29. Number of social welfare services.

Municipality	No. of social worker	No. of day care worker	No. of day care center	No. of children served	No. of registered senior citizens
Naujan	2	77	77	1,862	1,266
Socorro	0	40	40	1,123	1,700
Victoria	1	40	40	920	2,461
Pola	1	32	31	866	No available data
Oriental Mindoro	26	572	564	10,397	23,565

Source: PSWDO, 2010

Table 3.3.1.30. Number and Rate of Births, Total Deaths, Infant and maternal Deaths (Provincial level)

INDICATORS	2008		2009		2010	
	No.	Rate	No.	Rate	No.	Rate
Births	16,464	22.1	16,979	19.7	16,615	18.8
Total Deaths	2,992	4.0	2,896	3.3	3,192	3.6
Infant Deaths	124	7.5	143	8.4	194	0.22
Maternal Deaths	7	0.4	9	0.5	7	0.42

Source: PHO, 2010 Annual Report

Table 3.3.1.31. Number and Rate of Births, Total Deaths, Infant and maternal Deaths (NLNP municipalities)

INDICATORS	2008		2009		2010	
	No.	Rate	No.	Rate	No.	Rate
Naujan:						
Births	1,675	36.57	3,175	68.59	1,992	42.58
Total Deaths	408	9	380	8.21	383	8.19
Infant Deaths	23	13.73	12	3.78	22	11.04
Maternal Deaths	1	59.70	1	31.50	1	50.20
Socorro:						
Births	746	19.58	644	13.71	604	12.55
Total Deaths	184	4.83	160	3.4	163	3.38
Infant Deaths	12	16.08	7	10.86	3	4.96
Maternal Deaths	0	0	0	0	0	0

Victoria: Births Total Deaths Infant Deaths Maternal Deaths	No available data					
Pola: Births Total Deaths Infant Deaths Maternal Deaths	No available date	21.8 4.1 6.8 1.3	No available data	14.8 3.5 16.7 0	No available data	17.8 2.1 2.7 1.3

Source: Municipal report

Table 3.3.1.32. Leading Causes of Morbidity.

CAUSES	Number of cases
PROVINCE* (2010):	
1. AURI (Acute Upper Respiratory Infection)	18,571
2. Pneumonia	2,914
3. Bronchitis	2,855
4. UTI (Urinary Tract Infection)	1,805
5. Hypertension	1,387
6. Masculo Skeletal Disorder	1,198
7. Diarrhea	1,301
8. Wound	1,090
9. PTB (Pulmonary Tuberculosis)	1,014
10. IDA (Iron Deficiency Anemia)	872
NAUJAN** (2009):	
1. AURI (Acute Upper Respiratory Infection)	465
2. UTI (Urinary Tract Infection)	201
3. Bronchitis	113
4. Hypertension	48
5. Wound	42
6. Acute Gastero Enteritis	29
7. Degenerative disease	26
8. Animal bite	22
9. Dermatitis/Hypersensitivity	15
10. Acute Tonsilopharingitis	14
SOCORRO** (2010):	
1. AURI (Acute Upper Respiratory Infection)	3024
2. Masculo Skeletal Disorder	718
3. IDA (Iron Deficiency Anemia)	655

4. Pneumonia	318
5. Bronchitis	245
6. Cute Viral Illness/Influenza	219
7. Hypertension	171
8. UTI (Urinary Tract Infection)	167
9. Gastritis	132
VICTORIA** (2006):	
1. Pneumonia	338
2. Diarrhea	72
3. PTB Respiratory	61
4. Disease of the Heart	45
5. Hypertension	43
6. Bronchitis /Bronchiolitis	37
7. Vital Hepatitis	35
8. Measles	12
9. Typhoid and Paratyphoid	2
POLA** (2010):	
1. AURI (Acute Upper Respiratory Infection)	1,916
2. UTI (Urinary Tract Infection)	171
3. ERTI	163
4. Pneumonia	118
5. Wound Hypertension	97
6. PTB (Pulmonary Tuberculosis)	95
7. PUD (Peptic Ulcer Disease	61
8. Acute Tonsilopharingitis	173
9. Hypertension	12

Source: *PHO, 2010 Annual Report; **Municipal report

Table 3.3.1.33. Provincial data for Infant Morbidity: Leading Causes, Number and Rate per 100,000 Population Five Year Average (2005-2009), 2010

CAUSES	2010		5 Yr. Average	
	No.	Ratio	No.	Ratio
1. AURI (Acute Upper Respiratory Infection)	2,808	318	2,572	291
2. Pneumonia	645	73	627	71
3. Bronchitis	585	66	764	87
4. Diarrhea	346	39	400	45
5. Rhinitis	254	29	180	20
6. Influenza	51	6	81	9
7. Allergy	32	4	6	1
8. Wound	29	3	49	6
9. Skin Disease	27	3	66	7
10. Asthma	22	2	51	6

Source: PHO, 2010 Annual Report

Table 3.3.1.34. Leading causes of Mortality.

Causes	Number of Cases
PROVINCE* (2010):	
1. Disease of the Heart	224
2. CVA (Cerebrovascular Accident)	205
3. Cancer	135
4. Degenerative Diseases	95
5. Bronchial Asthma	88
6. Pneumonia	84
7. COPD (Chronic Obstructive Pulmonary Disease)	82
8. PTB (Pulmonary Tuberculosis)	64
9. Severe Renal Failure	34
10. Diabetes	33
NAUJAN* (2009):	
1. Cardiovascular accident	84
2. Cancer all forms	46
3. Degenerative Diseases	45
4. COPD (Chronic Obstructive Pulmonary Disease)	31
5. AMI (Acute Myocardial Infarction (?))	25
6. Bronchial Asthma	23
7. IHD (Ischemic Heart Disease (?))	17
8. Chronic Renal Failure	15
9. Diabetes	12
10. CVD (Cardiovascular disease)	10
SOCORRO* (2010):	No available data
1. Disease of the Heart	
2. CVA (Cerebrovascular Accident)	
3. Cancer	
4. Degenerative Diseases	
5. Bronchial Asthma	
6. Pneumonia	
7. COPD (Chronic Obstructive Pulmonary Disease)	
8. PTB (Pulmonary Tuberculosis)	
9. Severe Renal Failure	
10. Diabetes	
VICTORIA* (2006):	
1. COPD (Chronic Obstructive Pulmonary Disease)	17
2. Pneumonia	15
3. Hypertension	13
4. CVA (Cerebrovascular Accident)	11
5. PTB (Pulmonary Tuberculosis)	10

6. Hypertensive CVD	5
7. Peptic ulcer	5
8. Massive blood loss	5
9. Diabetes	4
10. Congestive heart failure	4
POLA* (2010):	
1. CVD (Cardiovascular disease)	24
2. CHA (Congested Heart Failure)	10
3. Cancer	9
4. HPN	10
5. Multiorgan failure	9
6. Pneumonia	5
7. COPD (Chronic Obstructive Pulmonary Disease)	12
8. PTB (Pulmonary Tuberculosis)	6
9. Liver Cirrhosis	5
10. Diabetes	4

Source: *PHO, 2010 Annual Report; **Municipal Report

Table 3.3.1.35. INFANT MORTALITY per 100,000 Population Five Year Average (2005-2009), 2010 (Provincial level)

CAUSES	2010		5 Yr. Average	
	No.	Ratio	No.	Ratio
1. Very Severe Pneumonia	41	0.46	11	1.25
2. Bronchial Asthma	38	0.43	28	3.17
3. Heart Diseases	21	0.24	7	0.79
4. Congenital Diseases	14	0.16	8	0.91
5. Neonatal Sepsis	8	0.09	5	0.57
6. Asphyxia	7	0.08	5	0.57
7. Prematurity	7	0.08	11	1.25
8. Hydrocephalus	5	0.6	3	0.34
9. TB Meningitis	4	0.05	1	0.11
10. Sudden Infant Death	3	0.03	2	0.23

Source: PHO, 2010 Annual Report

Table 3.3.1.36. Nutritional Status.

	Province* (2010)	Naujan	Socorro	Victoria** (2006)	Pola** (2010)
Actual Estimated No. of Pre-Schoolers (PS)	120,767			9,229	311
Actual No. of PS Weighed	97,328			9,229	311
Percentage (%) Weighed	81.0			100.0	100.0
No. of Below Normal (Low)	8,570			58	282
No. of Below Normal (Very Low)	1,385			12	29
No. of Below Normal/Below	9,955			70	311

Normal Very Low					
Percentage of Below Normal/Below Normal Very Low	10.2			0.76	100.0

Source: *PHO, 2010 Annual Report; **Municipal report

Table 3.3.1.36. Barangays with Schistosomiasis cases.

Municipality	Barangays
NAUJAN	Adrialuna Bayani Concepcion Montelago Laguna Sta. Isabela San Pedro
SOCORRO	Batong Dalig Bayuin Daan Lapog Mabuhay II Matungao Pasi I Pasi II
VICTORIA	Malabo San Narciso Urdaneta Duongan San Isidro Poblacion I Poblacion II Poblacion III San Gelacio Canaan Bethel Pakas Leido
POLA	Calubasanhon Casiligan Malibago Matula-tula Tagbakin

Source: Municipal reports

Table 3.3.1.37. Occupied Housing Units by Construction Materials of the Roof and Outer Walls and Municipality: 2007

Construction Materials of the Outer Walls and Municipality	Construction Materials of the Roof				
	Wood	Cogon/Nipa/ Anahaw	Makeshift/ Salvaged/ Improvised materials	Asbestos/ others	Not reported
Oriental Mindoro					
Total	3,876	42,102	642	338	1,403
Concrete/Brick/Stone	146	714	8	33	88
Wood	1,463	5,068	33	77	60
Half Concrete/Brick/Stone and Half Wood	533	2,339	11	49	84
Galvanized Iron/Aluminum	80	97	1	1	5
Bamboo/Sawali/Cogon/Nipa	1,604	32,694	52	70	118
Asbestos	-	-	-	13	2
Glass	35	-	-	-	2
Makeshift/ Salvaged/ Improvised materials	4	302	532	6	7
Others/Not reported	11	861	2	89	1,037
No walls	-	27	3	-	-
Naujan					
Total	310	4,885	62	6	604
Concrete/Brick/Stone	19	91	2	2	26
Wood	60	504	-	1	5
Half Concrete/Brick/Stone and Half Wood	53	324	1	1	18
Galvanized Iron/Aluminum	10	22	-	-	-
Bamboo/Sawali/Cogon/Nipa	134	3,893	1	2	16
Asbestos	-	-	-	-	-
Glass	31	-	-	-	1
Makeshift/ Salvaged/ Improvised materials	1	22	57	-	1
Others/Not reported	2	26	-	-	537
No walls	-	3	7	-	-
Pola					
Total	669	2,309	6	11	27
Concrete/Brick/Stone	9	32	-	-	2
Wood	503	216	-	1	1
Half Concrete/Brick/Stone and Half Wood	77	169	-	-	4
Galvanized Iron/Aluminum	10	3	-	-	-
Bamboo/Sawali/Cogon/Nipa	69	1,879	1	-	6
Asbestos	-	-	-	-	-
Glass	1	-	-	-	-
Makeshift/ Salvaged/ Improvised materials	-	2	5	-	1
Others/Not reported	-	8	-	10	13
No walls	-	-	-	-	-
Socorro	92	1,320	44	2	45
Total	1	5	-	-	1
	36	142	7	-	4

Concrete/Brick/Stone	6	69	-	-	2
Wood	8	4	-	-	-
Half Concrete/Brick/Stone and Half Wood	40	1,074	16	2	7
Galvanized Iron/Aluminum	-	-	-	-	-
Bamboo/Sawali/Cogon/Nipa	-	-	-	-	-
Asbestos	1	12	20	-	-
Glass	-	13	-	-	31
Makeshift/ Salvaged/ Improvised materials	-	1	1	-	-
Others/Not reported					
No walls					
Victoria					
Total	626	1,918	2	2	33
Concrete/Brick/Stone	15	25	-	-	2
Wood	362	259	-	-	3
Half Concrete/Brick/Stone and Half Wood	93	96	-	1	2
Galvanized Iron/Aluminum	7	2	-	-	-
Bamboo/Sawali/Cogon/Nipa	149	1,530	1	1	1
Asbestos	-	-	-	-	-
Glass	-	-	-	-	-
Makeshift/ Salvaged/ Improvised materials	-	5	1	-	-
Others/Not reported	-	1	-	-	25
No walls	-	-	-	-	-

Source: NSO, 2007

Table 3.3.1.38. Level III Systems by Municipality.

Municipality	Water System
Naujan	Naujan Water District
Pola	Pola Water District
Socorro	Socorro Water System
Victoria	San Gabriel Water System

Source: PPDO, 2010

Table 3.3.1.39. Population by type of water facility and urbanity.

Type of Water Facility	Total	Urban	Rural
Community Water Systems - Owned	84,680	20,486	64,194
Community Water Systems – Shared	96,117	10,476	85,641
Deep Well - Owned	57,240	10,499	46,741
Deep Well - Shared	120,095	17,898	102,197
Artesan Well - Owned	52,150	5,560	46,590
Artesan Well – Shared	86,165	7,057	79,108
Dug/shallow well - owned	18,951	525	18,426
Dug/shallow well – Shared	32,196	1,143	31,053
River, stream, lake, spring bodies of water	61,264	2,007	59,257
Bottled water	4,792	1,883	2,909
Tanker truck/Peddler	59,111	21,620	37,491
Others	3,433	356	3,077
Total	676,194	99,510	576,684

Source: CBMS Survey, 2008

Table 3.3.1.40. Status of Electrification

Municipality	Barangays			House Connections	Members Approved
	Covered	Energized	%		
Naujan	70	70	100	16,569	15,229
Pola	23	23	100	4,301	4,780
Socorro	26	26	100	5,967	5,285
Victoria	32	32	100	9,151	7,840
Oriental Mindoro	426	426	100	132,611	115,174

Source: Oriental Mindoro Facts and Figures, 2010

Table 3.3.1.41. Present Sources of Power

Power Plant	Installed Capacity	Dependable Capacity	Location
1. Agrekko Rental/NPC	17 MW	17 MW	Sta. Isabel, Calapan City
2. Mid-island Power/Power One Corp.	5.5 MW	Not Operational	Sta. Isabel, Calapan City
3. Dulangan Mini-Hydro	1.6 MW	1.6 MW	Paitan, Naujan
4. Global Business Holdings	7.5 MW	5.5 MW	Papandayan, Pinamalayan

Source: Oriental Mindoro Facts and Figures, 2010

Table 3.3.1.42. Power Substations

Power Substations (ORMECO)	MVA Rating	Ownership
Naujan	5 MVA	ORMECO
Socorro – Pola	5 MVA	ORMECO
(No data on Victoria)	-	-

Source: Oriental Mindoro Facts and Figures, 2010

Table 3.3.1.43. Breakdown of actual connections

Connections	Usage
Commercial	8,805
Residential	97,000
Industrial	115
Public buildings	2,823
Street Lights	420
BAPA	1,194
Total	110,357

Table 3.3.1.44. Previous livelihood of NLNP respondents

Previous livelihood	Frequency	Percentage (%)
Farming	51	15
Fishing	8	2
Wage earner	22	7
Other jobs (overseas work, self-employment, etc.	32	10
Do not have previous jobs	217	66
Total	330	100

Table 3.3.1.45. Present livelihood of NLNP respondents.

Present livelihood	Frequency	Percentage (%)
Farming	117	35
Fishing	20	6
Wage earner	1	0.3
Buy and sell	16	5
Government employee	14	4.2
Motorcycle/tricycle driver	5	1.5
Self-employed	36	11
No job at the moment (Housewife)	84	26
Others (seasonal jobs)	37	11
Total	330	100

Table 3.3.1.46. Present income of NLNP respondents.

Present income	Frequency	Percentage (%)
Higher than the previous earnings	50	16
Lower than the previous earnings	28	8
The same	31	9
Others (not sure if there is a difference)	8	2
No previous jobs for comparison	213	65
Total	330	100

Table 3.3.1.47. Livelihood of other household members of NLNP respondents.

Livelihood of other household members	Frequency	Percentage (%)
Farming	38	11
Fishing	17	5
Wage earner	16	5
Buy and sell	3	1
Government employee	7	2
Motorcycle/tricycle driver	5	1.5
Self-employed	6	2
Others (seasonal jobs)	22	7
OFW	5	1.5
Unemployed	211	64
Total	330	100

Table 3.3.1.48. Types of annual crops grown by NLNP respondents

Types of annual crops	Frequency	Percentage (%)
Rambutan, lanzones, calamansi	2	0.6
Calamansi and banana	5	1.5
Banana, calamansi, coconut	0	0
Calamansi, lanzones, saging, coconut	3	1
Lanzones and coconut	1	0.3
Lanzones, rambutan, calamansi, sintones, mangga, santol, niyog	1	0.3
Coconut, rambutan, calamansi, saging	2	0.6
Rice and calamansi	5	1.5
Rice	94	28
Banana	1	0.3
Rice and banana	1	0.3
Lanzones , rambutan, calamansi, durian	1	0.3
Coconut and rambutan	1	0.3
Banana, lanzones, calamansi	4	1.2
Banana, coconut, calamansi, durian lanzones, sintones	1	0.3
sintones, lanzones, rambutan, banana	12	3.6
coconut	1	0.3
Banana, rambutan, lanzones	3	1
Calamansi, sintones, banana	3	1
Durian, lanzones, banana, marang, calamasi, kape, mangosteen, ubi, san fernando, balinghoy	1	0.3
For residents who do not own piece of land	188	57.3
Total	330	100

Table 3.3.1.49. Harvest allotment of NLNP respondents

Harvest goes to	Frequency	Percentage (%)
Home use	36	11
Sold in the market	26	8
Used to pay debts	6	2
All of the above	75	23
For residents who do not own piece of land	187	56
Total	330	100

Table 3.3.1.50 Types of animals raised by by NLNP respondents

Types of annual crops	Frequency	Percentage (%)
None	175	52.6
Chickens and pigs	13	4
Pigs only	37	11
Chickens, pigs, and goats	4	1
Chickens and goats	6	2
Chickens only	58	18

Carabao and goats	2	0.6
Carabao and pigs	1	0.3
Carabaos only	7	2
Goats only	6	2
Cows only	3	1
Carabao and chicken	5	1.5
Pigs and goats	3	1
Pigs, chicken, ducks	2	0.6
Pigs and ducks	1	0.3
Carabao, goat, chicken	2	0.6
Ducks	2	0.6
Cows and carabaos	1	0.3
Cows, pigs, chickens	1	0.3
Cows and goats	1	0.3
Total	330	100

Table 3.3.1.51. Types of forest products collected by NLNP respondents

Types of forest products collected	Frequency	Percentage (%)
Fuelwood (gatong na kahoy)	319	97
Bamboo	7	2
With no adjacent forest located	4	1
Total	330	100

Table 3.3.1.52. Place where forest products are collected by NLNP respondents

Place where forest products are collected	Frequency	Percentage (%)
Adjacent forest	11	4
Just around the community	315	95
Do not collect any type of forest product; respondent with no adjacent forest located	3	1
Total	330	100

Table 3.3.1.53. Threats identified by the respondents to the NLNP.

Usual practices that serve as threat to the NLNP	Frequency (N=330)	Percentage (%) total=100
1) I use of chemical fertilizers, pesticides, etc.	219	66
I don't use chemical fertilizers, pesticides, etc.	111	34
2) I use of organic fertilizers, pesticides, etc.	115	35
I don't use of organic fertilizers, pesticides, etc.	215	65
3) I do fishing	236	72
I don't do fishing	64	28
4) I wash clothes in the creek, river, or lake	200	61
I don't wash clothes in the creek, river, or lake	130	39
5) I throw garbages into the water body	88	27
I don't throw garbages into the water body	242	73
6) I ride boat in the water body	143	43

I don't ride boat in the water body	187	57
7) I take a bath in the water body	226	68
I don't take a bath in the water body	104	32
8) I dig sand from the water body	75	23
I don't dig sand from the water body	255	77
9) I think the lake or the river is used to irrigate the ricefields	156	47
I don't think the lake or the river is used to irrigate the ricefields	174	53

Table 3.3.1.54. Benefits derived from the lake of the NLNP respondents.

Benefits derived from the lake	Frequency	Percentage (%)
Food Source	211	64
Livelihood source	27	8
Tourism	0	0
Food and livelihood source	25	8
Food, livelihood source, and tourism	8	2
No benefits derived	52	16
Water used to irrigate ricefields	7	2
Total	330	100

Table 3.3.1.55. Garbage disposal of the NLNP respondents

Garbage disposal	Frequency	Percentage (%)
shallow pit	128	39
sewage depot	1	0.3
canal, creek, or river	23	7
collect by the trees near the house then burn	72	22
burning garbage (both plastics and dried leaves)	28	8.4
shallow pit and burning	64	19
collect non-biodegradables in a shallow pit and burn the rest	10	3.1
ravine/ others (dumpsite, trash can)	4	1.2
Total	330	100

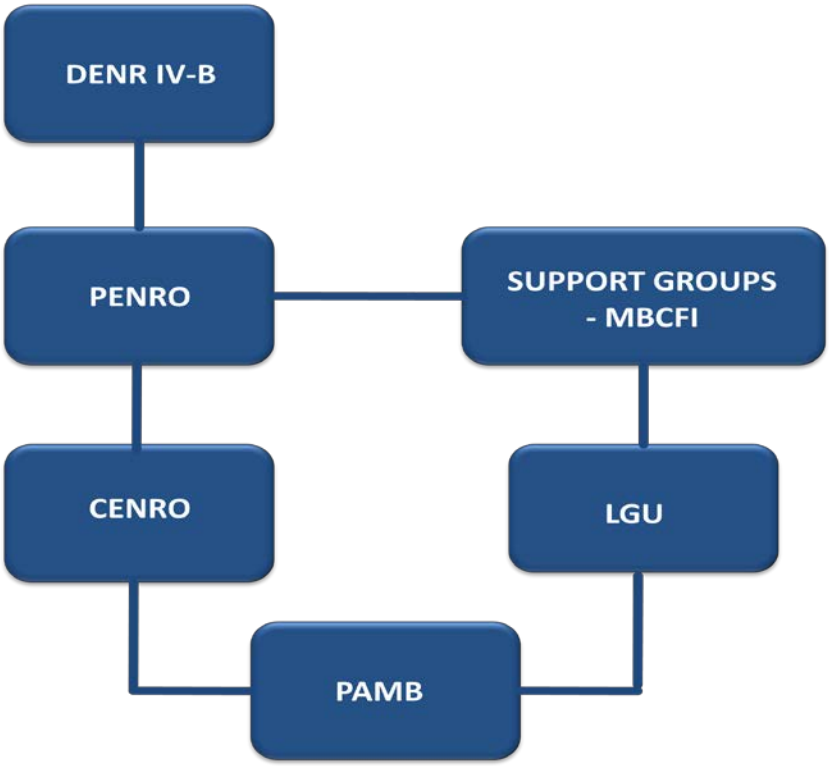


Figure 3.4.1. Current management structure of NLNP.

Table 4.1.1. Comparison of birds recorded in Naujan Lake National Park conducted by this study and Ticsay and Ledesma (1998)

Species	Common Name	1997 STUDY	2011 THIS STUDY
Family ARDEIDAE			
Ardea cinerea	Grey Heron		X
Ardea purpurea	Purple Heron	X	X
Egretta alba	Great Egret	X	X
Egretta intermedia	Intermediate Egret	X	X
Egretta garzetta	Little Egret	X	X
Bubulcus ibis	Cattle Egret	X	X
Butorides striatus	Striated Heron	X	
Ixobrychus cinnamomeus	Cinnamon Bittern	X	X
Ixobrychus sinensis	Yellow Bittern	X	X
Family ANATIDAE			
Dendrocygna arcuata	Wandering Whistling-Duck	X	X
Anas luzonica	Philippine Duck	X	X
Aythya fuligula	Tufted Duck	X	X
Family PANDIONIDAE			
Pandion haliaeetus	Osprey		X
Haliastur indus	Brahminy Kite	X	X
Accipiter virgatus	Besra		X
Spilornis holospilus	Crested Serpent-Eagle		X
Spizaetus philippensis	Philippine Hawk-Eagle		X
Family PHASIANIDAE			
Gallus gallus	Red Junglefowl		X

Family TURNICIDAE			
Turnix suscitator	Barred Buttonquail		X
Family RALLIDAE			
Gallirallus philippensis	Buff-Banded Rail		X
Gallirallus striatus	Slaty-breasted Rail		X
Gallirallus torquatus	Barred Rail		X
Rallina fasciata	Red-legged Crake	X	
Rallina eurizonoides	Slaty-legged Crake	X	
Porzana cinerea	White-browed Crake		X
Amaurornis olivacea	Plain Bush-Hen	X	X
Amaurornis phoenicurus	White-breasted Waterhen		X
Gallinula chloropus	Common Moorhen		X
Fulica atra	Eurasian Coot		X
Family CHARADRIIDAE			
Charadrius dubius	Little Ringed-Plover		X
Family STERNIDAE			
Sterna bergii	Great Crested Tern		
Sterna sumatrana	Black-naped Tern		
Chlidonias hybridus	Whiskered Tern		X
Family COLUMBIDAE			
Treron pompadora	Pompadour Green-Pigeon		X
Treron vernans	Pink-necked Green-Pigeon	X	X
Phapitreron leucotis	White-eared Brown-Dove	X	X
Ducula aenea	Green Imperial-Pigeon		
Macropygia tenuirostris	Reddish Cuckoo-Dove	X	X
Streptopelia bitorquata	Island Collared-Dove	X	X
Streptopelia tranquebarica	Red Turtle-Dove		X
Streptopelia chinensis	Spotted Dove		X
Geopelia striata	Zebra Dove	X	X
Chalcopaps indica	Common Emerald Dove	X	X
Family PSITTACIDAE			
Bolbopsittacus lunulatus	Guiabero	X	
Tanygnathus lucionensis	Blue-naped parrot	X	
Loriculus philippensis	Colasisi		X
Family CUCULIDAE			
Cacomantis merulinus	Plaintive Cuckoo		X
Cacomantis variolosus	Brush Cuckoo		X
Eudynamys scolopacea	Common Koel		X
Centropus steeri	Black-hooded Coucal		X
Centropus bengalensis	Lesser Coucal	X	X
Centropus viridis	Philippine Coucal	X	X
Family STRIGIDAE			
Ninox philippensis	Philippine Hawk-Owl	X	
Family CAPRIMULGIDAE			
Eurostopodus macrotis	Great Eared Nightjar		X
Caprimulgus affinis	Savannah Nightjar	X	X
Family APODIDAE			
Collocalia esculenta	Glossy Swiftlet	X	X
Collocalia troglodytes	Pygmy swiftlet	X	X
Apus pacificus	Fork-tailed Swift	X	
Cypsiurus balasiensis	Asian Palm Swift	X	
Hirundapus celebensis	Purple Needletail		X
Family CORACIIDAE			
Eurystomus orientalis	Dollar Bird	X	

Family ALCEDINIDAE			
Alcedo athis	Common Kingfisher		X
Alcedo cyanopecta	Indigo-banded Kingfisher	X	X
Halcyon smyrnensis	White-throated Kingfisher	X	X
Halcyon chloris	White-collared Kingfisher	X	X
Family MEROPIDAE			
Merops viridis	Blue-throated Bee-eater	X	X
Merops philippinus	Blue-tailed Bee-eater		X
Family BUCEROTIDAE			
Penelopides mindorensis	Mindoro Tarictic	X	
Family CAPITONIDAE			
Megalaima haemacephala	Coppersmith Barbet		X
Family PICIDAE			
Dendrocopus maculatus	Philippine Pygmy Woodpecker	X	X
Chrysocolaptes lucidus	Greater Flameback	X	
Dryocopus javensis	White-bellied Woodpecker		X
Family PITTIDAE			
Pitta eryrthrogaster	Red-bellied Pitta		X
Pitta sordida	Hooded Pitta		X
Family HIRUNDINIDAE			
Hirundo rustica	Barn Swallow	X	X
Hirundo tahitica	Pacific Swallow		X
Family CAMPEPHAGIDAE			
Lalage melanoleuca	Black-and-white Triller		X
Lalage nigra	Pied Triller		X
Family PYCNONOTIDAE			
Pycnonotus goiavier	Yellow-vented Bulbul	X	X
Hypsipetes philippinus	Philippine Bulbul	X	X
Family DICRURIDAE			
Dicrurus balicassius	Balicassiao	X	X
Family ORIOLIDAE			
Oriolus chinensis	Black-naped Oriole	X	X
Family CORVIDAE			
Corvus macrorhynchos	Large-billed Crow	X	X
Family PARIDAE			
Parus elegans	Elegant Tit	X	X
Family TURDIDAE			
Copsychus saularis	Oriental Magpie-Robin		X
Saxicola caprata	Pied Chat	X	X
Zoothera cinerea	Ashy-Ground Thrush		X
Family SYLVIIDAE			
Gerygone sulphurea	Golden-bellied Flyeater		X
Phylloscopus borealis	Arctic Warbler		X
Acrocephalus stentoreus	Clamorous Reed-Warbler		X
Megalurus timoriensis	Tawny Grassbird		X
Megalurus palustris	Striated Grassbird	X	X
Locustella ochotensis	Middendorf's Grasshopper Warbler		X
Cisticola exilis	Bright-capped Cisticola		X
Cisticola juncidis	Zitting Cisticola	X	X
Family MUSCICAPIDAE			
Muscicapa griseisticta	Grey-streaked Flycatcher		X
Cyornis rufigastra	Mangrove Blue Flycatcher		X
Rhipidura javanica	Pied Fantail	X	X
Hypothymis azurea	Black-naped Monarch	X	X

Family PACHYCEPHALIDAE			
Pachycephala albiventris	Green-backed Whistler		X
Family MOTACILLIDAE			
Motacilla cinerea	Grey Wagtail		X
Anthus novaeseelandiae	Richard's Pipit	X	
Family ARTAMIDAE			
Artamus leucorhynchus	White-breasted Wood-Swallow	X	
Family LANIIDAE			
Lanius schach	Long-tailed Shrike	X	X
Lanius cristatus	Brown Shrike	X	X
Family STURNIDAE			
Aplonis panayensis	Asian Glossy Starling	X	X
Sarcops calvus	Coleto	X	X
Family NECTARINIIDAE			
Nectarinia jugularis	Olive-backed Sunbird	X	X
Nectarinia sperata	Purple-throated Sunbird	X	X
Aethopyga shelleyi	Lovely Sunbird	X	X
Family DICAEIDAE			
Dicaeum bicolor	Bicolored Flowerpecker		X
Dicaeum retrocinctum	Scarlet-collared Flowerpecker		X
Dicaeum trigonostigma	Orange-bellied Flowerpecker		X
Dicaeum pygmaeum	Pygmy Flowerpecker	X	X
Family ZOSTEROPIDAE			
Zosterops meyeni	Lowland White-eye	X	
Family PLOCEIDAE			
Passer montanus	Eurasian Sparrow	X	X
Family ESTRILDIDAE			
Lonchura leucogastra	White-bellied Munia	X	X
Lonchura punctulata	Scaly-breasted Munia		X
Lonchura malacca	Chestnut Munia	X	X
Padda oryzyvora	Javan Sparrow	X	
TOTAL SPECIES		68	105
BIRD SPECIES UNIQUE TO THE STUDY		15	37

Table 4.1.2. Comparison of mammals recorded in Naujan Lake National Park conducted by this study and Ticsay and Ledesma (1998).

Species	Common Name	1997 STUDY	2011 THIS STUDY
Family PTEROPODIDAE			
Cynopterus brachyotis	Common short-nosed fruit bat	X	X
Eonycteris spelaea	Common nectar bat		X
Macroglossus minimus	Dagger-toothed flower bat	X	X
Ptenochirus jagori	Musky fruit bat	X	X
Pteropus pumilus	Little golden-mantled flying fox		X
Rousettus amplexicaudatus	Common rousette	X	X
Family RHINOLOPHIDAE			
Hipposideros bicolor	Bicolored roundleaf bat		X
Hipposideros diadema	Diadem's roundleaf bat		X
Rhinolophus arcuatus	Arcuate horseshoe bat		X

Family VESPERTILIONIDAE			
Harpiocephalus harpia	Hairy-winged bat		X
Myotis rufopictus	Orange-fingered myotis		X
Family CERCOPITHECIDAE			
Macaca fascicularis	Long-tailed macaque	X	X
Family SORICIDAE			
Suncus murinus	Asian house shrew	X	X
Family MURIDAE			
Chrotomys mindorensis	Lowland striped shrew-rat		X
Mus musculus	House mouse	X	X
Rattus argentiventer	Rice-field rat		X
Rattus exulans	Polynesian rat	X	X
Rattus norvegicus	Common brown rat		X
Rattus tanezumi	Oriental house rat		X
Family VIVERRIDAE			
Paradoxurus hermaphroditus	Palm civet	X	X
Viverra tagalunga	Malay civet	X	X
Family SUIDAE			
Sus philippensis	Philippine warty pig	X	
Family CERVIDAE			
Cervus mariannus	Philippine brown deer	X	
Family Bovidae			
Bubalus mindorensis	Tamaraw	X	
TOTAL SPECIES		13	21
MAMMALS UNIQUE TO THE STUDY		3	8

Table 4.1.3. Comparison of frogs and reptiles recorded in Naujan Lake National Park conducted by this study and Ticsay and Ledesma (1998).

Species	Common Name	1997 STUDY	2011 THIS STUDY
Family BUFONIDAE			
Rhinella marina	Giant South American Toad	X	X
Family MICROHYLIDAE			
Kaloula conjuncta	Truncate-toed Chorus Frog		X
Kaloula pulchra	Chorus Frog		X
Family DICROGLOSSIDAE			
Fejervarya cancrivora	Asian Brackish Frog		X
Fejervarya vittigera	Common Pond Frog		X
Limnonectes macrocephalus	Luzon Fanged Frog	X	X
Limnonectes woodworthi	Woodworth's Fanged Frog		X
Occidozyga laevis	Puddle Frog	X	X
Family CERATOBATRACHIDAE			
Platymantis corrugatus	Black-masked Ground Frog		X
Family RANIDAE			
Hylarana erythraea	Common Green Frog	X	X
Hylarana mangyanum			X

Family RHACOPHORIDAE			
Polypedates leucomystax	Common Tree Frog	X	X
Rhacophorous pardalis	Gliding Tree Frog		X
Family EMYDIDAE			
Coura amboinensis	Malayan Freshwater Turtle		X
Family GEKKONIDAE			
Cosymbotus platyurus	Flat-bodied house Gecko	X	X
Gehyra multilata	Tender-skinned House Gecko		X
Gekko gekko	Tokay Narrow-disked Gecko	X	X
Gekko mindorensis	Mindoro Narrow-disked Gecko		X
Hemidactylus frenatus	Common House Gecko	X	X
Family AGAMIDAE			
Bronchocela cristatella	Green Crested Lizard		X
Draco quadrasi	Quadra's Flying Lizard		X
Hydrosaurus pustulatus	Philippine Sailfin Lizard		X
Family SCINCIDAE			
Eutropis multicarinata	Two-striped Mabouya	X	X
Eutropis multifasciata	Common Mabouya	X	X
Sphenomorphus cumingi	Cuming's Sphenomorphus		X
Family VARANIDAE			
Varanus marmoratus	Monitor Lizard	X	X
Family ACROCHORDIDAE			
Acrochordus granulatus	Small Warty Snake		X
Family BOIDAE			
Python reticulatus	Reticulated Python	X	X
Family COLUBRIDAE			
Dendralaphis pictus	Common Bronze-back Snake		X
Elaphe erythrura	Common Rat Snake	X	
Lycodon aulicus	Common Wolf Snake	X	
Oligodon ancorus	Northern Short-headed Snake		X
Zaocys luzonensis	Smooth-scaled Mountain Snake		X
Family ELAPIDAE			
Calliophis calligaster	Barred Coral Snake	X	
Naja philippinensis	Philippine Common Cobra		X
Opiophagus hannah	King Cobra	X	X
TOTAL SPECIES		22	33
FROGS AND REPTILES UNIQUE TO THE STUDY		3	11

Table 4.1.4. Fishes recorded by the 1997 SEARCA Survey.

SCIENTIFIC NAME	TAXONOMIC STATUS[1]	REMARKS
*Chanos chanos**	Valid	
Anguilla sp.*	- - -	Possibly *Anguilla marmorata*
Clarias batrachus	Valid	
Liza supviridis[2](*subviridis*)*	*Liza subviridis*	Possibly *Liza macrolepis*
*Caranx ignobilis**	*Caranx ignobilis*	Possibly *Caranx sexfasciatus*
*Lutjanus argentimaculatus**	Valid	
Lutjanus sp.*	- - -	
Ophiocephalus[2] (*Ophicephalus*) *striatus*	Synonym of *Channa striata*	
Ophiocara aporos	Synonym of *Giuris margaritacea*	
Glossogobius giurus	Synonym of *Glossogobius giuris*	
Microgobius[2] (*Mirogobius*) *Lacustris*	Synonym of *Gobiopterus lacustris*	Possibly fry of *Glossogobius giuris*
Oreochromis niloticus	*Oreochromis niloticus niloticus*	
Therapon plumbeus	Synonym of *Leiopotherapon plumbeus*	
Trichogaster pectoralis	Synonym of *Trichopodus pectoralis*	

Note: *Migratory species, [1] Currently accepted name of the species based on FishBase (Froese and Pauly 2011) and Catalogue of Fishes (Eschmeyer 2011), [2]Misspelled (correct spelling).

Table 4.1.5. Water quality and microbial diversity comparison between 1997 SEARCA Survey and this survey.

Characteristics	1997	2011
Light and Temperature	24°C	26 - 32°C
pH and Salinity	7.40 – 8.50	8.0 – 8.30
Turbidity	2.0 – 42.7	3.0 – 56.0 NTM
Presence of Nitrogen	1.30 – 1.80 mg/L	0.087 – 0.152 mg/L
Presence of Phosphorus	-	0.034 – 0.172 mg/L
Dissolved Oxygen (DO)	-	6.5 – 8.7 mg/L
Biological Oxygen Demand (BDO)	5.65 mg/L	2.10 – 5.07 mg/L
Presence of Iron	-	0.85 ppm
Presence of Coliform	-	350 – 2400 MPN/100 ml
Phytoplankton density	29 genera	21 genera

Table 4.1.6. Introduced species of Naujan Lake National Park.

SCIENTIFIC NAME	YEAR OF INTRODUCTION
A. Fish	
Anabas testudineus	Introduced by Malays and Hindu pre or during the Spanish Era (Herre 1927) but possible that its geographic range includes the Philippines.
Carassius sp.	Introduced from Japan in 1964 for aquaculture (Guererro, 1997). Possibly late introduction to Naujan Lake since no record during the 1997 survey of SEARCA.
Channa striata	Introduced by Malays and Hindu pre or during the Spanish Era (Herre 1927) but possible that its geographic range includes the Philippines.
Clarias batrachus	Recorded as introduced to the Philippines from Thailand in 1972 (Guerrero 1997, Cagauan 2007) which is definitely an error since Jordan and Richardson (1910) and the 1927 survey of Herre in Naujan Lake already recorded the existence of this species in Philippine freshwaters. We, therefore, consider that the native geographic range of *C. batrachus* includes the Philippines.
Cyprinus carpio carpio	Introduced in the Philippines from Hongkong with conflicting year: 1915 (Guererro 1997) and 1910 (Cagauan 2007) but possibly late introduction to Naujan Lake since no earlier records available.
Leiopotherapon plumbeus	Philippine endemic but possibly recently introduced to Lake Naujan since it was recorded only during the 1997 SEARCA survey and confirmed by the current survey.
Oreochromis niloticus niloticus	Introduced to the Philippines from Israel in 1972 (Guererro 1997, Cagauan 2007)
Tilapia zillii	Introduced to the Philippines from Taiwan with conflicting year: 1973 (Guererro 1997) and 1978 (Cagauan 2007).
Poecilia reticulata	Introduced from Honolulu, Hawaii, USA in 1905 (Guererro 1997, Cagauan 2007) but they may be referring to *Gambusia affinis* instead which was introduced by Alvin Seale to the Philippines in 1913 (Seale 1917).
P. sphenops	No record of introduction but possible through aquarium trade.
Trichopodus pectoralis	Recorded as introduced from Thailand to the Philippines in 1938 (Conlu 1986, Guererro 1997, Cagauan 2007).
T. trichopterus	Recorded as introduced from Thailand to the Philippines in 1938 (Conlu 1986, Guererro 1997, Cagauan 2007) but already reported by Seale as *Osphronemus insulatus* in 1909 and by Herre in 1924 as *Trichogaster trichopterum* and considered it as native to the Philippines. Possible that its geographic range includes the Philippines.

B. Macroinvertebrate	
Pomacea canaliculata	Introduced in the countries in the 1980s through the private sector for aquarium industry (Cagauan 2007).

Table 4.1.7. Feeding habit of fishes collected from Naujan Lake National Park

FAMILY	SCIENTIFIC NAME	STATUS	FEEDING HABIT
Ambassidae	*Ambassis urotaenia*	Native	Detrivore
Anabantidae	*Anabas testudineus*	Introduced	Omnivore
Anguillidae	*Anguilla marmorata*	Native	Carnivore
Carangidae	*Caranx sexfasciatus*	Native	Omnivore
Chanidae	*Chanos chanos*	Native	Omnivore
Channidae	*Channa striata*	Introduced	Carnivore
Cichlidae	*Oreochromis niloticus niloticus*	Introduced	Omnivore
	Tilapia zillii	Introduced	Omnivore
Clariidae	*Clarias batrachus*	Introduced	Carnivore
Cyprinidae	*Carassius* sp.	Introduced	Detrivore
	Cyprinus carpio carpio	Introduced	Omnivore
	Puntius hemictenus	Island Endemic	Detrivore
Eleotridae	*Eleotris melanosoma*	Native	Carnivore
	Giuris margaritacea	Native	Carnivore
	Hypseleotris cyprinoides	Native	Carnivore
Gobiidae	*Awaous melanocephalus*	Native	Carnivore
	Glossogobius celebius	Native	Carnivore
	G. giuris	Native	Carnivore
	Redigobius tambujon	Native	Carnivore
	Stenogobius sp.	Native	Carnivore
Mugilidae	*Liza macrolepis*	Native	Omnivore
Osphronemidae	*Trichopodus pectoralis*	Introduced	Detrivore
	T. trichopterus	Introduced	Detrivore
Poeciliidae	*Poecilia reticulata*	Introduced	Detrivore
	P. sphenops	Introduced	Detrivore
Scatophagidae	*Scatophagus argus*	Native	Carnivore
Syngnathidae	*Microphis* sp.	Native	Detrivore
Teraponidae	*Leiopotherapon plumbeus*	Philippine Endemic but Introduced to Naujan Lake	Carnivore
	Mesopristes cancellatus	Native	Carnivore