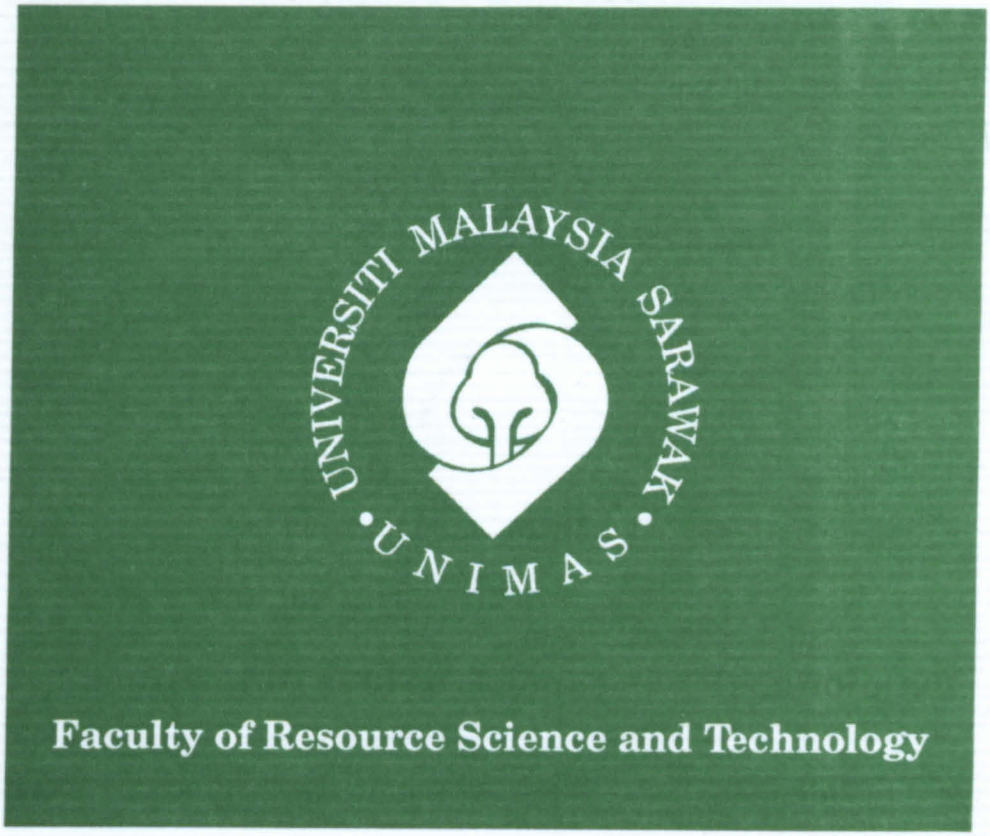

SUSTAINABLE MANAGEMENT PLANNING OF MATANG WILDLIFE CENTRE, SARAWAK

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Kota Samarahan
2001

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ABSTRACT

The management of national parks requires the appropriate management planning at varying spatial scales. This is to ensure for its maintenance or restoration of ecological integrity to achieve appropriate opportunities for appreciation, understanding and enjoyment. As part of the overall momentum towards the environmental sustainability, Matang Wildlife Centre had been selected to undergo the management planning process, thereby establishing a model framework for future wildlife centre initiatives in Sarawak. The study suggest for the establishment of Park Steering Committee comprise of related government and non government agencies and the community living near the centre to plan and manage the centre, to ensure its sustainability for the current and the future generation. The study also suggest the need for the Forest Department, Sarawak to increase their manpower to manned the centre. more effective and efficiently.

ABSTRAK

Pengurusan Taman Negara memerlukan perancangan pengurusan yang mantap dari berbagai tahap dan lapisan pengurusan. Ianya adalah untuk menjamin and membaik pulih Integriti ecology demi untuk membolehkan kita memuja, memahami dan memberikan kepuasan. Untuk mencapai hasrat ini, Pusat Hidupan Liar Matang telah dipilih sebagai lokasi kajian pembentukan proses perancangan pengurusan Pusat Hidupan Liar. Keberkesanan model dan hasil kajian di pusat ini nanti akan dilaksanakan dan di aplikasikan dipusat yang sama di seluruh negeri Sarawak. Kajian yang dijalankan mengesyorkan sebuah jawatankuasa bertindak ditubuh untuk merancang dan mengurus pusat ini

CHAPTER 1

INTRODUCTION

1.1 BACKGROUND AND RATIONALE

Maintaining the sustainability and the resilience of the parks ecosystem integrity for the present and the future generations had faced the challenge in this century. It is due to the increasing and cumulative stress from sources such as adjacent land use, downstream effects of air and water pollution, invasion by exotic species, visitor use and climate change. These stresses had resulted in irreversible degradation of park ecosystems, the loss of biodiversity and impoverishment of gene pools. Therefore, the management of national parks requires the appropriate management planning at varying spatial scales. The modern concept of national parks, basically providing large tracts of land set aside as wilderness or natural areas had been evolving in Sarawak as an effective mean of nature conservation and preservation. As part of the overall momentum towards the environmental sustainability, Matang Wildlife Centre had been selected to undergo the management planning process, thereby establishing a model framework for future wildlife centre initiatives in Sarawak.

The primary rationale of this research was to fulfill the demand for the parks management planning of Matang Wildlife Centre, setting its goal to establish and ensure that there are clearly defined directions for the maintenance or restoration of ecological integrity in order to achieve appropriate opportunities for appreciation, understanding and enjoyment. This project will identify some common and essential critical features for effective management planning of the centre.

Matang Wildlife Centre, which was officially declared opened since 1998 had become one of the popular spot for those visitors who are nature lovers and to experience the nature periodically. It is only 35 km from Kuching city and lies within Kubah National Park and occupying an area of about 179 ha. Its primary objectives of establishment was for conservation of nature and also meant to provide an area for protected and totally protected animals confiscated under the Wildlife Protection Ordinance (1998) within the state prior to their release to their free ranging natural habitat (forest). There are a number of wildlife housed in the centre, but Orang-Utan (*Pongo pygmaeus)* is the most fascinated to the visitors and tourist.

The centre also provides diverse high quality recreational experiences for local residents and visitors in a natural mountain environment. It provides arrays of recreational activities, such as nature trails for nature observation and trekking, bird watching, camping, education and research. Sungai Rayu with its clear natural water, attracts visitors, who are fond of swimming activity and picnicking.

The centre was identified to host varieties of land uses including residential neighbourhoods and infrastructural development. The infrastructure development within the centre was remarked to be progressed to meet it's needs, which includes the building of offices and information centers, staff quarters, chalets, animal clinic etc. Further infrastructural development is expected for the centre as the demands for park resources

was increased significantly. The number of animal enclosures and man power will also be increased accordingly.

The unusual nature of development , demographics, and stakeholders adjacent and within this Matang Wildlife Centre has provided distinctive context for parks management planning initiative. This project will identify and highlight some of the unique opportunities and challenges of parks management planning experiences of the centre related to the community-based ecotourism. It is of the prime aim of the project to provide and highlight park managers and decision makers with different perception towards parks management planning.

1.2 PROJECT OBJECTIVES

The objectives of the project were:

- To gather the baseline data of biological and physical characteristics of Matang Wildlife Centre
- Survey the socio-economic status of the community living adjacent to the Matang Wildlife Centre
- Proposed management strategies for inclusion into the Matang Wildlife Centre Management Planning

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

The Congress Act of 1916, which led to the establishment of the National Park Service, defined national parks, as *areas of unusual scenic beauty or natural phenomena set aside to conserve the scenery and the natural and historic object, and the wildlife therein ... to provide for the enjoyment... in such manner and by such means as will leave them unimpaired for the enjoyment of future generations (Hans & Abang Kashim, 2000).*

The lOth General Assembly of the Intemational Union for Conservation of Nature and Natural Resources (IUCN) held at New Delhi in 1969 defined a national park as follows: *A national park is a relatively large area where: 1) one or several ecosystems are not materially altered by human exploitation and occupation; 2) plant and animal species, geomorphological sites and habitats are of special scientific, educative and recreative interest or which contains a natural landscape of great beauty; 3) the highest competent authority of the country has taken steps to prevent or eliminate as soon as possible exploitation or occupation in the whole area and to enforce effectively the respect of ecological, geomorphological or aesthetic features which had led to its establishment; and 4) visitors are allowed to enter, under special conditions, for inspirational, educative, cultural and recreational purposes (IUCN, 1974).*

2.2 THE NATIONAL PARK CONCEPT

Riney (1972), states that preservation of forest land as hunting ground for the use by the wealthy, nobility and royalty as well as the protection of nature for religious and other reasons has been part of man's history through many civilizations. Such areas have been known as "parks" or "hunting grounds". Centuries ago, in eastern China, small parks were preserved for the display and propagation of hoofed animals. A site near Varanasi, India, where the gospel of Ahisma was preached by Guatama Buddha, was reserved for deer and today this is the location of the famous deer park of Sarnath (Hans & Abang Kashim, 2000). During the Middle Ages, the sovereigns and princes of western and central Europe forbade any form of hunting or lumbering in certain forest domains. Similar measures were taken by Aztec and African monarchs (Anon., 1962).

The modern concept of "national park" which originated in the United States of America was the extension and modification of the old "park" concept (Hans & Abang Kashim, 2000). The main difference is that the old park was exclusively for use by certain privileged groups of people while the modern national park is meant for public use. The concept of national park has been with the world for more than a century. It start of in 1870 at an historic campfire in the Yellowstone, U.S.A. There, the explorers who were investigating reports of the wonders of Yellowstone, decided that the area should be dedicated as a "public park or pleasure-ground for the benefit and enjoyment of the people". Two years later. a bill authorizing such use, the Yellowstone National Park Act of 1872 was passed by the United States Congress and the words national park came into official use. With the passing of the 1872 Act, the Yellowstone National Park became the world's first national park in accordance with the modern concept of national park (Hans &

Abang Kashim, 2000).

The Yellowstone National Park Act of 1872. which is sometimes referred to as the "Magna-Carta" for national parks, stipulates that the area (a large tract of undisturbed land) was to be preserved and withdrawn from settlement (Hans & Abang Kashim, 2000). The area was put under the jurisdiction of the Secretary of the Department of the Interior who, five years later, published management rules and regulations. These prohibited such activities as hunting. trapping and fishing (except for recreation and to supply food for visitors or actual residents). The sale of fish or game taken in the park to anyone outside the park was also prohibited, as well as cutting of timber without permission, removal or breaking of natural resources, the setting of unnecessary fires or leaving fires burning. No persons were allowed to reside permanently in the park and those who lived there at that time were required to vacate the area within 30 days of notice being served.

The early interpretation of the words national park was a large wild area or pleasure-ground where people could enjoy themselves. The pleasures of Yellowstone National Park were firstly curiosities of nature, including geysers and hot springs and secondly an abundance of wild game and a landscape of grasslands, lakes and forests (Darling & Eichhorn 1967). It is unlikely that the general public understood at that time that the Yellowstone National Park Act (1872) was in fact intended for the preservation of wilderness and natural areas for future generations.

The national park concept then provides for large tracts of land set aside as wilderness or natural areas (Olindo 1972). The main objective is to protect outstanding examples of the natural world for the perpetual benefit of mankind. National parks contribute to the inspiration, culture and welfare of mankind, and apart of being valuable for economic and scientific reasons. National parks are instruments for the saving of rare and threatened species of flora and fauna from extinction and act as gene-reservoirs or gene-pools (Morshidi, 1977).

The concept of national parks, since its inception over one hundred years ago, has been understood and interpreted by different people in different ways. Most agree that, the national park concept is very much inclined to the philosophy of conservation and preservation of the natural world and human survival. In the true sense, national parks are multiple-use areas where people can enjoy themselves. Thus, the basic purpose and interpretation of the concept of national park as pleasure-ground is still valid until today.

2.3 PARKS DEVELOPMENT IN SARAWAK

The national park concept was accepted in Sarawak in the early 1950s and as a result the National Parks Ordinance was passed in 1956 (Morshidi. 1977). The Ordinance was to provide for the constitution, maintenance and control of national parks in Sarawak. A Board of Trustees known as the Sarawak National Parks' Trustees was set up to control and manage the national parks. Bako National Park was the first national park in Sarawak and gazetted in 1957. With the setting up of the National Parks and Wildlife Section in the Forest Department in 1974, other potential national parks were identified and more of the new national parks were constituted. The total area of each park in Sarawak is shown in Table 1.1

Table 2.1 : National Parks established in Sarawak

Name	*Year gazetted*	*Area(ha)*
Bako National Park	1957	2728
Gunung Mulu National Paik	1974	52,866
NiahNalional Park	1974	3140
Lambir Hills National Park	1975	6952
Similajau National Park	1978	7067
Gunung Gading National Park	1983	4106
Kubah Nalional Park	1989	2230
Loagan Bunut National Park	1991	10,736
Batang Ai Nalional Park	1991	24,040
Tanjung Datu National Park	1994	1379

Source : (Hans & Abang Kashim, 2000).

In 1990, the National Parks Ordinance was amended to include a new category of land-use, namely nature reserves. Nature reserves (or equivalent reserves) are of smaller size than national parks but they are equally important for habitat protection and biological conservation. With the establishment of nature reserves, a wider spectrum of biodiversity conservation can be realised in the state. National parks and nature reserves are part of the network of Totally Protected Areas (TPAs), which also include wildlife sanctuaries. The role of TPAs and it's network is to conserve and preserve Sarawak's biodiversity apart from stabilising the climate.

In their role as a venue for ecotourism, national parks and nature reserves are of utmost economic importance to Sarawak. Ecotourism has been identified as a key in generating foreign exchange by attracting more tourists to the state. The state govemment's current tourism strategy is to promote culture, adventure and nature tourism. A great variety of landscapes, geological wonders, plant and animal life can be explored in the national parks and nature reserves. Thus, visitors are offered a spectrum of different physical and spiritual experiences as they travel through these areas.

Environment-compatible planning and management principles, based on care and professionalism, guide the development of national parks and nature reserves in Sarawak. This means that facilities and activities are not obtrusive, damaging or incompatible with the local environment.

Wildlife conservation in Sarawak is not restricted to protected areas, but is being implemented throughout the State. To facilitate this. "A Master Plan for Wildlife in Sarawak" was prepared by the Wildlife Conservation Society and Sarawak Forest Department (1996) and was approved for implementation by the State Government in early 1997, thereby making it as an official policy. It is a comprehensive policy document covering all aspects of wildlife conservation and management and placing Sarawak as the

first in the world to have prepared such a plan. Highlights in the initial implementation of the Master Plan include dissemination of information, initiation of training programmes, steps to control hunting, that includes the strict enforcement of regulations on issuing of shotgun cartridges, and full-scale application of the Plan in a large concession of production forest which serves as a test area (Bennett *et al.*, 1997).

2.4 PARKS MANAGEMENT PLANNING PROCESS

Thorsell (1984) defined management plan as a document that guides and controls the management of the protected area resources, the uses of the area, and the development of facilities needed to support that management and use. Thus, a management plan is a working document to guide and facilitate all development activities and all management actions to be implemented in an area. Central to such a plan is a statement of goals and measurable objectives to guide management of the area. These goals and objectives form the framework for determining specific action to take, when it will be taken, and the budget and personnel needed to implement those actions. Thus a management plan is a valuable tool for identifying and prioritizing management needs and organizing our approach to the future.

Woodbury (1966) summarized the process of planning as "the process of preparing, in advance of action and in a reasonable systematic fashion, recommendations for policies and courses of action (with careful attention to their probable by-products, side effects or spill-over effect) to achieve accepted objectives"

Management planning must have proper setting of objectives, in order to provide direction, to aid coordination, to stimulate action and to provide measures for management control. Darling & Eichorn (1967) notify that the only absolute administrative principle (for national parks) is to consider the ecological health of a park at a priority so that it shall endure for posterity.

Mattyasorky (1974) suggested few relevant factors to be included in considering the physical and ecological character of a park as follows :

1. Size
2. Physiography, soil, geology
3. Water
4. Vegetative covering
5. Animal Life
6. Management and maintenance practices

Planning is also an interdisciplinary process and as such Dansereau (1957) summarized : "The problems of natural resources utilization can neither be posed nor solved by one discipline alone. Therefore, an efficient understanding of them awaits a better communication between the natural scientist and the emergence of a larger number of men capable of encompassing both aspects (social and natural sciences) and of acting upon this unproved knowledge"

Eidsvik (1978) has outlined the process and checklist of parks management planning as follows :

I. **Management Responsibility**
- Legislation
- Policy
- Objectives
- Guidelines

II. **Resource Specialist Responsibility**

Natural Resource Inventory and Analysis
- Climate
- Physical Resources
- Vegetation
- Wildlife
- Water and Wetlands
- Cultural Resources
- Planimetric and Topographic Details

Socio-Economic Inventory and Analysis
- Legal Structure of Region
- Government Authority
- Community Structure
- Population Characteristics
- Educational Levels
- Recreational Activities
- Social Organizations
- Land Ownership and Use
- Transportation Systems
- Tourism Activitives

III **Planning Team Responsibilities**

Data Analysis
- Natural Resources
- Rarity
- Representativeness
- Ecological Importance
- Scientific Importance
- Visitor Interest
- Recreational Capability

Socio-Economic
- Impact of Park on Local Population
- Impact of Local Population on the Park
- Impact of Park on Region, Nation, etc.
- Projections of Visitor Use
- Public Participation
- Information and Communication

- Infrastructure-Utilities, Access

Data Synthesis

- Review Objectives and Guidelines
- Determine Boundary Alternatives
- Test Zoning Alternatives
- Relate to Visitor Use Facilities
- Relate to Administration and Management Requirements
- Review Access and Circulation Systems
- Evaluate Impact on Environment of Alternatives
- Recommend Range of Alternatives for Public Participation
- Prepare Planning Documents for Approval

IV. Management Responsibilities

- Review and Evaluate Proposals
- Provide Written Direction Related to Approval and Funding
- Identify Responsibility for Execution
- Initiate Re-Evaluation Process

2.5 TOURISM

Maintaining the quality of the natural resource base is critical to the continued sustainability of most tourism destinations. Especially in mountain regions, the "essential spirit of place" which draws tourists and residents alike to seek such environments should not be compromised (Gill & Williams 1994). Principles of sustainable tourism have become increasingly important as tourism destinations continue to expand. Sustainable tourism identifies conventional tourism as "an eternal triangle of forces, with host communities and habitats, visitors and tourism businesses in an unstable relationship. In such situations, the growth requirements of the industry can lead to the domination of host areas by visitors and tourism businesses. The aim of Sustainable Tourism is to bring the opposing forces of the triangle into equilibrium" (Lane 1991). Inskeep (1991) defines sustainable tourism as providing a quality experience for visitors, while enhancing the quality of life of the host community and protecting the quality of the environment.

In mountain tourism environments, the quality of the natural resource base therein is being concerned and focussed in management process. The necessity for tourism management that is sensitive to natural and cultural heritage and host communities is exemplified by a growing number of sustainable tourism initiatives around the world (Hawkes & Williams 1993). Sustainable tourism is becoming more associated with education and learning, as the industry strives to meet the demands of an increasingly mature and aware visitor market (Lane 1991; Leslie 1998). Urry (1990) suggests that the primary feature of all tourism is that it involves looking at and learning about other places and people. "Holidays are not so straightforwardly contrasted with education and learning as in the past. In a wide variety of ways, much tourism is coming to be more closely interwoven with learning" (Urry 1990). For a growing number of people, vacations and recreation are perceived as chances to stimulate and not switch off the brain (Gibson 1998). The tourism industry has recently begun to acknowledge the educational, recreational and management values of interpretation. Lane (1991) explores the connection between the increasing concern for sustainable tourism management and the role of interpretation. Lane (1991)

proposes that interpretive plans be established within visitor management strategies which seek to optimise visitor enjoyment, minimise environmental damage and maximise community benefit. He further emphasise the need within the tourism industry - in relation to both visitors and managers - for education designed to promote environmental awareness and stewardship. In this way, tourism management can hope to partially address the growing need for sustainability at both local and global scales.

2.6 INTERPRETATION

Interpretation is widely recognised as a valuable tool for communicating information, fostering education, and promoting attitudinal and behavioural change towards mindfulness and stewardship (Biggs & Roth 1986; Stewart *et al.*, 1998). Interpretation is defined by Tilden (1977) as "an educational activity which aims to reveal meaning and relationships through the use of original objects, by firsthand experience and by illustrative media, rather than simply to communicate factual information". Interpretation is the translation of information into understandable terms (Wagar 1973). Interpretation should be a synthesis of education, communication, participation, provocation and inspiration. Interpretation generally includes initiatives such as visitor centers, information brochures, signs and displays, and guided activities.

Tilden (1977) proposes the following key principles for effective interprctation: Provide a personal connection; present information in understandable terms; recognise interpretation as an art of communication; provoke as well as instruct; and focus on the whole rather than parts. Interpretive initiatives commonly involve the telling of stories or emphasising themes and messages to inspire learning. It is often associated with leisure and outdoor recreational activities, interpretation is instrumental in enhancing visitor appreciation of a place (Lane 1991; Wagar 1973). Interpretation also has the potential to achieve various objectives relating to tourism and resource management such as enhancing recreational experiences, facilitating user education, and reinforcing management goals (Biggs & Roth 1986; Lane 1991; Sharpe & Gensler, 1978; Wagar 1973). Sharpe and Gensler (1978) demonstrate how interpretation is an effective tool for managing visitor behaviour. Effective interpretation can often overcome ignorance and disregard for management directives simply by explaining the reasoning behind them (Sharpe & Gensler, 1978).

Beyond these benefits, interpretation aims to stimulate, facilitate and enhance people's understanding of a place to develop compassion towards conservation (Biggs & Roth, 1986; Lane 1991; Sharpe & Gensler 1978; Stewart *et al.* 1998; Tilden, 1977). Tilden (1977) proposes that through interpretation comes knowledge, from knowledge comes understanding, from understanding comes appreciation, and from appreciation comes conservation.

The challenge for managers is to ensure that tourism and recreation are rewarding and sustainable for both hosts and guests and that the quality of the environment is maintained. Interpretation can play a critical role in creating mindfulness among residents and visitors, a necessary condition for sustainable tourism. Public education and interpretive strategies comprising part of the parks management planning initiative can encourage stewardship and mindfullness towards the local residents and visitors and contribute to sustainable parks management.

2.7 RIPARIAN AREAS

The parks management planning recognises that riparian conditions may have significant impacts on the quality of stream health. Good riparian habitat is a necessary condition for healthy streams. Studies have shown a strong correlation between the biotic integrity in streams and the proportion of stream with intact riparian forest (Miller *et al.* 1997). Some of the essential functions that natural riparian vegetation performs for streams include:

- providing stream bank stability and preventing erosion/sedimentation;
- providing large organic debris (mature growth) needed to sustain stream morphology, complexity and oxygenation;
- helping to control sediment movement within streams;
- maintaining floodplain processes;
- providing small organic debris and terrestrial insects (nutrition for fish and invertebrates);
- filtering pollutants from runoff and groundwater flows;
- providing microclimate modification (shade);
- providing cover for fish to hide from predators;
- maintaining better water depth and annual flow cycle; and
- providing more biodiversity and productivity (Millar *et al.* 1997; Schreier *et al.* 1997; Taccogna & Munro 1995; Yates 1988; Zandbergen 1998).

Recently a subject of debate within this field of inquiry is the architecture, or structure, of riparian buffers. An extensive review of the literature by Miller *et al.* (1997) describes the range of riparian buffer widths required to protect the various beneficial functions mentioned above. Riparian buffers of 10 m in width or less are shown to have very limited effects in terms of providing these beneficial functions. The standard 30 m riparian buffer, frequently used in urban development guidelines and municipal bylaws (Department of Fisheries and Oceans Canada 1994), is inadequate to attain all the benefits of a protective riparian zone. There are significant added benefits to the structure and ecology of streams with a larger riparian buffer (Millar *et al.* 1997; Zandbergen 1998). Therefore, riparian integrity is vital to the health of any stream system.

CHAPTER 3

RESEARCH METHODOLOGY

3.1 DATA COLLECTION ON THE EXISTING ENVIRONMENT

The need and the assistance from relevant authorities like the Ministry of Resources planning, Forestry Department, Drainage and Irrigation Department, Agriculture Department and District Office is highly sought for, in providing the relevant information pertaining to the study area or as required in achieving the objectives of the project. The relevant information includes, the demographic characteristics, land use pattern and the biophysical attributes of the study area.

3.2 SOCIO-ECONOMIC SURVEY

The nearest neighberhood resident to the Matang Wildlife Centre is Kampong Rayu. The Kampong was comprised of two ethnic groups mainly the Malay and Iban. Social surveys were conducted in this Kampong, basically to assess on their economic activities, demographic characteristics, education level, water and electricity supply, perceptions and needs/problems with the existing of Wildlife Center in their area and some other relevant informations.

Questionaire of self administered in nature and interviews or house to house (doors to doors) is the method deployed. Prior to the real interviews, meeting were conducted to brief and explain the purpose of the interviews. Presence in the meeting were the headmen for both the Malay and Iban community within that Kampong and Forest Department staff. The sample of the questionnaire is shown in Appendix 1.

The data gathered were then analysed manually to asses the socio economic status of the communities living adjacent to the centre and their perception towards the establishment of the Matang Wildlife Centre. The informations gathered is expected to help the managers to draw proper management planning in solving the socio problems arise.

3.3 WATER RESOURCE

The water resources of the Matang Wildlife Centre is one of the most important resource to the center. The main source of water is from Sungai Rayu, where it plays an important role to the neighberhood residents in supplying water for their daily consumptions, apart from attracting tourist who are fond of swimming activity. Therefore, to sustain such resource, the park manager had to assess the quality of such river. This would furnish the current status of Sungai Rayu and its tributaries pertaining to their water quality and the findings/result would aid the managers in recommending strategic and proper management option towards the efforts of sustaining the water resource in the center. The procedure followed/used to analyse the water resource were as follows:

3.3.1 Water Sampling

Surface water samples were collected from four rivers which irrigate the park, namely, Sg. Sendok, Sungai Rayu, Sg. Najis and Sungai Amok respectively. Due to insufficient time, each river was only sampled twice. Two sampling stations were chosen for Sg. Rayu (Station Rayu 1 and 2), one each for Sg. Sendok, Sg. Amok and Sungai Najis (Figure 1). All the rivers studied were under low and high flow condition and appeared to be stable. They are mostly of sandy bottom but occasionally with gravel bed. The width of the rivers under low flow condition range from 3-6 m wide and their depths are uneven.

3.3.2 Water Analysis

Measurements of physical water quality parameters such as pH, temperature, dissolved oxygen (DO) and conductivity were carried out *in situ*. pH was measured by a Coming portable pH meter, temperature and dissolved oxygen by a YSI oxygen meter and conductivity by Horiba conductivity meter. Chemical parameters such as nutrients (nitrate, total dissolved phosphate, Ammonical nitrogen), heavy metals and total suspended solids were analysed according to standard procedures (APHA, 1992). Pa-rameters which required to be analysed within a day after collection were brought to the Unimas laboratory, immediately after the field work.

3.4 RIPARIAN VEGETATION SURVEY

The integrity of the stream including the biotic environment has a strong correlation to the proportion of stream with intact of riparian forest (Millar et. al. 1997). Good riparian habitat is necessary condition for healthy streams. To quantify and estimate the above ground biomass and basal area of the vegetation in the study site, the following actions were undertaken.

Three plots of size 10 m x 40 m were established/set up. Each plot is located along Sungai Rayu, Sungai Sendok and Sungai Amok respectively. For each plot, it is further subdivided into four sub plot of size 10 m x 10 m. each. The exact location of the plot is shown in Figure 1.

Standard herbarium specimen collection procedures were applied, whereby each of the flowering and/or fruiting plant specimen were collected (triplicate) was tagged with a collection number in the field. Their full notes were taken, pertaining to their location, habitat and characters.

Specimens were identified to the family and genus level in the field as far as possible. For each specimen, details of it's local name, uses (if any) and potential as ornamental species (if any) were noted.

Those specimens that could not be identified in the field, will be pressed between sheets of newspaper, and preserved in methanol in the field. Such specimen were brought to the Sarawak Forest Department herbarium for further identification.

3.4.1 Data analysis

All trees with a DBH of > 10 cm were measured and enumerated, and their identities were established. The basal area and above ground biomass of all enumerated trees were estimated from diameter and height data using the following regression equations (Kato *et al.* 1978):

1. Basal Area (BA) $= 0.7857 \times D^2$, unit in cm^2, where
   D = diameter at breast height

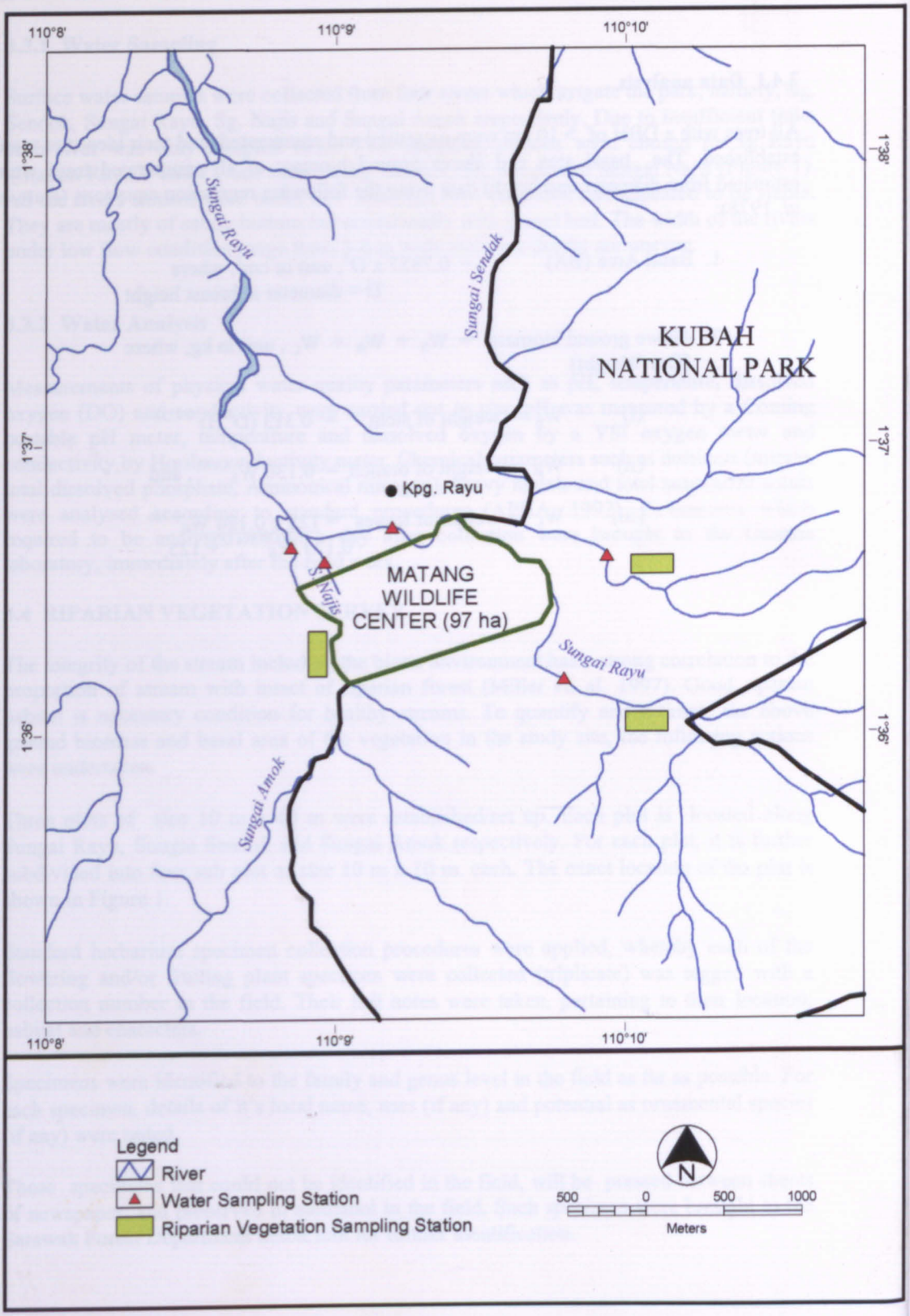
2. Above ground biomass $= W_S + W_B + W_L$, unit in kg, where
   [Dry Weight]

   (i) W_S = weight of stem $= 0.313 (D^2 H)^{0.9733}$

   (ii) W_B = weight of branch $= 0.136 W_S^{1.070}$, and

   (iii) W_L = weight of leaves $= \frac{125 \times 0.124 W_S^{0.794}}{0.124 W_S^{0.794} + 125}$

FIGURE 1 : RIVER SYSTEM OF MATANG WILDLIFE CENTRE



CHAPTER 4

RESULTS AND DISCUSSION

4.1 SOCIO-ECONOMIC STATUS

4.1.1 Introduction

Kampung Rayu is located adjacent and a just few minutes walk from the Matang Wildlife Centre. The Kampung, comprises of two ethnics groups namely the Malay and the Iban. It is resemblance to other kampung in Malaysia at local level, where it is headed by the headman known as Tuai Rumah for the Iban and Penghulu or Ketua Kaum for the Malays. The village activities mainly run by the Village Development and Security Committee or Jawatankuasa Keselamatan Kampung. The Iban group in this Kampung is staying in their typical traditional long house comprising of 66 doors, whereas the Malays stay in their individual house. The religion of the communities are mainly Christians and Muslim.

4.1.2 Demographic Characteristics

4.1.2.1 Age

Table 4.1 : Age Distribution of community of Kampung Rayu

Age Range (Yrs)	Frequency	Percent (%)
19 - 35	17	33.3
36 - 55	23	45.1
55 - 85	11	21.6
Total	**51**	**100.0**

From the survey conducted as reflected in Table 4.1 the community of Kampung Rayu widely represented by the population at the age range of 36 to 55 years. The gender ratio is 57% male : 43% female. The male out numbered the female probably due to the nearness of the longhouse to the city, which provides more job opportunities for women, especially at the nearby industries. About 80 % of the population were within the economically active group of age 19 – 55 years.

4.1.2.2 Race

Table 4.2 : Race

Race	Frequency	Percent (%)
Iban	36	70.6
Malay	10	19.6
Chinese	4	7.8
Others	1	2.0
Total	**51**	**100.0**

It is highlighted in Table 4.2 that, most of the population were dominated by the Iban, comprising of 70.6 %, followed by the Malay 19.6 % and Chinese 7.8 %. The area was originally colonised by the Malays. It denotes that the mobility of the Iban is quite fast to the area knowing very well that they are more adventurous.

4.1.2.3 Educational level

Table 4.3 : Educational level

Level	Frequency	Percent (%)
No formal Education	23	45.1
UPSR	15	29.4
PMR/SRP/LCE	7	13.7
SPM/SPMV	5	9.8
Others	1	2
Total	**51**	**100**

- PMR – Penilaian Menengah Rendah
- SRP – Sijil Rendah Pelajaran
- LCE – Lower Certificate Education
- SPM – Sijil Pelajaran Malaysia
- SPVM – Sijil Pelajaran Vokasional

The education level of the community is relatively low as compared to the urban areas of Sarawak. Table 4.3, indicates that the community undergone no formal education denotes the highest percentage 45.1 % when compared to the highest level of education of only 2 %. The primary education were attended at primary school Kampong Selang. The main

reason given for children not attending the secondary school was the distant of the school and unbearable cost incurred or involved in sending children to school.

4.1.2.4 Household economy

Table 4.4 : Estimated Household Income (RM) per month

Income level	Frequency	Percent (%)
45.00	1	2.0
100.00	1	2.0
200.00	4	7.8
250.00	1	2.0
290.00	1	2.0
300.00	1	2.0
330.00	1	2.0
350.00	3	5.9
355.00	1	2.0
400.00	2	3.9
480.00	1	2.0
500.00	13	25.5
550.00	1	2.0
600.00	3	5.9
640.00	1	2.0
700.00	2	3.9
800.00	4	7.8
900.00	1	2.0
950.00	1	2.0
1000.00	2	3.9
1200.00	1	2.0
1300.00	1	2.0
2000.00	1	2.0
2300.00	1	2.0
5000.00	2	3.9
Total	**51**	**100.0**
Average	**775.29**	
Minimum	**45**	
Maximum	**5000**	

The household income basically the incomes that were generated through employment, sale of rice, sale of farm product and jungle produce. The value of other food produced or

collected and consumed by the household is excluded. About 60 % of the household income falls between RM 45 – RM 500 per month. The average income per household is RM 775.29 per month with the minimum income of RM45 and maximum income of RM 5000 (Table 4.4).

4.1.3 Health

The health and sanitary facilities for the community at Kampung Rayu is considerably poor and limited. The hospital and clinics are at distant from the area. The Kampung community has to travel quite a distant to go for their daily clinical needs. The clinics are situated at Telaga Air and Lundu.

4.1.4 Water and Electricity Supply

About 18 % of the household are still using gravity fed water system but they never experience of water shortage even during dry spell. It is this group of community that still relies heavily on rivers as source of water for their daily domestic use. All of the area are well supplied with electricity.

4.1.5 Land Tenure

Out of 51 respondents surveyed, 54% of the community has land and the remaining 46% declares none. The land are mostly untitled land. The average land area per household is 2 acres. There is no Native Customary Right land over the area as the Kampung Rayu was exist after 1957.

4.1.6 Land Use

Land are primarily kept for hill padi cultivation and pepper garden. Usually they farm at the average size of one to two acres of hill padi and half to one acre of pepper garden. Some of the household are having their backyard garden, where they plant some fruit trees.

4.1.7 The perception and awareness towards Conservation and Preservation of National Parks.

With the establishment of new government project such as National Parks will usually cause fuzzy impact to the local community. The local community of Kampong Rayu is not an exception to this scenario. Initially the local community would feel uncomfortable and unable to adapt to the tight regulations and circumstances enforced by the government. The resistance could be expected especially if they were not properly imparted with adequate knowledge with the project to be implemented and it's long term benefits.

After the constitution of the National Park with management and enforcement activities implaced, the local community were then directly participated in park development where it would provide employment opportunities to the local. The local perception and awareness towards conservation were gradually developed to those locals involve in the park management and thereafter spread to the entire local community of the region.

From the analysis of the survey conducted over 51 respondents as reflected in Table 4.5, it is clear that their perception and awareness towards conservation and preservation of National Park is such that forest must be conserved to give sustainable returns for their future generation. More than 90% of the respondents surveyed are aware on the importance of forests and it's contribution to them. More than 50% of the respondents correspond of their dissatisfaction over the degree of involvement in Park development and 40 % of them disagree to the laws governing the harvesting of the forest produce.

Table 4.5 : Perception and awareness towards constitution of National Park.

Community Perception	1 (%)	2 (%)	3 (%)	4 (%)
1. It is important for us to save some of our old forests.	62.7	33.3	4.0	0.0
2. The forest contains many useful plants and animals which are useful for the future generations	47.1	49.0	4.0	0.0
3. The forest is a very important source of our water supply and we want clean water.	58.8	33.3	5.9	2
4. Our children should be taught to value the forest and its importance.	62.7	31.4	5.9	0
5. The community has been involved in conservation efforts too.	13.7	27.5	45.1	13.7
6. The forestry department has managed the National Park successfully.	62.7	31.4	5.9	0
7. Laws governing the harvesting of forest resources (plants and wildlife) in the national parks are really not necessary.	37.3	21.6	11.8	29.4

1 = Strongly agree;
2 = agree;
3 = Disagree;
4 = Strongly disagree

When touching issues which relates to the community livelihood, majority of the respondent demand the governing laws to be relaxed in order to give them rights in the parks, such as hunting and collection of forest produce. Table 4.6 indicate that 75% of the respondents had agreed farming in the park should be controlled to minimize natural hazards such as erosion and wild fire. There is a contradict notion, where 92% the community had agreed for logging to be enforced in the park. Perhaps this will give them better financial returns or dissatisfaction to the governing law of giving them no right over the collection of produce from the concerned park. Probably what they understand on logging in the parks is extraction of timber for their domestic use and not the commercial logging.

Table 4.6 : The overall scenario of respondent Perception and awareness towards conservation and preservation of National Park.

Community Perception	1 (%)	2 (%)	3 (%)	4 (%)
1. It is important for us to save some of our old forests.	62.7	33.3	4.0	0.0
2. The forest contains many useful plants and animals which are useful for the future generations	47.1	49.0	4.0	0.0
3. Clearing of the old forests in the hills for farming should be allowed.	5.9	35.3	52.9	5.9
4. Farming activities in the hills should be controlled / limited to protect against erosion and wildfire	13.8	60.8	17.6	7.8
5. Logging of the forests in the national parks should be allowed.	56.9	35.3	5.9	1.9
6. Villagers should be allowed to hunt in the national parks.	60.8	37.2	0.0	2.0
7. Collection of minor forest produce (rattan, bamboo, etc) by the community living by the borders of the national parks (for personal use) should be allowed.	13.7	21.6	51	13.7
8. The forest is a very important source of our water supply and we want clean water.	58.8	33.3	5.9	2
9. Our children should be taught to value the forest and its importance.	62.7	31.4	5.9	0
10. The community has been involved in conservation efforts too.	13.7	27.5	45.1	13.7
11. The forestry department has managed the National Park successfully.	62.7	31.4	5.9	0
12. Laws governing the harvesting of forest resources (plants and wildlife) in the national parks are really not necessary.	37.3	21.6	11.8	29.4
13. It is good if the Forestry Department totally bans the harvesting of forest resources.	13.7	25.5	41.2	19.6

1 = Strongly agree;
2 = Agree;
3 = Disagree;
4 = Strongly disagree

As the overall assessment, the neighbouring community of Matang Wildlife Centre were positive and receptive towards the conservation and preservation of the parks. However,

61% of them disagreed that it is good that if forestry department totally banned the harvesting of forest resources as shown in Table 4.7. This indication relates that the community needs to have rights to collect natural forest produce from their natural forest proximity to their area.

Table 4.7 : Respondent perception on totally ban on harvesting of the forest resources

Total ban of harvesting the forest resources	Percentage
Strongly agree	14
Agree	25
Disagree	41
Strongly Disagree	20

Generally, the local community had accepted National Park and it's implementing ingredients. They are now craving for privileges on their rights, particularly in practicing their daily life style such as hunting, fishing and collection of forest produce in their natural environment or natural forest.

The whole scenario advocated that it is crucial that implementing authority should deal the social issue seriously and critically. This would aim to improve their standard of living, education and most importantly the sense of belonging to the park concerned. At the end of the tunnel, the authority should achieve an objective of caring and law abiding society towards the park.

4.2 WATER QUALITY ANALYSIS

The analysis of the water quality for the rivers surveyed on the 21st July, 2001 are summarized in Table 4.8 and Table 4.9 .

The pH value of the rivers examined are ranging from 7.24 to 8.03. Sungai Amok was detected to have a pH value of almost neutral (7.24) whereas pH value for Sungai Najis is slightly higher (8.03). The pH value for all rivers surveyed are generally higher probably due to less humic substances presence (Soeyink and Jenkins, 1980). The Department of Environment (DOE, 1974) had recommended that pH value ideal for catchment water quality for drinking water to range from 6.0 to 9.0.

The temperature of the rivers surveyed are higher ranging from 25.5 °C to 29.2 °C. The temperature recorded for Sungai amok is considerably higher when compare to Sungai Sendok merely due to the less foliage cover along the river bank.. The less foliage cover had exposed the areas to direct sunlight causing the water temperature to be higher when compared to other rivers. Salinity was not detected for all the rivers sampled, indicating that these rivers are free from saline-water intrusion.

The dissolved oxygen level (DO) for all the rivers surveyed was normal (6.7 to 7.10 mg/l) as the river flow was considerably swift except for Sungai Amok(2.6 mg/l). The low dissolved oxygen level for Sungai Amok was due to very slow flow (stale state) of it's water in this river. The river was observed to be blocked by some fallen trees. The conversion of sawn timber was also observed by the river bank when this study was conducted. Human intrusion of such nature had contributed to the anoxic condition of this river. Generally, 3 mg/l or less of dissolved oxygen (anoxic condition) is stressful to aquatic vertebrates and other aquatic life (Lind, 1979).

The total dissolved solid for all rivers are detected to be very low, ranging from 0.02 to 0.03 mg/l. It was also observed that , the conductivity follows the same trend, ranging from 24.30 to 48.7 ms/cm. This had been due to the low level of heavy metals (Cu, Pb, Cr, Mn , Zn) and trace metals presence in the rivers surveyed (Table 4.8). The low and consistence suspended solids content of the rivers surveyed, notifying that little soil

erosion had occurred at the upper stream of the rivers, whereas the less presence of heavy metals had indicated that there is no or little anthropogenic activities within the area.

The total suspended solid and turbidity is closely associated with each other (Law and Mohsin, 1980). In this study, it was detected that for all rivers surveyed, the total suspended solids and turbidity is considerably low. The total suspended solids measured for all the rivers range from 0.40 to 10.40 mg/l and turbidity from 11.35 to 21.50 (NTU) respectively. The total suspended solids for all rivers in the study is far better than the standards set by DOE (1974) for drinking water and water catchment management which is 50 mg/l.

Total coliform count and *E.coli* counts were determined and compared between two stations viz. Sungai Rayu 2 and Sungai Najis (Table 4.9). The mean total coliform counts recorded were 200 cfu/100ml for Sungai Rayu 2 and 400 cfu/100ml for Sungai Najis. The *E. coli* counts were recorded at 50 cfu/100ml for Sungai Rayu 2 and 80 cfu/100 ml for Sungai Najis respectively. The measurement denotes that Sungai Najis had exceeded the total coliform count of Sungai Rayu 2 by 100 % and *E. Coli* counts by 60%. This phenomena occurs basically due to the discharge of the captive animals within the centre was being drained directly into Sungai Najis. It was observed that the coliform count for both rivers had not only exceeded the standard set by the WHO Drinking Water Quality, but also failed to satisfy the standard of WHO Quality for bathing water – 100 cfu/100 ml (WHO, 1977b)

TABLE 4.8 : WATER QUALITY DATA OF RIVERS DRAINING MATANG WILDLIFE CENTRE

GENERAL WATER QUALITY PARAMETERS:	STATIONS				
	Sg. Rayu 1	Sg. Rayu 2	Sg. Sendok	Sg. Amok	Sg. Najis
pH (units)	7.80	7.60	7.96	7.24	8.03
Electrical conductivity (ms/cm)	27.00	24.30	26.50	48.70	33.00
Turbidity (NTU)	11.35	11.93	21.50	19.50	14.40
Dissolved oxygen, DO (mg/L)	7.00	6.70	7.10	2.60	6.70
Temperature (°C)	26.40	28.20	25.50	25.57	29.20
Salinity (ppt)	0.00	0.00	0.00	0.00	0.00
Biological oxygen demand, BOD (mg/L)	3.76	3.80	5.53	2.57	3.74
Chemical oxygen demand, COD (mg/L)	5.00	3.00	3.00	3.00	8.00
Total dissolved solid, TDS (mg/L)	0.02	0.02	0.02	0.03	0.02
Total suspended solid. TSS (mg/L)	10.40	3.60	6.00	0.40	6.20
TRACE METALS:					
Cadmium (mg/L)	0.02	0.04	0.00	0.00	0.02
Chromium (mg/L)	0.20	0.21	0.22	0.20	0.18
Copper (mg/L)	0.00	0.00	0.00	0.00	0.00
Iron (mg/L)	0.08	0.13	0.10	0.19	0.11
Lead (mg/L)	0.25	0.11	0.14	0.36	0.21
Phosphate (mg/L)	0.016	0.097	0.022	0.032	0.009
Zinc(mg/L)	0.06	0.07	0.02	0.05	0.04
OTHERS:					
Ammonia (mg/L)	0.04	0.11	0.13	0.18	0.15
Nitrate (mg/L)	0.04	0.04	0.04	0.09	0.04

TABLE 4.9 : COMPARISION OF MICROBIOLOGICAL PARAMETERS BETWEEN TWO STATIONS AT MATANG WILDLIFE CENTRE

STATIONS	MEAN TOTAL COLIFORM(cfu/100ml)	MEAN *E.coli* COUNTS(cfu/100ml)
SG. RAYU 2	200	50
SG. NAJIS	470	80

4.3 RIPARIAN VEGETATION OF ULU RAYU MATANG

The study of biomass is to inventory the total potential raw material that can be obtained from an area (Young 1964, 1978, 1977). It's inventory also includes an estimate of volume production for forest management planning in ensuring the forest growth in perpuity (Young 1977, 1978). In addition, forest biomass has been used to characterize the productivity of forest communities (Whittaker 1966; Wittaker and Woodwell 1968), where biomass production is highly dependent on the quantities of nutrients returning to the soil in the litter and through decomposition (Malkonen 1976).

The total above ground biomass (kg/ha) in respect of all plots surveyed in Ulu Rayu was 583,070 kg/ha. and the total basal area is 48.02 m^2/ha. (Appendix II). The break down of the taxonomic diversity (family, genera and species) of each river surveyed is shown in Table 4.10

Table : 4.10 : Taxonomic Diversity and Tree Biomass (kg/ha) in riparian forest of Ulu Rayu Matang

	Sg. Sendok	Sg. Rayu	Sg.Amok	Total
Families	5	6	15	**26**
Genera	13	13	28	**54**
Species	20	17	34	**71**
No.of trees	27	20	46	**93**
Basal Area (m^2/ha)	19	11.6	17.23	**47.83**
Biomass (kg/ha)	181,164.35	123,483.82	278,421.01	**583,069.2**

The most dominant family in the area surveyed is represented by the family of Dipterocarpaceae (43%) followed by Anacardiaceae (6.45%) and Myrtaceae (5.37%). Table 4.11 indicates the families of tree species and their frequency in Ulu Rayu Matang.

Table 4.11 : Family frequency of Riparian Forest, Ulu Rayu Matang

Family	Frequency
Dipterocarpaceae	40
Anacardiaceae	6
Myrtaceae	5
Burseraceae	5
Fagaceae	4
Euphorbiaceae	4
Tiliaceae	3
Myristicaceae	3
Polygalaceae	2
Ulmaceae	2
Fabaceae	2
Clusiaceae	2
Meliaceae	2
Sapindaceae	1
Hypericaceae	1
Proteaceae	1
Sapotaceae	1
Tetrameristaceae	1
Moraceae	1
Aquifoliaceae	1
Crypteroniaceae	1
Rhizoporaceae	1
Elaeocarpaceae	1
Flacourtiaceae	1
Rosaceae	1
Lauraceae	1
Total	**93**

The area surveyed is prone to flooding when there is heavy downpour. Therefore, most of the vegetation are physically adapted to withstand the forces of the fast flowing water by having a strong root system, thick bark, tough branches and narrow leaves.

The forest was formed by two-storeyed structure. A row of emergent trees comprise of *Shorea richetia, Shorea palembanica* and *Shorea splendida* found inline with the river fringes in a slanting position with the crowns overhanging the river. The trees reach to a diameter of 45 cm and the height of 35 m.

Right behind the river fringes, another emergent occur in scattered individuals. The species occurs here mostly *Hopea dryobalanoides, Vatica micrantha* and *Shorea parvifolia.* The non-dipterocarps mostly dominate the lower story at the height of 8 to 17 m and comprising members of Anacardiaceae (*Gluta wallichi, Mangifera griffithi* and *Pentaspadon motleyi*), Myrtaceae (*Tristanopsis sumatrana* and *Whiteodendron moultonianum),* Burseraceae (*Santiria tomentosa* and *Dacryodes rostrata*) and Euphorbiaceae (*Macaranga hypoleuca* and *Ptychopyxis bacciformis*)

The woody species below 10 cm dbh are represented by seedlings and saplings. The seedling observed are mostly from the family of Fagaceae, Ulmaceae, Tiliaceae and Euphorbiaceae. Palms are relatively common especially *Pinanga* sp. and *Calamus* sp.

4.4 SUMMARY

It had been identified that 75% of the community are illiterate. The community usually attended the primary school level. 60% of the community has an earning less than RM500.00 per month which is below poverty level for Sabah and Sarawak. The people living in poor health conditions and inadequate sanitary facilities may be due to poverty and low education level.

Some local people are employed as park workers, but have not given up farming. They are aware of the importance of forest conservation which will directly or indirectly provide their future generations with sustainable returns. On the contrary, they also demand for the governing laws to be relaxed to give them rights including logging in the park.

The presence of the local communities has to a certain extent adversely caused enviromental degradation. The opening up of upper forest canopy through human activities such as working of hewn timber and felling of trees which blocked the water ways are clear evidence of such effects.

The park authority allowing the discharging of wild animals waste direct into Sg. Najis has resulted in river pollution which is reflected by relatively high coliform counts and *E. coli* counts.

It is observed that riparian vegetation provides equilibrium which affects directly the physical and ecological conditions of the rivers. Timber species composition and different storeys of canopy casting over the water ways provide sufficient protection to all form of aquatic life. Regular floods over the forest floor would provide enough additional nutrition to its habitats.

Matang Wildlife Centre was under the charged of a veterinary officer with limited experience on park management. It is notified that, Matang Wildlife Centre has not enough manpower to keep a proper management of that park. A review is needed to improve its management practices and to solve problems through systematic management planning.

CHAPTER 5

ISSUES AND PROBLEMS.

5.1 Administrative issues

5.1.1 Insufficient Trained Staff

After conducting the field research and observations, and compilation of interviews with the officers concerned in the centre, under-staffing and exacerbated by low level of expertise is one of the most chronic problem of Matang Wildlife Centre. Due to under-staffing, the staff are frequently called upon or directed to do jobs which they are not qualified for or not in their jobs description. This had resulted in the form of crisis management, putting the staff into the position where they cannot plan and accomplish little on the park management programs. This had led to failure in achieving the conservation initiatives within the centre.

Currently, the centre had been manned and charged by three permanent forestry officers (1 veterinary officer, 2 forest guards). The veterinary officer was the officer incharge of the centre, who is specialized in the field of animal husbandry and research. The officer had admitted of lacking in the experience on park management and thereby resulting inadequate management of the centre. The issues of conservation and preservation of parks was only known when he was posted to the centre. No proper management training has been organized for the staff of the centre. The administrative duties were mainly performed and monitored by his junior officers. The junior officers were also untrained and lack of administrative and technical experienced. The existing organization chart of the Matang Wildlife Centre is as shown in Figure 2.

6.1.3 Environmental Education

Matang Wildlife Centre, with its present setting has an educational centre. With the increasing interest in ecotourism, private operators and tourist resorts have recognised the importance of environmental conservation and education in meeting the needs of the tourist as well as protecting the resources. In the ecotourism context, environmental education can serve two distinct roles, that is satisfying visitor information needs and visitor management. The values and attitudes of tourists are beginning to change whereby the tourists are now demanding more environmentally responsible services and products as well as information. Tourists want to learn about the environments they visit as well as understand their connections with a broader environment. Through environmental education, ecotourists can gain a better understanding, awareness and appreciation of the natural and cultural environment. Due to inadequate manpower, Matang Wildlife cannot serve the tourist and visitors properly in term of providing the environmental conservation education. Most of the visitors are not guided during their visits and therefore knowledge gain are considerably limited.

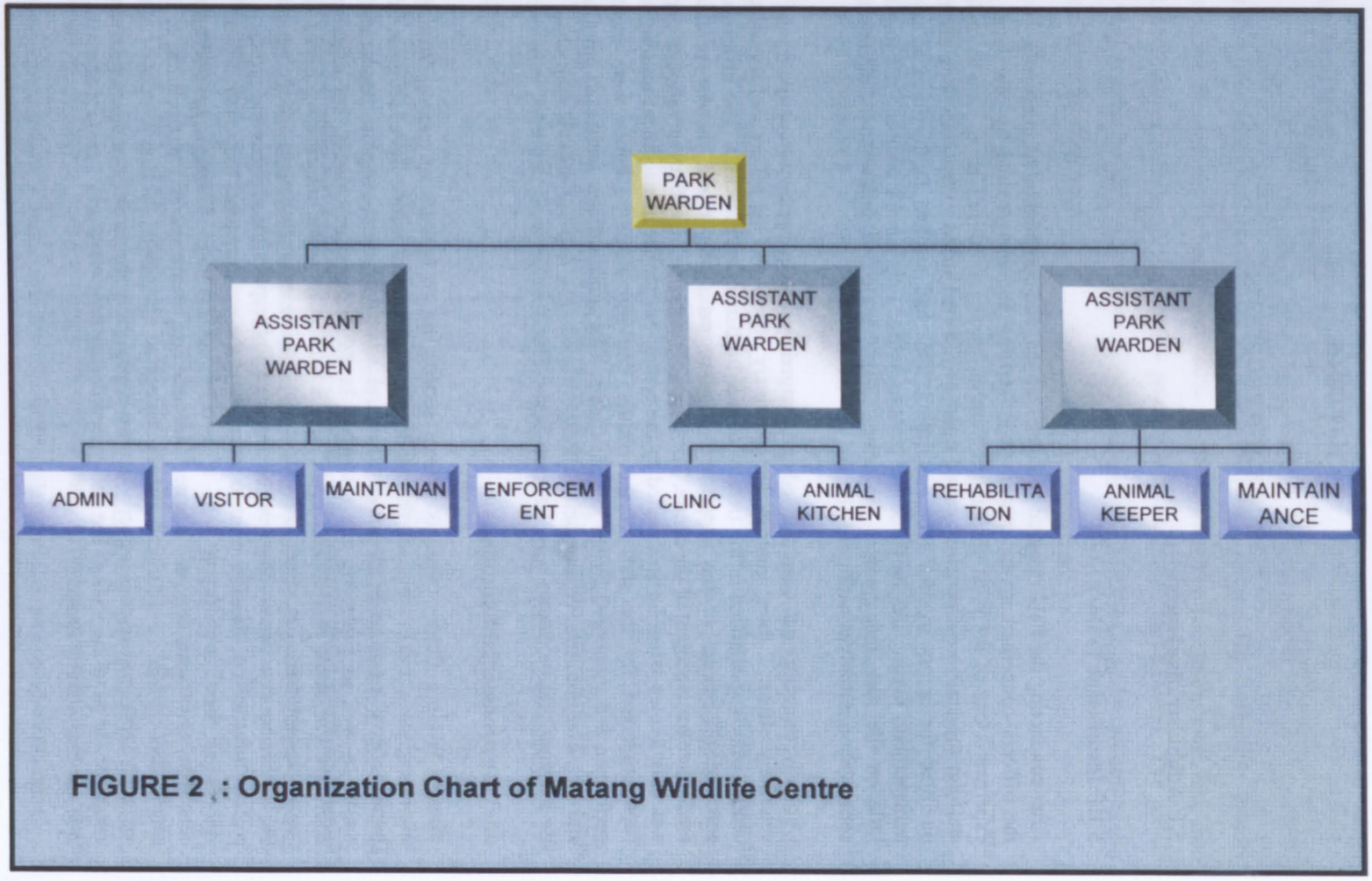


FIGURE 2 : Organization Chart of Matang Wildlife Centre

5.2 WATER RESOURCE

These water quality impairment problems stem from activities within and outside the parks (visitation, active concession, and park maintenance). The main rivers (Sg. Rayu, Sg. Senduk and Sg. Amok) that drained the Matang Wildlife Centre does not receive adequate attention from the management. Research and observation that were carried out reflected that the ignorance of authority concerned in addressing the problems and thereafter led to water quality deterioration. The poor management of animal waste by the management has cause the total coliform count and *E. coli* count found to be higher in Sungai Najis as shown in Table 4.9. Illegal activities such as conversion of sawm timber were rampant (Plate 1). Fallen trees that blocked the water ways were not cleared by the management (Plate 2). It was observed too that, visitors were generally uncaring towards the cleanliness. Solid wastes were simply thrown into the river despite the presence of numerous rubbish bin provided by the park management. Such environmentally undesirable habits was most likely attributed to the lack of environmental awareness among the general public.

5.2 COMMUNITY ISSUE

The existence of the centre to the area does not bring much benefit to the local community, though some of them were engaged as casual labourers. The local community had a higher expectation particularly in raising their standards of living. They are keen to participate in minor contract works, repair and maintenance of infra-structure, canteen operation and animal food supply contract. The involvement of the local community living in close proximity of the centre has always been overlooked in its management and development plan. This might be due to avoid taking the time in informing the communities of the specific management and development plan of the centre or seek to marginalized them so as to deprive them of anticipated economic benefits. However, the needs of local communities should be taken into account, particularly since they are directly dependent on the natural resources that attract tourists to an area.

5.3 OVERCROWDING

The ideal location of Matang Wildlife Centre, whereby it is only 35 km from the city and accessible by tar sealed roads, has naturally attracted the picnikers and nature lovers especially over weekends and public holidays. This had caused the centre to be congested or overcrowding at certain time. Congestion or overcrowding is a significant management problem of the parks and many protected areas. The implication of the congestion usually render the tendency of the tourism resources to be overused. With the present setting of Matang Wildlife Centre, the activities were not well spelt. Most of the visitors were keen in camping and swimming activities. The biophysical carrying capacity of the resources in the centre was not exactly known, since no study has been conducted. It was always the case that such overcrowding to certain activities did jeopardize the sustainable environmental condition of the area.

Plate 1 : Conversion of illegal sawn timber along Sungai Amok

Plate 2 : Fallen tree blocks water ways of Sungai Rayu

CHAPTER 6

MANAGEMENT PLANNING OF MATANG WILDLIFE CENTRE

Establishment of Steering Committee

Management of Matang Wildlife Centre should be planned based on fundamental principle, where it should be viewed not merely as physical entity that exist within the narrow confines of artificial boundary. It should be viewed base on ecological unit which exist within a complex web of inter-related biological system. Related to this, there must be a conscious and committed effort on the part of the authorities responsible for administrating areas adjacent to the Matang Wildlife Centre, to ensure that development occurring around the center are consistent with the philosophy and objectives of a protected area system.

To effectively enhance proper management of Matang Wildlife Centre, establishment of a Steering Committee that involves various government department agencies, non-government organizations as well as representatives from local communities is crucial. The National Parks & Wildlife Office of the Forest Department Sarawak is the key department to draw up a long term Master Plan, implementing the plan, monitoring progress as well as surveillance works to ensure compliance. Ministry of Resource and Management Planning and Ministry of Tourism and Environment may be included as advisors. The proposed composition of this committee is summarized below :

Advisors

i) Permanent Secretary of the Ministry of Resource Planning
ii) Permanent Secretary of the Ministry of Tourism & Enviroment

Chairman

Director of Forest, Sarawak in the capacity of Chief Game Warden

Related Government Agency

i) Land & Survey Department, Sarawak.
ii) Drainage & Irrigation Department, Sarawak.
iii) Agriculture Department, Sarawak
iv) Resident and District Office

Non-Government Organisation (NGO)

i) Sahabat Alam Malaysia
ii) Malaysian Nature Society

Local Communities of Kampung Rayu

i) Representatives from Iban community

ii) Representatives from Malay community
iii) Representatives from Chinese community

6.2 TASKS OF STEERING COMMITTEE

6.2.1 Manpower Requirement for Matang Wildlife Centre

A new propose organization chart (Figure 3), underlying the need of manpower requirement in order to enhance the management of the center. Currently, the manpower in Matang Wildlife Centre (MWC) is comprised of only three permanent officers headed by a Veterinary Officer. Under the enhanced management plan, the number of permanent officers in MWC will be increased from five officers to twenty one permanent officers and to be headed by a Park Warden. The best suit will be at least a Conservator of Forest (G.3) and assisted by an Assistant Park Warden (G5). The duties of the veterinary officer will be stream-lined to undertake tasks pertaining to management of captive animals, reptiles and birds. Rehabilitation and medical treatments for these animals in captivity would be his main role of duties and responsibilities. He is also responsible to undertake Research and Development Projects together with the Park Warden. The Park Warden will undertake the responsibilities on the wildlife management in their own area of jurisdiction, giving them more autonomy and authority at the possible expense of headquarters coordination and monitoring. Under the new structure exercise, four distinct units were established, namely Enforcement, Management, Education and Administration Unit.

Enforcement Unit is responsible to rule and enforce the Wild Life Protection Ordinance and laws. The duties shall includes, regular patrol within and outside the MWC in order to control encroachment and illegal hunting.

Management Unit is responsible to the planning of the center and ensuring a healthy ecosystem of the area be maintained. Physical and biological inventory of the resources is also a major task of the unit besides demarcating and clearing of boundary.

Education unit will be responsible in deliberating of conservation education to the community and general public. Other task of the unit includes the publicity and training. The needs for training of all level of MWC staff is highly emphasized in the propose new structure exercise. The well planned and systematic programs are envisaged to equip the staff with the necessary knowledge and skill in wildlife, as well as motivating the staff in the performance of their duties.

Administration unit mainly deal in financial estimate of the centre and any other office administration duties.

6.2.2 Establishment of River Task force

River is very important resource of the centre and therefore needs special attention and management. It is proposed that special river task force be established. The committee is suggested to be comprised of the local community and the forest department staff of the centre. The main task is to ensure the rivers are clean and safe. The issue of fallen trees that blocked the water ways and poor management of animal waste should be taken as priority assignment of the committee. It is suggested that, waste water should be treated before discharging it to the main river.

6.2.3 Giving opportunity to the local communities

Besides being engaged in the task force committee, the local communities should be given priority to undertake the followings:-

- To operate canteen(s) within the Wildlife Centre,
- To do repair & maintence works for buildings and other structural facilities in the centre,
- To be employed as park workers doing manual, carpentery works, etc,
- To be trained as animal keepers.

6.2.4 Establishment of management zones

Establishment of management zones did solved a problem of overcrowding in Maara National Park of Kenya (Gakahu, 1992a). The congestion usually occur when the animals high on the "must see" list spotted. The excessive congestion was the result of a preference of a limited number of animals, limited time, inadequate information, poor road and viewing tract. However, in Serengeti National Parks, management zones objective is primarily addressing the issues pertaining to the visitor use and development of tourist facilities inside the park (Tanzania National Park, 1996).

Management zones should also be established in the MWC in order to avoid overcrowding and also provide the proper recognition of protection for a protected area resources and greatly appropriate their management. Zoning strategy and regulation could be apply to concentrate visitation in some areas or disperse to others. In this way, extreme pressure of tourist activities can be restricted to more resilient environments and the most rigid protection measures applied to a fragile ecosystem. In the case of MWC, it is suggested to be divided into four zones. The zones are :

• Strict protection zone	This is mainly the reserves zone, where tourist is prohibited to visit
• Wilderness zones	Tourist are allowed to enter but on foot only
• Moderate tourism use zones	Visitors are encourage to carry out diverse activities compatible to the natural environment setting of the area
• Development zones	Area of limited extent, in which facilities are concentrated

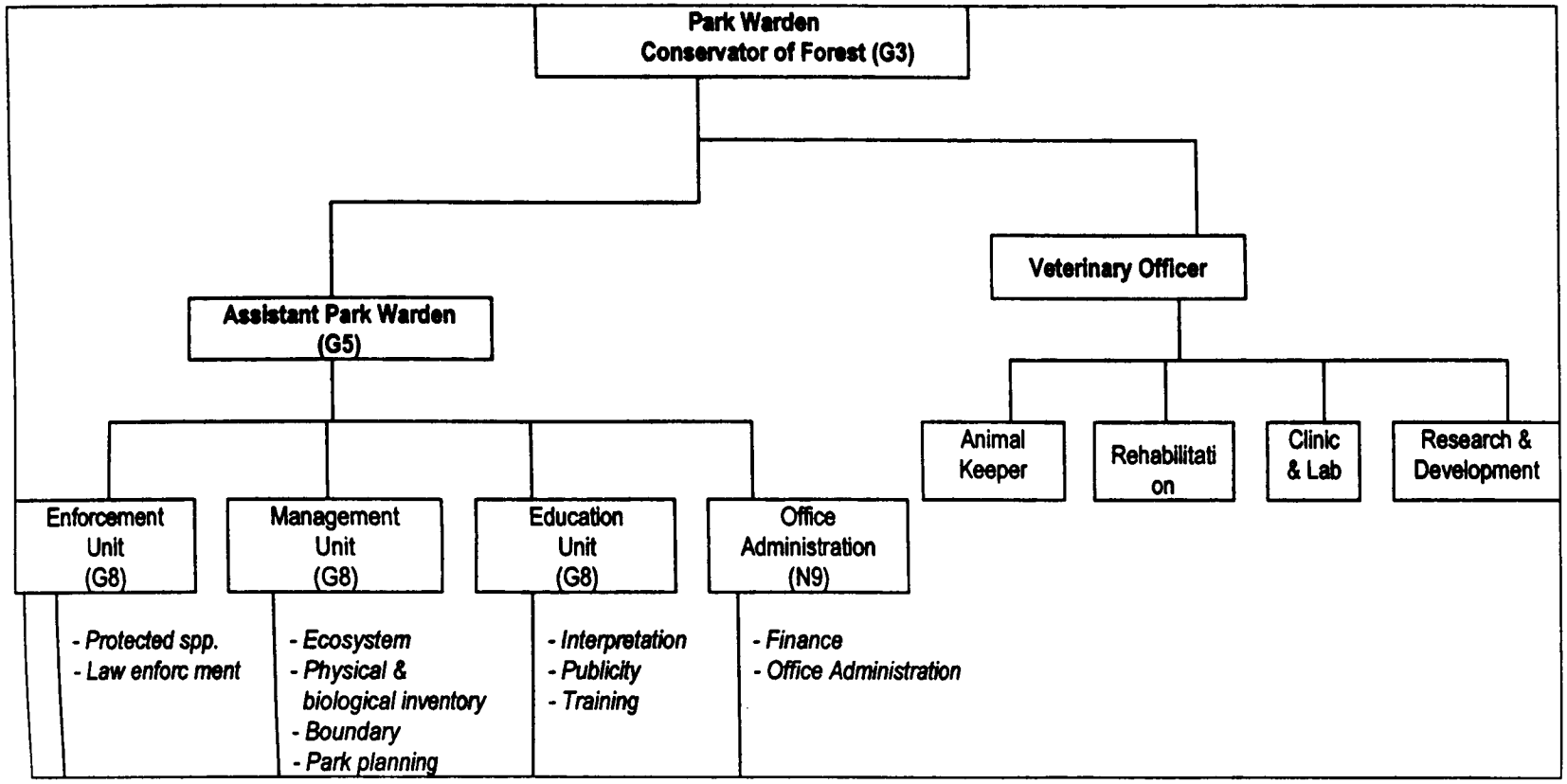


Figure 3 : Propose Organisation Chart of Matang Wildlife Centre

CHAPTER 7

CONCLUSION AND RECOMMENDATION

From the study conducted, it is found that the community of Kampung Rayu had a higher expectation towards the establishment of Matang Wildlife Centre. Despite some of the community members were engaged by the centre as the casual labourer, most of them had expected to participate in minor contract works, such as repair and maintenance of infra-structure, canteen operation and contract on supply of animal food. They had agreed to involve in the management planning of the centre.

The water quality at Sungai Najis was found to be impaired, with the presence of higher total coliform and *E. coli* counts. It is recommended that Forestry Department should monitor the water quality of this river every month besides to have a proper waste water treatment at the centre.

The biomass of the area surveyed in this study showed that, the area is still healthy. The biomass is 583,070 kg/ha. The species composition is complex, where it is represented by 26 families and 71 species. The vegetation along Sungai Amok is found to be disturbed by the culprit of converting illegal sawn timber. It is suggested that the management of Matang Wildlife Centre could take stern action against the culprit immediately.

The study also found that, the centre had faced a shortage of manpower to properly manned the centre. The centre was manned and charged by the vertinary officer and assisted by two junior officers. They are all lack of experience and no training was organized by the management.

It is of a crucial importance to notify that the Matang Wildlife Centre has experienced some environmental degradation and disturbance as a result of under staffing, visitors and tourist pressure towards the resources therein and lacking of the environmental conservation education channel by the management to the general public. If Matang Wildlife Centre is to maintain its ecological integrity and to meet the objectives of long term preservation and conservation of nature, the issues on the bio-physical and socio-environment of the centre must be fully understood. By understanding such environmental factors, only then, a more holistic management policies and management planning can be developed. From this study, the management planning of the centre should be drawn by few stake holders in order to maintain its environmental sustainability. The stakeholders, includes various government agencies, non-government agencies and the local community.

This study has considerably fulfilled it objectives viz. gathering data on bio-physical characteristic, socio-economic status of the centre and proposed few management strategies for inclusion into future management planning of Matang Wildlife Centre. Such finding in this study, would aid and help the park manager in drawing the proper management planning of the center and subsequently maintain the ecological integrity of the centre for the current and the future generation.

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APPENDIX I :

PERCEPTION AND AWARENESS ON CONSERVATION EFFORTS TOWARDS MATANG WILDLIFE CENTRE

INTERVIEW SURVEY

Recorder :
Location : Matang Wildlife Centre Date:
Community : _____

A. BACKGROUND

A.1 Respondents/Household Head's Particulars

1. Name of respondent:
2. Age: 3. Sex: Male/Female
4. Race: Bidayuh Selakau /Iban /Chinese / Malay / others:_____
5. Formal education (no. years):
6. Highest academic qualification:
   (i) no formal education (ii) UPSR (iii) PMR/SRP/LCE
   (iv) SPM/V (v) STPM (vi) Polytechnic (v) Diploma/Degree
   (vi) other certificates (specify)

7. Occupation:
8. Monthly income (personal):
9. Water Source:

A2. Household Particulars

9. Household Monthly Income : RM _____
10. Sources of Household Income:

Sources	Amount (RM)	Comment
Agriculture/farm		
Salary / Wage		
Businesses / etc.		
Forest Resources		
Contribution from children		
Others		
Total		

11. How long have you lived in this village? _____ mths/year
12. Do you have a home garden in the vicinity of your house? YES / NO
13. Do you have farming land adjacent to the National Park boundaries? YES / NO

B. PERCEPTION AND AWARENESS ON CONSERVATION EFFORTS

1. In relation to park management, please indicate your response to the following statements:

1 = Strongly agree; 2 = Agree; 3 = Disagree; 4 = Strongly disagree

	1	2	3	4
1. It is important for us to save some of our old forests.				
2. The forest contains many useful plants and animals which are useful for the future generations				
3. Clearing of the old forests in the hills for farming should be allowed.				
4. Farming activities in the hills should be controlled / limited to protect against erosion and wildfire				
5. Logging of the forests in the national parks should be allowed.				
6. Villagers should be allowed to hunt in the national parks.				
7. Collection of minor forest produce (rattan, bamboo, etc) by the community living by the borders of the national parks (for personal use) should be allowed.				
8. The forest is a very important source of our water supply and we want clean water.				
9. Our children should be taught to value the forest and its importance.				
10. The community has been involved in conservation efforts too.				
11. The forestry department has managed the National Park successfully.				
12. Laws governing the harvesting of forest resources (plants and wildlife) in the national parks are really not necessary.				
13. It is good if the Forestry Department totally bans the harvesting of forest resources.				

APPENDIX II: Riparian Biomass of Ulu Rayu Matang

SPECIES	Diam(cm)	Ht.(m)	BA (m^2)	A (m^2/ha	Ws (kg)	Wb (kg)	WL (kg)	Biomass(kg/ha)
Aglaia crassinervia	12.9	12	0.0130748	0.11	510.25	107.37	15.36	632.98
Aglaia crassinervia	12.9	12	0.0130748	0.11	510.25	107.37	15.36	632.98
Anisophyllea corneri	13.2	15	0.0136900	0.11	663.05	142.10	18.39	823.54
Artocarpus kemando	15	10	0.0176783	0.15	573.09	121.57	16.65	711.31
Beilschmiedia sp.	15.5	12	0.0188764	0.16	729.48	157.38	19.61	906.47
Calophyllum canum	35	20	0.0962483	0.80	5854.90	1461.45	61.63	7377.99
Cratoxylum cochinchinenses	22.4	21	0.0394233	0.33	2575.45	606.95	42.04	3224.43
Crypteronia macrophylla	19.2	10	0.0289640	0.24	926.66	203.30	22.96	1152.92
Dacryodes rostrata	10.2	10	0.0081744	0.07	270.51	54.45	9.76	334.72
Elaeocarpus pedunculatus	12.4	10	0.0120809	0.10	395.64	81.78	12.84	490.26
Garcinia beccarii	12.1	10	0.0115034	0.10	377.22	77.71	12.41	467.34
Gironniera nervosa	48.5	25	0.1848163	1.53	13728.54	3637.45	82.09	17448.08
Gironniera nervosa	27.6	25	0.0598515	0.50	4581.77	1124.20	55.58	5761.54
Gluta wallichii	60	35	0.2828520	2.35	28822.72	8043.69	96.90	36963.31
Grewia elmeri	26.5	18	0.0551758	0.46	3074.62	733.63	46.05	3854.29
Grewia sp.	15	8	0.0176783	0.15	461.21	96.36	14.31	571.89
Gymnacranthera contracta	11.2	10	0.0098558	0.08	324.53	66.16	11.14	401.82
Gymnacranthera contracta	10.2	10	0.0081744	0.07	270.51	54.45	9.76	334.72
Helicia petiolaris	11.7	10	0.0107554	0.09	353.33	72.46	11.84	437.63
Hopea dryobalanoides	17	15	0.0227067	0.19	1084.99	240.68	25.40	1351.08

Hopea dryobalanoides	14.5	18	0.0165193	0.14	950.65	208.94	23.34	1182.93
Hopea dryobalanoides	25.2	20	0.0498951	0.41	3088.89	737.27	46.15	3872.32
Hopea dryobalanoides	16	12	0.0201139	0.17	775.98	168.14	20.44	964.56
Hopea dryobalanoides	12	12	0.0113141	0.09	443.25	92.35	13.92	549.52
Hopea dryobalanoides	11.8	12	0.0109401	0.09	428.98	89.18	13.60	531.76
Hopea dryobalanoides	10.5	12	0.0086623	0.07	341.79	69.93	11.56	423.28
Hopea dyrobalanoides	13.6	15	0.0145323	0.12	702.72	151.21	19.13	873.06
Hydnocarpus pinguis	18.2	20	0.0260255	0.22	1639.43	374.33	32.68	2046.44
Ilex borneensis	21.1	18	0.0349801	0.29	1973.10	456.40	36.35	2465.86
Jarandersonia clemensiaceae	11.2	10	0.0098558	0.08	324.53	66.16	11.14	401.82
Knema curtisii	14.5	12	0.0165193	0.14	640.66	136.97	17.97	795.60
Lithocarpus echinifer	67	35	0.3527007	2.93	35729.17	10122.17	100.44	45951.78
Lithocarpus nieuwenhuisii	25.5	18	0.0510901	0.42	2852.81	677.14	44.33	3574.28
Lithorcarpus bennettii	13.2	15	0.0136900	0.11	663.05	142.10	18.39	823.54
Macaranga bancana	10	10	0.0078570	0.07	260.28	52.25	9.48	322.01
Macaranga hypoleuca	21	20	0.0346494	0.29	2166.05	504.32	38.29	2708.66
Macaranga hypoleuca	40.1	20	0.1263413	1.05	7629.88	1940.14	68.19	9638.20
Mangifera decandra	27.5	20	0.0594186	0.49	3661.36	884.37	50.15	4595.88
Mangifera foetida	32.6	20	0.0835011	0.69	5098.78	1260.46	58.21	6417.44
Mangifera griffithii	32.1	25	0.0809593	0.67	6147.83	1539.83	62.84	7750.50
Melanochyla bullata	10.8	10	0.0091644	0.08	302.35	61.33	10.58	374.26
Nephelium ramboutan-ake	10	10	0.0078570	0.07	260.28	52.25	9.48	322.01
Palaquium sp.	28.9	20	0.0656224	0.54	4032.93	980.74	52.47	5066.14

Hopea dryobalanoides	14.5	18	0.0165193	0.14	950.65	208.94	23.34	1182.93
Hopea dryobalanoides	25.2	20	0.0498951	0.41	3088.89	737.27	46.15	3872.32
Hopea dryobalanoides	16	12	0.0201139	0.17	775.98	168.14	20.44	964.56
Hopea dryobalanoides	12	12	0.0113141	0.09	443.25	92.35	13.92	549.52
Hopea dryobalanoides	11.8	12	0.0109401	0.09	428.98	89.18	13.60	531.76
Hopea dryobalanoides	10.5	12	0.0086623	0.07	341.79	69.93	11.56	423.28
Hopea dyrobalanoides	13.6	15	0.0145323	0.12	702.72	151.21	19.13	873.06
Hydnocarpus pinguis	18.2	20	0.0260255	0.22	1639.43	374.33	32.68	2046.44
Ilex borneensis	21.1	18	0.0349801	0.29	1973.10	456.40	36.35	2465.86
Jarandersonia clemensiaceae	11.2	10	0.0098558	0.08	324.53	66.16	11.14	401.82
Knema curtisii	14.5	12	0.0165193	0.14	640.66	136.97	17.97	795.60
Lithocarpus echinifer	67	35	0.3527007	2.93	35729.17	10122.17	100.44	45951.78
Lithocarpus nieuwenhuisii	25.5	18	0.0510901	0.42	2852.81	677.14	44.33	3574.28
Lithorcarpus bennettii	13.2	15	0.0136900	0.11	663.05	142.10	18.39	823.54
Macaranga bancana	10	10	0.0078570	0.07	260.28	52.25	9.48	322.01
Macaranga hypoleuca	21	20	0.0346494	0.29	2166.05	504.32	38.29	2708.66
Macaranga hypoleuca	40.1	20	0.1263413	1.05	7629.88	1940.14	68.19	9638.20
Mangifera decandra	27.5	20	0.0594186	0.49	3661.36	884.37	50.15	4595.88
Mangifera foetida	32.6	20	0.0835011	0.69	5098.78	1260.46	58.21	6417.44
Mangifera griffithii	32.1	25	0.0809593	0.67	6147.83	1539.83	62.84	7750.50
Melanochyla bullata	10.8	10	0.0091644	0.08	302.35	61.33	10.58	374.26
Nephelium ramboutan-ake	10	10	0.0078570	0.07	260.28	52.25	9.48	322.01
Palaquium sp.	28.9	20	0.0656224	0.54	4032.93	980.74	52.47	5066.14

Shorea richetia	29.2	20	0.0669919	0.56	4114.82	1002.06	52.96	5169.84
Shorea richetia	49.5	35	0.1925161	1.60	19820.03	5388.16	89.90	25298.08
Shorea scaberrima	85.5	35	0.5743663	4.77	57431.61	16820.17	107.04	74358.83
Shorea scaberrium	24.5	20	0.0471616	0.39	2924.07	695.26	44.89	3664.22
Shorea seminis	17.5	15	0.0240621	0.20	1147.97	255.66	26.32	1429.96
Shorea seminis	26.6	22	0.0555930	0.46	3765.29	911.26	50.82	4727.37
Shorea seminis	12.9	7	0.0130748	0.11	301.96	61.25	10.57	373.78
Shorea splendida	11.5	12	0.0103909	0.09	408.01	84.52	13.13	505.65
Shorea splendida	33.3	20	0.0871255	0.72	5314.06	1317.48	59.23	6690.78
Shorea splendida	30	20	0.0707130	0.59	4337.12	1060.09	54.23	5451.44
Shorea splendida	15.8	18	0.0196142	0.16	1123.59	249.86	25.97	1399.41
Shorea splendida	15	18	0.0176783	0.15	1015.50	224.23	24.36	1264.08
Shorea splendida	39	30	0.1195050	0.99	10724.89	2792.92	76.41	13594.23
Sindora beccariana	24.3	30	0.0463948	0.39	4270.19	1042.60	53.86	5366.65
Tetramerista glabra	16.5	15	0.0213907	0.18	1023.74	226.17	24.48	1274.39
Tristaniopsis sumatrana	10.9	5	0.0093349	0.08	156.79	30.38	6.51	193.67
Tristaniopsis sumatrana	53	20	0.2207031	1.83	13131.44	3468.43	81.09	16680.96
Vatica badiifolia	46.5	35	0.1698880	1.41	17548.89	4730.27	87.41	22366.57
Vatica micrantha	17.5	10	0.0240621	0.20	773.65	167.60	20.40	961.64
Vatica micrantha	16.2	12	0.0206199	0.17	794.97	172.55	20.77	988.29
Vatica oblongifolia	12.2	12	0.0116944	0.10	457.74	95.59	14.24	567.57
Vatica venulosa	32	30	0.0804557	0.67	7297.12	1849.74	67.09	9213.95
Whiteodendron moultonianum	4.5	25	0.0015910	0.01	134.18	25.71	5.78	165.68

Whiteodendron moultonianum	14.3	7	0.0160668	0.13	369.02	75.91	12.22	457.15
Whiteodendron moultonianum	14.6	17	0.0167480	0.14	911.32	199.70	22.71	1133.73
Xanthophyllum affine	12.5	10	0.0122766	0.10	401.87	83.16	12.98	498.02
Xanthophyllum sp.	26.1	20	0.0535227	0.44	3307.27	793.18	47.74	4148.19
TOTAL	**2207.5**	**1698**	**5.78558916**	**48.02039**	**458271.2**	**121245.08**	**3554.56568**	**583070.85**
Mean	**23.73655914**	**18.2580645**	**442.68**		**3219.84**	**770.76**	**47.12**	**4037.72**