F-4.1 Evaluation of biodiversity of reserved area in Asian-regions

Contact Person Toshinori Okuda
Global Environment Division
National Institute for Environmental Studies, Environment Agency
16-2 Onogawa, Tsukuba 305 Japan
Tel: +81-298-50-2426 Fax: +81-298-50-2483
E-mail: okuda@nies.go.jp

Total Budget for FY1996-1998 59,999,000 Yen (**FY1998**; 20,004,000 Yen)

Abstract Conservation of biodiversity is one of the most significant global environmental issues. Because of rapid development in Asian countries, protection of endangered species and their habitats is a problem of great urgency. The objectives of this study are i) to quantify biodiversity and to build a database including lists of the animal and plant species present, endangered species present, and the distribution of their habitats, and ii) to apply GAP (Geographic Approach to Protection of Biodiversity) analytical approach in establishing a network system of reserves so that conservation and management efforts are promptly implemented. The database is expected to facilitate better management of nature reserves in line with biodiversity conservation programs. The GAP approach seeks to identify gaps in the proposed area that have high potential as wildlife habitat but have not been designated as reserves.

Merapoh, western part of Taman Negara in Malaysia was selected as a study site for GAP analysis. All the field surveys were conducted in this protected area and its surrounding area, mostly secondary forests. In 1998, a vegetation map was obtained through the analysis of various satellite images and basic GIS data on topography was made. We also carried out wildlife surveys in the area and obtained distribution data of 33 species of mammals and 43 bird species. The data showed apparent difference in species composition between primary and secondary forests.

Key words Biodiversity, GAP Analysis, Nature Reserve, Wildlife, Asian Countries

1. Introduction

In order to set aside a reserve area to conserve biodiversity, it may be ideal to draw a specific distribution map of every species in the proposed study area. Considering that the number of vulnerable species is increasing and that their habitats are decreasing rapidly, a new approach is therefore required for the conservation of biodiversity. Until now, habitat protection has been driven by the needs of rare species rather than the identification of habitats representative of all species. The new perspective must consider large regions, integrate the distributions of many species, and achieve rapid implementation to identify the areas which need protection, including the potential habitats where those rare species might be able to inhabit when their number increase.

GAP analysis is a proactive approach for protecting biodiversity. It seeks to identify gaps in the biological reserve network that may be filled through the establishment of new reserves or changes in land management practices. This will ensure that a viable collection of taxa will be guarded from future disturbance. In the past, reserve areas were set aside often without regard to their biodiversity content. As a result, many of protected areas have little significance in terms of biodiversity, and a lot of areas of great significance lack protection.

GAP analysis works by overlaying maps of land cover and species occurrence onto maps of protected areas, using Geographical Information System (GIS) technology. The

resulting maps show the relationship between areas of biological significance and the level of protection afforded these areas. One of the strongest features of GAP analysis is its flexibility in utilizing data layers previously developed for other purpose. Furthermore, GAP data can be used in building and environmental information infrastructure (from home page of GAP analysis)

A realistic solution which will be provided by this project consists of analysis of the potential habitats of the respective species and determination of areas for new reserves. More detailed methods will be given in the following section. In this subtopics, we conducted field survey for wildlife habitat and constructed vegetation map in order to accomplish GAP analysis, which is also supported by the research output of subtopic-2.

2. Research Objectives

Conservation of biodiversity is one of the most significant global environmental issues. Thus, the protection of endangered species and their habitats from development is a problem of great urgency. In order to meet such demands, this project aims at realistic and effective goals as follows;

i) To quantify biodiversity in the study areas and to create a database which will include lists of inhabiting animal and plant species, endangered species, and the distribution of their habitats, with the aim of using the database for better management of nature reserve in line with biodiversity conservation programs.

ii) To obtain a physiognominal vegetation map of the study area (Merapoh side of Taman Negara) with using satellite images as a preparation for GAP analysis.

iii) To list up all the mammal and bird species occurring in the study area and to evaluate the community diversity.

And finally,

iv) To analyze the relationships between habitat structures and use by mammal and bird species and to grade the importance of each habitat type.

3. Research Methods

1) Quantification of biodiversity

Several sites were chosen for pilot studies. Complete data on habitat environments (vegetation, topography, meteorology, etc.) were collected, and a Geographic Information System (GIS) will be developed incorporating these data. By the use of this system, plausibility of selection of the existing preservation sites was evaluated. Also, diversity assessment system which is capable of proposing biodiversity preservation programs corresponding to the respective site conditions will be developed and experimentally used in broader areas in East Asian countries.

2) Vegetation map from satellite images

Satellite image acquisition

Satellite images used for the analysis were as follows. All these data were obtained through RESTEC (REmote Sensing TEchnology Center of Japan). Since each sensor has different ground resolution and coverage area, all the data were adjusted to have the same resolution of SPOT/XS data which has the highest resolution after geometrical correction. The study area is the region surrounded by N 4° 20' 23_ – N 4° 52' 58_ and E 101° 46' 23_ - E 102° 18' 48_.

Kind of satellite image	Path－Row	Date of observation	correction level	remarks
SPOT/XS	269 - 340	24 Jan 98	1B	
SPOT/XS	270 - 340	29 May 97	1B	
LANDSAT/TM	126 - 57	18 Jan 96	Bulk correction	
JERS-1/SAR	120 - 293	6 Oct 97	2.1	
JERS-1/SAR	121 - 293	7 Oct 97	2.1	

Geometric correction

All the satellite images did not have the geometric correction at the time of the data distribution, they were geometrically corrected with use of topographical maps of 1:50,000 scale which were obtained from the Survey Department of Malaysia. For every satellite images, 10 to 20 ground control points (GCP) were chosen, and minute geometrical correction was carried out for each scene with these GCP by affine transformation (cubic convolution method). Specifications of the images after the geometric correction are shown below.

Item	specification	remarks
Projection method	UTM	
UTM zone	48	
Ellipsoid	modified Everest	
Mesh size	20 m	

Mosaic images

A pair of geometrically corrected SPOT/XS images and JERS-1/SAR images were mosaicked into one scene, respectively, automatically with the UTM coordinate information. Since the images used for the mosaic were obtained on different observation date, they have different reflection intensities. Therefore, the intensities were corrected by a statistical method before the mosaic process.

Classification of images

SPOT/XS image has high resolution and it is a great advantage for manual classification by eyes. Thus, we employed manual classification method to distinguish the secondary forest from the primary forest. Secondary forests usually have logging roads which can be easily detected with SPOT/XS images if the logging was operated not long before. In order to detect logging roads, high spatial resolution as much as that of SPOT/XS or SPOT/P (panchromatic) is necessary. Urban, denuded and water areas were also able to be detected with SPOT/XS images.

The whole vegetation was classified by applying tasseled cap method to LANDSAT/TM 3, 4, 5 bands. Several kinds of plantations were easily distinguished by this procedure. Scrubs are usually very difficult to distinguish from secondary forests, however, we could successfully sort them out by using JERS-1/SAR images. SAR data possessed lower reflection in scrubs because they have higher density of woods.

3) Wildlife communities along land-use gradient

Trapping

Subject species are small mammals (insectivores, tree shrews and rodents). Three trap lines have been established along the census line below in the typical habitats (primary forest, secondary forest and oil palm plantation). Each trap line (2km) consists of 100 trap stations at 20m intervals along the census line described below. Trapping was conducted twice in March and September 1998, and the traps were set for seven nights in each session.

The study area was set in western part of Taman Negara (Merapoh side) and its surroundings.

Line census

Subject species are diurnal mid-sized mammals (primates and sciurids), large mammals (ungulates and large cats), and birds. Census lines of 5km have been established through the above three habitats, and the census was conducted to record the following information: Species, type of data (direct observation, footprint, dropping etc.), location, time and date, number of individuals, and behavior. The census was carried out once every two months from March to December 1998 by walking three times along the line in each session.

Elephant dung counting

The number of elephant dung piles was counted for each 100m section of the jeep track (13km). Dung counting was done in March and July 1998. Also the occurrence of bamboo, bananas and palms, which are the main food plants, at the roadside was recorded for each section in the first occasion.

4. Results and Discussion

1) Vegetation map

Synthesizing all the analyses, we could finally obtain a vegetation map of the study area composed of eight categories; primary forest, secondary forest, scrub, oil palm, rubber plantations, orchard, water surface and urban areas. The categorized areas were converted to vector data and prepared as a GIS dataset. Thus, this vegetation map is now available for further application for GAP.

2) Wildlife habitat

Trapping

Three species of squirrels and six species of murid rodents were captured in primary forest, one species of tree shrew, one squirrel and six murids in secondary forest, and 12 species of small mammals were recorded in total. The number of murid species was the same in both forests, but the species composition was quite different between the two habitat types. In primary forest *Leopoldamys sabanus* and *Maxomys surifer* were the dominant species, while *Niviventer cremoriventor* and *Rattus tiomanicus* in secondary forest. These differences reflect habitat preference of each species, and further study will reveal which species are most vulnerable to habitat alteration.

Census

Twenty-one species of mid to large-sized mammals and 43 bird species were recorded by the line census. In primary forest, one species of tree shrew, two species of primates, one species of squirrel, three species of carnivores and seven species of ungulates were confirmed, and in secondary forest, four species of primates, three species of squirrels

and five species of ungulates were recorded. The number of field signs per 1km suggested that elephant mainly inhabits primary forest but wild boar and barking deer show the opposite tendency. The number of common bird species in primary and secondary forests was very small and indicated a big difference in species composition between the two habitat type. This indicated that many bird species may disappear by forest logging.

Dung counting

Elephant dropping were particularly abundant in the road sections from 2.0 to 3.5 km and from 5.5 to 7.0km. Bamboo and bananas showed the concentrated distribution pattern, while palms occurred evenly along the road (Figure 1). However, no clear relation was found between vegetation and dung distribution. Habitat utilization may be affected by the other factors such as topography and location of salt licks, and the further study would be necessary.

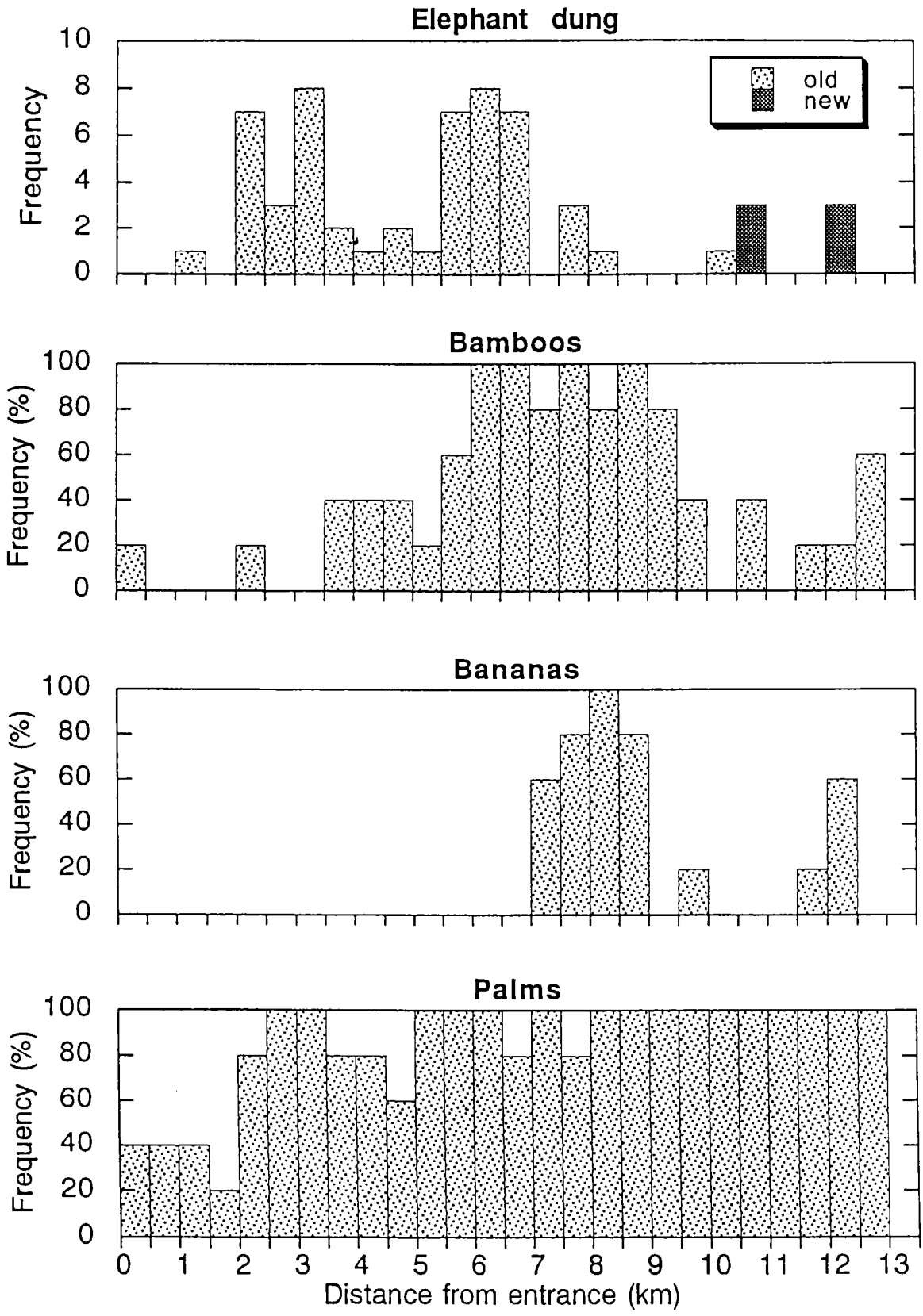

Figure 1 Distribution of elephant dungs and fringe vegetation along the jeep track.