MODELING OF JAVA RHINO HABITAT IN THE UJUNG KULON NATIONAL PARK

S. Trenggana, George. CH. Cho

soma@indo.net.id: g.cho@aerg.canberra.edu.au

Abstract

Makalah ini membahas hasil penelitian pemanfaatan teknologi SIG dalam pendugaan geografis habitat badak jawa (Rhinoceros sondaicus) di Taman Nasional Ujung Kulon.. Menggunakan peta dan data sekunder sebagai bahan dan software ARC/INFO sebagai alat,modeling, penelitian ini menghasilkan dua model habitat, yaitu habitat pada musim kemarau dan habitat pada musim penghujan. Analisa komparasi menyimpulkan bahwa SIG dapat dipakai sebagai alat untuk penetapan habitat secara spasial. Bahwa keakuratan model tergantung kepada data dan DSS yang dibangun. Bahwa model habiat pada musim kemarau merupakan habitat paling efektip..

.

Introduction

Selecting the most appropriate or suitable habitat for the very protected animals in protected areas is an important part of conservation management. This importance is connected to responsibility of management to manage the protected areas as effective and efficient as possible without decreasing the function of habitat as a site for animal to live, to feed and to cover from any disgraced impact and external disturbance.

The Ujung Kulon National Park probably a case where the park manager should carry out such work considering its status as a habitat for the very rare Java rhino population. This rarity even has assign the park into a status of the world heritage site (*IUCN, 1992*) where Indonesia has to responsible for the continuity of this species life, not only to the Indonesian communities but also to the international communities. At this point, initiative to build the most effective and efficient management aimed to conserve Java Rhino population is of necessity. This includes the determination of the most effective habitat expressed in the forms of spatial data that clearly show its position and extent

There is no standard procedure to determine the habitat suitability in a spatial format. Some may adopt a terrestrial exploration technique and draw a habitat map conventionally, while others may use secondary data and adopt Remote Sensing and GIS technologies to model a habitat. Ormsby and Lunetta (*1987*), Hodgson *et al*. (*1988*), and Tappan *et al*. (1991) were some authors who have elaborated the studies of animal habitat using remotely sensed data for which they come to the conclusion that RS dan GIS technologies were effective for use in monitoring habitat conditions.

This paper presents the result of research work carried out in 1993 concerning the modeling of Java Rhino habitat in Ujung Kulon National Park using GIS. The aims of this study were: (1) to determine the most suitable area for Java Rhino population to inhabit in the Ujung Kulon National Park; and (2) to elaborate the accuracy and easiness of GIS use in simulating a model of habitat.

Decision Support System (DSS).

The DSS for modeling the effective habitat was drawn from the philosophy of habitat functions for wildlife, in which Alikodra (*1980*) argues that the movement of animals is governed by their needs to three important habitat components, that is, food, water and cover. In the sense of Java rhino habitat, Schenkel and Schenkel (*1969*), Hoogerwerf (*1970*), Amman (*1985*) and Sadjudin (*1991*) apparently agree that the Java rhino movement in Ujung Kulon National Park has a strong connection to the needs of species on food, wallow, mineral, water and a secure site.

Food

According to Hoogerwerf (*1970*) Java rhinos are largely depending on the shrub and sapling of rain forest, which is almost exclusively to be found in the region principally covered with secondary vegetation. This considerably true as no subsequent authors have found the rhino's tracks surrounding Mt. Payung in which mainly covered by primary forest. In response to the distribution of Java rhino food, Hommel (*1987*) devided the Ujung Kulon Perninsula into four categories of habitat suitability: (1) Very suitable,(2) moderately suitable, (3) marginally suitable, and (4) not suitable. Geographic positions of each category refer to the Hommel's Landscape Ecology Map, in which for this purpose Hommel grouped the 30 landscape units into 4 categories subject to the similarity of units in character.

Water

Java rhinos require water for wallowing, drinking and bathing. The need of water for wallowing seems to be more vital for Java Rhinos than that for bathing (*Hommel, 1987*). According to Amman (*1985*) the rhinos can go without bathing for periods up to four days, but can go without wallowing for only 1 to 1,5 day. Hommel (*1987*) assumed that during dry season, the availability of water for bathing and wallowing decreases in quantity based on facts that lower courses of major streams turn into brackish and pools

upstream become too shallow for rhinos to bathe. By the time wallows cannot be used, rhinos will move to the river banks or to the edge of the tidal forest (*Hoogerwerf, 1970*). Hommel (*1987*) finally assumed that the availability of fresh water during dry season to be more than one kilometer away from the nearest water suppliers. This implicitly assumed that the availability of water for wallowing and bathing will only be in a radius of one kilometer from the water suppliers (springs, river current).

Human pressures

Schenkel and Schenkel (*1969*), Hoogerwerf (*1970*), Amman (*1985*), Sadjudin (*1991*) and Santiapillai *et al.* (*1989*), acknowledge that Java rhinos are very intolerant to human presence, and tend to inhabit areas inaccessible for human beings. Rhinos commonly choose plains which are isolated by swamps (*Sukohadi 1973*), any human disturbance will forces them to migrate elsewhere (*PPTN and HWP 1990a*). These arguments implicitly notify that rhinos tend to keep away from the existing trails inside the Ujung Kulon National Park.

The way of life of Java Rinos as described above brings to the conclusion that there are at least 4 characteristics of Java rhinos in dealing with their habitat. These characteristics are:

- Java rhinos prefer to live in the lowland area (less 100 m above sea level).
- Java rhinos tend to live surrounding water springs and river courses, and during dry season they will traverse within area some one kilometer from rivulets or water springs.
- Java rhinos tend to keep away from trails. Considering rhinos have a strong sense of smell, areas at a distance of minimum 500 m from the trail will likely chosen by rhinos to live.
- Java rhinos tend to travel around the marginally suitable, moderately suitable and preferably most suitable landscape units.

Those four characters are key-points for modeling the effective area of Java Rhino habitat.

A. Development of GIS data Base.

The study was initiated by developing GIS data base, and for this purpose the American Map Service (AMS) topographic map published in 1962 was chosen as the

spatial base data. Consideration of choosing this map is because it is the only appropriate topographic map available for the Ujung Kulon area.

Three thematic maps were added to complete GIS data base of Ujung Kulon National Park. These were: (1) The map of Ujung Kulon National Park boundary (1:50,000); (2) The Resort District Map (1: 50,000); and (3) The landscape ecology map of Ujung Kulon (1:75,000). The first was taken from the General Directorate of Forest Protection and Nature Conservation, The second was collected from the head office of Ujung Kulon National Park, while the third was taken from Hommel's report.

Digitizing process Using Arc/INFO 3.4.2 to all collected maps generated coverages as follow:

Table 1. Input Maps and Coverages generated

No	Map Source:	No.	Coverages generated
1	AMS Topographic Map	1	Coastline
		2	River network
		3	Road outside park
		4	Contour line
4	The map of Ujung Kulon National Park boundary	7	The national park boundary
5	The Resort District Map	8	Resort district
		9	Trail inside park
6	The landscape ecology map of Ujung Kulon	10	Landscape ecology unit
		11	Habitat suitability

The coastline in this case was defined as a geo-reference coverage where all coverage were transformed based on this coverage.

Modeling of Java Rhino Habitat.

The following flowchart is a summary of habitat modeling procedures, while the table shows a list of ARC/INFO commands and input coverages used in the modeling procedures. Modeling produces two habitat models: (1) habitat during dry season, and (2) habitat during wet season.

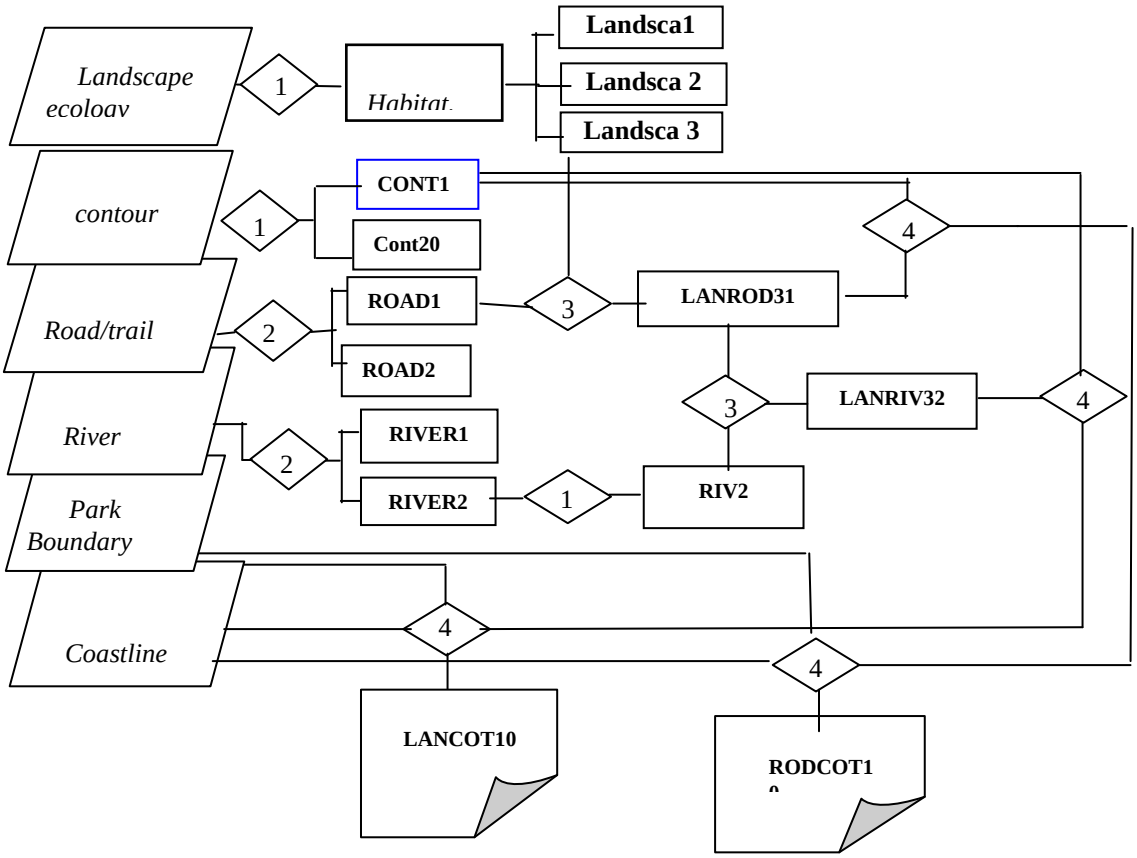


Table 2. Description of some processes in Habitat Modeling

Commands	Input coverage	Criteria/ In-file	Out. Coverage
RESELECT (1)	Landscape ecol	Lscape = 1 (most suit)	Landsca1
		Lscape < = 2 (mod. suit)	Lansdca2
		Lscape < 3 (marg. suit)	Landsca3
	Contour	Contour_ID > = 100 m	Cont10
		Contour_ID > = 200 m	Cont20
	River2	Inside_ID = 0	Riiv2
BUFFER (2)	Road	Distance = 500 m	Road1
		Distance = 1000 m	Road2
	River	Distance = 500 m	River1
		Distance = 1000 m	River2
ERASCOV (3)	Road1	Landsca3	LANROD31
	RIV2	LANROD31	LANRIV32
OVERLAY (4)			

1. Habitat during wet season

Map 1 is a result of modeling which presents the considerably effective habitat during the wet season. The map indicates that during dry season almost the whole lowland area of Ujung Kulon Peninsula, except for the area of one Km width along the trail and area of Mt. Payung.

The map also shows that the eastern part of national park encloses the Mt. Honje Nature Reserve, is likely impossible to be inhabited by Java rhinos. Based on the model, only the southern part of Mt. Honje Nature Reserve Rhinos might able to live which is only about 25 percent of the Mt. Honje area. The steepness of hill slope seems to be a constraint for Java rhinos to occupy Mt. Payung and Mt. Honje.

2. Habitat during dry season

Map 2 (the ideal habitat during dry season), clearly displays that total area of considerably effective in peninsula decrease significantly during the dry season, especially during the long drought. During this season, the central part of peninsula seems be the most critical site for Rhinos to occupy. At this point, the southern part of Mt. Honje shows a more stable habitat in extent than that of the Ujung Kulon peninsula. There is almost no change in the extent of the effective area in the southern part of Mt. Honje compared to the one during wet season.

3. Accuracy and validity of modeling

Water seems to be the most significant factor influencing the effective habitat of Java Rhino in Ujung Kulon National Park. The uncertainty of the validity then comes up at this scene knowing Hommel (1987) actually feels uncertain about the water condition and its behavior in relation to the seasonal change. His prediction of the availability of water one km away from water resources is simply based on the scientifically unproved argument which is cited from the statements of other scientists.

Is this model can be accounted as an accurate model? Figure 1. drawn by Sadjudin (*1984*), and Amman (*1985*) could likely be used as a comparative data to justify the validity of model. Figure roughly displays the pattern of concentration of Java Rhino population in the Ujung Kulon peninsula.

Schenkel and Schenkel (*1969*) Amman (*1985*) and Santiapillai *et al*. (*1989*) concluded that nearly half of the rhino population distribution was concentrated in the southern half of peninsula in between Citadahan and Cibandawoh. Schenkel and Schenkel even did not indicate a high density of rhino tracks in the central part. Considering of how they build the arguments before drawing the pattern, the figure is considerably reasonable.

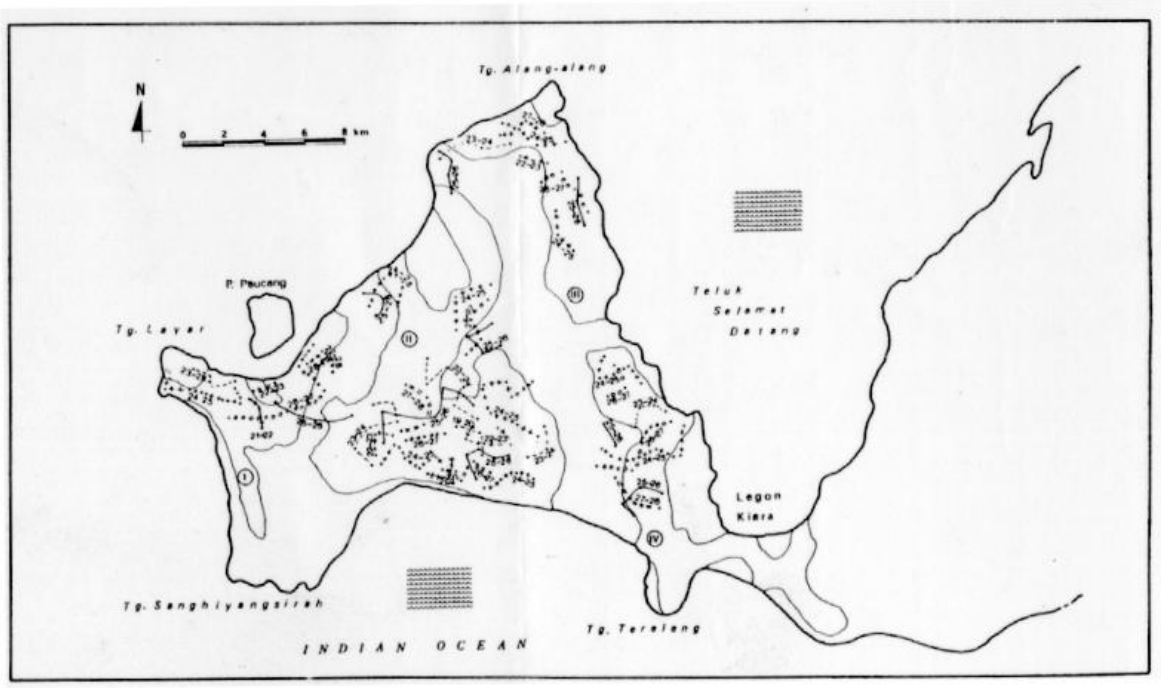


Figure 1. The Prediction of Java Rhino concentration areas based on the Java Rhino census (*Cited from Sadjudin, 1984*)

The study of modeling basically accepted the natural process. The further the site from water sources, the less the site will contain water. In case of how far the sufficient water will available from the water sources (in this case rivulets) depends on how bad the drought was in the peninsula. At least, by setting up the one kilometer buffer distance from rivers, the model as shown in the Map 2 matched the results of rhino census carried out by Sadjudin (1984).

Human presence is another case that potentially give the significantly different output, so that setting of appropriate distance is important to give a reasonable model. Distance in this model was set at 250 m simply based on the assumption that interaction to human is mainly govern by the smell than view or sound. In this case, wind assumed could flow a flavor of human body maximum 250 m before completely neutralized by air.

The presence of rhinos on trails inside park (Hoogerwerf, *1970*) and approaching to one rhino during fieldwork at less than 50 m before he finally aware of human presence, seemingly weaken the above assumption and lead to the question of how far rhinos can actually smell the presence of human? The encounter between human and rhino seems more significant in influencing the habit of rhinos to use human trails for their travel. It was noted that the frequency of human presence on trails between Karang Ranjang, Cibunar and Peucang Island was about 2 person/ day on average (*Forest ranger pers*

comm. 1993), and they traveled during the day. Likewise, people who traveled along northern trails from Peucang Island to Jammang vice-versa. This assumption may also applicable to answer the fact that no rhino inhabits the southern part of Mt. Honje notably suitable habitat.

Frequency of human presence is probably more reasonable to define the appropriate buffer distance of trails. The 250 m buffer distance was considerably too wide at the time of study, but it may be reached when frequency of human presence increase up to the certain amount. Research concerning the impacts of frequency of human to the rhino movements is likely important to carry out to determine the accurate buffer distance.

Conclusion

- Under the uncertainty of DSS parameters, the model of habitat during dry season can be adopted as a representative model to present the most effective habitat of java Rhinos in the Ujung Kulon National Park..
- GIS can be effectively used to determine and simulate the spatially and geographically habitat of wildlife in a given area.

Recommendation

It is important to carry out studies concerning all parameters of DSS to gain the more accurate model of habitat of Java Rhino in the Ujung Kulon National Park, so that the result is not only used for propagation but also used as a main reference for making decisions. .

BIBLIOGRAPHY

Alikodra, HS. 1980. *Dasar-dasar Pembinaan Margasatwa (The Principles of Wildlife Management*). Faculty of Forestry. Bogor Agricultural University. Bogor.

Amman, H. 1985. *Contribution to the Ecology and Sociology of the Javan Rhinoceros (Rhinoceros sondaicus Desm) in the Ujung Kulon National Park*. Econom-Druck AG. Basel.

Hodgson, ME., JR. Jensen, HE. Mackey, Jr., and MC. Coulter. 1988. Monitoring Wood Stork Foraging Habitat Using Remote Sensing and Geographic Information Systems. *Photogrammetric Engineering & Remote Sensing, 54 (11)* : 1601 - 1607.

Hoogerwerf, A. 1970. *The Land of Ujung Kulon : The Last Java Rhinoceros*. EJ Brill. Leiden.

Ormsby, JP. and RS. Lunetta. 1987. Whitetail Deer Food Availability Maps from Thematic mapper Data. *Photogrammetric Engineering & Remote Sensing, 53(8)* : 1081 - 1085.

Proyek Pembangunan Taman Nasional dan Hutan Wisata Pusat. 1990a. *Studi Tingkah Laku Badak Jawa (Rhinoceros sondaicus Desm); Paper Penunjang (The Study of Java Rhino Behaviour ; A Contribution Paper).* The Directorate General of Forest Protection and Nature Conservation. Bogor.

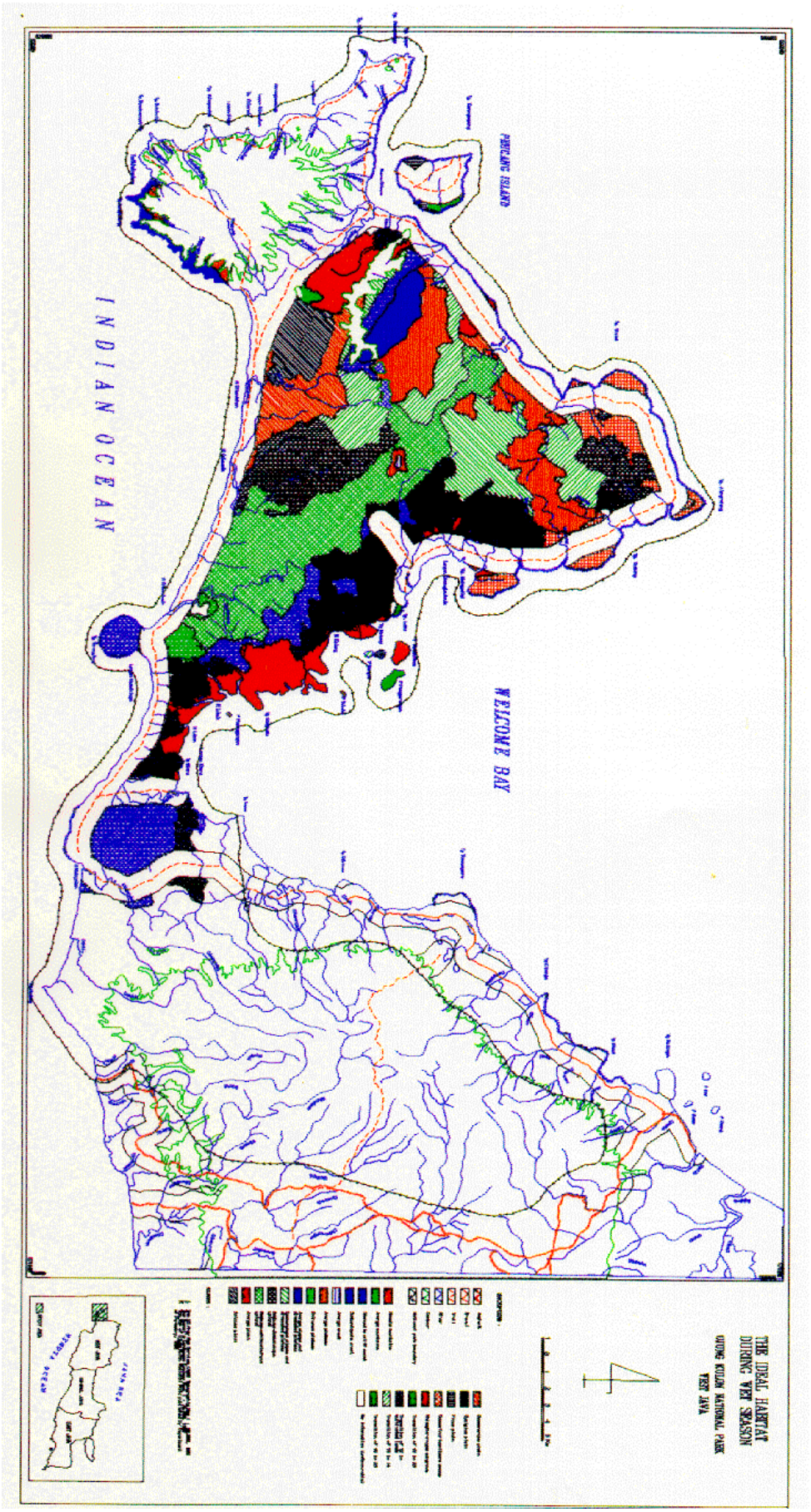
Sadjudin, HR. 1983. Badak Jawa (*Rhinoceros sondaicus* Desmarest, 1822) di Semenanjung Ujung Kulon. *Biologica VII : 46,* Senat mahasiswa Fak. Biologi Universitas Nasional. Jakarta.

Sadjudin, HR. 1991. *Ekologi and Perilaku Badak Jawa di Ujung Kulon (Ecology and Behaviour of Java Rhino in Ujung Kulon).* One Day Seminar of Java Rhino Conservation. Department of Forest Resource Conservation, Faculty of Forestry, Bogor Agricultural University. Bogor.

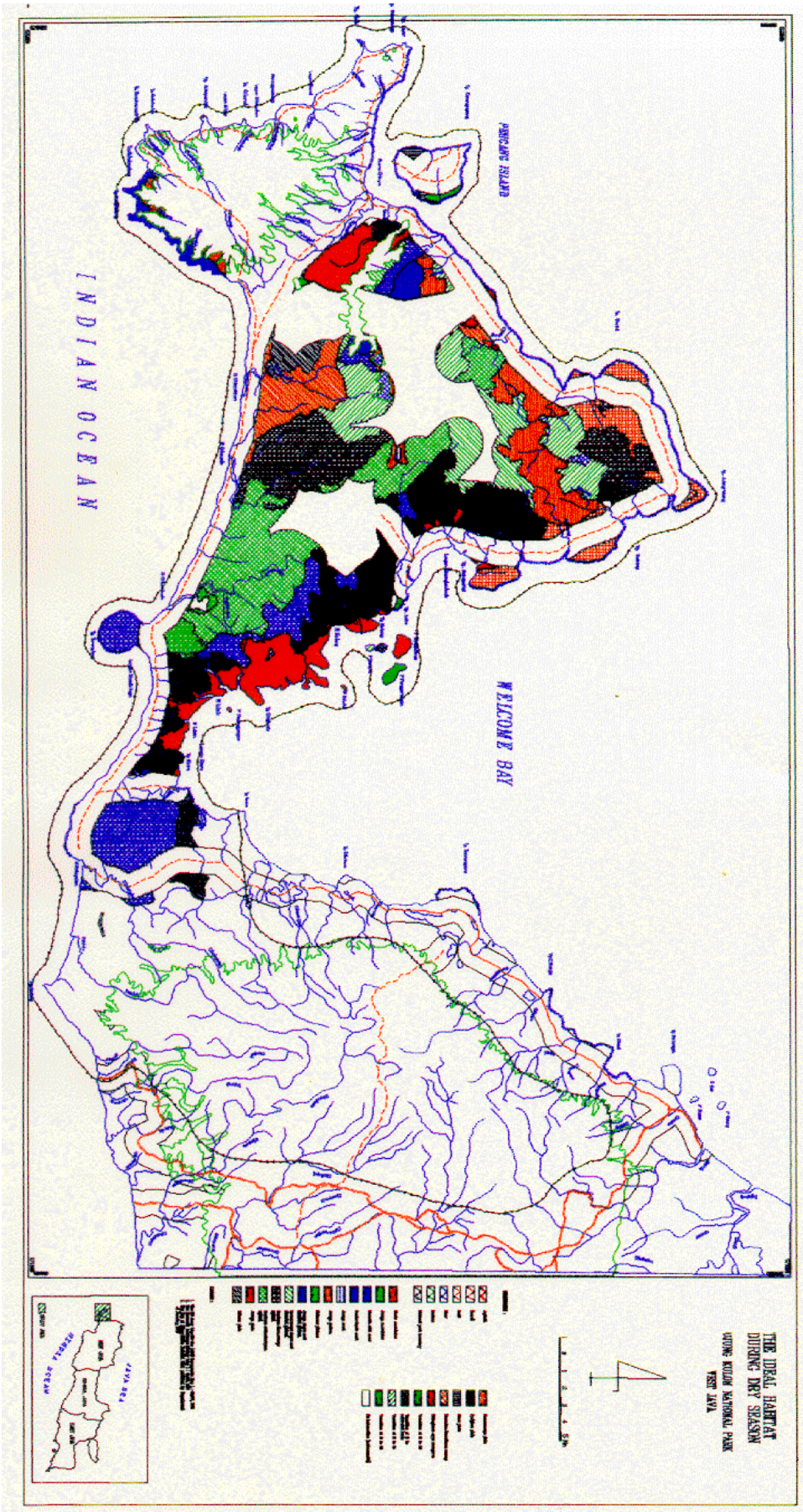
Santiapillai, C., WS. Ramono, and BP. Darmadja. 1989. *Status of the Javan Rhino in Ujung Kulon National Park.* WWF 3875 Report No : 3. Bogor, Indonesia.

Schenkel, R. and Schenkel HL. 1969. *The Java Rhinoceros in Ujung Kulon Nature Reserve. Its Ecology and Behaviour.* Druck von Fredrich Reinhardt A.G. Basel.

Sukohadi, W. 1973. *Beberapa Catatan Mengenai Badak Jawa (Some Notes About the Javan Rhino).* Bogor.



Map 1. The effective habitat during dry season



Map 2. The effective habitat during dry season