Ecological and social aspects of reintroducing megafauna

A case study on the suitability of the Honje Mountains as a release site for Javan rhinoceros *Rhinoceros sondaicus*

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Summary

Among the rarest and most endangered large mammals on earth is the Javan rhinoceros (*Rhinoceros sondaicus*). There are only about 60 specimens left worldwide, which are restricted to two small and isolated locations in Indonesia and Vietnam. In order to save the Javan rhino from extinction, it has been proposed to translocate a number of breeding animals to protected areas within its historical range.

In a world where more and more animals become endangered and habitats become more and more fragmented, reintroductions are an increasingly popular tool to save species from the brink. Although reintroductions have been carried out since the early 1900s, many of them resulted in failure, and little was learned from mistakes. Little reintroduction literature is generally accessible, although this number has started to rapidly increase in the last decade.

However, the amount of reintroduction literature dealing with social aspects is even more limited. Therefore, among the objectives of this research is to test a method of assessing social acceptability judgments by applying it to a concrete situation, namely the reintroduction of Javan rhinoceros in the Honje Mountains, Indonesia.

The principle aim of reintroduction programmes is to re-establish a free-ranging, viable population of locally extinct species in the wild. The objectives of such programmes may be to increase the chances of long-term survival of a species, to re-establish a key-stone species in an ecosystem, to maintain or restore biological diversity, to generate economic benefits or to increase conservation awareness among the public.

Before any reintroduction should be attempted, a number of prerequisites should be met. These prerequisites include biological considerations, such as the suitability of the habitat at the potential release site, the genetic make up of the founder population, behavioural requirements of the animal in question, home range size and territoriality. Furthermore, social aspects should also be considered, including the impact, costs and benefits of the reintroduction on local communities, as well as the attitudes of local inhabitants towards the reintroduction programme.

As such, there are five factors that influence people's attitudes, i.e. knowledge; spatial, temporal and social context; perceived risks; ethics and the amount of trust they have in decision making bodies. In this study, a scale was developed for each of these factors in order to be able to quantify them, and analyze which factors most determine local people's attitudes towards the reintroduction of Javan rhinoceros to the Honje Mountains in Ujung Kulon National Park, Banten Province, Indonesia.

Ujung Kulon acquired the status of National Park in 1984 and was declared Indonesia's first World Heritage Site in 1991. In 1992, Ujung Kulon National Park was expanded to include the Honje Mountains, which were a Nature Reserve since 1967. The population of Javan rhinoceros is restricted to the peninsular part of Ujung Kulon National Park and only occasionally ventures into the southern Honje Mountains.

In this research, the suitability of the Honje Mountains as Javan rhino habitat was assessed based on a number of habitat requirements. These habitat requirements are the availability of food plants, the accessibility of an area based on the angle of its slopes, the availability of water and mud-wallows and the availability of cover. Furthermore, the level of human disturbance is considered an important criterion in defining the suitability of an area as Javan rhino habitat.

To analyze the extent to which the Honje Mountains fulfil these habitat requirements, the availability of each requirement was visualized in a map. The results were summarized in a table, which was analyzed using a Multi Criteria Analysis to produce a theoretic habitat suitability map of the Honje Mountains. This map was further analyzed to determine the practical and potential suitability of the Honje Mountains as Javan rhino habitat.

The attitudes of local inhabitants towards Javan rhino reintroduction were assessed through interviews. In these interviews, the respondents were asked a number of questions related to each of the attitude defining factors. Next, the answers were translated into a point on a five-point scale, with the aim to assess how favourable each answer would be for rhino conservation. Finally, the results are analyzed in order to identify which factors are the most important in defining local inhabitants' attitudes.

It was found that the Honje Mountains theoretically offer approximately 9.072 hectares of suitable Javan rhino habitat, which is around 40,61 % of the entire Honje Mountains. However, this area can potentially be increased to 10.289 hectares (46,05 %) if the level of human disturbance is reduced.

The villagers living around the Honje Mountains all support the conservation of Javan rhinoceros. However, more than a third does not agree with its reintroduction to the Honje Mountains. The most important attitude defining factors were found to be their awareness of the critically endangered status of Javan rhinoceros (spatial, temporal and social context), the positive or negative associations they have with this animal (ethics) and most decisively the number of benefits they expect to reap from the reintroduction (spatial, temporal and social context).

The results are further analyzed to come with some estimations on the number of rhino that could be reintroduced to the Honje Mountains, and which role this area could play in the reintroduction of Javan rhinos to other areas. The Honje Mountains show a high potential to act as a Javan Rhino Sanctuary, where rhinos can breed and be studied before they are translocated to areas further away.

The benefits that Javan rhino translocation could bring to the inhabitants of the Honje Mountains are analyzed. Eco-tourism has much potential, especially if a Javan Rhino Sanctuary is established. Furthermore, eco-development projects such as community forestry will allow both the development of the people and the conservation of the environment.

Finally, a number of other ways to increase the Javan rhino population are discussed. Intensive habitat management should stop and at least partially reverse the wild spread of *Arenga obtusifolia*, allowing the regeneration of rhinoceros food plants. Furthermore, intensive management of grazing grounds may encourage banteng to come out of the forest to forage, reducing any potential competition for space with Javan rhino. It may even be necessary to translocate a substantial number of banteng to other protected areas within its natural distribution.

Analyzing people's attitudes towards reintroductions by determining which factors shape their judgments helps to design projects that benefit both the people and the conservation of the environment. The method tested in this research has proven to be useful, although it needs to be further developed for the specific case of reintroductions. Currently, there is too much freedom in the interpretation of some of the factors. In this study, a number of suggestions as to how to improve this method are given.

The translocation of Javan rhinoceros to areas within their former natural distribution is crucial to save to species from extinction. The establishment of a Javan Rhino Sanctuary in the Honje Mountains is an important step towards increasing the population of this animal.

The local inhabitants support the conservation of Javan rhinoceros, but many do not agree with its translocation. Nevertheless, eco-development projects such as community forestry should be able to generate more support. Furthermore, working in close cooperation with the local inhabitants should greatly improve their relationship with National Park staff, which further benefits the conservation of the Javan rhinoceros.

Foreword

When I went to Java for the first time in 2002, I had no idea what to expect. As so many tourists do, I bought myself a traveller's guide and started reading, exploring all the places that could be of particular interest to me. When I came across a description of Ujung Kulon National Park, I read for the first time about the rare and elusive creature that roams its forests. Against all odds, this creature had managed to survive the growing human population and the fragmentation of its habitat, to retreat itself to a remote peninsula where human settlements had been wiped out by the famous eruption of Krakatau in 1883. The moment I read about it, I knew I had to go there, if not to encounter the animal, then at least to see the place that had become its last safe haven.

As I trudged through the jungles of Ujung Kulon in search of a Javan rhinoceros, I was amazed at the high variety of habitats that I encountered; from mangroves to impenetrable scrubland, and from dry beach vegetation to lush rainforest. It was not at all the kind of habitat that I imagined for a rhino; I was familiar with the Indian and African rhinos, which live on open grasslands. Seeing the dense jungles of Ujung Kulon only added to the mystery of the fascinating animal of which I was hoping to catch a glimpse.

It was not to be. I faced searing heat and immense exhaustion, and my travel companion was struck with a fever, hardly able to move on any more. But on the last day of our trek, we were rewarded with a single, three-toed footprint on the soil in front of us. A Javan rhino had crossed our path not long ago. It was not what I had hoped for, but, despite the exhaustion, seeing proof of its existence made my heart beat faster.

I left Ujung Kulon fatigued, sunburnt and dirty, but most of all I was exhilarated and enthralled with the beauty of the place. From that moment on I knew where I wanted my studies of Nature Conservation to lead; I would do what I could to contribute to the protection and rescue of that magnificent mammal. I began to read about Javan rhino history, ecology and the current threats to its survival, and I successfully completed my Bachelor of Science thesis on the subject of its stagnant population. After graduating for my BSc., my enthusiasm for Javan rhino conservation only increased, and I was determined to write my MSc.-thesis about this animal as well.

I wanted my research to be useful for Javan rhino conservation. That is why I decided to focus my study on the expansion of its population by means of reintroduction. A layman to the field of reintroduction, I took great interest in literature on the subject. I became aware of the great value of reintroductions as a means to save species from the brink. The growing human world population and the severe fragmentation of habitats that it causes, make reintroductions one of the most promising ways to maintain viable populations of rare and endangered species.

The document that you are holding is a report of a case study on the reintroduction of Javan rhinoceros. In this report, I will explore ecological and social aspects of a potential release site in order to assess its suitability as Javan rhino habitat. To do so, I make use of a set of attitude defining factors proposed in literature, and I will assess the usefulness of this set of factors. It is my hope that this study proves useful, not only to Javan rhinoceros conservation, but to the conservation of rare and endangered species around the world.

The author

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PART I

Introduction

1. Introduction

1.1. Situation review

One of the rarest and most endangered large mammals on earth is, without doubt, the Javan rhinoceros *Rhinoceros sondaicus* (Amman, 1985; WWF, 2002; Dinerstein, 2003; Fernando *et al.*, 2006). Worldwide, there are approximately 60 specimens left, most of which live in Ujung Kulon National Park in Indonesia. A handful of Javan rhino still survive in Cat Tien Nature Reserve, in Vietnam. Historically, the Javan rhino ranged from Assam in eastern India, through Indochina and the Malaysian peninsula to the islands of Sumatra and Java in Indonesia (Fernando *et al.*, 2006). Up until the middle of the eighteenth century, the number of rhino on Java was so high that it was not uncommon to encounter them in the vicinity of Batavia (Jakarta). However, intensive hunting has contributed to the extirpation of rhino throughout their former range, and in 1934, the last rhino outside Ujung Kulon was killed near Tasikmalaya, in West-Java, even though it had become a legally protected species by 1910 (Hoogerwerf, 1970).

Since 1967, when the first census since World War II estimated the number of rhino at 25 (YMR *et al.*, 2002), the population in Ujung Kulon has grown to 58-69 animals in 1983, after which it has been fluctuating around 60, until today (Ministry of Forestry of the Republic of Indonesia, 2007).

To save the Javan rhino from its precarious situation, it has been proposed to translocate a number of breeding animals to areas within its former range. Santiapillai and Suprahman (1986) have discussed this proposed reintroduction, and recommended to wait until the rhino population had reached 80 individuals. Unfortunately, the population has not grown to this number until now, which may be one of the reasons why translocation has not been thoroughly studied since Santiapillai and Suprahman (1986). Nevertheless, WWF-Indonesia and the Indonesian Ministry of Forestry are currently working on a two-year programme to investigate the suitability of a number of sites for the reintroduction of Javan rhinoceros. Among these sites are Tesso Nilo National Park in Riau Province, Central Sumatra; Berbak National Park in Jambi Province, South Sumatra; Gunung Halimun Salak National Park in Banten and West Java Provinces, West Java; and Harapan Forest in South Sumatra. This programme is part of the Rhino Century Programme, which set a number of targets for future rhino populations. For the Javan rhinoceros, the short term targets are to have a stable metapopulation of 70 – 80 animals in two locations by 2015, which should have increased to 100 – 120 animals by 2025 (Ministry of Forestry of the Republic of Indonesia, 2007).

Reintroductions are an increasingly popular tool for the protection of endangered species (Mathews *et al, 2006*). Unfortunately, however, they suffer from a poor success rate. Although reintroductions for conservation purposes have been carried out since the early 1900s, many of them failed, and little was learned from these failures (Armstrong & Seddon, 2007). In 1988, this situation led to the formation of the IUCN Species Survival Commission's reintroduction specialist group, which formulated a set of guidelines (IUCN, 1998). These Guidelines for Reintroductions give a rather detailed overview of biological requirements for reintroductions, but unfortunately the social aspects are not sufficiently emphasized. Research has shown that a lack of cooperation between reintroduction biologists and local people often results in the failure of a reintroduction project (Reading & Kellert, 1993; Dunham, 2000). There are however many opportunities to involve local people in the decision making process, which can lead to very positive results (Dinerstein, 2003; Steinmetz *et al*, 2006). Sadly, though, the literature on social aspects of reintroductions is still very limited, and examples of successful involvement of local people are still rare. Most studies on reintroductions and reintroduction biology focus on the biological and ecological aspects, even though the importance of social aspects is generally recognized by reintroduction biologists.

1.2. Motivation of the topic

For this research, the topic of reintroduction was chosen, because it is a very valuable conservation tool in a world where the number of endangered species is increasing, and where habitats are becoming ever more fragmented. Unfortunately, the success rate of reintroduction programmes is still very low (Armstrong & Seddon, 2007). It is therefore necessary to study which factors contribute to the success or failure of a reintroduction, and how these factors can be influenced in such a way that the chance of success is highest. Apart from investigating the ecological aspects that should be taken into account when preparing for the reintroduction of an endangered species, this research pays special attention to the social aspects that come into play.

The research was done by means of a case study of Javan rhinoceros, because this is arguably the rarest large mammal in the world. Since the remaining Javan rhino populations are very small and isolated, and located in densely populated Southeast Asian nations, it is particularly challenging to find suitable locations for the establishment of a new viable population. A major hurdle in reintroduction programmes of large mammals in South-East Asia is the high density of human populations combined with the low availability of large areas of undisturbed habitat (Dinerstein, 2003). This situation stresses the importance of cooperating with local inhabitants, and finding opportunities for them to benefit from the conservation of large mammals and their habitats.

The study area chosen for this research is the Honje Mountain Range, which is part of Ujung Kulon National Park. Currently, Javan rhino only ranges on the peninsular part of the national park, and only occasionally visits the Honje Mountains (Hariyadi, pers. comm. 2008). However, Clarbrough (1997) suggests that there is some suitable rhino habitat available in the Honje Mountains. Therefore, this area was chosen as a study area to further assess its suitability as rhino habitat, and to explore the attitudes of surrounding communities towards a possible reintroduction of Javan rhino to the Honje Mountains.

1.3. Objectives

The objectives of this research are as follows:

1. assess the suitability of the Honje Mountains as a habitat for Javan rhinoceros,
2. explore the attitudes of local communities towards the possible reintroduction of Javan rhinoceros to the Honje Mountains,
3. explore the applicability of Stankey and Shindler's (2005) five attitude determining factors when trying to define the reason why a certain attitude is prevalent. These five factors are knowledge; spatial, temporal and social context; perceived risks; ethics; and institutional and personal trust.

1.4. Research questions

The main research question of this research is: How does the combination of ecological and social considerations influence the definition of suitable locations for the reintroduction of threatened species?

A number of sub research questions has been formulated, which address the different objectives of the research in an attempt to answer the main research question. These are as follows:

1. Do the Honje Mountains provide sufficient suitable habitat to support a Minimum Viable Population of Javan rhinoceros?
2. Can future interaction between the founder population and the source population be realized?
3. What are the attitudes of local communities towards rhino conservation, and more specifically, the possible reintroduction of Javan rhino to the Honje Mountains?
4. Which factors are most important in defining such attitudes?
5. How can local communities be actively involved in rhino conservation?

1.5. Contents of this report

This report starts with a discussion of the history of reintroduction biology. The theoretical framework is also explained, after which the objectives of reintroductions and their requirements are laid out.

The discussion of reintroduction biology is followed by the presentation of the case study. Here, the history, topology, climate and conservation significance of Ujung Kulon National Park and specifically of the study site are presented, followed by a description of the Javan rhinoceros. This description includes its morphology, habitat requirements and current threats to its survival.

Next comes an outline of the methodology used in the research. Different phases of the research are discussed, namely the preparation phase, the collection of data and the data analysis.

After the methodology has been explained, the results are presented and analyzed. First, the ecological aspects are examined, followed by the social aspects. Next, the most important factors defining people's attitudes are defined.

Finally, the usefulness of the methodology is discussed, as well as the reliability of the data collected. After this discussion, a number of conclusions are presented, in which the above research questions are answered. The report is concluded with a set of recommendations for rhino conservation, improvement of the methodology, and further research.

PART II

Reintroduction Biology

2. Reintroduction of endangered species

2.1. Introduction

This chapter presents an overview of the history and theoretical framework of reintroduction biology, as well as its objectives and requirements. The aim of this chapter is to provide the reader with the necessary background knowledge to understand the approach taken in this research as well as the choice of methodology. The approach and methodology of this research are built on the information given in this chapter. Furthermore, the information presented here provides a basis for answering the research questions.

2.2. Historical overview

Reintroduction is an increasingly popular tool for wildlife conservation (Mathews *et al, 2006*), but unfortunately it suffers from poor success rates (Armstrong & Seddon, 2007). Attempts at reintroductions have been made at least since the early 1900s, but most of these failed, and little was learned from these failures. In 1987, the International Union for Conservation of Nature and Natural Resources formulated a Position Statement on reintroductions (IUCN, 1987), and in 1988, the IUCN Species Survival Commission (IUCN/SSC) formed a Reintroduction Specialist Group (RSG), in an attempt to better monitor and regulate reintroduction programmes (Armstrong & Seddon, 2007). The IUCN/SSC Reintroduction Specialist Group formulated a set of guidelines for reintroductions in 1995, to help to ensure the success of reintroduction programmes. (IUCN, 1998). However, according to Fischer and Lindenmayer (2000), it is as of yet uncertain whether reintroduction programmes have become more successful since then (table 2.1). This observation can for a great part be attributed to the fact that half of the reintroduction programmes from after 1990 had not yet been evaluated during their study.

Table 2.1 Reintroduction success through time

Year	No. of studies	No. of successes	No. of failures	No. unknown
Unknown	6	1 (17%)	1 (17%)	4 (67%)
Pre 1970	3	1 (33%)	2 (67%)	0 (0%)
1970s	9	5 (56%)	1 (11%)	3 (33%)
1980s	38	13 (34%)	8 (21%)	17 (45%)
1990s	60	10 (17%)	19 (32%)	31 (51%)
Total	116			

Source: Fischer & Lindenmayer, 2000

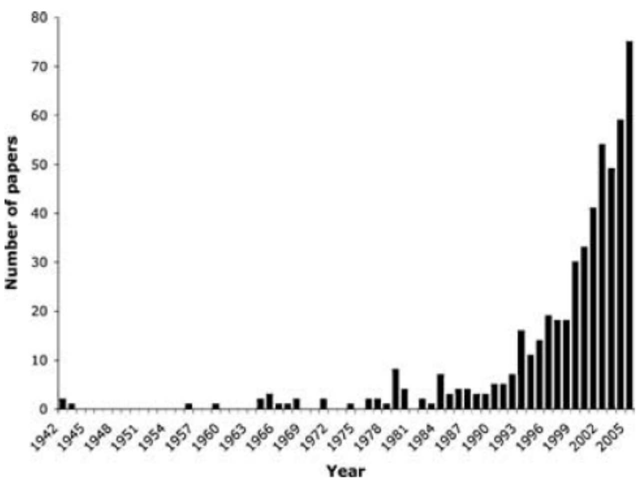

Figure 2.1 Number of reintroduction-related papers published in peer-reviewed journals. *Source: Seddon* et al, *2006*

Fischer and Lindenmayer (2000) make the observation that there is little reintroduction literature generally accessible, and they recommend that reintroduction results should be published more often, both in cases of success and in cases of failure. Since Fischer and Lindenmayer (2000) the number of papers published that deal with reintroductions has increased dramatically (Seddon *et al*, 2006, see fig. 2.1). However, this is probably not so much a result of their recommendation, but should rather be attributed to the availability of a set of guidelines since 1995. Sadly, however, most of these papers focus on the ecological aspects, and the number of articles that deal with the social aspects of reintroductions is still fairly low.

2.3. Theoretical framework

According to Caughley (1994), strategies for species conservation follow either of two paradigms: the small-population paradigm, or the declining-population paradigm. The small-population paradigm deals with the effect of small populations on the chances of survival of a species, and is generally applicable across species. The declining-population paradigm, on the other hand, deals with the causes of smallness, and how it can be remedied. This paradigm can not be generalized across species, because the factors that cause a population to decline are too many.

The small-population paradigm suffers from an excess of theory, and has a limited applicability to real-world conservation problems, while the declining-population paradigm suffers from a critical lack of theory, which may hinder the development of a scientific framework for the management of complex systems (Caughley, 1994; With, 1997). According to With (1997), theories in conservation biology have been criticized of not being usefully predictive, and thus have a limited use as a guide to management decisions. However, according to Hedrick *et al* (1996), the integration of practice and theory is more successful than Caughley (1994) and With (1997) describe. As an example, they mention efforts by the Conservation Breeding Specialist Group of IUCN to integrate habitat considerations in population viability analyses. Hedrick *et al* (1996) recommend conservation biologists to use all the existing methods in conservation programmes, in order to achieve maximum success.

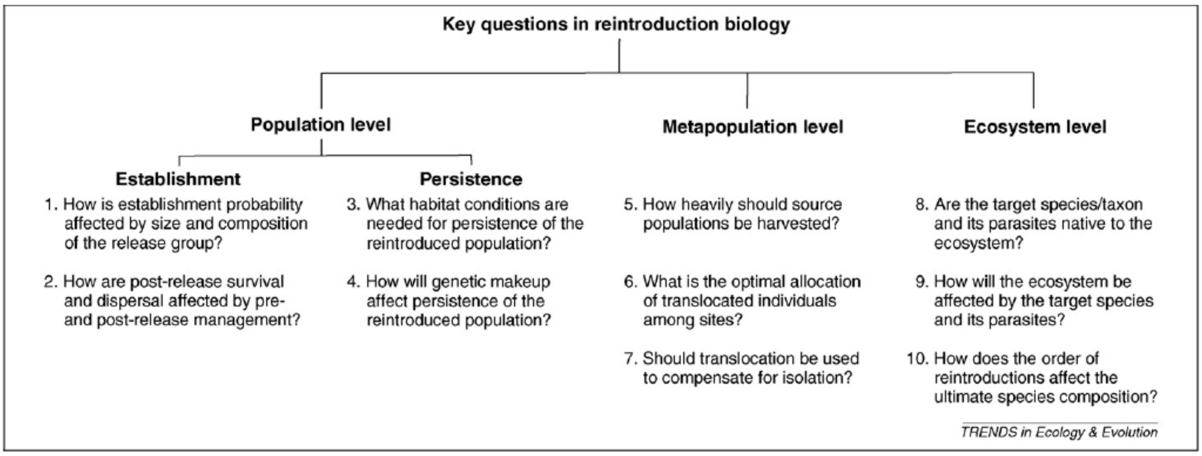

Figure 2.2 Key questions for reintroduction biology, at the population, metapopulation and ecosystem levels. *Source: Armstrong & Seddon, 2007.*

Similarly, Armstrong and Seddon (2007) encourage reintroduction biologists to consider both the small-population paradigm and the declining-population paradigm. They propose a set of ten key questions to be addressed when preparing for a reintroduction programme (fig. 2.2). If all ten questions are considered in research, the scope of reintroduction biology would be greatly increased. According to Armstrong and Seddon (2007), only four of these questions are usually addressed in reintroduction research (Q1-3, Q5). This is quite surprising, since eight of these questions (Q1-6, Q8-9) are described in the Guidelines for Reintroductions (IUCN, 1998). Armstrong and Seddon's (2007) comment seems to be a bit rash, and their list of questions incomplete. Several articles found during the present research deal with genetic questions (Howells & Edwards-Jones, 1996; Olech & Perzanowski, 2002) and questions related to demographic stochasticity (Saltz, 1995; Komers & Curman, 1999), which are not included in the list of Armstrong and Seddon (2007). However, it is true that no studies have been found that address all key questions at once. This can be attributed to practical reasons. Reintroduction programmes are usually very expensive, and rely on long-term financial and political support (IUCN, 1998; Sarrazin & Barbault, 1996). More often than not, it is this long-term funding, rather than scientific research, that defines the success of reintroductions. Furthermore, the choice to start a reintroduction is more often based on ethical or economic reasons, rather than scientific facts (Sarrazin & Barbault, 1996).

Nevertheless, the importance of balancing the small-population and the declining-population paradigms is quite clear. A study by Asquith (2000) shows the risk of using only one of these paradigms in the search of a solution to a conservation problem. When designing management strategies for the conservation of Javan gibbon (*Hylobates moloch*), each paradigm offers totally different and nearly opposite solutions. A field study of Javan gibbon (declining-population paradigm) suggests that populations of <25 animals should not be considered of high conservation priority. Instead, resources would be better spent on management activities that aim to reduce threats to larger, more viable populations. According to this field study, reintroduction of Javan gibbon would be more feasible than *ex situ* conservation (i.e. captive breeding). On the other hand, a Population and Habitat Viability Analysis (small-population paradigm) suggests that the smaller populations have a high priority, and that resources be spent on costly, technical management activities, including *ex situ* conservation (Asquith, 2000). It is probably true that resources can be spent more effectively on the reduction, or preferably the removal, of threats to larger, more viable populations. However, this should not result in the smaller, less viable populations to be ignored. Clearly, the best solution would be one that guarantees the long-term survival of all populations.

Concerning *ex situ* conservation versus *in situ* conservation, the debate on this subject is among the greatest in the conservation community (Dinerstein, 2003). The aim of captive breeding is to rescue animals that are facing extinction in the wild, due to habitat loss. Ultimately, the goal is to release captive bred animals back into the wild when suitable habitats have been secured. However, every individual of a species in captivity is one individual of that species less in the wild. As will be discussed later, releasing captive bred animals into the wild has a number of disadvantages compared to translocating wild animals, including increased inbreeding depression and a lack of necessary survival skills. Furthermore, the money needed for a new zoo exhibit would be much better spent on *in situ* conservation efforts like habitat regeneration and more effective protection measures (Dinerstein, 2003). Obviously, it makes much more sense to spend money on removing a threat from an area and allowing an animal to survive in the wild, rather then removing an animal from the wild and doing nothing about the threat.

2.4. Objectives of reintroductions

According to the IUCN/SSC Reintroduction Specialist Group (1998), the principle aim of reintroductions is to re-establish a free-ranging, viable population of locally extinct species in the wild. The animals to be reintroduced should be released in areas with sufficient suitable habitat available, which are located within the species' historical range.

Reintroductions may have a broad range of objectives, including:

- to increase the chances of long-term survival of a species;
- to re-establish a keystone species in an ecosystem;
- to maintain or restore biological diversity;

- to generate economic benefits;
- to increase conservation awareness;

or a combination of any of these (IUCN, 1998). However, according to Fischer and Lindenmayer (2000), the primary objective in the majority of reintroduction programmes is conservation (fig. 2.3), which could be (a combination of) any of the first three of the above-mentioned objectives. More specifically, Teixeira *et al.* (2006) define three main objectives of reintroduction programmes which aim at conservation of a species: (1) post-release survival of the animals, (2) settlement of the animals in the release area, and (3) successful reproduction of the animals in the release area.

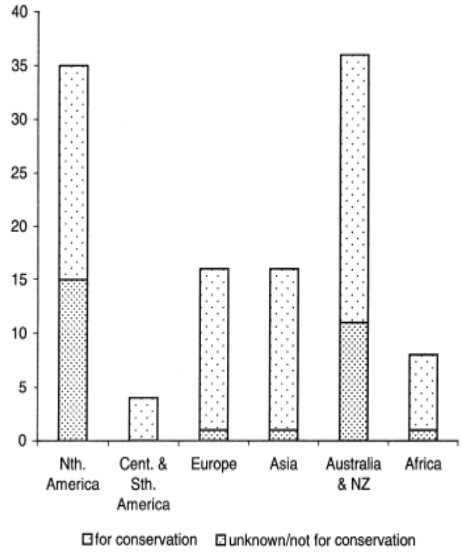

Figure 2.3 Objectives of reintroduction in 116 cases. *Source: Fischer & Lindenmayer, 2000*

2.5. Requirements for reintroductions

The IUCN (1998) proposes a long list of prerequisites that should be met before attempting a reintroduction. Most of these recommendations are on the ecological aspects, although the socio-political and legal aspects are also briefly discussed. These recommendations are discussed below.

2.5.1. Biological requirements

A feasibility study and background research should be carried out prior to the planning of any reintroduction (IUCN, 1998). First of all, an assessment of the taxonomic status of the individuals that are to be reintroduced should be made. It is recommended that they are of the same subspecies as those that previously existed at the release site, unless the remaining numbers of this subspecies are not sufficient to achieve this. This is particularly important when translocating animals for the purpose of reinforcement of a remnant population (Sarrazin & Barbault, 1996). In such cases, there is a risk of outbreeding depression, which means that the partial genetic incompatibility between animals of different origin may result in increased infant mortality (Pluháček *et al*, 2007). However, Pluháček *et al* (2007) argue that the high infant mortality found in a reintroduced population of greater one-horned rhinoceros (*Rhinoceros unicornis*), where founder animals came from different origins, should not be attributed to outbreeding depression, but rather to the mother's age and parity (i.e. the number of offspring previously born).

When the former population at the release site has long been extinct, it is particularly important to assess the genetic diversity within and between the remaining populations, especially if the remaining populations are small and isolated. It is generally accepted that small and isolated populations face the threat of inbreeding depression, i.e. low genetic diversity (Santiapillai & Suprahman, 1986; Saltz, 1995; Hedrick *et al*, 1996; Amin *et al*, 2006; Armstrong & Seddon, 2007). Inbreeding depression is expressed in reduction in heterozygosity, allelic diversity and polymorphism (Dinerstien, 2003), and it manifests itself in higher rates of birth defects, slower growth, higher mortality, and lower fecundity (IUCN, 1987); factors which would jeopardise the successful reproduction of released animals originating from an inbred population. However, according to several sources referred to by Dinerstein (2003), the threat of inbreeding depression may be overemphasized. Populations must be very small during several generations before heterozygosity is seriously diminished.

Furthermore, when populations are at such low numbers, the threat of sudden extinction is very high, making it probable that the population will have gone extinct before losing its genetic diversity.

Most supportive data for decreasing genetic diversity as a result of small, isolated populations comes from research on captive animals. Because inbreeding depression is found in captive animals, it is assumed to be true for wild populations as well, even though in most cases, little evidence exists to support these assumptions (Dinerstein, 2003). In his work on the natural history of the greater one-horned rhinoceros, Dinerstein (2003) shows that the heterozygosity in the rhino population in Royal Chitwan National Park in Nepal is among the highest observed in free-ranging animals, despite the fact that this population experienced a bottleneck in the 1950s and 1960s. This is attributed to the high numbers of greater one-horned rhinoceros in and around Chitwan prior to its decimation, which allowed high levels of genetic diversity to accumulate. Fernando *et al* (2006) also found a higher genetic diversity in the Javan rhinoceros population in Ujung Kulon than they had expected, based on the prolonged small population size that this population has experienced since at least 1967, until today.

Based on the findings of Fernando *et al* (2006) and Dinerstein (2003), it is recommended to take the possibility of inbreeding depression into account, but not to let assumptions become an obstacle for the reintroduction of endangered species. Therefore, if inbreeding depression is suspected, it is necessary to study the genetic diversity of individuals to be reintroduced, in order to achieve the highest possible genetic diversity in the founder population, without reducing the genetic diversity of the source population.

Second, the status and biology of wild populations should be studied in order to determine the ecological needs of the species in question. These studies should include habitat preferences, intra-specific variation and adaptations to local ecological conditions, social behaviour, group age structure and sex ratio, home range size, territory size if applicable, shelter and food requirements, foraging and feeding behaviour, predators (and/or prey, if the species to be reintroduced is itself a predator) and diseases (IUCN, 1998). Furthermore, it is recommended that interactions between the species in question and other species are determined, to identify competitors, parasites, and other symbiotic relationships. For migratory species, potential migratory areas should be identified (IUCN, 1998). For other highly mobile species, research should be done to determine how far individuals will travel in search of a territory, food or mate. A study by Preatoni *et al* (2005) on the space use and settlement behaviour of reintroduced bears, where a reintroduced bear was found 90 kilometres away from the release site, shows that some animals may travel long distances before settling.

Third, it is possible that the species in question has been replaced by another species after it was exterminated from the intended release area. If this is the case, the species which has replaced it should be identified, and the effect that the reintroduced species would have on the ecology of the release area should be determined. This is important to make sure that the founder population will survive, settle and reproduce successfully in the release area (IUCN, 1998). While this recommendation is a critical step in the feasibility study, the IUCN does not further develop it. It is not explained what should be done if a substitute species has been found and identified. Obviously, in many cases it will be undesirable to simply remove the substitute species from the release site, especially if it is also an endangered species. As recommended by the IUCN (1998), research should be done to determine the effect of the reintroduced species on the ecosystem, and particularly on the (expected) interaction between the reintroduced species and the substitute species. If results show that competition between these species could result in the demise of either one, an alternative release site will have to be found.

An important thing to consider in reintroductions is that the release site be located within the historic natural distribution of the species concerned. The release area should be devoid of a remnant population, to prevent disease outbreaks, social disruption and the introduction of alien genes (IUCN, 1998). Preventing the introduction of alien genes is definitely important. If different sub-species of an endangered species exist, the aim should be to ascertain the long-term survival of all sub-species. However, in some cases a sub-species may be in such a precarious condition, that it is more important to attempt to save the species as a whole, by cross-breeding one sub-species with another. This would help to increase the genetic diversity of an endangered species, reducing the risks associated with inbreeding (Pluháček *et al*, 2007). Examples of such cases are the Indian or greater one-horned rhinoceros and the Javan rhinoceros. In case of the former, individuals from different source populations (which allegedly have such a genetic variability that some have suggested they belong to different sub-species) were reintroduced to Dudhwa National Park, India. The reintroduced animals are breeding successfully (Pluháček *et al*, 2007). In case of the latter, the situation of the Vietnamese sub-species (*Rhinoceros sondaicus anamiticus*) is so precarious that it may be beyond saving. In order to save at least some of the genetic information inherent to the Vietnamese sub-species, cross-breeding with Javan rhino from the Ujung Kulon population (*R. s. sondaicus*) may be the only option (Fernando *et al*, 2006). In cases like these, conservationists and reintroduction biologists should set their priorities carefully, and determine whether the long-term survival of different sub-species is a realistic goal, or whether cross-breeding between sub-species would increase the long-term survival chances of the species as a whole.

In their Guidelines for Reintroductions the IUCN (1998) state that "in some circumstances, a reintroduction or reinforcement may have to be made into an area which is fenced or otherwise delimited," as long as it is still within the species' natural habitat and historic range. In fact, Santiapillai and Suprahman (1986) have suggested that, as a first stage of reintroduction to other areas, a captive, free-ranging breeding population of Javan rhinoceros could be established on the island of Pulau Panaitan, which is part of the Ujung Kulon National Park complex. This island has a surface of 120 km², which could accommodate an estimated 12 rhinos. Surplus animals could then be collected from this population for release in a suitable area in the wild.

While some reintroduction programmes include on-site breeding in enclosures before release, in order to expand the released population, an important other objective of such on-site breeding is to acclimatise the animals to the site (IUCN, 1987). If animals were to be translocated to an island for the sole purpose of increasing the number of animals that could be reintroduced to another site, the latter objective is lost. In fact, the risks to some of the animals to be reintroduced would become greater, since they would suffer stress from handling and transportation twice. Furthermore, establishing a captive, free-ranging breeding population on a relatively small island can only be a last resort, and only temporary. If such a breeding population were to be managed for a long time, the risk of inbreeding depression becomes too high. What should also be taken into account is the occurrence of other valuable biological features, such as breeding colonies of seabirds or populations of other (endangered) mammals (Abbott, 1999). On the island of Pulau Panaitan, there are populations of barking deer (*Muntiacus sp.*) and lesser mouse deer (*Tragulus javanicus*). Although there is no evidence of competition between these species and Javan rhino, the possibility that establishing a population of rhino on Pulau Panaitan would have a negative impact on the existing barking deer and lesser mouse deer populations should be carefully investigated, before considering any rhino translocation there.

The release site should meet a number of other requirements. Obviously, it should have sufficient suitable habitat available to allow the reintroduced species to grow to a viable population size. The possibility that the habitat and/or the political or socio-cultural environment at the release site has changed since the species concerned went locally extinct, should be taken into account. Before a reintroduction is carried out severely degraded habitat should be restored and the factors that caused the species concerned to go locally extinct should be removed (IUCN, 1998). The importance of removing the previous causes of decline is supported by Fischer and Lindenmayer (2000). Their study shows that in 69 % of the cases where the cause of decline was known, but not removed, reintroductions failed. Of the remaining 31 % of such cases, the success or failure was not known. On the other hand, of the cases where the cause of decline was known and effectively removed, only 7 % resulted in failure. Reintroductions were successful in 22 % of such cases, whereas in 71 % of these cases, success was yet uncertain (fig. 2.4).

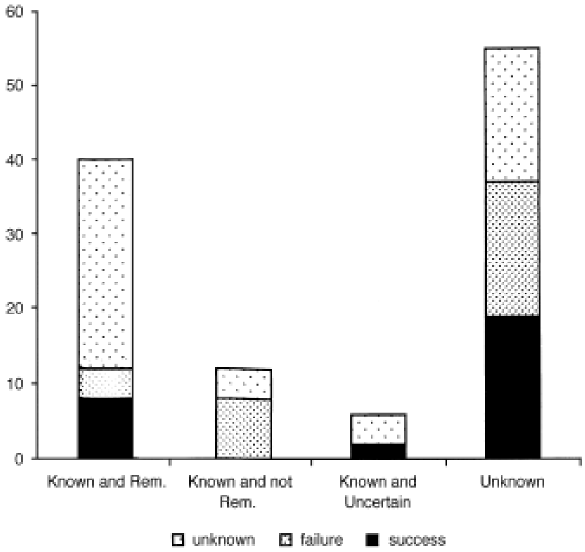

Figure 2.4 Reintroduction success in relation to causes of decline. 'Known and uncertain' refers to cases in which the causes of decline were known, but it was not certain whether they had been removed. *Source: Fischer & Lindenmayer, 2000*

When reintroducing an endangered species, it is preferable that the individuals to be reintroduced are taken form a wild population, if a sufficiently large wild population exists. Before capturing wild animals, the effect of removal on the source population should be assessed. Removal may only take place when it is guaranteed that the source population will not be negatively affected (IUCN, 1998).

If captive bred animals are used, the risk of reintroducing animals with a low genetic fitness is higher than with wild animals. Furthermore, the drawback of using captive bred animals is that they may not have learned the skills needed to survive in the wild, and they may be so familiar with humans that they become a danger to local human populations, livestock, and ultimately, to themselves (IUCN 1998).

2.5.2. Socio-economic requirements

In the Guidelines for Reintroductions (IUCN, 1998), the socio-economic requirements for reintroductions are much less developed in detail than the biological requirements. It is stated that the impacts, costs and benefits that a reintroduction programme would or could have to local inhabitants should be assessed through socio-economic studies. What is very important to assess is the attitude of local people to the proposed reintroduction, because their attitude strongly influences the long-term protection of the reintroduced population (e.g.: Reading & Kellert, 1993; Dunham, 2000). This is especially true if the cause of decline was anthropogenic. If human activities taking place in the release area are of a harmful nature to the reintroduction project, adequate measures should be taken to minimise their impact, or an alternative release site should be sought. On the other hand, the reintroduced species may pose a risk to life or property. Extensive efforts should be done to minimise these risks, and compensations should be made where necessary and appropriate (IUCN, 1998).

In sum, the local communities should fully understand, accept and support the reintroduction programme (IUCN, 1998). What's more, opportunities should be sought to actively involve local communities in the long-term protection of the reintroduced population. This is referred to as "eco-development" projects (Dinerstein, 2003). Such eco-development projects aim at conserving biodiversity and local development. Since the 1990s, this kind of conservation approach has gained a lot of popularity among funding bodies, as opposed to traditional approaches such as strict protection. Such traditional approaches are often viewed as ineffective, because they supposedly only delay the inevitable human encroachment on the reserve (Dinerstein, 2003). While this may be true in some cases, the strict protection of natural habitats is necessary to ensure survival of endangered species. Nevertheless, local inhabitants should be involved in this protection in order to increase the probability of survival on the long term. However, when eco-development projects are adopted as a conservation approach, with disregard to the more traditional approaches, successful biodiversity conservation can not always be guaranteed (Dinerstein, 2003). A balance needs to be struck between eco-development and strict protection. One way to do this is to divide protected areas into different zones, such as a core zone, which is under strict protection, and a buffer zone, where eco-development projects can take place.

Dinerstein (2003) gives an inspiring example of local participation in the protection of greater one-horned rhinoceros in Royal Chitwan National Park, Nepal. One of the big challenges in nature conservation in many Asian countries is that most remaining natural areas are too small to maintain long-term viable populations of large mammals, and the land surrounding them is densely populated. Eco-development projects open up opportunities for managing conservation units such as corridors, buffer zones and multiple-use areas. Such features are of great importance to the conservation of biodiversity in densely populated landscapes. In Chitwan, such an approach was successfully implemented. The core area of the national park was strictly protected, while eco-development projects were carried out in the buffer zone. Managing the buffer zones more effectively allowed the local communities to meet their resource needs, thus reducing the pressure on the natural habitats in the park. Fuel wood, fodder, grazing areas and thatch grass have always been in high demand among the villagers surrounding Chitwan. The implementation of community forestry programmes has resulted in improved people-park relationship, reduced stress on riverine forests and regeneration of degraded habitats. In turn, these have led to an anti-poaching information network, which allows better control of poaching in the park, and an increase in available habitat for endangered species. Putting buffer zones under local management has allowed villages to be self-sufficient in firewood and fodder. Revenues from the sale of firewood, thatch, fodder and other products are invested in the management of flood control plots or local development. This approach has benefited not only the local communities, but also rhinoceros and tiger populations.

In order to achieve local people's acceptance of a reintroduction programme, there are a number of factors to consider. Stankey and Shindler (2005) identify five main factors which shape local people's judgments of conservation policies (fig. 2.5), which can also be applied in the case of reintroductions. In this study, the model described by Stankey and Shindler (2005) was used to develop a five-point favourability scale for each of the attitude determining factors, in order to be able to quantify them.

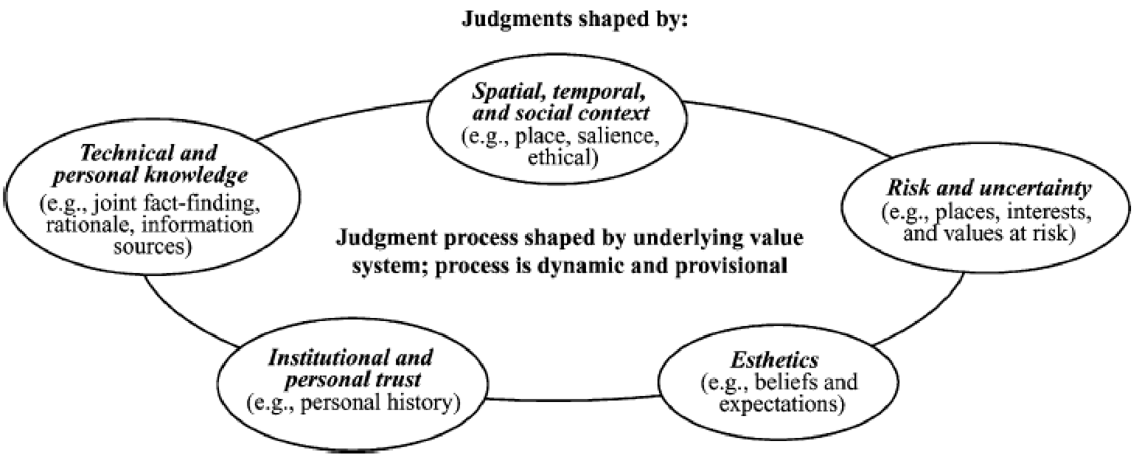

Figure 2.5 Structure of the social-acceptibility judgment process in policy implementation. *Source: Stankey & Shindler, 2005*

Knowledge

Technical and personal knowledge is often seen as the basis of sound management. Studies by Reading and Kellert (1993) and Aipanjiguly *et al* (2002) show that knowledge is positively related to support of conservation policies. People who were knowledgeable about manatees (*Trichechus manatus latirostris*) also tended to support their conservation (Aipanjiguly *et al*, 2002). On the other hand, a reintroduction project for black-footed ferrets (*Mustela nigripes*) was not supported, even though local knowledge about black-footed ferrets was relatively high (Reading & Kellert, 1993). The lack of support was partly related to the lack of knowledge on the black-footed ferret's main prey species, the prairie dog (*Cynomys* spp.). Many policy makers blame public opposition to the public's lack of knowledge (Stankey & Shindler, 2005). This leads to the misconception of some conservationists that they should tell the public the truth that only they know. However, such an approach would only lead to more opposition, because the public will feel that it is not taken seriously (European Centre for Nature Conservation ECNC, 2000). The fact that knowledge is not based on scientific facts does not mean that it is not valuable and useful. Steinmetz *et al* (2006) stress the importance of exchanging knowledge between locals and scientists. Both local people and scientists gather their knowledge through an accumulation of observations and personal experiences. Local people are usually very aware of the changes that occur in ecosystems around them, because they have been living in the area for generations. Scientists, on the other hand, usually have extensive spatial knowledge of species, meaning that they know about the status of species in different locations. Both local people and scientists have knowledge about the processes that underlie the observed changes in ecosystems, though on a

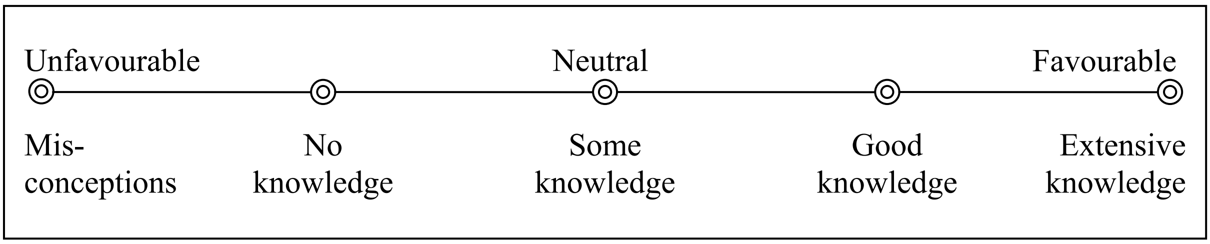

Figure 2.6 Scale of favourable versus unfavourable levels of local knowledge in relation to a certain conservation issue.

different scope. Through cooperation, local people and scientists can learn a lot from each other, which opens up opportunities for more effective wildlife management.

It is shown above that a higher level of knowledge will generate more support for a certain conservation policy, so the most favourable situation would be when local communities have extensive knowledge on the matter at hand. A total lack of knowledge, on the other hand, is unfavourable. However, a situation in which local communities have strong convictions about a certain species, based on misconceptions, is far more unfavourable for conservation than a simple lack of knowledge (fig. 2.6). Furthermore, such a situation is more difficult to improve and move up the scale. An example of a situation in which misconceptions about a species cause opposition to their conservation is the case of the great white shark (*Carcharodon carcharius*). Its image as a cold-blooded man-eater causes many people to fear and even hate it, which encourages poaching activities (Baillie *et al*, 2004). Taking away that fear and hate is not impossible, but it requires intensive education of the public.

Spatial, temporal and social context

Spatial, temporal and social context implies that what works in one situation will not necessarily work in another, even when the cases are similar. The relationship between people and the environment differs among different communities or social classes. Furthermore, within a community, this relationship will change over time. People may find it difficult to accept conservation measures that locally affect them in an inconvenient way, but hold benefits for a larger area (Stankey & Shindler, 2005). Opening dikes to give rivers more room to flood is an example. It is unlikely that the people living on or near the floodplain will accept this policy. Similarly, it may be challenging for the public to understand complex ecological processes like succession, thus making it difficult for them to appreciate long-term management actions (Stankey & Shindler, 2005). When a forest manager logs an area to simulate natural disturbance, the public may not easily understand that the aim is to maintain a varied forest structure and high biodiversity, because it will take time before the effects are visible.

This implies that people will accept a certain policy more easily if they have some notion of the potential benefits that this policy will bring them. Thus, the most favourable situation is when people see a lot of opportunities for personal benefit, while the least favourable situation is when people think that the policy concerned will only harm them (fig. 2.7). These people's perceptions can be influenced through education and public participation in the implementation of the policy.

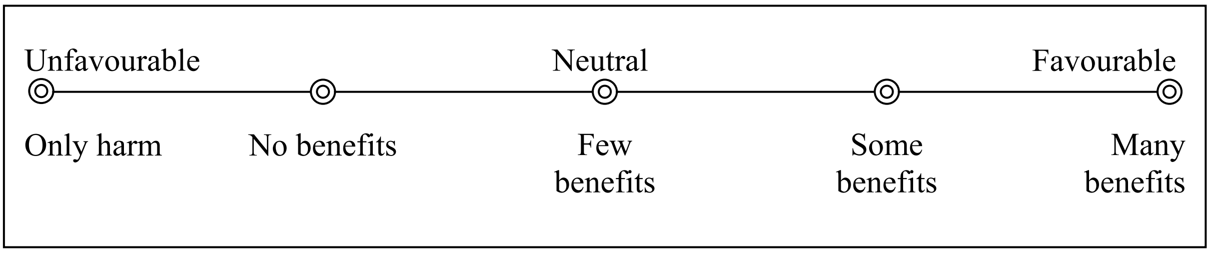

Figure 2.7 Scale of favourable versus unfavourable perceptions of local inhabitants concerning potential benefits from a certain policy or management practice

Perceived risks

Risks and uncertainties contribute to the level of public acceptance (Stankey & Shindler, 2005). In case of a reintroduction of a large herbivore, the risk of crop damage will be of great concern to local people, and their acceptance of the project will depend greatly on the

measures that are taken to reduce that risk. Although most people generally support the protection of species, they will often become less supportive when species protection has negative effects on them, such as imposed limitations on land use (Reading & Kellert, 1993; Stankey & Shindler, 2005). This kind of problem may be avoided through cooperation which aims at finding and using opportunities for local people to benefit from conservation. Thus, the needs of local people, conservationists, and ultimately the species concerned can be met.
The risks associated to a certain conservation intervention can be quantified by correlating their probability of occurrence with their expected impact (fig. 2.8). Thus, a risk with a high impact, but a low probability of occurrence scores better on the scale than a risk with a medium impact, but a high probability of occurrence.

Unfavourable		Neutral		Favourable
1	2	3	4	5
Very serious risk	Serious risk	Medium risk	Low risk	Very low risk

Probability \ Impact	High	Medium	Low
High	1	2	3
Medium	2	3	4
Low	3	4	5

Figure 2.8 Scale of favourable versus unfavourable situations of the severity of risks perceived, based on the probability of occurrence and the expected impact of that risk

<u>Ethics</u>

Fourth, aesthetics can greatly influence local people's acceptance of a policy (Stankey & Shindler, 2005). The forest manager who logged an area to simulate natural disturbance, in the example above, can encounter public opposition simply because the public does not like the way it looks.
It should be remarked that Stankey and Shindler (2005) include beliefs and expectations in aesthetics, while they classify ethics under social context. Since ethics also include beliefs and expectations, the present author prefers to use the term 'ethics' instead of 'aesthetics', and will do so for the remainder of this report. As such, ethics can be defined as the associations that people have with a certain ecosystem, landscape feature, forest patch, plant or animal. For example, some mountains are revered as the dwelling place of a god or king, and some

Unfavourable		Neutral		Favourable
Fear/hatred	Negative associations	No associations	Positive associations	Sacred

Figure 2.9 Scale of favourable versus unfavourable associations that people have

animals are sacred because they are believed to be ancestral spirits. Thus, these associations can either be positive or negative (fig 2.9).

If people have negative associations with a certain animal based on their beliefs, it can be extremely difficult to convince them that their fears are ungrounded. In general, it is better not to try to change people's beliefs, because this will cause mistrust and conflict. Therefore, it is best to teach people how they can co-exist with the animal that they fear, in order to minimize competition and conflicts between the animal and the people.

Trust

Institutional and personal trust is shaped by relationships among individuals and between individuals and conservation organizations. The openness and fairness of an organization's decision making processes greatly determines the amount of trust that the organization will receive from local people (Stankey & Shindler, 2005). For example, indigenous communities in Thung Yai Naresuan Wildlife Sanctuary (the Karen people), Thailand, have been distrustful of Thung Yai officials since the sanctuary was established in 1974. This distrust was a result of the fact that the Karen have repeatedly been threatened with relocation from the sanctuary, and resulted in periods of conflict between the Karen and officials. However, when sanctuary staff started to communicate with these communities, exchanging knowledge and explaining intentions, the relationship between them improved a lot, to the point that they can now cooperate in anti-poaching measures and other management activities (Steinmetz *et al*, 2006).

This example shows the importance of active participation and cooperation by local communities in the decision making process as a means to create a good relationship built on trust between these communities and the decision makers. On a scale from unfavourable to favourable situations (fig. 2.10), the most favourable situation would be one with mutual trust. This situation ensures that local communities are fully aware of the reasoning behind the decisions being made, and that their knowledge will be integrated in this reasoning. On the other hand, in the absence of communication between local communities and managers of protected areas, the chance is high that decisions are being made that have a negative impact on the life of local communities. This situation could easily lead to a more antagonistic relationship between indigenous or local communities and policy makers. Once such an antagonistic relationship exists, it may be difficult to get out of that situation. However, the example of the Karen above shows that it is possible to regain the trust of local communities once they are included in the decision making process.

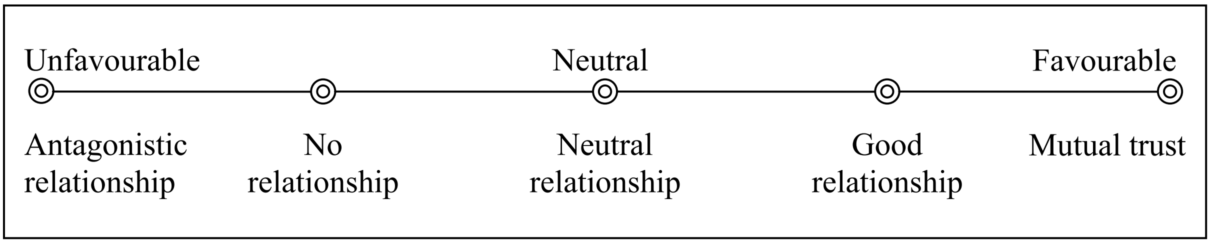

Figure 2.10 Scale of favourable versus unfavourable levels of trust and cooperation in the relationship between local communities and policy making parties

2.6. Conclusion

Reintroductions require careful planning. Not only should the ecological needs of the species in question be carefully investigated, the genetic make-up of remaining populations should also be thoroughly assessed, in order to avoid in-breeding or out-breeding depression. However, genetic drift in small and isolated wild populations is perhaps not as severe as is generally assumed, and should therefore not be a barrier to the reintroduction project.

Among the crucial things to consider are the social aspects of reintroduction programmes. Often, a release site may be surrounded by local human settlements, the inhabitants of which may make use of the release site in a number of ways. The attitude of these local people toward the reintroduction should be carefully assessed. For this study, a method to assess social acceptability judgments was developed, based on the model proposed by Stankey and Shindler (2005).

If possible, reintroduction biologists, managers and local people should cooperate in the decision making process. This will generate vital support from all stakeholders, which will increase the possibility of a successful reintroduction. Unfortunately, there are still many reintroduction projects that underestimate the importance of local cooperation. While many of these may initially succeed, cooperation with local people is needed to guarantee the long-term survival of the reintroduced population.

PART III

Case Study: Javan rhinoceros (*Rhinoceros sondaicus*) in Ujung Kulon National Park, West Java, Indonesia

3. Introduction to the case study

This chapter starts with a description of Ujung Kulon National Park and specifically of the study area, the Honje Mountains. Although the Honje Mountains are part of Ujung Kulon National Park, they are discussed separately, because the Javan rhino currently mostly lives on the peninsular part of the National Park and only occasionally ventures into the Honje Mountains on the mainland.
The histories of Ujung Kulon National Park and the Honje Mountains are discussed in order to give the reader an overview of the chain of events that led to the survival of this population of Javan rhinoceros, but also to some of the social issues that currently arise. Next, the topology, climate and conservation significance of Ujung Kulon National Park and the Honje Mountains are described in order to allow for a comparison of the natural conditions between the study area and the peninsula.
Finally, the morphology and habitat requirements of the Javan rhinoceros are described, and a list of threats currently faced by this animal is given.

4. Ujung Kulon

Ujung Kulon National Park is located on the south-westernmost tip of Java, about 153 kilometres from Jakarta, in the district of Pandeglang (Hutabarat, 1997) (fig. 4.1). It covers a total area of 120.551 hectares, which consist of 76.214 hectares of land area and 44.337 hectares of sea. The land area consists of the Ujung Kulon Peninsula, Peucang Island, Panaitan Island and the Honje Mountains, of which the eastern slopes define the border of the national park (Fig. 2.2). The Ujung Kulon Peninsula alone covers 39.120 hectares (YMR *et al.*, 2002).

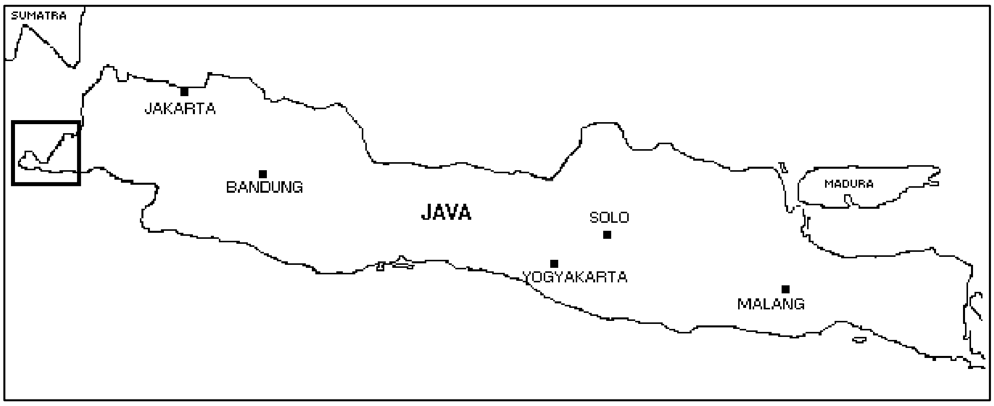

Figure 4.1 Location of Ujung Kulon National Park on the island of Java, Indonesia. The area indicated by the rectangle is magnified in figure 3.2. *Modified from http://home.scarlet.be/ ~evdleene/images/indo/java_map.gif*

4.1. Brief history of Ujung Kulon

According to Hoogerwerf (1970), Ujung Kulon was formerly intended to become one of the strategically and economically most important regions of Java. In November 1853, the Organization for Scientific Research in the Netherlands-Indies (Koninklijke Natuurkundige Vereeniging) sent out an expedition to explore Meeuwenbaai (between Pulau Peucang and the Ujung Kulon Peninsula, fig. 4.2). This expedition landed off the village of Djungkulan, which was the only inhabited place on the peninsula, counting around forty households. In the report of this expedition (1854) it is stated that Djunkulan could become a new Singapore, thanks to

its strategic location for commerce, at the entrance to the Sunda Strait, but also through its coal seams, fertile soil and various resources like timber and Non-Timber Forest Products.
There was another expedition in 1854 with the same goal, but neither the expeditions nor a survey carried out in 1855 led to the opening up of the peninsula, and the plans to exploit the coal seams were abandoned after the survey was considered terminated by Order of the Governor-General in June 1861 (Hoogerwerf, 1970).

Figure 4.2 Ujung Kulon National Park. *Modified from anonymous author, Javan Rhino Colloquium, 1997*

The volcanic eruption of Krakatau in 1883 had a devastating effect on the area. This disaster caused a tidal wave with a height of approximately 15 meters, which swept away the village of Djungkulan, as well as the smaller villages of Tjikuja and Rumah Tiga which were established later on or near Pulau Peucang (Hoogerwerf, 1970). After the Krakatau eruption the entire peninsula was covered in forest, where tigers and rhinos were abundant.
In 1896, two smaller villages, both presumably branches of Djungkulan, were rebuilt (Hoogerwerf, 1970). However, at the beginning of the twentieth century, the entire peninsula of Ujung Kulon had to be evacuated, due to regular outbursts of malaria and dysentery, and a plague of tigers. According to anonymous sources referred to by Hoogerwerf (1970), however, these were not the actual reasons; the area was evacuated in accordance to plans to set it aside as a nature reserve.

On November 16th, 1921, Ujung Kulon acquired the status of nature reserve (Hoogerwerf, 1970). At that time, the reserve covered 28.600 hectares. As such, it was prohibited to kill or trap all animal species living in the area, as well as reclaiming land and any other activities that could have a negative effect on the preservation of the area. However, there was no supervision whatsoever, and the fact that the Handeuleum Islands and Pulau Peucang were not included in the nature reserve and that access to Ujung Kulon was not forbidden, made it next to impossible to effectively protect the area.

It was not until June 1937 that measures were taken to better protect the area. On the 24th of that month, the Nature Reserve Ujung Kulon was declared a Game Sanctuary. The Handeuleum Islands (70 ha) and Pulau Peucang (450 ha), as well a strip of land east of the isthmus were included therein (Hoogerwerf, 1970). Although Hoogerwerf (1970) does not explicitly state how much land east of the isthmus was included in the Game Sanctuary, he probably refers to the area of Kalejetan (fig. 7.1). Pulau Panaitan, already a nature reserve at that time, was also declared a game sanctuary, and all these territories were closed to the public as of June 2nd, 1938 (Hoogerwerf, 1970).

The status of Ujung Kulon changed from Game Sanctuary back to Nature Reserve in 1958 (YMR *et al.*, 2002). Since then, the management of Ujung Kulon has changed hands several times, until it acquired the status of National Park on May 12th, 1984, when the management became the responsibility of the PHPA (Perlindungan Hutan dan Pelestarian Alam: the Directorate General of Forest Protection and Nature Conservation). In 1991, Ujung Kulon NP was declared as Indonesia's first World Heritage Site by UNESCO (Hutabarat, 1997).

4.2. Topology

The relief of Ujung Kulon NP consists mostly of low rolling hills, with a maximum height of 30-50 meters (Hoogerwerf, 1970). In the south-west, the scenery is dominated by Mount Payung, with a height of 480 meters. The Payung range has steep slopes which drop straight to the sea in all directions, except to the north where they gradually become lower, ending in Tanjung Layar, a cape with a height of approximately 50 meters. The rolling hills in the centre of the peninsula are connected with the Payung range by the slightly higher ridge formed by Mount Telanca, which reaches a maximum height of 140 meters. Further to the east of the peninsula, these hills give way to tidal forests and swamps. Across the isthmus on the mainland, Ujung Kulon NP is dominated by the Honje Mountains, with the highest peak at 620 meters (YMR *et al.*, 2002). The topology of the Honje Mountains will be discussed in more detail in chapter 5.

4.3. Climate

Ujung Kulon NP has a tropical monsoon climate, with the wet season occurring from October to April, and the dry season from May to September. The average annual rainfall is 3249 mm, December being the wettest month with an average rainfall of more than 400 mm. The average air temperature during the year lies between 25-30 °C, with a relative humidity of 80-90 % (YMR *et al.*, 2002).

4.4. Conservation significance

Ujung kulon is not only the last stronghold of the Javan rhino; it also provides a place to live for many other rare and vulnerable species. Sadly, Javan tiger (*Panthera tigris sondaica*) is no longer among them. Although there was a plague of tigers in the area in the beginning of the twentieth century, and Hoogerwerf encountered tigers on nine different occasions between 1937 and 1941 (Hoogerwerf, 1970), the species is now almost certainly extinct. Although there have been recent sightings by the locals, in Ujung Kulon as well as elsewhere in Java, these have never been confirmed. It is very probable that those sightings were actually of leopards, since Indonesians tend to say 'tiger' to any big cat.

The high animal diversity in Ujung Kulon can be attributed to the relatively high variety of habitats. These habitats are becoming very rare on Java, where the growing human population is putting a lot of pressure on the remaining natural areas. Wetlands and lowland habitats are most threatened to be converted to agricultural land, because they are most suitable for such developments, and easily accessible (PHPA & YMR, 1994). Both habitat types cover a significant area of Ujung Kulon, especially lowland habitats. It is thus essential that Ujung Kulon is well protected, so that in the future, this national park can continue to be a place with a rich and unique biodiversity.

Ujung Kulon NP harbours a broad range of wildlife species, including several species endemic to Java (YMR *et al.*, 2002). Legally protected endemic species living in Ujung Kulon are Javan rhino (*Rhinoceros sondaicus*), Javan gibbon (*Hylobates moloch*), Javan leaf-monkey (*Presbytis comata*) and Javan dhole (*Cuon alpinus javanicus*). Other protected species in Ujung Kulon are, among others, banteng (*Bos javanicus*), rusa deer (*Cervus timorensis*), barking deer (*Muntiacus muntjak*), lesser Malay mouse deer (*Tragulus javanicus*), leopard (*Panthera pardus melas*), clouded leopard (*Neofelis nebulosa*), Malayan porcupine (*Hystrix brachyura*), Bengal cat (*Felis bengalensis*), binturong (*Arctictis binturong*), smooth-coated otter (*Lutrogale perspicillata*), pangolin (*Manis javanicus*), Malayan flying lemur (*Cynocephalus variegatus*), and black giant squirrel (*Ratufa bicolor*).
Among the reptilian and amphibian species of the national park are reticulated python (*Python reticulatus*), saltwater crocodile (*Crocodylus porosus*), monitor lizard (*Varanus salvator*), green turtle (*Chelonia mydas*) and 21 species of snakes and 17 species of frogs.
Ujung Kulon is home to approximately 270 species of birds. Grey-headed fish eagle (*Ichthyophaga ichtyaetus*), rhinoceros hornbill (*Buceros rhinoceros*), green peafowl (*Pavo muticus*), white-faced hill-partridge (*Arborophila orientalis*), Chinese egret (*Egretta eulophotes*), and lesser adjutant (*Leptoptilos javanicus*) are among the most threatened (YMR *et al.*, 2002).

Floristically, Ujung Kulon offers a high variation in vegetation structure and composition. There are 10 distinct plant community groups, comprising a total of 39 plant communities (Hommel, 1987). A striking observation made by Hommel (1987) is that approximately 8 % of plant species found in Ujung Kulon occur at an altitude of 100 metres or more below their normal lower limit. Some of the abnormally low occurrences of these species can be explained by their growth along watercourses in shaded valleys, in lowland swamps, in beach vegetation or as an epiphyte on unusually low altitudes of normally terrestrial species. However, if these were the only situations in which plant species grow abnormally low in Ujung Kulon, their distribution would be expected to be at random altitudes. Conversely, Hommel's (1987) study shows a clear correlation between abnormally low occurrence of species and relatively high altitude, i.e. the higher the altitude, the more instances of abnormally low growing species. 76 % of these species normally grow above 500 metres elsewhere on Java; altitudes that are not present in Ujung Kulon.
The occurrence of many plant species at abnormally low altitudes in Ujung Kulon can be explained by the telescope effect. Isolated mountains of relatively low altitudes reflect vegetation zonations of higher mountains in a condensed, 'telescopic' way. Being the highest points of elevation in an otherwise flat landscape, or, as is the case in Ujung Kulon, a wide expanse of sea, such low, isolated mountains attract clouds. These clouds influence the mountain's temperature and relative humidity, creating a variety of climatic conditions and their associated flora similar to higher mountains (Hommel, 1987).

Further contributing to the conservation significance of Ujung Kulon is the occurrence of plant species that are rarely found elsewhere on Java. Hommel (1987) gives a list of 57 rare species found in Ujung Kulon. Most of these are probably found on Sumatra as well, but according to Hommel, there are at least three exceptions, namely *Knema globularia*, a species of rocky coasts and small islands; *Launaea sarmentosa*, which according to Hommel (1987) was not recorded elsewhere in Malaya in recent years before his study; and *Heritiera percoriacea*, which is probably endemic to West Java, and during the time of Hommel's study was restricted to Tanjung Layar (fig. 4.2).

5. Honje Mountains

5.1. Brief history of the Honje Mountains

In 1967, a 10.000 ha area of the southern part of the Honje Mountains was designated as a Nature Reserve (Haryono, 1996). Later, in 1978, a 9.498 ha large area of the northern part of the Honje Mountains was added to this Nature Reserve. The Honje Mountains have been under national park management since 1984, but its status as a Nature Reserve did not change until it was fused with Ujung Kulon National Park in 1992.

Before the Honje Mountains were designated as a Nature Reserve in 1967, it was a production forest under the management of the Forestry Service. The management system used was one of catch-cropping, which allowed local inhabitants to work the land in between stands of timber trees (Haryono, 1996). After the area was designated as a Nature Reserve, efforts were done to relocate the kampongs that had been established inside what was now Nature Reserve. Some of these efforts were successful, but some failed, as is the case with Legon Pakis. After the villagers were relocated, they returned to Legon Pakis, because they were concerned about who would own and take care of their land (Ngatiman, pers. comm., 2008).

5.2. Topology

The Honje Mountains have a hilly too deeply dissected relief, with steep slopes averaging between 30°-60° (Fauzi & Stoops, 2004; Haryono, 1996). There are several peaks in the Honje Mountains, the tallest being Mount Honje II at 620 meters above sea level. Other peaks are Mount Honje I (608 m), Mount Tilu (562 m), Mount Ciung (465 m), Mount Patujah (400 m), Mount Batu (314 m) and Mount Cimahi (183 m).

5.3. Climate

The Honje Mountains have a tropical monsoon climate. The wet season starts in October and lasts until April, and the dry season is from May to September. The average annual rainfall is 3140 mm, December being the wettest month with an average rainfall of more than 400 mm. The average air temperature during the year lies between 28-30 °C, with a relative humidity of 80-90 % (Haryono, 1996). Fauzi and Stoops (2004) describe the climate in the northern part of the Honje Mountains as isohyperthermic, with a mean annual temperature of 26,8 °C. They mention an average annual rainfall of 3388 mm, with a peak of 549 mm in December, July being the driest month with only 108 mm of rainfall on average.

5.4. Conservation significance

The Honje Mountains provide habitat for a number of threatened animal species. Among these are banteng, barking deer, Sunda langur (*Presbytis aygula*), Javan gibbon, Javan dhole, leopard, reticulated python, saltwater crocodile and monitor lizard. Among the 200 bird species found in these mountains are green peafowl, osprey (*Pandion haliaetus*) and hornbills (*Bucerotidae*) (Haryono, 1996).

A big part of the Honje Mountains are mixed tropical rainforest, with the dominant tree species being *Acmena aciminatissima*, *Neesia altissima*, *Aglaia* sp., *Quercus* sp., *Alstonia* sp., and *Pometia pinnata*. There are also a number of indigenous palms, most importantly *Arenga obtusifolia* (langkap), *Arenga pinnata* (sugar palm), *Caryota mitis* (fishtail palm), and *Salacca edulis* (snakefruit). In areas that used to be cultivated, a number of exotic species still grow, such as *Cocos nucifera* (coconut palm) and *Psidium guajava* (guava) (Haryono, 1996). In those parts of the forest on the lower slopes that are still undisturbed, the tree layer is made up of *Pterospermum javanicum*, *Engelhardia serrata* (small-leaved lupisan), *Ficus* spp., *Eugenia* spp., *Dipterocarpus gracilis*, *Intsia bijuga* (Borneo teak) and *Lagerstroemia* spp. In these forests, the undergrowth consists of palms, of which langkap and rotans are the most widespread. The higher slopes on the eastern side of Mount Honje are dominated by *Palaeocarpus sphaerius*, *Podocarpus neriifolia*, *Dipterocarpus hasseltii* (highland panau), *Aphana misxis* and *Eurya* spp. (YMR *et al.*, 2002).

5.5. Economic significance

Ujung Kulon National Park is surrounded by 19 villages, all of which are located on the mainland of Java, surrounding the Honje Mountains. The inhabitants of these villages are mostly self-subsistent farmers, but some of their needs can not be met by their agricultural activities; the local communities are still dependent on resources from the forest. Some resources that are used directly are fire wood, timber and bamboo as building materials, and vegetable proteins (YMR *et al.*, 2002). Other resources provide the villagers with a source of income. Honey is one of such resources, as well as edible swift's nests. Nest collectors may travel as far as the Syanghyangsirah cave in the south-westernmost tip of the peninsula to collect swift's nests.
Poaching, particularly of birds, still happens in Ujung Kulon. Luckily, however, the last report of rhino poaching was in 1970 (Hariyadi, pers. comm. 2008).

6. The Javan rhinoceros

The Javan rhinoceros, or lesser one-horned rhinoceros, belongs to the order of the odd-toed ungulates, or *Perissodactyla*. According to the IUCN Red List of threatened species (www.iucnredlist.org, 2008), the taxonomic classification of the Javan rhino is as follows:

Kingdom:	Animalia
Phylum:	Chordata
Class:	Mammalia
Order:	Perissodactyla
Family:	Rhinocerotidae
Genus:	Rhinoceros
Species:	*Rhinoceros sondaicus*, Desmarest 1822
Sub-species:	*Rhinoceros sondaicus sondaicus*, Desmarest 1822 (in Ujung Kulon)
	Rhinoceros sondaicus annamiticus, Heude 1892 (in Vietnam)

The genus *Rhinoceros* is the only genus of rhino which has more than one species surviving today, being the Javan rhino (*R. sondaicus*) and the Indian, or greater one-horned rhinoceros (*R. unicornis*).

6.1. Morphology

Just like the Indian rhinoceros, the Javan rhinoceros has a thick skin with prominent folds and only one horn. However, compared to the Indian rhinoceros, the Javan rhinoceros' folds are less prominent, and the horn is smaller. In males, the horn can grow to a length of 48 centimetres. In females, the horn usually looks like a mere bump on the head. The colour of the horn ranges from dark grey to black, getting darker as the animal grows older. The skin is

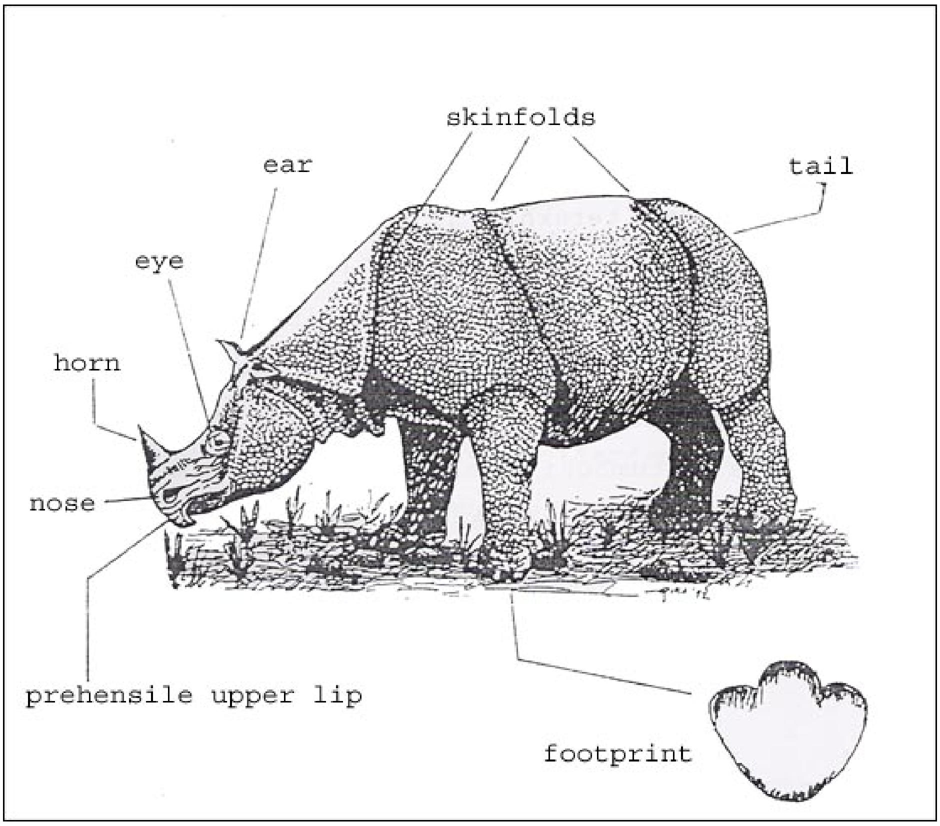

Figure 6.1 Morphology of Javan rhinoceros (*Rhinoceros sondaicus*) *Source: Haryono, 1996*

hairless, except for some tufts on the ears and the tip of the tail, and dark grey of colour. An adult rhino typically has a body length of 300-315 centimetres, with a shoulder height of 140-175 centimetres and a body weight of 1500-2000 kg (YMR *et al.*, 2002).
The Javan rhino has a stout body with a big head on a short neck, and short legs. The rhino is near-sighted with small eyes, but its hearing and sense of smell are well developed. It has a pointed, prehensile upper lip, which is well suited for browsing (fig. 6.1).

6.2. Habitat

The Javan rhino historically ranged from Assam in eastern India, through Indochina and the Malaysian peninsula to the islands of Sumatra and Java in Indonesia (Fernando *et al.*, 2006). Unfortunately, this once common South-East Asian mammal is now restricted to two small areas, namely Ujung Kulon National Park in Indonesia and Cat Tien Nature Reserve in Vietnam (fig. 6.2).

Defining the original habitat requirements of Javan rhino is quite a challenge, because there is little information on this in literature. The rhinos in Ujung Kulon have survived thanks to a combination of favourable circumstances, i.e. the destruction of human settlements by the eruption of Krakatau, and the lack of resettlement afterwards, as well as legal protection, but they may be living in sub-optimal conditions. Nevertheless, the choice of different habitats in Ujung Kulon is quite varied, which makes it possible to speculate about the optimal habitat of Javan rhino by studying the preferences shown by the Ujung Kulon population (Amman, 1985).

According to Amman (1985), the optimal habitat of Javan rhino would be a mixture of scrubland types of vegetation where tall trees are absent and where high quality food is

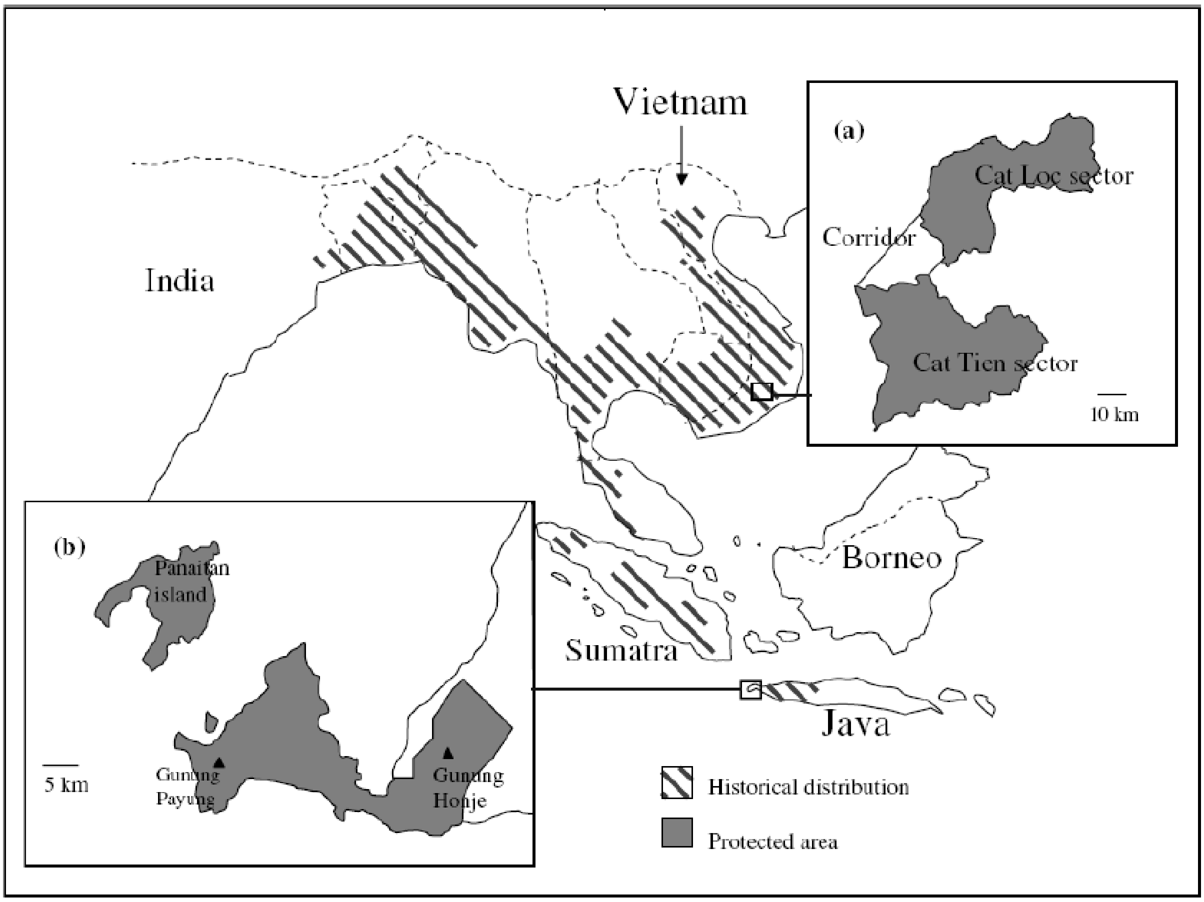

Figure 6.2 The historic range of Javan rhino. Insets show the current range in Cat Tien Nature Reserve, Vietnam (approximately 5-8 rhino) and Ujung Kulon National Park, Indonesia (approximately 56 rhino). *Source: Fernando* et al.*, 2006*

provided, and forest types of vegetation, which provide other habitat requirements, such as shading and wallows. Priambudi (1992) confirms that Javan rhino enjoys lowland forests with open spaces, as well as beach vegetation, tidal forests, swamps and forests bordering on open areas. On the other hand, YMR *et al.* (2002) state that closed areas with dense shrub are preferred, while open spaces are avoided, especially during the day. The different observations by different authors are probably complementary, rather than contradictory. However, the statement that Javan rhino prefers lowland forests may not fully reflect the reality, but rather be a result of the fact that the only reference comes from Ujung Kulon, where altitudes of more than 480 metres are absent. According to YMR *et al.* (2002), Javan rhino formerly ranged in mountains up to a height of 1000 metres, and Hoogerwerf (1970) speculates that the Javan rhino used to visit volcanoes to somehow profit from the minerals found there, for example by using sulphurous wallows. However, these sites were not essential to their survival (Hoogerwerf, 1970).

6.2.1. Food preference and feeding behaviour

The Javan rhino is a browser, feeding on foliage, small branches, lianas and the bark of shrubs and small trees. It may also feed on fruit, when available (Hommel, 1987). The Javan rhino is not a selective feeder. Hoogerwerf (1970) gives a list of around 70 plants known to be rhino food species, but he also points out that this list is probably far from complete. Indeed, Amman (1985) recorded 190 species that are part of the rhino's diet, 179 of which are dicotyledones. Grasses and sedges are not among the preferred food plants of rhino. According to Amman, the four most important foodplant species are *Spondias pinnata*, *Amomum* sp., *Leea sambucina* and *Dillenia excelsa*, which together made up 44 % of the food intake he recorded. According to YMR *et al*. (2004), at least three of these species (namely *S. pinnata*, *L. sambucina*, and *D. excelsa*) are becoming less abundant. YMR *et al.* (2002) adds *Eugenia polyantha* and *Glachidon macrocarpum* to the list of important rhino foodplants. Hoogerwerf (1970) mentions *Glochidion zeylanicum*, and Haryono (1996) mentions *Desmodium umbellatum* as part the rhino's most favourite food, but reference to these species could not be found in other literature.

When feeding, rhino can reach up to a height of 2.5 metres (Hoogerwerf, 1970). Most authors agree that rhino usually feeds on plants with a stem size of 15 centimetres or less, but Hoogerwerf (1970) gives a maximum stem diameter of 23 centimetres. Mostly, rhino feeds by simply biting off the desired part of the plant, but if it is out of reach, the rhino will bring it down, either by tearing off branches or by breaking or up-rooting stems, provided that they are not too thick. To do so, a rhino will crush a stem between its jaws, push it over with its head, neck and shoulder, or simply trample it (Hommel, 1987). Usually, trees which were felled in such a way continue to live and sprout new leaves and twigs (Hoogerwerf, 1970). Thus, the rhino acts as a landscape architect, maintaining patches of secondary growth and a reliable source of food.

The sustainable use of food sources is a very striking feature of the rhino's feeding behaviour. While foraging in their home range, Javan rhino often use the same tracks, taking only small bites of each food source along the way. Even when taking a lot of effort to bring the food within reach, it will still feed only a little bit of that food source, after which any nearby plants of the same species are usually ignored (Hommel, 1987). According to Amman (1985), this ostensibly inefficient feeding behaviour guarantees that the rhino optimally balances its intake of nutrients, while avoiding harmful levels of toxins.

The home range of Javan rhinos is different for females and males. According to Amman (1985), females have a home range of 2,6 to 13,4 km² (260 – 1340 ha), while males have a home range of 12,5 to 21,0 km² (1250 to 2100 ha). However, according to Hariyadi (pers. comm. 2008), female home ranges are 4 km² and male home ranges are between 6,25 and 16 km². For this study, the average home range for males was calculated to be 13,9 km² (1.394 ha) and for females 6,67 km² (667 ha). Javan rhinos are not territorial, and female home ranges can overlap between 2-3 animals (Hariyadi, pers. comm. 2008). Male home ranges do not overlap with each other (Amman, 1985), but they may overlap with several females (Hariyadi, pers. comm. 2008).

6.2.2. Other important habitat requirements

When studying the suitability of an area as rhino habitat, a number of habitat requirements are of particular importance. Apart from the availability of food plants, Hommel (1987) also mentions the following:

<u>Accessibility</u>

Javan rhino is a very large and heavy animal, which may therefore be expected to be limited in its movements by steep terrain, swampy terrain and very dense vegetation. However, the Javan rhino is not as unwieldy as it may seem at first glance (Hommel, 1987). As mentioned before, rhinos formerly ranged in mountains with heights of up to 1000 metres, as well as on steep volcanoes and ridges (Hoogerwerf, 1970; YMR *et al.*, 2002). Amman (1985) mentions a rhino that roamed through the entire Payung range from 1978 to 1980, with the exception of the steepest slopes in the southern part of the range. Rhino also do not seem to have too much trouble with swampy terrain, as Hoogerwerf (1970) mentions rhino footprints in very soft mud of 40-60 centimetres deep. Finally, the Javan rhino is locally known for its ability to disappear through very dense vegetation without leaving a trace (Supriyadi, pers. comm., 2008).

Nevertheless, the Javan rhino is not unlimited in its movements. As far as known, the Payung range has never had a high density of rhinos, and the steep slopes in the southern part of the area are clearly avoided by rhino (Hommel, 1987). Concerning swampy terrain and dense vegetation, Amman (1985) mentions a rhino that consistently avoided swampy and densely overgrown terrain, steering clear of such areas long before they came into the animal's view. Haryono (1996) states that areas with an altitude of more than 500 metres are inaccessible to rhino, but this must be a wrong conclusion based on observations within Ujung Kulon, where such altitudes are not available. However, Haryono (1996) also mentions the inaccessibility of areas with a slope of 45° or more, which certainly seems a more likely barrier to Javan rhino than altitude. In the present study, a slope angle of 45° or more are considered inaccessible to rhino, while slopes of 30-45° are considered difficult to access and slopes of less than 30° are considered easily accessible (Haryono, 1996).

Water and mud-wallows

Rhinos not only need water to drink, but also to bathe. According to Amman (1985), bathing is an opportunity to rest, to keep the skin moist, and to regulate body temperature. Furthermore, fish and crustaceans clean the rhino's skin from parasites.

Rhinos can go without bathing for up to four days, provided that enough wallowing sites are available, which is usually the case (Amman, 1985). Suitable bathing spots are in relatively deep streams and pools. In the dry season, suitable bathing sites may become less abundant, but generally remain sufficiently available. The availability of drinking water is never a problem in Ujung Kulon (Hommel, 1987), nor in the Honje Mountains, where streams and rivulets are abundant.

Wallowing serves many of the same functions as bathing and the two activities are, to a certain extent, interchangeable (Hommel, 1985). However, wallowing is more important than bathing; while rhinos can go without bathing for up to four days, they can only go without wallowing for 24-36 hours (Amman, 1985).

The availability of wallows is mostly determined by soil type and slope. According to Amman (1985), any depression in flat or gently sloping terrain with loamy or muddy soil can be suitable for wallowing, provided that the site is large enough for a rhino to roll in. According to Hoogerwerf (1970), the average size of a wallow is 3 metres wide by 6 metres long, with a mud depth of 50 centimetres. Throughout the peninsula, suitable wallowing sites are sufficiently available (Hommel, 1985). In the Honje Mountains, the availability of wallowing sites may be less, due to the occurrence of more and steeper slopes. However, according to Hariyadi (pers. comm., 2008), wallows are still sufficiently available in the Honje Mountains.

Haryono (1996), in his study on the suitability of the Honje Mountains as rhino habitat, does not differentiate between the availability of water for drinking, bathing or wallowing. While the same water sources may be used for drinking and bathing, it is the present author's opinion that the availability of wallowing sites should have been treated separately, because it is such a vital activity. However, due to a lack of time to collect primary data, the findings of Haryono (1996) will also be used in this study to determine the availability of water.

Salt

In contrast to other rhino species, Javan rhino does not visit salt licks to satisfy its need for minerals. Instead, it visits the shore and brackish rivers. Some authors referred to by Amman (1985) have suggested that rhino satisfy their need for minerals by drinking brackish or saltwater. However, it seems that this need is for a great part satisfied through the consumption of plants growing near the shore. According to Amman (1985), *Spondias pinnata* plants growing near the shore contain six to seven times more sodium than *S. pinnata* plants growing further inland. Furthermore, the deposit of crystalline salt on the leaves of plants growing on the beach may be a further source of minerals for Javan rhino.

In this study, the need for salt is not taken into account, because data were not available. It would have been a valuable additional factor to include, because it can not be assumed that rhinos have access to the beach from any given location in the Honje Mountains. The entire coastline west of the Honje Mountains is occupied by humans, as is part of the southern coastline. It would have been valuable to collect data on the availability of salt licks or other mineral rich sources in the Honje Mountains, but the limited availability of time did not permit it.

Cover

The Javan rhino is a very shy animal and therefore needs plenty opportunities to hide. However, cover is also important as a protection from direct sunlight and heat (Hommel, 1987). Nevertheless, according to Amman (1985), rhinos do not have any preference for shaded wallowing sites as opposed to non-shaded wallowing sites. Hommel (1987) further states that in some areas in Ujung Kulon rhinos are present despite the lack of dense vegetation. Indeed, as discussed earlier, the optimal rhino habitat also contains open spaces. Hommel (1987) concludes that rhino tend to hide in dense vegetation during the day, but that it is not indispensable.

According to Haryono (1996), a crown cover between 25 and 75 % is suitable for rhino, while a crown cover of more than 75 % is highly suitable. A crown cover of less than 25 % is unsuitable for rhino. These values have also been adopted in this study when determining the availability of cover in the Honje Mountains.

6.3. Threats

According to the IUCN Asian Rhino Specialist Group (1997) all three Asian rhino species are in a demographic crisis, caused primarily by over-exploitation by poachers for rhino products used in Chinese and allied medicine, and secondarily by habitat degradation as a result of expanding and developing human populations. According to Dinerstein (2003), the biggest market for rhino horn is not as Chinese medicine, but as handles for Yemeni *jambiyas*, traditional weapons that are worn by (nearly) every Yemeni man. *Jambiyas* made from rhinoceros horn are a symbol of high status in Yemeni society.

In the particular case of the Javan rhino, the problems for conservation are as follows (Sriyanto & Sutedi, 1997; Foead, 1997):

- The rhino population is restricted to the Ujung Kulon peninsula, which covers only 39.120 ha. This makes the rhino population very sensitive to disturbances of any kind, e.g. volcanic eruption and tidal wave (from nearby Krakatau), disease, and habitat degradation. The population size and isolation also decrease its genetic fitness. The rhinos in Ujung Kulon numbered 30 or less during 60 years, which is equal to 3-4 generations. It is possible that many of the currently breeding rhinos are more or less related. This situation may have led to an inbreeding depression, i.e. a higher rate of birth defects, higher mortality, slower growth and lower fecundity (IUCN SSC Captive Breeding Specialist Group & Asian Rhinoceros Specialist Group, 1990).

- Although poaching has not been recorder since 1970, it should by no means be dismissed. The price of rhino horn on the Asian black market is US$ 20.000 per kilogram (YMR *et al.*, 2002), which makes rhino poaching very attractive to those who are unconcerned with their survival.
- The forest in Ujung Kulon is still in a stage of succession. However, Hoogerwerf (1970) states that the vegetation in the hills in the interior of the peninsula has reached a climax, based on his observations that this vegetation did not show evidence of changing its composition during the twelve years of his association with Ujung Kulon. On the other hand, it is undeniable that currently, there is a fast spread of *Arenga obtusifolia*, which may subdue rhino food plants (YMR *et al.*, 2004).
- The grazing areas are in a bad condition and suffer form forest encroachment. This causes banteng to be distributed over rhino habitat, where it probably competes with rhino for food and space.
- Possibly, the carrying capacity of the habitat is reaching its limits, although it is difficult to say for sure what the potential carrying capacity is.
- There is little information on the exact structure of the population, but it may be such that it does not allow an increase in rhino numbers. According to Hoogerwerf (1970) the age distribution was such that the largest proportion of the population was very suitable for reproduction. He also mentioned an uneven sex ratio in the advantage of males. Considering the long stagnation of the population, and the probably high longevity of the species (Hoogerwerf, 1970), it may be assumed that the rhinos which were well suited for reproduction in 1970 now still make up a big part of the population, but are no longer able to reproduce much. Hariyadi (pers. comm., 2008) confirms that most rhino in Ujung Kulon are of sub-adult and adult age, and that there seem to be more males than females in a ratio of 3:2 (m:f).

7. Conclusion

Topologically, the Honje Mountains are quite different from peninsular Ujung Kulon. While the peninsula consists mainly of low rolling hills with a maximum altitude of 50 metres, the Honje Mountains consist have a deeply dissected relief with steep slopes and altitudes of up to 620 metres.

The most important habitat requirements of Javan rhinoceros are the availability of important food plants, reasonable accessibility, sufficient availability of water and mud-wallows, access to sources of salt and sufficient cover. Of these, only the abundance of salt sources is not taken into account in this study, because of a lack of data.

PART IV

Methodology

8. Methodology

8.1. Introduction

This chapter gives a detailed overview of how this research was carried out and clarifies the choices that were made. It starts by describing the preparation phase of the research, explaining how the research problem was identified and how the research approach was chosen. Next, the data collection phase is discussed, in which the choices of how to collect the social and ecological data are elaborately clarified.
This chapter concludes with a detailed explanation of the methods used to quantify the social data and to analyze the ecological data.

8.2. Preparation

The first step in any research is to identify the research problem. In this case, the basic problem was identified as the increasing number of endangered species in combination with the increasing fragmentation of habitats (Armstrong & Seddon, 2007). This situation has lead to the emergence of reintroduction programmes in an attempt to re-establish populations of endangered animals in areas where they have gone locally extinct (IUCN, 1998). One of the problems of reintroduction programmes, however, is that little attention seems to be paid to the social aspects.

After the problem was identified, the main research question was formulated. The main research question here addresses the lack of attention paid to social aspects of reintroductions, and tries to find ways in which the social aspects can be incorporated in the consideration of ecological aspects. For example, the behaviour of an animal greatly defines its habitat needs, but it also gives an indication to what extent there is a risk of future human-animal conflict, be it direct or indirect. If these ecological and social aspects are combined, it opens up the way to a better design of the reintroduction programme.

In preparation of the research, a large amount of relevant literature was studied, in order to become familiar with the current knowledge and theories, as well as the methodologies used in research. This allowed the researcher to choose the approach to be taken and methodology to be used to answer the main research question. Furthermore, it resulted in the acquisition of part of the required data.

The approach chosen for this research was to identify opportunities for local participation in the management of a protected area, using a case study of Javan rhino reintroduction in the Honje Mountains, in the eastern part of Ujung Kulon National Park. This approach was chosen, because literature shows that the participation of local villagers in the management of a protected area can result in more efficient protection (Dinerstein, 2003; Steinmetz *et al*, 2006).

In this research, the data that were needed were ecological data on the Honje Mountains, which include the topography, climate, hydrology, vegetation structure and composition, and rhino habitat availability. Furthermore, socio-economic data needed to be collected, which include demographic data (such as population density and growth), livelihood, human activities within the national park, local knowledge about rhino, perception of risks related to the vicinity of a rhino population, awareness of potential benefits that may result from rhino reintroduction, the ethical value local villagers give to rhinos, and the amount of trust that exists between local communities and decision making bodies. These data help to define the attitude of local people to rhino conservation and to a possible reintroduction of Javan rhino to the Honje Mountains (Stankey and Shindler, 2005). The ecological data were collected from secondary sources, while the socio-economic data were collected through interviews.

8.3. Data collection

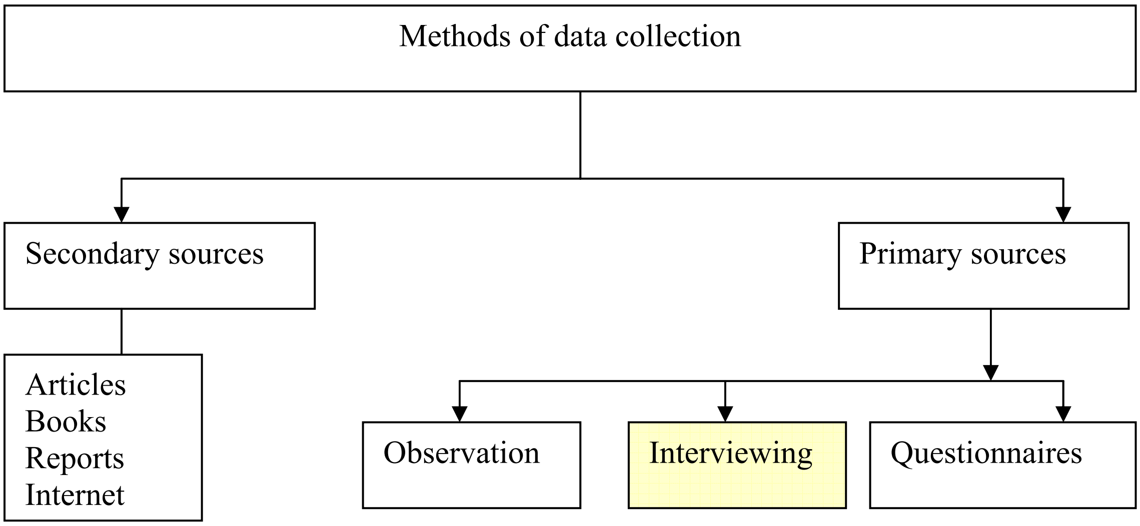

Figure 8.1 Methods of data collection. *Source: Groenendijk, 2003*

As stated above, the ecological data were collected from secondary sources (fig. 8.1). Ecological data needed include the topography, climate, hydrology, vegetation structure and composition, and rhino habitat availability in the Honje Mountains, as well as the Ujung Kulon Peninsula. Furthermore, the ecological needs of the Javan rhino had to be identified, including habitat preferences, food requirements, foraging and feeding behaviour, social behaviour, and home range size.

<u>The interviews</u>

The socio-economic data, on the other hand, were collected from both secondary and primary sources. Data specific to the case study were mostly collected from primary sources, namely through interviews. The goal of these interviews was to learn about the attitude of local villagers towards rhino conservation, and particularly towards the possibility of rhino reintroduction to the Honje Mountains. Furthermore, the interviews tested which factors define local people's attitudes. According to Stankey and Shindler (2005), these factors are technical and personal knowledge, spatial, temporal and social context, risk and uncertainty, aesthetics, and institutional and personal trust (fig. 2.5). In this research, the applicability of these factors for the identification of the cause of a certain attitude was studied.

The type of interview that was conducted was a semi-structured interview (table 8.1). This type of interview consists mainly of open ended questions, which are predefined and follow a predefined order (Groenendijk, 2003). However, the interviewer has the freedom to add additional questions during the interview, based on the answers that are given. Also, if the respondent does not understand the question, it may be rephrased, as long as the meaning stays the same. Another great advantage of semi-structured interviews is that topics can be discussed in-depth. Using open ended questions also allow for the collection of qualitative data, which is the type of data that was collected during this research.

Table 8.1 Overview of major interview types and their main characteristics. Explanation of symbols: + = low, ++ = medium, +++ = high. *Source: Groenendijk, 2003*

	Structured interview	Semi-structured interview	Topic focused interview	Un-structured interview	Group interview
Field of application	Census Large-scale survey Social/anthropology research Evaluations	Feasibility study Diagnostic study PRA/RRA Evaluations	Exploratory survey In-depth study Pre-feasibility study PRA/RRA Evaluations	Exploratory survey Diagnostic survey PRA/RRA	Exploratory survey Diagnostic survey PRA/RRA Evaluations
Interviewer skills	+	++	+++	+++	+++
Background respondent	General respondent	General respondent Key informant	Key informant	General respondent Key informant	Interest group Community
Type of data collected	Quantitative data	Quantitative/ qualitative data	Qualitative data	Qualitative data	Quantitative/ qualitative data
Degree of structuring	+++	++	+	+	+++
Form of questions	Closed ended	Closed and open ended	Open ended	Key points	Open ended
Effect of personal bias	+	++	++	+++	+

Before each interview, an introductory talk was given, which had three main goals (Groenendijk, 2003). First, it was supposed to make the interviewee feel that the interaction that was about to take place would be a pleasant one. The interviewee should be convinced that he or she would be listened to with interest, and treated with respect. Second, it was important to show the interviewee how his or her cooperation in the research was vital, and that it would bring personal benefits to the interviewee. Finally, the goal and the implications of the interview were made clear, assuring the interviewee that the interview would stay confidential.

Each interview took less than an hour, in order to prevent the respondent from losing interest (Groenendijk, 2003). The questions were asked in a predefined order, although additional questions could be added in the course of the interview. Any changes in the interview were carefully recorded. The questions were formulated following a number of rules of thumb, which reduce the risk of misunderstandings (Groenendijk, 2003). First of all, clear and simple language was used, avoiding jargon and technical terms, to ensure that the questions were easy to understand and had the same meaning to the interviewer and the respondent. Second, ambiguous questions were avoided, to ensure that a question had only one meaning, which was the same for each respondent. Third, questions were not supposed to lead the respondent to a particular answer, which would make the answer unreliable. Fourth, questions were not allowed to be based on assumptions. Before such questions were asked, other questions were asked to confirm or disconfirm the truth of the assumptions. Finally, all questions were asked one at a time, even if it seemed practical and time saving to combine some questions. Combined questions might have confused the respondent to the point that they did not know which question to answer.

After each interview, the respondents were asked what their hopes were for the future. They were free to say whatever was on their mind.

Each interview was recorded on a voice recorder, after permission was granted by the respondent. This allowed the interviewer to listen to answers attentively, without missing out on something, which could have been the case when the interviewer would have had to write down every answer (Groenendijk, 2003). The questions asked in each interview are listed in appendix A.

Selection of respondents

The Honje Mountains are surrounded by 19 villages (fig. 8.2). Most of these villages border directly on the national park, but only a few border on suitable rhino habitat. For this study, only those villages bordering on suitable rhino habitat were visited for interviews, namely Taman Jaya, Ujung Jaya, Rancapinang, and Cibadak. Two other villages were visited to function as a control village, namely Kramat Jaya, which borders on the National Park, but not on suitable rhino habitat, and Ciburial, which does not border on the national park. In each village, the Head of Village and/or the Village Secretary was interviewed, because they were considered to be representatives of the entire village. However, in Cibadak, the Head of

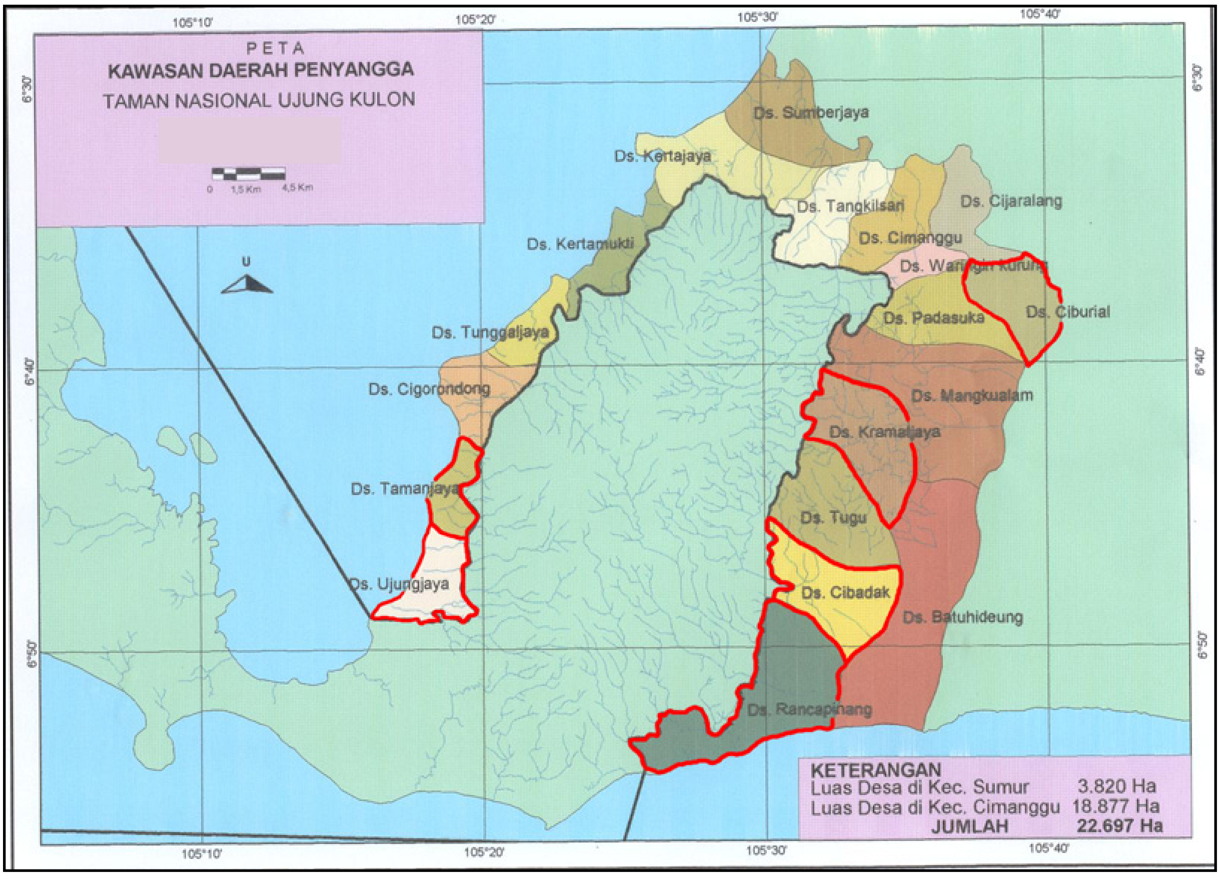

Figure 8.2 Location of villages surrounding the Honje Mountains. Indicated in red are the villages visited for this research. *Source: Rahmaningsih, pers. comm. 2008*

Village was only recently installed, and had moved there from outside the area. Therefore he was not considered to be representative of the entire village, and the interview was repeated with the Village Secretary, who had been in his function for several years already.
Furthermore, each village consists of a number of kampongs, which can be quite far apart. Therefore, in cooperation with WWF Ujung Kulon, two kampongs per village were selected. In each kampong, one farmer, who could represent the entire population, was interviewed. However, there are two kampongs that are located inside the national park. These kampongs (Legon Pakis and Ciakar) were treated as separate cases, rather than including them in the village to which they belong, in order to be able to differentiate between their situation as enclaves instead of buffer zone villages. For these kampongs, both a farmer and a member of the village council were interviewed. For an overview of the villages and kampongs that were visited, refer to table 8.2 below. Village profiles, including population size and types of livelihood, are presented in appendix G.

Table 8.2 Villages and kampongs visited. Numbers in brackets show the number of respondents per kampong. For villages, numbers in brackets show the number of respondents from the village government.

Village	Ujung Jaya (1)	Taman Jaya (1)	Rancapinang (1)	Cibadak (2)	Kramat Jaya (1)	Ciburial (1)
Kampong	Kiaragondok (1)	Paniis (1)	Cegog (1)	Cilubang (1)	Sompok (1)	Sadang (1)
	Cikawung Sebrang (1)	Cimenteng (1)	Air Jeruk (1)	Cibadak (1)	Pasir Ranji (1)	Ciburial (1)
	Legon Pakis (2)		Ciakar (2)			

8.4. Data analysis

Since the data collection was shaped by theoretical propositions (the factors that influence attitude proposed by Stankey and Shindler, 2005), these same theories were used in analyzing the data. Using this strategy helps with the identification and examination of alternative explanations (Yin, 2003).

However, an analytic strategy alone is not enough, and needs a specific analytic technique. This research uses an explanation building technique. The theoretical propositions as outlined by Stankey and Shindler (2005) were compared to the findings of the case study on Javan rhino reintroduction. Where necessary, the initial theoretical propositions were revised, based on this comparison.

In order to identify which factor (knowledge; ethics; perceived risks; spatial, temporal and social context; trust) most defines the attitudes of local inhabitants to Javan rhinoceros reintroduction to the Honje Mountains, each factor had to be quantified on a five-point scale, such as described in chapter 2.

Knowledge

To quantify the level of knowledge of each respondent, their answers to knowledge related questions were given a value of 1 if the answer was correct, 0 if the respondent could not answer and -1 if the answer was incorrect. These values were then added up to each other, so as to quantify the level of knowledge of each respondent. In total, there were four questions related to knowledge, which focussed on Javan rhino social behaviour, feeding behaviour, cover preferences and its reaction to a direct encounter with a human. Thus, each respondent could get a score between -4 and 4, which was then translated to a point on the scale (table 8.3).

Table 8.3 Translation from summed scores of answers to level of knowledge on a five-point scale

Score of answers	-4	-3	-2	-1	0	1	2	3	4
Level of knowledge on scale*	1	1	1	1	2	3	3	3	4

*Legend: 1 = Misconceptions (Highly unfavourable)
2 = No knowledge (Unfavourable)
3 = Some knowledge (Neutral)
4 = Good knowledge (Favourable)
5 = Extensive knowledge (Highly favourable)

A respondent with a total score of 0 is considered to have no knowledge of Javan rhinos, while a respondent with a score below 0 is considered to have misconceptions about Javan rhinoceros. A respondent with a score of 1, 2 or 3 is considered to have some knowledge, while the knowledge of a respondent with a total score of 4 is considered to be good. This method of translation was chosen in order to weigh the level of knowledge down, so as to compensate for lucky guesses. Thus, no respondent could be considered to have an extensive level of knowledge solely based on the number of correct answers given. Only if over the course of the interview the respondent showed to be particularly knowledgeable about rhino could he or she be considered to have an extensive level of knowledge.

Spatial, temporal and social context

To quantify the spatial, temporal and social context, a difference is made between the benefits that local inhabitants expect to reap from the reintroduction of rhino, and their awareness of the status of Javan rhino as a critically endangered species (www.iucnredlist.org, 2008).

During the interview, each respondent was asked which benefits he or she expected to get from the reintroduction of Javan rhinoceros to the Honje Mountains. Furthermore, each respondent was specifically asked whether they expect to get benefits from increased ecotourism and community forestry projects, because the author considers these benefits to have high potential in the study area. What is meant with community forestry here is that local communities are given seedlings of timber and fruit trees, which they can grow on their own lands and harvest for their personal use or sale on the market. If such programmes are planned carefully and prove successful, the pressure on the National Park will reduce, because the people do not need to enter it to collect timber any more.

Each respondent was given points for the benefits mentioned. For each benefit mentioned spontaneously, the respondent was given 2 points. If a respondent could see the benefit of ecotourism or community forestry after being asked, he or she was given 1 point per benefit. If after being asked specifically about ecotourism and community forestry, a respondent still did not expect to get any benefits, 0 points were given. A respondent who mentioned a benefit that could be harmful to the rhinos was given -1 point. Next, the total score of each respondent was translated to a point on the favourability scale (table 8.4). To do so, two points were added to all respondents' scores. Thus, a respondent who did not see any benefits (score 0) is attributed to point 2 on the scale. The highest point on the scale is 5, so respondents with a score of 3 or more are all attributed to this point.

Table 8.4 Translation from respondents' scores to a point on a five-point scale of expected benefits

Total score of respondent	0	1	2	3	4
Point on scale*	2	3	4	5	5

*Legend: 1 = Only harm expected (Highly unfavourable)
2 = No benefits expected (Unfavourable)
3 = Few benefits expected (Neutral)
4 = Some benefits expected (Favourable)
5 = Many benefits expected (Highly favourable)

The respondents' awareness of the status of Javan rhinoceros as a critically endangered species was assessed by asking them how they thought the rhino population in Ujung Kulon was faring; whether it is growing, stable or declining. Their answers were translated to a point on a five-point scale as summarized in table 8.5.

Table 8.5 Translation from respondents' answers to a point on a five-point scale of awareness of Javan rhino's status as a critically endangered species

Respondent's answer	Pop. growing	Pop. stable, large	Doesn't know	Pop. stable, small	Pop. declining
Point on scale*	1	2	3	4	5

*Legend: 1 = Awareness of population size and trend far from actual situation (Highly unfavourable)
2 = Awareness of population size far from actual situation, but awareness of population trend close to actual situation (Unfavourable)
3 = Does not know about population size and trend (Neutral)
4 = Awareness of population size and trend close to actual situation (Favourable)
5 = Awareness of population size and trend (almost) equal to actual situation (Highly favourable)

Perceived risks

The quantification of perceived risks was done by comparing the risk's probability of occurrence to its expected impact (fig. 2.8). Thus, the severity of a risk can be determined with a score of 1 (very serious risk) to 5 (very low risk). Next, the respondents' answers are quantified by dividing the average severity of risks perceived by the number of risks perceived (equation 8.1). Since lower numbers on the scale correspond to less favourable situations, dividing the average severity of perceived risks by the number of risks perceived results in less favourable situations as the number of risks increases. Thus, a respondent who mentions many very low risks can be attributed to the same point on the scale as a respondent who mentions only one, but very serious risk. Respondents who do not perceive any risks related to Javan rhino reintroduction to the Honje Mountains are attributed to the highest point on the scale (i.e. 5; highly favourable).

$$\text{overall severity of perceived risks} = \frac{\text{average severity of perceived risks}}{\text{number of perceived risks}} \qquad \textit{equation 8.1}$$

Ethics

In order to quantify the level of ethical values associated to Javan rhinoceros and its existence, the respondents were simply asked which cultural, spiritual or religious values they associated to rhinos or their existence nearby. The answers could directly be translated to a five-point scale, i.e. negative associations are unfavourable, with fear and hatred on the extreme left of the scale, while positive associations are favourable, with sanctity on the extreme right of the scale (fig. 2.9).

Trust

The quantification of the level of trust between local inhabitants and decision making bodies is similarly straightforward. The respondents are asked how they view their relationship with the National Park management as well as with WWF, which is deeply involved with Javan rhino conservation. Their answers can be directly translated to points on a five-point scale (fig. 2.10).

Finally, in order to define which factors are the most important in determining the attitude of local people towards Javan rhinoceros reintroduction, the average scores for each factor on their corresponding scales of people who support reintroduction was compared with those of people who do not support reintroduction.

The analysis of ecological data is done by means of mapping each criterion (i.e. food availability, accessibility, water availability, available cover, as well as human disturbance). To do so, this study greatly relies on the habitat suitability study by Haryono (1996). His MSc.-thesis is the only in-depth study found on the subject. Haryono mapped the same criteria used in this study, using undefined GIS tools. Next, he summarizes his data in a table, before coming to a habitat suitability map. However, it is not entirely clear how he analyzed his data so as to generate this final habitat suitability map. Therefore, the maps drawn by Haryono (1996) are reproduced in this study, using ArcGIS 9 ArcMap Version 9.2. The shapefile needed to work in ArcMap was created by BAKOSURTANAL, the Indonesian National Coordinating Agency for Surveys and Mapping, and retrieved from foruminformatika.wordpress.com (2008). Haryono divided the Honje Mountains in thirteen blocks. For this study, a scanned version of this map was overlayed with the shapefile and georeferenced to make the overlay fit. However, Haryono's map proved to be rather inaccurate. Therefore the borders of the thirteen blocks had to be redrawn. As a result, the maps created in this study are not entirely accurate either. However, for the purpose of this study, this relatively low accuracy does not pose a problem.

Next, the thirteen blocks were given values for each criterion. These values are summarized in a table, which is then used to analyze the rhino habitat suitability of the Honje Mountains, using a Multiple Criteria Analysis. The result is visualized in a habitat suitability map. This map is then further analyzed to compare the theoretical suitability with the practical and potential habitat suitability of the Honje Mountains, in order to come to a final recommendation.

PART V

Results and Analysis

9. Results

9.1. Introduction

In this chapter, the results of the study are presented and analyzed. To begin with, the ecological data are presented in a series of maps, which discuss the suitability of the Honje Mountains as rhino habitat according to the habitat requirements outlined in paragraph 6.2, i.e. availability of food plants, accessibility, availability of water and mud-wallows and availability of cover. Furthermore, the level of human disturbance is included as one of the criteria that define the suitability of an area to accommodate Javan rhinos. These data are analyzed by means of a Multi-Criteria Analysis in order to define which parts of the Honje Mountains are suitable Javan rhino habitat.
Next, the data on the social aspects are discussed. The respondents' attitudes are presented, after which the factors that define them are quantified on their respective five-point scales of favourability. Subsequently, these quantifications are analyzed in order to define which factors are most important in determining the attitudes of local people towards Javan rhino reintroduction.
Finally, the findings on both the ecological and social aspects are further analyzed in order to determine how they affect the design of an eventual reintroduction programme. The chapter is concluded with a discussion of other ways to increase the Javan rhino population in Ujung Kulon.

9.2. Habitat suitability of the Honje Mountains

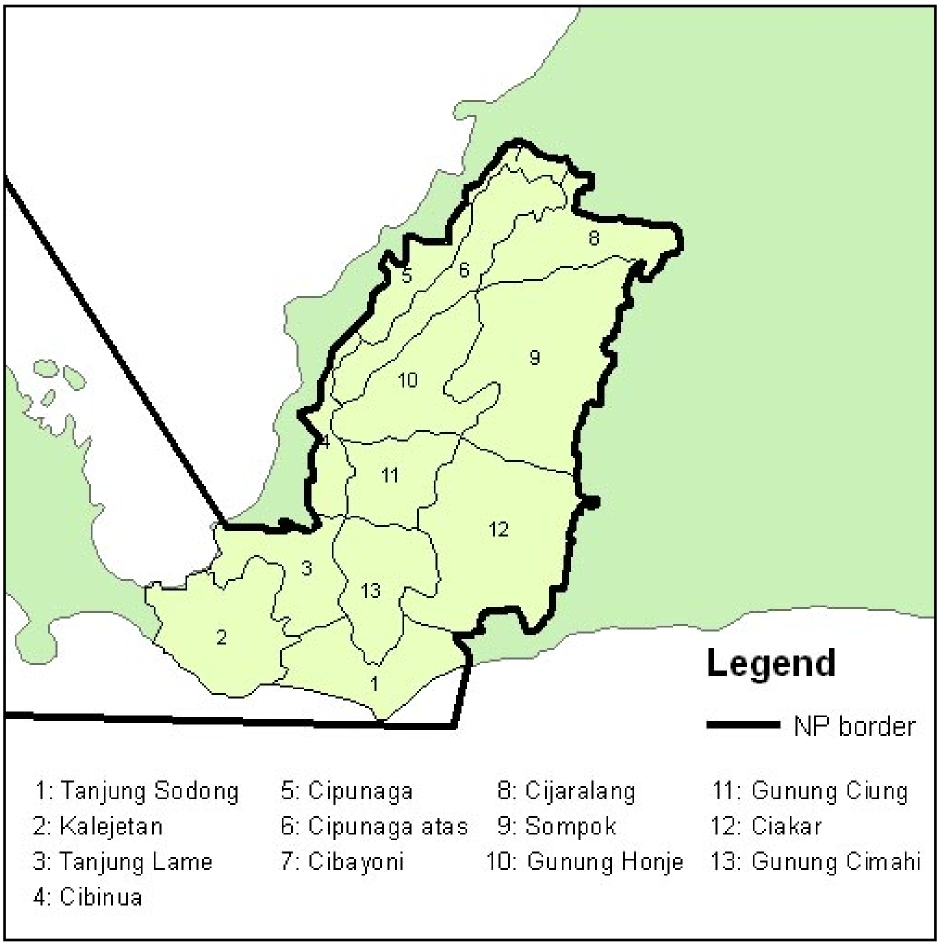

Figure 9.1 Division of the Honje Mountains in blocks. *Modified from Haryono (1996)*

To be able to differentiate between different areas of the Honje Mountains, the study area was divided in blocks (fig 9.1; Haryono, 1996). The advantage of this division is that it allows for easier reference when discussing the suitability of a particular area, but the disadvantage is that differences within these relatively large areas can not be recorded. However, for the purpose of this study, this division is very useful.

Availability of food plants

According to Haryono (1996), at least 24 rhino food plants are available in the Honje Mountains. Of these 24, five are classified as very important (i.e. *Spondias pinnata, Leea sambucina, Dillenia excelsa, Eugenia polyanta* and *Desmodium umbellatum*). The most widely available food species is *Vitex pubescens*, which is not among the most important ones, followed by *D. excelsa*, *Lagerstroemia flos-reginae*, *Alstonia cholaris* and *S. pinnata*. Thus, it seems that at least two of the most important rhino food plants are very common in the Honje Mountains.

An important remark to make is that *Arenga obtusifolia*, the palm that is suspected of outcompeting rhino food plants for light, is by no means uncommon in the Honje Mountains, especially in the Kalejetan and Tanjung Lame blocks. However, according to Hariyadi (pers. comm., 2008), it is not yet threatening to cause serious habitat degradation.

The central and southern part of the Honje Mountains (15.784 ha, or 70,65 %) has the highest availability of food plants, while in the northern part (6.558 ha, or 29,35 %), this availability is rather low (fig. 9.2).

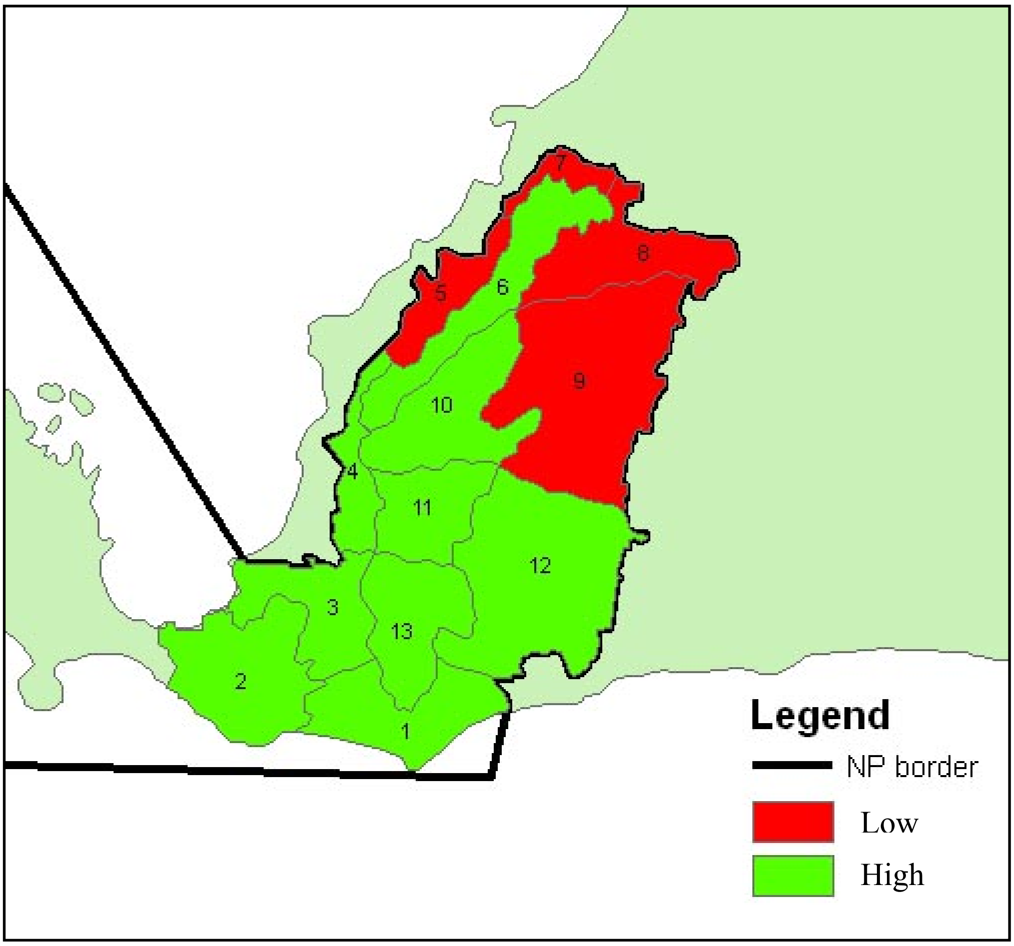

Figure 9.2 Availability of food plants in the Honje Mountains. *Modified from Haryono (1996)*

Accessibility

As described above, the accessibility of each block depends on the average angle of slopes. The density of the vegetation is not taken into account in the identification of accessible areas. This is probably not a problem, because as previously stated, Javan rhino seem to have no trouble with crossing dense vegetation if they have to. Haryono (1996) uses altitude as a defining factor in accessibility, but for reasons previously explained, the present author is of the opinion that altitude is not a limiting factor for Javan rhino.

The accessibility of each block is summarized in figure 9.3 and table 9.1 below.

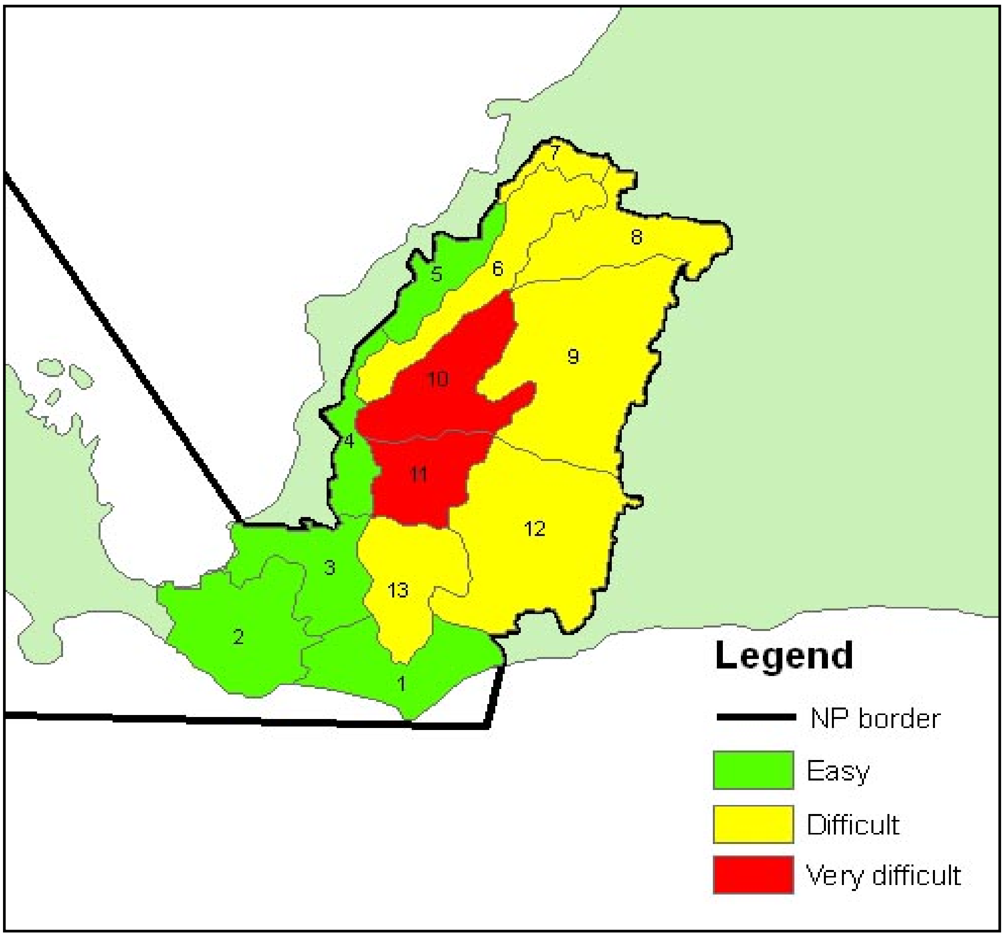

Figure 9.3 Accessibility of the Honje Mountains for rhino. *Modified from Haryono (1996)*

The parts of the Honje Mountains that are most easily accessed by rhino are the western and south-western parts. Together, these account for approximately 6686 hectares, or approximately 29,93 % of the total area. Together with the more difficult to access areas, which account for 12.548 hectares (56,16 %), the total area that is accessible to rhino covers approximately 19.234 hectares, or 86,09 % of the total Honje Mountains.

The area that is very difficult for rhino to access accounts for 3.108 hectares, or 13,91 % of the total area. These results are somewhat different from those found by Haryono (1996), because he classified Gunung Ciung as difficult to access, rather than very difficult, because the altitudes in that block do not exceed 500 metres. Nevertheless, the slopes are very steep, and therefore, this area is considered very difficult for rhinos to access.

Table 9.1 Accessibility of the Honje Mountains for Javan rhino. *Modified from Haryono (1996)*

Average slope angle (°)	Block	Accessibility
0-30	Tanjung Sodong Kalejetan Tanjung Lame Cibinua Cipunaga	Easy access
30-45	Cipunaga atas Cibayoni Cijaralang Sompok Ciakar Gunung Cimahi	Difficult access
>45	Gunung Honje Gunung Ciung	Very difficult

Water and mud-wallows

Haryono (1996) made an inventory of the availability of open water sources in the Honje Mountains, including rivers, streams, springs and pools. The availability was classified according to the number of open water sources encountered per 25 km², based on the average distance a rhino covers in 24 hours. The distance covered by rhino in 24 hours is 1,4 – 3,8 km

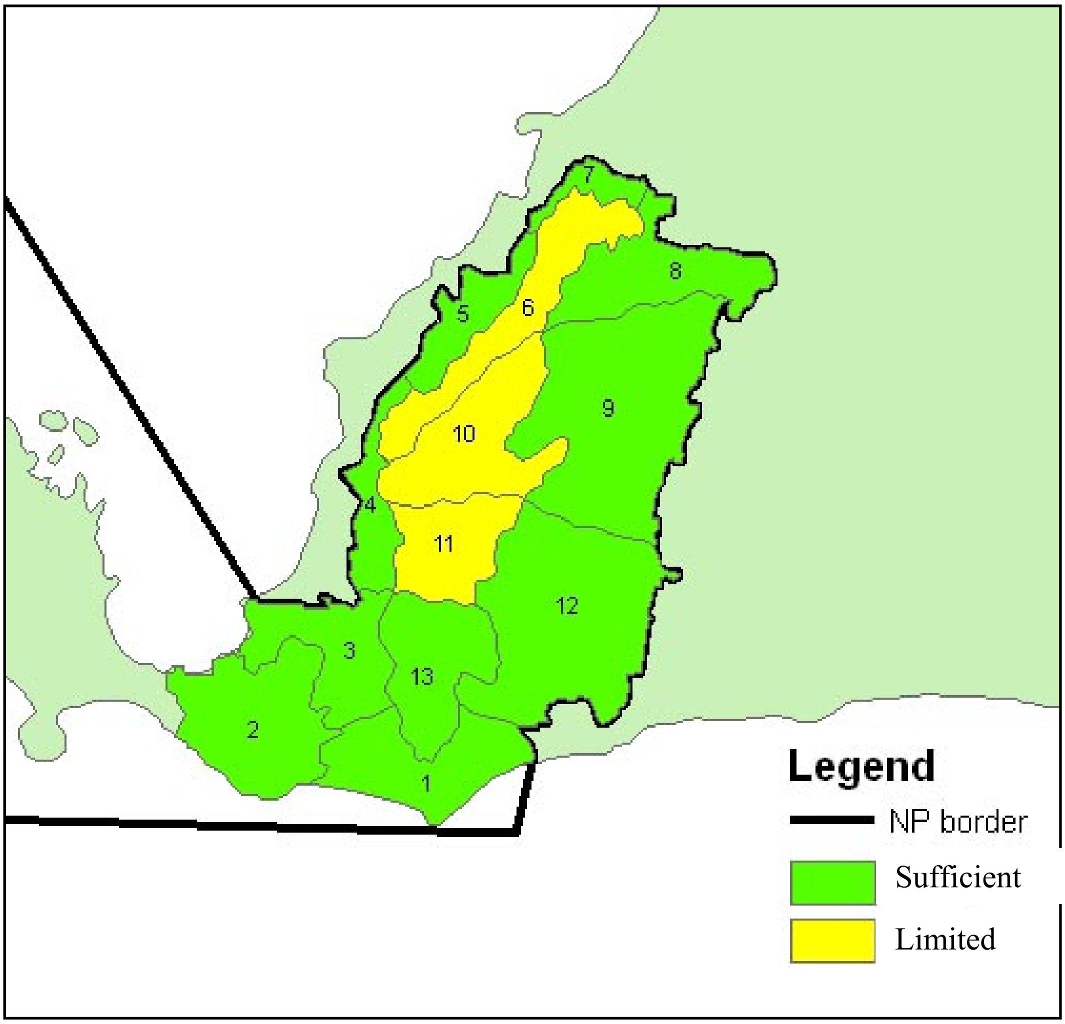

Figure 9.4 Water availability in the Honje Mountains. *Modified from Haryono (1996)*

(average 2,6 km) (Amman, 1985). Considering that Javan rhino needs to wallow every 24 hours, a suitable wallowing site has to be available within 2,6 km in any direction from the location where a rhino is at any given moment. This means that in a circle of 21,24 km^2 around a rhino, there needs to be at least one suitable wallowing site available.

Haryono (1996) classified the availability of water as follows:

- Sufficiently available, if in an area of 25 km^2 more than one open water source was encountered,
- Limited availability, if in an area of 25 km^2 only one open water source was encountered,
- Unavailable, if in an area of 25 km^2 no open water sources were encountered.

The availability of water in the Honje Mountains is mostly defined by rivers, rivulets and springs, while there are only a few marshes during the wet season, which are located in the Kalejetan block (Haryono, 1996). Except for the central part, the entire area of the Honje Mountains can be classified as having a sufficient availability of water for drinking, bathing and wallowing (fig. 9.4 and table 9.2). The total area with a sufficient water availability accounts for 21.383 hectares, or 78,7 % of the Honje Mountains.

Table 9.2 Water availability of the Honje Mountains. *Modified from Haryono (1996)*

<table>
<tr><th>Block</th><th>Average number of water sources per 25 km²</th><th>Classification of water availability for rhino</th></tr>
<tr><td>1. Tanjung Sodong</td><td>3</td><td rowspan="5">Sufficient</td></tr>
<tr><td>2. Kalejetan</td><td>3</td></tr>
<tr><td>3. Tanjung Lame</td><td>2</td></tr>
<tr><td>4. Cibinua</td><td>2</td></tr>
<tr><td>5. Cipunaga</td><td>2</td></tr>
<tr><td>6. Cipunaga atas</td><td>1</td><td>Limited</td></tr>
<tr><td>7. Cibayoni</td><td>2</td><td rowspan="3">Sufficient</td></tr>
<tr><td>8. Cijaralang</td><td>3</td></tr>
<tr><td>9. Sompok</td><td>3</td></tr>
<tr><td>10. Gunung Honje</td><td>1</td><td rowspan="2">Limited</td></tr>
<tr><td>11. Gunung Ciung</td><td>1</td></tr>
<tr><td>12. Ciakar</td><td>3</td><td rowspan="2">Sufficient</td></tr>
<tr><td>13. Gunung Cimahi</td><td>2</td></tr>
</table>

Cover

In the Honje Mountains, there are three main vegetation types that are important providers of cover for wildlife (Haryono, 1996). These vegetation types are beach forest, lowland rainforest and secondary forest and scrubland. However, the lowland rainforest in the western part of the Honje Mountains has already suffered quite some disturbance, to the point that it is intersected with patches of secondary forest.

Secondary forest is generally found throughout the Honje Mountains, but in some places at the periphery of the National Park, it has been converted to irrigated rice fields, non-irrigated rice fields, fields for seasonal crops or even housing. Examples of such places are kampong Legon Pakis, in the Tanjung Lame block, and kampong Ciakar, in the block of the same name.

Table 9.3 Classification of the amount of cover in the Honje Mountains. *Modified from Haryono (1996)*

Vegetation type	Block	Average cover (%)	Classification of cover availability
1. Beach forest	Kalejetan	78	Much cover
2. Lowland rainforest	Kalejetan, Gunung Cimahi, Gunung Ciung, Gunung Honje, Cipunaga atas	82	Much cover
3. Secondary forest and scrubland	Tanjung Sodong, Tanjung Lame, Cibinua, Cipunaga, Sompok, Cibayoni, Cijaralang, Ciakar	63	Sufficient cover

In the south-eastern part of the Honje Mountains, in the block of Sompok, Ciakar and Tanjung Sodong, there is some illegal farming (Haryono, 1996). The National Park soils are somewhat more fertile than the soils owned by the communities, which causes them to convert parts of the forest to agricultural land. Moreover, this area is rather remote and difficult to access, to the point that it does not get much attention from the local government, nor from National Park rangers.

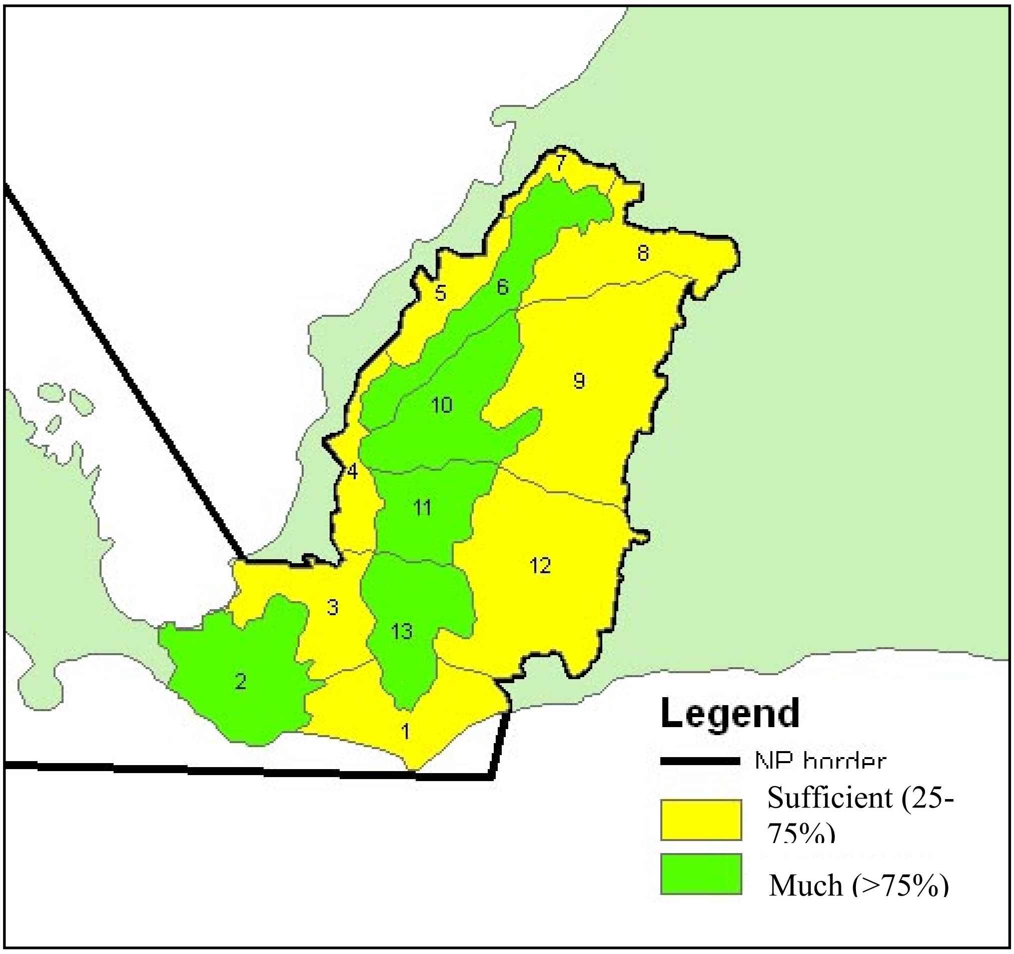

Figure 9.5 Amount of cover available to rhino in the Honje Mountains. *Modified from Haryono (1996)*

However, farming, both legal and illegal, are limited to the fringes of the Honje Mountains. Further inside the protected area, there is still sufficient cover for wildlife, including Javan rhinoceros (table 9.3). The total area that provides suitable cover for rhino is 21.505 hectares, or 96,25 % of the study area (Haryono, 1996).

The suitability of the Honje Mountains concerning available cover for rhino is mapped in figure 9.5.

<u>Human activities</u>

There are a number of human activities to be taken into account when investigating the suitability of the Honje Mountains as rhino habitat, which, if too severe, can become limiting factors. First, there is the issue of illegal farming and illegal housing within the borders of the National Park. According to Haryono (1996), this is an issue all around the Honje Mountains, although the kampongs of Legon Pakis and Ciakar are the only instances of illegal housing.
The history of illegal farming and illegal housing in the Honje Mountains is directly linked to the history of the status of the area. As explained before, when the Honje Mountains were under the management of the Forestry Service as a production forest, the local inhabitants were allowed to work the land in between stands of timber trees. When the status of the Honje Mountains changed to Nature Reserve in 1967, these farmed lands became illegal. In some cases, kampongs had to be relocated, which was only partially successful. In other cases, as well as those cases where relocation failed, the local inhabitants have been tolerated to continue working their land, as long as they do not extend their fields in the protected area. Nevertheless, this does not solve the problem, but rather creates conflict between the National Park and the local communities. The local communities feel limited in their rights and they can not fulfil their alimentation needs. On the other hand, the management of the National Park can not give the local communities more land, because this would make the situation unmanageable and the protection of the National Park impossible. A possible solution to the problem would be if the management of the National Park would provide seedlings of certain dearly needed crops (vegetables, fruit trees and timber trees) to the local communities, which they could plant on their own land and tend for their personal needs (Priambudi, pers. comm. 2008). Thus, they can make more efficient use of their land, and generate products and materials, which can be sold on the market.

Second, there is the issue of poaching. While rhino are not being poached any more, other wildlife still is, most frequently birds. These are either shot or caught with nets and resin. Other animals that are often hunted are lesser mouse deer and wild boar. Wild boar is hunted because it is considered a pest for community crops. According to Haryono (1996), during the five years from 1992 to 1996, there were on average two cases of poaching in the Honje Mountains, with a total of three animals killed on average.

Third, there is the collection of forest products. The people living around the Honje Mountains are still relatively dependent on the forest fore their survival. Therefore, they collect a number of forest products, such as timber, fuel wood, honey and resin. Of these, the felling of timber trees has the most severe consequences for the National Park. In the years 1994-1995, there were five cases of illegal logging in the Honje Mountains, with a total of 211 trees felled (Haryono, 1996). Illegal logging is most common in the blocks of Cipunaga, Cibinua and Tanjung Lame, and the most frequently logged trees are *Artocarpus elasticus*, *Dillenia excelsa*, and *Albizzia procera*. As discussed before, *D. excelsa* is one of the most important food plants for rhino. The trees logged for timber are assumed to typically be of a larger diameter than the specimens fed on by rhino, but they are important sources of seeds. When these larger trees are removed, it can be expected that there will be less regeneration of this species. Thus, there will be less food available for rhino. It is vital that research be done

to investigate to which extent the illegal logging of rhino food species is affecting the abundance and distribution of these species.
The effects of illegal logging are not restricted to the disappearance of species and the disturbance of forest structure. Another consequence is the increased risk of land slides, especially in a sloped environment such as the Honje Mountains (Haryono, 1996). Thus, the disturbance of the forest structure is not restricted to the logging site, but can reach much farther downhill. Furthermore, since the logging is usually done near rivers, which serve as infrastructure for the transportation of logs, the debit of these rivers may also be affected. If there are no trees to catch rainwater, there will be more surface runoff, which ends up in the rivers. Thus, the risk of flooding in areas downstream also increases.
Another forest product frequently collected is honey. Honey is collected by smoking out beehives. This is usually done during the flowering season, which coincides with the dry season. Consequently, the collection of honey sometimes results in forest fires. Forest fires can also be caused by camp fires of collectors of other forest products (Haryono, 1996).

Finally, another human activity causing disturbance in the Honje Mountains is the tending of livestock, mainly buffalo and goats. This activity is restricted to the fringes of the forest, where it borders directly on community farming land. In the wet season, when crops are planted, the livestock is left to roam freely in the forest, while in the dry season, the livestock is left in the rice fields, which have dried up and do not grow rice anymore. As a result of grazing livestock, the forest structure has been severely damaged (Haryono, 1996).
Another consequence of tending livestock in or near the National Park is the increased risk of disease being transferred from the livestock to wildlife, especially banteng and rhino. In December 1981 and January 1982, five rhino died (approximately 8,9 % of the population at that time), presumably as a result of disease. According to Priambudi (1992), it was probably anthrax, a common disease among ungulates, which was transmitted to the rhinos by local livestock. Santiapillai and Suprahman (1986) support this theory, and they mention an outbreak of *Septicaemia epizootica*, which killed 50 buffaloes and 350 goats in the neighbourhood of Ujung Kulon in November 1981. YMR *et al.* (2002) briefly mentions the possibility of poison, which resulted from a wrong choice of food plant. Rinaldi *et al.* (1997) support this possibility, stating that the fact that a high death toll like this did not occur again, and that a calf was found dead alongside its mother, point in the direction of poison being the cause of these deaths. According to Rinaldi *et al.* (1997), a change in diet was observed in 1991, which, in their opinion, would further support the theory of poison. However, these arguments seem rather flawed. First, the fact that a high death toll like the one in 1981/1982 did not happen again is more proof of disease being the cause of these deaths rather than poison from a regularly eaten plant. If a harmful food plant caused these animals to die, it should be expected that more rhinos would die from the same cause in the years to follow, at least until the diet changed in 1991. This does not seem to have been the case, nor did any rhino die from natural poisoning in the years before 1981, as far as literature shows. Second, the fact that a calf was found dead next to its mother does not necessarily indicate that poison was in play. The calf may just have stayed near its dead mother, not knowing where to go and how to survive on its own. It may as well have starved to death. All in all, a short outbreak of disease seems a much more likely cause for the deaths of these five rhino.

The intensity of human activities in the Honje Mountains is summarized in table 9.4, and visualized in figure 9.6. It should be remembered that these activities mainly take place in near the border of the National Park, and that the map in figure 9.6 is therefore not a very accurate representation of the actual situation.

Table 9.4 Human activities in the Honje Mountains. Frequency: * = seldom; ** = sometimes; *** = often. *Modified from Haryono (1996)*

Block	Illegal housing	Illegal farming	Poaching	Forest products	Livestock	Level of disturbance
Tj. Sodong	-	***	*	*	-	High
Kalejetan	-	-	-	*	-	Medium
Tj. Lame	***	*	*	***	***	High
Cibinua	-	-	-	**	**	Medium
Cipunaga	**	-	**	**	*	High
Cipunaga atas	-	-	-	*	**	Medium
Cibayoni	**	*	*	***	*	High
Cijaralang	-	-	-	*	**	Medium
Sompok	*	*	*	**	***	High
Gn. Honje	-	-	-	*	-	Medium
Gn. Ciung	-	-	-	*	-	Medium
Ciakar	***	***	*	*	**	High
Gn. Cimahi	-	-	-	*	-	Medium

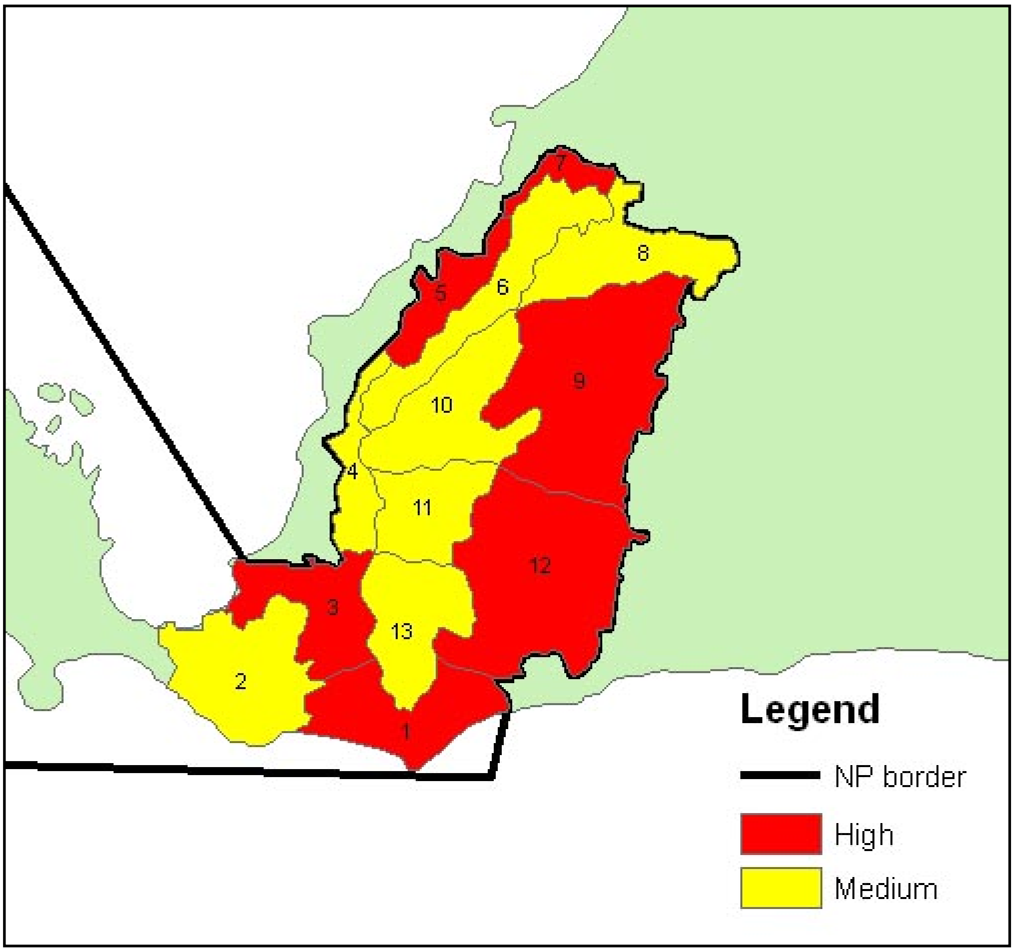

Figure 9.6 Level of disturbance from human activities in the Honje Mountains. *Modified from Haryono (1996)*

Habitat suitability

In order to analyze the suitability of the Honje Mountains as habitat for Javan rhinoceros, the values for each habitat requirement are summarized in table 9.5, and analyzed using a Multi Criteria Analysis. For each criterion, areas that are highly suitable for rhino are rated 1, while areas that are unsuitable are rated -1. Areas that are suitable, but not optimally so, are rated 0. Summing up these values per block results in the theoretic suitability of each block (table 9.5; fig. 9.7). However, it should be considered that simply summing up these values may cause unexpected results. For example, if in a certain block 'accessibility' is rated -1 (unsuitable), but all other criteria are rated 1 (highly suitable), the block concerned will be defined as suitable rhino habitat. Obviously, an area that is inaccessible to rhino is not suitable rhino habitat. Therefore, the Multi Criteria Analysis should make a correction for crucial criteria with a negative value, such as accessibility and food availability. In this study, such a correction was not necessary, because no areas were classified as suitable rhino habitat despite a negative value for critical criteria.

Table 9.5 Multiple Criteria Analysis of the suitability of the Honje Mountains as Javan rhinoceros habitat. Values of Suitability (extreme right column): -1 = Highly unsuitable; 0 & 1 = Unsuitable; 2 & 3 = Suitable; 4 = Highly suitable.

Nr.	Block	Area (ha)	Area %	Food availability	Accessibility	Water availability	Cover	Human disturbance		Suitability
1	Tanjung Sodong	1652	7,39	1	1	1	0	-1	Σ	2
2	Kalejetan	2094	9,37	1	1	1	1	0	Σ	4
3	Tanjung Lame	1414	6,33	1	1	1	0	-1	Σ	2
4	Cibinua	736	3,29	1	1	1	0	0	Σ	3
5	Cipunaga	790	3,54	-1	1	1	0	-1	Σ	0
6	Cipunaga atas	1651	7,39	1	0	0	1	0	Σ	2
7	Cibayoni	340	1,52	-1	0	1	0	-1	Σ	-1
8	Cijaralang	1557	6,97	-1	0	1	0	0	Σ	0
9	Sompok	3871	17,33	-1	0	1	0	-1	Σ	-1
10	Gunung Honje	1900	8,50	1	-1	0	1	0	Σ	1
11	Gunung Ciung	1208	5,41	1	-1	0	1	0	Σ	1
12	Ciakar	3604	16,13	1	0	1	0	-1	Σ	1
13	Gunung Cimahi	1525	6,83	1	0	1	1	0	Σ	3
TOTAL		22342	100	-1 = Low	-1 = Very difficult	-1 = None	-1 = Little (<25%)	-1 = High		
				0 = Medium	0 = Difficult	0 = Limited	0 = Sufficient (25-75%)	0 = Medium		
				1 = High	1 = Easy	1 = Sufficient	1 = Much (>75%)	1 = None		

An area is considered highly suitable as rhino habitat when all habitat requirements (accessibility, food and water availability and cover) are easily available (Haryono, 1996) and disturbance from human activities is not too high. In the Honje Mountains, there is only one block that fulfils all these criteria, namely Kalejetan. This is also the part of the Honje Mountains that is directly connected to the Ujung Kulon peninsula. The reason why this area is in such a good condition for rhinos is probably because it has been protected longer than the rest of the Honje Mountains. Hoogerwerf (1970) mentions the inclusion of a strip of land east

of the isthmus to the Ujung Kulon Game Sanctuary in 1937. Although no hard proof could be found, it is the present author's opinion that the strip of land that Hoogerwerf (1970) refers to must be Kalejetan. This would also explain why the total area of the Honje Mountains as presented in table 9.5 is 22.342 hectares, instead of the 19.498 hectares given by Haryono (1996), considering that the area of Kalejetan is approximately 2.049 hectares. Another reason for the difference in area is the error caused by the inaccuracy of the maps used to draw the blocks of the Honje Mountains. Nevertheless, these differences are so small that they are acceptable. Haryono (1996) calculated that the area of Kalejetan represents 9,26 % of the total area of the Honje Mountains, while the present study estimates this percentage at 9,37.
Kalejetan is highly suitable as rhino habitat, because it not only is a relatively flat area, but it also has a high availability of food and cover. According to Haryono (1996), more than 50 percent of all plant species encountered in Kalejetan are rhino food plants. Furthermore, they are present in higher amounts than in some areas on the peninsula that have been classified as highly suitable for rhinoceros. Finally, human activities in Kalejetan are limited to the collection of honey, and it only rarely happens.

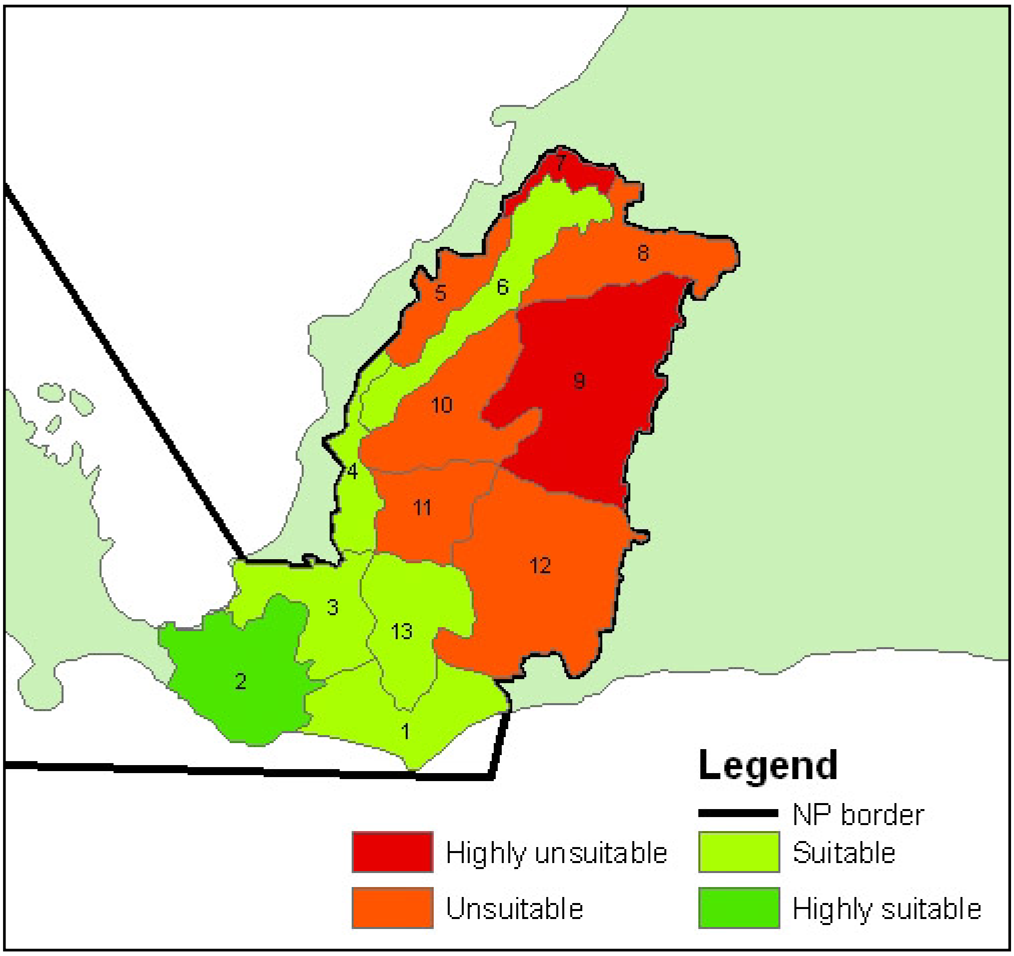

Figure 9.7 Theoretic suitability of the Honje Mountains as Javan rhino habitat

An area is classified as suitable when at least two habitat requirements are easily available and the other habitat requirements are at least sufficiently available. Furthermore, disturbance from human activities should not be too high, or should be compensated by the high availability of habitat requirements. Thus, an area such as Cipunaga atas, which is classified as difficult to access and has limited water availability, is still considered suitable for rhino, because it has a high availability of food and cover, and only medium disturbance

from human activities. Similarly, an area such as Tanjung Sodong, which is easily accessible and has high food and water availability and sufficient cover, is considered suitable rather than highly suitable, because of the high disturbance caused by human activities.
Thus, the area that is considered to be theoretically suitable for Javan rhino is the entire southern part, as well as a strip of land stretching north along the western slopes of the Honje Mountains, i.e. the blocks of Cibinua and Cipunaga atas (fig. 9.7). However, since these areas are very narrow (in the order of approximately 1 km at the narrowest point), for practical reasons these blocks should be excluded from the area suitable for Javan rhino (fig. 9.8). Rhinos can not be expected to stick to borders that were designed by humans. Since the area to the east of Cibinua and Cipunaga atas is inaccessible to rhino, it follows that they would be likely to move west, into areas occupied by humans, which would cause considerable conflict.
The disturbance caused by human activities in the area considered suitable for Javan rhino comes from housing (kampong Legon Pakis in block Tanjung Lame), poaching and the collection of forest products. (Haryono, 1996). However, it should be remembered that this disturbance is mostly restricted to the fringes of the National Park. An exception to this is the path connecting Ujung Jaya to Rancapinang, which goes through blocks Tanjung Lame and Tanjung Sodong. Many of the inhabitants of these villages are family and regularly visit each other.

The area in hectares of the theoretically suitable area, combining suitable and highly suitable areas, is presented in table 9.6 below. The area in hectares of the practically suitable area, which excludes Cibinua and Cipunaga atas, is presented in table 9.7.

Table 9.6 Area theoretically suitable for Javan rhino

Theoretic suitability		
	Area (ha)	Area (%)
Suitable	9.072	40,61
Unsuitable	13.270	59,39

Table 9.7 Area practically suitable for Javan rhino

Practical suitability		
	Area (ha)	Area (%)
Suitable	6.685	29,92
Unsuitable	15.657	70,08

An area is considered unsuitable if one or more habitat requirements are not available, or disturbance by human activities is too high. Thus, the entire central and eastern part, as well as the north-western border, is considered unsuitable (fig. 9.7). As explained before, the unsuitable area increases when considering the impracticality of including Cibinua and Cipunaga atas in the suitable area (fig. 9.8). Most of the blocks classified as unsuitable are either too difficult for rhino to access, or do not offer sufficient food plants. However, there is one exception, namely block Ciakar (table 9.5). Ciakar is difficult for rhino to access, but it has high food availability, as well as sufficient water availability and cover. The only reason why it is classified as unsuitable is because of the disturbance from human activities. All of the activities previously discussed are practiced in Ciakar. Illegal housing and farming lands are frequent and there is also some tending of livestock. Poaching and the collection of forest products also occur, though rarely (table 9.4).

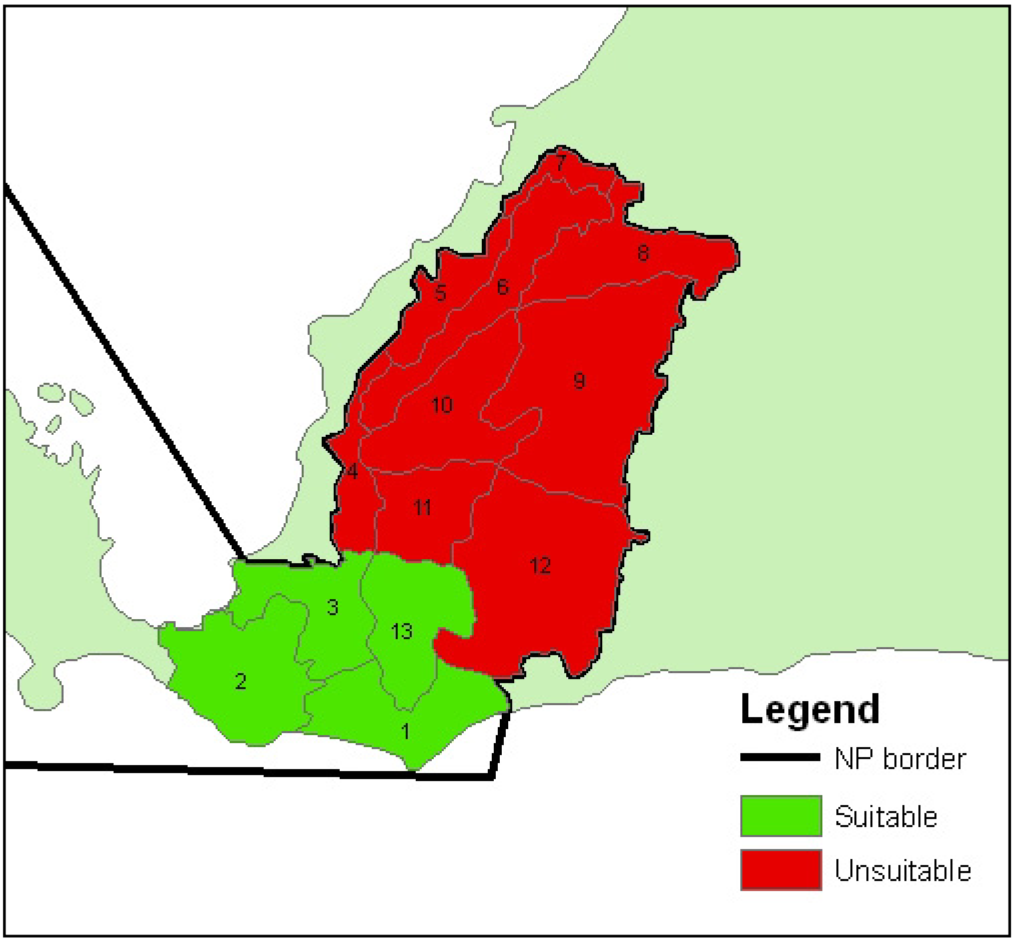

Figure 9.8 Practical suitability of the Honje Mountains as Javan rhino habitat

The reason why Ciakar scores so high on the scale of disturbance from human activities is because kampong Ciakar is partly located within the border of the National Park. However, it may not be the kampong that is expanding into the National Park, but the border of the National Park that has been redrawn several times to the point that it has started to engulf the kampong (Usi, pers. comm. 2008; Warti, pers. comm. 2008). Furthermore, the human activities are mostly limited to the fringes of the National Park. Therefore, it is worth further studying the extent of the disturbance caused by these activities in block Ciakar, and examining how they can be reduced. Until such studies have been done, it seems sensible to assume that at least part of block Ciakar is suitable habitat for rhinos. Thus, including it in the practically suitable area results in a potential area of 10.289 hectares of suitable rhinoceros habitat (table 9.8 and fig. 9.9).

Table 9.8 Area potentially suitable for Javan rhino

Potential suitability		
	Area (ha)	Area (%)
Suitable	10.289	46,05
Unsuitable	12.053	53,95

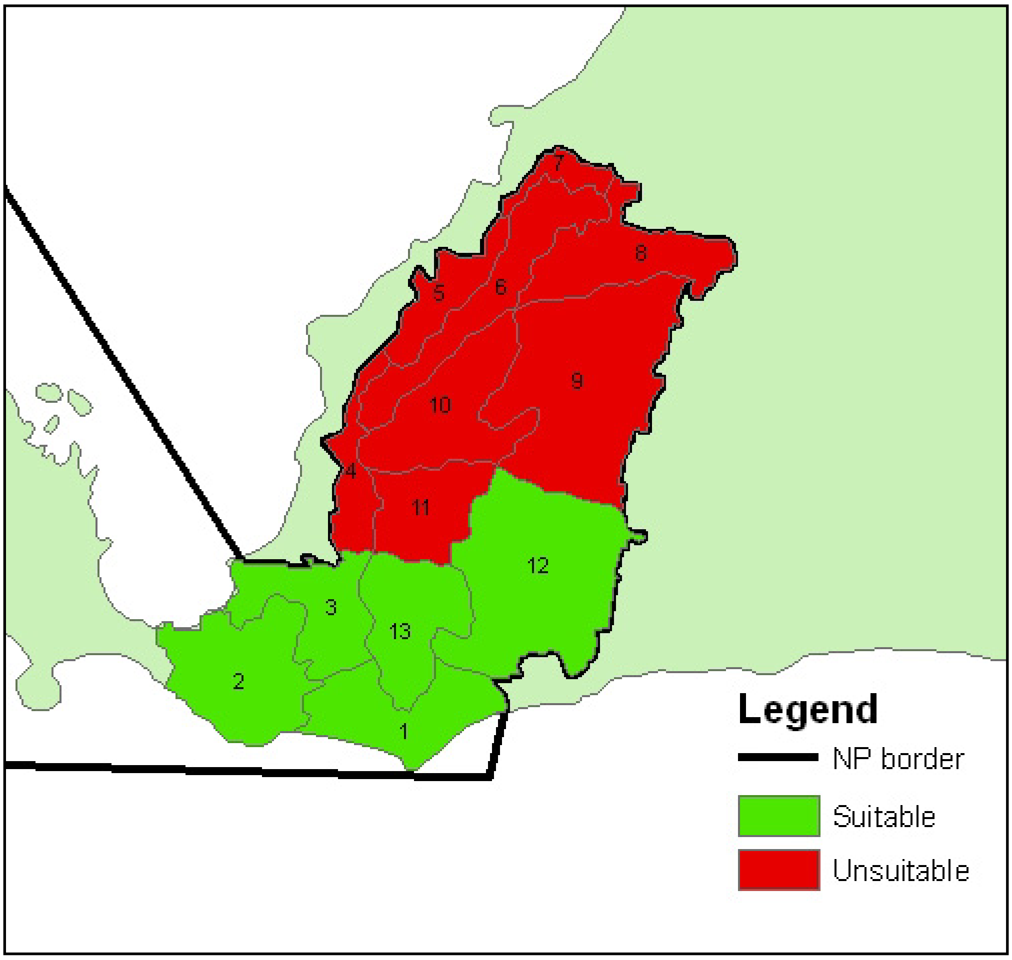

Figure 9.9 Potential suitability of the Honje Mountains as Javan rhino habitat

9.3. Attitudes of local inhabitants towards rhino conservation

The attitudes of members of the local communities bordering on the potentially suitable area have been assessed according to the five determining factors proposed by Stankey and Shindler (2005), i.e. knowledge, ethics, perceived risks, spatial, temporal and social context, and trust. It was found that all 23 respondents support Javan rhinoceros conservation, but when asked about the possibility that rhino be reintroduced to the Honje Mountains, many did not agree (8, or 34,8 %; table 8.9). The reasons given were mostly the same. The most common reason was fear for the rhino's safety. Many respondents were worried that rhino poaching would resume if rhinos were to be reintroduced to the Honje Mountains, because they would become more accessible to people of ill will. The fact that all respondents supported rhino conservation indicates that potential poachers might not be locals, but people from elsewhere. However, when asked about the benefits of a possible translocation of Javan rhino to the Honje Mountains, one respondent mentioned the high price of rhino horn. Yet, this respondent did not live near potentially suitable rhino habitat, but in the control village, which does not even border on the National Park. This further supports the assumption that would-be poachers might be from areas further away from the National Park.

Table 9.9 Local villagers' attitudes towards rhino conservation and reintroduction

Village	Kampong	Supports rhino conservation	Supports rhino reintroduction
Ujung Jaya		yes	no
	Kiaragondok	yes	no
	Cikawung Sebrang	yes	no
	Legon Pakis	yes	no
		yes	no
Taman Jaya		yes	yes
	Paniis	yes	yes
	Cimenteng	yes	no
Rancapinang		yes	yes
	Cegog	yes	yes
	Air Jeruk	yes	yes
	Ciakar	yes	yes
		yes	yes
Cibadak		yes	not sure
		yes	yes
	Cilubang	yes	-
	Cibadak	yes	yes
Kramat Jaya		yes	no
	Pasir Ranji	yes	yes
	Sompok	yes	no
Ciburial		yes	yes
	Sadang	yes	yes
	Ciburial	yes	yes

Another reason for not supporting the reintroduction of Javan rhino to the Honje Mountains was the assumed inability of rhino to adapt to their new environment. In other words, some respondents considered the Honje Mountains not to be suitable rhino habitat for reasons of lack of food and water.

Finally, a number of respondents only supported rhinoceros reintroduction if it could be guaranteed that there would be no crop damage, and one respondent would only support reintroduction if it could be guaranteed that the rhinoceros population would increase.

The answers to the questionnaire are given in appendices B – F.

Knowledge

Each interview was started with a brief introduction on the purpose of the research and an indication of subjects that were to be discussed with the respondent. After the introductory talk, most respondents would indicate that they could not help, because they had no knowledge about Javan rhinoceros. Nevertheless, they agreed to cooperate.

The first thing that needed to be ascertained was whether or not the respondent had ever seen a rhino or its traces. Out of 23 respondents, only 3 (13 %) had ever directly seen a rhinoceros, but 10 (43,5 %) had seen traces such as footprints and dung. Therefore, the knowledge that they have is mostly hearsay. Nevertheless, only 4 respondents (17,4 %) had an almost complete lack of knowledge of Javan rhinoceros, while 11 respondents (47,8 %) had some knowledge. The remaining 7 respondents (30,4 %) had a relatively good amount of knowledge (table 9.10).

Table 9.10 Quantified scores of 'knowledge' on a favourability scale of 1 to 5. Highlighted scores are from respondents that do not support rhinoceros translocation

Quantified scores of 'knowledge'	**Ujung Jaya**	Kiaragondok	Cikawung Sebrang	Legon Pakis	**Taman Jaya**	Paniis	Cimenteng	**Rancapinang**	Cegog	Air Jeruk	Ciakar	**Cibadak**	Cilubang	Cibadak	**Kramat Jaya**	Pasir Ranji	Sompok	**Ciburial**	Sadang	Ciburial
Knowledge	4	4	2	3 3	4	3	3	4	3	2	3 3	3 4	4	3	2	4	3	3	2	2

Legend:
1 = Misconceptions (Highly unfavourable)
2 = No knowledge (Unfavourable)
3 = Some knowledge (Neutral)
4 = Good knowledge (Favourable)
5 = Extensive knowledge (Highly favourable)

Spatial, temporal and social context

In order to be able to quantify the factor of spatial, temporal and social context, the respondents were asked about the benefits that they expected to be able to get from rhino reintroduction. Furthermore, their awareness of the status of Javan rhinoceros as a critically endangered species (www.iucnredlist.org, 2008) was assessed.

Of all respondents, only 2 (8,7 %) did not expect to reap any benefits whatsoever from rhino reintroduction to the Honje Mountains. Surprisingly, only 6 respondents (26,1 %) mentioned benefits spontaneously. The benefits that they mentioned were the chance to see rhinos directly and learn more about them through personal experience, the increased level of protection of the forest, reduced unemployment (unspecified), and the high value of rhino horn (table 9.11). After being asked about ecotourism and community forestry, 15 respondents (65,2 %) and 20 respondents (87 %), respectively, confirmed that they expected to be able to reap these benefits.

Table 9.11 Benefits mentioned by respondents, and how often each was mentioned. Numbers between brackets shows the total number of respondents mentioning the benefit after being explicitly asked

Expected benefits						
	Ecotourism	Community forestry	See rhino directly	Protection of forest	Reduced unemployment	Rhino horn
Count	(15)	(20)	4	1	1	1

The benefits expected by the respondent were quantified by the number of benefits mentioned by each. Thus, the more benefits mentioned, the more favourable the situation is for rhino reintroduction. Benefits mentioned spontaneously are counted more heavily than benefits that were only recognized after being asked about specifically. The benefit of the value of rhino horn is counted as a negative, so the respondent who mentioned it is placed lower on the scale than would have been the case if he had not mentioned it. Benefits

spiritually associated to the vicinity of Javan rhinos are not counted in this quantification, but are used as a measure for the ethical values local inhabitants give to this animal.
The results of the quantification of benefits are given in table 9.12 below.

Table 9.12 Quantified scores of 'spatial, temporal and social context (benefits)' on a favourability scale of 1 to 5. Highlighted scores are from respondents that do not support rhinoceros translocation

Quantified scores of 'spatial, temporal and social context (benefits)'																				
	Ujung Jaya	Kiaragondok	Cikawung Sebrang	Legon Pakis	**Taman Jaya**	Paniis	Cimenteng	**Rancapinang**	Cegog	Air Jeruk	Ciakar	**Cibadak**	Cilubang	Cibadak	**Kramat Jaya**	Pasir Ranji	Sompok	**Ciburial**	Sadang	Ciburial
Benefits	3	2	3	4 3	5	5	2	4	4	4	4 3	5 4	3	5	5	4	4	4	4	4

Legend:
1 = Only harm expected (Highly unfavourable)
2 = No benefits expected (Unfavourable)
3 = Few benefits expected (Neutral)
4 = Some benefits expected (Favourable)
5 = Many benefits expected (Highly favourable)

To assess the respondents' awareness of the status of Javan rhinoceros as a critically endangered species they were asked whether the rhino population in Ujung Kulon is big or small, and whether it is growing, stable (cq. stagnant) or declining. Unfortunately, four respondents were not asked this question, because it was added to the interviews at a later stage, and there was no opportunity to revisit these respondents, due to a lack of time.
Most respondents (47,4 %) agreed that the rhino population in Ujung Kulon is small and 'stable'. The majority estimated the number of rhino at 40, which is below the current estimates derived from censuses. One respondent (5,3 %) estimated the number of rhinos at 80, which he considered to be many. Three respondents (15,8 %) thought that the rhino population was decreasing, while four (21,1 %) did not know. Of nineteen respondents, only one (5,3 %) explicitly said that Javan rhino is almost extinct.

The awareness of respondents was highly influenced by the fairytales about Javan rhino that are traditionally told. Some of these fairytales also define the spiritual values associated with rhino (see the section about ethics). In one of the fairytales, there is mention of a Rhino Princess (Putri Badak), who protects the rhinos. The tale goes that each time a rhino dies the Princess will take its spirit and give it to another animal, which will then turn into a rhino. Thus, it is believed that the rhino population will never decrease, nor increase. Hence, the majority of respondents believed that the rhino population is stable.
While the belief that the rhino population is stable is, in essence, close to the truth, it is by no means true that every dead rhino is replaced by another. Such beliefs should therefore be considered unfavourable. However, those respondents who believed the rhino population to be stable all referred to the fairytale as, indeed, a fairytale. For that reason, their belief that the population is small and stable is considered favourable for rhino conservation.

Table 9.13 Quantified scores of 'spatial, temporal and social context (rhino status)' on a favourability scale of 1 to 5. Highlighted scores are from respondents that do not support rhinoceros translocation

Quantified scores of 'spatial, temporal and social context (rhino status)'																				
	Ujung Jaya	Kiaragondok	Cikawung Sebrang	Legon Pakis	**Taman Jaya**	Paniis	Cimenteng	**Rancapinang**	Cegog	Air Jeruk	Ciakar	**Cibadak**	Cilubang	Cibadak	**Kramat Jaya**	Pasir Ranji	Sompok	**Ciburial**	Sadang	Ciburial
Rhino status	3	-	-	- -	5	3	4	4	2	4	4 1	3 4	4	4	5	4	4	5	5	3

Legend:
1 = Awareness of population size and trend far from actual situation (Highly unfavourable)
2 = Awareness of population size far from actual situation, but awareness of population trend close to actual situation (Unfavourable)
3 = Does not know about population size and trend (Neutral)
4 = Awareness of population size and trend close to actual situation (Favourable)
5 = Awareness of population size and trend (almost) equal to actual situation (Highly favourable)

Perceived risks

Of all the respondents, there were only 3 (13 %) who did not associate any possible risks with the reintroduction of Javan rhino to the Honje Mountains. Even when asked about the risks of crop damage and the tightening of user rights, they did not consider those risks to be there.

Regardless of the answers, each respondent was asked about the risks of crop damage and the tightening of user rights, because in this study these risks are considered to have a severe impact and a high probability of occurrence, respectively. When asked, most respondents would confirm that they considered the risk of crop damage. However, out of 14 respondents who considered this risk, 8 (57,1 %) did not mention it until they were asked specifically. Similarly, out of 5 respondents who considered the risk of tightening user rights, 4 (80 %) did not mention it unless explicitly asked. Other risks mentioned by respondents, by order of frequency, are poaching, rhino attacks on humans, the movement of rhino back to the peninsula and the inappropriate protection of reintroduced rhinos (table 9.14). As can be derived from table 9.14, the risks that concerned the respondents most are poaching, rhino attacks on humans, and crop damage, respectively.

Table 9.14 Risks perceived by respondents, and how often each risk was mentioned. Numbers in brackets show the total number of respondents mentioning the risk after being explicitly asked

Perceived risks						
	Crop damage	Rhino attacks	Tightening user rights	Poaching	Rhino moves	Inappropriate protection
Count	5 (14)	7	1 (5)	9	1	1

In order to quantify the severity of each risk, they are given relative values (low, medium and high) of their probability of occurrence and the impact they would have either on the local communities or on the reintroduced rhinos (tables 9.15 to 9.20).

Table 9.15 Crop damage

Impact / Probability	High	Medium	Low
High			
Medium			
Low	3		

Table 9.16 Rhino attacks on humans

Impact / Probability	High	Medium	Low
High			
Medium			
Low	3		

Table 9.17 Tightening user rights

Impact / Probability	High	Medium	Low
High		2	
Medium			
Low			

Table 9.18 Poaching

Impact / Probability	High	Medium	Low
High			
Medium	2		
Low			

Table 9.19 Rhino moves to peninsula

Impact / Probability	High	Medium	Low
High			3
Medium			
Low			

Table 9.20 Inappropriate protection

Impact / Probability	High	Medium	Low
High	1		
Medium			
Low			

The overall severity of risks perceived per respondent, in which the average severity of risks is divided by the number of risks (equation 6.1), is summarized in table 9.21 below. From this quantification, it becomes clear that, apart from the three respondents (13 %) who did not see any risks, all the respondents are worried about medium to very serious risks. All respondents who are worried about medium risks (6, or 26 %) only mentioned one risk, while respondents worried about serious risks (7, or 30,4 %) either mentioned one serious risk or two medium risks. Those respondents who are worried about very serious risks (7, or 30,4 %) mentioned two or more risks ranging from medium to very serious.

Table 9.21 Quantified scores of 'perceived risks' on a favourability scale of 1 to 5. Highlighted scores are from respondents that do not support rhinoceros translocation

Quantified scores of 'perceived risks'	**Ujung Jaya**	Kiaragondok	Cikawung Sebrang	Legon Pakis		**Taman Jaya**	Paniis	Cimenteng	**Rancapinang**	Cegog	Air Jeruk	Ciakar		**Cibadak**		Cilubang	Cibadak	**Kramat Jaya**	Pasir Ranji	Sompok	**Ciburial**	Sadang	Ciburial
Average risk severity (x)	3	2,5	-	2,33	3	3	2	2	3	2,5	3	-	3	-	2	3	3	2,5	3	3	2	2	2,5
Nº Risks (n)	1	4	0	3	1	2	1	1	2	4	1	0	1	0	2	1	2	2	1	2	3	1	2
x/n	3	0,625	-	0,78	3	1,5	2	2	1,5	0,625	3	-	3	-	1	3	1,5	1,25	3	1,5	0,67	2	1,25
Point on scale	3	1	5	1	3	2	2	2	2	1	3	5	3	5	1	3	2	1	3	2	1	2	1

Legend:
1 = Very serious risk (Highly unfavourable)
2 = Serious risk (Unfavourable)
3 = Medium risk (Neutral)
4 = Low risk (Favourable)
5 = Very low risk (Highly favourable)

Ethics

In order to identify how the villagers around the Honje Mountains value Javan rhinoceros, they were asked about any symbolisms they associated with this animal. Furthermore, over the course of the conversation, it was determined whether or not the respondent values Javan rhino simply because it exists. This so-called existence value is not derived from any kind of economic use of the object that is being valued, but rather from a wish to see that object's continued existence. For example, most people do not use tigers, but they wish to see tigers protected and conserved for future generations. The reasons for this can be of a religious, spiritual or ethical nature (Secretariat of the Convention on Biological Diversity, 2007). The villagers around the Honje Mountains may value the Javan rhino for similar reasons. In fact, over the course of the conversations, it was found that all respondents do highly value Javan rhinoceros simply because it exists. The reasons for this are partly spiritual and partly a matter of pride. All respondents are aware that Ujung Kulon is the only place where Javan rhino can be found, which seems to give them a sense of pride and ownership. The same is true for the local governments of the Province of Banten and the District of Pandeglang (Hariyadi, pers. comm. 2008), which may not want the Javan rhino to be translocated to areas outside their respective jurisdictions, simply because of their sense of ownership.

As for the symbolisms associated with Javan rhino, and the spiritual reason for the high value given this animal, most respondents (19, or 82,6 %) mentioned fairytales about rhino, which were told by their grandmothers. These fairytales talk about the positive effects of having a population of Javan rhinoceros nearby. It is believed that the vicinity of this animal brings cool air and water, and fertile soils. Furthermore, the villagers are protected from disease and conflict. However, it seems that these beliefs are disappearing, since all respondents talked about them as being fairytales from their grandmothers. Table 9.22 gives an overview of the associations that villagers have with rhinos.

Table 9.22 Quantified scores of 'ethics' on a favourability scale of 1 to 5. Highlighted scores are from respondents that do not support rhinoceros translocation

Quantified scores of 'ethics'																				
	Ujung Jaya	Kiaragondok	Cikawung Sebrang	Legon Pakis	**Taman Jaya**	Paniis	Cimenteng	**Rancapinang**	Cegog	Air Jeruk	Ciakar	**Cibadak**	Cilubang	Cibadak	**Kramat Jaya**	Pasir Ranji	Sompok	**Ciburial**	Sadang	Ciburial
Ethics	3	4	4	4 / 3	4	4	4	4	4	4	4 / 4	3 / 4	4	4	4	4	3	4	4	4

Legend: 1 = Fear/hatred (Highly unfavourable)
2 = Negative associations (Unfavourable)
3 = No associations (Neutral)
4 = Positive associations (Favourable)
5 = Sacred (Highly favourable)

Trust

Each respondent was asked about the relationship between their village and National Park staff, as well as with WWF, which is among the NGOs most involved with Javan rhino conservation. Most respondents seemed not to be entirely honest about this relationship, as their answers were disconfirmed by both the Head of the National Park and the Community Empowerment Officer of WWF Ujung Kulon. While the villagers mostly said that the relationship with National Park staff was good or satisfactory (neutral), the relationship is actually rather awkward (Priambudi, pers. comm. 2008; Ngatiman, pers. comm. 2008). This awkwardness has several causes. First of all, the National Park border is not entirely clear to the villagers, especially in Legon Pakis and Ciakar. In Ciakar, the border has been moved several times in the past, most recently in 2005, engulfing part of the kampong. In Legon Pakis, the villagers believe that the border was redrawn when the Honje Mountains became a Nature Reserve in 1967, causing their kampong to become an enclave. Actually, the border is in the same place as it used to be when the Honje Mountains were still production forest, but the change of status of the area caused the kampong of Legon Pakis to become an illegal enclave. Therefore, the villagers and the National Park staff do not agree about the ownership of the land, which sometimes results in conflict. Also, since Legon Pakis is located in the National Park, it is forbidden to build new infrastructure or facilities. Consequently, the villagers are not allowed to have electricity, nor running water and they are not allowed to irrigate their fields. This understandably makes them feel that the National Park is inhibiting their development.

Other conflicts result from the user rights that villagers have. As discussed before, the villagers are partly dependent on the forest for their needs. Nevertheless, the collection of forest products such as fuel wood is illegal. In 2007, a National Park ranger on patrol encountered a couple of villagers returning with a bundle of fuel wood. The encounter resulted in a conflict, and unfortunately, the ranger, defending himself, shot one of the villagers. Consequently, the villagers burnt down a newly built ranger post, which had nearly reached completion (Rahmaningsih, pers. comm. 2008). This conflict has currently been resolved, but it is still fresh in the memory of both villagers and National Park staff. The relationship between them is starting to get better again, but only slowly (Priambudi, pers. comm. 2008).

Although the results gained from the interviews are not reliable due to the respondents' fear that being honest would have repercussions for them, they are still quantified in table 9.23. The quantification was done by directly translating the respondent's answer to a point on the scale. From the answers given by the villagers, it seems that the relationship between them and the National Park and WWF is relatively good. However, it seems that these relationships are actually slightly antagonistic (or at least distrustful) and unsatisfactory, respectively. In the case of WWF, several villagers pointed out that they had never heard of this NGO, or that only the Head of the Village was directly in touch with them.

Table 9.23 Quantified scores of 'trust' on a favourability scale of 1 to 5. Highlighted scores are from respondents that do not support rhinoceros translocation

<table>
<tr><th colspan="24">Quantified scores of 'trust'</th></tr>
<tr><th></th><th>Ujung Jaya</th><th>Kiaragondok</th><th>Cikawung Sebrang</th><th colspan="2">Legon Pakis</th><th>Taman Jaya</th><th>Paniis</th><th>Cimenteng</th><th>Rancapinang</th><th>Cegog</th><th>Air Jeruk</th><th colspan="2">Ciakar</th><th colspan="2">Cibadak</th><th>Cilubang</th><th>Cibadak</th><th>Kramat Jaya</th><th>Pasir Ranji</th><th>Sompok</th><th>Ciburial</th><th>Sadang</th><th>Ciburial</th></tr>
<tr><td>Trust</td><td>3</td><td>4</td><td>3</td><td>4</td><td>4</td><td>4</td><td>4</td><td>3</td><td>4</td><td>3</td><td>3</td><td>5</td><td>3</td><td>4</td><td>4</td><td>3</td><td>3</td><td>4</td><td>4</td><td>4</td><td>3</td><td>3</td><td>3</td></tr>
</table>

Legend:
1 = Antagonistic relationship (Highly unfavourable)
2 = No relationship (Unfavourable)
3 = Neutral relationship (Neutral)
4 = Good relationship (Favourable)
5 = Mutual trust (Highly favourable)

9.4. Most important factors defining attitudes

Comparing the average scores per factor of people who support Javan rhino reintroduction to the average score per factor of people who do not support Javan rhino reintroduction (table 9.24) shows that there are three factors that seem to be more important in defining people's attitudes than the others, although the data are not sufficient to draw definite conclusions. These factors are the awareness of the Javan rhino's status as an endangered species (spatial, temporal and social context), the associations people have with Javan rhinos (ethics) and particularly, the benefits that people expect to reap from the reintroduction (spatial, temporal and social context).

The results for the awareness of Javan rhino status are quite surprising, because they show that a higher awareness results in more opposition to Javan rhino reintroduction. It would be expected that people who are aware that Javan rhino is critically endangered would strongly support its translocation. However, when their awareness turns into fear that a reintroduction would endanger the animals, they tend to oppose such measures. Indeed, people who do not support Javan rhino reintroduction are also more worried about serious risks, although the difference with people who support reintroduction is not all that big.

Table 9.24 Average scores for each factor on their corresponding scales, arranged per attitude

Average scores for each factor, per attitude						
	Knowledge	Spatial, temporal and social context (benefits)	Spatial, temporal and social context (rhino status)	Perceived risks	Ethics	Trust
Supporting reintroduction	3,13	4,13	3,67	2,40	3,93	3,27
Not supporting reintroduction	3,00	3,25	4,00	2,25	3,63	3,44
Difference	0,13	0,88	-0,33	0,15	0,30	-0,17

People who do not support reintroduction have fewer positive associations with Javan rhinos than people who do support reintroduction. As mentioned before, such associations include cool air and water and fertile soils. Those people who have many positive associations may tend to support reintroduction to an area near their home, because they expect to gain the benefits of more fertile soils and cooler air temperatures.
The most striking difference between supporters and opponents of Javan rhino reintroduction is the number of benefits they expect to get from it. The more benefits are expected, the more support there will be. Therefore, the most efficient way to increase local support for Javan rhino reintroduction is to convince opponents of the benefits that they can get, and to actually make them feel those benefits before the reintroduction commences.

10. Analysis

10.1. Suitability of Honje Mountains as rhino habitat

From the ecological point of view, 6.685 ha (29,92 %) of the Honje Mountains is suitable habitat for Javan rhinoceros. Potentially, this area can be increased to 10.289 ha (46,05 %), if the level of human disturbance is reduced, particularly in block Ciakar. Based on the average home ranges of male and female Javan rhinos, as discussed in paragraph 6.2.1 (1.394 ha and 667 ha, respectively), different scenarios concerning the number of rhinos reintroduced to the Honje Mountains should be analyzed (table 10.1). The approach taken in identifying the scenarios in table 10.1 is very straightforward. Starting with the number of males, a simple calculation was done for the number of females that could share the suitable area with them. Any overlaps between home ranges is not taken into account.

Table 10.1 Number of rhinos (males:females) that can be reintroduced to the Honje Mountains, making use of all available space

Area	Number of rhinos (m:f) reintroduced						
	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6	Scenario 7
6.685 ha	1m:8f	2m:5f	3m:3f	4m:1f			
10.289 ha	1m:13f	2m:11f	3m:9f	4m:7f	5m:5f	6m:3f	7m:1f

Some scenarios are obviously very unreasonable, such as scenario 1 (regardless of the available space), where there are simply too many females for one male to reproduce with effectively. Scenarios with a higher number of males than females (scenario 4 with 6.685 ha available, and scenarios 6 and 7 with 10.289 ha available) are also not a good option, because the males will become too competitive and might unnecessarily hurt each other. However, translocating a larger number of males than females could benefit the source population on the peninsula, because the current sex ratio of that population is 3:2 in the favour of males (Hariyadi, pers. comm. 2008). Nevertheless, with the chances of success of the founder population in mind, any scenario in which not all reintroduced rhinos can partake in reproduction should be considered ineffective. Therefore, reintroducing a larger number of males than females seems unwise. The data that are currently available on Javan rhinoceros reproduction behaviour are not sufficient to come with a well-considered recommendation on the optimal sex ratio of reintroduced rhinos, but scenarios 2 and 3 (with 6.685 ha available) and scenarios 3, 4 and 5 (with 10.289 ha available) certainly deserve more attention. The effect that these scenarios would have on the source population should be carefully studied. The translocation of any number of rhinos will result in the availability of more space for the remaining rhinos on the peninsula. If care is taken that sufficient good quality breeding rhinos remain, this new available space may result in an increase of the source population.

It should be mentioned that the scenarios shown in table 8.1 make use of all the available space. Consequently, there would not be sufficient space available for any offspring. Also, the availability of food may not be enough to support such a big rhino population.

Another disadvantage of the limited available space is that there is a high risk that the reintroduced rhinos will migrate back to the peninsula, making all the efforts and stress of translocating them useless. The Honje Mountains also do not provide sufficient suitable habitat to support a Minimum Viable Population of Javan rhino, which is estimated at approximately 100 animals (Ministry of Forestry of the Republic of Indonesia, 2007). Therefore, the Honje Mountains are not suitable as a final destination of translocated Javan rhinoceros. However, this area is extremely suitable as a stop-over for rhinos that are to be reintroduced to other locations, such as the Halimun-Salak National Park.

In order to be effective as a stop-over, the area will have to be fenced. Thus, the Honje Mountains can take on the function of Javan Rhino Sanctuary, where a semi-free roaming population of rhinos can live in safety, until they are eventually translocated to their final destination (Ministry of Forestry of the Republic of Indonesia, 2007). The advantages of such a sanctuary are many. First of all, the rhinos that are to be reintroduced to an area further away can be monitored for genetic fitness and pathogens. Specimens that are unsuitable for founding a new population can easily be returned to the Ujung Kulon peninsula, without increased levels of stress. Second, the rhinos can reproduce in the sanctuary, where they can easily find each other, before they are released in larger areas. Third, a sanctuary offers many great opportunities for research on Javan rhino behaviour, ecology and genetics. Fourth, although the rhinos will suffer stress from handling and transportation twice, the level of stress may be much lower the second time (Hariyadi, pers. comm. 2008). This could increase the chances of the rhinos successfully settling at their final destination. What's more, individual animals that do not respond well to this stress can be easily and safely returned to the peninsula instead of being transported to their intended destination.

A further advantage of a sanctuary is that rhinos from within the sanctuary can not interact with rhinos from outside the sanctuary. While this increases the risk of genetic drift, it reduces the risk of an epidemic disease wiping out the entire (meta)population of Javan rhinos. Thus, the health of translocated rhinos can be more easily monitored and cared for.

10.2. Opportunities for local benefit from rhino conservation

Building a fence around the designated area will also increase the support from local inhabitants, because they need not worry about crop damage or rhino attacks. Furthermore, the rhinos can be protected more effectively against poachers. Since most respondents who did not agree with rhino reintroduction to the Honje Mountains were concerned about poaching, their support may also be gained by fencing off the area.
Furthermore, the establishment of a Javan Rhino Sanctuary in the Honje Mountains will provide job opportunities, allowing local communities to improve their economy. Several respondents said that they wanted closer cooperation with the National Park and WWF in the conservation of their environment, and some even suggested that they could join a Rhino Monitoring and Protection Unit (RMPU) on patrol. With the establishment of a Javan Rhino Sanctuary, their will be a need for more RMPUs to provide strict protection, which is another of the local communities' expectations (table 10.2).

Knowing what the local communities need will make it easier to help them more effectively and to design the Javan Rhino Sanctuary in such a way that it will bring benefits to these communities. As table 8.2 shows, the majority of respondents (65,2 %) is hoping to get help in the form of community forestry (eco-development described by Dinerstein, 2003), where they are given seedlings of trees that are particularly useful to them, such as timber and fruit trees. Each village will have different needs, so a close cooperation between them and the designer of such eco-development projects (the National Park and/or WWF, for example) is necessary. Indeed, 43,5 % of all respondents indicated that they hope that their relationship with the National Park and WWF will improve.

Table 10.2 Respondents' expectations for the future

Expectations of respondents							
	(Closer) cooperation with NP and WWF	Development help (road construction, clean water, health facilities, irrigation, etc.)	Stricter protection	Less intensive research	Community forestry	Locals join RMPUs	Education about Javan rhinoceros
Count	10	13	4	1	15	2	1

Eco-development projects and close cooperation with local communities benefit both the communities and the environment, and thus, the Javan rhinoceros. However, a substantial part of the respondents (56,5 %) indicated that they want development help of a different kind as well. This includes the construction of a road, so they can take their goods to market, as well as clean water and health facilities and irrigation. The current state of the road, especially on the steeper eastern slopes of the Honje Mountains, is miserable at best. The most common

means of transportation in the area is the motorcycle. The average longevity of motorcycles in the area is 6 – 18 months (Supriyadi, pers. comm. 2008), due to the state of the road. The road surface consists of dirt and rocks. The slightest amount of rain will turn it into a slippery mud, which sticks to the motorcycle wheels, clogging them and eliminating their grip. The present author experienced this first hand when travelling from Rancapinang to Cibadak, and again when passing Kramat Jaya a few days later. During the rainy season the villagers on the eastern slopes are basically trapped in their respective villages, because the state of the road resembles a mud-slide (Supriyadi, pers. comm. 2008).
The construction of a road would definitely be an immense boon for the local communities, but it may have a negative effect for conservation. The Ujung Kulon peninsula and the Honje Mountains have always been remote, which certainly has contributed to the conservation of Javan rhinoceros. Making the area more accessible could jeopardize Javan rhino conservation in the future. However, the construction of a road would also bring benefits to rhino conservation, most obvious of which is the increased ease of transportation of animals to be reintroduced to areas further away. The area would also become more accessible for tourists, who can bring much needed money into the area, benefiting both local communities and conservation efforts. Therefore, constructing a road will be beneficial for all parties involved, but it should be accompanied by increased efforts of strict protection of the National Park and the recommended Javan Rhino Sanctuary.

The establishment of a Javan Rhino Sanctuary will open up opportunities to boost eco-tourism in the area. In a sanctuary, it will be easier to see rhinos directly, because the regular patrols of RMPUs will increase the awareness of the whereabouts of the animals. In cooperation with the National Park and WWF, the local communities can run their own travel agency and design their own eco-tourism programmes. Currently, there is already a travel agency in Ujung Jaya, which is run by locals and offers a variety of activities in the National Park. This travel agency (Kagum) is currently designing a new eco-tourism project in cooperation with WWF, which will greatly increase tourists' chances to see Javan rhinos on the peninsula. Similar programmes can be designed for the sanctuary, and if the villages on the eastern slopes of the Honje Mountains are made more accessible, more people can benefit from eco-tourism.

10.3. Other opportunities to increase the Javan rhino population

Since the Honje Mountains are part of Ujung Kulon National Park and are sometimes visited by rhinos, the Javan rhino population may be increased by less invasive and less expensive methods. If the National Park would be more strictly protected and human disturbances reduced, the rhinos that occasionally visit the Honje Mountains may do so more regularly, and may even settle in the area. Thus, the population remaining on the peninsula may have some more room to grow again, even if only a little. However, this will only work if protection is very strict, which should be accompanied by community development by means of eco-development and eco-tourism projects. Increasing the rhino population in this way is not invasive on the rhinos, and thus, will not cause them stress. However, it will not increase the rhino population by much, because the extra available space from the Honje Mountains as well as the peninsula is limited. It will still be necessary to reintroduce Javan rhinos to other, larger areas.

There are still other ways to increase the rhino population on the Ujung Kulon peninsula. The wild spread of *Arenga obtusifolia*, as mentioned in paragraph 6.3 as one of the threats for Javan rhino, should be stopped and at least partly reversed by intensive habitat management.

Arenga inhibits the growth of most other plants, although the few plants that can still grow under *Arenga* include some rhino food plants. Nevertheless, the high regeneration potential of this palm is a serious threat to rhino habitat. YMR *et al.* (2004) have shown that *Arenga* can be destroyed by injecting them with round-up herbicides that do not leave any traces in the soil or otherwise harm the environment. It is very labour intensive, but in the long run it may be more effective than cutting *Arenga* down, because it effectively kills the tree. A cut down *Arenga* tree will quickly sprout again from its stump (YMR *et al.*, 2004). However, the effectiveness of this treatment on the regeneration of rhino food plants is as of yet uncertain, and more research needs to be done. It is indeed possible that the killed *Arenga* is replaced by other specimens of the same species, which would render the effort wasted.

The competition for space and maybe even food between Javan rhino and banteng, as mentioned in paragraph 6.3, may be reduced by intensively managing degraded grazing grounds, which may reduce the number of banteng foraging in the forest. The degradation of the grazing grounds, in combination with the reproductive success of banteng, has forced more and more banteng to rely on the forest as the main source of food. There is little proof that competition with banteng inhibits the potential population growth of rhino, but there is some indication that in areas where they occur together, both animals switch their diets to one with a high proportion of less desirable food plants, even in places where the more desirable food plants appear to be sufficiently abundant (Van Merm, 2007). This could have a negative effect on their reproductive success, especially for rhino.

Intensively managing the grazing grounds in order for them to regain and maintain a sufficiently high quality for banteng will encourage these to leave the forest and forage more on the open grasslands, thus relieving the pressure they may be exerting on rhino. The rhino population may then be able to grow. However, an improved quality of grazing grounds will in all probability also result in increased banteng population growth (YMR *et al.*, 2002). Banteng is a protected species and consequently can not be culled. Therefore, translocating a relatively large number of banteng to other protected areas may be a solution. However, before such drastic measures are taken, it is important that more research be done on the competition between the two herbivores. Currently, there is not sufficient proof to blame banteng for the reduced population growth of rhino, and if banteng is indeed not a factor in the stagnation of the rhino population, there is no reason whatsoever to remove them from the area (Van Merm, 2007).

PART VI

Discussion and Conclusions

11. Discussion

11.1. Methodology

The methodology of this research is suitable for data collection of small samples. If large numbers of respondents are interviewed, the methodology may become too time consuming, and questionnaires may be more useful than interviews. The choice of methodology may differ with each case, depending on the size of the area and the complexity of the issue at hand. As the area becomes larger, more people will have to be interviewed, and questionnaires will be a good choice. However, as the complexity of the problem increases, questionnaires become too elaborate and may easily lose clarity, so one-on-one interviews will be more effective.

For the purposes of this particular research, the chosen method proved to be useful, although somewhat imperfect. The presence of an interpreter who was himself a local villager proved to be indispensable. Although the author speaks sufficient Indonesian to handle the interview himself, many respondents did not answer as freely and openly to the author as they did to the local interpreter. Furthermore, some respondents only spoke their local language, Sundanese, so the interpreter definitely proved his worth. However, employing an interpreter requires planning. Time should be allocated to train the interpreter in the appropriate manner of conducting the interview, in order to avoid questions that steer the respondent towards a certain answer. Such was the case with the question about the plant species that were eaten by Javan rhino. Therefore, the answers to this question were not used in the analysis of the results.

The sample taken in this research seems rather small, considering the number of villages surrounding the Honje Mountains. However, the northern villages are considered irrelevant to this research, because they do not border on rhino habitat. Furthermore, the living conditions in the villages that were visited are remarkably similar, with the exception that villages on the eastern slopes of the Honje Mountains are less accessible and do not have access to the sea. Therefore, the sample taken may be considered large enough to represent the entire community. The similarity of the answers supports this notion.

However, in order to identify the factor that most defines people's attitudes towards conservation issues with statistical significance, a much larger sample (at least 100 people) would be necessary. Nevertheless, the purpose of this research was not to identify the most important factor with statistical accuracy, but to explore the usefulness of the factors proposed by Stankey and Shindler (2005) in studying people's attitudes. For that purpose, the sample taken was deemed large enough.

11.2. Data reliability

The ecological data all had to come from a single reference. There is little literature available on the Honje Mountains, at least in the context of Javan rhinoceros ecology. The study used so extensively in this research is old and outdated. Unfortunately, time did not allow the current author to update the data. The results found are likely to be inaccurate to the current situation, especially since the maps had to be redrawn. A new, elaborate study of the suitability of the Honje Mountains as Javan rhino habitat is necessary.

The results obtained during the interviews greatly depend on the openness and honesty of the respondents. The interviewer can very much influence these factors by being respectful and a good listener, showing interest in what the respondent has got to say. However, sometimes the fact that the interviewer is someone from outside the community, or worse, a

foreigner, stands in the way of a smooth interview. During this research, the local interpreter certainly helped to make the respondents feel at ease, but some of their reservations remained. Thus, sensitive questions are not likely to be answered honestly, as was the case with the questions about the relationship between the local inhabitants and the National Park staff and WWF. The information given by the Head of the National Park and the Community Empowerment Officer of WWF gives a better description of the actual situation, but it is still only one side of the story. Therefore, the data on 'trust' are rather unreliable. Nevertheless, the fact that most respondents lied about this topic says enough about the real situation. In any case, a lot of time and effort is always needed to establish and maintain a good relationship between local inhabitants and policy makers.
The other data collected through the interviews do not suffer much from dishonesty, because they are related to what people know, which risks and benefits they perceive, and which associations they have with Javan rhinoceros. Being dishonest about these things does not serve respondents anything, and the answers can therefore be considered reliable.

The process of quantifying the answers on a five-point scale needed to be carefully thought out. It is easy to be too subjective in this quantification. In order to remain objective, it is important to treat the data as literally as possible. Nevertheless, a lot of information can be hidden in a respondent's body language, which is not conveyed through the answer alone. This information can be important and of considerable influence on the results. Therefore, the researcher should be very conscious about which information is used in the quantification process, and which information is not relevant.

11.3. Other aspects of reintroductions

During the planning of a reintroduction project, it is vital to study the ecological and social aspects of the intended release site. However, even if all these aspects are favourable for the reintroduction, there may still be something else that becomes the limiting factor: politics.
Political views on reintroductions may be different in the country of the source population and in the country of the founder population, which makes a successful reintroduction difficult. But on a national, regional and even local scale, politics can also be different and a hindrance. Such is the case of the Javan rhinoceros. Even if ecologically and socially suitable areas on Java are found, the sense of pride and ownership of the governments of Banten Province and Pandeglang District could prevent the reintroduction from being carried out. Reintroducing Javan rhino to areas on Sumatra or outside Indonesia (such as Vietnam) will be even more problematic. Nevertheless, it will eventually be necessary to reintroduce Javan rhino to areas outside Java, because there simply are not enough suitable sites of sufficient size to reach the Rhino Century targets, mentioned in chapter 1, within Java alone. Therefore, the local governments need to be closely involved in the planning of the reintroduction project, and they should be convinced of the urgency of taking action.

12. Conclusions

12.1. Case study

12.1.1. Javan rhino translocation

The translocation of Javan rhinoceros to areas within their former range is not only highly desirable; it is also indispensable if the species is to be saved from extinction. This study shows that the Honje Mountains can play an important role in such translocation programmes.

Do the Honje Mountains provide sufficient suitable habitat to support a Minimum Viable Population of Javan rhinoceros? Can future interaction between the founder population and the source population be realized?

The Honje Mountains do not provide sufficient suitable habitat to support a Minimum Viable Population, but reintroducing Javan rhino to this area will allow the population to increase a little. There are two possibilities to make use of the Honje Mountains to expand the Ujung Kulon rhino population. First, the area could be made available through strict protection, which aims to keep the human disturbance to an absolute minimum. Thus, the rhinos that occasionally venture into the area may decide to stay, allowing the Ujung Kulon rhino population to make use of a larger total area. The new population in the Honje Mountains will be able to continue interacting with the existing population on the peninsula.

Second, the southern Honje Mountains, including blocks Kalejetan, Tanjung Lame, Tanjung Sodong, Gunung Cimahi and Ciakar, could be assigned as a Javan Rhino Sanctuary and a stop-over for rhinos that are to be reintroduced to larger areas further away. Thus, an area of approximately 10.289 hectares would be fenced off. Strict protection would keep poachers and other human disturbances out of the sanctuary. Research on the rhinos that temporarily stay in the sanctuary will be much easier than it is on the peninsula, and the most suitable rhinos for reintroduction to other areas can be distinguished from the less suitable specimens. However, it will not be possible for the new rhino population to interact with the source population on the peninsula. This is also true for Javan rhino founder populations in other areas that are further away and not connected to Ujung Kulon National Park. Yet, while this isolation increases the risk of genetic drift in all Javan rhino populations, it reduces the risk of an epidemic disease wiping out the entire metapopulation.

What are the attitudes of local communities towards rhino conservation, and more specifically, the possible reintroduction of Javan rhino to the Honje Mountains? Which factors are most important in defining such attitudes?

Concerning the social aspect, it was found that all people interviewed support the conservation of Javan rhinoceros. However, over a third of the respondents did not support the reintroduction of Javan rhinos to the Honje Mountains. Their opposition was mainly caused by three factors, i.e. the associations they have with Javan rhino (ethics), their awareness of Javan rhino's status as a critically endangered species (spatial, temporal and social context) and most clearly by the number of benefits that they expect to get from a reintroduction (spatial, temporal and social context). The more benefits are expected, the more support there is for reintroduction.

How can local communities be actively involved in rhino conservation?

The involvement of local communities in Javan rhino conservation can take several different forms. First, the implementation of eco-development projects such as community forestry shows a lot of potential in the area. Second, the development of eco-tourism in the area is very attractive. Third, local people can be directly involved in Javan rhino conservation by joining Rhino Monitoring and Protection Units and filling other job openings when a Javan Rhino Sanctuary is established.

12.1.2. Other possibilities to increase the Javan rhino population

Other possibilities to increase the Javan rhino population in Ujung Kulon are stricter protection and intensive habitat management. This not only includes the reversion of the wild spread of *Arenga obtusifolia*, but also the management of grazing grounds to reduce the number of banteng foraging in the forest. Furthermore, a relatively large number of banteng could be translocated to other protected areas within their natural range, to reduce the competition for space and food between this species and the Javan rhinoceros.

The future of the Javan rhino looks dim. Ujung Kulon National Park is not large enough to allow the population to grow much, even if intensive habitat management is carried out and a number of banteng is translocated. In order to increase the Javan rhino population, translocation to several other protected areas within their former range is utterly indispensable. However, this is currently rather difficult, because of the local governments' sense of pride about being the only province and district where rhino survives, and the sense of ownership that comes with this pride.

12.2. General conclusions

12.2.1. The Main Research Question

The combination of ecological and social considerations allows to more effectively prepare a potential release site for the reintroduction of an endangered species. As such, the ecological aspects of the site are most important in the decision whether or not it is suitable for the species in question, while the social aspect gives insight in the chances of success of a reintroduction in an ecologically suitable site. Thus, an ecologically suitable release site where local inhabitants strongly oppose the reintroduction, the chances of success are very low. Further research on the reasons for such opposition allows the reintroduction programme managers to design projects that aim at increasing the support from local inhabitants.
Furthermore, even if local inhabitants do support the reintroduction programme, as is the case in the Honje Mountains, insight in their living conditions and needs can (and should) influence the way in which the reintroduction is executed, to the point that local people receive the potential benefits.

12.2.2. The five factors determining attitudes

This study has found that it is useful to analyze people's attitudes towards conservation policies or management plans by determining which factors shape their judgments. By doing so, it is easier to design plans and projects that benefit both conservation and local people. Also, if there is a lot of opposition, defining the factor that causes this opposition helps to face it and change it into support.
The set of factors proposed by Stankey and Shindler (2005) is certainly useful, but it should be elaborated. For instance, 'institutional and personal knowledge' should be further elaborated to include the general level of education of the public. Whether a person has completed an academic study or barely finished elementary school greatly influences the way he or she thinks about conservation issues. Also, the factors 'spatial, temporal and social context' and 'ethics' need more in-depth explaining of how they should be assessed. Currently there is too much freedom for researchers to choose their own way of assessing these factors. Freedom is fine, but it should not become confusing, nor should it threaten the comparability of studies that address these issues.
In this study, 'spatial, temporal and social context' was redefined as the number of benefits expected by local inhabitants and their awareness of the critically endangered status of Javan rhino. It is suggested that this definition is used in other studies on reintroduction programmes as well, because it is applicable to a wide range of species, locations and cultures.

The factor 'ethics', in this study already a redefinition of the original 'aesthetics' proposed by Stankey and Shindler (2005), was defined as the existence value that local inhabitants give to rhinoceros, as well as the cultural, religious or traditional associations that they have with the animal. The assessment of an animal's existence value for local inhabitants is very tricky and rather subjective and should therefore not be considered as the best approach to assess 'ethics'. However, the associations that people have with the animal proved to be a useful approach in this study, and it is suggested that this approach is also taken in other studies on reintroduction programmes, especially because it appears to be one of the most important factors defining people's attitudes.

13. Recommendations

13.1. Further research

13.1.1. Case study

Expert studies will need to be carried out in order to design the reintroductions of Javan rhino to be as effective as possible. The different scenarios presented in this report should be investigated in detail, with the appropriate ecological modelling software. Furthermore, elaborate habitat suitability studies of the Honje Mountains and other potential release sites should continue to be carried out, making use of Remote Sensing techniques where such is possible. Detailed maps, which show the exact location and extent of suitable habitat, should be produced. Additionally, the most appropriate technique for capturing Javan rhinos should be investigated. The difficult accessibility of its habitat makes it impossible to transport them overland. Air transportation seems to be the only alternative, but access from above is also difficult, due to the dense canopy of the forests on the peninsula and in the Honje Mountains. Therefore, gaps will have to be opened in the canopy in strategic places (Hariyadi, pers. comm. 2008). Studies on the home ranges of likely candidates should reveal where these strategic places are, so as to minimize the number of gaps and the amount of unintended and incidental damage.

Further studies on the social aspect of Javan rhino reintroduction are also needed for every potential release site. Indonesia is a densely populated country with few large protected areas left. Therefore, it is vital that the needs of the people are taken into account if conservation is to be successful. Community forestry is one approach, but different locations may need different kinds of eco-development projects. Research should identify which approach is most appropriate for each location.

13.1.2. General

More research is needed on the social aspects of reintroductions, particularly on the factors that determine people's attitudes. The only available study is the one by Stankey and Shindler (2005). It is suggested that the model they propose is developed further and that alternative models that are more specific to reintroductions be developed.

Furthermore, the effect of temporary captivity should be studied further. While it is suggested that temporary captivity can reduce stress, different animals will react to it in a different way. More specifically, it should be studied how long such temporary captivity should be, so it is long enough to have the anticipated effect of reduced stress, but not so long that stress levels start to increase again, or worse, the animal loses its wildness. The difficulty with this kind of studies is that they often lack a reference population of animals that have been reintroduced to the same area without being held temporarily captive. The endangered status of many species will not allow such an experimental setup. Nevertheless, it is suggested that all reintroduction programmes, whether or not they make use of temporary captivity, record the levels of stress endured by the animals through behaviour studies. Recording stress by analyzing the amount of stress-hormones in blood would give a distorted result, because collecting the blood will increase the level of stress. Bit by bit, a large database can thus be collected, analyzed and become available for future reference.

13.2. Action to be taken

The translocation of Javan rhinoceros can wait no longer. Action needs to be taken now. The plans and targets are already in place. Now decision makers and governments need to find the will to implement these plans. If the necessary expertise is not available in Indonesia, help should be sought from India, Nepal and African countries, where rhinoceros translocations have been successful before. The IUCN SSC Reintroduction Specialist Group will also be very valuable in the execution of Javan rhinoceros translocation.
In addition to translocating rhinos to large suitable areas, Ujung Kulon National Park staff, in cooperation with WWF-Ujung Kulon and local NGOs, should put into operation intensive habitat management on the peninsula, to improve living conditions for the rhinoceros population there. A number of banteng may also need to be translocated.

Eco-development and other development projects for local inhabitants around the Honje Mountains and other potential release sites should be designed and implemented as soon as possible. If local people can begin to feel the benefits that conservation can bring them, more support can be gained. These projects should be carried out in close cooperation between the people, National Park staff, local governments, WWF and local NGOs, such as YABI (Yayasan Badak Indonesia, formerly YMR). The people know best what they need most, while National Park staff, governments and NGOs know best how to make things possible and beneficial for all stakeholders involved.

Local governments need to be convinced to overcome their sense of pride and ownership. The international community should play an important role here. If local governments can not be made to see the urgency of taking action, their pride will soon turn into shame when the Javan rhino goes extinct. Being responsible now and supporting the translocation of rhinos to areas outside their jurisdictions will allow these governments to feel an even stronger sense of pride, for they will have helped to safeguard the future of this magnificent species that is the Javan rhinoceros.

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Interviews

All interviews were conducted in June 2008.

Ainuddin & Sari'an	Farmers in kampong Kiaragondok
Armedi	Farmer in kampong Ciburial
Asra & M. Sastra	Farmer and Village Supervisor in kampong Cibadak

Awang	Farmer in kampong Air Jeruk
Bayong	Farmer in kampong Cikawung Sebrang
Dulhalim & Subadri	Farmer and Village Council in kampong Sadang
Dulhalim & A. Wahyuddin	Farmers in kampong Sompok
Eman	Head of Village of Ciburial
Gunawan, M.	Farmer in kampong Cimenteng
Hariyadi, A.R.	WWF-Ujung Kulon Site Manager
Harun	Village Secretary of Taman Jaya
Juli	Farmer in kampong Cilubang
Kamiruddin & Safruddin	Head of Village and Village Secretary of Ujung Jaya
Ngatiman	WWF-Ujung Kulon Community Empowerment Officer
Priambudi, A.	Head of Ujung Kulon National Park
Rukanda, D.	Farmer in kampong Pasir Ranji
Sadikin	Village Council of kampong Legon Pakis
Sakiwan	Farmer in kampong Paniis
Sugiarto, A.	Village Council of Kramat Jaya
Suhaya	Farmer in kampong Legon Pakis
Sulaiman	Head of Village of Cibadak
Supendi, E.	Farmer in kampong Cegog
Supri & Warti	Village Secretary and Head of Village of Rancapinang
Sutri	Village Secretary of Cibadak
Toha, T.	Village Council of kampong Ciakar
Usi	Farmer in kampong Ciakar

Personal communications

Hariyadi, A.R. *December 2007.* WWF-Ujung Kulon Site Manager
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Appendices

Appendix A: Topics discussed during the interviews

The topics below are discussed in and informal manner. Their structure is not rigid, and new questions can be added during the interview, in order to discuss a topic more in depth.

- General:

  - Has the respondent or someone he/she knows ever seen a rhino or its trace?
  - If yes, where and when?

- People's opinion on rhino conservation:

  - Do the people support the conservation of Javan rhino? Why or why not?
  - If yes, do they still support rhino conservation if it means that rhinos would live close to their village?

- Knowledge:

What is the knowledge of the people on the following topics?

  - Rhino social behaviour (does it live in groups or alone?)
  - Feeding behaviour (does it eat grasses or twigs, leaves, etc.?)
  - Which plants are eaten by rhinos?
  - Does rhino like open or closed spaces?
  - In case of an encounter with humans, is rhino going to run or attack?

- Ethics:

  - According to the people, does rhino have any symbolic values, based on cultural, religious and similar values?
  - Do the people value rhino simply because it exists (existence value)? (Because this question is difficult to be understood, the answer was derived form the overall conversation. All respondents gave the impression to highly value the existence of Javan rhino.)

- Risks:

  - What are the risks that the people are worried about, if rhino would live in the vicinity of their villages?
  - After the respondents have mentioned all the risks they could think of, they are asked about the following risks:
    - Crop damage
    - Tightening user rights

- Spatial, temporal and social context:

  - According to the people, which benefits could they get if the Honje Mountains were to become rhino habitat?
  - Do the people realize which benefits there are for the rhinos themselves, if they are to be moved to the Honje Mountains?
  - If they have not yet been mentioned, ask about the following benefits:
    - Eco-tourism
    - Community forestry (explain)
  - Do the people realize that the Javan rhino is critically endangered, and that it only survives in Ujung Kulon?

- Trust:

  - How is the relationship between the people and National Park staff?
  - Do the people consider the intentions of the National Park staff towards the people to be good or bad?
  - What is the reason for the relationship between the people and the National Park to be either good or bad?

  - How is the relationship between the people and WWF?
  - Do the people consider the intentions of WWF towards the people to be good or bad?
  - What is the reason for the relationship between the people and WWF to be either good or bad?

Appendix B: Answers to knowledge related questions

	Knowledge about rhino			
	Social behaviour	Feeding behaviour	Cover preferences	Shyness vs. Aggression
Ujung Jaya	individual	browser	closed	sometimes runs, sometimes attacks
Kiaragondok	individual	browser	closed	sometimes runs, sometimes attacks
Cikawung Sebrang	doesn't know	doesn't know	doesn't know	doesn't know
Legon Pakis	doesn't know	browser; also grass	closed	doesn't know
	-	browser	-	runs
Taman Jaya	individual	browser	closed	runs
Paniis	individual	browser	closed	doesn't know
Cimenteng	individual	browser	closed	attacks
Rancapinang	individual	browser; also grass	closed	runs
Cegog	group	browser	closed	runs
Air Jeruk	group	browser	closed	attacks
Ciakar	individual	grazer; browser	closed	runs
	small groups	doesn't know	closed	runs, but interpreted as attack
Cibadak	individual	browser	-	attacks
	individual	browser	closed	runs
Cilubang	individual	browser	closed	runs
Kampong Cibadak	individual	browser	closed	attacks
Kramat Jaya	group	browser	closed	attacks
Pasir Ranji	individual	browser	closed	runs
Sompok	doesn't know	browser	closed	doesn't know
Ciburial	individual; group	browser	closed	runs
Sadang	group	browser	open	runs
Kampong Ciburial	doesn't know	doesn't know	closed	attacks

Appendix C: answers to spatial, temporal and social context related questions

	Social, temporal and spacial context	
	Benefits	Rhino status
Ujung Jaya	ecotourism	doesn't know
Kiaragondok	none	-
Cikawung Sebrang	community forestry	-
Legon Pakis	ecotourism; community forestry	-
	community forestry	-
Taman Jaya	locals can see rhino directly; ecotourism; community forestry	almost extinct
Paniis	ecotourism; forest conservation; community forestry	doesn't know
Cimenteng	none	population stable
Rancapinang	ecotourism; community forestry	population stable
Cegog	ecotourism; community forestry	population stable; still many (~80)
Air Jeruk	ecotourism; community forestry	population stable
Ciakar	ecotourism; community forestry	population stable (40)
	community forestry	population increasing
Cibadak	less unemployment; community forestry	-
	ecotourism; community forestry	population stable (40)
Cilubang	community forestry	population stable
Kampong Cibadak	locals can see rhino directly; ecotourism; community forestry	population stable
Kramat Jaya	locals can see rhino directly; ecotourism; community forestry	population decreasing
Pasir Ranji	ecotourism; community forestry	population stable (48)
Sompok	ecotourism; community forestry	population stable (40)
Ciburial	locals can see rhino directly; community forestry; rhino horn valuable	population decreasing
Sadang	ecotourism; community forestry	population decreasing
Kampong Ciburial	ecotourism; community forestry	doesn't know

Appendix D: answers to risk related questions

	Perceived risks
Ujung Jaya	crop damage
Kiaragondok	crop damage; rhino attacks; user rights tighten; poaching
Cikawung Sebrang	none
Legon Pakis	crop damage; user rights tighten; poaching crop damage
Taman Jaya	crop damage; rhino attacks
Paniis	user rights tighten
Cimenteng	poaching
Rancapinang	rhino moves; crop damage
Cegog	rhino attacks; crop damage; poaching; user rights tighten
Air Jeruk	crop damage
Ciakar	none crop damage
Cibadak	none
	poaching; user rights tighten
Cilubang	rhino attacks
Kampong Cibadak	rhino attacks; crop damage
Kramat Jaya	crop damage; poaching
Pasir Ranji	rhino attacks
Sompok	crop damage; rhino attacks
Ciburial	crop damage; poaching; rhino extinct if not well protected
Sadang	poaching
Kampong Ciburial	crop damage; poaching

Appendix E: answers to ethics related questions

	Ethics	
	Symbolism	Existence value
Ujung Jaya	-	high
Kiaragondok	protects local inhabitants	high
Cikawung Sebrang	fertile soil; cool air	high
Legon Pakis	cool weather none	high high
Taman Jaya	rhino princess	high
Paniis	has positive effect	high
Cimenteng	cool water; fertile soil	high
Rancapinang	fertile soil	high
Cegog	cool air; illnesses disappear	high
Air Jeruk	cool air	high
Ciakar	cool air; fertile soil; Southern Java peaceful cool air; influences environment	high high
Cibadak	doesn't know	high
	cool air; fertile soil	high
Cilubang	cool air; fertile soil	high
Kampong Cibadak	cool air; fertile soil	high
Kramat Jaya	cool air; fertile soil	high
Pasir Ranji	cool air; fertile soil	high
Sompok	doesn't know	high
Ciburial	cool water; fertile soil	high
Sadang	cool air; fertile soil	high
Kampong Ciburial	cool air	high

Appendix F: answers to trust related questions

	Trust	
	National Park Management	WWF
Ujung Jaya	a little suspect	good
Kiaragondok	good	good
Cikawung Sebrang	good	doesn't know WWF
Legon Pakis	getting better again	satisfactory
	good	good, but not close enough to villagers
Taman Jaya	good	not close enough to villagers
Paniis	good	not fruitful
Cimenteng	good	doesn't know WWF
Rancapinang	needs improvement	good
Cegog	good	not yet
Air Jeruk	good	doesn't know WWF
Ciakar	good	very good
	good	doesn't know
Cibadak	needs improvement	can be felt
	good	good
Cilubang	needs improvement	not yet
Kampong Cibadak	needs improvement	doesn't know WWF
Kramat Jaya	good	good
Pasir Ranji	good	good, but somewhat slow
Sompok	good	good
Ciburial	good	doesn't know WWF
Sadang	more understandable	doesn't know
Kampong Ciburial	good	doesn't know WWF

Appendix G: Village profiles

Village Profiles										
Village	**Pop.**	**House-holds**	**Agriculture**			**Livestock**		**Other livelihoods**		
			Crops	*Destination*	*Income (Rp/month per household)*	*Species*	*Destination*	*Type*	*Destination*	*Income (Rp/month per household)*
Ujung Jaya	3690		Rice Coconut Coffee Pepper Vegetables	Personal needs	-	Buffalo Duck Chicken Goat	Personal needs	Honey collection Fishing Firewood and construction wood collection	Personal needs	-
Legon Pakis		86	Rice Corn Vegetables	Personal needs	-	Buffalo Goat Chicken Duck	Personal needs; excess sold	Fishing Firewood and construction wood collection	Personal needs	-
Taman Jaya	2603	672	Rice Corn Vegetables	Sold locally	300.000,-	Buffalo Goat Chicken Duck	Personal needs	Firewood collection	Personal needs	-
								Fishing	Sold on market	2.000.000,- (only some households)
Rancapinang	3642	989	Rice Coconut Clove Coffee Melinjo Petai	Personal needs	-	Not successful yet	-	Shrimp fishing	Sold on market	unknown
Ciakar	570		Rice Clove Coffee Melinjo Petai	Personal needs	-	Chicken Duck	Personal needs	-	-	-
Cibadak	>3000		Rice Coffee Clove Coconut	Personal needs	-	Buffalo Duck Chicken Goat	Personal needs	-	-	-
Kramat Jaya	>1000		Rice Clove Melinjo Petai	Sold locally	300.000,-	Chicken Duck	Personal needs	-	-	-
Ciburial	4378		Rice Clove Casava Melinjo Coconut	Sold	500.000,-	Buffalo	Working animal	-	-	-