ASSESSMENT OF WILDLIFE POPULATIONS, FOREST AND FOREST RESOURCE USE ON TALISE ISLAND, NORTH SULAWESI, INDONESIA

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EXECUTIVE SUMMARY AND OVERVIEW

The Wildlife and Forest Assessment Project on Talise Island is part the Coastal Resource Management Project's (Proyek Pesisir) effort to assist the communities of Talise island to develop a sound natural resources management plan.

Biologically, Sulawesi is a unique island in the Indonesian archipelago. It contains the highest level of animal endemism—species that occur nowhere else—of the archipelago with 62 percent, 25 percent and 28 percent of the mammal, bird and reptile species, respectively, being endemic species. In addition, the plant community is extremely diverse in its structure and composition—including an estimated 5,000 species of higher plants.

However, the plants and animals of Sulawesi are under serious threat from hunting, agricultural encroachment and plant harvesting. Talise is subject to these threats. Talise's small land area increases these threats to the island plant and animal communities. Moreover, destructive land use practices can lead to ecological disturbances leading to a reduction in soil productivity and watershed problems.

A forest assessment for Talise island was carried out during October - November 1998 to evaluate the status of the forest and wildlife, define forest resource use issues, and provide recommendations to communities. The purpose of this report is to present the results of the wildlife and forest assessment on Talise, and provide recommendations regarding forest and wildlife management.

FINDINGS

1. Between 1994 and 1998, total forest cover decreased from 46 percent to 25 percent, resulting in a 43 percent loss of forest area in 4.5 years. Based on a simple linear projection (at 7.88 hectares [ha] lost per month), Talise is expected to have 15.5 percent forest cover (323 ha) by the year 2000, and no forest cover by mid-2004, if current forest conversion continues.

2. The vegetation structure indicates heavy tree loss (through collecting and/or tree falls) in recent years. Seventy percent of the enumerated trees were smaller than mid-canopy and canopy-sized trees.

3. The vegetation composition shows a low diversity of tree species. Ninety-seven tree species were identified.

4. Bird diversity is moderately high. Eighty-seven bird species were recorded in the forest and along the shore.

5. Key forest species such as the crested black macaques, bear cuscus and tarictic hornbills all have low population densities. Scarcity of forest fruit resources, limited habitat and hunting have all contributed to the rarity of wildlife. Further disturbances most likely will result in their extirpation in the near future. Already, the Sulawesi wild pig and Maleo bird have been exterminated on the island.

6. Hunting still takes place—much of it by people outside of Talise. Macaques, cuscus and deer are killed by the use of traps, snares and shotguns. In addition, a significant percentage of the people on Talise hunt. Based on sustainable hunting estimates, *any* hunting of medium- to large-sized mammals will lead to their immediate demise.

7. Due to limited land, local community members have gardens inside forests. More than half (55 percent) of the households possess gardens inside forests, and a considerable number of people (41 percent) have gardens at the edge of forests. Close access to the forest often means a high likelihood of intensive use of forest resources.

8. There is no statistically significant relationship between the distance from village and vegetation structure. This result could mean either that the people from Talise may be using the forest evenly or that people from other dusuns (settlements within a village which have official government administrative recognition) on the island and those from Kinabuhutan are coming to Talise island to harvest trees.

9. The proximity of gardens and their available crops invite crop damage. Fifty-five out of 63 people reported having crops damaged by animals. Most people report the use of snares and traps to deter further crop damage. This, in turn, leads to the decimation of wildlife populations.

10. All respondents use forest resources in one form or another. Forest resources are taken for a variety of uses—for food; as lumber for houses, boats and furniture; for firewood. They also use rattan and bamboo for household items. The least sustainable, and most frequent use, is the harvesting of trees for boat, furniture and house building.

11. Most people harvest no more than three tree species. The most preferred species are lingua (*Ptercarpus indicus*) for lumber; woka palm (*Livistona rotundifolia*) for leaves; and matoa (*Pometia pinnata*) for lumber.

12. Although there is a desire by most residents to preserve natural resources for continued use, land tenure and legal issues complicate and weaken efforts to actively conserve resources.

RECOMMENDATIONS

1. A complete tree harvest ban, as well as a ban on chainsaws, should be instituted with an allowance for collecting of fallen trees and limited harvesting of woka palm leaves. This ban should be set for at least five years.

2. At the same time, a reforestation program of important economic and forest fruit trees (particularly lingua) should be initiated.

3. A program to sustainably hunt wildlife on the island, by either local community members or outsiders, is not feasible. The community should institute a hunting ban.

4. Tree cutting and hunting bans will require a consensus between the five dusuns on Talise and Kinabuhutan islands. Proyek Pesisir should help facilitate discussions between communities.

5. Once a consensus is achieved, Proyek Pesisir should assist the communities in drawing the boundary of the no-use zone, and begin drawing up a draft decree. A legal consultant should be contracted to resolve the land tenure and legal issues.

6. Land tenure is an important but small step in conserving resources. Rather, it should be viewed as an important but small step toward sound natural resource management. The most important goal should be to develop a management plan with which the use of natural resources is sustainable and which protects ecosystems. Regardless of whether the forest is owned by the government or the community, the consequences of poor land use practices still fall on the community.

7. Alternative agricultural methods such as slope agriculture, terracing, inter-cropping and barrier hedges should be tested and initiated. As a part of using new agricultural techniques, people should be encouraged to move their gardens away from the higher slopes of the island to prevent pest damage and maintain wildlife populations. A consultant with an agronomy background should be contracted to establish pilot plots.

8. Tourism probably promises few economic gains, and will probably harm the local ecology and social fabric. However, if the community strongly wishes to pursue tourism, Proyek Pesisir should assist in its planning, implementation and monitoring.

9. Monitoring programs should detect negative trends and appropriate management decisions can be made to avert irrevocable events. Particular attention should be given to key forest mammal and bird species; shore birds; soil and water quality; and coral reefs.

10. Study tours should be conducted to show both the benefits of using new techniques (e.g., slope agriculture and terracing) and repercussions for continued land use practices (e.g., sites where soil and water quality has decreased due to harmful agricultural and forest use practices).

11. A handicraft product made of coconut tree bark and bamboo already produced by a Talise family represents the most ecologically sustainable and financially lucrative option for the community of Talise. Proyek Pesisir should help explore the possibility of expanding and marketing these products.

12. The community must become more aware of natural resource management issues. The community should be provided with more educational information, and be engaged in the planning and design of projects.

1.0 INTRODUCTION

Marine and coastal areas throughout the Indonesian archipelago are a source of economic benefits for many Indonesian people. The approximately 81,000 kilometers (km) of coastline provide vast amounts of marine and terrestrial resources as well as shelter for nearly 60 percent of the Indonesian human population. However, increasing human populations and their unsustainable use of natural resources are creating severe ecological problems on Indonesian islands.

Until recently, the nexus between marine and terrestrial resource issues has generally been ignored. Marine resource issues revolved around marine resource harvesting while terrestrial issues revolved around forest protection. However, resource managers and scientists are coming to the realization that the two are inextricably linked to each other, particularly on islands where the two are linked both ecologically and economically.

To bridge these two components, Proyek Pesisir is assessing the status of both the marine and terrestrial ecosystems in order to assist local communities with natural resource management. A forest assessment for Talise island was carried out during October - November 1998 to evaluate the status of the forest and wildlife, define forest resource use issues and provide recommendations to communities. The purpose of this report is to present the results of the wildlife and forest assessment on Talise, and provide recommendations regarding forest and wildlife management.

1.1 Talise Island

Talise Island is located approximately 40 km northeast of Manado city in Kebupaten Minahasa in North Sulawesi (Figure 1). It is a 2,075 ha island bordered by the islands Gangga to the south and Bangka to the east. Talise Island is surrounded by shallow waters off the east coast and deep waters off the west coast. The island elevation ranges from sea level to approximately 349 meters (m) above sea level. The shoreline consists of white sandy beach interspersed with mangrove forests and sandstone walls. The topography features a chain of hills that runs length-wise along the center of the island with steep slopes (some > 40°) on both hillsides (Figure 2).

The island community is composed of four dusuns: Talise on the south-central area on the eastern side; Tambun on the southern tip; Airbanua on the north-central area on the western side; and Wawunian on the south-central part on the western side. The population is ethnically made up of people mostly from Sangir, and the rest from Bajo and Minahasa.

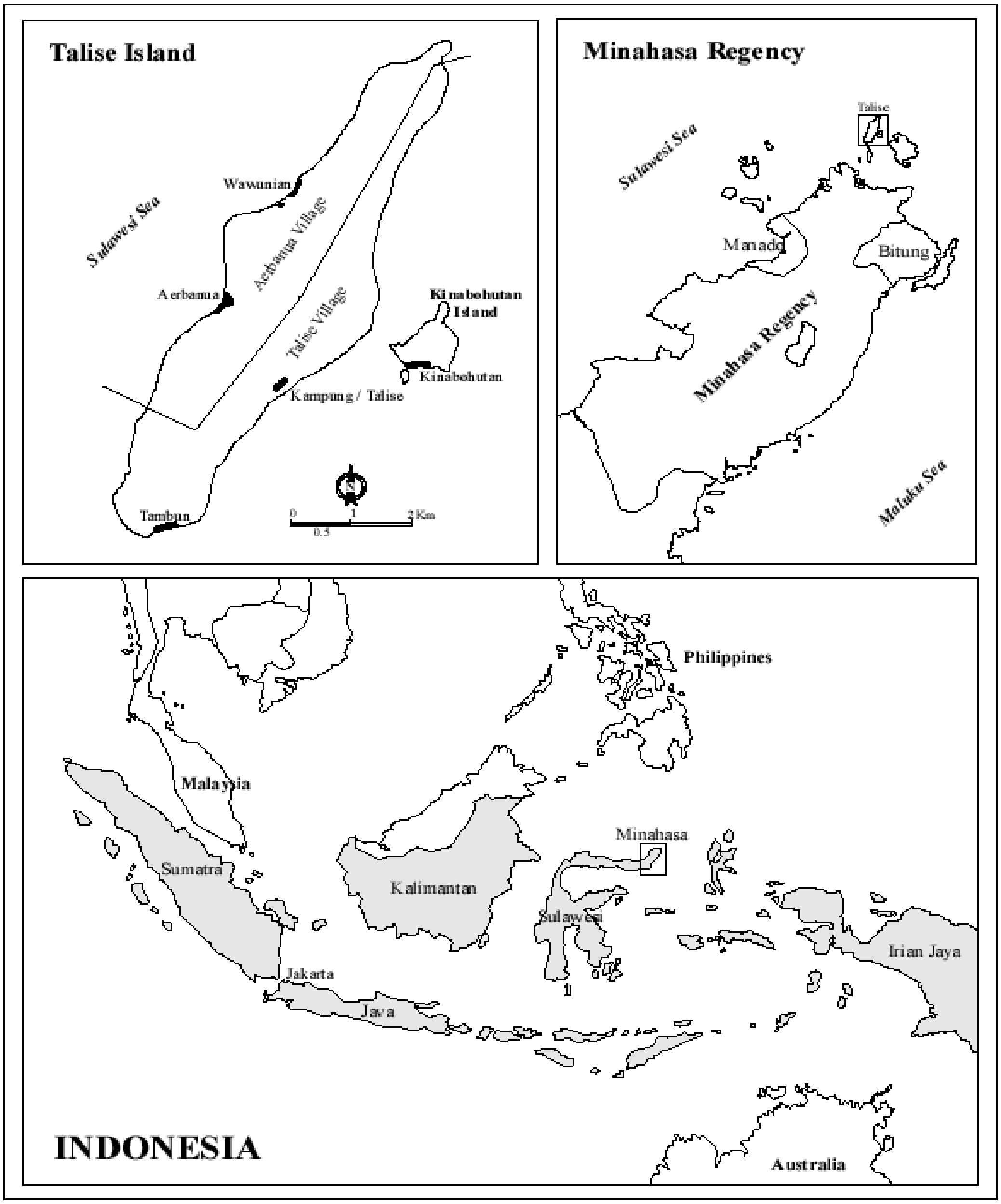

Figure 1. Location of Talise Island

According to official Kabupaten census statistic of 1997, the present human population size[1] is reported to be 1,902 people which equates to 91.66 persons/km^2.

Although the income base is variable between villages, most income activities fall under fishing, mariculture (a Japanese pearl farming operation on the southern end of dusun Talise) and agriculture. The Kepala Desa (government-appointed village head) reported 65 percent of the workers as fishermen and 20 percent as farmers (see Pollnac et al. 1997). However, because most families are involved in several trades, it is difficult to make clear distinctions between occupations. In fact, most families depend heavily on agriculture for either income or personal consumption.

[1] This population does not include the people from Desa III on Kinobuhutan Island but includes Dusuns Tambun, Airbanua, Wawunian and Talise.

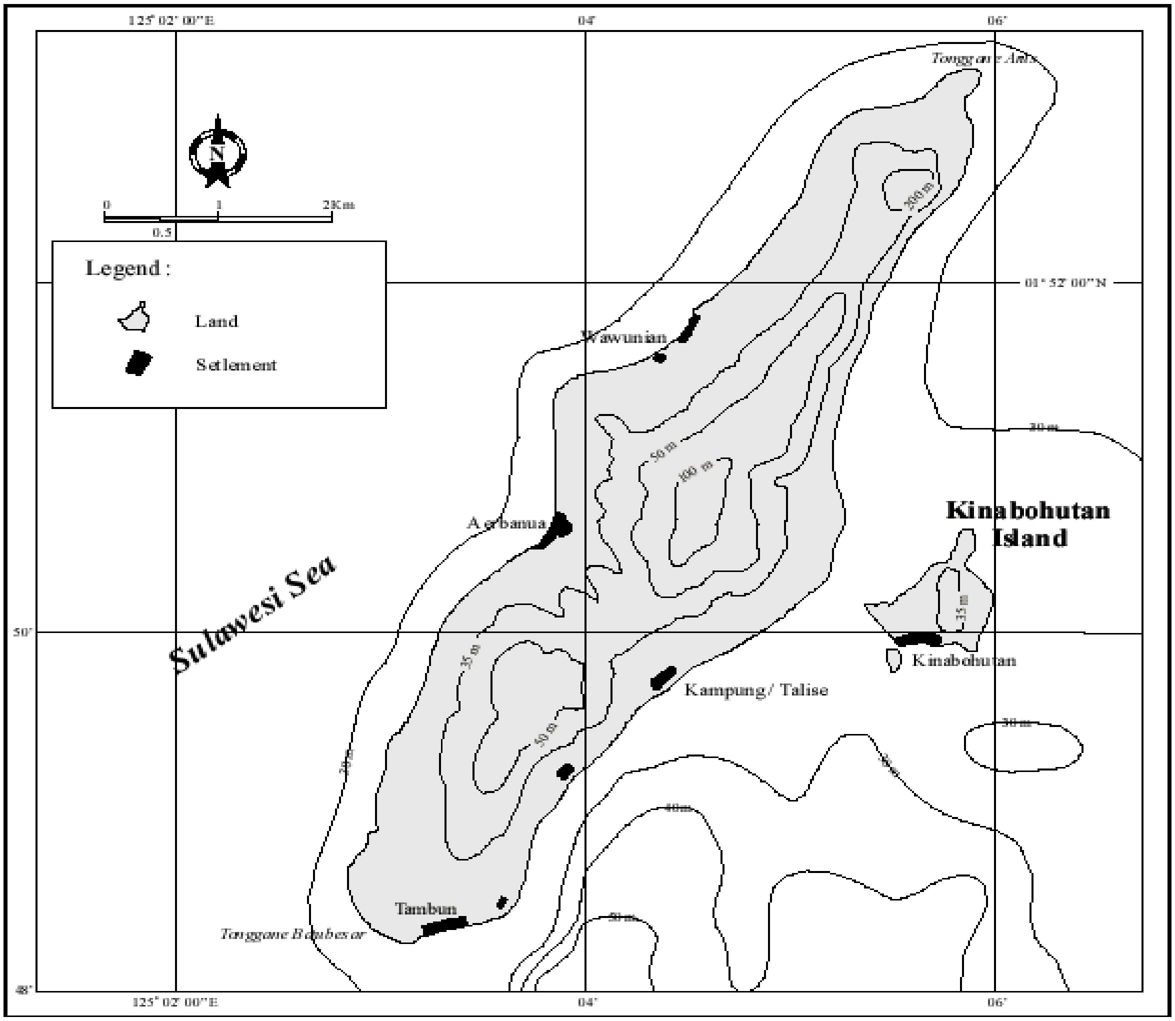

Figure 2. Topography and bathymetry of Talise Island

Coconut and banana, usually grown in lower elevations, are usually grown for income whereas *singkong* (cassava), corn and tomatoes, grown in higher elevation, are grown for personal consumption. Both types of agriculture require intensive labour and land use. The end effect is usually the whittling down of natural areas (i.e., forest), loss of wildlife and ecological problems such as soil erosion and loss of biological productivity.

1.2 Sulawesi Forests and Wildlife

Sulawesi is a biologically unique island in Indonesia. The 159,000-km2 island of Sulawesi is the largest island in the biogeographical sub-region of Wallacea (Figure 3). Sulawesi's complex geological history and long isolation from surrounding islands have produced one of the highest levels of faunal endemism—species that occur nowhere else—in the world. Species endemism for Sulawesi is remarkably high. Of the 127 mammal species, 328 bird species and 104 reptile species, 79 (62 percent), 88 (27 percent), and 29 (28 percent) species, respectively, are endemic, and mammal species rises to 98 percent if bats are excluded (FAO, 1982; Whitten *et al*, 1987). Furthermore, North Sulawesi shows the highest level of faunal endemism in Sulawesi (Kinnaird and O' Brien, 1995$_a$). However, faunal populations in North Sulawesi have declined dramatically in the past fifteen years (Kinnaird and O' Brien, 1995$_a$, 1996, in press; Lee, 1995, 1999$_{a, b}$). Wildlife is intensively hunted, and farming practices continue to raze and compromise the integrity of natural landscapes. Large mammal species such as the anoa (*Bubalus depressicornis, B. quarlesi*), babirusa (*Babyrousa babyrussa*) and crested black macaque (*Macaca nigra*), as well as small mammals such as flying foxes (*Pteropus* spp.) and bear cuscus (*Ailurops ursinus*), have become rare and are under serious threat.

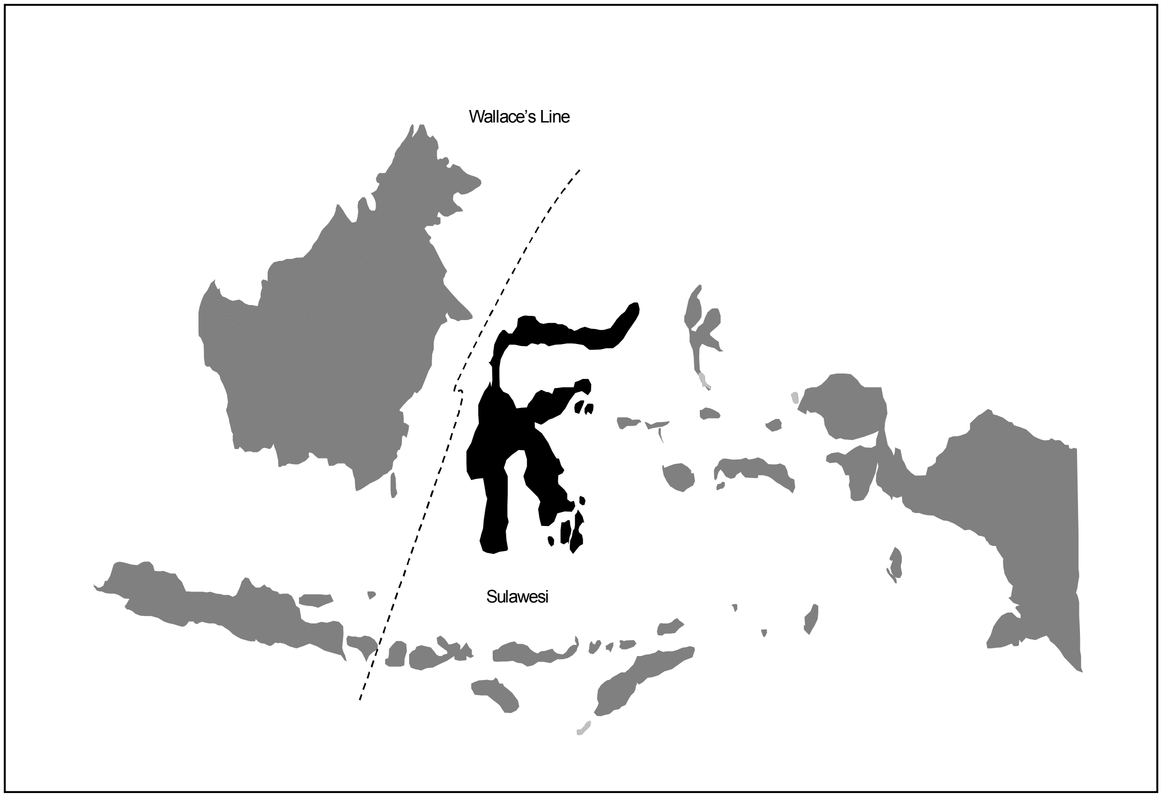

Figure 3. Map of biogeographical zones, highlighting Wallacea

The local flora and fauna provide both ecological and indirect economic benefits:

- Each species is the storage bank for tremendous genetic information.
- Each species contributes to the maintenance of the forest ecosystem.
- Forest animals help to maintain not only forest systems, but also help propagate domesticated plants. Fruit bats are one of the most important vertebrate species for the pollination of banana, mango, and papaya.
- A healthy forest contributes to improved productivity and quality of soil and water—two resources basic to farming.

Therefore, the loss of local fauna and flora poses serious problems for the maintenance of genetic diversity and natural landscapes and, ultimately, for the lives of humans.

1.3 Small Island Ecology

A healthy ecosystem is paramount, particularly to small islands. Species loss is dependent on the size of the island. Of worldwide extinctions that have occurred in the last three centuries, most have occurred on islands. Of 94 species of birds known to have been present worldwide since European contact, 86 percent of them have occurred on islands (Gorman, 1979).

Human-induced disturbances disrupt an island's delicate balance. Since small islands have a small amount of land, the forest and wildlife populations are, accordingly, very small. According to the theory of island biogeography, as total land area decreases, the probability of habitat and wildlife demise increases (Diamond, 1972) (Figure 4). Small wildlife populations are vulnerable to extinction through a number of random processes—genetic isolation, disease or climatic disturbance. Therefore, species on small islands, even without disturbance, are subject to extinction risks. The additional pressures on populations from disturbing factors steer them toward a probable path of extinction.

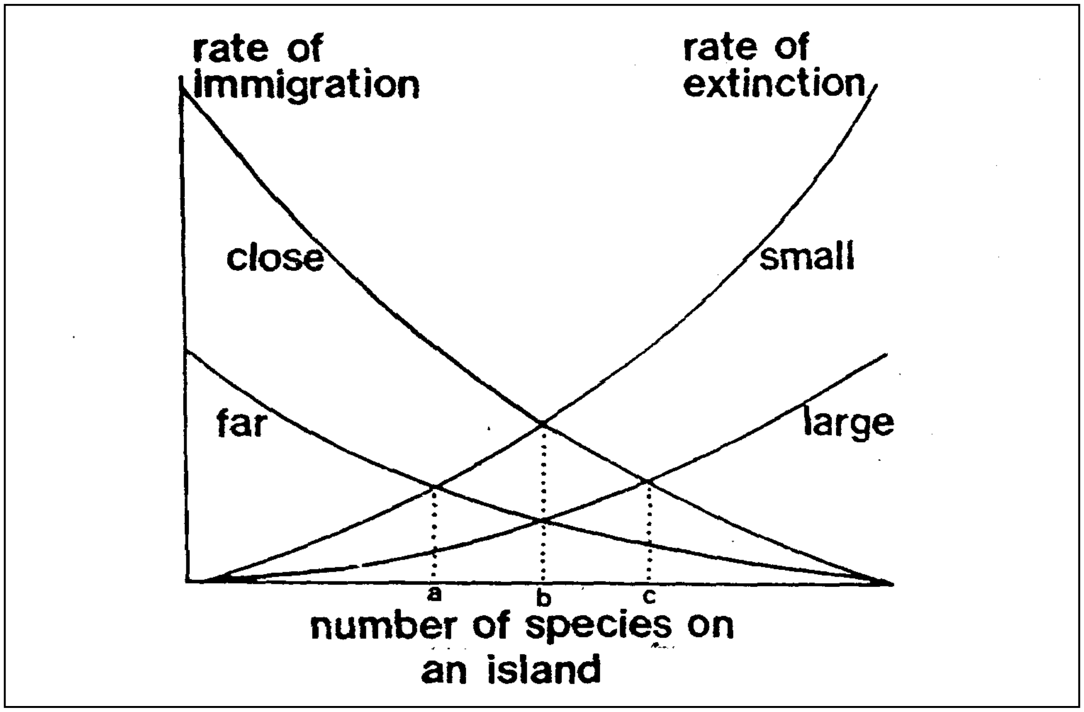

Figure 4. Extinction curve on islands

Small islands are also more easily subject to ecological damage. Fragile soils exposed to heavy rains and/or intensive use of the land through burning and farming can lead to lower productivity of the soil, sediment runoff, lower floral structure and species diversity, decreased forest regeneration and animal population decline. Each of these factors feed into a cycle in which, ultimately, the livelihood of local communities is negatively affected. This is a critical point since land resource use is crucial to the daily lives of island community members.

Implementation of forest protection and sound agricultural practices that will provide for the island residents, while reducing their impact on the remaining forest and supporting their active participation in resource management, appears to be essential if long-term sustainability is sought. Given this reasoning and recognizing the potential negative consequences of overuse of natural resources, programs to avert irreparable ecological damage and to secure an income base by engaging in non-consumptive activities are critical to a healthy ecosystem of small islands.

2.0 OBJECTIVES

Based on a rationale for maintaining an intact, functioning forest, the following objectives were established for the wildlife and forest assessment study:

- Obtain information about the condition of the remaining forest and wildlife populations on Talise Island.
- Determine current forest resource use by local communities.
- Provide recommendations to the stakeholder groups on how to strengthen forest and wildlife protection.
- Provide information to the community on ways of managing the remaining forest in a sustainable manner.

2.1 Tasks

- Meet with concerned parties (i.e. the community, local government agency, local field assistants) to determine the direction of the program.
- Train local field assistants in ecological data collection and monitoring.
- Assess forest vegetation and wildlife population on Talise.
- Provide recommendations for forest resource management based on ecological assessments.
- Give presentations to Talise communities on research objectives, research findings, and reasons for preserving the forest ecosystem.

2.2 Outputs

The main outputs for the wildlife and forest assessment were the following:

- Reports on forest conditions, wildlife population and forest resource use data.
- Training of local assistants.
- Training of a Forestry Office staff member.
- Presentations to communities on Talise.
- Recommendations for community planning.

3.0 METHODS AND RESULTS

In preparation for the current project, prior to the consultant's arrival, the Proyek Pesisir Talise extension officer and research extension officer held several group discussions with community members. In addition, Proyek Pesisir staff and community members held a number of discussions about project planning and participation. As a result, most community members gained some knowledge about the current project.

Field work was comprised of six components: initial site visit, establishing survey trails, forest habitat assessment, wildlife census, household interviews concerning resource use and community meetings.

3.1 Initial Site Visits

This phase of the program was concerned with compiling sufficient information to address the specific needs of the program and work out the logistical details entailed in carrying out the subsequent field work. Initial site visits consisted of visiting the island to meet community members and to become familiar with the island's land use patterns, geology, topography, major floral community types and fauna, and to test the equipment to be used.

3.2 Survey Trails

Upon initially surveying the forest, it was decided that three trails running the length of the forest would suffice for two reasons. First, the size of the forest was small enough so that three trails would meet sampling needs. Second, the forest is fairly consistent throughout its range, consisting of semi-closed canopy in the secondary succession. Therefore, stratification of trails based on habitat zones was deemed unnecessary.

A total of approximately 10 km of trails were established (Figure 5), running from a southwesterly to northeasterly direction through the forested areas of the island. Trail A, extends 1.2 km, Trail B extends 2.3 km and Trail C extends 6.1 km.

3.3 Forest Assessment

Forest habitat assessment consisted of two forms of data: 1) GPS units were used to outline the boundary of the forest; and, 2) the island's forest ecosystem was described through a floristic inventory.

A Garmin IIXL GPS (Geographical Positioning Unit) unit was used in collecting positions at the boundary of the forest. This work entailed a person walking the boundary of the forest and entering locations every 100 m. "Forest" was defined as a large area where there were no evidence of systematic cultivation activities, no large burned areas or regenerating grassfields, and where a cluster of trees (other than agricultural products such as coconut or banana) equal to or higher than 5 m was present.

Figure 6 shows the boundary of the forest in 1994 (based on a LANDSAT image) and in 1998 (based on the boundary of the forest as delineated through GPS mapping). Current total forest cover (as of 1998), not including mangrove forest, is 533.3 ha which represents 25.7 percent of the total land area for Talise Island.

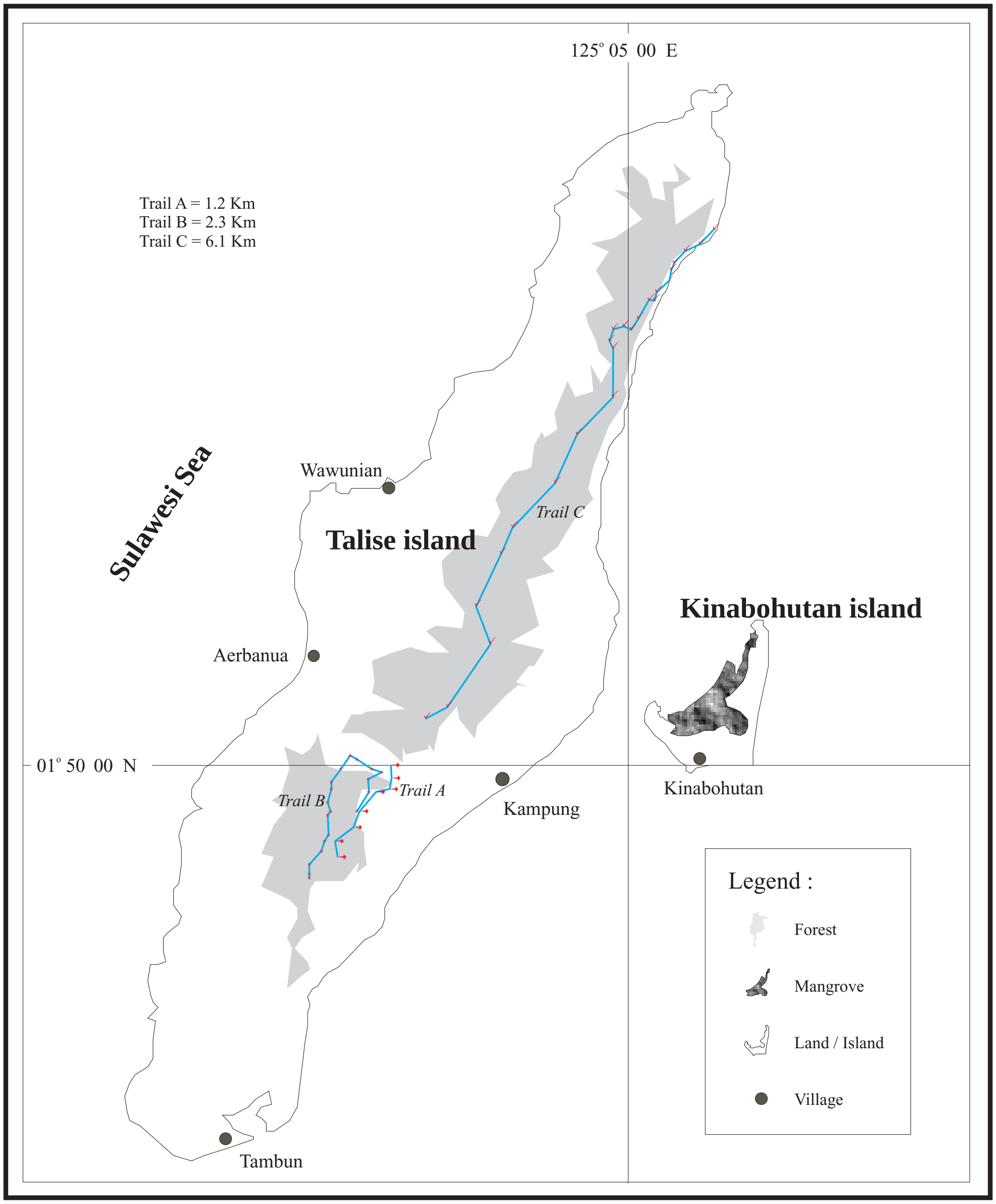

Figure 5. Location of trails on Talise Island

3.4 Vegetation Assessment

The gross vegetation makeup for both trails was similar, falling under the either pioneering or building phase of forest growth cycle. Near the forest edge, the forest vegetation consists of small trees (2 to 5 m trees) such as *Macaranga* spp. and *Piper aduncum* and small scrub species such as *Lantana camara* surrounded by grasses. These pioneering plants are often found where there are cultivation practices that use fire on a regular basis for either keeping down grasses (e.g., alang alang, *Imperata cylindrica*) or encouraging the growth of young grasses to attract deer for hunting.

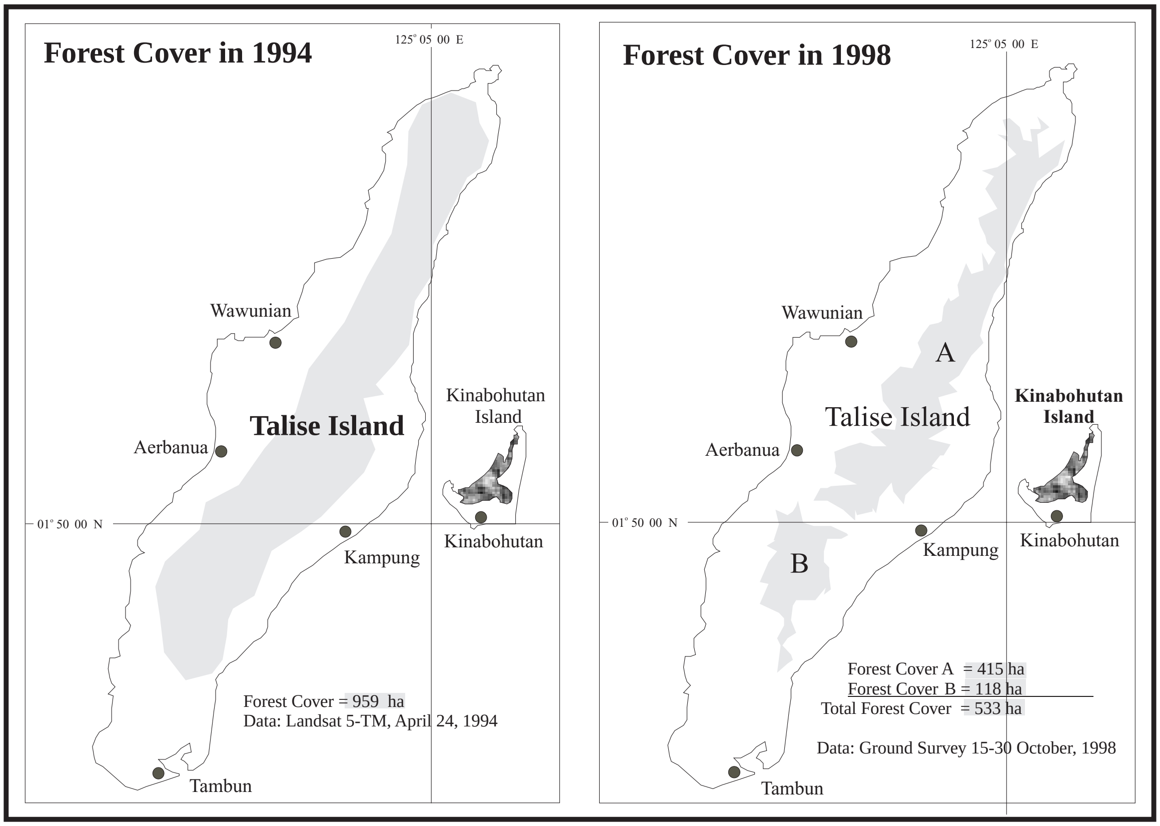

Figure 6. Comparison of forest cover between 1994 and 1998

The edge forest with scrub and grasses changes into an understory and mid-canopy forest with occasional canopy-sized trees. The dominant species were palms (e.g., areng, *Areca pinnata*; woka, *Livistona rotundifolia;* and seho yaki, *Caryota mitis*) and certain non-palms (binunga daun besar, *Macaranga tanarius*; kananga, *Cananga odorata*; kayu kambing, *Garuga floribunda*; and coro, *Ficus varietaga*). Gardens were found scattered throughout the forest and forest edges. Most of the crops were banana and coconut. From discussion with community members and people we encountered in the forest, many of the gardens were tended by the people from Kinabuhutan.

Tree falls seemed to be quite common. During the last week of field work when heavy winds and rains were occurring on a daily basis, at least fifty medium to large trees were found that had fallen on a 4 km part of Trail C. Given the steep terrain and thin soils, repeated storms may cause the forest to remain in a continuous building phase, or vacillate between a pioneering and building phase of forest growth cycle.

The present sample size of 100 plots, equalling five ha, accounts for 0.94 percent of the total forest area. There were 1,498 trees with diameter at breast height (DBH) ≥ 10 cm. Of the total, 1,399 were identified at the species level. Leaf and fruit samples of the 99 trees that could not be identified were collected and sent to the National Herbarium in

Bogor for analysis. Ninety-seven[2] species from 38 families are represented. Tree density per plot was fairly uniform. There were between two to 16 trees per plot with an average of 7.6 species per plot (SD = 2.76). Extrapolating the plot data to the forest, tree density was 299.6 per ha. This is lower than at Tangkoko, but higher than at Manado Tua (Table 1).

Table 1. Comparison of tree density at Talise with other sites.

Site	Tree Density per Hectare
Tangkoko[a]	351.7
Talise	299.6
Manado Tua[b]	176.8

[a]Kinnaird and O' Brien (1995[a]); [b]Lee (1996)

Although there is not a linear relationship between tree DBH and height, there is a strong correlation by which one can set a scale to: 10-24 centimeters (cm) DBH = understory; 25-39 cm DBH = mid-canopy; > 40 cm DBH = canopy. Trees considered understory-sized made up more than half (58.42 percent) of the trees sampled and, therefore, the DBH of the trees sampled are heavily skewed toward smaller tree size classes. The average DBH was 25.06 cm (SD = 16.6). Tree size distribution is presented in Figure 7. Proportions of mid-canopy and canopy-sized trees were 25.6 percent and 15.98 percent, respectively. Of the mid-canopy and canopy species, the most common species were *Garuga floribunda* (4.4 percent), *Macaranga tanarius* (4.2 percent), *Canarium asperum* (3.9 percent), *Cananga odorata* (3.3 percent), *and Dracontomelum mangiferum* (3.0 percent).

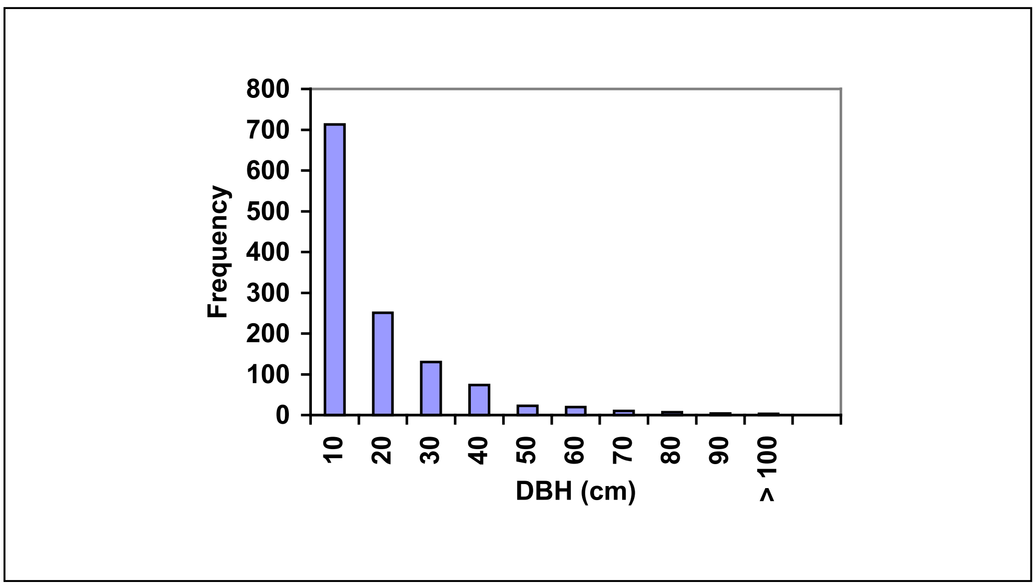

Figure 7. Distribution of DBH (cm) for enumerated trees

[2] Based on morphological characteristics, the 97 unidentified trees probably belong to at least 19 different species. Therefore, the total tree diversity in the Talise forest may be approximately 126 species. However, this does not include mangrove tree species nor domesticated trees (e.g., papaya) near the forest.

Appendix 1 provides a list of trees species identified and measured. Tree density was 14.98 trees per plot (SD = 6.67) with the dominant species being *Areca pinnate* (locally known as arrange) (17.2 percent), *Macaranga* tanarius (binunga daun kecil) (11.2 percent), *Cananga odorata* (kananga) (5.6 percent), *Ficus variagata* (coro) (4.02 percent), and *Garuga floribunda* (kayu kambing) (3.5 percent).

Measures of plant species diversity are considered useful management tools since species diversity often reflect the structural diversity and, consequently, the availability of food and shelter for animals. In addition to simply supplying information on species richness, an index of species evenness should be given. Two such indices are Simpson's Index (1949) and the Shannon-Weaver Diversity Index (*H*) (Margalef, 1958)[3]. These indices provide a measure of uncertainty. Higher values indicate greater uncertainty that the next individual picked from a random sample will not belong to the same species as the previous one. Therefore, a sample containing one species would have a value of zero, whereas one that contains a high number of species apportioned evenly would have a high index.

Simpson's index gave a value of 0.902 meaning that the probability that two individuals chosen at random of different species would be high (i.e., showing high heterogeneity). From this, we calculate that it would take 10.19 equally common species to produce the observed value of *D*. A similar value (10.11) from the Shannon-Wiener index was calculated.

Linear regression analysis was carried out to examine whether proximity to the village was related to the number of trees per plot. Because Trail C extends from near dusun Talise to the northern part of the island, where no large settlements exist, Trail C was used for the analysis[4]. If there was a increasing number of trees as distance from the village increased, this would mean that people from dusun Talise are taking more trees closer to their home. The results show that there is no relationship between the distance from the dusun and trees per plot (Mean square = 27.87, F = 1.063, df = 64, $p > .025$). The lack of significance could be due to fewer trees but comparable vegetative biomass (i.e., fewer overall trees but trees of greater girth). A regression analysis was run to see if there was a relationship between proximity and total biomass (as measured by basal area derived from DBH measurements). Again, there was no significance between these two factors (Mean square = 11.99, F = 0.519, df = 64, $p > .025$).

These findings may mean either of two possible answers. One, the people from Talise may be using the forest evenly. Because the forest is small, distance from the village may not be an important factor in harvesting forest resources. Two, the people from other dusuns on the island and those from Kinabuhutan are coming to Talise Island to harvest forest resources. There is a network of trails throughout the island through which people can use the forest.

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[3] Simpson's index (D) where $D = Sum\ p^2_i$ where p_i = proportion of species in the sample. Shannon-Wiener index (N_1) where $N_1 = e^{H1}$ where e = base 2 log and ^{H1} is the evenness index.

[4] Trails A and B were too short and too close to villages to run such an analysis.

3.5 Wildlife Census

The line-transect sampling method (Anderson *et al*., 1979), entailing systematic walks on transects, was used. Three trails, (A) 1.2 km, (B) 2.3 km and (C) 6.1 km long (total 9.6 km) were walked once to twice a day - in the morning (0600-1100) and afternoon (1300-1700) at the rate of 1 km/hour. Observers were required to walk slowly, stopping every five minutes to stop and listen for sounds. Data included: location, time, sighting angle, sighting distance, number of animals, and age and sex composition of macaque groups and bear cuscus. Censuses were repeated seven times for both trails A and B, and four times for trail C for a total of 68.9 km of census walks.

3.5.1 Mammals

Table 2 shows census results for the crested black macaque and bear cuscus populations.

- Crested Black Macaque (*Macaca nigra*)

Quantitative data were based on 22 observations of macaque groups. Brief contacts with macaque groups and concurrent training activities often precluded complete and accurate age and sex determinations. The average strip width on one side of the transect—the distance between the transect and where the group could be reliably detected—was 34.78 m (SD = 15.70). Therefore, by multiplying the strip width by two (accounting for width on both sides of the transect), measuring the length of the trails, and factoring in the number of times surveys were run, a total of 5.85 km^2 was surveyed. The average group size was 5.73 animals (SD = 3.92). The density was 21.53 macaques per $km^{2,}$ amounting to a total population estimate of 114.77 animals on Talise.

This density is fairly low compared with density figures from Tangkoko, but comparable to the Manembonembo Nature Reserve macaque population. Most recent survey results show a density of 58 macaques per km^2 at Tangkoko (1995). The estimate of 22.8 macaques per km^2 at Manembonembo (1995) was a sharp decline from previous years as a result of heavy hunting pressure. On Manado Tua, the macaque density was 78 ± 34 macaques per km^2, but this high density is probably due to a constriction effect in which the population is forced into an increasingly small area of forest, thus, creating a high density (Lee, 1996).

- Bear Cuscus (*Ailurops ursinus*)

The bear cuscus is one of two[5] endemic cuscus species belonging to the Phalangeridae family that occur on Sulawesi. It occupies the high strata of the forest structure feeding on leaves (e.g., *Garuga floribunda*, *Melia azedarach*) and fruits (e.g., fig, *Dracontomelum dao*) (Dwiyahreni *et al*., in press). The social group is comprised of only the mother and her infant (up to eight months). Otherwise, the adult males and females are solitary except for mating.

The population of bear cuscus on Talise is very low. The density is 1.67 animals per km^2 with a total island population of 8.93 animals. The low abundance figure has serious negative implications for the viability of the cuscus population on Talise Island.

[5] The other species is the Sulawesi dwarf cuscus, *Strigocuscus celebensis*. According to village reports, this species still occurs on Talise island.

- Other Mammals

Based on the brief cave visits, bat diversity is probably low. Three bat caves were visited. The two southernmost caves contained small insectivorous bats, (*Myotis* spp., *Pipistrellus* spp.) while the northernmost cave contained the fruit bat, Sulawesi rousette (*Rousettus celebensis*). Figure 8 shows the locations of caves.

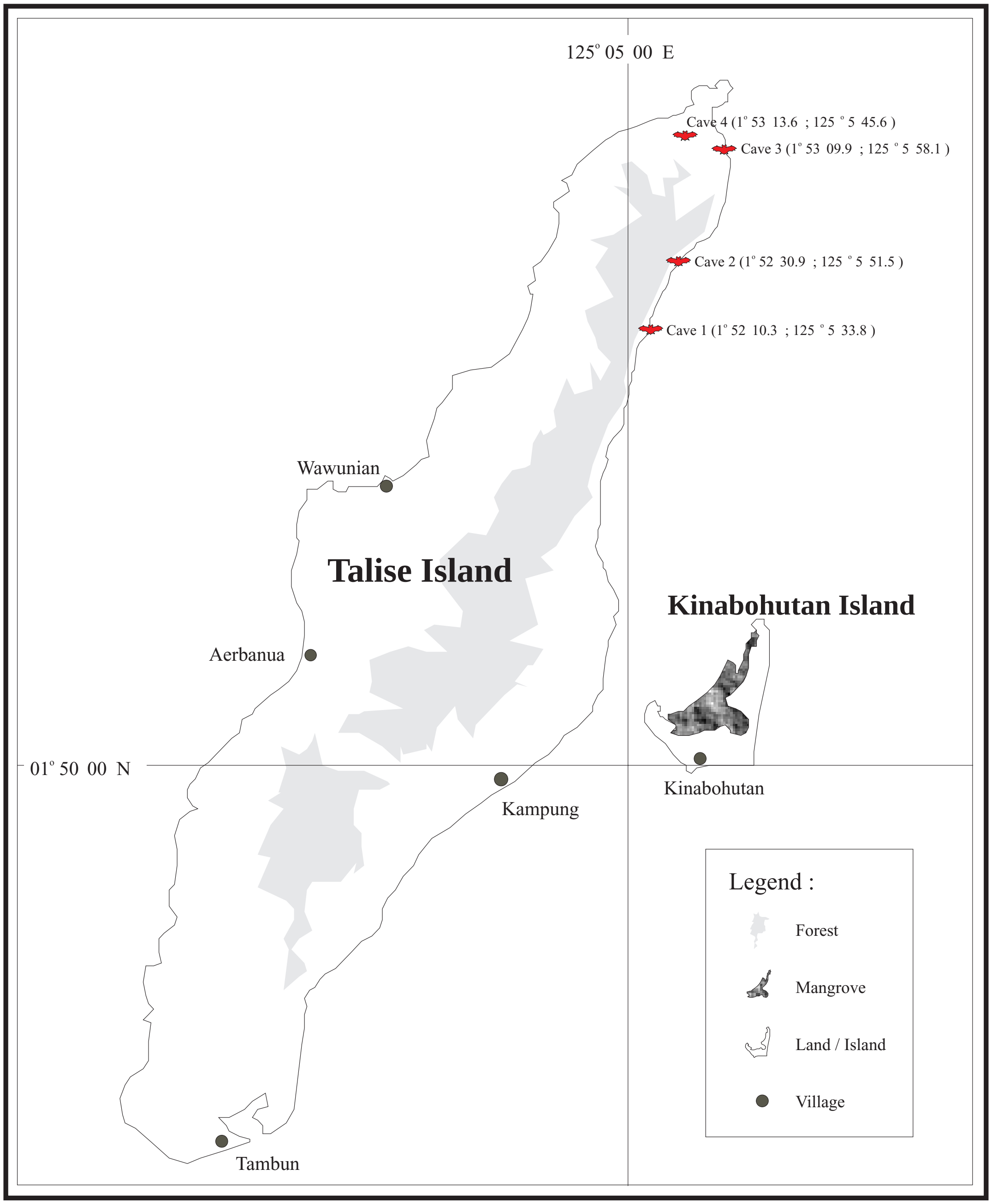

Figure 8. Location of bat caves

Although no reliable population estimates can be given due to the brevity of the survey, a brief description of the observations may be useful. The first cave extends nearly 50 m. The second cave is located approximately 100 m above sea level on a steep hill. The cave splits into two smaller channels and extends approximately 10-15 m. According to one of the guides, it has not been used by hunters in over two years. The cave contained at least 300 adult bats with nearly 50 infants. The third cave contained approximately 100-200 flying foxes.

Deer (*Cervus timorensis*) or civets (*Paradoxurus hermaphroditus, Viverra tangalunga*) were not directly observed during the censuses. However, deer and civet tracks were found during initial site visits and trail cutting. Although tracks show the presence of ungulates, using track count does not allow for estimation of actual densities. Because of the homogeneous habitat on the island, and animal signs outside of the forest were not surveyed, no meaningful information on relative abundance for different habitats was yielded. From discussions with local people, deer are definitely still on the island, and the arrival of deer hunters from Manado was noted. In addition, although there were several reports of feral Bali cattle (the domestic form of *Bos javanicus*), none was encountered.

Tarsiers are quite common. Systematic surveys were not carried out, but at dusk tarsiers were frequently encountered, and their calls were heard. Tarsiers are nocturnal animals that feed on insects, and are found in many different types of habitats including forest edges. The disturbed forest habitats of Talise allow for moderate to high densities of tarsiers. According to the local people, Talise had wild pigs (*Sus celebensis*) at one time. However, they have all been eradicated. The most likely cause is hunting.

3.5.2 Birds

Appendix 2 lists all species observed during the study. Eighty-seven species of birds were observed during the census. Bird diversity is high compared to that of Manado Tua, but much lower than mainland sites such as Tangkoko (156 species) and Gunung Ambang (117 species). The most common birds observed were the drongo (*Dicrurus* spp.); black-naped oriole (*Orioles chinensis*); and fruit pigeons and doves (family Columbidae). Spectacular coastal birds and birds of prey include the serpent eagle (*Spilornis rufipectus*); osprey (*Pandion haliaetus*); Brahminy kite (*Haliastur indus*); and white-bellied sea eagle (*Haliaetus leucogaster*).

In addition, using boats, an inventory of birds along the coast was carried out. The variety of coastal habitats such as mangroves and caves provide suitable habitats for a suite of coastal birds. Thirty-four species were observed including swiftlets (Moluccan swiftlet, *Collocalia infuscata*; glossy swiftlet, *C. esculenta*); frigatebird (great frigatebird, *Frigata minor*); boobies (red-footed booby, *Sula sula*, brown booby, *Sula leucogaster*); egret (great egret, *Egretta alba*); heron (pied heron*, E. picata*); and shorebirds (Terek sandpiper, *Xenus cinereus*; Australian pranticole, *Stiltia isabella*).

Table 2. Population estimates for select mammal and bird species.

Species	Density per km^2	Total Abundance
Crested black macaque	21.53	114.77
Bear cuscus	1.67	8.93
Tarictic hornbill	1.87	9.99
Philippine scrubfowl	6.154	32.80

- Tarictic Hornbill (*Penelopedes exharhatus*)

The Sulawesi tarictic hornbill occurs in lowland forest up to 1,100 m. Females are entirely black, while males have yellow faces and throats, with both having yellowish white bill. They live in social groups that are thought to be family units.

Hornbills were observed seven times. The density of hornbills is 1.87 animals per km^2. No hornbills were seen on Trails A and B. This was most likely due to the lack of preferred food species including figs (*Ficus* spp.) which, at Tangkoko, made up one-third of all food species (Kinnaird and O' Brien, 1995_b). There is a moderate association between the abundance of fig trees and frequency of hornbill sightings, but no statistical significance (Pearson's r = .64, p > .05, n = 7) (Table 3).

Table 3. Fig frequency and hornbill sightings on each trail.

Trail	Fig frequency	Hornbill sighting per km^2
A	8	0
B	17	0
C	19	0.29

Density results may have been confounded by timing of the survey in relation to hornbill breeding biology. Immediately prior to egg laying, the female hornbill seals herself into a nest hole in a fig tree cavity by plastering up the cavity with her faecal matter. Typically, hornbills begin nesting around October, and female hornbills remain in the nest until chicks fledge (Kinnaird and O' Brien, 1995_b). Therefore, we would have missed nesting hornbills during the census. However, given the low ratio of nesting females to the rest of the population, and the low density of hornbills, nesting females would not have significantly increased density estimates.

Hornbills require large intact forest for survival (Whitmore, 1986). Densities for Asian hornbills range between 0.3 - 2 birds per km^2. At Tangkoko, densities for the tarictic hornbill are 3.0 animals per km^2. The density of tarictic hornbill at Talise reflects the patchy nature and small size of the Talise forest.

- Philippine Scrubfowl (*Megapodius cumingii*)

The Philippine scrubfowl is a ground-dwelling bird that occurs in lowland scrub and hill forests. It feeds mainly on invertebrates, seeds, and fallen fruit. It also lays its nest in decaying wood of tree trunks. Because it does relatively well in degraded forest, it is not as negatively affected by habitat disturbance as are those that occupy mature forests such as hornbills. Scrubfowls were observed 27 times. Density was 6.154 animals per km^2 for a total island population of 32.8 animals.

3.5.3 Reptiles

Reptile population estimates require special methods for which there was not adequate time to employ. There is probably a limited diversity of reptiles due to the island's small size. We observed the common skink (*Mabuia multifasciata*), blue-tailed skink (*Emoia cyanura*), monitor lizard (*Varanus salvator*) and reticulated python (*Python reticulatus*). In addition, several villagers reported seeing the common land tortoise (probably the Malaysian box turtle, *Cuora ambioensis*) that is often found along human settlements.

3.6 Community Forest Resource Use

Village surveys were comprised of interviews in the local language (*Bahasa Manado*) with household members at four dusun on the island. The first household within a village was randomly selected and asked a standard set of questions followed by the same procedure three houses away. Sample questions are provided in Appendix 5. Sampling continued until the sample size represented approximately 10-15 percent of the total number of households in the dusun.

Sixty-three households were sampled at dusuns Talise, Tambun, Airbanua and Wawunian. There were no statistically significant differences between dusuns and: their use of forest resources (for use of five species, r^2 = .069, .14, .073, .05, .113, $p > .05$) (Chi-square = .949, df = 3, $p > .05$); and/or income derived from forest products (for selling of five species collected in the forest (r^2 = .217, .184, .149, .11, .114, $p > .05$). In other words, all dusuns were fairly uniform with regard to livelihood and their use of forest resources.

Table 4 shows the ranking of income sources. The highest income source category is "Other" which includes pensions and remittances, accounting for 41.3 percent of first rank. With regard to forest resource use, the income source categories of farming, carpentry/lumber and hunting have the most significant bearing. These are occupations which depend directly (hunting and carpentry/lumber) or indirectly (farming) on forest resources. The second-highest source of income is through farming, accounting for 28.6 percent of first rank and 44.4 percent of second rank. Carpentry is a low first rank occupation (7.9 percent) but a relatively high (22.2 percent) second rank occupation. Finally, although hunting registers as a minor occupation in all ranks (1.6 percent in second and third ranks), a single hunter who relies on hunting as income can have significant effects on wildlife populations, particular on small islands with diminishing wildlife populations.

Table 4. Ranking of income sources

Ranking$_a$	Fishing	Pearl Farming	Farming	Store	Hunting	Carpentry & Lumber	Other
0	44	53	3	54	61	39	20
1	8	6	18	0	0	5	26
2	6	2	28	2	1	14	14
3	4	1	12	4	1	4	3
4	1	1	2	3	0	1	0

$_a$ 0 = not an income source; level of financial dependence decreases with increasing rank (i.e., 1= highest dependence, 2= second highest dependence, etc.)

Due to limited land, people have gardens inside forests. More than half (55 percent) of the households posses gardens inside forests and a considerable number of people (41 percent) have gardens at the edge of forests.

Table 5 shows the results on tree species harvesting. All households harvest forest products. We asked respondents to list five plant species they harvest most frequently, and describe which part of the plant they use. As shown by Table 5, most people use no more than three species of trees. The most commonly (30.1 percent) harvested species is lingua (*Ptercarpus indicus*). Lingua is often used for building houses and furniture. It is a large buttressed tree with yellow flowers and full-domed crown. It is a preferred species because of its pale, moderately hard and heavy wood that is easy to work. The woka palm (*Livistona rotundifolia*), and matoa (*Pometia pinnata*) are, respectively, the second (18.8 percent) and third (9.4 percent) most frequently harvested species.

Analysis was conducted to determine whether the frequency of species use affected its relative frequency in vegetation plots. Pearson's one-tailed test showed a low correlation between the frequency of species use and frequency in vegetation plots (r^2 = .078, p > .05). Neither linear regression (r^2 = 0.001, F = 0.02, df = 107, p > .025) nor curvilinear regression showed significance (r^2 = 0.013, F = 0.46, df = 105, p > .025). Therefore, there appears to be no relationship between use levels and relative abundance in species. However, the lack of statistically significant relationships were due to: 1) the high numbers of species that are not used by local people, and therefore, are in high abundance; and, 2) a number of species used by local people, but not found in plots.

Table 5. Forest tree use by communities

Part of Tree	Species 1	Species 2	Species 3	Species 4	Species 5	Total Frequency
No Use	1	5	15	34	44	99
Bark	0	1	0	0	0	1 (0.32 percent)
Root	0	0	0	0	0	0 (0 percent)
Body	57	46	32	25	16	176 (55.9 percent)
Leaves	5	11	15	3	2	36 (11.43 percent)
Fruit	0	0	1	0	1	2 (0.63 percent)
Others	0	0	0	1	0	1 (0.32 percent)
Total of Usage $_a$	63	59	49	30	20	315 (100 percent)

Total$_a$ does not include No Use

The most frequently harvested part of the tree is the body, which is used for lumber (55.9 percent), followed by collection of leaves (11. 43 percent). Most people cut down trees for lumber using either a *parang* (54.7 percent) or a chainsaw (43.5 percent). The use of chainsaws is particularly harmful to the forest. Although there is a limited number of chainsaws on the island (e.g., three at Airbanua), they are rented out. This sets up economic incentives for both the owner and the renter of the chainsaw. The owner tries to obtain maximum profit by renting out the chainsaw as many days as possible, and the renter tries to cut as many trees within the rental period. Because harvesters are able to fell and process the tree much quicker with a chainsaw, the forest loss rate accelerates with increasing use of chainsaws.

Crop damage is a source of conflict between humans and wildlife. Fifty-five people out of 64 (85.9 percent) reported having crops damaged by animals. As a result, many (37.5 percent) use snares and traps to deter crop damage. *Singkong* (cassava) is a crop that is favoured by animals. Unfortunately, singkong is also the most common crop that is found on Talise. Despite problems with crop damage, most people feel that their livelihood is satisfactory. Nearly all (93.8 percent) felt that their gardens provide them with enough food and money.

Respondents were asked to report on whether they catch animals from the forest. Forty (63.5 percent) respondents reported that they do not catch wildlife, and nine (14.3 percent) reported that they catch wildlife. Of the five of the nine people that catch wildlife, wild meats make up between 25-50 percent of their total meat intake (Figure 9). Furthermore, four people regularly sell wild meat, particularly of monkeys and rusa, to others.

The level of hunting does not appear to reflect protein deficiencies. Most people appear to be satisfied with their meat consumption: 79.9 percent of the respondents feel that they obtain enough meat.

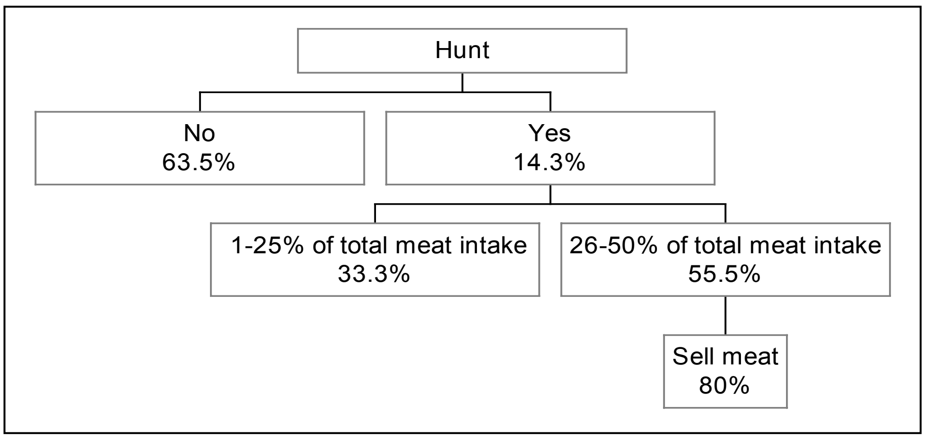

Figure 9. Hunting activities by local community members

We also asked respondents if they have seen less wildlife on the island in the last five years. Fifty-six (87.5 percent) respondents felt there was less wildlife on the island, with most (71.9 percent) feeling that hunting was the primary reason why animal populations have been diminishing (Table 6).

3.7 Community Meetings

Table 6. Reasons why animal populations are diminishing.

Reason	Percentage
Too much hunting	71.9
Forest is getting smaller	4.7
God's will	4.7
Diseases	6.3
Drought	0
Don't know	6.3

A group from the project including the authors, a technical assistant, an extension officer and two Talise assistants, gave presentations on the preliminary findings to the dusuns on Talise. These findings were complemented by a presentation by the technical assistant on the importance of forest and wildlife protection to North Sulawesi. The meeting ended with a discussion on resource issues.

The most critical issues raised by community members were[6]:

- *Land Tenure*. Since most people of Talise do not own their own land, few people felt secure about creating long-term plans.
- *Legal Procedures for Forest Protection and Use.* Most people were not aware of the administrative procedures or legal basis for actively protecting forest resources, and therefore expressed concern over whether establishing a village-initiated decree would be effective.
- *Consensus between Dusuns.* Although there are exchanges between the five dusuns that make up the villages of Talise and Airbanua, the dusuns have different sets of priorities and levels of awareness. For example, whereas the community of Airbanua feels strongly against any form of tourism, the community of Tambun would like to initiate plans for tourism. Talise appears to have a higher awareness of resources issues as compared to Airbanua. The people at meetings expressed the need for assistance in reconciling these differences.
- *Government Involvement in Relation to Future Projects.* Given the inevitable changes in government personnel and policies, particularly in light of the upcoming 1999 elections, people expressed concerns over whether: 1) plans for natural resource management will be affected by these changes; and, 2) the government will decide to impose their agenda onto community plans.

[6] A more detailed discussion follows in the Discussion and Recommendations section. See meeting reports by Talise Extension Officer and Research Officer for meeting notes.

4.0 DISCUSSION AND RECOMMENDATIONS

4.1 State of the Forest

As of 1999, total forest cover for Talise is 25.7 percent of the total land area. This figure represents a higher percentage than most other small islands (e.g., Manado Tua) along the North Sulawesi coast. However, an analysis of a 1994 LANDSAT-5 TM image of the forest cover, the present figure represents a dramatic decline from previous years. Forest cover decreased from 958.8 ha in 1994 to 533.3 ha in 1999, which represents a loss of 43 percent in 4.5 years.

Based on a simple linear projection (at 7.88 ha lost per month), Talise is expected to have 15.5 percent forest cover (323 ha) forest cover by the year 2000, and no forest cover by the mid-2004 if current forest conversion continues (Figure 10). However, there are a number of reasons why linear projections don't often accurately reflect future trends. On one hand, because areas at forest edges become increasingly larger in relation to the overall size of the forest, and people's access to the forest becomes easier, the rate of forest loss is likely to be greater than predicted by linear projections. In addition, a closer link to the mainland economy and population growth will also contribute to an accelerated loss. On the other hand, there is a realization on the part of the island community that the severe forest loss and related ecological problems may trigger a series of efforts to curb heavy forest resource use.

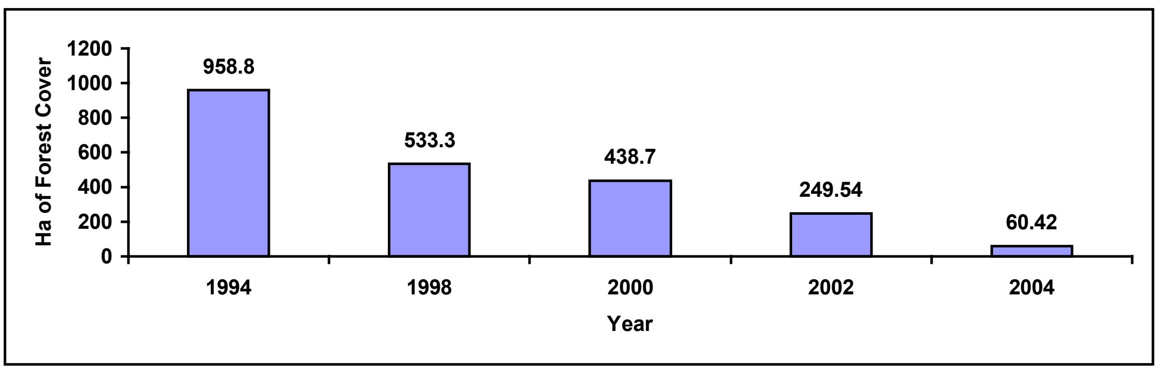

Figure 10. Linear projection of forest loss on Talise

The structure of the forest indicates heavy disturbance. The population of trees over 10 cm DBH was heavily skewed toward smaller tree sizes. This is most likely due to continued intensive harvesting. Furthermore, the use of certain tree species for domestic use has led to the scarcity of certain species. For example, the lingua tree (*Ptercarpus indicus*) is heavily used for building houses and furniture. Even though *Ptercarpus* is known to be a fast-growing species, sometimes as much as 10 cm in girth a year, the heavy demand for it makes current use unsustainable. The woka palm (*Livistona rotundifolia*) is also heavily used. Its leaves are used for roof thatching, and packaging food.

4.2 Status of Wildlife Populations

The current estimate of macaques is far below densities found in other North Sulawesi forests. Four permanent groups are already at a risk of extirpation. Bear cuscus, deer and tarictic hornbill populations face a similar situation.

Small, isolated populations experience genetic drift and inbreeding resulting in decreased genetic variability which, ultimately, limits the extent to which the population can adapt to changing environmental conditions. Diamond (1972) predicted extinction rates based on quantifiable environmental parameters, with habitat size being the central variable. Specifically, when a habitat ranges from 1 to 25 km^2, the rate of bird extinction in the first 100 years is 10 to 50 percent, and a dramatic extinction rate occurs once the habitat falls below 1 km^2. The small forest of Talise, coupled with the fact nearby areas (e.g., Likupang) are denuded of forests, restricts most Talise bird species to a small patch of habitat. Even when area size is not considered, small populations face a greater risk of extinction than large populations because of random variation in genetic and demographic events.

Even disturbance-tolerant species have particular habitat needs. For example, although the deer actually benefit from field burnings—making available shoots and charcoal representing essential minerals—they also use the bush thickets and forest for cover at night. Tarsiers, which thrive in areas with high insect abundance, do well in disturbed areas. However, tarsiers often use mature strangling fig trees because they contain holes and crevices that are ideal for nesting. Therefore, there must be enough fig trees for tarsiers. At TBD where strangling fig trees are abundant, tarsier density reached as high as 82 individuals per km^2 (Kinnaird and O'Brien, 1995_b), which equates to roughly 30 mating pairs. The lack of strangling fig trees on Talise is probably a limiting factor to high tarsier abundance.

4.3 Hunting

The current hunting level on Talise is not clear because most hunting is reported to be carried out by outsiders who were unavailable for interviews.

Only two respondents reported that they hunt actively. All others stated that hunting is done by outsiders. However, there are several contra-indications. First, traps were observed that contradicted these statements (i.e., traps that need to be maintained on a regular basis). Second, local hunters were encountered. Third, based on household interviews, a significant percentage of people reported that they obtain animals from the forest and, of those that catch animals, also sell animals. Therefore, the hunting level is probably higher than reported from household interviews.

Strictly based on the reproductive biology and current island density of the black macaque and bear cuscus, one can arrive at an estimate of allowable harvests (Table 7). Robinson and Redford's (1994) model of sustainable hunting of tropical animals was used for the projection. The model evaluates whether an actual harvest might be sustainable under maximum production (P_{max}) by using the formula, $P_{max} = (D \times P_{max})$, which is then converted to total allowable harvest for the entire area. Results show that only 3.34 macaques per year can be hunted. For bear cuscus, only 1.04 animals per year can be harvested. Given such low quotas, it is not feasible to consider a sustainable hunting program. Rather, it would be most productive to put on a hunting ban for community members as well as outsiders.

Sustainable hunting is defined as *harvesting a species in a way that hunting mortality plus natural mortality does not exceed natural production for the species.* Species that are in balance with their environment frequently produce more offspring than is necessary to maintain a stable population. These offspring must either move to new areas or die. If the natural production exceeds natural mortality, the surplus production may be harvested without damaging the population.

Sustainable hunting programs take advantage of this surplus production. However, when harvests become excessive, the population can no longer produce enough offspring to replace individuals that die of hunting and other causes. The population then begins a decline that makes it vulnerable to local extinction through continued hunting or other indirect causes such as habitat loss and disturbance. These effects are particularly acute on islands.

Biological features of the animal population are important to the consideration of sustainable hunting. Because the crested black macaque and bear cuscus have low reproductive rates and their young take a long time to mature, even moderate hunting pressure may result in population declines.

Table 7. Sustainable hunting estimates on Talise for select species

Species	Density	r_{max}	P_{max}	Potential Harvest Per km^2 Per Year	Total Allowable Animal Harvest Per Year
Bear cuscus	1.67	0.293	0.489	0.196	1.044
Macaque	21.57	0.145	3.128	0.626	3.337

Agricultural pest activities by wildlife jeopardize both the survival of wildlife populations and income of farmers. Crops are damaged and, consequently, farmers use snares to prevent further damage. While animals are creating economic problems for farmers, farmers must also realize that the location of their gardens invites crop damage. Nearly all (96 percent) gardens are located either in or near the forest. It is unlikely that an animal will avoid eating such available foods. The solution lies in relocating the gardens to lower elevations and using agricultural methods that are more productive. This would increase agricultural production and at the same time prevent further wildlife decline.

4.4 Land Tenure and Community Stake

In recent years, there has been an increasing acceptance of policies that promote handing over forest management to local communities and offering opportunities for economic enterprises that attempt to offset intense resource use (also known as Integrated Conservation and Development Program, or ICDP). This is based on the idea that if local communities are given the authority to use and manage forests, they will have more of an incentive to protect and sustainably use them. Land tenure is one of the most important factors that determine the success of ICPD, in that people are likely to invest effort into sustainably using lands and resources that they own.

Most of the people on Talise do not own their land. Last year, Talise village began the paperwork to obtain ownership to their farmlands. However, the paperwork is still being processed as of publication of this report. In addition, the forest (504 ha) is owned by the *Kantor Wilaya* (*KANWIL*) *Kehutanan* as a production forest (*Hutan Produksi*). Furthermore, it does not appear that KANWIL has recently or will use the forest in the near future.

Because the forest on Talise is not protected and is not being actively managed, it would make sense for the community to try to manage it. If the current effort to gain ownership of private land is successful, the people would be more encouraged to lease the land from KANWIL. Then, if they are able to successful lease the land, they would be able to make a concerted effort to manage it.

A legal consultant should be contracted to investigate the feasibility of leasing the forest land from KANWIL. The legal consultant should also investigate the proper protocol for establishing decrees at the different levels of the government. For example, if the community wishes to establish a hunting and tree harvesting ban, the consultant should outline the administrative procedures at the village, district, and regency level. Following this, the consultant should also specify the laws, jurisdiction, etc. for administering and enforcing the decrees.

Though the concept of ICDP is appealing, a recent comprehensive study by the World Bank (1998) showed that most ICDPs face fundamental problems. The reasons are:

- Regardless of financial success gained through ICDP, with resources available to all and the possibility of increasing their personal income, some people are taking more than was agreed upon.
- When there are restrictions put on a community, the quality of life changes. As a result, people soon have negative attitudes about the program.
- Sustainable resource use has different meanings and impacts for different people. For example, people who depend less on the forest (e.g., fishermen) may support the program, while people who rely more on the forest (e.g., carpenters) may begin to suffer economically. The differences between those that suffer from ICDPs and those that don't create a conflict within the community.
- If the ICDP does not show immediate economic benefits, the community may feel that it does not help them.
- Sustainable development does not necessarily contribute to biodiversity conservation.
- Local management without careful technical planning leads to failures.

Given these findings, ownership and management of lands by the Talise community, in and of itself, should not be the end goal. Rather, it should be viewed as an important but small step toward sound natural resource management. Ultimate success should be evaluated by whether the local ecology deteriorates further from land use practices. The most important goal should be to develop a management plan under which the use of natural resources is sustainable and ecosystems are protected. Regardless of whether the forest is owned by KANWIL or the community, the consequences of poor land use practices still fall on the community.

One method to resolve the dilemma of using forest resources on government land is to hand over management decisions to communities while the government retains the ownership of the land. This method is being used in Nepal (see Melnyk, USAID Report, 1999). The key element in this method is to form forest user groups (FUG) within or across villages. Principal forest users are chosen to form these groups thereby eliminating the conflict between those who have differing use levels. FUGs, then, act as village representatives. They have rules of membership and operational plans, and work with the government and NGOs to implement these plans. Forming small representative groups may expedite the village consensus process and increase local awareness of management plans and decisions.

4.5 Sustainability of Land Use Practices

Findings from this study show that nearly every household uses forest resources. Further compounding the problem of unsustainable forest resource use is the harvesting of trees for commercial purposes. Although the commercial use of trees is limited, because large trees are scarce, even limited harvesting for commercial purposes seriously threatens the integrity of the forest ecosystem and ecological health of the island.

At present, the use of forest resource use on Talise is not sustainable. Village surveys conducted at the four Talise dusuns, as well as ecological assessments, indicate that current harvesting practices are seriously compromising the integrity of the forest system. In addition to harvesting of trees by local community members, people from outside Talise (e.g., people from Likupang and Manado) either directly use the resources for personal purposes (e.g., animal hunting), or contract out for labourers to harvest resources (e.g., lumber).

However, it is not a foregone conclusion that the forest of Talise will disappear in the near future. This is an important point because whether or not resource use is sustainable depends very much on how the community will use the resources in the future, and what outcomes they expect from increased forest protection. Several options have been raised by both community members and Proyek Pesisir including: 1) full protection of the forest for watershed management; 2) protection of the forest for ecotourism; and, 3) planting and selective harvesting of several tree species for souvenir production. Obviously, these options would all contribute to the maintenance and integrity of the forest system.

If the communities of Talise are expected to derive basic ecological benefits from the forest, it is imperative to maintain and perhaps plant several important tree species. For example, tree species such as *kananga* (*Cananga odorata*), *leu* (*Dracontomelum magniferum*), and *beringin* (*Ficus* spp.) are essential to the survival of macaques and frugivorous birds. In turn, because frugivorous animal species act are effective in dispersing the seeds of these fruit species, the maintenance of viable populations of frugivorous animal species ensures the maintenance of fruit tree species.

However, the community and other stakeholders must realistically assess what these protective measures would mean to the lifestyles of community members. First, forest protection means decreasing forest resource use. For example, in order to sustainably harvest trees for lumber, the community would need to devise and carefully manage a harvest scheme under which members would be allowed to harvest on a rotation basis. Harvesting by outsiders must be completely banned. Furthermore, the community would have to monitor whether members are following the agreed harvest regime. Also, all dusuns on the island, as well as Kinabuhutan, must agree to a decree that would forbid harvesting outside of the agreed-upon terms. Although natural resource management is a process of continuous fine-tuning, whatever the plan, the community must agree to stay committed to it by adhering to the set of agreements.

In terms of the actual planning of a reforestation program, many of the details depend on the level of involvement from the community. First, since the forest is relatively immature, it will take approximately five to 10 years before enough production-size trees are available for harvesting. Therefore, a tree harvesting ban for at least five years would allow the forest to mature[7]. At the same time, the community, with assistance from technical agencies, should start replanting several key species. Lingua (*Ptercarpus*) is a good choice because this species: 1) is the most desired species on Talise; 2) is fast growing and provides shade to other shade-tolerant species; and 3) has shown it can thrive in replanting programs (e.g., Singapore). In addition, the above-mentioned forest fruit trees should be replanted for the maintenance of wildlife populations.

Limited harvesting of woka palm leaves should be allowed. A study by O' Brien and Kinnaird (1995_b) showed that harvesting of two to three leaves per tree per year is sustainable. Lightly harvested trees closely resemble the growth patterns of non-harvested trees. The leaf harvesting should be closely monitored.

4.6 Alternative Agricultural Practices

The current system of agriculture on Talise depends to a large degree on the use of fire. Ash is then used as a source mineral for the next crop. However, continued use of this practice will result in a number of ecological problems and reduced agricultural production. A number of alternative agricultural methods have been devised to reduce these ecological problems in other areas. Sloping agriculture and terracing are two such methods (NRMP Report No. 49). The steepness of Talise island lends itself to these methods. In addition, alley cropping, barrier hedges, inter-cropping and/or live fences should be considered. A consultant with an agronomy background should be contracted to establish pilot plots.

4.7 Tourism

Tourism in developing countries has been seen as a way to develop economically while using natural areas in a non-consumptive manner. Therefore, tourism, as part of an integrated model that considers economic, sociocultural and conservation factors, can be a useful tool for fulfilling the objectives set out by Proyek Pesisir.

There has been an upsurge of tourism in North Sulawesi in recent years. The rash of hotels, dive operations and restaurants is an indication of the demand for tourist dollars. In seeing the financial gains from tourism throughout North Sulawesi, Talise community members have expressed interest in initiating ecotourism activities. The scenic beauty of the marine and terrestrial landscape at Talise certainly is a basis for considering ecotourism potential.

[7] Limited and closely monitored harvesting of fallen trees should be allowed.

However, a number of issues must be considered before engaging in such an endeavour. While tourism can provide many benefits, tourism can also bring with it a host of problems—economic inequity and hostilities between members of the community, cultural conflicts between tourists and local people, and ecological disturbance—often unforeseen by local communities. The principal problem of tourism, particularly as operated at the local level, stems from the desire to obtain quick profits. Consequently, individualism often overshadows the greater community good.

Tangkoko Nature Reserve is a good example of the pitfalls of tourism. At present, PHPA has jurisdiction over any activity inside Tangkoko. Consequently, the *Kepala Resor* and the forest guards monopolize the guiding of tourists. Over the years, the guards have amassed such wealth from tourism that all the *losmen*s (small housing units for rent) at the nearby village are owned by forest guards. This has created situation in which there is a clear split between the economic have and have-nots. The local community has become resentful not only of the guards, but also of the fact that the protected status of the reserve allows others to benefit financially while they do not.

The ecology of Tangkoko has also suffered from tourism. Wild monkeys that normally used to rely on forest fruits have now become pests, wandering into villages and occasionally biting and frightening humans due to being exposed to artificial feeding by forest guards. Guides also arouse animals by chasing and disturbing them so that tourists can get a better look at the animals. Scarce water and forest resources are collected to serve tourists. Human traffic in the forest has led to soil compaction and destruction of tree seedlings and saplings.

Given these potential problems, the Talise community should clearly define their needs and expectations from tourism. Do they expect to depend on tourism as the principal source of income? Are they willing to make the necessary infrastructure changes (e.g. roads, docks, etc.)? The local people must realize that foreigners have a set of expectations and cultural values that may not always be compatible with their customs and tastes. Some examples of possible problems and considerations are:

- The level of noise from communal speakers and music from stereos will disturb most tourists. Are people willing to restrict hours of village announcements, and turn down their stereos to accommodate tourists?
- Most tourists will expect indoor toilets. Are people who maintain losmens willing to spend the extra money to build indoor toilets?
- Most tourists expect some level of privacy. Is the community willing to restrict or avoid their daily activities so that a tourist can enjoy his privacy?
- Most tourists will not speak Indonesian, and therefore will depend on people who have English skills. Are people willing to learn English to accommodate tourists?
- Some tourists who do not understand the local dress code or customs may offend local community members. Are people willing to ignore offensive dress and behavior by tourists?
- Tourists who come to enjoy nature hikes will be critical of degraded forests, gardens in the middle of the forest and noise from forest activities (e.g., tree cutting with chainsaws). Are people willing to replace gardens in the forest with forest tree species and refrain from their forest activities to accommodate tourists?

- Tourists expect, at the very least, information concerning the place they are visiting. Are people willing to spend the time, energy and money to produce informational materials (e.g., brochures, and leaflets) to distribute to tourists?
- Guides must: 1) ensure that tourism doesn't disturb the local ecology; and, 2) provide the best possible information about the local ecology. Are potential guides willing to spend the time and energy to learn about forest ecology and wildlife, and follow strict guidelines for responsible guiding?
- The market for tourism on Talise will be relatively small. What are the financial expectations, and how will the community determine who will participate?

Clearly, responsible tourism requires a great deal of work, it may not always be successful, and, more importantly, may not serve the community's best long-term interest. These are difficult questions and issues that must be considered before deciding to engage in tourism. Most importantly, communities on Talise must discuss and keep in mind possible repercussions on the ecology and the social fabric of the island that tourism will have. If tourism is to take place, all concerned parties should work to ensure that it develops in a manner that will not subvert the needs of the local communities and ecology.

If the community still wishes to pursue tourism even after considering the above potential problems, Proyek Pesisir should assist in the planning, implementation and monitoring. This may entail assisting in marketing (e.g., designing a web page and brochures); facilitating meetings between the community and tour operators, and the government tourism office; advising the community about setting up accommodations and pricing; helping design an information billboard; facilitating English classes for potential guides; and monitoring the impact of tourism on the local ecology (e.g., water usage, waste management, soil impacts).

4.8 Monitoring

Trends of forest conversion seen in recent years will certainly deplete the plants and animals on Talise. This is why monitoring will become increasingly important for future resource management. Appropriate decisions to avert negative trends can be made based on sound monitoring data.

The following monitoring components are recommended.

- *Monitoring of the Forest*. Annual censuses of key animal populations (e.g., macaque, bear cuscus, deer, bat, tarictic hornbill) should be undertaken. Vegetation plots from the study should be monitored. Because trees in plots have been measured, identified and tagged, monitoring of the tree harvest should be relatively easy. A forest ecologist with statistics skills, preferably Indonesian, who can plan and carry out data collection should supervise the monitoring program.

- *Monitoring of Shorebirds*. Shorebirds feed mostly on small fishes, crabs, prawns, bivalves, fish larvae and worms along beaches, mangroves and mudflats. They are good indicators for assessing the impact of land use practices on coastal resources. Since physical composition of the sediment influences the density and availability of these prey, monitoring the diversity and population trends in shorebird populations can indicate whether land use practices are having adverse effects on coastal resources. An ornithologist who has a good background in coastal bird monitoring should supervise the monitoring program.

- *Monitoring of Soil and Water Quality*. Soil quality and water quality go hand-in-hand. Soil erosion leads to sedimentation of waterways, necessitates treatment of water, leads to the need for flood controls, results in reduction of aquatic life, and impedes proper nourishment of plants. Soil texture, moisture retention, chemistry, litter-soil density and chemical composition—both in the forest and agricultural plots, with particular attention to sediment run-off and leaching—should be monitored. An environmental engineer with natural resource management knowledge should tailor a program that meets the needs of forest management with infrastructure needs (i.e., public water system, alternative agricultural system).

- *Monitoring of Reefs*. The surrounding coral reefs should be monitored to understand whether current land use practices are negatively affecting the marine ecosystem. Such a monitoring program would fit well with current mapping and marine survey work being carried out by Proyek Pesisir

Monitoring objectives are defined by the level of logistical support, compatibility of monitoring with other survey work, compatibility of monitoring with community needs, and working relationships between different parties. One of the major problems in carrying out long-term monitoring has been the lack of financial support stemming from the fact that most monitoring efforts are directed at collecting general baseline data. Wolfe (*et al*. 1987) emphasized the need for directed questions or hypothesis-testing framework in monitoring programs. In other words, broad objectives are acceptable as long as the objectives are translated into usable methodologies and practical questions. For example, if the major objective is to understand the impact of forest use practices on soil quality, monitoring regimes must include long-term testing of soil in concert with village surveys on forest use and ecological assessments. Before monitoring begins, the allowable limits of soil quality decline and management solutions must be predetermined. Once monitoring shows the level of soil quality reaching the set limit, management solutions can be put in place. Therefore, the questions to be investigated will shape the direction of the monitoring program (Figure 11).

Proyek Pesisir and community should recognize that monitoring is a dynamic process, and that there may be infinite changes in priorities. For example, if the community decides at a later time that an agroforest is preferable to a natural forest, then monitoring regimes must reflect these changes. In addition, shifting priorities may be sources of conflict between different monitoring programs and projects. For example, a decision to introduce a study to examine the effect of agriculture on insects will have to be modified accordingly[8]. Finally, Proyek Pesisir should develop an active inventory of regional scientific works for the purpose of cross-linking databases that eventually will be useful for comparative analysis and making available information for communities interested in initiating similar programs.

[8] For more detailed information on biological and natural resource use monitoring see Margoluis and Salafsky (1998).

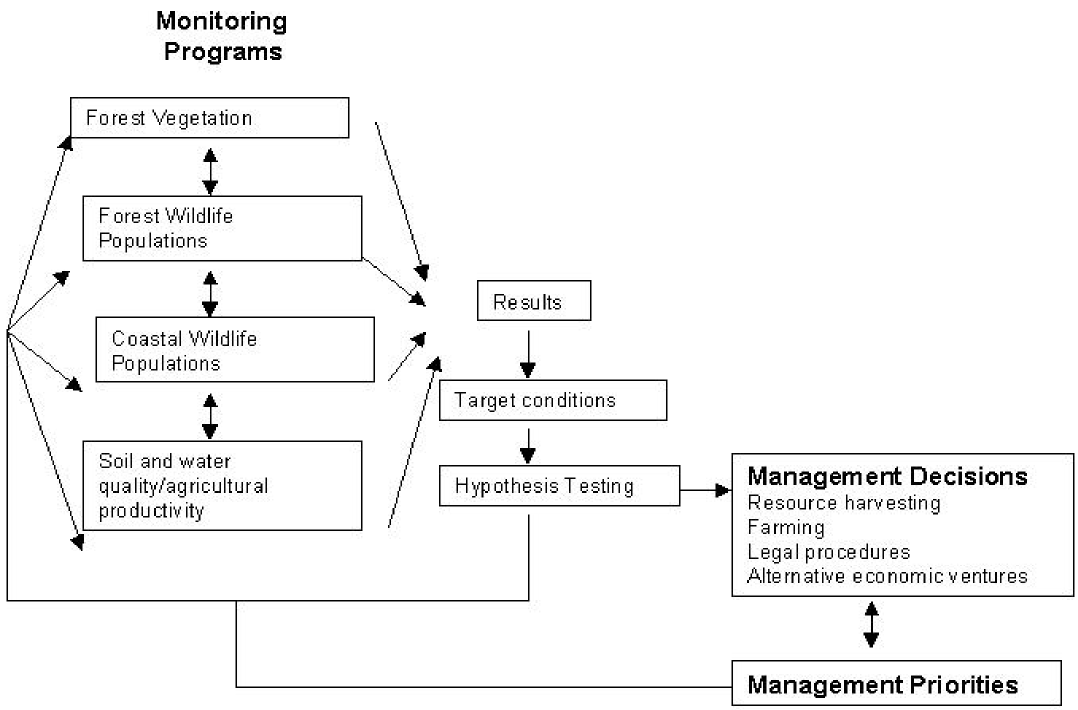

Figure 13. Flow chart on the relationship between monitoring and program.

Figure 11. Flow chart of the relationship between monitoring and program

The structure and format of monitoring is paramount. Because monitoring has been planned for the long term, there needs to be a cohesive structure of the program and standardization in the collection and dissemination of information to ensure that there is a consistent flow of information that will be understandable to the Proyek Pesisir staff and community. Therefore, monitoring objectives, regimens and how the results will affect further monitoring activities must be clearly stated at the outset.

It is also critical that future monitoring operations involve local community members. Involvement of community members for day-to-day operations as well as planning exemplifies the principle underlying the goals of Proyek Pesisir—that community involvement in all phases of programs will strengthen community resolve to manage their natural resources in a sustainable manner. In particular, those involved in monitoring operations will be able to reconcile the goals and the process for achieving those goals with the cultural values and experiences of residents. Table 8 outlines the basic skills needed by local technicians for monitoring.

Finally, for rapid analysis and future reference, all data should be entered into a computer spreadsheet (e.g., Excel, Dbase) whose format is compatible with statistical packages (e.g. SYSTAT, SAS, SPSS). This will help in the standardization of facilitating operational procedures in collecting and aggregating data, and disseminating information to other workers interested in Proyek Pesisir's data.

Table 8. Skills required by local technicians for monitoring forests and wildlife

Task	Basic Skills Needed
Map Use	Compass bearings and navigation, navigation with GPS, reading and producing maps.
Making Field Observations	General site description based on habitat characteristics, gross floristic inventory, identifying physical features based on maps.
Vegetation Analysis	Developing knowledge of classification system, sampling and identification methods, and discerning habitat quality - animal species relationship.
Animal observations	Identify animal species, distance, consistent data collection, identifying age and sex classes of animals, looking for certain behavioral clues to understand activity patterns, population parameters, diet, and social organization, using binoculars to accurately judge distance of animals from trails.
Note taking and data reporting	Reporting of field data in a systematic manner.

4.9 Study Tours

Study tours often involve taking a group of people to sites where innovative methods have proven to be successful. As a result, people are given the choice between remaining engaged in current activities, or initiating a new venture that may be positive, but may also be expensive, time consuming, and risky. As such, people are not able to observe the consequences of what would happen if they do not change their current practices. Given the two choices, people may not always feel the need to change.

The community of Talise should be presented with two views. Study tours should, of course, show the people of Talise alternatives to current agricultural and forest resource use practices. At the same time, they should be presented with possible scenarios that they may face if they don't change their current practices. One of the most successful study tours that the Wildlife Conservation Society conducted involved taking a group of Papua New Guinea villagers to a nearby village to show how over-harvesting of forest resources and slash and burn agriculture can result in massive landslides and decline in agricultural production (A. Johnson, pers. comm.). This study tour galvanised an effort by the community to look for alternative agricultural and forest resource use methods. An example of communities facing ecological problems from unsustainable Land use practices is on Manado Tua.

Talise staff assistants who worked on the project, as well as those interested in seeing first-hand an ecotourism and research operations, should visit Tangkoko Nature Reserve. They should note the state of a protected and consequently mature forest and its the abundance of wildlife, the level of technical knowledge of the research assistants there, and the benefits and drawbacks of ecotourism.

4.10 Other Sustainable Income Ventures

The handicraft industry offers a good income alternative to agriculture. Handicrafts have generated modest income for businesses in Manado, Bunaken and Tangkoko. A family on Talise currently produces attractive framed pictures of natural landscapes and wildlife made out of coconut tree bark and bamboo for approximately Rp. Ten to fifteen thousand (US$ 1.50 - 2.00 in August 1999). The bark is cut into shapes and dyed, which is then pasted onto a board with bamboo frames. In contrast to other handicrafts that use hardwood (e.g., teak), because coconut tree bark is a natural and abundant by-product, building a local handicraft industry using coconut bark products would be ecologically sound. In addition, if the market demand were high, it would generate more revenues for the community. Already, the major hotels and some businesses in Manado have bought these pictures, and no other community uses this technique for making handicrafts. As such, these pictures can be marketed as unique, Talise-made products.

An ebony (*Diospyros* sp.) replanting program for handicrafts was suggested by Proyek Pesisir staff and community members. The feasibility of doing this is questionable considering the long wait for ebony trees to mature. In addition, it is a less ecologically sustainable option compared to making pictures from coconut tree bark. Therefore, these trees should be planted, but not for the purpose of using them for the handicraft industry.

4.11 Environmental Education

The community must become aware of natural resource management issues for long-term benefits. Although local residents appear to have a general understanding of Proyek Pesisir's goals, the driving mechanisms behind the problems and solutions—namely, local ecosystems and the role of humans within them, and the interface between land and coastal issues—have not been clearly presented to them. Without an understanding of these mechanisms, community members may misunderstand the role of natural resource management and consequently engage in activities detrimental to the local ecology.

The community meeting was the first step in raising community awareness. Follow-up meetings and materials, preferably with significant community input, should be produced to maintain the residents' interest. Local non-governmental organizations with an environmental background and experience in conducting public meetings such as *Kelola* should be asked to play a role.

5.0 CONCLUSIONS

The land use practices of the Talise community has led to dramatic forest loss in recent years, as evidenced by degraded forests and small wildlife populations. Projections based on the current assessment indicate a complete loss of the forest and wildlife populations in several years. However, a number of possible options offer a more positive outlook, including a village decree to ban hunting and tree harvesting, reforestation, alternative agricultural methods and establishment of a local handicrafts industry. Although the community realizes the potential ecological and economic problems that lie ahead, their desire to actively protect forest resources is obstructed by land tenure and legal issues. Two other factors—low technical awareness of economic alternatives and lack of knowledge about the relationship between coastal and land resource use issues—hamper rapid progress.

The immediate steps for Proyek Pesisir should be to clarify and provide administrative help on land tenure and legal issues; build a consensus between dusuns to establish guidelines and rules (or decrees) on forest resource use; provide educational materials on ecologically sound practices; and provide technical assistance for economic alternatives. The issue of time is key to implementing new solutions. Delays in full protection of the forest and economic alternatives will add to the depth of the problems on Talise.

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APPENDICES

Appendix 1. List of tree species on Talise Island

Family	Genus	Species	Local Name
Actinidiaceae	*Saurauia*	*Tristyla*	K. air gunung
Anacardiaceae	*Buchanania*	*Arborescens*	Mangga kecil
	Dracontomelum	*Dao*	Rao
	Dracontomelum	*Mangiferum*	Leu
	Koordersiodendron	*Pinnatum*	Bugis hutan
Anonaceae	*Cananga*	*Odorata*	Kananga
	Polyalthia	*Glauca*	Salakapu kecil
	Polyalthia	*Lateriflora*	S. daun
	Polyalthia	*Grandifolia*	S. kananga
Apocynaceae	*Alstonia*	*Ranvolfia*	Kayu telur
Araliaceae	*Gastonia*	*Papuana*	Wariu
Bignonacea	*Spathodea*	*Campanulata*	Kayu prao
Bombaceceae	*Bombax*	*Valetonii*	Kapok hutan
Boraginaceae	*Cordia*	*Mysca*	Konkujiang/nouang
Burseraceae	*Canarium*	*Aspermum*	Damar babi
	Canarium	*Hirsutum*	Kanari besar
	Canarium	*Vriesanum*	Karnari sedang
	Garuga	*Floribunda*	Kayu kambing
Capparidaceae	*Crateva*	*Nurlava*	Balontang
	Capparis	*Micracantha*	Kuning keras
Cluciaceae	*Garcinia*	*tetrandra*	Daun halus
	Garcinia	*daedalanthera*	Daun besar
	Garcinia	*celebica*	
	Calophyllum	*soulattri*	
Combretaceae	*Terminalia*	*catappa*	Nusu pantai
	Terminalia	*celebica*	
Datiscaceae	*Tetrameles*	*nudiflora*	Bolangitan
Ebenaceae	*Diospyros*	*celebica*	Kayu hitam asli
	Diospyros	*maritima*	Kanume
	Diospyros	*sp.*	
Euphorbiaceae	*Antidesma*	*celebica*	Buah merah
	Drypetes	*sp.*	Kalawatan
	Macaranga	*mappa*	Binunga daun besar
	Macaranga	*tanarius*	B.d.kecil
	Mallotus	*columnaris*	Tula tula
	Malanolepis	*multiglandulosa*	Kayu kapur
Fabaceae	*Albizia*	*saponaria*	Langehe
	Pongamia	*pinnata*	Langehe
	Ptercarpus	*indicus*	Linggua
Flacourtiaceae	*Pangium*	*edule*	Pangi
Gnetaceae	*Gnetum*	*gnemenoides*	Gnemon

Appendix 1. List of tree species on Talise Island (cont.)

Family	Genus	Species	Local Name
Lauraceae	*Cryptocarya*	*bicolor*	Pemulia
Lechythidaceae	*Planchonia*	*valida*	Ipil
Leeaceae	*Leea*	*indica*	Momaling biasa
	Leea	*rubra*	Momaling daun halus
Meliaceae	*Aglaia*	*macrocarpa*	
	Melia	*azedarach*	
Moraceae	*Artocarpus*	*dadah*	Maumbi
	Artocarpus	*elasticus*	
	Ficus	*caulocarpa*	
	Ficus	*drupacea*	
	Ficus	*garciniaefolia*	
	Ficus	*hispida*	Tine
	Ficus	*magnoleaefolia*	
	Ficus	*pubinervis*	
	Ficus	*septica*	
	Ficus	*variegata*	
	Ficus	*sp.*	
Musaceae	*Musa*	*musa sp.*	Pisang
Myristicacae	*Gymnocranthera*	*paniculata*	Pala jela buka/kecil
	Gymnocranthera	*forbessi*	P.j.b./besar
	Knema	*latericia*	P.j. buah merah
	Horsfieldia	*breachiata*	Hobra
Myrsinaceae	*Ardiasia*	*rumphii*	Burarah
Myrtaceae	*Eugenia*	*accuminatissima*	Tentigona
	Eugenia	*sp.*	
Palmae	*Arenga*	*pinnata*	Areng
	Caryota	*mitis*	Seho yaki/waru
	Livistona	*rotundifolia*	Woka
Piperaceae	*Piper*	*aduncum*	Sirih
Rosaceae	*Prunus*	*arborea*	Tenang
Rubiaceae	*Neonauclea*	*sp.*	Kayu danser
Sapindaceae	*Pometia*	*pinnata*	Matoa
Sapotaceae	*Palaquium*	*obtusifolium*	Nantu
Sterculiaceae	*Kleinhovia*	*hospita*	Bintangar
	Pterocymbium	*javanicum*	Biji helikopter
	Pterocymbium	*diversifolium*	Wolo daun besar
	Pterospermum	*javanium*	
	Sterculia	*insularis*	Momum
	Sterculia	*comosa*	Sirum peniki
Tiliaceae	*Grewia*	*koordisiana*	Kakene
Ulmaceae	*Celtis*	*philipinensis*	
	Trema	*orientalis*	Rupu
Urticacea	*Dendrocnide*	*microstigma*	Sosoro
	Pipturus	*argentus*	Soso

Appendix 1. List of tree species on Talise Island (cont.)

Family	Genus	Species	Local Name
Verbenaceae	*Vitex*	*quinata*	Gopasah gedi
			Ginto / Tali tikus
			Gomu
			Rufu
			Lamtoro
	Bambusa	*sp.*	
			Dendehe
	Sweetenia	*Mahagoni*	Mahoni
			Lema
			ManggaKuini
			Langsa
			Rambutan
			Tega
			Moa
			Kayu Besi
			Ropit
			Daihango
			Limpega
			Lolang
	Tectona	*grandis*	Jati (*Tectona grandis)*
			Bayur
			Katu

Appendix 2. List of birds observed at Talise Island

Species Number[a]	Species
16	*Fregata minor*
24	*Sula sula*
25	*Sula leucogaster*
31	*Egretta alba*
32	*Egretta picata*
38	*Bubulcus ibis*
42	*Nycticorax-nycticorax*
45	*Ixobrychus sinensis*
54	*Pandion haliatus*
62	*Haliastur Indus*
63	*Haliaeetus leucogaster*
64	*Haliastur indus*
67	*Spilornis rufipectus*
75	*Accipiter gularis*
82	*Butastur indicus*
83	*Ictinaetus malayensis*
84	*Aquila gurneyi*
86	*Hieraaetus kienerii*
108	*Megapodius cumingii*
164	*Limosa-limosa*
168	*Tringa nebularia*
171	*Xenus cinereus*
172	*Actitis hypoleucos*
183	*Calidris alba*
192	*Stiltia isabella*
202	*Sterna hirundo*
204	*Sterna sumatrana*
219	*Streptopelia chinensis*
229	*Chalcophaps stephani*
236	*Treron vernans*
238	*Treron griseicaudia*
238	*Lonchura molucca*
246	*Ptilinopus subgularis*
250	*Coracina temminckii*
256	*Ptilinopus melanospila*
257	*Ducula forsteni*
258	*Ducula radiata*
259	*Ducula aenea*
259	*Oriolus chinensis*
259	*Ducula aenea*
261	*Ducula concinna*
268	*Ducula bicolor*
269	*Ducula luctuosa*

Appendix 2. List of birds observed at Talise Island (cont.)

Species Number[a]	Species
306	*Loriculus stigmatus*
330	*Eudynamis melanoryncha*
330	*Hypothymis azurea*
330	*Eumyias panayensis*
331	*Eudynamys scolopacea*
338	*Centropus bengalensis*
346	*Otus manadensis*
367	*Collocalia infuscata*
368	*Collocalia esculenta*
376	*Hemiprocne mystacea*
390	*Halcyon chloris*
393	*Halcyon sancta*
401	*Alcedo meninting*
409	*Penelopides exarhatus*
415	*Mullerpicus fulvus*
415	*Spilornis rufipectus*
422	*Hirundo rustica*
423	*Hirundo tahitica*
437	*Coracina temminckii*
438	*Coracina bicolor*
439	*Coracina leucopgia*
447	*Coracina morio*
464	*Dicrurus hottentottus*
471	*Oriolus chinensis*
475	*Hifotingis asurea*
475	*Ptilinopus melanospila*
475	*Corvus enca*
507	*Gerygone sulphurea*
553	*Hypothymis azurea*
581	*Culcicapa helianthea*
596	*Artamus monachus*
603	*Aplonis minor*
604	*Aplonis panaiencis*
636	*Treron vernans*
642	*Nectarinia aspasia*
643	*Nectarinia jugularis*
650	*Ptilinopus melanospila*
658	*Dicaeum celebicum*
689	*Lonchura molucca*

[a] Number of species corresponds to numbers in Coates *et al*. (1997).