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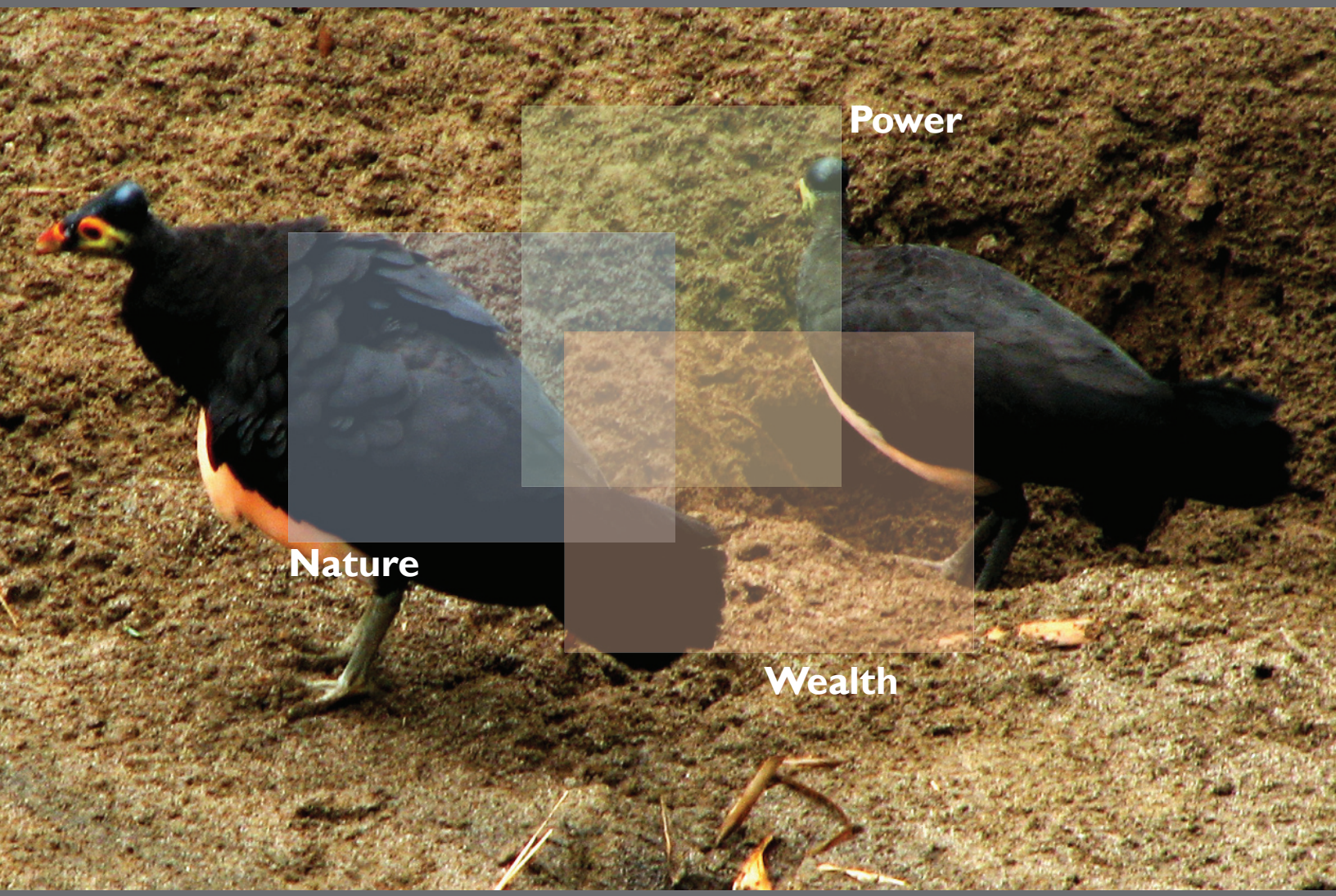

Case Study:

Conservation of Sulawesi's Endangered Mascot – the Maleo – through Conservation Incentive Agreements

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Report prepared for WCS TransLinks Program

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Cover photo: © Iwan Hunowu

Abbreviations

BNWBNP	Bogani Nani Wartabone National Park
PALS	*Yayasan Pelestarian Alam Liar dan Satwa*, the Indonesian 'Wild Land and Wildlife Conservation Foundation'
WCS	Wildlife Conservation Society
WWF	World Wide Fund for Nature

Introduction

Indonesia is one of the world's richest countries in terms of biodiversity, spanning 5,400 km along the equator and encompassing more than 17,000 islands. Despite covering only 1.3% of the Earth's land surface, Indonesia contains a high proportion of the world's species, including 17% of bird, 12% of mammal, 16% of reptile and amphibian, 25% of fish, 33% of insects, and 10% of the flowering plant species. This, along with a high diversity of cultures, makes it one of the richest and most challenging countries in which to work. Indonesia has a large protected area network; however, the coverage of these protected areas, and allocation of human and financial resources to this network, is uneven. The weakest protected area coverage occurs on the islands of East Indonesia, particularly across the thousands of islands of Sulawesi, Maluku and Nusa Tenggara. Within these islands are found some of the highest levels of terrestrial endemism and marine diversity in the world. In Sulawesi, for example, 62% of mammals and 36% of birds are endemic to the island.

The unique characteristics of the endemic maleo (*Macrocephalon maleo*) have historically made it one of Sulawesi's most important species, and also one of the most endangered. The maleo lays its eggs in pits in communal nesting grounds, where they are incubated by sun- or volcanically-heated soils. After laying the eggs in this warm ground, the parents play no further role in raising the chicks. When a chick hatches after a long incubation period, it digs up to the soil surface and runs and flies for the nearest forest, returning when mature to the spot where it was born to lay eggs of its own. The communal nesting grounds are highly vulnerable to local hunters, who collect the enormous eggs and to the clearance of surrounding forests for agriculture and residential land (Argeloo & Dekker 1996, Baker & Butchart 2000, BirdLife International 2009, Gorog et al. 2005, MacKinnon 1981). Population declines and local extirpation of maleos have been reported in many areas of Sulawesi (BirdLife International 2009, MacKinnon 1981, O'Brien & Kinnaird 1996), especially in the northern peninsula where the nesting grounds were traditionally the most concentrated (Argeloo 1994, Butchart & Baker 2000). Of the 36 remaining known nesting sites in North Sulawesi, half are already abandoned and at least six others are at high risk of imminent abandonment (Gorog et al. 2005). The number of maleo pairs visiting nesting grounds is estimated to have declined 90% since the 1950s (Argeloo & Dekker 1996).

In response, the Wildlife Conservation Society (WCS) established the Maleo Conservation Project in northern Sulawesi in 2001. Initially, the project focused on the protection of the nesting grounds, recruiting local rangers and maleo hunters as nest guardians. Similar approaches have been used for marine turtles (Ferraro 2007) and breeding waterbirds (Clements et al. 2007; Clements et al. 2009). Recruitment of hunters as nest protectors does, however, rely on being able to make annual payments, which is unsustainable given the nature of conservation funding. Consequently in 2007, WCS began to explore a new model, whereby the nesting sites and surrounding land was purchased by an Indonesian partner and managed in a sustainable manner in order to protect the birds and to generate revenue to pay for management costs. Locally managed privately-owned protected areas are commonplace in developed nations, but have rarely been attempted in Southeast Asia. The model has proved highly popular with local people because it ensures livelihoods in addition to protecting the maleo.

Background

Sulawesi

Sulawesi, the eleventh largest island in the world and the fourth largest in Indonesia, covers an area of about 190,000 km2 and is an exceptionally important area for biodiversity conservation. This has been recognized by the international conservation community, with the region's inclusion in the Wallacea Global Biodiversity Hotspot (Conservation International), the Sulawesi Global Endemic Bird Area (BirdLife International) and the Sulawesi Moist Forests Global 200 Ecoregion (WWF) (see Figure 1).

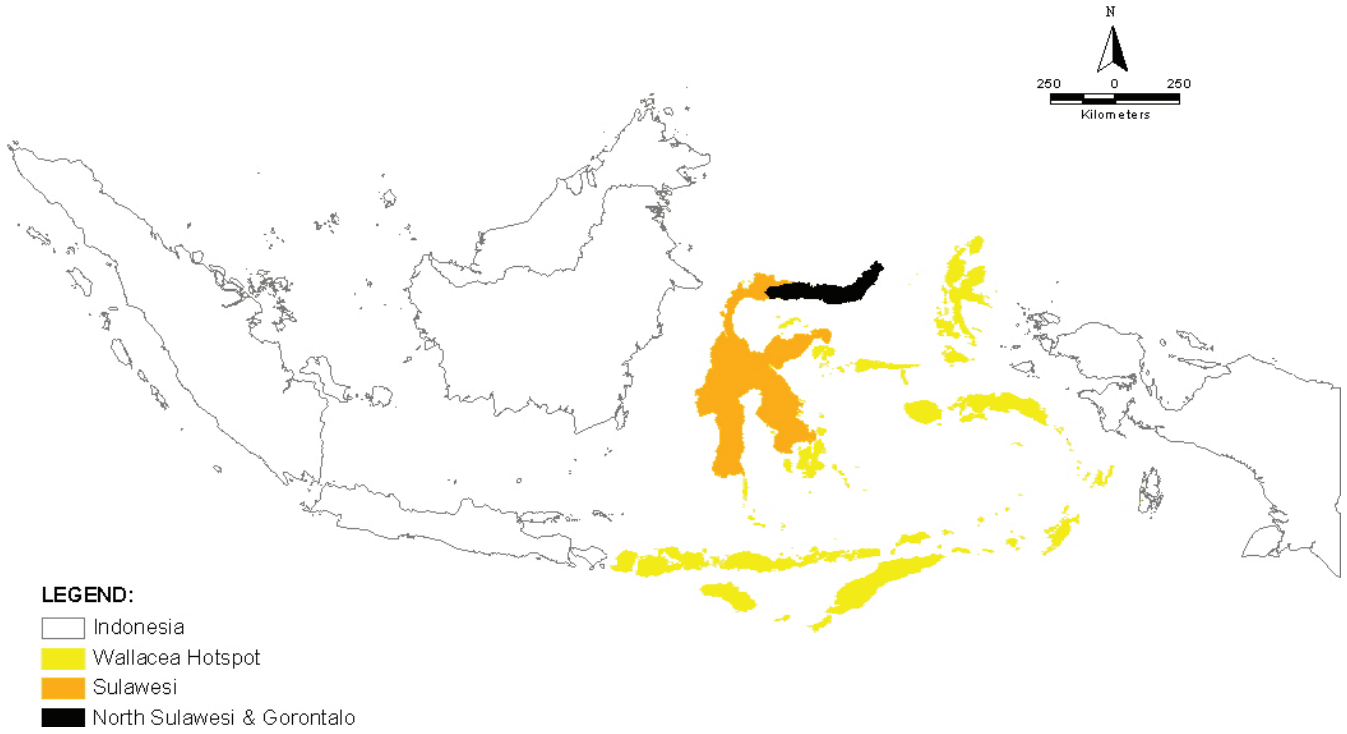

Figure 1. The location of the project site within Indonesia, the Wallacea Hotspot and Sulawesi.

Sixty-two percent of the 127 mammals found in Sulawesi, and 36% of its 233 bird species, are endemic to the island. These include the maleo (*Macrocephalon maleo*) which incubates their eggs in sun- or volcanic-heated soils and is the subject of this project, the babirusa (*Babyrousa babyrussa*) which has two large tusks that grow to pierce the snout before curling back in front of the eyes, the crested black macaque (*Macaca nigra*) which is the largest primate in Sulawesi, the anoa (*Bubalus* spp.) a unique dwarf buffalo which stands a mere one meter at the shoulder, the cuscuses (*Ailurops ursinus* and *Stigocuscus celebensis*) which are Australasian-originated marsupials which have never reached the islands beyond the western coast of Sulawesi, and the civet (*Macrogalidia musschenbroeckii*) which is the world's least-known large carnivore.

Sulawesi's population of 15 million is divided among six provinces: North, Central, West, South, Southeast and Gorontalo, in the northwest. Sulawesi has Indonesia's highest incidence of poverty when compared to other major island groups (including Papua but not the Eastern Islands). In 1999, 24% of the population lived below the national poverty line. Gorontalo, South and Southeast Sulawesi are among the country's poorest provinces while North Sulawesi is among the wealthiest.

Three key factors are escalating the human pressure on the natural ecosystems of Sulawesi: increasing human populations, economic pressure and national policy. In the last decade, the human population in northern Sulawesi increased by more than 20%. As a result of the Indonesian financial crisis, job scarcity and under-employment started in the mid-1990s and have continued to the present day. The easiest way for poor, young, new farmers to find a livelihood is to expand agricultural land into the natural forests, often encroaching into protected areas. Decentralization and a paucity of regional revenue means that forests are often seen by local government authorities as a source of immediate capital, able to generate money through ventures such as logging concessions. Hunting and habitat destruction pose additional serious threats to Sulawesian wildlife species. Consumption of wildlife occurs throughout the island but is most prevalent in North Sulawesi Province, where the people are not constrained by religion from consuming wildlife species such as monkeys, pigs, bats, and rodents.

Maleos

Maleo (*Macrocephalon maleo*) is a highly distinctive megapode (Family Megapodidae, Order Galliformes), and one of Sulawesi's most important species. It is listed as Endangered by IUCN (the International Union for Conservation of Nature) on the basis of rapid population declines due to exploitation and habitat degradation (BirdLife International 2009). This black-and-pinkish chicken-like bird displays an unusual reproductive strategy, common to all megapodes, in which mated pairs lay eggs in pits. Maleos' pits can be found in nesting grounds throughout most of Sulawesi (Argeloo 1994, Butchart & Baker 2000,

Dekker 1990). Female maleos lay 8-12 eggs over a 2-3 month period, peaking markedly at some localities during the regionally variable dry season (Dekker 1990). The eggs (averaging 16% of adult female body weight) comprise 61-64% yolk, and when laid are left to incubate (for 2-3 months) and hatch with no further parental support. Instead, eggs are incubated by solar radiation at beach nesting grounds or by geothermal sources at inland nesting grounds. The young take up to 2 days to tunnel to the surface after hatching, emerging ready to fly (MacKinnon 1981). Chicks enter the forest soon after hatching, probably migrating reasonably long distances from beach nesting grounds to return to the forest. Adults inhabit lowland and lower montane forest (MacKinnon 1978). Maleos start to lay eggs after three years and can live for up to 30 years in captivity (Baker & Butchart 2000).

Eggs are laid communally rather than separately, which may have been be an evolutionary strategy for satiating natural egg predators such as the monitor lizard (*Varanus salvator*) and wild pig (*Sus celebensis*) (MacKinnon 1981). However, this communal strategy also makes the birds extremely vulnerable, to both the destruction of nesting grounds and the harvesting or consumption of eggs by exotic predators such as dogs, rats and people (Argeloo & Dekker 1996; Baker & Butchart 2000; BirdLife International 2009; MacKinnon 1981). Additionally, adult birds are widely hunted and declining populations of maleos reduces the number of eggs laid, making the remnant nesting sites more vulnerable to over-harvesting or predation. Population declines and local extirpation of maleos have been reported in many areas of Sulawesi (BirdLife International 2009, MacKinnon 1981, O'Brien & Kinnaird 1996), especially in the northern peninsula where nesting grounds were most concentrated (Argeloo 1994, Butchart & Baker 2000). In recent years, deforestation and habitat degradation have become important additional threats, particularly for beach nesting grounds that are abandoned by Maleos as the surrounding forest is cleared (Gorog et al. 2005).

Rudy Mokoginta (member of a local NGO trained by WCS) measuring size of a newly hatched maleo chick

Maleo Conservation Project in Northern Sulawesi

Maleo conservation has a long history, with the first surveys and research carried out in the 1970s and 1980s (Dekker 1990, Dekker & Wattel 1987, MacKinnon 1978, MacKinnon 1981), and continued into the 1990s (Argeloo 1994, Argeloo & Dekker 1996, Baker & Butchart 2000, Butchart & Baker 2000, O'Brien & Kinnaird 1996). A hatchery was built by Rene Dekker in the 1980s at Tambun, in Bogani Nani Wartabone National Park (BNWBNP), to protect eggs while they incubate.

WCS has been working in Northern Sulawesi since the 1990s, focusing particularly on conserving the maleos in the Domoga Bone landscape, which includes BNWBNP and surrounding forests. The Bronx Zoo, which is run by WCS in New York, has the only captive breeding collection of maleos outside of Indonesia. The Domoga Bone landscape is one of the most important sites in Sulawesi for conservation of endemic Sulawesi fauna, containing, for example, a quarter of the known maleo nesting grounds (Figure 2). These are divided into inland forest nesting sites, particularly in BNWBNP and adjacent forest concession lands, and beach nesting sites.

Forests in the Domoga Bone landscape, as with other areas in Indonesia, are facing a high rate of deforestation. Forest jurisdiction can be divided into conservation forests (National Parks and Nature Reserves), production forests which are normally under concession management, district watershed protected forests and forests on village or smallholder land. Of the forest concessions, the KPH-Bolmong-III block is particularly important as it adjoins BNWBNP to the south, acting as a buffer, and connecting the park to maleo beach nesting sites on the south coast. WCS's work at the inland forest sites has focused on building the capacity of park staff in BNWBNP, developing methods to secure the forest concessions surrounding BNWBNP, and the Maleo Conservation Project.

The Maleo Conservation Project, initiated by WCS in 2001, focuses on the protection of the remaining maleo nesting sites, using two main methods. Firstly, local rangers and former maleo hunters are paid to protect eggs at the nesting grounds, although such annual payments to nest guardians are unsustainable in the longer-term because they are reliant on continual fundraising by WCS. Therefore, the second main activity undertaken by the Maleo Conservation Project involves developing models for sustainable management of the remaining nesting sites through land purchase and management.

Turning Poachers into Game Keepers: Maleo Nest Guardians

Maleos are hunted as adults, chicks and, particularly, for the eggs. The average weight of a maleo egg is 232 g and it possesses one-half to two-thirds yolk. In comparison, a chicken egg weighs 55 g and possesses only one-third yolk. Thus, a maleo egg is very valuable as a food resource, being four times the weight, and perhaps six times the nutritional value, of a chicken egg (Collar et al. 2001). Although the egg trade was illegal in the 1980s, the market price of a maleo egg at that time was five times that of a chicken egg (Dekker & Wattel 1987), similar to the price ratio today where maleo eggs are worth around 5,000 rupiah each ($0.50 US). In the 1800s, people were recorded traveling as far as 80 km from a nesting ground in order to harvest eggs (Wallace 1869), and collection was supervised by local kings or other authorities who leased nesting grounds to a few harvesters (von Rosenberg 1878). While maleo eggs are not particularly important for local diets, the potential cash value of the sale of eggs makes their harvest an attractive option.

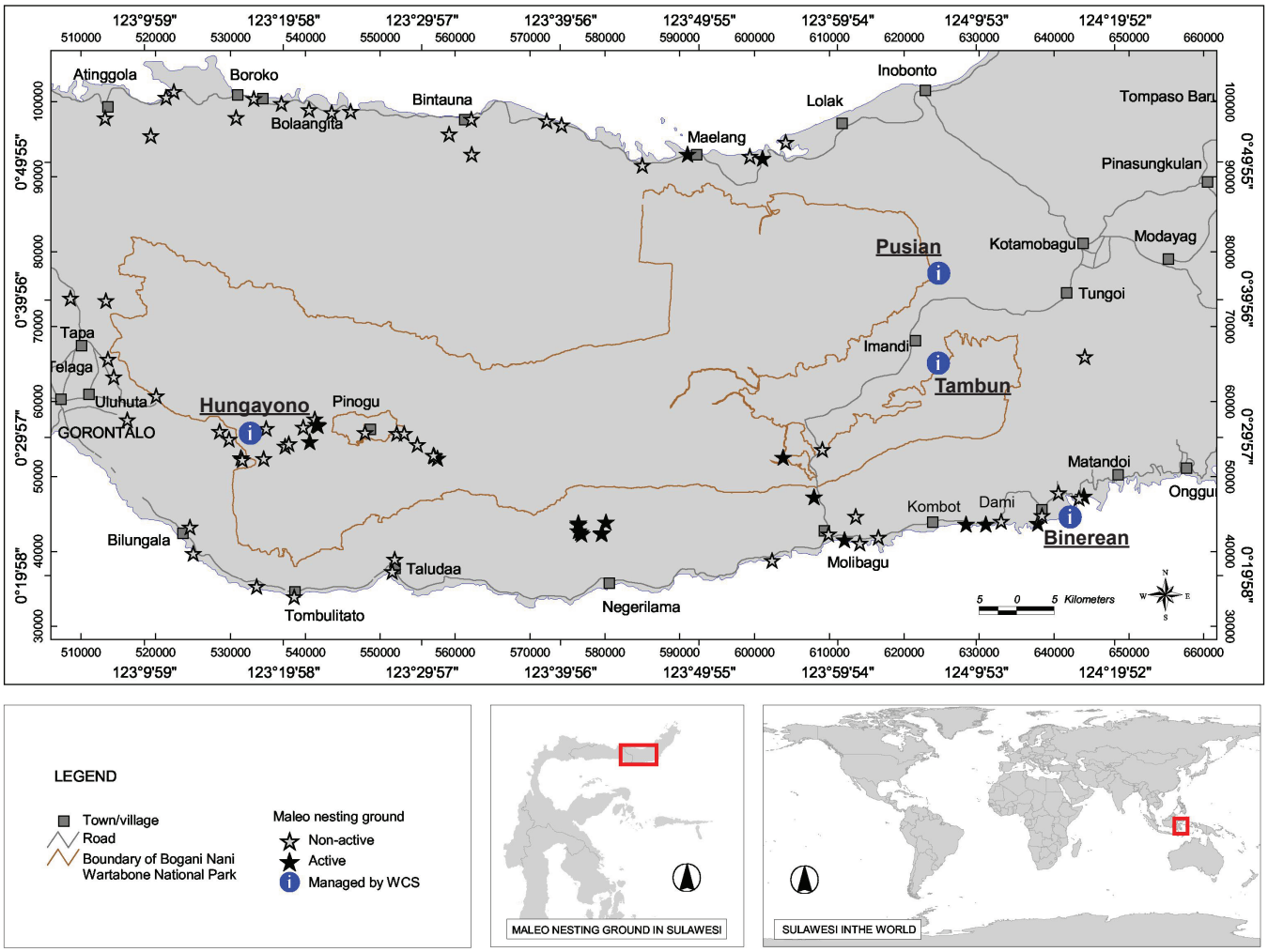

Figure 2. Known maleo nesting grounds in North Sulawesi. The map shows the status of all known nesting grounds, including those known or suspected to be abandoned.

Since 2001, WCS has managed two inland nesting grounds at Tambun and Muara Pusian in the east of BNWBNP in Bolaang Mongondow District of North Sulawesi (Figure 2). A third inland site at Hungayono in the west of BNWBNP in Bone Bolango District of Gorontalo was added in 2003 (Figure 2). In 2008, a fourth site, the beach nesting ground at Tanjung Binerean, was added to the project. Nest protection was started as a conservation initiative undertaken to reduce unsustainable egg collecting by hunters and predators.

Nest Protection Methods

Nest guardian teams are composed of two local people, chosen from among the park staff, local villagers and former collectors. The strategy of employing nest collectors as guardians has been highly successful at other sites (Clements et al. 2009, Ferraro 2007) and is very popular in Sulawesi. The protected nesting grounds are used to create tourism opportunities, to enhance local employment and to increase awareness in schools and through the media.

Maleo visitation, threats and the number of eggs laid are recorded daily at each nesting ground by the guardians. Adult visitation is recorded in the morning from 6-11am, based on both visual sightings and vocalization. Every two months, the nest guardians carefully perform some maintenance of the nesting ground to ensure that exotic weeds do not disturb the nesting process. Fences are placed around the nesting grounds and checked on a daily basis. Elevated observation towers have been built at all nesting grounds to allow the guardians to monitor the areas.

At the inland nesting grounds, the freshly laid eggs are counted once the adults have left, extracted from the nesting pits and transferred to a nearby hatchery. Hatcheries are rigorously fenced enclosures built from reinforced concrete beside the nesting grounds where the soil is heated to a similar temperature by the same geothermal sources. Soil temperature is carefully monitored. The hatcheries need to be very robust in order to protect the eggs from possible predators, such as dogs, monitor lizards and poachers. The location of the eggs within the hatchery is clearly marked with small stakes in order to monitor hatching success. On average, the eggs are incubated for 50 days before they hatch and the chicks dig themselves to the surface. The hatcheries are monitored three times a day: early in the morning, when burying newly collected eggs, and just before dusk. Chicks that are found are immediately released into the forest. Eggs that have not hatched after 100 days are dug up and removed from the hatchery. A total of eleven hatcheries are maintained at the three nesting grounds.

At the beach nesting ground at Binerean, the eggs cannot be transferred to an enclosed hatchery because the eggs rely on solar radiation rather than geothermal heat for incubation. Accordingly, the nest guardians maintain a daily watch of the nesting ground to ensure that the eggs are not disturbed by poachers or predators.

Results

The number of maleo pairs seen at the four nesting grounds shows a seasonal pattern, with the lowest numbers recorded between June and October each year (Figure 3a). The pattern is more distinct at Hungayono, where the number of pairs seen is always higher than Tambun and Pusian nesting grounds. The number of eggs detected shows a relatively good correspondence to the adult maleo visits, which is expected since adult visits usually coincide with egg laying (Figure 3b). The number of chicks displays a similar seasonal pattern, with peaks between February and April each year (Figure 3c). Hatching success rates at the sites vary each year, but are around 50%. In some years, nesting grounds and hatcheries were flooded killing almost all incubating eggs. The first flood was in December 2006, at both sites, the second at Muara Pusian in June 2007, and the third at Hungayono in September 2007.

The 5,000th maleo chick was released in November 2008 (Figure 4 shows the cumulative release of maleo chicks from all sites since the inception of the project).

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John Tasirin (WCS Sulawesi Program Coordinator), with the team, heading by boat toward the nesting ground at Cape Binerean

Through the nest guardian program and educational activities, nearby villagers' behavior toward maleos has changed; egg harvesting and consumption have been greatly reduced. Inland nesting sites have become popular with tourists due to their proximity to hot springs and the nearly guaranteed sighting of maleos.

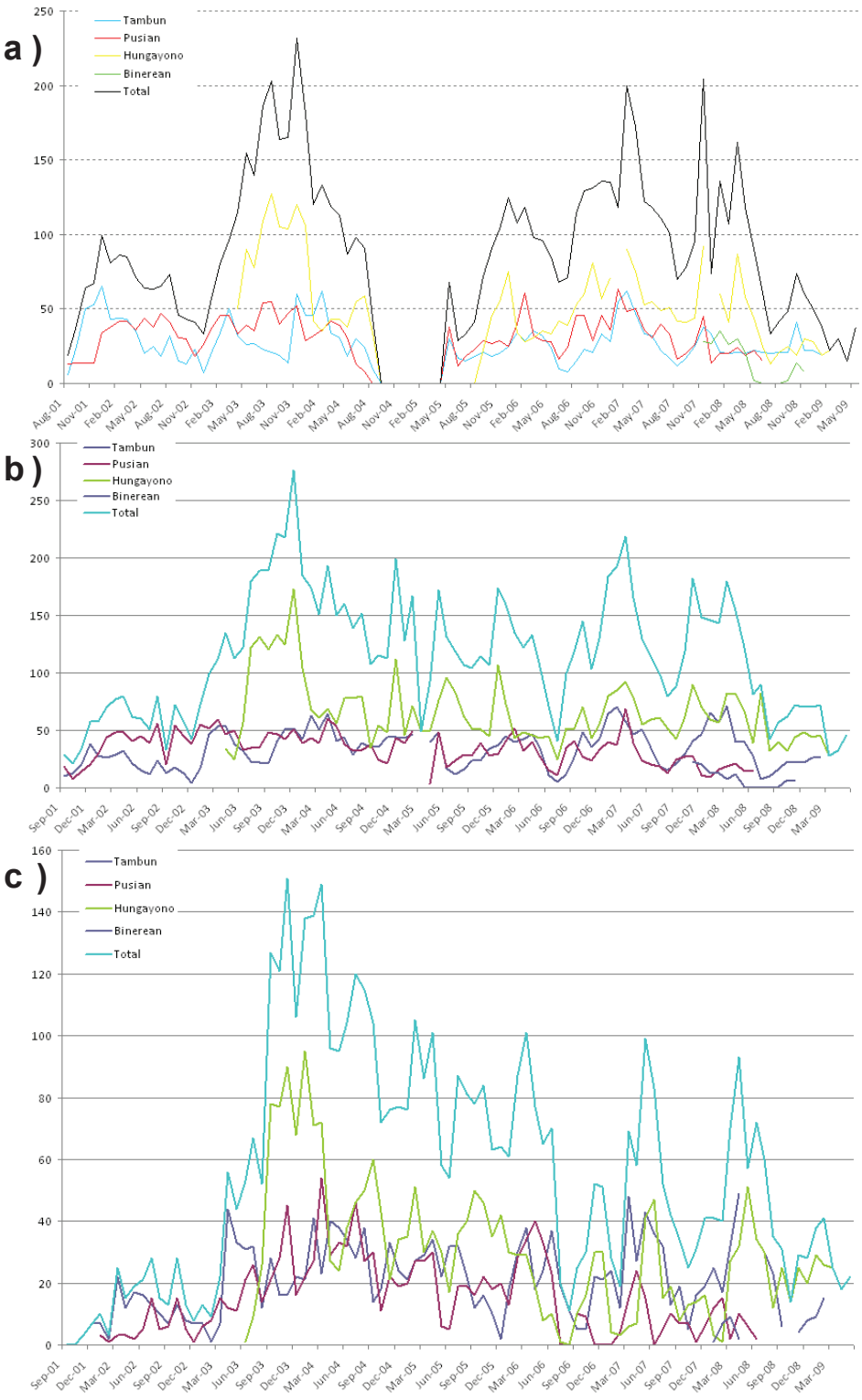

Figure 3. Maleo pairs (a), eggs (b) and chicks (c) hatched at WCS managed nesting sites. The gap in data on maleo pairs was a result of a funding shortfall.

Conclusions

Impact evaluation of conservation interventions requires comparison with the counterfactual (Ferraro & Pattanayak 2006), i.e. what would have happened in the absence of the intervention. A full evaluation of this conservation program's impact on maleos is beyond the scope of this case study, primarily because insufficient baseline data exists from control sites that were not protected. However, the prevailing trend has been that maleo numbers at nesting sites have been declining and sites have been being abandoned (Gorog et al. 2005). Therefore, the fact that the maleos continue to use the four protected nesting sites in substantial numbers suggests that the program has been successful at reducing poaching and predation incidences and has increased the number of chicks released back into the wild. Similar direct payment schemes to local guardians to protect nesting sites have been established in other countries, such as for bird nests in Cambodia (Clements et al. 2009) or for marine turtles in Kenya, Tanzania, Solomon Islands, Malaysia and Indonesia (Ferraro 2007).

Direct payment schemes such as the maleo nest guardian program can also be a very efficient way to achieve the desired conservation outcome (Ferraro 2001; Ferraro & Kiss 2002). For example, based on the annual cost of this program, maleo nest protection costs WCS approximately $4 per chick. Other types of conservation interventions, such as strengthening park management or integrated conservation and development programs, are usually much more expensive, but also help conserve more than one species.

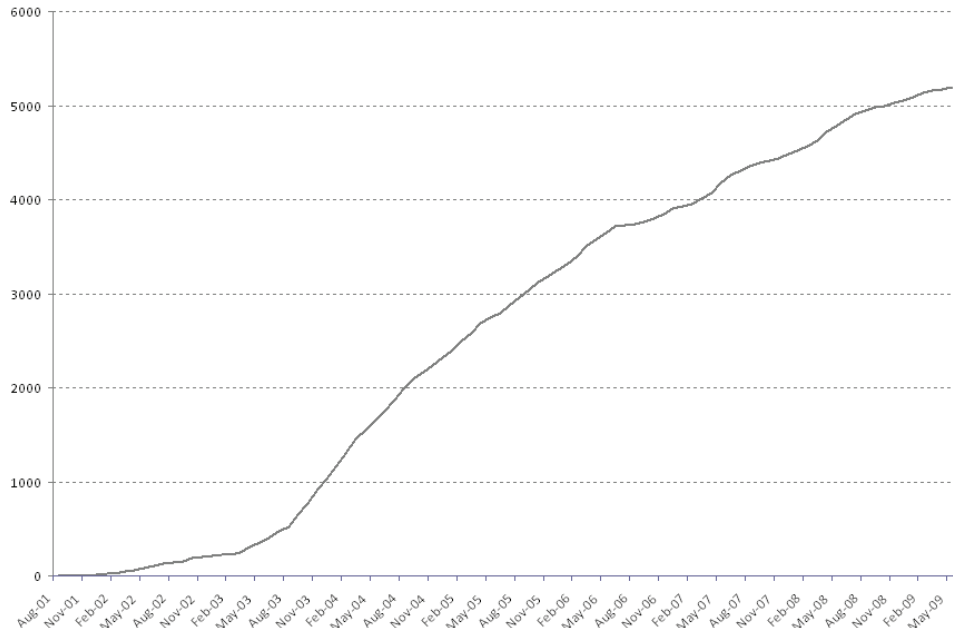

Figure 4. Cumulative release of maleo chicks from all WCS managed nesting sites.

Nest protection programs also support local livelihoods. Nest guardians receive a salary of around 600,000 rupiah per month or 7.2 million rupiah per year, which is significant in rural Sulawesi. The payments offered are usually much greater than the value of the maleo eggs. Around 300-800 eggs are laid each year at each site, which would equal a total income of 1.5 to 4 million rupiah if harvested and sold.

Nest guardians at one site, Tambun, are able to supplement their income by guiding international birdwatchers who come to see the maleos during May-October. Tours come to Tambun because it is the closest place to a large airport (Manado) to see the birds. Birdwatchers stay for around three nights, as the maleos can be unpredictable and hard to see in the scrub at the nesting grounds. Guiding fees can be 100,000 rupiah/day, which is a significant extra source of income. Birdwatchers also pay park entry fees and for accommodation. Similar birdwatching tourism community programs in Cambodia are known to generate significant local support for bird conservation activities (Clements et al. 2008).

Habitat destruction and degradation is probably the greatest long-term threat to the maleos (Gorog et al. 2005), even at the protected nesting grounds. Logistic regression modelling by Gorog et al. (2005) predicted with 85% accuracy the likelihood that a nesting ground would be abandoned between 1991 and 2003 based on a single variable: the extent of connectivity with inland forests in 1991. Based on the same logistical model, all three inland sites (Tambun, Muara Pusian and Hungayono) have only an 11% risk of being abandoned in future years since the surrounding forest is intact and is located within a protected area. By contrast, Tanjung Binerean, which lies outside the BNWBNP, has a 67% risk of being abandoned, due to the widespread clearance of the forest corridor connecting the beach to the inland forests for coconut plantations. Consequently, habitat protection at Binerean is of the highest priority.

John Tasirin and Papa Bakri (one of the owners of land in the nesting ground of Cape Binerean) walking the limits of his land

Sustainable Protection of the Maleo through Land Purchase and Management

Following the success of the nest guardian program, the next challenges for maleo conservation in Sulawesi are safeguarding the habitat that surrounds those nesting grounds outside protected areas and developing a sustainable financing mechanism to pay for this protection in perpetuity. Protection of the remaining beach nesting sites is a particular priority, since 15 of 24 known sites have already been abandoned and the rest are threatened by the deforestation of land between the beach and natural forest. This connecting land, located between the beach nesting sites and the forested areas further inland, provides an essential corridor for maleos since they will not pass through open agricultural areas.

In 2007, WCS undertook an assessment of maleo nesting beaches along the southern coastline of northern Sulawesi, between Mataindo and Molibagu (see Figure 2), in order to identify new potential sites for protection. The assessment highlighted the importance of Tanjung Binerean and the nearby beach of Tanjung Lagamuru for nesting maleos (0° 24' 06.32" N; 124° 16' 32.53" E; see Figure 2 and Figure 5). Maleos were also found to be nesting at Kombot (0° 23' 41.96" N; 124° 09' 06.68" E) 13 km to the west, although maleos were only recorded visiting this site occasionally. More promising was the site (0° 23' 46.19" N; 124° 10' 31.21" E) 3 km east of Kombot, where locals reported collecting eggs daily. Based on the results of this field assessment, WCS decided to initiate site protection at the Tanjung Binerean site due to a combination of factors, including: the high level of use by maleo populations; the connectivity of the site with inland forests; the relative inaccessibility of the site; the opportunity to purchase the land surrounding the site; and the willingness of local people to support a maleo conservation initiative in the area.

Ir. Papalangi Luther (Head of National Park Wartabone Bogani Nani) burying maleo eggs in the hatchery

Description of Binerean

Binerean consists of a 5 km coral sand beach which faces the open ocean and is backed by forested areas (Figure 5). Along the length of the beach, and stretching inland up to 200 m, is a strip of productive cultivated coconut trees which are about 10-15 years old. The understory of the coconut plantation is mildly cultivated in places, for example with cacao. Behind the coconut plantation is a watershed protection forest ('Hutan Lindung'), which is legally protected to maintain watershed function but has no active management. Although the forested area is only about 100 hectares in size, it is an essential corridor for the maleo, connecting the beach nesting sites with the extensive forested areas further inland. This site is about 25 km south of the WCS-managed maleo nesting ground at Tambun.

The most active maleo nesting ground is located at the end of Binerean Cape, furthest from the nearest village, on both Tanjung Binerean and around the point on Tanjung Lagamuru. However, maleos have been recorded occasionally laying eggs all along the 5 km beach (see Figure 5). Binerean is also important for two species of nesting marine turtles: Green Turtle (*Chelonia mydas*), and Hawksbill Turtle (*Eretmochelys imbricate*). The Leatherback Turtle (*Dermochelys coriacea*) and Olive Ridley (*Lepidochelys olivacea*) may also be present, and Olive Ridley turtles are known to breed further up the same coast at Tulaun.

At the time of the first assessment, the coastal coconut trees were owned, in several small parcels, by villagers from nearby Mataindo. Discussions with these farmers and the village head indicated a willingness to protect the maleo nesting ground and the surrounding forests; including a willingness to sell existing farmland to WCS for the purpose of nature conservation. Preparatory legal work indicated that

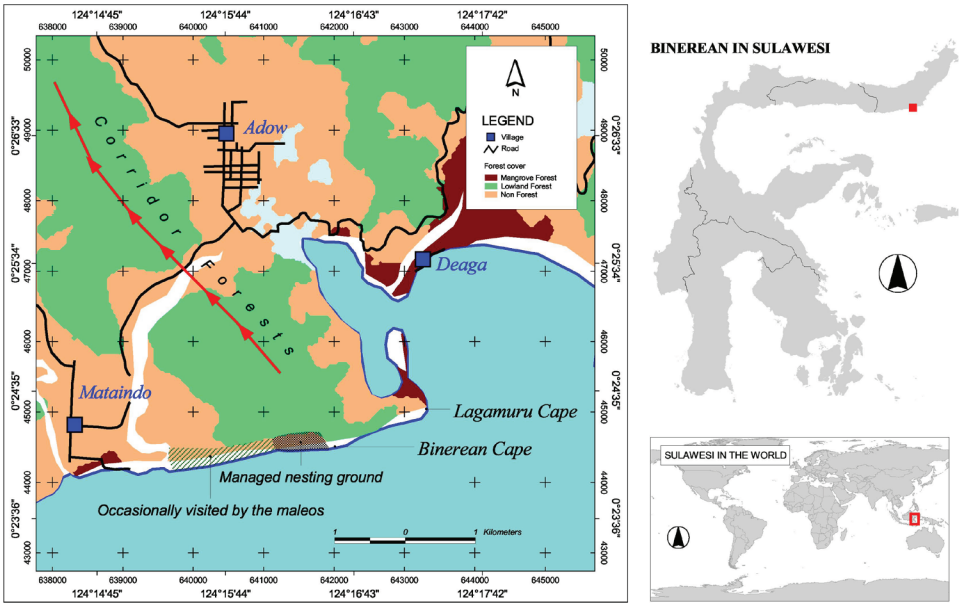

Figure 5. Detailed map of the Mataindo-Binerean area, showing managed maleo nesting grounds, villages, forest cover and agricultural land (non-forest).

the targeted land was without dispute and of a tenure type that could be sold and purchased. Discussions with companies responsible for management of the inland forests also indicated a strong willingness to assist with the conservation of maleo in the area.

Accordingly, WCS decided to create an alternative model to the protected area in Indonesia – based on locally-owned and managed, publicly accessible, small nature reserves with the joint aims of protecting one of Sulawesi's most threatened species and establishing a network of education centers to promote wise natural resource use. The land would be managed for the benefit of wildlife, with the proceeds from agricultural revenues being returned to the site management.

Establishment of the Binerean Nature Reserve

Under Indonesian Law it is not possible for an international organization, like WCS, to own and manage land. Consequently, the new nature reserves would be owned and managed by a local NGO called PALS (Yayasan Pelestarian Alam Liar dan Satwa, 'Wild Land and Wildlife Conservation Foundation'). This Indonesian NGO was formed in 1991 by existing and former staff of WCS and has had a long and close working relationship with WCS.

While the land purchase negotiations were ongoing, WCS established a basic warden facility at the site, with the agreement of local villagers, the local village head and the incumbent landowners. Construction began on September 11th, 2007. Two local villagers from Mataindo were contracted to build an accommodation block for the local site warden. The building lay-out followed traditional local design and materials and consisted of a 5x6 meter building built under the shade of the coconut canopy on gently rising land behind the main beach, about 200 m from the main nesting area. The guard post contains two rooms (3x2.5 m each) and a communal living room. Drinking water is available from a

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Maleo nesting sites in Binerean Cape Coast near Mataindo Village

well located near the house. Following construction, a new permanent warden was selected for the guard post from the local village. The warden, who used to be an egg collector himself, was trained in adult maleo monitoring, egg handling, data recording and reporting. During the training he was also trained in how to handle intruders, including egg poachers, predators and domestic animals. The initiation of the protection program was then formally announced in all surrounding villages and to local (Kacamaten) Government.

In 2008, the seven owners of the 22 hectares of coconuts along Binerean beach agreed to sell their land and the coconuts to PALS in order to create the Binerean Nature Reserve. Transactions were completed in 2009, land was purchased at 700,000 rupiah per hectare and coconuts at 200,000 rupiah per tree on average, which is probably slightly above the market price. The land and the coconut trees were then transferred to the management of PALS, which undertook the necessary action to ensure that the full ownership of the property was duly and legally transferred to its name. The original coconut farmers were then re-hired as site managers, nest guardians and workers, ensuring that they continue to receive an annual income similar to that which they received as farmers. Coconuts continue to be harvested, but PALS has implemented a series of measures to ensure that production is 'maleo-friendly'; these include, for example, the protection of the beach nesting site and the forest corridor. The size of the initial grant from WCS to PALS was determined based on the value of sufficient land needed to generate an income equal to the annual operating cost of the project (detailed in Table 1), based initially on the sale of copra alone (the flesh from mature coconuts). Expansion of the area under management in future years should generate an operating profit to fund additional land purchases and enable profit-sharing to the original coconut farmers. In the future, PALS will also investigate new revenue-generating opportunities, such as the sale of processed coconut products or ecotourism.

The land sale was popular with the farmers, who effectively capitalized their assets in exchange for a one-off payment and continual income via employment as the site managers (on both a salaried and profit-sharing basis). Furthermore, interviews suggested that the Binerean site was not ideal for coconut farming anyhow because it was far from the village; many farmers intended to use the income received from the sale to buy other land closer to the village or to invest in the education of their children.

Research suggests that, even with successful protection of the actual beach nesting site, the project may fail to ensure its long-term survival without efforts to maintain the site's connectivity to the forest. This requires protection of the forest corridor that links Binerean with the inland forests. Protecting the forest corridor has so far proven challenging because the land is under the authority of local government (the Kabupaten Government of Bolmong) who do not actively manage the site. As a consequence, it has been slowly encroached upon by local

Table 1. Initial investment costs and annual management costs of the Binerean Nature Reserve. Expenses are shown in red, revenue in black. All values shown in US Dollars.

Expense/Revenue	Notes	Units	Value	Cost	Total
Land purchase (initial investment)					
Land	Price per Ha	22	Ha	58	**1,276**
Trees	Price per tree (@60/ha)	1,320	Tree	19	**25,080**
Land registry fee	Per land purchase	8	Purchase	350	**2,800**
Associated costs	Per land purchase	8	Purchase	110	**880**
				Sub-total Land purchase	*30,036*
Land management (annual)					
Site Manager	Part-time	6	Month	260	**1,560**
Maleo Guardians (x2)	Full-time	12	Month	215	**2,580**
Coconut Management	Inclusive costs	1,320	Tree	1.9	**2,508**
Local Transport		12	Month	84	**1,008**
Supplies/Materials	Routine operations	12	Month	300	**3,600**
Station Maintenance	Routine repairs etc.	2	Annual	270	**540**
Insurance		1	Annual	215	**215**
Land and Buildings Tax ('PBB')		22	Hectares	1.5	**33**
				Sub-total Land management	*12,044*
Revenue from copra sale (annual)					
Estimated revenue per tree	Mid-2008 sale prices	1,320	Tree	9.2	**12,144**
				Sub-total revenue from copra sale	*12,144*
Balance Sheet	**Notes**				**Total**
Initial Investment required	One-time payment				**30,036**
Annual operating balance	profit/loss				**100**

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Dr. Noviar Andayani (Director WCS-Indonesia Program) holding a maleo egg and talking about maleo conservation with local community members

and immigrant farmers. Furthermore, due to its status as state forest, the land could not be purchased. WCS's approach was therefore to lobby the responsible local government agency (Dinas Kehutanan) for greater active protection and for recognition of its protection status among local villages. The latter tactic was more successful, and the local villages have since been keen supporters of conservation in these forests. Regular monitoring is performed by the on-site warden so that active encroachments are detected early. In addition, WCS and PALS are investigating purchasing agricultural land adjoining the corridor area in order to further secure protection of the site and generate additional revenue to cover management costs.

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Maleos digging in Muara Pusian

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The program is organized around four core activities that will be implemented in overlapping phases over the life of the program. These are:

1. Knowledge building including an initial review, synthesis and dissemination of current knowledge, and applied comparative research in a number of different field locations to help fill gaps in our knowledge;
2. Identification and development of diagnostic and decision support tools that will help us better understand the positive, negative or neutral relationships among natural resource conservation, natural resource governance and alleviation of rural poverty;
3. Cross-partner skill exchange to better enable planning, implementing and adaptively managing projects and programs in ways that maximize synergies among good governance, conservation and wealth creation; and
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