

THE BIOLOGICAL CASE FOR PROTECTING THE LAMBUSANGO FORESTS

Biogeography

Buton Island lies in the centre of the Wallacea Biogeographical Zone. This region bounded by deep ocean trenches has remained isolated from the Asian and Australasian continents even when the sea levels dropped during the last Ice Ages by up to 100 metres. The long period of isolation has produced many unique or endemic species to the region. For example the bird fauna has the highest number of endemic species of any similarly sized land area in the World. In addition to the endemic elements of the fauna, Asian and Australian species have also invaded producing a unique mix of species. Sulawesi forms the largest landmass within the Wallacea biogeographical region and has the highest numbers of endemic species. Many of the lowland forests on mainland Sulawesi though which harbour these species have been damaged by human activity.

Buton Island has the advantage of being large and close to the mainland of Sulawesi. The larger the island and the closer it is to the mainland, then the greater the proportion of the mainland fauna it will contain. Buton also has the advantage that because of its hilly terrain it still has a high degree of forest cover. From 1995 to 1999 Operation Wallacea teams travelled around Buton Island surveying birds to obtain an initial indication of the best areas on which to concentrate the biodiversity survey effort. Birds were used as an indicator group because they could be assessed fairly rapidly and without the need for trapping effort. In addition they are the best studied faunal group and the habitat requirements of most of the species are known. The results of this survey indicated that the forest in the north part of Buton had the greatest diversity of birds but unfortunately in 1996 a start was made in this area on a transmigration camp that was eventually to become 10,000 strong. The next best area of forests on Buton were the Lambusango and Kakenauwe forests around the village of Labundo and in 2000 the first of the biodiversity scientists and volunteers arrived in Labundo and started working on the surrounding forests. In 2002 the biodiversity survey teams in Labundo comprised 35 scientists from UK, Ireland, USA and Australia universities along with counterpart Indonesian scientists. Much of the work is concentrated on three study grids that have been cut in the forest. Each grid covers 1km X 1km and consists of vertical and transverse transect paths cut through the forest at 100m intervals. This system allows for easy access, quantification of data collected and comparison between forests and between years. Interim reports on the findings of the team have been reported to LIPI (Indonesian Institute of Sciences) and copies of these reports are available elsewhere on this web site.

Forest Structure

A team of botanists, hydrologists and geologists have been characterising the forest types in the Lambusango and Kakenauwe forests. Forest transects have been established on plateau and ridge top sites and on adjacent moderately steep slopes at grids 1 and 2. The botany, forest structure, topographical and soil (physical and hydrological) characteristics have been determined from these transects. Work has also begun on monitoring 1ha plots at grids 1 and 2 for botanical diversity.

Study grid 1 in Kakenauwe and study grid 2 in Lambusango are situated on karst coral limestone of quaternary age, whilst study grid 3 is on ophiolite with significant amounts of magnesian limestone present. Grid 1 at Kakenauwe is c. 300m altitude, Grid 2 in Lambusango is somewhat higher (400m) and grid 3 in Lambusango is at 600m. All of these sites fall within the definition of lowland forest. The Kakenauwe site shows evidence of local selective logging pressure and as such is disturbed. This site is also close to the road and there is evidence of edge effects since the land on the other side of the road is not forested in parts. The Lambusango site is less accessible and was therefore considered to be relatively

pristine, although there is evidence of abandoned farmsteads at grid 2. Grid 3 appears to be undisturbed forest.

The initial results from 2001 show that there is a difference between the slope and plateau elevation profiles in grids 1 and 2, with the slopes showing signs of stress – trees somewhat stunted, mis-shapen, more leaning and fallen naturally, and a more open and less continuous canopy. However, despite the shallow soils present on the slopes, basal area is similar on slopes and plateaus at $55 \pm 20 \text{ m}^2 \text{ ha}^{-1}$, and is equivalent to other rainforests in the region on much deeper soils and on non-carbonate lithologies (Crowther 1982). This would suggest that the tree biomass on the slopes is comprised of more smaller trees with the larger trees having a greater chance of falling than on the plateaus. Canopy cover is sparser and less luxuriant than other lowland rainforests on mainland Sulawesi (O'Donovan 1987) but this is probably due to the effects of the thin limestone soils and differences in species composition. Other work on rainforest types on limestone soils in nearby Peninsular Malaysia show striking similarities in structure and basal area to the central Buton sites (Crowther 1982, 1987a,b).

However, botanically, these sites are probably quite different to Buton, being on opposing sides of Wallace's line. Crowther (1982) notes that his sites support a rich variety of flora with many endemic species confined to those outcrops, and it is likely that the forests on Buton will also reflect these differences from other rainforests on non-limestone geologies. Diversity is potentially high in both grids with species area curves for both still rising steeply, suggesting that the area sampled needs to be increased before the species area curves will start to flatten out. Sixty tree species at Kakenauwe and a similar number at Lambusango from a sample area of only 300 m^2 which is only one third the normal sampling size of 1 ha used for assessing tropical forest diversity. An indication of how species rich the area may be is that there was no overlap in species composition from these small sampling areas either between grids 1 and 2 or between slopes and plateaus within these grids. There was also little overlap in families.

Given the species accumulation data and the complete lack of overlap between the sites it is likely that when the 1 ha plots are completed that the diversity of the Kakenauwe and Lambusango sites will approach the maximal diversity recorded from mainland Sulawesi forests on Karst limestone.

Invertebrates

It is very difficult to use invertebrates to identify the importance of a forest area in comparison with other areas in the region, since so little is known about many of the taxa. The discovery of new species or range extension records in these groups is therefore more a function of the effort put in by specialist scientists than a true reflection of the importance of the area. An example of this would be the discovery and description of three new endemic water mite species: *Hydrobates colesi*, *Koenikea oliveri* & *Mideopsis gillespiei* - Wiles, in Press) from the forests of Lambusango and Kakenauwe. There are likely to be many Sulawesi water mite species still awaiting discovery.

Butterflies are perhaps the one invertebrate group, which have been fairly well studied world wide and the rate of discovery of new species in this group is the lowest amongst all the invertebrate groups reflecting this greater level of knowledge. An intensive survey of the butterfly fauna of Buton was carried out in 2000 concentrating mostly on the Lambusango and Kakenauwe forests. 175 species were recorded including 30 species, which are endemic to Sulawesi. A large percentage of the Sulawesi butterfly fauna was contained within these forests and samples of the fauna are currently being analysed by the Natural History Museum in London. It is probable that a number of new sub species will be described from this collection, since a number of the records were considerable range extensions of species found in distant parts of Sulawesi.

Freshwater fish

The surveys of freshwater fish in Buton indicate that rather like Darwin's finches on the Galapagos islands where an early finch invader from South America radiated into many species to fill the available niches, a similar pattern has occurred with the gobies in Buton. Gobies have invaded virtually all the freshwater habitats in the island and have radiated into a number of species. Unfortunately the taxonomy of gobies is in need of revision so it is difficult to be certain of exactly how many new species have been found in the surveys to date. However, at least 4 goby species would appear to be new, with the most of these new species coming from upstream sections of rivers. One of these species was found in the Lambusango reserve. A full taxonomic revision of the gobies may well reveal other new species within the proposed National Park. Many of the other fish species living in the Lambusango rivers are adapted to feeding on the insects which fall into the water from the canopy. The family Hemiramphidae known as the halfbeaks have an elongated lower jaw and much shorter upper jaw, which provides a useful adaptation for surface feeding. A number of the species in this family are endemic and many would be highly sensitive to deforestation which would substantially reduce the fallen insect input to the river, increase the exposure to sunlight thereby raising temperatures and lowering oxygen levels as well as increasing flow rates and sedimentation levels. Loss of the forest in Lambusango would eliminate the population of endemic halfbeaks that still survive there.

Herpetofauna

The herpetofauna of the Lambusango and Kakenauwe forests is notable for its snake fauna with 28 species so far recorded from the reserves which is 48% of all the land snake species described for Sulawesi. An astonishing 11 species of herpetofauna new to science have also been described from the Lambusango and Kakenauwe forests. These include:

- 3 snakes (two from the genera *Calimaria* and one *Typhlops*)
- 2 geckos (*Gehyra* sp. one of a complex of poorly understood species and probably new and *Hemiphyllodactylus* which is the first specimen of the genus from Sulawesi - only previously known from Sunda shelf)
- 4 skinks (one *Lygosoma* sp, two *Sphenomorphus* sp which are the first records from Sulawesi and one *Mabuya* sp. A genera for which there is only one previous record of an undescribed species from central Sulawesi).
- 2 frogs *Oreophryne* sp (confirmed as new species and a paper in preparation and *Rhacophorus* sp which is currently being described Iskander and Gillespie)

All of the species (except one of the *Calimaria* species) have all been restricted to forested areas despite widespread searching outside the area. The *Rhacophorid* frog is an obligate stream breeding species and will be sensitive to disturbance to stream systems such as enhanced run off caused by logging. One of the *Sphenomorphous* species and the *Mabuya* are arboreal and appear to be strongly associated with large trees such as strangling figs and trees with well-developed buttress systems.

Rhacophorus georgii a forest interior species of frog which was thought to has been extinct since the early part of the century was also recorded in 2001 from the Lambusango reserve. Tadpoles of this species were also seen in water bowls in hollow tree trunks.

The only known populations in the World of the 11 new species and the previously considered extinct species, *Rhacophora georgii* are found in the Lambusango and Kakenauwe forests, making these forests of international importance for herpetofauna alone.

Birds

In 1996 Operation Wallacea published a report on the results of the bird surveys conducted across the island of Buton during 1995 and 1996. This report recorded the time spent surveying and species of birds seen in 5km X 5km squares. 56 of the 85 squares covering Buton island were surveyed and squares 40 - 45, 50 - 52, 57 -59 and 66 - 67 cover the area bounded by the proposed National Park. In total 110 hours were spent recording and 126 species were noted including 42 Sulawesi endemics and 10 Indonesian endemics. Buton appeared to contain most of the Sulawesi lowland endemic species and as noted for some other offshore islands, some montane species on the mainland were recorded at much lower altitudes on Buton. These included 12 species recorded around Lambusango and Kakenauwe that had previously been recorded at much higher levels on the mainland. Conservation of the Lambusango and Kakenauwe forests therefore would result in a good cross section of the lowland endemic bird fauna being included within the boundaries as well as a few more montane species.

Of the bird species recorded in the 1995 and 1996 survey in Lambusango and Kakenauwe, one species, the Yellow-Crested Cockatoo *Cacatua sulphurea* is listed by IUCN as Endangered. The Endangered category includes species considered to have a 20% chance of going extinct in the next 20 years. *Cacatua sulphurea* was recorded in the 2001 survey of Lambusango, so this species still survives at present in the proposed protected area. There were a further 2 bird species (Milky Stork, *Mycteria cinerea* and Snoring Rail, *Aramidopsis plateni*) recorded that were in the IUCN Vulnerable category. The Vulnerable category includes those species, which are considered to have a 10% chance of becoming extinct in the next 100 years. There were a further 9 species of bird recorded in the Near Threatened category including the Pale-Bellied Whiteeye (*Zosterops consobrinorum*) which has a world distribution restricted to just SE Sulawesi. A taxon is Near-threatened when it has been evaluated and does not qualify for any of the categories Critical, Endangered, Vulnerable, Conservation Dependent or Data Deficient, but is close to qualifying for one of the threatened categories.

Following this initial work, which demonstrated the value of the Lambusango and Kakenauwe forests for birds, a long term monitoring programme was established in 2001 to assess changes in annual abundance of some of the forest dependent species. 100 point count sites are being monitored annually in grids 1 - 3.

Mammals

The forest floor small mammal fauna in Lambusango and Kakenauwe contains a large percentage of the known Sulawesi fauna in this category. 8 species of rodents and 4 species of shrew have been captured from the forests of Lambusango and Kakenauwe. All are endemic to Sulawesi and are forest specialist species, which would be lost if the forest were removed. Amongst these animals there are two new species of small mammal. One of these is a shrew species *Crocidura* sp which has been confirmed as distinct by analysing the DNA and placing the animal in the overall phylogeny of shrews. The DNA analysis suggests that there were two separate invasions of shrews into Sulawesi from Asia, each of which then adapted into a range of new species. The *Crocidura* species found in Lambusango appears to belong to the second wave of adaptive radiation. The second small mammal species found is a Pygmy Tree Mouse (*Haeromys* sp). Analysis of skull measurements and DNA analysis is needed to confirm this as a new species.

Approximately 50% of all the bat species recorded from Sulawesi have been recorded from the Lambusango and Kakenauwe forests. 11 of these species are endemic to the Wallacea region and two are new records for Sulawesi of which the *Hipposideros* species appears to be a previously undescribed bat. Also of note is the capture of three size morphs of *Rhinolophus philippinensis* which because of their differing echolocation frequencies, may represent distinct species, which to date have not been described. Rare species such as the Sulawesi

Naked Bat (*Cheiromeles parvideus*) an endemic species about which very little is known has been caught from the Kakenauwe area and only the fourth known specimen of *Boneia bidens* was captured from the Labundo area. A major point about the bat fauna is that 15 of the species including 4 endemics are forest interior specialists and if the forest was degraded or removed entirely, would be lost.

A Sulawesi Palm Civet *Macrogalidia musschenbroeki* has been sighted in the Lambusango forest. This species is an endemic to Sulawesi and is classified as an IUCN vulnerable species. The Sulawesi Palm Civet prefers undisturbed forest habitat and appears to be replaced by the introduced Malay Civet in areas of disturbed forest. Live trapping is continuing in the Lambusango forests to catch the Sulawesi Palm Civet and attach a radio collar. There have been no previous natural history studies of this species in the wild and the radio tracking would enable home range size, habitat utilisation and activity patterns to be studied. Radio tracking of Malay Civets around the village of Labundo has been carried out for two years and the field techniques developed.

Probably the strongest case for the retention of the Lambusango forest is the presence of an apparently large population of anoa (*Bubalus depressicornis*). This endemic Sulawesi species is rapidly approaching extinction, as its last remaining strongholds in SE and central Sulawesi are logged. One of the last remaining populations of anoa is on Buton Island, and Lambusango appears to have a substantial population. At the study grid in the centre of Lambusango sightings of anoa are frequent and plans to estimate population size from spoor counts are included in the Operation Wallacea survey programme for 2003. Regular trapping and killing of anoa is still occurring around the forests of Lambusango and the anoa which were seen around Labundo up to a few years ago have disappeared with sightings now confined to deep forest areas. Unless the level of patrolling against this illegal poaching is increased the Lambusango population may be driven to extinction in the next few years.

Primates

Macaca ochreata is one of 7 species of macaque on Sulawesi. *M. ochreata* is confined to the SE of Sulawesi and has a distinctive subspecies (*brunnescens*) on Buton and Muna. The Lambusango and Kakenauwe forests appear to contain large numbers of macaques with densities of up to 23 macaques per km² in forest edge habitat and 12.5 macaques per km² in deeper forest recorded from transect counts and mapping home range size for troupes. Using even the lowest of these figures, which are likely to be underestimates, the macaque population in the Lambusango and Kakenauwe forests is likely to exceed 3,500 animals. A population this size is likely to form a viable population where there is no net loss of genetic diversity over the generations and protection of this species could be ensured by establishment of the National Park.

A tarsier species resembling *Tarsius spectrum* is present in the Lambusango and Kakenauwe forests. However, this tarsier has a distinctive call from other populations of *T. spectrum* and the sonograms from this species and other tarsiers are currently being analysed along with DNA material to determine the species present in Sulawesi. Since call is used as a recognition signal by tarsiers it is possible that the tarsier in the forests of Lambusango will be separated as a new species when the taxonomic revision is completed.

Conclusions

The biological case for the Lambusango and Kakenauwe forests to be properly protected is overwhelming:

- the tree diversity of the proposed reserve appears to approach that of the most diverse forests on karst limestone on mainland Sulawesi.
- The proposed protected area seems to contain a good cross section of the lowland forest fauna of mainland Sulawesi for groups such as butterflies, birds, snakes, bats and small mammals.
- To date 24 species including 3 water mites, 4 fish, 11 reptiles and amphibians, 2 small mammals, 3 bats and 1 primate have been discovered within the proposed Park boundary. There is not another protected forest in the world that can claim to be the only site for 21 unique vertebrate species.
- The proposed protected area contains populations of threatened species including one frog which was thought to have been extinct plus numerous other reptile and amphibian species, 12 bird species on the IUCN vulnerable, threatened or near threatened lists, and 2 bats only recorded on a few previous occasions.
- There appears to be a viable population of flagship endemic species such as the Buton macaque, and the Lambusango forest is one of the last strongholds of the anoa. Sulawesi Palm Civet may also be present in the forest.