

## IN201 The Ecology of Palms, Indonesia

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The island of Buton occupies a semi-isolated position at the tip of the south east peninsula of Sulawesi, in the biogeographic region known as Wallacea. At least 26 species of palm are native to the Lambusango Forest on Buton. These species can be divided into those with a classical 'palm tree' structure and those known as rattans which have thin, flexible stems and rely on other vegetation for support. Among the palms of Lambusango are considerably more rattans than palm trees (nineteen species to seven), which might be because rattans are better able to colonise new areas and so reach islands like Buton. Of the seven native palm tree species four are endemic to the Wallacea region, whilst thirteen of the nineteen rattan species are endemic. Some of the rattan species are collected for sale to the furniture trade, and so are valuable sources of income for local communities.

Previous work by Operation Wallacea on Buton has identified the palm species and studied the growth and ecology of some of the common rattan species. The ecological investigation has concentrated on the environmental characteristics of the habitats in which various species grow. This has allowed the application of the concept of 'ecological niche'. It has been possible to show that species segregate along some environmental niche axes to a greater extent than might be expected by a random distribution of the species along the axes. This suggests that competition with other plant species forces the rattan species into different environmental niches, often called 'realised niches', i.e. environmental conditions in which they are sufficiently competitive not only to survive but also to reproduce in the presence of other species.

The next stage of this study is to extend the work to other palm species that are less common than the rattans investigated so far. The species to be investigated will include the following 'palm tree' species: *Areca vestiaria*, *Caryota mitis*, *Hydriastele selibica*, *Licuala celebica*, *Livistona rotundifolia*, *Oncosperma horridum* and *Pinanga rumphiana*. Rattans that might be included in the investigation include *Calamus mindorensis* (suspected to be competitive in dense forest), *Calamus zollingeri* (which is present in two distinct forms) and *Daemonorops robusta* (the only species in its genus occurring on Buton).

Since most of these species are relatively rare it will be necessary to walk sufficient distances in the forest to find enough individuals of the various species to give adequate statistical samples. This will require stays in forest camps situated in various parts of the forest which differ from each other in surface geology. Previous work in the forest has shown where the different species are found, so they can be located relatively easily and untargeted wandering can be avoided. A basic procedure will be followed, as outlined below.

Established routes through the forest will be walked in the company of a local guide until an individual or a group of the species under investigation is found. At this site a series of measurements and collections will be made. The palm species will be recorded together with the number of stems and the height of the stems. Any other palm species growing within a 5 metre radius will be recorded. A measure of the density of the forest canopy at the site will be obtained by

measurements of tree circumferences and by digital photography of the canopy from below; these photographs will later be subjected to computer analysis. The measurements will indicate how much light reaches the surface of the site.

The surface rock type will be identified, if possible. A soil sample from a depth of 5 – 10 cm will be taken. At a later time measurements of soil pH, conductivity and texture will be made, also the water-holding capacity of the soil will be measured giving an indication of the drought-proneness of the site in the dry season. The slope of the ground at the site will be recorded and the altitude (from GPS) noted.

Students are welcome to make suggestions for further measurements and analyses that could be incorporated into the investigation.

In this way the characteristics of the environment in which a species grows will be established. Later analyses of the results will involve graphical presentation of the data, use of statistical programs (e.g. Minitab) for techniques such as binary logistic regression, use of the program 'Image J' to analyse digital photographs of forest canopies, use of a spreadsheet program (e.g. Excel) to calculate niche breadths and overlaps, and use of a program such as 'EcoSim' to simulate random niche overlaps against which the observed niche overlap can be compared. Again, suggestions from students concerning the analysis of data are welcome.

The result of this work will be a descriptive account of the ecology of the different species. More analytical results should be obtained showing whether the palms investigated show segregation in niche space suggestive of inter-specific competition causing species to occupy distinct realised niches. Also evidence of 'trade offs' may be obtained, whereby one species is specialised to be successful in competition for one resource or in one environmental circumstance, but then inevitably is unable to compete successfully for a different resource or in a different circumstance.

#### Suggested Reading

Powling, A., The palms of Buton, Indonesia, an island in Wallacea. *Palms* 53(2): 84-91, 2009. [A general account of the palm species found on Buton – see the Operation Wallacea web site.]

Primack, R. & R. Corlett, *Tropical Rain Forests, an ecological and biogeographical comparison*. Blackwell Publishing, Oxford, UK, 2005. [General background information; chapters 1 and 2 contain relevant information.]

Silvertown, J., Plant coexistence and the niche. *Trends in Ecology and Evolution* 19(11): 605-611, 2004. [A critical review of evidence for the concept of ecological niche applied to plants.]

Silvertown, J., *Demons in Eden* (Ed. 2). University of Chicago Press, Chicago, 2008. [A popular account of plant diversity and ecology; see particularly chapters 5 and 6.]

Waite, S., *Statistical Ecology in Practice*. Prentice Hall/Pearson Education, Harlow, UK. 2000. [Section 5.3 describes the calculation of niche breadths and overlaps using a spreadsheet.]

Whitmore, T.C., *An Introduction to Tropical Rain Forests* (Ed. 2). Oxford University Press, Oxford, UK. [General background information; chapters 3 and 8 contain relevant information.]

Whitten, T., M. Mustafa & G.S. Henderson, *The Ecology of Sulawesi*. Gadjah Mada University Press, Yogyakarta, Indonesia, 1987. Republished by Periplus, Hong Kong, 2002. [A voluminous source of information about plants, animals and the environment in Sulawesi.]