DAVIS EXPEDITION FUND

REPORT ON EXPEDITION/PROJECT

Expedition/Project Title: Study of *Chaetocarpus rabaraba*, a critically endangered species of Madagascar

Travel Dates: 18 May 2005 – 24 July 2005

Location: Analalava Forest, Toamasina Province, Toamasina District, central-east coast of Madagascar

Group Members: Cynthia Skema

Aims: To study the natural history of and complete census work on *Chaetocarpus rabaraba* (Euphorbiaceae *s.s.*) as a means of improving its conservation action plan.

OUTCOME (not less than 300 words):-

Introduction.

Chaetocarpus rabaraba (Euphorbiaceae *s.s.*) is a critically endangered species endemic to the northern portion of the central-east coast of Madagascar in Toamasina Province. This woody, dioecious species grows on both laterite and sandy soils in the vicinity of the coastal town of Foulpointe. There exist three *C. rabaraba* populations: Analalava, Mangalimaso and Mahatsara. Analalava forest is home to the largest population of *C. rabaraba* and is currently becoming a conservation "micro-reserve" for the threatened and rapidly disappearing flora and fauna of the low elevation humid forests of Madagascar through the work of the Missouri Botanical Garden's Madagascar Research and Conservation Program (MBG) and collaborators. New data from a field study completed from May to July 2005, which studied individuals of *C. rabaraba* and their natural history as a means for improving the conservation action plan for the species, are presented.

Census Work.

New census work for *C. rabaraba* found a total of 162 individuals, showing a sharp increase in known individuals from previous census work (*e.g.* 12 individuals found in 2004) due to more systematic search methods, better field identification and the exploration of the Mahatsara population (formerly known but never included in census work). Critically, almost 68% of the known *C. rabaraba* individuals showed no signs of fertility (*i.e.* no flowering/fruiting in observed 2005 season, no remnants of old flower clusters, no old fruits on ground, no seedlings evident). The majority of these "sterile" individuals may represent young trees which are not yet of reproductive age, though long term field data would be needed to substantiate this. Due to the intense felling pressure affecting this species until the very recent past, it is not surprising that the majority of remaining individuals found are too small (*i.e.* young) to provide useful timber products. Census work also showed that the majority of natural regeneration of *C. rabaraba* is occurring on the fringes of Analalava forest itself, where the low elevation humid forest meets secondary degraded forests characterised by *Ravenala madagascariensis* (Strelitziaceae) and *Pteridium aquilinum*

(Dennstaedtiaceae). The peripheral location of many young *C. rabaraba* saplings has lead to recommendations that the Analalava forest micro-reserve plans should be altered to include an outer ring of secondary forest around the primary forest tract which is already slated for conservation.

Pollinator Observation Work.
C. rabaraba trees were observed to have some portion of flowers available to pollinators for roughly two weeks. Anthesis for individual flowers is a shorter period, approximately 2-6 days. Pollination observations of *C. rabaraba* found six "morpho-species" visiting male flowers. Morpho-species are defined, for this study, as groupings of individual insects based on morphological characteristics visible from ~6 m distance with 10x28 binoculars. Three of these morpho-species (B, C and D) were determined to be the primary pollinators during early June (the period of observations), with 8-10 times as many visits to flower clusters than the other insects. Morpho-species C and D were also seen to spend up to two times as long in a flower cluster with each visit than any other insect. Morpho-species may or may not correspond to actual named species, often being comprised of a few species which are superficially similar in appearance. Preliminary identifications of insects captured during this study propose the following taxa as potential pollinators of *C. rabaraba* (with a brief description and the morpho-species they correspond to in parentheses): *Lasioglossum* subgenus *Ctenonomia* sp. (~7 mm long, yellow and black, hairy bee; morpho-species C), Syrphidae fly (~8 mm long, black fly; morpho-species D), Vespoidea wasp (~7 m long, black; morpho-species D). Though identification is preliminary as no capture was made, morpho-species B appears to be some species of honey bee (*Apis* sp.).

Pollinator visits varied greatly by hour of day (peak hours 10.30 a.m.-12.30 pm) and date (3 times as many visitors on Day 2 of observations, due to high number of visits by "honey bee" morpho-species B). Preliminary pollinator observations completed at Mangalimaso intimated that there were fewer pollinators at this site than at Analalava. Further work investigating the potential paucity of pollinators at Mangalimaso, a site that was once a forest fragment and now is largely an agricultural field, compared to Analalava forest could be of interest. Nocturnal pollinator observations and observations of pollinators of female *C. rabaraba* trees still need to be completed. They were prevented by the new moon during the flowering period and the lack of females in flower during the field work period.

Propagation Work.
C. rabaraba has shown resprouting capabilities in the wild, both in new sucker growth visible at trunk injury sights as well as by the many adult individuals showing signs of multiple trunks united laterally at a broad base, presumably sprouts grown from a trunk cut long ago. Despite this, propagation work proved unsuccessful in attempts to sprout *C. rabaraba* from cuttings for this project. Cuttings were taken from both mature plant material which came from tree crowns and from sucker growth found on a damaged tree. No cuttings grew any root material within the 37 day period in which propagation work was completed, though it must be noted that 37 days may not have been adequate time for roots to develop. Cuttings were propagated in native soil (*i.e.* soil taken from forest under trees to allow for possible inoculation of mycorrhizae) with Perlite added to enable good drainage. Cut stems were dusted with commercial rooting hormone powder to encourage root growth and apply fungicide. Some leaves were trimmed from cuttings to decrease loss of moisture via transpiration but adequate leaf surface was left for photosynthesis. Despite these measures, the propagation set-up was rudimentary due to field conditions and far from ideal. Cloches were constructed out of plastic water bottles to help create a moist environment for cuttings,

but it was possible to mist stems only twice a day (before departure for the forest each morning and upon return each evening) which may not have been sufficient.

Propagation of *C. rabaraba* from seed proved impossible this field season as seed collected and stored from last year had rotted and fieldwork terminated before fruits had matured enough to release new, ripe seed. *C. rabaraba* seeds seem to be recalcitrant and it may be the case that immediate planting or refrigeration of seeds must be worked into any seed propagation protocol if it is to be successful. Four of the eighteen *C. rabaraba* seedlings found were collected and nurtured throughout the field work period. Three seedlings came from one female and the fourth seeding coming from a different female. Seedlings were only collected from sites where their chance for survival seemed diminished for some reason (*e.g.* close proximity to road or high foot traffic area). All seedlings were distributed to nurseries for *ex situ* conservation in early July, with two of the four seedlings given to Antetazana, the nursery run by the University of Tamatave in partnership with Service des Eaux et Forets (Water and Forestry Department of the Malagasy Government), and the other two given to the nursery at Parc Ivoloina, a local botanical and zoological park run by the Madagascar Fauna Group in association with the St. Louis Zoo (St. Louis, Missouri, USA). These institutions were chosen because their nursery sites are close to Analalava Forest and have a climate more similar to the natural habitat of *C. rabaraba* than the climate of the high plateau nurseries in Antananarivo, for example.

Conservation Recommendations & Conclusions.

Despite the increase in known individuals of this species, *C. rabaraba* remains a critically endangered species under the IUCN guidelines (IUCN, 2001; IUCN, 2003). Work done by MBG, in cooperation with local government authorities (*e.g.* mayor of Foulpointe and representatives from the local *fokotany*, a parish-like entity) and the Malagasy government agency which manages protected areas (ANGAP), has alleviated many, though unfortunately not all, of the anthropological pressures weighing on Analalava forest, the site of the largest *C. rabaraba* population.[1] New census work on *C. rabaraba* has led to proposals for how to improve *in situ* conservation measures by altering proposed micro-reserve conservation areas. *Ex situ* conservation efforts for *C. rabaraba* should focus on the Mangalimaso site. Despite a tentative agreement with the Mangalimaso landowner to leave any *C. rabaraba* trees standing, all *C. rabaraba* seed and seedling materials from this site should be collected annually as the proposed conversion of the land into a vanilla plantation will not allow for natural regeneration on site. It should be remembered that both Mangalimaso and Mahatsara, due to their (current) geographical fragmentation from the larger *C. rabaraba* population at Analalava forest, most likely harbour genetically unique individuals of this species.

Putative pollinators of *C. rabaraba* have been identified for the time period of observations completed. Primary pollination by bees, and perhaps flies, fits the observed pollination syndrome characteristics as well as previous anecdotal observations of pollination for congeneric species. Further pollinator observations (*e.g.* female tree pollinators, nocturnal pollinators), particularly earlier in the flowering season, and examination of the breeding system of *C. rabaraba* (*e.g.* possible role of pseudohermaphrodite flowers; possible occurrence of agamospermy) would be useful. Successful methods for seed storage for *C. rabaraba* are still badly needed. Development of a local agro-forestry system based on propagation of *C. rabaraba* remains an attractive proposal for many reasons (*e.g.* linking

[1] Though it should be noted that currently none of the three sites in which *C. rabaraba* occur are legally classified as protected areas by the Malagasy government.

economic incentives from sustainable timber production practices with conservation measures), though more sophisticated horticultural work must be completed before such an initiative could begin.

Other work completed this past field season included further study of other species of the Analalava forest flora. I worked with Véronique Ravololonarivo, a student from the University of Tamatave[2], to develop and complete a study of four species potentially endemic to Analalava forest: *Macrostelia* sp. nov. (Malvaceae), *Malleastrum minutifoliolatum* (Meliaceae), *Mammea castrae* (Clusiaceae) and *Cynometra capuronii* (Leguminosae). Rapid census work (including mapping and data collection on natural history traits, regeneration, habitat, etc.) and interviews were conducted as a means to make a preliminary assessment of how endangered these species are and what pressures they may be under. General collections of fertile specimens were also made throughout the field study to augment the botanical checklist for Analalava forest. Preliminary herbarium work indicates we may have collected a new species of *Diospyros* (Ebenaceae), a duplicate of which will be deposited at the Herbarium of the Royal Botanic Garden Edinburgh.

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Literature cited.

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[2] The Malagasy government requires foreign researchers to collaborate with (and employ) a Malagasy specialist in their field or to train a Malagasy student during the course of their field work in the country.