

Kwamkoro forest plot, Amani Nature Reserve, East Usambaras, Tanzania

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2006

Plot history: The Kwamkoro Forest Plot was established in February 1987. The aims were to:

- study the impact of pit-sawing on the forest,
- investigate past patterns of treefalls in a mature stand, and
- assess species and size structure of trees.

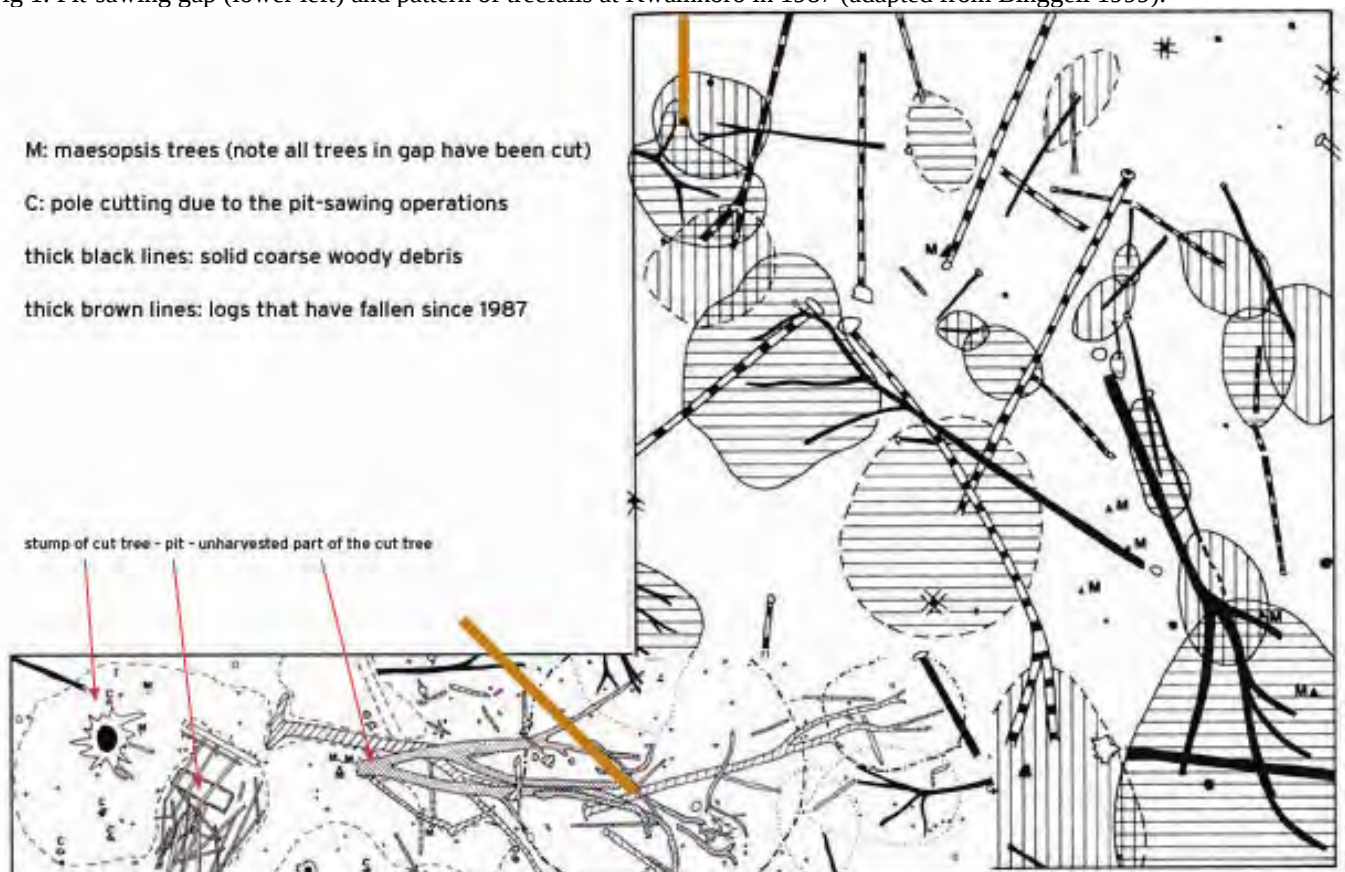
The work was carried out by P. Binggeli (plot establishment and disturbance), A.C. Hamilton and C.K. Ruffo (tree identification) with the technical help of the Kwamkoro Forest Office personnel. For details see Binggeli (1989). The plot was relocated in 2001 and visited in 2006.

Location and characteristics: The plot is located at the North-western end of the former Kwamkoro Forest Reserve on a small plateau. The area is flat or gently sloping and is close to a small stream. This part of the forest was impacted by the removal of some large trees by pit-sawyers during the late 1970s. No further disturbance to the plot has occurred since, although the nearby stream has been severely affected by gold mining operations over the past year. The plot is L-shaped and consists of two distinct tree stands and covers 6,000 m² (Fig. 1). The largest (4,000 m²) area is of mature forest where a number of large trees have died over the past 100 years or so whilst the other (2,000 m²) is a gap at the building-up phase.

Methodology: All trees (GBH > 10cm) were identified, measured and located in a grid square. In addition, in the pit-sawing gap area, the height of all trees was measured and the cover and height of the shrub layer was also documented. Damage to trees, tree mortality and pole cutting due to the logging operation were also recorded. Throughout the plot the degree of decomposition of fallen logs and stumps was assessed.

Species composition: In total 61 species were recorded. The commonest species were in order of decreasing importance: *Sorindeia madagascarensis* (13%), *Greenwayodendron suaveolens* (8%), *Myrianthus holstii* (7%), *Macaranga capensis* (6%), *Cynometra* spp (5%), *Mesogyne insignis* (5%), *Newtonia buchananii* (5%), *Allanblackia stuhlmannii* (4%), *Anisophyllea obtusifolia* (4%) and *Xymalos monospora* (4%). Two common invasive species were *Maesopsis eminii* (3%) and *Milletia dura* (1%), whereas *Lantana camara* did not dominate the open gap area as it often does elsewhere in the region.

Fig 1. Pit-sawing gap (lower left) and pattern of treefalls at Kwamkoro in 1987 (adapted from Binggeli 1999).



Observed changes between 1987 and 2006: This section is based on casual observations carried out in 2001 and 2006.

Pit-sawing gap: In 1987 the gap was still very much opened and was covered by a dense shrub layer with a small amount of tree saplings emerging here and there (photo below left). Since then a tree canopy has formed over much of the gap, but over the crown zone of the cut tree in particular. The shrub layer is now less dense and near the cut stump one tree (*Harungana madagascariensis*) has grown rapidly (DBH growth from 5 to 50 cm and height from 4 to around 20 m). Little regeneration of canopy trees has occurred since the 1987 survey and gaps still exist in the canopy. The *N. buchananii* stump and the section of the main log not harvested are still partly solid when this species is generally thought to decompose rapidly (N. Geddes, pers. comm.). On large dead standing tree fell during the 1990s.

Mature plot: Until a large tree fell down recently (probably late 2005), little change occurred to the stand. The large hard logs that were on the ground (in black on Fig. 1) have partly decayed whereas the others (partly decayed in 1987) are now difficult to identify on the ground. Few trees appear to have grown much with the exception of most *Maesopsis eminii* (largest DBH increment was from 20 to 63 cm).



Figure 2. Forest gap created by the cutting of a large *Newtonia buchananii* by pit-sawyers in 1978. Left: view of the gap in 1987 looking towards the cut stump. Right: same view in 2006 showing the continuous canopy cover that now dominates the crown zone area of the treefall gap. In contrast the zone where timber extraction operations were carried out has remained pretty open with a low density of tree seedlings and saplings.



Potential for research: Because the Kwamkoro Plot is much larger than the many small permanent plots established in the East Usambaras, it provides data that can be used in investigations of forest dynamics including:

- tree mortality and recruitment
- growth rates both in terms of height and diameter
- assessment of forest recovery following human and natural disturbances
- changes in shrub cover and species composition
- gaining insights into forest processes such as rates of decomposition of coarse woody debris and lifespan of large tree species

Resources availability: Data and plot maps are held by P. Binggeli. A.C. Hamilton has the 1987 photographic record. Although a number of people (ANR and TBA staff) have now visited the plot, accurate knowledge of the site, and position of the plot in particular, is only currently available from P. Binggeli.

Reference: Binggeli, P. (1989) The ecology of *Maesopsis* invasion and dynamics of the evergreen forest of East Usambara, and their implications for forest conservation and forest practices. In: A.C. Hamilton & R. Bendsted-Smith (Eds) Forest conservation in the East Usambara Mountains, Tanzania, pp. 269–300. IUCN, Gland.
