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Tropical forest primates and logging: long-term coexistence?

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Over 10 years ago, Oryx *published initial details of an investigation into the effects of selective timber logging on primates in the Sungai Tekam Forestry Concession in peninsular Malaysia (Johns, 1983). This original 2-year field study developed into a long-term monitoring programme, in which the recovery of primates in the regenerating forest is to be recorded throughout the logging cycle. This is the only such monitoring programme so far established in the world's tropical forests. The dataset is now complete for forests logged up to 18 years ago.*

Introduction

Detailed studies of the effects of timber logging on rain-forest wildlife date back only to the late 1970s. At that time, logged tropical forest was generally viewed as 'lost' habitat of no use to species conservation (Myers, 1980). Since then opinions as to whether logged forests should necessarily be excluded from conservation strategies have started to change (e.g. Ledec and Goodland, 1988). In some cases, areas of logged forest have been gazetted as new protected areas; in many regions sustained-yield logging is viewed as an appropriate activity in buffer zones around strictly protected areas (e.g. TELESIS, 1991).

This turnaround has come about mainly for practical reasons. While unlogged forests are undoubtedly the best conservation areas, they tend to be in short supply and compete poorly with other land-use options in economic terms. Forests logged in the past are often heavily damaged, but can retain conservation value. Forests scheduled for logging in the future represent a possibility for biologically sound management.

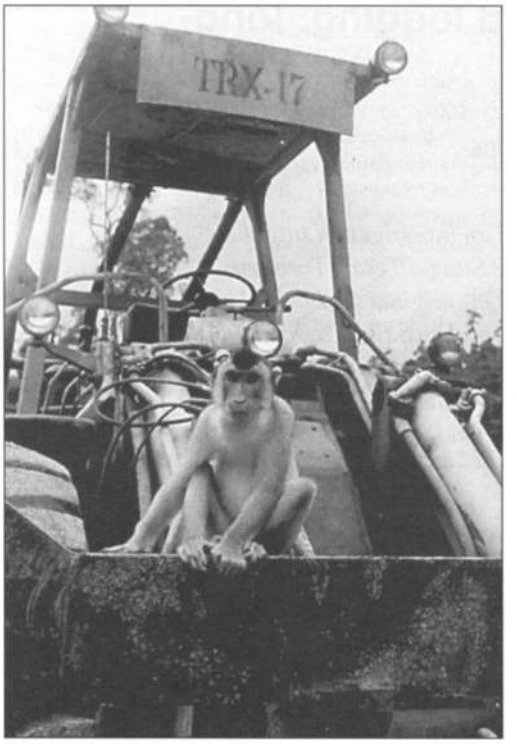
Logging studies

Studies of wildlife in logged tropical forests usually concentrate on conspicuous vertebrate species, notably primates. Among primates, some species, generally large-bodied frugivores, may be less frequently encountered in logged forests and are thus inferred to be adversely affected (Johns and Skorupa, 1987). Comparative studies are largely speculative, however, in that they cannot allow for variation in initial primate densities. This can be considerable over even very short distances (Johns, 1989) and can reflect differences in vegetation as well as historical or other factors.

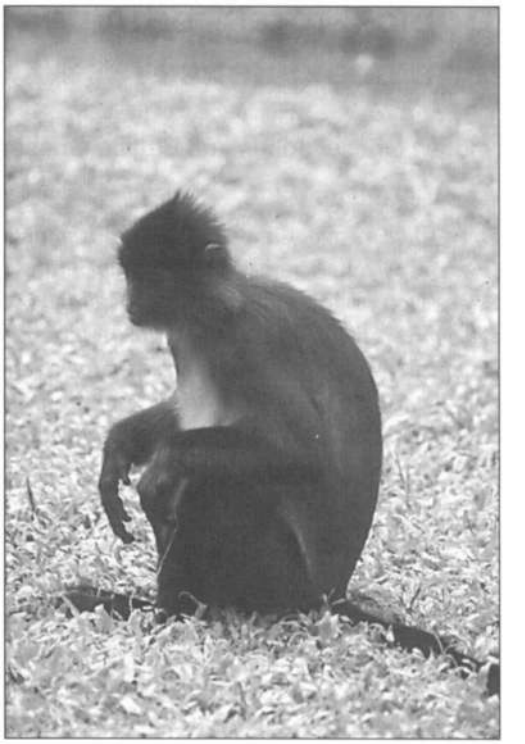
To record the responses of primates to logging it is really necessary to study single populations right through the process from pre-logging, through the felling operation, and throughout the forest regeneration cycle. Of course, this takes a long time. Between 1979 and 1981 a long-term study of this type was established in the Sungai Tekam Forestry Concession (now the Tekam Forest Reserve) in peninsular Malaysia (Johns, 1983). Further surveys were undertaken in 1987 and 1993. This study apparently remains the only attempt to create such a long-term database.

Felling and recovery

The forests at Tekam are managed on a polycyclical logging system ('Selective Management System') whereby damage to seedlings and pole trees of commercial species is avoided during the felling operation. These small trees



Pig-tailed macaque (*A. Grieser Johns*).



Banded leaf monkey (*A. Grieser Johns*).

grow rapidly following opening up of the canopy and increased light intensities to form a new timber crop within a projected time of 35 years. At least, that is the theory.

The most notable feature of a felling operation studied at Tekam was that damage was completely non-selective in its effects. It removed or damaged all size-classes of trees, and all species of trees, to a similar extent. Initially it caused about a 50 per cent loss (Johns, 1988). A number of small commercial trees did survive the operation and these were supplemented with a certain amount of replanting. Fieldwork carried out by the Forest Research Institute of Malaysia at Tekam is demonstrating that the growth rate of these

Table 1. Estimated infant/female ratios among primates at site C13C, Tekam Forest Reserve

Species	Infant/female ratios				
	Unlogged forest	During logging	6 months after logging	6 years after logging	12 years after logging
Banded leaf monkey *Presbytis melalophos*	0.41	0	0.13	0.14	0.16
Dusky leaf monkey *P. obscura*	0.31	0	0.09	0.20	0.09
Long-tailed macaque *Macaca fascicularis*	0.25	0.18	0.18	0.25	no data
White-handed gibbon *Hylobates lar*	0.50	0	0.50	0.33	0.50

Comparative data are not available for the fifth diurnal species, the pig-tailed macaque *Macaca nemestrina*. Site C13C was logged in 1980–81. (For map of study sites see Johns, 1989.)

trees has been minimal over the 12 years or more that they have been monitored (S. Appanah, pers. comm.). The time required for the timber crop to regenerate will probably fall between 35- and 70-year projections, representing best- and worst-case scenarios, respectively.

Primate population density

Felling operations at Tekam resulted in a great deal of immediate mortality of infant primates (although precise causes for this were unclear). Surveys in the same area 6 and 12 years after logging showed recovery of infant numbers in white-handed gibbons, but not in leaf monkeys (Table 1). For leaf monkeys this suggests that fewer infants would reach maturity and thus that group size should decrease in logged forests. The average size of encountered parties decreased significantly for leaf monkeys but not for gibbons (Table 2). Encounter rates with both leaf monkeys and gibbons increased in older logged forests. The reduction in leaf-monkey party size appears to be due to subgrouping, which is an adaptation by these species in response to the different distribution of food sources in logged forests. Party sizes are smaller but the number of parties increase. Why more gibbon parties are being encountered is unclear.

Looked at in terms of the estimated density of individuals recorded by line transect surveys, there are few obvious trends (Figure 1). The only consistent feature appears to be a peaking of the population density of long-tailed macaques in forests logged at least 6 years previously. This species is a specialist of high-productivity edge and secondary habitats (Marsh and Wilson, 1981) and groups appear to be extending their ranges from the main river valleys into surrounding logged forests. There is no evidence of decreasing populations of gibbons and leaf monkeys in most areas, which is contrary to what would be expected from a reduction in breeding success. The 1993 surveys do suggest populations of primates are decreasing at one site C5A, which is close to the entrance to the Tekam Reserve, but this may be due to the recent occurrence of hunting.

Table 2. Mean party sizes and encounter rates for surveyed primates in Tekam Forest Reserve

	Unlogged	1–6 years after logging	6–12 years after logging	12–18years after logging
Party size				
Banded leaf monkey *Presbytis melalophos*	14.0	8.5*	7.4†	7.7†
Dusky leaf monkey *P. obscura*	14.0	8.5*	7.5†	6.9†
White-handed gibbon *Hylobates lar*	3.5	3.0†	3.0††	3.1††
Encounter rate				
(parties seen/km walked)				
Banded leaf monkey *P. melalophos*		0.34	0.46	0.60
Dusky leaf monkey *P. obscura*		0.17	0.25	0.37
Pig-tailed macaque *Macaca nemestrina*		0.01	0.01	0.15
Long-tailed macaque *M. fascicularis*		0.01	0.09	0.05
White-handed gibbon *Hylobates lar*		0.21	0.32	0.49

Data from 1–6-year-old logged forest combines sites C5A=, C1A and C2; data from 6–12-year-old logged forest combines sites C13C, C5A, C1A and C2; data from 12–18-year-old logged forest combines sites C13C, C1A and C2 (C5A is excluded due to hunting pressure at that site). Party sizes in *Macaca* spp. tend to be large and the number of accurate counts obtained were considered insufficient for mean party sizes to be calculated. Encounter rate data are not available for unlogged forest.

* Group counts significantly smaller than in unlogged forest (Kolmogorov–Smirnov test, $P<0.05$).

† Group counts not significantly different from those in unlogged forest (Kolmogorov–Smirnov test, $P>0.05$).

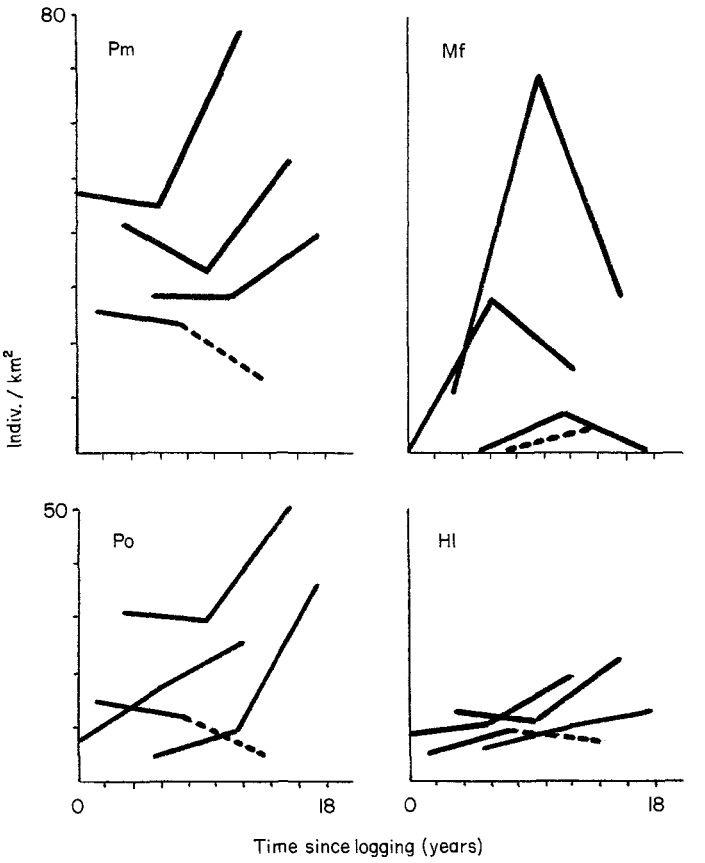


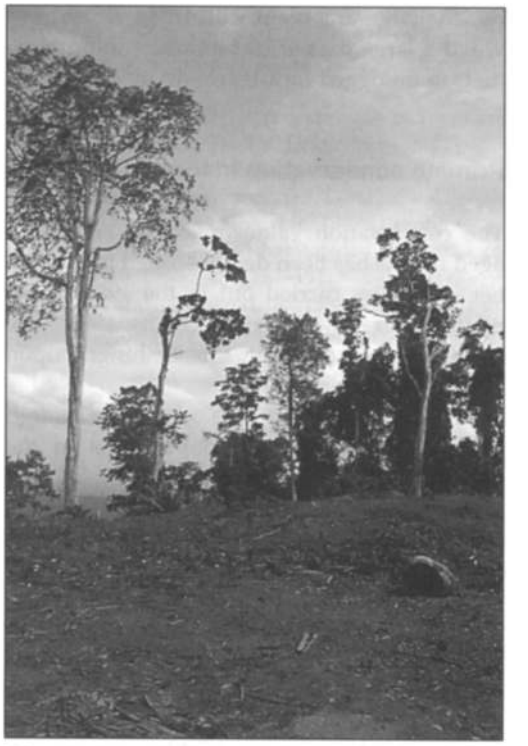
Figure 1. Estimated primate population densities in four sites at Tekam.
Pm, *Presbytis melalophos* (banded leaf monkey), Po, *P. obscura* (dusky leaf monkey), Mf, *Macaca fascicularis* (long-tailed macaque), Hl, *Hylobates lar* (white-handed gibbon).
Lines link data points from the same study site; dotted lines indicate the presence of hunting. Densities are estimated by hazard-rate statistics using the DISTANCE programme (Buckland *et al.*, 1993). (Data from 0–12 years post-logging are reanalysed for uniformity.) Insufficient survey repetitions have been conducted to date to allow statistical examination of trends.

(In between the 1987 and 1993 surveys, native Orang Asli were resettled from their original hunting grounds in the National Park [Taman Negara] to areas near the Tekam Reserve, and allowed to hunt in the forest using traditional weapons. Hunting is generally conducted from logging roads using blowpipes, and primates are often targeted. Unlike other surveyed sites, access to site C5A was by open road rather than by forest trails cut for the purpose. The extreme shyness of primates at this site, easy access, and evidence of Orang Asli [bare footprints: forestry workers wear boots] suggests that hunting may have occurred here: there was no evidence of hunting at any other site.)

Apparent increases in numbers of primates at non-hunted sites require some explanation. It might be suggested that the size of the parties being encountered is being overestimated. This is possible, because accurate numbers are difficult to obtain, but estimates tend to err on the low side. It may also be suggested that more parties are being seen because the animals are becoming more habituated to observers: this is rejected because the only other human contacts outside survey periods are with infrequent forest inventory teams. Finally, perhaps food availability is increasing in logged-over forests? A very dense lower canopy forms by 10 years after logging, which provides some extra food for leaf monkeys,

Opposite. Ridgetop habitat at site C13C (photos taken from approximately the same location). *Eucalyptus* trees were planted along the ridgetop in mid-1981 to aid regeneration: (a) Before logging (September 1979); (b) 3 months after the end of logging (April 1981); (c) 6.5 years after logging (June 1987); (d) 12.5 years after logging (August 1993).

(a)



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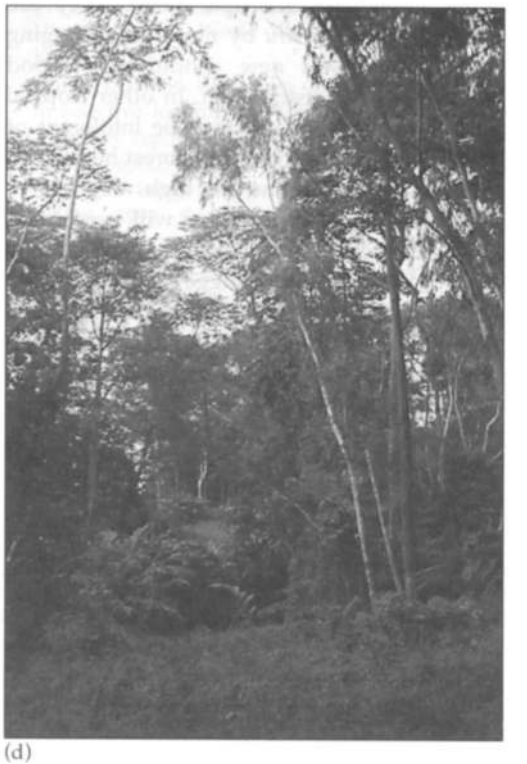

(d)

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but the large emergent fruit trees, which provided a large part of leaf-monkey and gibbon diets in unlogged forest, are still infrequent.

Primate conservation in logged forest

The conservation value of logged and managed forests has been demonstrated by a number of studies carried out in the 1980s in all major geographical regions (Johns, 1992). The specific value of these forests hinges upon three main factors:

- whether the logged forests provide enough resources to maintain populations in the critical period immediately after logging;
- whether refuges exist within the logging areas to maintain species sensitive to the initial impact;
- whether all species recolonize and regain stable populations before the next felling cycle.

The primates studied at Tekam are not highly selective of microhabitat types or specific food resources (unlike certain primates elsewhere: Skorupa, 1986). They are able to survive *in situ* by modifying foraging behaviour to suit new conditions of food abundance and distribution. In other tropical forest regions, primates may be intolerant of conditions in recently logged forest because of specific specializations or high degrees of logging damage, and refuges will need to be provided from which they can recolonize. There have been some suggestions from East Malaysia, for example, that orang-utans *Pongo pygmaeus* may concentrate in unlogged compartments of logging concessions from which they will later recolonize logged-over areas (Payne, 1988).

There are no data available covering more than one felling cycle, so the last factor remains uninvestigated at present. Logging on a cyclical basis will probably change the forest ecosystem, perhaps reducing its complexity. This may be expected to affect the primate community, as well as populations of other animals, but to an extent as yet unknown.

The status of tropical forestry

Viewing forest management as a technical problem in both technology and economics, there is certainly scope for management on a sustained-yield basis. Some systems already developed appear both biologically and economically sound and should work in the long term (Whitmore, 1991). In general, however, natural management of tropical forests has failed (Mergen and Vincent, 1987; Gómez-Pompa *et al.*, 1991), although reasons for this are varied and disputed.

The main problem seems to be that silvicultural rules are not followed – usually in order to maximize initial financial returns. Experimental operations, where rules are followed and the felling is carefully monitored, give good results in terms of limiting damage and encouraging regeneration (e.g. Sarawak – Marn, 1982; Queensland – Nicholson and Keys, in Whitmore, 1990; Suriname – Hendrison, 1990). Carrying it out properly also reduces operating costs, although it does require a high level of training of forestry field staff.

In late 1991, one of the authors (A.G.J.) addressed a seminar organized by FINNIDA on the principles of environmentally sound forest management. This was attended by around 40 government officers and industrialists concerned with the forestry sector. The general feeling among participants seemed to be that the scientific basis for sustained-yield logging was all very well, but it did not touch upon their chief concern. Managers view their role as one of ensuring the production of a commodity to within specific time limits and within specific cost brackets, both rigidly defined. Managers had little room for manoeuvre because profit margins were low due to the underpricing of timber on the world market.

Unlike most natural resources, timber is renewable if managed correctly. This is frequently misinterpreted as meaning that timber production is by definition sustainable. To achieve sustainable production over the long-term, some level of investment in the resource is required. Foregoing a percentage of poten-

tial profit in order to improve the regeneration potential of the forest would pay off in the long term. This percentage of profit could probably be spared more by the importing than the exporting countries. Unless there is some commitment by both importing and exporting industries, the gulf between scientifically based management recommendations and actual timber harvesting industries is likely to remain rather large.

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