Life after logging

How to reconcile wildlife conservation and production forestry in Indonesian Borneo

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Synergies: the tropical forest ecosystem supports an extraordinary range of interactions between different life forms. *Photo: © Gabriella Frederiksson*

BORNEO contains the richest and largest expanse of forest in Southeast Asia. It harbours exceptional biodiversity, including 6% of the world's flowering plant species, 6% of the world's bird species and 6% of the world's mammal species—all on less than 1% of the earth's land area. Safeguarding this natural wealth is a globally significant conservation task.

The Indonesian government has pledged to do its best to protect the nation's rich natural heritage, but achieving conservation goals remains an immense challenge. We know that biodiversity suffers whenever natural forest is cleared for other uses; on the other hand, selectively logged forests can provide valuable habitat for many species that would disappear if the forest was lost altogether.

Timber extraction inevitably affects forest flora and fauna, but operational practices can influence this in various ways. Understanding the nature of the impacts can help us devise forest management practices that are more 'wildlife friendly'.

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We recently conducted a comprehensive review of how vertebrate species of Borneo's lowland and hill dipterocarp forest are affected by logging and associated changes, and what might be done to minimise any negative impacts. We focused on the wildlife of Malinau District in Indonesia's East Kalimantan Province, the most forest-rich area remaining on Borneo[1].

The result of this review, undertaken with a range of local partners, government agencies and non-governmental organisations, was published recently in a multi-author book (Meijaard et al. 2005); it shows that forest management can be improved in many simple ways to allow both timber extraction and wildlife conservation.

Our sources included 280 publications and reports concerned with wildlife in Borneo, as well as a large body of regional and global literature. We consulted various local and international experts, several of whom became co-authors and contributors, examined various unpublished data sets, and gathered information from local people. Our main aim was to provide guidance that would help forest managers minimise the negative impacts of their logging operations on wildlife and maximise the role of production forests in wildlife conservation.

In this article we present some general results, give examples and make some specific recommendations for reducing logging impacts on wildlife.

[1]*The Malinau research site is the focus of an ITTO-supported project, PD12/97 Rev. 1 (F):* Forest, science and sustainability: the Bulungan Model Forest*, under which considerable research on the effects of logging on wildlife was conducted.*

Accommodating wildlife

Bornean species that would most benefit from more wildlife-friendly concession management

SPECIES (COMMON NAME)	MAIN THREAT	REMARKS
Sus barbatus (bearded pig)	Hunting and habitat fragmentation	Not threatened on Borneo but may be vulnerable to fragmentation. Migratory. Probably a major selective force in forest regeneration. The preferred food item of forest-interior people (except amongst Muslims)
Ursus malayanus (sun bear)	Habitat modification, hunting, disturbance and fragmentation	Listed as 'data deficient' and proposed as 'vulnerable' in the IUCN red list of threatened species (IUCN 2003); legally protected. Bear parts are traded as high-value items. Local people fear and kill them
Muntiacus atherodes (Bornean muntjac)	Habitat modification and hunting (especially in lowlands)	Not in the IUCN red list
Presbytis spp (leaf monkeys)	Logging-related hunting and targeted collection of bezoar stones	*P. hosei* and *P. frontata* listed as 'data deficient' in the IUCN red list
Tragulus spp (mouse-deer)	Habitat modification and hunting	Not listed in the IUCN red list; legally protected
Hylobates muelleri (Bornean gibbon)	Habitat modification and hunting	Listed as 'lower risk/near-threatened' in the IUCN red list; legally protected
Pongo pygmaeus (Bornean orangutan)	Hunting and pet trade	Listed as 'endangered' in the IUCN red list; legally protected
Cervus unicolor (sambar)	Hunting, although benefiting ecologically from habitat modification	Legally protected. Still common at distance from settlements and widely hunted in Malinau
Neofelis nebulosa (clouded leopard)	Little known; probably limited by prey availability; also targeted for hunting	Listed as 'vulnerable' in the IUCN red list; legally protected. Hunted for traditional ceremonial clothing
Most small carnivores (cats, mongooses and civets)	Probably fragmentation	*Cynogale bennettii* and *Catopuma badia* are listed as 'endangered' in the IUCN red list
Ratufa affinis (pale giant squirrel)	Habitat modification; hunting	Not in the IUCN red list
Sundasciurus hippurus (horse-tailed squirrel)	Habitat modification	Not in the IUCN red list
Rhinosciurus laticaudatus (shrew-faced ground squirrel)	Habitat modification	Not in the IUCN red list
Lariscus hosei (four-striped ground squirrel)	Habitat modification	Listed as 'vulnerable' in the IUCN red list
Lariscus insignis (three-striped ground squirrel)	Habitat modification	Not in the IUCN red list
All hornbill species	Habitat modification (nesting trees and fruit) and fragmentation; hunting for food, feathers and trophies	*Anthracoceros malayanus*, *Buceros rhinoceros* and *Rhinoplax vigil* are listed as 'lower risk/near-threatened' in the IUCN red list. Have strong cultural significance for local people. Feathers and skulls used in rituals
Most woodpecker species	Habitat modification	*Dinopium rafflesii* and *Meiglyptes tukki* are listed as 'lower risk/near-threatened' but do not seem to suffer much from logging. Others are not listed but are much affected by logging
Most trogons and broadbills	Habitat modification and fragmentation	4 trogons and 2 broadbills are listed as 'lower risk/near-threatened'
All pheasants	Hunting	Although pheasants are probably quite tolerant of the effects of habitat modification, they are much affected by hunting
Several owls, frogmouths and raptors	Especially interior forest specialists are likely to be affected by vegetation changes and disturbance, although most of the listed species probably also hunt outside forests	Many of these species are protected and in the IUCN red list
Gracula religiosa (hill myna)	Affected by trapping	Not in the IUCN red list, not protected
Irena puella (Asian fairy bluebird)	Ecological effects of habitat modification and fragmentation	Not in the IUCN red list
Several *Malacopteron* babblers	Habitat modification	Logging-intolerant species are not in the IUCN red list
Alcedo euryzona (blue-banded kingfisher) and *Lacedo pulchella* (banded kingfisher)	Both affected by habitat modification and fragmentation	Not in the IUCN red list but both species legally protected
Pigeons	Especially frugivore specialists are sensitive to the ecological effects of habitat modification; many pigeons are hunted	*Treron fulvicollis* is listed as 'lower risk/near-threatened' in the IUCN red list; *Ducula pickeringii* and *T. capellei* are listed as 'vulnerable'
All crocodiles	Hunted and collected	Not protected in Indonesia. Almost extinct in Malinau
All turtles/terrapins/tortoises	Hunted and collected	Most are listed as 'critically endangered', 'endangered' or 'vulnerable' in the IUCN red list; none is protected in Indonesia
Certain fish species, such as *Tor tambra*, *T. tambroides* and *Pangasius* spp	Ecological effects of habitat modification; overfishing. Need clean water and silt-free stream bed	Not in the IUCN red list. High-value and highly sought-after by local people. *Tor* species eat fruit and algae and are not found in logged forest or deforested land

Logging impacts

Habitat modification

Logging modifies forest habitat, at least in the short term. For example, various microclimatic changes occur in a forest that has been subjected to timber harvesting. These factors are important for species such as ground-dwelling amphibians and agamid lizards that require humid conditions.

Structural changes can affect perching, foraging, nesting, breeding or resting. We know that gibbons are obligate



Keystone: bearded pigs are important seed predators and ecosystem engineers in Bornean forests and a major source of animal fats and protein for indigenous communities. *Photo: © Kimabajo*

canopy-dwellers that require intact canopy structure. Some squirrels (eg *Ratufa* spp) prefer upper canopy, binturong (*Arctictis binturong*) are reluctant to travel on the ground and hornbills rely on branches for insect foraging.

Certain species, such as small rodents, benefit from the denser, more complex understorey conditions that can follow logging, while others—such as frogmouths (*Batrachostomus* spp) and forest owls like *Otus rufescens*—seem to require the orderly and open structure of primary forests. Some, like forest bats (*Hipposideros* spp and *Rhinolophus* spp), are poorly adapted to finding food in open forest.

Larger-stemmed trees provide wildlife with hollows for nesting and food storage. Practices that remove trees with cavities, as well as dead standing trees, may be one reason why hole-nesting birds suffer from logging. Certain hollow-using civets and squirrels, especially species like *Ratufa affinis*, may also suffer from the disappearance of hollow trees after logging.

Rotting tree stumps are used by species such as squirrels, sun bear (*Ursus malayanus*), trogons, forest kingfishers and forest bee-eaters. Rocky outcrops provide nesting and roosting spaces for a variety of species, including reptiles, birds (raptors, swifts) and small mammals, and provide refuge against predators; such sites are often damaged during the collection of material for road-building. Liana-cutting can lead to reduced fruit abundance.

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We found no evidence of any vertebrates having a specific dependency on dipterocarps or other targeted commercial timber species such as *Agathis*. Nonetheless, mast fruiting episodes (in which a population of trees produce fruit simultaneously) involving dipterocarps may be critical for the long-term breeding success of several species. Large dipterocarp trees (especially those with cavities) also serve as important nesting sites.

The low vertebrate abundances found in areas like Malinau can be attributed not only to hunting but also to the naturally low abundance of fruits and palatable foliage, and to mineral deficiencies in the soils. Such poor resources suggest the critical importance of fruiting trees and sources of minerals ('salt springs', 'salt earths' and sites with clays that are eaten by animals).

Apart from modifying habitat, logging may also lead to an increased risk of fire, the invasion of weedy and exotic species, damaged soils and increased sediment loads in rivers. Two other potential effects are particularly important: hunting and habitat fragmentation.

Hunting

Increased accessibility and the provisioning needs of logging camps often escalate hunting. Camp staff themselves often set traps, trade in cage birds, and fish using harmful techniques. Hunting is especially intense for species that are targeted for food or trade, such as ungulates, primates, pangolin, terrapins, crocodiles and specific bird species such as hornbills, pheasants and the straw-headed bulbul (*Pycnonotus zeylanicus*).

Fragmentation

Fragmentation is a major concern, especially for species that occur at low densities and have large home ranges (eg carnivores and migrating species); divided populations are at much greater risk of local extinction. New forest edges can also have deleterious effects which might extend considerable distances into undisturbed forests. The effects of fragmentation are greatest in forests with excessive road density, wide clearings and many large deforested openings.

The character of sensitive species

By analysing results from numerous studies we identified factors typically associated with vulnerable vertebrates *(see box opposite)*. These were dietary specialisation, restricted feeding strata, endemicity, apparent evolutionary age, and absence from small islands. Terrestrial insectivores and frugivores (fruit-eaters) appear particularly sensitive, whereas herbivores and omnivores are more tolerant or even benefit from logging. Typically, the wider a species' ecological niche, the more tolerant it is of changes. We also identified the main threats posed by logging to specific wildlife *(see table previous page)*.

Reducing logging impacts

What can be done to mitigate the impacts of logging on wildlife? The results of our review show how the application of conservation planning and implementation, good road-building and reduced impact logging methods can benefit wildlife. The implications of some recommendations require further evaluation (for example, is it possible to maintain canopy connectivity across logging roads and still allow the road surface to dry? Perhaps yes in rocky areas), but most appear ready for implementation.



Will he make it? Red leaf monkeys (*Presbytis rubicunda*) require canopy connectivity for their arboreal lifestyles. *Photo: © Kimabajo*

Recommendations

It is important to retain contiguous forest as far as possible. Reducing the width of roads and tracks, and limiting felling-gap sizes, should reduce the effects of fragmentation on arboreal species.

We recommend the regulation of hunting in timber concessions. Ideally, the hunting of IUCN-listed and locally vulnerable species should be eliminated.

Various types of ecologically important habitat structures (such as large trees, hollow trees and old fruit gardens) and locations (pools, wallows, salt-licks, and river-side habitats offering nesting opportunities for reptiles and amphibians) should be identified and maintained where possible.

Plant species and genera that are important habitat components (some of which are listed in Meijaard et al. 2005) should be retained. Protecting the mid-canopy by minimising incidental tree damage is a good strategy for conserving a whole host of palms and fruiting shrubs. We strongly recommend that understorey slashing (currently a legal requirement) be discontinued.

Conclusions

Researchers usually emphasise what is unknown over what is known. Indeed, our review shows that in many respects Bornean wildlife remains poorly understood. Nonetheless, we have sufficient knowledge to identify a number of practices that, if applied in logging operations, would be beneficial for wildlife conservation in Borneo. While research will continue to contribute to our understanding, a lack of knowledge now cannot justify delay in implementing these practices whenever the opportunity arises.

We believe that reviews like ours are essential if we are to begin addressing the complex realities of conserving tropical biodiversity without constraining development options. Production forests can serve as a useful component in a large-scale conservation strategy, not as a replacement for strictly protected areas but as a valuable addition. Improving current management practices requires pragmatic collaboration between ecologists and forest managers. Our multi-stakeholder review and synthesis is one contribution to such collaboration.

References

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Protecting the mid-canopy by minimising incidental tree damage is a good strategy for conserving a whole host of palms and fruiting shrubs.

The book can be downloaded as a 2.6 MB pdf file at: www.cifor.cgiar.org/scripts/newscripts/publications/detail.asp?pid=1663. To request a hard copy of the book contact Nia Sabarniati at n.sabarniati@cgiar.org. While stocks last, copies are free for people from developing countries; others must pay postage.

Logging impacts on wildlife groups

Mammals

Various mammals are sensitive to timber extraction. These include: (a) those with specialised diets, like the Bornean gibbon (*Hylobates muelleri*); (b) species restricted to particular vegetation strata (eg ground level, high canopy), such as the terrestrial Malay civet (*Viverra tangalunga*); and (c) species endemic to Borneo, like the Bornean yellow muntjac (*Muntiacus atherodes*).

Birds

Specialist insectivorous birds of the understorey like the inconspicuous striped wren babbler (*Kenopia striata*) are rarely seen in logged forest, probably because of reduced food. Birds sought by hunters, such as the culturally important hornbills, suffer indirectly from logging when hunting pressures increase. Some, like the helmeted hornbill (*Rhinoplax vigil*), are further impacted because they only nest in large dipterocarps, which are often felled in timber operations.

Amphibians

Logging can, at least initially, increase the species-richness of frogs. This happens because logging creates ecological niches that are normally not found in unlogged forests; these, in turn, attract species like the spotted stream frog (*Rana signata*), a species generally encountered in more open forest areas. It is unclear how the increased competition from these new species might affect forest specialists.

Reptiles

Little is known about the direct ecological effects of timber extraction on reptiles; most species occur at low densities. Certain species (such as terrapins) suffer because they are sought-after for trade. Species that live within the leaf litter are locally impacted, but more data are needed.

Fish

The fish that suffer most from logging occur in fast-flowing streams and rivers. Species like the Borneo-endemic hillstream loaches (*Gastromyzon* spp, *Neogastromyzon* spp, *Homaloptera stephensoni*) and stone-lapping minnows (*Garra borneensis*) require silt-free surfaces and clear water. They decline sharply after logging, although most populations recover rapidly as long as the forested stream environment is maintained. A few species (eg carps like *Tor* spp and *Pangasius* spp) appear more vulnerable: *Tor* eat fruit from riverside forest and algae that grow on silt-free surfaces, have slow reproductive rates and range widely, while *Pangasius* aggregate in a predictable manner, making them vulnerable to over-exploitation, while their breeding sites are also susceptible to damage by logging.