BIODIVERSITY

Hidden impacts of logging

A meta-analysis of changes in the abundance of tropical-forest birds reveals that the effect of selective timber harvesting varies with logging practices and species traits. The results offer a framework for managing impacts on biodiversity.

JOSEPH A. TOBIAS

Tropical forests are famed for their exceptional biological richness, but the future of this biodiversity is increasingly threatened by land-use change. Selective logging — the commercial extraction of valuable timber species — is perhaps the most widespread and rapid form of change, currently affecting at least one-fifth of the remaining tropical forests and proceeding at 20 times the rate of clear-felling (full deforestation)[1]. The effect of selective logging on biodiversity has been the focus of intensive debate, fuelled by decades of local-scale studies that have generated contradictory results. Writing in *Proceedings of the Royal Society B*, Burivalova *et al.*[2] describe an ambitious attempt to resolve this issue by combining local-scale results into a pan-tropical meta-analysis of bird species responses to selective logging.

The authors quantified species responses as the difference in abundance or population density between a logged site and a nearby control site surveyed with the same methods. This focus on abundance is a forward step because broad-scale analyses are often forced to rely on 'presence or absence' data, thus concealing many of the effects of land-use change on biodiversity[3]. With more than 4,000 matched observations for a total of nearly 1,000 species, Burivalova and colleagues' data set has the statistical power and flexibility needed to unravel the complex effects of selective logging on bird populations. The authors capitalize on this potential by building models that simultaneously consider variations in both logging practices and species traits.

The main environmental variables considered were logging intensity, time since logging, the number of logging cycles and the type of logging undertaken. Type of logging ranged from sustainable forestry practices, such as reduced-impact logging, to more-damaging conventional logging. Introducing this level of detail is valuable because variation in the history and type of logging can have markedly different effects on biodiversity[4,5]. Moreover, it is not enough to focus exclusively on the environment because the intrinsic ecological and life-history traits of different species also influence their responses to land-use change[6–8]. The authors therefore incorporated several such traits in their analyses, including diet and body mass, as well as differences in sensitivity to human pressures, such as hunting.

This analytical approach revealed that responses to logging vary according to species traits. For example, the feeding groups most adversely affected by logging were fruit-eating and insect-eating bird species, both of which declined in abundance at high logging intensity. By contrast, populations of nectar-eaters and seed-eaters increased in response to selective logging, at least until forest regeneration closed the tree canopy. This is not particularly surprising: many frugivorous and insectivorous species are forest specialists, whereas nectarivores and granivores are typically associated with non-forested or lightly forested habitats where flowering and seed-bearing plants are more abundant. Similarly, the authors' pan-tropical models revealed that different forms of logging practice had varying, but intuitive, outcomes — higher logging intensity caused the most lasting changes to bird populations (Fig. 1).

Earlier studies have reported similar patterns, both in the effects of logging practices[4,5] and in species traits[6–8]. However, Burivalova *et al.* were able to show that the best-fitting model of avian responses to logging does not pinpoint the dominant predictor to be either logging practices or species traits, but instead a combination of both. Their findings show, for example, that the most important predictors of shifts in abundance after logging were the time elapsed since the most recent logging event and the feeding group of the species involved, along with the interaction between these factors.

A key implication of these findings is that models incorporating information about planned logging practices and species traits could be used to predict the response of individual species, or communities of species, to future logging events. Similar models could even be applied retrospectively to evaluate the impact (and appropriate mitigation) of completed operations in areas where biodiversity was not monitored. Whether these applications are viable remains to be seen, because the models in their current form are relatively crude and have limited predictive power.

This is partly because the meta-analysis was based on a restricted sample of 26 studies, spanning a range of local contexts. Although Burivalova *et al.* made every effort to ensure comparability between these studies, many unavoidable inconsistencies remain — in

MATTIAS KLUM/NATL GEOGR./GETTY

Figure 1 | Logged and loaded. Burivalova *et al.*[2] show that selective logging has long-lasting implications, with populations of some bird species showing little sign of recovery even 40 years after timber extraction.

50 Years Ago

In a written answer in the House of Commons on June 24, the Minister of Technology, Mr. F. Cousins, gave the names of 17 research associations which actively encouraged the use of computers in their respective industries; of 18 research associations which had access to computers on their premises, at universities or at member firms … In another written answer on June 24, Mr. Cousins stated that of 4,064 non-industrial Civil Servants employed by his Department … 1,400 had university degrees or equivalent qualifications in scientific or technological subjects, and about another 1,400 had other scientific or technological qualifications. In a third written answer, Mr Cousins stated … action was in hand … to promote the greater use of technological subjects in television and radio programmes, and to produce special booklets and films for wide distribution among young people.
From *Nature* 10 July 1965

100 Years Ago

Among the recent additions to the zoological department at South Kensington are some specimens which are surely destined to possess historical interest for posterity. They consist only of two or three examples of harvest-mice and one house-mouse, but they were caught in the trenches in northern France, in that part of the trenches, in fact, occupied by some of our Indian troops. These specimens were collected and presented to the museum by one of the officers of an Indian regiment, whose keenness for his favourite pursuit of natural history allowed him in the intervals of being heavily shelled by the enemy a little relaxation in the way of trapping and skinning any animals for the national museum in London.
From *Nature* 8 July 1915

factors such as spatial scale, logging-practice terminology, disturbance history, hunting pressure, road-building activity, survey intensity and observer experience. Moreover, although the total species list seems extensive, it contains numerous open-country or garden birds (such as the common bulbul *Pycnonotus barbatus* and the house wren *Troglodytes aedon*), along with highly conspicuous dispersive taxa (such as parrots and raptors) that may have been observed flying between primary forest patches rather than using logged forests. Inclusion of these categories may obscure the key impacts of logging on populations of forest-dependent species. Similar issues arise with species traits, which Burivalova *et al.* treat in a simplified form. For example, the authors assigned bird species to one of seven feeding groups (carnivores, insectivores, granivores, nectarivores, frugivores, omnivores or herbivores), but many species belong in multiple categories, and shift between categories over space and time[9].

Many of these issues can be addressed by expanding or refining the underlying environmental and biological data. Attempts should be made to coordinate and standardize methods across the current spate of long-term initiatives that monitor the effects of selective logging at the local and landscape scale in tropical and temperate forests. In addition, the immediate prospects for improving information on species traits are good, particularly for birds. For instance, comprehensive data sets that describe the diet, habitat use and biometrics of birds are available (see ref. 9, for example). These offer a more nuanced assessment of key attributes such as dietary niche and dispersal ability, which are relevant to ecosystem processes such as seed dispersal.

Incorporating these advances into global models will shed further light on the role of species traits in predicting responses to land-use change, as well as the broader implications for ecosystem function and services[10,11]. Thus, although Burivalova and colleagues' efforts may fall short of providing a workable model for sustainable forestry, they point the way to more-sophisticated approaches that can help us to understand the impacts of selective logging on biodiversity, and to develop guidelines for logging practices that balance the needs of people with biodiversity across the tropics and beyond. ■

Joseph A. Tobias *is in the Department of Life Sciences, Imperial College London, Silwood Park, Ascot SL5 7PY, UK.*
e-mail: j.tobias@imperial.ac.uk

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ASTROPHYSICS

A twist in the tale of γ-ray bursts

An unusually long burst of γ-rays zapped Earth in December 2011, lasting 4 hours. The cause of this burst is now proposed to be a peculiar supernova produced by a spinning magnetic neutron star. **SEE LETTER P.189**

STEPHEN J. SMARTT

The story of γ-ray bursts (GRBs) originates in nuclear-weapons monitoring during the cold war, and has been elaborated by subsequent technological developments and scientific detective work. GRBs were discovered by the Vela satellites launched in the late 1960s by the US Air Force. The spacecraft carried sensitive γ-ray detectors to monitor the Soviet Union's compliance with the Nuclear Test Ban Treaty. No nuclear explosions on Earth were seen. Instead, mysterious γ-ray flashes were detected, randomly distributed on the sky[1]. On page 189 of this issue, Greiner *et al.*[2] present data for a γ-ray flash that suggest an association with a rare type of supernova, similar to an unusual type of stellar explosion that has been recognized only in the past few years[3].

Nearly 50 years after the end of the cold war, following several space missions dedicated to high-energy astronomy and the harnessing of the most powerful ground-based telescopes,