

## LETTERS

edited by Jennifer Sills

## Exploitation in Northeast India

LITTLE STUDIED AND LITTLE VISITED, NORTHEAST INDIA IS THOUGHT TO be second only to the northern Andes in terrestrial species density (1). Because of its distance from Delhi and its predominantly tribal culture, minimal regulation protects biodiversity in the region. As a result, there has been a transition over the past two decades from sustainable harvesting of wildlife to, in many places, empty forests (2).

The Amur Falcon, *Falco amurensis*, recently joined the list of relatively abundant species that are heavily exploited (3). BirdLife International estimates that, worldwide, the population of these birds is more than 1 million (4). In just one location in the state of Nagaland, more than 120,000 of them are harvested annually during



Captured Amur Falcon.

their stopover on migration from northeast Asia to their winter quarters in southern Africa. The main reason for high exploitation appears to be market forces, with trappers selling birds at the rate of two per U.S. dollar. Carcasses are piled into pickup trucks, whose destination is currently unknown (3).

We draw attention to this phenomenon for three rea-

sons. First, although overexploitation is a problem globally (5), India has a strong legal framework for species protection and a good record of enforcement in other areas of the country. India recently hosted the 11th Conference of the Parties to the United Nations Convention on Biological Diversity, at which it committed \$50 million to the biodiversity targets agreed upon at the previous meeting in Nagoya, Japan. Second, researchers and tourists alike need to be aware that this magnificent area is now relatively easy to access, and not only to developers. Research is essential. Third, time is of the essence. The next few decades will be critical. Relatively few well-protected areas may conserve a large fraction of the region's biodiversity. Alternatively, local communities can become rapidly engaged in wildlife conservation, given the right incentives (6).

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Sharing Future  
Conservation Costs

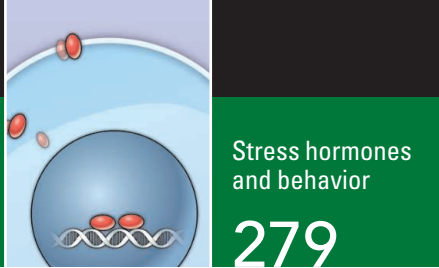
IN THEIR REPORT "FINANCIAL COSTS OF MEETING global biodiversity conservation targets: Current spending and unmet needs" (16 November, p. 946), D. P. McCarthy *et al.* estimate the financial costs required for conservation of terrestrial species as US\$76.1 billion annually. They highlight the need for increased spending while noting that these costs are small relative to the value provided by biodiversity. However, when budgeting current and future funds, we should factor in necessary changes to our conservation approach.

McCarthy *et al.*'s expert-derived expenditure estimates assume a "more of the same" approach to conservation, focusing on the immediate financial costs of rearguard efforts to prevent extinctions. This approach ignores the potential of relatively inexpensive reforms such as regulatory measures to prevent conversion of production forest and the removal of perverse subsidies. It also ignores the need to build a society in which conservation goals are widely acceptable. Critically, it neglects local opportunity costs (i.e., forgone incomes).

McCarthy *et al.*'s cost assessments highlight the expectation that the wider economic benefits resulting from such conservation

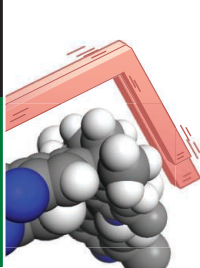
activities surpass their associated costs (i.e., expenditures). These aggregate comparisons avoid the pertinent question of which biodiversity provides what values (and costs) to whom, and confound the opportunity costs imposed upon poor stakeholders with the values accruing to the global community.

For many, the benefits associated with conservation interventions do not outweigh the costs. Much conservation expenditure ensues from the resulting conflicts (1). Yet local people are often sympathetic to conservation, and would accept, and even support, specific actions performed in a transparent and equitable manner and with adequate compensation. Conservation gains will only be secured once



Stress hormones  
and behavior

279



Stiffening microporous  
membranes

284

we reduce the burden on those people who bear unreasonable costs and conservation efforts earn the legitimacy of local democratic accountability.

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## Response

IN THEIR LETTER, SHEIL *ET AL.* APPEAR TO HAVE misinterpreted several key points. Far from ignoring local opportunity costs, we assumed

that for reasons of fairness and effectiveness, establishing new protected areas “will require the full opportunity costs of conservation to be paid” (Supplementary Materials to our Report), as implied in the Convention on Biological Diversity (CBD)’s target (1). Such costs were reflected in our estimate of the sum required for protecting and managing important terrestrial sites for biodiversity globally. Moreover, at least 13% of our estimate of the total costs of preventing extinctions and improving species’ conservation status was for actions relating to education, awareness-raising, improving local livelihoods, and ensuring local participation in (and benefits from) conservation so that “conservation efforts earn the legitimacy of local democratic accountability,” as called for by Sheil *et al.*

We agree with Sheil *et al.*

## CORRECTIONS AND CLARIFICATIONS

**Reports:** “Satellite estimates of precipitation-induced dissipation in the atmosphere,” by O. Pauluis and J. Dias (24 February 2012, p. 953). The authors inadvertently used a “rectangular” method for the integration rather a “trapezoidal” method. This led to an overestimation of the integral and the dissipation rate by about 20%. In the published paper, the dissipation rate is said to be about 1.8 W/m<sup>2</sup>. The new calculations yield 1.5 W/m<sup>2</sup>. The corrected Figs. 1 and 3 are shown here (right). The authors thank A. Makarieva, V. Gorshkov, A. Nefiodov, D. Sheil, A. Nobre, P. Bunyard, and B.-L. Li for bringing this problem to their attention.

## TECHNICAL COMMENT ABSTRACTS

### Comment on “Extinction Debt and Windows of Conservation Opportunity in the Brazilian Amazon”

John M. Halley, Yoh Iwasa, Despoina Vokou

A paper by Wearn *et al.* (Reports, 13 July 2012, p. 228) yields new insights on extinction debt. However, it leaves out the area dependence of the relaxation process. We show that this is not warranted on theoretical or observational grounds and that it may lead to erroneous conservation recommendations.

Full text at <http://dx.doi.org/10.1126/science.1231438>

### Response to Comment on “Extinction Debt and Windows of Conservation Opportunity in the Brazilian Amazon”

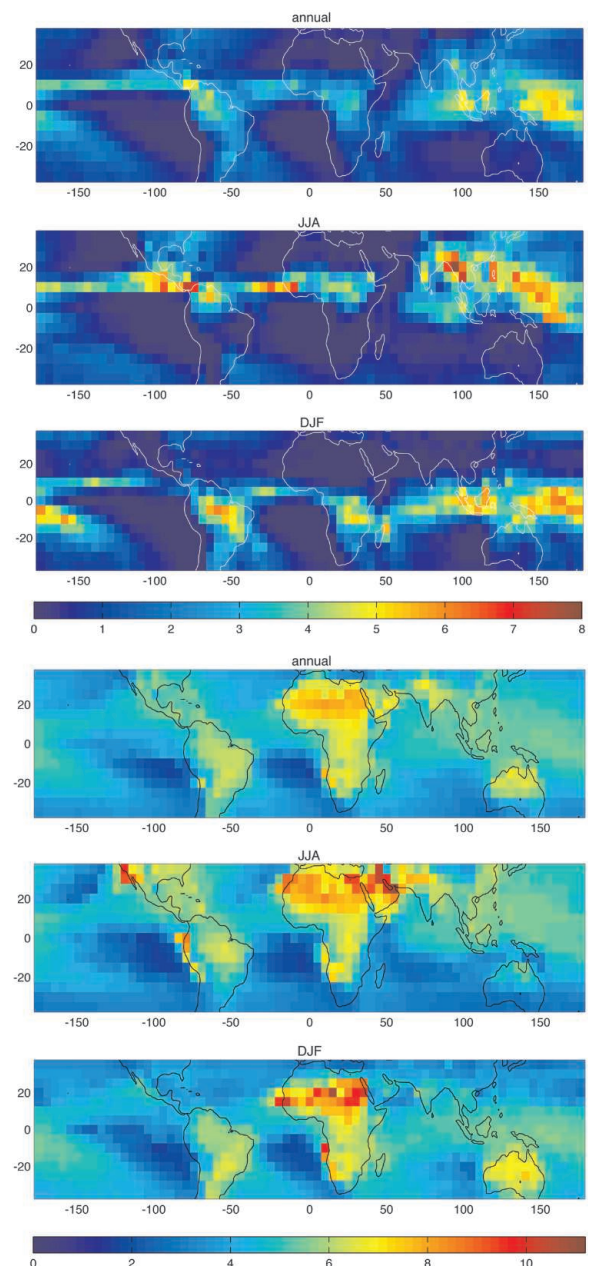
Oliver R. Wearn, Daniel C. Reuman, Robert M. Ewers

Halley *et al.* purport to show a power-law relationship between fragment size and relaxation rates. We use a much more extensive data set to show that area dependence of relaxation rates exists only for very small fragment sizes (<60 hectares), which has limited relevance for our analyses conducted using 250,000-hectare grid squares. We also show that the example of Halley *et al.* is based on an unrealistic fragmentation model with an infinite number of fragments that have an average size of zero hectares. A more realistic formulation of the model shows that relaxation is much less dependent on fragmentation than Halley *et al.* present.

Full text at <http://dx.doi.org/10.1126/science.1231618>

that the benefits and costs of conservation are often inequitably distributed and that this issue needs addressing. However, a global cost-benefit analysis was not the topic of our paper. Instead, we focused on providing the information needed by the CBD Parties on the financial costs of meeting the biodiversity conservation targets that they have adopted. Our analysis informed their decision in October 2012 to “double total biodiversity-related international financial resource flows to developing countries” by 2015 (2). It will be essential to invest these resources in ways that address the unequal distributions of conservation costs and benefits (3).

We did not assume a “more of the same” approach to conservation, as Sheil *et al.* sug-





gest; we imposed no restrictions when asking respondents to estimate the cost of the actions necessary to improve species' status and to protect and manage important sites. This allowed respondents to include innovative approaches where appropriate, including compensation schemes, conservation easements, integrated livelihoods, community-conserved areas, and other measures to rebalance inequities resulting from the cost and benefit flows from biodiversity conservation.

Sheil *et al.* comment that we ignored the potentially cheaper options of regulatory measures to prevent conversion, and the removal of perverse subsidies. However, our estimates do include these options where appropriate, at a local scale and feasible within the time frame of the CBD 2020 targets. Many experts have recognized that simple enforcement of regulations may be less effective than more collaborative approaches. More broadly, these options are mostly about reducing future threats to avoid further habitat conversion, and are addressed by separate CBD targets. Estimating conservation costs beyond 2020 under hypothetical future regulatory regimes would be fraught with difficulty.

Finally, although it was not the topic of our paper, we concur with Sheil *et al.* that existing resources need to be better targeted and spent more effectively [e.g., (4, 5)]. However, even with increased efficiency, the financial shortfall for biodiversity conservation shown by our analysis is so great that substantially increased investment will be essential to meet the CBD Aichi Targets.

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## Letters to the Editor

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