Biodiversity

The trouble with trade

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A study of habitat loss associated with global trade reveals growing impacts on bird biodiversity and carbon sequestration. Overall increases in impacts are driven by changing consumption patterns and human population increases – and may be even greater if land-use intensification is considered.

Human activities continue to cause deterioration of the environment and biodiversity, despite increasing awareness and efforts to mitigate the problem[1]. To form a complete understanding of global environmental degradation, and to design policies to reduce future degradation, it is essential that we understand the impacts associated with the trade in human-consumed goods across national borders. Previous studies have investigated how international trade drives carbon emissions[2], depletion of groundwater sources[3], and threats to animal species[4] outside the countries where the traded goods are consumed. Writing in *Nature Ecology & Evolution*, Marques et al.[5] make a key addition to this research, by taking estimates of habitat loss associated with international trade, and then predicting the extinctions of bird species and loss of sequestered carbon caused by trade between different world regions. Crucially, the authors also investigate how these patterns changed between the years 2000 and 2011.

Marques et al. find that trade is likely to have caused multiple actual or impending bird extinctions and a substantial amount of lost carbon sequestration, and that the influence of trade has grown between 2000 and 2011. They also show that while impacts appear to have decreased for a given amount of goods produced, this effect has been over-ridden by increases in the size of the human population and, even more importantly, by shifts in consumption patterns toward more land-demanding goods — for example, the shift toward more meat-rich diets in many parts of the world, which has long been known to have large impacts on the environment[6]. Another key finding is that the relative effect of consumption in North America and Western Europe has lessened over time, but consumption in other world regions, especially Asia and the Pacific, the Middle East and Eastern Europe, is having a growing impact.

To draw their conclusions, Marques et al. use a database describing the volumes of goods traded across world borders, together with estimates of the associated land footprint of these goods, to estimate loss of sequestered carbon and numbers of global bird extinctions (many of these extinctions are still impending, because there is a time lag between habitat loss and actual extinction). The estimated changes in overall impacts are broken down using the 'IPAT' equation, which considers total impacts (I) to be the combination of: human population change (P); increased affluence (A), which is reflected in changing consumption patterns; and technological progress (T), which is reflected in a change in impacts per unit of economic output. Across the world, overall impacts grew between 2000 and 2011, with current agriculture and forestry estimated to cause as many as 121 bird species to become extinct, and 3.4 gigatonnes (Gt) of sequestered carbon to be lost per year. These outputs can be compared with 140 species that have ever become extinct as a result of any human activity[7], and total carbon emissions from all sources of about 8 Gt per year between 2002 and 2010[8]. Overall increases in impacts are seen in most world regions — the reduced total impacts recorded for North America and Western Europe appear to be the result of reduced consumption during the financial crisis of the early 2000s , and so are likely to be temporary.

As in other studies that have looked at the environmental impacts of different economic sectors[9], cattle farming is estimated to cause the greatest losses of bird species, while forestry causes the greatest losses of sequestered carbon (followed second by cattle farming). But one interesting finding is that oil-seed production has contributed the biggest increase in impacts between 2000 and 2011 – this category includes palm oil, which is used in many food and cosmetic products and also for biofuels (Fig. 1).

Studies such as this one, which make it possible to assign environmental impacts to consumption in other countries, will help inform international environmental negotiations, such as those being conducted under the auspices of the Intergovernmental Platform on Biodiversity & Ecosystem Services (IPBES). Similar studies attributing greenhouse gas emissions of traded goods to their countries of origin have been influential in agreeing future commitments to reducing climate change[11]. In addition, identifying policies to reduce human environmental impacts will only be successful if we recognize that impacts often occur far from where the goods responsible are consumed, because of the global nature of supply chains.

Any modelling study is subject to various sources of uncertainty. In studies of trade impacts, the uncertainties are compounded because of the combination of uncertain estimates of the volume of traded goods, uncertain maps of where humans use the land, and uncertainty in the models of impacts (in this case on biodiversity and carbon sequestration). One particular area of uncertainty is around the reported reductions in impacts per unit of economic output. The authors suggest (perfectly plausibly) that the most likely explanation for a reduced area of land used per unit economic output is a shift in consumption among different sectors. However, an alternative explanation (acknowledged by the authors) is that land use has intensified, allowing a smaller area of land to be used to produce the same quantity of goods. Increasing intensity of land use is associated with large reductions in biodiversity[12] and sequestered carbon[13], so the fact that these effects were not accounted for in Marques and colleagues' impact models suggests that their results under-estimate the overall losses of biodiversity and carbon sequestration. Accounting for the impacts of intensification is a major challenge, because maps of where humans use land rarely give a good indication of land-use intensity[12]. Addressing this gap must be a priority. Another remaining question is the extent to which the results extend to aspects of biodiversity other than bird extinctions, and to other ecosystem services than carbon sequestration.

Despite the uncertainties and opportunities for further refinement, Marques and colleagues' study makes a significant contribution to our understanding of human impacts on the environment. Increasing our knowledge about environmental degradation is vital at a time in which losses continue unabated[1,14]. Understanding trade impacts is essential to developing solutions to help reduce biodiversity losses in future.

References:

1. Tittensor, D. P. *et al.* A mid-term analysis of progress toward international biodiversity targets. *Science* **346,** 241–244 (2014).
2. Hertwich, E. G. & Peters, G. P. Carbon footprint of nations: a global, trade-linked analysis. *Environ. Sci. Technol.* **43,** 6414–6420 (2009).
3. Dalin, C., Wada, Y., Kastner, T. & Puma, M. J. Groundwater depletion embedded in international food trade. *Nature* **543,** 700–704 (2017).
4. Lenzen, M. *et al.* International trade drives biodiversity threats in developing nations. *Nature* **486,** 109–112 (2012).
5. Marques, A. *et al.* Increasing impacts of land-use on biodiversity and carbon sequestration

driven by population growth, consumption and trade. *Nat. Ecol. Evol.* (2018).
6. Tilman, D. *et al.* Forecasting agriculturally driven global environmental change. *Science* **292,** 281–284 (2001).
7. Ceballos, G. *et al.* Accelerated modern human–induced species losses: Entering the sixth mass extinction. *Sci. Adv.* **1,** e1400253 (2015).
8. Blanco, G. *et al.* in *Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* (eds. Edenhofer, O. et al.) (Cambridge University Press, 2014).
9. Poore, J. & Nemecek, T. Reducing food's environmental impacts through producers and consumers. *Science* **360,** 987–992 (2018).
10. Phillips, H. R. P., Newbold, T. & Purvis, A. Land-use effects on local biodiversity in tropical forests vary between continents. *Biodivers. Conserv.* **26,** 2251–2270 (2017).
11. Rajamani, L. The principle of common but differentiated responsibility and the balance of commitments under the climate regime. *Rev. Eur. Community Int. Environ. Law* **9,** 120–131 (2000).
12. Newbold, T. *et al.* Global effects of land use on local terrestrial biodiversity. *Nature* **520,** 45–50 (2015).
13. Grandy, A. S. & Robertson, G. P. Land-use intensity effects on soil organic carbon accumulation rates and mechanisms. *Ecosystems* **10,** 58–73 (2007).
14. Grooten, M. & Almond, R. E. A. *Living Planet Report - 2018: Aiming Higher*. (2018).

Figure 1 | Palm oil growth. Global demand for palm oil – an ingredient in many common food and cosmetic products – is a leading cause of deforestation in the tropics, resulting in very large declines in biodiversity[10]. Marques et al.[5] show that production of oil seeds (including palm oil) is having the fastest-growing impacts on biodiversity, and the second-fastest growing impacts on carbon sequestration.