TECHNICAL RESPONSE

CONSERVATION ECONOMICS

Response to Comment on "Using ecological thresholds to evaluate the costs and benefits of set-asides in a biodiversity hotspot"

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Finney claims that we did not include transaction costs while assessing the economic costs of a set-aside program in Brazil and that accounting for them could potentially render large payments for environmental services (PES) projects unfeasible. We agree with the need for a better understanding of transaction costs but provide evidence that they do not alter the feasibility of the set-aside scheme we proposed.

As Finney points out (*1*), transaction costs are rarely quantified and/or reported in the payments for environmental services (PES) literature, and this is particularly true for the Atlantic Forest. Finney correctly suggests that transaction costs were ignored in Banks-Leite *et al.* (*2*) due to a lack of existing data and proposes four questions that should be answered before we can understand the actual feasibility of PES projects. The questions posed by Finney should certainly be used to guide future research on the feasibility of PES at large scales, but their answers require collecting additional data. In the absence of those data, we here focus on whether including transaction costs would change the main conclusion reported in Banks-Leite *et al.* (*2*). Specifically, we ask whether the set-aside program would become prohibitively expensive if transactions costs are explicitly accounted for, and discuss ways in which transaction costs could be curtailed.

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Finney provides data to show that transaction costs vary widely and mentions one specific case study where transaction costs were shown to be comparable to PES costs. This suggests that the PES estimates reported by Banks-Leite *et al.* (*2*) were roughly half of the real cost of paying for set-asides in the Atlantic Forest. We have reanalyzed the data provided in Banks-Leite *et al.* (*2*) by doubling our previous estimates of US$56.3 million per year for paying landowners to set aside 424,000 ha of private land for restoration. In our new estimates, US$112.6 million would be needed to cover PES and transaction costs, which, added to the active restoration costs of US$141.3 million, gives a total sum of US$253.9 million per year for the biome-wide set-aside program. This estimate accounts for 0.0118% of Brazil's GDP (previous calculated as 0.009%) and 8.3% of Brazil's annual expenditure on agricultural subsidies (previous calculated as 6.5%). The new figures are obviously higher but still show the feasibility of the set-aside program advocated in Banks-Leite *et al.* (*2*) and suggest that even greater transaction costs would still be feasible.

The data reported by Finney in table 1 (*1*) show that 55% of transaction costs consist of general assessment, property mapping, and monitoring, but we believe that the costs of these measures can be reduced. First, the Brazilian government is now implementing a new program called CAR (Cadastro Ambiental Rural), for which it will buy high-resolution satellite images for the whole country every year and will restrict the endowment of rural credits just to landowners who submit to the national database a detailed map of their properties (including native vegetation, production areas, legal reserves, and potential areas for restoration). This would reduce the costs of general assessment and property mapping by improving the database of potential areas for restoration.

Second, remote sensing techniques are often underused in pilot projects, such as the ones mentioned by Finney, and their efficiency and cost-effectiveness dramatically increase with scale. For instance, monitoring the recovery of biodiversity and ecological processes depends on expensive and time-consuming field work. However, field monitoring can be replaced by remote sensing and appropriate landscape indicators for a fraction of the costs (*3*), thus reducing the need for a more complete and detailed field assessment to just a subset of the restored sites.

It is also appropriate to further explore another advantage of the set-aside program advocated by Banks-Leite *et al.* (*2*). Although we propose the restoration of 424,000 ha of Atlantic Forest, the initial area can be increased or reduced according to an existing budget, and more areas can be added to the program once active restoration is no longer needed. For instance, using Banks-Leite's *et al.* (*2*) original estimates, let's consider that only $100 million can be committed each year, which halves the amount of area that can be set aside for restoration. When active restoration practices are no longer needed after 3 years, the overall costs of the program would drop to US$28.5 million, which means that US$71.5 million would become available for restoring a further 153,500 ha of priority landscapes. The addition of new areas to the program after the active-restoration period can be iterated many times and could potentially restore up to 750,000 ha within 30 years with a limited budget of US$100 million per year. If the whole budget of US$200 million is available, the effect of this program would be much wider and larger and it would deliver outcomes much faster.

In conclusion, although Finney raises a very important issue that we indeed had not dealt with in Banks-Leite *et al.* (*2*), we believe that even reasonably high transaction costs would not be an impediment to the proposed PES scheme and that our approach is still robust and cost-efficient. A biome-wide set-aside program is also still more realistic than creating protected areas, and it can be easily adapted to protecting watersheds or other discontinuous areas.

REFERENCES AND NOTES

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