LETTER

Reply to Kirchhoff: Homogenous and mutually exclusive conservation typologies are neither possible nor desirable

Kirchhoff (1) highlights inherent difficulties in organizing the rationales that motivate conservation. The author provides two critiques: first, that our conservation objective typology aggregates conflicting subgoals, and second that the objectives are not mutually exclusive (2). We contend that homogenous and mutually exclusive typologies are neither feasible nor desirable for improving awareness of trade-offs in conservation decisions.

Kirchhoff (1) claims that classifying conservation objectives into broad categories may obscure trade-offs. However, it can be more elucidating than obscuring. Doing so allows practitioners to examine the aggregate behavior of similar goals that may appeal to similar stakeholders. Moreover, such classifying can help practitioners engage with stakeholders and set priorities (3) through facilitating conversations about their core goals and values.

Critically, broad classifications do not preclude trade-off assessments within categories, as implied by Kirchhoff (1). Indeed, we were always careful to examine intracategory heterogeneity. In our case study, bird species mentioned in the popular press benefit from replacing forest with agriculture, even as species valued by bird-watchers decline. Such heterogeneity within objectives cannot be ignored; in this case, it could lead to the belief that land conversion has no effect on cultural services when effects are strong but mixed.

Trade-offs must be identified both within and between categories in any typology because no classification scheme could ever achieve complete homogeneity within categories. For example, internal trade-offs would still exist if cultural services were divided into local identity, ecotourism, and recreation categories, because each category still encompasses multiple subgoals (e.g., strategies to bolster recreation value could be very different when focused on hunting versus bird-watching). Attempting to create typologies with artificially homogenous objectives would be as nonsensical as it is counterproductive. Preventing extirpation (minimizing loss of species richness) is a core conservation objective. The fact that it is not homogenous (preserving species *A* could threaten species *B*) does not diminish the fact that it is a real objective. It does, however, highlight the additional importance of examining within-category heterogeneity (the intrinsic biology of species *A* and *B*).

Kirchhoff's (1) second concern is that our categories are not mutually exclusive, which could lead to "double-counting." Kirchhoff asserts that reducing extirpation/extinction risk and enabling evolution leads to increased naturalness and ecosystem services. Preventing extirpations may sometimes increase ecosystem services, but in other cases decrease them (4). For example, predatory insect diversity can lead to lower pest control when predators consume each other (5). This complexity makes characterizing relationships between conservation objectivities difficult, necessitating independent consideration of each objective. Furthermore, even when preventing extirpations diminishes ecosystem services, mitigating extirpation risk has value independent of the ecosystem service impact. This contrasts intermediate services (e.g., crop pollination), which do not have independent value from associated final services (e.g., crop yields).

We agree with Kirchhoff (1) that identifying objectives could help "overcome serious problems connected with nature conservation." We hope that our typology serves as a practical starting point for improving decisions, and encourage further refinement to better highlight and reconcile trade-offs in nature conservation.

Daniel S. Karp[a,b,1], Chase D. Mendenhall[c,d], Elizabeth Callaway[e], Luke O. Frishkoff[c,d], Peter M. Kareiva[b], Paul R. Ehrlich[c,d], and Gretchen C. Daily[c,d,f,g]

[a]Department of Environmental Science, Policy, and Management, University of California, Berkeley, CA 94720; [b]The Nature Conservancy, Seattle, WA 98105; [c]Department of Biology, Stanford University, Stanford, CA 94305; [d]Center for Conservation Biology, Stanford University, Stanford, CA 94305; [e]Department of English, University of California, Santa Barbara, CA 93106; [f]Global Economic Dynamics and the Biosphere, Royal Swedish Academy of Sciences, Stockholm SE-104 05, Sweden; and [g]Stockholm Resilience Centre, University of Stockholm, Stockholm SE-106 91, Sweden

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[1]To whom correspondence should be addressed. E-mail: danielsolkarp@gmail.com.