TECHNICAL COMMENT

Response to Comment on "Status and Trends of Amphibian Declines and Extinctions Worldwide"

Using information on Brazilian species, Pimenta *et al.* assert that we overestimated the number of threatened amphibians. This claim, based on a misunderstanding of the IUCN–The World Conservation Union Red List criteria and a strongly evidentiary attitude to listing species, almost certainly seriously underestimates the number of threatened amphibians in Brazil.

Much of the argument of Pimenta *et al.* (*1*) is based on their belief that IUCN–The World Conservation Union recommends adjusting thresholds for distributional area depending on the taxon in question. This is a misunderstanding: IUCN recommends adjusting the scale at which species are mapped to the taxon in question, not using different thresholds for distribution size (*2*). Thus, the threshold of 20,000 km^2 in criterion B1 (for the Vulnerable category), for example, is the same whether assessing an orchid or a frog (*2*).

IUCN, with extensive input from many scientists, including the leader of our research (S.N.S), developed the criteria and thresholds as global standards between 1989 and 2001 and tested them on a wide variety of taxa, including plants, marine species, invertebrates, fishes, reptiles, and amphibians (*3*). Allowing assessors to adjust the thresholds independently would create a chaotic listing process in which two scientists evaluating similar species would rarely choose the same values. The distributional area criterion is not a "straitjacket," as Pimenta *et al.* suggest, but a reflection of the intrinsic risks to extirpation that populations occurring in limited geographical areas face as a result of a variety of threats. IUCN developed the Red List criteria so that at least one, but by no means all, of the criteria apply to every species (excluding microorganisms), encompassing the wide diversity of life-history strategies exhibited by life on Earth (*2, 3*). One would not expect to use the same criteria to assess species as different from each other as a tiger and a leaf-litter frog (*4*).

That many Brazilian amphibian species are poorly known is not in dispute, and Pimenta *et al.* demonstrate this well. They assert that Brazilian amphibians are too poorly known for the detailed assessment of conservation status that we carried out (*5, 6*). However, the Red List categories and criteria represent a coarse, rather than a detailed, measurement of conservation status (*7*). Data showing species to be more widespread than previously known frequently do not result in a change in the Red List category, because the categories represent broad bands of extinction risk. Therefore, movements of species between Red List categories usually reflect major changes in conservation status (*8, 9*).

The observed discrepancies between the lists can be accounted for in part by different applications of the Red List criteria (Pimenta *et al.* admit to using them only tentatively) and by differences in the underlying data (*10*). However, we believe that many of the discrepancies are due to different attitudes to uncertainty and risk, ranging from evidentiary to precautionary (*11, 12*). IUCN's guidelines on dealing with uncertainty (*13, 14*) state that assessors should adopt a "precautionary but realistic" attitude. The Global Amphibian Assessment (GAA) Brazil workshop results represent a strongly evidentiary viewpoint (*15*). If the approach to identifying threatened species is too evidentiary, the list can fail in its basic purpose of flagging species in urgent need of conservation attention before it is too late. For Brazilian amphibians, this strongly evidentiary attitude leads to a higher percentage of data-deficient (DD) (28%) and nonthreatened (69%) species and a lower percentage of threatened species (3.3%), compared with DD (22%), nonthreatened (63%), and threatened (15%) with the precautionary but realistic "consistent" categories.

New data (*16*) indicate that perhaps 19 of 38 species in Brazil in which declines have been recorded could be globally at risk (*17*). Only 5 of these 19 species were listed as threatened in the GAA Brazil workshop, compared with 12 as a result of the consistency check. There is growing evidence (*18–23*) that such declines can rapidly lead to extinction. Under a strongly evidentiary approach, the extinction of species in genera such as *Cycloramphus* [declines reported or suspected in at least seven species (*16*)] could occur before any conservation alarm sounds.

We agree with Pimenta *et al.* that exaggerating the level of threat compromises the credibility of lists. However, minimizing threat levels, especially if extinctions take place, also compromises credibility. Scientists might exaggerate threats to obtain more funding for their research or minimize threats to avoid restrictions on scientific collecting. Both approaches lead to a distortion of the Red List process and support the need for consistency checks.

Pimenta *et al.* also criticize our concept of rapidly declining species. The use of the IUCN Red List to identify such species is explained by Butchart *et al.* (*8, 24*). Of 435 rapidly declining species globally, we identified only 13 from Brazil. The inclusion of two species mentioned by Pimenta *et al.* (*Bokermannohyla claresignata* and *Scinax heyeri*) as rapidly declining was based on the GAA data but could be incorrect in view of the information provided by Pimenta *et al.* (*25*). However, Eterovick *et al.*'s new data (*16*), with 19 species possibly meeting our definition of rapidly declining (*6, 17*), indicate that we might have underestimated the number of rapidly declining species in Brazil.

Pimenta *et al.* raise several important issues with which we agree wholeheartedly: The tendency of governments to restrict scientific collecting of listed species is a disincentive for research on those species that need it most (*26, 27*); DD species are very high priorities for research funding, especially because many of them are likely to be threatened, and conservation priorities should not be determined using threatened species lists alone (*28*). We believe that greater harmonization between threatened amphibian lists in Brazil is urgently needed and will most easily be achieved by following the approach suggested by Keith *et al.* (*29, 30*). In the longer term, funding and implementing an enhanced program to describe and document Brazil's remarkable amphibian fauna would greatly reduce the level of data uncertainty.

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References and Notes

1. B. V. S. Pimenta, C. F. B. Haddad, L. B. Nascimento, C. A. G. Cruz, J. P. Pombal Jr., *Science* **309**, 1999 (2005); www.sciencemag.org/cgi/content/full/309/5743/1999b.
2. IUCN–The World Conservation Union, *IUCN Red List Categories and Criteria* (IUCN, Gland, Switzerland, and Cambridge, UK, 2001).
3. G. M. Mace, S. N. Stuart, *Species* **21-22**, 13 (1994).
4. If the tiger had a range as small as that of most frog species, it would be considered more threatened than these frogs because its population would be tiny, not because of its small geographic range (*2*); the tiger would be listed under population-based criteria, the frogs under distribution-based criteria.
5. IUCN Species Survival Commission, Conservation International Center for Applied Biodiversity Science, NatureServe, *IUCN Global Amphibian Assessment* (www.globalamphibians.org) (2004).
6. S. N. Stuart *et al.*, *Science* **306**, 1783 (2004).
7. The disadvantage of the IUCN Red List categories and criteria is that they are not a fine measure of extinction risk, compared, for example, with population viability analysis (*31*). However, this coarseness becomes an advantage in that the categories can be used defensibly in data-poor situations because they represent broad bands of extinction risk.
8. S. H. M. Butchart *et al.*, *PloS Biology* **2**, e383 (2004).
9. T. M. Brooks, E. Kennedy, *Nature* **431**, 1046 (2004).
10. See Supporting Online Material for a fuller explanation of the listings of Brazilian amphibians and possible discrepancies, both in the use of the Red List criteria and in the underlying data.
11. H. R. Akçakaya *et al.*, *Conserv. Biol.* **14**, 1001 (2000).
12. As Red List assessors evaluate species for inclusion on threatened species lists, there is a risk that errors will be made. There are two main classes of such errors: omission errors (a species that is genuinely threatened is not included on the list) and commission errors (a species that is not genuinely threatened is included on the list). The attitudes of assessors to such risk and uncertainty range along a spectrum from evidentiary (demanding substantial evidence of threatened status before allowing such a classification) to precautionary (allowing a species to be listed in a nonthreatened category only if there is strong evidence that it is not threatened). For a well-known species with extensive quantitative data, the effects of the assessors' attitudes on listings are generally small. However, when the level of uncertainty is high, attitudes can easily cause the observed discrepancies. Assessors with strongly precautionary attitudes are concerned mainly about omission errors, whereas assessors with strongly evidentiary attitudes (such as Pimenta *et al.*) are concerned mainly about commission errors. Seeking to minimize the risk of one type of error inevitably increases the risk of the other type. IUCN is concerned about both types of error and, therefore, seeks to find a balance between the extremes.
13. IUCN–The World Conservation Union, *IUCN Red List Categories and Criteria* (IUCN, Gland, Switzerland, and Cambridge, UK, 2001), Annex 1.
14. Standards and Petitions Subcommittee of the IUCN Species Survival Commission Red List Programme Committee, *Guidelines for Using the IUCN Red List Categories and Criteria* (www.iucn.org/webfiles/doc/SSC/RedList/RedListGuidelines.pdf) (2005).
15. Supporting Online Material for (*1*).
16. P. C. Eterovick *et al.*, *Biotropica* **37**, 166 (2005).
17. See Supporting Online Material for a fuller explanation and analysis.
18. J. A. Pounds, M. P. L. Fogden, J. M. Savage, G. C. Gorman, *Conserv. Biol.* **11**, 1307 (1997).
19. B. E. Young *et al.*, *Conserv. Biol.* **15**, 1213 (2001).
20. P. A. Burrowes, R. L. Joglar, D. E. Green, *Herpetologica* **60**, 141 (2004).
21. E. La Marca *et al.*, *Biotropica* **37**, 190 (2005).
22. K. R. Lips, P. A. Burrowes, J. R. Mendelson III, G. Parra-Olea, *Biotropica* **37**, 163 (2005).
23. K. R. Lips, P. A. Burrowes, J. R. Mendelson III, G. Parra-Olea, *Biotropica* **37**, 222 (2005).
24. S. H. M. Butchart *et al.*, *Phil. Trans. R. Soc. Series B* **360**, 255 (2005).
25. See Supporting Online Material for a fuller explanation of the situation regarding these two species.
26. J. V. Remsen Jr., *Bird Cons. Internat.* **5**, 145 (1995).
27. N. J. Collar, *Bull. Brit. Orn. Club* **117**, 122 (1997).
28. J. Lamoreux *et al.*, *Trends Ecol. Evol.* **18**, 214 (2003).
29. D. A. Keith *et al.*, *Ecol. Lett.* **7**, 1101 (2004).
30. This approach would involve reassessing the species in contention, incorporating uncertainty into the parameter estimates (*11*), and seeking consensus among the assessors, including some who are experts in the application of the criteria. This is in line with Pimenta *et al.*'s statement that "enhancement of the bidirectional transfer of information between specialists and conservationists could avoid misclassifications on threatened species lists." This might be achieved through a follow-up GAA workshop.
31. H. R. Akçakaya, M. A. Burgman, L. R. Ginzburg, *Applied Population Ecology* (Applied Biomathematics, New York, 2002).
32. We thank R. Akçakaya, T. Brooks, D. Church, and G. Mace for their comments on an earlier draft of this note and P. C. Eterovick for sharing her paper in *Biotropica* before publication. We also thank B. V. S. Pimenta, C. F. B. Haddad, L. B. Nascimento, C. A. G. Cruz, and J. P. Pombal Jr. for useful discussions and comments; although we do not agree on all points, we are committed to working with them to help harmonize the differing lists of threatened amphibians in Brazil.

Science

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