

to reach the desired audience. However, the methods used to assess their diversity or distribution are both unusual and, at present, not well established. Recognition of these facts by editors and reviewers of these journals and the appointment of microbial ecologists to their editorial boards would be great first steps.

All conservation efforts are ultimately funded by the public and here some education is needed, not only to counteract negative perceptions ('bad bacteria' or 'poisonous fungi'), but also to highlight the beauty and biotechnological utility of microbes, as well as their fundamental importance to ecosystem function. As Tom Curtis [12] has stated: 'if the last blue whale choked to death on the last panda, it would be disastrous but not the end of the world. But if we accidentally poisoned the last two species of ammonia-oxidizers, that would be another matter. It could be happening now and we wouldn't even know'.

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# Megadiverse developing countries face huge risks from invasives

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Recently, Davis *et al.* [1] claimed that “non-native” species have been vilified for... generally polluting “natural” environments’. They further assert that ‘a pervasive bias

against alien species... has been embraced by the public, conservationists, land managers and policy-makers, as well as by scientists’. They postulate that eradication

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attempts are mostly a waste of time and money, that many introductions are ecologically beneficial and that the alarm raised about invasive organisms has been exacerbated by unsubstantiated nativism. Reactions so far [2,3] have lacked the voice of developing-country scientists. As a group of scientists from developing countries and/or with extensive field experience in those countries, we seek to change this.

Davis *et al.*'s [1] views are not only imprecise, but in the case of megadiverse developing countries, are also potentially damaging. They maintain that only 'some' species caused extinctions and 'many' of the claims of harm caused by invasive organisms are not backed by data. These qualifiers should be reversed. Many species caused profound, and well-documented, negative effects on native organisms and ecosystems [4], whereas, in some cases, the expected effects were not as drastic as originally predicted.

International transportation and trade have intensified the movement of non-native species [5]. Although all countries face a growing threat from biological invasions, the challenge for many developing countries in blocking the advance of these invaders can be especially formidable, particularly when these countries are undergoing intensive economic development [6]. This often leads to a pernicious false choice of 'economy or ecology'. Additionally, effective management strategies for non-native species in developing countries would be more beneficial, because they have the high biodiversity that is key to future benefits world-wide [7].

Although the effect of both non-native and native species can vary with time, the two should not be conflated. Non-natives turn problematic more frequently than do natives: 49% of the alien insects established in Europe have a negative economic or health impact, whereas <5% of native insects reach pest status in temperate countries [8]. Invasions often lead to decreased biodiversity and faunal homogenization. Thus, they are rightly recognized as an important component of global change [9], and constitute a serious threat to biodiversity, especially in megadiverse (often also developing) tropical countries [7]. The 'invasion debt' [5] could exacerbate the problem, as human-mediated non-native species introduction and native species extinction processes act on different temporal scales.

In some cases, attempts to eradicate introduced species will be useless, but, apart from a steady development in eradication methodology [10], this is an insufficient and inadequate ground for a general change of worldwide policy. In developing countries, the 'embrace the invasives' policy could be used to justify hasty introductions, for instance, in aquaculture. There are examples of introduced fish causing limnological perturbations, introduction of diseases and parasites, or hybridization with native spe-

cies, with negative consequences for fisheries and the local economy [11].

The ethical dimension is also significant. Humans have profound links to, and a psychological need for, nature, subsumed in the 'cultural services' category of ecosystem services. It matters deeply to humans what kind of environment they live in, and it does (and should) matter to them what kind of species populate that environment. This motivated many early attempts to translocate species, and this motive remains valid when considering the desirability, or not, of non-native species. Even if a cow were the full ecological equivalent of an elephant, to an African they are both integral parts of his/her environment, although there is a clearly perceived and well-justified difference. Recently, Didham [12] raised the alarm about the creeping change in mentality of conservation goals, calling attention to the importance of the ethical dimension of biodiversity conservation.

If the real danger of species introductions is minimized because of insufficient and unreliable data, or misguided ecological pragmatism, *carte blanche* is in fact provided to decision-makers or organizations who think only about immediate profit that introductions can bring, without considering longer term losses. Those losses will be tremendous and experienced by all future generations, especially those who live in megadiverse tropical countries.

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