LETTERS

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Fauna in decline: Plight of the pangolin

IN THEIR REVIEW "Defaunation in the Anthropocene" (special section on Vanishing Fauna, 25 July, p. 401), R. Dirzo *et al.* discuss the human impacts on species decline and extinction. The pangolin is a good example of these anthropogenic effects. On 12 May, about 4 tons of smuggled frozen pangolins were seized in Zhuhai, China, making the country's largest smuggling case of a national protected animal in the past several years (*1*). The pangolin turns out to be "the most traded" wild animal, due to the large demand for its scale and flesh (*2*).

According to the *Chinese Medicinal Pharmacopoeia*, roasted pangolin scale can be used for detoxification, draining pus, attenuating palsy, and stimulating lactation (*3*). Since the 1990s, the price of pangolin scale has been continuously climbing, rising from £8.50 to £360 per kilogram (*4*). In even greater demand is the pangolin meat, despite the risk of infection associated with eating it. The excessive consumption has been catastrophic for the species, as the pangolin typically produces only one offspring per year.

In China, pangolins are facing the risk of extinction due to human consumption, which will have devastating effects on pangolins in other areas of the world. Similar to its cracking down on the smuggling of ivory and rhinoceros horn, the Chinese government should strengthen enforcement against illegal pangolin transactions and ban the wild animal markets. Further publicity and education are also called for to put an end to the chase for "wildlife delicacies." Finally, developing herbal alternatives to pangolin scales would benefit the population. These actions may be crucial to prevent the extinction of the pangolin in China.

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REFERENCES

1. "Zhuhai border seized about four tons of smuggled frozen pangolins," *Xinhua Net* (13 May 2013); http://news.xinhuanet.com/local/2014-05/13/c_1110670956.htm [in Chinese].
2. "The most traded wild mammal—the Pangolin—is being eaten to extinction," *IUCN Net* (22 July 2013); www.iucn.org/news_homepage/news_by_date/?13434/The-most-traded-wild-mammal---the-Pangolin---is-being-eaten-to-extinction.
3. S. Z. Li, B. C. G. Mu, *Compendium of Materia Medica* (People's Medical Publishing House, Beijing, 1982).
4. Z.-M. Zhou, Y. Zhou, C. Newman, D. W. Macdonald, *Front. Ecol. Environ.* **12**, 97 (2014).

Confiscated pangolin scales.

Fauna in decline: First do no harm

IN THEIR REVIEW "Reversing defaunation: Restoring species in a changing world" (special section on Vanishing Fauna, 25 July, p. 406), P. J. Seddon *et al.* warn that loss of animal species can disrupt ecological communities, cause cascading effects, and alter ecosystem functions. Introduced nonnative animals can have similar consequences. Burgeoning evidence implicates nonnative species as driving biodiversity loss (*1*–*3*) and a host of other ecological disruptions (*4*). Whereas some can have positive effects on ecosystem services, others have disproportionately large negative effects. Risk assessment of these outcomes is undermined by context-dependence and time lags (*4*, *5*). An introduced species that has negligible effects in some areas, or whose population is threatened in its native range, can have strong impacts when translocated elsewhere (*6*, *7*). Such species may appear innocuous for decades—well beyond the attention span of monitoring programs—before suddenly becoming problematic (*8*). Moreover, their impacts may be subtle, but nonetheless great, and remain unrecognized until damage is incurred and containment is impossible (*9*). Even carefully planned introductions for conservation purposes can have devastating consequences (*10*, *11*).

These considerations are largely ignored by Seddon *et al.* in their discussion of assisted colonization and ecological replacements—deliberate introductions of species beyond their native range. Although Seddon *et al.* reassuringly cite new approaches (quantitative risk analysis, active adaptive management, and structured decision-making) for managing what could go wrong, none of the cited references offer reliable methods for predicting impacts of nonnative animal releases. Despite making considerable progress in understanding impact (*5*), invasion science has not developed a predictive capacity sufficient to engage in frequent introductions without harming biodiversity and ecosystems (*7*). Thus, risks of unintended effects cannot be evaluated and weighed against expected benefits.

At best, assisted colonization is analogous to other human interventions (such as geoengineering) that are prone to unpredictable consequences and do not address root causes of the problems they are supposed to mitigate (*7*, *12*). Ironically, in an earlier article on using nonnative species for conservation purposes, Seddon *et al.* (*13*) rightly conclude that "the concern is not the failure to establish the intended ecological interactions, but rather the risk of creating new and unwanted interactions." Perhaps what is needed is a Hippocratic oath ("Do no harm") applicable to conservation biologists.

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REFERENCES

1. M. Clavero, E. García-Berthou, *Trends. Ecol. Evol*. **20**, 110 (2005).
2. M. Clavero *et al.*, *Biol. Conserv.* **142**, 2043 (2009).
3. R. E. Gozlan, *Nature* **435**, 1046 (2005).
4. D. Simberloff *et al.*, *Trends Ecol. Evol.* **28**, 58 (2013).
5. A. Ricciardi *et al.*, *Ecol. Monogr.* **83**, 263 (2013).
6. C. E. Turner *et al.*, *Wetlands Ecol. Mgmt*. **5**, 165 (1998).
7. A. Ricciardi, D. Simberloff, *Trends Ecol. Evol.* **24**, 248 (2009).
8. G. Rilov *et al.*, *Biol. Inv*. **6**, 347 (2004).
9. K. Douda *et al.*, *Div. Distrib.* **19**, 933 (2013).
10. C. W. Benkman, A. M. Siepelski, T. L. Parchman, *Mol. Ecol.* **17**, 395 (2008).
11. C. N. Spencer *et al.*, *BioScience* **41**, 14 (1991).
12. H. D. Matthews, S. E. Turner, *Environ. Res. Lett.* **4**, 045105 (2009).
13. P. J. Seddon *et al.*, *Conserv. Biol.* **25**, 212 (2011).