

## Letter

### Moving scholarship on invasion science forward

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Sax *et al.* [1] argue that invasion biologists should more systematically consider positive impacts of non-native species to ‘people and nature’. They state that research has been dominated by a perspective that overemphasizes negative impacts. This perspective, they assert, has skewed researchers’ views on the value of non-native species and, as a consequence, policy recommendations regarding the threat that such species pose. The authors propose a framework for considering positive effects of non-native species and a series of broad research areas that should be elevated.

However, we believe their opinion article assigns unfounded motives to published research and makes recommendations that could impede reaching the goals the authors advocate.

Although scientists have emphasized well-documented, often devastating effects of invasions, it is widely recognized in the literature that non-native species can have cultural, economic, social, and ecological benefits. Research on positive benefits has waxed and waned for years, but has gained prominence over the last decade apace with a broadening of invasion science to include the social sciences, governance and policy implementation, and incorporation of ethical principles [2,3]. While we acknowledge it is impractical to provide an exhaustive citation list in a

short opinion piece, Sax *et al.* have overlooked a wide swath of relevant scholarship on non-native and invasive species. We detail two of the most concerning omissions here and highlight how recognition of these gaps can more fruitfully move the field forward.

First, while Sax *et al.* present a framework (with examples) to quantify the benefits of non-native and invasive species, there are other publications that outline similar existing frameworks (e.g., [3–5]). One of these, the Invasive Species Effects Assessment Tool, published in 2019, explicitly considers both positive and negative impacts of non-native species on ecosystem services [3]. Another, method (published at the same time as Sax *et al.* [1]) builds on a widely accepted framework, the Environmental Impact Classification of Alien Taxa (EICAT) [4]. EICAT+ importantly distinguishes between impacts to biodiversity and effects on human enterprises, as well as between demonstrated and unproven benefits. EICAT+ is formally accepted by the International Union for the Conservation of Nature and provides users with a ‘simple, objective and transparent’ method for evaluating all impacts. Thus, methods similar to that which Sax *et al.* propose have already been developed and are currently in use. A productive next step is to consider how the perspective of Sax *et al.* articulate with these frameworks, identifying any gaps in needed knowledge or approaches this comparison may reveal.

Likewise, a growing body of literature directly addresses most of the ‘outstanding questions’ posed by Sax *et al.* and does so within discipline-appropriate theories (e.g., [5–10]). This literature demonstrates that impacts of non-native and/or invasive populations can vary based on (for example) geographical location [7], time since establishment in the novel range [8,9], and according to the values held by individuals [7,10]. While more research into such

questions can advance understanding, it is pertinent to acknowledge progress when critiquing a field. In particular, we encourage engagement with convergence approaches to invasion science where perspectives from diverse research fields are integrated.

Second, the authors suggest that the failure to consider non-native and invasive species impacts fully is driven by ‘normative’ values that ‘cloud’ judgment and create scientific outputs of dubious policy relevance. In service to this argument, Sax *et al.* highlight examples of benefits of non-native and invasive species. We echo the caution of Vimercati *et al.* [4] that perceived positive impacts should not be used to ‘offset or understate’ negative impacts produced by invasive species, which in many cases can be irreversible, such as species extirpation and ecosystem transformations. Further, we recommend avoidance of providing lists of positive (or negative) impacts without the needed context on the extent of irreparable consequences.

Further, Sax *et al.* ascribe motives to invasion scientists, suggesting that they are driven by a dualistic ‘nativist’ ethical foundation. Looking past the issue of leveling such broad-brush claims, we note that the motivations driving invasion science go well beyond concern for native species and biodiversity to include economic damage to agriculture and industry, reduced ecosystem services, and loss of cultural history and traditions [7,10]. By failing to consider the full scope of invasion science, Sax *et al.* appear to diminish the contributions of cultural and social perspectives on the negative impacts of non-native and invasive species to the role of a conservation ethic. We suggest a productive way forward is to acknowledge the array of ethical principles underlying concern about invasive species’ negative impact, considering how these principles can complement or counter one another.

Non-native and invasive species issues have been identified as a classic ‘wicked problem’ because they often entail apparently contradictory, context-dependent, and changing aspects [11]. We imagine Sax *et al.* would agree that there are no silver-bullet solutions or simplistic frameworks for non-native and invasive species policy and management. However, we believe that progress can be achieved by recognizing and building upon the burgeoning foundation of existing scholarship that examines why non-native species can become ecological and socioeconomic problems in different areas and at different times.

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### References

1. Sax, D.F. *et al.* (2022) Valuing the contributions of non-native species to people and nature. *Trends Ecol. Evol.* 37, 1058–1066
2. Shackleton, R.T. *et al.* (2019) The role of invasive alien species in shaping local livelihoods and human well-being: a review. *J. Environ. Manag.* 229, 145–157
3. Martinez-Cillero, R. *et al.* (2019) A practical tool for assessing ecosystem service enhancement and degradation associated with invasive alien species. *Ecol. Evol.* 9, 3918–3936

4. Vimercati, G. *et al.* (2022) The EICAT+ framework enables classification of positive impacts of alien taxa on native biodiversity. *PLoS Biol.* 20, e3001729
5. Howard, P.L. (2019) Human adaptation to invasive species: a conceptual framework based on a case study metasynthesis. *Ambio* 48, 1401–1430
6. Kourantindou, P.J. *et al.* (2022) Invasive alien species as simultaneous benefits and burdens: trends, stakeholder perceptions and management. *Biol. Invasions* 24, 1905–1926
7. Sheergoji, I.A. *et al.* (2022) Invasive species services-disservices conundrum: a case study from Kashmir Himalaya. *J. Environ. Manag.* 309, 114674
8. Zavorika, L. *et al.* (2018) The negative ecological impacts of a globally introduced species decreases with time since introduction. *Glob. Chang. Biol.* 24, 4428–4437
9. Spear, M.J. *et al.* (2021) The invasion ecology of sleeper populations: prevalence, persistence, and abrupt shifts. *BioScience* 71, 357–369
10. Costanza, K.K.L. *et al.* (2017) The precarious state of a cultural keystone species: tribal and biological assessments of the role and future of black ash. *J. For.* 115, 435–446
11. Woodford, D.J. *et al.* (2016) Confronting the wicked problem of managing biological invasions. *NeoBiota* 31, 63–86