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COMMENT

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Comment: Novak et al. (2021) overestimated the successes of species translocations and minimized their risks

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When deciding whether to translocate a species, it is important to know likely benefits and risks. Thus, Novak et al.'s (2021) analysis of past species translocations to assess their successes and unintended consequences is welcome. However, their conclusion that "The widespread benefits and paucity of negative impacts stemming from conservation translocations are a signal to regulators, decision-makers, and stakeholders that conservationists can be entrusted with the safe and timely use of translocations" is undermined by several problems that led them overstate the successes of translocations and minimize their negative impacts.

Their conclusions about the overwhelming success of translocations ("Translocations have played and will play a vital and necessary role in conserving 70% of US endangered species," "conservation translocations routinely yielded their intended benefits") are not supported by their data. The figure of 70% includes the 41% of listed or recovered species for which translocations have been performed, 16% for which translocations are planned, and 12% for which possible future translocations are implied by existing or planned captive propagation. For the 28% of species for which no translocation has yet been performed, it's impossible to know whether translocations will benefit species conservation. Including possible future translocations in the 70% success figure is extremely optimistic because it is unsupported by actual successes.

In addition, translocations played "a vital and necessary role" in species conservation for only a fraction of the 41% of species that were translocated. Table 1 summarizes the history and success of translocations for a sample of 20 species randomly drawn from Novak et al.'s data set that they identified as having been translocated. Three to five of these species appear not to have been translocated into nature at all. Ten to twelve of the species that were translocated failed to establish translocated populations, were translocated in such small numbers that conservation impacts up to this point must have been small, and/or were translocated so recently that it is impossible to assess their long-term success. Novak et al. (2021) did not present any quantitative criteria by which translocations could be judged as "vital and necessary," but a generous reading of Table 1 suggests that translocation has been vital to the conservation of perhaps 5 of the 20 species (the Kootenai River population of *Acipenser transmontanus*, *Amorpha crenulata*, *Gila purpurea*, *Mustela nigripes*, *Rana sevosa*). Consequently, the number of listed and recovered species for which translocation has been "vital and necessary" is probably closer to 10% than 70%.

Novak et al. also minimized the negative impacts of translocations, writing that: "Of the 1014 total taxa we found with recorded conservation translocations spanning 125 years, we found only one restricted instance that

TABLE 1 Summary of translocation efforts for selected species of conservation interest

Species	Translocation performed	Sources
Acipenser transmontanus (white sturgeon, Kootenai River population)	Translocations done to augment sole extant population; successful to the point of reproduction and regarded as vital to population persistence	Paragamian et al. (2005), USFWS (2019a)
Alasmidonta atropurpurea (Cumberland elktoe)	No record of any translocations	Guyot (2005), USFWS (2004)
Alectryon micrococcus (mahoe)	Recently translocated into several sites, but no data given on success	USFWS (1997, 2021a)
Amorpha crenulata (crenulate lead-plant)	Three of five extant populations are the result of translocations	USFWS (1999, 2019b)
Dipodomys ingens (giant kangaroo rat)	Translocations successful in establishing new populations	Loew et al. (2005), Saslaw and Cypher (2020), USFWS (1998)
Epioblasma capsaeformis (oyster mussel)	Four translocations to sites in a river where the species already occurred; two failures, evidence for survival at two sites and reproduction at one	Carey et al. (2015, 2019), USFWS (2004)
Eremophila alpestris strigata (streaked horned lark)	Twenty eggs moved into a population with evidence of inbreeding depression; at least one bird survived and had offspring; long-term success not yet clear	Stinson (2016), USFWS (2019c, 2019d)
Fusconaia cor (shiny pigtoe)	No translocations done; erroneously recorded by Cummings and Cordeiro (2012) as translocated	Cummings and Cordeiro (2012), USFWS (1983, 2021b)
Gila purpurea (Yaqui chub)	Translocations successful in establishing populations over the long term and regarded as vital to species survival	Lohrengel (2014), USFWS (1994)
Hylaeus anthracinus (anthracinian yellow-faced bee)	A few translocations attempted; some failed, and some succeeded (survival, reproduction) over the short term (1 year)	Magnacca (2020), USFWS (2020a, 2021c)
Kadua st-johnii (no common name)	Unclear whether translocation has occurred. If it did, it was very limited (11 plants), with no data on success	USFWS (2017a, 2021d)
Mustela nigripes (black-footed ferret)	All extant populations arose from translocations, which are regarded as vital to species survival, although translocations have not met their stated goals	USFWS (1988, 2013, 2019e)
Nothocestrum peltatum (‘aeia)	One or two individuals were translocated, at least one of which died	USFWS (2017b, 2021d)
Opuntia treleasei (Bakersfield cactus)	Translocations established several new populations	Cypher et al. (2015), USFWS (1998, 2020b)
Pritchardia hardyi (lo'ulu)	Propagated in captivity, but not translocated into nature	USFWS (2017c, 2021d)
Pseudobahia peirsonii (San Joaquin adobe sunburst)	One short-range translocation succeeded over the short term; long-term success uncertain; “[translocation] is not considered a reliable option for saving the affected populations of *P. peirsonii* owing to the limited success of previous transplanting efforts”	USFWS (2007)

TABLE 1 (Continued)

Species	Translocation performed	Sources
Ptilimnium nodosum (harperella)	Some translocations succeeded (with reproduction) over 2–4 year periods, but "the disadvantages of reintroduction may outweigh the advantages"	Guerrant (2012), USFWS (1990), Wells (2012)
Rana sevosa (dusky gopher frog)	Several translocations, some at least partially successful over short time-periods. Too soon to judge long-term success, but will be needed to preserve species	USFWS (2015)
Scheidea jacobii (no common name)	Propagated in captivity; unclear whether species has been translocated into nature	USFWS (2019f)
Scheidea pubescens (ma'oli'oli)	Limited translocations made, no data on success	USFWS (2019f)

Note: Species were randomly chosen from "Currently Listed Species" scored in Table S1 of Novak et al. (2021) as having a translocation performed (see Supporting Information S1 for details).

caused a loss of biodiversity"; and (referring to biocontrol agents in the United States) "only 3% (21) resulted in negative unintended consequences." But the sources that Novak et al. searched for negative or unintended impacts (e.g., USFWS recovery plans and Schwarzländer et al. [2018]) do not typically contain such information. None of the recovery plans or other USFWS documents used to compile Table 1 contained data on unintended impacts of translocations, although some species in Table 1 are known to have the potential to cause problems (e.g., Gurney et al., 2015; Schiffman, 1994). Schwarzländer et al. (2018) did not address nontarget effects of biocontrols at all, and the compendium upon which it is based (Winston et al., 2014) mentioned only a few known nontarget effects in passing, rather than a complete list. Novak et al. found few negative impacts of translocations because they consulted sources that did not routinely report negative impacts, and so did not provide a reliable estimate of the severity or frequency of possible negative impacts of translocation.

Novak et al. further claimed that routine monitoring of game species should detect negative impacts of species translocations. This assumes that monitoring data are strong enough to support analyses of impacts and that someone did such analyses. The paucity and ambiguity of analyses of the effects of zebra mussels (a species with enormous impacts) on game fish populations (Higgins & Vander Zanden, 2010; Strayer et al., 2004) illustrates how unwise it is to rely on detecting impacts using game species.

Although unintended impacts of translocations have yet to be accurately assessed, I agree with Novak et al. that *most* past translocations probably had small unintended impacts. Rather than attributing this to the motivation of the translocation (conservation), I suggest that small unintended impacts have been a product of the kinds of translocations that have been most common: small to modest augmentations or reintroductions of specialized species whose populations are kept small by multiple factors. Based on the literature on non-native species (e.g., Ricciardi et al., 2013), the impacts of species translocations may be predictable from (i) species traits, (ii) how radical the translocation is (augmentation of an existing population vs. re-establishment at a recently occupied site vs. introduction to a new site), (iii) and the rigor of planning and translocation protocols (as Novak et al. emphasized for biocontrol). To the extent that future conservation translocations differ from past efforts in the traits of the species (e.g., potentially widespread keystones like woolly mammoth and passenger pigeon hybrids vs. narrowly endemic specialists), in moving species outside of recent ranges (assisted migration), or in protocols, past impacts may not reliably predict future risks.

I agree with Novak et al that translocations have yielded important benefits for conservation and other purposes, and will be essential in confronting climate change and other threats to biodiversity and ecosystem services. But translocations have often failed to reach their goals, diverting resources from other activities, and some have had harmful consequences. If we are to maximize the benefits of future translocations, we must fairly assess their benefits and their risks. Despite their admirable goals, Novak et al. added little to our understanding of how often translocations succeed, or how often they have harmful impacts.

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CONFLICT OF INTEREST

None.

AUTHOR CONTRIBUTIONS

David L. Strayer conceived and wrote the paper, and did all data analyses.

DATA AVAILABILITY STATEMENT

All data collected in this study are presented in the paper or in Supporting Information S1.

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SUPPORTING INFORMATION

Additional supporting information may be found in the online version of the article at the publisher's website.

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