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COMMENTARY

Some matchmaking advice when translocated immigrants are a population's last hope

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Too often in conservation management, we underestimate the risks of doing nothing. Faced with lawsuits, letters to the editor and scientific uncertainty, it is easy to delay action – forgetting that a decision of no action is very much a decision with consequences. This phenomenon plays out for conservation topics ranging from invasive species eradication to population restoration.

In the case of rescuing small, isolated populations, management actions to foster movement of individuals via natural dispersal or human-mediated translocations can be remarkably successful. The benefits come from both demographic rescue – whereby immigrant individuals take the population away from the debilitating effects of the extinction vortex – and genetic rescue that increases population growth by breaking the costs of inbreeding depression on vital rates. Restoring connectivity among such isolated populations is best accomplished by nurturing 'natural' dispersal and gene flow across the landscape and through corridors. However, when habitat restoration to facilitate natural connectivity is overwhelmingly difficult or slow and isolated populations teeter on the edge, human-mediated physical translocations sometimes remain the only option to rescue a population. Beyond the commonly cited cases of genetic rescue (e.g. Florida panthers, greater prairie chicken, European adders), decisive human-mediated translocations have undoubtedly fostered the persistence of many species ranging from peregrine falcons *Falco peregrinus* in North America (Kauffman, Frick & Linthicum, 2003) to South Island saddlebacks *Philesturnus carunculatus* in New Zealand (Taylor, Jamieson & Wallis, 2007).

At the same time, the multiple risks of imposing connectivity through translocations are well known. The translocated individuals may harm the recipient population through disease transmission, disturbance to social structure, genetic swamping and outbreeding depression. From the perspective of the source population providing the immigrants, viability may be compromised as individuals are drained away to translocate elsewhere. At a human dimension level, human-mediated translocations can create in the public an illusion of meaningful action to sustain a wild population when fundamentally the translocation may be less effective than other conservation actions (Johnson *et al.*, 2011) or may even create a 'conservation reliant' species dependent on intense human management in perpetuity (Scott *et al.*, 2010; Carroll *et al.*, 2015).

In short, human-mediated translocations should be executed thoughtfully in each particular case, with a strong reliance on best available science. Fortunately, the science of applied population ecology provides a strong conceptual basis to help guide biologists and managers as they implement translocations and face decisions about the devilish details (Mills, 2013): where to get the animals; how many individuals to move; and what sex, age, behavioral characteristics and even genotypes would provide the most benefit to the imperiled population. Because translocations usually play out with particularly high public visibility and strong public opinions on what to do and how to do it, additional scientific insights drilling into these details are welcome additions to the decision making toolbox for conservation managers.

Such is the contribution of the paper by Kronenberger *et al.* (2017). The elegant experiments conducted by Kronenberger *et al.* were neither set up as a comprehensive test of the costs and benefits of using translocations to rescue a small isolated population, nor could the study design separate the benefits of demographic and genetic rescue. However, the experiments do use a classic laboratory animal system to squarely address an often-asked questions in real translocations. Should chosen immigrants be pulled from populations that: (a) have similar adaptive traits, yet differ strongly at neutral markers of genetic variation (perhaps because they too are recently isolated and small); or (b) are adaptively divergent but genetically similar. These questions are tough to ask in wild systems regardless of the taxon. But Kronenberger *et al.* (2017) turn to experiments to address those questions with Trinidadian guppies *Poecilia reticulata*, a compelling system with well described and varying predation pressures that stands as a model for rapid evolution (on an ecological time scale) in meaningful traits with clear fitness consequences.

Kronenberger *et al.* (2017) find that over the short term, immigrants derived from adaptively similar yet genetically divergent source populations increased short-term abundance of recipient populations more than genetically similar yet adaptively different immigrants. As the authors note, this finding is conservation-relevant in many cases where populations are separated by great distances and therefore genetically differentiated from each other. These results imply that if desperate times call for translocations and the only potential sources are genetically divergent from the focal population, the best choice for immigrants would share adaptive similarities in behavior, mortality and life-history traits between populations. Of course, this simple rule may be overwhelmed by other considerations mentioned above, including effects on the donor populations, relative costs of inbreeding versus outbreeding depression and so on. But still, the results build a strong case for short-term rescue in small, isolated, vulnerable populations seeded by translocated immigrants that may diverge at neutral genetic markers but share adaptive traits with individuals in the imperiled population.

I have noted elsewhere that 'If your back is against the wall and you have to do a translocation, know that your actions will be scrutinized by the public, but take solace in the wealth of ecological insights that can underlie your decisions' (Mills, 2013: 198). This paper adds nicely to those ecological insights, helping to guide action for implementing rescue when a population is in dire need of demographic and genetic supplementation.

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