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Letter to the editor

Genetic rescue, not genetic swamping, is important for Mexican wolves

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The recent article by Odell, Heffelfinger et al. (2018) (hereafter OH) is another effort to limit and stymie Mexican wolf recovery by state game and fish ungulate biologists and their allies. OH advocate relying substantially on Mexico for recovery, a possibility that is very uncertain due to a largely unquantified but limited natural prey base and widespread killing of predators in the Mexican areas suggested for recovery. On the other hand, the reintroduced Mexican wolf population in Arizona and New Mexico, outside what OH state is historical range, now numbers over 100, and preys primarily on elk despite the availability of white-tailed deer. Further, it is unlikely that there will be effective natural interchange between Mexican and USA populations because of the proposed construction of a border wall and inhospitable habitat between the two countries.

A new aspect of the anti-wolf arguments in OH is that if Mexican wolves are successful in expanding their range northward they would be in danger from "genetic swamping" by northern gray wolves. However, such contact would actually reinstate the historical situation where wolves once occupied the geographic range in the western United States from Mexico to Canada and formed a continuous population with clinal variation in phenotypic traits (Wayne and Shaffer, 2016) and gene flow between wolf subspecies (Leonard et al., 2005).

Wolves in the reintroduced Mexican wolf population, descended quite unequally from three lineages (0.78 McBride, 0.07 Aragon, 0.15 Ghost Ranch) with seven total founders, have an average pedigree inbreeding coefficient of 0.20 and the estimated number of remaining founder genome equivalents is only 2.0 (Siminski and Spevak, 2017). Fredrickson et al. (2007) found that there was inbreeding depression for litter size in both captive and wild Mexican wolves and also found that crosses between the three lineages showed an increased fitness, resulting in temporary genetic rescue.

Since 2009, there has been artificial supplemental feeding of wild denning Mexican wolves that has greatly increased the survival of pups. It is probable that this supplemental feeding masks some of the detrimental effects of inbreeding, an impact that would be evident if feeding is discontinued. The present-day descendants, three generations later than examined by Fredrickson et al. (2007), are in need of genetic rescue again and crosses with northern gray wolves would provide an appropriate cross to increase fitness.

OH suggested that the somewhat smaller body size and smaller pack size in Mexican wolves than in other wolves would make Mexican wolves at a disadvantage when interacting with northern gray wolves. However, the smaller body size and smaller pack size might actually be adaptive characteristics that allowed Mexican wolves to survive where there was more limited and smaller prey, and where larger body size might be disadvantageous. Because of their predatory flexibility, Mexican wolves can use larger prey, such as elk, where the current wild population exists, and potentially other areas.

Eight Texas cougar females were translocated to Florida to breed with Florida panthers because Florida panther numbers were very low and they showed several traits indicating inbreeding depression. There was concern that adaptive traits that allowed Florida panthers to successfully survive in the Florida environment would be eliminated by this translocation. As a result, the number of animals translocated were at a level such that expectations were that detrimental traits accumulated by inbreeding would be eliminated but traits adaptive to Florida would be retained (Hedrick, 1995), a prediction that has generally been proven correct (Johnson et al., 2010). As precedent, descendants of Texas cougars and Florida panthers are considered Florida panthers and are therefore protected as endangered species.

Using genomic analysis, Mexican wolves have the lowest genetic variation of any wolves (vonHoldt et al., 2011), indicating that there is limited standing variation for future adaptation to environmental challenges, such as new diseases and climate change. Two other sources of adaptive variation are from mutation and from crosses with related subspecies or species, called adaptive introgression. Generating adaptive variation from mutation generally takes very many generations and often has negative pleiotropic effects. On the other hand, variants present in other related subspecies or species should be adaptive in those species and are more likely to be adaptive when introgressed.

There are a number of examples, including humans, in which genetic variation that has been naturally introduced from other animal subspecies or species has been adaptive (Hedrick, 2013). For a genetically depauperate subspecies such as Mexican wolves, crosses with another subspecies, such as northern gray wolves, might restore variation and provide a source of genetic variants that would allow future adaptation.

Overall, given the discussion of the relevant evolutionary biology principles here, genetic rescue from crossing with northern gray wolves would likely facilitate Mexican wolf recovery. Unfortunately, the goal of OH appears to be to put as many roadblocks in the way of Mexican wolf recovery as possible, including now the specter of genetic

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swamping, because of their short-sighted view that fewer wolves will provide more ungulates for hunters.

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