Will A Changing Climate Increase Interaction Between Rare And Non-Native Plant Species In Alaska?

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Non-native species represent a significant threat to rare plant species in North America (Wilcove et al. 1998), in Alaska however, very few rare plant populations are immediately threatened by non-native plant populations. Less than one percent of the documented critically-imperiled (G1) to vulnerable (G3)[5] plant populations occur within one kilometer of a documented non-native plant population. Despite the low area of overlap between rare and non-native plants, the increasing introduction and spread of invasive species is concerning, particularly in the context of climate change. Approximately 13 species and 7,000 populations of non-native plants are added to state records annually, and the rate of introductions is accelerating (Carlson and Shephard 2007). Additionally, the increases in temperature and changes in precipitation patterns predicted for Alaska are likely to expand the area of overlap between globally-rare and non-native plant species, thereby increasing the probability of ecological interactions.

To assess the potential for increased interaction between rare and non-native plant species in Alaska, we modeled current and future habitat envelopes for a rare species, a non-native species, and a species indicative of steppe-bluff habitats. In Alaska, steppe bluffs are considered an ecosystem of conservation concern and suggested to be particularly susceptible to colonization by non-native species (Roland 1996). These habitats are sagebrush-graminoid dominated and typically occur on south-facing slopes adjacent to large river systems in interior Alaska. The species included here are: the rare species ***Cryptantha shackletteana*** L.C. Higgins, a critically-imperiled species that is narrowly endemic to steppe bluffs along the upper Yukon and Nabesna Rivers; the non-native species ***Melilotus albus*** Medik., which is an extremely invasive colonizer of open habitats, particularly along river systems and roadsides in Alaska; and the native sagebrush, ***Artemisia frigida*** Willd., whose presence can be used as an indicator of steppe-bluff habitat in Alaska.

Several attributes of steppe-bluff ecosystems render them appropriate for the study of potential interactions between rare and non-native flora. First, the warm and arid microclimates of steppe bluffs reflect conditions of more temperate and/or continental regions and for this reason foster a distinctive, azonal flora, which is thought to be vulnerable to invasion and is predicted to increase in extent in a warming climate. Second, the natural geomorphic disturbances and aridity that is thought to exclude colonization by trees, holds steppe bluffs in an early successional state, favoring the establishment and

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growth of all ruderals, including non-native plants. Last, steppe bluffs are typically linked by river systems that are likely to facilitate the movement of non-native species such as ***Melilotus albus*** (Conn et al. 2008).

The native and non-native plant locations used in this modeling exercise were taken from Alaska Natural Heritage Program (AKNHP) and Alaska Exotic Plant Information Clearinghouse (AKEPIC) records, as well as collections housed at the University of Alaska Fairbanks and Tongass National Forest Herbaria. The study area is defined as the Intermontane Boreal Division of Alaska (Nowacki et al. 2001). Habitat suitability was modeled using MaxEnt (Phillips 2006), which integrated the WorldClim bioclimatic variables of mean annual temperature, temperature seasonality, precipitation seasonality, and precipitation of warmest quarter across a two kilometer grid. Current climate was replicated by averaging conditions from 1980 to 2010; future climate was replicated by averaging conditions from 2020 to 2030 under the A1B midrange emission scenario.

The results generated here indicate that suitable habitat for the rare species (***Cryptantha shackletteana***) is predicted to increase in extent, while suitable habitat is predicted to shift towards the northeast for both the invasive species (***Melilotus albus***) and the steppe bluff indicator (***Artemisia frigida***). Thus, the potential for interaction between rare and non-native species will likely be similar in the near future (circa 20 years); however, assuming no dispersal limitations, these interactions may occur in a location more interior to the continent. In the changing climate modeled here, neither the rare plant species nor its endemic steppe-bluff habitat appear to be at immediate risk of ecological degradation due to the impacts of non-native plants. Regardless of potential changes in future interaction between rare and invasive plant species, invasive species with large current and future potential ranges, such as ***Melilotus albus*** remain poor candidates for eradication. Limited resources should instead be focused towards preventing their spread to ecosystems of conservation concern, such as steppe bluffs, where rare plant populations could be adversely impacted.

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