Patterns and vulnerabilities of Arctic Alaska to non-native plant invasion: estimating current and future susceptibility in the face of climate change and development

M. L. Carlson1,2, E.J. Trammell1,3, M. Aisu1, and L. Flagstad1

1Alaska Center for Conservation Science, 2Biological Sciences Department, 3Geography and Environmental Science, University of Alaska Anchorage, 3211 Providence Drive, Anchorage, Alaska 99508

Non-native plant species currently are restricted to only the warmer margins of arctic Alaska. Here we explore the relationship of non-native plant establishment to climate and anthropogenic variables in arctic and subarctic Alaska for current and future climatic and development scenarios. The model outputs are then used to identify more problematic species and vulnerable regions. Results suggest that growing season length currently limits the establishment of non-native plant species in much of arctic Alaska and that non-native plants are currently found in warmer regions with anthropogenic disturbance. By 2060, the Arctic Coastal Plain is predicted to transition from largely resistant to non-native plant establishment to susceptible to weed establishment by the more cold-tolerant non-native species. Areas with greater than 150 frost-free days currently support more ecologically damaging species elsewhere in Alaska, and by 2060, areas this warm are predicted to expand north along the Chukchi Sea and to the south side of the Brooks Range. Overall, future scenarios suggest increasing vulnerability to invasion in both the arctic and subarctic regions due to the interaction of increasing growing season length and increasing anthropogenic disturbance.
Patterns and Vulnerabilities of Arctic Alaska to Non-Native Plant Invasion:

Estimating current and future susceptibility in the face of climate change and development

Matthew L. Carlson, E. Jamie Trammell, Lindsey Flagstad, Megumi Aisu, Justin Fulkerson, and Timm Nawrocki

Alaska Center for Conservation Science & Biological Sciences Department, University of Alaska Anchorage
Humboldt’s geographic distribution of plants (1817)

Geographiae plantarum lineamenta.


1. hexag. = 6 ped. par. = 1° 35.
Current Status - Geographic patterns of non-native plant diversity
Current Status - Geographic patterns of non-native plant diversity

Invasive Spp by Cliome
- SNAP - cliomes

[Map showing geographic patterns with color codes for invasive species by cliomes]
Central Yukon
Rapid Ecoregional Assessment

Rapid assessment of an ecoregion's Conservation Elements, the Change Agents that impact them, and their current and future status

http://accs.uaa.alaska.edu/rapid-ecoregional-assessments/
Core REA Analysis

1. Current Distribution

2. Conceptual Model

3. Intersect the distribution of each Conservation Element with most important Change Agent variables

4. Future Scenarios
Distribution of non-native plant infestations
4. Develop and Implement Management Plan

1. Establish Management Goals

2. Identify and Prioritize Species that Interfere with Management Goals AND Identify sensitive AREAS or those vulnerable to invasion

3. Assess Control Techniques

4. Develop and Implement Management Plan

5. Monitor and Assess Impacts of Management Actions

6. Review Management Goals, Control Priorities and Control Techniques

Application of REA products Early Detection Rapid Response
1. Viable weed seeds are entering the Arctic (Ware et al. 2011)
2. Yet, no weeds have been detected in surveys in Prudhoe Bay, Barrow, etc.
Currently weeds are only known from areas with a ‘growing season’ of ≥ 120 days
Which Non-Native Species could become a problem in Arctic Alaska?
• Transition from largely inhospitable to vulnerable to extremely cold-tolerant weeds
• Southern margin projected to be vulnerable to establishment of moderately cold-tolerant weeds
Invasion Vulnerable Arctic Habitats

Human footprint and intersecting floodplains with warmer climates are anticipated to be most vulnerable areas to invasion.
Specific areas most susceptible?
- Warm areas and population centers, road corridors, floodplains
A Cautionary Tale…
Questions…