

ALASKA NON-NATIVE PLANT INVASIVENESS RANKING FORM

Botanical name: *Geranium robertianum* L.

Common name: herb Robert

Assessors:

Timm Nawrocki Research Technician Alaska Natural Heritage Program, University of Alaska Anchorage, 707 A Street, Anchorage, Alaska 99501 (907) 257-2798	Lindsey A. Flagstad Research Technician Alaska Natural Heritage Program, University of Alaska Anchorage, 707 A Street, Anchorage, Alaska 99501 (907) 257-2786
Matthew L. Carlson, Ph.D. Associate Professor Alaska Natural Heritage Program, University of Alaska Anchorage, 707 A Street, Anchorage, Alaska 99501 (907) 257-2790	

Reviewers:

Ashley Grant Invasive Plant Program Instructor Cooperative Extension Service, University of Alaska Fairbanks 1675 C Street, Anchorage, Alaska 99501 (907) 786-6315	Bonnie M. Million. Alaska Exotic Plant Management Team Liaison Alaska Regional Office, National Park Service, U.S. Department of the Interior 240 West 5 th Avenue Anchorage, Alaska, 99501 (907) 644-3452
Gino Graziano Natural Resource Specialist Plant Materials Center, Division of Agriculture, Department of Natural Resources, State of Alaska 5310 S. Bodenburg Spur, Palmer, Alaska, 99645 (907) 745-4469	Jeff Conn, Ph. D. Research Agronomist Agricultural Research Service, U.S. Department of Agriculture 319 O'Neil Building, 905 Koyukuk St. – UAF Campus, Fairbanks, Alaska 99775 (907) 474-7652
Robert L. DeVelice, Ph. D. Vegetation Ecologist Chugach National Forest, Forest Service, U.S. Department of Agriculture 3301 C Street, Suite 300 Anchorage, Alaska 99503 (907) 743-9437	Whitney Rapp Katmai, Lake Clark, Alagnak, and Aniakchak Planning, Research Permitting, GIS/GPS, and Invasive Species National Park Service, U.S. Department of the Interior P.O. Box 7 King Salmon, Alaska, 99613 (907) 246-2145

Date: 10/19/2010

Date of previous ranking, if any: 5T

OUTCOME SCORE:

CLIMATIC COMPARISON

This species is present or may potentially establish in the following eco-geographic regions:

Pacific Maritime	<u>Yes</u>
Interior-Boreal	<u>Yes</u>
Arctic-Alpine	<u>Yes</u>

INVASIVENESS RANKING

	Total (total answered points possible ¹)	Total
Ecological impact	40 (<u>40</u>)	<u>22</u>
Biological characteristics and dispersal ability	25 (<u>23</u>)	<u>18</u>

Ecological amplitude and distribution	25 (25)	21
Feasibility of control	10 (10)	5
Outcome score	100 (98) ^b	66 ^a
Relative maximum score ²		67

¹ For questions answered “unknown” do not include point value for the question in parentheses for “total answered points possible.”

² Calculated as $a/b \times 100$

A. CLIMATIC COMPARISON

1.1. Has this species ever been collected or documented in Alaska?

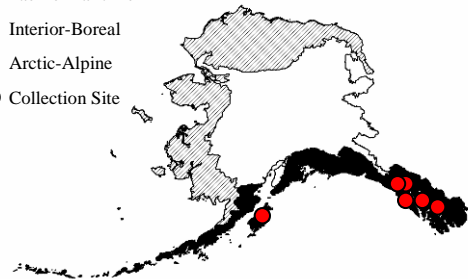
- Yes - continue to 1.2
 No - continue to 2.1

1.2. From which eco-geographic region has it been collected or documented (see inset map)?

Proceed to Section B. INVASIVENESS RANKING

- Pacific Maritime
 Interior-Boreal
 Arctic-Alpine

- Pacific Maritime
□ Interior-Boreal
▨ Arctic-Alpine
● Collection Site



Documentation: *Geranium robertianum* has been documented from the Pacific Maritime ecogeographic region of Alaska (Hultén 1968, AKEPIC 2010, UAM 2010).

2.1. Is there a 40 percent or higher similarity (based on CLIMEX climate matching, see references) between climates where this species currently occurs and:

- a. Juneau (Pacific Maritime region)?
 Yes – record locations and percent similarity; proceed to Section B.
 No
- b. Fairbanks (Interior-Boreal region)?
 Yes – record locations and percent similarity; proceed to Section B.
 No
- c. Nome (Arctic-Alpine region)?
 Yes – record locations and percent similarity; proceed to Section B.
 No

If “No” is answered for all regions; reject species from consideration

Documentation: *Geranium robertianum* rarely grows in regions with minimum January temperatures below -20°C (Tofts 2004), which suggests that it is unlikely to establish in the Interior-Boreal or Arctic-Alpine ecogeographic regions of Alaska. However, it is known to occur in several locations in Finland that have 40% or greater climatic similarities with Fairbanks and Nome (CLIMEX 1999, NatureGate 2010). This species has been documented from a site approximately 48 km south of Dombås, Norway, and a site 15 km from Lillehammer, Norway, which have 52% and 44% climatic similarities with Fairbanks and 63% and 49% climatic similarities with Nome, respectively (CLIMEX 1999, Vascular Plant Herbarium Oslo 2010, Vascular Plants Field Notes Oslo 2010). It has also been documented from a site 14 km northeast of Lærdalsøyri, Norway, which has a 45% climatic similarity with Nome (CLIMEX 1999, Vascular Plant Herbarium 2010).

B. INVASIVENESS RANKING

1. Ecological Impact

1.1. Impact on Natural Ecosystem Processes

- | | | |
|----|---|----|
| a. | No perceivable impact on ecosystem processes | 0 |
| b. | Has the potential to influence ecosystem processes to a minor degree (e.g., has a perceivable but mild influence on soil nutrient availability) | 3 |
| c. | Has the potential to cause significant alteration of ecosystem processes (e.g., increases sedimentation rates along streams or coastlines, degrades habitat important to waterfowl) | 7 |
| d. | Has the potential to cause major, possibly irreversible, alteration or disruption of ecosystem processes (e.g., the species alters geomorphology, hydrology, or affects fire frequency thereby altering community composition; species fixes substantial levels of nitrogen in the soil making soil unlikely to support certain native plants or more likely to favor non-native species) | 10 |
| e. | Unknown | U |

Score

5

Documentation: *Geranium robertianum* is believed to reduce the nutrients and moisture available to native plant species when it grows at high densities. Additionally, populations in the Pacific Northwest are likely to affect forest community dynamics by severe inhibition of native species; however, the full impacts of this species are poorly documented (ODA 2009).

1.2. Impact on Natural Community Structure

- | | | |
|----|---|----|
| a. | No perceived impact; establishes in an existing layer without influencing its structure | 0 |
| b. | Has the potential to influence structure in one layer (e.g., changes the density of one layer) | 3 |
| c. | Has the potential to cause significant impact in at least one layer (e.g., creation of a new layer or elimination of an existing layer) | 7 |
| d. | Likely to cause major alteration of structure (e.g., covers canopy, eliminating most or all lower layers) | 10 |
| e. | Unknown | U |

Score

5

Documentation: *Geranium robertianum* can grow at densities of up to 250 plants per square meter in the Pacific Northwest (NWCB 1997). It is associated with reduced forb and graminoid structural diversity in the forests of Oregon (Carlson pers. obs.). This species has the potential to change the understory layers in Alaska.

1.3. Impact on Natural Community Composition

- | | | |
|----|--|----|
| a. | No perceived impact; causes no apparent change in native populations | 0 |
| b. | Has the potential to influence community composition (e.g., reduces the population size of one or more native species in the community) | 3 |
| c. | Has the potential to significantly alter community composition (e.g., significantly reduces the population size of one or more native species in the community) | 7 |
| d. | Likely to cause major alteration in community composition (e.g., results in the extirpation of one or more native species, thereby reducing local biodiversity and/or shifting the community composition towards exotic species) | 10 |

e. Unknown

U
Score

7

Documentation: *Geranium robertianum* forms dense monocultures that displace native herbaceous plant species and reduce local species diversity in forests of the Pacific Northwest (NWCB 1997, Tofts 2004, King County 2008, Jones et al. 2010). This species has the potential to reduce the populations of native species in shaded woodlands and forests in Alaska.

1.4. Impact on associated trophic levels (cumulative impact of this species on the animals, fungi, microbes, and other organisms in the community it invades)

- a. Negligible perceived impact 0
- b. Has the potential to cause minor alteration (e.g., causes a minor reduction in nesting or foraging sites) 3
- c. Has the potential to cause moderate alteration (e.g., causes a moderate reduction in habitat connectivity, interferes with native pollinators, or introduces injurious components such as spines, toxins) 7
- d. Likely to cause severe alteration of associated trophic populations (e.g., extirpation or endangerment of an existing native species or population, or significant reduction in nesting or foraging sites) 10
- e. Unknown

U
Score

5

Documentation: *Geranium robertianum* is not palatable to wildlife, and grazing is rare. This species is susceptible to rust fungi, but associations with other plant parasites and diseases have not been documented. A wide range of insect herbivores feed on this species. The flowers are visited by flies, butterflies, and bees (Tofts 2004). In Yorkshire, England, the proximity of flowering species increased the pollination of *Geranium robertianum* (Goyder 1983). The presence of this species may alter native plant-pollinator relationships. Roots are often associated with mycorrhizal fungi (Boerner 1990).

Total Possible

40

Total

22

2. Biological Characteristics and Dispersal Ability

2.1. Mode of reproduction

- a. Not aggressive (produces few seeds per plant [0-10/m²] and not able to reproduce vegetatively). 0
- b. Somewhat aggressive (reproduces by seed only [11-1,000/m²]) 1
- c. Moderately aggressive (reproduces vegetatively and/or by a moderate amount of seed [<1,000/m²]) 2
- d. Highly aggressive (extensive vegetative spread and/or many seeded [>1,000/m²]) 3
- e. Unknown

U
Score

3

Documentation: *Geranium robertianum* reproduces by seeds only. In England and Poland, this species has been documented producing from 50 to 1,550 seeds per plant. When growing at a density of 3 to 6 plants per square meter in Europe, *Geranium robertianum* produced 300 to 1,200

seeds per square meter. In Washington, seed density can be as high as 3,100 seeds per square meter (NWCB 1997, Tofts 2004, King County 2007).

- 2.2. *Innate potential for long-distance dispersal (wind-, water- or animal-dispersal)*
- a. Does not occur (no long-distance dispersal mechanisms) 0
 - b. Infrequent or inefficient long-distance dispersal (occurs occasionally despite lack of adaptations) 2
 - c. Numerous opportunities for long-distance dispersal (species has adaptations such as pappus, hooked fruit coats, etc.) 3
 - d. Unknown U
- Score 3

Documentation: Seeds are forcibly ejected from the capsules and can land up to 21 feet away from the parent plant. Each seed has a sticky, thread-like fiber that can attach to vegetation, leaf litter, ants, garden snails, and possibly browsing mammals (NWCB 1997, Tofts 2004).

- 2.3. *Potential to be spread by human activities (both directly and indirectly – possible mechanisms include: commercial sale of species, use as forage or for revegetation, dispersal along highways, transport on boats, common contaminant of landscape materials, etc.).*
- a. Does not occur 0
 - b. Low (human dispersal is infrequent or inefficient) 1
 - c. Moderate (human dispersal occurs regularly) 2
 - d. High (there are numerous opportunities for dispersal to new areas) 3
 - e. Unknown U
- Score 3

Documentation: In Southeast Alaska, *Geranium robertianum* spreads along road systems, and 85% of documented infestations are associated with fill importation (AKEPIC 2010). This species has been cultivated as a garden ornamental and a medicinal herb, and it can easily escape cultivation (NWCB 1997, King County 2008, ODA 2009).

- 2.4. *Allelopathic*
- a. No 0
 - b. Yes 2
 - c. Unknown U
- Score U

Documentation: It is likely but not confirmed that *Geranium robertianum* is allelopathic (Barndt 2006).

- 2.5. *Competitive ability*
- a. Poor competitor for limiting factors 0
 - b. Moderately competitive for limiting factors 1
 - c. Highly competitive for limiting factors and/or able to fix nitrogen 3
 - d. Unknown U
- Score 3

Documentation: *Geranium robertianum* can be highly competitive with other forbs in early spring but does not compete well with grasses (ODA 2009). It displaces native herbaceous species in the Pacific Northwest (NWCB 1997).

2.6. *Forms dense thickets, has a climbing or smothering growth habit, or is otherwise taller than the surrounding vegetation.*

- a. Does not grow densely or above surrounding vegetation 0
- b. Forms dense thickets 1
- c. Has a climbing or smothering growth habit, or is otherwise taller than the surrounding vegetation 2
- d. Unknown U

Score

Documentation: Despite being a small plant, *Geranium robertianum* can grow at a density of 250 plants per square meter in forest sites with 90% canopy cover in western Washington. In forest sites with 50% to 60% canopy cover, *Geranium robertianum* can grow at a density of 112 plants per square meter (NWCB 1997). This species can cover 50% to 100% of the ground surface in Washington (Jones et al. 2010).

2.7. *Germination requirements*

- a. Requires sparsely vegetated soil and disturbance to germinate 0
- b. Can germinate in vegetated areas, but in a narrow range of or in special conditions 2
- c. Can germinate in existing vegetation in a wide range of conditions 3
- d. Unknown U

Score

Documentation: Seeds can germinate in undisturbed, vegetated areas in moist, nutrient-rich, moderately basic soils in forests and woodlands (Tofts 2004, King County 2008).

2.8. *Other species in the genus invasive in Alaska or elsewhere*

- a. No 0
- b. Yes 3
- c. Unknown U

Score

Documentation: No other *Geranium* species are listed as noxious weeds in the U.S. (Invaders 2010, USDA 2010). Several other *Geranium* species are known or suspected to occur as non-native species in Alaska: *G. bicknellii*, *G. carolinianum*, *G. pusillum*, and *G. sanguineum* (AKEPIC 2010). *G. dissectum* and *G. molle* are considered weeds in California (DiTomaso and Healy 2007). *G. lucidum* aggressively invades oak and fir woodlands in Oregon (ODA 2009).

2.9. *Aquatic, wetland, or riparian species*

- a. Not invasive in wetland communities 0
- b. Invasive in riparian communities 1
- c. Invasive in wetland communities 3
- d. Unknown U

Score

Documentation: Populations of *Geranium robertianum* extend along the Columbia River in Klickitat County, WA, but appear to invade dry oak and brush habitat there instead of riparian habitats (NWCB 1997).

Total Possible	23
Total	18

3. Ecological Amplitude and Distribution

3.1. *Is the species highly domesticated or a weed of agriculture?*

- | | | |
|----|---|-------|
| a. | Is not associated with agriculture | 0 |
| b. | Is occasionally an agricultural pest | 2 |
| c. | Has been grown deliberately, bred, or is known as a significant agricultural pest | 4 |
| d. | Unknown | U |
| | | Score |
| | | 4 |

Documentation: *Geranium robertianum* has been cultivated as an ornamental plant and occasionally as a medicinal herb. It escapes from cultivation and is a well-known garden pest (NWCB 1997, King County 2008, Plants for a Future 2010).

3.2. *Known level of ecological impact in natural areas*

- | | | |
|----|---|-------|
| a. | Not known to impact other natural areas | 0 |
| b. | Known to impact other natural areas, but in habitats and climate zones dissimilar to those in Alaska | 1 |
| c. | Known to cause low impact in natural areas in habitats and climate zones similar to those in Alaska | 3 |
| d. | Known to cause moderate impact in natural areas in habitat and climate zones similar to those in Alaska | 4 |
| e. | Known to cause high impact in natural areas in habitat and climate zones similar to those in Alaska | 6 |
| f. | Unknown | U |
| | | Score |
| | | 4 |

Documentation: *Geranium robertianum* displaces native herbaceous plant species and threatens species diversity in coniferous forests of the Pacific Northwest. It spreads in undisturbed areas, such as oak and fir woodlands (NWCB 1997, Tofts 2004, King County 2008, ODA 2009).

3.3. *Role of anthropogenic and natural disturbance in establishment*

- | | | |
|----|---|-------|
| a. | Requires anthropogenic disturbance to establish | 0 |
| b. | May occasionally establish in undisturbed areas, readily establishes in naturally disturbed areas | 3 |
| c. | Can establish independently of natural or anthropogenic disturbances | 5 |
| e. | Unknown | U |
| | | Score |
| | | 3 |

Documentation: In the Pacific Northwest, *Geranium robertianum* escapes cultivation and thrives in shaded or partially shaded woodland sites (King County 2008, ODA 2009). Although all recorded infestations in Alaska are associated with disturbances (AKEPIC 2010), *Geranium robertianum* has the potential to establish in undisturbed forests and woodlands similar to those of the Pacific Northwest. In northern Spain, *Geranium robertianum* grew to its highest percent

cover in grazed woodlands, indicating that grazing disturbance promotes the growth of this species (Onaindia 2004).

3.4. *Current global distribution*

- a. Occurs in one or two continents or regions (e.g., Mediterranean region) 0
 - b. Extends over three or more continents 3
 - c. Extends over three or more continents, including successful introductions in arctic or subarctic regions 5
 - e. Unknown U
- Score

5

Documentation: *Geranium robertianum* is native to Europe, North Africa, Central Asia, and Siberia. Populations have been introduced to Japan, southwest China, temperate South America, North America, Australia, and New Zealand (Tofts 2004). This species has been collected from several sites above the Arctic Circle in Troms County, Norway (Vascular Plant Herbarium Oslo 2010).

3.5. *Extent of the species' U.S. range and/or occurrence of formal state or provincial listing*

- a. Occurs in 0-5 percent of the states 0
 - b. Occurs in 6-20 percent of the states 2
 - c. Occurs in 21-50 percent of the states and/or listed as a problem weed (e.g., "Noxious," or "Invasive") in one state or Canadian province 4
 - d. Occurs in more than 50 percent of the states and/or listed as a problem weed in two or more states or Canadian provinces 5
 - e. Unknown U
- Score

5

Documentation: *Geranium robertianum* has been documented from 26 states of the U.S. and is listed as a Class B noxious weed in Oregon and Washington (ODA 2009, Invaders 2010, USDA 2010).

Total Possible	25
Total	21

4. Feasibility of Control

4.1. *Seed banks*

- a. Seeds remain viable in the soil for less than three years 0
 - b. Seeds remain viable in the soil for three to five years 2
 - c. Seeds remain viable in the soil for five years or longer 3
 - e. Unknown U
- Score

3

Documentation: Seeds can remain viable in soil for up to six years (Roberts and Boddrell 1985).

4.2. *Vegetative regeneration*

- a. No resprouting following removal of aboveground growth 0
- b. Resprouting from ground-level meristems 1
- c. Resprouting from extensive underground system 2

- d. Any plant part is a viable propagule 3
 - e. Unknown U
- Score

0

Documentation: *Geranium robertianum* does not resprout following the removal of the above ground portion of the plant (Tofts 2004).

4.3. Level of effort required

- a. Management is not required (e.g., species does not persist in the absence of repeated anthropogenic disturbance) 0
 - b. Management is relatively easy and inexpensive; requires a minor investment of human and financial resources 2
 - c. Management requires a major short-term or moderate long-term investment of human and financial resources 3
 - d. Management requires a major, long-term investment of human and financial resources 4
 - e. Unknown U
- Score

2

Documentation: Small or isolated populations of *Geranium robertianum* can be controlled by hand-pulling. Plants have shallow roots and can be pulled easily. Manual control efforts are most effective before plants produce seeds. Populations can also be controlled by covering with a layer of cardboard underneath 3 or 4 inches of mulch. The spread of *Geranium robertianum* can be prevented by cutting plants several times per growing season before they produce flowers. Populations can also be controlled by herbicide applications; pre-emergent herbicides and glyphosate herbicides without a surfactant have proven successful. Controlled areas may need to be observed for several years to prevent the reestablishment of populations from the seed banks. The aphid *Acyrtosiphon malvae geranii* is a potential biological control agent, but it may damage native *Geranium* species in addition to *Geranium robertianum* (NWCB 1997, Tofts 2004, King County 2008).

Total Possible	10
Total	5

Total for four sections possible	98
Total for four sections	66

References:

AKEPIC database. Alaska Exotic Plant Information Clearinghouse Database. 2010. Available: <http://akweeds.uaa.alaska.edu/>

Bardt, J. 2006. Invasive Species in the Pacific Northwest. University of Washinton Press. Seattle, WA. 287 p.

Boerner, R. 1990. Role of Mycorrhizal Fungus Origin in Growth and Nutrient Uptake by *Geranium robertianum*. American Journal of Botany. 77(4). 483-489 p.

Carlson, M. L., Associate Research Professor – Botany, Alaska Natural Heritage Program, University of Alaska Anchorage, 707 A Street, Anchorage, Alaska. Tel: (907) 257-2790 – Pers. obs.

CLIMEX. 1999. CLIMEX for Windows, Predicting the effects of climate on plants and animals. Version 1.1a. CISRO Publishing. Collingwood, Australia.

DiTomaso, J., and E. Healy. 2007. Weeds of California and Other Western States. Vol. 2. University of California Agriculture and Natural Resources Communication Services, Oakland, CA. 974 p.

- Goyder, D. 1983. Pollination ecology of five species in a limestone community. *Watsonia*. 14(4). 397-405 p.
- Hultén, E. 1968. *Flora of Alaska and Neighboring Territories*. Stanford University Press, Stanford, CA. 1008 pp.
- Invaders Database System. 2010. University of Montana. Missoula, MT. <http://invader.dbs.umt.edu/>
- ITIS. 2010. Integrated Taxonomic Information System. <http://www.itis.gov/>
- Jones, C., S. Acker, C. Halpern. 2010. Combining local- and large-scale models to predict the distributions of invasive plant species. *Ecological Applications*. 20(2). 311-326 p.
- King County. 2007. Weed Alert, Herb Robert, *Geranium robertianum*. Noxious Weed Control Program, Water and Land Resources Division, Department of Natural Resources and Parks. King County, WA. [21 October 2010] <http://www.kingcounty.gov/environment/animalsAndPlants/noxious-weeds.aspx>
- King County. 2008. Best Management Practices, Herb Robert, *Geranium robertianum*. Noxious Weed Control Program, Water and Land Resources Division, Department of Natural Resources and Parks. King County, WA. [21 October 2010] <http://www.kingcounty.gov/environment/animalsAndPlants/noxious-weeds.aspx>
- NatureGate. 2010. Finland Nature and Species. Helsinki, Finland. [21 October 2010] Available: <http://www.luontoportti.com/suomi/en/>
- Onaindia, M., I. Dominguez, I. Albizu, C. Garbisu, and I. Amezaga. 2004. Vegetation diversity and vertical structure as indicators of forest disturbance. *Forest Ecology and Management*. 195(3). 341-354 p.
- Oregon Department of Agriculture (ODA). 2009. Herb Robert (*Geranium robertianum*). ODA Plant Division, Noxious Weed Control. Salem, OR. [25 October 2010] http://www.oregon.gov/ODA/PLANT/WEEDS/profile_herbrobert.shtml
- Plants for a Future. 2010. [21 October 2004] Available: <http://www.pfaf.org/user/default.aspx>
- Roberts, H. and J. Boddrell. 1985. Seed survival and seasonal emergence in some species of *Geranium*, *Ranunculus*, and *Rumex*. *Annals of Applied Biology*. 107(2). 231-238 p.
- Tofts, R. 2004. Biological Flora of the British Isles, *Geranium robertianum* L. *Journal of Ecology*. 92(3). 537-555 p.
- UAM. 2010. University of Alaska Museum, University of Alaska Fairbanks. Available: <http://arctos.database.museum/home.cfm>
- USDA. 2010. The PLANTS Database. National Plant Data Center, Natural Resources Conservation Service, United States Department of Agriculture. Baton Rouge, LA. <http://plants.usda.gov>
- Vascular Plants Field Notes, Oslo. 2010. Accessed through GBIF (Global Biodiversity Information Facility) data portal (<http://data.gbif.org/datasets/resource/1079>, 2010-10-19). Natural History Museum, University of Oslo. Oslo, Norway.
- Vascular Plant Herbarium, Oslo. 2010. Accessed through GBIF (Global Biodiversity Information Facility) data portal (<http://data.gbif.org/datasets/resource/1078>, 2010-10-21). Natural History Museum, University of Oslo. Oslo, Norway.
- Washington Noxious Weed Control Board (NWCB). 1997. Written Findings of the Washington State Noxious Weed Control Board, *Geranium robertianum* L. Washington State Noxious Weed Control Board. Olympia, WA. [25 October 2010] http://www.nwcb.wa.gov/weed_info/Geranium_robertianum.html