Climate Change Vulnerability Index Report

Impatiens noli-tangere (Western jewelweed)

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Geographic Area: Washington Heritage Rank: G4G5/S1

Index Result: Moderately Vulnerable Confidence: Very High

Climate Change Vulnerability Index Scores

Section A	**Severity**	**Scope (% of range)**
1. Temperature Severity	>6.0° F (3.3°C) warmer	0
	5.6-6.0° F (3.2-3.3°C) warmer	0
	5.0-5.5° F (2.8-3.1°C) warmer	0
	4.5-5.0° F (2.5-2.7°C) warmer	0
	3.9-4.4° F (2.2-2.4°C) warmer	14
	<3.9° F (2.2°C) warmer	86
2. Hamon AET:PET moisture	< -0.119	0
	-0.097 to -0.119	0
	-0.074 to - 0.096	100
	-0.051 to - 0.073	0
	-0.028 to -0.050	0
	>-0.028	0
Section B		**Effect on Vulnerability**
1. Sea level rise		Neutral
2a. Distribution relative to natural barriers		Neutral
2b. Distribution relative to anthropogenic barriers		Neutral
3. Impacts from climate change mitigation		Neutral
Section C		
1. Dispersal and movements		Increase
2ai Change in historical thermal niche		Increase
2aii. Change in physiological thermal niche		Somewhat Increase
2bi. Changes in historical hydrological niche		Neutral
2bii. Changes in physiological hydrological niche		Somewhat Increase
2c. Dependence on specific disturbance regime		Neutral
2d. Dependence on ice or snow-covered habitats		Somewhat Increase
3. Restricted to uncommon landscape/geological features		Neutral
4a. Dependence on others species to generate required habitat		Neutral
4b. Dietary versatility		Not Applicable
4c. Pollinator versatility		Neutral
4d. Dependence on other species for propagule dispersal		Neutral
4e. Sensitivity to pathogens or natural enemies		Neutral
4f. Sensitivity to competition from native or non-native species		Somewhat Increase
4g. Forms part of an interspecific interaction not covered above		Neutral
5a. Measured genetic diversity		Unknown
5b. Genetic bottlenecks		Unknown
5c. Reproductive system		Neutral

6. Phenological response to changing seasonal and precipitation dynamics	Neutral
Section D	
D1. Documented response to recent climate change	Neutral
D2. Modeled future (2050) change in population or range size	Unknown
D3. Overlap of modeled future (2050) range with current range	Unknown
D4. Occurrence of protected areas in modeled future (2050) distribution	Unknown

Section A: Exposure to Local Climate Change

A1. Temperature: Six of the seven occurrences of *Impatiens noli-tangere* in Washington (86%) occur in areas with a projected temperature increase of <3.9˚ F (Figure 1). One other population (excluding an historical record from Spokane County that has been found to be misidentified) occurs in an area with a predicted temperature increase of 3.9-4.4˚ F.

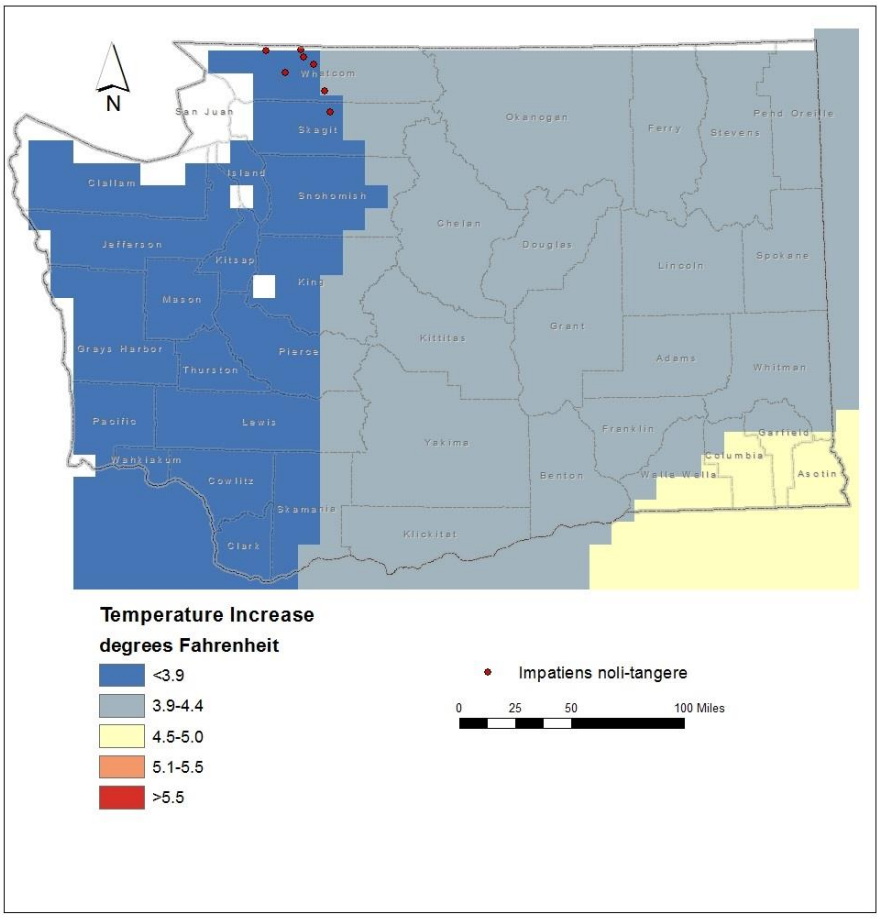

Figure 1. Exposure of *Impatiens noli-tangere* occurrences in Washington to projected local temperature change. Base map layers from www.natureserve.org/ccvi

A2. Hamon AET:PET Moisture Metric: All seven of the Washington occurrences of *Impatiens noli-tangere* (100%) are found in areas with a projected decrease in available moisture (as measured by the ratio of actual to potential evapotranspiration) in the range of -0.074 to -0.096 (Figure 2).

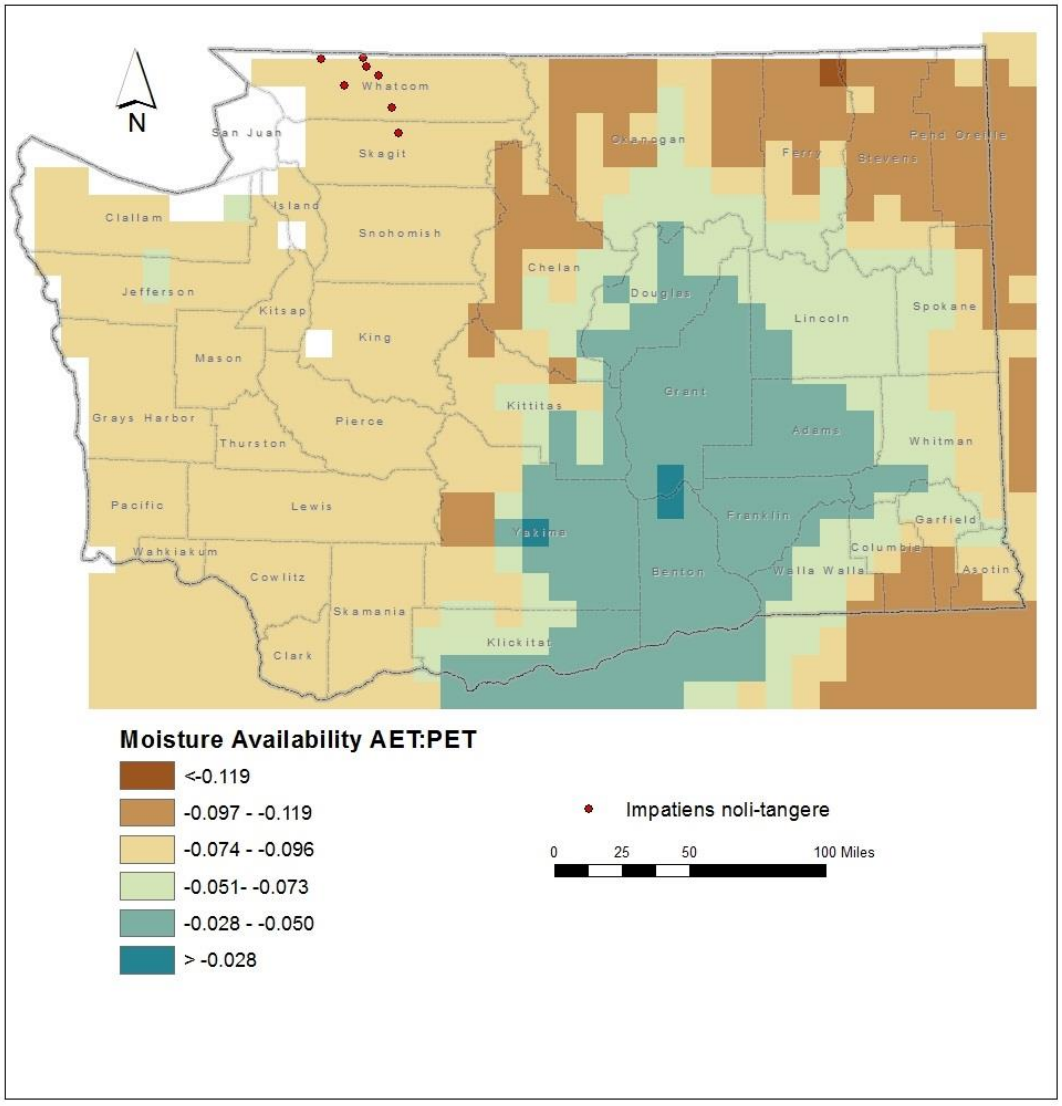

Figure 2. Exposure of *Impatiens noli-tangere* occurrences in Washington to projected moisture availability (based on ratio of actual to predicted evapotranspiration). Base map layers from www.natureserve.org/ccvi

Section B. Indirect Exposure to Climate Change

B1. Exposure to sea level rise: Neutral.
Washington occurrences of *Impatiens noli-tangere* are found at 400-1700 feet (120-520 m) and would not be inundated by projected sea level rise.

B2a. Natural barriers: Neutral.
In Washington, *Impatiens noli-tangere* is found in shady, moist riparian forests and ditch banks (Camp and Gamon 2011, WNHP records). This habitat is a component of the North Pacific Lowland Riparian Forest and Shrubland ecological system (Rocchio and Crawford 2015). Individual populations occupy small areas and are separated from each other by 6-30 km (4-19 miles). This is a relatively widespread habitat type, so the discontinuities in distribution might be the result of insufficient survey effort or competition from related species. Based on available information, this factor is scored as neutral.

B2b. Anthropogenic barriers: Neutral.
The range of *Impatiens noli-tangere* in Washington is mostly in the foothills of the North Cascades and is moderately bisected by roads, forestry activities, and human habitations. Whether these anthropogenic impacts create a significant barrier for dispersal of this species is not well established.

B3. Predicted impacts of land use changes from climate change mitigation: Neutral.

Section C: Sensitive and Adaptive Capacity

C1. Dispersal and movements: Increase.
Impatiens noli-tangere produces many-seeded fruits that are released explosively for distances of 2-3 meters by sudden dehiscence of the fruit wall (Hatcher 2003). Seeds produced by plants in streamside habitats may be secondarily transported by flowing water (Hatcher 2003). In Europe, *I. noli-tangere* often grows in association with ant mounds, suggesting that ants may help disperse seeds (Gorb and Gorb 2003). Hiratsuka and Inoue (1988) found that fruits produced by chasmogamous (open) flowers dispersed over larger distances than those from cleistogamous (closed) flowers. Average dispersal distances are probably relatively short, however (less than 100 meters).

C2ai. Historical thermal niche: Increase.
Figure 3 depicts the distribution of *Impatiens noli-tangere* in Washington relative to mean seasonal temperature variation for the period from 1951-2006 ("historical thermal niche"). All of the known occurrences (100%) are found in areas that have experienced small (37-47˚F/20.8-26.3˚C) temperature variation during the past 50 years and are considered at Increased vulnerability to climate change.

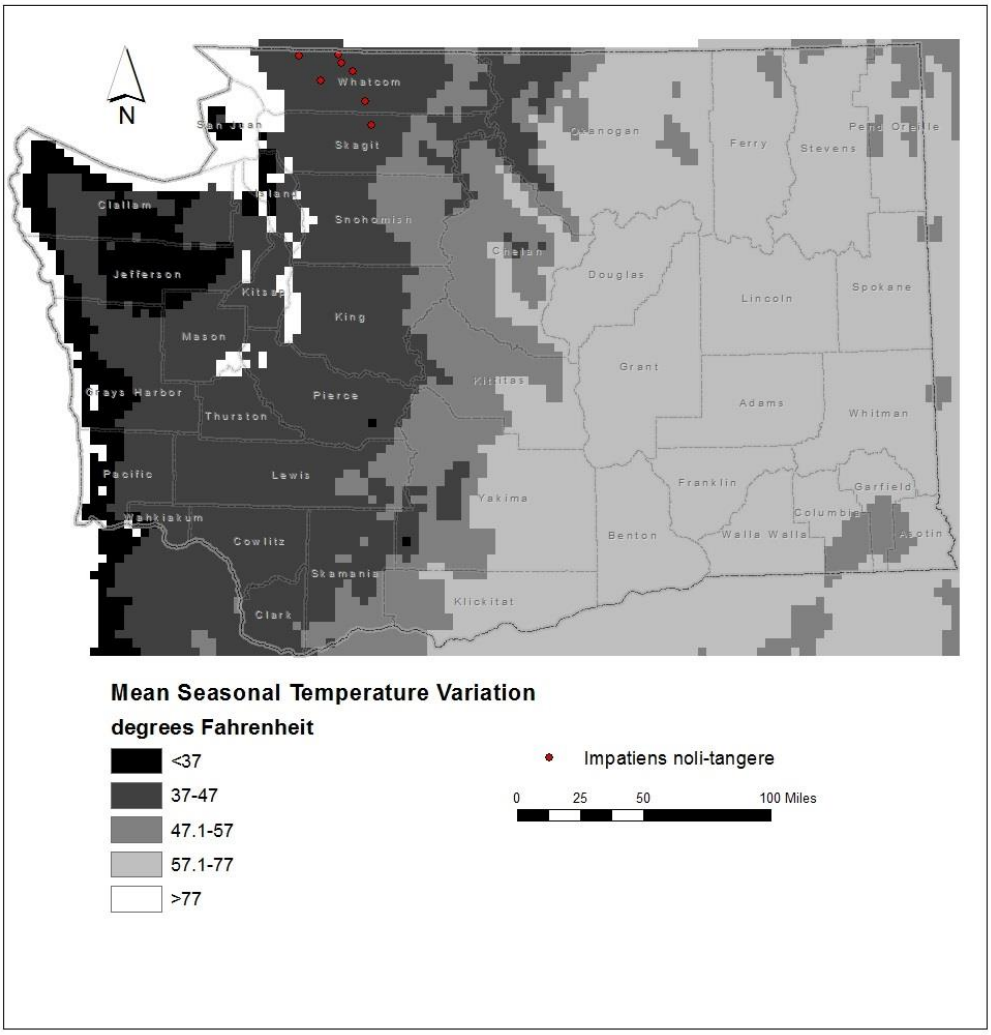

Figure 3. Historical thermal niche (exposure to past temperature variations) of *Impatiens noli-tangere* occurrences in Washington. Base map layers from www.natureserve.org/ccvi

C2aii. Physiological thermal niche: Somewhat Increase.
The foothills riparian forest habitat of *Impatiens noli-tangere* is associated with cool, shaded conditions during the growing season and would be potentially impacted by increased drought that would affect the width of riparian habitat (Rocchio and Ramm-Granberg 2017).

C2bi. Historical hydrological niche: Neutral.
All seven of the known populations of *Impatiens noli-tangere* in Washington (100%) are found in areas that have experienced average or greater than average (>20 inches/508 mm) of precipitation variation in the past 50 years (Figure 4). According to Young et al. (2016), these occurrences are at neutral vulnerability from climate change.

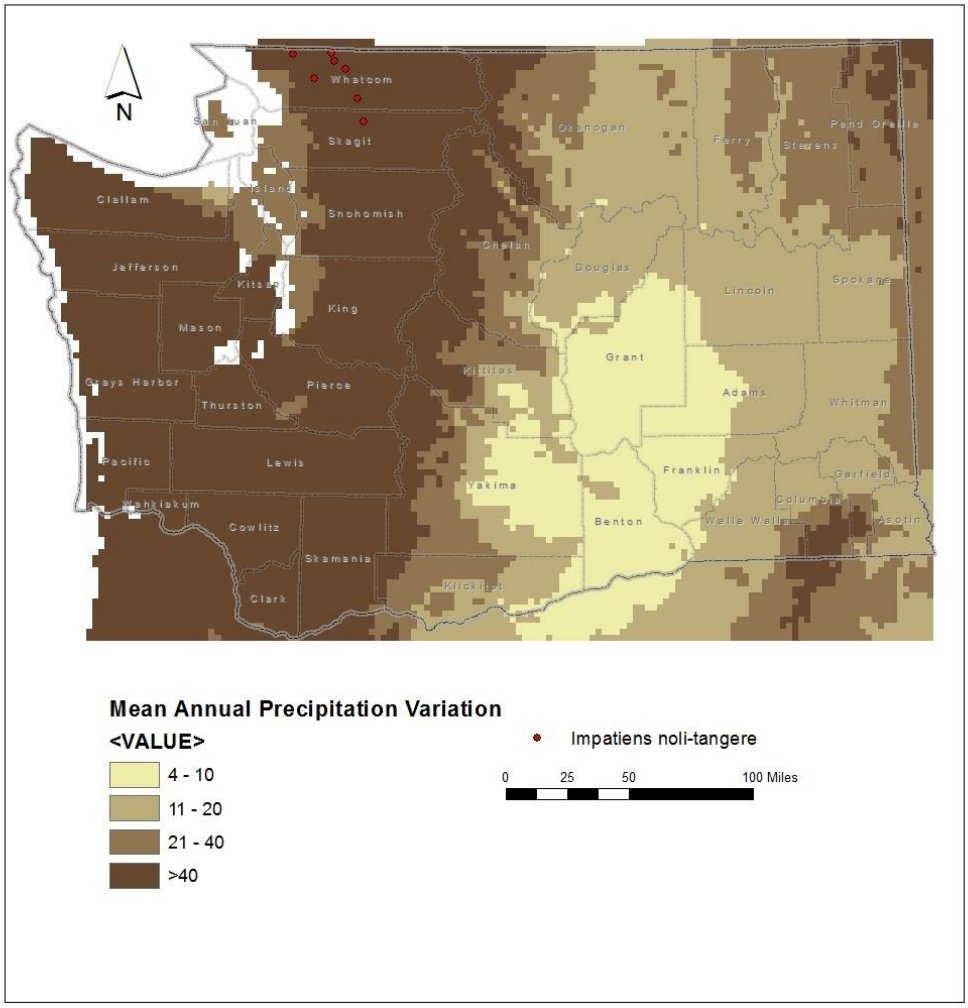

Figure 4. Historical hydrological niche (exposure to past variations in precipitation) of *Impatiens noli-tangere* occurrences in Washington. Base map layers from www.natureserve.org/ccvi

C2bii. Physiological hydrological niche: Somewhat Increase.
As an annual species adapted to cool, moist, forested wetlands, *Impatiens noli-tangere* is somewhat vulnerable to seasonal fluctuations or long-term decreases in moisture availability. Changes in the onset and intensity of annual flooding from melted snowpack could impact the

condition of montane riparian habitats occupied by this species (Rocchio and Ramm-Granberg 2017).

C2c. Dependence on a specific disturbance regime: Neutral.
Impatiens noli-tangere is not dependent on periodic disturbances to maintain its riparian forest habitat. The species could, however, be detrimentally affected by loss of forest canopy due to wildfire, or long-term drought associated with potential climate change (Rocchio and Ramm-Granberg 2017).

C2d. Dependence on ice or snow-cover habitats: Somewhat Increase.
The populations of *Impatiens noli-tangere* in Washington occur in lower montane riparian forest habitats that could be negatively impacted by earlier flooding due to decreased snowpack and reduction in base flow levels in summer (Rocchio and Ramm-Granberg 2017).

C3. Restricted to uncommon landscape/geological features: Neutral.
Impatiens noli-tangere is found on a variety of Pleistocene glacial and tertiary sedimentary formations that are relatively widespread in northwestern Washington.

C4a. Dependence on other species to generate required habitat: Neutral
The habitat occupied by *Impatiens noli-tangere* is maintained primarily by natural abiotic processes.

C4b. Dietary versatility: Not applicable for plants

C4c. Pollinator versatility: Neutral.
Hatcher (2003) observed that chasmogamous flowers of *Impatiens noli-tangere* in Europe are pollinated by at least 11 insect species. These include long-tongued bees (*Bombus*, Halictid bees) as well as vespid wasps and syrphid flies. Tokuda et al. (2015) found that *I. noli-tangere* and *I. textori* compete for the same pool of pollinators in forests in Japan and this competition can lead to reduced seed production. This species can also self-pollinate within unopened cleistogamous flowers.

C4d. Dependence on other species for propagule dispersal: Neutral.
Initial dispersal of seeds is done by mechanical means of the fruit pod itself (explosive discharge of the fruit wall, often triggered by light touch – thus the common name 'touch-me-not'). Secondary dispersal may be from water or potentially by ants (Gorb and Gorb 2003). Overall importance of animal dispersers is low and the factor is ranked neutral.

C4e. Sensitivity to pathogens or natural enemies: Neutral.
Impacts from pathogens are not known. This species is edible to livestock and deer, though this does not appear to be a limiting factor to its persistence.

C4f. Sensitivity to competition from native or non-native species: Somewhat Increase.
In Europe, *Impatiens noli-tangere* can be sensitive to competition from other vegetation. Plants in open areas may respond favorably to increased light, but are impacted by drought (Hatcher 2003).

C4g. Forms part of an interspecific interaction not covered above: Neutral.

Does not require an interspecific interaction.

C5a. Measured genetic variation: Unknown.
Despite numerous studies on the pollination and dispersal of *Impatiens noli-tangere*, there appears to be limited data on its genetic diversity. Masuda and Yahara (1994) report that genetic diversity between populations may be high based on research in Japan where phenotypic differences were maintained in common garden trials.

C5b. Genetic bottlenecks: Unknown.

C5c. Reproductive System: Neutral
Impatiens noli-tangere produces showy, open chasmogamous flowers that are functionally unisexual and self-sterile due to maturation of the anthers before the stigmas are receptive for pollen. Such a reproductive system promotes outcrossing and should result in relatively high genetic variability. Under stressful environmental conditions or late in the flowering season, *I. noli-tangere* can also produce cleistogamous flowers which do not open and are entirely self-pollinated. Cleistogamy ensures that some seed will be produced each year, which is important for an annual species that does not produce a large seed bank (Hatcher 2003).

C6. Phenological response to changing seasonal and precipitation dynamics: Neutral.
No changes have been detected in phenology in recent years.

Section D: Documented or Modeled Response to Climate Change

D1. Documented response to recent climate change: Neutral.
No change has been detected to date.

D2. Modeled future (2050) change in population or range size: Unknown

D3. Overlap of modeled future (2050) range with current range: Unknown

D4. Occurrence of protected areas in modeled future (2050) distribution: Unknown

References

Camp, P. and J.G. Gamon, eds. 2011. Field Guide to the Rare Plants of Washington. University of Washington Press, Seattle. 392 pp.

Gorb, E. and S. Gorb. 2003. Seed Dispersal by Ants in a Deciduous Forest Ecosystem: Mechanisms, Strategies, Adaptations. Kluwer Academic Publishers, Dordrecht, The Netherlands.

Hatcher, P.E. 2003. *Impatiens noli-tangere* L. Journal of Ecology. 91(1): 147-167.

Hiratsuka, A. and O. Inoue. 1988. Dispersability of dimorphic seeds in *Impatiens noli-tangere* and *I. textori* (Balsaminaceae). Ecological Review 21:157-161.

Masuda, M. and T. Yahara. 1994. Reproductive ecology of a cleistogamous annual, *Impatiens noli-tangere* L., occurring under different environmental conditions. Ecological Research 9(1): 67-75.

Rocchio, F.J. and R.C. Crawford. 2015. Ecological systems of Washington State. A guide to identification. Natural Heritage Report 2015-04. Washington Natural Heritage Program, WA Department of Natural Resources, Olympia, WA. 384 pp.

Rocchio F.J. and T. Ramm-Granberg. 2017. Ecological System Climate Change Vulnerability Assessment. Unpublished Report to the Washington Department of Fish and Wildlife. Washington Natural Heritage Program, Department of Natural Resources, Olympia, WA.

Tokuda, N., M. Hattori, K. Abe, Y. Shinohara, Y. Nagano, and T. Itino. 2015. Demonstration of pollinator-mediated competition between two native *Impatiens* species, *Impatiens noli-tangere* and *I. textori* (Balsaminaceae).Ecology and Evolution 5(6): 1271-1277.

Young, B.E., E. Byers, G. Hammerson, A. Frances, L. Oliver, and A. Treher. 2016. Guidelines for using the NatureServe Climate Change Vulnerability Index. Release 3.02. NatureServe, Arlington, VA. 48 pp. + app.