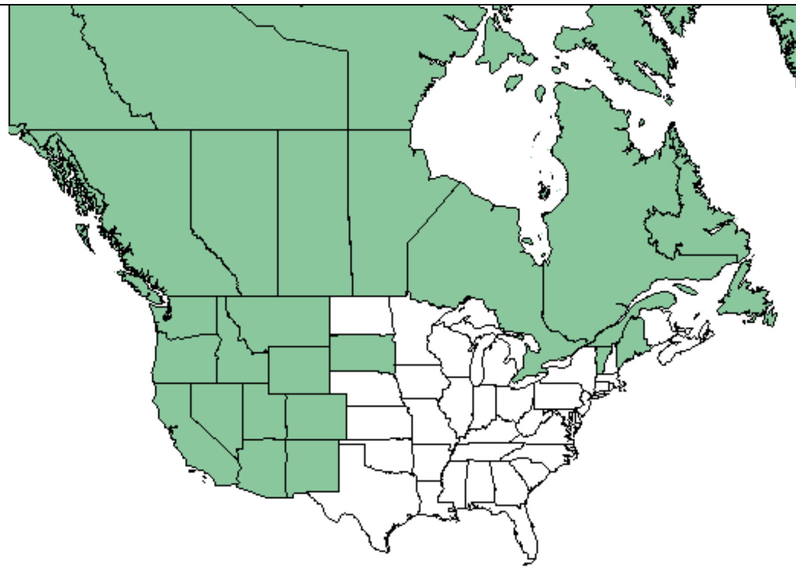
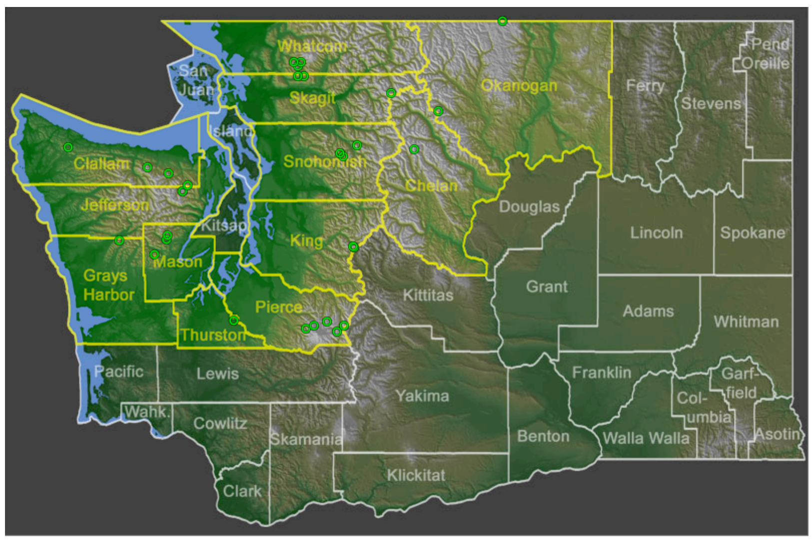
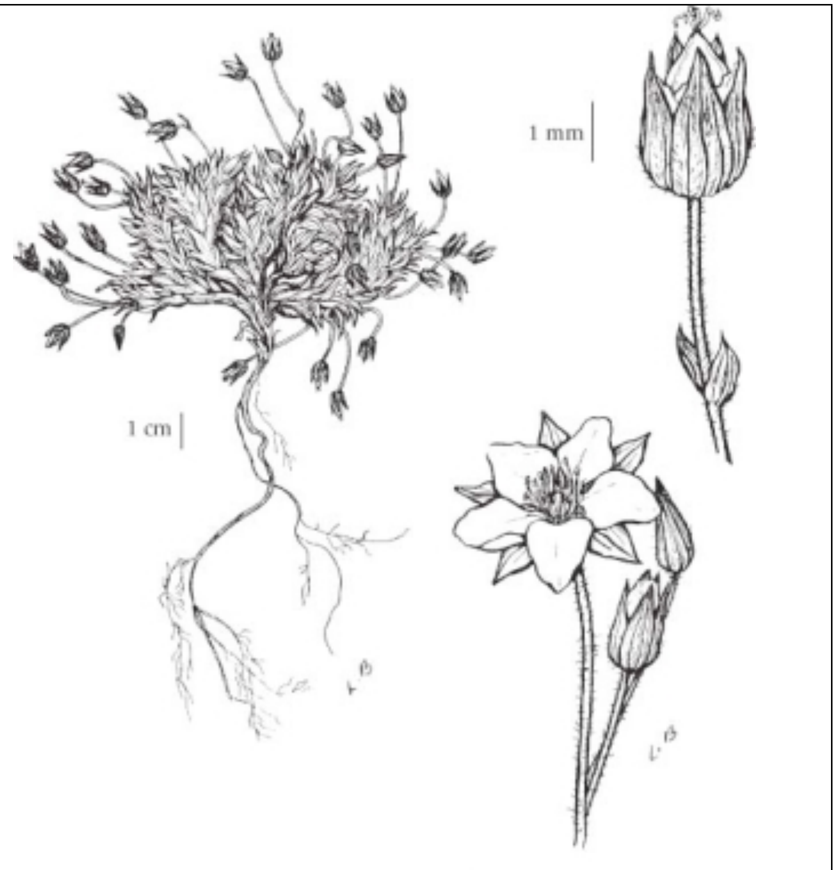
Plant Propagation Protocol for *Minuartia rubella*
ESRM 412 – Native Plant Production

Source: Burke Herbarium 2017 Photo credit: G.D. Carr 2013

TAXONOMY	
Plant Family	
Scientific Name	Caryophyllaceae
Common Name	Pink or carnation family
Plant species	
Scientific Name	*Minuartia rubella* (Whalenberg)
Varieties	None listed
Sub-species	None listed
Cultivar	None listed
Common Synonym(s)	*Arenaria propinqua* Richards. *Arenaria rubella* (Wahlenb.) Hiern. *Arenaria verna* var. *propinqua* (Richards.) Fern. *Arenaria verna* var. *rubella* (Wahlenb.) S. Wats. *Minuartia rossii* var. *orthotrichoides* auct. non (Schischkin) *Tryphane rubella* (Wahlenb.) Rchb. (E-Flora BC 2017)
Common Name(s)	Beautiful sandwort, mountain sandwort, Arctic sandwort, and boreal stitchwort (Flora of North America 2017)
Species Code (as per USDA Plants database)	MIRU3
GENERAL INFORMATION	

Geographical range	 Source: USDA Plants Database 2017.  Source: Burke Herbarium 2017.
Ecological distribution	Common on gravelly or sandy soils, rock outcrops, talus slopes, usually at high elevations. (Pojar et al 1994)
Climate and elevation range	Subalpine and alpine zones, from 870 meters to 2630 meters, with an average of 1979 meters (Eflora 2017).
Local habitat and abundance	Hummocks, along streams, river terraces, slopes, ridges, cliffs; dry, moderately well-drained areas; gravel, sand, till; with low organic content; calcareous soils (Aiken et al 2007).
Plant strategy type / successional stage	One study determined *Minuartia rubella* to be a late aestival species (so it blooms after July 11th) (Molau 1993), which is relevant to phenology but necessarily a successional strategy. Another study found *Minuartia aizoide* (in same genus as *M. rubella*) a dominant species at the seral stage in succession

	(Kikvidze 1993).
Plant characteristics	**Description from Flora of North America 2017:** **Plants** perennial, cespitose or mat-forming. **Taproots** filiform to somewhat thickened; rhizomes absent. **Stems** ascending to erect, green, 2-8(-18) cm, moderately to densely stipitate-glandular (very rarely glabrous), internodes of stems 1-10 times as long as leaves; trailing stems absent. **Leaves** overlapping, ± tightly, distally (cauline), concentrated proximally (cauline), connate proximally, with often loose, usually scarious sheath 0.2-0.7 mm; blade ± straight or outwardly curved, green, flat to 3-angled, prominently 3-veined abaxially, subulate, 1.5-10 × 0.3-1.3 mm, flexuous, margins not thickened, scarious, smooth, apex green or purple, acute to apiculate, often navicular, shiny, sparsely to densely ciliate, often stipitate-glandular; axillary leaves present among vegetative leaves. **Inflorescences** 3-7+-flowered, open cymes or rarely flower solitary, terminal; bracts broadly subulate to narrowly lanceolate, herbaceous, margins scarious. **Pedicels** 0.2-1.5 cm, densely stipitate-glandular. **Flowers:** hypanthium disc-shaped; sepals prominently 3-veined, ovate to lanceolate (herbaceous portion oblong to narrowly ovate), 2.5-3.2 mm, not enlarging in fruit, apex green to purple, acute to acuminate, not hooded, stipitate-glandular; petals elliptic, 0.8-1.3 times as long as sepals, apex rounded, entire. **Capsules** on stipe ca. 0.2 mm, ovoid, 4.5-5 mm, longer than sepals. **Seeds** reddish brown, suborbiculate with radicle prolonged into beak, somewhat compressed, 0.4-0.5 mm, tuberculate;

<table>
<tr><td></td><td>

Minuartia rubella
Source: E-Flora BC 2017</td></tr>
<tr><td colspan="2">PROPAGATION DETAILS: SEEDS
Four different scientific studies for seed propagation were found that included Minuartia rubella as a species in the study group.</td></tr>
<tr><td>Ecotype</td><td>1. Alsos et al 2012: Arctic tundra in Isfjorden area of Svalbard, Norway

2. Bell and Bliss 1980: Arctic tundra on King Christian Island, Northwest Territories, Canada.

3. Bliss and Gold 1999: Arctic tundra on Devon Island, Canada.

4. Cooper et al 2004: Arctic tundra on Colesdalen, NW coast, and Adventdalen in Spitsbergen, Svalbard, Norway.</td></tr>
<tr><td>Propagation Goal</td><td>Germinated seeds</td></tr>
<tr><td>Propagation Method</td><td>Seeds</td></tr>
<tr><td>Product Type</td><td>Germinated seeds</td></tr>
</table>

Stock Type	Native seed from: 1. Alsos et al 2012: Arctic Tundra in Isfjorden area of Svalbard, Norway 2. Bell and Bliss 1980: King Christian Island, Northwest Territories, Canada. 3. Bliss and Gold 1999: Western section of a plateau north of the Truelove River and Above Truelove Lowland, Devon Island, Canada. 4. Cooper et al 2004: Colesdalen, NW coast, and Adventadalen in Spitsbergen, Svalbard, Norway.
Time to Grow	1. Alsos et al 2012: Successful germination of seeds was the aim but no specific criteria for germination time was outlined. 2. Bell and Bliss 1980: The majority of seeds in the field trial germinated 4 to 6 weeks after being sown, in all cases following periods of precipitation (p. 3). The controlled environment studies ran for 60 days (p.4). 3. Bliss and Gold 1999: For seed germination, the experiment lasted 90 days. For the soil blocks, the study lasted 76 days (p. 626). 4. Cooper et al 2004: Soil samples from the polar heath, bird cliff, proglacial habitat and thermophilic heath were grown over 12 weeks (11 for thermophilic heath) simulating the maximum Svalbard summer period. Samples from intact and disturbed *Dryas* heath were grown over 14 weeks (p. 117).
Target Specifications	1. Alsos et al 2012: Germinated seed. No specifications set. 2. Bell and Bliss 1980: Germinated seed. No specifications set. 3. Bliss and Gold 1999: Germinated seed. No specifications set. 4. Cooper et al 2004: Germinated seed. No specifications

	set.
Propagule Collection Instructions	1. Alsos et al 2012: Seeds were collected between August 27th and September 19th, 2008 in the Isfjorden area of Svalbard. *M. rubella* seeds were collected on September 10th, 2008 in Sassendalen in a “disturbed moss tundra” habitat (Appendix 1). When possible, seeds were shaken out of the plants to ensure only mature seeds were collected (p. 820). 2. Bell and Bliss 1980: Seeds were collected from plants on King Christian Island between August 14th and August 22nd, 1973 (p. 2). 3. Bliss and Gold 1999: Seeds of select species were collected and weighed in spring of 1992. To assess the seed bank, five 20 x 20 cm blocks of soil were removed from a depth of 1.5 cm from crusted and non-crusted sites. Blocks of soil were frozen for five months, and then soils were thawed and placed in a growth chamber (p. 626). 4. Cooper et al 2004: Seeds collected in early July to late August in the year 2000 (p.116). The top 2 cm of organic soil was collected together with bryophytes and litter. Soil samples were collected within 10 cm of focus species to maximize chance of capturing dispersed seed (p. 117).
Propagule Processing/Propagule Characteristics	1. Alsos et al 2012: If the plants were wet, seed capsules were collected and left in paper bags at 5-8 °C in 35 % relative humidity (RH) to dry. Seeds that were obviously not ripe were not collected. Seeds of species which did not seem 100 % ripe were left in paper bags at 5-8 °C until September 19th to permit ripening, after which they were assumed to be ripe (p. 820). 1. Bell and Bliss 1980: Dry inflorescences or seeds were stored at 2 °C and -3 °C until tested (p. 2). 2. Bliss and Gold 1999: To determine viable seed bank size, five 20 x 20 cm blocks of soil were removed to a depth of 1.5cm, from both the crusted and non-crusted site. The soil blocks were returned to the

	laboratory and stored for 5 months (p. 626). 3. Cooper et al 2004: Samples of seed collected in the field were cooled 2-6 °C during transport and stored in paper bags at 0.5 °C for 5 to 7 weeks (p. 117).
Pre-Planting Propagule Treatments	1. Alsos et al 2012: *M. rubella* seeds were cold stratified for 28 days, then left to germinate at 20 °C for an unspecified amount of time until seeds germinated (see Appendix 1 of study). 2. Bell and Bliss 1980: Dry inflorescences or seeds were stored at 2 °C and -3 °C until tested (p. 2). 3. Bliss and Gold 1999: Harvested soil blocks were frozen for 5 months then placed in a 1 cm layer over a base of washed sand in 30 x 30cm trays. Trays were placed in a growth chamber under 24 hours of light to mimic summer field irradiance (p. 626). 4. Cooper et al 2004: Samples were kept at -5 °C for 5 weeks then thawed at 0.5 °C for 3 days and acclimatized at 4 °C for 4 days. Volumes of soil from intact and disturbed *Dryas* heath sites were reduced by sieving and washing (p.117).
Growing Area Preparation / Annual Practices for Perennial Crops	1. Alsos et al 2012: 3 to 50 seeds of each species were placed on a 9 cm diameter petri dish with 10% agar solution (p. 821). 2. Bell and Bliss 1980: In controlled environment studies, germination tests were made in closed petri dishes lined with two sheets of Whatman No. 1 filter paper moistened with distilled water. Other tests were made with seeds immersed in distilled water in small test tubes or flasks. For field tests, 25 seeds of one species were sowed on each 2.5 by 2.5 cm plot on natural surfaces immediately following snowmelt in late June (p. 2). 3. Bliss and Gold 1999: For seed germination, filter paper in petri dishes was kept moist with distilled water and treated three times with a mild fungicide. Harvested soil blocks were placed in a 1 cm layer over a base of washed sand in 30 x 30 cm trays (p.626).

	4. Cooper et al 2004: Soil samples from the polar heath, bird cliff, proglacial habitat and thermophilic heath were spread thinly on filter paper in plastic petri dishes. Samples from intact and disturbed *Dryas* heath were placed on commercial sterilized soil in aluminum foil boxes. Unidentified seedlings were transplanted to a mixture of peat and perlite and grown at 15 °C until identification was possible (p. 117).
Establishment Phase Details	1. Alsos et al 2012: The light temperature was 4,000 K (Osram 35 W, 840 HE) and the brightness was 3,300 lm (manufacturer's information). The proton flux was approximately 40 umol per square meter per second measured with a quantum flux sensor at the level of the seeds. If the germination percentage obtained was low, but the seeds still seemed viable, a new germination test was attempted following an additional period of stratification (p. 821). 2. Bell and Bliss 1980: All petri dish were kept at a constant temperature of 0.5 °C with 24 hours of light in plant growth chambers (Environmental Growth Chamber Co., models M-13 and M-15). Each test used 25 seeds with two replicates; seeds were not treated with fungicide (p. 2). 5. Bliss and Gold 1999: For seeds, growth chambers were set to provide warm summer conditions (15 °C at night, and 20 °C during the day), experiment lasted 90 days with germination recorded every 2-4 days. For soil blocks, trays were placed in a growth chamber under 24 hours of light to mimic summer field irradiance. The chambers were maintained with 8 hours of "night" using sodium vapor lamps and a temperature of 10-12°C, and a "day" using sodium vapor and metal halide lamps and a temperature of 15 to 16 °C. These temperatures were higher than field conditions and were used to maximize field conditions (p. 626). 3. Cooper et al 2004: Soil samples from the polar heath, bird cliff, proglacial habitat and thermophilic heath

	were spread thinly on filter paper in plastic petri dishes and germinated at 18 °C in a greenhouse, using a 24-hr photo-period (150 umol) over 12 weeks (11 for thermophilic heath) simulating the maximum Svalbard summer period. Samples from intact and disturbed *Dryas* heath were placed on commercial sterilized soil in aluminum foil boxes and germinated at 22 °C in a greenhouse over 14 weeks. These samples were stirred in weeks 3 and 11, and gibberillic acid (1 ppm) was added in week 12. All samples were moistened every second day, and seedlings counted weekly. Unidentified seedlings were transplanted to a mixture of peat and perlite and grown at 15 °C until identification was possible (p. 117).
Length of Establishment Phase	1. Alsos et al 2012: No information listed for how long seeds were germinated. 2. Bell and Bliss 1980: The majority of seeds in the field trial germinated 4 to 6 weeks after being sown, in all cases following periods of precipitation (p. 3). The controlled environment studies ran for 60 days (p.4). 3. Bliss and Gold 1999: For seed germination, the experiment lasted 90 days. For the soil blocks, the study lasted 76 days (p. 626). 4. Cooper et al 2004: Soil samples from the polar heath, bird cliff, proglacial habitat and thermophilic heath were grown over 12 weeks (11 for thermophilic heath) simulating the maximum Svalbard summer period. Samples from intact and disturbed *Dryas* heath were grown over 14 weeks (p. 117).
Active Growth Phase	No information found.
Length of Active Growth Phase	No information found.
Hardening Phase	No information found.
Length of Hardening Phase	No information found.
Harvesting, Storage and Shipping	No information found.
Length of Storage	No information found.
Guidelines for Outplanting / Performance on Typical Sites	No information found.

Other Comments	
INFORMATION SOURCES	
References	See below
Other Sources Consulted	See below
Protocol Author	Sage Stowell
Date Protocol Created or Updated	May 24th, 2016

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