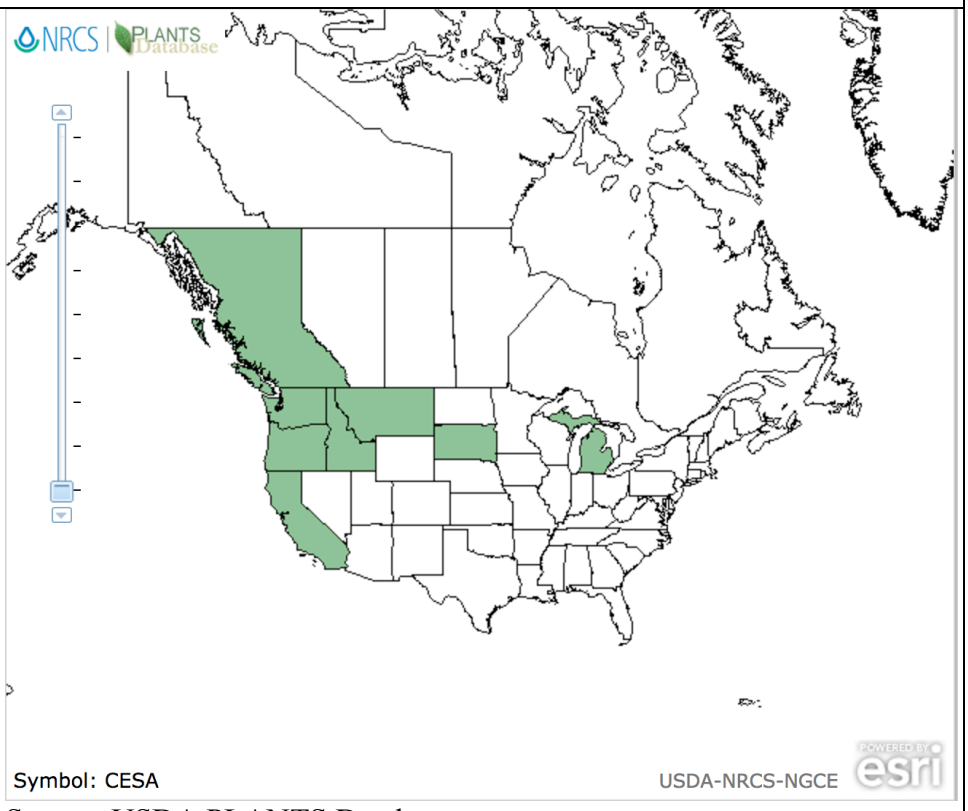
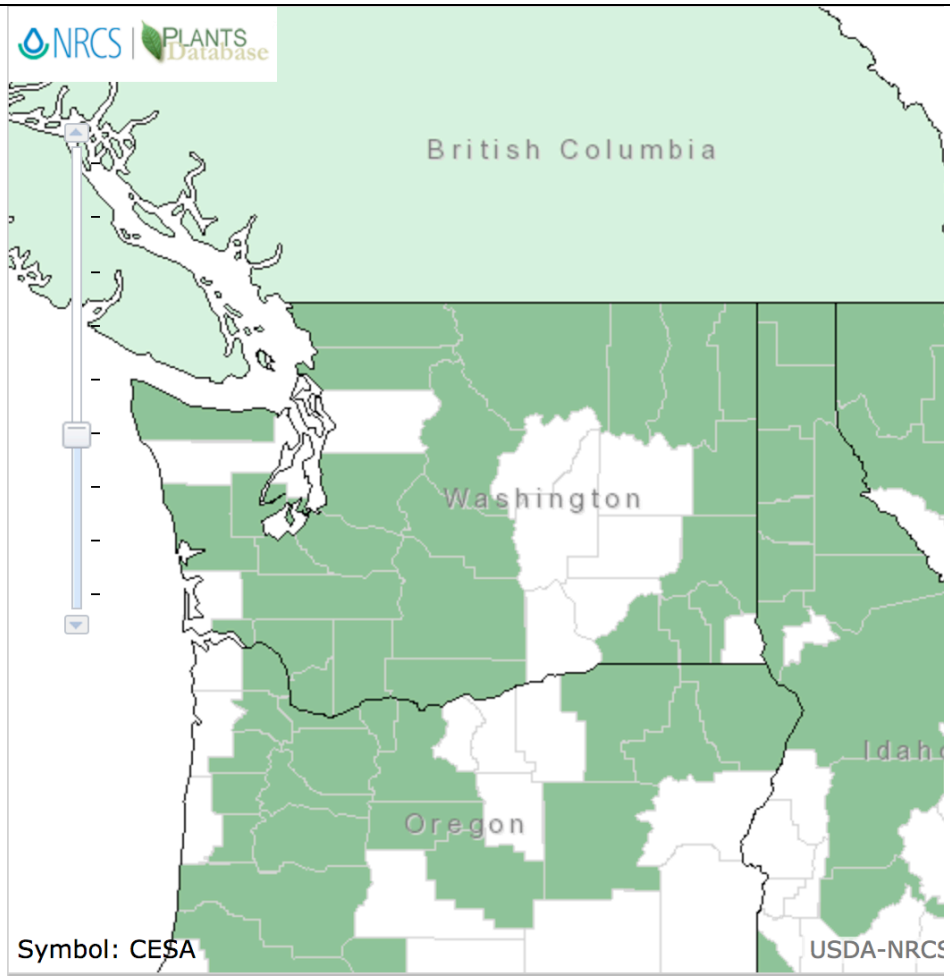
Plant Propagation Protocol for *Ceanothus sanguineum*
ESRM 412 – Native Plant Production
Protocol URL: https://courses.washington.edu/esrm412/protocols/*CESA*

TAXONOMY	
Plant Family	
Scientific Name	Rhamnaceae
Common Name	Buckthorn Family
Species Scientific Name	
Scientific Name	*Ceanothus sanguineus* Pursh.
Varieties	N/A
Sub-species	N/A
Cultivar	N/A
Common Synonym(s)	*Ceanothus oreganus* Nutt.
Common Name(s)	Redstem Ceanothus, Oregon Tea-Tree, Wild Lilac
Species Code (as per USDA Plants database)	CESA
GENERAL INFORMATION	
Geographical range	 Source: USDA PLANTS Database

	 Source: USDA PLANTS Database
Ecological distribution	*C. sanguineus* is found in dry, open areas, such as open woodlands or roadside strips (Pojar & MacKinnon 1994), or moist rocky or sandy slopes. *C. sanguineus* commonly appears after fire, as seeds germinate after fire (Turner & Kuhlmann 2014).
Climate and elevation range	*C. sanguineus* is found from low to mid elevation range, from lowlands to mountainous areas (Turner & Kuhlmann 2014; Pojar & MacKinnon 1994). Establishment usually occurs on slopes (Robson & Kingery 2006). *C. sanguineus* requires a minimum of 300 frost-free days per year and can survive a minimum temperature of -13° C (USDA).
Local habitat and abundance	*C. sanguineus* is a common understory species of Western hemlock, Ponderosa pine, and mixed-conifer forests in the Pacific Northwest (Johnson 2001). *C. sanguineus* is commonly associated with other understory species, including vine maple (*Acer circinatum),* ocean spray (*Holodiscus discolor),* snowberry (*Symphoricarpos albus),* and California hazel (*Corylus cornuta* var. *californica)* (Johnson 2001). *C. sanguineus* is a

	preferred species for browsing by deer and elk (Turner & Kuhlmann 2014).
Plant strategy type / successional stage	*C. sanguineus* is associated with early to middle stages of seral succession in forests (Johnson 2001). *C. sanguineus* is a post-fire colonizer, and maintains vigor and site density when burned through every 10-15 years. Seeds germinate after heat scarification by summer fire, followed by cold, moist stratification from winter conditions. Seedbanks are established that require fire to begin development. *C. sanguineus* can also regenerate vegetatively from below-ground root crowns that sprout after aboveground foliage is burned by fire (Johnson 2001).
Plant characteristics	*C. sanguineus* is an erect, multiple-stemmed shrub, distinguishable by red-purple glabrous stems (Turner & Kuhlmann 2014). Grows to be one to three meters high. Leaves are elliptical to ovate, with glabrous uppers and pale, finely pubescent lowers. Small, bright white perfect flowers in clusters on thin pedicels. Fruit is three-lobed and opens at ripening (Piper & Beattie 1915). Reaches reproductive capacity at 3 to 6 years of age, and lifespan is approximately 40 years or longer (Johnson 2001).
PROPAGATION DETAILS: Propagation by Seed	
Ecotype	N/A
Propagation Goal	Plants
Propagation Method	Seed
Product Type	Container
Stock Type	Styrofoam containers (Hudson & Carlson 1998)
Time to Grow	Approximately 8 months: collect seeds in August, sow seeds in April (Husdon & Carlson 1998; Rose et al. 1998).
Target Specifications	10 to 25 cm in height; 3 to 5 cm in diameter; and a firm root plug (Hudson & Carlson 1998).
Propagule Collection Instructions	Plants produce capsules that will begin to ripen in August. Collect capsules by hand as the first capsules begin to open on the plant (Rose et al. 1998).
Propagule Processing/Propagule Characteristics	Seed density is approximately 150,667 seeds per pound (USDA). Seeds are approximately 2 mm in length, with a hard, impenetrable seedcoat and dormant embryo. Mature, viable seeds are dark brown in color (Rose et al. 1998).
Pre-Planting Propagule Treatments	Crack capsules open to remove seeds by hand or place seeds in dry, covered container at 21-27° C for several days and capsules will crack open on their own (Rose et al. 1998). When seeds are extracted from capsules, they require cleaning by working capsules over a fine screen (Robson & Kingery 2006). Soak seeds in water at 88° C for 24 hours prior to stratification. For stratification, place seeds in between layers of peat in a permeable bag,

	and store at 2° C for two months (Hudson & Carlson 1998). Germination can also be improved by scarification in sulfuric acid or dipping in gibberellin (Rose et al. 1998). Seeds can be stored for up to 15 years in a dry, covered container at a temperature of 1-2° C (Plants for a Future).
Growing Area Preparation / Annual Practices for Perennial Crops	Best growing medium is 90% peat and 10% coarse growing medium, such as coarse fir sawdust. If this is not successful, try a more porous medium (Hudson & Carlson 1998). Note: if sowing seeds directly on-site, it has been found that seed establishment is typically more successful on pre-burned soil than unburned soil (Radwan & Crouch 1977). Suggested container is Styrofoam 77/125 mL (412A) or 77/170 mL (415D) (Hudson & Carlson 1998).
Establishment Phase Details	Best temperature conditions for germination are 24° C during the day and 20° C at night. Best light conditions are a day length of 20 hours (Hudson & Carlson 1998).
Length of Establishment Phase	1 to 2 months (Plants for a Future).
Active Growth Phase	Seedlings grow slowly, and do not require frequent watering. Watering should be done from above the soil only. The seedlings do not require any pruning as they grow (Hudson & Carlson 1998). Seedlings are susceptible to damping-off in the greenhouse environment, so sanitized equipment must be used for watering and fertigation (Johnson 2001). Fertigation is suggested as follows: 30-50 ppm Nitrogen one to two times per week through watering. Dry soil between fertigation treatments. If the seedlings do not respond well, reduce amounts of fertigation or raise soil pH (Hudson & Carlson 1998).
Length of Active Growth Phase	N/A
Hardening Phase	No information available.
Length of Hardening Phase	No information available.
Harvesting, Storage and Shipping	No information available.
Length of Storage	No information available.
Guidelines for Outplanting / Performance on Typical Sites	Outplanting of seedlings should occur in early spring (Robson & Kingery 2006).
Other Comments	*C. sanguineus* is listed as a threatened species in Michigan, however there are no restrictions on collection in that state (USDA).

PROPAGATION DETAILS: Vegetative Propagation (Wick, Johnson, and Keaty 2001)	
Ecotype	Lodgepole Forest, Middle Fork Flathead River, Montana (Wick, Johnson, & Keaty 2001).
Propagation Goal	Plants
Propagation Method	Vegetative
Product Type	Container
Stock Type	800 mL container (Wick, Johnson, & Keaty 2001).
Time to Grow	2 years (Wick, Johnson, & Keaty 2001).
Target Specifications	Height of approximately 20 cm, diameter of approximately 8 mm, and firmly established roots (Wick, Johnson, & Keaty 2001).
Propagule Collection Instructions	Collect semi-hardwood cuttings from May to June (Wick, Johnson, & Keaty 2001).
Propagule Processing/Propagule Characteristics	After collecting cuttings, keep them in moist, cool conditions until they are ready to be treated (Wick, Johnson, & Keaty 2001).
Pre-Planting Propagule Treatments	Separate cuttings into lengths of 20-30 cm. Treat cuttings with 2000 ppm IBA (Indole-3-butyric acid) (Wick, Johnson, & Keaty 2001). After this treatment and direct striking into a humidity-controlled misting chamber, there was a 44% success rate of root development in cuttings (Wick, Johnson, & Keaty 2001).
Growing Area Preparation / Annual Practices for Perennial Crops	Strike cuttings directly into a container with a porous rooting medium. Suggested media combination is 50% sand and 50% perlite. Container should be in humidity-controlled misting chamber covered with a shadecloth, with misting occurring for 6 seconds every 6 minutes; this should be adaptable to ambient temperature conditions to ensure that the cuttings are not exposed to excess moisture. Containers should be bottom-heated at a temperature of 21° C, and heating cables should be set up 12 cm beneath the container (Wick, Johnson, & Keaty 2001).
Establishment Phase Details	Cuttings that rooted successfully should be moved out of the mist chamber and kept in the greenhouse until transplanting during active growth phase (Wick, Johnson, & Keaty 2001).
Length of Establishment Phase	4 to 5 weeks (Wick, Johnson, & Keaty 2001).
Active Growth Phase	Cuttings are transplanted into 3L containers with a rooting medium of 6:1:1 ratio of sphagnum peat moss, perlite, and vermiculite. Fertilization is 5 grams of Osmocote controlled-release fertilizer and 2 grams of Micromax fertilizer per container. Water cuttings after transplanting to pots and transfer to shadehouse for 4 weeks, before moving to outdoor full-sun exposure (Wick, Johnson, & Keaty 2001).
Length of Active Growth Phase	6 weeks (Wick, Johnson, & Keaty 2001).

Hardening Phase	Fertigate plants with 200 ppm 10-20-20 liquid NPK (Nitrogen, Phosphorus, Potassium) during August and September, and reduce watering during September and October. Before plants are exposed to winter conditions, give them one more watering (Wick, Johnson, & Keaty 2001).
Length of Hardening Phase	4 weeks (Wick, Johnson, & Keaty 2001).
Harvesting, Storage and Shipping	Established cuttings can be harvested after 2 years of growth. Cuttings should be harvested in September. Cuttings should be stored through the winter outdoors under cover to protect from snow (Wick, Johnson, & Keaty 2001).
Length of Storage	5 months (Wick, Johnson, & Keaty 2001).
Guidelines for Outplanting / Performance on Typical Sites	Outplanting should occur in early spring (Robson & Kingery 2006).
Other Comments	*C. sanguineus* is listed as a threatened species in Michigan, however there are no restrictions on collection in that state (USDA).
INFORMATION SOURCES	
References	Hudson, Shelley and Michal Carlson. "Propagation of Interior British Columbia Native Plants From Seed." British Columbia Ministry of Forests, Research Program. 1998. Retrieved from: *https://www.for.gov.bc.ca/HFD/Pubs/Docs/Mr/Mr093/Mr093.pdf*. Web. Accessed 20 April 2017. Johnson, Kathleen A. 2000. "Ceanothus sanguineus." Fire Effects Information System, U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). Retrieved from: http://www.fs.fed.us/database/feis/. Web. Accessed 20 April 2017. Piper, Charles, and R. Kent Beattie. *Flora of the Northwest Coast.* State College of Washington, 1915. Print. Plants for a Future. "Ceanothus sanguineus – Pursh." (n.d.) Retrieved from: *http://pfaf.org/User/Plant.aspx?LatinName=Ceanothus+sanguineus*. Web. Accessed 20 April 2017. Pojar, Jim, and Andy MacKinnon. *Plants of the Pacific Northwest Coast: Washington, Oregon, British Columbia, & Alaska.* Lone Pine Publishing, 1994. Print. Radwan, M.A. and G.L. Crouch. "Seed Germination and Seedling Establishment of Redstem Ceanothus." *The Journal of Wildlife*

	Management, 41(4): 1977. Retrieved from: *https://www.jstor.org/stable/pdf/3800003.pdf*. Web. Accessed 20 April 2017. Robson, Sara and James Kingery. "Idaho Native Plants for Roadside Restoration and Revegetation Programs." The Idaho Transportation Department, 2006. Retrieved from*: http://itd.idaho.gov/wp-content/uploads/2016/06/RP171Roadside_Revegetation.pdf*. Web. Accessed 20 April 2017. Rose, Robin et al. *Propagation of Pacific Northwest Native Plants.* Corvallis: Oregon State University Press, 1998. Print. Turner, Mark, and Ellen Kuhlmann. *Trees and Shrubs of the Pacific Northwest.* Timber Press, 2014. Print. USDA National Plant Data Team. "Ceanothus sanguineus." Natural Resources Conservation Service, U.S. Department of Agriculture. Retrieved from: https://plants.usda.gov/java/reference?symbol=CESA. Web. Accessed 20 April 2017. Wick, Dale; Johnson, Kathy; Keating, Rosemary. 2001. "Propagation protocol for production of Container (plug) *Ceanothus sanguineus* Pursh plants 800 ml container; USDI NPS - Glacier National Park West Glacier, Montana." Native Plant Network, U.S. Department of Agriculture, Forest Service, National Center for Reforestation, Nurseries, and Genetic Resources. Retrieved from: http://NativePlantNetwork.org. Web. Accessed 20 April 2017.
Other Sources Consulted (but that contained no pertinent information) (full citations)	Arbury, Jim et al. *The Complete Book of Plant Propagation.* Reed International Books Limited, 1997. Print. Dumroese, R.K., Tara Luna, and Thomas D. Landis. *Nursery Manual for Native Plants: a Guide for Tribal Nurseries.* U.S. Department of Agriculture, Forest Service Agricultural Handbook 730, 2009. Print. Hartman, Hudson et al. *Plant Propagation: Principles and Practices 8th Edition.* Pearson Education Inc, 2015. Print. Kains, Maurice. *Plant Propagation: Greenhouse and Nursery Practice.* Applewood Books, 2008. Print. USDA. "Woody Plant Seed Manual." U.S. Department of Agriculture, Forest Service Agricultural Handbook 727, 2008. Retrieved from: https://www.nsl.fs.fed.us/nsl_wpsm.html. Web. Accessed 20 April 2017.
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Date Protocol Created or Updated	04/26/17

Original Protocol:

Plant Data Sheet

Species: *Ceanothus sanguineus*
Commonly called: Redstem Ceanothus, Soap bush, and Oregon Tea Tree

Range:
Redstem is found on both sides of the Cascades, from British Columbia to California, east to Idaho and western Montana.

Climate, elevation:
Redstem can be found from low to moderate elevations
It is reported at 2,400 feet (732 m) in western Montana as well as at 4,000 feet (1200 m) in northern California

Local occurrence:

Redstem is usually found in disturbed areas particularly in soils are often low in organics. They play a prominent role in dense brushfields that develop throughout its range after fire or timber harvest and subsequent burns and disappears as tree canopy cover increases.

Habitat preferences:
Dry rocky crests, bluffs, borders of woods, clear cuts, logging roads.

Plant strategy:
Redstem is associated with early- or mid-seral stages of forest succession. It remains vigorous when burned at 10- to 15-year intervals. This shrub may be best adapted to summer wildfires that provide heat scarification followed by cold, moist stratification over winter. Redstem cover was positively correlated with years since disturbance. As tree canopy cover reached 56 to 100%, the shrub disappeared. In the absence of subsequent disturbances, redstem may be replaced by oceanspray and chokecherry

Associated species:
Redstem is found in several ecosystems that include; Douglas-fir, Ponderosa pine, Western white pine, Fir-spruce, and Hemlock-Sitka spruce.

May be collected as:
Redstem is typically collected as seed. Bags are placed over the un-ripe fruit and are left on the plant until the seeds are ripe and the plant ejects them into the bags. Cutting are possible as well.

Collection restrictions or guidelines:
Do not cut branches with unripe seeds because the seeds will not ripen correctly once removed from the mother plant.

Seed germination:
Seeds can be scarified by hot water at temperatures of 80 to 90° C (176 to 194° F). Seeds are added to the boiling water for only 5 to 10 seconds and then immediately transferred to a vat of cold water so that they cool quickly and avoid killing the embryo. The seeds remain in, and imbibe, water for 1 day. Following scarification, seeds are cold stratified for 90 days.

Seed life:
Seeds have the ability to stay in dormancy for decades. Seed banks is a prominent strategy used by redstem.

Recommended seed storage conditions:
Seeds stored for 15 years in an air-tight dry container at 1 - 5°c have shown little deterioration in viability.

Propagation recommendations:
Easiest and cheapest method is to scarify and sow seeds directly in the fall to self stratify. Next they can be container grown in the nursery from seeds or cuttings to be planted out at 1yr old. It is not recommended to leave in containers past the first year as the redstem doesn't respond well to root disturbance.

Soil or medium requirements:
The plant prefers light (sandy) and medium (loamy) soils and requires well-drained soil. The plant requires soil pH between 6.5 – 8.0. It can grow in semi-shade (light woodland) or no shade. It requires dry or moist soil. Redstem forms a symbiotic relationship with nitrogen fixing bacteria. Inoculate seeds with Frankia bacteria at time of sowing.

Installation form:
One site stated that the roots to do not like transplanting while another site stated that they were suitable for bare root. Most recommend heat treating the seeds to scarify them planting out in the fall to naturally stratify.

Recommended planting density:
Minimum and maximum density 100 plants per acre.

Care requirements after installed:
No special care is required after installation. It is noted the mortality is highest during dry periods in August so a water regime in late summer may improve survival.

Normal rate of growth or spread:
Most seedling losses occur the 1st year after emergence, with many succumbing to August droughts. Those that are still alive by the 2nd growing season generally survive. Early growth of redstem is often rapid. Twigs have reportedly grown as much as 48 inches (122 cm) in a single growing season. Growth slows as plants age, with annual twig growth of older stands (32-36 years) averaging 9.3 to 12 inches (23.6-30.5 cm). Height of a mature redstem is between 3 to 10 ft.

Sources cited:

Plants for a future
http://www.ibiblio.org/pfaf/cgi-bin/arr_html?Ceanothus+sanguineus

Central Washington Native Plants
http://www.cwnp.org/photopgs/cdoc/cesanguineus.html

USDA Forest Service
http://www.fs.fed.us/database/feis/plants/shrub/ceasan/all.html#GENERAL%20DISTRIBUTION

USDA Natural Resource Conservation Service
http://plants.nrcs.usda.gov/cgi_bin/plant_attribute.cgi?symbol=CESA

Native Plant Nursery Glacier National Park
http://www.nativeplantnetwork.org/Network/view.asp?protocol_id=2907

Data compiled by:

Nancy Toenyan
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