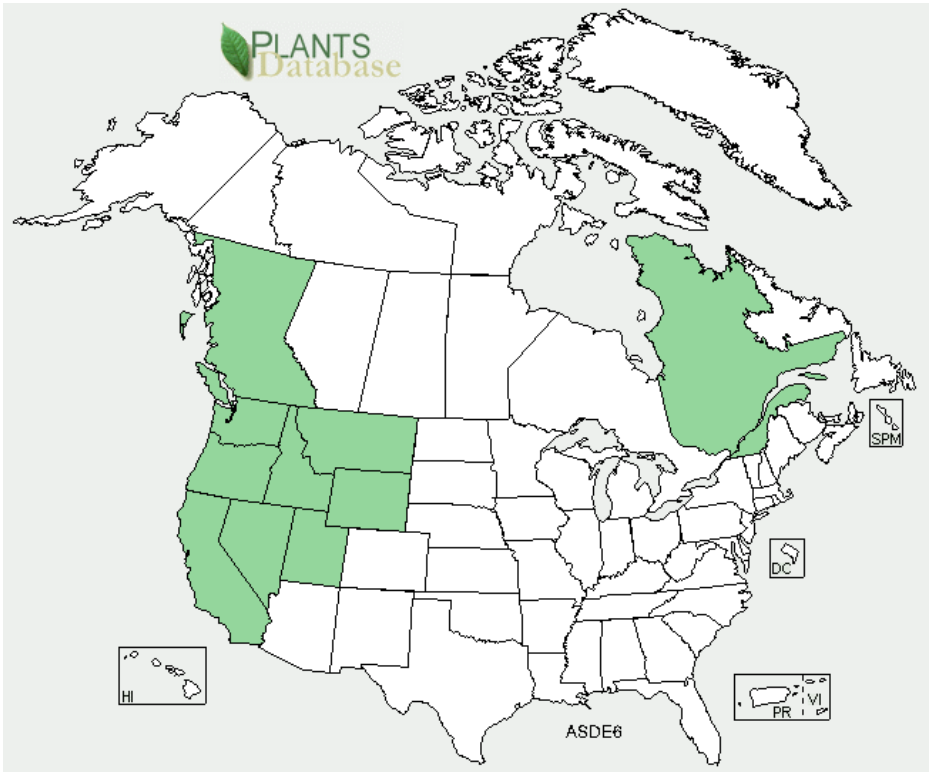
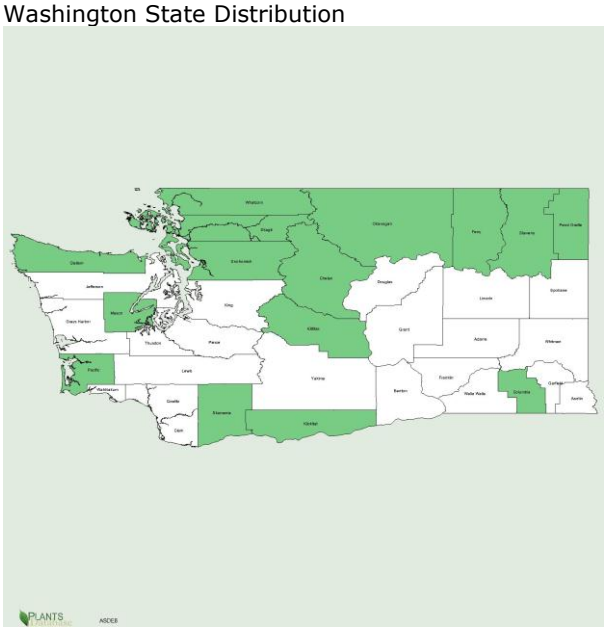
Plant Propagation Protocol for *[Aspidotis densa]*
ESRM 412 – Native Plant Production

TAXONOMY	
Family Names	
Family Scientific Name:	Pteridaceae
Family Common Name:	Maidenhair Fern
Scientific Names	
Genus:	*Aspidotis*
Species:	*Densa*
Species Authority:	(Brack) Lellinger
Variety:	
Sub-species:	
Cultivar:	
Authority for Variety/Sub-species:	
Common Synonym(s) (include full scientific names (e.g., *Elymus glaucus* Buckley), including variety or subspecies information)	CHSI3 *Cheilanthes siliquosa* Maxon CRDE10 *Cryptogramma densa* (Brack) Diels ONDE *Onychium densum* Brack PEDE13 *Pellaea densa* (Brack) Hook
Common Name(s):	Cliff Brake, (Native Plant Database, 2012) Indian's Dream, (USDA, 2012) Rock Brake, (Native Plant Database, 2012)
Species Code (as per USDA Plants database):	ASDE6
GENERAL INFORMATION	

Geographical range (distribution maps for North America and Washington state)	United States and Canada Distribution  Image courtesy of USDA Plants Database Washington State Distribution  Image courtesy of USDA Plants Database
Ecological distribution	This plant is distributed in North Western United States, British Columbia , Western Montana, , south to California. (Hardy Fern, 2012). It appears in

(ecosystems it occurs in, etc):	crevices, rocky outcrops, associated with serpentine, sometimes in chaparral. (Hardy Fern, 2012). In California it appears in Northern Oak Woodland, Douglas Fir Forest, Yellow Pine Forest and Red Fir Forest. (Califlora, 2012).
Climate and elevation range	This species is found at 2800 to over 3900 foot elevations in Oregon and Washington. (Franklin, 1984). It is mainly found at elevations of between 5000 to 8900 feet of elevation in California. (Califlora, 2012). It is found in partly shady areas in moist, cool, well drained soils. Preferred conditions are on the wet side of the mountains under the protection of a rock overhang.(Native Plant Database, 2012) There does appear to be a fairly broad range of elevation from 330 feet to over 11000 feet and is arid. (Smith, 1993)
Local habitat and abundance; may include commonly associated species	In the Siskiyou Mountains, this fern is found with grasses in the *Festuca-oregana* complex and in the Poa sandbergii complex and by serpentine indicator species such as *Allium falcifolium* and *Ceanothus pumilus.* Other species found are those that thrive on shallow, stony soils at high elevations. In the Wenatchee Mountains, this fern appears in areas of steep talus or on exposed ridge tops as well as less severe sites such as moist swales and gentle slopes. Trees do not occur on the more severe sites and the vegetation is mainly made up of perennial herbs and the other serpentine indicator species discussed previously. In north western Washington these serpentine indicator herb species occur as discussed for the other locations that are devoid of woody cover. (Franklin, 1984).
Plant strategy type / successional stage (stress-tolerator, competitor, weedy/colonizer, seral, late successional)	This thickly packed fern is hardy to -30 degrees C, USDA Zone 4. (Hardy Fern, 2012)
Plant characteristics (life form (shrub, grass, forb), longevity, key characteristics, etc)	Plant Description – Rhizome: short – creeping, scales brown to black or often bicolored with dark central stripe. This is a very thickly packed fern. The name Densa meaning crowded or thickly packed. (Hardy Fern, 2012). This herbaceous perennial is a serpentine indicator species. (Franklin, 1984). It has a size class of 12 – 36 feet and leaf retention is evergreen. It is a low densely tufted fern, 4 – 6 inches high. (Native Plant Database, 2012)
PROPAGATION DETAILS	
Ecotype (this is meant primarily for experimentally derived protocols, and	Spores of this species come from rocky slopes and faces. Trying to establish them rhizotomously out of their habitat is illegal without a permit. Results are often disappointing. They are slow to re -establish when disturbed. Adult plants grow slowly and do not compete well with other species. To get to plant locations, usually entails a significant hike. (Diamond, 2003).

is a description of where the seed that was tested came from):	
Propagation Goal (Options: Plants, Cuttings, Seeds, Bulbs, Somatic Embryos, and/or Other Propagules):	The *Cheilanthes* species is best cultured from spores, and spores can be collected without permanent damage to the plant. (Diamond, 2003).
Propagation Method (Options: Seed or Vegetative):	
Product Type (options: Container (plug), Bareroot (field grown), Plug + (container-field grown hybrids, and/or Propagules (seeds, cuttings, poles, etc.))	
Stock Type:	
Time to Grow (from seeding until plants are ready to be outplanted):	It takes from November / December until April/ May for the species to be ready to be out planted, so about 6 months. (Diamond, 2003).
Target Specifications (size or characteristics of target plants to be	

produced):	
Propagule Collection (how, when, etc):	This species is best cultured from spores. Spores should be harvested in November and December. This is done by clipping sporophylls, fronds that bear spores. Support the rhizoid ball carefully during the harvest to avoid dislodging the fern. Harvest in a haphazard manner to reduce the impact on the population. Avoid the removal of all the fronds on one plant and randomly choose individuals. (Diamond, 2003)
Propagule Processing/Propagule Characteristics (including seed density (# per pound), seed longevity, etc):	Place the fronds in zippable plastic food bags, although glass would be better, as the spores adhere to the plastic because of static. This could be a hazard as hiking with glass in a backpack could be dangerous, so zip lock bags are recommended. (Diamond, 2003) Divide mature clumps. This species is commercially available (Native Plant database, 2012).
Pre-Planting Propagule Treatments (cleaning, dormancy treatments, etc):	When back at green house or other propagation location, place the sporophylls loosely in glass canning jars or petri dishes. Store the fronds at 4 degrees celcius, in the dark and slightly ventilated so they can dry. (Diamond, 2003)
Growing Area Preparation / Annual Practices for Perennial Crops (growing media, type and size of containers, etc):	**Sowing the spores** - In shallow glass containers, such as saucers, plates or Petri dish bottoms, pack clean fine sand. Saturate spore material with liquid growth medium or fertilizer: 1 part spore material and 2 parts liquid. The fertilizer should contain high calcium, even for those species that do not inhabit calcareous soils. It should be low in nitrogen. A half-strength mixture of commercial houseplant medium will suffice. Gently squirt the spore material in a spiral pattern over the sand with a baster, blue bulb, or Pasteur pipette. Next, moisten the sand from beneath by squirting growth medium in a thin forceful stream around the outer edge of the sand.(Diamond, 2003)
Establishment Phase (from seeding to germination):	Spores stored for more than a few months will need to be coaxed out of dormancy. Fresh spores (2-3 months of storage) germinate in 10 days in the dark. Spores that have been stored longer will need 1-1.5 weeks of darkness, followed by 1-1.5 weeks of heavy shade, and 1-1.5 weeks of continuous indirect white light. (Diamond, 2003)
Length of Establishment Phase:	
Active Growth Phase (from germination	

until plants are no longer actively growing):	
Length of Active Growth Phase:	
Hardening Phase (from end of active growth phase to end of growing season; primarily related to the development of cold-hardiness and preparation for winter):	**Culture Conditions** - Cover cultures with aluminum foil and incubate at 25-30°C for 1-1.5 weeks (don't worry about air flow the first week). Next, remove the foil and place cultures in bright indirect light. Place cultures under glass, but allow baffled air flow. Glass Petri dishes are perfect, but an old fashioned dome, propped up 0.5 cm, is also good. The correct watering regime is crucial. After planting, the cultures will remain moist under aluminum foil. When they are uncovered, and air is allowed to flow, the cultures should dry very slowly. The ideal condition is one in which moisture beads on the glass, and the sand feels dry to the gentle touch, but not so dry that it forms a hard cake. The sand should remain loose. Water with ddH_2O only, with a squirt bottle to force water under the sand, and only around the edges of the sand. Never water gametophytes directly. They will die or "burn." Water vapor is the goal and standing water is to be avoided. (Diamond, 2003)
Length of Hardening Phase:	
Harvesting, Storage and Shipping (of seedlings):	**Spore Harvesting** - After a few months, the spores can be harvested. Remove the dried fronds from storage and crush them thoroughly with a motar and pestle. Once the fronds are completely crushed, filter the stems pieces and hairs out with a tea strainer and an animal hair or artist type brush. (Diamond, 2003).
Length of Storage (of seedlings, between nursery and outplanting):	In 4-6 weeks sporophytes will emerge from the gametophytes and can be transplanted outside. (Diamond, 2003)
Guidelines for Outplanting / Performance on Typical Sites (eg, percent survival, height or diameter growth,	Divide mature clumps. This species is commercially available (Native Plant database, 2012). Humidity is important, but the soil must be well drained and watered from beneath. Avoid chlorinated water. The key to growing *Cheilanthes* is to provide moisture so that the fern can access without immersion. In the rock crevices in which they grow, their substrate is actually wet. Rock crevices, particularly sedimentary rock, silt catchments, or humus mats on stone outcrops retain moisture, and these ferns are adept at extracting moisture out of "thin air" (Diamond, 2003)

elapsed time before flowering):	
Other Comments (including collection restrictions or guidelines, if available):	
INFORMATION SOURCES	
References (full citations):	Califlora, (2012), Aspidotis densa, (http://www.calflora.org/cgi-bin/species_query.cgi?where-taxon=Aspidotis+densa, accessed on 14 May 2012.) Diamond, H and Swatzell, L. (2003), The American Fern Society – Cultivation of Cheilanthes species, (http://amerfernsoc.org/pages/swatzell/, accessed on 15 May 2012) Franklin, F. and Dyrness C.T. (1984), Natural Vegetation of Oregon and Washington, Oregon State Publishing, pp.306-309 Hardy Fern. (2012), Aspidotis densa, (http://hardyfernlibrary.com/ferns/listspecies.cfm?auto=176, accessed on 14 May 2012) Images reference: *Aspidotis densa.* USDA, NRCS. 2012. The PLANTS Database (http://plants.usda.gov, 8, May 2012). National Plant Data Team, Greensboro, NC 27401-4901 USA. Native Plant Database, (2012), Wildflower center, (http://wwwwildflower.org/plants/result.php?id_plant=ASDE6, accessed 14 May 2012. Smith, A. and Lemieux, T. (1993), Pteridaceae Brake Family, (http://ucjeps.berkeley.edu/cgi-bin/get_JM_treatment.pl?92,100,103, accessed on 14 May 2012), USDA, NRCS. 2012. The PLANTS Database (http://plants.usda.gov, 8, May 2012). National Plant Data Team, Greensboro, NC 27401-4901 USA.

Other Sources Consulted (but that contained no pertinent information) (full citations):	Barbour, M. and Billings W. D. (2000), North American Terrestrial Vegetation, United Kingdom, Cambridge University Press. Barbour M., et al, (1999) Terrestrial Plant Ecology, California, Benjamin/ Cummings. Chappell, C.B., (2006), Upland plant associations of the Puget Trough eco region, Washington, Washington Department of Natural Resources, Natural Heritage Program, Olympia, WA (http//www.dnr.wa.gov/nhp/refdesk/communities/pdf/intro.pdf , accessed 14 May 2012) Flora of North America, (http://www.efloras.org/florataxon.aspx?flora_id=1&taxon_id=233500185, accessed on 15 May 2012) Harker, D et al (1999), Landscape Restoration Handbook, 2nd Edition, Boca Raton, London, New York, CRC Press Harris, T and Rajakaruna N., Adiantum virdimontanum, Aspidotis densa, Minuartia marcescens and Symphyotrichum Rhiannon: Additional Serpentine Endemics from Eastern North America, Northeastern Naturalist, 16(special issue 5): 111-120 Propagation Protocol Search Native Plant Network (2009). (http://www.nativeplantnetwork.org/network/search.aspx?SearchType=Continental, accessed on 14 May 2012) The Plant List, 2012, Aspidotis (http://www.theplantlist.org/browse/P/Adiantaceae/Aspidotis/, accessed on 15 May 2012)
Protocol Author (First and last name):	Robert Edsforth
Date Protocol Created or Updated (MM/DD/YY):	6/07/12

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