Plant Propagation Protocol for _____*Xerophyllum tenax*_____
ESRM 412 – Native Plant Production
Spring 2008

TAXONOMY	
Family Names	
Family Scientific Name:	Liliaceae
Family Common Name:	Lillies
Scientific Names	
Genus:	*Xerophyllum*
Species:	*tenax*
Species Authority:	(Pursh) Nutt.
Variety:	None
Sub-species:	None
Cultivar:	None
Authority for Variety/Sub-species:	None
Common Synonym:	HETE11 *Helonias tenax* Pursh
Common Name(s):	Common beargrass, Indian basket grass, Squaw-grass, soap-grass, Quip-Quip
Species Code:	XETE
GENERAL INFORMATION	
Geographical range :	*Xerophyllum tenax* is found in California, Oregon, Washington, Idaho, Montana, Wyoming, British Columbia and Alberta (USDA PLANTS).
Ecological distribution:	RES20 Douglas-fir FRES21 Ponderosa pine FRES22 Western white pine FRES23 Fir - spruce FRES24 Hemlock - Sitka spruce FRES25 Larch FRES26 Lodgepole pine (Crane 1990) *X. tenax* occurs in open woods and clearings, on well drained soils, from near sea level on the Olympic Peninsula, Washington to over 2700 meters in the Rocky Mountains (USDI NPS). In southeast British Columbia it is found in clay and peat soils (Clark 1976). It can be found in all soil types, but prefers xeric to subxeric and submesic sites. It is moderately shade tolerant and can be found in the understory of subalpine forests or in open sites on high ridges and slopes (USDI NPS).

	X. tenax has a low tolerance to CaCO3 (TWC). It is suitable for infertile, dry soil and frost tolerant (Crane 1990). *X. tenax* can tolerate serpentine soils and volcanic ash (Harlow et al. 2004). It may be used in rock gardens (Culina 2000).
Climate and elevation range	*X. tenax* is found from sea level to krummholz (Pojar and MacKinnon 1994).
Local habitat and abundance:	*X. tenax* is abundant in dry meadows and subalpine forest understory (Pojar and MacKinnon 1994). *X. tenax* can occur in monospecific stands. It is also commonly found with Vaccinium spp. (Whitney 1989, Crane 1990). Kuchler Plant Associations : K003 Silver fir - Douglas-fir forest K004 Fir - hemlock forest K005 Mixed conifer forest K007 Red fir forest K008 Lodgepole pine - subalpine forest K009 Pine - cypress forest K012 Douglas-fir forest K013 Cedar - hemlock - pine forest K014 Grand fir - Douglas-fir forest K015 Western spruce - fir forest K029 California mixed evergreen forest (Crane 1990) SAF Cover Types : 205 Mountain hemlock 206 Engelmann spruce - subalpine fir 207 Red fir 210 Interior Douglas-fir 211 White fir 212 Western larch 213 Grand fir 215 Western white pine 218 Lodgepole pine 226 Coastal true fir - hemlock 227 Western redcedar - western hemlock 228 Western redcedar 229 Pacific Douglas-fir 230 Douglas-fir - western hemlock 231 Port Orford-cedar 234 Douglas-fir - tanoak - Pacific madrone (Crane 1990) X. tenax is eaten by deer, elk, mountain goats and bighorn sheep, used as habitat by pocket gophers and used as a den lining by grizzly bears (Crane 1990, USDI NPS).

Plant strategy type / successional stage:	*X. tenax* was very common in ecosystems maintained by anthropogenic burning (Peter and Shebitz 2006). It commonly flowers after fire (Kruckeberg 2003). *X. tenax* resprouts from rhizomes after fire unless fire is severe enough to damage the meristem (Crane 1990). *X. tenax* replaces grasses and fireweed during succession after logging or burning (Ross and Chambers 1988).
Plant characteristics:	 (Bransford, W. D. from the Lady Bird Johnson Wildflower Center image gallery) "Large (to 1.5 m tall) perennial herb, from short, stout rhizomes. Basal leaves grass-like, tough, wiry, evergreen, numerous in large clumps, long (to 90 cm), with finely toothed margins; stem leaves similar but shorter, and becoming still shorter the farther up the stem you go. Flowers white, tiny, saucer-shaped, long-stalked, fragrant; in a dense, showy pyramidal terminal cluster that is at first bulbous and nippled; populations may flower irregularly every few years. Fruit oval 3 lobed capsules to 6 mm long, each with a few small seeds (Pojar and MacKinnon 1994)." Flowering is semelparous and colonies flower en masse. Flowering may

	occur in response to environmental cues or in 5- or 7- year cycles (Crane 1990, USDI NPS). Vegetative reproduction by rhizome is common (Crane 1990). *X. tenax* is the only evergreen lily in the Pacific Northwest (Clark 1976). Raunkaier life form is geophyte (Crane 1990).
PROPAGATION DETAILS	
Ecotype:	Glacier National Park (Majerus). Subalpine meadows, Logan Pass, 2032m elev (USDI NPS).
Propagation Goal:	Plants
Propagation Method:	Seed
Product Type:	Container (plug)
Stock Type:	160 ml conetainers (USDI NPS).
Time to Grow:	15 Months (USDI NPS). 7 months (University of Idaho, in Albright 2004).
Target Specifications:	Container seedling, 30 to 40 true leaves, 10 cm. height, firm plug in conetainer (USDI NPS). Firm rootmass (University of Idaho, in Albright).
Propagule Collection:	Seeds were collected in late August and early September when capsules turned tan and opened. Seeds were light tan at maturity. Seeds were stored in paper bags in a well ventilated drying shed prior to cleaning (USDI NPS). Fruits matured between August and September. Seeds ripened sequentially. Fruits were harvested when seeds at the bottom of the pod were golden-tan. Whole fruits were stored in large paper bags. Ripe seeds were also collected by shaking flowers over a container (Potash et al. 1994). Seed is commercially available from vendors at the Native Seed Network and the California Native Plant Link Exchange. Division of plants is an efficient way of propagating (TWC), but should not be used to remove plants from the wild (Pojar and Mackinnon 1994, Potash et al. 1994, Marjerus).
Propagule Processing/Propagule Characteristics:	Seed heads processed readily in a hammermill. Cleaning on an Office Clipper (fanning mill) separated the chaff from the seeds. Relatively high amounts of wind can be used to remove the chaff (Majerus). Seeds were cleaned at NRCS using a hammermill and air fan (USDI NPS). Seeds were also processed by screening (Potash et al. 1994) or by using a rolling pin to open fruits (Culina 2000). Percent purity unmeasured but appeared very high when processing clipped

	seed heads and using high wind to remove chaff (Marjerus). USDI NPS reported 100% purity. Seed was stored in a paper envelope or woven cotton sack in a basement maintained at approximately 55 to 65°F. Seed was stored for several years in above manner but no information on viability over time is available (Majerus). Seed longevity was reported to be at least 5 years at 3 to 5° C in sealed containers (USDI NPS). Thiram fungicide has been used as a seed treatment, but benefits are unknown. (Majerus). Number of seeds per kilogram was reported as 448,000. (USDI NPS).
Pre-Planting Propagule Treatments:	Seed dormancy is classified as physiological dormancy (Majerus). Dormancy breaking and germination results are based on controlled environmental conditions in a refrigerator and environmental growth chamber. GNP seed sources germinated well after 16 weeks of cold, moist chilling at 34 to 37°F (fresh seed). Germination occurred in a growth chamber maintained at 30° C days and 20° C nights on an 8-hour photoperiod (Majerus). Seeds were imbibed in distilled water for 10 minutes and placed in fine mesh bags buried in moist peat moss under refrigation at 1 to 3° C (USDI NPS). Percent germination at USDI NPS was 80%-100%. Seeds were imbibed in running water. Seeds were sown in Copperblock using 50% peat and 50% vermiculite, with a covering of No.2 grit. Seeds were cold stratified for 7 months in 31 to 42° F. (University of Idaho, from Albright). Rose et al. (1998) suggested soaking the seed in distilled water for 24 hours, sowing on moist vermiculite with a light covering of more vermiculite with cold stratification for 16 weeks at 3° C.
Growing Area Preparation / Annual Practices for Perennial Crops:	Standard greenhouse temperatures and photoperiods should result in similar germination. Since media moisture conditions are thought to be critical to transplanting success, it is recommended that container size be small initially (4 cubic inch or less) and that the seedlings be repeatedly transplanted to larger pots with age. Several types of media have been tried without good success. Poor results were obtained with 50:50 perlite:vermiculite, 100% perlite, and a well drained commercial peat-lite mix. Try very well-drained, coarse material with low water absorption and adsorption properties and irrigate lightly but frequently (Marjerus). USDI NPS recommended direct seeding. Seeds were covered with a perlite mulch on surface of container and irrigated thoroughly. Growing medium used at USDI NPS was 70% 6:1:1 milled sphagnum peat, perlite, and vermiculite and 30% #2 grade perlite. Greenhouse temperatures were maintained at 21 to 25° C during the day and 16 to 18° C at night. Seedlings

	were hand watered and remained in the greenhouse until mid May. Seedlings were then moved to outdoor nursery for the remainder of the growing season. Seedlings were irrigated with Rainbird automatic irrigation system in early morning until containers are thoroughly leached. Average growing season of nursery is from late April after snowmelt until October 15th (USDI NPS).
Establishment Phase:	Germination of 100-seed lots of fresh seed ranged from 38% to 82% with cold, moist chilling. Only 2 of 500 seed germinated without cold, moist chilling. Dormancy breaking is reported to be more difficult with other seed sources (Pacific Coast) and may require combinations of warm, moist stratification and cold, moist chilling. Seeds germinate well on double germination pads in a petri dish in the growth chamber. Although transplanting success was excellent, the seedlings deteriorated over time (within 4 to 8 weeks) and less than 20 percent ultimately survived (Marjerus). Seedlings must have well aerated growing medium and must dry down between irrigations (USDI NPS). Cold stratified seeds are moved to a greenhouse at 70 to 81° F. At eight weeks thin and consolidate to 4 plants per cell (University of Idaho, in Albright 2004).
Length of Establishment Phase:	4 weeks (USDI NPS).
Active Growth Phase:	Seedling growth is slow in the absence of mycorrhizal inoculant. A significant increase in growth rate was observed in 1st year seedlings that were inoculated (USDI NPS). Bear grass forms a fleshy taproot. Plants were fertilized with fish emulsion fertilizer 5:1:1 during the growing season. A tuft of 20 to 30 true leaves and a central taproot develops by the end of the season (USDI NPS). 24 hour light was provided using 500 watt halogen lamps suspended 1.8 meters above plants. Plants were fertilized twice weekly using Peterson's Conifer Starter. Fertilizer was changed to Peterson's Conifer Grower and CAN 17 calcium nitrate after 7 weeks (University of Idaho, in Albright 2004).
Length of Active Growth Phase:	16 weeks (USDI NPS).
Hardening Phase:	Plants were fertilized with 10-20-20 liquid NPK at 200 ppm during August and September. Irrigation was gradually reduced in September and October (USDI NPS). Light was reduced and water tapered. Fertilizer was changed to Peterson's 4-25-35 Conifer Finisher alternating with calcium nitrate. Plants were moved outdoors to a shadehouse one month before outplanting (University of Idaho, in Albright 2004).

Length of Hardening Phase:	4 weeks (USDI NPS). 10 weeks (University of Idaho, in Albright 2004).
Harvesting, Storage and Shipping:	Several, 1-year-old seedlings overwintered well in 10 cubic inch cones in an unheated plastic hoophouse (coldframe) in Bridger, Montana (Marjerus). Harvest date is July. Plants overwintered in outdoor nursery under insulating foam cover and snow (USDI NPS).
Length of Storage:	5 months (USDI NPS).
Guidelines for Outplanting / Performance on Typical Sites:	Seedlings were outplanted at Logan Pass, Glacier National Park, MT after snow melt (USDI NPS). Plants were transported to outplanting sites by wrapping roots in plastic bags and packing in boxes, with paper stabilizers (University of Idaho, in Albright 2004).
Other Comments:	Seeds are the most common means of propagation. Potash et al. (1994) consider seed collection to be less destructive than division of wild plants. Offshoots collected from the wild failed to establish in containers. Wild plants form clumps of offshoots which may not flower for years (USDI NPS). *X. tenax* is "very difficult to cultivate and should not be removed from the wild (Pojar and MacKinnon)." Beargrass may be used for longterm revegetation and erosion control (USDI NPS, Crane 1990).
INFORMATION SOURCES	
References:	Albright, M. 2004. *Appendix C: Detailed Propagation Methods for Beargrass, Heather, Huckleberry and Partridgefoot*. http://www.wilderness.net/toolboxes/documents/restoration/pdf06232815dpi72pt19.pdf [2008, May 14] California Native Plant Link Exchange http://www.cnplx.info/nplx/species?taxon=Xerophyllum+tenax [2008, May 14] Clark, L. 1976. Wild Flowers of the Pacific Northwest from Alaska to California. Sidney, B. C.: Gray's Publishing Limited. Crane, M. F. 1990. Xerophyllum tenax. In: Fire Effects Information System. USFS, Rocky Mountain Research Station, Fire Sciences Laboratory. http://www.fs.fed.us/database/feis/ [2008, May 14]. Culina, W. 2000. The New England Wildflower Society Guide to Growing and Propagating Wildflowers. Houghton Mifflin Books.

	Harlow, N., Jakob, C., and Raiche, R. 2004. Wild Lilies, Irises and Grasses: Gardening with California Monocots. University of California Press. Kruckeberg, A. R. 2003. *Gardening with Native Plants of the Pacific Northwest*. University of Washington Press, Seattle, WA. Majerus, M. E. Protocol Information: *Xerophyllum tenax*. USDA NRCS, Bridger Plant Materials Center. http://www.nativeplantnetwork.org/network/view.asp?protocol_id=2758 [2008, May 11] Native Seed Network http://www.nativeseednetwork.org/viewtaxon?taxon_code=XETE [2008, May 14] Potash, L., Aubry, C., Busse, B., Hamilton, W., Ketcherson, G., Henderson, J., Mace, R. 1994. *Mt-Baker-Snoqualmie National Forest Native Plant Notebook*. Mt. Baker-Snoqualmie National Forest R6-MBS-003-94. Pojar, J. and A. MacKinnon *eds*. 1994. Revised Plants of the Pacific Northwest Coast. Vancouver, B.C.: Lone Pine. Rose, R., Chachulski, C. E. C. and Haase, D. L. 1993. Propagation of Pacific Northwest Native Plants. Corvallis: Oregon State University Press. Ross, R. A. and Chambers, H. L. Wildflowers of the Western Cascades. Portland, OR: Timber Press. TWC Lady Bird Johnson Wildflower Center http://www.wildflower.org/plants/result.php?id_plant=XETE [2008, May 14] USDA PLANTS database http://plants.usda.gov/java/profile?symbol=XETE [2008, May 9] USDI NPS. Protocol Information: *Xerophyllum tenax*. Glacier National Park Native Plant Nursery. Whitney, S. 1989. A Sierra Club Naturalist's Guide the Pacific Northwest. San Francisco: Sierra Club Books.
Other Sources Consulted:	Hitchcock, C. L. and Cronquist, A. 1973. *Flora of the Pacific Northwest An Illustrated Manual*. Seattle: University of Washington Press. Smart, A. W.; Minore, D. 1977. Germination of beargrass (Xerophyllum tenax [Pursh] Nutt.). Plant Propagator. 23(3): 13-15.
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Note: This template was modified by J.D. Bakker from that available at: http://www.nativeplantnetwork.org/network/SampleBlankForm.asp

Plant Data Sheet

Species (common name, Latin name) – Beargrass, *Xerophyllum tenax*

Range – British Columbia east to southwestern Alberta and south through the coast ranges and the west slope of Sierra Nevada to central California. Also in the Rocky Mountains. States where beargrass is present: CA, ID, MT, OR, WA, WY, AB, and BC.

Climate, elevation – Beargrass often occurs in cold, dry sites of the subalpine zone. There are low elevation populations of beargrass, however, in which it occurs in bogs and some dry areas.

Local occurrence (where, how common) – Beargrass is relatively common in the subalpine zone in the Cascades and Olympics.

Habitat preferences – Beargrass occurs on poor nutrient soils. It is often a dominant understory on upper slopes under a canopy of conifers. In addition, it is common in subalpine meadows in which there is full sunlight.

Plant strategy type/successional stage (stress-tolerator, competitor, weedy/colonizer, seral, late successional) – Beargrass is very frost tolerant. It is a facultative seral species that does well following fire.

Associated species – Huckleberry, subalpine fir, mountain hemlock, Pacific silver fir, Shasta red fir, grand fir, western white pine, western hemlock, and lodgepole pine.

May be collected as: (seed, layered, divisions, etc.) – Seed. Transplanting the whole plant is extremely difficult.

Collection restrictions or guidelines – Seeds start setting in July and continue through September. Beargrass is protected in many locations in which it exists (i.e. Olympics and Cascades).

Seed germination (needs dormancy breaking?) – seeds need at least 12-16 weeks of cold stratification for germination.

Seed life (can be stored, short shelf-life, long shelf-life) – Seeds can be dried and stored for extended shelf life.

Recommended seed storage conditions – Seeds can be sown directly in the fall or stored dry at subfreezing temperatures.

Propagation recommendations (plant seeds, vegetative parts, cuttings, etc.) – Plant seeds in late fall and hand sow by covering seeds with ½" of soil.

Soil or medium requirements (inoculum necessary?) – Well-drained soil, gritty and open with good humus on top. No fertilizer products should be used. For spring sowing, presoak the seed in distilled water for 24 hours, sow on moist vermiculite with a light covering of more vermiculite, and cold stratify for 16 weeks at 3 degrees C. Set the flats in a growth chamber at 18 degrees C for 12 hours during the day and 13 degrees C for 12 hours at night. Seed also germinates well if it is soaked and sown on a peat:vermiculite:perilite:pumice (2:2:2:1) edium, covered with 1-2 cm of perlite, and wetted down.

Installation form (form, potential for successful outcomes, cost) – Propagation is mostly done with seeds since transplanting it is not effective.

Recommended planting density – 3 oz. Of seed per 1000 ft^2

Care requirements after installed (water weekly, water once etc.) – Do not water seeds a lot at first. They may rot in the spring (late winter) if they are too wet. Once they begin their seasonal growth, they can handle a lot of water.

Normal rate of growth or spread; lifespan – Beargrass reproduces by rhizomes, so once it is established in an area, it is long-lived in that area unless area is heavily disturbed.

Sources cited–

Nicholls, D. 2000. Beargrass, lily of the high country. Sandpoint Magazine. Keokee Co. Publishing, Inc: Summer.

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Seed trust, Inc. 2002. Beargrass, Xerophyllum tenax seed packet. Native Wildflower Seeds.

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Data compiled by (student name and date) – Daniela Shebitz, April 9, 2003