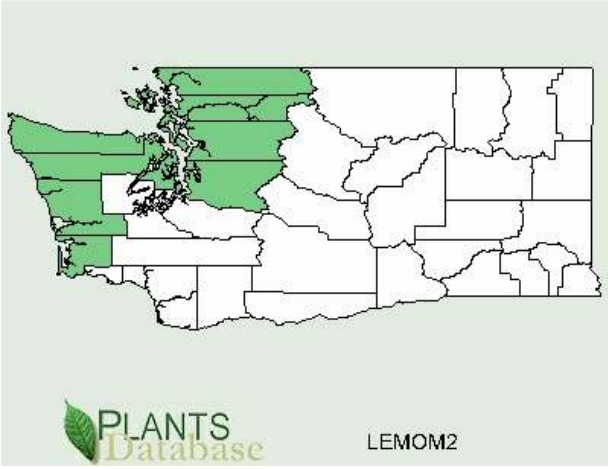
Plant Propagation Protocol for Leymus mollis spp. mollis
ESRM 412 – Native Plant Production
Spring 2008

US and Canada Distribution

Washington State distribution



Source: USDA PLANTS database

TAXONOMY	
Family Names	
Family Scientific Name:	Poaceae
Family Common Name:	Grass family
Scientific Names	
Genus:	Leymus
Species:	mollis
Species Authority:	(Trin.) Pilg
Variety:	
Sub-species:	mollis
Cultivar:	
Authority for Variety/Sub-species:	
Common Synonym(s) (include full scientific names (e.g., *Elymus glaucus* Buckley), including variety or subspecies information)	*Elymus arenarius* L. ssp. *mollis* (Trin.) Hultén *Elymus arenarius* L. var. *scabrinervis* (Bowden) B. Boivin *Elymus arenarius* L. var. *villosus* E. Mey. *Elymus capitatus* Scribn. *Elymus mollis* Trin. *Elymus mollis* Trin. var. Benson *Leymus arenarius* (L.) Hochst. ssp. *mollis* (Trin.) Tzvelev[1]
Common Name(s):	American dune grass, dune ryegrass, sea lyme-grass, strand grass, beach wildrye(Alaska), hama-ninniku(Japan)
Species Code (as per USDA Plants database):	LEMOM2
GENERAL INFORMATION	

Geographical range (distribution maps for North America and Washington state)	Found in the following states: AK, CA, MA, ME, MI, NH, OR, PA, WA and also much of Canada. See North America distribution map above. Also found in Soviet Far East, Mongolia, China, Japan, and Korea.[2]
Ecological distribution (ecosystems it occurs in, etc):	Located on coastal dunes in the foredune zone. Found on sand/gravel beaches up to the edges of shoreline forests[3]. It was the dominant grass on dunes adjacent to the ocean before the introduction of European beachgrass, which is now the more abundant associated dune species.[3]
Climate and elevation range	Dry, Low elevation sites.[6] Elevation ranges up to shoreline forests.
Local habitat and abundance; may include commonly associated species	Sun, some moisture, good drainage[6]
Plant strategy type / successional stage (stress-tolerator, competitor, weedy/colonizer, seral, late successional)	A stress-tolerator of salt spray, continual sand burial and droughty conditions.[5] American dune grass is a sand binder, salt, and drought tolerant plant that allows it to dominate foredune habitats.
Plant characteristics (life form (shrub, grass, forb), longevity, key characteristics, etc)	Rapidly spreading rhizomatous grass. Foliage is dormant in the winter[6].
PROPAGATION DETAILS	
Establishment of a native grass seed industry for the west coast of British Columbia.[14]	
Ecotype (this is meant primarily for experimentally derived protocols, and is a description of where the seed that was tested came from):	Various areas on Vancouver Island, BC.
Propagation Goal (Options: Plants, Cuttings, Seeds, Bulbs, Somatic Embryos, and/or Other Propagules):	Seeds, plants
Propagation Method (Options: Seed or Vegetative):	seed
Product Type (options: Container (plug), Bareroot (field grown), Plug + (container-field grown hybrids, and/or Propagules (seeds, cuttings, poles, etc.))	Seeds, container(plug)
Propagule Collection (how, when, etc):	Various areas on Vancouver Island, BC. Only 5 to 10% of seeds from each individual should be taken so that natural seeding from the donor area can take place[15].
Propagule Processing/Propagule Characteristics (including seed density (# per pound), seed longevity, etc):	257 grams of seed were produced on 8/4 with a 53.25% germination rate.

Growing Area Preparation / Annual Practices for Perennial Crops (growing media, type and size of containers, etc):	Plastic "supercells" and "cones" work well to force deep downward rooting.[15] Since *L. mollis* creates many horizontal rhizomes, it may be best to seed in wide pots so that the plant does not become pot bound. Soil substrate used for the RON project wasMcCalif's Sunshine Mix #3 (3 parts sunshine mix #3 with 1 part sand and 2 cups nutracote or osmacote pellets per wheelbarrow of soil/sand mix.)[15]
Propagation of Benson Cultivar for use in rapid recolonization of Alaskan coastline areas.[10]	
Ecotype (this is meant primarily for experimentally derived protocols, and is a description of where the seed that was tested came from):	"Parental seed for this accession was collected by Stoney Wright with the Alaska Plant Materials Center on September 9, 1980. The collection site was on a beach segment near the USCG Narrow Cape Loran station. Seed was collected from four seed heads of an isolated stand of beach wildrye measuring ten feet by six feet. This stand exhibited extremely lush growth and aggressive rhizomes. Tips of emerging rhizomes extended five feet from the parent stand."[10]
Propagation Goal (Options: Plants, Cuttings, Seeds, Bulbs, Somatic Embryos, and/or Other Propagules):	Seeds and Plants
Propagation Method (Options: Seed or Vegetative):	Seed and vegetative
Product Type (options: Container (plug), Bareroot (field grown), Plug + (container-field grown hybrids, and/or Propagules (seeds, cuttings, poles, etc.))	Seed(Benson cultivar exhibited quick vegetative growth, but did not produce commercial quantities of viable seed), transplants
Time to Grow (from seeding until plants are ready to be outplanted):	Transplants can be readily planted after they are dug up.
Propagule Collection (how, when, etc):	Brooks and Agate describe that dune grass transplants should have at least 6" of healthy rhizome with at least 2 or 3 nodes.[11] Grass transplants should be collected on unexposed leeward sides of dunes to minimize erosion. Plants are best collected in cool spring months at temperatures below 55 degrees F.[11] Schaefer et al. note that collection can occur all year around[12]. Plants can by separated by shovel or spade for deeply rooted plants in wet soils. Quick and successful gathering can be done by hand pulling young(less than 2 years old) plants. The sheath of the roots should be dry and yellowing, if the shoots are a pink/purple color, then the plant is too young to be pulled. This method

	reduces the amount of soil disturbance, but requires more experience than the digging method.[11] A mechanical potato harvester has also been listed as a possible too for separating propagules.[10]
Propagule Processing/Propagule Characteristics (including seed density (# per pound), seed longevity, etc):	"Work rates vary greatly, from under 200 to almost 2,000 offsets dug, transported and planted per person per day."[11]
Harvesting, Storage and Shipping (of seedlings):	Transplanted seedlings can be wrapped up in folded netting for shipping large quantities. Parent site of transplants should be located close to new planting location. If plants are being hand carried, they can be coiled and put into polythene bags and kept moist and dark.[11] Storage time is limited.[10]
Length of Storage (of seedlings, between nursery and outplanting):	"If you have to store the offsets for more than a few hours, cover them with damp sand and keep this moist. This is especially important when planting in hot dry weather."[11]
Guidelines for Outplanting / Performance on Typical Sites (eg, percent survival, height or diameter growth, elapsed time before flowering):	The Benson cultivar in Alaska used 1 acre of donor area to plant 7 acres.[10] This figure may be less or more for other areas depending on vigor of plants, density, and ecological impacts of removing from the donor site. Work rates in the lower 48 of the U.S. for transplanting vary from 200 to 2000 grasses dug up, transported, and planted in 1 day.[11] Plants need to be planted so that the active growing point at the leaf base is at least 2 to 4 inches below the sand surface. *Leymus mollis* has shown to have high survival rates(87%) after being buried by 2cm of sand per week for 7 weeks.[13] Plants should be spaced 1-3' apart in a quincunx ('domino 5') pattern[11]. A 1.5" diameter bundle of several individual transplants may fill 1 hole so that survival rates are higher.
Propagation method for studying ". Spatial Aspects of Clonal Expansion with Reference to Rhizome Growth and the Dispersal of Buds" by [7]Pavlik BM. 1983	
Ecotype (this is meant primarily for experimentally derived protocols, and is a description of where the seed that was tested came from):	Rhizomes were collected at Kehoe Beach, Point Reyes National Seashore, California(1980-1981).[7]
Propagation Goal (Options: Plants, Cuttings, Seeds, Bulbs, Somatic Embryos, and/or Other Propagules):	Plants
Propagation Method (Options: Seed	Vegetative. Rhizomes were propagated at Bodega

or Vegetative):	Marine Laboratory[7]
Product Type (options: Container (plug), Bareroot (field grown), Plug + (container-field grown hybrids, and/or Propagules (seeds, cuttings, poles, etc.))	16cm were propagated in order to determine characteristics of rhizome growth and dispersal of buds.
Time to Grow (from seeding until plants are ready to be outplanted):	160 days
Target Specifications (size or characteristics of target plants to be produced):	16cm pots
Propagule Collection (how, when, etc):	Rhizomes were collected from a 10x12m plot at Kehoe Beach, Point Reyes National Seashore, California
Propagule Processing/Propagule Characteristics (including seed density (# per pound), seed longevity, etc):	Crown division was used in order to collect rhizomes of *L. mollis.*
Active Growth Phase (from germination until plants are no longer actively growing):	Laboratory conditions were kept at ambient coastal conditions. The plants received a 16 hour photoperiod. 25^{o}C days and 18^{o}C nights and were given distilled water every other day. Reactions to nutrient stress were tested by giving half of the tested pots 372mg of N per pot per month and the other half 46mg. Limiting nitrogen significantly reduced rhizome and bud production by ~50%. Seasonal bud sprouting showed that most bud sprouting occurred in winter months. *L. mollis* rhizomes spread horizontally to the edges of the pot before sending vertical rhizomes. Results of field experiments showed that clonal expansion dispersal was much more spread out when compared to *Ammophilia arenaria*.[7]
Length of Active Growth Phase:	160 days.
Guidelines for Outplanting / Performance on Typical Sites (eg, percent survival, height or diameter growth, elapsed time before flowering):	In Pavlik's study, individual new raments recorded in the field had 0% survival after 1 year due to herbivory. When outplanting, a plan to control leaf herbivory by deer should be kept in mind. This may be a localized problem though, in a study by Handa et al. grazing had no significant affect on *L. mollis.*[9]
Other Comments (including collection restrictions or guidelines, if available):	Easy from seed or division[6]. Does well confined to a container if it is not resting on the ground[6]. Can spread 10ft underground in 1 season[6]. To propagate by division, use a sharp knife to separate two rhizome sections. Dig deeply so not to damage the deeply rooted rootmass[8].

INFORMATION SOURCES	
References (full citations):	See below:
Protocol Author (First and last name):	Patrick Sowers
Date Protocol Created or Updated (MM/DD/YY):	4/30/08

References:

[1]USDA, NRCS. 2008. The PLANTS Database (http://plants.usda.gov, 28 April 2008). National Plant Data Center, Baton Rouge, LA 70874-4490 USA.

[2]USDA, ARS, National Genetic Resources Program.
Germplasm Resources Information Network - (GRIN) [Online Database].
National Germplasm Resources Laboratory, Beltsville, Maryland.
URL: http://www.ars-grin.gov/cgi-bin/npgs/html/taxon.pl?102171 (29 April 2008)

[3]Pojar J., McKinnon A.,1994 Plants of the Pacific Northwest: Washington, Oregon, British Columbia and Alaska, B.C. Ministry of Forests and Lone Publishing, Canada

[4]Hornaday K., Pisani I., Warne B. Recovery Plan for the Western Snowy Plover: Volume 1: Recovery Plan. U.S. Fish and Wildlife Service. Sacramento, California

[5]Jordan Cove Energy Project, L.P. 2007. Resource Report 3: Jordan Cove Energy Project Docket No. CP07-___-000

[6]Jakob, editors ; [contributors], Roger Raiche ... [et al.]. Wild lilies, irises, and grasses : gardening with California monocots / Nora Harlow and Kristin Berkeley : University of California Press, c2003

[7]Pavlik BM. 1983. Nutrient and Productivity Relations of the Dune Grasses Ammophila arenaria and Elymus mollis. III. Spatial Aspects of Clonal Expansion with Reference to Rhizome Growth and the Dispersal of Buds. Bulletin of the Torrey Botanical Club, Vol. 110, No. 3, (Jul. - Sep., 1983), pp. 271-279. Torrey Botanical Society.

[8]NOAA. 2001. Native Species Planting Guide for the Elkhorn Slough National Estuarine Research Reserve.

[9]Handa I.T., Harmsen R., Jefferies R.L. 2002. Patterns of vegetation change and the recovery potential of degraded areas in a coastal marsh system of the Hudson Bay lowlands. Journal of Ecology 2002 90, 86–99.

[10]State of Alaska Department of Natural Resources (AKDNR). 1991. Notice of Naming and Release of' Benson' Beach Wildrye for Vegetative Production.

[11]Brooks A. and Agate E. 2001. Sand Dunes. 7: Vegetation Establishment Transplanting Grasses.

[12]Schaefer B., Swenerton K., and Heimbinder E., 2007. Plant and Seed Request Protocol. Golden Gate National Recreation Area.

[13]Gagne J.-M., Houle G. 2002. Factors responsible for Honckenya peploides (Caryophyllaceae) and Leymus mollis (Poaceae) spatial segregation on subarctic coastal dunes. Am. J. Bot. 89: 479–485.

[14]Vaartnou M. 2006. ESTABLISHMENT OF A NATIVE GRASS SEED INDUSTRY FOR THE WEST COAST OF BRITISH COLUMBIA: FINAL REPORT – 1996-2006. M. Vaartnou & Associates. Richmond, B.C.

[15]Detka J. Return of the Natives to Moss Landing Dunes Restoration Project Project Proposal. RON Dune Restoration Coordinator.

Other Sources Consulted (but that contained no pertinent information):

Hitchcock, Charles Leo. Grasses and grass like plants of Montana, Idaho, Washington and Alberta and British Columbia. St. Louis, John S. Swift Co. [n.d.]

Wiedemann, A. M., Dennis LR. J., Frank H.1999. Plants of the Oregon coastal dunes. Smith Corvallis, Or. : Oregon State University Press.

Emery, Dara E., 1988. Seed propagation of native California plants. Santa Barbara, Calif. : Santa Barbara Botanic Garden.

Harlow, Nora. 2004. Plants and landscapes for summer-dry climates of the San Francisco Bay region / Oakland, Calif. : East Bay Municipal Utility District.

A.L. Hafenrichter ... [et al.]. 1979. Grasses and legumes for soil conservation in the Pacific Northwest and Great Basin States. Pub info Washington, D.C. : Soil Conservation Service, U.S. Dept. of Agriculture.

Dalton D.A., Kramer S., Azios N., Fusaro S., Cahill E., Kennedy C. 2004. Endophytic nitrogen fixation in dune grasses (Ammophila arenaria and Elymus mollis) from Oregon FEMS Microbiology Ecology, 49 (3), pp. 469-479.

Klinkenberg, Brian. (Editor) 2007. E-Flora BC: Electronic Atlas of the Plants of British Columbia [www.eflora.bc.ca]. Lab for Advanced Spatial Analysis, Department of Geography, University of British Columbia, Vancouver. [Accessed: 4/29/2008 3:20:07 PM]

HWR Engineering & Science. 2007. Ma-le'l Dunes Access Plan Project Humboldt County, California Preliminary Initial Study / Environmental Assessment with Proposed Mitigated Negative Declaration and Finding of No Significant Impact. DRAFT IS/EA January 2007

Englert JM. 2002. Improved Conservation Plant Materials Released by NRCS and Cooperators Through September 2001. United States Department of Agriculture Natural Resources Conservation Service National Plant Materials Center.

Note: This template was modified by J.D. Bakker from that available at: http://www.nativeplantnetwork.org/network/SampleBlankForm.asp