Introduction

Land management in the 21st century increasingly emphasizes the need to maintain ecosystem integrity, and to restore integrity where it has been lost. Even in the recent past, it was considered responsible and sufficient to revegetate degraded sites – it didn't really matter what was grown, so long as it was green and could control erosion. Now we realize that it is possible to accomplish these goals without introducing weedy exotics or domesticated species that may out-compete native vegetation, interfere with natural succession, and alter community structure and function. It has become important to pay attention to what was growing on sites before human disturbance, so that appropriate restoration can be carried out after disturbance. Hence the increased interest in using native plants for revegetation purposes, and in growing native plants to produce the seed needed for revegetation and restoration work.

Some government agencies in both Alberta and British Columbia now require the use of native species for restoring certain disturbed sites (Gerling et al. 1996). But because native plants were not routinely used in the past, little is known about their ecology, biology, propagation and husbandry. This manual provides information on these topics. Species documented in the manual are all native to the northern Interior of British Columbia and, as such, are recommended for use in that area. However, since some of the species are found in other parts of Canada and the adjoining U.S.A., much of the specific information and general advice contained in this manual is pertinent to the broader region.

This manual takes a species by species approach to meeting two objectives: (1) providing seed growers with useful information for establishing, growing, and harvesting seed of the designated native species; and (2) providing the ultimate users of these plant materials with guidance for their use in revegetation and ecological restoration projects. We draw primarily upon our own experience in providing these recommendations, as supplemented by reference to the literature where appropriate. This manual emphasizes the husbandry and use of individual species, and is not intended to be a comprehensive manual for plant propagation or revegetation procedures in general. For good background information on native plant propagation and seed production, the reader is referred to Rose et al. (1998), Pahl and Smreciu (1999), and the propagation protocols regularly updated at the website of the Native Plant Network (based at the University of Idaho) at www.nativeplantnetwork.org. For broader overviews of relevant considerations in revegetating disturbed and degraded land, the reader is referred to Greene et al. (1992), Morgan et al. (1995), Gerling et al. (1996), B.C.'s *Soil Rehabilitation Guidebook* (Anonymous 1997), and the *Native Plant Revegetation Guidelines for Alberta* (Anonymous 2001).

Background

This manual is a product of a five year long research project conducted by Symbios Research and Restoration, based in Smithers, B.C. Funding was provided primarily by Forest Renewal B.C., to develop and test native plants for seeding in the northern B.C. Interior. Other supporters of that research included Woodmere Nursery Ltd. (Telkwa, B.C.), and the Canadian Forest Service (Pacific Forestry Centre, Victoria, B.C.). Literature reviews were first conducted to collate existing information on candidate herbaceous species. These species were identified on the basis of their widespread distribution in the region, and their frequent occurrence on disturbed sites such as compacted landings, clearcuts, skidder trails and roadsides. Over 1,000 accessions of 45 different

species were collected over three years from 22 biogeoclimatic subzones and 12 forest districts across northern B.C., from 52°N to 60°N and from the Coast Range to the Rocky Mountains. The area from which plant material was collected is broad, but seed was only collected at low to middle elevations (below alpine tree line), so these species and techniques described here are primarily applicable to the treed ecosystems of B.C.'s northern Interior. The climate is fairly homogenous in its boreal, sub-boreal, and subalpine character. Dominated by long snowy winters and short cool summers, this region approximates the zones described by the Canadian Committee on Ecological Land Classification (CCELC) as the boreal and subalpine sections of the Interior Cordilleran, Southern Cordilleran and Mid-Cordilleran ecoclimatic regions (CCELC 1989).

Some researchers and restoration practitioners advocate the use of only local plant materials when conducting ecological restoration. This approach is highly desirable and is especially important for ecological reserves, species at risk of extirpation, or for species that reproduce predominantly by selving. But such an approach ignores the potential benefits of high genetic diversity in populations exposed to a changing climate, and to the practicalities of being able to produce seed in cultivation so that it can be marketed on an economically feasible scale (for which moderately broad geographic applicability is required). Large revegetation programs, such as the roadside seeding of new logging roads and the reclamation of mine spoils, often manage dozens or hundreds of hectares of land every year, making the collection of local wild seed supplies and cuttings neither practical nor sustainable.

In the Symbios program, wild seed from diverse locations was collected in the summer and fall, dried at room temperature, manually cleaned, and stored over winter in refrigerators. Tests for germination capacity using a programmable incubator were conducted in late winter. Seed germination tests were initially conducted for 30 days at 30°C days and 20°C nights, but subsequent tests were done at 25°C days and 15°C nights, with tests often extended for many weeks until germination stopped. In early spring, all accessions were germinated in a greenhouse in peat-filled styroblocks to lengthen their first growing season and to shorten the time to seed production. Seedlings were then transplanted into outdoor seed increase plots. Each seedling was planted in a single-species plot in a computer-generated planting pattern designed to optimize the conditions for outcrossing and hence maximize the potential to produce seed with broad genetic diversity (Burton and Burton 2002). Seeds produced from these plots in the following years were also tested for germination capacity, then passed on to growers to initiate large-scale seed production. Over the course of the project, several species were eliminated due to poor germination, or harvesting and cleaning difficulties.

Field trials testing various species combinations, sowing densities, mulches, and the use of fertilizer were conducted over the course of four growing seasons, and were monitored for 2 or 3 years after seeding. Details of these and other tests and procedures in the development of native seed supplies are provided in the final report for the project (Burton and Burton 2001a), which is available from the authors. Information for the 31 species included in this manual was obtained from direct experience in cultivation and revegetation trials, supplemented by information from the literature and other researchers. These species are presented with their plant family affiliation in Table 1. Most of this manual consists of species by species accounts of growth form, site preferences, seed size, germination behaviour, techniques for seed production, harvesting and seed processing, and considerations for use in revegetation. Some general guidelines apply to all species, as presented in the next section, but much of this information is repeated in the individual species treatments so that those subsections can stand alone as well.

Table 1. The plant species covered in this manual, organized by plant family.

Family	Species	Family	Species
Asteraceae	*Achillea millefolium*	Polemoniaceae	*Polemonium pulcherrimum*
	Anaphalis margaritacea	Poaceae	*Agrostis exarata*
	Arnica chamissonis		*Bromus ciliatus*
	Arnica cordifolia		*Calamagrostis canadensis*
	Aster conspicuus		*Calamagrostis rubescens*
	Aster foliaceous		*Elymus glaucus*
Cyperaceae	*Carex aenea*		*Elymus trachycaulus*
	Carex macloviana		*Festuca occidentalis*
	Carex mertensii		*Leymus innovatus*
Fabaceae	*Lathyrus ochroleucus*		*Poa alpina*
	Lupinus arcticus		*Trisetum spicatum*
	Lupinus polyphyllus	Rosaceae	*Dryas drummondii*
	Vicia americana		*Geum macrophyllum*
Juncaceae	*Luzula parviflora*		*Festuca saximontana*
Liliaceae	*Allium cernuum*	Scrophulariaceae	*Collinsia parviflora*
Onagraceae	*Epilobium latifolium*		