E S T A B L I S H M E N T A N D S U R V I V A L
O F G R O U N D C O V E R P L A N T I N G S
O N D I S T U R B E D A R E A S I N A L B E R T A

BY

H. VAARTNOU and G.W.WHEELER

Final Report

of

Phase I

Edmonton, Alberta

June 1974

Plant Industry Laboratory

Alberta Department of Agriculture

ALBERTA DEPARTMENT OF AGRICULTURE

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July 5, 1974

Dear Sir:

Enclosed please find a copy of the Final Report of Phase I on 'Establishment and Survival of Ground Cover Plantings on Disturbed Areas in Alberta'.

This report concludes Phase I of the project. Phase I was the survey of existing vegetation on disturbed areas. Phase II, the testing of selected ecotypes of native species and comparing them with commercial varieties of grasses and legumes was started in May of 1974. We expect to establish about thirty test sites on disturbed areas in different environments during 1974 and 1975.

We would like to take this opportunity to thank all the agencies and individuals who helped us carry out Phase I of this study, and look forward to continued technical, moral, and financial support to help us to complete and conclude the entire study as planned.

Sincerely yours,

H. Vaartnou, Head
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HV/ke

INTRODUCTION

In February of 1973 a meeting of representatives from interested government agencies and industries was held in Edmonton in order to determine the need for research on the revegetation of disturbed areas in Alberta. As a result of this meeting a research project was set up to study the establishment and survival of ground cover vegetation on roadsides, utility rights-of-way, and non-cultivated disturbed areas in Alberta.

The purposes of the project, as set out by that meeting, were:

1. to provide the basic information necessary for recommendations for revegetation and management of disturbed areas, such as roadsides, utility rights-of-way, erosion control, etc.,
2. to improve wildlife habitats in non-cultivated, disturbed areas, when practical and possible,
3. to provide the basic information regarding the amount of pesticides required to control undesirable vegetation on non-agricultural areas in Alberta,
4. to improve the aesthetic values of disturbed areas.

A preliminary field survey was conducted during the summer of 1973 to provide background information on the vegetation presently growing on disturbed areas. The objectives of this survey were:

1. to study the natality, mortality, and biotic potential of the species providing the vegetation on roadsides, utility rights-of-way, and other disturbed areas in Alberta,

2. to locate, evaluate, and identify native vegetation which may be used for revegetation purposes on rights-of-way, roadsides, erosion control, and surface-mined areas, etc. in Alberta,
3. to study the weed infestation and bio-competitive weed control on reclaimed areas such as roadsides, utility rights-of-way, eroded, and surface-mined areas,
4. to collect seeds of native plants for testing,
5. to identify and evaluate problems involved in maintaining rights-of-way.

The first three progress reports covered the vegetation along roadsides, pipeline and powerline rights-of-way, and some strip-mining areas. Progress report #4 related the vegetation to some important soil properties. This report attempts to synthesize the information from the previous four reports as well as that gained in previous ecological studies and in some growth chamber testing conducted during the winter in order to provide preliminary recommendations as to which species are likely to be useful for what revegetation purposes.

METHODS

Roadside, pipeline, and powerline right -of-way vegetation was sampled at various locations throughout the province. The sites were selected to include as much variation in the vegetation as possible. The roadside sites were limited to highways and major secondary roads because data was available on the time of seeding and the seed mixture used. These sites were also selected to include as wide a range of planting dates as possible within each region. On pipeline and powerline rights-of-way, only those areas were included where the right-of-way traversed native vegetation. Grain fields, seeded pastures, and seeded hay fields were not included.

In the Athabasca Tar Sands area several sites were located in the major plant communities. The majority of these sites were located so that a cleared area along a cutline, for example, could be paired with a nearby uncleared area. Several sites were located in a fifteen to twenty-year-old burned off area, where no attempt was made to pair cleared and uncleared areas.

Sites were also located on natural and man-made revegetation areas on the Whitewood coal mine at Wabamun.

With few exceptions the vegetation on each site was sampled using ten one meter square plots. The exceptions were several of the vegetation stands on the Whitewood mine which were small enough and uniform enough for the entire stand to be treated as a single plot. Where ten

plots were used on the Whitewood mine and in the Tar Sands area, the individual plots were randomly located within each plant community studied. At sites on roadsides, and pipeline and powerline rights-of-way, the plots were not located randomly. Their locations were selected to include as much as possible of the topographic and vegetational variation on the site.

Within each plot the data was recorded as an estimate of the ground cover of each species present. However, species covering less than one percent were only listed as being present. In addition to this, a list of species existing in a stand of vegetation studied but not included in any of the plots was made for each Tar Sand and Whitewood mine site. This list of additional species was handled differently on the right-of-way sites. In this case, plants not actually in the plot but in the surrounding area were included with the list of species covering less than one percent. No attempt was made to provide a complete species list for any site, because the rare species were not considered as good candidates for revegetation purposes.

Two soil samples were taken from each right-of-way site. One sample would represent the best soil and the other the poorest soil at the site, with vegetation cover as the determining factor.

Once the field work was completed, the data for the right-of-way sites was divided into six groups, based on the soil zone the site was located in. Each type of right-of-way covered, (i.e. roadsides, pipeline rights-of-way, and powerline rights-of-way), was treated separately

and covered in a separate progress report.

The soil zones, taken as a convenient indicator of climate, were used as defined by the Alberta Soil Survey. They were the brown, dark brown, thin black, black, degraded black, and grey wooded soil zones. Each of these six groups was subdivided on the basis of soil texture into coarse textured soils and fine textured soils. In the grey wooded and degraded black soil zones, organic soils were placed in a third group. From this it was possible to determine which species provided the greatest ground cover on disturbed areas. Those species providing good ground cover on disturbed sites and not classed as weeds were thought most likely to be useful for revegetation of disturbed areas.

The cleared and uncleared sites in the plant communities studied in the tar sands area, were compared to see what changes clearing brought about in the ground cover. Species which occurred in significant amounts in cleared areas and which were also present in uncleared areas were thought most likely to be useful in establishing ground cover in revegetation projects.

The soil samples collected along the rights-of-way were analysed at the Alberta Soil and Feed Testing Laboratory, using their standard testing methods. These analyses are routinely used to evaluate the fertility status of agricultural soils. The data was divided into groups based on the levels of the soil properties measured. These groups were then compared to see what species would be best on soils with various levels of these properties. The following ones provided information for determining which

species would be useful. They included: pH, free lime, sodium, potassium, phosphorus, organic matter, and texture.

In addition to the data discussed in the progress reports[1], the past experience of the authors in working with and observing the vegetation in Alberta and surrounding areas, was used as an aid in formulating the recommendations. These recommendations are based on the ecological regions listed below. These regions roughly correspond to the soil zones as indicated in the list.

Mixed Prairie - brown soil zone and part of the dark brown soil zone.

Fescue Grassland - part of the dark brown soil zone and the thin black soil zone.

Central Parkland - black soil zone.

Boreal Mixed Wood - part of the degraded black soil zone and the grey wooded soil zone.

Peace River Parkland - part of the degraded black soil zone.

Foothills and Mountains - part of the grey wooded soil zone.

1. Progress Report #1 included Pipeline rights-of-way and the Athabasca Tar Sands.
   Progress Report #2 included powerline rights-of-way and the Whitewood coal mine.
   Progress Report #3 included roadsides.
   Progress Report #4 discussed the soils along roadsides, and pipeline and powerline rights-of-way.

USEFUL SPECIES FOR RECLAMATION

GRASSES:

Agropyron cristatum (Crested Wheat Grass):

A. cristatum (a species of grass with densely tufted culms) was introduced to Alberta from Russia and is especially prevalent in southern Alberta. It provided good ground cover in the mixed prairie region. Within the Fescue grassland and central parkland it provided some ground cover on coarse textured soils in dry sites. Negligible ground cover was provided by this species in the Boreal mixed wood and Peace River parkland regions. The soil-vegetation study indicated that it was good on high pH and high free lime soils and was also able to survive on high sodium soils. A. cristatum is a valuable species as a dry-land grass and is recommended for reclamation projects in mixed prairie regions.

Agropyron dasystachyum (Northern Wheat Grass):

This is a wide-ranging species of prairie and other dry, open places with the plants having long, creeping rhizomes. A. dasystachyum was found to be a major ground cover species on medium and fine textured soils in the Boreal mixed wood region. Since it is a variable species, ecotype selection of A. dasystachyum for various environments is necessary before definite recommendations can be formulated as to its use for reclamation purposes in Alberta.

Agropyron smithii (Western Wheat Grass):

This species has plants which are often blue-glaucous and that have creeping rhizomes. A. smithii is common in prairie grasslands, expecially on heavier and alkaline soils. It was found to be an important native species in providing ground cover in the mixed prairie region, particularly on finer soils. Past experience indicates it is best suited to finely textured and 'alkaline' soils. As with A. dasystachyum the variability of A. smithii necessitates appropriate ecotype selection before suitable varieties may be obtained for reclamation in Northwest America.

Agropyron spicatum (Bluebunch Wheat Grass):

This caespitose grass, rarely found with rhizomes, usually forms large bunches. It is common in dry, open places in southern Alberta, especially in the foothills and mountains, where it is expected to be useful for range reclamation purposes.

Agropyron subsecundum (Bearded Wheat Grass):

A. subsecundum is a species of grass which has tufted plants that lack rhizomes. It provided some ground cover in the mixed prairie, fescue grassland, and parkland regions. Its usefulness for reclamation purposes and management requires more study before any recommendation can be provided.

Agropyron trachycaulum (Slender Wheat Grass):

The characteristics of A. trachycaulum closely resemble

that of A. subsecundum and it is primarily found in meadows and woodlands. The species provided ground cover in all areas of the province, including coarse textured, high pH, high free lime, and high sodium soils. This is a very important species with respect to providing the initial ground cover on disturbed areas. Some of its ecotypes are very useful for tar-sands reclamation and others are exceedingly resistant to northern diseases.

Agrostis gigantea (Red Top):

This is a perennial with rhizomes and it is usually growing as an excape from cultivation, mainly in damp places such as stream banks and roadsides. A. gigantea was thought most likely to be useful in the parkland, foothills, and Boreal mixed wood regions. It performed reasonably well on tar sand tailings in a growth chamber study. Some of its ecotypes are very resistant to northern diseases and this species also establishes good ground cover very fast.

Agrostis scabra (Hair Grass, Tickle Grass):

A. scabra forms small dense tufts and is common on moist ground in meadows, fields, and open woods. This is an important species for future study in the Boreal forest region. It is a variable species such that selection of ecotypes suitable for revegetation plantings is necessary. Some of the ecotypes of the species are very resistant to Sclerotinia borealis, one of the

most common snow molds in northern Alberta.

Alopecurus pratensis (Meadow Foxtail):

A perennial with flat leaf-blades and erect culms from three to six decimeters tall. A. pratensis is found in fields and waste places. Introduced to Alberta, the species is one of the most disease resistant grasses in northern areas. Possibly very useful for reclamation purposes north of 55 °N. latitude.

Arctagrostis arundinacea

A. arundinacea is a creeping perennial with culms up to ten decimeters tall. It is a common grass in permafrost areas in Northwest America but also exists in the Caribou Mountains and other northern regions in Alberta. The species will definitely be a useful grass for reclamation purposes north of 58°latitude. More research is required on its agronomic characteristics and management.

Bouteloua gracilis (Blue Gamma Grass):

B. gracilis is a low perennial of the dry prairie and is abundant in the prairie grasslands of southeastern Alberta. It is an important native ground cover species especially in the mixed prairie region. It was not found on high sodium soils.

Bromus inermis (Smooth Brome):

This common perennial (with creeping rhizomes) was intro-

duced to Alberta and is widely grown for hay and pasture. Sometimes it persists as a weed. B. inermis is one of the most valuable ground cover species throughout Alberta. If it is not the primary source of cover, then it is present as one of the major species in every region. It appears to be somewhat more prevalent on fine textured soils than on coarse textured soils. This species did not do well on the high sodium soils studied. Varieties which are resistant to northern diseases would be useful for reclamation in Northwest America.

Bromus pumpellianus (Northern Awnless Brome):

B. pumpellianus is very similar to B. inermis but can be distinguished chiefly by its pubescent lemmas. The species is common in the Boreal mixed wood and mountain regions, being found there in open woods, thickets, slopes, and low grasslands. It can provide a disease resistant, permanent ground cover in these regions, however ecotype selection and testing in the various environments is necessary before useful recommendations can be made.

Calamagrostis canadensis (Marsh Reed Grass):

This is a very common though variable grass on moist, somewhat shaded areas in Northwest America. Through natural seeding, C. canadensis readily establishes itself on suitable environments in Alberta and other areas. The handling of its

seed requires study before it will be feasible for reclamation purposes. Difficulties of handling, the abundance of the seed in nature and the ease with which it establishes itself on disturbed areas all combine to raise the question of the rationality of including C. canadensis in future seed mixtures.

Calamagrostis inexpansa (Northern Reed Grass):

The species is a tall perennial with creeping rhizomes. The Fort McMurray ecotype, from sandy soils, might be useful for the reclamation of tailing sands and waste dump areas.

Calamovilfa longifolia (Sand Grass):

This species is a coarse perennial with long, stout, scaly rhizomes. It is found in the sandy prairie and open woods especially in the mixed prairie region. C. longifolia is one of the few species which is able to provide a ground cover for stabilizing pure sands. Again selection of ecotypes for use in northern and southern areas is necessary and establishment and management of the plantings should be studied.

Danthonia parryi (Parry Oat Grass):

D. parryi is a tufted perennial which lacks rhizomes and often forms tough clumps. It is an important component of the foothill grasslands in southwestern Alberta. It is considered to have a limited value for reclamation outside of this area.

Deschampsia caespitosa (Tufted Hair Grass):

This species is a perennial with shining, pale, or purplish spikelets and forms culms in dense tufts. It is a common species, often prominent in wet meadows of prairie and mountain regions. The selection of disease and drought resistant ecotypes of D. caespitosa, and their testing in various environmental regions, is required before the species' usefulness for reclamation purposes can be determined.

Elymus canadensis (Canada Wild Rye):

A coarse, tufted perennial, with or without rhizomes, found on river banks, railway grades and sandy areas. E. canadensis might prove to be useful as a ground cover plant on moist, semi-shaded areas such as river banks and similar environments. However, before any use is attempted, more work on establishment and early management is required.

Elymus innovatus (Hairy Wild Rye):

This species has creeping rhizomes with brown scales and is very common in woodlands, especially the pine forests of western Alberta. E. innovatus was found to be an important ground cover species on coarse textured soils in the Peace River parkland region and on coarse to fine textured soils in the Boreal mixed wood region. The only extreme of the soil factors studied, that it was found to tolerate, was coarse texture. Although a very

variable species, E. innovatus is considered to be one of the most valuable native forage plants. Ecotype selection is essential in order to obtain disease resistant clones for reclamation in semi-shaded grey-wooded soil areas. This species might also be useful for reclamation on oilsand tailings, and waste dump areas.

Festuca brachyphylla (Alpine Fescue):

This species is similar to F. ovina (see below) in that it is densely tufted. It is commonly found on rocky slopes and summits. This native fescue should be useful for high altitude plantings where F. ovina and other fescues are not permanent components of ground cover communities.

Festuca idahoensis (Bluebunch Fescue, Idaho Fescue):

It is a densely tufted species common in the fescue grasslands of southwestern Alberta and in the Cypress Hills. F. idahoensis is a native species in the fescue grassland and central parkland regions, occurring more often on sandy soils. This grass should be considered for inclusion in future seed mixtures for open wooded areas, rocky slopes in the foothills, and mountain areas.

Festuca ovina (Sheep Fescue):

F. ovina was introduced from Eurasia and is occasionally found as an escape in Alberta. The species is likely to be

useful in the parkland, foothills, and Boreal mixed wood regions. Selected ecotypes could provide very useful ground cover on light sandy soils such as tailings sands in the Fort McMurray region. Other areas would include those mined for heavy metals or polluted by sulphur as well as areas in the foothills and low mountains which are to be reclaimed.

Festuca rubra (Red Fescue):

This fescue species is loosely tufted, with matted rootstocks and sometimes with short-creeping rhizomes, and occasionally is found as an excape from cultivation. It is generally established on shores and low meadows. F. rubra was found by the survey teams to be an important introduced ground cover species in the Boreal mixed wood and Peace River parkland regions, and on some sites in the central parkland and fescue grassland regions.

Its susceptibility to diseases reduces its longevity. Certain varieties with longer rhizomes which are adapted to coarse sandy soil and resistant to local diseases will be useful if they are made available.

Festuca scabrella (Rough Fescue):

F. scabrella is densely tufted, often as large tussocks, and is the leading species in the fescue grasslands and the grassland portions of the central parkland.

It is variable and some strains indicate an ability to produce short rhizomes. It grew reasonably well on low-grade oilsands and tailings sands. F. scabrella is considered to be very valuable for reclamation purposes.

Glyceria pulchella (Manna Grass):

The plants are pale green, rhizomatous, and often form large clusters. It is common in shallow water and boggy meadows. G. pulchella might be useful for seeding of wet areas in the Boreal mixed wood region but more information on its agronomic characteristics, disease resistance and establishment is required before useful recommendations can be made.

Hierochlo odorata (Sweet Grass):

A creeping, sweet-smelling perennial grass with flat leaves. It is common throughout the province, especially low meadows, and is sometimes found in recently disturbed areas. As a result it may prove useful as a loosely creeping and disease resistant component of ground cover for light, moist soils in the parkland regions, the Boreal mixed woods region, and the foothills.

Koeleria cristata (June Grass):

A tufted perennial common in prairie grasslands. This species is regarded as an important native species in the mixed prairie,

Peace River parkland and fescue grassland regions. K. cristata will be useful on coarse textured soils and possibly also on high lime and high sodium soils. It should be considered for reclamation of disturbed mixed prairie, fescue grassland and parkland areas.

Oryzopsis hymenoides (Indian Rice Grass):

This is a stout species with tufted culms and is generally found on sand dunes, dry banks and rocky slopes. O. hymenoides is a useful plant for lighter soils in the mixed prairie region but more information is needed on its establishment and adaptability.

Oryzopsis pungens (Shorthorn Rice Grass):

This species, found in open, sandy and gravelly places, has densely tufted culms. It was found in the Boreal mixed wood regions and occasionally in the parkland regions. As with O. hymenoides, more information on its establishment and adaptability is required.

Phalaris arundinacea (Reed Canary Grass):

This robust perennial has tall stems with numerous flat blades and creeping rhizomes. It is found on shores and marshes. P. arundinacea will withstand ponding up to two months if the alkali content of the soil is low.

Phleum alpinum (Alpine Timothy):

A plant that has culms which are solitary or in small tufts.

It is common in alpine meadows, forest borders, and open slopes in the Rocky Mountains and Cypress Hills. It may prove useful for reclamation on high elevation and other wildlife ranges.

Phleum pratense (Timothy):

This species, a native of Europe, has tufted culms and is commonly grown for hay and pasture. It is found in meadows, roadsides, and trails in the mountains. P. pratense was an important introduced species in the Boreal mixed wood, parkland, and fescue grassland regions. It is good on high pH and high lime soils but not likely to be useful on high sodium and coarse textured soils. If it is to be used for reclamation purposes, a selection of naturalized ecotypes resistant to local diseases and adapted to various habitats is necessary.

Poa alpina (Alpine Bluegrass):

A low perennial grass with erect culms from a rather thick crown. It is common in mountainous regions. P. alpina is considered to be one of the grasses for high elevation reclamation of wildlife ranges and other disturbed areas. However, additional testing in various environments is required.

Poa ampla (Big Bluegrass):

A tufted, sometimes with short rhizomes, plant found in meadows and slopes. The species was recommended for further testing in all

six zones in the preliminary reports. Ecotypes of P. ampla should be very useful in reclamation as it can provide ground cover in areas of moist, open ground to areas of dry and rocky slopes. Some ecotypes may be good on alkaline soils but trials on adaptability and disease resistance should be carried out.

Poa canbyi (Canby Bluegrass):

This bluegrass has tufted culms, inhabits dry, open places, and is widespread in prairie-parkland regions. The selection of useful clones for various environments is necessary.

Poa compressa (Canada Bluegrass):

This introduced grass has culms formed from long rhizomes and is erect and decumbent at the base. It frequents meadows and waste places. The growth habits of P. compressa make it very suitable for the reclamation of poor soils. Varieties for various environments should be tested for disease resistance and establishment of ground cover.

Poa interior (Interior Bluegrass):

P. interior has tufted culms, is stiffly erect and slender and is common in parkland prairies. This widespread grass should be included for future study as it is one of the most common bluegrasses on slopes and open woods at medium altitudes. It would be a useful species for reclamation of disturbed areas in foothills

and mountainous regions. More work on adaptation to different environments and establishment of stands should be done before final recommendations are made.

Poa palustris (Fowl Bluegrass):

A species whose culms are loosely tufted. It is very common in moist meadows and open woods in the Boreal mixed wood region. It is one of the primary invaders of disturbed soils and should be considered for inclusion as a component of seed mixtures for rapid groundcover. More selection of useful ecotypes as well as testing for local disease resistance should be conducted.

Poa pratensis (Kentucky Bluegrass):

This is one of the leading grasses of meadows and lawns. It spreads by rhizomes, is sod-forming and has culms that are often tufted. Although introduced to the region, it has become so widespread that it is sometimes classed as a native species. Suitable varieties selected from local ecotypes of P. pratensis should be included in most reclamation seed mixtures. Kentucky bluegrass is one of the most effective grasses for nearly all soil types and environmental conditions found in Northwest America. A primary criterion for the ecotypic selection and longevity of a stand of this species is snow mold resistance.

Poa secunda (Sandberg Bluegrass):

This bluegrass forms small dense tufts and is common on dry

plains and slopes. P. secunda should be useful in the mixed prairie region and dry woods regions as well as rocky slopes at medium and higher altitudes. More research, however, is necessary to determine its usefulness on various environments in Northwest America.

Puccinellia distans (Weeping Alkali Grass):

P. distans is a smooth perennial with tufted culms and is decumbent at the base. Generally it is found in moist places but apparently is rare in our region. P. distans as well as P. airoides (Nuttall Alkali Grass) may be important for the reclamation of alkaline soils. Though usually located in moist soils, some of the ecotypes do colonize and persist well in drier conditions and also on roadsides. Further testing and selection for various environments is required.

Stipa comata (Needle and Thread, Spear Grass):

A perennial bunchgrass with narrow, elongated blades whose culms are from three to seven decimeters tall. Found in the dry plains and hills, S. comata is a leading grass of the mixed prairie. It is likely to be useful on high pH, high lime, and coarse textured soils in the mixed prairie region.

Stipa spartea var. curtiseta (Western Porcupine Grass):

This species' culms are mostly from five to ten decimeters tall. It is a leading grass of the mixed prairie, fescue grass-

land, and the grassland part of the parkland regions. Further testing is required before its usefulness as a grass for reclamation can be determined.

LEGUMES:

Astragalus canadensis (Canada Milk Vetch):

A tall, erect, perennial herb which has creeping rhizomes. It is commonly found in moist, open woodlands, banks, shores, and roadsides in western Alberta. It may be a useful nitrogen fixing legume for the boreal mixed wood, parkland, and foothills regions.

Astragalus cicer (Cicer Milk Vetch):

A. cicer is an introduced perennial rhizomatous legume. It is best suited to coarse textured and medium textured soils and may prove useful for tar sands reclamation. The species is good for soil conservation, however methods to establish and maintain the plantings have to be researched further.

Astragalus crassicarpus (Buffalo Bean):

This several-stemmed, prostrate legume spreads from a stout caudex forming a wide mat. In dry grassland ecosystems, A. crassicarpus would be very useful towards developing a stable, self-supporting community. Its establishment and early management do require more study though.

Hedysarum alpinum (Alpine Hedysarum):

This species, found in prairies or open woods, has stems which are either erect of ascending. It is a deep-rooted native legume

and is one of the more promising species for future seed mixtures for reclamation in northern areas as well as foothills and similar environments. The testing of ecotypes in various environmental conditions is required before recommendations can be made.

Lathyrus ochroleucus (Pea Vine):

A perennial herb with horizontal rootstocks and slender, climbing stems. It is very common among bushes in open woods and in northern meadows. It is a regular component of native communities in the parkland and boreal mixed wood regions and is considered to be a useful legume in self-supporting ecosystems. L. ochroleucus is unlikely to respond well on high sodium and coarse textured soils but more testing in various environments is necessary before recommendations can be made.

Lupinus argenteus (Silver Lupine):

L. argenteus is a perennial herb, diffusely branched and the stems erect. It is common on prairies in southern Alberta. Its poisonous properties should be considered before its selection is made for reclamation use.

Medicago falcata (Alfalfa):

This species is a deep-rooted, creeping perennial with a thick crown. It was introduced as a fodder plant and is found growing on roadsides and in waste places. M. falcata could be one of the

best legumes for reclamation in boreal mixed wood regions.

Medicago sativa (Alfalfa):

This introduced forage plant, common in fields, waste places, and along roadsides, is similar to M. falcata in habit. The species was a common legume in the mixed prairie, fescue grassland, and parkland regions. M. sativa did well on high pH and high lime soils and could be useful on high sodium soils and for its nitrogen fixing ability. It did best on fine and medium textured soils but not well on coarse textured soils. A variety with a loose, extensive rhizomatous habit and resistant to local diseases is required for reclamation purposes.

Melilotus alba (White Sweet Clover):

An introduced biennial herb that has smooth stems, is leafy branched and sweet-smelling in drying. It is common along roadsides and in waste places. In the mixed prairie region M. alba was the most common legume present and was found often along roadsides throughout the province. Usage of the species for roadside seeding mixtures was stopped after 1966 because of its rank growth, weedy tendencies, and annual growth pattern. It is good for high pH and high lime soils but not so for high sodium soils. This species may have some use as an original colonizer in areas of bad erosion but since it is a biennial plant it is not useful for permanent ground cover purposes. M. officinalis is very similar to M. alba.

Oxytropis serecia (Early Yellow Loco-weed):

O. serecia is a perennial herb usually with a stout multiple caudex. It is recommended for further study in the mixed prairie, fescue grassland, and parkland regions. Testing its adaptability on various environments, disease resistance and establishment patterns is required before recommendations can be formulated. Its poisonous properties should be considered before its selection is made for reclamation use.

Oxytropis splendens (Showy Loco-weed):

This caespitose herb is usually found on grassy slopes, open woods and gravelly areas in the mixed prairie, fescue grassland, and parkland regions. Its conclusions are the same as for O. serecia (above).

Thermopsis rhombifolia (Golden Bean):

T. rhombifolia is a perennial herb with creeping rootstocks and whose stems are erect or ascending. It is very common on sandy soils in the prairie regions. It might be useful in mixed prairie regions. Poisonous properties should be considered before recommendation.

Trifolium hybridum (Alsike Clover):

A glabrous, perennial herb, the stems of which are usually much-branched. The species has escaped from cultivation and is generally found on roadsides and waste places. T. hybridum was

an important introduced legume supplying ground cover in the boreal mixed wood, and parkland regions. It was less important in the fescue grassland regions. It does not do well on coarse textured or high sodium soils. The species is better adapted to moister soils. If it is to be used for reclamation purposes then selection for disease resistance is required in order to obtain a variety of a more permanent nature.

Trifolium medium (Zigzag Clover):

This species is a rhizomatous, perennial clover. T. medium might be useful for the Boreal mixed wood region and on tailings from oil sands oil extraction. A proper, disease resistant variety can provide a permanent legume ground cover for certain environmental situations. More research on its establishment and maintenance is required.

Trifolium pratense (Red Clover):

A biennial or short-lived perennial that is either erect or spreading and widely branched. This species also has escaped from cultivation. T. pratense was a prominent introduced legume in the parkland and boreal mixed wood regions. It was found to grow well on high pH and high lime soils but not well on high sodium or coarse textured soils. The species would be useful in seed mixtures as a temporary, nitrogen-fixing ingredient.

Trifolium repens (White Clover):

This clover is a low, glabrous perennial with creeping stems. It is commonly planted and has escaped into lawns and roadsides. T. repens was prominent as an introduced legume in the parkland and boreal mixed wood regions. Similar to T. pratense, this species will be useful on high pH and high lime soils but is not useful for high sodium and coarse textured soils. If a proper disease resistant variety is chosen it may be a good permanent component in moist environments.

Vicia americana (Wild Vetch):

V. americana is a perennial herb which often climbs and spreads in tangled masses. It is found in open woods, thickets and low grasslands. It was an important native species in the parkland and boreal mixed wood regions and to a lesser extent in the fescue grassland regions. V. americana was found to grow well on high pH and high free lime soils and on coarse textured soils, but not on high sodium soils.

Vicia cracca (Vetch):

This perennial has weak stems and is either climbing or trailing. It is an introduced species of roadsides, fields and waste places. V. cracca also may be useful on high pH and high free lime soils and possibly so on coarse textured ones. The species

likely will not be useful on high sodium soils and more research is required on its establishment and management.

Vicia sparsifolia (Wild Vetch):

A low perennial herb whose slender stems are either spreading or nearly erect. It is common in the prairie grassland, and is similar to V. americana regarding growth on different soils. It was more common in the mixed prairie region than V. americana.

SHRUBS:

Amelanchier alnifolia (Saskatoon-berry):

This is a shrub or small tree which is very common in open woodlands, and is found growing throughout Alberta. Research to find ecotypes suited to the various ecological regions of the province is needed.

Arctostaphylos uva-ursi (Bearberry):

A. uva-ursi is a trailing evergreen shrub that is common on sandy and rocky ground. This species is likely to be most useful on coarse textured soils in the boreal mixed wood region, the parkland region, and in the mountains and foothills. Practical methods of using seed in establishing the plantings are required before recommendations for reclamation can be formulated.

Arctostaphylos rubra (Alpine Bearberry):

This is a prostrate or tufted shrub which is prevalent in the Rocky Mountains and northern Alberta. A. rubra is recommended for future study in the boreal mixed wood region. Possibly it could prove to be a useful ground cover shrub on moist soils in the north and at higher elevations in the mountains.

Cornus stolonifera (Red Osier, Dogwood):

A shrub which is common in moist woods and on river banks.

Before useful recommendations can be provided for C. stolonifera, practical methods of using the seed in establishing the plantings are required.

Corylus cornuta (Beaked Hazelnut):

This species is a shrub and is generally found in thickets and open woods. As with C. stolonifera practical seeding methods are required.

Dryas drummondii (Yellow Dryad):

A loosely caespitose, mat-forming undershrub whose horizontal stems are much-branched. D. drummondii is found on rocky slopes and gravel banks in the Rocky Mountains and adjacent foothills. It may be good for reclamation of dry rocky areas but its establishment and management will have to be studied before recommendations can be made.

Dryas hookeriana (White Dryad):

This is a dwarf undershrub which forms small dense mats. D. hookeriana is found mostly above the timber-line in rocky areas and high mountains. As for D. drummondii (see above) it may be useful for rocky areas but more information is necessary.

Elaeagnus commutata (Silver Willow, Wolf Willow):

An upright shrub (up to four meters in height) which is

commonly found on the lighter (coarser) soils of parkland regions and valley slopes. E. commutata is an important native species in the central parkland region. Past experience shows it to be useful on coarse textured soils. Some of its clones may be among the most useful shrubs on parkland and valley slopes in grassland communities.

Juniperus horizontalis (Creeping Juniper):

J. horizontalis is a prostrate shrub forming large mats with its main branches greatly elongated and producing numerous branchlets. This species is usually found in sandy and rocky areas. It is a useful shrub on light soils in northern and western Alberta but more study is required on seeding and early management if it is to be used for reclamation.

Lonicera involucrata (Bracted Honeysuckle):

This is an erect or ascending shrub and found in low, moist woods. It might be a useful shrub for improving the wildlife habitat and aesthetic value of reclaimed areas in the parkland and boreal mixed wood regions. However, more information on stand establishment is required.

Potentilla fruticosa (Shrubby Cinquefoil):

This freely branched shrub is found in the Cypress Hills and foothills prairie regions of southern Alberta, open areas in the

Rocky Mountains and in boggy thickets in northern Alberta. P. fruticosa, as groundcover for reclaimed areas, might aid by improving the wildlife habitat and aesthetic value.

Prunus pensylvanica (Pin Cherry):

This is a slender shrub or small tree up to eight meters high, that is common in dry woods and thickets. P. pensylvanica is a very useful species for improving the aesthetic value and wildlife habitat in central, western and northern regions of Alberta. The germination of seed and early management require further study before useful recommendations can be submitted.

Prunus virginiana (Choke Cherry):

A slender shrub or small tree with dark bark, up to ten meters in height. It is predominantly found in thickets and open woods. These small trees are good for improving the aesthetic value and wildlife habitat of an area.

Rosa acicularis (Prickly Rose):

A bushy shrub, from one-half to one and one-half meters high, which has stout stems and is densely covered with slender, straight thorns. It is most common in forested regions but is found throughout Alberta. The species will be useful on high pH and high lime soils, good on coarse textured soils and possibly so on high sodium soils.

Rosa woodsii (Common Wild Rose):

This also is a bushy shrub whose stems have scattered bristles and thorns or they are prickly solely at the base. This is the most widespread and prevalent rose in Alberta, being found in prairies, woods, ravines, and sandhills. It is likely to be useful on similar soils as R. acicularis (see page 27). Both R. acicularis and R. woodsii will be useful for purposes of improving the wildlife habitat and aesthetic value of reclaimed areas.

Shepherdia argentea (Thorny Buffalo-berry):

A shrub with spreading branches, sometimes tree-like, which can grow up to six meters in height. It is found in the coulees and river valleys of southern Alberta. S. argentea may be useful for improving the wildlife habitat in that region, however more information is required on its establishment and the management of plantings.

Shepherdia canadensis (Buffalo Berry):

A spreading shrub with brown scruffy branches which is from one to three meters tall. Found on slopes and thin woods, it is common throughout the forested regions of Alberta. It may prove useful on coarse textured soils. S. canadensis requires more testing in various environmental conditions as well as to how the plantings are to be established.

Symphoricarpos albus (Snowberry):

A freely branched, slender shrub, which grows up to one meter in height. It is found in woodlands and open places in the parkland and boreal mixed wood regions. S. albus may be useful for slope stabilization, wildlife habitat improvement, and aesthetic enhancement. More information is required on its establishment and management for various ecozones in Alberta.

Symphoricarpus occidentalis (Buckbrush):

A robust shrub which is very common on the prairie, in thickets, and on the borders of aspen groves. This species was found to be an important native groundcover species for the fescue grassland and parkland regions and to a lesser extent in the boreal mixed wood region. The recommendations as to the uses for S. occidentalis in reclaimed areas are as for S. albus (see above).

Vaccinium myrtilloides (Blueberry):

A low shrub, from one to four decimeters tall, which is found especially on sandy ground in thickets and dry bogs, in the boreal mixed wood region. The species may prove useful but more information is required on its establishment and maintenance.

Vaccinium vitis-idaea (Bog Cranberry, Cow-berry):

This is a mat-forming, shrubby plant. It is common in fairly dry bogs, rocky thickets and low coniferous woods, in the boreal

mixed wood region. More information on its establishment and maintenance is required.

Viburnum edule (Low Bush Cranberry):

This branching shrub, from one to two meters high, is common in woodlands. As with Vaccinum myrtilloides and V. vitis-idaea (see page 35) Viburnum edule was found in the boreal mixed wood region, but more information is necessary before useful recommendations can be made.

SUMMARY

This report concludes phase I of the project. Phase I was the survey of existing vegetation. Phase II, the testing of selected ecotypes of native species and comparing them with commercial varieties of grasses and legumes, was started in May 1974.

Using the information gained through the survey and in doing previous ecological research in Alberta and surrounding areas, several lists of species have been prepared. A separate list of species recommended for future study within each of the six ecological zones the province has been divided into. Separate lists have been provided because reclamation and revegetation work is site specific. That is, revegetation methods suitable for the mixed prairie region will not work in the boreal mixed-wood region. Ecotypic variation within a species means that where a species is listed for more than one zone, different ecotypes may be needed for different zones. The species lists as given here are preliminary and will have to be modified as more information becomes available. Recommendations at the varietal level should be provided after detailed study of the sites to be revegetated.

SPECIES FOR RECLAMATION AND REVEGETATION

1. Mixed Prairie Region

Agropyron cristatum	Crested Wheat Grass
A. smithii	Western Wheat Grass
A. trachycaulum	Slender Wheat Grass
Astragalus cicer	Cicer Milk Vetch
A. crassicarpus	Buffalo Bean
Bromus inermis	Smooth Brome
Bouteloua gracilis	Blue gramma grass
Calamouilfa longifolia	Sand grass
Elaeagnus commutata	Silver berry
Elymus canadensis	Canada Wild Rye
Festuca ovina	Sheep Fescue
Koeleria cristata	June grass
Medicago sativa	Alfalfa
Oryzopsis hymenoides	Indian rice grass
Oxytropis sericea	Early yellow loco-weed
Poa ampla	Big bluegrass
P. canbyi	Canby bluegrass
P. compressa	Canada bluegrass
P. pratensis	Kentucky bluegrass
P. secunda	Sandberg bluegrass
Puccinellia distans	Weeping alkali grass

Mixed Prairie Region cont'd

Stipa comata	Spear grass
S. spartea var. curtiseta	Western Porcupine grass
Thermopsis rhombifolia	Golden bean
Vicia sparsifolia	Wild Vetch

2. Fescue Grassland Region

Agropyron cristatum	Crested Wheat grass
A. smithii	Western Wheat grass
A. subsecundum	Bearded Wheat grass
A. trachycaulum	Slender Wheat grass
Astragalus canadensis	Canada Milk Vetch
A. cicer	Cicer Milk Vetch
Bromus inermis	Smooth Brome
Calamovilfa longifolia	Sand grass
Elaeagnus commutata	Silver berry
Elymus canadensis	Canada Wild Rye
Festuca idahoensis	Idaho Fescue
F. rubra	Red Fescue
F. scabrella	Rough Fescue
Koeleria cristata	June grass
Oxytropis sericea	Early yellow loco-weed
O. splendens	Showy loco-weed

Fescue Grassland Region cont'd

Medicago sativa	Alfalfa
Poa ampla	Big bluegrass
P. canbyi	Canby bluegrass
P. compressa	Canada bluegrass
P. pratensis	Kentuchy bluegrass
P. secunda	Sandberg bluegrass
Puccinellia distans	Weeping alkali grass
Thermopsis rhombifolia	Golden bean
Trifolium hybridum	Alsike clover
Vicia americana	Wild Vetch
V. cracca	Bird Vetch
V. sparsifolia	Wild Vetch

3. Central Parkland

Agropyron cristatum	Crested Wheat grass
A. smithii	Western Wheat grass
A. subsecundum	Bearded Wheat grass
A. trachycaulum	Slender Wheat grass
Agrostis gigantea	Red Top
Astragalus canadensis	Canada Milk Vetch
A. cicer	Cicer Milk Vetch
A. crassicarpus	Buffalo bean

Central Parkland cont'd	
Bromus inermis	Smooth Brome
Calamovilfa longifolia	Sand grass
Elaeagnus commutata	Silver berry
Festuca rubra	Red Fescue
F. scabrella	Rough Fescue
Hedysarum alpinum	Alpine Hedysarum
Koeleria cristata	June grass
Lathyrus ochroleucus	Pea vine
Medicago sativa	Alfalfa
Oxytropis sericea	Early yellow loco-weed
O. splendens	Showy loco-weed
Poa ampla	Big bluegrass
P. compressa	Canada bluegrass
P. pratense	Kentucky bluegrass
Puccinellia distans	Weeping alkali grass
Rosa acicularis	Wild rose
R. woodsi	Wild rose
Symphoricarpus albus	Snowberry
S. occidentalis	Backbrush
Trifolium hybridum	Alsike clover
Vicia americana	Wild vetch
V. cracca	Bird Vetch

4. Peace River Parkland

Agropyron smithii	Western Wheat grass
A. subsecundum	Bearded Wheat grass
A. trachycaulum	Slender Wheat grass
Agrostis gigantea	Red Top
Alopecurus pratensis	Meadow foxtail
Bromus inermis	Smooth Brome
Calamagrostis inexpansa	Northern reed grass
Deschampsia caespitosa	Tufted hair grass
Elaeagnus commutata	Silverberry
Festuca rubra	Red Fescue
Hedysarum alpinum	Alpine hedysarum
Koeleria cristata	June grass
Lathyrus ochroleucus	Pea vine
Medicago sativa	Alfalfa
Oxytropis serecia	Early yellow loco-weed
Poa ampla	Big bluegrass
P. compressa	Canada bluegrass
P. palustris	Fowl bluegrass
P. pratensis	Kentucky bluegrass
Puccinellia distans	Weeping alkali grass
Symphoricarpus albus	Snowberry
S. occidentalis	Buckbrush
Trifolium hybridum	Alsike clover
Vicia americana	Wild Vetch
V. cracca	Bird Vetch

5. Boreal Mixed-wood Region

Agropyron dasystachyum	Northern Wheat grass
A. smithii	Western Wheat grass
A. trachycaulum	Slender Wheat grass
Agrostis gigantea	Red Top
A. scabra	Tickle grass
Alopecurus pratensis	Meadow foxtail
Arctagrostis arundinaceae	Arctagrostis
Arctostaphylos rubra	Alpine bearberry
A. uva-ursi	Bearberry
Astragalus agrostis	Purple Milk Vetch
A. cicer	Cicer Milk Vetch
Bromus inermis	Smooth Brome
B. pumpellianus	Northern awnless brome
Calamagrostis canadensis	Marsh reed grass
C. inexpansa	Northern reed grass
Deschampsia caespitosa	Tufted hair grass
Elaeagnus commutata	Silverberry
Elymus innovatus	Hairy wild rye
Festuca rubra	Red Fescue
Glyceria pulchella	Manna grass
Hedysarum alpinum	Alpine hedysarum
Hierochloe odorata	Sweet grass
Lathyrus ochroleucus	Pea vine

Boreal Mixed-wood Region cont'd

L. venosus	Pea vine
Medicago falcata	Alfalfa
M. sativa	Alfalfa
Phalaris arundinaceae	Reed canary grass
Phleum pratense	Timothy
Poa compressa	Canada bluegrass
P. interior	Interior bluegrass
P. palustris	Fowl bluegrass
P. pratensis	Kentucky bluegrass
Puccinellia distans	Weeping alkali grass
Rosa acicularis	Wild rose
R. woodsii	Wild rose
Symphoricarpus albus	Snowberry
Trifolium hybridum	Alskie clover
T. medium	Zig-zag clover
Vaccinium myrtilloides	Blueberry
V. vitis-idaea	Bog cranberry
Vicia americana	Wild vetch

6. Foothills and Mountains

Agropyron cristatum	Crested Wheat grass
A. dasystachyum	Northern Wheat grass
A. smithii	Western Wheat grass
A. spicatum	Bluebunch Wheat grass
A. subsecundum	Bearded Wheat grass
A. trachycaulum	Slender Wheat grass
Agrostis gigantea	Red Top
A. scabra	Tickle grass
Alopecurus pratensis	Meadow Foxtail
Astragalus agrostis	Purple Milk Vetch
A. canadensis	Canada Milk Vetch
A. cicer	Cicer Milk Vetch
A. crassicarpus	Buffalo bean
Arctostaphylos rubra	Alpine bearberry
A. uva-ursi	Bearberry
Bromus inermis	Smooth Brome
B. pumpellianus	Northern awnless brome
Calamovilfa longifolia	Sand grass
Danthonia parryi	Parry oat
Deschampsia caespitosa	Tufted hair grass
Elaeagnus commutata	Silverberry
Elymus innovatus	Hairy Wild Rye
Festuca brachyphylla	Alpine Fescue

Foothills and Mountains cont'd

F. idahoensis	Idaho Fescue
F. ovina	Sheep Fescue
F. rubra	Red Fescue
F. scabrella	Rough Fescue
Glyceria pulchella	Manna grass
Hedysarum alpinum	Alpine hedysarum
Koeleria cristata	June grass
Lathyrus ochroleucus	Pea vine
Lupinus argenteus	Silvery lupine
Medicago falcata	Alfalfa
M. sativa	Alfalfa
Oxytropis sericea	Early yellow loco-weed
O. splendens	Showy loco-weed
Phalaris arundinaceae	Reed canary grass
Phleum alpinum	Alpine timothy
P. pratense	Timothy
Poa alpina	Alpine bluegrass
P. ampla	Big bluegrass
P. canbyi	Canby bluegrass
P. compressa	Canada bluegrass
P. interior	Interior bluegrass
P. palustris	Fowl bluegrass
P. pratensis	Kentucky bluegrass

Foothills and Mountains cont'd

P. secunda	Sandberg bluegrass
Puccinellia airoides	Nuttall alkali grass
P. distans	Weeping alkali grass
Rosa acicularis	Wild rose
R. woodsii	Wild rose
Thermopsis rhombifolia	Golden bear
Trifolium hybridum	Alsike clover
T. medium	Zig-zag clover
T. repens	White clover
Vaccinium myrtilloides	Blueberry
V. vitis-idaea	Bog cranberry
Vicia americana	Wild Vetch
V. cracca	Bird Vetch

The aim of this study has been and will be to provide a stable self-supporting plant community for revegetated areas. Because natural plant communities integrate all ecological factors reasonably well, we feel that the native plant communities serve best to identify the potential for natural or induced vegetation.

ACKNOWLEDGEMENTS

The financial assistance of the following agencies in gratefully acknowledged: Syncrude Canada Limited for both summer and winter help. Calgary Power Limited, The Oil Sands Environmental Study Group, and the Alberta Department of the Environment for providing summer help. The assistance of the Canadian Wildlife Service in conducting part of the field survey is also gratefully acknowledged. Provision of seed by the Canada Department of Agriculture research stations at Beaverlodge and Lethbridge is gratefully acknowledged.