Proceedings of the 23rd Annual British Columbia Mine Reclamation Symposium in Kamloops, BC, 1999.
The Technical and Research Committee on Reclamation

ATTITUDES TOWARD NATIVE SPECIES IN RECLAMATION

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ABSTRACT

An attitude/opinion survey designed to describe reclamationists attitudes toward agronomic and native species use in high-elevation reclamation programs was administered to 116 potential respondents representing government regulators, suppliers and consultants and industry environmental and engineering personnel.

Species suitability was considered to be very important by a large majority (98%) of respondents, but many were uncertain as to the utility of agronomic species in high-elevation reclamation programs. Most respondents indicated that the inclusion of grass species is necessary for successful reclamation of high-elevation disturbances but were uncertain about the necessity of including legume species.

In general, results were inconclusive with respect to the use of native species and their benefits to long-term revegetation success within high-elevation mine reclamation programs. Native species 'islands' were considered useful as seed sources for plant successional development by most respondents. Attitudes toward the aesthetic benefits of native species were inconclusive. The use of native species as a method of reducing the visual contrast between disturbed and undisturbed areas was not favored strongly. Attitudes towards commercial production of native species favored both the expanded production of native species seed and native species seed or seedling development programs.

Keywords: attitudes, opinion, reclamation, native species, agronomics.

INTRODUCTION

Agronomics are heterozygous herbaceous cultivars ('aliens' or 'exotics') that have a narrowed genetic base and are the result of breeding selection programs designed specifically for intensively managed agricultural systems (Brink 1980). Often, agronomic species are available as either common (wider genetic base) or as selected (narrower genetic base) varieties (Richardson 1980).

Agronomic species, when used in revegetation, are supposed to function as facilitating mutualists (companion crops) that provide initial erosion control and condition the soil. However, agronomics may or may not facilitate the establishment of native species (Tomm and Takyi 1982, Densmore et al. 1989). Moreover, a large number of species trials at high-elevation have shown consistently that permanent establishment of vegetation cover with agronomic species in the alpine is uncertain and that the use of native species is necessary (Hardy BBT Limited 1990).

In contrast, natives are plants which have not been domesticated and are indigenous to a particular region. As defined, the term 'native species' relies on both geographical and temporal limits and can be viewed as a biogeopolitical construct (Wilson et al. 1992). The discussion surrounding the preferential use of native species over agronomics in revegetation programs has been the source of considerable polemics (Bengson 1986, Berger 1993). Native species selections are thought to be optimal for revegetation of boreal (Mitchell 1987, Vaartnou 1992), alpine/subalpine (Thirgood and Ziemkiewicz 1978, Chambers et al. 1988, Brown and Chambers 1990) and arctic areas (McKendrick et al. 1984, Johnson 1987 and Cargill and Chapin 1987). Native species may be the only species for revegetation of true alpine disturbances (Etra et al. 1984, Guillaume et al. 1986).

From an ecosystem functioning perspective, native species are desirable because generally they are more tolerant of low fertility, soil acidity and short growing seasons than are introduced or agronomic species

(Chapin 1980, Sadasivaiah and Weijer 1982, Carlson 1986, Chambers et al. 1988). Native species adapted to low nutrient sites can ensure long-term stability on disturbances without nutrient supplementation (Hubbard and Bell 1977).

In addition to their ecological advantages, native species have aesthetic value since they generally provide better visual integration or harmony with the surrounding undisturbed vegetation than do agronomic species (Sutton 1975, Brown et al. 1976, Evans 1984, Jones and McTavish 1986).

Initially, relatively little thought was given to the use of native species (Bell and Meidinger 1977, Kenny and Cuany 1978), but positive changes in the last twenty years have enabled the development of a number of nurseries producing native species exclusively (Morrison 1987). In the United States, the Federal Surface Mining and Reclamation Act of 1977 (SMCRA PL 95-87 [30 USC 1201 - 91 STAT 445-532, Title V, Sec 515 paragraph 19]) specifically states that permanent vegetative cover of the same variety native to the area must be established on surface mine disturbances. The enactment of this law has been a major driving force behind native species research and commercial seed production in the United States (Armbrust 1985, Bengson 1986). Unfortunately, no such legislative requirement for native species use exists in Canada.

RESEARCH OBJECTIVES

The ethos of participants dictates the direction and, ultimately, the success of any revegetation program. Plant species selection for surface mine reclamation programs has been the subject of academic discussions, but little is known about attitudes of regulatory and operational personnel toward this issue. Therefore, characterizaton of the opinions or attitudes of reclamation practitioners toward the use of agronomic or native species is warranted.

METHODS

A questionnaire survey was chosen to study reclamationists' attitudes toward the use of agronomic and native species in high-elevation reclamation programs in Alberta and British Columbia, Canada.

Sample Population Description

The population under study was composed of six groups involved in some capacity with high-elevation coal mine reclamation program development or implementation at active or proposed coal mines near or above treeline in Alberta and British Columbia, *Canada.* Sub-populations were defined based upon professional group différences, occupation and role within the reclamation process as defined by Morrison (1987) and Ziemkiewicz (1987). With direct occupational involvement as the selection criterion, a population of 116 individuals was identified. Questionnaires were sent to the entire population.

Survey Administration

A dual survey mechanism (mail and telephone) was used to maximize survey response (Lovich and Pierce 1986). Potential respondents were telephoned prior to mailing the questionnaire. All potential respondents who had not returned questionnaires after four weeks were contacted by telephone in order to ensure they had received a copy of the questionnaire. Several subsequent telephone conversations were needed to encourage a number of individuals to complete and return their questionnaires.

Survey Instrument

Each respondent completed a multi-part questionnaire. The funnel-filter approach (Sheskin 1985) was included in the design of Sections A and B of the questionnaire so that respondents were not required to complete sections for which they did not have a knowledge-base. The majority of the statements in each

section were close-ended because the questions or statements were mainly technical, and the potential responses of the respondents were well defined (Backstrom and Hursh-Cesar 1981).

Section A of the questionnaire contained statements and a series of responses from which each respondent was required to list three in order of priority. The respondents were also given the option, where necessary, to specify an item (category) not listed. The section proceeded from general to more specific statements.

Attitudes have two properties: (1) direction (positive or negative feelings or beliefs) (Olson and Zanna 1993) and (2) magnitude (degree of favorableness or unfavorableness) (Himmelfarb 1992). Therefore, Section B of the questionnaire contained a series of statements where individuals were asked to respond to an attitudinal continuum between strongly disagree and strongly agree using the 5-point Likert rating 'scale' (Bailey 1987). The scale was used to measure how strongly the respondents felt about a particular statement. A neutral alternative was included so that the respondents were not forced to make a choice. Section C of the questionnaire contained a series of demographic questions that allowed for sub-population identification.

Data Analysis

The data collected from the survey were nominal in form and pre-coded, so they were input into a spreadsheet without modification. The data were validated (computer input errors) following input in order to ensure reliability (Stoddard 1982). Data analysis for Section A of the questionnaire involved simple frequency tables to identify response priorities and a series of Kruskal-Wallis tests to examine subpopulation differences in the ranking of responses (Blalock 1979). Data analysis in Section B involved the production of cross-tabulation matrix-form tables of the number and percentage of respondents who answered particular questions. The existence of relationships between variables was explored using chi-square tests.

Attitudinal responses to all of the statements in Section A were first subjected to a goodness-of-fit test to determine if there were inter-provincial differences in attitudes, and then, where appropriate, responses to statements were pooled according to professional groups and subjected to a two-way contingency table analysis (Norcliffe 1982). Goodness-of-fit tests were performed as a means of pooling responses from both jurisdictions since the entire population size was small.

RESULTS AND DISCUSSION

Survey Response

Mean percent response rate for combined sub-populations was 86% and exceeds the 74% percent recorded byDillman (1978). 'Occupational sub-populations varied in size: government environmental (28), industry environmental (21), nursery stock/seed producers (9), environmental consultants (23), government engineers (7) and industry engineers (12).

Sub-population response rates varied between 75 and 100%. Government engineers were the highest while industry engineers and nursery stock and seed suppliers were the lowest. Jurisdictional differences in response rates were also evident. Alberta industry environmental personnel and environmental consultant response rates were greater than their counterparts in British Columbia while government environmental response was greatest in British Columbia.

Return rates were significant for industry environmental, nursery stock and seed suppliers and industry engineer sub-populations and highly significant for the government environmental, environmental consultant and government engineer sub-populations according to percentage response categories provided by Backstrom and Hursh-Cesar (1981).

General Reclamation Information Priorities

General statements concerned with high-elevation surface mine reclamation were provided to determine the priorities and concerns of respondents. The non-parametric Kruskal-Wallis test was applied to compare sub-population rankings.

Environmental Limitations: The most important limitations to high-elevation revegetation were ranked by respondents, with short growing season (25%), infertility of plant growth material (18%), slow soil development (16%) and cool growing season temperatures (15%) considered most important. Ranked responses by sub-population were not significantly different (Kruskal-Wallis *H=0.29,* X^2=0.3, df=5, P=1.00).

Respondents ranked short, cool growing seasons, infertility of growing media and slow soil development to be the main environmental limitations to high-elevation revegetation. The opinions thus expressed were consistent with much of the research of Brown et al. (1978) and Chambers et al. (1984).

Plant Materials: The use of commercially available plants (seeds or seedlings) for reclamation was ranked by respondents, with vegetative cover for land-use objectives (23%), short-term erosion control (20%), soil development (17%) and long-term erosion control (15%) considered to be the most important. Response rankings by professional groups were not significantly different (Kruskal-Wallis H=O. 92, X^2=0.9, df=5, p=0.97).

The perceived benefits of native species in high-elevation reclamation programs were ranked by respondents, with ecosystem restoration (28%) and plant adaptation to local environment (29%) considered to be the most important. The ranked responses of the professional groups were not significantly different (Kruskal-Wallis H=1.48, X^2=1.5, df=5, p=0.92). Only 94% of the respondents completed this portion of the questionnaire.

The major limitations to the use of native plants in reclamation programs were ranked, with seed availability (30%), lack of information (18%), seed cost (17%), slow growth (10%), poor seedling establishment (8%) and inconsistent seed germination (8%) considered to be the most important determinants. Ranked responses by sub-population were not significantly different (Kruskal-Wallis H=0.08, X^2=0.1, df=5, p=1.00). Again, only 94% of the respondents completed this portion of the questionnaire.

In general, based on response rankings, respondents were informed sufficiently to make decisions regarding plant species selection. The role of commercially available plant species (land-use objectives, short- and long-term erosion control and soil development) and perceived native species benefits (ecosystem restoration and natural adaptation) are consistent with the report published by Hardy BBT Limited (1990). Respondents considered lack of information, seed cost and slow growth or seedling establishment to be the major limitations to the use of native species in high-elevation reclamation programs. The survey results describing the constraints on native species use are consistent with Brown and Chambers (1990).

Respondent Attitudes

Survey participants were asked to respond to a series of statements related to surface mine reclamation. Attitudinal responses were first checked with a goodness-of-fit test to determine if the responses from both Alberta and British Columbia could be pooled. Two statements could not be pooled.

Respondents were asked to provide their opinion on several plant materials selection statements. The statements were grouped into four categories: (1) plant species selection, (2) native plant species, (3) aesthetics and native species, (4) commercial production of native species.

Plant Species Selection: Species suitability was considered to be very important by a large majority (98%) of respondents, and 60% of these same respondents considered EISs to be an effective source for species suitability information. Respondents were uncertain as to the utility of agronomic species in high-elevation reclamation programs. Many respondents (40%) felt that agronomic species are suitable for purposes other than 'nurse' or 'companion' crops whereas 30% indicated that agronomics were suitable only as 'nurse' crops. The responses of professional groups were highly significant (X^2=38.21, df=20, P=0.010), but a large number (27%) expressed no opinion. The attitudes of industry environmental professionals (70%) and nursery/seed producers (56%) were the most supportive of a less restrictive interpretation of agronomic species utility.

Most respondents (76%) indicated that the inclusion of grass species is necessary for successful reclamation of high-elevation disturbances. However, respondents were uncertain as to the necessity of including legume species in high-elevation seed mixes. Only a small percentage of respondents from Alberta (36%) and British Columbia (12%) considered legume species to be essential to high-elevation reclamation. The attitudes of professionals varied by jurisdiction (X^2=8.90, df=3, p=0.032). However, a large number of respondents (Alberta - 40%, British Columbia - 49%) expressed no opinion or were uncertain of the value of legume species in high-elevation seed mixes.

Shrub species establishment was considered to be essential by 62% of the respondents although 26% expressed no opinion or were uncertain.

Native Plant Species: Respondents were divided on the requirement of native species for long-term revegetation success at high elevations. Many respondents (41%) believed that native species will be necessary for long-term success whereas 42% were opposed The attitudes of professional groups were significantly different (X^2=36.61, df=20, p=0.016) with the industry environmental group least supportive (10%) and environmental consultants most supportive (64%). Attitudes of government environmental (41% agreed, 41% disagreed) and nursery/seed producers (44% agreed, 45% disagreed) were divided almost equally.

Half of the respondents (48%) indicated that native species suitability is not restricted to specific seeding practices although a high number (34%) expressed no opinion or were uncertain. A large majority (78%) agreed that native species establishment rates do not limit the value of native species in reclamation programs.

Professional group attitudes toward productivity as a restriction on native species use in high-elevation reclamation programs was mixed, with 42% in agreement with productivity requirements being restrictive and 36% in disagreement.

Professional group attitudes were also divided with respect to the use of native species transplant economics for large-scale projects. A number of respondents (32%) considered seedling transplants uneconomical whereas 22% considered the use: of transplants economically viable. However, the largest number of respondents (46%) expressed no opinion or were uncertain as to the economic viability of seedling transplants.

Native species 'islands' were considered useful as seed sources for plant successional development by most respondents (Alberta 75%, British Columbia 80%) although differences between jurisdictions were significant (X^2= 12.69, df=4, p=0.014). The primary difference between jurisdictions relates to the magnitude of agreement with more British Columbia respondents strongly favoring 'islands' as seed sources.

In general, results were inconclusive with respect to the use of native species within high-elevation mine reclamation programs. The general attitude towards dependency on native species for long-term high-elevation reclamation success was divided although environmental consultants were in favor. Most respondents believed native species use is not limited by restrictive establishment practices, slow

establishment and growth rates or regulatory productivity criteria. The results contrast with the anecdotal observations of Bengson (1986).

Attitudes toward native species transplant economics were split although the large number of neutral responses may indicate of a lack of knowledge on the part of the respondents. However, the use of native species 'islands' was favored strongly and may be a perceived mechanism for circumventing uneconomical native species establishment.

Aesthetics and Native Species: The attitudes of respondents toward the relationship between native species use and aesthetics was divided. Many respondents (40%) agreed that the use of native species reduces the visual contrast between reclaimed and 'natural' areas whereas 39% disagreed. Attitudes toward greater emphasis on aesthetics as a driving force for increased use of native species in mine reclamation were also divided. Many respondents (37%) agreed that more emphasis on aesthetics would result in greater native species use whereas 34% disagreed. For both statements, a large number, 21% and 29% respectively, expressed no opinion or were uncertain.

Attitudes toward the aesthetic benefits of native species were inconclusive. The use of native species as a method of reducing the visual contrast between disturbed and undisturbed areas was not favored strongly. Moreover, attitudes toward increased emphasis on native species was divided. The aesthetics results are in contrast to the observations of Bell and Meidinger (1977) and Jones and McTavish (1986) who strongly favored the use of native species in reducing the visual contrast between reclaimed and undisturbed landscapes. The visual appearance of adapted species and ecotypes should be considered as part of the selection process (Brown et al. 1976).

Commercial Production of Native Species: Attitudes towards commercial production of native species favored both the expanded production of native species seed and native species seed or seedling development programs. Most respondents (81%) agreed with the existence of a market for expanded native species seed production. However, significant differences (X^2=33.43, df=20, p=0.034) were recorded between government engineers and industry engineers and environmental professionals. Government engineers expressed no opinion or were uncertain about expanded native species seed production. A majority (71%) felt that seed or seedling development plans are necessary for successful reclamation of high-elevation mine disturbances.

The majority of respondents were supportive of increased research development and expanded native species seed or transplant production for high-elevation mine disturbances. The results on native species production are consistent with the Alberta reclamation research priority survey results of Smith (1989).

CONCLUSION

As expected, species suitability was considered to be very important by most respondents but many were uncertain as to the utility of agronomic and native species in high-elevation reclamation programs. The large number neutral responses by different professional groups to many of the statements suggests that reclamationists are in need of greater training and instruction on the issues surrounding species selection.

The general ambivalence of the respondents toward native species suggests that the widespread use of native species is still, after several decades of polemics, far from resolution. The use of native species is still in need of both technical, e.g., seed collection and germination, establishment methods and socio-political (aesthetics, land-use values) research.

REFERENCES

Armbrust, A. (1985). Commercial seed production and sales of species for revegetation. *Vegetative Rehabilitation and Equipment Workshop. 39th Annual Report, February 10 and 11, 1985, Salt Lake*

City, Utah. United Slates Department of Agriculture, Forest Service and the United States Department of the Interior Equipment Development Center, Missoula. pp. 16-17.

Bailey, K.D. (1987). *Methods of Social Research. Third Edition.* The Free Press, New York. 533pp.

Backstrom, C.H. and G, Hursh-Cesar. (1981). *Survey Research. Second Edition.* John Wiley and Sons, New York 436pp.

Bell, M.A.M. and D. Meidinger. (1977). Native species: their use in reclamation of disturbed lands. *Reclamation of Lands Disturbed by Mining.* Proceedings of the British Columbia Mine Reclamation Symposium. Technical and Research Committee, British Columbia Ministry of Mines and Petroleum Resources and the Mining Association of British Columbia. Victoria, pp. 143-158.

Bengson, S.A. (1986). 'Native' vs. 'exotic' - the dilemma of ecological mine waste revegetation. *Rangelands,* 8, 2, 65-67.

Berger, JJ. (1993). Ecological restoration and non-indigenous plant species: a review. *Restoration Ecology,* 1, 2, 74-82.

Blalock,H.M. (1979). *Social Statistics. Second Edition.* McGraw-Hill Publishing, New York. 224pp.

Brink, V.C. (1980). Use of native species in mine land reclamation. *Reclamation of Lands Disturbed by Mining.* Proceedings of the Fourth Annual British Columbia Mine Reclamation Symposium, Technical Research Committee on Reclamation, Ministry of Energy, Mines and Petroleum Resources and Mining Association of British Columbia. Paper 1980-11. Victoria, pp. 231-240.

Brown, R.W. and J.C. Chambers. (1990). Reclamation practices in high-mountain ecosystems. *Proceedings - Symposium on Whitebark Pine Ecosystems: Ecology and Management of a High Mountain Resource.* (W.C. Schmidt, Compiler). United States Department of Agriculture - Forest Service. Intermountain Research Station General Technical Report INT-270, Ogden, Utah. pp. 329-334.

Brown, R.W., J.C. Chambers, R.M. Wheeler, E.E. Kelrick and M.I. Kelrick. (1988). *Deschampsia cespitosa* L. (Tufted hairgrass) for revegeitation of high-elevation disturbances: some selection criteria. *Proceedings of the High Altitude Revegetation Workshop No. 8.* (W.R. Keammerer and L.F. Brown, Editors). Information Series 59, Water Resources Research Institute, Colorado State University, Fort Collins, pp. 147-172.

Brown, R.W., R.S. Johnston and D.A. Johnson. (1978). Rehabilitation of alpine tundra disturbances. *Journal of Soil and Water Conservation,* 33, 4, 154-160.

Brown, R.W., R.S. Johnston, B.Z. Richardson and E.E. Farmer. (1976). Rehabilitation of alpine disturbances: Beartooth Plateau, Montana *Proceedings: High Altitude Revegetation Workshop No. 2.* (R.H. Zuck and L.F. Brown, Editors). Information Series No. 21, Colorado Water Resources Research Institute, Colorado State University, Fort Collins, pp. 58-73.

Cargill, S.M. and F.S. Chapin III. (1987). Application of successional theory to tundra restoration: a review. *Arctic and Alpine Research,* 19, 4, 366-372.

Carlson, J.R. (1986). New developments in plant materials for high-elevation. *Proceedings: High Altitude Revegetation Workshop No. 7.* (M.A Schuster and R.H. Zuck). Colorado Water Resources Research Institute, Information Series No. 58. Colorado State University, Fort Collins, pp. 122-130.

Chambers, J.C., R. W. Brown and R.S. Johnston. (1984). Examination of plant successional stages in disturbed alpine ecosystems: a method of selecting revegetation species. *High Altitude Revegetation Workshop No. 6.* (T.A Colbert and R.L. Cuany, Editors), Water Resources Research Institute, Information Series No. 53, Colorado State University, Fort Collins, pp. 215-224.

Chambers, J.C., J.A MacMahon and R.W. Brown. (1988). Seedling establishment in disturbed alpine ecosystems: implications for revegetatioa *Proceedings of the High Altitude Revegetation Workshop No. 8.* (W.R. Keammerer and L.F. Brown, Editors). Information Series 59, Water Resources Research Institute, Colorado State University, Fort Collins, pp. 173-191.

Chapin, F.S. III. (198Oa). The mineral nutrition of wild plants. *Annual Review of Ecology and Systematics,* 11, 233-260.

Densmore, R. V., L. Dalle-Molle and K.E. Holmes. (1989). Restoration of alpine and subalpine plant communities in Denali National Park and fteserve, Alaska, USA. *1989 Annual Conference of the Society for Ecological Restoration.* (HG. Hughes and T.M. Bonnicksen, Editors). Society for Ecological Restoration, Madison, pp. 509-519.

Dillman, D. A (1978). *Mail and Telephone Surveys, The Total Design Method.* John Wiley and Sons, New York. 325pp.

Etra, J., R.L. Cuany and G.L. Thor. (1984). Persistence and performance of grass and legume strains at subalpine test plots in Colorado. *Proceedings: High-Altitude Revegetation Workshop No. 6.* (TA. Colbert and R.L. Cuany, Editors). Colorado Water Resources Research Institute, Information Series No. 53, Colorado State University, Fort Collins, pp. 59-71.

Evans, M. (1984). Revegetation nursery stock availability and supply problems - the propagators perspective. *Proceedings of the Native Plant Revegetation Symposium, November 1984.* California Native Plant Society, San Diego, pp. 15-21.

Guillaume, M., W.A. Berg and J.T. Herron. (1986). Performance of native and introduced species seven years after seeding on alpine disturbances. *Proceedings: High-Altitude Revegetation Workshop No. 7.* (M. A Schuster and R.H. Zuck, Editors). Colorado Water Resources Research Institute, Information Series No. 58, Colorado State University, Fort Collins, pp. 131-141.

Hardy BBT Limited. (1990). *Reclamation of Disturbed Alpine Lands: A Literature Review.* Alberta Land Conservation and Reclamation Council Report No. RRTAC 90-7. Queens Printer, Edmonton. 209pp.

Himmelfarb, S. (1992). The measurement of attitudes. *The Psychology of Attitudes.* (A.H. Eagly and S. Chaiken, Editors). Harcourt Brace Jovanovich Publishers, San Diego, pp. 23-87.

Hubbard, W.F. and M.A.M. Bell. *(1977). Reclamation of 'Lands Disturbed by Mining in Mountainous and Northern Areas: A Selected Bibliography and Review Relevant to British Columbia and Adjacent Areas.* Prepared by Biocon Research Limited for the Province of British Columbia Ministry of Energy, Mines and Petroleum Resources. Victoria. 255pp.

Johnson, L. A. (1987). Management of northern gravel sites for successful reclamation: a review. *Arctic and Alpine Research,* 19, 4, 530-536.

Jones, C.E. and B. McTavish. (1986). Economic and biological feasibility of native plants for land reclamation in western Canada. *Land Rehabilitation: Policy, Planning Systems and Operational Programs.* Eleventh Annual Mœting of the Canadian Land Reclamation Association. Guelph. pp. 277-295.

Kenny, S.T. and R.L. Cuany. (1978). Grass and legume improvement for high altitude regions. *Proceedings: High Altitude Revegetation Workshop No. 3.* Information Series No. 53. (S.T. Kenny, Editor). Colorado Water Resources Research Institute, Colorado State University, Fort Collins, pp. 84-100.

Lovrich, N.P. Jr. and J.C. Pierce. (1986). The good guys and bad guys in natural resource politics: content and structure of perceptions of interests among general and attentive publics. *The Social Science Journal,* 23, 3, 309-326.

McKendrick, J.D., C.L. Elliot and C.P. Broddy. (1984). Evaluation of plants used for strip-mine reclamation near Healy, Alaska. *Agroborealis,* 16, 2, 5-8.

Mitchell, W.W. (1987). Revegetation research on coal mine overburdens in interior to south central Alaska. *Focus on Alaska's Coal 86.* Proceedings of the Conference, Anchorage Alaska USA October 26-28 1986, Mineral Industry Research Laboratory, MIRL Report No. 72, Fairbanks, Alaska, USA. pp. 72-86.

Morrison, D. (1987). On aesthetics, restoration and management *Restoration and Management Notes, 5,* 1, 3-4.

Norcliffe, G.B. (1982). *Inferential Statistics for Geographers. An Introduction. Second Edition.* Hutchinson University Library, London. 262pp.

Olson, J.M. and M.P. Zanna. (1993). Attitudes and attitude change. *Annual Review of Psychology,* 44, 117-154.

Richardson, AS. (1980). Use of agronomic species in mine reclamation. *Reclamation of Lands Disturbed by Mining.* Proceedings of the Fourth Annual British Columbia Mine Reclamation Symposium. Paper 1980-11. Sponsored by the Technical and Research Committee on Reclamation, British Columbia Ministry of Energy, Mines and Petroleum Resources and the Mining Association of British Columbia. Victoria, pp. 219-218.

Sadasivaiah, R.S. and J. Weijer. (1982). The utilization of native grass species for reclamation of disturbed land in the alpine and subalpine regions of Alberta. *Reclamation in Mountainous Areas.* Proceedings of the Sixth Annual Canadian Land Reclamation Association and the Fifth Annual

British Columbia Mine Reclamation Symposium. Paper 1982-2. Technical Research Committee on Reclamation, Ministry of Energy, Mines and Petroleum Resources and the Mining Association of British Columbia, pp. 211-219.

Sheskin, LM. (1985). *Survey Research for Geographers*. Resource Publications in Geography, The Association of American Geographers, Washington, D. C. 112pp.

Smith, J.A. (1989). *RRTAC Future Research Needs Project - Summary*. Prepared for Alberta Land Conservation and Reclamation Council by Concord Scientific Corporation. Edmonton. 43pp.

Stoddard, R.H. (1982). *Field Techniques and Research Methods in Geography*. Kendall/Hunt Publishing Company, Dubuque, Iowa. 234pp.

Sutton, R.K. (1975). Why native plants aren't used more. *Journal of Soil and Water Conservation,* 30, 240-242.

Thirgood, J.V. and P.P. Ziemkiewicz. (1978). Reclamation of coal surface-mined land in western Canada. *Reclamation of Drastically Disturbed Lands*. (F.W. Schaller and P. Sutton, Editors). American Society of Agronomy, Crop Science Society of America and Soil Science Society of America, Madison, Wisconsin, pp. 537-552.

Tomm, H.O. and S.K. Takyi. (1982). Influence of cultivated grasses and legumes on the establishment success of native grass mixtures at two abandoned coal mines in the subalpine region of Alberta. *Reclamation in Mountainous Areas*. Proceedings of the Sixth Annual Canadian Land Reclamation Association and the Fifth Annual British Columbia Mine Reclamation Symposium. Paper 1982-2. Technical Research Committee on Reclamation, Ministry of Energy, Mines and Petroleum Resources and the Mining Association of British Columbia, pp. 195-209.

Vaartnou, M. (1992). The northern native grass seed industry' - spring 1992. *Mine Reclamation from Exploration to Decommissioning*. Proceedings of the Sixteenth Annual British Columbia Mine Reclamation Symposium. Sponsored by the Technical Research Committee on Reclamation, Mining Association of British Columbia, Ministry of Energy, Mines and Petroleum Resources, Ministry of Environment, Lands and Parks, The Coal Association of Canada and the University of British Columbia. Victoria, pp. 75-109.

Wilson, M.V., D.E. Hibbs and E.R. Alverson. (1992). Native plants, native ecosystems and native landscapes. *Wild Earth,* 2, 2, 34-36.

Ziemkiewicz, P.P. (1987). Evolution of reclamation practice - from simple to complex. *Reclamation Targets for the 1990s*. (C.B. Powter, Editor). Proceedings of a Symposium Sponsored by the Alberta Society of Professional Biologists, Canadian Land Reclamation Association and the Canadian Society of Environmental Biologists, Edmonton, pp. 1-4.