

## NEAR SURFACE COMPACTION UNDER GRAZING OF ANNUAL AND PERENNIAL FORAGES\*

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### BACKGROUND

Soil compaction was defined by Gupta et al. (1989) as the compression of unsaturated soils, causing an increase in bulk density. Many researchers have reported soil compaction by grazing animals (e.g. Warren et al., 1986; Chanasyk and Naeth, 1996). However, few researchers have examined the influence of grazing intensity on soil bulk density for different forage types under the same soil and climatic regime. Since the objective of most grazing management practices is to maximize livestock production per unit area while maintaining sustained forage resource, using annual forages as supplemental pastures may be an option for some managers. Generally the effect of annual cultivation of these forages on soil bulk density, in conjunction with grazing, is unclear.

The objective of this study was to assess near-surface bulk density under different forages and grazing intensities at a site in central Alberta. It was hypothesized that bulk density would increase as grazing intensity increased. Bulk density was expected to be higher under perennial forages than under annual forages and to increase less under smooth brome grass than under meadow brome grass.

### MATERIALS AND METHODS

The study site was at the Agriculture and Agri-Food Canada Lacombe Research Center in the aspen parkland. Annual precipitation averages 447.5 mm. Soils at the study site are Orthic Black Chernozems of a sandy loam texture. Slopes average 1 to 3%.

Heavy, medium and light grazing intensity treatments were implemented on a rotational basis throughout the growing season. Grazing was initiated and ceased at different specific target forage heights for each grazing intensity. Four forage treatments with potentially differing abilities to control erosion and produce litter were used. Smooth brome grass (*Bromus inermis* L.) and meadow brome grass (*Bromus riparius* Rehm.) were the perennial treatments; triticale (*X Triticosecale* Whitnack) and a triticale/barley (*Hordeum vulgare* L.) mix were the annual treatments. The twelve resulting treatments were arranged in a randomized complete block design within four parallel blocks across an east-facing 3.8% slope.

In this study, near-surface refers to the top 10 cm of the surface mineral soil horizon. Nuclear gauges were used to measure near-surface bulk density and near-surface volumetric moisture simultaneously. Measurements were made at three locations in the middle of each third of the plots. Measurements were made over two growing seasons: 1994 and 1995, and at three times during each year: after snowmelt but before annual cultivation, immediately after cultivation and again in the fall before freezeup. The total number of cow-days of grazing was used as a measure of the compactive effort imposed on the treatments.

### RESULTS AND DISCUSSION

In both study years, cow-days under heavy grazing were at least twice those under light grazing, except for the triticale/barley treatments. Similarly, cow-days under perennials were approximately twice those under annuals. Surface volumetric moisture content (VMC) was generally not significantly different among forages, except at the

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beginning of the study. In contrast, VMC was higher in lightly grazed treatments than in the medium or heavily grazed treatments.

Bulk density (Db) was generally not significantly different among forages except at the end of the first growing season. Fewer grazing events throughout the first summer likely kept Db lower under annual forages than perennial forages at all grazing levels.

In all treatments, Db was higher after one season of grazing compared to the beginning of the study. In both springs, with Db averaged over all annual treatments, cultivation only reduced Db 3%. Over the two year study period, Db increased more under perennials than annuals.

Db was significantly different among grazing intensities on all measurement dates after grazing was established, except after cultivation. Generally Db was lower under light and medium grazed than under heavily grazed treatments. The change in Db was most dramatic in the heavily grazed treatments after the first season while the change in Db under both medium and light grazed treatments increased only slightly during this period.

### CONCLUSIONS

Grazing increased Db, especially the heavily grazed treatment. Although Db under annual forages was lower than under perennial forages, Db under annual forages increased faster than under perennial forages. Cultivation lowered Db only slightly. Db was lower under smooth brome grass than under meadow brome grass, likely because of the former's rhizomatous rooting habit which helped mitigate Db increase in the zone of greatest compaction.

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*Conservation and Reclamation:  
An Ecosystem Perspective*

Canadian Land Reclamation Association's  
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## TABLE OF CONTENTS

<b>LIST OF SPONSORS</b> .....	vi
<b>INDUSTRIAL FACILITIES</b>	
Industrial Site Decommissioning in Alberta .....	1
<b>Walter J. Ceroici</b>	
Changing Knowledge Needs for Wellsite Reclamation .....	3
<b>Jim Smith</b>	
The Orphan Facilities and Pipeline Program: An Industry/Government Responsibility .....	7
<b>David Lloyd and David Sandmeyer</b>	
In-Situ Amelioration of Sodic Mine Spoil Using Sulfur, Gypsum and Crop Management ...	11
<b>Jeff J. Sansom, M. Anne Naeth, and David S. Chanasyk</b>	
Bioremediation of Contaminated Sites .....	13
<b>Christopher Schneider</b>	
Contaminant Metal Concentration in Alberta Soils Under Different Land Uses .....	17
<b>Gerry Lutwick, Gordon D. Dinwoodie, David Gower and G. E. Nason</b>	
Waste Disposal Guidelines from a Testing Lab's Perspective .....	19
<b>John Ashworth</b>	
Reclamation of a Former Heavy Oil Plant in Northeastern Alberta .....	23
<b>Tim R. Bossenberry, J. Jeffrey Wilson, David Evans, Darrell Chollak and George Walker</b>	
Nutrient and Metal Levels and Dynamics on a 30-year Revegetated Copper-Nickel Tailings Site at Copper Cliff, Ontario .....	27
<b>Jeremy Niemi, John Giffen and Keith Winterhalder</b>	
<b>FORESTS</b>	
Land Application of BCTMP Mill Waste Research in Alberta .....	31
<b>Terry M. Macyk</b>	
Reclamation to Native Forest Ecosystems in the Oil Sand Region .....	33
<b>Steve Tuttle</b>	
Land Capability Classification for Forest Ecosystems .....	37
<b>Leonard A. Leskiw, Steve Tuttle and Earle Anderson</b>	
Forest Land Restoration on Vancouver Island .....	39
<b>David Polster</b>	

Lichen Diversity in the Reclaimed Areas of Sudbury, Ontario .....	43
<b>S. Wainio and Peter Beckett</b>	

## **MOUNTAINS**

Application of Population Biology, Conservation Biology and Succession Theory to the Reclamation of a High Elevation Coal Mine .....	47
<b>Clint R. Smyth</b>	

Plant Community Changes in Response to Anchor Chaining and Seeding on Pinyon/Juniper Sites in Central Utah .....	51
<b>J. Gregory Sutor</b>	

Tailings Disposal and Reclamation at the Coal Valley Mine .....	53
<b>Dane McCoy</b>	

In-Pit Disposal Program for Acid Generating Waste Rock .....	57
<b>Jamie Quesnel and S. W. Stogran</b>	

Reclamation, Trans Canada Highway Twinning, Banff National Park .....	63
<b>Otto Hammer</b>	

## **GENERAL ISSUES**

Railway Reclamation: Issues and Opportunities .....	67
<b>Chris B. Powter and David A. Lloyd</b>	

Experiences in Reclaiming Railways Under Alberta's new Reclamation Guidelines .....	71
<b>Mark Polet</b>	

Pipeline Abandonment: A Discussion Paper .....	73
<b>Karen Etherington</b>	

Legal Perspectives on Land Reclamation .....	75
<b>Gilbert Van Nes</b>	

Liability for Reclamation: Enforcement at Common Law .....	77
<b>Adrian Currie</b>	

## **WATER AND WETLANDS**

Coursier Reservoir: The Planning and Costs Associated with the Reconstruction and Revegetation of a Subalpine Lake .....	81
<b>J. Leah Jackson</b>	

Spray Lakes Reclamation Project .....	85
<b>Margwyn R. Zaccaruk</b>	

The Pine Coulee Project: Linking Reclamation Planning to Impact Assessment .....	89
<b>Ron Middleton</b>	
Design and Construction Management Aspects of Constructed Wetlands .....	93
<b>Bernard Amell and Kim Eastlick</b>	
Natural Revegetation of an Alberta Peatland after Horticultural Peat Extraction .....	97
<b>Wayne S. Tedder and Larry W. Turchenek</b>	
<b>RUNOFF/EROSION</b>	
Computer Modelling of Soil Erosion from Reclaimed Land .....	101
<b>Les Sawatsky, Wes Dick and Senarath Ekanayake</b>	
Runoff and Sediment Yield under Grazing in Foothills Fescue Grassland of Alberta .....	103
<b>M. Anne Naeth and David S. Chanasyk</b>	
Runoff Curve Numbers for Two Reclaimed Watersheds in Central Alberta .....	107
<b>Ted E. Harms and David S. Chanasyk</b>	
Vegetation Characteristics, Grazing Disturbance and Soil Erosion .....	111
<b>Suzanne I. Gill, M. Anne Naeth, David S. Chanasyk and V. S. Baron</b>	
<b>PRAIRIE</b>	
Renewing the Ecological Integrity of Disturbed Native Prairie .....	113
<b>Heather S. Gerling</b>	
Mixed Grass Prairie habitat Restoration Project: Landscape Restoration in the Moist Mixed Grass Prairie .....	117
<b>Dean Nerberg</b>	
Native Prairie Regeneration After Pipeline Construction: A Comparison Between Topsoil Stripping versus No Topsoil Stripping During Construction .....	119
<b>Gordon Dunn and Gina Fryer</b>	
Restoration of Native Sandhills Vegetation after Pipeline Construction in the Great Sand Hills Region of Saskatchewan .....	123
<b>David G. Walker, Laurier Kremer and Wayne Marshall</b>	
The Effects of Grazing, Mowing, Glyphosate and Burning on Smooth Brome in Fescue Grassland .....	125
<b>D. J. Brown and M. Anne Naeth</b>	
<b>VEGETATION</b>	
Avoiding Downy Brome When Buying Seed .....	127
<b>Kerby Lowen and Sarah Foster-Stubbs</b>	

Biodiversity and Reclamation: How Many Species do we Need in a Seed Mix? . . . . .	131
<b>Dana Bush and M. Anne Naeth</b>	
Germination and Survivability of Selected Native and Introduced Grasses and Legumes . . . . .	133
<b>William E. Pelech and M. Anne Naeth</b>	
Road Maps for Repairing Ecological Damage . . . . .	135
<b>Andy Hammermeister</b>	
Ecovar Developments in Western Canada . . . . .	137
<b>Les Wetter and Brent Wark</b>	
Plant Growth on Aggregated Oil Sands Processing Wastes . . . . .	139
<b>Xiaomei Li, Jim Storey, Paul Y. P. Yeung and Martin Y. P. Fung</b>	
The Clover Bar Landfill: A State of the Art Landfill Reclamation Process . . . . .	141
<b>Ann Smreciu, Nolan Turner and Don Barron</b>	
<b>BULK DENSITY</b>	
A Method of Characterizing the Bulk Density of Compressible Particulate Material . . . . .	145
<b>D. Guenther, Stacy Schaub and J. Leonard</b>	
Near-Surface Compaction Under Grazing of Annual and Perennial Forages . . . . .	149
<b>Dennis Twerdoff, David S. Chanasyk, M. Anne Naeth and V. S. Baron</b>	
Grazing Impacts on Bulk Density and Soil Strength in the Foothills Fescue Grasslands of Alberta, Canada . . . . .	151
<b>David S. Chanasyk and M. Anne Naeth</b>	
Computer Modelling of Soil Erosion from Reclaimed Land . . . . .	155
<b>Les Sawatsky, Wes Dick and Senarath Ekanayake</b>	

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