



Drilling Waste on Native Prairie – a Critical Review

by Cheryl Bradley

Alberta Native Plant Council members interested in minimizing the effects of the oil and gas industry on native prairie will be interested in a report entitled *Landspraying While Drilling (LWD) Review* prepared by a team within Alberta Sustainable Resource Development (ASRD). Although written in December 2003, the report was not publicly released until summer 2006. This is probably because the results of the review of landspraying while drilling reflect badly not only on industry’s operations but also on government’s ability to effectively monitor and enforce compliance.

Landspraying while drilling (LWD) is the practice of disposing of waste drilling fluids by spraying them onto land using vacuum trucks. LWD began in the 1990s on cultivated land as a way of avoiding the need to construct sumps for drilling waste disposal or haul to a disposal facility. It began as a practice on public land grasslands in 1998 after a two-year field study (by Pedocan) and a further two-year trial period led to the conclusion that at appropriate application rates there were not significant effects on rangeland function and soil quality. Conditions were applied to the practice on public land. LWD was widely used by Encana in CFB Suffield; but was not allowed by the Special Areas Board.

In 2001, provincial public land managers noted increased vegetation stress from drought conditions - conditions which appeared to aggravate potential impacts of LWD. The practice was suspended on public rangelands. In CFB Suffield the practice was allowed to continue on industry pipelines and trails. A government review of LWD was initiated in 2003 when oil and gas companies requested a lifting of the moratorium.

The review included examination of hundreds of LWD case files and field inspection records, a field audit of LWD sites at CFB Suffield, a review of LWD alternatives, and feedback from land managers in ASRD, Special Areas Board, Eastern Irrigation District and CFB Suffield. The review of files and records revealed a number of major issues including LWD outside of approved areas, no final field report, field plans of poor quality, heavy loading rates and siting problems. The survey of sites within CFB Suffield revealed poor distribution of LWD residual solids



Tracks left from spraying drilling waste on native prairie in CFB Suffield
photo: Lorne Fitch

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resulting in skins and mudpacks which smothered grassland vegetation; rutting of soft soils; and LWD application on sensitive sites including sand dunes, watercourses, wetlands and steep slopes.

The study committee concluded that several key issues and operational deficiencies must be addressed before LWD can be resumed on native prairie on public rangelands. Seventeen recommendations are made regarding government administrative procedures, industry operations, environmental protection measures and research needs. Another controlled study, funded by industry, is currently underway in CFB Suffield to examine the effects of LWD on native range, however operational deficiencies remain unaddressed. Currently a moratorium on LWD remains in effect on provincial public lands although it can and does occur on private lands. ☞

Reference

LWD Review Team. December 2003. Landspraying While Drilling (LWD) Review. Alberta Sustainable Resource Development. (available at <http://issues.albertawilderness.ca/PL/archive/RP0312LWD.pdf>)

Invasive Species

SEA BUCKTHORN, *Hippophae rhamnoides*

by *Gustave J. Yaki. gyaki@calcna.ab.ca*

Sea buckthorn (*Hippophae rhamnoides*, family *Elaeagnaceae*) is a patchily distributed, showy shrub or small tree, native of Eurasia. It was first introduced into the Canadian Prairies by Dr. Skinner of Dropmore, Manitoba in the 1930s (Dharmananda 2007, Government of Manitoba 2006) and was initially used for shelterbelts. Because it tolerated coastal situations and saline soils, it was also planted along roadways that are salted during the winter months. Since then, it has been grown in urban areas for its ornamental fruit and foliage. Recently, however, federal and provincial agricultural departments are touting other alleged benefits. It is described as a “new crop opportunity” and “has momentous economic potential” (Li 1999). Presently, authorities presume that those markets will mostly be in Europe (Li 1999).

In its original environment, like native species everywhere, locals view it as a very highly regarded plant. It is especially treasured for its nutritious fruit, used for making excellent jams, jellies, syrups, pies

and liqueurs --- and a very refreshing, thirst-quenching drink. The juice of the fruit is high in protein and Vitamins C and F (Mann *et al.* 2001). Its strong acidic taste is reported as pineapple-like, leading to one of its alternate names of Siberian Pineapple. The berries are also valued for their purported pharmaceutical and medicinal uses. In all, it is stated that it contains 190 nutritional compounds. Some of these are incorporated into lotions and cosmetic products.

Sea buckthorn is armed with thorns, which makes hand harvesting of the berries both difficult and time consuming. In China, it requires about 1500 person hours per hectare (Mann *et al.* 2001, Todd 2006), thereby making harvesting a costly affair. It is anticipated that mechanical harvesters will be the answer. However, despite government developmental funds of \$360,325.00 to create such a machine, to date, no one has come up with satisfactory one. All present devices leave up to 75% of the fruit still attached, while also causing considerable damage to the plants (Mann *et al.* 2001).

The leaves, fresh or dried, have long been used as a tea (Todd 2006) and are also fed to livestock. It was noticed that when fed to horses, their coat developed a gloss, hence the scientific name *Hippophae*, which in classical Latin translates into ‘shiny horse’. Leaves can be successfully removed by machines that use brushes.

The roots are said to reach a depth of three metres (McLaughlin 2007) as is the case with other members of their family --- and about two dozen additional plant families, such as the Legume Family (*Fabaceae*), they harbour nitrogen-fixing bacteria. They are,



Sea Buckthorn in flower

photo: Lorna Allen

ANPC Small Grant Program

The ANPC Small Grant Program provides funds for research, study and appreciation of native plants to support plant conservation. An application form can be obtained from the ANPC web page, by e-mail, or by writing to ANPC (see page 8).



Sea Buckthorn

photo: Lorna Allen

therefore, considered beneficial because they enrich poor-quality soils (Dharmananda 2007, Small *et al.* 2002).

In the Calgary area, this species is well adapted to our climate and soils, so it grows readily when in a well watered areas with full sun exposure. This dioecious species is wind-pollinated. The male plants may reach a height of 5 metres; the shorter females are usually up to 3 metres tall at maturity. The pistillate plants produce an abundance of small, showy, orange to yellow, oblong berries, each 4-6 mm in width, and 6-10 mm in length. In North America, the berries decorate the plants all winter. Because of those showy berries, this species has been promoted for landscape use to attract birds to your yard.

In fact, since sea buckthorn evolved in another land, our native birds seldom use it, except as a reserve emergency food. Early returning spring migrants, such as hungry flocks of Bohemian Waxwings, only feast on

them when all other wild foods are depleted. The birds then fly to nearby natural areas to drink, where the seeds are defecated, along with a supplementary packet of fertilizer. Seeds that have been through a bird's digestive tract are six times more likely to germinate (Small *et al.* 2002). Come spring, the seeds readily grow.

It has been noted as an escape in Calgary since the early 1970s (Pelzer, pers. comm., 2007). It was observed growing on an island in the Elbow River, west of the parking lot at the west end of Riverdale Avenue in the Southwest. It was also recorded in a biological inventory of Sandy Beach Park, published in 1980 as "Rare introduced species; occupies one large gravel bar just below the [Glenmore] dam" (Pinel 1980). In fact, there are now no less than ten

colonies known along the Elbow River, between the Glenmore Reservoir and the 4th Street Bridge, a distance of about five kilometres. Colonies are also established along the Bow River, upstream of Calgary. Undoubtedly, there are some colonies downstream, presently unknown to the writer.

Once a seed has germinated along a stream or seepage area, it sends up a stem to capture the sun's energy. It then quickly sends out horizontal rhizomes, which in turn, send up more stems, similar to trembling aspens. The original single trunk is quickly surrounded by a dense, impenetrable thicket of clonal stems ... soon covering an area of up to an acre or more. Nearby colonies may soon meet and grow together.

Because the species arrived here as seeds, it left behind all its natural biological controls --- its pathogens, parasites and predators. The dense colonies that form soon shade the ground, resulting in the total loss

of all native plant species below it. Since it also uses up most of the available moisture and nutrients, it also quickly displaces the nearby native shrubs and trees.

Riparian areas are usually the richest in biodiversity. Because sea buckthorn displaces the native vegetation, their co-evolved wildlife (insects, birds, mammals) soon disappears. As a result, sea buckthorn is destroying our native biodiversity. The resulting monoculture becomes a biological desert.



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A number of the colonies are on islands. Since the ground below this species is now bare, in flood conditions, much of the topsoil is washed downstream, silting the waterway and choking insect and fish habitat.

A colony about 0.20 hectares in size, growing at the West end of the Weaselhead Natural Area, has been annually cut and pulled by volunteers, since 2003. Because it grows along the Elbow River, the source of one-half of Calgary's drinking water, it cannot be controlled chemically. To date, remnant pieces of roots keep sending up new sprouts. How often will we have to visit and pull the new suckers to control this infestation? If one piece is overlooked and allowed to grow, it quickly rejuvenates the colony, requiring us to start all over again.

Agricultural authorities are blindly looking at only the potential profits of growing sea buckthorn in North America, as perceived in the 64,600 entries found in a search on the world wide web. None have considered the cost of controlling it after it escapes. That cost, in the long term, may be much greater than any perceived benefits to the economy. They must look at both the value of lost services provided by the displaced species as well as time and money required to control it. The further decline and loss of native species may trigger a domino effect that could have profound, adverse, long-term implications on the environment. Canada signed the Convention on Biological Diversity so all Canadian government agencies are required to honour it.

Because of the invasive nature of sea buckthorn, rather than promoting it, we should have legislation prohibiting its further planting. If grown agriculturally in Southern Alberta it will compete with existing crops for water and may require irrigation. With global warming, less water will likely be available. Rather than growing it here, it would seem wisest to allow Eurasians to grow it on their home turf.

Instead, federal and provincial agricultural departments should be investigating the benefits of growing our own native, closely related thorny buffaloberry (*Shepherdia argentea*). Being a member of the same family, it likely has all or many of the same attributes. It is already adapted to our climate, therefore would not require any extra water. Since the berries can be easily harvested after the first frost, there is no

need for an expensive mechanical harvester. It presently makes good jams and jellies. Research will likely find that it offers all the benefits of sea buckthorn without harming the environment. ☞

References

- Dharmananda, S. 2007. Institute for Traditional Medicines, Sea Buckthorn website. Available at: www.itmonline.org/arts/seabuckthorn.htm
- Government of Manitoba. 2006. Sea Buckthorn Production in Manitoba. Available at: <http://www.gov.mb.ca/agriculture/crops/fruits/blk01s00.html>
- Li, T.S.C. 1999. Sea Buckthorn: New Crop Opportunity. From: Janick, J. (ed.), *Perspectives on New Crops and New Uses*. ASHS Press, Alexandria, VA. P. 335-337. Available at: www.hort.purdue.edu/newcrop/proceedings1999/v4-335.html
- Mann, D.D., Petkau, D.S., Crowe, T.G. and W.R. Schroeder. 2001. Removal of sea buckthorn (*Hippophae rhamnoides* L.) berries by shaking. *Canadian Biosystems Engineering* 43:23-28.
- McLaughlin, S. 2007. Vista Online Health Magazine, Sea Buckthorn: The Unsung Herb. Available at: http://www.vistamagonline.com/articles/page.php?tp=1&p=1&id=2&s=seabuckthorn_the_unsung_herb
- Pelzer, M. Aileen, Volunteer for Calgary Field Naturalists Society. 2007. Personal communication discussing Sea Buckthorn in Calgary.
- Pinel, H.W. (ed). 1980. Calgary's Natural Areas, A Report Prepared by the Natural Areas Committee of the Calgary Field Naturalists' Society. Calgary, Alberta. Pp 513.
- Small, E., Catling, P.M. and T.S.C. Li. 2002. Sea Buckthorn (*Hippophae rhamnoides*) - an ancient crop with modern virtues. *Biodiversity* 3(2): 25-27.
- Todd, J. 2006. Introduction to Sea Buckthorn: Transition Crop Specialist. Ontario Ministry of Agriculture Food and Rural Affairs, Crops website. Available at: <http://www.omafra.gov.on.ca/english/crops/facts/seabuckthorn.htm>

ANPC Objectives

The Alberta Native Plant Council

strives to:

- Promote knowledge of Alberta's native plants.
- Conserve Alberta's native plant species and their habitats.
- Preserve plant species and habitat for the enjoyment of present and future generations.

specific objectives are to:

- Educate individuals, industry, and government about native plants.
- Promote awareness of native plant issues through a newsletter, an annual workshop, and in the media.
- Co-ordinate information and activities concerning Alberta's native plants.
 - ☞ To develop briefs or position papers for special projects; for example, biodiversity, forest vegetation management, wetlands, rare species or phenology.
 - ☞ To organize field trips, plant studies and May Species Counts.
 - ☞ To update lists of current research and conservation projects.
- Preserve natural habitats and plant communities.
 - ☞ To support legislation that protects native plants.
 - ☞ To take action to establish, preserve and manage protected areas.
 - ☞ To undertake Alberta projects jointly with like-minded groups.
- Encourage appropriate use of Alberta's native plants.
 - ☞ To produce information on the use of native plants in land reclamation.
 - ☞ To develop and distribute collection, salvage and management guidelines.
 - ☞ To update a list of native seed sources and suppliers for horticulture and reclamation.

Collapse of Astotin Seasons of Change

by Don E. Gordon

The first time they are touched by light they don't know how long a lifetime is. They belong in a world they don't understand but their purpose is destined to be one of the most important functions in life's metabolic relations. Their embryonic impulse is to open their budding scales and begin a life as a leaf – a leaf that excites the season with color and gives the forest a state of prominence and form. From the viscous fluid from which it was developed and enclosed, a bronzed leaf is born and from it comes the scent of birth that is the signature of the forest in spring. Nature's own organic oils - the essence of balsam and white poplar drift from the source – the spice of the boreal. Tender and already growing, they are brushed by afternoon breezes – new invisible sensations that temper the petioles and enliven the branches in wooded chorus. In his triumphant return, the vireo sings in



North gate of the Astotin Natural Area photo: Suzanne Benoit

the shadowed freshness of this spring morning where the vigor of chlorophyll transforms a restless forest. Melt water has softened the mudpack of a forest pond and warm amphibian nights release the winter bonds to a wood frog's vocal sac. Velvety mourning cloak butterflies probe the surfaces of leaf litter sucking up the amber juices that make up the tannin based supplement. Soon the blossoms of celebration will send forth parcels for life scattered by the wind to new destinations far from the original sprout and root. These parcels for life tell a story of a complex journey from flowing sap to a petal swaying in the breeze, from pollination to maturity.

Now the winds of summer have diluted the fragrance of spring until the scent of birth has been lost and frozen somewhere in the molecules of space, just an organic memory of another season gone by. Summer unfolds with generosity; it is not in a stingy mood. It comes with bouquets of northern roses and freckled wood lilies. A breath is filled with heavy pungency as you wade through feathery ostrich fronds in your search for the mourning warbler. A passage through white spruce is a framework to another view where

sunlight has stimulated a patch of northern star flowers, where muskeg tea whitens the moss hummocks. In the mixed woods of the boreal forest, the sarsaparilla spreads its low canopy in olive-green foliage. They are part of the summer infusion – the tonics that are centuries old, a family of therapeutics, the remedies decocted into medicinal flavor, bathing tissues into comfort. Here in the boreal – the forest door is open this early hour to praise; a bird awakens first to sing and then a brood to raise. But as we preserve the remembrance of summer, our steady earth takes its course and path to change.

The first time it is touched by human hands a forest doesn't know how long a lifetime is. Fortunately for us, some forests are not suitable for clearing – by human standards they contain poor soils and the wetland terrain is difficult to farm. For the most part, so it is with the Astotin, a track of land undisturbed and located just a few miles northeast of Fort Saskatchewan amid the growth of new upgraders in the Industrial Heartland of Alberta. It is one of the last stands of boreal forest in touch with a densely populated area; an ecosystem of primordial wealth that was sought after to protect by concerned citizens of the Fort Saskatchewan area – stewards who foresaw its need twenty years ago to successfully have it granted.

The Astotin has shown its restorative capacity to heal itself and develop throughout the centuries; like seasons of



Leather grape fern, before transplant

photo: Suzanne Benoit

change affecting its symbiotic communities, it has survived into the twenty-first. Today, Astotin is on the verge of losing that distinction, not by natural causes, but through economic forces and a government that will not stand by a commitment to protect a natural area once designated. Specific natural areas are protected because in their special way they form a bond to a society, and in the case of Astotin, it is a link to an old growth heritage in responsible management. A bond to a society is strengthened over time; a protected area in its infancy, Astotin will be appreciated to a greater extent in the future placing more emphasis to its longevity and to the foresight in management today. Astotin is relevant to Fort Saskatchewan by its role of association to its populace. One of the goals specified under Protected Areas in Alberta states that these places are granted in perpetuity; it is with hope that the Province of Alberta and the Minister will honour that vision. Protected Areas in this province are for all Albertans and is therefore a concern to a vast population that has an interest in their preservation. Those who would share that vision would be urged to contact their MLA to prevent the collapse of Astotin. As it now stands, Astotin is looked upon to be declassified from a protected area to a region of development. ☞

Editorial Comment

In keeping with using natural areas to help preserve biodiversity when industrial development impinges on rare native plant species, the Astotin natural area was used for just this purpose in 2005. In response to nearby development, Astotin was selected to receive a rare grape fern and three rare lichens due to its diversity of habitat and because the area had a natural area notation registered on the public land standing report. I had the honour to work with the Fort Saskatchewan Naturalist Society to transplant these species and have enjoyed getting updates on the SUCCESS of these transplants. It was disappointing to learn recently that this haven was slated for development, thereby negating all efforts to maintain these transplanted rare species. I urge everyone to contact their MLA to make them aware of the desire to maintain areas that have acknowledged natural area (or similar) status. ☞

Cardamine dentata Recently Discovered in Alberta

by Graham C.D. Griffiths
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Text excerpt from Botanical Electronic News No. 369 January 3, 2007 with Photos from various sources.

Plant surveys in Alberta have resulted in an addition to the Alberta list of vascular plants. In the present article I discuss a new *Cardamine* species that I have personally collected in surveys near Conklin during 2005 and 2006.

Cardamine dentata Schult.

The ranks of taxa constituting the *Cardamine pratensis* complex are interpreted differently in different publications. North American authors have generally treated the whole complex as a single species, within which subspecies or varieties are recognized. But in recent special European literature (e.g., Marhold et al. 2004), the complex is divided into 11 species. It is my understanding that the Flora of North America treatment now being

written by Karol Marhold and collaborators will apply the nomenclature used in recent European special studies to North American material.

The basic subdivision of this complex derives from the monograph by Lovkvist (1956). He divided the material he studied into two main groups, between which he did not succeed in obtaining hybrids in crossing trials: the "Temperate Group" [including *Cardamine pratensis sensu stricto*, *C. palustris* (= *paludosa*), *C. matthioli*, *C. granulosa* and *C. rivularis*] and the "Arctic Group" containing the single species *C. nymanii* (within which he included North American material of var. *angustifolia*). He also recognized a third "Repent Rhizome Group" containing the Pyrenean *C. crassifolia* and the Siberian *C. prorepens*, but was unable to obtain living material of this group for experimentation. The "Repent Rhizome Group" does not occur in North America.

As far as I am aware, all collections of the *Cardamine pratensis* complex in Alberta prior to 2005 belong to the plant to be called *C. nymanii* Gandoger in the Flora of North



Suzanne Benoit and Laurie Hamilton getting ready to transplant

photo: Suzanne Benoit



Cardamine nymanii

photo: Patrick Kyle

America [= *C. pratensis* L. var. *angustifolia* Hook.]. I have seen this plant in the field east of Fort MacKay and in Elk Island National Park, also a herbarium specimen from northwest of Athabasca in the University of Athabasca Herbarium. The plants flower from the end of May through June. The leaflets are thick with embedded veins; on basal leaves the terminal leaflet is not much larger than the lateral leaflets; leaflets on the upper stem leaves are narrowly wedge-shaped, not borne on petiolules. In Alberta populations, the plants flower profusely; but an increased reliance on vegetative reproduction is reported towards the northern range limits of this taxon in the Arctic. The entries for *Cardamine pratensis* in the current Tracking List for rare vascular plants in Alberta (Gould 2006) and for the "*Carex limosa* *Menyanthes trifoliata* *Cardamine pratensis* community" in the Preliminary Ecological Community Tracking List (Allen 2006) both

refer to this taxon. The occurrence of a second member of the *Cardamine pratensis* complex in northeastern Alberta first came to light in 2005. Only nonflowering plants were found during that season, on which account identification proved problematical.

I sent photographs by e-mail to numerous botanists, and eventually received a firm identification of *C. pratensis* L. ssp. *paludosa* (Knaf) Celak. from Thomas Karlsson of the Swedish Natural History Museum. An equivalent identification (as *C. pratensis* var. *palustris*) was also suggested by Canadian botanist Paul Catling. This same taxon (when ranked as a full species) is known as *C. dentata* Schult. in recent European special literature (e.g., Marhold et al. 2004), and I understand that this name will be used in the Flora of North America. Confirmation that this identification is correct

was obtained in 2006, when the first flowering stem was found. This well shows the diagnostic feature used in published keys (e.g., *Flora Europaea* 1: 287), that the leaflets of all leaves (including upper stem leaves) are stalked (borne on petiolules).

So far *Cardamine dentata* is known from seven localities, six situated northwest of Conklin and one east of Conklin. The habitats are in most cases rich shrubby mossy fens (prominent shrubs including *Betula*

pumila var. *glandulifera*, *Larix laricina* saplings and diverse *Salix* spp.); in one case a flooded sedge fen (dominated by *Carex aquatilis*). Most plants grow as emergents in water-filled depressions, with only the tips of their basal leaves rising above water level. In Alberta populations the plants reproduce mainly by means of "adventitious shoots" arising from their leaflet blades; flowering stems are very rarely produced. The leaflets are relatively thin (veins not embedded); on basal leaves the terminal leaflet is often much larger than the lateral leaflets; leaflets on all leaves (including those on flowering stems, if present) are borne on petiolules. My observations of plants grown indoors indicate that leaflets bearing adventitious shoots may fall off and give rise to separate new plants; or, if the leaf is prostrate, the new plant may remain attached to the parent plant. In the latter case plants may appear to be connected by stolons, but the apparent stolons originated as the petioles and rhachises of basal leaves. True stolons (horizontal stems producing new plants) are not known in any North American members of the *Cardamine pratensis* complex. ☞



Adventitious buds on fallen leaflets of *C. dentata*

photo: Linda Kershaw



Flowering stem of *Cardamine dentata*
photo: Paulina Brudnicki, courtesy of the North American Oil Sands Corporation

Key

The following key couplet is intended to distinguish the two members of the *Cardamine pratensis* complex now known in Alberta:

1a. Leaflets thick, with embedded veins; terminal leaflet of basal leaves normally not much larger than lateral leaflets; leaflets on upper stem leaves narrowly wedge-shaped, not borne on petiolules (petiolules evident at most on basal and lower stem leaves). Alberta populations flowering readily

C. nymanii Gandoner [= *C. pratensis* L. var. *angustifolia* Hook.]

1b. Leaflets thinner (veins not embedded); terminal leaflet of basal leaves often much larger than lateral leaflets; all leaflets borne on petiolules (including those on upper stem leaves). Alberta populations reproducing mainly by adventitious shoots arising from leaflets, rarely flowering.....

C. dentata Schult. [= *C. pratensis* L. ssp. *paludosa* (Knaf) Celak.].

References

Allen, L. 2006. Alberta Natural Heritage Information Centre Preliminary Ecological Community Tracking List. Alberta Community Development, Edmonton. 116 p.

Gould, J. 2006. Alberta Natural Heritage Information Centre Tracking and Watch Lists - Vascular Plants, Mosses, Liverworts and Hornworts. Alberta Community Development, Edmonton. 25 p.

Lovkvist, B. 1956. The *Cardamine pratensis* complex. Outlines of its cytogenetics and taxonomy. Symbolae Botanicae Upsalienses XIV, no. 2. 131 + xvi p.

Marhold, K., J. Lihova, M. Pern, & W. Bleeker. 2004. Comparative ITS and AFLP analysis of diploid *Cardamine* (Brassicaceae) taxa from closely related polyploid complexes. *Annals of Botany* 93: 507-520.

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