Control of Invasive Plants on Crown Land in British Columbia

FPB/SR/30

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Glossary of Terms

Alien plant: Plant species that have established outside their natural distribution.

Biodiversity (Biological diversity): The diversity of plants, animals, and other living organisms in all their forms and levels of organization, including genes, species, ecosystems, and the evolutionary and functional processes that link them.

Biogeoclimatic zone: A geographic area having similar patterns of energy flow, vegetation, and soil as a result of a broad, regional climate.

Biological control: The use of living organisms, such as predators, parasitoids, and pathogens, to control invasive plants.

Chemical control: The application of herbicides to control or eradicate plant species.

Climate: The average weather conditions of a place over many years.

Crown land: Land that is owned by the government of Canada or British Columbia.

Cultural control: An invasive plant management practice that manipulates plant populations by cultivation, pulling, cutting, or other hand-applied techniques.

Dispersal: The scattering of plant seeds or movement of an animal to a new habitat.

Ecosystem: Organisms together with their physical environment, forming an interacting system, inhabiting an identifiable space.

Endangered species: Any indigenous species, or sub-species, threatened with imminent extinction throughout all, or most of its range.

Environment: The sum of all external conditions that affect an organism or community and influence its development or existence.

Eradication: Elimination of every individual plant of an invasive plant population, including all viable seeds, and vegetative propagules.

Habitat: The natural dwelling of a plant or animal, including all biotic, climatic, and edaphic factors affecting life.

Herbicide: A chemical that kills or regulates growth of plant species or groups of species.

Invasion: The arrival of an organism in an area where it was not formerly represented.

Landscape: The fundamental characteristics of a specific geographic area, including its biological composition and physical environment.

Mechanical control: Control of invasive plants by physical and mechanical means such as plowing, tilling, chain sawing, and weed whacking.

Native plant: Plant species that are part of the original flora of an area.

Non-native: A species that is not native to the region in which it is found.

Noxious weed: Any plant species so designated by the *Weed Control Act*.

Prevention: All activities that interrupt the dispersal of new invasive plant species into a geographic area or specific location where they were not previously found.

Risk: The probability that an adverse effect (injury, disease, or death) will occur under exposure to a specific agent.

Species at risk: A species that is extirpated, endangered, threatened, or of special concern.

Weed: 1) A plant growing where it is not wanted; 2) A plant that interferes with management objectives for a given area of land at a given point in time.

Executive Summary

Management of invasive plants in British Columbia is a complex task involving a range of jurisdictions, legislation, policies, and guidelines. This report examines the current status of invasive plant management in BC, concentrating primarily on the role of range and forest tenure holders under the *Forest and Range Practice Act* (FRPA).

Invasive plants are species that are non-native to a respective ecosystem under consideration and whose introduction causes, or is likely to cause, economic or environmental harm, or harm to human health. Uncontrolled, these species can invade new environments and alter the structure and function of natural ecosystems. In 1995, an estimated 100,000 hectares of grassland and open forest were infested with a variety of invasive plant species, including knapweed, and at least another 10 million hectares of Crown land were susceptible to invasion.[1]

The *Invasive Plant Regulation* under FRPA provides a list of species that forest and range tenure holders are responsible for, however it provides no direction on priorities among species. The list also overlaps, but is not consistent with, the *Weed Control Act.*

No comprehensive survey has been conducted to determine the area and distribution of invasive plants in BC. Currently, range and forest licensees have no obligation to carry out invasive plant inventories. The Ministry of Forests and Range (MOFR) has taken the lead role in conducting invasive plant inventories, but this effort is focused on a variable set of selected species from the FRPA *Invasive Plant Regulation*.

The linkage between FRPA, the *Weed Control Act* and the *Integrated Pest Management Act* needs to be clarified so that government agency, licensee, and private landowner responsibilities are clearly understood by all parties. A core policy, or legislation, that integrates invasive plant responsibility among acts could assist in providing this clarity.

MOFR continues to plan and conduct weed control programs on Crown land but other players are now involved such as the Ministry of Environment (protected areas), local weed committees, industry and the pilot projects. So far, there has been little coordination among the various players.

Forest and range licensees have no responsibility for controlling existing invasive plants on Crown land. Under FRPA, forest and range licensees must specify measures in an operational plan to prevent the introduction or spread of invasive plants only if likely to result from their forest or range practices. No criteria, standards, and few guidelines are available to the licensees. As a result, most forest stewardship plans, range stewardship plans and range use plans examined to date describe only cursory measures to prevent the introduction and spread of invasive plants. In addition, FRPA does not promote coordination between forest and range licensees regarding management of invasive plants on Crown land. Coordination is limited to voluntary cooperation.

Program reorganization, combined with unclear requirements and guidance has resulted in the combined level of chemical and biological treatment for invasive plant control declining significantly since 2002. Much more effort needs to be directed to on-the-ground delivery of appropriate treatments. However, most tenure holders interviewed expect to do little on-the-ground control of invasive plants over the next five years because they lack the staff and expertise to deliver programs.

Compliance and enforcement (C&E) relating to invasive plants is through the *Weed Control Act* and FRPA. Presently, there is no connection between FRPA and the *Weed Control Act* for C&E, and C&E officers have no authority to serve weed notices under the *Weed Control Act*.

Board Commentary

Invasive plants are literally set to grow in BC in the coming years. Climate change, massive harvesting and replanting of areas devastated by the mountain pine beetle—including possible conversion to agricultural lands—continued oil and gas exploration and development; all of these activities will likely contribute to the further spread of invasive plant species in BC.

While this special report was initially conceived to look at how invasive plants are being managed by licensees under FRPA, it has revealed a much larger issue involving limited overall provincial coordination of legislation, roles and responsibilities, and on-the-ground delivery of treatments for dealing with invasive plants.

The Board recognizes that some progress is being made, but to date the issue has been tackled primarily through voluntary and cooperative discussions among many layers of committees and working groups. That is an important precursor to effective control and management of invasive plants, but so far has shown only limited results on the ground. Much more needs to be done for effective control of both existing infestations, and spread of invasive plants in BC.

Recommendations

To improve the effectiveness of invasive plant management under FRPA and MOFR's Invasive Plant Program, the Board makes the following recommendations:

1. The Inter-Ministry Invasive Plant Committee should review and consolidate the invasive plant and weed lists and consolidate them into a single list for the province.

2. MOFR should identify which invasive plants will be managed as priorities at the district level, so that treatments can be applied in a coordinated fashion. In addition, MOFR inventories should include all species listed in the FRPA *Invasive Plant Regulation* so that licensees are aware of their presence when they are preparing operational plans.

3. The linkage among FRPA, the *Weed Control Act*, and the *Integrated Pest Management Act* needs to be clarified so that government agency, licensee, and private landowner responsibilities are clearly understand by all parties. Government should develop policy or legislation that integrates invasive plant responsibility among acts to provide this clarity.

4. MOFR should develop training courses for licensees to increase skills in plant identification, control measures and the use of the Invasive Alien Plant Database.

5. MOFR should give consideration to amending section 26 of FRPA to include invasive plants. This would enable government to require strategies to address invasive plants in appropriate areas on both Crown and private land.

The Board requests that the provincial government respond to these recommendations by March 31, 2007.

Introduction and Objectives

Invasive plants are species that are non-native to a respective ecosystem and whose introduction causes, or is likely to cause, economic or environmental harm, or harm to human health.[2] Uncontrolled, these species can invade new environments, and alter the structure and function of natural ecosystems. Control of invasive plants in BC, however, is a complex issue involving many land jurisdictions, and a wide range of legislation, government policies, and guidelines.

Invasive plants are also called alien plants, weeds, and noxious weeds. See the glossary on page iii for definitions of these and other technical terms in the report.

Over the last decade, there has been a growing awareness that effective invasive plant control can only be accomplished though a coordinated program involving all jurisdictions where invasive plants grow. Numerous initiatives have emerged during the last five years that have influenced the direction and flow of the provincial program including the:

- restructuring of the Ministry of Forests and Range's (MOFR) Invasive Plant Program;
- formation of the Invasive Plant Council and development of an Invasive Plant Strategy for BC;
- creation of the Inter-Ministry Invasive Plant Committee; and
- introduction of the *Forest and Range Practices Act* (FRPA).

Despite these initiatives, numerous impediments are limiting the on-the-ground implementation of an effective invasive plant control program. This report examines the current status of invasive plant management in BC, concentrating primarily on the forest and range industries regulated under FRPA.

This investigation was conducted by interviewing staff in the Ministries of Agriculture and Lands, Forests and Range, Environment; and representatives from regional districts, forest and livestock industries, and local weed committees. (See Appendix 1 for a list of organizations interviewed). Additional information was obtained by reviewing relevant legislation, district policies, forest development plans, range use plans, and draft forest and range stewardship plans.

Background

Invasive Plant Biology and Threats

Plant invasion is a complex process that includes plant characteristics, the physical and biological nature of ecosystems, and climate. Alien plants can be introduced and spread in many ways including wind, water, vehicles, boats, pets, wildlife, livestock, and humans. Seeds that pass through domestic animals and wildlife can remain viable and able to establish in new locations. Roads, railroad right-of-ways, trails, and utility corridors are often primary dispersal routes. Although some alien species are well adapted to a wide range of habitats, they usually succeed best within the climatic variation of their native range first.[3]

Generally, only about one percent of introduced species that establish in new environments become pests.[4] Nonetheless, those that are invasive pose a formidable threat to biological diversity, rare and endangered species, and ecological processes in natural ecosystems. Several species of invasive plants are destructive, widespread, and persistent in various parts of BC, although their invasive potential varies from one ecological and geographic location to another (see Table 1).

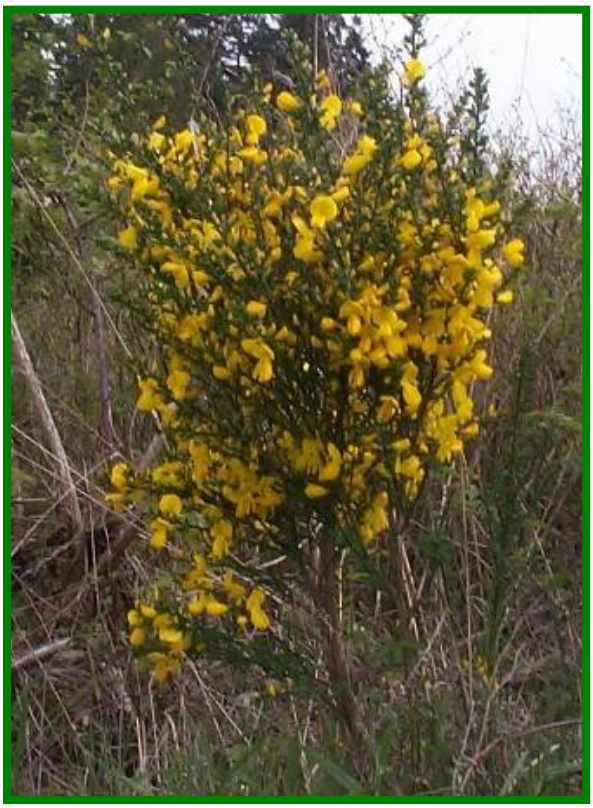
Table 1: Examples of Invasive Plant Species by Geographic Area in BC*

Invasive Plant Species**	Southern Interior	Northern Interior Northeast	Coastal
Canada Thistle		X	X
Common Hound's-tongue	X	X	
Common Tansy		X	X
Dalmatian Toadflax	X		X
Giant Knotweed			X
Gorse		X	X
Japanese Knotweed			X
Leafy Spurge	X	X	
Marsh Thistle	X	X	
Orange Hawkweed	X	X	X
Plumeless Thistle		X	
Purple Loosestrife			X
Rush Skeletonweed	X		
Scotch Broom	X		X
Spotted Knapweed	X	X	
Sulphur Cinquefoil	X		

* Derived from tables provided in the Invasive Alien Plant Reference Guide, based on Category 1 invasive plants.

** See Appendix 2 for scientific names of species.

No province-wide survey has been conducted to document the area and distribution of invasive plants in BC. Some species, such as marsh thistle, orange hawkweed and rush skeletonweed are likely expanding their distribution over large geographic areas, while scotch broom, puncture vine, and gorse appear to be confined to smaller geographic areas with local expansions. Still other species such as common hound's-tongue, Dalmatian toadflax, and spotted knapweed, may be dispersing and declining simultaneously as new infestations establish, and other populations decline as a result of local success in biological or chemical control.



Scotch Broom

Although invasive plants have been present in BC for more than a century, only in the last 30 years have populations increased sufficiently to generate interest in controlling them on Crown land. A weed survey in 1952 revealed that diffuse and spotted knapweed occupied about 200 hectares in the Thompson-Nicola area, and smaller infestations also occurred throughout the Okanagan, Kettle, and Columbia Valleys. By the mid-1980s, these species covered over 80,000 hectares and approximately 1.4 million hectares of grassland and open forest were considered susceptible to invasion.[5] In 1995, an estimated 100,000 hectares of grassland and open forest were infested with a variety of invasive plant species, including knapweed, and at least another 10 million hectares of Crown land were susceptible to invasion.[6]

Most invasive species adapt best to hot, dry conditions and are mostly shade intolerant. Therefore, grasslands and open forest communities are at greater risk of invasion than undisturbed forests with a closed canopy. Species adapted to coastal and northern conditions are usually most successful in moister, milder conditions, and their distribution often coincides with open Garry Oak habitats or disturbance regimes that create openings in forest canopies.

Disturbance is a primary factor favoring plant invasions. Large-scale natural disturbances, such as fires, floods, and storms disturb soils or create temporary openings in forest ecosystems where invasive plants can persist as dominant species for long periods of time. Forest harvesting, road construction, livestock and wildlife grazing, and global warming create conditions that foster the advance of invasive plants into new areas. Smaller disturbances such as gopher mounds, insect holes, and bird dusting areas can also provide temporary sites for invasive plants to establish before they spread further.

The mountain pine beetle infestation and increased petroleum exploration and development are two significant events that may have an important bearing on the distribution and area covered

by invasive plants in BC. The mountain pine beetle has already affected over seven million hectares of pine forest and has the potential to double its area of impact in the future.[7] Salvage operations in mountain pine beetle stands will open forest canopies, cause soil disturbance, and remove natural barriers that will affect livestock distribution on Crown land.[8] To add to this threat, the Canada-BC Implementation Strategy for mountain pine beetle[9] currently proposes tripling animal unit months for forage within the affected area, which will result in further disturbance to the landscape. The BC government's recent *Mountain Pine Beetle Action Plan for 2006-2011* commits to controlling invasive plant species to maintain and protect range resources from impacts of salvage harvesting, but it remains to be seen how this will translate to action on the ground.[10]

Oil and gas reserves in the northeast sector of BC have stimulated considerable economic activity in the region, with more than 1,275 wells drilled in 2004, and similar activity forecast for the future.[11] In addition to drilling, oil and gas industry activities will result in extensive road building, pipeline construction, and development of other infrastructure to service the industry. Between 20,000 to 30,000 kilometres of annual new road construction is expected over the next decade to service the oil, gas, and mining sectors, and to salvage trees killed by mountain pine beetle.[12]

Dalmatian Toadflax

Oxeye Daisy

Much of the area affected by mountain pine beetle already contains invasive plants, especially the area south of Williams Lake in the southern interior, whereas northeastern BC is less infested. Nonetheless, all activities that create disturbance and promote access will predispose sites to the introduction and spread of invasive plants. In the southern part of the province, species such as spotted knapweed, Dalmatian toadflax, sulphur cinquefoil, and hoary alyssum could colonize pine-harvested areas rapidly if seeds are introduced. In the northeast, Canada thistle, oxeye daisy, bull thistle, orange hawkweed, and other hawkweed species are likely the most immediate threats.

Ecological Threats

Invasive plants have many adaptations and characteristics that enable them to invade and form persistent populations in new environments (see Table 2). In addition, most species are introduced without the parasites and other organisms that limit their populations in native habitats.

Table 2: Characteristics of Invasive Plants

- Germinate in many environments.
- Continuous seed production.
- High seed production and long viability.
- Reproduce both sexually and vegetatively.
- Self-fertilize.
- Cross-pollinate easily by a variety of vectors.
- Adapted for short- and long-distance dispersal.
- Rapid growth.
- Vigorous vegetative reproduction from fragments.
- Resistant to being broken from ground.
- Compete with other plant species by special means such as rosettes, rapid growth, or chemical properties.

Some possible effects of invasive plants on individual plants and animals, native plant communities, and ecological processes include:

- Displacement of native plant species and loss of biological diversity.
- Domination of disturbed habitats for prolonged periods of time, which impedes ecological restoration of native plant communities.
- Changes in habitat structure for large and small mammals, reptiles, amphibians, insects, and possibly soil organisms.
- Reductions in forage production for wildlife and domestic livestock.
- Alterations of natural fire regimes.
- Modifications of ecological processes such as nitrogen, hydrological, and nutrient cycles.

The specific effects of invasive plants on biodiversity, or on populations of individual plants and animals in BC, have not been studied and are largely unknown. Nonetheless, most people interviewed regarded invasive plants as a threat to biodiversity, and as a significant factor adversely affecting forage values for domestic livestock and wildlife. Long-standing dense populations of invasive plants in BC are well known in the East and West Kootenays, Boundary, Okanagan, Thompson, and on Vancouver Island. At a minimum, these populations significantly constrain restoration of natural ecosystems and limit forage production for domestic and native ungulates in those parts of the province where invasive plants encroach onto rangelands and wildlife habitat.

Economic Threats

Although some estimates have been made of economic losses that result from invasive plants, few comprehensive studies have been conducted that evaluate their economic impacts.[13] Predictions from Oregon report that tansy ragwort infestations have caused losses of $US 6 million annually, while knapweeds in Montana, North Dakota, and South Dakota are projected to cost $US 42 million in annual losses to the state economies.[14]

Most economic analyses of weed control have been conducted in agricultural systems where the costs and benefits are most easily measured, and where competition between weeds and crops results in added costs of production and/or lower crop yields.[15] In natural ecosystems, however, costs and benefits are more difficult to quantify, especially for ecological values such as rare, threatened or endangered species, habitats at risk, and forage values for wildlife.[16] Consequently, numerous assumptions are made to compensate for actual data, and usually results are limited to specific geographic areas or the ecological conditions under which the analyses are made.

In the absence of comprehensive economic analysis, decisions regarding invasive plant control are usually based on assessments of the potential risk of not controlling these species compared to the benefits of immediate control. Generally, the benefits of control are considered as the reverse of the potential threats; namely, that natural ecosystem processes remain intact; rare, threatened or endangered species are protected; forage values on Crown land are not diminished; and, opportunities for sustainable resource management are not adversely affected.

In BC, the damage attributed to invasive plants on Crown land has not been quantified, but is probably greater than generally recognized. Estimates for agricultural losses from invasive plants on crop and rangelands in BC may exceed $50 million annually, not factoring in the costs of weed control.[17] Although the extent of damage caused by invasive species is only beginning to be appreciated, many economists and policy makers accept that these species can cause serious economic losses.

Spotted Knapweed

Legislation

Although numerous acts, regulations, policies and guidelines provide authority and direction for the control of invasive plants in BC,[18] the *Weed Control Act, Integrated Pest Management Act*, and FRPA are the most important pieces of legislation governing invasive plant activities on Crown land (see Table 3 for selected other relevant legislation).

Table 3: Selected Legislation Governing Control of Invasive Plant Species in BC

Legislative Authority	Applicability to Invasive Plants
Federal Legislation	
Pesticide Control Products Act	Describes the criteria for registration of pesticides, and the safe conditions for their use.
Plant Protection Act	Describes the requirements for the introduction of biological control agents into Canada.
Seeds Act	Provides guidelines regulating invasive plant seeds in crop seed and the transportation of crop seed in Canada.
Species at Risk Act	Protects species at risk and their habitat in Canada.
Provincial Legislation	
Forest and Range Practices Act	Describes responsibility for invasive plant control for a person conducting a forest and range practice use, and lists target species under the *Invasive Plant Regulation*.
Integrated Pest Management Act	Regulates the use of pesticides (including herbicides) for invasive plant control, and explains that a pest management plan is required before they can be applied.
Park Act	Describes the management of native plants and their habitat, and the protection of natural features.
Pipeline Act	Designates responsibility to control noxious weeds along pipeline rights-of-way.
Plant Protection Act	Regulates the spread of insects, plant pests or diseases that adversely affect plants in BC.
Weed Control Act	Outlines the obligation to control designated noxious weeds by the land occupier.

Weed Control Act

The *Weed Control Act* applies to all provincial Crown land in BC. Exemptions within the province may include railroads, First Nations lands, and federal lands (airports, sea ports, National Defense land, etc.). Pipelines that span provincial or international boundaries may also be excluded. Other pipelines are responsible for weed control under Section 38 (2) (a) of the *Pipeline Act*, but the prescribed species are not listed in the Act or regulations and likely default to the *Weed Control Act*.

Forest Practices Code Act (the Code)[i]

Under the Code, MOFR operated an integrated weed control program as the "occupier" of Crown land described in section 2 of the *Weed Control Act*. Section 52 (2) of the Code assigned responsibility to licensees by stating that:

> Subject to an operational plan, persons carrying out a forest practice must, in accordance with the regulations and the standards, carry out the forest practice at a time and in a manner that will limit the spread of noxious weeds to a level acceptable to the district manager.

Relevant operational plans included forest development plans, range use plans, silviculture prescriptions, and stand management prescriptions. Noxious weeds that were subject to control under the Code were listed in the regulation of the *Weed Control Act* (Appendix 2). Guidebooks provided strategies for prevention and spread on forest and rangeland.[19]

Forest and Range Practices Act (FRPA)

Licensee's responsibility for invasive plants is described both in FRPA and its regulations (see Table 4). Unlike under the Code, the role of the *Weed Control Act* on Crown land lacks clarification under FRPA. The FRPA *Invasive Plant Regulation* lists 42 species of concern on Crown land, while 49 species are listed in the *Weed Control Act* (Appendix 2). Although these lists have 30 species in common, each list contains unique species that either reflect agricultural concerns or potential risk to Crown land resources.

Table 4: FRPA and Regulations Relating to Invasive Plants

***Forest and Range Practices Act* - Section 47** A person carrying out a forest practice or a range practice must carry out measures that are (a) specified in the applicable operational plan, or (b) authorized by the minister to prevent the introduction or spread of prescribed species of invasive plants.
***Forest (and Range) Planning and Practices Regulation* - Section 17 (Section 15)** For the purpose of section 47 *[invasive plants]* of the Act, a person who prepares a forest stewardship plan (a range use plan or a range stewardship plan) must specify measures in the plan to prevent the introduction or spread of species of plants that are invasive plants under the *Invasive Plants Regulation*, if the introduction or spread is likely to be the result of the person's forest (range) practices.

[i] In January 2004, the *Forest and Range Practices Act* (FRPA) replaced the Forest Practices Code as British Columbia's forest practices legislation. FRPA will be phased in over a transition period ending on December 31, 2006 (with government authorized to extend the period until December 31, 2007). The transitional provisions of FRPA state the Code continues to apply to forest practices carried out under a forest development plan. This continues until there is an approved forest stewardship plan under FRPA, at which point the requirements of FRPA apply.

Integrated Pest Management Act (IPMA)

The IPMA requires a confirmed pest management plan (PMP) before herbicide treatments can be applied on Crown land where the total area sprayed exceeds 50 hectares. These plans authorize treatments over specific geographic areas and provide the holder with the mandate to control invasive plants on Crown land. Forest and range licensees require their own PMP to operate on Crown land, or authority can be granted under an existing plan such as the Southern Interior PMP from MOFR. When licensees operate under an existing PMP, the holder may be responsible for their activities and need to monitor their program.

Invasive Plant Control Delivery

Early Control

The control of invasive plants is widely accepted as necessary to protect ecosystems and resources in BC (see Appendix 3 for a description of control measures). Their control on Crown and private land, however, is complex and requires a complicated, concerted and cooperative effort by all landowners and resource users. The Invasive Plant Council, for example, lists 94 potential signatories for the Invasive Plant Strategy for British Columbia,[20] most of which have a direct role to play in controlling invasive plants.

Weed control on Crown land began in the 1950s with biological control of St. John's-wort. In the 1960s, the provincial government began spraying knapweed along roadsides and on Crown forestland.[21] This program continued until 1985, when the Ministry of Forests adopted an integrated pest management approach to control more than 20 invasive plant species.[22]

Between the late 1960s and 2003, the Ministry of Transportation and Highways was responsible for roadside spraying and the Ministry of Forests conducted virtually all activities on other Crown land. The Ministry of Forests' program was delivered through a combined regional and district effort with the Cariboo, Kamloops and Nelson Forest Regions coordinating control efforts. Except in the Cariboo Forest Region, Ministry of Forests' districts were responsible for most of the on-the-ground chemical, manual, and biological control treatments. Local partnerships with other government ministries, ranchers, forest industry, railroads, utility companies, and private landowners were developed where appropriate to provide a comprehensive program.

Ministry of Forests and Range's Present Program

In 2003, the weed program in MOFR was reduced and the district weed programs were centralized to the regional level. Staffing in the Southern Interior Forest Region was reduced from the equivalent of approximately seven full-time employees to one full-time and one auxiliary position. Funding also was significantly reduced, and the program refocused to an "initial attack" model concentrating on new invasive plants.

In 2005, the Southern Interior Regional program was transferred to the Range Branch in Kamloops. Currently, five full-time positions are assigned to the Branch to support a

province-wide program that consists of planning, coordination, inventory and monitoring, as well as chemical, manual, and biological control treatments. Partnerships with the Ministries of Transportation and Environment, and with BC Transmission Corporation provided some additional program funding in 2005.[23]

MOFR has also retained the biological control program within the Forest Practices Branch. This program is principally responsible for developing primary biological controls for invasive plants. The program liaises and collaborates with Agriculture and Agri-Food Canada in promoting the collection, screening and release of new agents into BC. Before restructuring, the Ministry of Agriculture and Lands contributed funding to these activities, but this money is now consolidated into MOFR's biocontrol program.

Licensee Delivery

Presently, forest and range licensees have no authority or responsibility for controlling existing infestations of invasive plants on Crown land. However, some range licensees are involved with on-the-ground delivery in the Southern Interior Region through the Invasive Plant Treatment Agreement. This pilot project authorizes licensees to conduct chemical control of invasive plants on their tenure areas under the Southern Interior Pest Management Plan (see Case Study #1).

Case Study #1: Invasive Plant Treatment Agreement

The Invasive Plant Treatments Agreement (IPTA) provides a means for range and forest licensees who have an approved operational plan (forest stewardship, range use or range stewardship plan) to chemically treat invasive plants within their tenures. Participating licensees must agree to all conditions in the Southern Interior Pest Management Plan regarding notifications, herbicide use, reporting, and mapping.

Range licensees set their own objectives for their tenure, which allows them to address local invasive plant concerns within their range unit. Presently, tenure holders are responsible for all treatments, insurance, equipment, and labor costs. Although these costs may be acceptable for licensees with small infestations or new invasive plants, they may be too expensive for those with large infestations. Under these circumstances, costs could restrict invasive plant control, especially on sites where the tenure holder is not responsible for the introduction and spread of invasive plants under FRPA.

While the program may encourage further involvement, some ranchers regard it as an example of government downloading without financial compensation. Most forest companies do not see much benefit in participating in the program at this point. Nonetheless, the program does provide an opportunity to expand invasive plant treatment on Crown land.

Regional Districts

Regional District Boards have the authority under the *Weed Control Act* to appoint Regional District Weed Committees.[24] Membership on these committees is solicited from a wide range of community representatives to ensure that many interest groups contribute to local planning. Invasive plant control priorities are set through committee consensus. Each committee approaches invasive plant control differently, depending on the species present and locations of invasive plants, with respect to jurisdiction. The Columbia Shuswap and North Okanagan Regional Districts provide good examples of programs that coordinate invasive plant control with other government agencies such as MOFR, the Ministry of Environment, and other non-government agencies.[25]

On-the-ground activities vary among committees, from no invasive plant control to chemical and biological treatments. Treatments are usually confined to lands under their jurisdiction. Regional districts do not have any responsibility under FRPA.

Local Weed Committees

Local weed committees were established in the 1990s in parts of the province where weed management overlapped several jurisdictions. These committees set their own agendas within local geographic areas. Some committees, such as the South Okanagan-Similkameen Invasive Plant Society and the Central Kootenay Invasive Plant Committee, operate as registered societies. Participation in the committees is voluntary and committees consist of various government agencies, utility companies, livestock associations, forest companies, conservation groups, local governments and other interest groups. Committee structure is often similar to that of the Invasive Plant Council, but at a local level. Other examples of local weed committees include the Southern Interior Weed Management Committee and the Boundary Weed Management Committee (see Case Study #2).

Case Study #2: Local Weed Committees

The primary objective of these programs is to raise awareness and promote invasive plant control, but some committees are also involved in education and training for schools, community groups, livestock associations, and forest companies. Regional districts, local governments, and private companies also contract committees to distribute and monitor biocontrol agents, develop weed plans, and conduct inventories. Each committee is staffed with either a full- or part-time regional coordinator to administer and deliver programs.

Coordinators and their committees may identify high priority areas that require treatment, but they have no legal right to conduct control programs on Crown land. Occasionally, committees coordinate or contract spraying on priority sites on Crown or private land. Once sites have been identified, the coordinator arranges for contractors to spray under a local agency's pest management plan. For example, the South Okanagan-Similkameen Invasive Plant Society conducted inventory and chemical control on several invasive plant species within and adjacent to fires in the south Okanagan during 2004 and 2005. The Inter-Ministry Invasive Plant Committee provided funding for this project.

Pilot Project Delivery Models

Since 2005, a community-based delivery model has been tested in pilot projects in the East Kootenay and Omineca-Skeena. The objective of these three-year pilot projects is to manage invasive plant programs from a single, central organization as opposed to individual agencies conducting separate programs. Program activities mostly involve awareness, prevention, cultural control and some inventory. Representatives from user groups with a vested interest in invasive plant control make all operational decisions, while the regional district administers funding, bookkeeping, and contracts. Funding for the two projects totals $1.2 million for the East Kootenay Invasive Plant Pilot Project and $750,000 to the North West Invasive Plant Committee (see Case Study #3).

Case Study #3: East Kootenay Invasive Plant Pilot Project

The East Kootenay Invasive Plant Pilot Project is a three-year program operating through the East Kootenay Regional District. The program focuses on proactive prevention with an urban emphasis, but also conducts invasive plant control outside urban areas.

Program direction is being established through committee consensus with the hope that this will remove jurisdictional boundaries and make invasive plant control more financially and technically feasible. A vision statement and strategic plan for the program is being developed.

The East Kootenay Region has been divided into five weed management areas. Priorities for invasive plant treatments are established within each area and contractors ("controllers") have been assigned to conduct chemical treatments and inventory. The regional district provides controllers with herbicide but each contractor sprays invasive plants within the management unit at their discretion. In 2005, the project operated under MOFR's Southern Interior Pest Management Plan. The program, however, is preparing a regional PMP to provide greater flexibility in defining local priorities and delivering invasive plant treatments in a timely manner.

Although Crown land is not currently a principal focus of the program, ranchers conducted invasive plant treatments on Crown range units through contracts administered by the Kootenay Livestock Association. Similar to the Invasive Plant Treatment Agreement, ranchers mostly sprayed within their own range unit and set their own priorities for spraying. More than 280 hectares were sprayed in 2005. In addition, 400 volunteers from youth groups conducted hand pulling in 10 communities within the region through the Weed Warrior program. These events were well publicized by the media, which added to public awareness in the region.

Issues

Listing and Inventory

The FRPA *Invasive Plant Regulation* defines the various species that tenure holders need to address. However the regulation provides no direction on priorities among those species. In addition, the species in the FRPA regulation overlap, but are not identical with, those listed in the *Weed Control Act* (see Appendix 3), creating confusion about which species need to be controlled.

MOFR also describes a process for assessing site and species priorities based on regional invasive plant categories and a priority matrix.[26] Implementation of this procedure has resulted in additional species lists for various parts of the province, presumably to accommodate ecological variation (see Table 5). All of these lists contain invasive species beyond those listed in the *Weed Control Act* or FRPA regulation. As a result, there is considerable confusion and disagreement regarding which species should be included in invasive plant plans by tenure holders, and others involved in invasive plant management in the province.

Presently, more than 550 alien plant species occur in British Columbia.[27] Collectively, the *Weed Control Act* and FRPA require control of only 60 of these species, while management of the remaining species is at the discretion of tenure holders or those agencies responsible for Crown or private lands. Without some clarity on prioritizing species, pursuing treatment on a large list of invasive plants has the potential to dilute control efforts and deflect resources from those species of greatest ecological threat.

The resources presently available limit the extent to which inventory, treatment, and monitoring can be conducted, given the current complex mix and geographic distribution of invasive plants in the province. Therefore, priorities about which invasive plants will be managed need to be established on a provincial, regional and local basis so that treatments are applied in an orderly and coordinated fashion. While all legislation and plant lists have a role to play in invasive plant management, a single core policy or legislation that integrates this information for BC could make planning and program delivery more effective.

Existing provincial and regional invasive plant lists need to be re-evaluated to ensure they address current policies and legislated responsibilities. Invasive plant biology, ecological adaptation to biogeoclimatic units in BC, potential impacts, and the feasibility of controlling individual species are all important considerations.

Table 5: Number of Species Listed in Legislation and MOFR Regional Plant Lists

Invasive Plant Designation Source	Number Listed
Seed Act (Canada)	79
Weed Control Act	49
Forest and Range Practices Act	42
MOFR Regional Plant Lists	
• Southern Interior Forest Region	43
• Coast Forest Region	49
• Northwest BC	68
• Northeast BC	68
Invasive Alien Plant Database	>120

MOFR has taken the lead role in conducting invasive plant inventories in BC. Roadside surveys were conducted in 2004 and 2005 to provide baseline information for planning program activities, and to identify where containment for particular species was feasible.[28] More than 27,000 sites have been entered into the Invasive Alien Plant Database.

Forest districts regularly conducted invasive plant inventories up to 2002, and some of the data from these inventories was integrated into the Invasive Alien Plant Database. Although some of the data may be obsolete now, it provides valuable information on the geographic locations and ecological distribution of invasive plants throughout the province. In addition, it provides immediate information to guide treatment applications while additional inventory data are being collected.

Although the Invasive Plant Council is developing an early detection and rapid response procedure for new invasive plants, no province-wide protocol has been adopted for reporting new invasive species or infestations in the province, or within geographic areas. Some sightings of new invaders are reported directly to forest districts, but these are usually referred on to MOFR's Range Branch in Kamloops. Other, new infestations are conveyed to the East Kootenay and Omineca-Skeena pilot projects, or to local weed committees.

Range and forest licensees have no legal obligation to conduct invasive plant inventories under FRPA, and only one forest tenure holder in the province has conducted a formal inventory using the MOFR inventory procedures and the Invasive Alien Plant Database. Some ranchers and forest licensees are aware of invasive plant locations in their tenure areas, but few have mapped the sites. Although most licensees acknowledge new invaders as high-risk and see the value in reporting them to an appropriate agency, most licensees do not identify and map high-risk areas or consider the potential for invasive plant spread as a criteria for setting priorities in operational plans. Many licensees expect government to provide information on the locations of invasive plants or priority areas at this time. So far, there has been little communication between the MOFR Invasive Plant Program and licensees to update the forest and range industries on invasive plant distribution.

Generally, forest licensees view the Invasive Alien Plant Database as an unreliable guide for forest management and cannot see how it will improve forest management. There is also considerable uncertainty regarding the accuracy of the surveys because of the inherent variability over time. Accordingly, there is no motivation for licensees to participate in these surveys, especially since they may be responsible for dealing with new species found in their tenures.

The intent of the inventory in relation to FRPA is not clear. Presently, it appears to be comprehensive in geographical scope, but focused on only a few priority species as determined by MOFR's priority matrix. Non-priority species that may be listed in the *Invasive Plant Regulation* are not recorded in all surveys. If the inventory is designed to support FRPA, then all species listed in the *Invasive Plant Regulation* should be included in surveys so that licensees are aware of their presence when they are preparing operational plans.

Although the Invasive Alien Plant Database is expected to provide a bridge between MOFR and licensees, there is some justified skepticism that it can deliver accurate and useful information. Significant training is required on plant identification, inventory procedures, and technicalities of the Invasive Alien Plant Database before forest and range licensees will readily accept the merits of the inventory and mapping tools available.

Legislation

Generally, all forest and range licensees are aware of FRPA requirements for invasive plants. While the forest industry is aware that they need to specify measures for invasive plants in forest stewardship plans, the specific measures required to address the legislation are not fully understood.

Some range tenure holders may not be aware of current FRPA legislation, especially those still operating under range use plans. (A recent information document, prepared by the BC Cattlemen's Association, provides range licensees with non-legal guidance on invasive plant responsibilities under FRPA).

The *Integrated Pest Management Act* requires a confirmed pest management plan (PMP) before herbicide treatments can be applied on Crown land, where the total area sprayed exceeds 50 hectares. These plans authorize treatments over specific geographic areas and provide the holder with the mandate to control invasive plants on Crown land. Numerous confirmed PMPs already exist in the southern interior, but the single MOFR PMP covers the largest contiguous area. Several agencies in the Southern Interior Region worked under the umbrella of MOFR PMP in 2005 to conduct chemical spray programs on Crown land. Nonetheless, coordination of spraying under this PMP has not been effective in some areas of the province, and some local programs are applying for their own PMPs to gain greater control over their programs. While this autonomy may produce more effective short-term delivery, multiple PMPs do not facilitate a coordinated and cooperative provincial program.

Currently, no legislation is directed to non-regulated uses of Crown land such as hunting,

recreation, and off-road vehicle use. A recent report by the Coalition for Licensing and Registration of Off-Road Vehicles has recommended that government enact an Off-Road Vehicle Act for licensing off road vehicle, and in it include provisions for minimizing the spread of invasive plants.[29]

The linkage among FRPA, the *Weed Control Act*, and the *Integrated Pest Management Act* needs to be clarified so that government agency, licensee, and private landowner responsibilities are clearly understand by all parties. A core policy, or legislation, that integrates invasive plant responsibility among the acts could assist in providing this clarity.

Roles and Responsibilities

The distribution of invasive plants in BC transcends jurisdictional boundaries, and the need for a coordinated invasive plant program with well-defined roles and responsibilities is widely understood. Effective coordination, however, requires a champion for the program, clear leadership and organization at both the provincial and local level. To some extent, this role has been assigned to the Invasive Plant Council of British Columbia. While many accomplishments have been achieved in promoting awareness and developing partnerships at a ministry level, less has been accomplished in translating these efforts into on-the-ground delivery.

Although the Invasive Plant Strategy for BC outlined broad roles and responsibilities for federal and provincial governments, First Nations, local weed committees, local government and other stakeholders, there does not appear to be sufficient acceptance from all participants to facilitate a well-coordinated invasive plant control program. In addition, specific strategies for government ministries, forest and range licensees, and third party stakeholders have not been developed.

The formation of the Inter-Ministry Invasive Plant Committee has resulted in more communication among ministries than in the past, and cooperation with local weed committees appears to be improving as the provincial program develops.[30] Currently, priorities are set through negotiation among agencies but there is little evidence of a provincial plan, or coordination that ties local initiatives together in a coherent program. The Inter-Ministry Invasive Plant Committee is currently developing a provincial strategy, which should improve coordination and cooperation in the future.

Before restructuring, MOFR district and regional programs coordinated weed control operations with utilities, ranchers, forest companies, and other user groups. Some districts were able to leverage funds from non-government partners that were administered through local weed committees. The funds were used to integrate weed control on Crown land with adjacent lands from other jurisdictions. Many of these partnerships expired when the program was centralized to the Southern Interior Region, while others were reformed though local weed committees. Presently, few partnerships exist among ranchers, forest licenses, utilities, and other users.

Industry involvement in a provincial invasive plant program, outside of FRPA, is expected through voluntary participation,[31] but presently there is no incentive for forest licensees to

participate. Most range licensees see the value in managing invasive plants on Crown land, but do not dedicate resources for voluntary participation in their control.

Virtually all tenure holders interviewed said they do not expect to conduct much on-the-ground control of invasive plants over the next five years because they lack the staff and expertise to deliver programs. Consequently, they are relying on local weed committees and MOFR program for assistance.

Currently, there is little coordination between the forest and livestock industries in planning invasive plant activities on overlapping or adjoining tenures. Most communication between the two industries has focused on protection of plantations, removal of barriers, grass seeding, fencing, and cattle guards. Similarly, there is little coordination with other users. Some forest companies and range licensees are involved in local weed committees and the East Kootenay Pilot project, but this has been a recent development. These committees have taken the initiative to develop local partnerships on their own, and to fill the gap created since the forest district programs expired. Joint ventures between forest and range licensees are developing, but so far, there has been little coordination among MOFR, industry, and local weed committees.

FRPA does not promote closer cooperation and coordination between forest and range licensees regarding management of invasive plants on Crown land. Coordination is limited to voluntary cooperation among tenure holders, agencies, landowners and others who may have responsibility under the *Weed Control Act.* Forest districts variably contribute to coordination through their involvement in local weed committees and in reviewing operational plans.

Presently, no regional or local invasive plant management plans are in place to help tenure holders direct their programs in a coordinated fashion with broader, landscape level goals and objectives. Although some ranchers have shown an interest in spraying invasive plants on Crown land, many do not want to participate unless they are reimbursed for chemicals. In addition, there is some concern regarding the cost and requirement for liability insurance to conduct treatments on Crown land.

Planning

Strategic Planning

An effective program for invasive plant control in BC requires provincial, regional and local level plans. These plans should identify the target species, locations and extent of infestations, and the control options that are feasible so that appropriate treatment methods can be implemented.

In 2004, the Invasive Plant Council of British Columbia prepared the Invasive Plant Strategy for British Columbia. This strategy aims to "build cooperation and coordination to…minimize the social and economic impacts caused by …invasive alien plants" [32] through commitment and participation from a wide range of agencies, organizations and individuals concerned with the control of invasive plants in BC. Although partnerships are being established, and this strategy outlines broad goals and objectives for a province wide program, the strategy has not been translated into specific goals and objectives for managing invasive plants at a landscape level. Consequently, local-level initiatives are frustrated by a lack of clear direction for planning invasive plant programs. Similarly, linkages between the strategy and FRPA planning processes are not clearly evident.

In 2004, the Inter-Ministry Invasive Plant Committee was formed to improve coordination and planning for invasive plant management in BC. Composed of representatives from the Ministries of Agriculture and Lands, Environment, Forests and Range, Transportation, and the Invasive Plant Council of British Columbia, one of the main activities of the committee includes developing a strategic plan that may provide some of the necessary background for local level planning.

Planning Under FRPA

Licensees must describe, in their forest stewardship plans, the measures that will be taken whenever "it is reasonably foreseeable that forest practices conducted by the licensee will likely result in the introduction or spread of a prescribed invasive plant." [33]

Generally, only cursory measures have been described for invasive plants in range stewardship and range use plans. Grass seeding on disturbed soils that directly result from forest or range practices is the most common measure described. Most plans have not included chemical or biological control treatments.

Few draft forest or range stewardship plans have described additional measures or management practices that will reduce the introduction or spread of invasive plants. Road closures have been used on private forest and rangeland in BC, but this practice is often not feasible for licensees on Crown land and can be difficult to enforce.[34] Other measures that have been proposed include: staff training for invasive plant identification; reporting invasive species to local weed committees or MOFR; confining travel to established roads; cleaning equipment where feasible; and hand pulling invasive plants.

No criteria, standards, and few guidelines are provided for licensees in preparing plans. Guidelines for invasive plant measures could help licensees prepare plans with respect to high-, medium-, and low-risk species, and for high-risk areas where invasive plants have a probability of establishing. To be effective, guidelines should describe the ecological conditions and sites where individual species are considered a threat, and reflect our best current knowledge for measures to be successful. Presently, FRPA relies on professional judgment for determining appropriate measures, but many licensees concede they are not fully trained in invasive plant identification, or in prevention and control methods.

Program Implementation

Generally, the restructuring of the invasive plant program in MOFR to a centralized delivery model has not improved the overall effectiveness of a provincial program. The increase in the area of land that the program is responsible for covering is too large to be adequately serviced with the present level of staffing, even with contractor support.

Although licensees, regional districts, and local weed committees are contributing to control of invasive plants on Crown land, the combined level of chemical, manual, and biological treatment throughout the province has declined significantly since 2002.[ii]

MOFR district involvement in the invasive plant program is minimal, consisting mainly of participation in some local weed committees as advisors; enacting compliance and enforcement; and taking responsibility for reviewing and approving forest and range stewardship plans. Most local knowledge and expertise in invasive plant control is no longer available, and many of the partnerships developed through the district programs have been lost. A broader involvement in the program by district staff would be an asset for a strong and effective provincial program.

Should government wish to have forest and range licensees take a more active role in invasive plant control on lands where they are operating, one mechanism would be to amend the definition of forest health factors in section 26 of FRPA to include invasive plants. This would enable government to require strategies to address invasive plants in appropriate areas on both Crown and private land.

Tenure holders and local governments have expressed concern about downloading of provincial responsibility for invasive plant control since 2002. To some extent, the increases in provincial government funding since 2004 to $4 million annually for invasive plant control has offset these concerns.[35]

[ii] Based on interviews with the organizations identified in Appendix 2.

Compliance and Enforcement

Compliance and enforcement (C&E) relating to invasive plants on Crown land is through the *Weed Control Act* and FRPA. Under the *Weed Control Act*, the Ministry of Agriculture and Lands is the only agency with enforcement authority on all Crown land. Although regional districts and municipal councils can appoint weed control officers to enforce the *Weed Control Act* on private land, enforcement is difficult when adjacent Crown land is infested with invasive plants. In addition, the officers have no authority on Crown land. Therefore inadequate management often results in both jurisdictions.[36] Under FRPA, C&E officers with MOFR have no authority under the *Weed Control Act*, and there is no connection between FRPA and the *Weed Control Act* for C&E.

Pursuing voluntary compliance through working with licensees to solve their invasive plant problems may be more constructive than enforcement through FRPA. This approach has been used effectively under the *Weed Control Act*, and voluntary compliance occurs in almost all cases where a weed notice has been served.[37]

Financial Resources

Adequate funding and human resources have always been significant constraints for invasive plant control in BC. The gap created between licensee responsibility on Crown land under FRPA, and the government's responsibility to control invasive plants though the *Weed Control Act* creates a significant short-fall in program delivery. While many licensees, and especially range tenure holders, may be receptive to participating in some invasive plant control on Crown land beyond their responsibility under FRPA, costs may become a limiting factor discouraging involvement.

So far no provision exists to compensate licensees for invasive plant control on their tenure areas where their forest or range practices may result in invasive plant introduction or spread, on areas in their tenure where weeds may have established by some other means, or in areas outside their tenures where present infestations may be a threat to their tenures.

The lack of compensation may be a disincentive to licensees getting involved in invasive plant control beyond the responsibilities they have under FRPA. Similarly, local weed committees, municipalities, and other stakeholders might also be encouraged to cooperate and coordinate local invasive plant initiatives if they were not burdened with the full costs of inventory, prevention and control. This is especially important where the cause of invasive plant infestations cannot be clearly established.

In 2004, the provincial government approved an uplifted budget that increased funding over the following two years to approximately $4 million annually.[38] In addition, the Rural Enhancement Initiative provided another $2.35 million in February 2005, to evaluate the effectiveness of local delivery models, biological control research, and support for the Invasive Plant Council. Returns on these investments are already evident, as the Inter-Ministry Invasive Plant Committee has funded numerous projects involving inventory, control and public awareness.[39]

Conclusions

Management of invasive plants in BC is a complex task involving a range of jurisdictions, legislation, policies, and guidelines. Numerous issues need to be resolved before an effective provincial program can be implemented for their control. This report examines the current status of invasive plant management in BC, concentrating primarily on the role of range and forest tenure holders under FRPA.

Listing and Inventory of Invasive Plants

The *Invasive Plant Regulation* under FRPA provides a list of species that tenure holders are responsible for, however it provides no direction on priorities among species. The list also overlaps, but is not consistent with, the *Weed Control Act.*

No comprehensive survey has been conducted to determine the area and distribution of invasive plants in BC. Currently, range and forest licensees have no obligation to carry out invasive plant inventories. MOFR has taken the lead role in conducting invasive plant inventories, but this effort is focused on a variable set of selected species from the FRPA *Invasive Plant Regulation*.

Legislation

The linkage between FRPA, the *Weed Control Act* and the *Integrated Pest Management Act* needs to be clarified so that government agency, licensee, and private landowner responsibilities are clearly understood by all parties. A core policy, or legislation, that integrates invasive plant responsibility among acts could assist in providing this clarity.

Roles and Responsibilities

MOFR continues to plan and conduct weed control programs on Crown land but other players are now involved such as the Ministry of Environment (protected areas), local weed committees, industry and the pilot projects. So far, there has been little coordination among the various players.

Under FRPA, forest and range licensees must specify measures in an operational plan to prevent the introduction or spread of invasive plants that likely result from their forest or range practices. Forest and range licensees have no responsibility for controlling existing invasive plants on Crown land.

FRPA does not promote coordination between forest and range licensees regarding management of invasive plants on Crown land. Coordination is limited to voluntary cooperation.

Planning

Presently, no landscape level invasive plant management plans are in place to help tenure holders direct their programs in a coordinated fashion.

There is little coordination between the forest and livestock industries in planning invasive plant activities on overlapping or adjoining tenures.

Most forest stewardship plans, range stewardship plans and range use plans describe only cursory measures to prevent the introduction and spread of invasive plants. No criteria, standards, and few guidelines are available to the licensees.

On-the-Ground Implementation

The combined level of chemical and biological treatment for invasive plant control has declined significantly since 2002. More effort needs to be directed to on-the-ground delivery of appropriate treatments. Most tenure holders interviewed expect to do little on-the-ground control of invasive plants over the next five years because they lack the staff and expertise to deliver programs.

Compliance and Enforcement

Compliance and enforcement relating to invasive plants is through the *Weed Control Act* and FRPA. Presently, there is no connection between FRPA and the *Weed Control Act* for C&E, and C&E officers have no authority to serve weed notices under the *Weed Control Act*.

Recommendations

To improve the effectiveness of invasive plant management under FRPA and MOFR's Invasive Plant Program, the Board makes the following recommendations:

1. The Inter-Ministry Invasive Plant Committee should review and consolidate the invasive plant and weed lists into a single list for the province.

2. MOFR should identify which invasive plants will be managed as priorities at the district level, so that treatments can be applied in a coordinated fashion. In addition, MOFR inventories should include all species listed in the FRPA *Invasive Plant Regulation* so that licensees are aware of their presence when they are preparing operational plans.

3. The linkage among FRPA, the *Weed Control Act*, and the *Integrated Pest Management Act* needs to be clarified so that government agency, licensee, and private landowner responsibilities are clearly understand by all parties. Government should develop policy or legislation that integrates invasive plant responsibility among acts to provide this clarity.

4. MOFR should develop training courses for licensees to increase skills in plant identification, control measures and the use of the Invasive Alien Plant Database.

5. MOFR should give consideration to amending section 26 of FRPA to include invasive plants. This would enable government to require strategies to address invasive plants in appropriate areas on both Crown and private land.

The Board requests that the provincial government respond to these recommendations by March 31, 2007.

Appendix 1: List of Organizations Interviewed

Agriculture and Agri-Food Canada
BC Cattlemen's Association Stewardship Committee,
Boundary Weed Management Committee
Canfor Ltd.
East Kootenay Invasive Plant Project
Fraser Basin Council
Invasive Plant Council of BC
Kootenay Livestock Association
Kootenay Wildlife Services
Ministry of Agriculture and Lands
Ministry of Forests and Range, Forest Practices Branch
Ministry of Forests and Range, Invasive Plant Program
Ministry of Forests and Range, Kamloops Forest District
Ministry of Forests and Range, Okanagan Shuswap Forest District
Ministry of Forests and Range, Range Branch
Ministry of Forests and Range, Rocky Mountain Forest District
Pope and Talbot Ltd.
Southern Interior Weed Management Committee
Tembec Ltd.
Tolko Industries
Weyerhaeuser

Appendix 2: Invasive Plant Species

Common and scientific names of invasive plant species listed in the *Weed Control Act* and the *Forest and Range Practices Act* regulations.

Invasive Plant Species*	Scientific Name	Designation Under the Weed Control Act**
Species Found In Both Acts		
Blueweed	*Echium vulgare*	R
Canada Thistle	*Cirsium arvense*	P
Common Bugloss	*Anchusa officinalis*	R
Common Burdock	*Arctium minus*	R
Common Hound's-tongue	*Cynoglossum officinale*	P
Common Tansy	*Tanacetum vulgare*	R
Dalmatian Toadflax	*Linaria dalmatica*	P
Diffuse Knapweed	*Centaurea diffusa*	P
Field Scabious	*Knautia arvensis*	R
Gorse	*Ulex europaeus*	P
Hoary Alyssum	*Berteroa incana*	R
Hoary Cress	*Cardaria draba*	R
Leafy Spurge	*Euphorbia esula*	P
Marsh Thistle	*Cirsium palustre*	R
Meadow Hawkweed	*Hieracium pilosella*	R
Meadow Knapweed	*Centaurea pratensis*	R
Orange Hawkweed	*Hieracium aurantiacum*	R
Oxeye Daisy	*Leucanthemum vulgare*	R
Perennial Pepperweed	*Lepidium latifolium*	R
Plumeless Thistle	*Carduus acanthoides*	R
Puncturevine	*Tribulus terrestris*	R
Rush Skeletonweed	*Chondrilla juncea*	P
Russian Knapweed	*Acroptilon repens*	R
Scentless Chamomile	*Matricaria perforata*	P
Scotch Thistle	*Onopordum acanthium*	R
Spotted Knapweed	*Centaurea maculosa*	P
Sulphur Cinquefoil	*Potentilla recta*	R
Tansy Ragwort	*Senecio jacobaea*	P
Yellow Starthistle	*Centaurea solstitialis*	P
Yellow Toadflax	*Linaria vulgaris*	P

Invasive Plant Species*	Scientific Name	Designation Under the Weed Control Act**
Species Unique To The *Weed Control Act*		
Annual Sow-thistle	*Sonchus oleraceus*	P
Cleavers	*Galium aparine*	R
Common Crupina	*Crupina vulgaris*	P
Dodder	*Cuscuta spp.*	P
Green Foxtail	*Setaria viridis*	R
Jointed Oatgrass	*Aegilops cylindrica*	P
Kochia	*Kochia scoparia*	R
Night-flowering Catchfly	*Silene noctiflora*	R
Perennial Sow-thistle	*Sonchus arvensis*	P
Purple Nutsedge	*Cyperus rotundus*	P
Quackgrass	*Agropyron repens*	R
Russian Thistle	*Salsola kali*	R
Tartary Buckwheat	*Fagopyrum tataricum*	R
Velvetleaf	*Abutilon theophrasti*	P
White Cockle	*Silene latifolia* syn. *Lychnis alba*	R
Wild Chervil	*Anthriscus sylvestris*	R
Wild Mustard	*Sinapsis arvensis*	R
Wild Oats	*Avena fatua*	P
Yellow Nutsedge	*Cyperus esculentus*	P
Species Unique To The *Forest And Range Practices Act*		
Baby's Breath	*Gypsophila paniculata*	
Black Knapweed	*Centaurea nigra*	
Brown Knapweed	*Centaurea jacea*	
Bull Thistle	*Cirsium vulgare*	
Fuller's Teasel	*Dipsacus fullonum*	
Giant Knotweed	*Polygonum sachalinense*	
Japanese Knotweed	*Polygonum cuspidatum*	
Nodding Thistle	*Carduus nutans*	
Purple Loosestrife	*Lythrum salicaria*	
Scotch Broom	*Cytisus scoparius*	
St. John's-wort	*Hypericum perforatum*	
Yellow Iris	*Iris pseudacorus*	

* Plant nomenclature follows the illustrated flora of British Columbia.

** P=Provincial noxious weed; R=Regional noxious weed.

Appendix 3: Control of Invasive Plants

Invasive plant infestations generally establish for a variety of reasons. Therefore, no single treatment option will likely provide effective and sustainable control for any, or all, species. All methods of invasive plant control can be effective depending on the weed species, distribution and density of invasive plant populations, and the environmental conditions under which invasive plants grow. Conversely, control methods often fail when they are extended beyond their intended scope of use. Appropriate management actions can be evaluated considering the following factors:

- The biology and potential risk of the target species.
- The size of the infestation.
- Specific site conditions such as slope, soil texture and proximity to water.
- The relative availability, efficacy, and cost of the treatment option.
- The comparative risks and benefits of the treatment including location of the infestation relative to non-target native species, red- and blue-listed plants, species and ecosystem at risk, sensitive areas, and other management concerns.

Cultural and Mechanical Control

Cultural and mechanical control measures are usually used on sites that are unsuitable for herbicide applications, or where biological control is not feasible. Cultural methods include treatments such as hand pulling, hoeing, cutting, burning, mulching, or girdling. These methods are most effective for removing small patches of scattered plants, especially where invasive plants are dispersing into a new location. They are also used in sensitive habitats such as riparian areas where chemical treatments cannot be applied. Usually, cultural methods are slow and tedious, and become costly when invasive plants are widespread over the landscape.

Power driven machinery such as chain saws, bulldozers, seeders, and disk-ploughs are sometimes used to control weeds over larger areas. Generally, these techniques are intrusive; and can cause significant soil disturbance, adverse effects on native vegetation, and sometimes promote the spread of invasive plants.

To be most effective, cultural and mechanical methods are timed to prevent plants from producing and disseminating seeds, or to displace invasive plants from the site. Follow-up treatments may be required to ensure control, especially for perennial plants with creeping roots, and for species whose seeds remain viable in the soil seed bank for extended periods of time.

Cultural and mechanical methods can be highly effective for small infestations, especially as new invasive species enter a geographic area or habitat for the first time. An immediate response to these introductions can result in complete control and is the most cost-effective method of weed control when applied under these circumstances. As infestations grow larger, however, the relative cost and efficacy of cultural methods often declines.

Chemical Control

Chemical control provides the greatest certainty of immediate control for the broadest spectrum of invasive plant species when herbicides are applied at the proper time and rate. Herbicides are often used to eliminate relatively small, isolated patches of invasive plants or contain larger infestations that are adjacent to highly susceptible habitats, agricultural crops, or other sensitive areas that are not affected by their application.

Herbicide applications are restricted by such factors as the distance infestations occur relative to water, soil texture, wind speed, air temperature, and relative humidity. Other ecological considerations that may restrict herbicide use include the presence of species at risk, proximity to sensitive or critical habitats, and potential impacts on non-target species. Human health concerns also limit herbicide use in some locations. Herbicides cannot be applied on Crown land in BC without a confirmed pest management plan issued by the Ministry of Environment. These plans specify the rate, timing, and conditions under which herbicides can be applied.

Biological Control

Biological control is often considered the most environmentally acceptable alternative for managing invasive plants over broad geographic areas. In BC, this method uses mostly insects and pathogens to reduce invasive plant populations to ecologically and economically acceptable levels. Once established, these agents are expected to become a self-regulating system controlling invasive plant species.

Biocontrol agents can be released in North America only after careful studied and rigorous screening has been conducted. Agents are not approved for release until an international panel reviews these studies to ensure the agent is host-specific, and will not adversely affect native plants and animals, or horticultural and agricultural crops.

Few studies have documented the success rate of biocontrol and none have been conducted in BC. Worldwide, however, biological control has been about 50 percent successful in controlling invasive plants. Nearly 80 biological control agents have been introduced into BC to control a variety of invasive plant species. Currently, 29 agents are available for operational release on 13 invasive plant species. Some of these species, such as *Mogulones cruciger* for hound's-tongue, *Mecinus janthinus* for Dalmatian toadflax, and *Agapeta zoegana* and *Cyphocleonus achates* for spotted knapweed have been successful on a local basis while the effects of other species are less well known.

Historically, little monitoring has been conducted to determine the efficacy of agents in the field. Future monitoring and release information will be entered into the Invasive Alien Plant Database, which should improve understanding of species performance in the future. Biological control is not considered an eradication tool and will not prevent invasive species from eventually expanding their range. It is also not suitable for small infestations where the critical mass of plants will not support populations of the agent.

Relative Costs of Control

Efficacy of control measures is not the only determining factor for control: environmental impacts; social attitudes; and perceived cost/benefits also influence choices (see Table 6). Comparisons of the relative efficacy of methods usually involve considering the ability of a particular treatment to kill or contain the target species, cost, and relative impact on non-target organisms or habitats.

Table 6: Cost Comparison for Three Weed Treatment Options In Deschutes National Forest, Oregon

Treatment Option	Cost ($US)/acre
Cultural (Hand Pulling)	332
Chemical (Ground Applied)	95-130
Biological Control	40-50

Environmental impact studies in Montana, Oregon and New Mexico have considered the threats and relative costs of various treatment options on "native lands" in relation to the perceived ecological and social benefits of weed control. All these studies concluded that an integrated approach including herbicides was the most expedient approach, and that the potential environmental threats of weeds spreading unimpeded in natural landscapes outweighed the risks of using herbicides when they are applied in a prudent manner, following label specifications.

Integrated Pest Management

Traditionally, weed management programs relied on herbicides as the primary tool for controlling weeds. Over the last several decades, concerns about the environmental and health hazards of herbicides, soil erosion and degradation, and pest adaptation to control methods, resulted in the development of Integrated Pest Management as an alternative to sole reliance on herbicides. This approach has been endorsed by the Invasive Plant Council of BC, and used by provincial ministries for weeds for over 20 years in BC.

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