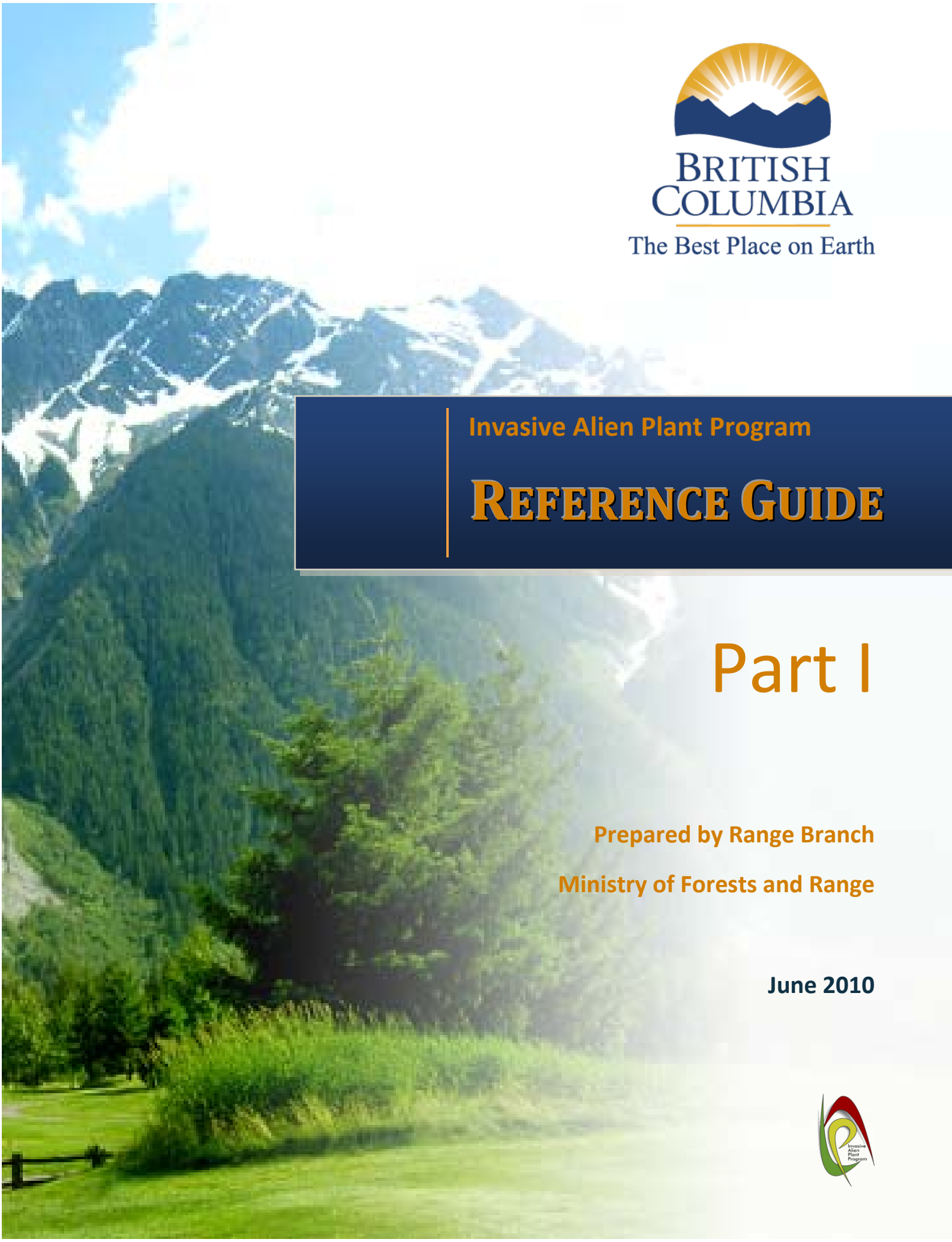


BRITISH COLUMBIA

The Best Place on Earth

Invasive Alien Plant Program

REFERENCE GUIDE

Part I

Prepared by Range Branch

Ministry of Forests and Range

June 2010

MODULE 1.1

INTRODUCTION TO THE MINISTRY OF FORESTS AND RANGE INVASIVE PLANT PROGRAM REFERENCE GUIDE

The Ministry of Forests and Range Invasive Plant Program reference guide is a resource manual for all agencies and partners involved in invasive plant management in British Columbia. The guide is divided into four parts:

Part 1: Understanding the business of invasive plant management;
Part 2: Using the Invasive Alien Plant Program (IAPP) application Data Entry module;
Part 3: Using the IAPP application Map Display module; and
Part 4: Appendices.

Part 1 covers the business of invasive plant management, including prevention, planning, inventory, monitoring, and different treatments. Part 2 contains the complete user manual for the IAPP application Data Entry module, while Part 3 provides the manual for the IAPP Map Display module. And finally, Part 4 contains the appendices for Parts 1–3. Each part is divided into a number of modules, which are briefly described below for easy reference and access.

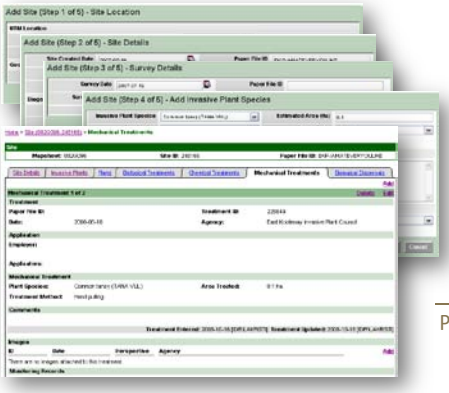
1- FIELD SCABIOUS

PART 1

Following this introduction to the reference guide, Module 1.2 provides an introduction to invasive plants, describes the ministry's Invasive Plant Program, and lists relevant legislative requirements. Invasive plant prevention and program planning are outlined in Modules 1.3 and 1.4, respectively. Module 1.5 presents invasive plant inventory standards and describes field preparation and inventory methods. Data collection procedures are outlined, and detailed descriptions of the Site and Invasive Plant Inventory Record and the Photo Plot Record Form are provided. Mechanical, chemical, and biological methods are used for treating

invasive plants. Modules 1.7, 1.8, and 1.9 describe these treatments, respectively, and provide instructions on completing the associated forms: Invasive Plant Chemical & Mechanical Treatment Record and the Biological Control Agent Release Record. These modules also include information about monitoring treatment activities, and provide instructions for completing the following monitoring forms: Chemical & Mechanical Monitoring Record, the Biological Control Agent Establishment Monitoring Record, and the Biological Control Agent Dispersal Monitoring Record.

PART 2



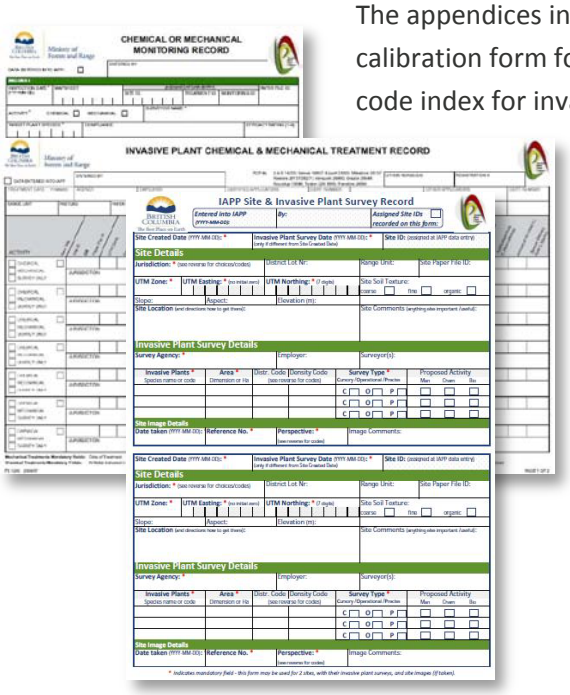
Part 2 provides explicit instructions on how to access and use the IAPP application Data Entry module to its full potential for entering, querying, and reporting on attribute data. Module 2.1 covers why the data entry application was created, defines various database "user roles," describes how to access the database, explains how to navigate in the database, and describes key functions and features. Modules 2.2 and 2.3 describe the details on adding a new site, and adding invasive plant species and surveys to an existing site; Module 2.4 explains how to add images to site and treatment records. Modules 2.5, 2.6 and 2.7 detail the process of adding and editing mechanical, chemical and biological treatment and monitoring records, respectively. Module 2.8 explains how enter biological dispersal records. Module 2.9 allows users to fully understand the use of the Within Agency Administrative Area module, and Module 2.10 describes how to use containment lines. Module 2.11 offers background information and tips on how to best conduct searches and generate extracts and reports. Module 2.12 explains the planning features within the IAPP application Data Entry module.

PART 3

Part 3 explains how to ensure maximum benefit and optimal information gathering by using the IAPP application Map Display module and its built-in Report-A-Weed

tool. Consisting of four modules, it covers everything a user needs to know to access, display, and report specific information. Module 3.1 introduces the Map Display module, and Module 3.2 describes the layers and tools available. Specific invasive plant layers and display functions are explained in Module 3.3. Module 3.4 presents the "Report-A-Weed" wizard and explains how to report a new invasive plant sighting.

PART 4



The appendices in Part 4 contain all field forms; a calibration form for backpack herbicide application; a code index for invasive plant species, treatments, distribution, and density classes; and a list of additional resources.

MODULE 1.2:

UNDERSTANDING INVASIVE PLANTS, THE INVASIVE PLANT PROGRAM, AND LEGISLATIVE REQUIREMENTS

THIS MODULE COVERS:

- background information on invasive plants;
- the Ministry of Forests and Range Invasive Plant Program;
- Integrated Pest Management;
- the Invasive Alien Plant Program application
- provincial legislation that applies to invasive plant management; and
- federal legislation that governs the management of invasive plants.

WHAT ARE INVASIVE PLANTS?

Invasive plants are plants that are not native to British Columbia and the ecosystem in which they are present. In British Columbia, the terms invasive plant and invasive alien plant are synonymous. Invasive plants pose a threat to the natural environment and are recognized globally as the second greatest threat to biodiversity. Free from the pests that keep them in check in their native ranges, invasive plants reproduce rapidly and spread aggressively, dominating natural areas and altering biological communities.

2-RUSSIAN KNAPWEED

Invasive plants often exhibit aggressive growth and out-compete native plant species and crops, which can adversely affect a variety of economic and natural resources. They have many characteristics that allow them to rapidly invade new areas and replace native plants. These characteristics include:

- early maturation;
- profuse reproduction by seeds and/or vegetative structures;

- seed dormancy, which assists periodic germination and sprouting during favourable conditions;
- prickles, spines, or thorns that can cause physical injury and repel animals;
- mechanisms to parasitize other plants;
- roots or rhizomes with large food reserves; and
- the ability to survive and produce seed under adverse environmental conditions.

Impacts from invasive plants can include reduced plant biodiversity, loss of wildlife habitat, increased soil erosion and water sedimentation, reduced crop quality and yield, and damage to human and animal health. Invasive plants are introduced and spread primarily by human activity, but wind, water, livestock, and wildlife also act as dispersal agents.

3-Giant hogweed

Problems caused by invasive plants have increased in recent decades, due in part to an increasing and more mobile human population. Population growth often leads to greater soil disturbance from roads and building sites, increased demand for food and fibre, overuse of public land for recreational purposes and commercial production, development of new travel corridors, increased international travel, and globalization of world trade. All of these complex factors promote the introduction, establishment, and spread of invasive species.

Invasive plant infestations can cause one or more of the following impacts:

- disruption of natural ecosystem processes;
- altered soil chemistry, which prevents the regrowth of native plants and economic crops;
- increased soil erosion, and potential for steam sedimentation;
- altered wildlife habitat and reduced forage availability;
- poisoning of livestock and wildlife;
- increased risk of wildfires,
- interference with forest regeneration; and
- allergic reactions and severe skin abrasions and burns.

4-GORSE

Invasive plants also pose significant economic impacts. Reductions in forage production, private property values, public land amenities (such as recreation potential and visual quality), and other land values create economic costs and lost opportunities to the landowner and all of society. Invasive plants are clearly a significant ecological, economic, and social concern.

Numerous invasive plant species require disturbance for their seeds or propagules to germinate and grow, and most spread rapidly in native plant communities that are under stresses such as drought, over-use, trampling, and soil compaction. Forest and range practices and recreational activities that create disturbance and alter or stress native plant communities can lead to the establishment and spread of invasive plants. The Ministry of Forests and Range is responsible for managing legislated invasive plants and noxious weeds on Crown land within the provincial forest land base.

MINISTRY OF FORESTS AND RANGE INVASIVE PLANT PROGRAM

The Ministry of Forests and Range is responsible for invasive plant management on the provincial forest and range landbase. To ensure efficiencies and effectiveness in government, the ministry works in partnership with other government agencies through the Inter-Ministry Invasive Species Working Group, and collaboratively with stakeholders through the Invasive Plant Council of BC and regional Invasive Plant (or "Weed") Committees. Examples of stakeholders and partners involved in regional invasive plant programs include provincial, federal, and local government agencies; First Nations; utility companies; private landowners; forest licensees; range tenure holders; guide outfitters; and environmental organizations.

The Inter-Ministry Invasive Species Working Group invasive plant strategy[1] identifies three strategic goals for addressing invasive plants on Crown land:

[1] Inter-Ministry Invasive Species Working Group. 2008. Invasive Alien Plants in British Columbia – The Provincial Government Strategy for Protecting Our Resources

- Prevent the establishment of new invasive plant infestations in British Columbia.
- Reduce the socio-economic and environmental impacts of existing invasive plants in British Columbia.
- Provide a framework and capacity for the ongoing management of invasive plants.

To achieve these goals, the Ministry of Forests and Range has specific management objectives, which include the following:

1. Prevent the establishment of new invasive plant species through effective early detection and rapid response actions.
2. Promote implementation of preventative measures with stakeholders and clients.
3. Complete and regularly update inventories of legislated and other invasive plant species of interest.
4. Reduce the spread and decrease the density of invasive plant infestations through a variety of methods, including manual and mechanical measures, chemical treatments, and biological control.
5. Restore impacted ecosystems by supporting improved grazing and forest management practices, using available biological control measures, and implementing other cost-effective activities.
6. Support, maintain, and enhance the Invasive Alien Plant Program (IAPP) application.
7. Train staff, clients, and partners to identify and report invasive plants and use the IAPP application.
8. Monitor and evaluate Ministry invasive plant management activities and ecosystem response to ensure overall program effectiveness, and improve the efficacy of future treatments.
9. Coordinate planning and management activities with other agencies, stakeholders, private landholders, and First Nations through active participation in local invasive plant (weed) committees, or directly as required.
10. Participate in international consortia for research and screening of potential biocontrol agents to control priority invasive plant species in British Columbia.

11. Develop biocontrol agents that have been approved for importation and release in British Columbia into operation-ready agents through a process of propagation, limited release, and documentation.
12. Monitor and evaluate the value and effectiveness of biocontrol agents released in British Columbia to control invasive plants.
13. Support collaborative research with academia, research scientists, and partners.
14. Provide information to the public to improve awareness of invasive plants and the Ministry's Invasive Alien Plant Program.

The ministry's Invasive Plant Program is designed to minimize or, if possible, stop the spread of invasive plant species that are threatening the province's forest and range resources. Once invasive species become widely established, it is extremely difficult or impossible to eradicate them. The program uses an Integrated Pest Management approach and is conducted in partnership with other land management agencies. The intent of Integrated Pest Management is to bring invasive plant species populations into equilibrium with native species at an acceptable economic cost and ecological level.

Through regional invasive plant programs, invasive plant management activities—such as education and awareness, planning, inventory, and treatment—are coordinated and integrated across jurisdictions. Additionally, shared strategic approaches to addressing prevention, early detection and rapid response (EDRR) actions, regional rapid response, and invasive plant containment create efficiencies in delivery of, and improvements to, landscape-level invasive plant management. Communication and coordination of invasive plant management activities help improve treatment effectiveness and control actions taken by all land managers. The Ministry supports a cooperative, collaborative approach to invasive plant management in British Columbia.

Both awareness of, and knowledge about, invasive plant issues are critical for the success of invasive plant management programs. Education programs raise awareness of invasive plant species and their impacts, which helps in the identification of new invasive species that appear in British Columbia. The public is encouraged to report new sightings of invasive

plants through the IAPP application **"Report-a-Weed"** function (http://www.for.gov.bc.ca/hra/Plants/raw.htm), discussed in Part 3 of this guide, or through the IPCBC toll-free invasive plant hotline at 1-888-933-3722 (1-888-WEEDSBC).

5-YELLOW STARTHISTLE IS AN EDRR SPECIES

EDRR involves surveying, identifying, and preventing the establishment of invasive plant species that are new to British Columbia as soon as they are found. Regional rapid response activities are aimed at preventing establishment of an invasive plant species that is found elsewhere in the province but is new to the region. Effective education programs, surveillance, and timely reporting of new occurrences of invasive plants are critical to the success of both these detection and eradication programs.

The planning and delivery of on-the-ground treatments requires prioritizing invasive species to determine containment and control strategies, and for treatment. Invasive plants that are a significant threat to resources, the economy, or social values in a region are actively managed before other species that have lesser impacts. Once the priority species are agreed upon, methods for containing and controlling them can be determined. Consensus among partners is required for the establishment of containment lines, which are the delineation of an area or areas in which a particular invasive plant species will be contained. Once a containment line is established for a species, locating and treating infested sites outside of that line is the focus. However, if biological control agents are available, they may be used to control an invasive species both within the containment line and on sites beyond the line if it is not suitable to use other treatment techniques.

INTEGRATED PEST MANAGEMENT

Integrated Pest Management is a balanced, ecological management approach that employs a combination of knowledge, practices, and actions to achieve invasive plant management objectives. Techniques used include the following:

- accurate identification of species, and knowledge of the biology of the target plant and its impact on the environment;
- preventative practices and proper land management activities;
- inventory and monitoring of invasive plant populations;
- selection of active control measures or combinations of treatments that consider potential damage, cost of control method, and environmental impact of the invasive plant and particular control option;
- implementation of control strategies that may include a combination of methods;
- monitoring of results and evaluating effectiveness; and
- adjustment of strategies based on results and new information, as required.

The Invasive Alien Plant Program (IAPP) Application

The centralized, web-based Invasive Alien Plant Program (IAPP) application promotes effective communication, collaboration, and planning of invasive plant programs in British Columbia. It is composed of two modules: a database that houses inventory, treatment, monitoring, biocontrol agent dispersal, and planning information (described in Part 2); and an interactive mapping component that displays the information (described in Part 3). All land management agencies and stakeholders involved in invasive plant management in the province are encouraged to use IAPP; participation is increasing over time.

By sharing invasive plant information through a centralized database, agencies involved in invasive plant management are able to plan and co-ordinate their activities, optimize the use of their resources, avoid duplication of efforts, and record plans for future surveys and treatments. This is important, as there are many agencies performing invasive plant management on the land base, and their activities can overlap and possibly conflict. Coordination will avoid incompatible treatment activities and duplicated efforts, and will additionally protect investments made to manage invasive plants.

LEGISLATION

Many pieces of provincial and federal legislation govern invasive plant management in British Columbia. An overview of key legislation relating to invasive plants is provided below. More information about legislation, regulation, and policy governing invasive plant management in British Columbia is included in Report #3 of the Invasive Plant Council of BC (2007): A Legislative Guidebook to Invasive Plant Management in BC, which can be found at: http://invasiveplantcouncilbc.ca/publications/ipcbc-reports/IPC3-Legislative-Guidebook.pdf

For additional information on statutes and regulations in British Columbia, visit: http://www.bclaws.ca/.

Information on federal laws can be found at: http://laws.justice.gc.ca/en/.

PROVINCIAL LEGISLATION

1. ***Forest and Range Practices Act*** (FRPA)

Ministry of Forests and Range: FRPA describes the responsibility for preventing the introduction and spread of invasive plants resulting from a forest or range practice. Specific reference to invasive plants is made in section 47 of the Act, which states the following: "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."
http://www.for.gov.bc.ca/tasb/legsregs/frpa/frpa/frpatoc.htm

FRPA Invasive Plants Regulation—Currently, 42 prescribed species of invasive plants are listed in the Invasive Plants Regulation. Section 17 of the Regulation states the following regarding invasive plants: "For the purpose of section 47 of the Act, a person who prepares a forest stewardship plan must specify measures in the plan to prevent the introduction or spread of species of plants prescribed in the Invasive Plants Regulation, if the introduction or spread is likely to be the result of the person's forest practices."
http://www.bclaws.ca/Recon/document/freeside/--%20F%20--/Forest%20and%20Range%20Practices%20Act%20%20SBC%202002%20%20c.%2069/05_Regulations/18_18_2004.xml

http://www.for.gov.bc.ca/tasb/legsregs/frpa/frparegs/forplanprac/fppr.htm#section17

Section 15 of the Regulation states that: "For the purpose of section 47 of the Act, a person who prepares a range use plan or a range stewardship plan must specify measures in the plan to prevent the introduction and spread of species of plants that are invasive plants under the Invasive Plants Regulation, if the introduction, spread, or both are likely to be the result of the person's range practices."
http://www.for.gov.bc.ca/tasb/legsregs/frpa/frparegs/rangeplanprac/rppr.htm#section15

2. *Weed Control Act*

Ministry of Agriculture and Lands: As enabling legislation, the Weed Control Act aims to control the spread of designated noxious weeds on all provincial Crown and private land in British Columbia. There is an obligation under the Act for the land occupier to control these designated noxious weeds. There are currently 21 species classed as noxious within all regions of British Columbia and 27 additional species are listed as noxious weeds within the boundaries of certain Regional Districts.
http://www.qp.gov.bc.ca/statreg/stat/W/96487_01.htm

3. Community Charter Spheres of Concurrent Jurisdiction – Environment and Wildlife Regulation

Ministry of Community Development: This Regulation provides municipalities with the authority to control or eradicate invasive species within their jurisdiction. Forty-seven terrestrial plant species are considered invasive under this Regulation.
http://www.bclaws.ca/Recon/document/freeside/--%20C%20--/Community%20Charter%20%20SBC%202003%20%20c.%2026/05_Regulations/39_144_2004.xml

4. *Integrated Pest Management Act*

Ministry of Environment: This Act establishes conditions for the sale and use of pesticides in British Columbia

through a pesticide classification system and regulatory provisions for licences, certification, permits, pesticide use notices, and pesticide use notice confirmations. It also specifies reporting, monitoring, and enforcement requirements. Under this Act, all pesticides must be used as part of an Integrated Pest Management program. Federal lands such as Indian Reserves and National Parks are exempt.
http://www.bclaws.ca/Recon/document/freeside/--%20I%20--/Integrated%20Pest%20Management%20Act%20%20SBC%202003%20%20c.%2058/05_Regulations/10_604_2004.xml

5. *Environmental Management Act*

Ministry of Environment: This Act identifies powers of the Minister to prevent the introduction of wastes into the environment and requires that used pesticide containers be emptied and rinsed in a specific manner, then recycled or disposed of in an approved landfill. The Act also outlines the process for appeals of pesticide use to an Environmental Appeal Board.
http://www.bclaws.ca/Recon/document/freeside/--%20E%20--/Environmental%20Management%20Act%20%20SBC%202003%20%20c.%2053/00_Act/03053_01.xml

6. *Pipeline Act*

Ministry of Energy, Mines, and Petroleum Resources: This Act requires companies that operate pipelines to annually treat invasive plants growing adjacent to pipelines.
http://www.bclaws.ca/Recon/document/freeside/--%20p%20--/pipeline%20act%20%20rsbc%201996%20%20c.%20364/00_96364_01.xml

7. *Hydro and Power Authority Act*

Ministry of Energy, Mines, and Petroleum Resources: BC Hydro and the BC Transmission Corporation are exempt from FRPA, the Community Charter, and the *Weed Control Act*. However, the *Hydro and Power Authority Act* states that they are not exempt from the *Integrated Pest Management Act*.
http://www.bclaws.ca/Recon/document/freeside/--%20h%20--

/hydro%20and%20power%20authority%20act%20%20rsbc%201996%20%20c.%20212/00_96212_01.xml

8. *Transport of Dangerous Goods Act*

Ministry of Public Safety and Solicitor General: This Act is intended to protect people and the environment from the hazards of accidental spills of dangerous goods. It regulates the transportation of pesticides.
http://www.bclaws.ca/Recon/document/freeside/--%20t%20--/transport%20of%20dangerous%20goods%20act%20%20rsbc%201996%20%20c.%20458/00_96458_01.xml

Federal Legislation

1. *Plant Protection Act*

Canadian Food Inspection Agency: This Act prevents the introduction or spread of pests that may be destructive to Canadian agriculture or forestry crops. It also describes the requirements for the introduction of biological control agents into Canada.
http://laws.justice.gc.ca/en/P-14.8/index.html

2. *Wild Animal and Plant Protection and Regulation of International and Inter-Provincial Trade Act*

Environment Canada: This Act controls international and inter-provincial transport of wild animals and plants as a means of preventing the introduction of harmful species, including invasive plants.
http://laws.justice.gc.ca/en/W-8.5/index.html

3. Pest Control Products Act

Pest Management Regulatory Agency (PMRA): This Act requires that all pesticides be registered by the PMRA before they can be sold or used in Canada. Data concerning physical and chemical properties of active ingredients, toxicology, residuality, efficacy, and environmental persistence and degradation must be submitted to and reviewed by PMRA before a pesticide is considered for registration.
http://laws.justice.gc.ca/en/P-9.01/

4. *Migratory Birds Convention Act*

Environment Canada: This Act establishes criteria for protecting migratory birds from improper use of pesticides.
http://laws.justice.gc.ca/en/M-7.01/

5. *Fisheries Act*

Environment Canada: This Act establishes criteria for protecting fisheries and fish habitat from improper use of pesticides.
http://laws.justice.gc.ca/en/F-14/

6. *Food and Drugs Act*

Health Canada: This Act establishes maximum pesticide residue limits that are considered to be safe levels in or on foods intended for human use.
http://laws.justice.gc.ca/en/F-27/

7. *Seeds Act*

Canadian Food Inspection Agency: This Act governs the testing, inspection, quality, sale, and transportation of seed in Canada. It includes regulations that identify the species of plants classified as noxious weed seeds for the purpose of establishing seed grades.
http://laws.justice.gc.ca/en/S-8/index.html

8. *Canada National Parks Act*

Parks Canada: This Act provides for the prevention of exotic plant and animal introductions into national parks, and for elimination or containment of such species where they already exist.
http://laws.justice.gc.ca/en/N-14.01/index.html

MODULE 1.3:

INVASIVE PLANT PREVENTION

THIS MODULE COVERS:

- the importance of preventing invasive plant establishment;
- how to encourage prevention through public awareness; and
- what practices to be aware of.

PREVENTION

Prevention is the most practical, economic, and effective way to manage invasive plants. Impeding the dispersal and hindering the establishment of invasive plants to uninfested areas are critical aspects of invasive plant management. Detecting new invasive plant occurrences early will usually simplify their control. However, preventing invasive plant establishment requires public awareness and improved practices, as described below.

PUBLIC AWARENESS

Early detection of new invasive plant infestations is essential to stopping their spread. There is a much higher probability of gaining control over invasive plants when their populations are small and more manageable. An informed public that can identify invasive plant species can help prevent those species from spreading, through early detection and reporting of occurrences. Public awareness is most successfully built through coordination with the many groups and agencies involved in invasive plant management. Many provincial-level and regional programs are in place to help increase public awareness of invasive plants and their impacts.

Improved Practices

In general, preventing invasive plant establishment can be achieved by modifying cultural practices and applying an integrated approach to land use. Management practices that maintain native vegetation in a vigorous, productive condition should be emphasized as a means of deterring the establishment and spread of invasive plants. Forest and range activities must be carried out in a manner that prevents the introduction or spread of invasive plants. Some key cultural practices are discussed below.

6-Selection of native plants

Plant and cultivate native and non-invasive species

Many ornamental plants that adorn yards and gardens cannot survive without cultivation. The plants that easily establish and grow, however, are often invasive and can create significant impacts if able to spread by wind, birds, and in other ways. Therefore, horticultural plants available for purchase, or traded between neighbours, must be non-invasive.

Many beautiful invasive plant species have been available for purchase at nurseries and landscaping retail outlets. However, increased awareness within the horticulture industry is leading to successful self-regulation to stop the sale of invasive plants. Resource materials to help gardeners select suitable non-invasive species are available at some nurseries and retail outlets, as well as on the Invasive Plant Council of BC website. Gardeners are advised to enquire about a plant's invasiveness, particularly if it is promoted as a species that easily establishes and grows. They are also encouraged to increase awareness within their neighbourhoods and clubs about invasive plants to collectively prevent invasive plant establishment and spread.

Minimize soil disturbance

Appropriate forest and range management practices will help native plant communities remain resistant to invasive plants. This includes the following approaches:

- manage for a late seral plant community. Although some invasive plants can establish in late seral or potential natural community plant

communities, earlier seral stages are more susceptible to colonization by invasive plants;

- manage grazing to prevent excessive soil disturbance at salt areas, watering sites, stock trails, and corrals. Some disturbance is inevitable at these sites, so they must be checked frequently for invasive plants; and
- minimize soil disturbance during road construction and maintenance.

Areas that are repeatedly disturbed, such as livestock congregation areas and recreation sites, are particularly susceptible to invasive plant invasion. The first step in reducing the risk of infestation is to reduce disturbance through sound management. For example, salt locations and range riding can distribute livestock over the range and reduce disturbance. This will allow the native vegetation to recover, which will make the site less susceptible to invasive plant invasion.

Act quickly to re-establish vegetation

Land disturbance may be unavoidable, however, such as when fires disturb ecosystems and plant communities, creating sites where invasive plants can easily establish. Vegetation should be re-established on disturbed areas as quickly as possible, preferably within two weeks during the growing season. Use a seed mix that includes fast, early-growing species of grasses and legumes that are non-invasive and suitable for the local site characteristics and the area's management objectives. Successful re-seeding also requires consideration of the following factors:

- the site's biogeoclimatic unit, soil type(s), slope, and aspect;
- plant species to be used;
- the most appropriate seeding methods for the site;
- the most appropriate rates and timing of seeding; and
- management objectives for the area.

All seed sold in Canada is subject to the federal *Seeds Act*, and thus is subject to conditions regarding prohibited and primary noxious invasive plant seed. Section 3(1) of the Act states the following:

3. (1) Except as provided by the regulations, no person shall:

(a) sell, import into Canada or export from Canada any seed unless the seed conforms to the prescribed standard and is marked and packed and the package labelled as prescribed, or

(b) sell or advertise for sale in Canada or import into Canada seed of a variety that is not registered in the prescribed manner.

MINIMIZE INVASIVE PLANT DISPERSAL

Invasive plant seeds can be dispersed by wind, water, animals, people, and machinery. Some invasive plants are also spread when root fragments are transported to new locations. The following table of vector management techniques is provided to help minimize the dispersal of invasive plants:

Vector type	Description	Examples	Activities to prevent
Wind and water	Many invasive plant species, such as thistles, have specialized featherlike structures (pappus) attached to their seed coat. The pappus allows the seed to readily disperse by wind. Seeds and root fragments are also carried by water.	Canada thistle Yellow flag iris	• Remove and properly dispose of invasive plants before flowering. • If treated after flowering, invasive plants should be dug up or clipped and the seed heads bagged to prevent seed dispersal. • Take refuse to landfills where the material will be buried deep or the surrounded area will be treated for escaped invasive plants.
Human transport	Hikers, tree planters, and other forest and range workers can unknowingly transport invasive plant seeds and plant parts from an infested area to an uninfested one.	Hound's-tongue Burdock	• Check clothing and equipment after being out of doors. • Check any pets that are travelling with you.
Livestock and wildlife	Both livestock and wildlife graze on some invasive plant	Seeds of burdock, hound's-	• Allow seeds to pass through animals before they are moved to a non-

	species. Seeds of invasive plants can be moved to new locations by animals that create caches of seeds for later use, or transported through an animal's digestive system. Cattle, horses, working dogs, pets, and birds are all capable of transporting invasive plants seeds.	tongue, and sulphur cinquefoil	infested area, which can usually be accomplished by holding the livestock for three days in an area that is free of invasive plants. • Ensure livestock are free of invasive plant seeds when moving the animals into a non-infested area. Remove all seeds attached to their coat.
Vehicles	Invasive plants can often travel by attaching to vehicles.	Knapweeds	• Inspect the undercarriages and wheel wells of logging trucks and other vehicles, and remove any attached parts of invasive plants before leaving an infested area. • Before machinery is moved or livestock are trailered into an area that id free of invasive plants, consider spraying, mowing, or hand pulling invasive plants along the travel route
Horticulture	Garden refuse containing invasive plants can spread to uninfested areas if not properly disposed. Wildflower seed mixtures can contain invasive plant seeds.	Purple loosestrife Lamium Yellow archangel	• Avoid landscaping with creeping rootstock ornamentals; remove any existing ones and discard them in a designated landfill. • Keep invasive plants out of compost piles. • Remove invasive plants before selling your property. • Avoid growing non-native herbal remedy plants. • Avoid using invasive plants in dried flower arrangements—for example, teasel.

			• consumers should buy wildflower seed mixtures that are free of invasive plant seed.
Soil and gravel transport	Transporting soil and gravel infested with invasive plant species seeds expands the infestation to new areas Infested stockyards of soil and gravel subsequently infest new areas when transported	Knapweeds Hoary alyssum	• Locate any invasive plant species on a site, and confine and treat soil and gravel contaminated with invasive plants so it can be treated before being removed and transported. • Maintain gravel pits and soil stockpiles as weed-free as possible.
Road and utility construction and maintenance	Disturbed soil provides opportunities for invasive species to establish	Knotweeds	• Where possible, limit road maintenance to the road surface so that the vegetated areas along the road are retained. • Ensure that gravel used for a road construction contains no invasive plant seed or rhizominous plant parts.

Activities to be aware of

The following activities may introduce invasive plants or encourage their spread:

Forestry

- road building and maintenance
- landing and skid trail construction
- harvesting that exposes mineral soil
- post-harvest site preparation
- movement of machinery related to the above activities
- log hauling

Range

- grazing that creates early or mid-seral plant communities
- trampling around salting sites and other livestock congregation areas

- building of stock trails, water developments, and corrals
- herding livestock in ways that encourage trampling and exposed mineral soil
- transport of invasive plant seeds on stock dogs or cattle

Horticulture

- unrestricted importation and planting of potential invasive species
- sharing of invasive plants among neighbours and garden club members
- improper disposal of garden refuse

Recreation

- off-trail soil disturbance by all-terrain vehicles and mountain bikes, and hikers establishing trail shortcuts on switchbacks
- transport of invasive plant species attached to watercraft (for example, Eurasian watermilfoil)
- transport of invasive plant seed in clothing, pets, or by bikes or ATVs

For guidelines on addressing invasive plant management in operational plans, as required by the *Forest and Range Practices Act*, refer to the Provincial Invasive Plant Guidelines in Part 4 of this guide.

MODULE 1.4:

PLANNING INVASIVE PLANT MANAGEMENT PROGRAMS

THIS MODULE COVERS:

- resources available for planning invasive plant management programs and how they can be accessed;
- factors involved in constructing invasive plant management plans;
- situations when the development of a Pest Management Plan is required under the Integrated Pest Management Act;
- how various plans interact; and
- using the Invasive Alien Plant Program application to develop, implement, review, and adjust plans.

INTRODUCTION

Invasive plant management involves the integration of numerous activities across a landscape with multiple jurisdictions and organizations. Therefore, it is important to consider more than a specific activity, organization, or geographic area when developing plans.

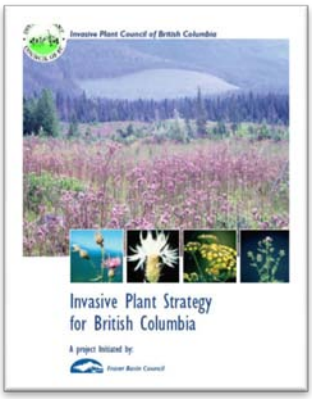
Planning invasive plant management programs and activities usually involves two components: strategic plans and tactical or annual work plans. Strategic plans function at a large scale and indicate what goals are to be achieved and where to apply management activities. They can specify general and long-term goals, such as "prevent the introduction of new invasive alien plant species," and can include immediate requirements of regional rapid response to new invasive plants in the region.

The more detailed tactical or work plans provide the steps or directions that must be followed to achieve the strategic plan's goals. A work plan is developed to outline how awareness training, reporting, and responses of treatment crews will be conducted, for example, along with measurement

milestones and monitoring activities to ensure that an effective regional rapid response program is in place.

The Ministry of Forests and Range, Invasive Plant Program participates with regional invasive plant committees in developing strategic plans. Where delivery of on-ground management activities is through a pooled resource partnership approach, the ministry also participates in establishing and updating annual work plans with invasive plant committees and other land management agencies.

Available Resources and Plans



Invasive Plant Strategy for British Columbia

The *Invasive Plant Strategy for British Columbia* (2004) is "a process-oriented framework developed to improve province-wide invasive plant management."[2] The strategy enabled the establishment of the Invasive Plant Council of BC, and it provides guidance for developing regional or agency strategic plans.

Provincial Government Strategy

The provincial government strategy[3] outlines three strategic goals for addressing invasive plants on Crown land:

1. Prevent the establishment of new invasive plant infestations in British Columbia.
2. Reduce the socio-economic and environmental impacts of existing invasive plants in British Columbia.
3. Provide a framework and capacity for the ongoing management of invasive plants.

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[2] Available from the Invasive Plant Council of BC's web page: http://www.invasiveplantcouncilbc.ca. On the web page, click on "About Us": "The Strategy" is listed on the left panel.

[3] Inter-Ministry Invasive Species Working Group. 2008. Invasive Alien Plants in British Columbia – The Provincial Government Strategy for Protecting Our Resources

The strategy also identifies objectives and actions required to achieve each goal. This document provides the framework for the various agencies represented on the Inter-Ministry Invasive Species Working Group to achieve the strategy's objectives.

Regional Strategies

Regional strategies, or strategic plans, identify regionally specific invasive plant species priorities. Examples of such plans include the Northwest Invasive Plant Council (NWIPC) 2009 Strategic Plan and Plant Profiles (found at http://nwipc.org/downloads.php) and the Central Kootenay Invasive Plant Management Strategy (found at http://www.kootenayweeds.com/regional.php). Regional strategies are used as guides and models to develop detailed work plans for a geographic area or an organization.

Regional strategies usually include the following components:

- Overall goal(s). For example, the NWIPC overall goal is "to prevent further damage to the ecosystems of northwest and central BC from invasive alien plants and begin to rehabilitate ecosystems that have been degraded by invasive alien plants."
- It is important that stakeholders and others in a geographic area or an organization develop, agree upon, and work towards overall goals or visions.
- Operating principles: One example is in the Invasive Plant Strategy for BC, which states the following: "Two important principles of the 'Invasive Plant Strategy for British Columbia' are that it incorporates integrated pest management practices and an ecosystem approach."
- Categorization of invasive plant species: At the regional or organizational level, processes can be developed for categorizing invasive plants based on characteristics such as how aggressive they are, or the degree of impact they will have on sensitive habitats or economic activities such as the production of grass and legume seeds.
    - For example, the NWIPC plan uses the following approach for categorizing invasive plants: "The aggressiveness and range of habitats that invasive plants will infest and dominate are estimated. This is done by reviewing literature on the habitat range and aggressiveness of invasive plants, having scientists review and advise NWIPC, and having the collective membership

of NWIPC, which has substantial expertise and experience, assess invasive plants. The various invasive plants present or threatening northern BC are then categorized. The process is flexible and reviewed by NWIPC on an ongoing basis … Based on similar provincial groupings, invasive plants are given a rating or category." The NWIPC plan groups more than 60 invasive alien plant species identified as present and/or threatening into four categories based primarily on how aggressively they invade natural undisturbed habitats.

- Prioritization of sites: At the regional or organization level, processes can be developed for prioritizing treatment of sites infested by invasive plants. Prioritization can be based on factors such as the opportunity for control. For example, small infestations that are adjacent to largely uninfested, susceptible habitats and which could be effectively treated by several methods, would be given higher priority than large infestations that are not adjacent to uninfested areas and which have limited treatment options.
    - For example, the NWIPC plan uses the following approach for prioritizing sites: "priority 1 – extremely high opportunity for control - To stop the spread of invasive plants threatening currently un-infested, highly susceptible areas. These sites are less than or equal to 0.25 ha and there is a good expectation of control. This priority also includes sites that are threatening a large neighbouring economic base, for example, seed and other high value crops."
    - "priority 4 – low opportunity for control - To stop the enlargement/contain sites greater than 0.5 ha in moderately susceptible areas."
- Injury thresholds or treatment matrices: The invasive plant categories and site priorities can be used to create a matrix that indicates when treatment is critical and defines various program levels. For example, the NWIPC plan indicates that category 1 invasive plants up to priority sites 3, and category 2 invasive plants up to priority site 1, are classed as a critical program level, which includes Regional Rapid Response to new invaders. The matrix produced in a strategic plan can usually be transferred to a PMP to meet the requirements of the Integrated Pest Management Act.

- Profiles of invasive plant species that are present or of threat: Regional and organizational strategic plans often include a list, with profiles, of invasive plant species that are of concern or are considered to be a threat. The profiles include information, both local knowledge and scientific findings, about the plants, their management requirements, and species-specific goals and treatment methods. The profiles can also indicate where containment of an infestation is being addressed and which species are involved. A containment area defines an area in which an invasive plant species has become so well-established that it is no longer worthwhile trying to eradicate it from the area. Instead, treatment is focussed on eradicating occurrences of the species outside the perimeter of the containment area in order to prevent the species from expanding into surrounding areas. Within the defined area, containment efforts may include one or more of the following: preventing seed spread, protecting critical habitats, and site rehabilitation.
- Processes and procedures: Some strategic plans include descriptions and schematics outlining processes and procedures for activities such as public or hotline reporting of infested sites, Regional Rapid Response, and containment. Examples of this can be found in the appendices of the NWIPC 2009 Strategic Plan and Profile.

Pest Management Plans

Herbicide treatments of invasive plants on public lands must comply with the *Integrated Pest Management Act*. Under regulation 5(1) 1: "the management of noxious weeds or invasive plants on not more than 50 ha a year of public land managed by a single entity" is allowed by, or through the employment of, a service licence holder. Alternatively, a Pesticide Use Permit (PUP) or Pest Management Plan (PMP) is required for herbicide treatments on public land. The requirements and components of PMPs are outlined in the *Integrated Pest Management Act* and regulations; additional information is available on the Ministry of Environment web page: http://www.env.gov.bc.ca/epd/ipmp/. Regional or organizational strategic and tactical plans often contain information needed to develop PMPs. Consequently, strategic and tactical plans usually cross-reference and link with PMPs.

Pest Management Plans are the basis for all herbicide use, which is covered in Module 1.8.

Tactical or Work Plans

Tactical plans, or work plans, are often subsets of regional or organizational strategic plans, and they generally focus on a current year's activities. For example, many regional invasive plant committees divide their operational areas into Invasive Plant Management Areas and develop a tactical or work plan for each one. Alternatively, organizations divide their invasive plant management activities into components and develop tactical or work plans for extension and awareness, regional rapid response, and containment, for example.

Tactical plans for geographic areas or Invasive Plant Management Areas often have the following components:

- a summary of the work planned for the area during the specified time period. The proposed work is often dictated by the available budget; therefore, the plan presents options or levels of activity that vary depending on expected and realized financial and personnel resources.
- a description of what will be done, or is expected to be done, with regards to Regional Rapid Response, containment, and rehabilitation.
- a description and timing of activities—for example, when treatments will commence, when any needed subsequent visits to sites will be made, when sites will be monitored, and when reporting will occur.
- a description of related activities and how they will be integrated—for example, the system to be used for public reporting of invasive plant sightings; how that information will be relayed to treatment crews; key people and other crews working in the area, and how these people will be identified and contacted to co-ordinate activities.
- a description of responsibilities for entering information into IAPP, how the information will be entered, and it will be retrieved from the IAPP application.

Developing Plans

Collaborative planning is a challenging and rewarding endeavour. The first step in the process is to identify land management goals and overall invasive plant management objectives. Specific steps and considerations to develop plans include the following:

- Review existing information, such as strategies, existing plans, local knowledge, and scientific findings, and use that information to begin developing components of the plan, including profiles of invasive plant species of concern where appropriate. The inventory information in the IAPP application is particularly useful for this purpose as it indicates the presence of various invasive plant species. However, it must be recognized that IAPP and other inventory information may be incomplete. Over time, as more information is entered into IAPP and the integrity of existing data is verified, analysis will become easier.
- Once a profile of an invasive plant species is begun, other invasive plant managers can contribute their observations and knowledge. The description of, and the information about, the species will likely improve in subsequent drafts of the profile. A profile can be used to categorize invasive plants and identify site conditions that influence treatment decisions; therefore, it can form the basis for prioritizing management efforts.
- Identify the range of activities, organizations, and people influenced by or interested in the plan, and solicit participation in plan development.
- Hold discussions with the individuals identified above and aim for consensus on overall and specific goals, strategies, and operating principles.
- Develop milestones, timetables, and roles and responsibilities in tactical plans.
- Tactical or work plans are often quite specific when identifying invasive plant species that need to be treated and sites and geographic areas where management activities are required. Because IAPP is a repository for inventory information, it is particularly useful for developing and adjudicating these types of plans.
- Ensure plans are regularly reviewed, adjudicated, and adjusted.

Using the Invasive Alien Plant Program (IAPP) for Planning

The Invasive Alien Plant Program (IAPP) is a centralized, web-based application with two modules: a database that houses inventory, treatment, monitoring, biocontrol agent dispersal, and planning information (described in Part 2); and an interactive mapping component that displays the information (described in Part 3). The IAPP

application is therefore an essential tool for invasive plant management planning.

The development and use of tactical plans and work plans often indicates species and locations requiring inventory and treatment. These plans may even identify specific sites, such as containment areas, for inventory and later treatment and monitoring. IAPP is a valuable tool for acquiring information to develop plans, planning site-specific activities, and sharing this information with others, and conveying information to crews about areas and species to inventory and treat. Since IAPP is the repository for information that crews collect in the field, it can be used to adjudicate and update plans, as well as generate abstracts to prepare reports. However, caution must be used when analyzing IAPP information, for the reasons mentioned above.

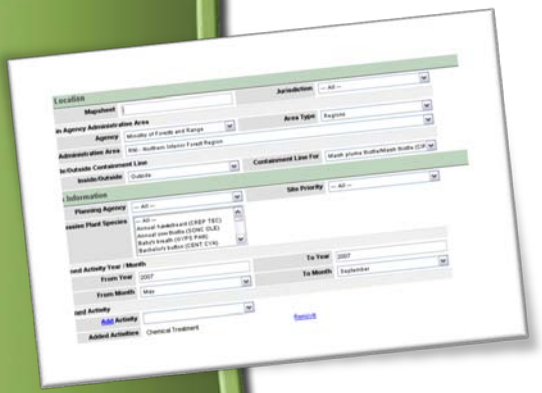
Getting information for plans through IAPP extracts

The map display and extracts functions in IAPP can be used to identify known locations of invasive plant species.

Extracts, particularly when used in conjunction with profiles of the various invasive plant species, can indicate which species need to be managed through regional rapid response, containment, and rehabilitation strategies.

Extracts can also be developed to determine which agencies and jurisdictions need to be involved in invasive plant management to integrate and coordinate management activities.

Once a plan has prioritized invasive plant species and/or sites, IAPP can be used to estimate the amount and location of work required to implement it. The use of containment lines is extremely useful in this type of exercise.



Conveying information from plans to crews through IAPP extracts and planning functions

IAPP can be used to generate extracts for known infestations of targeted invasive plant species within defined geographic areas, such as regional districts, forest districts, provincial parks, etc. These extracts can then be modified to produce site lists, which crews can use to implement inventory, treatment, and monitoring activities according to the plan's goals and

objectives. The site list can include the site's ID, UTM co-ordinates, location descriptors, target species, jurisdiction, and any other information that crews may need when working in the field.

IAPP's planning function can be used to identify specific activities for sites. The batch plan function can be used to identify actions for multiple sites of a specific species in a particular geographic area. For example, all marsh thistle sites outside a defined containment line can be targeted for inventory during a specific month and year. An extract that lists those sites, their jurisdiction, and location information can then be generated and provided to field crews.

Reviewing and adjusting plans through IAPP extracts and reports


Invasive Alien Plant Program
Treatment Summary Report
Treatment Agency: East Kootenay Invasive Plant Council
Report Criteria
Invasive Alien Plant Program
Treatment Detail Report
Treatment Agency: Ministry of Forests and Range
Report Criteria
Biological Treatments
Invasive Plant Species
Biological Agents
Number of Releases
Total Number of Insects

There are various reporting requirements and activities involved in invasive plant management. For example, holders of PMP confirmation numbers must submit an annual summary report to the Ministry of Environment. IAPP can be used to generate extracts that can be modified to develop such reports.

Monitoring extracts can be generated to indicate the adequacy of work performed and its adherence to a plan.

Extracts can be generated to compare the amount of work done to the amount required, as estimated in a plan. They can be created for various years to make year-to-year comparisons. The cautionary notes above about using the IAPP for analysis should be considered, however.

Reports allow users with IAPP Data Manager privileges to generate several standardized reports for year-end summaries and comparisons. The reports available include:

- Biological Control Monitoring Summary Report
- Inventory Summary Report
- Treatment Detail Report
- Treatment Summary Report
- Survey Report

MODULE 1.5:

INVENTORY AND MONITORING

THIS MODULE COVERS:

- Field preparation;
- Field procedures;
- Inventory standards;
- Inventory data recording;
- Sketch maps; and
- Photo inventory.

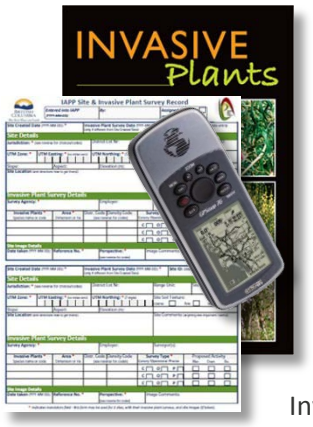
Invasive plant inventories are important for a variety of reasons. Inventories can be used to determine the extent of localized outbreaks of invasive species, define containment lines for treatment activities, calculate potential control costs, develop strategic plans for managing endemic species, and provide valuable information for research purposes. Regular surveillance can also identify new invaders and help ensure effective implementation of Early Detection and Rapid Response programs.

An invasive plant inventory consists of a general review of the species being investigated and the collection of detailed information about the species, such as the physical characteristics of the site, and its location and distribution across the landscape. The inventory may also include proposed treatment activities.

FIELD PREPARATION

Before heading to the field for an invasive plant inventory, existing inventory information should be reviewed to estimate the amount of time required to inventory a particular area or species to a desired standard. The Invasive Alien Plant Program (IAPP) Map Display module (described in Part 3 of this reference guide) allows highlighting of previously inventoried invasive plant species within a given area of interest. Additionally, the IAPP site selection extract function can provide detailed lists of sites that have been previously inventoried in a given area.

Current maps of the area to be inventoried must be obtained and used. The maps should be at a scale of 1:5,000 to up to 1:50,000, with 1:15,000 or 1:20,000 being the typical size used for most invasive plant work, and show features such as roads, water bodies, utility corridors, private land, and First Nations reserves. Satellite imagery and orthophotos of the area are also useful for drawing a spatial polygon of an infestation to be inventoried.



Other equipment needed to complete an inventory include inventory data sheets, plant identification books, related plant keys, and a GPS unit. A plant press is recommended for collection of voucher specimens for species that are new to an area or unknown by the observer.

Field Procedures

Invasive plant inventories can be conducted on foot or horseback, or with 4 x 4 or all-terrain vehicles. The chosen mode of transportation should have the least impact on the landscape being reviewed. If vehicles are used, speeds should not exceed 30 km/hour. While some inventories can be conducted by one experienced person, it is recommended that two people complete the work as it improves accuracy of observations, is more efficient, and maximizes safety when using motorized vehicles.

Begin the inventory on a selected road, and branch off onto smaller roads and trails, if necessary. While travelling, make careful observations of areas that have been recently disturbed or that are disturbed on a regular basis, as they are generally the preferred habitats of invasive plant species. These types of sites include road rights-of-way (including ditches), pullouts, landings, cutblocks, recreation sites, openings under the forest canopy, range developments and overgrazed areas, airstrips, and gravel pits.

It is helpful to make a record of the area inventoried and the inventory date, which can be done by creating an Excel spreadsheet, developing a track log with the GPS unit while travelling, or both. Track logs can be plotted on maps to show areas inventoried.

Before leaving the area after the inventory, be sure to check all clothing and travel equipment for any invasive plant parts, to avoid spread to other areas.

Inventory Standards

Inventory data should meet the standards set by the respective agency's program. Three standards for conducting inventories are used, depending on the level of detail required and the purpose for which the data will be used, as described in the following table.

Inventory Standard	Description
Cursory	This inventory standard provides a systematic process for acquiring baseline inventory data. Cursory inventories are often conducted for low-priority invasive plant species or for species that are endemic but not well-represented in existing inventory databases. The collected data are not as detailed as operational or precise inventory data. Cursory data may be used to indicate the presence of an invasive plant, and to inform other field personnel and researchers about a given site. These data cannot be used for analysis or research purposes. Only the minimum mandatory fields are required for entry into the IAPP application. They include, but are not limited to: • invasive plant species, • GPS co-ordinates, • area, and • comments.
Operational	The operational standard provides a systematic approach to acquiring accurate inventory data that can be used for analyses, as well as the following applications: • containment and control activities, • compliance and enforcement needs, • unit-based contract prescriptions, and • Pest Management Plan reporting requirements. Conducting an operational inventory of an infested site over 0.2 ha in area requires drawing a spatial polygon on a map. The polygon should represent the extent of the infestation to within 20 m of accuracy. The accuracy standard can be met by drawing the polygon on forest cover or orthophoto maps at a scale of 1:5,000 to 1:20,000. Spatial polygons are not required for invasive plant sites smaller than 0.2 ha. The mandatory fields for an operational inventory are the same as those required for IAPP data entry, as well as:

	• site location, • digital polygon for infestations larger than 0.2 ha, • distribution code, and • density code.
Precise	This standard provides a systematic process for acquiring accurate and highly detailed inventory data. It is designed for use in research and data analysis. These data can be used for various applications, including: • determining the rate of spread of an invasive species, • determining the risk and potential impacts of invasive plant populations, and • evaluating impacts of biological control agents on invasive plant populations. During spatial data collection, the perimeter of each infestation must be walked, and each polygon must be distinguished by a change in density greater than a factor of 2. Spatial polygons should be recorded as described in the operational inventory method above. The mandatory fields for a precise inventory are the same as those required by for IAPP data entry, as well as: • site location, • distribution code, • density code, and • soil texture

Inventory Data Recording

When a target species is found, information about it must be recorded on the "Site & Invasive Plant Inventory Record" form. Print-ready copies of this form can be downloaded from the "IAPP Field Forms" section at the bottom IAPP home page: http://www.for.gov.bc.ca/hra/Plants/application.htm. If the species was found on a new site, information about the site must be recorded in addition to the data gathered during the inventory of the infestation(s). If the target species was found on an existing site, only the Site ID and data gathered during the inventory need to be recorded.

If field personnel are unable to correctly identify a particular plant species as an "invasive alien", a photo or sample should be taken for later verification of the plant's identity. Care must be taken not to spill any seeds

or plant parts during collection and travel, however. A sealed paper bag works well for transporting samples.

Generally, continuous invasive plant occurrences with less than a 100-m gap between plants are recorded as one site. Occurrences over 100 m apart with no target species between them are recorded as separate sites.

It is mandatory to record the spatial distribution of target plants on infested sites that are larger than 0.2 ha. This can be done in one of two ways:

1. Make a visual estimate of the infestation. Draw the infestation using reference points on an approved forest cover map or orthophoto at a scale of 1:5,000 to 1:20,000. These polygons can be digitized later and loaded into IAPP.
2. Or, capture the spatial data with a GPS unit by walking the perimeter of the site and downloading the polygon that is generated.

A GPS location is required for any site. Ideally, the co-ordinates are taken at the centre of the infestation, or they can be derived from the centroid of a digitized polygon. (When using a GPS unit to obtain site co-ordinates, ensure that the NAD 83 datum is selected.)

Extremely large infestations (greater than 5 ha), for which creating a spatial polygon by walking the perimeter of the infestation would be impractical, can be assigned a best estimate of the total area, average density, and distribution.

When a single site supports multiple invasive plant species, record all the species on that site. Exceptions to this can occur when a priority invasive plant species with limited distribution in the survey area is found within a larger patch of another species, or group of species. In this case the observer may choose to identify a separate site for the priority species from the larger, surrounding infestation. Species may also be recorded as separate sites if one or more species occupies less than 0.2 ha, while other species have larger areas for which spatial data have been collected.

Under the *Freedom of Information and Protection of Privacy Act*, personal information collected from landowners during invasive plant inventories must be obtained directly from the individual with his/her knowledge of its intended use. However, personal information must not be entered into IAPP.

Sketch Maps

A good way to later relocate an invasive plant site is through a sketch map showing access to the site. The map should include the names of nearby towns and communities, road names, and the distance and direction travelled on each road leading to the site. Sketch maps can be scanned and added to IAPP provided that each image is under 200 KB in size.

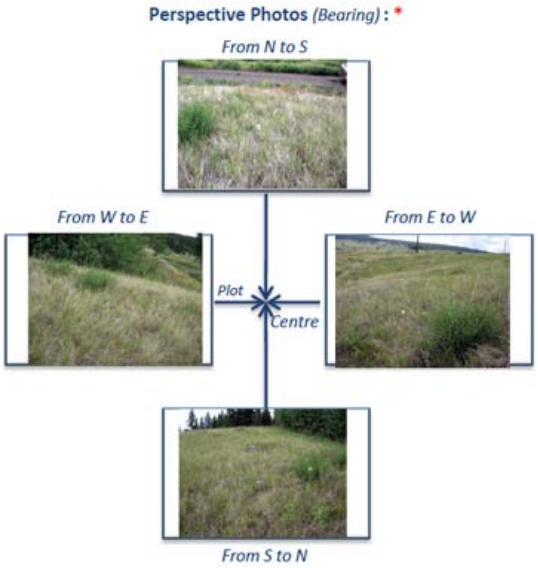


Photo Inventory

A photo inventory can be helpful to visually monitor changes in an invasive plant infestation over time. Either take individual photos of an invasive plant or infested site, or make a complete photo inventory consisting of a group of photos of the infestation. To monitor changes in the height of an invasive plant, a stadia rod (range pole) should be erected adjacent to a permanent photo point. A complete photo inventory of an infestation should include the following:

- Photos taken from each cardinal direction (north, south, east, and west). Photos should be taken 3 m from, and be directed toward, the photo point; and,
- A landscape photo that captures the best representation of the entire infestation while encompassing the release site.

Avoid taking pictures with people in them, or where unavoidable, ensure the individuals in the photograph are not recognizable (i.e. no facial shots). As previously stated, under the *Freedom of Information and Protection of Privacy Act,* personal information may not be disclosed to the public, and this includes photographs where the person within the photo can be easily identified.

Individual invasive plant inventory photos can be recorded in the image details section of the "Site & Invasive Plant Inventory Record". However, if a photo inventory has been completed, photo information should be recorded on the "Photoplot Record Form" which can be downloaded from

the "IAPP Field Forms" section at the bottom IAPP home page: http://www.for.gov.bc.ca/hra/Plants/application.htm.

Inventory photos should be uploaded into IAPP, but individual photos must be no larger than 200 KB. Copies of the photos may be kept in the project file and/or in a digital archive system created by the agency that conducted the inventory. The date, direction in which the photo was taken, and site number should be recorded on the back of each photo in the release file.

Each field of the Site & Invasive Plant Inventory Record form is explained below:

Field	Description
Data Entered into IAPP	Checkbox to designate that the site details have been entered into the IAPP Data Entry module, which demonstrates that the data exist electronically.
By	Text entry of the name of the individual who entered the data into IAPP. This allows for checking if data errors are noted or additional information is required.
Assigned Site IDs recorded on this form	Checkbox to be checked when the data entry has been completed, and the Site ID created by IAPP has been written in the **Site ID** box.
Site Created Date	Mandatory text entry; refers to the date when the field staff filled in the data on the form (*not* the date when the data entry staff member enters the record into the database)
Invasive Plant Survey Date	If the Site already exists in IAPP, then the Site Details portion of the form does not require to be filled out; however, the date for the survey details does need to be recorded.
Site ID	This unique identifier is created by IAPP. If the site already existed in IAPP, write the existing number here. If not, then write it in during the data entry process (see item 3 in this list).
Jurisdiction	Mandatory text entry to identify the legal entity that is responsible for the land on which the site is located
District Lot Nr.	Text entry to provide information regarding the lot that may be useful to Regional District users.
Range Unit ID	Text entry of a MFR administrative unit within a stock range
Site Paper File ID	Text entry to provide information, up to 20 characters, for cross-referencing paper and electronic files for a given site. The format of this field varies widely among agencies.
UTM Zone	Mandatory number entry; the zone in which the UTM easting and northing for the site location fall. **Ensure the GPS unit is set to NAD 83**.

UTM Easting	Mandatory number entry; although the GPS unit will display this as a 7-digit number starting with a zero, the initial zero is **not** recorded in IAPP.
UTM Northing	Mandatory number entry - a Northing will always have 7 digits, and will start with either a 5 or 6, depending on how far north the site location is.
Site Soil Texture: Coarse, Fine, or Organic	Checkbox for the relative amount of sand, silt, clay, and organic matter in a soil. (For in-house use only; this field cannot be entered into IAPP)
Slope %	Number entry to provide a measurement of how much the land surface deviates from the horizontal; measured with a clinometer (must be an integer between 0 and 90 in IAPP)
Aspect	Number entry to identify the direction that a slope faces; measured with a compass (must be an integer between 0 and 360 in IAPP)
Elevation (m)	Text entry to identify the height of land above sea level; measured with a GPS unit or an altimeter.
Site: Location	Text entry to provide the location of, and directions to, a site. Locations should start general and get more specific. For example: "Near Kamloops → North on Deadman Vidette Road → 15.2 km Criss Creek FSR."
Site: Comments	Text entry to provide an opportunity to enter any additional information about the site that has not been captured elsewhere. For example: "Must obtain gate key" or "Very steep terrain; not suitable for truck access".
Survey Agency	Mandatory text entry to identify the agency that conducted the inventory. "Agency" is defined as the legal entity that pays to have the inventory done.
Employer	Text entry of the employer who conducted the inventory. This may often be the name of a contractor hired to perform the work on behalf of the Survey Agency.
Surveyor(s)	Text entry to identify the individual(s) who conducted the inventory.
Invasive Plants	Mandatory text entry to indicate which invasive plant species are present at the site. For additional information, see the Invasive Plant Codes in Part 4 - Appendices.
Area (Ha)	Mandatory number entry of the estimated area of an invasive plant infestation, measured in hectares. Often, this is entered on the form in the field as a dimension, which is then translated into hectares by the data entry staff member.
Distribution Code	Text entry to describe the spatial distribution of invasive plants on a site. For additional information, see the Distribution Codes in Part 4 - Appendices.

Density (plants/m2)	Text box to provide an estimate of the number of plants per square metre, expressed in density classes. For additional information, see the Density Class Codes in Part 4 - Appendices.
Survey Type: Cursory, Operational, or Precise	Checkbox to identify the type of inventory completed at a site. See the definition of cursory, operational, and precise inventories provided earlier in this module.
Proposed Activity: M, C, B	Checkbox to provide an opportunity to recommend a treatment option following the inventory: M (mechanical), C (chemical),or B (biological).
Image Section: Date taken	If a picture is to be uploaded to the site, record the date the picture was taken.
Perspective	Mandatory text entry to indicate the direction in which the photo was taken (e.g., north to south)
Reference No.	Mandatory text entry of up to 20 characters to allow cross-referencing of the filing location/number of the image to the electronic image file
Image Comments	Text entry to provide space for entering any additional information about the photos taken that was not captured elsewhere.

Each field of the "Photoplot Record" form is explained in the table below:

Field	Description
Data Entered into IAPP	Checkbox to designate that the site details have been entered into the IAPP Data Entry module.
Entered By	Text entry of the name of the individual who entered the data into IAPP. This allows for checking if data errors are noted or additional information is required.
Date	Date that the photos were taken in the field.
Site ID	Automatically generated by IAPP; if the site already exists, enter the Site ID here; if the site does not yet exist then the data entry staff member will enter this number on the form once the site has been created.
Treatment / Monitoring ID	If the treatment or monitoring record, to which these photos will be attached, already exist in IAPP you may enter them here. Otherwise, the treatment or monitoring ID will be generated by IAPP at time of data entry.
Reference No.	Mandatory text entry of up to 20 characters to allow cross-referencing of the filing location/number of the image to the electronic image file
Photos Taken By	Name of the individual who took the photos.

Location	Accurate description of the location where the individual taking the photo was standing; important for future retakes for comparison purposes.
Purpose	Checkboxes for biorelease or weed/veg inventory. If the purpose is 'other', write a short purpose description.
Photo Retake?	Checkboxes indicating whether the photos are retakes.
Distance From Plot Centre	Number entry, in metres.
Camera Used:	Name, type and number of the equipment
Photo Numbers	Text entry to allow cross-referencing of the filing location/numbers of the images to the electronic image file.
Perspective Photos (graphic boxes)	Spaces to enter the photo numbers, indicating the direction in which they were taken.
Landscape Photos (graphic boxes)	Spaces to enter the photo numbers, indicating they were overview images of the site / infestation.
Aerial Photos (graphic box)	Space to enter the photo number(s), indicating they were ground shots (taken at a 90^0 angle above the ground).
Comments	Text entry to provide an opportunity to enter any additional information about the photos that has not been captured elsewhere.

MODULE 1.6:

TREATMENT METHODS OVERVIEW

The Ministry of Forests and Range uses an Integrated Pest Management approach to invasive plant management in British Columbia (described in Module 1.2). Once targets for acceptable levels of an invasive plant species in an area are established, control measures or combinations of treatments can be determined. The selection of method, or methods considers the potential efficacy and cost of the treatment method, and environmental impact of the targeted invasive plant and particular control option. For example, the goal for one site may be eradication, whereas it may be containment at another. A combination of treatment methods, if necessary, can then be used to achieve the established targets. This reference guide discusses three of those methods:

- Mechanical;
- Chemical; and
- Biological control.

MECHANICAL TREATMENT METHODS

Mechanical treatment of invasive plants includes all the physical methods to treat invasive plants, such as hand-pulling, digging, targeted grazing by livestock, ploughing, tilling, chainsawing, and weed whacking. These techniques negatively affect the plant's life cycle by cutting the plant at its base, destroying roots, preventing seed production, or depleting seed reserves. Mechanical control is most successful when completed before seed set, but is not an appropriate control method for rhizomatous plants that can sprout from root fragments. Hand-pulling, as a means of mechanical control, is often used in areas where chemical control is not an option, such as in riparian zones and around wells, or when biological control agents are unavailable for the target invasive plant species.

Mechanical control is discussed in more detail in Module 1.7 of this reference guide.

Chemical Treatment Methods

The Ministry's Integrated Pest Management (IPM) program includes herbicides, where necessary, for the spot treatment of invasive plants. The herbicides used depend on a number of factors, including the target plant species, as well as site conditions such as soil texture and associated plant species.

Legislation governing the use of herbicides in Canada, and more specifically in British Columbia, is designed to protect human health, non-target species, and the environment. Applicable federal legislation includes the *Pest Control Products Act*, the *Fisheries Act*, and the *Food and Drugs Act*. The *Integrated Pest Management Act* and the *Transport of Dangerous Goods Act* are two pieces of legislation governing herbicide use in British Columbia. As well, the *Integrated Pest Management Act* establishes conditions for the sale and use of herbicides in British Columbia. The Act also specifies that all herbicides used in the province must be part of an IPM program, and a Pest Management Plan must be developed.

Herbicide use is discussed in more detail in Module 1.8 of this guide.

Biological Treatment Methods

Biological control, or biocontrol, of invasive plants involves the deliberate use of naturally occurring organisms to limit the distribution and abundance of a target invasive plant species. These organisms are the natural enemies of the invasive plant in its native range. Biological control agents may include insects, mites, nematodes, and pathogens that kill the plant directly or reduce its vigour, reproductive ability, and competitive ability. The goal of biocontrol is to establish a long-term balance between the biological control agent and the invasive plant species.

The use of biological treatment methods is discussed in more detail in Module 1.9 of this guide.

MODULE 1.7:

MECHANICAL TREATMENT AND MONITORING

THIS MODULE COVERS:

- the various types of mechanical treatments that are used to control invasive plants; and
- how to record mechanical treatment and monitoring data.

The following data collection forms are discussed in this module:

- Invasive Plant Chemical & Mechanical Treatment Record
- Chemical or Mechanical Monitoring Record

MECHANICAL TREATMENT STRATEGIES

Various mechanical treatment strategies can be used to control invasive plants:

- Burning is an effective strategy for some species if seed production has already occurred, because it destroys some of the plant's seeds. However, the effectiveness of burning depends on various factors, such as the duration and intensity of the burn, and the seeds' maturity and location in relation to the fire.
- Cultivating or tilling prevents seed production and depletes the invasive plant's seed reserves in the soil.
- Digging is used to cut the invasive plant below its reproductive root—the point from which the plant sprouts.
- Hand-pulling is practical for individual invasive plants or small infestations. Plants should be pulled prior to seed production and when the soil is moist.
- Mowing is an acceptable strategy if there are too many invasive plants to hand-pull and cultivation is impractical or impossible. It is best to mow before seed production, and as close to the ground as possible.

Repeat mowing treatments may be necessary to fully deplete the plants' resources.

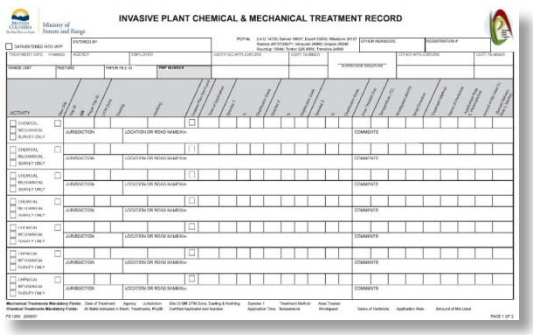
Grazing is also a mechanical treatment strategy, but it is not specifically tracked in IAPP. Mowing and grazing have similar effects on invasive plants, since removing the plant's top growth by the grazing animals prevents seed formation and gradually weakens the plant's underground resources.

- Mulching prevents light from reaching the top of the plant, which depletes the roots' reserve food supply and starves the plant.

Collecting and Recording the Data

Mechanical Treatment Record

The mechanical treatment of invasive plants must be recorded on the "Invasive Plant Chemical & Mechanical Treatment Record" form. Print-ready copies of this form can be downloaded from the "IAPP Field Forms" section at the bottom the IAPP home page: http://www.for.gov.bc.ca/hra/Plants/application.htm. The form should be used to record information in the field at the time of treatment. Later, in the office, the data should be transferred from the form into the IAPP Data Entry module, which is covered in Part 2 of this guide.


INVASIVE PLANT CHEMICAL & MECHANICAL TREATMENT RECORD

Note: The "Invasive Plant Chemical & Mechanical Treatment Record" form is also used to record the chemical treatment of invasive plants; therefore, it is also discussed in Module 1.8 in this guide.

Sample Mechanical Treatment Record Form

The following sample form includes descriptions that will help IAPP application users understand how to use each field on the "Invasive Plant Chemical & Mechanical Treatment Record" form. The descriptions also indicate the importance of each field to the Invasive Alien Plant Program. *Note that this is a dual purpose form for both chemical and mechanical treatments and therefore some fields may apply to only one or the other type of treatment.*

Field	Description
Data Entered into IAPP	Checkbox to designate that the site details have been entered into the IAPP Data Entry module.
Entered By	Text entry to record the name of the individual who entered the data into IAPP.
PCP #s	Mandatory field; applies only to chemical treatments.
Other Herbicide	This field applies only to chemical treatments.
Registration #	Mandatory field; applies only to chemical treatments.
Treatment Date	Mandatory text entry to indicate when the chemical or mechanical treatment was conducted
Agency	Mandatory text entry for recording the agency that paid to have the treatment performed, and able to provide information for future reference
Employer	Text entry to enter the name of the employer that conducted the treatment and possibly able to provide additional information about the treatment.
Certified Applicators	Mandatory field; applies only to chemical treatments. In case of a mechanical treatment this field is optional.
Cert. Number	Mandatory field; applies only to chemical treatments.
Supervisor Signature	Mandatory field; applies only to chemical treatments.
Other Applicators	Optional text entry, in case that more than one person carried out the treatment.
Cert. Number	This field is not applicable to mechanical treatments.
Range Unit	Text entry to indicate if the site is part of a Range Unit. Use an MFR administrative unit within stock ranges in some locations.
Pasture	Text entry to provide optional information that indicates if the site is part of a Pasture in a Range Unit
Paper File ID	Optional text entry to a maximum of 20 characters; this allows the agency to use their own specific data recording system in addition to the IDs created by IAPP.
PMP Number	Mandatory field; applies only to chemical treatments.
Activity	Mandatory checkbox to indicate the type of treatment applied.
New Site	Checkbox to designate the site does not yet exist in IAPP.
Site ID or Paper File ID	SITE ID: If the site already exists, enter the existing Site ID here so the treatment data may be attached to that site later by the data entry staff member. PAPER FILE ID: If the site doesn't yet exist, enter the agency Paper File ID here.
UTM Zone, Easting, Northing	Mandatory text entry fields if the site does not yet exist, and the "New Site" checkbox has been marked.
Invasive Plant Not Found	Checkbox to designate if no target species were found growing on the site. No other information, except Site ID, is required. Important for indicating whether previously existing target species are no longer present on the site.
Time of Application	Text entry to identify the time the applicator began the treatment.

Species 1	Mandatory text entry field of the species codes (See Part 4 of the reference guide) to identify the invasive plant species being treated.
%	Text entry field of the percent composition of each target species found on the site, adding to a total of 100 (i.e., 75% spotted knapweed and 25% sulphur cinquefoil would be SK 75 SC 25). It is important to identify the percentage of each target species being treated on a site in order to assign the correct percentage of the herbicide mix used to each plant treatment.
Distribution Code	Text entry for a derived combination of plant cover, to provide the distribution code for the species. See Part 4 of this guide for additional information.
Species 2 & 3	Text entry field using two-letter codes if there is more than one target species treated on a site, to identify the invasive plant species present and being treated (if there are multiple).
Area Treated (Ha)	Mandatory number entry to identify the estimated area treated
Temperature (ºC)	Mandatory field; applies to chemical treatment only.
Wind Speed (Km/h)	Mandatory number entry to provide climate conditions during the herbicide treatment.
Wind Direction	Number entry, between 0 and 360, to note wind direction during the herbicide treatment.
Treatment Method	Mandatory text entry to identify the type of manual or chemical treatment method using codes from the code sheets (Part 4). Important for indicating the various methods used to mechanically treat the site
Name of Herbicide	Mandatory text entry using a code (available in Part 4) to provide the name of the herbicide used. Not applicable to mechanical treatments.
Application Rate (L Herbicide/ha)	Mandatory number entry to provide the application rate of litres of herbicide per hectare. Not applicable to mechanical treatments.
Amount of Mix Used (L)	Mandatory number entry to provide the amount of **mix** used for the herbicide treatment. Not applicable to mechanical treatments.
Sprayer Delivery Rate (L Mix/ha)	Number entry to provide the sprayer calibration for the number of liters of herbicide mix are applied per hectare. Not applicable to mechanical treatments.
Jurisdiction	Mandatory text entry (obtain the information from the code sheet) to identify the site's jurisdiction—i.e., the legal entity responsible for the site.
Location or Road Name/Km	Text entry to provide the road system name or general location and identify nearby roads to the site; this is important for future applicators returning to the site.
Comments	Text entry for adding comments that may be useful for future reference, particularly if the site is hidden or if there

	is special information that should be highlighted.
Image Details	Image Details should include the following: Date, Perspective, Reference No, and Comments.

Mechanical Treatment Monitoring Record

The effectiveness of each mechanical treatment varies; therefore, site monitoring helps determine the long-term effectiveness of the treatment method used. The "Chemical or Mechanical Monitoring Record" form is used in the field to record mechanical treatment monitoring information. Print-ready copies of this form can be downloaded from the "IAPP Field Forms" section at the bottom of the IAPP home page: http://www.for.gov.bc.ca/hra/Plants/application.htm. The form should be used to record information in the field at the time of application. Back at the office, the data should be transferred from the form into the IAPP Data Entry module. Part 2 of this guide demonstrates how to enter information into that module.

Note: This form is also used to record chemical treatment monitoring of invasive plants; therefore, it is also discussed in the next module in this guide.

Sample Mechanical Monitoring Record Form

The following sample form includes descriptions for each field on the "Chemical or Mechanical Monitoring Record" form. The descriptions also indicate the importance of each field to the Invasive Alien Plant Program.

Field	Description
Data Entered into IAPP	Checkbox to designate that the site details have been entered into the IAPP Data Entry module by the data entry staff member.
Entered By	Text entry to record the name of the individual who entered the data into IAPP.
Inspection Date	Mandatory text entry to record when monitoring occurred
Site ID	Number entry; this number is generated by IAPP and is important to record so that the monitoring record may be attached to the correct site.
Treatment ID	The ID generated by IAPP for the treatment that is being monitored. This is important to record, so that the monitoring

	record may be attached to the correct treatment.
Monitoring ID	This ID will be generated by IAPP once the monitoring record has been entered; this number will be filled in by the data entry staff member upon completion of data entry.
Paper File ID	Optional text entry, up to 20 characters, to provide useful for cross referencing paper and electronic files. The format of this field varies widely among agencies.
Activity	Mandatory checkbox to indicate if the monitoring activities are being conducted for a chemical or mechanical treatment.
Surveyor Name	Mandatory text entry to identify the individual(s) who conducted the monitoring. This is important should others require additional information about the survey.
Target Plant Species	Mandatory text entry field to identify the invasive plant species that was previously treated and is now being monitored. Use the two-letter species codes or the seven-letter full codes, available in Part 4 of this guide.
Compliance	Text entry to Indicate whether the treatment crew has met the conditions of the contract, Pest Management Plan, or Pesticide Use Plan. Enter Yes or No. If No is entered, explain the non-compliance and actions required.
Efficacy Rating	Text entry to identify the efficacy rating of mechanical and herbicide treatments. The efficacy rating is the percent mortality achieved on a treated site according to the scale shown below. Consideration should be given to using the Expert Committee on Weeds (ECW) ranking scale, as it reduces the requirement to know the pre-treatment situation. The ECW scale, 1–9, can be used if the pre-treatment population of plants cannot be determined. Use the following efficacy ratings. If the monitoring occurred late in the season, and/or the pre-treatment population of plants cannot determined, estimate the acceptability of control as indicated by the modified ECW ranking scale. 10–100% efficacy complete control 9–90% to 99% efficacy] 8–80% to 89% efficacy] commercially acceptable control 7–70% to 79% efficacy] may need additional passes 6–60% to 69% efficacy 5–50% to 59% efficacy 4–40% to 49% efficacy 3–30% to 39% efficacy 2–20% to 29% efficacy 1–0% to 19% efficacy
Comments	Text entry for providing any comments about the monitoring activities

MODULE 1.8:

CHEMICAL TREATMENT AND MONITORING

THIS MODULE COVERS:

- legislation and regulations that apply to herbicide use; and
- how to record chemical treatment and monitoring data.

The following data collection forms are discussed in this module:

- Invasive Plant Chemical & Mechanical Treatment Record
- Chemical or Mechanical Monitoring Record.

HERBICIDES

Herbicides are chemicals that are designed to kill or regulate the growth of specific plant species or groups of species. Herbicides can be very effective but can pose risks if not properly handled, transported, and applied. Therefore, the use of herbicides is regulated through legislation.

The federal *Pest Control Products Act* regulates the development, approval, and use of herbicide products in Canada. Under this Act, herbicide label information is developed and approved for users. The herbicide label indicates which plant species can be treated, what application rates should be used, and what types of restrictions apply—for example, buffer zones are required around sensitive habitats. The application of herbicides on public or Crown land is further regulated through the provincial *Integrated Pest Management Act*. Under this Act and its Regulations, herbicide use on public lands must occur under a service licence, Pesticide Use Plan (PUP), or Pest Management Plan (PMP). Section 35 of the *Integrated Pest Management Ac*t Regulations indicates which information a service licence holder must collect when applying herbicides on public land.

To comply with specific legislation regarding herbicide use, the IAPP application requires some mandatory information requirements, as outlined below.

Calibration of Herbicide Delivery Rate

Calibration of the herbicide delivery rate is the process of determining the rate of fluid a sprayer delivers per hectare of land. Delivery rate provides a method for applicators to practice and maintain accurate application rates under all herbicide spraying conditions. This ensures that the proper amount of herbicide is used to control target species. Applying too much herbicide can damage desirable plants; applying too little can be ineffective and can lead to the need for more treatments (chemical or non-chemical), which increases costs. Since spray nozzles change as they wear, and applicators have different application techniques, it is important that equipment be calibrated regularly for each individual applicator.

Herbicide Selection

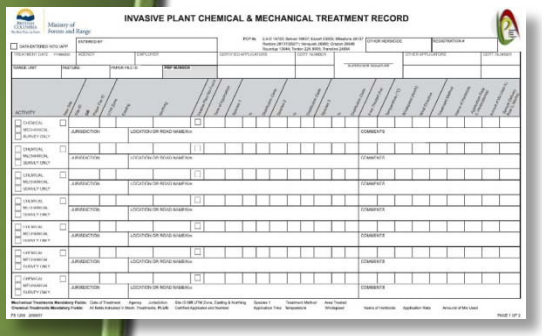
Several herbicides are registered for use in controlling invasive plants in British Columbia. Herbicide selection is based on the target invasive plant species, site characteristics of the infested area, and treatment objectives. The methods for determining which herbicide to use are referenced in various locations, including the applicable Pest Management Plan if the application is on Crown land. Specific herbicide labels, and Fact Sheets and Field Guides (see http://www.al.gov.bc.ca/cropprot/weeds.htm#field) are also useful tools in selecting the correct herbicides.

The "Handbook for Pesticide Applicators and Dispensers" is a reference for the safe handling of pesticides, available from the BC Government Distribution Centre (order form found at http://www.env.gov.bc.ca/epd/ipmp/pest_certification/study_materials.htm)

Collecting and Recording the Data

Chemical Treatment Record

Herbicide use to control invasive plants must be recorded in the field on the "Invasive Plant Chemical & Mechanical Treatment Record". Print-ready copies of this form can be downloaded from the "IAPP Field Forms" section at the bottom of the IAPP home page: http://www.for.gov.bc.ca/hra/Plants/application.htm. The form should be used to record information in the field at the time of application. Back at the office, the data should be transferred into the IAPP Data Entry module, which is covered in Part 2 of this guide. The *Integrated Pest Management Act Regulations*, Part 2 Administrators Regulations, Section 83 states that records for treatments done on public land must be kept for three years.


INVASIVE PLANT CHEMICAL & MECHANICAL TREATMENT RECORD

Sample Chemical Treatment Record Form

The sample form to help IAPP application users understand how to use each field on the "Invasive Plant Chemical & Mechanical Treatment Record" is explained on pages 48-50.

Chemical Treatment Monitoring Record

Monitoring is used to determine the efficacy of treatment and to record any treatment impacts, such as injury to non-target species. Monitoring is recommended for at least 10% of the treated sites; however, a greater amount should be completed when monitoring the highest priority sites (e.g., early detection and rapid response (EDRR) or containment). This amount will depend on the treatment objectives and urgency.

Chemical treatment monitoring information is recorded on the "Chemical or Mechanical Monitoring Record" form. Print-ready copies of this form can be downloaded from the "IAPP Field Forms" section at the bottom of the IAPP home page: http://www.for.gov.bc.ca/hra/Plants/application.htm. The form should be used to record information in the field at the time of application. Back at the office, the data should be transferred into the IAPP Data Entry module (again, covered in Part 2 of this reference guide).


Chemical & Mechanical Monitoring Record

Chemical or Mechanical Monitoring Record

The sample form to help IAPP application users understand how to use each field on the "Invasive Plant Chemical & Mechanical Treatment Record" is explained on pages 50-51.

MODULE 1.9:

BIOLOGICAL TREATMENT AND MONITORING

THIS MODULE COVERS:

- Defining biological control;
- Collecting and shipping biological control agents;
- Selecting the release site and releasing the agents; and
- Monitoring biological control agents.

DEFINING BIOLOGICAL CONTROL

Biological control, or biocontrol, is the use of a specific agent, an invasive plant's natural enemy, to reduce the plant's population to below a desired level. Biocontrol agents include insects, mites, nematodes, and pathogens that kill the plant directly or reduce its vigour, reproductive ability, and competitive ability. The objective of biocontrol is not eradication, but rather to reduce the targeted invasive plant population density to a level that no longer causes significant impacts on native species or ecosystem functions. The long-term goal of this approach is to establish a balance between the biocontrol agent and the target invasive plant species.

COLLECTING AND SHIPPING BIOCONTROL AGENTS

COLLECTING BIOCONTROL AGENTS

Collection methods for biocontrol agents depend on the species being collected and its host plant. The most commonly used methods involve collecting the agent by hand picking, aspirating, sweep netting, or gently tapping or shaking the host plant.

- Hand picking is used to collect agents that are large and easy to see. Agents are gently picked off the plant and placed in a container. Care must be taken when removing the insects because some adults will cling tenaciously to the plant and forceful removal may damage it.
- Modified vacuum suction aspirators are used to collect adult moths and other small adult insects. The collection tube is gently placed over the insect to draw it, head first, into a collection container. The suction strength used will depend on the species being collected. Moths should be removed with light suction to prevent damage to their wings; however, certain weevil species, such as *Mogulones cruciger*, require greater suction because they tend to cling more tenaciously to the plant.

- Lightweight cotton canvas sweep nets can be used to collect a variety of agents. An area of infestation is systematically traversed on foot while sweeping plants with a back-and-forth motion. The nets' contents are periodically transferred into a collection container to prevent agents from escaping. Sweep netting is not suitable, however, for plants and insects (particularly moths) that damage easily.
- Gently tapping a plant works well for adult weevils and beetles that drop from the plant when they sense danger. A container should be held under the insect to capture it when it dislodges from the plant.

The following table presents collection windows and methods for a select list of biological control agents:

Biocontrol agent	Host plant	Collection window	Collection method
Agapeta zoegana (moth)	Diffuse knapweed, Spotted knapweed	July–mid August	Vacuum aspirator
Cyphocleonus achates (weevil)	Diffuse knapweed, Spotted knapweed	July–mid-September	Hand picking

Larinus minutus (weevil)	Diffuse knapweed, Spotted knapweed	early June–July	Sweep net
Larinus obtusus (weevil)	Diffuse knapweed, Spotted knapweed	Late June–July	Sweep net
Larinus planus (weevil)	Canada thistle	May–June	Hand picking, sweep net, or tapping the plant
Mecinus janthinus (weevil)	Dalmatian toadflax	May–June	Shaking
Mogulones cruciger (weevil)	Hound's-tongue	April–June	Aspirator: use a small shop-vac powered by a generator, and suction the rosette

During hot weather, when collecting should take place, most agents will be located on upper portions of the plant, either on the flowers or leaf axils. During cooler weather, they are typically found under the leaves near the base of the plant.

Storing Biocontrol Agents

After collection, count the biocontrol agents into clean, ventilated 1-L containers. Most insects are collected in quantities of 100 or 200 per container, except for *Cyphocleonus achates* and *Agapeta zoegana*, which are larger and require more space; therefore, collect them in quantities of 50 per container. Place a small amount of paper towel inside containers to reduce condensation and moisture. Include host plant material, with flowers and seeds removed, to provide food and habitat for the agents, then cap the containers with mesh lids to allow ventilation. Nylon or metal mesh may be used depending on the biocontrol agent being collected; use metal mesh lids for *Cyphocleonus achates* because the insects chew through nylon mesh. After counting, label each container with the following information:

- Collection date
- Biocontrol agent name
- Biocontrol agent quantity
- Collection location

If biocontrol agents must be held for a few days prior to shipping, store them in a cool place to lower their activity levels and prevent them from damaging themselves from excessive movement. Use a refrigerator, or a cooler with ice packs wrapped in newspaper or paper towel and placed in plastic bags to prevent condensation from forming inside the storage unit. Fresh plant material may need to be added and containers may need to be cleaned if insects are held for more than a day or two before shipping.

Shipping Biocontrol Agents

Use appropriate-sized boxes to ship biocontrol agents. Ice packs must be placed in each box to cool the agents and reduce their activity levels. Again, the ice packs should be wrapped with newspaper or paper towels and placed in plastic bags to prevent condensation from forming. Fill spaces left between containers with newspaper or foam chips to prevent them from shifting during transport. Seal and address the boxes, and ensure that the courier marks the box as fragile. Finally, request confirmation that the shipment has been received.

Selecting the Release Site and Releasing the Agents

Selecting the Release Site

Sites selected for the release of biocontrol agents should support a high likelihood of success for the agent's survival while addressing the long-term invasive plant management objectives for the area. Various means can be used to identify potential release sites, beginning with available inventory and biocontrol agent dispersal and monitoring information, and additionally including reconnaissance surveys, invasive plant occurrence reports, and local knowledge. The following factors should be considered when choosing a release site:

Criterion	Considerations
Invasive plant density	The invasive plant infestation should be of an adequate density to support the population of released biocontrol agents.
Size of infestation area	The area of infestation should be large enough to support the released biocontrol agent and allow for its natural dispersal. However, biocontrol should be considered for smaller sites where no other treatment options are available.
Long-term stability	Low-disturbance sites are preferred. Sites where construction, flooding, logging, trampling, or vandalism readily occur should be avoided.
Habitat suitability	The biogeoclimatic zone, elevation, aspect, canopy closure, microclimate, and soil texture of a potential release site should be considered since the habitat requirements of control agents are species-specific. Also, release sites that are near predators, such as ants or wasps, should be avoided.
Tenure	Biocontrol agents should be released in a variety of jurisdictions to conduct the necessary invasive plant control, as well as to establish and maintain working relationships with key agencies and individuals, and create future cost-effective collection sites.
Biological agent presence	Potential release sites should be checked for the presence of existing biocontrol agents. Evidence of agents includes root-tunnelling, emergence holes from the plant stems, feeding damage, and the presence of larvae, pupae, or adults. If the biocontrol agent is already present at the site, a "Biological Control Agent Dispersal Record" form should be completed; the form is available from the Invasive Alien Plant Program (IAPP) home page: http://www.for.gov.bc.ca/hra/Plants/application.htm.
Biological agent dispersal	Biocontrol agent releases should be strategically planned and spaced to allow for insect dispersal. Many existing release and dispersal locations are identified in IAPP.
Latitude and elevation	Biocontrol agent releases should be made at similar latitudes and elevations to the collection site to ensure that plant phenology is conducive to agent establishment.

Releasing Biological Control Agents

Follow standard protocols when releasing biocontrol agents. Protocols will then enable effective monitoring. The following topics are discussed In this section:

- Marking a biocontrol agent release site;
- Establishing a photo record;
- Completing the "Biological Control Agent Release & Monitoring Record"; and
- Releasing the biocontrol agent.

Marking a biocontrol agent release site

Accurately marking a biocontrol agent release site is important because it will allow surveyors to return to the site in subsequent years to monitor the success of the release. There are several ways to mark a release site:

- Record the co-ordinates of a release site using a GPS unit, with the level of accuracy of the GPS unit noted when the site is marked. An accuracy level of 10–15 m or better is preferable. (Accuracy will improve as the number of satellite signals received increases. Buildings, terrain, electronic interference, and dense foliage can block signal reception.)
- Use white wooden stakes to temporarily mark a biocontrol agent's release site. Place the stake at the point of release and hammer it into the ground as far as possible to prevent it from being moved by snowpack, wind, or grazing animals.

Label the stake in permanent ink with the following information:

- Agency that conducted the release (e.g., MFR);
- Biocontrol agent name code (e.g., Mocr);
- Number of biocontrol agents released (e.g., 100); and
- Date of release (e.g., May 15, 2010).

The original stake can be used, if it is in good condition, for a subsequent release at an initial release site. The original release information will be written on one side of the stake; write the new information on the opposite side.

- Maps can be drawn and used to relocate the biocontrol agent release general location and specific site. Location maps should include the names of nearby towns and communities, road names, and the distance and direction travelled on each road leading to the site.

Site maps should include more site-specific information, such as the location of cattle guards, signposts, fences, railways, and telephone poles. These maps should also include one or two tie-points to the release site. The distance and compass bearings to the tie-point(s) from the release site should be labelled on the map. Tie-points should be no farther than 50 m from the release stake. If there are no obvious tie-points, paint a blue dot on a rock outcrop or other feature. It may be helpful to record the co-ordinates of the object used as the tie-point.

A sketch map may be scanned and added to IAPP if it is no larger than 200 KB.

- Signs marking biocontrol release sites can be beneficial because they may deter activity in the area and prevent disturbance to the site. They also help raise public awareness. Signs should be placed near the release site and stapled or nailed to a permanent feature, such as a stake or post. Permission from the landowner or agency may be required before a sign can be posted.

BEFORE AND AFTER BIOCONTROL:

THE BEETLE *GALERUCELLA CALMARIENSIS* WAS RELEASED ON THE PURPLE LOOSESTRIFE IN THIS WETLAND.

AFTER 2 YEARS, A MARKED IMPROVEMENT WAS OBSERVED.

AFTER 10 YEARS, THE VEGETATION IN THE WETLAND HAS REASSERTED ITSELF, WITH ONLY THE OCCASIONAL LOOSESTRIFE PLANT.

ESTABLISHING A PHOTO INVENTORY

A photo inventory is a collection of photos of the biocontrol release site. Photos are used to visually monitor changes in the invasive plant infestation over time. To monitor changes in invasive plant height, a stadia rod (range pole) should be erected adjacent to the release stake. A minimum of six photos should be taken, including:

Photos taken from each cardinal direction (north, south, east, and west). Photos should be taken 3 m away from, and be directed toward, the release point.

- A vertical photo. This photo should be taken vertically looking down over the release stake and should illustrate the characteristics of the release location.

- A landscape photo. This photo should capture the best representation of the entire infestation while encompassing the release point.

The "Photoplot Record Form" is used to record the information gathered from a photo inventory. Print-ready copies of this form can be downloaded from the "IAPP Field Forms" section at the bottom IAPP home page: http://www.for.gov.bc.ca/hra/Plants/application.htm.

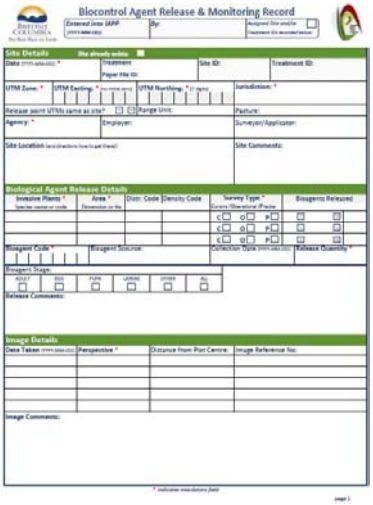
Avoid taking pictures with people in them. In order to comply with the privacy provisions of the *Freedom of Information and Protection of Privacy Act*, personal information may not be disclosed and photos with people cannot be uploaded into the IAPP application.

Photo Storage

Photos of release sites should be uploaded into the IAPP application. They may need to be resized so each photo is no larger than 200 KB. Copies of the photos may be kept in the release file and/or in a digital archive system created by the agency that conducted the inventory. The date, direction in which the photo was taken, and site number should be recorded on the back of each photo in the release file.

Completing the Biocontrol Agent Release & Monitoring Record

Site and Biological Control Agent Release Portions Only



All biocontrol agent releases must be recorded on the "Biological Control Agent Release & Monitoring Record" form. Print-ready copies of this form can be downloaded from the "IAPP Field Forms" section at the bottom IAPP home page: http://www.for.gov.bc.ca/hra/Plants/application.htm. The corresponding fields in this form for biocontrol agent release are defined below:

Field	Description
Data entered into IAPP	Checkbox to designate that the site details have been entered into the IAPP Data Entry module by the data entry staff member.
Entered by	Text entry to record the name of the individual who entered the data into IAPP.
Temporary Site #	Text entry to provide a temporary number assigned to individual forms in the field, which allows for each form to be tied to field maps. The temporary field site number is not intended for long-term use.
Site Already Exists	Checkbox to eliminate the duplicate entry of sites. Check this box if the site details already exist in IAPP at the time of the site visit and enter this in the Site ID box.
Date (YYYY-MM-DD)	Mandatory text entry to provide the date the survey was conducted.
Site ID	Automatically generated by IAPP at the time of data entry to provide the site with a unique identifier.
Treatment ID	Automatically generated by IAPP at the time of data entry to provide the biorelease (=treatment) with a unique identifier.
Treatment Paper File ID	Text entry of up to 20 characters to provide information for cross-referencing paper and electronic files for a given site. The format of this field varies widely among agencies.
Range Unit	Text entry to designate a MFR administrative unit within a stock range
Pasture	Text entry to designate a MFR administrative unit within a range unit
Agency	Mandatory text entry for recording the agency that conducted the treatment and able to provide information for future reference
Jurisdiction	Mandatory text entry to identify the legal entity that is responsible for the land on which the site is located
Employer	Text entry to identify the employer or contractor that conducted the survey on behalf of the agency.
Surveyor / Applicator	Text entry to identify the individual(s) who conducted the survey, release or monitoring of biocontrol agents.
Release point UTMs same as Site?	Checkbox to indicate that the Site already exists in IAPP, and that the biological agents were released at the same UTM locations that are noted on the Site Details record in IAPP.
UTM Zone, Easting, Northing	Mandatory text entry only if the site was previously unknown and the "New Site" checkbox has been marked. Identifies the precise geographic location of the site. All three fields—UTM Zone, UTM Easting, UTM Northing—must be entered.

Site Location	Text entry to provide the location of, and directions to, a site. Locations should start as general and become more specific. For example: "Near Kamloops → North on Deadman Vidette Road → 15.2 km Criss Creek FSR."
Site Comments	Text entry to provide an opportunity to enter any additional information about the site that has not been captured elsewhere. For example: "Must obtain gate key" or "Very steep terrain; not suitable for truck access".
Invasive Plants	Mandatory text entry to indicate which invasive plants are present at the site. See the Invasive Plant Codes in Part 4 - Appendices for additional information.
Area (Ha)	Mandatory number entry of the estimated area the invasive plant infestation encompasses.
Distribution Code	Text entry to describe the spatial organization of invasive plants at a site. See the Distribution Codes in Part 4 - Appendices for additional information.
Density (Plants/m2)	Text entry to provide an estimate of the number of plants per square metre. See the Density Codes in Part 4 - Appendices for additional information.
Survey Type: Cursory, Operational, or Precise	Checkbox to identify the standard used to conduct a survey. See the definition of Cursory, Operational, and Precise surveys in Module 1.5 of this guide.
Bioagents released	Checkbox to indicate whether or not a bioagent species was released on any of the noted invasive plant species.
Bioagent Code	Mandatory text entry to provide the name of the biological control agent that was released at the site. See the Biological Control Agent Codes in Part 4 - Appendices of this guide for additional information.
Bioagent Source	Text entry to provide the location where the biocontrol agent was previously collected.
Collection Date (YYYY-MM-DD)	Text entry of the date the biocontrol agent was collected at the bioagent source.
Bioagent Stage: Adult, Egg, Pupa, Larvae, Other, or All.	Checkbox to designate the life cycle stage of the biocontrol agent at the time of release
Release Quantity	Mandatory text entry of the total number of the biocontrol agent released at the site on the treatment date.
Release Comments	Text entry of any additional information about the invasive plant species and biological control release that was not captured elsewhere.
Image Details	If photos are taken, enter the image details below:
Date Taken	Mandatory text entry to indicate the date the photo was taken.
Perspective	Mandatory text entry to describe the orientation of the photo; valid choices includes east, west, north, south, landscape, and aerial. For example, choosing east indicates

	the photo was taken looking from west to east.
Distance from Plot Centre	The distance (in meters) the photographer was away from the subject; additional photos from different perspectives are usually taken, all at the same distance from the plot centre.
Image Reference No.	Mandatory text entry of up to 20 characters for cross-referencing of the filing location/number to the electronic image file
Image Comments	Text entry for any additional information about the image that was not captured elsewhere
Sketch Map (on page 2)	Field use only to provide an opportunity to add a field map to the form or to sketch one; this sketch may be scanned and added to the biological treatment record in IAPP as an image record.

Releasing the Biocontrol Agent

After all the preparatory work has been done to mark and map the site, create a photo inventory, and complete the biocontrol agent release form, remove the insects from the cooler and gently shake them out of the container onto the host plant closest to the release stake. Avoid walking around the release point after the biological control agents have been released.

The number of biological control agents required for a release depends on the species of insect, the size of the target invasive plant infestation, and the number of available biocontrol agents. Past releases of 100, 200, 400, 600, and 800 have been completed. The following are considered the minimum numbers of each species that should be released at a site:

Agapeta zoegana –100

Cyphocleonus achates –100

Larinus minutes –200

Larinus obtusus –200

Larinus planus –100

Mecinus janthinus –200

Mogulones cruciger –100

It is important to release biological control agents at a single location within an infestation, as it is more difficult for insects to propagate if they are spread over a large area.

Biocontrol Agent Monitoring

Techniques for establishment and dispersal monitoring are discussed in this section. Monitoring release sites is important for determining the following:

- Biocontrol agent establishment
- Impacts to invasive plants
- Dispersal rate and extent
- Preferred habitat of the biological control agent
- Gaps in distribution of the biological control agent
- Information about the biological control agent's life cycle
- Potential collection sites
- Impacts to existing collection sites

Establishment Monitoring

Sites should be monitored for one to three years after the biocontrol agents are released, to determine if they have become established. Monitoring for establishment involves searching invasive plants for the presence of the agent. This is referred to as the "search effort," and it differs for each type of agent as outlined below.

Root-Attacking Agents (Larvae)

When searching for root-attacking larvae, the host plant must be pulled and the root searched for evidence of the biological control agent. Once an agent is found, the number of agents present in the root should be counted and recorded. After one biocontrol agent is found, no more plant roots need to be examined.

If larvae are not found, the root should be examined further for secondary evidence that the biocontrol agent may have been present. If root-feeding damage, exit holes, tunnels, frass, and/or pupal casings are found, establishment of the agent is considered to have been successful.

If larvae are not present and there is no secondary evidence of establishment, additional roots should be pulled until an agent or evidence

of an agent is found. A maximum of 25 roots should be pulled before establishment is considered to have been unsuccessful. The search effort in this situation refers to the number of plant roots pulled before an agent is found.

Adult Agents

When searching for adults of the biocontrol agent, the entire plant must be carefully scanned. Once an agent is found, no additional plants need to be examined.

If adults are not observed, the plant should be examined further for secondary evidence that the agent may have been present. If foliar and/or seed-feeding damage, exit holes, and oviposition marks are found, establishment of the agent is considered to have been successful.

If adults are not present and there is no secondary evidence of establishment, additional plants should be examined. Searching for the presence of adults should continue for a maximum of 10 minutes before establishment is considered to have been unsuccessful. The search effort in this situation refers to the number of plants checked before an agent is found.

Searching for Adults by Sweep-Netting

If sweep nets are used to search for adults, ten sweeps at a time should be made for each interval and the net checked for biocontrol agents between intervals. Once an agent is found, no additional plants need to be swept. A maximum of 100 sweeps should be completed before establishment is considered to have been unsuccessful. The search effort is the number of sweeps required before capturing an agent in the net.

If there is no evidence of agent establishment on the site the first time it is monitored, it should be checked in succeeding years until there is confidence in knowing that the release has either succeeded or failed.

The following table lists some commonly released agents and the methods used to monitor their presence:

Biocontrol agent	Host plant	Monitoring window	Monitoring method
Agapeta zoegana	Diffuse knapweed, Spotted knapweed	Fall, spring, or summer	In the fall and spring, look for larvae in the outer layers of the root. In late June, July, and August, check the site for adults.
Cyphocleonus achates	Diffuse knapweed, Spotted knapweed	Fall, spring, or summer	In the spring and late fall, look for C-shaped larvae in the centre of a root. Adults may be observed on the upper stems of the plant during warm days in July, August, and September. On cool summer days, adults are found under basal leaves or rosettes.
Larinus minutus	Diffuse knapweed, Spotted knapweed	Fall, spring, or summer	In the spring or fall, look for exit holes in the previous year's flower heads. In the summer, look for adult weevils on the upper part of the plant, mostly on the flowers.
Larinus obtusus	Diffuse knapweed, Spotted knapweed	Fall, spring, or summer	In the spring or fall, look for exit holes in the previous year's flower heads. In the summer, look for adult weevils on the upper part of the plant, mostly on flowers.
Larinus planus	Canada thistle	Spring or early summer	In the spring or early summer, look for adult weevils on the upper part of the plant, mostly on the flowering bud. Also look for evidence of egg laying on the flower buds.
Mecinus janthinus	Dalmatian toadflax	Fall, spring, or summer	Locate adults or larvae. Adults are typically located on the leaf axil or flower, and the larvae are found in the stems. Stems should be cut open longitudinally.
Mogulones cruciger	Hound's-tongue	Spring or summer	Look for evidence of feeding damage on leaf petioles and the root crown. Feeding damage only on leaves is not enough evidence to consider that establishment on the site has been successful. Adults are elusive and difficult to find, but may occasionally be seen on rosettes at the base of leaf petioles.

Photos that replicate the original release photos may be taken at selected release sites. The original and new photos can then be compared to monitor the effectiveness of the biological control agent and to follow changes in the invasive plant infestation. All photo inventories should be recorded on the "Photoplot Record Form".

Completing the Biological Control Agent Release & Monitoring Record

Biological Monitoring Portion Only

Monitoring biological control agent establishment efforts must be recorded on the "Biological Control Agent Release and Monitoring Record." These data will be entered into IAPP by the agency that conducted the fieldwork (see Part 2 of this guide for additional information regarding data entry). Each section of this form is explained below:

Field	Description
Agent Destroyed?	Checkbox that is only checked if there is certainty that the agents on site have been destroyed.
Inspection Date (YYYY-MM-DD)	Mandatory text entry to provide the date the site was monitored in the field.
Time (24 hr)	Text entry to provide the time the biological control agent monitoring commenced, based on the 24-hour clock.
Surveyors	Text entry to identify the individual(s) who conducted the survey and/or monitored the release site.
Monitoring ID	Automatically generated by IAPP at the time of data entry.
Plant Count	Text entry to indicate the number of invasive plants counted before the first biological control agent was observed. Provides information about search effort and agent abundance.
Duration Of Count (Min)	Text entry to indicate the length of time invasive plants were examined before the first biocontrol agent was encountered. Provides information about search effort and agent abundance.
Bioagent Count	Text entry to indicate the number of agents found on/in the first positive plant, root, or sweep.
Plant Species	Mandatory text entry to indicate which invasive plants are present at the site. See the Invasive Plant Codes in Part 4 – Appendices for additional information.
Area (Ha)	Mandatory text entry of the estimated area of an invasive plant infestation.

Distribution Code	Text entry that describes the spatial organization of invasive plants on a site. See the Distribution Codes in Part 4 – Appendices for additional information.
Survey Type: Cursory, Operational, or Precise	Checkbox to identify the type of survey completed at a site. See the definition of Cursory, Operational, and Precise surveys in Module 1.5 of this guide.
Density (Plants/m2)	Text entry to provide an estimate of the number of plants per square metre, expressed in density classes
Biological Agent Presence	Checkbox to refer to additional cues that indicate the presence of the bioagent(s), including foliar feeding damage, seed feeding damage, larva present, oviposition marks, root feeding damage, adults present, pupa(e) present, exit holes/tunnels, or eggs present.
Comments	Text entry for any additional information about the invasive plant species and biological control release that was not captured elsewhere.

Dispersal monitoring

Dispersal refers to the processes by which a species moves away from an existing population as it expands its distribution. Dispersal of biocontrol agents from a release site should also be monitored, since one goal of biological control is that the agents disperse to and control host plants that exist outside the original release location.

Existing biocontrol agent release sites provide a starting point for dispersal monitoring. Plants near the release site are first monitored for the presence of, or damage from, biocontrol agents. Then plants at increasing distances from the site are checked. Monitoring distances may increase or decrease depending on the number of positive or negative findings. For example, if the agent is consistently found at 100-m intervals, the monitoring distance may be increased to 500 m or 1 km or more.

Completing the Biological Control Agent Dispersal Record

All biological control agent dispersal information is recorded on the "Biological Control Agent Dispersal Record" form. Print-ready copies of this form can be downloaded from the "IAPP Field Forms" section at the bottom

IAPP home page: http://www.for.gov.bc.ca/hra/Plants/application.htm.
Each section of the form is explained below:

Field	Description
Data Entered Into Invasive Alien Plant Program	Checkbox to designate that the site details have been entered into the IAPP Data Entry module by the data entry staff member.
Entered By	Text entry to record the name of the individual who entered the data into IAPP.
Temporary Site #	Text entry to provide a temporary number that is assigned to individual forms in the field, which allows for each form to be tied to field maps. The temporary field site number is not intended for long-term use.
Site Already Exists	Checkbox to eliminate the duplicate entry of sites. Check this box if the site details already exist in IAPP at the time of the site visit.
Inspection Date (YYYY-MM-DD)	Mandatory text entry to provide the date the site was inspected in the field
Time (24 hr)	Text entry to provide the time the site was inspected in the field based on the 24-hour clock
Site ID	Automatically generated by IAPP at the time of data entry to provide the site with a unique identifier.
Paper File ID	Text entry of up to 20 characters to provide information for cross-referencing paper and electronic files for a given site. The format of this field varies widely among agencies.
Range Unit ID	Text entry of a MFR administrative unit within a stock range
Pasture	Text entry of a MFR administrative unit within a range unit
Survey Agency	Mandatory text entry to identify the agency that conducted the survey and/or dispersal monitoring. "Agency" is defined as the legal entity that pays to have the survey done.
Employer	Text entry to identify the employer who conducted the survey on behalf of the survey agency.
Surveyor(s)	Text entry to identify the individual(s) who conducted the survey.
Jurisdiction	Mandatory text entry to identify the legal entity that is responsible for the land on which the site is located
GPS/UTM Grid: Zone, Easting, Northing	Mandatory text entry; only if the site was previously unknown, and the "New Site" checkbox has been marked, to identify the precise geographic location of a site. All three fields—Zone, Easting, and Northing—must be entered.
Location	Text entry to provide the location of, and directions to, a site. Locations should begin generally and become more specific. For example: "Near Kamloops → North on Deadman Vidette Road → 15.2 km Criss Creek FSR."
Comments	Text entry for any additional information about the site that has not been captured elsewhere. For example: "Must obtain

	gate key" or "Very steep terrain; not suitable for truck access".
Slope %	Text entry to provide a measurement of how much the land surface deviates from the horizontal; measured with a clinometer (must be an integer between 0 and 90 in IAPP)
Aspect	Text entry to provide the direction that a slope faces; measured with a compass (must be an integer between 0 and 360 in IAPP)
Elevation	Text entry to identify the height of land above sea level; measured with a GPS unit or an altimeter
Site Soil Texture: Coarse, Fine, or Organic	Checkbox to designate the relative amount of sand, silt, clay, and organic matter in a soil. (For in-house use only; this field cannot be entered into IAPP)
Plant Species	Mandatory text entry to indicate which invasive plants are present at the site. See the Invasive Plant Codes in Part 4 – Appendices for additional information.
Area (Ha)	Mandatory number entry of the estimated area of an invasive plant infestation.
Distribution Code	Text entry to describe the spatial organization of invasive plants on a site. See the Distribution Codes in Part 4 – Appendices.
Survey Type: Cursory, Operational, or Precise	Checkbox to identify the type of survey completed at a site. See the definition of Cursory, Operational, and Precise surveys in Module 1.5 of this guide.
Density (Plants/m2)	Text entry to provide an estimate of the number of plants per square metre, expressed in density classes. See the Density Class Codes in Part 4 – Appendices.
Proposed Activity: M, C, B	Checkbox to provide an opportunity to recommend a treatment option following the survey: M (mechanical), C (chemical), or B (biological).
Comments	Text entry of any additional information about the invasive plant species that was not captured elsewhere
Dispersal ID	Automatically generated by IAPP at the time of data entry.
Bioagent Code	Mandatory text entry to indicate which biocontrol agents are present on the site. Up to three agents may be recorded on each form. Refer to the Biological Control Agent code list in Part 4 – Appendices.
Target Plant Species	Indicates invasive plants on which biological control agents are found. Refer to the Invasive Plant Codes in Part 4 – Appendices.
Duration Of Count Min)	Text entry to indicate the length of time invasive plants were examined before the first agent was encountered. Provides information about the search effort and agent's abundance
Bioagent Count	Text entry to indicate the number of agents found on or in the first positive plant, root, or sweep
Plant Count	Text entry to indicate the number of target invasive plant parts, or net sweeps, as appropriate, counted before the first biocontrol agent was observed. Provides information about the search effort and agent's abundance.

Biological Agent Presence:	Checkboxes to provide an opportunity to note all evidence of a biocontrol agent's presence. Check **any** that apply.
Comments	Text entry for any additional information about the biocontrol agent dispersal that was not captured elsewhere
Map	Field use only to provide an opportunity to add a field map to the form or to sketch one
Image ID	Automatically entered by IAPP at time of data entry, to provide the photo with a unique identifier
Date	Mandatory text entry to indicate the date the photo was taken
Perspective	Mandatory text entry to describe the orientation of the photo; valid choices includes east, west, north, south, landscape, and aerial. For example, choosing east indicates the photo was taken looking from west to east.
Reference No.	Mandatory text entry of up to 20 characters for cross-referencing of the filing location/number to the electronic image file
Comments	Text entry for any additional information about the image that was not captured elsewhere

The appropriate search effort used to monitor different species of biological control agents is described in the previous section: "Establishment Monitoring."

MODULE 1.10:

SUMMARY

You have now completed Part 1 of the Invasive Plant Program Reference Guide. You should be very familiar with the following:

- the Invasive Plant Program, including a basic understanding of the Invasive Alien Plant Program (IAPP) application;
- applicable legislation related to invasive plants in British Columbia;
- a basic understanding of invasive plant inventory, as well as mechanical, chemical, and biological treatments, and
- how treatments are monitored.

You should also understand how to complete the following IAPP field forms:

- Site & Invasive Plant Inventory Record
- Invasive Plant Chemical & Mechanical Treatment Record
- Chemical & Mechanical Monitoring Record
- Biological Control Agent Release & Monitoring Record
- Biological Control Agent Intensive Monitoring Record
- Biological Control Agent Dispersal Record
- Photoplot Record Form

NEXT STEPS

PART 2

Part 2 of this guide describes the IAPP Data Entry module, which outlines the data entry process to enable editing, searching, and extracting the invasive plant data that were collected on the field forms.

PART 3

Part 3 of the reference guide describes the IAPP Map Display module, which displays all spatial data for invasive plant species in British Columbia. The

data are generated from the collective data entry records of the various IAPP agencies.

PART 4

Part 4 contains the appendices for this guide. The appendices provide all codes and tables, field collection forms, and other reference material.