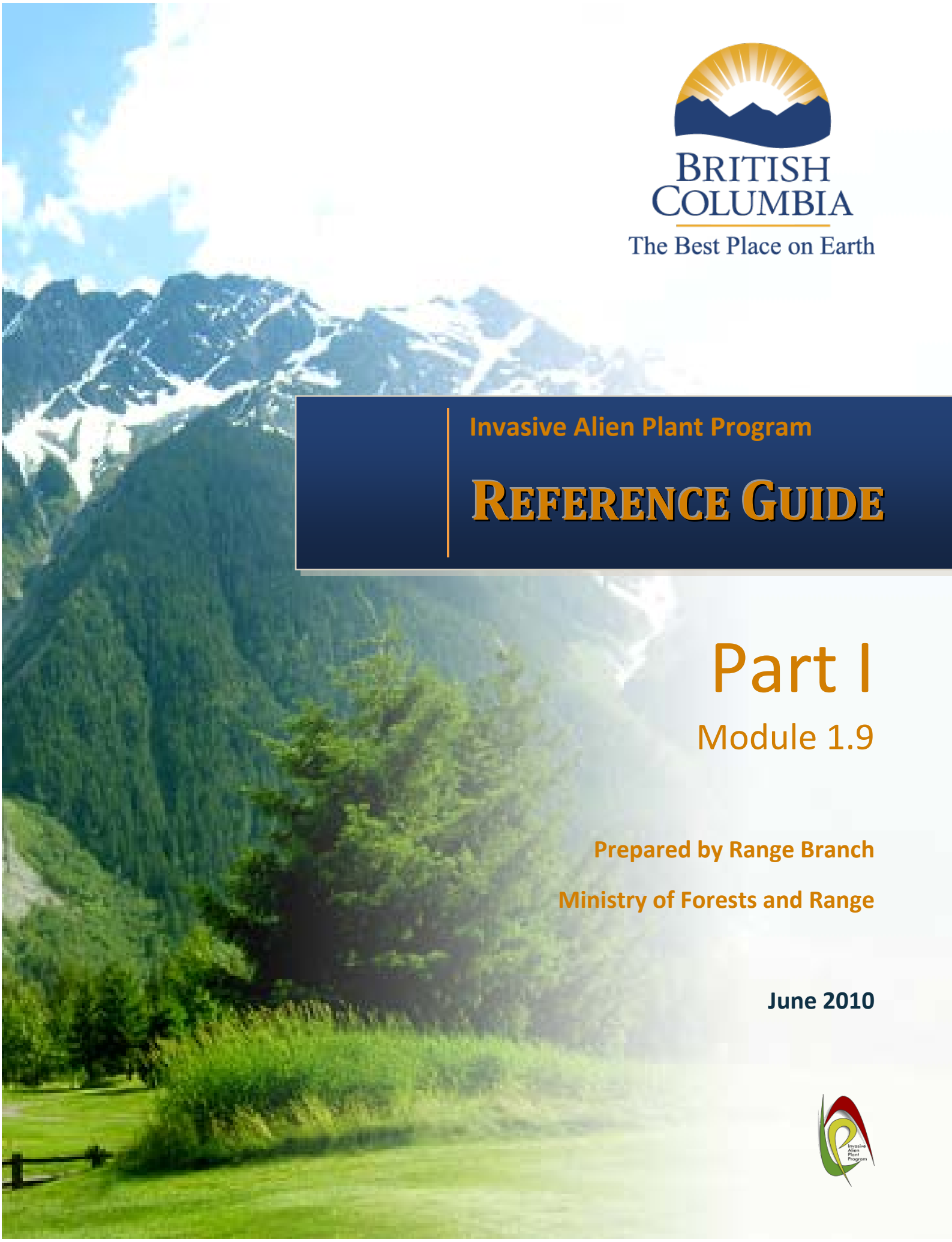


BRITISH COLUMBIA

The Best Place on Earth

Invasive Alien Plant Program

REFERENCE GUIDE

Part I

Module 1.9

Prepared by Range Branch

Ministry of Forests and Range

June 2010

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.

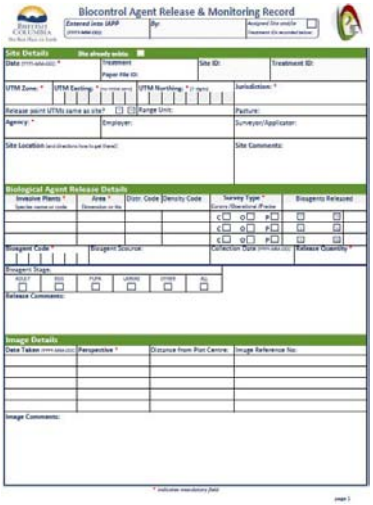
Avoid taking pictures with people in them. In order to comply with the privacy provisions of the *Freedom of Information and Protection of Privacy Act*, personal information may not be disclosed and photos with people cannot be uploaded into the IAPP application.

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."