# British Columbia Aquatic Invasive Species Survey Methods

Inter-Ministry Invasive Species Working Group (IMISWG)

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# 1. INTRODUCTION

This document outlines the appropriate methods to use for reporting new sightings, collecting voucher specimen and surveying aquatic invasive species within British Columbia (BC). The crayfish sampling protocols (Section 3.0) have been modified (with permission from the authors) from; *Larson and Olden (In press)- Sampling Techniques for Crayfish*. The general shellfish sampling protocols (Section 4) have been modified (with permission from the authors) from; *Oregon Lake Watch Aquatic Invasive Species Sampling Protocol (Portland State University 2013).* The plant sampling protocols have been modified from; *Montana Invasive Aquatic Plant Survey and Sample Collection Protocol* 4th Revision (*C. Duncan, Weed Management Services on behalf of the Montana Noxious Weed Summit Advisory Council, 2011*).

## 1.1. Regulations

To ensure all survey and sampling activities are in compliance with federal and provincial regulations, the jurisdiction of each waterbody must be determined and related permits obtained prior to commencing work. If a lake or river contains a species that is registered under the Federal *Species at Risk Act* (SARA) then a federal SARA permit (issued by Fisheries and Oceans Canada (DFO) SARA Department) may be required. The BC Species and Ecosystems Explorer contains information on the distribution of Species at Risk in BC, a provincial government regional biologists can be contacted for further information. Sampling in National Parks requires a special Research Permit, a Parks Canada Research Coordinator must be contacted for further information.

The BC Freshwater Fishing Regulations should be checked prior to conducting any crayfish surveys as the daily catch quotas for freshwater crayfish may vary by region and sometimes even by individual waterbody. A Provincial Scientific Collection Permit may be required for sampling within certain waterbodies in BC, provincial government regional biologists should be contacted for further details.

## 2. FISH

Sampling for invasive fish species requires the use of active sampling methods such as gillnets and/or trawl nets which can have high bycatch levels of native fish species. Surveys for invasive fish species are therefore restricted to provincial fisheries biologists or privately contracted companies. Local anglers and angling clubs are encouraged to report any sightings or captures of non-native fish species to the **reportinvasives.ca** website. For more information on invasive fish species in BC please visit the BC Species and Ecosystems Explorer and the Oregon Sea Grant: On the Lookout for Aquatic Invaders booklet is a good resource for identifying aquatic invaders.

# 3. CRAYFISH

Signal crayfish (*Pacifastacus leniusculus*) are the only reported native crayfish species present in British Columbia, and currently there is very little information available on their distribution within BC. Rusty crayfish (*Orconectes rusticus*) have not been reported in BC but have been introduced into Oregon. The Brief Guide to Crayfish Identification in the Pacific Northwest and the BC Crayfish and Lobster Identification Key are both good resources for identifying crayfish species in the PNW. Presence/absence information obtained through crayfish surveying by researchers and volunteers is important for determining the distribution of signal crayfish in BC, and for early detection of any new invasive crayfish species. Crayfish sampling can occur anywhere from small streams to large lakes, and sampling methods will vary depending on the survey site and conditions. The sections below describe appropriate survey methods for different habitat types.

## 3.1. Regulations

Under the BC Freshwater Fishing Regulations 2013-2015 there is no limit on the number of traps that can be set for crayfish collection but the daily catch quota is limited to 25 crayfish but may vary by individual waterbody. Any finfish caught in traps must be released immediately with as little harm as possible. Crayfish must not be transferred live or used as live bait. Please refer to the BC Freshwater Fishing Regulations for further information.

## 3.2. Survey Methods

### *3.2.1. Hand Nets*

Crayfish are commonly associated with small streams and rivers with rocky substrate and low to intermediate gradients and flow (Olden and Larson 2013, Larson and Tait 2011). While minnow traps can be used in these substrates, they can be difficult to effectively set in higher flowing water and may be more susceptible to tampering or theft. One hour directed searches in the best available habitat using a hand net, d-frame net or seine net is recommended in small streams to intermediate rivers (Olden and Larson 2013, Larson and Tait 2011). Crayfish typically use structure (e.g., rock, wood or aquatic plants) to avoid predators during the day; therefore daytime sampling should focus on these habitats.

For sampling by hand net in wadeable water, suitable substrate such as rocks and woody debris can be flipped over and visually inspected for crayfish. Hand nets should be placed directly behind a crayfish and the habitat in front should be disturbed causing the crayfish to "tail flip" backwards into the net. D-nets and seines are most effective with two people. The first person holds the net downstream of the target area and the second person disturbs the target area by flipping rocks and kicking the substrate which flushes water (and any crayfish) downstream into the net. Any crayfish collected should be kept in a bucket of freshwater until the end of the one hour directed survey.

Equipment

- Net for collection (Hand net, D-frame or seine);
- Large bucket (for holding crayfish);
- Data sheets (waterproof paper if possible);

- Wading boots or chest waders;
- GPS (optional);
- Ruler for scale in photos (optional);
- Digital camera (optional), and
- Thermometer (optional - for water temperature).

### *3.2.2. Minnow Traps*

Standard minnow traps are recommended for sampling in large lakes, rivers and wetlands (Figure 1). The minnow traps should be modified by expanding the trap opening to 4-5 cm in diameter (Larson and Tait 2011). Trapping will be most effective if done overnight; it is recommended that you set them in the afternoon and retrieve them the next morning. However, if you cannot stay overnight, simply set the trap as soon as you arrive and retrieve it just before leaving. Additional time in the water allows the bait to diffuse further from the trap and for crayfish to find it (Portland State University 2013). The more traps that are deployed the greater the sampling efficiency, and a minimum of five traps are recommended but more can be used for larger lakes. Crayfish tend to prefer firm to sandy substrates, typically avoiding areas with mucky bottoms. Deploy your trap in areas with hard substrates and materials (rock/wood) that provide cover from crayfish predators (Figure 1). Aim for warm, littoral areas approximately 1 to 3 meters in depth (Portland State University 2013).

**Figure 1. Standard metal-mesh gee minnow trap (left) and minnow trap set in shallow water of a stream (right). Photo credit: M. Herborg.**

**Figure 2. Photos of signal crayfish (*Pacifastacus leniusculus*) present in British Columbia. Photo credit: M. Herborg.**

**STEP 1:** The trap can be baited with dry dog or cat food, canned cat food, fresh fish heads, or mackerel or other oily fish. Any bait should be enclosed in a bait bag (cheese cloth or other mesh material) or, alternatively, a plastic bag or film container poked with numerous holes.

**STEP 2:** Deploy the trap either offshore from a boat/canoe being sure to securely tie it to a rope and buoy, marked with your name ; or near shore simply staked to the bank, a tree, rock or other stable object.

- Traps may be stolen or vandalized if left unattended, but alternately are at risk for becoming a nuisance to boaters navigating in high-use areas. Use your best judgment. If staking your trap to the shore, think about setting it in a less obvious site and making the ropes and/or buoy difficult to see. If using a buoy, make it as visible as possible to help boaters avoid it.

**STEP 3:** Retrieve the trap and check for crayfish.

**STEP 4:** If there is more than one species of crayfish in the trap, retain 1-2 of each and take representative pictures of the crayfish (see Section 3.2.3 for further detail) prior to releasing them. See Olden 2009 for further information on crayfish identification.

**STEP 5:** Survey information can be submitted to the reportinvasives.ca website**.**

Equipment

- Crayfish (minnow) trap;
- Rope (to secure the trap);
- Bait and bait container;
- Plastic milk/juice jug for buoy (optional);
- Wading boots/chest waders (optional);
- Digital camera;
- Ruler for scale in photos (optional);
- GPS (optional);
- Depth Sounder and thermometer (optional);

- Boat or canoe (for setting traps offshore in lakes), and
- Data sheets (waterproof paper if possible).

### *3.2.3. Data Collection:*

All crayfish should be identified as precisely as possible (see Olden 2009 for species ID) and detailed photographs of representative crayfish from each site should be taken. When photographing crayfish for identification purposes, if possible the crayfish should be placed on a clean white surface showing the dorsal surface of the crayfish (Figure 3). If possible place a ruler for scale reference and a label with the site name (Larson and Tait 2011). Two to three pictures should be taken to ensure the entire specimen has been photographed. Additional information to collect includes the sampling date, time, and the duration of the directed search. The location (GPS coordinates preferred) of the survey site and a brief description of the habitat should also be recorded which can include gradient, substrate type, current velocity, and water temperature.

For minnow traps additional information to collect includes; the date and time of trap deployment and the date and time of trap retrieval and the depth of each trap location (in lakes primarily). A general description of the habitat type that the trap was set in (rock, wood, aquatic plant or sand/mud) and the location of each trap (GPS coordinates if possible) should be recorded.


**Figure 3. Example photograph taken of a crayfish to be used for identification purposes. Photo credit: Larson and Tait 2011.**

# 4. MOLLUSCS & OTHER SHELLFISH

Monitoring is critical for early detection of new invasive mussel species in BC. There are several invasive species of shellfish that are already present in BC or pose a significant risk if they were to be introduced. Zebra (*Dreissena polymorpha*) and quagga (*Dreissena rostriformis bugensis*) mussels are two species that are not currently found in BC but pose significant environmental and economic risks if they were to be introduced.

## 4.1. Species Identification

Native Species

There are several freshwater mollusc species that are native to British Columbia including one endangered species listed under COSEWIC (see Section 4.2 for further detail), and several species belonging to the genus Anodonta, or more commonly referred to as "floaters" such as the Winged Floater (*Anodonta nuttalliana*), Western Floater (*Anodonta kennerlyi*) and Oregon Floater (*Anodonta oregonensis*). For further information on shellfish identification please see the following resources:

- Identifying Freshwater mussels in BC (Author: L. Gelling)
- Freshwater Mussels of the Pacific Northwest (2nd Edition) (Author: Nedeau et al. 2009)
- Freshwater Snails (Mollusc: Gastropoda) of North America (Author: J.B. Burch)
- Freshwater Sphaeriacean Clams (Mollusca: Pelecypoda) of North America (Author: J.B. Burch)
- Monitoring and control of macrofouling mollusks in fresh water systems, 2nd Edition. (Authors: G. L. Mackie and R. Claudi. 2009)

*Distinguishing Features of Native Mussels and Clams:*

- Most species' adults are far larger than zebra and quagga mussels >3 cm/1 inch;
- Either oval or heart shaped;
- Buried, partially buried or on soft substrate or between cobbles, and
- Do not form clumps or attach to vertical surfaces.

Invasive Species

There are two invasive species already present in BC; the Asian clam (*Corbicula fluminea*) and the New Zealand mudsnail (*Potamopyrgus antipodarum*) (Figure 5).

*Asian Clam Identification:*

- Small shell usually less than 25 mm, and rarely exceeds 50 mm.
- Shell is light green/yellow to blackish brown with elevated/coarse growth rings.
- Shell is triangular in shape and thick.

*New Zealand Mudsnail Identification:*

- Shell height usually 5 mm but up to 8 mm, and twice the shell width.
- Shell is spire cone-shaped; slender with pointed apical whorl; usually 5-6 whorls, and up to 8.
- Normally horn-colored but ranges from light to dark brown.


**Figure 4. Invasive Asian clam (*Corbicula fluminea*) (left) and invasive New Zealand mudsnails (*Potamopyrgus antipodarum*) (right). Photo credit: Portland State University.**

Zebra and quagga mussels (ZQM), which are not current present in BC, are relatively small mussels, ranging in size from 1 mm to 3 cm as fully grown adults (Figure 4). While they often have the characteristic zebra stripes this can be highly variable in both the species and should not be used as a distinguishing feature. The shells of zebra and quagga mussels can also be brown or cream coloured. One unique, distinguishing feature is that they are the only freshwater mussel in North America that can attach to solid surfaces, often forming clumps, like some marine mussels (Figure 6).

*Distinguishing Features of Zebra and Quagga Mussels:*

- **Small** only up to 3 cm / 1 inch;
- Form **dense clumps attached to hard surfaces;**
- **Propeller blade shaped, and**
- Zebra stripes often but not always present.


**Figure 5. Size range of zebra and quagga mussels (top) compared to native mussels (bottom).**


**Figure 6. Example pictures of zebra and quagga mussel clusters attached to various substrates.**

## 4.2. Species at Risk

The BC Species and Ecosystems Explorer contains information on mussel species present in BC, including their federal/provincial threat status. The Rocky Mountain Ridged Mussel (*Gonidea angulata*) is native

to BC and is listed as Special Concern under SARA (2005) and in 2010 was re-assigned as Endangered by the Committee on the Status of Wildlife in Canada (COSEWIC). Any live specimens of a Species at Risk such as the Rocky Mountain Ridged Mussel should not be disturbed and only photographs and the location (GPS coordinates preferred) of the specimen should be recorded and the data should be sent to the BC Conservation Data Center as soon as possible:

**B.C. Conservation Data Centre**

Ministry of Environment

P.O. Box 9358 Stn. Prov. Gov.

Victoria, BC  V8W 9M2

Phone: 250-953-3823

**Rocky Mountain Ridged Mussel (*Gonidea angulata*)**

- Found in the Okanagan and Kootenay rivers.
- Trapezoidal in shape and 12.5 cm long and 0.4 cm wide (DFO 2014)
- This mussel is listed as Special Concern under SARA (2005) and was re-assigned as Endangered by (COSEWIC) in 2010 and should not be disturbed (Gelling 2008).

**Figure 7. Mountain Ridged Mussel (*Gonidea angulate*) native to BC. Photo credit: The Xerces Society.**

## 4.3. Regulations

Under the BC Freshwater Fishing Regulations there are no restrictions on the number of shells of freshwater mussels that can be collected, however, live specimens must not be removed from a site or transported live. If a live specimen is believed to be invasive, then it should be photographed and the location should be recorded (GPS coordinates preferred) and reported to the **reportinvasives.ca** website**.**

## 4.4. Shoreline Surveys

### *4.4.1. When and Where to Survey*

Sampling for mollusks can typically be done at the same sites that are sampled for aquatic plants (see Section 5.0 for Plant Monitoring) including high-use areas such as boat launches, swimming areas, marinas, fishing piers, but may also include stream inlets, outlets, shallow arms or lake margins. However, still-water systems such as lakes and ponds can create a wide array of habitats depending

upon the substrate (cobble, rock, sand, silt, etc.), water depth, sunlight, and wave action (Portland State University 2013). It is therefore important to sample across as many habitats as possible to increase your sampling efficiency. Avoid sampling when algae blooms create poor water clarity. Some snails are sensitive to high light levels, so sampling during the early morning or later afternoon is a good option (Portland State University 2013).

### *4.4.2. Zig-Zag Method*

**STEP 1:** This method involves walking parallel the shoreline in a zig-zag pattern wading between shallow water and deeper water (go only as deep as you feel comfortable given the terrain and the length of your arm). Stop every other step to pull out loose rocks, cobble and woody debris and/ or aquatic plants to inspect for snails and loose shells along the bottom. Do this for 10-15 minutes.

**STEP 2:** If you find any suspected invasive mussel/shellfish species or Species at Risk, take 2-3 photos (using methods similar to those for crayfish) and record the site location (GPS coordinates preferred).

**STEP 4:** Report your survey information as soon as possible to the **reportinvasives.ca** website**.**

### *4.4.3. Rake Toss*

Sampling from the shoreline in deeper water can be difficult, requiring a heavy and expensive dredge. For these purposes, it will be sufficient to look at attached mollusks within plant samples gathered using the plant rake.

**Figure 8. Photo of sample collected during a plant rake toss from shore. Photos credit: Portland State University.**

**STEP 1:** Take a sample of plants using the plant rake.

**STEP 2:** Free the plants from the rake and place them in a 5-Gallon bucket ~ half filled with water out of the lake. Shake the plants gently (swirling and dunking) for one to two minutes. This will loosen many organisms which should then drop to the bottom of the bucket.

**STEP 3:** Pour out the excess water carefully (New Zealand mudsnails are very small (3-6 mm or 0.1-0.3 in) and could easily get discarded in the water).

**STEP 4:** Closely observe what remains in the bucket. A hand-lens may be helpful.

**STEP 5:** Document, preserve and report any invasive species as outlined in the previous section.

Equipment

- Plant rake (*if sampling in deep water areas*);
- 5-Gallon bucket (*if sampling in deep water areas*);
- GPS unit (optional);
- Hand lens (optional);
- Wading boots/chest waders (optional), and
- Digital camera (optional).

Survey information can be reported to the **reportinvasives.ca** website**.**

## 4.5. ZQM Substrate Sampler

Substrate sampling allows for widespread/low cost and low effort monitoring across the province to help prevent zebra or quagga mussels from entering and spreading in BC.

### *4.5.1. Where to Survey*

One substrate sampler should be deployed at each of the monitoring stations in a manner that will not interfere with boater or swimmer activities. Ideally the substrate sampler should be deployed in a covered area with some water flow and as deep as possible (up to 8m). As boat traffic is an essential part of the spread of aquatic invasive species, it is recommended that substrate samplers be deployed in areas with high boat traffic (e.g. marinas, boat docks, etc.). A physical description and/or GPS coordinates of each monitoring station must be obtained at initial deployment. If possible, it is ideal to get a contact person for each site (the person who will be checking the substrate sampler most often).

Substrate Sampler Construction (see Figure 9)

- The substrate sampler consists of 17 cm sections of white PVC pipe (5-cm diameter) and black ABS pipe (5 cm diameter) with 7 mm diameter holes drilled into the pipe.
- Pipe sections are suspended along a rope with the pipe located at the end of the rope and approximately 3 m up from the bottom of the rope.
- A plastic construction mesh (13 mm diameter mesh) is cut into 3 cm wide strips, and the rope is woven through this plastic mesh strip in between the terminal pipe sections and those located 3 m from bottom. Large flat washers are used above and below the pipe sections to keep them stable.
- A small (16 oz) concrete anchor is tied to the end of the rope. The length of rope used depends on water depth of deployment.
- The ideal depth to deploy the substrate sampler is 8 m, keeping the end of substrate sampler off the lake bottom. A secure surface structure to tie the surface end of the rope to is the most limiting factor for substrate monitoring; dam booms work best.
- Buoys work well but substrate rope can get tangled with mooring line. Docks and piers are often used, but are typically found in shallower waters.

- Keep in mind that any hard surface works. Concrete, bare steel and certain plastics work well. Biofilm is good for settlement. Surface roughness or irregularities are best.

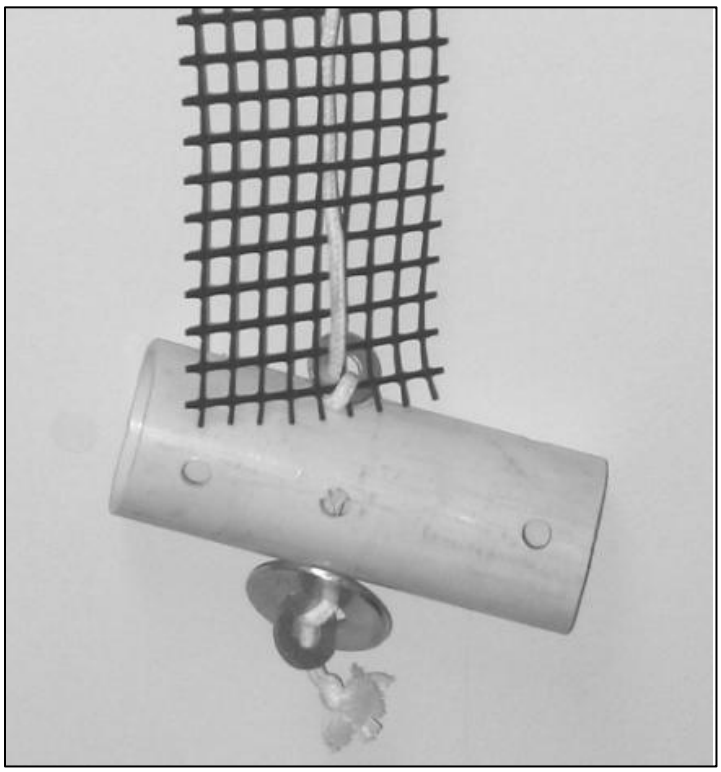

**Figure 9. Zebra/quagga mussel substrate sampler (aka the "Portland Sampler"). Photo credit: Portland State University.**

### *4.5.2. When to Survey*

Monitoring stations will be checked mid-month from May through October when water temperatures are between 16°C and 19°C, which is most conducive to *Dreissenid* reproduction. Monitoring shall be conducted once a month from May to September using methods outlined below:

1. Retrieve substrate sampler from water carefully – place in a bucket for close inspection.
2. Juvenile mussels are very small, but have a rough sand-paper feel relative to the substrate sampler.
3. A scraping of suspect organisms should be collected into the supplied vial, with water added, and then kept cool in a refrigerator.
4. Examine bucket for other suspect aquatic invasive species such as Eurasian Water Milfoil, Flowering Rush, or New Zealand mudsnails.
5. If you suspect that substrate is contaminated with *dreissenids* remove it from the water and report it to the **reportinasives.ca** website.
6. Put the substrate sampler back into the water where it was found.
7. Fill out the information sheet found in Appendix E.

8. The substrate sampler is a small surface area, so this is also an opportunity to check other substrates nearby (e.g., dock, pilings, boat hull, or anything in the water) and look for shells on rocks or beaches.

## 4.6. ZQM Veliger Surveys

### *4.6.1. Where to Survey*

Samples should be collected from a boat, if possible, at a minimum of three sites in each waterbody. A boat allows the sampling to be independent of land-accessible structures (e.g., docks). Samples should be collected in near shore and open water areas. Sampling should be focused on areas near boat launches and marinas, near outflows (e.g., intakes for powerhouse), near inputs (e.g. aqueduct entering a reservoir), in downstream and downwind positions and other areas where plankton collects (e.g., eddy).

### *4.6.2. When to Survey*

Veligers can exhibit spatial and temporal patchiness in the water column and high sampling frequency (weekly or biweekly) increases the likelihood of collecting veligers. The optimal time to sample veligers in North America is between May and September or when water temperatures are between 16$^{o}$C and 19$^{o}$C. Ideally, sample a minimum of three times during the June through October period, and ideally once a month. Veliger sampling can be performed anytime during the day but preferably not immediately following a storm event. Storm events can increase water turbidity and hence the time required to process the sample.

### *4.6.3. Survey Methods*

Collect a minimum of four plankton tows at each site and combine into one sample container. More than four plankton tows may be collected to increase the likelihood of collecting veligers. The sample container should be no more than about 1/4 full to allow room for the preservative. If samples are too large to combine into one sample container use a separate sample container for each tow. Collect each plankton tow in a different area of the site to further increase the likelihood of collecting veligers. Figure 10 depicts the location of plankton collection at a site.

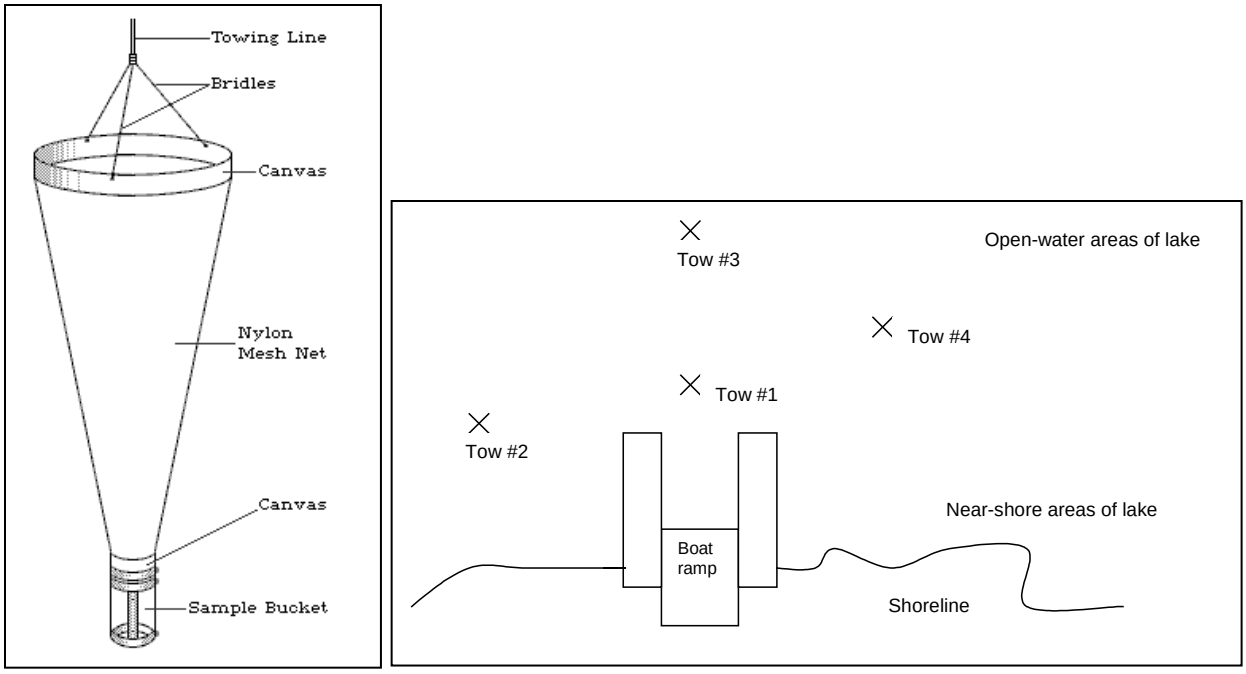


**Figure 10. Simple conical plankton-tow net (left) and example of plankton collection at a site location (right). Image credit: Portland State University.**

**Figure 11. Plankton sample being collected by US Army Corps of Engineers staff. Photo credit: Portland State University.**

Vertical Plankton Tow

1. Secure the cod-end piece and check that the line is securely attached to the plankton net. Secure the other end of the line to the boat.
2. Lower the net 6.1 m below water surface, or to 1 m above the sediment. Record the depth that the net is lowered.
3. Keep net at this depth for 60 seconds and then manually retrieve using a hand-over-hand technique at a rate of 0.5 m/s. Slow and steady retrieval is the key to collecting a good plankton tow.
4. Rinse the net by raising the net so that the cod end of the net is at the water surface. Rinse organisms into the cod end of the net by lowering the net back into the water, keeping the opening above the water surface. Then quickly pull net straight up; this action will move collected plankton into the cod-end piece. Repeat this procedure several times to ensure that all the organisms inside the net are in the cod end.
5. A squirt bottle, filled with either tap water or water from the lake or river, can be used to squirt down the sides of the net. Spray the outside of the net starting at the mouth to rinse organisms into the cod end.
6. Condense the sample as much as possible before pouring into sample container. Carefully remove the cod-end piece without spilling collected water and plankton. Condense the sample by swirling the cod-end piece. You may need to use tweezers or a spatula to gently clear the mesh netting in the cod-end piece to allow the water to filter through.
7. Lower the cod-end-piece (separated from the plankton net) into the water, keeping the opening above the water surface. Condense the sample again and pour into the sample container. Repeat this procedure until the cod-end piece appears clean.
8. It is important to record the number and length of tows so that the quantity of water sampled can be determined.
9. Record survey information and report it to the **reportinasives.ca** website, and contact information will be provided for shipping the plankton samples.

Horizontal Plankton Tow

Horizontal plankton tows are taken in near shore depths that are too shallow to collect a vertical tow. A weight (1-2 kg or 2-4 lbs) is attached to the rope immediately in front of the net opening to keep the net below the water surface. The net is thrown into the water and allowed to sink. Slowly pull the net back to you at a slow and steady rate as described above. Keep the net off the sediment to avoid both snagging and collecting debris. Record the distance that the net is towed through the water. Repeat techniques used for vertical plankton tows to concentrate organisms into the cod end of the net.

Equipment

- Plankton net (simple, conical plankton-tow net, 63 um pore size, 0.25 m diameter net opening, removable, weighted cod-end piece) (Figure 11);
- Line for deploying the net (8 m or about 25 feet long);
- Sample container (polyethylene material, 50 to 500 mL volume, screw lid);
- Decontamination materials (white vinegar (5% solution of acetic acid), 5-7% solution of household bleach, tap water (do NOT use lake or river water));

- Preservative (95% regular ethanol (ETOH));
- Field sheets and pen/ pencils;
- Thermometer;
- Permanent marker;
- GPS unit (*recommended*);
- Tweezers or small spatula (*recommended*);
- Boat (*recommended*);
- Multiprobe water quality instrument (e.g. Hydrolab®) (*recommended*), and
- Measuring tape or ruler (*optional*)

#### *4.6.4. Sample Preservation and Labelling*

Preserve plankton samples in a 70% ethanol solution immediately after collection to ensure sample integrity. Use regular ethanol instead of denatured ethanol because denatured ethanol will dissolve the calcite in shells more than regular ethanol. To make a 70% ethanol solution in the sample container note the volume of sample in the container and then add three times the volume of 95% ethanol to the sample.

For example, if your sample bottle contained one inch of sample, you would add three inches of 95% ethanol so that the sample bottle contained four inches of combined sample and preservative. This is why it is important to not fill the sample bottle more than ¼ full of sample. A measuring tape or ruler may be placed alongside the sample container to estimate the volumes. Ethanol is the preferred preservative.

Samples preserved with ethanol may be stored in a cool, dry place for a maximum of three months prior to analysis. Avoid placing samples in direct sunlight or freezing conditions. Samples that cannot be preserved immediately after collection should be placed on ice until preservative can be added. Do not wait more than three hours to preserve samples. Keep preserved samples in a plastic container such as a bin or cooler in the back of the car while in transit.

Sample containers must be labeled. The label should contain the following information:

- Site location (GPS coordinates and/ or detailed descriptions);
- Name of water body;
- Number of tows;
- Length of tows;
- Type of tow (vertical or horizontal);
- Date of collection, and
- Name of collector.

This information should also be recorded in a separate field log for backup information if the label should come off the bottle. Report the survey information to the reportinvasives.ca website, and contact information will be provided for shipping the plankton samples.

# 5. INVASIVE PLANTS

Monitoring is critical for early detection of new invasive plant species in BC and for improving our knowledge of existing plant populations. To report new invasive plants to BC: www.reportaweedbc.ca.

## 5.1. Identification

For detailed information on invasive plant species in BC please visit the Ministry of Forests, Lands and Natural Resource Operations Invasive Plant Program website. Recommended plant identification materials include:

- Pondweeds and Bur-reeds and their relatives of British Columbia (Author: T.C. Brayshaw)
- Buttercups, Waterlilies and their relatives of British Columbia (Author: T.C. Brayshaw)
- Studies on Aquatic Macrophytes Part XXXIII: Aquatic Plants of British Columbia (Author: P.D. Warrington).

## 5.2. Survey Design

### *5.2.1. Where to Survey*

Survey/monitoring should be done so that high risk sites (e.g., sites with high recreational use, waters downstream from a known infestation, or waters within 80 kilometres of a known infestation) are monitored at a greater frequency than low risk sites. In lakes and reservoirs, focus surveys near dams, outflows, inflows, marinas, boat launches, and in areas where plant fragments may be blown or washed. In streams and rivers, focus monitoring in areas where plant fragments are likely to be introduced such as fishing access sites (FAS) and boat launches, or in areas where fragments can become established such as oxbows and other backwater channels, and near structures that create eddies. Invasive plants may be found near shore and in up to 7.5 metres of water depending on water clarity.

### *5.2.2. When to Survey*

Monitor high risk sites (e.g., backwater areas, old oxbows, and other slow-water flow sites downstream from FAS or other high recreational use areas) twice a year if possible and other sites once per year (see Table 1). Record notes on native aquatic vegetation since this will help identify sites that may have optimal habitat for non-native species.

**Table 1. Aquatic Invasive Plant Target Survey Timing.**

| SPECIES | TARGET GROWTH STAGE | OPTIMAL SURVEY TIME | NOTES |
|---|---|---|---|
| **Brazilian elodea** (*Egeria densa*) | Actively growing, prior to senescence. | Late spring to early fall. | |
| **Curly leaf pondweed** (*Potamogeton crispus*) | Prior to fruiting | June and July following highwater flow | Summer dormant species (may die back mid-summer) |
| **Eurasian watermilfoil** (*Myriophyllum spicatum*) | Flowering; max growth. | Late July – mid Sept. | |
| **Flowering rush** (*Butomus umbellatus*) | Flowering (may not flower); max growth. | Late July – early Sept. | May appear submerged or emergent; with or without flower. |
| **Hydrilla** (*Hydrilla verticillata*) | Actively growing. | Late spring to early fall. | Actively grows in water temperatures 10 to 35$^{o}$C. |
| **Parrot feather** (*Myriophyllum aquaticum*) | Flowering; max growth. | June – Aug. | |
| **Water hyacinth** (*Eichhornia crassipes*) | Actively growing. | Late spring to early fall. | |

Equipment

- Double sided thatching rake and line for deploying the rake [note: cut the handle near the rake head and attach a rope (30 m on spool or about 100 feet). For deep-water sampling you may need to put a weight on the rake].
- Field data sheets (waterproof paper), labels, and waterproof marker and pencils
- Global Positioning Satellite unit (GPS)
- Boat -if sampling on a lake or reservoir *(recommended*)
- Measuring tape or ruler
- White tub to place plants for identification when removed from rake
- Sealable plastic bags (e.g., Ziploc)
- Cooler with cubed/ crushed ice
- Plant identification guide
- Paper towels

- Digital waterproof camera
- Bucket, measuring cup and bleach for post survey equipment decontamination
- hand lens
- Optional considerations:
  - Secchi disk (if sampling lake or reservoir)
  - Sample vials prefilled with ethanol (for samples needing genetic confirmation)
  - Plant press board (for voucher collections)
  - GPS coupled photo points (for photo comparison over time)

## 5.3. Survey Methods

### *5.3.1. Lakes & Reservoirs (Littoral Zone - water <8 metres deep)*

- Review bathymetric maps[1] to identify littoral survey area.
- To begin the survey, complete the site description portion of a *Site and Invasive Aquatic Plant Inventory Record* (see Appendix C).
  - Site details should include: Survey date; UTM coordinates; site location (include regional district, water body name, closest town, and directions how to get there); surveyor name; site comments (include water body type, flow and turbidity, aquatic vegetation present, sediment type, type of public use, draw down history, factors influencing plant growth, other notes of importance).
  - If a continuous occurrence of the target plant population is encountered, sample methods may be modified to note the UTM coordinates at the start point, presence or absence every 200 metres and the end point. This will generate a polygon or line delineating the plant population. Regular sampling frequency resumes once continuous occurrence ceases. Note, this modification is only appropriate for targeted species surveys, not general aquatic plant population surveys.

<u>Type 1: Lake & Reservoir Boat Surveys</u>

- Littoral surveys are best conducted from a boat using rake throws and/or underwater viewers, by snorkeling or SCUBA divers.
- Surveys should be conducted so they are repeatable over time. The number of points sampled is based on the size of the water body and should be adequate to find relatively small populations of plants (<3 $m^2$); a good rule of thumb is one point per 100 metres. Visual observations should be made between points to optimize potential of locating small infestations. Be sure to survey the entire littoral zone in the lake/reservoir, up to the high water mark.

<u>Type 2: Lake & Reservoir Shore Surveys</u>

[1] Bathymetric maps show water depth based on geographical coordinates.

- If possible, conduct a quick visual reconnaissance from a point above the site prior to sampling to note areas of likely plant colonization (i.e., Suitable substrate, points of substrate deposition, etc.) and presence of existing aquatic vegetation. This will assist in focusing sampling efforts.
- *High-risk site surveys* (boat docks; fishing access points; etc.) on a lake or reservoir can be conducted from shore. Survey 100 m upstream and downstream from initial access point using rake throws (every 25 m) and/or underwater viewers. This approach will result in seven sample points at each high risk feature on the waterbody: one at the feature, three downstream of the feature (at 25 m intervals) and three upstream of the feature (at 25 m intervals).
- At each GPS sample point:
    - Use a sampling rake (2 rake throws/site), or divers (or combination) to identify submersed aquatic plants.
    - Complete the survey details portion of a *Site and Invasive Aquatic Plant Inventory Record* (see Appendix C).
    - Sample point survey details should include: UTM coordinates (GPS point shows site was surveyed and allows future surveyors to navigate back to original sample points), sample date, name of person sampling, native and invasive submersed aquatic vegetation (Remember, it is important to also record if no vegetation is present at the sample point), substrate depth, and sediment type (muck/silt, rock, etc.) when visible. (Optional) Collect secchi[2] depth readings at a minimum of two locations within the water body.
    - If invasive emergent shoreline plants are present (e.g., yellow flag iris) they should be noted and UTM coordinates recorded on a new *Site and Invasive Aquatic Plant Inventory Record* (see Appendix C).
    - Note any fragments of invasive species floating or washed up on shore while surveying, if different from those species noted in the sampling.

- Plant species observed at sample points that are "unknown" to the surveyor should be collected and sent to Royal BC Museum herbarium. Voucher specimen of invasive aquatic plants in a water body (i.e., flowering rush, curly-leaf pondweed, and Eurasian watermilfoil) should also be collected, preserved and sent to the Royal BC Museum Herbarium for identification confirmation and archiving (See sample collection and mailing instructions below).
- Frequency of occurrence for each plant species in a water body can be calculated two ways:
    - (1) By dividing the number of survey points where the individual species was observed by the total number of points surveyed for a given water body, then multiplying by 100 to achieve a percent. Note: Frequency calculations will be highly influenced by the number of points surveyed (i.e., sampling intensity). For example if you survey/sample 100 points and find EWM at 10 of those points the frequency will be 10%, however if you only sample 25 points and record EWM at the same 10 points the frequency becomes 40% which is likely an over estimate of the population.

[2] Secchi depth is the depth at which the pattern on the Secchi disk is no longer visible and is taken as a measure of the transparency (clarity) of the water.

- (2) To estimate broad classes of density and distribution (see density/distribution classes in Appendix D) where a site is an entire lake or reservoir, an estimate is made based on the average density and distribution observed at each sample point. This approach is not suitable for shore surveys as only accessible points for survey would be reflected in the results, and inaccessible and/or remote shoreline sections would not be captured.

*Note: For **whole-lake surveys**, points can be pre-selected on a GIS generated map and distribution and frequency of aquatic vegetation can be determined by point intercept method described by Madsen, 1999[3].*

### *5.3.2. Streams & Rivers*

- High risk areas along streams and rivers include sites where stream gradient slows (areas of deposition), areas of high visitor use (fishing access sites) and back-water sloughs and channels.

Type 1: Stream & River Point Surveys

- Survey in a zig-zag pattern (visual observation with bottom viewer, snorkeling, and/or rake throws depending on water depth) for 100 m upstream and downstream from initial access point (be sure to sample riffles, pools and slack-water areas).
- Sample/survey in upstream direction so disturbed sediment does not reduce visibility.
- Sample point survey details should include: UTM coordinates (GPS point shows site was surveyed and allows future surveyors to navigate back to original sample points), sample date, name of person sampling, native and invasive aquatic vegetation (Remember, it is important to also record if no vegetation is present at the sample point), estimate water clarity (visibility), flow characteristics.

Type 2: Navigable River Boat Surveys

- It is recommended that sections of the river are surveyed in addition to access points. Select sections of river suitable for aquatic plant colonization and growth (e.g., sloughs, backwater channels, oxbows). Selection can be done in the office to optimize sample efficiency for the length of river section selected.
- Depending on size of the river, suggested sampling is a three-member team. Two boats with one team member each (one on each side of the river), increases the probability of detecting a non-native aquatic plant. The third crew member can drive to the take-out access point and complete a "point survey" as described above.
- The number of points surveyed in each river will vary because of variability in river channels and location of aquatic plant beds.
- Sample point survey details should include:

3 Madsen, JD 1999. Point intercept and line intercept methods for aquatic plant management. APCRP Technical Notes Collection (TN APCRP-MI-02) u. s. Army Engineer Research and Development Center, Vicksburg, MS 16 pp..

- UTM coordinates, native and invasive aquatic vegetation (Remember, it is important to also record if no vegetation is present at the sample point).
- Data recorded should include: River name and description of section surveyed, UTM coordinates; name of person sampling; aquatic vegetation present; other notes of importance. It should also be noted if no submersed aquatic vegetation was present in the sample area.

- If aquatic invasive vegetation is located, continue surveying upstream river segments (or points) until the source (upper-most infestation) is located. Survey 100 m upstream of this point to ensure it is the upper-most infestation.
- If invasive emergent shoreline plants are present (e.g., yellow flag iris) they should be noted and UTM coordinates recorded on a new Site and Invasive Aquatic Plant Inventory Record.

## 5.4. Data Reporting & Recording

New invasive plants to BC are candidates for eradication and should be reported directly to: www.reportaweedbc.ca. For a list of new plants to BC see: www.for.gov.bc.ca/hra/invasive-species/candidate.htm.

Survey data for plants with established populations can be entered into the provincial **Invasive Alien Plant Program (IAPP)** database and mapping application. To enter data into IAPP one must obtain an IDIR or BCeID.

For the purpose of documenting aquatic plant surveys in IAPP, a site is defined as one or more sample points where the target plant presence is confirmed in a single waterbody. Plant presence in each water inflow and outflow to that body of water are documented as new sites. For example, if five sample points on Lake Milfoil confirmed presence of parrot's feather, a single IAPP site would be created, with all sample point data entered into comments, especially UTMs and presence/no presence. If two sample points on an in-flow to Lake Milfoil confirmed presence of parrot's feather, an additional IAPP site would be created specific to that in-flow.

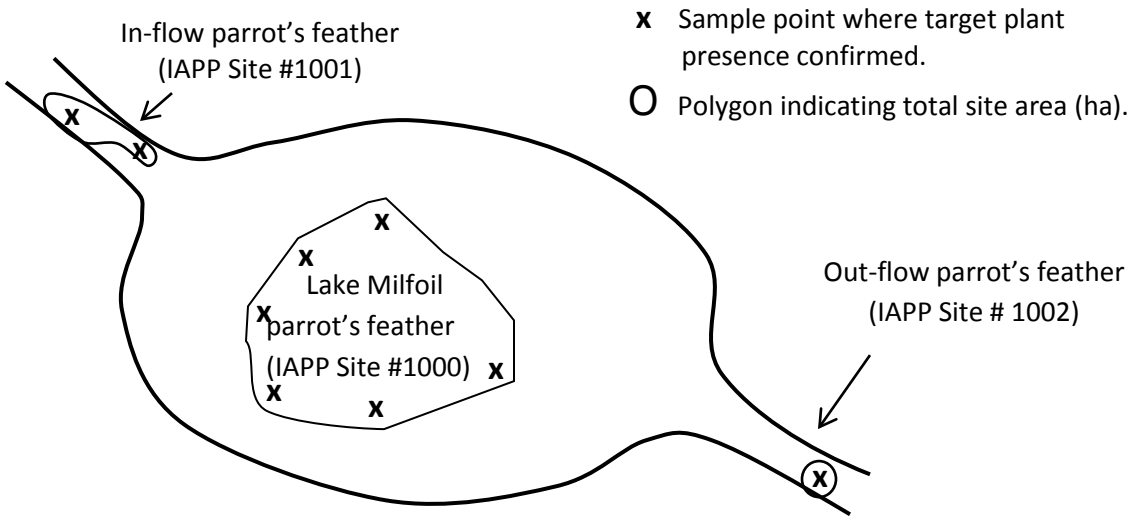


**Figure 12. IAPP Site Numbering Example**

**Table 2. Definitions for fields in the Site & Aquatic Invasive Plant Inventory Record form.**

| Field Name | Definition |
|---|---|
| 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 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. |
| Jurisdiction | Mandatory text entry to identify the legal entity that is responsible for the land (and water) on which the site is located. |
| Elevation (m) | Text entry to identify the height of land above sea level; measured with a GPS unit or an altimeter. The elevation should be recorded from the shore at the put-in point. |
| 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. The site UTMs are recorded from the survey start point, which may also be sample point #1. |
| 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. The site UTMs are |

| Field Name | Definition |
|---|---|
| | recorded from the survey start point, which may also be sample point #1. |
| 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 "Vehicle parking in pull-out across from boat put-in" or “Boat put-in along public right-of-way, foot access only”. |
| Sample Date | The date sample points are recorded. |
| 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. |
| Sample Voucher Submitted for Verification | Select yes or no. If yes, provide details such as: “Unknown floating aquatic plant with whorls of 5-leaflets submitted to Royal BC Museum.” |
| Sample Point # | Sequential sample point number. |
| Sample Point UTM Easting | Mandatory number entry; 7-digit number starting with a zero, the initial zero is not recorded in IAPP. The sample point UTMs are recorded at each sample point to allow surveyors to return to the point for future monitoring or sample collections. |
| Sample Point 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. The sample point UTMs are recorded at each sample point to allow surveyors to return to the point for future monitoring or sample collections. |
| Water depth (m) | The vertical measure from the water surface to the substrate bottom. The water depth of some water bodies may fluctuate significantly due to man-made infrastructure (e.g. weirs). Presence of such structures (and min/max depths) should be noted in the site comments where possible. |
| Secchi Depth (m) | A measure of water turbidity obtained using a secchi disk; used to gauge the transparency of water by measuring the depth (Secchi depth) at which the disk ceases to be visible from the surface. |
| 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 (length x width), which is then translated into hectares by the data entry staff member. The total area for an aquatic site is delineated by a polygon around the perimeter of all sample points where the target plant was found to be present. Area ***IS NOT*** a measure of the entire water body area, unless the entire water body is infested with the target plant. |

| Field Name | Definition |
|---|---|
| Sample Point Comments | Text entry to provide an opportunity to enter any additional information about the sample point that has not been captured elsewhere, including list of invasive/native aquatic species present, flow characteristics, water turbidity, water quality, substrate depth, sediment type, adjacent land use, access options, etc. |

## 5.5. Sample Collection, Labeling and Preservation

- Collect a sample of the plant and place it in a plastic zip-lock bag with damp paper towels, label as described below, and put the bag in a cooler or other container to protect from damage (heat, cold, physical damage).
- Record the following information on both the sample bag and plant identification form (see below). Use a waterproof permanent marker for sample bag label and a pencil for the identification form.
    - Collection Date
    - Collector Name & Agency
    - Water Body Name
    - UTM Coordinates: Zone (10 or 11); Easting (6-digits); Northing (7-digits)
    - Site Location
- Mailing the sample: Samples should be sent in damp paper towels in a zip-lock bag. The bag should be placed in a padded box so the sample can't be crushed, and mail priority delivery (Monday through Thursday). Shipping addresses are shown on the plant identification form located at the end of this document.
    - Complete the plant identification form and send the form and the sample to the Royal BC Museum diagnostic lab for analysis (see Appendix D for the form and contact information).

## 6. OTHER AQUATIC INVASIVE SPECIES

For further information on other invasive species in the PNW the Oregon Sea Grant- On the Lookout for Aquatic Invaders booklet can be purchased online. The BC Frogwatch Program website contains information on identifying frogs and toads in BC. Any frogs or toads encountered during surveying should not be disturbed and observations should be reported using the Online Incidental Wildlife Observation Form.

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## APPENDIX A: EQUIPMENT DECONTAMINATION

Field equipment must be decontaminated at the site to prevent transfer of organisms within and between waterbodies and samples. Equipment and any affiliated rope are decontaminated by soaking in a solution of 5% acetic acid (i.e., white vinegar). Vinegar dissolves calcite in the shells of veligers. The ideal soak time is 24 hours and the minimum soak time is 4 hours. Multiple sets of field equipment are recommended. Equipment is thoroughly rinsed with clean water in a spray bottle before and after the vinegar soak. The vinegar may be reused.

Another method is a 5-7% bleach solution (i.e., approximately 0.05 mL of active chlorine per 1L of water assuming 10% of bleach solution is active chlorine). To make the bleach solution, add 7oz/210 mL (a little less than 1 cup) of household bleach to 1 gal (3.8 L) of water, or alternatively 5 mL of household bleach solution to 1L of water. Ropes and nets can then be soaked in the bleach solution. Bleach is corrosive and equipment must be thoroughly rinsed with tap water following decontamination. Bleach can also be re-used but it will lose its strength over time.

Recommended decontamination procedures are as follows:

- Remove any visible plant material from equipment and clothing;
- Soak equipment and any affiliated rope in 5% bleach solution for 30 minutes;
- To make 5% bleach solution use 7oz (a little less than 1 cup) of household bleach to 1 gal (16 cups/ 128 oz) of water;
- Thoroughly rinse all gear with fresh water, and
- Allow gear to dry thoroughly for as long as possible.

Inspect, **clean, drain and dry** all gear and boats following use. If possible, avoid launching a watercraft into more than one waterbody per day (depending on weather conditions) to allow time for boat and gear to dry. If possible decontaminate watercraft using hot water power wash (≥60$^{o}$C on boat surface). For sampling questions contact your BC Ministry of Forests, Lands and Natural Resource Operations (FLNR) Invasive Plant Specialist.

## APPENDIX B: SHIPPING PROTOCOLS

Sample Handling and Custody

Ethanol (>24% by volume) is a Class 3 flammable liquid under Transport Canada Regulations (UN # 1170) and there are restrictions regarding its transport. Ethanol can only be transported on the ground/ surface and cannot be transported by air and it is illegal to ship samples preserved in ethanol by regular mail (i.e., Canada Post). Therefore they must be shipped by courier (i.e., FedEx, UPS or Purolator), and because ethanol is classified as Dangerous Goods by IATA (International Air Transport Association) there are specific labeling and shipping requirements.

Non-infectious natural history samples preserved in small quantities (<500 mL) of 95% ethanol can be shipped under the *IATA Special Provision A180 (SP A180)*.

SP A180 Restrictions:

- Max 30 mL of ethanol (ETOH) per sample/tube;
- Max 1 L of ethanol per shipment (or 500 mL if 95% ETOH);
- Samples must contain natural history samples (i.e., tubes/containers containing only ETOH cannot be shipped under SP A180), and
- Samples must be packed in heat sealed plastic bags.

SP A180 Packing Protocol:

From the *IATA Dangerous Goods Regulations 2013 page 358* (54th edition)

**A180** Non-infectious specimens, such as specimens of mammals, birds, amphibians, reptiles, fish, insects and other invertebrates containing small quantities of UN 1170, UN 1198, UN 1987, or UN 1219 are not subject to these Regulations provided the following packing and marking requirements are met:

**(a)** specimens are:

1. wrapped in paper towel and/or cheesecloth moistened with alcohol or an alcohol solution and then placed in a plastic bag that is heat-sealed. Any free liquid in the bag must not exceed 30 mL; or
2. placed in vials or other rigid containers with no more than 30 mL of alcohol or an alcohol solution;

**(b)** the prepared specimens are then placed in a plastic bag that is then heat–sealed;

**(c)** the bagged specimens are then placed inside a another plastic bag with absorbent material then heat sealed;

**(d)** the finished bag is then placed in a strong outer packaging with suitable cushioning material;

**(e)** the total quantity of flammable liquid per outer packaging must not exceed 1 L; and

**(f)** the completed package is marked "scientific research specimens, not restricted Special Provision A180 applies".

The words "not restricted" and the special provision number A180 must be included in the description of the substance on the Air Waybill as required by 8.2.6, when an Air Waybill is issued.

Protocols for Shipping Ethanol (Ground Transport Only):

1. Samples must be in plastic containers with a screw lid. The volume in each container cannot exceed 30 mL. Secure screw lids.
2. The total volume of 95% ethanol in all the containers can NOT exceed 500 mL.

3. Place all containers into a sealable plastic bag (e.g., Zip Lock) and then place this bag into a heat sealed plastic bag.
4. Place sealed bags and sample containers into a box and add cushioning material such as plastic grocery bags or scrap paper. Seal this box with clear packing tape. The box does NOT need to be a specific type of box so long as it is sturdy.
5. Place this box into another box and add cushioning material as needed. The outer box does NOT need to be a specific type of box so long as it is sturdy. Seal box with clear packing tape.
6. <u>The outside of the box must be clearly labelled with the following:</u>
   **"Scientific research specimens, not restricted, Special Provision A180 applies**."
7. If using an Air Waybill, check the dangerous goods option "Yes-Shipper's declaration not required" and in the description of the contents section write:
   **"Scientific research specimens, not restricted, Special Provision A180 applies."**
8. If shipping internationally be sure to include any import/export documents with the Air Waybill and also indicate **"No Cities Required"** and **"No endangered Species".**
9. Include a complete return address. Label that is placed on address side of box.

## APPENDIX C: SITE AND AQUATIC INVASIVE PLANT INVENTORY RECORD

B.C. SITE AND AQUATIC INVASIVE PLANT SURVEY RECORD

BRITISH COLUMBIA

**SITE DETAILS**

| | | |
|---|---|---|
| Site Created Date: | | |
| Invasive Plant Survey Date: | | Site Paper File ID: |
| Jurisdiction: | | Elevation (m): |
| UTM Zone: | UTM Northing (7-digits): | UTM Easting (6-digits): |
| Site Location (regional district, water body name, description of section surveyed (if river), closest town, directions how to get to site): | | |
| Site Comments (water body type, flow and turbidity, aquatic vegetation present, sediment type, type of public use, etc): | | |

**SAMPLE POINT SURVEY DETAILS**

| | |
|---|---|
| Sample Date: | |
| Survey Agency: | Employer: |
| Surveyor(s): | |
| Sample voucher submitted for verification (If yes, provide details): Yes / No | |

B.C. SITE AND AQUATIC INVASIVE PLANT SURVEY RECORD

| Sample Point # | UTM Easting | UTM Northing | Water Depth (m) | Secchi Depth (m) | Area (ha) |
|---|---|---|---|---|---|
| | | | | | |
| Comments (invasive/native aquatic species present, flow characteristics, water turbidity, substrate depth, sediment type, adjacent land use, access options): | | | | | |
| | | | | | |
| Comments: | | | | | |
| | | | | | |
| Comments: | | | | | |
| | | | | | |
| Comments: | | | | | |
| | | | | | |
| Comments: | | | | | |

## APPENDIX D: AQUATIC INVASIVE PLANT SAMPLE COLLECTION FORM

**Herbarium**, Royal BC Museum

675 Belleville St.

Victoria, BC V8W 9W2

**Collection Date (MM/DD/YY): _____ / _____ / _____**

**Client Name: _____**

**Email: _____**

**Phone: _(_____)_____**

***Accompanying this form is a plant sample to be identified. Please answer all items before submitting the plant sample.***

**1. CONTACT**

| | |
|---|---|
| Collector Name: | |
| Phone: | Address: |

**2. SAMPLE LOCATION**

| | | |
|---|---|---|
| Regional District: | Water Body Name: | |
| Water Body Type:<br>LAKE \| SLOUGH \| MAN-MADE POND \| RIVER \| CREEK \| DON'T KNOW | | |
| UTM Zone (10 or 11): | Easting (6-digits): | Northing (7-digits): |

**3. COLLECTION HABITAT (circle below):**

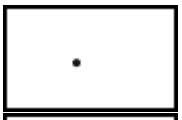
STREAM/RIVER | POND (<10 ACRES) | AQUASCAPE (ORNAMENTAL POND) | LAKE (>10 ACRES) | OTHER (SPECIFY BELOW)

DESCRIBE:

**4. PLANT FORM (circle below):**

| MOSS | BROADLEAF | GRASS | DON'T KNOW |
|---|---|---|---|

**5. DISTRIBUTION (circle below):**

1  RARE INDIVIDUAL, A SINGLE OCCURRENCE

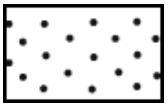
2  FEW SPORADICALLY OCCURRING INDIVIDUALS

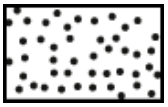
3  SINGLE PATCH OR CLUMP OF A SPECIES

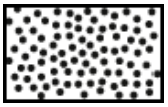
4  SEVERAL SPORADICALLY OCCURRING INDIVIDUALS

5  A FEW PATCHES OR CLUMPS OF A SPECIES

6  SEVERAL WELL-SPACED PATCHES OR CLUMPS

7  CONTINUOUS UNIFORM OCCURRENCE OF WELL-SPACED INDIVIDUALS

8  CONTINUOUS OCCURRENCE OF A SPECIES WITH A FEW GAPS IN THE DISTRIBUTION

9  CONTINUOUS DENSE OCCURRENCE OF A SPECIES

**6. OTHER PLANT INFORMATION:**

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**7.** Send email to Ken Marr (Curator Botany, RBCM): KMARR@royalbcmuseum.bc.ca AND your FLNR Invasive Plant Specialist with the following information:

- Preliminary sample ID
- Indicate if species Prohibited weed and/or rapid verification required
- Indicate if sender wants to be notified of verification
- Date sample in the mail
- Sample gift to museum or return of sample to sender required

## APPENDIX E: ZEBRA AND QUAGGA MUSSEL SUBSTRATE SAMPLER DATA SHEETS

| Sampling location, lake, site on lake, nearest town | Sample site description | Latitude / UTM | Longitude / UTM | Date sampled DD-MM-YYYY | Observations / comments |
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