COLUMBIA SHUSWAP INVASIVE SPECIES SOCIETY AQUATIC INVASIVE SURVEYS 2016

PREPARED FOR:
The Columbia Shuswap Invasive Species Society
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Introduction:

Aquatic invasive species (AIS) consist of plants, invertebrates, fish, amphibians and other organisms that have been introduced to a waterbody to which they are not native. While some non-native introductions may not survive or thrive in their new environment, AIS have the potential to cause significant economic or ecological damage. The threat of AIS to British Columbia's waterways has been steadily increasing as new species are being found and species that are known to be present in BC are spread throughout the province. A number of aquatic invasive plants are already known to be present in the Columbia Shuswap Regional District (CSRD) (Figure 1) including Eurasian watermilfoil, and in 2016, curly-leaf pondweed was discovered in Shuswap Lake and fragrant waterlily was found in White Lake. There is a neighbouring fragrant waterlily infestation in the Central Kootenay region. There is an ongoing risk of spreading these plants to other lakes within the CSRD region. In order to minimize the threat of AIS, a number of steps have been taken throughout the province. These include education and outreach programs targeting the main pathways of introduction such as the horticulture (PlantWise) and aquarium (Don't Let it Loose) industries and recreational boaters (Clean, Drain, Dry). The BC Government's Mussel Defence Program has been implemented province-wide, stopping boaters at roadside inspections to check for AIS and increase public awareness. Another key component in preventing the spread of AIS is an effective monitoring program. In particular, programs such as BC's Early Detection Rapid Response (EDRR) allow for the detection and containment of AIS before they become established. Once established in a system, AIS become much more difficult to control or eradicate. The goal of the CSISS AIS program is to assist where there are gaps in the BC EDRR program, and as indicated in the work-plan for the Canadian Columbia Basin Aquatic Invasive Species Framework (Craig 2015). The CSISS 2016 aquatic invasive plant and veliger sampling program coincided with Ministry of Environment (MoE) and BC Hydro veliger sampling taking place in the CSRD. In 2015, CSISS conducted initial aquatic invasive plant and veliger sampling in the North Columbia region with funding from the Columbia Basin Trust (Harkness 2015).

Methods:

This study was conducted in order to complement CSISS's ongoing AIS surveys on priority lakes as determined by using the Draft Ranking Matrix for Monitoring Priority of Water Bodies in the document "Canadian Columbia Basin Regional Framework for an Aquatic Invasive Species Program: 2015 to 2020." (Craig 2015). Waterbodies where zebra/quagga mussel (ZQM) veliger sampling required the use of a watercraft were predetermined by CSISS and a work plan was developed. As a result, Joyce Lake, Skimikin Lake, Three Valley Lake, Echo Lake, Blackwater Lake, Cedar Lake, Loon Lake, Wilbur Lake and Bittern Lake were ranked and chosen for AIS monitoring. With the exception of Three Valley Lake, these lakes were located in proximity to Forest Recreation Sites and many are popular with fishermen. AIS surveys for ZQM veliger (larvae) and aquatic plants were carried out in accordance with British Columbia Aquatic Invasive Species Survey Methods (Government of British Columbia, June 2016).

At each site, ZQM veliger samples were taken by watercraft at a depth of up to six meters using a plankton tow net and vertical tows. Samples were then preserved in Isopropyl alcohol and shipped to a government approved laboratory for analysis. Aquatic plants were sampled using a hard rake at 100m intervals along the entire littoral zone of each lake surveyed. At each sampling point UTM's, depth, substrate, plants found (native and non-native) and other relevant data was recorded. Secchi depth (a measure of water clarity or turbidity) was also recorded at each lake. Plants were identified using the key provided in Studies on Aquatic Macrophytes Part XXXIII, Aquatic Plants of British Columbia"

(Warrington, 1980). Where riparian or aquatic invasive plants were found, the data was entered into the Invasive Alien Plant Program (IAPP) database following provincial standards.

Results:

Sampling data for ZQM veliger monitoring is presented in Table 1 and all results came back negative after analysis by the Province's laboratory contractor. No aquatic or riparian invasive plants were found at any of the sampling points (Appendix A and Figure 1) on any of the lakes surveyed in the course of this study. Data collected at each sampling point is provided in the attached spreadsheet (Appendix A). The additional ZQM veliger monitoring completed by CSISS staff at other waterbodies will be detailed in the CSISS Annual Report, to be released in December 2016.

Table 1. Zebra/quagga mussel sampling points and data.

Waterbody	Invasive Plant Management Area	Date	Zone	Easting	Northing	Depth of tow	Temp (C)	# Tows
Joyce Lake	Salmon Arm	26-Sep-16	11U	314948.4	5605100	3m	12	3
Skimikin Lake	Salmon Arm	26-Sep-16	11U	327718.1	5628902	4m	14	4
Three Valley Lake	Salmon Arm	27-Sep-16	11U	396616.4	5643106	6m	13	4
Echo Lake	Revelstoke	27-Sep-16	11U	424925.2	5634415	6m	16	4
Blackwater Lake	Golden	28-Sep-16	11U	471977	5461180	3.5m	11	4
Cedar Lake	Golden	28-Sep-16	11U	501253	5679063	6m	13.5	4
Loon Lake	Golden	29-Sep-16	11U	523667	5656137	6m	13	4
Wilbur Lake	Golden	29-Sep-16	11U	522487	5650870	6m	11	4
Bittern Lake	Golden	29-Sep-16	11U	528033.8	5647520	6m	15.5	4

In general, the amount of aquatic vegetation present decreased as Secchi depth increased at all of the lakes. Larger beds of native macrophytes were present at Joyce and Blackwater Lakes and at Three Valley Lake were confined mainly to the east and west ends (inflow and outflow) and the inflow creek at the Trans-Canada rest area. On Skimikin, Echo, Cedar, Loon, Wilbur and Bittern Lakes, native plants were present at many sampling points, but were growing sporadically in isolated clumps or individuals.

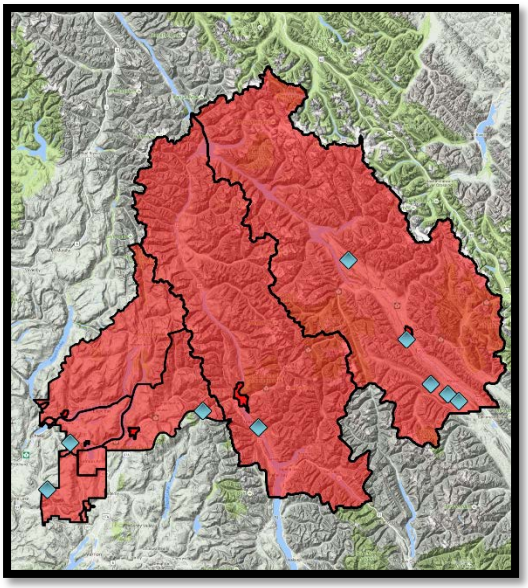

Figure 1. The Columbia Shuswap Invasive Species Society's operational area is encompassed within the Columbia Shuswap Regional District, and has been further divided into three Invasive Plant Management Areas (IPMAs), Salmon Arm, Revelstoke and Golden, shown in red. The waterbodies surveyed for aquatic invasive plants and Zebra Quagga Mussel Veligers within this study are highlighted in blue.

For a complete map highlighting all Zebra Quagga Mussel Veliger samples taken within CSRD waterbodies from CSISS, MoE, and BC Hydro in 2016 please view CSISS's 2016 Annual Report.

Discussion:

The Draft Ranking Matrix for Monitoring Priority of Water Bodies has been designed as a tool to assist managers and planners to establish which lakes are at a greater risk of introductions and impacts of AIS, as well as respond to any early detection high priority species. The lakes surveyed in this study were ranked as medium and low priority for monitoring due to their small size and lower usage by recreational boaters. It is an excellent finding that no aquatic invasive plants or zebra/quagga mussel veligers were detected this sampling season in surveyed waterbodies. However, the close proximity of infestations of invasive Eurasian Watermilfoil and curly-leaf pondweed in Shuswap Lake and Lake Revelstoke pose a significant risk of fragments or turions being transported to many of these smaller lakes. Turions are specialized vegetative reproductive buds that can remain dormant for many years. Intentional plantings of fragrant waterlily have recently been discovered in small waterbodies adjacent to rest areas in the West Kootenays (Vogel et. al., 2015). Joyce, Skimikin and Blackwater Lakes are shallow, mesotrophic lakes with maximum depths of 7.5m, 5m and 5.1m respectively. If introduced, aquatic invasive plants, such as Eurasian watermilfoil, curly-leaf pondweed or fragrant waterlily, could potentially colonize a large proportion of these lakes (Joyce, Blackwater and Skimikin) as native plants were found growing in depths of up to 4.5m. Mesotrophic lakes are characterized by higher nutrient concentrations and an increase in plant abundance. Madsen (1998) found that Eurasian watermilfoil is more abundant in mesotrophic and moderately eutrophic lakes and suggests that these lakes are at a greater risk of new introductions. Many of these lakes are also important habitat for the blue-listed Western Painted Turtle and species of concern such as the Western Toad. Western Toads were observed emerging from the shores of Echo Lake. The EDRR monitoring program is key to preventing the introduction of invasive species, such as American Bullfrog, aquatic invasive plants, and others, and maintaining existing native biodiversity.

In order to maximize the probability of collecting ZQM veligers in a plankton tow it is recommended that sampling be carried out earlier in the sampling season. This will also ensure that sampling will occur when veligers are most active, that is when water temperatures are between 16 and 19 degrees Celsius. If possible, veliger tows should occur multiple times throughout the summer.

Monitoring of medium and low priority lakes should continue along with monitoring of critical and high priority lakes throughout the CSRD region. A smaller waterbody could potentially become colonized with ZQM and if left unmonitored could become a vector for spread throughout the region. AIS activities should also continue to include increasing public awareness about the negative impacts of AIS on recreation and native ecosystems. Due to the inter-connectivity of waterways throughout the Columbia Basin, collaboration with existing partners and forging new relationships with a variety of stakeholders (stewardship groups, boating associations, etc.) are also key factors in mitigating the impacts of AIS.

Waterbodies within the CSRD that are ranked as medium and low priority should continue to be monitored for AIS in the future. Factors such as suitable environment/ habitat for plant growth (ie. a large amount of native plants present), proximity to known infestations, and accessibility and size of the littoral zone (the near shore area where sunlight penetrates to the substrate allowing aquatic plants to grow), place Joyce Lake, Skimikin Lake, Three Valley Lake and Blackwater Lake at a higher risk of introduction and impacts of AIS. Due to the high variability in the life-cycles of aquatic invasive plants many organizations suggest that monitoring occur frequently over the summer (Government of British Columbia 2016, Duncan 2011, Lund et. al. 2015). Multiple sampling events for ZQM veligers also increase the probability of detecting small populations before they become established. It is therefore recommended that these lakes be sampled on a yearly basis. The limited amount of vegetation and higher secchi depths observed at Echo, Cedar, Loon, Wilbur and Bittern Lake suggest that these are oligotrophic (less productive, low nutrients) or possibly marl (high concentration of $CaCO_3$) lakes. In oligotrophic lakes suitable habitats for invasive plants are smaller and more isolated and growth is slow (Madsen and Wersal 2009). The substrate at Loon, Wilbur and Bittern Lakes was consistent with substrate at other marl lakes such as White Lake in the Shuswap region. Eurasian watermilfoil is present in White Lake but has not exhibited typical invasive behaviour, perhaps a result of the calcite deposits limiting macrophyte growth (CSRD 2016). Aquatic plant surveys at these lakes should be conducted every three years. ZQM veliger monitoring should occur yearly at these lakes if possible.

There are numerous priority AIS listed in The Canadian Columbia Basin Regional Framework for an Aquatic Invasive Species Program (Craig 2015) for which no monitoring has been conducted within the CSRD. In the course of surveying for ZQM veligers and aquatic plants, surveyors should keep watch for species, such as American bullfrogs and red-eared slider turtles. Mollusks and shellfish other than ZQM, such as New Zealand mudsnails, Asian clams and mystery snails, can be sampled for in the course of plant rake-toss surveys by observing mollusks attached to plant material. Species exhibiting aggressive growth or that are identified as invasive should be documented and preserved in accordance with the Provincial protocol.

Currently American bullfrogs and virile crayfish are present in areas bordering the CSRD region. Bullfrogs have been detected in the Pend D'Oreille system and are approaching Creston in the Central Kootenay Invasive Species Society's (CKISS) district and virile crayfish have been detected in Nose Creek (a tributary of the Bow River) in Alberta as well as in Idaho and Washington. These populations are still a significant distance from the CSRD region and crayfish present in the Columbia system are also downstream reducing the risk of passive introduction to the region. CKISS is currently using song-meters and eDNA to track bullfrog migration in their region. If populations begin to approach the CSRD borders similar monitoring programs should be implemented. Collaboration and information sharing with CKISS would greatly assist in the development of a successful program.

Introductions of AIS by humans, both accidental and intentional, pose a substantial risk to the region. Increasing public awareness through programs such as PlantWise, Clean, Drain, Dry and Don't Let it Loose are integral components in the fight against AIS. Engaging the public to photograph and report any suspected invasive species observed will also help significantly as the region is extremely large and has finite resources. A citizen's photograph recently helped the Christina Lake Stewardship Society identify a red-eared slider turtle that had been released into the wild (CBC 2016).

The threat of invasive species entering the CSRD region are only increasing as new populations of AIS species continue to be discovered in neighbouring regions. In following a multi-pronged collaborative approach including education, outreach, monitoring and treatment the risks and impacts of these invaders can be successfully reduced and mitigated.

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Appendix A

Please see attached sampling points for waterbodies sampled in 2016, including native vegetation data.