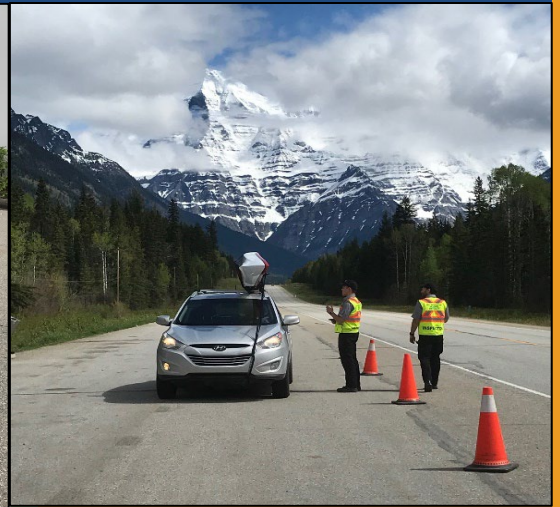


B.C. Invasive Mussel Defence Program: 2020 Final Report



Ministry of
Environment and
Climate Change Strategy

November 2021

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Table of Contents

GLOSSARY	1
EXECUTIVE SUMMARY	3
1. BACKGROUND	4
1.1 HISTORY	4
1.2 REGULATORY AND JURISDICTIONAL FRAMEWORK	4
1.3 JURISDICTIONAL COORDINATION	5
2. PROGRAM LOGISTICS	6
2.1 OPERATIONS	6
2.2 INSPECTION CREW TRAINING (AUXILIARY COs).....	8
2.3 WATERCRAFT RISK ASSESSMENT	8
2.4 PROGRAM FUNDING AND BUDGET	8
3. WATERCRAFT INSPECTION SUMMARY FOR 2020	10
3.1 ALL WATERCRAFT ENCOUNTERS	10
3.2 HIGH-RISK WATERCRAFT ENCOUNTERS	22
3.3 MUSSEL FOULED WATERCRAFT.....	30
3.4 COMMERCIALY HAULED WATERCRAFT	33
3.5 PASSPORT PROGRAM.....	36
3.6 CANADA BORDER SERVICES AGENCY NOTIFICATIONS	36
3.7 K9 INSPECTIONS	37
4. OUTREACH/EDUCATION ON CLEAN, DRAIN, DRY	37
4.1 INSPECTION STATIONS.....	37
4.2 OUTREACH EVENTS	39
5. LAKE MONITORING	39
6. PARTNERSHIPS AND COLLABORATIONS	41
7. SUMMARY OF LESSONS LEARNED AND IMPROVEMENTS	43
7.1 GENERAL OPERATIONS.....	43
7.2 INSPECTION STATIONS.....	44
7.3 COMPLIANCE.....	45
APPENDIX A 2020 WATERCRAFT INSPECTION STATION DETAILS.....	46
APPENDIX B 2020 LAKE MONITORING SAMPLING DETAILS.....	47

List of Tables

TABLE 1. SUMMARY OF 2020 OPERATING BUDGET AND THE ACTUALS AS OF MARCH 31 ST 2021.	9
TABLE 2. TOTAL NUMBER OF PLANKTON TOW SAMPLES COLLECTED AND WATERBODIES SAMPLED BY SEASON SINCE THE PROGRAM STARTED IN 2015.....	40

List of Figures

FIGURE 1. WATERCRAFT INSPECTION STATION LOCATIONS FOR THE 2020 SEASON.	7
FIGURE 2. TOTAL INSPECTIONS BY STATION LOCATION FOR THE 2020 SEASON.	11
FIGURE 3. ENCOUNTER FREQUENCY (BARS) BY INSPECTION STATION IN COMPARISON TO PERCENT OF HIGH-RISK BOATS (LINE) PER INSPECTION STATION, FROM MAY TO NOVEMBER 2020.....	12
FIGURE 4. TOTAL NUMBER OF JURISDICTIONS (PROV/STATE) WHERE BOATS WERE COMING FROM THAT WERE INTERCEPTED AT EACH INSPECTION STATION FOR THE 2020 SEASON.....	12
FIGURE 5. TOTAL INSPECTIONS (LEFT) AND TOTAL EFFORT (RIGHT) BY MONTH ACROSS INSPECTION STATIONS.....	13
FIGURE 6. ENCOUNTER FREQUENCY BY MONTH ACROSS ALL INSPECTION STATIONS (ERROR BARS ILLUSTRATE THE STANDARD ERROR).	14
FIGURE 7. TOTAL INSPECTIONS (LEFT) AND TOTAL EFFORT (RIGHT) BY DAY OF THE WEEK ACROSS INSPECTION STATIONS. STATUTORY HOLIDAYS WERE INCLUDED IN THE DATA ANALYSES.....	14
FIGURE 8. ENCOUNTER FREQUENCY BY DAY OF THE WEEK FROM MAY TO NOVEMBER 2020, ACROSS INSPECTION STATIONS. ERROR BARS ILLUSTRATE THE STANDARD ERROR. STATUTORY HOLIDAYS WERE INCLUDED IN THE DATA ANALYSES.	15
FIGURE 9. TOTAL INSPECTIONS BY TIME OF DAY ACROSS ALL INSPECTION STATIONS FOR THE 2020 SEASON.	16
FIGURE 10. HOME RESIDENCE BY PROVINCE/STATE OF ALL INSPECTIONS DURING THE 2020 SEASON.....	17
FIGURE 11. DESTINATION WATERBODIES BY PERCENT OF ALL INSPECTIONS DURING THE 2020 SEASON.....	18
FIGURE 12. PERCENT COMPLIANCE BY INSPECTION STATION FOR THE 2020 SEASON.	19
FIGURE 13. PERCENT COMPLIANCE BY INSPECTION STATION FOR THE 2020 SEASON.	20
FIGURE 14. PERCENT OF WATERCRAFT INTERCEPTED PER INSPECTION STATION THAT HAD BEEN PREVIOUSLY INSPECTED.....	21
FIGURE 15. FREQUENCY OF WATERCRAFT PREVIOUSLY INSPECTED AT ANOTHER WATERCRAFT INSPECTION STATION (EITHER IN BC OR ANOTHER JURISDICTION).....	21
FIGURE 16. TOTAL HIGH-RISK INSPECTIONS BY MONTH ACROSS THE 2018-2020 SEASONS.	22
FIGURE 17. THE NUMBER OF HIGH-RISK INSPECTIONS BY INSPECTION STATION FOR THE 2020 SEASON.	23
FIGURE 18. SOURCE LOCATIONS OF THE HIGH-RISK INSPECTIONS IDENTIFIED DURING THE 2020 SEASON.....	25
FIGURE 19. DESTINATION REGIONS OF ALL HIGH-RISK INSPECTIONS IDENTIFIED DURING THE 2020 SEASON.	25
FIGURE 20. SOURCE LOCATIONS OF THE HIGH-RISK WATERCRAFT INSPECTED DURING THE 2020 SEASON.	26
FIGURE 21. DESTINATION LOCATIONS OF THE HIGH-RISK INSPECTIONS IDENTIFIED DURING THE 2020 SEASON.	27

FIGURE 22. TOTAL WATERCRAFT INSPECTED BY WATERCRAFT TYPE (SEE ABOVE FOR EXPLANATION OF EACH CATEGORY) FOR THE 2020 SEASON.29

FIGURE 23. HIGH-RISK INSPECTIONS BY WATERCRAFT TYPE FOR THE 2020 SEASON.29

FIGURE 24. THE NUMBER OF MUSSEL FOULED WATERCRAFT INTERCEPTED BY MONTH ACROSS ALL SEASONS OF THE PROGRAM (2015-2020).30

FIGURE 25. SOURCE PROVINCES AND STATES OF THE 16 MUSSEL-FOULED WATERCRAFT INTERCEPTED DURING THE 2020 SEASON.31

FIGURE 26. DESTINATION REGIONS IN B.C. OF THE 16 MUSSEL-FOULED WATERCRAFT INTERCEPTED DURING THE 2020 SEASON.31

FIGURE 27. SOURCE LOCATION OF MUSSEL FOULED BOATS.32

FIGURE 28. WATERCRAFT TYPE OF THE 16 MUSSEL-FOULED WATERCRAFT INTERCEPTED DURING THE 2020 SEASON.....33

FIGURE 29. NUMBER OF COMMERCIALY HAULED BOATS INTERCEPTED AT THE WATERCRAFT INSPECTION STATIONS DURING THE 2020 SEASON.....34

FIGURE 30. SOURCE LOCATION OF COMMERCIALY HAULED WATERCRAFT COMING FROM OUTSIDE BC.....35

FIGURE 31. CBSA NOTIFICATIONS RECEIVED ACROSS SEVERAL BORDER CROSSINGS FOR THE 2018 TO 2020 SEASONS.....36

FIGURE 32. WATERCRAFT OWNERS’ PREVIOUS KNOWLEDGE OF AQUATIC INVASIVE SPECIES AND/OR CLEAN, DRAIN, DRY BY WATERCRAFT INSPECTION STATION FOR 2020.38

FIGURE 33. PRIMARY SOURCES OF PREVIOUS KNOWLEDGE OF AQUATIC INVASIVE SPECIES OR CLEAN, DRAIN, DRY.....38

FIGURE 34. 2020 LAKE MONITORING PLANKTON TOW SAMPLING LOCATIONS, PLEASE SEE ABOVE FOR THE FULL NAMES OF THE SAMPLING AGENCIES.41

GLOSSARY

Acronym	Definition
AGRI	Ministry of Agriculture
AIS	aquatic invasive species
BISS	Boundary Invasive Species Society
CAS	Controlled Alien Species Regulation
CBSA	Canada Border Services Agency
CBT	Columbia Basin Trust
CDD	Clean, Drain, Dry
CLSS	Christina Lake Stewardship Society
CO	Conservation Officer
COS	Conservation Officer Service
CSISS	Columbia Shuswap Invasive Species Society
DFO	Fisheries and Oceans Canada
EB	Ecosystems Branch
EKISS	Eastern Kootenay Invasive Species Society
ENV	Ministry of Environment and Climate Change Strategy
FLNRORD	Ministry of Forests, Lands, Natural Resource Operations and Rural Development
IMISWG	Inter-Ministry Invasive Species Working Group
TRAN	Ministry of Transportation and Infrastructure
NAD	North American datum
NWIPC	Northwest Invasive Plant Council
OASISS	Okanagan and Similkameen Invasive Species Society
RAPP	Report All Poachers and Polluters; refers to a toll-free number used to report suspected poachers, polluters, or other infractions of the <i>Wildlife Act</i> .
RCMP	Royal Canadian Mounted Police
ZQM	Zebra and Quagga mussels

Term	Definition
AIS Passport	A system for local watercraft users that frequently operate in Alberta and/or B.C. lakes, and regularly stop at inspection stations. The goal of the passport program is to expedite the inspection process at the mandatory watercraft inspection station. It is still mandatory for all passport holders to stop at all inspection stations in B.C. and Alberta, it is not a free pass.

Clean, Drain, Dry	Is a preventative step that all boaters should practice when moving any watercraft or water equipment between waterbodies to prevent the spread of aquatic invasive species. This includes boats that are just moving between lakes in B.C. to prevent the spread of species already present in some lakes but not others such as Eurasian watermilfoil.
Decontamination	Is applied when there is an identified risk that a conveyance (either watercraft or water equipment) may be transporting AIS. The Provincial auxiliary conservation officers are trained at identifying and treating the risk of transporting AIS through specified decontamination procedures. For zebra and quagga mussels, decontamination procedures involve hot water with specific contact times to kill the mussels and high pressure to remove them and no chemicals are used.
Decontamination order	A written, legal instrument issued by conservation officers requiring parties to take measures (through written instruction) to remove confirmed or suspected invasive mussels before a watercraft can be launched in any B.C. waters.
Quarantine period	A drying time of 30 days that is required to ensure that confirmed (adult mussels) or suspected invasive mussels (microscopic veligers) are dead before a watercraft is considered free to launch in B.C. waters. 30 days is based on the biology of dreissenid mussels that can survive as adults out of the water for up to 30 days under suitable temperature and humidity levels and the microscopic veliger stage could be present in standing water for 3-4 weeks.
Watercraft seal	A wire seal that is affixed to the watercraft in such a way that the seal would be broken if the watercraft were to be launched. Seals are used to monitor compliance with decontamination orders.
High-risk watercraft	<p>A high-risk watercraft may be any of the following:</p> <ul style="list-style-type: none"> • Any watercraft or equipment that has been launched in any waters of a province or state known or suspected of having zebra or quagga mussels in the past 30 days; or • Any watercraft or equipment that is coming from or is registered in a state / province that has zebra or quagga mussel infestations and is not clean, and to the extent practical, drained and dry; or • Any watercraft that is dirty, crusty or slimy with the potential risk of transporting other AIS.

EXECUTIVE SUMMARY

The Invasive Mussel Defence Program (IMDP) is a shared delivery between staff from the B.C. Conservation Office Service (COS) and the Environmental Sustainability Division (ESD) within the Ministry of Environment and Climate Change Strategy (ENV). The Program would like to recognize the ongoing funding provided by BC Hydro, Fortis BC, Columbia Power Corporation, and Columbia Basin Trust to support the delivery of the Program.

The 2020 IMDP season was met with some significant impacts to program delivery resulting from COVID 19. Due to public health restrictions implemented to mitigate the spread of COVID 19, the Program start-up was delayed to May 15, 2020 and stations were operational until late October 2020. The Program was able to safely on-board 37 returning staff who were stationed at seven inspection stations and two roving inspection crews.

As a result of the U.S. border closure through the entire 2020 season, staffing levels at the southern inspection stations were reduced due to the limited number of watercraft crossing into B.C. During this time, the Program continued to work with Canada Border Services Agency (CBSA) to receive and follow up on notifications of watercraft coming through any of the southern border crossings.

During the 2020 season approximately 29,900 inspections were performed and crews interacted with approximately 55,900 people to promote Clean, Drain, Dry. Of the total watercraft inspected, 159 were identified as high-risk, 27 Decontamination Orders were issued, and 17 watercraft were issued quarantine periods to meet the required 30-day drying time. A total of 83 decontaminations were performed by provincial inspectors.

Of the 29,900 inspections performed, 16 watercraft were confirmed to have adult invasive mussels. These watercraft came from Ontario (12), Arkansas (2), Wisconsin (1) and Manitoba (1) and were destined for the Okanagan (7), Lower Mainland (3), Vancouver Island (3), Thompson-Nicola (2), and unknown (1). The Program received advanced notification on 13 of the 16 mussel fouled boats either from another jurisdiction (e.g., AB, MT, ID, WA) or by Canada Border Services Agents (CBSA).

In 2020, the average compliance rate at inspection stations was 87.7%, which represents an increase from 83% in 2019. Of the watercraft that failed to stop at inspection stations, 88% were non-motorized watercraft, such as canoes, kayaks, and paddleboards, which pose a much lower risk than motorized watercraft. The increase in overall compliance was likely driven by the closure of the Laidlaw station for the 2020 season. Compliance at Laidlaw was on average 64% over the last three years (2017-2019) and lower than all other stations except Pacific and therefore brought the average across all stations down in past years.

In 2020, a total of 101 violation tickets and 76 warnings were issued by conservation officers to motorists for failing to stop at inspection stations. Watercraft operators who fail to stop at an inspection station are reported to the Report All Poachers and Polluters (RAPP) hotline and full-time conservation officers are responding and following up.

In 2020, approximately 954 water samples were collected across 89 lakes and 50 artificial substrate samples to monitor for invasive mussels. All samples came back negative for the presence of invasive mussels.

1. BACKGROUND

1.1 HISTORY

The presence of zebra and quagga mussels (ZQM) can result in substantial economic, environmental, and social impacts. These impacts include increased maintenance costs to infrastructure such as hydropower, water-works, irrigation, and degradation of native ecosystems, thereby affecting fisheries, recreation, and tourism. Unlike B.C.'s native mussels, ZQM attach to hard surfaces, allowing them to be moved between water bodies by boats and equipment. While not present in B.C., ZQM could survive in B.C. freshwater systems and would cause devastating impacts to B.C.'s lakes and streams.

The introduction of these two aquatic invasive species (AIS) could lead to serious impacts on our native salmon populations and could affect the viability of important commercial, recreational, and Aboriginal fisheries. In 2015, it was estimated that the costs associated with failing to prevent an invasion of invasive freshwater mussels (dreissenids) in the Pacific Northwest states and western Canadian provinces would exceed **\$500 million** annually¹. An economic risk assessment specific to B.C. estimates annual costs of at least C\$43 million if ZQM are introduced to B.C. This assessment does not include impacts to tourism, fisheries or property values.

The Program was launched in 2015 and has since adapted and expanded operationally and geographically each year through additional funding. This document reports on the logistics, activities, and findings of the Program's 2020 season for the operational period of April 1, 2020 to March 31, 2021. More information about previous seasons, including annual reports, is available on the Program [website](#).

1.2 REGULATORY AND JURISDICTIONAL FRAMEWORK

The Program is designed to mitigate the risk of ZQM introduction into B.C. by intercepting and inspecting watercraft travelling into or through B.C.

The Program consists of three main components:

- **A watercraft inspection program** to detect and respond to high-risk watercraft potentially transporting ZQM into B.C.;
- **Lake monitoring** to assess for the continued absence of ZQM in B.C. waters; and

¹ Source: *Advancing a Defense Against Invasive Mussels: a Report Prepared by the Pacific Northwest Economic Region and Pacific States Marine Fisheries Commission.*

http://www.pnwer.org/uploads/2/3/2/9/23295822/advancing_a_regional_defense_against_dreissenids_in_the_pacific_northwestfinal_1.pdf

- **Outreach and education** to promote the message of CLEAN, DRAIN, DRY to the boating community, in collaboration with our partners including the Invasive Species Council of B.C. and regional invasive species organizations.

The continued success of the Program is a direct result of:

- Integrating science, education, and enforcement through a unique joint delivery between the Conservation Officer Service and Ecosystems Branch (EB)
- Multi-agency collaboration (within B.C.) for the delivery of Program operations;
- Cross-jurisdictional collaboration to coordinate inspection locations, training, policy and procedures, lake monitoring, and immediate notification of high-risk boats; and
- Stakeholder engagement to work collaboratively with the boating industry to prevent the introduction of ZQM into B.C.

Inspectors are trained to deliver the watercraft inspection program and have been designated as auxiliary conservation officers under the *Environmental Management Act*. This designation provides powers to intercept/stop, inspect, question, obtain information, and issue decontamination orders. See *the Zebra and Quagga Mussel Early Detection and Rapid Response (ZQM EDRR) Plan* for more information on the Controlled Alien Species (CAS) Regulation as it pertains to ZQM (available at www.gov.bc.ca/invasive-species).

Provincial legislation gives the Province authority to take action on ZQM. The CAS regulation under the *Wildlife Act* is the principle legislation that defines, lists, and affords provisions to regulate invasive mussels in B.C. Under the CAS Regulation, prohibitions apply in relation to any mussel listed in Schedule 4 (Zebra, Quagga, and Conrad's False Mussel). Specifically, it is illegal for a person to:

- possess, breed, ship, or transport prohibited mussels in B.C.;
- release prohibited mussels into B.C. waters; or
- allow a prohibited mussel to be released or escape into B.C. waters.

In June 2015, the Aquatic Invasive Species Regulation, under the Federal *Fisheries Act*, was brought into force. This regulation prohibits the importation, possession, transportation, release and introduction of ZQM in the western provinces.

1.3 JURISDICTIONAL COORDINATION

Ongoing coordination with other jurisdictions in Canada and the U.S. has been critical for the overall success of the Program. Outside of B.C., the Program shares research, procedures, and notifications of high-risk boats with, but not limited to; Idaho, Montana, Washington, Oregon, Wyoming, Nevada, Arizona, California, Alaska, Yukon, Saskatchewan, Manitoba, and Alberta. This is part of B.C.'s ongoing commitment as a signatory to the trans-boundary *Columbia River Basin Inter-agency Invasive Species Response Plan: Zebra Mussels and Other Dreissenid Species* (available for download [here](#)). As a signatory, B.C. receives notifications of high-risk watercraft from neighbouring states, and is provided access to professional advice on risk management and training opportunities. B.C. is also a member of

the [Western Regional AIS Panel](#) and an active participant in the Pacific Northwest Economic Region (PNWER) invasive species working group.

In late 2015, the *Inter-Provincial-Territorial Agreement for Coordinated Regional Defense Against Invasive Species* was signed by B.C., Yukon, Alberta, Saskatchewan, and Manitoba. One of the primary objectives under this agreement is to develop and address shared priorities for invasive species with an initial focus on invasive mussel prevention and rapid response. In 2020 B.C. signed an update to this agreement to support continued collaboration across western Canada.

2. PROGRAM LOGISTICS

2.1 OPERATIONS

In 2020, program operations were administered by the Ministry of Environment and Climate Change Strategy. The officer in charge (OIC), three sergeants and the auxiliary conservation officers were staffed through the COS and oversaw the field operations of the watercraft inspection stations. EB staff within the Ministry led the science and policy aspects of the program including the lake monitoring program and research collaborations detailed in sections 5 and 6. The delivery of outreach and education and partnerships was shared between the COS and EB staff.

Hours of Operation

The 2020 IMDP season was met with some significant impacts to program delivery resulting from COVID-19. Due to public health restrictions implemented to mitigate the spread of COVID-19, the Program start-up commenced on May 11, 2020. The Program was able to safely on-board 37 returning staff who were fully trained in previous years.

The 37 trained auxiliary conservation officers formed teams that operated seven inspection stations and two additional roving crews (Okanagan and Fraser Valley). Each team had their own mobile decontamination units. The Golden inspection station had nine inspectors during the peak boating season from May to early September providing 06:00AM-12:00AM coverage seven days a week. The Yahk and Olsen (Hwy 3) stations operated dawn to dusk seven days a week during the peak season (May to early September). The Radium, Mt. Robson and Pacific stations were operational 10 hrs per day. The Dawson Creek inspection station was closed for the 2020 season due to staffing shortages and COVID-19 restrictions at the start of the season. The Program continued to implement a roving inspection crew in the Okanagan for the 2020 season and added a roving crew in the Fraser Valley. When the roving crews weren't responding to high-risk watercraft notifications, they rotated between setting up stations at alternate locations due to the border crossings being closed. The roving crews also conducted inspections and outreach at boat launches throughout the Okanagan and Lower Mainland.

Inspection Station Locations

Data from the 2019 boating season and inspection locations were used to adjust program operations for the 2020 season (Figure 1). The locations and hours of operations were assessed for suitability based on encounter frequency (watercraft encounters/effort), safety/communication, direction of traffic

targeted, the source location of boaters (percent coming from outside B.C.) and the number of high-risk and mussel fouled watercraft intercepted.

In addition to conducting watercraft inspections at established stations, the inspection crews responded to high-risk watercraft notifications received from within the province and from other jurisdictions. The Program worked very closely with neighboring jurisdictions to send and receive notifications of high-risk boats either destined for B.C. or traveling to other jurisdictions.

The COS Report All Poachers and Polluters (RAPP) hotline (1-877-952-7277) was used for reporting watercraft suspected of transporting invasive mussels, and any notifications received were sent to the watercraft inspectors. High-risk watercraft notifications from other jurisdictions were sent through an email distribution list to all inspectors and senior program staff. A response was then coordinated based on the location and availability of inspectors.



Figure 1. Watercraft inspection station locations for the 2020 season.

2.2 INSPECTION CREW TRAINING (AUXILIARY COs)

New inspectors were selected based on the candidate's education and background from a recognized compliance and enforcement or natural resource management program. These positions are excellent opportunities for senior students and recent graduates of environmental science and enforcement programs to gain hands-on experience and training towards a potential career in enforcement or environmental management.

Inspectors were trained in watercraft inspection and decontamination following the [Uniform Minimum Protocols and Standards for Watercraft Interception Programs for Dreissenid Mussels in the Western United States](#) (updated 2016). This is the standard protocol used for inspection and decontamination across the Pacific Northwest.

2.3 WATERCRAFT RISK ASSESSMENT

All motorists coming through watercraft inspection stations were asked a series of questions to determine if the watercraft was of high or low risk. Data was recorded electronically.

Two key questions asked by inspectors to determine watercraft risk were:

1. Where was the watercraft in the last 30 days?
2. How long has the watercraft been out of the water?

In accordance with ENV's watercraft risk assessment, if any watercraft or piece of equipment was in waters of any province or U.S. state known or suspected of having ZQM in the previous 30 days, it was considered high-risk. Any watercraft or equipment coming from a state or province that has quagga or zebra mussel infestations and was not clean to the satisfaction of inspectors, and had not been drained and dried, was also considered high-risk, even if it had been out of the water for over 30 days. Low-risk watercraft are those that have been used solely within B.C. or other non ZQM infested provinces or states within the previous 30 days and are found to be clean, drain, dry.

The inspectors verified information provided by watercraft owners through detailed watercraft inspections, and if required, through follow-up with third parties to confirm information obtained during interviews. Other circumstances may trigger a high-risk inspection such as unknown history of the watercraft; for example, if the owner of a recently purchased used boat does not know where the boat was last in the water, it would be considered high-risk.

2.4 PROGRAM FUNDING AND BUDGET

Overall Program Costs

The overall Program budget for 2020 consisted of \$2M from the four program partners (BC Hydro, Columbia Basin Trust, Columbia Power Corp and Fortis BC), \$1.5M of provincial funding for a total of \$3.5M. A total of \$250,000 from the provincial funding went to the EB to cover staff salary time for program support, travel, reporting, outreach materials & partnerships, research, and overseeing the lake monitoring program. Staff time for the lake monitoring program includes the annual review and update of the provincial protocol and chairing the technical committee for reviewing the Habitat Conservation

Trust Foundation (HCTF) grant proposals. The lake monitoring costs were also for the lab analysis of all water samples collected during the 2020 season.

The COS operational budget covered salary, travel, vehicle, training, lake monitoring, educational, and miscellaneous equipment and maintenance costs. Non-capital equipment and maintenance costs included uniforms, highway signs, and safety equipment. Salary costs included the 37 auxiliary conservation officers operating from either May to October or May to September. It also included the salary for the officer in charge, three sergeants, and one administrative coordinator. Education and awareness costs include the production of various outreach/education materials that were distributed by the inspectors at the watercraft inspection stations.

Additional significant contributions were made by COS and Ecosystems Branch to support program operations such as investigations and enforcement, science and policy and BC's response to the moss ball incident in March 2021.

Table 1. Summary of 2020 operating budget and the actuals as of March 31st 2021.

2020-2021	2020-2021 Program Budget	2020-2021 Program Actuals*
Salary	\$2,706,220	\$2,280,468
Travel & Training	\$80,500	\$58,339
Corporate Overhead	\$80,000	\$80,000
Vehicle	\$214,000	\$194,993
Education/ Awareness/ Research	\$121,280	\$110,233
Non-capital equipment/ maintenance	\$168,000	\$192,073
Lake Monitoring	\$75,000	\$73,063
Equipment Amortization	\$15,000	\$15,043
Total Operations	\$3,460,000	\$3,004,211
Capital Equipment	\$40,000	\$27,101
Total	\$3,500,000	\$3,031,312

** Additional significant contributions were made by COS and Ecosystems Branch to support program operations such as investigations and enforcement, science and policy and BC's response to the moss ball incident in March 2021.*

3. WATERCRAFT INSPECTION SUMMARY FOR 2020

3.1 ALL WATERCRAFT ENCOUNTERS

During the 2020 season, just under 30,000 inspections were performed, and the crews interacted with approximately 55,900 people to promote Clean, Drain, Dry. Of the total watercraft inspected, 159 identified as coming from a high-risk province or state, 27 were issued Decontamination Orders, and 17 were issued quarantine periods to meet the required drying time. Of the total watercraft inspected, 16 were confirmed to have adult invasive mussels (see Section 3.2 for further detail on high-risk watercraft).

The remainder of this section discusses the watercraft inspection data collected by the crews at each station across the entire season. Data has been summarized in several ways, including an assessment of total watercraft encounters (total number of watercraft inspected), and total effort (total operational hours). To quantify the frequency at which watercraft came through the inspection stations, the ratio of watercraft encounters to effort was calculated as the encounter frequency. The encounter frequency was assessed across several different temporal scales (by month, day, and hour) as illustrated in Figures 3 through 10.

3.1.1 Watercraft Inspection Summary by Station

Watercraft encounters (Figure 2) were highest at the Golden station (8,204), the Yahk station (7,485), the Olsen station (5,316) and the Radium station (4,890). Several of the stations (Golden, Yahk and Mt. Robson) saw slightly increased total inspections in 2020 relative to the 2019 season. This illustrates that boater traffic was not significantly reduced, despite the U.S. border closure being in place for the entire season.

The encounter frequency (watercraft encounters/effort) across each inspection station showed that the busiest inspection stations were Yahk, Osoyoos, Golden and Radium (Figure 3). The station with the lowest frequency of boater traffic was Pacific but also had the highest percent of high-risk boats. This is expected as it is the primary border crossing in the lower mainland for commercially hauled boats coming from the U.S. It is also important to note that the percent high-risk for the Pacific station was likely partially inflated by the very low number of total inspections. The Osoyoos inspection station is typically located at the Osoyoos border crossing however due to the US-Canada border closure the inspection crew was roving between different locations in the Okanagan. Finally, it is important to note that the encounter frequency only represents boater traffic during operational hours.

Watercraft inspection data was also used to quantify the boats coming from different jurisdictions (prov/state)(Figure 4). The Golden and Pacific stations inspected boats coming from 25 different provinces and states, more than the other inspection station. This does represent a decrease from the maximum seen in 2019 at the Dawson Creek inspection station with boats intercepted from 41 different provinces and states. This decrease in the number of jurisdictions that boats are coming from in 2020 is expected due to the US border closure and travel restrictions in place throughout the season. The data illustrates the importance of looking at both the total number of boats inspected as well as the

proportion of high-risk boats going through each inspection station. The data also provides important information on the different routes boaters are traveling.

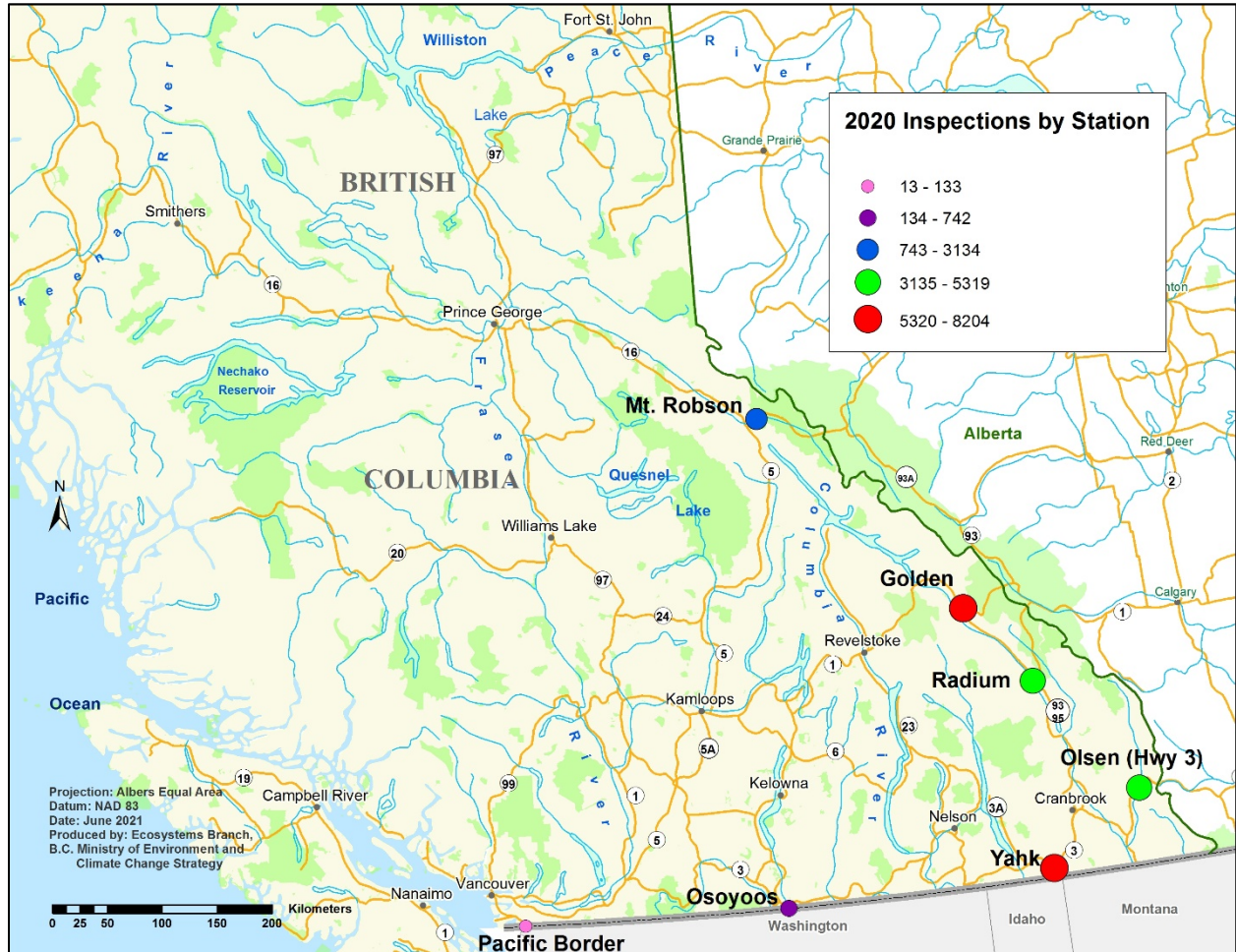


Figure 2. Total inspections by station location for the 2020 season.

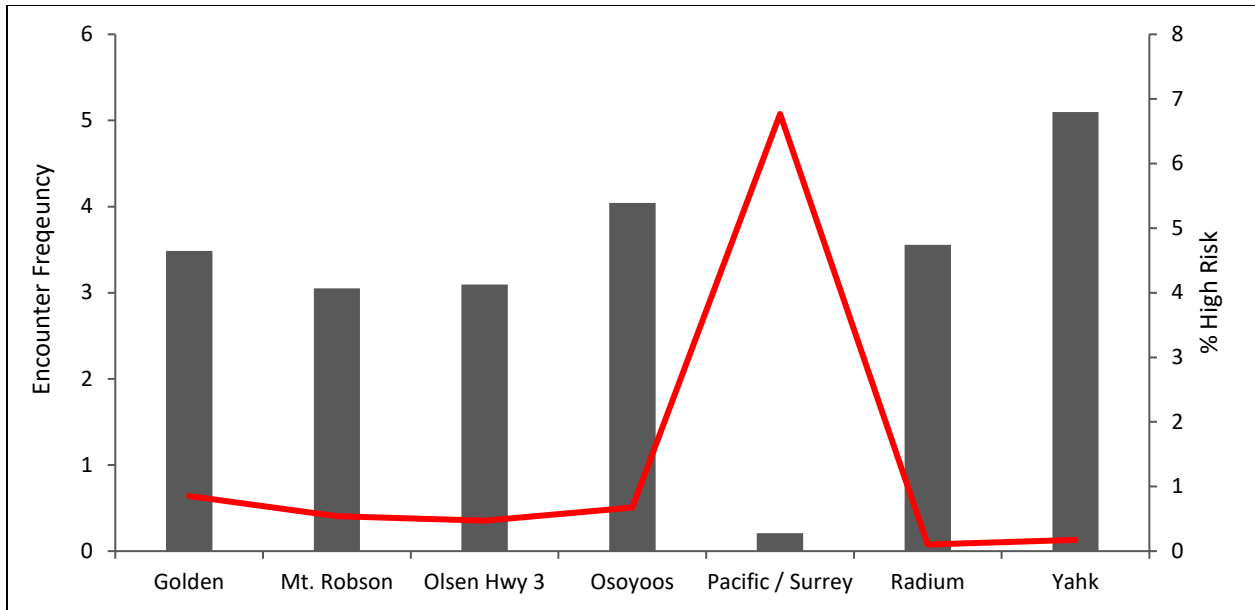


Figure 3. Encounter frequency (bars) by inspection station in comparison to percent of high-risk boats (line) per inspection station, from May to November 2020.

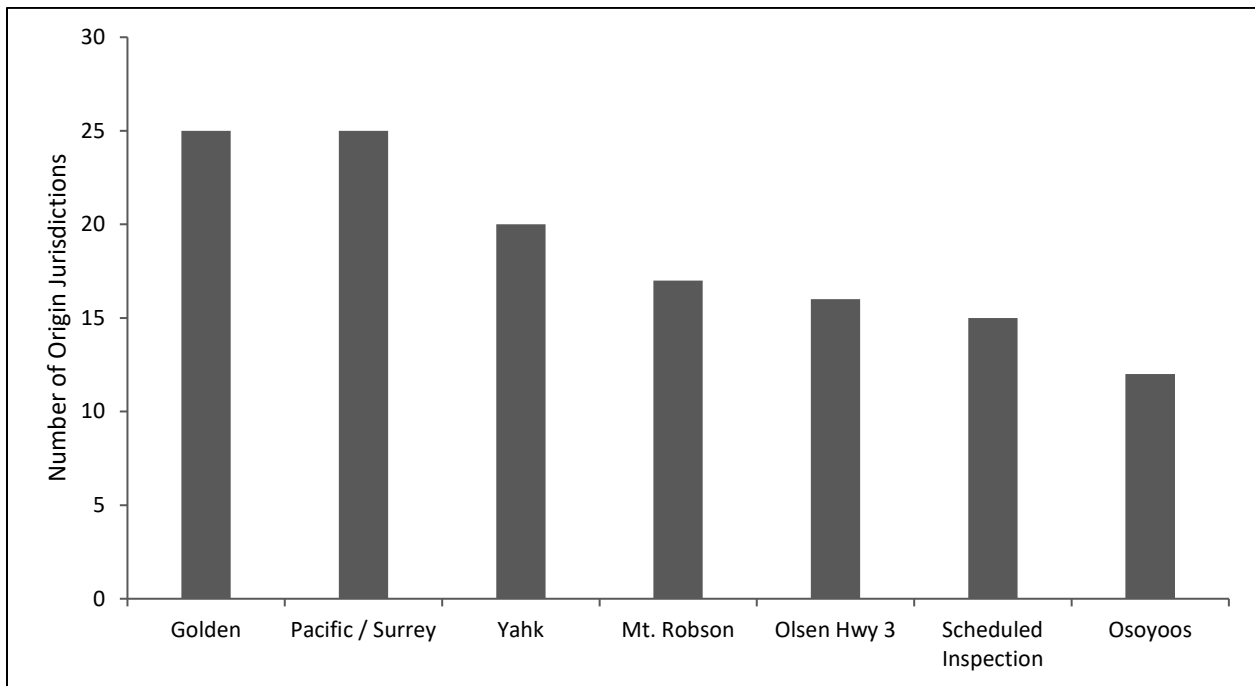


Figure 4. Total number of jurisdictions (prov/state) where boats were coming from that were intercepted at each inspection station for the 2020 season.

3.1.2 Watercraft Inspection Summary by Month and by Day of the Week

Highway inspection stations were operational from May 15 to late October 2020. The inspection station total effort (operational hours) increased over the spring months (May and June), peaking in July and August (Figure 5). Total effort was lowest in October since the northern inspection station (Mt. Robson) closed at the end of August. Watercraft encounters and encounter frequency (Figure 6) showed a similar trend to previous years with the peak occurring in July and August.

Figure 7 shows the total watercraft encounters and total effort by days of the week across the 2020 season. Watercraft encounters and encounter frequency peaked on Fridays and Saturdays and were lowest on Tuesdays and Wednesdays. This is consistent with the data from the 2019 season. The encounter frequency was also high on Sundays which is consistent with increased traffic on weekends. Total effort was similar across all days of the week, with the exception of Tuesdays and Wednesdays which were slightly reduced due to occasional operational circumstances requiring stations to be closed on those days (Figure 7). Statutory holidays were included in the data; however, peaks in the volume of boats were typically seen on the Thursday, Friday and Saturdays of long weekends at the inspection stations along the eastern border. This reflects those stations intercepting out-of-province boaters traveling into B.C. for holiday long weekends.

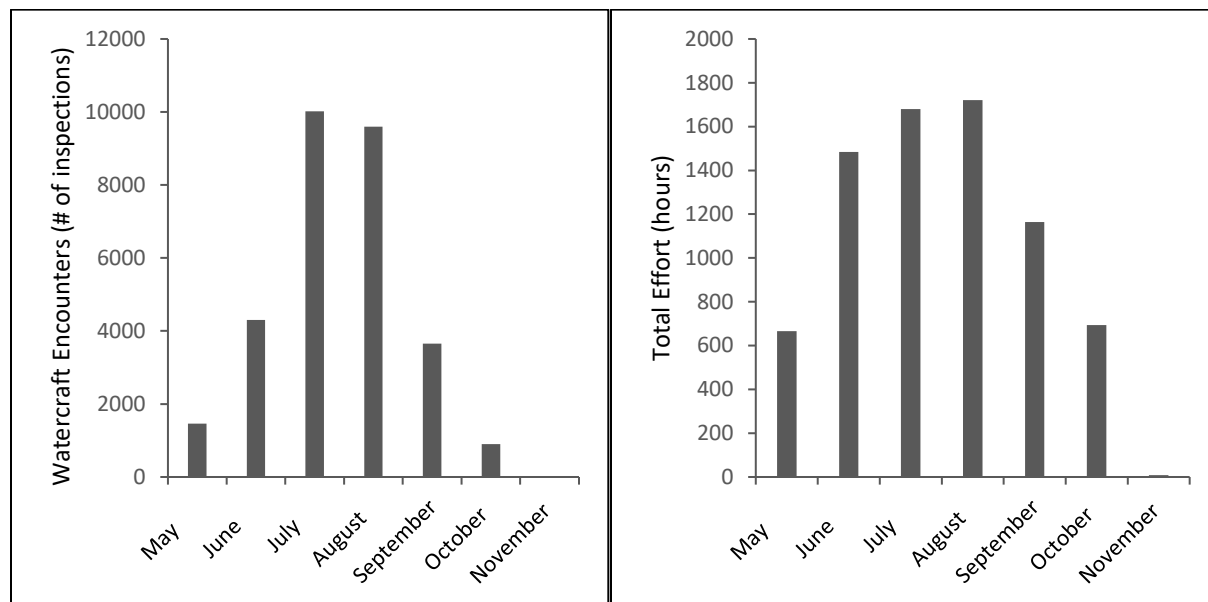


Figure 5. Total inspections (left) and total effort (right) by month across inspection stations.

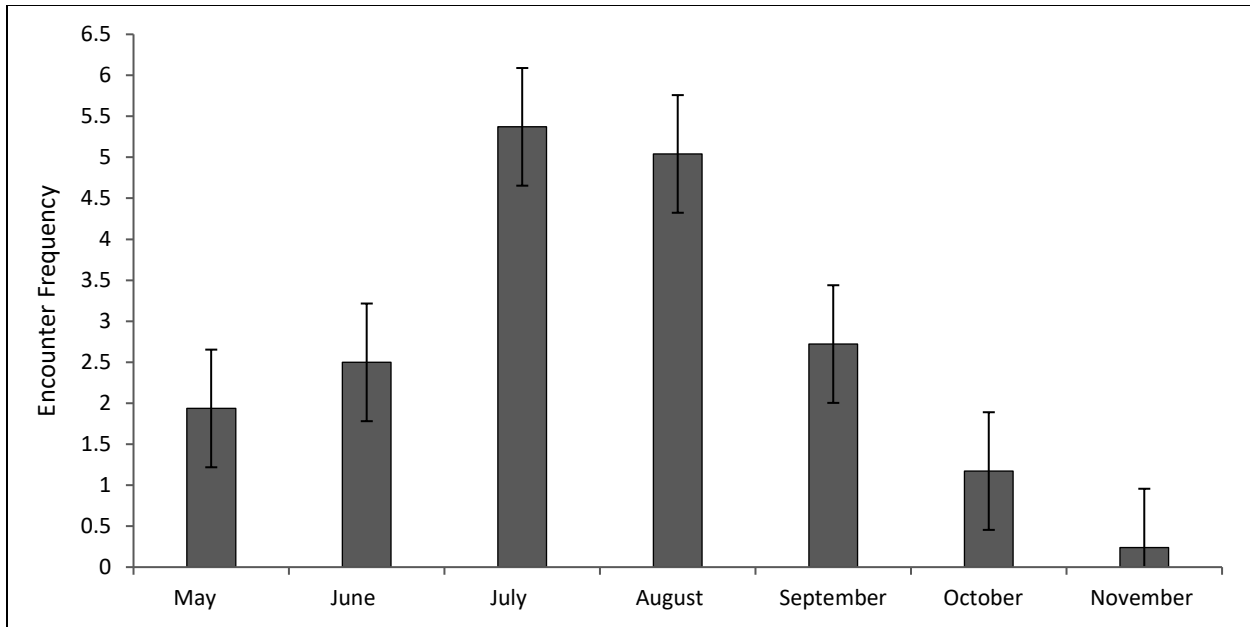


Figure 6. Encounter frequency by month across all inspection stations (error bars illustrate the standard error).

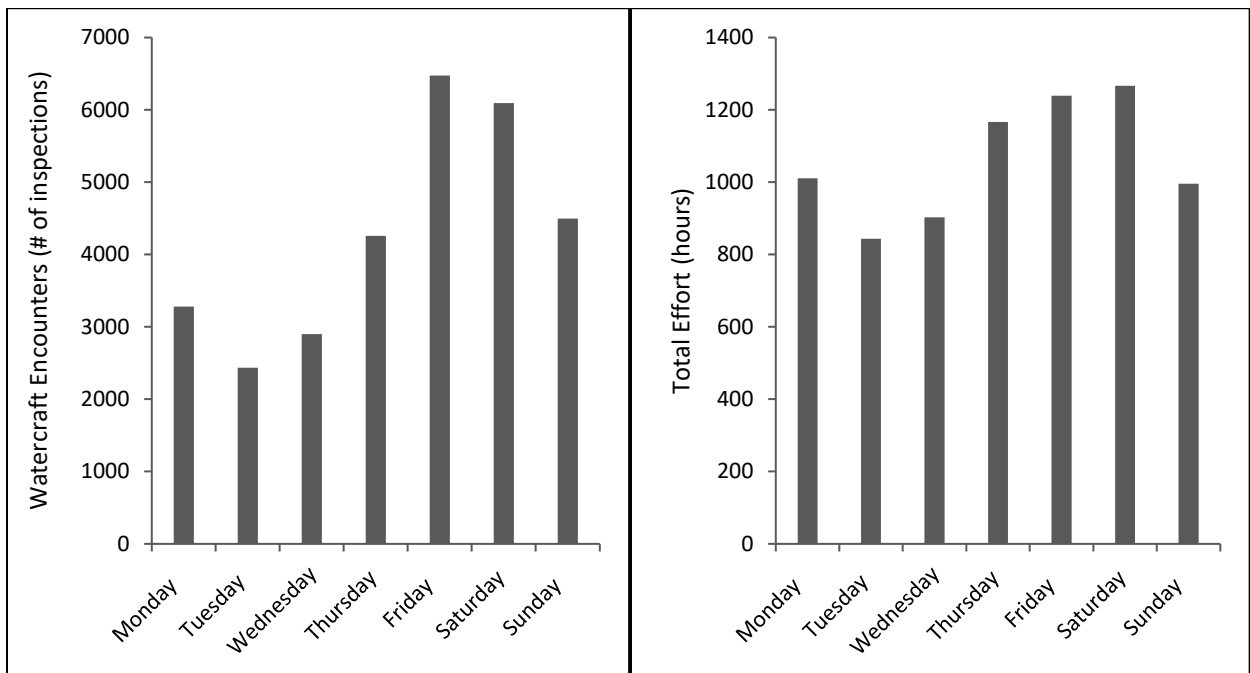


Figure 7. Total inspections (left) and total effort (right) by day of the week across inspection stations. Statutory holidays were included in the data analyses.

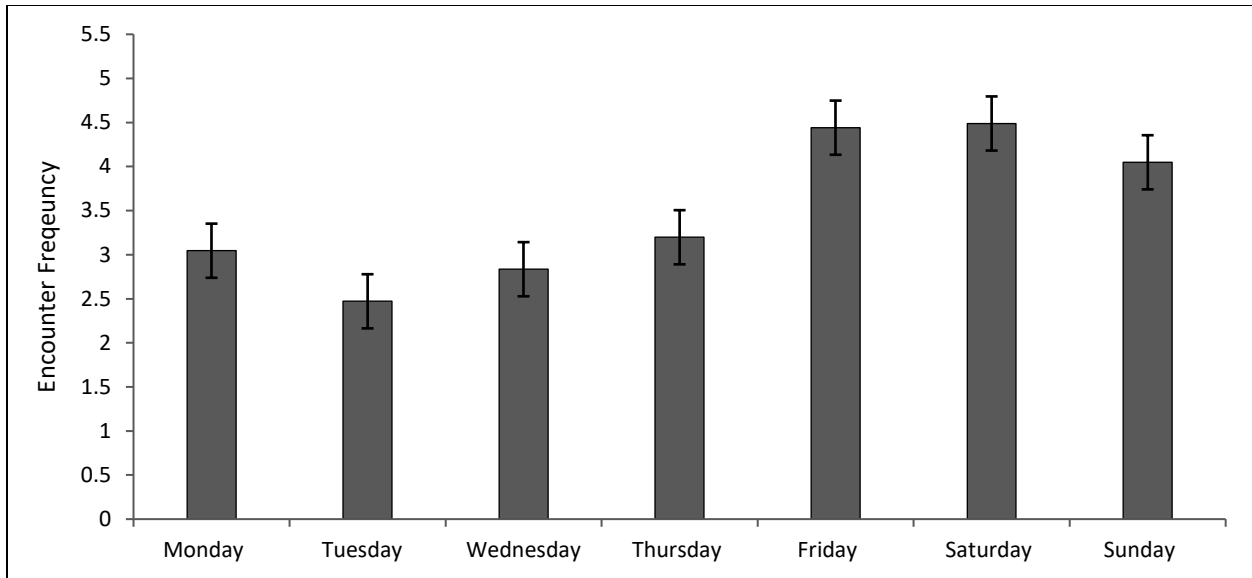


Figure 8. Encounter frequency by day of the week from May to November 2020, across inspection stations. Error bars illustrate the standard error. Statutory holidays were included in the data analyses.

3.1.3 Watercraft Inspection Summary by Hour of the Day

The time of the inspection was recorded by inspectors for every watercraft and Figure 9 illustrates that the volume of boater traffic was normally distributed across all inspection stations, peaked in the middle of the day, and was lowest at the start and the end of the daily operational period. The Golden inspection station was operating extended down to dusk hours (06:00AM-12:00AM) from May to September. The late night (10-12pm) and early morning inspections represent the Golden station only.

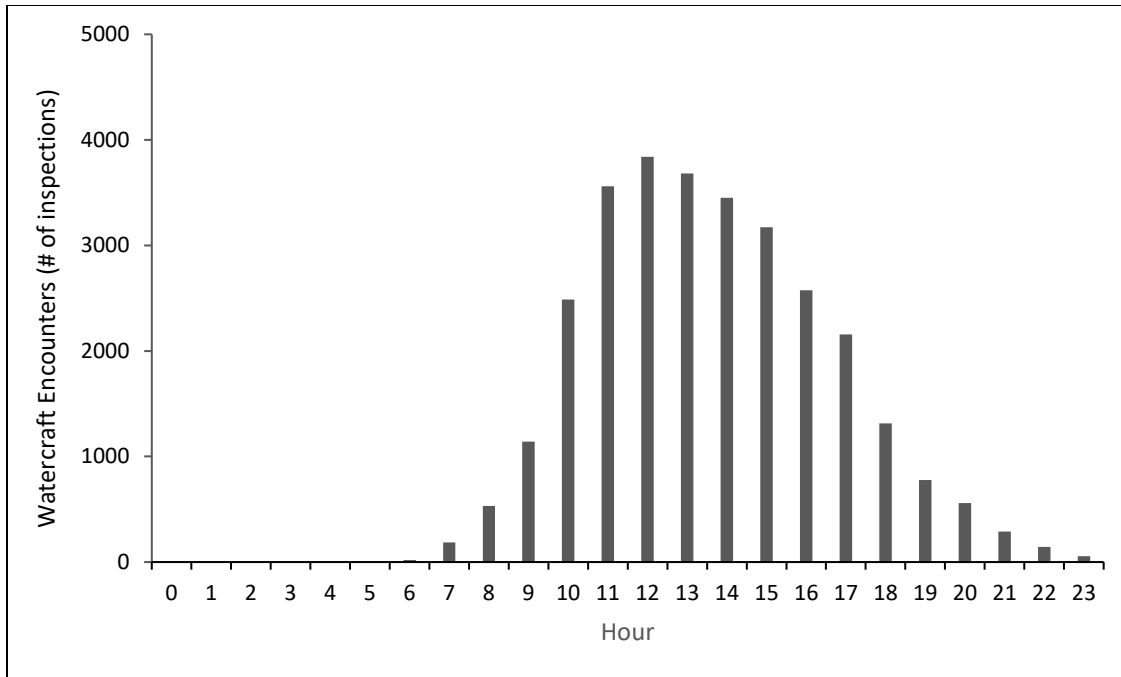


Figure 9. Total inspections by time of day across all inspection stations for the 2020 season.

3.1.4 Source and Destination Locations

Figure 10 shows the home residence for all watercraft inspections and this corresponds to the province/state where the watercraft is most commonly located/stored throughout the year. The home residence doesn't always correspond to where the watercraft was last launched. The majority of watercraft were traveling within BC or coming from AB, followed by other provinces (SK, MB, ON and QC) which is consistent with increased domestic travel during the pandemic.

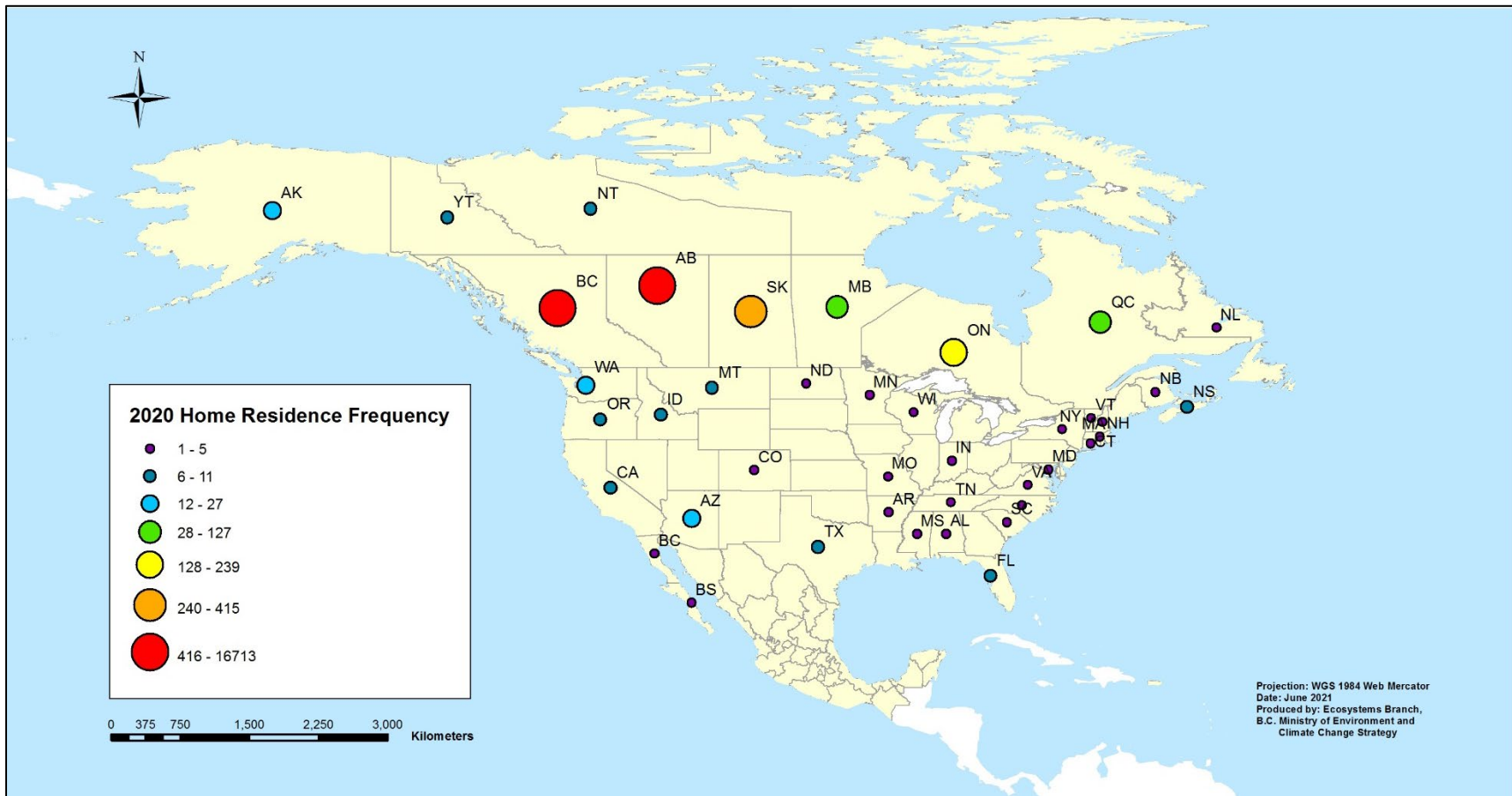


Figure 10. Home residence by province/state of all inspections during the 2020 season.

The most common destination waterbodies within B.C. were Shuswap Lake (10.3%), Kootenay Lake (9.4%), Windermere Lake (9.1%), Okanagan Lake (7.6%), Koocanusa Lake (7.0%), Columbia River (4.8%), Moyie Lake (2.4%), Christina Lake (2.1%) and the Pacific Ocean (1.7%) (Figure 11).

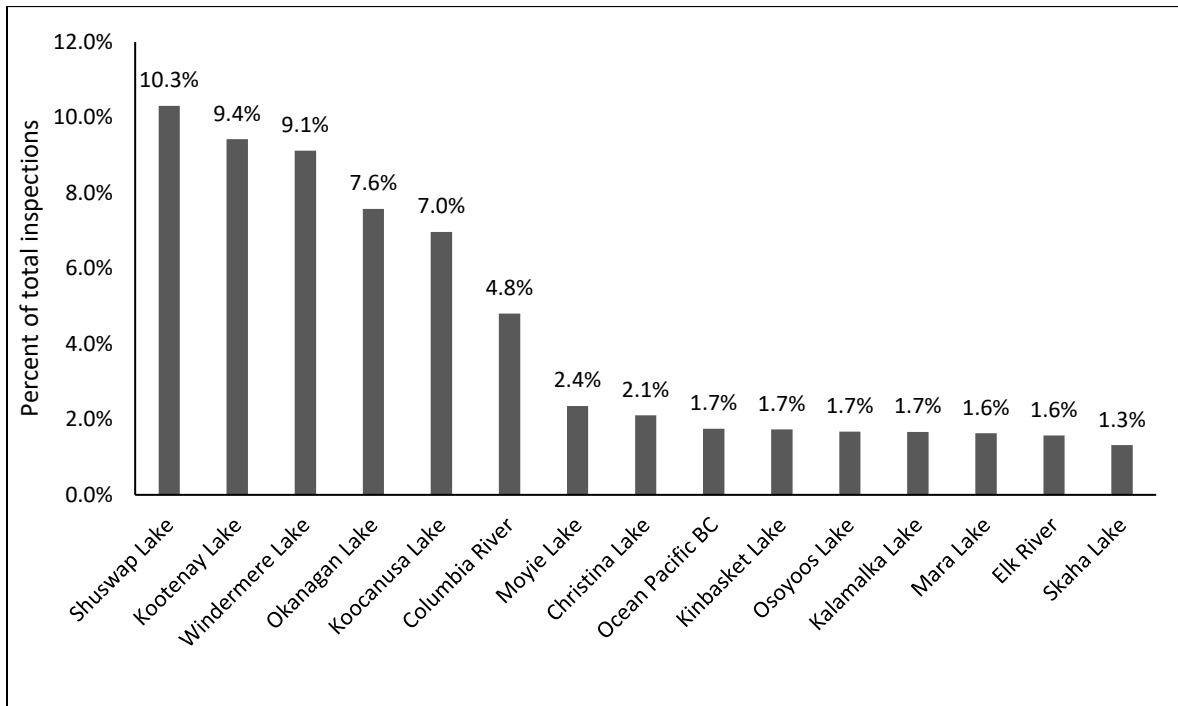


Figure 11. Destination waterbodies by percent of all inspections during the 2020 season.

3.1.5 Compliance

During each shift, inspectors recorded watercraft that failed to stop at the inspection station and used this number as a measure of compliance. The compliance rate for a shift was calculated as the number of watercraft that stopped divided by the total number of boats that went by an inspection station. The average compliance across all the inspection stations for the 2020 season was 87.7% which represents an increase from 83% in 2019. The increase in overall compliance was likely driven by the closure of the Laidlaw station for the 2020 season. Compliance at Laidlaw was on average 64% over the last three years (2017-2019) and lower than all other stations except Pacific. This reduced the average across all stations in past years. Overall the compliance at the stations operating in 2020 were very similar to the 2019 season. For example, the Golden station compliance saw a slight increase from 85% in 2019 to 86% in 2020.

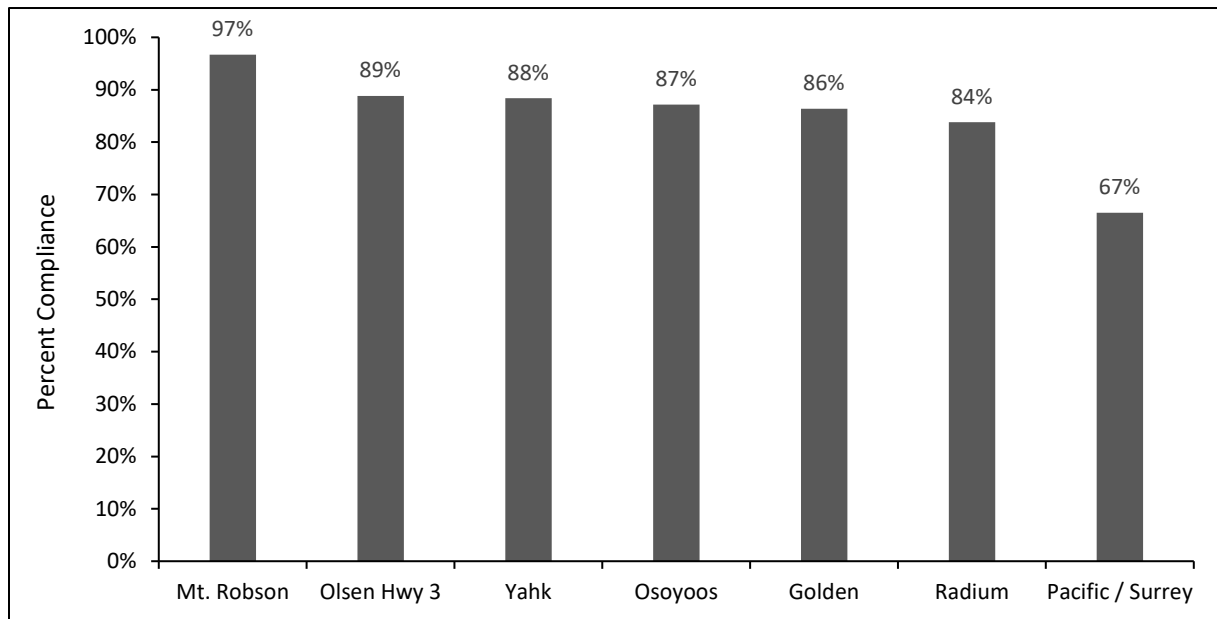


Figure 12. Percent compliance by inspection station for the 2020 season.

During the 2020 season, inspectors also recorded whether the watercraft that failed to stop were motorized or non-motorized. Figure 13 shows that, on average across all the months, 88% of the watercraft that failed to stop were non-motorized. This is an increase from the 2019 season of 84% non-motorized watercraft that failed to stop. This shows continued outreach and education to the non-motorized boating community is needed to help raise awareness that inspection stations are mandatory for all types of watercraft. It is also important to note that at some of the inspection stations such as Golden, a large proportion of the non-motorized watercraft that fail to stop at the inspection station are local boaters and low risk. While it does not grant these boaters an exemption from stopping at the stations, it does give an indication of reduced risk for the majority of the non-motorized watercraft that are failing to stop at the stations.

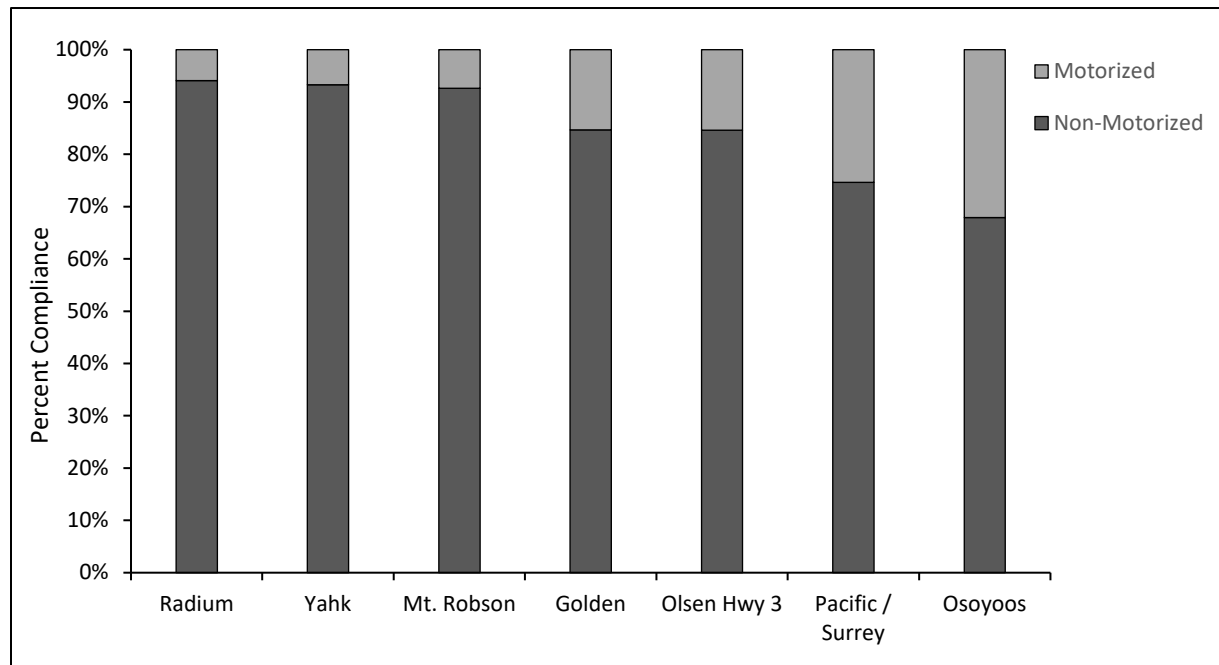


Figure 13. Percent compliance by inspection station for the 2020 season.

The inspectors also recorded when and if each watercraft coming through a station had been through a previous inspection in B.C. or elsewhere. Figure 14 shows the percentage of boats that stopped at an inspection station which had already been through an inspection station.

The highest percentages of previously inspected watercraft by station occurred at Yahk (52%), Radium (51%), Osoyoos (29%) and Mt. Robson (13%). This does represent a decrease from the 2019 season and could be an indication of more travelers being new boaters as a result of more people purchasing boats during the pandemic. This decrease could also be a reflection of reduced inspection station operations across western jurisdictions due to the pandemic, resulting in less repeat inspections.

The timing of when the boater had been through a previous inspection was also recorded at each station. Of the previously inspected watercraft across all stations, 5% had been through over one year prior, 16% had been through within the last year, 61% had been through within 30 days and 18% on the same day (Figure 15). Relative to the 2019 season it represents a decrease in the number of boaters that had been through a station in over a year but represented an increase in the number of that had been through within the last 30 days. Again, this may be a reflection of more BC residents boating locally and subsequently visiting BC inspection stations multiple times during the 2020 season.

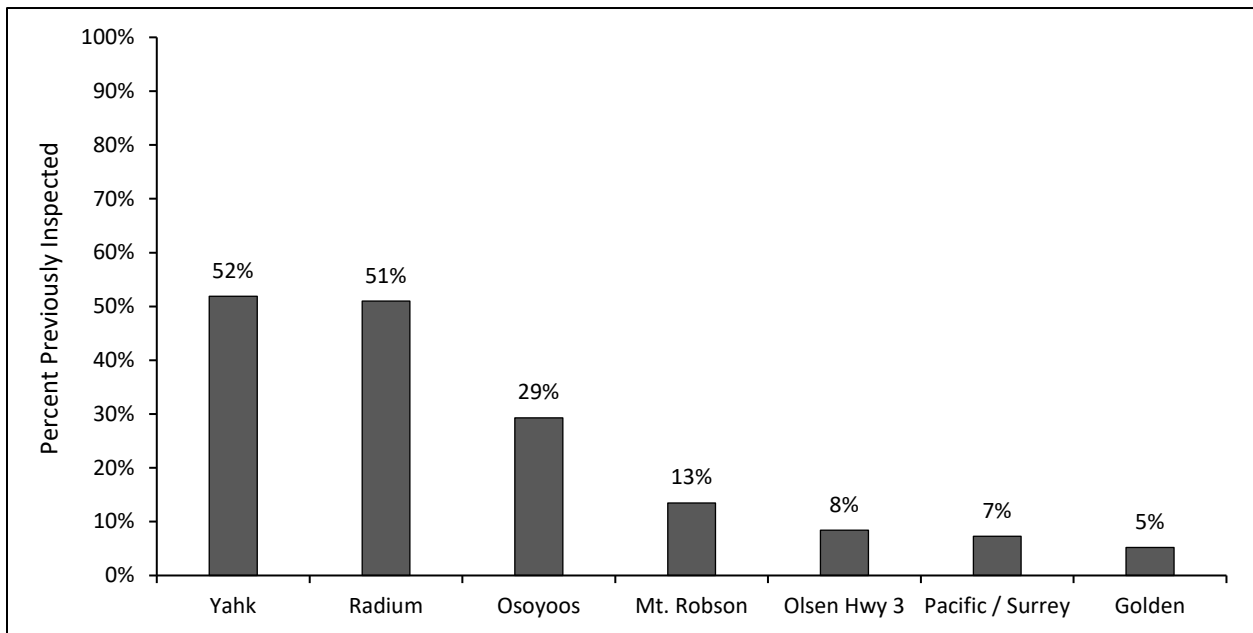


Figure 14. Percent of watercraft intercepted per inspection station that had been previously inspected.

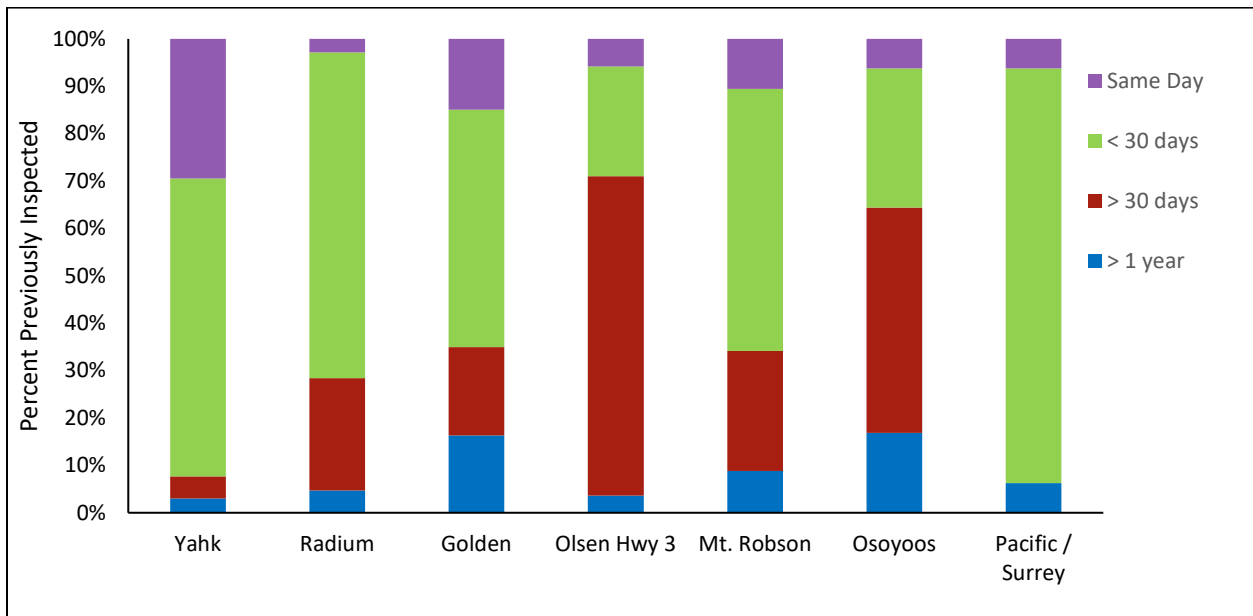


Figure 15. Frequency of watercraft previously inspected at another watercraft inspection station (either in BC or another jurisdiction).

3.2 HIGH-RISK WATERCRAFT ENCOUNTERS

Watercraft can be identified as high-risk for several different reasons based on the information obtained by the inspectors during the inspection/interview process. High-risk watercraft are identified as any watercraft or equipment that meet the following criteria:

- Launched in any waters of a province or state known or suspected of having zebra or quagga mussels in the past 30 days.
- Coming from or is registered to a state / province that has zebra or quagga mussel infestations and is not clean, and to the extent practical, drained and dry.
- Appear dirty, crusty or slimy with the potential risk of transporting other AIS.

3.2.1 By Station and Month

There was a total of 159 high-risk inspections during the 2020 season which represented an overall decrease, as well as a decrease across all months. Since the Program has been operational, the total number of high-risk boats inspected has peaked in July. However, for the 2020 season the peak occurred in August and the number of high-risk inspections were almost the same in July and September, whereas in past seasons the number of high-risk inspections was much lower in September relative to the month of July.

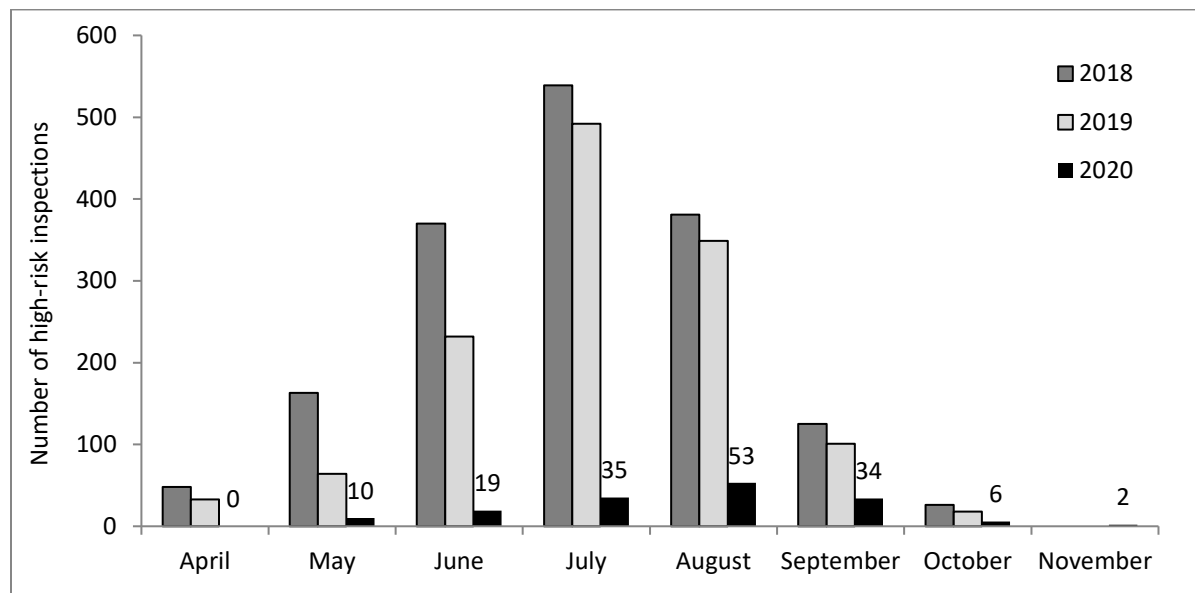


Figure 16. Total high-risk inspections by month across the 2018-2020 seasons.

Figure 17 illustrates the number of high-risk inspections by station. The Golden station intercepted the most high-risk watercraft (70), followed by Olsen (Hwy 3) (25), Mt. Robson (17), and Yahk (13). The

number of high-risk inspections was quite a bit lower in 2020 (159) relative to 2019 (1,290) suggesting the majority of the boater traffic was local from BC and Alberta. This is consistent with the travel restrictions in place throughout most of the 2020 season.

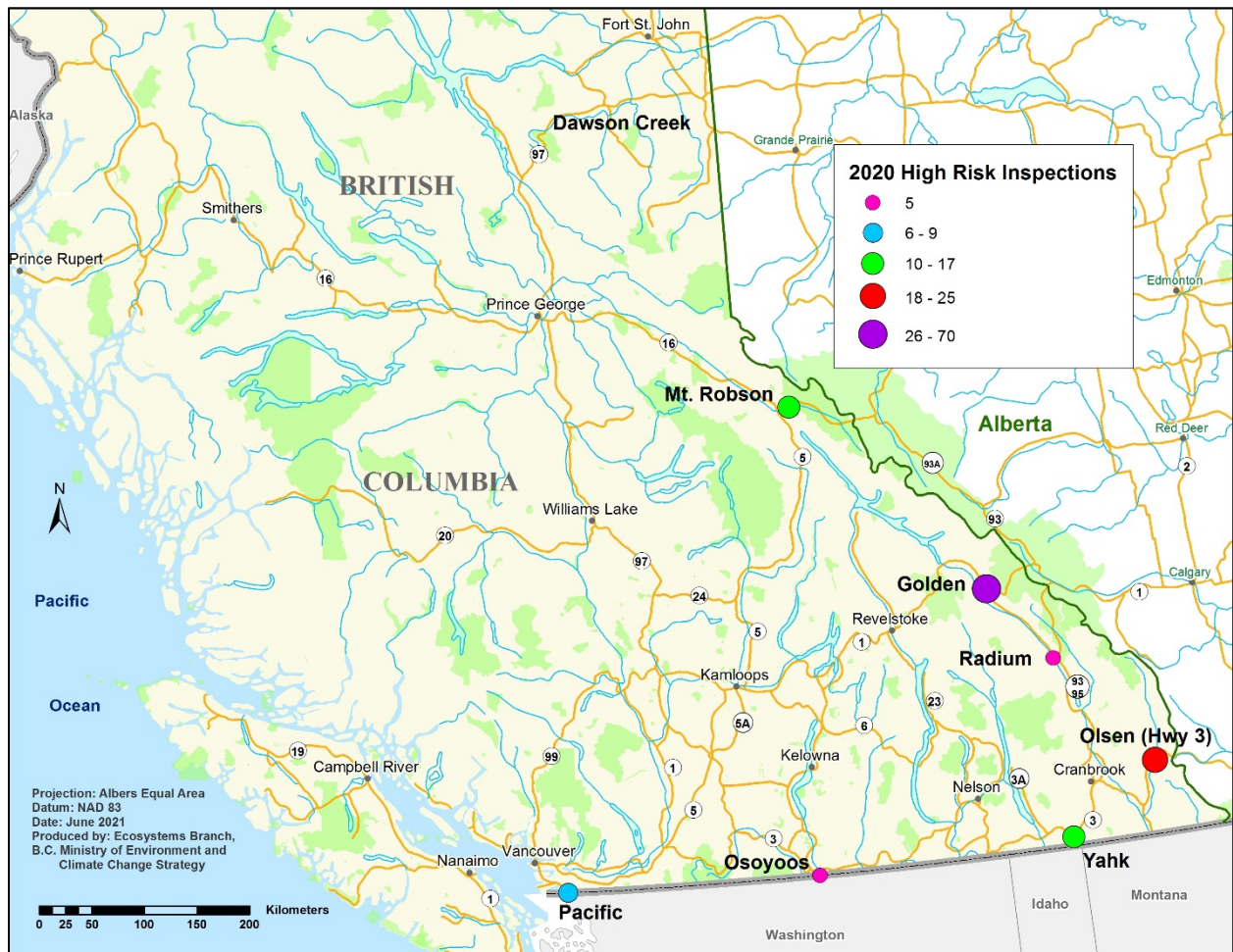


Figure 17. The number of high-risk inspections by inspection station for the 2020 season.

3.2.1 High-risk Inspection Findings

Of the 159 high-risk watercraft, 83 were decontaminated, 27 were issued a decontamination order and 17 had associated quarantine periods to allow for sufficient drying time. Not all high-risk watercraft require a decontamination. A watercraft may initially be considered high-risk for either dreissenid mussels or other AIS when they enter an inspection station. However following a thorough inspection, it may be deemed low risk without further action required (i.e. decontamination) if it is found to be Clean,

Drain, Dry. Of the 159 high-risk inspections, 40 were deemed Clean, Drain, Dry either after a thorough inspection and/or completion of a decontamination.

In addition, not all watercraft that were decontaminated require a decontamination order and quarantine period. Quarantine periods are issued when: standing water or mussels are found and the boat has been out of the water less than 30 days, if inspectors cannot confirm the history of the boat at the time of inspection, or if a full decontamination cannot be completed at the time of inspection. Quarantine orders were enforced by applying wire seals to the boats and inspectors followed up at the end of the quarantine period to ensure the seals were still intact prior to the boat being launched.

Inspectors also record other findings during inspections: 57 inspections found aquatic plants, two with marine mussels or barnacles, and four with other unidentified species/organic matter. Inspectors routinely offer to clean the watercraft to ensure they are free of aquatic plants and Clean, Drain, Dry before leaving an inspection station.

In addition to the 159 watercraft identified as high-risk for either dreissenid mussels or other AIS, 597 watercraft were identified as coming from an area in Alberta of high-risk for whirling disease (*Myxobolus cerebralis*). Inspectors were equipped with outreach and education resources on whirling disease to share with watercraft owners and conveyed the importance of Clean, Drain, Dry for boats and gear to prevent the spread of the disease.

A total of 72 of the 159 high-risk watercraft (45%) had been through a previous inspection station within either B.C. or another jurisdiction. This is consistent with the 2019 season with 44% of the high inspections previously inspected. Collectively, these results highlight the importance and efficacy of the perimeter defence approach. Having multiple inspection stations across jurisdictions intercept high-risk boats coming from the east and for educate the boating public is critical to mitigate the risk of ZQM to B.C..

3.2.2 Source and Destination Locations

Of the 159 high-risk watercraft identified by inspection crews, 71 came from Ontario (45%), 30 from Manitoba (19%), 14 from BC (9%), 13 from Alberta (8%), 11 from Quebec (7%), and 12% from other provinces and states (AR, AZ, CT, OR, ND, NH, NV, MA, OR, TN, SK, VT and WI) (Figure 18). It is important to note that a watercraft may be low risk for dreissenid mussels but high-risk for other AIS if they are not found to be Clean, Drain, Dry. Therefore if a watercraft coming from AB or traveling within BC is not clean, drain, dry it will be considered high-risk if further action such as decontamination is required.

Of the high-risk watercraft inspected, 21.6% were destined for waterbodies in the Okanagan region, 17.1% for waterbodies in the Kootenay region, 9.5% for the Thompson-Nicola, 9.5% for the Pacific Ocean, 7.6% for the Lower Mainland, 3.8% for Vancouver Island, and 0.6% for the Cariboo (Figure 19). The remaining 30.3% of the high-risk watercraft were destined for waterbodies outside of BC (e.g. AB, WA or WY) or unknown waterbodies. If a watercraft was still considered high-risk following inspection and decontamination, the destination jurisdiction was notified.

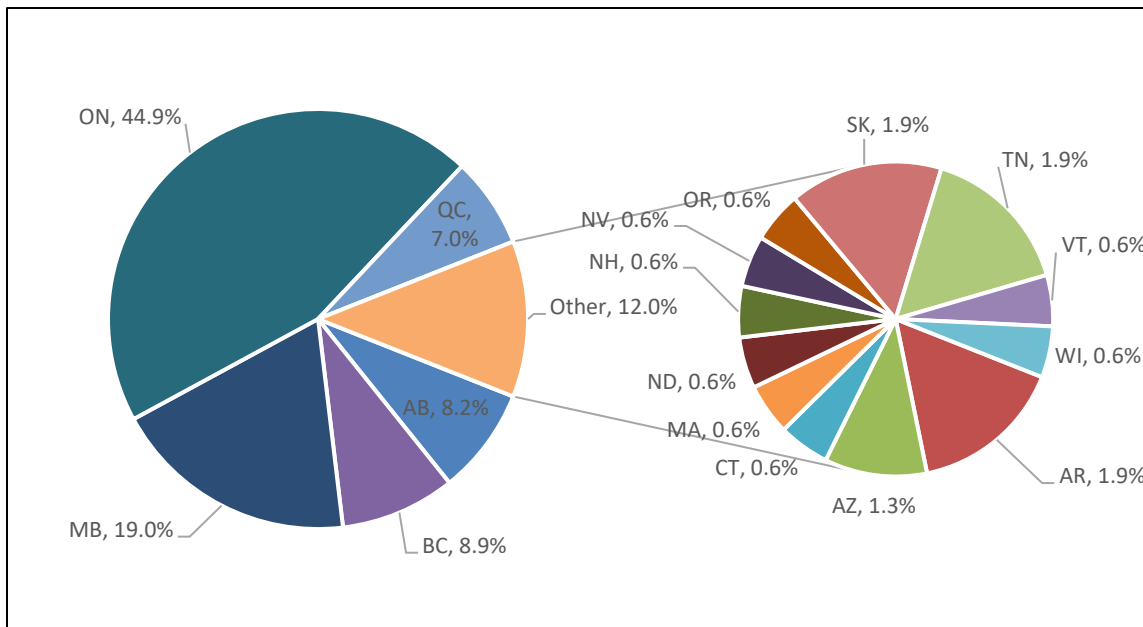


Figure 18. Source locations of the high-risk inspections identified during the 2020 season.

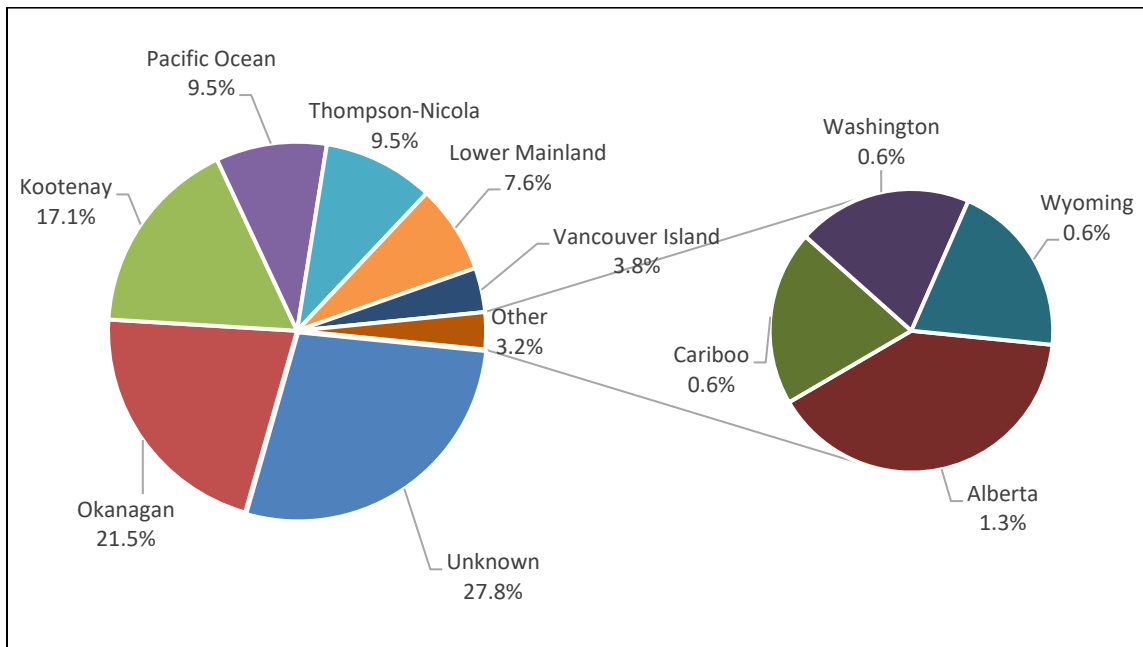


Figure 19. Destination regions of all high-risk inspections identified during the 2020 season.

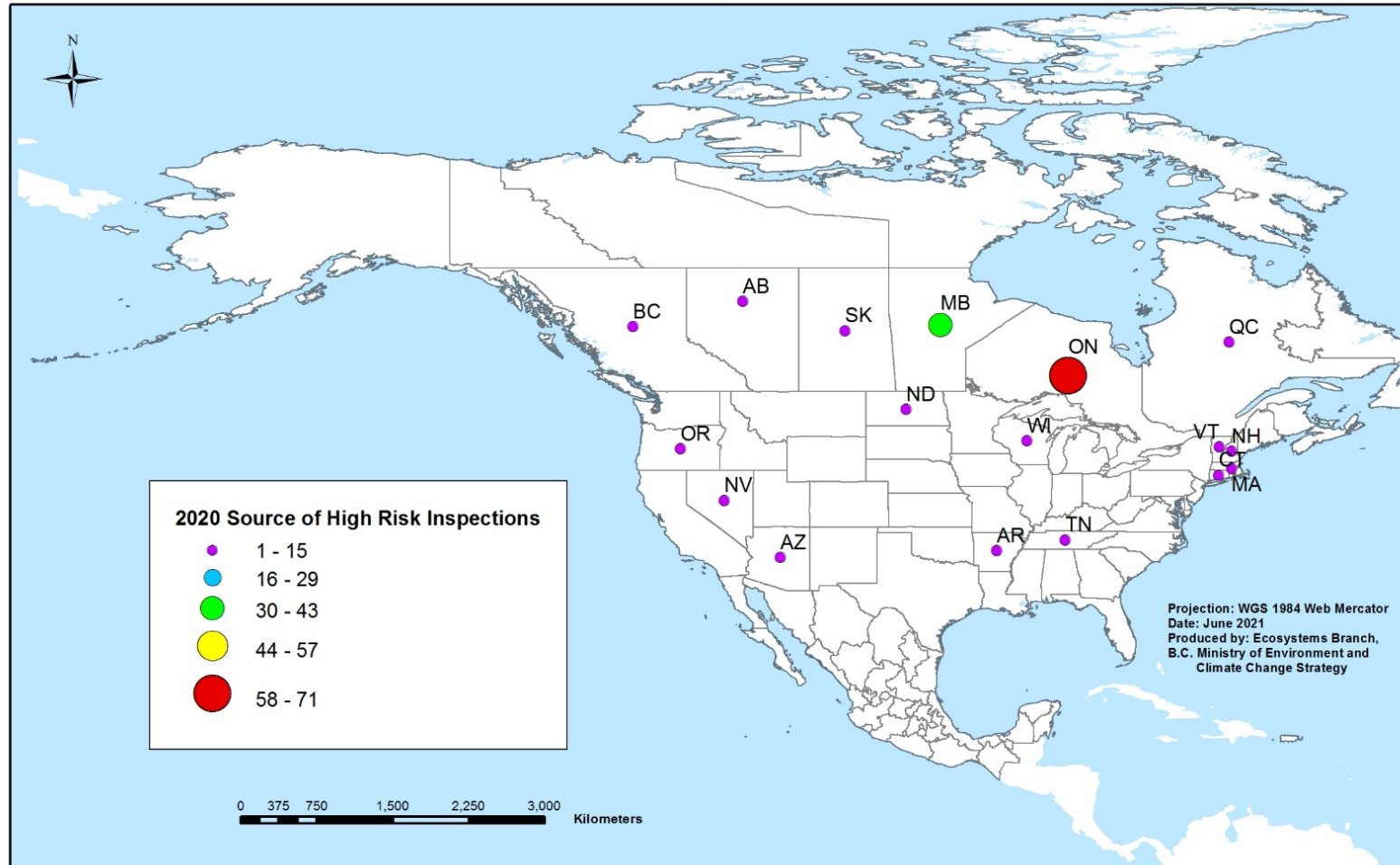


Figure 20. Source locations of the high-risk watercraft inspected during the 2020 season.

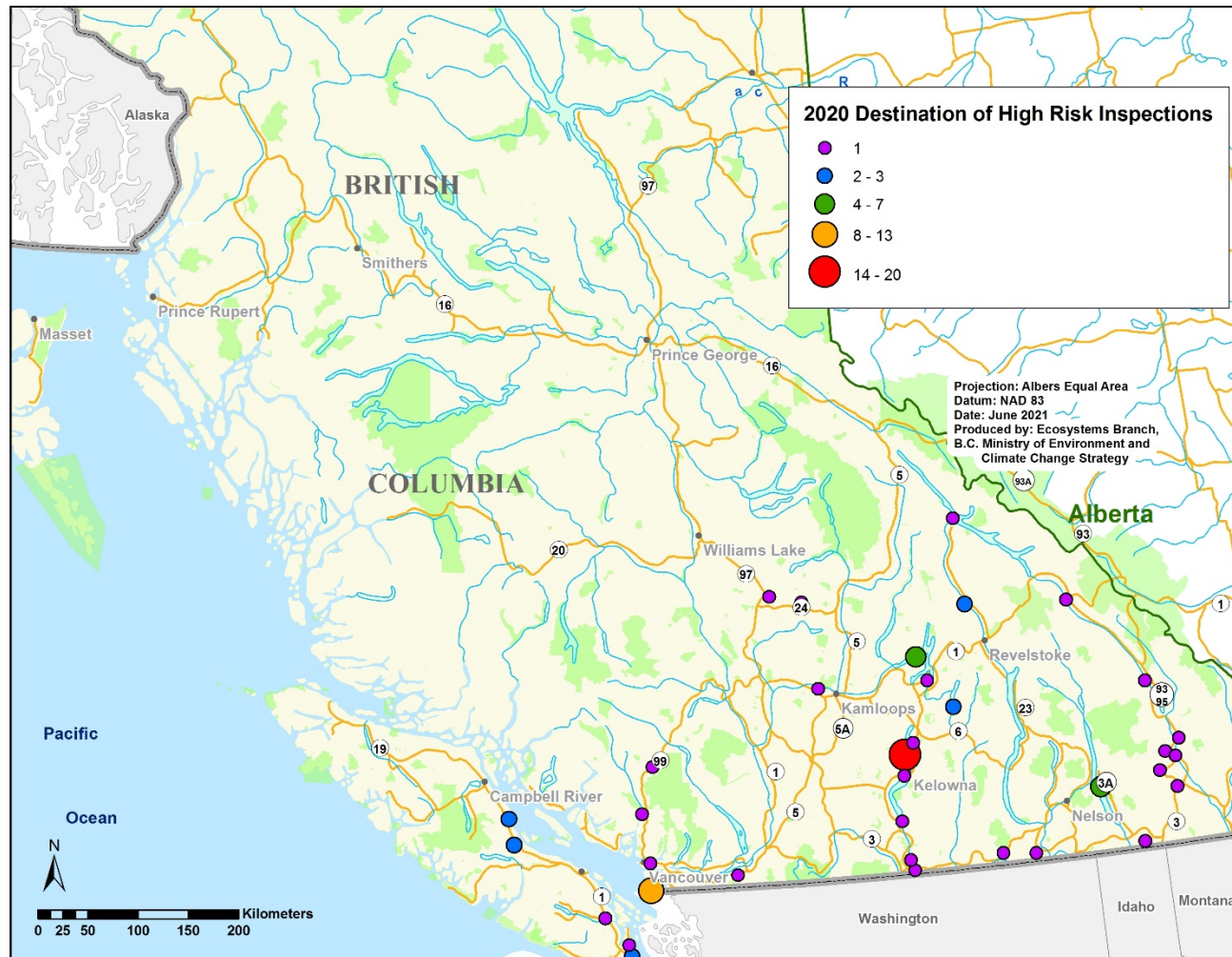


Figure 21. Destination locations of the high-risk inspections identified during the 2020 season.

3.2.3 Watercraft Types

During the 2020 season, the type of watercraft was recorded for all inspections and grouped into four categories:

- **Non-motorized/hand launched:** boats that are not launched from trailers and do not have motors or engines. Examples include canoes, kayaks, paddle boards.
- **Simple watercraft:** A boat with an open hull and no containers/interior compartments and a single outboard motor. This is a hand launched boat that is either launched from a trailer or adds a motor. Examples include car toppers (with engine), aluminium runabouts, open hull fishing boats (no live wells).
- **Complex watercraft:** A boat that has interior compartments or a closed hull or more than one motor. Examples include: fishing boats, speed boats, jet boats.
- **Very complex watercraft:** A complex watercraft with more than one internal water system (e.g. generator, air conditioners, sea strainers, swamp coolers etc.) or other sources of unverifiable water (e.g. ballast tanks). Examples include cabin cruisers, wakeboard boats, houseboats, larger sailboats.

In 2020 non-motorized watercraft comprised the highest percentage of the total watercraft inspected (63%), followed by complex (20%), very complex (9%) and simple watercraft (8%) (Figure 22). This is similar to the 2019 data but there was an overall increase in non-motorized relative to 2019 (46%). While very complex watercraft only made up 9% of the total inspections, they represented 25% of the high-risk inspections (Figure 23). Similarly complex watercraft only made up 8% of the total inspections but represented 27% of the high-risk inspections.

Generally, the results are consistent with very complex watercraft posing greater risk for transporting invasive mussels or other AIS as there are more crevices and hidden places that cannot be visually inspected. However, canoes, kayaks, and small sailboats can still pose a risk of transporting standing water with potentially viable invasive mussel larvae as they are more commonly moved between waterbodies from multiple jurisdictions in short periods of time.

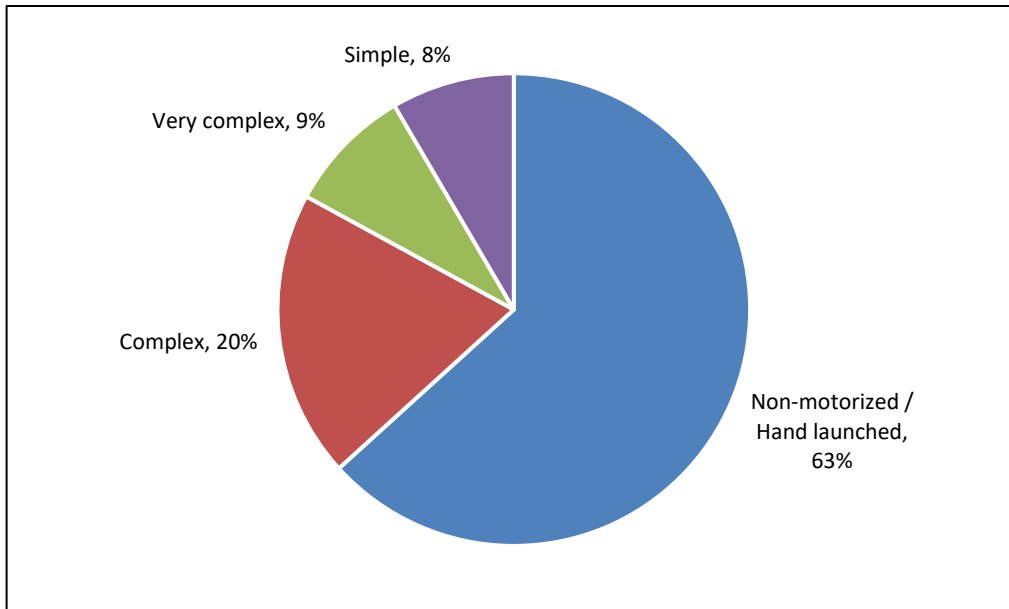


Figure 22. Total watercraft inspected by watercraft type (see above for explanation of each category) for the 2020 season.

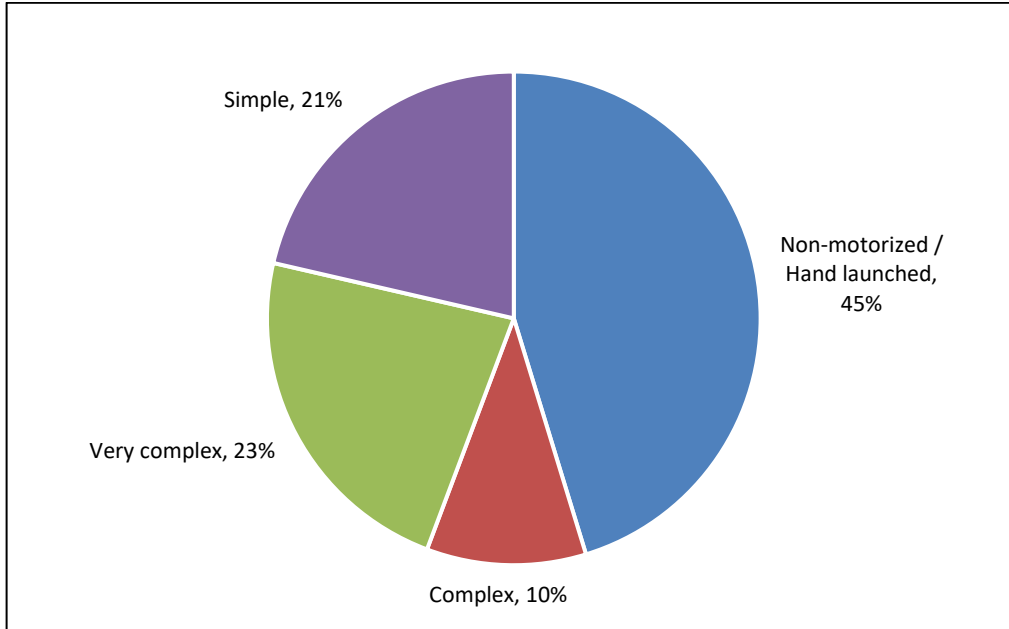


Figure 23. High-risk inspections by watercraft type for the 2020 season.

3.3 MUSSEL FOULED WATERCRAFT

A total of 16 mussel fouled watercraft were encountered, of which B.C. received advanced notification for 13. These notifications came from another jurisdiction or the Canadian Border Services Agency (CBSA). This highlights the importance of having several jurisdictional layers of inspection stations, it increases the likelihood of detection and timely decontamination of high-risk boats.

The highest number of mussel fouled watercraft were intercepted in July (4). In previous years the Program also saw peaks in the number of mussel fouled boats in May, June and September (Figure 24). It's important to note that the Program was not operational in April for the 2020 season. The two mussel fouled boats intercepted in October is consistent with past seasons with boats being hauled from the Great Lakes region at the end of the season. These boats are typically destined for dry storage over the winter.

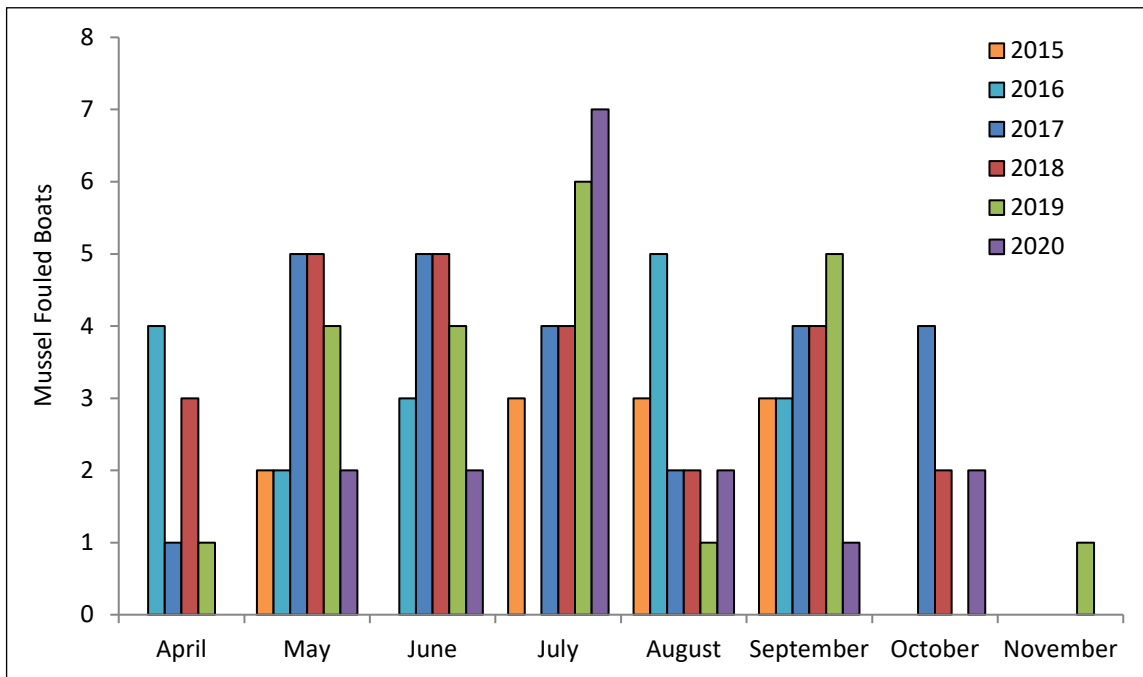


Figure 24. The number of mussel fouled watercraft intercepted by month across all seasons of the Program (2015-2020).

The 16 mussel fouled boats came from Ontario (12), Arkansas (2), Wisconsin (1) and Manitoba (1) (Figure 25 and Figure 26). The proportion of mussel fouled boats that came from eastern/Great Lakes jurisdictions in the 2020 season was 75%, a slight increase from 73% in 2019. The three mussel fouled boats coming from the U.S. were commercially hauled and therefore exempt from the US-Canada border restrictions.

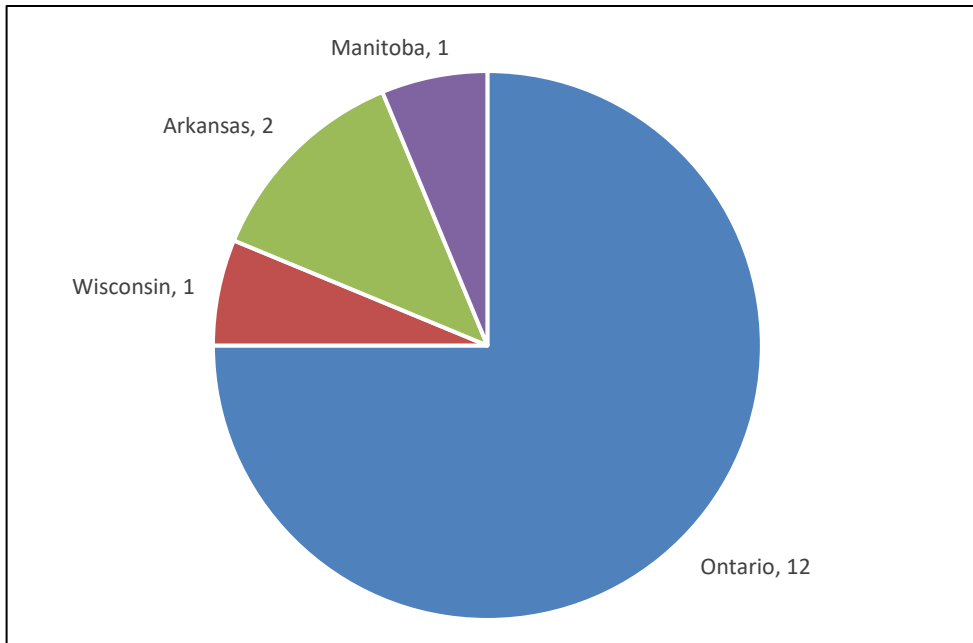


Figure 25. Source provinces and states of the 16 mussel-fouled watercraft intercepted during the 2020 season.

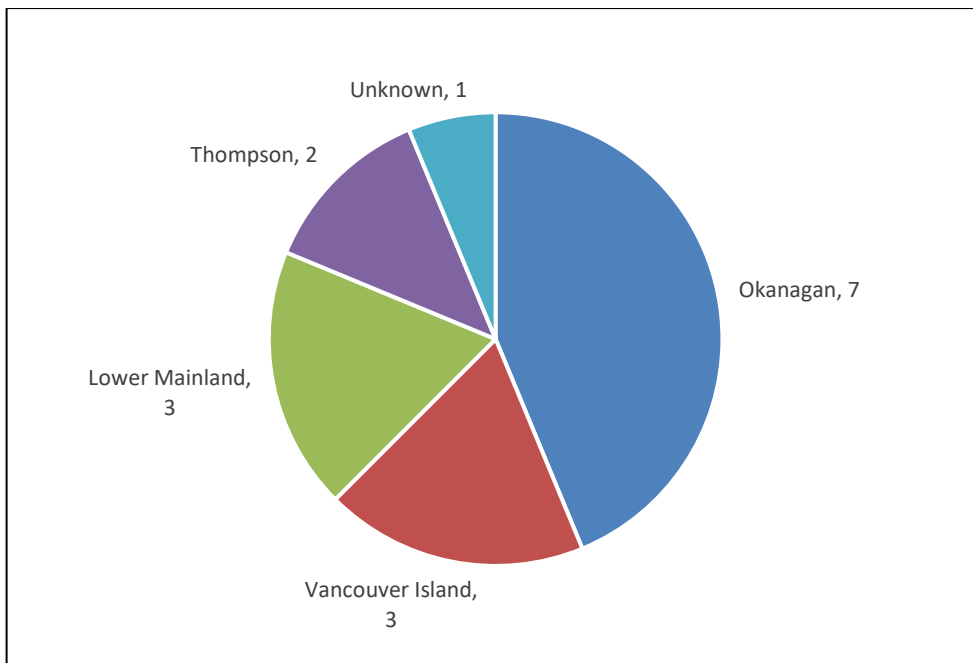


Figure 26. Destination regions in B.C. of the 16 mussel-fouled watercraft intercepted during the 2020 season.

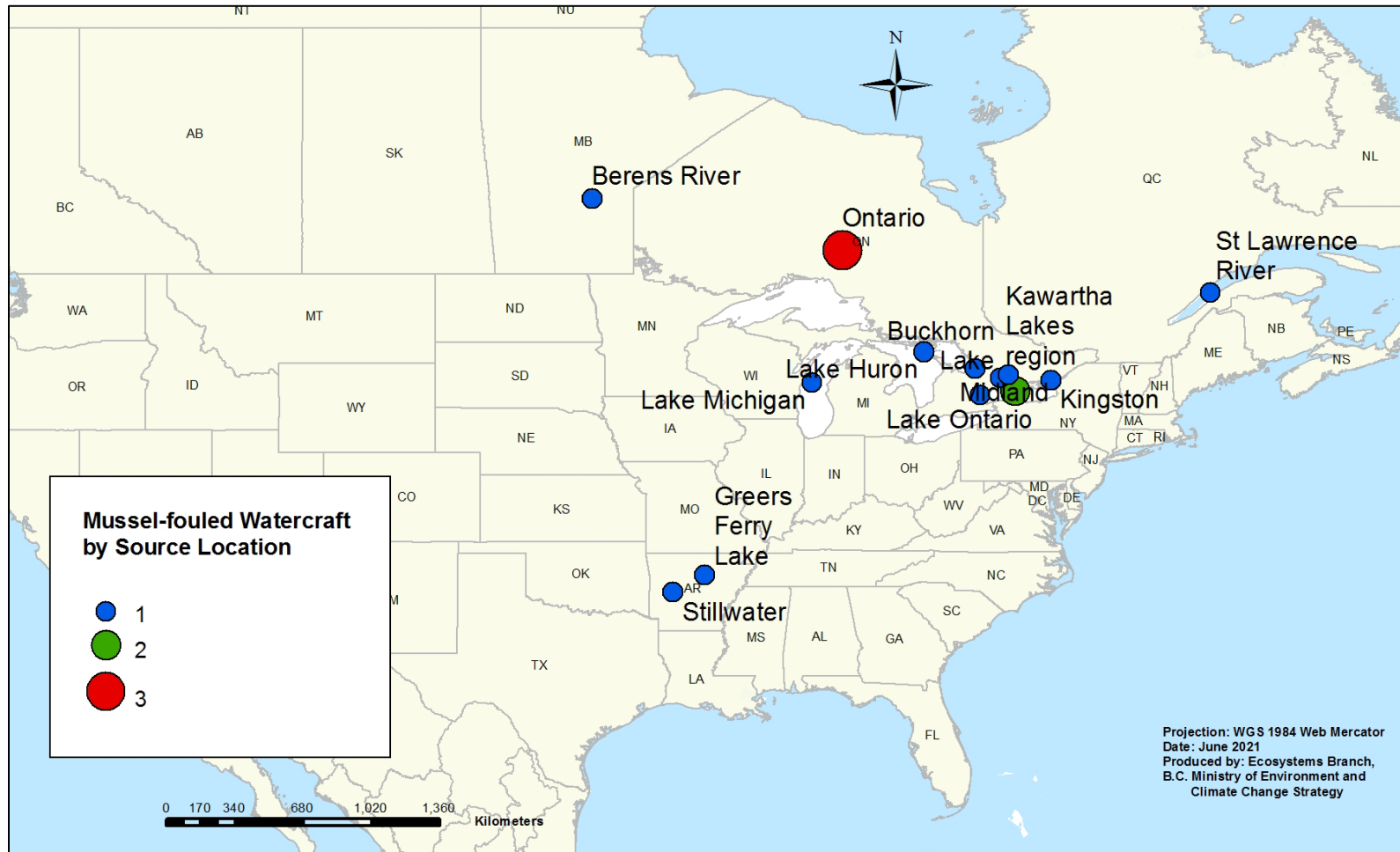


Figure 27. Source location of mussel fouled boats.

The destination of the mussel fouled boats by region was the Okanagan (7), Lower Mainland (3), Vancouver Island (3), Thompson-Nicola (2), and unknown (1) (Figure 26). Of the 16 mussel-fouled watercraft 9 (56%) were very complex watercraft, 6 (38%) were complex watercraft, and 1 (6%) simple watercraft (Figure 28). Four of the six mussel fouled boats destined for either the Lower Mainland or Vancouver Island were confirmed to be going to either saltwater or dry storage, while the destination waterbody was unknown for the remaining two watercraft.

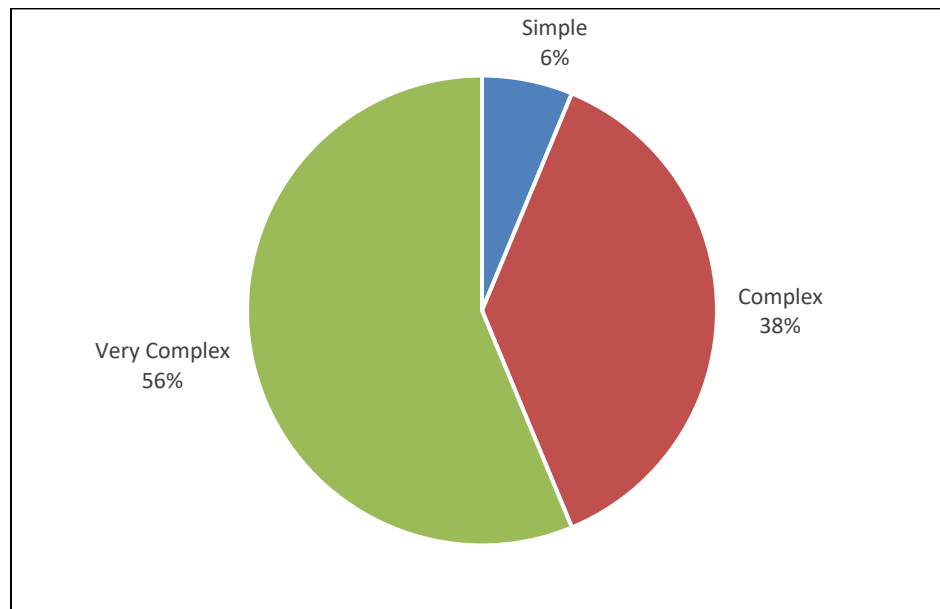


Figure 28. Watercraft type of the 16 mussel-fouled watercraft intercepted during the 2020 season.

3.4 COMMERCIALY HAULED WATERCRAFT

Of the total watercraft inspected (29,900), 199 were commercially hauled, representing less than 1% of the total boats inspected. Commercially hauled watercraft represent a very low percentage of total watercraft inspected; however, they demonstrate a disproportionately high-risk of carrying invasive mussels. While only 16% of high-risk watercraft were commercially hauled, 56% of the mussel fouled watercraft (9 of the 16 boats) were commercially hauled.

The Golden station intercepted the highest number of commercially hauled watercraft (88), followed by Pacific/Surrey (61), Mt. Robson (18) and Yahk (11) (Figure 29). The commercially hauled boats intercepted at the Pacific/Surrey station would have been exempt from the U.S.-Canada border closure as it only applied to recreational traffic. This data is consistent with the 2019 season which also saw the Golden and Pacific stations intercepting the most commercially hauled boats. This is expected as the Pacific border crossing is one of main crossings in the lower mainland that permits commercial traffic. The Trans-Canada Highway, where the Golden station is located, is another primary travel route for

commercially hauled watercraft. Despite the east Kootenay inspection stations (Olsen and Yahk) having high watercraft encounter frequency, they only saw 16 commercially hauled watercraft, indicating Highway 3 is not a major route for commercial haulers during the operating hours of the inspection stations.

The most common source locations for commercially hauled boats outside of BC was Alberta, Ontario, and Washington (Figure 30). Commercially hauled boats include a combination of new boats being shipped from manufacturers to marinas/dealers and used boats purchased privately but are too large to be transported recreationally. New boats from manufacturers in the U.S. are frequently transported to Alberta and then shipped to B.C. (typically the Okanagan). Common locations of boat manufacturers in the U.S. include Texas, Indiana, Florida and Washington. Used boats being commercially hauled from mussel infested jurisdictions pose the highest risk for transporting invasive mussels and common source location is the Great Lakes (Figure 30). Scheduled inspections at the destination are typically required for commercially hauled boats as they are typically plastic wrapped and inaccessible for inspection and decontamination during transport.

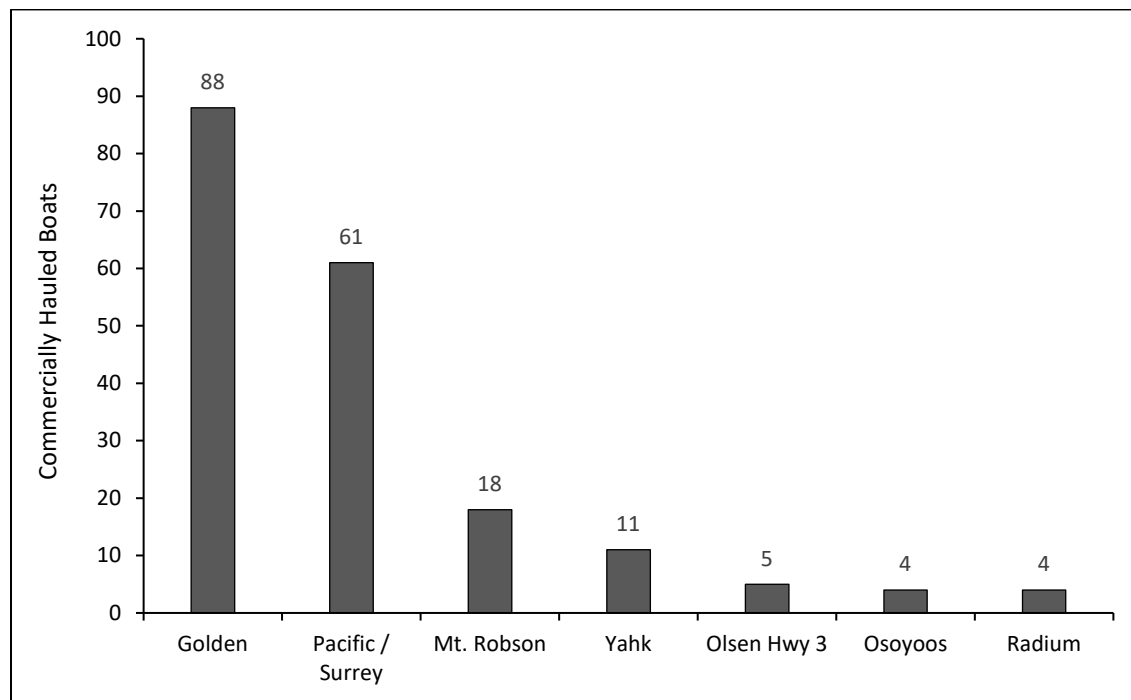


Figure 29. Number of commercially hauled boats intercepted at the watercraft inspection stations during the 2020 season.

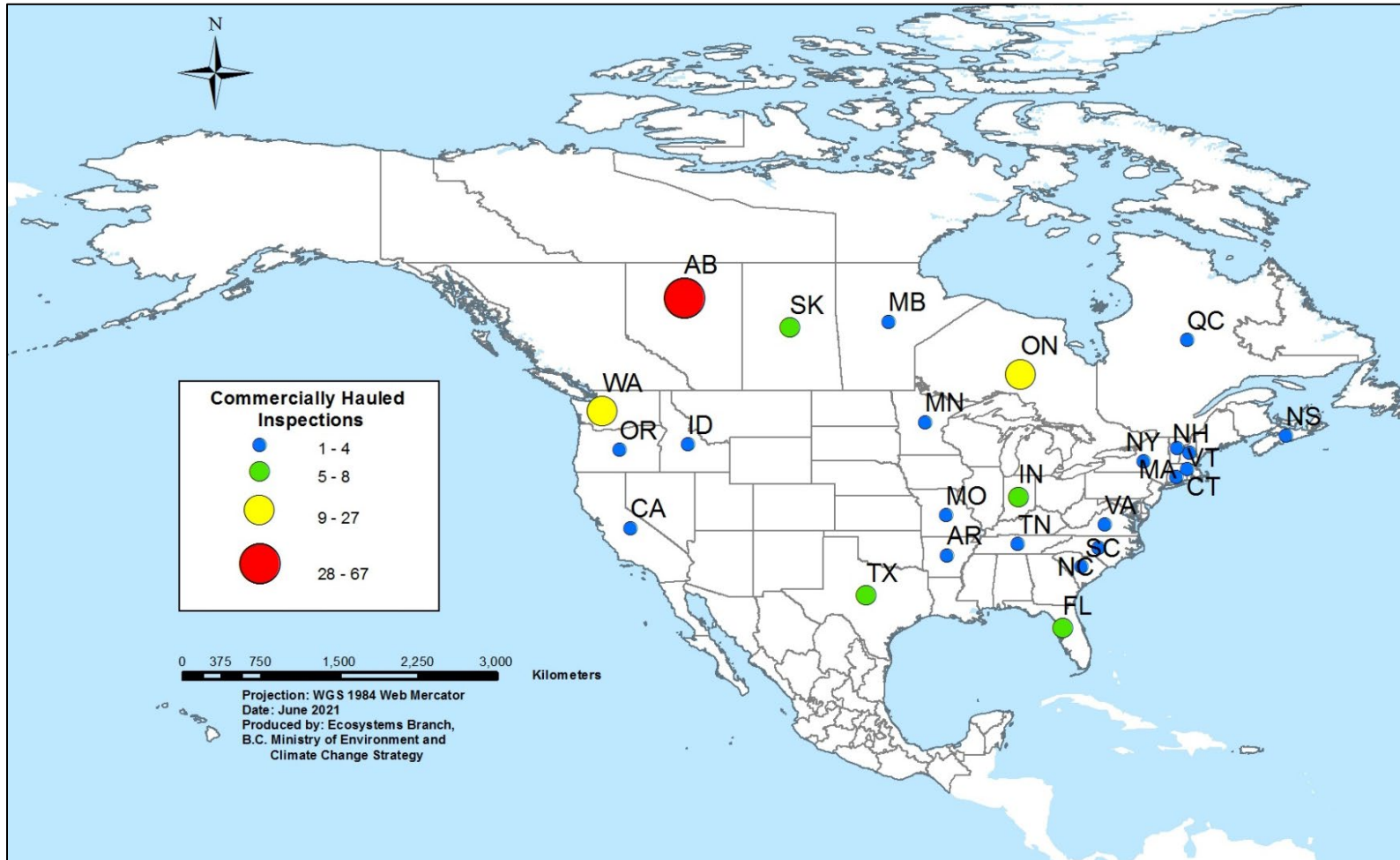


Figure 30. Source location of commercially hauled watercraft coming from outside BC.

3.5 PASSPORT PROGRAM

In 2017, B.C. and Alberta launched a joint watercraft passport program. The passport is intended for watercraft traveling frequently through B.C. and Alberta. When passports are issued, boaters sign a commitment to practice Clean, Drain, Dry and stop at all inspection stations. It is still mandatory for all passport holders to stop at inspection stations, but the inspection process is quicker. The passport is stamped each time a boater goes through an inspection station. The passport serves as a record of past watercraft inspections.

Of the nearly 30,000 total inspections for the 2020 season 2,439 (81.5%) were passport holders. These boaters are asked a reduced number of questions during the inspection process. If the watercraft has not been launched outside of B.C. or Alberta in the last 30 days and the boat is found to be clean, drain, dry, then the passport is stamped and the watercraft is released.

3.6 CANADA BORDER SERVICES AGENCY NOTIFICATIONS

During the 2020 season, the Program worked directly with CBSA to receive notifications of watercraft at the southern border crossings. While the US border was closed to non-essential travel throughout the 2020 season, commercially hauled boats were still permitted to cross the border. For the 2020, season, the Program received 32 notifications from CBSA at several different border crossings that inspectors responded to (Figure 31). As expected, this represents a decrease from the notifications received in 2019 (94). These numbers reflect all the notifications that were received through the Program’s email during the season. The Program also receives notifications from CBSA during the winter months when the inspection stations are closed. These notifications are also followed up by the AIS sergeants in the COS.

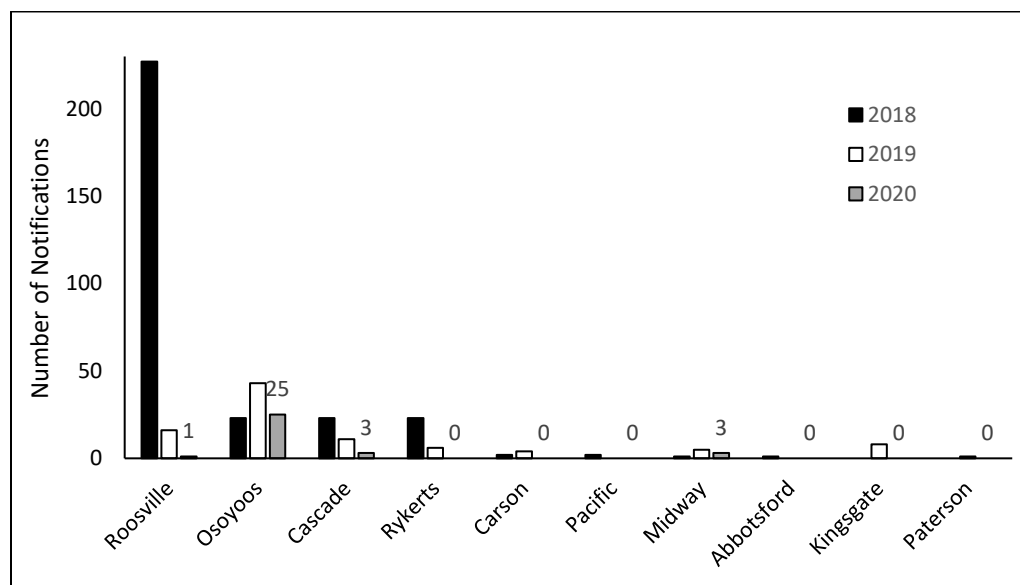


Figure 31. CBSA notifications received across several border crossings for the 2018 to 2020 seasons.

3.7 K9 INSPECTIONS

In 2017, the Program launched the AIS K9 Unit with the training of B.C.'s first multipurpose detection dog, Kilo and in 2020 K9 Major joined the Program. Kilo and his handler Staff Sergeant Major Josh Lockwood are based in Kelowna while Major and his handler Sergeant Cynthia Mann are based in Nelson.

Both teams were deployed at inspection stations during the 2020 season and they spent at least 150 hours conducting AIS inspections at various stations. An additional 170 hours were spent doing various outreach/education events which included supporting COVID-19 screening at the US border and checking any commercial boats that were permitted to cross the US border. However due to COVID-19 the number of outreach events was significantly reduced for the 2020 season. An additional 80 hours were spent on various enforcement related inspections and searches. A significant amount of time is required for ongoing training and off duty care and maintenance of the K9's. For the 2020 season over 1,000 hours were spent on training and off duty care and maintenance between the two handlers.

4. OUTREACH/EDUCATION ON CLEAN, DRAIN, DRY

4.1 INSPECTION STATIONS

Inspection crews had approximately 55,900 interactions across all the inspection stations during the 2020 season to promote the message of Clean, Drain, Dry (CDD). Inspectors recorded whether the watercraft owner had any previous knowledge of AIS or CDD as a measure of efficacy of the Program to educate the public about AIS and CDD.

For the 2020 season, watercraft owners having previous knowledge of AIS and CDD averaged 61%, which is consistent with the 2019 season (62%). Figure 32 shows the breakdown of previous knowledge by watercraft inspection station with Yahk being the highest at 70%. As expected, this data aligns closely with the percent of watercraft previously inspected at each station (Figure 14). Figure 33 shows that the top source of previous knowledge was the previous inspection station visited (in B.C.) (80.4%), followed by previous inspection (other jurisdiction) (8%), highway inspection signs (6%), personal experience (3%), word of mouth (1%), and other (2%). Of the previous other inspection stations visited, 7% were from Alberta and the remaining 1% were from other jurisdictions.

Other sources of knowledge include but are not limited to provincial government TV advertising/ news, provincial government, signs at boat launches, US/Canada border inspection, highway billboard signs, regional invasive species groups, radio, internet, TV advertising/news and social media. Data was collected from boaters attending inspection stations. This data provides important information about how to effectively target the boating community to raise awareness about AIS/CDD in future years of the Program.

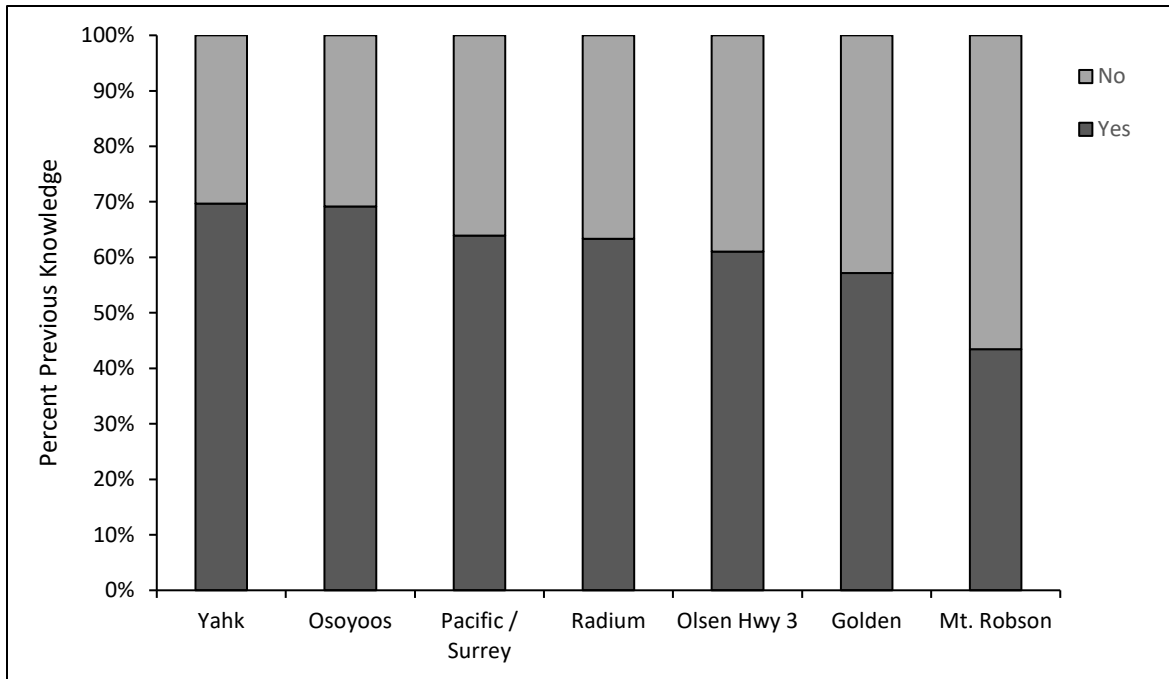


Figure 32. Watercraft owners' previous knowledge of aquatic invasive species and/or Clean, Drain, Dry by watercraft inspection station for 2020.

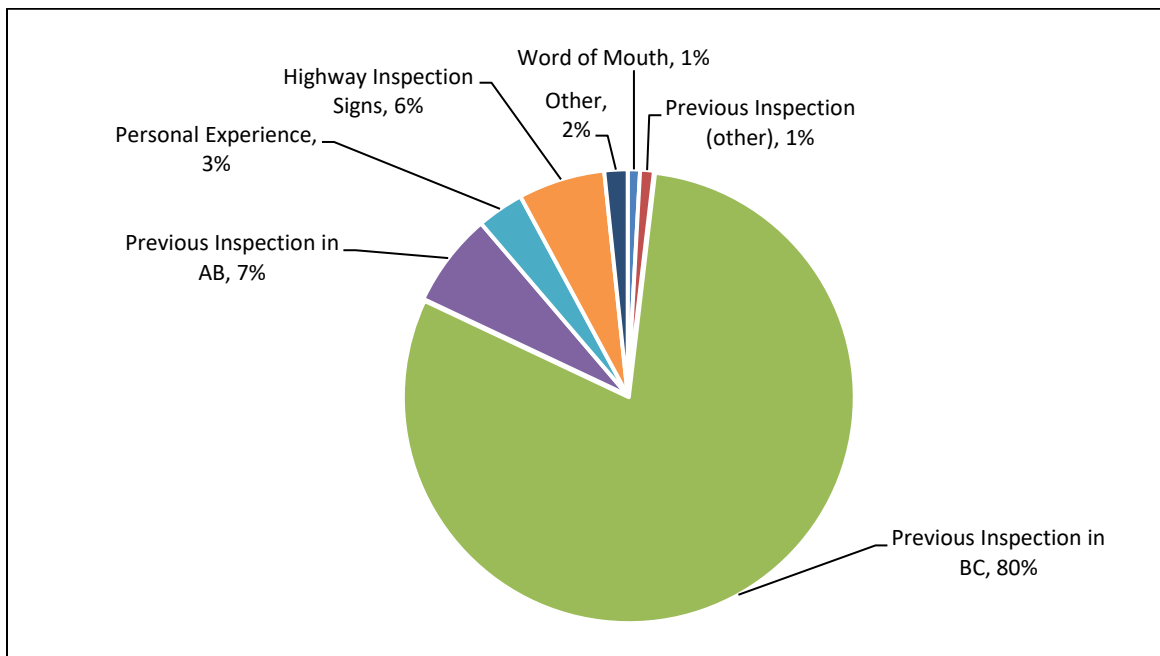


Figure 33. Primary sources of previous knowledge of aquatic invasive species or Clean, Drain, Dry.

The Program also received 118 public inquiries over the 2020 season through the Program's email (COS.Aquatic.Invasive.Species@gov.bc.ca) which is monitored by all the inspectors and senior program staff. These emails included reports of suspected invasive mussels which were immediately followed up on; all were verified to be native freshwater mussels or other native species. Most emails were from boaters bringing their boats into B.C. and contacting the Program about the watercraft inspection stations and necessary steps to take. The Program saw an increase (118) in the number of public inquiries relative to the 2018 (87) and 2019 (85) seasons. This is a positive sign as increased awareness about the Program amongst boaters bringing their boats into B.C. leads to increased compliance. The increase may also be linked to boaters wanting to ensure they are in compliance with COVID 19 public health orders.

4.2 OUTREACH EVENTS

While provincial inspection stations are the first priority of the Program, in past seasons when time permitted inspection crews also attended local events to provide education about CDD, invasive mussels, and other high-risk AIS. Unfortunately, due to COVID-19 and outreach events being cancelled in 2020 the crews were unable to attend events in person. The Okanagan roving crew did conduct inspections and outreach at several boat launches in the Okanagan throughout the summer months. The crews also continued to provide outreach materials and promote Clean, Drain, Dry at the inspection stations throughout the season.

5. LAKE MONITORING

Monitoring is critical for early detection of new invasive species incursions in B.C. and is an important first step in the [Provincial Early Detection Rapid Response \(EDRR\) Plan](#). The Province has been conducting lake monitoring for ZQM since 2011. B.C. is one of many jurisdictions across North America conducting monitoring and active prevention efforts for invasive mussels.

The [British Columbia Dreissenid Mussel Lake Monitoring Field Protocol](#) was updated and published in December 2020. It details the provincial protocols used for lake monitoring for invasive mussels. As a signatory of the *Columbia River Basin Inter-Agency Invasive Species Response Plan: Zebra Mussels and Other Dreissenid Species*, B.C. has committed to following the accepted standards for the collection, preservation, and analysis of invasive mussel veliger samples. As such, B.C. uses a specified cross-polarized microscopy method which is done through a designated lab to ensure the provincial standards are met. Waterbodies are prioritized for sampling based on best available science and data to optimize use of available resources. Available resources must be allocated for both the number of priority waterbodies to be sampled and the frequency of sampling within an individual waterbody. The frequency of sampling includes both the number of sample sites within the waterbody and frequency with which they are sampled throughout the season. Large priority waterbodies (e.g. Shuswap and Okanagan Lakes) are prioritized for sampling at multiple locations throughout the sampling season. Table 2 provides a summary of the total number of samples collected and the number of waterbodies sampled by year since the Program started in 2015. The total number of waterbodies sampled decreased slightly since the 2017 season as resources have been allocated to balance both the number of priority

waterbodies sampled and the frequency in which they are sampled. More information about the criteria used to prioritize waterbodies for sampling can be found in the provincial field protocol referenced above.

Table 2. Total number of plankton tow samples collected and waterbodies sampled by season since the Program started in 2015.

Year	Total Samples	Total Waterbodies
2015	161	58
2016	233	98
2017	402	109
2018	800	90
2019	892	79
2020	954	89

In 2018, HCTF announced a new granting program in partnership with ENV designed to fund community efforts to monitor lakes in B.C. for the presence of invasive freshwater mussels. For more information about the program please visit <https://hctf.ca/grants/invasive-mussel-monitoring-grants/>

For the 2020 season, sampling was carried out by both partner organizations and Ministry staff from early June to October. A total of 12 grants were administered by the Habitat Conservation Trust Foundation with funding provided by the B.C. Ministry of Environment and Climate Change Strategy and Fisheries and Oceans Canada for the collection of water samples in priority waterbodies across the province. The grant recipients were: Boundary Invasive Species Society (BISS), Central Kootenay Invasive Species Society (CKISS), Columbia-Shuswap Invasive Species Society (CSISS), Christina Lake Stewardship Society (CLSS), East Kootenay Invasive Species Society (EKISS), Fraser Valley Invasive Species Society (FVISS), Okanagan and Similkameen Invasive Species Society (OASISS), Sea to Sky Invasive Species Council (SSISC), Invasive Species Council of British Columbia (ISCBC), Okanagan Nation Alliance (ONA), Lillooet Regional Invasive Species Society (LRISS) and the Upper Fraser Fisheries Conservation Alliance. Additional samples were also collected by ENV and FLNRORD regional staff.

In 2019 the Province was successful in receiving four years of federal funding under the Canada Nature Fund for Aquatic Species at Risk to support invasive mussel lake monitoring activities within the Fraser and Columbia River Watersheds. The province would like to acknowledge Fisheries and Oceans Canada for their financial support of the 2020 lake monitoring activities. For more information about the Canada Nature Fund for Aquatic Species at Risk, please visit <https://www.dfo-mpo.gc.ca/species-especies/sara-lep/cnfasar-fnceap/index-eng.html>

A total of 954 plankton tow samples were collected across 89 priority waterbodies and 50 substrate samples were deployed (Figure 13) during the 2020 season. All samples tested negative for the presence of invasive mussels. A complete list of waterbodies sampled in 2020 can be found in Appendix B.

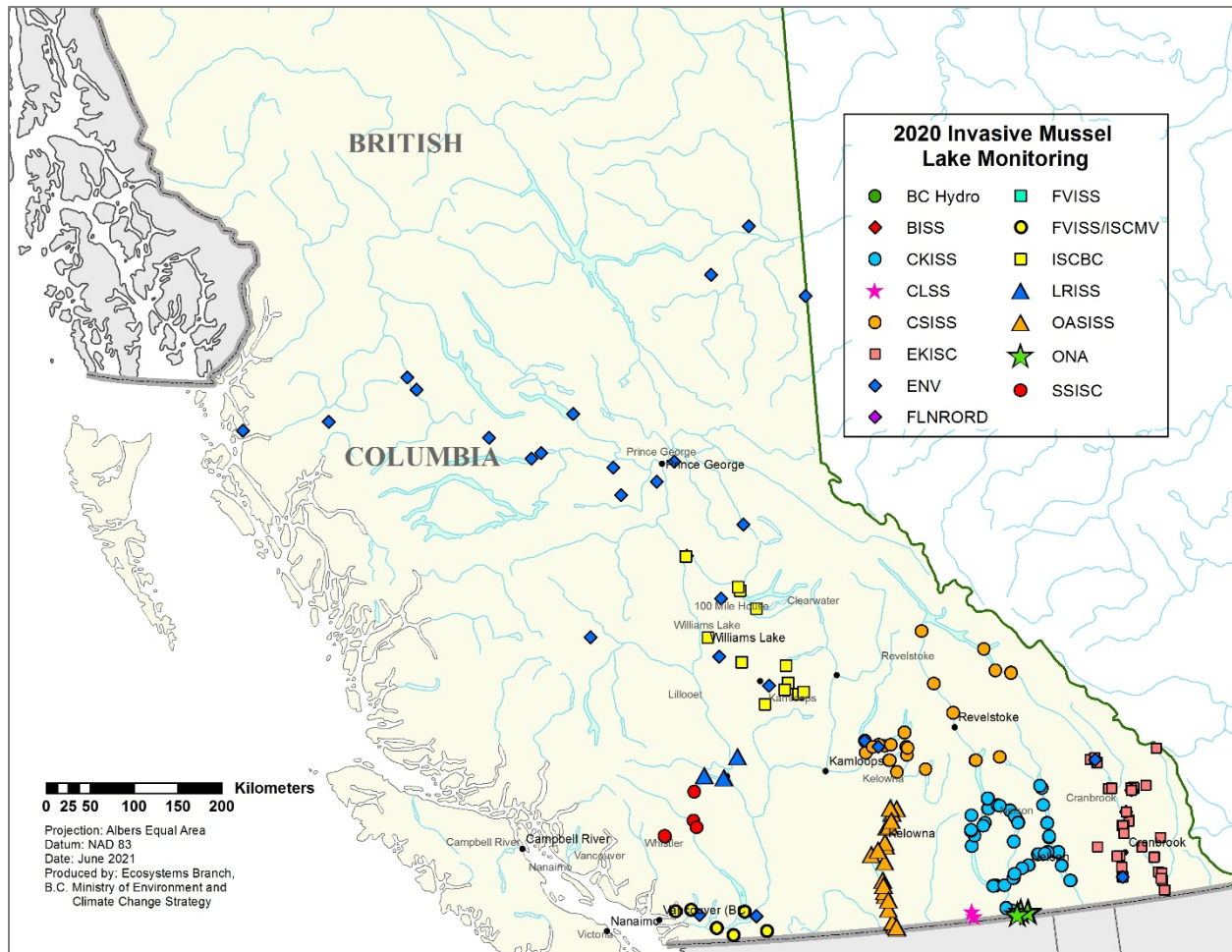


Figure 34. 2020 Lake monitoring plankton tow sampling locations, please see above for the full names of the sampling agencies.

6. PARTNERSHIPS AND COLLABORATIONS

Partnerships are the foundation of the Program and below is a summary of several of the many partnerships that the Program is involved with.

RESEARCH

The Province is currently updating the original economic impact assessment that was conducted in 2013 that estimated the cost if zebra and quagga mussels were to be introduced into BC (\$43M/annually). The analysis requires updating to reflect a more accurate assessment of the potential costs that would be incurred across a broader range of sectors across B.C.’s economy, if invasive mussels were established. This work has included reaching out to subject matter experts across all the impacted

sectors to ensure appropriate data and analysis is being used to estimate costs. The report is anticipated to be completed in fall/winter 2021 and will be shared with partners.

ENV has been collaborating with Dr. Caren Helbing at the University of Victoria to conduct research and development of eDNA assays for aquatic invasive species (zebra and quagga mussels and invasive clam). The mussel assay has been developed and validated, pending further specificity testing with native species and field validation. EDNA methods are rapidly being implemented in a variety of operational contexts for their utility to detect species in low abundance with minimal impacts and cost effectiveness. The need for standards is increasing as eDNA is brought into an operational context. To this end, the Program is assisting in the development of two national standards with Fisheries and Oceans Canada and the Canadian Standards Association. The province is also apprised of emerging applications of this new detection tool and is working to ensure its consistent application across jurisdictions through eDNA working groups under the National Aquatic Invasive Species Committee as well as the USGS Western Regional Panel.

CROSS-BORDER:

The Program continues to work directly with the CBSA to receive notifications of watercraft at the southern border crossings, including 24-hr coverage along several of the southern border crossings. The Program receives notifications for all types of watercraft including canoes, kayaks, and river rafts. Due to the US-Canada border closure the Program received a limited number of notifications during the 2020 season.

Within Canada, B.C. is an active participant on several Federal/Provincial/Territorial invasive species committees including the Invasive Alien Species National Committee and the National Aquatic Invasive Species Committee (NAISC). B.C. is also a signatory of the *Interprovincial Territorial Agreement for Coordinated Regional Defence Against Invasive Species*. Through this agreement B.C. collaborates with Alberta, Yukon, Saskatchewan and Manitoba on enhanced coordination for preventing and managing aquatic invasive species; the collective priority being zebra and quagga mussels. A central component of this work is coordination of the watercraft inspection programs to enhance the perimeter defence approach for western Canada.

B.C. is also participating (and chairing) a newly formed federal/provincial aquatic invasive species pesticide working group with participation from Fisheries and Oceans Canada (DFO), Pesticide Management Regulatory Agency (Health Canada), and western provinces (BC, ON, MB, SK and AB). The purpose of this working group is to establish mechanisms to streamline the registration process for pesticide control products for priority aquatic invasive species such as zebra and quagga mussels. A priority action for this year has been supporting Alberta's application for registration of potash as a control product for zebra and quagga mussels across Western Canada.

Ongoing coordination with other jurisdictions in Canada and the U.S. has been critical for the overall success of the Program. Outside of BC, the Program shares research, procedures, and notifications of high-risk boats with Idaho, Montana, Washington, Oregon, Wyoming, Nevada, Arizona, California, Alaska, Yukon, Saskatchewan, Manitoba, and Alberta. This is part of BC's ongoing commitment as a

signatory to the trans-boundary *Columbia River Basin Inter-agency Invasive Species Response Plan: Zebra Mussels and Other Dreissenid Species* (available for download [here](#)). As a signatory, BC receives notifications of high-risk watercraft from neighbouring states, and is provided access to professional advice on risk management and training opportunities. BC is also a member of the [Western Regional AIS Panel](#) and an active participant in the Pacific Northwest Economic Region (PNWER) invasive species working group.

MOSS BALL RESPONSE

In early March 2021 zebra mussels (ZM) were confirmed in ‘moss balls’ (*Cladophora* species) being sold as aquarium plants across Canada and the US. Following the initial positive detections Program experts worked closely with our American counterparts and western provinces to understand and respond to the threat of ZM coming into Canada through the pet industry supply-chain. This included providing early advice and key contacts to the Federal Government to support a national response. Since early March the COS made contact with over 1,100 businesses across the province and more than 9,000 moss balls that were suspected or confirmed to be contaminated with zebra mussels, were seized or surrendered to B.C. conservation officers. The Program will be reviewing lessons learned from both the provincial and national responses to the incident and continuing to work with the Government of Canada to address this pathway at our borders.

EXTERNAL PARTNERS:

At the provincial level, the Program works on outreach and education messaging directly with the non-governmental community, including the Invasive Species Council of BC and regional invasive species organizations across the province. The Province appreciates the ongoing support provided by invasive species groups to help educate British Columbians on the threat of invasive mussels and promoting the consistent messaging of Clean, Drain, Dry.

7. SUMMARY OF LESSONS LEARNED AND IMPROVEMENTS

At the end of each season, the Program undergoes annual reviews considering ongoing feedback from staff, partners, and the public, as well as lessons learned from other jurisdictions across western Canada and the United States. Below is a summary of the lessons learned from the 2020 season that were considered in the planning and implementation of the 2021 season.

7.1 GENERAL OPERATIONS

The 2020 IMDP season was met with some significant impacts to Program delivery resulting from COVID 19. Due to public health restrictions implemented to mitigate the spread of COVID 19, the Program start-up was delayed to May 15, 2020. The Program was able to safely on-board 37 returning staff who were fully trained in previous years. As a result of the US border closure throughout the entire season staffing at the southern inspection stations were reduced due to the limited number of watercraft crossing into B.C.. The Program continued to work with Canada Border Services Agency (CBSA) to

receive and follow up on notifications of watercraft coming through any of the southern border crossings.

AIS Inspectors were also utilized from April 13, 2020 to June 20, 2020 to perform COVID 19 screening at various US/Canada border ports of entry as part of the Province's strategy to educate the public and ensure compliance with the Federal Quarantine Act, ensuring that travelers were completing their self-isolation compliance forms. AIS staff were instrumental assisting in this capacity to work with full time Conservation Officers at the borders.

In addition to conducting watercraft inspections at established stations, the inspection crews responded to high-risk watercraft notifications received from within the province and from other jurisdictions. The Program worked very closely with neighboring jurisdictions to send and receive notifications of high-risk boats either destined for BC or traveling to other jurisdictions. The Program continued to implement a roving inspection crew in the Okanagan for the 2020 season. When they weren't responding to high-risk watercraft notifications, the Penticton crew rotated between setting up stations at alternate locations (Keremeos and Midway) due to the Osoyoos border crossing being closed. The roving crew also conducted inspections and outreach at boat launches throughout the Okanagan region.

The Program launched a new internal watercraft inspection App at the start of the 2020 season. This new App has created enhanced remote data entry at the inspection stations. In addition, improved data security features will significantly decrease the risk of data loss while in the field. Program staff also worked closely with the developers to create a new internal dashboard that provides real time data summaries that will improve data storage and analysis of the watercraft inspection data. This will create significant efficiencies and enhancements for the Program's ongoing and annual reporting.

The Program continues to explore and maximize incremental improvements to program operations and processes to increase efficiencies in program delivery.

7.2 INSPECTION STATIONS

For the 2020 season the Program continued to implement a roving inspection crew in the Okanagan. This was in response to the successful pilot during the 2019 season to augment the Program's capacity to respond to watercraft notifications in the region, coming from other inspection stations in B.C. (such as Golden), other jurisdictions (AB, SK, ID, OR, MT, WA) and CBSA. Watercraft cannot always be decontaminated during transportation at a roadside inspection station and therefore require follow-up upon arrival at the destination. When the watercraft is intercepted at the B.C. inspection station, it is issued a decontamination order that requires it to report to an inspection crew for decontamination upon its arrival. When the roving crew was not responding to notifications, they were able to conduct outreach at local boat launches at key locations in the Okanagan.

Building on the success of the roving crew in the Okanagan, a second roving crew was implemented in the Lower Mainland for the 2020 season. The roving crews were able to respond accordingly to high-risk watercraft notifications and conduct outreach at local boat launches as time permitted.

For the 2021 season, the Program will continue to implement operations in accordance with the Provincial and Federal COVID-19 health orders and the continued US-Canada border restrictions. Should the US-Canada border re-open during the 2021 season operational adjustments will be made accordingly.

7.3 COMPLIANCE

The average compliance across all the inspection stations for the 2020 season was 87.7% which represents an increase from 83% in 2019. Of the watercraft that failed to stop at the inspection station, 88% were non-motorized watercraft such as canoes, kayaks, and paddleboards which pose a much lower risk than motorized watercraft. Overall the compliance at the stations operating in 2020 were very similar to the 2019 season.

A total of 101 violation tickets and 76 warnings were issued by Conservation Officers to motorists for failing to stop at inspection stations. This marks a slight decrease from the 2019 season (116 tickets and 114 warnings) which could be linked to the delayed start of the season and overall reduction in Program operations with less stations operational in 2020. When full time Conservation Officers were not on site to issue tickets and warnings to motorists, the inspectors reported all high-risk boats that failed to stop to the RAPP line. RAPP line notifications were circulated to all the full-time Conservation Officers within the region. The Program also received support from local RCMP with apprehending motor vehicles transporting watercraft that failed to stop at the inspection stations.

APPENDIX A 2020 WATERCRAFT INSPECTION STATION DETAILS

Station Name	Hwy #	Region	Type	Traffic Direction
Cutts (Hwy 93)	93	Kootenay	Pullout	Northbound
Fraser Valley		Lower Mainland	Roving crew	
Golden	1	Kootenay	Pullout	Westbound
Mt. Robson	16	Omineca	Pullout	Westbound
Olsen (Hwy 3)	3	Kootenay	Rest area	Westbound
Pacific	176 Ave	Lower Mainland	Weigh scale	Northbound
Penticton		Okanagan	Roving crew	
Radium	95	Kootenay	Pullout	Southbound
Yahk	95 and 3	Kootenay	Pullout	Westbound

APPENDIX B 2020 LAKE MONITORING SAMPLING DETAILS

Waterbody	Region	Sampling Group/Agency	Sampling Method(s)	Adult or veliger ZQM detected? (Y/N)
Adams Lake	Thompson-Nicola	ENV	Plankton tow	no
Adams Lake	Thompson-Nicola	CSISS	Plankton tow & substrate Sampler	no
Alouette	Lower Mainland	ENV	Plankton tow	no
Alta Lake	Lower Mainland	SSISC	Plankton tow	no
Anderson Lake	Lower Mainland	SSISC	Plankton tow	no
Anderson Lake	Lower Mainland	LRISS	Plankton tow	no
Arrow Lake, Lower	Kootenay	CKISS	Plankton tow & substrate Sampler	no
Arrow Lake, Upper	Kootenay	CKISS	Plankton tow & substrate Sampler	no
Arrow Lake, Upper	Kootenay	CSISS	Plankton tow & substrate Sampler	no
Bowron Lake	Cariboo	ENV	Plankton tow	no
Bridge Lake	Cariboo	ISCBC	Plankton tow & substrate Sampler	no
Buntzen Lake	Lower Mainland	FVISS/ISCMV	Plankton tow & substrate Sampler	no
Burns Lake	Skeena	ENV	Plankton tow	no
Canim Lake	Cariboo	ISCBC	Plankton tow	no
Charlie Lake	Peace	ENV	Plankton tow	no
Chilliwack Lake	Lower Mainland	FVISS/ISCMV	Plankton tow	no
Chilliwack Lake	Lower Mainland	ENV	Plankton tow	no
Chimney Lake	Cariboo	ENV	Plankton tow	no
Christina Lake	Okanagan	CLSS	Plankton tow & substrate Sampler	no
Christina Lake	Okanagan	ENV	Plankton tow	no
Chute Lake	Okanagan	OASSIS	Plankton tow	no
Chute Lake	Okanagan	OASISS	Plankton tow	no
Cluculz Lake	Omineca	ENV	Plankton tow	no
Columbia Lake	Kootenay	EKISC	Plankton tow	no
Columbia Lake	Kootenay	ENV	Plankton tow	no
Columbia River	Kootenay	CKISS	Plankton tow	no
Columbia River	Kootenay	CSISS	Plankton tow	no
Columbia River	Kootenay	EKISC	Plankton tow	no
Cultus Lake	Lower Mainland	FVISS/ISCMV	Plankton tow & substrate Sampler	no
Cultus Lake	Lower Mainland	ENV	Plankton tow	no
Deka Lake	Cariboo	ISCBC	Plankton tow	no
Diana Lake	Kootenay	ENV	Plankton tow	no

Waterbody	Region	Sampling Group/Agency	Sampling Method(s)	Adult or veliger ZQM detected? (Y/N)
Dragon Lake	Cariboo	ISCBC	Plankton tow & substrate Sampler	no
Dragon Lake	Cariboo	ENV	Plankton tow	no
Duncan Lake	Kootenay	CKISS	Plankton tow	no
Francoise Lake	Skeena	ENV	Plankton tow	no
Fraser Lake	Omineca	ENV	Plankton tow	no
Gardom Lake	Thompson-Nicola	CSISS	Plankton tow & substrate Sampler	no
Green Lake	Lower Mainland	ISCBC	Plankton tow	no
Harrison Lake	Lower Mainland	FVISS/ISCMV	Plankton tow & substrate Sampler	no
Hatzic Lake	Lower Mainland	FVISS/ISCMV	Plankton tow	no
Horse Lake	Cariboo	ENV	Plankton tow	no
Horsefly Lake	Cariboo	ISCBC	Plankton tow	no
Jewel Lake	Okanagan	BISS	Plankton tow & substrate Sampler	no
Jim Smith Lake	Kootenay	EKISC	Plankton tow	no
Kalamalka Lake	Okanagan	ENV	Plankton tow	no
Kalamalka Lake	Okanagan	OASISS	Plankton tow & substrate Sampler	no
Kinbasket Reservoir	Kootenay	CSISS	Plankton tow & substrate Sampler	no
Kootenay Lake	Kootenay	CKISS	Plankton tow & substrate Sampler	no
Kootenay River	Kootenay	CKISS	Plankton tow	no
Lac Des Roches	Cariboo	ISCBC	Plankton tow	no
Lac La Hache	Cariboo	ISCBC	Plankton tow & substrate Sampler	no
Lake Kathlyn	Skeena	ENV	Plankton tow	no
Lake Kooconusa	Kootenay	EKISC	Plankton tow	no
Lake Kooconusa	Kootenay	EKISC	Plankton tow	no
Lake Revelstoke	Kootenay	CSISS	Plankton tow & substrate Sampler	no
Lakelse Lake	Skeena	ENV	Plankton tow	no
Lazy Lake	Kootenay	EKISC	Plankton tow	no
Lillian Lake	Kootenay	EKISC	Plankton tow	no
Lillooet Lake	Thompson-Nicola	SSISC	Plankton tow	no
Little Shuswap lake	Thompson-Nicola	CSISS	Plankton tow	no
Mabel Lake	Okanagan	CSISS	Plankton tow & substrate Sampler	no
Mabel Lake	Okanagan	ENV	Plankton tow	no
Mara Lake	Thompson-Nicola	CSISS	Plankton tow & substrate Sampler	no
Mara Lake	Thompson-Nicola	ENV	Plankton tow	no

Waterbody	Region	Sampling Group/Agency	Sampling Method(s)	Adult or veliger ZQM detected? (Y/N)
Moberly Lake	Peace	ENV	Plankton tow	no
Moose Lake	Omineca	UFFCA	Plankton tow	no
Moyie Lake	Kootenay	EKISC	Plankton tow	no
Moyie Lake	Kootenay	ENV	Plankton tow	no
Nadsilnich (West) Lake	Omineca	ENV	Plankton tow	no
Naltesby (Bobtail) Lake	Omineca	ENV	Plankton tow	no
Norbury Lake	Kootenay	EKISC	Plankton tow	no
Okanagan Lake	Okanagan	OASISS	Plankton tow & substrate Sampler	no
Okanagan Lake	Okanagan	ENV	Plankton tow	no
Osoyoos Lake	Okanagan	OASISS	Plankton tow & substrate Sampler	no
Osoyoos Lake	Okanagan	ENV	Plankton tow	no
Pavilion Lake	Thompson-Nicola	LRISS	Plankton tow	no
Pend d'Oreille River	Kootenay	ONA	Plankton tow & substrate Sampler	no
Pennask Lake	Thompson-Nicola	ENV	Plankton tow	no
Pitt Lake	Lower Mainland	FVISS/ISCMV	Plankton tow & substrate Sampler	no
Premier Lake	Kootenay	EKISC	Plankton tow	no
Premier Lake	Kootenay	ENV	Plankton tow	no
Puntzi Lake	Cariboo	ENV	Plankton tow	no
Quesnel Lake	Cariboo	ISCBC	Plankton tow & substrate Sampler	no
Seton Lake	Thompson-Nicola	LRISS	Plankton tow	no
Sheridan Lake	Cariboo	ISCBC	Plankton tow & substrate Sampler	no
Shuswap Lake	Thompson-Nicola	CSISS	Plankton tow & substrate Sampler	no
Shuswap Lake	Thompson-Nicola	ENV	Plankton tow	no
Skaha Lake	Okanagan	OASISS	Plankton tow & substrate Sampler	no
Skaha Lake	Okanagan	ENV	Plankton tow	no
Slocan Lake	Kootenay	CKISS	Plankton tow	no
St Mary's Lake	Kootenay	EKISC	Plankton tow	no
Stuart Lake	Omineca	ENV	Plankton tow	no
Sugar Lake	Okanagan	ENV	Plankton tow	no
Summit Lake	Kootenay	CKISS	Plankton tow	no
Surveyors Lake	Kootenay	EKISC	Plankton tow	no
Swan Lake	Peace	ENV	Plankton tow	no

Waterbody	Region	Sampling Group/Agency	Sampling Method(s)	Adult or veliger ZQM detected? (Y/N)
Tabor Lake	Omineca	UFFCA	Plankton tow	no
Tabor Lake	Omineca	ENV	Plankton tow	no
Tie Lake	Kootenay	EKISC	Plankton tow	no
Trout Lake	Kootenay	CSISS	Plankton tow	no
Tuc-el-nuit Lake	Okanagan	OASISS	Plankton tow	no
Tyhee Lake	Skeena	ENV	Plankton tow	no
Vaseux Lake	Okanagan	OASISS	Plankton tow	no
Wahleach Reservoir	Lower Mainland	ENV	Plankton tow	no
Wasa Lake	Kootenay	EKISC	Plankton tow	no
Whatshan Lake	Kootenay	CKISS	Plankton tow	no
White Lake	Thompson-Nicola	CSISS	Plankton tow	no
Whiteswan Lake	Kootenay	EKISC	Plankton tow	no
Whiteswan Lake	Kootenay	ENV	Plankton tow	no
Williams Lake	Cariboo	ISCBC	Plankton tow	no
Williams Lake	Cariboo	ENV	Plankton tow	no
Windermere Lake	Kootenay	EKISC	Plankton tow	no
Windermere Lake	Kootenay	ENV	Plankton tow	no
Wood Lake	Okanagan	OASISS	Plankton tow & substrate Sampler	no
Wood Lake	Okanagan	ENV	Plankton tow	no

**Please see section 5 for the full names of the sampling groups/agencies.*