2019 – 2022 Invasive Smallmouth Bass Cultus Lake, BC Brief Project Overview

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OVERVIEW

The goal of the project was to document the diet and movement of smallmouth bass in Cultus Lake in order to effectively suppress the bass population. In 2017/2018, smallmouth bass (*Micropterus dolomieu*) were detected in Cultus Lake. This was the first established population of the species within the Lower Mainland. The presence of sockeye salmon (*Oncorhynchus nerka*) (COSEWIC status Endangered) and Cultus Lake pygmy sculpin (*Cottus aleuticus*) (SARA and COSEWIC status Threatened) in Cultus Lake was especially concerning, given that smallmouth bass have been documented preying on both species (Fayram and Sibley 2000; Brown et al. 2009). The data collected throughout two years of fieldwork (2020 – 2021) will inform fisheries managers of the best next steps in suppressing the smallmouth bass population in Cultus Lake.

This work was done in collaboration with the Ministry of Environment and Climate Change Strategy (MOE), the Ministry of Forests, Lands, Natural Resource Operations and Rural Development (FLNRORD), Fisheries and Oceans Canada (DFO), Thompson Rivers University (TRU), and the Cultus Lake Stewardship Society (CLASS). Funding for this project was through the Canada Nature Fund for Aquatic Species at Risk (CNFASAR), and Mitacs (with the Pacific Salmon Foundation).

DIET

Using targeted angling, bass were collected from May to September in 2020 and April/May in 2021. 204 bass were caught by local anglers Nick Basok and Peter Buck over the two seasons. All fish were measured, weighed, and sexed for data on population characteristics. Stomachs and otoliths (ear bones) were removed and preserved for future processing. Back in the lab, all stomachs were dissected, and prey items were categorized into the lowest identifiable unit. 145 of the stomachs were then sent to the Canadian Centre for DNA Barcoding at the University of Guelph for barcode sequencing. 76 otoliths were sent to the BC Provincial Aging Lab for age estimates of the bass and to create a length-age key.

Male smallmouth bass caught in this study were significantly larger (by 51 mm total length) than female smallmouth bass. Females caught in the spawning ground were larger than females caught elsewhere, but there was no difference in size for males caught in the spawning vs non-spawning ground. The largest bass caught weighed 1354 g and had a total length of 440

mm. Figure 1 shows the age-length key for smallmouth bass in Cultus Lake. You can use this to get an approximate age of bass from their total length.

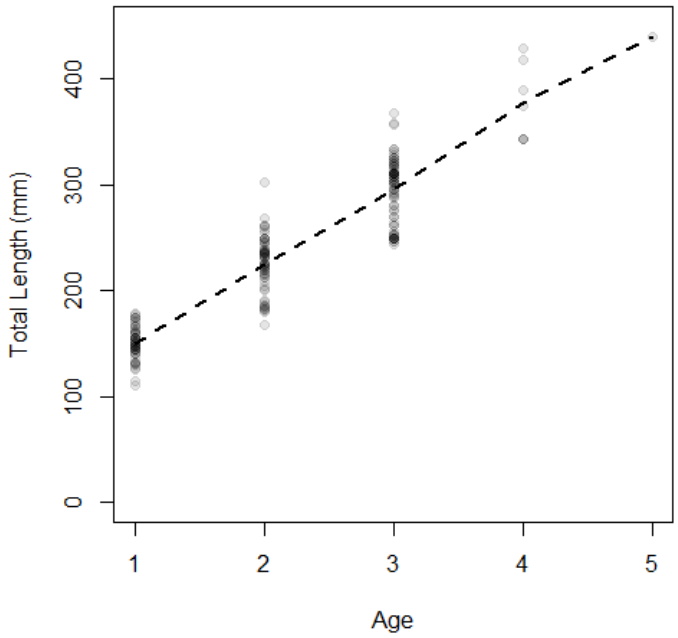

Figure 1. Age-length key for smallmouth bass in Cultus Lake, BC.

DNA Sequencing identified 82 species. The orders with the highest sequencing detections and the average proportional contribution of count data combined were sculpin/stickleback (Cottidea/Gasterosteidae: Scorpaeniformes) crayfish (Astacidae: Decapoda), and mayflies (Baetidae: Ephemeroptera). Figure 2 shows a count of how many stomachs had each prey item present. **Seven fish species** were identified during metabarcoding. They were (including count): Prickly sculpin (110), coastrange sculpin (98), three-spined stickleback (34), sockeye salmon/kokanee (26), redside shiner (10), Northern pikeminnow (8), and peamouth chub (1). These species are all known residents of Cultus Lake. DNA analysis was not able to distinguish *Oncorhynchus nerka* into subcategories of kokanee and sockeye salmon.

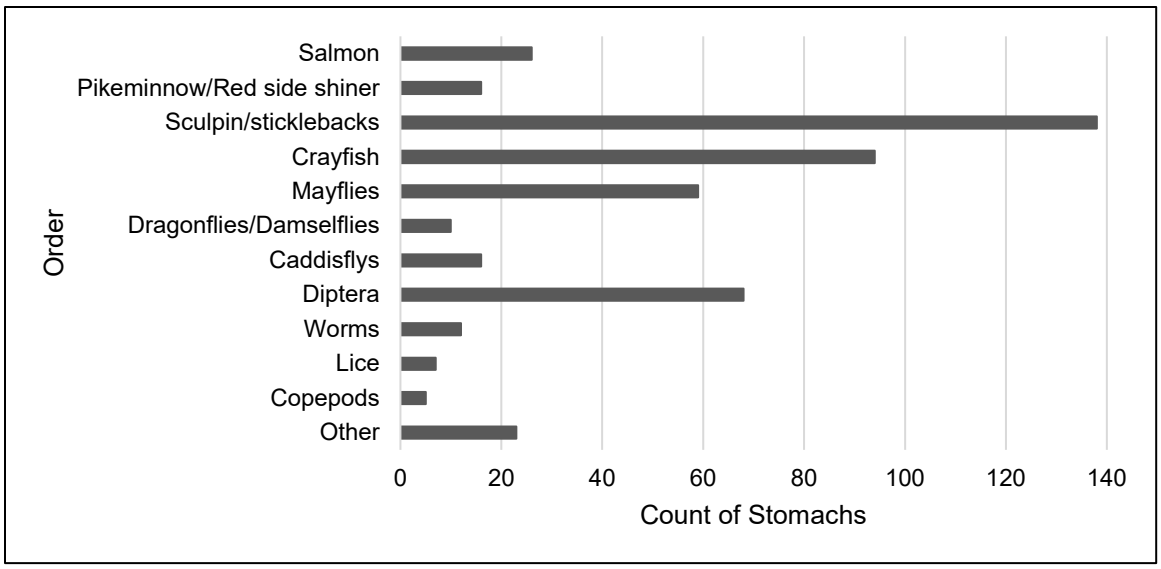

Figure 2. Number of smallmouth bass stomachs with each order present, based on DNA analysis from 2020-2021 Cultus Lake, BC. Scientific order names were converted to common names for ease of understanding. The 'other' category represents orders with less than 5 counts.

Oncorhynchus nerka (sockeye/kokanee) were found in 17.8% of the smallmouth bass stomachs analyzed using metabarcoding. We determined the probability of bass predation on salmon based on variables such as bass length, month caught, and location caught. Using a statistical model, we determined that bass were significantly more likely to consume sockeye/kokanee in the bass spawning ground.

DISTRIBUTION

Acoustic telemetry is a method of tracking aquatic animals using tags and receivers. The tags are inserted into the fish and send out pings with unique IDs, and in some cases tags also recorded the temperature of the fish. The stationary receivers listen and document the pings whenever the tags are within reach of the receivers' detection range. We placed 10 receivers in Cultus Lake in spring/summer of 2020 and downloaded their data every 6 months (Figure 3). Tags were surgically implanted into bass at Cultus Lake in 2020 and 2021. To collect supplementary data, snorkel surveys were completed every two weeks during the spawning season, and water temperature/oxygen depth profiles were taken from May – September each season by John Axford, with additional temperature data provided by Dr. Dan Selbie, DFO.

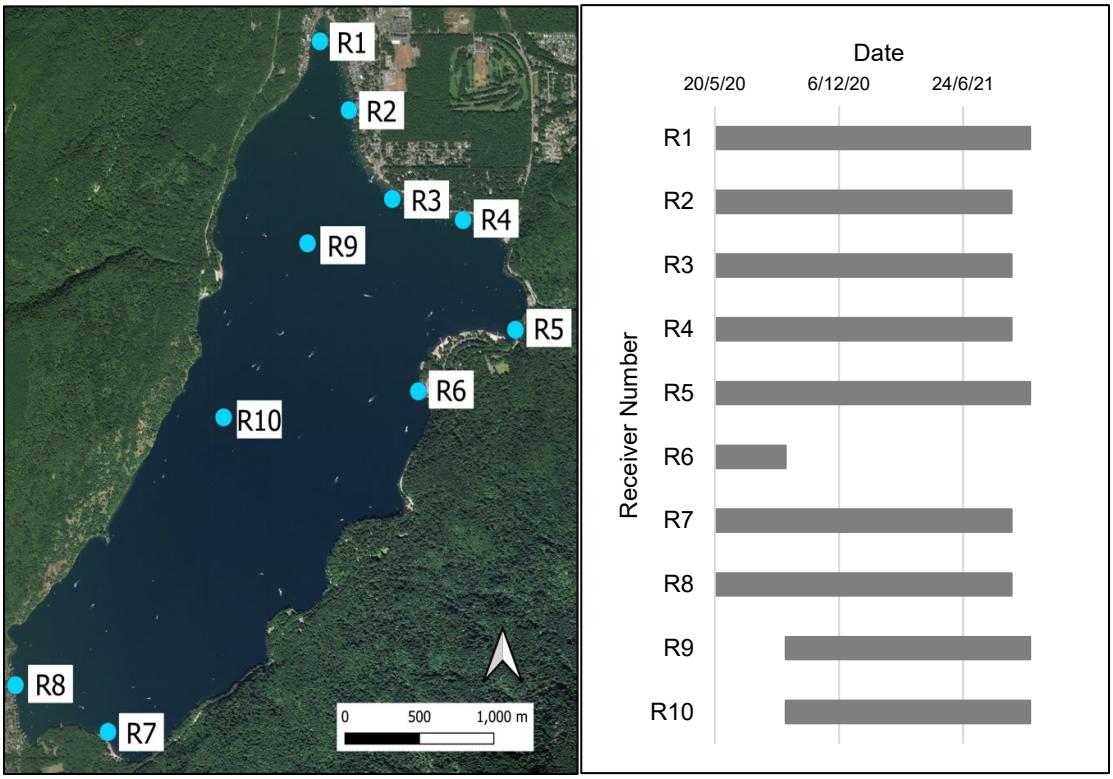

Figure 3. Receiver locations in Cultus Lake, BC (left). Deployment and removal dates of receivers (R1 - R10) (right).

Seasonal migrations and spawning patterns were documented over the two field seasons. Bass appear to move into the northwest corner of the lake (between Sweltzer Creek and the Marina) for spawning in late April – May. They remain here until mid-June when they begin to disperse throughout the lake. Then, in October/November they move offshore, and congregate at depth near receiver 9 (R9). Figure 4 shows the approximate depth of the bass throughout the year (note that during winter, the water column temperature is homogenous, and so depth approximations are impossible), Figure 5 shows the seasonal movements of the bass and Figure 6 shows the distribution of nests in the spawning area.

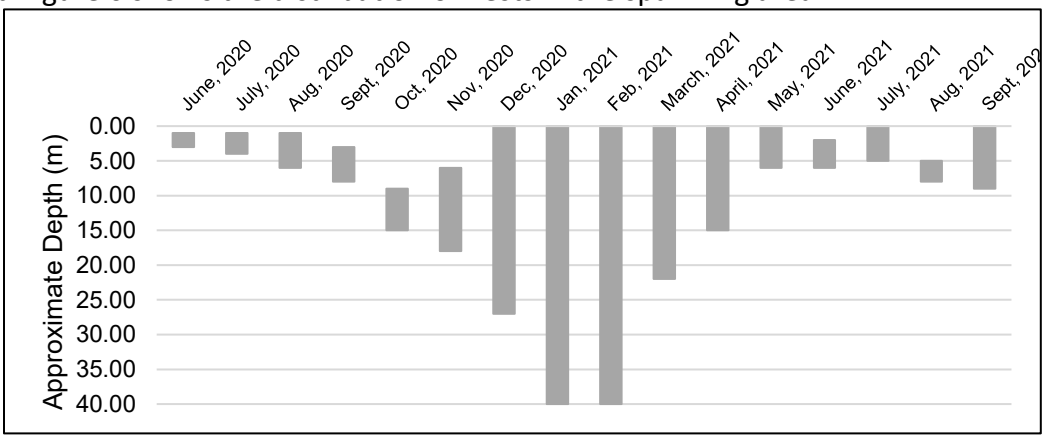

Figure 4. Correlated smallmouth bass depths, based on monthly temperature profiles and average bass temperature.

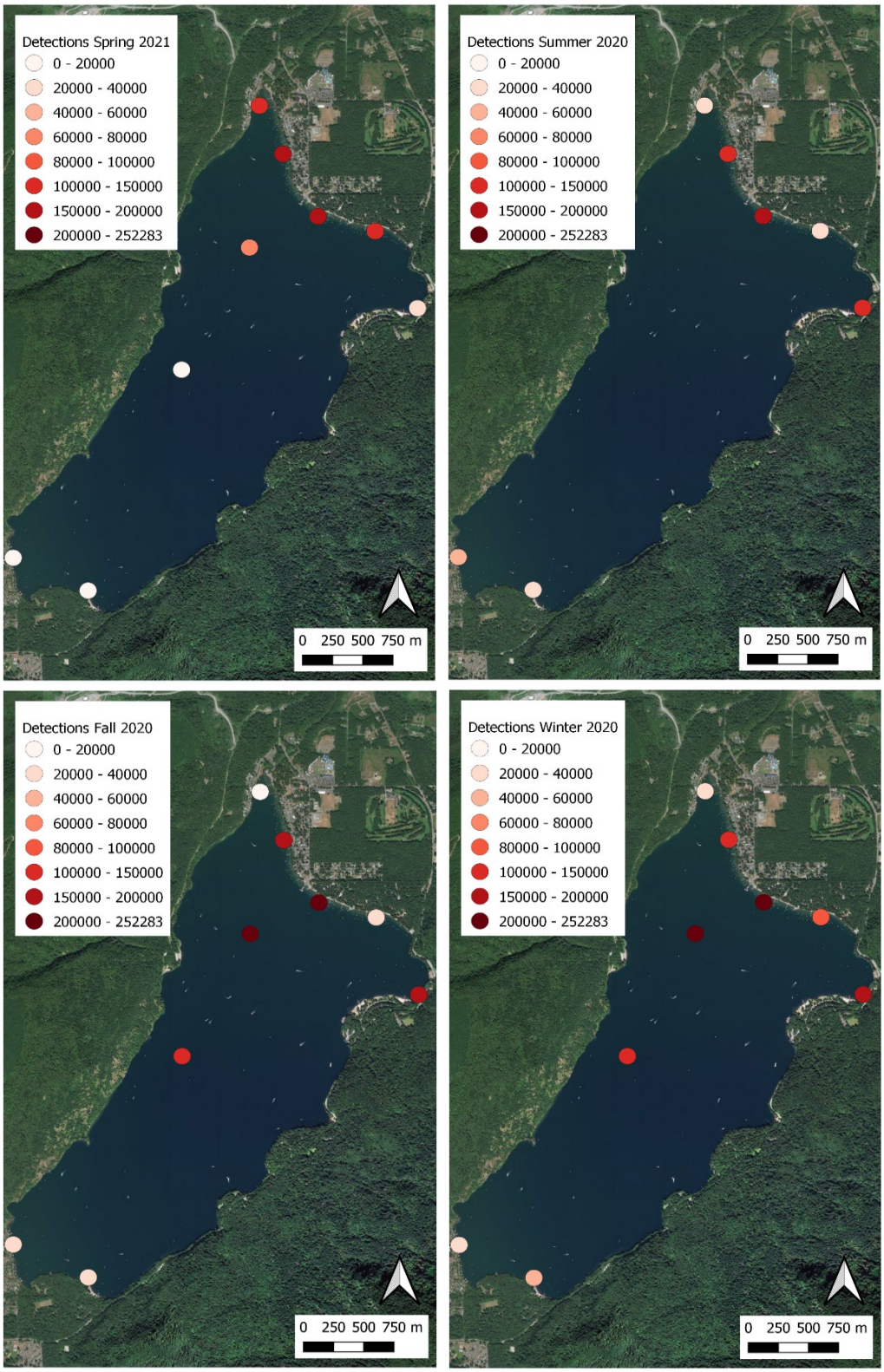

Figure 3. Frequency of smallmouth bass detections on receivers 1 - 10 for Spring 2021, Summer, Winter, and Fall 2020 (clockwise) in Cultus Lake, BC. The gradient of colours represents detection rates, with lighter-coloured receivers detecting less fish and darker coloured receivers detecting more fish. Map created using QGIS.

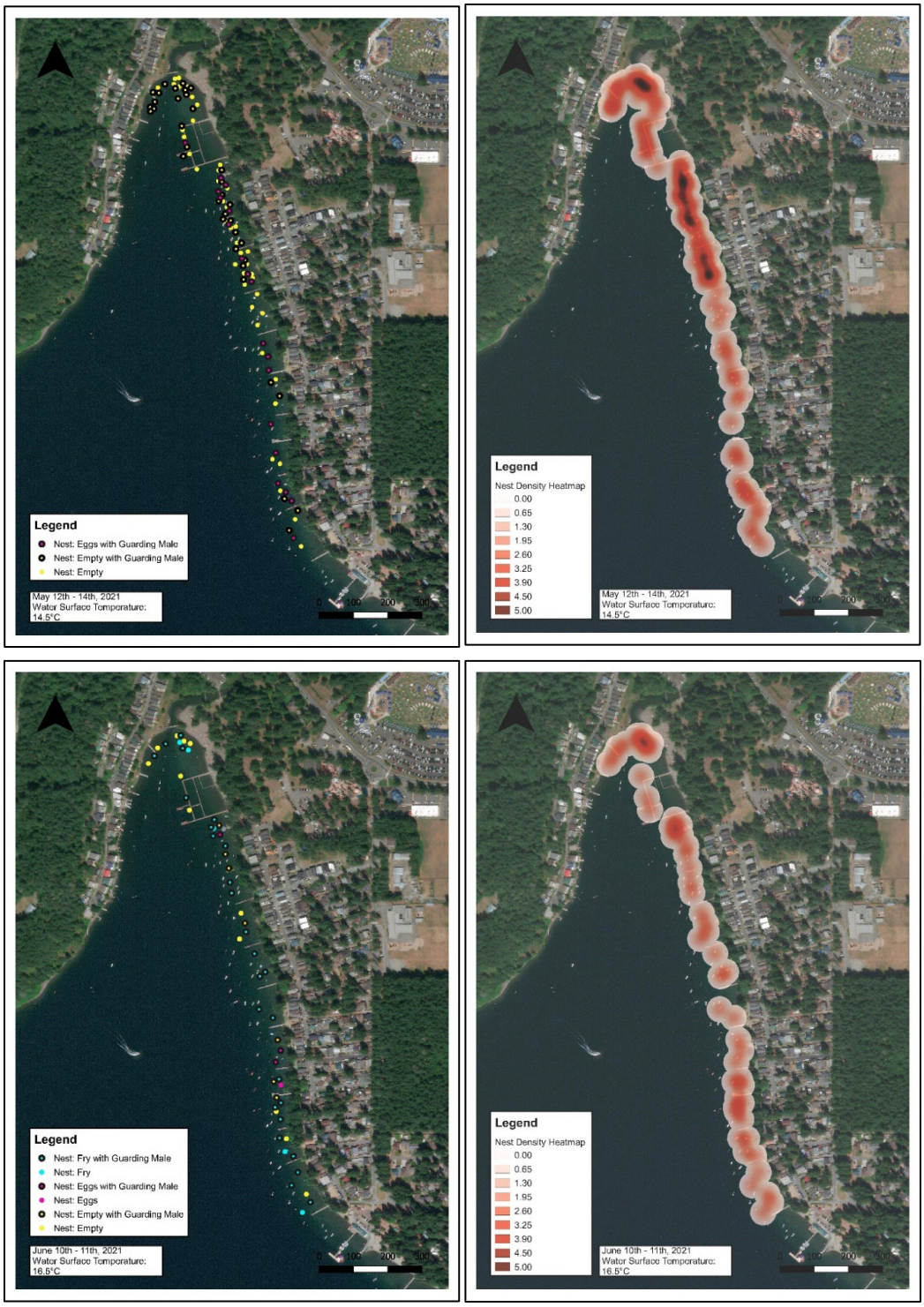

Figure 4. Nest Locations (left) and heatmap (right) of smallmouth bass nest sites found during a May 12th - 14th snorkel survey (top), and a June 10th - 11th snorkel survey (bottom). Nest locations were documented as 'between dock x/z', and were then plotted randomly between identified docks, within 0.5 – 2.5 m depth. Map projection from QGIS using WGS 84 UTM zone 10N. Map created using QGIS

RECOMMENDATIONS FOR CLASS

We all want this project to continue; however, funding and commitment from government partners is a continual challenge. Here are some suggestions as to what can be done independently.

1. Use the Derby Day to collect data on bass and deliver information on invasive species

- Hand out sheets to anglers and ask them to write down each bass they catch, their lengths, and whether they killed or released the fish. Collecting this data will help with long term population studies.
- Have a booth or a few volunteers roaming at the boat launches talking to people about invasive species, and how the bass have impacted the ecosystem. Feel free to use any of the figures or signage we've provided in the past.

2. Kayak from dock 22(ish)to the Marina and count nests

- When the water is calm and clear, you can see the bass nests from a kayak. Counting the nests will help with population estimates, and help determine if the spawning area is expanding. In 2021 there were only 6 nests found along Sunnyside Campground Beach. We suggest kayaking this area as well to see if the population is expanding and more nesting is occurring along this stretch of beach.

3. Destroy nests and burry eggs/fry

- Bass begin to lay eggs at the start of May. Eggs look like a thin membrane with off-white dots (like Rice Krispies), and fry look like black rice when first hatched. Because the nests are only up to 2 m deep, snorkeling and nest destruction is simple. WE used a small garden tool and would stir-up any nests with eggs or fry, dislodging the eggs from the membrane. Keep track of how many nests and which areas you destroyed.

4. Angle for spawning bass

- Angle and kill spawning bass in the spring, in areas highlighted in Figure 6. Pulling the guarding males off the nests will significantly decrease the eggs/fry chance of survival.
- NOTE: We had originally planned to spearfish the guarding males. We still think this would be an excellent option and a creative new way to kill guarding males. To do this, you would need to apply for a Scientific Collecting Permit through FLNRORD. Colin Scwhindt is our contact there, and is very familiar with the project.

5. Continue to 'remind' government about the project

- We have had an amazing 3 years working on this project for Thompson Rivers University in collaboration with DFO, Ministry of Environment, and FLNRORD. While we would love

to continue working at Cultus we did not receive funding for research in 2022-2023. One element identified as a limitation for research was the lack of a provincial 'regional management plan' for smallmouth bass. Unfortunately, we are a research university and not regional managers, and so unless we can get a large grant for a second masters student, it's going to be up to different government groups AND YOU to keep the work on track. We are always happy to offer our expertise in the future, and wish you all the best with continuing this important work.