Guidelines for the Collection and In Situ Scientific Study of Stickleback Species Pairs (*Gasterosteus* spp.)

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The Recovery Team for Non-Game Freshwater Fish Species in BC:

Jordan Rosenfeld, BC Ministry of Environment, (co-chair)
Dan Sneep, Fisheries and Oceans Canada, (co-chair)
Todd Hatfield, Solander Ecological Research, (coordinator)
Don McPhail, Department of Zoology, University of British Columbia
John Richardson, Department of Forest Sciences, University of British Columbia
Dolph Schluter, Department of Zoology, University of British Columbia
Eric Taylor, Department of Zoology, University of British Columbia
Paul Wood, Department of Forestry, University of British Columbia

The following guidelines represent advice from the Recovery Team for Non-game Freshwater Fish Species in BC regarding collection and in situ scientific study of stickleback species pairs. With the exception of a newly-discovered species pair on Nelson Island, BC, stickleback species pairs are listed under the Species at Risk Act (SARA) as endangered. The purpose of the guidelines is to inform regulators issuing collection and study permits under SARA and the BC Wildlife Act. The guidelines are meant to apply to sympatric stickleback species pairs, but the rationale presented may be relevant to other listed fish species in the province. The Recovery Team reserves the right to update the guidelines based on new information or interpretations.

Background

The fish known collectively as "sympatric stickleback species pairs" are small, freshwater fish descended from the marine threespine stickleback (*Gasterosteus aculeatus*). In each case, one of the species (referred to as "limnetic") primarily exploits plankton, and has morphological traits considered adaptations to a zooplankton-consuming lifestyle. The other species (referred to as "benthic") mainly eats benthic invertebrates in the littoral zone, and has traits considered to be advantageous in benthic feeding. The pattern of morphological and ecological divergence is similar in each of the lakes, such that limnetics all look alike, as do all benthics. Despite similar appearance, phylogenies based on molecular genetics strongly indicate that the pairs are independently derived.

Stickleback species pairs exist in two watersheds on Texada Island, and one on nearby Nelson Island. A pair in Hadley Lake, on Lasqueti Island has been declared extinct, likely due to the introduction of brown bullhead (*Ameiurus nebulosus*). Another pair in Enos Lake on Vancouver Island has collapsed into a single hybrid swarm, and is unlikely to recover. The present global range is therefore restricted to two watersheds on northern Texada Island — the Paxton Lake watershed, and the Vananda Creek watershed (with three lakes, Balkwill, Priest and Emily) — and Little Quarry Lake on Nelson Island.

Stickleback species pairs have been the focus of intense scientific study since the 1980s and there is an increasing demand for wild stock for use in laboratory-based studies and for permits to conduct in situ scientific study. The Recovery Team has indicated that collecting activities are likely a significant source of mortality on adult fish, and constitute a threat to the species pairs that should be carefully managed.

RECOMMENDATIONS

Collection Locations

The Recovery Team recommends the establishment of no-take areas in each lake to allow reproduction and other ecological processes to proceed undisturbed in portions of each lake. Approximately half of each lake is considered reasonable at this time for this purpose. It is suggested that trapping, seining, and other capture techniques should be prohibited within the no-take areas. This applies to both lethal sampling and capture and release. We acknowledge that occasional captures may be justified for some research programs, but these requests should be reviewed on an individual basis with approval based on merit and risk.

Paxton Lake: Collecting should occur only within the southern basin. The no-take area includes the northern basin from the midway point in the narrows between the two main basins. Approximate UTMs of boundary[1]: 10 U 390009 5507563 to 10 U 390065 5507550.

Priest Lake: The lake does not have distinct basins and a boundary has been defined to divide the lake into approximate halves. Approximate UTMs of the boundary are: 10 U 387105 5511354 to 10 U 387422 5511533. Collecting should occur only within the southeastern half of the lake. The no-take area includes the northwestern half.

Balkwill Lake: The other common name for this lake is Spectacle Lake, and as this name implies there are two distinct basins. However, one basin is considerably smaller so we have defined a boundary dividing the entire lake into approximate halves. Approximate UTMs of the boundary are: 10 U 385675 5511863 to 10 U 385725 5511970. Collecting should occur only within the eastern half of the lake. The no-take area includes areas west of the boundary.

Emily Lake: This lake is small and roughly circular. We have defined a boundary dividing the entire lake into approximate halves. Approximate UTMs of the boundary are: 10 U 388655 5511709 to 10 U 388666 5511405. Collecting should occur only within the eastern half of the lake. The no-take area includes all areas west of the boundary.

Little Quarry Lake: The lake does not have distinct basins so a boundary has been defined that divides the lake into approximate halves. Approximate UTMs of the boundary are: 10 U 419904 5501814 to 10 U 420101 5501615. Collecting should occur only within the northeastern half of the lake. The no-take area includes all areas southeast of the boundary.

Sampling Quantities and Methods

Scientific collections should constitute less than 10% of the mature fish population, as measured in spring and summer seasons. A mark-recapture study[2] assessed abundance in Paxton Lake and indicated approximately 3,300 mature benthic males and 25,800 mature limnetic males. Confidence in the estimate of benthics was considerably greater than that for limnetics. Extrapolated abundance estimates for other species pair lakes based on lake perimeter are summarized in Table 1.

[1] UTMs have been taken from MapSource mapping software (Garmin Ltd.), and may be updated based on field measurements.

[2] Matthews, B., P. Ramsay and K. Tienhaara. 2001. Population estimation and recovery planning for stickleback species pairs. An excerpt and adaptation from an undergraduate honours thesis at the University of British Columbia. Available on the internet at http://www.science.ubc.ca/envsc/theses.html

Table 1. Estimates of mature benthics for each of the species pair lakes. These projected estimates are based on a single mark-recapture estimate of mature benthic males in Paxton Lake in June 2005. All estimates, including 95% confidence intervals, are calculated by multiplying the Paxton Lake estimates by a factor that corrects for lake perimeter, and multiplying by 2 to account for both sexes.

lake	perimeter (m)	mature benthic	lower CI	upper CI
Paxton	2277	6,663	4,486	10,610
Priest	3868	11,319	7,620	18,024
Balkwill	2268	6,637	4,468	10,568
Emily	1091	3,193	2,149	5,084
Little Quarry	2700	7,900	5,319	12,581

Lethal sampling.— The Recovery Team recommends the following maximum lethal sampling limits. Please note that these are under review and are likely to be updated based on additional information. For example, there is discussion regarding implementing a size restriction for lethal sampling of benthics, to protect large individuals.

Paxton Lake: The recommended lethal sampling limit for Paxton Lake is 200 mature fish of each species and sex (i.e., 200 mature benthic males, 200 mature benthic females, 200 mature limnetic males, 200 mature limnetic females). Twice these limits are proposed for juvenile fish.

Priest Lake: The recommended lethal sampling limit for Priest Lake is 340 mature fish of each species and sex (i.e., 340 mature benthic males, 340 mature benthic females, 340 mature limnetic males, 340 mature limnetic females). Twice these limits are proposed for juvenile fish.

Balkwill Lake: The recommended lethal sampling limit for Balkwill Lake is 200 mature fish of each species and sex (i.e., 200 mature benthic males, 200 mature benthic females, 200 mature limnetic males, 200 mature limnetic females). Twice these limits are proposed for juvenile fish.

Emily Lake: The recommended lethal sampling limit for Emily Lake is 95 mature fish of each species and sex (i.e., 95 mature benthic males, 95 mature benthic females, 95 mature limnetic males, 95 mature limnetic females). Twice these limits are proposed for juvenile fish.

Little Quarry Lake: The recommended lethal sampling limit for Little Quarry Lake is 235 mature fish of each species and sex (i.e., 235 mature benthic males, 235 mature benthic females, 235 mature limnetic males, 235 mature limnetic females). Twice these limits are proposed for juvenile fish.

Catch and release.— In our experience there is some mortality associated with catch and release sampling activities, even where considerable care is exercised. This form of sampling is obviously superior to lethal sampling in terms of direct effects on the population, but some caution is warranted. It is probably reasonable to assume a 5% mortality rate for "non-lethal" sampling, and this should be factored into overall permitting levels. To avoid undue stress on animals, traps should be left in for less than 24 hours. All traps should be accounted for at all times.

Sampling methods.— To prevent the spread of invasive species and disease organisms the Recovery Team recommends that all sampling equipment (traps, seines, boats, boots, etc.) be sterilized using appropriate methods prior to moving gear from one lake to another. Treatment with 2% bleach is the most straightforward method at this time[3], although researchers are encouraged to educate themselves on potential threats and appropriate treatments.

In Situ Scientific Studies - *Use of Hybrids*

The Recovery Team supports the full prohibition of use of hybrids in experimental studies, where the source of hybrids is not directly from the wild. Hybrids are often reared in laboratory faculties, in experimental ponds, and also occur in Second Lake on Texada Island. Use of hybrids from these sources is considered inappropriate and high risk, whether these individuals are retained in enclosures or not, due to the possibility of escape into the wild. It is acknowledged that such experiments have been conducted in the past, however the Recovery Team has indicated that this is now believed to introduce an unacceptably high risk to wild populations. The primary rationale for this recommendation is that the collapse of the Enos Lake pair and the extinction of the Hadley Lake pair has highlighted the potential fragility of the pairs, and there may be a threshold of hybrid abundance beyond which the species pairs are not able to maintain themselves and would collapse to a hybrid swarm. Note that this recommendation does not preclude the use of wild hybrids from the same lake, or the use of hybrids in laboratory or experimental pond settings.

In Situ Scientific Studies - *Transfer of Fish from Other Locations*

The Recovery Team supports the full prohibition of transfer of fish from other natural or laboratory locations. Fish are often reared in laboratory facilities and in experimental ponds, and are a potential source of fish for experimental studies. Translocation of fish is considered inappropriate and high risk, whether these individuals are retained in enclosures or not, due to the possibility of escape into the wild and the potential for disease transfer. It is acknowledged that such experiments have been conducted in the past, but the Recovery Team has indicated that this is now believed to introduce an unacceptably high risk to the wild populations.

It should be noted that translocation of fish requires a permit from the BC Ministry of Environment, and all applications will be reviewed by the Transplant Committee.

In Situ Scientific Studies - *Use of Non-native Species*

The introduction of non-native species is implicated as the primary cause of extinction of the Hadley Lake pair and the collapse of the Enos Lake pair. The Recovery Team recommends full prohibition of use of non-native plant or animal species in experimental studies in the wild. By "non-native species" we refer to all species that do not naturally occur within the watersheds where species pairs occur.

[3] Practice advisory for Didymo http://www.apbbc.bc.ca/files/Didymo.pdf