

Sticklebacks on Gabriola (notes by Nick Doe)

Most populations of three-spined sticklebacks are marine fish that breed in fresh or brackish water (like salmon, they're "anadromous") but some populations are found in freshwater lakes, ponds, and ditches with no current connection to the sea. These populations are descendents of marine ancestors that were stranded by sharply falling sea levels at the end of the last ice age, which on Gabriola was between 13000 and 14000 years ago.¹

So far, Gabriola Streamkeepers have found three-spined sticklebacks in Castell Brook, Descanso Creek, Dick Brook, and Wagg Brook, all of which are accessible by fish from the sea, and also in the Hoggan Lake catchment area—the lake itself, the Commons Pond, and Goodhue Creek—which are not.²

Because they are common, it is frequently the case that sticklebacks are recorded automatically as the species *Gasterosteus aculeatus* when observed, and in nearly every case this would be correct,³ especially so when they have access to the sea, but there are reasons on Gabriola to take a little more care when identifying fish without access to the sea.

In spite of its world-wide distribution, only three sub-species of *G. aculeatus* are currently recognized; *G. a. spp. aculeatus*, the common or garden often sea-going "tiddler"; *G. a. spp. santaanae*, restricted to a few small isolated freshwater waterbodies in California and of no local interest; and *G. a. spp. williamsoni*, the unarmored three-spined stickleback, also known mostly from a handful of catchment areas in southern California but with isolated reports of its occurrence in lakes across the border in Mexico and up in Haida Gwaii (the Charlottes) BC.

Not all authorities however would agree with this limited "official" classification, some even going so far as to argue that all populations that have lived in isolation for thousands of years will have evolved differences in morphology (shape, colour, pattern, size) and feeding habits to warrant them each being regarded a separate subspecies. Three-spined sticklebacks show great morphological variation throughout their range and have elaborate breeding habits, social behaviours, and antipredator adaptations that evolve through natural selection in response to differing environments.⁴

Disagreements among authorities however don't end there. At what point does a subspecies become so distinct from another subspecies that it becomes a separate species? The Ernst Meyr test as to whether or not one form can interbreed with another is hard to apply when geographical isolation is complete. Trying to resolve the issue as to what specific genetic changes render it impossible for one form to interbreed with another has engendered great interest in species-pairs of three-spined sticklebacks. Species-pairs only exist in the world in a handful of lakes in BC.⁵ They are two forms of the three-spined stickleback that live in the same lake.⁶ Members of a

¹ SILT 8-10, <http://www.nickdoe.ca/pdfs/Webp530.pdf> The fall in that time (calendar years) was about 90 metres.

² The Coats Marsh shallow-water wetland is in the Hoggan Lake catchment area but there are no passages for fish between it and Hoggan Lake, and the wetland was drained for a few decades in the last century. So far, there is no evidence that it currently contains fish of any kind.

³ There are a few other *Gasterosteus* species found in other parts of the world but never here.

⁴ Hendry, A.P., Taylor, E.B., McPhail, J.D., *Adaptive Divergence and the balance between selection and gene flow: Lake and Stream Stickleback in the Misty System, Evolution*, 56(6), 2002, pp. 1199–1216.

⁵ Texada (4), Lasqueti (1, now extinct), and Vancouver Island near Nanoose Bay (1).

⁶ [*Stickleback Species Pairs*](#), BC Environment, Lands and Parks, ISBN 0-7726-7665-8, 1999.

species-pair are adapted to different niches within the lake, with corresponding changes in feeding morphology and defensive armor. The two “species” do not interbreed in the wild.

The benthic “species” of species-pairs feeds on invertebrates near the lake bottom and has a great reduction in the amount of body armor, spines are often reduced or absent, increased body depth, a dark mottled colouring that makes them difficult to see against the bottom vegetation, and a decreased number of gill rakers for filtering ingested food.

The limnetic “species” feeds on zooplankton in open water where they are more vulnerable to bird and fish predation. They are smaller and more closely resemble an ancestral marine fish, with more extensive body armor, a longer and more streamlined body, larger eyes, longer snouts and jaws, light-coloured bellies, silvery sides, and more numerous gill rakers.

There is no evidence that species-pairs exist on Gabriola; however, sticklebacks in Hoggan Lake have been identified as being benthic in nature, although not to the extent that they indicate phenotypic divergence into, as it were, half of a species-pair.^{7 8}

This lack of evidence of species-pairs in Hoggan Lake is disappointing because the lake has physical attributes that would make it a good candidate for hosting them. Its height above sea level, surface area, the length of its shoreline, and average depth closely match the averages for the six lakes along coastal BC that do, or once did, host species-pairs.⁹ Interestingly, all six of these lakes also host cutthroat trout but no other species of fish, while of sixteen other lakes selected because they too appear to be good candidates for hosting species-pairs, all too host cutthroat trout, but only one of the sixteen does not additionally host rainbow trout and/or prickly sculpins.⁸ Hoggan is known to currently host cutthroat trout, but the current status of rainbow trout is unknown since they were introduced in the 1920s and (bad news) still found to be present in 1972. There are however no known prickly sculpins (*Cottus asper*) in Hoggan Lake.¹⁰

While the likelihood of there being a species-pair population of three-spined sticklebacks on Gabriola is either zero or extremely low, it behoves streamkeeper observers to keep careful photographic records of any that they trap—just in case something interesting turns up. ◊

⁷ Di-Poi C, Lacasse J, Rogers SM, Aubin-Horth N (2014) [Extensive Behavioural Divergence following Colonisation of the Freshwater Environment in Threespine Sticklebacks](https://doi.org/10.1371/journal.pone.0098980). PLoS ONE 9(6): e98980. doi:10.1371/journal.pone.0098980.

⁸ E-mail conversation with Dr. Andrew Maccoll, November 2017. They are not so obviously deep bodied but have relatively few gill rakers.

⁹ Elevation (m): Paxton 88; Priest 75; Balkwill 61; HOGGAN 60; Enos 55; Hadley 50; Emily 23.
Area (ha): Priest 44.3; HOGGAN 19.7; Enos 17.6; Paxton 17.0; Balkwill 11.5; Emily 7.2; Hadley 6.7.
Shoreline (m): Priest 4400; Paxton 3500; Balkwill 2268; HOGGAN 2219; Enos 1440; Hadley 1130; Emily 1091.
Avg. depth (m): Balkwill 6.3; Paxton 6.2; Priest 5.4; Enos 4.0; Hadley 3.5; HOGGAN 3.0; Emily 3.0.
Data from: Steven Vamosi, *The presence of other fish species affects speciation in threespined sticklebacks*, Evolutionary Ecology Research, 2003, 5: 717–730.

¹⁰ *Fish Data*, <http://www.nickdoe.ca/pdfs/Webp678.pdf>