

Background

In this lab activity, you will be examining specimens of threespine stickleback (*Gasterosteus aculeatus*) from different lakes in Alaska. Today, we will examine fish from different populations, learn some ecological differences between the lakes, generate hypotheses as to how the ecology might affect the fish, measure several traits on the fish, and summarize these measurements using a combination of visualization and summary statistics.

Freshwater populations of threespine stickleback provide an excellent opportunity to study rapid and dramatic evolutionary responses to natural selection. Ancestrally, all lake populations have evolved from a large marine anadromous (meaning, swims to freshwater to breed) population. All of the lake populations you will examine today must have evolved from this marine population within the past 22,000 years, as glaciers covered the area before then.

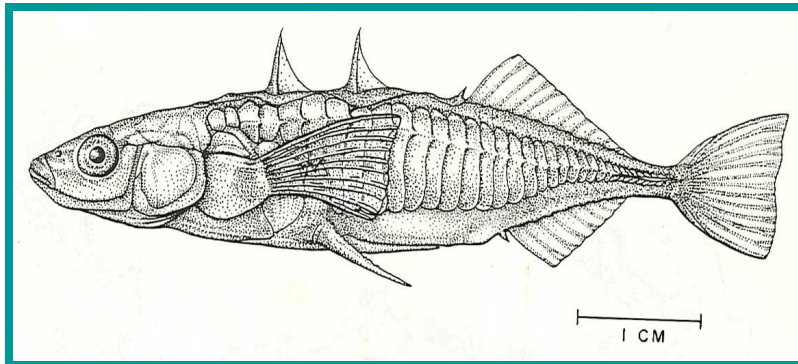


Figure 1: Example of a marine stickleback (courtesy of Dr. Matthew Travis, Rowan University)

Freshwater populations of stickleback look quite different from this marine individual, and many freshwater populations also differ from each other. For example, Figure 2 shows some of the differences that exist between freshwater populations, as well as between freshwater and marine populations. The marine population is in the center, and several different freshwater morphologies are arrayed around the outside.

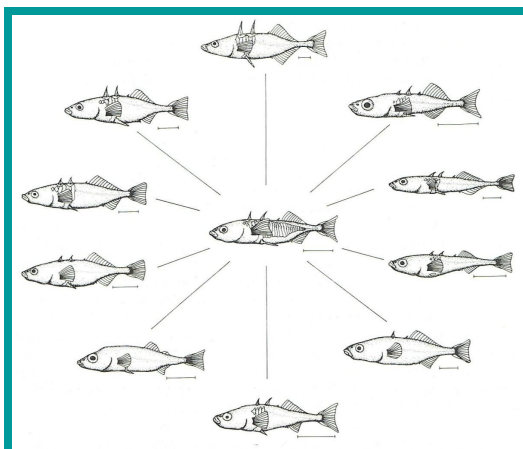


Figure 2: Adaptive radiation of freshwater threespine sticklebacks from a marine ancestor (Bell and Foster, 1994)

We will be examining several populations of preserved stickleback fish collected from glacial lakes in Alaska, and one population of marine stickleback fish. Importantly, *all lakes* have existed for <22,000 years, and therefore all lake fish populations have evolved from a marine ancestor in only this short time. Notably, Loberg Lake was only colonized much more recently (~30 years ago).

| Stickleback Population (lake name) | Lake information |
|------------------------------------|---|
| Rabbit (marine stickleback) | Marine environment with lots of large predatory fish |
| Bear Paw Lake | Shallow lake with <i>no</i> predatory fish |
| Corcoran Lake and Jim Lake | Shallow lakes with predatory fish |
| Loberg Lake | Shallow lake with predatory fish, only very recently colonized around ~1989 |
| Long Lake and Lynda Lake | Deep lakes with predatory fish |

Physical features of threespine stickleback

Using Figures 3-4 below, identify morphological features in your sample of marine stickleback:

Figure 3:

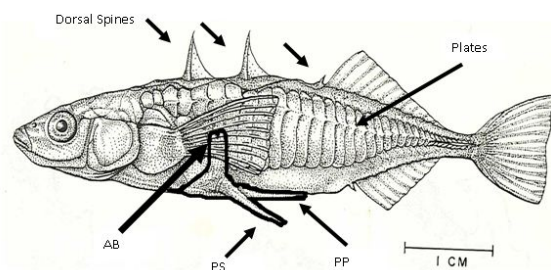


Figure 4:

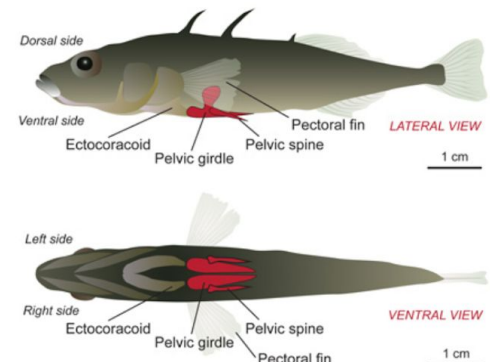


Figure 3: Marine stickleback with key morphological features. Labeled elements of the pelvic girdle include AB: ascending branch; PP: posterior process; and PS: pelvic

Figure 4: An improved view of the pelvic girdle from lateral and ventral views ([https://media.hhmi.org/biointeractive/vlabs/stickleback2\).spine](https://media.hhmi.org/biointeractive/vlabs/stickleback2).spine). (courtesy of Dr. Matthew Travis, Rowan University)

What are we doing today?

Several traits in which stickleback populations often differ include the following:

- The number of lateral plates
- Body depth
- Body length
- Pelvic girdle expression

In this lab, you will collect data on these four measurements and compare the populations in terms of these traits. **ONE person from each group should record all measurements directly in the class Google Sheet!**

Measuring the number of lateral plates

Lateral plates are located on the side of the body beginning just behind the head of the fish. The number of plates can differ on the left and right side of the body, so in order to make sure every group is measuring the same thing, count only the number of plates on the left side of the fish.

Measuring body depth

Body depth can be measured with calipers. Measure body depth just in front of the first dorsal spine (the one closest to the head of the fish). Do not squeeze the calipers - this will yield an inaccurate measurement!



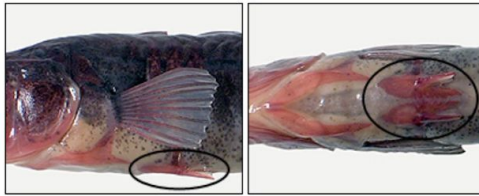
Measuring body length

Body length can be measured with calipers or with a ruler. Record your data in the provided Excel spreadsheet.

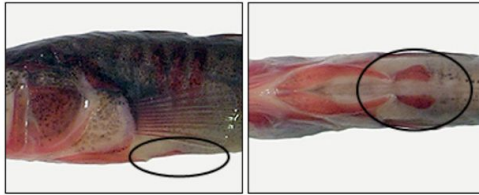
Measuring pelvic girdle expression

To measure pelvic girdle expression we will use the guidelines in the figure below. You should categorize each pelvis as **complete**, **reduced**, or **absent**. If you observe that fish differ on left/right sides, this is probably because a previous student has unfortunately broken a piece off. Defer to the more "complete" side!

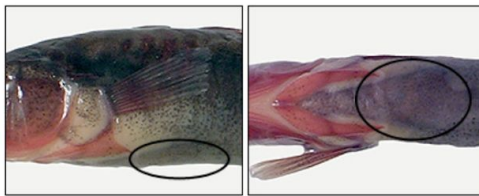
Complete: a pelvis with a full pelvic girdle and two pelvic spines. (Note that only the fish with a complete pelvis have pelvic spines.)



Reduced: a range of structures from a simplified girdle with no pelvic spines to an oval nub for a girdle.



Absent: no pelvic girdle and no spines.



<https://media.hhmi.org/biointeractive/vlabs/stickleback2>

Acknowledgements

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References

Bell, M.A. and Foster, S.A. 1994. The evolutionary biology of the threespine stickleback. Oxford University Press, Oxford, UK.

Bell, M. 1993. Stickleback Lake Information. unpublished data, compliments of Dr. Matt Travis, personal communication. October 2009. Rowan University.