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Fish out of water? Parasites and evolution in new environments

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Background - why sticklebacks?

The three-spined stickleback is a small fish common globally. While they are found in marine habitats they have also colonised freshwaters such as rivers, lakes and ponds. What makes them so interesting is their adaptations to these new environments, making them an excellent example of natural selection.

Marine stickleback population, North Uist, Scotland

Bony armour and parasites

One of the freshwater adaptations of the three-spined stickleback is a reduction in the number bony plates on the side of the fish (Fig.3). After much research in the field it was discovered that the EDA gene controls the number of these bony plates, and it is possible to determine the form of the gene the fish has from a DNA sample (Fig. 2).

What we are uncertain about is why this adaptation has taken place. Why is reducing armour in freshwater beneficial? One hypothesis is parasite pressure could be selecting for a lower number of bony plates.

Parasites are capable of causing loss of reproduction and mortality in fish, therefore if one plate morph were less susceptible to the effects of infection then it would be selected for.

Marine completely plated stickleback colonises freshwater

Freshwater stickleback population, Carsington Reservoir, Derbyshire

The study

A sample of sticklebacks were taken from Carsington reservoir in Derbyshire, which has a mix of plate morphs and screened for parasites by microscopy. The fish were then genotyped for the EDA gene as shown in Fig. 2.

Low plated stickleback

Partially plated stickleback

Completely plated stickleback

LL

CL

CC

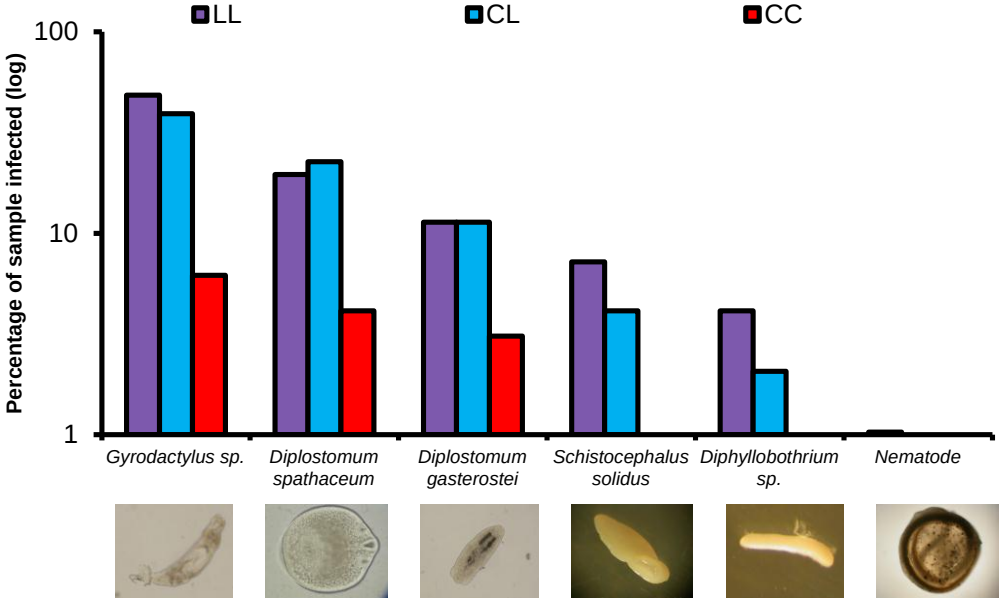

Fig.3 Distribution of parasite infections among the three plate morphs of the three-spined stickleback

Fig.1 Male three-spined stickleback

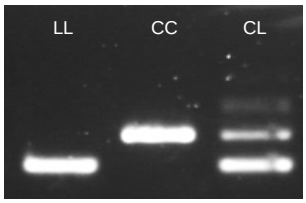

Fig.2 Gel electrophoresis bands formed by DNA from sticklebacks with each of the three forms of the EDA genotypes; LL low plated, CL partially plated, CC completely plated

Results

1. Most parasites were found to be evenly distributed between plate morphs (Fig.3).

This indicates that not all parasites may be a strong factor in natural selection of stickleback at this site.

2. Stickleback with the low plated (LL) genotype have more *Schistocephalus* infections (Fig.3).

This could indicate that survival is higher among these low plated fish, giving them an advantage over other genotypes and allowing them to evolve.

Future work

I will be doing a lab based experiment to test the responses of the three plate morphs to *Schistocephalus* infection.

This will allow me to see if this common parasite may be an agent of selection.

Drawings of sticklebacks adapted from: Bell, M.A. and Foster, S.A. *Evolutionary Biology of the Threespine Stickleback*, Oxford University Press, Oxford, 1994

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