



Invasion of the hybrids

The sticklebacks of coastal B.C. are ideal for studying natural selection in action – but now crayfish and crossbreeding are threatening to eliminate evolutionary scientists' favourite fish. **Elie Dolgin** reports

The threespine stickleback is found throughout the Northern Hemisphere, but in four lake systems off the Strait of Georgia in B.C., it exists in a unique form called “species pairs.”

Each lake contains its own species pair and all of them are descended from a single marine ancestor that appeared after the most recent ice age, 10,000 to 15,000 years ago. The pairs have not interbred since – which makes the stickleback an ideal subject for studying speciation in action.

Now, scientists are alarmed at the imminent disappearance of one species pair in Enos Lake near Nanoose Bay, B.C., where the fish are suddenly crossbreeding themselves into a single hybrid species – a development that is the virtual opposite of natural selection.

“Million-year-old species are a dime a dozen; 15,000-year-old species are not,” says Jenny Boughman, an evolutionary biologist at the University of Wisconsin-Madison who studies the B.C. sticklebacks.

The problem is an invasive crayfish, a lobster-like animal that is wreaking havoc on the Enos ecology by clear-cutting the vegetation at the bottom

of the lake, home to the tiny creatures that sustained the bottom-dwelling – or benthic – sticklebacks. The fish were forced to look for food and potential mates among the limnetic sticklebacks that live in the open water above.

After at least 10,000 years of separation, the species pair is now mingling – and interbreeding with a vengeance.

Don McPhail, a retired zoologist from the University of British Columbia, discovered the Enos Lake sticklebacks (*Gasterosteus* spp.) in 1974. In those days, the two stickleback species rarely interbred, and the most exotic creatures he ever found were red-bellied newts. “There were no crayfish then,” he says. “That’s for certain.”

Then, in the early 1990s, the American signal crayfish (*Pacifastacus leniusculus*) arrived in Enos Lake.

The crayfish, which is native to the B.C. mainland, was probably introduced into nearby lakes on Vancouver Island as fishing bait. From there, scientists believe, the crayfish crawled overland through wet grass into Enos Lake.

“With the loss of vegetation through the crayfish, there was little to hold those two distinct

populations apart,” says Ross Peterson, an aquatic ecologist in Nanoose Bay. “They began to interbreed simply because they found themselves in closer proximity to each other.”

In 2001, researchers from the University of Leicester in England, first reported an unusual abundance of hybrids in Enos Lake based on morphological – or body shape – evidence. In 2006, a UBC team led by zoologist Eric Taylor confirmed the findings using genetics.

“It’s just a total random mixture of genetic types,” Dr. Taylor says. “These two species are collapsing into a swarm of hybrids.”

Now, Mr. Peterson is spearheading an effort to remove all the crayfish in hopes of saving the sticklebacks. “Somewhere, there’s a possibility, however remote, that we might be able to turn the clock back and return the pure forms back in Enos Lake,” he says.

This summer alone, his team removed more than 25,000 crayfish from the lake, but he estimates that 100,000 more remain at large.

Even if Mr. Peterson’s team can successfully eliminate the crayfish, however, many scientists fear it might be too late to re-establish the original stick-

leback species pair.

Unlike hybrids in other undisturbed lakes, where maladapted intermediate species usually die off without reproducing, the Enos Lake hybrids are surviving and breeding successfully.

“There is no longer selection against hybrids,” Dr. Boughman says.

“It looks like there are no pure species left,” Dr. Taylor adds. Even if the original lake conditions can be reconstructed, “it will be really hard to put the pieces back together again,” he says.

The sticklebacks are now one of only around a dozen fish species listed as endangered under the Species at Risk Act, although each lake system species pair is listed separately because they all evolved independently of one another.

Comparing the different populations allows scientists to test the repeatability of natural selection.

Dolph Schluter, a UBC evolutionary biologist, analyzed the stickleback species from Enos Lake before the crayfish’s arrival together with species pairs from two other lake systems, and showed that parallel adaptations occurred in all three cases under similar ecol-

ogical conditions.

“We’re often left studying events in nature that have happened only once,” Dr. Schluter says. “But here, similar species were arising again and again.” Thus, the loss of the Enos Lake species pairs may be devastating for biological research. “Each of the pairs is important in and of itself,” Dr. McPhail notes.

There is a silver lining, however. The Enos Lake hybrids’ muddled genetics are making it easier to find new genes. For example, Dr. Boughman and her colleagues used the hybrids to identify five regions of the genome that underlie male stickleback colour patterns. “It’s a conservation catastrophe,” she says, “but it’s also a scientific opportunity.”

The Enos Lake sticklebacks are probably a lost cause, most scientists admit. Still, Mr. Peterson thinks that a valuable lesson can be learned from his team’s recovery efforts.

“This should redouble people’s efforts to keep invasive species, such as crayfish, out of those lakes, because we now know that it may be practically impossible to get rid of them once they’re there.”

» Elie Dolgin is a science writer and broadcaster in Philadelphia.



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ABOVE: This male limnetic stickleback descended from a single marine ancestor that appeared 15,000 years ago.
ERNIE COOPER