

Understanding how fish grow their hearts could help humans, professor finds

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It's already known some fish have big hearts - at least during the winter.

Now a U of G professor has identified a protein that enables fish to change the size of their hearts based on the [temperature](#) of the water.

The finding might yield clues to treating or preventing heart damage in humans.

"Fish put on collagen in the winter and take it off in the summer," said Todd Gillis, whose study, conducted with PhD student Elizabeth Johnston, was recently published in the *Journal of Experimental Biology*. "They do this so they can keep swimming over a broad range of temperatures."

Understanding how fish are able to add and remove collagen is important because fish hearts and human hearts are similar in composition, said Gillis, a professor in the Department of Integrative Biology.

When our heart becomes injured from a heart attack or other stressor, the body responds by building a scar, composed of collagen, in the damaged area. This scar is permanent and impairs cardiac function, eventually resulting in heart failure.

"If we can find out how fish are able to naturally add and remove this tissue we can develop treatment modalities for humans that enables a more controlled way for the heart to repair itself after a [heart attack](#)," said Gillis.

Johnston examined the cells in rainbow trout hearts that are responsible for regulating collagen. They exposed the cells to the protein TGF-Beta1, known to be a signal for regulating connective tissue in humans.

"The hypothesis is that the drop in temperature increases blood viscosity and this makes the heart work harder, leading to an increase in the release of the TGF-Beta1 protein," said Gillis.

Laboratory tests confirmed that exposing the fish heart cells to TGF-Beta1 protein did lead to an increase in the production of collagen.

Previously, work in Gillis' lab demonstrated that rainbow trout are able to increase their heart size by as much as 50 per cent their normal size in colder temperatures. The heart will remain larger and stronger in water that is around 4C and return to normal size at temperatures between 12 and 17C.

Trout, salmon and a number of other of fish that remain active in the water throughout the year also have this ability, added Gillis.

Gillis and a team of researchers are now focused on the next step which is determining how [fish](#) are able to remove the collagen from the heart in the warmer months.

"This work is targeting molecular pathways involved in regulating collagen degradation pathways. The ultimate goal is applying what we learn in trout hearts to cardiac fibrosis in humans so that we can help control or reduce this response to injury."

More information: Elizabeth F. Johnston et al. Transforming growth factor beta-1 (TGF- β 1) stimulates collagen synthesis in cultured rainbow trout cardiac fibroblasts, *The Journal of Experimental Biology* (2017).
[DOI: 10.1242/jeb.160093](https://doi.org/10.1242/jeb.160093)

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