Warmer and murkier waters favor predators of guppies, study finds

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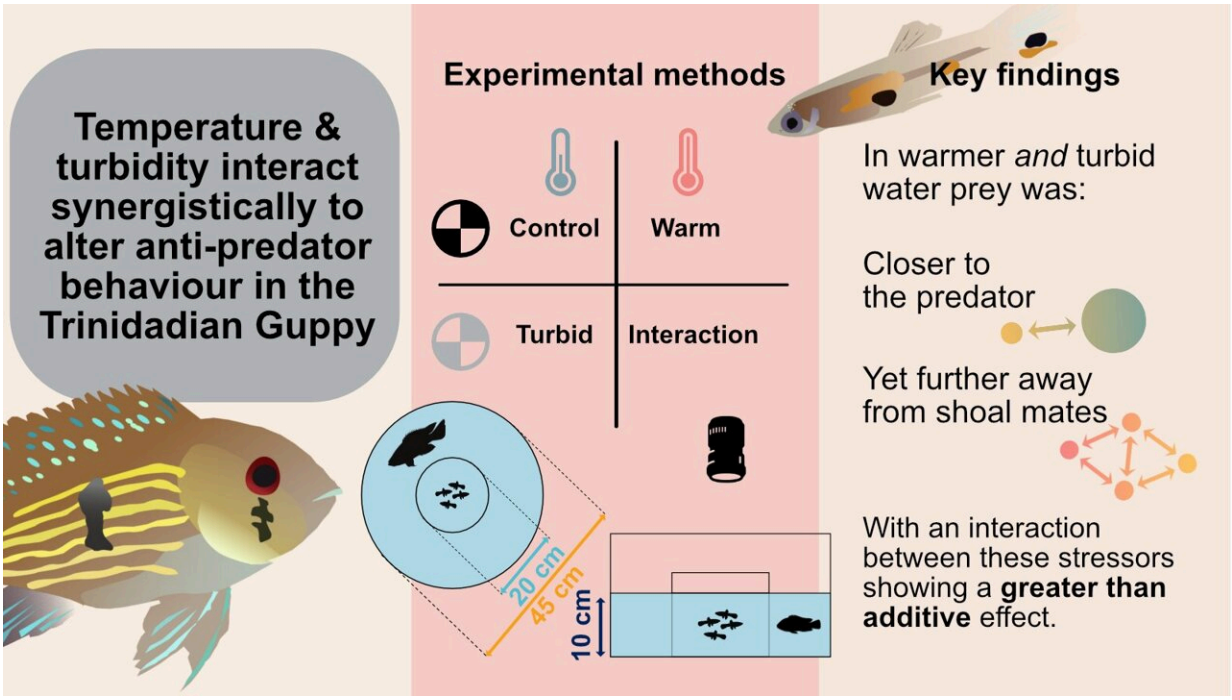

Visual abstract showing guppy interactions. Credit: Costanza Zanghi

Changes in water conditions interact to affect how Trinidadian guppies protect themselves from predators, scientists at the University of Bristol have discovered.

Known stressors, such as increased temperature and reduced visibility, when combined, cause this fish to avoid a predator less, and importantly,

form looser protective shoals.

The findings, published today in the journal *Proceedings of the Royal Society B*, show guppies' responses are more affected by the interaction of these stressors than if they acted independently.

Natural habitats are facing mounting environmental challenges due to human activities such as land use changes, exploitation and climate change.

Lead author Costanza Zanghi from Bristol's School of Biological Sciences, explained, "Of all the possible environmental parameters that can stress a system, we decided to focus on increased temperature and water turbidity because previous research has shown that visual animals, like most fish, are greatly affected by them.

"We know that warmer water affects fish swimming ability and hunger levels, and we also know that increased turbidity, such as haziness, can change how visual predators and prey interact with one another.

"In this research we wanted to take these common stressors, which are known to be increasing in freshwater habitats globally, and see how visual fish would respond to one another when they are subject to these stressors at the same time.

"This is important and novel because sometimes, especially when multiple stressors modify similar behaviors in different ways, the overall outcome can be very different from what is shown by studies where only one stressor is tested. That's because these stressors can interact in unpredictable ways."

The team observed the reciprocal responses between a predator and a shoal of prey under four treatments, optimal housing conditions (as a

control), and in treatments where either temperature or cloudiness of water was increased. They were then tested with an interaction treatment where both temperature and turbidity were increased at the same time.

This took several weeks of trials in the lab involving 36 predators and 288 prey fish. The animals were separated so they did not come to any harm.

All the video recordings were then processed to obtain fine scale movements of all the fish so that the researchers could calculate the swimming speeds of all fish and how they related to one another: how close together the prey stayed and how far from the predator each prey tried to remain.

Co-author Milly Munro, who joined the Ioannou Group specifically for this project said, "The opportunity to be involved in this study with the team was a great experience, and I am grateful having been awarded ASAB's Undergraduate Scholarship funding. Designing and running the research alongside Costanza and the team was brilliant as my first academic research experience. I learned a lot of valuable skills and insights into what it takes to produce and conduct a study of this kind, all I gained from this experience has truly aided me in current and future projects."

Zanghi said, "Incorporating multi-stressors in such experiments enhances the ecological relevance and applicability of findings.

"In natural environments, organisms rarely experience isolated stressors but rather face complex combinations of stressors. By investigating how organisms respond behaviorally to these realistic scenarios, the research becomes more applicable to conservation and management efforts.

"It provides insights into how organisms may cope with and adapt to

multiple stressors, aiding in the development of effective strategies for mitigating the negative impacts of environmental change."

Now the team plan to test whether the decrease in anti-predator behavior is as negative for the prey as it may seem and not a clever adaptation to allow prey fish to worry less about predators in an environment that keeps them safe. By using a wider range of predators, they will also investigate whether these changes can affect multiple species differently.

Zanghi concluded, "This study is exciting as it introduces crucial ecological complexity in the context of predator-prey interactions.

"By incorporating additional stressors and specifically testing the potential interactions between these factors, this study significantly contributes to our understanding of the dynamics between prey and their predators in a rapidly changing world."

More information: Costanza Zanghi et al, Temperature and turbidity interact synergistically to alter anti-predator behaviour in the Trinidadian guppy, *Proceedings of the Royal Society B: Biological Sciences* (2023). DOI: 10.1098/rspb.2023.0961. royalsocietypublishing.org/doi …/10.1098/rspb.2023.0961

Provided by University of Bristol

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