SECOND PLACE WINNER: STUDENT WRITING CONTEST

What Doesn't Kill Fish Doesn't Necessarily Make Them Stronger: Understanding the Long-term Population Consequences of Stress

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When considering human impacts on freshwater ecosystems, the adage, "What doesn't kill you, makes you stronger" can be reversed; sublethal stressors have lasting impacts on the health of individuals and the dynamics of populations. In order to prevent human activities from depleting fish populations, we need to accurately predict the effects of stress. From the chemical runoff of a factory to the noise of a cottager using an outboard motor, fish experience a wide range of stress as a result of human activity. These stressors may not directly kill a fish, but they can cause a myriad of other problems, such as reducing the ability to escape predators or to acquire food. The effects of stress on an individual fish have been measured extensively, but extrapolating these effects to a population remains one of the biggest challenges in ecological research.

To illustrate the complexity of the problem, imagine a watershed that has recently been developed. To determine the effect on trout, many variables can be measured: chemical levels in the water, the effect of these chemicals on trout in a laboratory, or capturing minnows at the site and comparing their numbers and health to minnows from an undeveloped site. However, to definitively state that the population was affected by the development using traditional methods, it would be necessary to have before and after comparisons of the same population within the river, as well as comparisons between populations at multiple developed and undeveloped sites. As a consequence of the financial and logistic difficulties involved with conducting studies of this scale, the effects beyond the individual are rarely determined.

Using hormone manipulation techniques that have previously been reserved for the laboratory, my research investigates the long-term population effects of stress in wild freshwater fish in their natural environment. In fish, as in humans, any stressor will elevate cortisol, the primary stress hormone. This in turn is correlated with a whole suite of effects that range from changes in immune function to changes in behavior. By using an injection of cortisol, it is possible to stress fish in a standardized manner. The results can then be applied to any stressful situation; changes in water flow or quality, habitat degradation, or any unpredictable disturbance will all cause elevations of cortisol.

For my research, I used largemouth bass as a model to look at how a short-term stress can have long-term impacts in a population. I injected cortisol into a group of largemouth bass in a closed freshwater lake. I am directly comparing the growth, reproductive activity, and survival of the stressed individuals to unstressed fish in their natural environment. Since the stressed and unstressed fish are in the same lake, under identical conditions, any effects I see will be due to stress, rather than an effect of other uncontrollable environmental factors.

I gave the "stressed" fish a cortisol injection that caused them to be stressed for five days in the early summer, and then recaptured both stressed and unstressed fish in the fall, measured them, and took blood samples. In the fall, there was no delayed mortality as a result of the five-day stress. However, the short-term stress was sufficient to reduce growth throughout the summer, and stressed fish had lower reserves of stored energy than unstressed fish. In the spring, I will again recapture these fish, take measurements and blood samples, and monitor reproductive activity. I would like to know whether the fish are able to recover from the stress by the spring, or if their growth and body condition are still affected. I will discover whether relatively short-term exposure to a stressor in early summer can cause increased over-winter mortality, and decreased reproduction the following spring.

Human activity will inevitably stress fish. However, the negative impacts of stress can be managed if we have comprehensive knowledge of how stress affects wild fish. My research will contribute by providing an understanding of the long-term consequences of stress on a wild population of fish. My hope is that ultimately, this understanding will be translated into more effective conservation methods. With knowledge of the consequences of our actions, we can ensure that fish populations stay strong, and our freshwater ecosystems recover and persist.