

## Pollution Affects the Personality and Cognition of Fishes

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A recent review shows how vulnerable fishes are to environmental contaminants. There's a lot going on beneath the surface that has major effects on fishes, other animals, and ecosystems.

I recently read a fascinating and important research essay by Université Toulouse III Paul Sabatier's [Dr. Lisa Jacquin](#) and her colleagues published in *Frontiers in Ecology and Evolution* called "[Effects of Pollution on Fish Behavior, Personality, and Cognition: Some Research Perspectives](#)." It's well known that fishes are highly diverse sentient and intelligent beings who also display [various complex personalities](#) and large individual differences in how they respond to [stress](#). This paper clearly shows that fishes are far more than mere edible streams of protein who don't mind being cooped up in a small barren aquarium. The essay is available online for free, so here are a few snippets to whet your [appetite](#) for more.<sup>1</sup>

— A review of earlier work shows that pollutants can affect cholinesterase activity, neurotransmitter, or [hormone](#) levels. For example, "Fluoxetine [antidepressant](#) (Prozac) alters [aggression](#), boldness and learning in the Siamese fighting fish *Betta splendens* by altering the serotonin system."

— Pollution affects activity, exploration, and avoidance. The researchers write, "Such impaired exploration tendencies could in turn affect fish ability to assess habitat quality, because exploration is a key trait enabling individual to gather information and cues about their environment."

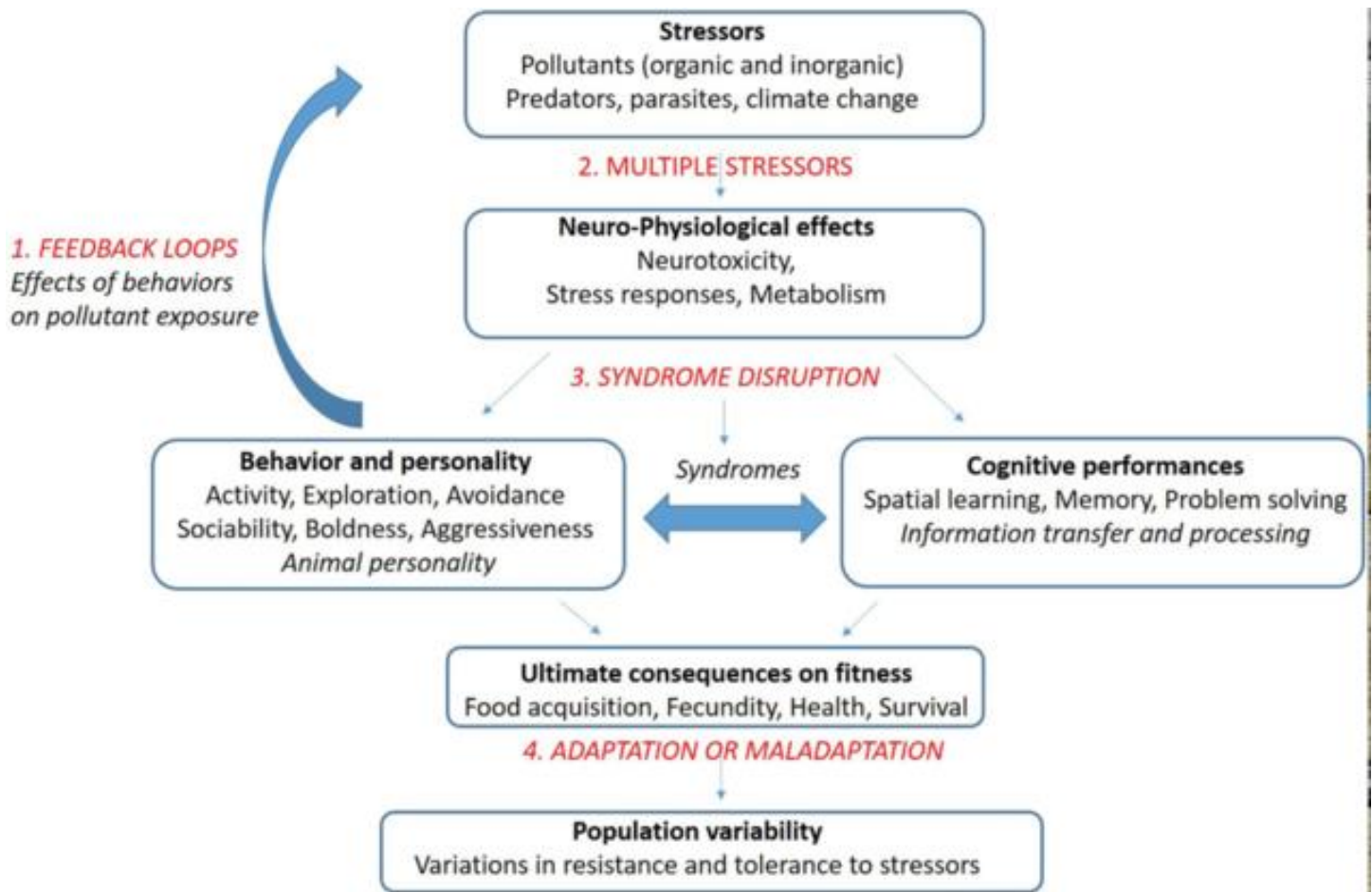
— Organic pollutants such as pesticides have serious cognitive effects and may affect fishes "ability to learn and memorize information to escape predators, find food and mates, and to avoid polluted areas and food items. Contaminated fish could thus have difficulties to collect, process and memorize information about habitat and food quality, which might further affect their exposure to pollution and result into positive feedback loops."

— Pollution affects fishes' boldness, appetite, and patterns of foraging.

— Pollutants can increase fishes' vulnerability to predation by impairing their ability to perceive alarm cues.

— Local populations may adapt to the presence of environmental poisons and this might lead to within-species variations among fishes who live in different locales.

As shown in the figure below, the authors emphasize the importance of taking a *multistress perspective* that studies the relationships among ecotoxicology, cognitive ecology, and evolutionary ecology.



Potential links between pollution, behavior and cognition, and proposed research perspectives (in red).

All in all, "pollution-induced alterations of exploration, sociability, [memory](#), learning, appetite, boldness, and foraging could potentially in turn amplify fish exposure to environmentally or dietary contamination, and generate positive feedback loops." Thus, there can be significant influences on the fitness of fishes.

"Effects of Pollution on Fish Behavior, [Personality](#), and [Cognition](#): Some Research Perspectives" is packed with numerous examples and I highly recommend it not only to people with a special interest in fishes, but also to those who want to get a good handle on how pollution can have diverse effects on many different patterns of behavior, personality, and cognitive capacities in a wide variety of other animals.

The researchers conclude, "With this study, we hope to encourage future studies to use integrative approaches bridging the gap between behavioral, cognitive and evolutionary ecology to tackle these challenging questions and to better understand the impacts of current and future stressors on wild fish populations."

As we head into a future in which environmental pollution is surely going to have major widespread and damaging effects in the air, on land, and beneath the surface, the data and ideas contained in this landmark essay must be applied to other nonhuman animals, including those we don't routinely see or dismiss as unfeeling objects. Understanding how we poison other animals and their homes is among the most important projects facing conservation and evolutionary biologists and environmental scientists. I look forward to writing more on this topic.

References

Note 1) For convenience and for those who can't easily get online, the abstract reads as follows:

"Pollutants, and more generally, environmental stressors, are a neglected source of behavioral and cognitive variations in wild populations. Based on recent literature in fish, we highlight four interesting research perspectives to better understand the effects of pollutants on the links between fish behavior, cognition and fitness. First, (1) we review the neurotoxic effects of pollutants on fish behavior, personality, and cognition. These behavioral and cognitive effects could in turn affect the level of exposure to pollutants, potentially generating feedback loops that may amplify the effects of pollutants on fish fitness. Second, we propose that (2) the effects of pollutants should be studied in a multistress context, i.e., in realistic environmental conditions in combination with other stressors, because some stressors could amplify the behavioral effects of pollutants on fitness. Third (3), existing studies show that physiology, personality, cognition, and fitness components are often linked in syndromes. Pollutants could lead to syndrome disruption, which could affect the evolutionary trajectories of exposed populations. Future studies should thus focus on the complex links between traits to better understand the consequences of stressors on evolutionary trajectories. Fourth, (4) exposure to chronic pollution could lead to local adaptation or maladaptation, which could result into high intraspecific variability of sensitivity among wild populations. In addition, evolutionary responses to pollution could constrain, or be constrained by evolutionary responses to other stressors. We thus encourage future studies to use integrative approaches to bridge the gap between ecotoxicology, cognitive ecology and evolutionary ecology in a multistress framework to tackle these exciting questions and improve our ability to predict the effects of anthropogenic stressors on wildlife."

- Bekoff, Marc. [A Tribute to Dr. Victoria Braithwaite and Sentient Fishes.](#)
- \_\_\_\_\_. [Manta Ray Fishes Make Friends—and It's Not Very Surprising.](#)
- \_\_\_\_\_. [It's Time to Stop Pretending Fishes Don't Feel Pain.](#)
- \_\_\_\_\_. [Fishes Show Individual Personalities in Response to Stress.](#)
- \_\_\_\_\_. [Fish Feel Pain: Let's Get Over it and Do Something About It.](#)
- \_\_\_\_\_. [Fish Smarts: Why Fish Are More Than Just Streams of Protein.](#)