

Effects of a pesticide and a parasite on neurological, endocrine, and behavioral responses of an estuarine fish

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ABSTRACT

In coastal waters, pesticides and parasites are widespread stressors that may separately and interactively affect the physiology, behavior, and survival of resident organisms. We investigated the effects of the organophosphate pesticide chlorpyrifos and the trematode parasite *Euhaplorchis californiensis* on three important traits of California killifish (*Fundulus parvipinnis*): neurotransmitter activity, release of the stress hormone cortisol, and behavior. Killifish were collected from a population without *E. californiensis*, and then half of the fish were experimentally infected. Following a 30 day period for parasite maturation, infected and uninfected groups were exposed to four concentrations of chlorpyrifos (sol-vent control, 1–3 ppb) prior to behavior trials to quantify activity, feeding behavior, and anti-predator responses. Water-borne cortisol release rates were measured non-invasively from each fish prior to infection, one-month post-infection, and following pesticide exposure. Killifish exposed to 3 ppb Chlorpyrifos exhibited a $74.6 \pm 6.8\%$ and $60.5 \pm 8.3\%$ reduction in brain and muscle acetylcholinesterase (AChE) activity relative to controls. The rate of cortisol release was suppressed by each chlorpyrifos level relative to controls. Killifish exposed to the medium (2 ppb) and high (3 ppb) pesticide concentrations exhibited reduced activity and a decrease in mean swimming speed following a simulated predator attack. Muscle AChE was positively related to swimming activity while brain AChE was positively related to foraging behavior. No effects of the parasite were observed, possibly because of low metacercariae densities achieved through controlled infections. We found that sublethal pesticide exposure has the potential to modify several organismal endpoints with consequences for reduced fitness, including neurological, endocrine, and behavioral responses in an ecologically abundant fish.

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