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THE COMPLEX ECOLOGICAL IMPACTS OF MULTIPLE ANTHROPOGENIC STRESSORS

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Ecosystems are affected by many anthropogenic activities. Streams, for example, are affected worldwide by nutrient enrichment, inputs of sediment and pesticides, raised water temperatures, reduced discharge due to water abstraction for irrigation, and the introduction of invaders. Each of these stressors can be expected to exert individual effects on stream community composition and ecosystem functioning, but their combined impacts are poorly known. We have studied key stressors in pairs and triplets to determine their individual and combined effects. Each stressor had strong individual effects, but in combination they often produced synergistic or antagonistic outcomes. For example, the presence of fine sediment (from erosion in the catchment) can prolong the adverse effects of herbicide in streams. Moreover, the reduced flow associated with water abstraction often acts synergistically to increase the negative impact of sediment on the bed. In contrast, water abstraction acted antagonistically to decrease the adverse impact of invasive trout on native fish by providing refuges from trout predation. The ecological consequences of multiple stressors are often unpredictable on the basis of knowledge of single effects. Our findings imply that unless resource managers know how stressors interact, their assessment of risk may be higher or lower than reality.