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Understanding the Invasion Ecology of Exotic Crayfish in California

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Background

If ecologist Lee Kats of Pepperdine University had his way, every last Louisiana red swamp crayfish that has invaded California would be made into the world's largest crawfish etouffee and served piping hot to whoever would eat it.

The Louisiana red swamp crayfish—yes, the same one that is a centerpiece of Cajun cuisine—is a pest species here in the Golden State, unwanted because it is elbowing out native crayfish, snails, salamanders and frogs. Think of it as the Viking of the crayfish world—hearty, strong and aggressive, especially on foreign soil.

Some non-native crayfish were probably introduced by anglers, who use the crustaceans as bait. Some blame likely also rests with crayfish aquaculture. That is, scientists believe that some non-native crayfish now thriving in the state's streams are descendents of escapees of aquaculture.

Project

Kats and colleague Andy Sih of UC Davis studied the invasion ecology of red swamp crayfish (*Procambarus clarkii*) and signal crayfish (*Pacifastacus leniusculus*), another exotic species that seems to out-compete native ones.

Their goals were 1) to identify ecological factors favoring the crustaceans' spread and 2) to evaluate their impacts on stream communities via predation and competition with native benthic invertebrate species.

The research consisted of field experiments along streams in Southern and Northern California, as well as controlled experiments in an outdoor, semi-natural stream, housed at the Center for Aquatic Biology and Aquaculture at UC Davis.

This data, where applicable, were paired and/or compared with GIS-maps of watershed characteristics, indicating dominant land-use, land-cover, drainage and stream gradient. The idea was to examine whether certain human activities or land-use patterns might influence the observed distribution of crayfish, both native and non-native.

Results

During their fieldwork, the scientists observed that the absence of both snails and native crayfish was a good indicator that the habitat would not be suitable for signal crayfish either. Crayfish eat (read: love to eat) snails. They cannot survive without snails. Native and non-native crayfish require remarkably similar environmental conditions, given the differences in their native landscapes, the scientists said.

Snail densities are often a limiting factor for spread of signal crayfish. Snails are the best predictor of which streams are least vulnerable to invasion.

Vertical physical barriers (e.g., steep gradients in the elevation of a stream bed, waterfalls and culverts) are also effective at limiting their spread.

Yet another important factor is the amount of land developed in a watershed. When development exceeds 8 percent of the total area, the number of invasives jumps significantly. Kats called this finding "mind blowing" as it implies that the human footprint is usually a size EEE. There is an intrinsic challenge in co-existing with native crayfish, surprising given their small size, he said.

Invasive crayfish were observed to reduce abundances of benthic invertebrates more than native crayfish – locally and in the number floating downstream. *(continued)*

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Not surprisingly, the greater the density of crayfish, the greater the impact on benthic populations. Regardless of crayfish density, however, their per capita prey consumption was relatively constant.

Crowding was observed to lead to aggressive behavior among crayfish. Aggression was also correlated with greater activity, which scientists suspect would stimulate the animals' movement to new areas and hence further their spread.

In experiments in which the scientists removed invasive crayfish from an area, native species were observed to return, in the short term. In the long term, Kats said, it is likely exotics would re-infest the area and thus re-suppress native communities.

Prevention is the key. Eradicating established populations of invasive crayfish may be impossible.

Collaborator

National Park Service

Students

Laura Jones, B.S. Biology, Pepperdine
Lauren M. Pintor, Ph.D., Ecology, UC Davis

Presentations

Pintor, L.M. & A. Sih. Density versus per capita impacts of an invasive crayfish in stream communities. August 2005, Ecological Society of America, Montreal, Quebec, Canada.

Pintor, L.M. & A. Sih. Variation in aggression level influences behaviors underlying impacts of an invasive crayfish. August 2004, Ecological Society of America, Portland, OR.

Watters, T. S., L. H. Jones, S. M. O'Hare, M. A. Kerby, and L. B. Kats. Seasonal removal of invasive stream predators to protect sensitive amphibian populations. August 2004, Ecological Society of America, Portland, OR.

Pintor, L.M. & A. Sih. Interpopulation variation in behavior and growth underlying geographic differences in species interactions of an introduced crayfish. August 2003, Ecological Society of America, Tucson, AZ.

Pintor, L.M. & A. Sih. Interpopulation variation in behavior and growth underlying geographic differences in species interactions of an introduced crayfish. August 2003, Ecological Society of America, Tucson, AZ.

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