

Seeing the trees for the forest: Getting interdisciplinary at the small scale

IF ONLY HUMAN INVASIONS COULD BE SO HUMANE.

When the invasive crab species *Hemigrapsus sanguineus*, the Asian shore crab, first landed on the New England shore in the late 1980s and nestled into patches of Atlantic cordgrass (*Spartina alterniflora*) and beds of ribbed mussels (*Guekensia demissa*), there was seemingly little commotion among the native biodiversity. After causing initial concern among biologists with its “high abundance and voracious omnivorous diet,” the crab thrived, reaching population density levels even higher than in Asia—all without damaging the native environs. Here is perhaps where the average invasive species study would begin to wrap up. The invasive species’ relationship to the native biodiversity would be labeled “positive,” conclusions would be drawn, papers would be written, and resource managers would scratch their heads. Altieri et al. (2010), however, argue that the context for such a study, and for many other landmark experiments, is not nearly interdisciplinary enough to warrant ecological significance.

As any cinematographer worth his or her salt will tell you, careful composition of an establishing wide shot will only improve the clarity, drama, and visual punch of the subsequent zoom-in. And as any ecologist will tell you, extending a study’s perspective beyond a single species’ taxonomic group and particular position in the food chain may lead to more composite data about a landscape.

Altieri et al. (2010) discovered that native cordgrass acted as a foundational species, providing a quality habitat for Asian crab by offering protection from the sun and predators and by providing abundant invertebrate food sources. Moreover, the cordgrass reduced solar stress on mussels and provided an area for mussels to harden the substrate, creating a habitable and shady environment for nonnative crabs and native species alike. Thus, cordgrass was at the core of a facilitation cascade. The authors use the invasion of the Asian shore crab on intertidal New England cobble beaches to examine how single-variable invasive species studies can create

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inconsistencies when resource managers draw large-scale conclusions from small-scale observations.

Using a multitrophic (multiple–food web) approach, Altieri et al. (2010) observed this facilitation cascade, manipulating the native biodiversity to discover its connection to invader population densities. The investigators clipped the cordgrass canopy, reducing shade, shelter, and the stability of the substrate, in order to tease out their separate and interactive effect on densities of Asian shore crabs and the species richness of native organisms. The mussels were also clipped and removed, and the resulting thermal stress and substrate instability were observed. In a crab-tethering experiment, casualties were kept to a minimum. Several crabs were tied down away from cordgrass and left to fend for themselves so that the investigators could study the effects of solar stress, predation, and other causes of mortality.

The findings indicate nonnative Asian shore crabs thrived in areas of high native biodiversity, where the grass was long and green, and where there were mussels; crabs did not thrive in areas where grass and mussels were removed. The authors met their objective to test the hypothesis that a facilitation cascade in cordgrass beds enhances both native diversity and invader abundance, while addressing the inconsistencies that can occur when using small-scale studies to draw large-scale conclusions.

As a result of the experiments, the authors argue that large-scale invasion relationships can be better understood by observing interactions across multiple trophic levels. In particular, facilitation cascades, which too often play “an important but unrecognized role,” can “drive patterns of biodiversity, invasive species, and the diversity-invasion relationship.”

The authors encourage future research to prioritize conservation efforts by identifying the foundational species that mediate large-scale patterns of community diversity and invasion in natural ecosystems.

Reference

Altieri, A. H., B. K. Van Wassenbeeck, M. D. Bertness, and B. R. Silliman.
2010. Facilitation cascade drives positive relationship between native
biodiversity and invasion success. *Ecology* 91(5):1269–1275.

—Jonathan Nawn and Amy Stevenson