Invasions as consequences of change: examples from the Californias

Jeffrey Crooks[1], Julio Lorda[2], Kellie Uyeda[1], Justin McCullough[1], Monica Almeida[1], Melissa Belen-Gonzalez[3,1]

1: Tijuana River National Estuarine Research Reserve, USA.
2: Universidad Autónoma de Baja California, Mexico.
3: San Diego State University, USA.

Biological invasions can be viewed as both causes and consequences of environmental change. While there has been considerable focus on the means by which invaders change ecosystems, invasions as indicators of change has received somewhat less attention. Most generally, anthropogenic invasions result from fundamental changes in the manners by which species move around the globe. Also, "natural" range expansions might be viewed as a consequence of change, especially when driven by climate factors such as warming. Climate change, as well as smaller-scale changes in environmental conditions due to factors such as habitat degradation and pollution, also are likely to influence invader success with ecosystems. The coastal waters of California, USA, and Baja California, Mexico, provide examples of both natural and anthropogenic invasions that highlight various ways in which invaders can be viewed through the lens of changing ecosystems. These include responses to large-scale climate factors and extreme events, such as El Niño, as well as local effects due to urbanization and disturbance. Examination of these invasions provides insight into drivers of change and offers opportunities to preview potential consequences of further human alteration to ecosystems.

Presenting author: Jeffrey Crooks. E-mail: jcrooks@trnerr.org

Management of the invasive oyster drill *Urosalpinx cinerea* to improve native oyster (*Ostrea lurida*) restoration outcomes: field experiments in San Francisco Bay

Chela Zabin[1], Brian Cheng[2], Jeffrey Blumenthal[1], Andrew Chang[1], Karina Nielsen[3], Sarah Ferner[4], Matthew Ferner[4], Gregory Ruiz[1]

1: Smithsonian Environmental Research Center, USA.
2: University of Massachusetts at Amherst, USA.
3: Estuary & Ocean Science Center, San Francisco State University, USA.
4: San Francisco Bay National Estuarine Research Reserve, USA.

The Atlantic oyster drill *Urosalpinx cinerea* is found in San Francisco Bay (CA, USA) and other estuaries along the west coast of the US, where it presents a hurdle to restoration of the native oyster *Ostrea lurida*, and impacts a suite of other intertidal species. We engaged community scientists in two experiments testing potential methods for managing this invader: functional eradication and using tidal elevation to reduce predation. The goal of functional eradication for a non-native species is to reduce its population density to levels that have negligible-to-low impacts on native species. The Atlantic drill has several traits that indicate this approach may be successful: 1) benthic egg capsules from which crawl-away juveniles emerge; 2) a predictable reproductive period based on water temperatures; 3) low adult dispersal. In 2017 and 2018, ~300 community members helped remove 29,000 snails from two sites. At one site, we recorded a decrease in catch per unit effort (CPUE) over sequential removal efforts each year, and a decline in drill densities in the removal plot compared to a control plot. CPUE did not decline at the second site, but drill densities had decreased in the removal plot by spring 2018. A field experiment in summer 2018 will determine whether oyster survival is improved in the removal plots compared with control plots. In 2017, surveys of 10 sites in San Francisco Bay indicated differences by tidal elevation in oyster recruitment and survival on experimental tiles, and in adult oyster and oyster drill densities and distribution on the shoreline. In an earlier pilot study, we found drill abundance decreased and oyster survival increased on tiles placed at +40 cm MLLW compared with +70 cm. A field experiment in summer 2018 will test oyster survival at three tidal elevations at our functional eradication control sites.

Presenting author: Chela Zabin. E-mail: zabinc@si.edu