Settlement in fouling communities of San Francisco Bay at varying time intervals

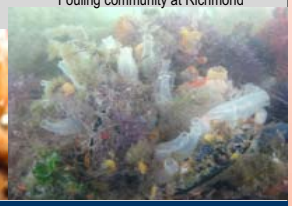
Jacqueline Hill[1, 2] and C. Sarah Cohen[2], California State University Fresno[1], Romberg Tiburon Center[2]

Abstract

Settlement among native and invasive marine organisms in fouling communities was observed at various time intervals in the San Francisco Bay. Many of these well-known, globally invasive organisms grow rapidly and often outcompete or overgrow natives. Settlement plates were placed at three different protected areas within the Bay (Richmond Marina Bay Yacht Club (1), Berkeley Marina (2), and Fort Baker (3)) and scored once a week for 5 weeks. The two larger East Bay sites (1 and 2) showed considerably greater species diversity and abundance in comparison to the smaller site near the mouth of the Bay (site 3). Furthermore, at the Easy Bay sites, algal cover gradually decreased as animal diversity and abundance progressively increased. Species including *Didemnum sp., Balanus glandula, Watersipora subtorquata*, white encrusting bryozoan, and white branching bryozoan showed significant settlement differences in initial recruitment density on empty plates deployed in the 1st versus the 3rd week. Recruitment on the plates appeared to show a priority effect where the earliest settlers (colonial tunicates and *Bugula neritina*) were consistently the most abundant species present each subsequent week. Measuring the growth and abundance of the invasive organisms is important to study because they are altering the habitats and opportunities for native organisms to persist.

Colonial tunicates growing on mussels.

Fouling community at Richmond



Introduction

A fouling community is a community of plants and animals found on hard natural and artificial substrates in marine and freshwater communities (Sh. E. et al., 2006). Many of filter-feeding sedentary invertebrates found in fouling communities can potentially harm the substrate they grow on.

The priority effect can greatly affect the composition of a marine community. Organisms which settle first have a major advantage over other species; once established, they have the ability to prevent late colonizers from settling. Because of this the community assemblage may be determined by the monopolization of early settlers and their ability to adapt to different habitats (Urban et al., 2008). Established fouling communities are also characterized by seasonal variations in larval settlement along with possible random disturbances (Keough, et al., 1982). The invasive fouling organisms mentioned in this study are: *Botryllus schlosseri, Botrylloides violaceus, Botrylloides sp.* (BC), *Didemnum sp., Molgula sp., Ciona sp., Ascidiella aspersa, Bugula neritina,* white branching bryozoan, *Watersipora subtorquata,* white encrusting bryozoan, tube-dwelling animals, *Balanus glandula, Ulva sp., Enterpmorpha sp.,* and brown scuzzy algae (Cohen, 1995).

Literature Cited

Ramadan, Sh. et al. 2006. "Marine fouling community in the Eastern harbour of Alexandria, Egypt compared with four decades of previous studies." *Mediterranean Marine Science* 7(2): 19-29.
Urban, Mark et al. 2009. "The metacommunity monopolization effect: Priority effects and evolution shape community assembly". Proc. R. Soc. B 276: 4129-4138.
Keough, Michael et al. 1982. "Recruitment of marine invertebrates: The role of active larval choices and early mortality". Oecologia. 54: 348-352.
Cohen, Andrew et al. 1995. "Nonindigenous aquatic species in a United State estuary: A case study of the biological invasions of the San Francisco Bay and delta". Report U.S. Fish and Wildlife Service

[1]*Botrylloides sp.* (BC): The species name is unknown; BC refers to the bi-colored colors of the zooids.
[2]Colonial tunicates include indistinguishable juveniles of either: *Botrylloides sp.* (BC), *B. violaceus,* or *B. schlosseri.*
[3]Solitary tunicates include *Ciona sp., Molgula sp.,* and/or *Ascidiella aspersa.*
[4]Week 4 at Richmond: Only 2 out of 4 apparatuses scored.
[5]Week 3 at Fort Baker: None of the apparatuses were scored.
[6]Graph counts are accumulative across all weeks.

Organisms

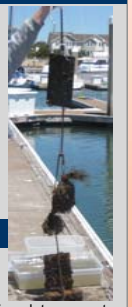
Materials and Methods

Settlement Apparatus:
- 2 0.30m X 0.15m plastic plates separated by 1m of rope.
- Top plate suspended 0.30m below water surface; bottom suspended 1.22m below water surface.
- Bottom plate tied to brick.
- Blue Tuffy placed between plates for crab larval settlement. (Data not included.)
- 4 settlement apparati placed at each site.

Scoring:
- Plates placed in plastic tubs of saltwater to prevent desiccation.
- Non-rope side of each plate scored.
- Organisms counted on site.

Settlement apparatus in tubs.

Jacqueline Hill and Mary Dournaee scoring an apparatus at Fort Baker.



Settling plate apparatus

Results

Figure 1

Species that settled 1st at Richmond and Berkeley were the most abundant in the 5th week. Animal diversity increased in the 3rd week; many of the animals that settled at Richmond did not settle at Berkeley (Fig.1). Richmond and Berkeley display the greatest diversity, while Fort Baker did not show as much diversity (See also Fig. 2).[1,2,3,4,5,6]

Berkeley showed the most species diversity. Richmond was dominated by *B. neritina, Didemnum sp.* and tube-dwellers appeared in greater abundance at Fort Baker; both species of *Bugula* were not found at Fort Baker (Fig.2). Colonial tunicates include *Botrylloides sp.* (BC), *B. violaceus*, and *B. schlosseri*.[1,2,3,4,5,6]

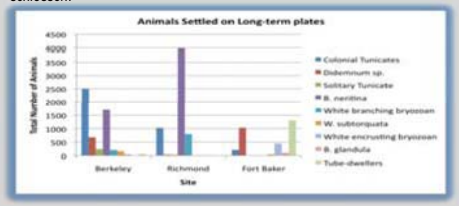


Figure 2

Comparison of the 7-day cumulative settlement among the three sites. Settlement plates were initiated at two dates separated by 14 days in summer 2010. There is more species diversity and abundance in early July than in late June (Fig.3).[2]

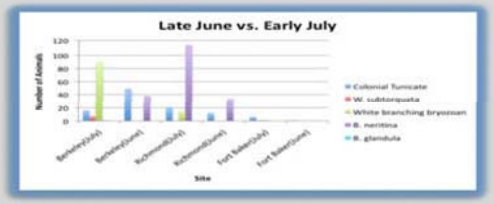


Figure 3

Acknowledgements: Tricia Goulding, Christy Bedayan, Michelle Wray, Damion Delton, Mary Dournaee, Eric Dexter, Lawrence Horvath, Lyn Moreno, STAR, CESAME, RTC, Christina Piotrowski, Linda McCann, Wim Kimmerer, Anne Slaughter, Anne Cohen, Ellen Kosman, Richard Strathmann, Shigeko Ooishi,.

Map of Sites

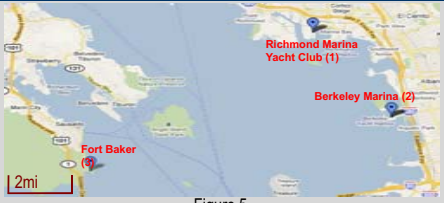


Figure 5

Results

There were 4 different types of colonial tunicates scored at the end of the 5th week according to their size (Fig. 4). At Richmond *Botrylloides sp.* (BC) and *Didemnum sp.* began settling after two weeks.[1] (See also Fig.1)

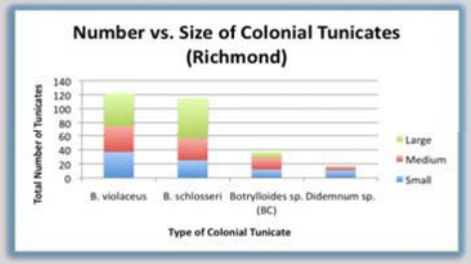
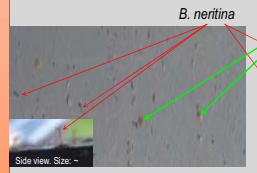
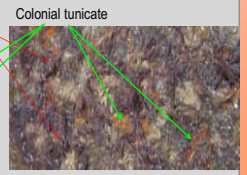


Figure 4

Organisms found on the plates on the 1st week (*B. neritina* and colonial tunicates) dominated the plate by the 5th week (Fig.1).



5-Week apparatus plate at Richmond after 1 week.



5-Week apparatus plate at Richmond after 5 weeks.

Conclusion/Future Directions

The fouling communities observed in the San Francisco Bay display a large assortment of native and invasive species. In this study, variation in community composition of fouling organisms was observed at multiple locations within San Francisco Bay over the course of 5 weeks. Commonalities among the sites were also found. In 2 of the 3 sites algae settled in the first 2 weeks, but was increasingly displaced by animals starting in the 3rd week. The dominance of early settlers on our settling plates is attributed to the priority effect. Colonial organisms dominated at all 3 sites, although each site differed in species composition and dominance. Environmental variation may play a large role in the recruitment; see accompanying poster "Analysis of San Francisco Bay Environmental Conditions as They Relate to Organismal Abundance" by Mary Dournaee. Further study should be carried out to observe long-term behavior of fouling communities and possible causes of the changes in community composition.