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Small-Scale Recruitment of Flora to a Newly Developed Tidal Inlet in the Northwest Gulf of Mexico

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SHORT PAPERS AND NOTES

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SMALL-SCALE RECRUITMENT OF FLORA TO A NEWLY DEVELOPED TIDAL INLET IN THE NORTHWEST GULF OF MEXICO.—Photosynthetic microbial biofilms are an important functional component of rocky intertidal habitats worldwide (Thompson et al., 2005). They influence habitat selection by settling larvae (Crisp, 1974) and provide a food source for a variety of grazers (Steneck and Watling, 1982). Rock roughness affects both the biofilm and algal species that recruit to rocky intertidal communities, as well as their abundance. Diatoms and cyanobacteria seem to increase in abundance with increased surface structure (Hutchinson et al., 2006).

Rock jetties aid in the stabilization and maintenance of channels and are important economically and ecologically, creating an ideal habitat for benthic marine macroalgae. The assessment of flora recruiting to jetties during the initial stages of habitat development is important in fully understanding community dynamics. Hard substrate provides vertical relief and supports a dense cover of attached microalgae (periphyton) and epifauna (Atilla et al., 2003). Although poorly documented in the past, these meioflora are necessary to fully evaluate the flora of jetties. They influence food webs and affect benthic productivity by increasing deposition of organic matter around hard structures (Atilla et al., 2003).

Jetties are likely to draw at least part of their populations from the floating pool of individuals in the Gulf of Mexico (Britton and Morton, 1989). Until jetties were constructed along the Texas coast, the outer shores were limited in algal growth, for they generally lack the necessary hard substrate. With increased human impact in coastal zones and the increase in numbers of coastal jetties and seawalls, we have significantly increased the algal diversity in our coastal zone (Britton and Morton, 1989; Atilla et al., 2003).

Packery Channel is located along the Texas coast in the northwest Gulf of Mexico, near Corpus Christi, TX. The pass connects the subtropical Upper Laguna Madre and Corpus Christi Bay to the Gulf of Mexico. Jetties stabilize the channel by hardening shorelines and extending granite breakwaters into the surf zone. Packery Channel is a newly constructed pass, completed in September 2006, and provides a unique opportunity for observing flora recruitment.

We herein examine a jetty system by assessing the recruitment patterns of flora to the rocky granite substrate. By taking advantage of this new habitat we were able to examine algal recruitment by means other than the traditional scraping and successional studies seen so often in the literature. This approach allowed for observing order of organism recruitment and community development in a system with no preexisting attached flora.

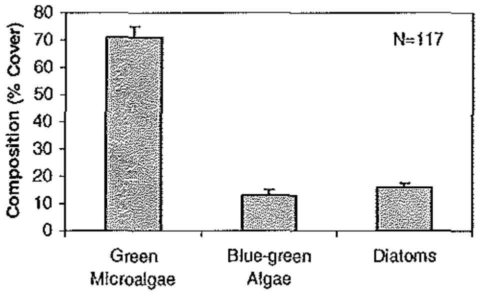
Methods.—Sampling was conducted during Aug. and Sept. 2005 along the granite jetties of Packery Channel (27°36′50.16″N; 97°12′2.64″W). A 1-wk settlement period was allowed for reduced turbidity after rock placement, as well as for initial settlement of bacteria to the substratum. Points were selected haphazardly along the channel side of the south jetty and sampled every 2 d at a depth of 30 cm. At each site a paint scraper was used to remove all attached material from approximately 10 cm^2 of the rock jetty. Material was scraped into a labeled 500-μm mesh biobag and was placed in a field container of 2% glutaraldehyde and seawater solution. A total of 21 samples were collected, representing approximately 52 d of recruitment data.

Three permanent slides were made from each sample by affixing a small portion of the sample with Cytoseal-60^{TM}, creating a total of 63 slides. Eight to 10 random images were taken of each slide using a microscope and digital imaging system by using a standard grid and number table. Percentage of cover was calculated and linear regression analysis was conducted to evaluate trends in composition cover over time. These data were used to assess recruitment of cyanobacteria, diatoms, and microalgae to the jetties.

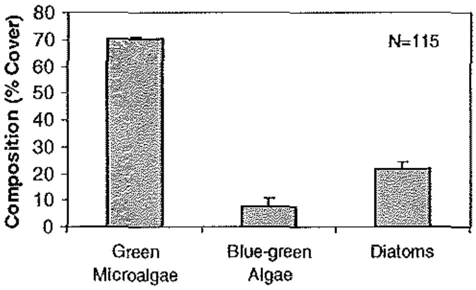
Results.—Green algae (Chlorophyta) were present from the first days of sampling and comprised the dominant group of organisms colonizing the freshly lain granite blocks (Fig. 1). There was a transition from blue-green algae (cyanobacteria) growing independently on the granite substrate to growing epiphytically on green filamentous microalgae. This was evident as a decrease in overall percentage of composition of blue-green algae in the rock biofilm ($R = 0.7217$) (Fig. 2). No trend in microalgal cover was apparent over time.

Discussion.—Very little is known about microbial intertidal ecology. Diatoms are considered to be the dominant organisms in certain temperate

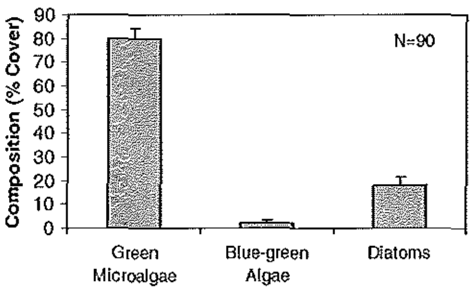
a) 15 Day Recruitment



b) 25 Day Recruitment



c) 31 Day Recruitment



d) 37 Day Recruitment

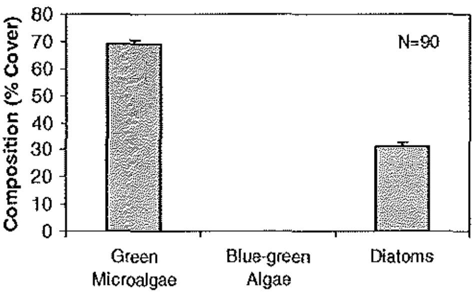


Fig. 1. Weekly recruitment averages for major taxa recorded for study. Values represent total percentage of composition identified for all images during that period. Error bars represent standard deviation from the mean. The first week is omitted as an initial settlement period.

a) Green Microalgae

b) Blue-green Algae

c) Diatoms

Fig. 2. Trends in composition cover over the course of 1 mo of sampling at Packery Channel ($\alpha = 0.05$). Values represent total percentage of composition identified for all images during each sampling event. The first week is omitted as an initial settlement period.

shore biofilms (Hill and Hawkins, 1991); however, studies on epilithic biofilm in an artificial canal in the southern Gulf of Mexico clearly demonstrate the dominance of cyanobacteria (Nagarkar and Williams, 1997; Ortega-Morales et al., 2005). It was shown by these authors to be a factor of temperature, allowing cyanobacteria to outcompete diatoms in a tropical environment.

This study was conducted in Aug. and Sept., which typically exhibit a tropical climate, but cyanobacteria never dominated the microflora of the community. Though grazing is often a factor influencing algal growth on rocky substrates, this community was newly developed, and most likely did not yet have a resident population of grazers. Certain studies have also found that season and spatial heterogeneity of the substrate affect density and diversity of microflora (MacLulich, 1987; Williams et al., 2000).

Analysis of biofilm communities on *Thalassia testudinum* Banks (ex König) from Texas showed that clean blades were initially colonized by diatoms such as *Cocconeis* spp. (Kitting, 1984). Similar work on Grand Cayman Island showed tripartite community succession, in which *Cocconeis* spp. recruited first, followed by naviculoid diatoms, then filamentous/encrusting algae (Corlett and Jones, 2007). Diatoms produce polysaccharide threads, mucus pads, and tubes that allow them to attach to surfaces (Darly, 1977; McIntire and Moore, 1977). They may also colonize first because of their overall decreased surface area (Borowitzka and Lethbridge, 1989).

If uncolonized rocks exhibit the same recruitment patterns as new seagrass leaves, perhaps the diatoms that initially colonized are more important than was originally thought. Successional patterns in rocky intertidal communities demonstrate that biofilms (i.e., diatoms and cyanobacteria) develop rapidly, followed by ephemeral macroalgae (i.e., *Ulva* spp.) (Williams et al., 2000). Mesocosm experiments may be beneficial to analyze these relationships more closely.

Sediment plumes were present within the channel during the early dredging stages of construction, possibly affecting the jetty biofilm. Discharged water from tidal inlets is almost always more turbid than Gulf waters (Hunter and Hill, 1980). Also, differences in marine biofilms have been observed between sheltered and exposed rocky shores (Thompson et al., 2005). Because of differences in wave energy, our results may have varied if we had examined both the channel and beach sides of the jetties. Future studies might warrant sampling at increments of shorter time (e.g., hourly sampling during first 24–48 hr), in order to observe true order of organism recruitment.

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