The purpose of this study is to analyze trends in environmental conditions in the San Francisco Bay and to determine whether these environmental factors have a significant impact on the growth of organisms. This study analyzed temperature, salinity, and current data collected from an array of different field sites located in the central region of the San Francisco Bay through July 2010. This environmental data was compared to organismal growth on recruitment devices at each site. The recruitment devices consisted of two 6X12 PVC plates and one mesh wrap containing two Tuft kitchen scrub pads. Settled organisms included native and invasive crustaceans, bryozoa, polychaetes, nudibranchs, and tunicates. Protected field sites in the East Bay experiencing maximum currents between 20-30 cm/s and average temperatures of 16-18.4 °C demonstrated the most overall organismal growth. The relationship between salinity and organismal growth is unclear and further study addressing tidal considerations is necessary.

Physical and Biological Conditions in the San Francisco Bay

The San Francisco Bay is the largest estuary on the Pacific Coast. An estuary is a body of water where fresh water enters under the Golden Gate Bridge and quickly dissipate as they move further into the bay. These currents change direction approximately twice a day according to the tidal cycle (see Figure 1). Temperature and salinity are not as easily linked in the San Francisco Bay as they are in the open ocean. In the ocean, cold-water streaming links it to high salinity and density; while in the bay, the coldest water comes from different tidal places depending on the season (either from snow run off or the ocean). Because of mixing in the water column and the relative contributions of fresh and salt water, temperature and salinity change drastically with proximity (at different locations in the Bay) and temporarily (in different seasons and different years).

Due to ever increasing trade and traffic in the SF Bay, a phylogenetically diverse assemblage of non-native species, including various invertebrates, fish, and plants, have been introduced into the bay. This study investigates several physical characteristics of six different field sites in the central bay and compares these physical characteristics to species composition. The Crissy Field, Fort Baker, Berkeley Marina, and Angel Island sites were studied during the month of July, snapshots including daily, weekly, and monthly averages in July were used to estimate typical tidal, current, temperature and salinity ranges.

Recruitment devices were collected to document organismal abundance. Each field site had two devices at two different locations along the dock. The top plate was approximately one meter above the bottom plate to allow for differentiation at separate depths. A 2 cm thermometer and temperature logger were used to measure real-time salinity and temperature. The temperature logger was attached to the top loop of the device and a brick was attached to the bottom to keep the settling plates and Tuft oriented vertically in the water column.

Biological Materials, Methods and Monitoring

Recruitment devices were collected to document organismal abundance. Each field site had two devices at two different locations along the dock. The top plate was approximately one meter above the bottom plate to allow for differentiation at separate depths. A 2 cm thermometer and temperature logger were used to measure real-time salinity and temperature. The temperature logger was attached to the top loop of the device and a brick was attached to the bottom to keep the settling plates and Tuft oriented vertically in the water column.

The following graphs show monthly maximum, minimum, and average values for temperature and salinity at the RTC and Crissy Field locations (Figure 7). All years of accessible data were analyzed for the field sites. RTC temperature ranged from 10.0-20.0 °C while salinities ranged from 11.0-32.0 ppt. Crissy Field temperature ranged from 0.5-17.0 °C while salinities ranged from 23.0-33.0 ppt. Though both sets of long term temperature data were consistent with the temperature logger data of the short term study, long term salinity data for RTC had noticeably more variation than the short-term data. This is most likely because the years averaged (2005-2009) included an El Niño year (2005) where excessive rainfall might have resulted in lower salinities across habitats for the majority of the year.

Physical and biological measurements were taken weekly. This study reports that the most organismal abundance was recorded in the following categories: "abundant" if more than 100 specimens were visible, "frequent" if between 10-100 specimens were visible, "few" if less than 10 specimens were visible, and "absent" if none were visible on the settling plate.

To analyze San Francisco Bay environmental conditions, three main sources for data collection were used. Since field sites were studied during the month of July, snapshots including daily, weekly, and monthly averages in July were used to estimate typical tidal, current, temperature and salinity ranges. For ocean current data, Coastal Ocean Current Monitoring Program (COCMP®) and Central and Northern California Ocean Observing System (CenCOOS) maintain a state-wide network of high frequency (HF) radar instruments to monitor coastal ocean surface currents in real-time (see Figure 8). The current maps in Figure 6 show the averaged hourly currents over a one day period on July 15, 2010. Tidal exchange for this day is fairly extreme but not the absolute highest or lowest for that month.

For long-term data collected at various field sites, the San Francisco Bay Environmental Assessment and Monitoring Station (SF-BEAMS) is run through the Romberg Tiburon Center (RTC) and monitors bay water quality and weather conditions at the RTC and Crissy Field locations on the bay. SF-BEAMS is run through the Romberg Tiburon Center (RTC) and monitors bay water quality and weather conditions at the RTC and Crissy Field locations on the bay. My greatest thanks to Toby Garfield and Sarah Cohen for their encyclopedic and experiential knowledge of the bay and invaluable field research.}

References and Resources Cited