Little Bay Water Quality Report Card
Winter 2014

Little Bay is a small, semi-enclosed estuary located in the heart of Rockport, Texas. Estuaries, where freshwater from rivers and streams mixes with salt water from the oceans, are extremely productive and valuable ecosystems that provide flood protection, filter nutrients and contaminants, and provide valuable habitats for wildlife, including nursery areas for many commercially and recreationally important fishes and invertebrates. Little Bay has been an important part of the Rockport community for many years. It not only provides the important ecological functions mentioned above, but it also supports the local tourism industry by providing opportunities for both residents and visitors to fish, kayak, boat, jet-ski, and watch birds.

Water quality station in Little Bay, Rockport.

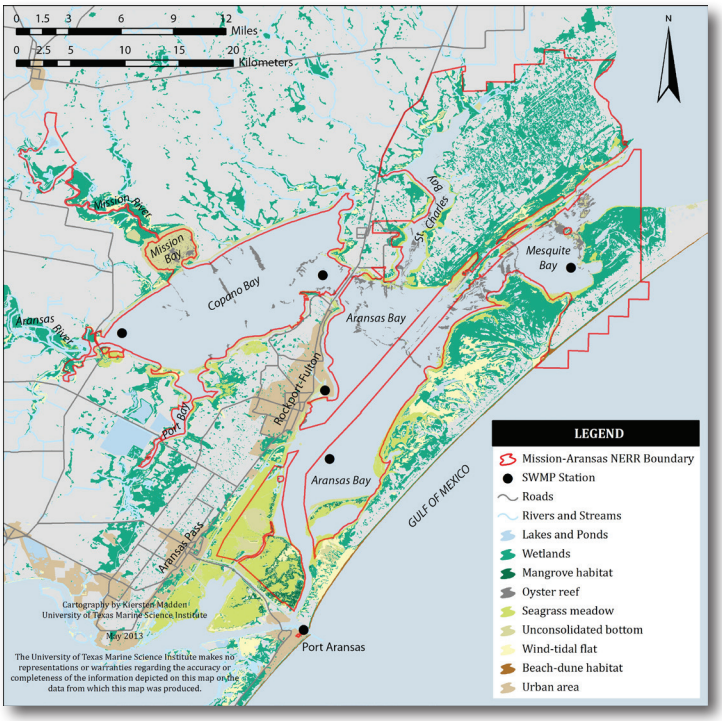
For the last few years, there has been growing concern about the "health" of Little Bay. Many long-term residents and visitors have noted marked changes in the habitats and wildlife of Little Bay. They are worried about Little Bay's ability to function properly and to continue to support the recreational activities which have made it such a popular destination for both residents and visitors. Various monitoring programs, including seagrass and water quality monitoring projects, have been conducted in Little Bay and its tributaries to try and understand the recent decline in environmental quality of Little Bay. However, definitive explanations for the declines witnessed in Little Bay have not been found and further long-term monitoring efforts would be useful.

In 2012, the Mission-Aransas National Estuarine Research Reserve proposed the idea of establishing a "Report Card" to monitor the long-term health of Little Bay. Report cards are an effective way to portray the changing conditions of the estuary and have been used in several bays throughout the United States, including the heavily-impacted Chesapeake Bay system.

The Little Bay Report Card includes measurements of water quality and is based on the following parameters: temperature, salinity, dissolved oxygen, turbidity, and chlorophyll. Water quality is compared to measurements taken in Aransas Bay. This comparison with Aransas Bay will be used to provide a "grade" for each parameter and will be factored into an annual score. Aransas Bay is generally regarded as a "healthy" bay with good water quality and healthy habitats.

Water quality station in Aransas Bay.

The information provided in this report includes a quarterly review of all water quality parameters, including nutrients. The information presented is a summary of water quality data collected by the Mission-Aransas Reserve. The Mission-Aransas Reserve manages five data-logging stations throughout the estuary and one in Little Bay. Each site contains a data logger that collects water quality information at 15 minutes intervals throughout the year. The data for five stations, not including Little Bay, are available online at: nerrsdata.org



Water quality station locations operated by the Mission-Aransas Reserve.

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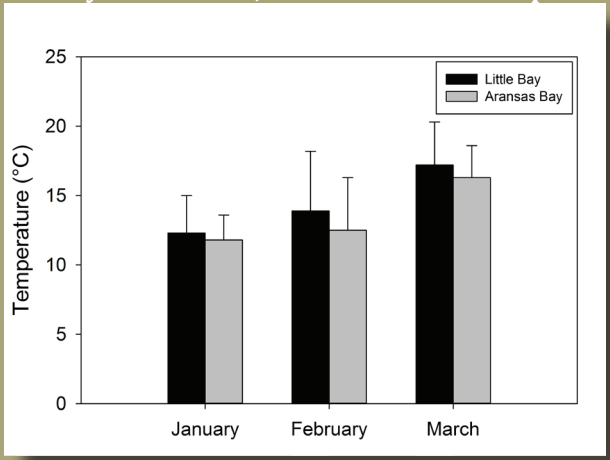
Positive: Parameter indicates generally good or improving conditions relative to Aransas Bay.

Cautionary: Parameter indicates potentially deteriorating conditions relative to Aransas Bay; however, additional information or data are needed to fully assess the indicators response.

Negative: Parameter indicates poor or deteriorating conditions relative to Aransas Bay.

TEMPERATURE

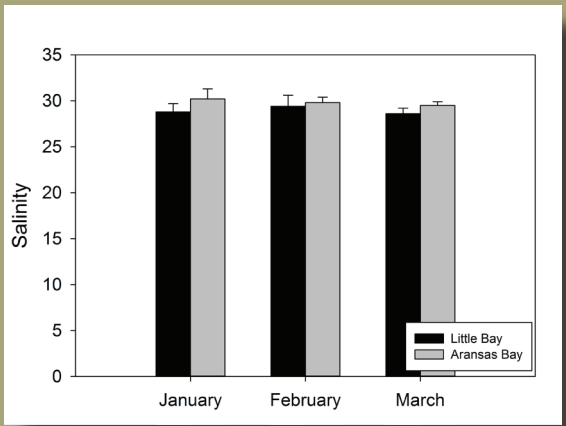
Water temperature is an important indicator of the health of estuarine systems because of the direct relationship between water temperature and oxygen. As water temperature increases, the amount of oxygen that can be dissolved in the water decreases. Additionally, all plants and animals have a range of temperatures in which they thrive. Therefore, temperature determines what types of plants and animals are able to survive in the estuary. If the water in the estuary is outside the normal seasonal temperature range for which local organisms are adapted, it is most likely an indication that something is adversely affecting the health of the estuary. As a result, seasonal water temperature is an important indicator of habitat quality for many estuarine species.



Comparison of mean monthly temperature in Little Bay and Aransas Bay from January to March 2014 showed no substantial differences. We would generally expect Little Bay to experience greater temperature extremes as it is shallower and more confined in comparison to the larger and more open Aransas Bay. In general, Little Bay average temperatures do show more variation. The measured temperatures do not indicate a concern for water quality.

SALINITY

Salinity refers to the amount of dissolved salts in seawater. Salinity levels in an estuary vary daily, seasonally, geographically, and with tidal cycles. Salinity levels in estuaries can rise on hot sunny days when evaporation removes fresh water and leaves behind the salt. Conversely, salinity is reduced by large amounts of rain and increasing freshwater inputs from rivers and creeks. Salinity gradients exist throughout an estuary, from the river mouth to the open ocean. Salinity levels are generally highest near the area where saltier water enters, and lowest upstream where freshwater flows into the estuary. Since salinity has major effects on physiological processes, salinity levels greatly influence the species of plants and animals that inhabit an area.



Comparison of mean monthly salinity from January to March 2014 showed some slight differences. In January and March Little Bay salinity was slightly lower than Aransas Bay, but in February no differences were seen. We would generally expect Little Bay to experience lower salinities due to increased freshwater run-off from the surrounding area and point sources such as Tule Creek and storm drains. Little Bay is also a confined system with less potential water exchange than Aransas Bay. The measured salinity do not indicate a concern for water quality.

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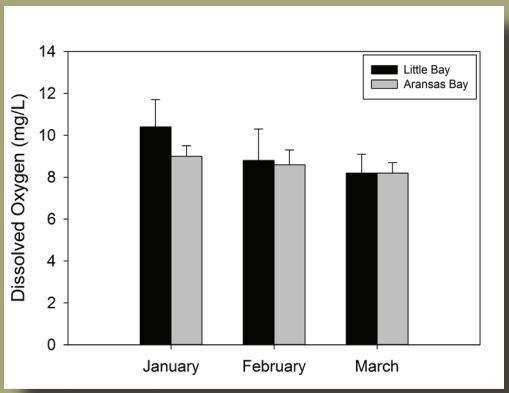
DISSOLVED OXYGEN

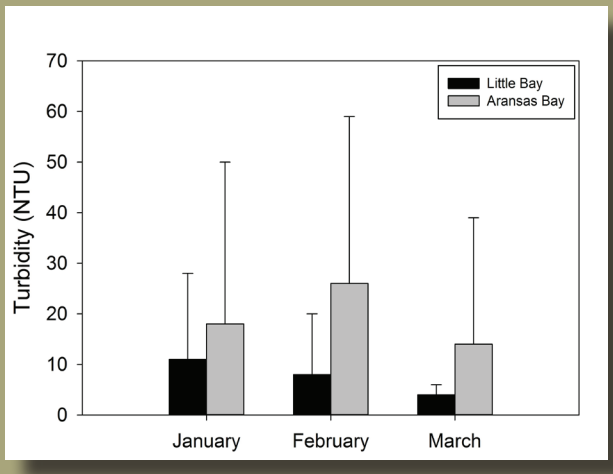
Dissolved oxygen (DO) refers to the oxygen that is available to aquatic organisms for respiration. Oxygen enters the water through two natural processes: diffusion from the atmosphere and photosynthesis by aquatic plants. The mixing of surface waters by wind and waves increases the rate at which oxygen from the air can be mixed into the water. Oxygen concentrations in estuarine waters undergo both daily and seasonal fluctuations due to changes in the tides, temperature, and plant photosynthesis. Oxygen levels typically peak during the daylight hours as plants are photosynthesizing and decrease at night when photosynthesis ceases and both plants and animals consume oxygen through respiration. Very high levels of DO, or supersaturation, can actually be harmful, causing capillaries in fish gills to rupture or tear. Low levels of DO are an even greater concern in estuaries when they create a condition known as hypoxia. Hypoxic conditions tend to support a lower diversity of species. Therefore, proper DO levels are critical to maintaining estuarine health.



Comparison of mean monthly dissolved oxygen concentrations from February to March 2014 showed no substantial differences but January 2014 showed slightly lower dissolved oxygen concentrations in Aransas Bay. Although the concentrations were lower, the concentrations overall are still indicative of a healthy system. Hypoxia, or low oxygen content in water, is problematic when concentrations are at 2-3 mg/L or lower. The measured dissolved oxygen levels do not indicate a concern for water quality.

TURBIDITY

Turbidity is a reduction in the clarity of water due to the presence of particles suspended in the water column. Sediments, such as silt and clay, are generally transported into the estuary by river systems and are responsible for high turbidity conditions, although phytoplankton or other organic material can also contribute significantly to turbidity. High turbidity limits the amount of light that can penetrate through the water, which can influence the vertical distribution and productivity of phytoplankton, seagrasses, and large algae (or macroalgae). This, in turn, affects other organisms that depend on these plants for food and oxygen. Scientists often consider turbidity of the water in connection with other factors to get a better understanding of its causes and consequences. For example, high levels of turbidity can indicate problems with shoreline erosion, or malfunctioning sewage treatment facilities.



Comparison of mean monthly turbidity levels from January to March 2014 showed higher turbidity in Aransas Bay than Little Bay. Aransas Bay also shows a wider range of turbidity readings most likely due to the strong cold fronts from the north. As a shallow water body, Little Bay can be more affected by seasonal shifts in weather patterns and impacts of wind than in the larger Aransas Bay. However, because Little Bay is smaller, it is also more protected from wind. It is likely that the seasonal wind pattern is the cause for the difference in turbidity. The measured turbidity levels do not indicate a concern for water quality.

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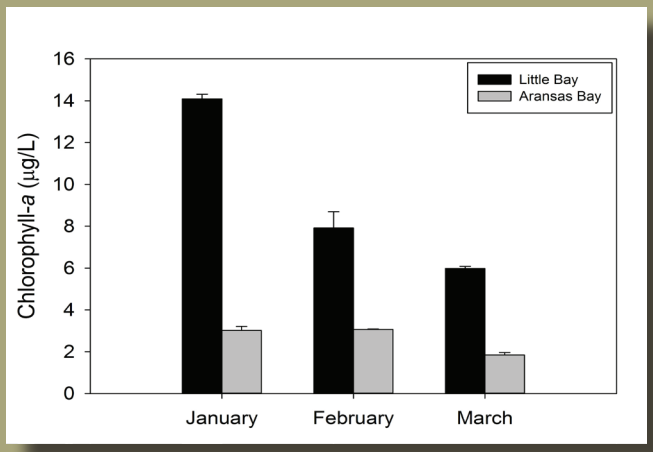
CHLOROPHYLL

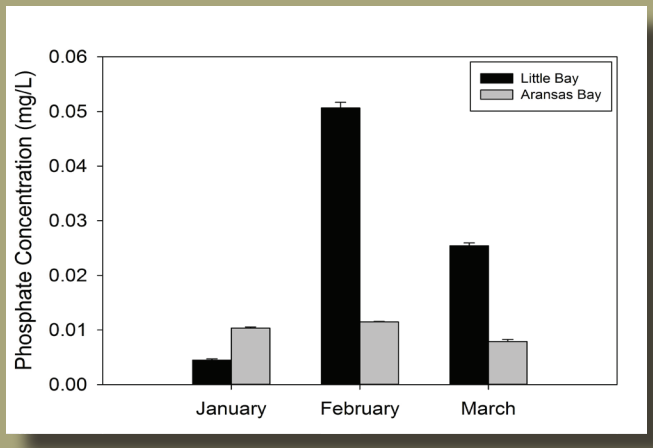
Chlorophyll is a green-colored pigment that plants use to make their own food using the sun's energy and nutrients in a process known as photosynthesis. In the ocean and estuaries, microscopic plants, known as phytoplankton, are suspended in the water column and use chlorophyll to photosynthesize. By measuring the amount of chlorophyll in an estuary, scientists can quantify the levels of phytoplankton and estimate the photosynthetic activity in the water. Chlorophyll levels can vary seasonally, with higher levels measure in the sunny, summer months when phytoplankton are actively photosynthesizing. However, high chlorophyll levels can also indicate high levels of storm water runoff or other sources of excess nutrients entering the estuary. After a heavy rain, nutrient-loaded runoff from roads, farms, building sites, and poorly designed sewage treatment systems can enter the estuary and cause phytoplankton blooms, which ultimately can lead to depleted dissolved oxygen levels and even fish kills. Thus, chlorophyll can be utilized as an indirect indicator of nutrient levels.



Comparison of monthly extracted chlorophyll concentrations from January to March 2014 showed that phytoplankton (or algal) biomass was substantially higher in Little Bay than in Aransas Bay. The elevated chlorophyll concentrations in Little Bay is likely attributed to nutrient loading from run-off or the Tule Creek outfall into a relatively small bay with limited water exchange. Even though the Little Bay chlorophyll levels are elevated, they are still at levels that are not detrimental to the environment.

PHOSPHATE

In nature, phosphorus usually exists as part of a phosphate molecule (PO_4^{3-}). There are many sources of phosphorus, both natural and human. These include soil and rocks, wastewater treatment plants, runoff from fertilized lawns and cropland, failing septic systems, runoff from animal manure storage areas, disturbed land areas, drained wetlands, water treatment, and commercial cleaning preparations. Phosphorus is a chemical that naturally attaches to sediment particles, and often, excess phosphorus and sediment pollution are linked. Phosphorus is an essential nutrient for plant and algae growth, but too much phosphorus can lead to algal blooms. Phosphorus can get into the bay through sources such as fertilizers and waste water effluent.



Comparison of monthly phosphate concentrations from January to March 2014 showed that phosphate was higher in Aransas Bay than in Little Bay during January, but higher in Little Bay in February and March. High levels of phosphate in estuaries is often attributed to storm runoff or wastewater effluents. The concentration of phosphate in Little Bay and Aransas Bay are very low and are at levels that are not detrimental to the environment.

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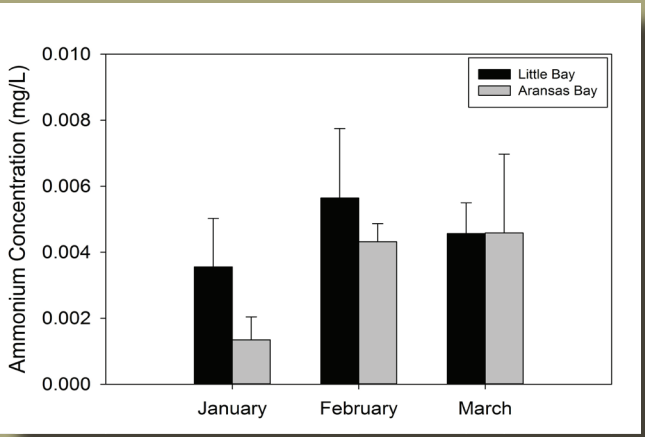
AMMONIUM

NH_4^+

Ammonium is one of the three forms of naturally-occurring nitrogen found in water. Nitrogen is formed when organic matter, such as plants, decomposes. Nitrogen is an essential nutrient for plant growth, but excessive amounts of nitrogen can cause algal blooms, which may lead to low dissolved oxygen levels. Nitrogen can enter the bay through several sources, including phytoplankton decomposition, rain, fertilizer run-off, and wastewater treatment plant effluent. Ammonium is the form of nitrogen that is the easiest for plants and phytoplankton to use.



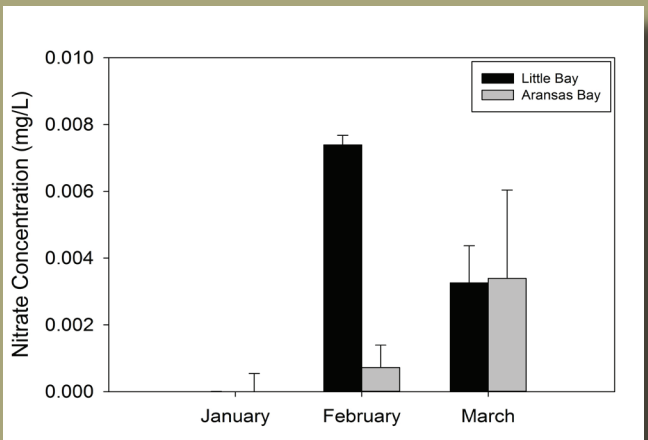
Comparison of monthly ammonium concentrations from January to March 2014 showed that ammonium was higher in Little Bay than in Aransas Bay during January and February, but similar between the bays in March. Ammonium is often attributed to nutrient loading from storm water run-off or discharge from the wastewater treatment plants. It can also be attributed to the decomposition of algae in the water. The levels found are very low and do not signify a problem.

NITRATE

NO_3^-

Nitrate and nitrite are the other two forms of naturally-occurring nitrogen found in water. In this report, the concentrations of nitrate and nitrite are combined and reported as nitrate because the concentrations of nitrite are very small. (Nitrites are formed when ammonium is converted to nitrate through oxygenation.) Nitrogen is an essential nutrient for plant growth, but excessive amounts of nitrogen can cause algal blooms, which may lead to low dissolved oxygen levels. Nitrogen can enter the bay through several sources, such as phytoplankton decomposition, rain, fertilizer run-off, and wastewater treatment plant effluent. High nitrate levels in combination with high phosphate levels are largely responsible for eutrophication or algal blooms.

During January in Little Bay and Aransas Bay, the samples were below the level of detection (N.D.). Comparison of monthly nitrate concentrations from January to March 2014 showed different patterns in Little Bay and Aransas Bay. Concentrations were near zero in January, higher in Little Bay in February, and similar in the bays in March. Rain events, phytoplankton blooms, and waste water treatment effluent, could contribute to the variability in nitrate concentrations, but additional sampling will help explain the overall trend. The total dissolved nitrogen (ammonium + nitrate + nitrite) concentrations are within the range of previous studies and an order of magnitude less than in Tule Creek (Wilson 2010).



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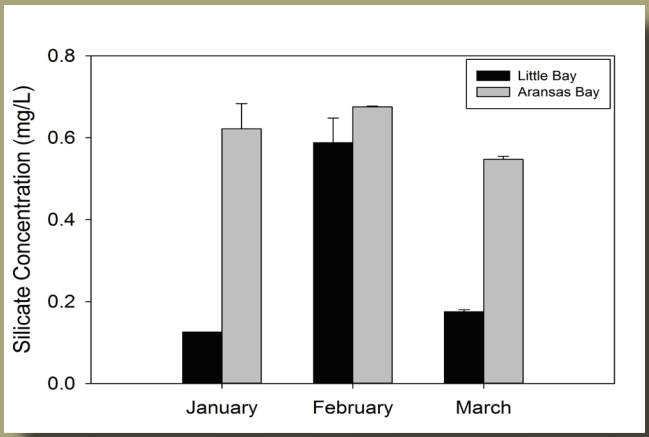
SILICATE

SiO_2

"Silicate" is a generic term for compounds that contain silicon, oxygen, and one or more metals. Silicate is common in water and is produced primarily from the weathering of silicate minerals. Silicate-based clays can cause higher turbidity levels and high presence of silicate in the water can create a milky appearance. Excess silicate in the water causes no harmful human health effects. Unlike the other major nutrients (phosphate, nitrate, or ammonium) that are needed by almost all plankton, silicate is an essential chemical requirement for very specific types of plankton, such as diatoms, radiolarians, and siliceous sponges. These organisms extract dissolved silicate from the water in order to produces hard skeletal structures. Once the plankton have perished, the skeletal material dissolves and as it settles through the water column, it enriches the waters with dissolved silica.



Comparison of monthly silicate concentrations from January to March 2014 showed that silicate was higher in Aransas Bay than Little Bay. However, during February the concentrations were more similar. During January and March, Aransas Bay showed much higher silicate concentrations as compared to Little Bay. This is likely due changes in the abundance of phytoplankton, specifically diatoms. The levels do not signify a problem.