Little Bay Water Quality Report Card
Spring 2013

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.

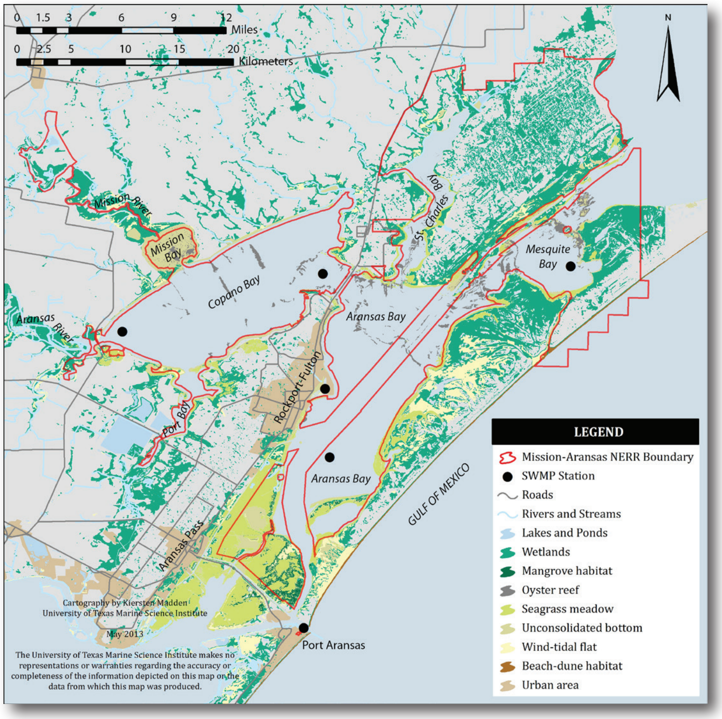
For the last few years, there has been growing concern about the "health" of Little Bay. Many long-term residents and visitors have noted marked changes in the habitats and wildlife of Little Bay. They are worried about Little Bay's ability to function properly and to continue to support the recreational 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.

Water Quality Indicators - Spring 2013

✓ **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.

This past quarter the data sonde that measures water quality had to be removed from the water for repair. The table below reports discrete ('one-time') measurements of water quality parameters taken in Little Bay on the day of water collection for nutrients and chlorophyll compared to the monthly averages in Aransas Bay. It is difficult to compare the two measurements since they are temporally different, but it does show some variation and patterns.

In general, Little Bay had very similar measurements to Aransas Bay for temperature, salinity, and dissolved oxygen. Turbidity was lower in Little Bay than in Aransas Bay on all three measurements. This pattern was also seen in the spring and the protection from the wind and wind-driven tides could cause this difference. Chlorophyll was higher in Little Bay than in Aransas Bay. This is likely attributed to nutrient loading from storm water run-off or discharge from the Tule Creek outfall into a relatively small bay with limited water exchange.

		✓ (Positive)	✓ (Positive)	✓ (Positive)	✓ (Positive)	✓ (Cautionary)
Date	Station	Temperature (°C)	Salinity	Dissolved Oxygen (mg/L)	Turbidity (NTU)	Chlorophyll a (µg/L)
4/25/2013	Little Bay	18.03	32.62	7.62	10.4	14.9
Apr-13	Aransas Bay	20.9 ± 1.2	32.4 ± 0.6	7.2 ± 0.3	37 ± 45	8.1 ± 4.2
5/8/2013	Little Bay	23.36	32.48	6.05	17.8	10.4
May-13	Aransas Bay	24.5 ± 2.4	32.1 ± 0.7	6.8 ± 0.5	37 ± 47	8.7 ± 4.0
6/25/2013	Little Bay	28.81	32.86	5.32	12.1	9.7
Jun-13	Aransas Bay	28.9 ± 0.8	32.9 ± 1.1	6.1 ± 0.3	15 ± 32	5.8 ± 2.1

Measurements for Aransas Bay have standard deviations because they are monthly averages.

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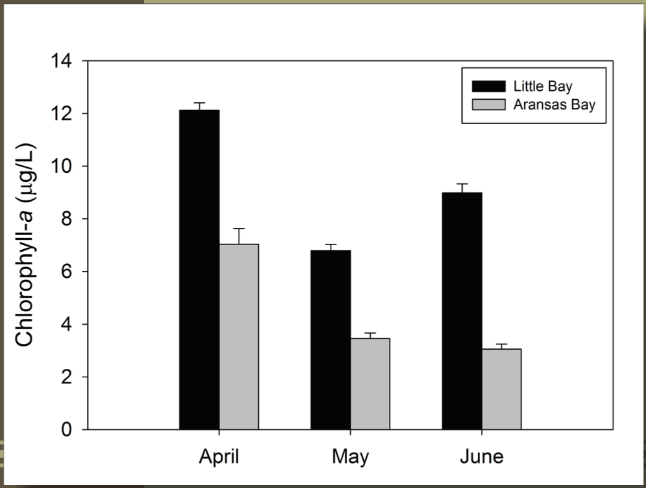
CHLOROPHYLL

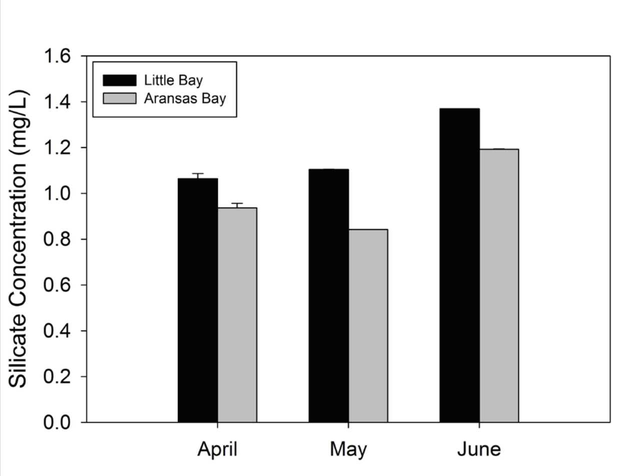
Chlorophyll is a green-colored pigment that plants use to make their own food using the sun's energy and nutrients in a process known as photosynthesis. In the ocean and estuaries, microscopic plants, known as phytoplankton, are suspended in the water column and use chlorophyll to photosynthesize. By 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 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. These blooms can ultimately lead to depleted dissolved oxygen levels (from decomposition) and even fish kills. Thus, chlorophyll measurement can be utilized as an indirect indicator of nutrient levels.

In addition to the continuous measurements of chlorophyll taken via the water quality equipment, water samples were also taken once per month. This is a more precise measurement than is possible with the water quality equipment. Comparison of mean monthly chlorophyll concentrations from April to June 2013 showed that phytoplankton (or algal) biomass was consistently and noticeably higher in Little Bay than in Aransas Bay. This is likely attributed to nutrient loading from storm-water run-off or discharge from Tule Creek outfall into a relatively small bay with limited water exchange. The level of chlorophyll was not sufficient enough to cause a major drop in dissolved oxygen levels.



SILICATE

"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 April to June 2013 showed that silicate was noticeably higher in Little Bay than in Aransas Bay. This is likely attributed to storm water run-off or discharge from the Tule Creek outfall which led to a higher abundance of phytoplankton (specifically diatoms), as indicated by the higher chlorophyll concentrations, however the levels do not signify a problem.

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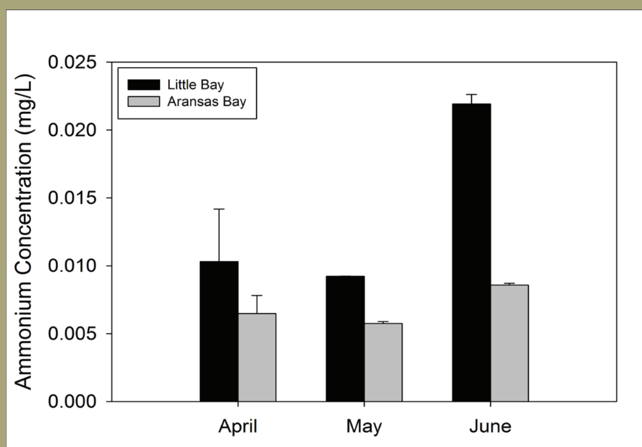
AMMONIUM

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.

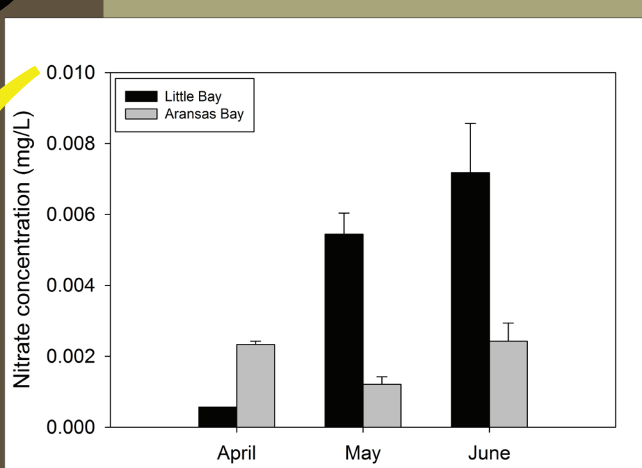
Comparison of monthly ammonium concentrations from April to June 2013 showed that ammonium was consistently higher in Little Bay than in Aransas Bay. This is likely attributed to nutrient loading from storm water run-off or discharge from the Tule Creek outfall into a relatively small bay with limited water exchange. It can also be attributed to the decomposition of algae in the water. Chlorophyll levels indicated that algae biomass was high in Little Bay. Even though the ammonium levels are higher in Little Bay, they are still at levels that are not detrimental to the environment. The total dissolved nitrogen (ammonium + nitrate + nitrite) are within the range of previous studies and an order of magnitude less than in Tule Creek (Wilson 2010).



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.



Comparison of monthly nitrate concentrations from April to June 2013 showed different patterns in Little Bay compared to Aransas Bay. Concentrations increased throughout the sampling period in Little Bay. Aransas Bay nitrate concentrations were more variable, measuring higher than Little Bay in the month of April, but then becoming noticeably lower in May and June. According to the Copano Bay Weather Station (and another weather station located in Rockport), there were several small precipitation events in late April and all of May/June. Rain events, in addition to waste water treatment effluent, could contribute to the 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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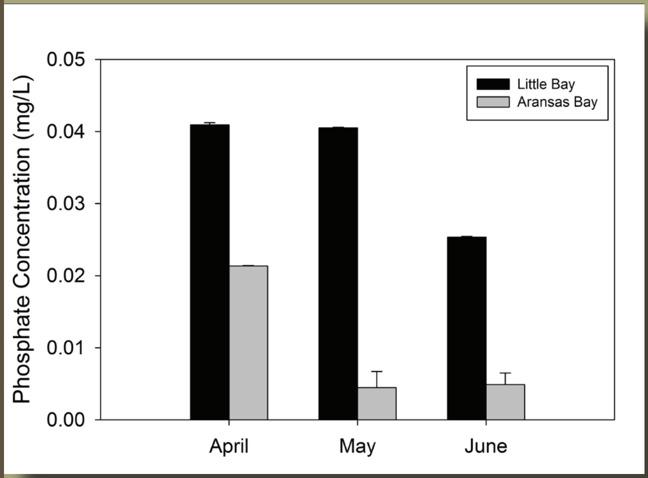
PHOSPHATE

PO_4^{3-}

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 April to June 2013 showed that phosphate was significantly higher in Little Bay than in Aransas Bay. This is likely attributed to nutrient loading from storm water run-off or discharge from the Tule Creek outfall into a relatively small bay with limited water exchange. Even though the phosphate levels are higher in Little Bay, they are still at levels that are not detrimental to the environment.