Hamman Hall of Texas Coastal Ecology

Underwritten by The George and Mary Josephine Hamman Foundation

The Texas Coast

The Texas coast stretches for 367 miles between Louisiana and Mexico, spanning 18 Texas counties. In addition, there are seven major protected bays and estuaries formed by five barrier islands and two major peninsulas.

Ecology of the Texas Coast

The Texas coast is a wonderful natural laboratory for the study of ecology. Ecology is the study of how organisms interact with their environment.

Marine life abounds in these widely varied habitats, which include everything from northern bays and estuaries with a lot of rainfall and low salinity to South Texas' semi-arid, hypersaline waters.

The entire outer coast is dominated by sandy beaches, while visitors to the upper and middle coast bays will be greeted with salt marshes and oyster reefs. The lower coast of Laguna Madre is home to seagrass beds and wind-tidal flats. Each of these coastal areas is home to an astoundingly diverse array of plant and animal life.

The 367-mile long Texas coast is often divided into three segments or regions because of its great length and the differing natural and anthropogenic characteristics of each area: Upper, Middle, and Lower Coast. Although these

are arbitrary divisions of the coast and there are no distinctive lines that separate them, we have chosen to divide the coast in this fashion in the Hamman Hall for ease of presentation and discussion of the various areas. Each segment is approximately 125 miles in length and has six Texas counties.

The Hamman Hall of Texas Coastal Ecology will teach visitors about the diversity of life and habitats along the Texas coast, as well as the impacts that humans are having on these natural systems and what conservation measures are needed to sustain the coast for future generations.

Disappearing Oyster Reefs

Once, oyster reefs were both highly important and incredibly common in estuaries around the world, providing a structural and ecological component that fueled coastal economies for centuries.

For years, oysters supported civilization as an easy-to-collect source of food. However, a recent global survey revealed that 85% of all oyster reefs on earth are now gone. This once flourishing habitat is now threatened on a global scale.

The Gulf of Mexico is home to some of the best and largest remaining oyster reefs in the world. Even so, overharvesting, pollution, and dredging for shells used in industrial processes have taken a toll on these reefs, and there is a great

need for conservation and restoration to recover this important species and habitat.

Oyster reef habitat of the Bay Area. In addition to providing an important fishery, oysters provide a hard substrate for a diverse array of other organisms.

1 - Crassostrea virginica (oyster)

2 - Balanus sp. (acorn barnacles)

3 - Serpulid polychaete worms

4 - Mussels

5 - Tunicates (sea squirts)

6 - Stramonita haemastoma (rock snail)

7 - Crepidula fornicata (slipper shell)

8 - Corophium sp. (amphipod)

9 - Nereid polychaete worm

10 - Libinia dubia (spider crab)

11- Menippe adina (stone crab)

12 - Pogonias cromis (black drum)

The Eastern Oyster

The Eastern oyster (Crassostrea virginica) has often been called an ecosystem engineer, because they not only produce their own habitat, but habitat for an entire ecosystem.

In addition to habitat, oyster reefs provide many ecosystem services, including water filtration, food, shoreline stabilization and protection, and fisheries.

The Eastern oyster ranges from Canada to Texas along the Atlantic coast and into the Gulf of Mexico. It lives in the intertidal and subtidal waters of our estuaries, preferring the upper parts of bays where freshwater rivers result in a slightly lower concentration of salt. Despite this, they can survive in high salinity environments, although disease and parasites, as well as

predators like stone crabs and oyster drills, do take a toll.

Birth and Death

Oysters spawn in estuaries where their eggs and larvae are very common. The young larvae must have a hard surface, preferably an oyster reef, to settle on and grow. Juvenile oysters, called spat, are less than one inch in size. It takes about 18–24 months for the young oysters to grow to three inches or more, what is considered market size.

Oyster reef shells, both living and dead, form the foundation for the oyster reef community. This diverse habitat includes many species of algae, invertebrates, and fish. Acorn barnacles and worm tubes attach themselves to the oyster shells, and several kinds of sponges, worms, and bivalves actually bore into the shells.

Mussels, snails, crabs, snapping shrimp, and small fish live among the oyster shells, and larger fish are found around the reefs feeding on the abundant life present on the reefs.

- **Known as ecosystem engineers, oysters build the reefs in areas where many other species live, resulting in high biodiversity.**
- **Ecosystem services include:**
  - **Water filtration**
  - **Food and habitat**
  - **Shoreline stabilization and protection**
  - **Fisheries**
- **The oyster reefs within the Gulf of Mexico are some of the healthiest in the world.**
- **The Eastern oyster ranges from Canada to Texas.**
- **Oysters grow best in lower salinity, brackish waters; they can grow in higher salinity, but have trouble with disease, parasites, and predators.**
- **Oysters are a favorite seafood item for many people.**

- **Galveston Bay is the most important area for oyster harvest in Texas.**

Salinity

The salinity of water refers to how much salt is in it. Water with low salinity has very little salt. Water with high salinitiy has a lot of salt. Hypersalinity refers to coastal or ocean with waters higher than normal ocean salinity. Waters that are a mixture of fresh water and salt are referred to as brackish.

Economic Importance

Galveston Bay is the primary oyster fishing bay in Texas. Other bays include Matagorda, Aransas, and Copano. These bays serve as important economic centers for the fishing industry, providing an abundance of seafood to communities. Healthy oyster reefs are also a favorite place for recreational fishermen, given the diversity of these areas.

Unfortunately, in 2008, Hurricane Ike damaged many of the oyster reefs in Galveston Bay, covering them with sediment.

The Restoration of the Reefs

Recognizing both the ecological and the economic importance of oyster reefs, organizations have begun to investigate their restoration.

The once large and famous Half Moon Reef in Matagorda Bay almost disappeared entirely due to overfishing and other issues. It has now been partially restored due to the work of The Nature Conservancy, re-establishing it with limestone rocks and restoring ecological function while preventing oyster fishing activities. This project has been a great success, with many oysters now growing on the new, limestone substrate.

The “Sink Your Shucks Program”, developed by the Harte Research Institute for Gulf of Mexico Studies at Texas A&M University-Corpus Christi, is a restoration program that encourages

seafood restaurants to recycle oyster shells to shrinking reef areas to promote growth.

Upper Coast

The upper Texas coast is characterized by a large human population centered around Galveston Bay, Galveston Island, the Bolivar Peninsula, and the mainland reaching the coast to the east and west of Galveston. The major natural passes from the bay into the Gulf include Bolivar Pass, which serves as the entrance to the Houston Ship Channel, on the east end of Galveston Island, and San Luis Pass on the west end. The six counties reaching the coast include Orange, Jefferson, Chambers, Harris, Galveston, and Brazoria. There are two main estuaries in this region: Galveston Bay and Sabine Lake, which is situated on the Texas-Louisiana border. There are considerable coastal protected lands along the upper coast, and ecologically the area is characterized by high rainfall and freshwater

inflow, which provides good habitat for extensive salt marshes and oyster reefs.

Salt Marshes

- **Salt marshes are the most common shoreline habitat on the upper Texas coast.**
- **Ecosystem services include:**
  - **Important nursery ground for shrimp, crabs, and fish**
  - **Protection and stabilization of shorelines**
  - **Water filtration of run-off from the land**
- **The habitat is dominated by salt marsh cordgrass, but includes many other salt-tolerant plants.**
- **These marshes are primarily found in environments with quiet water, low energy environments and gently sloping shorelines.**
- **Salt marshes are split into three regions: the outer/lower marsh, the middle marsh, and the high marsh.**

Salt marshes are a type of coastal wetland dominated by salt marsh cordgrass (Spartina alterniflora). This habitat is common on the bay shorelines of the upper Texas coast, where the water has a lower salinity. Moving down the coast, salt marshes become less frequent until disappearing entirely in the Corpus Christi region. Here, they are replaced by wind-tidal flats as the salt content in the water becomes higher.

Because salt marshes tend to exist in calm water, with little in the way of waves or currents, they are often found near river deltas and upper bay areas along the coast. Fine, soft sediments and muds make up the surface of the salt marsh habitat, and the shoreline tends to be low and gently sloping.

Although salt marsh cordgrass is the dominant species of the outer or lower marsh, many other

plant species occur landward of it. In the middle marsh, common species include saltwort, glasswort, sea purslane, and shore grass. In the high marsh, common species include sea ox-eye daisy, camphor daisy, saltgrass, seashore dropseed, sea blite, Carolina wolfberry, and sea lavender.

Diverse Wildlife

Ecologically, salt marshes are important nursery grounds for many species, and they also serve to filter water run-off and stabilize shorelines from erosion. Salt marsh cordgrass grows in the intertidal zone, an area that is below water during high tide and above water during low tide. As a result, the marshes have an extensive outer edge that serves as important nursery ground.

Coastal birds are the most common animals seen in the salt marsh, though only a few birds

are restricted to the marsh, like the Clapper Rail and Seaside Sparrow. Others use the marshes as feeding areas, such as the Common Egret, Reddish Egret, Snowy Egret, Great Blue Heron, Tri-color Heron, and many species of terns, gulls and shorebirds.

Birds are not the only animals that have found a home within the salt marsh. A close look reveals a wide range of wildlife.

The marsh periwinkle is an herbivore that eats microalgae on the stems of the cord grass, moving up and down with the tide. In the middle marsh, several species of fiddler crabs live in burrows, and the plicate hornsnail is found on the marsh mud among the cord grass, along with the southern ribbed mussel. When the tide is in, many juvenile crabs, shrimp, and fish use the dense cord grass for protection and feeding.

Mosquitoes can be dense in the salt marshes, so most people stay away from this habitat. As a result of mosquito abundance, and the possibility of disease associated with them, channelization and the draining of marshes in many areas is common.

Colonial Waterbird Rookery

Many species of birds seek out over 100 natural and man-made islands along the Texas coast to raise their young each summer. Referred to as colonial water birds during nesting season, they gather in large groups, called rookeries or colonies. By gathering together, they increase the likelihood of their chicks surviving, as the colony provides many eyes to lookout for predators.

Colonies are most often located on islands out in Texas bays, away from shorelines. Sometimes, though, they may be found on mainland beaches or peninsulas, or even in the trees of swampy areas.

There are approximately 25 bird species that form these colonies coast during nesting season. Species include gulls, terns, herons,

egrets, ibis, the Brown Pelican, the Roseate Spoonbill, and the Black Skimmer.

Some of these, like terns and the Black Skimmer, prefer areas with low elevation and vegetation, where they hollow out a small depression in the sand to lay their eggs. These are called ground nesters, and their eggs are always well-camouflaged to blend in with their surroundings.

Other birds, such as the heron and egrets, are considered shrub nesters. They build their nests in low vegetation, brush, or even trees to keep their chicks away from predators. The nests are made of twigs, sticks, and grass from the surrounding island area.

Protecting the colonial waterbirds and their nesting sites is an incredibly important conservation effort. The National Audubon Society gained national recognition in the early

1900s by raising awareness of the shooting of many colonial waterbirds for their feathers in the millinery trade. Today, Audubon remains instrumental to the protection of birds across the U.S., and Audubon Texas is important specifically for their work in protecting the colonial nesting sites along the Texas coast.

The annual Texas Colonial Waterbird Survey monitors waterbird abundance along the entire Texas coast each year. This monumental effort involves a large number of volunteers who attempt to count all of the colonial waterbirds and their nests. This information is used to better understand the status and population trends of each species as it changes over time.

The Texas Colonial Waterbird Society is an important coalition working to monitor, promote research, and inform the management of colonial

waterbird populations in Texas. The partnership includes a number of state and federal agencies, as well as universities and individuals who care about this treasured resource all along the Texas coast.

What is an Estuary?

Estuaries exist all along the Texas coast. These partially enclosed areas of water are fed by freshwater rivers and streams, as well as ocean water. This mixture of fresh and salt water is what form an estuary.

Key characteristics for a good rookery or colony location are:

- **Lack of predators.**
- **Good foraging habitat nearby.**
- **Proper nesting substrate or vegetation.**
- **Lack of human disturbance.**

Brown Pelican—A Conservation & Restoration Success Story

(From Audubon Texas website)

Through the early 1900s, shooting for the millinery trade and to "protect" fishing caused a major decline in the Brown Pelican population. Legal protection began in 1903 when Pelican Island, Florida was set aside as a federal preserve. Despite this, and despite the birds' longevity and popularity, Brown Pelicans nearly disappeared from North America between the 1950s and the 1970s as a result of pesticide use.

The pesticide endrin killed pelicans outright, and DDT caused thin-shelled eggs that broke under the weight of incubating parents. By 1970 all North American populations, with the exception of a few in Florida, were gone, and the species

was placed on the Federal Endangered Species List.

DDT use was banned in the United States in 1972, and populations have rebounded since that time. Their growing abundance in the U.S. since the banning of DDT represents a conservation success story.

The total U.S. population size now exceeds historical levels, the number of breeding pairs in most states is stable, and Audubon Christmas Bird Counts and USGS North American Breeding Bird Survey data show increases. The birds were removed from the Endangered Species List in the southeastern United States in 1985; however, endangered status has been retained throughout the remainder of its range.

Middle Coast

The middle Texas coast is characterized by the low human population and large areas of private lands, many of which support ranching and farming. There are three major estuaries or bay systems along this part of the coast: Matagorda Bay, San Antonio Bay, and Copano Bay. In addition, there is one large federal protected area for whooping cranes known as the Aransas National Wildlife Refuge. The six counties reaching the coast here are Matagorda, Jackson, Victoria, Calhoun, Refugio, and Aransas. The outer coast is bordered by Matagorda Peninsula, Matagorda Island, and San Jose Island. Pass Cavallo leads into Matagorda Bay and the ephemeral Cedar Bayou between Matagorda Island and San Jose Island. Ecologically, rainfall and freshwater inflow are lower than the upper

coast. As a result, salt marshes and oyster reefs do exist, although they are not as widespread as on the upper coast.

Sandy Beaches

- **Sandy beaches are the dominant outer coast habitat along the Texas shoreline.**
- **Fine-grained sandy beaches are derived from land erosion carried by rivers to the sea.**
- **Vegetated dunes protect barrier islands and the mainland.**
- **The beach foreshore is dominated by animals that live in the sand as well as shorebirds.**
- **The surf zone typically consists of three sand bars and rows of breakers with worms, snails, clams, and crustaceans living in the sand.**
- **Unique shell beaches can be found within Padre Island National Seashore in South Texas.**

The Anatomy of a Beach

Stretching from the furthest inland point to the water, these areas typically consist of sand dunes, backshore, foreshore, sand bar, and trough.

Sand dunes and the vegetated flats behind them are characterized by a variety of grasses, annuals, and perennials. These dunes are ecologically and economically important, protecting barrier islands and the mainland from storm surges during tropical storms and hurricanes. On the upper Texas coast, these sand dunes are generally only 3–5 feet in height, whereas on the lower coast, along Padre Island, they reach 20–30 feet.

Kangaroo rats, ground squirrels, coyotes, rattlesnakes, and earless lizards live in the sandy dune habitats, while ghost crab burrows are

found on the backshore near the dunes. Morning glory vines extend across the backshore, serving as pioneering plants to develop new, embryo dunes. Other plant life includes beach tea, beach evening primrose, and sea purslane.

The change in slope between the dry sand backshore and the wet sand foreshore habitat is called the berm. The foreshore, or swash zone, is where the waves constantly wash ashore. Because this is a harsh environment no macro-vegetation and only a few animals are found there. Various shorebirds can be found along the foreshore, resting or feeding upon the small organisms that live in the sand, such as worms, mollusks, and crustaceans. These small organisms either live in the sand in burrows, as in the case of the ghost shrimp, or push along through the sand, as with mole crabs. Coquina

clams are also adapted to live in this intertidal zone, where they migrate up and down the beach with the tides and waves.

Offshore, there are typically three sandbars, each progressively deeper, forming three rows of breakers along the coast. This subtidal area, known as a bar and trough zone, is a high energy place with an unstable, sandy bottom. Because of this, there are no rooted or attached plants. Instead, the area is home to worms, snails, clams, and crustaceans that are adapted to living in burrows or down in the sand. Fish of varying sizes live in the surf zone, feeding upon the invertebrates that live here.

Long-shore currents move water and sediments along the beach, generally to the north in the summer and the south in the winter. As in most places of the world, heavier surf erodes Texas

beaches, making them narrower during the winter months and wider during the calmer, summer months. As sea levels rise, a process that has been going on for millennia, barrier islands migrate landward.

Two special shell beaches are found within Padre Island National Seashore along the South Texas coast, within an area of converging currents. Little Shell Beach is an accumulation of coquina clam shells that form a fine, shelly matrix. To the south of that is Big Shell Beach, which is an accumulation of ark shells that form a coarser shell matrix. These two beaches are very difficult to access or drive through, requiring a four-wheel drive vehicle.

Understanding The Tides

Water is constantly on the move, and one cause of this movement is the tide. The shifting tides impact where the shoreline is in relation to the water. At low tide the water recedes to its furthest point. At high tide the water line is at its highest point.

Tides are created primarily by astronomical factors that result from the combined gravitational forces of the Moon, the Sun, and the rotation of the Earth. Sometimes tides are also influenced by meteorological, or weather-related, factors, such as storms. Wind-tides in the Laguna Madre are a good Texas example

The shoreline itself can be split into different areas based on where it falls in relation to the tides: Subtidal: This part of the shore is always underwater, during both low and high tides.

Intertidal: During high tide, this area is completely submerged. At low tide, however, it is exposed to the air. Intertidal means between the tides. Supratidal: Above the high tide line, this area of shore is rarely submerged, although it may be subject to splash and spray.

Jetties

- **Jetties are artificial rocky shores protecting inlets into Texas ports and harbors.**
- **There are eight major and three minor sets of jetties along the Texas coast.**
- **Ecological zones governed by the tides are common on jetties.**
- **Sea roaches (isopod crustaceans) and periwinkle snails are common in the supratidal zone.**
- **False limpets, fragile barnacles, and fleshy macroalgae dominate the intertidal zone.**
- **Sea urchins are very common subtidally, along with sea anemones, sea whips, bivalves, snails, octopus, crabs, and fish.**

There are no natural rocky seashores along the outer Texas coast, but artificial rocky shores exist as “jetties” at various locations. These

exist to protect inlets, or passages through the coast into inner ports and harbors.

Four major sets of jetties protect natural inlets at Sabine, Bolivar, Aransas, and Brazos Santiago. Four additional large jetties are found at the Freeport Ship Channel, Matagorda Ship Channel, Velasco Channel, and Mansfield Cut through Padre Island. Three smaller jetties are found at Rollover Pass, Fish Pass, and Packery Channel.

The first of these larger structures were built in the late 1800s to protect and stabilize natural passes, allowing commercial vessels to pass safely through them. To build them, a bed of limestone rock is laid down as a foundation for granite tops. Granite is used because it is very hard and long-lived, and it is not used by marine boring organisms.

Ecologically, there is a big difference between the unstable sandy beaches along most of the coast and these jetties. The jetties provide a stable surface for the attachment of diverse marine life, both plant and animal.

Different ecological zones are common on these artificial rocky shores, just as they are on naturally rocky coastlines. This zonation is governed by the tides and how long water covers the rocks or splashes and sprays the rocks. Biologists often refer to these zones as follows:

- **Supratidal zone: Above the highest tide, receiving only splash or spray.**
  - **In the highest supratidal zone only the sea roach, a scavenging crustacean, is obvious scurrying around over the rocks.**

    - **The lower supratidal zone is home to microalgae that is fed on by herbivorous periwinkle snails.**
  - **Intertidal zone: Between the tides.**
    - **In the upper intertidal zone the false limpet and fragile barnacle are most common.**
    - **The lower intertidal zone houses fleshy macroalgae, such as sea lettuce and other red and brown algae.**
    - **The rocksnail is a common predator in the intertidal zone, and it feeds readily on the false limpet and other bivalves or snails in this zone.**
- **Subtidal zone: Below the lowest tide level.**
    - **The red sea urchin is a common herbivore that feeds on all of the abundant sea weeds growing on the jetty rocks.**

- **Other subtidal organisms include sponges, sea anemones, sea whips, segmented worms, bivalves, snails, octopus, crabs, and many species of fish.**

Freshwater Inflows

A Critical Need for Texas Coastal Bays and Estuaries

When the fresh water of rivers flows into coastal bays and estuaries this is known as freshwater inflow, and it is a critical element of estuarine health. Unfortunately, due to expanding human populations and increases in urban, agricultural, and industrial needs, there is less water available for the environment.

Texas has only one natural lake, Caddo Lake in East Texas, but it has over 50 water reservoirs built to meet the needs of the expanding population. Within the upper coast, where there is plentiful rainfall and freshwater inflow, estuaries are doing well. In the middle coast, where there is not much human population,

several issues have arisen, but overall the estuaries are doing well. In the Corpus Christi area, however, where the Nueces River provides little freshwater inflow anymore, due to water-capture in two large reservoirs, the estuary is showing signs of stress and health failure.

The water cycle is shown in this figure. The bays and estuaries are where river water meets and mixes with ocean water to form estuaries along our coast. These coastal embayments serve as nursery grounds for over 95% of our recreational and commercial fishery species, and are critical to the ecology and economy of the Texas coast.

Altered freshwater inflows can have a profound effect on coastal bays and estuaries. The lower salinity, as well as the nutrients and sediments delivered, are key elements in maintaining the natural function and high productivity of

estuaries. The figure above shows the negative effects that occur when freshwater inflow is reduced or cut off.

Recognizing the need for these environmental flows to reach the coast, some states, including Texas, California, and Florida, have enacted laws to protect water quantity inflow. The following are examples of Texas water laws regarding the protection of our bays and estuaries.

1985, HB 2 requires: “maintain a sound ecological environment” in Texas bays and estuaries.

2001, HB 1629: “maintain the ecological health and productivity of the Matagorda Bay system.”

2003, SB 1639 requires: “provide for the freshwater inflows necessary to maintain the

viability of the state's bay and estuary systems."

2007, SB 3: "adequate to support a sound ecological environment and to maintain the productivity, extent, and persistence of key aquatic habitats . . ."

Despite these protections, there have been ongoing problems. For instance, in 2001 the Rio Grande in South Texas stopped flowing, closing off the mouth of the river to the Gulf of Mexico (see photograph above). In addition, after a year of expert analysis, the Nueces Bay adjacent to Corpus Christi was determined to be an "unsound ecological environment" due to the lack of adequate freshwater inflows.

The graph below depicts the differences in freshwater inflow along the Texas coast. The highest flows occur in the Sabine-Neches

(Sabine Lake) and Trinity-San Jacinto (Galveston Bay) estuaries of the upper coast, and the lowest occur in South Texas.

As the human population increases, urban, agriculture, and industry water needs will continue to stress the natural environment of the Texas coast. This is particularly true of the southern portion of the state, but eventually the middle and upper coast will also suffer.

As Texans, one of our biggest challenges for the future will be the protection of our coasts, reconciling the demands of an increasing population with the needs of the coastal environment.

Kemp’s Ridley Sea Turtle

The Kemp’s ridley sea turtle is the most endangered sea turtle species in the world. It is one of only five sea turtle species that live in the Gulf of Mexico, and one of only seven in the world.

The Kemp’s ridley is the smallest of all sea turtles, and it is the only one with an almost circular upper shell. Hatchlings are black in color, juveniles are dark gray, and adults are olive green above and yellow below. Their geographic range is primarily in the Gulf of Mexico, but they also extend up the eastern coast of the U.S. to New England and Nova Scotia.

The Kemp’s ridley feed mostly on crabs, but they also eat other marine invertebrates and plants. Males, after hatching from nests on sandy

beaches, spend their entire lives at sea, while females become sexually mature between 10–15 years of age and move ashore to nest.

Preferring the sandy beaches of the western Gulf of Mexico, the single primary nesting site for the Kemp's ridley is Rancho Nuevo, Tamaulipas, Mexico, located about 230 miles south of the Texas-Mexico border. Females lay 1–4 clutches of eggs every two years, primarily during the months of May and June. Clutches can range from 50–130 eggs and incubation is for 50– 60 days. Interestingly, although most sea turtles nest in the nighttime, the Kemp's ridley, like the Olive ridley in the Pacific Ocean, nests primarily in the daytime.

Both the Kemp's ridley and the Olive ridley turtles display one of the most unique synchronized nesting habits in the natural world.

Large groups of the Kemp’s ridley gather off the nesting beaches of Rancho Nuevo and then come ashore in wave upon wave, in what is known as an “arribada”, which means “arrival” in Spanish.

Kemp’s Ridley Sea Turtle—A Conservation and Restoration Success Story

The Kemp’s ridley population underwent a devastating decline during the mid-1900s, primarily due to the overharvesting of eggs on nesting beaches and the loss of juveniles and adults due to commercial fishing.

Biologists did not know the location of the main Kemp’s ridley nesting beach in Mexico until the early 1960s, when a film from 1947 was discovered that showed an estimated 43,000 females nesting at Rancho Nuevo on one day. Corpus Christi marine biologist Dr. Henry Hildebrand discovered this nesting site after years of searching; however, protection efforts were not initiated at Rancho Nuevo until the mid-1960s. Despite these early protection efforts by

the Mexican government, the population continued to decline.

In 1978, the U.S. joined with Mexico in an international effort to try to save the species from extinction and recover the population. Multi-agency programs were developed in both countries, including an attempt to develop a secondary nesting colony at Padre Island National Seashore.

From 1978 to 1988 over 20,000 eggs were transported from Rancho Nuevo to Padre Island. After incubation, they were released on the beach sand to allow the hatchlings to imprint to that area. The young turtles were then captured and taken to a special facility of the National Oceanic and Atmospheric Administration, National Marine Fisheries Laboratory in Galveston. There, they were raised for

approximately one year and then released in various places, including Padre Island. This "head start" program allowed the turtles to grow to a larger size, enabling them to avoid many predators and increasing their survival rate. Most of the young turtles were tagged to help determine where they would return for nesting.

Despite all of these efforts, the turtle's population continued to decline and reached a low of only 702 nests worldwide in 1985.

Fortunately, the number of nests and eggs began to increase in the 1990s, and by the mid-2000s numbers began to look promising. By 2009, there were almost 200 nests on the Texas coast (mainly Padre Island) and almost 20,000 in Mexico, and recovery seemed to be underway. The numbers have fluctuated slightly in recent years, so continued conservation efforts in both

countries is a must if the species is to reach full recovery. If all goes well, delisting from the Endangered Species List could happen by 2020, but conservation diligence will be required to meet that goal.

Padre Island National Seashore biologists are leading the way for the recovery of this species in the United States. Eggs are collected from all discovered nests and incubated in National Seashore facilities for safety from predators and vehicles on the beach. This also increases survivability of hatchlings when released.

Interested parties are encouraged to go to the Padre Island National Seashore website to find out about timing and place of the public releases of the hatchlings that occur each summer (usually during July and early August). It is a wonderful and thrilling experience to see the

young turtles scamper across the beach and into the ocean for the first time.

Lower Coast

The lower Texas coast is characterized by a medium human population level centered at the north end around Corpus Christi and the southern end around Brownsville and South Padre Island. The major estuaries or bay systems include the Nueces-Corpus Christi Bay system and the Laguna Madre-Baffin Bay system. The six counties in this region include San Patricio, Nueces, Kleberg, Kenedy, Willacy, and Cameron, and the outer coast is bordered and protected by three barrier islands: Mustang, Padre, and Brazos. The two major natural passes, which also serve as ship channels, include Aransas Pass (Corpus Christi Ship Channel) and Brazos Santiago Pass (Brownsville Ship Channel). Padre Island is the longest undeveloped barrier island in the world, and

most of it is protected as Padre Island National Seashore. West of Padre Island is the Laguna Madre, which is the most famous hypersaline lagoon in the world. It is protected on the mainland side by the large ranches that line most of the shoreline (King, Kenedy, and Yturia ranches). Ecologically, the lower coast receives little rainfall or freshwater inflow, so seagrass beds and wind-tidal flats dominate as the main habitat types in Laguna Madre.

Seagrass Beds

- **Seagrass beds grow in shallow waters where there is the greatest amount of sunlight.**
- **Ecosystem services include:**
  - **Stabilization of substrate**
  - **Provision of nursery grounds**
  - **High biodiversity and productivity**
- **Seagrasses are flowering plants that grow submerged in Texas bays and lagoons.**
- **Texas seagrass beds are most common in the Laguna Madre of South Texas.**
- **There are five species of seagrasses in Texas**

Seagrasses are flowering plants that grow submerged in bays, estuaries, and marine environments, forming seagrass beds or meadows. Since they require sunlight, they are found in shallow, clear coastal waters that vary

from brackish water ponds to hypersaline lagoons.

Over 80% of Texas seagrasses are found in the Laguna Madre of South Texas, a shallow water lagoon averaging only three feet in depth. In other Texas bays, seagrasses are usually found only around the margins of shorelines, where the water is shallow and more transparent, so sunlight can reach the plants.

Species of Seagrass

There are five species of seagrass in Texas: shoal grass, manatee grass, turtle grass, clover grass, and widgeon grass.

Shoal grass (Halodule beaudettei): An early colonizer, or pioneering seagrass species, usually is the first to move into disturbed areas. This is the most tolerant species regarding

temperature and salt-content, and it forms dense stands.

Manatee grass (Cymodocea filiformis) is easily recognized with its long (4–12 inches) cylindrical blades. It is usually found mixed within other seagrass species or in small monotypic patches.

Turtle grass (Thalassia testudinum) is a favorite food of sea turtles, hence its common name, and it is easy to identify from other seagrass species by its wide leaf blade. It is most common in the extreme southern part of the Laguna Madre in extensive meadows.

Clover grass (Halophila engelmannii) has a rosette of leaves, making it look much different from any of the other seagrasses. It is also the least common Texas seagrass species, and it usually grows mixed within other species.

Widgeon grass (Ruppia maritima) can withstand wide ranges in both temperature and salinity. It can be found in freshwater ponds along the coast, as well as in the hypersaline waters of the Laguna Madre. Like shoal grass, widgeon grass is a favorite food of wintering ducks along the coast.

Ecological Importance and Environmental Impacts

Ecologically, seagrass beds are important in stabilizing bay bottom substrates. Additionally, they serve as nursery grounds for certain species, especially near Gulf inlets where young fish and shrimp settle for food and protection. Because both productivity and diversity is high in seagrass beds, recreational anglers consider it a prime spot for catching a variety of species.

Large numbers of waterfowl overwinter in the shallow seagrass beds of South Texas each year, and over 80% of the North American population of Red Head ducks is found in the Laguna Madre of Texas and Tamaulipas.

The seagrass beds depend on ample sunlight. Unfortunately, they have been impacted by outboard motor scarring, dredging, nutrient overload, and the brown tide in the Laguna Madre, which darkened the water, and killed off almost all of the seagrass below three feet.

Wind-Tidal Flats and Clay Dunes

- **Wide, gently sloping tidal flats, primarily in the Laguna Madre of South Texas, are inundated primarily by wind tides.**
- **Tidal flats are covered by blue-green algal mat and serve as an important habitat for selected herons, egrets, and shorebirds.**
- **Clay dunes line the upland edge of the mainland upwind from these wind-tidal flats.**

Wind-tidal flats are a unique Texas coastal habitat that is unknown to most Texans. Spreading over 350 square miles in the remote areas of the Laguna Madre of South Texas, they are rarely seen by the casual traveler because there are no public roads that go where they are most common.

As their name implies, these tidal flats are covered by wind tides, caused by the weather,

rather than the astronomical tides caused by gravity. They consist of wide, gently sloping shorelines one to three miles wide and occur along the backside of Padre Island and the South Texas mainland.

One area where wind-tidal flats are particularly common is the area of the Laguna Madre known as the Land-Cut. This land bridge of tidal flats extends from Padre Island to the mainland and is "cut" through by the Gulf Intracoastal Waterway canal. The flats on the backside of the barrier island are primarily composed of sand, whereas those along the mainland are composed of clay.

A Home For Algae

The featureless, flat terrain of wind-tidal flats are home to blue-green algae that can survive for months, or even years, without water. When the flats dry, the algae become dormant and the

ground cracks into distinctive polygons. Over time, the fine clay blows across the flats and accumulates, forming clay dunes in a process similar to how sand dunes are built on barrier islands.

When water rushes in as a result of wind tides, the algae becomes a lush brownish-green mat, and small invertebrates and fish move in. Long-legged herons and egrets can be found on the water-covered flats during this time, and when the water recedes small shorebirds feed on them.

Mangrove Swamps

- **Mangroves are tropical trees that grow in marine environments.**
- **Mangroves serve as important shoreline protection and nursery grounds.**
- **Only the black mangrove is common along Texas shorelines, primarily in the south.**

Mangroves are a special kind of tree that can grow in saltwater. When there are many of these trees they form a mangrove swamp or forest. These are typically found in tropical coastlines along the southern Gulf of Mexico and the Caribbean.

Three species of mangroves line the shorelines in bays and coastal lagoons in the southern Gulf, occupying specific zones related to the tide. The white mangrove is found on the land adjacent to the water, known as the supratidal zone. The

black mangrove is found in the area between the tides, or the intertidal zone. Finally, the red mangrove is found in the edge of the water along the coastline just below the lowest tide, known as the subtidal zone.

Although no white mangroves and only a few red mangroves are found in Texas, the black mangrove, which is more cold-tolerant, is spreading northward and has become quite abundant in certain areas.

Ecologically, mangroves are the tropical counterpart of the warm, temperate salt marshes that are widespread along the middle and upper Texas coast. They serve as shoreline protection, as well as a nursery ground area for many estuarine dependent species. The vertical air roots of black mangrove provide excellent protection for many small species, and some

Texas colonial waterbirds now use these small trees for nesting sites.