SEA GRANT COLLEGE PROGRAM

TEXAS SHORES

Capture the space and time of our coast, but don't mess with Texas beaches. Tons of garbage are tossed out, thrown overboard or wash up on our shore each year. We must not perpetuate this practice. Take a moment and stow your trash. Even better, please volunteer in local beach cleanup efforts and join the Texas Land Commission's Adopt-a-Beach program. That way we can all view the seascape from a better vantage point.

CLEAR THE DECK

Texas Sea Grant

An organization of professionals dedicated to the better understanding of our marine environment.

INSIDE

VOLUME 20 -- NUMBER 01

Galveston Bay at sunrise
by Norman Martin

In This Issue: Galveston Bay

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HISTORY – In 1968 Texas A&M received the distinction of being named among the nation's first six institutional award recipients. Three years later the school was designated a Sea Grant College. The university has a rich heritage of oceanography research dating back to 1949 when the program began. In addition there is an ongoing program to get marine information to the public.

SERVICE – The effort is aided by seven county marine extension agents serving the nine coastal counties of Texas. These individuals are backed by a group of specialists in marine recreation, fisheries and business management, as well as seafood marketing and consumer education.

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N O T E S

New president selected at Texas A&M-Galveston

Dr. William Merrell Jr. has been appointed to the joint position of president of Texas A&M University at Galveston (TAMUG) and coordinator for marine programs for The Texas A&M University System.

Merrell is currently on leave from Texas A&M University to serve as assistant director for geosciences for the National Science Foundation. He holds the rank of professor of oceanography and was associate dean of the College of Geosciences when he accepted the temporary federal assignment.

He will assume his new duties this summer upon completion of his National Science Foundation responsibilities, noted Texas A&M University System Chancellor Perry Adkisson, who recommended the appointment to the Board of Regents.

Merrell succeeds Dr. William Clayton, who retired from the presidency at Galveston January 1 but remains with the institution as superintendent of the U. S. Maritime Service Program through this summer to provide staff leadership for the annual training cruise.

Dr. Sammy Ray is currently serving as interim president.

Merrell has served as an assistant NSF director since October of 1985. Before taking leave of absence to accept the NSF post, Merrell was associate dean of Texas A&M's College of Geosciences and was instrumental in having Texas A&M named science operator for the Ocean Drilling Program.

ODP is a multi-national $30-million-per-year project headquartered at Texas A&M's new research park. Its activities involve deep-sea drilling throughout the world to learn more about the origin of the earth.

Earlier in his career, Merrell directed Texas A&M's Earth Resources Institute and the College of Geosciences Division of Atmospheric and Marine Sciences.

Merrell earned bachelor's and master's degrees from Sam Houston State University and a Ph.D. from Texas A&M.

– Ed Walraven

Texas A&M archeologists study ancient shipwreck

The recently uncovered hull from a Columbus-era Spanish shipwreck is the most intact yet found in the Caribbean and is probably among the oldest, say nautical archeologists from Texas A&M University.

Many vessel artifacts, including guns, were removed 20 years ago by freelance collectors, but the extent of hull preservation was unknown until Texas A&M researchers excavated the wreck near Highborn Cay in the Bahamas.

In addition, a land survey turned up drinkable water on the cay and evidence of Indian habitation -- both unexpected because there was no reason to suspect the piece of land ever attracted or was visited by either European explorers or Indians.

"Both the water and the Indians, probably Arawaks, could partly explain what the ship was doing there in the first place," says project director Don Keith, a researcher with the Institute of Nautical Archeology (INA), a university-affiliated group.

While representing less than 10 percent of the ship's total bulk, the hull timbers found are significant, says ship reconstruction specialist Tom Oertling.

In a report just sent to the Bahamian government, Oertling estimates the Spanish ship was just over 60 feet long. He says the wreck gave the first hard evidence of dimensions of a ship of discovery and allowed an estimate of size.

—Ed Walraven

Soft-shell crab markets still moving at a crawl

Commercial harvesting of the soft-shell blue crabs so pleasing to the palate of seafood lovers has been a multi-million dollar enterprise for decades. The soft-shell crabbing industry, however, is restricted almost exclusively to the Chesapeake Bay area, despite the fact that in Texas the crabs are plentiful and the season during which soft-shell crabs could be harvested is almost twice as long.

Although the hard-shell crab industry is fairly stable in Texas, the state's soft-shell crab industry remains undeveloped, says Dr. James Cameron, a professor of marine studies and zoology at The University of Texas Marine Science Institute at Port Aransas.

According to Cameron, soft-shell crabbing requires specialized fishing methods because the crabs have soft shells for only a few hours between the time they shed their old shells and form new ones.

In Chesapeake Bay, he points out, watermen know precisely where the peelers hide during molting. Crabs that are about to molt hide in shallow beds of seagrass near shore which will offer some protection during the short period after molting when they are more vulnerable, Cameron explains. Commercial crabbers locate such crabs, known as peelers, collect them and keep them in containers until they molt. Immediately after molting, the crabs are removed from the containers or peeler floats and are shipped under refrigerated conditions to wholesalers.

Because of the long molting season for blue crabs, named for the color of their legs, the potential for successful soft-shell crabbing industries in Texas is great, Cameron notes.

However, some problems must be overcome first. Unlike Chesapeake Bay, crabbers in Texas are still searching the bays for the protected areas in which the peelers hide, he says, and are still developing effective fishing methods for soft-shell crabs. Crabs can frequently live up to three years.

—Julia Goplerud

Number of whoopers finally taking flight

This past year was the most successful since the early 1940s for breeding of endangered whooping cranes which annually winter along the Gulf Coast, Texas A&M University wildlife scientists say.

The number of birds increased to 110, up from the mid-90s the previous year, with only one chick lost. Whooping cranes usually find a mate while in Texas and breed in Canada during the summer months.

The cranes will return next fall to open fields and roasted acorns, the researchers say.

Cranes like the uplands that are cleared so they can watch for predators. They are especially fond of roasted acorns that fall off small oak trees cleared with fire, says Howard Hunt, a doctoral student, and Dr. Doug Slack, both of Texas A&M's Department of Wildlife and Fisheries Sciences. They studied the endangered species' reaction to brush burning.

Upland habitats were cleared with controlled fire at the Aransas National Wildlife Refuge and within a day or two the birds were on site.

"People don't generally understand that you can use something like fire as a wildlife management tool. It's been used extensively, but rarely do you get to use it for helping out an endangered species," Slack says.

"It might be an especially good tool if major disturbances to the wetlands occur, such as an oil spill. In the short term we can attract the birds to the uplands," he says.

Brush burning not only opens up the fields and increases the availability of acorns that the birds like to eat, it increases the abundance of insects, which they also eat in the uplands, Hunt says. In the wetlands they eat seafood, such as crabs and clams, he says.

"There's even the advantage of tourists getting a good view of the birds," he adds. This past winter, the number of birds increased to 110, from an all-time low of 21 birds in 1941, says Hunt.

–Michael Courtney

Female fellow warms to cold-climate study

One of the first female oceanography students to ever carry out her graduate research in Antarctica hails from Texas A&M University. She is examining microscopic sea plants found in the icy seas.

Carol Stephens spent two months in Anarctica this spring, alternately collecting plant samples from the Southern Ocean and doing land-based analysis at Palmer Station before she returned to College Station.

Palmer Station is located on the Antarctic Peninsula which juts northward toward the South American continent. Some of the phytoplankton that interests Stephens has not even been classified by biologists.

Stephens is a Marine Fellow in Texas A&M's Sea Grant College Program.

"My purpose is to find out how much is there and at what rate it reproduces," says Stephens, who came to Texas A&M after earning a master's degree at the University of Georgia.

Her adviser at Texas A&M is a leading Southern Ocean researcher, Dr. Sayed Z. El-Sayed.

El-Sayed, involved in Antarctic studies for more than two decades, says Stephens follows in the footsteps of other women scientists who have contributed to the study of Antarctic phytoplankton -- including Grethe Hasle of Norway, the late O.G. Kozlova of the USSR, and Texas A&M's Dr. Greta Fryxell.

–Ed Walraven

Clean Water Act will include Galveston Bay

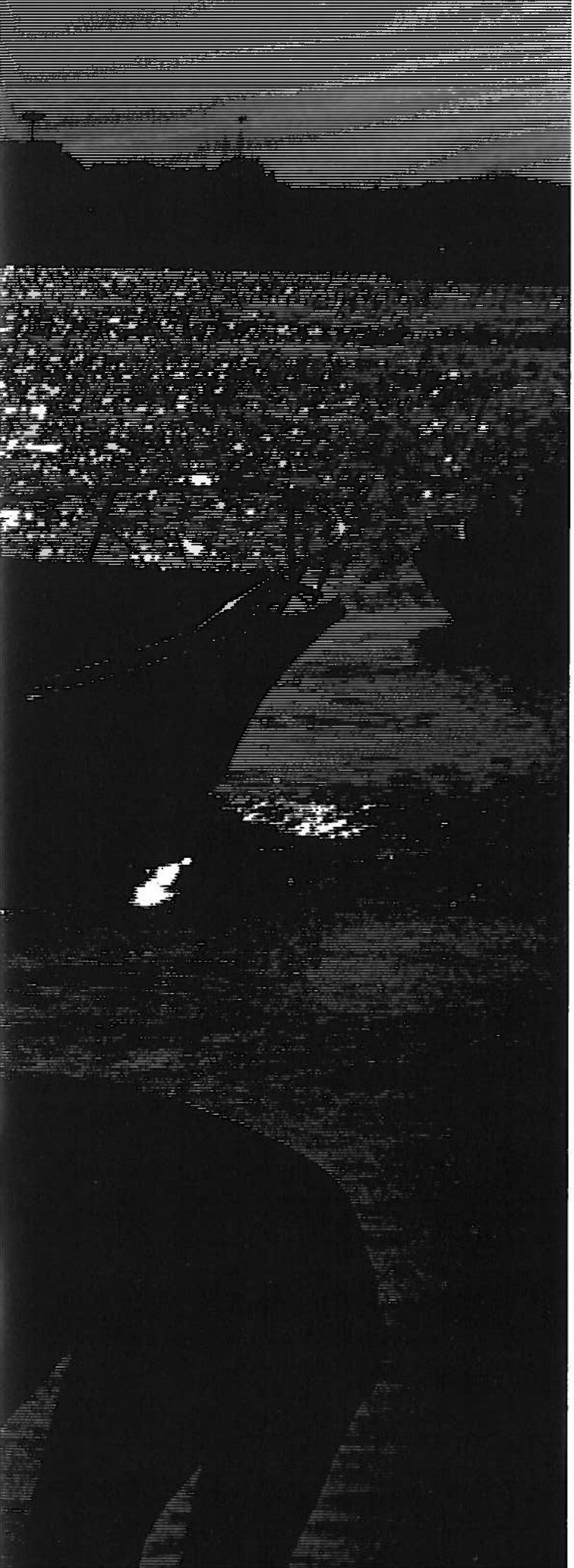
Galveston Bay is one of 11 bays or estuaries in the United States designated for priority consideration under provisions of an amendment to the Federal Water Pollution Control Act. The legislation, commonly known as the Clean Water Act, is to provide, among other things, for the renewal of the quality of the country's waters.

The bill provides for a National Estuary Program to be administered by the Environmental Protection Agency in recognition of the importance of estuaries to fish and wildlife resources and recreation and economic opportunities. It continues by stating that maintaining the health and ecological integrity of these estuaries is in the national interest, but increasing coastal population, development and other direct and indirect uses threaten the health and ecological integrity of the estuaries.

Nationally significant estuaries that are threatened by pollution, development or overuse will be identified, and funding will be provided for comprehensive planning, research, conservation and management. Although Galveston Bay is identified for priority consideration, it will be included only if formally requested by the Governor.

Once this request is made, a management conference will be convened to assess trends in water quality, natural resources and estuarine uses; collect, characterize and assess data on toxics, nutrients and natural resources within the estuarine zone to identify the causes of environmental problems; develop a comprehensive conservation and management plan that recommends priority corrective actions and compliance schedules both for federal, state and local agencies and officials; and monitor effectiveness of subsequent actions. In addition to Galveston, the others are Long Island Sound, Narragansett Bay, Buzzards Bay, Puget Sound, New York/New Jersey Harbor, Delaware Bay, Delaware Inland Bays, Albemarle Sound, Sarasota Bay and San Francisco Bay.

–Amy Broussard



Mel Russell squinted into the sun as he looked down off the bow of the *Elizabeth R* as it slowly plodded across the rippling waters of Galveston Bay.

"It's not a pretty bay, but it works hard," said the Texas A&M University Sea Grant marine agent who first made his home here in 1967. In the distance a huge, lumbering oil tanker rolls steadily toward the narrow corridor of the Houston Ship Channel that slices across the bay.

"This stretch of water is pushed to the limit every day of the year. We've got development, fishing, recreation and big-time transportation and still it's the most productive bay in Texas. It's a wonder," said Russell with an ever-present grin.

Galveston Bay does exist somewhat removed from the daily life of most Texans. Lacking proximity and the visual splendor of a San Franscisco Bay, it's easy to ignore.

"The casual visitor isn't likely to leave his heart in Galveston Bay or even to consider it, on the visual-level evidence alone, a resource worth saving," says Dr. Robert Ditton, a professor of recreation and parks at Texas A&M University. But this stretch of water is of crucial importance to the economic well-being and quality of life on the Texas Gulf coast.

THE BIG BAY

TEXT AND PHOTOGRAPHY BY NORMAN MARTIN

Almost three-fourths of the state's coastal population live in the surrounding counties. The largest of the state's seven major estuarine systems, the Galveston Bay complex provides the nursery and spawning grounds for some 30 percent of the total fishing products harvested from the Texas coast.

Dr. James Kendall, a water quality specialist with the Texas Water Commission in Deer Park, says, "Galveston Bay is a dynamic system. It's not just a lake sitting there."

Dewayne Hollin, a business management specialist with the Texas A&M Sea Grant Program in College Station, says one of the primary economic values of the bay system itself is in transportation of products in and out of the Gulf of Mexico.

This facet is represented by both the Houston and Galveston ship channels. "The Port of Houston represents the third-largest U.S. port in tonnage and is the second in international tonnage," Hollin says. "More than 85 million short tons of cargo are handled through the port every year." More than 4,700 ships a year call at the Port of Houston, which is closely tied to the the area's petrochemical-petroleum refining complex.

Moreover, he says, the bay is Texas' largest in terms of landed seafood value. In 1985, the latest year for which there are figures, the value of commercially landed seafood was $11.2 million, of which $5.8 million was oysters and $4.3 million was shrimp. "It's a very valuable resource for all types of seafood production," Hollin says.

In addition, the bay has a major recreational industry impact. Hollin says a recent study tabbed the bay's recreational fishing industry value at more than $100 million annually.

Hollin adds that Galveston Bay is an important boating resource as evidenced by the number of coastal marinas and wet slips. In 1985 Galveston Bay accounted for 29 percent of all the marinas on the entire Texas coast. It accounted for 61 percent of all the wet slips – more than 8,000. Also, regional boat ownership approaches 20 to 25 boats per 1,000 population, which compares well with some other major boating areas in the United States.

"This disproportionate level of development is no doubt a response to the large adjacent population in the Houston, Galveston, Brazoria complex," Ditton says.

"Galveston Bay is clearly the major center for bay boat fishing on the entire Texas coast," Ditton says. Of the major bay systems in Texas, Galveston Bay accounts for nearly half, 48 percent, of the boat fishermen who go bay fishing. Matagorda Bay is second, with a distant 17 percent. Thirty-five percent of the fishermen who go fishing offshore on the Texas coast do so directly adjacent to Galveston Bay.

"This is the highest percentage along the entire Texas coast," Ditton says.

In purely logistic terms, Galveston Bay is an irregularly shaped, shallow body of water, roughly 30 miles long and 17 miles wide at its widest point. Water depth is generally between

Almost three-fourths of the state's coastal population are packed around Galveston Bay (top). Even so, the ecosystem of estuaries and wildlife habitats is one of the most productive in Texas (center). It's also the breadbasket of a huge recreational boating and marina industry (bottom).

GALVESTON
I S L A N D C I T Y

Galveston Bay is more than big ships and fast fish. It's homeport to the city of Galveston itself.

By Texas standards, Galveston is an ancient city, ranking right up with Athens in some folks' minds. What Dallas is today, Galveston was in the last century. The Island was the state's most advanced, prosperous city – an international port doing brisk commerce with the world.

In 1900, the worst national disaster in United States history set the island back as a massive hurricane roared through the community, ultimately killing more than 6,000 people. But the city survived and part of that historic past remains today.

Some of the grandest homes ever built in Texas were constructed in Galveston during the 19th century. Many still stand. Among the most magnificent is Bishop's Palace, a staggering work of design, material and craftsmanship. Ashton Villa, built in 1859, not only survived the 1900 Hurricane but also the cannonballs that crashed to ground nearby during the Civil War. The city's East End Historical District covers an area of 40 square blocks and has been designated a National Historical Landmark.

The Strand on Galveston Island.

Another historical artifact is the The Strand, located one block from the dock area. Named after the famous London street, The Strand was the main commercial artery of Galveston when the city was the heart of Texas trade. Most of the Victorian buildings have survived and have been restored. Today they house a new era of businesses, mostly catering to tourists. Trendy shops, art galleries, restaurants and historic exhibits compete along this five-block stretch.

Galveston is also home to the tall ship, Elissa. Built in 1877, the ship originally visited Galveston in 1886 as a commercial vessel. In 1974, a Galveston group found it in Greece, waiting to be scrapped. Seven years and $4 million later, it was restored. The crew and captain's quarters and cargo hold are now a mini-museum of 19th-century sailing.■

7 and 9 feet. It is nearly separated into two parts by Red Fish Bar, a chain of small islets and shoals. The part of the bay northward of Red Fish Bar is called the "Upper Bay" and the part southward as "Lower Bay." The northeastern end of Upper Bay is known as Trinity Bay.

Why is Galveston Bay the most productive of all the Texas estuaries? Robert McFarlane, a Houston-based environmental consultant, says the Galveston Bay has some rather unique features. Among these are:

- A humid ecosystem as opposed to the arid variety found further south down the coast.
- Relatively low temperatures, which are particularly important during the summer fish and shellfish reproduction periods.
- High rainfall, which aids in maintaining low overall salinity.
- And, finally, there is a difference in the vegetation growing around the bay compared to other Texas bays.

Perhaps the most important of these factors, though, is salinity. "In an age of lite beer and bread, we can talk about Galveston Bay as having lite water. It has half to two-thirds less salt than the Gulf of Mexico," McFarlane says. In short, this low salinity is key to its success because so many estuarine species require low-salinity water, particularly shrimp during critical parts of their life cycle.

Salinity in the bay increases from the top to the bottom of the water column and is greatly influenced by freshwater inflows. Maximum salinities occur during dry periods from September to November when the flow of freswater into the bay of less than 2,000 cubic feet per second is common. Minimum salinities are found in conjunction with heavy spring rains when flows of more than 100,000 cubic feet per second can occur for short periods. The typical temperature range of the bay waters is from 59°F to 90°F.

Galveston Bay is part of a major ecosystem called the Trinity River Watershed that extends all the way to Oklahoma. "We're talking about a big, big area," McFarlane says. The Trinity River watershed is 360 miles long and 100 miles wide. That's more than 18,000 square miles. The system runs through the Dallas and Fort Worth area and includes 44 percent of the state's population.

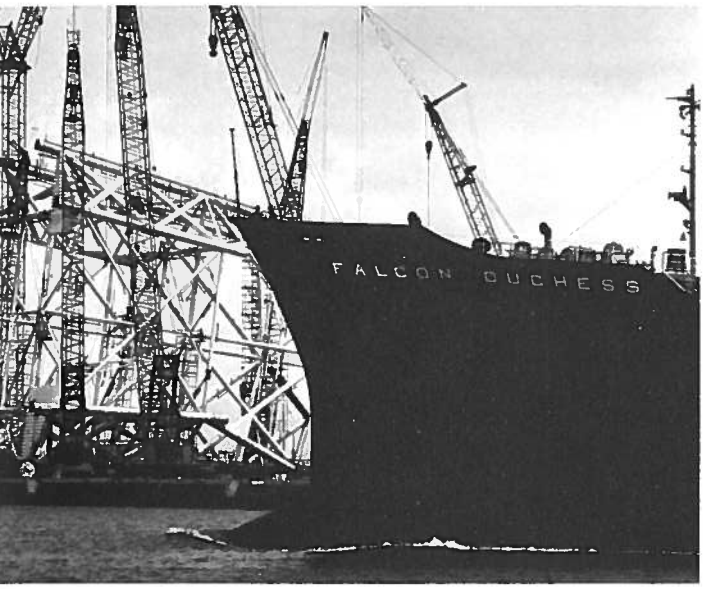
McFarlane says 48 percent of the fresh water that flows into Galveston Bay comes out of the Trinity River alone. Rainfall accounts for another 14 percent. How much water comes down the Trinity River? According to the U.S. Geological Survey, the bay has received an average of 5.23 million acre feet annually for the past 61 years. An acre foot is one acre of water, one foot deep.

"Everything that happens to the Trinity River as far as Oklahoma has a potential effect on Galveston Bay," McFarlane says.

If you looked at Galveston Bay from space, it would appear as part of the Texas Coastal Prairie, a region of nearly continuous marginal marine embayments, separated from the Gulf of Mexico by a system of sand barrier islands and peninsulas.

The coastal zone is entirely underlaid by sedimentary deposits. The area is rich in mineral, energy and groundwater resources. While the leading moneymakers are oil and natural gas, the area also contains important supplies of sulfur, salt and shell for lime.

The mix of natural forces making up the bay system is the



result of several interacting processes, including tides, currents and those varying freshwater inflows around the edge of the bay. The mean lunar tidal range is low, less than 1 foot. Winds also influence water levels. Marine experts say a change between onshore and offshore winds can produce a 3-foot difference in bay water levels. The waves are determined by water depth, wind strength and fetch. Typical wave heights are in the 1- to 3-foot range.

While usually light brown in color, water quality is generally characterized as good. The waters are relatively turbid most of the time due to the shallow nature of the bay.

One aspect of the bay's water quality that can't be described as good is the level of coliform bacteria. During the past 30 years, large portions of the bay – usually around the shoreline – have remained closed to shellfishing. This is primarily the result of bacteria being introduced by runoff from surrounding lands. One useful way to better understand how this bay works is to divide it into two zones – open bay and estuarine shallow water.

The open-bay zone, ranging in depth from 4 feet to 15 feet, occurs on either side of the Houston Ship Channel. The estuarine shallow-water zone occurs in areas of less than 4 feet of water. Estuarine organisms depend heavily on the shallow-water zone for protective cover, food sources and nutrients from nearby marshes. These areas are particularly valuable for species that use them as nursery and spawning grounds.

The wetlands that affect Galveston Bay are occupied by emergent vegetation, McFarlane says. That means the various species of grasses grow up and out of the water, standing erect in full sunshine and are able to photosynthesize at full speed.

Dr. Frank Fisher, a professor of biology at Rice University, says the basis of the food chain in the estuaries is generally assumed to be plant material in some state of decomposition. Fisher says this material floats into the bay and becomes absorbed into clay and other sediments. "That affords a life support system for the other animals living there," Fisher says.

There are five types of habitat – upland, swamp, marsh, aquatic and beach. Smooth cordgrass is the major species of salt marshes in the area. The most characteristic species in less salty marshes is saltmeadow cordgrass. A large part of the habitat classified as wetlands by the U.S. Fish and Wildlife Service is located on islands created or expanded by dredged-material deposition during construction and maintenance of ship channels.

"Life in the bay is relatively easy," Fisher says. "It's not exposed to big temperature and salinity shifts." The climate is dominated by the influence of the Gulf of Mexico and Galveston Bay, and is generally characterized by short, mild winters and long, hot summers.

A primary economic value of the bay system is transportation in and out of the Gulf of Mexico (top). Still, despite the heavy ship traffic, there are plenty of wide open spaces to walk (middle). Tourism development is another of the region's revenue producers (bottom).

SHIFTING SANDS

SO THE BEACH DIDN'T STAY PUT. IT MADE MONEY

More than 1,500 cubic yards of sand was piled on a Galveston beach in a gamble to stop erosion.

But 17 months and $21,000 later, the beach had retreated 174 feet due to a combination of wind and waves.

A steady combination of wind and waves has gutted a $21,000 experiment to restore the beach area to one section of Galveston's tourist-laden Seawall Boulevard.

Texas A&M researchers say a small-scale ocean beach nourishment project in front of one of the island's largest hotels was initiated in the spring of 1985 along a 750-foot section of the seawall. The San Luis Hotel piled 1,500 cubic yards of sand onto the beach in a gamble that more beach would draw more tourists. But during 17 months of monitoring, the shoreline retreated approximately 174 feet and lost approximately 16 percent of the material after the nourishment was completed.

"Obviously the San Luis' management felt their expenditure was justified by the increase in business for the hotel that the nourished beach would produce," says Dr. John Giardino of Texas A&M's Department of Geography.

Dr. Robert Bednarz, a co-researcher on the project, adds that the material exited from the beach largely by means of wave action and wind transport. On numerous visits, the Texas A&M researchers also observed sand blowing from the beach and over the top of the seawall.

"So much sand was deposited on the road, which occupies the top of the seawall, that patches up to 100 square feet and 4 inches thick were measured on one occasion," Bednarz says. "Local merchants complained regularly that the doorways of their businesses were blocked by sand dunes."

The Galveston Island shoreline has been retreating for a number of years. Following the initial construction of the seawall in 1902, the ocean beach in front of the seawall began to disappear. In an effort to maintain the beach and to protect the base of the seawall, 13 groins were constructed along the eastern portion of the wall, and large granite blocks were placed at the seawall's base to protect it from erosion by waves. Although these actions protect the base of the seawall to some extent, the beach is still narrow, and this limits its recreational use.

Experts say coastal erosion is, for the most part, the result of low frequency-high magnitude events like hurricanes or high frequency-low magnitude events such as the daily pounding of waves. In addition, human intervention with the natural system, such as with construction of dams on both the Brazos and Trinity Rivers and destruction of the island's dune system, contribute to shoreline erosion by either restricting or removing the supply of sand that might otherwise be used to maintain the beach naturally.

Some marine researchers have suggested that a beach can be maintained or even advanced seaward by the addition of substantial volumes of material – a process known as beach nourishment or renourishment. There are clear economic reasons for wanting the beach to stay put.

The U.S. Army Corps of Engineers estimates the benefit value of a daily visit to the beach is $5.27 per person. If the figure is accurate, the expenditure by the San Luis is justified by an increased attendance at the beach of only 4,037 people.

"Because of the modest cost of the nourishment project, the net return to the San Luis Hotel might well have been positive," Giardino says.

The Texas A&M researchers found two distinct changes as a result of the beach nourishment experiment. The initial nourishment of the beach extended the shoreline 200 feet. During the period of study, the base of the beach was eroded approximately 175 feet, for a net gain of 25 percent. Analyses of the volumetric change for the study period showed the beach lost approximately 16 percent of the material added during the nourishment project. ■

TEXT AND PHOTOGRAPHY BY NORMAN MARTIN

Because of the moderating influence of the bay and Gulf waters and relatively low latitude, cold fronts are seldom severe. Temperatures below freezing are recorded on an average of only four times a year. Most freezing temperatures last only a few hours and are usually accompanied by clear skies. The normal monthly maximum temperatures at Galveston from 1951 to 1980 ranged from 59°F in January to 87.5°F in August.

Normal rainfall is about 48 inches and is distributed throughout the year. Amounts vary greatly in different bay locations during the summer due to local thunderstorm activity. Minimum and maximum annual rainfall was 21.40 inches in 1948 and 67.20 inches in 1946.

Unfortunately, Galveston Bay has at times been the target of major tropical storms of hurricane force. At least 13 storms have crossed the coastline in the immediate Galveston Bay vicinity since 1900. A huge hurricane in 1900 almost destroyed the city of Galveston. Because of that storm, a 17-foot, 10-mile-long seawall was built to minimize storm surge damage.

Average monthly wind speeds vary from 9.4 to 12.1 mph for August and April, respectively. The prevailing wind direction is out of the south-southeast. The National Weather Service says the fastest wind speed recorded was 100 mph from the northeast on September 8, 1900.

In terms of value, sportfish and shellfish top the money list. Commercial and recreational fish species include spotted seatrout, redfish, black drum, flounder, Gulf menhaden, sheepshead minnow, mullet, gafftopsail catfish and Atlantic croaker. The most valuable commercial species among invertebrates are shrimp, blue crab and oysters.

Dominant fish, crab and shrimp species in Galveston Bay are the Gulf menhaden, bay anchovy, gafftopsail catfish, sea catfish, sand seatrout, speckled trout, spot, Atlantic croaker, black drum, redfish, star drum, striped mullet, southern flounder, tidewater silversides, sheepshead minnow, striped killifish, brown shrimp, white shrimp and blue crab. Oysters are the dominant attached bottom organisms, and are responsible for the naturally occurring reefs in the bay.

Lee Maril, of Texas Southmost College in Brownsville, says Texas commercial fishermen have sailed the bay since the turn of the century.

Those first fishing efforts were in wooden, shallow-draft sail or oar-driven boats. Later, motors, often from cars, were adapted for bay use. White shrimp were commonly netted along with other local fish species, including sea bass, redfish, flounder, whiting and shellfish in season.

Immediately after World War II, Maril says, Gulf shrimp fishermen from Louisiana began exploiting large fisheries of brown shrimp off the Texas coast and the Mexican coast. These fishermen, the majority of whom were Cajuns, employed deep-draft vessels that normally exceeded 50 feet in length. These deep-

Please Turn to Page 24

Birds are the most conspicuous wildlife feature in the bay (top). Another feature of the ecosystem is its abundance of shrimp (middle). But in addition to the economic and avian features, Galveston is a focal point for Texas' past.

HOMEPORT FOR MARINE SCIENCE

Texas A&M wants to make Galveston the Woods Hole of the Gulf of Mexico.

Marine research activities at Texas A&M University at Galveston campus should be expanded, in cooperation with The University of Texas System and perhaps other institutions, to rival Woods Hole Oceanographic Institution in Massachusetts or Scripps Institution of Oceanography in California.

That was the main point in The Texas A&M University System testimony before the Select Committee on Higher Education that met this spring to consider the fate of certain low-enrollment institutions, including Galveston.

System Chancellor Perry Adkisson proposed establishing an organization to be known as the Texas Institution for Oceanography on the Galveston campus.

He said a cooperative administration and cost-use structure could be negotiated for all user institutions. He said a model for the framework might be the Houston Area Research Center (HARC), whose member institutions are Texas A&M University, The University of Texas at Austin, University of Houston-University Park and Rice University.

Such a marine-oriented research facility at Galveston "would provide a focal point to advance development in fields with brilliant futures by providing training for Texas students, facilities for Texas scientists, and it also would bring new revenue and jobs into the state," Adkisson said.

Addressing the specific issue of the future of Galveston, he reminded committee members that the marine-oriented institution at Galveston is a "special purpose" entity. It has a narrowly defined curriculum set forth in House Bill 181 of the 67th Legislature, restricting it to marine-oriented undergraduate instruction. Its major functions include training ships' officers through its maritime license option, and undergraduate degree programs in marine biology, marine fisheries and marine science.

"It should be noted that from its creation, Texas A&M University at Galveston was limited in its mission by this enabling legislation and, therefore, cannot fairly be compared with general academic institutions within the state," Adkisson pointed out.

In addition, because of the small enrollment of some 575 students and the specialized training provided, costs-per-student are considerably higher than those of the other universities of The Texas A&M University System. Cost data show that the 1985 cost-per-student at Galveston was $9,352, compared with $5,395 at Texas A&M University at College Station.

"Because Texas A&M University at Galveston is a special-purpose institution restricted to undergraduate programs in the marine sciences, it has appeal only to a small number of students in the total college student pool," Adkisson said.

"Various options are being evaluated concerning how best to strengthen the focused academic programs. There will be a continuing need to maintain and expand instructional, research and extension activities involving marine resources," Adkisson said. "The Gulf of Mexico and the oceans are of vital importance to Texas. Marine resources – oil, gas, fisheries, transportation and recreation – all enhance the state's economy."

He said a "tremendous need" exists for expanded research and development activities and for the continuance of high-quality education programs in the marine sciences. "Because of these necessities and opportunities, Texas must develop marine research and extension programs and facilities that will rival those of Woods Hole or the Scripps Institution of Oceanography," Adkisson said.

Texas A&M is the federally mandated Sea Grant university for Texas. Texas A&M also operates a large oceanography department and was recently designated as manager of the Ocean Drilling Program, a $30-million-per-year global endeavor involving several other U.S. institutions and agencies of six foreign governments. This year's budget for atmospheric and marine sciences at Texas A&M exceeds $51.3 million, of which only $4.3 million is provided by state funding.

"Marine programs at The University of Texas at Austin are also substantial," Adkisson said, adding that the programs of the two institutions are complementary and not duplicative or competitive. "Each would benefit scientifically and eco-

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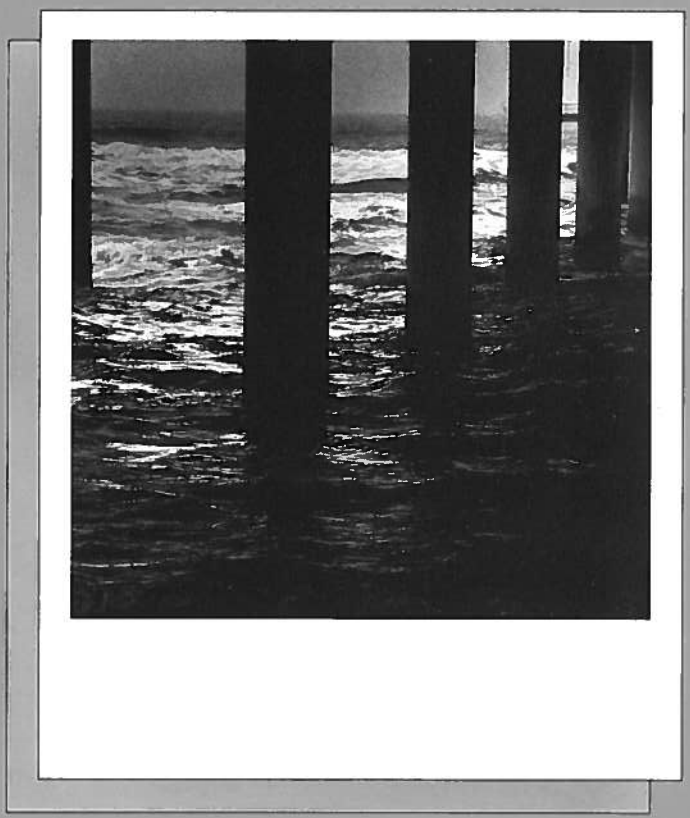
TEXT BY LANE STEPHENSON

C H A N N E



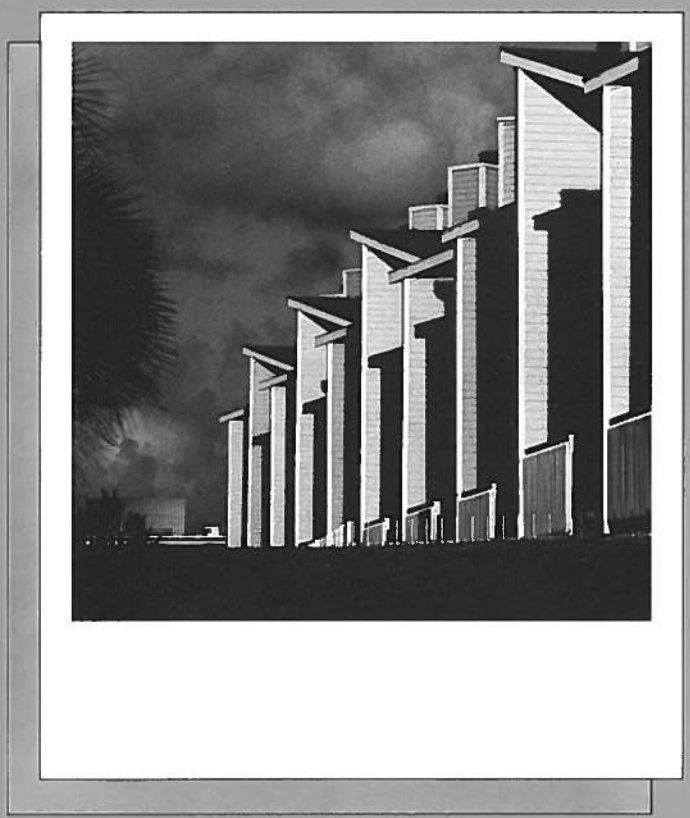
Down on Galveston Island you can hear the soothing rhythm of waves lapping at the sand. What you can't hear yet is the bureaucratic, legal and economic battle being waged between the U.S. Army Corps of Engineers and environmental interests over expansion plans for the Houston Ship Channel.

The Corps' Galveston district, at the request of the Houston and Galveston port authorities, has proposed deepening and widening the Houston and Galveston ship channels to accommodate larger vessels. The project to enlarge the channel, which bisects the bay, would result in major savings for shippers and only minimal environmental damage to the bay, according to a Corps study.

Several state agencies and environmental groups believe there is little to gain by the dredging project and that the bay, home of one of the nation's most productive fisheries and a key recreation area, could be damaged. The environmental statement portion of the proposal has been sharply criticized by state and federal fishery agencies. Even the Corps acknowledges that unavoidable effects of the huge project include loss or disturbance of bay bottom and oyster reefs, and increased saltwater intrusion during certain periods of low freshwater inflow, as well as increased turbidity during dredging operations.

Lee Vela, a spokesman for the Port of Houston, says, "They've been dredging

L N O I S E



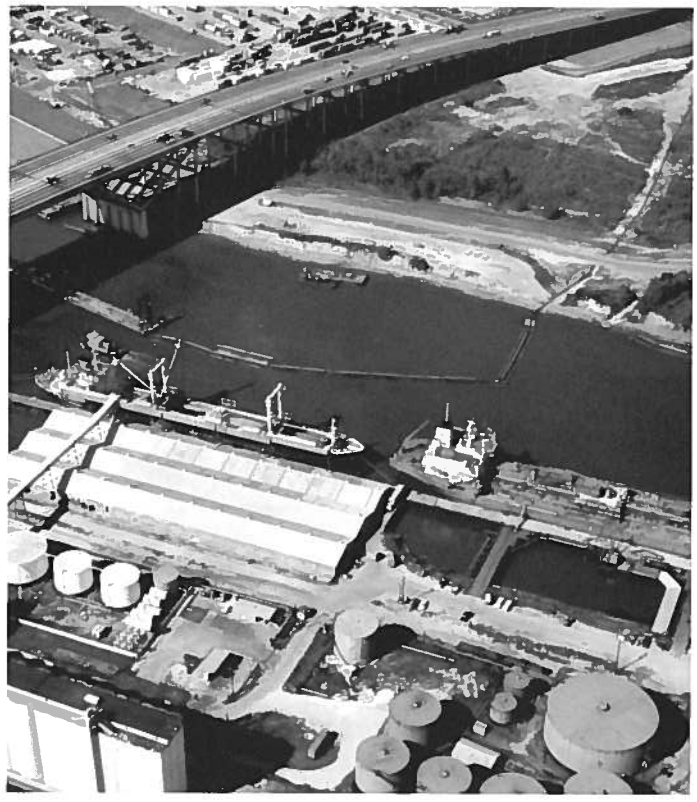
since 1867 and the bay has never been more productive than it is today." Vela contends that the Corps has just "got a bad rap" in news media reports about the channel project.

"They're not out there just to create jobs for themselves," Vela says. "They only react to requests made by local entities. They are not a promoter of this project. We – the Port of Houston – are the promoter and the driving force behind this project."

District Engineer Col. Gordon Clarke explains that the plan calls for the ship channel to be deepened to 50 feet from the present 40 feet and widened to 600 feet from the present 400 feet from the confluence of the Houston Ship Channel and Texas City Channel to the vicinity of the Shell Docks at Boggy Bayou in Houston. Additional widening is provided to the Clinton Island Turning Basin on the channel. Improvements to the Galveston Channel include a 50-foot deep by 450-foot wide channel.

Although Texans long viewed navigation as the bay's biggest benefit, many scientists and sociologists believe it is more valuable today as an environmental resource. "Galveston Bay is one of the most incredible and irreplaceable natural resources of our state," says Paul Hopkins, chairman of the Texas Water Commission.

Clarke says Corps studies show the project will have little impact on the bay



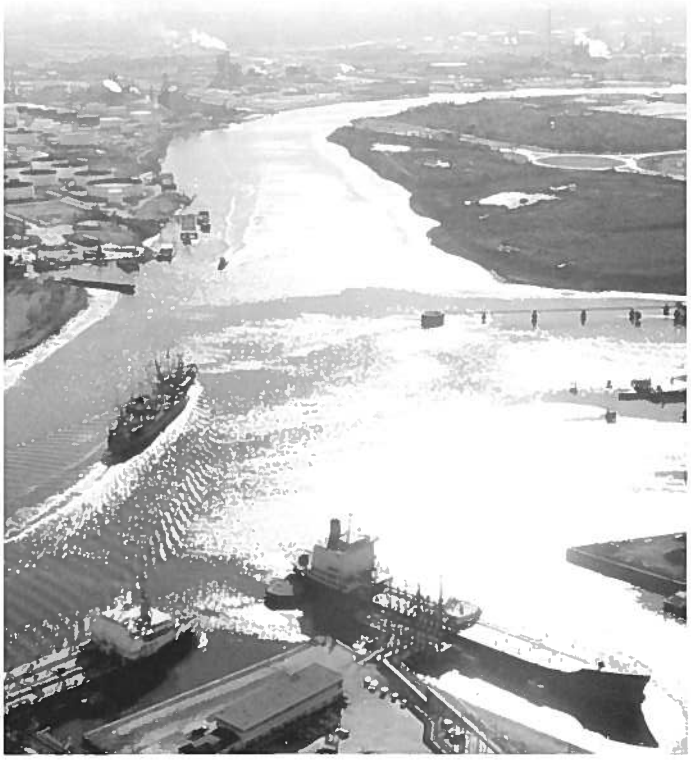
—CORPS OF ENGINEERS

The $355 million Corps of Engineers project would deepen and widen Galveston Bay to 50 feet deep and 600 feet wide.

Proponents say the Corps has been dredging the bay since 1867 and it's never been more productive than it is today.

Port of Houston officials believe there are clear economic, environmental and safety advantages to a deeper channel.

More fully laden ships means lower transportation costs. In the long term that could translate to a savings for consumers.



CORPS OF ENGINEERS

Opponents say there is little to gain from a deeper channel, and the sensitive bay could be damaged by extensive dredging.

Several state agencies have sought a cumulative environmental impact statement from the Corps of Engineers.

while providing an economic benefit of $97 million a year after annual costs. The project is estimated to cost $355 million, with local sponsors paying $201 million and the federal government $154 million. The return would be $3.80 for each dollar spent annually, he says. The project would not begin for four or five years and would take eight years to complete.

Clarke says the Corp's plan was selected after thorough study of several proposals. A variety of structural and non-structural plans were considered. Based on the results of the impact assessments and the economic evaluations of the various plans, one plan out of 22 was selected as superior to the others.

Corps project engineer Mike Kieslich acknowledges environmental concerns. But he points out that the Corps is required by law to mitigate environmental harm, and that's what it will do. But Susan Rieff, director of the Texas Parks and Wildlife Resource Protection Division in Austin, says, "Our early reviews led us to conclude that there is serious potential for damage." In fact, other state agencies, including the General Land Office, Texas Water Commission, Texas Department of Agriculture, and, to some degree, the Attorney General's office, identified issues that fell within their areas of responsibility.

According to Rieff, several problem areas were highlighted as a result of interagency discussions:

- The potential environmental effects were not being fully addressed.
- Those potential negative effects would likely be exacerbated by other federal water projects pending in the Galveston Bay area.
- And, finally, a full understanding of the potential adverse environmental effects can only be achieved in a comprehensive environmental assessment that would address cumulative impacts.

Clarke says the cumulative impact request is a ploy by environmental groups to stop the project. No funding for such a project has come forward, nor has a plan as to how to judge the cumulative impact assessment been designed, he says. One plan that may soon address some of the cumulative environmental concerns is the recently passed Clean Water Act, which will include a study of Galveston Bay.

Still, the U.S. Fish and Wildlife Service, joined by the National Marine Fisheries Service, lists several concerns about the dredging, including disturbance of toxic sediments, salinity changes and effects of turbidity and siltation on organisms.

One major criticism of the plan by conservationists has been that the dredging would stir up toxic chemical pollutants and heavy metals that have accumulated in the bay's bottom sediments through the years. The Corps says testing has shown no harmful levels of pollutants in the bay bottom, and maintains that dredging will not damage production of fish and shellfish.

But Dr. Brian Cain, a pollution specialist with the U.S. Fish and Wildlife Service in Clear Lake, says recent testing revealed 11 parts per million of polycyclic aromatic hydrocarbons (PAHs) in the Texas City area. Cain and other Fish and Wildlife Service officials say the Corps testing has not been specific enough to detect such contaminants as PAHs, a family of chemicals that includes a number of carcinogens.

"These sediments are on the bottom of the bay, but they don't stay there. Wave action reworks the sediment and resuspends materials." As a result, Cain says, "There is a long-term

DEVELOPMENT

HOUSTON SHIP CHANNEL

1839 Local contributions were used to remove tree limbs and snags to clear Buffalo Bayou.

1840 Sunken boat obstructing bayou channel was removed, using funds collected by lottery.

1853 Texas legislature appropriated funds for improvements to Buffalo Bayou.

1853 State and local funds were used to deepen passages at Clopper's Bar in San Jacinto Bay and at Red Fish Bar in Galveston Bay.

1856 City of Houston built its own dredge boat for removal of shoals in Buffalo Bayou.

1865 City ordinance allowed voluntary loans for improvement of Buffalo Bayou at 10 percent interest, repayable from taxes.

1869 City subscribed $30,000 of capital stock of Buffalo Bayou Ship Channel Co. and lent its credit by issuance of $100,000 of Ship Channel Bonds to provide nine feet of water from Houston to the Gulf of Mexico.

1870 First federal survey was made of Houston's proposed ship channel for 100-foot-wide by 6-foot-deep channel.

1872 U.S. Congress made first appropriation, for $10,000, for improvement of channel depth at Red Fish Bar in Galveston Bay.

1874 Commodore Charles Morgan agreed to construct 120-foot-wide by 9-feet deep channel from Galveston Bay to Houston in exchange for $806,500 of capital stock of Ship Channel Company.

1874 U.S. Congress made second appropriation, for $10,000, for improvement of channel depth at Red Fish Bar in Galveston Bay.

1875 U.S. Congress appropriated additional $10,200 for improvements at Red Fish Bar and $25,000 for Houston Ship Channel from mouth of San Jacinto River to Galveston.

1876 Finally, 9.5-foot depth channel was achieved from Galveston to mouth of Sims Bayou.

1882 U.S. Congress appropriated $349,500 for Houston Ship Channel improvement to provide 12-foot-deep channel.

1892 U.S. Congress appropriated $92,316.85 for purchase of Morgan's Canal Cut across Morgan's Point.

1896 U.S. Congress appropriated money for Galveston jetties and increased depth of channel across bar entrance from Gulf from 12 feet to 25 feet.

1896 U.S. Congress authorized study of a 25-foot-deep channel from Galveston to Houston.

1897 U.S. Engineers recommended 100-foot by 25-foot channel to Houston at estimated cost of $4 million.

1900 U.S. Engineers modified their recommended depth for the Houston Channel from 25 feet to 18.5 feet.

1902 U.S. Congress appropriated a total of $1 million for work in 1902, 1903 and 1904 for the 18.5-foot deep Channel.

1905 The Turning Basin at the head of navigation was located in 1904 and first dredged in 1906-1907.

1908 The 18.5-foot deep channel was almost completed by 1908 when recession stopped improvement work.

1911 Harris County voters approved the sale of tax bonds in the amount of $1.25 million to provide local funds to the newly created Navigation District to match an equal amount to be appropriated by U.S. Congress.

1914 Harris County voters approved the sale of tax bonds in the amount of $250,000 to match a federal appropriation to purchase two dredges to maintain the channel and basin.

1914 In September 1914 the 25-foot-deep Houston Ship Channel was completed. The new deep-water channel was formally opened November 10, 1914.

1919 U.S. Congress appropriated funds in 1921 to increase the depth of the Houston Ship Channel from 25 to 30 feet.

1932 The U.S. Engineers approved deepening the channel to 32 feet together with widening.

1935 U.S. Engineers approved deepening the channel to 34 feet with additional widening.

1939 U.S. Engineers approved additional widening of the channel.

1944 U.S. Engineers approved additional widening of the channel.

1947 U.S. Engineers approved deepening the channel to 36 feet.

1958 River and Harbors Act of 1958 provided authorization for 40-foot project Houston Ship Channel, completed about 1966.

1961 Navigation District completed the dredging of the Greens Bayou 36-foot project deep-draft channel.

1965 Navigation District dredged its Bayport Barge Channel, 100 feet by 12 feet.

1970 Navigation District performed maintenance dredging of the Bayport Barge Channel.

1970 Navigation District dredged its San Jacinto Bay Barge Channel. Approximately 2.3 miles in length.

1975 Navigation District dredged its Bayport Ship Channel.

1978 Maintenance dredging of Bayport Ship Channel.

1975 Maintenance dredging of flared entrance to Barbours Cut channel.

1977 Maintenance dredging of flared entrance to Barbours Cut channel and including part of channel upstream.

1980 Third dredging project Barbours Cut Terminal, for 0.19 miles upstream of previous dredging, to complete 0.87 miles of ship channel.

chronic exposure of our fish and other organisms in the bay to these contaminants." However, the Corps points out that there are currently no criteria defining such long-term chronic effects.

These toxic contaminants are not at levels high enough to cause fish kills, Cain says. Rather, he says, they're at low levels that will cause loss of eggs, non-hatching of small organisms and lower production of fishery resources.

The Corps says that extensive tests on samples of water and bottom sediments from the ship channel and the bay have been taken. Bioassays on sensitive marine species and bioaccumulation studies on plants and marine animals show conclusively that no potential exists for significant contaminant-related effects resulting from dredging operations under the tentatively selected plan.

C.R. Harbaugh, chief of the Corps of Engineers Environmental Resources Branch, says one of the key points that many environmentalists appear to ignore is that the overriding amount of material – 90 percent – that will be dredged is virgin material. "It's not polluted. It does not have contaminants in it. It's just there." In fact, he says, before the Corps starts construction on the channel, it will go through a normal maintenance dredging cycle and, as usual, put that material in contained disposal areas.

There are also concerns that deepening and widening would increase salinity in Galveston Bay and disposal of dredged materials would smother creatures living on the bay bottom. The Corps contends that the net environmental impacts of the plan in terms of salinity will be small, and Galveston Bay will continue to be the most valuable commercial fishery on the Texas coast. Clarke says that during periods of reduced freshwater inflow into the bay, which occur less than 10 percent of the time, salinities in part of Galveston Bay would increase between 1 and 2 parts per thousand above existing conditions.

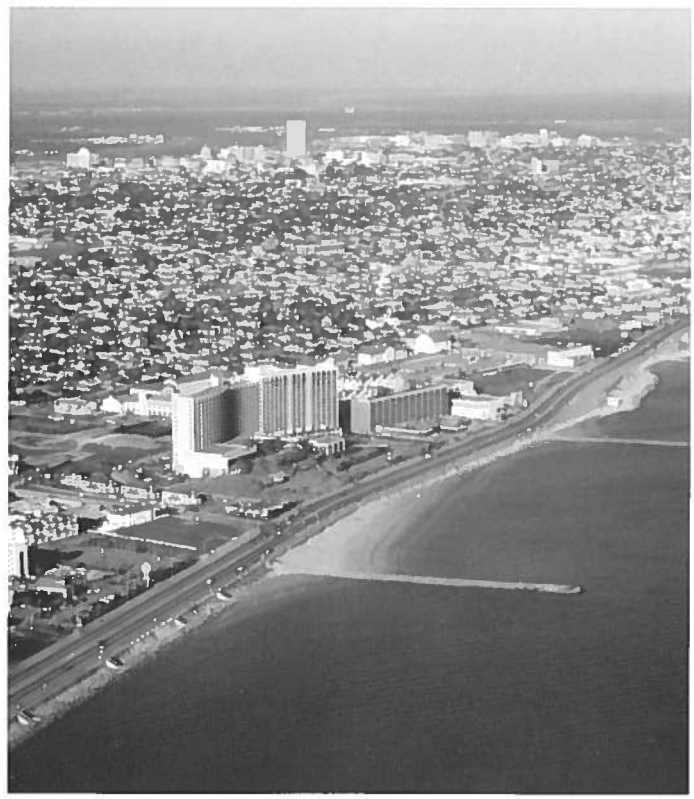
The oyster population could be temporarily affected during these rare occurrences, since the slightly higher salinities could make oysters more vulnerable to parasites and disease. The Corps estimates that there could be an average annual loss of 8 percent in the oyster harvest value, but hastens to point out that these losses would be offset by the construction of replacement oyster reefs. One proposed method to compensate for the lost habitat is by establishing an additional 407 acres of new oyster reefs, to be built at a cost of $40,000 per acre.

Clarke says Corps studies have shown that if the plan goes ahead as designed and if anticipated freshwater withdrawals from other projects stay normal, salinity regimes in the bay would not be significantly higher than those occasionally measured during the past 25 years. Any reductions in the oyster population would be difficult to distinguish from normal seasonal variations, he says.

He agrees that habitat losses would result from the conversion of about 900 acres of bay bottom to deep channel, the disposal of dredged material over approximately 11,000 acres of bay bottom, permanent filling of around 1,300 acres of bay bottom for use as confined disposal areas, and an increase of about 25 percent in maintenance dredging disposal requirements.

Clarke points out that these losses would reduce Galveston Bay's annual commercial and sport fishery value by around 2 percent. The construction of additional oyster reefs will mitigate these economic losses, enhancing the commercial oyster

–PORT OF HOUSTON



–CORPS OF ENGINEERS

The primary beneficiaries of the deepening project would be bulk carriers, principally grain and petroleum carriers.

Construction costs from improvement to the channel would add millons of dollars to the Houston/Galveston economy.

DIG DEEP

THE ECONOMIC STARS ARE BIG AND BRIGHT DEEP IN THE HEART OF THE HOUSTON SHIP CHANNEL

The ports at Houston and Galveston have received some news they can dig – literally. A new Texas A&M University study has uncovered that digging the ports at Houston and Galveston to a deeper depth produces a substantial shift in the nation's midwestern flow of grain offshore.

In short, deepening upper Texas ports would attract larger vessels and, due to economies of ship size, rates on selected routes would fall, says Dr. Stephen Fuller, a Texas A&M agricultural economist.

"Deepening the channel from 40 feet to 45 feet increases export volume from 646 million to 933 million bushels, a 44 percent increase," Fuller says. A 50-foot depth increases the volume to 1,163 million bushels.

The study used a special computer model that included 165 domestic surplus regions, 85 domestic demand regions and 25 world sub-regions.

In general, he says, the changing grain flow pattern is the result of rerouted corn exports. The additional corn originates in western Iowa and southeastern Nebraska. When the channel is deepened to 50 feet, additional corn flow originates in the same general area, but, in particular, in the western and central Iowa regions.

"Deepening the Houston/Galveston channel clearly shifts the eastern boundary of this port's hinterland toward the Mississippi River or into the Corn Belt," Fuller says. "The boundary also adjusts northwest so that increasing quantities of Nebraska-produced corn are directed to the upper Texas ports."

Several factors may increase grain volume at the deepened port area. One, the reduced ship rate linking the deepened port area with selected world regions provides an incentive to reroute grain exports because of reduced logistic costs. Two, additional grain volume may flow to the deepened port area as a result of the lowered ship rate and an associated decline in the foreign buyer's delivered grain price.

"Obviously, the size of the flow is dependent on how much ship rates are reduced and the number of foreign ports affected by the lower rates," Fuller says.

But he cautions that deepening a U.S. port does not uniformly decrease ship rates to all foreign destinations. Only those foreign ports with deep-draft port facilities can take advantage of price cuts. Now many Third World trading countries cannot accommodate larger vessels, even though they import more than 50 percent of the U.S. grain and soybean outflow. So, on the average, at least half of the nation's annual grain exports would be unaffected by a deepening of U.S. ports, Fuller says.

Today, the lower Mississippi River and upper Texas Gulf coast ports maintain a water depth of about 40 feet. But U.S. Army Corps of Engineers proposals now call for deepening the ports to 45 feet and 50 feet.

The upper Texas Gulf port area – Houston and Galveston – is linked by railroad to the south and central plains of Texas, Oklahoma and Kansas. Historically, this port area has been an important outlet for the nation's sorghum and hard red winter wheat exports. The lower Mississippi River port area extends from Baton Rouge, La., to the mouth of the Mississippi River. Grain elevators along this river segment annually handle more than 40 percent of the nation's total grain outflow.

Fuller says that, in the final analysis, several major port areas lose significant quantities as a result of deepening the Houston-Galveston channel. They are the lower Mississippi River, Pacific Northwest and Great Lakes ports. When the Houston-Galveston channel is deepened to 45 feet, lower Mississippi River port volume declines 192 million bushels (14 percent), while Pacific Northwest and Great Lakes (Duluth-Superior) port volumes decline by 82 million bushels (13 percent) and 12 million bushels (16 percent), respectively.

harvest and increasing sport fishing opportunities. Galveston Bay is Texas' largest in terms of landed seafood value. In 1985, the latest year for which there are figures, the value of commercially landed seafood was $11.2 million, of which $5.8 million was oysters and $4.3 million was shrimp.

David Aubrey, of Woods Hole Oceanographic Institution in Massachusetts and a Texas Parks and Wildlife Department consultant, says the bay is already under heavy stress from 250 miles of navigation channels and industrial centers at Houston, Texas City and Galveston. Key issues needing further study include the effect on salinity, temperature, muddying of the water, bacteria, effects on bay currents and future changes in sea level.

There are clear economic advantages to a larger ship channel, principally that improvements will make the Port of Houston much more attractive to shippers, since it will be safer and more efficient to use. With larger deep-draft vessels able to navigate the channel fully loaded, tonnage shipments will increase, while the number of vessel trips decreases. Also, as the Port of Houston becomes fully competitive with other ports, the local and state economy should see even greater economic benefits from the Galveston Bay area.

Vela at the Port of Houston says, "We as a port have to stay competitive with other ports in the future. We're not talking short-term future, we're talking long-term future." Port commissioner Rey Gonzales Jr. adds that without a deeper and wider channel, Houston is doomed to become a second-rate port. "At the end of World War II, the channel could accommodate any ship afloat." But, he says, many ships built in the future will be too big to navigate the channel at all if it's not improved.

Already 60 percent of the tankers and 75 percent of the bulk-carrying ships in service in the world today can't navigate the channel when fully loaded, he says. "A lot of grain ships that come in here have to go to another port to be topped off and we lose that business," says Vela. "More fully laden ships mean lower transportation costs, which mean, lower production costs. In the long term, the consumer saves," Vela says.

Frank Incaprera, chief of the Corps' Economics and Social Analysis Branch in Galveston, agrees, "The project will put the United States in a more positive and competitive position to reduce the transportation costs."

Port officials say the primary beneficiaries of the deepening project would be the bulk carriers, principally the grain and petroleum carriers. Even though the grain industry is now in a cyclical slump, marine transportation experts believe it will come back. There is also the matter of the hard-hit Houston economy. "The channel improvements would generate $709 million in local revenue during the eight-year construction period," says Gonzales, who is also an engineer. "Another benefit would be jobs related directly and indirectly to the channel improvements."

The Corps says previous channel deepening projects have produced positive economic results and the current plan should be no different. For example, when the channel went to 25 feet in 1914, tonnage climbed from 1 million to 7 million by 1924, an increase of some 560 percent. When the channel was deepened to 30 feet in 1925, tonnage leaped from 9 million to 20 million by 1935, roughly 111 percent. And in 1966, when the channel cleared 40 feet, tonnage rose from 59 million to 89 million ten years later – about 50 percent.

–CORPS OF ENGINEERS

–PORT OF HOUSTON

There are concerns the dredging would disturb toxic sediments, increase salinity and significantly raise turbidity levels.

The Corps agrees there are unavoidable effects, such as disturbance to oyster reefs, but the problems will be mitigated.

BRIGHT LIGHTS CLEAN CITY

Galveston Bay has a direct pipeline into one of the nation's largest population centers – Houston. Luckily, despite its free-wheeling enterprise credo and a freefall in oil prices, the big city dwellers care about the environmental conditions that have a direct bearing on the state's most productive bay.

A five-year series of studies by Rice University sociology professor Dr. Steven Kleinberg suggests a surprisingly strong commitment by area residents toward environmental protection. This is in spite of Houston's traditional view of itself as a free enterprise city.

"Houston imposed probably the least amount of government regulations on development of any city in the Western world," Kleinberg says.

During the early 1980s, Houston rode an amazing boom that made it the fastest-growing big city in America. More than 1 million people moved into the Houston region between 1970 and 1982. "Houston was one of the resource and energy capitals of the world – the golden buckle on the sun belt."

The boom ended when oil prices fell from $34 a barrel at the beginning of 1982 to $28 a barrel at the end of 1982. The all-important rig count entered into a freefall that took it from a peak of 4,530 active rigs in the United States down to less than 3,000 by the close of the year to 2,000 by the summer of 1983. This spring the active rig count hovers near 800.

"Houston area residents have gradually, reluctantly, unmistakably come to the conclusion that the boom years of the city are over and will not soon return," Kleinberg says. But the downturn contains some surprising silver linings. The ending of the boom seems to be stimulating a profound rethinking of the nature of the city and its future, Kleinberg points out. He says the end of the boom seems to have brought about a new awareness of the city and its future. "For the first time in its history, Houston must compete with other urban regions in attracting new business and encouraging new investment.

"We kept expecting to find a sense that, 'Sure the environment is important, but obviously the economy has got to come first.'

No matter how we asked the question, we have not been able to show a shift in the basic commitment Houston area residents seem to have made with regard to environmental protection," Kleinberg says.

The ending of the boom rather than putting environmental issues on the back burner in relation to economic growth and jobs, seems only to have strengthened that commitment.

Last year, 4,730 deep-draft, ocean-going ships made the trip in from the Gulf to Houston. Counting barge tows, there were 32,000 round trips on the channel in 1985. Houston has ranked as the nation's third- or fourth-busiest port for years, lately exporting mostly grain, heavy equipment and petroleum products. Houston imports oil, steel and cars.

Today ports with existing channels deeper than 40 feet include Corpus Christi, 45 feet; Long Beach, 60 feet; New York, 42 feet; Portland, 45 feet; and Seattle, 60 feet. In addition, projects are on the drawing board to create 50-foot deep channels at New Orleans, Mobile, Philadelphia, Norfolk and Texas City.

The plan would allow lightly loaded crude oil carriers up to 270,000 deadweight tons in size to use the channel. These vessels are about 1,100 feet long and 175 feet wide. Although ships of this size draw about 70 feet of water when fully loaded, they draw 49 feet when about 60 percent filled. Among major crude oil beneficiaries for deepening the channel are Shell, Exxon, Oiltanking and Paktank.

Clarke adds that widening the channel would make shipping safer and faster, citing savings of $10 million per year. The Corps' environmental impact statement notes that the safety record of the channel is as good or better than at other ports; nevertheless, there were an average of 140 casualties per year from 1978 to 1982. The Corps forecasts that unless the project is accomplished, this number will increase to an average of 300 a year by the year 2045.

Port of Houston officials emphasize that widening the channel is just as important as the deepening because the narrowness of the 400-foot-wide channel forces ocean-going traffic and slower vessels to pass in close quarters. Today the channel is much like a one-way street with two-way traffic.

But instead of Toyotas, they're ships, big ships. Vela, the Port of Houston's spokesman, says most of the vessels that navigate the channel are anywhere from 160 to 180 feet wide. The channel is 400 feet. "As you can see, that doesn't leave you a whole lot of room for error when you're passing each other.

"We've been very lucky in this port," Vela adds.

Pilots on the Houston Ship Channel are a little like truck drivers guiding big tractor-trailer rigs past each other on narrow country roads. To get past each other, the Houston Ship Channel pilots perform what is called the Suez manuever or, as the Houston pilots call it, the Texas Chicken. In short, the two ships head on a collision course until at the last moment they break to the right, creating a wall of water between the two vessels which prevents a collision.

That's one reason the pilots support the U.S. Army Corps of Engineers plan to deepen the channel to 50 feet and widen it to 600 feet for most of its length.

"The channel hasn't changed in nearly 30 years, but ships are twice as big as they were," pilot Gene Garrison told the Dallas Morning News. "There are very few places that have the length of narrow channel we do," said Garrison, 64, who has guided ships through the Houston Ship Channel for the past 19 years.

What happens now? The Corp's 8-inch thick draft proposal now moves from the Galveston office to the division office

where a Division Engineering Notice will be written. From there, it heads for the Office of the Chief, Board of Engineers for Rivers and Harbors this summer for an independent review followed by a comment period. That could take between nine months and a year.

After the Chief's Report is finalized, it is forwarded to the Secretary of the Army office for yet another review. The proposal then moves to the Office of Management and Budget where it will begin to enter the federal budgetary process. Ultimately, the project goes to Congress for authorization for construction.

"We're talking about a long, drawn-out process," says Sid Tanner, chief of the Corps of Engineers Coastal Navigation Branch. Construction on the 8-year project is set to start in 1991, with the first part of the project to go on line in 1994.

Ken Bonham, chief of public affairs for the Corps of Engineers' Galveston office, says, "There are many steps in this process, which is one reason it takes so long for a government agency to complete a project like this. It's really unbelievable."

H I S T O R Y

PORT OF HOUSTON

When the tiny steamship *Laura* made its way up Buffalo Bayou to the foot of Houston's Main Street in 1837, only a few farsighted businessmen saw the muddy, winding waters of the bayou and shallow waters of Galveston Bay as a promising route to the Gulf of Mexico.

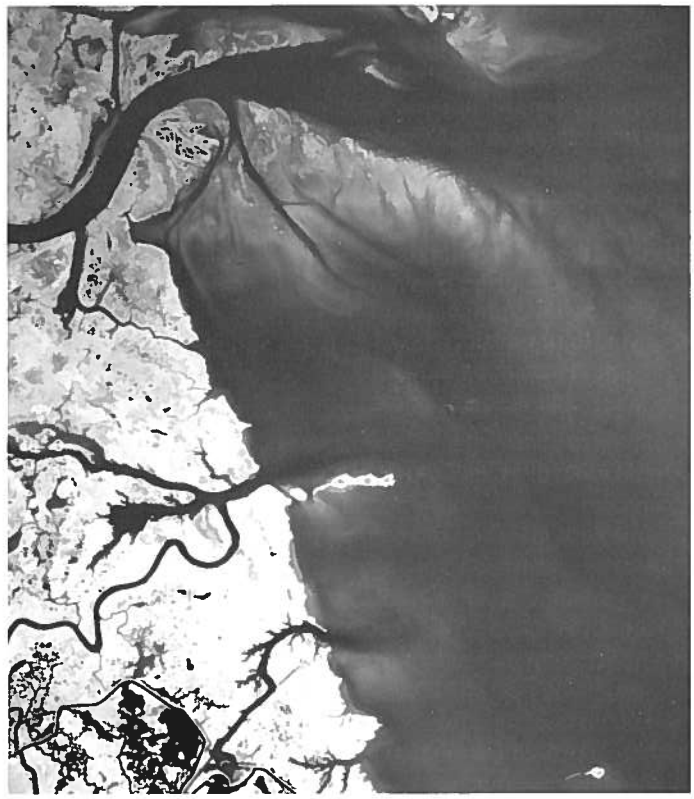
But they were right. The bayou has become a channel lined with hundreds of state-of-the-art maritime and manufacturing facilities, thanks in large part to the Houston Ship Channel – an underwater ditch carved out of the land and bay bottom, stretching 52 miles from the jetties at Galveston to the Port of Houston Authority Turning Basin just six miles from downtown Houston.

Lee Vela, a spokesman for the Port of Houston, says the huge marine facility is one reason why Houston is the fourth-largest city in the nation. "Port activity directly affects 32,000 jobs in this area alone, and indirectly 160,000 jobs throughout the state," he says. In addition, port activity has a $3 billion annual impact on the city's and state's economies.

After *Laura's* maiden voyage, other steamships began to traverse the bayou regularly, and in 1856, Congress began to encourage navigation in Texas by providing $350,000 for expansion projects along the channel.

Expansion of the port came slowly. The Atlantic, Gulf and Pacific Company of New York was awarded a contract in 1912 to widen and deepen the channel. The new deepwater ship channel was formally opened November 10, 1914, boasting a water depth of 25 feet.

The nature of the port has changed, too. Cotton was replaced as the port's major trading commodity by petroleum products and steel. Today the port has a diversified cargo base that includes general cargo, liquid bulk materials, dry bulk materials and a wide variety of items packed in intermodal containers. ■



Port officials say the Houston Ship Channel is much too narrow for the size of ships being used in the world today.

Houston pilots now have to perform a manuever known as the Texas Chicken in order to pass each other along the channel.

MARINE ADVISOR

BY RHONDA SNIDER

Willis Clark announces retirement at Sea Grant

Willis "Bill" Clark, associate director of the Texas A&M University Sea Grant College Program, is retiring May 31, 1987, after 19 years with the program. Clark has been with Texas Sea Grant since Texas A&M became associated with the national program in 1968, and was instrumental in the initial steps that brought Sea Grant to the institution.

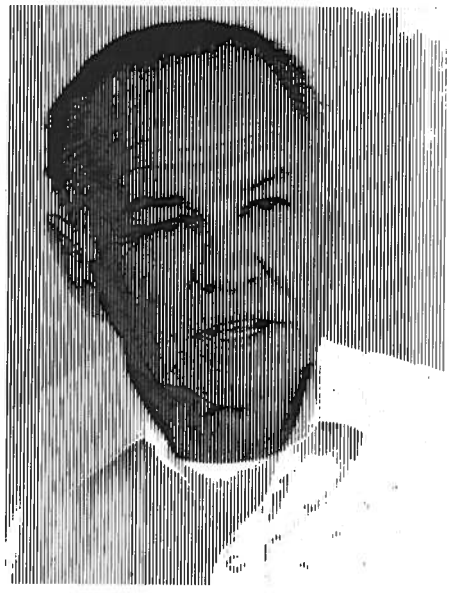
Clark has served under seven directors, and was particularly involved in the development and promotion of Texas' Marine Advisory Service.

When Dr. John Calhoun, then vice president of academic affairs at Texas A&M, first asked Clark to assist him in establishing the University as a Sea Grant College, Clarks says that he knew he was in for hard work and long hours because of his experience with a similar agency, the Gulf University Research Corporation. That didn't deter him, however, since "we realized right off that this was something important for Texas and for Texas A&M."

During the Program's early days, Clark traveled the Texas coast extensively to get a feel for the needs and wants of coastal residents. "I saw a need for the people in the Sea Grant office at Texas A&M to understand what was going on at the coast," he says. He continued to act as a liaison between campus administrators and coastal residents even after Sea Grant began to hire agents and specialists for the newly formed Marine Advisory Service. "I liked the type of work that our pioneers were doing down there," he now says.

And, apparently, they liked him. Joe Surovik, who serves in Calhoun County and was the Sea Grant Program's first agent, says Clark was "instrumental in making the program a success."

Surovik says Clark had a way of getting the inside track on new policies and regulations and new techniques for solving marine-related problems. "Bill was in a unique situation because he could do some things that we couldn't," Surovik says. "While we were on the front lines working with the fishermen, Bill was out scouting around, getting the basic information that we needed to make this program successful.



Willis "Bill" Clark

"Anytime we've had a special problem through the years, we have always been able to call on Bill," Surovik says. "He'd do what was needed to solve the problem. He has always been someone you could count on for whatever was needed."

Clark will be honored by a special farewell reception May 15 on the Texas A&M campus.

Texas chef uses seafood to haul in the top honors

Texas chef Victor A.L. Gielisse won top honors at the 1987 American Seafood Challenge in South Carolina in March, besting 25 other professional chefs from across the country. According to Annette Reddell Hegen, Texas Sea Grant's seafood consumer education specialist who attended the national competition, Gielisse showed his Texas flair by creating innovative, tasty recipes.

The recipes were developed on the spot when Gielisse and other contestants were given a basket of ingredients from which they had to select the makings for a four- to five-course meal. The winning menu consisted of:

Appetizer - Texas Gulf Shrimp Mousseline with Cilantro, Chive Cream and Red Chard

Soup - Ocean Sea Scallops with Mussels

Entree - Farm-Raised Catfish Actuelle with Gingered Black Beans, Sesame Roast Asparagus and Red Pepper Sauce

Dessert - Lemon Tort

Gielisse told reporters that he emphasized cookery fundamentals in his winning recipes. As winner of the Seafood Challenge, Gielisse was awarded two gold medals from the American Culinary Federation, a "Governor's Cup" trophy, a trip and $2,000. California chef Elka Gilmore won second place in the competition and third prize went to Illinois chef Pierre Pollin.

Gielisse won Texas' seafood competition in February to qualify for the national event. The Texas Chefs' Association and Texas A&M's Marine Advisory Service coordinated the state competition, and Seafood Supply, Inc., of Dallas and Austin, provided monetary support.

Hegen was one of the judges in the state competition and helped coordinate publicity and contest entries.

Hegen says the chefs' interest in the competition reflects a growing awareness of seafood's nutritional aspects and the advantages of making this type of food available in their restuarants.

State's marine leaders receive special awards

Marine industry leaders from throughout Texas received special recognition from the Texas A&M Marine Advisory Service during an awards banquet held in their honor on February 26 in College Station. Certificates of appreciation were

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given to 177 men and women for their special contributions to marine-related projects and programs conducted by MAS.

The recipients were nominated by MAS' agents and specialists for their support of marine educational and professional development programs. A special award was given to Sea Grant associate director Willis Clark for his years of dedication and work with the advisory program. Dr. Donn Ward, MAS project leader, says it also is noteworthy that each of the three Texas Agricultural Extension Service district directors who supervise the coastal marine agents were recognized for their support of marine advisory programs.

Erosion losses require greater public awareness

An increased awareness of the need for answers to severe erosion problems on Texas' coastline is spreading throughout the state, according to Jefferson and Chambers County marine agent Bob Nailon. He and the Soil Conservation Service's Eddie Seidensticker have been the focus of recent attention for their efforts to control erosion and re-establish a marsh habitat in the Galveston Bay area.

The two have received commendations for their work by Texas Land Commissioner Garry Mauro and from Senators Chet Brooks and Lloyd Bentsen.

Nailon and Seidensticker have experimented with various techniques to control the coastline in the past three years. By replanting smooth cordgrass in shallow near-shore bay waters, the two hope to establish a marsh that will foster marine life such as shrimp, crabs and bait fish that are now scarce in the Galveston Bay area.

It is estimated that erosion steals thousands of feet of land each year on the Texas coast. According to Seidensticker, erosion claims soil at an average rate of four to five feet per year, and some landowners have reported losses of as much as 12 feet per year. This translates into a half acre per mile per year in the Galveston Bay area. Much of the shoreline has become littered with old cars, culverts, pipes and discarded appliances in an unsightly attempt by landowners to keep the tides from eroding their land.

Tony Reisinger

The erosion-plagued areas are also experiencing a decline in marine life. Nailon and others attribute the absence of shellfish to the unfavorable conditions created by the turbidity and muddying that results from a lack of vegetation.

Nailon and Seidensticker have received a Moody Foundation grant to continue their erosion abatement study. "There are no established rules for stopping erosion," Seidensticker says. "There's no book you can go to to learn about what we have done. Most of it is just experimenting."

Nailon adds, "You have to experiment with different things. If you need to modify the techniques, that's what you do. We're attempting to create a favorable habitat that will benefit the sport and commercial fishing industries, as well as the landowners. Everyone in the Galveston Bay area should realize the value of the marsh habitat."

Pond-raised clam study underway in SouthTexas

A Sea Grant-funded study to determine the feasibility of growing out pond-raised clams is underway in South Texas. Cameron County marine agent Tony Reisinger is assisting Durwood Duggar of MariQuest, Inc., in implementing the project in a 100-acre dredge spoil pond on the Brownsville Ship Channel.

Reisinger says the demonstration project involves placing clams in 1-foot by 2-foot plastic-covered trays that have a layer of pea gravel in the bottom. These trays are then suspended by floats about midway in the 3- to 4-foot-deep pond to avoid the silt-covered bottom that might inhibit growth of the clams.

If the results on this study are similar to a small pilot project Duggar performed earlier, it may mean that clam farming in South Texas has potential. The current study also will determine the feasibility of polyculture (raising more than one species in the same pond). Duggar tested the feasibility of raising clams out of their natural habitat this past winter when he placed clams in trays in the bottom of his dredge spoil pond. The clams had normal growth rates and excellent survival rates compared to those in the natural habitat where many predators exist. He currently is testing shrimp growout in the pond through an agreement with the U.S. Army Corps of Engineers.

Dr. Sammy Ray, interim president of Texas A&M at Galveston and a nationally acclaimed shellfish biologist, is an advisor to the project.

Reisinger says he and Duggar hope to have clams in the pond by the end of April, but that it will be one to two years before there is enough data to indicate whether clam growout and polyculture is feasible.

Management Specialist; Sea Grant College Program; Texas A&M University; College Station, Texas 77843; (409) 845-3854. **Recreation**: *Ken Pagans*; Marine Recreation Specialist; Texas A&M Research and Extension Center; Route 2, Box 589; Corpus Christi, Texas 78410; (512) 265-9203. **Seafood:** *Michael Haby*; Seafood Marketing Specialist; P.O. Box 158; Port Aransas, Texas 78373; (512) 749-5207. *Annette Reddell Hegen*; Seafood Consumer Education Specialist; P.O. Box 158; Port Aransas, Texas 78373; (512) 749-5207. **Fisheries**: *Gary Graham*; Marine Fisheries Specialist; Rt. 2, Armory; Angleton, Texas 77515; (409) 849-5711, ext. 1564 or (409) 265-4261, ext. 1564. *Russell Miget*; Marine Fisheries Specialist; Texas A&M Research and Extension Center; Route 2, Box 589; Corpus Christi, Texas 78410; (512) 265-9203 or (512) 749-5207. *Thomas Linton*; Marine Fisheries Specialist; Department of Wildlife and Fisheries; Texas A&M University; College Station, Texas 77843; (409) 845-5794.

THE BIG BAY

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water vessels were ill-suited to the shallow Texas bays. As a result, two distinct Texas commercial shrimp fishing industries developed – a bay shrimp industry and a Gulf shrimp industry.

Today the commercial shrimp fishery is the most important fishery in Texas and one of the most important commercial fisheries in the United States. The value of shrimp landings in Texas in 1985 was approximately $127.7 million.

The value of Texas shrimp landings has historically been second only to Alaska and Louisiana. It is estimated that Texas bay shrimping contributes 20 percent of the annual landings in Texas, although this figure was thought very conservative by the Texas Coastal and Marine Council. The estimated value of Texas bay shrimp landings in 1985 statewide was a minimum of $25.5 million and perhaps as high as $45 million. Of this, Galveston Bay produced $4.3 million.

Birds are the most conspicuous wildlife feature in the bay. Massive bird rookeries and nesting colonies are perched primarily on dredged-material disposal islands. In recent wildlife surveys, more than 50,000 pairs of birds nested in at least 50 colonies of varying sizes in the entire bay system. Colonies vary greatly in size from a few pairs of single species to tens of thousands of pairs of 15 or more species.

In a typical year, nearly three-quarters of all waterfowl in the Central Flyway winter in Texas. The Texas Parks and Wildlife Department says a fair portion of this total use the Galveston Bay/San Jacinto and Trinity Delta areas. Four federally listed endangered bird species are known to occur in the bay area – the brown pelican, Arctic peregrine falcon, southern bald eagle and Attwater's prairie chicken.

Five species of sea turtles (three endangered and two threatened) occur in coastal waters: loggerhead, green, leatherback, hawksbill and Kemp's ridley. Two terrestrial reptiles known to occur on the shores of Galveston Bay in Harris, Galveston and/or Chambers Counties are the Texas horned lizard and Louisiana milk snake.

Several state-listed endangered or threatened mammals possibly occur in Harris, Galveston and Chambers Counties, including several species of whales, three dolphin species, one manatee and one bat species. In addition, the threatened southeastern bat probably occurs in the three-county area.

Other animals making their home on the bay include the coyote, raccoon, nutria, eastern cottontail, armadillo and various species of small rodents.

"All these things make Galveston Bay an extremely important body of water from an economic standpoint," says Dr. Tom Bright, a noted oceanographer and director of Texas A&M University's Sea Grant College Program.

Unfortunately, he believes, there has not been enough research activity relating to how the Galveston Bay system functions and the impact of man's activities on such an important bay system.

"Galveston Bay and its adjacent bays are critical nursery areas for commercial shrimp and important sport fisheries, particularly redfish and speckled trout."

Among the areas needing increased research attention are problems and procedures associated with the oyster fishery and oyster depuration process, Bright says. Oysters can only be harvested from areas that are free of domestic pollution. If they are harvested, they must be depurated in unpolluted waters in order to flush pollutants from their tissues before human consumption.

Another area requiring consideration is the impact of freshwater inflow and water movement in Galveston Bay on the commercial fishery population. Bright says present mathematical models of bay inflow, circulation and dynamics are considered obsolete at this time. "They may be replaced by more appropriate models through research being done by the Texas Water Development Board," he says.

"This is one of the most used bays in the country. And, frankly, the research effort expended toward determining all the impacts on the bay ecosystem is inadequate at the present time," Bright says. ■

HOMEPORT FOR SCIENCE

Continued from page 11

nomically by sharing access to a first-class marine research facility at Galveston." The universities currently share ship time and ship support facilities, and negotiations are in progress to develop an agreement for the expansion and joint use of docks and ship facilities at Galveston. Texas A&M's ship operations are currently based at Galveston's Mitchell Campus on Pelican Island, while Texas' operations are headquartered at its medical branch in Galveston.

The Texas A&M University System Board of Regents has taken the first step to develop a major marine sciences research institute at Galveston –possibly in collaboration with The University of Texas – to help enhance and diversify the state's economy.

If otherwise feasible, greater cooperation between Texas A&M and The University of Texas in marine sciences and related endeavors could maximize the use of existing resources and result in some overall savings for the state, Texas A&M officials note.

While deciding to move forward with plans to develop a major research facility similar to the pre-eminent oceanographic installations on the East Coast and West Coast, the regents underscored their commitment to continue offering academic instructional programs at Galveston. They indicated, however, that the scope of the programs offered by Texas A&M University at Galveston would be closely studied and probably be coordinated more formally in the future with those on the main campus at College Station.

Noting that "marine and coastal studies are important to the present and future economic well-being of Texas," the regents concluded that a "major research institute of marine sciences should be developed."

Texas A&M already has a significant investment in the Galveston area. The Mitchell Campus includes 10 buildings constructed within the past 15 years, in addition to the docks and other accommodations for sea-going vessels. Texas A&M University at Galveston also operates programs out of a large and recently renovated building at Fort Crockett on the opposite side of town. ■

P R E S S

The following publications are available from Marine Information Service, Sea Grant College Program, Texas A&M University, College Station, TX 77843. Prices quoted are for single copies. Write for prices for multiple copies. Request publication by both title and TAMU-SG number, and send a check payable to Texas A&M University.

Proceedings of the Tenth Annual Tropical and Subtropical Fisheries Conference of the Americas. Ward, Treece. TAMU-SG-86-102. $15.

Proceedings of the Eighteenth Dredging Seminar. Herbich. TAMU-SG-86-105. $10.

Proceedings of the Shrimp Yield Prediction Workshop. Landry, Klima. TAMU-SG-86-110. $10.

Marine/Offshore Outlook 1986. Hollin. TAMU-SG-86-111. $5.

Economics of Harvesting and Market Potential for the Texas Blue Crab Industry. Miller, Nichols. TAMU-SG-86-201. $5.

Nonparametric and Parametric Estimation of Wave Statistics and Spectra. Yamazaki, Herbich. TAMU-SG-86-202. $10.

1984 Deep Sea Roundup: An Analysis of Participant's Characteristics, Attitudes and Expenditures. Ditton, Arneson. TAMU-SG-86-203. $5.

Readership Survey of Marine Education. Gresham, Bush. TAMU-SG-86-204. $2.

Monthly Wave Characteristics National Oceanographic Data Center Vol. I, II, III. Yamazaki, Herbich. TAMU-SG-86-205. $25.

Bird Island Basin–An Environmental Study Area. Harris. TAMU-SG-86-401. $2.

An Annotated Guide to the Barnacles of the Northern Gulf of Mexico. Gittings, Dennis, Harry. TAMU-SG-86-402. $3.

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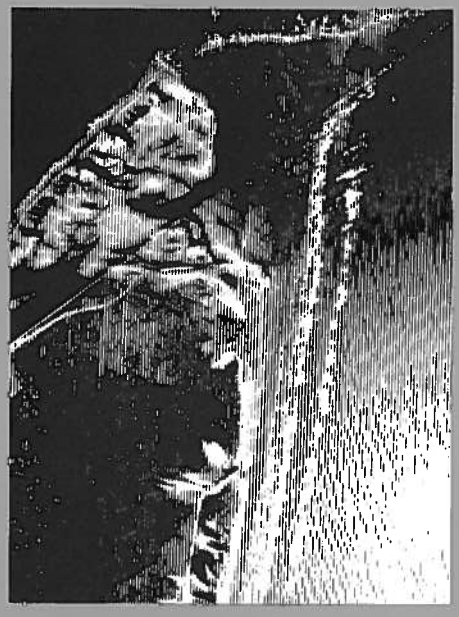
Texas Coast Hurricanes. Broussard & Martin. TAMU-SG-86-505. Single copies free.

Keeping Fish Tournament Fresh. Russell. TAMU-SG-86-504. Single –free.

Hurricane Relocation Planning for Cameron & Willacy Counties. Ruch. TAMU-SG-86-601. $8.



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Guidelines for Establishing Open-Water Recreation Beach Standards-Proceedings. McCloy, Dodson (ed). TAMU-SG-81-116. $5.

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Fairy Tales of the Sea (Teachers Guide). Wiseman. TAMU-SG-81-403. $2.

Fairy Tales of the Sea. Cowan & Davis. TAMU-SG-81-402. $4.50.

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Fishing the Texas Surf. Fedler. TAMU-SG-79-605. Single copies free.

Freezing Fish and Shellfish. Nickelson & Hegen. TAMU-SG-77-503. Single copies free.

1986-1987 Texas A&M Sea Grant College Program Directory. Broussard (ed). TAMU-SG-87-602. Single copies free.

Safety and Quality Aspects of Oysters, Mussels and Clams. Haby. TAMU-SG-85-503. Single copies free.

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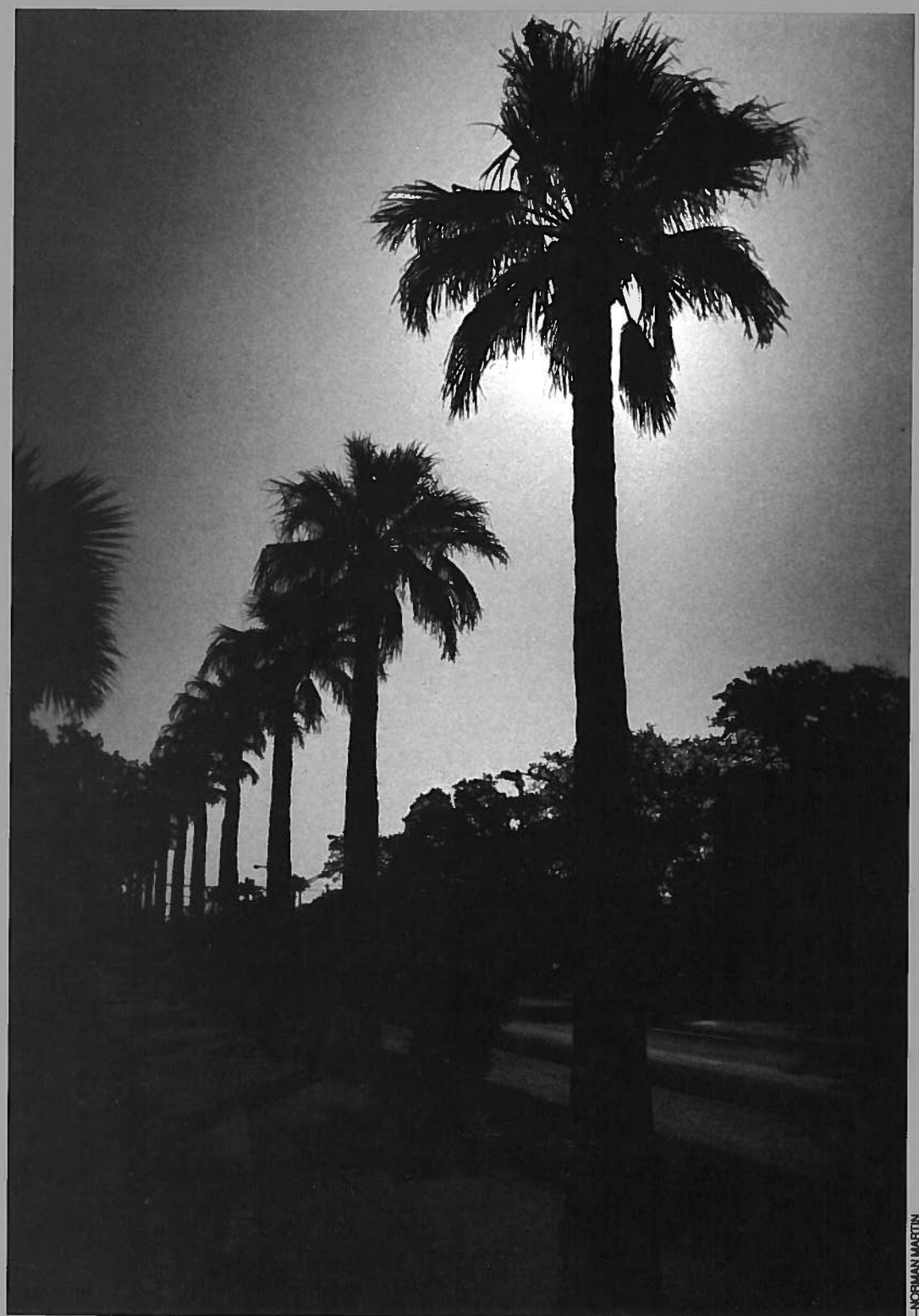

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