

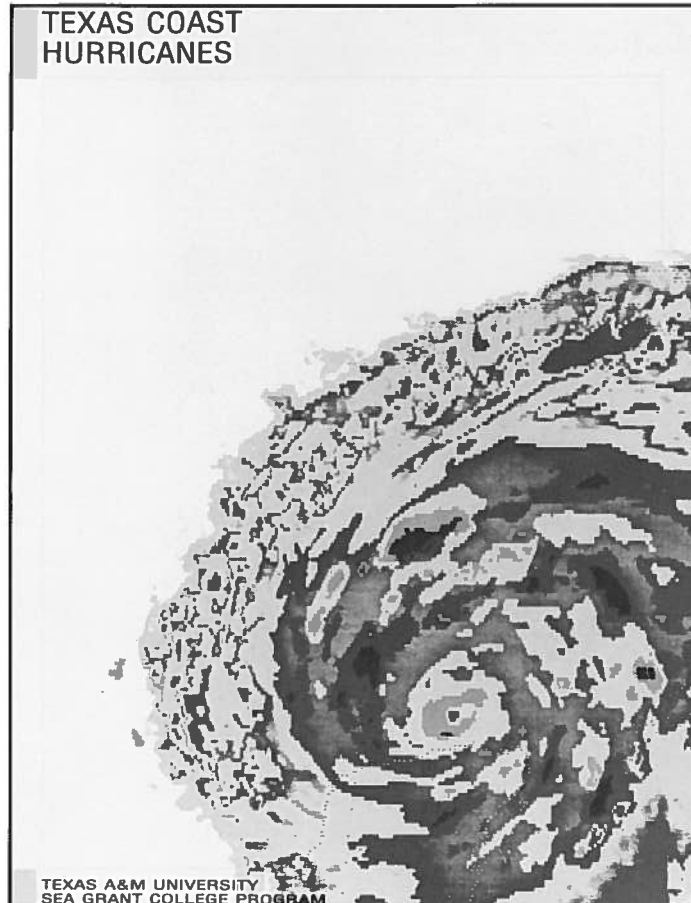
SEAGRANT COLLEGE PROGRAM

TEXAS SHORES



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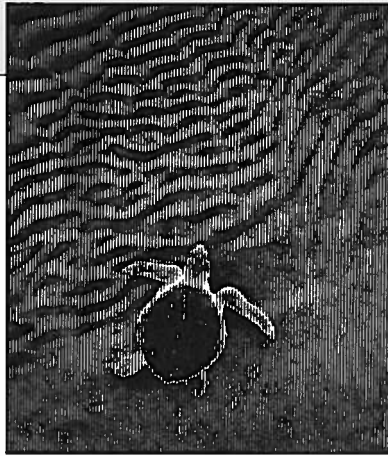
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Texas A&M researchers find more proof that sea turtles just follow their noses home.

TEXAS SHORES

Now is the time for turtles at Texas Shores. The state's huge shrimping industry is on the verge of a major battle with environmentalists over the use of turtle excluder devices, TEDs for short. In this issue we look at both sides of the controversy, as well as at the birth of TED. We'll also trace the efforts of a dedicated group of marine scientists who are trying to get a head start on the endangered Kemp's ridley sea turtle. And then we talk to the Turtle Lady herself, Ila Loetscher. This South Padre Island legend has been putting forth love and turtle shows for decades. From there Texas Shores goes down under to report on the exploits of an adventurous team of researchers who went to Australia for a turtle rodeo. The cover photograph was taken by Norman Martin.

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Texas Shores is published quarterly by the Sea Grant College Program at Texas A&M University in an effort to promote a better understanding of the Texas marine environment.

Dr. Tom Bright, *Texas A&M Sea Grant Director*; Amy Broussard, *Head of Marine Information Servic*; Norman Martin, *Editor of Texas Shores*; Celia Jeter, *Graphic and Printing Consultant*.

Sea Grant is a partnership of university, government and industry focusing on marine research, education and advisory service. Nationally, Sea Grant began in 1966 with the passage of the Sea Grant Program and College Act. Patterned after the Land Grant Act of the 1860s, the Sea Grant concept is a practical, broad-based scientific effort to better the world for all those living in and out of the sea.

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 on-going program to get marine information to the public.

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 sea food marketing and consumer education.

Sea Grant is a matching funds program. The Texas A&M Sea Grant College Program itself is made possible through an institutional award from the National Oceanic and Atmospheric Administration, U.S. Department of Commerce, and appropriations from the Texas Legislature and local governments.

Change of Address, Subscription Information or Other Questions: *Texas Shores*, Sea Grant College Program, Texas A&M University, College Station, Texas 77843. Or call 409-845-7524. Please include old label when changing mailing address.

Texas Shores (ISSN 0747-0959), is published quarterly by the Sea Grant College Program, Texas A&M University, College Station, TX 77843. Second class postage is paid at College Station, TX. **Postmaster:** Send address changes to the Sea Grant College Program, Texas A&M University, College Station, TX 77843. ■

SEA NOTES

Texas shrimpers headed for more rough waters

The future looks bleak for Texas shrimpers who have been broadsided by federal agents enforcing fishing boundaries between the U.S. and Mexico, says a Texas A&M University sociologist studying the Gulf of Mexico shrimp wars.

"The shrimpers are pretty well beaten now, and they'll tell you so," says Associate Professor Ben M. Crouch. "It's a very depressing situation down there."

Crouch says many of the shrimpers, who are forbidden to fish in Mexican waters, are facing serious financial problems now that the territorial limits are strictly enforced by U.S. officials. Compared to years past, only a few are attempting to break the law by shrimping in Mexican waters, Crouch says.

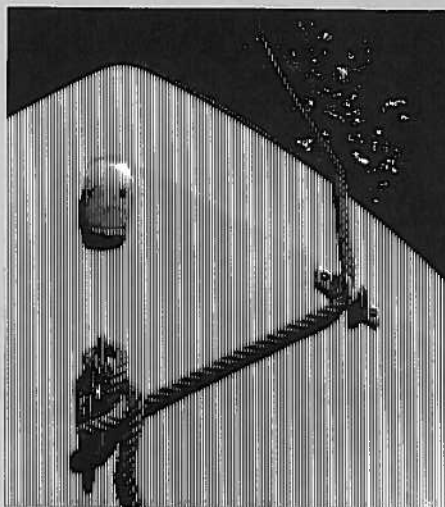
He is in the midst of a two-year study funded by the Texas Sea Grant College Program to examine the continuing confrontation that began in 1982 between the federal government and the shrimpers over the Mexican fishing boundary.

Crouch is chronicling the history of the dispute to determine what impact enforcement policies have had on the shrimpers. He is interviewing federal officials, U.S. Coast Guard officers and shrimpers, as well as examining federal records for enforcement figures. Crouch said he has been able to gain access to both sides of the dispute because he is looked on as an objective observer.

Until 1976, American fishermen were permitted by Mexico to fish in the Gulf up to 12 miles off the country's coast. That freedom was particularly important to Texas shrimpers, who follow the shrimp as they swim south from their hatching area near Galveston down toward Mexico.

When Mexico extended its fishing boundary to 200 miles in 1976, little was done by either U.S. or Mexican authorities to stop the shrimpers from entering Mexican waters. The situation changed dramatically, however, in 1981 when the U.S. Congress passed the Lacey Act, forbidding any product that was obtained illegally on foreign territory to be brought inside the United States.

The law was brought to bear against the shrimpers in 1982, when armed federal agents began boarding fishing boats in the Gulf to check on shrimp catches. Tensions escalated immediately, especially because the shrimpers refused to see that what they were doing was illegal, Crouch says. ■



Texas A&M develops new seafloor mapping system

A new seafloor mapping system is being developed by the Geodynamics Research Program at Texas A&M University that will map continuous 15-mile wide swaths of the seafloor. Costing more than \$2 million to build, the new high resolution, long-range side-scan sonar system constitutes a major advancement over existing seafloor mapping systems, experts say.

The device offers rapid evaluation of offshore frontier exploration areas, precise mapping of outer continental shelf, slope or deep seafloor regions as well as maps showing the distribution of deep seafloor mineral deposits, sediments, rock types and morphological features, scientists say.

"The device will permit Texas A&M to make significant contributions to many scientific and societal programs," says Dr. Mel Friedman, dean of geosciences. "For example, the device could be used to locate airplanes, ships or submarines lost at sea, or to contribute to the disposal in the oceans of nuclear and other toxic wastes by permitting identification, monitoring and retrieval of the canisters on the seafloor."

Dr. Thomas W.C. Hilde, professor of geophysics and leader of the Geodynamics Research Program, says that construction and testing of the device, referred to for short as LRSSS, is expected to be completed in December 1987. Funding for the system comes from the state through the University, the Navy, Lamont-Doherty Geological Observatory, the National Science Foundation and John E. Chance Inc. ■

Beach goers understand signs, if they see them

With the lemming-like spring rush to the beaches near, a Texas study has found that nationwide, people tend to understand beach warning signs well — but only one in three persons see them.

A survey of 14 popular beaches around the country revealed that on average, only a third of people recalled seeing signs prohibiting swimming, diving, surfing and other activities, says James M. McCloy of Texas A&M University at Galveston.

McCloy is director of the Galveston campus' Coastal Zone Laboratory and has conducted ongoing research on swimming and safety, including a survey of 1,750 beachgoers last summer in a project sponsored by Texas A&M's Sea Grant College Program.

Persons who do see warning signs apparently understand them well, says McCloy. Ninety-seven percent of the interviewees in a control group correctly interpreted what the signs were supposed to say.

The signs were 20 inches in diameter with the international circle-and-slash "prohibited" symbol superimposed on the drawing of the activity.

Awareness of beach safety seemed high, as more than 90 percent of those polled knew when a lifeguard was on duty, knew about holes and sandbars created on the bottom by waves and currents, and understood it is unsafe to run and dive in the water.

Beachgoers at Bradley Beach, N.J., had the highest marks in the survey, with just under 70 percent recalling the signs, with Crescent Beach, Maine and Island Beach State Park, N.J., also earning high marks.

Persons who did poorest in spotting the signs on the day of the survey were at Del Mar, Calif., and Fort Lauderdale, Fla.

McCloy says drowning is the second leading cause of accidental death in Americans until age 44. Most victims are teenagers with the second largest group being children 4 and under.

The Texas A&M Sea Grant office has released the following safety tips:

- Don't swim if you've been drinking alcohol or using drugs.
- Don't swim if you're tired or sick.
- Don't swim alone or in boating and surfing areas.
- If you can't swim, stay in water shallower than waist deep.
- When possible, swim near a lifeguard. ■

Freefall safety studies aid offshore oil crews

Studies of the jolt the human body takes on amusement park rides and when ejected from jet aircraft are being used by Texas A&M University engineers to help design safer freefall lifeboats for use on offshore oil drilling rigs and large sea-going vessels.

In a project sponsored by Sonat Offshore Drilling, Inc., of Houston, structural engineering researchers are developing instruments and computer models to measure and predict deceleration levels experienced by occupants of lifeboats in free falls of up to 130 feet.

"A majority of the lifeboat accidents occur during and after lowering into rough seas," says Dr. Teddy Hirsch, professor of civil engineering and co-principal investigator on the project with James Nelson, assistant professor. "Lifeboat passengers can be seriously injured or killed."

"We are looking especially at lifeboats to be used in the North Sea where the seas are often stormy and many times lifeboat passengers can be seriously injured or killed. The lifeboat can hit the sides of the ship or rig, causing severe damage," Hirsch says.

"The lifeboat may be unable to move away from the vessel in distress because high seas continually return the lifeboat to the vessel. Its passengers can be injured or killed by the impact, exposure to cold water, or burned in oil and gas fires."

Nelson says the freefall lifeboat concept, first developed by the Harding Co. in Norway, overcomes these problems by allowing the lifeboat to slide down an inclined surface and then fall freely from 50 to 100 feet into the sea. The inclined ramp and the free fall provide kinetic energy that causes the lifeboat to be propelled forward after it hits the water, he says.

Hirsch, who received the Automotive Safety Foundation's Highway Safety Award in 1968, says more realistic deceleration values that the human body can withstand will aid the continued development of the freefall lifeboats.

He and Nelson studied designs of Air Force pilot ejection seats that expose the pilot to high acceleration levels parallel to the spine in an "eyeballs down" condition. "Eyeballs down" is a term used by engineers to describe the action on the human body in a situation such as one experiences when an elevator stops suddenly. ■



Major world ocean study receives Japanese input

American scientists have returned from a meeting with the Japanese in which the two nations began joint planning for the World Ocean Circulation Experiment (WOCE), the first international study of the effect of worldwide ocean currents on climate.

"It was the first step in the process of trying to form the plans of the two countries so that they have more common elements," says Dr. Worth Nowlin, the Texas A&M University oceanographer helping formulate America's role in WOCE. The U.S. planning office for WOCE is headquartered at Texas A&M.

By 1995, WOCE is expected to provide the first comprehensive global survey of physical properties of the oceans. The resulting data will be used to establish the first "global baseline" for long-term behavior of the ocean, and to test computer models of the ocean circulation vitally needed to understand global climates and to predict climate change, Nowlin said.

Nowlin, who went to Japan with other American researchers, said the major Japanese research interests seem to be in studying the Pacific Ocean. "We discussed research, related technology and data management," he says.

Japan established a WOCE steering committee in 1985 chaired by Prof. Yutaka Nagata of the Ocean Research Institute at the University of Tokyo. France, West Germany, Britain and South Africa have also established planning committees for the experiment. ■

ODP scientists finding new life on ocean floor

Scientists for the international Ocean Drilling Program have returned from a drilling expedition in the Atlantic Ocean with samples of a unique biological community they found living amid 30-foot-high chimney structures that spew hot, metal-enriched fluids onto the seafloor.

Their ship, JOIDES Resolution, was the first ever to collect core sample adjacent to Atlantic Ocean smokers, a system of underwater hot springs that produce rich deposits of ore on the ocean floor.

"We were using an underwater camera at about 10,000 feet below the surface of the water in an area of suspected hydrothermal activity when we first saw these little creatures swimming in and out of view in an actual black smoker area," says Dr. Andrew C. Adamson, Texas A&M University staff scientist. Texas A&M is the headquarters for the Ocean Drilling project.

"There were shrimp-like crustaceans of various sizes swimming around and small organisms, possibly anemones, that attached themselves to the rocks of the seafloor," Adamson says. "This community, which consists of mostly small, mobile organisms, differs from the hydrothermal communities in the Pacific, which are known for their large, polyp-like tubeworms, clams and mussels."

The cameras also gave scientists a firsthand look at a submarine hydrothermal vent system in the Mid-Atlantic Ridge, an underwater volcanic mountain range that encircles the world. Cold sea water circulating down into hot, recently erupted lava is heated to high temperatures in these hydrothermal vents and is upwelled as hot springs onto the seafloor.

Marine geologists are particularly interested in these hydrothermal systems because of their ore-producing capabilities.

Another ODP group last year successfully deployed a new guide base system that allows drilling into the bare, fractured rock.

Eight months ago, a 20-ton steel device called a guide base was lowered to the seafloor and locked in place with 2,000 cubic feet of cement. The base gave the stability needed to drill into the rocky surface. ODP engineers also developed new drill bits to penetrate and drill into the brittle, highly fractured volcanic rock successfully. ■



REQUIEM FOR TED

**Teds, Teds, everywhere,
and not many turtle
excluder devices in
Texas. That may soon
change to the joy of
environmentalists and
disgust of shrimpers.**

Gary Graham, a big man who looks and talks more like the son of Popeye than a nationally known expert on shrimp trawling gear, is tired of talking about Ted.

Ted isn't a person. Ted is short for "Turtle Excluder Device" and it's supposed to prevent endangered sea turtles from drowning in shrimp nets. A push by the federal government to get the historically independent Texas shrimpers to use the device for an animal they rarely catch has this burly man down.

"They (shrimpers) don't call me Gary anymore, they call me Ted," laments Graham, who has tested TEDs up and down the Texas coast for more than five years as a fisheries specialist with the Texas Marine Advisory Service. But TED isn't about to go away. Indeed, this controversy may soon pit the massive Texas shrimping fleet and environmentalists in a ideological battle over the best method to save the ancient, and now endangered, sea turtle.

The TEDS are sewn into shrimper's trawling nets. The steel and mesh boxes are supposed to allow turtles and unprofitable trash fish to pass through the massive nets unscathed, while still reaping the shrimp.

STORY AND PHOTOGRAPHY BY NORMAN MARTIN



The shrimp industry believes TEDs are inherently dangerous to boat crews.

The government has spent some \$3.5 million to develop a workable TED. Shrimpers in other states also are attempting to develop their own by modifying what they call "cabbagehead shooters." But trial tests in Texas have failed miserably, and few Texas shrimpers are willing to bring TEDs on board voluntarily. Apparently, the TEDs let far too many shrimp escape.

The rift is reminiscent of the 1970's snail darter controversy when construction of a major dam project was halted to protect an endangered species. But a dam isn't the number one cash fishery in Texas; shrimp is — to the tune of \$161 million in 1985.

After almost a decade of expecting widespread use of TEDs, marine environmentalists are tired of waiting. "By conserving this turtle and not drowning them in shrimp nets, we can bring these turtles back," says Carole Allen, director of HEART (Help Endangered Animals-Ridley Turtles), a conservation organization in Houston.

Putting the situation in a gaming scenario, Ralph Rayburn, executive director of the Texas Shrimp Association in Austin, says, "It's the environmentalist's call. It's going to be war for the next year or so." The better path, he says, would be to continue voluntary efforts and ultimately make the TED a norm within the industry.

Rayburn emphasizes that Gulf offshore shrimping vessels are larger than their counterparts on the East Coast; Texas-size

if you will. The big boats will frequently tow four nets at a time, as opposed to two on the Atlantic trawlers. This means four TEDs on the running nets, plus spares in case those are damaged. He estimates the Gulf fleet will require some 36,000 TEDs at a cost of more than \$20 million. An individual TED now costs between \$350 and \$500.

"That's a significant, instantaneous cost to the industry," Rayburn says. Moreover, TEDs will be a continuing cost since they undoubtedly will have to be replaced.

Part of the uproar surrounding the endangered turtles has been caused by the rising number of turtle carcasses that have been washing up on Texas beaches this year. Almost 200 appeared by June. Sea turtles in the United States are either endangered or threatened with extinction and are protected by the Endangered Species Act. Under the law, anyone taking, killing, injuring or harassing sea turtles is subject to arrest, and penalties could result in five-year imprisonment and/or a \$20,000 fine.

U.S. National Marine Fisheries Service (NMFS) officials estimate there are some 45,000 sea turtles caught each year in shrimp nets. About 12,000 of those die. While there is no official estimate on how many of those are Gulf catches, the Gulf has approximately 6,000 offshore shrimping vessels. Even one turtle catch per year for each boat means a sizeable number annually.

"One boat may only catch a couple of

turtles a year," says Wilber Seidel, NMFS chief of harvesting in Pascagoula, Miss. "But if you add that up for 6,000 boats — each one towing thousands of hours — it's a lot of effort. They end up with a fairly high total number of captured turtles."

While sea turtles can remain under water for extended periods, the death rate for a sea turtle caught in a shrimp net for an hour is about 4 percent; at 1.5 hours, the rate climbs to 10 percent. On the Atlantic coast the average trawl time is between 2 and 2.5 hours. However, in the Gulf of Mexico, trawl times average more than 3 hours. "We have had observers on boats that towed more than 13 hours without picking up the net," Seidel says.

The Texas shrimp industry counters that TEDs are inherently dangerous to boat crews in their present form, and that much more research is required. The TEDs take up precious deck space and add extra weight to the nets. Moreover, there are no TED manufacturers in Texas and those devices that are shipped in are very expensive for the shrimpers.

But the writing may be on the wall. "I wish they (shrimpers) didn't have to do it, but I'm convinced that they will either have to reduce the tow time, not shrimp in that area or put on the TEDs," says Bob Jones, spokesman for the Southeastern Fisheries Association, a fisheries trade organization representing fishermen from Texas to Virginia. The organization has some 450 company members that employ more than 12,000 people.



Even one turtle catch per year for each boat means a sizeable number annually.

"A lot of our people say they don't catch them (turtles)," Jones says. "Well, the fact of the matter is that they are being killed by something and they just tend to die more often when there is significant shrimping in the area."

Meanwhile, there is a split over TED use between the two federal agencies — U.S. Department of Interior's Fish and Wildlife Service and NMFS — charged with protecting the sea turtle. Fish and Wildlife, which is responsible for the turtles while on land and historically has been inclined to protectionist stances, is tired of NMFS's policy of waiting for voluntary cooperation from shrimpers.

"Their (NMFS) position all along has been to encourage voluntary use," says Jack Woody, the U.S. Fish and Wildlife National Sea Turtle Coordinator in Albuquerque, N.M. "Fish and Wildlife has sat back and said, 'Okay, that's your business.' But frankly we don't think voluntary use is going to work.

"Trawlers aren't going to adopt it (TED) on their own. I don't see any incentive for them to be honest," he says. "I'd like to keep this thing from getting nasty." Unfortunately, that appears doubtful. Indeed, Woody believes a lawsuit directed at NMFS from environmental organizations will be filed within a year.

NMFS is sticking by volunteerism for

the moment. But the agency is increasingly weary of being prodded from all sides. For the past five years, NMFS has tried to encourage voluntary use of the TED, says Charles Oravetz, chief of NMFS's Protected Species Branch in St. Petersburg, Fla.

"But to be frank, if the voluntary program doesn't pick up speed, TEDs very likely could be required on a mandatory basis within the next year," Oravetz says. That move could be accomplished, he says, through a lawsuit forcing the agency's hand or "just the fact that the voluntary program isn't working too well."

Mandatory use is a reality most Texas shrimpers haven't faced up to yet. But a newsletter sent to Texas shrimpers by Mel Russell, Texas Marine Advisory Service agent for Galveston County, quoted the St. Bernard Fisherman, "If certain groups can hold up a billion dollar dam for years in Tennessee because of the snail darter, you can bet the rent that they can force the use of TEDs."

The best way to increase TED use is to stress the improvements the device can bring to the shrimper's operations, says Graham, who is based in Angleton.

"In the industry, they talk in terms of dollars," Graham says. Besides excluding turtles, the TED can get rid of between 60 and 80 percent of the fish, or what the shrimpers call by-catch, caught in the trawl during the day. Fewer fish and other by-catch on the back of the boat means enhanced processing time for the far more valuable shrimp.

A Gulf trawler normally will bring in more than nine pounds of finfish for every pound of shrimp. That's close to 2 billion pounds of finfish a year that are taken and thrown over. There are some 150 species of finfish in the Gulf and a number of those are young commercial or recreational fish.

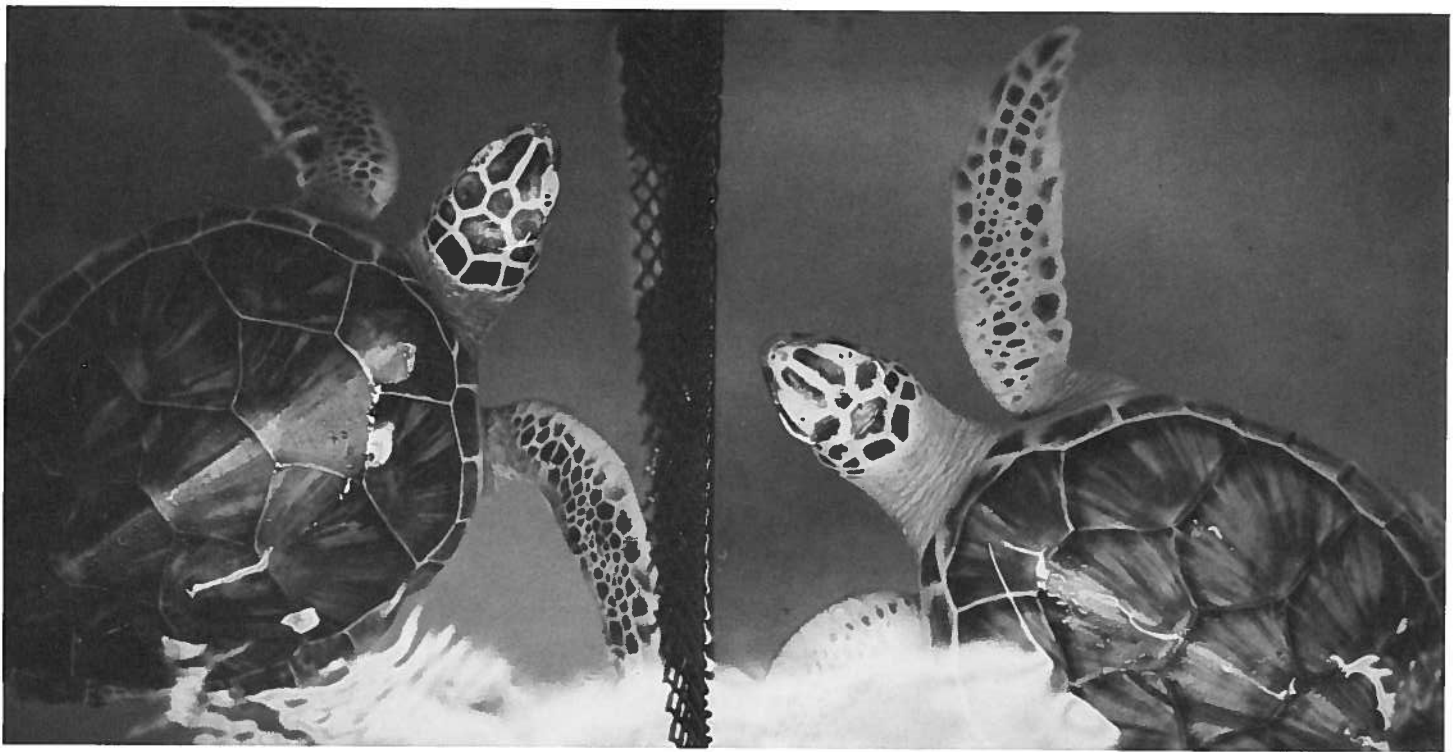
Cannonball jellyfish, which sometimes occur in such large numbers that they clog shrimp trawls and decrease towing time, are also eliminated so that longer tows can be made. "The reason any shrimper tows a TED is not for the turtle," says David Harrington, a marine fisheries specialist with Georgia Sea Grant. "The reason a shrimper tows any device is to get rid of trash such as jelly balls."

"This is going to have to be our selling point," Graham says.

Part of the controversy swirling around TEDs is their lack of availability in the Texas market.

Seidel says a fair market price for a NMFS-designed TED is \$350 to \$400. There are problems, though. "There aren't that many manufacturers available yet," he says. "And, there is a tendency to charge \$600 to \$800 by those (manufacturers) who can build one well." The actual cost of materials is about \$225.

"We've been trying to get shops set up and qualified to build TED correctly, but it's a problem in Texas," Seidel says. "None of the present sources are in Texas." Meanwhile, though, he says NMFS will continue to provide help through work-



After almost a decade, marine environmentalists are tired of waiting.

shops and construction demonstrations.

Jones believes widespread commercial construction of TEDs isn't likely to occur unless the federal government determines that mandatory use of TEDs is going to come into being.

So far, he says, Georgia probably has the best acceptance of TEDs. Georgia also has the smallest coastline, the fewest number of commercial shrimpers, and a dynamic Sea Grant Program to demonstrate TED use. Florida is a different story. "We couldn't get anybody to bid on the construction of TEDs," Jones says.

"This is a chicken-and-egg world," counters Oravetz, who says manufacturers contend they are not building TEDs because there is no demand for them. Fishermen contend they are not using TEDs because there is no place they can buy them.

"If a fisherman really wanted a TED, he could find one. So I don't think that is really a valid excuse." But, even Oravetz admits that getting one in Texas now is difficult because some manufacturers are simply not filling TEDs orders.

TSA's Rayburn says the difficulties in enforcing TEDs include:

- An unrealistic time frame for implementation.
- No commercial outlets are available in Texas.
- There are other significant causes for sea turtle deaths in the Gulf besides Texas shrimpers.
- Few, if any, sea turtles are caught by an individual shrimper during the year.

- More research needs to be done on different types of TEDs to reduce the loss of shrimp attributed to the TEDs.
- Texas is already ahead of other states in introducing the device into the shrimping fleet.
- And, more study must be given to exactly where these endangered turtles are in Gulf waters.

Moreover, Rayburn believes there is an inherent danger to the shrimp boat crew from TEDs. While boat owners may well have to buy TEDs eventually, he says, it will be up to the captain of the vessel to decide how he is going to protect the crew. "The danger to the crew is real," he says.

Georgia's Harrington points out, "If it is unseaworthy, who is going to pay the liability insurance? Would the boat owner be forced to pay higher premiums or be sued for phenomenal amounts of money, when he is forced to put something on his boat that he really doesn't want?"

One factor favoring mandatory TED use is the message it sends to Mexico and other Central American countries who continue to harvest sea turtles for commercial use. "If we get our own people to use TEDs," says Woody, "it would put me on a better stand to convince other countries to use them."

The TED has been demonstrated in

several foreign countries. Development work is being conducted on a smaller TED for shrimp nets normally used in inshore waters. If it is effective, the small TED could play a significant role in protecting young turtles in inshore waters.

Just who has the best TED is still undecided. There is certainly no question about who has spent the most money.

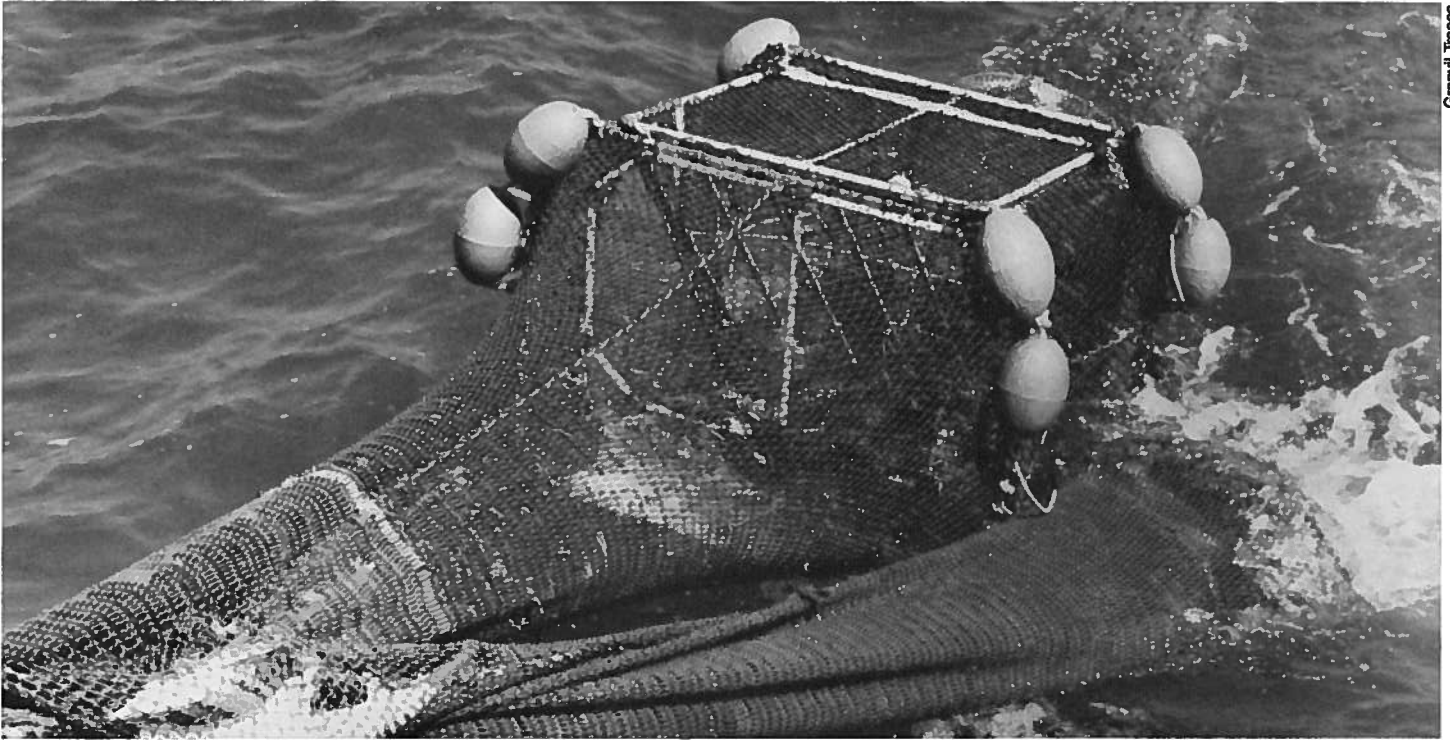
The multi-million development of the NMFS-designed TED began in 1977 when interest in marine environmental issues was near its peak, according to Seidel. Joint meetings were held between representatives of the shrimp industry, the environmental community and NMFS to find a way to keep turtles from drowning that would not hurt the shrimp industry.

During the following four years, NMFS tested a variety of approaches. By 1981, the agency had a workable device termed TED, short for turtle excluder device. The TED, which had an escape door on top, essentially eliminated turtle captures and didn't lose shrimp, Seidel says.

Even NMFS officials now admit that there were severe problems with the first TEDs. The solid frame design took up deck space and weighed about 75 pounds.

"But it did get rid of turtles, and it didn't lose shrimp," Seidel says. "And those were the two main objectives." Secondary considerations were ease-of-use and cost. Seidel emphasizes all testing work was done on commercial boats, including diving studies, research evaluations and fuel testing.

The first TEDs were tested in several



The government has spent some \$3.5 million to develop a workable TED.

Gulf states, but principally along the Georgia and South Carolina coasts where many more turtles are caught by shrimpers each year. By 1981, NMFS began to look at ways to improve TED. The agency examined lighter materials, such as aluminum and fiberglass, and developed a collapsible design that wouldn't take up so much deck space. Other studies reviewed methods to improve finfish separation, particularly during the evening hours, as well as getting rid of jellyfish balls, oysters and crabs.

By 1984 NMFS had developed a collapsible steel pipe TED that weighed only about 30 pounds. "It gets rid of 75 percent or more of the finfish during daytime shrimping and 50 percent or better at night," Seidel says. The finfish reduction is optional, and the feature can be removed if not needed. The NMFS TED also removes jellyfish quite effectively, as well as larger objects such as horseshoe crabs and even blue crab.

"It's lighter. Easier to use. It doesn't tangle in the net. And you don't have to worry about twists in the bag when you throw the net over. It will clear itself," he says.

But there are those who believe they can build a better TED. Commercial shrimpers have always attempted to develop techniques and devices that would exclude unwanted species in trawl catches.

Prior to 1978, many Louisiana fishermen used an excluder device constructed of plastic (PVC) pipe that deflected unwanted by-catch out of the trawl through a top opening cut in the trawl throat. The

early 1980's version of the NMFS TED had an iron, top-escape, hinged door. Fishermen found the TED a little cumbersome and heavy, but exclusion performance was good.

During this time, Louisiana shrimpers modified the PVC excluder considerably, and developed an aluminum excluder device that eliminated by-catch through a cut in the throat of the trawl, along the top attachment point of the webbing, according to Paul Coreil, Cameron and Calcasieu Parish agent for the Louisiana Cooperative Extension Service. No hinged door was used.

The Cameron Aluminum Excluder (CAE) weighs much less than the NMFS TED, Coreil says. NMFS found the Louisiana device to provide good turtle exclusion and it has been well accepted in the state. But the NMFS collapsible TED also has been well accepted in Louisiana, according to Coreil, primarily because of the fish exclusion option and the light weight and collapsibility. Many ports, Coreil says, are showing as much as 75 to 80 percent usage.

Woody points out that while U.S. Fish and Wildlife supports the use of TEDs, it doesn't necessarily have to be the NMFS-designed device. And, as NMFS' Oravetz adds, there obviously are individuals who think they can make a better TED.

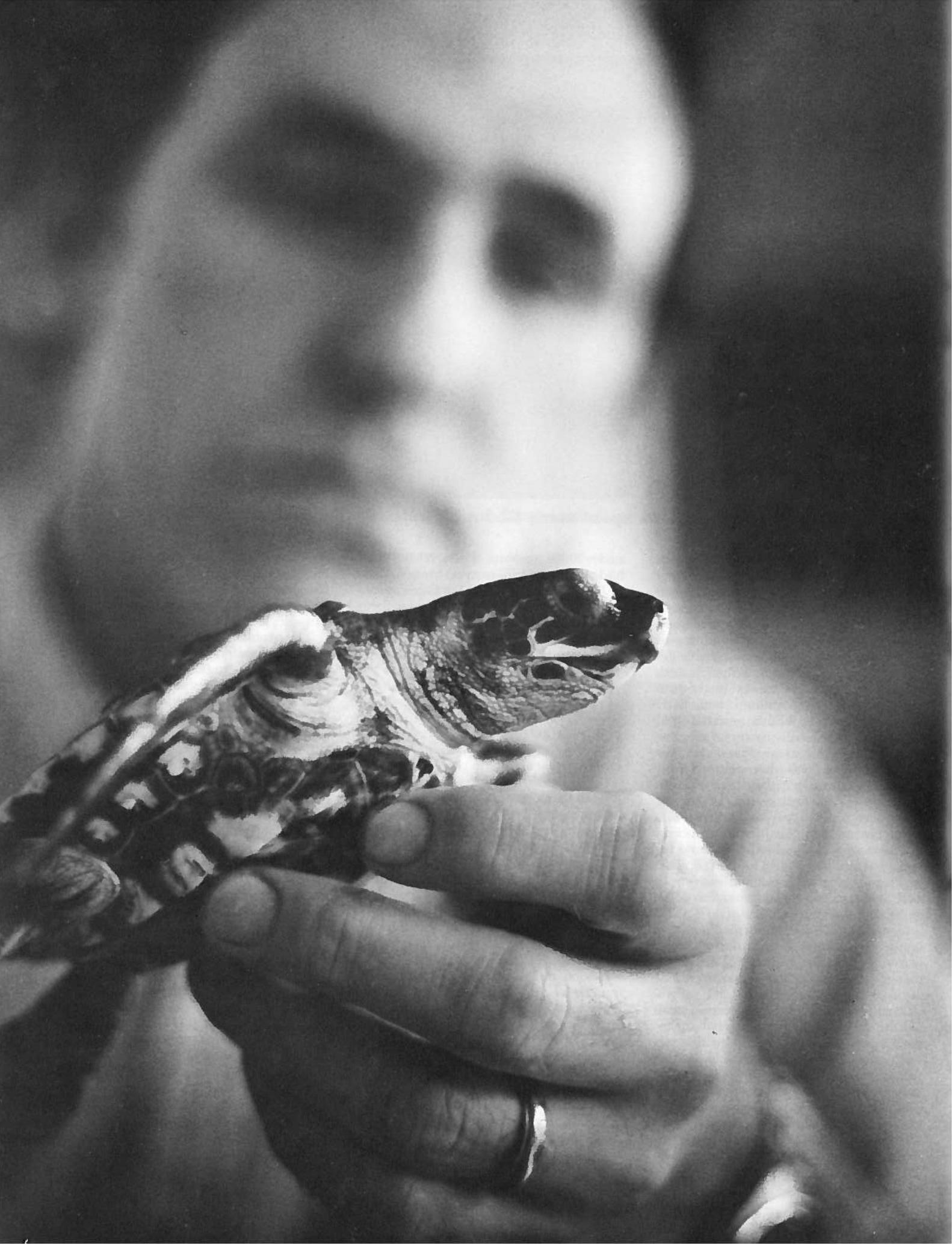
"That's good," Oravetz says. "We want to encourage that. If there is ever a regulation requiring the use of TEDs, we would like to see that regulation be as flexible as possible."

The problem at this point is that no one is sure how effectively the new TEDs toss out turtles. In August, Georgia's Harrington and a team of fishery experts will test the Cameron TED as well as TEDs from Georgia and possibly Texas. "We want to prove to the environmentalists that TEDs other than the federal one will indeed exclude turtles," Harrington says.

Meanwhile, Graham once again will test TEDs up and down the Texas coast this summer, but this time with the addition of several new designs. Twenty TEDs will be examined inshore in the bays, while 10 Gulf boats will test another 20.

Still, no matter if the government finds the perfect TED, it is a device that most Texas shrimpers believe they can do without. The conflict will, in all likelihood, deepen in the coming months. The unusually high number of sea turtle standings over a small area in Texas will continue to cause great concern for environmentalists and wildlife officials.

And, while biologists and law enforcement agents have been unable to determine the exact cause of turtle death, shrimpers will likely be targeted by protectionist groups and environmentalists. Ultimately, it appears, the debates will be decided by the courts. "This is a real problem that is not going to go away," Rayburn says. ■



THE SWEET SMELL OF

S U C C E S S

A team of Texas A&M marine scientists tracked down how sea turtles find their way home. They just follow their noses.

THERE'S NO PLACE — OR SMELL — LIKE HOME TO
a sea turtle.

Indeed, biologists have found significant new evidence that baby sea turtles have the biological equipment and abilities necessary for imprinting. In other words, these ancient and increasingly rare animals can find their way home again — even after 15 years — by remembering how it smelled.

Marine experts say the new findings are good news to several environmental government agencies. The groups are attempting to use the sea turtle's long-term memory of where it was born as an experimental conservation strategy.

Dr. Dave Owens, a Texas A&M University associate professor of biology, and Dr. Mark Grassman of The University of Texas at Austin's Department of Zoology, report that sea turtles can detect subtle differences in natural water samples by remembering olfactory (smell) clues to which they were exposed as babies and that these differences affect their behavior.

Funding for the research came from Texas A&M's Sea Grant College Program. The turtle imprinting studies have been continuing for the past four years. The species of sea turtle has varied over the years depending on their availability and their appropriateness as experimental animals.

STORY AND PHOTOGRAPHY BY NORMAN MARTIN

The first imprinting experiments, which began with loggerhead turtles, produced some interesting results but nothing scientifically tangible. That soon changed when a new series of studies on the much endangered Kemp's ridley turtle proved positive. "We found a strong attraction of the Padre Island exposed animals to those Padre Island olfactory cues," Owens says. Using a computer analogy, the Texas A&M researcher suggested that the turtles have the necessary hardware to remember.

Imprinting is just a high-tech type of memory. It is a long-term memory that occurs during a specific, short period in the animal's life, known as a "critical period." In the early 1980's the scientific



Sea turtles can detect subtle differences in water.

team discovered that sea turtles do, in fact, have a critical period, could remember this smell for a long time, and were attracted to that smell.

Still, evidence wasn't conclusive, at least not until the latest experiment. The study used green sea turtles which are famous for their long distance migrations, in addition to being very site specific in terms of nesting. For instance, a green sea turtle will often nest, wait three or four years, and come back to that same beach area.

An artificial set of conditions was used in the experiment. In other words, the researchers artificially imprinted the animals to two chemicals that don't even occur in nature. "They are organic molecules that are of the size and shape

RIDE THAT TURTLE

These marine researchers like being Australian turtle cowboys, but they're still rooting for the turtles.



When biologist Dr. David Owens and his family left Heron Island National Park on Australia's Great Barrier Reef late last year, they probably gave up their position as the island's longest term residents. They had been there five months.

Unlike the tourists who paid \$125 a night to stay at the island's resort to relax in the beauty of this natural wonderland in the Coral Sea, Owens and a contingent of graduate students were there to labor, sometimes from dawn late into the night, on a research expedition to study sea turtles. Like rodeo steer wrestlers, the researchers jumped into the sea from their

BY JANE MILLS SMITH

Mercury-powered horses to grab the swiftly-moving turtles — sometimes weighing hundreds of pounds — and wrestle the flapping and sometimes snapping turtles to the surface and into a small boat.

"We'd spend the day doing that," Owens said as he thought back about the expedition from his laboratory at Texas A&M University. "At the end of the day, we'd have a boat so full of turtles that it would be dragging bottom as we fought the tide to get back to shore.

"Then we'd see an outstanding-looking individual swim by and we'd just have to try to catch it. We'd gun the motor and head off after it."

Called turtle rodeoing, the activity at Heron Island is unique to this setting because of the large numbers of turtles, the clear and shallow water, and the gusto of Dr. Colin Limpus of the Queensland National Parks and Wildlife Service who showed the Texas A&M crew how to catch the giant turtles, says Thane Wibbles, a doctoral student who was a member of the research team.

"Limpus pushes to the limit. As soon as we'd get a turtle aboard, he'd be off after another one," Wibbles says. "This is the most ideal place in the world to do it and rodeoing is an efficient way to catch turtles for study."

Owens chose Heron Island because of its robust populations of green, loggerhead and hawksbill turtles who live out much of their life cycles within easy viewing range of scientists. Limpus has studied turtles at Heron Island for many years and offered to collaborate with the Texas A&M researchers on their project that is funded by Sea

that you'd expect animals to smell and remember," Owens says.

The chemicals — morpholine and phenylethanol — were used years ago in imprinting studies of salmon. "We found that if the animal had been exposed to that chemical, he showed attraction only to the chemical to which he was exposed. He wasn't attracted to the other chemical that he had never smelled before.

"We had the two treatment groups both doing the opposite thing — showing response only to the chemical to which they were exposed," Owens says. "That makes it a powerful experiment—a classic example of what statisticians call an interaction effect."

Another major conclusion coming from

the study is an indication that time of exposure is extremely important to this imprinting phenomenon. "Time of exposure is going to be very critical," Owens says.

In the study, three treatment groups were exposed to the chemicals — one just while they were eggs, one right after hatching, and, one, both pre- and post-hatching. The only treatment group to suggest imprinting was the last. Owens believes the turtles can be imprinted, but exposure is going to have to be prolonged.

There is a practical consideration to this finding. Government researchers have been headstarting thousands of endangered baby turtles for some eight years now on the assumption that imprinting is

real and does work. Owens says more attention must be paid in the future to the length of exposure.

"Patience is the hardest part of this whole project," Owens says. "It's tough for the government because these guys are putting out the money for this project.

"They are saying, 'When are we going to get some results?' Well, they aren't going to show up anytime soon." These turtles take years to reach sexual maturity." Owens says it's probably going to be 15 years before they can expect the turtles to come back to their home nesting beaches. "They're all nervous, but it's going to take a while," Owens says.

Sea turtles are ancient animals. They can live for more than 100 years, so an

Grant and the National Science Foundation. Owens was given a research leave from the university that was funded by Texas A&M's alumni organization, the Association of Former Students.

Owens and his family were called the longest term residents because they did not leave the island for five months. Most people leave Heron Island occasionally to fly to the mainland for brief periods to enjoy more modern living with television, telephones and such.

The expedition's specific goal was to study the role of hormones in controlling migratory, courtship, mating and other behaviors in sea turtles and to eventually make recommendations for captive breeding and other conservation practices.

"Sea turtles have the highest reproductive potential of all advanced vertebrates, which seems surprising since seven species of sea turtles are considered threatened with extinction," Owens says. "Man is still exploiting these species in the U.S. and other countries. In many countries, the turtles are killed for their leather. In the United States, they are being killed when they accidentally get caught in shrimper's nets."

Since harming the turtles was the last thing Owens and the other researchers wanted to do, they took special care to first study the impact of their research. What they found was that the huge turtles had an uncanny ability to return to their home range after being in captivity and showed no ill effects from the research activities. They seemed to continue life as usual.

The incredibly long period of 30-40 years before sexual maturity for sea

turtles adds to conservationists' problems, Owens said. After 30 or 40 years (some say 50 years), the turtles become sexually active and a female may come ashore and lay 120 eggs. She may go back into the water and then come back one to eight more times at two-week intervals and lay 120 more eggs each time, and then not lay another egg for five to 10 years, he said.

"After attaching sonic tags, we'd let the turtles go and they would rush back to the very place where we'd caught them. They have a very well-defined home range. They'd be in that spot the next day and still be there weeks later. We caught some animals 10-15 times," Owens recalls. To avoid recatching unneeded individuals, the scientists painted some of the turtles so that they could be spotted and identified from the boat.

On the first time a turtle was caught, it would be pulled into the boat and a blood sample would be taken immediately and frozen for later study. The turtles would then be taken ashore for weighing and measurements and then turned over on their backs for laparoscopic surgery to determine their sex and state of sexual development.

There's no way to tell immature male and female sea turtles apart on sight, the scientists say. Not unless one wants to wait 30-40 years until they mature to see the males grow long tails. Part of the group's research focuses on a blood test method for determining sex.

Diana Comuzzie, another graduate student who participated in the research and rodeoing, was there to compare similarities between the behavior of the wild sea turtles and other turtles

she is studying that were bred in captivity in the Cayman Islands.

How does a male turtle locate a willing female? What does courtship involve? Those are some of the questions Comuzzie is studying.

By carefully documenting hormone levels in the Australian turtles during their various activities and rituals, the scientists hope to improve conservation management techniques and captive breeding programs as well as answer biological questions on evolution and ecology.

"For biologists, turtles can serve as a model of relatively primitive reptiles and animals that have adapted to a marine environment," Wibbles says.

Limpus will continue the group's collaborative research on the island, observing the seven months Dave Owens says he'll always wonder about. But with a large freezer back in his laboratory now filled with hundreds of blood samples, reams of notes, more than 50 rolls of film and videotape from the expedition, Owens has plenty of work to keep him busy.

Besides, when he returned to campus, he returned to teaching marine biology, too — a task he does so skillfully that he was recently honored with a teaching excellence award from Texas A&M's alumni association. Besides, he has his memories to last until the next time.

There will a video record of Owens' Australian adventure. A film crew from KUHT, the Houston public television station, accompanied the research team and now is the process of preparing a documentary on the research project.■

extended period before mating isn't that surprising. In some turtles, like the green turtle and loggerhead turtle, sexual maturity may take 30 to 50 years. Sex isn't the only thing turtles are slow to grasp. Simply growing up is an unbelievably slow process.

Owens says the maximum growth that some of those animals have in the 15 years

is 15 cm in shell (carapace) length. That's about 8 inches or some 25 pounds in weight. A mature adult can weigh more than 400 pounds.

"It just takes forever," laments Owens. "As a biologist it's frustrating. You realize your lifetime isn't going to be adequate to really do the complete study.

"Still, there are a lot more turtles on the

Texas coast right now than there was when I came here eight years ago. There's absolutely no doubt about it," Owens says. "There are two possibilities. One, Mexico is doing a much better job protecting turtle nesting beaches from scavengers, both human and non-human. Two, the NMFS head start program is apparently working."■

SEA TURTLE WATCH

Kemp's Ridley Sea Turtle (*Lepidochelys kempi*)

Smallest of the sea turtles. Adults do not exceed 30 inches in shell length and range in weight from 80 to 100 pounds. The broadly oval shaped shell is usually gray, but young are black and adults olive-gray. Found in the coastal waters and bays of the Gulf of Mexico and Atlantic where they forage on crabs. Only a few hundred females nest in the state of Tamaulipas, Mexico, each year.

ESA* Status: **Endangered**

Hawksbill Sea Turtle (*Eretmochelys imbricata*)

Small to medium sea turtles with a very attractively colored shell of thick, overlapping scales . . . the source of "tortoise shell." Has distinct hawk-like beak. Adults range in size from 30 to 36 inches and weigh between 100 and 200 pounds. A tropical reef dwelling species where it forages primarily on sponges.

ESA Status: **Endangered**

Loggerhead Sea Turtle (*Caretta caretta*)

A large reddish-brown turtle with a disproportionately large head. Adult shell length averages 36 inches and weights range from 150 to 400 pounds. This is the most common sea turtle encountered in southeast U.S. waters. Frequently observed around wrecks, underwater structures and reefs where it forages on crabs, mollusks and sponges.

ESA Status: **Threatened**

ESA* — **Endangered Species Act**

Green Sea Turtle (*Chelonia mydas*)

A medium to large dark brown sea turtle with a radiating or mottled pattern of dark markings on the shell. The head is small in comparison to other sea turtles. The biting edge of the lower jaw is saw-like. Adult shell length ranges in size from 36 to 48 inches and weights average 300 pounds or more. Primarily a tropical herbivorous species, the juveniles frequently occur in Florida waters, especially in areas abundant in sea grasses.

ESA Status: **Endangered** for Florida and East Pacific (Mexico) breeding populations; **Threatened** everywhere else.

Leatherback Sea Turtle (*Dermochelys coriacea*)

The largest sea turtle. Can attain a shell length of six feet and weight of 1,400 pounds. Black with white blotches, the shell lacks scales and is covered by a firm, rubbery skin with seven longitudinal ridges or keels. A highly migratory turtle that nests in the tropics and ranges as far north as Canada and northern Japan. Feeds primarily on jellyfish.

ESA Status: **Endangered**

To report sightings or data on sea turtles, contact: Sea Turtle Program/Southeast Fisheries Center/75 Virginia Beach Drive/Miami, Florida 33149/Telephone: 305/361-5761

Note: Many sea turtles are tagged with metal or plastic tags usually on the inside edge of the front flippers but sometimes on the rear flippers or even the shell. If you see a tag it should not be removed (unless the turtle is dead). The tag numbers should be reported to the address on the tag or to the nearest State Marine Fisheries office, the National Marine Fisheries Service, or the Fish and Wildlife Service.

THE TURTLE LADY

Welcome to South Padre Island, the home of Ila Loetscher and her sea turtle pals.



Will Van Overbeek

KISSING A SEA TURTLE IS TOUGH duty for most people. But for the "Turtle Lady of Padre Island," a peck and a pat are continuing signs of affection between this legendary woman and some of the world's most endangered animals.

At 82, Ila Loetscher has no aspirations of making a global attitude change toward her ancient friends in one broad stroke. She prefers to do it more slowly — usually one child at a time. "Our thing is awareness," she says.

Loetscher, a widow, has an abundance of affection for sea turtles. "She has probably been responsible for more people becoming aware of the plight of critically endangered Kemp's ridley sea turtles than anyone in the country," says Pat Burchfield, chief herpetologist at Brownsville's Gladys Porter Zoo and field coordinator of a joint U.S.-Mexico Kemp's ridley turtle rescue project.

Since 1966, Loetscher has been a turtles' good Samaritan, caring for any turtle brought to her home. "People just don't think about sea turtles," she says. "I feel lucky just being able to touch them."

Loetscher and volunteers from her Sea

Turtles, Inc., group present four shows a week at her home on the island. Thousands of school children and tourists see her turtle extravaganzas each year.

A turtle show isn't exactly a display of aerobatics. Actually, it's more vaudeville than anything. A normal children's show includes turtle introductions, brief skits with the turtles dressed up — sometimes in frilly skirts, serapes, wigs and hats — followed by a tour of holding tanks where larger turtles circle about. At times, some lucky child may even get a turtle massage from a well-oiled flipper.

"Children are always enthusiastic when they can feel them and hold them," she says. "They're thrilled to find out turtles are not only intelligent, but they love people. I've got one with very strong flippers, and he'll just hang on to people."

Loetscher has 17 sea turtles in captivity now. While some turtles, such as the Atlantic Green Turtles can weigh more than 600 pounds, the largest she has is 120 pounds. She has two rare Kemp's ridleys.

"We name every one of the turtles, and they all know their names," she says. Some of the more unusual names include John

Livingston Sea Turtle, Pancho Gonzales, Geraldean, Ray, Dave, Irene (after her twin sister) and Dr. Porter.

"Dr. Porter is our male ridley," she says. "We're thinking of taking him to the Cayman Islands for breeding." Kemp's ridley turtles — the smallest, rarest and most endangered species — nest about 400 miles south of the border on a tiny, isolated stretch of beach called Rancho Nuevo.

Despite their rather prehistoric appearance, few children are afraid to touch Loetscher's turtles. One thing that still surprises her, though, are the small children who want to kiss a turtle. "They learn that sea turtles are something to be loved, and that sea turtles love them as much as they love sea turtles."

Being the Turtle Lady, one would naturally expect others to bring her turtles and they do. "I even get some tortoises (land turtles). Children, of course, don't know the difference. But, oh, they get so disappointed when they find out that they don't have a sea turtle."

When the Iowa native moved to South Padre in 1959 after her husband died, she

Please Turn To Page 24



Sea turtle species much like those seen today swam the seas more than 150 million years ago. They were contemporaries of the large dinosaurs but have managed, thus far, to avoid the same fate as their large reptilian cousins.

This, indeed, is the problem with sea turtles today - they appear headed for extinction. There are only seven species, and six of these are considered either endangered or threatened with extinction. All five species found in Texas are in danger of becoming extinct.

Some people might argue that with only seven species, sea turtles are naturally on their way to extinction and that today we have only a remnant of a previously flourishing group. This is not true for at least two reasons. First, according to paleontologists, it is unlikely that there were ever many sea turtle species at one time.

As most living kinds of sea turtles demonstrate today, each species is widely distributed in the tropical and subtropical oceans around the world. Thus, there have been many individuals of each species rather than many different species.

The second reason that sea turtles clearly are not dying out naturally is that man is directly or indirectly responsible for their demise. In his diary, Christopher Columbus said there were so many turtles in the Cayman Islands that he felt as if he could walk ashore on their backs. Today that entire population, which once nested in great numbers on the beaches of Grand Cayman, is gone.

Early navigators found the many nesting beaches and would make regular stops to fill their ships for the long voyages. Some historians have argued that because sea turtles would remain alive in the holds of ships where other animals died, that their use on ships as fresh food was one of the major contributors to the exploration of the Americas.

Every part of the sea turtle has been used by man for food or trade. Today, for example, cosmetics, leather for boots, steaks, soup, jewelery, tourist curios and even aphrodisiacs are all made from wild sea turtles. There is a vast illegal trade in products made from these species.

The U.S. Fish and wildlife Service now says that the trade in illegal sea turtle products is the largest in the world in terms of dollar value, even greater than ivory.

Sea turtles also are accidentally trapped in the trawls of fishing vessels. Thousands of turtles are accidentally drowned each year in shrimp trawls off the East Coast. These air-breathing reptiles can hold their breath for hours under minimal metabolic demand conditions, but the stress of being dragged in a trawl after several hours is usually fatal.



Actually, sea turtles make incredible long distance migrations. The green sea turtle (*Chelonia mydas*) population which nests on tiny Ascension Island in the middle of the Atlantic Ocean makes a round trip of approximately 4500 kms. This migration has been verified by adult tagging studies, but we do not know if a hatchling produced from an egg deposited at Ascension comes back several years later when it is sexually mature.

The feeding ground for these turtles is known to be the shallow coastal areas of Brazil. Since this species may take from 30 to 40 years to reach sexual maturity, there is thus far an insurmountable problem of tagging a small 20 gram hatchling and

finding it again as a 100-250 kilogram adult. Tags that are small enough initially simply will not last that long. There have been some attempts to notch the edge of the shell, but these are quickly overgrown or are later confused with natural injuries.

At one time, large numbers of sea turtles inhabited the Gulf of Mexico. Populations decreased for several reasons, including fishing and development along the coast. Also, in the late 1800's, turtles were commercially important in Texas. There were turtle fishermen, and in Indianola, on Lavaca Bay, a factory slaughtered turtles and shipped canned turtle meat to cities.

Turtle meat is almost 100 percent protein because the fat is concentrated elsewhere in the turtle's body. The Texas "turtlery" was small - a cottage industry - and was wiped out, along with Indianola, by hurricanes long before the United States, in 1972, made it illegal to kill sea turtles. Unfortunately, in other countries turtle harvests have not been outlawed.

In Central America, the Caribbean, Africa or the Pacific Islands, turtles are still big business. They're prized for meat, their shells, eggs, leather and oil. In Mexico, for example, the Pacific Ridley Sea Turtle supports a major, perfectly legal fishery. Three slaughterhouses on Mexico's Pacific coast process as much as 60,000 pounds of turtle a day - each. I've seen 600 turtles in a slaughterhouse at one time. Catches are highly seasonal, though.

But seasonality heightens the problem. The turtles arrive in Mexico in huge numbers to breed, wait offshore until the time is right, and crawl onto the beach at the same time to nest.

I was on a Oaxaca beach one night and 21,000 Pacific Ridelies nested on less than one mile of beach. And that wasn't a big arribada (Spanish, meaning "arrival"). Historically, they talk about as many as 120,000 turtles in one arribada.

Fishermen wait until the turtles are ready to crawl onto the beach and just pick them out of the water. They don't use nets, spears or anything - just their bare hands - so it's hard to call it a fishery. It's more like picking apples. ■



Turtles aren't known for speed, but it's amazing how fast the Kemp's ridley sea turtle rocketed to the brink of extinction. In the mid-1940s these ancient relics of a prehistoric age swamped nesting beaches in Mexico. As recently as 1947, an estimated 42,000 Kemp's ridley (*Lepidochelys kempii*) moms waddled ashore to plop down countless golf ball-sized eggs on a 12-mile remote stretch of beach near the village of Rancho Nuevo, in the state of Tamaulipas, Mexico. Now fewer than 500 females come ashore each nesting season.

Natural predators took their toll on the hatchlings, gobbling up thousands of tiny turtles as they made their break for the surf. But it was only when voracious human egg hunters discovered a taste for turtle that the entire existence of the Kemp's ridley took a nosedive.

M I S S I O N P O S S I B L E
S T O R Y A N D P H O T O G R A P H Y B Y N O R M A N M A R T I N

During the nesting season — between March and August — donkey trains heading for Mexico City were frequently laden with thousands of eggs. Turtle eggs are said to be tasty, high in protein, and rumored to have aphrodisiac qualities. Unfortunately, the Kemp's ridley nesting beach near Rancho Nuevo was discovered by the scientific world long after traffickers overexploited the eggs, says Rene Marquez Millan, head of Mexico's National Program for Research and Conservation of Sea Turtles.

By then marine scientists feared the species would decline to the point of extinction, unless major steps were taken to reverse the trend. The turtles now needed a head start, a way back.

In 1963, commercial trade of the eggs was totally prohibited. In 1977, Rancho Nuevo was declared a natural reserve, and, by 1978, a turtle station was under construction. Also in 1978, there was an intensive effort between government agencies of Mexico and the United States, as well as a number of private individuals and organizations, to reverse the decline.

The nesting beach near Rancho Nuevo is now patrolled and protected during the nesting season each year. About 70,000 to 90,000 hatchlings are produced there each year. Some nests are relocated within protected corrals. Also, a small proportion of the total egg production, some 2,000 eggs, are collected from the Rancho Nuevo beach by the National Park Service and its contractor, Gladys Porter Zoo in Brownsville, Texas.

Marquez says the decline in the population seems to have been stopped, but any catastrophic problem that affects the habitat or part of the population will increase the danger of extinction of the Kemp's ridley. There are other troubling signs, says Jack Woody, U.S. Department of the Interior National Sea Turtle Coordinator.

Until 1985, it appeared that the nesting population had stabilized. But a decrease in numbers of turtles nesting at the beach near Rancho Nuevo during the 1985 season may indicate efforts have not been completely successful. Woody believes that until a much greater degree of cooperation is received from the Gulf of Mexico shrimp trawling industries of both Mexico and the United States, this species' status will not improve. In fact, the species may continue to decline, he says.

The Kemp's ridley sea turtle might not be in such trouble if it weren't for its tradition of laying its eggs on only one known nesting beach. Researchers have long wondered why when the mother turtle leaves the surf, she repeatedly pushes her nose into the sand from waterline to the sand dunes. Some marine experts believe the chemical characteristics of this particular area of beach was somehow imprinted in the memory of the giant

turtle when it was a hatchling. That's how it is able to return to the same spot years later.

When satisfied that she has found the right location, the female Kemp's ridley digs a bell-shaped chamber in the sand, backs into it, and lays approximately 105 leathery, golden-hued eggs. After the task is completed, she fills the hole, tamps down the sand and returns to the sea.

Biologists gather eggs at the moment the turtles lay them, collecting them in plastic bags, so they never touch Rancho Nuevo sand. Under normal conditions the baby Kemp's ridleys dig their way out about 50 days later and head for the water.

Milford Fletcher, chief of the National Park Service's Division of Natural Resources Management in Santa Fe, New Mexico, says the eggs are collected and placed inside polystyrene foam boxes for incubation. The boxes are flown to the Padre Island National Seashore near Corpus Christi, Texas. The eggs are protected and incubated until hatched 50 to 60 days later.

The hatchlings are then released on the Padre Island beach to make their way to the surf. Exposure to the beach and surf is assumed to "imprint" the hatchlings to Padre Island as their natal beach. After entering the surf, Fletcher says, the hatchlings are captured and transferred to the National Marine Fisheries Service's Laboratory in Galveston, Texas.

The hatchlings are "imprinted" under surveillance by National Park Service personnel. Because adult sea turtles are known to return to the same beach over a number of years, marine biologists theorize that hatchling turtles may become "imprinted" by exposure to the beach sand and adjacent surf and return as adults to their natal beach. As a result, most of the eggs gathered for head starting are incubated in Padre Island sand and the hatchlings are exposed to Padre Island sand and surf.

Rare Kemp's ridley turtles (center) are head started in buckets at the National Marine Fisheries Service's Laboratory in Galveston.





Biologists hope that these turtles will be "imprinted" and that, following head starting, tagging and release, they will later return to the Padre Island beach upon reaching the age for reproduction. More than 10,500 hatchling turtles have been imprinted at Padre Island, but there has been no documented returns of imprinted and tagged turtles to Padre Island National Seashore, Fletcher says.

At Galveston, the hatchlings are head started for one year or less. "We do this to increase their survival during their first year of life," says Dr. Charles Caillouet, chief of NMFS' Life Studies Division. Since 1978, 9,258 tagged Kemp's ridley sea turtle juveniles have been released into the wild, according to Caillouet. Survival during head starting has been greater than 80 percent, while first-year survival in the wild is estimated at less than 1 percent.

For a year, the little turtles live in plastic buckets that have been perforated to permit seawater to flow through. They must be separated in individual buckets, because the Kemp's ridley is very aggressive and individuals will bite and injure one another when grouped together. Also, bucket location is used to identify the clutch or origin of each turtle throughout its stay in captivity.

"In our facility, the turtles grow from less than an ounce as a hatchling to about 2 pounds in 10 to 12 months," Caillouet says. A fully mature individual can reach a weight of 100 pounds and have a shell (carapace) length of 28 inches. By the time the turtles are released from Galveston, they have grown to the size of a frisbee and are large enough to fend off most predators.

The turtles are fed a modified trout chow made especially for the turtles by a well-known animal food manufacturer. The food is in the form of floating pellets and is very high in protein. Much of the food is bought with donations, primarily

Scientists (far left) are trying to imprint the tiny hatchlings to Texas. HEART (far right) donations aid in buying food.



from schoolchildren to HEART — Help Endangered Animals Ridley Turtles. The organization is a special committee of the Piney Woods Wildlife Society, a nature club of North Harris County College in Houston.

HEART raises funds by publicizing the problems facing the Kemp's ridley among school groups and conservation organizations. Carole Allen, founder and chairwoman of HEART, says that it costs about \$4 to feed one turtle for a year.

"We as a human race have to have responsibility for our actions," Allen says. "If we all pull together, we can reverse the trend of the loss of this turtle. We can bring them back."

Individuals making a donation get their names placed on a small red heart, which is posted on the bulletin board at the NMFS laboratory in Galveston. There are some 1,400 hearts now, representing about \$10 per year. The largest donations have come in the form of grants from corporations such as Exxon, which has donated more than \$15,000, she says.

The head-started turtles are weighed, measured and tagged with metal flipper tags before being released into the Gulf of Mexico, usually off Padre and Mustang Islands. "Whether or not we are successful will not be known until the turtles reach reproductive age, which may take more than 10 years in the wild," Caillouet says. "By using the tags, vital information on growth and movements can be recorded for those that are later found and reported to us. Data gathered so far indicates that the captive-reared ridleys adapt well to the wild."

Once the sea turtles hit the water, they cover great distances. Larry Ogren of the NMFS Southeast Fisheries Center Panama City Laboratory in Panama City, Fla., says juvenile life stages of Kemp's ridleys are widely distributed throughout U.S. coastal waters from Texas to New England.

Clark Fontaine of the NMFS Southeast Fisheries Center in Galveston, says that during the first six years of the project, 8,241 Kemp's ridleys were head started, tagged and released into the Gulf of Mexico. As of September 1985, there had been 384 reported recoveries distributed from the East Coast of Mexico, throughout the U.S. coast of the Gulf of Mexico, along the east coast of the U.S. as far north as New York, and from France and Morocco.

The Fishery Analysis Division of NMFS's Southeast Fisheries Center Miami Laboratory is responsible for maintaining and managing several data bases that contain information on marine turtles. The tagging-recapture data base contains release records of tagged turtles and all subsequent reported recaptures. The stranding data base contains records of stranded turtles reported through the Ma-

rine Mammal and Sea Turtle Stranding and Salvage Network.

Many of the recaptured turtles have doubled or tripled in weight and some have traveled more than 1,000 miles from their release site, Caillouet says. The marine researchers have also used radio-tracking to monitor the movements of a few turtles following their release.

World-wide tracking of the wide ranging sea turtles has been extremely difficult in the past, but marine scientists believe they have a high-tech solution.

John Mysing of the NMFS Southeast Fisheries Center Mississippi Laboratories in Bay St. Louis, Miss., says satellite tracking technology promises to provide world-wide monitoring of sea turtle migrations. Mysing says prototype transmitters have been procured from two different manufacturers and packaged for use with sea turtles.

There are dangers away from the nesting beaches though. Peter Lutz of the University of Miami Division of Biology and Living Resources in Miami, Fla., says contact with petroleum is likely to be harmful to all sea turtles.

Yet, because of reduced population size

and restricted nesting distribution, the Kemp's ridley may be especially vulnerable to damage from accidental spills, he says. In behavioral studies with green and loggerhead sea turtles there was no evidence that sea turtles detect and avoid oil slicks or distinguish tar balls from food items.

Still, no matter what the dangers, the battle to save the Kemp's ridley goes forward. Charles Oravetz, chief of the National Marine Fisheries Service Protected Species Branch in St. Petersburg says his office has a five point plan for aiding the Kemp's ridley.

One is an information and education program. A broad range of independent and cooperative activities inform and educate the general public and fishermen of the need to conserve Kemp's ridley. These activities include development and distribution of posters, video tapes, brochures and other means of communication.

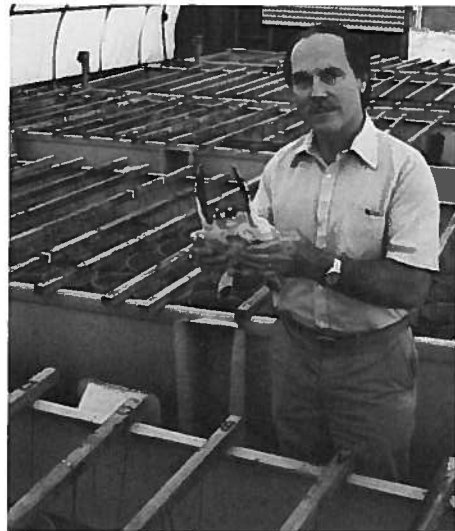
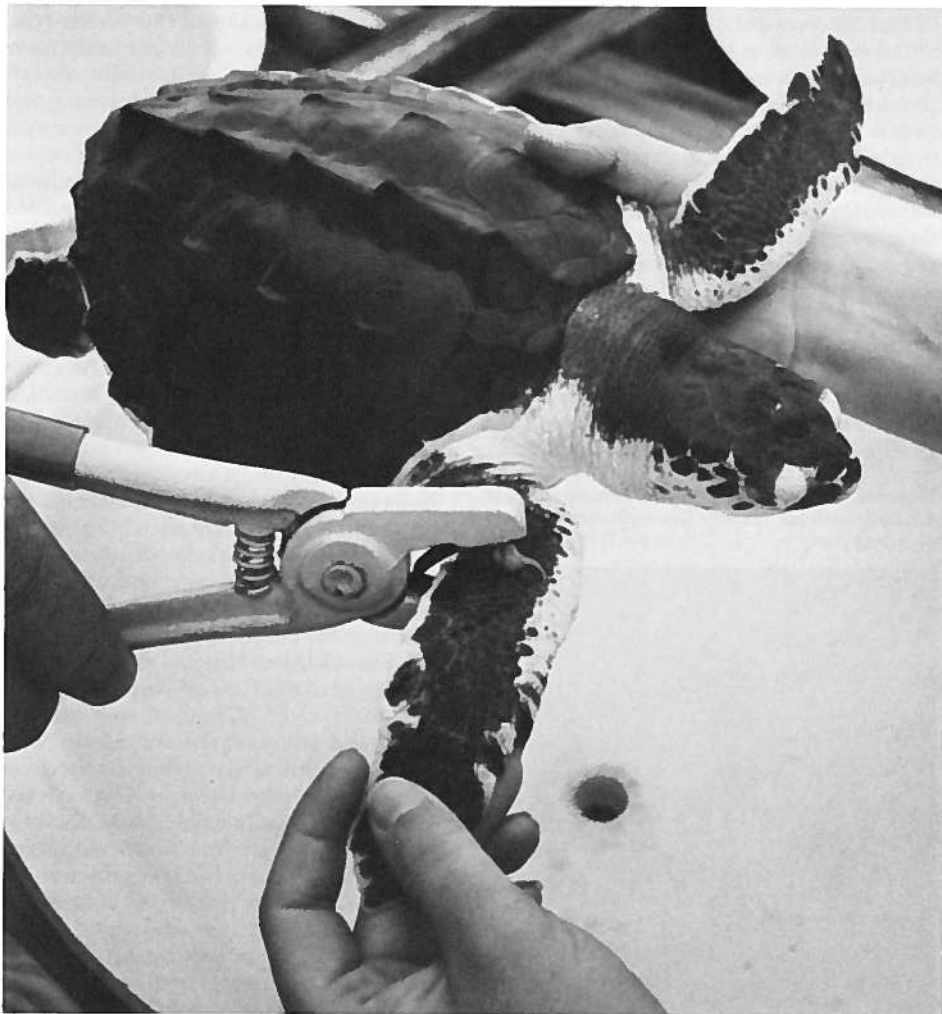
Two is transfer of TED technology. TED, short for Trawling Efficiency Device or Turtle Excluder Device was developed in the late 1970's principally to allow sea turtles to escape from shrimp trawls.

Oravetz says NMFS is encouraging voluntary use of the TED and is transferring the technology of the TED to shrimpers.

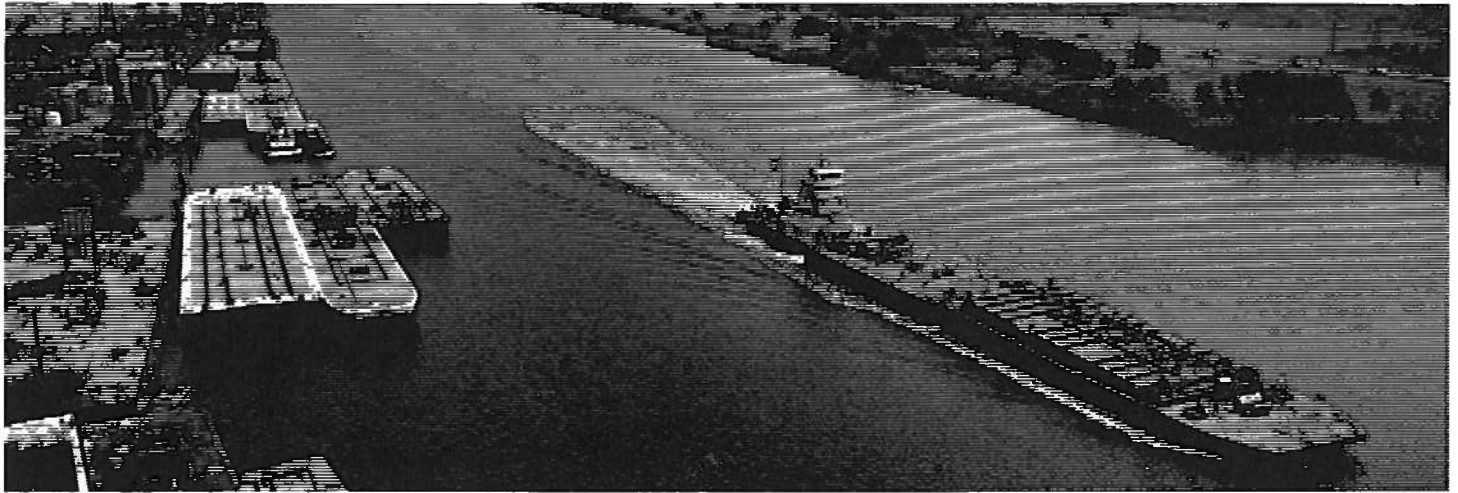
Three is incidental catch information that can be used for management purposes and to increase conservation through awareness. Amendments to the Endangered Species Act allow reporting of the incidental take of the endangered Kemp's ridley. Oravetz says an incidental catch reporting scheme is being explored with the Texas Shrimp Association.

Four is the Sea Turtle Recovery Plan. The plan for the recovery of six species of marine turtles was completed in 1984 and defines recovery actions for Kemp's ridley. Recovery actions such as head starting, captive breeding, and at-sea monitoring are being implemented.

And, five is enforcement of a rule under the Endangered Species Act — Section 7 — that requires that all federal agencies conserve endangered species and consult with the Fish and Wildlife Service and/or the NMFS to make sure that they do not jeopardize the existence of any listed species. Oravetz says Section 7 consultations are used to mitigate adverse impacts to Kemp's ridley. ■



Dr. Charles Caillouet, (above) chief of NMFS' Life Studies Division, says more than 9,200 Kemp's ridleys have been released since 1978. The head-started turtles are always weighed, measured and tagged with metal flipper tags. Fewer (top) than 500 nesting females are left in the world.



Changes in regulations cause rising protests

Recent changes in recreational fishing permit requirements have brought negative reactions from coastal fishermen who think they are being unfairly taxed.

On Jan. 1 the Texas Parks and Wildlife Department began requiring purchase of a \$5 saltwater fishing stamp for all persons who fish non-commercially in saltwater. This stamp is required in addition to a valid fishing license. The stamp is required for all saltwater fishing east and south of a designated string of coastal highways running from Brownsville to Orange.

Mel Russell, Marine Advisory Agent for Galveston County, says a group of irritated fishermen circulated a petition against the stamp. Don Brown of La Marque, leader of the petition drive, says about 5,000 signatures were collected from people opposed to the stamp. Brown also has produced and distributed bumper stickers that read "Repeal the saltwater stamp."

Bob Nailon, Marine Advisory Agent for Chambers and Jefferson Counties, says he has received criticisms about the stamp requirement in his area as well. "Some people are not too pleased," Nailon says. "They think all fishermen should be taxed equally."

Russell says, "The general consensus is that people are not opposed to an overall increase in the price of fishing licenses. They would be in favor of a \$5 increase that would affect all fishermen."

However, Parks and Wildlife indicates

MARINE ADVISOR BY RHONDA SNIDER

that the saltwater stamp revenue will be used for projects that impact saltwater fishermen. News releases from the department say the revenue from the stamps "will be used for biological monitoring in the bays and offshore as well as enforcement of coastal fishing regulations." Some monies coming from the stamp will be used for the new Sabine Lake fishery station near Port Arthur, according to Parks and Wildlife.

"I think this funding is a good move on the part of Parks and Wildlife," says Nailon, who is agent for the Sabine Lake area. "We need one (a fisheries lab) in every major bay system on the coast, and Sabine has never had one. But, I'd also like to see some of the stamp money used for aquaculture research, such as the commercial redfish growout project."

Beginning Sept. 1, fishermen will have to adapt to another change. All recreational fishermen, regardless of age, will be required to obtain a fishing license, although those under 17 or those 65 or older will be issued free licenses. Previously, those in these age groups did not need licenses. According to Parks and Wildlife, saltwater fishing stamps also will be issued free.

Nailon says the reason for this new requirement is for the Parks and Wildlife department to get a more accurate picture of how many people are fishing in Texas. ■

Oil company president predicts more troubles

Low oil prices and a depressed offshore oil industry are likely to continue into the 1990s necessitating some belt-tightening within the industry, predicts William J. Johnson, president of Standard Oil Production Co.

"The conclusion I reach is that we have to live with this situation for a while longer," Johnson said. "In so doing, all of us—operators, contractors alike—are going to have to take some innovative steps to keep our costs down, toughen up, change our strategies, and combine forces in order to work our way through this period."

Johnson's remarks came during the Sea Grant-sponsored Marine/Offshore Industry Outlook Conference coordinated by Dwayne Hollin, Marine Advisory Service business specialist. About 150 people attended the day-long April conference in Houston.

Although a few of the dozen conference speakers had a more optimistic outlook for the offshore industry, most seemed to have views similar to Johnson's. Dr. William L. Leffler, Shell Oil Company's manager of energy planning and economics, declined to guess at the future, but instead listed several possibilities and gave his explanation for how the industry got in this situation.

"These three things," Leffler said, "really created a soft oil market: (1) a tremendous response by consumers in conservation, (2) the ability of consumers to

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switch to other kinds of energy, and (3) the capability of the exploration and production industry to generate significantly more oil and gas than was expected."

Johnson said he expects there to be a slow trend leading to higher prices sometime in the 1990s, but doesn't expect to see oil much more than \$20 to \$25 a barrel. He further warned the participants not to assume the industry is in the clear if prices start to go up in the meantime.

"Between now and the 1990 period I think that we will see prices cycling seasonally," he said. "Low prices in the spring, firming up in the summer, higher prices in the fall and back down to lower prices again."■

Save Cedar Bayou Pass project getting support

Save Cedar Bayou, Inc., is progressing well in attempts to raise its part of the \$405,000 needed to reopen Cedar Bayou pass. The Texas Parks and Wildlife Commission has approved the plan to dredge the Aransas County pass and agreed to allocate \$303,750 in state funds to the project provided Save Cedar Bayou can raise \$101,250.

Thus far about \$85,000 has been contributed to the non-profit organization's efforts to help dredge and maintain the fish pass, says Rich Tillman, Aransas and San Patricio counties marine agent. Tillman and marine recreation specialist Ken Pagans helped form the corporation to raise funds and public support for the project.

Cedar Bayou is a pass located between Matagorda and San Jose Islands opposite the Aransas National Wildlife Refuge on Aransas Bay. The only natural pass between Port O'Connor and Port Aransas, Cedar Bayou has gradually sanded over in recent years due to natural and man-made causes. Reopening the pass will allow the exchange between Gulf and bay waters necessary for fish and shellfish to live and breed.

In addition to the money raised, three nationally-known wildlife artists have donated original paintings to the cause. Tillman says an oil painting and two water colors donated by Al Barnes, Herb Booth and John Cowan have been valued at \$10,000. Tillman says everyone who gives a \$100 donation to the Save Cedar Bayou fund will be entered in a drawing for one of the paintings.■

Matagorda Island site for summer marine camp

The 1986 Summer Ocean Awareness Retreat gave 54 4-H club members from the Coastal Bend area a chance to learn about and experience first hand many of

the activities that affect the marine environment.

Coordinated by Marine Advisory Service Agents Willie Younger, Rich Tillman and Joe Surovik and Home Economics Extension Agent Edith Collins, the marine camp is designed to provide the campers with an understanding and appreciation of the marine environment.

"As the 4-Hers grow into adults the SOAR experience will help them make intelligent decisions about our marine resources," says Younger, agent for Matagorda County.

The 4-Hers went on early morning shrimping trips, participated in scavenger hunts that helped rid the beaches of trash and debris, visited a collection of the island's wildlife and listened to biologists and fisheries specialists discuss marine life and ecology. The campers also were given a chance to fish, swim and comb the beach for shells.

SOAR was divided into two sessions this year. The first camp, June 2-4, saw 36 nine- to 13-year-old 4-Hers converge on the island. The second session, June 4-6, brought 18 teenagers ages 13 to 19.■

Redfish fingerlings are presented to operators

More than 400,000 redfish fingerlings were distributed in June to three growout operations in Texas as part of a project designed to test the feasibility of raising the fish on a commercial basis, says Tom Linton, Marine Advisory fisheries specialist.

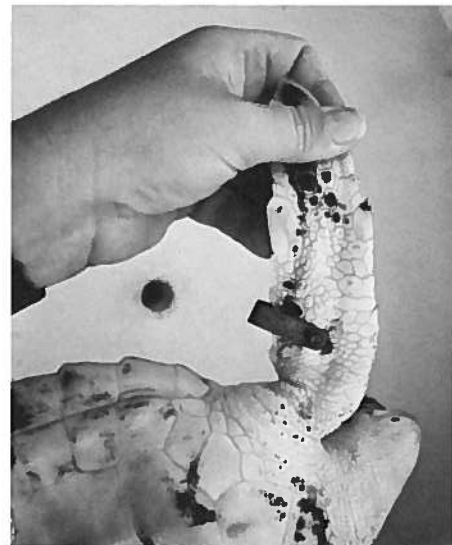
The project is a cooperative effort between the Texas Parks and Wildlife Department and Texas A&M University, in which TPWD will provide about 1 million fingerlings to grow-out operators over the next two years and Texas A&M will provide overall project management and technical guidance.

Linton says he expects good results from a West Texas operation and from a Palacios site that were stocked with redfish. Although it will take 10 to 12 months for the fish to grow to market size, operators should get a good idea of the success of these operations within the next couple of months.

While many species of fish have the potential to provide successful growout operations redfish is considered one of the best choices to study for several reasons.

First, redfish is popular both as a game and food fish in Texas. Second, since the 1981 ban on the commercial fishing of redfish in Texas, the demand for and value of redfish has increased. Third, redfish can grow in fresh water of the proper ionic content, which extends the potential growout area from the coast to less expensive inland sites.■

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Ila Loetscher has 17 sea turtles in captivity now.

knew nothing of sea turtles. But she did have a love for the sea. Padre Island residents often saw the small, white-haired lady driving her red Jeep along deserted stretches of the shoreline in search of shells.

Shell hunting took her far south, where she became familiar with the Mexican coast. So when Dearn Adams needed volunteers with rugged transportation vehicles to go on a turtle rescue expedition, Loetscher was asked to go along. The noted Brownsville sportsman and conservationist had seen a dramatic decline in the number of Kemp's ridley turtles and recruited a group to pick up eggs to bring back for hatching on South Padre Island.

Since the 1970's, a sophisticated, international program to save the turtle has evolved, using resources from the National Marine Fisheries Service, U.S. Coast Guard, U.S. Fish and Wildlife Service, two Mexican ministries and a number of Mexican universities to protect, hatch and rear the turtles.

When Loetscher first went to Mexico to bring back eggs, 5,000 nesting females remained of the 42,000 on the beach 19 years before. Still, wholesale slaughter of sea turtles continued. Now, under the international management program, the turtle population has stabilized somewhat and efforts are underway to increase that number. Even so, only 500 nesting females remain.

There remain continuing worries about the future of the endangered sea turtles, particularly the Kemp's ridley. "We haven't seen much progress in the number that are coming in to nest," Loetscher says. Still, she points out that sea turtles will spend more than seven years in the world's oceans before returning to their home beaches to nest, so, perhaps it is too early to see results.■

PUBLICATIONS

The following publications are available from the 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. \$15.00.

Proceedings of the Eighteenth Dredging Seminar. Herbich. TAMU-SG-86-105. \$10.00.

Proceedings of the Shrimp Yield Prediction Workshop. Landry, Klima. TAMU-SG-86-110. \$10.00.

Marine/Offshore Outlook 1986. Hollin. TAMU-SG-86-111. \$5.00.

Economics of Harvesting and Market Potential for the Texas Blue Crab Industry. Miller, Nichols. TAMU-SG-86-201. \$5.00.

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Readership Survey of Marine Education. Gresham, Bush. TAMU-SG-86-204. \$2.00.

Monthly Wave Characteristics National Oceanographic Data Center - Vol. I, II, III. Yamazaki, Herbich. TAMU-SG-86-205. \$25.00.

Bird Island Basin—An Environmental Study Area. Harris. TAMU-SG-86-401. \$2.00.

An Annotated Guide to the Barnacles of the Northern Gulf of Mexico. Gittings, Dennis, Harry. TAMU-SG-86-402. \$3.00.

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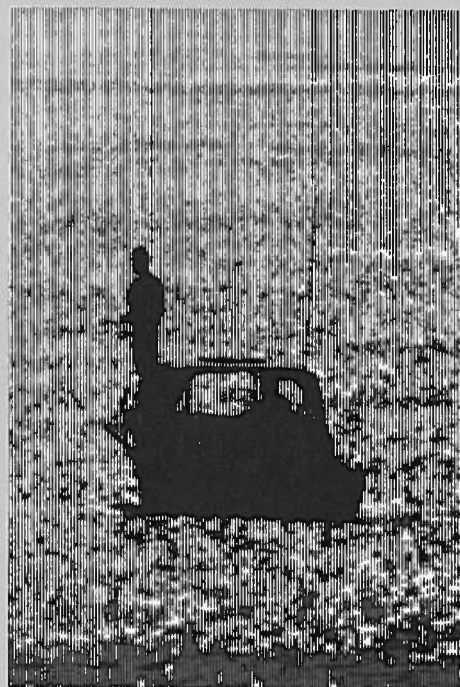
Effects of Seismic Sounds on Marine Organisms: An Annotated Bibliography & Literature Review. Linton, Hall, LaBomascus, Landy. TAMU-SG-86-604. \$3.00.

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Emergency Service for Boat Operators Along the Texas Gulf Coast. Whitehorn, Miori. TAMU-SG-73-603. \$2.

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Recreational Guide to the Central Gulf Coast. Doran, Brown. TAMU-SG-75-606. \$2.

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Supplemental Aeration System Design for the Houston Ship Channel. Hookings, Reynolds, Hann. TAMU-SG-78-201. \$5.

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Bibliography of Maritime & Naval History Periodical Articles Published 1976-77. Schultz. TAMU-SG-79-607. \$4.

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Marine Organisms in Science Teaching. Hunt. TAMU-SG-80-403. \$4.

Shrimp in Microwave Cookery. Reddell. TAMU-SG-80-505. \$2.

Hangs & Bottom Obstructions of the Texas/Louisiana Gulf-Loran C (3rd. Rev). Graham. TAMU-SG-81-501. \$5.

Summary of Shrimp Mariculture Production Data at Texas A&M, 1968-78. Johns, Holcomb, Griffin, Hutchins. TAMU-SG-81-603. \$5.

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Predicting Marine Recreational Fishing Patterns from Boat Characteristics & Equipment. Ditton, Grefe, Fedler. TAMU-SG-81-814. \$1.

Nutritional Response of Two Penaeid Species to Various Levels of Squid Meal in a Prepared Feed. Fenucci, Zein-Eldin, Lawrence. TAMU-SG-82-813. \$1.

Generalized Budget Simulation Model for Aquaculture. Griffin, Jensen, Adams. TAMU-SG-83-202. \$5.

User Guide for General Bioeconomic Fisheries Simulation Model (GBFSM). Adams, Jensen, Griffin. TAMU-SG-83-204. \$5.

Marine Education: A Seagoing Experience. Tinnin. TAMU-SG-83-401. \$1.

Life On Board An American Clipper Ship. Schultz. TAMU-SG-83-402. \$1.

Bibliography of Maritime & Naval History Periodical Articles Published 1978-79. TAMU-SG-83-602. \$5.

Computer Accessible Annotated Bibliography of the Corpus Christi Bay Estuary. Flint. TAMU-SG-83-605. \$5.

Saltwater Fishes of Texas: A Dichotomous Key. Murdery. TAMU-SG-83-607. \$7.

Microbial & Chemical Changes During Storage of Swordfish (*Xiphias gladius*) Steaks in Retail Packages Containing CO₂ Enriched Atmosphere. Finne, Hanna, Vand., Nickelson. TAMU-SG-83-808. \$1.

Western Gulf of Mexico Sea Turtle Workshop: Proceedings. Owens et al. TAMU-SG-84-105. \$3.

The Economic Viability of a Four-Metal Pioneer Deep Ocean Mining Project. Andrews, Brown, Flipse. TAMU-SG-84-201. \$3.

The Texas Shrimp Fishery: Analysis of Six Management Alternatives Using the General Bioeconomic Fishery Simulation Model. Warren, Grant, Nichols. TAMU-SG-84-202. \$5.

Reproductive Activity & Biochemical Composition of *Penaeus setiferus* & *Penaeus aztecus* in the Gulf of Mexico. Chamberlain, Lawrence. TAMU-SG-84-203. \$7.

Marine Offshore Outlook 1984. Hollin, (Arnold). TAMU-SG-84-509. \$5.

Hurricane Relocation Planning for Hardin, Jasper, Jefferson, Newton, and Orange Counties. Ruch. TAMU-SG-84-620. \$5.

Understanding Involved Fishermen: A Survey of Members of the Gulf Coast Conservation Assoc. Ditton, Holland. TAMU-SG-84-623. \$2.

Airphoto Analysis of the Impact of Hurricane Alicia on Galveston Island. Broussard (ed), Benton. TAMU-SG-85-201. \$2.

Nocturnal Activity of Birds on Shrimp Mariculture Ponds. Beynon, Hutchins. TAMU-SG-85-805. \$1.

SUMMER 1986



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