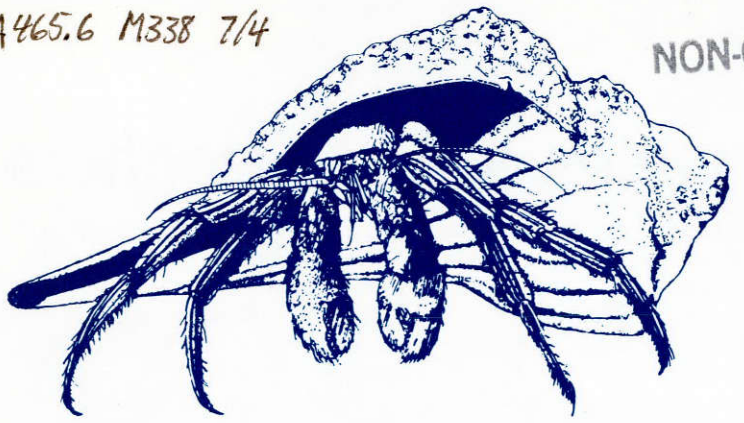

Marine Education

A COOPERATIVE EFFORT OF THE TEXAS A&M UNIVERSITY SEA GRANT COLLEGE PROGRAM AND DEPARTMENT OF EDUCATIONAL CURRICULUM AND INSTRUCTION

Don't mess with Texas beaches

On September 20, 1986, Texas' Commissioner of the General Land Office, Garry Mauro, participated in the beach cleanup sponsored by the Center for Environmental Education. That experience convinced him that the real problem in Texas is a beach garbage problem resulting from offshore dumping by ships, pleasure boats, and oil and gas platform operators rather than a litter problem.

Viewing the problem first-hand, Mauro made a commitment to do all within his authority to help rid Texas beaches of unsightly and hazardous litter and garbage.

The result? A statewide Adopt-a-Beach program and an anti-litter plan that employs the slogan "Don't Mess with Texas Beaches," an extension of the Highway Department's "Don't Mess with Texas" anti-litter campaign.

The program is designed to put an end to Texas beaches being used as garbage dumps, with the strategy being to battle beach pollution at its many sources. Mauro estimates that as much as 80 percent of the beach garbage comes from offshore sources such as international shipping. The remaining trash is the result of recreational boaters, beach visitors, offshore seismic operations, and oil and gas platforms.

Since there is no overall state, federal or local agency responsible for keeping the garbage off Texas beaches, the Land Office is soliciting an all-volunteer army for its comprehensive anti-litter war. Theirs is a four-part program that includes –

New "get-tough" rules, issued by the Land Office, that prohibit companies engaged in offshore oil and gas operations in Texas waters from discharging any solid wastes from production platforms, crew or supply barges, seismic boats, or exploration vessels. While most companies operating offshore have soild waste disposal systems in place, these rules are intended for those who are exceptions to the general rule of responsible offshore operators. The Land Office will inspect oil and gas operations routinely to ensure compliance, and violators face loss of any state permit or lease as well as responsibility for cleanup costs.

The second part of the plan involves the Texas Adopt-a-Beach program, designed to encourage private businesses, environmental and civic groups, and other organizations to assume responsibility for the maintenance of Texas beaches. Mauro hopes residents and visitors alike will join in the effort.

"Beach garbage is not just an aesthetic problem," he says. "It is a dollars and cents problem also. Tourism is Texas' second largest industry, and beaches are the state's number one tourist attraction. This garbage problem has serious environmental, as well as economic, consequences."

(See Land Office, page 4)

Six Sea Camp sessions set at Galveston campus

Sea Camp preparations at Texas A&M University at Galveston are well underway for 1987 when marine explorers aged 10-12, 13-16 and 14-17 will convene for five days of fun and educational adventures.

Camps for the 10-12 age group are scheduled June 28 through July 4 and July 12 through July 18, while camps for 13- to 16-year-olds are set for June 7 through 13, July 5 through 11, and August 2 through 8. An advanced sea camp is being offered for 14- to 17-year-olds August 2-8 for those who have some previous experience in the marine environment.

The Sea Camps are sponsored by Texas A&M at Galveston, the Texas A&M Sea Grant Program, Sea-Arama Marineworld and the Oceanic Society. A staff of marine professionals will share their expertise and appreciation of marine life with campers in the field at marshes, bays and the Gulf, at laboratory facilities at the Galveston campus, and at Sea-Arama's oceanarium.

Field trips to the natural habitats of local marine organisms will be conducted both on foot and on research vessels. Aboard the ROAMIN' EMPIRE, a 44-foot research vessel, campers will use oceanographic instru-

(See Sea Camp, page 5)

Vol. 7 No. 4 May 1987

Variety of summer courses open to teachers

Elementary and secondary teachers have a number of educational opportunities facing them this summer at several Texas universities. Between regular summer sessions and special short courses, a wide range of marine-related topics will be explored.

Many of these courses will be offered at Texas A&M University in College Station.

Survey of Oceanography (OCN 600), taught by Dr. Doug Biggs, is designed for graduate or upper-level students. Biggs will devote approximately half the course to an overview of the basic principles of oceanography, and the remaining time to applying these principles to practical uses. A minimal background in the sciences and math is required; the course is concept-oriented. Each application will be treated as a separate topic entity, from pollution to fishing and from energy to coastal management.

Special supplemental information, such as slides, reference materials and lab suggestions, is available for those involved in teaching earth or marine science at the pre-college level.

Marine Biology (BIO 440), taught by Dr. Mary Wicksten, is a general course that emphasizes marine environments and their inhabitants along the Texas coast. Plants and animals are presented in the context of their natural habitat. Emphasis will be placed on general ecological concepts rather than on memorization of names. The laboratory work includes a field trip to marine habitats along the northern Texas coast.

The prerequisites for the course are a class in introductory biology and an ability to perform upper-division course work. The course is open to non-majors in general science education, geology, wildlife and fisheries sciences and related disciplines. For further information, contact Dr. Wicksten, Department of Biology, Texas A&M University, College Station, Tex., 77843 (409/845-3388).

Texas A&M's Department of Wildlife and Fisheries Sciences offers four courses for teachers this summer– *Integrating Natural Resources for Classroom Use* (WFS 409); *Ecology for Teachers* (WFS 420); *Lab and Field Techniques* (WFS 600); and *Museum Programming* (WFS 630). The first course implements nationally developed programs, while the museum programming course will instruct teachers on integrating museum resources into the classroom.

Further information on the courses is available through Dr. Clark Adams, Department of Wildlife and Fisheries Sciences (409/845-5777).

Two computer education courses will be offered during the first summer session. *Creative Application of Technology in Education* (EDCI 605) is designed for teachers of kindergarten through grade 12. For more information, contact Dr. Robert Kansky, Department of Educational Curriculum and Instruction (409/845-3895).

Classroom Applications of Microcomputers (EDTC 645) is an introduction to the use of microcomputers. Many class activities will be directed toward the students' areas of application and expertise. For more information, contact Dr. Ronald Zellner (409/845-7924).

Dr. Robert James will teach a five-week class, *Special Topics in Science Curriculum* (EDCI 489), to explore trends and issues in effective school science programs. It will include the design, selection, evaluation and implementation of science curriculum, and opportunities will be provided for students to emphasize elementary, junior high/middle or high school levels.

In the same department, Dr. Marla Stone will conduct a three-week course, *Texas Coast from the Rio Grande to the Sabine* (EDCI 689). It will be the study of biotic and abiotic factors in coastal habitats, including geomorphology, plant/animal adaptations and niches, and human influences. Classroom and laboratory techniques for on-site data gathering, including beach, transects, sampling, specimen collecting, photography and chemical testing will be taught. One week will be at Texas A&M and the other two weeks will be at selected sites along the Texas coast.

Texas A&I University

Texas A&I University's Department of Biology offers two, three-week summer workshops (BIOL 341 and BIOL 342). The first will be held June 2 through June 19 and the second from June 22 through July 8.

Participants can enroll in either for four hours' credit, or in both for eight. The latter option is advised since the second workshop is a continuation of the first. The workshops stress aquatic and near-aquatic organisms, both plant and animal, how to study them, their places in the natural scheme, how "people pressures" affect them, how they came to be, and what they are.

More than half of each workshop deals with the marine environment. The courses are open-ended–there are no prerequisites and persons with no biology background can work at their own level while those with biology majors can advance as far as they wish with any of the topics covered.

A number of day-long and overnight field trips are included, to Padre Island National Seashore, the Port Aransas jetties and the Welder Wildlife Foundation.

Further information is available from Dr. Allan H. Chaney, Department of Biology, Texas A&I University, Campus Box 158, Kingsville, Texas 78363 (512/595-3803).

Texas A&M University at Galveston

Texas A&M University at Galveston has two summer sessions and graduate-level, marine-related courses will be offered during each. These include *Problems in Biology, Research in Biology, Problems in Wildlife and Fisheries Sciences* and *Research in Wildlife and Fisheries Sciences.*

Other courses include *Biology of the Mollusca, Research in Oceanography, Biology of Invertebrates, Special Topics in Marine Biology of the Upper Texas Coast,* and *Statistical Methods in Ecology.*

More information is available through the Student Records Office, Texas A&M University at Galveston, P.O.

(See Summer, page 5)

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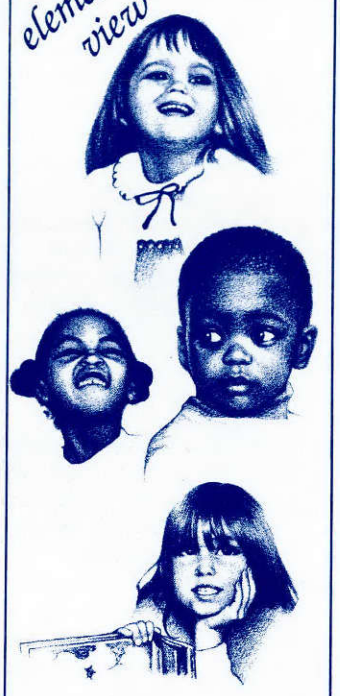
Marine Education is to inform elementary and secondary teachers about current research and activities in the marine environment. *Amy Broussard, editor.*

An elementary view



Corrosion

by Bob Swift*

Beneath the cynical boatowner's quip that "Eventually, everything will either rust, rot, corrode or sink" lies a grain of truth. Searching for that basis in fact provides a worthwhile science activity for the elementary classroom.

The best investigations start simply, with the outcome of each step answering some questions and raising others. A study of iron in saltwater is a logical first step.

Since learning to ask the right questions is an important, but frequently neglected, part of science, be sure students help formulate each round of questions to be considered and the tests by which they will be answered. A general statement or question, such as "How could we find out whether saltwater rusts iron?" might result in the quick answer, "Put some iron wire in saltwater and see whether it rusts."

Depending on their ages and science experience, students may recognize – either before or after the experimental test is made – an arguable possibility that the wire rusts in tap water also. Or in no water at all. So a better question might be, "Will there be a difference in the way iron behaves in saltwater and in fresh water?" The answer comes by putting pieces of iron in both fresh and salt water.

Students who accept this point are, in effect, recognizing the value of "controls" in scientific work. Seeing that iron rusts in saltwater is a useful observation; seeing that it rusts more readily in saltwater than in fresh water or in air is a scientific observation.

Disposable styrofoam cups, which can be discarded if stained by rust, are suitable containers for conducting simple corrosion experiments. Inexpensive plastic ice-cube trays (clear or neutral ones are easier to use than colored ones) provide eight pairs of containers for tests involving sets of metal objects. One cup or set of cups can be filled halfway from a saltwater aquarium if one is available; the other cup or set is filled to the same height with tap water. (Instant Ocean or table salt dissolved in tap water – six teaspoonfuls per quart – will approximate seawater closely enough to illustrate the chemical reactions in these investigations.)

Iron left in water for as little as an hour can show evidence of rust; pieces left over a weekend will often exhibit dramatic changes. Students generally have seen rust but few have examined it closely.

Research Associate, Marine Education Program

What about other metals? The results of testing iron virtually invite experimentation with other metals. If your classroom is not well equipped, a hardware or builder's supply store can supply objects made of a variety of clearly identified common metals.

Once a protocol has been established (the type of container, the amount of water and the duration of the activity), hold to it even if "better" results can be obtained through a different procedure. That different procedure would form the basis for a different series of activities. Throughout work with metals and corrosion, it is more important for students to understand the reason for each procedure than to have them "do things right" the first time.

Although dictionaries and other sources provide definitions of "corrosion," the students' own observations are best. Words should follow and depend on direct observation whenever possible.

Careful examination of the water in which a piece of metal has been immersed will often reveal evidence of newly formed substances. Slight tints may result from soluble compounds, and solid chemical "precipitates" may be suspended in the water or settled at the bottom.

Close observation of "corroded objects (a reading glass or simple microscope is useful here) will show that while some objects have apparently been etched away, others appear to have been built up by the addition of rust or similar materials. Comparisons of the resistance of various metals to corrosion are likely to lead students to the same conclusion reached by boatbuilders of past centuries – while iron may be satisfactory to nail siding on a barn, bronze fasteners are preferable for ships.

After the metals have been tested individually, pairs of them can be immersed. For example, a piece of copper wire wrapped around a piece of iron bailing wire leads to different results than does testing each alone. This type of observation led to the widespread use of "sacrificial" metals to protect essential parts of ships from corrosion. Cheap, easily replaceable zinc blocks are frequently connected to bronze propeller shafts, which are then protected.

While observations of corrosion are sufficient in themselves, various simple extensions are possible.

An inexpensive voltmeter, attached to different pairs of metals, clearly shows the difference in electrical potential between the metals being tested. It also implies the relationship between chemical activity and electricity that students will investigate in greater depth during later science courses.

The results shown in the table on page 4, while typical, must be recognized as specific for one set of conditions. The tap water used was noticeably hard; bottled water or tap water containing different amounts of chlorine or natural impurities would be expected to produce different results.

The precise composition of the iron, the saltwater and the bronze will also affect results, as will variations in temperature. Exploring these different variables (while always maintaining careful controls) will provide students with a practical knowledge of corrosion as well as a knowledge of the scientific process.

In a recent series of tests, both brass and zinc-plated screws, copper wire, iron bailing wire, bronze nails and household aluminum foil were left standing for three days in tap and in salt water.

Metal	Fresh Water	Saltwater	Air
Aluminum	One spot of a soft, white material built up on the foil.	White crystals at surface. Water cloudy. Some white precipitate.	No change
Zinc-plated steel screw	Threaded area gray; microscope shows zinc missing and steel is pitted. Water cloudy. White precipitate.	Threaded and patches of non-threaded gray. Similar to fresh water but more extensive. No precipitate.	No change
Bronze	No change	Turned a dull, coppery color all over. Blue-green material in water.	No change
Brass	No change	No change	No change
Copper	Slightly brighter than original. Water greenish. Slight precipitate.	Slight discoloration; milky blue-green powder on bottom of container.	No change
Iron nail	Rust built up on nail and on bottom. Wipes off easily.	Very thick, dark rust built up on nail and on bottom of container.	No change
Copper wire wrapped around zinc screw	Copper is shinier. Zinc is dull and discolored. White powder on bottom.	Copper is much shinier. Red-brown flakes in water. Zinc discolored; appears coated. Red flakes over coating.	No change
	(Both the fresh water and saltwater reactions were more pronounced than zinc only or copper only.)		
Copper wire wrapped around iron wire	Copper brighter. Appears etched under microscope. Nail rusted. Water greenish.	Iron heavily rusted. Thin coating on copper. Wipes off easily; copper bright under coating. Clear to white crystals at surface; threadlike (under scope) white scum on surface of water. Heavy build-up of rust in water.	No change

Land Office leads beach cleanup effort

(Continued from page 1)

The idea behind Adopt-a-Beach, the first of its kind nationally, is for a sponsor to assume responsibility for periodically cleaning and maintaining a specific segment of beach. Under Adopt-a-Beach guidelines, an individual or group adopts a particular section of beach for one year and sponsors at least three cleanup efforts during that year. "Adoption" certificates are issued, plus a certificate of recognition for each individual who actually participates in the beach cleanup.

The Adopt-a-Beach Task Force has joined with the Texas Congressional delegation, including U.S. Sen. Lloyd Bentsen and U.S. Reps. Kika de la Garza and Solomon Ortiz to eliminate the sources of beach garbage on the federal and international levels. Contacts aimed at curbing this garbage problem have already been made with the other states, the U.S. Department of Agriculture, the U.S. Coast Guard, the Texas Legislature and national environmental groups.

The final part of the beach cleanup plan involves international negotiations. The United States, working with the International Maritime Organization, is promoting new rules to regulate international shipping. These changes will be a major step toward a long-term solution, according to Mauro, particularly if the international organization designates the Gulf of Mexico as a special area where garbage disposal at sea would be prohibited.

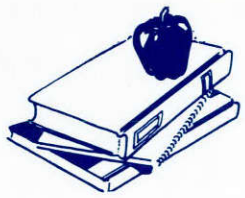
"Special area" designations have already been granted to the Mediterranean Sea, the Baltic Sea, the Black Sea, the Red Sea and the Persian/Oman Gulf, and U.S. representatives remain optimistic about getting a similar designation for the Gulf of Mexico.

While Land Office staff members acknowledge that some parts of the program involve actions beyond the control of Texas officials or residents, they say Adopt-a-Beach is something that can succeed now. Volunteers are being signed up now, and the Task Force is working with government agencies, private individuals and with companies to find additional solutions.

Want to adopt your own beach?
Call
1-800-85-BEACH

Anyone within Texas who is interested in joining the beach cleanup effort should call 1-800-85-BEACH. Those in other states who want to learn more about the campaign or who want to find out how to implement a similar campaign in their own state should write to Tom Henderson, Adopt-a-Beach Task Force, Texas General Land Office, S.F. Austin Building, Room 751, Austin, Texas 78701.

Summer . .



(Continued from page 2)

Box 1675, Galveston, Texas 77553 (409/740-4400).

Corpus Christi State University

Corpus Christi State will offer a *Coral Reef Ecology* course during the first summer session, June 4 through July 13. Students will spend one week in class and laboratory sessions to prepare for a 17-day field trip to Vera Cruz, Mexico. Upon their return, students will work on independent research projects.

The course will focus on such aspects of coral reefs as ecology, geology and organisms. Registration for the course begins June 3. Students will earn six graduate credit hours.

For more information, contact Dr. Wes Tunnell at (512) 991-6810, extension 470.

Gladys Porter Zoo

The education department of the Gladys Porter Zoo in Brownsville is sponsoring a teacher-training institute and nature expedition to Australia this summer. The program lasts from Aug. 1 through Aug. 13. Participants will conduct research through the naturalist, or "out-in-the-wild," approach of the program.

The group will visit Cairnes and Brisbane and will spend two days on the Great Barrier Reef. It also will visit several rainforest sanctuaries to study animals, such as the koala and the platypus. Group members also have the option of visiting other cities, including Sydney and Melbourne, or neighboring New Zealand.

The trip includes educational activities designed especially for teachers. Graduate credit is available and the trip is applicable to science teachers' career ladder plans.

For more information, call Sandra G. Skrei, Curator of Education and Information, Gladys Porter Zoo, 500 Ringgold St., Brownsville, Tex., 78520 (512/546-7187).

Welder Wildlife Foundation

The Welder Wildlife Foundation of Sinton, Tex., is offering two natural science conservation workshops for elementary and secondary teachers with little or no scientific background in natural science. Librarians and principals also are encouraged to apply.

The workshops will be offered June 8-15 and June 22-29. The program includes aspects of natural history, conservation, ecology, botany, ornithology, mammalogy, herpitology, limnology, and range and wildlife management. The program is sponsored in cooperation with Texas A&I University. There are no prerequisites, and the workshop can be applied for three semester hours of graduate credit.

Contact the Wildlife Foundation at (512) 364-2643.

Texas Marine Educators Association

A one-week field trip to the San Francisco Bay area is planned for the week of July 13th for a maximum of 20 teachers. Participants will examine the rocky coastline of the West Coast to compare it with Texas' sandy coast.

The trip will begin at the Bodega Bay Marineland, and teachers will work their way south to the Monterrey Bay Aquarium.

The workshop is designed primarily for members of the Texas Marine Educators Association. For more information, contact Rick Tinnin at The University of Texas Marine Science Institute in Port Aransas, (512) 749-6720.

Sea Camp

(Continued from page 1)

ments to measure environmental factors, and trawls, dredges and nets to collect live animals and plants. On another outing, campers will board the 64-foot oyster lugger SECURITY in Galveston Bay to dredge for oysters and lunch on the catch of the day. An outboard boat trip is planned for bird watching around Deer Island, which is a rookery for tall wading birds and other marine birds. Outboard boats also will be used in gill net and crab trap setting and collection.

Walking field trips to marshes and shallow bay areas will involve such activities as seining and push netting for fish and other nekton, feeling for clams with their feet, and digging for angel wings. The hard substrate of the jetties on the beachfront and a coastal lagoon will be explored for marine inhabitants.

Campers will get a behind-the-scenes look at sharks and other fish, dolphins, sea lions and marine invertebrates at Sea-Arama Marineworld. Campers are taught marine mammal training and holding and maintenance techniques for live marine animals.

Advanced Sea Camp includes some classroom activities but emphasizes field trips to various coastal environments and preservation techniques used by marine scientists in many fields as well as the use of microcomputers for analysis of information gathered on field trips.

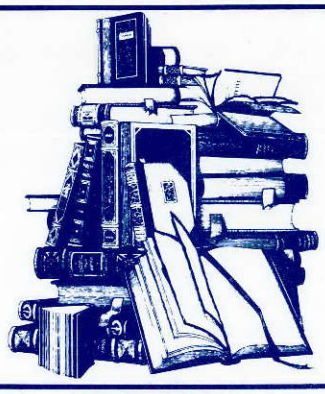
Recreational activities include a tour of the tall ship ELISSA; lunch on the Strand, Galveston's historical district; pizza and pool parties; and a beach cookout and water safety demonstration.

Sea Camp's instructors are experienced faculty members and graduate students from the University's Departments of Marine Biology and Marine Science and the curatorial staff at Sea-Arama. Dr. Sammy Ray is camp director.

Campers will live in campus dormitories A fulltime counselor and recreation director will be in attendance 24 hours daily. Sea Camp's $450.00 registration fee and the Advanced Sea Camp's $500.00 fee includes housing, meals and all activities.

Further registration information is available by contacting Dr. Ray, Department of Marine Biology, Texas A&M University at Galveston, P.O. Box 1675, Galveston, Texas 77553 (409/740-4525). Registrations will be accepted until one week before the start of a specific session.

books & things



A bill to bar the disposal of plastic materials into the United States' Exclusive Economic Zone (EEZ) has been introduced in the U.S. House of Representatives by Rep. Gerry Studds (D-MA). The chairman of the House fisheries subcommittee was joined in introducing the bill by Rep. Walter B. Jones (D-NC), and seven others, including Republicans Don Young (AK) and Robert Davis (MI).

The Studds bill will set a maximum penalty of $25,000 for each violation. An exception to the ban would be made for the accidental loss of a fishing net, provided that all "reasonable precautions" have been taken against such a loss. The President would also be required "to take steps to guarantee compliance" by the U.S. Navy, Coast Guard and other government ships "to the extent consistent with the operational requirements and capabilities" of the ships. The Studds bill will also apply to offshore platforms.

In addition to the 200-mile EEZ aspects of the bill, it will seek to bar the disposal of other forms of unprocessed garbage within 12 miles of the U.S. coast; direct the Secretary of State to negotiate with foreign countries to reduce the number of seabirds, marine mammals and fish accidentally killed by entanglement with driftnets off the Pacific coast; establish a sanctuary around the Aleutian Islands where driftnet fishing is prohibited; and authorize $3 million per year for two years for a study of the effect of driftnet fishing on U.S. marine resources, to evaluate the need for a driftnet marketing system, to assess the feasibility of requiring the use of biodegradable materials in driftnets, and to study the overall problems of plastic pollution in the marine environment.

(Ocean Science News report)

It is already time to start gearing up for another Beach Buddy cleanup day, according to Linda Maraniss of the Center for Environmental Education. Although the cleanup will be held in September, she says people should start thinking about it now and making their plans.

CEE sponsored the cleanup in September 1986 that saw 2,772 Beach Buddies haul in about 140 tons of garbage and debris from Boca Chica near the Mexican border to McFadden Beach near the Louisiana border. Approximately 171,470 individual debris items were collected then, and each Beach Buddy filled out a data card on the specifics of what and how much was found.

The 1987 cleanup will be from 9 a.m. until noon, Saturday, Sept. 19. Beach Buddies will again be asked to complete data cards, for, as Maraniss says, "You're not just cleaning up litter, but helping us out with needed scientific information as well. You have to be good scientists."

Certain hotels along the coast also will be lending a helping hand by providing discounts to the Beach Buddies. Nine hotels participated in 1986, Maraniss says, but more than 30 will be joining the effort in 1987.

According to present plans, the cleanup will stretch from South Padre Island to the Louisiana border, but CEE is hoping to find a zone captain in Boca Chica to help spread the efforts even further.

For more information on the cleanup or the hotels, contact Linda Maraniss at CEE at (512) 477-6424 or (512) 479-0206.

National Geographic, Texas A&M join forces for institute

Texas A&M University and the National Geographic Society are combining their efforts this summer to sponsor an intensive, three-week program for social studies teachers of grades seven through 12.

The Summer Geography Institute will be June 8 through June 26, and will be based at the Texas A&M campus in College Station except for two extended field trips. The institute's aim is to enrich teachers' backgrounds in geography and to provide them with effective materials and instructional strategies, as well as to instill enthusiasm for teaching geography. The course will use classroom, discussion, laboratory, field experience and materials preparation sessions.

The institute, which is modeled after the National Geographic Society Summer Institute in Washington, D.C., will focus on geographic elements in the Texas curriculum for such courses as Texas History and Geography, American History I and II, and World Geography.

The National Geographic Society is providing 30 scholarships that will cover tuition and fees, and 20 stipends to pay room and board for participants from the Dallas-Fort Worth and Houston-Galveston metropolitan areas.

The 30 participants will be chosen from three areas–10 from Dallas-Fort Worth, 10 from Houston-Galveston, and 10 from within 50 miles of the Texas A&M campus.

The National Geographic Society, by assisting in the institute's funding, will help Texas A&M's Department of Geography's efforts to develop three new chapters of the Texas Alliance for Geographic Education. The Society has already funded the first chapter in the San Antonio-Austin area.

Further information on the institute is available by contacting Dr. Robert S. Bednarz or Dr. John R. Giardino, Department of Geography, Texas A&M University, (409) 845-7141.

As the school year ends, remember to notify ***Marine Education*** of any changes of address before the Fall semester. The next issue will be mailed Sept. 1.

Marine Facts

Remote sensing enhances marine education

by James Zuhn*

Wouldn't it be wonderful if all students could experience the oceans directly rather than learning about them from books? A stroll along the tide line or an exciting day aboard an oceanographic research vessel would seem the ideal way to let students learn about the sea. In most cases.

Coastal residents can attest to the fact that some forms of ocean-generated weather, such as hurricanes, are best experienced from a safe distance. How, then, can we provide realistic but safe involvement with weather systems whether students live near to or far from the sea?

Today's students can learn about their environment in ways never before possible. Until recently, orbiting environmental satellites have been inaccessible to public use because of prohibitive costs. Now, with the availability of affordable equipment and with curriculum applications being developed by various teachers, these satellites are becoming valuable tools for students' investigations of marine and earth sciences, biology and physical sciences.

Pioneering teachers have already demonstrated that students can benefit greatly from constructing and using amateur environmental satellite stations. An inexpensive VHF FM radio receiver, a homemade antenna and a surplus photofacsimile printer are all that is needed for students to receive and print reasonable quality images.

There are three Tiros-N environmental satellites (a more appropriate term than weather satellites) in polar orbits that bring each within receiving range at least four times daily. Each transmits two images simultaneously, one in the visible spectrum and another in the infrared. Students can view landforms and bodies of water in the visible images. Positions and movements of weather systems are also observed and measured from these images. The infrared images, which are thermal, reveal cloud temperatures that, in turn, indicate cloud height and storm severity. Weather is an important topic for the marine science teacher; a study of sea surface temperatures is even more important.

By adding a personal computer and an inexpensive peripheral device, temperatures can be false-color coded to distinguish warm water zones from those of cooler water. The temperature patterns indicate currents and convergence zones. Commercial fishermen already use the relationships between this information and their day-to-day activities. Students can use the equipment to discover seasonal changes of temperature, currents and weather patterns.

In classrooms with satellite-receiving technology, students work with real-time information and, quite understandably, develop unique perspectives of what they are studying. Since neither students nor teacher knows what will be seen in the next image, activities involve true inquiry. Students make many small, but important, discoveries that help them understand the context and significance of the subject more clearly. Characteristic patterns of weather system movement are discovered, not read from tables. The deterioration of a hurricane when it moves away from its energy source (the ocean) is directly observed.

The results of using contemporary environmental satellite technology in science education suggest that there is something of equal, if not greater, importance than the factual content of information to be learned. The processes of observing phenomena as they happen, predicting events on the basis of personal observations, and application of new concepts to other similar situations are as important as the facts learned through those processes.

Aerial photographs supply an alternative source of remote sensing activities. These can be ordered from the U.S. Geological Survey or borrowed from larger libraries.

Aerial photographs often display vivid cause-effect relationships between waves and currents and the beaches produced by them. In some photographs waves can be seen approaching the shore and being refracted (turned) toward the shore as they enter shallow water. Reflection and convergence along shorelines can also be seen. Students who have worked with ripple tanks enjoy seeing their in-class work substantiated by nature; those who have not will be motivated to do so.

Photographs in which waves are not visible (or in which sand deposits do not conform to present wave and current patterns) provide exercises in deduction. What direction of longshore current flow would have produced the accumulation of sand on one side of the jetty but not on another? What prevailing wave direction would produce that longshore current? What factors, other than wave action, influence beach deposits? The questions and the search for answers are never-ending.

Not only do aerial photographs show barrier islands, deltas and other coastal features, they often provide clues to the formation of these features through detailed information on sites of sand accumulation. Even the absence of beach sand may be significant. Along some coastlines the abrupt cessation of beaches is indirect evidence of submarine canyons.

Pairs of photographs taken at various times of the same beach area reveal recurrent seasonal changes in beach profiles. Waves impinging on beaches during the summer generally produce less turbulence than those of the winter months. As a result, more sand is pushed up onto the beach by incoming waves than is removed by the back-rush of subsiding water. The result is a build-up of sand on many beaches during the summer followed by a loss during winter, when even the returning water is sufficiently agitated to hold sand in suspension.

Inland students should be given an opportunity to study and interpret aerial photographs of nearby areas. Lakes and rivers often constitute the most striking features. Photographs taken several years apart frequently display dramatic changes in river courses, encroachment or loss of vegetation, and the interaction between

*Associate Director, Marine Education Program, co-sponsored by Texas A&M Sea Grant and Department of Educational Curriculum and Instruction.

Marine Facts

man-made structures and the environment.

Having examined and speculated on the significance of features in aerial photographs, students should be encouraged to visit the areas depicted, either as part of a scheduled field trip or on their own. Confirmation of predictions they have made will give them confidence in knowing the nature of areas that will necessarily remain inaccessible to them.

[The Texas A&M Sea Grant marine education program has made it possible for teachers and students to work with a demonstration system for classroom applications of satellite receiving technology. Curriculum materials are being prepared specifically for marine, earth and life sciences. For more information, write to Earth Sensing Project, Marine Education Program, Department of Educational Curriculum and Instruction, Texas A&M University, College Station, Texas 77843.]

House selects lightning whelk as state's shell

*Texas is on its way to having an official state seashell. The Texas House of Representatives voted unanimously to adopt the lightning whelk (**Busycon perversum pulleyi**) as the state's shell and forwarded the resolution to the Senate in late April.*

In introducing the resolution, Rep. John Willy, R-Angleton, said the lightning whelk was appropriate as a state symbol because it is found only on the Texas Gulf coast.

The lightning whelk is often caught with crab lines in the bays when it comes to feed on bait or buried in the sand. It is an intertidal animal that ranges from Brenton Sound, Louisiana, to the northern Mexican coast.

Idea for the classroom

Using remote sensing

High quality aerial photography is available for virtually every area of the country from a local Agricultural Stabilization and Conservation Service (ASCS) office, a U.S. Forest Service office or the state highway department. The public generally can view photographs of a specific county or region in one of these offices. After selecting a good photograph for classroom use, copies can be ordered for what usually is a nominal charge.

Procedure:

1. Working in groups of three to five students, have the class attempt to identify the area in the photograph by comparing river meanders, highways or other recognizable features with various highway and topographic maps.
2. Discuss such questions as:
   - Is this area flat, hilly, mountainous or other?
   - Is this area wooded, brushy, grassy or other?
   - Identify some natural features and some man-made structures.
   - How many different land uses can you identify?
   - Which direction is the river flowing? Describe the flow.
   - Can you find evidence of erosion or deposition?
   - From the observations, can you describe how local industry and/or agriculture could affect plant and animal life in an estuary or bay downstream?
   - How could human activity in central Texas affect a shrimper in the Gulf of Mexico?
3. If possible, take the students to the site so they can compare their remotely sensed observations and inferences with direct ground-truth observations and measurements. Experiences of this kind will do much to enhance student appreciation and responsibility toward the terrestrial and marine environments of which they are a part.