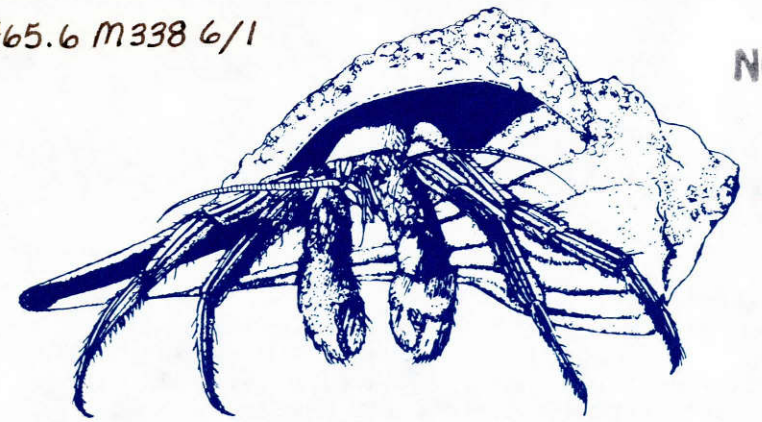

Marine Education

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

Symposium set for March 1 at Texas A&M

Plans are underway for the seventh annual Marine Education Symposium, to be held Saturday, March 1, 1986, at Texas A&M University. As in previous years, the Symposium will include a full day of presentations and other activities.

The Symposium, sponsored by the Sea Grant College Program at Texas A&M in cooperation with the Department of Educational Curriculum and Instruction, is open to all high school students and teachers. More than 1,700 students and teachers registered in 1985.

Two changes will affect the 1986 Symposium. Attendance will be limited to students in grades 9 through 12, although teachers at any grade level will be welcomed. There also will be a $1.00 increase in the registration fee. The preregistration fee will be $3.00 per student or adult. Registrations received the day of the Symposium will be $4.00.

"Last year's registration figures made us realize that we have to limit attendance to high school-level stu-

(See Symposium, page 2)

Project WILD can help enrich nature studies

Teachers and administrators wanting to include wildlife and the environment in their curricula can now receive assistance through a program known as Project WILD.

Project WILD is an interdisciplinary, supplementary environmental and conservation education program that emphasizes wildlife. Wildlife can be small organisms only visible to people if seen through a microscope, or as large as a great blue whale. Wildlife includes, but is not limited to, insects, spiders, birds, reptiles, fish and non-domesticated mammals.

An education program designed by and for teachers, Project WILD includes a six-hour workshop and printed activity guides. During the workshops, teachers are instructed in the various activities which can be incorporated into their lesson plans. The program is designed for both elementary and secondary schools. Both the workshops and the activity guides are free.

Project WILD began as a joint project of the Western Association of Fish and Wildlife Agencies and the Western Regional Environmental Education Council. The Western Association is a group comprised of the directors of state agencies in 13 western states who are responsible for wildlife management. The Council is a not-for-profit corporation comprised of representatives of state departments of education and state resource agencies in 13 western states. Agreements between these two sponsoring organizations allow for additional sponsorship by other interested organizations and agencies, and Project WILD now includes an international network of educators, wildlife professionals, youth leaders, community representatives and 32 state wildlife and resource agencies.

The activity guides, one for elementary students and one for secondary, are designed for easy integration into school subject and skill areas—particularly science, social studies, language arts and mathematics. Classroom teachers can use the materials to teach required concepts and skills, while teaching about people, wildlife and the environment.

Each activity includes an objective;

(See Project, page 2)

Conference studies minority roles in science

The potential for minorities to excel in science and math-related fields is strengthened with improved educational, parental and industrial support. This was the focus of the first Minorities in Science Conference, held at Texas A&M University in August.

Dr. Julia Clark, associate professor in the Department of Educational Curriculum and Instruction at Texas A&M, coordinated the conference. She told participants that since 1981 blacks have accounted for 5 percent of undergraduates majoring in mathematics and in biological sciences and 3 percent of those in engineering.

Alice Moses, immediate past president of the National Science Teachers Association, said the first answer to increasing minority involvement in these fields is a strong science program and an increase in qualified teachers. Students should be exposed to the sciences, particularly non-traditional sciences, while in grade school according to Moses.

Museum visits, improved science materials and interacting with role models provide benefits to students that texts cannot begin to accomplish, Moses said. Teachers who are excited about teaching cannot achieve what they should without proper utensils. As as example, Moses said a textbook cannot explain the phases of chemistry as well as beakers, test tubes and interacting chemicals.

"An exposure to a fun form of science will stimulate students' interests and help them gain a clearer interpretation of science," said Dr. Wayne Perry, dean of the School of Engineering at Prairie View A&M University. "The

(See Conference, page 4)

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Tinnin continues specialized workshops

Secondary teachers interested in barrier island geology and ecology and physical science and chemistry teachers have an opportunity to learn more about the relationship of the marine environment to their fields in special workshops Oct. 4-6, 1985, and Nov. 8-10, 1985. Both workshops will be at The University of Texas Marine Science Institute in Port Aransas under the direction of Richard Tinnin. Attendance is limited to the first 30 registrants for each.

The registration deadline for the first session, *Barrier Island Geology and Ecology*, is Sept. 27. The workshop begins early on Saturday morning (Oct. 5), but Tinnin encourages all teachers to arrive Friday evening. The session will end by mid-afternoon on Sunday, Oct. 6. During the workshop, teachers will spend one morning in lectures and the remaining time in beach study activities.

The November workshop, *Physical and Chemical Oceanography*, has a Nov. 1 registration deadline. Participants will spend one morning aboard a research vessel collecting specimens and performing tests. During the cruise, teachers will take boxcore and water column samples and do some sediment work. Onshore sessions will include lectures and laboratory workup on the collected samples.

Each workshop is available to teachers in grades 9 through 12 at a cost of $40. This fee includes registration, supplies, handouts, dormitory rooms for two nights and five meals. Registrations or inquiries should be addressed to Richard Tinnin, The University of Texas Marine Science Institute, Port Aransas, Tex. 78373 (512/749/6729).

Tinnin's spring workshop schedule includes a basic teacher orientation workshop (March 28-30), and two specialized sessions on phytoplankton and zooplankton (April 11-13) and seaweeds and sea grasses (May 2-4). Further details, including registration deadlines, for the spring workshops will be announced later.

Symposium intended for high school students

(Continued from page 1)

dents," said Symposium coordinator Amy Broussard. "We can only seat 1,900, if every room is filled to capacity, and we come closer to this number each year. The program was always intended for a high school audience, although we have not enforced this until now.

"We may have to consider instituting a similar program on the middle school and junior high level if there is enough interest," added Broussard. "This will depend on available funds and teacher response."

The fee increase is due to rising costs and a general decrease in Sea Grant funding both on the state and federal levels.

"The Symposium is supposed to be self-supporting," Broussard explained, "but as our costs for room rental and buses and vans have increased in the past six years, we found we were consistently exceeding our budget. When our general operating budget was decreased, we realized we had no choice except to raise the fee if we wanted to continue the same level of program."

March 1 - *go to Symposium*

House Bill 72 presented another problem in 1985 that Broussard hopes to resolve in 1986.

"Although we consider the Symposium to be a Sea Grant-sponsored event, rather than school-sponsored, we found that the "no pass, no play" rule was being enforced last spring and some students were told they could not attend. In most cases, the students pay their own registration fees, and, since we cannot refund this money, the result is that students are paying for a program they cannot attend.

"Students need not be part of a school group to attend," Broussard said. "I would hope that any student who is denied permission to attend with the group be told that he or she is welcome to come as an individual. This is an educational activity, not a sports event, and it seems self-defeating to tell students that they cannot supplement their learning process."

As in previous years, there will be three sessions on scientific research and more general topics from 9:15 a.m. until noon, followed by field trips and workshops in the afternoon. Exhibits representing various Texas A&M departments and coastal organizations will be displayed throughout the day, and general campus tours will be available for those wanting to learn more about the University.

Further information on the Symposium is available by writing Marine Education Symposium, Sea Grant College Program, Texas A&M University, College Station, Tex. 77843-4115.

Project WILD . .

(Continued from page 1)

a brief description of the instructional method employed; background information; a list of needed materials; step-by-step procedures; examples of ways to evaluate student learning; recommended grade level; major subjects from which concepts are drawn; skills; duration; recommended group size; setting (indoors or outdoors); and key vocabulary.

Texas teachers can obtain more information on Project WILD by contacting Darrell Holt, Project WILD Coordinator, Texas Parks and Wildlife Department, 4200 Smith School Road, Austin, Tex. 78744, or by calling (toll-free) 1-800-792-1112. Teachers in other states should either contact their state wildlife management agency or write to ***Marine Education*** for a complete mailing list of Project WILD coordinators throughout the country.

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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; *Bonnie Blackburn*, marine education coordinator.

An elementary view

Two feet, a pair of wings and a beak

by Mary K. Judd

The estuarine environments along the Texas coast support a wide variety of bird life. Herons, gulls, terns and sandpipers are only a few of the many shorebirds inhabiting the coastal wetlands. Each bird species occupies a specific place in these wetlands and each performs its own unique job. An animal's "occupation" within its special habitat (or place in the environment) is called its NICHE (pronounced like "nitch").

Birds, like humans, make a living for themselves and their families. Their most important "jobs" include finding the proper food, water and shelter necessary for survival, avoiding predators, finding mates, building nests, and rearing their young. As with humans, birds possess special tools that help them perform their jobs most effectively . . . the only difference is that the bird's set of "tools" is part of its body. The most obvious tools for a bird are its beak, legs and feet. Less obvious tools are the shape and size of the wings and the color of the feathers. Let's look at some examples.

The Great Blue Heron

The Great Blue Heron, one of the largest of our coastal birds, can be found stalking along the shores of quiet bays and estuaries. As you drive along the coast, from island to island, you need to keep a sharp eye out for these birds. Their feathers are tinted a medium blue-gray, which matches the waters nearly perfectly, thus helping them hide from view of predators, prey and people. This camouflage is especially effective in the mornings when the mist rises up from the warm waters.

Being a shore bird, the heron does not require the shape and size of wings necessary for flying fast or soaring for long periods of time. Its relatively short, broad wings are suited for getting it from pond to pond, or from bay to bay.

The Great Blue Heron has very long, slender legs. These "tools" serve as stilts, allowing the heron to wade rather far from shore without getting its feathers wet (which could lead to serious illness due to exposure to nature's elements). Since the shores of bays and estuaries are frequently mucky, one might expect that the heron would sink into the mud on his "stilts." Not so. To counteract this tendency to sink, the heron has yet another set of special tools—very long, thin toes. By increasing the area on which the heron can walk, these toes keep the bird from sinking too far into the ooze. This is the same principle behind the effectiveness of snowshoes.

Being able to search for dinner offshore opens up a wide variety of food items not available to the heron's "dry-docked" cousins. An array of fish, crabs, shrimp and other invertebrates make up this bird's "buffet." The heron needs a device to catch this prey, however, and the special tools for this job include a long, slender neck and a long, sharp, spear-like beak. Few animals can escape the carefully aimed thrust of a heron's head.

With the stealth of a stalking cat, the heron slowly moves out into the shallow waters on its long, stilt-like legs. Once it glimpses a fish or invertebrate darting here and there, it stops and with patience that often outlasts that of any human observer, it waits and waits and waits for that right moment when an unsuspecting morsel swims too near. Once the prey is within range, the heron jerks out its snake-like neck with lightning speed and spears its dinner with its beak. Tossing the prey up and off its beak, the heron then swallows its meal whole.

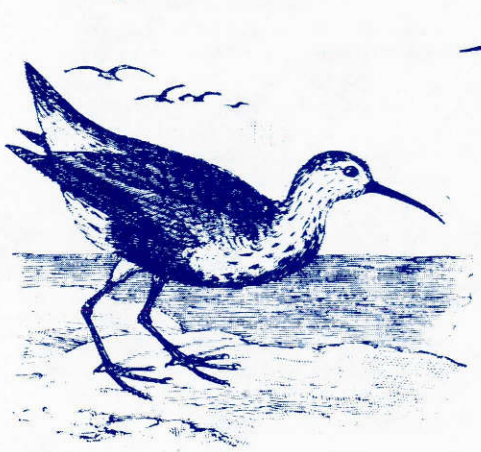
Sandpipers

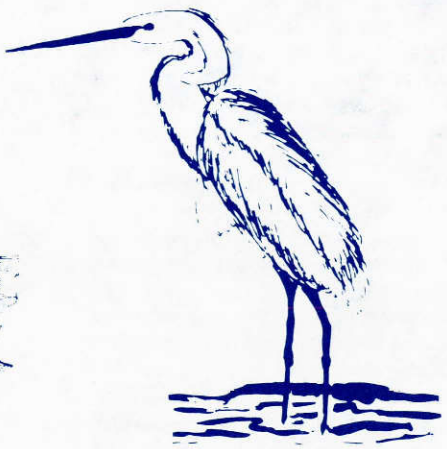
Numerous species of sandpipers can be found dashing among the waves along the Gulf's sandy beaches. Like the Great Blue Heron, these shorebirds possess special "tools" that help them perform their jobs. As their niche differs from that of the heron, however, so do their tools.

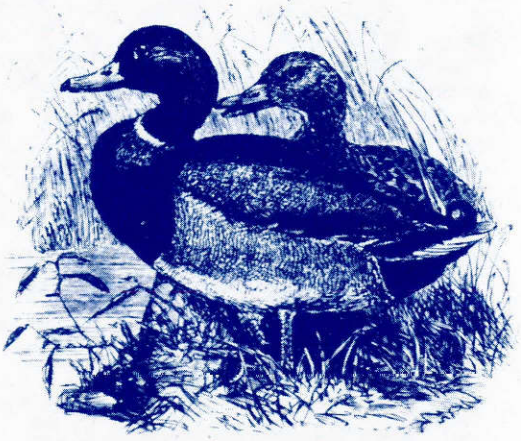
These birds have rather long legs for their body size. This not only helps them stay high and dry, but also gives them the extra speed needed to race the waves (compare the speed, for instance, of a robin with that of a sandpiper). Their coloration is sandy duff, with speckled shades of brown. Such coloring is excellent camouflage for life on sandy or small-pebble beaches.

These birds use their uniquely shaped bills in their search for food. All sandpiper beaks are sleek and narrow, well suited for searching out the burrowing worms and crustacea that compose their diet. The length of their bill depends on where their special food is located. If the burrowing invertebrates are close to the sand's surface, the bird's beak is medium in length. If, however, the bird's prey is a deep burrower, its beak is somewhat longer.

A sandpiper's wings are designed for the quick bursts of flight needed to escape from predators. Sandpipers do not need long, slender wings for







soaring. These birds have rather short wings, frequently tapering to a point. Such wings are responsible for the constant flapping and sharp turns made in flight.

Ducks

Ducks are another common inhabitant of the Texas marshes and shorelands. Characteristics "tools" of ducks that allow them to perform their "jobs" effectively include short legs and webbed feet for paddling through water, a bill with serrated edges for straining plants out of the water, and strong wings for fast flights. The females of most species are mottled with browns and tans to help camouflage them while they sit on their nests. During summer when the males have molted their flight feathers and are temporarily flightless, they exchange their colorful breeding plummage for a duller, more camouflaged coat of feathers.

This activity is designed to help students understand how coastal birds obtain appropriate food.

Materials

Color photos of a variety of shorebirds and waterfowl in their natural habitats (nature magazines are a good source)
Plastic containers:
3 shallow containers
1 deep bucket
Sand
Mud
Water
Paperclips
Raisins
Paper towels
Pine or spruce needles or grass clipped in short pieces
Plastic tubing (aerator tubing from aquarium pumps or other small diameter tubing)
Bird seed or freeze-dried white shrimp (for medium to large fish, available from most pet stores)

Materials for beaks

Spoons, tongue depressors, popsickle sticks, toothpicks, pipe cleaners, long barbecue tongs, short cooking tongs, wire mesh, thread and needle, glue, rubberbands, paperclips, tape, various other construction-type materials found around the home or school

Procedure

1. Discuss niche adaptation in coastal birds. Show slides or photos of a variety of coastal birds.
2. Tell students that they are to assume the role of a wetland bird for this activity. Their task is to build a bird beak suitable for retrieving food from each of four habitats.
3. Set up the habitats in the following manner:

Bay Habitat: Fill a large plastic bucket nearly to the top with water. Dump several paperclip "fish" into this habitat.

Marsh Habitat: Fill a shallow pan with water. Sprinkle a handful of small pine or spruce needles (or grass clippings) on top of the water. The needles represent marsh vegetation.

Beach Habitat: Fill another shallow pan with sand. Sprinkle bird seed in the sand to represent small, buried invertebrates. (Or use small, freeze-dried white shrimp.)

Mud Flat Habitat: Fill a third pan with mud. Bury a few raisins in the mud and insert one or two U-shaped tubes filled with raisins. The raisins represent a variety of worms and crustaceans. The raisins in the tubes represent several of the worm species that form their own tubes in natural habitats.

Rules

1. Students cannot get their hands wet. This would be similar to a bird getting its feathers wet . . . an unhealthy thing.
2. Each student needs to retrieve at least five pieces of "food" from his habitat in order to survive. The quicker and more efficiently he can do this, the "healthier" his bird will be.
3. Remind students to be as bird-like as possible.

Conference rates educational, parental, industrial support

(Continued from page 1)

earlier students learn about and understand their environment, the more excited they will be to excel in their studies."

Clark told participants that first-rate teachers and counselors are just as important as first-rate educational materials. Good teachers, according to Clark, need to be "competent, committed to discipline, comfortable with their teaching methods, and compassionate with their students and colleagues." She went on to say that if a teacher is not motivated to teach, students will not be motivated to learn.

Clark recognized the current teacher shortage, saying there are three times as many vacancies now as there are education graduates. This shortage, she said, is forcing school districts to hire uncertified and, in Clark's opinion, unqualified teachers. This further decreases the number of role models available for minority students.

Moses said qualified and enthusiastic teachers are available, but there are not enough. This puts even more focus on the counselor's role, who becomes the key person to discover a student's strengths.

Counselors need to encourage minorities to attend college, Clark said, and, more importantly, to pursue a career in a science or math-related field.

Parental influence is the next most positive reinforcement for students, according to Perry. When a student is a second generation college student, the percentage preferring a science or math-related career is increased. Parents encourage an interest in science by helping children understand their environment.

The participants agreed that once students are encouraged to excel by their schools and parents, the next most notable influence is industry, which can sponsor schools, provide resources and share current technology. These advanced forms of technology provide another way students can learn about science beyond the textbook.

Moses pointed out that there are numerous career opportunities available for a minority student with a bachelor's or master's degree in a science- or math-related field. Graduates can enter the teaching field, or find positions in government, medicine, research or industry.

Marine Facts

Waste disposal in a watery dump

by Dr. B.J. Presley*

All living organisms produce waste products. Man, however, produces wastes not only through the process of living and dying but through a myriad of other activities, including agriculture, manufacturing, transportation and recreation. The mass of the resulting waste is enormous, especially in an industrialized country such as the United States. We produce about 10 tons of waste per person per year. What should we do with this unwanted material? Obviously, the answer depends on what the material is, where it is and how much there is of it. Obviously, too, the material should be recycled and reused whenever possible. Recycling not only solves the disposal problem but conserves our natural resources.

To recycle wastes is, unfortunately, often physically or economically impractical. At our present stage of technological development, some things must be thrown away at the end of their useful life. Waste gasses are released into the air, and solids and liquids are dumped into the ocean or stockpiled on land. Several characteristics of the ocean make it an appealing place for waste disposal. For one thing, it is big, having more than twice the surface area of all the land. It is also deep, on the average about as deep as an oil well. It is well mixed so that waste materials added to it are rather quickly dispersed through a large volume. There is one thing to note, however — it would take more than 1,000 years to mix an added substance equally throughout the ocean. Organisms in the ocean can degrade some wastes, actually using them for food or fertilizer. At the same time, little of man's food or fertilizer comes directly from the sea and no people live permanently on or in the seas.

The capacity of the ocean to assimilate seemingly unlimited amounts of waste materials led to its indiscriminate use for waste disposal until relatively recent times, although concerns that coastal waters were being degraded were expressed as long as 100 years ago. The first U.S. legislative effort to control ocean pollution seems to be the Rivers and Harbors Act of 1890, but only after the public was aroused by Rachel Carson, Jacques Cousteau and other environmentalists in the 1950's and 1960's did protection of our ocean resources become a national priority.

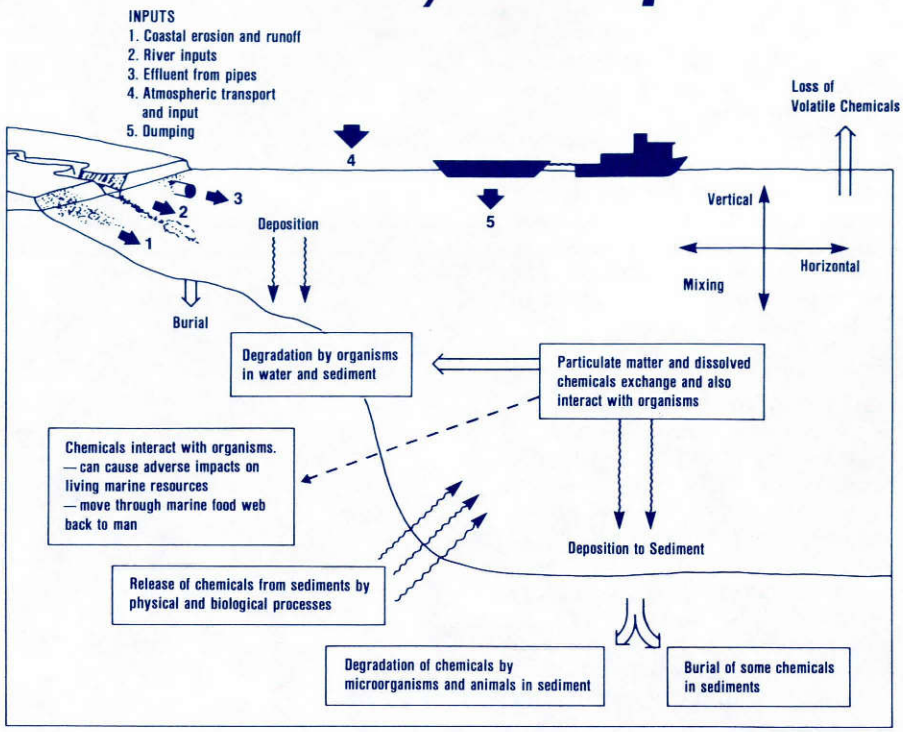


Fig. 1 The pathways of entry and movement for wastes in oceanic ecosystems.

The philosophy behind government regulation of environmental quality was outlined in the National Environmental Policy Act of 1969, and this was followed by laws which specifically regulated various activities, such as the "ocean dumping act" of 1972. This act prohibits disposal of anything in the ocean without a permit issued by the Environmental Protection Agency (EPA). By the middle 1970's EPA, urged on by environmentalists and others, had declared its intention to phase out ocean dumping completely by 1981. In a 10-year period the public had gone from viewing the ocean as having an infinite capacity to assimilate wastes to having little or no capacity to do so.

The change in the public's perception of ocean pollution was brought about not only by environmental activists, but also by several incidents in which human health was impared by pollutants in the marine environment. The best known of these is the death of dozens of people in Japan who had eaten seafood contaminated by industrial waste discharges (specifically mercury). Even before the human poisoning episodes, scientists had expressed concern over the health effects and effects on marine organisms of three classes of chemical substances:

1. pesticides and other man-made organic chemicals
2. petroleum and petroleum products
3. heavy metals such as cadmium, lead and mercury.

This list has not changed, although new organic compounds have been added to that class in recent years and some things, such as DDT, are now of less concern due to decreased use. Criteria for concern about a chemical's potential harmful effects include:

1. large-scale production
2. wide-spread use
3. persistence
4. toxicity

Newly created or recognized material should be examined with these criteria in mind when assessing their potential for environmental damage.

Substances, whether harmful or not, are transported from continents to the ocean in several ways, including:

**Dr. Presley is a professor in the Department of Oceanography at Texas A&M University who specializes in chemical oceanography.*

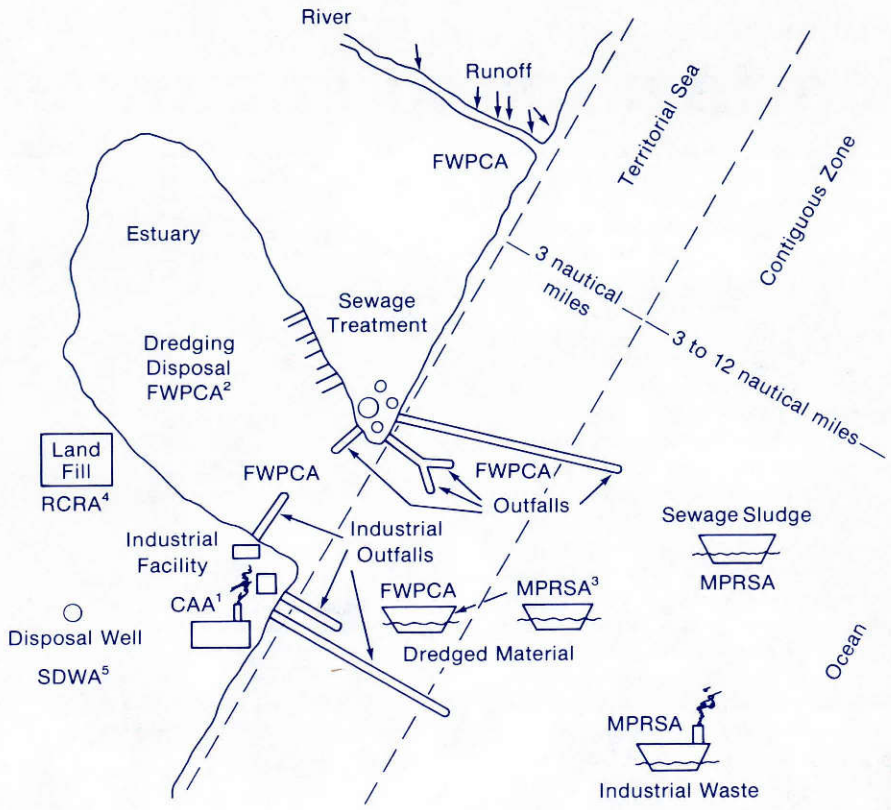
1. by the wind
2. by rivers and streams
3. through pipelines
4. by ships and barges

These transport pathways and transfers within the ocean are shown in Fig. 1. Wind and river transport are natural processes which have operated throughout geological time to erode the continents slowly, but both natural and man-made materials are being transported at the present time. All continental materials tend to be moved into the ocean by these transporting agents due to the unrelenting force of gravity. For this reason, pollutant production in mid-continent areas is nearly as important as that along the seashore. In no case can pollutants be permanently stored on land. They may be stored for our lifetime and that of our children's children, but ultimately they will end up in the sea. In order to protect the marine environment, then, it is important to consider all inputs of pollutants, not just direct additions from pipes and ships. A marine organism cannot know where a pollutant came from, it can only respond to the total amount present in its environment.

The term ocean dumping is usually restricted to additions from ships and barges, which are regulated differently from pipeline outfalls. In fact, the maze of laws regulating ocean disposal of wastes is confusing even to the experts. The most important of these laws and the areas where they apply is shown in Fig. 2. Industrial wastes and dredged material are the main substances to be disposed of now, and will be for the next 20 years as is shown in Fig. 3. Sewage sludge is also important.

Dredged material has been removed from harbors and navigation channels by the U.S. Army Corps of Engineers or its agents to keep shipping lanes open. Such activity is essential to our modern society, and the dredged material has to be put somewhere. Disposal on shore can contaminate land and ground water, is expensive and can only be a temporary expedient in view of the constant natural seaward transport of all things. Most dredge spoil is, therefore, dumped at sea.

Luckily, in view of its large volume, most dredged material is relatively harmless to marine organisms, unless they are physically buried by it. An exception to this is material from busy harbors. It, in many instances, is highly contaminated with some or all of the



[1] Clean Air Act (CAA)
[2] Federal Water Pollution Control Act (FWPCA)
[3] Marine Protection, Research, and Sanctuaries Act (MPRSA)
[4] Resource Conservation and Recovery Act (RCRA)
[5] Safe Drinking Water Act (SDWA)

Fig. 2 Jurisdictional boundaries of key environmental laws.

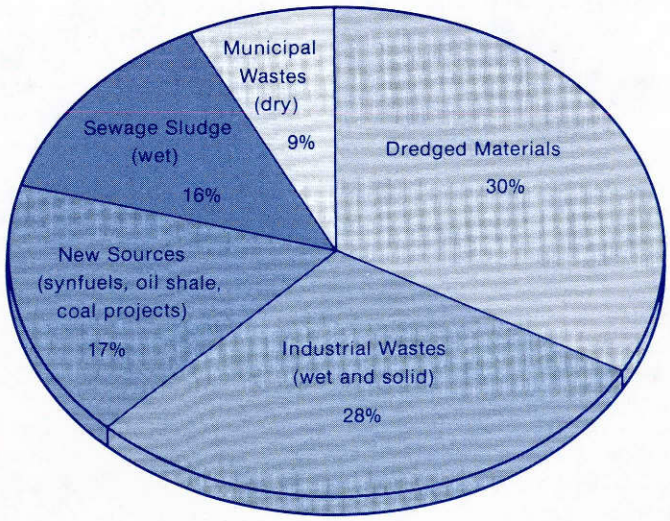


Fig. 3 Estimated percentage of wastes that will need to be disposed of by the year 2000.

toxic substances listed earlier (man-made organics, petroleum and heavy metals). Such contamination is inevitable in a harbor in an industrialized area because nearly all pollutants which are added to water quickly stick to particles and become part of the bottom sediment. The disposal of contaminated dredge material is a major environmental problem, and no general solution has been agreed on by the parties affected (the port authorities, Corps of Engineers, environmentalists and others). A number of approaches are being used, including diked disposal, both on land and in the ocean, covering contaminated material with a layer of clean material, and disposal far from land.

The problem of contaminated dredge material disposal can be generalized to disposal of any toxic substance. In the simplist analysis, the choice is between confining the material in a small area and keeping it separated from most of the environment, or widely dispersing it in hopes that dilution will render it harmless. There is no agreement as to which of these approaches is best in any given case. The idea that "dilution is the solution to pollution" has appeal, especially when a volume as large as that of the ocean is available. Unfortunately, mixing of the whole ocean is rather slow by human standards, and once something has been mixed into the ocean there is no way to unmix it. What if, no matter how unlikely, the whole ocean becomes contaminated and unsuited for life? Confinement would seem to be a safer choice if any doubt as to the long-term effect of the pollutant exists. Confinement at least allows for monitoring of the disposal site and the possibility of remedial action (clean-up) should the need arise.

In issuing dumping permits, EPA considers both confinement of wastes and their dispersal. The company applying for an ocean dumping permit must give details on what is in their waste, how much there is, where it is, etc. At the present time they must also prove that no alternative to ocean dumping exists. EPA carefully studies the permit application and invites experts and the general public to comment on it. If a permit is issued, it will be for a specific waste, in a specific amount, for a specific time, to be dumped in a specified place. Usually there is a requirement that the dumpsite be monitored periodically to see if marine organisms are being harmed by the waste dumping.

Waste dumpsites have been monitored by the companies doing the dumping and by various government agencies and university research groups. Harmful effects on marine organisms have been found, especially in large dumpsites like the one near New York City, but the effects have been small — so small, in fact, that it is usually hard to be sure there is an effect. Most marine scientists today believe that waste materials can be dumped into the ocean without causing unacceptable harm to the environment, if the dumping is carefully controlled and monitored.

Ideas for the classroom

Many of America's largest metropolitan areas are located near the marine coasts. These cities have usually turned to the ocean (or to large rivers that empty into the nearby ocean) as outlets for their tons of sewage wastes. One of the major problems with sewage disposal is the effect on oxygen concentration in the contaminated water.

Most organisms require oxygen to survive. The bacteria and fungi responsible for decomposing the sewage consume large quantities of oxygen—leaving little, if any, oxygen for other marine organisms to use. The added stress placed on the system's inhabitants frequently causes them to die. Once these organisms die, the decomposers begin working on the dead plants and animals. The demand for oxygen intensifies . . . the cycle worsens.

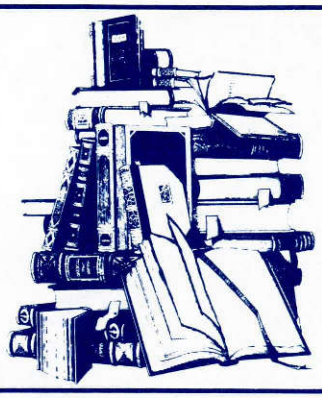
The following activity, adapted from **Investigating the Marine Environment: A Sourcebook, Vol. 2**, allows students to study the effects of sewage disposal in a marine environment. Rather than working with harmful sewage, this activity uses a simulated "model environment." Powdered milk simulates the sewage and yeast simulates the decomposers.

Procedure

1. Add two teaspoons of powdered milk to 40 ml of tapwater in a jar or beaker. Label the jar MILK.
2. In a second jar, thoroughly mix 2 teaspoons of dry, granulated yeast with 40 ml of tap water. Label the jar YEAST.
3. Label 3 clean test tubes #1, #2, #3. Place them in a test tube rack.
4. Add 1 ml milk and 11 ml water in test tube #1.
   Add 6 ml milk and 6 ml water in test tube #2.
   Add 12 ml milk and 0 ml water in test tube #3.
5. Now add 20 drops of methylene blue solution to each test tube and mix thoroughly. (Methylene blue is an indicator dye that is blue when oxygen is present and colorless when oxygen is absent.)
6. Add 4 ml of yeast solution to test tube #1. Mix it well. Record the exact time. Return the tube to the rack and do not disturb (otherwise, air may mix with the contents). Follow the same procedure for test tubes #2 and #3.
7. Observe carefully and continuously, and record the exact time when any changes occur in the tubes. Record not only the time when the change occurred, but also the amount of time for the change to occur. This part of the experiment may take about 20 minutes.
8. While waiting, think about what has just been done and predict what may happen.
9. Consider and discuss the following questions:
   Which tube contained the most food for the "decomposers"? Which had the least food?
   Why may there have been a ring of blue at the surface of the tubes, even after the majority of the liquid in the tubes changed color? In which tube did the change occur most rapidly? Is this what you expected? Why? Why did the tubes vary in the time needed for change to occur? What effect would an increase in temperature have on this "mini-system"? How could you find out? What would have happened if more decomposers (yeast) had been present at the beginning of the experiment?
   How does this system compare to natural systems? What would have happened to the plants and animals growing in the natural systems similar to the three test tubes? Can you make any suggestions, based on these findings, about methods of sewage disposal? How is sewage treated in your state? How could present methods be improved?

Investigating the Marine Environment: A Sourcebook Vol. 2 — Laboratory-Classroom Studies, *written and edited by Howard M. Weiss and Michael W. Dorsey. Project Oceanology, Avery Point, Groton, Conn. 06340. 1979.*

books & things



Jean Andrews' *Shells and Shores of Texas* has long been considered the definitive work on the subject for both serious students and weekend beachcombers. If the book has any flaw, it is that it is too big to carry on a field trip.

Now Andrews and The University of Texas Press have eliminated that flaw with publication of *Texas Shells*. With material drawn from her earlier book as well as new material, Andrews has made *Texas Shells* **the** field guide to be carried and consulted on the beach. Its handy size (5¼ x 8½), plus descriptions and illustrations of 279 mollusks of the Texas Gulf Coast make this a worthwhile addition to a school or personal library.

Texas Shells is available in bookstores ($8.95) or through The University of Texas Press, P.O. Box 7819, Austin, Tex. 78712.

The Sierra Club Environmental Education Committee has six ecology filmstrips for use by environmental educators and teachers. The films, which are targeted to grades K-7, cover conservation principles, endangered species, pollution and John Muir. There is a $10 rental fee for each film. A descriptive brochure is available by writing Sierra Club Information Services, 530 Bush St., San Francisco, Calif. 94108 (telephone: 415/981-8634).

The South Carolina Sea Grant Program has just published **Sea Sampler — Aquatic Activities for the Field and Classroom** in both elementary and secondary versions. While most of the field activities relate to South Carolina's aquatic ecosystems, the books can be adapted for use elsewhere along the Atlantic coast.

Teachers interested in more information on either book should contact Wendy Allen, Belle W. Baruch Institute for Marine Biology and Coastal Research, University of South Carolina, P.O. Box 1630, Georgetown, S.C. 29442.

A Teachers' Guide to the Whales of the Gulf of Maine, just released by the University of Maine's Sea Grant College Program, is a whale curriculum guide for those interested in presenting their own study units on marine mammals. It offers detailed, up-to-date information on whale anatomy, diving physiology, whale intelligence, feeding and locomotion, sighting charts, and numerous activities about whales and other marine mammals.

Readers will find many highly original activities included in the guide, such as a two-part session for training humans how to use dolphin language. In order to teach a person an artificial sign language based on dolphin conditioning techniques, students develop their own language of hand signals and then teach other student "dolphins" how to make correct responses using positive reinforcement.

The guide is available for $5.00 from the Sea Grant Communications Office, 30 Coburn Hall, University of Maine, Orono, Me. 04469.

Reader survey rates success of newsletter

As ***Marine Education*** begins its sixth year, the staff is reviewing results of a recently completed reader evaluation of the newsletter. Independent marketing consultants conducted a random sample of subscribers in May 1985 to assess the content of the newsletter, its value as a source of marine-related information for classroom use, and reader recommendations for improvement.

This information, coupled with a demographic and geographic profile of the subscriber audience, will assist the editorial staff in determining if ***Marine Education*** is accomplishing its objectives and provide suggestions for modifying the publication to meet reader needs.

"We have more than 5,000 subscribers in all 50 states and several foreign countries," said Editor Amy Broussard, "but after five years, we weren't sure if we were helping teachers . . . or even if anyone was reading it.

"The survey shows that it is being read, and that it is helping many of our teacher-subscribers. It also shows areas for improvement. For one thing, we have more elementary teachers than we thought, and nearly all asked for more elementary-level activities. Another consistent request was that we provide more activities for inland classrooms."

Both requests are being implemented in this issue of ***Marine Education***. A new section, *An elementary view*, begins with this issue and will become a regular feature. Both this activity and that included with the *Marine Facts* are ones that can be used in any classroom.

"We are still reviewing the survey findings," Broussard went on, "and may make additional changes based on the results. Ultimately, we will publish a report of the findings.

"We have discovered one problem. Since the survey was conducted by outside consultants, the respondents were not identified for us. Some requested additional information or materials, but we cannot reply without names and addresses. Any reader needing materials or information should contact me directly at the Sea Grant office."