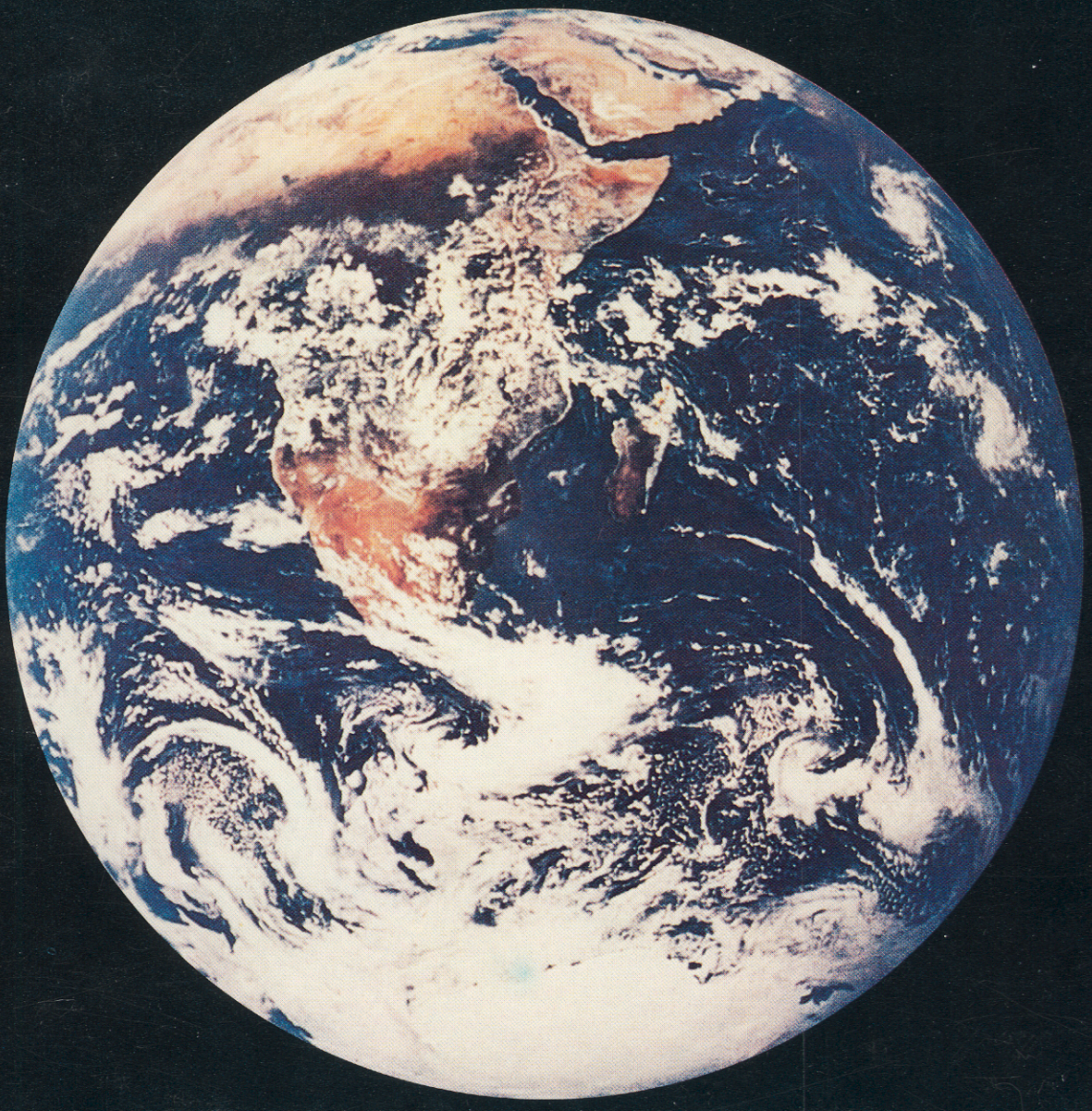
Virginia MARINE RESOURCE BULLETIN



Virginia Sea Grant Program, Virginia Institute of Marine Science
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MARINE RESOURCE BULLETIN

Fall & Winter 1993 **Vol. 25, No. 3 & 4**

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Cover: Apollo 17 view of Earth, courtesy of NASA; page three: blue whale by Pieter Folkens©, artwork which appeared in *Guide to Marine Mammals of Alaska*, an excellent field guide by the Alaska Sea Grant Program; page four: deep-sea anglerfish, an illustration which appeared in the *Dana Report*, a publication from a famous expedition in the early part of the century; page five: global belt artwork by InterNetwork©, courtesy of the University Corporation for Atmospheric Research; pages 10, 11, 12: Beth Hens; pages 13, 14: Bill Jenkins; page 15: zebra mussel artwork by Carol Allaire, courtesy of Michigan Sea Grant; pages 17, 20, 23: Susan C. Waters.

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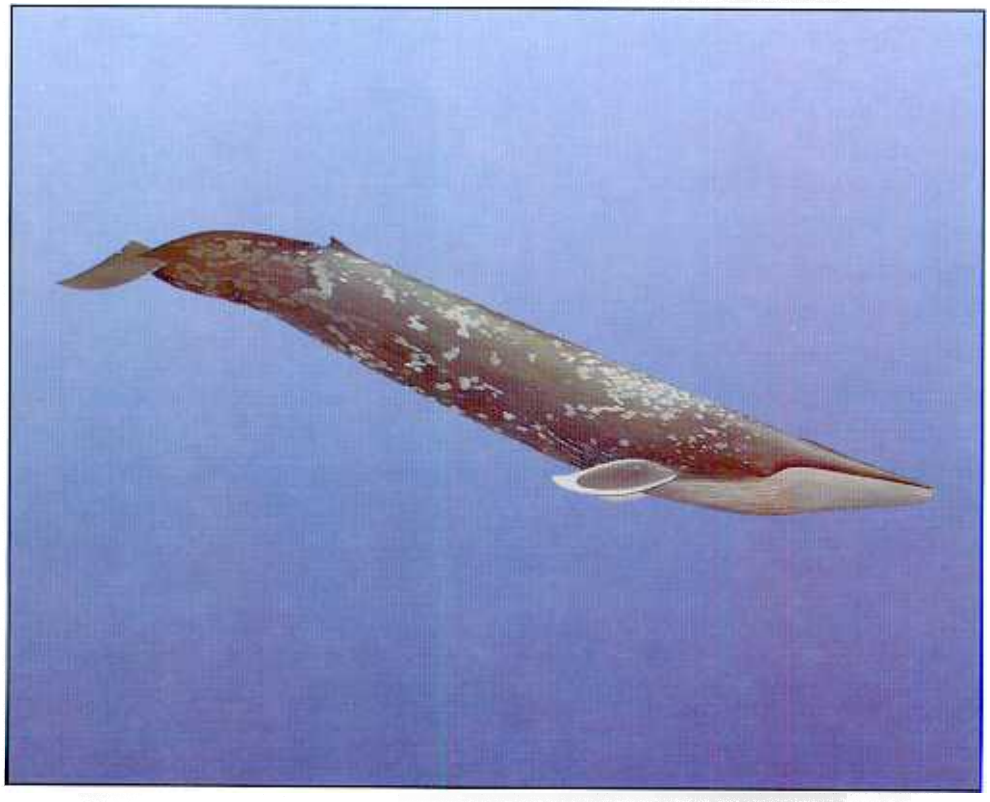
The BULLETIN is intended as an open forum for ideas. The views expressed do not imply endorsement, nor do they necessarily reflect the official position of Sea Grant or the Virginia Institute of Marine Science.

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 passage of the Sea Grant Program and College Act.

The world ocean



© Pieter Folkens

Balaenoptera musculus, *the blue whale, is Earth's largest animal, weighing in as an average adult at 100 tons. Between the 1860s and the 1960s, the blue whale was overharvested—an estimated 350,000 were killed in a century. The current population estimate is 12,000 worldwide. A blue whale may live 80 years.*

constitutes the largest ecosystem on Earth, about 70 percent of the planet's surface. It is an interconnected entity which houses life forms stranger than any fiction—tube worms and crabs capable of sustaining life in the Hades-like habitat around fractures in the Earth's mantel, deep-sea anglerfish, which appear more like the concoction of a nightmare than of the natural world.

The world ocean quarters mammals of such a colossal size that they seem more chimera, products of an impossibly imaginative mind, than they do a reality. Earth's largest mammal, the blue whale (*Balaenoptera musculus*) weighs in at 100 tons, and is 26m (85 ft.) as an average adult. Most ocean life, however, is obviously on a much lesser scale of magnitude. Even though this life is frequently minute, it amounts to a significant quantity: nearly 80 percent of all life on Earth is found in the seas.

Beyond its uniqueness as an ecosystem, the world ocean has a

purely utilitarian value for humans: the oceans contain a storehouse of protein, which, managed properly, could be an ever-renewable resource.

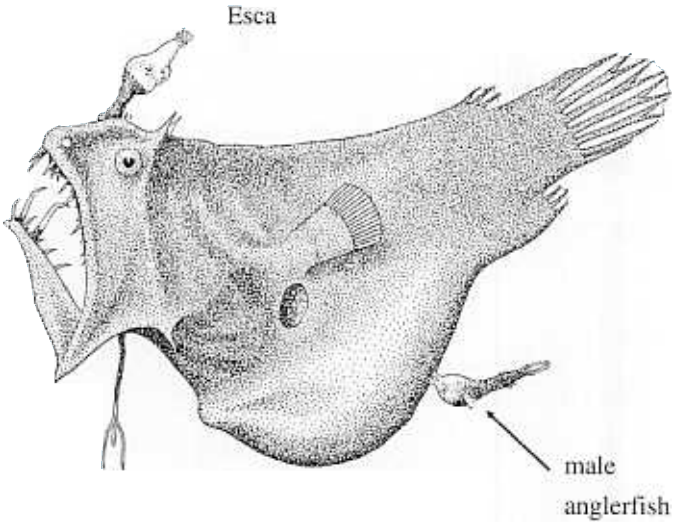
On a day to day level, the oceans influence our weather on both a local and global level, from a daily sea breeze or regional storm, to a global phenomenon like El Niño. When the current El Niño brings warm coastal waters to Peru and Chile, the normally arid regions of South American can experience torrential rain and floods. The same El Niño can concurrently produce drought in the western Pacific, severe winter and spring flooding in North America, and can cause warm winters on the U.S. east coast.

The world ocean contains a "great conveyor belt," a global belt of currents, which makes the northern climes hospitable for life. Warm waters from the lower latitudes move into the northern latitudes, conveying a significant amount of heat—in some areas as much as is received from the sun. Some scientists believe that a shutting off and on of the great ocean conveyor belt brought about some of the violent climatic changes during the ice ages.

From a futuristic point of view, the seas may well possess a cache of valuable information within its life forms. Sea Grant researchers in California are currently sorting through exotic marine organisms in search of drugs that might benefit people who have inflammatory diseases such as arthritis. The biomedical marine research field is flourishing, and pharmaceutical companies, especially, are scouring the sea for answers to human medical problems.

Massive ecosystem, protein factory and reserve of to-be-discovered ideas, the world ocean is that and even more. It can irrevocably impact lives. Hurricanes, typhoons—which derive their power from warm water—spiral across oceans, careening sometimes catastrophically with islands and coasts. A tsunami* can wreak havoc in short order; in only a few minutes, a 1896 tsunami took 21,959 lives in Japan.

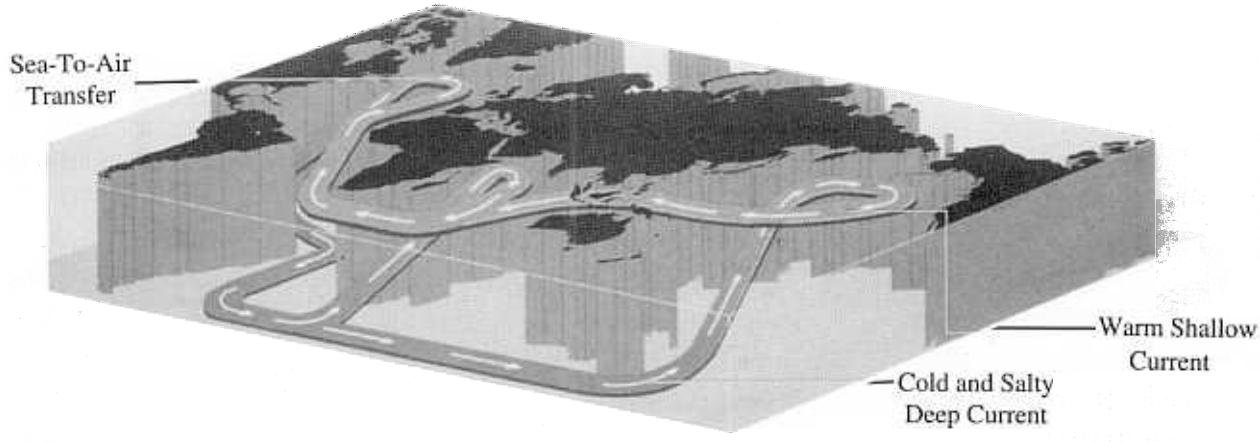
Netdevil *(Linophryne)* Deep-sea anglerfish



Was this animal forged in a nightmare? Actually, this deep-sea anglerfish's physical attributes are well suited for its habitat, one in which food can be scarce. It has a conveniently large mouth and an artificial lure (esca) which contains a light organ (deep-sea prey are many times luminous). The male of this species exists for one reason—reproduction—and is a parasite attached to the female Linophryne.

Illustration: Regan and Trewavas, 1932, part of the *Dana Report*, from the well-known Danish expeditions.

*Tsunamis are often incorrectly called tidal waves. A tsunami has nothing to do with the tide; it is caused by a major sea disturbance such as an earthquake (seaquake). In open ocean a tsunami can reach a speed of 500 miles per hour.



The illustration above is a conceptual rendering of the global belt currents (the actual system is far more complicated).

Water circulates globally through the oceans as though carried by a huge conveyor belt. Colder water in the North Atlantic sinks to the deep ocean to resurface and be rewarmed in the Indian and North Pacific oceans. Surface currents carry the warmer stream back again through the Pacific and South Atlantic. The circuit takes almost 1000 years.

The global belt artwork is courtesy of the University Corporation for Atmospheric Research, and was created by InterNetwork. The art appeared in Reports to the Nation.

For all that the oceans represent to humankind, little in our formal education prepares us to recognize or even vaguely understand the oceans' importance. Marine science is a relatively new science and is poorly represented in school textbooks. Even within the Commonwealth of Virginia, a state which borders one of the world's largest estuaries, marine science is a fairly exotic course of study.

This issue of the *Marine Resource Bulletin* is devoted to the educational component of Virginia Sea Grant, an active division which manages to disseminate a significant amount of marine science information to schools and to teachers, so that the future stewards of this ecosystem will have the interest and knowledge needed for resource preservation and management. ✣

Sea Grant and Marine Science Education

William Rickards,
Virginia Sea Grant Director

Since it was begun in 1966, Sea Grant has presented marine education opportunities for school children, college students, graduate students, people in various marine-related industries, and the general public.

As you might imagine, the content and approach of such educational opportunities vary widely depending largely upon the type of audience; they also vary among the Sea Grant programs which offer the information since the relevant resource or environmental issues differ from one region of the country to another.

At the most general level, marine education activities in the national Sea Grant network involve many "informal" educational programs. These are programs that take place outside of a structured classroom setting, often involving the public and

civic groups. In any given year, Sea Grant programs nationwide present hundreds of seminars, workshops, conferences and other types of meetings for educational purposes related to issues concerning the marine environment and its resources. These might be designed specifically to address seafood processing sanitation practices, optimal designs for man-made wetlands, farming of fish or shellfish, and a myriad of other topics.

The more "formal" or structured aspect of Sea Grant's marine education program takes place in our schools and universities. There are substantial Sea Grant activities related to grade school education, some of which involve the preparation of curriculum materials for use by teachers while others actually involve the presentation of special programs to children in kindergarten through twelfth grade. Virginia Sea Grant's Bay Team is one such in-school program.

At a higher level, Sea Grant has played a part in enabling the development of some specialized college-level courses and teaching materials related to marine and coastal issues. This occurs at both the undergraduate and graduate levels. Usually, Sea Grant has assisted the development of a course for subsequent adoption and support through the university itself; Sea Grant is then able to use its funds to address other emerging problems or activities.

The final aspect of formal education occurs through many of the research projects supported by Sea Grant programs around the nation. Many such projects involve graduate students who are conducting their degree research. The knowledge and experience gained through such support is essential to the development of the nation's science and technology expertise, and is an extremely important, but sometimes undervalued, aspect of Sea Grant's activity in marine education.

Marine education specialists from among the Sea Grant programs, recently identified the network's goals for marine education beyond the year 2000. These goals include the following:

- To contribute to the development of a more scientifically literate citizenry who possess the skills and knowledge to bring about desirable change.
  To improve the environmental ethic of our populace.
  To better educate and train precollege teachers.
  To formulate and effect strategies to improve student performance in the sciences and to strengthen the pool of students attracted to and retained in graduate and undergraduate studies in science and engineering.
  To increase the participation of women and minorities in science and education.
- To develop, improve and disseminate relevant curricula and to provide educators with information concerning effective marine and aquatic educational materials which use both traditional and new communications technologies.
  To participate in the development and implementation of evaluation methodologies for formal and informal educational programs.
- To cooperate with other groups to further marine science education.

Simply reading through these goal statements gives an appreciation for the breadth of Sea Grant's marine education program. Its successes and products are evidence of the dedicated people who carry out the programs within each of the state Sea Grant programs.

Global Change

Homo sapiens has long suspected that his acts could disastrously impact the world around him. Misguided as it might seem within our historical context, some 14th century people were so convinced of mankind's culpability for the black plague, that they travelled through streets, sprinkled with ashes, in an agonizing, wailing frenzy, committing acts of self-flagellation, seeking repentance from a vengeful deity.

From a *scientific* point of view, the knowledge that *Homo sapiens* could impact the entire planet is a relatively new chapter in human history. Nuclear weapons ushered in a 20th century frenzy of bomb-shelter building, a proliferation of even more dangerous weapons, while the phrase "ground zero" became part of the human lexicon. As the nuclear threat hovered, something more insidious happened: acid rain. Suddenly, it mattered where high-sulfur fossil fuels were burning. Toxic wastes cropped up, and suddenly issues seemingly more ambiguous, but nonetheless troubling surfaced: global warming* and ozone depletion—buzz words for just how dramatically people could possibly influence not just the world about them, but an entire planet.

Even with a general awareness that the Earth is an interconnected entity, the information about global change, especially, from T.V., newspapers, and magazines is fragmented, sometimes sensational and oftentimes confusing. On the other side of the proverbial coin, the information emanating from scientific institutions can be overwhelmingly technical and tends to shed light on a facet—for instance, the importance of vegetation in the global water cycle in transporting large amounts of water to the atmosphere.

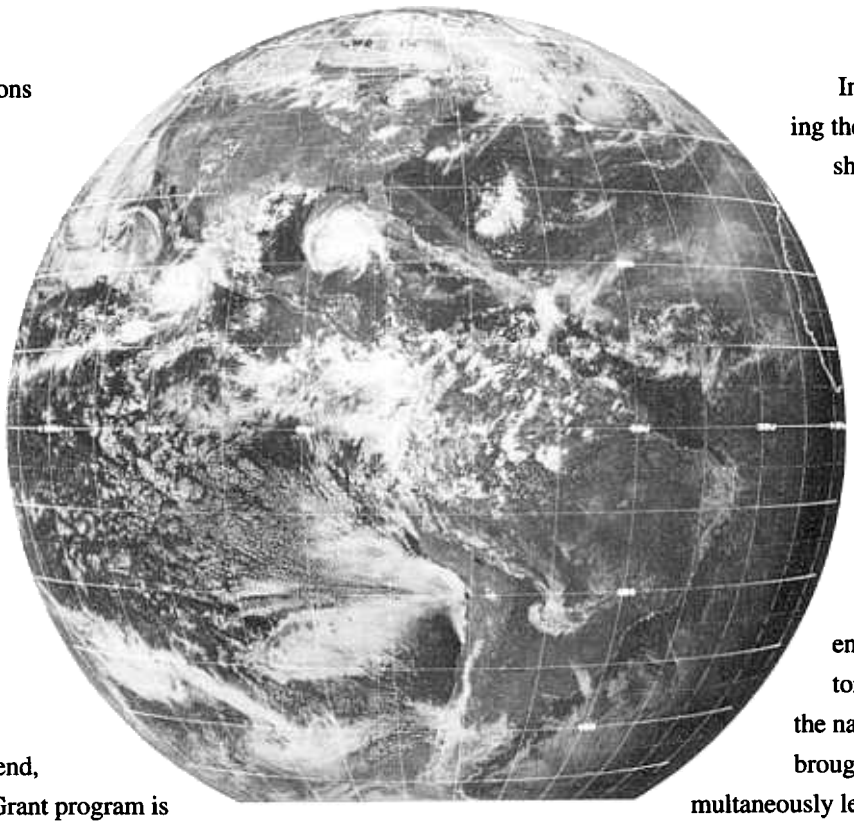
The ambiguity about what is happening or could happen to Earth has a basis: probably no issue in the universe is without an opposing argument, and to fully comprehend the intricacies of all the interacting biological, chemical and physical processes of planet Earth is an unparalleled task.

In the sciences, thinking is encouraged within a discipline; a geneticist is not expected to be a Renaissance man, would obviously not be expected to have the same depth of understanding regarding the physics of a shoreline. Even so, some progress has been made toward global scientific thinking: more universities and institutes now address Earth system science, a science directed toward understanding the global ecosystem. Ambitious programs for predicting global change exist and are in the midst of collecting and interpreting data.

Still, all the available information lacks pragmatic meaning if the people who will be making decisions about Earth are not educated. It is true that scientists have shared their research through scientific journals, legislative briefings and world organizations. However, the educational community as well as the general public have not had easy access to current, objective information. Ironically, these are the client groups which need the information; legislators do not stay in office forever, and, furthermore, it is unlikely that international agreements, government programs and regulations, or research alone will be sufficient to resolve climate and global change issues. Rather, the success of programs will depend on support and action from a public that recognizes the linkages be-

*Global warming and ozone depletion are two kinds of global change. Other examples include deforestation, desertification and marine pollution.

tween human actions and Earth's responses. Educators, community leaders and citizens need accurate, objective information concerning climate and global change and their implications for our society, economy and natural systems.



Toward this end, the national Sea Grant program is promoting a proactive, long-term program which will be research based, but will also go beyond the simple dissemination of scientific information, striving to instill an ethic of responsible global environmental stewardship. A long-term program was designed by Sea Grant educators from six regions. Frances Larkin, regional representative for the national steering committee, oversees the project at the Virginia Institute of Marine Science; Vicki Clark is coordinator for the region; and Jan Hodges is coordinator for an electronic communications component of the project.

The three-year national education effort would provide programs to educators across the United States; educators from Canada and Pacific Island nations would also be invited to participate. Current knowledge from university and governmental scientists would be provided on issues such as 1)natural climate variability and ocean dynamics; 2) ozone depletion and greenhouse warming; 3) marine and terrestrial ecosystem response; and 4) decision-making under scientific uncertainty. The educators would be equipped with skills and content expertise, enabling them to subsequently train other educators in their home localities. This multiplier effect would broaden the impact of the initial workshops.

In the plan, "training the trainer" workshops would be conducted over a three year period, utilizing the latest in satellite video conference technology. Through a series of satellite uplinks and downlinks, scientists and educators from around the nation would be brought together to simultaneously learn about and discuss climate and global change issues.

The electronic component of the project would entail a dedicated Internet e-mail listserver. The system would include updates of current scientific findings on climate and global change issues and would facilitate the sharing of successful ideas and strategies among global change educators.

It is expected that the global change program will be in place within the year. For those interested in more information about the educational opportunities, call Vicki Clark at (804) 642-7169; for electronic communications information, call Jan Hodges at (804) 642-7171. ✣ ✣

The Bay Team

Beth Hens,
Virginia Sea Grant
Communications Coordinator

The group of 30 first-graders could scarcely contain their excitement. Each wanted to be the first to tell "the Bay lady" what he or she had done to protect Chesapeake Bay. "We shouted and sang to our seeds to make them grow," reported one youngster enthusiastically. The reply was in response to Bay Team teacher Carol Rideout's question asking what students had done since her previous visit.

"We planted a tree—a peach tree," said one student. "An apple tree," said another. "Me and my mom planted five gardens since you were here," volunteers one boy shyly. "We planted a coconut tree," shouts another. Rideout gently interrupts the barrage of answers to explain that maybe coconut trees would grow better where it's warmer, and commends the class on their contributions toward saving the Bay.

Rideout had visited the class four months earlier to teach a lesson on Chesapeake Bay ecology. The first-graders learned, through skits and activities directed by Rideout, how preventing erosion can protect water quality and marine life in the Bay. This visit was a follow-up to evaluate what the class learned from their first lesson, and how they had put this knowledge into practice.

Rideout is one of two Bay Team teachers who travel to K-12 schools statewide armed with enthusiasm and current information about the Chesapeake Bay. Rideout, who says the opportunity to work with children and a concern for the environment drew her to the position, has been with the program for six years. Rideout holds a bachelor's degree in chemistry, a master's degree in biology, and Virginia teaching certificate. Before joining the Bay Team, Rideout taught high school biology and pursued a scientific career in subjects ranging from estuarine studies to aquaculture.

This year, Rideout took on a special project in addition to her Bay Team duties. She works with several groups of senior girl scouts, teaching them to teach younger girls about the environment. "The response of the senior scouts has been terrific," Rideout says. "They've gone beyond the resources I provided, and embellished skits and developed props and costumes for use in their lessons. I hope this experience will lead some of the girls to consider environmental education as a career."

Jean Hodges, Senior Girl Scout leader in the Tidewater area, said her girls were enthusiastic about presenting Rideout's Bay Team activities to younger Scouts. "At one gathering, there were approximately 150 Brownie and younger Scouts. Another time, my girls worked with students at an elementary school 'read-in,' " Hodges said. According to Hodges, her troupe wants to continue working with Rideout.

Tom Miller, who for two years has made up the other half of the Bay Team, says he likes being able to focus on topics which he knows will contribute toward positive changes for the environment. Miller holds a bachelor's degree in physical science, and has designed and taught interpretive programs for state parks, and worked with Scouts, and gifted and talented students.

Miller feels the strength of the Bay Team lies in its ability to serve as a clearinghouse. "Some teachers are actually overwhelmed with materials," Miller explains. "Unlike them, we have time to sift through what's available and choose the very best. This takes the burden off teachers who are already engulfed in paperwork."

The Bay Team teachers face a demanding schedule involving 800 classroom visits annually. Even so, the demand for Bay Team visits is so high that many requests must be turned down. Bay Team teachers and one assistant are currently funded part-time by the state of Virginia. Frances Larkin, founder of the Bay Team and head of marine education for the Virginia Sea Grant Marine Advisory Program at the Virginia Institute of Marine Science, would like for the teachers and assistant to be funded full-time. "That way we could meet more requests," she says, "especially for camps and summer programs. It's hard to say no to people who are genuinely interested in the program."

Larkin's idea for the award-winning Bay Team grew out of a 1985 request for Chesapeake Bay

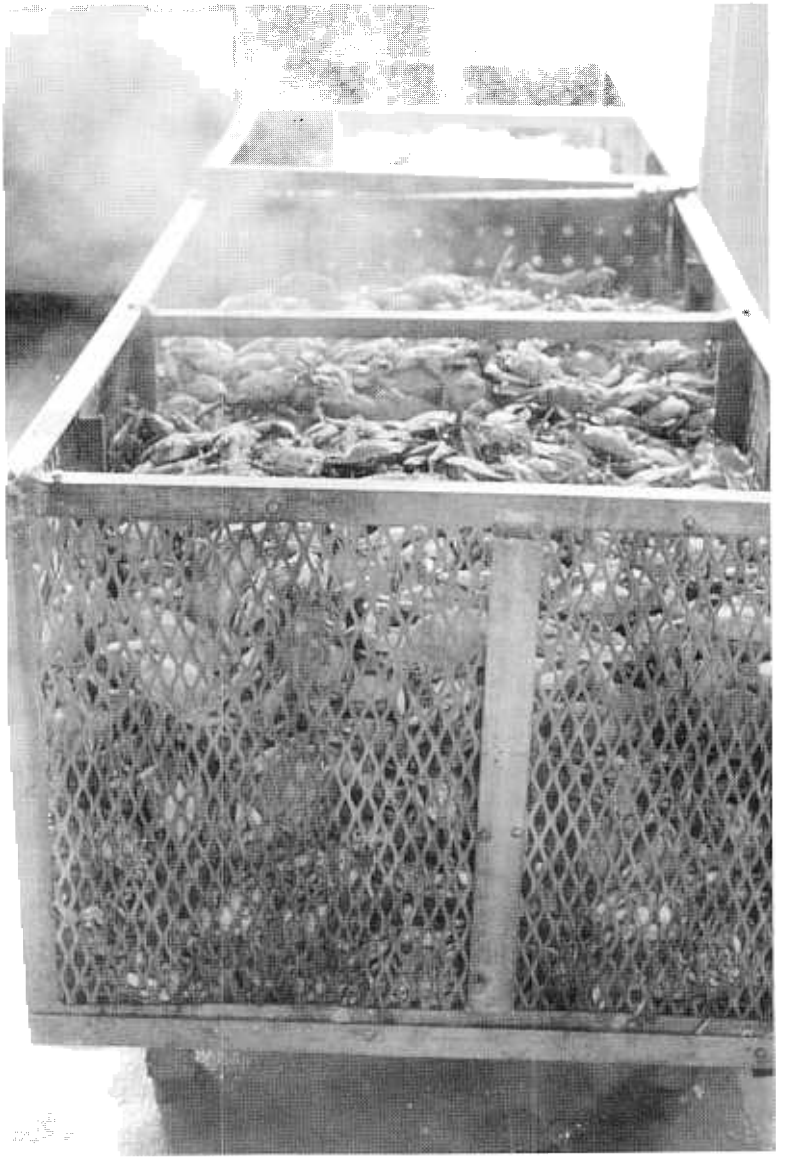
Bay Team teacher, Carol Rideout, with students.

educational programs from the Virginia Council on the Environment. "We offer a unique resource," explains Larkin. "We offer environmental education programs, at no cost to the school or teachers, that are tailored to existing school curricula and schedules. We advocate hands-on learning and encourage students to develop skills with which to use information. We are also very oriented toward teacher assistance. We provide teacher seminars, in-service programs, and supplemental materials which will carry a teacher far beyond our classroom visit. Our goal is emphasizing personal involvement so students will learn the ethics of global stewardship."

Bay Team lesson plans for 1993 revolved around the central theme "connections." Students learned how personal lifestyles are connected to environmental problems and solutions. While first-graders learned how erosion affects blue crabs and eelgrass in the Bay, middle school students focused on global change, food production, and the food chain. High school students learned to identify environmental problems in the Chesapeake Bay, evaluate their causes and impacts, and employ critical thinking to reach and implement solutions.

According to Larkin, training for environmental education and current environmental materials were relatively rare in Virginia school systems until recently. "Our recent Bay Team evaluation of the 1992-93 season proves that there is a very real need we can fill." Of the 133 teachers who participated in the survey, 47% felt that environmental education was not adequately represented in their schools' curricula.

The Bay Team is administered by the Virginia Institute of Marine Science and the Virginia Sea Grant College Program. Bay Team visits are available to school grades K-12 (public and private), Scouts and other interested groups of 30 or less. Visits are generally scheduled at the first of each school year. There is no charge for Bay Team visits, but there are certain obligations which must be fulfilled by each school. For more information or to schedule a Bay Team visit, contact Frances Larkin, Virginia Institute of Marine Science, Gloucester Pt., Virginia 23062, (804) 642-7172. ✣ ✣



The VIMS Aquarium

One of the more readily visible educational programs at the Virginia Institute of Marine Science (VIMS) can be found in the main lobby of Watermen's Hall, the VIMS Aquarium. Over fifty different species of marine organisms throughout Virginia's waters are housed in the aquarium, including a unique, hybrid loggerhead/ridley turtle. Eight exhibit tanks range in size from 50 to 2,000 gallons, including a 200-gallon touch tank . The VIMS Aquarium is one of the few places in Virginia where one can see this many species native to the area.

In addition to the display tanks, the aquarium includes life-size models of maine mammals and fish, an extensive shell collection, and displays describing research currently being conducted at the marine lab. The Aquarium is open 9 a.m. to 4 p.m., Monday through Friday, and there is no entrance fee.

VIMS aquarist Patrick Richardson has a busy schedule,

Checking out the touch tank.

dividing his time between the upkeep and improvement of the aquarium itself, and the many educational programs which he conducts at area events. Maintaining animals in tanks is not as easy a task as it might appear. The animals must be fed daily and all sorts of water quality parameters need to monitored, including salinity, ammonia and nitrate levels. The animals in each tank are carefully observed daily for signs of stress, which may result from living in such close quarters. Lastly, what is one animal's preferred fare is not necessarily another's. For an urchin, fresh algae is fine enough feed, whereas the turtle would rather have blue crabs and whelks.

A strong volunteer program is an important underpinning of the VIMS Aquarium, and Richardson encourages interested individuals to contact him at (804) 642-7176. Internships are offered for high school and college students.

To make a reservation or for more information about the aquarium, call (804) 642-7176. Groups are limited to 30 or less. Call in advance to reserve program time. ✣ ✣ ✣

Zebra Mussel Information

Most of the information about zebra mussels in the following article is from a Sea Grant publication, Mid-Atlantic Zebra Mussel Fact Sheet, *which was written by Barbara Doll, Coastal Water Quality Specialist of North Carolina Sea Grant. Copies of the fact sheet can be obtained, free of charge, by writing Virginia Sea Grant, Marine Advisory Program, Virginia Institute of Marine Science (VIMS), Gloucester Point, Virginia 23062.*

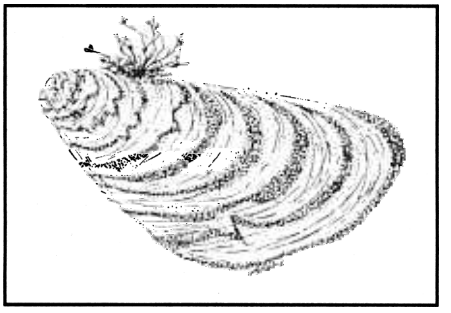
It is a current issue which could have serious implications for the mid-Atlantic region. zebra mussels (*Dreissena polymorpha*)—small, striped mollusks capable of raising havoc in incredibly short order. Virginia Sea Grant has been involved in a three-faceted effort to disseminate information about the mollusks: fliers and fact sheets for the general public; scientific papers* for general distribution; and an educational packet for educators.

In less than a decade the exotic, freshwater bivalves spread throughout the Great Lakes and into several major river systems of the eastern United States, including the Ohio, Illinois, Mississippi, Mohawk, Hudson, Susquehanna, Tennessee and Arkansas rivers. The striped mollusks were delivered to U.S. waters via European shipping ballast water.

The advantage, biologically speaking, that an introduced species has is that the natural predators which presumably kept it in control in its native ecosystem, are absent in its new habitat. So it was with *Dreissena polymorpha*. They have colonized their new habitat so well that some experts believe that is only a matter of time before they spread throughout most of the United States. When the bivalves colonize they can seriously interfere with municipal and industrial water-users, sport and recreational fisheries, food webs, navigation, recreational boating and beach use.

Zebra mussels extensively colonize, forming barnacle-like encrustations. The intake pipes at drinking water, power generation and industrial facilities serve as excellent habitat and commonly fall prey to zebra mussel infestations. The water flow provides a continuous source of food and oxygen and carries away wastes, while the structures themselves protect the mussels from predation.

The mid-Atlantic region of New Jersey, Delaware, Maryland, Virginia and North Carolina is certainly at risk of being infested by zebra mussels. Freshwater resources are plentiful, and zebra mussels have several potential routes to access the region's waters. Thousands of man-made impoundments are in the area, including farm ponds, aquaculture facilities, drinking water supplies, detention facilities for water quality or flood control, and recreational or multipurpose lakes.



Zebra mussel. Although the mollusk can grow up to two inches, it is usually much smaller—fingernail size.

Virginia Sea Grant's 8-12 education program involved developing and distributing a zebra mussel teaching packet which includes problem solving activities based on scientific data. The packet also includes additional resource information. This project is overseen by Vicki Clark, Virginia Sea Grant Education Specialist. ✣ ✣

*The scientific papers include *Criteria For Predicting Zebra Mussel Invasions In The Mid-Atlantic Region* and *Potential Range of the Zebra Mussel In and Near Virginia.* Both papers are by researchers Patrick Baker, Shirley Baker and Roger Mann and can be obtained by writing Virginia Sea Grant at the Virginia Institute of Marine Science.

Graduate Marine Science Studies: An Insider's View

Popular culture's image of graduate work in marine science is tremendously romantic. . . bronzed students adrift on a research vessel with, possibly, some high-minded mission that relates to the marine environment. In truth, graduate work can be arduous, time-consuming and seemingly never-ending. Any romanticism a graduate student might possess surely dissipates in the lab, where countless hours are spent amassing data which then must be interpreted.—ed.

Neils Moore
Graduate Student
Virginia Institute of Marine Science
Sea Grant Assistantship Recipient

At a young age, perhaps we present-day students of marine science were transfixed in front of a television mesmerized by Jacques Cousteau's heavily French-laden descriptions of his deep-sea adventures. Watching his colorful undersea camera work, something must have clicked inside our unmolded minds—Gee, that looks fun! I want to be just like him. Then again, for those of us who were late-bloomers, our reaction may have been, "O.K. . . . great . . . where's the man-eating shark?" As members of the MTV generation, the generation X, the lost generation, or whatever you'd like to label us, it would seem fitting that our future was predetermined by a television show.

Upon acceptance into a marine science program, a budding student must successfully hurdle a number of obstacles at most institutions before he/she can focus on an individual research project. At the Virginia Institute of Marine Science (VIMS), for instance, we must complete a group of core classes consisting of biological, chemical, geological, and physical oceanography as well as a statistics course.

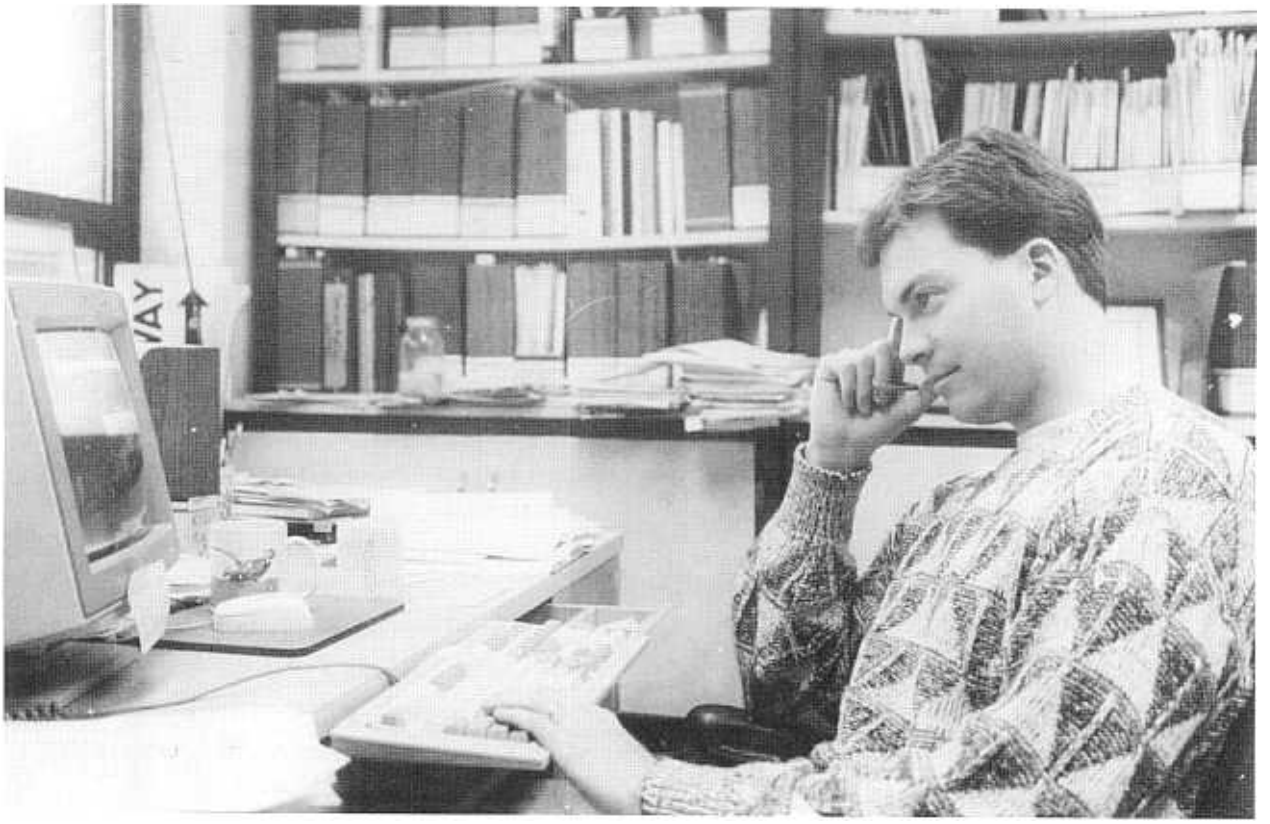
At the onset of classes, since the majority of students have undergraduate degrees in only one area of study such as biology, marine science quickly establishes itself as a non-pure science during the core course work. Moreover, it is a mix of sciences that combine together to form a big puzzle . . . a big, unsorted, no flat edges, 10,000 piece puzzle.

Of all of the episodes of Cousteau's adventures we ever watched, Jacques was never sitting at some desk plugging away on his calculator; he always appeared much too busy with activities such as swimming along with playful sea otters. But in reality, as students, we must quickly juggle logarithms, exponential equations, and differential calculus as well as loads of statistics.

Another of the obvious concerns of the graduate student is the necessity to find a source of income. Fortunately, many oceanographic institutes including VIMS offer student workships, assistantships, and fellowships to the degree-seeking student. However, for some students, obtaining and maintaining a money supply is not a cakewalk.

Assistantship duties include scrubbing mountains of glassware, counting hundreds of plankton through a microscope, entering data into computer spreadsheets, monitoring juvenile populations of various critters, and the ever-popular shucking and measuring of thousands of scallops' shells and weighing of meats and gonads (yes, gonads).

Furthermore, the duties assigned to students often require a coffee pot to brew around the clock. For instance, at certain times of the year, students studying juvenile crab behavior conduct sampling all night from the end of the VIMS ferry pier. Other students interested in life forms within the muddy bottoms



Neils Moore at the computer.

of our local waters often sift through many, many, many pounds of dark brown to black mud that smells strongly of hydrogen sulfide (i.e. rotten eggs).

Ultimately, graduate study requires mature time-management skills to ensure success. For starters, at VIMS, assistantship duties require 20 hours per week for each recipient student. Next, classes occupy a minimum of 12 hours per week during the first year of study. But actual class time usually only represents a fraction of time commitment—reading assignments are the primary time-absorber, along with labs and the occasional field trip. For most, especially for those whose English is a second language, little time is left over for a lavish social life. But as respectable members of the lost generation, we do our best to socialize the remaining time away in the most efficient, non-productive means available.

But enough of this crying and moaning. We students do have some things going for us. At VIMS, we have intramural- and club-team sports, thank God it's Friday parties, occasional pig roasts, and spontaneous student gatherings. Most importantly, from a professional viewpoint, we study and work in a learning environment that fosters student/professor relationships. We can directly interact with many of the world's most highly respected marine scientists.

So where are these blessed people who grace the T.V. screens with their well-tanned bodies and sun-bleached hair? Simple. . . some of them are our professors (and subsequent bosses), high atop the pecking order, while we students pay our dues as we begin our (hopeful) ascent. Others are simply created through the eyes of Hollywood, an image that it believes we would like to embrace. . . ?

✣ ✣ ✣

Educational Tools for Teachers

Published by Virginia Sea Grant

Biology and Identification of Rays in the Chesapeake Bay

Joseph W. Smith and J.V. Merriner. Educational Series No. 20, 22 pages $.50.

Rays, along with sharks and skates, make up a group of fishes known as elasmobranchs. The skeleton of these fishes is composed entirely of cartilage. You can identify rays either by looking at the illustrations accompanying each species description or by following the key. A key is a table of characteristics for a group of organisms arranged in couplets, one of which you choose. At the end of the chosen characteristic, you are directed to another couplet and again make a choice. The species is eventually reached.

Sensing the Sea: A Curriculum Guide for Grades Two-Three

Ellen Odell-Fisher and Ronald N. Giese. Educational Series No. 21, 53 pages. $2.

Most education is very land-oriented. Children learn shapes, colors, sizes, and textures from materials, plants, and animals found on land. There is another 70 percent of the earth that many people ignore, the sea. If children are to develop responsible attitudes through total understanding of the earth, they must be exposed to all of its environments. The overall purpose of this unit is to arouse curiosity and interest in divergent questions for which the student proposes possible solutions rather than deciding specific "correct" answers. Throughout these lessons, the process of investigation is most important. Facts about specific content are vehicles for developing interest in the marine environment and for teaching inquiry skills.

Sensing the Sea: A Curriculum Guide for Grades Kindergarten and One.

Ellen Odell-Fisher, Ronald N. Giese and Mary E. Sparrow. Educational Series N. 23, 44 pages. $2.

In this unit, both you and your students will be working together to establish a saltwater aquarium in your classroom. Setting up and maintaining the aquarium should be carried out with and by your students. Draw up the portals and batten down the hatches! Have your students transform your classroom into a submarine preparing for a voyage to "inner space." You may enhance the illusion of a voyage by decorating your classroom windows as portholes and the door as a watertight ship's door.

The Marine Turtles of Virginia

J.A. Musick. Educational Series N. 24, 22 pages. $2.

The marine turtles are among the most interesting representatives of Virginia's migratory marine fauna. They include the leatherback (the world's largest living reptile) and four species of hard-shelled sea turtles. The latter are represented by the very large and common loggerhead, and the much smaller, less common Atlantic ridley, the rare Atlantic green turtle and the Atlantic hawksbill. This booklet identifies Virginia's marine turtles, describes their habits, habitat, distribution and nesting.

The Chesapeake: A Boating Guide to Weather

Jon Lucy, Terry Ritter and Jerry LaRue. Educational Series No. 25, 22 pages. $1.

A more ideal boating area than the Chesapeake Bay would be difficult to find along the Atlantic Seaboard. With thousands of miles of sheltered shoreline, good water depth and proximity to major urban cen-

ters, the Bay is a boater's paradise. However, the Bay's many protected harbors and relatively narrow width (a boater normally can keep at least one shore in sight at all times) tend to produce a feeling of false security about the need to keep a close watch on weather conditions. The purpose of this publication is to remind boaters that the Bay has many different weather moods, some of which can change quite rapidly. In addition, it should promote a better understanding of how basic weather features develop on the Bay and enable boaters to enjoy the Chesapeake's unique waterways with fewer weather surprises.

Handle With Care: Some Mid-Atlantic Marine Animals That Demand Your Respect

Jon Lucy. Educational Series No. 26, 13 pages. $1.50.

Generally speaking, the marine organisms found along middle Atlantic shores are not considered threatening to people. However, some of these animals can cause problems, either upon simple contact with the skin, as in the case of some jellyfish, or through careless handling. Larger inhabitants of coastal waters, such as stingrays and sharks, must always be treated with great respect because of the danger potential and their unpredictable nature. This description of nuisance and potentially harmful organisms is presented to help coastal residents and visitors become more aware of how problems with such marine animals might develop, how they can be avoided and how certain injuries should best be treated if they occur.

Fishy Activities for Your Small Fry

Mary E. Sparrow, Frances L. Lawrence and Ronald N. Giese. Educational Series No. 28, 36 pages. $2.

This kit is a collection of fishy ideas for use in your classroom. The ideas in this kit are diverse in nature and complexity. Select and adapt objectives and activities to meet the interests, capabilities and grade level of your students.

Shoreline Erosion in Virginia

S. Hardaway and G. Anderson. Educational Series No. 31, 25 pages. $1.

This booklet is designed as an introduction to the process of erosion and some of the alternative measures used to combat it. The problem of shoreline erosion is most acute when shoreline property with improvements is being threatened by a rapidly receding shore bank. Many waterfront properties are bought and developed each year with little or no consideration of the shoreline situation. Consequently, additional money must be spent for erosion protection structures. Virginia's coast is a dynamic and active environment as well as a beautiful place to live. Sound judgement in coastal development is essential to effective control of shoreline erosion.

Nontraditional Marine Education Activities: A Planning Guide

Elizabeth A. Cornell. Educational Series No. 32, 10 pages plus Marine Science Method (MSM) inserts. $1.50.

To a classroom teacher, the rising cost of gasoline often means few or no field trips. If trips are still permitted, restrictions on distance may be imposed and justification required. Therefore, teachers must make any enrichment trip or alternative experience demonstrably accomplish objectives not readily achieved in the classroom. The information contained in the booklet provides guidelines to getting the most from research field trips, museum visits, resource speakers and other non-traditional experiences.

The Marine Mammals of Virginia

R.A. Blaylock. Educational Series No. 35, 34 pages. $1.

To aid citizens in identification, this guide describes the natural history of marine mammals. This guide is organized by taxonomic orders and families; within a subfamily, species are listed by their frequency of appearance in Virginia waters. Space limits

descriptions of the species' habitats and distributions to the western North Atlantic.

Virginia's State Parks...Your Backyard Classrooms

Irvine Wilson, Nancy Balcom, Frances Lawrence. Educational Series No. 38, 200 pages. Available through teacher training workshops sponsored by the Virginia Department of Conservation and Recreation (804-786-2132).

This booklet gives educators easy access to seven field trip sites on the waters of the Chesapeake Bay and its tributaries, and provides a wide selection of Bay-related environmental education lesson plans created specifically for those sites. The guidebook is held in a three-ring binder to facilitate easy duplication of its many assorted hand-outs and worksheets. Each of the 40 teacher-friendly lesson plans includes:

- A concise background section, describing key scientific, historical and environmental concepts.
- A step-by-step procedure that begins and ends in the classroom.
- Lists of necessary materials, objectives and resources.
- A description of the most suitable location in each park for the activity.
- A cross-reference to the Virginia state instructional objectives for science and social studies.

Rally Round!

Virginia Bay Team, Educational Series No. 40, 60 pages. Distributed through Sea Grant teacher training workshops.

Teachers and students all over Virginia are getting involved in caring for Virginia's environment. *Rally Round!* tells how to do it.

Upper elementary and middle school students often feel strongly about environmental issues, but lack the skills and information necessary to take responsible and appropriate action. *Rally Round!* is a tool for teachers and students grades 4-7 to use in channeling this interest and enthusiasm into productive learning experiences which result in positive environmental outcomes. Projects provide a structured approach to open-ended problem solving: teachers serve as facilitators and advisors, and students have a real world experience in defining and addressing problems.

Groups accepted into the program receive a copy of the handbook, a brief, concentrated on-site training seminar, an introductory classroom lesson taught by the Bay Team, and year-round advisory support services. Supplemental extended inservice training sessions are available on request.

Virginia Environmental Education Resources Directory

Jan Hodges, 80 pages.

The directory contains information about 80 environmental education organizations and agencies and over 250 individual entries about the products and services they provide. The directory is organized by topic (e.g., waste management/recycling, global issues, and marine and aquatic resources) and each chapter is introduced by a brief summary of current issues for the topic. The directory is co-sponsored by the Virginia Environmental Endowment, the Department of Environmental Quality, Virginia Sea Grant College Program, the Chesapeake Bay National Estuarine Research Reserve, the Virginia Resource Use Education Council, and the Virginia Department of Education. The database will be on-line searchable on VA-PEN in 1994.

Ordering instructions: Make checks payable to VIMS. Send requests, with remittance, if required, to:

Sea Grant Communications
Virginia Institute of Marine Science
Gloucester Point, Virginia 23062

For commercial and recreational fishermen

New Publications

To order the following publications, write Virginia Sea Grant, Marine Advisory Program, Virginia Institute of Marine Science, Gloucester Point, VA 23062. The Use of Recycled Plastic for Bin Boards in Fishing Vessels *is free of charge. The first copy of* Marine Aquaculture in the Commonwealth of Virginia *is free to Virginia residents; additional copies cost $1.00. The cost of the publication for out-of-state residents is $1.00.* A Guide to Wastewater Management for Seafood Processors *has a cost of $5.00. Please make checks payable to the Virginia Institute of Marine Science.*

The Use of Recycled Plastic for Bin Boards in Fishing Vessels

Bin boards and bin shelving are used to contain and support ice-stowed fish and shellfish in the ice holds of fishing vessels. Traditionally, yellow pine or spruce construction lumber has been used. However, alternative materials are being sought to help reduce problems associated with product contamination by these supporting structures.

The Use of Recycled Plastic for Bin Boards in Fishing Vessels includes the results of an investigation by Commercial Fisheries Specialist Robert Fisher. The objective of Fisher's study was to evaluate recycled plastic lumber as a substitute for wood in fishing vessel holds. The performance of plastic lumber was compared to painted yellow pine boards with moderate wear. Evaluations were based on bacteriological sampling; a fishermen's written survey; and estimated cost efficiency.

Results from Fisher's investigation indicate that recycled plastic lumber is a viable replacement for enamel painted wood as bin boards in fishing vessel iceholds. Plastic boards were more efficiently cleaned and sanitized, were highly preferred over wood by fishermen who had worked with them, and were cost-efficient due to the lack of maintenance and replacement costs over years of usage. ✥ ✥

Marine Aquaculture in the Commonwealth of Virginia

Virginia marine aquaculture activities currently focus on three species: oysters (*Crassostrea virginica*), hard clams (*Mercenaria mercenaria*) and soft shell blue crabs (*Callinectes sapidus*). *Marine Aquaculture in the Commonwealth of Virginia* provides the history of culturing these animals, plus the status of today's efforts.

Although aquaculture has had a long history in Virginia, the Commonwealth initiated an aquaculture development task force in the late 1980s. Initially envisioned as an agricultural diversification activity, this program has broadened its scope to encompass the promotion of all aspects of aquaculture, including coastal marine aquaculture activities. In addition to providing information about past and present marine aquaculture activities, *Marine Aquaculture in the Commonwealth of Virginia* addresses future culture possibilities and sources of information and assistance. The 24-page booklet was written by Michael Oesterling, Commercial Fisheries Specialist. ✥ ✥

A Guide to Wastewater Management for Seafood Processors

In the past, state and federal agencies paid particular attention to wastewater discharges from large municipal wastewater treatment plants and industrial plants. At the time, relatively little attention was given to seafood processors. This has changed: over the past few years various segments of the seafood industry in Virginia have been scrutinized with regard to the wastewaters they discharge to state waters. Government agencies at all levels are exerting greater control over the environment and it is not likely that regulations will diminish in the future.

A Guide to Wastewater Management for Seafood Processors is intended to aid members of the seafood industry as they work to meet state standards. In the first part of the manual, the principals of wastewater management are reviewed. These include the reasons why waste management must become a higher priority for seafood processors, the options for treating wastewaters, and the general requirements for disposing wastewaters on the land, to rivers and streams, and to the ocean. The second part of the manual deals with the ways that wastewaters can be treated to reduce both pollutants and water quality impacts. The characteristics of seafood processing wastewaters are reviewed in the third section, using hypothetical blue crab processing plants to illustrate the types of problems encountered and how these problems might be approached. The manual includes references, a glossary, and a listing of state agencies.

A Guide to Wastewater Management for Seafood Processors was written by Dr. Bruce Neilson,

To order this manual, include a $5.00 check payable to the Virginia Institute of Marine Science, and send to

Virginia Sea Grant
Marine Advisory Program
Virginia Institute of Marine Science
Gloucester Point, VA 23062

On the cover: Apollo 17 view of Earth, courtesy of NASA.

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