Study to Reveal Effects of Human Impact on Tidepool Marine Life

By Bob Breen
Supervising Naturalist

Moss Beach is a place where a combination of physical and biological factors come together, offering the visitor considerable protection from hazardous surf. For nearly 90 years professional biologists, visitors and students have been able to walk easily and safely onto the flat-topped reefs, and spend hours enjoying a wealth of marine life.

During the past few years, staff, volunteers and visitors began to sense that something was going wrong in the intertidal at the Marine Reserve. Tidepool life, formerly abundant, was becoming more difficult to find. Lush algal beds had a worn and scuffed appearance. And in the protected lagoon most of the rocks were turned upside down. Almost nothing is known about the effects of recreational use of the intertidal. Visitor trampling, when combined with other effects such as handling, rock rolling, and souvenir collecting are difficult to observe, and reports are few in number.

Recommendations on mitigation from the scientific community, prompted a meeting last November at the Marine Reserve with Ralph Larson and Tom Niesen, from San Francisco State University. We set out to devise a way to measure human impact. It was decided that the best way would be to cordon off three locations, each 100 square meters in area, and limit foot traffic to these patches of the intertidal. Adjacent to the cordoned off areas would be the control portions of the experiment. The control areas would be subjected to the full force of visitor activity. All of the areas would be monitored monthly. Such procedures include counting the animals present, measuring the coverage of algal species, and photographing each sub-plot within the test area four times a year. We will then send the slides (there will be 20) to Texas A&M University for analysis.

During the next few years we want to discover if certain kinds of marine plants and animals will reappear, and how long it takes them to re-establish themselves. This information will enable us to set long range management goals for the reserve so that it will continue to be a significant scientific and educational resource for future generations.
TEACHER'S WORKSHOP, shown in the above photo, attracted 25 elementary school teachers to the Farallone View Elementary School in Montara, on Feb. 26. Sponsored by the Friends of Fitzgerald Marine Life Refuge, the one day session included morning study and an afternoon tidepool walk. Story below.

Classroom Study, Tidepool Walk Highlights Teacher's Workshop

Preparing to share the wealth of marine life at the Fitzgerald Marine Reserve tidepools with their young students, 25 elementary school teachers attended the Fourth Annual Teacher's Workshop at Farallone Elementary School, in Montara, on Feb. 26.

The one day program, taught by Bob Breen, supervising naturalist at the reserve, Tom Niesen, professor of biology at San Francisco State University, and guest speaker and archeologist, Mark Hylkema, drew high praise and maximum attendance from teachers representing more than 10 Bay Area schools.

Breen’s subject dealt with zonation habitat, while Niesen emphasized animal diversity. Hylkema reviewed the recent diggings at the reserve, where evidence of Early American campsites and a wide variety of dietary shell and bone from terrestrial and marine fauna was uncovered.

Teachers in attendance were:

Joyce Zimmermann, Farallone View; Katherine Locord, Debbie Tidd, Terry Wright, Linda Baarts, Crestmoor School; Lisa Hopper, Clifford Elementary; Kathleen Stevens, Clifford; Diana Purucker, Farallone View; Lois Tustin, San Francisco Day School; Frances Cuvi, Vivian Jenna, Clifford Elementary; Jane Kesselring, Mt. View Elementary School; Nancy Napoli, Slater Elementary; Rose Bly, Margaret Kennedy, Michele McIntyre, Genevieve Brigham, Kathy Greth, Joann Bohart, Piedmont Middle School; Linda Santone, Piedmont Middle School; Robert May, Piedmont Middle School; Angela Poleselli, Clifford Elementary; Stephanie Wald, All Souls; Georgia Osborne, Laurelwood Elementary, and Pam Fitzgerald, Laurelwood

Second Class Added to Junior Ranger Program at Reserve

It's time again for Junior Rangers, one of the most popular events sponsored by the Friends of Fitzgerald Marine Life Refuge. Because of demand, this activity for boys and girls from 9-12 is going to be conducted in two separate sessions: one, June 27-July 2, and a later summer program from August 29 to September 2.

The programs, always well attended, will add something this year by using the curriculum guide, Biological Diversity, written by the National Park and Minnesota Department of Education. The June 27-July 2 session will be held from 9:30 a.m. to 12 noon. The August 31, Sept. 1, and Sept. 2 sessions will be held from 10 a.m. to 12:30 p.m. to take advantage of low tides.

The cost of the program (for both dates) is $14 for FFLMR members, and $21 for non-members. All reservations are on a 'first come, first served' basis. Reservations (with check) should be sent to FMR PO Box 451, Moss Beach, Ca., 94038.

BETWEEN THE TIDES is published quarterly by Friends of Fitzgerald Marine Life Reserve, James V. Fitzgerald Marine Reserve, P.O. Box 451, Moss Beach, Ca., 94038.

ADVISORY BOARD. Dustin Chivers, Dr. Diane Conradson, Dr. Jean DeMouthe, James V. Fitzgerald, Dr. John E. McCoaker, Dr. Mary Wicksten. BOARD OF DIRECTORS. Virginia Welch, Helen Bedessen, Robert Breen, Walter Burnett, Patricia Dal Porto, Kumi Ishida, Dona Juergens, Maryann Danielson, Dr. Thomas M. Niesen, Doris Newbery, Bart H. Oxley, Mary Ragan. Editor/Graphics, Bart H. Oxley.
It's Not a Marine Animal. It's...

Slippery, Slimy Seaweed in Large Life Form at Marine Reserve

By Ellen Gartside
(Marine Reserve Park Aide)

Last year 135,000 people visited the Fitzgerald Marine Reserve. Most of them came in search of sea stars, hermit crabs, and colorful nudibranchs. During their visits they probably noticed another of the Reserve’s most abundant life forms, if only to swear at it as they slipped across the rocks to get a better look at a sea anemone. I’m referring to the seaweed, or algae, which covers the rocks. To most people it all looks the same: a mass of reddish-brown, slippery, slimy, sometimes-smelly “stuff”. Upon closer look, however, one will find that the algae at Fitzgerald are extremely diverse, interesting, and even beautiful.

Algae are found in many habitats, from the Antarctic to hot springs. In the marine environment there are two major categories of algae: phytoplankton, which are microscopic algae drifting in the ocean, and the seaweeds found in coastal areas usually attached to the bottom. A survey conducted at Fitzgerald in 1992 revealed there were 134 different species of algae here.

Algae are very different from land plants. They do not have any true roots, stems, leaves, flowers, seeds, or fruit. The body of an algae is called a thallus (Fig. 1). It is composed of structures which resemble those of terrestrial plants. The thallus is attached to the rocks by a mass of root-like, adhesive processes called the holdfast. A stem-like structure called the stipe may extend from the holdfast. The stipe is flexible and acts as a shock absorber to the pounding surf. Attached to the stipe are leaf-like structures called blades. In many species of algae, the blades are where the reproductive structures are found. Some algae also have air bladders which hold the blades near the surface during high tide. The algae of the intertidal zone are particularly slippery because they have a protective slime layer to reduce drying out during low tide.

Algae possess the green pigment chlorophyll which is essential for photosynthesis; however, this is often masked by accessory pigments which range from blue to brown to red. Surrounded by nutrient-rich water, algae have no conducting tissues and are able to absorb nutrients across the surface of the whole thallus. Photosynthesis occurs throughout the organism. The most important function of algae is oxygen production. Algae and cyanobacteria (blue-green algae) were responsible for the introduction of oxygen into the earth’s early atmosphere. Today terrestrial plants contribute oxygen to the atmosphere, but its production is still dominated by algae.

NEW NIESEN BOOK AT TIDEPOOLS

Tom Niesen, a professor of biology at San Francisco State University, and a member of FFMLR, is author of a new book on sale at the reserve. The book - Beachcomber Guide to California Marine Life - covers common marine fauna and flora from San Francisco to San Diego, and includes marine mammals, sea lions, otters, seals and whales. A forward to the book is written by John E. McCosker, Director of Steinhart Aquarium.

CORRECTION

The pistol shrimp that was illustrated on Page 2 of the winter 1994 issue of Between the Tides was incorrectly identified as Crangon dentipes or Alpheus dentipes. Our local snapping shrimp is now known as Alpheus clamator. We regret any inconvenience caused by this misidentification.
Many Species of Sea Urchins Draw Widespread Collection of Names

By Rich Mooi

Sea biscuits, sea pancakes, pencil urchins, heart urchins, pea urchins, lamp urchins, hedgehogs... People come across sea urchins frequently enough to give the many different forms a wild collection of names. There are about 1,000 living species of urchins, and many more extinct ones that we know only from fossils. All these animals belong to the class Echinoidea, which is in turn placed in the phylum Echinodermata (Greek: echino = spiny; derma = skin).

An urchin's body is made of columns of plates rigidly joined to form the "test". Scientists studying urchins are not trying to be difficult when they use the special term "test" instead of "shell". Even though the test is made of the mineral calcite, somewhat like the shell of snails and clams, it is covered with skin, and technically inside the urchin. The test is much more like your skull than the external shell of snails and clams.

The most conspicuous feature of urchins is the impenetrable field of sharp spines that envelope the test. Each spine is mounted on a muscle-operated ball and socket that can swing the spine into any position necessary to jam the urchin into rocky crevices, or to thwart predators. Anyone who has stepped on an urchin in bare feet knows the effectiveness of this spiny defense. The pain can last a long time as the soft tissues of the broken spines decay inside the wound. The quickest remedy is to bathe the wound in vinegar. Although this sounds excruciating, it pays off when the shouting stops. Spines, like the test, are made of calcite. Calcite is a form of limestone, which dissolves in vinegar acids. What seems like painful remedy results in fast removal of the offending spines.

Urchins are dinner to animals that can overcome their "force field" of spines. As they bob along in the kelp along our coast, sea otters hold a stone "anvil" on their chests to crack open urchins. Gulls pick up hapless urchins and drop them onto the rocks below. The broken test reveals the internal organs, which otters and gulls triumphantly eat. These same internal organs, namely the egg-filled ovaries, attract another group of predators: sushi-loving humans. "Uni" is a kind of urchin caviar, much prized for its sweet, rich flavor. There is now a large uni fishery off the coast of California.

At first glance, an urchin doesn't present a very dynamic subject. A closer look reveals a world of constantly moving spines and tube feet. Tube feet, with their sticky sucker-tips, can manipulate objects, or act as rock-anchored guy wires securing the urchin against wave action or prying predators. Turn over an urchin, and you will find the mouth. In the mouth’s center are five strong, sharp teeth that come together in a jaw apparatus called Aristotle’s lantern. The teeth in this up-side-down, cone-shaped internal structure are constantly worn down and replaced as the animal chews at the rock surface to eat kelp and other algae. At the low tide line, you can see the Swiss cheese effect this has on softer rock. Each urchin has eventually rasped itself into a hole just

(Please turn to page 5. See Urchins).
URCHINS  (Continued from page 4).

large enough to accommodate itself. The urchins are often trapped in these little caves for life, as they outgrow the opening. Apparently, just enough food grows on the inside of the cavity to keep the urchin alive.

By far the most commonly seen intertidal species is the purple sea urchin, *Strongylocentrotus purpuratus*. This species is responsible for the Swiss cheese at the low tide line. Its spines tend to be purplish, and shorter than those of the red sea urchin, *Strongylocentrotus franciscanus*. Red urchins are uncommon, usually found only at low tide in channels, and not in chewed out holes. "Big reds" can get very large, as much as a foot across including the spines.

Sometimes it's a surprise for people to learn that the sand dollar (*Dendraster excentricus*) so commonly washed up on beaches as dead, white tests, is also a kind of sea urchin. It evolved a very flat test that reduces chances of being dragged away by wave surge over its sandy habitat. Sand dollar spines are almost black and very short, giving the living animal the appearance of a cookie wrapped in black velvet. The five flower-shaped rays on the top consist of rows of modified tube feet forming the dollar's "gills". Look for the mouth in the center of the flat underside.

In sea urchins, the sexes are separate. There is no mating (which is thankful, given those nasty spines!). The sperm and eggs are released into the surrounding water, where chance meetings occur to fertilize the eggs. Eggs develop into tiny larvae quite unlike the adult. They have small bodies with several arms lined with cilia (tiny hairs) that beat food into the mouth and propel the larvae through the water. After several weeks in the plankton, surviving larvae look for a place to settle down. A settled larva undergoes a dramatic series of changes called metamorphosis that produce a tiny replica of the adult.

Geological Survey May Determine Rate of Seal Cove Fault Movement

By Steve Thompson

If you have walked through the Cypress Forest recently you may wonder what we have been doing here with the heavy equipment and upturned earth. We are geologists investigating the Seal Cove fault, an earthquake fault that passes through James Fitzgerald Marine Reserve. The purpose of this study is to determine how much, how fast, and how often this fault has moved in the last 10,000 years. The trench we have excavated crosses perpendicular to the fault trace. By studying the layers of sediment exposed in the walls of our trench, we are hoping to reveal the fault’s recent history.

The Seal Cove fault is a part of the large San Andreas fault system, which constitutes the boundary between the Pacific Plate and the North American Plate. The fault is believed to be a strike-slip fault, which means, the "blocks" of earth on either side of the fault slide laterally. For example, we believe that ground beneath the sea cliff behind you is moving slowly to the north, or towards San Francisco, relative to the earth below the flat, grassy field in front of you. As these "tectonic plates" are trying to

(Please turn to page 6. See Diggings).

(End of article on Seal Cove Earthquake Fault. Please turn to page 6. See Diggings.)
move against each other, the rocks on either side of the fault build up stress because they behave in a rigid, or inelastic, manner. When enough stress builds up, the rocks release their energy in the form of an earthquake.

This site also happens to be a gathering place for early Native American hunters. The white flakes in the dirt under your feet are pieces of shell these early Americans left behind about 1500 years ago. They are from mollusks that hunters brought up from the rocky shore. They made some of the shells into tools or jewelry. This deposit of shell fragments is called a "midden." Earlier this winter, archaeologists carefully recorded the contents of this deposit, and found stone tools, roasting pits, and porpoise bones.

Our work shows that the Seal Cove fault runs through this deposit of midden, and over the years earthquakes along the fault have split and moved the deposit. Since we can determine the age of the shell deposit and of Native American occupation, we hope to find how much the fault has moved since that time, and possibly, how often. These data will tell us about the recent activity of the Seal Cove fault.

For finding a record of earthquakes that occurred here prior to human occupation, we can investigate the layers of dirt in the walls of our trench, and interpret how much each layer has moved relative to the other side of the fault. These layers of sediment may also be dated, using pieces of charcoal from early plants and trees that were buried in the deposit.

Studying the earthquake record of active faults, such as the Seal Cove fault, is useful for many reasons. This study will shed light on how often earthquakes occur along the Seal Cove fault, and how large past earthquakes have been. This information helps city planners and engineers control the damage caused by large earthquakes. It helps determine how and where to build (and how and where not to build) houses, schools, hospitals, and other facilities. For geologists, the study of earthquake faults is valuable to determine where and how the earth's plates are moving, and how the earth's landscape is changing as a result.

(Steve Thompson is a staff biologist with Wm. Lettis Co., a geological research company. He earned his bachelor of arts degree in geology from Dartmouth in 1992, and has been accepted at the University of Washington where he will work on his doctorate. Much of the study in this discipline will be done in Tibet.)

Diggings Reveal Site of Early Hunters

Recent diggings at the site located in the cypress forest above the beach at the reserve, have revealed that this was at one time a gathering place for early Native American hunters. The inhabitants of this ancient campsite are thought to be a people ancestral to the Ohlone Indian tribe. This culture existed in San Mateo County seven to nine thousand years ago. Because the San Mateo coast was several miles to the west of its present location, shell fish were not a primary part of their diet. Instead, aquatic birds were hunted on the ephemeral ponds that once dotted the area.

ARTIFACTS UNCOVERED AT MARINE RESERVE IDENTIFY TOOLS OF EARLY hunters. Photo above shows a crescent stone (left), found here last January during the archaeological dig, believed to be from 7,000 to 9,000 years old. Center photo shows three types of stone: a dimpled rock, a projectile point used as a throwing weapon, and a crescent. At right is a dimpled rock that was one of more than 100 found at this site. The stone tool had a variety of uses, from breaking shells to heating food.
Volunteer Honors for FFMLR President

Virginia Welch, president of the Friends of Fitzgerald Marine Life Refuge, was honored on March 24 with 13 other volunteer workers at the sixth annual recognition luncheon of the Volunteer Center of San Mateo County and Junior League of Palo Alto Mid-Peninsula. The luncheon, which was held at the Villa in San Mateo, was in conjunction with National Volunteer Week.

Virginia, a docent coordinator at Coyote Point Museum, where she helped develop the seashore and foothill programs, initiated the Friends’ organization in 1985. Since then, under her leadership, the organization has grown to more than 250 members and has developed numerous informational programs for the public. Her unceasing dedication in developing public awareness for the fragile resource at the Moss Beach tidepools has gained wide attention from political, environmental, and education groups. With her guidance, the FFMLR has introduced such programs as guided tidepool walks for the public, docent training programs, tidepool booklets and written materials, and junior ranger and naturalist training for young people. She has also maintained the Peninsula Girl Scout Summer Day Camp for 25 years.

A letter of commendation from Anna Eshoo, congresswoman of the 14th district, was presented to Virginia in recognition of her long-time volunteer work, and a certificate of merit was awarded her by the San Mateo County Board of Supervisors.

The staff of FFMLR wish to congratulate Virginia as a deserving recipient of this honor.

THE PRESIDENT'S CORNER

by Virginia Welch
(FFMLR Board Chairman)

I would like to welcome Jean and George LeMaitre as our new mailing co-chairmen. These are the people who fold, staple, address and post our mailings. This makes possible our communications with all of you members. Jean has been a docent at the reserve for many years, and we appreciate her taking on this added responsibility.

Good news! The Alan H. Balsam Memorial Fund has awarded the Friends a $2000 grant for a bird study at the Pillar Point Marsh. By our next issue we hope to have first plans for the study, and we’ll give you all the details at that time. Board member Maryann Danielson is coordinating the planning.

The Memorial Fund was established two years ago in memory of Alan H. Balsam. He was a Hollywood film editor for both screen and television. Because of his love of the underwater world, one third of his memorial fund is designated for the protection and preservation of the marine environment. The remainder of the fund is to go to recreational activities for inner city youth and AIDS research and social services.

TOP VOLUNTEER HOURS

The two tidepool docents who contributed the most time at the tidepools during the 1993-94 school year were Jean LeMaitre and Elaine Eisenberg. In addition to her volunteer docent duties, Elaine also employs time taking photos of marine life. Jean LeMaitre, an active docent, has now assumed the responsibility of addressing and mailing the newsletter to FFMLR members. Both docents compiled more than 70 hours each of combined tidepool duties.
TIDEPOOL TALES
By Debbie Rogers

As the Beatles said so well once upon a time: "I'd like to be, under the sea, in an octopus's garden in the shade." This writer's sentiment exactly! At some time during every visit to the tidepools the thought occurs, 'Oh, to be able to see these creatures going about their business of living and surviving in their habitat under water or during the darkness of night.' Fitzgerald not in limbo, but in action! Science lab tanks provide a view of many creatures' movements, and scuba gear allows visiting privileges with a limited time factor, but to be able to spend a full tide's-worth of time just loitering underwater around the familiar territory of Fitzgerald Marine Reserve would be heaven!

Imagine being able to lurk under water near Nye's Rock and watch those familiar, smiling, yet usually resting harbor seals cruise the area in search of fish, or to see those big owl limpets rasping algae film off their particular "farm" on the rock, creating those grooves which represent so many years of working that small area. Or to see them slip their big strong shell under the encroaching shell of another limpet and push it into the sea. When visited during a low tide, the big limpets cling so tenaciously and quietly to their place, but we know from all the physical signs that a great deal of slow motion action takes place here, and there is a strong desire to see it all happening.

A plastic one-person bubble such as Deep Rover would serve very well to allow a person to unobtrusively observe all the chitons which leave their permanent "homes" at night to graze on algae nearby and then return to those little hollows they've formed for themselves in the soft rock, going back to their holding positions which is all we see during a daytime visit at low tide. Graham Hawkes invented the Deep Rover vehicle for scientific research, with a maximum ranging depth of 3,000 feet. Perhaps he could invent a Shallow Rover for intertidal enthusiasts so we could observe the numerous little purple urchins on the reef. And the barnacles which always look so un-alive must create a beautiful sight with all their tiny legs simultaneously sweeping the moving water.

Fitzgerald has its octopus garden, too. It is the large area covered with cobble rocks. It is primarily where the octopus like to live and occasionally one or two are spotted during a low tide visit.

Mr. Hawkes' latest project is to develop a craft to take him 7,000 feet down into the Mariana Trench, which is all very exciting, but it would be delightful if he'd build something from which we could, at length and leisure, observe the wonders of Fitzgerald under water.