TIME TO BAG IT is the message here as docents Leah Cohen (left) and Ardi Haleblian display the kind of litter bag that will be distributed to volunteer workers for the Coastweeks' beach clean-up day on September 23. What these ladies want to make certain is that they are not left "holding an empty bag." For information see story below.

Tidepool Tours and Beach Clean-Up
FFMLR Sponsoring Two Activities For Coastweeks' Celebration

Friends of Fitzgerald Marine Life Reserve will sponsor two activities this year in cooperation with Coastweeks 1989 annual celebration, scheduled from September 16 through October 9.

The first activity will take place on September 16 at Moss Beach, where docent-guided tidepool tours will be conducted every half hour from 3 to 5 p.m. The tours will focus on Coastweeks' effort to maintain public awareness of our nation's salt and freshwater shores. The tours will be conducted by the Roving Interpreters.

According to Coastweeks, an organization dedicated to the preservation of our coastal beaches and lake shores, approximately 90 percent of our country's population lives within 100 miles of shorelines of the Atlantic, Pacific or Great Lakes coasts.

No Social Manners With This Critter
Naturalist Describes Rugged Pacific Seastar Lifestyle

By Michael Ellis

Imagine sitting down to a fine repast at your favorite French restaurant. Your entree of roast duck and pommes de terre francaise is steaming hot. Suddenly your stomach comes rising out of your mouth and plops down right on the plate. Blobs of white flesh ooze digestive enzymes and gradually the food dissolved into a slimy paste which is then absorbed by the lining of your stomach. After an hour or so you suck your stomach back in. Hmm, not quite satisfied, you ask the waiter for chocolate mousse.

Thank goodness this is not how humans eat. But for some sea stars it's a normal procedure. Along the outer coast of central and northern California the commonest sea star is Pisaster ochraceus. We will call it the Pacific seastar. Like human beings, (Please turn to page 6)

The second activity occurs on September 23 when the FFMLR joins in Coastweeks' statewide "Adopt-A-Beach" Coastal Clean-Up Day in Half Moon Bay. The area to be cleaned, a midstate beach on Poplar Avenue, will take place from 9 a.m. to 12 noon. The beach is three miles south from Highway 92 on Coast Highway 1. Rangers will be waiting for volunteer workers in the parking area on Poplar. Each volunteer will receive a litter bag as well as a data card to record the types of litter collected, whether it is recyclable litter or other refuse left by beachgoers. The information on the data card is used by the California Coastal Commission to keep a record of the kinds of litter collected on coastal beaches.

For further information regarding beach clean-up, call the Visitors Center at 728-3584.
Eighteen Hours of Nature Study

Youngsters Learn About Marine Life In Third Annual Jr. Ranger Program

Seven young people ages 9 to 12 know more today about marine life, the causes of tides and waves, and life science concepts because of eighteen hours of study and exposure as Junior Rangers at the Moss Beach tidepools on July 3 through July 14.

This was the third annual Junior Ranger program sponsored by the FFMLR, and was conducted over a two-week period. Each young participant attended the outdoor nature-study course three times a week for three hours each session.

"The kids really seemed to enjoy this activity," said Bob Breen, Supervising Park Naturalist. "It's always a rewarding experience to see the interest and enthusiasm expressed by each of them.

Assisting Breen with the program were Ranger Tim Sullivan and Park Aide Steve Thompson.

Activities for the group during the period included compass work (orienteering), shelter building, bird watching, fish printing, identifying tidepool animals, studying tides and waves, Ohlone Indian life styles and marine food chains. Life science concepts studied included animal phyla, adaptation and natural selection, and ocean food webs and food chains. Some of the tasks assigned each participant were to complete a Junior Ranger notebook and log, and to give a short tour to other Junior Rangers.

Students participating this year were Amanda Urioste, Jessica Urioste, Owen Davies, Melissa Clark, Bruce Welch, Brian Morrison and Tammy Brown. All were local Bay Area students except Tammy Brown, from New Mexico, who was visiting relatives here with her parents.

Each of the young participants received a Junior Ranger shoulder patch.

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

Editorial suggestions and contributions are welcomed, and should be addressed to the Editor at the above address.

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JUNIOR RANGERS HAD A BUSY SCHEDULE AT MOSS BEACH IN JULY. Photos here were taken during the Rangers' six days of becoming familiar with "life at the tidepools." Bob Breen, Supervising Naturalist, is shown with the youngsters on the day these pictures were taken.
Board Extends Thanks to Roving Interpreters

By Jan Urioste

FFMLR Board Member

The board members of the Friends of Fitzgerald would like to thank those people who have made our Roving Interpreter program a reality during the very busy months of May and June at the Marine Reserve. Three main objectives of the program were implemented by the Roving Interpreters:

1. To have a positive impact on visitors by their presence on the beach,

2. To aid visitors with information regarding the guidelines of protecting marine life and habitat found at the Reserve, and

3. To report any observed, unacceptable behavior to the park ranger.

The individuals who make up the Roving Interpreter Corps are Ed Erdelyi, Bruce Harlow, Jane Early, Jean Le Maitre, Dona Juergens, Elaine Eisenberg, Sue Kocienski, Virginia Ich, Jane Payne and Kimi Ishida.

A Challenge for Volunteers

Intertidal Training Classes Begin September 13 at Coyote Pt. Museum

If you are interested in learning more about marine life and the behavior of species in the daily struggle for survival in the intertidal, then a thirteen-week course in docent training at Coyote Point Museum, beginning September 13, is just what the naturalist ordered.

The class in marine biology will be held each Wednesday at the Museum classroom from 9 a.m. to 12 noon. Naturalist Bob Breen will teach the course, which attracts more new volunteer docents each year.

"Some of the docent graduates have taken the course a second time to review and update their experiences at the tidepools," Breen said. Graduating docents become qualified to conduct tours at Moss Beach tidepools, mostly for school children during the busy school year.

Docents Must Complete Course to Become Guides

The course includes laboratory sessions with five afternoon field trips scheduled at Fitzgerald Marine Reserve. Participants may request college credit if desired. All docent students must complete the course before they can qualify as tidepool guides. New student docents will be required to pay $35 for the training which will include all materials and instruction as well as membership in the Coyote Point Museum for one year. There is no charge for returning docents.
Most Active Pacific Coast Starfish

Multi-Rayed Sunflower Star Occasional Tidepool Guest

By Bob Breen
Supervising Naturalist

One of the largest seastars found along the Pacific Coast occurs in the intertidal of Moss Beach. Ranging from the Aleutian Islands to San Diego the sunflower or sun star is usually found in the subtidal down to depths of more than 1400 feet. However, this more than two-foot in diameter star will occasionally wander into the intertidal as far up as the Mid Tide Zone or the 1.0 foot tide level.

A multi-rayed star that starts off life with a "normal" 5 arms, it can have as many as 24 arms once it attains adult size. A magnificent animal, brilliantly colored, it is the largest, heaviest, and most active of all our Pacific Coast stars. When underway with a full head of steam with thousands of tube feet lashing about, it can travel more than a meter a minute. Its bright colors include hues of pink, purple, brown, red, yellow and orange.

WILL SUBDU ROCK CRABS AND SWALLOW SEA URCHINS

So active is this star that it has been even observed to catch and subdue rock crabs and fish with its many tube feet. It is also a predator on sea urchins, swallowing them whole, spines and all, digesting the urchin internally. Other prey items include bivalves, chitons, hermit crabs, sea cucumbers and other sea stars.

When two sunflower stars meet they exhibit actions that could be interpreted as combative. Their vigorous arm movements are thought to influence the dispersion of the sun star populations. Bouts between the sunflower star and other seastar species such as the pink star, Pisaster brevispinus also occur for the possession of food.

Locomotion is by means of its numerous tube feet (they have more than 15,000). Movement by tube feet is one of the most specialized means of movement in the animal world. Sea water is drawn into the interior of the seastar via the water vascular system and suction is applied by creating a vacuum when the water is pumped back out of the tube foot. The tube foot can be released from the substrate by then allowing water to return back into the tube foot. The tube feet also function as legs that can operate without this adhesive effect as they have been demonstrated to be able to walk on grease and sand where it is not possible to apply this kind of force. Tube feet not only help to give the animal a firm foothold when walking but in addition, allows the seastar to climb steep surfaces.

Asteroids as a group are found in all of the seas of the world and number some 2,000 living species; and they have been found in the fossil record for 500 million years. Almost all live in the marine environment, although a few can tolerate brackish water. Most are predators with the exception of those few that are scavengers (the bat star) and a few more that are detritus feeders, feeding on drifting organic material. None of the seastars inject poison into their prey as far as it is known, although there is one star that is venomous. The crown of thorns seastar has spines that are covered with cells that secrete a painful toxin into a wound created upon impact with the spines.

SHOULD ARMS BE HANDLED ROUGHLY

If handled roughly the sunflower star will readily shed its arms. However, as in all seastars, these are regenerated within

(Please turn to page 6)
The moon's gravity causes two movements of water on the earth's surface—one on the side toward the moon and one on the opposite side of the earth.

**TIDES: Their Relationship to the Moon and Sun Eluded Ancient Mariners**

Man has been observing tides and their effects since he took to the sea. Yet it is only recently that he has been able to explain the tides. Ancient mariners thought tides were caused by the breathing of an earth monster. Later in history when man began recording the events around him, he found that tides were closely related to the movements of the moon and the sun.

**MOON EXERTS GRAVITATIONAL PULL**

The tides are caused primarily by the gravitational pull of the moon. Although the sun is much larger than the moon, the moon is closer to the earth and exerts more gravitational pull than the sun. The moon's gravitational pull causes a movement of water like a massive 'wave'. One such movement occurs on the side of the earth facing the moon and another 'wave' occurs on the opposite side of the earth.

**DAILY CYCLE OF 2 HIGH, LOW TIDES**

The earth makes a complete revolution once every 24 hours. This constant motion puts different sections of the earth's oceans under the moon's gravitational influence during the course of a day, resulting in a daily cycle of two high tides and two low tides. However, this tidal cycle occurs (on the average) not every 24 hours, but every 24 hours and 50 minutes. The extra 50 minutes is due to the rotation of the moon around the earth. The moon rotates around the earth once each month, moving in the same direction as the earth revolves. Therefore, the moon has changed position in relation to a spot on the earth during the 24 hours in which the earth makes a complete revolution. As a result, it takes an average of 50 minutes extra each day for a spot on the earth to "catch up with" (or pass under) the moon.

Spring tides are the highest and the lowest of the tides. Neap tides are the opposite of spring tides and show the least difference between high and low tide. The change from spring tides to neap tides is gradual, depending on the positions of the moon and the sun in relation to the earth.

Spring tides occur at the time of the new moon and the full moon. A new moon produces higher tides than a full moon because the sun and the moon are pulling in the same direction. Neap tides occur when the moon is in the first quarter and the last quarter. At these times, the sun and the moon form a 90-degree angle with each other, resulting in the least amount of gravitational pull on the earth.

While the earth makes a complete revolution every 24 hours, the moon also moves around the earth. To pass directly under the moon again, California must travel an extra 50 minutes or so each day. Thus, the tides are about 50 minutes later each day.
PISASTER SEASTAR

It's a Comical Sight to See a Gull Try to Ingest a Seastar

(Cont. from page 1)

this species comes in several color forms, including brown, purple and orange. And, also like humans, these varieties can interbreed. The five rigid arms and the entire top surface are covered with hundreds of tiny white spines. This seastar can tolerate exposure to air for up to eight hours. It may not move for weeks and when it does its motion is almost imperceptible. This is one tough critter; it inhabits an area that routinely gets smashed by giant waves.

The Pacific seastar has few predators but birds will sometimes eat one. It's a comical sight to watch a gull try to ingest a seastar. It may take hours of gulping before the bird can finally swallow it. The seastar's stiff arms still protrude out the gull's mouth and stretch its neck. Surely the taste cannot be worth the discomfort. Sea otters will also eat seastars but usually only bite off an arm or two. Since seastars can regenerate body parts, the otters do no long term damage to the population.

SNAPPING PINCERS REMOVE HOMESTRADERS

Most slow moving objects in the sea are soon covered with fouling organisms such as barnacles and sponges. The Pacific seastar is slow, but its surface remains free of organisms. For seastars this is very important because they breathe through their skin. On the skin are tiny pincers called pedicellariae. These snapping jaws remove any animal that attempts to homestead on the seastar's back. The power of the pincers can be demonstrated by placing the back of a seastar on your forearm. Soon your hairs are firmly in the grasp of the pedicellariae. Ouch!

FILTER SYSTEM FOILS BACTERIA INVADERS

Just off center on the top of the animal is a whitish plate. This is a sieve that filters ocean water. This filter is so efficient that even microscopic bacteria cannot get through. The siphoned water is part of the hydrovascular system that enables the animal to maintain its shape and to move. Thousands of tiny tube feet run out along canals in the arms, each tubefoot is capable of exerting suction against the substrate. Under nervous control the tube feet enable the animal to slide along. This is definitely movement by committee!

Seastars reproduce by shedding sperm and eggs into the ocean via pores in their armpits. Fertilization is external.

Along the central coast the primary foods of the Pisaster ochraceus are mussels, barnacles, limpets, and chitons, in that order. Using their powerful tube feet Pacific seastars only have to open a mussel's shell .1 mm. Then they evert their stomach and begin eating. The overall effect on mussels is profound. This seastar is solely responsible for determining the lower limit of the mussel beds.

Like most of the other invertebrates in the tidepools, seastars are protected by law and may not be collected. What looks beautiful in a tidepool soon loses its color and shape at home and beings to smell. The seastar is then discarded in the garbage can, an ignoble end to such a tenacious survivor.

Michael Ellis is an itinerant naturalist. He leads natural history excursions throughout West Marin and as far afield as Tierra del Fuego. You may reach him at Box 1179, Point Reyes Station, California 94956.

SUNFLOWER STAR

If Handled Roughly the Sunflower Star Will Shed Its Arms

(Cont. from page 4)

months. Only one star, the Linckia's of tropical seas, can regenerate an entire body from a fragmented arm.

To observe this splendid invertebrate a good minus tide is required. Unfortunately during most of the fall months, most minus tides fall during the middle of the night. However, provided below is a list of the tides for November and December that will be low enough for you to be able to observe at least one sunflower star.

Nov. 12, Sun. -1.4', 8:30 p.m. Dec. 10, Sun. -1.2', 2:40 p.m.
Nov. 13, Mon. -1.8', 4:20 p.m. Dec. 11, Mon. -1.5', 3:25 p.m.
Nov. 14, Tue. -1.6', 6:10 p.m. Dec. 12, Tue. -1.7', 4:10 p.m.
Nov. 15, Wed. -1.3', 8:00 p.m. Dec. 13, Wed. -1.6', 5:00 p.m.
Docents, Volunteers Feted At Coyote Point Dinner

Docents and volunteer workers were honored on May 24 at the Coyote Point Museum in the first Docent/Volunteer Recognition Dinner given by the Museum. In addition to certificates of thanks, several people were recognized for special contributions. These included:

Frances Wright, docent; Ele Quinn, volunteer; Al Seubert, docent; Bruno Magnani, volunteer; Earl Dubas, docent; Darian Heimlich, volunteer; Mary Haworth, docent; Dorothy Katz, volunteer; Mary Laura Ploug, volunteer; Beth Payne, docent; Jeanne Pfleg, volunteer; and Sue Kocienski, Al Seubert, Peg Utterback, and Kathy Weatherby, docents.

In addition, recognition was given to Sue Kocienski and Ele Quinn, newsletter editors, and newsletter reporters Molly Engelbrecht, Dona Juergens, Beth Payne, Cecelia Pelicon and Cliff Stanfield.

Jris Newbery, docent, and Jeanne Pfleg, volunteer, were thanked for their long standing active status, both representing the largest uninterrupted length of service.

Ed Erdelyi was honored for giving the highest number of tours in the last year, and Mary Ploug for the most volunteer hours. Erdelyi conducted 39 tours, all at the Fitzgerald Marine Reserve, from September 1988 to May of this year.

Early morning tidepoolers rewarded. Even a 6:15 a.m. tidepool call didn't daunt a group of Friends of Fitzgerald and their guests from joining Naturalist Bob Breen one early Sunday morning recently. Some unusual discoveries were observed in one of the lowest tides this year. Art Buhs is shown at right, holding a seastar.

COASTWALKERS ENJOY BEACH CAMPOUT

Coastwalk, a non-profit organization that is sponsoring six four-day excursions (with overnight camping) this year, spent a night in the cypress forest of Moss Beach on August 17. The Coastwalkers had their first overnight campout at Moss Beach last year.

Although registration for walks is filled for this year, people interested in belonging to Coastwalkers will be able to follow their activities through the organization's mailing list by calling Jan Warren, 415-591-8565 or Carl May, 415-726-6244. Registration fee is $15 a day and includes dinner and transportation of gear to campsites. Hikers supply their own equipment, lunch and breakfast.

The group's walks are designed to foster awareness of the state's coastal environment, and to promote the development of a California Coastal trail.
MAKE A FRIENDSHIP GIFT — MEMBERSHIP IN FFMLR

Do you have a friend or relative you think would enjoy being part of the Friends of Fitzgerald? If so, you can give a very nice friendship gift by providing them with a membership to our organization. Membership categories can be found on page 7. Your donation is fully tax deductible, and membership entitles the bearer to the quarterly Newsletter which will keep the advised of upcoming events regarding the ecology, lectures and slide presentations of marine life, and special tidepool tours.

FRIENDS OF FITZGERALD MARINE LIFE RESERVE
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