

BETWEEN *the* TIDES



F r i e n d s o f F i t z g e r a l d M a r i n e R e s e r v e
JUNE 2009

Monitoring FMR's Harbor Seal Population

by Ranger Sarah Lenz

Harbor seals are a common sight for visitors, since they usually haul out in large groups along Fitzgerald Marine Reserve's (FMR) reefs. Their habit of hauling out on land to rest and warm themselves in the sun provides a chance for excellent wildlife watching, but also makes the harbor seal vulnerable to disturbance.

Female harbor seals haul out to give birth and nurse their young on land. Park staff begin harbor seal surveys along the three miles of coastline during early March at the start of pupping season.

A mother nurses her pup for four to six weeks with her rich milk. The 48% fat content of milk makes the pup gain weight rapidly, and by around 30 days they are weaned. Pups weigh around 25 pounds at birth but when they are weaned they may weigh as much as 50 pounds.

Shortly after the pups are weaned, the seals begin their annual molt. During the molt, old fur falls out in patches while new fur grows in. The molt period begins around mid-June and extends through July. During this time, seals will spend more time resting onshore because

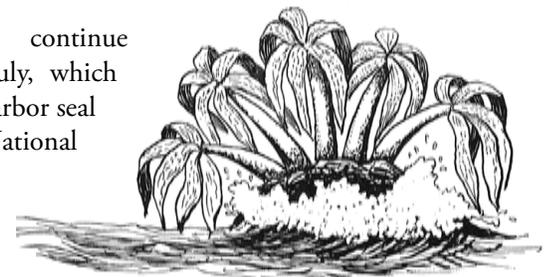


During the 2008 molt a pup born at FMR became critically ill. After treatment at the Marine Mammal Center he was released at FMR and has made his home here.

molting is energetically taxing. Also, studies have shown that hair follicles grow faster when the seals rest onshore rather than in the water. Seals can stay onshore resting for an average of 12 hours per day during the molt compared to around 7 hours per day during fall and winter months.

Our surveys continue through the end of July, which

marks the end of the molting season, to give us an accurate accounting of the harbor seal population. FMR staff conducts these surveys in cooperation with Point Reyes National Seashore's Harbor Seal monitoring program, which has long-term data on harbor seal populations along the San Mateo County Coast and Point Reyes National Seashore.



Sea Palms

*Please take care NOT to make your presence known
— either visually or audibly — when you come
across an individual or a group of harbor seals when
you are on land or on the water.*

continued on page 2

Friends of Fitzgerald Marine Reserve

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Our Mission:

To inspire the preservation of our unique intertidal environment through education and the support of research.

The graph displayed across the page bottoms shows tides for 6/22/08 to 11/16/09. Where the date appears is midnight. The reefs are accessible for exploring only during low tides. See: www.fitzgeraldreserve.org/resources.html and click on "high and low tides," for a more detailed tide chart. **Note:** the lowest tides this period are:

-1.94	6/23	5:46 am
-1.53	7/22	5:28 am
-.93	8/19	4:21 am
-1.10	11/4	5:32 pm

Seal Population *continued from page 1*

Harbor Seals	Apr 30 2006	May 7 2006	Apr 29 2007	May 6 2007	Apr 24 2008	May 10 2008	Apr 26 2009	May 4 2009
pups	16	9	14	14	33	31	24	29
adults	115	237	156	139	133	191	66	234

Table 1: Harbor seal counts at FMR from 2006 to 2009 during the months of April and May.

The pup count jumped considerably during the 2008 survey, and as you can see from the table, this year's pup count is proving to be nearly as large as last year's! The fluctuations in the numbers of harbor seals sighted may have any number of causes, from differing times of day, weather conditions, and tide levels to changes in their haul-out sites. We will look forward to seeing what 2010 has in store for the FMR population. ♦

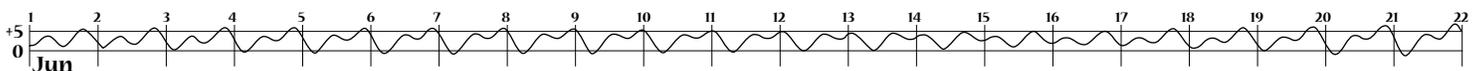
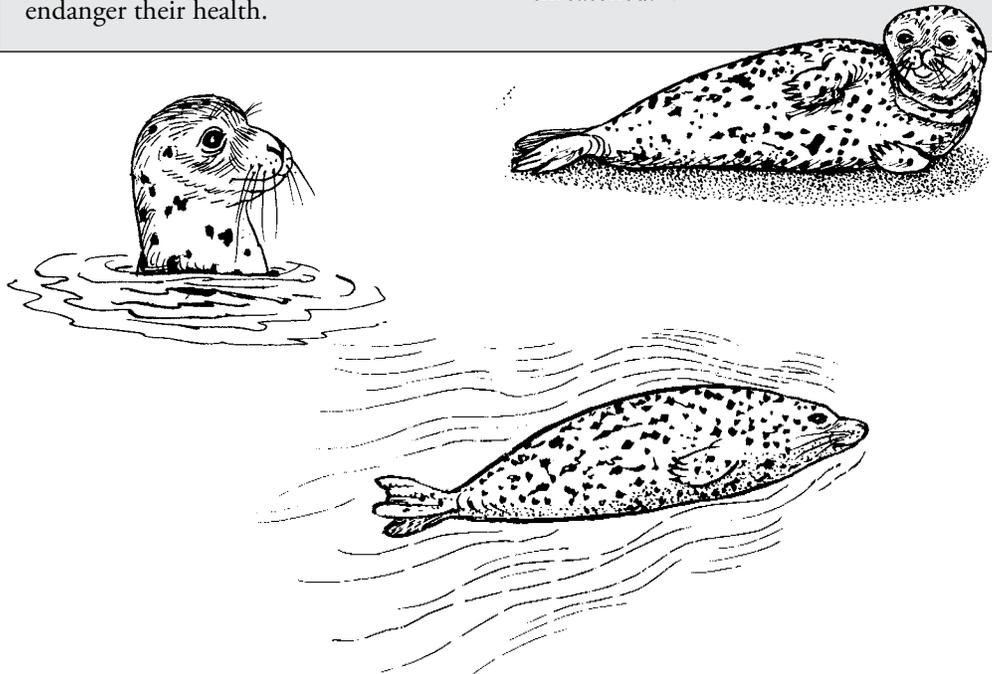
Help Us Protect Harbor Seals

Harbor seals are shy animals whose habits are easily disrupted by the presence of humans on land. Maintain a minimum distance of 300 feet from any marine mammal in the water or on the shore to prevent a disturbance.

Please take care NOT to make your presence known — either visually or audibly — when you come across an individual or a group of harbor seals when you are on land or on the water. Seals may flee into the water immediately when they hear or see a human. This flight disrupts their resting, can cause mother-pup separations and may endanger their health.

- If you see a lone pup, do not touch, move or otherwise disturb it. It is extremely difficult to reunite a mother and her pup once they have been separated.
- It is best to move out of the area to give the mother and pup the best chance for reuniting.
- Report any signs of a distressed animal to park staff.

If you see the seals raise their heads, you have disturbed them. Immediately back away so that they do not feel threatened. ♦



Board Member Dr. Tom Niesen, or “Surfer Dude Makes Good!!”

by Linda Ciotti

Tom Niesen, Ph.D. Biology, has been a member of the Board of Directors of Friends of Fitzgerald Marine Reserve (FFMR) since the mid-1970s. As a brand new professor at San Francisco State University, he met Virginia Welch, one of the co-founders of the Friends organization. She asked Tom if he would join the FFMR board and luckily for us, he said “yes.”

Tom was born in San Diego and raised in Southern California. As you might suspect, he has been a surfer since age 14. His interest in marine science began around the age of 16. As he tells it: “I guess I was 16 years old and sitting out on my board, and all of a sudden there was this group of thrasher sharks going crazy in the water. I watched with total amazement. I had this epiphany that, ‘Wow, I could study this and become a marine biologist.’” Few people are lucky enough to know at such a young age what they want to do.

So, after graduating high school, Tom attended community college. He transferred to U.C. Santa Barbara where he earned his BS in Zoology, and met his future wife, Anne, who was studying sociology. Then, he earned his MS in Biology from San Diego State. Upon Anne’s graduation they married and she began her career as a social worker in San Diego while Tom completed his studies at San Diego State. They moved to Oregon where Tom obtained his Ph.D. in Biology from the University of Oregon and Anne continued her work in counseling, receiving her MS in Rehabilitation Counseling at University of Oregon.

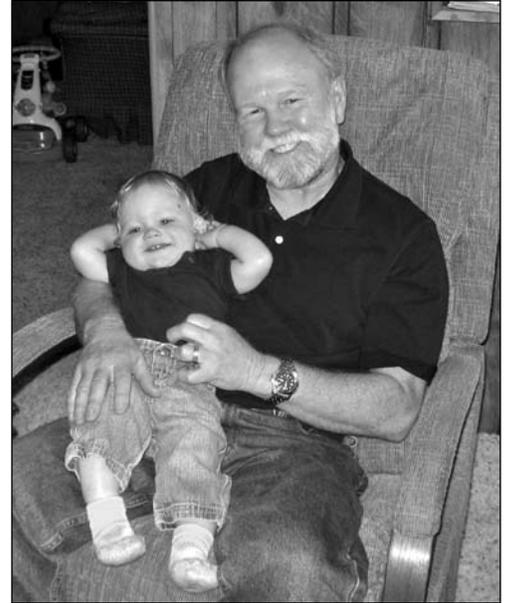
They moved to the Bay Area in 1973 where Tom had been hired by San Francisco State as an instructor in biology. He was promoted to assistant professor in 1975 and retired as a full professor of marine biology in 2006. Anne continues working full time, not as a social worker, but as a financial planner for the last 25 years,

although she says it is as much a counseling position as it is a financial one!

Tom’s interest in marine biology started out with studying fish, but he developed a greater interest in invertebrates which he says “are much more interesting. After all, there isn’t a whole lot going on with fish . . . but there is so much more going on with invertebrates.” His Ph.D. work involved studying the intertidal with an emphasis on 6-ray star reproductive biology. While at San Francisco State he began studying the ecology of introduced marine invertebrates in San Francisco Bay.

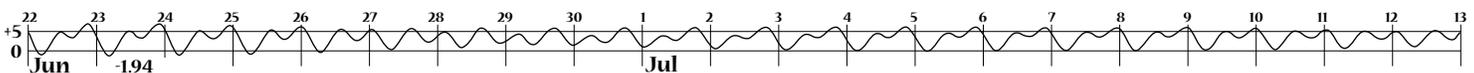
He worked with Professor Ralph Larson at San Francisco State and they became life-long friends. They have traveled together for various research programs, including in the Channel Islands where they studied the distribution of fish species over a 25-year span. Two years ago, they traveled to Australia where they dived The Great Barrier Reef.

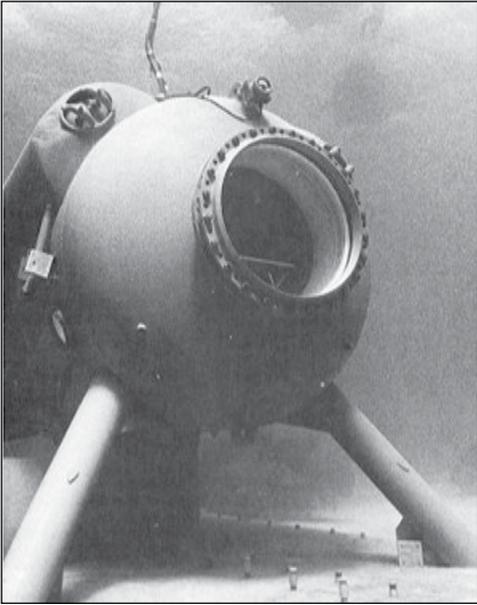
Tom also had some amazing opportunities for research during his career. In the early 1980s he was invited to participate in a NOAA-sponsored project where he lived in an underwater habitat called Hydrolab off St. Croix, U.S. ➤



Tom and his grandson, Connor.

*I had this epiphany that,
‘Wow, I could study this and become a
marine biologist.’*





The Hydrolab was a cylindrical chamber 16 feet long by 8 feet in diameter, equipped with spartan accommodations, yet unmatched in its day in scientific support efficiency. Photo and text: National Oceanic and Atmospheric Administration

Since his retirement in 2006, Tom has traveled to Australia, New Zealand, the Baltic Sea, Russia, Scandinavia, Berlin, the Suez Canal, has been chased by pirates off the coast of Somalia, and traveled to Malaysia and Singapore.

Virgin Islands, for one-week periods over the course of several years. They conducted experiments on a deep-water sea grass that grows at low light. "Living underwater was interesting. Four people living together in a tube that was 8' in diameter and 16' long about 1 mile offshore, at a depth of approximately 50' for seven days at a time." During the first excursion, they had a hurricane scare on the fourth day of their stay in Hydrolab and had to be evacuated. The Hydrolab project also investigated offshore transport of plant material and used catch-nets at the bottom of a deep-water canyon to collect algae for a quantitative study. At the end of the project Hydrolab

was placed in the Smithsonian Museum in Washington, D.C., where a plaque lists the names of the participants, including Dr. Tom Niesen.

Another highlight of his career was a research project in the Channel Islands where he was invited by the lead biologist, Dr. Eric Vetter, to participate in two-man mini-submarine dives studying the deep-water canyons. Each dive lasted approximately 90 minutes and went down to 200'-300'. "I was surprised at all of the trash you can find down there: every kind of beer bottle you can imagine, tin cans, etc."

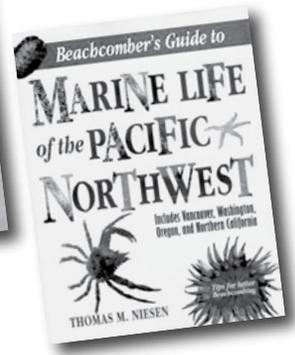
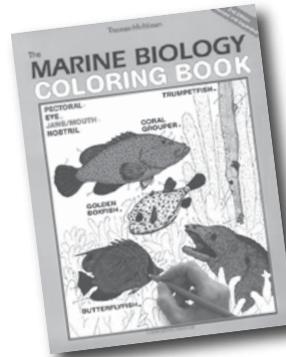
During the summer of 1989 he spent one month in the Bering Sea with a team taking plankton samples to study the total ecosystem of plankton and gray whales.

Since his retirement in 2006, Tom has traveled to Australia, New Zealand, the Baltic Sea, Russia, Scandinavia, Berlin, the Suez Canal, has been chased by pirates off the coast of Somalia, and traveled to Malaysia and Singapore.

Nowadays, Tom continues to surf regularly "when there are waves" and is enjoying his retirement, which allows him more time for his interest in gardening. While Anne continues to work full time, Tom has taken over the household chores

and doesn't seem to mind it at all. He is an avid photographer. "I started out taking photographs of the marine critters I would find, but now enjoy taking pictures of almost anything."

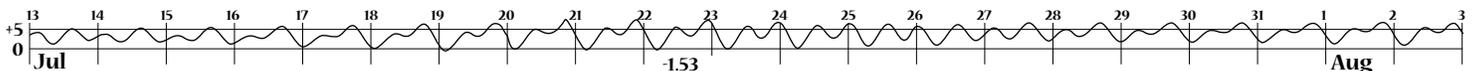
In addition to FFMR, Tom serves on the Board of Ocean Discovery!, which is an educational outreach program for under-served schools that was started by one of his former graduate students and her husband. He recently retired from the Board of the Surfrider Foundation. He is an occasional lecturer for Gulf of the Farallons National Marine Sanctuary Association and the docent classes at the California Academy of Sciences where he also is a Fellow. During the winter Tom also works as an underwater naturalist in Baja California for Lindblad Expeditions. He is proud that a number of his former students are now in career positions with state and federal agencies or are working as professors and call upon him to speak to their students. Tom has also been involved in FFMR's training of volunteer naturalists and participated in continuing education events. He is the author of *The Marine Biology Coloring Book*, which is an excellent resource and guide about life in the ocean, and the *Beachcomber's Guide to Marine Life of the Pacific Northwest*.



He and Anne have one daughter, Amy, and are now proud first-time grandparents of Connor. "We have become the typical obnoxious grandparents. We truly dote on the little guy and get cranky when we haven't seen him at least every other week. He is pretty cool."

We think Dr. Tom Niesen is pretty cool, too. ♦

Note: See Tom's "Creature Feature" on page 7.



Join Us for Family Fun Days

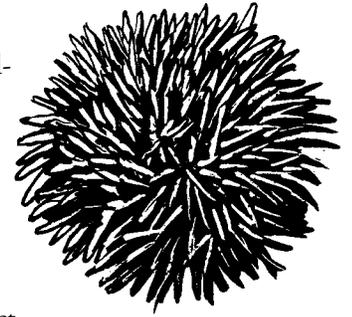
Friends of Fitzgerald Marine Reserve isn't offering a Junior Rangers camp this year, but we are launching a new program we hope families will take advantage of: Family Fun Days! These events are open to both members and non-members.

Family Fun Days will run from 2 to 4 hours. They are designed to let a small family group explore a topic together through discussions and hands-on experiences led by park staff and volunteer naturalists. Activities may include hiking, hunting for specimens on the reef, finding information in a guide book, using binoculars and spotting scopes, playing educational games, listening to short lectures, writing field notes, and discussing how we can take better care of the ocean.

We invite parents and their kids 8 and older to join us for one or more of the Family Fun Days described below. There is no fee, but you do need to pre-register by calling the ranger station at the reserve at (650) 728-3584 and speaking to Ranger Sarah Lenz. Information she needs includes:

- the registering adult's full name and contact information
- each child's first name and age

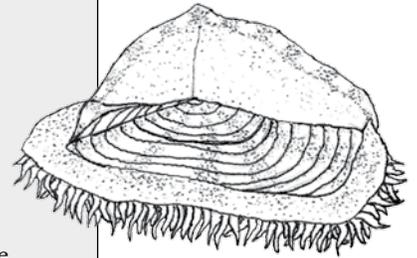
No more than 3 kids per adult, please! Space is limited for some of our events, so be sure to register early.



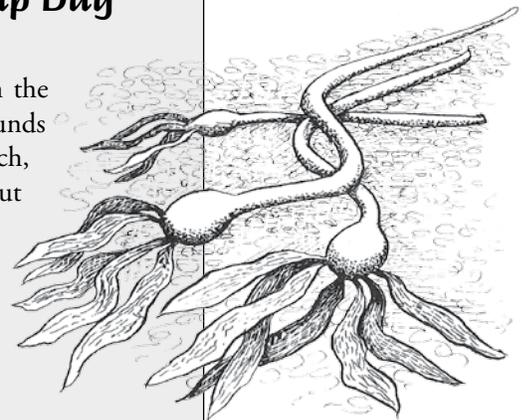
Sea Urchin



Sea Anemone



Velevella Velevella



Bladder Kelp

Saturday June 13th: Breakfast at the Reserve 8-11am

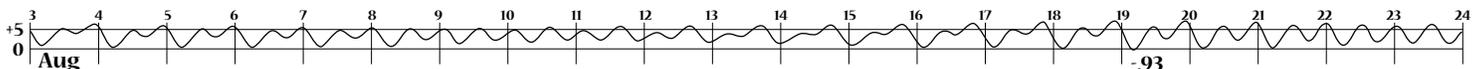
Come down to the reserve to enjoy a donut and a cup of coffee before venturing out onto the reef to learn about what our reef critters like to eat. Park staff and volunteers will be pouring coffee and juice, and volunteer naturalists will be on hand to answer your questions and show you the wonders of the intertidal environment. Bring your own reusable cups to make this an earth-friendly event! Meet at the ranger station.

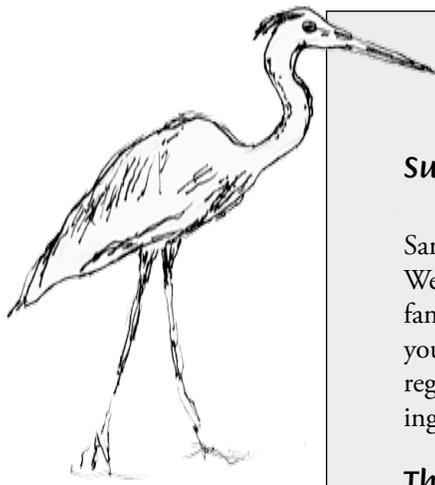
Saturday July 25th: All About Algae 8-10 am

You probably know that algae form the base of the food web, and that they produce a lot of the oxygen we breathe. But did you know that a substance from algae is common in products we use on a daily basis? Or that giant kelp can grow up to two feet a day? Join us to learn more interesting facts, tour the reef in small groups to see algae in its natural habitat, play games like "Seaweed Sort," sample edible seaweed, and have a lot of fun in the process. Meet at the ranger station.

Saturday September 19th: California Coastal Cleanup Day 9-Noon

For years now, tens of thousands of volunteers have turned out on the third Saturday of every September to pick up litter, removing 12 million pounds of debris since the Cleanup started in 1985! Join us this year at Surfer's Beach, just south of the Princeton Harbor breakwater, to pick up litter and pack out recyclables. Last year 60 volunteers picked up 500 pounds of trash and another 250 pounds of recyclables. Mark your calendars and help us set a new record in 2009! There's a pretty high tide predicted for this morning, so we'll concentrate on cleaning up the grassy bluff, roadsides and parking lots above the beach. Stop by our registration table for gloves and bags. Come alone or bring a whole team. ➤





Great Blue Heron



Pelican

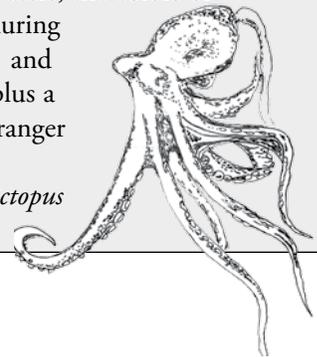
Family Fun Days *continued*

Sunday October 4th: **What Bird is That?** 9-Noon

Veteran birder Shannon Lyday from the Gulf of the Farallones National Marine Sanctuary will lead a bird-spotting expedition through the southern part of the reserve. We'll start at the Pillar Point Marsh and work our way along the harbor beach to the famous Maverick's Beach to look for fall migrants! Bring binoculars and a bird guide if you have them. (If you don't, mention you'd like to borrow some for the tour when you register, and we'll try to accommodate you with loaners.) Meet at the Maverick's parking lot. Space is limited to 20 so register early. Heavy rain cancels this event.

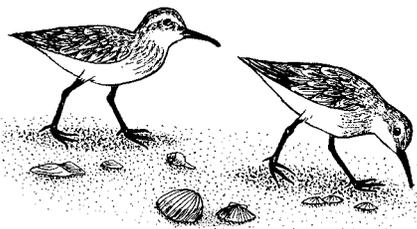
Thursday December 17th: **Night Tidepooling Tour** 4-7 pm

Under cover of darkness, crabs scuttle from crevice to crevice, and octopuses creep from pool to pool. When flashlights probe the shadowy waters, the colors of sea stars and nudibranchs show up brighter and richer than during daylight hours. Bundle up in warm clothes, wear sturdy shoes, and bring your flashlights (one for every member of your group, plus a spare!) for a guided tour of the night time reef. Meet at the ranger station. Heavy rain cancels this event. ♦



Octopus

Weekend Greeters



Western Sandpipers

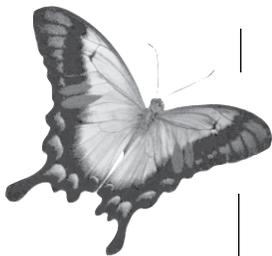
This summer, many expect that the shaky economy will prompt Bay Area residents to trade their usual summer travel for "staycations." Families will probably look for low-cost alternatives to multiplexes, museums, amusement parks, and other pricey entertainment. These trends will drive higher-than-usual visitation to Fitzgerald Marine Reserve, and we all know that more visitors can mean more wear-and-tear on the reef and its inhabitants.

Ranger Sarah Lenz is asking volunteer naturalists to help out by signing up to act as "greeters" on weekends. "We want to remind people to visit carefully and remember there is no collecting."

Greeters will work near the parking lot ramp, pointing out hauled out harbor seals and other wildlife. They'll remind visitors to stay outside the line formed by the orange cones which park staff put out to create a buffer zone for resting harbor seals. They'll answer questions and ask visitors to return buckets and other collecting containers to their cars.

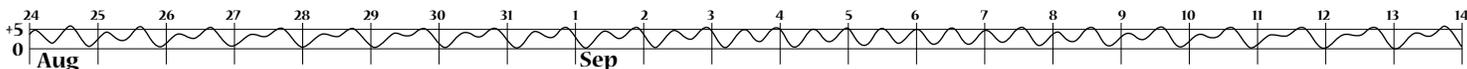
Although our usual volunteer shifts are confined to low tides and often involve organized tour groups, "greeters" are needed any time between 9 am and 4 pm on weekends. To volunteer for a 1-hour or 2-hour shift, contact our volunteer coordinator, Amy Albers-Mead, at aalbersmead@jaminc.com. ♦

Eileen Bowden



We are deeply saddened by the unexpected death of FFMR volunteer naturalist Eileen Bowden. Eileen, 59, collapsed and died on Tuesday, April 28, 2009, after performing life-saving CPR on a coach on the campus of Santa Clara High School. Eileen, who lived in Half

Moon Bay, worked as a school nurse at a number of Santa Clara schools. She was also a Girl Scout Leader. Through her work in the schools and with FFMR and other volunteer organizations, Eileen touched the lives of many. We will miss her. Our hearts go out to her family. ♦



Intertidal Bio-Engineers: Clams and Urchins Reshape Reef

by Dr. Tom Niesen

The intertidal zone of Fitzgerald Marine Reserve (FMR) is a rugged place to try and make a living. At high tide, crashing waves and wave-borne debris pummel the inhabitants. At low tide, exposure to the air subjects delicate tissues to drying. You may ask, “why live here at all?” The answer is simple. The constant motion provided by waves and tides bathes the intertidal with a rich mix of plant nutrients. Combined with the high light penetration in the shallow water, these conditions foster tremendous plant productivity. This lush plant life is consumed directly by herbivores like snails and chitons, and wave action pulverizes plant and animal tissues into suspended food for filter-feeders like mussels and barnacles.

Intertidal organisms have evolved many structures and behaviors to avoid the harsh physical environment and yet take advantage of the wealth of available food. Limpets and aggregating anemones seek the shady vertical sides of rocks; snails like *Tegula* seek out cracks and crevices that hold water where they aggregate to avoid desiccation at low tide. Mussels use stout byssal fibers to anchor themselves to the rocks and each other to avoid being washed away.

Other intertidal animals actually alter their environment to ensure their safety and still feed on the intertidal bounty. These animals are the bio-engineers of the intertidal and their modifications affect not only themselves, but many other intertidal denizens as well. To understand these alterations, first we must consider the nature of the intertidal substrate at the reserve.

The rocks and boulders found in the intertidal zone of FMR are derived from a variety of sources. Some material may come from the weathering of cliffs that abut the intertidal zone. Much rocky debris may be thrown onto the reef from the subtidal zone by wave action. However, the majority of the rock is usually composed of pieces broken from the solid reef substrate itself, especially if the reef is made up of soft, sedimentary rock like the shale, sandstone and siltstone that dominate the reserve. Often these soft,

weathered rocks and small boulders have round holes in them. These are the burrows of our first group of bio-engineers, rock-boring bivalve mollusks. The burrows excavated by these unique clams appear round from the surface, and conical when viewed from the side (Figure 1). These clams riddle the soft, rocky reef in the mid- and lower-intertidal zones until it becomes unstable, and pieces break away under the pounding surf.

There are several species of bivalve borers on the reefs of FMR, and the most abundant is the common piddock, *Penitella penita* (Figure 2). Occasionally a detached piece of reef rock will contain a live specimen still in place in its burrow, but more often only the elongated, augur-shaped shells remain. Piddocks or pholads, as they are also called, burrow by mechanical action. The anterior edges of their shells are laid down as a series of stout ridges which function as drill blades to cut into the soft reef rock. The clams anchor themselves by their foot with the anterior end of their shell pressed against the bottom of their burrow. They then rotate their shells around the foot by alternate contractions of the shell muscles, and a grinding, drilling action results. The secretion of new shell replaces the worn shell ridges. In this way the clam excavates a conical burrow into the rock, which increases in diameter as the clam grows. Once the clam becomes sexually mature the burrowing ceases. If enough clams have burrowed in proximity, the rock is severely ➤



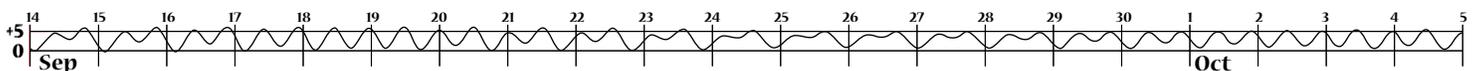
Figure 1. Side view of boring clam burrows. Rock was weakened by the boring activity and then fractured by wave action.



Figure 2. Common piddocks, *Penitella penita*.

At high tide, crashing waves and wave-borne debris pummel the inhabitants. At low tide, exposure to the air subjects delicate tissues to drying.

You may ask, “why live here at all?”



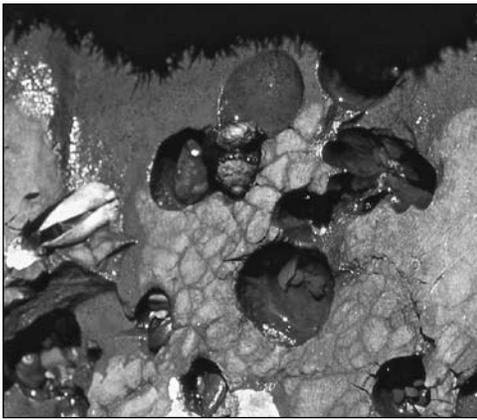


Figure 3. Round bases of piddock burrows that have weakened a rock and subjected it to fracturing.



Figure 4. The lumpy porcelain crab, *Pachycheles rudis*, a frequent inhabitant of old piddock burrows.

weakened and subject to fracturing (Figure 3).

When the boring clams die, the now vacant burrows become the home of a variety of other animals. Sipunculid and polychaete worms, snails, small sea stars, nestling clams, and encrusting animals like sponges and bryozoans all may show up. Probably the most surprising animal to find here is the lumpy porcelain crab, *Pachycheles rudis* (Figure 4). This small (one inch across the carapace) crab often occurs in mated pairs, and sometimes grows too large to escape its tapered abode. It is also common in mussel clumps and in the holdfasts of large seaweeds. These porcelain crabs are filter-feeders, so they only need an open connection with the circulating water to feed successfully.

Bio-engineers of the Low Intertidal Pools

Low intertidal pools are unique habitats found at FMR. The nature of the reserve's rocky substrate is such that dished-out areas occur in the low intertidal region, where they are exposed to strong wave action, which plays an important role as well. Viewing these pools requires that the tide for the day be below the zero tidal level (a "minus tide") and relatively calm waves.

The most noticeable inhabitant of these low tidepools is the purple sea urchin, *Strongylocentrotus purpuratus* (Figure 5). The purple urchin is one of the most common marine animals along the open coast of the Pacific. However, except for an occasionally stranded urchin tossed up by wave action or a hearty individual in an upper tidepool, it is often missed because it only occurs abundantly in the low intertidal zone and subtidally.

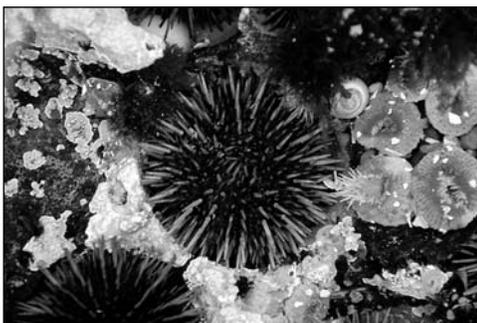


Figure 5. The purple sea urchin, *Strongylocentrotus purpuratus*. Photo by David Dewey.

This sea urchin cannot withstand long periods of exposure to warm air. Therefore it inhabits the edge of the intertidal reef that is exposed only at extreme low tides, and low pools that are not exposed to the sun and air long enough for the water to heat up beyond the urchin's tolerance. How does the urchin handle the strong wave action that occurs here? Turns out the urchin is yet another bioengineer.

At very low tides (-1.0' MLLW or lower), large numbers of urchins can be found exposed on flat, seaward portions of the lower reef, especially in the Seal Cove region of the reserve. In both this exposed, lowest intertidal region and in the low tidepools, the urchins occur in rounded depressions or pits (Figure 6). These pits are thought to be excavated by the urchins using their spines and their special, five-jawed chewing apparatus called Aristotle's lantern. By rotating in the pit, the urchin abrades the rock and tailors it to fit its body.

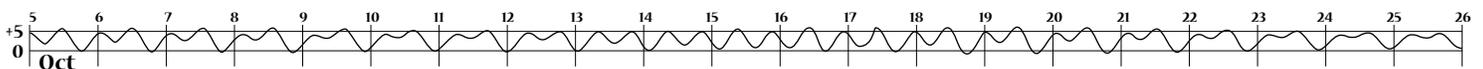
You would think this boring activity would take a toll on the urchin's spines and jaws, and it does. But the spines are actually part of the urchin's internal skeleton, and as such are covered in a layer of epidermal tissue that secretes new spine



Figure 6. Low intertidal pool with purple urchins in rounded depressions.



Figure 7. The lined chiton, *Tonicella lineata*.



material, keeping the spines long and sharp. The jaws are likewise replenished as they wear, but they are secreted internally at their base.

The urchin remains in its pit and feeds on any nearby attached fleshy algae or drifting plant material that is washed its way by wave action. As the urchin grows it enlarges its pit, and if sufficient food is obtained, it will remain in place for years. The urchin sometimes becomes trapped in its pit, having grown too large to escape from the opening. The pit offers the round urchin a greater surface area for attachment of its anchoring tube feet, and protection from rolling rocks and other wave-borne materials. Not all urchins excavate their own pits. Close inspection of a low tidepool often reveals an urchin in a pit much larger than its diameter, suggesting the animal migrated into a pit vacated by the demise of the previous owner.

Excavating a protective pit turns out to be a great way to survive in the low wave-swept tidepools of FMR, so it is common to find such areas lined with dozens or even hundreds of urchins

livings in holes -- areas volunteer naturalists often refer to as "urchin condominiums."

These tidepools dominated by urchins are devoid of fleshy algae -- all of which has been consumed by the voracious urchins! In time, the fleshy algae are replaced by growths of pink encrusting coralline algae. Coating the rocky substrate, the bumpy pink hard-shelled plant provides a vivid backdrop to the urchin's purple coloration. The urchins cannot eat the coralline algae, so it flourishes in these "urchin condominiums."

By creating habitat for the pink encrusting coralline algae, the urchin bioengineers "set the table" for two unique mollusks that are able to feed on the pink plant: the lovely lined chiton, *Tonicella lineata* (Figure 7), and and the dunce cap limpet, *Acmaea mitra* (Figure 8), which both make a living by grazing in these colorful tidepools.

But that's another story. ♦



Figure 8. The dunce cap limpet, *Acmaea mitra*. Note the limpet's shell is covered by a growth of coralline alga.

Note: Author Tom Niesen is profiled on page 3.

Pagoo continued from page 10

algae growth with its radula. This tongue moved like a strap pulled forward and back. Where the radula pressed down, sharp-edged blades like the teeth of a file rasped the algae food from rock and week....Pagoo saw only the shells....Rounded, smooth,...spinning tops and rajah turbans. And they came in all sizes...but could he leap down, yank a Snail from its shell and take over?"

I eagerly turned the next page.

There are many children's books about ocean animals, but *Pagoo* succeeds in conveying

the variety and complexity of the intertidal. The author has painstakingly researched his subject, and brought it to life through rich, interpretive language, 20 color plates, and margins packed with detailed line illustrations. When visiting tide pools, most excited children have limited attention spans. *Pagoo* is the perfect follow-up. Children can all relate to the need for a home, family and tasty meals. It's a fun book to read out loud to your 1st or 2nd grader, as well as an exciting self-read for your 3rd-5th grader. It's an old classic worth rediscovering! ♦

When visiting tide pools, most excited children have limited attention spans. *Pagoo* is the perfect follow-up. Children can all relate to the need for a home, family and tasty meals.

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Book Review

Pagoo

by Holling Clancy Holling; Houghton Mifflin Company; 87 pages; \$11.95 (paperback), \$20 (hardback)

Reviewed by Denise Dowsett



We float in the plankton, settle onto a mussel bed, are tossed in the splash zone, wander through kelp forest and sandy bottom, and barely survive the deep reef realm of octopus and wolf eel.

Through the eyes of a Hermit Crab named Pagoo, a complex and amazing web of life is brought into focus. This is a book the whole family can enjoy, the perfect extension of a day at the tidepools. From planktonic larva to adulthood, through each molt, we hold our breath with Pagoo, as he witnesses and is caught in the middle of a constant battle for space, safe shelter, and food.

Pagoo first moves into an empty barnacle shell. "Pagoo's Barnacle towers had grown on a two-inch Smooth-Turban Shell, made by a Snail, and inside the shell lived a fat lady Hermit. What with Pagoo lodged in her attic, she was his landlady...She wobbled quite a bit when she walked, but, of course, she was carrying an apartment building." Pagoo soon discovers that his fate is tied to that of his fellow tenants. "The fish who had swallowed Pagoo (along with his landlady, five Barnacles, and seven shells of Traveling Towers), was Big Head Sculpin."

Pagoo survives this and many other adventures as he continues his search for the perfect shell. "But this was Tide-pool town, with a housing shortage. When poor Pagoo got to the shells, they were taken...he was switched by feelers, smacked by gloves, or he got a foot in his face."

Along the way we discover the dangers Pagoo and his fellow tidepool dwellers face. When a rainstorm hits, "At first there was the blankness

of muddied water. Then Pagoo saw nightmares of frightened creatures rushing seaward—dim shapes of Crabs, Fishes, Shrimp, Worms, Lobster, Swimmers and Crawlers by the thousands were on the move to deeper places. They knew by instinct that unsalted water would kill them. Now this poisonous freshness was raining down!"

A rich, detailed 360-degree panorama unfolds. We float in the plankton, settle onto a mussel bed, are tossed in the splash zone, wander through kelp forest and sandy bottom, and barely survive the deep reef realm of octopus and wolf eel. We learn how sea stars and snails eat, how mussels anchor themselves, that limpets return to rocky home scars, that sea cucumbers, sea stars and sea urchins are related to each other.

"While Pagoo snoozed, the purple Starfish began eating his shellfish meal. How? He had no mouth like yours, no tongue nor teeth, but he did have a very remarkable stomach...Just as your meat is sometimes made more tender by soaking it in tenderizing liquid, a Starfish has its own special solution...While his Mussel steaks become very tender, the Star spreads out his stomach like a frilly napkin. Draping it over the food in the double-shell serving tray, he absorbs the dainties right through it..."

"The Snails with shells, were feeding everywhere,...each Snail was grazing, scraping off

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