BETWEEN the TIDES

Friends of Fitzgerald Marine Reserve
March 2021

Fitzgerald's Only Coral: Balanophyllia Elegans (Orange Cup Coral)

by Tom Ciotti

Orange cup coral is undoubtedly the least commonly talked about Cnidarian found at Fitzgerald Marine Reserve. Until now there has never been a Between the Tides article about it. In my notes from my 2003 docent training class there is but a single sentence, "There is a coral, bright orange and red in the reserve." In FFMR's publication "The Natural History of the Fitzgerald Marine Reserve" there is a photo of it and two sentences about it and indicates it can be seen in the urchin pools adjacent to Cypress Point (an area to which access is now restricted for harbor seal protection). Its lack of attention is sad, because it is one of the more interesting denizens of the reserve.

It is a solitary coral consisting of a polyp encased within a cylindrical limestone skeleton. The interior of the cylinder is divided into numerous chambers by radial septa according to an exquisite architecture called the Pourtàles plan (Fig. 1). This coral is relatively small, averaging about 1 cm in diameter. The oral disc of the polyp has a single slit-shaped mouth that opens into its gastrointestinal cavity and is surrounded by 36 translucent tentacles which extend out of the skeleton when the coral is feeding. The entire polyp can be retracted into the skeleton. As its common name indicates, it is indeed orange—not just run-of-the-mill orange, but a vivid, elegant red orange, hence the term "elegans" in its scientific name. Most of the coloring we see in Fitzgerald's organisms results from the light wavelengths that are reflected from the surfaces of the organisms. But the vivid orange color of cup coral is not the result of reflected wavelengths. Instead it results from wavelengths emitted from the coral's pigment via fluorescence. That pigment, a member of the green fluorescent protein family, absorbs wavelengths from the short, high-energy end of the spectrum (blue and shorter) and emits wavelengths from the longer lower energy portion of the spectrum, in this case orange. Because its color is generated in this manner, its orange color can still be seen at ocean depths up to about 9 meters.

Orange cup coral
Photo Source: Monterey Bay Aquarium

Orange cup coral is a suspension feeder and its main prey is zooplankton which it catches with its tentacles. Like other Cnidarians its tentacles are armed with nematocysts which it uses to sting and immobilize its prey. But its tentacles also carry a second weapon—spirocysts. Spirocysts are hollow sticky threads which are ejected from cells on the tentacles and coil around and ensnare prey. I didn't know spirocysts existed until I did research for this article! Did you? Orange cup coral is also uniquely capable of extracting dissolved organic carbon as a nutritional source from seawater. This capability may be critical to the coral's survival in times when zooplankton is scarce.

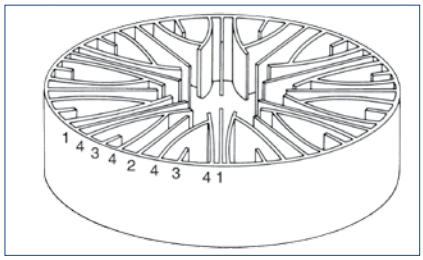

Fig. 1 Pourtàles plan.
Source: coralsoftheworld.org, Veron Archives

continued on page 2

Fitzgerald's Coral *continued from page 1*

Predators of adult cup coral are few, likely because of the coral's limestone armor and toxic weaponry. The leather star is one, but it will avoid cup coral if easier pickings are available. Aeolid nudibranchs such as *Hermissenda crassicornis* are also known to occasionally attack orange cup coral.

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Unlike most of its colonial coral and anemone relatives, orange cup coral does not harbor symbiotic algae. The scientific name for this condition is "azooxanthellate." As such, cup coral is not susceptible to coral bleaching, a situation in which corals that do harbor symbiotic algae expel the algae, usually due to warming stress, and often die.

Orange cup coral is found in the low and subtidal zones along rocky shores of western North America from British Columbia to Baja California. It is partial to locating in areas of high water flow such as on the walls and overhangs of surge channels. This is likely because of the abundance of prey in such areas. At Fitzgerald, I was always able to find them on walls and overhangs of the surge channels located at the southwest edge of the Rhodomela-Gastroclonium Flat habitat. There is an interesting research article from the Friday Harbor Laboratories in Washington that involves the geographical range of orange cup coral and how ocean acidification might affect populations in the northern part of the range differently than populations in the southern portion. This range is exposed to fluctuating pH caused by seasonal occurrence of upwelling which brings more acidic (lower pH) water to the surface. But the extent of upwelling and thus pH fluctuation differs along the range. Along the California coast, Northern California (roughly above Santa Barbara) experiences more upwelling than Southern California. The article reports that the Northern California populations of orange cup coral are exposed to pH<8 water (relatively acidic) about 42% of the time, whereas the Southern populations were exposed to such water only 22% of the time. The article reports looking at the effects of exposure to pH<8 water on individuals from each of the populations with respect to metabolism and gene expression and found that the Southern populations were adversely affected, whereas the Northern populations were relatively unaffected. The article thus concluded that the Northern populations had already adapted to more acidic conditions and would tolerate future ocean acidification better than the Southern populations. Of course, to some of us it was totally expected that Northern Californians would be more adaptable and tolerant than Southern Californians!

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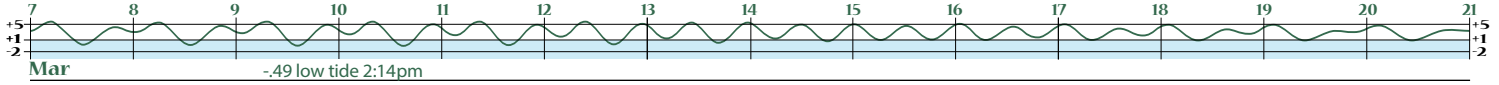
The graph displayed across the page bottoms shows tides for 3/7/21 to 7/26/21 at Princeton Harbor. Where the date appears is midnight. The reefs are accessible for exploring during low tides—at least +1 or below. This area is shaded light blue. See: http://www.fitzgeraldreserve.org/newffmrsite/lowtides/ and click on "Tides" for a more detailed tide chart.

The winter afternoon low tides change to morning low tides in March. There are almost equally low tides several days before and several days after the noted low tide dates.

The lowest tides this period at Princeton Harbor are:

-.49	3/9	2:14 pm	-1.99	5/27	6:02 am
			lowest tide of 2021		
-.31	3/26	3:59 pm	-.86	6/12	6:46 am
-.66	4/1	8:17 am	-1.93	6/25	5:50 am
					second lowest tide of 2021
-1.56	4/29	7:06 am			
fourth lowest tide of 2021			-.81	7/11	6:27 am
-.62	5/14	7:04 am	-1.45	7/23	4:51 am
			fifth lowest tide of 2021		



Now we come to the most interesting thing about orange cup coral: its reproductive biology, which is quite different than that of its anemone relatives and even most of its coral relatives. The leading research on this subject is reported in a 1982 article in Marine Biology by John Pearse, et al. It reports that reproduction in this species is exclusively sexual. This is highly unusual since the vast majority of Cnidarians, including both colonial and solitary corals, are capable of both sexual and asexual reproduction. Females of reproductive size harbor eggs and brood embryos continuously throughout the year. The Pearse study found an average of about 40 eggs and about 25 embryos in such females. In contrast, males spawn only once a year in late summer/early fall. Fertilization occurs within the gastrovascular cavity and the embryos first attach to septal tissue and later in their development cycle are brooded in the interseptal chambers. The presence of both eggs and embryos throughout the year may be the result of exceptionally long, overlapping egg growth and embryo development times, on the order of 14 to 15 months (5 to 6 months longer than human embryo development!). Since the fertilization cycle is shorter than the embryo development cycle, this means that sexually mature female orange cup corals are pregnant all the time, often with two distinct broods! As in most animal species, the females of this species clearly do the vast majority of the work.

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The embryos develop into larvae called "planulas." The planulas look like small flatworms measuring 3 to 5 mm in length and 1 to 2 mm in width when extended. They have a distinct crimson-red color in contrast to the orange color of adults. At full maturity the planulas crawl out of their parent's mouth and down her skeletal wall to the substrate. This process is called "planulation." Pearse et al found that planulation occurs in winter/early spring 14 to 15 months after egg fertilization. Orange cup coral planulas are uniquely strictly benthic. In other words they never swim or float in the seawater as is typical of Cnidarian larvae. They remain on the substrate and their only mode of locomotion is crawling/gliding which is believed to be aided by the short flagella that cover their bodies. There is also speculation that they may use their spirocysts in attaching to the substrate.

The seasonal planulation observed in orange cup coral is thought to coincide with environmental conditions that favor successful settling and survival of juveniles. Studies have shown that available rock substrate and moving water are two factors that affect settling with 90% settlement within 3 days of planulation when both factors were present and only 11% settlement within that time period in the absence of one or both of those factors. In this regard winter storms scour the rock substrate along our coast and there is typically maximum free rock space available for settlement in winter/early spring before heavy algal growth begins.

Interestingly, Pearse observed only about 50% juvenile mortality within 2 months of planulation. This exceptionally low level of mortality is undoubtedly attributable to brooding, timing of planulation, and strictly benthic dispersal of juveniles.

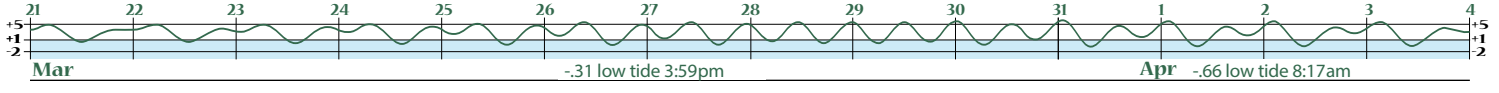
Because orange cup coral planulas are strictly benthic one would expect that orange cup coral is a short distance-dispersing species. And that is absolutely the case. Juveniles settle only an average of about 15 inches from their mother. To me, this earns orange cup coral the title of "mammoni of the intertidal." For the non-Italian speaking reader "mammoni" means mama's boys and refers to the young Italian men who never stray far from their mothers. This short distance dispersing explains why we often see cup coral in patches at Fitzgerald. So how did they get spread over a geographical range extending from British Columbia to Baja California? Most likely by "stepping stone" expansion over a VERY VERY long time.

I hope that you enjoyed reading this article as much as I enjoyed researching and writing it. And if I run into you at Fitzgerald, you're definitely going to be quizzed about *Balanophyllia elegans*! ◆

Orange cup coral
Photo: wikipedia

Juveniles settle only an average of about 15 inches from their mother. To me, this earns orange cup coral the title of "mammoni of the intertidal."

Planula larva of
Balanophyllia elegans
Photo: © Allison J. Gong
9 April 2020



Tide Pooling Beyond Tide Pools!

by Scott Snow · photography by Scott Snow

Snakehead cowry

Helmet urchin

White sea urchin

Monterey dorids

By exploring and broadening your definition of tide pooling, you can enjoy this rewarding activity more frequently and in more places.

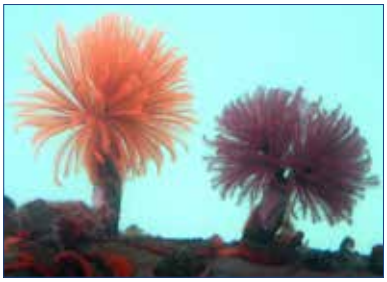
Back in 2004, I finally took heed of the tiny brown "Wildlife Viewing" sign on Rt 1 that I'd passed dozens of times before and pulled off at Moss Beach to visit the Fitzgerald Marine Reserve (FMR) for the first time. After that initial visit, I was hooked on tide pooling. Looking back I think what captivated me most was the certainty of an up-close observation of such an interesting, diverse, and concentrated collection of creatures. It was like a treasure hunt where you know you are going to find an amazing variety of gems every time, but you don't know which gems specifically. Since then I've been volunteering at FMR and tide pooling almost everywhere I go. All it takes is an explorer mindset and, in some cases, a slightly broader definition of tide pooling.

An adventurous spirit will go a long way. Anytime you are near any tidal rocky coast you will find tide pools. Of course reefs are best because the flat surface makes for loads of surge channels and tide pools, but even low-lying rocks and boulders can have small pools on top of or under them, in cracks, and even pools in the sand between boulders. Following the formal definition of a tide pool, I've found tide pools from San Diego, California, to Newport, Oregon. In Maui, Hawaii, I found a snakehead cowry *(Cypraea caputserpentis)* and a helmet urchin *(Colobocentrotus atratus)*; on St. Croix a white sea urchin *(Tripneutes ventricosus)*; and many other animals in tidepools near Playa Negra, in Costa Rica, and in the Galapagos Islands. Some of these places are easily found with an internet search, but others I found just by heading to any random coast at low tide.

If you expand the definition of tide pooling slightly to include any accessible hard substrate where animals and algae can attach, the possibilities expand to all saltwater ecosystems. Just within the San Francisco city limits, I've found giant pink sea stars on pylons feasting on barnacles; California sea stars on rocks feeding on mussels; orange and yellow sponges on docks; green-lined shore crabs *(Pachygrapsus crassipes)* in the cracks of the rock jetty; a foursome of Monterey dorids *(Doris Montereyensis)* on the wall of a crack in a sea cliff engaged in daisy-chain reproduction; gooseneck barnacles with unfurled fanned legs filtering the seaspray for breakfast; limpets traveling (slowly) across a cliff face with eyes and foot fully expanded from their shells; green and aggregating anemones, and purple sponge attached to rocks and cliff faces. Many of these sightings have been outside the Golden Gate, but some sightings within the Golden Gate include Angel Island, a San Francisco marina, and along the rock jetty/seawall near Crissy Field.

Limpet

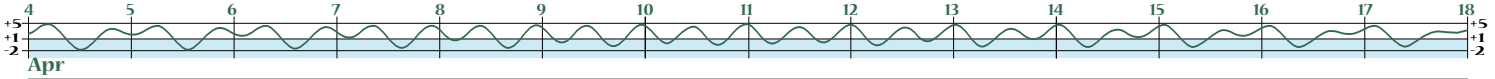
Strawberry anemones



Feather duster worms

White sea cucumber

Outside of San Francisco, I've enjoyed spotting barnacles in such unexpected places as Brooklyn, New York City, and Copenhagen, Denmark.

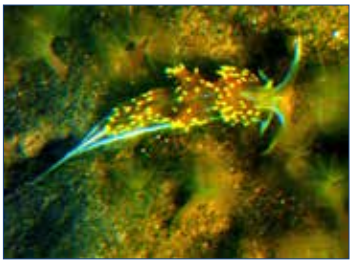


I have observed feather-duster worms *(Euedistylia vancouveri)*, strawberry anemones *(Corynactis californica)*, scallops, tunicates, and plumose anemone *(Metridium senile)* on the submerged sides of floating docks in Half Moon Bay, black abalone near Monterey; and white sea cucumbers *(Eupentacta quinquesemita)* at Bean Hollow State Beach.

Scallops, plumose anemone, tunicates, and white-plumed anemones

Thetys vagina

Moonsnail



Hermissenda crassicornis

Ghost shrimp

Shag rug nudibranch

If we expand the definition of tide pooling further to include searching for any sea creature by any means other than diving, the possibilities expand immensely. At Ocean Beach in San Francisco, I've found sand crabs, salp (*Thetys vagina)*, sand dollars, clams, and by-the-wind sailors *(Velella velella)* while walking along the beach. While surfing at Ocean Beach, I've paused to check out bryozoa on floating pieces of kelp and a kelp crab living on a floating discarded ski hat. In Tomales Bay, I have observed a number of creatures by peering over the side of my SUV, walking along the beach/mudflat—a moonsnail *(Euspira lewisii)*, or wading. I have found *Hermissenda crassicornis* in a forest of hydroids, sliding between their trunks, under their outstretched limbs spread like boas of trees; ghost shrimp in the mudflats, shag nudibranchs *(Aeolidia loudi)*, on bay rocks; and expanses of sea-grass with sea-hares and crabs hanging from their blades. In sandy tide pools on a beach in South Carolina, I found sea stars. While beach-combing in New Jersey, I witnessed thousands of horseshoe crabs *(Limulus polyphemus)* turn the bay into white milk with their sperm and eggs.

Even away from saltwater, it's possible to find tide pool-like creatures. While kayaking in California lakes, I have found blobs of the magnificent bryozoan *(Pectinatella magnifica)* attached to submerged tree trunks. And while wading in rivers and creeks from California to North Carolina to New Jersey, I have found clams, mussels, snails, and crayfish. While hiking in the mountains of Turkey, I observed a tree-climbing freshwater crab; and while hiking the coastal range south of San Francisco I filmed mating banana slugs *(Ariolimas columbianus)*. Even in my backyard I've photographed mollusks such as small slugs and gorgeous garden snails *(Helix aspersa)*.

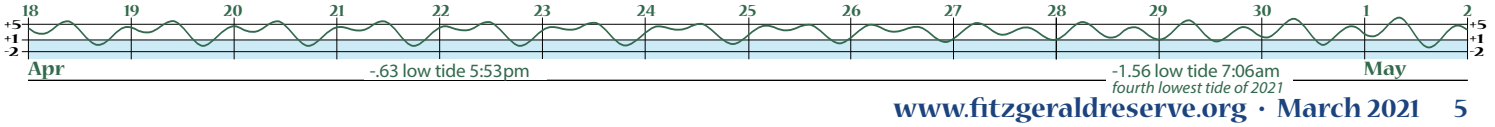
In most of the above examples, tide pooling was not the primary goal. Rather, I was on vacation, hiking with my family, camping on a lake with friends, at a wedding along the coast, in New Jersey for Thanksgiving, on a business trip to St. Croix, or just hanging out in my backyard. In many cases, I did not even think about tide pooling in advance. I just used my powers of observation in places I found myself and was rewarded with treasures. Often, these experiences were accompanied by other special sightings like whales, dolphins, porpoises, sea-lions, seals, leopard sharks, bat rays, long-legged birds, and fish-snatching osprey.

Even if I've stretched the definition of tide pooling a little bit, I hope this encourages you to try tide pooling everywhere you are and everywhere you go, sometimes by planning it out, and other times by just exploring wherever you find yourself. ◆

Crayfish

Banana slugs

Garden snail



Magnificent Ocean Matriarchs

by Mary Jane Schramm, NOAA-GFNMS

For two hours the whale watchers remained transfixed, witnessing an array of killer whale behaviors that included milling, resting, scouting, and hunting for fish. Some were even spyhopping… The encounter was as rare as it was magical.

These oceangoing "grannies" and the unique assets and experiences they bring to the pods may very well be the key to their collective survival.

It was March, 2009 and less than 20 miles from San Francisco in NOAA's Greater Farallones National Marine Sanctuary, when the whale watch captain and naturalist spotted several black fins approaching. Soon more appeared: in all, an estimated forty "Southern Resident" killer whales, *Orcinus orca,* were headed their way! The captain quickly reduced speed and maintained his distance to better observe their activity and assess their course. For two hours the whale watchers remained transfixed, witnessing an array of killer whale behaviors that included milling, resting, scouting, and hunting for fish. Some were even spyhopping: poking their heads above water to scope out their surroundings. There were bulls with their six-foot dorsal fins, cows with tender young calves, and other adult females, juveniles and sub-adults. The encounter was as rare as it was magical.

Gimme Shelter

Highly endangered Southern Resident killer whale pods J, K and L formerly lived year-round in the Puget Sound/the Salish Sea region, nearly 900 miles to the north, feeding mainly on chinook, or "king" salmon, *Oncorhynchus tshawytscha.* But salmon populations in the Pacific Northwest, greatly reduced through severe habitat degradation, have plummeted, and now these starved fish-eating whales must forage far to the south in North-Central California waters, where they're seen in winter and spring. As early as January 2020, they have been photo-documented in Monterey Bay, having visited our Greater Farallones and Cordell Bank national marine sanctuaries en route; they likely passed not far offshore from the marine reserve! These whales are refugees, driven by hunger to extremes, their numbers dangerously low; as of October, 2020 only 74 remained. But one great hope for their continued existence lies in an unlikely quarter: the eldest females among them. These oceangoing "grannies" and the unique assets and experiences they bring to the pods may very well be the key to their collective survival.

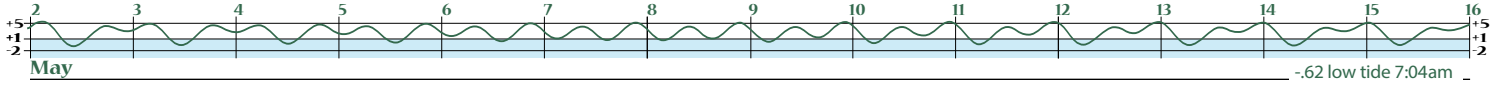
Typical killer whale group of adult females and younger males. Photo: NOAA-NMFS

Grand Dames

Killer whale societies worldwide are matriarchal, but these Southern Resident groups are the most socially stable of all. They are matrilineal, i.e., a female (matriarch), her offspring, and her daughters' offspring remain together for life. They hunt, play, socialize and rest together; they form extremely strong and long-lasting familial bonds. Female killer whales can reach 90 to 100 years of age, while males live only half that long. It is these dominant old matriarchs who exert the most enduring strength, resourcefulness, and leadership.

"Southern Resident" killer whales from the Pacific NW search far for fish prey in GFNMS. Photo: ©Chris Colombana, 2009

Killer whale bull breaches. Photo: NOAA



Menopause is rare in nature; females in only three animal species live a significant time after becoming reproductively inactive: killer whales, pilot whales, and humans. At around age 50 females undergo menopause, and cease bearing calves—yet they live on. Why? What is the advantage in living for several decades beyond their ability to contribute to the gene pool? The answer may lie in the complexity and stability of their societies, and the matriarchs' role in them, which may prove to be the Southern Residents' greatest hope against extinction.

Seasoned Strategists

Drawing on 35 years of field data and other research, scientists from the Center for Whale Research in Washington State collaborated with Fisheries and Oceans Canada, the University of Exeter, and the University of York in England to examine and analyze images and observations—multigenerational histories and behavioral patterns—of these tight-knit clans. The scientists had determined that older females, past calf-bearing age, typically choreographed and led their pod's activities while hunting, socializing, and traveling. This hierarchy prevailed when salmon were relatively abundant; and it continues even now, when nutritional crisis has driven them to dramatically alter their survival strategies.

Female killer whales can reach 90 to 100 years of age, while males live only half that long. It is these dominant old matriarchs who exert the most enduring strength, resourcefulness, and leadership.

The Greater Good

Freed from calf-rearing duties, the grannies can direct all of their energies toward helping other females' offspring survive. The intergenerational transfer of ecological information can promote maximum foraging efficiency and other essential skills. These whales remain available for decades, as hunters and providers, protectors, and as tutors, passing on killer whale culture, societal mores, and skills to subsequent generations. After menopause, they serve the broader extended family: grand-calves, nieces and nephews, even their own adult sons and daughters. Mothers have even been known to share their catch, most frequently with their adult sons; why? These sons will live to mate and pass along her maternal DNA to calves they sire; that's a "win" in the DNA Game.

Sustenance

Hope also lies in the bounty of Cordell Bank, Greater Farallones and Monterey Bay national marine sanctuaries. Though our salmon populations are also stressed, other prey abound here: rockfish, groundfish, herring and other species. These may be sufficient to sustain these whales through the present troubling times.

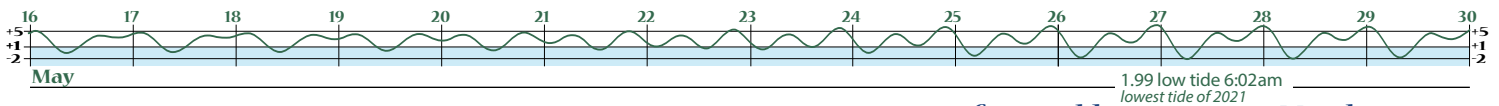
Learn what NOAA is doing about this at https://www.youtube.com/watch?v=_MFQljQvbkw and Saving the Southern Residents story map: https://noaa.maps.arcgis.com/apps/Cascade/index.html?appid=3405e6637bf74e998d4ebe992c54f613 (a scroll-through site)

Don't forget to visit www.farallones.noaa.gov ◆

Yellow tinge shows killer whale calf was just born. Photo: NOAA

Young calf clinging close to cow. Photo: NOAA

Killer whales jumping (breaching). Photo: Robert Pittman-NOAA



Friends of Fitzgerald Marine Reserve Granted Scientific Permit from San Mateo County

by Karen Kalumuck

"With changing climate conditions affecting the temperature, pH, and other characteristics of the ocean environment, the arrival of competing organisms or loss of resident organisms due to migration, change in food supplies, disease, or changing ecological structure, a first step to documenting these changes is the periodic counting of select species, monitoring the health of species, and reporting of novel organisms. In light of these concerns, we propose the following research activities: Counts of individual organisms; documentation of suspected disease in organisms; and documentation of novel and/or invasive species." From Friends of Fitzgerald Marine Reserve Scientific Research Permit Proposal, December 2020.

"…we propose the following research activities: Counts of individual organisms; documentation of suspected disease in organisms; and documentation of novel and/or invasive species."

What research questions do we want to ask? What areas of the reef would we study? How will we gather data, post data, distribute data? How frequently should we do these surveys?

How did we get here?

During the August 2020 ZOOM FFMR Board meeting, it was brought to our attention that long- time volunteer naturalist Keith Mangold was promoting the idea of surveying the Fitzgerald Marine Reserve (FMR) reef before FMR reopens to the public. FMR had been closed since mid-March 2020 due to the Covid-19 pandemic; surely the lack of human impact would be visible in the numbers and diversity of intertidal organisms? Little long-term research is ongoing at FMR, with the notable exception of the LiMPETS program (Long-Term Monitoring Program and Experiential Training for Students) (https://farallones.noaa.gov/education/limpets.html) run through the Greater Farallones National Marine Sanctuary, which has been collecting data at FMR since 2006. The closure provided an unprecedented opportunity to establish a picture of the intertidal ecosystem at FMR after it has had a break from human activity.

We quickly discovered that we needed to obtain a Scientific Research Permit from San Mateo County to access the reef. In lieu of going down that path, we explored "piggy backing" with the staff of LiMPETS during their research surveys of FMR. Rosemary Romero, the LiMPETS coordinator, was cautiously enthusiastic about our participation and wrote special protocols to accommodate us during the pandemic. Eight of us were approved to join Rosemary and a colleague for a December 11 survey. But it was not to be. On November 9 the Greater Farallones National Marine Sanctuary canceled all approved field trips due to the upward trajectory of Covid-19 cases.

Bummer.

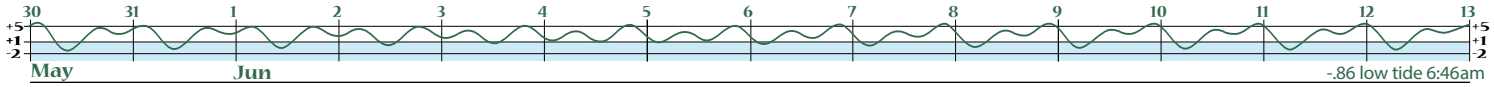
Yes, we can!

While we were making plans with Rosemary and LiMPETS, we were also batting an idea around at FFMR Board meetings—should we, could we, apply for and be awarded a Scientific Permit from San Mateo County? Nicholas Calderon, the Director of Parks for San Mateo County, routinely attends FFMR Board meetings. Initially he seemed unsure about the idea, but after consulting with County Parks Rangers and Natural Resource staff, he informed us during our November 11 Board meeting that we could potentially be awarded a Scientific Permit for 22 months, and the County would generously waive the permit fee. We just needed to submit a detailed plan.

Devil is in the Details

The FFMR Research Committee (Linda Ciotti, Karen Madsen, Julie Walters, and myself) rapidly set out to gather the information for our permit proposal. What research questions do we want to ask? What areas of the reef would we study? How will we gather data, post data, distribute data? How frequently should we do these surveys? Many hours of Zoom meetings and countless emails later, we had most of the answers. We considered the capacity and skills of our volunteer naturalist pool, and followed the goals set by the California Academy of Sciences and their "Snapshot Cal Coast" citizen science initiative (https://www.calacademy.org/calcoast). We decided that our surveys would focus on the counts of the following organisms:

Sea stars: Sea stars have been devastated by the sea star wasting disease, and we propose to document the numbers of six star species at the



reserve, including the ochre star, *Pisaster ochraceous* and the bat star, *Patiria miniate*.

The Giant Green and Sunburst Anemones: The giant green anemone, *Anthopleura xanthogrammica,* had been a predominant anemone species in the Northern California rocky coastline. There is evidence that the sunburst anemone, *Anthopleura sola,* normally a species found in Southern California, is migrating northward and competing with the giant green anemone.

Nudibranchs: The number and diversity of nudibranchs is an indicator for marine ecosystem health. We are particularly interested in documenting the numbers of species known to be migrating northward, such as the hopkins rose, and the Spanish shawl. We intend to count all nudibranchs found at our research sites.

In addition, we will document any incident of disease in organisms, such as sea star wasting disease, as well as several species identified by Snapshot Cal Coast as novel and invasive.

One last critical thing that we still needed to do was to determine exactly what parts of the reef we would survey. We needed access to the reef, and the next best day was December 14 with a -1.7 low tide. But we needed a County permit. After submitting an application, and a bit of nail biting on our part, the County issued us a short-term Scientific permit on Dec. 10.

On a blustery December 14, Linda, Karen, Julie and I, clad in yellow safety vests and armed with our Scientific Permit, metal tape measure, and our phones (for photos tagged with GPS coordinates) slid behind the chain link fence and over a wooden barricade to descend the Seal Cove stairs. We spent two hours considering sites, using natural landmarks as borders, measuring distances and collecting GPS coordinates. We settled on two sectors: a trapezoid- shaped one beginning just north of Cypress Point and including the mussel bed area, and the other, a long rectangle that follows a major surge channel (see Figure 1). We finished the painfully detailed proposal, and submitted it to the County just before Christmas. We crossed our fingers that we would receive the permit in time for our first real Survey on Monday, January 11, 2021. Thanks to the County's expedition of our request, the Scientific Permit was approved on January 5, 2021, and is valid through Dec. 31, 2022.

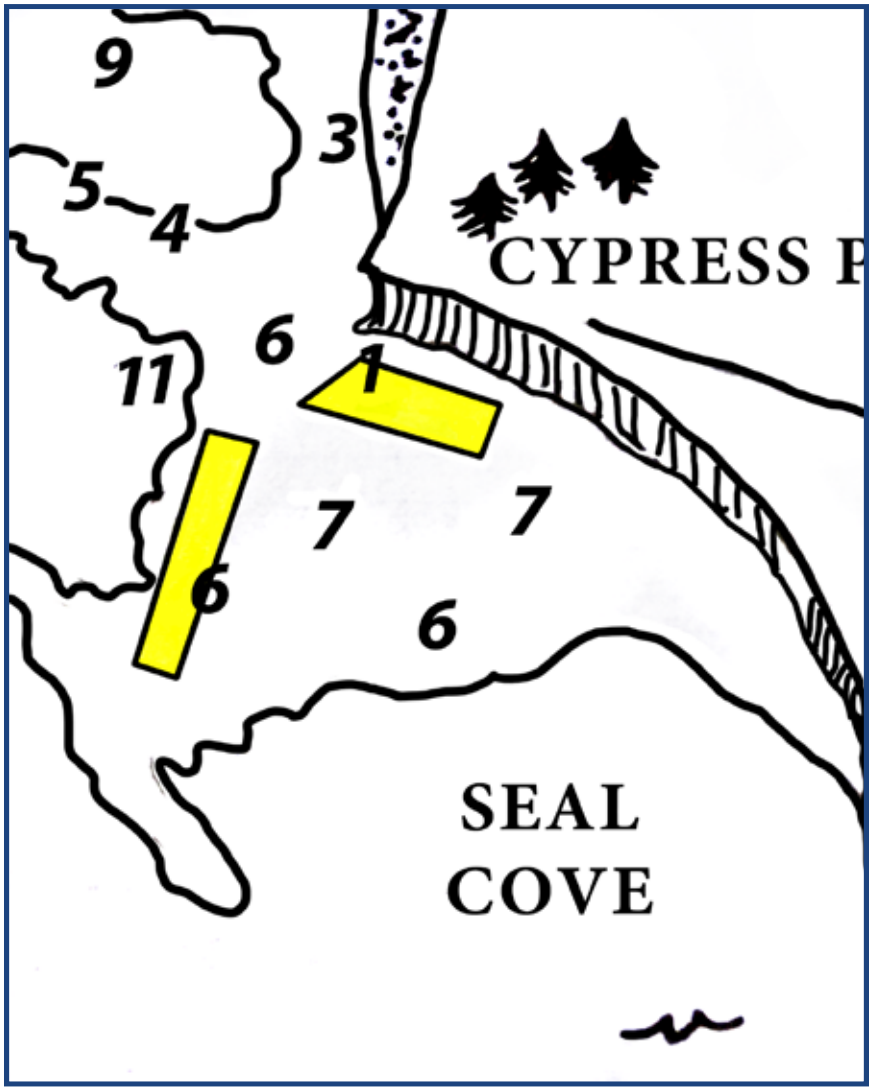


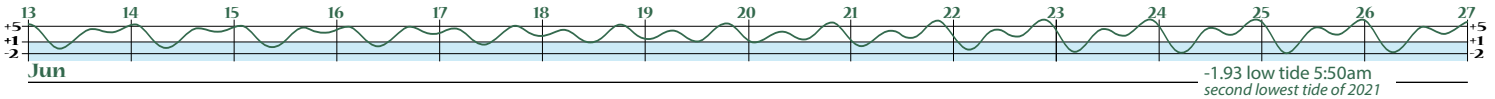
Figure 1. FFMR Research Sectors at FMR. Sector 1 (trapezoidal) has a corner at Cypress Point; Sector 2 follows a main surge channel (illustration is not to scale).

Nature Bats Last

While Covid-celebrating the holidays, we recruited the FFMR Research Team, all long-time volunteer naturalists. Due to Covid-19 restrictions we were limited to a total of ten people on the reef at any one time. We put together a training session on Zoom, and excitedly awaited the big day.

January 11 arrived, and a big day it was—for waves! Yep, there were 60-foot wave faces at Maverick's, and unrelenting pounding, huge surges. After agonizing over whether to go out or not (All the prep work! Folks changed their schedules to participate!), safety concerns won out and we wisely canceled the outing. ➥

On a blustery December 14, Linda, Karen, Julie and I, clad in yellow safety vests and armed with our Scientific Permit, metal tape measure, and our phones… slid behind the chain link fence and over a wooden barricade to descend the Seal Cove stairs.



The Research Team. From left, Graham Brew, Allison Adams, Tom Ciotti, Jeanette Hyer, Karen Kalumuck, Ron Olson, Linda Ciotti, Keith Mangold, Karen Madsen, and Julie Walters. Photo credit: Julie Walters

We were surprised at how few giant green anemones were found in Sector 2, and at the huge abundance of sunburst anemones! We were disappointed in the number of sea stars.

On the Reef

We rescheduled the first survey for February 9, with a solid -1.0 tide. We reassembled the team, and were rewarded with a perfectly calm day for our Survey.

Our group of ten was divided into two teams. Sector 1, the larger sector, was divided in half; two volunteers covered each sector, one tallying our target organisms, the other photographing them. Two other team members served as "monitors" to manage the boundaries of the subsectors. The boundaries of Sector 2 were five feet in either direction from the top of the surge channel. Two, two-member teams covered this sector.

The team at Sector 1. The two closest cones mark the beginning of Sector 2 along a surge channel. Photo credit: Karen Kalumuck

Each group completed the surveys in about 90 minutes. Everyone realized that we would learn a lot from this inaugural survey, not just about the animals on the reef, but how we could improve the survey, and the process will be tweaked as we continue doing quarterly surveys over the long term. As FMR re-opens and the limit on the number of participants is lifted, we hope to extend the opportunity to participate in these surveys to larger numbers of docents.

Initial Results

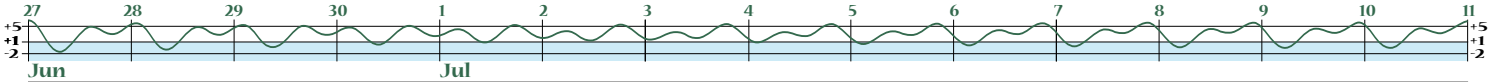
What did we find in the inaugural survey?

Julie Walters is the data cruncher of the group, and provided the initial tally of organisms:

	Sector 1	Sector 2	Total
Giant Green Anemone *Anthopleura xanthogrammica*	86	4	90
Sunburst Anemone *Anthopleura solas*	270	396	666
Sea Stars *Pisaster ochraceous*	11	4	15
Bat Stars *Patiria miniata*	4	0	4

No nudibranchs were observed, nor instances of sea star wasting disease, nor invasive species.

We were surprised at how few giant green anemones were found in Sector 2, and at the huge abundance of sunburst anemones! We were disappointed in the number of sea stars. And, we realized that very young sunburst anemones look pretty much like aggregating anemones… we hope to solve the identification problem by only counting sunbursts greater than three inches in diameter; this would exclude all aggregating anemones, which never grow that large.



Volunteer Spotlight on GRAHAM BREW

Graham Brew has been a docent with FFMR since 2014. He and his wife, Christine, completed the training class together that year and have been enjoying volunteering ever since. Graham and Chris have lived in California since 2001 and were delighted when they were able to move to the coast in 2006, first living for over a decade in Pacifica, and currently in Montara.

Graham grew up in the central English city of Birmingham (coincidently very close to where Paul Gater grew up—see BTT Fall 2020). As a young lad he loved being outside and exploring new landscapes, thus leading to a particular fondness for geography and geology. Following this passion, he studied geophysics at University College London, which included many fabulous field trips to coastal regions of the UK. He was also lucky in landing an internship in Santiago, Chile, which included fieldwork in the stunning (and exceptionally dry) Atacama Desert. His wanderlust still unsated, Graham was keen to journey further afield, and so he left the UK and entered the graduate school program in geophysics at Cornell University in beautiful upstate New York in 1995. He has lived in the United States ever since. It was at Cornell where Graham met Chris through a running group, and they married in Letchworth State Park, close to Ithaca in 2000.

As with many careers, Graham's work evolved away from fieldwork and towards the computer. He is currently a Product Manager with a small software company based in Alameda (and is very much enjoying not driving across the Bay Bridge every day in our current situation!). So when Graham was looking for volunteer opportunities he was keen to find a challenge

continued on page 12

Giant green anemone
Anthopleura xanthogrammica

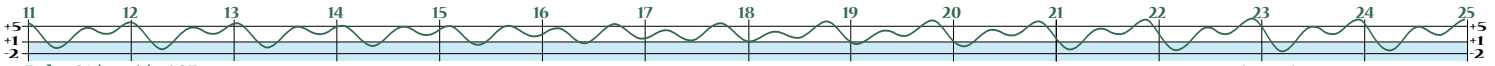
Sunburst anemone
Anthopleura sola

If an anemone is closed, such as at low tide, the giant green and sunburst can be distinguished by bumps on and texture of their column. The giant green (left) appears more like an avocado; the sunburst anemone (right) sports rows of raised bumps. Photos courtesy of Elaine Reade

Everyone realized that we would learn a lot from this inaugural survey, not just about the animals on the reef, but how we could improve the survey, and the process will be tweaked as we continue doing quarterly surveys over the long term.

Now What?

The Mission statement of FFMR includes the statement: *to encourage interpretive, educational, historical and scientific endeavors that relate to the marine environment and related ecosystems.* It's exciting for us to be directly involved in the scientific monitoring of our beloved FMR. We will be providing the data to the San Mateo County Parks Department, interested groups such as LiMPETS, and posting it to a world-wide audience on iNaturalist. By doing so, we will contribute to the body of knowledge about the ongoing health and composition of the rocky coastal environment at Fitzgerald Marine Reserve as its inhabitants are facing challenges due to climate change and human activities. ◆



Graham Brew *continued from page 11*

Grahame is an active orienteering participant…that involves running between locations indicated on a map (no GPS allowed—just an old school compass)….if you let your attention lapse for a minute it might take a while to work out where you are!

Hermissenda opalescens
photo: Arial Bauman

outside that involved working with a diverse public—aspects typically lacking in his daily work. FFMR seemed like an ideal fit. And when Graham spotted his first *Hermissenda opalescens* on an introductory tour (still his favorite tidepool critter) with Linda Ciotti, that sealed the deal!

Graham and Chris had been intending to take the training class for several years, but persistent travel for work (remember that?) meant that it had to wait until 2014. They consider themselves lucky that they saw many sunflower stars on the reef before the wasting disease took them all around that time.

Graham's work schedule allows some flexibility, so (during normal times) he typically manages to volunteer on several tours a month, or else you might find him roving on the low tide weekends. He enjoys revealing sea life on the reef to keen visitors. For the last several years he has also volunteered on the sea star counts. And he is currently enrolled in the research group taking a scientifically accurate census on the reef to help measure long term changes and the effects of recent events.

Graham considers himself very lucky and humbled to live in such a beautiful area and takes full advantage of this natural beauty whenever he can. When he is not working, or down on the reef, you might find him running on the trails around Montara and Moss Beach or biking along the coastal trail. He is a frequent participant in the Half Moon Bay triathlon which starts with an open water swim in the Princeton Harbor, usually in April. Those cool Pacific Ocean waters can be quite bracing, even with a wetsuit! Graham has also completed the Santa Cruz Half Ironman, and the Big Sur Marathon—no coincidence that he picks races that stick close to our spectacular coastline! He is also an active orienteering participant—a sport more popular in Europe than in the US—that involves running between locations indicated on a map (no GPS allowed—just an old school compass). Orienteering is an interesting blend of physical and mental challenge—if you let your attention lapse for a minute it might take a while to work out where you are!

Chris and Graham also love international travel tied with wildlife watching with Madagascar (lemurs), Uganda (mountain gorillas), and Arctic Canada (beluga whales) among past adventures. They look forward to traveling again. They have missed visiting Graham's parents and brothers who still live near Birmingham in the UK, just as we are all missing our far-away loved ones right now. In the meantime, they are enjoying pleasures closer to home with their mini pack of Pumi (Hungarian Herding dogs) with which Chris competes in dog agility nationally.

Graham thanks all the volunteer leaders and mentors at FFMR who over the years have organized the training, continuing education, and everything else that makes the FFMR such a fantastic group with which to belong. Graham looks forward to seeing folks, and all the marvelous sea creatures, back on the reef as soon as we are able. ◆

Friends of Fitzgerald Marine Reserve

Donation Chair, P.O. Box 669, Moss Beach, CA 94038, or through our website: www.fitzgeraldreserve.org

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