

# 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

October 2019

## It's a Party: *Babakina festiva* Makes an Appearance at Fitzgerald Marine Reserve

by Robin Agarwal

Looking like a fanciful Pokémon creature made out of pink, blue and yellow-striped candy corn, *Babakina festiva* (Roller, 1973) is one of California's more infrequently-seen nudibranchs and an even more infrequent visitor to the northern half of our state. It was therefore with great delight that nudibranch researcher Maria Schaefer spotted one of these rarities at Fitzgerald Marine Reserve's Seal Cove on August 30, during one of the last early morning minus-tide cycles of the summer.

The common name for *B. festiva*, Single-stalk Aeolid, comes from their unusual rhinophores, chemical sensory organs on their head that resemble ears. Unlike most nudibranchs' rhinophores, which appear distinctly separate from each other, *B. festiva* rhinophores appear to be fused at their base. Its genus name honors the esteemed Japanese sea slug researcher Dr. Kikutaro Baba.

*B. festiva* are not seen every year at Fitzgerald, but Schaefer and I were hoping to spot one of these beautiful animals, since many of the same favorable weather conditions were developing as in the years they were last seen at the reserve: 2015 and 2016. According

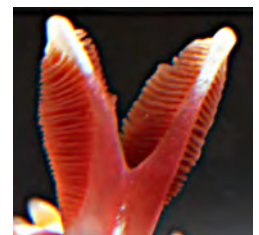
to iNaturalist.org observation data, no *B. festiva* had been seen north of Los Angeles County since those years, with the exception of one 2018 sighting at 40' depth off Anacapa Island by

scuba instructor Douglas Klug, and my own observation of a single specimen in Monterey Harbor earlier this year, in April 2019. The Monterey *B. festiva* was our inspiration for further investigations at Fitzgerald this summer.

"Colorful rare animals such as *B. festiva* can bring people together in their quest to see unusual beauty in nature," says Schaefer. In fact, Schaefer and I first met in 2016 at Seal Cove, the day after my first discovery of a *B. festiva* at Fitzgerald; we were both hunting for more. She continues: "It was great fun after those intervening years for us to get back on the same reef again in late August, and lo and behold, we saw another *B. festiva*."



*Babakina festiva*, photo: Robin Agarwal



*Babakina festiva* rhinophores (contrast enhanced)

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*"Colorful rare animals such as *B. festiva* can bring people together in their quest to see unusual beauty in nature."*

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While the published range of *B. festiva* extends from Nayarit, Mexico to Duxbury Reef in Marin

County, California, these beauties are far more likely to be encountered in the warm-water tidepools of San Diego County and points south. However, it appears that when anomalously warm

*continued on page 2*

## Friends of Fitzgerald Marine Reserve

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[www.fitzgeraldreserve.org](http://www.fitzgeraldreserve.org)

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## **B. festiva** *continued from page 1*

El Niño conditions bring warmer-than-normal water temperatures north, as in 2015-17 and perhaps to a certain extent this summer, settlement (the transition of a planktonic nudibranch

larva, called a veliger, to its more familiar adult, slug-like form) appears to increase for some southern nudibranch species such as *B. festiva*. For those interested in further reading on this topic, northern range extensions for 37 species of nudibranchs, with an average shift of 270 km during this period, were extensively researched by Dr. Jeffrey Goddard of UC Santa Barbara and published in September 2018.

The settlement of these beautiful nudibranchs may also coincide with increased availability of food, but we cannot be certain: nudibranch research scientists do not have enough data yet to identify the preferred prey of *B. festiva*. Nudibranchs are picky carnivores,

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*Nudibranchs are picky carnivores, feeding on very specific hydroids, sponges, anemones and other invertebrates according to species*

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feeding on very specific hydroids, sponges, anemones and other invertebrates according to species; this is the primary reason that most species of nudibranchs are nearly impossible to keep

in captivity for any length of time.

Based on their morphology, educated guesses have been made regarding *B. festiva*'s preferred habitat and prey, and more research is undoubtedly called for in the future. "With that big, broad snowplow foot, they look like they hang out in sand," says evolutionary biologist Brenna Green, comparing them to the even bigger-footed *Cerberilla* sp. nudibranchs of the tropical Indo-Pacific. "So if they do live in sand, that probably rules out hydroids; they might feed on anemones." Indeed, our recent *B. festiva* at Seal Cove was found crawling on red algae near sand, as was the Monterey Harbor specimen earlier this year. ♦

## Sea Star Wasting Disease Update

Every indication from our sea star counts point to a recovery of at least some of the populations of sea stars along the West Coast after the horrifying outbreak of Sea Star Wasting Syndrome (SSWS) that ravaged the West Coast for six years starting in 2013. Populations at nearly all sites in Washington and Alaska have not recovered to pre-SSWS levels. Drew Harvell, a marine ecologist who runs a Cornell University program at Friday Harbor, Washington, says that more of their study sites are stable now, with about 70% of the populations they had at the beginning of the outbreak. As of the end of August, SSWS was present, but only at low levels along the coast of Oregon south to central California.

Sunflower stars, *Pycnopodia helianthoides*, have disappeared from virtually all areas along the coast of California and Oregon, and have declined precipitously from Washington north to Alaska.

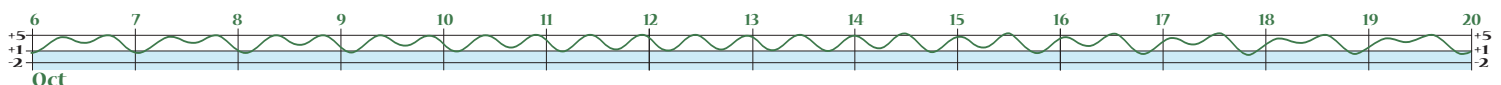
See the results of the Fitzgerald Sea Star Count held on July 6, 2019 on page 11.

The graph displayed across the page bottoms shows tides for 10/6/19 to 2/22/20 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/s>.

*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:

-0.90	10/29	6:22 pm	-1.18	12/25	4:11 pm
-0.63	11/15	6:26 pm	-1.33	1/11	5:13 pm
			6th lowest tide of 2020		
-1.25	11/27	5:06 pm	-0.85	1/23	3:59 pm
			5th lowest tide of 2019		
-1.09	12/13	5:06 pm	-1.18	2/08	4:11 pm
			-0.42	2/20	3:03 pm



## Exquisite Nudibranchs



*AEOLIDIA LOUI*



*DENDRONOTUS SUBRAMOSUS*



*DIRONA PICTA*



*HANCOCKIA CALIFORNIA*

Some of the more  
unusual finds in this  
year's Nudibranch Count  
(see page 11)



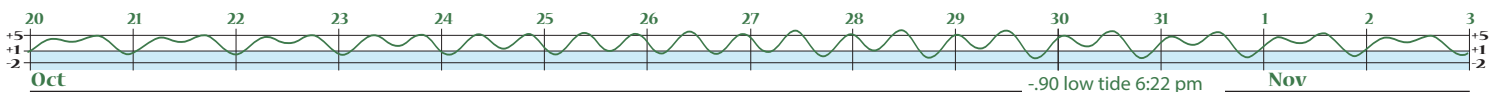
*DENDRONOTUS SUBRAMOSUS*



*ANTEAEOLIDIELLA OLIVE*



*DIAPHOREOLIS LAGUNAE*





# Students Contribute to MPA Monitoring by Measuring Owl Limpets at Fitzgerald Marine Reserve

by Rosemary Romero, LiMPETS Coordinator, Greater Farallones Association



Owl limpet, photo: Hannah Sarver

Recently, scientists observed that heavily harvested populations still contain females, but that the male-to-female transition occurs at smaller sizes than at protected sites like Fitzgerald.

LiMPETS examined differences in the range of size classes, or size distributions, of owl limpets found inside and outside Fitzgerald Marine Reserve. We hoped to use this exercise to teach students the importance of marine protected areas.

Fitzgerald Marine Reserve draws visitors from all over the world to explore its tidepools teeming with biodiversity and serves as an outdoor classroom for hundreds of students annually. Many are aspiring scientists with the Long-term Monitoring and Experiential Training for Students, or LiMPETS program. Established by marine biologist John Pearse, PhD, and managed by the West Coast national marine sanctuaries and partners, the statewide LiMPETS Rocky Intertidal Monitoring Program empowers youth to contribute to conservation of California's intertidal ecosystems.

Last spring, LiMPETS brought 35 high school students from San Francisco to Pillar Point Reef, in Monterey Bay National Marine Sanctuary's northern sector, managed by Greater Farallones National Marine Sanctuary. We encountered other schools as well—using the Rocky Intertidal Field Guide we developed with generous support from Friends of Fitzgerald Marine Reserve! It was great to see so many young students exploring the tidepools. While Fitzgerald and Pillar Point reef are located geographically nearby, they differ in one important way: how we interact with them.

Fitzgerald Marine Reserve is a no-take marine protected area—where fishing, collecting and other extraction is prohibited. Fitzgerald's highly protected status also restricts the number of people allowed in the tidepools at one time. By contrast, at Pillar Point recreational harvesting and sport fishing are allowed and no visitor limit is set. On this particular morning, the contrast between the Pillar Point crowds and Fitzgerald's relatively quiet mornings prompted us to wonder, could the LiMPETS program help to understand the long-term impacts of humans on these intertidal communities?

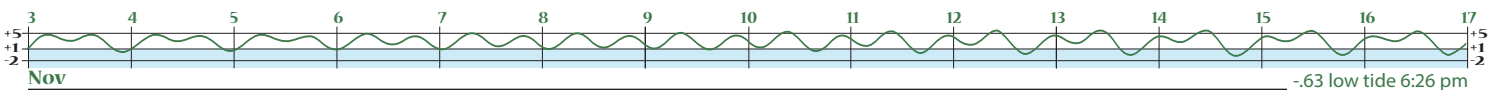
Reserve resource protection managers have sought to understand long-term impacts on commonly harvested intertidal organisms in San Mateo County. LiMPETS students monitor a variety of marine molluscs including owl limpets (*Lottia gigantea*) at LiMPETS sites, some of which, like Fitzgerald, are located inside California State Marine Protected Areas (MPAs).

Owl limpets are inconspicuous brownish-gray marine snails with cone-shaped shells that inhabit the high- to middle-intertidal zones from

Baja California, Mexico to northern California. During the recent marine heat waves in 2014-2016, owl limpets expanded their known range from Point Cabrillo to Bruhel Point, CA. Considered to be warm water loving creatures, they reach their highest densities in southern California, with historically low abundances north of Monterey, CA. These territorial limpets can grow larger than 7cm in size, the largest of which are usually female, as owl limpets are sequential hermaphrodites. (Owl limpets will begin their life as males and change from male to female as they grow). The size at which they change from male to female can depend on several factors including the amounts of physical disturbance by waves and harvesting. Students have been collecting size measurements and counts of owl limpets with LiMPETS at Fitzgerald since 2006 because they play an important role in intertidal ecosystems. Resident owl limpets will maintain a garden of microalgae to feed from, bulldozing any unwanted settlers like barnacles and ramming any other limpets that try to feed in their gardens. As owl limpets grow larger, they become more territorial. These territorial grazing activities help to maintain biodiversity in rocky intertidal assemblages by cultivating small patches of microalgae that would otherwise be replaced by mussels or barnacles.

Owl limpets are an important source of food for Black Oystercatchers and other shorebirds. However, they are harvested by people, who often select the largest individuals—the females. This has raised concerns that harvesting could result in populations dominated by smaller males, and thus impede reproduction and reduce overall numbers. Recently, scientists observed that heavily harvested populations still contain females, but that the male-to-female transition occurs at smaller sizes than at protected sites like Fitzgerald. Also, owl limpets in harvested populations grow more slowly than those found in protected areas. This indicates that harvesting forces the transition to female at an older yet smaller size. In the animal kingdom, larger and older females often produce more young than smaller, younger ones, which raises the question: how does harvesting affect owl limpets' capacity for reproduction, or reproductive output?

Since owl limpets play such an important role in the ecosystem, LiMPETS examined differences in the range of size classes, or size distributions, of



owl limpets found inside and outside Fitzgerald Marine Reserve. We hoped to use this exercise to teach students the importance of marine protected areas. Typically, we would have compared Fitzgerald to Pillar Point as it is geographically closer and the habitat is more similar to Fitzgerald. Unfortunately, we were consistently unable to locate any owl limpets in the Pillar Point plot after 2015. This could indicate that harvesting pressure in San Mateo County has a greater impact on owl limpets because they already have historically low numbers here.

As a result, we compared size distributions of owl limpets at Fitzgerald to those at Pigeon Point. Already historically low in abundance north of Monterey, we had a hard time identifying years in which at least 20 individuals were measured to generate size distributions for our owl limpet populations at both of these sites, despite having 12 years of data. In the end we were only able to compare data in 2010 and 2011 and detected significant differences in the size distributions in 2010 but not in 2011. During 2010, 95% of the owl limpets measured at Pigeon Point were smaller than 5cm, whereas 49% of the owl limpets measured at Fitzgerald were 5cm or larger, the largest of which was 8cm. The most common size of owl limpets

measured was twice as large inside Fitzgerald than at Pigeon Point. This means there are more territorial owl limpets at Fitzgerald, and they are likely to have a greater reproductive output than those documented at Pigeon Point.

There are several reasons other than protected status that could explain these results. Differences in habitat, including food supply, water temperature, physical disturbance by waves, and ability for larval owl limpets to settle at these two sites could all contribute to the difference we observed in 2010.

LiMPETS will continue to monitor at Fitzgerald and other San Mateo sites for future comparisons. This year we will be working with the California MPA Long-term Monitoring Program so that the data we collect can be combined with larger data sets to better understand the effects of over-harvesting on owl limpet populations. Partnerships among LiMPETS, scientists and resource managers enable students to actively contribute to the protection and responsible management of special places like Fitzgerald Marine Reserve. ♦



*Measuring an owl limpet*

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*Owl limpets are an important source of food for Black Oystercatchers and other shorebirds.*

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## 2019 Scholarship Awards

Each year FFMR presents a \$5000 scholarship to three students graduating from Half Moon Bay High School. The scholarships were created in honor of Bob Breen's work at the Fitzgerald Marine Reserve and his teaching of the original marine science course at Half Moon Bay High School. It is intended to support students with a strong science background who are planning careers in marine biology, ecology, or environmental science and who will contribute directly to the preservation of coastal/marine environments.

The 2019 recipients are:

Stu Jaeger will enter the University of California, Santa Barbara, planning to pursue a degree in marine biology.

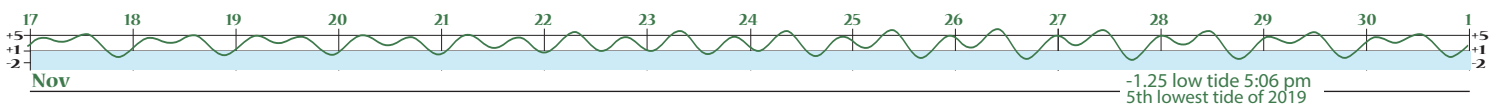
Braden Baxter heads to Humboldt State University and intends to study fisheries biology.

Carlos Salazar-Colorado will attend the University of California Berkeley and will study environmental science.

These students were successful in the marine ecology and/or advanced placement environmental science course at Half Moon Bay High School, and all three are very interested in issues related to marine science and conservation. ♦



*Pictured (left to right) are Joseph Centoni, Stuart Jaeger, Braden Baxter, Carlos Salazar-Colorado, and Tom Ciotti*



# Duskie Lowdown

by Mary Larenas, Volunteer Naturalist Fitzgerald Marine Reserve

In April I was picking up a plastic bag that had blown into the willows near the main entrance to the Fitzgerald Marine Reserve. It was before the spring growing period and the willows had not yet set leaves. As I reached for the bag, I looked up, and right in front of me I saw the tell-tale cone-shaped pile of sticks of a Dusky-footed Woodrat nest.



Duskie nest FMR 7 ft. tall, photo: Mary Larenas

Although Duskie found at Fitzgerald live in a riparian habitat, they are not to be confused with the subspecies *Neotoma fuscipes riparia* (Riparian woodrat) which has been designated Federally Endangered since 2000. The Riparian woodrat is mostly confined to the San Joaquin Valley and is endangered due to loss of habitat because of agricultural and urban development. Although our Duskie, *Neotoma fuscipes*, is not endangered, we still need to be vigilant to ensure human encroachment does not threaten this amazing rodent's health and welfare.



Dusky-footed Woodrat

Duskie are small, cinnamon- to gray-colored rodents with long whiskers, lovely large rounded ears, big eyes and tails covered in short fur. The name "dusky-footed" refers to their dark gray-colored feet. Their bodies are about 10 inches long, well-rounded or sausage-shaped, and with the tail, they're about 16 inches in length. It is unknown how long Duskie live but estimations are on average 1.5 to 4 years. Members of the taxonomic family Cricetidae, Duskie are actually more closely related to hamsters than rats. Duskie are known as keystone species because their nests allow for commensal living, meaning Duskie homes are habitat for other species such as spiders, insects, salamanders, lizards, mice and frogs.

Duskie live in a matriarchal social system. Female Duskie build the large stick homes and basically rule the roost. Males travel to different houses to find a mate but the female Duskie makes the choice of who will be the father of her offspring. After mating, males retreat to tree nests constructed close by. Duskie breed from December to September. They average one litter of 2-3 pups a year. Mother Duskie take care of their young for about a year. Daughter Duskie tend to stay closer to mom while Duskie sons travel further away.

The riparian corridor that borders San Vicente Creek offers ideal conditions for Duskie nest sites consisting of thickets of willow trees with heavy underbrush. Duskie are known for building meticulous stick houses that can reach

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*Duskie are known for building meticulous stick houses that can reach six feet in height and eight feet in diameter. In fact, nests are so well built, they are often handed down to Duskie daughters, thus serving many generations.*

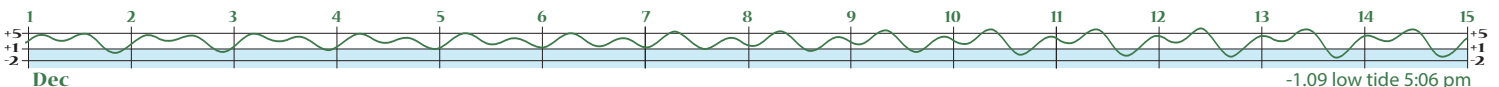
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six feet in height and eight feet in diameter. In fact, nests are so well built, they are often handed down to Duskie daughters, thus serving many generations. The large nest size also protects the nest from being dug out by predators such as coyotes, foxes and bobcats. Duskie purposely select nest sites that have branches running around, through and away from the nest. These branches are Duskie "freeways." Duskie can easily and quietly use the freeways to forage safely for food. A typical home will have multiple openings at different levels of the nest, tunnels throughout, several outside toilets, one or two sleeping quarters, nurseries lined with grasses and shredded bark, and a "pantry" for storing food. Food items that can be toxic when fresh (such as toyon leaves) are kept in a separate room to age before being moved into the pantry. Duskie really like a clean house. California bay leaves (*Umbellularia*) have been found throughout the nest to help control ectoparasites such as fleas. The leaves contain terpenes, volatile organic

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*Duskie are actually more closely related to hamsters than rats.*

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compounds, which are toxic to flea larvae. Duskie not only like a clean house, they like to be clean themselves. They engage in serious grooming, licking their fur, just like cats. They also practice dust-bathing, rubbing their stomachs on dirt mounds. It has been observed that after a nice dust-bath, Duskie appear to be quite relaxed.

And of course, all nests have a display room to showcase Duskie treasures. If something interests a Duskie and it can be carried, the object will find its way to the display room. Duskie also trade one object for another, if the new object is more interesting. Hoarding and trading objects is why Duskie are commonly referred to as packrats or trade rats. Duskie fill their display rooms with bottle caps, hair pins, fruit peels, bits of glass, candy wrappers and, if the nest is near a golf course, golf tees are a favorite! In fact Duskie homes have been used in forensic investigations. Ancient Duskie nests have provided data on what plants were growing in an area, the type of climate and other environmental and human factors dating as far back as 40,000 years!

Duskie are herbivores. Their diet consists of fungi, fruits, seeds, bark, nuts, plants, twigs,

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*Duskie really like a clean house. California bay leaves (Umbellularia) have been found throughout the nest to help control ectoparasites such as fleas.*

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and acorns. In dry areas, their food can also serve as a source of water. Duskie are voracious eaters. They eat throughout the night and consume on average 44 grams during one feeding period. That's a lot given the average weight of a Duskie is around 260 grams. Duskie have strict rules



*Looking inside a Dusky-footed Woodrat nest, illustration: Mary Larenas*

regarding sanitation, which is good because a single Duskie can poop over 100 pellets a day! Any relieving of one's self is done outdoors in specifically designated latrines.

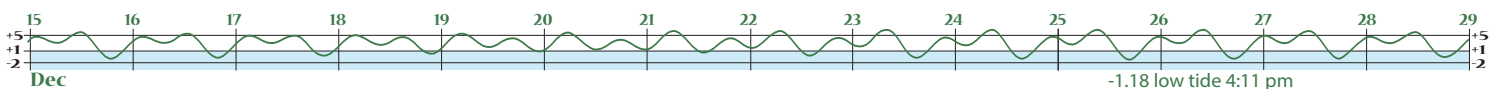
Duskie are by nature nocturnal, solitary, busy, quiet, but alert. They go about their lives foraging, building, raising their young, and keeping a clean house. But when a predator is nearby, both female and male Duskie have been known to use tail drumming as a warning sign. Duskie can become quite feisty when threatened, irritated or in courtship mode. Females have been known to attack and bite opponents. But it is the male Duskie who really get into it. One male will initiate an argument by flattening his ears against his body, charging and biting his opponent. Fight behavior can also include drumming their tails against the ground while opening and closing their mouths. Face washing is characteristically seen following a disturbance, but only when the Duskie feel safe.

Need more Duskie? Take a look at a video of a Duskie tail drumming: <https://youtu.be/75lTwBCT7ak> ◆

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# Ticks! What You Need to Know

by Julie Walters

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*If you think you might have ticks on your clothes: put your clothing, including socks, in a white pillow case as soon as you get home. Tie up the pillow case so it is closed. Place the pillowcase by itself in the dryer on high heat for 15 minutes. This should kill any ticks.*

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The good news is that Lyme disease is much less common on the West Coast of the U.S. than the East Coast. The bad news is that the most dangerous ticks are the small ones (the size of a poppy seed) and consequently difficult to see. Here are some suggestions from a recent lecture given by the San Mateo County Mosquito and Vector Control District in conjunction with San Mateo County Parks.

**STAY ON THE TRAIL** Ticks can't jump or fly. Instead, they wait on vegetation until a person or animal brushes against them. They are often found at hip level on the edge of vegetation on the uphill side of a trail. You can avoid them by staying in the middle of the trail and avoiding contact with brush, grass, and leaf litter. Don't sit on the ground or on logs, or lean against trees. This is where ticks like to hang out.

**NYMPHS ARE THE HIGHEST CARRIERS OF DISEASE** In April and May you run the most risk of being exposed to the juvenile or nymph phase of ticks which are the ones that most often carry disease. Be extra vigilant during that time of year.

**ANIMALS THAT CARRY TICKS:** Fence lizards, deer and small rodents such as squirrels and mice

**DRESS APPROPRIATELY** When outdoors in areas where there may be ticks, wear long pants and sleeves. Don't wear shorts, sleeveless shirts or sandals. Tuck pants into socks or boots, and shirts into pants. Light-colored clothing makes it easier to see ticks before they attach to skin.

**USE INSECT REPELLENT** The insect repellents that work for mosquitoes are effective against ticks. Look for formulas containing Permethrin or DEET. Use the 25% DEET formula, not the 8%. However, DEET reacts with plastic so don't spray it on glasses or watches. All repellents should be applied according to the label instructions only. Note that Permethrin is toxic to cats. Insect-repellent clothing is also available.

**CHECK FOR TICKS** After outdoor activities in areas where there may be ticks, check

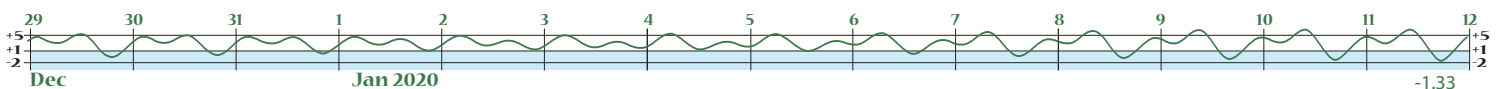
yourself, your children, and your outdoor gear carefully for ticks. Remember to check areas that cannot be easily seen, such as inside and around ears, on the scalp, between toes, around waistband and under arms. Ticks like warm, moist crevices on the human body. Showering soon after being outdoors can help rinse away unattached ticks, and will allow you to check all areas of your body. If you think you might have ticks on your clothes: put your clothing, including socks, in a white pillow case as soon as you get home. Tie up the pillow case so it is closed. Place the pillowcase by itself in the dryer on high heat for 15 minutes. This should kill any ticks.

**PROTECT YOUR PET** Pets can get ticks, too. Don't let your pet roam off-leash in tick habitat, and check your pet for ticks after time spent outdoors. Don't let your dog play in a pile of leaves. Look for ticks in the area where your pet sleeps.

**WHAT'S THE RISK?** Lyme disease is the most common tick-borne disease in California, with 141 confirmed human cases in 2016. It is caused by the bacteria *Borrelia burgdorferi*, and transmitted to humans through the bite of an infected western blacklegged tick (*Ixodes Pacificus*) or deer tick (*Ixodes scapularis*). Results from the District's 2016/2017 tick-borne disease surveillance program indicate that up to 3% of ticks collected in San Mateo County are infected with pathogens capable of causing illness in humans. Other tick-borne diseases are found in California, but are less common:

- Anaplasmosis
- Babesiosis
- Borrelia miyamotoi
- Ehrlichiosis
- Rickettsia
- Rocky mountain spotted fever (rare)
- Tick-borne relapsing fever
- Tick paralysis
- Tularemia

The same precautions recommended to reduce the risk of Lyme disease will also reduce the risk of other tick-borne diseases. If you experience symptoms after being bitten by a tick





or after spending time outdoors in areas where ticks are common, you should be evaluated by a medical professional. An itchy, painful redness around the site of a tick bite that occurs within 24 hours is likely to be an allergic reaction rather

than an indication of tick-borne disease.

See the chart below for areas in San Mateo County where ticks are most commonly found. For more information go to [smcmvcd.org](http://smcmvcd.org) ◆

## Tick Collections 2018-2019 Winter Season, YTD

Park	Nearest City/Town	Number of Ix. pacificus
Half Moon Bay Coastal Trail	Half Moon Bay	1
Montara Mountain	Montara	216
Memorial Park	Loma Mar	44
Frontierland Park	Pacifica	6
Purisima Creek Redwoods OSP	Half Moon Bay/Woodside	240
Junipero Serra County Park	San Bruno	46
San Pedro Valley	Pacifica	449
Wavecrest OSP	Half Moon Bay	9
Coal Creek OSP	Portola Valley	358
Sweeney Ridge National Recreation Area	San Bruno	15
Año Nuevo State Park	Pescadero	186
Rancho Corral de Tierra	Half Moon Bay	17

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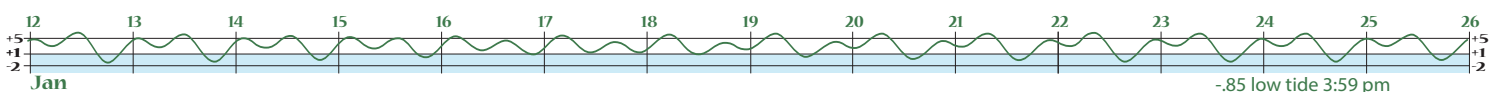
### To remove a tick:

- Use tweezers to grab the tick as close to your skin as possible.
- Pull the tick firmly, straight out, away from the skin (do not jerk, twist or burn the tick).
- Wash your hands and the bite site with soap and water after the tick is removed and apply an antiseptic to the bite site.
- See your doctor if you develop a rash or flu-like symptoms within 30 days after a tick bite.



For more information: <http://www.dhs.ca.gov/> Call: 916-552-9730 or your local health department

**REMINDER: The 2020 Docent Training Class will begin February 1.**  
**Please check our FFMR website for the schedule and registration form in November**



# 90 Million Years in 190 Minutes!

by Karen Kalumuck



*Irina prepares us for what we will see with a review of Plate Tectonics.*



*Docents examine the "mineral frosting" layer deposited in a crack in the rocks.*



*Carbon dioxide gas bubbles are produced when acid interacts with calcite.*

*At the area of the actual "slide," we spent time marveling at the netting and extensive system of (up to) 150 foot long dowels drilled into the mountain to stabilize it.*

On Saturday, September 7, twenty-two docents and friends, and one well-behaved dog, enjoyed an utterly engaging and fascinating tour of Devil's Slide trail led by Geologist Irina Kogan. Perfect weather—slightly overcast and no wind—visited the three-hour Continuing Education event, where Irina expertly answered questions as she pointed out significant geologic features and challenged us to think about what might have led to what we see today.

An overall take-home message from the day is that the geology here is extremely complicated! Irina wisely started off with a review of plate tectonics. I had never heard of the "Kula Plate" that was adjacent to the Farallon plate, 80 million years ago, and that their junction was right about at San Francisco. Today, only small remnants of the Farallon plate remain, the rest subducted into the earth and replaced by the Pacific Plate.

The Montara Granite found at the south end of the trail is at least 80–90 million years old (the dinosaurs were still around!). It originated 10–20 miles below the surface in what is now Southern California. The granite was carried here by the "conveyor belt"-like movement of the San Andreas Fault. It probably had been a magma chamber under a volcano, with the upper volcano eroded away. Irina memorably referred to it—an "ancient zit chamber."

Around half way up the trail, Irina challenged us

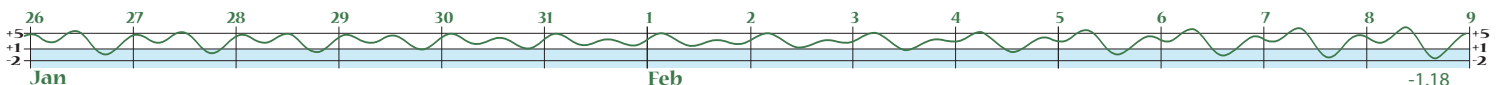
to find a boundary between the types of rocks making up the hillside. Indeed, we soon found convoluted layers of sedimentary rock. This rock, much younger at about 55 million years old, contrasts to the Montara granite with sharp, naturally fractured edges. At the area of the actual "slide," we spent time marveling at the netting and extensive system of (up to) 150 foot-long dowels drilled into the mountain to stabilize it. This, Irina informed us, serves to anchor a very unstable landslide zone to a somewhat more stable landslide zone underneath it. Not very comforting! We also viewed the human-added-fix to the ocean side of the trail, "shotcrete," that is, rock and cement spray. That layer is already eroding and cracking. As a favorite bumper sticker says, "Nature Bats Last."

Irina's enthusiasm is utterly contagious and we all learned so much! But I must say that even Irina had a little surprise; there is a mineral deposit filling an ancient crack in the granite, which looks a bit like frosting on a cake. She brought some acid to test the layer for calcite (a stable form of calcium carbonate, likely from the skeletons of tiny ancient marine creatures). Much to her surprise, it foamed, indicating the presence of calcite.

There are just too many fascinating things we learned to fit in the space of this article. Thanks, Irina, for a fascinating day well spent! ♦



*Our intrepid group poses in front of sedimentary layers. Thanks to John Dye for taking the photo!*









# Results of the Sea Star Count Held on July 6, 2019

by Julie Walters

Seven Fitzgerald docents surveyed the reef during our count in July during a -1.0 low tide. Thanks to Jeanette Hyer, Deryck Marsh, Tom Ciotti, Karen Madsen, Marsha Cohen, and Elaine Reade. They covered different parts of the reef including portions of Frenchman's Reef. During this count we saw 163 sea stars (listed in the table below).

While the overall quantity of sea stars from the most recent count in July was similar to the one held last December, we are not seeing the variety of species that we saw before Sea Star Wasting Disease hit in 2013 and 2014. (A comparison is shown in the table below.) Unfortunately, the beautiful Sunflower star has not been seen at Fitzgerald or Pillar Point since 2013. The only recent observations that I was able to find on iNaturalist were in Alaska and British Columbia. These observations were from scuba divers. Compare this to November 2011 during a -1.7 low tide, when I saw ten sunflowers stars along Frenchman's Reef between Seal Cove and Pillar Point. There is talk of adding the Sunflower star to the endangered species list.

The next sea star count at Fitzgerald will be Friday, December 13th at 3:30-5:30pm. An email with more information will go out to docents. ♦

SPECIES	July 6, 2019 7:30-9:30am Low tide -1.0 at 8:25am			Dec. 2018 Low Tide -1.4
	LESS THAN 5" DIAMETER	MORE THAN 5" DIAMETER	TOTAL	TOTAL
 OCHRE STAR ( <i>Pisaster ochraceus</i> )	47	47	94	108
 LEATHER STAR ( <i>Dermasterias imbricata</i> )	4	6	10	27
 BAT STAR ( <i>Patiria miniata</i> )	2	0	2	20
 KNOBBY STAR ( <i>Pisaster giganteus</i> )	0	0	0	0
 PINK BAY STAR ( <i>Pisaster brevispinus</i> )	0	0	0	0
 6 RAY STAR (1/2"-2") ( <i>Leptasterias hexactis</i> )	46	0	46	8
<b>Total</b>	<b>99</b>	<b>53</b>	<b>152</b>	<b>163</b>

If you see any pink bay stars or knobby stars while you are out at Pillar Point or Fitzgerald, please take a photo of them and upload your observation to iNaturalist.

## Nudibranch Count

by Julie Walters

We had a fantastic nudibranch count on Friday, July 5th with a wonderful low tide of -1.39. Perfect weather, clear water, calm seas and great volunteers made for an ideal Nudibranch count. Many thanks to our wonderful volunteers: Ariel Bauman, Galen, Deryk Marsh, Karen Madsen and Beth Roellig. The team found a total of 361 nudibranchs in 2 hours. Here is how the results broke down:

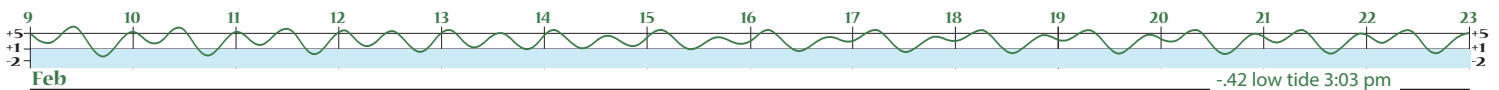
- |   |   |
|---|---|
| 151 Spotted triopha ( <i>Triopha maculata</i> )           | 4 Sea clowns ( <i>Triopha catalinae</i> )               |
| 13 Three-lined aeolid ( <i>Flabellina trilineata</i> )    | 1 Sea goddess. ( <i>Doriopsilla albopunctata</i> )      |
| 7 Monterey Dorid ( <i>Doris montereyensis</i> )           | 5 Sea lemon ( <i>Peltodoris nobilis</i> )               |
| 5 Heath's dorid ( <i>Geitodoris heathi</i> )              | 5 Shag rug ( <i>Aeolidia loui</i> )                     |
| 1 Olive's aeolid ( <i>Anteaeolidiella</i> )               | 7 Colorful Dirona ( <i>Dirona picta</i> )               |
| 2 San Diego dorid ( <i>Diaulula sandieuegensis</i> )      | 1 Orange peel doris ( <i>Acanthodoris lutea</i> )       |
| 1 Modest Cadlina ( <i>Cadlina modesta</i> )               | 2 <i>Limacia mcdonaldi</i> ( <i>Limacia mcdonaldi</i> ) |
| 5 Red dorid ( <i>Rostanga pulchra</i> )                   | 4 Hammerhead doto ( <i>Doto amyra</i> )                 |
| 1 Chan's dorid ( <i>Hallaxa chani</i> )                   | 71 Hilton's aeolid ( <i>Ophidiana Hiltoni</i> )         |
| 2 British Columbia doto ( <i>Doto Columbiana</i> )        | 6 Laguna Beach aeolid                                   |
| 7 Hopkin's rose ( <i>Okenia rosacea</i> )                 | 1 ( <i>Hermisenda crassicornis</i> )                    |
| 2 ( <i>Dendronotus subramosus</i> )                       | 1 Hancock's nudibranch ( <i>Hancockia californica</i> ) |
| 53 Opalescent nudibranch ( <i>Hermisenda opalescens</i> ) |   |

See photos of the more unusual finds on page 3.

Observations: The population of Hilton's aeolid seems to be exploding at Pillar Point. We observed many large specimens often exceeding 3" in length. This species used to be seen from Baja to central California but its range is now extended to north of the Golden Gate. Another trend of warming ocean temperatures.

Rare sightings: Olive's aeolid and Hancock's nudibranch.

Our next surveys will be either around Thanksgiving or Christmas.



## Friends of Fitzgerald 4th of July Parade

The Friends of Fitzgerald volunteers marched in the annual Half Moon Bay 4th of July Parade. The group was small, with about 13 volunteers, but made a spectacular parade entry.

FFMR volunteer Betty Sills hand-crafted many of the crowd-pleasing marine critters that were carried, wheeled or worn by FFMR marchers. Making their appearances this year were an enormous paper-mache kelp crab, a beautiful multi-colored lined chiton, and Sealia, the life-sized harbor seal who is a parade veteran. Volunteer Jeanette Hyer carried her bulbous bull-whip kelp made from a green, cloth-covered beach ball tethered to a long PVC pipe. Mary and Ed Larenas carried a colorful banner, hand-made by Mary, depicting the tidepool marine life at Fitzgerald.

All of this plus a few crab hats, jellyfish umbrellas and lots of salt water taffy handed out to children and adults along the parade route made the FFMR parade entry a crowd-pleaser. ♦



### Friends of Fitzgerald Marine Reserve

Donation Chair, P.O. Box 669, Moss Beach, CA 94038, or through our website: [www.fitzgeraldreserve.org](http://www.fitzgeraldreserve.org)

Contribution Levels:

- \$25   
  \$100   
  \$1000  
 \$50   
  \$500   
  Other \_\_\_\_\_

- I want to double the value of my gift through my employer's matching gift program (please enclose the matching gift forms).

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