SAND CRAB MONITORING STUDY
STUDENT RESOURCE PACKET

YMCA Point Bonita Outdoor & Conference Center
981 Fort Barry GGNRA
Sausalito, CA, 94965
(415) 331-9622
http://www.pointbonitaymca.org
Staff Contact: Lisa Snickars <lsnickars@ymcasf.org>

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Edited, written, and assembled by David Taus and Courtney Rudd
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Dear High School Science Student,

We look forward to your participation in the YMCA Point Bonita's *High School Science & Service Learning Program*! During this field trip, you will be spending the day in the Marin Headlands, a 10,000 National Park just north of the Golden Gate Bridge. With beaches, crashing waves, rolling hills, a lagoon and pond, and abundant wildlife, the Marin Headlands is a beautiful and awe-inspiring place to take part in both hands-on field science and community service that affects the health of our planet.

The scientific investigation that you take part in is a part of an on-going study. By participating for even one day, you are contributing to data that will allow scientists to assess the health of our oceans and/or fresh water, as well as the living creatures that use them.

During your visit, you will be hiking through the park to the site of your scientific investigation. You may be hiking on trails, or you may stick to the road. Some students might get dirty or wet while conducting the study. You may be removing non-native plants. **Please don't wear your best shoes!!!**

Also, because we are right on the coast, the weather in the Marin Headlands can vary dramatically. **Please come prepared dressed in layers, with everything from a t-shirt to a jacket!** The weather can go from hot and sunny to foggy, windy, and cold in an instant. **If you have a wind-breaker and/or a rain jacket, bring them!**

Bring a small back-pack or bag with the following items:

- **extra clothing, wind breaker, rain jacket**
- **a pen or pencil**
- **your lunch**
- **this student packet**
- **a water bottle (as big as possible)**
- **sunscreen**
- **a hat to keep the sun off of your face**

We hope you have a great time here at Point Bonita. See you soon…

BACKGROUND ON THE PACIFIC MOLE CRAB (*Emerita analoga)*

The Pacific mole crab (*Emerita analoga*), also known as the sand crab, is a common inhabitant of the sandy beach. The crabs live along the Pacific coast from Alaska to Baja California in the northern hemisphere and between Ecuador and Argentina in the southern hemisphere. They live in the swash zone of the sandy beach intertidal zone. The **swash** zone ranges from the lowest to highest reaches of the waves at any given time. Because the swash zone changes with the tide, so does the location of the sand crabs. Thus, sand crabs are not distributed uniformly across a beach. In fact, females are found lower in the intertidal zone than males and recruits (juveniles).

Natural History

The sand crab is small in size, growing up to 35 mm long and 25 mm wide. It is gray or sand colored
and does not have claws or spines. Like other crustaceans, it periodically molts, so empty exoskeletons may be found on the shore.
The crab spends most of its time buried in the sand. The main predators of the sand crab are fish, water birds, and shorebirds. It has five pairs of legs that allow it to swim, crawl, and burrow, all of which are done backwards. Commonly called the sand crab or mole crab, *Emerita analoga* is the epitome of burrowing efficiency.

While other crabs are able to move in any direction, the sand crab can only move backwards. Its rear legs are modified as paddles, which gives it very good swimming capability, an essential skill when it is stirred out of the sand by crashing waves. The sand crab burrows tail first into the sand, with its head near the surface facing seaward. Its eyestalks reach above the sand. When a wave recedes, its large antennae are unfurled to form a “V” through which the backwash is sifted for phytoplankton. The antennae collect small organisms, mostly dinoflagellates (a type of zooplankton), which are scraped off for food when the antennae are retracted into the body. The entire population moves up and down the beach with the tides, with the greatest concentrations nearest the breakers.

Sand crabs are used by humans in a variety of ways. Fishermen use them as bait. In southern California, approximately two million *Emerita* were taken for bait in one year. They have also been used to indicate levels of DDT and domoic acid in the waters off of California. Domoic acid is a neurotoxin produced by diatoms, a type of phytoplankton. When sand crabs eat the toxic plankton they become toxic to birds, otters, and fish that eat them.

BACKGROUND OF THE SAND CRAB MONITORING PROJECT

(Adapted from the Farallones Marine Sanctuary Association's Coastal Ecosystem Curriculum, 2002, www.farallones.org)

The Farallones Marine Sanctuary Association is coordinating a sandy beach monitoring project. Through this program, you will learn how to monitor, collect data, and analyze your results in order to monitor the Pacific Mole Crab along the Pacific shoreline. This data will provide baseline abundance and distribution patterns about the sand crab.

The data will be given to the Sanctuary for marine management purposes and for reference in the event of an oil spill. Natural resource managers will be able to compare the density of sand crabs before and after an oil spill, thereby helping them to determine the ecological effects of such a catastrophe, which are often devastating to wildlife. The results will also be shared between the schools that are participating in the project. This will allow you to experience another component of the scientific process: communicating with peers.

The project is funded by the Gulf of the Farallones National Marine Sanctuary through the T/V PUERTO RICAN Oil Spill Restoration Fund. The PUERTO RICAN was a tanker vessel that spilled 1.4 million gallons of oil into the Gulf of the Farallones in 1984. The oil injured and killed many birds and washed onto beaches in the Gulf of the Farallones National Marine Sanctuary.

You will be the scientists that conduct the monitoring and data analysis from start to finish.

Common Questions About the Sand Crab Monitoring Project

• Why monitor sand crabs?

They are part of the food web. As filter feeders, they can accumulate toxins, such as DDT and domoic acid. These are then passed along to their predators.

• What do the data tell us?

The data provide baseline information about the density of sand crabs on a beach. This information can be helpful if there is an oil spill. Since the crab density will be known it may be possible to determine how long it takes for the population to recover from an oil spill.

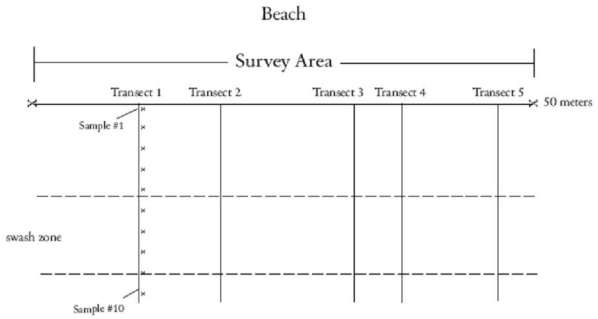
• Why long-term monitoring?

Long-term monitoring provides a long dataset which includes natural fluctuations. Analysis of a long dataset can describe the natural cycles of populations. In addition, the impact of manmade impacts and natural catastrophic events can be investigated.

MONITORING PROCEDURE

Setting Up

1. Set up the 50m survey line parallel to the shore (the 50 m line should be marked at every meter Obtain a location using the random number table along the survey line. Once you are in the correct location, stretch the 10m length of rope out perpendicular to the survey line in the direction of the water in order to mark your transect. Place a flag at each meter (shown as ablack tick mark) on the white rope.



Taking a Sample

2. Push the end of the plastic core sampler 10 cm into the sand. Use the calibrations on the core sampler as a guide.

3. Push the tube over and, at an angle, lift the sand in the tube. Use one hand to hold the sand in the tube and one hand to keep the sand in the tube. Use a bucket to transport the sand if needed.

4. Pour the sand collected into the sieve. Shake the sieve to remove the sand; adding some water will make this process go more quickly. If you have any crabs in your sample, they will be left above the mesh metal cloth.

Measuring Crabs and Recording Data

5. Using the plastic calipers, measure the length of the crab's carapace to the nearest millimeter. Record all data on the data sheet provided. See directions on data sheet for recording procedures.

6. The gender of each crab should be determined and recorded.

7. When you have finished, return the animals to the water **away from the transects**, so the crabs won't be counted in another sample.

DATA COLLECTION SHEET 1
Sampling Conditions

Beach Name: _____ Date: _____

School: _____ Start Time: _____

Group Members: _____ End Time: _____

_____

_____

_____

Tide *(circle one)*: *rising* *falling*		Approximate Tidal Height (ft):
Wind Speed (Beaufort Wind Scale): Wind Speed (mph):		Air Temperature (°C):
Cloud Cover *(circle one)*: 0% 1-25% 26-50% 51-75% 76-100%	Visibility *(circle one)*: < 300 feet < 0.25 mile < 1 mile > 1 mile	Location (GPS coordinates): Latitude: Longitude:

Sand crab data instructions:

1) Record the SIZE of each crab (in mm) in the columns shown below. Refer to the following codes:

2) If any of the crabs have a soft shell, please also include (SS). *For example, a 22 mm female with eggs and a soft shell = 22 SS.*

3) Sample #1 should be the farthest away from the water and sample #10 should be the farthest into the water.

Example:

CODES
F = Female
FE = Female with eggs
M = Male
R = Recruit (< 9 mm)
SS = Soft Shell

Sample # 1 **Dry or Swash** ***(circle one)***	F 23	R 8	R 7	FE 28	FE 19	F 9 SS	M 15	Tally
	M 14							
								8

DATA SHEET 2:

Sand Crab Data

Beach Name: ________________________ School: ___________________ Date: _____________

Vertical Transect Number (1-5)	Random Number: Location along Survey Line	Distance between Sample #1 and the highest reach of the swash zone	Depth of water at Sample #10 (m)

Sample #								Tally
Dry or Swash ***(circle one)***								

Sample #								Tally
Dry or Swash ***(circle one)***								

Sample #								Tally
Dry or Swash ***(circle one)***								

Sample #								Tally
Dry or Swash ***(circle one)***								

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Sample #								Tally
Dry or Swash ***(circle one)***								