



LiMPETS Monitoring Site: Davenport Landing



Directions

1. From Santa Cruz, take Highway 1 north.
2. Turn left off Highway 1 on to Davenport Landing Road, which is a continuation of Swanton Road. Park near the public access trail to the beach.
3. Turn to your left when you reach the beach and walk above the cement structure that drains seawater from the US Abalone mariculture facility.
4. The vertical transect and mussel permanent plot are on the western edge of the rock platform, while the anemone permanent plot is near the middle of the rock platform, see Figure 6.
5. Restrooms are located at the top of the stairs next to the road and parking area.



Figure 1. Davenport Landing is along Highway 1 north of Santa Cruz, CA.

Sampling methods

Four sampling methods are used at Davenport Landing: 1) Vertical transect, 2) Total organism counts in a permanent area, 3) Random quadrats in two permanent plots: mussel plot and anemone plot, 4) Size measurements in a permanent area.



Figure 2. Sampling site at Davenport Landing, north of the town of Davenport.



Figure 3. Davenport Landing vertical transect, looking back towards US Abalone mariculture facility, houses and beach.



Figure 4. Davenport Landing mussel plot.



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Vertical Transect

Once on the platform look for the 0m marker with the GPS location of: N 37° 01.345' W 122° 12.936'. Two other bolts are at 12m, and 21m, their GPS locations are, respectively, N 37° 01.340' W 122° 12.943' and N 37° 01.338' W 122° 12.947'. See Figure 6.

1. Center the quadrats over the transect tape every 3m at: 0m, 3m, 6m, 9m, 12m, 15m, 18m, and 21m.
2. Record the species abundance within each quadrat as instructed on the data sheet. For algae, only the square(s) that contain the holdfast should be recorded. Count only live organisms, this may require some close investigation.



Figure 5. Clockwise from far left: ochre sea star (orange phase), closeup of an owl limpet, ochre sea star (purple phase), black abalone.

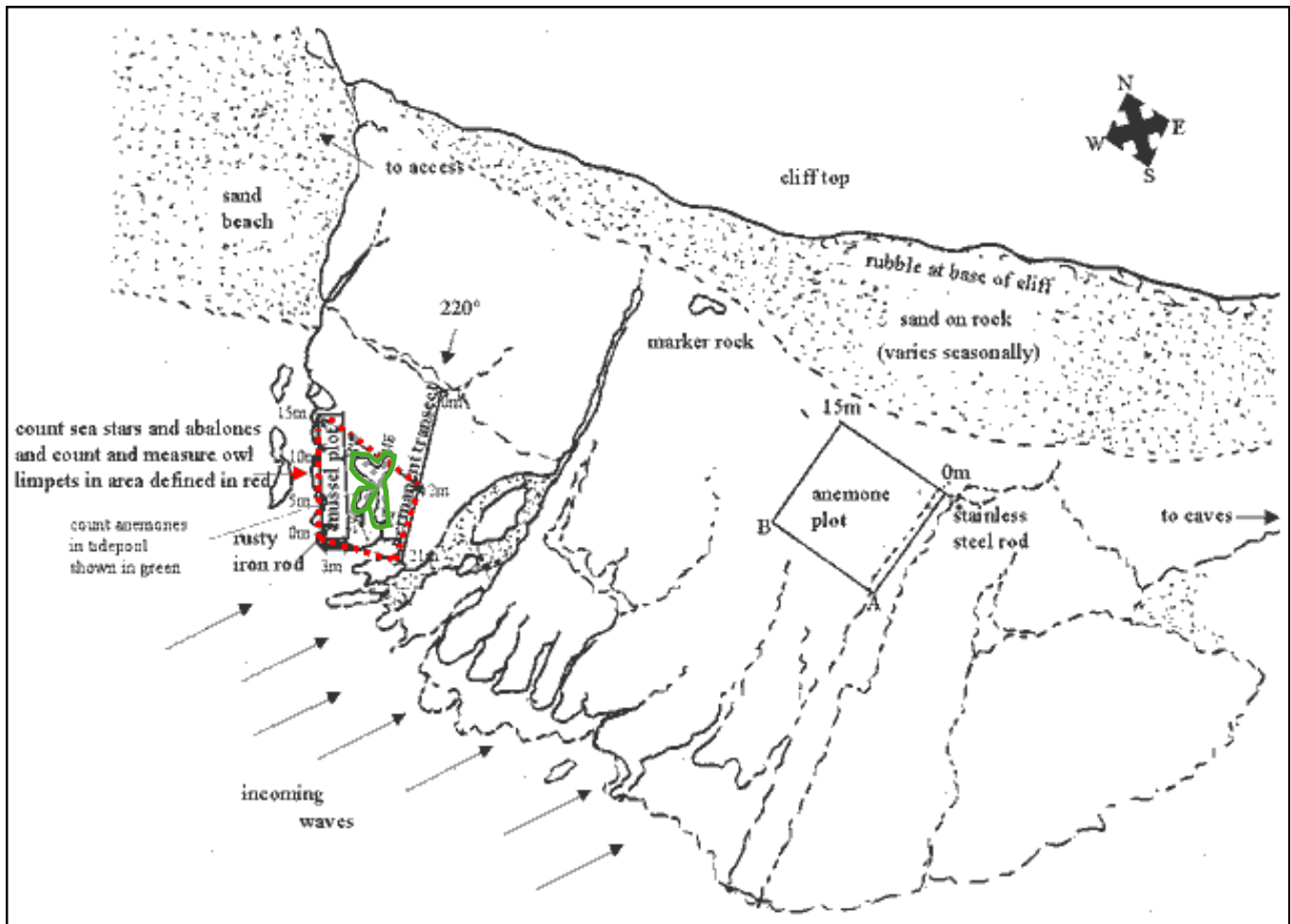


Figure 6. Hand drawn map of the monitoring area.



Total Organism Counts in a Permanent Area

Species counted are ochre sea stars, black abalones and sea anemones. Teams of 2 or 3 students should tackle total organism counts for one species at a time. Systematically search the whole area by moving back and forth across it, searching successive swaths about the width of your outstretched arms.

The delineated area for total counts stretches from the 12 and 21m bolts on the vertical transect to the 15 and 0m bolts on the far side of the permanent mussel plot. This area will roughly be a trapezoid and is known as Area 1. Area 2 is the pool located within Area 1. See red and green areas in Figure 6.

1. Ochre sea stars (*Pisaster ochraceus*): Both sea star color phases (orange and brown/purple) are counted in Area 1. The orange color phase will be easy to spot, while the purple/brown phase will require close inspection of cracks, overhangs, crevices and under alga.

2. Black abalones (*Haliotis cracherodii*): Counted in Area 1. Look deep into cracks and crevices and underneath overhangs. To do accurate count some scrambling and close investigation will be necessary. Look for the tell-tale black/blue/green shell.

3. Giant green (*Anthopleura xanthogrammica*) and sunburst (*Anthopleura sola*) sea anemones: Anemones are counted in the four lobed tidepool known as Area 2, located within Area 1. The tidepool is broken up into 5 sections, NE, NW, SE, SW and central areas assigned to the different lobes and the middle. See Figure 6 for green area. Count anemones that are larger than 5 cm (or 2.5 inches) in diameter, and any that are large and solitary but closed.

Size Measurements in a Permanent Area for Owl Limpets

The permanent area is the same as for the total organism counts. Only owl limpets (*Lottia gigantea*) are counted and measured.

Smaller owl limpets are sometimes difficult to distinguish from other species of limpets, therefore we only count and measure owl limpets equal to and above 2.5 cm in shell length. The length of each limpet is measured and recorded.



Figure 7. Sarah Wood sits at the 0m mark for Area 1: the TOC permanent area, near the 21m mark on the vertical transect.



Figure 8. Giant green anemone, and sunburst anemone.

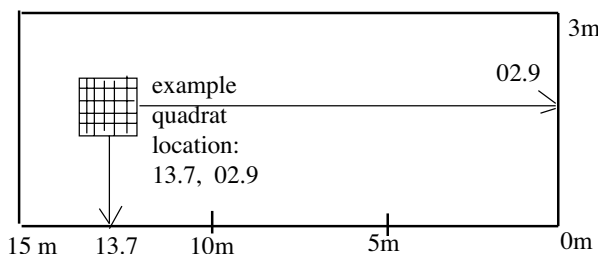


Random Quadrats in a Permanent Plot

Two permanent plots exist at Davenport Landing, the mussel and the anemone plots. For both plots, random numbers must be generated beforehand for quadrat placement. Data sheets for random quadrats are similar to those for vertical transects. Only count live organisms. For algae count only the square(s) that contain the hold-fast. Ideally 20 or more quadrats should be sampled for means and variances of the abundances to be calculated for statistically rigorous comparisons over time.

1. Mussel plot: Four stainless steel eyebolts cemented along the western edge of the rock platform identify the 0m, 5m, 10m, and 15m points of the 3x15-m mussel permanent plot. Mussels will crowd over the eyebolts so you may need to dig around to find them. The GPS locations of these eyebolts are: N 37° 01.344' W 122° 12.945', N 37° 01.343' W 122° 12.948', N 37° 01.347' W 122° 12.946' and N 37° 01.349' W 122° 12.944', respectively. Next to the 0m bolt, within the plot, is a rusted, iron bolt that was embedded in the rock probably to aid in boat landing. Attach the transect tape to the stainless steel eyebolt at the southwest edge of the plot, this corner is 0m. Extend the tape parallel to the shoreline towards the north and look for eyebolts at 5m, 10m and 15m, hook the tape on the 15m. Extend the tape to the east 3m, look for an eyebolt to hook the tape onto, and then again to the south 15m, lastly back to the 0m. See Figure 6.

The positions of the quadrats within the 15x3m plot are determined by a series of two, three-digit numbers, selected at random before going out in the field. The first number should be between 00.0 and 15.0, the second number between 00.0 and 03.0. Find the first number on the meter tape, and then extend a second meter tape eastward, perpendicular to the first tape, until it reaches the second number. Place the quadrat down so that the number is in the center.



2. Anemone plot: This permanent plot is not attached to any of the previous plots and is located to the east and south, see Figure 6. The anemone permanent plot is marked by two stainless steel eyebolts in the upper portion of the platform, east of the vertical transect and south of a conspicuous “marker” rock. The two eyebolts are 15 m apart, and the southernmost is 5.2 m north of a bent stainless steel bolt that was embedded in the rock in 1972, when the permanent plot was established. The GPS locations of the two eyebolts are N 37° 01.305' W 122° 12.924' and N 37° 01.343' W 122° 12.922'. The line between the two eyebolts delineates the northeastern, shoreward edge of the anemone permanent plot. The southwestern edge is 15m seaward of the line. The southwestern and northwestern corners are marked with dabs of olive green “glue” inscribed “A” and “B”, with GPS locations of N 37° 01.308' W 122° 12.931' and N 37° 01.312' W 122° 12.933', see Figure 6.

The position of the quadrats are determined by a series of two, three-digit numbers, between 00.0 and 15.0, selected at random before going out in the field. Find the first number on the meter tape stretched between the eyebolts, and then extend a second meter tape seaward, perpendicular to the first, until it reaches the second number.

