

A DESCRIPTION OF THE NORTH SHORE
OF THE SALMON RIVER MOUTH

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The following observations were made on July 20, 1966, at a low tide of -1.7 feet. The Salmon River, located in the extreme northwest corner of Lincoln County, Oregon, is a small, short river which enters the sea just south of Cascade Head, [REDACTED]. The mouth of the river may be approached on its northern shore by an asphalt road leading from Highway 101, which continues as a graveled road along the river virtually to the mouth. The north side of the river mouth is bounded by the high cliffs of volcanic origin making up Cascade Head, and the south side of the mouth by a lower rocky point and sand beaches. At present, the river runs along the northern side of its valley, and the mouth is located at the base of the cliff on that side. There is no branching of the river before it enters the ocean. The entire northern shore of the estuary is rocky, and rises to cliffs at the mouth. The volcanic material overlies sedimentary rocks, and both sandstone and siltstone also outcrop along the north shore. At the end of the road to the mouth are located several houses, only a few of which are occupied permanently.

At the end of the road, the river is sinuous and under tidal influence. The north shore of the bend at the end of the road is exposed as mud and sand flats with Zostera

(eelgrass) beds at low tide, and *Callinassa* spp. (mudshrimp) is found burrowing in this mud and sand. Toward the mouth, the upper reaches of the beach is covered with gravel and cobbles; lower down the edges of the stream are bordered by loose coarse sand and mud. The lower stones and occasional small boulders are covered with the green algae, Ulva and Enteromorpha. Hemigrapsus oregonensis and H. nudis, shorecrabs, are present among the stones. Still further seaward the stones on the shore increase in size until boulders are reached below the cliff. Where the slope of the beach allows the accumulation of small boulders, cobbles and flattened shingle, several arthropods are abundant. Under these stones and lower down under larger rocks and pieces of wood are found large numbers of the polychromatic euryhaline sphaeromid isopod, Gnorimosphaeroma oregonensis, as well as an abundant amphipod. Under the higher stones these are also accompanied by a small whitish oniscoid isopod, thysanurans, crab like megalopa, bright red mites, and two species of littorine snails, Littorina planaxis and ~~OL~~ Pitkiana.

Further toward the sea, the beach flattens and widens considerably as a small creek enters the estuary. At this place a siltstone outcrop has been levelled and is covered with a thin layer of muddy reddish sand, with scattered Fucus, popping wrack, and Ulva covered boulders in the lower levels and some cobbles and shingle in the upper zone. A nereid polychaete (Nereis vexillosa), also found farther up

the estuary, is common under the stones at the lower levels of the beach, accompanied by an abundant whitish nemertean. Beyond this point the stream curves southward and the beach below the rising hillside is covered with large boulders, heavily overgrown with a large species of Fucus, (F. furcata?) which forms a dense covering on the top and stream side of the boulders. Along the bare side of these boulders at the higher tidal level are found numbers of large individuals of the limpet Acmaea persona. Patches of the flat smooth blackish alga, Ralfsia sp. also occur on these boulders. Below the boulders, on stones along the stream are found clumps of Mytilus edulis, the bay mussel, covered with Balanus sp., acorn barnacles.

Beyond the large boulders, toward the sea, the cliff side is broken up into very large standing rocks, and at this point, the mouth of the stream meets the sea, with surf indicating a small bar. Along the south bank of the stream there are no rocks, but areas of sand in ridges and exposed bars, and at the mouth proper, these become confluent with the sand beach running across the front of the deltaic valley to its opposite side, where there is a low rocky point, with a sand beach in front of it. At slack water (tide level -1.7) the depth of the stream at the mouth was only about three feet deep.

Beyond the mouth of the stream, the shoreline is directed northwest, and the beach area is at the foot of a high sliff.

The base of this basaltic cliff is eroded into a narrow intertidal platform and broken into large boulders. Near the mouth of the stream, accumulated sand around the rocks eliminates any intertidal rock organisms at the lower levels, but a broken band of Mytilus edulis and barnacles is evident. Beyond this point seaward, the rock bench drops off to deeper water and the biota is well developed. The cliff face is eroded into two step-like benches, one at approximately the level of the high tide mark, and another narrower bench at the lowest tide level below which the drop-off appeared very steep. Marked intertidal zonation was noted on this cliff base area, with obvious horizontal differences over a short distance from the estuarine end toward the outer tip of the point. A deep narrow cleft in the cliff and bench face prevented exploration of the extreme tip of the point bounding the north side of the slight embayment into which the river opens.

The remarkable circumstance of a sharp zone of Mytilus edulis below a similar zone of Mytilus californianus, the sea mussel, prompted a rough examination of zonation both at the estuarine end of the cliff base and at the farthest point which could be reached seaward along the cliff.

The inshore station examined was located to the west of a large conspicuous sea cave in the cliff face. At the -1.7 foot tide level, the irregular lower bench and boulders showed rich plant cover on the flat bench top and in pools.

At the lowest level, the kelp Laminaria andersoni and surf grass, Phyllospadix sp. were the predominant organisms. Phyllospadix sp. occurred as large scattered clumps and beds covering the bottoms of pools. Mixed in with the surf grass were a number of large species of red algae and the brown kelp, Alaria marginata. A few Cancer magister (edible crab) occurred in the pools. Pisaster ocraceus (starfish) and large Anthopleura xanthogrammica (anemone) were also found here. Scattered about at the lowest level were found small live Mytilus edulis, and also many dead shells. Large individuals of the snail Thais lamellosa were common at this level and were found eating the M. edulis.

Above the -1.7 foot tidal level, distinct bands of organisms were apparent. At each level the most abundant large organism was used to characterize the band and its vertical limits of occurrence was measured. A description of this vertical zonation is given in Table I. In some places, at the 0 tide level in this general area, boring clam holes formed a zone about two feet wide but no continuous horizontal band was present.

The Mytilus edulis populations appeared to be in their second year since the members could be divided into two size groups (lengths: ca. 23 mm. and 7.5 mm.) and no erosion of valves was found. Those bay mussels which were attached to and obscured by Rhodamela larix (a red alga) of Band 5 were preyed upon extensively by a large, robust population of

Thais lamellosa and a few young Pisaster ocraceus. M. edulis of Band 4 formed a dense, continuous mat easily removable from the substrate: byssal development was less than that found in older populations. The entire bed overlays dead Balanus sp. Nonmelanistic individuals, although conspicuous, accounted for less than one per cent of the total population.

Mytilus californianus of Band 2 were small for this species, attaining a maximum length of 75 mm. here. (No information was gathered on size ranges or distributions.) Predator activity was not obvious here, i.e., there were no large bare patches in the bed, but a few small Pisaster ocraceus were present as were Thais emarginata. The latter were feeding on Balanus spp. attached to the mussels. Egg capsules of the snails were observed in crevices of the bed.

In other rocky areas visited along the coast we have been accustomed to seeing a greater variety of red algae at the level of our Band 4 and below. Articulate coralline algae were completely missing although a few patches of the encrusting red alga Lithothamnium sp. were here. We also have come to expect the presence of the sea urchin Strongylocentrotus purpuratus but saw none at this site.

A second station was selected for examination near the deep fissure in the cliff face which blocked access to the tip of the point. This more seaward location is obviously more exposed to the action of surf, and even though it is located along the same continuous face only approximately

125 yards away from the inshore station, marked differences were obvious in the nature and number of the species present in their zonation. In this place, the cliff face was somewhat steeper than before, but the upper bench is well marked and about six feet wide. The lower bench was not well marked here. The almost vertical slope from the top bench continued down below water level in most places. Table II contains more species than Table I because a more detailed examination for smaller and less numerous species was made at this station, but the over-all impression upon comparison of the two areas in the field was that the inshore station area had a lesser number of species present.

The results from the examination of Station II are given in Table II, arranged in the same manner as those given in Table I for the inshore station.

Seaward along the cliff face of the point, beyond the impassable channel near Station II, certain differences from Station II could be observed. Large Pisaster ^hocraceus were abundant in the lower part of the Mytilus edulis bed and had entirely removed patches of muscles. The stalked barnacle Mitella polymeris was present as dense clumps forming a narrow band about one foot wide between the M. edulis and M. californianus beds. This barnacle band corresponds in position to the Balanus cariosus band found at Station I, but not present as a separate band at Station II.

Red algal bands 5 and 6 of Station I correspond in

position to the wide band dominated by the brown alga Hedophyllum sessile at Station II where these red algae were entirely absent. An important and abundant predator of M. edulis, Thais lamellosa, present at Station I was not present at Station II, where the lower part of the mussel band was more extensively preyed upon by large P. ocraceus which was not abundant at this place in Station I.

The upper bands of Mytilus spp. and Balanus spp. correspond at the two stations, with the exception of the separate B. cariosus and M. polymeris bands mentioned above.

The intertidal zonation described here is located on the south cliff-face of the high point forming the southern extension of Cascade Head, landward of the tip and within the un-named embayment bounded on the north by the point. The area lies somewhat behind two small islands located in the middle of the outer part of this slight embayment and near the mouth of the Salmon River. Conditions here are essentially marine rather than estuarine, as indicated by the composition of the biota and the open and deep nature of the embayment. It is however, a rather unique situation for the central and northern Oregon coast, since it affords some of the characteristics of protected, non-estuarine rocky bay along a coast lacking well-defined bays not associated with estuaries. The area is no doubt influenced by the river, probably strongly so during periods of heavy winter run-off, but most of its zonation characteristics seem to be related to the rapid

decrease in intensity of surf action along the south face of the point from the tip eastward. M. edulis is principally found in the protected estuarine bays in Oregon, and the estuary of the Salmon River, where it also occurs, probably serves as a reserve for yearly recolonization of the outside rock face. The semi-protected conditions in this rather open area at the same time provide sufficient exposure for M. californianus, and sufficient protection for M. edulis to survive and develop a high population density.

TABLE I

VERTICAL INTERTIDAL ZONATION AT
SALMON RIVER ESTUARY STATION I

Band number and predominant species, vertical range, other species and notes.

1. Balanus glandula: +9.7 to +12.2 feet.
Location: Slope and vertical face above top bench. Acmaea digitalis, Littorina sp. and Ligyda spp. range upward. On flat bench, small (green nemertean) Thais emarginata, Emplectella sp. Algae in small tufts only-- Pelvetiopsis sp., Gigartina sp., Endocladia sp., Fucus sp. in shallow pools.
2. Mytilus californianus: +7.2 to 9.7 feet.
Location: Lower and top edges of upper bench. B. cariosus, B. glandula, small T. emarginata, and A. digitalis on mussels. Few separate Mitella polymeris.
3. Balanus cariosus: +5.5 to +7.2 feet.
Large adult B. cariosus on vertical surface below edge of top bench and mussel bed. Some bare rock, few small M. edulis and M. californianus, Acmaea spp., T. emarginata. In crevices: A. xanthogrammica and A. elegantissima (small).
4. Mytilus edulis: +2.5 to +5.5 feet.
Location: Slope and vertical surface above lower bench. Mussels very close spaced, small. Lower level of bed with irregular breaks, bare rock with B. cariosus, and either Pisaster ocraceus and/or Thais lamellosa present, preying on the M. edulis.
5. Rhodamela larix (red alga): 0 to +2.5 feet.
Location: Slope and vertical surface above lower bench. Many small M. edulis attached to this alga, many dead. Thais lamellosa abundant here, eating mussels.
6. Gymnogongrus sp. (red alga): -1.7 to 0 feet.
Location: Lower part of lower vertical face. Other red algae mixed in with Gymnogongrus. No abundant large animals in this zone.
7. Phyllospadix: Subtidal to -1.7 feet.
In open areas surf grass forms small beds on the horizontal portion of the lower bench. Pisaster ocraceus and large A. xanthogrammica present in pools and under the edges of boulders. Laminaria andersoni and Alaria marginata common.

TABLE II

VERTICAL ZONATION AT
SALMON RIVER ESTUARY STATION II

Band number and predominant species, vertical range, other species and notes.

1. Balanus glandula: +10.2 upward.
Location: Vertical face above upper bench. Acmaea digitalis. Flat upper bench area with shallow pools, scattered tufts of Ulva, Endocladia, Pelvetiopsis. Small Mytilus edulis, Balanus cariosus, Thais emarginata.
2. Mytilus californianus: +5.2 to +10.2.
Location: Top edge of upper bench and slope below it. B. glandula and B. cariosus on Mytilus. Acmaea spp. and T. emarginata. Lower part of mussel band: Clumps of Mitella polymeris and B. cariosus. Upper foot of band-- fewer Mitella and B. cariosus. Corallina sp. on rock breaks in mussel bed.
3. Mytilus edulis: +2.4 to +5.2.
Location: Steep slope below upper bench. Very dense close packed population of M. edulis with small individuals below large. Scattered M. polymeris, small A. xanthogrammica, T. emarginata, B. glandula, B. cariosus, Acmaea spp. Nemertineans, Idothea sp.
4. Hedophyllum sessile (Brown alga): ?
Location: Lower part steep slope between two benches below M. edulis. Katharina tunicata and Pisaster ochraceus abundant. Idothea sp., Flustrella sp., Henricia leviuscula, Acmaea spp., Tonicella lineata, Corallina sp.
5. Phyllospadix sp.: ?
Location: Bottom portion of vertical slope and small irregular bottom bench. Surf grass covered most of the area of this band and extended below water level. Laminaria andersoni was present with the surf grass in the lower two feet and below water level.

Other spp.: Tubularia sp., Flustrella sp., Lacuna sp., Tonicella lineata, Mopalia lignosa, Iridaea sp., Ralfsia sp., Lithothamnion sp., Hemigrapsus nudis, Serpula sp., Pagurus sp., Sabellidae, Nemertean, Penitella penita.