

Discussion of the *Mytilus californianus* Community on Newly Constructed Rock Jetties in Southern California

(Mollusca: Bivalvia)

BY

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(3 Text figures)

INTRODUCTION

THE CALIFORNIA SEA-MUSSEL, *Mytilus californianus* CONRAD, 1837, is distributed from the Aleutian Islands, Alaska, to Isla Socorro, Mexico (110° 55' W. Longitude and 18° 45' N. Latitude). It is particularly abundant on rocks in the intertidal zone of the more exposed coasts (SOOT-RYEN, 1955). The re-establishment of a *M. californianus* community was studied by HEWATT (1935) at Monterey, California. He scraped an area free of all macroscopic life and studied the settlement of organisms on this denuded rock during the ensuing 2.5 years. Evidence for true succession was found; some of the earliest inhabitants were essential for the settlement of some of the later organisms. The study of succession by scraping a rock and following the settlement of organisms has been pursued by others, for example, BOKENHAM & STEPHENSON (1938) and HOSHIAI (1960).

The construction of new boat harbors in southern California has provided opportunities to study settlement of organisms on new structures never before exposed to sea water. Rock jetties are built on both sides of the entrance (Figures 1 and 2) in order to minimize the wave action within the marina and to prevent offshore sediments from being deposited within the boat harbor. The settlement of organisms, especially *Mytilus californianus*, on these jetties was studied at Ventura County (Port Hueneme) and Playa del Rey (Los Angeles) Marinas (Figures 1 and 2). This paper reports the results of these observations.

MATERIALS AND METHODS

The rock jetties at Ventura County and Playa del Rey Marinas were constructed in a similar manner. Two trenches were excavated in the sandy beach to a required depth and then filled with large rocks. Afterwards the jetty was extended beyond the coast line. The sand between the two jetties was not removed for about a year; in other words, only that portion of the jetty which extended beyond the coastline was exposed initially to sea water. Collections were first made in June and July 1960, at Ventura and Playa del Rey Marinas, respectively, or about 3 to 4 months after the rocks were first exposed to sea water. Collections were made approximately bimonthly until the end of the study in June 1962. As the dredging of the land between the jetties proceeded, the rocks were first exposed to sea water at a different time of the year. Therefore, it was possible to determine what effect, if any, the time of year has on the colonization of organisms on the rocks.

Collections were made from the mid-tide horizon where the *Mytilus californianus* community reached its maximum development. Successive collections were either made from the same rock or an adjoining one. An area associated organisms. Specimens were preserved in the field. The animals were sorted, identified, weighed and measured in the laboratory.

Three collecting sites were selected on the south jetty of Ventura County Marina (Figure 1): Site 1 was first exposed approximately March 1, 1960, the first collection

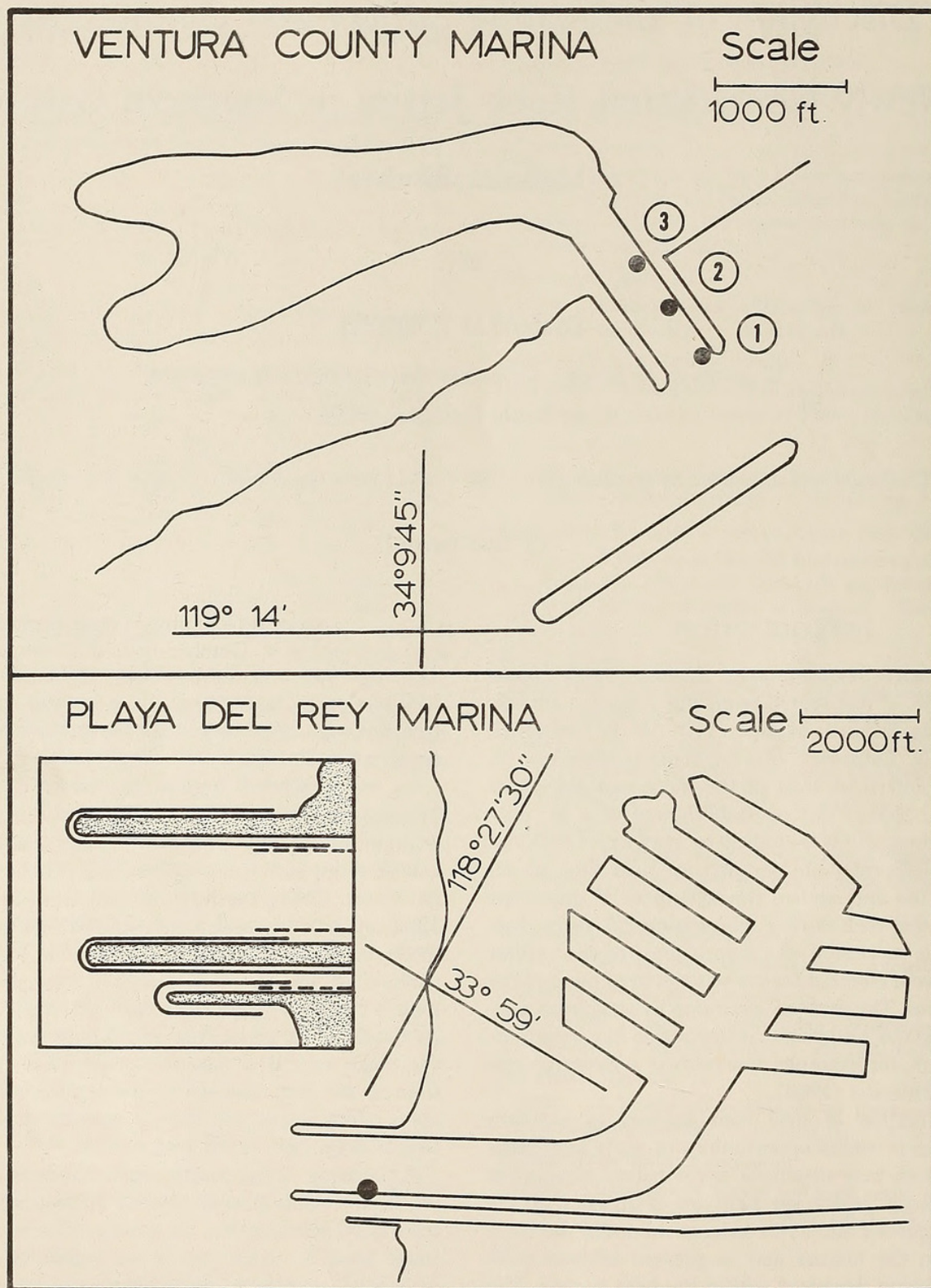


Figure 1: Map of Ventura County Marina, California, showing station locations.

Figure 2: Map of Playa del Rey Marina, California, showing collecting site. Distribution of *Mytilus californianus* is indicated by solid line and of *M. edulis* by dotted line.

made on June 17, 1960, and Sites 2 and 3 were first exposed approximately September 1 to 15, 1960, the first collections made on December 14, 1960. Only one site was used at Playa del Rey; it was first exposed approximately April 1, 1960, and the first collection made on July 1, 1960. Observations were made periodically inland to the collecting site especially for signs of *Mytilus californianus*.

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VENTURA COUNTY MARINA

The green alga, *Ulva dactylifera* SETCHELL & GARDNER, 1920, was the earliest macroscopic organism to settle on the rock jetties at both marinas. Luxuriant growths were observed throughout the mid-tide horizon within two months after the rocks were first exposed to sea water in spring 1960. The algae began to diminish shortly thereafter. *Ulva dactylifera* completely disappeared from Site 1 at both Ventura County and Playa del Rey Marinas after seven months exposure.

Settling of *Mytilus californianus* was rapid on the newly constructed jetties (Figure 3, Table 1). A peak of 1540 specimens for the 400 cm² area was reached by the end of summer 1960. The number of mussels decreased during the winter of 1960-61; a second peak of 1535 specimens was reached during August 1961. Thereafter the number of specimens continued to decrease until the entire population of *M. californianus* had been completely eliminated by August 1962, at Ventura. No mussels have been seen at Site 1 in Ventura County Marina since the summer of 1962, although a population is located nearby at the end of the jetty (see discussion).

The curve for the weight of the population of *Mytilus californianus* follows the trend of number of specimens during 1960. A plateau in the biomass occurred during the winter 1960-61 rather than a decrease as observed in the number of specimens; therefore, the weight per individual increased during this time. The weight of the population showed a second rise during the spring and summer of 1961 with a maximum weight of 1453 grams measured in August 1961. The weight of the population, but not per specimen, remained relatively constant during the next year.

Growth of the population of *Mytilus californianus*, as determined by the shell length of the largest specimens

in each collection, proceeded at a regular rate of 6 mm per month for the first year ending February 24, 1961. (Actually, this figure of 6 mm per month is a conservative one since the year was figured from March 1, 1960, the approximate date that Site 1 was first exposed to sea water. It is highly unlikely that *M. californianus* settled on the rocks the first day. The exact date the mussels first settled on the jetty is, of course, unknown; therefore, the conservative estimate was used.) No specimens were collected greater than 70 mm in length.

Sites 2 and 3 (Figure 1) at Ventura County Marina were originally exposed to water September 1 to 15, 1960. Growth of *Ulva dactylifera* dominated the entire mid-tidal zone from December 14, 1960 to April 2, 1961. *Mytilus californianus* were first seen at Site 2 on April 12, 1961. A total of 904 specimens, weighing 288 grams, and measuring up to 18 mm in length, was collected from a 400 cm² area on April 12, 1961. This was the largest population of mussels seen at this site. Small clumps of mussels were observed for the next six months, but none were seen after October 6, 1961. The population had not been re-established by July 1963. A few specimens of *M. californianus* were observed on the side of rocks at Site 3 on June 6, October 6, and December 19, 1961, but none since. A few small specimens of *M. edulis* LINNAEUS, 1758, were taken here on June 26, 1962, but none after this date.

PLAYA DEL REY MARINA

The growth and development of the *Mytilus californianus* community at Playa del Rey Marina was similar to what was observed at Ventura County Marina. As stated above, *Ulva dactylifera* preceded the establishment of the mussel. One striking difference in the mussel community in the two marinas was noted; the population of *M. californianus* has persisted to date at the jetties at Playa del Rey. An overlapping population of *M. californianus* and *M. edulis* was observed on each side of the rock jetties at Playa del Rey. The distribution of these two species of mussels is diagrammed in Figure 2.

ASSOCIATED SPECIES

The principal species of plants and animals associated with the population of *Mytilus californianus* are listed in Table 1. Seasonal differences are noted with respect to the number of species and specimens. The larger and more diverse populations were encountered during the summer and smaller, less diverse populations were observed during the winter months. The majority of the known species collected show a seasonal peak in occurrence. For example, the polychaetes *Nereis grubei* (KINBERG, 1866), *Lumbrineris zonata* (JOHNSON, 1901), and *Boccardia proboscidea* HARTMAN, 1940, were collected

Table 1

List of species and number of specimens collected from the *Mytilus californianus* community on the rock jetty at Ventura County Marina

Species	6/17 1960	8/4 1960	9/30 1960	12/14 1960	2/14 1961	4/12 1961	6/6 1961	8/3 1961	10/6 1961	12/19 1961	6/26 1962
Phylum Chlorophyta											
* <i>Ulva dactylifera</i>	+	+				+					+
*Phylum Coelenterata											
sea anemones, unidentified					1	5	2	6	7		8
*Phylum Platyhelminthes											
unidentified		2	6	1	9	7	1	14	16	14	146
*Phylum Nemertea											
unidentified	1	4	1	2	3		24	16	10	8	315
Phylum Annelida; Class Polychaeta											
<i>Paleonotus bellis</i>								2			24
*Phyllodocid			3	14	1			1	4		
*Syllinae	1	3	51	18	6	10	1	198			305
* <i>Nereis grubei</i>	1	1	1				1	1			
* <i>Nereis latascens</i>		7	3								
<i>Glycera sp.</i>						1		2	3		
* <i>Lumbrineris zonata</i>			1					4	1		1
<i>Dorvillea articulata</i>							3				1
* <i>Naineris dendritica</i>			20					3	6	10	22
* <i>Boccardia proboscidea</i>		12	407				20	5			1
* <i>Cirriformia luxuriosa</i>			5					1	9	10	
* <i>Polyophthalmus pictus</i>		2	90		4		1	6	74	62	
* <i>Capitella capitata</i>		1	30					2			
<i>Phragmatopoma californica</i>							6	4			1
* <i>Chone sp.</i>			7					5			2
Phylum Sipunculoidea											
<i>Phascolosoma agassizii</i>			3			1	3	45	20	26	4
Phylum Arthropoda; Class Crustacea											
<i>Pachygrapsus crassipes</i>		1						1	1	4	2
* <i>Balanus crenatus</i>		4			10			27	42	64	440
* <i>Chthamalus dalli</i>								70	46	281	21
* <i>Mitella polymerus</i>			4	9	3			2	1		41
Phylum Mollusca; Class Pelecypoda											
* <i>Hiatella arctica</i>	1	9	10	1	1		7	19		5	30
* <i>Mytilus californianus</i>	141	645	1540	929	934	1219	900	1535	1126	796	559
* <i>Protothaca staminea</i>					1		4		10		22
*Clams, juvenile			3					1			
Class Gastropoda											
* <i>Acmaea digitalis</i>								5		5	
* <i>Acmaea limatula</i>								55	41	15	23
* <i>Acmaea sp.</i> , juvenile		35	42	12	18	2	30	7			
* <i>Littorina planaxis</i>			1		2		1				
<i>Littorina scutulata</i>		2	2							4	
<i>Tegula sp.</i>						8	5	5			
*Snails, juvenile							19	19	5	8	7
Additional species	0	1	3	1	0	0	1	0	1	4	6
Additional specimens	0	1	4	1	0	0	1	0	1	5	5+
Total number of species	6	16	24	9	13	9	18	29	19	19	28
Total number of specimens	145	729	2224	987	993	1253	1029	2051	1423	1357	1980
Total number of specimens excluding <i>Mytilus californianus</i>	4	84	684	58	59	34	129	516	297	561	1421

* Indicates species also present in the *Mytilus californianus* community on the jetty at Playa del Rey Marina.

only during the months of June through October. The two acorn barnacles, *Balanus crenatus* BRUGUIÈRE, 1789, and *Chthamalus dalli* PILSBRY, 1916, were not taken in large numbers until 14 months after the first mussels were collected. Limpets were present the first summer, but the specimens were too small to make specific identifications. *Acmaea limatula* CARPENTER, 1864, was the most frequently encountered limpet in 1961.

Some species were incidental inhabitants of the mussel community and present more abundantly elsewhere. The polychaete *Phragmatopoma californica* (FEWKES, 1889)

builds sandy tubes which formed a conspicuous community in the low intertidal zone at Ventura County Marina. All specimens of the crab *Pachygrapsus crassipes* RANDALL, 1839, were small; the adults were very abundant between the rocks in the intertidal zone. All specimens of the clam *Protothaca staminea* (CONRAD, 1837) were small; this species was more commonly encountered in the benthos.

Additional species were collected, in most cases only one or two specimens and not listed in Table 1, from the *Mytilus californianus* community at Ventura County;

Settlement and Growth Rate in a Population of *Mytilus californianus*

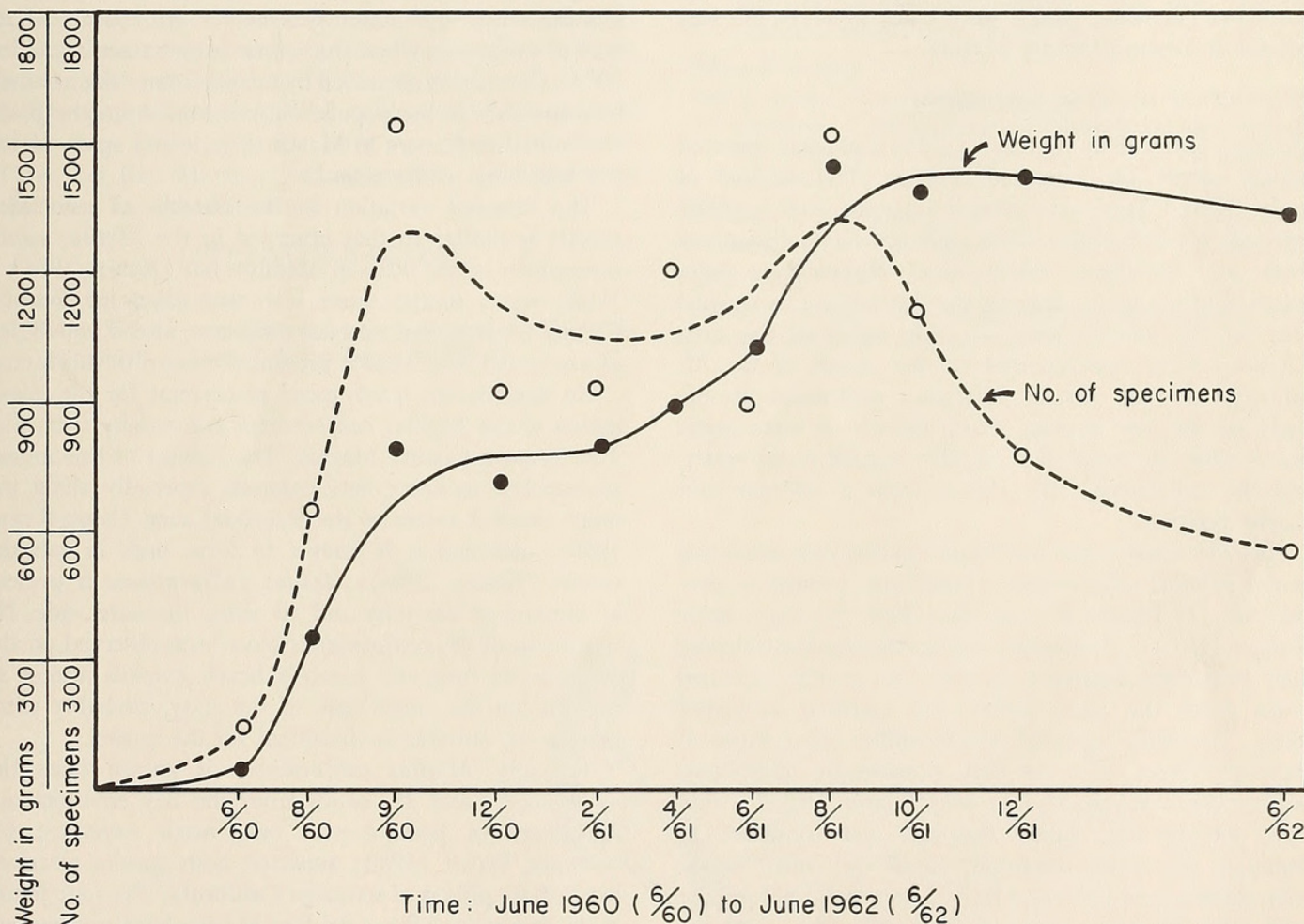


Figure 3: Graph showing settlement and growth rate of a population of *Mytilus californianus* in Ventura County Marina, California.

these include an unidentified sponge, the polychaetes *Halosydna johnsoni* (DARBOUX, 1899), *Eteone pacifica* HARTMAN, 1936, *Nereis vexillosa* GRUBE, 1851, *Ctenodrilus serratus* (SCHMIDT, 1857), *Pherusa capulata* (MOORE, 1909), *Armandia bioculata* HARTMAN, 1938, an unidentified oligochaete, the amphipods *Caprella californica* STIMPSON, 1857, *Corophium acherusicum* (COSTA, 1857), the pelecypod *Septifer bifurcatus* (CONRAD, 1837), a chiton, *Mopalia* sp., and the ectoprocot *Bugula neritina* (LINNAEUS, 1758).

Of the total number of macroscopic organisms collected from the *Mytilus californianus* community at the two marinas, 31, or 62%, were species in common; these species are indicated by an asterisk (*) in Table 1. Five species, the alga *Enteromorpha minima* NAEGELI, 1849, unidentified specimens of isopods, amphipods, and pycnogonids, and one young specimen of the starfish *Pisaster ochraceus* (BRANDT, 1835), were taken at Playa del Rey but not at Ventura County Marina.

DISCUSSION

The data obtained by HEWATT (1935) and these reported herein cannot be compared directly. The method of study differed. HEWATT removed a square yard ($=8281 \text{ cm}^2$) of *Mytilus californianus* and associated organisms from an established community; observations were reported of the larger animals that settled in this scraped area for the ensuing year. He then revisited the area 1.5 years later and reported on the extent of the *M. californianus* and *Mitella polymerus* settlement. In the study on the new marina jetties collections were made shortly after the rocks were initially exposed to sea water, and the collections were always from a different but nearby position.

HEWATT summarized his data by stating that succession in the *Mytilus californianus* community seemed to progress as: (1) formation of an algae film, (2) appearance of algae feeders, (3) mussels and barnacles attach during their respective spawning seasons, (4) as the attached forms grow, the algae feeders are crowded to higher zones. The data reported herein differ from those of HEWATT. Algae were the first macroscopic inhabitants as HEWATT observed. *Mytilus californianus* settled within three months after initial exposure and continued to dominate the entire community until the entire association disappeared two years later. Limpets did not appear until after the appearance of *M. californianus* and the specimens collected were small until a year later. The elimination of *Ulva dactylifera* was largely completed prior to the appearance of algae feeders such as gastropods. The acorn barnacles, *Balanus crenatus* and *Chtham-*

malus dalli, did not appear in large numbers until the second summer; the majority of these specimens attached to the shells of the mussels rather than to the rocks.

The importance of the time of year rather than true succession for the pattern of development of the *Mytilus californianus* community is similar to the observations on the establishment of the *M. edulis* community in protected waters (REISH, 1964a). *Mytilus californianus* settled during the spring months shortly after the rocks were first exposed to sea water at both Ventura and Playa del Rey Marinas. The California mussel did not settle on rocks initially exposed to sea water in late summer until the following spring.

The growth rate of 6 mm per month is slightly less than the 7 mm per month observed by COE & FOX (1942) for the same species at La Jolla, California. They found the principal growth in shell length to occur during the months when the water was colder with little or no growth occurring when the water temperature exceeded 20°C . Growth, as measured by the maximum size attained by a member of the population, occurred from the probable initial settlement in March to June and again during the following winter months.

The seasonal variation in the number of associated species is similar to that observed in the *Mytilus edulis* community on the floats in Alamitos Bay (REISH, 1964b). While water temperatures were not taken at Ventura County Marina, the seasonal difference in the population of associated organisms is presumed related to this factor.

No explanation is advanced to account for the elimination of the *Mytilus californianus* community from Site 1 at Ventura County Marina. The habitat of this mussel is described as being very common especially along the more exposed coasts of the intertidal zone (SOOT-RYEN, 1955), although it is known to form beds in subtidal waters (BERRY, 1954). *Mytilus californianus* is present at the end of the jetty and all along the outer side. No specimens of *M. californianus* have been observed on the north jetty; however, a sandy beach extends almost to the end on the ocean side of the jetty, probably eliminating any suitable environment for the mussel.

Typically, *Mytilus californianus* is known from the rocky shores and *M. edulis* from the bay environment. Specimens of both species may occur together; for example, FITCH (1953) reported both species attached to off-shore pilings of southern California. The rock jetties at the entrance of Playa del Rey Marina have overlapping populations (Figure 2). Two notable differences between the population of *M. californianus* at the two marinas were the smaller sized specimens (a maximum of 53 to 70 mm) and the larger number of specimens (a maximum

of 2261 to 1535) at Playa del Rey Marina. However, the total weight of the population of *M. californianus* was greater at Ventura County Marina. The rock jetties at Alamitos Bay and Newport Bay have a population of *M. californianus* at the end of the jetty and a population of *M. edulis* at the base of the jetty with an intermediate region in which neither mussel occurs.

SUMMARY

1. In a study of the growth and development of the *Mytilus californianus* community on rock jetties, newly constructed in Ventura County and Playa del Rey Marinas, data collected periodically over a two-year period indicated that *Ulva dactylifera* was the earliest macroscopic inhabitant regardless of what time of year the area was initially exposed to sea water. *Mytilus californianus* settled on the rocks during the spring months.
2. The larger, more diverse populations were encountered during the summer months and smaller, less diverse populations observed during the winter months.
3. The population of *Mytilus californianus* disappeared at Ventura County Marina after two years, but not at Playa del Rey Marina. No explanation is advanced at this time for this difference.

LITERATURE CITED

BERRY, SAMUEL STILLMAN

1954. On the supposed stenobathic habitat of the California sea mussel. Calif. Fish and Game 40: 69 - 73

BOKENHAM, N. A. H., & T. STEPHENSON

1938. The colonization of denuded surface in the intertidal region of the Cape peninsula. Ann. Natal Mus: 9: 47 - 81

COE, WESLEY R., & DENIS L. FOX

1942. Biology of the California sea mussel (*Mytilus californianus*). I. Influence of temperature, food supply, sex and age on the rate of growth. Journ. Exper. Zool. 90: 1 - 30

FITCH, JOHN E.

1953. Common marine bivalves of California. Calif. Dept. Fish and Game, Fish Bull. 90: 102 pp.

HEWATT, WILLIS G.

1935. Ecological succession in the *Mytilus californianus* habitat as observed in Monterey Bay, California. Ecology 16: 244 to 251

HOSHIAL, TAKAO

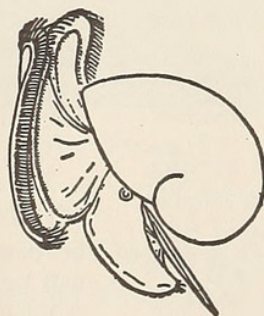
1960. Synecological study on intertidal communities. III. An analysis of interrelation among sedentary organisms on the artificially denuded rock surface. Bull. Mar. Biol. Sta. Asamushi, Tokoku Univ. 10: 49 - 56

REISH, DONALD J.

- 1964 a. Studies on the *Mytilus edulis* community in Alamitos Bay, California. I. Development and destruction of the community. The Veliger 6 (3): 124 - 131 (1 Jan. 1964)
California: II. Composition and variation of the associated organisms. The Veliger 6 (4): 202 - 207 (1 April 1964)

SOOT-RYEN, TRON

1955. A report of the family Mytilidae (Pelecypoda). Allan Hancock Pacific Exped., 20, 1 - 175





Reish, Donald J. 1964. "Discussion of the *Mytilus californianus* community on newly constructed rock jetties in southern California (Mollusca: Bivalvia)." *The veliger* 7, 95–101.

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