

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF FISH AND GAME

DIABLO CANYON POWER PLANT SITE
ECOLOGICAL STUDY
QUARTERLY REPORT No. 7
January 1 - March 31, 1975

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by

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Laurence L. Laurent and
Fred E. Wendell

PACIFIC GAS AND ELECTRIC COMPANY
COOPERATIVE RESEARCH AGREEMENT 6S-1047

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ABSTRACT

During the period January 1 -- March 31, 1975 we relocated and remarked five permanent subtidal stations and surveyed 28 random and two permanent intertidal stations. We failed to find a single giant red sea urchin, *Strongylocentrotus franciscanus*, around station 16 during a dive in March. Abalone, *Haliotis* spp., numbers decreased at random intertidal stations in North Diablo Cove and the North Control Area.

The commercial sea urchin fishery was inactive, while the commercial red abalone, *H. rufescens*, fishery continued to operate around Pecho Rock.

Counts of sea otters south of Point Eucbon increased significantly, 20 to 30 otters are now feeding just north of Pecho Rock.

Eight random fishery stations in Diablo Cove, Lion Rock Cove and the North Control Area yielded a substantial increase in catch-per-unit-of-effort.

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Marine Resources, Administrative Report No. 75-4, July 1975.

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This is the seventh quarterly report submitted in partial fulfillment of Research Contract No. 68-1047 between the Department of Fish and Game and the Pacific Gas and Electric Company. Through this contract, the Department of Fish and Game is to conduct ecological monitoring studies to determine what changes have occurred since the 1970-71 base line inventory of the marine biota, with special reference to fish and abalone.

Quarterly reports will be followed by annual reports. Full tables and species lists will be included in each annual report.

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INTRODUCTION

Most of our field effort during this quarter was devoted to intertidal surveys, both random and permanent stations were occupied. Some effort was directed towards relocating and remarking permanent subtidal stations. The commercial sea urchin, *Strongylocentrotus* spp., fishery was inactive and the commercial abalone fishery was closed for 1 month during the quarter. Weekly observations of sea otters, *Enhydra lutris*, continued. We collected more data on sportfish catch-per-unit-of-effort in Diablo Cove and the Control Area.

OPERATIONS

Permanent Subtidal Station Surveys

A series of severe winter storms during February and March prevented us from surveying any of the permanent stations; however, we were able to relocate and replace buoys on stations 7, 9, 11, 15 and 16 (Figure 1).

While diving in the vicinity of stations 16 and 10 (relocated) on March 10, we were unable to locate a single giant red sea urchin, *Strongylocentrotus franciscanus*. Conversely, a dive in the north part of Diablo Cove indicated that giant red sea urchins are still a common segment of the fauna. On August 6, 1974, we counted 86 urchins at the relocated station 10 (Figure 1) and on August 5, 1974 we observed 26 giant red sea urchins at relocated station 16. Random station 6 surveyed on August 17, 1974, yielded a giant red sea urchin count of three. All of the above counts were made after the abalone mortality.

We are aware of five factors that could have caused the disappearance of red urchins from south Diablo Cove: 1) otter predation,

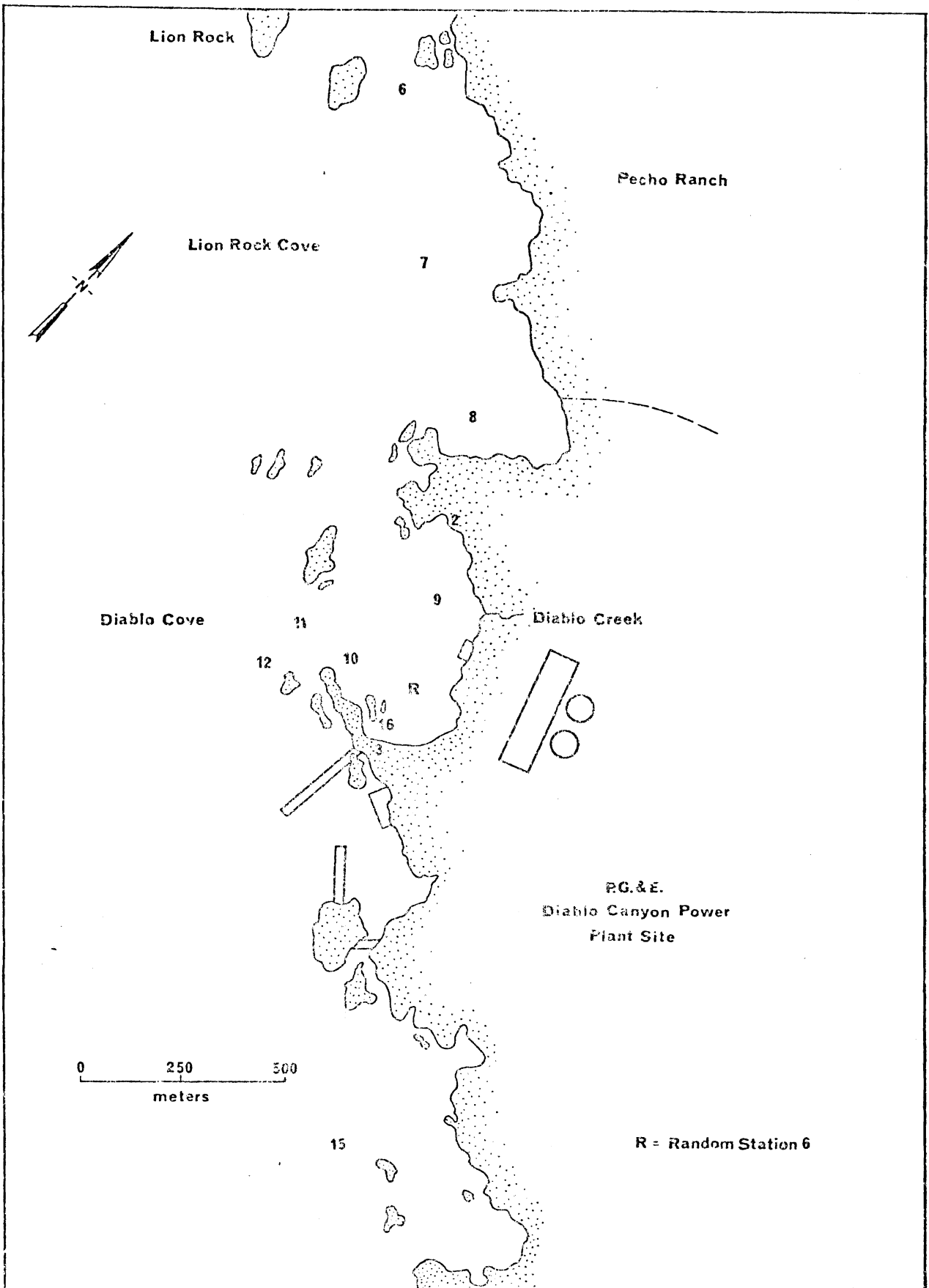


FIGURE 1. Location of permanent subtidal stations - Diablo Canyon power plant site.

ii) commercial sea urchin harvest, iii) copper, iv) red tide, and v) sanding in of reefs. Based on our field observations we can reject the first two factors, as very few otters have been observed in South Cove since July 1974 and only a few commercial urchin divers have visited the cove. It is possible that the mortality of urchins was due to the large amount of copper discharged into the cove in June, July and October when the cooling water pumps were being tested. However, this would indicate a delayed mortality rather than a short term one. The strong red tide conditions observed in South Cove during October and at least part of November also could have caused this mortality. Observations by Department of Fish and Game biologists (Burge and Schultz 1975) indicate a substantial number of urchins and red abalone were killed during October off Shell Beach, presumably by red tide conditions. Quoting directly from their report "a near complete kill of red abalone, *Haliotis rufescens*, and giant red sea urchins, *Strongylocentrotus franciscanus*, was found off Shell Beach, Sunset Palisades and Avila Beach." Finally, in March we observed what we feel to be an increase of sand deposition in South Diablo Cove; this sanding could have caused some of the mortality.

It is impossible to pinpoint the exact cause of the urchin mortality in South Cove; however, we strongly suspect that the red tide conditions last fall were a major factor. In addition, it is possible that the release of copper into the cove last summer and fall could have had a synergistic effect with the red tide or even have been the sole factor. It is interesting to note that the circulating pumps were operating on October 22, 1974 during the red tide period.

Intertidal

During this quarter, 28 intertidal stations were surveyed, making a total of 38 stations surveyed during the Davidson Period; 4 in Diablo Point Intertidal (DPI), 13 in South Diablo Cove Intertidal (SDCI), 12 in North Diablo Cove Intertidal (NDCI), and 9 in the North Control Intertidal (NCI) (Figure 2). Survey methods remain consistent with those previously reported, however, an additional survey method was begun this quarter: a perpendicular-to-shoreline transect to provide complementary data on the population of black abalone, *H. cracherodii*.

The parallel-to-shoreline transects, while adequate to assess much of the floral and faunal organisms statistically, were missing the bulk of the black abalone population because only the lower end of their distribution was being sampled. The importance of sampling the entire distribution was revealed by the abalone mortality of this past summer. A total of 20 perpendicular transects was performed simultaneously with the parallel transects in SDCI, NDCI and NCI.

Comprehensive statistical treatment of the data (population estimates of invertebrates, biomass of algal, and percentage cover by articulated corallines and *Phyllospadix* sp.) will be presented in the next annual report which will also summarize the work of this next quarter. However, the method with which the percentage cover of coralline algae and *Phyllospadix* was handled will have to be changed because an arc-sine (or similar) conversion is necessary to treat this type of data statistically.

Random Stations

No significant changes in floral or faunal composition from the $\frac{1}{4}$ m² quadrats appear to have occurred in the study areas since the last report or when compared to the previous Davidson Period. However, the

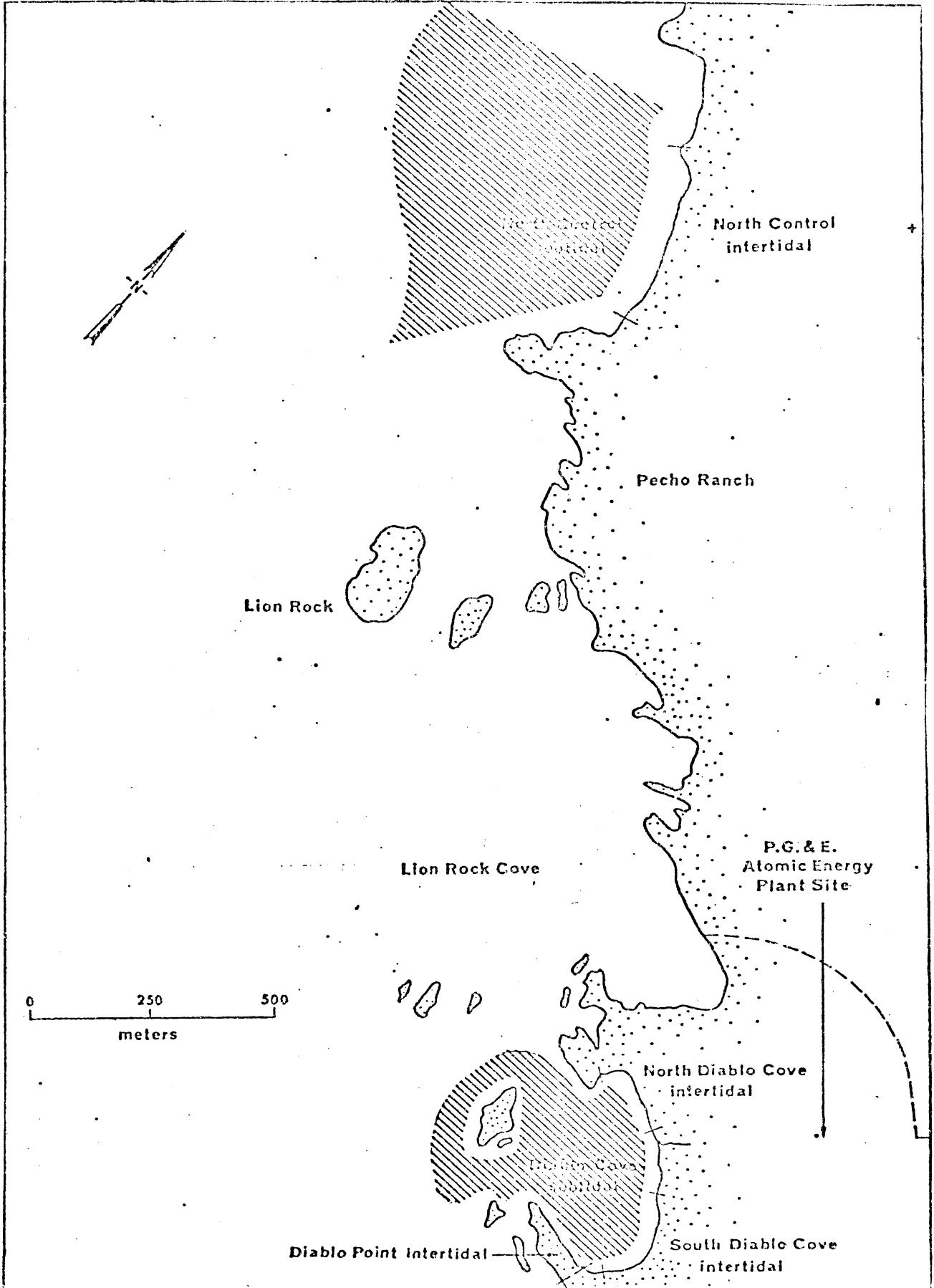


FIGURE 2. Location of random subtidal and intertidal areas, Diablo Canyon power plant site.

abalone counts taken along the transects from this Davidson Period, when compared to counts from the preceeding Davidson Period, show rather marked decreases in two of the study areas (Table 1). These decreases most likely reflect the results of sea otter foraging over the past year. The DPI study area shows no abalone decline because its exposure to wave action presents an inhospitable area to the otter. It is interesting to note that the SDCI, where an abalone mortality occurred in summer 1974, shows no significant decline of abalone stocks as sampled in our parallel transects.

Table 1. Comparison of Abalone Counts (Mean per m²) During Davidson Periods from Parallel Transects, Diablo Canyon Power Plant Site.

	<u>1974</u>		<u>1975</u>	
	Black abalone	Red abalone	Black abalone	Red abalone
Diablo Point Intertidal	0.94	0.00	1.05	0.00
South Diablo Cove Intertidal	0.03	0.10	0.02	0.08
North Diablo Cove Intertidal	2.84	0.31	1.48	0.12
North Control Intertidal	1.98*	0.03*	0.55	0.02

* Counts are higher for black abalone and lower for red abalone than reported in 1974 Annual Report because 10 stations (11-20) sampled at that time have been deleted due to habitat dissimilarities. These means represent counts taken at remaining stations (1-10). See Quarterly Report #6.

Perpendicular Transects

This additional method, begun in late January, reveals that the bulk of the black abalone population was missed by the parallel transects (Table 2), especially in SDCI where only 8% of that area's black abalone appeared in the parallel sampling. Therefore, if a mortality occurred

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in the higher zones of SDCI, it would not have been detected by our parallel transect methods.

Table 2. Comparison of Abalone Counts (Mean per m²) Along Parallel and Perpendicular Transects, 1975 Davidson Period, Diablo Canyon Power Plant Site.

	Parallel transects		Perpendicular transects	
	Black abalone	Red abalone	Black abalone	Red abalone
South Diablo Cove Intertidal	0.02	0.08	0.22	0.05
North Diablo Cove Intertidal	1.48	0.12	2.41	0.04
North Control Intertidal	0.55	0.02	1.15	0.00

Permanent Stations

The two permanent stations within Diablo Cove were resurveyed this quarter (Table 3). The only transect to show a decline from previous years' surveys is 3A with an approximate 65% decrease in black abalone numbers. Station 3B, located 11 m (36 ft), east of 3A, showed no decline.

Commercial Fisheries

The commercial abalone fishery, concentrated around Pecho Rock, was active through January. Two interviews showed a landing of 128 red abalone, for a catch-per-hour of 10.7 abalone. The closed season during February and winter storms curtailed fishing effort during the remainder of the quarter.

The urchin fishery was inactive during the entire quarter.

Table 3. Numbers of Abalone (Mean per m²) from Diablo Cove Permanent Intertidal Stations, Diablo Canyon Power Plant Site.

	1970*	1971*	1974	1975
<u>North Diablo Cove</u>				
<u>Station 2A</u>				
Black abalone	3.02	4.45	4.17	4.23
Red abalone	0.04	0.05	0.02	0.03
<u>Station 2B</u>				
Black abalone	1.15	1.71	2.02	2.70
Red abalone	0.03	0.05	0.05	0.09
<u>South Diablo Cove</u>				
<u>Station 3A</u>				
Black abalone	0.32	0.37	0.35	0.12
Red abalone	0.01	0.04	0.00	0.00
<u>Station 3B</u>				
Black abalone	0.50	0.60	N.S.**	0.66
Red abalone	0.03	0.09	N.S.	0.07

* Mean of 3 surveys

** N.S. - Not surveyed

Sea Otter Counts

During the quarter, the population of sea otters south of Point Buchon increased significantly, similar to the pattern observed in early 1974. Mean weekly counts increased from 56 in January to 91 in March. Along with the increase in numbers, we also observed a move by the otters to the south: on February 25, 28 otters were observed just north of Pecho Rock and on March 27, 35 otters were observed in this area. The Pecho Rock area is the last area north of Point Conception with a large enough population of red abalone to support a commercial fishery. Assuming the otters will remain in this area for the next year, we predict that this commercial fishery will cease to exist by the end of 1976. A total of 66 sea otters was observed feeding, nine were eating abalone and two had giant red sea urchins; the remaining food items could not be identified.

Catch-Per-Unit-of-Effort of Sportfishes Study

Catch rates during the quarter improved substantially over last quarter rates. In Diablo Cove three stations yielded a catch per hour of 0.33 fish, two stations in North Cove (Lion Rock Cove) yielded 0.50 fish per hour and three stations in the North Control yielded 3.56 fish per hour. These rates compare with 0.07, 0.43 and 1.77 fish per hour respectively last fall. Blue rockfish made up 94% of the catch.

Discharge Cofferdam Removal

It has been 1 year since the removal of the discharge cofferdam adjacent to the south side of Diablo Creek. Since washed materials were used in constructing the cofferdam, removal of this structure was a fairly clean operation. The intertidal bench to the south of the discharge, which was covered by rock rip-rap, is now in the process of

recovery with *Ulva* spp., *Laminaria dentigera*, and *Pterygophora californica* the dominant algal species. Some red algae is also beginning to take hold. Few adverse effects of the cofferdam can now be seen. The same may not be true, however, for the removal of the road to the cofferdam. Since the road was built with native fill material, this, with washout from Diablo Creek, may have contributed to the amount of sanding we now see occurring in the southern portion of Diablo Cove.

REFERENCES

- Burge, Richard and Steve Schultz. 1975. Red Tide Report. Calif. Dept. Fish and Game, Cruise Rept. 74-Y-2, 75-R-1, 75-Y-1:6 p.

APPENDIX I

MAN-DAYS SPENT AT DIABLO CANYON POWER PLANT SITE

January 1 - March 31, 1975

Subtidal surveys:	March 9 - 14
Participants:	Wendell, Benech and Gotshall
Intertidal surveys:	January 8 - 14
Participants:	Laurent, Wendell and Benech (January 8-12) Wendell and Benech (January 13-14)
Participants:	January 23 - 29 Gotshall, Benech, Tersol and Wendell
Participants:	February 6 - 11 Gotshall, Benech and Laurent
Participants:	February 21 - 27 Laurent, Benech and Wendell Gotshall (February 24-27)
Commercial abalone and sea urchin fishery surveys:	January 3, 4, 8, 9, 10, 11, 12, 13, 22, 24, 25, 26, 27, 28, 29 February 6, 7, 8, 9, 10
Participant:	March 28 Benech
Total man-days during quarter	231
Total man-days at site	68
Boat-days lost to weather	1
Total stations surveyed	41
Travel time man-days	12
Boat time (hour)	7.2
Laboratory time man-days	151

PROJECT PERSONNEL:

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Margaret M. Hughes	Stenographer II
Suzanne V. Benech	Seasonal Aid
Kathleen M. Cheap	Seasonal Aid
Antony Tersol	Seasonal Aid