

State of California
The Resources Agency
DEPARTMENT OF FISH AND GAME

DIABLO CANYON POWER PLANT
SITE ECOLOGICAL STUDY LABORATORIES
PACIFIC GAS AND ELECTRIC COMPANY
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DIABLO CANYON POWER PLANT SITE ECOLOGICAL STUDY

QUARTERLY REPORT NO. 10

OCTOBER - DECEMBER 31, 1975

by

Daniel W. Gotshall
Laurence L. Laurent
and
Fred E. Wendell

PACIFIC GAS AND ELECTRIC COMPANY
COOPERATIVE RESEARCH AGREEMENT 5-11-75

MARINE RESOURCES
Administrative Report No. 76-7

July 1976

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ABSTRACT

Field work during the quarter included surveys of permanent and random subtidal and intertidal stations. At permanent subtidal stations densities of the brown algae *Laminaria* and *Nereocystis* decreased as did densities of giant red sea urchins, *Strongylocentrotus franciscanus*.

Counts of small invertebrates within one-quarter meter square ($\frac{1}{4}$ -m²) quadrats at random subtidal stations were begun. A total of 32 quadrats was completed. *Balanophyllia elegans* was the most abundant and most common animal encountered. The annual surface count of bull kelp (*Nereocystis*) was not possible because of the increased density; instead we utilized subtidal counts to estimate the surface canopy. An estimate of 33,000 plants was made for this year's canopy; this compares with a count of 18,000 plants last year. Sampling of random intertidal stations for the Davidson period began; 15 stations were surveyed. In addition, permanent intertidal stations 1, 2 and 3 were surveyed for abalone densities.

The sea otter, *Enhydra lutris*, herd continued to occupy the area around Point Buchon.

In November daily observations were initiated on foam location and abundance in Diablo Cove.

^{1/} Marine Resources, Administrative Report No. 76-7
July 1976.

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This is the 10th quarterly report submitted in partial fulfillment of Research Contract N. 5-11-75 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 1970 and 1971 in the baseline inventory of the marine biota, with special reference to fishes 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

Field work during the period included quantitative surveys of the "micro" community at random subtidal stations, survey of permanent subtidal stations and random and permanent intertidal stations. The commercial sea urchin fishery was active again but at a relatively low level. Commercial abalone divers were inactive. Beginning in November, daily observations of foam location and abundance in Diablo Cove were made.

OPERATIONS

Permanent Subtidal Stations

Methods

We were not successful in relocating stations 8 or 10; stations 9, 11, 12 and 16 in Diablo Cove were surveyed as well as Control Stations 6, 7, and 15 (Figure 1).

Results

Densities of *Laminaria dentigera* and *Nereocystis luetkeana* in Diablo Cove decreased from summer densities; for *Laminaria* the mean per m^2 decreased from 1.07 to 0.30 and for *Nereocystis* the mean changed from 1.79 to 0.30. The mean density per m^2 for *Pterygophora californica* increased slightly, 1.96 to 2.19. At Control Stations the densities of all three species decreased.

Changes in densities for the following major invertebrate species in Diablo Cove were noted: *Astraea gibberosa* (0.09 to 0.18 per m^2), *Cancer antennarius* (0.02 to 0.01 per m^2), *Haliotis rufescens* (0.00 to 0.01 per m^2), and *Strongylocentrotus franciscanus* (0.62 to 0.39 per m^2). *Astraea* increased in density at Control Stations (0.01 to 0.02 per m^2) while

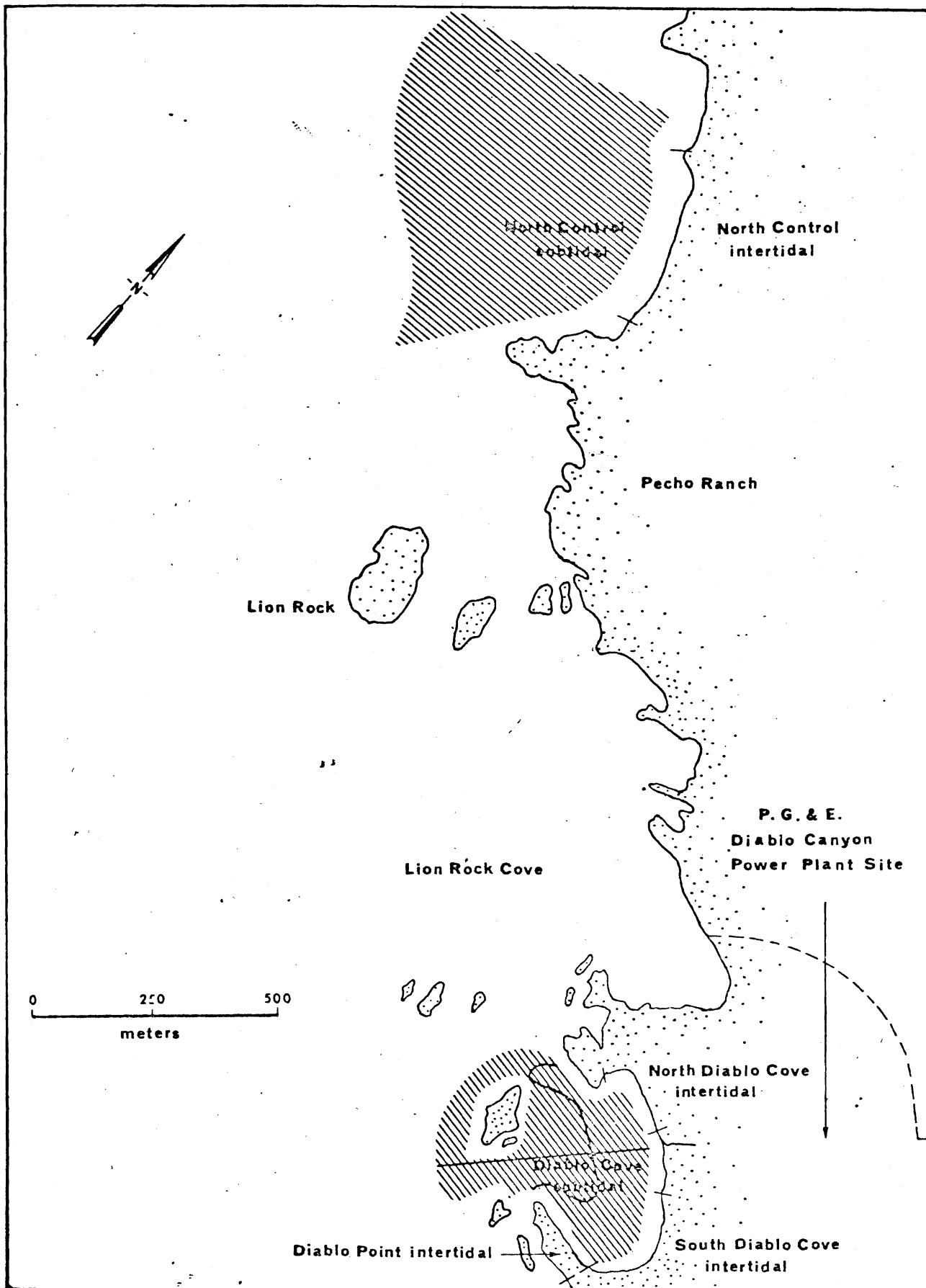


FIGURE 1. Location of random subtidal and intertidal areas - Diablo Canyon power plant site.

giant red sea urchins and red abalone decreased in density 2.48 to 2.04 and 0.01 to 0.00 per m^2 , respectively.

Random Subtidal Stations

Methods

We made counts of small invertebrates ("micro" counts) within randomly placed $\frac{1}{4}$ - m^2 quadrats at eight of the random subtidal stations in Diablo Cove. These counts should allow us to document further changes in the Diablo Cove subtidal community.

Results

Four quadrats were sampled at each station for a total of 32 samples. We have identified 53 species of invertebrates representing all of the major phyla and have collected many more species yet to be identified in the laboratory. The cup coral, *Balanophyllia elegans*, was the most abundant and most common animal observed (Table 1) followed by the polychaete, *Diopatra ornata*. It is interesting to note that the lined chiton, *Tonicella lineata*, as predicted in our 1974-75 annual report, was considerably more abundant in the $\frac{1}{4}$ - m^2 samples than our random macro surveys would indicate. The mean density of this colorful chiton at macro stations in Diablo Cove was 0.06 per m^2 while the $\frac{1}{4}$ - m^2 quadrats yielded a density of 7.24 per m^2 . Small red abalone were encountered in two of the quadrats.

Bull Kelp Census

Methods

The distribution of bull kelp, *Nereocystis luetkeana*, within Diablo Cove was so extensive and dense this year that no annual shore count of the surface canopy was attempted. Instead, a total population estimate was

generated utilizing counts from 27 random and permanent subtidal stations surveyed between June and October 1975. Eight additional randomly selected stations were also surveyed for bull kelp to supplement these data.

Results

The mean number of bull kelp per m^2 and the 95% confidence interval from these 35 stations was 2.6 ± 0.87 . Expanding from this, a total population estimate of 339,160 plants was made assuming Diablo Cove to be 32 acres ($129,500 m^2$) in area (Burge and Schultz 1973).

Discussion

Because this is a total population (i.e. standing crop) estimate rather than an estimate of mature plants comprising a surface canopy, a comparison with earlier surface canopy censuses is difficult. Last year's canopy count was slightly over 18,000 plants. However, a total population estimate made utilizing the 12 permanent and random subtidal stations surveyed within the same time frame (June-October 1974) was 194,120 plants. If this rough 1:10 ratio is applied to the 1975 data, the surface canopy would have approximately 33,000 plants, or almost twice the 1974 shore count figure for bull kelp.

Intertidal Surveys

Methods

During the quarter, sampling for the 1975-76 Davidson period began. A total of 15 random stations was surveyed: eight in the Control Area and seven in Diablo Cove. In addition, surveys on permanent stations, numbers 1, 2, and 3 were conducted.

Results

So far, the counts from the random stations indicate no significant

Table 1. Numbers, Frequency of Occurrence, and 95% Confidence Intervals for Selected Invertebrates at Random Subtidal Stations ($\frac{1}{4}$ m²) - Diablo Cove - Diablo Canyon Power Plant Site - September 1975.

SPECIES	Sum	Percent frequency	Mean/ $\frac{1}{4}$ m ²	95% Confidence interval
<i>Balanophyllia elegans</i>	512	87.5	16.00	± 6.29
<i>Henricia leviscula</i>	10	25.0	0.31	± 0.23
<i>Pateria miniata</i>	46	65.6	1.44	± 0.65
<i>Diopatra ornata</i>	168	40.6	5.25	± 5.35
<i>Loxorhyncus crispatus</i>	5	15.6	0.16	± 0.13
<i>Pagurus</i> spp.	12	21.9	0.38	± 0.35
<i>Acmaea mitra</i>	44	59.4	1.38	± 0.78
<i>Astraea gibberosa</i>	10	21.9	0.31	± 0.23
<i>Homolopoma luridum</i>	36	40.6	1.12	± 0.71
<i>Tegula brannea</i>	14	28.1	0.44	± 0.32
<i>Tonicella lineata</i>	58	62.5	1.81	± 0.80
<i>Serpulorbis squamigerus</i>	46	31.2	1.44	± 1.17
<i>Boltenia villosa</i>	6	15.6	0.19	± 0.17
TOTAL STATIONS ($\frac{1}{4}$ m ²)	32			

deviation from species composition and abundances reported from previous surveys. However, the abalone survey of permanent station transect 3A, when there was an apparent decline of black abalone, *Haliotis cracherodii*, after the 1974 copper-ion discharge, revealed a resurgence of this animal's numbers. The January 1975 after-mortality survey revealed 0.12 black abalone per m² down from an average of 0.35 per m² during the previous 3 years, while this latest survey showed 0.53 black abalone per m². This increase probably represents a "lebensraum" phenomenon, a filling of a vacant habitat by abalone from more crowded surrounding areas.

Sea Otter

Results

Within the area surveyed, sea otter, *Enhydra lutris*, remained relatively stable during the during the quarter. The mean weekly counts were as follows: October, 45 ± 2; November, 46 ± 2; and December 48 ± 17. Most foraging, feeding, and rafting activity were observed near the Point Buchon area. A few animals were observed as far south as our North Control Study Area. Observed feeding activity during the quarter was slight. Of the seven food items observed being consumed three were identifiable: one abalone, one sea urchin and one crab.

Commercial Sea Urchin and Abalone Fisheries

Results

Both commercial fisheries were relatively quiescent during the quarter. The commercial sea urchin fishery activity was very sporadic while no commercial abalone fishing effort was noted.

Dredging Activities

Dredging of the Intake Cove area, which had gone on fairly continuously since early 1974, was halted when P.G. & E. received permission from the State Land Commission to remove the dredge this November. Although a great deal of effort and money were spent in dredging, little progress toward restoration of the Cove was ever noted by us. We came to the conclusion that dredging would have no curative effect on the damage done by sloppy construction and removal of the intake structure cofferdam. However, had no siltation occurred during the construction phase, we deem it quite likely that the quiet body of water formed by the intake breakwaters would have been subjected to continuing and rapid siltation from both terrestrial and marine sources. We will continue monitoring the Intake Cove with periodic reconnaissance dives.

Surface Foam

Methods

After initial cooling system testing, it became apparent that discharge-produced surface foam might be a factor influencing the intertidal and nearshore marine environment. The foam was apparently produced by cavitation and agitation of cooling water at the discharge structure. Resumption of cooling system testing began November 10, 1975. On November 7, 1975, we initiated a survey of surface foam conditions within Diablo Cove. The survey includes estimates of wind, swell direction and energy (i.e. swell height), a map showing the distribution of foam at the time of the report, and photographs of the Cove for verification.

Results

The foam distribution pattern within the Cove was strongly influenced by wind speed and direction as well as swell height. With slight to moderate winds and swell out of the northwest, a condition which occurred on 50% of the 24 survey days, foam was found within South Diablo Cove. Foam impinged at times in thick pads upon the intertidal area. With stronger winds or higher swell (4 of the 24 survey days) the foam rarely formed thick pads and apparently dispersed quickly. North Diablo Cove was affected only occasionally by foam (3 of the 24 survey days) when wind direction was out of the south or southwest. The southern portion of Diablo Cove was the only area during the quarter where foam was found with a sufficiently high frequency of occurrence to have any influence on subtidal algae.

APPENDIX I

MAN-DAYS SPENT AT DIABLO CANYON POWER PLANT SITE

October 1 - December 31, 1975

Subtidal surveys:	October 1 - 3
Participants:	Laurent, Wendell, Cheap
	October 6 - 10
Participants:	Gotshall, Laurent, Wendell, Cheap
	October 13 - 17; 20 - 24; 27 - 31
Participants:	Laurent, Wendell, Cheap
Intertidal and subtidal surveys:	November 2 - 8
Participants:	Gotshall, Laurent, Wendell, Cheap
	November 10 - 14; 17 - 21; 24 - 26
Participants:	Laurent, Wendell, Cheap
	November 29 - December 4
Participants:	Gotshall, Laurent, Wendell, Cheap
	December 8 - 12; 15 - 19; 22 - 24
Participants:	Wendell, Cheap
	December 29 - 31
Participants:	Laurent, Wendell
Total man-days during quarter:	260
Total man-days at site:	197
Boat-days lost to weather:	4
Total stations surveyed:	15+
Travel time man-days	3
Boat time (hours)	25.5
Laboratory time man-days*	63

*includes only those days spent at Monterey office.

PROJECT PERSONNEL:

Daniel W. Gotshall	Senior Marine Biologist, Project Leader
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Fred E. Wendell	Assistant Marine Biologist
Lois E. Sloan	Stenographer
Kathleen M. Cheap	Seasonal Aid
Jane E. Dykzeul	Seasonal Aid