DIABLO CANYON POWER PLANT SITE ECOLOGICAL STUDY

QUARTERLY REPORT NO. 3 [1]

by

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ABSTRACT

During the period January 1 - March 31, 1974, winter surveys of the permanent subtidal stations were initiated. Three stations were surveyed.

We completed our winter random intertidal surveys; a total of 14 stations in Diablo Cove and the North Control Area were visited.

The commercial sea urchin fishery resumed and we began interviewing fishermen again.

Very little commercial abalone fishing occurred due to the one-month closed season and winter storms.

We observed a sea otter in North Cove for the first time and harbor seals were also observed on the eastern end of the south breakwater for the first time since we began our studies.

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[1] Marine Resources Administrative Report No. 6, May 1974.

[2] Operations Research Branch, Monterey.

This is the third quarterly report submitted in partial fulfillment of Research Contract No. 6S-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 during 1970 and 1971 in the 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

This is the third quarterly report covering Department of Fish and Game activities during the second phase of Diablo Canyon Ecological Studies. These studies are designed to assess the impact of natural and man-made changes on the permanent study areas set up during the preoperational phase. In addition, random sampling of the intertidal and subtidal are being conducted to further quantify the major plant and animal communities. Finally, this second phase includes monitoring of the commercial sea urchin and red abalone fisheries to obtain further baseline data and attempt to evaluate their impact on the study areas.

OPERATIONS

Winter surveys of the permanent subtidal stations were attempted; but, due to large seas generated by winter storms, we were able to complete only 3 of 11 stations. Station 10 and 11 in Diablo Cove were surveyed on March 11 and 14, and Station 7 in the North Cove was surveyed on March 14. Counts of most animals were similar to counts obtained last fall; in fact, some were identical (Table 1). This was the case with *Tealia crassicornis* and *T. lofotensis*, *Orthasterias koehleri*, *Pisaster giganteus*, *Stichopus californicus* and *Astraea undosa* at Station 7; *Dendrodoris fulva* at Station 10; and *Henricia leviuscula* and *Patiria miniata* at Station 11. No red abalone species were observed at any of the stations; however, we did encounter pinto abalone, *Haliotis kamtschatkana*, at all three stations. Giant red sea urchin, *Strongylocentrotus franciscanus*, numbers remained about the same at Station 7

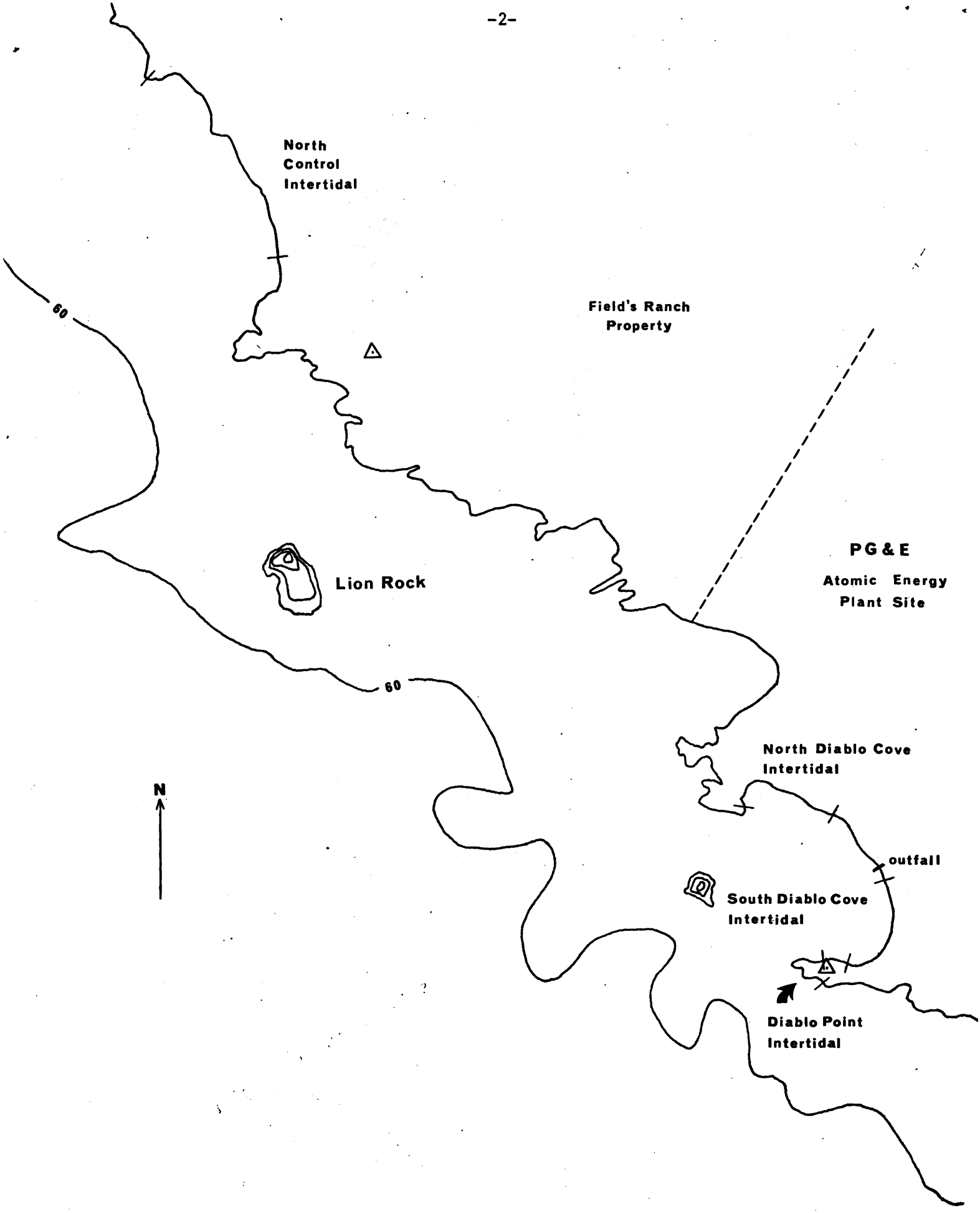
North
Control
Intertidal
60
Field's Ranch
Property
PG&E
Atomic Energy
Plant Site
Lion Rock
60
North Diablo Cove
Intertidal
N
outfall
South Diablo Cove
Intertidal
Diablo Point
Intertidal

TABLE 1. Comparison of Invertebrate Numbers Observed During Fall 1973 and Winter 1973-74 from Permanent Subtidal Transects - Diablo Canyon.

Species	Station 7		Station 10		Station 11	
	Fall	Winter	Fall	Winter	Fall	Winter
PORIFERA						
Tethya aurantia	11	11	3	4	20	12
COELENTERATA						
Anthopleura xanthogrammica	0	0	3	4	0	3
Antnopleura artemesia	*NC	2	0	0	NC	0
Tealia crassicornis	1	1	0	0	0	0
Tealia lofotensis	3	3	0	0	0	0
ECHINODERMATA						
Cucumaria miniata	NC	0	1	0	6	0
Eupentacta quinquesemita	0	2	1	0	0	0
Henricia leviuscula	2	1	0	2	4	4
Orthasterias koehleri	4	4	0	3	5	1
Patiria miniata	195	167	129	119	110	110
Pisaster brevispinus	10	5	0	1	5	7
Pisaster giganteus	9	9	4	2	6	9
Pisaster ochraceus	0	0	0	0	3	1

TABLE 1. (continued)

Species	Station 7		Station 10		Station 11	
	Fall	Winter	Fall	Winter	Fall	Winter
ECHINODERMATA (cont.)						
Pycnopodia helianthoides	0	1	4	0	11	1
Stichopus californicus	1	1	0	0	1	2
Strongylocentrotus franciscanus	131	137	86	56	89	81
Stylasterias forreri	0	0	1	2	0	2
ARTHROPODA						
Cancer antennarius	0	1	0	0	0	0
MOLLUSCA						
Astraea undosa	4	4	11	26	32	8
Cryptochiton stellerli	0	3	0	0	0	0
Dendrodoris fulva	1	9	3	3	17	3
Haliotis kamtschatkana	0	1	0	2	0	1
Haliotis rufescens	1	0	0	0	1	0
Hinnites multirugosus	0	0	0	0	0	1
CHORDATA						
Styela montereyensis	0	0	0	1	0	0

*NC - Present but not counted.

and 11 but decreased by about 1/3 at Station 10. The lack of red abalone and decrease in urchin numbers might be due to commercial fishing effort, otter predation, or both.

During the quarter, 14 random intertidal stations were visited during periods of minus tides - nine in the North Control Area and five in Diablo Cove. Twenty-six random stations were surveyed during the 1973-74 Davidson Current Period. Fourteen of these stations were in Diablo Cove (in the three study areas) and 12 were in the North Control Area. Sampling was conducted as described in the previous report; all macroinvertebrates within the ¼ m^2 quadrats were counted, soft algae was collected for later quantification, and the percentage cover by articulated corallines and *Phyllospadix scouleri* was estimated. When possible, abalone were counted within 1 m of the 30 m (98 ft) transect line.

The invertebrate data from this quarter have been summarized (Table 2) and, when compared to our previous studies at Point Arena, again show low average numbers of animals in all study areas except the more exposed Diablo Point Intertidal area (DPI).

Abalone transects (Table 3) again showed abundant black abalone, *Haliotis cracherodii*, in most study areas, and red abalone, *H. rufescens*, constituting a much smaller intertidal population. Both of these abalone populations consisted of mature individuals. The percentage of sport legal-sized abalone measured from transects in all areas was 62.9% for blacks ($\geq$ 5 inches shell length) and 64.7% for reds ($\geq$7 inches shell length).

All algae collected from quadrats during the Davidson Period have been sorted by species and have had wet weights and dry weights recorded.

TABLE 2. Summary of Invertebrate Numbers Found in ¼ m^2 Samples in the Four Subtidal Study Areas from January 1 through March 31, 1974 - Diablo Canyon.

Species	NDCI*			SDCI*			DPI*			NCI*		
	Sum	Percent frequency	Mean ¼m^2	Sum	Percent frequency	Mean ¼m^2	Sum	Percent frequency	Mean ¼m^2	Sum	Percent frequency	Mean ¼m^2
COELENTERATA												
Anthopleura xanthogrammica				8	37.5	1.0	1	25.0	0.2			
Corynactis californica							50+	25.0	12.5			
Epiactis prolifera	9	66.7	1.5	15	67.5	1.9	6	75.0	1.5	45	27.8	1.2
MOLLUSCA												
Acmaeidae	1	16.6	0.2	4	50.0	0.5	4	75.0	1.0	25	22.2	0.7
Aletes squamigerus							3	50.0	0.8			
Astraea gibberosa	2	33.3	0.3	4	25.0	0.5						
Fissurella volcano	6	33.3	1.0				2	50.0	0.5	28	27.8	0.8
Haliotis cracherodii							5	25.0	1.2	13	8.3	0.4
Haliotis rufescens	1	16.6	0.2									
Mopalia spp.				1	12.5	0.1				16	13.9	0.4
Mytilus californianus							5	50.0	1.2	31	2.8	0.9
Nuttallina californica	5	16.6	0.8				3	25.0	0.8	2	5.6	0.1
Tegula brunnea	28	50.0	4.7	9	37.5	1.1	16	75.0	4.0	61	41.7	1.7
Tegula funebralis	9	33.3	1.5	1	12.5	0.1				32	19.4	0.9
Tonicella lineata	1	16.6	0.2	1	12.5	0.1	1	25.0	0.2	2	2.8	0.1

TABLE 2. (cont.)

Species	NDCI* Sum	NDCI* Percent frequency	NDCI* Mean ¼m²	SDCI* Sum	SDCI* Percent frequency	SDCI* Mean ¼m²	DPI* Sum	DPI* Percent frequency	DPI* Mean ¼m²	NCI* Sum	NCI* Percent frequency	NCI* Mean ¼m²
ARTHROPODA												
Balanus sp.	Many small	16.6	--				Common	25.0	--			
Cancer sp.										2	5.6	0.1
Pugetia producta	8	66.6	1.3	8	50.0	1.0	3	50.0	0.8	11	25.0	0.3
ECHINODERMATA												
Henricia leviuscula	2	16.6	0.3				1	25.0	0.2	2	5.6	0.1
Leptasterias spp.	1	16.6	0.2	8	37.5	1.0	1	25.0	0.2	14	25.0	0.4
Patiria miniata										1	2.8	0.3
Pisaster ochraceous							1	25.0	0.2			
Strongylocentrotus purpuratus							20	50.0	5.0	4	8.3	0.1
MEAN NUMBER OF ANIMALS/¼ m²			12.16			7.37			30.75			8.03
TOTAL ¼ m² QUADRATS	6			8			4			36		

* NDCI = North Diablo Cove Intertidal.
SDCI = South Diablo Cove Intertidal.
DPI = "Diablo Point" Intertidal.
NCI = North Control Intertidal (adjacent to Field's Ranch).

TABLE 3. Average Numbers and Frequencies of Two Species of Abalone Found Along 30 m Transects in Diablo Cove.

Species	NDCI* Percent frequency	Mean ¼ m^2	SDCI* Percent frequency	Mean ¼ m^2	DPI* Percent frequency	Mean ¼ m^2	NCI* Percent frequency	Mean ¼ m^2
Haliotis cracherodii	100	5.565	100	0.083	100	1.183	75	0.594
Haliotis rufescens	100	0.466	100	0.133	0	0.000	62.5	0.056

* NDCI = North Diablo Cove Intertidal.
SDCI = South Diablo Cove Intertidal.
DPI = "Diablo Point" Intertidal.
NCI = North Control Intertidal (adjacent to Field's Ranch).

To date, 56 species of red algae and one of green have been enumerated. The intertidal zone is rich in algae and most stations have been averaging over 100 gm dry weight/m^2. The dominant and most frequent forms are: *Iridaea cordata* var. *splendens*, *Prionitis lanceolata*, *Gastroclonium coulteri*, and *Botryoglossum farlowianum*.

The commercial fishery for sea urchins resumed in January. Most effort seems to be concentrated in the area between Diablo Cove and Pecho Rock in depths of 3-13.5 m (10 to 45 ft). At least three boats are fishing out of Port San Luis and landing an average of between 450-900 kg (1000 and 2000 lb) of urchins per day.

Landings of red abalone were practically non-existent during the quarter due to winter storms and the closed season during February.

Sea otter numbers increased substantially in the area between Point Buchon and Lion Rock, with a high count of 135 animals on March 30. Only one otter was observed south of Lion Rock in North Cove on March 25. One third of the feeding sea otters observed were feeding on urchins compared with those observed from July through December 1973 (15.2%).

On March 27, we observed approximately 12 harbor seals hauled out at the eastern end of the south breakwater. This group included at least two very young animals. On February 20, we used an ichthyocide to collect 170 fishes of 12 species from a small tidepool in our North Control Area. Stomachs were obtained fom 6 *Gobiesox maeandricus*, 29 *Xiphister mucosus*, 8 *Gibbonsia metzi*, 5 *G. montereyensis*, and 30 *Xiphister atropurpureus*.

ABALONE TEMPERATURE TOLERANCE STUDIES

We continued testing temperature tolerances of adult specimens. A sample of adult red abalones was obtained from the Diablo Canyon

TABLE 4. Summary of Sea Otter Counts* and Feeding Habits - Point Buchon to Lion Rock - January through March 1974.

Date	Otter count	Number observed feeding Food items			
		Abalone	Urchins	Crabs	Unidentified
January 15	73	2			1
January 21	81	2	1		
January 29	97	1			
February 5	91	4			
February 10	95				
February 18	56	1			1
Febraury 27	97	2	3		
March 5	93	1	3		
March 14	124		2	1	
March 19	127	1	1		
March 30	135	1			2

* Data supplied by Suzanne Benech, P. G. & E.

region intertidal zone. These specimens were acclimated at 15 C (59 F) for two weeks and then subjected to instantaneous elevated temperatures.

Tests were accomplished at four temperature elevations. At 20 C (68 F) all test animals survived the 120-hr exposure period. Initial mortality occurred after a 12-hr exposure to a temperature of 23 C (73 F). However, 60% of the test animals survived after a 120-hr exposure to this same temperature. This may be contrasted with an elevated temperature of 26 C (79 F) that effected total mortality within 24 hr, or a 30 C (86 F) temperature that brought about total mortality within 6 hr (Table 5).

Loss of attachment ability was first observed within 3 hrs at 23 C (73 F). At 26 C (79 F), 20% of the test animals lost their attachment ability within 1 hr and all became detached within 3 hrs. A temperature of 30 C (86 F) caused all test animals to lose their attachment ability within 1 hr (Table 6).

TABLE 5. Percent Survival of Adult Red Abalone, *Haliotis rufescens*, Acclimated at 15 C (59 F) and Subjected to Instantaneous Elevated Temperature Shock.

Test Temp. C	Number of test animals	Percent survival												
		Exposure time (hr)												
		1	3	6	12	24	36	48	60	72	84	96	108	120
20	10	100	100	100	100	100	100	100	100	100	100	100	100	100
23	10	100	100	100	90	80	70	70	60	60	60	60	60	60
26	10	100	100	100	90	0	0	0	0	0	0	0	0	0
30	10	100	100	0	0	0	0	0	0	0	0	0	0	0

TABLE 6. Percent Remaining Attached of Adult Red Abalone, *Haliotis rufescens*, Acclimated at 15 C and Subjected to Instantaneous Elevated Temperature Shock.

Test Temp. C	Number of test animals	Percent remaining attached												
		Exposure time (hr)												
		1	3	6	12	24	36	48	60	72	84	96	108	120
20	10	100	100	100	100	100	100	100	100	100	100	100	100	100
23	10	100	80	80	70	70	60	60	60	60	60	60	60	60
26	10	80	0	0	0	0	0	0	0	0	0	0	0	0
30	10	0	0	0	0	0	0	0	0	0	0	0	0	0

MAN-DAYS SPENT AT DIABLO CANYON POWER PLANT SITE

January 1 - March 31, 1974

Intertidal Surveys:	January 4-9
Participants:	Farrens and Wendell
	January 18-21
Participants:	Laurent and Gotshall
	February 3-7
Participants:	Farrens and Wendell
	February 17-20
Participants:	Gotshall, Laurent and Farrens
Subtidal Surveys:	March 11-14
Participants:	Gotshall, Wendell and Farrens
	March 25-26
Participants:	Gotshall, Laurent and Farrens
Commercial Sea Urchin Fishing Surveys:	March 4-6
Participants:	Laurent

Total man-days during quarter:	252*
Total man-days at site:	63
Boat-days lost to weather:	4
Total stations surveyed:	17
Travel time man-days	16
Boat time (hr)	16.2
Laboratory time man-days	173

*Non-project personnel man-days are not included in totals, and totals do not include time spent on abalone temperature tolerance studies.

PROJECT PERSONNEL:

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Laurence L. Laurent	Associate Marine Biologist
Fred E. Wendell	Jr. Aquatic Biologist
Margaret M. Hughes	Stenographer II
Gary D. Farrens	Seasonal Aid

NON-PROJECT PERSONNEL:

Earl E. Ebert	Senior Marine Biologist, Operations Research Branch
Suzanne V. Benech	P. G. & E.