ENVIRONMENTAL CONDITIONS AT REFERENCE SITES ALONG THE SOUTHERN CALIFORNIA COAST, 1985

Very little is known about environmental changes over time in relatively clean areas off southern California. Natural fluctuations in biological parameters may occur seasonally, yearly, or over longer periods because of life histories or in response to changes in physical and chemical factors. Estimates of changes in concentrations of contaminants over time in reference areas have not previously been reported.

In 1977 SCCWRP conducted a "60-Meter Survey" of 71 stations at 60 m depth between Point Conception and the Mexican border (Word and Mearns, 1979). This survey provided biological data, sediment analysis, and contaminant measurements of the sediment for trace metals, DDTs and PCBs.

To evaluate changes in environmental conditions along the southern California mainland shelf, specifically in less frequently monitored "clean" areas, and to update the information from the 1977 survey, Bruce Thompson and other SCCWRP personnel returned to 13 of the 60-Meter Survey sites in 1985 for a second look at biological fauna, sediments, and contaminant levels. The 13 sites revisited in 1985 were sites selected objectively by Word and Mearns as "controls" and by Smith and Bernstein (1985).

In addition to the 60 meter depths sampled in 1977, Thompson made sediment grabs and trawled at 30 meter and 150 meter depths as well. Only one 30 meter station, in a kelp bed, was abandoned. In all, 38 stations were surveyed (Figure 1). Thompson also added analyses of megafaunal invertebrate and fish distributions and polynuclear aromatic hydrocarbons (PAHs) to the list of measurements made by Word and Mearns in 1977.

There was a trend in sediment type from silty-sand to sandy-silt over shelf depth, and organic content also increased with shelf depth (Table 1).

Trace metals and organic contaminants were found at low concentrations in sediments from reference sites; silver and cadmium were less than 0.1 ppm (measured on a dry weight basis), and the other metals were found in the low (1 - 50) ppm range. Trace organic compounds were present in the 0 to 10 ppb range (dry weight) in sediments. In general, trace contaminants increased in concentrations with shelf depth and in areas closer to Los Angeles.

Species composition and structure of infaunal assemblages of the mainland shelf were influenced mostly by depth and sediment type (grain size and organic content) (Table 2). Mainland shelf assemblages were dominated by the ophiuroid *Amphiodia urtica* and polychaete *Spiophanes missionensis* except in sandy areas where a much different fauna existed. Infaunal assemblages at the 150 m sites were dominated by the polychaete *Spiophanes berkeleyorum* and *A. urtica*. There was a transition in species composition and structure from that at 60 m to typical slope assemblages at 150 m.

Trawl-caught megabenthic invertebrates were heterogeneously distributed on the mainland shelf. The asteroid *Astropecten verrilli*, the urchin *Lytechinus pictus*, and the prawn *Si-*

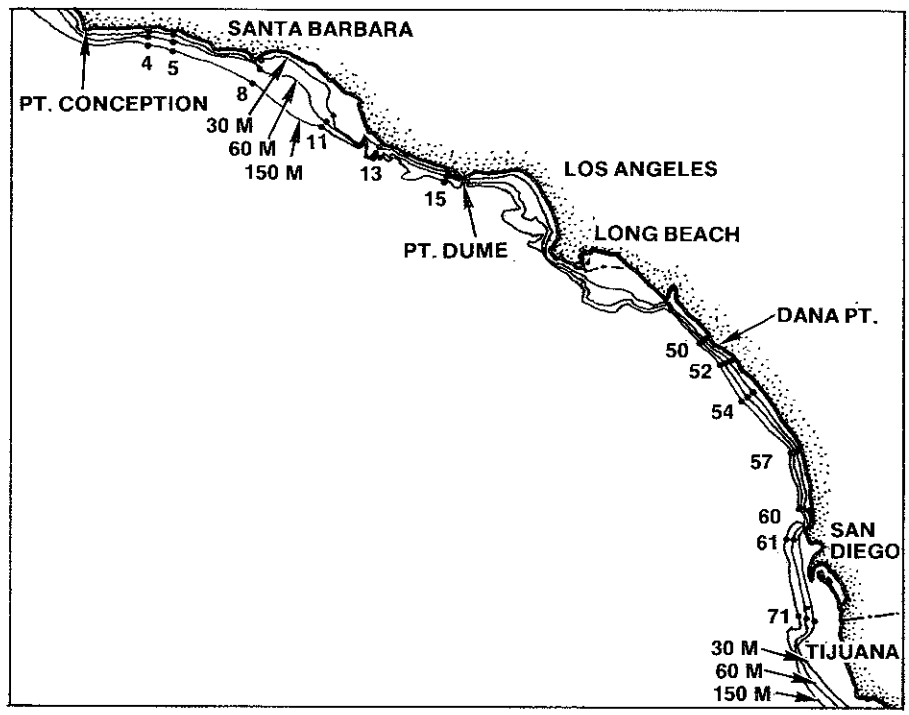

Figure 1. Reference Site Stations

cyonia ingentis were the most common and abundant species collected. Similarly, trawl-caught epibenthic and demersal fish were heterogeneously distributed on the shelf. Speckled and Pacific sanddabs, bigmouth sole, and plainfin midshipman were the most common and abundant species collected. Both megafaunal invertebrate and fish associations showed the greatest changes in composition and structure at the 150 m sites reflecting transitions to the slope fauna. There was a large amount of variation in the trawl data.

Animal tissues at reference sites were contaminated with chlorinated hydrocarbons; flatfish livers (4 species examined) averaged around 8.6 ppm (wet weight) total chlorinated organics and *Sicyonia* hepatopancreas averaged around 1.2 ppm (wet weight). These levels are much lower than those found in fish and *Sicyonia* taken near outfalls (Brown et al, 1986).

The reference sites sampled probably represent the cleanest areas that exist along the coastal shelf off southern California, but they all have contaminated sediment and animal life. Many of the parameters measured during the Reference Site Survey were also measured during the 60-Meter Survey and provide an opportunity to evaluate long term changes. However, there are many problems with comparing the data from the two surveys, particularly in attempting to make statistical comparisons. The methods of analysis used for some sediment parameters have changed and we do not know exactly how the methods compare. Neither survey used replication and there have been no studies of within-grab, within site, or analytical error in sediment or tissue contaminant measurements, except for metals. The contaminants all exist in low concentrations in the sediment, often near the limits of detection, and the changes between surveys may reflect the high variability associated with measurements of low concentrations. For the biological parameters, different taxonomists identified the animals collected in each survey, making comparison of species richness questionable.

Sediment Quality (percent dry wt.)	30m (n=12)	60m (n=13)	150m (n=13)
Sand	63.1 (27.3)	37.0 (28.0)[a]	37.2 (25.1)
Silt	32.5 (26.0)	53.4 (25.7)	49.8 (18.8)
Clay	4.4 (2.1)	9.6 (3.3)[a]	13.0 (7.7)
Dry	69.3 (2.9)	64.4 (5.8)	61.5 (7.7)
TVS	2.4 (1.0)	3.9 (1.0)	4.5 (1.6)
TOC	0.52 (0.38)	0.72 (0.22)[a]	0.85 (0.33)
Lipid	0.34 (0.26)	0.19 (0.26)	0.26 (0.36)
Trace Metals (ppm dry wt.)			
Ag	0.01 (0.01)	0.03 (0.04)	0.04 (0.05)
Cd	0.13 (0.11)	0.14 (0.09)	0.23 (0.11)
Cr	18.5 (5.6)	25.4 (9.3)	31.1 (11.9)
Cu	5.7 (2.5)	10.4 (5.7)	13.1 (7.9)
Ni	9.0 (5.0)	12.9 (6.5)	13.6 (6.3)
Pb	2.9 (1.3)	4.8 (2.6)	5.5 (3.0)
Zn	31.1 (12.0)	48.0 (19.5)	52.3 (23.8)
Trace Organics (ppb dry wt.)			
PAHs	38.7 (55.1)	20.3 (33.9)	36.9 (48.3)
DDTs	9.1 (8.0)	18.9 (19.8)	30.1 (26.7)
PCBs	10.8 (17.0)	19.2 (10.4)	22.5 (18.3)
Trace Organics (ppb, TOC wt.)[b]			
PAHs	8365 (12630)	3861 (5846)	3885 (4446)
DDTs	1762 (1589)	2773 (2385)	3861 (3543)
PCBs	1857 (1228)	3597 (3056)	3114 (3008)

[a] excluding Stas. R71-60 & R60-60.

[b] Means (std. dev.) for sediment trace organics expressed on a basis of ng/g TOC (ppb).

Table 1. Mean (standard deviation) for sediment parameters measured in the Reference Site Survey.
Values presented on a dry weight basis.

Biological Parameters	30m (n= 12)	60m (n = 13)	150m (n = 13)
infaunal species (no/grab)	89.2 (16.3)	67.7 (19.9)	41.9 (12.9)
infaunal individ. (no/grab)	323.8 (87.5)	348.4 (120.3)	154.8 (57.6)
infaunal biomass (g. wet)	15.7 (9.2)	11.4 (7.0)	8.1 (6.2)
megafaunal species (no./trawl)	13.2 (7.8)	15.8 (8.7)	14.1 (9.3)
megafaunal individ. (no./trawl)	100.4 (141.2)	181.9 (175.7)	994.2 (1348.5)
megafaunal biomass (kg. wet)	0.7 (0.6)	7.0 (8.7)	26.6 (29.5)
Fish species (no./trawl)	10.3 (3.5)	11.8 (3.6)	14.1 (3.8)
Fish individ. (no./trawl)	109.2 (106.4)	201.3 (141.0)	334.4 (196.8)
Fish biomass (kg. wet)	6.0 (4.4)	3.3 (1.7)	17.6 (13.8)

Table 2. Mean (± S.D.) for biological parameters at each depth.
A 0.1m² Van Veen grab and a 10-minute, 25-foot otter trawl (over approximately 0.5 km) were used.

However, analysis of trace metals used the same methods in both surveys. The means of the parameters measured in the two surveys are shown in Table 3. The contaminants measured did not consistently decrease or increase; silver, cadmium and lead decreased, and chromium, copper and nickel increased. DDTs and PCBs increased in concentration.

Most of the biological parameters decreased, with the exceptions of infaunal biomass and number of megafaunal invertebrate species. The large amount of variation in the trawl data precludes detection of even large changes such as those occurring in numbers of megafaunal individuals per trawl.

To use the information from the reference sites in a monitoring context, several questions need to be answered:

- Should the means for each parameter from all sites be used for comparison to outfall parameters?
- Or should only the reference site(s) nearest a particular outfall be used?
- Is a monitoring site in compliance if the sediment chemistry parameters exceed reference levels but the biological ones do not?

The information from the Reference Site Survey, 1985, is available in a SCCWRP Technical Report.

	60m 1977		Ref. 1985	
Sediment Measurements				
+ % TVS	2.81	(0.6)	3.48	(1.42)
+ % Sand	45.9	(26.9)	45.8	(33.46)
Ag	0.2	(0.2)	0.03	(.04)
Cd	0.3	(0.2)	0.1	(.09)
Cr	21.7	(7.5)	25.4	(9.3)
Cu	6.8	(3.8)	10.5	(5.7)
Ni	12.1	(7.6)	12.9	(6.5)
Pb	5.8	(2.2)	4.8	(2.6)
Zn	40.3	(12.6)	48.0	(19.5)
+ DDTs	20.2	(22.8)	18.9	(19.8)
+ PCBs	7.2	(5.5)	19.1	(10.4)
Biological measurements				
+ Infaunal species	74.7	(19.9)	67.7	(19.9)
Infaunal indiv.	407.5	(96.0)	348.4	(120.3)
Infaunal biom.	6.9	(2.6)	11.4	(7.0)
+ megafaunal species	10.8	(4.6)	15.8	(8.7)
megafaunal indiv.	638.8	(1153.8)	181.9	(175.7)
megafaunal biom.	7.9	(8.0)	7.0	(8.7)
+ Fish species	14.4	(3.8)	11.8	(3.6)
Fish indiv.	386.6	(353.4)	201.3	(141.0)
Fish biom.	5.6	(5.1)	3.2	(1.7)

+ indicates differences in methods of measurement between the two surveys.

Table 3. Comparisons of means (S.D.) from the 1985 Reference Site Survey and the 1977 60-Meter Survey.

Data from 13 sites for all parameters except DDTs and PCB where 5 sites were used.

References

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