CHARACTERIZI NG NEARSHORE BENTHIC WATERS

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Very little physical and chemical data have been taken in conjunction with southern California trawling surveys in the past. Thus, the relationships between the benthic biota and the quality of the surrounding bottom water environment cannot be directly evaluated. For instance, the distribution of benthic organisms is apparently correlated with depth to some degree, and questions have arisen as to what "depth" means in terms of physical parameters.

In 1973, we initiated a program to measure the physical and chemical properties of the nearshore benthic waters that we trawl; the work was supported in part by a grant from the Environmental Protection Agency. We have now obtained information about the principal environmental factors associated with changes in depth Csuch as available light, temperature, and dissolved oxygen) and have determined how much seasonal change occurs in nearshore bottom waters; we have also been able to relate these water quality parameters to the natural distribution patterns of benthic organisms. Our preliminary efforts have been directed toward characterizing general physical and chemical trends in coastal bottom waters in the next year, we will concentrate on defining associations between water quality and fish biomass, diversity, species distribution patterns, and regional differences.

Data on the temperature and dissolved oxygen in bottom water were collected during the quarterly trawl surveys off Orange County and Dana Point and the biannual surveys off Palos Verdes. We also obtained bottom water quality data during two trawl cruises in Santa Monica Bay, a synoptic survey of the Santa Monica, Palos Verdes, and Orange County areas, and an oceanographic survey of Santa Monica basin waters. Measurements of salinity, transparency, and pH were included in some cases.

DEPTH AND SEASONAL TRENDS IN TEMPERATURE AND DISSOLVED OXYGEN

Average temperature and dissolved oxygen values from the surveys were plotted by depth of bottom (20, 6G, and 140 m) and time of year. Several trends were common to all regions:

- Temperatures in bottom waters at 20 m are influenced by surface phenomena throughout most of the year, cooling during the winter months and warming during summer. At 60 to 140 m depths, bottom temperatures show opposite trends: The waters are coldest during late spring and summer, and relatively slight warming periods occur in the winter months.

- Seasonal temperature gradients in bottom waters are greatest at shallow (20 m) depths, with a mean yearly temperature change of about 3°C and a maximum of 9°C noted. In

contrast, deeper bottom waters (140 m) show a mean temperature change of less than 2°C and a maximum of 3.5°C.

- Dissolved oxygen trends approximate those of temperature: Mean values of percent saturation varied the most at shallow depths (ranging from 60 to 120 percent saturation), whereas saturation at deeper depths ranged from 40 to 50 percent throughout most of the year, with an increase to 65 percent occurring during winter.

Using the data cited, as well as information from previous surveys, we can obtain a general picture of the major physical and chemical features of water masses immediately overlying the coastal shelf. Seasonal temperature and dissolved oxygen trends at three depths are shown in Figures 1 and 2, and extrapolated data for depth regimes that exhibit distinct characteristics are summarized in Table 1. Of particular importance is the fact that the shallow inshore benthic waters can be subject to rather rapid changes in temperature and dissolved oxygen that reflect surface events, particularly the rate and strength of thermocline development during the summer months. However, much of the coastal shelf is not influenced by the seasonal thermocline, but instead is affected by basin waters (depending on the strength and direction of currents). Off shore of the shelf edge, temperature and dissolved oxygen fluctuations are minor (Figure 3). Therefore, regional differences in the bottom water habitats of the coastal shelf are primarily determined by the configuration of the shelf area (e.g., San Pedro Bay has a greater area of shallow bottom than Santa Monica Bay) and the dynamics of adjacent basin water circulation.

RELATIONSHIPS OF WATER QUALITY TO BENTHIC FAUNA

The patterns in water quality in the various depth regimes are consistent with faunal distributions. In comparing the physical and biological data, we have noted a rather striking trend of increasing biomass and diversity with decreased temperature and oxygen (Figure 4). In general, the abundance and species composition of the benthic communities inshore of 20 m exhibit major seasonal changes. There is an abrupt change in species composition between 20 and 60 m, particularly in demersal fish and shrimp. From 60 to 200 m, there are additional (but less dramatic) changes in the species of shrimp, flatfishes, poachers, and rockfishes present. These changes in species composition may reflect temperature and dissolved oxygen gradients to some extent, but other factors such as sediment type, the presence of sedentary versus migratory species, and interspecies dynamics are significant.

The characteristics of bottom waters thus differ significantly from those of the surface and are important considerations in the assessment of the nearshore benthic environment. We are continuing our benthic sampling and analyses and encourage other agencies to participate in these efforts.

FIGURES

Figure 1.
Composite of mean temperature data from surface and bottom waters taken in southern California trawl surveys, 1970-74.

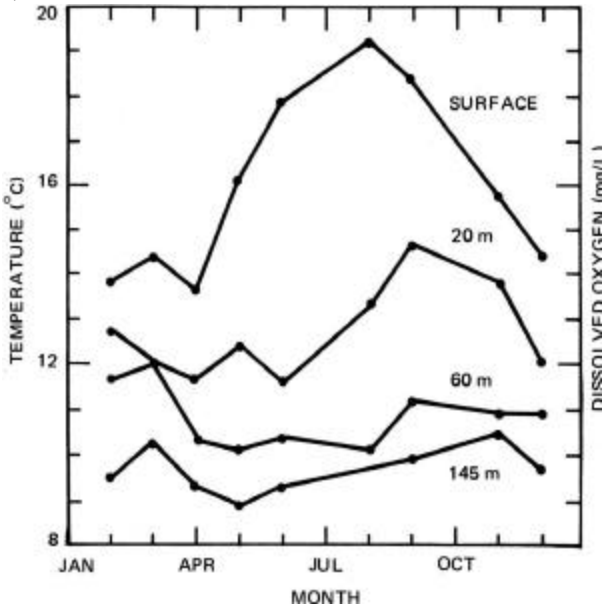


Figure 2.
Composite of mean dissolved oxygen data taken from surface and bottom waters in southern California trawl surveys, 1973 74.

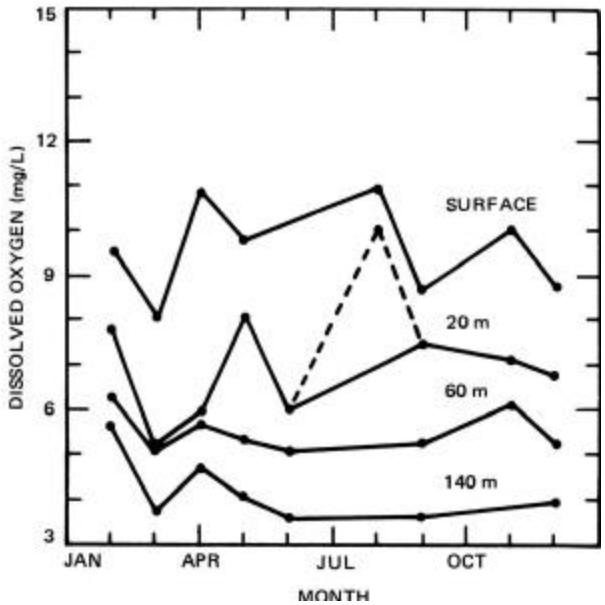


Figure 3.
Comparison of winter and summer basin waters. (Represents mean from 9 stations surveyed in Santa Monica Basin in January and June 19 74)

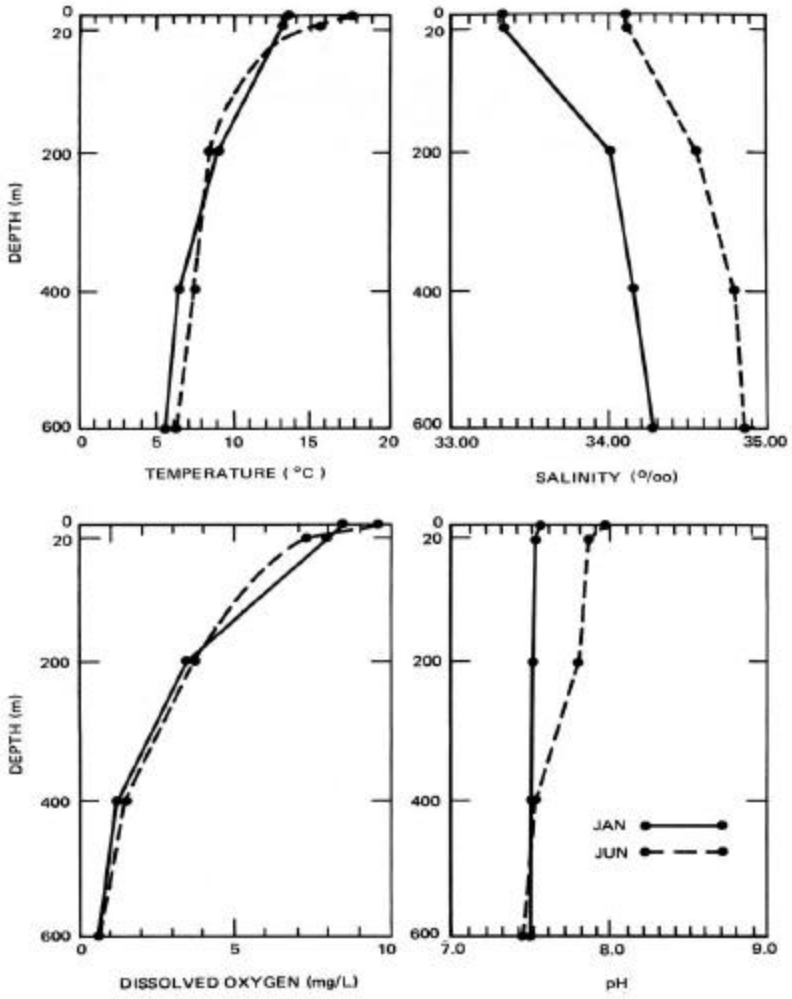
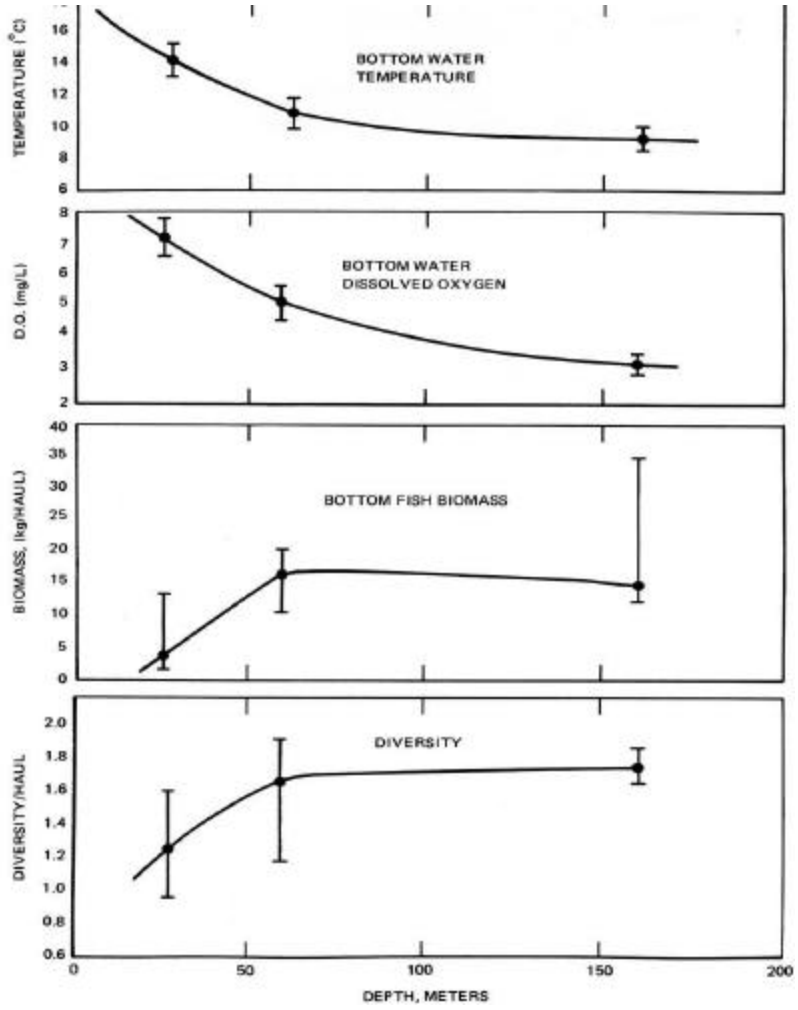


Figure 4.
Comparison of physical and biological data collected from 27 stations during synoptic cruise of Santa Afonica Bay, Palos Verdes, and Orange County, September 1973.



TABLES

Table 1.
Temperature and dissolved oxygen characteristics at various depths in southern California coastal waters[a]

Depth Regime[b]		**Temperature (°C)**			**Dissolved Oxygen (mg/l)**	
	Min_x	**Max_x**	**Delta T**	**Min_x**	**Max_x**	**Delta D.O.**
Shore or surface (0-10 m)	13.6(Sp)	19.3(Su)	5.6	8.0(Sp)	11.0(Su)	3
Shelf						
Shallow (20-40 m)	11.6(Su)	14.8(Su)	3.2	5.2(Sp)	10.1(Su)	4.9
Transitional (60-90 m)	10.1(Sp/Su)	12.1(Su)	2.1	5.1(Sp/Su)	6.3(W)	1.2
Deep (100-200 m)	8.9(Sp)	10.7(w)	1.8	3.6(Su)	5.8(Su)	2.2
Basin						
200 m	8.6(W)	9.1(Su)	0.4	3.5(W)	3.7(Su)	0.2
400 m	6.8(W)	7.5(Su)	0.7	1.1(W)	1.3(Su)	0.2
600 m	5.7(W)	6.2(Su)	0.5	0.5(W)	0.5(Su)	0.0

[a]Seasons are indicated Sp (spring), su(summer), and W(winter). Note that the highest bottom water temperatures and the lowest oxygen concentrations occur in the winter between 90 and 200 meters-- the depths at which most of the municipal wastewaters are now discharged in southern California.

[b]Approximate depth range.