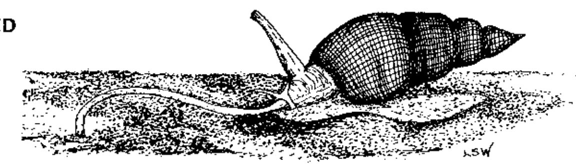

Figure 1. Possible sources of food to the benthic community.

Flux of Organic Material and Benthic Community Structure

Discharges from ocean outfalls are frequently accompanied by changes in the composition of the sediments and the abundance and structure of the animals living on and within the sediments. Staff oceanographer Terry Hendricks has been developing numerical simulation models to relate these changes to the characteristics of the effluent, the discharge system, and the receiving water environment (SCCWRP 1987).

These models attempt to predict the distribution, concentration, and accumulation of effluent and natural particles in the sediments around the outfall. Measurements of populations of benthic biota and organic content of the sediments showed an inverse relationship between these two variables (Hendricks 1985). In previous simulations, predictions of the distribution and concentration of organic material in the sediments were combined with this relationship in an attempt to provide estimates of the outfall-induced changes in the benthic community structure. The ability to predict community structure, as measured by the Infaunal Index, appeared to be better than the ability to predict concentrations of organic material in the sediments (Hendricks 1985). This was surprising because the biological predictions were based on the sediment organic content predictions.

Sediment trap studies conducted by Hendricks have provided a possible explanation for this paradox. It is assumed that the availability of food (e.g., organically enriched effluent particles) plays a role in regulating benthic community structure and abundance. This food may become available through sedimentation from the water column, accumulation in the sediments, or transport through the area by near-bottom currents (Figure 1).

The fluxes of resuspended material into sediment traps are generally one, or more, orders of magnitude greater than the rates of sedimentation from the water column or accumulation in the sediments. Thus the supply of organic matter to the benthic biota is likely to be dominated by the horizontal transport of organic matter by near-bottom currents. This flux of material, however, may have little relation to the concentration of organic material in the sediments.

In order to examine this hypothesis, Hendricks used the numerical simulation models SEDF2D and SEDR to simulate the deposition and the resuspension, transport, and accumulation of sediments, respectively. SEDR is an updated version of the model SEDP; SEDF2D and SEDP have been described previously (SCCWRP 1987). A by-product of the simulation process is an estimate of the transport fluxes of organically enriched outfall particles by the near-bottom currents.

Simulations were carried out for the Orange County (Newport Beach), City of San Diego (Point Loma), and Los Angeles County (White Point) outfall areas. Near-bottom transport fluxes were obtained for stations in each outfall area where Infaunal Index values were already available (Bascom 1979). Infaunal Index values for stations with comparable transport fluxes were combined into a composite value to reduce the natural variability.

The results for the Orange County and San Diego outfall areas are shown in Figure 2. At both sites, the Infaunal Index was inversely related to the flux of effluent material in the near-bottom waters. The Infaunal Index is observed to decrease by about 21 to 25 units for each 100 mg/cm^2 (bottom area) per year increase in near-bottom effluent particle transport flux. Although the two sites have approximately the same dependence on this flux, the natural (flux = 0) community structures are different. In the absence of any discharge, the expected Infaunal Index at the Orange County outfall is about 93; at the Point Loma site, it is about 77. The correlation coefficients for significant relationships at the Orange County and San Diego sites are -0.95 and -0.90, respectively, yielding 92 and 95% confidence levels.

Figure 3 shows the corresponding plot for the White Point area. Again a significant inverse correlation is observed ($r = -0.95$; $P < 0.02$). At this site, however, the reduction in Infaunal Index per unit near-bottom flux is only about one-quarter the rate at the other two sites. The reason for this difference is not known. Since the no-discharge Infaunal Index for the White Point area is estimated to be only about 57, it is possible that this substantially different assemblage of bottom dwellers responds differently than the communities at the other two areas. Alternatively, since the water column sedimentation and the accumulation fluxes are comparable in magnitude to the horizontal transport flux at this site (SCCWRP 1987), a more detailed estimate of the total flux of effluent material through the

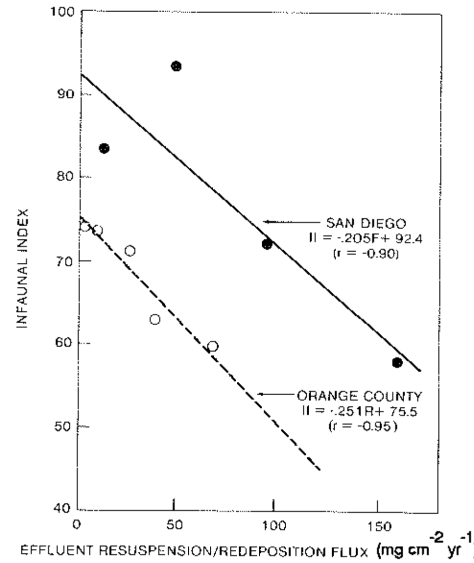

Figure 2. Infaunal Index values versus near-bottom flux for the City of San Diego and Orange County outfall areas.

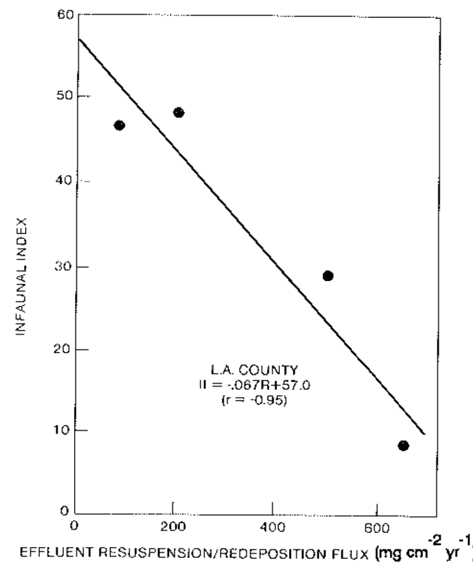

Figure 3. Infaunal Index values versus near-bottom flux for the Los Angeles County outfall area.

near-bottom environment may be required.

The correlation observed between Infaunal Index values and the (estimated) near-bottom transport of organically enriched particles is exciting because it offers the potential to estimate the effects on the benthic community structure associated with a discharge--and perhaps could assist in estimating the relative effects of toxicity and food supply on these assemblages. Additional work, including an explanation for the differences between White Point and the two other sites, will be required for this goal to be realized.

Acknowledgment

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