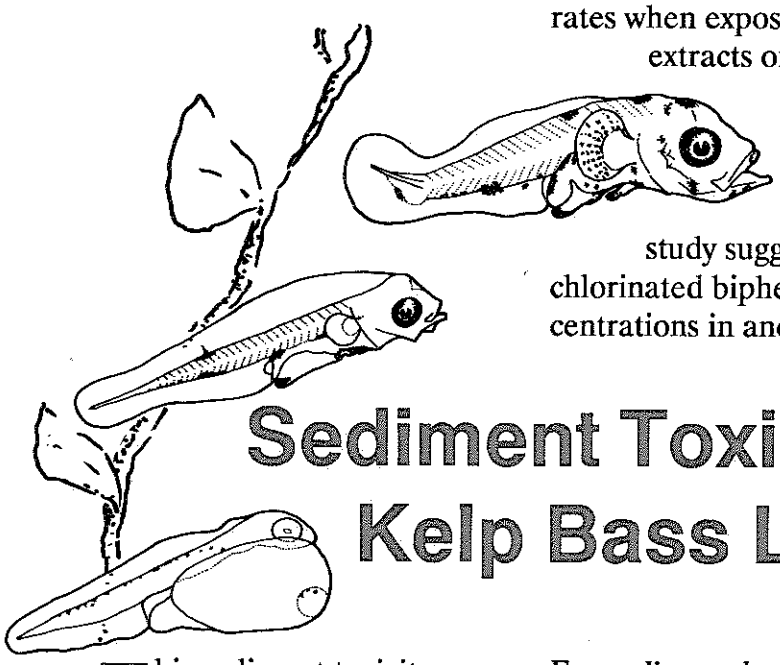

Sediment Toxicity to Kelp Bass Larvae

This sediment toxicity experiment by Dario W. Diehl (SCCWRP) and Jo Ellen Hose (Occidental College) focused on larval kelp bass (*Paralabrax clathratus*). Adults and juveniles are found in kelp beds and rocky reefs along the coast. They are a primary sport fish available throughout the year in the southern California region and become reproductively active in early summer. Kelp bass are very hardy fish, which makes them excellent laboratory animals. Some of these fish were spawning naturally after one year of captivity at Southern California Edison's research and development laboratory in Redondo Beach.

Kelp bass, like many other fish species, have larvae that develop in the water column during the spring and early summer. A previous study found that different species of fish larvae have different survival rates when exposed to seawater extracts of sediment from Charleston Harbor, SC (Hoss et al. 1974). Another study suggested that polychlorinated biphenyl (PCB) concentrations in anchovy larvae, *Engraulis mordax*, were dependent on the PCB concentrations in seawater and not on the PCB concentration in the food the larvae ingested (Scura and Theilacker 1977). For the present experiment the researchers tested the response of kelp bass larvae to sediments from four southern California coastal areas instead of seawater extracts.

Fish were captured from Catalina Island during the summer of 1986. Sediment was collected just prior to the experiment in the summer of 1987 from a relatively uncontaminated reference area (San Mateo Point), an industrialized harbor (Los Angeles), and two areas adjacent to large municipal wastewater outfalls (Orange County and Los Angeles County).

The static bioassay consisted of 5-gallon aquaria containing 2 cm of sediment and 15 L of filtered seawater. Control tanks contained only seawater. Five replicates of each sediment and seawater control were prepared. Water was changed carefully every 2 to 3 days, so little sediment resuspension occurred. One hundred and fifty 10-day-old yolk sac larvae were added to each aquarium. After 13 days, the surviving larvae were counted, weighed, microscopically measured, and examined for malformations. Larvae were fed daily with rotifers and brine shrimp nauplii during the experiment.

Chemical analysis showed that San Mateo Point is relatively clean, Orange County outfall is moderately contaminated, and Los Angeles Harbor and Los Angeles County outfall are fairly contaminated (Figure 1). Mean polynuclear aromatic hydrocarbon (PAH) concentrations were lowest at San Mateo Point (2 ng/g [ppb] wet weight) and highest in Los Angeles Harbor (2872 ppb). Mean PCB concentrations were lowest at San Mateo Point (2 ppb wet weight) and highest at Los Angeles

County outfall (345 ppb). Low levels of PAHs (47 ppb) and PCBs (18 ppb) were detected at Orange County outfall. Mean total DDT concentrations were lowest off Orange County and San Mateo Point (4 and 8 ppb wet weight, respectively). The highest level of DDT was found at Los Angeles County (2097 ppb) and Los Angeles Harbor had a moderate level (109 ppb) of DDT contamination.

Larval survival ranged from 11% in the control to 1.9% in Los Angeles Harbor sediment (Figure 2a). Larvae in Orange County, Los Angeles County, and Los Angeles Harbor sediment had statistically significant lower survival than those in San Mateo Point sediment. Survival of larvae in seawater control and reference area sediment were not statistically different and survival rates are typical of species with floating larvae. No statistical differences were found among the three contaminated areas.

Larval weight ranged from 0.93 mg in Orange County sediment to 0.57 mg in Los Angeles County sediment (Figure 2b). No statistical difference could be found among larvae from San Mateo Point, seawater, Orange County, Los Angeles County, and Los Angeles Harbor.

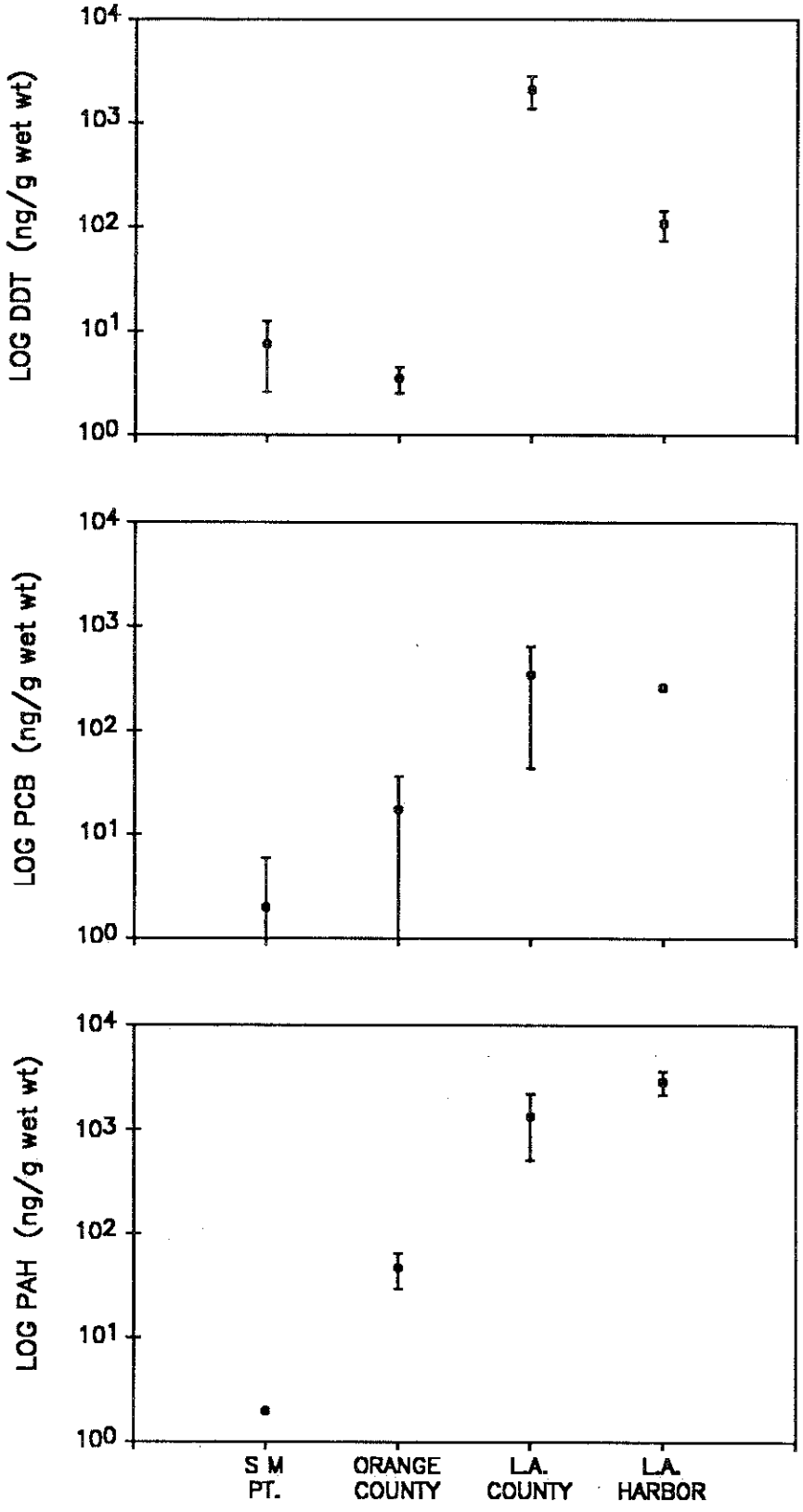

Figure 1. Organic contaminant concentrations in sediments from four southern California sites. Data shown are means; vertical lines indicate 95% confidence intervals. Note that data are plotted on a logarithmic scale.

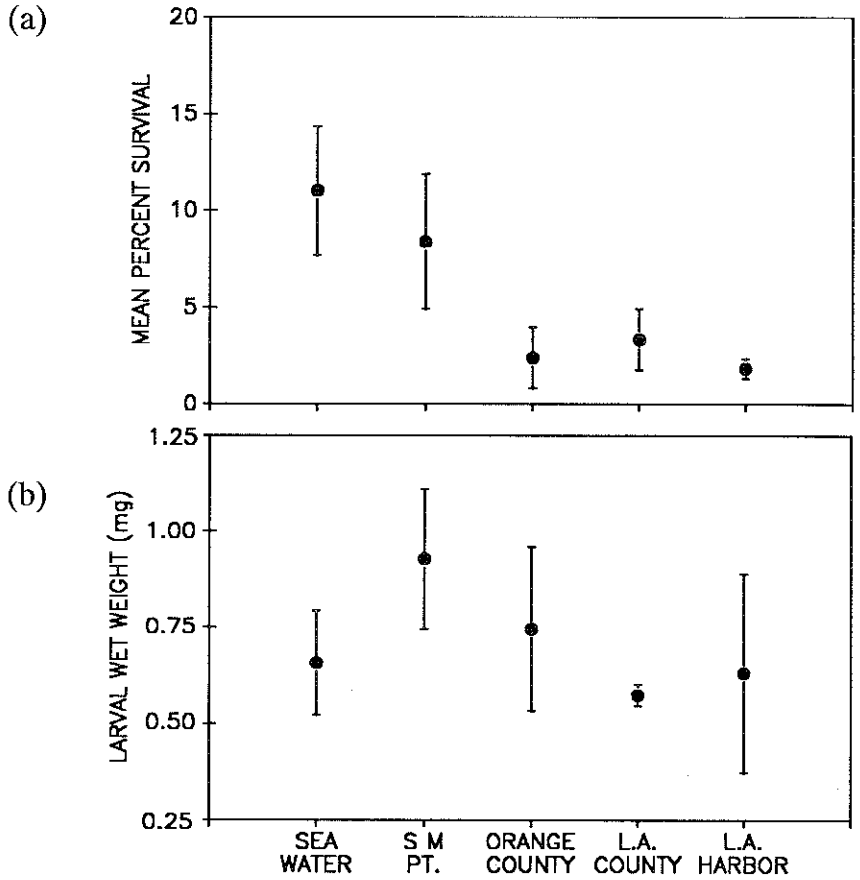

Figure 2. (a) Percentage of larval survival after 13-day exposure to seawater or sediment. Data shown are the means; vertical lines indicate 95% confidence intervals. (b) Weight of larvae after 13-day exposure to seawater or sediment. Data shown are the means; vertical lines indicate 95% confidence intervals.

Malformations were rarely observed. Only one malformed larva was observed during the experiment; it was exposed to sediment from Los Angeles Harbor (7.1% malformation rate). Larval mortality was so high in the contaminated sediments that the likelihood of deformed larvae surviving was slight.

These results suggest that even moderate levels of sediment contamination cause mortality among floating fish larvae. The moderate and higher levels were equally lethal to the larvae. Chronic toxicity (growth), however, was roughly proportional to sediment contamination. Further experiments need to be done to determine which contaminant caused mortality.

Kelp bass larvae have been successfully used in sea-surface microlayer bioassays (Cross et al. 1988) and appear to be promising candidates for sediment toxicity tests. Larval growth and survival endpoints are also used by the U.S. Environmental Protection Agency in their inland silverside (*Menidia beryllina*) bioassay for whole effluents (Heber et al. 1988). An advantage to the use of kelp bass over other indigenous species is that they have been induced to spawn outside of their natural reproductive period.

Acknowledgments

We thank J. N. Cross, A. M. Westcott, C. F. Ward, G. P. Hershelman, K. D. Englehart, and H. H. Stubbs of SCCWRP, and H. Parker, N. Macalinao, and L. Targgart of Occidental College. Without their valuable assistance, this study could not have been completed.

References

Cross, J. N., J. T. Hardy, J. E. Hose, G. P. Hershelman, L. D. Antrim, R. W. Gossett, and E. A. Crecelius. 1988. Contaminant concentrations and toxicity of sea-surface microlayer near Los Angeles, California. *Mar. Environ. Res.* 23:307-324.

Heber, M. A., M. M. Hughes, S. C. Schimmel, and D. Bengtson. 1988. Guidance manual for rapid chronic toxicity tests on effluents and receiving waters with larval inland silversides (*Menidia beryllina*). Contribution No. 792. U.S. Environmental Protection Agency, Environmental Research Laboratory, Narragansett, RI.

Hoss, D. E., L. C. Coston, and W. E. Schaaf. 1974. Effects of sea water extracts of sediment from Charleston Harbor, S.C., on larval estuarine fishes. *Estuarine Coastal Mar. Sci.* 2:323-328.

Scura, E. D., and G. H. Theilacker. 1977. Transfer of the chlorinated hydrocarbon PCB in a laboratory marine food chain. *Mar. Biol.* 40:317-325.