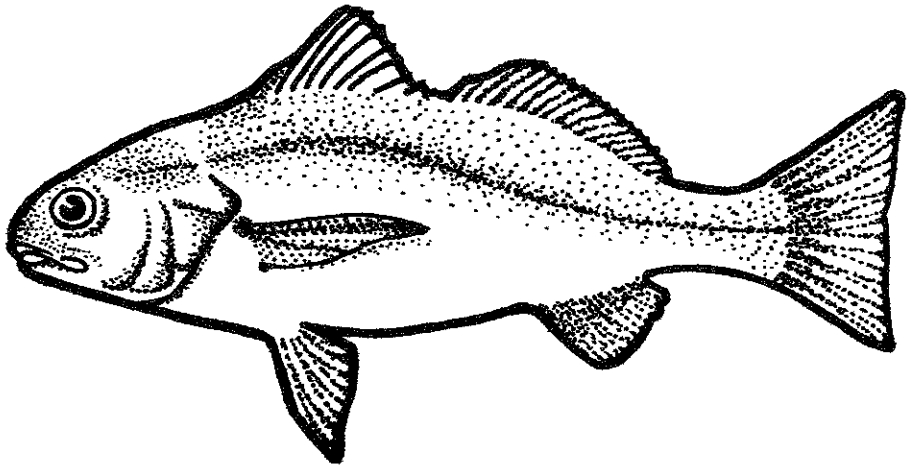


CHANGES IN DDT AND PCB CONCENTRATION IN WHITE CROAKER ARE RELATED TO THE REPRODUCTIVE CYCLE

Most marine fishes and invertebrates living in temperate waters spawn during one or at most two seasons of the year. As part of this seasonal spawning cycle, the gonad weight, particulary of females, varies seasonally, both on an absolute basis and as a percentage of body weight. The yearly reproductive cycle also affects body chemistry; for example, the concentration of lipids in the liver drops as lipid is diverted to the gonad during egg development.

As a result, contaminants from the environment such as DDT and PCBs that are lipid soluble are affected by lipid dynamics in the organism. In this study of the reproductive cycle of whit croaker (Sciaenidae: *Genyonemus lineatus*), J. N. Cross and his colleagues* examines seasonal changes in gonad weight, lipid content of the liver, and contaminant content of the liver. His study confirms that DDT and PCB concentrations in the liver vary over time, reflecting the seasonal reproductive cycle, even when the effects of changes in lipid content are removed.

Cross recommends that researchers report fish reproductive status when comparing contaminant body burdens of fish collected at different times of year. A report could include the gonadosomatic index (GSI) or alternatively histological condition of the gonad. At the very least, lipid content should be reported.

White croaker are the mainstay of the pier and small boat sport fish catches in southern California (Wine, 1979; Puffer et al, 1982). They are abundant in coastal areas with soft substrates from the surf zone down to over 100 m (Miller and Lea, 1972). They consume a wide variety of epibenthic organisms and live up to 15 years.

In his study, Cross determined the timing of the croaker reproductive cycle by examining the ratio of gonad weight to body weight. Expressed as a percent, this ratio is known as the gonadosomatic index (GSI). Among female white croakers collected in outer Los Angeles Harbor, GSI was lowest in the summer, rose to a peak in the winter, and declined through spring (Figure 1). Most spawning occurred between November and April; peak spawning occurred in February and March. Females are batch spawn-

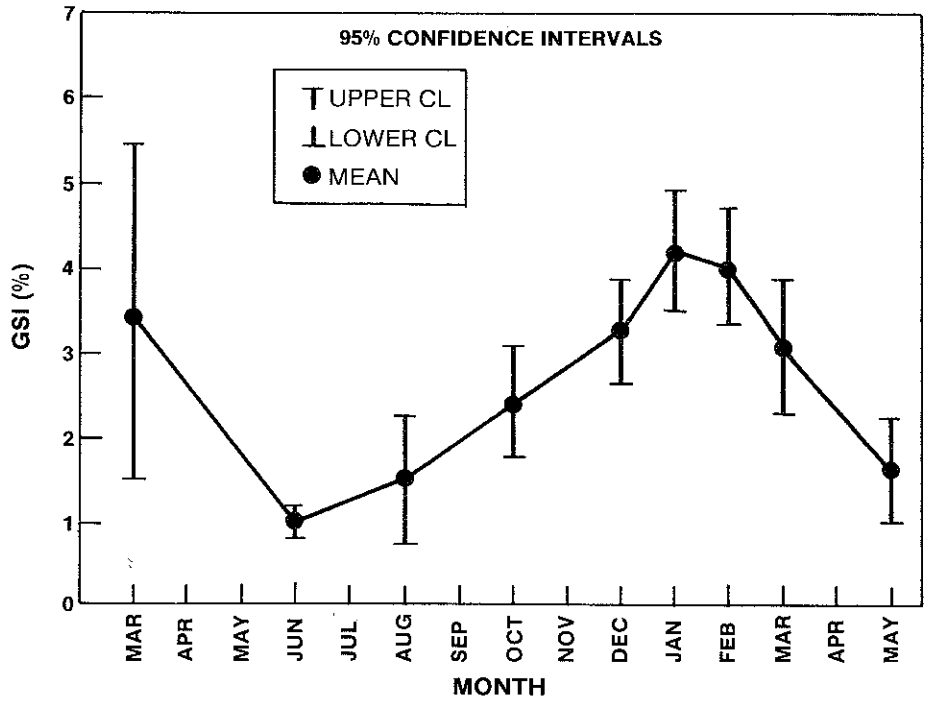


Figure 1. *Los Angeles Harbor Female GSI*

ers producing 18 to 24 batches per year with 800 to 37,000 eggs per batch. Approximately 50 percent of the population is mature after one year and 100 percent are mature by four years (Love et al., 1984).

The concentration of lipids in the livers of the fish changed seasonally with the reproductive cycle (Figure 2). After spawning, liver lipid content was at the lowest level of the year. Lipid content increased rapidly during the summer when the fish were feeding and accumulating energy reserves for the following spawning season. The decrease in liver lipids during the fall and winter was due to the provisioning of eggs with yolk (Figure 3). The liver produces a lipid-rich substance called vitellogenin that is released into the blood and taken up by the developing egg cells (Wallace and Selman, 1981).

The liver concentrations of total DDT (DDT + DDD + DDE) and total PCB (Aroclor 1242 + 1254) among female white croakers varied seasonally with the reproductive cycle (Figure 4). Both organic contaminants were accumulated during the summer when the fish were feeding and accumulating fat. Concentrations in the liver peaked in the fall and declined during the spawning season. The decline in liver contaminant concentration paralleled the decline in lipid

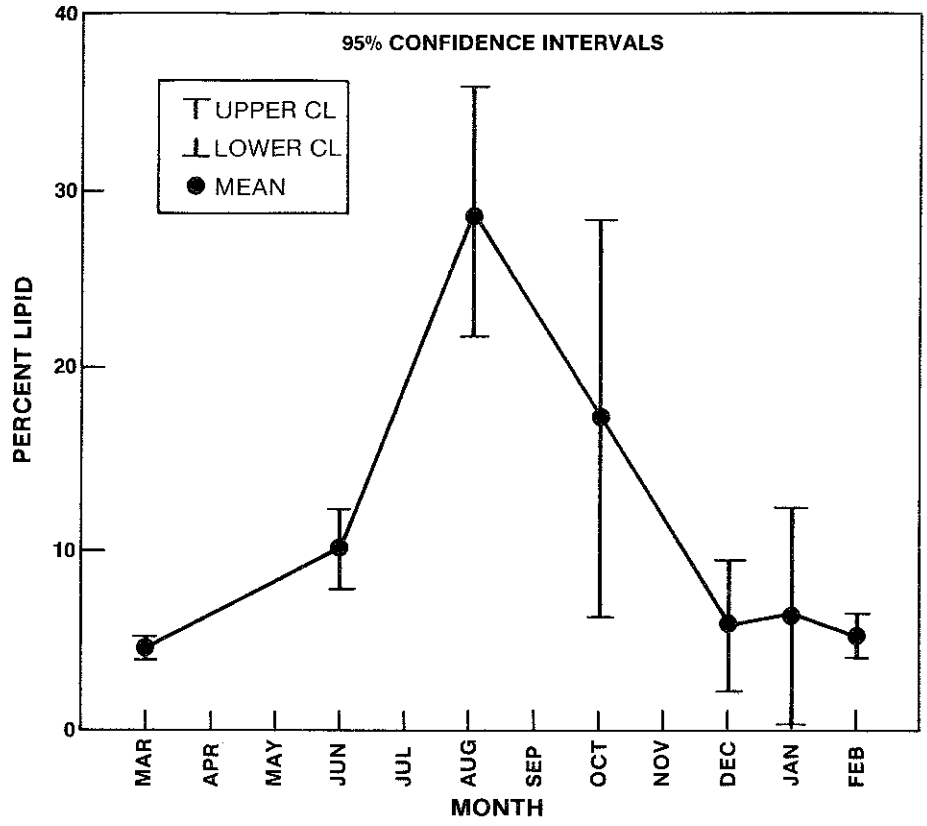


Figure 2. L.A. Harbor Female Livers — Mean % Lipid

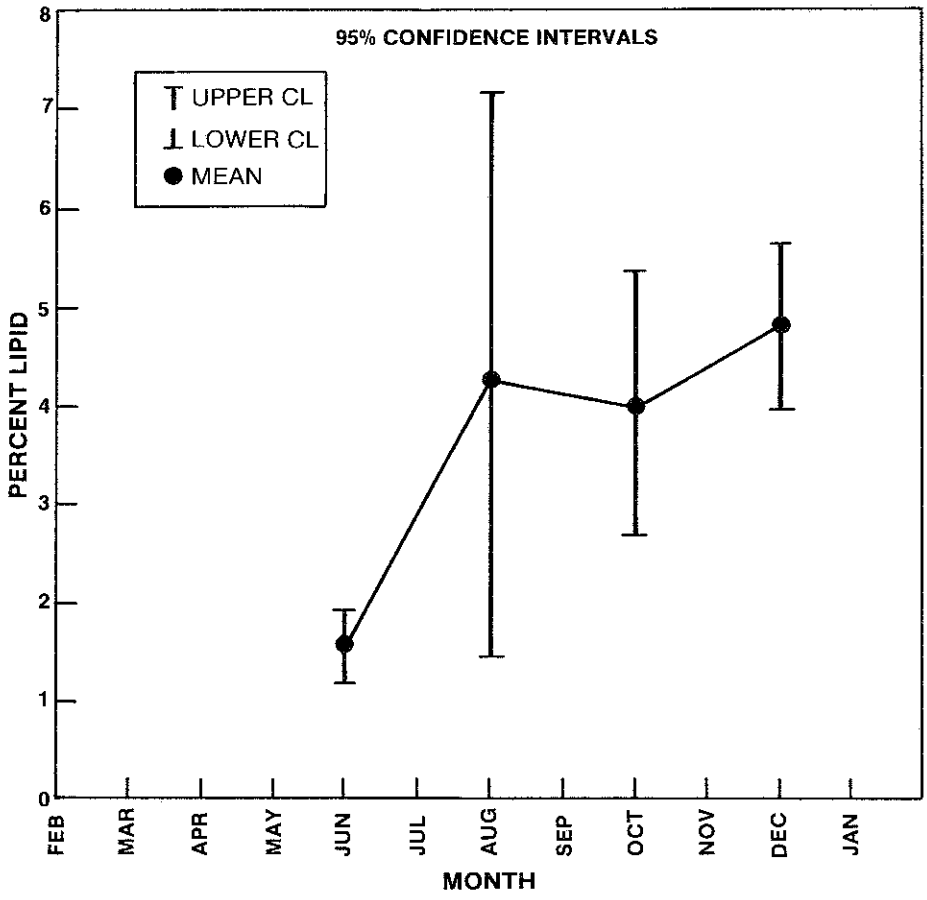


Figure 3. Palos Verdes Female Gonads — Mean % Lipid

content. These lipid soluble contaminants are deposited in the ovaries with vitellogenin (Figure 5). Normalizing the liver concentrations to lipid content does not remove the seasonality (Figure 6).

Cross points out that the variation in lipid and contaminant concentrations was greatest prior to spawning. This is related to the age of the fish and the onset of spawning. Older, larger females spawn earlier and more frequently than younger, smaller females. Consequently, some females are still accumulating lipids and lipid soluble contaminants in their livers while other females are depositing them in their ovaries.

The relationship between contaminant body burdens and the reproductive cycle is only one part of a larger study funded by NOAA. Cross is also studying the reproductive cycle and contaminant levels of the kelp bass, *Paralabrax clathratus*. He plans to add a third species to the study, probably one of southern California's flatfishes, such as Pacific sanddab or fantail sole.

Work with additional fishes will help to confirm the pattern seen in the white croaker. Also, there has been extensive research with flatfish in relation to water quality in other urban coastal areas, including Puget Sound, Boston Harbor and San Francisco Bay. Thus, Cross will be able to compare the contaminant-reproductive cycle relationship in several fish species and to compare his flatfish data with results of flatfish studies from other coastal areas.

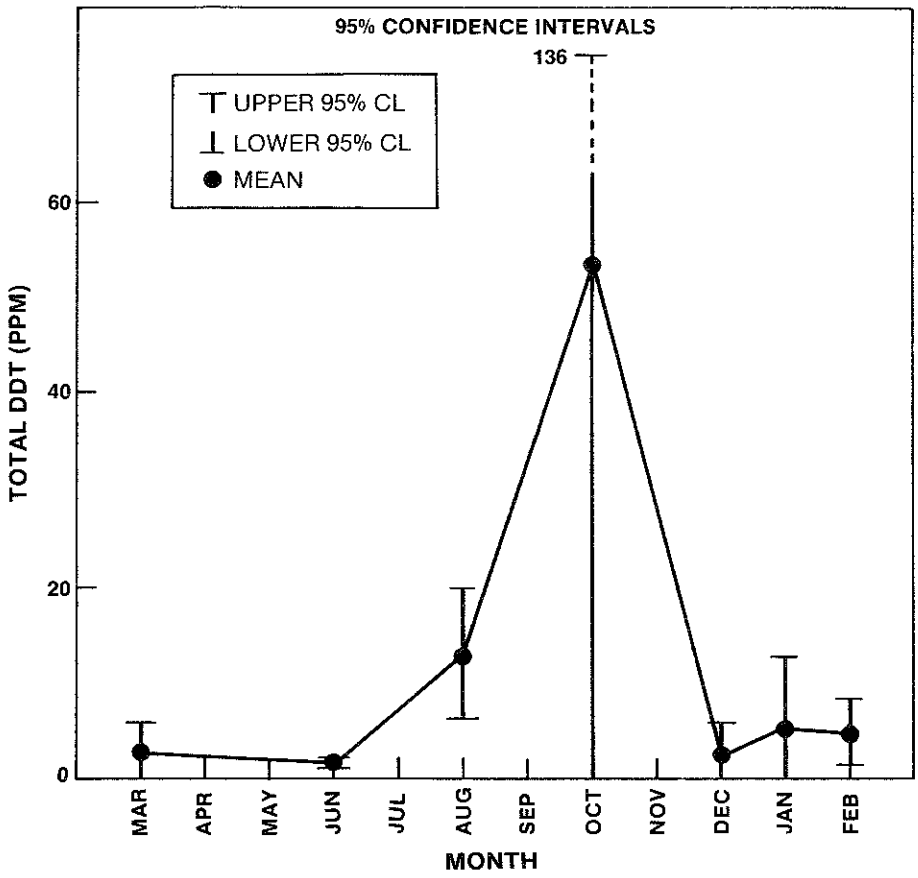


Figure 4a. L.A. Harbor Female Livers - DDT Conc.

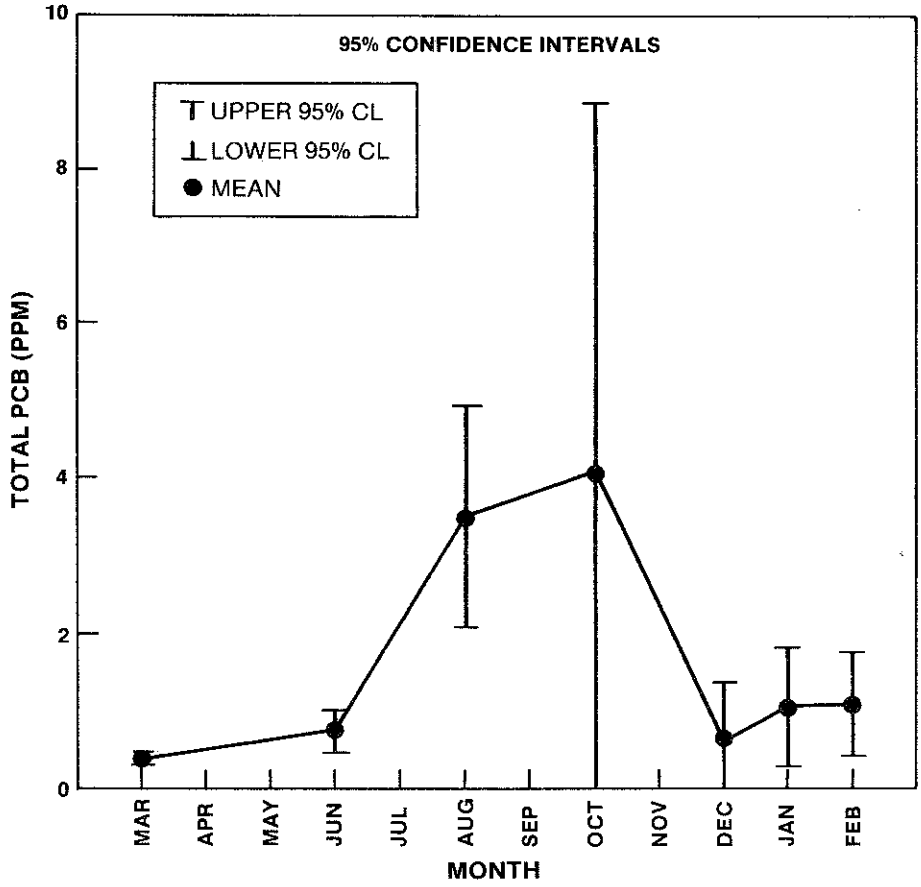
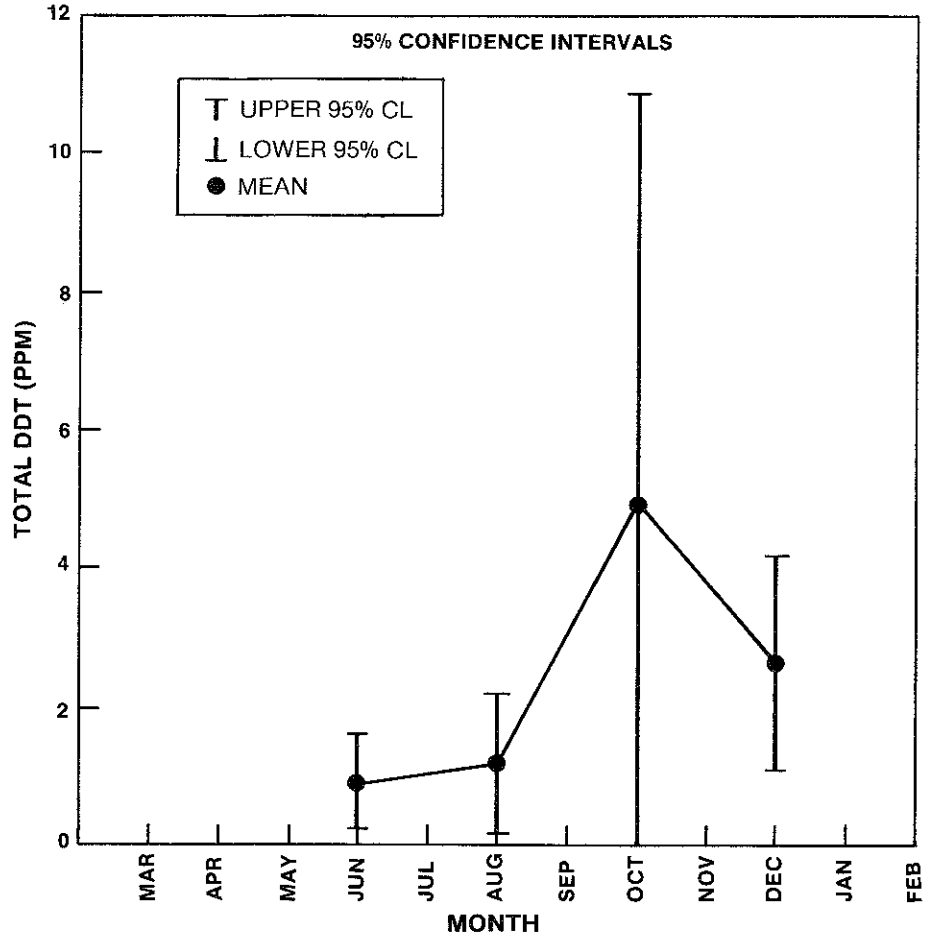


Figure 4b. L.A. Harbor Female Livers - PCB Conc.

Figure 5a. San Pedro Bay Female Gonads — DDT Conc.



*Dario W. Diehl, Richard W. Gossett, G. Patrick Hershelman, Valerie E. Raco, Karen D. Rosenthal, Harold H. Stubbs, Charles F. Ward, and Alvin M. Westcott.

References

Love, M. S., G. E. McGowen, W. Westphal, R. J. Lavenberg, and L. Martin. 1984. Aspects of the life history and fishery of the white croaker, *Genyonemus lineatus* (Sciaenidae), off California. Fish. Bull. 82:179-198.

Miller, D. J. and R. N. Lea. 1972. Guide to the coastal marine fishes of California. Calif. Dept. Fish Game, Fish Bull. 157, 235 pp.

Puffer, H. W., S. P. Azen, and M. J. Duda. 1982. Sportfishing activities and catches in polluted coastal regions of metropolitan Los Angeles. N. Amer. Fish. Mngt. 2:74-79.

Wallace, R. A. and K. Selman. 1981. Cellular and dynamic aspects of oocyte growth in teleosts. Amer. Zool. 21:325-343.

Wine, V. 1979. Southern California independent sportfishing survey. Annual Report N. 3, 1977 to 1978. Calif. Dept. Fish Game, Marine Resources Region, Admin. Rept. 79-3.

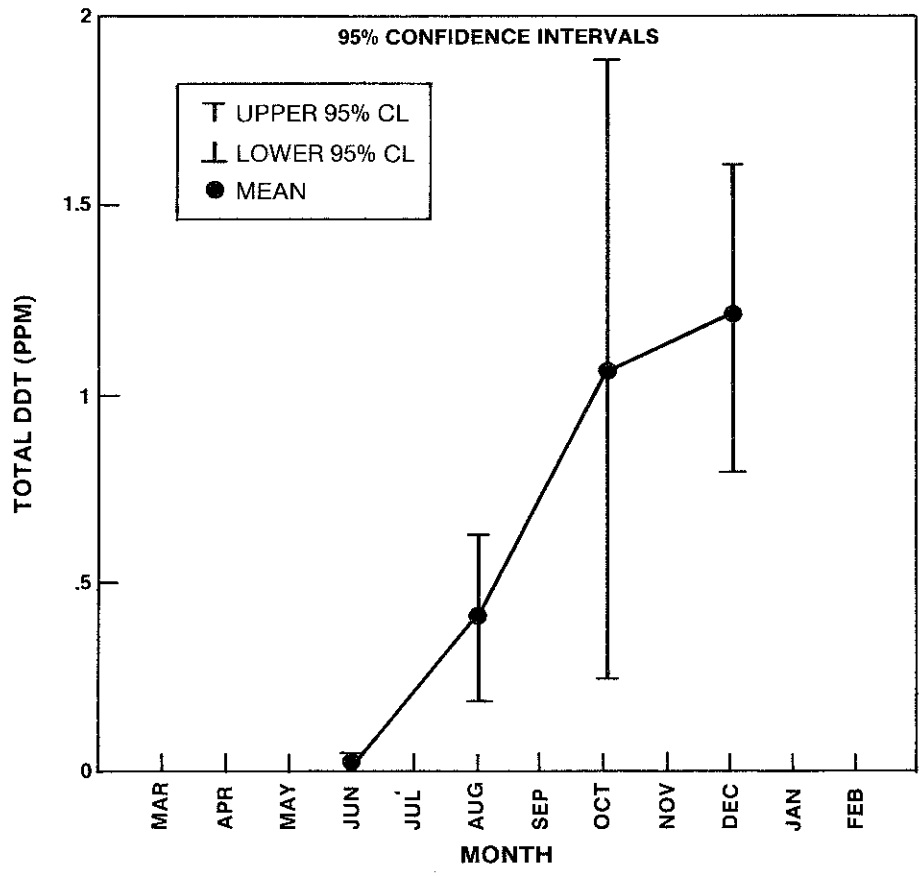


Figure 5b. San Pedro Bay Female Gonads — PCB Conc.

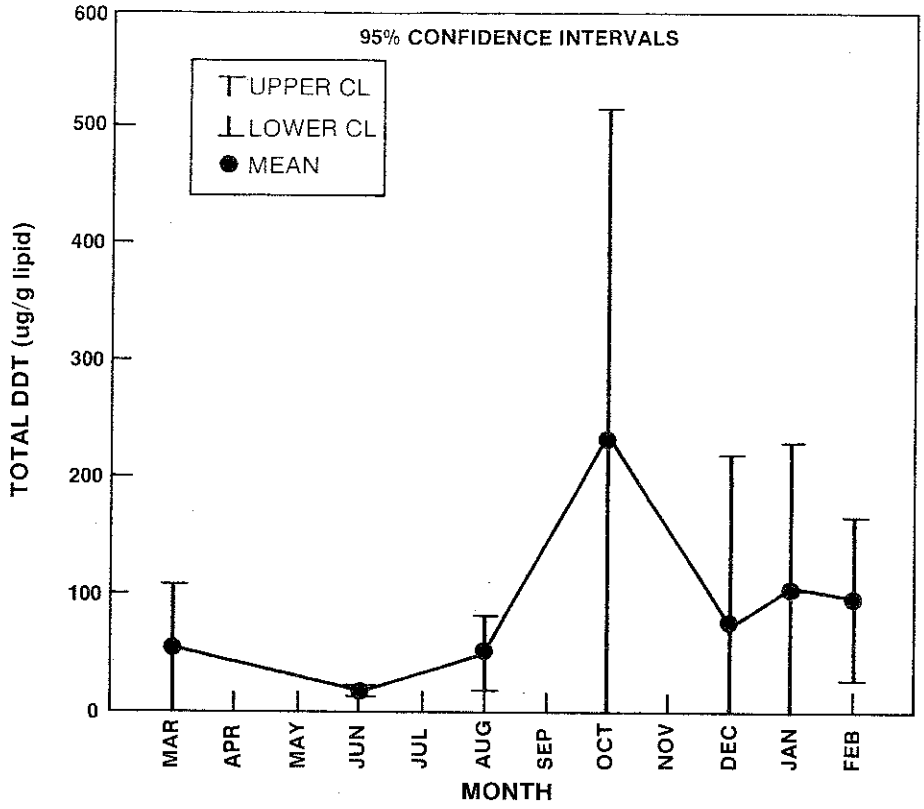


Figure 6a. L.A. Harbor Female Liver Lipid Normalized DDT Conc.

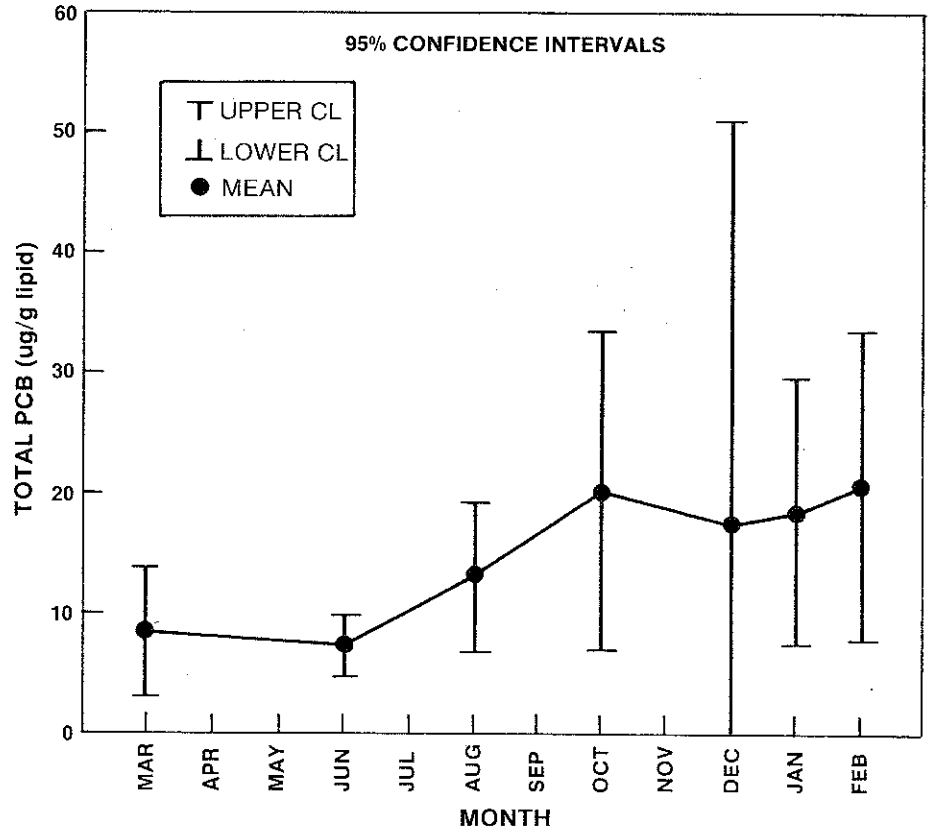


Figure 6b. L.A. Harbor Female Liver Lipid Normalized PCB Conc.