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Evidence for Impaired Reproduction in White Croaker (*Genyonemus lineatus*) from Contaminated Areas off Southern California

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Thousands of tons of contaminants were dumped into the coastal waters off Los Angeles in the last 40 years. Contaminant exposure has been implicated in the declines in catches of several sport and commercial fishes. Laboratory spawning studies demonstrated that white croaker (Sciaenidae: Genyonemus lineatus*) inhabiting contaminated areas near Los Angeles had higher chlorinated hydrocarbon body burdens, greater early oocyte destruction and preovulatory atresia, lower batch fecundities, and lower fertilization rates than fish from a reference area 80 km away.*

The coastal waters off Los Angeles receive a large portion of the domestic and industrial wastes generated by eight million people. Contaminant exposure has been implicated in the declines in catches of several sport and commercial fishes. The objective of this study was to determine if reproduction was impaired in white croaker (Sciaenidae: *Genyonemus lineatus*), an important sport and commercial species inhabiting contaminated areas near Los Angeles.

White croaker were collected from San Pedro Bay (SPB), a contaminated site near Los Angeles, and Dana Point (DP), a reference site 80 km to the southeast. Females were induced to spawn in the laboratory with human

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chorionic gonadotropin. Eggs from each female were fertilized with sperm pooled from at least three males from the same site.

Forty-one percent of SPB females and 54% of DP females were induced to spawn: the difference was not significant (Chi-square, $p > 0.25$). Ovaries of non-spawning females were catheterized and oocytes were staged microscopically. All of the non-spawning DP fish ($n = 13$) had hydrated oocytes indicating that the oocytes were maturing and spawning was imminent. Twenty-seven percent of the non-spawning SPB fish ($n = 30$) had hydrated oocytes: the remaining fish had only yolky oocytes and were unresponsive to the gonadotropin injections.

Chlorinated hydrocarbon concentrations were higher in livers and gonads of white croaker from SPB (Table 1). Females from SPB produced fewer eggs per spawn and had lower fertilization rates (Table 1).

To control for potential differences in the timing of oocyte maturation between sites, numbers of early oocytes were compared among females at the beginning of the reproductive season (October). Fish from SPB had fewer early oocytes and a higher proportion of early oocytes undergoing atresia (Table 1).

Destruction of early oocytes should be evident in the population as early cessation of reproduction or decreased fecundity among older individuals.[1] Based on regressions of batch fecundity against female size, the predicted number of eggs for a large female (200 g) was 70 900 (SE = 64 400) from SPB and 122 200 (SE = 28 100) from DP.

TABLE 1

Contaminant Body Burdens (mg/wet kg) and Reproductive Success of Female White Croakers Collected during December and January (1985–86) and Spawned between January and March (1986)

(Data are mean ± standard deviation (sample size). All site comparisons with Mann-Whitney U-test.)

	San Pedro Bay	*Dana Point*	*Significance*
DDT—Liver	1·52 ± 0·77 (19)	0·17 ± 0·07 (8)	$p < 0.001$
DDT—Ovary	2·10 ± 0·85 (19)	0·31 ± 0·18 (8)	$p < 0.001$
PCB—Liver	1·35 ± 1·34 (19)	0·03 ± 0·06 (8)	$p < 0.001$
PCB—Ovary	1·67 ± 1·02 (19)	0·16 ± 0·08 (8)	$p < 0.001$
Number eggs spawned (× 1000) per female	67·4 ± 62·8 (21)	104·5 ± 32·0 (9)	$p < 0.01$
Percent fertilization	80 ± 16 (21)	93 ± 3 (6)	$p < 0.05$
Early oocytes/field	1·5 ± 0·6 (6)	2·7 ± 0·8 (6)	$p < 0.01$
Percent atretic	15·0 ± 8·8 (6)	2·1 ± 2·4 (6)	$p < 0.01$

Ovarian DDT concentrations of spawning SPB croakers ($\bar{X} = 2{\cdot}1$ ppm, SD = 0·9, $n = 19$) were less than ovarian concentrations of fish from the general population in the bay ($\bar{X} = 4{\cdot}3$ ppm, SD = 1·5, $n = 16$) (U test, $p = 0{\cdot}025$). None of the spawning fish had ovarian levels greater than 3·8 ppm while 38% of the fish from the general population had higher levels. This suggests that fish with levels above 4 ppm total DDT did not spawn. A gonadal threshold of 3 ppm was determined in hatchery studies on salmonids.[2,3]

Ovarian PCB concentrations were not different between spawning SPB fish ($\bar{X} = 1{\cdot}7$ ppm, SD = 1·0) and fish from the general population in the bay ($\bar{X} = 1{\cdot}5$, SD = 0·8) (U-test, $p > 0{\cdot}05$). With the exception of one study,[4] PCB body burdens in excess of those measured in this study appear necessary to cause impaired reproduction.

Although reductions in reproductive success are correlated with body burdens of total DDT, it is probably not solely responsible for the observed effects since other contaminants (polycyclic aromatic hydrocarbons and metals) occur at high concentrations in SPB sediments and fishes.[5]

The mechanisms of reproductive toxicity are not completely understood but may include modulation of hormone levels essential for oocyte maturation and ovulation, toxicity to developing gametes or nutritive cells, and generalized stress responses.[6–9] Effects similar to those observed in this study (primordial oocyte destruction, preovulatory atresia, and decreased fecundity and fertility) were reported in mammals after laboratory exposures to polycyclic aromatic hydrocarbons and in fishes after laboratory exposures to certain chlorinated hydrocarbons.[1–6,10,11]

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