

# DDT AND PCB IN DISEASED DOVER SOLE

The May and August 1972 trawl catches in the vicinity of the Orange County outfall system contained higher numbers of Dover sole with fin erosion than previous catches. This increase was associated with a large influx of Dover sole into the area. Only fish in the size range of individuals that undergo seasonal onshore/offshore migrations were affected with the disease; this contrasted with the situation off Palos Verdes, where Dover sole in a wide size range had eroded fins. These observations suggested that Dover sole with fin erosion caught in the vicinity of the Orange County outfall could have come from the Palos Verdes shelf. To test this hypothesis, we measured the levels of total DDT and total PCB in muscle tissue of both diseased and unaffected Dover sole from the Palos Verdes and Orange County survey regions.

Generally, levels of total DDT in muscle samples taken from Dover sole collected off the Palos Verdes Peninsula are significantly higher, by a factor of 10, than levels found in muscle tissue taken from Orange County specimens. If the diseased Orange County specimens had come from Palos Verdes, the level of total DDT in their muscle tissue would not be significantly lower than the level found in diseased Palos Verdes fish (assuming there is not a rapid elimination of DDT from muscle tissue). If unaffected Palos Verdes Dover sole, also with high levels of total DDT, had migrated to the Orange County region, their number in our sample would be diluted by the resident Dover sole population. Thus, the median total DDT level for the sample of unaffected Dover sole collected off Orange County would be lower than that for the sample of unaffected individuals residing on the Palos Verdes shelf.

Our previous study on Palos Verdes Dover sole collected during 1971-72 showed no significant relationship between fin erosion and total DDT concentration in muscle tissue; however, total PCB levels were slightly higher in diseased fish. Another aspect of our current study was to verify the earlier results (which were based on tissue composites), using individual samples taken from the 1974-75 collections of diseased and unaffected fish.

## MIGRATION HYPOTHESIS

To test the hypothesis that the diseased Dover sole collected off Orange County had migrated from the Palos Verdes shelf, we determined the total DDT levels in muscle tissue from pairs of diseased and unaffected specimens from each location. The specimens were selected from different quarterly trawl catches at a number of stations to discount possible station and seasonal variability. We applied the Mann-Whitney U-test (a statistical method that determines the difference between two independent random samples) to the data and found no significant difference ( $p > 0.20$ ) between total DDT concentrations in the muscle tissue of diseased fish from the Orange County and from the Palos Verdes regions (the median concentrations were 8 and 16 mg/ wet kg, respectively). However, at the 99 percent confidence level ( $p = 0.01$ ), there was a significant difference between total DDT levels in the unaffected fish from the two regions (medians of 1 and 11 mg/wet kg, respectively).

There were no significant differences ( $p > 0.20$ ) in the total PCB levels in healthy fish from Orange County and Palos Verdes nor in the levels in diseased fish from the two areas. The median total PCB concentrations in muscle tissue from unaffected fish from the Orange County

and Palos Verdes were 1.0 and 1.5 mg/wet kg, respectively; from diseased specimens, 1.6 and 2.1 mg/wet kg.

## ASSOCIATION OF CHLORINATED HYDROCARBONS WITH FIN EROSION

We combined all 1974-75 data on total PCB in Palos Verdes and Orange County specimens to form a set of paired (unaffected and diseased) data. Again, to discount station and seasonal variability, these pairs were selected from individual quarterly trawls at a number of stations around each outfall.

The Wilcoxon signed-rank test was applied to the data. This is a statistical method used to determine the difference between two sample sets with data points that can be paired because of a common variable. The common variables that allowed us to pair the unaffected and diseased sample sets in this study were station location and collection date.

The levels of total PCB in the muscle tissue of unaffected and diseased Dover sole were different at the 90 percent confidence level ( $p = 0.10$ ). Although this level is not considered statistically significant, it shows a strong tendency for the total PCB levels to be higher in the diseased fish. The median values for the diseased and unaffected groups were 2 and 1 mg/wet kg, respectively.

In the determination of total DDT concentrations, only Palos Verdes specimens were considered because the Palos Verdes shelf is a point source of DDT to the coastal waters. There was a strong tendency (at the 92 percent confidence level,  $p = 0.08$ ) for diseased fish to have higher levels of total DDT than unaffected specimens. Median values for unaffected and diseased fish were 11 and 17 mg/wet kg, respectively.

## SUMMARY AND CONCLUSIONS

We found no significant difference between total DDT levels in the muscle tissue of diseased Dover sole collected from the Orange County and from the Palos Verdes regions. In contrast, the total DDT concentrations in the unaffected fish from both areas were significantly different. These results give strength to the hypothesis that the Dover sole with fin erosion collected at Orange County came from the Palos Verdes population and that the disease did not originate at Orange County. They also indicate that levels of DDT in tissue may be used as a tag when investigating the migration of fish from or across a region containing a known point source.

A comparison of total PCB levels in Orange County and Palos Verdes specimens indicated no significant differences for either the unaffected or the diseased group of Dover sole. This was reasonable as there is no dominant point source of PCB to the Bight.

There was a strong (although not statistically significant) association between high levels of total PCB and fin erosion in fish off Palos Verdes and Orange County and between high levels of total DDT and fin erosion in fish off Palos Verdes. If PCB was uniquely associated with the disease and had a cause-and-effect relationship, we would expect fin erosion to also be prevalent in Orange County and San Diego, as the level of PCB input to these regions is comparable to that at Palos Verdes. There are several possible reasons for the association between high DDT and PCB levels and fin erosion. The disease is predominantly found in the Palos Verdes region: Thus DDT and PCB, in combination with other constituents associated with this region (such as hydrogen sulfide or high trace metal levels), could be involved in the development of the disease. It is also possible that, when a fish is diseased, PCB and/or DDT uptake is enhanced; hence, the higher levels could be the result of the disease rather than a cause. These relationships are being further studied.