Marjorie J. Sherwood

FIN EROSION DISEASE AND LIVER CHEMISTRY: LOS ANGELES AND SEATTLE

Marine flatfishes with fin erosion diseases have been found in three coastal regions of the United States in which toxic wastes have been discharged—southern California, the Duwamish River Estuary in Seattle, Washington, and the New York Bight. Similarities in the nature of the diseases and in the distribution of affected individuals in each region have suggested the possibility that the diseases have a common cause related to the discharge of toxic wastes.

A very limited comparison of trace contaminants in diseased and nondiseased specimens from Washington and southern California indicated that diseased individuals from both regions might have higher tissue concentrations of total PCB than nondiseased specimens (Sherwood and McCain 1976). In October 1976, we began a more thorough study—one that involves enough samples to permit statistical analyses of the results and that includes specimens from flatfish populations of the New York Bight. The goal of the study is to identify statistically significant similarities and differences in the types of wastes to which the fishes have been exposed and in the degree of exposure in all three regions. Preliminary results of the study are presented here.

PROGRAM PLAN

The overall program consists of three parts—an analysis of trace contaminants in fish tissues, an analysis of trace contaminants in sediments at the fish collection sites, and a review of available information and data on the historical occurrence of fin erosion in bottom fishes.

Three categories of specimens were collected in each region--diseased individuals from the area in which prevalence of fin erosion was high, apparently unaffected individuals from the same area, and apparently unaffected individuals from a control area. Chlorinated hydrocarbons were measured in muscle, liver, and brain; lipids, in liver; and metals, in muscle, liver and kidney.

The study is still in progress, and only a comparison of trace metal content and condition of liver tissue in the southern California and Washington species—Dover sole (*Microstomus pacificus*) and starry flounder (Platichthys stellatus), respectively—will be presented here. The lengths and weights of the specimens are given in Table 1.

RESULTS

Levels of trace metals in the liver tissue of the two species are presented in Table 2. These samples, which were analyzed by atomic absorption spectroscopy, were from six individuals randomly selected from each of the two most extreme categories in each region. The objective was to determine if the same patterns of in- crease or decrease between control and high-disease- prevalence sites occurred in each region. A comparison of the ratios of median concentrations at the two sites suggests that although there were differences between sites, the patterns in the two regions were not the same.

The Dover sole from the Palos Verdes shelf appeared to have higher levels of two of the seven metals measured than did the control area specimens—chromium by a factor of 3.6 and copper by a factor of 1.7. The elevation of copper concentrations in Palos Verdes Dover sole was also seen in kidney samples measured by George Alexander, Laboratory of Nuclear Medicine, UCLA, using optical emission spectrometry (OES). The ratio on a dry weight basis of the median copper levels in 12 individuals with fin erosion from Palos Verdes and 12 apparently unaffected specimens from Dana Point was 5.0. Levels of chromium were too close to OES detection limits to determine if there were also significant differences in kidney sample concentrations of this metal. In a previous study, however, levels of chromium had been found to be higher in the liver tissue of Dover sole collected on the Palos Verdes shelf than in that of specimens from a control area off Santa Cruz Island (McDermott et al. 1976).

Starry flounder from the Duwamish River Estuary appeared to have higher levels of silver and lower levels of cadmium, copper, and zinc than did control specimens. A depression in cadmium concentrations had been reported previously from the Palos Verdes shelf in southern California in the digestive gland and gonads of scallops (*Hinites multirugosus*), the liver of Dover sole, and the digestive gland of mussels (*Mytilus californianus*) (Young and Jan 1976). Although the cadmium depression found in Dover sole in the present study was not statistically significant, based on previous data, it appears that cadmium depression may occur in both regions.

Liver tissue responds dramatically to stress conditions. Histologic examination of specimens from both regions (discussed elsewhere in this annual report) suggests that, in the high-disease-prevalence areas, there is structural disarray and fatty infiltration of the liver cells. In both species, the liver-somatic indices (ratio of wet liver weight to wet body weight multiplied by 100) were higher in specimens from the high-disease-prevalence areas than in those from the control areas (Table 3). In Dover sole, the difference was approximately a factor of 3; in starry flounder, approximately a factor of 2.

To date, lipid concentration has been measured only in the liver tissue of Dover sole (Table 4). The median levels in specimens from the Palos Verdes shelf were approximately three times that of specimens from Dana Point. Total lipid was determined using the method of Bligh and Dyer (1959), modified for analysis of small samples. A comparison of percent lipid in liver tissue with chlorinated hydrocarbons in muscle suggests that, in Palos Verdes Dover sole, fatty infiltration of the liver is related to exposure to chlorinated hydrocarbons (Figure 1).

There were no differences at the 95 percent level of significance (two-tailed Mann Whitney U-test) in liver-somatic indices (Table 3) or in percent lipid (Table 4) between specimens with and without eroded fins from the high-disease-prevalence areas. Therefore, these changes in liver may occur prior to appearance of fin erosion in both species.

SUMMARY

A comparison of the levels of seven trace metals in the liver tissue of Dover sole and starry flounder suggests that patterns of increase and decrease between specimens with fin erosion from the high-disease-prevalence sites and unaffected specimens from control sites were not the same in the two regions. A possible exception is the depression in cadmium levels, which was evident in starry flounder in this study and has been reported previously in Dover sole from southern California.

The occurrence of enlarged livers in specimens from the high-disease-prevalence sites in both regions and the measurement of increased amounts of lipid in the livers of Palos Verdes Dover sole suggest, with histologic observations, that liver damage is occurring at these sites and that it may precede the appearance of fin erosion.

ACKNOWLEDGMENTS

This program has depended on the cooperation and efforts of people from several laboratories. I thank Project staff members Tsu-Kai Jan and Pat Hershelman for analysis of metals, Ted Heesen and Rich Gossett for measurement of chlorinated hydrocarbons and lipids, Alan Mearns and David Young for overall support and advice, Jean Wright for sample preparation, and Harold Stubbs and Mike Moore for sample collection. I also thank Bruce McCain and Ken Pierce of the National Marine Fisheries Service in Seattle for advice and help in the collection of samples.

This work is a result of research sponsored by the NOAA Environmental Research Laboratories, Department of Commerce, under Grant No. 04-7-022-44002. The U.S. Government is authorized to produce and distribute reprints for governmental purposes.

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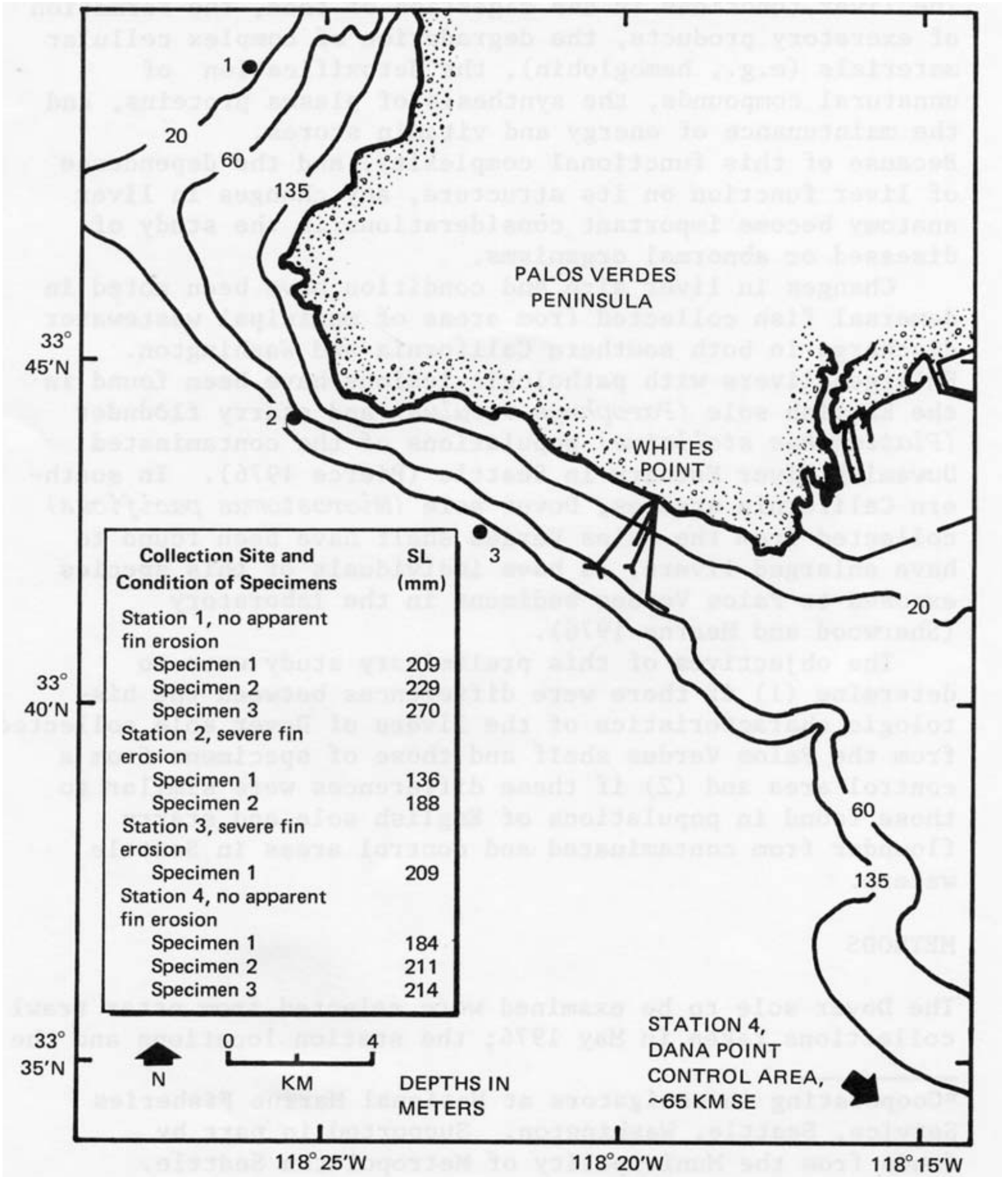

Figure 1. Relationship between chlorinated hydrocarbons in the muscle and percent lipid in the liver of southern California Dover sole, November 1976.

Table 1. Lengths and weights (median and 5 percent confidence limits) of Dover sole and starry flounder collected for a comparison of trace contaminant concentrations.

Species and Collection Site and Date	Number	Length (mm, SL)	Weight (g)
DOVER SOLE			
High-Disease-Prevalence Area (5 November 1976)			
Palos Verdes shelf, no fin erosion	12	180 (168-185)	76.6 (69.0-91.0)
Palos Verdes shelf, fin erosion	12	178 (174-186)	85.9 (79.5-90.0)
Control Area (18 November 1976)			
Dana Point, no fin erosion	12	182 (177-186)	88.8 (81.9-99.9)
STARRY FLOUNDER			
High-Disease-Prevalence Area (25 March, 15 April 1977)			
Duwamish River Estuary, no fin erosion	12	172 (157-181)	114.8 (93.3-153.2)
Duwamish River Estuary, fin erosion	12	162 (148-182)	106.4 (79.4-126.7)
Control Area (31 March 1977)			
Nisqually River Estuary, no fin erosion	12	210 (195-223)	197.3 (163.9-242.0)

Table 2. Median concentrations (mg/kg, wet weight) and ratios by area of trace metals in the liver tissue of Dover sole from southern California and starry flounder from Washington.

	DOVER SOLE			STARRY FLOUNDER		
	A Dana Point	B Palos Verdes, Fin Erosion	Ratio, B to A*	C Nisqually River Estuary	D Duwamish River Estuary, Fin Erosion	Ratio, D to C*
Silver	0.096	0.11	—	0.068	0.14	2.1
Cadmium	0.86	0.52	—	0.53	0.16	0.30
Chromium	0.056	0.20	3.6	0.045	0.040	—
Copper	2.3	3.8	1.7	6.4	4.4	0.69
Nickel**	<0.13–<0.32	<0.05–<0.16		<0.05–<0.19	<0.07–<0.14	
Lead	0.38	0.14	—	0.14	0.22	—
Zinc	23	26	—	36	28	0.78

*Ratios shown in cases where differences between collection sites are significant, $p \leqslant 0.05$, two-tailed Mann-Whitney U-test.

**Upper-limit values influenced by sample size.

Table 3. Liver-somatic indices (wet weight basis) in Dover sole and starry flounder with and without fin erosion.

	Control Area	High-Disease-Prevalence Area: No Apparent Fin Erosion	High-Disease-Prevalence Area: Fin Erosion
DOVER SOLE			
Median	0.8	2.2	2.6
95% confidence limits	0.7-1.0	1.5-2.8	2.4-3.0
Number of fish	12	12	12
STARRY FLOUNDER			
Median	1.5	3.0	2.8
95% confidence limits	1.4-1.8	2.6-3.6	2.2-3.5
Number of fish	12	12	12

Table 4. Percent lipid (wet weight basis) in liver tissue of Dover sole from control and high-disease prevalence areas off southern California, November 1976.

	Dana Point	Palos Verdes Shelf: No Apparent Fin Erosion	Palos Verdes Shelf: Fin Erosion
Number	12	12	12
% lipid, median	9.0	29	28
95% confidence limits	7.5-12	23-33	23-34