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COMPARISON OF FIN EROSION DISEASE: 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. The three disease syndromes are similar in that (1) the prevalence of each disease is elevated in the waste-impacted area, (2) the species most severely affected are those that have extensive contact with bottom sediments, (3) histological analyses reveal no inflammatory response associated with the lesions that characterize the disease, and (4) no known marine pathogen is present in abundance at the site of the lesions. The similarities suggest the possibility that the diseases in the three regions have a common cause related to the discharge of toxic wastes. To explore this possibility, we measured the levels of chlorinated hydrocarbons and trace elements in Dover sole (*Microstomus pacificus*) from southern California and in starry flounder (*Platichthys stellatus*) from the State of Washington. This was intended as a preliminary study, and only one set of specimens from each region was processed.

The Dover sole is the species most frequently observed with eroded fins in southern California. Prevalence of the disease is consistently highest on the Palos Verdes shelf, the site of a major municipal wastewater discharge. Bottom sediments on the shelf are contaminated with chlorinated hydrocarbons, metals, and organic material. Of 14,277 individuals collected on the shelf in 1972 and 1973, 39 percent had eroded fins; in contrast, less than 1 percent of 881 individuals collected in' the Dana Point coastal control area between 1972 and 1974 were affected. The lesions were restricted to the fins, and those fins that contact the bottom most frequently were the most frequently affected.

The starry flounder is the species most severely affected in the waters near Seattle, Washington. The disease has been found in the Duwamish River Estuary, but has not been noted at nearby coastal outfall sites (West Point and Alki Point) or at a coastal control site (Point Fully; Wingert et al. 1976). The

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Duwamish lower river and estuary are lined with ship moorings and industrial facilities, and the river has been the site of previous municipal and industrial waste discharge and at least one PCB spill. In 1974 and 1975, average monthly prevalence of the disease in starry flounder was 8 percent (Wellings et al. 1976). The disease was most prevalent early in the year and appeared to affect those fins that contact the sediment most frequently.

METHODS

Three categories of specimens were collected for our comparison: 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. Three composite samples from each region, each consisting of the tissues of three individuals, were analyzed. The mean lengths and weights of the specimens in the six composities are listed in Table 1.

RESULTS

Levels of total PCB and p,p'-DDE in the muscle, liver, and brain of Dover sole and starry flounder are presented in Table 2. Although it is not possible to determine significant differences between the categories with one set of composites, the data suggest that, for both species, total PCB levels are higher in the diseased fish. The values for p,p'-DDE are also high in diseased Dover sole, but not in diseased starry flounder. A previous study of chlorinated hydrocarbons in the muscle tissue of Dover sole from Palos Verdes indicated that levels of both total DDT ($p = 0.03$) and total PCB ($p = 0.08$) were higher in fish with fin erosion than in apparently unaffected specimens.* Levels of total PCB in the sole and the flounder differ by less than one order of magnitude, while levels of p,p'-DDE differ by up to four orders of magnitude. The most striking similarity in the levels of total PCB and the greatest difference in the levels of p,p'-DDE in the two species are in the livers of the diseased fish. These values appear to reflect differences in the chlorinated hydrocarbon content of the sediments in the two regions.

Levels of trace elements and cations in the muscle and kidney of Dover sole and starry flounder are presented in Table 3. The analyses were performed with arc emission spectroscopy by George Alexander (University of California, Los Angeles). The values presented for Dover sole are from a previous study in which ten specimens from each category were analyzed. Differences in trace metal or cation levels between the categories of Dover sole were considered to be associated with fin erosion if the concentrations of a given element in a given tissue in the diseased Palos Verdes fish and the unaffected fish from both Palos Verdes and Dana Point differed to a statistically significant degree ($p \leq 0.05$). Differences were considered to be regionally associated if, for a given element and tissue, significant statistical differences were observed between levels in Palos Verdes fish (both with and without fin erosion) and the unaffected Dana Point fish.

Significant differences were identified for calcium and potassium in the muscle, and copper and calcium in the kidney of Dover sole. The data for starry flounder suggest that, with the possible exception of calcium in the kidney, the patterns identified in the Dover sole do not occur in the starry flounder.

SUMMARY

A preliminary comparison of the trace constituents in Dover sole and starry flounder with and without fin erosion suggests that total PCB is elevated in the tissues of diseased individuals of both species. Similar trends for both species were not identified for p,p'-DDE or the metals considered here.

The results do not imply cause and effect; however, if similarities in tissue levels of trace contaminants in the two species occur, it is possible that the common constituent is involved in the disease in both regions. The common factor identified in this preliminary study is total PCB. A more complete comparison of trace contaminants in these two species and in the winter flounder (*Pseudopleuronectes americanus*) from the New York Bight, which also displays fin erosion, is planned.

REFERENCES

Wellings, S.R., C.E. Alpers, B.B. McCain, and B.S. Miller. 1976. Fin erosion disease of starry flounder (*Platichthys stellatus*) and English sole (*Parophrys vetulus*) in the estuary of the Duwamish River, Seattle, Washington. Paper in preparation.

Wingert, R.C., B.B. McCain, K.V. Pierce, S.F. Borton, D.T. Griggs, and B.S. Miller. 1976. Ecological and disease studies of demersal fishes in the vicinity of sewage outfalls. In 1975 Research in Fisheries, Annual Report of the College of Fisheries, University of Washington, Seattle, Contribution 444.

Table 1. Lengths and weights of Dover sole and starry flounder collected for trace contaminant analysis.

Species and Collection Sites	Length (mm, SL) Mean	CV*	Weight (g) Mean	CV*
Dover sole				
High-Disease-Prevalence Area				
Palos Verdes shelf, no erosion	200	2.6	140	7.1
Palos Verdes shelf, fin erosion	207	5.3	143	8.9
Control Area				
Dana Point, no erosion	187	18.7	110	61.8
Starry flounder				
High-Disease-Prevalence Area				
Duwamish River Estuary, no erosion	179	2.8	121	13.2
Duwamish River Estuary, fin erosion	173	7.6	114	28.1
Control Area				
Nisquali River Estuary, no erosion	247	10.1	324	25.0

*Coefficient of variation.

*D.J. McDermott-Erhlich, Lockheed Marine Biology Laboratory, Avila, Calif., personal communication.

Table 2. Chlorinated hydrocarbons (mg/wet kg) in the muscle, liver, and brain of Dover sole from southern California and starry flounder from Washington with and without eroded fins.

	Total PCB		p,p'-DDE	
	Dover Sole	Starry Flounder	Dover Sole	Starry Flounder
High-Disease-Prevalence Area				
No apparent fin erosion				
Muscle	0.159	0.591	1.34	0.008
Liver	3.69	11.9	43.3	0.213
Brain	0.978	0.916	2.92	0.008
Moderate to severe fin erosion				
Muscle	1.82	0.508	23.2	0.007
Liver	18.7	18.8	211	0.013
Brain	1.43	2.14	7.37	—*
Control Area				
No apparent fin erosion				
Muscle	0.047	0.112	0.038	0.006
Liver	0.355	0.530	0.519	0.035
Brain	0.672	0.311	0.276	0.032

*Below the limit of detectability

Table 3. Cations and trace metals (mg/dry kg) in the muscle and kidney of Dover sole from southern California and starry flounder from Washington with and without eroded fins*.

Trace Constituent	Dover Sole Muscle Median	Dover Sole Muscle 95 Percent Confidence Limits	Starry Flounder Muscle	Dover Sole Kidney Median	Dover Sole Kidney 95 Percent Confidence Limits	Starry Flounder Kidney
Silver						
Impacted Area						
Fin erosion	0.3	0.2-0.6	0.3	0.6	0.4-0.8	0.2
Unaffected	0.5	0.5-0.6	0.4	0.8	0.5-1.3	0.3
Control Area						
Unaffected	0.4	0.3-0.6	0.4	0.6	0.4-0.8	— **
Cadmium						
Impacted Area						
Fin erosion	**		<3.0	<3.2		<3.0
Unaffected	<1.8		<3.3	<3.2		<2.7
Control Area						
Unaffected	<3.0		<3.3	<4.0		<2.4
Chromium						
Impacted Area						
Fin erosion	**		<0.2	0.2		1.3
Unaffected	— **		0.2	0.2		5.0
Control Area						
Unaffected	— **		<0.2	**		0.3
Copper						
Impacted Area						
Fin erosion	0.9	0.5-1.7	1.1	19	6.8-62	4.8
Unaffected	1.0	0.6-1.3	1.5	19	9.4-32	4.4
Control Area						
Unaffected	1.0	0.6-3.2	1.6	5.9	4.5-8.1	5.2
Lead						
Impacted Area						
Fin erosion	— **		**	<1.7		— **
Unaffected	**		<1.1	1.4		**
Control Area						
Unaffected	**		— **	<1.2		0.9
Zinc						
Impacted Area						
Fin erosion	19	15-23	21	77	67-89	140
Unaffected	20	17-26	30	82	61-110	120
Control Area						
Unaffected	21	18-22	28	93	70-110	150
Calcium						
Impacted Area						
Fin erosion	640	520-760	910	1,300	1,000-1,400	1,000
Unaffected	590	420-720	420	960	800-1,200	560
Control Area						
Unaffected	370	260-490	820	450	270-600	670
Potassium						
Impacted Area						
Fin erosion	9,600	8,200-12,000	17,000	13,000	10,000-14,000	19,000
Unaffected	12,000	8,700-16,000	23,000	15,000	10,000-18,000	16,000
Control Area						
Unaffected	21,000	16,000-25,000	20,000	15,000	13,000-18,000	15,000
Magnesium						
Impacted Area						
Fin erosion	1,800	1,500-2,400	1,000	2,600	1,800-3,700	600
Unaffected	2,000	1,600-2,400	760	2,100	1,800-2,600	660
Control Area						
Unaffected	2,100	1,700-3,500	1,200	2,200	1,700-3,000	460
Sodium						
Impacted Area						
Fin erosion	18,000	11,000-19,000	6,400	22,000	20,000-25,000	9,000
Unaffected	17,000	16,000-20,000	3,800	22,000	20,000-26,000	8,200
Control Area						
Unaffected	15,000	12,000-19,000	13,000	25,000	22,000-26,000	11,000

*Values that represent a significant regional difference are enclosed in a dashed line box; those that represent a significant regional and disease associated difference are enclosed in a solid line box.

**Below the limit of detectability