FIN EROSION IN SOUTHERN CALIFORNIA FISH

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The Project's past work has shown that diseases involving the erosion or degeneration of fin tissue affect a number of southern California demersal fish species. For at least one, the Dover sole (*Microstomus pacificus*), prevalence of the disease is greatest on the Palos Verdes shelf the site of a major municipal wastewater discharge. The Project has continued studies of these diseases both in the field and in the laboratory to more completely define their distribution in space and time and to identify their causes.

In the past year, we have analyzed 350 trawl samples taken in 1972 and 1973 by the Project and various local monitoring agencies. We also conducted a special day/night trawl survey of five stations in Santa Monica Bay in mid-April of this year. Laboratory work included microscopic examination of tissues from diseased specimens and observations of diseased and apparently healthy fishes in our laboratory aquaria.

DISTRIBUTIONS OF DISEASED FISH POPULATIONS

In the data from the 1972 73 trawl surveys, we found some incidence of fin erosion in 31 species of bottom fish. As in earlier surveys, the Dover sole was the species most frequently and severely affected with the disease. The second most frequently affected species was the rex sole (*Glyptocephatus zachirus*).

In both the earlier and more recent data, Dover sole with fin erosion were most prevalent off the Palos Verdes Peninsula. Fewer affected individuals were found to the north in Santa Monica Bay and to the south in San Pedro Bay, and fewer still were collected in surveys further south, off Dana Point (Table 1). Thus we see a coastal gradient of diseased Dover sole extending in two directions from the Palos Verdes shelf. We have little information on the presence of the disease in the third direction, at depths beyond those sampled in routine monitoring surveys (beyond 200 m). However, one sample taken at 365 m off the Palos Verdes Peninsula contained 145 Dover sole, of which 21 percent had eroded fins.

Rex sole with eroded fins were also most prevalent off the Palos Verdes Peninsula. However, no affected individuals were collected in San Pedro Bay or off Dana Point.

Juvenile Dover sole undergo a seasonal migration, moving to deep waters in winter and then back inshore during the summer months. One possible explanation for the gradient of Dover sole with fin erosion along the coast is that the disease originates in the Palos Verdes area and that, in the seasonal onshore offshore movements, some individuals from this population tend to move into the other areas. The 1973 abundance and disease data in Figures 1 and 2 suggest that individuals with eroded fins from the Palos Verdes

population do take part in the winter offshore movement and that diseased individuals do move into San Pedro Bay in the summer migration.

The close proximity of Santa Monica Bay to the Palos Verdes shelf and the less frequent surveys of this area make it difficult to estimate the extent to which migration could be responsible for the presence of diseased Dover sole. In a sequential day/night survey of five stations (20 to 200 m in depth) on 16 17 April 1974, we found more affected Dover sole in the night catches, which also contained a higher number of larger specimens. These larger Dover sole may be moving inshore at night or may be present at all times but simply able to avoid the net during the day. Regardless of the day/night variations, the survey revealed that a substantial number of Dover sole with eroded fins were present in the Santa Monica Bay.

A fin erosion disease is also found in southern California white croaker (*Genyonemus lineatus*). But 1972 73 data have shown that the prevalence and distribution of the disease in this species are more variable than in the Dover sole. Fin erosion in white croaker has been reported in high frequency in Santa Monica Bay, in San Pedro Bay, off Palos Verdes, and in the Los Angeles Long Beach Harbor, but has not appeared consistently in any one area. Although only the larger fish (100 to 220 mm, standard length) are affected, the disease has not occurred in all catches in which individuals in this size range have been present. The fact that the disease has not appeared consistently in white croaker off the Palos Verdes Peninsula suggests that the factors that bring about fin erosion in the white croaker and the Dover sole are different.

The white croaker is a highly mobile species, as demonstrated by the fluctuations in its abundance near the Orange County outfall system (Figure 3). It was rare in catches made following the switch from a shallow to a deep water discharge site in April 1971. However, the aggregation of large numbers of white croaker near the outfall system in 1974 suggest the possibility that the pattern of fin erosion seen in 1970 may be repeated. Additional data on the movements of this species should be collected.

ANALYSIS OF DISEASED TISSUES

Over 200 tissue sections from diseased and apparently healthy specimens of seven fish species were prepared, stained, and examined for type of damage and presence of infectious organisms. Two categories of diseases were identified those that were characterized by the presence of microorganisms or by evidence of microbial infection (such as the presence of substantial numbers of inflammatory cells) and those that were not. Lesions in California tonguefish (*Symphurus atrioauda*), English sole (*Parophrys vetulus*), and white croaker from the Palos Verdes shelf and speckled sanddab (*Citharichthys stigmaeus*) from the San Gabriel River area belonged to the first group. Fin lesions in the Dover sole, rex sole, and slender sole belonged to the second. Lesions in these latter species were progressive, with indications of both acute and chronic processes occurring. In most cases, the epidermis be intact, suggesting the developed from within the over the damaged areas appeared to possibility that the lesions subcutaneous tissue of the fin tip rather than from trauma through the overlying skin.

AQUARIUM OBSERVATIONS

Both Dover sole with fine erosion and those that appear healthy have been brought into the Project's laboratory and maintained for several months. Preliminary observations suggest that the fin erosion disease seen in field specimens is not easily transferred from one individual to another. In addition, some individuals from several collection areas (including Dana Point and Palos Verdes) developed a progressive disease in the laboratory that involved fin erosion and resulted in death. In gross characteristics, this disease differed from the field syndrome in that (1) the caudal and upper pectoral fins rather than the dorsal and anal fins were the most severely eroded, (2) there were skin lesions on the body, and (3) there was reddening at the base of the fins. These observations indicate that Dover sole responses that involve fin erosion can be distinguished and that the field syndrome may be a special type of response.

CONCLUSIONS

The new data from field and laboratory work support the hypothesis that, within our study area, the Palos Verdes shelf is the primary site at which fin erosion occurs in at least two species the Dover sole and the rex sole. The origin of the disease in specimens captured to the north and south of this area could be investigated through analysis of DDT levels in diseased and apparently healthy fish at distances from the Palos Verdes shelf, a point source of chlorinated hydrocarbons. The occurrence of the fine erosion disease at depths beyond those sampled in routine monitoring surveys off the Palos Verdes Peninsula suggests the need for at least one deepwater study to define the seaward limits of the disease.

Microscopic examination of tissues from affected species supports hypotheses derived from field observations that the fin erosion that affects the Dover sole and rex sole differs from the one that affects the white croaker. Differences in the nature of the lesions in the various species were not completely distinctive, however, and could represent variations in host response.

Although many cases of fin erosion appear to be microbial in origin, several factors suggest that the cause of the fin erosion disease in the Dover sole is not bacterial. First, the amount of cellular inflammatory response was minimal. Second, no bacteria have been found in these lesions. This is not an absolute criterion, but it seems that, with all the sections that have been cut, bacteria would have been observed in a few of the lesions if they were the causative agent.

The disease also does not appear to be the result of the indiscriminant uptake of a toxic chemical from the environment. If it were, we would expect to find capillary degeneration (which occurred only in fin tissue) in other body tissues. Also, we would expect most of the fish exposed to the same environment to develop the disease, especially those species with dietary habits similar to those of the Dover sole. Although the dietary habits of the Dover sole, rex sole, English sole, and curlfin sole (*Pleuronichthys deaurrens*) appear similar, two of these species do not develop the

disease. And the slender sole, which feeds in a different manner, does develop the disease.

Our future studies will be directed toward examining the role of slime production in development of the fin erosion disease, in measuring the concentrations of trace metals (including chromium, arsenic, and selenium) in fin tissues from diseased and healthy specimens, and in exposing aquarium held fishes to various natural and artificial substrates to identify factors that produce lesions similar to those seen in specimens collected in the field.

Information summarized in this paper has been accepted for publication and will appear in the Transactions of the American Fisheries Society and in the Proceedings of the Naval Undersea Center Conference, 13 15 November'1973, San Clemente Island.

FIGURES

Figure 1.
Prevalence of fin erosion in Dover sole collected at a set of stations in San Pedro Bay, 1973.

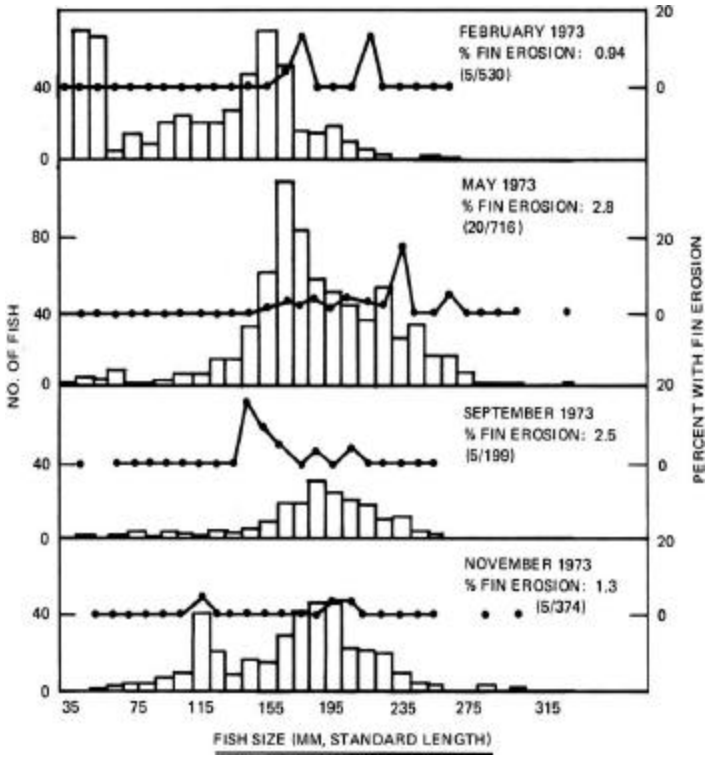


Figure 2.
Prevalence of fin erosion in Dover sole collected at a set of stations off the Palos Verdes Peninsula, 1973

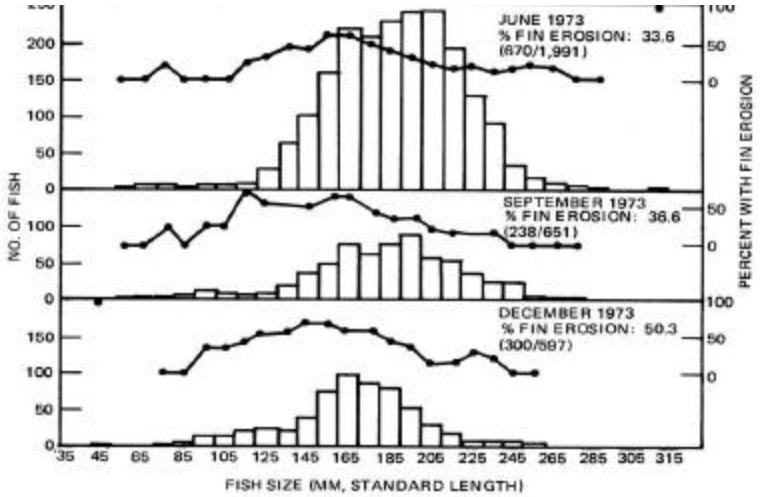
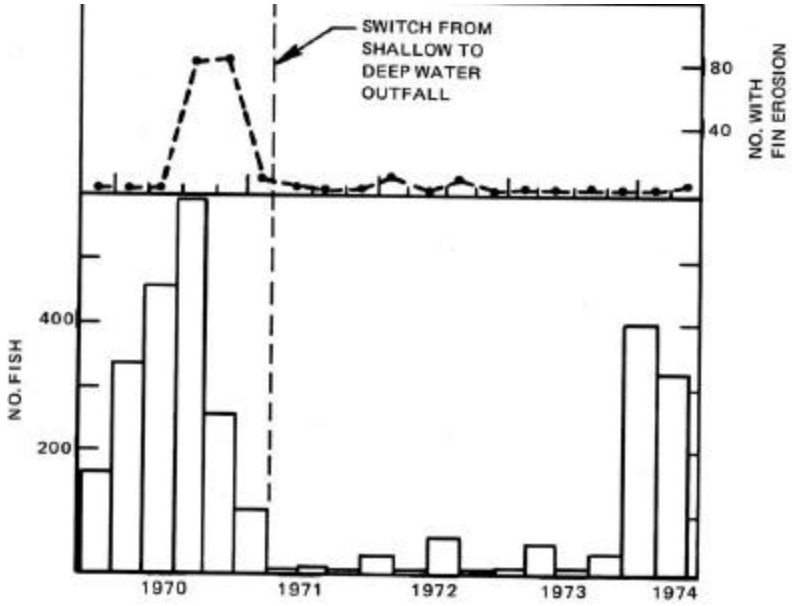


Figure 3.
Prevalence of fin erosion in white croaker collected in quarterly trawls at a set of stations in San Pedro Bay, 1969 74



TABLES

Table 1.
Prevalence of fin erosion in Dover sole collected in southern California trawl surveys, 53-66 m, August September 1973

Region*	No. of Fish	No. with Fin Erosion	Percent Fin Erosion
Santa Monica Bay	81	2	2.5
Palos Verdes Shelf	310	132	42.6
San Pedro Bay	135	4	3
Dana Point	42	0	0

*One haul at each of three stations in each region.