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MUCUS PRODUCTION IN DOVER SOLE

The Dover sole, also called the slime sole, produces a copious amount of external mucus. This slime may be important in the healing of wounds; in osmoregulation; in the control of the epidermal oxygen gradient, especially in a low oxygen or reducing environment; in protection from parasites, bacteria, and fungi; in the reduction of friction and abrasion during swimming; and in the control of suspended particles, which might clog the gills and inhibit respiration. Individuals from the Palos Verdes shelf with moderate or severe fin erosion produce less visible epidermal mucus than apparently healthy individuals from the same region. This may be an important factor in the development of the fin erosion disease. As Prof. John Isaacs (Scripps Institution of Oceanography) has suggested, without a protective mucus layer, the fins may be exposed to toxic com-pounds in the sediments, or they may dehydrate as a result of loss of tissue water to the environment. A number of toxic compounds—such as PCB, cadmium, and chromium, which are all present in elevated concentrations off the Palos Verdes shelf—have been reported to affect mucous cells.

To determine if the difference in mucus production could be detected at the cellular level; i.e., in the number or distribution of mucous cells, we examined 10 diseased specimens collected on the Palos Verdes shelf in May 1972 and 3 healthy specimens taken off Santa Catalina Island in June 1972.

The skin of healthy Dover sole is composed of three layers—the epidermis, the dermis, and the hypodermis or subcutis. The epidermis is the most superficial of the three layers, and it is by far the most complex. The morphology of the Dover sole epidermis is markedly different from that of seven other southern California flatfish species examined, primarily in that large cysts, which often extend from one edge of the epidermis to the other, are present in the Dover sole (Figure 1). These cysts, called multilocular cysts, appear to form from the coalescence of a number of smaller cells. When the membranes surrounding these original cells degenerate, the resulting structure, called a unilocular cyst, stains pink with hematoxylin and eosin and is weakly PAS-positive (Periodic acid Schiff reaction), indicating the presence of acid mucopolysaccharides. Acid mucopolysaccharides are abundant in most mucus-containing cells. Another cell, which stains strongly PAS-positive, is present in the epidermis of Dover sole. This cell, called a mucocyte, is similar in morphology and staining characteristics to mucous cells present in the epithelium of the gills and gastrointestinal tract of Dover sole and to mucous cells in the skin of other flat-fishes (Figure 2).

In comparing mucous cells in diseased and healthy Dover sole, we examined sections of skin, gill, and intestine. Samples were taken from the same location on each fish. The number, distribution, and staining characteristics of the mucous-producing structures in the three tissues from diseased Dover sole were not obviously different from those from healthy specimens. The number of multilocular cysts containing three or more coalescing cells ranged from 4 to 28 per

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section in the skin of diseased fish and from 8 to 22 in the skin of control fish (these counts are only estimates as pieces of the epidermis in some sections were lost during processing). The gill epithelium of both diseased and healthy fish contained from 200 to 300 PAS-positive mucous cells per filament; the cells were most numerous near the apex of the filament. Both mucous cysts and the PAS-positive mucocytes were present in epidermal areas adjacent to those in which erosion was occurring.

This study suggests that differences in mucus production between Dover sole with and without fin erosion cannot be accounted for by differences in the number or distribution of mucus-producing structures seen in fixed tissue. Additional studies are planned to investigate the rate of mucus production, the chemical composition of the mucus produced, and the association of both of these factors with the fin erosion disease. One factor that might have biased the results in this limited study is that the gross observations were made in February and the histologic observations were made on fish collected in May and June. The Dover sole move offshore for the winter and onshore for the summer; thus the fish collected for histologic examination might only recently have moved back onto the contaminated Palos Verdes sediments after spending the last 1/2 year off-shore. Additional studies are planned to investigate the effect of this movement on mucus production in the Dover sole.

Dover sole with severe fin erosion appear to be less flexible than the unaffected specimens. This suggests that the fish may be undergoing dehydration; i.e., losing tissue water to the environment, drinking excessive amounts of sea-water, and experiencing a buildup of salts in body tissues. Preliminary information on concentrations of calcium, magnesium, and sodium in body tissues, described in detail in the preceding article, indicates that calcium in muscle and kidney tissue from Palos Verdes fish was higher than that in fish from the Dana Point control region. Additional studies are planned to investigate the relationship between the fin erosion disease, mucus production, and osmotic stress.

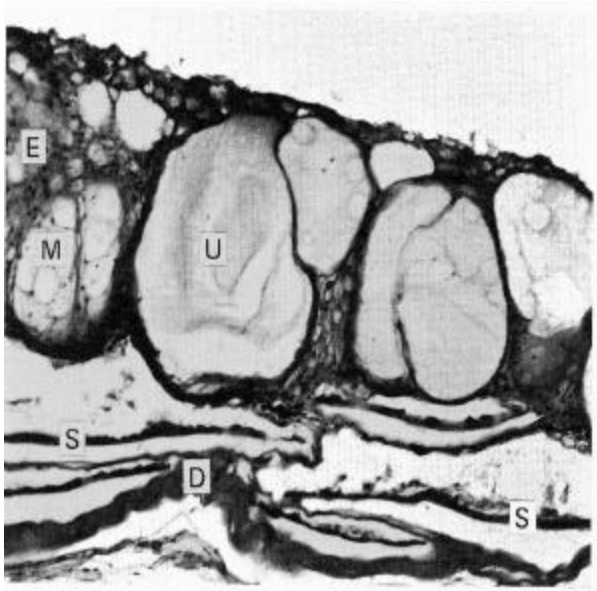

Figure 1. Section of Dover sole skin showing epidermis (E), multilocular mucous cyst (M), unilocular mucous cyst (U), scales (S), and dermis (D). 100X.

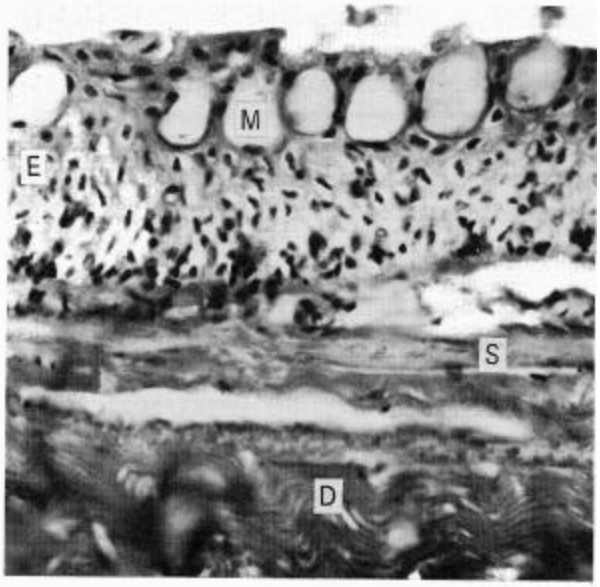

Figure 2. Section of English sole skin showing epidermis (E), mucocyte (M), scale (S), dermis (D). 100X.