

accumulation of heterogeneous dense bodies presumed to be ceroid/lipofuscin. Similar changes were observed within some neoplastic hepatocytes. Bile canaliculi were generally well developed in the well-differentiated neoplasms, whereas in the poorly differentiated, highly anaplastic lesions they were often very small and poorly formed. We saw no evidence of an infectious agent in the 20 cases that were examined ultrastructurally. This further supports the hypothesis that this epizootic has a chemical aetiology. The detailed morphological classifications currently being developed for the hepatic and extra-hepatic lesions of Elizabeth River mummichog may facilitate the use of this small non-migratory species as a sentinel of contaminated estuarine environments along the east coast of the United States.

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Recovery of Histological Lesions in the Gills of Brown Bullheads Exposed to Copper. R. REIMSCHUESSEL, A. S. KANE, A. G. MUHVICH & M. M. LIPSKY. *Department of Pathology, 711 MSTF, University of Maryland, 10 S Pine St, Baltimore, Maryland 21201, USA*

There is increasing concern that toxic chemicals have a significant sublethal impact upon the aquatic organisms. Exposure to toxic metals, such as copper, may result in altered immune status, accumulation of the metal in various organs, and subsequent morphological changes in those organs. Any or all of these elements can adversely affect the survival of the organism. Recently, after determining the 96-hour LC_{50} of copper in the brown bullhead, *Ictalurus nebulosus*, we examined the tissues of the surviving fish. We observed extensive histopathologic changes in the gills of the surviving fish. These changes were present even at the lowest concentration examined, 25 ppb copper. The secondary lamellae were fused and completely embedded in a solid mass. In some fish, there was an extensive mononuclear cell infiltrate between the secondary lamellae, underlying the hyperplastic epithelium. Mucus cells, although present, were a minimal component of the lesion. Previous investigations, examining only gross tissues, have assumed the death of fish exposed to copper to be due to excess mucus causing suffocation. Our study indicates that respiratory compromise may indeed be the cause of death but that inflammation and hyperplasia are responsible for this compromise. We also examined fish that were removed from copper after 96 hours and allowed to recover for one, two, and five days. After only two days of recovery, the secondary lamellae were no longer entirely fused but had begun to form a scalloped appearance at the tips. The gills of fish recovering for five days had almost re-established a normal histologic

appearance. This rapid restoration of normal morphology will be further characterized by examining the cell-turnover rates by using bromodeoxyuridine labeling.

Contaminant-Induced Lysosomal Injury in Flatfish (Dab): An *In-vitro* Assessment by Using Dye-Retention and Fluorescent-Probe-Uptake Assays. DAVID M. LOWE & MICHAEL N. MOORE. *Plymouth Marine Laboratory, Citadel Hill, Plymouth, UK.*

Molecules of neutral red and acridine orange freely permeate the cell and intracellular membranes in their non-protonized forms. Both compounds are used as lysosomal probes owing to the trapping effect of intralysosomal protonization. The degree of lysosomal trapping and retention of these compounds will be dependent on the efficiency of the lysosomal membrane-associated proton pump, and hence any impairment of the system will result in a reduction of probe uptake and/or retention.

These two cationic probes have been used to assess lysosomal membrane injury in isolated hepatocytes from dab (*Limanda limanda*) caught at five sites along a transect in the North Sea. The sampling sites extended northwest from the mouth of the River Elbe to the Dogger Bank in the central North Sea. Published data on chemical contamination along the transect indicate a decreasing gradient of contamination moving offshore with a reversal of this trend at the Dogger Bank site. Lysosomal fluorescence of protonized acridine orange was used as a measure of probe uptake after 30 min, whereas lysosomal retention time of neutral red was used as an indicator of lysosomal and cellular health. The results showed that lysosomal uptake of acridine orange and retention of neutral red were least at the innermost site, and both parameters gradually increased further offshore. However, this trend was reversed in the case of neutral red at the Dogger Bank site. These findings demonstrate that relatively simple molecular probes have considerable potential for the assessment of contaminant-induced damage in live cells.

Prevalence of Leukemia in Soft-Shell Clams (*Mya arenaria*) Transplanted to New Bedford Harbor. ANN CRAIG, HIDEMI SAKAMOTO & CAROL REINISCH. *Tufts University School of Veterinary Medicine, Marine Biological Laboratory, Woods Hole, Massachusetts 02543, USA.*

Leukemia in soft-shell clams (*Mya arenaria*) is ubiquitous in New England. To date, the highest prevalence of leukemia has consistently been recorded in