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Treasures in Archived Histopathology Collections: Preserving the Past for Future Understanding

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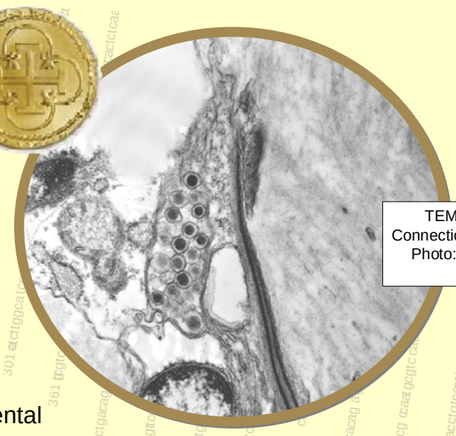
ABSTRACT

Extensive collections of histopathology materials from studies of marine and freshwater aquatic organisms are archived in the Registry of Tumors in Lower Animals (RTLA), the U.S. Environmental Protection Agency, NOAA's National Marine Fisheries Service, and other agency or academic institutions. These collections are valuable resources for scientists seeking to understand health/disease in diverse species, train new invertebrate pathologists, predict risks from biotic/abiotic stressors (e.g., toxicant impacts on organisms in multiple locations), determine disease status through DNA extraction and analysis, supply data for historical reconstructions (e.g., when a virus first affected a host species), examine trends in parasite distribution and prevalence, and improve interpretation of host/parasite population fluctuations for modeling ecosystems. However, they are in danger. For example, RTLA's collection (www.pathology-registry.org) now at Experimental Pathology Laboratories, Sterling, VA, formerly National Cancer Institute funded, lacks current funding for maintenance or processing of additional case submittals. To ensure future availabilities of these irreplaceable resources, online databases with cross-linking records of materials for search and retrieval—as is being developed for the EPA's Atlantic Ecology Division's collections— can provide access, but these collections need cross-agency support to improve their database capabilities, maintain histoslides, and provide hands-on examination and study.



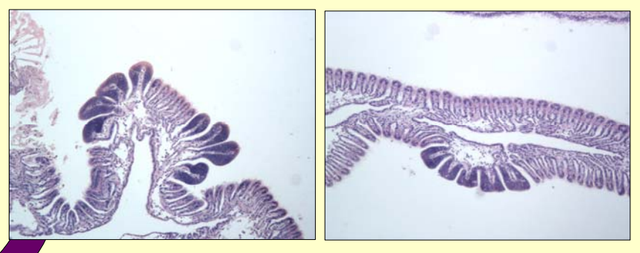
TEM herpesvirus in Connecticut soft-shell clams. Photo: Richard French, UCONN

RESEARCH

***Mya arenaria*, soft-shell clam (10x)**
HEALTHY GILLS

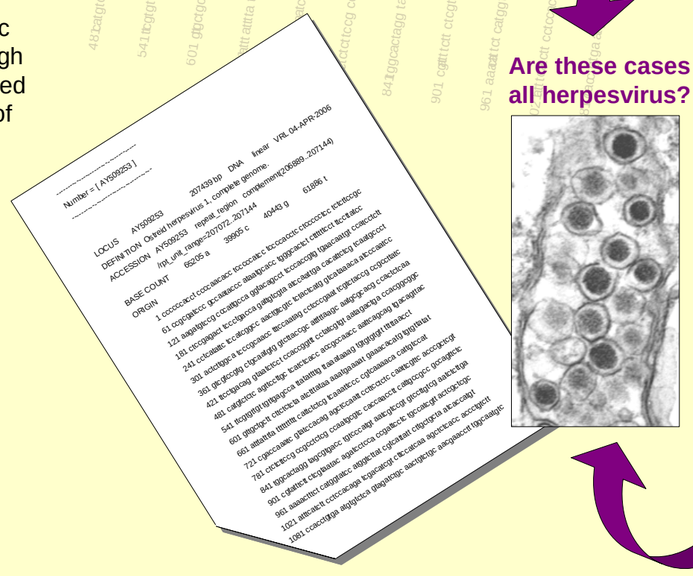
Connecticut soft-shell clams (10x)

BRANCHIAL HYPERPLASIA, GILLS



RTLA #1504 (10x) **RTLA #1515 (10x)**
Accessioned in 1976, collected from Searsport, Me

Are these cases all herpesvirus?



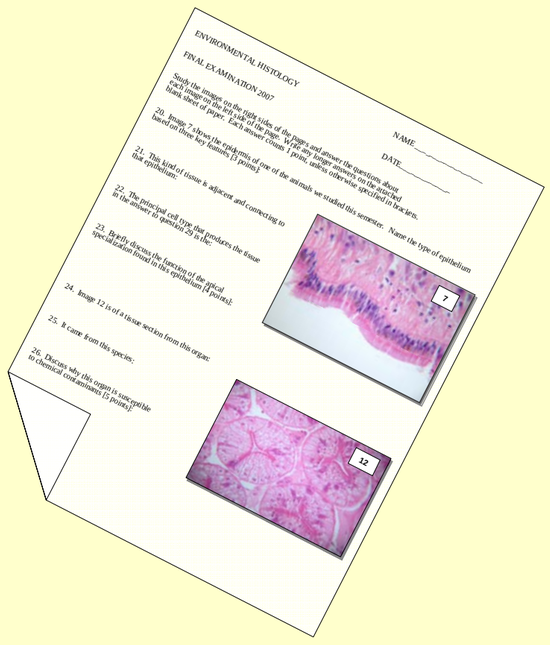
EDUCATION & TRAINING

HISTOLOGY FOR ENVIRONMENTAL SCIENTISTS

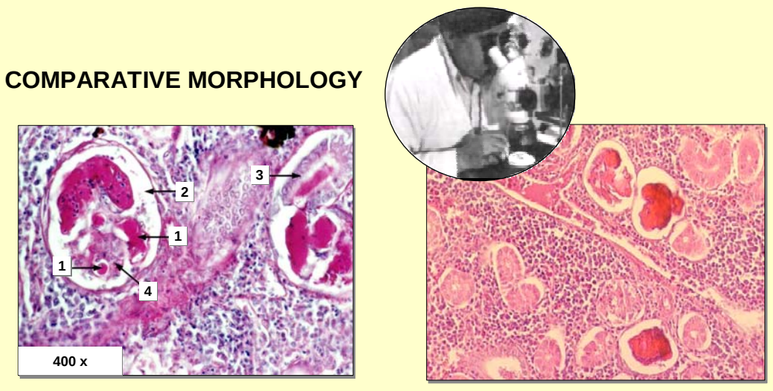
Developed Dr. Esther Peters and offered by George Mason University, Department of Environmental Science and Policy, Spring Semester 2007.

This advanced laboratory course introduced students to the basics of histology and how investigations of organism structure and function using light microscopy can solve environmental problems. Graduate students learned how to interpret various pathologies using case studies loaned from various archived collections which involved current issues in environmental science – community diversity, population dynamics, toxicology, and global change.

Environmental scientists often play the role of crime scene investigators, attempting to tease out the cause(s) of ecosystem degradation (the criminals) by examining changes occurring in the diversity and health of the organisms living in a particular ecosystem (the victims). One of the most useful tools in either scenario is the study of cells, tissues, organs, and organ systems. Microscopic anatomy, also known as histology, provides a visual record and bridge between changes occurring in cells and organisms as a result of exposure to physical, chemical, and biological stressors, and the impacts to populations, communities, and ecosytems. Pathologists learn in medical school to apply histo-techniques to help solve human health issues, but scientists are not often trained in this field to help solve animal health and ecosystem condition issues.



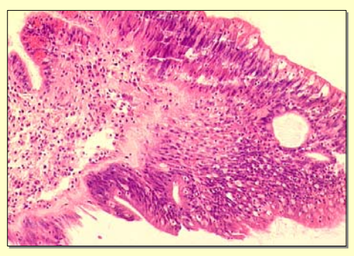
COMPARATIVE MORPHOLOGY



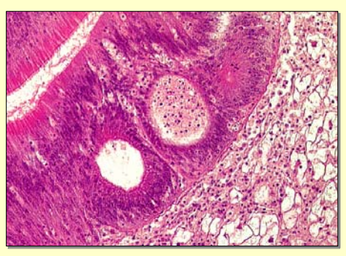
EPA archived collections, summer flounder (Paralichthys dentatus) exposed to EDC (estradiol, E2). Male kidney, PAS-Hematoxylin (400x)

EPA archived collections, cunner (Tautogolabrus adspersus) exposed to EDC (ethinyl estradiol, EE2). Male kidney, Hematoxylin & Eosin (200x)

ADENOCARCINOMA *IN SITU*

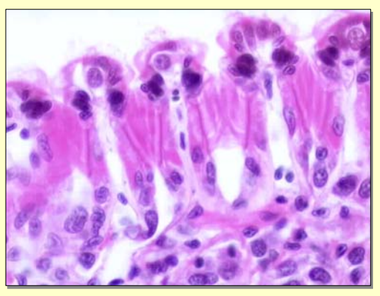


EPA archived collection, eastern oyster, *Crassostrea virginica*, Black Rock Harbor, CT 1985 AED #85-1959d (200x)



State of Connecticut, eastern oyster, 1997 CT # 97/22-26 (200x)

DISSEMINATED NEOPLASIA

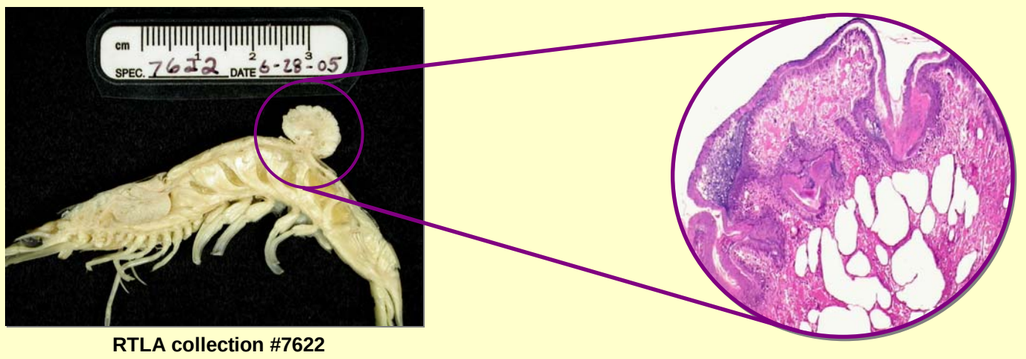


RTLA collection #4418, gill hemolymph vessels, *Macoma baltica* Accessioned in 1989, collected in Maryland in 1976

ARE BRANCHIAL LESIONS IN ARCHIVED SOFT-SHELL CLAMS CAUSED BY THE SAME VIRUS? DNA COULD BE THE KEY TO UNLOCK THIS TREASURE CHEST!

There are 47 cases of soft-shell clam, *Mya arenaria*, with branchial hyperplasia in the RTLA from the last 40 years submitted from Maine, Rhode Island, Maryland, and California. Analysis under transmission electron microscopy (TEM) of lesions seen in Connecticut soft-shelled clams has revealed herpesvirus. The extracted viral DNA is currently being sequenced. By extracting viral DNA from paraffin blocks with modern scientific technology, researchers can use archived materials from the past to compare with lesions seen in present day to determine etiologies and see trends.

EPIDERMAL PAPILLOMA, SHRIMP



RTLA collection #7622

Bisected Pacific white shrimp, *Litopenaeus vannamei*, with hemispherical firm white mass attached to the dorsal surface between the fourth and fifth abdominal segments by a narrow stalk. The mass has multiple cysts on the cut surface. The specimen was found in a culture pond and contributed to the RTLA by Dr. Ken Hasson on 6/14/2005, Texas Veterinary Medical Diagnostic Laboratory. The H&E-stained tissue section shows abnormal epidermis and cuticle development, abundant mitotic figures in some areas, and extensive hemolymph-filled stroma of the interior of the mass. This contribution proved valuable in confirming the neoplastic status of two *Farfantepenaeus spp*. submissions to the RTLA in the 1970's. All of these shrimp lesions were diagnosed as epidermal papillomas.

SUMMARY

Archived collections of tissues from diverse organisms exist around the world. These collections are not only in natural history museums or tissue registries developed for specific study purposes, but also in universities, state agencies, public and private research laboratories, and even in individual researcher's basements. Tissues have been preserved and processed into stained sections for histological examination for more than 150 years. These resources can be invaluable for studying changes in the ecology, morphology, physiology, biochemistry, systematics, genetics, parasites, and diseases of species over long time periods. Identification of these irreplaceable resources and development of online databases with cross-linking records of materials for search and retrieval will be critical to future scientists. Cross-agency support is needed to make the records available on the Internet, as well as to maintain the histo-slides and related materials, and only dedicated efforts will keep them accessible for continued examination with innovative technologies by inquiring minds.

US EPA ARCHIVE DOCUMENT