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# Disseminated Neoplasia in *Mya Arenaria* Linked to Chronic Heavy Metal Pollution.

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temperature in controlled laboratory experiments. Our results reveal clearly that infection with the etiological agent of WS increases significantly with regular fluctuations in the thermal environment, regardless of the mean temperature experienced by hosts. This finding highlights an urgent need to develop a better mechanistic understanding of the response of infectious disease to dynamic climate variables.

**THE IMPACT OF BAIT ON THE SUSCEPTIBILITY OF AMERICAN LOBSTERS (*HOMARUS AMERICANUS*) TO SHELL DISEASE INVESTIGATED USING NITROGEN ISOTOPE RATIOS.**

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Shell disease (SD), has been present in southern New England at low levels for decades and has recently increased in range and occurrence. Large proportions of fish in American lobster (*Homarus americanus*) diet has been linked to increased rates of SD. Therefore, the use of fish as lobster bait may be linked to increased SD rates in lobsters. Lobsters from the western portion of Martha's Vineyard, Massachusetts (WMV, 41°N 71°W) were randomly divided into three groups of 16 and exposed to dietary treatments (100% herring (H), 48% crab, 48%, blue mussel and 4% plant matter (W), or 50% herring, 24% crab, 24% mussel, 2% plant matter (M)) to determine if lobster tissue  $\delta^{15}\text{N}$  levels reflected diet. The results of the feeding experiment confirmed that differences in diet are observed in the  $\delta^{15}\text{N}$  levels of the consumer's muscle tissue. The  $\delta^{15}\text{N}$  levels of tissue samples from 175 wild lobsters with varying degrees of SD were unrelated to SD severity but did indicate lobsters were eating large amounts of fish (bait). This result does not support the speculation that fish used as bait is contributing to SD outbreaks in the southern New England area.

**DISSEMINATED NEOPLASIA IN *MYA ARENARIA* LINKED TO CHRONIC HEAVY METAL POLLUTION.**

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Disseminated neoplasia a diffuse tumor of the hemic system in bivalve molluscs is characterized by mitotic, rounded hemocytes. This disease is considered to be among the six most destructive

molluscan diseases identified in different geographic regions and mollusc species. Efforts to link the onset of this fatal disease to environmental contaminants have depended on data collected following episodic events. To document neoplasia onset during chronic contaminant exposure we examined disease development in the soft shell clam, *Mya arenaria*, at six New England locations of known environmental, contaminant and sediment qualities. Transplants of healthy *Mya arenaria* (22–25 mm) to six sites for four months documented the highest frequency of neoplasia development and decrease of phagocytic ability at sites characterized by silt/clay rich sediments with high frequencies of heavy metal contamination. Sediment levels of heavy metals were significantly correlated with neoplasia development though not with tissue levels of heavy metals. Animal growth at all sites showed no significant relationship to environmental temperatures, sediment characteristics or contaminant levels. These results indicate vulnerability of small clams to environmental stress induced by heavy metal contamination, which decreases their immune defenses. (CASSDA and FDG through WCU to SAB, Saltonstall/Kennedy NA08NMF4270416 to CWW/SAB)

**DISSEMINATED NEOPLASIA AND CLAM POPULATIONS IN A CANADIAN NATIONAL PARK—KOUCHIBOUGUAC NATIONAL PARK.**

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Kouchibouguac National Park of Canada (KNPC), situated along the Northumberland Strait in South Eastern New Brunswick, encompasses an area of 238 km<sup>2</sup> and allows both commercial and recreational softshell clam (*Mya arenaria*) harvesting. Clam populations at nine different sites of known sediment composition in KNPC were evaluated according to clam densities, sizes and neoplasia occurrence. With up to 34.31% of clams at marketable size and up to 48.36% of 20–50mm the majority of clams are in the size range where neoplasia has been detected in other natural populations. Fully neoplastic and therefore fatally ill animals are found at frequencies between 0–10% while animals without

neoplastic cells were detected at frequencies of up to 67.92%. Though this indicates that populations are impacted by neoplasia there is a downward trend with 0–2.63% frequencies of fully neoplastic animals during most recent detections. Since *Mya arenaria* is one of the most ecologically important bivalve species in Eastern Canada, influencing primary production and nutrient cycling with a long history of exploitation and traditional fishing activity in KNPC the Park's clam management strategies need to consider disseminated neoplasia to assess the health of its clam populations. (Funding to SAB through WCUA CASSDA and FDG)

#### FUNCTIONAL GENOMICS OF GAMETOGENESIS AND REPRODUCTIVE ALLOCATION IN THE PACIFIC OYSTER *CRASSOSTREA GIGAS*.

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The Pacific oyster is a marine bivalve of major economic and ecological importance. Its massive but also very flexible allocation to reproduction (up to 60% of an individual's flesh weight) makes it an interesting species in which to study factors regulating gametogenesis. Additionally, quantitative genetic studies have revealed trade-offs between reproductive allocation and survival. In this context, recent developments of genomic resources in *Crassostrea gigas* are being combined with experimental selective breeding, QTL mapping and functional approaches to identify genes involved in the variation of reproductive allocation. Microarray technology is used to identify genes differentially expressed between lines selected to be resistant or, conversely, susceptible to summer mortality, a trait known to be related to reproductive allocation. Similarly, reproductive stage- and sex-specific genes can be identified, providing insights into spermatogenesis and oogenesis in this hermaphroditic species. As no effective mutagenesis method is yet available in oysters, the function of specific genes is being investigated directly by RNA interference and protein neutralization with antibodies. Complementary approaches contribute to identifying genes involved in reproductive allocation in oysters and will ultimately show how evolutionary forces shape their variation.

#### A REO-LIKE VIRUS ASSOCIATED WITH MORTALITIES OF BLUE CRAB *CALLINECTES SAPIDUS*: DEVELOPMENT OF TOOLS TO IMPROVE SOFT-SHELL CRAB AQUACULTURE.

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Soft shell crabs are a high value commodity often produced in short term aquaculture. Unfortunately, soft-shell aquaculture facilities often suffer >25% crab mortality. To investigate the cause, we analyzed crabs from soft-shell aquaculture facilities and uncovered a reo-like virus (RLV) in most dead and dying animals. Subsequently, RLV was observed in a majority of sampled dead/dying crabs from soft shell aquaculture facilities from Delaware to Florida. Since 2002, IMET (previously COMB) has reared ~1 million blue crabs in a fully-contained recirculating aquaculture system. The aquaculture center has experienced sporadic unexplained mortality of captive broodstock crabs caught from the wild. Virus infections were suspected to be responsible for many mortalities. Using a molecular assay developed to detect RLV, the virus was observed in 44% of archived broodstock mortalities. Additionally, 7 of 8 RLV positive broodstock died within a few weeks based on non-lethal assays. The virus is passed easily by injection and we have evidence that it can be transmitted by cohabitation and cannibalism. We are currently working with local watermen to develop management practices to reduce mortality from RLV in aquaculture facilities, as well as reduce potential virus contamination of waterways from flow-through soft shell aquaculture shedding systems.

#### THE LOSS OF BAY SCALLOP LARVAE FROM NANTUCKET HARBOR DUE TO TIDAL FLUSHING.

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Nantucket Harbor supports a wild population of bay scallops (*Argopecten irradians irradians*) which is fished commercially. Recently, the harvest has varied from year to year by nearly a factor of ten, from a high of 32,500 bushels in 2004–5 to 3,850