1M

Life and Death in the Ocean

Session Moderator: Virginia Armbrust, Oceanography

MGH 284

12:30 PM to 2:15 PM

* Note: Titles in order of presentation.

Marine Diatom Resistance to Virus Conferred by Strain Specific Microbial Community

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Mentor: Gabrielle Rocap, Oceanography

Diatoms are small photosynthetic organisms that are important in global carbon fixation and help provide a base to the oceanic food web. Viruses are known to play a role in the overall life and death of diatoms but the extent of this role is not fully understood. A previous member of the Rocap laboratory has isolated a virus (PmDNAv) known to infect diatoms of the species *Thalassiosira pseudonana*. This virus is infectious in six out of the seven cultured strains kept in the lab; a seventh, CCMP 1012, is resistant. Each of the seven strains has a microbial community that propagates with the diatom cells as they are kept in culture. I hypothesized that the *T. pseudonana* CCMP 1012 was able to survive the viral inoculation because a beneficial microbe absent in the other strains was able to confer viral resistance. To test this hypothesis, I confirmed the previous results that showed viral resistance in the CCMP 1012 strain and susceptibility in another cultured strain. I then treated the diatoms with antibiotics to remove the microbial community. With the newly microbe free CCMP 1012 culture I performed infection experiments to test if the axenic strain would behave similar to the non-resistant strains and die, or if it would remain resistant to the virus. When the microbial community was removed from the previously resistant CCMP 1012, the strain was susceptible to viral infection. The most likely explanation was that the microbes were conferring resistance to the diatom strain. This implies that microbial interactions can lead to drastic changes in the dynamics at the base of the food web. Future work includes experiments questioning if the microbial community from the resistant strain can confer viral resistance to other strains and analyzing how the microbial communities differ genetically among resistant and susceptible strains.

Fatty Acids Show Variability in Food Sources for Aquaculture Mussels (*Mytilus spp*.) across Spatial and Temporal Scales

Molly K. Payne, Senior, Aquatic & Fishery Sciences
Mary Gates Scholar, UW Honors Program
Mentor: Alexander Lowe, Biology
Mentor: Emily Carrington, Biology

Seasonal stratification of the water column likely influences food availability to mussels grown at certain depths on aquaculture lines, as well as the environmental conditions experienced by the mussels. Fatty acids are important structural molecules that reflect the diet of the organism, such that fatty acid composition provides information on how the condition of mussels grown in different environments responds to food changes. Food sources vary based on a number of environmental conditions, including water temperature and turbulence, which differ between stratified water layers. Fatty acids in aquaculture mussels grown at 1m depth were compared to those at 7m in depth in the summer and fall of 2016 to test effects of varying environmental conditions between the depth layers. The results showed significant variability in the fatty acid composition of mussels grown at different depths in the summer months, but none in the fall. The difference between depths was contingent on the season. The variability in the summer months is likely due to stratification from increased surface temperatures, which decreases mixing and nutrient supply to mussels at lower depths. Stratification is then reduced in the fall and may explain homogenization of mussel fatty acid signatures from that period. In 2017, monthly sampling at the two depths was repeated and another experiment analyzing mussel plasticity was conducted in which mussels growing at 1m and 7m depth were switched during the summer and monitored at the new depth. Fatty acid signatures of switched mussels are predicted to adjust to become consistent with signatures of mussels established at the new depth by the end of the five-month sampling period. The results of this study will demonstrate the adaptability of mussels to new feeding environments and the effects of en-

vironmental changes on mussels as variable water conditions impact their algal food sources and overall health.

Morphological and Molecular Identification of a Shell-Boring Mudworm *Polydora Websteri* (Polychaeta: Spionidae) from Puget Sound, Washington

Heather M. Lopes, Senior, Aquatic & Fishery Sciences
Mentor: Julieta Martinelli, SAFS
Mentor: Chelsea Wood, Aquatic and Fishery Sciences

Some spionid polychaetes can burrow into the shells of bivalves, creating unsightly mud blisters. Because they are unappealing to consumer and can burst, fouling oyster flesh, these blisters are an economic burden on affected oyster half-shell industries. Historical invasions by the spionid *Polydora websteri* have resulted in the collapse of aquaculture operations in Australia, New Zealand, and Hawaii, USA. Recent sightings of mud blisters on Pacific oysters (*Crassostrea gigas*) in Puget Sound, Washington, USA suggest that the area might be experiencing a spionid polychaete invasion. To determine whether *P. websteri* is the polychaete creating the mud blisters recently observed in Puget Sound, we obtained 170 Pacific oysters from six locations and examined for blisters and burrows. Polychaetes were extracted from the shells and vouchered for molecular analyses. We used mitochondrial (cytochrome c oxidase I [COI] and cytochrome b) and nuclear (18S rRNA) genes for species-level identification. Positive identification of *P. websteri* found in the mud blisters of Puget Sound Pacific oysters will be the first confirmed sighting in Washington, USA. This study is the foundation for advising the Washington shellfish industry on strategies for mitigating the economic impacts of this invasive polychaete.

Use It or Lose It: Three Ways That Snailfishes (Liparidae) Reduce Their Skeleton in the Deep

Abigail Andrea (Abby) Von Hagel, Senior, Biology (Molecular, Cellular & Developmental), Neurobiology
Mary Gates Scholar, UW Honors Program
Mentor: Adam Summers, Biology
Mentor: Stacy Farina, Friday Harbor Laboratories
Mentor: Mackenzie Gerringer, Friday Harbor Labs
Mentor: Matthew Kolmann, Friday Harbor Labs

Skeletal reduction is a common feature among deep-sea fishes that have diversified from shallow-water relatives, such as snailfishes. These skeletal reductions may be an adaptation to environmental conditions of high pressures, low temperatures, declining luminosity and limited food availability. Snailfishes (family Liparidae) are found across a large bathymetric range (0 –>8,000 m), with intertidal ancestors giving rise to a large clade of deep-sea species. We used micro-computed tomography (micro-CT) to estimate average bone mineral density and examine jaw, pectoral girdle, and neurocranium morphology. Our results suggest at least three mechanisms of skeletal reduction: (1) reduction of bone size, (2) reduction of bone density, and (3) loss of skeletal elements. First, using phylogenetic generalized least squares (PGLS) analysis, we found that the change in cranial dimensions with depth was not uniform. While the size of the maxilla, dentary, and pectoral girdle decreased with greater depth, length of the upper premaxilla and the neurocranium did not vary with collection depth. Second, average density of the lower jaw decreased with increasing depth. Lastly, the ventral suction disc has been lost multiple times within the deep sea lineage. While all three methods are seen in snailfishes, other groups may use some or all of these mechanisms to different extents. Some mechanisms of skeletal reduction may be more advantageous than others. The extent to which a structure is retained in deep-dwelling fishes may indicate its functional importance. Variable skeletal reduction in the family Liparidae provides insights into the physiological adaptations that allow fishes to survive in deep-water environments. We conclude that some skeletal elements are maintained at the expense of others as fishes balance the functional demands of life in the deep sea.

Mortality of Juvenile Manila Clams from Predation in Sand and Gravel Sediment

Malise Ching Yun, Senior, Anthropology
Mary Gates Scholar
Mentor: Megan Dethier, Biology

Despite the large number of gametes that clams release, very few offspring survive to reproductive age and harvestable sizes. There are several ways that aquaculturists try to protect young settlers, including adding gravel on top of fine sediment. We tested whether the addition of gravel helped decrease the mortality rate from small crabs in lab experiments. We tested predation rates on juvenile manila clams, *Ruditapes philippinarum* by the hairy shore crab, *Hemigrapsus oregonensis* in different sediments. Clams were placed in tubs with no sediment (NS), fine sand (FS), or sand with gravel on top (SG). After allowing time for the clams to burrow, crabs were added to each tub and given 24 hours to consume the clams. Crabs consumed some clams in all treatments although there was high variation among individuals. Gravel addition did not reduce predation rates compared to fine sand alone, but there was a trend for more predation in no sediment than with sediment. We also tested the ability to consume small clams of different predators that live in the same sediment habitat as *R. philippinarum*. The worms, *Nereis brandti, Paranemertes peregrina* and *Hemipodus borealis* all showed no predation on clams within a 24-hour period. The snail, *Alia* also showed no predation on juvenile clams. By understanding multiple factors that lead to juvenile clam mortality, fisheries can improve upon their methods to increase harvestable populations.