Online Proceedings

Poster Session 1

MGH 206, Easel 177

11:00 AM to 1:00 PM

Varitation of Gill Rakers among the *Oncorhynchusnerka* Species

Seleen Abdul Jaber, Sophomore, Pre-Major, UW Bothell
Atom June Zheng, Senior, Biology (Bothell Campus)
Mentor: Jeffrey Jensen, Biological Sciences, STEM, UW Bothell

The Lake Washington, and Sammamish basin contains a complex mix of life history strategies of *Oncorhynchusnerka*. These life history strategies include 1) Anadromous sockeye that remain in the lake for one or two years before migrating to the ocean and returning to fresh water as mature adults; 2) "Residual" sockeye salmon that breed with and are genetically a part of the anadromous population but do not migrate to the ocean, and 3) "kokanee" salmon that are genetically distinct from anadromous and residual sockeye. Kokanee salmon are native to the basin and are thought to have evolved when glaciers or other barriers restricted access to the ocean. Although once extremely abundant throughout the basin, native kokanee are now thought to be found only in Lake Sammamish. Large numbers of kokanee-like fish continue to occasionally migrate from Lake Washington into the Sammamish river and its tributaries. Intriguingly, these "mystery *nerka*" migrate and spawn later than the sockeye/residual population and may represent a fourth distinct *O.nerka* population (e.g. a remnant of native Lake Washington kokanee, or a newly evolved kokanee population derived from sockeye ancestors). Sockeye, residuals, and kokanee use gill rakers, bony extensions in the throat, to capture prey. In other cases where kokanee have evolved from sockeye ancestors, the number and size of gill rakers differs – a reflection of the of the different types environments they mature in and the different types of prey available in freshwater vs. saltwater. In this research we document the variation in gill raker number and length in the Lake Washington/Sammamish populations of *O. nerka* in an attempt to 1) investigate trophic adaptations within the basin associated with life history strategy and location of maturation, and 2) to assess the relationship of "mystery *nerka*" to the other populations known to occur in the basin.

Poster Session 2

MGH 206, Easel 173

1:00 PM to 2:30 PM

The Effect of Wind Turbulence on Pollinator Visitation of *Oenothera pallida*

Regina Renee (Regina) Mettey, Junior, Extended Pre-Major
Mentor: Jeffrey Riffell, Biology

The interactions between pollinators and plants have a strong correlation to the fitness and reproductive success of both parties involved. These interactions are responsible for most of plant reproduction by seeds and they also drive evolutionary diversification of both plant and pollinator species. Wind turbulence plays an important role in navigation by smell, which is important for many pollinators while locating flowers. Climate change may alter wind patterns, which in turn may affect the ability of pollinators to locate flowers. The goal for this project was to determine the effect of wind on pollinator success. We determined the visitation rate of pollinators at *Oenothera pallida* flowers in the field by analyzing infrared camera videos recorded last summer at a field site in Grant County WA. Next we ran a multiple linear regression to determine the effects of wind speed, temperature, humidity, and ozone levels on floral visitation rates. Pollinators of *Oenothera pallida* include the hawkmoths *Hyles lineata* and *Manduca sp.*, various bee species including *Andrenids*, *Apids*, *Lassioglossum sp.* and *Megachilids*, *Bembix* wasps, and various flies. Wind speed is the strongest variable that affects pollinator visitation at different times of day, which implies that changing wind patterns significantly impact plant-pollinator interactions.

Poster Session 2

MGH 206, Easel 175

1:00 PM to 2:30 PM

Olfactory Learning and Memory in the Mosquito *Culex quinquefasciatus*

Elizabeth Rylance, Senior, Neurobiology
UW Honors Program
Mentor: Jeffrey Riffell, Biology
Mentor: Gabriella Wolff, Biology

Mosquitoes primarily navigate using their olfactory system,

and can use this system to form "memories" that influence their choice in hosts. When a mosquito encounters an odor, information is sent through the antennal lobes in the brain to the mushroom bodies, which are structures responsible for learning and memory consolidation. This odor-learning pathway is mediated by neurotransmitters like dopamine and serotonin. Recent research has shown that the mosquito *Culex quinquefasciatus* has extremely low levels of dopamine in the antennal lobes compared to other species, and is unable to learn to avoid odors associated with a negative response. This led us to predict that dopamine is essential for aversive learning in mosquitoes. We hypothesized that *Cx. quinquefasciatus* differed from other mosquitoes in learning ability because they were previously tested in the light and they are the most nocturnal of the originally tested species. To test this hypothesis, we conditioned the mosquitoes in the absence of light in an aversive learning paradigm to measure how frequently they chose to avoid the conditioned odor. An inability to learn regardless of light condition would indicate that the role of dopamine as a neuromodulator in the antennal lobes evolved partly to allow diurnal mosquitoes to avoid defensive hosts. Next, specific neurotransmitters in the antennal lobe were mapped using confocal microscopy, revealing their concentrations which may explain behavioral differences from other mosquitoes. Most mosquito species show some plasticity in host selection, which can lead to the transmission of animal diseases, like West Nile Virus, to humans. Mosquitoes are the world's deadliest disease vector, killing over 700,000 people globally each year, so understanding how and why this adaptation occurs can help us understand the framework that underlies the spread of mosquito borne diseases and bring us one step closer to solving this global issue.

POSTER SESSION 2

Commons East, Easel 59

1:00 PM to 2:30 PM

Modeling Pulsar Red Noise to Detect Gravitational Waves

Min Young Kim, Junior, Statistics, Physics: Comprehensive Physics
Mentor: Joey Key, Physical Sciences Division, University of Washington Bothell
Mentor: Jeffrey Hazboun, Physical Sciences Division

The North American Nanohertz Observatory for Gravitational Waves (NANOGrav) uses an array of galactic millisecond pulsars to search for low frequency gravitational waves. The stability of millisecond pulsars allows their pulse time of arrival (TOA) to be used as precise clocks. Gravitational waves will produce timing delays that are are correlated across pulsars. In order to detect such correlations in TOAs, we must also understand the noise processes in the pulsar signal. Noise model selection aims to produce custom noise descriptions for each pulsar. Using NANOGrav's search code enterprise a Markov Chain Monte Carlo (MCMC) algorithm is used to search for the most favored model. A hyper model framework is used to explore across a set of models, which have different red noise and dispersion measure (interstellar medium effect) processes. The posterior odds ratio is then represented by the relative amount of time the chain spends in a model. An iterative approach is taken, where one model selection analysis is used to inform the next set of models from which to choose. The resulting noise descriptions will aid in mitigating its effects within the pulsar signals, increasing chances of gravitational wave detection.

POSTER SESSION 2

MGH 206, Easel 174

1:00 PM to 2:30 PM

Neuromodulation of Sensory and Motor Feedback in Honeybees

Andrea Borrero, Junior, Microbiology
Mentor: Jeffrey Riffell, Biology
Mentor: Claire Rusch

In the last decade, a large amount of studies have been done using virtual environment (VE) because of the increased control over the sensory stimuli used and the detailed observation of the associated behavioral and sometimes neuronal responses. In this study, we placed honeybee in a VE and exposed them to visual stimulus in closed-loop. We showed that honeybees are able to fixate the stimulus regardless of the level of feedback fed to the sensors(e.g., the gain between the animal motion and the stimulus motion on the VE). Our next step is to investigate how different neuromodulators such as the octopamine and dopamine, may be important for fixation and adaptation to the different level of sensor feedback. Octopamine (OA) is key in modulates physiological process in invertebrates including honeybees. Recent studies have identified OA neurons that are critical for visual behaviors and that increase their activity during active behavioral state. To identify the effects on octopamine and dopamine (DA) on honeybee's ability to fixate, we are injecting bees with OA, DA or their respective antagonists in a visual processing brain area. Potential results of this study will impact the fields of neuroethology, providing insights on the modularity of neural processes and the feedback between sensory and motor pathways.

POSTER SESSION 2

MGH 206, Easel 176

1:00 PM to 2:30 PM

Day-Night Variation in Floral Volatiles of *Oenothera pallida* and Their Impact on Pollinator Attraction

Eleanore Cordia Sammeth, Junior, Biology (Ecology, Evolution & Conservation)
Mentor: Jeffrey Riffell, Biology
Mentor: Jeremy Chan, Biology

Insect pollination is crucial to agriculture and conservation, but little is known about the ecology and evolution of floral scent, which is one of the strategies that plants use to attract pollinators. Flowers that rely on insect pollinators have floral scent compositions that attract certain types of pollinators more than others. *Oenothera pallida* is a plant which is pollinated by both daytime and nighttime pollinators, so examining its floral volatiles gives us an idea of what attracts the different pollinators to this flower. My research examines how floral scent emissions from *Oenothera palllida* differ between the day and nighttime, and how these differences in floral scent emission affect the attractiveness of the flowers to different pollinators. I extracted the floral scent from *Oenothera pallida* that is grown in the lab. I used Porapak traps to sample volatiles from each plant for six-hour periods in the evening and in the morning, which allowed me to see the change in composition depending on the time of day. I analyzed the floral scent samples using gas chromatography - mass spectrometry (GCMS). Then I created artificial scent blends in mineral oil that reflected the scent compositions of daytime and nighttime floral scent emissions. I exposed the hawkmoths and honeybees to the different scent compositions in a wind tunnel and observed the different responses of the two species. Finally, I determined what proportion of the moths or bees were able to locate the scent source by counting the number of individuals that flew upwind and landed on the artificial flower.