2021 Undergraduate Research Abstracts

Quantifying edge design in Sepia officinalis camouflage patterns

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To avoid detection or recognition by visual predators, cuttlefish change their mantle and edge body patterns in relation to the visual background. Our goal is to quantify and compare the edge designs used in mottle and disruptive body patterns. Mottle body patterns have medium-sized light and dark patches with moderate contrast between them. Disruptive body patterns show large light and dark patches of varying shapes and orientations with high contrast between them. We took high-resolution images of 10 cuttlefish on six natural substrates that varied in scale and contrast; these substrates were designed to elicit either a mottle or disruptive body pattern. Using MATLAB to analyze the images, we quantified (1) the texture of the mantle pattern compared to the background and (2) the specific pattern designs of the mantle edges used in mottle versus disruptive body patterns. We hypothesized that the mottle body pattern would have edge designs correlated with the adjacent background to enhance blending. Conversely, we predicted disruptive patterns to have edge designs with little correlation with the background, and that instead the edge designs would have high contrast and pattern irregularities. The expected results will provide insight into how cuttlefish disguise their body outline and orientation by altering segments of their edges with contrast, concavity, or convexity in relation to visual surroundings. This approach can help reveal principles of pattern and edge design used in cuttlefish and many other animals that use mottle and disruptive camouflage.

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Cell Intercalation and Follicular Elongation in Butterfly Eggs

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In Drosophila, follicle cells secrete a molecular corset that restricts elongation along an anterior-posterior axis, producing oblong eggs. Butterfly and moth (Lepidoptera) egg shape ranges from hemispheres to peaked obelisks, yet we do not understand whether the same mechanisms that shape Drosophila oocytes apply. Through robust live imaging techniques in the Painted Lady (Vanessa cardui) and Blue Morpho (Morpho peleides), we observed that follicle cell rotation does not occur in elongated butterfly eggs like it does in Drosophila. In elongated eggs of V. cardui, follicle cells surrounding the developing oocyte undergo intercalation organizing into pairs of columns with cells of each column pair weaving pa 1 36 188.2(e

conclude that the actomyosin network was contributing to the final oocyte shape and that similar principles of growth constriction act to orient growth to one direction on an anterior-posterior axis as are occurring in V. cardui. Sampling of more species will help us clearly understand how particular forces drive elongation and yield an overall greater

Using Nematostella, we tested the effect of exposure to different concentrations of these pollutants on the animals ability

were amputated mid body or below the pharynx and incubated in different concentrations of the chemical. Defects in the tentacles and various phenotypes have been observed in the higher concentration animals. Feeding assessments have been done in order to identify a difference in the behavior and cnidocyte staining to quantify the presence of cnidocytes in the treated and untreated animals.

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Acute Behavioral Responses to Partial Spinal Cord Transections in Lampreys

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Unlike most mammals, including humans, non-mammalian vertebrates are better equipped to recover from spinal cord injuries. For example, sea lampreys (Petromyzon marinus) are able to recover swimming and burrowing behaviors after a complete spinal cord transection by 10-12 weeks post injury. While the long-term neuroplasticity that supports functional recovery after spinal cord transections is somewhat understood, much less is known about the acute, short term neuroplasticity that occurs. This is especially true after partial transections. We therefore set out to determine how partia1 lesions of the spinal cord acutely impact locomotor function. We performed video imaging (60 fps) on 5 lampreys with medial spinal lesions and 5 lampreys with bilateral lesions at 60 before their respective injuries, and at 2, 24, 48, and 72

avior were analyzed using custom software written in R (trackter; https://cran.r-project.org/web/packages/trackter/index.html), followed by confirmation of the spinal lesion site using histological methods. Lampreys that underwent bilateral spinal cord les

Field study provides insight into arm flexibility: Octopus vulgaris uses multiple arm actions simultaneously to achieve complex behaviors.

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Characterizing the flexibility of octopus arms is of keen interest to researchers in biomechanics, neuroscience and soft robotics. While the morphology and arm deformations of octopus arms have been studied in laboratory experiments, the arm actions used to achieve such flexibility have yet to be studied comprehensively in freely-moving octopuses under natural field conditions. This study aims to quantify arm flexibility in naturally behaving octopuses by visually characterizing the arm ac

Ontogeny of auditory sensitivity and ranges in the little skate (Leucoraja Erinacea)

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Relatively little is known about elasmobranch auditory ranges and how auditory sensitivity changes with age. The little skate (Leucoraja erinacea) has become a model organism partly because it is easily raised from its egg case in the lab. Changes in auditory sensitivity of little skates post-hatching were examined while submerged using auditory evoked potentials (AEP). The most sensitive frequency range for the little skate was determined to be 100 to 300 Hz which is similar to findings in a previous study on adult little skates. Auditory sensitivity was detectable at 200 Hz the first week post-hatching and increased in sensitivity and frequency range during at least the first 4 week post-hatching. During the last stages of development in the egg case, skates beat their tail to aid in respiration. Therefore, to also assess auditory sensitivity, a behavioral assay of stage 32 or 33 skates was developed that examined tail beating rate in response to sound. Approximately 50% of embryos displayed noticeable cessation of tail beating when presented with sound. Behavioral results suggest that the auditory sensitivity of the embryo might be greater than that newly hatched skates which support the claim that behavioral experiments can be more sensitive than AEPs. This research provides groundwork for future studies examining the role hearing plays in skate predator-prey interactions or the impacts of anthropogenic sound.

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Mummichog Size Distribution in Creeks of a New England Salt Marsh

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TIDE project under James Nelson Ecosystems Lab

Mummichogs, or Fundulus heteroclitus, are small fish in the Killifish family that live primarily in marsh environments. Uniquely accustomed to harsh water fluctuations, Fundulus heteroclitus can be found in intertidal zones from Nova Scotia to Florida (reviewed in Petersen et al. 2010; Able, 2002). This project was conducted with mummichogs within three creeks of Plum Island, Massachusetts. Each creek has previously received different experimental levels of nutrient enrichment leading them to have differences in geomorphology. The three levels of creek enrichment include; not enriched until this year, short term enrichment, and long term enrichment. This has led to three varying levels of breakage in the high and low marsh; very little breakage, moderate breakage, and significant breakage, respectively (Nelson and others 2018). Previously, mummichogs in these varying creeks were studied to see if their stomach content and food web role were impacted by creek geomorphology. These findings showed that fish from the reference creek consumed more high marsh organisms than both other creeks, followed by the short term enrichment creek, and lastly the long term

safely swim to the high marsh and feed. While their food source differed, their caloric value ultimately did not (Nelson and others 2018).

For this project, Fundulus heteroclitus were sampled from each of these creeks and then weighed and measured to see where trends in these aspects may lie. Since the mummichogs in the reference creek have access to more than one energetic pathway, we can hypothesize that size and weight will be greatest in this creek, followed by the short-term enriched creek, and lastly, the long term enriched creek.

TIDE project

Neofunctionalization of Trypanothione Synthetase Amidase in the bdelloid Adineta vaga

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Bdelloid rotifers are a freshwater micro-invertebrate that can survive periods of desiccation, contract their body, and lose 95% of unbound water. As a result of desiccation, the rotifers DNA is broken. However, when they are reintroduced to water, they rehydrate, and transcription occurs, implying that RNA polymerase can still function. Trypanothione is a small antioxidant molecule unique to bdelloids and some protists, such as trypanosomes. Trypanothione may play a role in bdelloid desiccation resistance by preventing oxidative damage. The bdelloid genome contains four divergent pairs(eight copies) of Trypanothione Synthetase Amidase(TSA). TSA catalyzes four reactions to produce and break down trypanothione. We hypothesize that the copies of TSA are not identical in function and behave differently in various conditions. We compared the activity of the four copies of TSA in the bdelloid Adineta vaga with the single copy in Trypanosoma brucei (TryS), in different salts with varying concentrations. Some copies seem to be inactive at all concentrations for the forward reaction. Other copies of TSA respond differently to salt concentrations than TryS. Understanding the role of TSA in rotifers can provide key insights into evolution and function of genes responsible for DNA repair and protection from oxidative damage. In the future, we would like to create knockout rotifers for TSA and evaluate any impacts on their desiccation response and recovery.

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found that the presence of recombinant HaRVT improves growth of E. coli in the presence of iron and allows Herpetosiphon aurantiacus to grow in Fe2+ concentrations up to 1.0 mM. Additionally, the reverse transcriptase domain -coil domain.

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