

$\Delta^9$ -tetrahydrocannabinol (THC) reduces opioid withdrawal signs in rodents via CB<sub>1</sub> receptors. The endocannabinoids, anandamide (AEA) and 2-arachidonylglycerol (2-AG), also activate CB<sub>1</sub> receptors, but they are rapidly metabolized by their respective enzymes, fatty acid amide hydrolase (FAAH) and monoacylglycerol lipase (MAGL). Research from our laboratory suggests that acute administration of these catabolic enzyme inhibitors reduces naloxone-precipitated withdrawal signs in morphine-dependent mice. In the present study, we investigated whether the MAGL inhibitor JZL184 would retain its anti-withdrawal effects following repeated administration. ICR mice were implanted with 75 mg morphine pellets, and challenged 72 h later with the opioid receptor antagonist naloxone to precipitate withdrawal. The presence of somatic withdrawal signs such as jumps, front paw flutters, weight loss, and the occurrence of diarrhea were measured. As previously reported, acute treatment of THC (10mg/kg) significantly reduced the occurrence of jumps and diarrhea. Repeated treatment with high dose of JZL184 (40 mg/kg), but not the low dose (4 mg/kg), reduced all measured signs of opioid withdrawal. The results of the present study indicate that inhibitors of MAGL offer a promising target to treat opioid dependence.

LYSOPHOSPHATIDIC ACID UPREGULATES EXPRESSION OF PEROXISOME PROLIFERATOR-ACTIVATED RECEPTOR GAMMA IN OVARIAN CANCER CELLS. J.K. Ngwainmbi, A. Mukherjee & F. Fang, Department of Biochemistry and Molecular Biology, Virginia Commonwealth University, Richmond, VA 23298. Ovarian cancer is the fifth most common cancer among women in the United States and it is the leading cause of death among all gynecological cancers. Most early stage ovarian cancers are detected incidentally on routine pelvic examinations, and five year survival rates of over 90% can be achieved for localized disease. Lysophosphatidic acid (LPA), is a soluble phospholipid made up of a single fatty acyl chain, a glycerol back bone and a free phosphate group. It stimulates proliferation, survival, migration and invasion of ovarian tumor cells by acting on its cognate G protein-coupled receptors. Previous studies by others suggest that LPA binds and activates *peroxisome proliferator-activated receptor gamma* (PPAR $\gamma$ ), a nuclear transcription factor important in regulation of fat and energy metabolism. In the current study, we did not observe any evidence for direct interactions between LPA and PPAR $\gamma$  instead, we demonstrated that LPA induces the expression of PPAR $\gamma$  in ovarian cancer cells leading to an increase in its transcriptional activity. This work points to a novel mechanism for activation of PPAR $\gamma$  by LPA in mammalian cells.

### Natural History & Biodiversity

TWELVE YEARS LATER: ECOLOGICAL COMMUNITIES OF THE ABRAMS CREEK WETLANDS IN WINCHESTER AND FREDERICK COUNTY, VIRGINIA. Briana L. Barron, James E. Bisset, Linden E. Lewis, Daniel A. Milhon, Cory M. Miller, Benjamin S. Sawyer, Amy L. Smith, John V. Stevens & Woodward S. Bousquet, Environmental Studies Department, Shenandoah University,

Winchester VA 22601. Located in northwestern Virginia, the Abrams Creek Wetlands support 18 vascular plant species and two community types (calcareous muck fen, wet-mesic prairie) considered rare in the state. A 1998 study by Shenandoah University (SU) supplemented investigations by Virginia's Natural Heritage Program in documenting the property's ecological significance. In the spring and fall of 2010, SU researchers resurveyed three communities and studied one new community at this site. Using the relevé (Braun-Blanquet) method, community plots were described by their vegetation and physical characteristics. The new plot includes *Carex lasiocarpa*, which is listed as critically imperiled (S1) in Virginia. Percent similarity comparisons of the three resurveyed plots show substantial change (PS = 15.5%, 17%) in two but little change (93.8%) in the third since 1998. Recommendations for managing the Abrams Creek Wetlands include removing invasive species and minimizing future disturbances from the area's planned housing developments and walking-biking paths.

REPRODUCTIVE BEHAVIOR OF THE POTOMAC SCULPIN (*COTTUS GIRARDI*). Kimberly J. Bolyard, Dept. of Biology, Bridgewater College, Bridgewater, VA 22812. Potomac sculpin (*Cottus girardi*) fish from Dry River, Virginia were brought into the laboratory to study their reproductive behavior and to evaluate if these fish are subject to sexual selection pressures. Reproductively mature males vary in standard length. I tested the hypothesis that females should prefer to mate with larger males because they should be able to defend the nest and eggs from predators better than smaller males. Studies were conducted during the breeding season, February-March, 2010 and 2011. Observations were made of groups consisting of two males, one large and one small, and one female. Male reproductive behavior included pectoral fin waving and body shaking associated with darkening the body color. An actively courting male would approach the female and bite her in the head region while turning her towards his nest cavity. If she entered the nest, the male would rest on her while shaking intermittently. Occasionally, the male would leave the female to chase the other male away from the nest area. More females, six of seven, associated with or spawned with the larger of the two males. While not statistically significant, the observations suggest that female mate choice may play a role in the reproductive ecology of these fish. In addition, Potomac sculpins may be subject to male-male competition for nest sites and for females; hence, intrasexual selection will be the focus of future studies.

INVESTIGATION OF PRE- AND POST-ZYGOTIC REPRODUCTIVE BARRIERS BETWEEN TWO HOST-COMPLEX RACES OF A PARASITIC WASP. Justin P. Bredlau & Karen M. Kester, Dept. of Biology, Virginia Commonwealth University, Richmond VA 23284. Understanding the mechanisms of speciation and reproductive isolation has important implications for studies in biodiversity, evolution, and ecology. Insect parasitoids in particular display rapid speciation that may be associated with chemically diverse host plants. Investigations of host-associated differentiation of parasitoids have largely focused on the degree of molecular genetic differentiation, but a true test of species status must consider whether differentiated populations are capable of interbreeding and producing viable offspring. We examined possible mechanisms of isolation between two genetically

distinct (2% divergence in the mtDNA COI locus) host-plant complex races of the parasitoid, *Cotesia congregata* (Hymenoptera: Braconidae) originating from *Manduca sexta* on tobacco and *Ceratonia catalpae* on catalpa. We compared male responses to female pheromones, elements of male acoustic courtship signals, and mating success between the two groups. Males responded to female pheromones of either race and male courtship songs showed only subtle differences, suggesting that factors other than courtship behavior may be involved in pre-zygotic isolation of the two races. Wasps from the two sources mated and produced offspring; however, 90% of females from one hybrid cross failed to produce offspring, leading to post-zygotic isolation. Development time, emerged brood size, and sex ratios among the wasp races also differed. Results suggest that the two host-complex races represent distinct sibling species.

MOLECULAR AND MORPHOLOGICAL VARIATION IN THE BARNACLE PREDATOR *NEMERTOPSIS BIVITATA* (NEMERTEA, HOPLONEMERTEA). Serena A. Caplins<sup>1</sup>, Jon. L. Norenburg<sup>2</sup>, & Clint Turbeville<sup>1</sup>, <sup>1</sup>Dept. of Biol., Virginia Commonwealth University, Richmond Va. 23284, <sup>2</sup>National Museum of Natural History, Smithsonian Institution, Washington D.C. The nemertean worm *Nemertopsis bivittata*, is a member of the hard-bottom intertidal community, occurring along the coasts of Europe, Brazil, and the Southeastern United States. Our laboratory observations indicate that this nemertean is a suctorial feeder of barnacle crustaceans. Individuals of *N. bivittata* are typically pale yellow to whitish in color with a pair of dorsally-situated dark greenish brown pigment bands that extend nearly the entire length of the worm. In most individuals these stripes are separated anteriorly, but in some individuals they are fused anteriorly. Variation in stripe configuration has been considered to reflect intraspecific variation. We describe variation in stylet basis morphology and assess genetic variation, which may be correlated with stripe configuration. Sequences of the mitochondrial cytochrome-oxidase one gene (CO1, 500-650 bps) were obtained for 8 individuals exhibiting the anterior fusion of pigment bands and for 14 individuals without this feature. A pair-wise comparison revealed a 14.8% difference exists between the morphs. This lies within the range of variation observed between species in Hoplonemertea. A tree-based approach will be used to further test whether these morphs represent different species.

TADPOLE DENSITY CHANGES THE RELATIONSHIP OF RED-EYED TREEFROG MORPHOLOGY AND JUMPING PERFORMANCE. J.F. Charbonnier<sup>1</sup>, T. Landberg<sup>2</sup> & J. Vonesh<sup>1</sup>, <sup>1</sup>Department of Biology, Virginia Commonwealth University, Richmond VA 23298 and <sup>2</sup>Department of Biology, Boston University, Boston MA 02215. As organisms develop, increased body size is often accompanied by shape changes that alter the morphology-performance relationship. Animals with different growth histories may also have different shapes at similar body sizes. To investigate how larval growth history affects the morphology-performance relationship, we raised red-eyed treefrog tadpoles (*Agalychnis callidryas*) at three densities (5, 25 and 50 tadpoles per 400 L tank) and measured jump distance during metamorphosis. We predicted that tadpoles grown at low density would metamorphose into larger frogs with relatively longer legs than

those grown at higher densities. We also expected low density frogs to jump further – both absolutely, because of their larger body size and relative to their size if they had longer legs. Frogs from low density had longer snout-vent lengths (SVL) than those from medium and high densities and longer tibiafibula lengths and greater masses relative to their SVL. Jump distance was strongly correlated with tibiafibula length; however, there was a significant density\*tibiafibula interaction. While longer tibiafibulas in high and medium density frogs were correlated with longer jump distances, there was no such correlation in the frogs from low density tanks. We interpret these results as a consequence of the greater relative mass of the frogs from low density tanks. The relatively long legs of these frogs may not fully compensate for their disproportionately higher mass. This study demonstrates that different larval densities can change not only red-eyed treefrog morphology, but also the morphology–performance relationship. It suggests a trade-off where low larval density can increase body size and presumably fat reserves, but the latter may decrease jumping performance.

FLEAS (SIPHONAPTERA) FROM A SMALL MAMMAL COMMUNITY IN A GUATEMALAN CLOUD FOREST. R. P. Eckerlin<sup>1</sup>, W. Bulmer<sup>1</sup>, H. Lanier<sup>2</sup>, J. O. Matson<sup>3</sup> & N. Woodman<sup>4</sup>, <sup>1</sup>Natural Sciences Div., Northern Virginia Community College, Annandale, VA 22003, <sup>2</sup>Dept. Biological Science, University of Alaska-Fairbanks, AK 99775, <sup>3</sup>Dept. of Biological Sciences, San Jose State University, San Jose, CA, 95192, <sup>4</sup>USGS Patuxent Wildlife Research Center, U.S. National Museum, Smithsonian Institution, P.O.Box 37012, Washington, DC 20013. The flea fauna of a mammal community at a specific site has never been recorded for Guatemala. We collected 104 small mammals (6 spp. shrews & rodents) and 323 fleas from remnant cloud forest at 2950-3160m in El Retiro, Huehuetenango, Guatemala. Fleas were brushed off the hosts, preserved in alcohol and later mounted on slides for identification. *Plusaetis vermiformis*, previously known from a single specimen in Guatemala, was the most common flea but found only on *Peromyscus beatae* and *P. guatemalensis*. An undescribed species of *Ctenophthalmus* was present on *Sorex saussurei*. *Plusaetis mathesoni*, found on several rodent host species, is a new country record for Guatemala. A single specimen of an *Atyphloceras* sp. from *P. beatae* extends the range of this genus south of central Mexico. Other species present on rodents were *Ctenophthalmus sanborni*, *Baculomeris schmidtii*, *Kohlsia osgoodi*, *Jellisonia painteri*, and *Strepsylla* sp. Most of the 3 species of *Reithrodontomys* that we examined had no fleas. Although the mammal diversity was judged to be low the flea fauna was robust and diverse.

TROPHIC DYNAMICS OF CHESAPEAKE BAY PLANKTON. Todd A. Egerton, Matthew R. Semcheski & Harold G. Marshall, Department of Biological Sciences, Old Dominion University, Norfolk VA 23529. Examining the relationship between diversity and ecosystem processes has become an important topic in ecology given the increased rate of species extinctions. Previous work has shown that stations in lower Chesapeake Bay with increased nutrient concentrations have higher productivity and algal abundances but lower phytoplankton diversity. However, the potential effect of algal diversity on higher trophic levels has not been examined. Using a 16 year dataset (1986-2001) of phytoplankton and zooplankton community

composition, water quality parameters, and commercial fisheries landings, several relationships were identified. Zooplankton diversity is positively correlated with phytoplankton diversity and negatively correlated with total phytoplankton abundance. Long-term trend analysis indicates a significant decline in zooplankton abundances, as well as a significant negative correlation between total nitrogen concentrations and zooplankton species richness. Furthermore, there has been a significant decline in the average annual landing of Virginia commercial fisheries. Fishing yield is positively correlated with zooplankton abundance and negatively correlated with algal productivity. This suggests that bottom up factors are driving the system, where increased nutrient levels lead to more productive less diverse algal communities capable of supporting fewer, less diverse grazers and an overall decline in fish populations. Supported by VADEQ.

EFFECT OF PHOTOPERIOD ON IMMATURE DEVELOPMENT IN THE TIGER MOSQUITO, *Aedes albopictus*. Allen Frisa & Deborah Waller, Dept. of Biol., Old Dominion Univ., Norfolk, VA 23529. Tiger mosquitoes are active from spring through fall and overwinter in the egg stage. We examined whether mosquito development varied depending on the photoperiod the immatures experienced. Late-instar larvae were collected from an incubator with a summertime photoperiod (16L:8D), placed in individual cups with 20 ml deionized water and fish food, and incubated in the following photoperiods: constant dark (DD), spring/fall (12L:12D), summer (16L:8D), reverse summer (8D:16L) and constant light (LL). There were ten replicates per photoperiod. Time from pupal formation to adult eclosion was recorded along with the gender of the adults. Under constant temperatures with a mean of 26°C, pupal durations were 2-3 days for both male and female with no differences related to photoperiod. In a second experiment in which spring/fall and constant light incubators were kept at a mean of 23°C, pupal durations were 3-4 days for both males and females. Therefore temperature influenced developmental rates but there was no influence of photoperiod on pupal duration.

A SURVEY OF MUSKRAT INTESTINAL PARASITES IN VIRGINIA. Jeronimo G. Da Silva Neto, Elizabeth R. Hepner, Allison E. Salinger, Emily A. Kimminau & Lisa K. Belden, Department of Biological Sciences, Virginia Tech, Blacksburg, VA 24061. Infectious diseases of humans and wildlife have increased dramatically in recent decades. These diseases can have important impacts on global health, agriculture and biodiversity. Despite these increases, we still know relatively little about disease in natural wildlife populations. In many cases, we lack even basic information about what parasites and pathogens are present in wildlife species. This prompted us to conduct a survey on local populations of muskrats, a common semi-aquatic rodent found in the United States. We conducted necropsies on donated muskrat carcasses collected from across Virginia, and began to establish a baseline database on parasites of muskrats, with a focus on the macroparasitic worms in the gastrointestinal tract (stomach, small intestine, large intestine and cecum). Since 2008, we have necropsied over 100 individuals. Three genera of parasitic flatworms (trematodes) dominated the samples – *Echinostoma*, *Quinqueserialis* and *Wardius*. As these parasites have complex life cycles involving multiple hosts in addition to muskrats, we can potentially use the presence of these parasites to infer

something about the ecological communities of the sites at which the muskrats were collected. We have also completed some analyses regarding the distribution of the parasites among hosts. We have not seen any significant relationship between total worm burden and either sex or mass of the host. Our research provides an important baseline for understanding parasite dynamics in natural muskrat populations. This allows a better understanding of potentially emerging diseases and can improve how we manage wildlife disease.

ALLEGHENY WOODRATS (*NEOTOMA MAGISTER*) IN VIRGINIA: COMPARISONS OF OCCUPANCY OVER TIME. Jennifer M. Kanine, Michael T. Mengak & Steven B. Castleberry, Warnell School of Forestry and Natural Resources, University of Georgia, Athens, Georgia 30602. The Allegheny woodrat (*Neotoma magister*) is a cryptic small mammal that occupies rocky outcrop and cave habitats throughout the Appalachian Mountains. Populations have been documented as declining throughout much of its historic range. Population declines have been attributed to a suite of effects occurring in the habitat including interactions with raccoon roundworms, loss of American chestnut, habitat reduction, and fragmentation. We surveyed 232 sites in Virginia in 2008-10 for woodrat occupancy and compared our results to results of surveys conducted from 1990-1999 to assess changes in woodrat occupancy over time. We also examined if our trapping protocol was adequate to determine occupancy through a combination of extending the number of nights trapped and through the use of remote cameras. Naïve occupancy during the 1990s was 67%, while only 49% of sites were occupied from 2000-2010. Woodrat populations exist as metapopulations, where sites consist of spatially separated populations that interact. Metapopulations systems have some groups that may be extirpated in some years which are followed by re-colonization in subsequent years. We have documented 38% of our sites having variable occupancy over time. Results of our camera surveys indicate that our current monitoring protocol is effective at determining occupancy 85% of the time.

A SKULL OF THE EXTINCT RIGHT WHALE *BALAENULA* FROM THE LATE PLIOCENE OF NORTH CAROLINA. Laura Kellam, Alton C. Dooley, Jr., & Vince Schneider. Roanoke College, Salem, VA 24153, Virginia Museum of Natural History, Martinsville, VA 24112, North Carolina Museum of Natural Science, Raleigh, NC 27601. A nearly complete balaenid skull was collected in May 2008 from the Bear Bluff Formation in Lake Waccamaw, North Carolina. The cranium as preserved is 165 cm in length. The tight closure of most of the cranial sutures suggests that this was a mature animal at the time of death. It has extreme telescoping, arched rostral bones, dorsoventrally compressed tympanic bullae, and the dentary has an anterior torsion and lacks a distinct coronoid process, all features that are typical of balaenids. Features shared with the genus *Balaenula* include: 1) small overall size; 2) large, block-like nasals; 3) approximately right angle between posterior and anterior processes of the petrosal; 4) anteriorly oriented squamosal; 5) right angle formed between supraorbital processes of frontals when viewed anteriorly. However, it differs from *B. astensis* from Italy and *B. balaenopsis* from Belgium in a number of characters. This is the first report of *Balaenula* from the Bear Bluff Formation, which has an approximate age of 2.75 Ma. All other reported specimens of *Balaenula* from

the western Atlantic are from the lower Yorktown Formation, with an approximate age of 4.5 Ma. *Balaenula balaenopsis* from Belgium and undescribed *Balaenula* specimens from Japan and California are Pliocene in age, but their ages are poorly constrained, while *B. astensis* from Italy has an approximate age of 3.5 Ma. The Lake Waccamaw specimen is thus possibly the youngest known occurrence of *Balaenula*.

**PRIMARY FEATHER PIGMENTATION IS CONSTRAINED BY FUNCTIONAL NECESSITY.** Joshua D. Kreitzer & Lisa Horth Dept. of Biology, Old Dominion University, Norfolk, VA 23529. Primary feathers are critical for powered flight. High exposure of these feathers to the wind and associated abrasive particles necessitates that they be strong relative to other, less exposed feathers. The black pigment, melanin, has been associated with increased feather strength via an increase in keratin thickness near the melanin and via the added strength provided by the melanin granules themselves. Furthermore, melanin provides protection from the damaging affects of ultraviolet radiation in comparison to paler feathers. We tested the hypothesis that primary feathers would be more frequently pigmented with melanin than a flight-neutral feather patch, the upper back. A survey of 4006 species of non-passerine and 1823 species of passerine birds showed that 63.4% had black in the primaries, 35.4% had other color as the darkest color, and 1.2% had wholly white primaries. The upper back feathers showed a different pattern, with 29.0% of species having black, 69.2% having other, and 2.0% having white. Chi-square analysis showed that the pigmentation of the primary feathers was significantly different from the expected color distribution of the more flight-neutral upper back feathers ( $p$ -value <0.0001). These results may be understood as evidence supporting the hypothesis that primaries are more constrained to be black than the upper back feathers.

**RESPONSE OF IMMATURE MOSQUITOES TO PREDATOR PRESENCE.** Jackie McKee & Deborah Waller, Dept. of Biol., Old Dominion Univ., Norfolk, VA 23529. Mosquito immatures are consumed by a variety of aquatic predators. We tested responses of mosquito larvae and pupae to the presence of dragonfly nymphs, backswimmers and whirligig beetles in the laboratory. Experimental units consisted of 14 cm diam petri dishes with a grid of 2 cm diam squares etched on the bottom. Petri dishes were filled with 80 ml deionized water and set in sleeves that were either black, white or half black/half white. Previous experiments demonstrated that first instar larvae prefer white backgrounds, later instars show no preference, and pupae prefer black backgrounds, and mosquito activity declines with age. A predator was placed in the petri dish and then either a larva or pupa was introduced to the center of the dish. Positions of both the mosquito and the predator were noted every 30 seconds for five minutes. Five different mosquitoes were tested in each experiment. Predators were replaced with a new predator of the same species if it consumed the mosquito. All three predator species ate mosquito larvae and pupae on occasion. There was no response by mosquito immatures to predator presence. Larvae were more active than pupae and pupae moved less frequently on black than on white backgrounds. These patterns are similar to mosquito behavior in the absence of predators, where larvae move frequently to find food and the non-feeding pupal stage seeks out dark areas.

HIGH SPEED EXAMINATION OF PECTORAL STRIDULATION SOUND GENERATION IN BLUE CATFISH *ICTALURUS FURCATUS*. Y. J. Mohajer, M. L. Fine & Z. N. Ghahramani, Department of Biology, Virginia Commonwealth University, Richmond VA 23284-2012. The blue catfish *Ictalurus furcatus* is an invasive species whose population numbers have exploded in Chesapeake Bay estuaries. Catfishes produce stridulation sounds by rubbing ridges on the dorsal process of the pectoral spine against a rough surface on the cleithrum to produce a series of pulses during abduction. We studied the mechanism of sound generation by synchronizing audio recordings with a high speed camera at 2000 frames per second. Unlike channel catfish that typically keep their pectoral fins retracted (adducted), blue catfish tend to maintain them in a forward position. Therefore sound production requires the fish to adduct the spine before forward stridulatory movement. Adduction movements were about a third as long as abductions (means of 49 and 152 ms respectively). The amplitude of abduction and adduction movements was similar at 25.9 and 26.5 degrees. Stridulatory abductions consisted of a series of 3-17 short rapid movements (median of 13) with an average rotation of 3.1 degree over 1.5 ms. Movement was followed by an interpulse period of 13.2 ms in which the spine was stationary. Sound amplitude was low during movement and increased during the stationary period suggesting time was required to activate vibrations in the pectoral girdle. Sounds are produced by a slip-stick mechanism similar to a bow over a violin string.

SYSTEMATIC REVISION OF THE NORTHERN SHORT-TAILED SHREW, *BLARINA BREVICAUDA* (SAY). N. D. Moncrief<sup>1</sup>, Wm. D. Webster<sup>2</sup>, J. R. Choate<sup>3</sup> (deceased) & H. H. Genoways<sup>4</sup>, <sup>1</sup>VA Museum of Natural History, Martinsville, VA 24112, <sup>2</sup>Dept. Biology, Univ. of North Carolina Wilmington, Wilmington, NC, 28403, <sup>3</sup>Sternberg Museum of Natural History, Fort Hays State University, Hays, KS 67601, and <sup>4</sup>University of Nebraska State Museum, Lincoln, NE 68588. The northern short-tailed shrew, *Blarina brevicauda* (Say, 1823) occurs from southern Canada southward to the central Great Plains, in the Appalachian Mountains south to Georgia and Alabama, and along the East Coast as far south as southeastern North Carolina. We analyzed 9 cranial and mandibular measurements of 2,736 specimens using a single classification ANOVA and a principal component analysis. We conclude that *B. brevicauda* consists of 7 well-defined subspecies. Two subspecies (*B. b. brevicauda* and *B. b. talpoides*) occupy almost the entire geographic range of the species. The other 5 subspecies (including 3 that were previously undescribed) occupy small-to-modest geographic ranges at the periphery of the species' range and in isolated geographic areas. We recognize these 7 subspecies because we believe that each has begun to follow its own evolutionary path. Mitochondrial DNA data and our morphological data indicate that most or all of the peripheral subspecies are derived from *B. b. talpoides*. These data also indicate that *B. b. brevicauda* and *B. b. talpoides* are semi-species.

A COMPARISON OF TOOTH BREAKAGE RATES IN MIOCENE CARCHARHINIFORM SHARKS FROM THE CARMEL CHURCH QUARRY, CAROLINE COUNTY, VIRGINIA. Brandi Neifert, Roanoke College, Salem, VA 24153 & Alton C. Dooley, Jr., Virginia Museum of Natural History, Martinsville, VA

24112. Excavation of marine sediments of the middle Miocene Calvert Formation at the Carmel Church Quarry has resulted in the collection of thousands of shark and ray teeth. Unlike most large collections of shark teeth, the Carmel Church specimens were all collected in situ from a single bed with a maximum thickness of less than 1 m. While the majority of teeth from Carmel Church represent clearly reworked specimens, a substantial portion show no evidence of reworking and provide a sample that may represent the local population of sharks over a relatively short period of time. Multiple shark taxa with similar tooth morphologies and body sizes may have coexisted through niche partitioning. This could have been achieved through behavioral variations such as temporal segregation (diurnal or nocturnal habits, or seasonal movements) or through variations in dietary preferences. In order to test for evidence of variation in dietary preferences, tooth breakage frequency and height-thickness ratios were examined in four shark genera that are broadly similar to each other in size and tooth morphology – *Hemipristis*, *Galeocerdo*, *Physogaleus* and *Carcharhinus*. Preliminary results show similar overall breakage rates among the four genera, but a higher rate of catastrophic breakage in *Carcharhinus* and *Galeocerdo*.

MODELING THE PERSISTENCE OF RARE GENOTYPE IN NATURE. Iordanka N. Panayotova, Department of Mathematics and Statistics & Lisa Horth, Department of Biological Sciences, Old Dominion University, Norfolk, VA 23529. Major theoretical constructs explaining the maintenance of rare genotypes include mutation-selection balance and balancing selection. Empirical work demonstrates that mutations arise on the order of  $\sim 10^{-6}$ /gene/generation ( $\pm$  an order of magnitude contingent upon data used). Thus, novel mutants that arise from one or two single nucleotide polymorphisms and that persist at a frequency exceeding the mutation rate (by three or four orders of magnitude) are not trivially explained by mutation-selection balance and are extremely understudied. Empirical demonstrations of negative frequency dependent selection tend to only address the maintenance of polymorphisms that oscillate around a frequency far in excess of  $\sim 10^{-2}$ . Thus, what maintains the rare genotypes that persist at frequencies of  $10^{-2}$ - $10^{-4}$ ? Here, we present a model that incorporates empirical life-history data on mosquitofish from 15 years of field-work. Our model simulates the maintenance of a stable polymorphism where the rare genotype persists at a frequency of  $\sim 10^{-2}$  (the actual frequency of the melanic pigmented genotype in nature). Our results present a novel and intriguing find by providing a robust mechanism for the maintenance of a rare (but not too rare) genotype in a stable polymorphism.

POPULATION GENETICS OF TUNDRA (*CYGNUS COLUMBIANUS COLUMBIANUS*) AND TRUMPETER (*CYGNUS BUCCINATOR*) SWANS: THE IMPACT OF CLIMATE CHANGE ON THE BREAKDOWN OF PRE-ZYGOTIC ISOLATING MECHANISMS. Lauren E Wilson, Department of Environmental Science and Policy, George Mason Univ., Fairfax, VA 220304444. The Tundra (*Cygnus columbianus columbianus*) and Trumpeter (*C. buccinator*) Swans are two migratory swan species with significant breeding populations in Alaska. Historically, breeding ranges have remained sympatric; the Trumpeter nests on boreal forest wetlands while the Tundra nests near tundra wetlands. However,

increased population size of both species and expansion of the boreal forest, a likely result of global climate change, have caused areas of geographic overlap to occur. The Trumpeter and Tundra Swans are known to be reproductively compatible, as a viable hybrid population exists in Virginia at the Airlie Center's Swan Research Program (SRP). Further, accounts from local wildlife managers indicate the presence of fertile hybrids in overlapping breeding areas in Alaska. This research seeks to confirm the presence of viable wild hybrids and to elucidate the genetic structure and relatedness of these interbreeding populations by comparison of phylogenetically relevant genetic loci of wild individuals to known hybrids from the SRP. We will also incorporate "historic" samples collected in 1920 (and prior) to confirm that this interbreeding is a recent phenomenon and likely due to habitat disturbance from climate change.

EFFECTS OF PREDATION, COMPETITION, AND ISOLATION ON THE RATE OF SHELL SELECTION IN THE HERMIT CRAB *PAGURUS LONGICARPUS*. Amber L. King & Deirdre Gonsalves-Jackson, Biology Department, Virginia Wesleyan College. Hermit crabs are most notably known for their use of gastropod shells to protect their soft bodies, which lack calcification on their abdominal exoskeleton. Because of the necessity for a gastropod shell, hermit crabs will often fight amongst each other for shells due to the scarcity of available shells because without a shell to provide adequate protection, they risk exposure. *Pagurus longicarpus* was used in this study to determine the effect of various factors on the rate of shell switching, specifically the effect of isolation, conspecifics, and predation. It was proposed that more hermit crabs would switch shells and the rate of shell switching would increase when isolated, rather than when in the presence of conspecifics or a predator. Three different treatments were set up and based on the results, the two hypotheses were supported because more hermit crabs switched shells and at a faster rate in the isolation treatment, rather than in the other two treatments, suggesting that predation may have posed as significant a threat in my study because the hermit crabs failed to switch shells.

## Psychology

SEX ANXIETY AND SEX GUILT FROM 1980 TO 2010. Yang Deng & Louis H. Janda, Department of Psychology, Old Dominion University, Norfolk VA, 23529. The present study examined perception of social desirability regarding sex anxiety, perceived norms regarding sex guilt, and attitude changes in sex anxiety and sex guilt over the past 30 years. Undergraduate students completed the Sex Anxiety Inventory (SAI) honestly, attempting to present a favorable impression and attempting to present an unfavorable impression. They also completed the sex guilt subscale of Mosher Forced-Choice Guilt Inventory (MFCGI) by describing their own feelings and estimating their same-sex peer responses. Both sex anxiety scores and sex guilt scores were compared among different instructions. The self-descriptive scores on sex anxiety and sex guilt were compared with those in 1979/1980. The results indicated that the favorable-impression scores on sex anxiety were significantly higher than the unfavorable-impression scores and the self-descriptive scores; the