EEOB NSF-DDIG Grant Recipients

Recipient	Award Year	Project Summary
Ryan Rapp	2007	Macroevolutionary change has long fascinated biologists as they have sought to understand the evolutionary transitions from plant leaf to petal, tetrapod arm to whale fin, and hundreds of other alterations between homologous structures. This proposal addresses a fundamental aspect of macroevolution, namely, how selection alters developmental allometry. In the specific case described, the transformation is from an unremarkable single-celled trichome to one of the most exaggerated cells in plants. The research seeks to discover evolutionary changes at the expression level between wild (short) and domesticated (long) cotton (Gossypium) fibers. To accomplish this, key time points during fiber development will be used to compare wild to domesticated forms in several separate domesticated species, identifying the key expression shifts as detected by microarray analysis (using chips designed to detect 22,000 putative genes). In addition, the genetic component of evolutionary change will be explored to reveal the nature of the 60% increase in DNA content that occurs during the first week of fiber development. Finally, the dissertation research will determine, for the first time, rates of gene loss at the diploid and polyploid levels in a phylogenetically well-characterized system.
Amanda Sparkman	2007	The research I propose here will test for endocrinological mechanisms underlying intraspecific evolution of life history traits. Specifically, I will examine how two ecotypes of the garter snake Thamnophis elegans, which derive from the same ancestral source population, have evolved genetically divergent life history characteristics. Snakes from replicate meadow populations exhibit slower growth rates, lower annual reproductive output, and longer median lifespans relative to their lakeshore counterparts. Hormones are well-known for their role in determining rates of growth, reproduction, and aging, and insulin-like growth factor-1 (IGF-1) is a hormone pivotally involved in all these traits – it has widely been shown to promote growth and reproduction, and has also been implicated in shortening lifespan. IGF-1 is also capable of responding plastically to environmental conditions such as resource availability and temperature. Therefore, theory predicts that pleiotropic control of life history traits by IGF-1 could provide a mechanism for the correlated evolution of life history traits upon dispersal into a novel environment. I hypothesize a differentiation in the IGF-1 system that could account for increased growth and reproduction and reduced survival in lakeshore versus meadow ecotypes. I will test this hypothesis by examining multiple levels of the IGF-1 system (ligand, binding proteins, receptor, and downstream rate-of-aging protein p66kk) in free-ranging snakes and through common garden and reciprocal transplant experiments, so that age-specific, environmental and genetic effects can be distinguished. This research will shed light on the physiological mechanisms between the levels of the genes and the whole-organism phenotype that may mediate evolutionary change among populations, and restrict it to certain trajectories. Furthermore, this research will significantly contribute to our knowledge of ectotherm ecology, life history, and population dynamics crucial for successful management of natural populations, and will increase our understanding of the physiological and genetic determinants of longevity relevant to concerns of human aging and health.
Erin Myers	2005	I propose to study speciation, reinforcement, and courtship in one of the most speciose clades of turtles (genus: *Graptemys*). Phenotypic variation in the post-orbital color pattern has played an important role in the phylogenetic history of the clade and is thought to be a key element in species identification and mate choice. I will examine current inter- and intraspecific interactions and post-orbital color pattern variation for three species of map turtles that are known to occur both in sympatry and allopatry with occasional hybridization events. I will examine the interplay of genetics, morphology, and behavior, particularly as they relate to speciation and reproductive isolation through reinforcement, reproductive character displacement, and mate choice. The broader goals of this project are 1) to determine the phylogenetic relationships in the genus Graptemys, 2) to identify the role of post-orbital color pattern in species identification and courtship, and 3) to determine the extent to which post-orbital color pattern has played a role in the radiation of the genus and in maintaining pre-zygotic reproductive isolation. These goals will be addressed using an integrative, multi-faceted study combining field and laboratory methods to generate a stronger, broader understanding of speciation and hybridization.

Mark Haussmann	2004	In this proposal I hypothesize that one potential mechanism underlying adaptive variation in species maximum lifespan is regulation of telomere dynamics. Telomeres cap the end of all eukaryotic chromosomes and shorten with each cell division. Once telomeres shorten to a critical length, cells enter replicative senescence, which has been suggested as a causal agent of aging and age-related diseases. In my dissertation work, I have shown that species with longer lifespans lose telomeric repeats slower than species with shorter lifespans. This suggests that selection may adjust the rate at which telomeres shorten to modify lifespan. In this proposal I develop a phylogenetically-controlled comparative analysis to determine whether telomere regulation has jointly evolved with species maximum lifespan and could thereby act as a molecular mechanism to adjust lifespan. This work investigates the link between telomere dynamics and longevity in 17 species of birds that vary in maximum lifespan from 5 to 44 years. This project will not only offer valuable insight into the evolution of mechanisms that influence lifespan but also depends on large-scale collaboration between many scientists and allows for undergraduate and graduate training.
Chris Olson	2003	Birds incubating eggs must allocate time between maintaining egg temperatures required for embryonic growth and spending time foraging for food. It has long been known that the range of thermal conditions for eggs to hatch successfully is narrow. However, the eggs of many small songbirds frequently undergo wide thermal fluctuations when the adults leave their nests to forage, and yet the eggs hatch successfully. Birds vary in their incubation behaviors. In some species both parents incubate and eggs seldom cool. In other species only the female incubates, resulting in episodic cooling of the eggs when the female leaves the nest to forage. This suggests that some avian embryos have evolved thermal tolerance, that is, they are able to survive episodes of cooling and still maintain normal growth. This study's general goal is to describe the relationship between the thermal profile of the eggs and the incubation strategy of the incubating adult. It will incorporate two experiments carried out in the lab on the physiological and developmental responses of embryos to episodic cooling and one field experiment. 1. Metabolism of zebra finch (*Taeniopygia guttata*) eggs will be examined during simulated cooling and rewarming bouts to define the embryonic metabolic response to different degrees of episodic cooling. 2. The phenotypic and survival consequences of episodic cooling throughout development will be examined. This knowledge will then be extended to the field to study constraints and limitations that both adult and embryonic birds endure. 3. Cooling rates of house wren (*Troglodytes aedon*) eggs will be increased or decreased and adult response monitored. When cooling rates are increased, adults are predicted to compensate by shifting to behaviors that benefit the eggs, mainly spending increased time on the nest. However, when cooling rates are decreased, adults should spend more searching for food. Combining the results of these three experiments will aid in understanding how egg thermal physiology places limits on adult incubation behavior and breeding biology.

If you would like further information, or wish to view full grant applications, please contact Jacki Hayes at jrhayes@iastate.edu