What Are Some URSA Supported Projects from the *College of Science, Engineering and Technology*?

"Morphological Plasticity: A Comparative Study of Leaf Traits Between Exotic Honeysuckle (Lonicera japonica) *and its Native Congener* (Lonicera sempervirens)*"*

Zachary Brian, Courtney Harris, and Kelly Harris—Biological Sciences
Dr. Kate He—Faculty Mentor

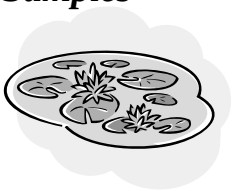
To understand what types of biophysical traits make a successful invader, we conducted a comparative trait-based study to identify leaf-level traits associated with a successful invasive species. We compared leaf traits of exotic invasive (Lonicera japonica) and native (Lonicera sempervirens) honeysuckle species to test the hypothesis that invasive honeysuckle outperforms its native congener owing to its possession of a suite of advantageous leaf traits. The examined traits included leaf biomass, specific leaf area, leaf thickness, stomatal length and density, main leaf vascular bundle size, proportion of photosynthetic tissues, and leaf nitrogen and carbon contents on mass basis. The resultsof multivariate analysis of variance (MANOVA) indicated that significant differences existed in traits directly related to plant photosynthetic capacity or carbon gain between the two species. Specifically, higher carbon gain, larger proportion of photosynthetic tissues, thicker leaves, larger stomatal size, higher stomatal density, and larger leaf vascular tissues were associated with the exotic species. Larger leaf area and higher nitrogen content on mass basis were found in the native species. Our results reveal that the leaves of the invasive honeysuckle are morphologically optimized for a higher CO2 gas exchange and faster carbon gain. Furthermore, the lower nitrogen content found in the invasive honeysuckle leaves characterizes the invader with a high nitrogen use efficiency, which enhances its growth potential. We conclude that the combination of advantageous leaf traits enable the exotic honeysuckle to be more plastic and successful compared to its native counterpart in the invaded ecosystems.

"Immunocytochemical Distribution of H-K-ATPase Beta-subunit in the Hyperglycemic Mice"

Adam Duley, Zac Elmore, Mikel Headford, Christopher Muncie,
and Nathaniel Phelps—Biomedical Sciences
Dr. Suguru Nakamura—Faculty Mentor

Two proton pumps, H-K-ATPase (HKA) and H-ATPase play an important role in acid-base balance in the kidney. Three H-K-ATPase subunits (HKAalpha1, HKAalpha2, HKAbeta) are expressed in the collecting duct. The beta-subunit is essential for the functional expression of both the HKAalpha1 and HKAalpha2. It has been reported that the HKAalpha1 (gastric) antibody level is increased in type 1 diabetic patients. Glucose stimulates H-ATPase and H-K-ATPase activities and has been demonstrated in the kidney cells. We examined whether hyperglycemia stimulates the HKA beta-subunit in the outer medullary collecting duct (OMCD) in the mouse kidney.The hyperglycemia was induced by an intraperitoneal injection of streptozotocin (65 mg/kg) and monitored for 5 days. The OMCD tubules were dissected and placed on the center of PLL-coated cover glass and covered with a phosphate buffered saline (PBS). The OMCDs were fixed in 4% paraformaldehyde, permeabilized with 0.5% Triton X-100, incubated with a specific monoclonal antibody (HKA beta-subunit, 34 kDa) and stained with FITC-conjugated antibody. In the normal mice OMCDs, the intercalated cells demonstrated the immunocytochemical distribution on HKA that was mainly polarized to apical pole and slightly polarized to basolateral pole. In the hyperglycemic mice OMCDs, there was a diffusely distributed staining throughout the cells. Results suggested that the HKA beta-subunit is stimulated by hyperglycemia in the renal OMCDs. The HKA beta-subunit is likely to associate with the HKAalpha1 and HKAalpha2 under normal and hyperglycemic conditions.

"Atrazine Levels in Water, Sediment and Amphibian Tissue Samples from Selected Ponds in Westernmost Kentucky"



Kimberly Dunlap—Chemistry
Dr. Bommanna Loganathan—Faculty Mentor

Atrazine (2-chloro-4-ethylaminio-6-isopropylamino-1,3,5-triazin) is the main herbicide used in Kentucky (approximately 1 million pounds annually), primarily on corn crops. Widespread use of atrazine causes environmental contamination. Exposure of atrazine causes endocrine disruption leading to harmful effects in aquatic organisms including reproductive toxicity and immunotoxicity. However, very little is known on the levels of atrazine contamination in regional ponds and the amphibians inhabiting the ponds. The objective of this study is to determine the levels of atrazine compounds present in water, sediment, and amphibian tissue and explain the distribution, environmental transformation and fate of atrazine in ponds in Western Kentucky. Ten sampling sites were selected including: Terrapin Creek, Terrapin Ditch, CLBL, Golden Pond (LBL), Elk and Bison pond, LBL-142, Starcamp, LBL Powerline Pond, LBL-Cedar Skunk and Grand Rivers pond were sampled for water, sediment, and amphibians (frogs and salamanders). Atrazine analyses were done using RaPID Assay Atrazine Test Kit. Results reveal that triazine concentrations in water samples ranged from below detention limit to 0.4 ppb. All of the sediment samples from the ponds showed the concentrations below the detection limit.

"Synthesis and Electro-Optical Characterization of Conjugated Oligomers for Use in Organic Solar Cells"

Broadus Fitzhugh—Chemistry
Dr. Kevin Revell—Faculty Mentor

The project involved the synthesis and electro-optical characterization of conjugated oligomers to be used in organic solar cells. The process involved piecing together certain monomer subunits in a "mix & match" manner in order to produce an optimum energy bandgap that will allow for efficient charge mobility and transport. This "mix & match" approach allows for accurate size control and great variability. Synthesis of the monomer units involves functionalization of 3,4-dihydroxybenzaldehyde, followed by condensation chemistry of multiple methods. This project had broad implications in that the organic solar cells to be produced are efficient and of relative low cost, reducing dependency on fossil fuels. It was the goal to optimize the bandgaps to have the ability to catalyze the photolysis of water to produce hydrogen as a form of energy.

"Genetic Analysis of Germline Development and Nuclear Division in the Fruit Fly **Drosophila"**

Christina Jackson, Andrew Mattmiller, Derek Nance, Keely Netz,
and Kevin Witbrodt—Biological Sciences and Chemistry
Dr. Alexey Arkov—Faculty Mentor

Many genes in the fruit fly Drosophila are very similar to human genes. Therefore, this study of genetics and cell biology of Drosophila helped to understand genetic and cellular mechanisms in humans. Our study focused on development of germ cells and nuclear division and migration in Drosophila embryos. Germ cells form early during embryogenesis and eventually give rise to sperm and egg. Therefore, germ cells are the ultimate stem cells responsible for generation of entire organism. In order to identify new genes required for germ cell formation we performed a large genetic screen and searched for mutants that show defects during germ cell development. As a result of this screen, we identified several groups of mutations that affect novel genes. Some mutations directly influenced germ cell formation and other mutants failed to form germs cells because of defects in nuclear division and migration of the nuclei to the embryonic site where germ cells form. We went through a process of characterizing these mutants and reporting the results. In addition, we identified the primary metabolic pathways utilized by germ cells for energy production. Understanding the genetic mechanisms of germ cell development and nuclear division may shed light on the biological causes of human disorders such as infertility and cancer.