Work Task C5: Effects of Abiotic Factors on Insect Populations in Riparian Restoration Sites

FY10 Estimates	FY10 Actual	Cumulative Accomplishment Through FY10	FY11 Approved Estimate	FY12 Proposed Estimate	FY13 Proposed Estimate	FY14 Proposed Estimate
$90,000	$97,189.14	$319,599.06	$90,000	$90,000	$90,000	$90,000

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Start Date: FY06

Expected Duration: FY14

Long-term Goal: Species research.

Conservation Measures: WIFL1, WIFL2, YBCU1, YBCU2, GIFL1, GIWO1, VEFL1, BEVI1, YWAR1, SUTA1, WRBA2, WYBA3, CLNB2, PTBB2.

Location: Cibola NWR Unit #1 (Reach 4, Cibola NWR, Arizona, 1/2 mile east of River Mile 97), Cibola Valley Conservation Area (Reach 4, Mohave County, Arizona, south of River Mile 103), and Beal Riparian and Marsh (Reach 3, Havasu NWR, Arizona, river miles 238-239).

Purpose: The purpose of this work task is to determine how two abiotic factors, plant water content and plant nutrient content, influence abundances of plant-feeding insects that are the prey base for many LCR MSCP species.

Connections with Other Work Tasks (past and future): Information obtained in these studies will be used in the design and implementation of future habitat creation projects detailed in Section E.

Project Description: Eight species of birds and four species of bats included in the LCR MSCP eat insects. Creating and maintaining habitat for these species requires providing an adequate supply of insects for food. This work task was extended to allow for greater studies determining insect response to water and other abiotic factors that may be needed for future management of restoration sites.

Plant-feeding insects respond to water and nutrient concentrations of their plant hosts. Plants with higher water concentrations produce more insects. This increase in phytophagous insects also increases densities of predaceous insects and spiders. Plant nitrogen concentrations similarly affect insect populations. Nutrient concentrations in spiders and insects also may affect foraging by insectivorous birds. Nutrients that vary among spiders and insects include nitrogen, sulfur, and phosphorous. This project will examine the following at MSCP restoration sites:

1. The influence of increased plant-nitrogen content on spider and insect densities.
2. Variation in nitrogen, sulfur, and phosphorus among spiders and insects.
3. The influence of plant water content on spider and insect densities.

Previous Activities: Effects of plant water and nitrogen contents on arthropod abundance and mass was examined at the Palo Verde Ecological Reserve during 2008. Fertilizer application increased branch water content and leaf nitrogen content. Abundances of insects in Homoptera (leafhoppers and aphids) were higher on branches on fertilized trees. Fertilizing trees with nitrogen had a small positive effect on insect abundance.

In 2009, nitrogen was examined as a nutrient in spiders and insects that are prey of insectivorous birds. Arthropods were collected from various plant species at the Beal Lake restoration site during April-August. Nitrogen concentrations were measured in collected arthropods. Most variation in nitrogen concentration was due to body size, with larger arthropods containing more nitrogen. Nitrogen concentrations also differed among arthropod orders, with herbivorous flies containing low nitrogen concentrations and spiders containing high nitrogen concentrations. Overall, arthropod herbivores and predators contained similar nitrogen concentrations.

FY10 Accomplishments: We examined the association between the amount of resilin, a digestible protein, and nitrogen-content of riparian insects collected at Beal Lake. Resilin and other digestible proteins may be important sources of nitrogen for insectivorous wildlife, especially birds. The amount of external resilin on insects was determined by its fluorescence in ultraviolet light. Amounts of resilin and nitrogen-contents were positively associated in beetles, flies, lacewings, true-bugs, dragonflies, and grasshoppers. Amounts of resilin and nitrogen-contents were not associated in bees and wasps.

FY11 Activities: We will expand our investigations of nutrients in spiders and insects eaten by birds by including the element sulfur. Sulfur is found in methionine and cysteine, two of the amino acids that are the building-blocks of proteins. Sulfur in methionine and cysteine has been implicated as an important nutrient in spiders and insects eaten by insectivorous birds. Spiders have especially high concentrations of sulfur and may be eaten selectively. In FY11, we will measure sulfur concentrations in a variety of riparian spiders and insects collected from one or more of the MSCP habitat restoration sites.

A second study will examine insect abundance and composition as a function of distance to surface water. Determining this relationship will help us design and locate future MSCP restoration projects. The composition of flying insects, aquatic and riparian will be sampled at different distances from water. This work would likely be performed at the Bill Williams National Wildlife Refuge as there is a gradient of habitats that could be sampled at various distances to water. As a comparison, a similar study would be set up at a restoration site such as PVER or CVCA.

Proposed FY12 Activities: The abundance/composition study as a function of distance to surface water will continue. The study determining the importance of sulfur as a

nutrient for insectivorous wildlife may be examined further in FY12. Alternatively we will examine the importance of phosphorus, needed by arthropods and birds primarily in energy metabolism and in some structural compounds. Similar to nitrogen, phosphorus is a limiting nutrient in plants, and plant phosphorus concentration may influence arthropod abundances.

Pertinent Reports: The 2010 Annual Report will be posted to the LCR MSCP website.

Wiesenborn, W.D. 2011. Nitrogen content in riparian arthropods is most dependent on allometry and order. Florida Entomologist. *In print*.

Wiesenborn, W.D. 2011. Biomasses of arthropod taxa differentially increase on nitrogen-fertilized willows and cottonwoods. Restoration Ecology. *Available online and in print*.