

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

| FY11 Estimate | FY11 Actual Obligations | Cumulative Expenditures Through FY11 | FY12 Approved Estimate | FY13 Proposed Estimate | FY14 Proposed Estimate | FY15 Proposed Estimate |
|---------------|-------------------------|--------------------------------------|------------------------|------------------------|------------------------|------------------------|
| \$90,000 | \$95,482.79 | \$415,081.35 | \$90,000 | \$95,000 | \$95,000 | \$0 |

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Start Date: FY06

Expected Duration: FY14

Long-term Goal: Species Research

Conservation Measures: WIFL1, WIFL2, YBCU1, YBCU2, GIFL1, GIWO1, VEFL1, BEV11, YWAR1, SUTA1, WRBA2, WYBA3, CLNB2, PTBB2

Location: Beal Riparian Restoration Site (Havasu NWR), Palo Verde Ecological Reserve, Cibola Valley Conservation Area.

Purpose: The purpose of this work task is to determine the effect of two abiotic factors, water and nutrient contents, on abundances of insects and insectivorous birds and bats covered by the LCR MSCP. Establishing vegetation at restoration sites will not by itself provide habitat for birds and other wildlife. Proper amounts of plant water and other nutrients in plants and insects will be needed to support wildlife.

Connections with Other Work Tasks (past and future): Work task C5 developed from the Southwestern Willow Flycatcher Prey Base Study (C20). Work task C20, completed in 2006, identified insects and spiders eaten by the southwestern willow flycatcher. Work task C6 was folded into C5 beginning in FY08. 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 is especially difficult at the LCR MSCP habitat creation sites being developed, because riparian vegetation is being planted in non-riparian farmland.

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 LCR 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. Greater abundances, or masses, of insects and spiders combined were not found on fertilized trees. Abundances and masses of insects in Homoptera (leafhoppers and aphids) were higher on branches on fertilized trees. Fertilizing trees with nitrogen had a small but significant affect on insect abundance and mass.

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.

A follow-up study was performed in 2010 examining the occurrence of resilin in insects. Resilin is an elastic protein found in the cuticle of insects, but not spiders that is digestible by birds. Most insect cuticle, where most nutrients reside, is hardened and not digestible by birds or bats. Resilin therefore may be in important source of protein nutrients for wildlife. Resilin fluoresces in UV light. We photographed a variety of insects in UV light to examine the prevalence of resilin. Resilin was abundant in grasshoppers, dragonflies, and true bugs and rare in flies and beetles.

FY11 Accomplishments: We examined amounts of sulfur in spiders and insects collected at the Beal Riparian Restoration Site during 2011. Sulfur occurs in two amino acids, methionine and cysteine, and a related compound, taurine, which are important nutrients for plants and animals. Insectivorous birds require these compounds for growth and reproduction. Concentrations of sulfur were measured in 4 families of spiders and 22 families of insects. Spiders contained higher sulfur-concentrations than insects, and concentrations of sulfur were lower in beetles than in other insects. Insectivorous birds, including the willow flycatcher, likely require spiders as prey to obtain required amounts of sulfur-containing compounds.

FY12 Activities: We will expand our investigations of nutrients in spiders and insects eaten by birds by including the element phosphorus. Phosphorus is found in adenosine triphosphate, the primary compound that supplies energy to all living cells. Concentrations of phosphorus in spiders and insects may influence foraging by insectivorous birds. In FY12, we will measure phosphorus concentrations in a variety of riparian spiders and insects collected from one or more of the LCR MSCP habitat-restoration sites.

Proposed FY13 Activities: The effects of plant water content, controlled by irrigation, may be examined if a study site becomes available. Alternatively, we will further examine the

importance of sulfur and phosphorus as nutrients for insectivorous wildlife. Insect immigration, especially from agricultural lands into restored habitat, may also be examined.

Pertinent Reports: Study plans are available upon request. The following reports were published in 2011:

Wiesenborn, W.D. 2011. UV-excited fluorescence on riparian insects except Hymenoptera is associated with nitrogen content. Psyche: A Journal of Entomology, available online at: www.hindawi.com/journals/psyche/.

Wiesenborn, W.D. 2011. Nitrogen content in riparian arthropods is most dependent on allometry and order. Florida Entomologist 94:71-80.

Wiesenborn, W.D. 2011. Biomasses of arthropod taxa differentially increase on nitrogen-fertilized willows and cottonwoods. Restoration Ecology 19:323-332.