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

FY09 Estimates	FY09 Actual	Cumulative Accomplishment Through FY09	FY10 Approved Estimate	FY11 Proposed Estimate	FY12 Proposed Estimate	FY13 Proposed Estimate
$90,000	$83,428.78	$222,409.92	$90,000	$90,000	$90,000	$0

Contact: Bill Wiesenborn, (702) 293-8699, wwiesenborn@usbr.gov

Start Date: FY06

Expected Duration: FY12

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 nitrogen 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): 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 flyctacher. 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.

Insect densities will be estimated on different species of restored plants grown under different irrigation and fertilizer treatments. Water and nitrogen will be manipulated, depending on soil conditions, by controlling plant irrigation and fertilization. Water and

nitrogen contents will then be measured in tissue samples taken from insect-sampled plants. Relationships between plant water and nitrogen contents, plant species, and insect density will be determined. The contribution of insects immigrating into restoration plots also will be evaluated. Field work will be performed at LCR MSCP habitat creation sites listed above.

Previous Activities: Two studies were conducted during 2007 on the effects of nitrogen and water on arthropod (spider and insect) populations. The first study examined the effects of plant water and nitrogen contents on arthropod numbers and masses on branches cut from cottonwood trees in a restoration plot (mass transplanting demonstration site) at Cibola NWR. The second study examined the effectiveness of small pools, installed to retain irrigation water, on increasing taxa of arthropods at Beal Lake, Havasu NWR. Artificial pools are not effective for increasing insect abundance at Beal Lake where restoration plots are bordered by large marshes that produce abundant, emigrant insects.

Examination of the effects of plant water and nitrogen contents on arthropod abundance and mass was repeated at the Palo Verde Ecological Reserve. 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.

FY09 Accomplishments: 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 2009. 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 Activities: Work during FY10 will examine the fraction of nitrogen in insects that is assimilated into the cuticle (exoskeleton) and not available as a nutrient to insectivorous birds. Insectivorous birds cannot digest the cuticle of arthropods. This is how arthropods are identified in bird fecal samples; undigested bits of arthropod cuticle are identified. The objective of this project will be to determine how much of an arthropod's nitrogen content cannot be assimilated by birds. Arthropods used in the nitrogen analyses will be collected from one or two of the MSCP restoration sites. Potential sites may include Beal Lake, CVCA, PVER, and Cibola NWR Unit #1.

An additional project may be to examine the effect of plant water content on arthropod abundance. This project depends on locating species of riparian plants, such as cottonwood, that are growing in different soil moistures.

Proposed FY11 Activities: The effects of plant water content, controlled by irrigation, may again be examined if a study site becomes available. Other research during FY11 may begin to look at nutrients in arthropods other than nitrogen. Possibilities include phosphorus (P), 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. Sulfur (S) may also be a limiting nutrient. Two amino acids, cysteine and methionine, contain sulfur. Spiders have unusually high concentrations of these amino acids. Some bird species appear to selectively feed on spiders, thereby increasing their sulfur intake.

Pertinent Reports:

Wiesenborn, W.D. 2009. Sampling riparian arthropods with flight-interception bottle traps. Florida Entomologist 92(4):535-692.

Wiesenborn, W.D. 2009. Biomasses of arthropod taxa differentially increase on nitrogen-fertilized willows and cottonwoods. Restoration Ecology.