

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

FY08 Estimates	FY08 Actual	Cumulative Accomplishment Through FY08	FY09 Approved Estimate	FY10 Proposed Estimate	FY11 Proposed Estimate	FY12 Proposed Estimate
\$90,000	\$82,971.14	\$138,981.14	\$90,000	\$90,000	\$90,000	\$0

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

Start Date: FY06

Expected Duration: FY11

Long-term Goal: Species Research

Conservation Measures: MRM1 (WIFL, YBCU, GIFL, GIWO, VEFL, BEVI, YWAR, SUTA, WRBA, WYBA, CLNB, PTBB)

Location: Cibola NWR Unit #1 (E24: Nature Trail and Mass Transplanting Demonstration Sites) (Reach 4, Cibola NWR, Arizona, 1/2 mile east of River Mile 97) and Cibola Valley Conservation Area (E5) (Reach 4, Reclamation, Hopi Tribe, and Mohave County, Arizona, south of River Mile 103). Beal Riparian and Marsh (E1) (Reach 3, Havasu NWR, Arizona, 0.5 miles east of river miles 238-239).

Purpose: The purpose of this study is to determine what abiotic factors may affect insect populations in riparian restoration sites.

Connections with Other Work Tasks (past and future): Work task C5 developed from 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 work task 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. Growing plants will not alone guarantee insect abundances large enough to feed and support bird and bat populations. Two abiotic factors, plant water content and plant nitrogen content, greatly influence abundances of plant-feeding insects. Both of these factors can be manipulated, depending on soil conditions, by controlling plant irrigation and fertilization. Immigration of insects into restoration sites also should be considered. Sites producing low abundances of insects may support bird and bat populations if insect immigration is high.

Insect densities will be estimated on different species of restored plants grown under different irrigation and fertilizer treatments. Water and nitrogen contents will 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 (see Location 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. Most arthropods captured on branches were spiders. Arthropods were sampled in August, when arthropods were most abundant, and arthropod mass, but not abundance, increased with increasing leaf percent-nitrogen. Branch percent-water was homogenous among trees, due to uniform irrigation, and did not influence arthropod numbers or masses. Percent leaf-nitrogen of trees planted for bird habitat should be monitored, and possibly increased, to maximize arthropod prey.

The second study examined the effectiveness of small pools, installed to retain irrigation water, on increasing taxa of arthropods at Beal Lake, Havasu NWR. Arthropods (mostly flies, gnats, and moths) were collected with three Malaise traps. One trap placed over a pool containing standing water, and one trap placed away from pools, captured insects comprising more bees and wasps and fewer flies and gnats than one trap placed between two pools. 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.

FY08 Accomplishments: Examination of the effects of plant water and nitrogen contents on arthropod abundance and mass was repeated at the Palo Verde Ecological Reserve. Arthropod abundances and masses were compared on 64 fertilized and unfertilized *Salix exigua* shrubs and *Populus fremontii* trees. Nitrogen contents of randomly-selected trees were increased by hand-applying urea in April 2008, and trees were sampled in May, June, and July. Arthropods were collected by bagging and fumigating branches, sorted by guild, counted, and weighed. Branch samples were taken from trees and analyzed for percentages of water and nitrogen. Insect abundances and masses were compared between tree species and fertilizer treatments and regressed against plant nutrient concentrations.

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 noteworthy effect on insect abundance and mass.

FY09 Activities:

1. Estimate and compare nutritional values (nitrogen contents) of different insects and spiders that provide food for birds at restoration sites; this is a follow-up to work in 2008 that examined effects of plant-nitrogen contents on abundances and masses of insects and spiders.
2. Compare abundances of moths with activities of bats at the Beal Lake Restoration Site. Moths will be trapped periodically from April 1 to October 1, 2009, and counted per size-class. Abundances will be compared with bat activities monitored with Anabat.
3. Examine the importance (proportion of abundance and mass) of insects that immigrate into, rather than develop within, restoration sites. Beal Lake is an example of a restoration site that benefits from an abundance of immigrant insects (see FY07 Accomplishments above). Traps can be placed around restoration sites to estimate immigration.

Proposed FY10 Activities: Work on 1 and 2 above (FY09 Activities) will continue through FY10. This includes additional work examining the effects of plant water and nitrogen contents on insect abundance and diversity that may be required depending on the results from FY08 and FY09. A comparison of moth abundances with bat activities may be performed at 'Ahakhav Tribal Preserve in conjunction with number 2 above. Moths would be trapped periodically at 'Ahakhav from April 1 to October 1, 2010 and counted per size class. Abundances would be compared with bat activity monitored at the permanent station site at 'Ahakhav.

Pertinent Reports: 1) *Wiesenborn, W.D., and S.L. Heydon. 2007. Diets of breeding Southwestern Willow Flycatchers in different habitats. Wilson Journal of Ornithology 119:547-557,* and 2) *Wiesenborn, W.D., S.L. Heydon, and K. Lorenzen. 2008. Pollen loads on adult insects from tamarisk flowers and inferences about larval habitats at Topock Marsh, Arizona. Journal of the Kansas Entomological Society 81:50-60,* are available on the LCR MSCP Web site.