

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

FY07 Estimates	FY07 Actual	Cumulative Accomplishment Through FY07	FY08 Approved Estimate	FY09 Proposed Estimate	FY10 Proposed Estimate	FY11 Proposed Estimate
\$90,000	\$47,426	\$56,010	\$90,000	\$90,000	\$90,000	\$90,000

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**Start Date:** FY06

**Expected Duration:** FY11

**Long-term Goal:** Species Research.

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

**Location:** Cibola NWR Unit #1, Cibola NWR, AZ; Cibola Valley Conservation Area, AZ; and Beal Lake, Havasu NWR, AZ.

**Purpose:** 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 by itself 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.

**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:** 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 the LCR MSCP habitat creation sites listed above.

**Previous Activities:** A technique for measuring amounts of nitrogen in plant tissue was developed based on a published method of measuring Total Kjeldahl Nitrogen in plant tissue; the technique was adapted to existing laboratory instrumentation for measuring nitrogen in water samples. Leaf samples were taken from 32 *Atriplex lentiformis* plants at Cibola NWR collected during work conducted under C7. Percent water of each plant was measured. Percent nitrogen (% of dry weight), measured in two samples from each plant, averaged 2.2%. Differences among plants accounted for 62% of variation in percent nitrogen, differences between subsamples accounted for 17% of variation, and interaction between subsamples and plants accounted for 21% of variation. Plant water and nitrogen contents were positively correlated. The procedure developed will enable comparison of plant nitrogen contents with insect abundances in created riparian habitats.

**FY07 Accomplishments:** Two studies were conducted during FY07 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 demonstration 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.

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 as any increase in insect production was inconsequential as compared to abundant insect populations already present at the site.

**FY08 Activities:** Examination of the effects of plant water and nitrogen contents on arthropod abundance and mass will be repeated. The uniform irrigation of the restoration plot sampled in FY07 produced trees with uniform plant water contents and prevented detecting an effect on arthropods. Trees at the adjacent Nature Trail restoration site will be sampled during FY08. Irrigation at this site is less uniform and should produce trees with different moistures. Goodding's willow and Fremont cottonwood are established at the site, enabling a comparison of the two species. Nitrogen contents of randomly-selected trees will be increased by hand-applying urea monthly in May, June, and July. Insects will be collected on trees every 2-4 weeks, sorted by guild, counted, and weighed. Branch samples will be taken from trees analyzed for percentages of water and nitrogen. Insect abundances and masses will be compared between tree species and regressed against plant nutrient concentrations.

**Proposed FY09 Activities:** Additional work examining the effects of plant water and nitrogen contents on insect abundance and diversity may be required depending on the results from FY08.

As a complementary study, the proportion of insects immigrating into restoration sites, rather than developing within sites, will be determined. 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.

**Pertinent Reports:** The study design is available upon request from the LCR MSCP. The following reports will be available on the LCR MSCP Web site: 2006 and 2007 annual reports for LCR MSCP C5: *Effects of Abiotic Factors on Insect Populations in Riparian Restoration Sites*; 2006 and 2007 annual reports for LCR MSCP C6: *Insect Population Biology in Riparian Restoration Sites*; and Wiesenborn, W.D. and S.L. Heydon, 2007, *Diets of Breeding Southwestern Willow Flycatchers in Different Habitats*, Wilson Journal of Ornithology.