



# Lower Colorado River Multi-Species Conservation Program

*Balancing Resource Use and Conservation*

## Survey and Habitat Characterization for MacNeill's Sootywing, 2008 Annual Report



April 2010

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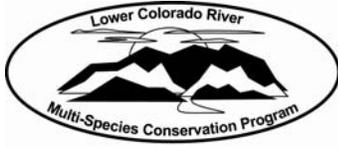
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*Prepared by William Wiesenborn, Wildlife Group*

Lower Colorado River  
Multi-Species Conservation Program  
Bureau of Reclamation  
Lower Colorado Region  
Boulder City, Nevada  
<http://www.lcrmscp.gov>

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# Abstract

We completed surveying of host plants (*Atriplex lentiformis*), and eggs, larvae, and adults of MacNeill's sootywing (*Hesperopsis graciellae*) along the lower Colorado River from the inflows to Lake Mead to the Southerly International Boundary with Mexico. We found stands of *A. lentiformis* at 102 localities, and eggs, larvae, or adults of sootywings at 54 localities. Localities were entered into Reclamation's Regional GIS. We measured masses of sugar, which approximated amounts of nectar, in *Heliotropium curassavicum* inflorescences on wild plants after the plants were visited by sootywings. Plants with inflorescences visited by females supported inflorescences with more sugar than plants with inflorescences visited by males. Ingestion of nectar by females, but not males, was detected by sugar masses in inflorescences that decreased as landing times increased. We present preliminary recommendations for restoring sootywing habitat based on our survey and study results.

# Introduction

MacNeill's sootywing skipper, *Hesperopsis graciellae* (MacNeill), is a small (wingspread = 23 mm) dark brown butterfly (Lepidoptera: Hesperidae; Pyrginae) found along the lower Colorado River and along its tributaries in southeastern California, western Arizona, southern Nevada, and southern Utah (MacNeill 1970, Austin and Austin 1980, Scott 1986, Nelson and Anderson 1999). Sootywings are more rare than would be expected based on the occurrence of their host plant (Austin and Austin 1980), and this rarity has caused the species to be listed as S1 (critically imperiled) in Nevada (NHHP 2007) and S2 (imperiled) or S3 (rare or uncommon but not imperiled) in California (CDFG 2009) and Arizona (AZGFD 2009). Flights of *H. graciellae* occur from April to October with three generations in southern Nevada (Austin and Austin 1980) and two flights in southeastern California (April and July to October, Emmel and Emmel 1973). The MacNeill's sootywing appears to require shade to tolerate the high temperatures where it lives (Wiesenborn 1999).

Larvae of sootywings feed only on quail brush, *Atriplex lentiformis* (Torrey) (Chenopodiaceae), a shrub found in dense clumps along lower Colorado River drainages (Emmel and Emmel 1973). Quail brush fixes atmospheric nitrogen (Malik et al. 1991). Female sootywings oviposit on large (radius > 1.6 m) host plants with high concentrations of water (> 64%) in branches and nitrogen (> 3.2% of dry-mass) in leaves (Wiesenborn and Pratt 2008). Sources of nectar for butterflies may limit the sootywing's distribution, because *A. lentiformis* is wind pollinated and does not produce nectar. Other plant species therefore are needed by the skipper for nectar.

This work task has two objectives: 1) to survey the insect and its host plant within the MSCP boundaries, and 2) to determine its habitat requirements. Surveys will be used to gauge the species' rarity within the project area and identify populations that can be expanded by habitat creation. Determining the sootywing's habitat requirements where it now lives will enable the creation of additional habitat. This work is being performed under a Cooperative Agreement with Gordon Pratt, Department of Entomology, University of California, Riverside.

In the 2007 Annual Report, we compared visitation by sootywings to flowers on potted sea-purslane (*Sesuvium verrucosum*) and heliotrope (*Heliotropium curassavicum*) plants. We present survey maps for the entire river, and examine nectar feeding on heliotrope in more detail in this annual report.

## Study Area

Surveys were conducted within the historical floodplain of the lower Colorado River from the upstream end of Lake Mead to the Southerly International Boundary (SIB) with Mexico. The river was surveyed in three sections: Parker Dam to the lower end of Cibola National Wildlife Refuge (Cibola NWR) during 2006, the upper end of Imperial NWR to the SIB during 2007, and the upstream end of Lake Mead to Parker Dam during 2008. Survey permits were provided by Lake Mead National Recreation Area (managed by the National Park Service), Bureau of Land Management, and Cibola and Imperial NWRs (managed by the U.S. Fish and Wildlife Service).

Permission from other landowners or managers was obtained as needed. Private property was not to be surveyed. Research on habitat requirements is being conducted primarily at Cibola NWR.

## Methods

### Surveys for sootywings, their host plants, and nectar sources

We completed our survey by examining areas upstream of Parker Dam. Surveys were conducted by recording GPS coordinates of stands of quail brush, found by driving, and by searching plants for sootywing eggs, larvae, and adults. Quail brush stands were repeatedly sampled for sootywings if possible. Plants with flowers being visited by sootywings for nectar were collected and identified.

### Nectar feeding by adult sootywings on heliotrope

Nectaring by male and female sootywings on wild heliotrope was quantified by observing sootywings on inflorescences (Figure 1) of different plants and estimating amounts of remaining nectar. We timed the duration of each landing on an inflorescence by counting seconds, and identified the sootywing's sex by the more mottled forewings (upper surface) of females (MacNeill 1970, Scott 1986). We marked each visited inflorescence with a partly unbent paper clip hung on the subtending stem, and marked each supporting plant with a numbered stake. We cut each visited inflorescence, counted its open flowers, and collected its nectar by shaking it for 30 seconds in a vial containing 5 ml of water. We cut a second inflorescence, which was not observed as visited by sootywings, from the same plant, counted its open flowers, and similarly collected its nectar. We performed the study during 1003-1320 MST on 15 April 2008.

Amounts of nectar in inflorescences were estimated by measuring masses of sugar in flower rinses (Roberts 1979). Sugar concentration was measured against standards (equal masses of fructose, glucose, sucrose) with a spectrophotometer (Cary 100, Varian, Palo Alto, CA) measuring absorbance at 490 nm. We compared masses of sugar in inflorescences between plants that were landed on by males vs. females and between inflorescences visited vs. not visited by sootywings. We examined the relationship between sugar masses remaining in inflorescences and landing durations by male and female sootywings.

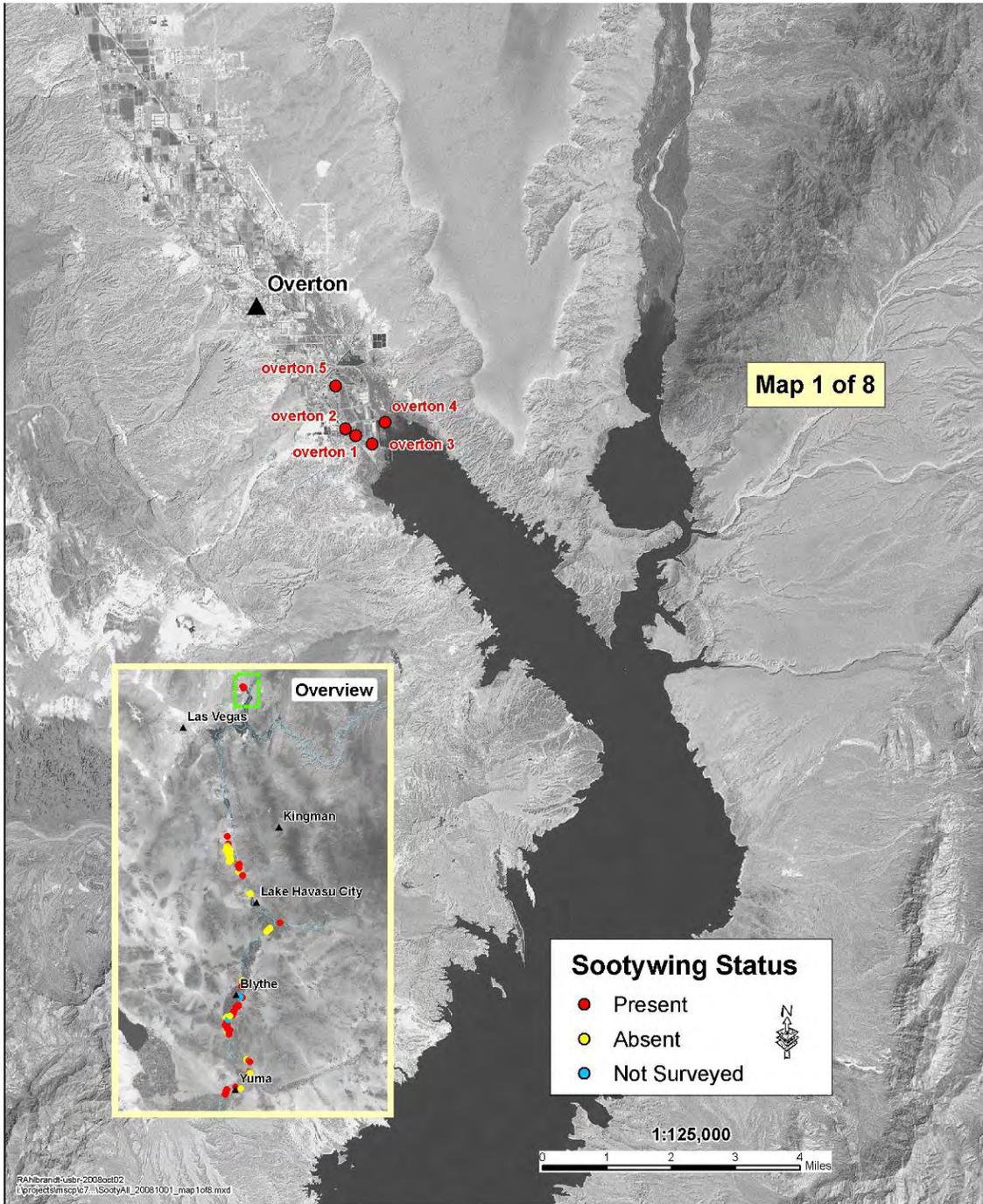
## Results

### Surveys for sootywings, their host plants, and nectar sources

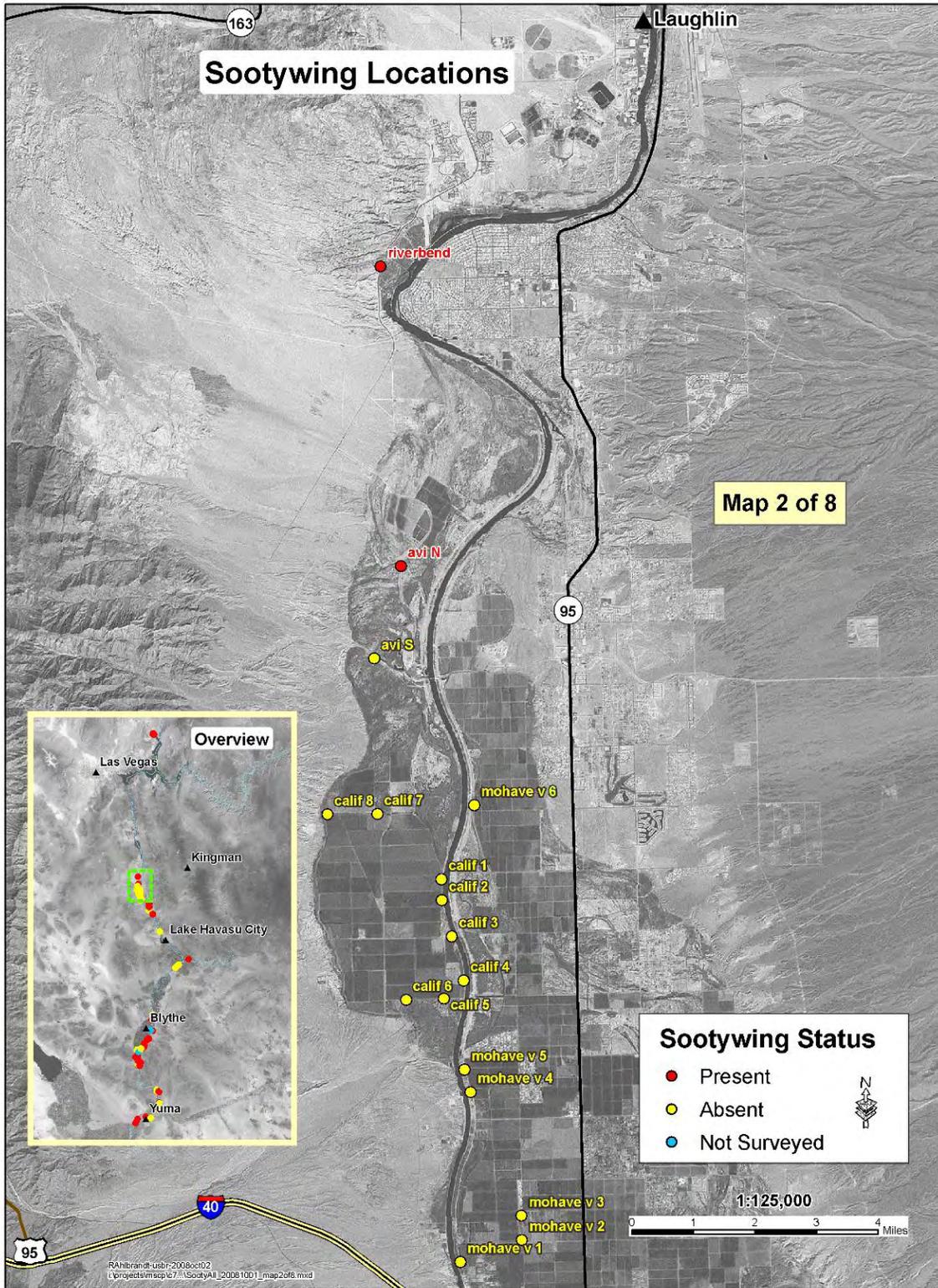
Stands of *A. lentiformis* were found at 36 localities between the Muddy River inflow to Lake Mead and Parker Dam. Sootywing eggs, larvae, pupae, or adults were found at 16 of these localities. Most sootywings were found in the Overton State Wildlife Refuge and at Havasu National Wildlife Refuge. Quail brush now has been found at 104 sites along the lower Colorado

River, and 52 of these sites support sootywings. Sootywings were found in 2008 within the Palo Verde Ecological Reserve, shown as PVER on Map 5. Survey results for 2006-2008 are shown below, from north to south.

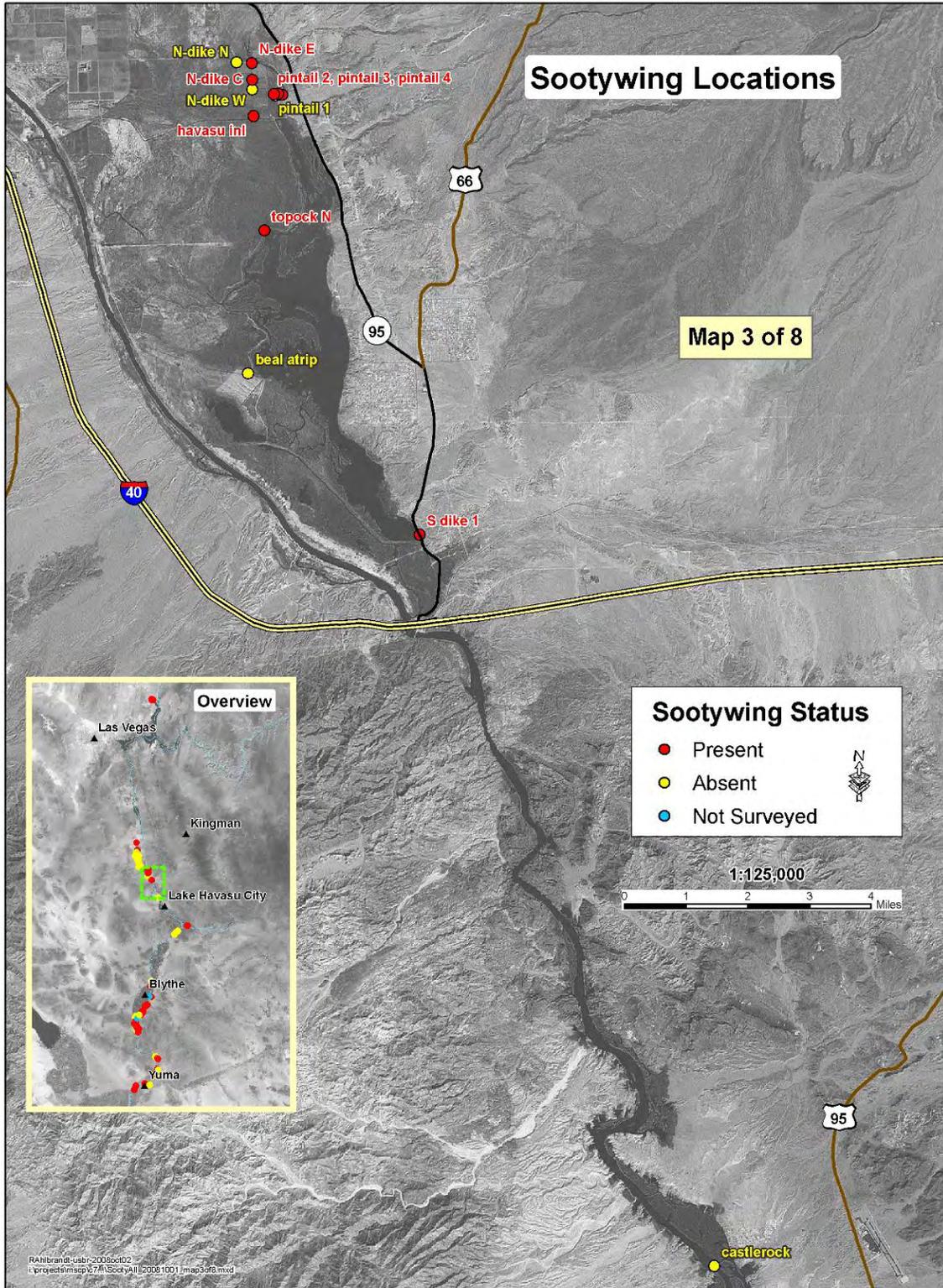
Map 1.



Map 2.

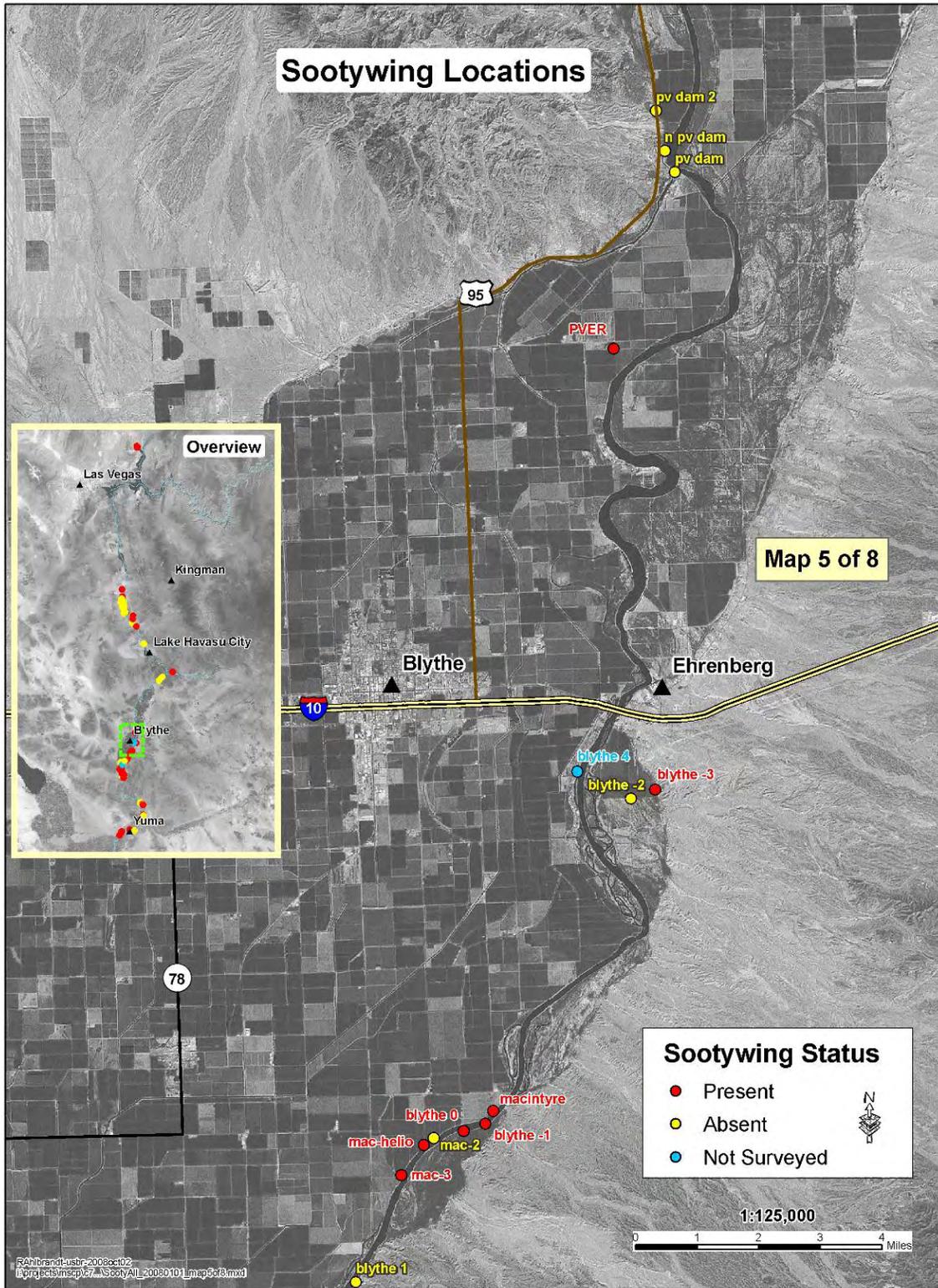


Map 3.

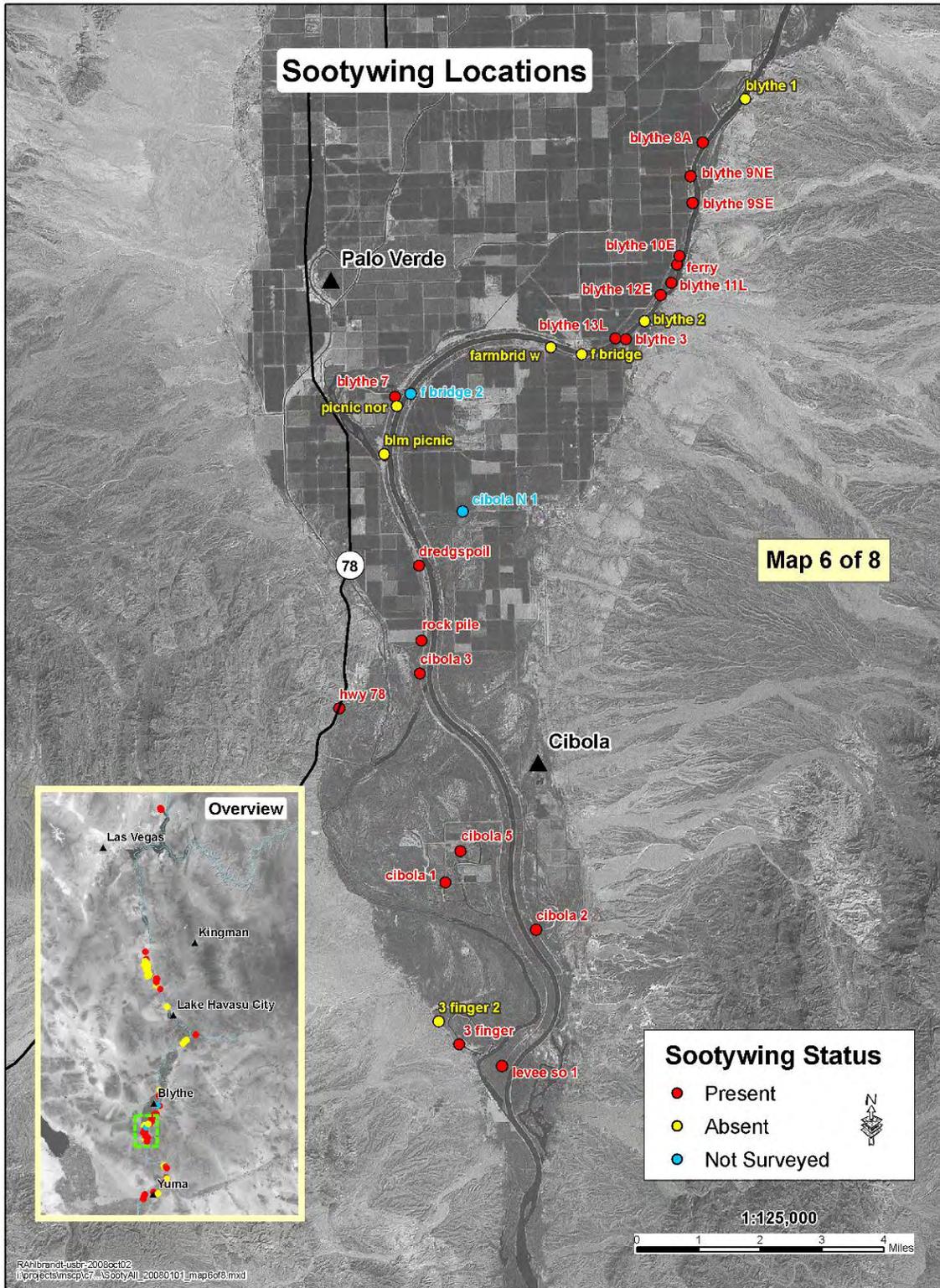




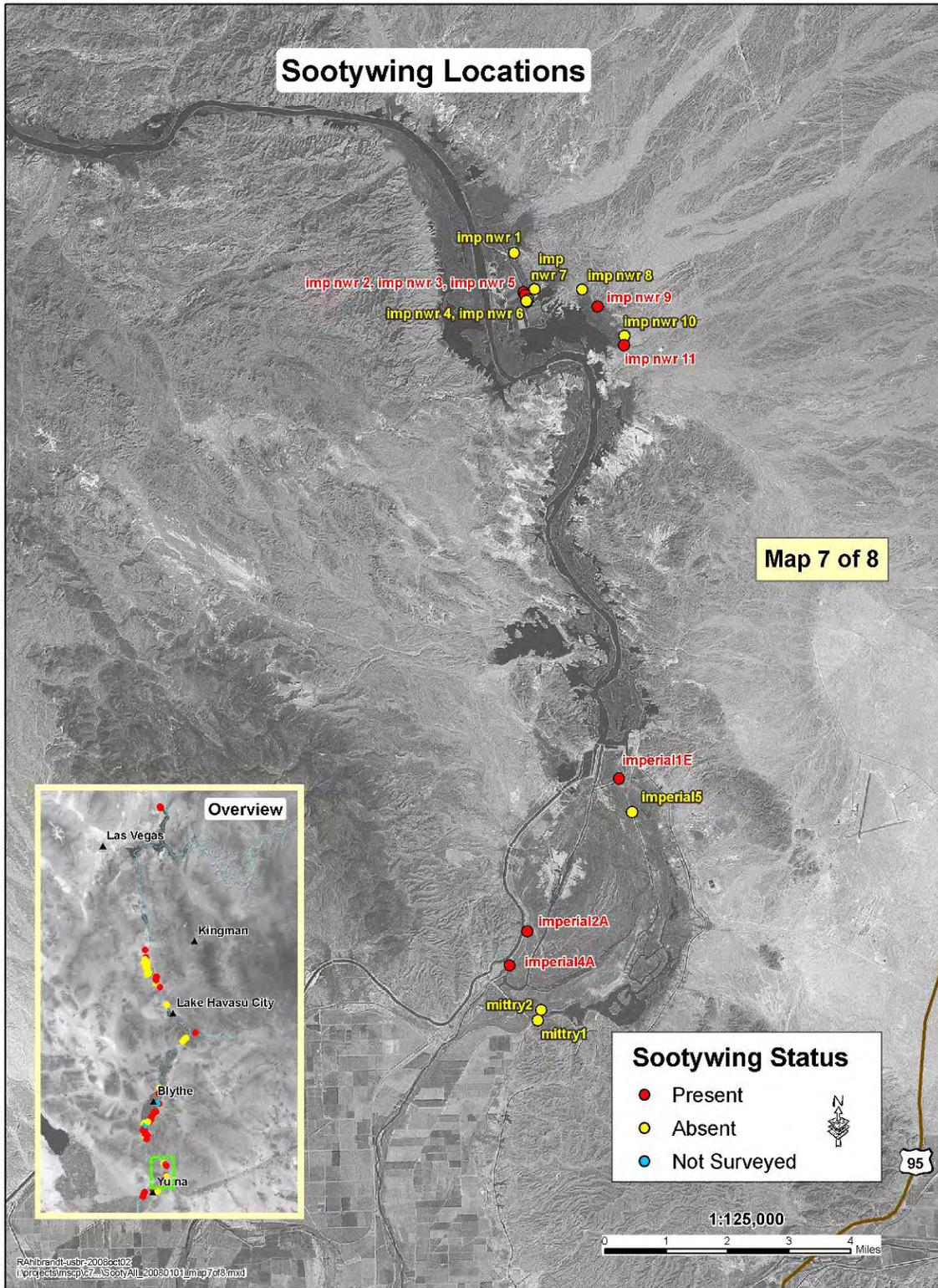
Map 5.



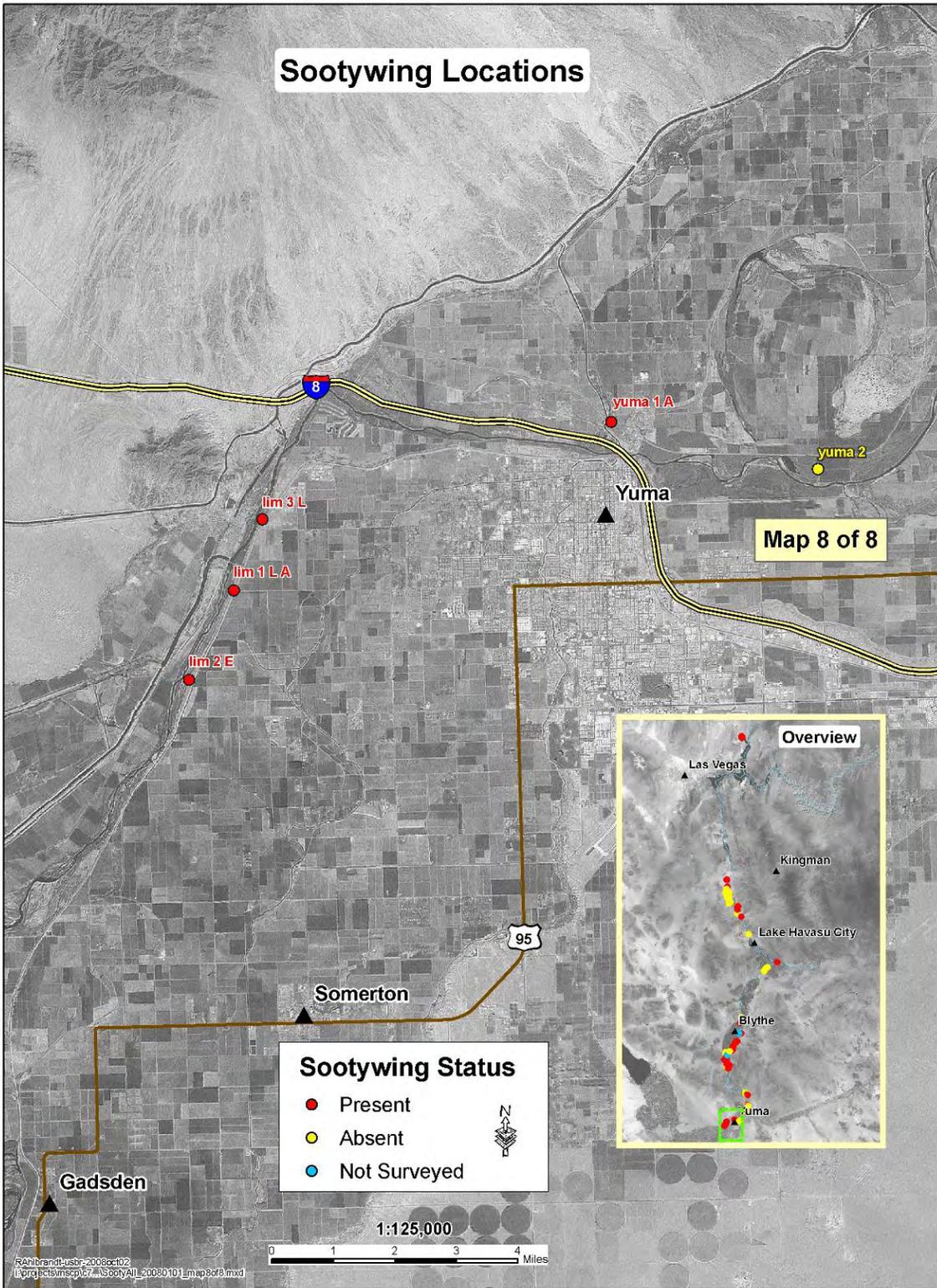
Map 6.



Map 7.



Map 8.



We did not observe sootywings nectar feeding on new plant species. We observed sootywings during 2006-2008 nectar feeding on:

Heliotrope	<i>Heliotropium curassavicum</i>	Boraginaceae	white flowers
Sea purslane	<i>Sesuvium verrucosum</i>	Aizoaceae	pink flowers
Arrowweed	<i>Pluchea sericea</i>	Asteraceae	purple flowers
Alkali mallow	<i>Sida rhombifolia</i>	Malvaceae	white flowers
Honey mesquite	<i>Prosopis glandulosa</i>	Fabaceae	yellow flowers
Tamarisk	<i>Tamarix ramosissima</i>	Tamaricaceae	white-pink flowers
Common purslane	<i>Portulaca oleracea</i>	Portulacaceae	yellow flowers

## Nectar feeding by adult sootywings on heliotrope

We observed 20 males and 13 females of *H. graciellae* visiting inflorescences on 33 different, wild *Heliotropium curassavicum* plants. A male sootywing feeding on a heliotrope inflorescence with two cymes is shown in Figure 1.

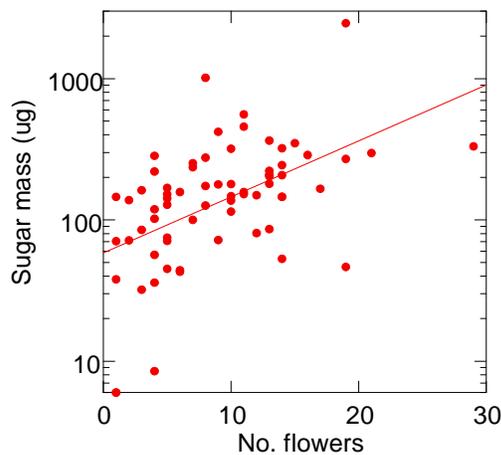
Figure 1.



Numbers of flowers did not differ among inflorescences (all had two cymes) visited by males (9, 1-21 flowers [mean, range]), by females (10, 2-14 flowers), or by neither sex (9, 1-29 flowers). Sizes of inflorescences did not influence selection by sootywings.

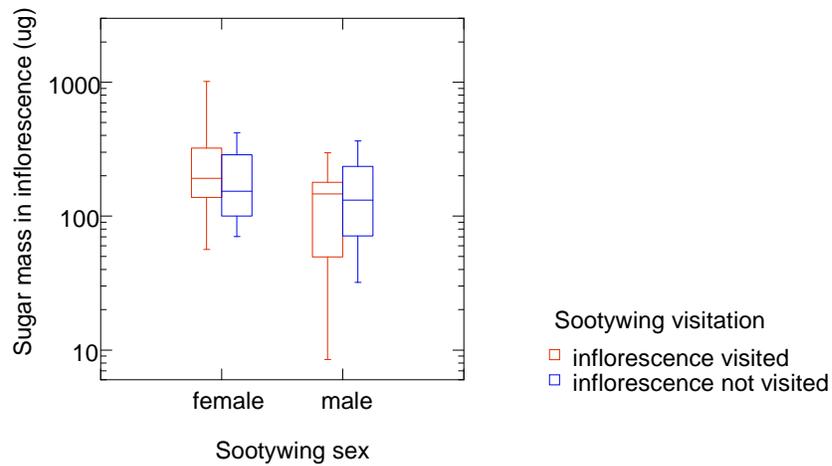
Larger inflorescences produced more sugar. Masses of sugar in inflorescences (133, 118-151  $\mu\text{g}$  [mean,  $\pm$  SE]) increased as numbers of flowers increased, shown in Figure 2.

**Figure 2.**



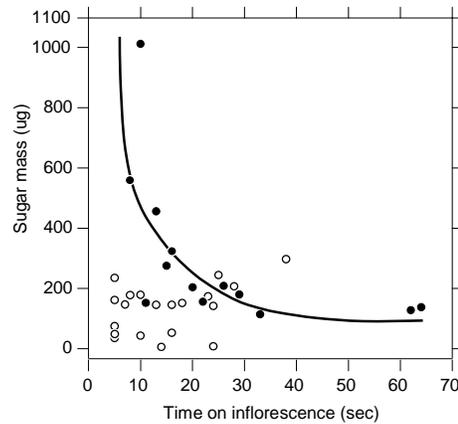
Inflorescences on plants landed on by females contained more sugar than on plants landed on by males. Females therefore landed on heliotrope plants supporting inflorescences with more sugar per flower. Amounts of sugar did not differ between inflorescences visited vs. not visited by sootywings. Figure 3 shows amounts of sugar remaining in inflorescences after being visited by male and female sootywings. Horizontal lines are medians, boxes enclose 50% of the values, and vertical lines are ranges.

**Figure 3.**



Masses of sugar remaining in inflorescences landed upon by sootywings varied with landing duration. Relationships between amounts of remaining sugar and landing times differed between sexes. Sugar masses in inflorescences visited by females decreased asymptotically with increasing landing duration, whereas sugar masses in inflorescences visited by males did not vary across landing durations (Figure 4).

**Figure 4.**



# Discussion

We have now completed surveying the lower Colorado River for MacNeill's sootywings and their host plants, quail brush. Sootywing eggs, larvae, or adults were found at half of the localities that supported quail brush. Presence of quailbrush therefore does not ensure presence of sootywings. Two notable areas with host plants but not sootywings are: 1) the Mohave Valley area (CA and AZ) between Laughlin and Topock Marsh (Map 2), and 2) the Parker Strip (Map 4), where the species was first described (MacNeill 1970). In contrast, we have found the sootywing to be geographically widespread. We have found them from the Muddy River inflow to Lake Mead south to the southerly Mexican border. The largest population of *H. graciellae* found during 2006-2008 is at Cibola NWR. This population has allowed us to study phenology, adult behavior, and oviposition on plants. The only sootywing population within an MSCP restoration site is at PVER. Unfortunately, the quail brush supporting this population bordered a lined irrigation canal and was cleared by Palo Verde Irrigation District during fall 2008.

Nectar feeding by sootywings is not restricted to specific plants or plant families. We have found sootywings feeding at flowers of seven species, each in a different family. Heliotrope appears to be utilized the most, followed by sea purslane. Female sootywings are more dependent on nectar. Female butterflies generally require more nectar, and more nutrients in nectar, due to their production of eggs.

# Recommendations

Further work determining *H. graciellae*'s habitat requirements is needed. Activities in 2009 likely will include examining:

1. The importance of amino acids in nectar in flowers selected by sootywings. This is a follow-up to our examination of the importance of nectar sugar content to males and females described in this report.
2. The importance of shade in sootywing thermoregulation. We will attempt to monitor body temperatures of sootywings in the field using an infrared thermometer.

Other potential projects are: (a) predation and parasitism of sootywing larvae, and (b) patterns of dispersion by sootywings among host plants and nectar sources (i.e., How far do sootywings move around?).

Management recommendations are as follows:

1. Stands of quail brush that support sootywings within refuges and MSCP restoration sites should be preserved if possible. Large stands of *A. lentiformis* supporting the skipper have been cleared for road maintenance at Cibola NWR and to maintain irrigation canals at PVER. Although these activities likely are required, more care needs to be taken to minimize effects on sootywing populations. Clearing quail brush during winter when adults are not active is not a solution, because sootywing larvae overwinter on plants.

2. Plant native *Atriplex lentiformis* as host plants. There is enough quail brush growing along the river to provide seeds or transplants for planting. Previous revegetation plants should be avoided. Plants will not become suitable as sootywing hosts until they reach a height of 1.6 m. We have not detected a minimum patch size required by sootywings. However, other studies have estimated minimum patch sizes of 2-6 ha for preserving butterflies (Crone and Schultz 2003).
3. Maintain host plant water content above 64% during 1 April through 30 September when sootywings are flying or larvae are feeding. We suggest a deep irrigation during March followed by monthly monitoring of plant percent water. Additional irrigation should be performed if plant water drops below this level. Maintaining adequate water content should produce adequate leaf nitrogen content, because these two quantities are positively correlated in quail brush. Leaf nitrogen content can be measured if sootywings fail to become established. If leaf nitrogen concentration is low (<3.2%), fertilizer containing phosphate, potassium, and nitrogen can be added to increase nitrogen uptake and fixation.
4. Establish native plants amongst the quail brush to provide nectar during 1 April through 30 September when sootywings are flying. Honey or screwbean mesquite may provide nectar during spring, but other plants will be needed to supply nectar through 30 September. We suggest a mixture of heliotrope, *Heliotropium curassavicum* (Boraginaceae), and sea purslane, *Sesuvium verrucosum* (Aizoaceae). These perennial ground covers flower (Munz 1974) from March to October (*H. curassavicum*) or April to November (*S. verrucosum*). Planting patches of both plants at each site will help ensure that flowers are present during years with different rainfalls. Nectar plants should be watered by the irrigations of quail brush.

Insects are strong dispersers. Dispersal by sootywings should enable them to colonize new habitat on their own. If suitable habitat fails to become colonized, then sootywings from nearby populations can be transplanted.

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