Final Report

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Gall wasp Species diversity in the prairies of Central and Southern Illinois

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Introduction

Antistrophus gall wasps (Cynipidae) are primarily found in prairie habitats of midwestern USA. Of the ten known species of the genus, eight are from Illinois, including five known only from the state, one from Arizona, and one from California. Like all cynipids, they make galls on plants and are specific with regard to host species and tissue. Four plant genera, all asteraceous, are used by the wasps, of which *Chrysothamnus, Lygodemnia*, and *Microseris* are known to host one *Antistrophus* species each whereas *Silphium* host the remaining seven species. Of the *Silphium*-associated species, five make cryptic galls in tissues of host internodes, whereas *A. laciniatus* makes minute galls in disk florets of *S. laciniatum* and *A. silphii* makes club-shaped terminal galls on stems of *S. perfoliatum*. The species *A. laciniatus* and *A. silphii* have not been reported since being described a century ago although the cryptic species found in host stems are relatively common (Tooker et al 2004, own field data) until a local population of *A. silphii* was found outside the city of Charleston in 2004. Informal estimation of this particular population found more than 100 galls. Since each gall contains up to 20 wasps, this population probably had more than 1,000 individuals and therefore did not cause much attention. However, a dramatic decline in the population was observed the following year and a thorough search in the winter of 2005 found only 14 obviously stressed galls, suggesting that local population of the species are subject to considerable fluctuation for reasons not yet understood. Subsequent efforts failed to find the species in other areas in central Illinois. *A. silphii* using only the tip of its host stems probably makes it more vulnerable to host plant population decline and other habitat disturbances. It is thus of great concern whether the species represents many of the prairie species of narrow ecological niche suffering from decline of prairie habitats, which are nonetheless not noticed because they are small in size. The local population of the species in Charleston could be one of the few, if not the only, remaining populations of the species in Illinois. Should this be the case, immediate measures needs to be taken to protect the *A. silphii* population in Charleston. Such action can only be justified on basis on reliable field data, and we

there propose a field survey in areas of the state where prairie habitats dominate.

Objectives:

a. Locate relatively large populations of *Silphium perfoliatum* across the state through literature search, plant distribution database, and consulting with experts and nature preservation agents;
b. Field Survey of selected large populations of host plants for detection of *Antistrophus silphii* across the state.
c. Focused survey of host plant populations of any size in Coles County and neighboring counties for detection the wasps.
d. Data analysis and mapping.
e. Preliminary conclusion made about the status of *Antistrophus silphii* in Illinois, especially in the central eastern part, based surveys.
f. Project report preparation and submission.

Methods:

a. *Deciding of survey sites.* We will conduct literature search, search plant distribution database, and consult with other experts of prairie plants, and nature preservation agents for information on the distribution localities of host plant, especially those of relatively large size;
b. *Inquiries in local communities.* We will visit places of gathering by local communities, such as churches, and make inquiries about the distribution of *Silphium perfoliatum* in the area. We will bring host plant specimens and pictures to assist our inquiries.
c. *Survey of selected populations.* This is straight forward and we can find out most galls out in the field relatively easily. We will estimate and record population density and size for both the host plant species and the gall wasps at each location visited;
d. *Survey of local populations.* We will try to visit every local populations of the host plant. Like in item 3, we will estimate and record population density and size for both the host plant species and the gall wasps at each location visited.
e. Data analysis and mapping.
f. Based on surveys, preliminary conclusion about the status of *Antistrophus silphii* in Illinois, especially in the central eastern part.
g. Project report preparation and submission.

Results

***1. Field Survey*.**

Sites of field survey are listed as in Table 1.

Table 1 List of surveyed sites. * indicates site where S*ilphium perfoliatum* was found, ** indicates site where big patches of S*ilphium perfoliatum* were observed, and † indicates site where *Antistrophus silphii* was found.

Site Number	Site Visited
1)	Argyle Lake State Park, McDonough Co.
2)	Beaver Dam State Park, Macoupin Co.
3)	Big River State Forest, Henderson Co.

4) Burksville, Monroe Co.
5) Carbondale (south suburb)
6) Charleston Lake areas, Coles Co.* †
7) Reasor Park, Charleston, Coles Co.
8) Crawford County Conservation Area, Crawford Co.*
9) Des Plaines Conservation Area, Will Co.**
10) Douglas Hart Nature Center, Coles Co.*
11) Fermilab Prairie, Kane Co.** †
12) Forest Glen County Preserve, Vermilion Co.*
13) Fox Ridge State Park, Coles Co.*
14) Galesburg, Knox Co.
15) Johnson Sauk Trail State park, Henry Co.*
16) Kankakee River State Park, Kankakee Co **
17) Kennekuk County Park, Vermillion Co.*
18) Kibbe Biological Research Station, Hancock Co.*
19) Kickapoo State Park, Vermilion Co *
20) Lincoln Log Cabin State Park, Coles Co.**
21) Middle Fork River County Forest Preserve, Champaign Co *
22) Nauvoo State Park, Hancock Co.
23) Pana area, Rosamond Co
24) Prospect Cemetery Prairie, Champaign Co.
25) Route 45 Railway Prairie, Champaign Co.
26) Sunset by the Mississippi, Hancock Co.*
27) Waggoner Creek, Hancock Co.*
28) Clinton, Indiana **†
29) Roads sides between survey destinations

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2. *Inventory of the host plant species Silphium perforliatum distribution in Illinois.*

Based on information we retrieved from library and internet sources and received from local botanists and conservation agents, we have been conducted statewide field surveys in areas listed above, but focused in areas in central Illinois, where some sites have been visited many times. While the host plant species has been found in almost 60% of the area that we visited, distribution of the species is mostly represented by scattered individuals. The only places in the state of Illinois where we found contiguous distribution patches of the plant are: 1) Lincoln Log Cabin State Park, Coles Co., 2) Des Plaines Conservation Area, Will Co., and Kankakee River State Park, Kankakee Co. Since 2004, part of the area where cup plants grew in Lincoln Log Cabin State Park in Coles County has been used for recreational activities (19th Century Militia Muster) and the original size of the cup plant population has shrank by half. In additional, we were able to locate an Illinois resident-owned land in adjacent Clinton area of Indiana with the largest population of cup plants known to us in the region.

3. *Galls on Silphium intergrifolium are not* made by *Antistrophus silphii*

In our field surveys, we discovered on rosin weeds (*S. integrifolium*) galls very similar to those induced by *A. silphii* on S. *perfoliatum*. Morphological comparison revealed very little difference and showed no obvious difference in phenology that would separate them reproductively in time.

In fact, biologists studying various aspects of the interactions of the rosin weed gall wasps and rosin weeds in Kansas identified those wasps as *A. silphii* (Fay et al 1991, 1993, 1996; Fay and Throop 2006). If they do belong to the same species, previous concerns over the status of *A. silphii* would be unwarranted because galls on the rosin weeds are very common and numerous in various locations, including the Illinois site at Fermilab Prairie. Nonetheless, we rarely encountered galls of both kinds in the same habitats, even if the host plants had overlapped distribution. The only exception was in Fermilab, where we found both kinds of galls in the same habitats. We also noticed that galls on rosin weeds are generally smaller, have a thick layer of short felt, are more rigid, and contained more resinous substances (Figures 1, 2). The wasps emerged from cup plants also appeared to be larger. It is possible that these too very similar species that have become isolated reproductively due to habitat or host plant preference. To test this hypothesis, we conducted host selection experiments (Figures 3, 4). Out of the 14 trials with 7 wasps reared from cup plants and 7 reared from rosin weeds, 5 wasps were observed to lay eggs into plant tissue, and an additional 9 wasps were recorded to land on and spent 2 – 140 mins on potential host plants. Complete fidelity to the original host plant species was observed for all wasps. While further work is planned to separate the wasps on the two different host species using molecular markers, it is obvious to us that they represent two species isolated reproductively because of host plant preference.

4. *Antistrophus silphii is uncommon in Illinois.*

We have not been able to find galls of *Antistrophus silphii* on scattered cup plants throughout the locations that we surveyed. Among the 4 locations where we did find relatively large patches of the host plant, only Lincoln Log Cabin site and Fermilab Prairie site had the gall wasp and the Des Plaines Conservation Area site and the Kankakee River State Park site were not found to have the wasp. The two sites that did have the gall wasps are very low in density. We recorded 14 galls for the population in Fermilab Prairie site and about 60% of these galls showed signs of stress or predator attack. We only dissected an apparently predated gall (shown to be destroyed by an unknown borer) and leave the rest undisturbed. The Lincoln Log Cabin site was obserbed to have only three galls before the winter. The site was once observed to have tens of galls in 2004 and the gall density at the site has since dwindled through the years for unknown causes. It has been noticed that recreational use of the historical site had resulted in half of the original habitat for cup plant being cleared. In a private land close to Clinton, Indiana for nature restoration, the largest cup plant population is observed, and a survey made in August, 2007 revealed more than 30 galls, which was obviously an underestimate because of lush vegetative growth.

5. *Suggestions for the conservation of Antistrophus silphii in Illinois.*

It is obvious to us that *Antistrophus silphii* has become very rare because of the lack of relatively shaded and moist habitats that are obviously required by the host plant *A. silphii*. A more comprehensive survey statewide is obviously needed, and before that, we propose to notify the Lincoln Log Cabin State Historic Site management about the situation and advise them to not disturb the cup plant population, and if feasible, relocate the recreation activity (apparently the 19th Century Militia Muster event) to a different part of the site so that the cup plant population can recover to its original size. Effort should be made to monitor the gall wasp population fluctuation from year to year at the two sites where the species has been discovered.

Literature cited

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Digital photographs

Figure 1. Gall of *Antistrophus* new species on *Silphium integrifolium*

Figure 2. *Gall of Antistrophus silphii* on *Silphium perfoliatum*

Figure 3. Host selection experiment setup. For each experimental selection trial, a plant of *Silphium integrifolium* (right) and a plant of *S. perfoliatum* (left) were placed side by side inside a naturally lighted cage.

Figure 4. For each host selection trial, a tube containing a wasp was placed in the cage opposite to the potted plants with equal distance to each potential host (note a wasp female perching on the rim of the tube from which it was just allowed to get out).