Final Report

Project Name: Historical Occurrence & Present Status of Insect Species in Greatest Need of Conservation

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Introduction

Insects are the most diverse class of animals included on the Illinois list of Species in Greatest Need of Conservation (SGNC). The exact number of insect species native to Illinois is unknown, but certainly exceeds 30,000. Although precise data on long-term population trends are available for relatively few insect species, recent surveys by Panzer and colleagues in the Chicago metropolitan area (Panzer et al. 1995) indicated that ca. 13% of the prairie-inhabiting insect species originally recorded from the region have been extirpated. A more recent general insect sampling program, part of the Critical Trends Assessment Project at the Illinois Natural History Survey, has shown that declines in the state's insect fauna have paralleled those observed for birds, reptiles and amphibians, and vascular plants. This sampling, conducted over the past 15 years, indicates that "typical" (i.e., poor quality) grasslands and wetlands collectively support less than 30% of the species originally recorded from such habitats in Illinois (Dietrich 2009).

Published data on long-term trends in insect populations are available only for a few pest species. For species not considered to be of economic importance, the most extensive historical data available are those associated with specimens deposited in insect collections. The insect collection of the Illinois Natural History Survey (INHS), which houses specimens accumulated over the past 150+ years, is the largest and oldest repository of information on the insect fauna of Illinois. As such, the collection provides a source of information on the historical distributions of insect species, including those currently listed as Species in Greatest Need of Conservation (SGNC) in the Illinois Wildlife Action Plan.

The present project aimed to assess the present status of the insect SGNC represented in the INHS collection by:

1. creating an Internet-accessible database of specimens of insect SGNC present in the INHS collection; and
2. sampling the historical localities represented by these specimens to determine whether the species are still present in those locations

Materials and methods

Collection resources. The insect collection of the Illinois Natural History Survey was searched for specimens identified as species included on the state list of insect SGNC. Specimen

identifications were verified and specimen records were then entered into the project database. Data fields included taxonomy, country, state, county, locality name, date of collection, name of collector, collecting method, and host (where relevant).

Database and website. A project database and website were developed by INHS Insect Collection Manager Dmitry Dmitriev. The relational specimen database was developed in Microsoft Access. Web interfaces for querying the database were developed using ASP and Java. Specimen data were entered for each unique collecting event/species combination. Multiple specimens of the same species collected as part of the same event were all included as part of the same database record and the number of specimens was included in a separate field of each record. The project website and database are accessible at the following URL: http://ctap.inhs.uiuc.edu/dmitriev/ilinsects.asp

Georeferencing. Because most labels did not include map coordinate (lat/long) data, locality data were georeferenced retrospectively using GeoLocate (Rios and Bart 2010). The distributions of many of the listed species are very incompletely known in Illinois and most previous locality records are imprecise. Specimens labeled with only a county or city name were georeferenced based on the geographic centroid of the named entity.

Field sampling. Historical localities represented among INHS collection holdings of insect SGNC were revisited to determine whether habitats likely to support conservative insect populations was still present. In many cases where only a town name was indicated on the specimen label, the surrounding area was searched for suitable habitats. Permits for sampling in designated Nature Preserves were obtained when necessary. Sampling methods included sweep netting, vacuuming, visual search with aerial netting, and night collecting using mercury vapor and UV lights. Collecting at lights was undertaken mostly during warm, humid nights when the sky was either overcast or during the few days prior to or following a new moon. Sweep and vacuum sampling was conducted during the day when vegetation was dry, usually between 10 am and 7 pm. All historical localities represented by specimens in the INHS insect collection were visited at least once and several were visited multiple times over the five years of the project. Because metropolitan Chicago and adjacent parts of northern Illinois were surveyed extensively for species in greatest need of conservation in recent years by R. Panzer and colleagues (Panzer et al. 1995) our sampling focused primarily on other areas in Illinois.

Sample processing. Because it is usually not possible to identify insects with certainty in the field, insect samples were returned to the lab, sorted, mounted and labeled, and identified to species. Insect SGNC were then recorded in the project database and deposited as vouchers in the INHS insect collection. Ph.D. student Adam Wallner, working on a related project under PI Dietrich's direction at the University of Illinois, completed a dissertation focused on Illinois hill prairie Auchenorrhyncha in December 2010 (Wallner et al. 2011). Wallner's sample data include ca. 200 relevant element occurrence records for insect SGNC collected by vacuum sampling that have been vouchered and added to the project database. Backlog samples obtained during field surveys by the author and colleagues at INHS since 1995 were also processed and these yielded additional recent records of insect SGNC that have been included in the database.

Results

The initial search of the INHS insect collection revealed the presence of 1417 specimens representing 118 Illinois insect SGNC (Table 1). Based on label data associated with the specimens, these specimens were originally obtained from 247 localities distributed throughout Illinois (Map 1). The earliest year of collection represented by these specimens was 1900 and the most recent was 2004. The remaining 229 listed insect SGNC are not represented in the INHS insect collection, so no Illinois distributional information was included in the database for these species, but the names are included in the database for completeness. Sampling during the project revealed the presence of at least one insect SGNC at 68 of the 247 localities (Map 2), 26% of the localities represented in the historical holdings of the collection. These samples included 1962 specimens representing 49 Illinois insect SGNC.

The current version of the Illinois Insect Species in Greatest Need of Conservation Database is accessible at: http://ctap.inhs.uiuc.edu/dmitriev/ilinsects.asp). Users of the web site are presented with two options for retrieving data: 1) the user may enter a taxon name into the database search field, or 2) the user may browse a list of taxa, organized hierarchically beginning at the level of insect order. Clicking on the name of a higher taxon returns a list of included taxa of lower rank. Clicking on a species name opens a new window containing information on that species. For species present in the INHS insect collection, the page include an Illinois distribution map and a list of collection records indicating the locality and date of collection for the species. Data for each point on the distribution maps may be obtained by clicking on the point within the web interface. Photos of a few species are included in the species pages; more will be added as they become available. The database is currently maintained on servers at the INHS and will be augmented as new data on insect SGNC become available.

Discussion

Although we were only able to verify the presence of 49 Illinois insect SGNC at 68 historical localities represented in the INHS insect collection, representing 42% and 26% of the previously recorded species and localities, respectively, much more sampling will be needed to confirm that the apparent declines we observed are real and persistent. Most of the listed insect SGNC are extremely rare, indicated in part by the fact that >100 years of collecting by INHS entomologists yielded only 1471 specimens of SGNC deposited in the INHS insect collection. Although most listed species were not detected by our sampling, many may persist in very low numbers in areas where they occurred historically, particularly if suitable habitat and host plants are available. Rare species of moths, which make up the majority of listed insect SGNC, are often very difficult to detect because many fly only at certain times of night, at certain times of year, and only when local temperature and humidity regimes are optimal. Thus, considerably more effort is required to document the presence of rare moths than it is for groups like auchenorrhynchous Hemiptera (leaf- and planthoppers, Figs. 1-8), which are easily sampled during the day using a vacuum or sweep net.

The prevalence of auchenorrhynchous Hemiptera among the Illinois insect SGNC detected in this study is largely due to the fact that the author has much greater taxonomic expertise on this particular group than for other groups of insect SGNC. Of the 56 species of leafhoppers and planthoppers included on the state list that were previously represented in the INHS insect collection, 17 (30%) have not been collected within the past 15 years. If this group is representative of insects in general, then the declines in presence of insect SGNC have indeed been significant, but perhaps not as dire as suggested by our sampling data overall.

One leafhopper species recorded at several localities during the project merits special mention: *Kansendria kansiensis* (Fig. 18). This species, a native of Oklahoma and Kansas, was not recorded from Illinois prior to 1995. It has since been recorded at more than 10 localities throughout the state, including prairie restorations and reconstructions. It appears to be one of the only prairie-specialist leafhopper species capable of colonizing isolated prairie remnants on its own, where it feeds on various native perennial warm-season grasses. Based on the distribution data obtained for this species during the present study, it probably merits de-listing because its range is expanding, in contrast to the many other native, conservative prairie leafhoppers (e.g., Figs. 1-7) that have experienced declines in their historic ranges since DeLong's (1948) original survey of Illinois leafhoppers.

Acknowledgments

This project could not have been completed without the help Dr. Dmitry Dmitriev (INHS Insect Collection Manager), who developed the project website and database, and prepared the distribution maps. Dr. Adam Wallner (currently at USDA, APHIS-PPQ Miami, FL) contributed numerous records from his recent sampling in Illinois hill prairies. Technical support by A. Keever, S. Krishnankutty, J. Potter, and funding from IDNR and USFWS are also gratefully acknowledged.

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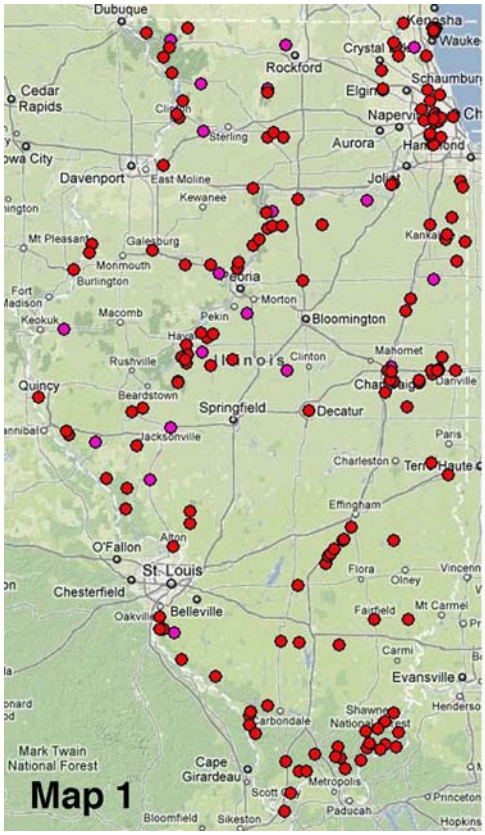
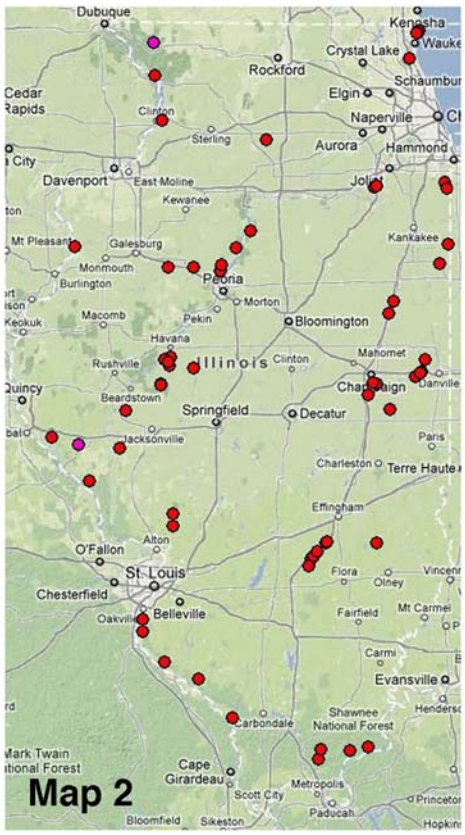
Maps 1 and 2. Map 1: historical collecting localities for insect SGNC in Illinois represented by specimens deposited in the INHS insect collection. Map 2: localities sampled for the current project at which insect SGNC were recorded, based on newly collected specimens and others sorted from backlog samples obtained since 1995 and stored at INHS.





Figures 1-8. Some leafhopper species included on the Illinois list of SGNC and recorded in the present project: 1, *Flexamia albida*; 2, *Flexamia pyrops*; 3, *Flexamia grammica*; 4, *Athysanella incongrua* (now listed as endangered in IL); 5, *Rosenus cruciatus*; 6, *Destria fumida*; 7, *Polyamia herbida*; 8, *Kansendria kansiensis* (not recorded in IL prior to 1995; native to Kansas/Oklahoma and appears to be expanding its range).

Table 1. List of Illinois insect SGNC represented in INHS insect collection, with numbers of specimens, localities, and collecting events, and the year of the most recent Illinois record.

Order	Family	Genus	Species	specimens	localities	events	last seen
Hemiptera	Caliscelidae	Fitchiella	robertsoni	1	1	1	2004
Hemiptera	Caliscelidae	Peltonotellus	histrionicus	2	2	2	1935
Hemiptera	Cicadellidae	Aflexia	rubranura	99	5	7	2003
Hemiptera	Cicadellidae	Amblysellus	aureovittata	2	1	2	2008
Hemiptera	Cicadellidae	Athysanella	balli	28	3	6	2008
Hemiptera	Cicadellidae	Athysanella	incongrua	14	1	3	2005
Hemiptera	Cicadellidae	Attenuipyga	vanduzeei	2	1	1	1945
Hemiptera	Cicadellidae	Chlorotettix	dentatus	5	1	2	1935
Hemiptera	Cicadellidae	Chlorotettix	fumidus	1	1	1	2007
Hemiptera	Cicadellidae	Chlorotettix	limosus	33	4	7	1936
Hemiptera	Cicadellidae	Commellus	colon	18	2	3	1968
Hemiptera	Cicadellidae	Cosmotettix	delector	20	7	7	2010
Hemiptera	Cicadellidae	Cosmotettix	luteocephalus	5	1	1	2008
Hemiptera	Cicadellidae	Deltocephalus	gnarus	109	6	6	1935
Hemiptera	Cicadellidae	Destria	fumida	20	7	7	2010
Hemiptera	Cicadellidae	Extrusanus	oryssus	1	1	1	2008
Hemiptera	Cicadellidae	Flexamia	abbreviata	62	3	4	2005
Hemiptera	Cicadellidae	Flexamia	albida	86	4	5	2008
Hemiptera	Cicadellidae	Flexamia	atlantica	41	9	16	2010
Hemiptera	Cicadellidae	Flexamia	grammica	249	4	6	2010
Hemiptera	Cicadellidae	Flexamia	pyrops	106	20	21	2007
Hemiptera	Cicadellidae	Kansendria	kansiensis	44	10	10	2011
Hemiptera	Cicadellidae	Laevicephalus	minimus	175	10	13	2010
Hemiptera	Cicadellidae	Laevicephalus	peronatus	17	6	6	2011
Hemiptera	Cicadellidae	Limotettix	elegans	9	4	4	2007
Hemiptera	Cicadellidae	Limotettix	parallelus	53	7	10	2003
Hemiptera	Cicadellidae	Limotettix	truncatus	12	4	4	2003
Hemiptera	Cicadellidae	Lonatura	catalina	108	5	9	2003
Hemiptera	Cicadellidae	Macrosteles	pottoria	18	3	3	1934
Hemiptera	Cicadellidae	Memnonia	panzeri	2	1	1	2003
Hemiptera	Cicadellidae	Mesamia	straminea	2	1	1	1996
Hemiptera	Cicadellidae	Paraphlepsius	altus	7	3	3	1962
Hemiptera	Cicadellidae	Paraphlepsius	electus	19	10	10	2010
Hemiptera	Cicadellidae	Paraphlepsius	humidus	5	3	4	1941
Hemiptera	Cicadellidae	Paraphlepsius	incisus	6	5	5	1935
Hemiptera	Cicadellidae	Paraphlepsius	lupalus	1	1	1	1935
Hemiptera	Cicadellidae	Paraphlepsius	maculosus	1	1	1	1934
Hemiptera	Cicadellidae	Paraphlepsius	nebulosus	4	3	4	2004
Hemiptera	Cicadellidae	Paraphlepsius	rossi	2	1	1	1934
Hemiptera	Cicadellidae	Paraphlepsius	solidaginis	7	7	7	2010
Hemiptera	Cicadellidae	Paraphlepsius	umbellatus	4	3	3	1962
Hemiptera	Cicadellidae	Paraphlepsius	umbrosus	1	1	1	1934
Hemiptera	Cicadellidae	Polyamia	dilata	25	4	4	2004
Hemiptera	Cicadellidae	Polyamia	herbida	46	9	11	2008

Hemiptera	Cicadellidae	Polyamia	interrupta	94	7	9	2007
Hemiptera	Cicadellidae	Polyamia	obtecta	59	19	24	2007
Hemiptera	Cicadellidae	Polyamia	rossi	127	14	19	2007
Hemiptera	Cicadellidae	Polyamia	similaris	103	15	22	2010
Hemiptera	Cicadellidae	Prairiana	cinerea	3	3	3	1944
Hemiptera	Cicadellidae	Rosenus	cruciatus	142	11	19	2010
Hemiptera	Cicadellidae	Scaphytopius	abbreviatus	7	2	2	2008
Hemiptera	Cicadellidae	Scaphytopius	cinereus	101	20	26	2008
Hemiptera	Cicadellidae	Scaphytopius	dorsalis	3	3	3	2007
Hemiptera	Cicadellidae	Texananus	cumulatus	129	2	4	1935
Hemiptera	Cicadellidae	Texananus	decorus	37	26	31	2009
Hemiptera	Cicadidae	Diceroprocta	vitripennis	31	7	10	1998
Lepidoptera	Cosmopterygidae	Triclonella	determinatella	18	2	18	1974
Lepidoptera	Gelechiidae	Stegasta	bosquella	35	6	32	1976
Lepidoptera	Geometridae	Apodrepanulatrix	liberaria	20	6	15	1940
Lepidoptera	Geometridae	Erastria	coloraria	41	12	29	1958
Lepidoptera	Geometridae	Euchlaena	milnei	6	1	5	1973
Lepidoptera	Geometridae	Petrophora	subaequaria	29	7	14	1961
Lepidoptera	Geometridae	Semiothisa	eremiata	9	5	8	1930
Lepidoptera	Hesperiidae	Amblyscirtes	aesculapius	7	4	5	1969
Lepidoptera	Hesperiidae	Amblyscirtes	carolina	2	1	1	1966
Lepidoptera	Hesperiidae	Atrytone	arogos	12	3	8	1982
Lepidoptera	Hesperiidae	Atrytonopsis	hianna	6	6	6	1968
Lepidoptera	Hesperiidae	Erynnis	icelus	42	31	40	1979
Lepidoptera	Hesperiidae	Erynnis	lucilius	9	9	9	1978
Lepidoptera	Hesperiidae	Erynnis	martialis	28	20	25	1978
Lepidoptera	Hesperiidae	Erynnis	persius	39	28	35	1979
Lepidoptera	Hesperiidae	Euphyes	bimacula	32	10	15	1976
Lepidoptera	Hesperiidae	Euphyes	dukesi	12	6	9	1976
Lepidoptera	Hesperiidae	Hesperia	leonardus	32	16	17	1978
Lepidoptera	Hesperiidae	Hesperia	metea	9	7	8	1979
Lepidoptera	Hesperiidae	Hesperia	ottoe	30	4	11	1981
Lepidoptera	Hesperiidae	Hesperia	sassacus	7	5	6	1978
Lepidoptera	Hesperiidae	Problema	byssus	28	10	12	1978
Lepidoptera	Lycaenidae	Glaucopsyche	lygdamus	29	11	26	1983
Lepidoptera	Noctuidae	Acronicta	tritona	6	4	4	1940
Lepidoptera	Noctuidae	Apamea	indocilis	2	1	2	1940
Lepidoptera	Noctuidae	Apamea	lignicolora	11	5	9	1977
Lepidoptera	Noctuidae	Apamea (Agroperina)	lutosa	5	3	5	1948
Lepidoptera	Noctuidae	Archanara	laeta	4	2	4	1967
Lepidoptera	Noctuidae	Archanara	subflava	19	8	18	1947
Lepidoptera	Noctuidae	Bagisara	gulnare	63	8	61	1974
Lepidoptera	Noctuidae	Calyptra	canadensis	21	9	17	1968
Lepidoptera	Noctuidae	Capis	curvata	9	4	6	1925
Lepidoptera	Noctuidae	Catocala	abbreviatella	12	3	11	1971
Lepidoptera	Noctuidae	Catocala	amestris	10	5	8	1948

Lepidoptera	Noctuidae	Catocala	antinympha	18	11	12	1935
Lepidoptera	Noctuidae	Catocala	dulciola	1	1	1	1900
Lepidoptera	Noctuidae	Catocala	marmorata	6	5	5	1913
Lepidoptera	Noctuidae	Catocala	relicta	22	12	16	1937
Lepidoptera	Noctuidae	Catocala	whitneyi	4	2	4	1961
Lepidoptera	Noctuidae	Papaipema	araliae	4	3	4	1922
Lepidoptera	Noctuidae	Papaipema	beeriana	32	7	32	1940
Lepidoptera	Noctuidae	Papaipema	birdi	2	1	2	1907
Lepidoptera	Noctuidae	Papaipema	cerussata	13	5	9	1986
Lepidoptera	Noctuidae	Papaipema	eryngii	24	4	23	1938
Lepidoptera	Noctuidae	Papaipema	eupatorii	12	5	12	1936
Lepidoptera	Noctuidae	Papaipema	harrisii	3	1	3	1928
Lepidoptera	Noctuidae	Papaipema	inquaesita	23	3	21	1963
Lepidoptera	Noctuidae	Papaipema	leucostigma	20	5	18	1976
Lepidoptera	Noctuidae	Papaipema	limpida	2	1	2	1946
Lepidoptera	Noctuidae	Papaipema	maritima	17	4	14	1937
Lepidoptera	Noctuidae	Papaipema	necopina	26	8	24	1982
Lepidoptera	Noctuidae	Papaipema	nelita	23	5	22	1941
Lepidoptera	Noctuidae	Papaipema	nepheleptena	4	2	4	1917
Lepidoptera	Noctuidae	Papaipema	pterisii	19	4	16	1955
Lepidoptera	Noctuidae	Papaipema	rigida	35	3	27	1982
Lepidoptera	Noctuidae	Papaipema	rutila	23	7	20	1969
Lepidoptera	Noctuidae	Papaipema	sciata	27	8	27	1986
Lepidoptera	Noctuidae	Papaipema	silphii	27	6	27	1959
Lepidoptera	Noctuidae	Papaipema	specioissima	16	4	12	1929
Lepidoptera	Noctuidae	Papaipema	unimoda	24	8	21	1960