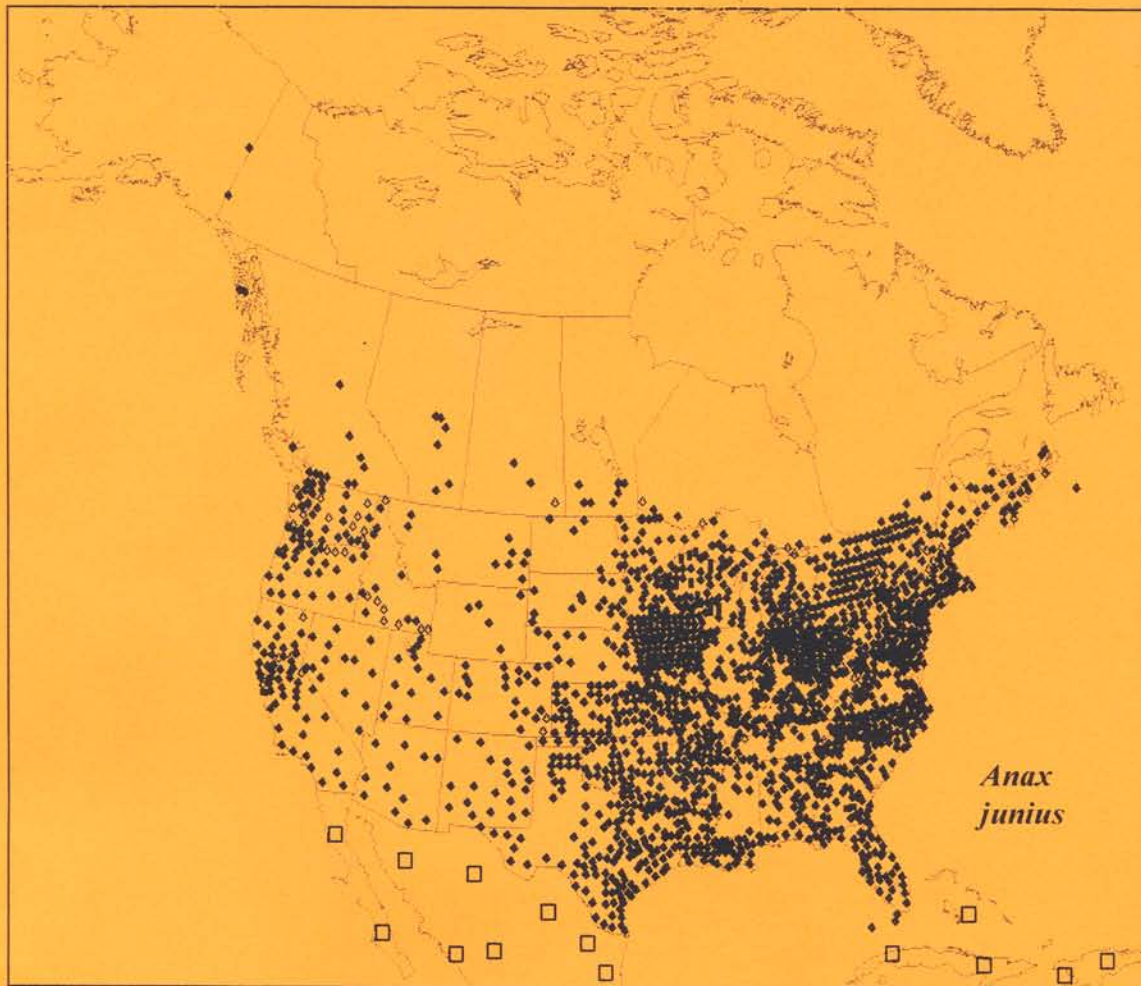


BULLETIN OF AMERICAN ODONATOLOGY



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**DISTRIBUTION OF NORTH AMERICAN ODONATA. PART I:
AESHNIDAE, PETALURIDAE, GOMPHIDAE, CORDULEGASTRIDAE**
Thomas W. Donnelly, p. 61-90

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DISTRIBUTION OF NORTH AMERICAN ODONATA. PART I: AESHNIDAE, PETALURIDAE, GOMPHIDAE, CORDULEGASTRIDAE¹

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ABSTRACT: Dot-map presentations show the distributions for species of Aeshnidae, Petaluridae, Gomphidae, and Cordulegastridae in North America. Additional comments, including subspecies information, are provided for several species.

INTRODUCTION: Nearly a decade ago I announced (Donnelly, 1994) the dot-map project, which was conceived to show the distribution of North American Odonata at the county level. Up to that date, distributional summaries commonly showed distribution by state, which is a level too coarse for the present state of knowledge and for the needs of the Odonata community.

Our knowledge of the distribution of Odonata is rudimentary compared, say, with birds. Even today there are far fewer people recording basic data about Odonata than for birds, and as recently as fifty years ago there were no more than a dozen people actively studying Odonata in all of North America. An example is a comparison of the state of knowledge of birds and odonates in my state, New York. When Robert Andrie published the Breeding Bird Atlas of New York in 1980 he noted that this project recorded the contributions of 4000 people. When I published my first list of New York Odonata in 1992 I listed 18 people who had contributed data, and half of these contributed only a single record!

The immaturity of Odonata study is also shown by the high numbers of species recorded from the home areas of a relatively few vigorous, long-term workers. These numbers are high because of repeated sampling, both through the season and over a period of several years. I have found after decades of study in Broome County NY that I can probably find no more than 80 % of the total recorded fauna in a single given year. The large number of species in these few areas emphasizes the importance of long-term monitoring. Dot maps show thoroughness of coverage more effectively than maps that show ranges with an amoeba-like uniform shading.

Even at our present rudimentary level of knowledge we can draw important conclusions about range limits, incidence of stray records, terrain

requirements, disjunctions, etc., for our odonate fauna.

The reason for selecting the county level was that most of the data was available for counties. Also, The average size of counties is of the same order of magnitude as potential metapopulations of many – perhaps most – Odonata. Another reason for selecting the county is for many older specimens localities were commonly given only for the nearest town, and I wish to avoid the implied precision of locating records at these points.

US counties are not uniform in size for the entire country, but reasonably uniform in large subdivisions of the country. The average size of counties grades from largest in the southwest to smallest in the southeast, with the western counties about two or three times larger than the eastern.

At the beginning of the project, there were only a few state-level data compilations in existence for US states or Canadian provinces. Several projects were organized in the mid-1990's, and, happily, there appear today to be organized efforts in data gathering for the majority of our states and provinces. A glance at the maps will instantly and vividly identify states with less thorough coverage. At the midpoint of this decade of data gathering, Missouri was one of the most poorly covered states. The vigor of several workers in this state in a very few years has raised its coverage to a similar level with adjoining states. A glance at the map, especially for the most common species, will identify those states whose coverage is still relatively poor.

PRESENTATION OF THE RESULTS: The results will be presented in three parts, each corresponding in size approximately to an issue of the *Bulletin of American Odonatology*. One of the advantages of presenting the results serially is that feedback from the first presentation may help in modifications of the presentation method in the subsequent numbers. A list of contributors and other sources will be appended to the final number.

ORGANIZATION OF THE DATA: For the United States, counties are the basic unit. In several instances, old but useful data is presented

¹ Bulletin of American Odonatology 7(4): 61-90

more vaguely, so I have devised additional multi-county units with their own dots, such as "Long Island", "Okefenokee Swamp", "Great Smoky Mountains National Park", "Yellowstone National Park", etc. I have divided widespread Monroe County FL into three units: "Dry Tortugas", "Keys", and the mainland, "Monroe". I have lumped the five counties that comprise New York City into a single unit, and data from the fifty odd "Cities" in Virginia (except for five county-size units) are lumped into the adjacent counties.

Unfortunately, counties are not permanent units. Several have been created in the last fifty years, and in one state (Virginia) several counties have been reorganized into cities. Thus, Nansemond County, the location of the Dismal Swamp, no longer exists, and the old records for this county are now assigned to Chesapeake (City) or Suffolk (City). More recently the state of Nevada attempted to create Bullfrog County, but this proposal was struck down by the US Supreme Court.

Except for the Maritime Provinces, counties (and equivalent sub-provincial divisions) in Canada are not biologically useful units. Rural divisions in Canada (and also Alaska) vary from province to province, with the less populated areas divided into relatively large districts or rural municipalities. Kenora District in Ontario, for example, is larger than New York, Pennsylvania, and Ohio combined, and by itself it is a meaningless unit for odonate distribution. For Canada and Alaska, therefore, I followed the innovation of Pilon and Lagacé (1998), who illustrated the distribution of Québec data in blocks measuring 30 minutes longitude and 15 minutes latitude. I use this system, except that the blocks in this presentation measure 30 minutes square. At 48 degrees latitude the size of a 30'X30' block is about 2060 square kilometers, which is approximately the same as average US counties (2380 square kilometers average).

Where locality data did not include county, or block, I located places using web-sites of the US Geological Survey, and of Natural Resources Canada. A very high success rate was achieved, with the main problems being the use of duplicated names (e.g. "Loon Lake"), or of milepost or mileage localities ("Milepost 248 on the Dempster Highway", or "52 miles east of Boise"). The now-popular use of GPS positioning systems has arrived too late except for some recent additions.

I show four classes of records ("levels") in the maps. Virtually all records fall in level one, which

was originally meant to indicate collected adult specimens or specimens verified in the hand and then released. Level 2 is photographic records, some of which are not useful even though often beautiful. Level 3 is larvae or exuviae. These are mainly useful for Gomphidae, for which many adults are elusive, or fly during a brief season. Level 4 is for sight records. I have had difficulty setting criteria for the acceptance of non-acceptance of these records. I have assumed that virtually all records of *Anax longipes* or *Libellula luctuosa*, to pick two examples, can be trusted, but that only a few sight records of *Enallagma* species can be accepted. In most cases the submitted record may be correct, but, because these maps will have an authoritative status, I have decided not to give such records the voucher status that is implied by a dot on the map. Unfortunately, most of the records submitted to me did not show the level of the data, and I have had to lump these into level one.

In many cases where the data looked suspicious I contacted the contributor to find the source. In cases where the record seemed improbable (especially in the Gomphidae, which tend to have tightly delineated ranges), I omitted the record. Some observers have not fully appreciated the difficulty in keying larvae using the standard handbooks, and I have omitted a few larval records because of potential ambiguities in identification.

I have arbitrarily deleted some records that seem to have been found unreasonably far from the well-known range of the species. I have examined many specimens to settle these problems. I have frequently sought advice from many colleagues, and I am grateful to all of them for always giving my enquiries a high priority. I have nearly always followed their advice. But in the end, the acceptance or rejection of many of these records has been based on my own judgment.

One conclusion that has arisen from this data compilation is that the Odonata community has underestimated the tendency of many odonates to disperse considerable distances from their normal ranges. Some of these cases are widely appreciated (e.g. *Tramea calverti*), but there are many less obvious cases. Aeshnidae and Libellulidae have numerous examples, and damselfly families have a few. The most surprising, to me, were several instances of records of strays from the Gomphidae.

In cases where the insect appears to have traveled under its own power, I have included the record without implying that the species has ever been

resident at the locality, but I have omitted records of what appear to be accidentally transported insects (see *Gomphus graslinellus*, below).

If nothing else is achieved from this effort, the maps should encourage workers to investigate the margins of ranges of species in an effort to define what a range margin should be like, and to determine core ranges versus ranges of satellite populations. Indeed, the entire concept of "range" of Odonata appears to be poorly understood.

I have not attempted to show in this presentation temporal evidence for spreading of ranges of several odonate species, nor have I indicated possible retractions of range. The change of range with time is an attractive subject for future research.

Where records are available for a state only, I have used a larger open square to indicate these records. I also show records from northern Mexico, Cuba, the Bahamas, and Hispaniola with this symbol.

SUBSPECIES, AND SPECIES OF SPECIAL INTEREST:

Aeshna interrupta: I have recorded where possible the four Walker (1908) subspecies of *A. interrupta*, which were originally described as species but re-evaluated as subspecies in his monograph (Walker, 1912). I show on the map the boundaries of these subspecies ranges as I presently understand them. The three western subspecies are best (in my view) distinguished by the morphology of the cerci, but in practice many odonatists today pay more attention to the width of the thoracic stripes, which appear to me to be too variable. In the western "core area" of this species (Oregon, Washington, and British Columbia) very few specimens have been determined to subspecies (as reported to me), so this core area remains subspecifically undifferentiated.

Aeshna multicolor. The record from Martha's Vineyard MA is of a specimen in the Pennsylvania State University collection, that was determined by Edmund Walker.

Tanypteryx hageni. Miller and Gustafson (1996) discuss a female specimen in the Montana State University collection labeled "Bozeman". The city itself would be highly improbable, but the Gallatin Range, about ten miles to the south, is at least possible. I regard the record as probably mislabeled and have omitted it.

Erpetogomphus lampropeltis. Garrison (1994) evaluated the former species (*lampropeltis* and *natix*) as subspecies, and I follow his conclusions.

Gomphus graslinellus. A specimen from Ulster County NY suggests a considerable extension of range of this mid-western species. I interpreted the occurrence (Donnelly, 2003), which was immediately adjacent to a busy interstate highway, as accidental transport by a vehicle, and have not included the NY record here.

Gomphus septima. Donnelly and Carle (2000) described *delawarensis* as a subspecies of *septima*. They are highly disjunct (600 km). A single sight record, at best attributable to the species alone, is slightly north of the southern population.

Lanthus parvulus and *vernalis*. A problem with *parvulus* is that there are many records prior to the description of *vernalis* in 1980 that may belong to the latter species. I have differentiated these records as smaller dots on the map of *parvulus*.

I have omitted two western records of *parvulus*, from Michigan and Minnesota. The first, which Mark O'Brien regards as improbable, is from a student collection at Michigan State University. I have arbitrarily removed the Minnesota (Mille Lac County) record as improbable.

Ophiogomphus incurvatus. Carle (1982) described *incurvatus* and *alleganiensis* as subspecies, but later (1986) noted *alleganiensis* as a species, without explanation. Informal discussions with colleagues have revealed variable interpretations of the status of these two taxa, but no defense of their specific distinction has appeared. I follow Carle's original assignment as distinct subspecies.

Ophiogomphus mainensis. Donnelly, (1987) described *fastigiatus* as a subspecies of *mainensis*, and I continue to recognize it at this level. In the same paper I noted that a southern population appeared to be indistinguishable from the northern *mainensis*. Recently I have found a consistent but minor morphological distinction between the northern *mainensis* and the southern population, which I note on the map as "southern form".

Ophiogomphus sp. A new species of *Ophiogomphus* from Wisconsin and Iowa is being described by Ken Tennessen and Tim Vogt. I refer to it here as *Ophiogomphus* sp.

Stylogomphus albistylus and *sp.* Carl Cook is in the process of describing a new species from Tennessee and Kentucky, and also west of the Mississippi River. I refer to it here as *Stylogomphus* *sp.* Many records of *albistylus* from its range may belong this new species, and the maps show these as small symbols. Cook identified two, and I add a third, morphologically intermediate specimens that are possible hybrids. These are shown as triangles rather than diamonds.

Cordulegaster bilineata and *diastatops*. These puzzling taxa have been interpreted as distinct species by Pilgrim (2002), and I follow his judgment. I also note that there are specimens in the area of overlap of the two species that appear morphologically intermediate; further studies might show either a case of extensive intergradation between two species, or two subspecies. Other records, whose specimens have not been examined by Pilgrim, are shown on the map as small symbols; in the area of overlap these records might be assignable to the other species.

Cordulegaster sp. A new species of *Cordulegaster* from central Arkansas is in the process of being described by Ken Tennessen. Here I refer to it as *Cordulegaster sp.*

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INDEX TO MAPS

(NOTE: A refers to Aeshnidae, P to Petaluridae (combined with final Aeshnidae map page), C to Cordulegastridae, and G to Gomphidae)

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Aeshna canadensis A 1
Aeshna clepsydra A 4
Aeshna constricta A 1
Aeshna dugesi A 6
Aeshna eremita A 1
Aeshna interrupta A 3
Aeshna juncea A 2
Aeshna multicolor A 3
Aeshna mutata A 3
Aeshna palmata A 5
Aeshna persephone A 6
Aeshna psilus A 6
Aeshna septentrionalis A 2
Aeshna sitchensis A 2
Aeshna subarctica A 4
Aeshna tuberculifera A 4
Aeshna umbrosa A 5
Aeshna verticalis A 4
Aeshna walkeri A 5

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 Anax longipes A 7
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 Gynacantha nervosa A 10 P
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 Oploniaeschna armata A 9
 Remartinia luteipennis A 9
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 Aphylla williamsoni G 1
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 Stylogomphus sp. G 3
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 Stylurus intricatus G 1
 Stylurus ivae G 11
 Stylurus laurae G 12
 Stylurus notatus G 12
 Stylurus olivaceus G 11
 Stylurus plagiatus G 12
 Stylurus potulentus G 11
 Stylurus scudleri G 12
 Stylurus spiniceps G 12

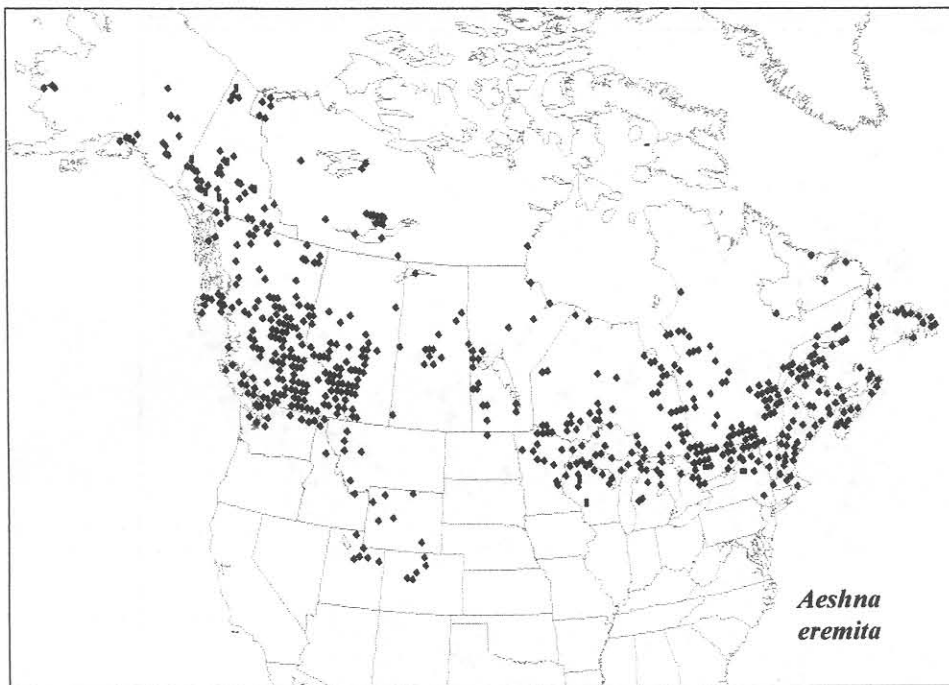
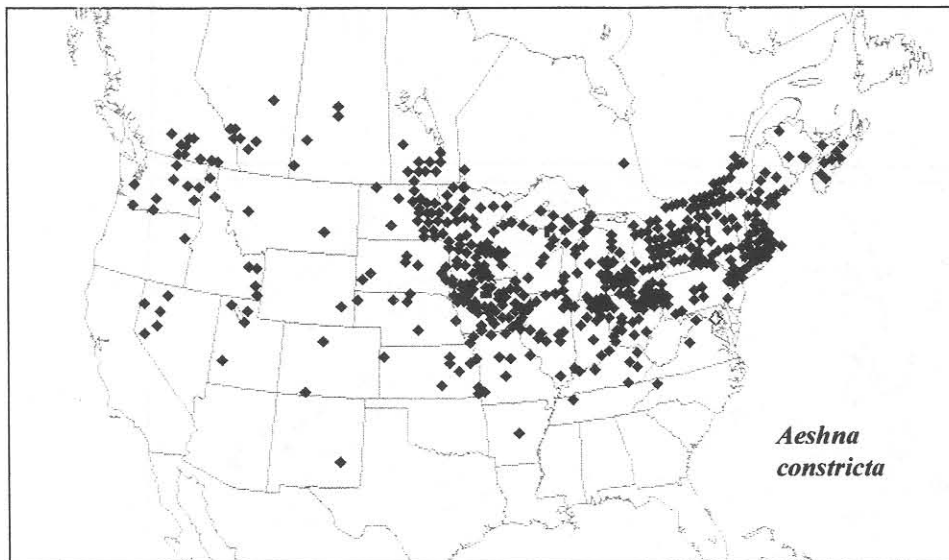
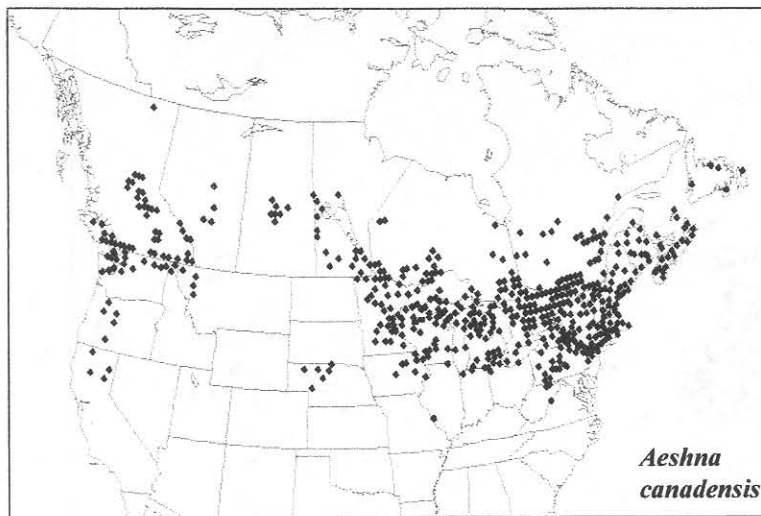
Stylurus townesi G 11

CORDULEGASTRIDAE

Cordulegaster bilineata C 1
 Cordulegaster diadema C 2
 Cordulegaster diastatops C 1
 Cordulegaster dorsalis C 2
 Cordulegaster erronea C 2
 Cordulegaster maculata C 1
 Cordulegaster obliqua C 1
 Cordulegaster sayi C 2
 Cordulegaster sp. C 2

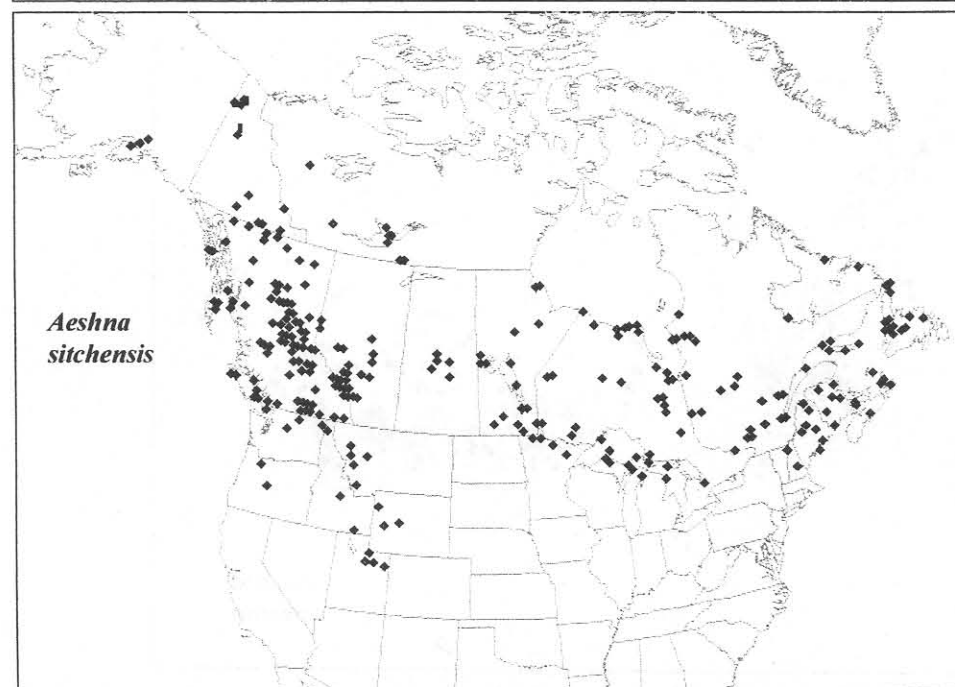
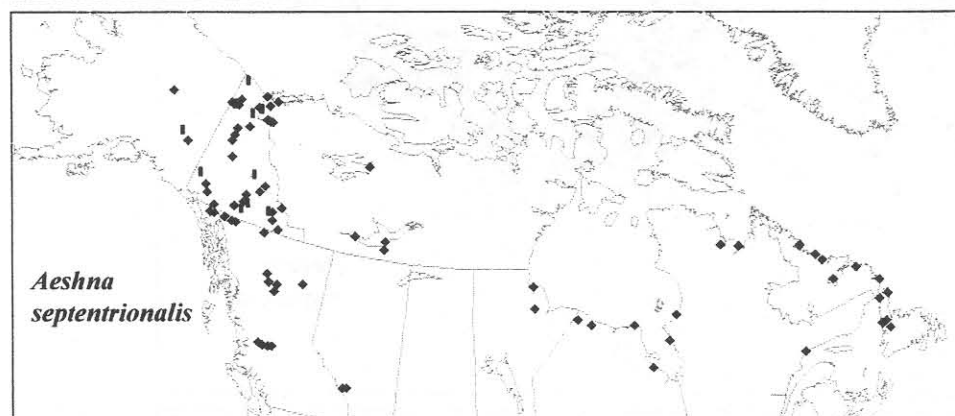
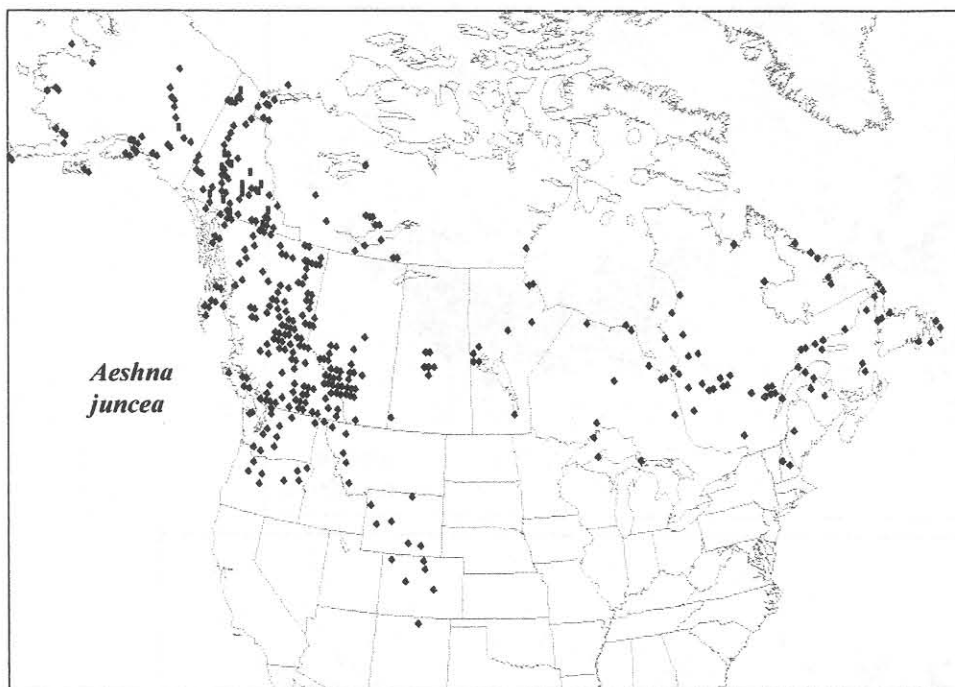
- ◆ Adult specimen; often used for stage unspecified
- Photograph of adult
- ▮ Larva or exuviae
- ◇ Sight Record
- Record specified for state (US or Mexico) or region

Key to the symbols used in the maps.



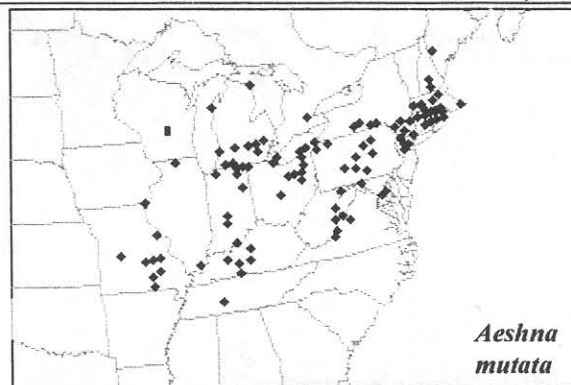
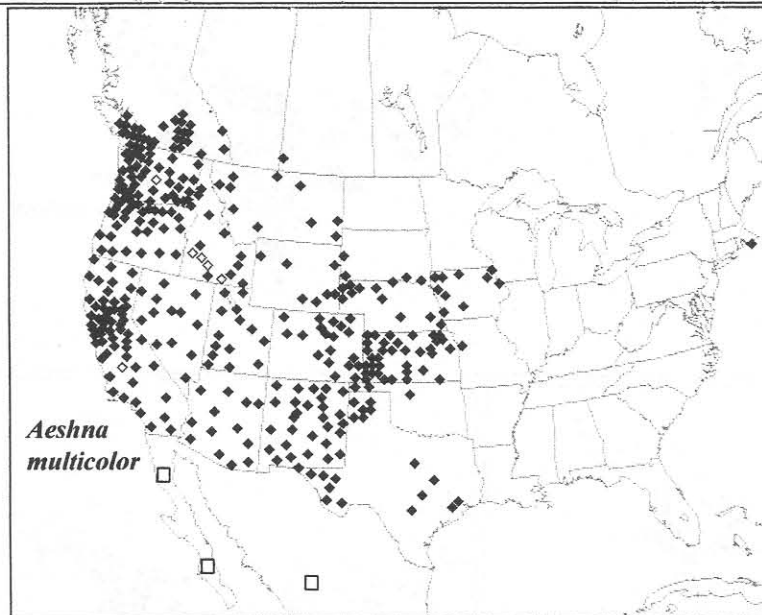
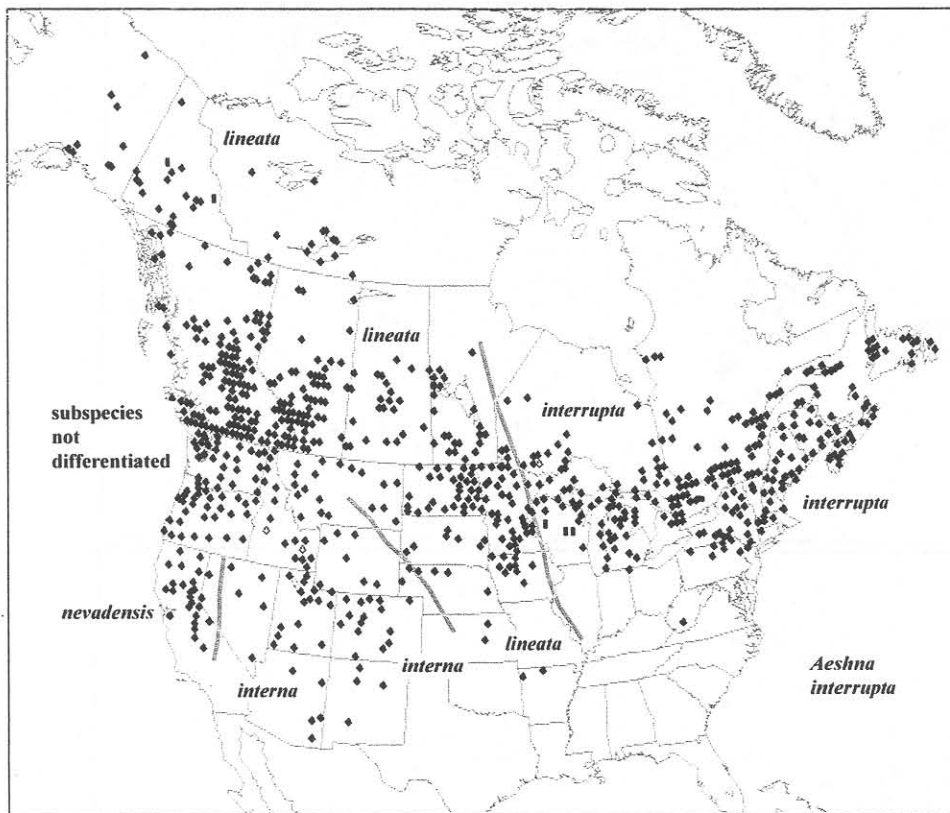
Aeshnidae 1

Aeshna canadensis, constricta, eremita



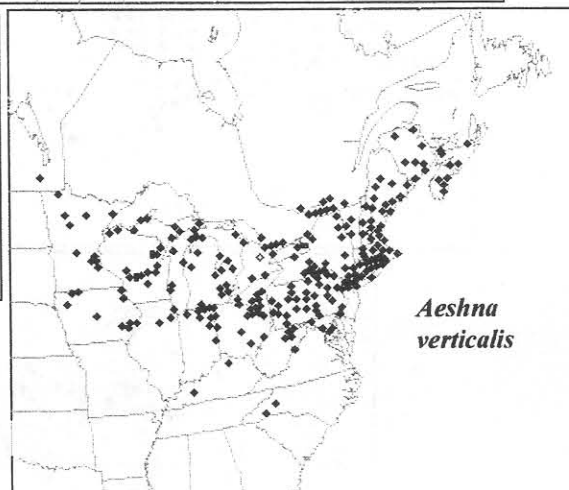
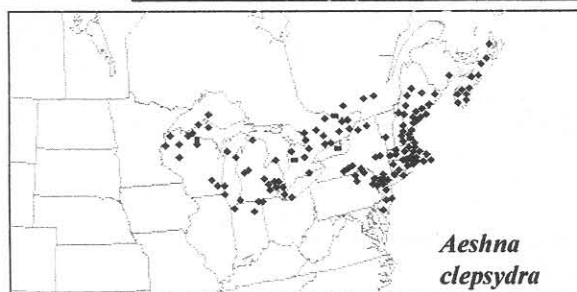
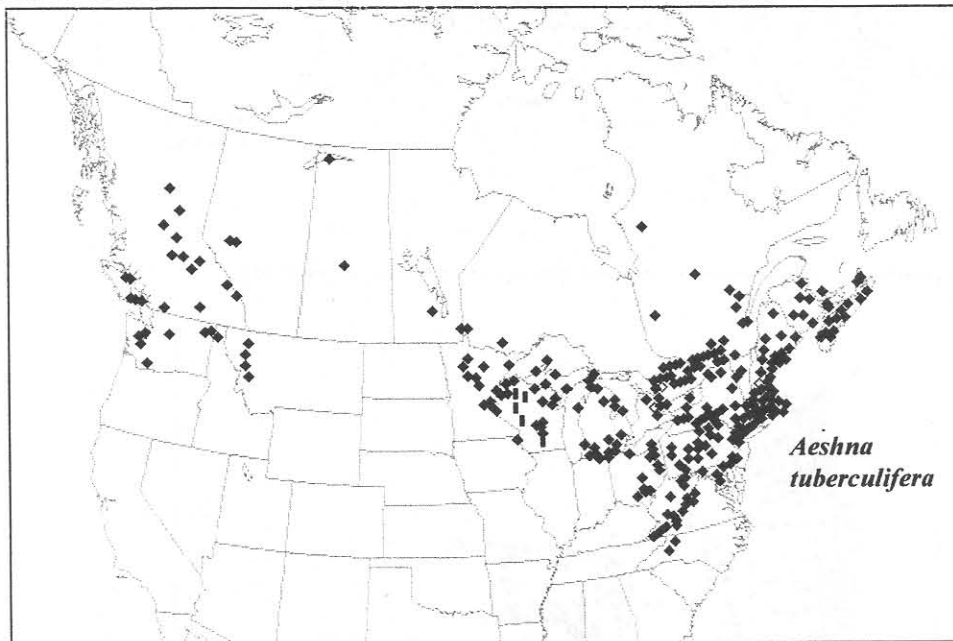
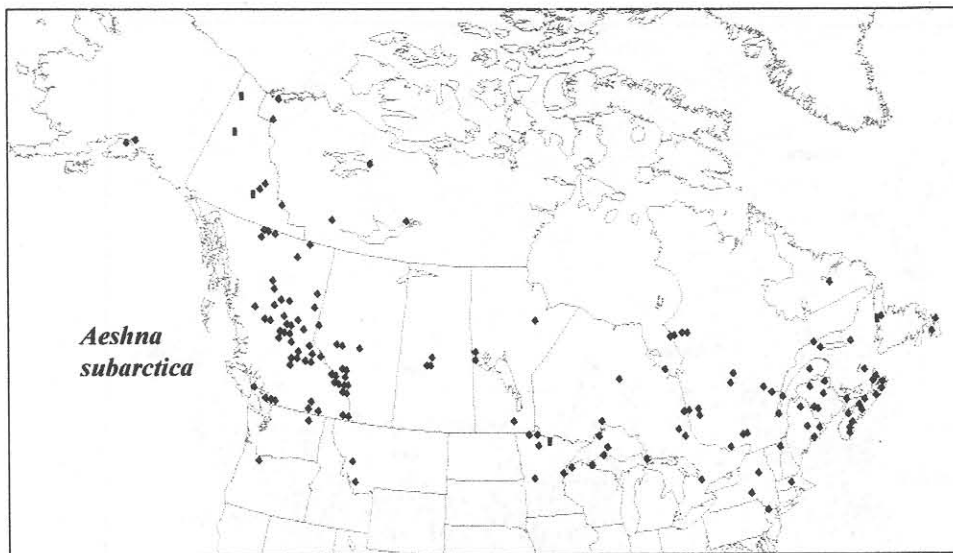
Aeshnidae 2

Aeshna juncea, septentrionalis, sitchensis



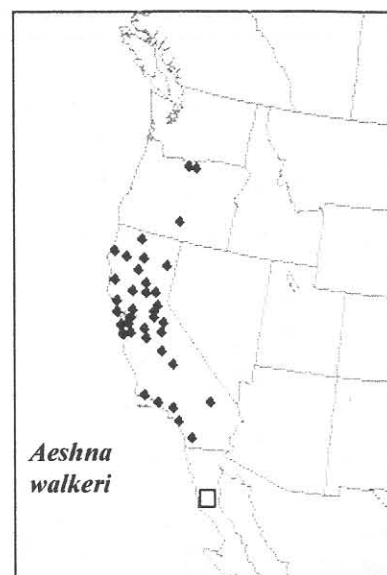
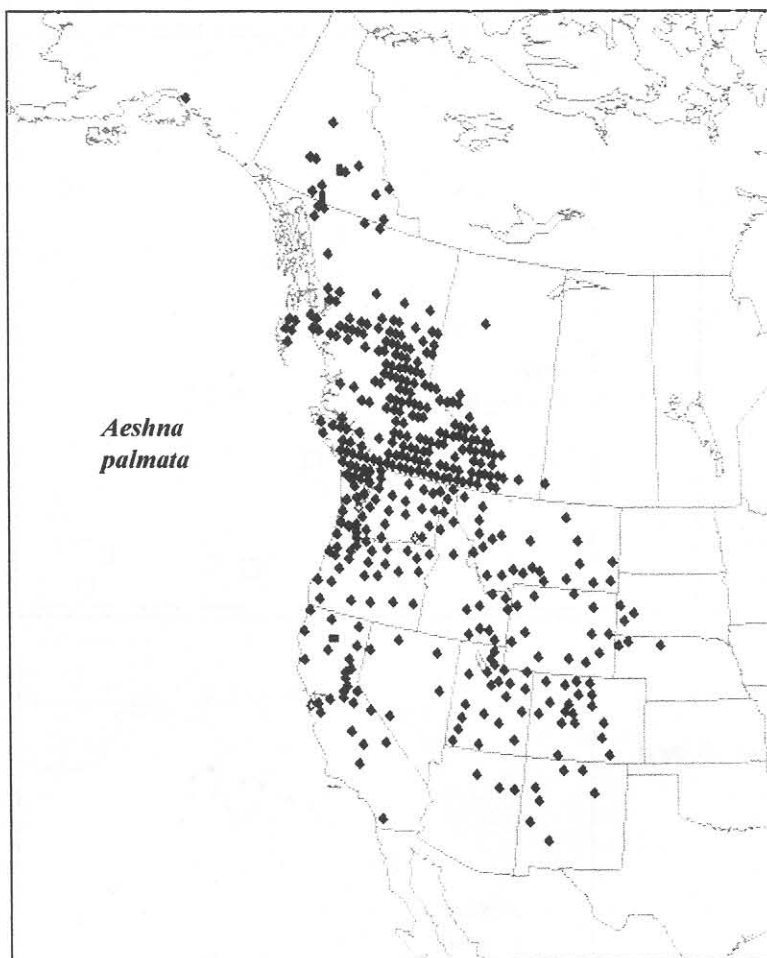
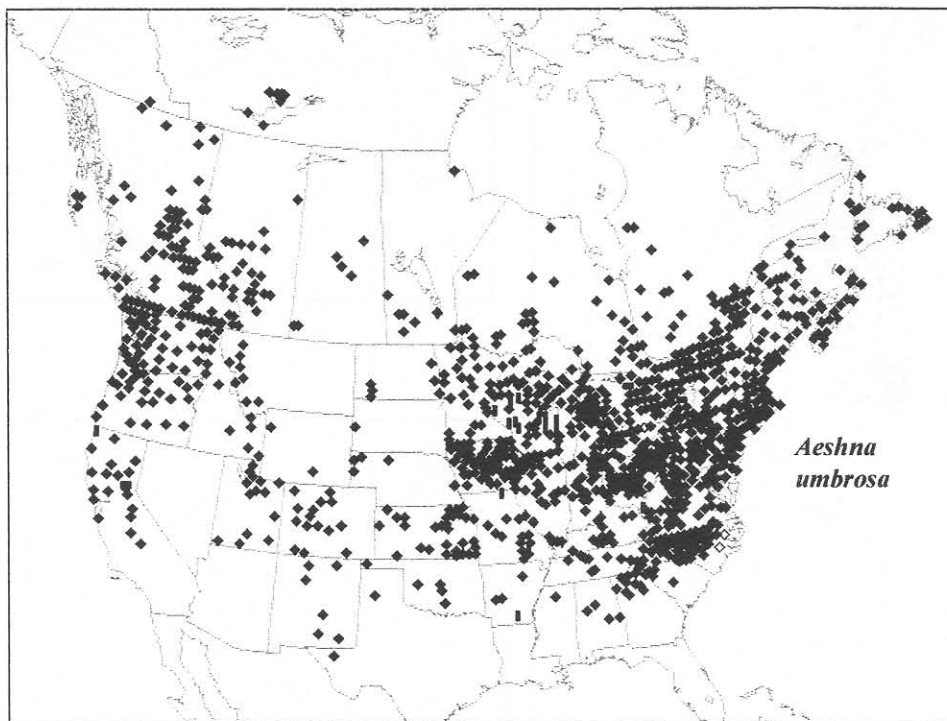
Aeshnidae 3

Aeshna interrupta, multicolor, mutata



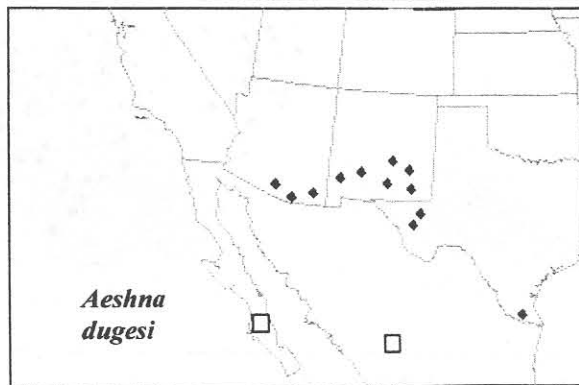
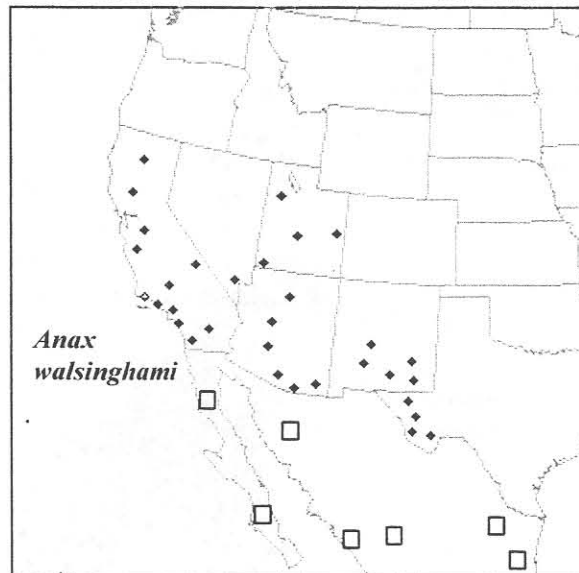
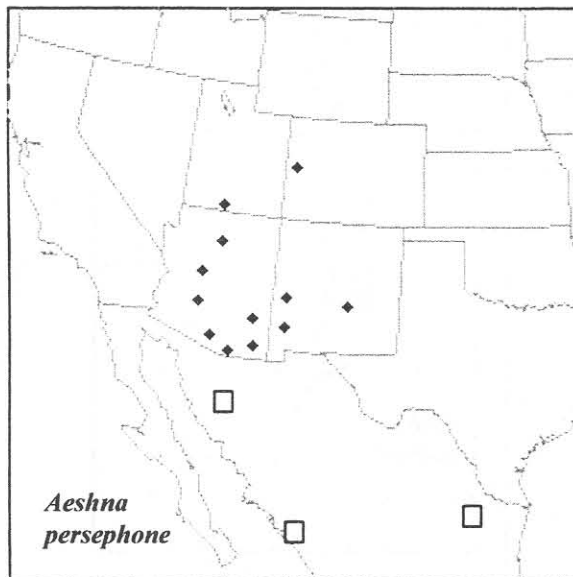
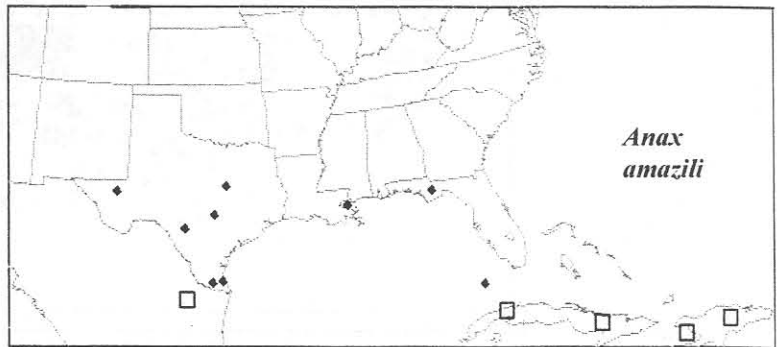
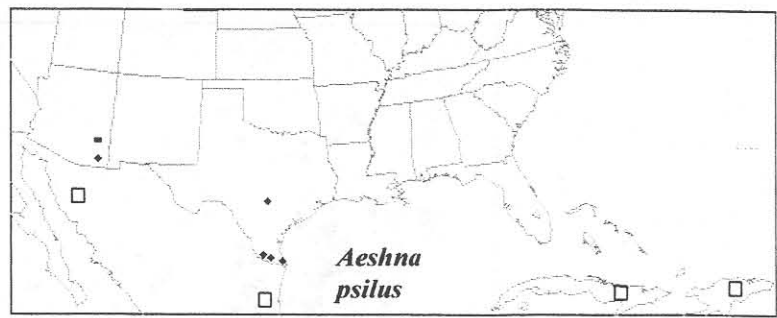
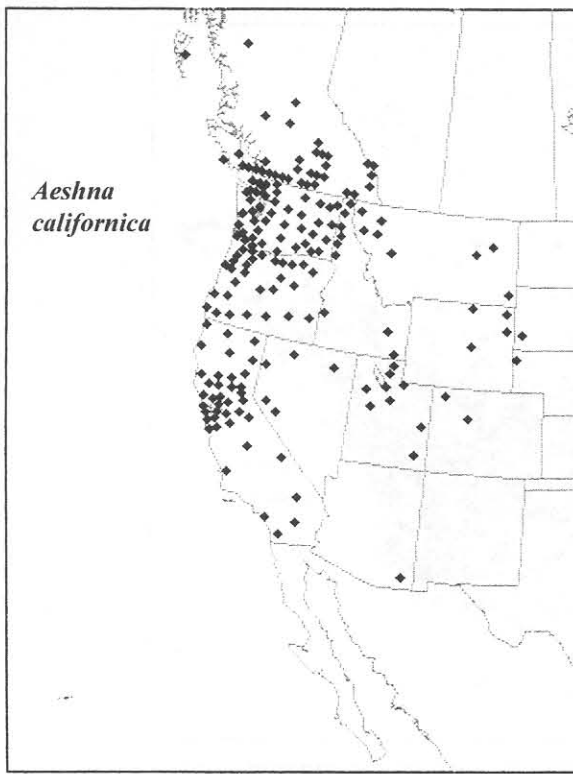
Aeshnidae 4

Aeshna subarctica, tuberculifera, clepsydra, verticalis



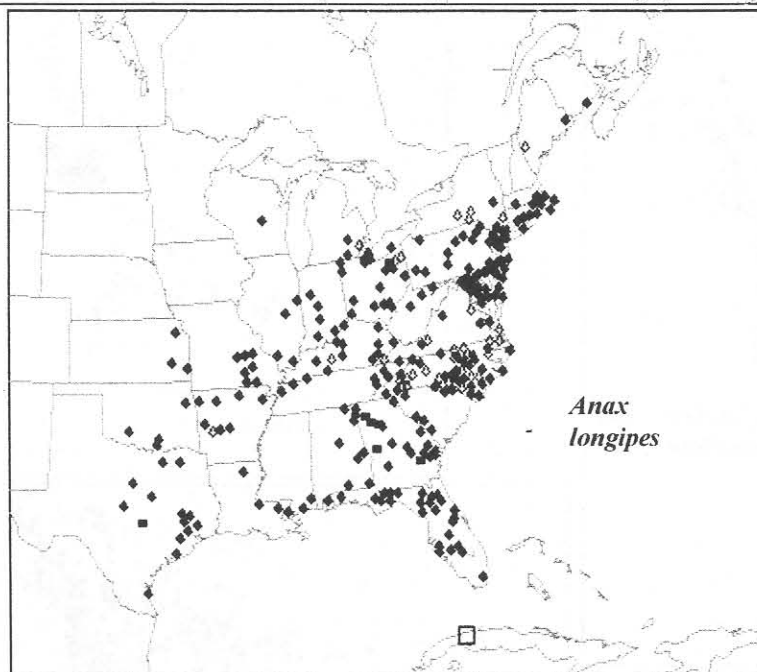
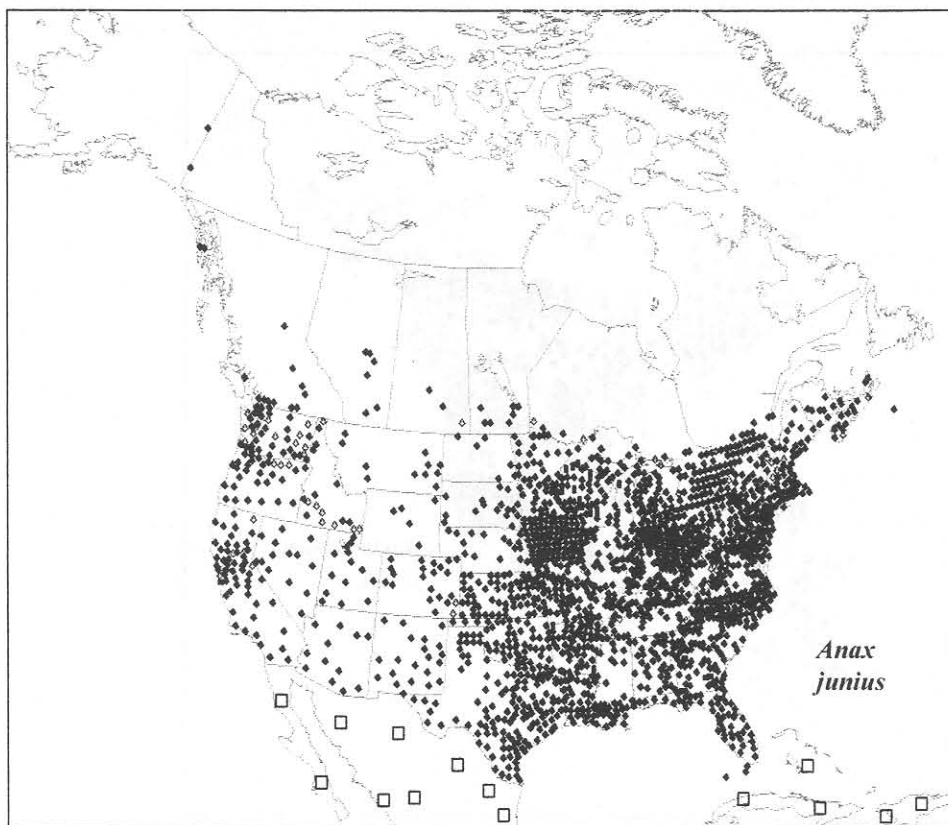
Aeshnidae 5

Aeshna umbrosa, palmata, walkeri



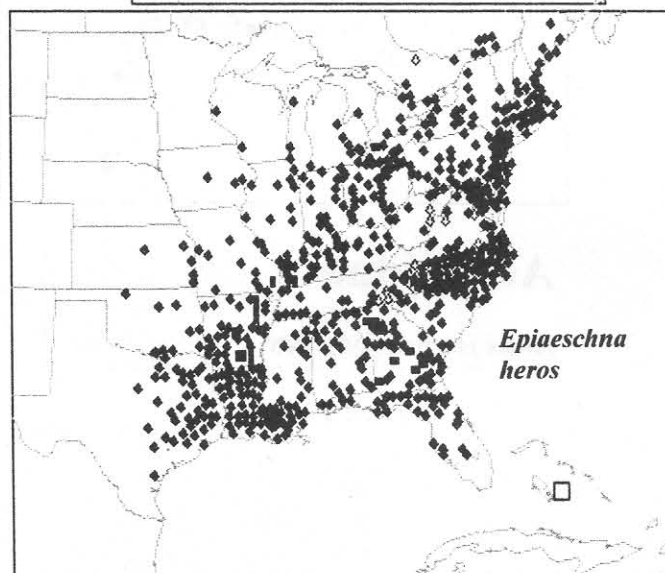
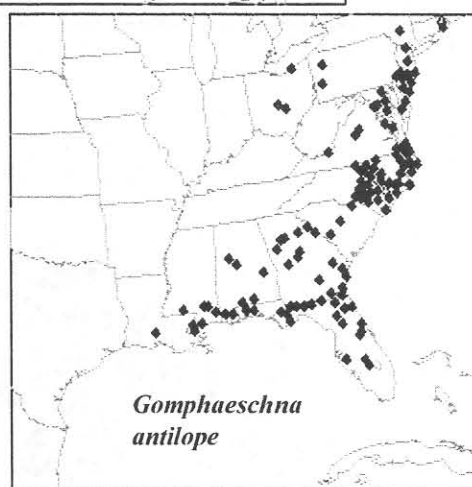
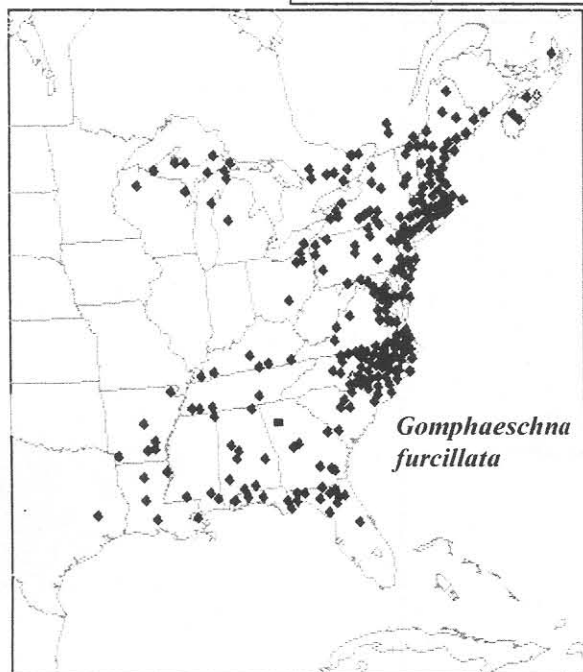
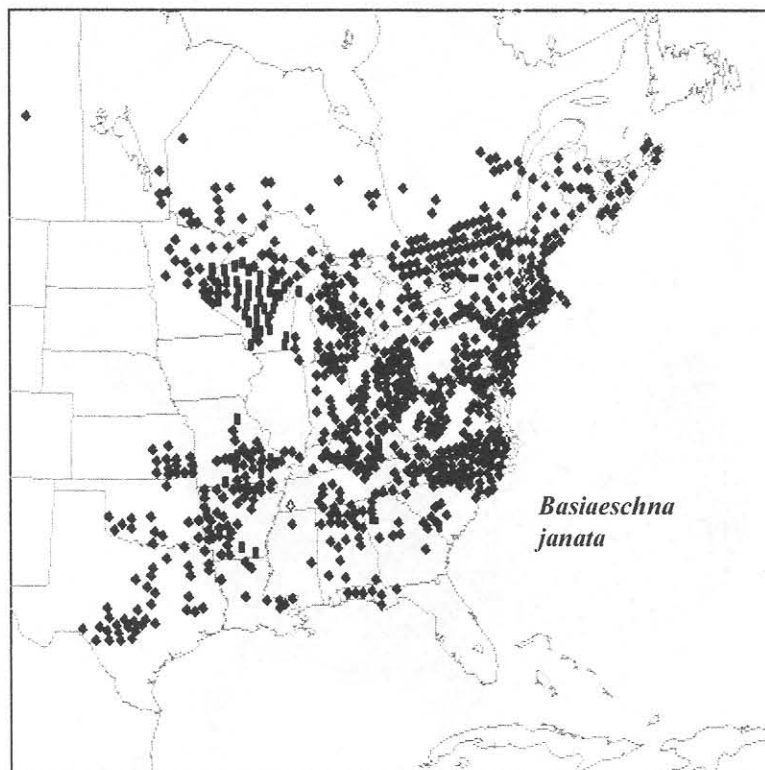
Aeshnidae 6

Aeshna californica, psilus, persephone, dugesi
Anax walsinghami, amazili



Aeshnidae 7

Anax junius, longipes

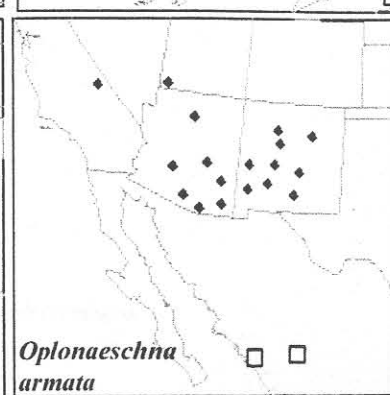
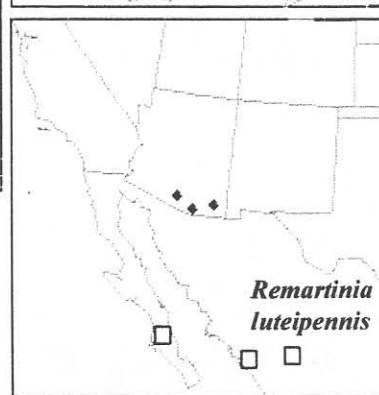
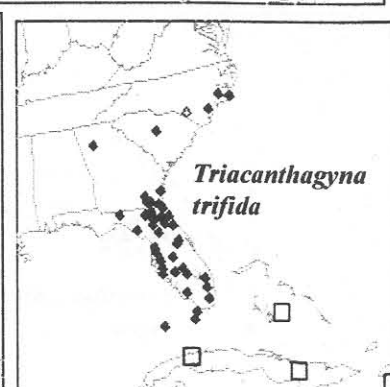
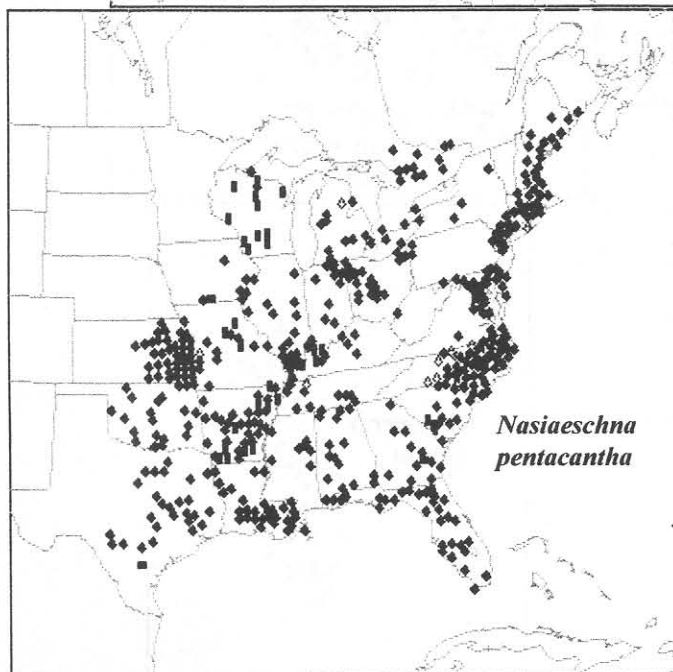
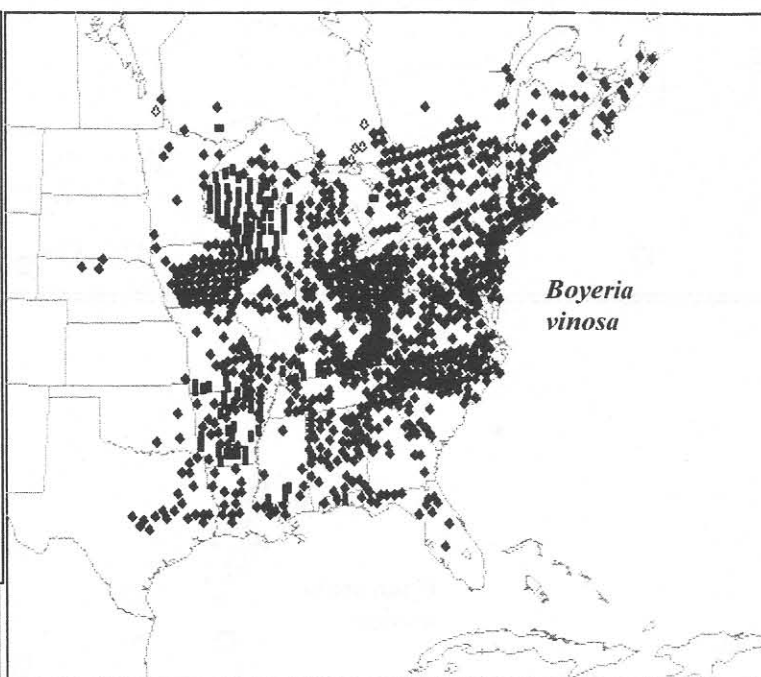
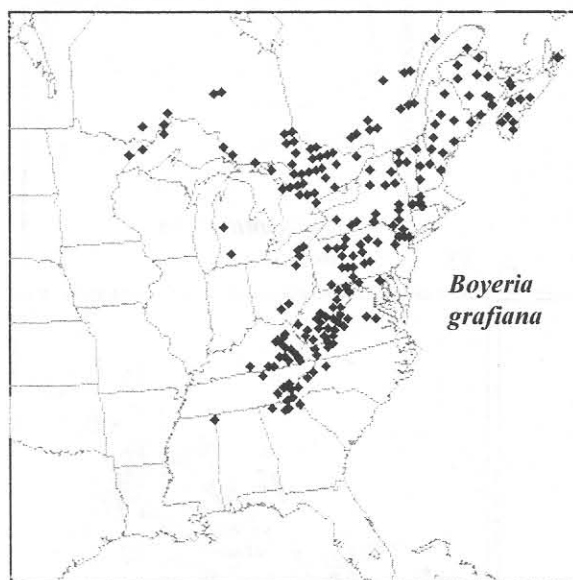


Aeshnidae 8

Basiaeschna janata

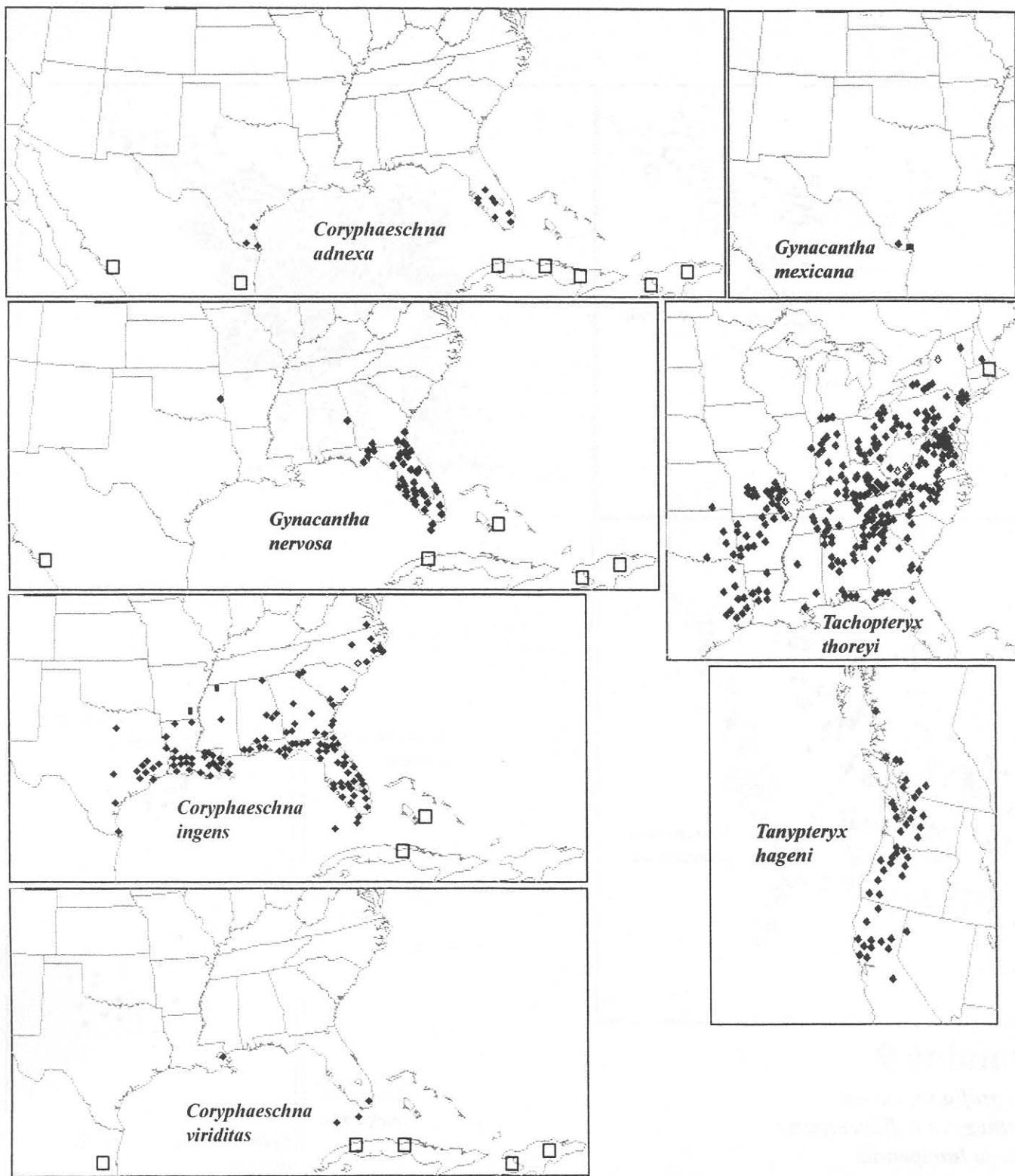
Gomphaeschna antilope, furcillata

Epiaeschna heros



Aeshnidae 9

Boyeria grafiana, vinosa
Triacanthagyna trifida, septima
Remartinia luteipennis
Nasiaeschna pentacantha
Oplonaeschna armata



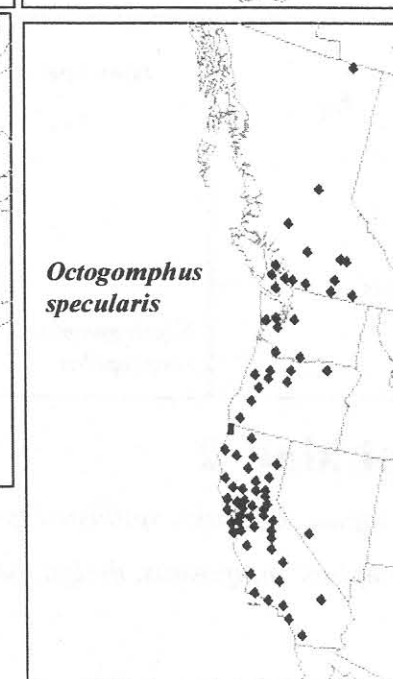
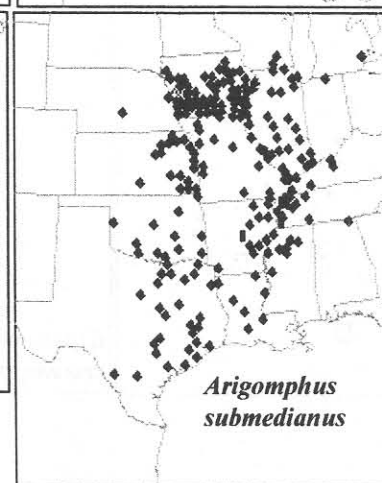
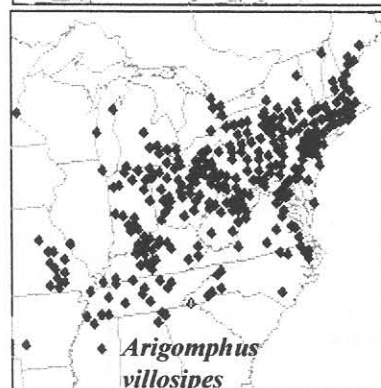
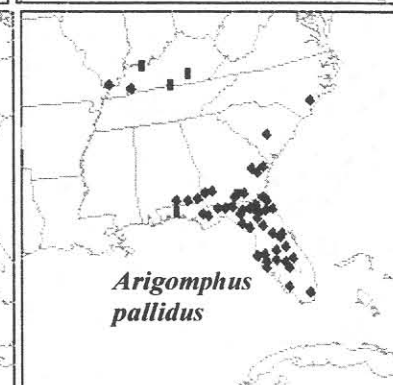
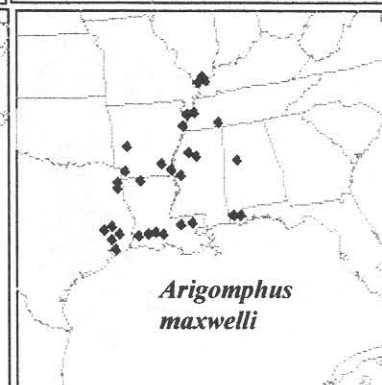
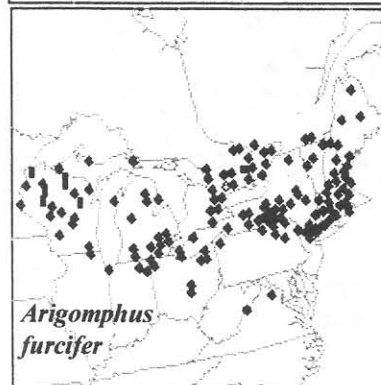
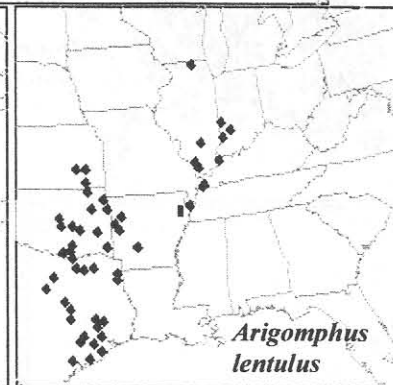
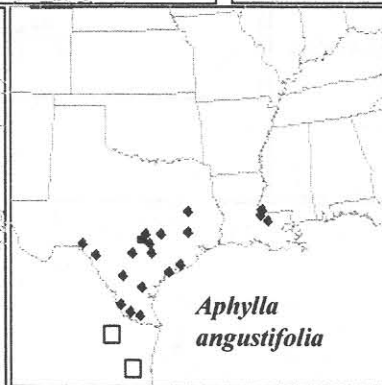
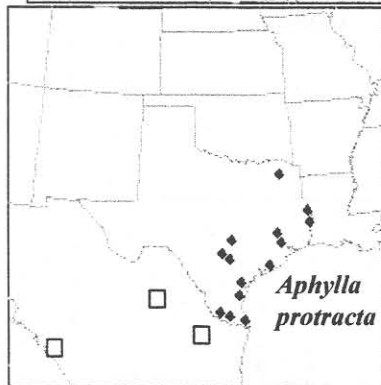
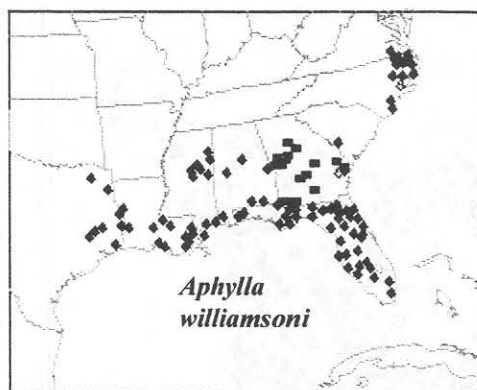
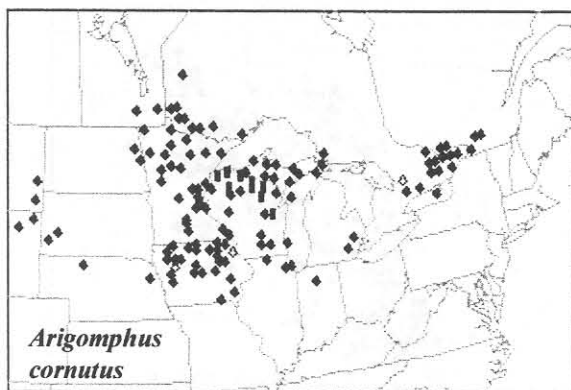
Aeshnidae 10; Petaluridae

Coryphaeschna ingens, adnexa, viriditas

Gynacantha nervosa, mexicana

Tachopteryx thoreyi

Tanypteryx hageni

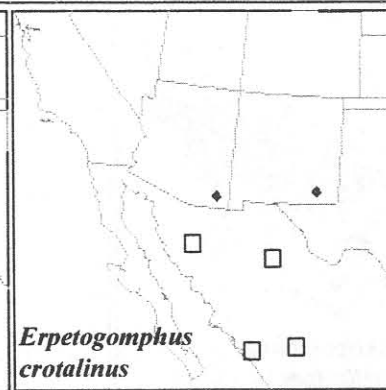
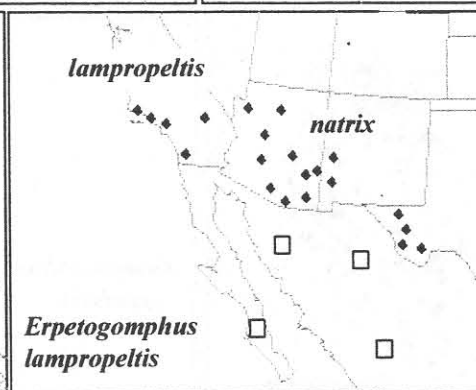
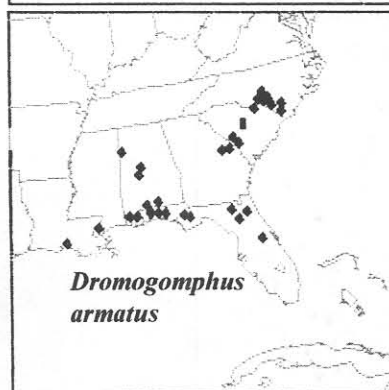
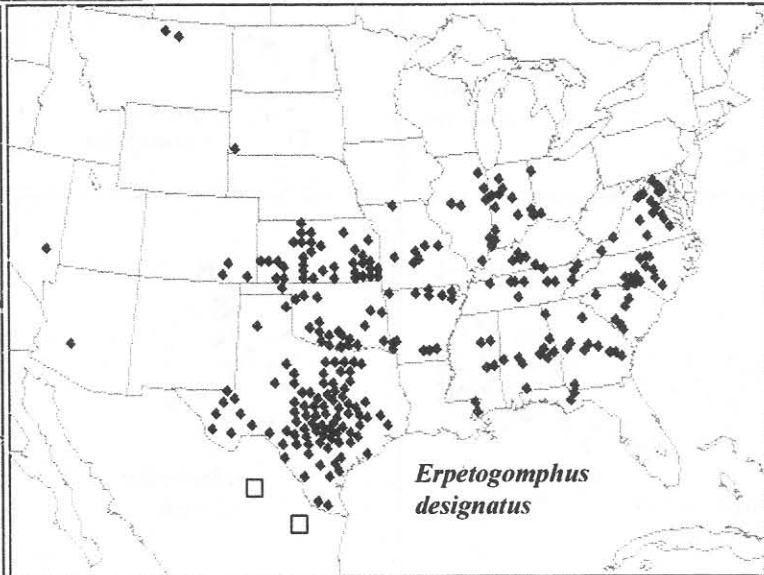
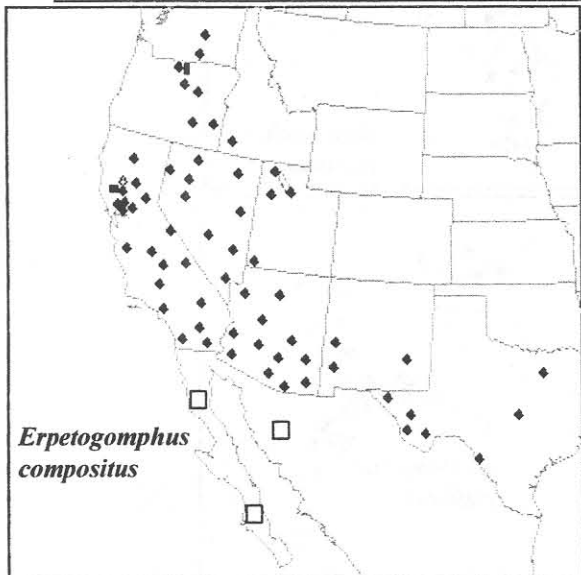
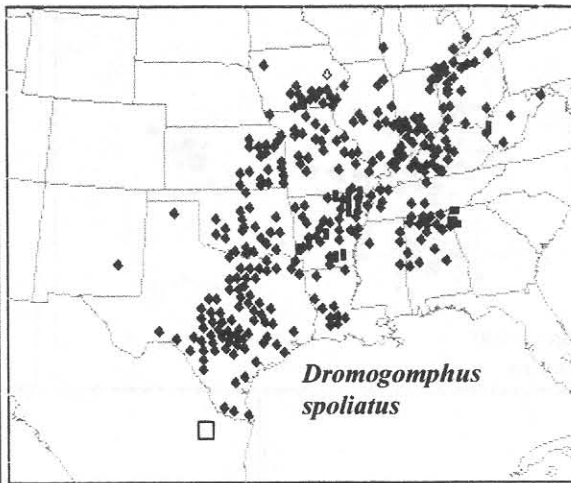
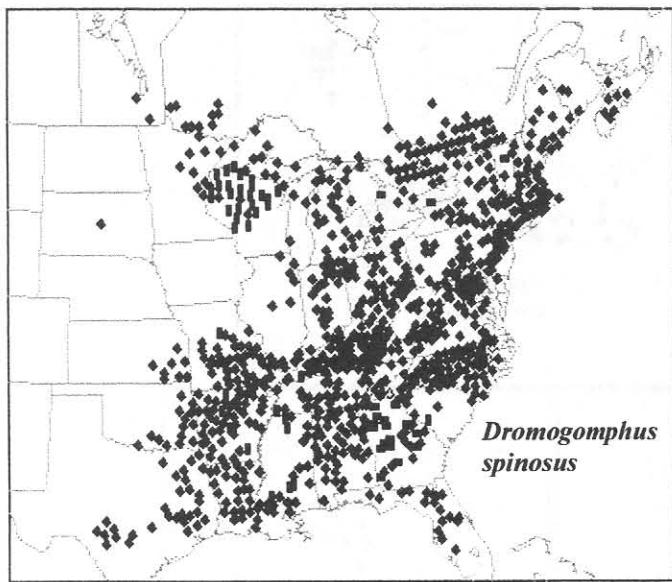


Gomphidae 1

Octogomphus specularis

Arigomphus cornutus, furcifer, lentulus, maxwelli, pallidus, submedianus, villosipes

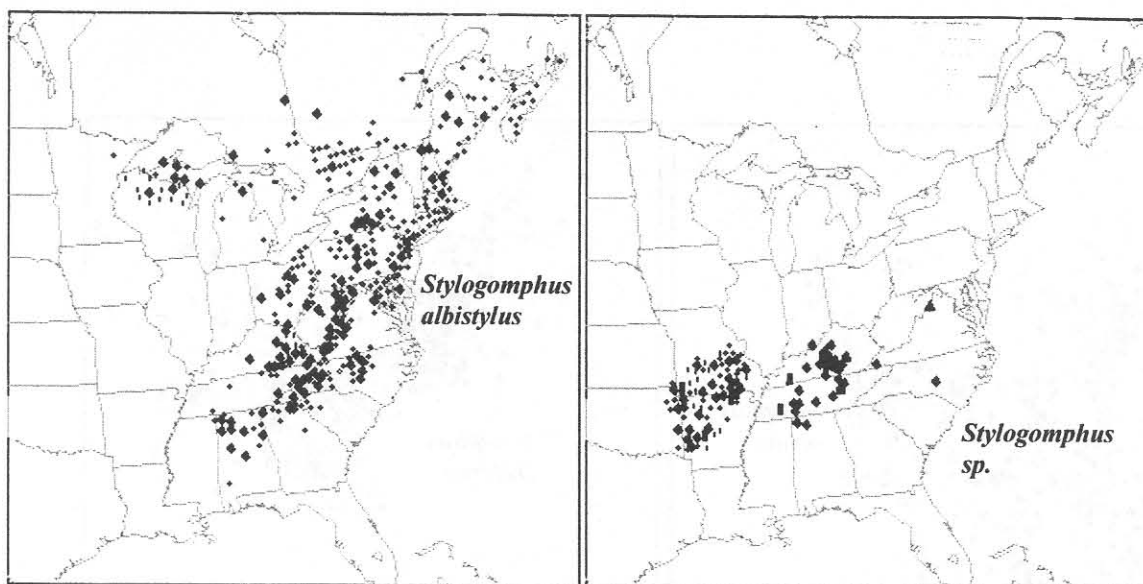
Aphylla angustifolia, protracta, williamsoni



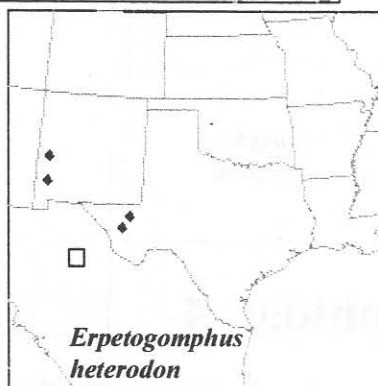
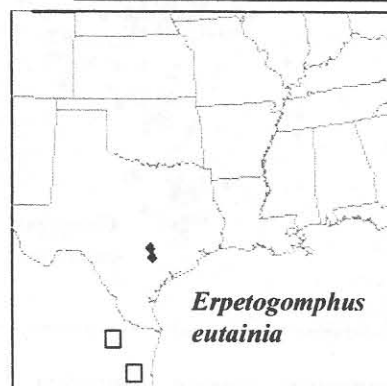
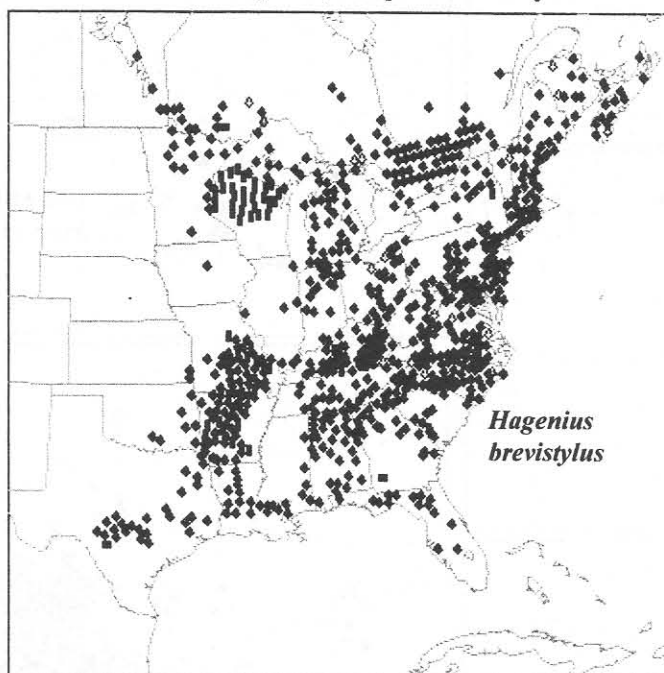
Gomphidae 2

Dromogomphus armatus, spinosus, spoliatus

Erpetogomphus compositus, designatus, crotalinus. lampropeltis



Large symbols are specimens recently examined by Carl Cook and T. Donnelly; *albistylus* small symbols may include the undescribed species; for *sp.* the small symbols are unexamined specimens.

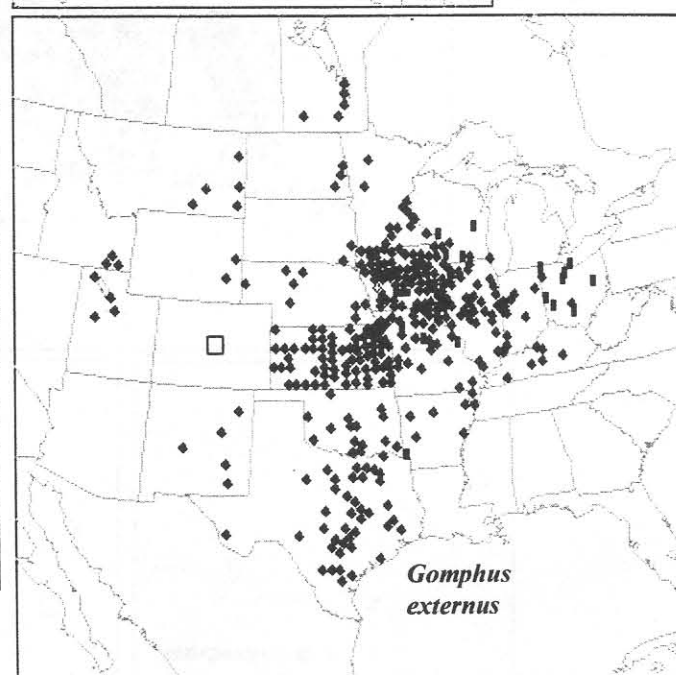
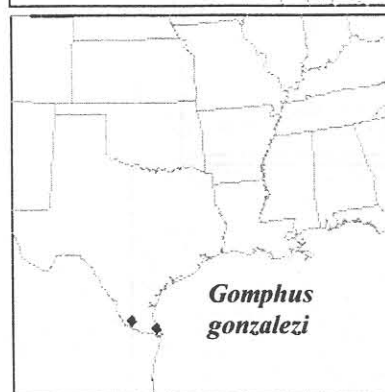
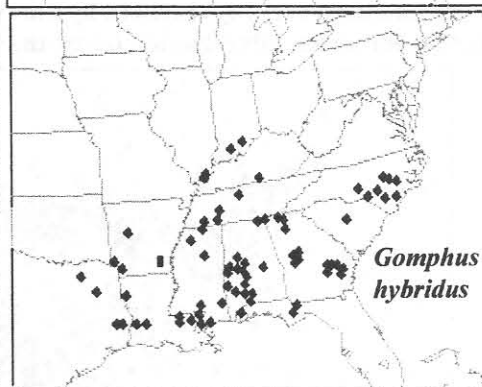
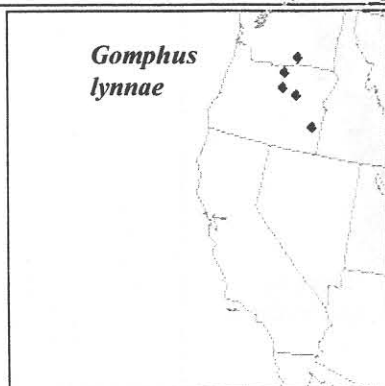
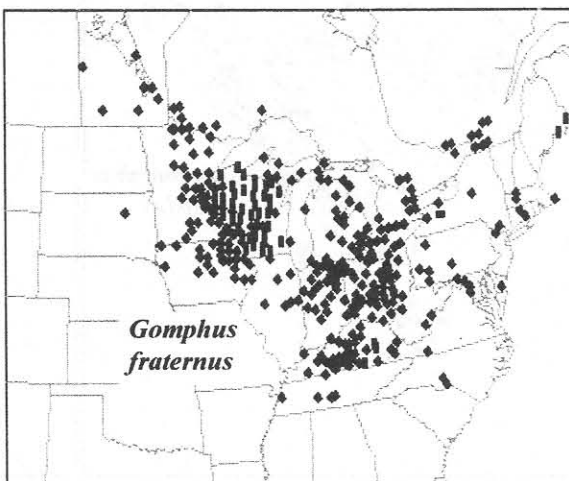
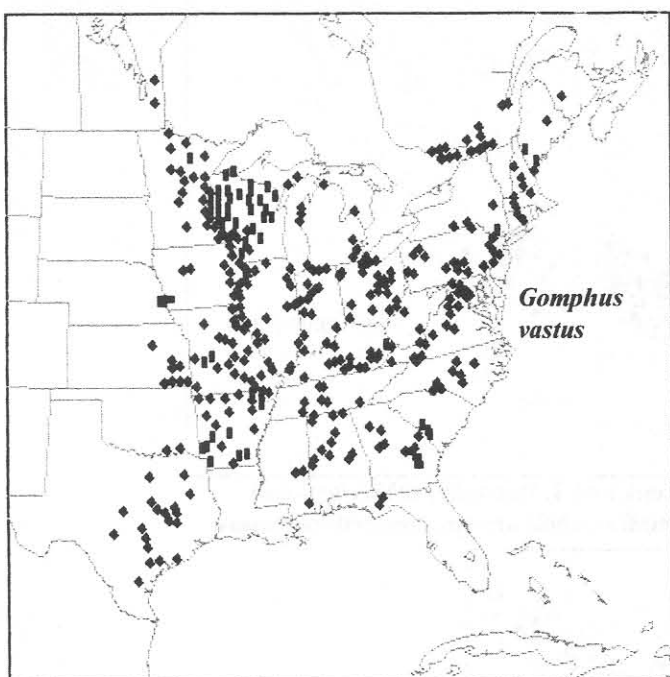


Gomphidae 3

Stylogomphus albistylus, undescribed *sp.*

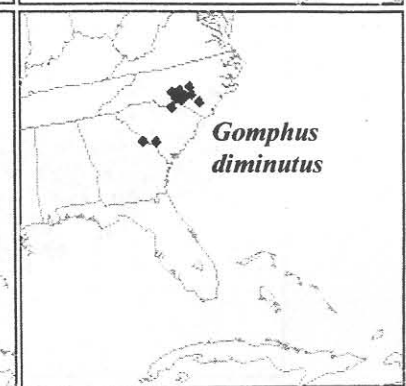
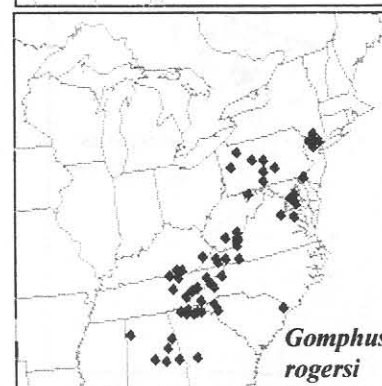
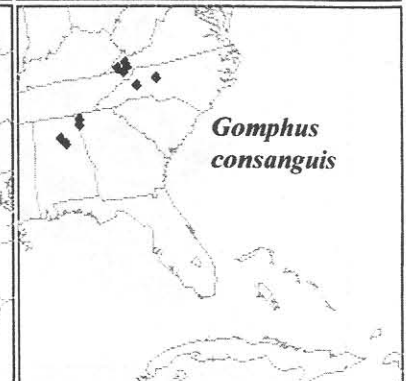
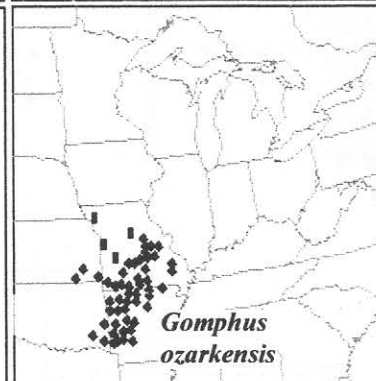
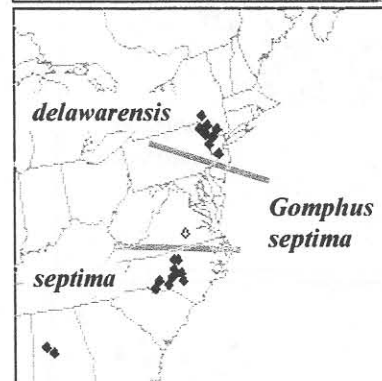
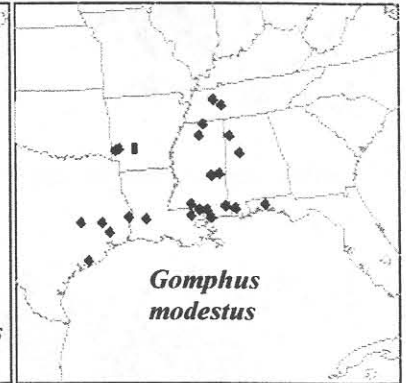
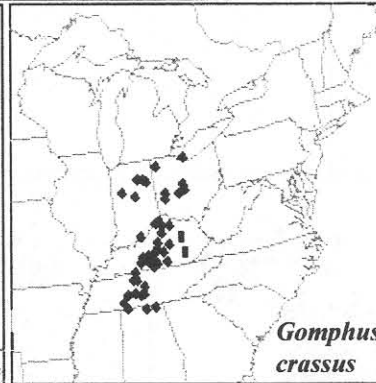
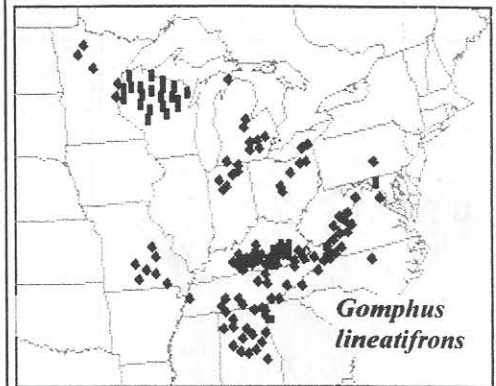
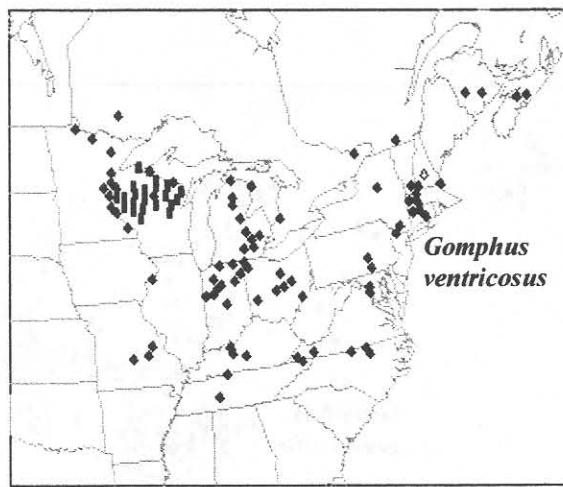
Hagenius brevistylus

Erpetogomphus eutainia, *heterodon*



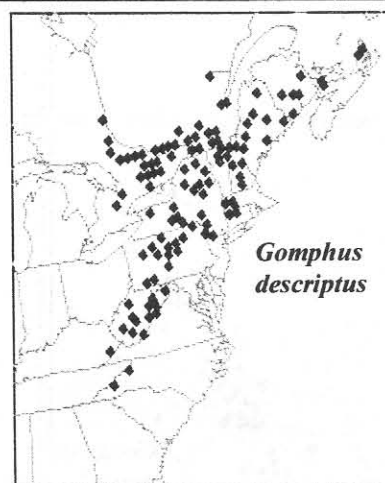
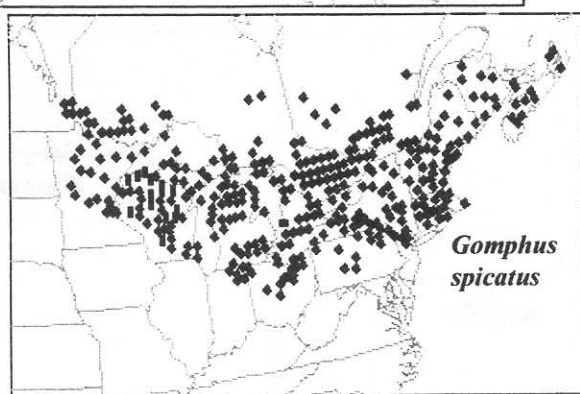
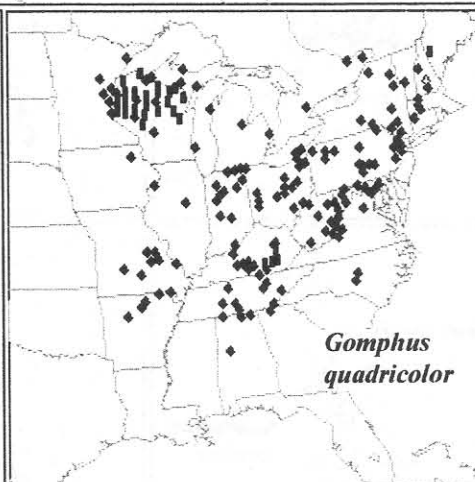
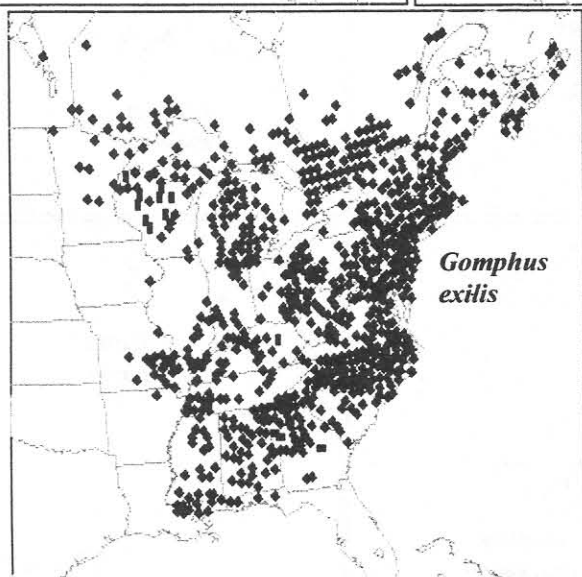
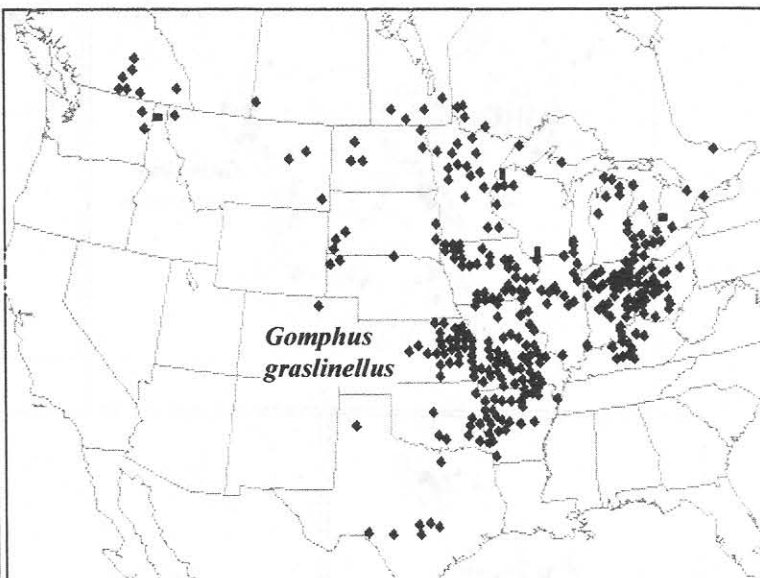
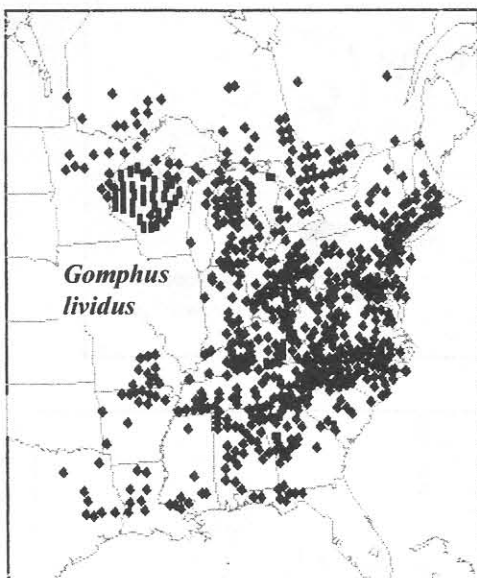
Gomphidae 4

Gomphus vastus, fraternus, hybridus, externus, lynnae, gonzalezi



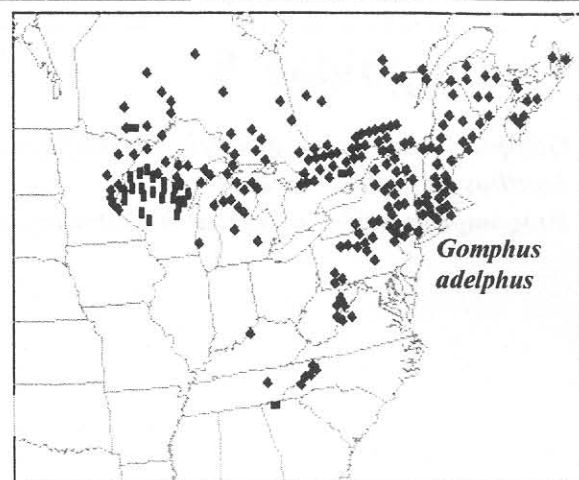
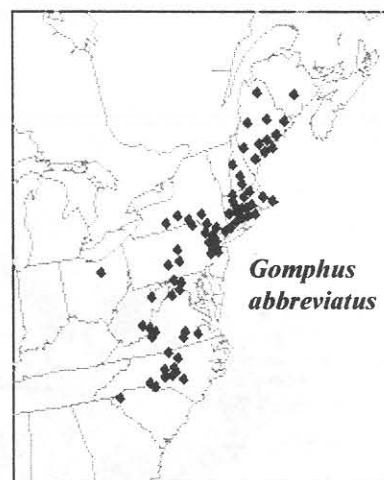
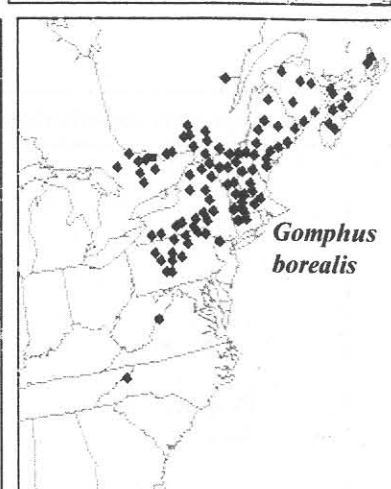
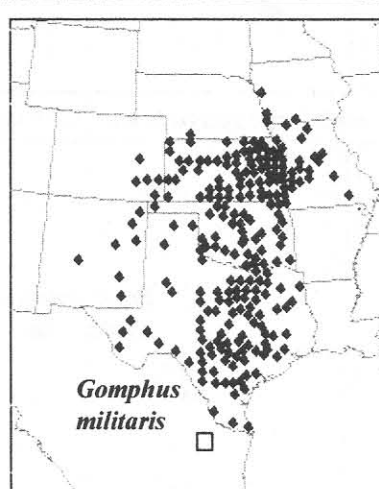
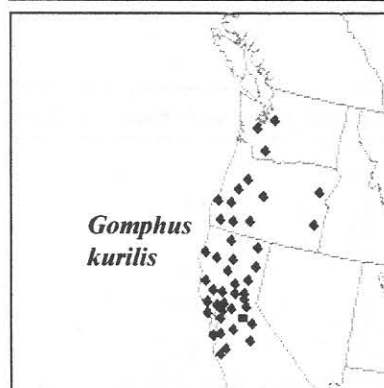
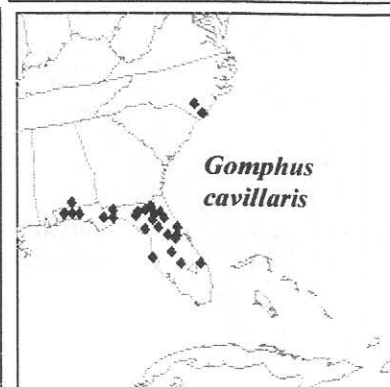
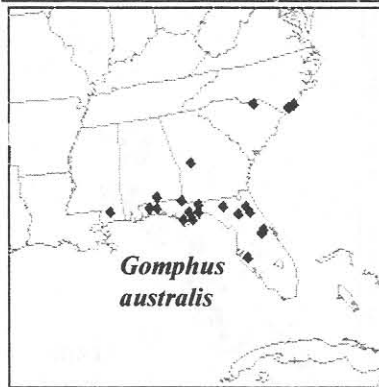
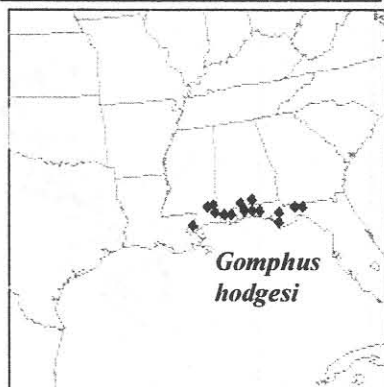
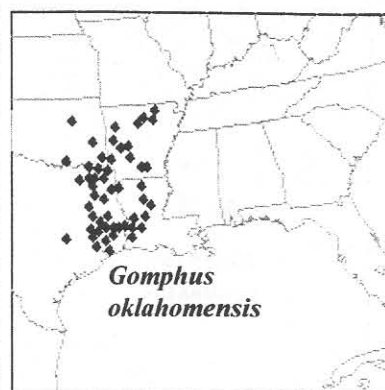
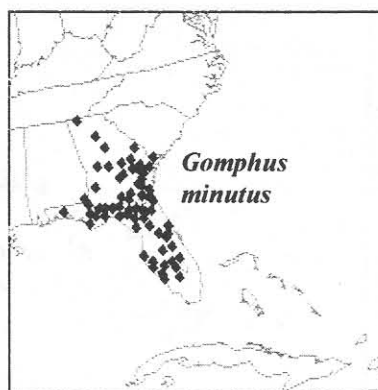
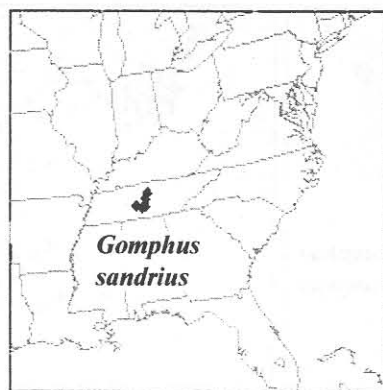
Gomphidae 5

Gomphus ventricosus, *lineatifrons*, *dilatatus*, *crassus*, *modestus*, *ozarkensis*, *septima*, *rogersi*, *consanguis*, *westfalli*, *diminutus*



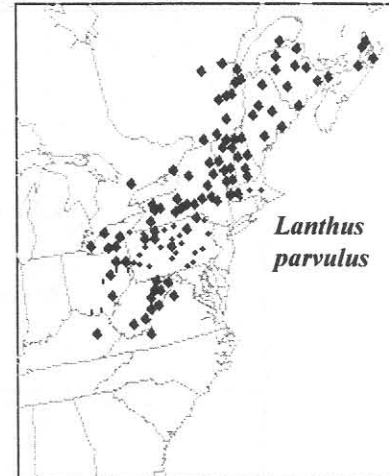
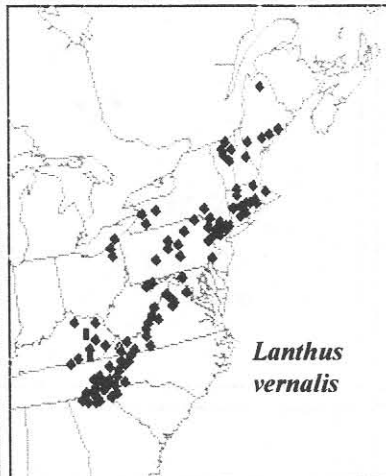
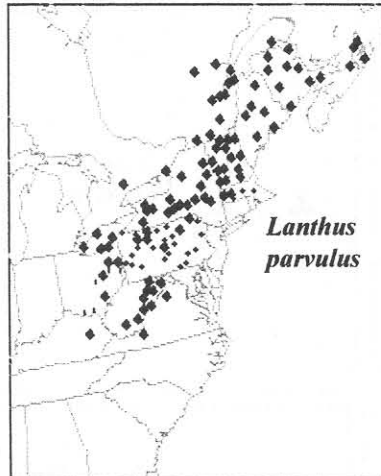
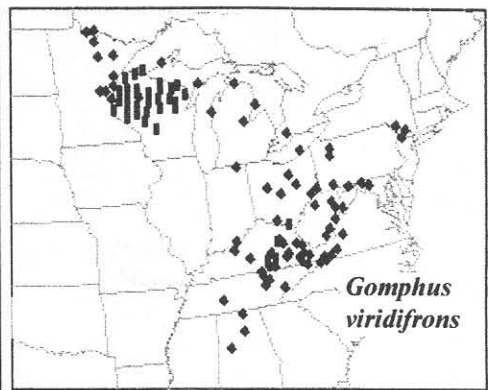
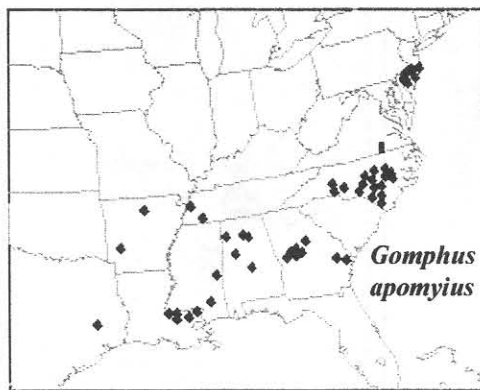
Gomphidae 6

Gomphus lividus, graslinellus, exilis, quadricolor, spicatus, descriptus

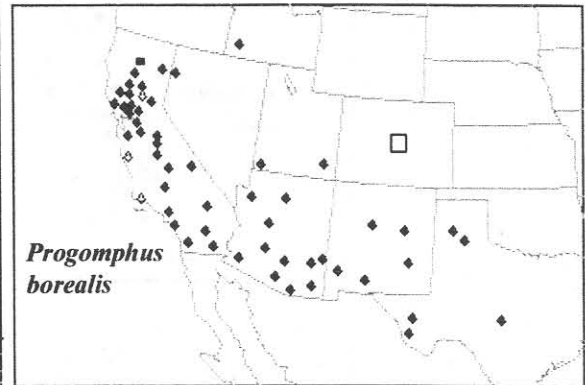
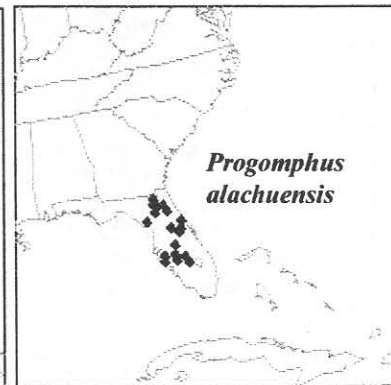
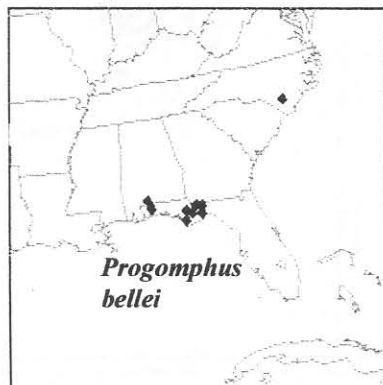


Gomphidae 7

*Gomphus sandrius, minutus, oklahomensis, hodgesi, australis
cavillaris, kurilis, militaris, borealis, abbreviatus, adelphus*



Lanthus parvulus records shown with large symbols have been confirmed; many with small symbols may be *vernalis*.

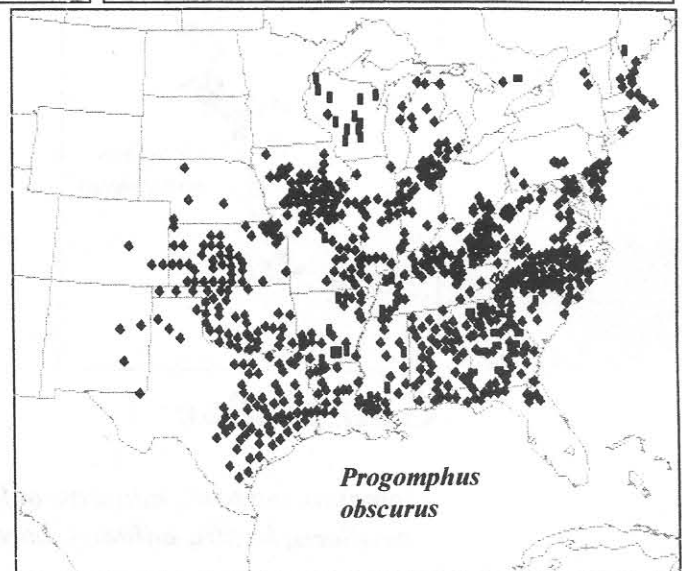


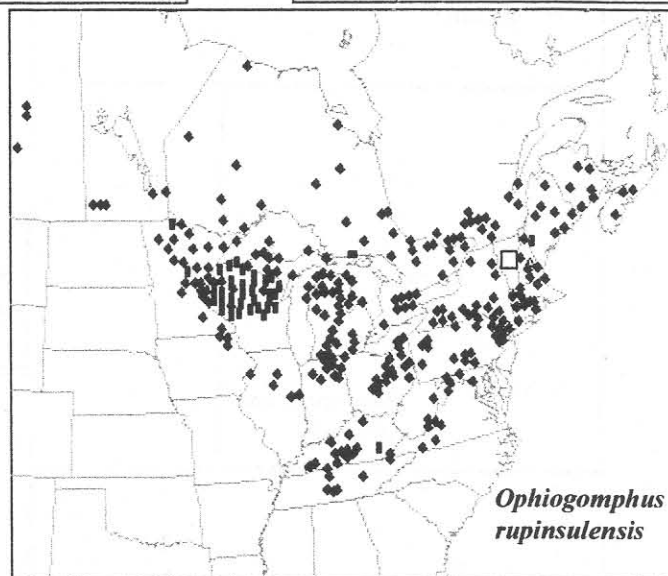
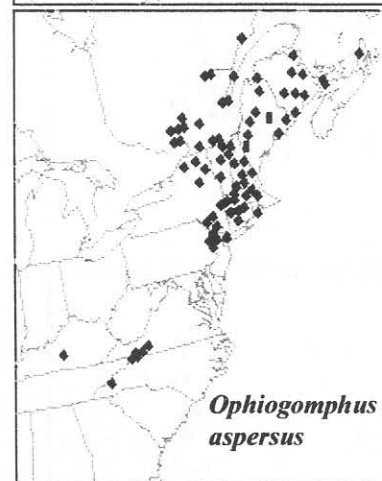
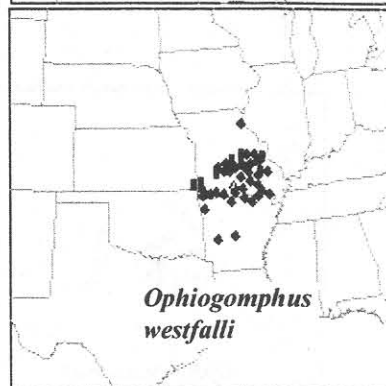
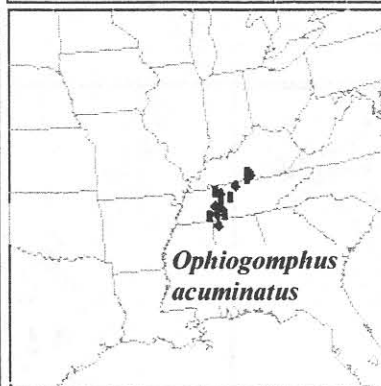
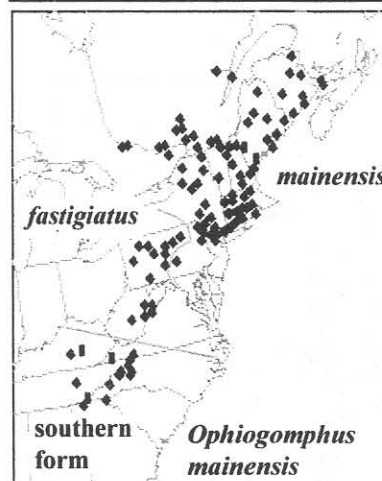
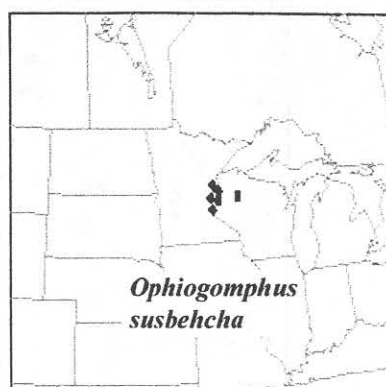
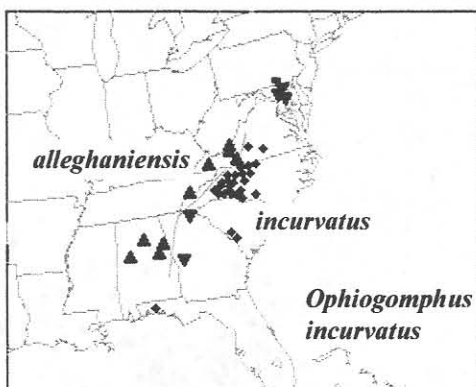
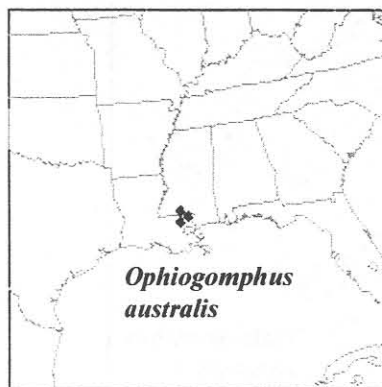
Gomphidae 8

Gomphus geminatus, apomyius, viridifrons, parvidens

Lanthus parvulus, vernalis

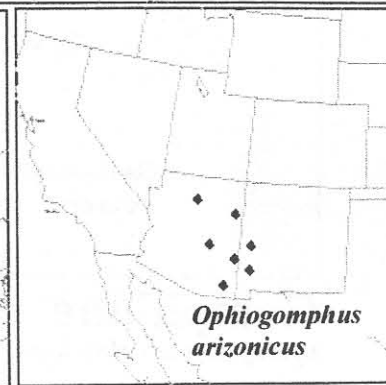
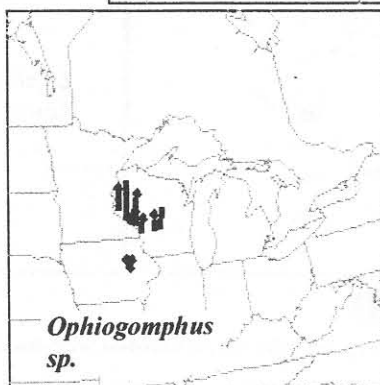
Progomphus bellei, alachuensis, borealis, obscurus

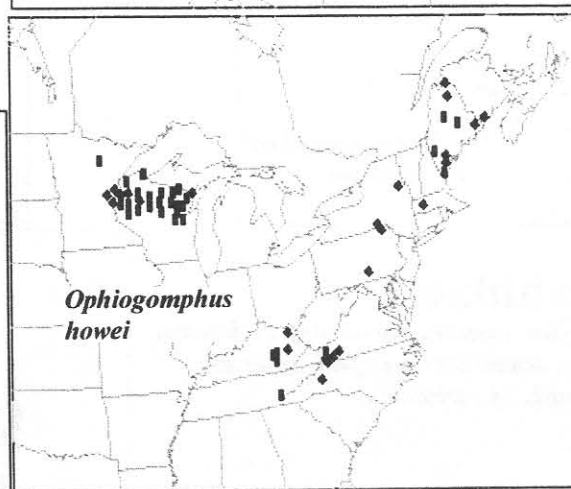
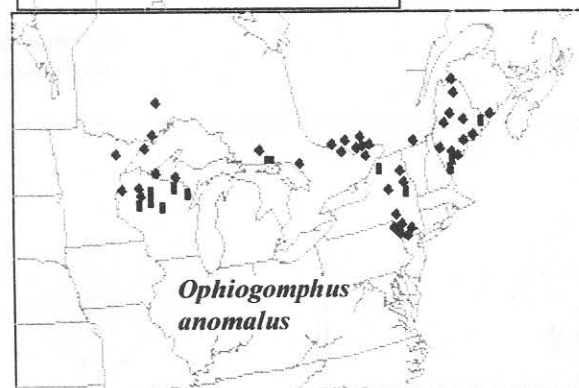
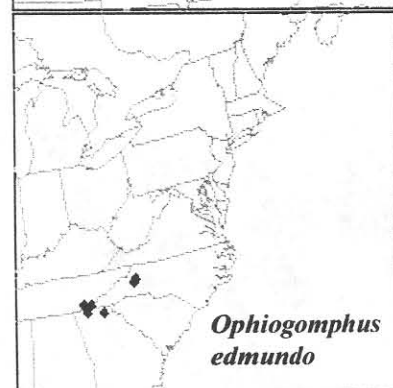
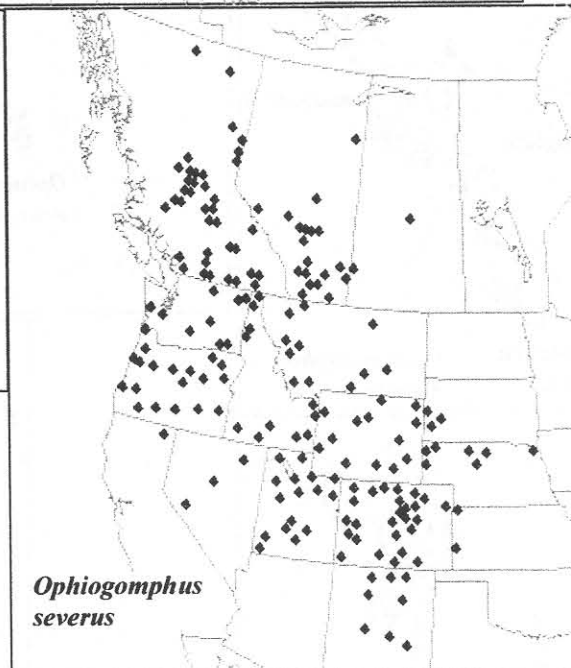
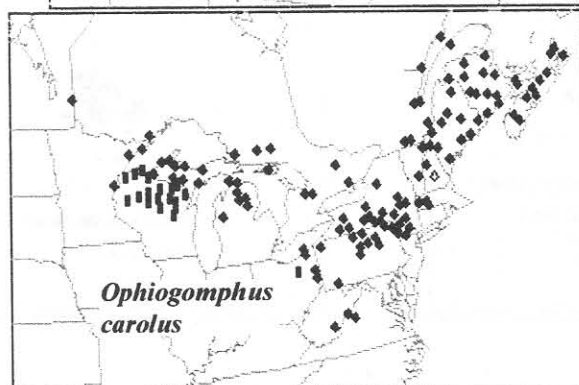
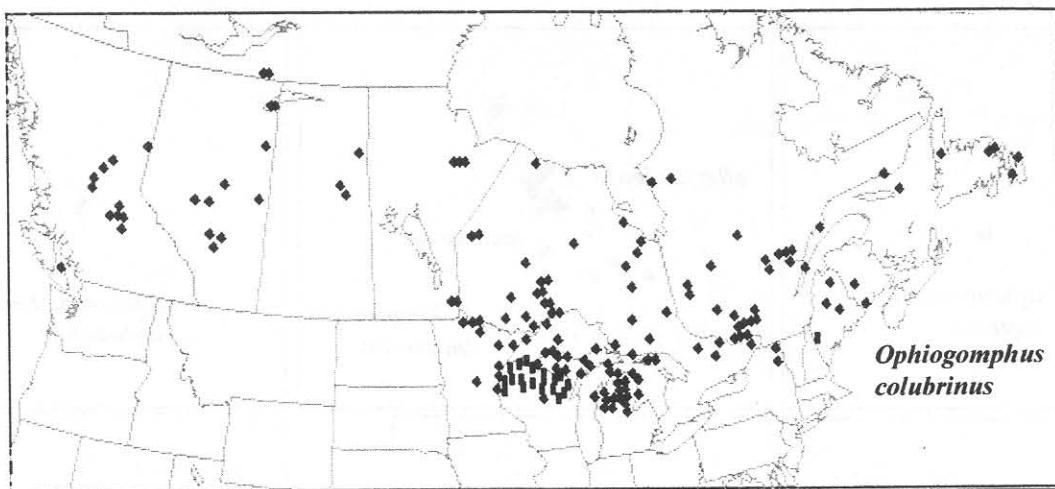




Gomphidae 9

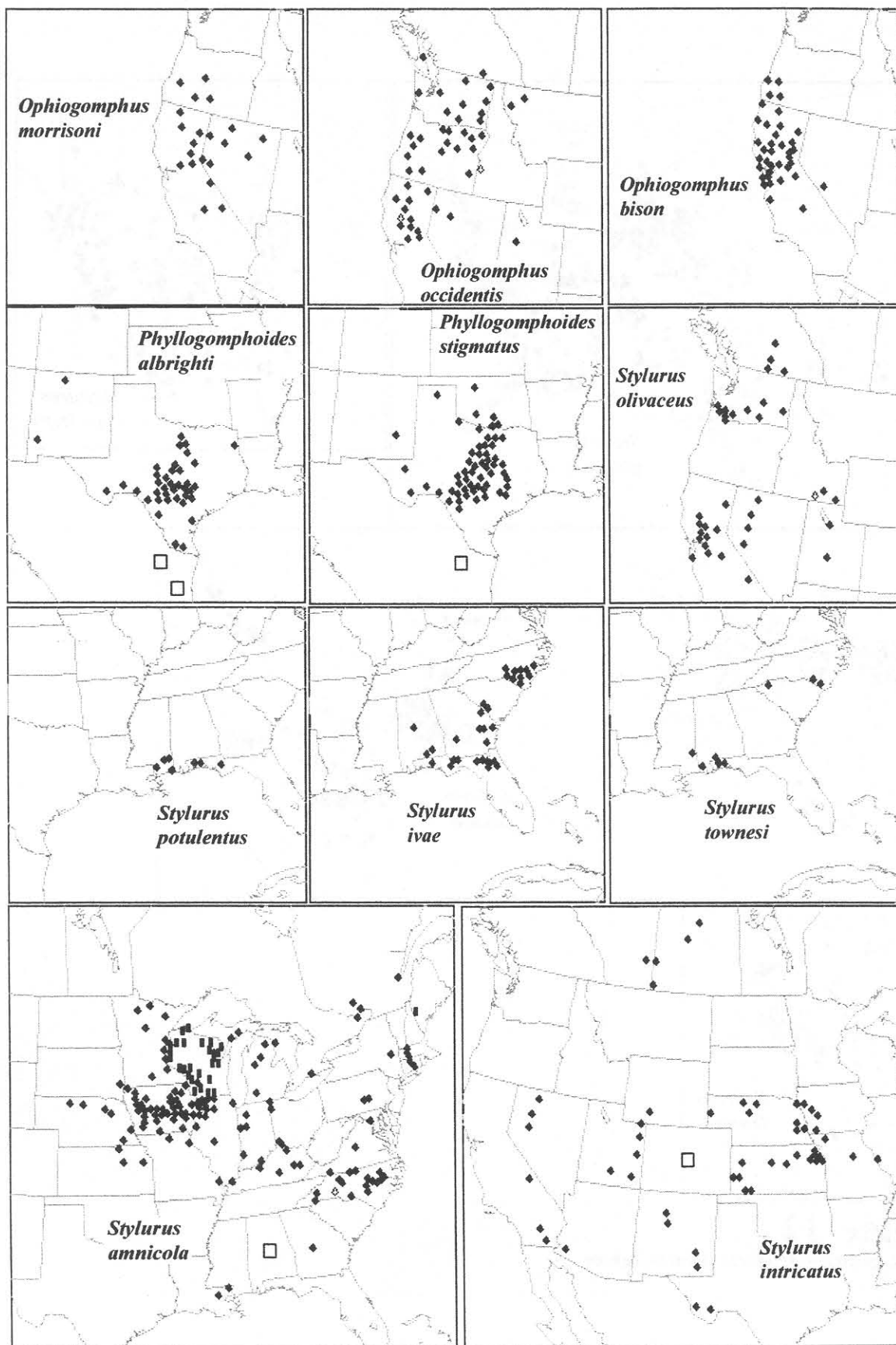
Ophiogomphus australis, incurvatus, susbehcha, mainensis, acuminatus, westfalli, aspersus, rupinsulensis, sp., arizonicus





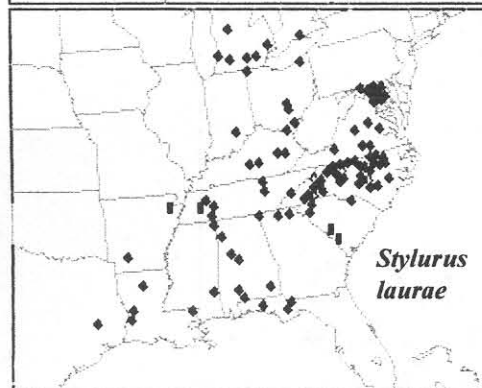
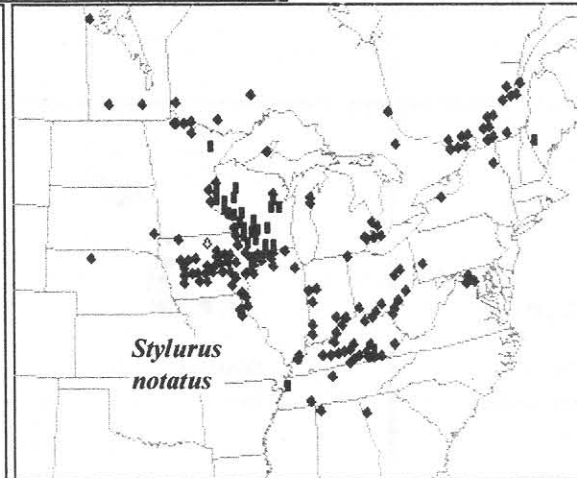
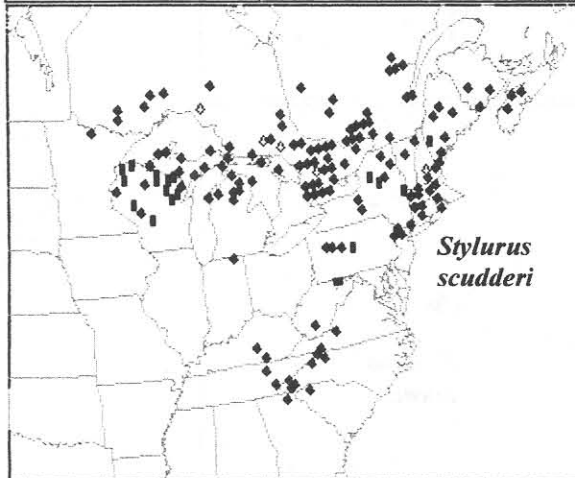
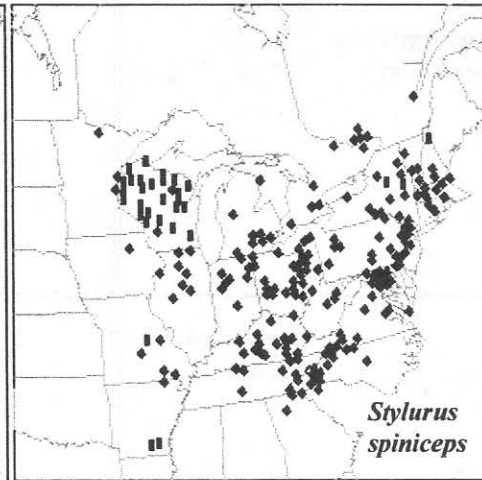
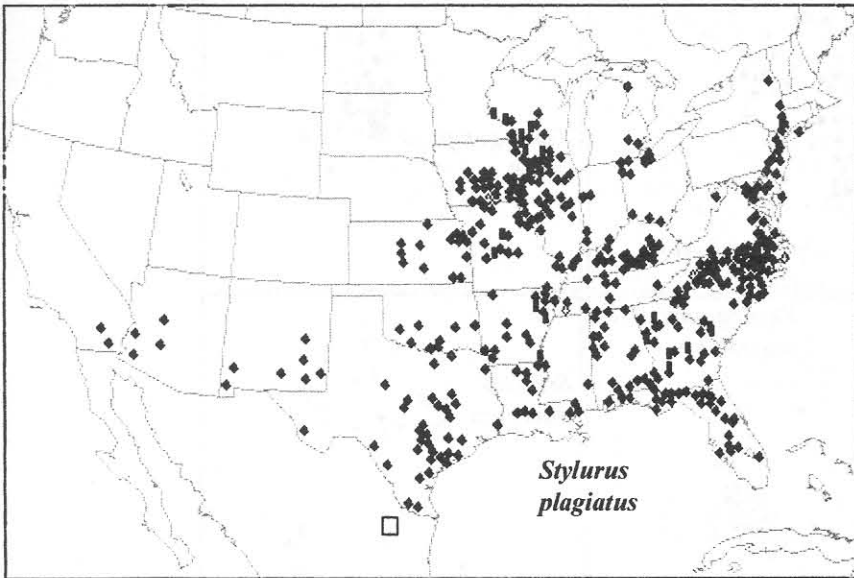
Gomphidae 10

Ophiogomphus colubrinus, carolus, severus, edmundo, anomalus, howei



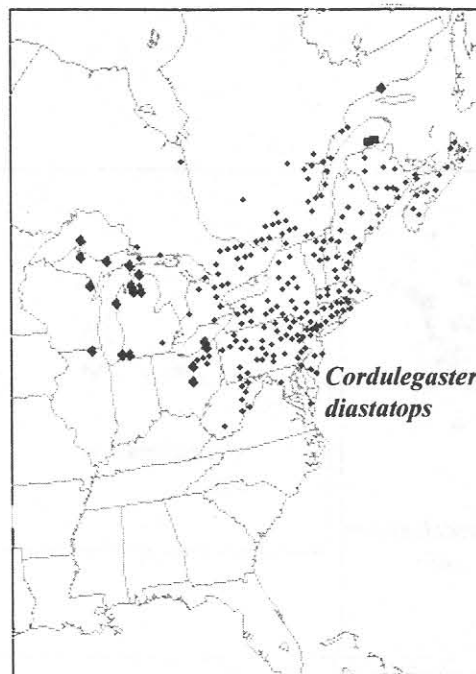
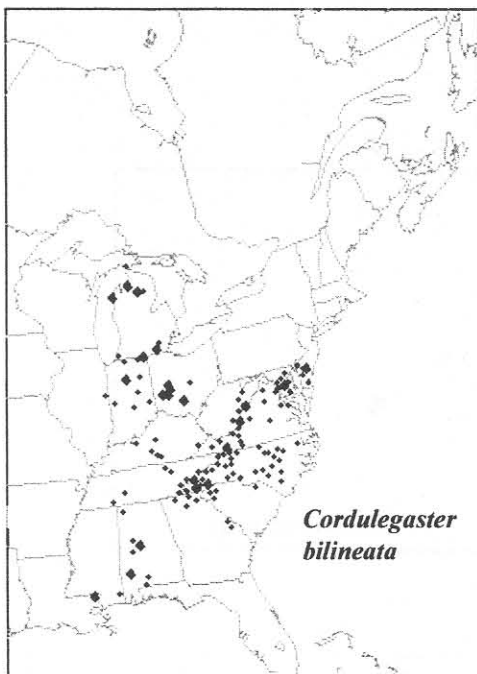
Gomphidae 11

Ophiogomphus morrisoni, occidentis, bison, olivaceus
Phyllogomphoides albrighti, stigmatus
Stylurus potentulus, townesi, ivae, amnicola, intricatus

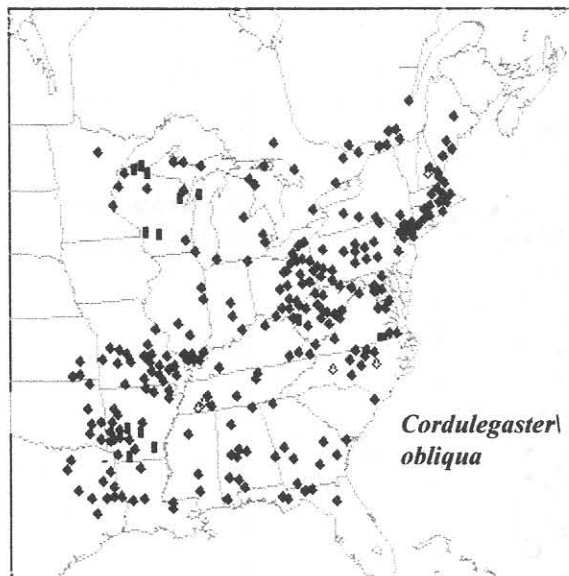
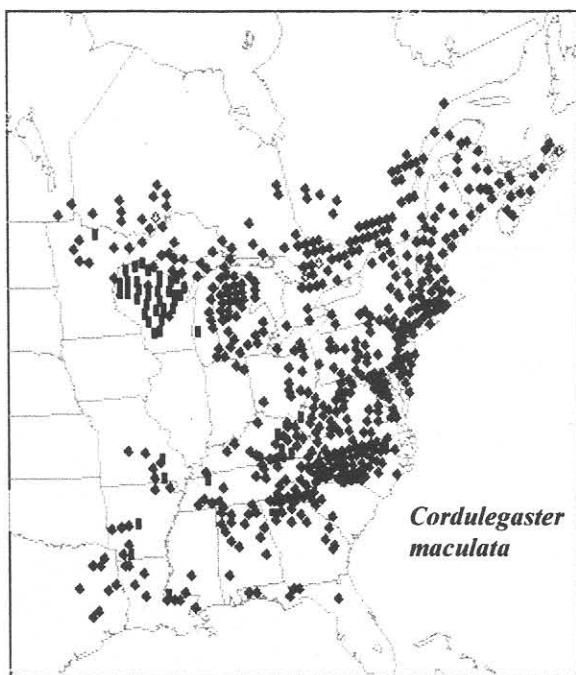


Gomphidae 12

Stylurus plagiatus, spiniceps, scudleri, notatus, laurae

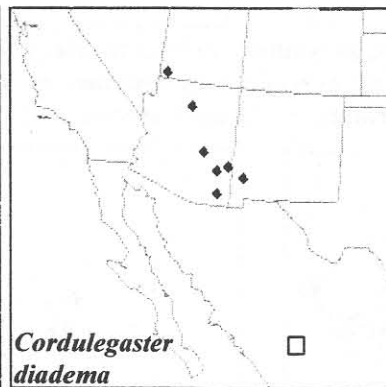
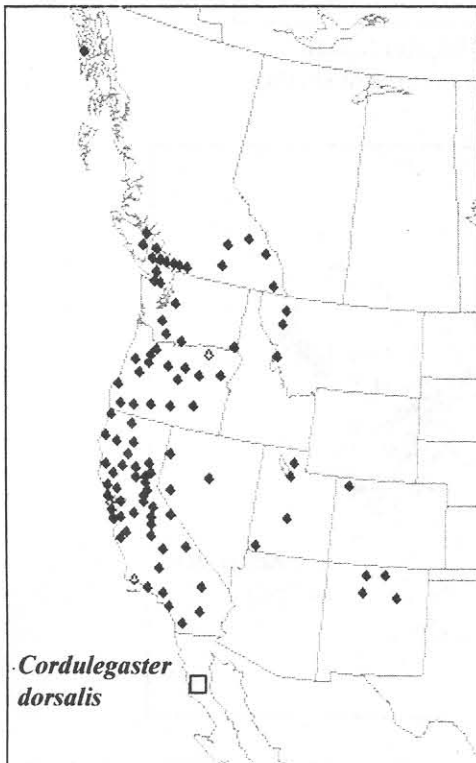
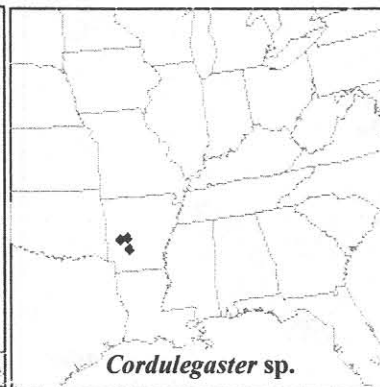
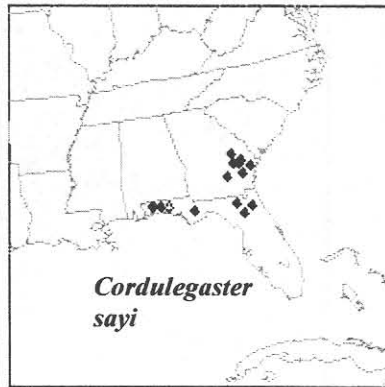
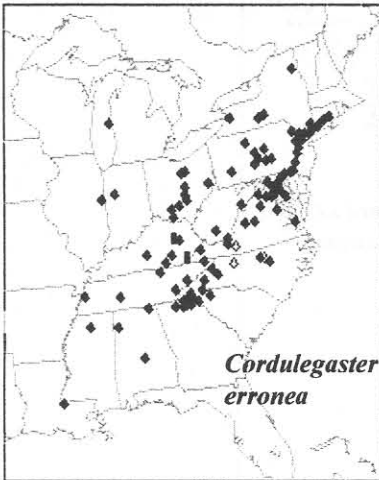


For *C. bilineata* and *diastatops* the large symbols are from the study of Pilgrim (2002).
For both species the small symbols are as reported by contributors. In the area of overlap
the records potentially could be attributed to the other species.



Cordulegastridae 1

Cordulegaster bilineata, diastatops, maculata, obliqua



Cordulegastridae 2

Cordulegaster erronea, sayi, sp., dorsalis, diadema

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