Checklist of Kansas Orbweaving Spiders

The Kansas School Naturalist

Vol. 52
No. 2

EMPORIA STATE UNIVERSITY

September
2005

Kansas School Naturalist

ISSN: 0022-877X
Published by EMPORIA STATE UNIVERSITY
Editor: JOHN RICHARD SCHROCK
Editorial Committee: TOM EDDY, GAYLEN NEUFELD, GREG SMITH
Editors Emeritus: ROBERT BOLES, ROBERT F. CLARKE
Circulation and Mailing: ROGER FERGUSON
Circulation (this issue): 10,000
Press Run: 15,000
Press Composition: John Decker Printed by: ESU Printing Services

Newly published issues of the *Kansas School Naturalist* are sent free of charge and upon request to teachers, school administrators, public and school librarians, youth leaders, conservationists, and others interested in natural history and nature education worldwide. Both in-print and out-of-print back issues are sent for one dollar photocopy and postage/handling charge per issue. A free back issue list is available upon request. The *Kansas School Naturalist* is published by Emporia State University, Emporia, Kansas. Postage paid at Emporia, Kansas. Address all correspondence to: Editor, *Kansas School Naturalist*, Department of Biological Sciences, Box 4050, Emporia State University, Emporia, KS 66801-5087. Opinions and perspectives expressed are those of the authors and/or editor and do not reflect the official position or endorsement of ESU. Many issues can be viewed online at: www.emporia.edu/ksn/ The *Kansas School Naturalist* is listed in *Ulrich's International Periodicals Directory*, indexed in *Wildlife Review/Fisheries Review*, and appropriate issues are indexed in the *Zoological Record*.

Librarians Note: The *Kansas School Naturalist* is an irregular publication issued from one to four times per academic year; there was no Volume 51 issued in 2004.

Cover: *Tetragnatha guatemalensis* female discovered while laying an egg sac on a black willow leaf at midnight in Baker Wetlands, Douglas County.

This issue was made possible, in part, by contributions from readers like you.

Author: Hank Guarisco is Adjunct Curator of Arachnids at the Sternberg Museum of Natural History at Fort Hays State University. His mailing address is: P.O. Box 4692, Lawrence, KS 66046. He is also co-author of two previous *Kansas School Naturalist* issues: *Checklist of Kansas Jumping Spiders* by Hank Guarisco, Bruce Cutler and Kenneth E. Kinman (Vol. 47, No. 1, February 2001) and *Checklist of Kansas Crab Spiders* by Hank Guarisco, Bruce Cutler and Dan Jennings (Vol. 49, No. 1, May 2003).

CHECKLIST OF KANSAS ORBWEAVING SPIDERS

by
Hank Guarisco
Sternberg Museum of Natural History
Fort Hays State University

INTRODUCTION

Arguably, the most interesting aspect of spider behavior is the construction of a web. The delicate beauty and intricacy of the orb web has fascinated people of many cultures through the ages. The Greek goddess Athena condemned Arachne, a skilled weaver who dared to challenge her, to a life of web spinning by turning her into a spider. Anyone fortunate enough to have witnessed its construction, will wonder how does the spider do it! Early investigations of the "mental powers" of spiders and behavioral "instinct" gave way to controlled experiments which elucidated the influence of drugs, coffee, alcohol as well as other parameters upon web structure (52).

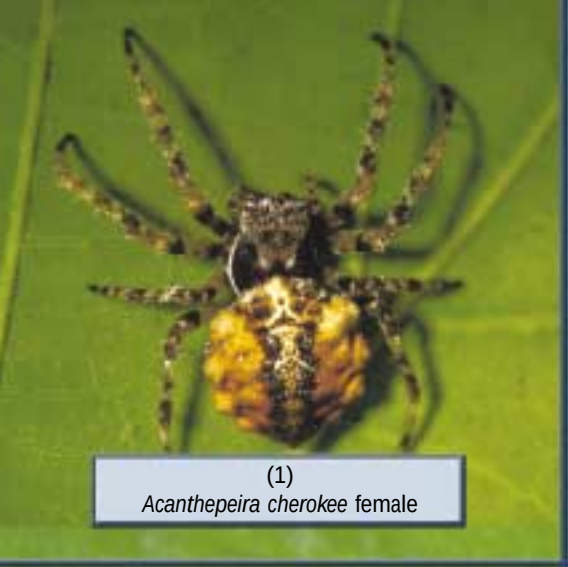
A fossil silk spinning organ (spinneret) from the Devonian is evidence that spiders have produced silk over the past 380 million years (49). Because spider silk is a lightweight, flexible fiber of extraordinary strength and toughness, there have been recent attempts to produce this protein-based "biopolymer" artificially. Artificial dragline silk with many of the desirable properties of natural silk was produced by inserting the dragline silk genes of two, large orbweavers into two mammalian cell lines. When the process is perfected, these synthetic fibers could be used as sutures in microsurgery as well as provide a "green" alternative to nylon fibers in a variety of industrial applications since they will eventually dissolve in wet environments (22).

Orbweaving spiders are "sit-and-wait" predators which generally build a web to capture prey. This group has been divided into two closely related families: the Araneidae (or Argiopidae) and the Tetragnathidae. Although two more distantly related families (Theridiosomatidae and Uloboridae) have members which construct orb-like webs, they are not included in this checklist. Orb web building behavior may have arisen several times in diverse spider groups, although some scientists believe this ability could only have arisen once (5, 34, 48).

The Araneidae include some of the most commonly encountered spiders around homes and gardens, such as the black and yellow garden spider (*Argiope aurantia*), as well as the rare bolas spider, *Mastophora dizzydeani*, which was named "in honor of one of the greatest baseball pitchers of all time, Jerome 'Dizzy' Dean" (9). Instead of constructing a web, bolas spiders swing a drop of glue suspended at the end of a silk strand at approaching prey. This weapon is reminiscent of the bolas used by South American gauchos to entangle the legs of cattle. Hence, members of the genus *Mastophora* have earned the common name of "bolas spider" (53).

The Tetragnathidae, or "long-jawed" spiders, usually have long bodies and legs, large forwardly projecting jaws (chelicerae), and occur near water. These characteristics are most pronounced in members of the genus *Tetragnatha*, which often consume many mosquitoes and midges during their lifetimes. Spiders of the genus *Pachygnatha* are sit and wait predators which don't build webs. They occur on tree trunks in moist woods and capture insects that come along.

Worldwide, there are 3,846 described species of orbweavers (45). There are currently 63 different orbweavers known in Kansas.



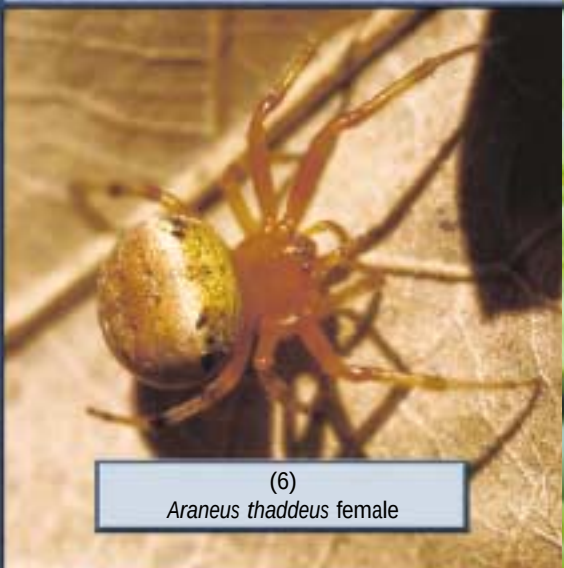
(1)
Acanthepeira cherokee female

(2)
Acanthepeira stellata female

(3)
Araneus cingulatus female

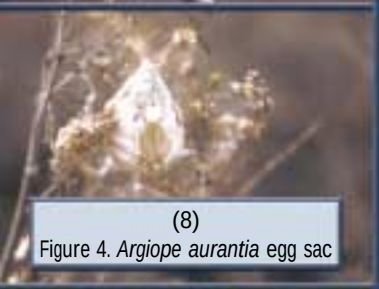
(4)
Araneus pegnia female

(5)
Araneus pratensis female



(6)
Araneus thaddeus female

(7)
Argiope aurantia female



(8)
Figure 4. *Argiope aurantia* egg sac

(9)
Figure 2. *Argiope trifasciata* female

(10)
Argiope trifasciata male

(10 2)
Argiope trifasciata egg sac

(11)
Cyclosa conica

(12)
Cyclosa turbinata female

(13)
Cyclosa turbinata male

(14)
Gea heptagon male

(15)
Hyposinga rubens male

(16)
Larinia directa female

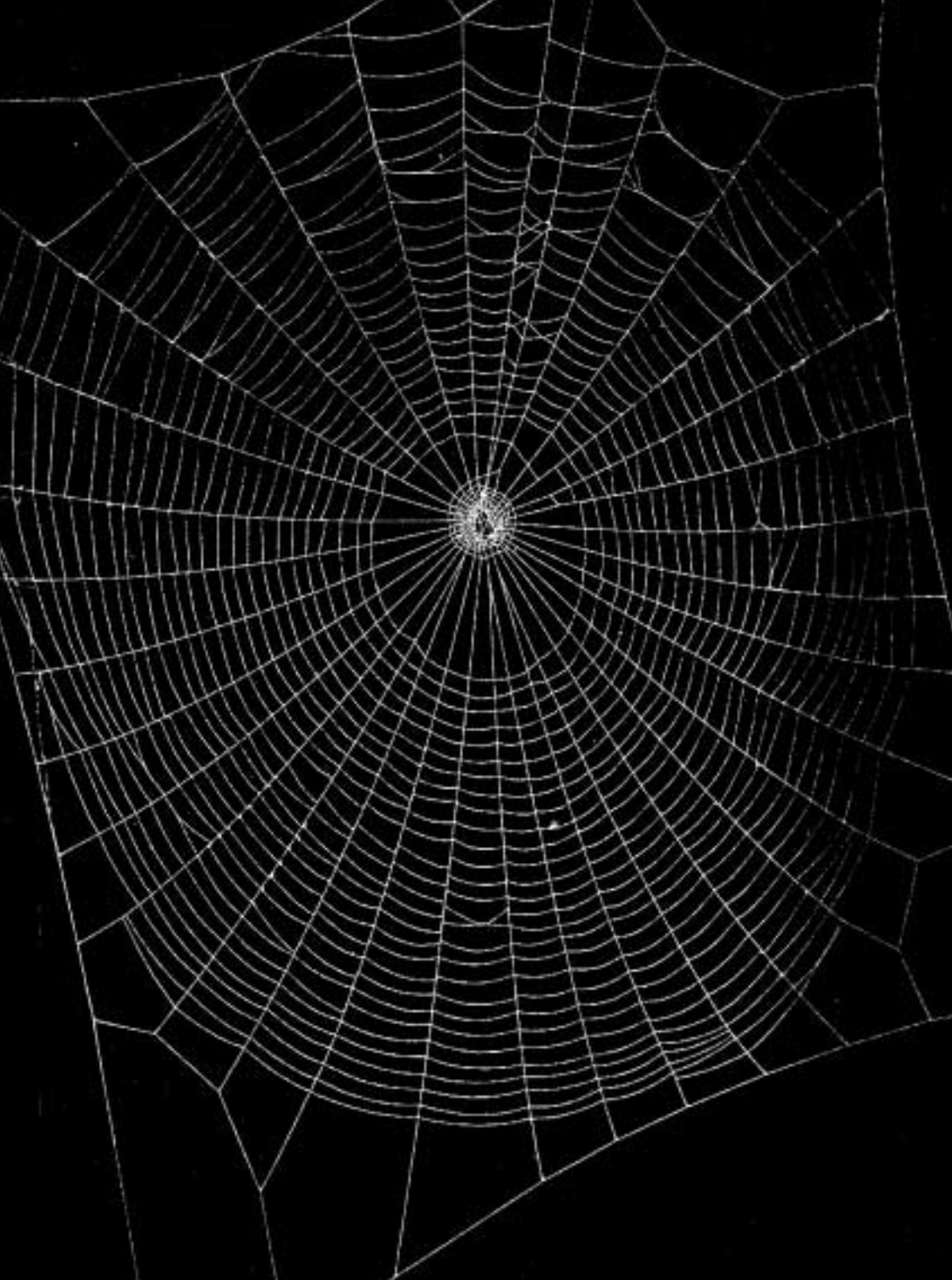


Figure 1. The orb web with frame (rim), radii (spokes) and sticky spiral. Mounted web provided by Bruce Cutter.

THE ORB WEB, PREY, AND ECONOMIC IMPORTANCE

The orbweavers of Kansas show a large diversity in body color, shape, size and pattern. The marbled orbweaver (*Araneus marmoreus*), one of the most attractive spiders in Kansas, builds large webs in wooded areas during late summer and early fall. Unlike many spiders which sit at the hub of the web, the marbled orbweaver remains hidden in a cone-shaped retreat made of leaves and silk situated at the edge of the web. When prey strikes the web, the spider detects the movement, rushes to the hub and determines its location, then proceeds rapidly to the prey and wraps it in silk. After a couple of quick bites, the spider continues to encase the prey in a silken swath. The prey bundle is then either left in place or carried back to the retreat to be eaten.

The spider is able to run rapidly upon the web without being entangled because it moves along the nonsticky radii and does not touch the sticky spiral, which contains glue droplets.

The construction of an orb web usually begins with the spider attaching silk to the substrate, then letting go. As gravity pulls her toward the ground, a silk thread, called a dragline, is pulled from the spinnerets. At some point, the spider produces a second silk thread which is lengthened by the wind (10). If the second line sticks to a solid object, the spider will strengthen it by adding silk as she traverses the line. Then she descends to a lower branch while pulling the loose thread, forming a Y. She returns to the center of the Y, anchors a silk thread, then climbs up a leg of the Y while carrying the loose thread. She climbs down the branch and anchors the thread to the branch. This process is continued until all the radii and frame threads are in place. At this point, the incomplete web resembles a wheel, with a hub (center), radii (spokes), and frame (rim). Beginning at the hub, the spider lays down temporary spiral scaffolding. Next, she proceeds from the edge of the web toward the center, laying down the sticky spiral and simultaneously removing the temporary scaffold, which she consumes (Fig. 1). At this point, some orbweavers (*Micrathena* sp.) remove silk from the hub. This allows the owner to pass easily from one side of the web to the other (34).

Members of the genera *Argiope* and *Cyclosa* add silk ornamentation in a zigzag or linear pattern to their webs (Fig. 2). This structure is called a "stabilimentum" because it was originally believed to provide strength and stability. This is unlikely, however, due to its location in the web. Experiments revealed that blue jays more strongly avoided webs of garden spiders containing stabilimenta than those that lacked these structures (21). Spiders in webs having stabilimenta were also better able to survive the attacks of mud dauber wasps, another group of spider predators (3). Interestingly, webs of *Cyclosa conica* with stabilimenta trapped more insects than undecorated webs (51). Detailed field and laboratory studies revealed that insects are attracted by the UV-reflecting quality of silk. Webs of the tropical garden spider, *Argiope argentata*, have stabilimenta which strongly reflect UV light (7). Therefore, these structures may have several functions, including prey attraction and defense against predators.

Most spiders, including orb weavers, are general predators which capture a wide diversity of prey. One unusual prey record involves the capture of a juvenile broad-headed skink (*Eumeces laticeps*) by the black and yellow garden spider (6). However, insects comprise the majority of a garden spider's diet. The European garden spider (*Argiope bruennichi*) is a voracious predator known to consume as many as 7 grasshoppers per day, and can reach high population densities–up to 6 per sq meter–in grassland during August and September. Theoretically, as many as 420,000 grasshoppers per hectare could be consumed in one day (43).

Although their prey often includes insect pests, assessing the importance of spiders as agents of biological control has only recently been attempted. In 1999, an international symposium on this topic concluded that spiders can be effective in suppressing pest species and improving the productivity of crops, and have been used in integrated pest control programs, for example, in China to control the brown planthopper and other insects (14). Leaving hedgerows, mulching and using other measures to increase the structural complexity of crop fields helps maintain higher spider numbers and diversity (50). The importance of orbweavers as predators of insect pests of cotton, such as the cotton aphid and cotton leafhopper, was studied in eastern Texas (44).

(17)
Larinioides cornutus female

(18)
Mangora gibberosa male

(19)
Mangora maculata female

(20)
Mangora placida female

(21)
Metepeira labyrinthea female

(22)
Micrathena gracilis male

(23)
Micrathena mitrata female

(24)
Micrathena sagittata female

(25)
Neoscona arabesca female

(26)
Neoscona crucifera female

(27)
Neocona pratensis male

(28)
Neoscona utahana female

PREDATORS, PARASITES AND SPIDER DEFENSES

The enemies of orb weaving spiders are legion. Mud dauber wasps (*Sceliphron*, *Chalybion*, and *Trypoxylon*) provision their mud nests with a wide variety of spiders, especially orb weavers. After locating a spider, the female wasp delivers a paralyzing sting, then transports her prey to an open mud cell that she has previously constructed. After capturing enough spiders to fill the cell, she lays a single egg, then closes the entrance with mud and begins constructing another mud nest. Once the egg has hatched, the paralyzed spiders become a ready food source for the developing wasp larva (13). I have routinely retrieved dozens of orb weavers (*Neoscona*, *Argiope* and *Eustala*) from four or five muddauber nests (Fig. 3). Incidentally, these mud nests often contain spiders that have not been collected by other means. For example, the Kansas record of *Neoscona utahana* in this checklist was based on a female taken from a mud nest.

The orb web is often the temporary home of a small, silver "dewdrop" spider (*Argyrodes elevatus*) which steals food from its host and may even kill and consume the much larger orbweaver! On several occasions, I observed this species feeding upon orbweaving spiders (16). Pirate spiders (*Mimetus* sp.) are specialized spider predators which invade a web, send signals to the host, mimicking prey or a potential mate by plucking the web, then attack its owner when it approaches to investigate (20).

The spherical egg sac of the black and yellow garden spider is often the target of many different predators and parasites (42). One winter, I examined several hundred egg sacs of this species in Douglas County and discovered the majority had been damaged or completely destroyed by birds (Fig. 4). The egg sacs appear in late summer and early autumn. By winter, the eggs have hatched but the spiderlings remain inside the egg sac until the following spring. Luckily, each egg sac containes approximately 1,000 eggs.

Spiders have a host of structural and behavioral defenses which enable them to survive their enemies'onslaughts (4). Some orbweavers (*Neoscona crucifera*, *Larinioides cornutus*) build webs at sunset and spend the day hidden in leaf retreats or under tree bark . Others (*Eustala* sp.) remain in exposed locations but have colors and patterns that match the background. A *Eustala* from western Kansas possessed a false-face pattern when viewed from the rear (15). The spiny-bellied orbweavers (*Micrathena* sp.) possess spines which disguise the outlines of their bodies. At the slightest disturbance, *Gea heptagon* drops from its web to the ground, legs folded, while the white areas on the abdomen instantly turn dark brown (47). However, dropping from the web was not an effective defense of garden spiders (*Argiope* sp.) against the mud dauber wasp, *Sceliphron caementarium* (Drury 1773) (2). The webs of garden spiders and *Gea heptagon* often have a parallel barrier web on one or both sides of the main web. In addition to adding structural support, these webs may quickly alert spiders of approaching predators.

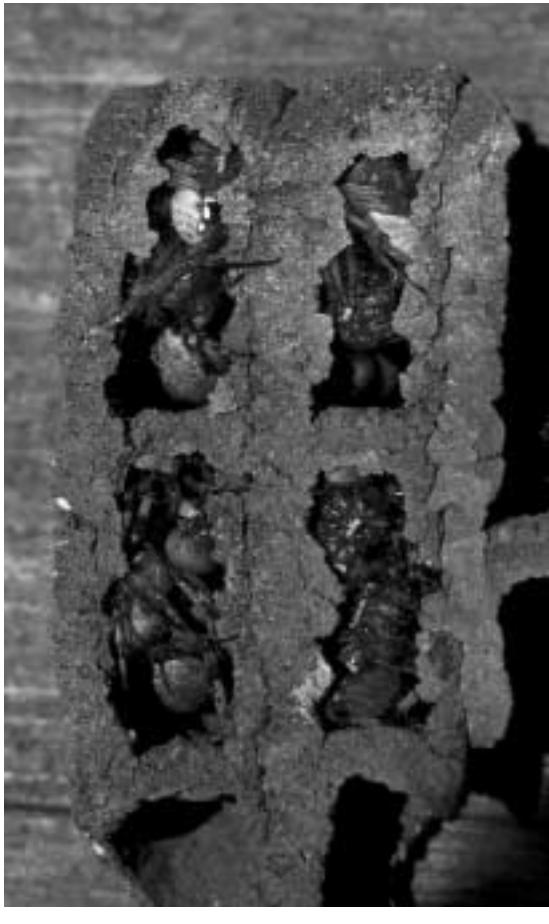


Figure 3. The organ pipe mud dauber nest contains the bodies of many orbweaver spiders.

KANSAS ORB WEAVERS (ARGIOPIDAE & TETRAGNATHIDAE)

A total of 63 species of orbweaving spiders are currently known in Kansas. The following checklists are based upon specimens examined by the author, and Kansas records in the latest taxonomic revisions. Because of the recent advances in spider taxonomy, some records in the older literature are unreliable and are not included. Each entry includes: the currently recognized scientific name of each species followed by its author, year it was described, and sometimes one or more outdated names used in the older literature (45). Habitat information concerning Kansas specimens is included when available. Except for a few conspicuous species, most spiders do not have common names. The "black and yellow garden spider" (*Argiope aurantia*), the "common star-bellied orbweaver" (*Acanthepeira stellata*), and the "marbled orbweaver" (*Araneus marmoreus*) are three exceptions. Because more field work is needed to determine the range of each species within Kansas, the counties of known occurrence do not accurately reflect a species range, but documents its occurrence within the state.

A key is not provided because positive identification is determined by detailed microscopic examination of the genitalia. However, orbweavers come in such a wide range of shapes and colors, many species may be identified by careful examination of the accompanying color photos. Pay particular attention to body shape, leg length, color and patterns. Although males and females of some species are similar, males of many orbweavers are much smaller than their mates, and may even radically differ in body color and form. Also be aware that coloration may be very variable in some species. Females of *Neoscona crucifera*, for example, may be dark with a distinct abdominal pattern, or very light and lack a pattern. The taxonomic references provide complete descriptions and distinguishing characteristics for each species in this checklist. Also of value are spider catalogues (45), checklists (11, 12, 19), and works which provide detailed keys (40, 46). All photos were taken by the author.

The records of *Cyclosa caroli* (Hentz) and *Araneus saevus* (L. Koch) (reported as *A. solitarius*) in Douglas County (11) were actually based upon misidentified specimens of *Cyclosa conica* (Pallas) and *Araneus bicentenarius* (McCook), respectively.

ARGIOPIDAE

1. *Acacesia hamata* (Hentz 1847): ATCHISON, CHAUTAUQUA, CHEROKEE, CRAWFORD DOUGLAS, FRANKLIN, JEFFERSON, NEOSHO, OSAGE, WILSON / edge of woods (11, 30)
2. *Acanthepeira cherokee* Levi 1976: DOUGLAS / woods (17, 30)
3. *Acanthepeira marion* Levi 1976: MONTGOMERY / edge of woods (17, 30)
4. *Acanthepeira stellata* (Walckenaer 1805): CHAUTAUQUA, CHEROKEE, DOUGLAS, JEFFERSON, MEADE, MORRIS, MORTON, POTTAWATOMIE, ROOKS, RUSSELL, SALINE, SEWARD, SHAWNEE, WOODSON / prairie, pasture, old field (11, 17, 30)
5. *Araneus bicentenarius* (McCook 1888): DOUGLAS / woods (11, 24)
6. *Araneus bonsallae* (McCook 1894): DOUGLAS, SALINE / backyard under tree (26)
7. *Araneus cingulatus* (Walckenaer 1841): DOUGLAS / edge of woods (26)
8. *Araneus guttulatus* (Walckenaer 1841): DOUGLAS / woods, edge of woods (26)
9. *Araneus juniperi* Emerton 1885 (=*Epeira juniperi* Emerton 1884): DOUGLAS / on red cedar (11, 26)
10. *Araneus marmoreus* Clerck 1757: ANDERSON, DOUGLAS, JOHNSON / open woods (11, 24)
11. *Araneus niveus* (Hentz 1847): DOUGLAS / on pawpaw tree in woods (26)
12. *Araneus pegnia* (Walckenaer 1841): BARBER, CHAUTAUQUA, DOUGLAS, HARPER / woods, on red cedar, eaves of building (26)
13. *Araneus pratensis* (Emerton 1884) (=*Singa pratensis* Emerton 1884): DOUGLAS, GREENWOOD, JEFFERSON, LEAVENWORTH, RILEY / prairie, old field (11, 26)
14. *Araneus raui* Levi 1973: JEFFERSON / backyard near woods (26)
15. *Araneus thaddeus* (Hentz 1847): DOUGLAS, ELLIS, LEAVENWORTH, MONTGOMERY, ROOKS / understory vegetation in woods (26)
16. *Araniella displicata* (Hentz 1847): DOUGLAS, JEFFERSON / edge of woods (11, 27)
17. *Argiope aurantia* (Lucas 1833): ATCHISON, BROWN, CHEROKEE, DECATUR, DOUGLAS, HARPER, JEFFERSON, MARION, MEADE, MORRIS, POTTAWATOMIE, RILEY, WOODSON / prairie, old fields (11, 12, 23)
18. *Argiope trifasciata* (Forskal 1775): ANDERSON, BOURBON, CHAUTAUQUA, CHEYENNE, CLARK, CRAWFORD, DOUGLAS, GEARY, HAMILTON, JEFFERSON, KIOWA, LOGAN, MEADE, POTTAWATOMIE, RAWLINS, RILEY, ROOKS, SHERMAN prairie, old fields (11, 12, 23)
19. *Colphepeira catawba* (Banks 1911): DOUGLAS / under rock on open hillside (11, 33)
20. *Cyclosa conica* (Pallas 1772): DOUGLAS, JEFFERSON, LEAVENWORTH / woods (11, 31)
21. *Cyclosa turbinata* (Walckenaer 1841): DOUGLAS, HARPER, JEFFERSON, MONTGOMERY, OSAGE, RILEY, WILSON / woods, edge of woods, on buildings (31)

(29)
Verrucosa arenata female, white form

(30)
Verrucosa arenata female, yellow form

(31)
Verrucosa arenata male

22. *Eustala anastera* (Walckenaer 1841): DOUGLAS, FRANKLIN, JEFFERSON, JOHNSON, OSAGE, ROOKS, SALINE / woods, edge of woods (11, 31)
23. *Eustala cepina* (Walckenaer 1841): BARTON, CHEROKEE, DOUGLAS, ELLSWORTH, LABETTE, MEADE, MONTGOMERY, ROOKS, SHAWNEE, WILSON, WOODSON / woods, edge of woods (11, 12, 31)
24. *Eustala emertoni* (Banks 1904): JEFFERSON, MONTGOMERY, ROOKS / mesic woods (31)
25. *Gea heptagon* (Hentz 1850): CRAWFORD, DOUGLAS, JEFFERSON, MEADE / old field near ground (11, 12, 23, 47)
26. *Hyposinga funebris* (Keyserling 1893) (=*Hyposinga singaeformis* (Scheffer 1904)): WALLACE (25, 29)
27. *Hyposinga rubens* (Hentz 1847) (= *Singa truncata* Banks 1901): BARBER, CLARK, COWLEY, DOUGLAS, JEFFERSON, KIOWA, LEAVENWORTH, MONTGOMERY, MORRIS, WOODSON / on red cedar, edge of woods (11, 25, 29)
28. *Kaira alba* (Hentz 1850): JEFFERSON / old field (18, 32, 38)
29. *Larinia borealis* Banks 1894: DOUGLAS, RILEY/ old field, edge of woods (28)
30. *Larinia directa* (Hentz 1847): DOUGLAS, JEFFERSON, NEOSHO / wet field, wood's edge (28)
31. *Larinioides cornutus* (Clerck 1757) (=*Nuctenea cornuta* (Clerck 1757)): ANDERSON, ATCHISON, BARTON, CHEROKEE, CLARK, CRAWFORD, DOUGLAS, ELLSWORTH, FRANKLIN, KINGMAN, LABETTE, LEAVENWORTH, MONTGOMERY, MORRIS, NEOSHO, OSAGE, POTTAWATOMIE, RILEY, RUSSELL, SCOTT, STAFFORD, WASHINGTON, WOODSON / woods, edge of woods, on buildings and bridges near water (27)
32. *Larinioides patagiatus* (Clerck 1757) (=*Nuctenea patagiata* (Clerck 1757)): BARTON, BROWN, CHEYENNE, CLAY, LINCOLN, MARION, MEADE, NORTON, RILEY, ROOKS / bridges, buildings near water (12, 27)
33. *Mangora gibberosa* (Hentz 1847): ANDERSON, BARBER, CHEYENNE, CRAWFORD, DOUGLAS, ELLSWORTH, FRANKLIN, JEFFERSON, MEADE, NEOSHO, OSAGE, ROOKS, SCOTT, SHAWNEE / old field near woods (11, 12, 28)
34. *Mangora maculata* (Keyserling 1865): ANDERSON, ATCHISON, CHAUTAUQUA, CHEROKEE, DOUGLAS, FRANKLIN, MIAMI, OSAGE, RILEY, WOODSON / woods (11, 28)
35. *Mangora placida* (Hentz 1847): ANDERSON, CHEROKEE, DOUGLAS, FRANKLIN, GEARY, KINGMAN, McPHERSON, MIAMI, MONTGOMERY, MORRIS, RILEY, SALINE, WOODSON / woods (11, 28)
36. *Mastophora archeri* Gertsch 1955: DOUGLAS / woods (41)
37. *Metepeira comanche* Levi 1977: BARBER / on red cedar near road (32)
38. *Metepeira palustris* Chamberlin and Ivie 1942: GREELEY / prairie herbs & shrubs (8, 32)
39. *Metepeira labyrinthea* (Hentz 1847): ANDERSON, CHAUTAUQUA, COMANCHE, DOUGLAS, ELK, JEFFERSON, JOHNSON, LEAVENWORTH, MARION, MEADE, SALINE, SHAWNEE, WASHINGTON, WOODSON / woods, edge of woods, on red cedar (11, 12, 32)
40. *Micrathena gracilis* (Walckenaer 1805): ANDERSON, ATCHISON, CHEROKEE, DONIPHAN, DOUGLAS, ELK, ELLSWORTH, FRANKLIN, GEARY, JEFFERSON, KIOWA, MIAMI, NEOSHO, OSAGE, RILEY, SALINE, SHAWNEE / woods, understory (11, 33)
41. *Micrathena mitrata* (Hentz 1850): ATCHISON, CHEROKEE, DOUGLAS, RILEY / woods (11, 33)
42. *Micrathena sagittata* (Walckenaer 1841): CHEROKEE, DOUGLAS, ELLSWORTH, GEARY, NEMAHA, RILEY / understory in woods (11, 33)

(32)
Leucauge venusta female

(33)
Tetragnatha guatemalensis male

43. *Neoscona arabesca* (Walckenaer 1841): ANDERSON, ATCHISON, BARTON, BROWN, CHASE, CHAUTAUQUA, CHEROKEE, DONIPHAN, DOUGLAS, ELLSWORTH, JEFFERSON, LABETTE, MARION, MEADE, MORRIS, OSAGE, RILEY, ROOKS, RUSSELL, SALINE, SHAWNEE, STAFFORD, WASHINGTON, WOODSON / prairie, old fields (1, 11, 12)
44. *Neoscona crucifera* (Lucas 1839) (=*Neoscona hentzii* Keyserling 1863 = *Neoscona benjamina* (Walckenaer 1841)): ATCHISON, BOURBON, BROWN, CHAUTAUQUA, CHEROKEE, CHEYENNE, CLARK, CRAWFORD, DOUGLAS, ELLIS, JEFFERSON, LEAVENWORTH, LINN, MIAMI, MONTGOMERY, MORRIS, OSAGE, RAWLINS, RILEY, SALINE, WOODSON / woods, edge of woods, on houses and bridges (1, 11)
45. *Neoscona domiciliorum* (Hentz 1847): JOHNSON / in arboretum (1)
46. *Neoscona oaxacensis* (Keyserling 1863): HAMILTON, LOGAN, MEADE, SHERMAN / sagebrush, shrubs (1, 12)
47. *Neocona pratensis* (Hentz 1847): BARTON, DOUGLAS, JEFFERSON, RILEY / prairies (1, 11)
48. *Neoscona utahana* (Chamberlin 1919): CHAUTAUQUA (1)
49. *Ocrepeira globosa* (F. P.-Cambridge 1904) (=*Wixia globosa* F. P.-Cambridge): BOURBON (30, 39)
50. *Ocrepeira ectypa* (Walckenaer 1841) (=*Wixia ectypa* (Walckenaer 1841)): DOUGLAS / understory in woods (30, 39)
51. *Singa keyserlingi* McCook 1893: DOUGLAS, JEFFERSON / old field, pasture by woods (25, 29)
52. *Verrucosa arenata* (Walckenaer 1841): ATCHISON, CHAUTAUQUA, CHEROKEE, DOUGLAS, LINN, MIAMI, NEOSHO, RILEY / open woods (11, 30)

TETRAGNATHIDAE

53. *Glenognatha foxi* (McCook 1893) (=*Mimognatha foxi* (McCook 1893): DOUGLAS, JEFFERSON / leaf litter in old field (11, 35)
54. *Leucauge venusta* (Walckenaer 1841): CLARK, DOUGLAS, ELK, GEARY, KIOWA, LABETTE, MEADE, MIAMI, MORRIS / understory in woods (11, 12, 35)
55. *Pachygnatha autumnalis* Keyserling 1884: DOUGLAS, JEFFERSON, RILEY / mesic woods (35)
56. *Pachygnatha tristriata* C.L. Koch 1845. DOUGLAS, JEFFERSON / woods (35)
57. *Tetragnatha elongata* Walckenaer 1805: ALLEN, BROWN, BUTLER, CHASE, CHAUTAUQUA, CHEROKEE, CLAY, COFFEY, CRAWFORD, DOUGLAS, ELK, HARVEY, JEFFERSON, LABETTE, LINN, MEADE, MONTGOMERY, MORRIS, NEOSHO, NESS, PHILLIPS, ROOKS, SALINE, SHAWNEE, STAFFORD, WILSON / near water on emergent vegetation, docks, bridges (11, 12, 36)
58. *Tetragnatha guatemalensis* O. P.-Cambridge 1889: DOUGLAS, LABETTE, MEADE, MONTGOMERY, ROOKS, SHAWNEE, WOODSON / mesic woods on *Anelosimus* webs, on vegetation near water (36)
59. *Tetragnatha laboriosa* Hentz 1850: ALLEN, ANDERSON, ATCHISON, BARTON, BROWN, CHAUTAUQUA, CHEROKEE, CHEYENNE, CLARK, CRAWFORD, DONIPHAN, DOUGLAS, ELLSWORTH, GOVE, JEFFERSON, LOGAN, MARION, MEADE, MIAMI, MITCHELL, MORRIS, MORTON, NORTON, OSAGE, REPUBLIC, ROOKS, SHAWNEE, SHERMAN, WILSON, WOODSON, WYANDOTTE / prairie, old fields, vegetation near water, but not restricted to water (11, 12, 36)
60. *Tetragnatha pallescens* F. P.-Cambridge 1903: ANDERSON, CLARK, CRAWFORD, DOUGLAS, MEADE, NORTON, RENO, SEWARD, SHAWNEE, STAFFORD, WOODSON / emergent vegetation near water (12, 36)
61. *Tetragnatha straminea* Emerton 1884: DOUGLAS / backyard (36)
62. *Tetragnatha vermiformis* Emerton 1884: TREGO / trunks of dead trees in lake (36)
63. *Tetragnatha versicolor* Walckenaer 1841: SHAWNEE / woods, edge of woods (36)

REFERENCES

1. Berman, J.D. and H.W. Levi. 1971. The orb weaver genus *Neoscona* in North America (Araneae: Araneidae). *Bulletin of the Museum of Comparative Zoology* 141(8): 465–500.
2. Blackledge, T.A. and K.M. Pickett. 2000. Predatory interactions between mud-dauber wasps (Hymenoptera, Sphecidae) and *Argiope* (Araneae, Araneidae) in captivity. *The Journal of Arachnology* 28(2): 211–216.
3. Blackledge, T.A. and J.W. Wenzel. 2001. Silk mediated defense by an orb web spider against predatory mud-dauber wasps. *Behaviour* 138: 155–171.
4. Cloudsley-Thompson, J.L. 1995. A review of the anti-predator devices of spiders. Bulletin of the *British Arachnological Society* 10(3): 81–96.
5. Coddington, J. 1986. The monophyletic origin of the orb web. In: *Spiders, webs, behavior and evolution*. W.Shear (ed.) pp. 319–363.
6. Cokendolpher, J. 1977. Comments on a lizard eating *Argiope* (Araneidae: Araneae). *The Journal of Arachnology* 5 (2): 184.
7. Craig, C.L. & G.D. Bernard. 1990. Insect attraction to ultraviolet-reflecting spider webs and web decorations. *Ecology* 71(2): 616–623.
8. Dondale, C.D., J.H. Redner, P. Paquin and H.W. Levi. 2003. The insects and arachnids of Canada Part 23. *The orb-weaving spiders of Canada and Alaska* (Araneae: Uloboridae, Tetragnathidae, Araneidae, Theridiosomatidae). NRC Research Press, Ottawa, Ontario, Canada. 371 pages.
9. Eberhard, W.G. 1980. The natural history and behavior of the bolas spider *Mastophora dizzydeani* sp. n. (Araneidae). *Psyche* 87: 143–169.
10. Eberhard, W.C. 1987. How spiders initiate airborne lines. *The Journal of Arachnology* 15(1): 1–9.
11. Fitch, H.S. 1963. Spiders of the University of Kansas Natural History Reservation and Rockefeller Experimental Tract. *Univ. Kansas Mus. Nat. Hist. Misc. Pub*., 33: 1–202.
12. Fitch, H.S. & V.R. Fitch. 1966. Spiders from Meade County, Kansas. *Transactions of the Kansas Academy of Science* 69(1): 11–22.
13. Gertsch, W.J. 1979. *American Spiders*. (2nd edition). van Nostrand Reinhold Co., NY 274 pages.
14. Greenstone, M.H. and K.D. Sunderland. 1999. Why a symposium on spiders in agroecosystems now ? *The Journal of Arachnology* 27(1): 267–269.
15. Guarisco, H. 1998. Caudal false face pattern in an orbweaving spider, *Eustala* sp. (Argiopidae) from western Kansas. *Transactions of the Kansas Academy of Science* 101(3–4): 138–139.
16. Guarisco, H. 1999. Distributional status and natural history observations of the genus *Argyrodes* (Araneae: Theridiidae) in Kansas. *Transactions of the Kansas Academy of Science* 102(3–4): 138–141.
17. Guarisco, H. (in press). Status of the orb-weaver spider genus *Acanthepeira* (Araneae: Araneidae) in Kansas. *Transactions of the Kansas Academy of Science*.
18. Guarisco, H. (in press). An unusual orbweaving spider, *Kaira alba* (Araneae: Araneidae), recently discovered in Kansas. *Journal of the Kansas Entomological Society*.
19. Guarisco, H. and H.S. Fitch. 1995. Spiders of the Kansas Ecological Reserves. *Transactions of the Kansas Academy of Science* 98(3–4): 118–129.
20. Guarisco, H. and D.J. Mott. 1990. Status of the genus *Mimetus* (Araneae: Mimetidae) in Kansas and a description of the egg sac of *Mimetus puritanus* Chamberlin. *Transactions of the Kansas Academy of Science* 93(3–4): 79–84.
21. Horton, C.C. 1980. A defensive function for the stabilimenta of two orb weaving spiders (Araneae, Araneidae). *Psyche* 87: 13–20.
22. Lazaris, A., S. Arcidiancono, Y. Huang, J.-F. Zhou, F. Duguay, N. Chretien, E.A. Welsh, J.W. Soares and C.N. Karatzas. 2002. Spider silk fibers spun from soluble recombinant silk produced in mammalian cells. *Science* 295: 472–476.
23. Levi, H.W. 1968. The spider genera *Gea* and *Argiope* in America (Araneae: Araneidae). *Bulletin of the Museum of Comparative Zoology* 136(9): 319–352.
24. Levi, H.W. 1971. The *diadematus* group of the orb-weaver genus *Araneus* north of Mexico (Araneae: Araneidae). *Bulletin of the Museum of Comparative Zoology* 141(4): 131–179.
25. Levi, H.W. 1972. [1971] The orb-weaver genera *Singa* and *Hyposinga* in America (Araneae: Araneidae). *Psyche* 78(4): 229–256.
26. Levi, H.W. 1973. Small orb-weavers of the genus *Araneus* north of Mexico (Araneae: Araneidae). *Bulletin of the Museum of Comparative Zoology* 145(9): 473–552.
27. Levi, H.W. 1974. The orb-weaver genera *Araniella* and *Nuctenea* (Araneae: Araneidae). *Bulletin of the Museum of Comparative Zoology* 146(6): 291–316.
28. Levi, H.W. 1975. The American orb-weaver genera *Larinia*, *Cercidia* and *Mangora* north of Mexico (Araneae, Araneidae). *Bulletin of the Museum of Comparative Zoology* 147(3): 101–135.

29. Levi, H.W. 1975. Additional notes on the orb-weaver genera *Araneus*, *Hyposinga*, and *Singa* North of Mexico (Araneae, Araneidae). *Psyche* 82: 265–274.
30. Levi, H.W. 1976. The orb-weaver genera *Verrucosa*, *Acanthepeira*, *Wagneriana*, *Acacesia*, *Wixia*, *Scoloderus* and *Alpaida* north of Mexico (Araneae: Araneidae). *Bulletin of the Museum of Comparative Zoology* 147(8): 351–391.
31. Levi, H.W. 1977. The American orb-weaver genera *Cyclosa*, *Metazygia* and *Eustala* north of Mexico (Araneae, Araneidae). Bulletin of the Museum of Comparative Zoology 148(3): 61–127.
32. Levi, H.W. 1977. The orb-weaver genera *Metepeira*, *Kaira* and *Aculepeira* in America north of Mexico (Araneae: Araneidae). *Bulletin of the Museum of Comparative Zoology* 148(5): 185–238.
33. Levi, H.W. 1978a. The American orb-weaver genera *Colphepeira*, *Micrathena* and *Gasteracantha* north of Mexico (Araneae, Araneidae). *Bulletin of the Museum of Comparative Zoology* 148(9): 417–442.
34. Levi, H.W. 1978b. Orb-weaving spiders and their webs. *American Scientist* 66(6): 734–742.
35. Levi, H.W. 1980. The orb-weaver genus *Mecynogea*, the subfamily Metinae and the genera *Pachygnatha*, *Glenognatha* and *Azilia* of the subfamily Tetragnathinae north of Mexico (Araneae: Araneidae). *Bulletin of the Museum of Comparative Zoology* 149(1): 1–74.
36. Levi, H.W. 1981. The American orb-weaver genera *Dolichognatha* and *Tetragnatha* north of Mexico (Araneae: Araneidae, Tetragnathinae). *Bulletin of the Museum of Comparative Zoology* 149(5): 271–318.
37. Levi, H.W. 1992. American *Neoscona* and corrections to previous revisions of neotropical orb-weavers (Araneae: Araneidae). *Psyche* 99: 221–239.
38. Levi, H.W. 1993. The orb-weaver genus *Kaira* (Araneae: Araneidae). *The Journal of Arachnology* 21(3): 209–225.
39. Levi, H.W. 1993. The neotropical orb-weaving spiders of the genera *Wixia*, *Pozonia*, and *Ocrepeira* (Araneae: Araneidae). Bulletin of the Museum of Comparative Zoology 153(2): 47–141.
40. Levi, H.W. 2002. Keys to the genera of araneid orbweavers (Araneae, Araneidae) of the Americas. *The Journal of Arachnology* 30(3): 527–562.
41. Levi, H.W. 2003. The bolas spiders of the genus *Mastophora* (Araneae: Araneidae). Bulletin of the Museum of Comparative Zoology 157(5): 309–382.
42. Lockley, T. C. and O. P. Young. 1993. Survivability of overwintering *Argiope aurantia* egg cases, with an annotated list of associated arthropods. *The Journal of Arachnology* 21(1): 50–54.
43. Nyffeler, M. 2000. Killing power of the Orb-weaving spider *Argiope bruennichi* (Scopoli, 1772) during a mass occurrence. *Newsletter of the British Arachnological Society* 89: 11–12.
44. Nyffeler, M., D.A. Dean and W.L. Sterling. 1989. Prey selection and predatory importance of orb-weaving spiders (Araneae: Araneidae, Uloboridae) in Texas cotton. *Environmental Entomology* 18(3): 373–380.
45. Platnick, N.I. 2005. *The World Spider Catalogue*, Version 5.5 American Museum of Natural History, online at http://research.amnh.org/entomology/spiders/catalogue/index.html.
46. Roth, V.D. 1993. *Spider genera of North America with keys to families and genera, and a guide to literature*. American Arachnological Society. Jon Reiskind, Dept. Zool. Univ. of Florida, Gainesville, FL 32611. 203 pages.
47. Sabath, L. E. 1969. Color change and life history observations of the spider *Gea heptagon* (Araneae: Araneidae). *Psyche* 76: 367–374.
48. Shear, W.A. 1994. Untangling the evolution of the web. *American Scientist* 82(3): 256–266.
49. Shear, W.A, J.M. Palmer, J.A. Coddington and P.M. Bonamo. 1989. A Devonian spinneret: early evidence of spiders and silk use. *Science* 246: 479–481.
50. Sunderland, K.D. and M.H. Greenstone. Summary and future directions for research on spiders in agroecosystems. *The Journal of Arachnology* 27(1): 397–400.
51. Tso, I-Min. 1998. Stabilimentum-decorated webs spun by *Cyclosa conica* (Araneae, Araneidae) trapped more insects than undecorated webs. *The Journal of Arachnology* 26(1): 101–105.
52. Witt, P.N., C.F. Reed and D.B. Peakall. 1968. *A Spider's Web Problems in Regulatory Biology*. Springer-Verlag, Berlin, NY. 107 pages.
53. Yeargan, K.V. 1994. Biology of bolas spiders. *Annual Review of Entomology* 39: 81–99.

ACKNOWLEDGMENTS

This issue is dedicated to my friend and teacher, Henry S. Fitch, professor emeritus of the University of Kansas, who so generously shared his interest and knowledge of spider biology and natural history through the past 35 years.

I thank Craig Freeman of the KU Herbarium for the generous use of a microscope and camera, and Bruce Cutler of the University of Kansas for sharing his knowledge of spider taxonomy and for critically reviewing the manuscript. I am grateful for the wonderful field trips with friends and associates throughout the state, especially Cameron Liggett of the Sternberg Museum and the participants in teacher workshops in Hays and Garden City, and Bruce Cutler.

KANSAS SCHOOL NATURALIST, BOX 4050
EMPORIA STATE UNIVERSITY
1200 COMMERCIAL ST
Emporia, KS 66801-5087

ADDRESS SERVICE REQUESTED

Nonprofit Org.
U.S. Postage
PAID
Emporia, Kansas
66801-5087
Permit No. 203

Araneus marmoreus **female**