

NEW STATE, HOST, AND DISTRIBUTION RECORDS OF THE FISH ECTOPARASITE, *ARGULUS* (BRANCHIURA), FROM ILLINOIS (U.S.A.)

BY

WILLIAM J. POLY

Department of Zoology, Southern Illinois University, Carbondale, Illinois 62901-6501, U.S.A.

ABSTRACT

Argulus americanus, *A. flavescens*, *A. lepidostei*, and *A. japonicus* are reported from Illinois for the first time. Gizzard shad (*Dorosoma cepedianum*) is a new host record for *A. japonicus*, bigmouth buffalo (*Ictiobus cyprinellus*) is a new host record for *A. catostomi*, and black crappie (*Pomoxis nigromaculatus*) is a new host record for *A. stizostethii*. Eight species, *A. americanus*, *A. appendiculosus*, *A. catostomi*, *A. flavescens*, *A. japonicus*, *A. lepidostei*, *A. mississippiensis*, and *A. stizostethii*, have been recorded from 13 Illinois fish species. Ciliated protozoans (*Epistylis* or *Opercularia*) were observed on four *Argulus* spp., and crustacean shell disease was observed on five species.

ZUSAMMENFASSUNG

Das Vorkommen von *Argulus americanus*, *A. flavescens*, *A. lepidostei* und *A. japonicus* in Illinois wird hier zum ersten Mal dokumentiert. Folgende Wirte werden erstmals für folgende *Argulus*-Arten beschrieben: *Dorosoma cepedianum* für *A. japonicus*, *Ictiobus cyprinellus* für *A. catostomi* und *Pomoxis nigromaculatus* für *A. stizostethii*. Insgesamt wurden acht *Argulus*-Arten (*A. americanus*, *A. appendiculosus*, *A. catostomi*, *A. flavescens*, *A. japonicus*, *A. lepidostei*, *A. mississippiensis* und *A. stizostethii*) an 13 Fischwirten in Illinois gefunden. An vier *Argulus*-Arten wurden Vertreter der Ciliata (*Epistylis* oder *Opercularia*) beobachtet, und fünf *Argulus* spp. waren von der Crustaceen-Schalenkrankheit befallen.

INTRODUCTION

Relatively little is known of the distribution and species composition of the crustacean ectoparasite genus *Argulus* in Illinois. Several reports in 1980 added to our knowledge, but since then additional information has not appeared (Buttner, 1980; Price & Buttner, 1980; Price & Jilek, 1980; Robinson & Jahn, 1980). Therefore, the author made new collections of *Argulus*, examined unidentified specimens collected earlier by others, and searched for published and unpublished records. New records as well as past host and distribution records of *Argulus* in Illinois have been compiled.

MATERIALS AND METHODS

Argulus spp. were collected in Illinois during July-September, 1995 and May-September, 1996. The parasites were collected directly from fishes that had just been captured with a seine and were preserved in 70% ethyl alcohol. Keys, original descriptions, and revisionary studies (Cressey, 1972, 1978; Mueller, 1936; Meehan, 1940; Wilson, 1902, 1916) were used to make identifications. I follow Wilson (1902) and Yeatman (1965) in distinguishing *Argulus americanus* Wilson, 1902 and *A. maculosus* Wilson, 1902 pending a more thorough examination of their taxonomy. Most specimens were deposited in the United States National Museum (USNM) as indicated in table I. Ciliated protozoans were identified using Kudo (1966).

RESULTS AND DISCUSSION

Thirty-eight *Argulus* were collected from six fish species at eight sites: Wabash River, Mississippi River, Horseshoe Lake, Cache River, Little Grassy Creek, and Lake Creek (3 sites). Six species of *Argulus* were collected by the author, and six species from other collections were provided by several colleagues. Recent collections and identification of specimens collected in the past have resulted in new state, host, and distribution records (table I; fig. 1). *Argulus americanus*, *A. flavescens* Wilson, 1916, *A. japonicus* Thiele, 1900, and *A. lepidostei* Kellicott, 1877 are new records for Illinois. Five species, *A. americanus*, *A. catostomi* Dana & Herrick, 1837, *A. flavescens*, *A. lepidostei*, and *A. mississippiensis* Wilson, 1916, were found just below the Horseshoe Lake spillway in Lake Creek, and *A. stizostethii* Kellicott, 1880 was collected in Horseshoe Lake. One *A. catostomi* was found on the inner surface of the right opercle of *Ictiobus cyprinellus* (Valenciennes, 1844), a new host for *A. catostomi*. *Argulus japonicus* has never been reported from Illinois, nor has it been known to parasitize *Dorosoma cepedianum* (Lesueur, 1818). Tokioka (1936: 335) mentioned that *A. japonicus* in Japan was found on *Carassius auratus* (Linnaeus, 1758), *C. carassius* (Linnaeus, 1758), *Cyprinus carpio* Linnaeus, 1758, and "many other freshwater fishes", and Amin (1981) reported *A. japonicus* from *Ictalurus punctatus* (Rafinesque, 1818) in southeast Wisconsin. Recent laboratory and field data also indicate that *A. japonicus* is not as host specific (for goldfish) as once believed (Shafir & Oldewage, 1992; LaMarre & Cochran, 1992; Avenant-Oldewage, 1994). *Argulus stizostethii* was identified from black crappie, *Pomoxis nigromaculatus* (Lesueur, 1829), collected in the Mississippi River by Robinson & Jahn (1980), and this is a new host record for *A. stizostethii*. In two cases, two species of *Argulus* were found on a single fish; *Lepisosteus platostomus* Rafinesque, 1820 from the

TABLE I
Localities and host species for *Argulus* in Illinois. Data from this study unless otherwise indicated. The number of host fishes parasitized is given in parentheses

Locality	Host fish	Location on fish	Number of <i>Argulus</i> collected	Species
Wabash River	<i>Lepisosteus platostomus</i> (1)	B	2♂, 1♀	<i>A. lepidostei</i> (USNM 274338, 1♂, 1♀) [†]
		B	1♂	<i>A. mississippiensis</i> (USNM 274339)
Lake Creek	<i>Lepisosteus platostomus</i> (1)	B	1♀	<i>A. lepidostei</i> (USNM 274338) [†]
	<i>Lepisosteus platostomus</i> (2)	B	1♂, 1♀	<i>A. mississippiensis</i> (USNM 274336)
		B	1♂, 1♀	<i>A. lepidostei</i> (USNM 274335) [†]
	<i>Lepisosteus oculatus</i> (1)	B	1♂	<i>A. sp. indet.</i> (author's collection)
	<i>Micropterus salmoides</i> (1)	M	1♀	<i>A. flavescens</i> (USNM 274337) [†]
Horseshoe Lake*** at Fairbury, IL Lake Springfield	<i>Amia calva</i> Linnaeus, 1766 (1)	B	2♂, 6♀	<i>A. americanus</i> (USNM 274331) [†]
	<i>Amia calva</i> (1)	B	2♂, 7♀	<i>A. americanus</i> (USNM 274331, N = 1♂, 6♀) [†]
	<i>Amia calva</i> (1)	B	1♀	<i>A. americanus</i> (USNM 274332) [†]
	<i>Amia calva</i> (1)	F	1♀	<i>A. americanus</i> (author's collection)
	<i>Ictiobus cyprinellus</i> (1)	O	1♀	<i>A. catostomi</i> (author's collection)* [†]
	cyrinid**	-	1♀	<i>A. catostomi</i> (USNM 274333)
	<i>Lepisosteus oculatus</i> (1)	B	1♂	<i>A. sp. indet.</i> (author's collection)
	<i>Pomoxis annularis</i> Rafinesque, 1818 (1)	B	2♀	<i>A. stizostethii</i> (author's collection)
	<i>Cyprinus carpio</i> (1)	-	1♀	<i>A. catostomi</i> (USNM 28935) ^{†,1}
	<i>Notropis</i> sp.	-	25	<i>A. stizostethii</i> (USNM 78570) ^{†,1}
Becks Creek Rend Lake	<i>Alosa chrysochloris</i> (Rafinesque, 1820)	-	2	<i>A. stizostethii</i> (USNM 78571) ^{†,1}
	<i>Pyloditcis olivaris</i> (Rafinesque, 1818) (1)	B	1♂, 9♀	<i>A. appendiculatus</i> (USNM 274334) ²
	free-swimming	-	5	<i>A. appendiculatus</i> (91 A.O., 92 A.O., N = 2) ³
Crab Orchard Lake	<i>Pomoxis annularis</i> (1)	B	3	<i>A. stizostethii</i> (93 A.O., N = 2♀) ³
	free-swimming	-	1	<i>A. stizostethii</i> ³
	<i>Dorosoma cepedianum</i> (1)	-	1	<i>A. stizostethii</i> ³
		-	1♂	<i>A. japonicus</i> (USNM 75296) ^{†,4,*}

TABLE I
(Continued)

Locality	Host fish	Location on fish	Number of <i>Argulus</i> collected	Species
Little Grassy Creek	<i>Amia calva</i> (2)	H	1♂, 2♀	<i>A. americanus</i> (author's collection)
Lake Carlyle	<i>Lepisosteus osseus</i> (Linnaeus, 1758) (1)	-	1♀	<i>A. mississippiensis</i> (90 A.O) ⁵
LaRue Marsh	<i>Amia calva</i>	-	3♀	<i>A. americanus</i> ⁶
Kinkaid Lake	free-swimming	-	9♂, 5♀	<i>A. stizostethii</i> (author's collection) ⁷
Lake Sara	free-swimming	-	5♂, 6♀	<i>A. stizostethii</i> (author's collection) ⁷
Cache River	host unknown	-	1♀	<i>A. appendiculatus</i> (author's collection)
Cache River	<i>Ictiobus bubalus</i> (Rafinesque, 1818) (1)	O	1♀	<i>A. catostomi</i> (author's collection)
Mississippi River (Pool 20)	<i>Pomoxis annularis</i>	-	2	<i>A. sp.</i> ⁸
(Pool 20)	<i>Pomoxis nigromaculatus</i>	-	3	<i>A. sp.</i> ⁸
(Pool 20)	<i>Pomoxis nigromaculatus</i>	-	2♂	<i>A. stizostethii</i> ⁸
(Pool 26)	****	-	1♀	<i>A. flavescens</i> [†]
(Grand Tower)	<i>Lepisosteus platostomus</i> (1)	B	1♂	<i>A. mississippiensis</i> [†]

B = body, F = fin, M = mouth, H = head and O = inside surface of opercle. †) New state record; *) New host record; **) Found by D. J. Eisenhour in collection jar containing the following species: *Hypognathus nuchalis* Agassiz, 1855, *Pimephales notatus* (Rafinesque, 1820), *Notemigonus crysoleucas* (Mitchill, 1814) and *Notropis atherinoides* Rafinesque, 1818; ***) In Alexander County; ****) Found in collection jar containing one *Notropis wickliffi* Trautman, 1931 captured by Illinois Department of Conservation personnel; †) Mentioned in Wilson (1903) and Meehan (1940); ‡) Unpubl. collections from 1939 in USNM; A.O = Southern Illinois University at Carbondale; †) USNM record courtesy of R. B. Manning; ‡) Collected by A. K. Wilson in 1992; ‡) Buttner (1980); ‡) Reported as *Argulus* sp. (N = 7) in Price & Jitek (1980); the one specimen deposited (USNM 75296) was identified as *A. japonicus* by the author (this specimen is in the U.S. National Parasite Collection, Beltsville, MD); ‡) Price & Buttner (1980); ‡) Collected by W. M. Lewis, 26 September 1963; invertebrate teaching collection, J. A. Beatty, Southern Illinois Univ.; ‡) Collected in plankton tows by Jimmy Waddell and Mike Garthaus, Southern Illinois Univ. Fisheries Lab.; ‡) Reported as *A. sp.* by Robinson & Jahn (1980); L. A. Jahn loaned two specimens to the author for identification; ‡) Specimen given to a visiting scientist from Iquitos, Peru; the specimen had numerous rust-colored lesions on the left, ventral side of the carapace and appendages indicating crustacean shell disease.

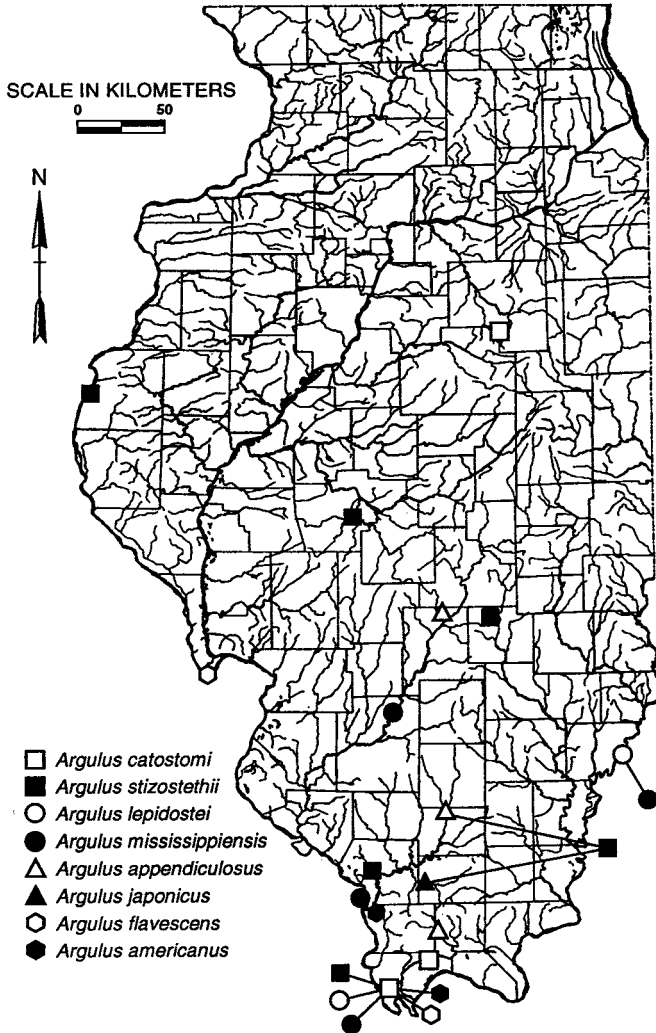


Fig. 1. Distribution of *Argulus* in Illinois (U.S.A.); symbols connected with lines indicate overlapping records.

Wabash River ($N = 1$) and Lake Creek ($N = 1$) had both *A. lepidostei* and *A. mississippiensis* on the same fish. Several *Argulus* taken from *L. oculatus* (Winchell, 1864) (table I) and *L. platostomus* (not listed in table I) are similar to *A. lepidostei*, but cannot be assigned to that species. The respiratory areas are identical or nearly so, while the second legs of males have either unilobed or bilobed structures on the coxa, rather than the fin-like lamellae of male *A. lepidostei*. Sucker rod elements number 6-9; therefore, the argulids are not *A. nobilis* Thiele, 1904. Perhaps in older males the unusual coxa may transform into the

normal shape for *A. lepidostei*; the author is attempting to collect additional specimens for further study.

Argulus flavescens was found inside the mouth of *Micropterus salmoides* (Lacépède, 1802) at the base of the right, fourth gill arch. Mueller (1936) also found this species scattered inside the mouth of *M. salmoides* in Florida, and Roberts (1957) reported it from the branchial cavity of *Cyprinus carpio*. *Argulus flavescens* carries eggs within internal "pouches" in the carapace alae, in addition to the normal thoracic position (Meehean, 1940; pers. obs.). Meehean (1940: 484) also stated that Thiele found these same egg chambers in *A. africanus* Thiele, 1900. Four African *Argulus* spp. are known to carry eggs in pouches in the carapace (Fryer, 1968; Rushton-Mellor, 1994). Females of six other U.S. *Argulus* spp. did not share this condition with *A. flavescens* (pers. obs.). In the original description, Wilson (1916: 350) noted "...the entire digestive canal, including the ramifications of the stomach, [are] a rich creamy yellow, in contrast to the white background..." and that "It may be recognized at once by the prominent yellow lateral lobes of the stomach." Not coincidentally, the eggs of *A. flavescens* are yellow. Mueller (1936) also noted the yellow appearance of the "digestive system" and stated that it was not as well developed in the specimens he collected (i.e., not as full of eggs). The distribution of melanophores on both males and females suggests a protective function, since the melanophores are usually concentrated over the testes in males and over the dorsal surface of the thorax in females. Melanophores are also abundant over the egg chambers in the alae of female *A. flavescens*. The dense array of melanophores likely protect the eggs held in the lateral egg chambers just as the melanophores on the dorsal surface of the thorax presumably function. Fryer (1968) stated the same hypothesis with regard to the African *Argulus*. Shen (1948) also noted the heavy concentration of melanophores on the dorsal thoracic surface of female *Argulus* spp.

Ciliated protozoans, either *Epistylis* or *Opercularia*, were observed on 15 of 18 *A. americanus* (often around the mouth tube), one of four *A. mississippiensis*, two of eight *A. lepidostei*, and one of two *A. flavescens*. Rust-colored lesions characteristic of crustacean shell disease were observed on one *A. catostomi*, three *A. americanus*, one *A. flavescens*, one *A. mississippiensis*, and one *A. lepidostei*; this disease has been reported from *A. foliaceus* Linnaeus, 1758 (cf. Rushton-Mellor & Whitfield, 1993) and *A. flavescens* (cf. Poly, in press).

Eight species, *A. americanus*, *A. appendiculosus*, *A. catostomi*, *A. flavescens*, *A. japonicus*, *A. lepidostei*, *A. mississippiensis*, and *A. stizostethii*, have been found on 13 fish species in Illinois, and additional species likely occur in the State.

ACKNOWLEDGEMENTS

I thank the following for their assistance: Raymond B. Manning and Paula Rothman provided USNM records and cataloged specimens, Allan K. Wilson provided specimens and helped collect additional specimens, J. Ralph Lichtenfels and Larry A. Jahn loaned specimens, David J. Eisenhour, Jimmy Waddell and Mike Garthaus provided specimens, Allan K. Wilson, David J. Eisenhour, James Rudacille, Brooks M. Burr, Kenneth M. Cook, Kyle R. Piller, Donovan B. Henry, Michael W. Littman, and Benjamin J. Braeutigam helped collect fishes, Sabine Schmid translated the abstract, Mark Sabaj checked the Illinois Natural History Survey collection, and the Department of Zoology, Southern Illinois University provided equipment and supplies.

REFERENCES

- AMIN, O., 1981. On the crustacean ectoparasites of fishes from Southeast Wisconsin. *Trans. American microsc. Soc.*, **100** (2): 142-150.
- AVENANT-OLDEWAGE, A., 1994. A new species of *Argulus* from Kosi Bay, South Africa and distribution records of the genus. *Koedoe*, **37** (2): 89-95.
- BUTTNER, J. K., 1980. Occurrence of *Argulus* (Crustacea: Branchiura) on the white crappie, *Pomoxis annularis* Rafinesque, and free-swimming in the southern Illinois Reservoirs. *Trans. Illinois State Acad. Sci.*, **72** (3): 5-7.
- CRESSEY, R. F., 1972. The genus *Argulus* (Crustacea: Branchiura) of the United States. Biota of freshwater ecosystems, U.S. Environmental Protection Agency Identification Manual, **2**: viii, 1-14.
- , 1978. Marine flora and fauna of the Northeastern United States. Crustacea: Branchiura. NOAA techn. Rept. Circular, **413**: 1-10.
- FRYER, G., 1968. The parasitic Crustacea of African freshwater fishes; their biology and distribution. *Journ. Zool., London*, **156** (1): 45-95.
- KUDO, R. R., 1966. Protozoology: 1-1174. (5th edn.; Charles C. Thomas, Springfield, IL).
- LAMARRE, E. & P. A. COCHRAN, 1992. Lack of host species selection by the exotic parasitic crustacean, *Argulus japonicus*. *Journ. Freshwater Ecol.*, **7** (1): 77-80.
- MEEHEAN, O. L., 1940. A review of the parasitic Crustacea of the genus *Argulus* in the collections of the United States National Museum. *Proc. U.S. natn. Mus.*, **88**: 459-522.
- MUELLER, J. F., 1936. Notes on some parasitic copepods and a mite, chiefly from Florida freshwater fishes. *American Midl. Natural.*, **17**: 807-815.
- POLY, W. J. (in press). Host and locality records of the fish ectoparasite, *Argulus* (Branchiura), from Ohio (U.S.A.). Crustaceana.
- PRICE, R. L. & J. K. BUTTNER, 1980. First reported occurrence of *Argulus mississippiensis* (Crustacea: Branchiura) from Illinois. *Trans. Illinois State Acad. Sci.*, **72** (3): 8.
- PRICE, R. L. & R. JILEK, 1980. Parasites of the gizzard shad, *Dorosoma cepedianum* Lesuer [sic], from two Southern Illinois lakes. *Trans. Illinois State Acad. Sci.*, **72** (3): 51-52.
- ROBERTS, L. S., 1957. Parasites of the carp, *Cyprinus carpio* L. in Lake Texoma, Oklahoma. *Journ. Parasitol.*, **43** (1): 54.
- ROBINSON, G. L. & L. A. JAHN, 1980. Some observations of fish parasites in pool 20, Mississippi River. *Trans. American microsc. Soc.*, **99** (2): 206-212.

- RUSHTON-MELLOR, S. K., 1994. The genus *Argulus* (Crustacea: Branchiura) in Africa: Identification keys. *Syst. Parasitol.*, **28** (1): 51-63.
- RUSHTON-MELLOR, S. K. & P. J. WHITFIELD, 1993. Transmission and scanning electron microscopic studies of crustacean shell disease in fish lice of the genus *Argulus* (Crustacea: Branchiura). *Journ. Zool., London*, **229**: 397-404.
- SHAFIR, A. & W. H. OLDEWAGE, 1992. Dynamics of a fish ectoparasite population: opportunistic parasitism in *Argulus japonicus* (Branchiura). *Crustaceana*, **62** (1): 50-64.
- SHEN, C. J., 1948. On three new species of fish parasites of the family Argulidae (Crustacea Branchiura). *Contrib. Inst. Zool. natn. Acad. Peiping*, **4** (4): 155-163, 4 pls.
- TOKIOKA, T., 1936. Preliminary report on Argulidae found in Japan. *Annot. zool. Japon.*, **15** (3): 334-343.
- WILSON, C. B., 1902. North American parasitic copepods of the family Argulidae, with a bibliography of the group and a systematic review of all known species. *Proc. U.S. natn. Mus.*, (1903) **25**: 635-742.
- —, 1916. Copepod parasites of fresh-water fishes and their economic relations to mussel glochidia. *Bull. U.S. Bur. Fish.*, (1914) **34**: 331-374.
- YEATMAN, H. C., 1965. Redescription of the freshwater branchiuran crustacean, *Argulus diversus* Wilson, with a comparison of related species. *Journ. Parasitol.*, **51** (1): 100-107.