Proceedings of the Iowa Academy of Science

Volume 77 | Annual Issue Article 28

1970

Caryophyllaeid Cestodes from Four Species of Carpiodes (Teleostei: Catostomidae)

Dennis D. Williams
Iowa State University

Martin J. Ulmer
Iowa State University

Caryophyllaeid Cestodes from Four Species of *Carpiodes* (Teleostei: Catostomidae)[1]

DENNIS D. WILLIAMS and MARTIN J. ULMER[2]

Abstract. The caryophyllaeid cestode fauna of four species of carpsuckers was investigated. Four hundred and thirty hosts from Iowa, Minnesota, Wisconsin, and Nebraska were examined (Aug. 1967-Dec. 1968) and 260 (60%) were parasitized. Four species of caryophyllaeids were found, of which *Spartoides wardi* and *Biacetabulum carpiodi* were most abundant. *B. carpiodi* exhibits a definite seasonal periodicity in spring and early summer, but none appears to exist for *S. wardi*. Single infections of *Glaridacris confusa* and *Monobothrium* sp. were also encountered.

Adult caryophyllaeid cestodes are intestinal parasites of catostomid, cyprinid, silurid, mormyrid, characid, bagrid, clarrid, and cichlid fishes in Africa, Europe, Asia, North America, and Australia. Cobitid, plotosid, zoarcid, and gobid fishes, according to Mackiewicz (1959) also serve as hosts. Adults of one genus (*Archigetes*) parasitize tubificid annelids. The known life histories have involved aquatic annelids of the families Tubificidae and Naididae. At present, the order Caryophyllidea is composed of 99 species, distributed among 34 genera.

North American caryophyllaeid cestodes parasitize native and introduced cyprinids (among the latter, *Cyprinus carpio* L.) and catostomid fishes. Surveys conducted on the caryophyllaeid fauna of North American catostomid fishes include several concerned with the white sucker, *Catostomus commersoni* (Lacépède): Mackiewicz (1960) examined white suckers from eastern states, and Canada; McCrae (1960) studied Colorado white suckers; Calentine and Fredrickson (1965), Iowa River white suckers; and Tobias (1967), Wisconsin white suckers.

Caryophyllaeids of the northern redhorse, *Moxostoma macrolepidotum* (LeSueur) and the golden redhorse, *M. erythrurum* (Rafinesque) from Iowa and South Dakota were reported by Fredrickson and Ulmer (1967). Self and Campbell (1956) investigated the caryophyllaeids of three species of buffalo fishes in Lake Texoma

[1] Many individuals aided in this study. We are grateful to Dr. Robert J. Muncy, Leader, Iowa Cooperative Fishery Unit, for his aid; to Dr. John S. Mackiewicz, State University of New York at Albany, for loan of specmens (*Spartoides wardi* and *Capingens singularis*) and for the use of certain data on caryophyllaeid cestodes. Mr. Monte L. Madsen and personnel of the Nebraska Game, Forestation, and Parks Commission helped in collecting fish hosts.

This study was supported in part by NSF grants GB-2345-X and GB-5465-X.

[2] Dept. of Zoology & Entomology, Iowa State University, Ames, Iowa.

(Oklahoma). Hunter (1930) also examined numerous buffalo fishes from the Mississippi River.

The caryophyllaeid fauna of the following catostomids have also been sporadically studied by various investigators: *Hypentelium nigricans* (LeSueur), northern hogsucker; *Erimyzon succetta* (Lacépède), lake chubsucker; *Minytrema melanops* (Rafinesque), spotted sucker; *Moxostoma anisurum* (Rafinesque), silver redhorse; *Catostomus clarki* Baird and Girard, gila sucker; and *C. insignis* Baird and Girard, sonora sucker.

Studies on the caryophyllaeid fauna of *Carpiodes* were first undertaken by Hunter (1927, 1929, 1930). Subsequent investigations on caryophyllaeids from carpsuckers include those by Bangham and Venard (1942), Self and Timmons (1955), Spall (1968), Mackiewicz (1964, 1969), and Calentine and Williams (1967).

The present study was undertaken to determine the caryophyllaeid fauna of river carpsuckers, *C. carpio* (Rafinesque), quillback carpsuckers, *C. cyprinus* (LeSueur), high fin carpsuckers, *C. velifer* (Rafinesque), and plains carpsuckers, *C. forbesi* Hubbs in rivers of Iowa, Minnesota (St. Croix River at Lakeland, Minnesota), and Nebraska (North Platte River at Lake McConaughy).

Many caryophyllaeid cestodes appear periodically in their fish hosts, as shown by Calentine (1962), Calentine and Fredrickson (1965), Fredrickson and Ulmer (1967), Tobias (1967), and hence may be seasonally present or absent. In the present study, investigations on periodicity of caryophyllaeids from two species of carpsuckers (*C. carpio* and *C. cyprinus*) from the Skunk and Des Moines Rivers, Iowa, were also undertaken.

Materials and Methods

Four hundred and thirty carpsuckers (*Carpiodes*) representing four species (*C. carpiodes,* river carpsucker; *C. cyprinus,* quillback carpsucker; *C. velifer,* high fin carpsucker; and *C. forbesi,* plains carpsucker) were collected and examined for caryophyllaeid cestodes.

Eleven hosts were collected from the St. Croix River at Lakeland, Minnesota and Buffalo Creek (Buchanan County, Iowa) in August, 1967, and from the Boone and Des Moines Rivers (Boone County, Iowa) in September, 1967; the remaining 419 fishes were collected from March 1968 - December 1968 in various regions in Iowa and at Lake McConaughy, Nebraska. Collection data are summarized in Table 1.

Fishes from the St. Croix River were obtained from a commercial fisherman. Carpsuckers (*C. carpio* and *C. forbesi*) from Lake McConaughy, Nebraska, were obtained from a Nebraska State Fisheries Commission fish trap located near the entry of the

Table 1. Incidence of parasitism of four species of *Carpiodes* by caryophyllaeid cestodes (number of hosts examined: number parasitized).

Source	*C. cyprinus*	*C. carpio*	*C. velifer*	*C. forbesi*
St. Croix River (St. Croix Co.) Wis.	3:3			
Mississippi River (Des Moines Co.) Iowa	3:3	1:0		
Lake MacBride (Johnson Co.) Iowa	3:3	6:5		
Des Moines River (Boone Co.) Iowa	27:22	70:34	3:1	
Boone River (Boone Co.) Iowa	6:6	10:5		
Skunk River (Story Co.) Iowa	62:49	21:10	11:3	
Little Sioux River (Dickinson Co.) Iowa	13:11			
Buffalo Creek (Buchanan Co.) Iowa	3:1			
West Fork Des Moines River (Emmet Co.) Iowa	13:13			
Lake McConaughy Nebraska		90:45		85:46

North Platte River into the west end of Lake McConaughy. Carpsuckers from Iowa (*C. carpio, C. velifer,* and *C. cyprinus*) were obtained with 20 and 50 foot seines, trap nets, and electric shockers. Electric shocking provided the most fish with minimum effort.

Fishes from the North Plate River at Lake McConaughy and from the St. Croix River at Lakeland, Minnesota were examined immediately after death; fishes from Iowa were examined either immediately after death, or the intestines were removed, placed in ice and examined within eight hours.

Intestinal contents were placed in a beaker containing tap water, river water, or 1% sodium bicarbonate solution in distilled water. The intestine was examined macroscopically for attached cestodes, and intestinal contents, placed in petri dishes, were examined microscopically. Recovered cestodes were washed in tap or river water, or if mucus was excessive, in a 1% solution of sodium bicarbonate as suggested by Meyer (1958). Specimens were fixed

in cold and hot A.F.A., hot A.F.A.—glycerol, or Bouin's fixative. Whole mounts were stained in Mayer's paracarmine with fast green counterstain, or in Erhlich's acid hematovylin, often counterstained in fast green, cleared in methyl salicylate, and mounted in resinous media. Drawings were produced with the aid of a microprojector.

Results

Six species of caryophyllaeids have been reported previously from carpsuckers, namely: *Spartoides wardi* Hunter, 1929; *Capingens singularis* Hunter, 1927; *Biacetabulum meridianum* Hunter, 1929; *Biacetabulum carpiodi* Mackiewicz, 1969; *Glaridacris confusa* Hunter, 1929; and *Hypocaryophyllaeus paratarius* Hunter, 1927. Of these, only *S. wardi, B. carpiodi,* and *G. confusa* were represented in the present survey. In addition, one specimen of *Monobothrium* sp. was recovered.

Of the 430 carpsuckers examined, 260 (60%) were parasitized with single and double infections of caryophyllaeids (Table 2). Double infections (infections of two species of caryophyllaeids) occurred in 34 fishes (8%). No fishes were infected with more than two species of caryophyllaeids.

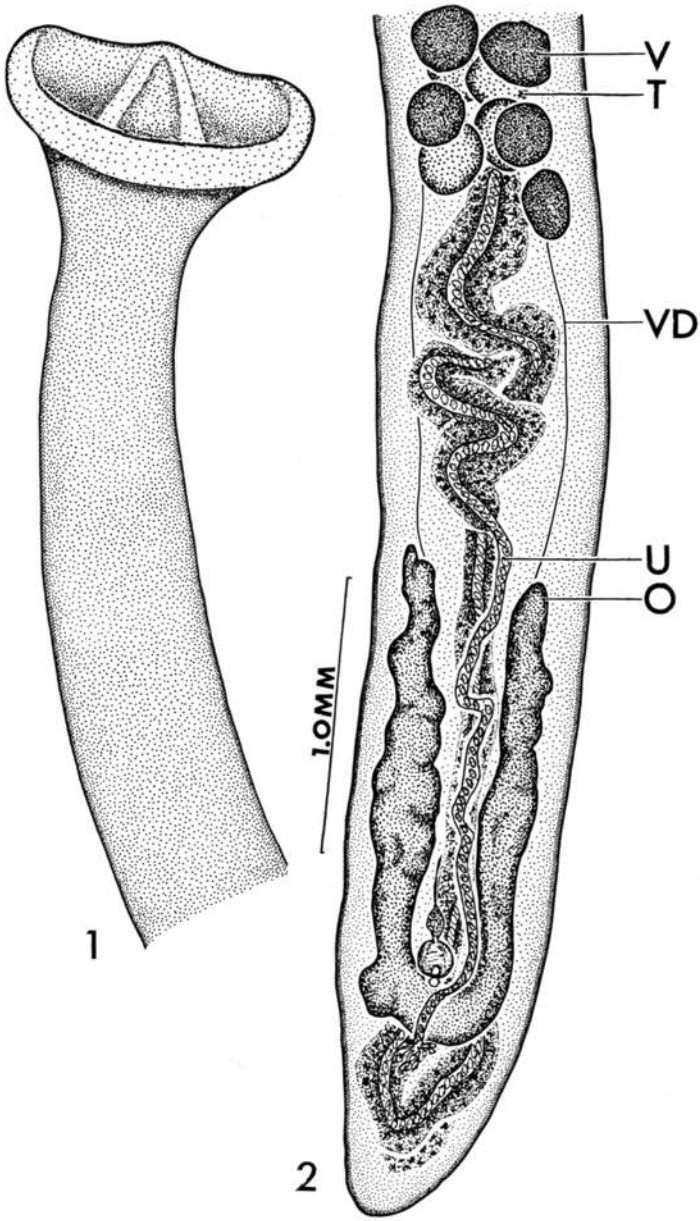
Table 2. Incidence of parasitism of *Carpiodes* by single and double infections by caryophyllaeid cestodes.

Fish host	Number of fishes examined	Number and percent of fishes with single and double infections	Number and percent of fishes with double infections
C. carpio	198	99 (50%)	19 (10%)
C. cyprinus	133	111 (83%)	9 (7%)
C. velifer	14	4 (30%)	0 (0%)
C. forbesi	85	46 (54%)	6 (7%)
Total	430	260 (60%)	34 (8%)

Spartoides wardi

Spartoides wardi has been reported from *Carpiodes carpio* and *C. cyprinus* by Hunter (1929, 1930), and by Spall (1968); and by Mackiewicz (personal communication, 1968) from *C. carpio.*

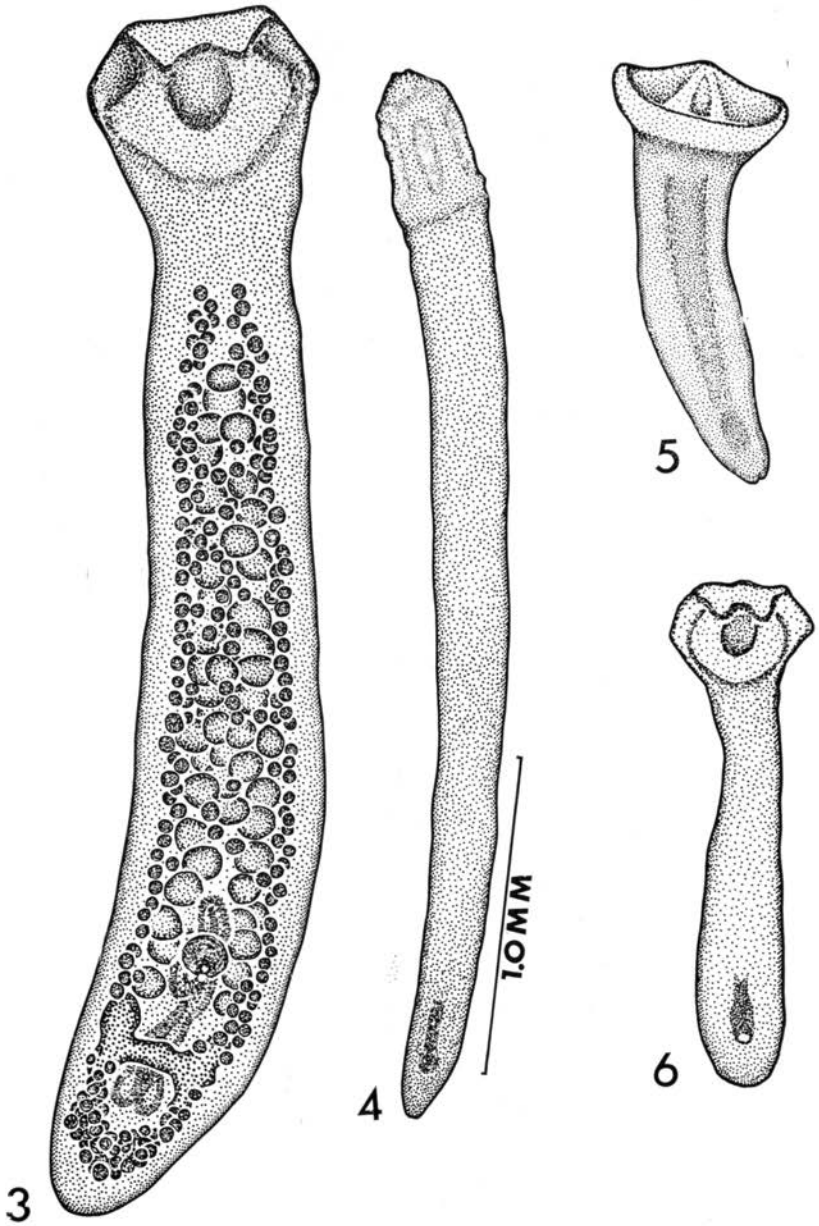
In the present study and in studies by other investigators noted above, *S. wardi* is widely distributed and is probably found over the entire range of *Carpiodes* (principally the Mississippi River drainage system). Areas in which *S. wardi* is now known to occur include Nebraska.



Figures 1-2.

1. Scolex of *Spartoides wardi* from *Carpiodes carpio* (Host 255) from the Des Moines River (Drawn to scale shown in Figure 2).
2. Posterior end of *S. wardi* from *C. carpio* (Host 255).

Abbreviations in Plates: O—Ovary; T—Testis; U—Uterus; V—Vitelline follicle; VD—Vitelline duct.



Figures 3-6 (All drawn to scale shown in Figure 4)

3. Gravid *Biacetabulum carpiodi* from *Carpiodes carpio* (Host 255).
4. Immature *Monobothrium* sp. from *C. cyprinus* (Host 428) from the Mississippi River at Fort Madison, Iowa.
5. Immature *S. wardi* from *C. carpio* (Host 258) from the Des Moines River, Iowa.
6. Immature *B. carpiodi* from *C. carpio* (Host 119) from the Boone River, Iowa.

In the present study, *S. wardi* was collected from all four species of *Carpiodes* and parasitized 41% (176 of 430) of them. Its occurrence in *C. velifer* and *C. forbesi* constitutes new host records.

S. wardi seems to lack a definite seasonal periodicity, having been present throughout 1968; gravid, mature and immature cestodes were usually present whenever collections were made.

S. wardi from various hosts varied considerably regarding body length and width, testes diameter, and ovary shape. According to Hunter (1930), maximum diameter of testes in this species was 0.2 mm; maximum body width, 0.5 mm. In the present study, maximum testes width, testes length, and body width were 0.13 mm, 0.29 mm, and 0.93 mm, respectively. These differences may be explained by age of the parasite in the fish host and/or the age of the fish host itself.

Other explanations for the differences in maximum length may relate to sample size or to methods of fixation. When cestodes were fixed in hot A.F.A.—glycerol rather than cold A.F.A., longer and thinner specimens resulted. Pseudobothria were more pronounced (Figures 1, 3, 5, and 6) in specimens fixed in cold A.F.A. or cold Bouin's. Differences in length, width, and testes diameter probably may also be explained by fixation procedures.

Biacetabulum carpiodi

B. carpiodi was reported Mackiewicz (1969) from *C. carpio* and *C. cyprinus*. In the present study, it occurred in 113 of 430 (26%) fishes and in all four species of carpsuckers studied. Its presence in *C. velifer* and *C. forbesi* constitute new host records. It was less frequent than *S. wardi* in carpsucker hosts.

Biacetabulum carpiodi was present in all areas except Buffalo Creek, Mississippi and St. Croix Rivers, where only a few hosts were examined. In Lake McConaughy, an equatic environment similar in size to the St. Croix and Mississippi Rivers, *B. carpiodi* occurred much more frequently than *S. wardi*. Where collections of *C. cyprinus* were made throughout the year, *B. carpiodi* was present in carpsuckers in the spring and early summer, but was absent after July. Its range is probably as great as that of *Carpiodes* (Iowa, Oklahoma, Tennessee, Nebraska, Minnesota, and Texas).

Glaridacris confusa

Glaridacris confusa was reported from *C. carpio* in Lake Texoma (Oklahoma) by Self and Timmons (1955), in *Carpiodes* spp. by Calentine and Williams (1967), and from one Mississippi River *C. cyprinus* in the present study. With reference to the *G. confusa* reported by Self and Timmons (1955), Mackiewicz (1969) examined some of these specimens and indicated them to be *S. wardi*.

Because *G. confusa* previously reported from *Carpiodes* were collected in areas where ictiobid fishes are also quite numerous (such as the St. Croix River at Lakeland, Minnesota and the Mississippi River at Fort Madison, Iowa), *G. confusa* found in the present study may represent accidental infections. *G. confusa* parasitizes principally fishes of the genus *Ictiobus,* (buffalo fishes); but because both *Carpiodes* and *Ictiobus* are morphologically and ecologically quite similar, *G. confusa* may parasitize *Carpiodes* as well.

Monobothrium sp.

One specimen of *Monobothrium* sp. collected from *C. cyprinus* from the Mississippi River probably represents an accidental infection, since the specimen (Figure 4) closely resembles *M. ingens,* a species known to principally parasitize ictiobid fishes.

Other Caryophyllaeids

Specimens of *Capingens singularis* and *Hypocaryophyllaeus paratarius* were not present in the *Carpiodes* examined in this study, although they have been noted by previous investigators as parasitizing catostomids. Hunter (1927) records *C. singularis* from *C. carpio* in the Rock River (Illinois) and Bangham and Venard (1942) found one *C. singularis* in a single *C. carpio* from Reelfoot Lake (Tennessee). Specimens of *C. singularis* have been collected by Mackiewicz (personal communication) from Lake Texoma ictiobids.

An examination of *Hypocaryophyllaeus paratarius* (slide H 412.1 from the G. W. Hunter collection sent to us by Dr. J. S. Mackiewicz) indicates these specimens to be *S. wardi.* Mackiewicz (personal communication) agrees with our conclusions.

Biacetabulum meridianum

Self and Timmons (1955) reported *Biacetabulum meridianum* from Lake Texoma *C. carpio.* Mackiewicz, however, (1969 and personal communication, 1968) believes this identification erroneous and considers the species involved to be *B. carpiodi. B. meridianum* is not a commonly found species and was originally reported by Hunter (1929) from Eno River, North Carolina chubsuckers, *Erimyzon succetta.*

Spall (1968) reported *Biacetabulum* sp. (considered by Mackietwicz (1969) to be *B. carpiodi*) in 13.2% of 38 *Carpiodes carpio* from Oklahoma. Two additional species of caryophyllaeids have been reported from Des Moines River *C. carpio* by Buchholz (1957): *Glaridacris catostomi* Cooper, 1920 and *Biacetabulum in-*

frequens Hunter, 1927, but these are almost certainly misidentifications. In collecting Des Moines River fishes for nearly two years with at least ten or more collections per year, no white suckers (the usual host of *G. catostomi*) were found.

The *B. infrequens* also reported from *C. carpio* by Buchholz (1957) in very possibly *B. carpiodi*, (*B. infrequens* normally occurs in *Ictiobus* spp.). Unfortunately, these specimens are not available for study.

No white suckers, the usual hosts for *G. catostomi* were found, nor has this species ever been recovered from fishes other than white sucker. Specimens considered by Buchholz (1957) to be *B. infrequens*, a species normally occurring in buffalo fishes (*Ictiobus*), very probably were *B. carpiodes*, but unfortunately are not available for study.

Discussion

Although no previous studies have been conducted on the caryophyllaeid fauna of all known species of *Carpiodes*, two investigations dealing with a single species of *C. carpio* have been reported. Self and Timmons (1955) reported 11% (22 of 201) *C. carpio* from Lake Texoma (Oklahoma) to be parasitized with caryophyllaeids, and Spall (1968) reported 45.5% (25 of 38) *C. carpio* from Oklahoma to be infected. In the present study, 50% (99 of 198) *C. carpio* harbored caryophyllaeids.

Generally, with large numbers of species of caryophyllaeids in a given area, the greater the total percentage of cestode infections in fishes from that area. Tobias (1967) found 196 of 230 (83%) Wisconsin white suckers parasitized with six species of caryophyllaeids. Calentine and Fredrickson (1965) reported 225 or 339 (75%) Iowa River white suckers were infected with five species of caryophyllaeids. In the present study, 60% of fish hosts harbored two species of caryophyllaeids (*S. wardi* and *B. carpiodi*) accounting for 99.5% of the infections. The precentage of infection of those catostomids commonly harboring only a single species of caryophyllaeid is much lower. Fredrickson and Ulmer (1967) recorded 38% of 275 northern redhorse as positive for *Isoglaridacris longus*; and 37% of 186 golden redhorse for *I. folius*. Anthony (1952) in a study of cestodes of 41 carp (*Cyprinus carpio*) in the vicinity of Ann Arbor, Michigan found that 46% were parasitized only with *Atractolytocestus huronensis*. Examinations of 70 hogsuckers (*Hypentelium nigricans*) from Iowa and Wisconsin rivers, in 1967-1968, indicated 22 fishes or 33% to be infected only with *Isoglaridacris* sp. (Williams, unpublished).

Periodicity or seasonal variation of certain caryophyllaeids is known to occur in their carpsucker hosts. In this study, *B. carpiodi*

occurred only in the sping and early summer months and was not present after July, although only incomplete data are at hand for November and no collections were made in October.

Other investigators, too, have reported additional species of *Biacetabulum* (*B. biloculoides* and *B. macrocephalum*) to be abundant in spring and early summer but rare in late summer and fall (Calentine and Fredrickson, 1965; Tobias, 1967; and Williams, 1968, unpublished data). In contrast, *S. wardi* infections were heaviest in spring and summer, but were also present in the fall and early winter months. *S. wardi* in contrast to *B. carpiodi,* does not appear to exhibit a pronounced seasonal periodicity.

The present study as well as previous investigations dealing with caryophyllacids, indicate that some species exhibit a definite seasona periodicity, and that other species do not. *Hunterella nodulosa* and *Spartoides wardi* must be included in the latter group, for gravid or mature members of these two species may be found in their fish hosts in nearly every month for the year.

Caryophyllaeids showing a marked seasonal periodicity may be separated into two groups: some display a definite seasonal periodicity, usually reaching a peak in the fish hosts in spring or early summer and generally disappearing from August to December. *Glaridacris catosomi, Biacetabulum carpiodi, B. biloculoides,* and *Archigetes iowensis* may be cited as examples. In other caryophyllaeid species, however, seasonal periodicity is present in the form of a population peak at a particular time of the year, although specimens may be found in their fish hosts throughout much of the year, *Isoglaridacris longus,* and *I. folius* may be cited as examples of this type of periodicity. Additional studies are needed to supplement the limited published data on seasonal periodicity of other caryophyllaeid species.

Literature Cited

ANTHONY, J. D. 1952. *Atractolytocestus huronensis* n. gen., n. sp. *Caryocestus* n. g. (Cestoda: Lytocestidae) with notes on the biology of the former and a review of the Lytocestidae. Microfilm Copy No. 3710. Unpublished Ph.D. thesis. Ann Arbor, Michigan, Library, University of Michigan. Ann Arbor, Michigan, University Microfilms.

BANGHAM, R. V. & C. E. VENARD. 1942. *J. Tenn. Acad. Sci.* **17**(1):22-38.

BUCHHOLZ, M. M. 1957. Life history of the river carpsucker (*Carpiodes C. carpio*) in the Des Moines River, Boone County, Iowa. Unpublished M.S. thesis. Ames, Iowa, Library, Iowa State University.

CALENTINE, R. L. 1962. *J. Parasitol.* **48**(4):523-524.

———— ————, & L. H. FREDRICKSON. 1965. *Iowa State J. Sci.* **39**: 243-250.

———— — ——, & D. D. WILLIAMS. 1967. *Parasitol.* **53**(4):692-693.

FREDRICKSON, L. H. & M. J. ULMER. 1967. *Proc. Iowa Acad. Sci.* **72**:444-461.

HUNTER, G. W. III. 1927. *J. Parasitol.* **14**:16-26.

————————. 1929. *J. Parasitol.* **15**:185-192.

————————. 1930. *Ill. Biol. Monogr.* **11** (for 1927):1-186.

MACKIEWICZ, J. S. 1959. *J. Parasitol.* **45** (4, sec. 2) : 25.
———————. 1960. Studies on the Caryophyllaeidae (Cestoidea) of *Catostomus commersoni* (Lacépède), with emphasis on those from fish near Ithaca, New York (Thompkins County) U.S.A. Microfilm Copy No. 61-1439. Unpublished Ph.D. thesis. Ithaca, New York, Library, Cornell University. Ann Arbor, Michigan, University Microfilms.
———————. 1964. *J. Parasitol.* **50** (3, sec. 2) : 31.
———————. 1969. *Proc. Helm. Soc. Wash.* **36**(1) : 119-126.
MCCRAE, R. C. 1960. Studies on the Caryophyllaeidae (Cestoda) of the white sucker *Catostomus commersoni* (Lacépède) in Northern Colorado. Microfilm Copy No. 60-6797. Unpublished Ph.D. thesis. Fort Collins, Colorado, Library, Colorado State University. Ann Arbor, Michigan, University Microfilms.
MEYER, F. P. 1958. *Proc. Iowa Acad. Sci.* **65**:477-516.
SELF, J. T. & J. S. CAMPBELL 1956. *Trans. Amer. Micro. Soc.* **75**(4) : 397-401.
———————— & H. F. TIMMONS. 1955. *Trans. Amer. Micro. Soc.* **74**: 350-352.
SPALL, R. D. 1968. Occurrence and distribution of helminth parasites of fishes from Lake Carl Blackwell, Oklahoma. Unpublished M.S. thesis. Stillwater, Oklahoma, Library, Oklahoma State University.
TOBIAS, R. C. 1967. The seasonal distribution of monozoic cestodes in the white sucker, *Catostomus commersoni* (Lacépède). Unpublished M.S. thesis. River Falls, Wisconsin, Library, Wisconsin State University.