Studies on the Life History of *Brachylecithum stunkardi* (Pande, 1939) (Trematoda: Dicrocoeliidae)\(^1,2,3\)

W. Patrick Carney
Naval Medical Research Unit No. 2, Jakarta Detachment, APO San Francisco 96356

**ABSTRACT:** *Brachylecithum stunkardi* (Pande, 1939) is reported for the first time from Clark’s nutcracker, *Nucifraga columbiana*, in Montana. *Allogona ptychophora* served as an experimental first intermediate host. Fully developed cercariae contained in slimeballs were shed 498 days after the ingestion of *B. stunkardi* eggs.

20 (+) flukes were recovered from the bile ducts and gallbladder of a Clark’s nutcracker, *Nucifraga columbiana* (Wilson), shot in Missoula County, Montana. Twelve were prepared for morphological studies and the remainder utilized in the life history experiments. These flukes were determined to be conspecific with *Brachylecithum stunkardi* (Pande, 1939). *Brachylecithum stunkardi* was originally described from specimens taken from the bile ducts of *Garrulus lanceolatus* in India by Pande (1939). It was found also in livers of *Cyanocitta cristata* (Linnaeus) from Texas and Virginia (Denton and Byrd,

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\(1\) This study was supported by funds provided by the Bureau of Medicine and Surgery, Navy Department for Work Unit MFS1.524.009-0003BF61, and the Department of Zoology, University of Montana.

\(2\) The opinions and assertions contained herein are those of the author and are not to be construed as official or as reflecting the views of the U. S. Navy Department.

\(3\) Experimental aspects of study conducted in the Department of Zoology, University of Montana, Missoula 59801. Reprint requests to Publications Office, NAMRU-2, Box 14, APO San Francisco 96363.
1951). This paper represents the first report of *B. stunkardi* from Clark's nutcracker and western North America.

The intramolluscan development has been described for five *Brachylecithum* species: *B. americanum* Denton, 1945, by Denton (1945), *B. alfortense* (Railliet in schedulis) Dollfus, 1954, by Timon-David (1956, 1957), *B. orfi* Kingston and Freeman, 1959, by Kingston (1965) and Carney (1966), *B. mosquensis* (Skrjabin and Isaitschikoff, 1927) by Carney (1967, 1970a), and *B. myadestis* Carney, 1972, by Carney (1972). Of these the complete life history is known for *B. mosquensis* and possibly *B. americanum*.

**Methods**

Adult flukes were teased from the bile ducts and placed in 0.85% NaCl. Those used for experimental infections were transferred to de-mineralized, distilled water and stored at 10°C. The remaining flukes were fixed, stained, and mounted as described by Carney (1970a). Land snails collected in Missoula County, Montana, were held and bred in plastic terraria maintained at temperatures ranging from 10—15°C as described by Carney (1970b). Snails exposed to eggs of *B. stunkardi* were transferred to a laboratory varying in temperature from 15—25°C when infections were diagnosed. Snails were dissected in 0.3% NaCl. The sporocyst stages were preserved as the adult flukes. Slimeballs, containing fully developed cercariae, were allowed to dissolve in water before the cercariae were preserved as were other stages.

Drawings were made with the aid of a camera lucida and microprojector. Measurements are in microns unless otherwise indicated. Average measurements are followed by ranges in parentheses.

**Observations**

**Description of Brachylecithum stunkardi adult from Nucifraga columbiana**

(Fig. 1)

Body elongate-cylindrical, of uniform diameter; body length 2.76 mm (1.6—4.0 mm) (estimated maximum length 9 mm or more since some fragments recovered with previtellarian length of 3 mm and others with postovarian length of more than 6 mm); body width 132 (115—192) between suckers, 150 (107—225) between testes, 130 (110—172) at posterior border of vitellaria. Tegument aspinose, without tuberculations. Oral sucker subterminal 151 (108—208) long, 124 (100—177) wide; mouth ventral; prepharynx absent; pyriform pharynx 61 (48—77) long, 55 (42—69) wide; esophagus 75 long and 5 wide; cecal bifurcation anterior to genital pores; ceca slender, course not determined posterior to ovary. Course and termination in hindbody obliterated by densely packed coils of uterus. Ventral suckers, anterior ¾ to ½ body, 160 (150—210) long, 216 (190—285) wide, with distinct lateral auricles, usually folded on lateral axis and protruding slightly above the ventral surface. Separate male and female pores close together on ventral surface posterior to cecal bifurcation; male pore posterior to female. Cirrus pouch usually anterior to ventral sucker 121 (112—144) long, 55 (54—64) wide, contains unarmed cirrus and coiled bulbus seminal.
vesicle. Testes usually distinctly oval, tandem, smooth, with width often exceeding mean body width; anterior testis 305 (200–540) long, 177 (123–280) wide; posterior testis 133 (184–462) long, 176 (92–280) wide. Both testes separated from ventral sucker, ovary, and each other by loop or loops of uterus. Ovary round, posterior to testes 133 (115–192) long, 112 (100–185) wide. Seminal receptacle 50 in diameter immediately posterior and dextral to ovary. Mehlis' gland and Laurer's canal not noted. Vitellaria posterior to seminal receptacle, with eight to 10 large, overlapping follicles on each side of body. Uterus descends in loops on dorsal side of body from ovary to posterior end of body where it turns and loops anteriorly ventral to vitellaria and ovary and dorsal to testes, ventral sucker and currenus pouch to terminate in female pore. Excretory pore terminates at end of narrow excretory duct; extent of bladder and other features of excretory system not noted.

**Host:** Nucifraga columbiana (Wilson), Clark's nutcracker, adult female.

**Habitat:** Bile ducts of liver and gall-bladder.

**Locality:** Pattee Canyon, Missoula County, Montana.

**Date:** 2 October 1965.

**Specimen deposited:** USNM Helm. Coll. No. 72327.

**Experimental molluscan host:** Allogona ptychophora (Brown), laboratory-reared from parental specimens collected in Missoula, Montana.

### Description of Larval Stages

**Egg (Fig. 2)**

Fully developed egg, 44.7 (41.6–51.2) in length and 26.7 (22.4–32.0) in width, oval, brown, and operculate with serrate opercular margin. Shell smooth, ca. 2–3 thick except at opercular margin were thinner. Miracidium with two granular bodies in posterior half and finely particulate gland and stylet in anterior half.

**Daughter sporocyst (Figs. 3, 4)**

Daughter sporocyst sacculate, 1,475 (800–2,800) in length and 175 (150–250) in width. Body wall ca. 10 thick except at poles where thickens. Undifferentiated embryos and developing cercariae in endosac. Posterior pole of sporocyst rounded, anterior pole generally attenuated. Birth canal not always distinct.

**Cercaria (Figs. 5–7)**

Cercarial body 376 (340–500) in length and 83 in width. Tegmentum cross-striated with small papillae on posterior ventral margin. Subterminal cup-shaped oral sucker 83 in length, 49 in width, and 53 in depth. Retractile stylet ca. 25 long, dorsal to apex of oral sucker, blunt at posterior with two blunt, dorsolateral extensions and ventral keel at anterior. Mouth funnels to pharynx ca. 20 in diameter. No prepharynx. Transversely oval ventral sucker 53 long, 60 wide, and 56 in depth. Flame cell pattern 2 \((2 + 2 + 2)\). Tapering tail 329 (280–400) in length, maximum width at base 63 (50–70). Cross-striations of tegument conspicuous on tail. Six giant nuclei and numerous small nuclei within tail.

### Life History Data

Eggs of *B. stunkardi* were fed to four species of land mollusks from habitats occupied by *N. columbiana*: Allogona ptychophora (Brown), Triodopsis mulloni (Bland and Cooper), Zonitoides arboreus (Say), and Val- lonia sp. The A. ptychophora were laboratory-raised whereas the remaining molluscan species were field-collected specimens. Of the 26 A. ptychophora experimentally exposed to *B. stunkardi* eggs, four were positive for larval forms of the fluke. Slimeballs, first observed 498 days postingestion, were passed periodically in an amorphous mass. *Brachylecithum stunkardi* did not develop in *Z. arboreus*, *T. mulloni*, or *Vallonia* sp.

Carpenter ants, *Camponotus herculeanus* (Linnaeus), and *C. pennsylvanicus* modoc Wheeler were exposed to slimeballs of *B. stunkardi*. The ants were not observed to feed upon the slimeballs, nor were metacercariae recovered upon necropsy.

### Discussion

When Denton and Byrd (1951) reported *B. stunkardi* from North America they con-
Figures 2–7. *Brachylecithum stunkardi*, morphology of eggs and intramolluscan stages. 2. Egg showing characteristic shape and operculum. 3. Daughter sporocyst showing fully developed cercariae and undifferentiated germinal masses. 4. Daughter sporocyst showing many developing cercariae and undifferentiated germinal masses. 5. Cercaria, ventral view. 6. Cercaria, lateral view. 7. Stylet of cercaria, ventral and lateral views, showing central keel and lateral bases.
sidered *B. ephophae* (Yamaguti, 1941) and *Brachylecithum* sp. (Braun, 1902) conspecific with *B. stunkardi* and suggested that *B. stunkardi* might be a synonym of *B. lobatum* (Rail\-liet, 1900). Travassos (1941) considered *B. halcyonis* (Yamaguti, 1941) identical with *B. stunkardi*. Oshmarin (1963), however, has since reported *B. ephophae* from Manchuria, and Faust (1966), although aware of Denton and Byrd's synonymy of *B. ephophae* with *B. stunkardi*, reported *B. ephophae* in the area of Peking and also questioned the synonymy of *B. halcyonis* with *B. stunkardi* by Travassos (1941).

Agrawal (1964) described as a new species a dicrocoelid from the intestine of *Acridotheres tristis* (Myna) in the vicinity of Varanasi, India, as *Lyperosomum stunkardi*. According to Fotedar and Raina (1965) this fluke belongs to the genus *Brachylecithum*, and they suggested that it was synonymous with *B. stunkardi* which was originally included in the genus *Lyperosomum*. *Lyperosomum stunkardi* Agrawal, 1964, as described, belongs in the genus *Brachylecithum* but may not be conspecific with *B. stunkardi*. A distinguishing feature of *B. stunkardi* is the lateral auricles of the ventral sucker. These are not evident or mentioned in the description given by Agrawal. The specific name likewise is invalid since it has been used previously in the genus *Lyperosomum* to which it was originally assigned and is already used in the genus *Brachylecithum* to which it correctly belongs according to the figure and description by Agrawal (1964). Thus, *Lyperosomum stunkardi* Agrawal, 1964, is considered a *species inquirenda*.

Macko (1969) recently examined a series of *B. lobatum* from corvids in eastern Europe and concurred with Rysavy's (1960) synonymy of *B. alfertense* with *B. lobatum*. Other *Brachylecithum* spp. closely related to *B. lobatum* are *B. stunkardi, B. ephophae, B. reei* (Jarswal, 1964), *B. chitowsca* (Pratt and Cutress, 1949), *B. eugenia* (Oshmarin, 1947), *B. glandarri* (Semenov, 1927) Odening, 1964, *B. strigis* (Yamaguti, 1939), and *B. strixi* (Oshmarin, 1952) Odening, 1964. The above-mentioned species all possess distinct lateral auricles on the ventral sucker, similar morphological configuration and gonadal topography. Although closely related, the question of their synonymy with *B. lobatum*, however, will require more detailed studies of intraspecific variability of the adult as well as larval stages.

Although studies of adult structure suggest that *B. stunkardi* and *B. alfertense*, a synonym of *B. lobatum* according to Rysavy (1960) and Macko (1969), are closely related, the daughter sporocysts of both species reveal some interesting differences. When the sporocysts of *B. alfertense* are fully developed the endosac swells to an ovoid or subspherical structure in the middle while the two extremities are narrowly constricted (Timon-David, 1957). This condition resembles daughter sporocysts of some brevicercous dicrocoelids such as *Eurytrema pancreaticum* (Janson, 1889) in which the daughter sporocysts are passed from the mollusk at maturity (Tang, 1950). The cercariae of *E. pancreaticum*, contained in the endosac, apparently mature simultaneously. Fully developed daughter sporocysts of *B. stunkardi*, on the contrary, resemble sausages with a large number of cercariae in various stages of development contained in the endosac. The latter pattern of development is common in all longicerous or magnicerous dicrocoelids thus far studied (Carney, 1972).

Timon-David (1957) did not describe how cercariae of *B. alfertense* were released from the molluscan host. He did, however, place *B. alfertense* in Patten's (1952) longicerous group in which the cercariae are released from the molluscan host in the form of slimeballs. But from his description the daughter sporocysts appear capable of withstanding desiccation as those described for the brevicercous dicrocoelids in which daughter sporocysts are released intact from mollusks.

In describing the cercariae of *B. alfertense*, Timon-David (1957) did not indicate the conditions under which the cercariae were studied nor did he mention the formation of slimeballs. Thus, the cercariae described may have been removed from daughter sporocysts. Carney (1970a) showed that the cercarial body of *B. mosquensis* was distended by the contents of the postacetabular glands while in the sporocyst whereas these glands were empty in the cercariae taken from slimeballs.

Contrary to expectations, life history data and larval morphology of two closely related species, such as *B. alfertense* and *B. stunkardi,
have not solved the taxonomic interpretations of the respected adult stages. Further studies of the larval stages of members of the B. lobatum complex are necessary. The atypical life history at larval stages of B. alfertense, as described by Timon-David (1957) from field-collected snails, should be reconfirmed using laboratory-reared mollusks.

Acknowledgments

I wish to thank Dr. J. Fred Denton for his helpful comments on this manuscript. My thanks are also extended to the staffs of the Medical Illustration Department, Naval Medical Research Unit No. 2, Taipei, and the Naval Medical Research Institute, Bethesda, Maryland.

Literature Cited


