A PRELIMINARY STUDY OF THE CESTODES OF THE SPOONBILL
Polyodon spathula (Wal.)

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The material upon which this paper is based was collected at Money, Mississippi, where field studies were carried on from February until June and during the latter part of August and the first few days of September, 1927. The hosts were taken by commercial fisherman from the Tallachatchie River and adjoining lakes, and were dressed before shipment to New York and Chicago. Inasmuch as the number of spoonbills secured daily averaged 25 to 30 and often was as great as 100 or more, the material for examination was exceedingly plentiful and the chief limiting factor in the study was the number of individuals that could be accurately studied each day, not the number available for such examination. In all, 171 spoonbill were studied, ranging in size from 2 to 50 pounds. Of this number the head and gills only were studied in 30 specimens, and in the remaining 139 the intestine and viscera were examined.

In dressing the fish for market, the heads were removed and the body eviscerated. Thus it was possible to examine the entire intestinal tract of each specimen studied, and in some cases the entire fish was available for study. It was not an uncommon occurrence to observe both mature and larval cestodes on the dressing block, for so completely filled was the intestinal tract of some individuals that the worms crawled out from the esophagus or the posterior region of the spiral valve during the dressing process. This also happened often when an accidental cut was made in any other part of the alimentary canal.

For ease in examination the alimentary canal was divided into its 4 natural parts: the esophagus, stomach, pyloric ceca, and spiral valve. As soon as possible after the fish was dressed the canal was cut into these parts and each portion placed in a clean container. Beginning at the anterior division, each was then cut lengthwise and the large cestodes removed. Finally, each segment was placed in a clean fruit jar (1 quart size) and shaken vigorously

with a small amount of water, and the mixture was poured into a silk plankton net or sieve. By this method it was felt that a quantitative collection was secured from each of the divisions of the intestinal tract.

The results of a preliminary study of this collection warrant the conclusion that the spoonbill in this locality harbors 3 species of cestode parasites. This was not so evident until the study was well underway, however, for the general appearance of these three species is quite similar and the small larvae are practically indistinquishable. Careful study, and the occurrence of all 3 species in several adult hosts, made it possible to quickly distinguish the adults of each species. The data accumulated from subsequent collections and study indicate that in addition to morphological details these species differ among themselves in size, appearance in the living condition, region of host infection, seasonal distribution, and perhaps in life history. The details of this morphology are now being studied and will be presented in a later paper, but the important facts relative to their general morphology, together with their relative degree and incidence of infection, as well as other facts of value for rapid field determination, will be considered briefly at this time.

The most common of the 3 cestode species of the spoonbill is *Marsipometra hastata* (Linton). This species was originally described by Linton in 1898 but his description was quite incomplete, and the form was restudied and redescribed by Cooper in 1918. Linton described the color of the living species as follows: ".....at first lemon-yellow; after lying in water for a few minutes the body became colorless or faintly bluish translucent, while the heads remained yellowish." Cooper based his study on preserved material and added nothing to the description of this cestode in life. My own observations on living material are in entire accord with those of Linton. While the size of the specimens collected varied from 0.425 to 210 mm. in length, all had the characteristic yellowish color in life, and the scolex of the large forms remained so after lying in water for some time, although the proglottides of the large forms and the entire body of the larvae soon became colorless. The extreme activity of the large larvae and mature forms was a characteristic feature.

Cooper's description of the external appearance of the scolex and strobila is much more accurate than Linton's and may be noted in part, as follows:

"Medium-sized cestodes up to a length of 110 mm. with a maximum breadth of 3 mm. at the middle. Scolex with deep bothria and prominent posterior borders, 1.5 to 2.8 mm. in length, 0.5 to 1.8 mm. in width anteriorly and 1.3 to 2.0 mm. posteriorly. Sub-cylindrical neck, 0.8 to 1.5 mm. wide. First segments very short and wide, middle much broader than long and rectangular in outline, posterior ones quadrate to slightly longer than broad. Whole strobila much depressed."

Certain additional notes should be recorded concerning the appearance of this form in life. The anterior portion, particularly the scolex, shows marked powers of elongation. The scolex is thrust, both forward and laterally, with great rapidity, and at such times the length of this portion may be three times its normal length when at rest, with the width and thickness varying in proportion. During such activity in the anterior half of the cestode, the posterior angles of the segments are much more distinct than in the preserved specimens.

It is of interest to note that of the 139 spoonbills studied, only one was entirely free from this species of cestode. In all the others either larval or adult forms or both were found. The average number of cestodes of this species found per host was about 400, although a maximum number of over 5,000 (mostly larvae) was collected from a single host. The distribution of this species in the intestinal tract proved an additional point of interest. In 5% of the hosts *M.hastata* was found only in the spiral valve; in 42% in both the spiral valve and plyoric ceca; in 5% in the stomach, ceca, and valve; and in 11% in all 4 regions of the intestine. The greatest infection was usually in the pyloric ceca and spiral valve. Mature parasites were collected during the entire course of the field work from February until September, but the heaviest infection was found in the summer and fall months.

Experiments were conducted to determine the important steps in the life history of this species. Adults were found to extrude eggs immediately after being placed in artesian water or rain water, but did not respond well in this respect to Ringer's solution. Almost immediately after the eggs were extruded the oncospheres forced their way through the egg membrances and began swimming actively about. Feeding experiments with many different species of copepods, a very common article in the spoonbill diet

(Eddy and Simer, 1929), failed to indicate a probable intermediate host; for in no case were the eggs eaten by any of the copepods. The occurrence of small larvae in such large numbers in the intestinal tract is evidence that the intermediate host is ingested in great numbers, but conditions at the time these experiments were conducted were not conducive to successful experimental work. It was noted that adult tapeworms remained alive and active in artesian water for only 6 days, but in Ringer's solution they retained their activity for a period of 13 days. In the latter case, however, the chain of proglottides showed a tendency to fragment after the 4th or 5th day, and activity was then limited to the portion containing the scolex, while the proglottides in the other segments often assumed an extremely irregular form.

The second species of cestode encountered in this study has been designated *Marsipometra parva.*

MARSIPOMETRA PARVA spec. nov.

Specific diagnosis: Small cestodes up to a length of 150 mm. with a maximum breadth of 1.40 mm. Scolex a truncated cone, flattened dorsoventrally, and provided with a flattened knob-like anterior end. Maximum length of scolex 1.044 mm., maximum width at enlarged base, 1.74 mm. Bothria not visible in total preparations. Neck narrowed behind scolex, subcylindrical, 0.39 to 0.87 mm. wide. First segments only slightly wider than long, and at approximately the same stage of maturity as the posterior segments. Middle and posterior proglottides slightly longer than wide. Entire strobila depressed and constricted at union of proglottides.

Genital cloaca large, at the margin of the proglottis, slightly anterior to the middle, and irregularly alternating. Vagina opens at about the same level as the cirrus. Testes ellipsoidal, 60 to 80 μ in diameter, 35 to 60 in number, and distributed throughout the cortex with the exception of the region of the uterus sac. Vas deferens a circular mass of coils dorsal to the uterine pore, 0.080 mm. in diameter. Cirrus sac elongate, 0.35 mm. long by 0.060 mm. in diameter.

Vagina about 0.020 mm. in diameter. The ovary is reniform, tubulolobular, 0.261 mm. wide, and 0.174 mm. long. The vitelline follicles are irregular in shape, and distributed throughout the proglottis with the exception of the central area. The shell gland is anterior to the ovary, near the mid-line. Uterine sac small, circular, and greatly enlarged in gravid proglottides by the formation of 8 to 12 radial pounches, which reach almost to the lateral margins of the proglottis. Uterine pore in the mid-line, slightly anterior to the level of the genital cloaca. Eggs 28 by 20 μ.

The characters of most importance in the recognition of this species in the living condition are its peculiar shaped scolex, white color, small size, chain of bead like proglottides, and the absence of almost all activity. The elongations of the living adult are slow and of short duration and are limited to the anterior one. third of the strobila. The poorly developed condition of the suckers is indicated by the fact that in no case, either in larvae or adults, was this species found attached to the tissue of the host. The union between the proglottides in this species appears to be an extremely secure one; for in no case were separate proglottides found except where an entire chain had broken loose from the scolex at the constricted neck region.

M. parva was not found as commonly or in such large numbers as was *M. hastata.* It was discovered in only 52 of the 139 examinations, the first larvae being secured February 15 and the first mature forms February 28. The last specimens collected during this study were secured April 23. This would indicate that the period of infection by this species is quite restricted in comparison with the other species considered. The average number of cestodes of this species present in each infected host was 26, but this includes both larval and mature forms. In 81% of the infected hosts, infection was limited to the region of the spiral valve, and in 17% infection occurred in both the pyloric ceca and spiral valve. In only one host were parasites taken from each of the three posterior regions of the intestinal tract.

Attempts were made to discover facts that would shed light on the life history of this species, but these did not meet with success. The eggs were extruded in great numbers, but no outer membrances could be seen, nor was it possible to study the morphological details of the eggs. No movement was observed, and none of the various species of copepods ingested the cestode eggs. The extremely limited period during which this species was collected from the spoonbill would seem to indicate that a seasonal distribution of the intermediate host is likely, but no proof of this supposition can yet be advanced.

The third species of cestode taken from the spoonbill has been named *Marsipometra confusa* because of the similarity of the living specimens of this species to *M. hastata.*

MARSIPOMETRA CONFUSA spec. nov.

Specific diagnosis: Medium-sized cestodes up to a length of 120 mm. and a maximum breadth of 2.088 mm. at the middle. The scolex in life is spool shaped with prominent suckers, the base slightly broader than the anterior part, and the entire organ flattened dorsoventrally. In preserved material the outline of the scolex is conical with a blunt anterior end, and no suckers are visible. Maximum measurements of the scolex are 1.044 mm. long and 0.87 mm. in breadth. The posterior region of the scolex narrows to join the somewhat constricted and subcylindrical neck, about 0.696 mm. in width. The first segments are very short and wide, the middle ones about as broad as long, and the posterior ones somewhat longer than broad. The entire strobila is much depressed and increases gradually to a maximum width near its center.

Genital cloaca near the middle of the margin of the proglottis, alternating irregularly. Vagina opening at about the level of the cirrus. Testes ellipsoidal, 60 to 100 μ in diameter from 180 to 260 in number, arranged in a single layer in the medulla, lacking in the region of the uterine sac. and at lateral margins. Cirrus sac short and cylindrical, 0.360 mm. long and 0.080 mm. in diameter. Cirrus 0.240 by 0.020 mm. Vagina 0.020 mm. in diameter. Ovary reniform and tubulolobular, 0.609 mm. wide by 0.267 mm. long. Vitelline follicles irregular in shape and size, in a layer around the proglottis. Shell gland anterior to the ovary, near the mid-line, about 0.174 mm. in diameter. Uterus sac in immature proglottides longitudinal in the mid-line, extending from the shell gland to near the anterior border of the proglottis, diameter 0.087 to 0.174 mm. In mature forms 5 to 8 lateral pouches on either side, extending to the region of the lateral nerve cord. Uterine pore at the posterior end of the uterine sac, anterior to the ovary. Eggs spherical, about 0.070 mm. in diameter.

The characters of special value in the field determination of this species are the shape of the scolex in both the active and inactive forms, the deeply serrated lateral boundaries in the active specimens, the short period of activity, and the ease with which segmentation of the strobila occurs.

Of the 139 spoonbills examined, 51 contained *M. confusa*. The first specimens were collected March 14, and infection continued as long as these studies were under way. The average number found in each infected host was 24. In 70% of the hosts infection was limited to the pyloric ceca, and in 11% infection occurred in both the stomach and ceca. In one host all four regions of the intestine contained this species. Experiments conducted in an attempt to elucidate the life history of *M. confusa* were generally unsuccessful as far as the determination of the intermediate host was con-

cerned, but eggs were easily obtained, were seen to hatch, and the 6-hooked, ciliated oncosphere was studied.

SUMMARY

Quantitative collections of the intestinal contents of 139 spoonbill indicate the occurrence of three species of pseudophyllidean cestodes in this host. The most frequent species was *Marsipometra hastata* (Linton, 1898), found in all regions of the intestine and in all but one examination. *Marsipometra parva* spec. nov. was found in 52 of the hosts and was limited in most cases to the region of the spiral valve. *Marsipometra confusa* spec. nov. was found in 51 of the hosts and was collected in a majority of cases from only the pyloric ceca, although it was also found in the stomach and spiral valve in a small percentage of the hosts.

The three species differ in shape and size of the scolex, the appearance of the strobila, and the shape of the uterine sac. There are also many minor points of difference in their anatomy. From the data at hand they appear to differ in seasonal infection and in degree of infection.

Attempts to elucidate the life history of these species were unsuccessful. In each, eggs were secured in quantity, but only in *M. hastata* and *M. confusa* were the oncospheres observed. No evidence was secured to indicate what forms serve as the intermediate hosts of these cestode species.

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