STUDIES ON SOME DIGENEA OF THE FAMILY

**DIDYMZOZOIDAE**

BY S. V. JOB

*(University of Madurai, Madurai–2, S. India)*

Received April 28, 1966

(Communicated by Prof. R. V. Seshaiya, F.A.Sc.)

**INTRODUCTION**

A chance discovery of a digenetic trematode of the family *Didymozoidae* on a species of *Sphyraena* (Barracuda) in the gulf of Mannar near the Southern extremity of the Indian Peninsula some years ago brought many interesting facts concerning this group that the author has ventured to present the following. It is more to arouse interest rather than to claim completeness of the information gathered, that this account is presented.

The study is, therefore, limited to the five new species described by the author: *Didymozoon apharyngi, Didymozoon tetragynae, Platocystis polystra, Didymocystis pseudobranchialis* and *Didymocystis singularis* (Job, 1961 a, b, c; 1964 and 1965 respectively). All of these have been isolated from one genus of marine fish *Sphyraena*. In this account details of morphology are omitted as they are fully dealt with by Yamaguti (1958). But it is interesting to note that the record in this publication indicates that they are parasitic on marine fish other than *Sphyraena* with one exception (*viz.*) *Didymozoon sphyraenae* (Syn: *Monostoma gemellum*—Steenstrup, 1860). It is not clear whether this is because the particular host genus had been neglected and not investigated as well as the others.

However, there is apparently some kind of exclusiveness in the host-parasite relationship which seems to vary in degrees. Even in the specific diagnosis of the parasites there are possibilities of one mixing up the individuals on the basis of morphology alone. Therefore, the present account may also serve to substantiate the setting up of five new species by the author. The question of the exclusiveness of host-parasite association or of their interchangeability appears to be a promising field of research in this context. Some aspects of this problem will also be presented in this study.
DISCUSSION

**Distribution**

The existing records of the distribution of this family of parasites brings them up to the Italian coastal waters on the west and the Pacific off Japan on the east. The present record around the Indian peninsula, which is also the first record, completes their global distribution. In the Indian region it was found as far as the author could investigate that *P. polyastra* (Job, 1961, b) is one which is restricted to the Palk Straight off Pamban and within a race of *Sphyraena obtusata* confined to that region. All attempts to spot this infection elsewhere including even contiguous areas of this region have proved fruitless. It is possible that the intermediate hosts of this species do not occur elsewhere or that both the first host as well as the intermediate hosts do not migrate or possibly the parasites develop directly avoiding intermediate hosts and on a non-migrant race of host. On this basis investigation of *S. jello* indicated that with at least two of the parasites *D. apharyngi* and *D. tetragyna* it is the most widely distributed in the Indian region being recorded as far as the Andaman seas. *S. picuda* especially with the parasite *D. pseudobranchialis* appeared much more restricted, being recorded in the bay of Bengal up to Madras and the parasites were notably absent in collections made in the Andaman region.

**Host-Parasite Specificity**

As is well known among parasites the specificity of the parasites to their hosts is displayed in this family as well, but it can be seen from the preceding discussion that there are gradations of this specificity. *D. apharyngi* appears to be the most cosmopolitan in its choice of hosts occurring both in *S. jello* and *S. picuda*. Its near ally *D. tetragyna* appears to prefer *S. jello* to any other host. *D. pseudobranchialis* was specific to *S. picuda*, *D. singularis* to *S. jello* and *P. polyastra* to *S. obtusata* only, as far as the author's study had indicated.

In the case of the last named species it is noteworthy that the hosts are restricted to a geographical region as was mentioned earlier and this fact poses very important problems not only of specificity of infection but of population dynamics and populations available for exploitation in fisheries. That, year after year a single population contributes exclusively to the fisheries of a particular region has indeed been demonstrated on morphometric and other data in the half-beaks in this region already (Talwar—personal communication). If that is so it is possible that host-parasite specificity using the
latter as "biological tags" (Job, 1961 b) can become a useful tool in the study of population dynamics.

Temporary and Permanent Parasites

In the five species described, the author was able to note that there were some which appeared to be permanent and others not so. As an illustration of a permanent one can be cited *D. pseudobranchialis*. The author collected in the Palk Straight in shallow lagoons a specimen of *S. picuda* measuring only about 10 cm., with ripe encysted parasites occupying the pseudobranch. Of course the parasites were small measuring just about 1 to 1.5 mm. along the longer axis. This is a clear indication that infection of the hosts commences very early. There were also cases of fish measuring over 50 cm. in length in which these parasites were found. These were of course much larger measuring about 5 mm. in length indicating that this association is relatively more permanent and the parasites continue to live as long as the host lives. Very likely this is true of *D. singularis* as well.

Figure 1 illustrates *D. apharyngi* as a case of temporary association. This figure is reproduced from a piece of buccal epithelium cut out from a large host. The juvenile, unencysted parasites moving towards each other in order to encyst as a pair are indicated by 4 (arrows). In 1, the body is already differentiated into the slender fore part and a capacious hind part and the parasites have enclosed themselves in a common cyst. In 2, a pair is seen in an advanced stage with the uterus filled with eggs. In 5, the degenerating individual of a pair is indicated. The hind body of this appears to have lost all other structures except a few clumps of eggs in an uterus which is itself fast disappearing. In that same figure, 3 marks the scar tissue left behind by the corresponding pair as well as others after they had degenerated completely. It is very likely this is true of *D. tetragyna* and *P. polyastra* as well, where they are lost with the wearing off of the tissue or shedding of the structure in which they are encysted. Similar conditions on the pseudobranch with reference to *D. pseudobranchialis* could not be found.

Place of Occurrence on Host

As was described earlier *D. apharyngi* occurs in the buccal epithelium and gill arches mostly. *D. tetragyna*, both in the buccal region and on the fins. *D. pseudobranchialis* is confined only to the pseudobranch. *D. singularis* which is very similar to the latter is found deeper in the host body surrounding the heart in the gular region. *P. polyastra* is confined to the scales on the ventro-lateral aspects of the host. The important question
now arises, whether the place of occurrence on the host can determine the morphology of the parasite. In other words whether, for instance, *D. apharyngi* (Fig. 3) and *D. tetragyna* could refer to one and the same species or whether *D. pseudobranchialis* and *D. singularis* could be so too. The question arose because the author was able to isolate several juvenile larvae in the pre-encysting free stage (Fig. 2) of what appeared to be those of *D. apharyngi* and *D. tetragyna* and a single one possibly of *D. pseudobranchialis*. But at this stage their specific identity is difficult to mark as all appeared as illustrated in Fig. 2. Further, the outline sketches in Fig. 3 especially of the

B2
four species mentioned above do not preclude the possibility of *D. tetragnæae* being derived from *D. apharyngi* or *D. pseudobranchialis* from *D. singularis* and the species being mistakenly called by distinct names. These parasites generally can be stretched and distorted out of proportion under pressure
on a slide and therefore the use of body proportions cannot be safe or correct criteria for purposes of classification especially as in cases referred to above. Secondly, it is not difficult to visualise *D. pseudobranchialis*, casting off its paired association in a common cyst and becoming free and unpaired like *D. singularis* in the deeper parts of the host where the latter lives securely free from disturbance. This doubt was always before the author while each of the descriptions was referred to a new species. Although ample evidence in support of creation of new species is presented in every account, the author investigated the possibilities of using ovic embryos, as possible tools in taxonomy because of their relatively stable dimensions. This study proved very encouraging.

**Ovic Embryos**

Figure 3 illustrates ovic embryos from the types sketched alongside, after the parasites had been fixed and stained. The contrast between

\[ \text{apharyngi} \quad D. \text{tetragyna} \quad P. \text{polyasta} \]

\[ D. \text{pseudobranchialis} \quad D. \text{singularis} \]

**FIG. 3.** Ovic embryos of the various Didymozoids together with outline sketches of the respective parasites. The scale is only for the embryos. The outlines are approximately of the same proportion to one another.

*D. apharyngi* and *D. tetragyna* is very clearly seen. The ovic embryos of the former were angular, thin-walled and bigger than those of the latter.
Between *D. pseudobranchialis* and *D. singularis* the contrast is even more clear. The former irrespective of the size of the parasite (sketch includes ovic embryos from a small and a large parasite) are bigger than those of *D. singularis*. Another interesting observation appears to be that while *D. apharyngi* and *D. tetragynae* follow one lineage in the size and shape of their ovic embryos, the rest follow another. It will be interesting if biochemically these ovic embryos are analysed as well as their whole bodies.

One important and interesting observation recorded with reference to the ovic embryos was the isolated case of *D. pseudobranchialis* in which it was histochemically demonstrated (Job, 1964) that each embryo cyst contains two embryos. This is a novel method of ensuring survival of the progeny. Whether this is true of the other species of Didymozoids is yet to be investigated. But all the same, this mode of encystment of ovic embryos appears to be unique and not recorded so far.

**Encystment**

In the manner of encystment also of the adults Fig. 1 clearly shows that the individuals in a common cyst have their fore bodies at opposite poles in the case of *D. apharyngi*. In *D. pseudobranchialis* the fore bodies of both were directed forwards along the flattened side of contact as was described already (Job, 1964).

**SUMMARY**

In the light of the above discussion, it appears that the parasites and their hosts form a biotype which is both exclusive and interchangeable. In the former case it is of such an extreme association as to be confined to a very limited geographical region. Using the parasites as "biological tags" in such cases appears to have great possibilities. In specific diagnosis and in creation of new species information could be gleaned from the study of other characteristics such as ovic embryos. Biochemical and histochemical investigations such as the formation of ovic embryos offer interesting new avenues of research.

**REFERENCES**


Job, S. V.  


.. "Description of a new species of digenetic trematode (Family: Didymozoidae) and some histochemical observations on the same," Proc. Indian Acad. Sci., 1964, 60 (2) B, 128-34.

.. "Didymocystis singularis (n.sp.): a digenetic trematode from the barracuda," Zool. anzei., 1965 (In press).

Yamaguti, S.  