Invertebrate Reproduction and Development, 24:3 (1993) 157–160
Balaban, Philadelphia/Rehovot
0168-8170/93/$05.00 © 1993 Balaban

Glochidiosis and juvenile production in a freshwater pearl mussel, *Chamberlainia hainesiana*

SOMSAK PANHA
Department of Biology, Faculty of Science, Chulalongkorn University, Bangkok 10330, Thailand
Fax: 662–2530337

Received 3 July 1993; Accepted 6 August 1993

Summary

Experiments on glochidiosis of the freshwater pearl mussel, *Chamberlainia hainesiana*, were carried out using the fry of four species of fish, namely Temminck's kissing gourami (*Helostoma temmincki*), striped tiger nandid (*Pristolepis fasciatus*), walking catfish (*Clarius macrocephalus*) and sand goby (*Oxyeleotris marmoratus*). The fry were exposed to four concentrations of glochidia, and the LE_{50} values (the concentrations that killed 50% of the fry) were determined. The most resistant species was *O. marmoratus*, which also gave the highest production of juvenile mussels. Juveniles appeared 18–27 days after infection.

Key words: Glochidiosis, juvenile, freshwater, pearl mussel

Introduction

The glochidial larval stage parasitizes fish and certain amphibians (Howard, 1951; Walker, 1981). Panha (1990) reported 14 species of fish that are hosts to glochidia. Glochidia are very host-specific (Heard, 1975; Bauer, 1987a, 1987b). Due in part to inadequate knowledge of their life-cycles, pearl mussels are being directly and indirectly eradicated (e.g., by over-fishing, fishing in the reproductive season and water pollution) (Bauer et al., 1980; Bauer, 1988).

Thailand has great potential for producing freshwater pearls on a large scale because so many of its species of freshwater mussels are capable of making pearls (Panha, 1990). Apart from study by Panha (1990), no work has been done on the relationship between glochidia and host species in Thailand. Study of this relationship is essential for conservation and management of both fish and pearl mussels and for the future of the pearl industry.

Tedla and Fernando (1969) studied the attachment of glochidia of *Lamsilis radiata* on *Perca flavescens* in Canada and the favourite sites were found to be around the gills. Meyers et al. (1977) investigated glochidiosis of salmon and found that 40–50 mm long

Contributed to the 6th International Congress on Invertebrate Reproduction, Trinity College, Dublin, 1992.

salmon are suitable hosts for *Margaritifera margaritifera*. Kondo (1983) found that the parasitic stage of glochidia to *Anodonta woodiana* extends over about 12–15 days. Bauer and Vogel (1987) found that encystment of glochidia induced in the fish an immune response and previously encysted fish are capable of resisting new encystment.

The present study is a laboratory investigation of glochidiosis by glochidia of the mussel *Chamberlainia hainesiana* on four species of host fish (Temminck's kissing gourami, *Helostoma temmincki*; striped tiger nandid, *Pristolepis fasciatus*; walking catfish, *Clarius macrocephalus*; and sand goby, *Oxyeleotris marmoratus*).

Materials and Methods

In December 1990, recently hatched fry of the species *Helostoma temmincki*, *Pristolepis fasciatus*, *Clarius macrocephalus* and *Oxyeleotris marmoratus*, of 12–17 mm in total length were exposed individually to 7.7×10^4, 1.54×10^5, 3.08×10^5 or 6.16×10^5 glochidia per litre for 3 h in small aquaria containing 3750 ml of aerated, dechlorinated tap water. The juvenile fishes had not previously been infected by glochidia. All the fry were obtained from commercial suppliers. The aeration and fish movement kept the glochidia in suspension. Ten fish of each species were used for each exposure level and ten unexposed control specimens were subjected to the same conditions as the test fish. After exposure the group of infected fish and the control group were kept apart in separate compartments of big aquaria. The fish were fed once daily with artificial fish pellets.

Gravid mussels from the Kwae Noi River were the major source of glochidia (Fig. 1). During the spawning period from 21 December 1990 to 26 January 1991, these mussels were collected by local people and by dredging from the river bottom and then transported to the laboratory and held for spawning.

In the laboratory each gravid female mussel was held in 1000 ml of dechlorinated tap water. Glochidia were usually released within 1–2 h after the water temperature rose to 28–29 °C (4–5 h at room temperature, 24–25 °C). The larvae were examined for viability using movement of the valves as the criterion. Glochidia from different mussels were pooled, and the average number per ml of suspension was determined by serial dilution so that the volume of the suspension necessary for the desired exposure concentration could be calculated. Fish were exposed to glochidia during the day on which the latter were spawned.

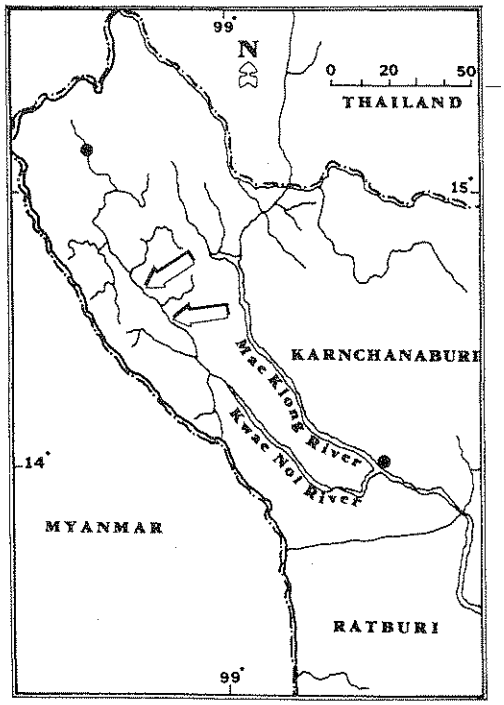

Fig. 1. Map showing main study area, Kwae Noi River, Karnchanaburi Province (arrows).

The 48 h mortalities were recorded and plotted against the exposure levels on semilogarithmic paper. The LE_{50} values (the exposure levels lethal to 50% of the fish in 48 h) were derived from the graphs for each fish species. The cumulative mortalities for all groups of fish were determined 30 days post-exposure when parasite excystment was complete for all fish species. Dead fish were preserved for later parasite enumeration.

Results

Fry from four species of fish were exposed to glochidium suspension of *C. hainesiana* at four concentration levels. Some fish exposed to high concentrations of glochidia died during the 48 h after infection. In *H. temmincki* 2–3 of the 10 fish were dead after exposure of 1.54×10^5 to 6.16×10^5 glochidia per litre. The mortality was low in *P. fasciatus* and *O. marmoratus*. However, no mortality at all occurred in *C. macrocephalus* (Fig. 2).

The average number of encysted glochidia in dead fry 48 h after infection are shown in Table 1. The

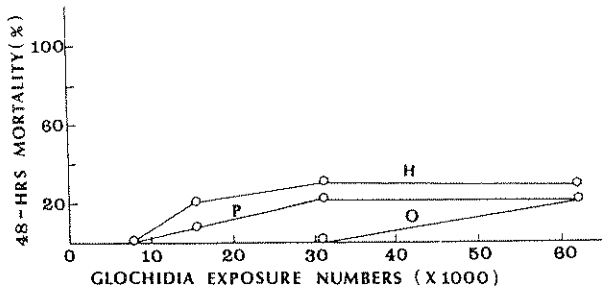

Fig. 2. 48 h mortality (%) of fry exposed to known numbers of glochidia of *Chamberlainia hainesiana* (H, *Helostoma temmincki*; O, *Oxyeleotris marmoratus*; P, *Pristolepis fasciatus*).

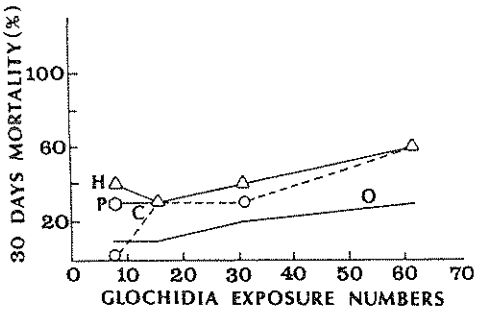

Fig. 3. Thirty days mortality (%) of fry of four species after infection (C, *Clarius macrocephalus*; H, *H. temmincki*; O, *O. marmoratus*; P, *P. fasciatus*).

Table 1. Average number of encysted glochidia in dead fry 48 h after infection at 6.16×10^5 glochidium concentration (n = number of fry examined)

Fry species	No. of glochidia found (mean±SD)	n
Oxyeleotris marmoratus	103.0±15.5	2
Helostoma temmincki	76.3± 8.0	3
Pristolepis fasciatus	69.0± 4.2	2

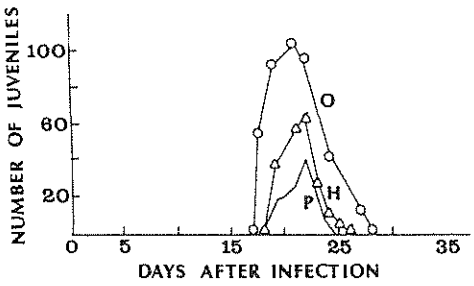

Fig. 4. Number of mussel juveniles found in each fry species after infection with the glochidia of *C. hainesiana* at a concentration of 7.7×10^4.

largest number of encysted glochidia were found on *O. marmoratus*, with substantial numbers on *H. temmincki* and *P. fasciatus*, but very few were found on *C. macrocephalus*.

Thirty days after exposure to a concentration of 6.16×10^6 glochidia per litre, six of the ten fish were dead in *H. temmincki*, *P. fasciatus* and *C. macrocephalus* (Fig. 3). The LE_{50} values (exposure concentration of glochidia that killed 50% of the fry) were about 4.5×10^5–5×10^5 glochidia per litre. In *O. marmoratus* only one dead fish was found.

Fish surviving a dose of 7.7×10^4 glochidia per litre were kept to observe juvenile development. Mussel juveniles were found on the 18th to 27th days after infection (Fig. 4). *O. marmoratus* gave the highest production of juveniles.

Discussion

In these experiments on glochidiosis of a freshwater pearl mussel, *C. hainesiana*, in four species of fish, *O. marmoratus* gave the highest number of glochidial cysts and juvenile mussels. This species is apparently a suitable host of *C. hainesiana* and could be of great potential in the production of young mussels in large quantities.

The mortality of the small fishes 48 h after infection is presumably due to physiological stress from encysted glochidia (Bauer and Vogel, 1987). Mortality after 30 days results from chronic physiological stress due to growing glochidia as well as infection by fungi and bacteria once weakened (Bauer 1987a, 1987b).

The experiments demonstrate the importance of host specificity as in other studies (Walker, 1981; Bauer, 1987a, 1987b; Bauer and Vogel, 1987). *H. temmincki*, *P. fasciatus* and *C. macrocephalus* apparently have low to moderate resistance to glochidia, whereas no mortality at all was found at 48 h after infection in *C. macrocephalus* and no juvenile production was found in this species.

Acknowledgement

I am very grateful to the Committee of Rachadapiseksompoj Research Fund, Chulalongkorn University, for a grant (2/1990) for this research project. I am

also grateful to Prof. L.B. Hothuis, Rijksmuseum of Natural History, The Netherlands, and Dr. Chulakasem Chinapha for their kind critical correction of English and valuable discussion of the manuscript.

References

Bauer, G., The parasitic stage of the freshwater pearl mussel (*Margaritifera margaritifera*). II. Susceptibility of brown trout. Arch. Hydrobiol. Suppl., 76 (1987a) 403–412.

Bauer, G., The parasitic stage of the freshwater pearl mussel (*Margaritifera margaritifera*). III. Host relationship. Arch. Hydrobiol. Suppl., 76 (1987b) 413–423.

Bauer, G., Threats to the freshwater pearl mussel (*Margaritifera margaritifera*) in Central Europe. Biol. Conserv., 45 (1988) 239–253.

Bauer, G., Schrimpf, E., Thomas, W. and Herrmann, R., Relation between the decline of the freshwater pearl mussel (*Margaritifera margaritifera*) in the Fichtelgebirge and the water quality. Arch. Hydrobiol., 88 (1980) 505–513 (in German with English abstract).

Bauer, G. and Vogel, C., The parasitic stage of freshwater pearl mussel, *Margaritifera margaritifera* L. I. Host response to glochidiosis. Arch. Hydrobiol. Suppl., 76 (1987) 393–402.

Heard, W.H., Sexuality and other aspects of reproduction in *Anodonta* (Pelecypoda: Unionidae). Malacologia, 15 (1975) 81–103.

Howard, A.D., A river mussel parasitic on a salamander. Nat. Hist. Misc. Chicago, 77 (1951) 1–6.

Kondo, T., The parasitic period of *Anodonta cygnea*. Venus, 42 (1983) 187–189.

Meyers, T.R. and Millemann, R.E., Glochidiosis of salmonid fishes. I. Comparative susceptibility to experimental infection with *Margaritifera margaritifera* (L.). J. Parasitol., 63 (1977) 728–732.

Panha, S., The site survey and the study on reproductive cycles of freshwater pearl mussels in the central part of Thailand. Venus, 49 (1990) 240–257.

Tedla, S. and Fernando, C.H., Observation on the glochidia of *Lampsilis radiata* (Gmelin) infesting yellow perch *Perca flavescens* in the bay of Quinte. Can. J. Zool., 47 (1989) 705–712.

Walker, K.F., The ecology of freshwater mussels in the River Murray. Aust. Water Res. Coun. Tech., No. 63, 1981.