INFESTATION OF *Haliotis tuberculata* SHELLS by *Cliona celata* and *Polydora species*

Jacques Clavier
Orstom BP A5, Noumea, New Caledonia

ABSTRACT

Infestation of *Haliotis tuberculata* shells in their natural environment was studied in the vicinity of St-Malo (Northern Britanny). The sponge *Cliona celata* and polychaetes of the genus *Polydora* are the major parasites and only shells greater than 50 mm are subjected to infestation. The mean incidence of parasites for *H. tuberculata* increases with shell length and reaches 80% for *C. celata* and 100% for *Polydora sp.*, in old individuals. An absence of relation between infestation rate and condition index for *H. tuberculata*, in our samples, suggests that parasites exercise only minor influence on the physiology of the species. Very severe infestations are likely to weaken the shell and facilitate predation.

RESUMEN

Infestación de la concha de *Haliotis tuberculata* por *Cliona celata* y *Polydora sp.*

Se analiza la infestación de la concha del abulón de Europa *(Haliotis tuberculata L.)* en ambiente natural cerca de Saint-Malo (costa del norte de Bretaña). La observación de 300 conchas indican que la esponja *Cliona celata* y los poliquetos del género *Polydora* son los parásitos mayores. Sólo las conchas que miden mas de 50 mm están sometidas a infestación. La tasa medio de parasitismo aumenta con el tamaño de la concha y puede llegar, en el caso de individuos viejos, hasta 80% cuando el parásito es *C. celata* y hasta 100% en el caso de *Polydora sp.* En las muestras estudiadas, la ausencia de relación entre el porcentaje de infestación y el índice de condición sugiere que los parásitos ejercen poca influencia sobre la fisiología de la especie. Sin embargo, infestaciones importantes provocan una debilitación de la concha que facilita la depredación.

INTRODUCTION

Infestation of mollusc shells by boring organisms may cause severe damage to exploited populations all around the world (Figeras, 1979, Krakatitsa and Kaminskaya, 1979, Rozbaczylo et al., 1980, Meixner, 1981, Velayudhan, 1983, Mori et al, 1985). *Haliotis* species are no exception to this rule (Stephenson, 1924, Crofts, 1929, Cox, 1962, Sinclair, 1963, Shepherd, 1973, Kojima and Imajima, 1982, Shepherd and Breen, this volume). Sponges of the genus *Cliona* and polychaetous annelids of the genus *Polydora* are the two major boring organisms.

Infestation of Haliotis tuberculata shells by Cliona celata and Polydora species. 16-20

1992

J. clavier

Pas dsH3

9204

ABALONE OF THE WORLD

Biology, Fisheries and Culture

Supplementary Papers

Proceedings of the 1st International Symposium on abalone
La Paz, Mexico 21-25 November 1989

ISSN 0728-1668 Fish. Res. Pap. Dep. Fish. (S.Aust.) No. 24
Department of Fisheries 135 Pirie Street Adelaide SOUTH AUSTRALIA 5000

Cliona and *Polydora* species are not parasites in the strict sense of the word. They rather use shells as a shelter and may be found in many other hard calcareous materials (Hatch, 1980, Baxter, 1984, Lagadeuc and Brylinski, 1987). However, the distinct or joint activities of the two groups weaken the shell and may facilitate predation (Forster, 1967, Kent, 1981). Furthermore, when deeper galleries extend to the inside of a shell, the mollusc may allocate resources to extra nacre production (Blake and Evans, 1973), to the possible detriment of other biological processes, such as growth or reproduction.

The present work investigates shell infestation of the ormer (*Haliotis tuberculata* L.) by *Cliona celata* and five *Polydora* species in the vicinity of Saint-Malo (Northern Brittany). I aimed to relate infection rate to the size and condition index of individuals, and to assess in this way the effect of shell borers on the resource.

MATERIAL AND METHODS

Samples of 150 animals from two contrasting sites were examined. The first location (station 1) is sheltered in the maritime basin of the Rance, unlike the other site (station 2), which is very exposed to surge, on the open sea (Clavier and Richard, 1984). Samples were collected by diving at different depths in the bathymetric range of the species (1 to 10 m).

Individuals were grouped into 10 mm shell-length classes. The number of individuals for each class ranged from 10 to 20. Shells were examined under a strong transmitted light (Forster, 1967, Shepherd, 1973). The number of U-shaped tubes of *Polydora* or the area covered by ramifications of *Cliona* were recorded. The accuracy of the method was established by comparison with X-ray photographs on 51 shells. Past or present infestation of *Cliona* was determined by the ratio of infested area to the projection of the shell and coded according to the following scale: no parasite, 0; less than 5%, 1; 5-20%, 2; 20-50%, 3 and more than 50%, 4. The number of *Polydora* burrows were coded separately according to a similar scale with five values: no parasite, 0; 1-4 burrows, 1; 5-20 burrows, 2; 10-50 burrows, 3 and more than 50 burrows, 4. In each case, a mean index was calculated for each size class.

For the larger shells, the two index values were pooled in a general infestation scale ranging from O (no parasite) to 8 (more than 50 *Polydora* burrows and more than 50% of the shell surface infested by *Cliona*). This general value was related to a condition index equal to the ratio of the weight of muscle to the cube of the shell length.

RESULTS AND DISCUSSION

The rate of infestation by *C. celata* and the mean infestation index by size class are given in Fig. 1. Values from the two sampling stations are very similar and, even when restricted to parasitized shells, they do not differ significantly (Chi square=1.84, P>0.05). The sponge is always absent from shells smaller than 60 mm; infestation levels rise rapidly with increasing size and stay around 70% for individuals greater than 80 mm. The mean extension of *C. celata* on the shell is always low and remains in the 5-20% class even for old *Haliotis*. *C. celata* seldom spreads over the whole shell and its network of galleries is often located on the apex or close to the middle of the shell. According to Hansen (1970), *Cliona* initially settles on the protoconch and progressively extends from this point. The mechanism for the dissolution of calcium carbonate by *C. celata* involves enzymatic activity from etching cells (Hatch, 1980). Excavation patterns in shells are described by Hoeksama (1983). Boring of *C. celata* in a shell is more often the work of only one individual, though Bromley and Tendal (1973) observed on X-radiography that boring of *C. celata* belonged to 2 individuals which showed strict avoidance of coalescence.

Infestation by *Polydora* species usually involves, on the other hand, several individuals. The rate of infestation by *Polydora sp.* and the mean infestation index by size class are given in Fig. 2.

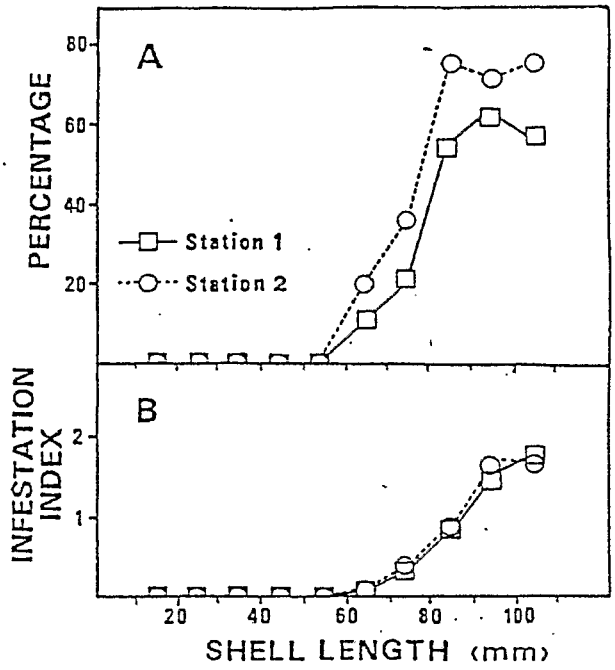

Figure 1. Relationship between infestation of Haliotis tuberculata shells by the sponge Cliona celata and the size of individuals at two sites. A- Percentage of shells infested. B- Mean infestation index.

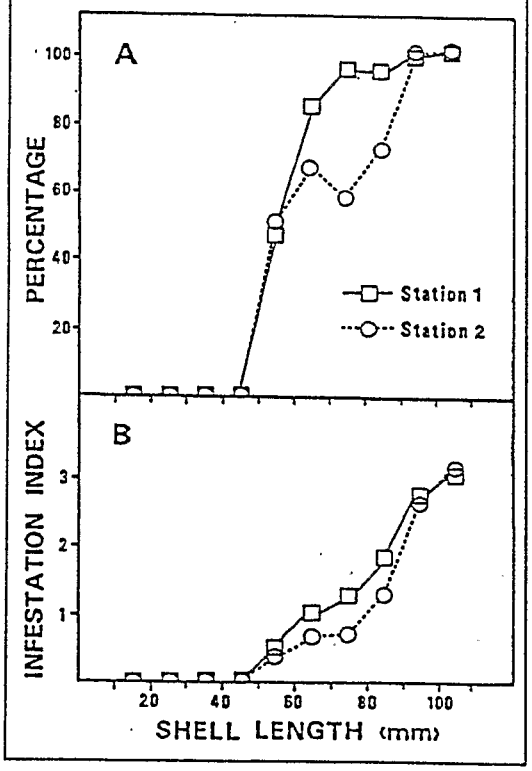

Figure 2. Relationship between infestation of H. tuberculata shells by Polychaetes of the genus Cliona and the size of individuals at two sampling sites. A- Percentage of shells infested. B- Mean infestation index.

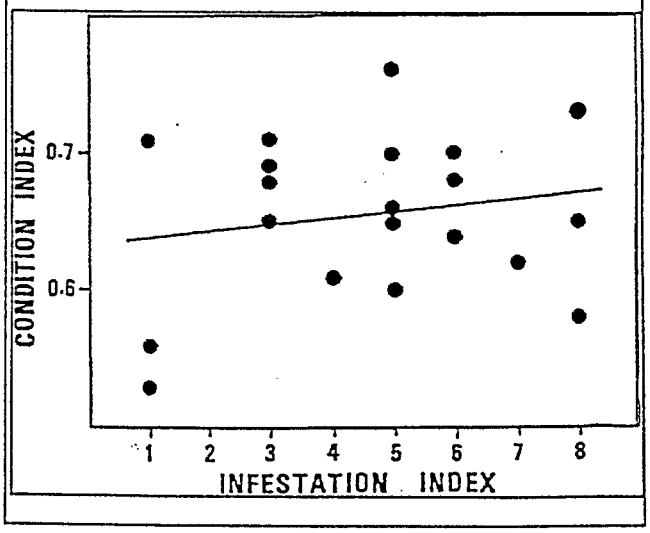

Figure 3. Relationship between the condition index of Haliotis tuberculata and a general infestation index taking both Cliona celata and Polydora sp. effects into account.

Estimates for the two sampling sites are still very close and do not differ significantly for parasitized shells (Chi square=8.98, P>0.05). Ormers smaller than 50 mm were not infected. Infestation rates increased rapidly until 80 mm and almost all specimen greater than this size were infested with a mean number of *Polydora* tubes of about 40. Several species of *Polydora* are able to damage molluscs shells by their boring activities (see Blake and Evans (1973) for a review). To illustrate the truth of this, we immersed 3 highly parasitized shells in a phenol solution to remove the worms (Mackin and Cauthron, 1952). The species of *Polydora* involved and their frequency of occurrence were: *P. hoplura*, 77%, *P. ciliata*, 19%, *P. caeca*, 2%, *P. armata*, 1% and *P. flava*, 1%. Total number of annelids was 170.

We then investigated the physiological effect of infestations. We established, for this purpose, the relationship between the values of the condition index and general infestation on a random set of 20 ormers greater than 80mm (mean shell length 91 mm) and thus likely to be parasitized (Fig. 3). The regression coefficient (b=0.0036) is not significantly different from 0 (t=0.78, P>0.05) and the observed infestation levels are not harmful to *H. tuberculata* contrary to the observations of Kojima and Imajima (1982) on *H. diversicolor aquatilis* in Japan. However, scraggy muscles were occasionally noticed on ormers with very damaged shells and parasites are certainly detrimental to *H. tuberculata* in cases of extreme infestations not considered in our random sampling.

Parasite larvae are susceptible to mechanical removal just after settlement and exposure to wave action is likely to inhibit the settlement of larvae and to limit the level of infection (Leloup, 1937, Baxter, 1984). Shell infections of *H. tuberculata* by *C. celata* and *Polydora* species are however, not significantly different in sheltered or exposed areas. In fact, *H. tuberculata* populations are mainly subtidal and less exposed to surge than more often studied intertidal species, such as oysters or mussels.

In conclusion, shell infections do not lead to major physiological stress in *H. tuberculata*. *C. celata* and *Polydora* species do not occur on this gastropod at a length smaller than 60 mm, which corresponds to an age of about 4 years (Clavier and Richard, 1986) and, as a general rule, infestations are slight for individuals smaller than 80 mm, the minimum legal size in Europe. High levels of infestation are only recorded for old, slow growing specimens with low production and with minor interest for a long-term exploitation.

ACKNOWLEDGMENTS

I would like to thank O. Richard for assistance in the field and M. Kulbicki, S. A. Shepherd and an anonymous reviewer for valuable editorial comments.

REFERENCES

Baxter, J.M., 1984. The incidence of *Polydora ciliata* and *Cliona celata* boring the shell of *Patella vulgata* in Orkney. *J. Mar. Biol. Ass. U.K.*, 64: 728-729.

Blake, J.A. and J.W. Evans, 1973. *Polydora* and other genera as borers in mollusks shells and other calcareous substrates. *Veliger*, 15: 235-249.

Bromley, R.G. and O.S. Tendal, 1973. Example of substrate competition and phototropism between two clionid sponges. *J. Zool.*, 169: 151-155.

Clavier, J. and O. Richard, 1984. Etude expérimentale du déplacement de l'ormeau *(Haliotis tuberculata)* dans le milieu naturel. *Rev. Trav. Inst. Pêches marit.*, 46: 315-326.

Clavier, J. and O. Richard, 1986. Growth of juvenile *Haliotis tuberculata* (Mollusca: Gastropoda) in their natural environment. *J. Mar. Biol. Ass. U.K.*, 66: 497-503.

Cox, K.W., 1962. California abalones, family *Haliotidae. Fish. Bull. Calif. Dept. Fish. Game.*, 118: 133 pp.

Crofts, D.R., 1929. Haliotis. *L.M.B.C. Mem. Typic. British Plants Anim.*, 29: 174 pp.

Figeras, A., 1979. Tanatogenesis de las ostreas. *Cuad. Marisqueros,* 2: 113 pp.

Forster, G.R., 1967. The growth of *Haliotis tuberculata*: results of tagging experiments in Guernsey. *J. Mar. Biol. Ass. U.K.*, 47: 287-300.

Hansen, J.C., 1970. Commensal activity as a function of age in two species of California abalones. *Veliger,* 13: 90-94.

Hatch, W.I., 1980. The implication of carbonic anhydrase in the physiological mechanism of penetration of carbonate substrata by the marine sponge *Cliona celata (Demospongiae). Biol. Bull., Mar. Biol. Lab., Woods Hole,* 159: 135-147.

Hoeksama, B.W., 1983. Excavation patterns and spiculae dimensions of the boring sponge *Cliona celata* from the SW Netherlands. *Senckenb. Marit.*, 15: 55-85.

Kent, R.M.L., 1981. The effect of *Polydora ciliata* on the shell strength of *Mytilus edulis. J. Cons. Int. Explor. Mer.*, 39: 249-255.

Kojima, H. and M. Imajima, 1982. Burrowing polychaetes in the shells of the abalone *Haliotis diversicolor aquatilis* chiefly on the species of *Polydora. Bull. Jap. Soc. Scient. Fish.*, 48: 31-35.

Krakatitsa, T.F. and L.D. Kaminskaya, 1979. The harmful effect of boring sponges on the black sea oyster beds. *Biol. Morya,* 6: 15-19.

Lagadeuc, Y. and J.M. Brylinski, 1987. Transport larvaire et recrutement de *Polydora ciliata* (Annelide, Polychéte) sur le littoral boulonnais. *Cah. Biol. Mar.*, 28: 537-551.

Leloup, E., 1937. Contribution à l'étude de la faune belge. VII- Les dégâts causés par le ver polychaete *Poludora ciliata* (Johnston) dans les coquilles de bigorneaux et les huîtres. *Bull. Mus. Royal Hist. Nat. Belgique,* 13: 1-4.

Mackin, J.G. and F. Cauthron, 1952. Effect of heavy infestations of *Polydora websteri* Hartman on *Crassostrea virginica* (Gmelin) in lousiana. *Proc. Natl. Shellfish. Assoc., 10: 14-24.*

Meixner, R., 1981. The infestation of *Mytilus edulis* on a wild mussel bed in the Flensbury fjord (W. Baltic) with *Polydora ciliata. I.C.E.S. Council Meet., I.C.E.S., Copenhagen (Denmark),* 6

Mori, K., N. Sato, T. Nomura and M. Imajima, 1985. Infestation of Japanese scallop *Patinopecten yessoensis* by the boring polychaetes *Polydora,* on the Okhotsk sea coast of Hokkaido, especially in Abashiri waters. *Bull. Jap. Soc. Sci. Fish.*, 51: 371-380.

Rozbaczylo, N., N. Schmiede and M. Sanchez, 1980. *Polydora sp. (Polychaeta: Spionidae)* un parasito de la macha *Mesodesma donacium (Mollusca: Mesodesmatidae). Arch. Biol. Med. Exp.*, 13: 105.

Shepherd, S.A., 1973. Studies on southern Australian abalone (genus *Haliotis*). 1- Ecology of five sympatric species. *Austr. J. Mar. Freshw. Res.*, 24: 217-257.

Sinclair, M., 1963. Studies on the paua, *Haliotis iris* Martyn, in the Wellington district, 1945-46. *Zool. Pub. Victoria Univ. Wellington,* 35: 16 pp.

Stephenson, T.A., 1924. Note on *Haliotis tuberculata. J. Mar. Biol. Ass. U.K.*, 13: 480-495.

Velayudhan, T.S., 1983. On the occurrence of shell boring polychaetes and sponges on pearl oyster *Pinctada fucata* and control of boring organisms. *Symp. Ser. Mar. Biol. Assoc. India,* 6: 614- 618.