FUTURE WORK ON THE OYSTER FAUNA OF SOUTHEAST ASIA, ESPECIALLY THAILAND. PROPOSAL OF A PROJECT.

By Kurt W. Ockelmann
Marine Biological Laboratory, Copenhagen University, Strandpromenaden, 3000 Helsingør, Denmark.

ABSTRACT

A project is proposed which aims at establishing a firm basis for oyster taxonomy in Southeast Asia via a sampling program to collect the late larvae of all oyster spp. found in the region. The background for this project and the results to be expected from it are discussed.

INTRODUCTION AND BACKGROUND

The bivalves belonging to the Ostreidae and the Gryphaeidae, the oysters, are of great interest in both neontology and palcontology. Besides, several species compete with members of Mytilidae to be most important economically and as food resources to man. However, identification of "wild" oysters to species is often difficult, for several reasons. Generally , adult oysters vary greatly in shell shape, sculpture, and other characters, several species form ecomorphs of strikingly different appearance. Moreover, for several species believed to have a very wide distribution, certain proof of specific identity through out their range is lacking. A survey of recent literature on oysters would demonstrate the persisting confusion as to taxonomy and nomenclature at the species level. In some contrast to this, oyster taxonomy above the species level is gradually being clarified thanks to studies by *e.g.* Harry (1985), Ranson (1960, 1967), and Stenzel (1971) (*cf.* also the enumeration of resent taxa by Vaught, 1989).

In the spring of 1986, I studied bivalve larvae from plankton hauls at the PMBC. Oyster larvae were a common element in the plankton and there were always some species present. The oyster larvae could easily be sorted out into species - much more easily than the larvae of most other bivalve families. The late larvae of some spp. settled and metamorphosed readily in the laboratory.

In an excellent monograph on the bivalves of the Red Sea, Oliver (1992) records and describes 9 spp. of oysters. The oyster fauna of Southeast Asia is certainly richer in species than this. In 1986, I found in one of my plankton hauls larvae of as many as 13 different oyster species. Hence the question: How many oyster species are there in Thai waters?

PROJECT PROPOSAL

The observations mentioned together with the well documented value of larvae characters in oyster taxonomy should be used to clarify the taxonomy of the oysters found around Thailand. This is the aim of the project outlined below:

At 3 stations in the Gulf of Thailand (*e.g.* Pattani or Songkla, Prachuap Khiri Khan, and Rayong) and 2 stations in the Andaman Sea (*e.g.* Phuket and Ranong) standardized plankton samples should be collected at about monthly intervals through 13 to 14 months. It is not essential to take quantitative samples. Samples should not be small. Neither is it essential that the samples taken at the 5 stations are from the same dates. Working up of the samples of the larvae will depend on arrangements between the stations participating. Samples not worked up immediately must be preserved properly and as soon as possible. It may be suggested that one person - perhaps at Prachuap Khiri Khan where expertise in oyster work is at hand - takes responsibility for further work on the samples from the Gulf, while another person (at the PMBC) will deal with the samples from the west coast. These two persons should closely co-operate and use the same designations for the same species of oyster larvae.

Results and outcome to be expected from the project

The information gained from the project should be published in English in scientific journals. Knowledge relevant for the oyster-fishermen should be made available in Thai as well. The information gained will include:

1. A complete representation of the oyster fauna of Thai waters in the form of larvae ready to settle. No extant oyster species is known to have direct development; this would be in conflict with the specialised settling biology of oyster larvae. Only two oyster spp. are known to produce lecithotrophic larvae (Chanley and Dinsmani, 1980, *a.o.*). But this is an adaptation to regions in which surface currents away from the coast predominate. Hence all oysters of Southeast Asia must be assumed to reproduce by way of planktrotrophic larvae which, accordingly, may easily be found in the plankton

2. A valuable basis for taxonomic studies on oysters from Southeast Asia, which later may be extended to cover the whole Indo-Pacific. Information on the late larvae greatly facilitates identification of the earlier larval stages and of the spat. This then forms a link to the adult oyster.

3. Data on the geographical distribution and the relative abundance of the various spp. of oyster larvae. Their occurrence in time will tell about the reproductive period(s) of the adults.

4. While working up live samples in the laboratory some observations may be made on behaviour and readiness to settle of the various spp. of oyster larvae.

5. The persons working up the samples and preparing the descriptions will become experts competent for future studies on oyster taxonomy and biology.

DETAILED DESCRIPTION OF THE PRACTICAL WORK

Since much of the success of the project will depend on the quality of the samples and on the precision of the descriptions of the larvae, some practical notes are given:

Sampling

The plankton-nets used should have a mesh-size of 180-200 µm in order to retain the late larvae of all oyster spp. Sampling should be made during rising tide and not at sites with little water exchange. The net should be towed obliquely trough most of the water column.

Transportation

Samples with larvae intended for live studies should be cooled to 10-15 °C during transportation over longer distances and sorted out as quickly as possible.

Sorting

Separation of the oyster larvae from the rest of the samples should always be done soon. If this is not possible dense samples should be diluted with sea water of the same quality as that from the sampling site. Also slight aeration may be useful. Standardized non-quantitative samples may give an idea of larval abundance and an estimate of relative species composition. Therefore, sub samples of large samples should be taken without affecting the species composition. Do not miss the rare species of oyster larvae.

Recognition of larval readiness to settle

This is most easily done with live larvae. Behavioural signs include frequent changes between swimming and creeping of the pediveliger, searching and testing movements of the foot. Morphological signs are large shell size, presence of many lipid droplets in the viscera, a well developed foot, and a pair of visceral eyes of maximum development. Often , some larvae will attach when kept alive in a rearing bowl.

Preservation

For special purposes larvae may be fixed in fully neutralized 1% formaldehyde in aqua, but should not stay in this medium more than few days. As the usual preserving medium for mollusc larvae a modification of Carriker's (1950) solution may be recommended. It is prepared as such: 100 g cane sugar + 10 ml of formaldehyde (~ 40%, high quality) is dissolved in enough sea water of 30‰ salinity to make 1 l of solution. This is buffered with a few g of sodium-borate (Borax) to pH 8.5-9.0 and filtered. It should be prepared several days before use. The

pH of the preserved samples should not be allowed to drop below 8.0 since even slightly acid media quickly destroy larval shells.

Storage

Sufficient, essential and identified material of all spp. of oyster larvae found should be preserved. When treated properly such material will stay in good condition for many years. Storage in dark will delay bleaching of the larval colours. Material of this kind is very valuable and may *e.g.* , be directly compared with oyster larvae from other parts of the world.

Preparations

For close study and photography of larval shells, the soft parts must be removed. Fresh as well as preserved material can be used. The latter, if preserved in Carriker's solution, should shortly be washed in distillated water before transfer to other media. Soft parts are dissolved in a 5% sodium-hypochlorite (NaClO) solution in distilled water. Unfortunately, this also affects the shell surface. Therefore, the process should be watched under the microscope and terminated when the larval shells begin to gape. After repeated washing in distilled water the clean shells can be mounted in glycerine or glycerine-gelatine. Here, the shells should not be left more than a day, since also these media have a slow etching effect. Shell valves to be photographed should be mounted with their edges toward the slide so that they are in a defined position. It is advisable to prepare a number of larvae of the same species at one time, as some of them may be lost or broken when handled. (*cf.* also Rees, 1950 on this topic).

Descriptions

These should be written in a way which facilitates comparison between species, *i.e.*, figures and photographs should be presented at standard magnification(s) and accompanied by scales. Description of the soft parts of late larvae should include their coloration, disposition of organs and lipid reserves, and position and size of the eye spots. Differences as to the appearance of these features in preserved larvae may be noted. As to the prodissoconch I, measurements of its length and height should be made and its outline figured. Other important characters are shell convexity and microsculpture, length of provinculum, and origin of larval ligament. Size and shape of prod.I are closely related to egg-size and to mode of early development. As for veliconcha of the pediveliger, both left and right valve should be photographed. Its size variation at metamorphosis, convexity, sculpture, and coloration should be recorded. Internal features such as hinge, ligament, and chomata and special traits should be figured accurately and described.

While the larvae of the various oyster spp. to begin with will be provisionally designated, their characters provide important clues for supraspecific assignment. For several spp. it may be easy to find the valid species name. For others it may be necessary to ask for help from oyster taxonomists outside Southeast Asia. Indeed, it would not be surprising if an undescribed oyster species should be detected by the project.

RESULTS FROM A PILOT PROJECT TO ELUCIDATE THE FEASIBILITY OF THE PROPOSED PROJECT

Feasibility and economy of the proposed project may be judged by a pilot project (Table 1). The plankton samples taken at 3 sites of increasing distance from the open sea were extremely dense due to much phytoplankton and dead seston. This made sorting of the oyster larvae (and some bivalve larvae) much more time consuming than it is usually the case. The oyster larvae could be referred to 8 different species and for each of these, the number of larvae was determined for each sampling site. Further a sketch and a short description for each kind of larvae were worked out and part of the material was preserved. While this work was going on, a number of larvae had settled and attached, and these were counted as well. Table 1 shows that 2 spp., dominated at all the 3 sampling sites, though they showed very different proportions of settling larvae. The decrease in species diversity following the decrease in salinity is not unexpected. But the fact that in 4 out of the 8 spp. at least one larva settled seems interesting. However , more important in the present context is that the work behind Table I (apart from collection and transportation of the samples) was accomplished

Table 1. Oyster larvae of 8 spp. sampled near high tide at 3 stations in Phang-nga Bay, 19 Oct. 1993, with a net of 200 µm mesh size (WP-2 type). - Larvae from Stations 1 and 2 were worked up on Oct. 20, those from Station 3 on Oct. 21 before noon.

	STATION 1. 20.3 - 23.0‰ S.				**STATION 2. 18.6 - 19.6‰ S.**				**STATION 3. 10.3 - 10.8‰ S.**				
Species	Not sett.	Sett.	Total	%	Not sett.	Sett.	Total	%	Not sett.	Dead	Sett.	Total	%
1	98	48	146	51.23	70	279	349	76.20	46	60	66	172	93.99
2	113	-	113	39.65	100	3	103	22.49	6	4	-	10	5.46
3	6	6	12	4.21	3	1	4	0.87	-	-	-	-	-
4	3	-	3	1.05	-	-	-	-	-	-	-	-	-
5	4	1	5	1.75	-	-	-	-	-	-	-	-	-
6	3	-	3	1.05	1	1	2	0.44	1	-	-	1	0.55
7	1	-	1	0.35	-	-	-	-	-	-	-	-	-
8	2	-	2	0.70	-	-	-	-	-	-	-	-	-
Total	230	55	285	100.00	174	284	458	100.00	52	65	66	183	100.00

in about 1 ½ working days by two persons - one of which gained considerable experience during this pilot study.

ACKNOWLEDGEMENTS

I wish to express my thanks to Miss Suree Poung-in who, with great enthusiasm assisted in the pilot project.

REFERENCE

Carriker, M.R. 1950. Killing and preservation of bivalve larvae in fluids. *The Nautilus*, **64**(1): 14-17.

Chanley, P. and P. Dinamani. 1980. Comparative descriptions of some oyster larvae from New Zealand and Chile, and a description of a new genus of oyster, *Tiostrea*. *New Zealand J. Mar. Freshw. Res.* **14**(2): 103-120.

Harry, H.W. 1985. Synopsis of the supraspecific classification of living oysters (Bivalvia: Gryphaeidae and Ostreidae). *The Veliger*, **28**(2): 121-158.

Oliver, P.G. 1992. *Bivalved seashells of the Red Sea*. Natl. Museum of Wales. Publ Christa Hemmen.

Ranson, G. 1960. Les prodissoconques (coquilles larvaires) des ostréides vivants. *Inst. Oceanogr. Monaco Bull. no.* 1183, 41 p. 135 figs.

Ranson, G. 1967. Les espèces d'huîtres vivant actuellement dans le monde dèfinies par leurs coquilles larvaires ou prodissoconques. *Pêches Maritimes, Rev. travaux l'Inst.* **31**(2): 127-199, 25 text figs; **31**(3): 205-274, text figs. 26-55.

Rees, C.B. 1950. The identification and classification of lamellibranch larvae. *Hull Bull. Mar. Ecol.* **3**(19): 73-104.

Stenzel, H.B. 1971. Oysters. Pp. I-IV, N953-N1224. **In**: R.C. Moore (*ed.*). *Treatise on invertebrate paleotology*. Part N, vol 3, Mollusca 5, Bivalvia. Geol. Soc. America.

Vaught, K.C. 1989. A classification of the living Mollusca. **In**: R.T. Abbott and K.J. Boss (*eds.*). pp. I-XII, 1-189. Amer. Malacologists. Melbourne, Florida.