ARTIFICIAL SPAWNING OF TRIDACNIDS FROM THE SPERMONDE ISLANDS, SOUTH-WEST SULAWESI

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ABSTRACT

Due to intensive fishing pressure, the Government of Indonesia has enacted protective measures for all giant clam species to secure the sustainability of this resource. Cultivation techniques may assist in attaining this goal. Serotonin and gonadal slurry injections were used to induce spawning in the giant clams *Tridacna squamosa, T. derasa,* and *Hippopus porcellanus*. Serotonin treatment proved effective, and stimulated both sperm and egg spawning in test individuals, resulting in 39 million larvae of which 1.9 million survived to the juvenile stage.

INTRODUCTION

The Tridacnidae, or giant clams, consist of eight species which have been placed into two genera. Six species are members of the genus Tridacna, while *Hippopus porcellanus* and *H. hippopus* comprise the genus *Hippopus* (Lucas 1988). With the exception of *T. tevora*, which is unique to the Fiji Islands (Braley 1992), all tridacnid species are found within the waters of the Spermonde archipelago, South-Western Sulawesi. However, to date, studies in the region have been limited to zoogeographic investigations and collation of inventory data (*e.g.*, Muchsin 1993).

Islanders of the Spermonde archipelago utilize giant clams as a source of food, especially during festivities, such as weddings, where on occasion, up to 300 adult clams have been put to use. The demand for clams, both for local consumption and export, has resulted in severe overexploitation of all species within the region, particularly in the period 1980-1990. This situation led, in 1987, to the Government of Indonesia banning the export of tridacnids, although local consumption still continues. The comparative scarcity of stocks has led to the initiation of culture trials for certain species such as *T. squamosa*, although these have met with limited success (Pasaribu 1988).

The present investigations were inaugurated in an effort to evaluate and develop the culture potential of several species of tridacnids found in Sulavesian waters. The motives underlying the described programme were several-fold, but most important, was to develop technology for captive cultivation, such that this could be transferred to the local population, and through supporting mariculture of these species, the natural stocks might be enhanced and thus become protected.

MATERIALS AND METHODS

Broodstock *T. squamosa, T. derasa* and *H. porcellanus* were collected either through scuba, snorkelling or by direct purchase from fishermen. Animals were maintained at a beach site near to the UNHAS clam hatchery facility Pulau Barang Lompo prior to their transfer for experimentation. All hatchery tanks were disinfected prior to use with Bayclean (R), which was dispersed evenly and left for 30 min until rinsing with fresh water. Spawning tanks were either 2 cubic metre fibreglass, or 14 and 25 cubic metre concrete, while that for egg incubation was 0.25 cubic metre fibreglass.

T. squamosa (n = 10), *T. derasa* (n = 13) and *H. pocellanus* (n = 15) were each injected with 2.5 ml 2 mM serotonin diluted in distilled water. The serotonin was injected intragonadally as described by Braley (1992). A further seven *T. squamosa* were given a mixture of gonadal material derived from a sacrificed animal, diluted as 2 parts water to 1 part gonad (2 ml injected as for the serotonin solution) once per day for four consecutive days. After the treatment, animals were observed continuously for germ cell release. Both sperm and eggs were collected on plastic sheets and subsequently fertilized in a nursery tank contain-

ing 650 litres of sea water to which had been added 10 ppm Tetra Strp (TM) anitbiotic. Water was aerated continuously through to egg hatch. Larvae were subsequently transferred to 14 cubic metre concrete raceways 5 hours post-hatch and reared as described by Braley (1992). Larval survival was evaluated for a 4 week period.

RESULTS AND DISCUSSION

Since serotonin is relatively expensive and difficult to access, attempts were made to induce spawning using a gonad slurry as a potentially inexpensive method of controlling reproduction in *T. squamosa*. gonad slurries have been successfully used to induce spawning in several tridacnid species and, indeed, it has been suggested that this technique is preferable to the use of serotonin (*e.g,*. Trinidad-Roa 1988). However, in the seven animals treated during the present study, considerable variation in responsiveness was observed, with sperm release occuring 42 seconds up to 22.2 minutes after slurry injection (Figure 1). Previous studies indicate that tridacnids generally release sperm between 1-5 minutes after treatment (Braley 1992). Examination of mean time to spermiation in the present study illustrates that for the first 2 days, *T. squamosa* responded as expected, however, the time to sperm release lengthened on day 3, and on the 4th day, two individuals failed to release sperm. No significant difference ($P > 0.05$) in the responsiveness of spermiating individuals was detected between treatment days (Fig. 1). The failure of animals to react to the gonad slurry might indicate a diminishing response to treatment over time and continued exposure, although future studies will have to be undertaken to confirm this supposition.

Table 1 summarizes the average time interval during multisperm release. No significant differences ($P > 0.05$) in responsiveness between days were recorded. It is noteworthy that the average time interval between sperm release, on an individual basis, was highly variable (Table 1). This phenomenon, however, may be a natural process, since testis development in *T. gigas*, and hence ability to produce and release sperm, is continuous with late and early stages being present simultaneously (Nash *et al.* 1988). Figure 2 illustrates the frequency of sperm release following injection of gonad slurry. The total average frequency for the 4 days of observation was 5.6 ± 3.7 although some animals produced sperm clouds on 13 occasions. It is evident however, that the average frequency of sperm release declined from day 2 to day 4. Similar observations have been made previously (Alcazar 1988). All species injected with serotonin produced sperm

Table 1. Mean (± Sd) time (minutes) to release of sperm following treatment of *Tridacna squamosa* with gonad slurry. x signifies a null reaction.

Animal	Day 1	Day 2	Day 3	Day 4
1	2.17	2.23	5.23	x
2	3	4.55	2	1.22
3	6.23	2.22	13.05	2.27
4	4	3	2.05	1.15
5	2	16.52	6.33	3.28
6	10.13	3.27	4.25	13.27
7	3.6	3.18	3.03	x
mean±SD	4.44±2.88	5.14±5.13	5.13±3.84	3.03±4.67

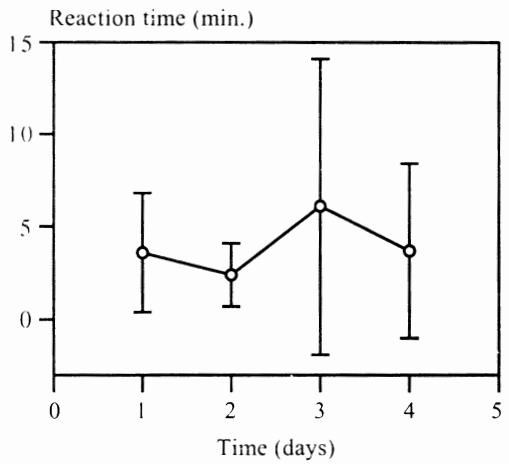

Figure 1. Average (± Sd) time interval between initial sperm release of *Tridacna squamosa* following treatment with gonad slurry (n = 7).

which cooroborates the findings of others (see Wong 1992). However, only *T. derasa* released eggs, and this was observed for 2 of 13 individuals, with the vast majority being derived from a single individual. Egg release was observed approximately 20 minutes post serotonin injection. This time interval between treatment and egg release has been seen on numerous occasions (*e.g.*, Alcazar 1988; Braley 1992). The number of eggs collected following release was approximately 42 million of which 39 million developed 5 hours after fertilization. The fecundity of the *T.*

derasa was thus high when compared to other reports in the literature (*e.g.*, Alcazar 1988). Trocophore larvae emerged at 18 hours and by 28 hours 23.3 million veligers had developed. However, by the end of week 1 approximately 75 % of animals had died and by trial termination only 2 million juveniles were accounted for (Fig. 3).

From a practical viewpoint, the present study illustrates that the use of gonad slurries to induce spawning of tridacnids provides for a highly variable response and, in the instance described herein, failed to induce the release of eggs. It is possible, however, that the inconsistency observed here, when compared against other studies was caused by stress, since animals were manipulated a short time after collection/purchase. Alternatively, it may be that the holding of the animals at the beach locality (see Materials and Methods) may have induced gamete release due to the shallowness and temperature (≥ 30°C) before experimentation. Future studies will, however, be more controlled since establishment of the captive 7 species broodstocks will permit greater command of the experimental design.

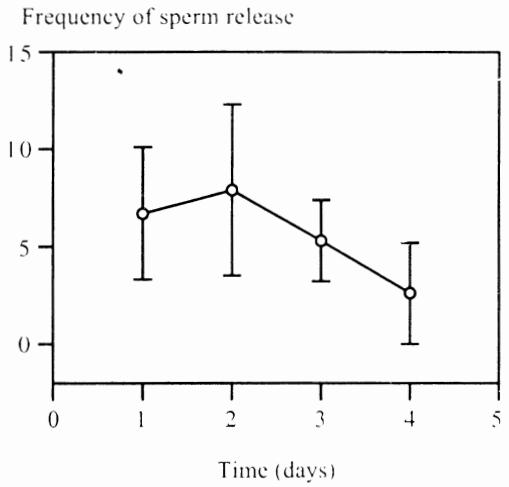

Figure 2. Average (± Sd) frequency of sperm release from *Tridacna squamosa* following treatment with gonad slurry (n=7).

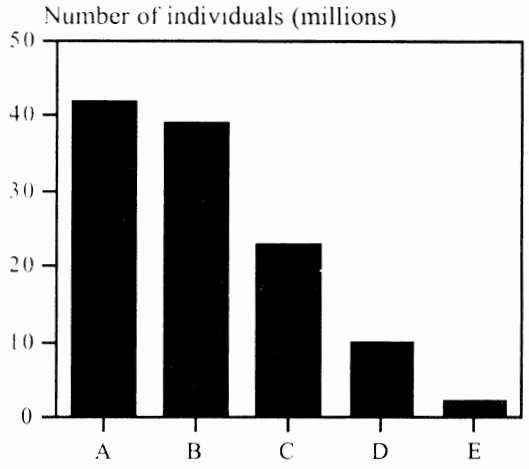

Figure 3. Survival of larval *T. derasa* following spawning induced with serotonin. A: Eggs; B: Live eggs after 5 hours; C: Veliger larvae; D: Pediveliger larvae; E: Juvenile

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