

Abstracts & publications

beche-de-mer

Reproductive aspects, larval and juvenile rearing of *Holothuria (Theelothuria) spinifera* Theel

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As in many Indo-Pacific countries, sea cucumbers form an important part of a multispecies fishery in India. Beche-de-mer exported from India during the period 1992–2000, varied from 10.5 to 140 tonnes (t) and ranked first among the dried marine products. The beche-de-mer industry mainly depends on two species of *Holothuria*: *H. scabra* and *H. spinifera*. Beche-de-mer exports have declined from 70 t in 1996–1997 to 3.8 t in 2001. Due to overexploitation, the Ministry of Environment, Government of India, has banned both the fishing and export of sea cucumbers since June 2001.

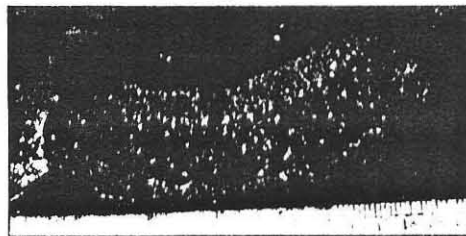
Considering the role of *H. spinifera* in the commercial fishery, and the fact that it has been indiscriminately exploited, knowledge on reproductive aspects and seed production through a hatchery system is essential for enriching the natural population of this species. Therefore, a study of *H. spinifera* was undertaken and the salient results are summarized below.

Of the 294 mature *H. spinifera* studied, 52.1% were females and 59.3% were males; the sex ratio was 1:1. The occurrence of 90% mature animals during September–October and 100% in April indicated the biannual reproductive activity. The mean gonadal index of males and females was 1.4 and 2.0, respectively. The peak gonadal index during September–November and the minor peak in February–March indicated biannual gametogenic activity. Gonochoric gonad consisted of 17–490 tubules of varying lengths from 9–51 mm, with uniform development. The tubule length in males (33–51 mm) was significantly ($t = 2.537$ $p < 0.05$) greater than that of females (24–47 mm). The white colour of the tubules in the indeterminate and spent stages changed to creamy white in mature males and dark yellow in mature females. The tubule diameter of 1–1.2 mm in the females was significantly higher ($t = 3.921$; $p < 0.01$) than that of the males. The mean oocyte diameter was 148 μm and the number of oocyte per tubule varied from 2233 and 29,667 with a mean value of 7938. The number of oocytes per tubule was significantly related to the tubule length ($r = 0.2903$; $p < 0.01$) and also to the oocyte diameter ($r = 0.923$; $p < 0.01$). The absolute fecundity ranged from 36.1 to 5195 $\times 10^3$, with a mean of 1739 $\times 10^3$. Out of this, the actual reproductive output is 1660 $\times 10^3$, which is equivalent to 5.4 g ovary weight. The mean fecundity index was 1770. The relative fecundity to eviscerated weight was 10.8 $\times 10^3$ and that of gonad weight was 307 $\times 10^3$.

The mean value of oxygen consumption in *H. spinifera* was 0.012 ml g^{-1} (dry wt) h^{-1} and the ammonia excretion was 12.45 $\mu\text{g g}^{-1}$ (dry wt) h^{-1} . The rate of oxygen consumption and ammonia excretion did not vary during the maturity stages but varied with length and dry weight of the animals. The mean values of protein, carbohydrate and lipid content in the body wall of *H. spinifera* were 17.8, 2.8 and 1.3%, respectively. The highest concentration of these organic constituents was during the maturity stages, and their decline during the post-spawning periods indicated their role as the source of energy during gametogenesis.

In *H. spinifera*, spawning was induced by powdered feed. The larval cycle lasted for about 10–15 days, with a pelagic larval stage: auricularia (809 μm) up to 10 days; non-feeding floating doliolaria (468 μm) on 10–12th day; and the settling pentactula (330 μm) on 13–15th day. On day 20, 200 juveniles attained 1 mm, and on the day 80 day, 55 juveniles attained 30 mm for the first time in the hatchery. The larval growth rate was 49–58 $\mu\text{m day}^{-1}$. Algamac, at a concentration of 0.5g 500 L⁻¹, was observed to be the best inducing agent for larval settlement. A sharp increase in the growth rate of juveniles (1.5 mm day^{-1}) was observed when they were fed with *Spirulina*. A survival rate of 73.3%, 16 $\mu\text{m day}^{-1}$ growth of stomach and 80% of late auricularia development with normal symmetrical shape suggested that 2 $\times 10^4$ cells ml^{-1} was the optimum algal

feed concentration for larvae. Among the single algal diet, a high larval growth rate of $59 \mu\text{m day}^{-1}$ was observed in the larvae that were fed with *Chaetoceros calcitrans*, whereas greater survival (68%) occurred in the larvae that were fed with *Isochrysis galbana*. Among the combination of algal feed, *I. galbana* and *C. calcitrans* yielded better growth rates ($43 \mu\text{m day}^{-1}$) and survival rates (73%). Highest survival rates (90.8% and 72.3%), growth rates ($62.6 \mu\text{m day}^{-1}$ and $33.6 \mu\text{m day}^{-1}$) and development of doliolaria (100%) and late auricularia (100%) indicated that suitable rearing conditions for *H. spinifera* larvae consisted of water temperatures of 28–32°C, salinity 35 ppt and pH 7.8. The maximum growth rate for length (0.52 mm day^{-1}) and weight (0.08 g day^{-1}) with *Spirulina*, as supplemented in the feed, indicated that 4% *Spirulina* could be supplemented as an additional protein source along with fine sand and *Sargassum* powder. Gonochoric gonad, biannual reproductive cycle, high fecundity and amenable for production of juveniles through hatchery techniques, show the suitability of *H. spinifera* as a candidate species for farming.



Holothuria spinifera