STUDIES ON THE BIOLOGY AND CULTURE OF THE NERITIC SQUID *SEPIOTEUTHIS LESSONIANA* LESSON: EFFECTS OF STOCKING DENSITY ON SURVIVAL RATE.

Edward Danakusumah.
Bojonegara Research Station for Coastal Aquaculture, P. O. Box. 1. Bojonegara, Cilegon 42454, Indonesia

ABSTRACT

The neritic squid *Sepioteuthis lessoniana* Lesson is one of the promising candidates for mariculture. However, culture of young squid from day 1 to 7 after hatching is still a problem. Among several factors, the initial stocking density is one of the most probable reasons. Newly hatched squid were cultured in cylindrical glass containers of 12 litres capacity at densities of 5, 10, 15, 20 and 25 individuals /10 litres. Each treatment was repeated 3 times. The squids were fed live mysids *Mesopodopsis* sp., which were kept abundant and alive in the containers to eliminate food as a limiting factor. All water in the culture facility was renewed daily with fresh filtered seawater. The survival rates were 60, 35, 30, 10, and 4 % respectively. The stocking density was negatively correlated with the survival.

INTRODUCTION

The neretic squid *Sepioteuthis lessoniana* Lesson constitute important commercial sea food in southeast Asia. The species is occurs in the Indo-Pacific, the Red Sea, the Arabian Sea, northern Australia, the Indian Ocean, Central Japan, and the Hawaian Islands (Roper *et al.* 1984; Shibata *et al.* 1990). The squid is distributed from the surface down to about 100 m depth (Roper *et al.* 1984). Squid are caught using lure-hooks, seine or purse seine, set-nets, light luring and scoop-nets, and jigs. Uncontrolled squid captured fisheries may lead into an overfishing condition, for instance, in the Alas Strait, Lombok, Indonesia (Sutomo. 1994, personal communication). Before 1987, the average annual squid catch was more than 4000 ton but then decreased to nearly zero. Only in 1996 and 1997 the condition seemed to recover somewhat. The annual squid production increased up to 900 kg (Annonymous, 1998).

Measures, such as adjustments of allowable fishing gear and number of fishing boats, should be taken to increase the production, without damaging natural squid resources. The development of squid aquaculture could have a significant positive impact on squid production. Aquaculture could make the supply of squid possible during the off-season and may relieve some of the pressure on the natural stocks. Several studies have been carried out on the biology and culture of squid, especially on spawning season, fecundity, egg incubation, larval rearing, and oxygen consumption (Prawin-Wudthisin and Tanin-Singhagraiwan, 1988; Danakusumah *et al.* 1995a, 1995b, 1997; Segawa, 1990, 1995; Sudjoko, 1990; Hamzah and Yusuf, 1995). *Sepioteuthis lessoniana* has been successfully cultured (Danakusumah *et al.* 1995). However, the survival rate was very low during day 1-7 after hatching. The stocking density of hatchlings, as well as the feed, seemed to affect their survival. Therefore, the objective of this study was to investigate the effects of these factors on the survival rate of the neretic squid.

MATERIALS AND METHODS

Wild squid eggs were collected from Banten Bay waters at 1 to 3 m depth. The eggs were

incubated in tanks of 30 litres capacity filled with sand-filtered sea water of 33 ‰ salinity, which was well aerated. The water was changed daily. Newly hatched squids were placed in 20 culture tanks (12 litres capacity).filled with 10 liters sand-filtered sea water. The newly hatched squids were cultured at densities of 5, 10, 15, 20, and 25 squid/10 litres. Each treatment was repeated 3 times. The experimental design used for the study was designed according to the Completely Randomized Design (Zar, 1974). To obtain uniform water temperature, each tank was placed in a water-bath of 1 m^3 capacity. The squids were fed live mysids (*Mesopodopsis* sp.), collected from brackish water ponds around the laboratory, and added to the culture tanks.

Survival rates were observed weekly. Mantle length of 20 individuals were measured every week. Water temperature, dissolved oxygen and salinity were measured using DO meter (YSI model 57) and refracto-salinometer (ATAGO S-100). The study was terminated after 28 days.

RESULT AND DISCUSSION

The egg diameter was enlarged in accordance with larval development inside the egg. Hatching took place after 15-16 days. The hatching rate was 90 %. The average mantle length of the hatchlings ranged from 4.9 to 5.4 mm. Newly hatched squid could prey on mysids of the same body length of their own. Bardach *et al* (1972) stated that mysid is suitable live food for squid. Moreover, Segawa (1990) found that mysid *Siriella longiceps* and atherinids *Atherion elymus* were suitable live food for *S. lessoniana*. Shokita *et al.* (1991) suggested that freshwater shrimp *Caridina typus* is good for young cuttlefish *Sepia latimanus.*

Hatchlings were mainly active at day time between 06.00 and 18.00 hour. This finding is in contrast to other studies stating that squids are very active at night (Storer *et al.* 1972; McConanghey 1978; Thursman and Weber 1984; Brusca and Brusca 1990).

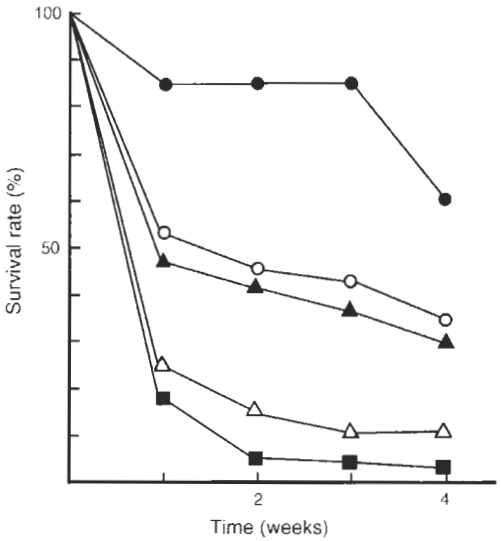

Figure 1. Survival rates of young neritic squid *Sepioteuthis lessoniana* cultured at different densities. Number of squids per 10 litres (brackets): filled circle (5), circle (10), filled triangle (15), triangle (20),filled square (25).

Shokita *et al.* (1991) found that survival rate of *S. latimanus* was 66 % during a 25 day's culture period. In the present study the average survival rate of the squids at day-28 were 60, 35, 30, 10 and 4 % respectively. Analysis of Variance and Duncan's Test of survival rates showed a highly significant difference ($P<0.01$) among treatments. Weekly changes in survival rate is shown in Figure 1.

Relationships between initial stocking density and survival rate is shown in Figure 2 ($Y = 68.90 - 2.47\ X$, $r = 0{,}884$). The figure illustrates that to some extent the lower the initial stocking density the higher the survival rate. Considering the experimental set-up, the low survival rates at higher densities were probably caused by space competition which may lead to stress and mortality (Shepherd and Bromage 1988). Inappropriate handling techniques may also harm the squid. If frightened, the young squid will squirt out ink, which drains energy. After 3 or 4 squirts, it becomes weak and has no appetite and finally dies.

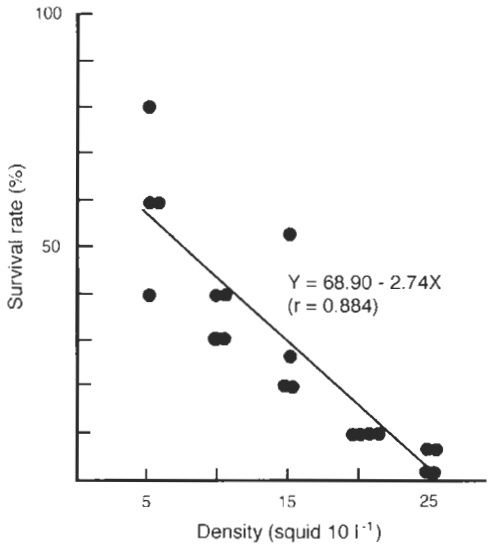

Figure 2. Relationship between initial density of squid and the survival rate at day-28.

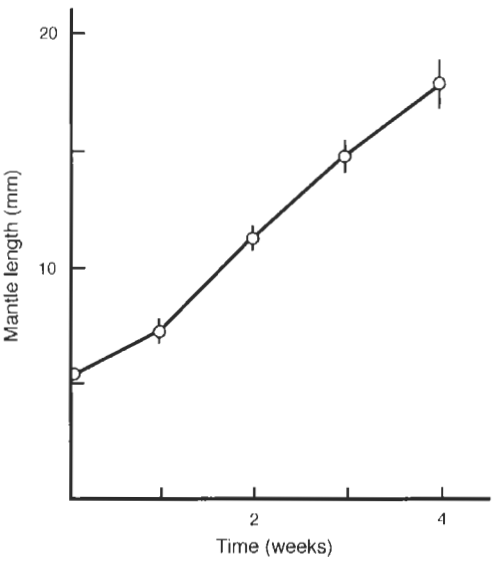

Figure 3. Weekly average mantle length (n = 20) of neritic squid *Sepioteuthis lessoniana*. Vertical lines expressed the standard deviation.

Shepherd and Bromage (1988) stated that stressed aquatic animals easily are attacked by parasites and easily infected by pathogenic bacteria. The average total number of squid at day-28 were 3.0, 3.5, 4.5, 2.0, and 1.0 individuals per 10 litres respectively. An initial density of 15 squid per 10 litres is considered to be the best, even if the percentage survival was lower compared with lower initial stocking densities. However, at the end of the experiment the overall production was higher.

The average mantle lengths of squid at the 5 stocking densities were 17.6, 17.2, 17.4, 17,8, and 20.1 mm when measured at the end of the experiment. Analysis of variance showed that different initial stocking density did not have any effect on the growth in terms of mantel length (Fig. 3).

The ranges of water temperature, dissolved oxygen and salinity were 26-28 ^{0}C, 5-7 ppm, and 31-34 ‰ respectively. Those values were optimal for culture of tropical aquatic organisms.

ACKNOWLEDGEMENT

I would like to express my deepest gratitude to Mr. Ahmad Makmur, Ms. Erni Marlina and Ms. Ismayanti who have helped me conducting this study. Thanks are also expressed to Ms. Nurjum'atti who typed this paper.

REFERENCES

Annonymous, 1998. Cumicumi muncul lagi di Lombok Timur. Kompas Daily Nespaper, 3 Februari 1998.

Bardach, J.E., J.H. Ryther and W.O. McLarney, 1972. Aquaculture, the farming and husbandry of freshwater and marine organisms, John Wiley and Sons Inc., USA, 868 p.

Brusca, R.C and G.J. Brusca, 1990. Invertebrates. Smauer Associated Inc. Publ., Massachusetts, 922 p.

Danakusumah, E., A. Mansyur dan S. Marthinus, 1995a. Perbenihan cumicumi *Sepioteuthis lessoniana*. Laporan Proyek Penelitian Perikanan Budidaya Pantai Maros, Maros, hal 90-109 (unpublished report).

Danakusumah, E., A.Mansyur dan S. Marthinus, 1995b. Studi mengenai aspek-aspek biologi dan budidaya cumicumi *Sepioteuthis lessoniana* I. Musim pemijahan. - Pros. Sem. Kelautan Nas. 15-16 Nov. 1995 di Jakarta, BPP-Tek., II. 17 (in Indonesian).

Danakusumah, E., A. Mansyur dan S. Marthinus, 1997a. Studi mengenai aspek-aspek biologi dan budidaya cumicumi *Sepioteuthis lessonia* Lesson II. Pengaruh pergantian air terhadap tingkat penetasan telur. - Pros. Sem. Nas. Biol-XV 24-26 Juli 1997 di Bandar Lampung. Hal. 868-871

Hamzah, M.S dan S.A. Yusuf, 1995. Pengamatan beberapa aspek biologi perairan pantai Wokam Bagian Barat, Kepulauan Aru Maluku Tengara. - Pros. Sem. Nas. Biol. XII Ujung Pandang, hal. 769-777 (in Indonesian).

McConnaughey, B.H, 1978. Introduction to marine biology, The C.V. Mosby Co., St. Louis, 624 p.

Roper, C.E.F., M.J. Sweeney and C.E. Neuen, 1984. Cephalopods of the world. - FAO Species Catalogue Vol. 3, FAO Fish Synop. 227 p.

Segawa, S, 1990. Food consumption, food conversion and growth rates of the oval squid *Sepioteuthis lessoniana* by laboratory experiments. - Nippon Suisan Gakkaishi, **56** (2), 217-222.

Segawa, S., 1995. Effect of temperature on oxygen consumption of juvenile oval squid *Sepioteuthis lessoniana*. - Fish. Sci., **61** (5), 743-746.

Shepherd, J. and N. Bromage, 1988. Intensive Fish Farming, BSP. Prof. Books, Oxford, 404 p.

Shibata, K., A. Masengi, and H. Takayama, 1990. Comparative Study on squid trolling jigs in Japan. - Proc 2nd Asian Fish. Forum, R. Isao and I. Hanyu (Eds.) Manila pp. 743-746.

Shokita, S., K. Kakazu, A. Tomori, T. Toma and M. Yamaguchi, 1991. Aquaculture in tropical areas. Midori Shobo, Tokyo, 359 p.

Storer, T.I., R.L. Usinger, R.C. Stebbins and J.W. Nybakken, 1972. Zoology. McGraw-Hill Book Co., Fifth Ed.,

Sudjoko, B, 1990. Hubungan panjang berat, tingkat kematangan gonad dan fekunditas cumicumi *Sepioteuthis lessoniana* Lesson di perairan Teluk Banten, Jawa Barat, *dalam* Perairan Indonesia dan sekitarnya (D.P. Praseno, W. Atmadja, O.H. Arinardi, Ruyitno dan I. Supangat eds), Puslitbang Oseanologi LIPI, Jakarta, hal. 1-5 (in Indonesian).

Thursman, H.W. and H.H. Weber, 1984. Marine Biology. Bell and Howell Co., Ohio, 446 p.

Wudthisin, P. and T. Singhagraiwan, 1988. Experimental breeding and nursing of Indian squid (*Loligo duvauceli* Orbigny). Bangkok.

Zar, J.H., 1974. Biostatiscal Analysis - Hall Inc., Engle Wood Cliffs, NJ. 620p.