7(4): 297-301 (2013) DOI: 10.3153/jfscom.2013032

Journal of FisheriesSciences.com

E-ISSN 1307-234X

SHORT COMMUNICATION KISA BİLGİLENDİRME

EFFECTS OF STRING DIAMETER PREFERENCE OF *Sepia officinalis* DURING (L. 1758) SPAWNING IN CAPTIVITY

Halil Şen*

Ege University Fisheries Faculty Aquaculture Department, Urla, İzmir, Turkey

Abstract: The aim of this study was to determine the importance of string diameter preference on spawning performance of *Sepia officinalis*. For this purpose, seven strings, 3.0, 4.0, 6.0, 8.0, 10.0, 12.0, and 14.0 mm in diameter were chosen in one meter length. After that two batches of strings for spawning of the cuttlefish were hanged on the two experimental tanks. Eggs were counted daily to determine which string aor stringss were preferred by the cuttlefish. The mean mantle length and body weight of the individuals used in the experiment were 12.97±1.46 cm and 231.5±48.9 g (n= 22), respectively. The string diameter preference in the cuttlefish were 6-8>10-12>3-4 mm with regards to egg numbers (χ^2; P<0.01). Finally, the present results showed that the 6 and/or 8 mm strings in diameter can be selected for spawning of cuttlefish in terms of aquacultural or biological studies.

Keywords: Captivity, Reproduction, *Sepia officinalis*, Spawning, String diameter

Özet: **Kontrol Altında *Sepia officinalis* (L. 1758)'in Yumurtalamasında İp Çapı Tercihi**

Bu çalışmanın amacı, *Sepia officinalis*'in yumurtalama verimi üzerine ip çapı tercihinin önemi olup olmadığını saptamaktır. Bu amaçla, 1 metre uzunluğunda ve 3.0, 4.0, 6.0, 8.0, 10.0, 12.0, ve 14.0 mm çaplarında yedi ip seçildi. Daha sonra ipler iki grup olarak sübyelerin yumurtlaması için deney tanklarına asıldı. Sübyeler tarafından kaç tane yumurta yumurtladığını ve hangi ip çapını veya çaplarını tercih ettiklerini tespit etmek için günlük kontroller yapıldı. Denemede ortalama manto boyları ve ağırlıkları sırasıyla, 12.97±1.46 cm ve 231.5±48.9 g (n= 22) olan bireyler kullanıldı. Sübyelerde ip çapı tercihi yumurta miktarı (χ^2; P<0.01) dikkate alındığında 6-8>10-12>3-4 mm oldu. Sonuç olarak, şimdiki sonuçlar akuakültür ve biyolojik çalışmalarda sübyenin yumurtlaması için 6 ve/veya 8 mm çapında iplerin seçilebileceğini göstermiştir.

Anahtar Kelimeler: Tutsaklık, İp çapı, Üreme, *Sepia officinalis*, Yumurtlama

* **Correspondence to:** **Halil ŞEN**, Ege University Fisheries Faculty Aquaculture Department, 35440, Urla, İzmir-TURKEY

Tel.: (+90 232) 752 11 62

E-mail: halil.sen@ege.edu.tr

Introduction

Sepia officinalis is one of the most easily cultured cephalopods (Richard 1971; Pascual 1978; Boletzky and Hanlon 1983; Forsythe et al. 1994; Lee et al. 1998; Domingues et al. 2001a,b, 2002, 2003a), and is a commercially important species throughout the world (Roper et al. 1984). It is highly adaptable to life in captive conditions (Forsythe et al. 1994; Domingues et al. 2001a,b, 2002, 2003a,b, 2005, 2006; Skyes et al. 2006; Şen 2009). Its life cycle in the laboratory varies from less than 6 months to 17 months with temperature, feeding regime and culture density (Richard 1971; Forsythe et al. 1994; Domingues et al. 2006). In the wild, cuttlefish live for 2 years on average, and the spawning period varies considerably with temperature (Guerra 2006), with females usually being much larger and older when they start spawning compared to laboratory-cultured cuttlefish.

Moreover, it's known that cuttlefish lay their eggs on various things especially floating things such as wood or branches of some macroalga and corals, fish net and/or other manmade objects (Choue, 1966; ; Arnold et al., 1972; Okutani, 1978; Boletzky and Boletzky, 1973; Şen, 2009). Nevertheless, there is only one information can be found from the Boletzky's (1983) study in the literature. So far, the data related to appropriate diameter of strings or other materials for laying eggs of *S. officinalis* hasn't been indicated in terms of rearing or culture studies. Therefore, preference to string diameter may be important while spawning of the cuttlefish in captivity. The aim of this study was to determine the importance of string diameter preference on spawning performance of *S. officinalis*.

Materials and Methods

The experimental animals were captured off the Izmir Bay by trammel nets on April 3, 2012. Totally 22 *S. officinalis* (11 males and 11 females) were selected and placed in an open flow-through filtered sea water system with two cylindrical polyester tanks (450 L volume) in indoor facilities of the Fisheries Faculty of Ege University (Urla, Izmir, TURKEY) at the end of the spawning (April 3-17, 2012). Avoiding congestion the cuttlefish were divided in two groups (5 males and 5 females, and 6 males and 6 females). Natural photoperiodicity was adjusted. The oxygen and pH meter YSI 5750 and salinity hand refractometer 508-IIW were used for measurements. The specimens were fed ad-libitium with low market price fish species (i.e. *Sardine pilchardus*, *Engrualis encrasicolus*) by hand. The following day, uneaten part or remains were removed by siphoning. The mean mantle length and body weight of the individuals using the experiment were 12.97±1.46 cm and 231.5±48.9 g (n= 22), respectively.

The seven strings, 3.0, 4.0, 6.0, 8.0, 10.0, 12.0, and 14.0 mm in diameter were chosen in one meter length. After that two batches of strings for spawning of the cuttlefish were hanged on the experimental tanks (Figure 1.). Daily control was carried out for how many eggs were laid on the strings and which string diameter or diameters were preferred for spawning by the cuttlefish.

The obtaining data were given as mean ± SD values in the text. The differences among means of the spawned egg numbers and the spawning numbers on chose string diameters were tested using chi-square test to determine any significance ($P<0.01$).

Results and Discussion

The salinity, pH, O_2 saturation and temperature in tanks were measured as 37±0.2‰, 8.1±0.1, 65±5%, and 16.5±1°C, respectively. The experiment lasted 14 days. During this period the cuttlefish mated multiple times in the tanks. Additionally, it's observed that after each mating the males generally allowed females to feed first. Also, agonistic behaviour occurred frequently in the tanks. Furthermore, total 53 spawning occurred and total 1519 eggs were laid on the strings. There were significant differences among string diameters ($P<0.01$) based on the egg numbers. On the other hand, there wasn't any significance between string diameters according to the spawning numbers ($P>0.01$). The string diameter preference in the cuttlefish were 6-8>10-12>3-4 mm in diameters with regards to egg numbers ($P<0.01$) (Table 1.). However, the 14 mm in string diameter was excluded from the statistical analysis because it was hardly chosen.

Present findings related to mating behaviour in the cuttlefish is parallel to that of Hanlon and Messenger (1996). Furthermore, the males allowed to first food intake of the mated females after mating which is observed firstly in the current research. Also, the agonistic behaviour is a known phenomenon in the cuttlefish (Hanlon and Messenger, 1996). In conclusion, the current re-

sults indicated that the cuttlefish prominently preferred the 6 and 8 mm in string diameters ($P<0.01$). The 14 mm in string diameter was chosen hardly ever. Therefore using this diameter is inadvisable according to the present study. Also, Boletzky (1983) said that *S. officinalis* lays its eggs on the oblong object, not more than 1 cm in diameter. The current results generally in agreement with that of the Boletzky (1983)'s findings.

Finally, the present results showed that the 6 and/or 8 mm in diameter of strings can be selected for spawning of cuttlefish in terms of aquaculture or biological studies. Unfortunately, the actual evidences couldn't be compared with any studies related to this subject. However, more detailed behavioural and/or physiological studies on why cuttlefish prefer the definite diameter for spawning is needed.

Conclusions

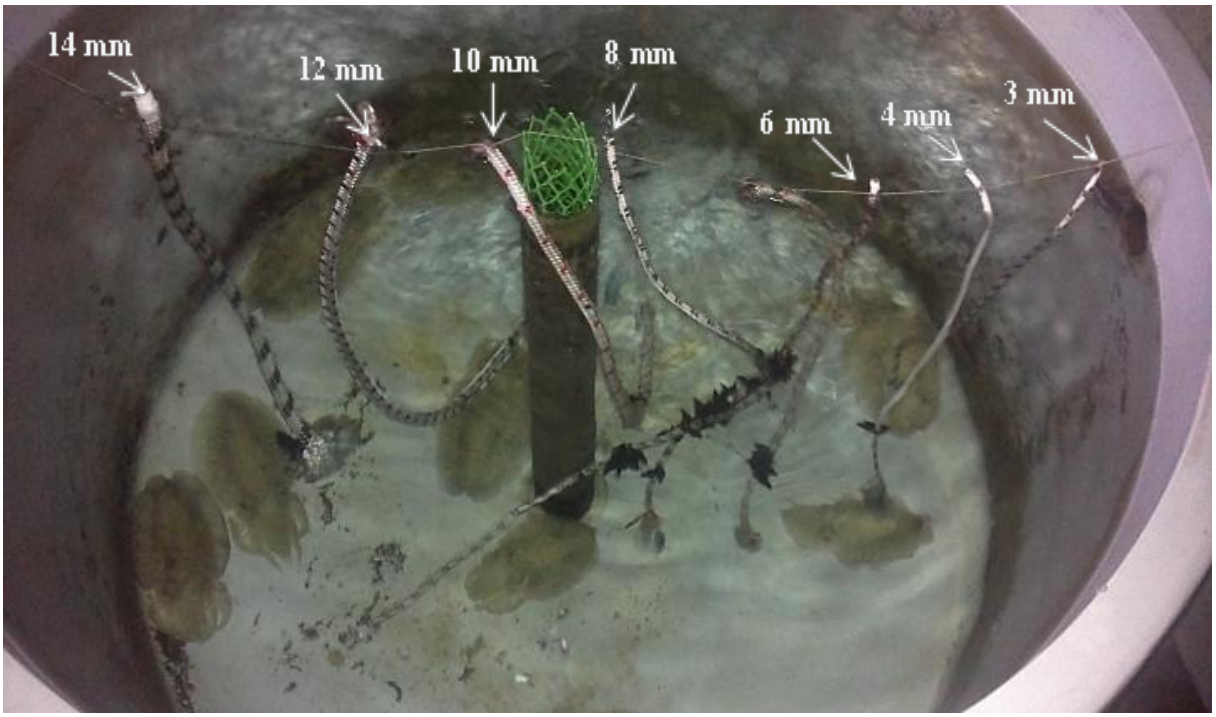

Figure 1. A general view of laying eggs on the strings and the cuttlefish from the one of the experimental tank.

Table 1. The total numbers of chosen string diameters and eggs.

Diameter (mm)	3	4	6	8	10	12	14*
Total egg numbers	120[a]	111[a]	360[b]	358[b]	292[c]	236[c]	42*
Total spawning number	5[-]	9[-]	8[-]	10[-]	13[-]	6[-]	2*

References

Arnold, J.M., Singley, C.T., Williams-Arnold, L.D., (1972). Embriyonic development and post hatchling survival of the Sepiolid squid *Euprymna scolopes* under laboratory conditions, *The Veliger*, **14**: 361-364.

Boletzky, S.V., (1983). *Sepia officinalis*. Boyle P.R. (ed) Cephalopod life cycles. Vol.1. Academic Press, London, pp.31-51.

Boletzky, S.V., Boletzky, M.V., (1973). Observation embriyonic and early postembryonic development of *Rossia macrosoma* (Mollusca: Cephalopoda), *Helgolender wiss Meeresunters*, **25**: 135-161.

Boletzky S.v., Hanlon R.T. (1983) A Review of the Laboratory Maintenance, Rearing and Culture of Cephalopod Molluscs, *Memoirs of the National Museum Victoria*, **44**: 147–187.

Choe, S., (1966). On the eggs, rearing, habits of the fry and growth of some Cephalopoda, *Bulletin of Marine Science*, **16**: 330-348.

Domingues P., Kingston T., Sykes A., Andrade J., (2001a). Growth of young cuttlefish, *Sepia officinalis* (Linnaeus, 1758) at the upper end of the biological distribution temperature range, *Aquaculture Research*, **32**: 923-930.

doi: 10.1046/j.1365-2109.2001.00631.x

Domingues P., Sykes A., Andrade J., (2001b). The use of Artemia or mysids as food for hatchlings of the cuttlefish *Sepia officinalis* Linnaeus, 1758; effects on growth and survival throughout the life cycle, *Aquaculture International*, **9**: 319-331.

doi: 10.1023/A:1020416811568

Domingues P., Sykes A., Andrade J., (2002). The effects of temperature in the life cycle of two consecutive generations of the cuttlefish *Sepia officinalis* (Linnaeus, 1758), cultured in the Algarve (South Portugal), *Aquaculture International*, **10**: 207-220.

doi: 10.1023/A:1022148802078

Domingues P., Poirier R., Dickel L., Almansa E., Sykes A., Andrade P., (2003a). Effects of culture density and live prey on growth and survival of juvenile cuttlefish, *Sepia officinalis*, *Aquaculture International*, **11**: 225-242.

doi: 10.1023/A:1024803802486

Domingues P., Sykes A., Sommerfield A., Almansa E., Lorenzo A., Andrade J. (2003b). Effects on feeding live or frozen prey on growth, survival and the life cycle of the cuttlefish *Sepia officinalis* (Linnaeus, 1758), *Aquaculture International*, **11**: 397-410.

doi: 10.1023/B:AQUI.0000004195.92236.3a

Domingues P., DiMarco F., Andrade J., Lee P. (2005). The effects of diets with amino acid supplementation on the survival, growth and body composition of the cuttlefish *Sepia officinalis*, *Aquaculture International*, **13**(5): 423-440.

doi: 10.1007/s10499-005-6978-9

Domingues P.M., Bettencourt V., Guerra A. (2006) Growth of *Sepia officinalis* in captivity and in nature, *Vie et Milieu*, **56**: 109–120.

Forsythe J., DeRusha R., Hanlon R., (1994) Growth, reproduction and life span of *Sepia officinalis* (Cephalopoda: Mollusca) cultured through seven consecutive generations, *Journal of Zoolology London*, **233**: 175-192.

doi: 10.1111/j.1469-7998.1994.tb08582.x

Guerra A., (2006). Ecology of *Sepia officinalis*, *Vie et Milieu*, **56**: 97-107.

Hanlon, R.T., Messenger, J.B., (1996). Cephalopod behaviour. Cambridge University Press; 230 pp.

Lee P., Turk P., Forsythe J., DiMarco F., (1998). Cephalopod culture: physiological, behavioural and environmental requirements. *Suisanzoshoku*, **46**(3): 417-422.

Okutani, T., (1978). Studies on early life history of decaodan Mollusca. VII Eggs and newly hatched larvae of *Sepia latimanus* Quoi ans Gaimard, *Venus* (*Japanese Journal of Malacalogy*), **37**: 245-248.

Richard A. (1971) Contribution a` l'e´tude expe´rimentale de la croissance et de la maturation sexuelle de *Sepia officinalis* L. (Mollusque, Ce´phalopode). The`se 248, Univ. Lille, France.

Roper C.F.E., Sweeney M.J., Nauen C.E., (1984) F.A.O. Species Catalogue, *Cephalopods on the World*. An Annotated and Illustrated Catalogue of Species of Interest to Fisheries, in F.A.O. Fisheries Synopsis, 1-277.

Sykes A., Domingues P.M., Correia M., Andrade J.P., (2006). Cuttlefish culture – State of the art and future trends, *Vie et Milieu*, **56**: 129-137.

Şen H., (2009). Kontrollü Koşullarda Sübye (Sepia officinalis L.)' nin Yumurtlaması, Yumurtaların Gelişimi ve İnkübasyonu, *Journal of FisheriesSciences.com*, **3**(3): 169-180.

doi: 10.3153/jfscom.2009021