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Reproduction Density and Growth Performance of Mediterranean Mussels, *Mytilus galloprovincialis* Lamarck, 1819 in Winter Season in Dardanelles

[1]Harun Yıldız, [2]Aynur Lök and [3]Mustafa Palaz
[1]Fisheries Faculty, Canakkale Onsekiz Mart University, 17100-Canakkale Turkey
[2]Fisheries Faculty, Ege University, 35100-Izmir Turkey
[3]The Ministry of Agriculture and Rural Affairs, Profencial Directory of Agriculture of the Canakkale, 17100 Canakkale, Turkey

Abstract: The study was carried out in Kilya (Poyraz) Bay in Dardanelles between November 2002 and December 2003. Net rope I and net rope II were hung in November and December 2002, respectively. The number of mussels was counted as 2630 seeds/100 cm^2 between November-December and 5019 mussel seed/100 cm^2 between and December-January, respectively. The number of mussel seeds in the collectors is remarkable for mussel culture. Since pediveliger and postlarvae mussels were found in all samples, reproduction continued throughout the year. As parallel to the changes, the sea water temperature and amount of chlorophyll-a, growth rate variation of mussels estimated here with low values in winter and maximum in spring. A great amount of first attachment mussels on collectors attained 35-48.3 mm length after a year. This growth rate is suitable for commercial mussel culture in the Dardanelles.

Key words: Dardanelles, mussel, *Mytilus galloprovincialis*, collector, growth rate

INTRODUCTION

The genus *Mytilus* is one of the most cosmopolitan of all marine genera, occuring at higher latitudes in all oceans and major seas of both northern and southern hemispheres (Seed, 1992). Their ability to grow profusely and rapidly makes them ideal candidates for aquaculture. The Mediterranean mussel, *M. galloprovincialis* has a dense population at the Turkish coast from the Black Sea to the Aegean Sea. Although there is rich mussel potential in the Dardanelles Sea of Marmara, mussel culture is new for this region. It seems necessary therefore to try and determine for culture such as suitable areas, collector materials, settlement sites, growth and seed collection.

The collection of sufficient seed quantities is an important factor in mussel farming. The artificial collectors, especially filamentous ones, are extremely effective for the settlement of mussel larvae in natural environments (Eyster and Pechenik, 1987; Karayücel *et al*., 2001). Growth rate in mussels depends on various factors, particularly shore level, degree of exposure to waves, population density, salinity and, above all, on temperature and the amount of food in the water (Seed, 1976; Rodhouse *et al*., 1984; Page and Hubbard, 1987). Usually in temperate waters shell growth is rapid during the spring and summer, and slow or may be absent during the colder months (Gosling, 1992; Karayücel and Karayücel 1997).

In the present study, the Mediterranean mussel, *M. galloprovincialis*'s reproduction density was determined for winter season in Dardanelles. The growth rate of the mussels attached on net rope collectors and the effects on growth of some environmental parameters of sea water (temperature, salinity and chlorophyll-a) investigated during a year.

MATERIALS AND METHODS

The study was carried out in Kilya (Poyraz) Bay off Dardanelles between November 2002 and December 2003 (Fig. 1). Kilya Bay is located around 3 kilometers from Eceabat province (GPS coordinates 40° 12'20' N, 26° 21'60' E). The Bay is 650 m long and 800 m wide. Depth in the study area is 15-18 m near the coast and 40-45 m in the open sea.

Temperature, salinity and chlorophyll-a were monthly analysed in the sea water. Temperature and salinity were measured with mercury thermometer and refractometer, respectively. Chlorophyll-a were determined with 0.45 mm filter paper and calculated according to Strickland and Parsons (1972)'s method.

Plaited rope collectors were used. Each net collector prepared as 25 cm long and 4 cm wide (100 cm^2) on average. 6 net collectors formed the main body. Net rope I and net rope II set in November and December 2002 in the study area, respectively. Each collector had a plastic

Corresponding Author: Harun Yıldız,Fisheries Faculty, Canakkale Onsekiz Mart University, 17100-Canakkale Turkey

prop at the bottom of the rope to prevent mussels from dropping down. Collectors were set below 1 m long from the surface (Fig. 2). Each collector group had two repetion.

As it was explained at the beginning, a net rope I collector consists 6 ropes laid in (November, 2002). As a sample, one rope was taken and spats was counted. In this way, mussel accumulation determined monthly in (December, 2002) and January, February, May, August, November 2003, respectively. Similarly, mussel quantity counted on net rope II in January, February, March, June, September, December 2003, respectively. Accumulation of mussel seeds in first month was determined in December 2002 on net rope I and January 2003 on net rope II.

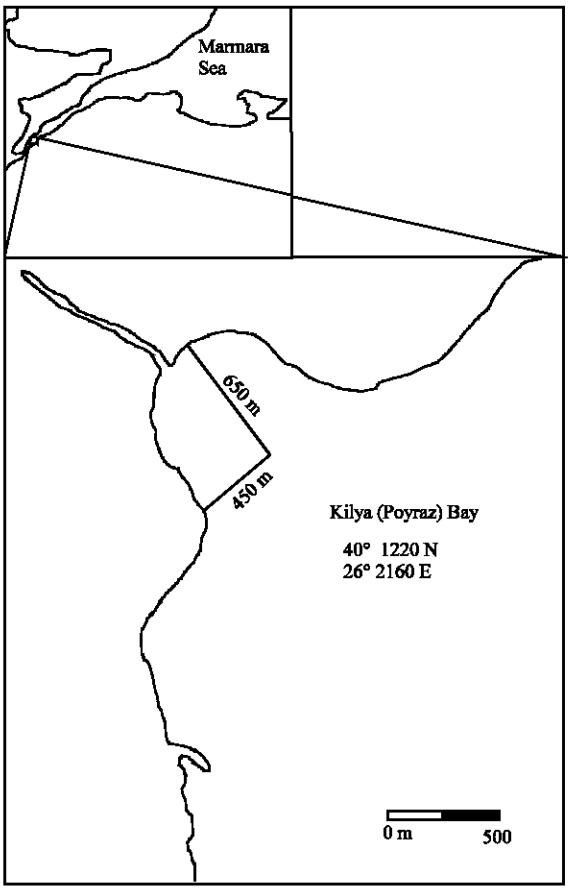

Fig. 1: The study area

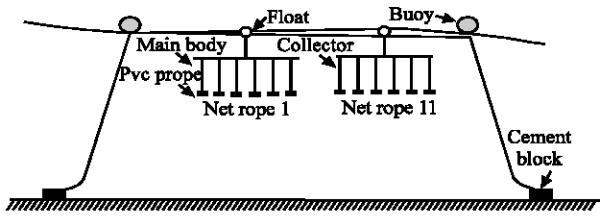

Fig. 2: Mussel seed settlement and growth on net rope collectors (not to scale)

Collector sampling was completed, as taking 4 cm collector parts from the beginning, from the middle and from the end of each collectors. All measurable (>2,8 mm) mussels were measured by 0.01 mm sensitivity compasse. The mussels have size under 2.8 mm were counted under binocular of Dolphus camera. Size measuring was carried out on randomly sellected mussels.

Total longevity of sample collector parts of the beginnig, middle and end of each collectors rated to the whole collector lenght. Total mussel number calculated and size groups were determined.

Correlation analyses were applied on environmental parameters on the sea water in Kilya Bay.

RESULTS

Chlorophyll-a, salinity and temperature of water were recorded between November 2002 and December 2003. Minimum and maximum water temperatures were 8.3 °C in March 2003 and 25 °C in August and September 2003, respectively. Salinity levels in the sea water were determined as between‰19-25.5 during the study (Fig. 3). Chlorophyll-a amount was maximum 1.91 μg Lt^{-1} in February, 2003 and minimum 0.14 μg Lt^{-1} in November 2003 (Fig. 4).

Although there was a statistical relation between salinity and temperature (R^2 = 0.87), there was not any correlation among other environmental parameters.

Table 1: Mussel amounts in net rope I in various periods (individuals/100 cm^2)

	Net Rope I		
Tarih	< 2.8 mm individual	>2.8 mm individual	Maximum lenght (mm)
Dec. 2002	2630	-	2.15
Jan. 2003	4513	42	4.1
Feb. 2003	5721	268	7.1
May.2003	8603	1297	27.4
Agu.2003	1714	753	38.2
Nov.2003	2616	379	48.3

Table 2: Mussel amounts in net rope II in various periods (individuals/100 cm^2)

	Net Rope II		
Tarih	< 2.8 mm individual	> 2.8 mm individual	Maximum lenght (mm)
Jan. 2003	5019	-	1.18
Feb. 2003	4384	155	4.9
May.2003	7205	475	9.3
Jun. 2003	7413	1275	30.3
Sep. 2003	1220	744	40.9
Dec. 2003	3043	431	45.5

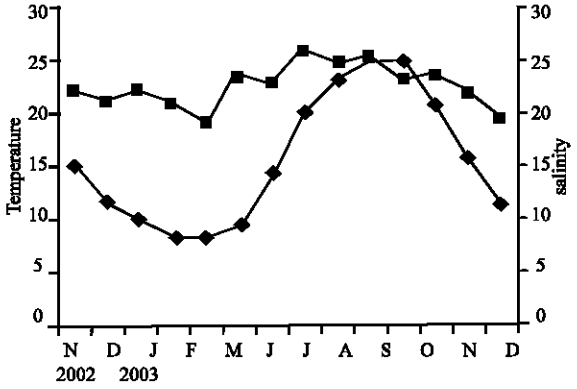

Fig. 3: Temperature and salinity levels

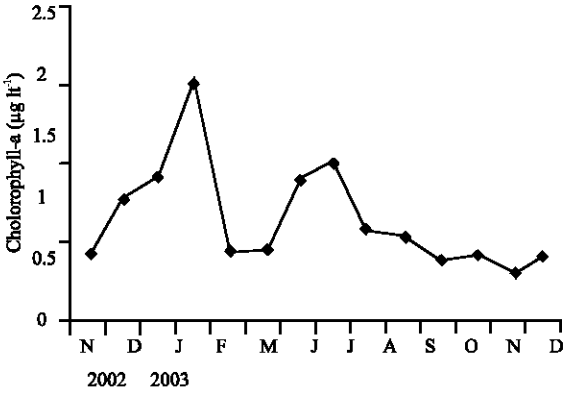

Fig. 4: Chlorophyll-a changes in Kilya Bay

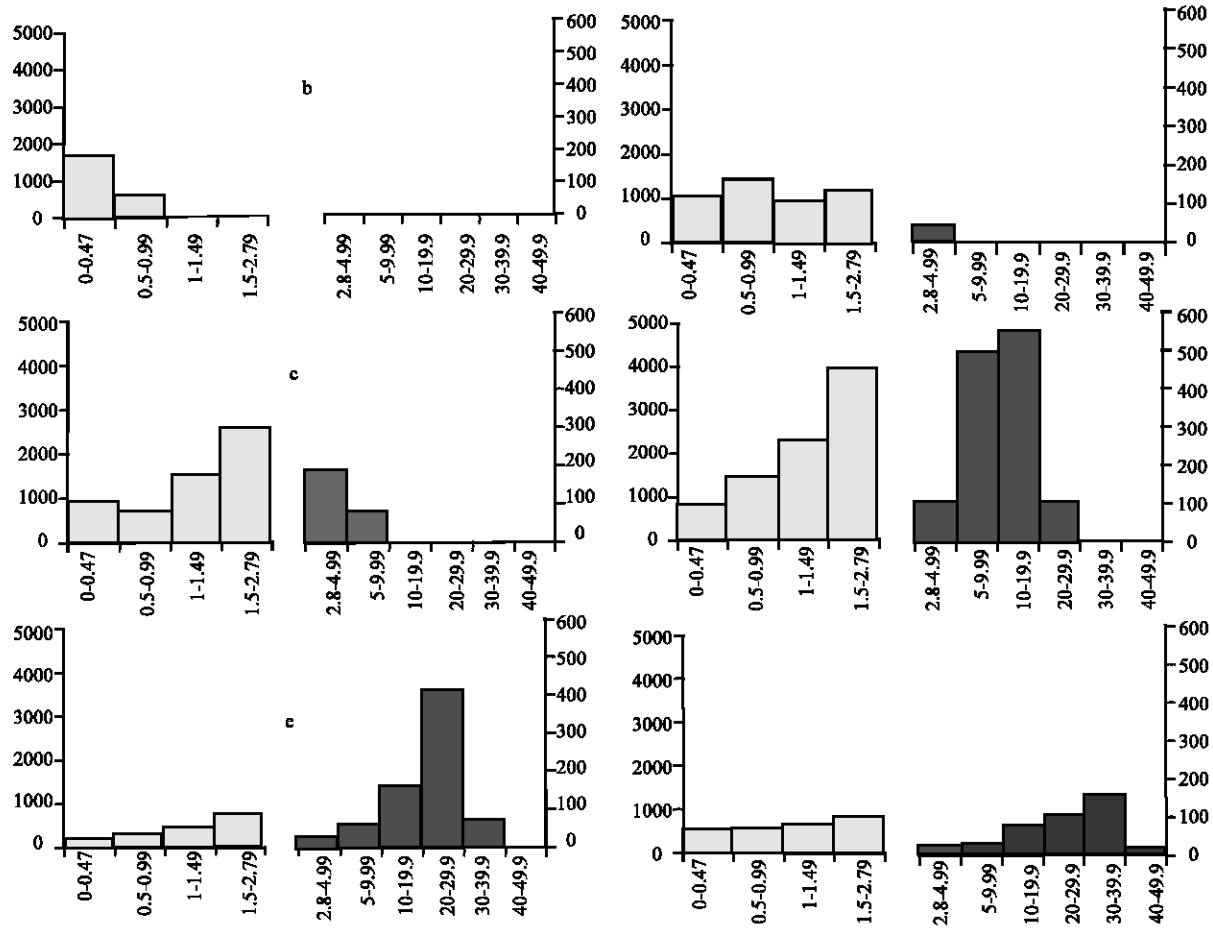

Fig. 5: Mussel growing performances in net rope I (number 100 cm^{-2}). a) December 2002, b) January 2003, c) February 2003, d) May 2003, e) August 2003, f) November 2003.*▮ : Mussel seed ▯: Mussel spat

The reproduction density of net rope I and net rope II was calculated as 2630 mussel seeds/100 cm^2 (in December sampling) and 5019 mussel seeds/100 cm^2 (in January sampling) in winter season, respectively (Table 1 and 2). All mussels under 2.8 mm were counted under microscope. In this term most of the mussels were between 0.20-0.47 mm, which were called pediveliger. Mussel reproduction was continued throughout the year (Fig. 5 and 6).

The growth rate was lower in winter period in bothcollector. Maximum mussel size was 7.1 mm in net rope I in November-February; and 9.3 mm in net rope II in

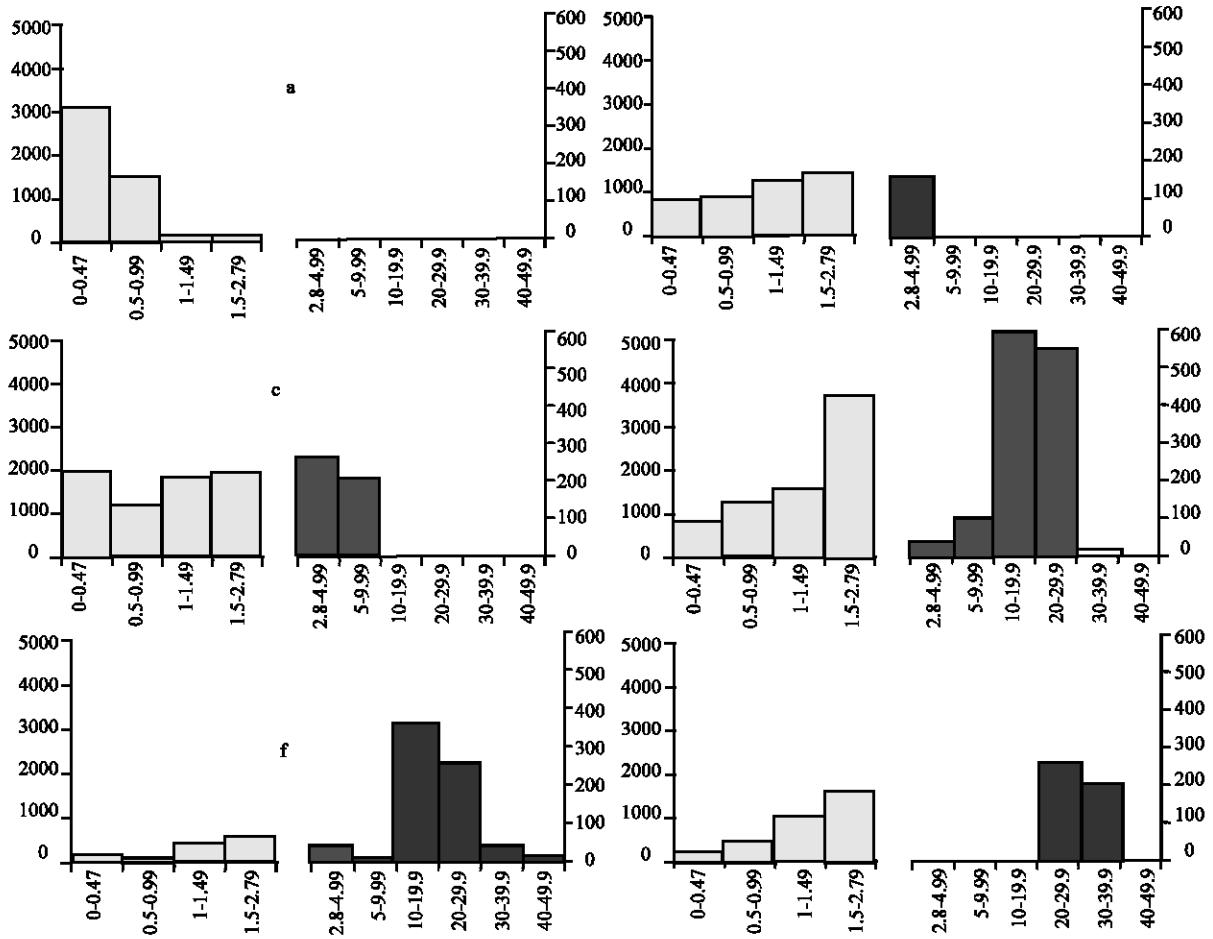

Fig.6: Mussel growing performances in net rope II (number 100 cm^{-2}). a) January 2003, b) February 2003, c) March 2003, d) June 2003, e) September 2003, f) December 2003.

December-March (Table 1 and 2). Both amount of chlorophyll-a and growth rate of mussels were peak in spring season (Fig. 4 and Table 1, 2). In this period, most of the mussel spats were between 10-20 mm in both collector groups (Fig. 5 and 6). The biggest mussel size was found in net rope I (27.4 mm); and 30.3 mm in net rope II. Also, growth rate decreased slowly in summer and autumn (Fig. 5 and 6).

In this study, there were all size of mussels in both collector groups since thinning out was not applied. First attached mussels on settlement collectors in sea water was generally between 35 and 48.3 mm lenght at the end of the studies.

DISCUSSION

The mussels is known to grow rapidly under identical conditions. The characteristics of the materials in the collectors generally seem to be important for collection, growth and attachment of the mussels to the material (Lekang *et al*., 2003). According to Mason and Drinkwater (1981), Pulfrich (1996) mussel spats prefer attachment to materials with thready and filamentous surfaces. Net collector materials used in this study was considerably resistant to the sea water. There was no visible fraying on collectors, and with filamentous surfaces were effective on spat collecting. Apparently, a seed density of over 1200 individuals per m is necessary to produce high yields of cultured mussels (Okumuþ, 1993). Dare and Davies (1975) studied settlement on ropes made of coir (the rough outer hair-like covering of coconut) reported 17000-28000 individuals per m in Wales. Okumuþ (1993) reported 1950 mussel seed per m in Loch Etive and 21100 mussel seed per m in Loch Leven on the west coast of Scotland. Similar net system in Dardanelles, Yıldız (2004) reported that postlarvae and pediveliger mussels density were found as 53641, 25491, 7002, 1502 mussel seed 100 cm^{-2} in sequence

between February-March, March-April, July-August, October-November, respectively. In this study it is observed that, mussel numbers were 2630 and 5019 mussel seed 100 cm^{-2} between November-December and December-January, respectively. The numbers of mussel seeds in the collectors are remarkable for mussel culture. However, considering main reproduction period of mussels (between February-April), the collectors are the most suitable for settlement in January around the Dardanelles. It is also derived that endogenous factors (physicological conditions, size and genotype) and the specific environmental conditions of the area (Zurburg *et al*., 1979; Kluytmans *et al*., 1980; Hunt and Scheibling, 1997) have great effect in mussel growth performance. Particularly, amount of chlorophyll-a in the water and water temperature had a significant effect on the variations in growth rate (Bayne and Newell, 1983; Babarro *et al*., 2000; Yıldız and Lök, 2005). As parrallel to the changes of the sea water temperature and amount of chlorophyll-a, growth rate variation of mussels estimated here with low values in winter and maximum in spring which followed a similar pattern in other regions (Freeman and Dickie, 1979; Ceccherelli and Barboni, 1983; Karayücel and Karayücel, 1997).

Since pediveliger and postlarvae mussels were found in all samples, reproduction was continued throughout year. In mussel culture, thinning out is applied on collectors in certain size and density. Mussels on one collector is parted on 2nd and 3rd collectors. This seperation helps classification and inhances growing speed of small mussels (Perez and Roman, 1979). In this study, since there was no thinning out on collectors, all size group mussels were found in whole sampling (Fig. 4 and 5). A great amount of first attachment mussels on collectors attained 35-48.3 mm length after a year. If thinning out had been made, bigger mussels could be found.

According to the results of this study, it may be said that amount of the mussels attached to the collectors are suitable for commercial mussel culture in winter season in Dardanelles. Marketing size of mussels are = 50 mm (Okumus, 1993). When attached mussels on a collector reach about 20-30 mm lenght (and if thinning out is done), they can reach marketable size in a year. So this growth rate is suitable for commercial mussel culture in the Dardanelles. Yıldız (2004) also reported that the mussels reached 40-50 mm lenght after a year and 52-67 mm lenght after 1.5 year without thinning out in the same region. Since in both collection, more mussels and better growth rate was determined on collectors, the more suitable period for mussel culture activities to start with may strongly be suggested as the period between February and April in the Dardanelles.

REFERENCES

Babarro, J. M. F., M. J. Fernandez-Reiriz and U. Labarta, 2000. Growth of seed mussel (*Mytilus galloprovincialis* L): effects of environmental parameters and seed origin. J. Shellfish. Res., 19: 187-193.

Bayne, B.L. and R.C. Newell, 1983. Physiological Energetics of Marine Mollusc. In: K. Wilbur and M. Salevdin, A.S.M. (Eds.). The mollusca, Physiology: I. Academic Press, London, 4: 407-515.

Ceccherelli, V. U. and Barboni., 1983, Growth, Survival and Yield of *Mytilus galloprovincialis* L. on fixed suspended culture in a bay of the Po River Delta. Aquaculture, 34: 101-114.

Dare, P.J. and G. Davies, 1975. Experimental suspended culture of mussels, *Mytilus edulis* (L), in Wales using spat transplanted from a distant settlement ground. Aquaculture, 6: 257-274.

Eyster, L.S. and J.A. Pechenic, 1987. Attachment of *Mytilus edulis* L. Larvae on algal and byssal filaments in enhanced water agitation. J. Exp. Mar. Biol., 114: 99-110.

Freeman, K.R. and Dickie, L.M., 1979. Growth and mortality of the blue mussel (*Mytilus edulis*) in relation to environmental indexing. J. Fis. Res. Board Can., 36:1238-1249.

Gosling, E., 1992, The Mussel *Mytilus*: Ecology, Physiology, Genetics and Culture. Dev. Aqu. Fish. Sci., pp: 25.

Hunt, H.L. and R.E. Scheibling, 1997. Role of early post-settlement mortality in recruitment of benthic marine invertebrates. Mar. Ecol. Prog. Ser., 155: 269-301.

Karayücel, S. and İ. Karayücel, 1997. Influence of environmental factors on condition index and biochemical composition in *Mytilus edulis* L. in cultivated-raft system, in two Scottish Sea Lochs. Turkish J. Marine Sci., 3: 149-166.

Karayücel, S., M. Erdem, O. Uyan, S. Saygun and İ. Karayücel, 2001. Spat settlement and growth on a long-line culture system of the mussel, *Mytilus galloprovincialis,* in the southern Black sea. The Israeli J. Aqu. Bamidgeh, 54: 163-172.

Kluytmans, J.H., D.I. Zandee, W. Zurburg and H. Pieters, 1980. The influenceof seasonal changes on energy metabolism in *Mytilus edulis* (L.). III. Anaerobic energy metabolism. Comp. Biochem. Phy., 67: 307:315.

Lekang, O.I., T.K. Stevik and A.M. Bomo, 2003. Evaulation of different combined collectors used in longlines for blue mussel farming. Aqu. Eng., 27: 89-104.

Mason, J. and J. Drinkwater, 1981. Experiments on suspended cultivation of mussels in Scotland, Scottish Fisheries Information Pamphlet. Nr. 4.

Okumuþ, İ., 1993. Evaluation of suspended mussel (*Mytilus edulis* L) culture and İntegrated experimental mariculture (salmon-mussel) trials in Scottish Sea Lochs. University of Stirling. PhD. Thesis, pp: 336.

Page, H.M. and D.M. Hubbard, 1987. Temporal and spatial patterns of growth in mussels *Mytilus edulis* on an offshore platform: Relationship to watertemperature and food availability. J. Express Mar. Biol. Ecol., 111: 159-179.

Perez, A. and G. Roman, 1979. Estudio del mejillon y de su epifauna en los cultivos flotantes de la Ria de Arosa. II. Bol. Inst. Esp. Oceanogr, 5: 21-42.

Pulfrich, A., 1996. Attachment and settlement of post-larval mussels (*Mytilus edulis* L.) in the Schleswig-Holstein Wadden Sea. J. Sea Res., Issues 3-4, 36: 239-250.

Rodhouse, P. G., C.M. Roden, G.M. Burnell, M.P. Hensey, T. Mcmahon, B. Ottway and T.H. Ryan, 1984. Food resource, gametogenesis and growth of *Mytilus edulis* L. on the shore and in suspended culture in Killary Harbour, Ireland. J. Mar. Biol. Associ. U.K, 64: 513-529.

Seed, R., 1976. Ecology In Marine Mussels: Their Ecology and Physiology. IBP Cambridge University Press, 10: 13-65.

Seed, R., 1992. Systematics evolution and distribution of mussels belonging to the genus *Mytilus*: N overview. American Malacological Bulletin, 9: 123-137.

Strickland, J.D.H. and T.R. Parsons, 1972. Apractical handbook of seawater analysis. Fish. Res. Brd. Canada, Bull., pp: 167.

Yıldız, H., 2004, Çanakkale Boðazýnda midye (*Mytilus galloprovincialis* L.) kültürü üzerine araştırmalar. Ege Üniversitesi Fen bilimleri Enstitüsü, Doktora Tezi, 137 sayfa.

Yıldız, H. and A. Lök, 2005. Çanakkale Boðaında farklı boy gruplarındaki midyelerin (*Mytilus galloprovincialis* L.) iki deðişik sistemde büyüme ve yaþama performanslarıSu Ürünleri Dergisi cilt, 22: 69-74.

Zurburg, W., J.H. Kluytmans, H. Pieters and D.I. Zandee, 1979. The influence of seasonal changes on energy metabolism in *Mytilus edulis* (L.). II. Organ specificity. In: E. Naylor and R. G. Hartnoll. Cyclic Phenomena in Marine Plants and Animals. Pergamon Pres, Oxford, New York, pp: 293-300.