Research on the Development of the Culture of Deep-Water Pink Shrimp *Parapenaeus Longirostris* (Lucas, 1846) in the Marmara Sea

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For the purpose of gaining optimum benefit from the shrimp stocks, this study aims at determining bio-ecological characteristics of pink shrimp, indices of change in the stocks, general fishing gear and catch per unit effort, design of alternative fishing gear for the sustainable shrimp catch and the fishing parameters, optimum mesh and catch size; assessing by-catch in the traditional and modified nets; defining benthic biodiversity in the Marmara Sea; optimizing fishing fleet; strengthening socio-economic means of shrimp fishermen and the structure of fisheries cooperatives; and increasing the awareness for fisheries.

This study was conducted all over the Marmara Sea at 200m depth from the shore from six different areas in 2001, 2002 and 2003. Sea surveys were realized seasonally and monthly by using traditional fishing gears e.g. trawl, dredge, and beach seine. Length distribution of the population was 5-16.5cm. The average length which was varying depending on the season and depth was 10.9cm. Individuals living at 100m or above were bigger than those living below 100m. Sex ratio of female individuals to male individuals (F/M) was determined as 1.2. Length distribution of female individuals was higher than that of male individuals. According to this distribution, the average length of females was 11.8cm (5.0-6.5) while it was 9.7cm (4.6-13.9) for males. Both males and females were distributed amongst the age group of 0-4. The highest ratio of occurrence was found for the individuals of age group 2. The relation of total length-body weight with rostrum was roughly calculated as a=0.0053, b=2.9665, R^2 =0.9519. Growth parameters were found as L∞=157.9 mm, k=0.380, t_0=-1.422; and L∞=170.2 mm, k=0.581, t_0=-0.962 for males and females, respectively. Age of recruitment was 1 and first catch size (Tc) was 9.2 cm. Average biomass per unit area obtained from deep trawl and dredge, was found as 229.8 kg/km^2 and 409.3 kg/km^2, respectively. Rate of total mortality (Z), fishing mortality (F) and natural mortality (M) for *Parapenaeus longirostris*, known to be short life individual was estimated as 1.91, 0.85 and 1.06, respectively. Exploitation rate (E=F/Z) was 0.5.

According to histological definition, there were four separate development stages identified in the ovaries of females that reached to sexual maturity: I. Resting stage (primary oocite stage); II. Embryonic stage; III. Maturity; and IV. Discharge stage (egg releasing stage). Mature females that released their eggs were mostly observed in March, April, May, June and October. At the beginning of ovary development, ovary cells (oogonim cells) are clustered on the ovary tissue inside the epithelial sheath. At the end of embryonic stage, a mature ovary cell, being ready to release is elliptical and clustered in a thin follicular cell membrane. The highest GIS values are obtained in three separate periods (March, June and October). The lowest spawning length (total rostrum length) was calculated as 97.9mm. The fist spawning length (L_{50}) of population was 106.1mm. Female individuals entered the reproduction phase almost by the early days of age one. Number of eggs released at once (batch fecundity) was calculated as 75549.4 ova/shrimp. Relative fecundity was 7520.1 (3110-14100.3 ova/g).

Deep trawl, deep beach seine, dredge and other conventional fishing gears were observed to use for catching deep water-pink shrimp and 118 different species from 10 taxonomic groups which are Osteichthyes,

Mollusks, Crustaceans, Echinoderms, Chondrichthyes, Polychaeta, Cephalopodes, Anthozoa, Spangiidae and Ascides. By-catch comprises 28 commercially important species, 81 non-commercially important species and 9 endangered species. CPUE values of by-catch species by fishing gears and season expressed as percentage number and percentage weight was 2247.7 (%30.1) number/h/gear and 58587.1 (%61.9) g/h/gear for trawl; 881.9 (%25.2) number/h/gear and 6056.4 (%25.0) g/h/gear for beach net; and 178.3 (%12.1) number/h/gear and 1816.4 (%24.4) g/h/gear for dredge. The highest value (45.5 kg/h/gear) of CPUE is obtained by means of trawl nets followed by beach seine and dredge with 15.4 kg/h/gear and 7.9 kg/h/gear, respectively. The highest catch occurred in winter.

Dredge nets, the diamond-shaped mesh of which was 24, 28 and 32 had selectivity length (L_{50}) and selectivity range as 9.0, 10.8 and 12.0cm; and 6.2, 6.6 and 2.6cm, respectively. As for dredge nets with square-shaped mesh of 24 and 28mm, selectivity length (L_{50}) and selectivity range were 10.2 and 11.0 cm; and 3.7 and 5.1cm, respectively. The modified dredge net having 28mm diamond-shaped mesh and grid panel had selectivity length (L_{50}) and selectivity range as 10.3 and 6.5cm, respectively.

Distance between the sticks of modified gear with grid panel which was intended to reduce the by-catch was 20mm. Grid panel was installed in a cylindrical cage at 45º degree in order to allow the by-catch to pass from “escape window”. The ratio for the modified dredge net in reducing the by-catch was found as %50.6 by number and %56.9 by weight.

In the Marmara Sea, a total of 219 licensed fishing vessels are involved in fishing deep-water shrimp. Most of fishing vessels consist of 12m (7-32) length group. 27.7% (54 vessels) of licensed fishing vessels used beach seines, 18.3% (40 vessels) dredge nets, and remaining 54% (125 vessels) deep trawl. Maximum fishing depth was 230m. Fishing was done during day time. Total catch amount of shrimp by a fleet during a catch period was estimated to be 6219.6 tons. The same fleet was estimated to have 7012.4 tons of by-catch from different taxonomic groups.

Most fishermen (approximately 80%) in shrimp fishing have small and medium size vessels of 15m or below in length. 42.9% of vessels are below 10m, 46% between 10-15m and 11.1% above 15m. Average annual income of these vessels in 2003 was realized as 9.169.080.000 TL, 11.799.200.000 TL and 21.035.520.000 TL, respectively. Cost of total fuel for smaller vessels during the season (114 days) was 3.304.860.000 TL, while it was 5.176.080.000 TL and 8.792.550.000 TL for the other groups. Cost of 1 kg shrimps for three groups of vessels was calculated as 2.496.000 TL, 2.681.172 TL and 2.672.465 TL., respectively. Considering average sale prices, there is no tangible damages in shrimp fishing. From the perspective of fisheries economy, according to the analysis of product/ business cost made for a vessel from the fleet in the Marmara Sea, Gross Production Value for small, medium and big vessels was calculated as 10.537.080.000, 13.941.200.000 and 24.542.520.000 TL/vessel/season, respectively. Gross profit was determined as 3.538.397.000, 4.717.970.000 and 9.902,756,000 TL/vessel/season, respectively. According to the data of 2003, there are 26 fisheries cooperatives established in the coastal regions of the Marmara Sea with high fisheries potential. Provinces of Istanbul and Çanakkale have 5 cooperatives each. All other provinces have 4 active cooperatives each. Total number of these cooperatives was calculated as 2073, 1869 (90.2%) of which are professional and 204 (9.8%) of which are amateur.