Investigation the selectivity of gillnet used in Roach (*Rutilus rutilus* L., 1758) fishery in Uluabat Lake, Bursa-Turkey

Hanol Z.[1*]; Cilbiz M.[1]; Çinar Ş.[1]; Korkut S.O.[1]; Yener O.[1]

Received: August 2014 Accepted: December 2014

Abstract

The purpose of this study was determine the selectivity properties of gillnet used in Roach (*Rutilus rutilus*) fishery in the Lake Uluabat. In the fishery works, 7 different gill net which were 100 meters in length and 32, 40,50, 60,70,80 and 90 mmmesh size with a same thickness and depth of 50 mesh as vertically have been used. Field work was carried out monthly in a period of January 2011 and December 2011. Length and weights of 434 samples were determined with 1mm and 1g precision measurement board and scale. SELECT method was used in the determination of the selectivity parameters. Obtained data were analyzed by PASGEAR II v 2.5 computer software. The program calculates parameters of 5 different model (Normal location, normal scale, log-normal, gamma and bi-modal) based on SELECT method. Normal scale yielded the best as a result of analysis. According to the this model optimum catch lengths and spread value of nets which have 32, 40, 50, 60, 70 and80 mm mesh size determined as 12.16-1.24; 15.20-1.56; 19.00-1.95; 22.80-2.34; 26.60-2.73; 30.40-3.12 respectively. According to the Kolmogorov-Smirnov test results differences were determined between size frequency distribution of fish caught by all nets.

Keywords: Selectivity, Roach, *Rutilus rutilus*, SELECT method, Uluabat Lake.

1-Fisheries research station Eğirdir- ISPARTA /TURKEY

*Corresponding author's email: zubeydehanol17@gmail.com

[DOI: 10.18331/SFS2015.1.2.2]

Introduction

Roach fish is 3rd in total biomass at relative density after *Blicca bjoerkna* (L., 1758) and *Carassius gibelio* (Bloch, 1782) which reported for Uluabat lake (Çınar et al., 2013). There is no current data due to the amount of production was determined in the other fish groups by Turkish Statistical Organisation. But the amount of production was determined as 61 tons by Anonim 2008. The economic value of roach fish lower than *Esox lucius* (L, 1758) and *Cyprinus carpio* (L, 1758). Therefore this fish are not main objective for fishermen. It is an economic alternative for low income people in the region and also alternative species for fishermen. There is no any legal size regulation for roach fish in Turkey. However gil nets which used in catching of this fish creates a catching pressure on the other species, it is extremely important knowing selectivity properties of net in terms of fisheries management. İn this study; the selectivity properties of gill nets which made of monofilament material and with of 32, 40, 50, 60, 70, 80 and 90 mm mesh size were determined for catching of roach fish in uluabat lake.

Materials and Methods

The Uluabat lake that located in Marmara region connected with Marmara sea through uluabat stream. The total surface area of lake is 116 km^2 and the depth of 2-3m also the sea level height is 8-10m (Aksoy, 2002; Çınar *et al*., 2013). The study was carried out a total of 12 catching operation in a monthly period of January-2011and December-2011 in a two different station (Fig. 1) of Uluabat lake. In catching trials 7 different gill nets which have 32, 40, 50, 60, 70, 80 and 90 mm mesh size andmade of monofilament material with a 50 vertical eye number, 0,18 mm rope thickness (Ø), 0,50 hanging ratio were used. The catching was made with renegade method by adding to nets together (setting nets at sunset and gathering early morning). In this way, it was provided to catching of nets in the same time and field. The sizes of caught samples was determined with 1mm precision measurement board and weights of 1g precision digital scales.

[DOI: 10.18331/SFS2015.1.2.2]

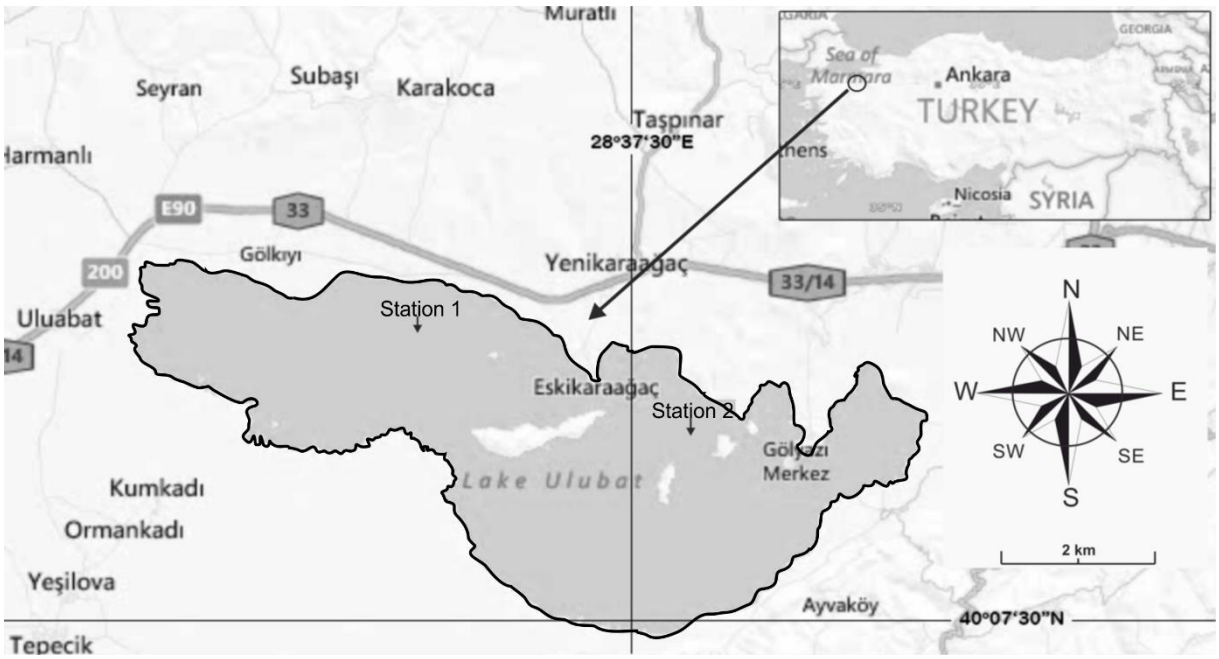

Figure 1: Study area and sampling locations

SELECT (*Share Each Lengthclass Catch Total*) method was used for determining selectivity(Millar, 1992; Millar and Fryer, 1999; Millar and Holst, 1997).

With this method, the expected catch rates and observed catch rates were determined by maximum likelihood Distribution and this is considered to be Poisson Distribution (Feller, 1968). The SELECT method which obtained from fishery trials and different sizes of fishing gear is expressed as $n_{lj} \approx Pois(p_i(l)\ \lambda_l\ r_j$ (1) n_{lj}'s log-log-likelihood distribution (l) as $\Sigma_l\ \Sigma_j\ \{n_l\ log_e\ [p_j\ \lambda_l\ r_j\ (l)]- p_j\ \lambda_l\ r_j\ (l)\}$ (2) the n_{lj} j:determine the number of (*l*) size fish which caught to net and Poisson distribution pj (*l*)λl rj (l):nl ≈ Pois (p_j (*l*) λ_l r_j (*l*)). λ_l: relative abundance of (*l*) size fish caught to net group, p_j (*l*): relative fishery abundance (jrelative abundance of *l*size fish which could caught by mesh). Poisson distribution of *l*size fish number which will caught to j mesh determined as p_j (*l*) $\lambda_{l.}$ r_j (*l*) distribution is also selectivity curve for j mesh (Akamca *et al*., 2010).

PASGEAR version 2.4 computer program (Kolding, 1999) was used for determining the selectivity parameters. The program calculates parameters of 5 different model (Normal location, normal scale, log-normal, gamma and bi-modal) based on SELECT method (Acarlı *et al*., 2013). The equations that used in the select model are shown below.

[DOI: 10.18331/SFS2015.1.2.2]

$$\exp\left(-\frac{\left(L-k.m_j\right)^2}{2\sigma^2}\right) \quad (3)$$

Normal Scale ;

$$\exp\left(-\frac{\left(L-k_1.m_j\right)^2}{2k_2^2.m_j^2}\right) \quad (4)$$

Log-Normal ;

$$\frac{1}{L}\exp\left(\mu+\log\left(\frac{m_j}{m_1}\right)-\frac{\sigma^2}{2}-\frac{\left(\log(L)-\mu-\log\left(\frac{m_j}{m_1}\right)\right)^2}{2\sigma^2}\right) \quad (5)$$

Gamma ;

$$\left(\frac{L}{(\alpha-1).k.m_j}\right)^{\alpha-1}\exp\left(\alpha-1-\frac{L}{k.m_j}\right) \quad (6)$$

Bi-modal ;

$$\exp\left(-\frac{\left(L-k_1.m_j\right)^2}{2k_2^2.m_j^2}\right)+c.\exp\left(-\frac{\left(L-k_3.m_j\right)^2}{2k_4^2.m_j^2}\right) \quad (7)$$

When selecting the most apropriate model from the calculations, Standard deviations of all models evaluated and the most apropriate model was chosen by considering the lowest deviation value (Acarlı *et al*., 2013).

In general, the standard deviation of applied model shouldn't greater than degrees freedom of model (Park *et al*., 2004; Akamca *et al*., 2010).

Kolmogorov-Smirnov test was used for determination of size frequence distribution of fish which caught by different mesh size (Siegel and Castellan, 1988; Karakulak and Erk., 2008).

Results

As a result of 12 catching operation a total of 434 fish the sizes ranged from 10.8 to 26.2 were caught. While the most efficient net was 60mm mesh size with 33.2%; 90 mm mesh size was the most inefficient. The average size (±SD) of fish caught by 32, 40, 50, 60, 70, 80 and 90 mm mesh size was determined as 12.86±0.85, 15.99±0.91, 18.24±1.76, 20.93±1.33, 21.46±1.8, 22.37±1.61 respectively (Table 1). Size frequency distributions of trial nets are shown in Fig. 1.

[DOI: 10.18331/SFS2015.1.2.2]

Table 1: The average sizes and fish number caught from trial nets

Mesh size	Number of fish (N)	Relative distribution of cath (%)	Average size±SD (cm)	Minimum size (cm)	Maximum Boy (cm)
32	107	24.70	12.86±0.85	10.80	15.10
40	93	21.40	15.99±0.91	14.50	17.90
50	57	13.10	18.24±1.76	14.50	23.00
60	144	33.20	20.93±1.33	18.10	24.50
70	30	6.90	21.46±1.8	18.40	26.20
80	3	0.70	22.37±1.61	21.20	24.20

The parameters which belong tothe normal location, normal scale, log-normal, gamma and bi-modal models were calculated with PASGEAR computer program separately and the results are shown in Table 2. From the results of model comparision it was determined that the best model was normal scale.

Table 2: Selectivity parameters and the best model

Model	Parameters	Model Deviance	p-value	Degrees of freedom (d.f.)
Normal location	(k, σ)=(0.363, 2.008)	256.315	0.000000	31
Normal scale*	(k1, k2)=(0.380, 0.039)	227.463	0.000000	31
Log normal	(μ_1, σ)=(2.497, 0.109)	230.164	0.000000	31
Gamma	(k, α)=(0.004, 89.025)	228.255	0.000000	31
Bi-modal	Uygun değil	-	-	-

*Apropriate model parameters

While selectivity curve drafted according to the parameters are given in Fig. 3; optimum size and distribution values that calculated according to normal scale mode for each different mesh size net in Table 3.

[DOI: 10.18331/SFS2015.1.2.2]

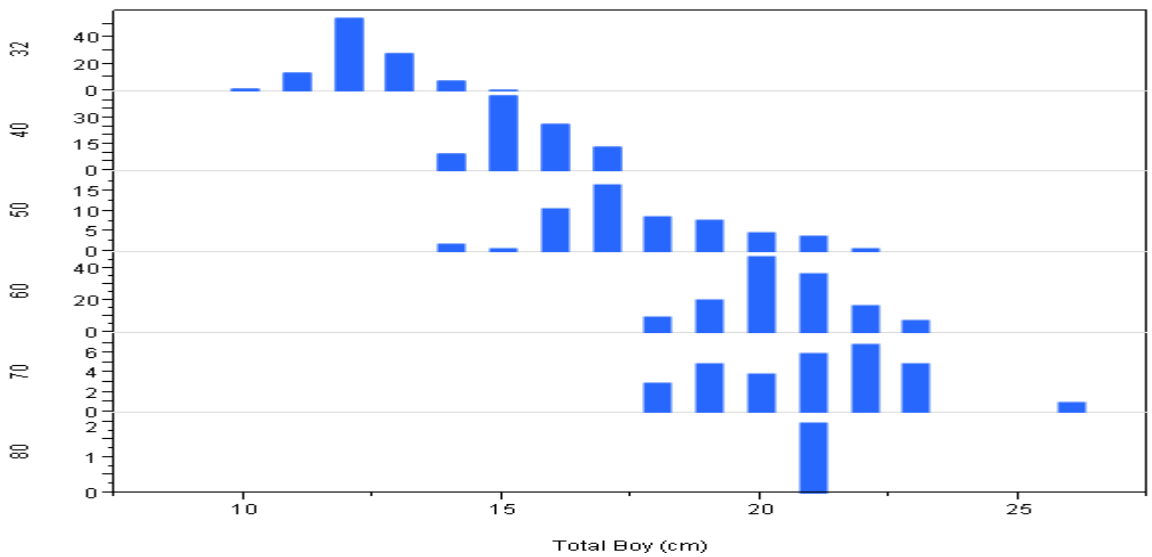

Figure 2: Size frequence distribution of fish caught by different mesh sizes net

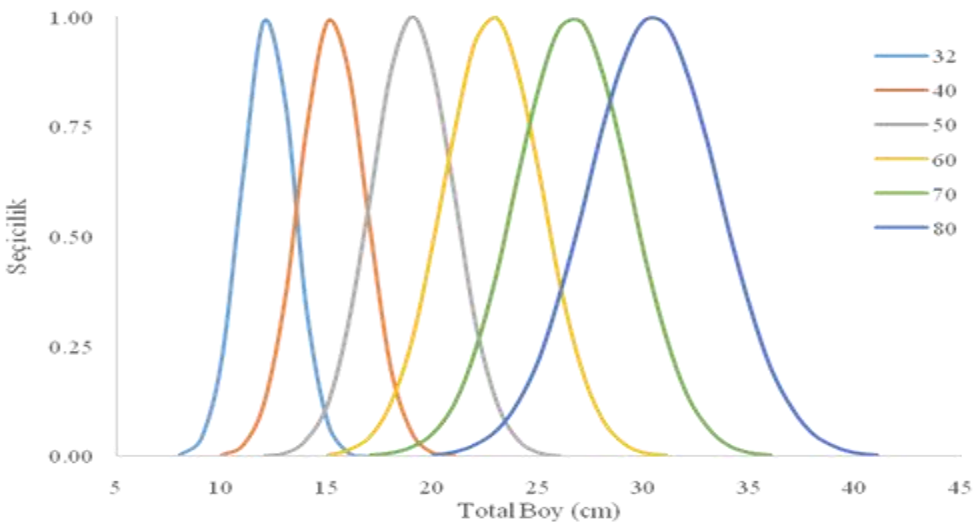

Figure 3: Selectivity curves of monofilament gill nets for *R. rutilus*

Table 4: Optimum size and distribution values for *R. rutilus* according to Normal scale

Mesh size	Optimum size (cm)	Distribution values(cm)
32mm	12.16	1.24
40 mm	15.20	1.56
50 mm	19.00	1.95
60 mm	22.80	2.34
70 mm	26.60	2.73
80 mm	30.40	3.12

[DOI: 10.18331/SFS2015.1.2.2]

It was determined that there are difference between size frequence of fish caught by al nets based on the results of Kolmogorav-Smirnov test (Table 5).

Table 5: Comparision of size frequence of fish caught by al different mesh sizes withKolmogorov-Smirnov test.

Net 1		Net 2		Kolmogorov-Smirnov Test		
Mesh size	**N**	**Mesh size**	**N**	**D max**	**Critical Values (α=0.05)**	**Determination**
32	107	40	93	0,9167	0,1897	H_oRed
32	107	50	57	0,9585	0,2167	H_oRed
32	107	60	144	1,0000	0,1729	H_oRed
32	107	70	30	1,0000	0,2645	H_oRed
32	107	80	3	1,0000	0,5704	H_oRed
40	93	50	57	0,6253	0,2225	H_oRed
40	93	60	144	1,0000	0,1801	H_oRed
40	93	70	30	1,0000	0,2693	H_oRed
40	93	80	3	1,0000	0,5727	H_oRed
50	57	60	144	0,6207	0,2113	H_oRed
50	57	70	30	0,6039	0,2911	H_oRed
50	57	80	3	0,9138	0,5832	H_oRed
60	144	70	30	0,3084	0,2568	H_oRed
60	144	80	3	0,6667	0,5669	H_oRed
70	30	80	3	0,6667	0,6066	H_oRed

H_o: There are no difference between length frequence distribution.

Discusion

The size range of caught fish determined as between10.8 and 26.2. it is thought the reason of this is to be lack of maximum size of fish. Examining the Table 1 it is seen the increasing of mesh size decreased the efficiency. Ergüden et al., (2008), reported that the minimum fork size of roach fish as 13.5cm and the maximum fork size as 24.0.

The most efficient net in catching was 60 mm mesh sizes net with 33.20% of total catch (Table 1). Balık and Çubuk 2001 who were investigated the catch efficient of gill netswhich have 18, 20, 22, 26, 30 ve 36 mm mesh sizes reported that CPUE values of trial nets for roach fish catching as 48.9, 64.9, 93.4, 67.7, 34.7, 2.6 g/m respectively. In this study,the efficiency decreased the mesh size increased. It was reported that the most efficient net was 22 mm mesh size.

According to our study, the reason of why the the most efficient net is smaler one is thought to as difference in the size distribution of fish dependendingon sampling period. It is thought the fish showed a good reproductive performance and increase in the number of juvenile as a

[DOI: 10.18331/SFS2015.1.2.2]

result of the lack of catching pressure on the fishin the 2000s.

İt is possible decreasing both breeding and feeding performance of *R.rutilus* due to the increasing catching pressure and introducing invasive species in the lake.In supportof this idea while Balık and Çubuk., (2001) reported that the most caught fish as roach with18, 20, 22 ve 26 mm mesh size net; Çınar et al., (2013) reported that this species in 3rd in total biomass after *B.bjoerkna* and *C.gibelio*.

It was determined that the most apropriate model was Normal Scale in the calculated selectivity parameters (Table 2). Similarly, Carol and Berthou (2007) reported that the most suitable model for *R.rutilus*as normal scale and determined the model sizes as 122.8, 161.0, 216.0, 271.1, 357.9 ve 430.0 for 29, 38, 51, 64, 84.5 ve 101.5 mm mesh sizes in the studies that carried for determine the gill net selectivity of fish which live in freshwater of Catalonia (Northeastern Spain) with SELECT method. As well as the mesh sizes of the nets different, the findings are consistent with ours. The roach fish which is an important economic value have distribution in freshwater of Europe, Black sea and Azov sea and in Turkey (Geldiay and Balık, 1996; Vasileva, 2003; Kuru, 2004; Özuluğ *et al*., 2005; Ergüden *et al*., 2008; Çınar *et al*., 2013).

Toensure the sustainabilitystock of this fish, catching is must beabove the 15.6 cm that reported by Stoessel (2013) as first breeding size. For this size, the nets below the 50mm mesh size shouldn't be use in the catching of roach fish in Uluabat lake.

References

Acarlı, D., Ayaz, A, Özekinci, U. and Aztecan, A., 2013. Gillnet Selectivity for Bluefish (*Pomatamus saltatrix,* L. 1766) in Çanakkale Strait, Turkey. *Turkish Journal of Fisheries and Aquatic Sciences*, 13, 349-353.

Akamca, E., Kiyağa, V.B. and veÖzyurt, C.E., 2010. İskenderun Körfezi'n de Çipura (*Sparus aurata*, Linneaus, 1758) Avcılığında Kullanılan Monofilament Fanyalı Uzatma Ağlarının Seçiciliği. *Journal of Fisheries Sciences.com*, 4(*1*), 28-37.(in Turkish).

Aksoy, E., 2002. Uluabat Gölüne Uzaktan Algılama ve Coğrafik Bilgi Sistem Teknikleri ile Bir Bakış. *Uludağ Üniversitesi Dergisi*, 2(**6**), 49-52.

Anonim, 2008. Uluabat (Apolyont) ve İznik Göllerindeki Kerevit ve Ekonomik Balık Stoklarının Tespiti ve Sürdürebilirliklerinin Araştırılması Projesi Sonuç Raporu. Tarım ve Köyişleri Bakanlığı Eğirdir Su Ürünleri Araştırma Enstitüsü Müdürlüğü, Isparta.

Balık, İ. and ve Çubuk, H., 2001. Uluabat Gölü'ndeki Bazı Balık Türlerinin Avcılığında Galsama Ağlarının Av Verimleri. *Ege Üniversitesi Su Ürünleri Dergisi*, 18, 3-4.

Carol, J. and Berthou-Garcia, E. 2007. Gillnet selectivity and its relationship

[DOI: 10.18331/SFS2015.1.2.2]

with body shape for eight freshwater fish species. *Journal of Applied Ichthyology*. 23, 654–660.

Çınar, Ş., Küçükkara, R., Balık, İ., Çubuk, H., Ceylan, M., Erol, K.G., Yeğen, V. and Bulut, C., 2013. Uluabat (Apolyont) Gölü'ndeki Balık Faunasının Tespiti, Tür Kompozisyonu Ve Ticari Avcılığın Türlere Göre Dağılımı. *Journal of Fisheries Sciences*, 4, 309-316.

Geldiay, R. and Balık, S., 1999. Freshwater fishes in Turkey. Ege Üniversitesi Su Ürünleri Fakültesi Yayınları, No: 46, Ders Kitabı Dizini No: 16, III. Baskı, 532, Bornova, İzmir.

Ergüden (Alagöz), S., Ergüden, D. and Göksu, M.Z.L., 2008. Seyhan Baraj Gölü'ndeki (Adana) Kızılgöz (*Rutilus rutilus* L., 1758)'ün Büyüme Özellikleri. *Journal of Fisheries Sciences*, 2(**1**), 77-87.

Feller, W., 1968. An introduction to probability theory and its aplication, volume: 1, 3rd ed. John Wiley and Sons, New York.

Karakulak, S.F and Erk, H., 2008. Gill net and trammel net selectivity in the northern Aegean Sea, Turkey. *Scientia Marina*, 72(**3**), 527-540.

Kolding, J., 1999. PASGEAR. A Data Base Package for Experimental or Artisanal Fishery Data from Passive Gears. University of Bergen. Dept. of Fisheries and Marine Biology: Bergen. Norway. 56P.

Kuru, M., 2004. Recent systematic status ofInland water fishes of Turkey, G.Ü, *Gazi Eğitim Fakültesi Dergisi*, 24(**3**), 1-24.

Millar, R.B., 1992. Estimating the Size-Selectivity of Fishing Gear by Conditioning on the Total Catch. *Journal of the American Statistical Association*, 87, 962-968.

Millar, R.B. and Fryer, R.J., 1999. Estimating the size-selection curves of towed gears. Traps. Nets and hooks. *Reviews in Fish Biology & Fisheries*, 9, 89-116.

Millar, R.B. and Holst, R., 1997. Estimation of gillnet and hook selectivity using log-linear models. *ICES Journal of Marine Science*, 54, 471-477.

Özuluğ, M., Altun, Ö. and Meriç, N., 2005. Onthe fish fauna of lake İznik (Turkey),*Turkish Journal of Zoology*, 29, 371-375.

Park, C.D., Jeong, E.C., Shin, J.K. and H.C.Fujimori, Y., 2004. Mesh selectivity ofencircling gill net for gizzard shad *Konosirus punctatus* in the coastal sea of Korea, *Fisheries Science*, 70, 553-560.

Siegel, J. and Castellan, N.S., 1988. Non parametric statistics for the behavioral sciences. Statistics Series, 2nd Edition, McGraw Hill, New York

Stoessel, D,J., 2013. Age, growth, condition and breeding of roach *Rutilus*

[DOI: 10.18331/SFS2015.1.2.2]

rutilus (Teleostei :Cyprinidae), in south-eastern Australia. *Marine and Freshwater Research*, 65(**3**), 275-281

Vasileva, E.D., 2003. Main alterations in ichthyo fauna of the largest rivers of thenorthern coast of the Black Sea in the last50 years: A review, *Folia Zoologica*, 52(**4**), 337-358.

[DOI: 10.18331/SFS2015.1.2.2]