

Annual fishable stock quantity respects to commercial fish species in Çaltıcak (Taşkısığı) Lake (Sakarya, Türkiye)

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Abstract

It was aimed to estimate the fish stocks of Çaltıcak (Taşkısığı) Lake in Sakarya province of Türkiye and determined the annual catchability of eight commercial fish species (*Bilicca bjoerkna*, *Scardinus erythrophthalmus*, *Carassius gibelio*, *Esox lucius*, *Silurus glanis*, *Perca fuliviatilis*, *Tinca tinca* and *Abramis brama*) stock quantities were calculated. The average total weight of fish caught in all fishing periods (2021 December and 2022 January, February, March) was 24.919.65 kg. The estimated total catchable stock amounts per unit area and annually are highest in *B. bjoerkna* (42.345.55 kg ha⁻¹; 3.811.10 tons year⁻¹, respectively) and lowest in *P. fuliviatilis* (1.053.85 kg ha⁻¹; 94.85 tons year⁻¹ respectively) was detected in the fish species. Although the difference between fish species in terms of total biomass was significant, it was determined that the difference between *P. fuliviatilis* and *B. bjoerkna* was greater (p<0.05).

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Çaltıcak (Taşkısığı) Gölü (Sakarya, Türkiye) ekonomik balık türlerine göre yıllık avlanabilir stok miktarı

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Öz

Türkiye, Sakarya ili Çaltıcak (Taşkısığı) Gölü'nün balık stoklarının tahmin edilmesi amaçlandı ve tespit edilen sekiz ticari balık türünün (*Bilicca bjoerkna*, *Scardinus erythrophthalmus*, *Carassius gibelio*, *Esox lucius*, *Silurus glanis*, *Perca fuliviatilis*, *Tinca tinca* ve *Abramis brama*) yıllık avlanabilir stok miktarları hesaplandı. Tüm avlanma dönemlerinde (2021 Aralık ve 2022 Ocak, Şubat, Mart) yakalanan balıkların ortalama toplam ağırlığı 24.919.65 kg bulunmuştur. Yıllık avlanabilir stok tahmini ise 10.439,26 ton yıl⁻¹ olarak gerçekleşmiştir. Birim alan başına ve yıllık tahmini avlanabilir toplam stok miktarları en yüksek *B. bjoerkna* (42.345,55 kg ha⁻¹; 3.811,10 ton yıl⁻¹, sırasıyla), en düşük ise *P. fuliviatilis* (sırasıyla 1.053,85 kg ha⁻¹; 94,85 ton yıl⁻¹, sırasıyla) balık türlerinde tespit edilmiştir. Toplam biyokütle açısından balık türleri arasındaki fark anlamlı olmasına rağmen Çaltıcak sekiz balık türünde toplam avlanabilir stok miktarları arasında farklılık olmasına rağmen, *P. fuliviatilis* ve *B. bjoerkna* arasındaki farklılığın daha fazla olduğu tespit edilmiştir (p<0.05).

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Introduction

Small-scale fishing contributes a high percentage to global fisheries and forms the livelihood of millions of people. However, for many years, some fish stocks have tended to decline due to overfishing (Froese, 2004; Winker, et al., 2011; Hicks and McClanahan, 2012), Fish population management seem to be essential for the continuation of fishing activities and their benefits to society. Knowledge of the fish ecology and life history of fish stocks is crucial for fisheries management. Stock assessment includes the study of population dynamics controlled by growth, recruitment, natural mortality, and fishing mortality (King, 1995). Losses from natural mortality and fishing outweigh gains from spawning, reproduction and individual growth, and fish stocks are declining. In order to sustain fisheries, the stock must be balanced with increases in biomass production (Tesfaye and Wolff, 2015). In order to implement a fishing plan in a region, a stock determination study must first be carried out (Hart, 1998). To grasp how species respond to ecosystem manipulation or disturbances, to evaluate the economic consequences of shifts in population sizes over time, and to conduct thorough analyses of population viability and Maximum Sustainable Yield (MSY), it is crucial to delve into the population dynamics of the relevant stocks (Tesfaye and Wolff, 2015).

Taşkısığ1 (Çaltıcak) Lake located within the borders of Adapazarı district of Sakarya province (40° 50' 25" N, 30° 27' 59" E). The Lake waters, which has a surface area of 90 hectares, are fresh. The distance to the center is 15 km and the altitude is 15 meters. The lake is fed from bottom sources. Taşkısığ1 neighborhoods are located in the south of the lake, and Çaltıcak neighborhoods are located in the north. For this reason, it is known by the names of both villages. Enkapower Adapazarı-Gebze Combined Cycle Power Plants are located by the lake The waters of the lake change noticeably during the spring. It is important for the immediate environment in terms of nature tourism, picnics and amateur fishing. Tench, pike, freshwater perch, catfish, woodcarp, mirror carp, silver crucian carp, rudd, burbot, carp and crayfish are caught from the lake. Similar fishing activities, such as in Çaltıcak Pond, affect fish stocks. FAO (2003) emphasized that fishing activities address the economic, social and biological factors that affect fish stocks by adopting a strategy that meets the nutritional needs of communities without destroying fish stocks. In addressing this issue, an estimated assessment of fish species biomass/stocks forms the cornerstone for research and management studies (Zargar et al., 2012). In addition, fishing pressure can cause irreversible damage in the future without knowing the amount of fish in reservoirs. Therefore, determining the current fish population in the reservoirs, the optimum amount of catchable fish, the sustainability of the population and the amount of catchable stock is important in terms of increasing the country's fisheries (Özvarol and İkiz, 2008). Thus, it is aimed to determine the stock assesment different 8 fish species (*Bilicca bjoerkna*, *Scardinius erythrophthalmus* and *Carassius gibelio*, *Esox lucius*, *Silurus glanis*, *Perca fuliviatilis*, *Tinca tinca* and *Abramis brama*) for Çaltıcak Lake fishing area, taking into account the time of the fish to reach sexual maturity as a result of retrospective fisheries studies due to the newness of the Pond. This study involved stock assessment efforts in Çaltıcak Lake, aiming to determine the stock quantities of fish populations in the lake and to identify the necessary fishing techniques and conditions required to ensure the protection of these stocks .

Material and Method

Sampling area

Çaltıcak Lake spreads over an area of 90 hectares within the borders of Sakarya province in western Türkiye. Its maximum depth is 5-6 m. The northern shores of the lake, whose southern part is deeper,

are reeds and swamps. It expands in winter and contracts in summer. Çaltıcak Lake is a pond where commercial fishing activities are intensely carried out.

Sample collection

In this study, 8 fish species (*Bilicca bjoerkna*, *Scardinius erythrophthalmus* and *Carassius gibelio*, *Esox lucius*, *Silurus glanis*, *Perca fulviatilis*, *Tinca tinca* and *Abramis brama* from) were obtained from commercial fishermen in Çaltıcak Lake. A total of 11 hunting operations were carried out with plain (galsama) gillnets with 32-40-50-60 and 80 mm mesh size. Samplings were done at cathing intervals (2021 December, 2022 January, February and March) in selected localities within the lake to represent the entire lake. The gillnets used in the sampling studies were used completely in the entire lake area.

In the study, a total of five sets of gillnets, each consisting of a single piece, equipped with fishing line (multifilament) material, were used. The gill nets used during the sampling operations were made of polyamide material with a diameter of 0.20 and 0.23 mm.

The total length of one size net used in the study (equipped length) is approximately 82 m, and the total length of the nets used is approximately 400 m.

Following the sampling operations in the study area, the fish samples taken from the gill nets with five different mesh sizes (32, 40, 50, 60 and 80 mm) were grouped and counted separately according to each mesh size, the numbers of the species coming out of each net were recorded and necessary measurements were taken.

The biometrics of the fish coming out of the nets were made separately according to the meshes. The total lengths of the caught fish samples were measured with a millimetric measuring board, and their weights were weighed with a balance with an accuracy of 0.1 g.

Catchable Stock Estimation

For catchable stock estimation, gillnets with different mesh sizes (32, 40, 50, 60, 80 mm) were used in the annual stock estimation study of different fish species in the Çaltıcak Lake area. Biometrics of the fish coming from the gillnets were made separately according to the nets and the total annual stock estimate was given (Avsar, 2001). The total length of the caught fish samples was measured with a millimetric measuring board and their weight was weighed on a scale with an accuracy of 0.1 g. Firstly, the surface area of the surface area of gillnets (ha) is first calculated.

$$(1) \quad a_i = (E_i * B_i)$$

a_i : Surface area of gillnet i (ha)

E_i : Width of gillnet i (hm)

B_i : Length of gillnet i (hm)

It is assumed that all the fish in the region equal to the total area (a_{ai}) of the gillnets used in fishing are caught. This region was calculated using the equation 2.

$$(2) \quad a_{ai} = \sum_{i=1}^n a_i$$

$$(3) \quad U_i = a_{pi}/a_{ai} \text{ kg/ha}$$

U_i : Amount of product/fish for the unit area

a_{pi} : Average amount of product/fish caught in sub-region I

a_{ai} : Area where all fish are caught

$$(4) \quad B_i = U_i * A_i$$

B_i : Biomass of sub region i (ton)

A_i : Total area of sub region i (ha)

Statistical analysis

The Relationships among the variables were determined using regression analysis (Spearman Rank Correlation). Statistical differences in the stocks' value among species were tested using one-way analysis of variance (ANOVA, $p < 0.05$) by STATISTICA 12 software.

Results and Discussion

The need for food is increasing due to population growth in the world. Therefore, the early years of humanity, people have been fishing to meet their nutritional needs (Timur, 1990). The increase in fishing causes problems such as pollution of water areas, unconscious fishing and damage to fish stocks. Controlled and conscious fishing is essential for the protection and continuity of the income obtained from fish and the fish population (Fasham, 1978; Laevastu and Larkins, 1981; Kocataş, 2004). Sustainability is achieved by replacing individuals that have diminished due to hunting and natural causes with offspring, as long as there is food and a suitable living environment. However, sustainability is damaged due to reasons such as increased pollution and activities that exceeds the catchable stock amount. As a result, the age and size of catchable individuals decrease and the amount of catchable stock decreases (Erdem, 1996). It is important to determine the amount of fish population in the reservoirs, to determine the optimum amount of catchable fish, to ensure the sustainability of the population, and to determine the amount of catchable stock to increase the country's fisheries. As we know, fishing pressure without knowing the amount of fish in reservoirs causes irreversible damage in the future (Özvarol and İkiz, 2008). Therefore, this study was conducted to determine the annual estimated catchable stock amount of 8 fish species (*Bilicca bjoerkna*, *Scardinius erythrophthalmus* and *Carassius gibelio*, *Esox lucius*, *Silurus glanis*, *Perca fuliviatilis*, *Tinca tinca* and *Abramis brama*) caught from Çaltıcak Lake in December 2021, January, February and March 2022. The total areas of the nets used in hunting are given in Table 1, and the amounts and total biomass values of all the fish species caught per unit effort and obtained from the unit area are given in Table 2.

Table 1. Total area used gillnets

Gillnet mesh size (mm)	Surface area of all the gillnets (ha)	Gillnet Lenght (m)	Number of mesh per Gillnet Depth	Gillnet Depths (mm)	Surface area of gillnets (ha)
32		82	50	32	0.0262
40		82	50	40	0.0328
50	0.21484	82	50	50	0.0410
60		82	50	60	0.0492
80		82	50	80	0.0656

Table 2. Catchable stock amounts for Çaltıcak Lake fish species

Fish Species	Total surface area of gillnets (ha)	Total number of the fish species	Number of operations	Weight of total fish (kg)	Weight of Average fish (kg)	Quantity of stock the unit area (kg.ha ⁻¹)	Total stock quantity (tons.year ⁻¹)
<i>B. bjoerkna</i>		708	11	10.0072.70	9.097.52	42.345.55	3.811.10
<i>S. erythrophthalmus</i>		159	11	22.902.70	2.082.06	9.691.23	872.21
<i>C. gibelio</i>	0.21484	64	11	44.176.60	4.016.05	18.693.23	1.682.39
<i>E. lucius</i>		39	11	40.280.80	3.661.89	17.044.75	1.534.03
<i>S. glanis</i>		35	11	45.459.90	4132.72	19.236.26	1.731.26
<i>P. fulviatilis</i>		18	11	2.490.50	226.41	1.053.85	94.85
<i>T. tinca</i>		15	11	9.075.60	825.05	3.840.32	345.63
<i>A.brama</i>		19	11	9.657.50	877.95	4.086.55	367.79
TOTAL				274116.3	24919.65	115991.74	10439.26

The quantities of the species *B. bjoerkna*, *C. gibelio*, *E. lucius*, *S. glanis*, *P. fuliviatilis*, *T. tinca* and *A. brama* caught using gill nets from the lake were calculated as follows: 100.072.70 kg; 22.902.70 kg; 44.176.60 kg; 40.280.80 kg; 45,459.90 kg; 2,490.50 kg; 9,075.60 kg; and 9,657.50 kg, respectively. A total of 274,116.30 kg of fish were identified and the average total weight of fish caught at all fishing trials was 24,919.65 kg. Stock quantity was found 115,991.74 kg.ha⁻¹ and annual caught stock amount was 10,439.26 tons year⁻¹ for Çaltıcak Lake.

The total stock per unit area and the annual estimated fishable stock quantities are highest in *B. bjoerkna* (42.345.55 kg ha⁻¹; 3.811.10 tons year⁻¹) and *S. glanis* (19.236.26kg ha⁻¹; 1.731.26 tons year⁻¹, respectively). The lowest total stock per unit area and annual fishable stock quantities were also determined in *P. fuliviatilis* (1053.85 kg ha⁻¹; 94.85 tons year⁻¹) and *T. tinca* (3.840.32 kg ha⁻¹; 345.63 tons year⁻¹, respectively). Annual fishable stock quantities of *E. lucius*, *C. gibelio* and *S. glanis* were close to each other (1534.03; 1682.39; 1731.26 tons year⁻¹, respectively).

The monthly estimated fishable stock quantities were the highest on December (485.25 tons month⁻¹), March (282.78 tons month⁻¹), February (270.61 tons month⁻¹) and January (266.30 tons month⁻¹). The difference between the estimated fishable stock quantity was statistically insignificant in total biomass for the months ($p>0.05$). However the difference between the fish species was statistically significant was important. The most statistically significant was between *P. fuliviatilis* and *B. bjoerkna* ($p=0.006$), followed by *B. bjoerkna* and *T. tinca* ($p=0.01$), *B. bjoerkna* and *A. brama* ($p=0.01$) and partially *B. bjoerkna* and *S. erythrophthalmus* ($p=0.044$) in Çaltıcak (Taşkısığı) Lake ($p<0.05$).

Conclusions

In inland water fisheries management, accurately estimating fish stocks relies heavily on comparing the amounts of fish caught, as this approach yields more reliable results. Therefore, it is advisable to conduct these studies at regular intervals (Yüksel and Celayir, 2010). Such periodic assessments provide decision-makers with scientific and sustainable information about the current and future status of fish stocks. These evaluations also establish a technical foundation for setting annual fisheries harvest levels through quotas, catch limits, and other management measures (Fisheries, 2012). Additionally, fish stock forecasting studies are valuable for researchers to understand and monitor changes in fish populations (Beri et al., 2023). This preliminary study of fish stocks in Çaltıcak Lake aims to provide a useful reference for future research on these topics, helping to better understand the fish stocks and their fluctuations in this lake.

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