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RESEARCH ARTICLE **e-ISSN 2651-5326** **ARAŞTIRMA MAKALESİ**

The Effect of the Live Bait Type and Hook Size on the Catch Per Unit Effort and Catch Composition of Seabass, *Dicentrarchus labrax* (L., 1758) in Longline Fisheries

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Abstract: The main objective of the study, was to determine the effect of the live bait type and hook size on the catch per effort and catch composition of seabass, *Dicentrarchus labrax* (Linnaeus, 1758) in longline fisheries. Live Mediterranean sand eel, blotched picarel and flathead grey mullet were used as baits together with 3/0, 4/0 and 5/0 J type fishing hooks. This study was carried out between March 2020 and April 2021 in the Çanakkale Strait, Turkey. The main body line thickness was 0.70 mm and snoods having a line thickness of 0.50 mm and length of 2 m were tied at 6 m intervals. The fishing time covered the period from sunset to early hours of the sun rise. In all trials, a total of 263 seabass were caught which consisted 84% of total catch followed by 42 individuals of European conger *Conger conger*, a non-target species, corresponding to a catch rate of 13.3%. A total of 314 fish were caught by longlines and the catch yields with respect to hook size were 149 fish with 3/0 hook, 91 fish with 4/0 hook and 74 fish with 5/0 hook. The highest and lowest numbers of non-target fish species were caught with hook size 3/0 and 5/0, respectively. Hook sizes smaller than 3/0 should not be used in seabass longline fishing to prevent excessive catch of smaller fish. Blotched picarel, *Spicara maena* proved to be a superior live bait than flathead grey mullet, *Mugil cephalus* and the Mediterranean sand eel *Gymnammodytes cicerelus*.

Keywords: Longline, Seabass, Çanakkale, Catch Composition, Live Bait

Paragat ile Levrek, *Dicentrarchus labrax* (L.,1758) Avcılığında Canlı Yem Tipi ve İğne Büyüklüğünün Birim Av Verimi ve Av Kompozisyonu Üzerine Etkisi

Özet: Çalışmanın temel amacı, paragat ile levrek (*Dicentrarchus labrax*, Linnaeus, 1758) avcılığında canlı yem tipinin ve iğne büyüklüğünün birim av verimi ve av kompozisyonu üzerine etkisini belirlemektir. 3/0, 4/0 ve 5/0 J tipi olta kancaları ile birlikte canlı Akdeniz kum yılanbalığı, lekeli pikarel ve yassı kefal yem olarak kullanılmıştır. Bu çalışma Mart 2020-Nisan 2021 yılları arasında Çanakkale kıyılarında gerçekleştirilmiştir. Ana beden kalınlığı 0,70 mm olup, köstek kalınlığı 0,50 mm ve uzunluğu 2 m olan köstekler 6 m aralıklarla bağlanmıştır. Paragat takımları, gün batımında kurulmuş ve sabahın ilk saatlerinde toplanmıştır. Tüm denemelerde, hedef tür olan levrek (263 adet) toplam avın %84'ünü oluşturmuş olup, bunu %13,3'lük bir yakalama oranına sahip hedef dışı bir tür olan mığrı *Conger conger* (42 adet) takip etmiştir. Paragat ile toplamda 314 adet olmak üzere 3/0 iğne ile 149, 4/0 iğne ile 91 ve 5/0 iğne ile 74 adet balık yakalanmıştır. En yüksek ve en düşük hedef dışı balık sayıları sırasıyla 3/0 ve 5/0 iğne ile yakalanmıştır. Paragat ile levrek avcılığında daha küçük balıkların fazla yakalanmasını önlemek için 3/0'dan küçük iğne boyutları kullanılmamalıdır. İzmarit *Spicara maena*, kefal *Mugil cephalus* ve Akdeniz kum yılanbalığı *Gymnammodytes cicerelus*' dan daha üstün bir canlı yem olduğunu kanıtladı.

Anahtar Kelimeler: Paragat, Levrek, Çanakkale, Av Kompozisyonu, Canlı Yem

Introduction

Longline fishing is a traditional fishing technique that targets fish with high economic value. Considering the effects of overfishing and habitat destruction by some fishing methods longlining is ecologically sustainable than other fishing methods. However, longline fishing with live baits requires high level of expertise. A variety of factors such as fish migration period, current direction, weather conditions, interspecific competition, operation depth, the size and shape of the hooks, the length of the snood, the material of the main body and snood, the type and the size of the bait and fishing time are major factors that affect the success of longline fishing (Bjordal, 1981). In Turkish waters, studies on longline fishing focused on the yield and hook selectivity (Hoşsucu 1991; Gönener and Samsun, 1996; Özdemir et al., 2006; Akyasan et al., 2016; Öztekin et al., 2020; Arı and Balık, 2021). In Turkish waters, longline fisheries usually target leerfish, gilthead seabream, red porgy, swordfish, shark, seabass, tuna, blue spotted seabream, two-banded seabream, white seabream, haddock, whiting, European hake, white grouper, common dentex, sand steenbras and octopus.

A major target of longline fishing in Çanakkale is the seabass (*Dicentrarchus labrax* Linnaeus, 1758). . Seabass migrate to coastal areas where food is abundant in the spring and summer and they inhabit a variety of habitats such as rocky shores and brackish waters in estuaries but prefer deeper waters by the end of autumn (Wheeler et al., 1975). They usually feed on pelagic fish like the European pilchard, annular seabream, European flounder, shore rockling, common sole, European eel, big-scale sand smelt and Mediterranean horse mackerel. The Çanakkale Strait is an important migration route of seabass and therefore, seabass is a popular gamefish for the amateur and professional fisherman alike. While lures and spinning gears are preferred by the amateur fishermen, commercial fishermen use longlines with live baits, especially in May and September and during the winter months. To our best of knowledge, no previous studies reported the performance of live baitfish on longline fishing. In this study, the effects of live baits (blotched picarel, *Spicara maena* (Linnaeus, 1758), flathead grey mullet, *Mugil cephalus* (Linnaeus, 1758) and the Mediterranean sand eel *Gymnammodytes cicerelus*, (Rafinesque, 1810) used for seabass (*Dicentrarchus labrax* Linnaeus, 1758) longline fishing on catch yield and composition in Çanakkale Strait, (North Aegean Sea) was studied.

Material and Methods

Fishing for seabass were carried out three times a month between March 2020 and April 2021, in the Çanakkale Strait (North Aegean Sea, Turkey; Figure 1).

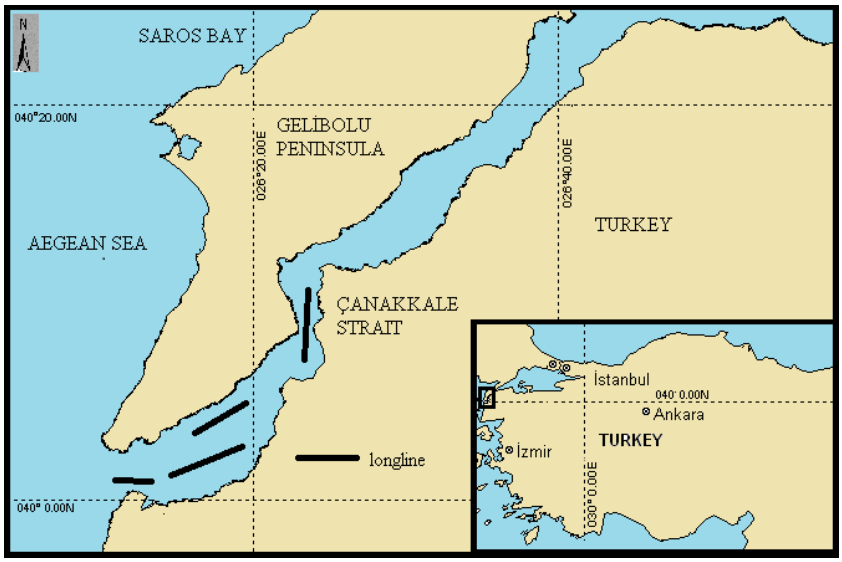

Figure 1. Locations of longline operations in Çanakkale Strait

A total of 43 longline operations were carried out at depths 40 - 150 cm. The fishing performance of three different live baits (Mediterranean sand eel, blotched picarel and flathead grey mullet) and three different hook sizes (3/0, 4/0 and 5/0; Figure 2) were tested. Hooks used were J type, short shanked and spade end hooks (Mariner Fishing Hooks, South Korea) and their characteristics are given in Figure 2.

Number of hooks used for each bait type, total operation number for each bait and hook size are given in Table 1. Operation numbers for each bait type were not identical due to availability of each bait type. Since blotched picarel was locally common and relatively easy to find in all seasons, a higher number of longline operations were carried out with this bait type.

Table 1. Matrix for bait and hook type used in longline operations

Baits	3/0 hook	4/0 hook	5/0 hook	Total baits	Operation N.
Blotched picarel	319	319	319	957	24
Mediterranean sand eel	106	106	106	318	12
Flathead grey mullet	72	72	72	216	7
Total	**497**	**497**	**497**	**1491**	**43**

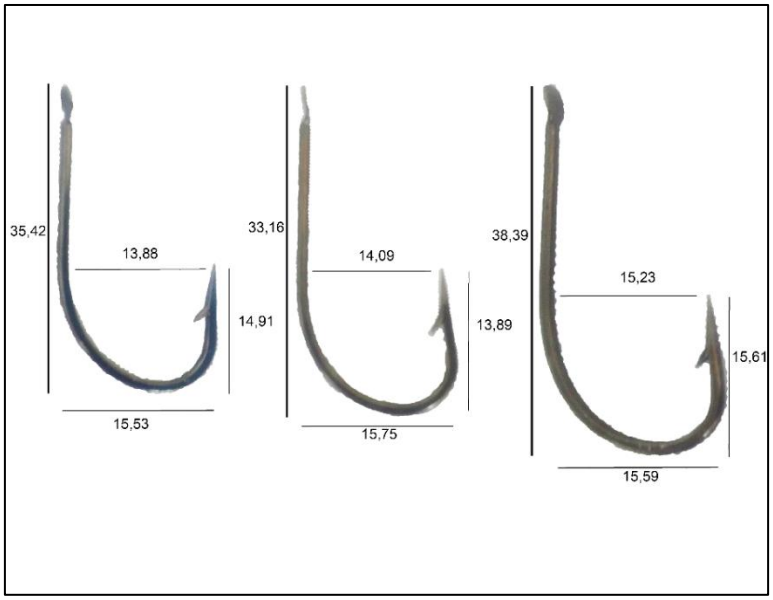

Figure 2. Characteristics of hooks (3/0, 4/0, 5/0) used in longline operations

For each hook size an equal number of hooks were tied to a given longline length. Longline lengths differed based on the characteristics of fishing locations, i.e. length of the coastal area. Hook numbers on longlines ranged between 48-105. Fishing time covered a period of 12 hours, from sunset to sunrise. In each longline operation only a single bait type tested.

Data Analysis

CPUE $_n$ (Catch Per Unit Effort by number of fish) and CPUE $_b$ (Catch Per Unit Effort by biomass of fish) were calculated for each hook size and bait type. In the calculation of CPUE $_n$ and CPUE $_b$ equations by (Godøy et al., 2003) were used:

Catch Per Unit Effort for No. of fish,

$$\text{CPUE n} = \frac{\text{N}}{\sum \text{h} * \sum \text{t}}$$

Catch Per Unit Effort for biomass,

$$\text{CPUE b} = \frac{\text{W}}{\sum \text{h} * \sum \text{t}}$$

N: No. of fish
W: biomass of fish
h: no of hooks per setting
t: no of setting

Results

Of the 314 fish caught in 43 longline operations 263 (83.7%) were seabass, 42 (13.3%) were European conger, 7 (2.2%) were stingray and 2 (0.6%) were turbot.

The results indicated that hook size 3/0 caught the highest number of fish whereas hook size 5/0 caught the least number of fish. Seabass catch rates by hook size 3/0, 4/0 and 5/0 were 77.8%, 84.6% and 95.9%, respectively (Table 2). Catch composition by bait type is given in Table 3.

Table 2. Catch composition by hook size

	Hook Size			
Caught Species	**3/0**	**4/0**	**5/0**	**Total**
Turbot	2	-	-	2
Seabass	116	77	71	264
European conger	26	13	3	42
Stingray	5	1	-	6
Total	**149**	**91**	**74**	**314**

Table 3. Catch composition of longlines by bait type

Baits	**Turbot**	**Seabass**	**European Conger**	**Stingray**	**Total**
Blotched picarel	-	150	28	2	180
Mediterranean sand eel	2	81	14	4	101
Flathead grey mullet	-	33	-	-	33
Total	**2**	**264**	**42**	**6**	**314**

When grey-mullet was used as bait, catch of longlines consisted of only seabass (150 individuals). (Figure 3; Table 3). In longlines with blotched picarel used as bait, the catch consisted of 150 seabass, 28 conger eels and only 2 stingrays. When sand eel was used as bait, the catch included 81 seabass, 14 conger eels, 4 stingrays and 2 turbots (Table 3). Due to seasonal availabilities, grey mullets were used as baits only in the spring and summer and the sand eels were used as bait in the spring, summer and fall.

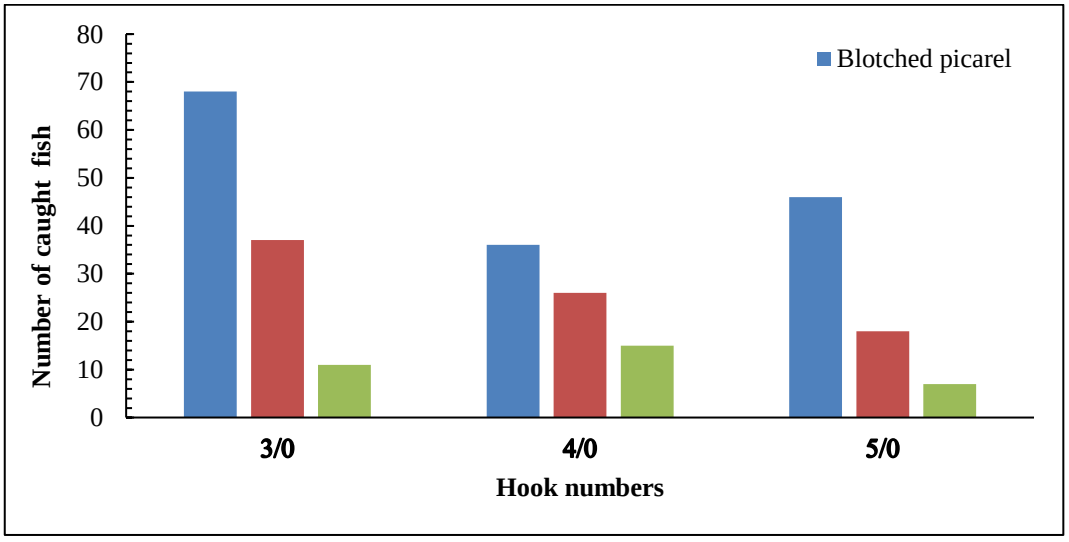

Figure 3. Total yield of seabass by bait and hook type

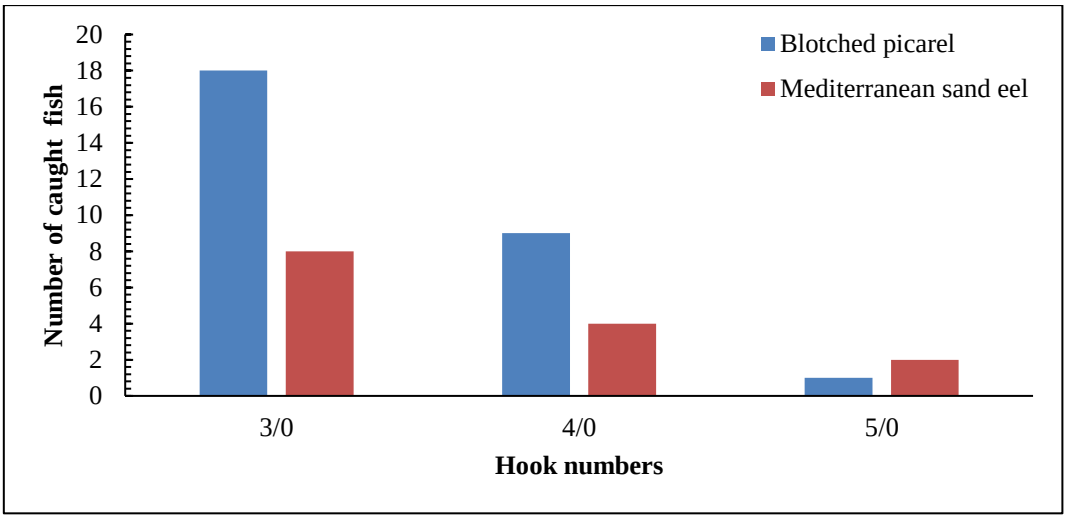

Figure 4. Total yield of European conger by bait and hook type

Table 4. Seasonal catch composition of longlines baited with blotched picarel

	Caught Species			
Seasons	**Seabass**	**European conger**	**Stingray**	**Total**
Spring	118	6	2	126
Summer	3	12	-	15
Autumn	17	5	-	22
Winter	12	5	-	17
Total	**150**	**28**	**2**	**180**

Table 5. Seasonal catch composition of longlines baited with sand eel

	Caught Species				
Seasons	**Seabass**	**European conger**	**Stingray**	**Turbot**	**Total**
Spring	24	7	-	-	31
Summer	42	7	4	-	53
Autumn	15	-	-	2	17
Total	**81**	**14**	**4**	**2**	**101**

Size characteristics (the mean, min and max length and weight) of the seabass caught by different baits and hook sizes are given in Table 7.

CPUEn and CPUEb values as a factor of hook size (3/0, 4/0 and 5/0) are given in Table 8. Although highest number of fish (149 fish) were caught by hook size 3/0, yield in terms of biomass (1700 g) was lowest. In contrast, although yield in number of fish caught by hook size 5/0 was lowest, yield in biomass was highest.

Table 6. Seasonal catch composition of longlines baited with flathead grey mullet

Caught species		
Seasons	**Seabass**	**Total**
Spring	24	24
Summer	42	42
Total	**66**	**66**

Table 7. Size characteristics (the mean, maximum and minimum weight and length) for seabass caught with different hooks and baits

Live Bait	Hook No	Max. L. (cm)	Min. L. (cm)	Mean L. (cm)	Max.W. (g)	Min. W. (g)	Mean W. (g)
Blotched picarel	3/0	56.0	29	39.8	2230	260	770.5
	4/0	51.0	30	40.5	1867	270.4	837.2
	5/0	58.4	31	45.0	3700	320	1181
Mediterranean sand eel	3/0	56.7	30	39.9	3700.9	260	705.1
	4/0	49.3	29	35.1	1693	270.4	473.2
	5/0	58.0	31	40.5	3700	290	823.7
Flathead grey mullet	3/0	51.0	32	40.4	1867	330	868.1
	4/0	53.9	29	40.6	1702.2	270.4	800.0
	5/0	52.1	32	42.0	1801	360	933.1

Table 8. CPUEn and CPUEb values calculated for 3/0, 4/0, 5/0 hooks

Hook Size	N	Total Catch (kg)	$CPUE_n$ (N)	$CPUE_b$ (g)
3/0	149	117.1	0.007	5.48
4/0	91	64.9	0.0043	3.04
5/0	74	78	0.0035	3.65

Discussion

In the present study, 263 seabass (corresponding to 83.7% of total catch) were caught out of a total of 314 fish caught by longline fishing using live baits. The non-target fish included, 42 (13.3%) European congers, 7 (2.2%) stingrays and 2 (0.6%) turbots. Earlier studies on longline fishing reported yields ranging from 294-1360 fish using different number and size hooks, different locations and non-living baits and therefore, no comparisons with respect to yield could be made (Gönener and Samsun, 1996; Dokumacı, 1999; Akamca, 2004; Öztekin, 2012). In the present study, fewer fish species were caught by longline fishing compared to those reported by others. This may be explained by the shallower operational depths (40-150 cm) of longlines in this study. Catch rates of non-target species were also relatively lower in this study and may be a factor of longline design, fishing time and bait type. Lower catch rate of non-target species is desired as selectivity is an important factor that mitigates fishing based mortality.

It is known that catch rate decreases as hook size increases. (Bjordal, 1981; Santos et al.,1995; Öztekin et al., 2018; Öztekin et al., 2020). Hook size was

positively correlated with the mouth width and fish length (Öztekin et al., 2014). Similarly, in this study, catch rate was highest with hook size 3/0 and was lowest with hook size 5/0. In addition, the catch rate of the target species, hence selectivity, increased with respect to the hook size. In contrast, total catch rate decreased with increasing hook size. However, catch rates of large-sized fish were higher with larger hooks. These results indicate the importance of hook selection in longline fishing. In addition to proper selection of hook size, selection of bait is critical for the success of longline fishing (Ferno and Olsen, 1994). Feeding habits and mouth size of the target species should also be taken into consideration when selecting baits in longline fishing (Balasubramanian, 1995). Although no direct comparisons could be made between live baits and non-living baits, the use of live baits in seabass fishing may reduce catch rates of non-target fish due to predatory feeding habits of seabass. However, the use of live baits in longline fishing presents operational difficulties and availability problems which may explain their limited use in longline fishing in this region.

The longline characteristics used in the present study, such as the main body line thickness, snood length and thickness can be recommended for seabass fishing. The catch rate of blotched picarel was highest compared to those of other bait types. Considering its availability in the region, live blotched picarel is highly recommended for seabass fishing using longlines.

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Conflict of Interests

The author declares that there are no conflicts of interests.

Author contribution

Alkan Öztekin and Ömer Serhat Uysal designed, performed and wrote the manuscript.

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