

Comparison of the discard characteristics of diamond and square mesh codends in the Aegean Sea trawl fishery

Ege Denizi trol balıkçılığında baklava ve kare gözlü torbaların ıskarta özelliklerinin karşılaştırılması

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Özet: Türkiye trol balıkçılığında 44 mm baklava gözlü torbaya bir alternatif olarak 40 mm kare gözlü torbanın kullanımı Eylül 2008'de kabul edilmiştir. Buna ilaveten, Avrupa Birliği tüm Akdeniz için bu göz açıklığı ve şeklinin kullanımını teklif etmiştir. Bu nedenle çalışma Ege Denizi'nde çok türün avcılığının yer aldığı demersal trol balıkçılığında farklı iki göz şekli ve açıklığındaki torbanın ıskarta özelliklerini karşılaştırmayı amaçlamıştır. Denemeler, Ege Denizi'nin Sığacık ve Kuşadası Körfezlerinde 30 Eylül - 25 Ekim 2007 tarihleri arasında ticari bir trol teknesi ile yürütülmüştür. Hedeflenmeyen türlerin miktarı, ıskarta av artı tesadüfi av ve ıskarta oranı ise yakalanan miktarın ıskartaya oranlanması ile tanımlanmış ve hesaplanmıştır. Çalışma süresince 21 geçerli trol operasyonu gerçekleşmiş, 53 tür yakalanmış ve bunlardan 11'i güverte üzerinde alıkonulmuştur. ıskarta oranı baklava gözlü torba (44 mm) için 0,42:1 ve kare gözlü torba (40 mm) için 0,25:1 olarak hesaplanmıştır. Baklava ve kare gözlü bu torbalar için toplam avın sırasıyla %30'u ve %20'si pazar değeri olmadığı için ıskarta edilmiştir. Bu çalışmanın sonucunda, demersal trol torbasında kare gözlü ağların kullanımının ıskarta miktarını düşürdüğünü açığa çıkarmıştır. Akdeniz balıkçılığının kendine has özelliklerini de göz önünde bulundurarak, balıkçılık kaynaklarının sürdürülebilir işletimini sağlamak için ağ göz şekli gibi ilave teknik düzenlemelerin uygulamaya alınması faydalı olacaktır.

Anahtar kelimeler: ıskarta, Baklava ve kare gözlü torbalar, Trol balıkçılığı, Ege Denizi.

Abstract: The use of 40 mm square mesh codends was adopted in September 2008 as an alternative to the 44 mm diamond mesh codend in Turkish trawl fishery. In addition, European Commission suggests using this mesh shape and size codend in whole Mediterranean. For this reason this study is aimed to compare the discard characteristics of two different mesh shape also mesh size codends of demersal trawlers on the multi-species fishery in the Aegean Sea. Fishing trials were carried out on board a commercial trawler between 30 September and 25 October 2007 in the Sığacık and Kuşadası Bays of the Aegean Sea. By-catch as discarded catch plus incidental catch and discard ratio as the ratio of discard to the actual retained catch are defined and calculated. During the study, 21 valid trawl operations were performed, 53 species were caught and 11 of these species were retained on board. The discard ratio has been calculated as 0.42:1 for diamond (44 mm) and 0.25:1 for square (40 mm) mesh codend. The 30% and 20% of total catch was discarded respectively for diamond and square mesh codends, due to the lack of market value. The result of the study reveals that using square-meshed nets at the codend will reduce the amount of discards. Taking into account the specific characteristics of Mediterranean fisheries, it will be appropriate to put into practice additional technical measures such as mesh shape in order to ensure sustainable exploitation of fishery resources.

Keywords: Discard, Diamond and square mesh codends, Trawl fishery, Aegean Sea.

INTRODUCTION

Shrimp fishery is one of the most important fishing sectors all over the world, but at the same time, this fishery is always subjected to discussions regarding discard and by-catch. Kelleher (2005), in his recent study, providing an update of the quantity of discards in the world's marine fisheries reported that, tropical shrimp trawl fisheries have the highest discard rate and account for over 27 percent of total estimated discards. There are widely differing estimates for the amount of by-catch in the various shrimp fisheries, partly resulting from different definitions of by-catch, different measurement systems of and the low level of actual monitoring (Gillett, 2008).

In Turkey, all of the shrimp catch is obtained during

capture fisheries. Annually, 358 tonnes of deep water rose shrimp, *Parapenaeus longirostris* is landed in the Aegean Sea coast, which corresponds to the 12.9% of total deep water rose shrimp landings of Turkey (Anonymous, 2008a). Aegean Sea provides 8% of the marine fish landings of Turkey.

As in all fisheries management schemes on the world, there are also important regulatory actions targeting by-catch and discard reduction in Turkey (Anonymous, 2008b). However, despite these legal measures in effect, the multispecies character of the fishery, in other words, species diversity makes this harder. For the Mediterranean and the Black Sea, discard database accounts for only 24 percent of 1.5 million tonnes nominal catch from the Mediterranean and

Black Sea. Kelleher (2005) has reported that the Mediterranean has relatively fewer trawl grounds, which contributes to a relatively lower level of discards and a weighted discard rate of 4.9 percent.

Exploitation of fishery resources in a sustainable manner requires the use of selective fishing gears, in aspects of both size and species. It is mentioned that the characteristic of the Turkish conventional demersal trawl fleets is rather low selectivity. According to Turkish fisheries regulations there is no specification regarding the codend, except for the 44 mm diamond mesh size. Almost all the commercial trawlers in Turkish waters use polyethylene (PE) netting material in constructing the modified or conventional gear. The European Commission (E.C. Council Regulation, 1967/2006) have suggested that demersal trawl codends should be made of 40 mm square mesh instead of diamond mesh concerned with sustainable exploitation of fishery resources in Mediterranean Sea. For this aim a series of trawl hauls were performed both diamond (44 mm) and square (40 mm) mesh codends along the Turkish coast of southern Aegean Sea. In this study, discard ratio of diamond and square mesh codends were tested under commercial fishery conditions.

MATERIALS AND METHODS

Fishing trials were carried out on board a commercial trawler Hapuloğlu (23.8 m in length and 550 hp main engine power) under commercial fishing conditions, in the coastal fishing areas (3 miles beyond the coastline) off the Aegean Sea (Sığacık and Kuşadası Bays) between 30 September and 25 October 2007, during daytime. Average towing duration was 3.4 h (2.4 - 4.3 h) and towing speed was 2.5 knots (2.3 - 2.6). The depth of the fishing areas varied between 137-187 meters.

Detailed information on the 1200 mesh modified trawl net used in the experiments was found in Tosunoğlu and Aydın (2007). In addition, characteristics of the codends are as follows: Diamond mesh (a commercially used standard codend): PE 210 d/24 knotless, nominal 44mm (44.7mm±0.08), 400 meshes on its circumference and 5m in length. Square mesh (a PE 0.40*10 knotted, nominal 40mm (42.4±0.19 mm), 200 bars in circumference and 5m in length).

During the study, 21 valid trawl operations were performed; 11 with diamond and 10 with square mesh codends. Specimens escaping from the codends were collected by a cover of 24 mm mesh size. Following each haul, the trawl net was taken onboard and the codend was unloaded on the deck. No intervention was made to the routine of fishermen's behaviors such as sorting, selecting, discarding etc.

For discard, by-catch and incidental catch estimations, all of the catch taken on board was sorted as target, incidental and discard. In this study, incidental catch, by-catch, discard were identified and discard ratio was calculated according to operational definitions of Alverson *et al.* (1994), who define the discarded catch as the portion of the catch returned to the sea as a result of economic, legal or personal considerations; incidental catch as the retained catch of untargeted species; by-catch as discarded catch plus incidental catch, and discard ratio as the ratio of discard to the actual retained catch.

RESULTS

A total of 2.585 t biomass were hauled and 53 species were caught at the end of the valid trawl operations (21 hauls) performed with square and diamond mesh codends. According to the preferences of fishermen, catch was sorted as commercial and non commercial catch. In the catch composition, *P. longirostris* were regarded as the primary target catch, 10 species were regarded as incidental catch and 42 species were regarded as discard. The amounts of landed, discarded and escaped catch in diamond and square mesh codends for some selected species are shown in Table 1.

Amount of totally retained catch was 987.8 kg for diamond and 937.6 kg for square mesh codends (Table 2). Calculated discard ratios were 0.42:1 and 0.25:1 for diamond and square meshes respectively. Incidental catch for this fishery consisted of 11 species namely *Trachurus trachurus*, *Merluccius merluccius*, *Illex coindetti*, *Lophius piscatorius*, *Zeus faber*, *Loligo vulgaris*, *Raja asterias*, *Phycis blennoides*, *Pagellus bogaraveo*, *Trigla lucerna*, *Trigla lyra* and 42 species were discarded, due to their non-commercial value for the market.

Table 1. The amounts of landed, discarded and escaped catch in diamond and square mesh codends for some selected species

Species	Diamond			Square		
	Landed	Discarded	Escaped	Landed	Discarded	Escaped
<i>Parapenaeus longirostris</i>	540.0	16.5	148.3	559.7	1.8	111.7
<i>Merluccius merluccius</i>	55.8	31.2	8.1	39.3	8.1	15.9
<i>Trachurus trachurus</i>	277.6	26.4	333.8	206.6	10.5	424.4
<i>Phycis blennoides</i>	0.2	1.1	0.4	0.3	1.2	1.2
<i>Loligo vulgaris</i>	2.3	0.1	0.1	2.8	0.2	0.3
<i>Illex coindetti</i>	55.0	3.6	0.7	36.9	1.6	4.0
<i>Sephia orbignyana</i>	19.4	2.7	0.7	28.9	1.6	1.2
Other	37.5	343.0	241.8	63.2	210.5	218.4
Total	987.8	424.5	733.8	937.6	235.4	777.1

The amount of commercial shrimp (*P. longirostris*) which was the primary target species of the catch was 540 kg in diamond and 559 kg in square mesh codends. In diamond mesh codend, the species constituted the 54% of retained catch while this ratio was 59% in square mesh codend. Horse mackerel was the second for both codends in volume and constituted the 28% (277.6 kg) of the total catch for diamond

and 22% (206.6 kg) for square mesh codend. Hake also should be noted as the third species of the catch composition, which constitutes the 5% (55.6 kg) of the total catch for diamond and 4% (39.3 kg) of the total catch for square mesh codend. For diamond and square mesh codends, weight based discard and by-catch evaluations of the catch composition are shown in Table 2.

Table 2. Weight (kg) based discard and by-catch estimations for diamond and square mesh codends

	Discard weight	Landed catch weight	Ratio of discarded weight to landed weight	Ratio of discarded weight to total weight	Incidental catch	By-catch weight
Diamond	424.6	987.8 (1412.4)	0.42	0.30	447.8	872.4
Square	235.4	937.6 (1173.1)	0.25	0.20	378.0	613.5

A total of 234 298 *P. longirostris* was caught (excluding covers) in number and about 85% of this amount was marketed and a small fragment (about 5%) was discarded. Because of the high market demand for this species, only damaged and missed (onboard) individuals of these species were discarded.

DISCUSSION

The main finding of the study is that 40 mm square mesh codend catches lower discard whereas higher escapes than that of the 44 mm diamond mesh codend. This is valid not only for the primary target species but also for the landed main three species namely *Trachurus trachurus*, *Merluccius merluccius* and *Ilex coindetti*. *Loligo vulgaris* and *Phycis blennoides* are the unique exception of this evaluation with a very small fragment which is neglectible. Similar findings obtained in the size selectivity studies for these species by Aydın *et al.* (2009), Tosunoğlu *et al.* (2009) and Aydın and Tosunoğlu (2010). In the framework of by-catch and discard evaluation, this fishery as indicated in the results may not be defined with the high discard rates when compared to other crustacean trawl fisheries in Turkey (Kinacıgil *et al.*, 1999; Soykan *et al.*, 2006; Duruer *et al.*, 2008) and around the world (Saila, 1983; Harris and Poiner, 1990; Wassenberg and Hill, 1990; Alverson *et al.*, 1994). However, it is not easy to say the same for the by-catch. Availability of different species inhabiting in the joint living zones causes high by-catch rates, which may only be reduced by species selectivity. Ensuring the low discard rate is that having economic value of the significant part of the catch, at least at the present time. The main factors determining the status of the catch were based on economic and legal considerations. In other words, in deciding what is *catch* and what is *discard*, market demand and legal limitations will be effective. Due to high market values of most of the species caught, discard rates are not as high as expected.

In Turkey, most of the studies regarding the discard and by-catch estimations focus on prawn fishery. Kinacıgil *et al.* (1999) have reported the rates as 1:1 incidental catch and 1:3

by-catch in winter and, 1:3 incidental catch and 1:6 by-catch in spring for shrimp trawl. Soykan *et al.* (2006) have reported, 118.5 (6%) kg target catch, 317 (17%) kg incidental catch and 1.420 (77%) kg discards for shrimp trawls. Duruer *et al.* (2008) have reported 2.37:1 discard ratio for commercial penaid fishery in Mersin Bay (northeastern Mediterranean). Studies on the discard characteristics of Aegean Sea fisheries are rather limited.

In respect to by-catch and discard problems of this fishery, it should be emphasized that by-catch is originated from the multi species character of the fishery and the difficulty to select target species while eliminating the others. The extent to which mesh size regulations can be applied to reduce by-catch is limited in multispecies fishery. Changes in mesh size to avoid limited species may also result in underfishing of some species or overfishing of other species (Hanna, 1990).

Perception regarding the issue of what discard is in a given time or fisheries are highly important. High-grading is also valid for this situation, because of the differing market values of some species in time. For the purpose of discard estimation, Kelleher (2005) suggests a division of the catch into three groups; species always retained, species always discarded and species sometimes/partially discarded. Since the reason of discard, depends to the market value of the species caught and legal limitations, the extent of the problem will vary according to time and management actions. To eradicate discard and by-catch completely is almost impossible in multispecies fishery. But, measures targeting discard reduction, such as improvement species and size selectivity of the nets, will serve to decrease the labour and other costs of the fishery.

In most fisheries, unobserved fishery mortality (Alverson *et al.*, 1994) is disregarded. Mortality rates of by-catch and escapees are generally unknown and constitute a large source of uncertainty in estimates of overall fishing mortality (Davis, 2002). Studies on the survival rates of certain species in the Mediterranean are scarce (Metin *et al.*, 2004). In this study, however significant amount of fish and shrimp escaped for both codends, since the fate of the escapees is unknown

as in most cases, it is difficult to guess the magnitude of the unobserved fishery mortality and impacts on habitat and further study needs to be done.

Taking into account the specific characteristics of Mediterranean fisheries, it will be appropriate to put into practice additional technical measures such as mesh shape in

order to ensure sustainable exploitation of fishery resources. In comply with the technical provisions of *E.C. Regulation (E.C.) No 1967/2006, Concerning Management Measures for the Sustainable Exploitation of Fishery Resources in the Mediterranean Sea*, the results of the study reveals that using square-meshed nets at the codend will reduce the amount of discards.

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