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Size selectivity of hand and machine woven codends and short term commercial loss in the Northeastern Mediterranean

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ABSTRACT

Poor selectivity of demersal trawls targeting fish, crustaceans and cephalopods in Mersin Bay, Turkey, (and more broadly for most Mediterranean demersal trawlers) is a significant concern. The majority of the boats working in the Mersin Bay trawl fishery use traditional gears with 44 mm mesh size hand-woven slack knotted codends in which approximately 50% of the catch by weight and 70% by numbers are discarded. The present study compares size selectivity of a commonly used hand-woven codend and three alternative machine woven codends (40 mm square mesh; 44 mm and 50 mm diamond mesh) for seven commercial species: red mullet (*Mullus barbatus*); brushtooth lizardfish (*Saurida undosquamis*); common pandora (*Pagellus erythrinus*); goldband goatfish (*Upeneus moluccensis*); Randall's threadfin bream (*Nemipterus randalli*); green tiger prawn (*Penaeus semisulcatus*); and speckled shrimp (*Metapenaeus monoceros*). A total of 87 hauls were conducted using a covered codend method in 2011. Short term commercial loss for 31 marketed species resulting from switching from the commercial codend to each alternative codend, was estimated. Results show that size selectivity of the commercial codend is rather poor for almost all the marketed species. The 40 mm square mesh codend is the best alternative for the majority of the marketed species in terms of releasing juveniles. We estimate a commercial loss of 17% in landing values if this codend is used.

1. Introduction

Mersin Bay is one of the richest fishing areas and, due to its topographic structure, one of the most suitable areas for trawl fishing (Gücü and Bingel, 1994) in the eastern Mediterranean (Fig. 1). There is an intensive fishing pressure in the region and as a result of this pressure, very sharp declines in Catch Per Unit Effort (CPUE) and reductions in the lengths of commercial species were reported by Gücü (2000). Poor selectivity of nets used by the trawl fleet is a significant factor in these declines.

Demersal trawling in Turkish waters is carried out on grounds where more than 130 species encounter the gear (Özbilgin et al., 2013). In this multi-species fishery, bycatch and discarding is a significant problem for fisheries management. Consequently, more than fifty published demersal trawl codend selectivity studies have been carried out in the Aegean and the Mediterranean waters of Turkey since the mid 1980s (Özbilgin et al., 2011) and these studies are still continuing today.

European Commission regulations (EC, 1967/2006) require fishermen to replace the 40 mm diamond mesh with square mesh at the codend. If the ship owner makes a justified request, a 50 mm diamond mesh may be substituted in Mediterranean demersal fisheries (E.C., 2006). In preparation for Turkey's entry to the European Community, the potential implications of these regulations upon Turkish Fisheries must be considered (Düzbastılar et al., 2010a). Currently, Turkish Fisheries Regulations (TFR) (Anonymous, 2012) define minimum diamond mesh sizes of 40 mm for the Black Sea, and 44 mm for both the Aegean and the Mediterranean Seas. The use of 40 mm square mesh codend is left to fishermen's preference. However, 40 mm diamond mesh codends are also used in the fleet (Tokaç et al., 2010), and in most cases are assumed to be legal. Multiple studies have shown that the 40 mm diamond mesh codend is unselective for many commercially important species in the Mediterranean (Özbilgin and Tosunoğlu, 2003; Tokaç et al.,

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2004, 2010; Özbilgin et al., 2005, 2007, 2012; Guijarro and Massuti, 2006; Bahamon et al., 2006; Ordines et al., 2006; Tosunoğlu et al., 2007; Sala et al., 2008; Luchetti, 2008; Sala and Luchetti, 2010; Ateş et al., 2010; Aydın et al., 2011). The General Fisheries Commission for the Mediterranean (GFCM) has encouraged scientists to continue to conduct selectivity studies and has suggested that experiments investigate the biological and socio-economic effects of 40 mm square mesh and 50 mm diamond mesh in Mediterranean demersal trawl fleet (GFCM, 2010).

Studies have clearly demonstrated that square mesh codends capture fewer juveniles than diamond mesh codends (e.g., Bahamon et al., 2006; Sala et al., 2008; Özbilgin et al., 2012). Diamond-shaped mesh in trawl nets has a tendency to close as the codend fills, so diamond mesh codends retain smaller fish than a similar sized square mesh codend, whose meshes remain open during a haul (Robertson and Stewart, 1988). But only a few studies (Guijarro and Massuti, 2006; Bahamon et al., 2006; Luchetti, 2008) have assessed the potential economic loss that would be experienced by fishermen during a transition to 40 mm square mesh codends. These studies showed that in the Mediterranean shelf grounds, economic losses would be higher than in the slope fishing grounds due to the escape of a high number of commercial species (Bahamon et al., 2006).

Poor selectivity of demersal trawls targeting fish, crustaceans and cephalopods in Mersin Bay is a significant concern. The majority of the boats working in this trawl fishery use traditional gears with 44 mm mesh size hand-woven slack knotted codends in which approximately 50% of the catch by weight and 70% by numbers are discarded (Özbilgin et al., 2013). This study firstly compares the selectivity of 44 mm hand-woven slack knotted ("commercial") and three machine woven ("fabricated") codends: 40 mm square mesh, 44 and 50 mm diamond mesh. Then, it estimates the potential short term losses in landing values if the commercial codend is replaced with one of the alternative codends.

2. Materials and methods

2.1. Sea trials

Sea trials were conducted on the commercial fishing grounds of Mersin Bay in the eastern Mediterranean (36°23′ N–34°20′ E; 36°27′ N–34°12′ E; 36°41′ N–34°48′ E; 36°44′ N–34°37′ E (see Fig. 1)), at depths ranging from 14.7 to 141.1 m, between 10 January and 16 December 2011. Experiments were paused between 15 April and 15 September due to the seasonal closure in fisheries. A total of 87 valid hauls were carried out onboard the commercial trawler 'Azim' (18 m LOA, 350 HP/261 kW engine power) with tow durations ranging between 80 and 220 min. The tow speed ranged between 2.3 and 2.8 knots.

2.2. Codends

The commercial codend (CD44) was hand-woven from multimonofilament (Ø 0.35 mm * 15) polyethylene (PE) twine material (Fig. 2A). It has 100 meshes and was 4.0 m in stretched length, and 400 meshes around the circumference. The nominal mesh size was 44 mm. Knots of this codend were deliberately left slack when sewn so that the mesh openings are rather small when no force is applied on them, but with tension are as large as 44 mm and therefore legal. The three test codends for comparisons were constructed from sheets of machine-woven webbing (Fig. 2B). The first test codend (S40) was made of 40 mm square mesh netting with 150 mesh bars on its circumference. The second test codend (D44) was 44 mm diamond mesh netting with 300 meshes on its circumference. The last test codend (D50) was 50 mm diamond mesh netting with 265 meshes on its circumference. Number of meshes around was adjusted to maintain a similar diameter across test codends. All the test codends were 5.5 m stretched length, and were made of the same fabricated PE material. Numbers of meshes along their lengths were 242 for S40, 124 for D44, and 100 for D50. Twine diameter in all test codends was 1.5 mm. All the codends were used with a protective bag which was made of 3 mm diameter PP twine with a nominal 88 mm diamond mesh, 60 meshes on its circumference and 6 m in stretched length as in commercial fishing. Codends were attached to the end of the funnel, which had 300 meshes around its circumference, and was made of 44 mm mesh size PE netting. The number of the valid hauls carried out with these codends was 23, 23, 20, and 21, respectively. The codends were changed as often as possible to balance the potential variability caused by the time and location of fishing.

The mean mesh size of each codend was measured using a digital calliper with a 4 kg weight tied vertically to the stationary jaw of the callipers (Özbilgin et al., 2012). Sixty meshes in total (three lines of 20 meshes) near the aft end of each codend were measured.

The covered codend method was used to collect the selectivity data (Wileman et al., 1996). The cover used was 7.5 m in length and

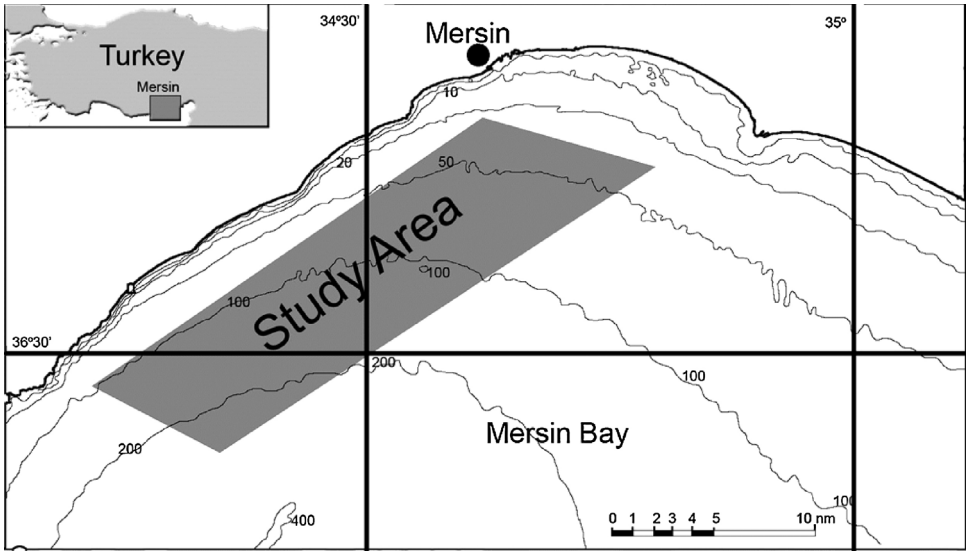

Fig. 1. Study area.