Mar. Sci. Tech. Bull. (2019) 8(2): 92–97
e–ISSN: 2147–9666
info@masteb.com

http://dergipark.org.tr/en/pub/masteb
http://www.masteb.com/
DOI: 10.33714/masteb.648531

Marine Science and Technology Bulletin

RESEARCH ARTICLE

New Alternative Fishing Gear Suggestions for Trap Fisheries from the Waste Recycle Materials: Case Study for Muricidae (Mollusca: Gastropoda)

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ARTICLE INFO

Article History:

Received: 19.11.2019
Received in revised form: 20.12.2019
Accepted: 23.12.2019
Available online: 24.12.2019

Keywords:
Trap
Fisheries management
Recreational fisheries
Hexaplex trunculus
Bolinus brandaris

ABSTRACT

Small-scale fisheries have a high socioeconomic importance for local communities. Therefore, ensuring the sustainability of fisheries resources would contribute to the socioeconomic development of fisheries communities. In this study, traps produced from plastic waste recycle materials which can be used in fishing of economically valued whelks (*Hexaplex trunculus* and *Bolinus brandaris*) that are used as natural bait in angling and longline fishing were investigated. These traps in different sizes were examined at the depths of 3-8 m in the Urla coasts of Izmir Bay, Turkey. The soaking times of traps were between 10-48 hours. The same amounts of baits (*Sardina pilchardus*) were equally placed in all traps. Catch per unit efforts (CPUE) of traps were calculated between 7-34 individuals/trap per day. The experimented traps were found successful for whelks fishing. Traps yield high quality and economically valued catches, related to restricted bycatch and low impact on habitat. Therefore, these traps can be suggested as alternative fishing gears designed for trap fisheries for whelks. This paper provides valuable knowledge for fisheries managers and decision makers to ensure the sustainability of local fisheries resources and small-scale fisheries.

Please cite this paper as follows:

Acarlı, D., Kale, S., Kara, A. (2019). New Alternative Fishing Gear Suggestions for Trap Fisheries from the Waste Recycle Materials: Case Study for Muricidae (Mollusca: Gastropoda). *Marine Science and Technology Bulletin*, 8(2): 92-97.

Introduction

Marine and freshwater fish species are not only caught for supplying food and raw components, but they are also used in recreational fisheries, ornamental aquariums and aquaculture facilities across the globe (Engelhard et al., 2019). Recreational fisheries is described as "*fishing of aquatic animals (mainly fish) that do not constitute the individual's primary resource to meet basic nutritional needs and are not generally sold or otherwise traded on export, domestic or black markets*" by FAO (2012). The economic importance of the recreational fisheries has promptly increased globally. Recreational fisheries is targeting several different fish species and engaging at least

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220 million participants in both marine and freshwater habitats (Cooke et al., 2018). In addition, recreational fisheries can support rural livelihoods in developing countries (Smith et al., 2005) besides small-scale fisheries have a high socioeconomic importance for local communities. Ensuring the sustainability of fisheries resources would contribute to the socioeconomic development of fisheries communities.

Muricid gastropods possibly will play an important role in the population dynamics of benthic organisms due to predation behaviours could lead to several variations on the amount and diversity of other benthic communities (Güler and Lök, 2019). The purple dye murex (*Bolinus brandaris* Linnaeus, 1758) and the banded murex (*Hexaplex trunculus* Linnaeus, 1758) are widely distributed species of the Muricidae family throughout the Mediterranean Sea (Gaillard, 1987; Houart, 2001). Both species have extended their distribution areas, possibly due to accidental introduction of juveniles among bivalves imported for shellfish culture (Vasconcelos et al., 2016). The purple dye murex (*Bolinus brandaris*) generally occurs in the sublittoral zone (Dalla Via and Tappeiner, 1981) although the occurring was reported at 200 m (Macedo et al., 1999). The species prefers sandy, muddy, and sandy-muddy habitats (Muzavor and Morenito, 1999). The banded murex (*Hexaplex trunculus*) usually occurs between intertidal and infralittoral zones until the depth of 200 m (Dalla Via and Tappeiner, 1981; Macedo et al., 1999). Houart (2001) reported that this species is frequently occurring between the depths of 0.3 m and 30 m. The banded murex prefers both soft and hard habitats such as sandy, muddy, rocky, and sandy-muddy substrates (Macedo et al., 1999; Muzavor and Morenito, 1999; Houart, 2001). These species are used as baits for small-scale and recreational fisheries (particularly for fishing of Sparidae species, i.e., *Sparus aurata, Diplodus vulgaris, Diplodus sargus, Pagellus erythrinus, Pagellus bogaraveo*, *Pagellus acarne*). Hence, they have an important economic value in commercial fish feed market. Morphometric relationships should be determined to contribute significant information for fisheries biology, population dynamics and fisheries management. Several researchers studied morphometric relationships and relative growth of *H. trunculus* and *B. brandaris* (Trigui El Menif et al., 2006; Lahbib et al., 2009, 2010; Abidli et al., 2012; Mutlu, 2013; Vasconcelos et al., 2012; 2016), reproductive cycle (Vasconcelos et al., 2008a; 2008b; 2008c; 2009; Gharsallah et al., 2010; Elhasni et al., 2010; 2013; Lahbib et al., 2011), embryonic development (Güler and Lök, 2014) and foraging behaviours of juvenile Muricid species (Güler and Lök, 2019) in the Mediterranean coasts. The aim of this paper is to develop new alternative fishing gears for trap fisheries and to investigate alternative materials to be used as traps for the whelk fishing. In addition, the length-weight relationship findings for collected individuals from these traps will also be provided.

Material and Methods

Materials

Seven fishing gears to be used for trap fisheries produced from plastic materials were experimented to recommend as alternative fishing gears for small-scale and recreational fisheries. The entrance hole of designed plastic fishing gears was constructed by net rigging. In addition, groundropes were attached to the underside of fishing gears in order to sink of fishing gears because they were floating plastic materials and had a lower specific gravity according to the sea water. The characteristics of these alternative fishing gears were given in Table 1.

Study Area

Modified fishing gears were investigated in the coasts of Urla in İzmir Bay. Experimental studies were carried out in two locations and repeated three times (Figure 1). The sediment of studied locations was directly observed by SCUBA divers and described as gravelly, gravelly loam, sandy, and muddy in addition to seagrass meadows (*Posidonia oceanica*).

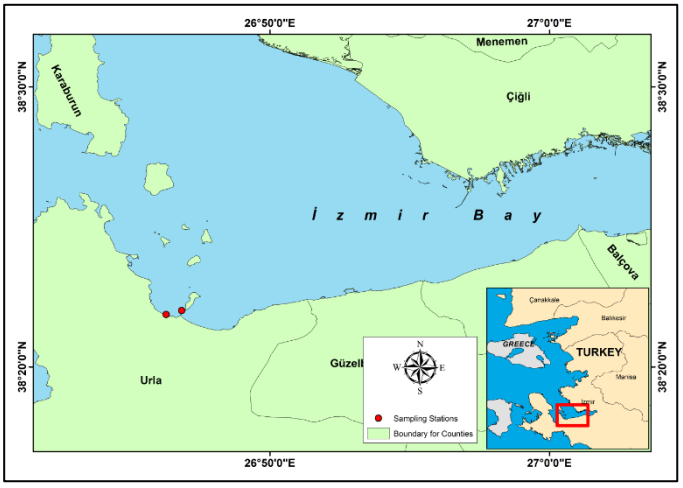

Figure 1. Sampling locations in the coast of Urla, İzmir Bay

Methods

Modified fishing gears at different shapes, sizes, and colours were deployed at the sea bottom between 3-8 m water depths. All fishing gears were attached to a rope with each other such as a longline. The soaking times of fishing gears were 24 hours. Splintered fresh sardine (*Sardina pilchardus*) individuals placed in a feedbag (produced by a net) were used as bait in order to attract the Muricidae species. Feedbag positioned in the centre of the fishing gears.

The morphometric measurements of the caught species were carried out by digital calliper and precision scales. Shell length (SL) and total weight of individuals were measured. Catch per unit effort (CPUE) were calculated by using equation 1 given below:

$$CPUE = \frac{N}{T \times S} \quad (1)$$

In this equation, N is the number of total caught individuals, T is the number of traps, and S is the soaking time of traps.

Table 1. Characteristics of alternative fishing gears for trap fisheries

Fishing Gears	Base Diameter (cm)	Entry Diameter (cm)	Height (cm)	Shape	Colour
#1	40	10	15	Circle	White
#2	45	10	35	Circle, Perforated	Pink
#3	40	10	35	Circle	Yellow
#4	40	10	25	Circle	Red
#5	40	10	20	Circle	Magenta
#6	40	10	40	Circle	White
#7	40	10	15	Square	Transparent

Results

Seven alternative fishing gears to be used in trap fisheries of Muricidae species were developed and the usability of these models was investigated. A total of 313 Muricid species were collected during the experiment. The total catch amount of each model was presented in Table 2. However, the only individuals that introduced into these fishing gears have been considered to calculate the amount of the total catch. The individuals that climbed to gears have not been taken into account to compute the number of the total catch. The most yielded model was found as model #2. This model had a pink coloured material and the highest size. The base diameter and the height of model #2 are bigger than other ones. The least individuals were collected from model #6. The model #6 is the second biggest model regarding base diameter and height. Although it was the second largest model, it was the least abundant model. Unexpectedly, the abundance varied between models even though the sizes were approximately equal.

Table 2. Total catch amount of each model

Fishing Gears	Catch Amount
#1	66
#2	71
#3	39
#4	45
#5	26
#6	14
#7	52

Moreover, length-weight relationships (LWRs) of Muricid species were computed for each model. LWRs for each model were presented in Figure 2.

Discussion

Modern fisheries management is intensely influenced by the ecosystem theory nevertheless concentrated principally on fishing activities and target fish resources (Garcia et al., 2003) due to fishing activities usually target one or several species, known to provide food for consumers and livelihood to the fisheries communities (FAO, 2003). Overexploitation of fish stocks, changes in ecosystems, and global skirmishes on fisheries management and trade of fishes still intimidate the long term sustainability of fisheries and the role of fisheries in supplying food (FAO, 2012). Ecosystem approach to fisheries management signifies the mere opportunity for fisheries to become sustainable and responsible (Garcia and Cochrane, 2005). Muricid species have already been caught by several fishing gears such as shrimp trawl (Elhasni et al., 2017), wallet-line (Vasconcelos et al., 2008d), collecting by divers (Güler and Lök, 2019), fishing nets (Abidli et al., 2012). Several and unstandardized fishing gears that used in whelk fishing and trap fisheries may cause significant damages on the marine habitat and ecosystem. Furthermore, fisheries required to be managed in an ecosystem context since fisheries play a significant role in the ecosystem besides human activities.

The limitation of the present study may be the unavailability of physicochemical characteristics of the study area. Environmental factors have possible impacts on the physiology of animals and trap fisheries. Similarly, Yee and Murray (2004) indicated that the temperature of water could affect the physiology of ectothermic animals containing gastropods. Güler and Lök (2019) stated that higher water temperature could impact the consumption rates of Muricid species. These species could feed a wide size range of mussels (Güler and Lök, 2016; 2019). However, the present study was carried out at the same time by using all fishing models, and then replicated two times again. Therefore, environmental conditions were maintained during the study period. Hence, environmental factors (water temperature, depth, current) are not considered in the calculations since the study assumes that all the fishing gears equally have been affected by environmental conditions. In addition, the baits were equally distributed in each model (50 g per model).

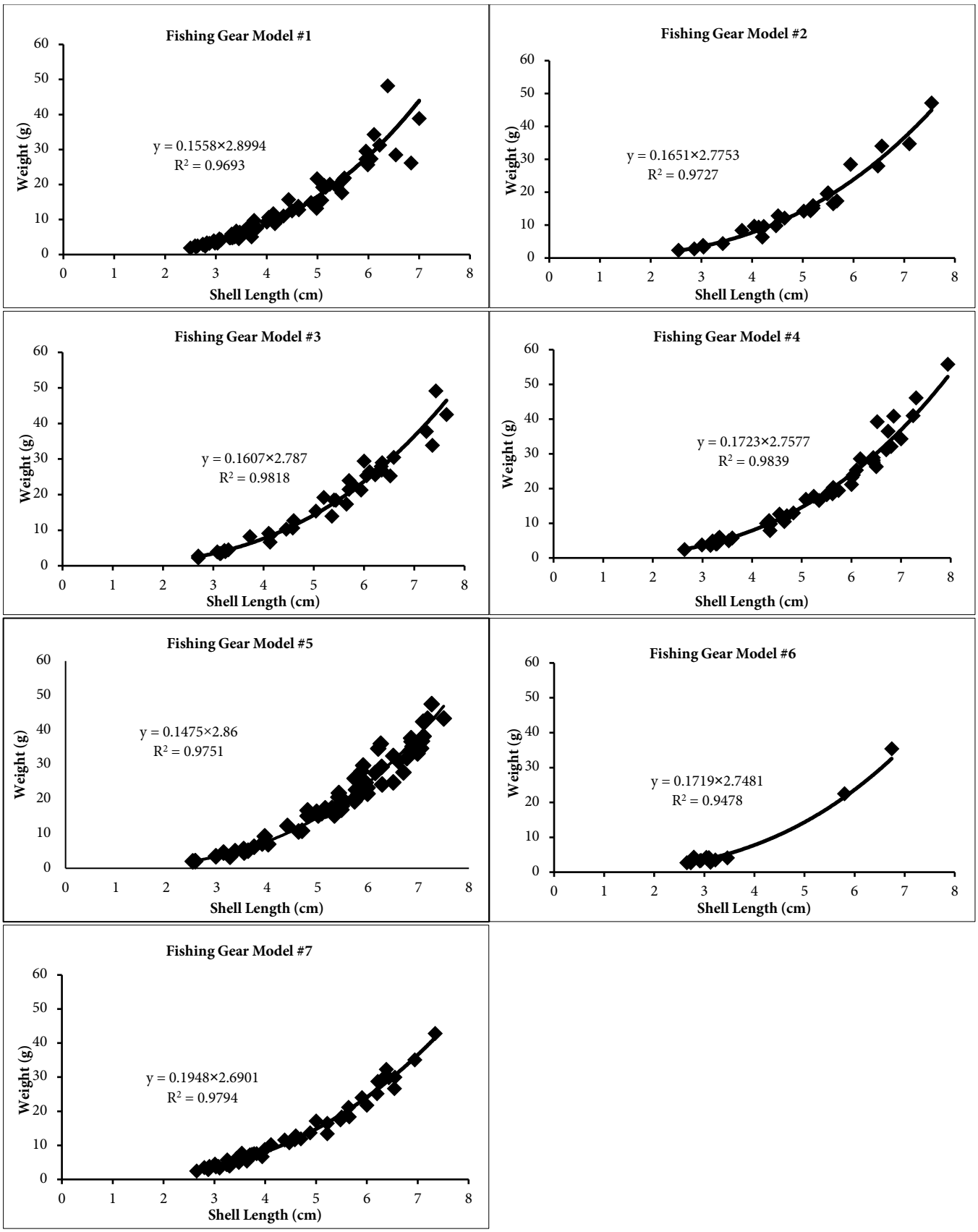

Figure 2. LWRs of Muricid species collected from fishing gear models

The differences in colour were not found to have a significant effect on catch efficiency. When the catch efficiencies of the two white models were compared, more individuals were collected in the shorter model than the higher model. Therefore, it can be said that Muricid species prefer shorter models rather than climbing high. On the other hand, although the height of the pink model is higher than the other models, the odour of the baits is spread over a larger area due to the perforated sides. Therefore, although it is perforated and the height of the model is high, the smell of the baits attracted the animals. As a matter of fact, most individuals are also observed in this model.

Conclusion

In conclusion, it was determined that the height and catch efficiency are inversely correlated. The higher model was favoured by less individuals. This study reveals effective fishing gears for trap fisheries that could be applied to compare different materials and models. Muricid species preferred the model that shorter and having perforated sides. Therefore, in future studies, it is considered that the catch efficiency will be higher if the height is low and the models have perforated sides are used. In the following researches, it is suggested to investigate the effect of feed amount on catch efficiency by using models developed with the present study.

Acknowledgments

An earlier version of this study was presented at XV. National Fisheries Symposium in Rize, Turkey on July 2009.

Conflict of Interest

The authors declare that there is no conflict of interest.

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