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Identification of Structural and Operational Characteristics of Deep Water Cast Nets Used for Whiting along the Turkish Coast of the Black Sea

Karadeniz Bölgesi'nde Mezgit Avcılığında Kullanılan Derin Su Serpmesinin Yapısal ve Operasyonel Özelliklerinin Tanımlanması

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ABSTRACT

In this study, it was aimed to define the structural and operational characteristics of traditional deep water cast nets used for whiting fishing off the Turkish coast in the Black Sea. The studies were carried out in two stages; 1) field operations and 2) face to face interviews with fishermen who are using deep water cast nets to catch whiting. Deep water cast nets are widely used for whiting fishing in small scale fisheries in the Black Sea. However, horse macherel, red mullet, scorpion fish and some bivalves can also be captured as bycatch with these nets. Deep water cast nets are released from the boat into the sea and sunk down to bottom with spread out like a parachute. Deep water cast nets are structured as follows; netting, sinker line, sinker, brail lines, horn, swivel and pulling cord. The operation of a cast net requires considerably high knowledge and skills of the fishermen. So, every stage of fishing operation is important in terms of catch efficiency and operational success. The main factors of successful operations are the type of bottom, depth, state of the sea, wind and deep currents. The operation stages are examined as follows; pre-operation, getting rid of curling and hurling, state of the first contact with water surface and downward move into the water column, reaching to the bottom and capture of the fish, hauling, opening procedure on the vessel, taking the fish and as final preparation of the for the next operation.

Keywords: Deep water cast nets, Black Sea coast, *Merlangius merlangus euxinus*, Demersal fish, Whiting fisheries.

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ÖZET

Bu çalışmada Karadeniz Bölgesi'nde mezgit avcılığında kullanılan derin su serpmesinin yapısal ve operasyonel özelliklerinin tanımlanması amaçlanmıştır. Çalışmalar 1) saha operasyonları ve 2) derin su serpme avcılığı yapan balıkçılarla yüzyüze görüşme şeklinde iki aşamada gerçekleştirilmiştir.Derin su serpmesi Karadeniz'de küçük ölçekli balıkçılar tarafından mezgit avcılığında yaygın olarak kullanılmaktadır. Bunun yanında istavrit, barbun, iskorpit ve bazı bivalve türleri de bu ağlar ile yakalanabilmektedir. Derin su serpmesi tekneden denize doğru atılır ve paraşüt gibi açılarak deniz tabanına oturur. Derin su serpme ağlar; ham ağ, kurşun yaka ve kurşun batırıcılar, çarmık, metal halka, fırdöndü ve çekme ipinden oluşmaktadır. Derin su serpme ağların atımı balıkçılar açısından önemli ölçüde bilgi ve beceri gerektirmektedir. Bu sebeple operasyonun her aşaması av verimliliği ve operasyon başarısı açısından önemlidir. Zemin yapısı, derinlik, dalga durumu, rüzgar ve dip akıntısı operasyon başarısını etkileyen önemli faktörlerdir. Derin su serpme avcılığı operasyonları; ön hazırlık, ağın burulması ve suya bırakılması, ağın su ile teması ve deniz tabanına inişi, ağın deniz tabanına oturması ve avın yakalanması, ağın çekilmesi, ağın tekneye alınarak altının açılması, avın toplanması ve son olarak derin su serpmesinin bir sonraki operasyona hazırlanması aşamalarından oluşmaktadır.

Anahtar sözcükler: Derin su serpmesi, Karadeniz, Merlangius merlangus euxinus, demersal balık, mezgit avcılığı

1. INTRODUCTION

Some of the fish stocks in the world and Turkey have been over-exploited apart from sustainability and below biological safety limits, and some others have been completely depleted. Despite of the policies and limitations implemented, fishermen`s desire is to catch more fish by using the existing fishing gears and fishing methods under ineffective control measures. Against highly over-exploited pelagic stocks, attention of the fishermen turns to the demersal stocks in recent years. Demersal stocks, which are already limited, have also begun to over-exploited due to illegal trawling activities in the region. Therefore, discovery or development of alternative fishing gears, definition/development of existing fishing methods and gears is important in terms of sustainable fishing. Traditional deep water cast nets have been used since the ancient times in whiting (*Merlangius merlangus*) fisheries in the Black Sea region. The structural and operational characteristics of this method has not been defined yet in the literature.

Cast nets are widely used all over the world in small-scale fisheries. FAO (2001) has described the cast nets as circular nets which is casted from the shore or from a small boat, but in shallow waters in general, to catch fish by falling down and closing in on them. These kinds of nets are used to catch fish swimming near the water surface, in rather shallow waters. Cast nets are circular nets in the group of thrown or falling nets (Meador and Kelso, 1990; Mizuno, 1993). Cast nets are thrown out in the area where the fish is observed or thought to exist. Due to the weights at the edge, it quickly sinks down to the bottom of the water (Brandt, 1984). Cast nets are used in fish sampling by scientific studies for ecological surveys and aquaculture purposes (Tago and Tsujimoto, 2006; Iguchi, 2012). MEGEP

(2008) has classified the cast nets under five groups; pocketed, pursed, shroud forms, cast nets with and with put strings.

Deep water cast nets are released from the boat into the sea and sank down to bottom with spread out like a parachute (MEGEP, 2008). The deep water cast net method to catch whiting is a small scale fishing method that can be conducted by one person. With a relatively long history, deep water cast net fishing is regarded as a traditional method of catching whiting that has been used since antiquity in the Black Sea. Studies on deep water cast nets was recently started and limited in the scientific literature. Emanet and Ayaz (2018), carried out surveys on the fishing performance of deep cast nets used for whiting off the coastline of Sürmene. In this study, it was aimed to define the structural and operational characteristics of traditional deep water cast nets used for whiting fishing in the Black Sea coasts of Turkey.

2. MATERIAL AND METHOD

The study was carried out in the Eastern Black Sea region during the fishing season between May 2017 and November 2017. The study data were collected in two stages; field operations and face to face interviews with fishermen who are using the deep water cast nets to catch. Field operations were conducted in Ordu region (Yalıköy, Medreseönü, Yason and Mersin Village) with the fishing boats used for deep water cast nets for whiting fisheries. In total 76 operations were carried out in 21 operation days throughout the field study. The interviews were conducted with small scale boats owners on the use of deep water cast nets and with the people in the region who made deep water cast nets at the fishing ports and shelters. Technical drawings of different types of cast nets were prepared under the scope of the survey.

3. RESULTS AND DISCUSSIONS

3.1. Traditional Deep Water Cast Nets

Traditional deep water cast nets are generally used from depth of 40 m to 140 m from May to December. An average of 4-12 kg of whiting can be caught per day, with the maximum amount 40 kg in one operation. Deep water cast net is a specific fishing gear for a given species; whiting in our case and quite selective for other demersal species. However, horse mackerel, red mullet, scorpion fish and some bivalves can also be captured as bycatch with these nets. According the fishermen, considering non-targeted catch ratio and survival rate of individuals; deep water cast nets was more beneficial than any of the other fishing gears. Fishermen state that fishing with this gear is a very profitable and may earn about 15.000 TL (1 $ = 6.72 TL) in a fishing season. Durability of the cast nets range between 2 or 3 years depending on the netting material and the bottom structure of the operation field.

3.2. Design Details and Technical Specifications

Deep water cast nets used in the region are made up by 7 panels. After joining the panels all together vertically, net takes the form of conical shape. Total depth of net varies from 4 to 4.5 m. The circumference and area of the net mouth is 16-20 m and 25-30 m^2. The effective coverage area of the net in the operations is about 20-30 m^2. The dry weight of the net is average 4.5-5 kg. The other details and specifications of nets are given in Table 1. The parts of deep water cast nets are structured as follows; netting, sinker line, sinker, brail lines, horn, swivel and pulling cord.

Netting

The nets are provided in three ways; by hand braiding in one piece, cut in desired sized panels and webbing together (commonly used) in the region or purchase a factory made nets. Netting material is made of white color polyamide (nylon) rope (multi-

filament) with 14-16 mm mesh size and thickness of 210d/6. Fabric nets with depth of 190 meshes are used for construction of deep water cast nets. The shape of each panel, are achieved by decreasing the number of meshes using different cutting methods. Two types of cutting method are used to shape the netting; point (N) and bar (B) cuts.

One piece of netting is cut from the upper and lower edge only N-cut along the 10 mesh, the remaining parts consecutively 1 N-cut and 2 B-cut (Fig 1). After the cutting process, one piece of panel has 20 meshes at the upper edge and 190 mesh at the lower edge (Fig 2). The piece of panel prepared by cutting are assembled together by joining made mesh to mesh. By combining the panels, the deep water cast net is completed which upper edge of panel 140 meshes and lower edge of panel 1330 mesh.

Table 1. Technical specifications of traditional deep water cast nets.

Design characteristics	Measurements and description
# panels	7 pieces
# meshes in depth	190 meshes
# meshes at the upper edge	140 meshes
# meshes at the lower edge	1330 meshes
Mesh size	14 - 16 mm
Height of net (h)	4 - 4.5 m
Circumference of net mouth	16 - 20 m
Area of net mouth	25 - 30 m^2
Dry weight of net	4.5 - 5 kg
Weight of per sinker	10 g
Sinker materials	Lead (Pb)
No of sinkers	220
Sinker line	spiral braid
Distance between sinker	7 cm
Pulling cord length	200 – 250 m
Pulling cord diameter	6 mm
Pulling cord material	PP twisted multifilament
Horn diameter	2.8 cm
Horn material	metal or plastic
Swivel material	stainless steel

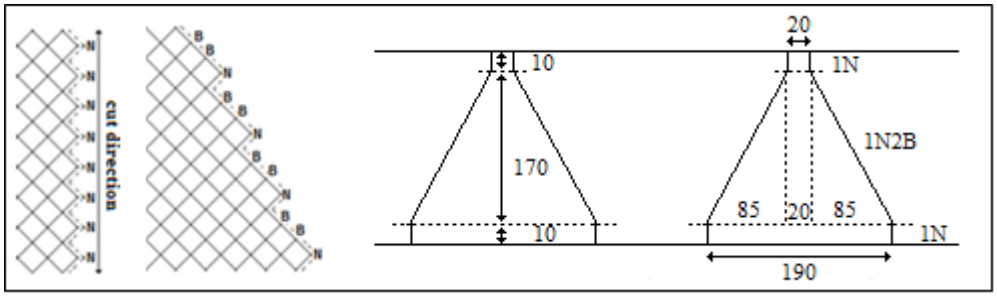

Fig 1. Preparation and the cutting for the mesh numbers at one piece of panel

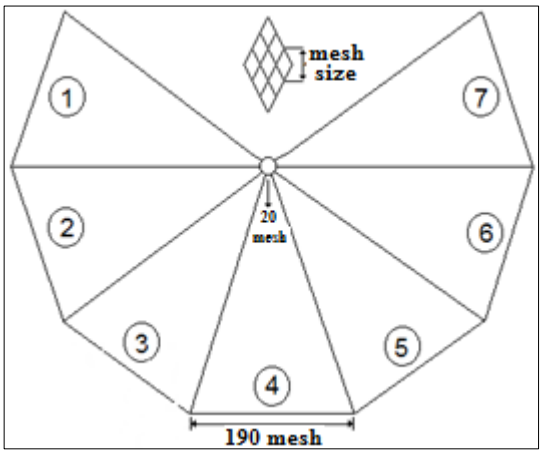

Fig 2. Whole view of cast net and joining the panel

Sinker Line

The sinker line is covering the fishes on seabed and prevents the escape of fish from the sides of the net. The sinker line is made from 18 no nylon rope by spiral braid on 100 no fish line. The purpose of using spiral braid and fishing line is to reduce of wear time and to prevent breakage of sinker line. After the competition of sinker line design, lower edge (selvedge) of net is webbed to brail lines (Fig 3).

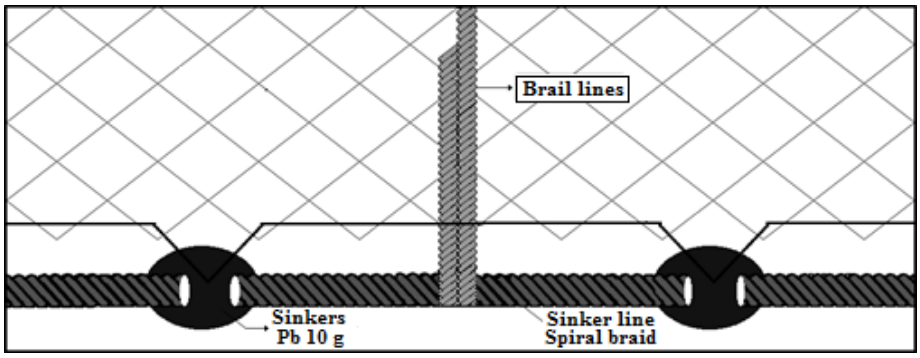

Fig 3. Sinker line and connecting to brail lines

Sinkers

The function of sinkers is to give weight for sinking faster to the deep waters. Oval shaped lead sinkers with the hole at center are attached to the sinker line at almost regular intervals. Total of 220 piece of sinkers, 10 g each are attached to the sinker line at a distance of 7 cm. Sinkers are fixed to sinker line to the 5th mesh by leaving 4 meshes empty (Fig 3). The sinkers are covered with spiral braid. If the cast nets are too heavy, the person who operates the cast the net may get too much tired. On the other hand, if it is too light, the nets may be affected by the external factors (ie. depth and surface currents or wind) and operation time may increase.

Brail Lines

Brail lines is an important part of a casting net which connected to sinker line and pulling cord. All brail lines go through in the metal ring and attached to swivel (Fig 4). Brail lines are gathering the net inward to trap all of catches inside of cast net. Cast nets usually consist of 20 brail lines joining

along the sinker line. There are 50-55 empty meshes between two sinker lines. The length of the brail lines should be at least 10 cm longer from the cast net height. If the cast net does not have enough brail lines, cast net will not close tightly, therefore, allows less catch than you expected.

Horn (Metal ring)

The horn with local name "godoş" in the region is the part that allows the sinker line of deep cast nets to open and close. This piece shrinks the bottom of the cast net by collecting the sinker line to trap the fish inside of the net. The horn is made of metal or plastic and the inner diameter is 2.8 cm. All brail lines pass through this ring that is located at the top of cast net (Fig 4). The upper meshes of net are joining the horn and in this way the cast net takes the conical shape.

Swivel

The swivel is made from stainless steel for preventing corrosion. Pulling cord and brail lines attached to the two sides of the swivel. Two free steel rings prevent clinching so the swivel turns right and left independently. In this wise it is reducing to likelihood intertwine of the pulling cord and brail lines with each another. Intertwining of the brail lines reduce the success of fishing operation and catch efficiency (Fig 4).

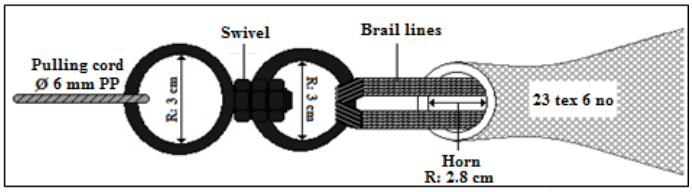

Fig 4. Horn, swivel and their connections to brail lines and pulling cord

Pulling Cord

Polypropylene (PP) twisted multifilament rope of 6 mm diameter was attached to the apex of the net. One side of the cord is connected to swivel to be used as pulling cord to haul the net. The pulling cord should be resistant to breakage and destruction. The length of the cord changes from 200 to 250 m length which varies according the depth of the operation, catch season or bottom infrastructures. Each boat must have a spare cord against breakage or lost.

3.3. Operation Stages

Cast net operation consists of the activities from the starting moment of the preparation of net for present fishing to the preparation of the next operation. Site selection is usually based on the place of the previous or first fishing operation and the information on the locations where successful operations were done in the same season in the past. The operation of a cast net requires considerable knowledge and skill from the fisherman. So, every stage of fishing operation is important in terms of catch efficiency and success of the operation. Main factors affecting the operation success are the type of bottom, depth, state of the sea, wind and deep currents. Knowledge of deep flow and speed of wind are the essentials for the successful operation for cast net operations. In case of the occurrence of both deep current and the strong wind speed, it is not advisable to operate the deep water cast nets. The duration of the operations varies according to the depth of fishing area and the meteorological factors of the sea. Deep water cast nets can be used by a single individual; however, when more than one individual is present, one person hurls the cast net and another person hauls the cast nets. In this way, 20 percent more

operations can be performed in per unit time. Deep water cast nets operations usually start in early morning hours and takes from 4 to 6 hours of work. The operation stages are examined as follows;

Before operation

Deep water cast nets kept in closed area are taken to the deck of the boat and the stowage pulling cord is connected to the swivel. The engine is taken to idler when arrived to the operation area. The swivel is lowered to the horn and the net is lifted up. The hydraulic reel that used to hauling the nets are activated and checked that the reel is running correct. If there are obstacles to catching, they must be eliminated.

Curling and hurling of deep water cast nets

The deep water cast net is held approximately 60 cm upper from the sinker line and the net is curled firmly (Fig 6a). The curling process is important for the success of the operation and catch efficiency. Otherwise, the net may not open properly when it is released. The sufficiently curled net is hurled upright on the water surface (Fig 6b). This process should be done in the opposite direction of the flow.

The first contact with water surface and downward into the water column

The deep water cast net should be vertically touched to water surface and it must be in rotating movement upon contacted to the water surface (Fig 6c). When the deep water cast net is hurled into the water, the net spreads out into a circular shape and open like a parachute (Fig 6d). The pulling cord should be kept tight enough until the net has completely settled to water bottom. It is necessary to make sure that the pulling cord is not dangerous for the fisherman during the hurling of nets.

Reaching to the bottom and captured the fish

When the deep water cast net reached the sea bottom, the pulling cord of the net is pulled strongly. In this way the mouth of the net closed into a sack like shape on the bottom. All organisms and fish swimming around will be captured under the mouth of the net (Fig 5). After this, the pulling cord is attached to the hydraulic reel for hauling the net. Meteorological conditions and sufficient depth are playing an important role for success of this stage. In uneven (stony and rocky) areas, the deep water cast net may not cover the seabed and captured fish may be escape under the sinker line.

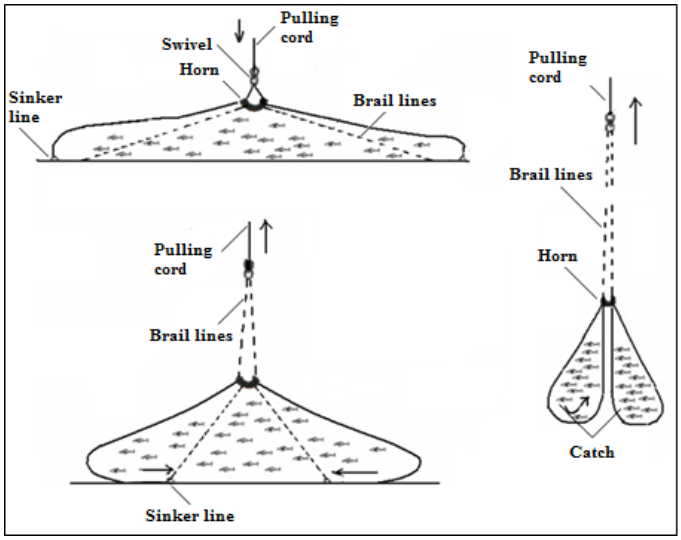

Fig 5. The captured stage of fishes

Hauling the deep water cast nets
Hydraulic reels on the head of the boat are used to the hauling of deep water cast nets (Fig 6e). The pulling cord should be hauling without interruption. The boat should be run slowly towards the direction of net. Otherwise, the pulling cord will be broken with the effect of wind and weight of the net. The pulling cord must be stored on deck of the boat in such a way that it cannot tangle and will not cause problems for the next operation. When more than one individual is present in the boat, one person haul the deep water cast net and another person stack the pulling cord.

Opening to bottom of deep water cast nets
When the hauling stage is complete, the engine is taken to the idler. The deep water cast net are removed from the hydraulic reel and transferred to the gunwale of the boat. The brail lines are opened from the sinker line to the swivel (Fig 6f). Swivel and horn are hold together to prevent escapes from the deep water cast net (Fig 6g). The net was carefully pulled out the water and cast net is placed on the deck of boat as closed.

Collection of catches from the net
The fish that are scattered in the deep water cast nets are gathered at the bottom of nets with the shaking movement (Fig 6h). It is necessary to take care not to crush the fish during this process. Captured fish are taken out of the net. If necessary, the fish are classified according to species and size groups. The catches are boxed to transfer to the land.

Preparation for the next operation
The deep water cast net and pulling cord must be properly stacked for the next operation. Sea weeds and the other organic and inorganic materials (stone, mussel shells etc.) are often collected within the cast nets during the operations. So, the deep water cats net should be clean from all objects (Fig 6i) for the next operation. During the operations, sharp objects such as crabs, sea snails, shells or stones can severely damage the meshes. So, it is necessary to check the meshes regularly and to repair in time when necessary. The deep water cast net should be washed with clean water (if possible with fresh water) and left to dry on the deck of boat (Fig 6j). The net meshes are sensitive and easily degraded by ultraviolet rays. Therefore, it must be kept away from the direct sunlight.

4. CONCLUSIONS

In this research it was aimed to define the structural and operational characteristics of the deep water cast net. The function of all parts and design details were given. The operation of a cast net requires considerable knowledge and skill from the fisherman. So, every stage of fishing operation is important in terms of catch efficiency and operational success. Type of bottom, distance of depth, and meteorological factors will be effect to operation success. The interview results indicate that the potential revenues of deep water cast net operations are beneficial for the artisanal fishermen. However, the deep water cast net was selective for whiting and other deep water organisms. But it can be an alternative fishing method for whiting along the Turkish Black Sea coasts. Future studies are needed for the efficiency and ecological effects of deep water cats net. The documented information of the traditional deep water cast net would serve as base line for the research studies in the future

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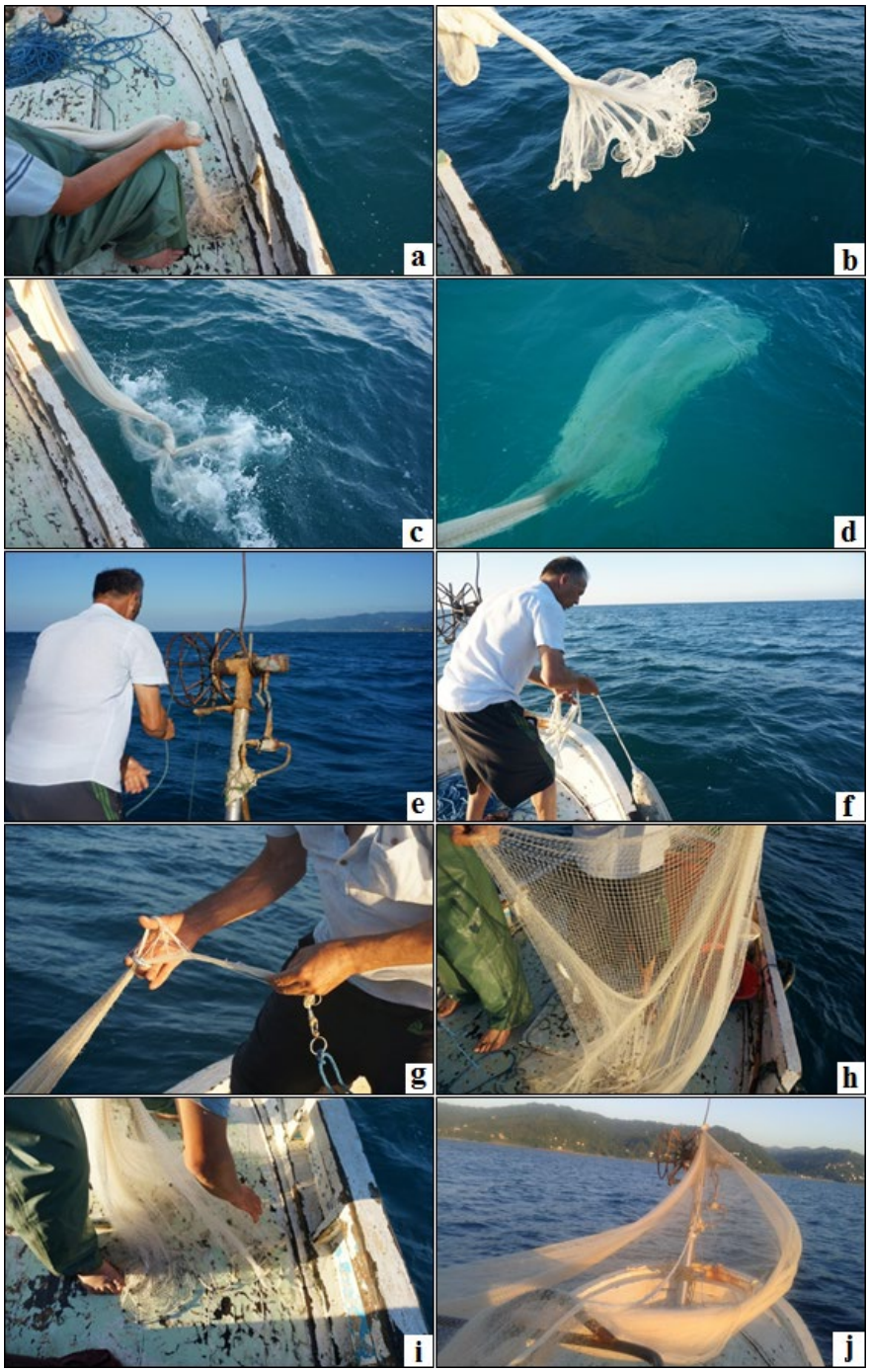

Fig 6. Some stages of deep water cast net operations (Ordu province, July 2017)

DISCLOSURE STATEMENT

The author declare that there is no conflict of interest.

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