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Ring-net Landings at Galle fishery Harbor, at South Coast of Sri Lanka with Special Reference to Trigger Fish Catches (*Canthidermis maculatus*)

Dulani Nadeesha Wickramanayake*, Indika Wickramarathne

Department of Animal Science, Uva Wellassa University, Badulla, Sri Lanka

Email address

wickramanayakadn@gmail.com (D. N. Wickramanayake)

*Corresponding author

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Abstract

Ring-net fishery which is mainly targeting medium sized pelagic fish has become popular in the south coast of Sri Lanka As no studies have been carried out to study the fishery and biology of trigger fish species in Sri Lanka, this study aims to evaluate the variations in ring net catch rates, total catch and length frequency distribution of *Canthidermis maculatus* landed at Galle fishery harbor from August to November 2017. Catch and effort data on ring net fishery were collected by making fortnightly field visits to the Galle fishery harbor. Trigger fish samples were collected randomly from the unloaded ring - net landings to estimate the morphometric parameters and length weight relationship. Monthly, as an average of 15 multiday boats operating ring- nets are landing at Galle fishery harbor. In ring- net caches *Thunnus albacares*, *Decapterus russelli*, *Katsuwonus pelamis*, *Canthidermis maculatus* were predominant. Ring- net catch rates variation ranged from 678.75 – 2872.6 kg per boat per trip while catch rates of *C. maculatus* were in the range from 89.37- 424.41 kg per boat per trip. The total ring net landings at the Galle harbor during the study were 855.8 tonnes of which contribution of *C. maculatus* was 197.37 tonnes. *Decapterus russelli* (Linna) showed the highest contribution (51%) to the total ring - net landings followed by Trigger fish (23.06%). Length and weight of *C. maculatus* ranged from 20.1 cm to 32 cm and 200.4 g to 600.1g, respectively. More than (75%) *C. maculatus* landed by ring- nets belonged to the length group of 25 – 30 cm. *C. maculatus* exhibits isometric growth (b=2.91). The observed variations in ring- net catch rates and contribution of *C. maculatus* to the fishery may be due to several reasons including the variations in number of multiday boats operated for ring net fishery, shifting of fishing grounds and seasonal variations in aggregation of these schooling fishes. This study indicates that *C. maculatus* is the second dominant species in the ring net catches landed at Galle fishery harbor.

Keywords

Catch Rates, Galle Fishery Harbor, Ring Net, Trigger Fish, Sri Lanka

1. Introduction

The fisheries sector in Sri Lanka is the primary source of animal protein production. According to the high population growth in Sri Lanka, fish food demand is increasing. To fulfill this demand should utilize fish effectively and in a sustainable manner. The use of the ring net, which is a type of surrounding net to exploit fish schools associated with naturally drifting objects is a recent development in the marine fisheries sector of Sri Lanka [1]. Initially, the ring net fishery was started in the sea areas off the south-west coast of Sri Lanka [2]. However at present most of the multiday boats operating from Sri Lanka frequently carry ring nets along with drift gill nets and tuna longlines [1]. Galle is the major harbor which ring net catches are landed frequently. Among the landings Trigger Fish catch are dominant in the catches. Although earlier Trigger fish were not interested to fisheries now it has become demanded due to its fresh flesh. According to the DFAR statistics in 2016 Galle fisheries

district is one of the district which provide high fish production to the nation. The ring net fishery is most commonly used fishing method in multiday boats fishermen in Galle fisheries district. The identification of Trigger fish and the catch composition in the ring net will be useful to fish production. The pelagic fish species attracted to FADs and floatsm differ from those caught by conventional fisheries such as drift gill netting and tuna longlining [3] Although ring net fishing activities have expanded in to many geographical areas off the coastal waters of Sri Lanka, limited information on catch composition, species diversity of targeted fish species [4] However, no studies have been carried out to study the species diversity, catch composition, biology or fisheries of Trigger fish species which are frequently landed by ring nets. Therefore this study is focused on catch composition, variations in ring net catch rates, total catch and length frequency distribution of *Canthidermis maculatus* targeted by ring nets.

2. Materials and Methods

2.1. Study Area

Study was carried out in "Galle" fisheries harbor (latitudes 0° and 8°N and 75° and 80°E in the East Arabian Sea region and between 0° and 15°N and longitudes 80° and 85°E in the Bay of Bengal region of the Indian Ocean), Galle fisheries district by interviewing off-shore multiday fishermen. The "Galle" fisheries harbor is one of the most famous, largest as well as main fishing harbor in Galle fisheries district and it gives a great contribution to increase fish production by deep sea multiday fishing. Normally, the total annual fish production is around 44,844 Mt [5]

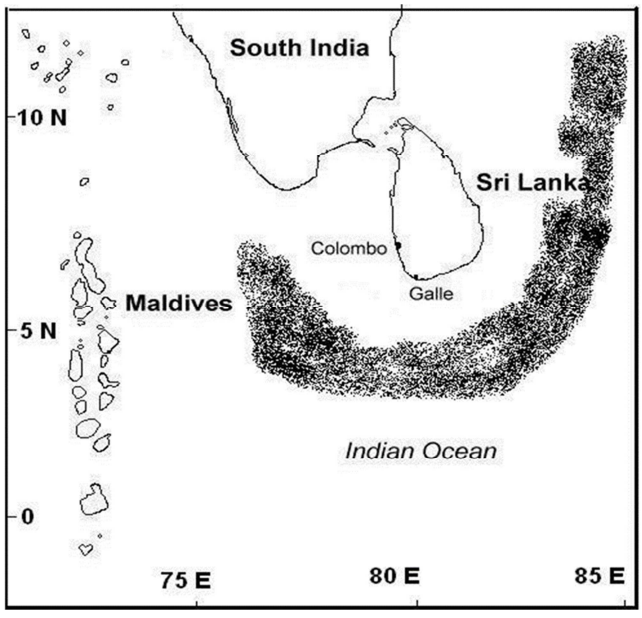

Figure 1. *Location of Galle fishery harbor in Sri Lanka and fishing areas associated with floatsam.*

2.2. Sampling Method

The data were collected from multiday fishing boats in Galle harbor by making fortnightly field visits to the fishery harbor. On each sampling day, 50-60% of unloaded multiday boats operating with ring nets were sampled randomly in the fishery harbor. Samplings were made as soon as the unloading process.

2.3. Data Collection

2.3.1. Catch and Effort Data

Catch data and total number of multiday boats operating with ring nets targeting flotsam- associated fish schools were collected at the Galle fishery harbour, south coast of SriLanka where all most all associated catches are unloaded.

Data were collected on bi-weekly field visits to Galle harbor from August to November 2017. On each sampling day, 50% - 60% of unloaded multiday boats operating with ring nets were sampled randomly in the fishery harbor. Samplings were made as soon as the catches were unloaded. The total number of multiday boats landed (total fishing effort) and those operating with ring nets (fishing effort for ring nets) were counted and recorded each sampling day. Skippers who used ring nets as their principal fishing gear were interviewed for information on the number of days at sea (trip duration), the actual number of fishing days, vessel size, plus other types of fishing gear used except ring nets during each fishing operation.

Collected catch and fishing effort data were used to calculate the ring net catch rates (CPUE). In this analysis, the catch per boat per trip (Kg) was taken as the CPUE by assuming that there were no partial landings of unloaded boats. Monthly total fish landings (MTP) of ring nets were estimated using the equation:

$$MTP = CPUE \times NFO \times MRD$$

Where, MTP- Monthly total fish landings from ring nets; CPUE – Mean catch per multiday boat (operated for ring nets) per trip; NFO – Average number of multiday boats with ring net catches landed at the Galle fishery harbor per day; MRD – Total number of days that multiday boats with ring net catches unloaded at the Galle fishery harbor each month.

2.3.2. Morphometric Data

Morphometric data of five species: *Thunnus albacares, Decapterus russelli, Katsuwonus pelamis, Canthidermis maculatus* predominant in the ring net catches during the study period were collected. Length weight measurements of predominant species *Canthidermis maculatus* were taken to estimate length weight relationship. In the laboratory, total length (TL) of each specimen was measured to the nearest 0.1 cm using a measuring board and total body weight (BW) taken to the nearest 0.1.

2.3.3. Lunar Effect Data

In order to see the lunar effect on catches sampling was conducted 2-3 days after full moon and new moon period.

3. Results

Ring Net Fishery

3.1. Fishing Gear and Method

Most of the multiday boats operated from Sri Lanka tend to carry gill net, longline and ring net as their major fishing gear. Among these, multiday boat fishers who fish off the south coast of SriLanka use ring nets extensively [6].

The ring net structure is very similar to the purse seine net. The net is around 200 m long and is hung between the head rope and lead line. The head rope is made of 8 mm Ø nylon while the lead line is made of 8 mm kuralon. Floats are attached to the head rope at 50 cm intervals, but in the bunt area the interval ranges from 20 to 25 cm. Around 120 -130 buoys are attached to the head rope at equal intervals. Both floats and buoys are attached to the head rope by a separate nylon rope. Cylindrical lead weights, each 20 mm Ø and 60 mm length, are attached to the middle area of the rope at about 50 m from either end of the net. The purse seine bridles are made of 12 mm Ø kuralone and are attached to the lead line at 7m distance. The purse rings are made of 100 mm Ø brass, and each weight ranges from 300 to 900 g. The 12 mm Ø kuralone purse line passes through these purse rings. The length of the wing and bunt is circa 160 and 40 m, respectively. Greatest depth of the net is about 80 m. The size of the multiday boats that are used to operate ring nets range from 32 to 56 feet (circa 9.8 – 17 m) and the average trip is around 8-10 days long.

Ring net fishers normally seek naturally drifting objects, such as logs in the sea. When such objects are sighted, they are encircled by a ring net and fish are captured using large scoop nets. When there are more fish than the storage capacity of the boat, the skipper notifies other nearby multiday ring net boat skippers via a radio telecom system to catch the remaining harvest. However, in such a situation, the second boat pays 50% of the income generated through the ring net catch to the first boat. In some instances, fishermen carry logs on their vessels to float in the sea and attract pelagic fish schools. Once the fishing operation is finished, the used log is sold to a nearby vessel and there by the weight of the vessel is reduced and an additional income is generated [7].

Usually 3-4 fishermen are on-board in the ring net multiday fishing boats. From the total income, 50% goes to the boat owner and the remainder is distributed equally among the crew members [8].

3.2. Major Fish Species Landed by Ring Nets

Six fish species belonging to three major families: Scombridae, Carangidae and balistidae, were identified in the ring net catches during the study period (Table 1) of these six species two belonging to the family Scombridae

Table 1. *Major fish species landed by ring nets at Galle fishery harbor, Southcoast of SriLanka, August - November 2017.*

Family	Species	English Name	Sinhala Name
Scombridae	*Katsuwonus pelamis*	Skipjack Tuna	Balaya
	Auxis thazard thazard	Frigate Tuna	Alagoduwaa
	Euthynnus affinis	Mackerel Tuna	Atawalla
Carangidae	*Decapterus russeli*	Indian scad	Linna
Balistidae	*Canthidermis maculatus*	Trigger fish	Muhudukukula

3.3. Variations in Fishing Effort, Catch Rates and Total Landings of Ring Nets

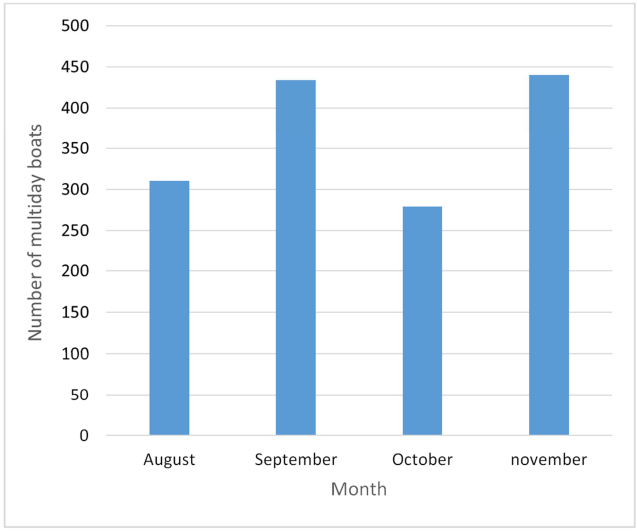

Figure 2. *Monthly variations of ring net operated multiday boats.*

On average 24 multiday boats landed at the Galle fishery harbor were operated for floatsam associated ring net fishery off the South coast of SriLanka each month. However, there were some large fluctuations in a number of ring net – operated multiday boats over time, with the highest number reported in November and the lowest in October (Figure 2). An average trip duration was around 8-10 days long.

Monthly variations in average catch rates of the three major fish groups in the family scombridae (tuna), Carangidae (Indian scad) balistidae (Trigger fish) were compared. The highest catch rate was in species belonging to the family carangidae, followed by scombridae; it was evident that those catches were significantly higher than the other two groups (ANOVA: d.f = 3, $P < 0.05$).

Total fish production at Galle harbor in 2006 is around 44844.774 Mt [9]. As a fisheries district Galle contributes about 20% to the Marine fish production in Sri Lanka. During the study period total Ring net landings were recorded as 855.8 tonnes of which contribution of *C. maculatus* was 197.37 tonnes. The highest landings of trigger was recorded in September (Figure 3). Therefore Galle fishery harbor mainly contributing to increase marine

fisheries production to the nation.

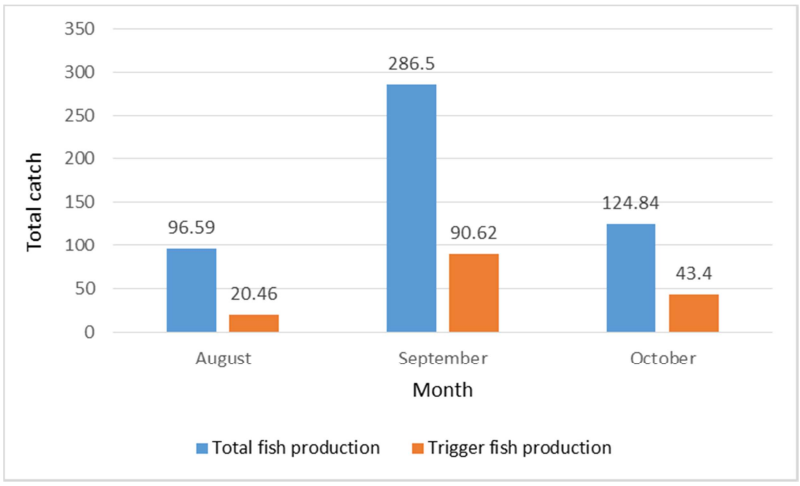

Figure 3. *Total fish production during study period.*

3.4. Catch Composition of Ring Nets landings

Species belonging to the family carangidae had the highest percentage contribution (44%) to the total ring net landings at the Galle fishery harbor. The percentage contribution of tuna to the total ring net landings was 17% and that of trigger fish and lenawa fishes 23% and were 14% respectively.

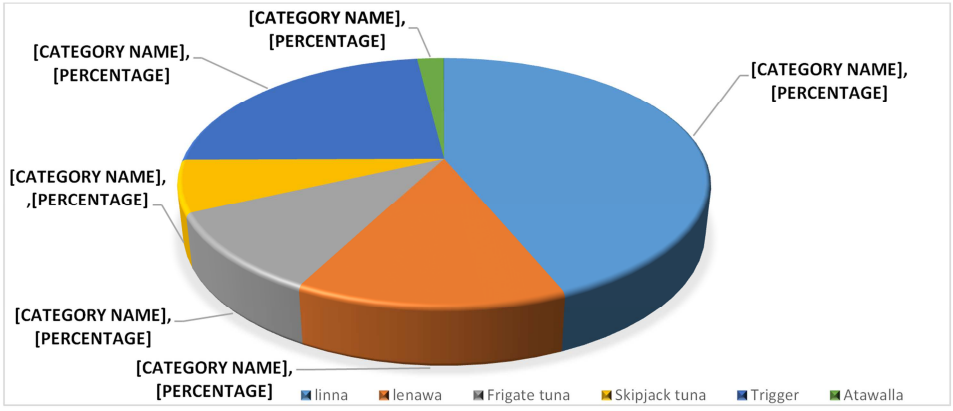

Figure 4. *Species composition of ring-net during the study period.*

Figure 3 depicted that monthly variation in Ring- net catch rates variation ranged from 678.75 – 2872.6 kg per boat per trip while catch rates of *C. maculatus* were in the range from 89.37- 424.41 kg per boat per trip, with the lowest in November and highest in September.

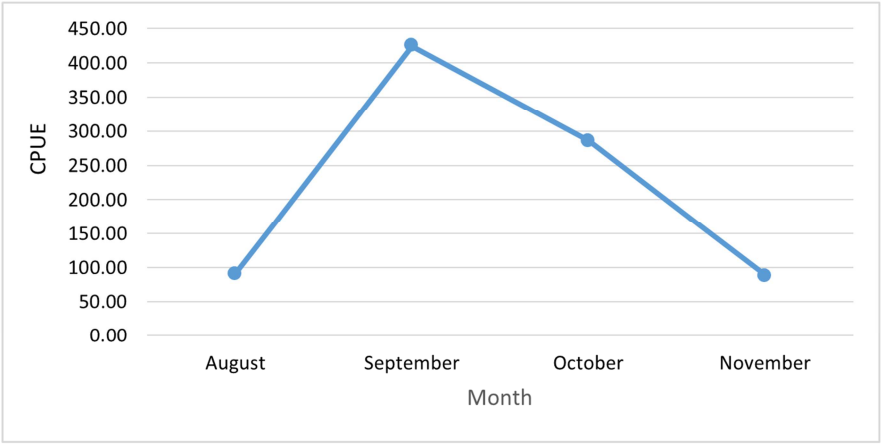

Figure 5. *Trends of CPUE (Catch per boat per trip in Kg) of Trigger fish.*

3.5. Population Parameters of *C. maculatus*

The parameters of a and b of LWR of *C. maculatus* sample was estimated using the logarithmic transformation of the equation $W = a L^b$

Table 2. *Statistics for LWR.*

r	a	b	p	R^2
0.955	0.0119	2.91	0.000	0.913

According to the regression the LWR equation is:

$$W = 0.0119\ L^{2.91}$$

Regression was highly significant with the coefficient of determination $R^2 = 0.913$ and P (0.000) < 0.05. The b value was 2.907. (nearly equals to 3) and a value was 0.0119. This implies that the cube law can be applied to *C. maculatus* species.

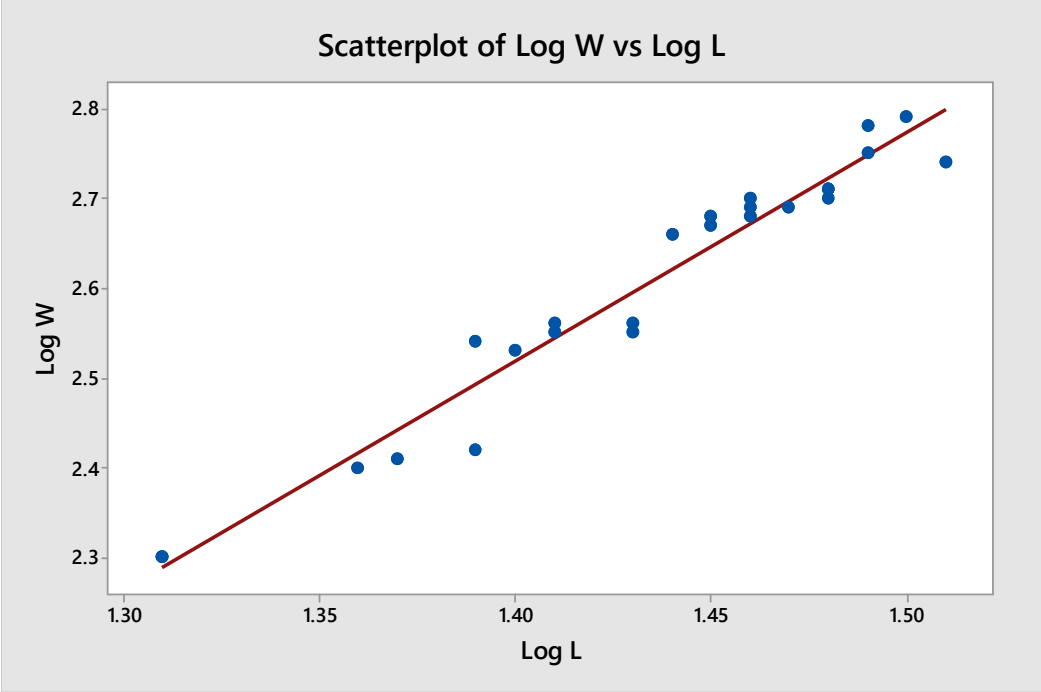

Figure 6. *Length Weight Relationship of Trigger fish (C. maculatus).*

3.6. Length Frequency Distribution

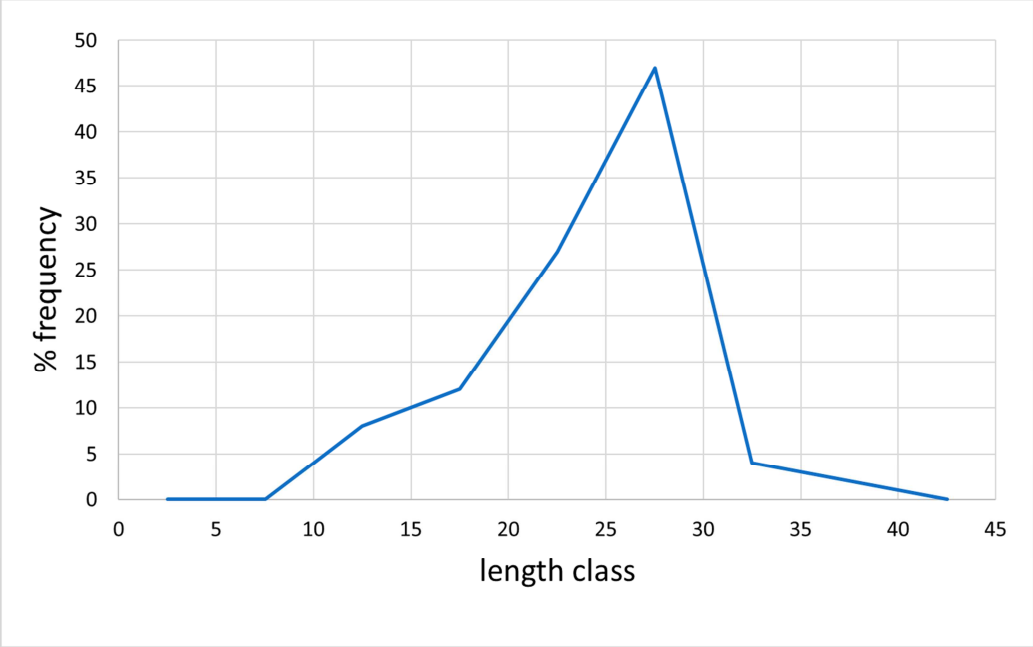

Figure 7. *Length frequency distribution of trigger fish.*

3.7. Lunar Effect on Exploitation Rate of Trigger

As t test results for the effect of lunar on exploitation rate of Trigger was significant ($P<0.05$). It implies that during full moon and new moon days catch rates become vary. Spring and neap tides occurred in the ocean may be the reasons for variations in catch rates of Trigger fish.

4. Discussion

The landings of floatsam associated fisheries are not reported as distinct fishing gear categories in the official fisheries production statistics [10]. The catches of surrounding net fishing consisted of fish species such as *Thunnus albacares, Decapterus russelli, Katsuwonus pelamis, Canthidermis maculatus*. According to the result of this study it has revealed that species belonging to the family Carangidae showed the highest percentage contribution to the total ring net landings, followed by Balistidae. Trigger fish contributes 23% percentage contribution to the total ring net landings.

These Trigger fish species are very important since they contributes highly to ring net landings. Trigger fish species were consumed in both fresh and dried forms and ring net fishing method was widely used popular fishing method among fishermen at Galle harbor as it generates high production of medium sized pelagic species.

Ring net operated fishermen tend to spend high trip duration according to this study so as to increase the catch of these FAD aggregating schooling fish species. As these species are not generally caught in other fishing methods [11], these fish species as mentioned by Joseph (1993), can be considered as underexploited. The species caught in the fisheries associated with floating objects in Sri Lanka are similar to those species caught around in other regions.

When considering catch per boat in terms of kilograms, the highest trigger fish catch was recorded in September. CPUE in terms of Kg per boat per trip seemed to have decrease from September to November 2017. The remarkable variations in ring net catch rates observed during the study period may be due to either differences in the aggregation behavior of fish around floatsm or variations in the number of multiday boats operating with ring nets.

Trigger fish length - weight relationship was significant and exhibited isometric growth. According to the results from t test, there is a significant effect of lunar on exploitation rate of trigger fish. Usually lunar effect on the occurring of spring and neap tides in the ocean. That may be the reason for the variation of catch rates in full moon and new moon days.

This study does have some limitations, as the ring net fishing efforts were estimated by considering the number of multiday boats landed at fishery harbor. However, more precise catch and effort information could be collected if researcher was on- board. At the landing point in Galle fisheries harbor, sometimes species-specific weight data could not be recorded because crew members, who work for wages, were reluctant to provide catch data without permission of boat owners. According to crew members, there were no discards at sea.

There's a great potential to increase the production of Ring fishery for medium sized pelagic fish species at Galle fishery harbor. It will helps to increase the income of fishermen and also fulfill the protein supplement of consumers. Different processing methods for trigger fish, value chain analysis of trigger fish are the future scopes for researches regarding trigger fish.

5. Conclusion

As per the results gained from this study in ring- net caches *Thunnus albacares*, *Decapterus russelli, Katsuwonus pelamis*, *Canthidermis maculatus* were predominant. Ring-net catch rates variation ranged from 678.75 – 2872.6 kg per boat per trip while catch rates of *C. maculatus* were in the range from 89.37- 424.41 kg per boat per trip. *Decapterus russelli* (Linna) showed the highest contribution (51%) to the total ring - net landings followed by Trigger fish (23.06%). Length and weight of *C. maculatus* ranged from 20.1 cm to 32 cm and 200.4 g to 600.1g, respectively. More than (75%) *C. maculatus* landed by ring- nets belonged to the length group of 25 – 30 cm. *C. maculatus* exhibits isometric growth ($b = 2.91$). The observed variations in ring- net catch rates and contribution of *C. maculatus* to the fishery may be due to several reasons including the variations in number of multiday boats operated for ring net fishery, shifting of fishing grounds and seasonal variations in aggregation of these schooling fishes.

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