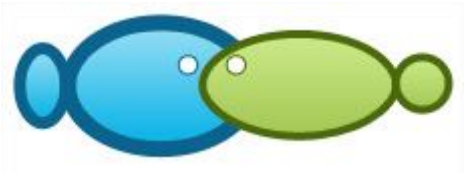

Study on the effect of scoop net towards *Stolephorus indicus* and *Sardinella fimbriata* capture in Cilacap waters, Indonesia

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Abstract. Scoop net is an artisanal fishing gear used by fishermen in the waters of Cilacap, Indonesia, specifically to catch *Stolephorus indicus* and *Sardinella fimbriata*. The opearation of scoop net used a halogen lamp, one piece of electric power of 500 watts, and concave and conical reflector types. The use of a lamp reflector was adjusted to the target catch of *S. indicus* or *S. fimbriata*. The purpose of this research was to analyze the scoop net, using an attractor lamp with different reflector types to capture *S. indicus* and *S. fimbriata* in the waters of Cilacap, Indonesia. The research was carried out in January to February 2020, fishing areas were at 109°1'30"-109°3'0" E and 7°45'0"-7°46'10" S, with a descriptive research method. The distribution of light illumination in lamps with conical and concave reflector types was 64-8 lux and 1001-10 lux, respectively. The total catch of *S. indicus* obtained using a conical reflector was 12896 kg, on a concave reflector it was 6518 kg. While the catch of *S. fimbriata* obtained 11904 kg (conical reflector) and 2958 kg (concave reflector). It can be concluded that the scoop net with the help of a conical type reflector can collect *S. indicus* over a large area so that it can catch more *S. indicus*.

Key Words: Cilacap waters, reflector lamp types, *Sardinella fimbriata*, scoop net, *Stolephorus indicus*.

Introduction. Cilacap waters are the largest area in Central Java Province, located in the southern part of Java Island (109°1'30"-109°3'0" E and 7°45'0"-7°46'10" S) and has a coast lenght of 105 km^2. In addition, some of the important economic commodities for small pelagic fish resources include *Stolephorus indicus* and *Sardinella fimbriata* (Nurfiarini et al 2015; Sartimbul et al 2021). The general condition of fishermen in this area involves the traditional (artisanal) techniques with floating means, using a 3 GT boat featuring a motor temple (Patria et al 2014; Alam et al 2021). Moreover, the generally adopted fishing gears include the gill net and Danish seine used during the day, as well as the scoop net employed at night (DKP 2018).

The capture of *S. indicus* and *S. fimbriata* in Cilacap waters requires the application of a scoop net (Anggawangsana et al 2014). In Cilacap waters, scoop net is adopted as the main fishing instrument in construction, operating techniques and fish yield profitability (Adiyanto et al 2018). The entire process is performed through the year, although October to December have generally been classified as the peak catch season for both species (Puspito et al 2017).

The scoop net is constructed with a triangular frame (Muthmainnah et al 2016), while a halogen lamp with two reflector types, including the concave and conical served as capture aid. Furthermore, lights are one of the modern and relatively effective techniques with effect on fish behavior (Nguyen & Winger 2019), aimed to attract attention, and also facilitate assemblage around the fishing gear (Jayanto et al 2016; Chairunissa et al 2018). The target species are captured by this attractor through positive phototaxis, including *S. indicus* (Fitri et al 2018) and *S. fimbriata* (Ahmad et al 2013; Solomon et al 2016). Moreover, the inherent reflectors are usually used to concentrate

light into the water column. This centering process helps fishermen to collect the selected fish in a catch area and also eases the hauling process (Gabriel et al 2005).

The aim of this article, therefore, is to analyze the scoop net, using an attractor lamp with different reflector types to capture *S. indicus* and *S. fimbriata* in the Cilacap waters, Indonesia.

Material and Method

Description of the study site. The study was conducted in Cilacap waters. Therefore, data was collected from January to February 2020 in the Cilacap waters, Indonesia, during the peak catching season, and the fishing ground spans through a 2 miles distance from fishing base. Figure 1 shows the Cilacap waters location. There were two ships involved in the study, namely ship 1 using a conical reflector and ship 2 using a concave reflector. Total trips during the study were 30 trips.

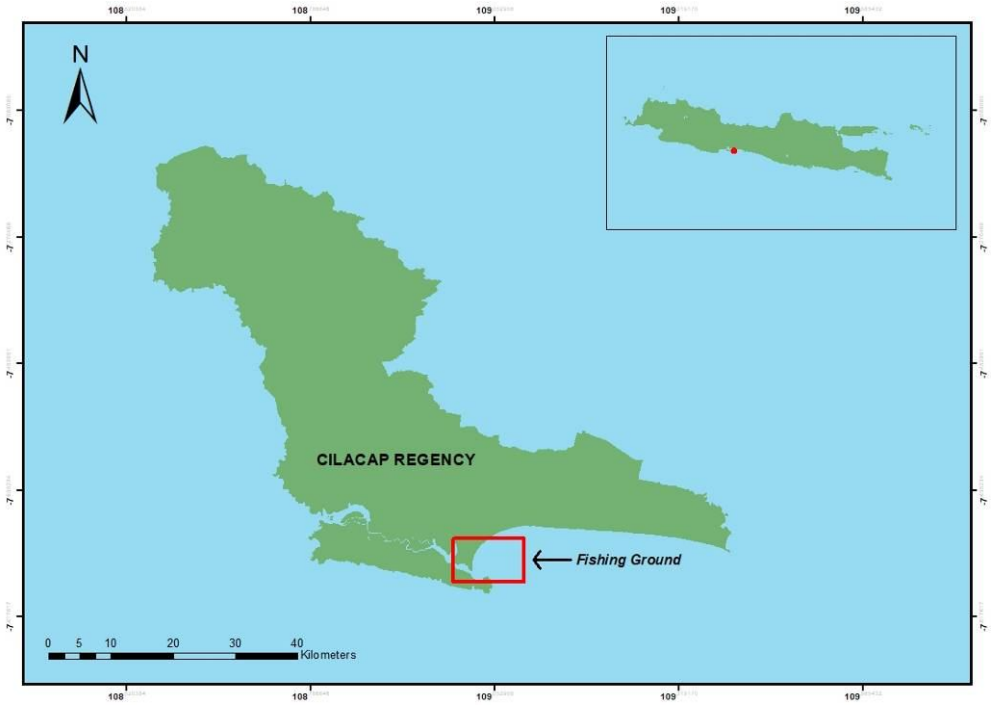


Figure 1. Map of data collection locations.

Figure 2 shows halogen as the type of lamp used (Figure 2), featuring a single electric power of 500 watts, while the reflector was constructed based on the concave and cone types (Figure 3). The specifications for conical and concave type reflectors are presented in Table 1.

Figure 2. Halogen lamps.

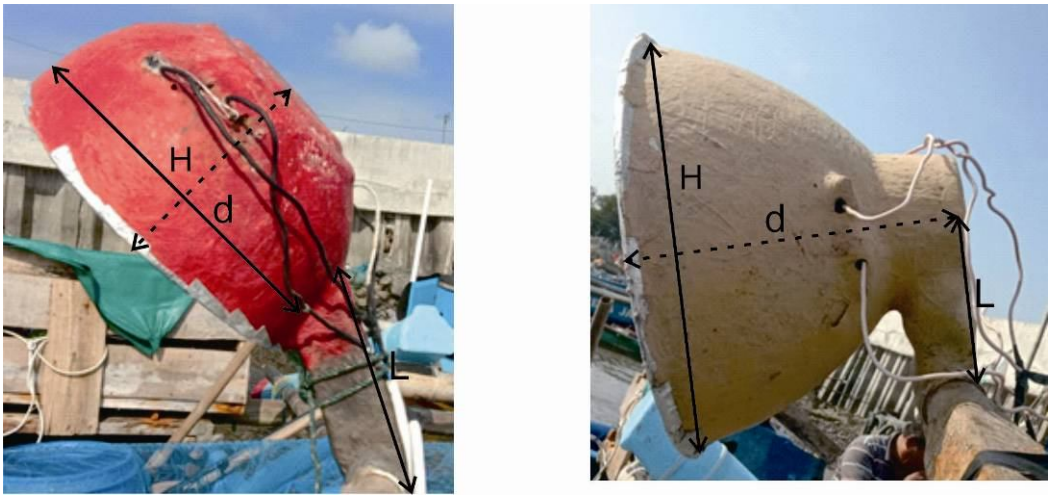


Figure 3. (left) Concave type reflector; (right) Conical type reflector (personal documentation, 2018).

Table 1

Specification for concave and conical type reflectors

No.	*Reflector part*	*Concave type*	*Conical type*
1	Reflector length (L)	7.08 inches	7.08 inches
2	Reflector height (H)	5.90 inches	5.11 inches
3	Reflector diameter (d)	11.81 inches	11.02 inches

Figure 4 and Figure 5 show the use of scoop nets with triangular frame constructed with bamboo to catch *S. indicus* and *S. fimbriata*, based on specifications depicted in Table 2.

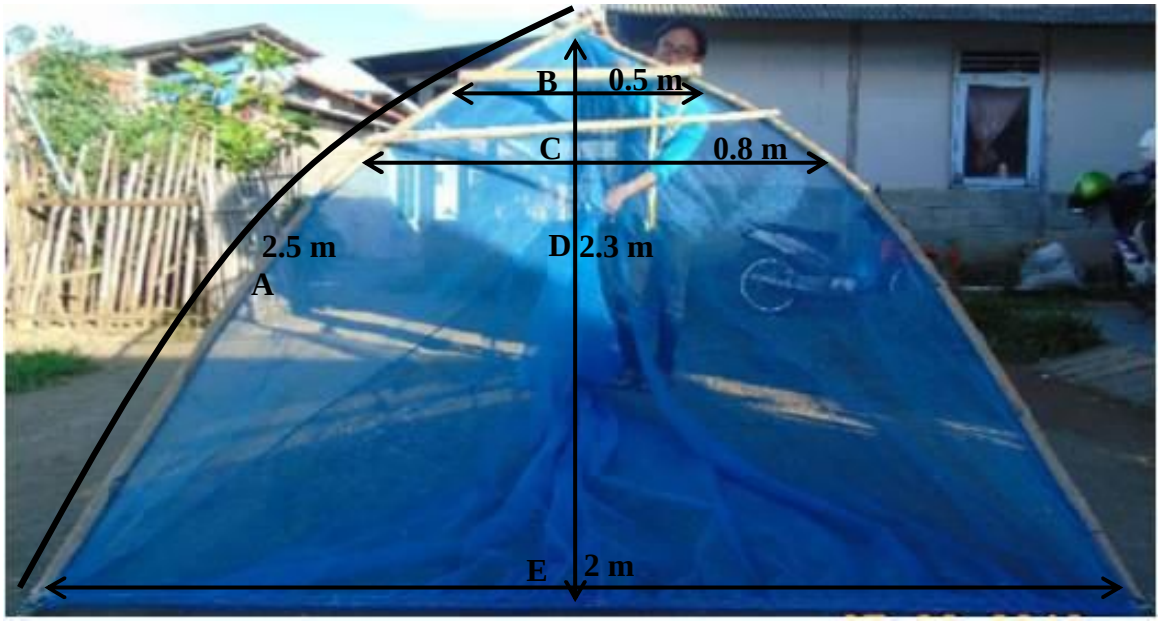


Figure 4. Scoop net from the front (personal documentation, 2018).

Figure 5. Scoop net from the side (personal documentation, 2018).

Figure 6 shows the fiber boat used for scoop net fishing operations, based on the scoop dimensions shown in Table 2.


Figure 6. Boat used for *S. indicus* and *S. fimbriata* fishing operations by using scoop net (personal documentation, 2018).

Table 2

Specification of scoop net

No.	*Part*	*Length*	*Diameter*	*Type of material*
1	Frame (A)	2.5 m	0.03 m	Bamboo
2	Handle (B)	0.5 m	0.03 m	Bamboo
3	Handle (C)	0.8 m	0.03 m	Bamboo
4	The height of scoop net (D)	2.3 m	0.004 m	Polyethylene
5	Bottom length (E)	1.8 m	0.004 m	Polyethylene

Table 3 shows principal dimensions of the boat used in the operation of the scoop net.

Table 3

Principal dimensions of the boat

No.	*Description*	*Dimension*
1	B max	1.25 m
2	B	1.14 m
3	Height	0.76 m
4	LoA	9.40 m
5	LdL	7.4 m
6	Engine capacity	20 HP

B max = maximal width; B = widht; LoA = overall length; Ldl = deck line length.

Data analysis. Scoop net catches with two different types of reflectors were then analyzed using the one-way ANOVA test and T-test to scientifically prove whether there is an effect of the type of reflector shape on the catch. Data analysis used the SPSS 25.0 application. The hypotheses formulated are as follows:

- H0: there is no effect of the shape of the reflector on the catch using scoop net fishing gear;
- H1: there is an effect of the shape of the reflector on the catch using scoop net fishing gear.

The decision-making criteria based on the significant value in this hypothesis are as follows:

- if the value of sig < 0.05 then H0 is rejected while H1 is accepted;
- if the sig value > 0.05 then H0 is accepted while H1 is rejected.

Figure 7 shows the scoop net operation stages, as one catch trip is embarked on daily. Furthermore, each movement was set by the alternate use of both reflectors (conical and concave). The average calibration for each lamp was 2 times, with a total of 30 times during this study, while the operation generally ensued at a depth of 5-8 meters.

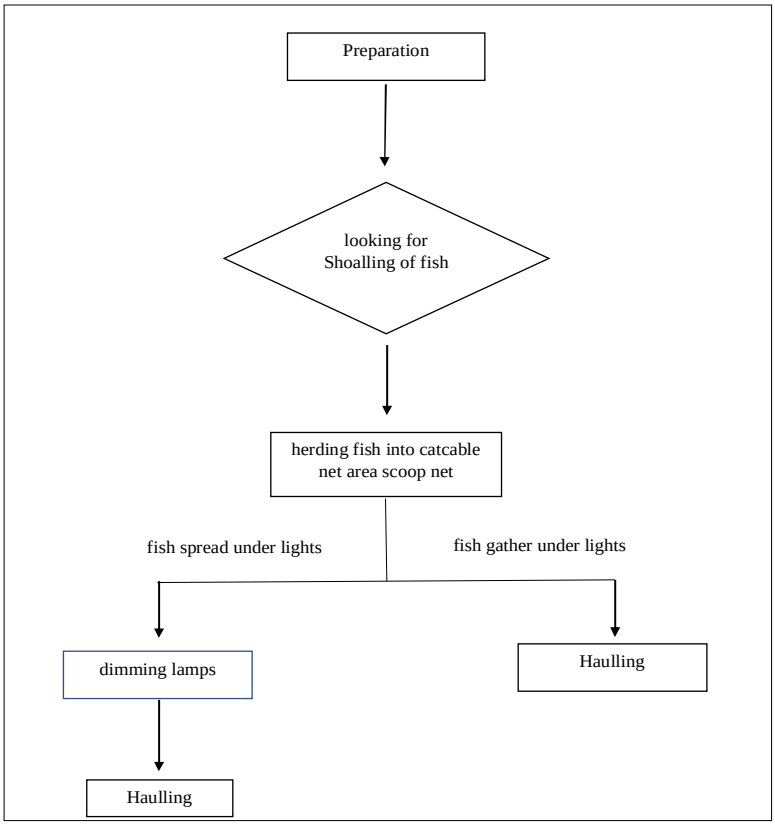


Figure 7. Stages of scoop net catching operation.

Results. Figure 8 presents the light illumination measurement results obtained using a conical and concave type reflector.

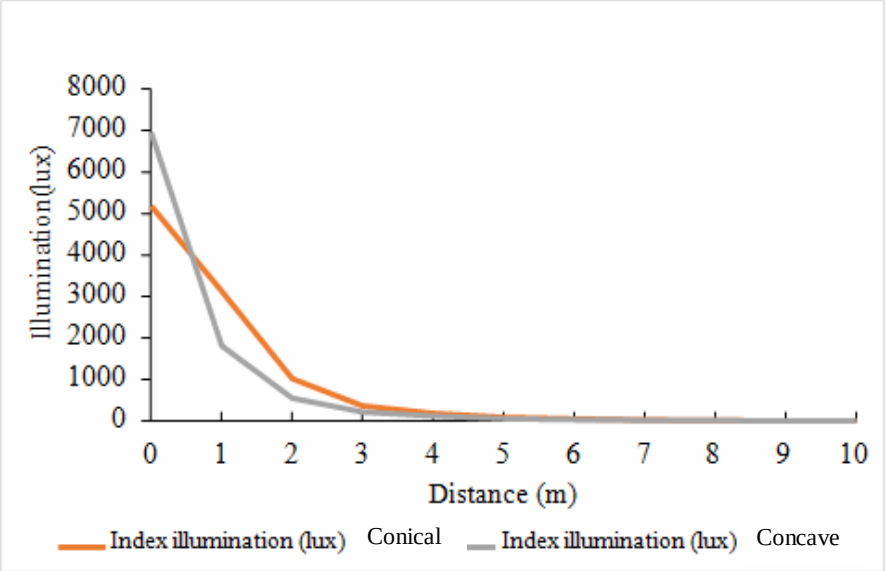


Figure 8. The measurement graph of light illumination with cone and concave type reflectors.

The different reflector shapes are known to influence the distribution and reflection of light. In addition, the conical reflector scatter pattern has greater focus at a single point, and is observed in a narrower area. The decline in light intensity appeared more significant in contrast with concave reflectors, which featured more even and horizontal distribution (Puspito et al 2017). Based on the reflected illumination value, the conical variant was observed to have better reflection, despite the inverse expectations in theory. This outcome is influenced by the shape of the reflective plane on the conical reflector, estimated to be narrower than the concave form (Ahmad et al 2013). Furthermore, the distance between lamp position and reflecting wall is also known to significantly influence the result. The narrow construction recorded with conical reflectors ensures higher light penetration into the water (Puspito et al 2015). Hence, the reflectors' inner wall surface is coated with silver paper, to attain higher reflected light intensity. Figure 9 shows the light scatter pattern on both reflectors.

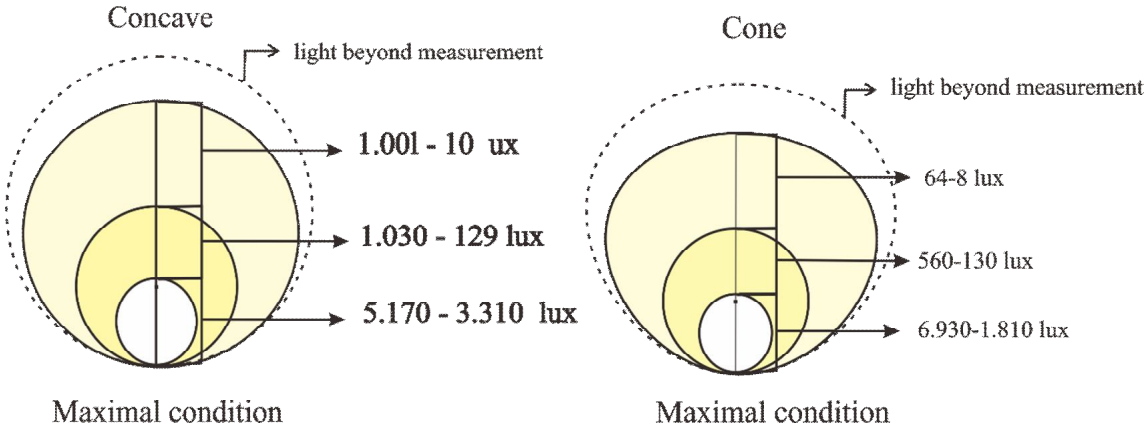
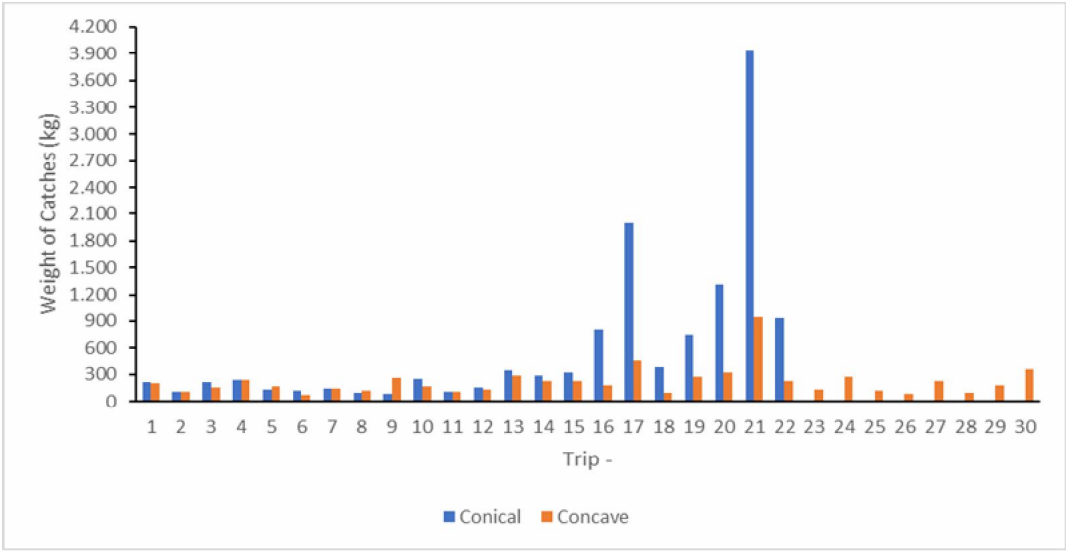


Figure 9. Spread of light illumination on lamps with conical and concave reflectors.

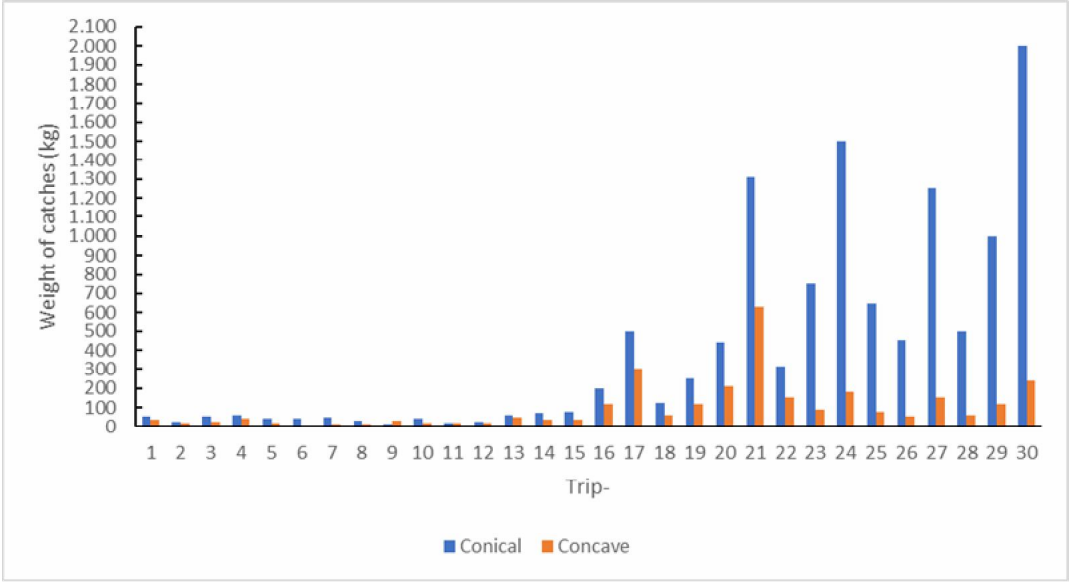
The focus area of light (with the highest illumination) obtained with both reflectors were in the range of 0-1 meter. This is an ideal distance, known as the scoop net catchable area, because crew members positioned in charge of operation were two meters away from the installation.

The conical light reflector provides a more significant impact on the catch of both species under investigation, compared to the concave reflector. The total catch of *S. indicus* obtained using a conical reflector was 12896 kg, on a concave reflector it was 6518 kg. While the catch of *S. fimbriata* obtained 11904 kg (conical reflector) and 2958 kg (concave reflector).

Figure 10 shows the average catch weight of *S. indicus* and *S. fimbriata* on the scoop net with different types of lamp reflectors.



(a)



(b)

Figure 10. Catches of (a) *S. indicus* and (b) *S. fimbriata* on the different types of lamp reflectors at each setting.

Figure 11 shows the difference between the catches of *S. indicus* and *S. fimbriata* in the use of conical and concave reflectors. Based on the graph, it can be seen that the catches obtained using a conical reflector are relatively higher when compared to a concave reflector.

This result is strengthened by the results of the ANOVA test (Table 4), the significance value is 0.005 < 0.05 (H0 is rejected), so it can be concluded that there are differences in the use of different lamp reflectors.

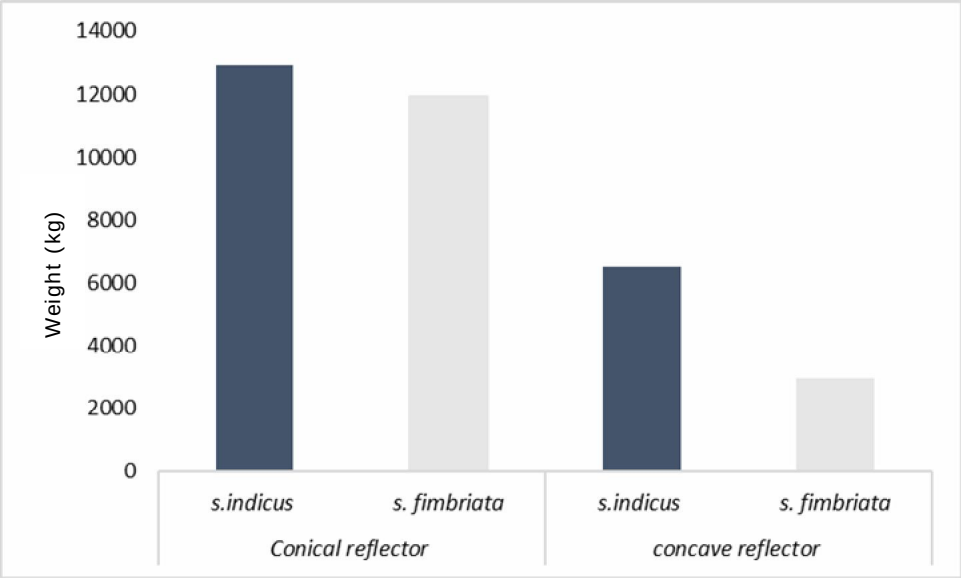


Figure 11. The average catch of *S. indicus* and *S. fimbriata* on different types of lamp reflectors.

Table 4

Summary details of the ANOVA test for checking the statistical differences between two groups of experiments

The catches	*Sum of squares*	*df*	*Mean square*	*F*	*Sig.*
Between groups	1956874.800	1	1956874.800	8.269	0.005
Within groups	27923864.197	118	236642.917		
Total	29880738.997	119			

Discussion. The scoop net is classified as an artisanal fishing gear in the Cilacap area, due to the simplicity in design, construction and operation. According to Manna et al (2011) this tool does not function as an aid to obtain catches, but as an instrument involving the use of floating means, with a boat. Generally, scoop nets are operated in coastal areas (Lawrence & Bhalla 2018) with a fishing ground distance of about 3 miles. The main catch of scoop net is small pelagic fish (Bhakta et al 2016; Ravikumar et al 2016), such as *S. indicus* and *S. fimbriata*. Both species are attracted to light. According to Syah & Abdillah (2021) the catch of the boat lift net consists of groups of small pelagic fish that are phototaxis, such as sardines, anchovies, tuna and other small fish species, which at the juvenile stage have positive phototaxis properties (Fitri et al 2019; Foss et al 2020).

The catch of scoop net is relatively more homogeneous in one fishing trip; in Figure 10 the catch shows that by-catch is not obtained during the fishing process. This is different from fishing gear that also uses light aids, such as stationary lift nets (Puspito et al 2017), boat lift nets, longlines (Afonso et al 2021) and purse seine (Nguyen et al 2021). The catch of fishing gear is relatively more heterogeneous, capturing more species. The species that are often caught in the fishing gear of the chart are predatory fish, such as *Trichiurus lepturus*. Predatory species can be caught due to the activity of predatory fish looking for food in the form of small fish. The length of exposure during the fishing process will also affect the number of fish that gather under the lights (Reppie et al 2016; Asrial et al 2021).

The difference in the shape of the reflector that functions to focus the light shows that the conical reflector gets more catch than the concave shape reflector (Puspito et al 2017). The effect of light intensity and the color of the lights that enter the waters will affect the behavior of the fish in responding to light (Sudirman et al 2013; Fitri et al 2019). The response of fish to light can affect the response of the target fish to approach

the net. Fish behavior is more responsive to objects seen in the presence of light than dark objects (Nguyen & Winger 2019; Nguyen et al 2021).

The amount of *S. indicus* obtained was more significant than *S. fimbriata*, based on data collected (January to February 2020) in Cilacap waters. This difference is due to the fishing season, although December to January is generally considered the peak (Latumeten & Latumeten 2021). The fishing season for *Stolephorus* sp. in Java waters lasts from November to May and the peak season for catching occurs in February (Imron et al 2020). Moreover, the highest yield for *S. fimbriata* was observed between January and February (Wujdi et al 2012) and the presence is not marked throughout the season. The fishing season for *Sardinella* sp. is from June to July and September to November (Sartimbul et al 2021). Therefore, scoop net fishing in Cilacap waters is preferred for catching *S. indicus* as the target species (Adiyanto et al 2018).

Conclusions. The difference in the light reflector as a means of catching the scoop net has an effect on the intensity and distribution pattern. The cone type reflector has a wider intensity and higher light distribution pattern than the concave type reflector, amounting to 6930 lux and 5170 lux, respectively. This affects the catch of S. *indicus* more than S. *fimbriata*.

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Conflict of interest. The authors declare that there is no conflict of interest.

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