

# 2023 CLOSED SEASON IMPLEMENTATION REPORT FOR THE ARTISANAL SECTOR



**FISHERIES COMMISSION**

**MINISTRY OF FISHERIES & AQUACULTURE DEVELOPMENT**

**December, 2023**

## Executive Summary

Biological studies, catch rates analyses and measurement of sea surface temperature (SST) were conducted on three small pelagic species; Round Sardinella, Flat sardinella and Anchovy in pre-closure and post-closure periods (June to October) to monitor the 2023 closed season. Data was collected at eight sampling sites along the coast namely Keta, Tema, Bortianor, Apam, Elmina, Shama, Sekondi, and Axim. SST measurements revealed that the closed season occurred within the upwelling season (July to September) and the closure of the fisheries in July enhanced the spawning potential of the small pelagic species in the post-closure period. Round sardinella landings for both purse seine and set nets reduced post-closed season. Similarly, Flat sardinella landings decreased post-closed season for the purse seine gear but increased for set net. Anchovy landings increased, exhibiting the highest mean catch per trip of 485.34 kg after the closed season.

The average size of Round Sardinella, Flat sardinella and Anchovy across the eight stations were 16.5 cm, 16.0 cm and 7.5 cm respectively. There were variations in the mean size distribution of Round sardinella across the eight sampling sites, with monthly mean size distribution of the species showing an increase in the months of August and September (post-closure). The gonadal development for Round sardinella peaked after the closed season. In terms of maturity stages, higher proportion of mature Round sardinella were landed than immature species of same after the closure. The closure period for the species in July thus enhanced growth and reproduction. Similar biological observations were made for the Flat sardinella and Anchovy.

The biggest size of Round sardinella increase was observed in 2023 compared to 2021 and 2022 closures. The highest proportion of Round sardinella recruitment were recorded in the post-closure months of August (65%) and September (76%) while the lowest took place in the pre-closure month of June (25%). Similar observations were made for the Flat sardinella and anchovy. This indicates a greater recruitment of the small pelagic species into the fishery after the closed season.

From these findings, it is recommended that the month of July should be maintained as the month for the closed fishing season for artisanal subsector as it protects the spawning stock and enhance recruitment. This will help rebuild the fish stocks. It is also recommended that fisheries enforcement measures are enhanced to curb inappropriate methods of fishing that can erode some of the gains of the closed season.

## 1- INTRODUCTION

In Ghana, fisheries play an immense social, cultural and nutritional significance for the populace engaged in fishing, fish processing, distribution and marketing. Unfortunately, the marine fisheries resources have been experiencing a decline over the past few decades, resulting in diminishing fish stocks.

The Ministry of Fisheries & Aquaculture Development (MoFAD) and its implementing agency, Fisheries Commission (FC) have been implementing closed fishing season for all fishing fleets since 2019. In 2023, the MoFAD and FC implemented the closed fishing season for all fleets from 1 July to 31 July for artisanal and semi-industrial fleets and from July 1 to August 31 for industrial trawlers. The tuna fleet had previously observed a two-and-a-half-month closed season from 1 January 2023 to 13 March 2023, as mandated by the International Commission for the Conservation of Atlantic Tuna (ICCAT), a Regional Fisheries Management Organization (RFMO) of which Ghana is a member.

The primary objective of the closed fishing season is to allow fish to maximize recruitment potential during the annual peak spawning period before being harvested by fishermen. The Fisheries Scientific Survey Division (FSSD) of the Fisheries Commission has identified July and August as the major upwelling season which is considered as the peak spawning periods for both small pelagic and demersal species. The decision to implement the closed season during these months is based on scientific evidence obtained through years of research by the FSSD. A nationwide stakeholder consultation and sensitization were conducted in the four coastal regions before the commencement of the closed season in July 2023.

The closed season serves as a management measure aimed at rebuilding depleted fish stocks and optimizing the spawning potential of the fisheries. The long-term goal is to increase the biomass and yield of both small pelagic and demersal species, thereby enhancing the benefits of the fisheries resource for livelihoods and food security. Mean fish catch rates and biological studies conducted before and after the closed season are instrumental in assessing mean fish catch per canoe, monthly fish size distribution, and monitoring spawning seasons.

## **2- METHODOLOGY**

The study focused on collecting data on fish catch per trip, mean price per kg and value per trip for Round Sardinella, Flat Sardinella and Anchovy exploited by canoes at eight sampling sites: Keta, Tema, Bortianor, Apam, Elmina, Shama, Sekondi, and Axim. Data was collected in the month of June before the closure of the fishing season and after resumption of fishing from August to October. The biological studies involved collecting fish samples at the eight sampling sites during the second and fourth weeks of each month. Seventy (70) specimens for each species were randomly selected from the fish sample bought at each sampling site. The specimens were analyzed for the following parameters: fish length (total length), weight, sex, gonad weight and maturity stage. Gonadosomatic index (GSI) was obtained from the ratio of the weight of the gonads to the weight of the fish specimen. The length frequency data were grouped into 1cm intervals and analyzed using the R statistical package.

## **3 - RESULTS**

### **Sea surface temperature**

It was observed that sea surface temperatures were lower than 26°C during the closure (July) and post-closure (August) signifying the period of the upwelling season (Figure 1). The closed season thus took place within the upwelling season to maximise the spawning potential of fish.

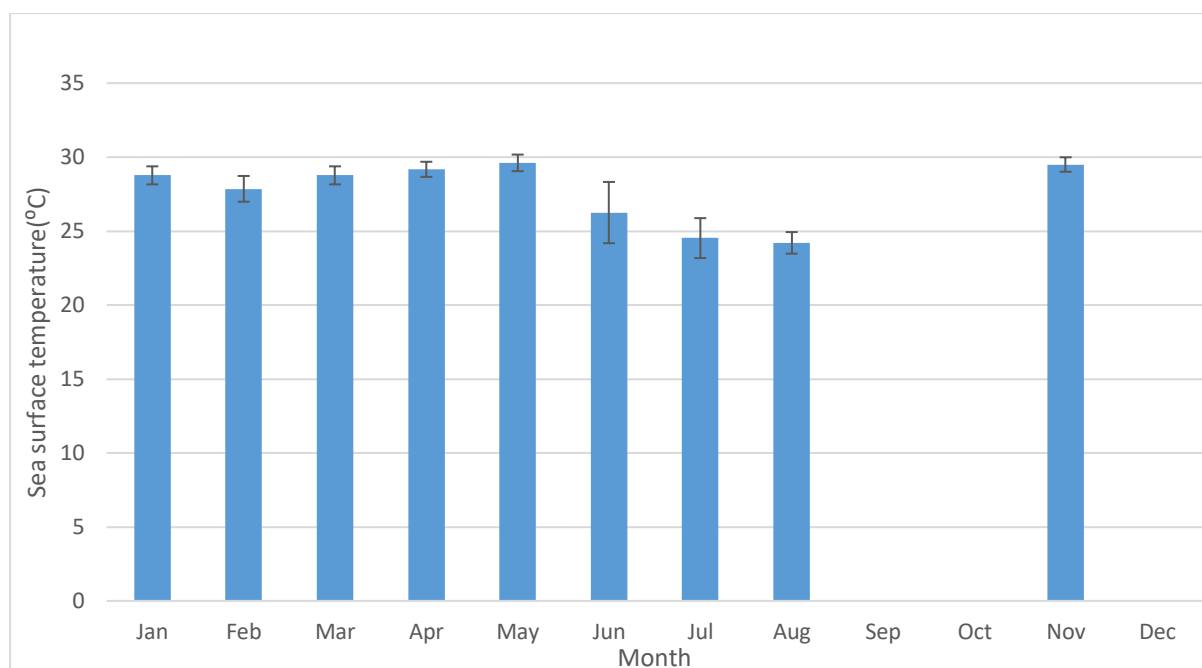


Figure 1: Monthly mean sea surface temperature for the year 2023 at Tema (Reference station).

### Mean catch rates of small pelagic species

Mean catch rates of the three principal small pelagic for purse seine gear (“APW”) and Set net were compared. There was a reduction in Round sardinella landings for both gears post-closed season. Similarly, Flat sardinella landings decreased post-closed season for the purse seine gear (“APW”), but increased for the Set net (Table 1). Anchovy landings increased, exhibiting the highest mean catch per trip of 485.34 kg after the closed season (Table 1).

There was a general increase in the mean price per kg of small pelagics post-closed season. With the exception of Round Sardinella which experienced a 1.5% decrease for purse seine price and Flat Sardinella a 5.6% decline for set net price, the mean price per kg for all species showed an increase after the closed season across all gears (Table 1).

Table 1: Mean catch per trip, price and value per Kg of Round sardinella, Flat sardinella and Anchovy before and after closed season

Species	Gear	Catch (kg)/Trip		Value/Trip (GHS)		Mean Price (GHS)/kg	
		Before	After	Before	After	Before	After
Round Sardinella	APW	284.71	182	4816	3033	16.91	16.66
Flat Sardinella	APW	339.3	242.15	5655	4130.29	16.66	17.06
Anchovy	APW	453.7	485.34	4350.76	5467.59	9.59	11.27
Round Sardinella	Set net	113.58	15	1893	262.5	16.6	17.5
Flat Sardinella	Set net	45	197.86	1100	4428.48	24.2	22.82
Anchovy	Set net	8	52.33	60	468	7.5	8.94

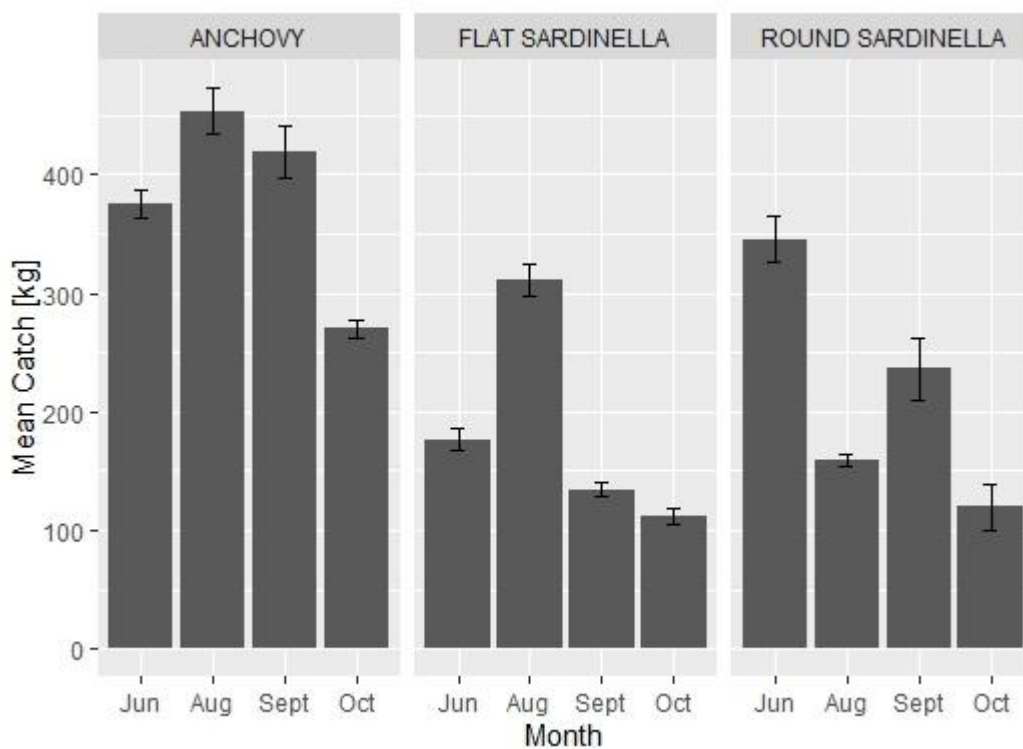


Figure 2: Mean catch of small pelagic species by month before and after the closed season.

## Biological Studies of Round Sardinella

### Length Frequency Distribution

The average size of Round Sardinella across all eight stations was determined to be 16.5 cm, with recorded minimum and maximum lengths of 9.8 cm and 24.0 cm respectively (Figure 3).

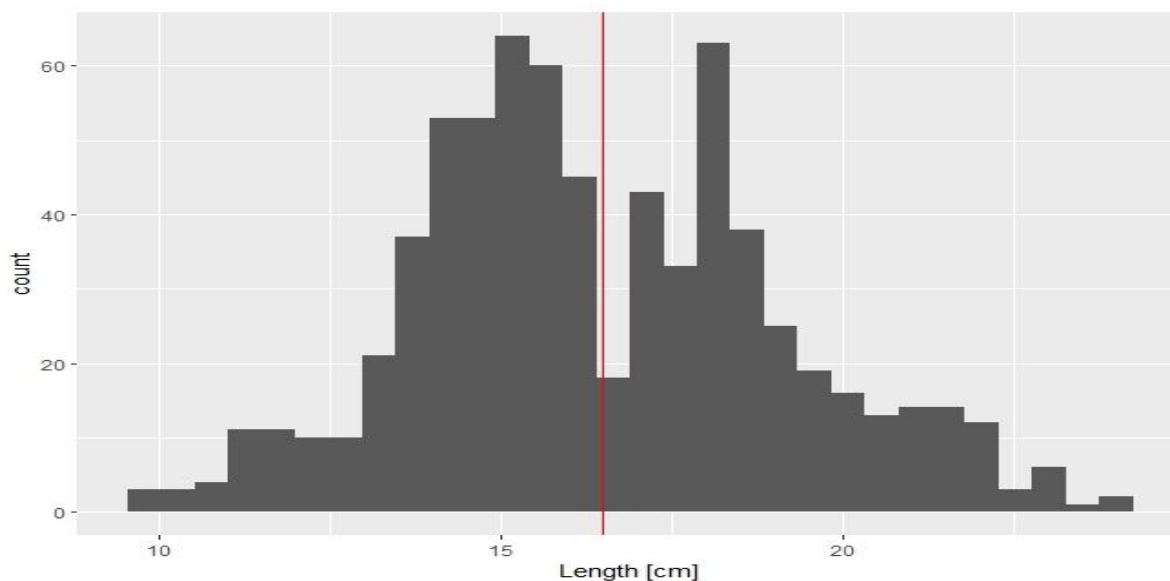


Figure 3: Length distribution of Round sardinella (red line shows mean length).

There were variations in size distribution observed across the eight sampling sites. The maximum size of Round sardinella (24 cm) was landed in Tema and the smallest size (9.8 cm) in Keta (Figure 4). Comparing the monthly mean size distribution of Round Sardinella, the months of August and September (post-closure) showed an increase in mean fish size (Figure 4).

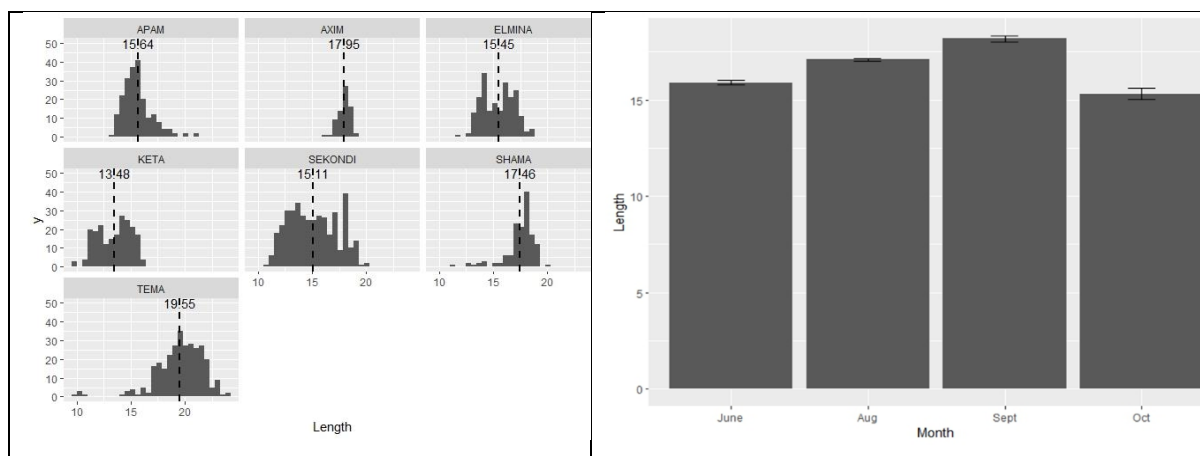


Figure 4: Length frequency distribution of Round sardinella at sampling sites (left). Black dash line indicates the mean length of the distribution. Monthly length frequency distribution by months (right).

Generally, a greater percentage of the Round sardinella landed within pre- and post-closure period were below the minimum allowable landing size. With the exception of Tema, where the greater proportion of Round sardinella harvested were above the minimum allowable

landing size of 18 cm, the rest of the sampling sites recorded greater proportion of Round sardinella below the minimum allowable landing size (Figure 5).

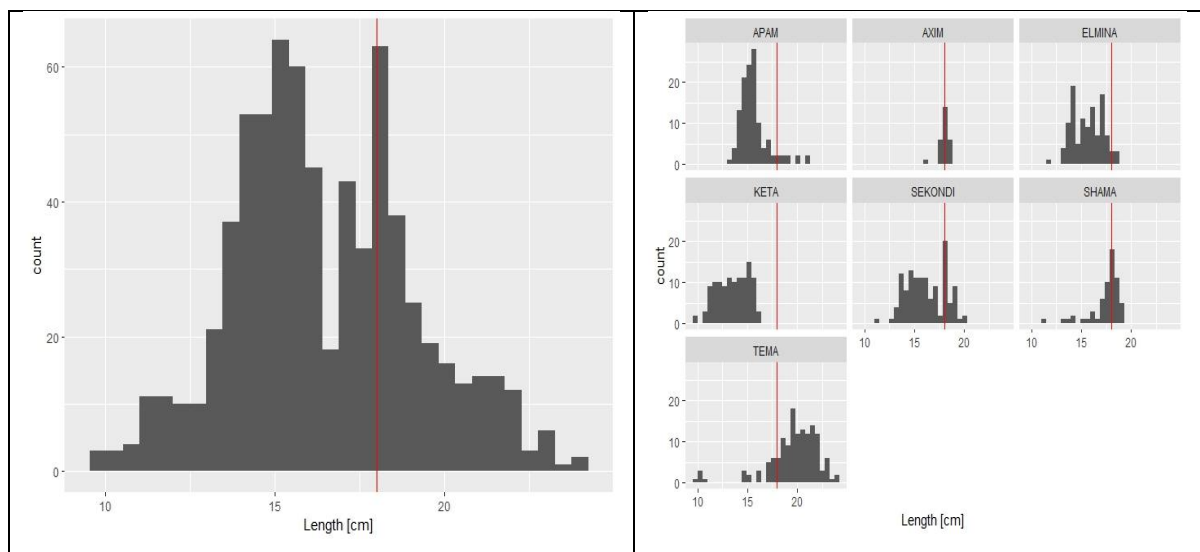


Figure 5. Length distribution of Round sardinella in total sample (left) and at sampling sites (right) (the red line indicates the minimum allowable fish landing size).



Fishermen being engaged in biological studies at Keta.

### Mean Gonadosomatic Index (GSI)

The highest spawning activity for Round Sardinella was observed at Tema and took place in October and August (post-closure). The lowest was observed at Axim and recorded in August



(Figure 6). It is apparent from the results that gonadal development for Round sardinella peaked after the closed season (August, September and October). This confirms the earlier studies (closed season reports of 2021 and 2022) of peak spawning activities for Round sardinella within the post-closure period.

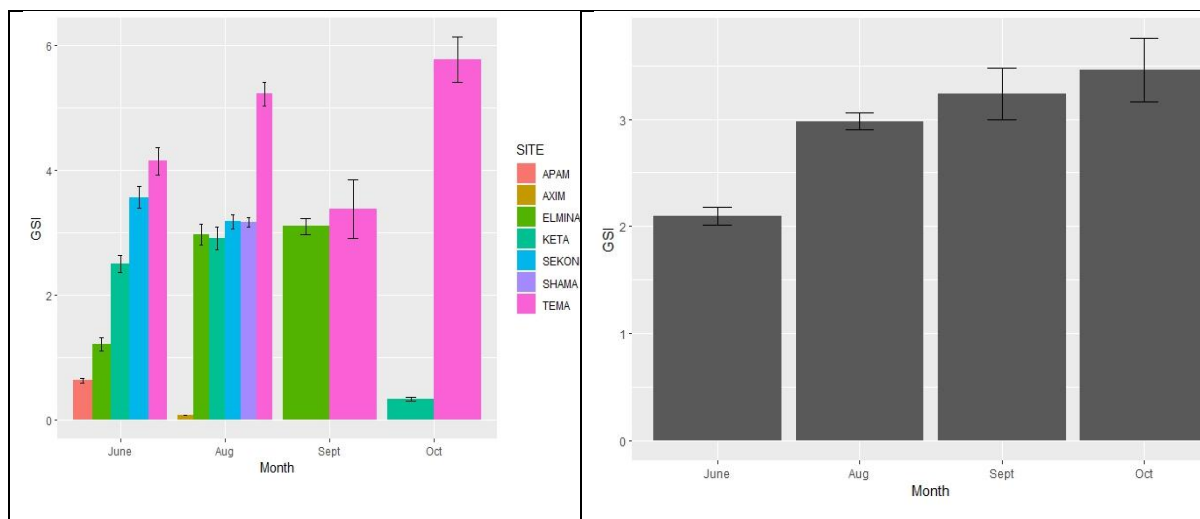


Figure 6. Monthly mean GSI of Round sardinella at the sampling sites (left) and combined sampling sites (right).

### Proportion of Maturity

In terms of maturity stages, higher proportion of mature Round sardinella and lower proportion of immature Round sardinella were landed in the months of August and September (post-closure) (Figure 7). This is an indication that the closed period for the species in July enhanced growth resulting in greater proportion of matured fish in August and September.

Analysis shows that the estimated length at first maturity ( $L_{50}$ ) of matured females of Round sardinella was 14.5 cm (Figure 7).

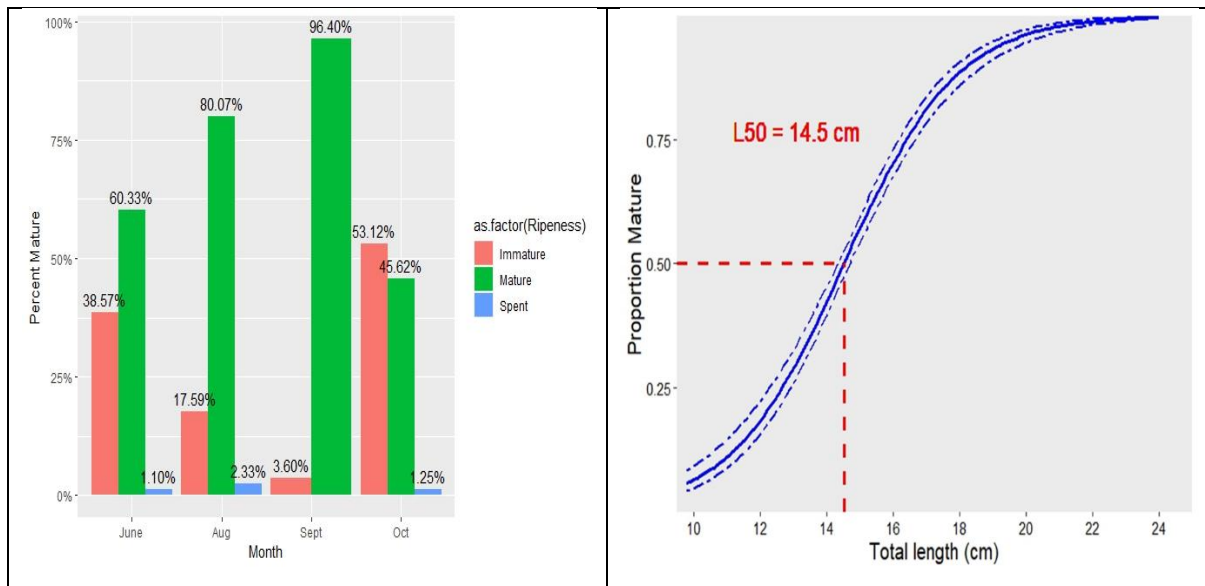


Figure 7: Proportion of gonadal stages of Round sardinella by month (left) and length at first maturity ( $L_{50}$ ) of Round sardinella (right).

## Biological Studies of Flat sardinella

### Length Frequency Distribution

The average size of Flat sardinella across the eight stations was determined to be 16.0 cm, with recorded minimum and maximum lengths of 7.0 cm and 24.0 cm respectively (Figure 8).

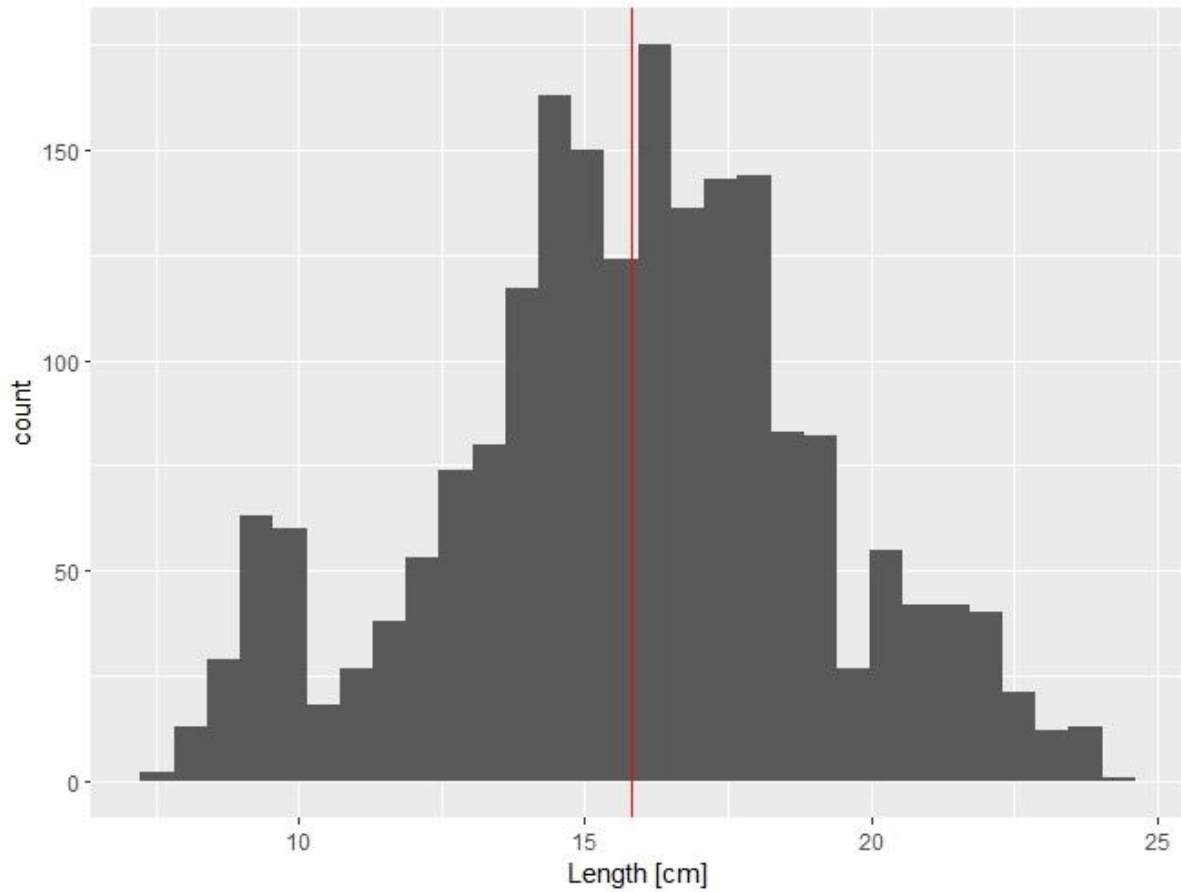


Figure 8: Length Frequency distribution of Flat sardinella (Red line indicates the mean length of the distribution).

There were variations in size distribution across the eight sampling sites. The maximum size of 24 cm was landed in Tema and the smallest size (7.0 cm) in Elmina (Figure 9). Comparing the monthly mean size distribution, the months of August and October (post-closure) showed an increase in mean fish size (Figure 9).

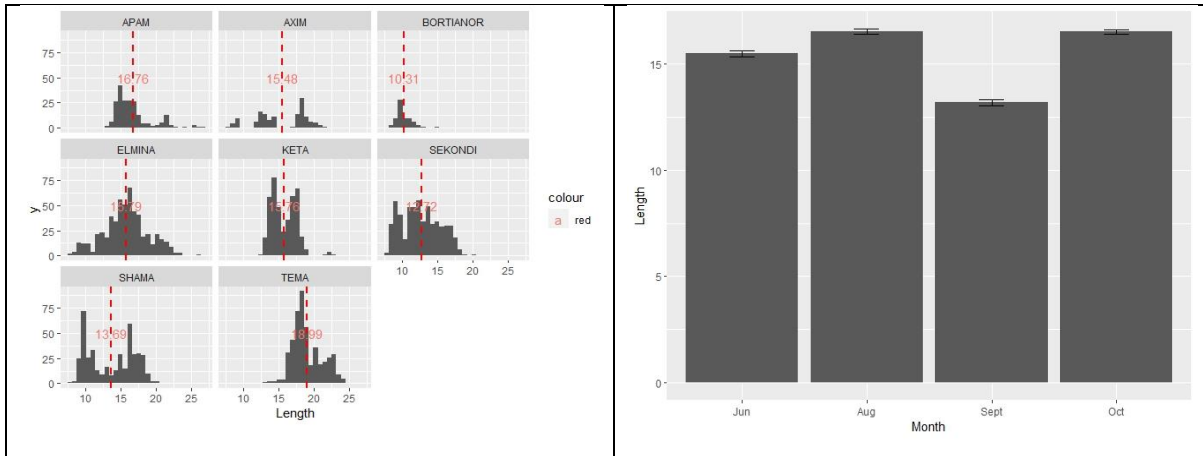


Figure 9: Length frequency distribution of Flat sardinella at sampling sites (left) (Red dash line indicates the mean length of the distribution). Monthly length frequency distribution by months (right).

Generally, a greater percentage of the Flat sardinella landed within the period were below the minimum allowable landing size. With the exception of Tema, where the greater proportion of Flat sardinella landed were above the minimum allowable landing size of 18 cm, the rest of the sampling sites recorded greater proportion of Round sardinella below the minimum allowable landing size (Figure 10).

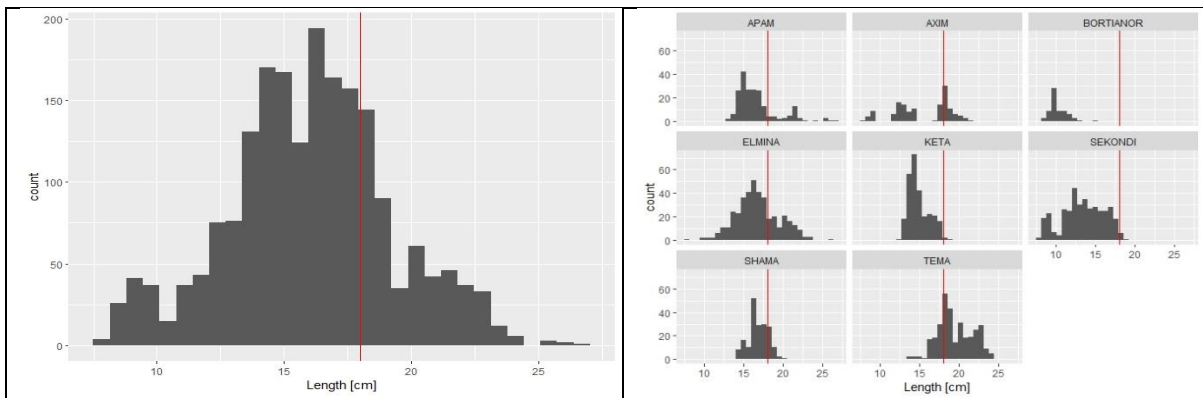


Figure 10. Length distribution of Flat sardinella in total sample (left) and at sampling sites (right) (The red line indicates the minimum allowable fish landing size).



Biological studies at Bortianor

### Mean Gonadosomatic Index (GSI)

The highest spawning activity for Flat sardinella was observed at Tema in August and October (post-closure). The gonadal development of Flat sardinella peaked after the closed season in the months of August and October (Figure 10).

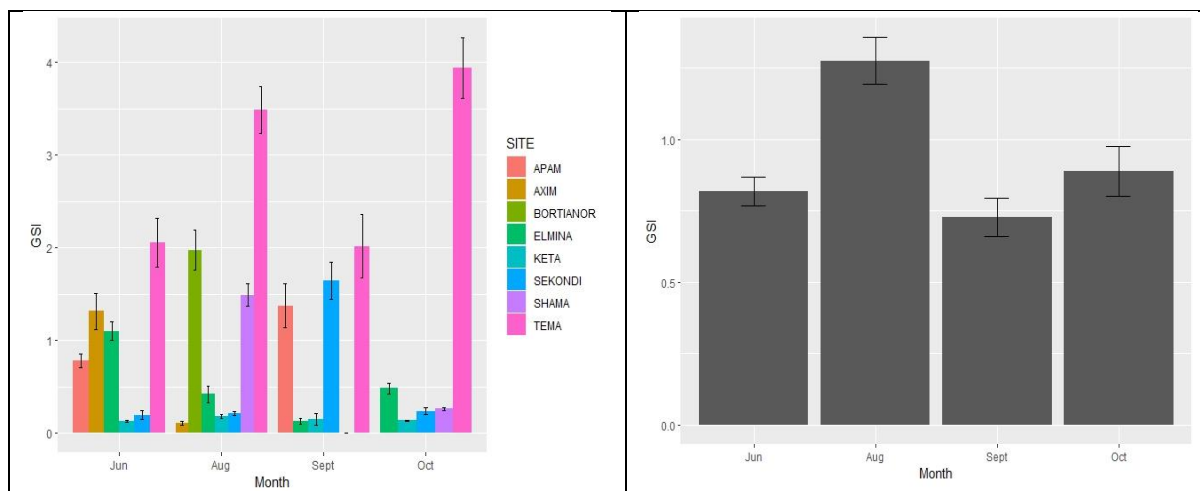


Figure 10: Monthly mean GSI of Flat sardinella at the sampling sites (left) and combined sampling sites (right).

## Proportion of Maturity

In terms of maturity stages, higher proportion of immature Flat sardinella and lower proportion of mature same species were landed in both pre-closure and post-closure periods. The proportion of matured species were however higher in August compared to the other months (Figure 11).

Analysis shows that the estimated length at first maturity ( $L_{50}$ ) of matured females of Flat sardinella was 19.4 cm (Figure 11).

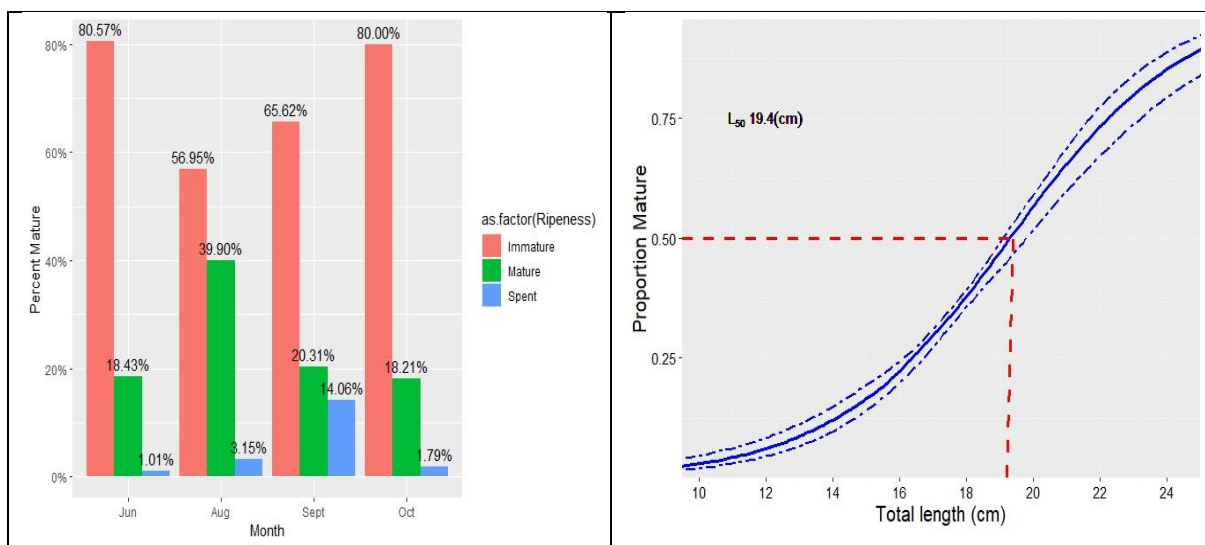


Figure 11: Proportion of gonadal stages of Flat sardinella by month (left) and length at first maturity ( $L_{50}$ ) of Flat sardinella (right).

With the exception of Tema which recorded the mean size of 19.0 cm which is above the minimum allowable landing size, all other sampling sites recorded mean size less than the minimum allowable landing size (Figure 9).

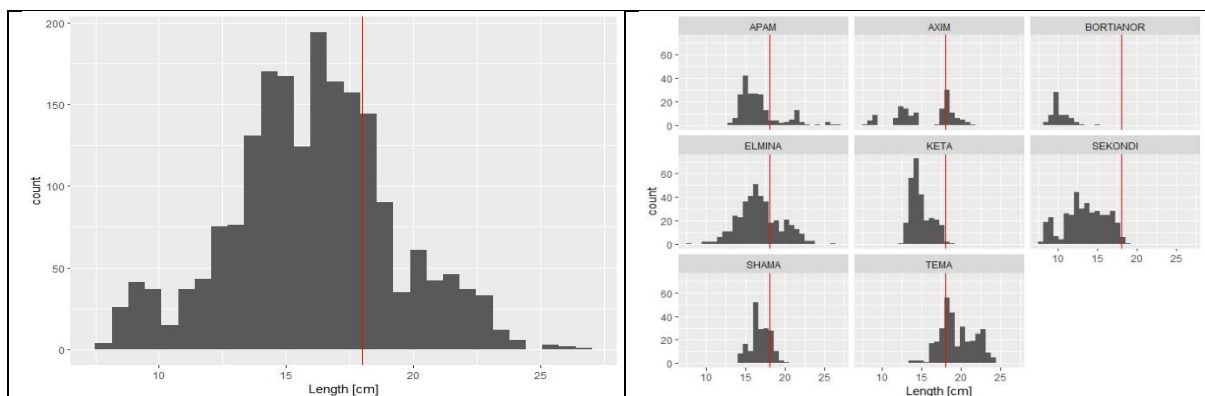


Figure 12: Length distribution of Flat sardinella showing legal landing size (18 cm, red line)

## Biological Studies of Anchovy

### Length frequency distribution

The average size of Anchovy across the eight stations was determined to be 7.5 cm, with recorded minimum and maximum lengths of 4.8 cm and 10.5 cm respectively (Figure 13).

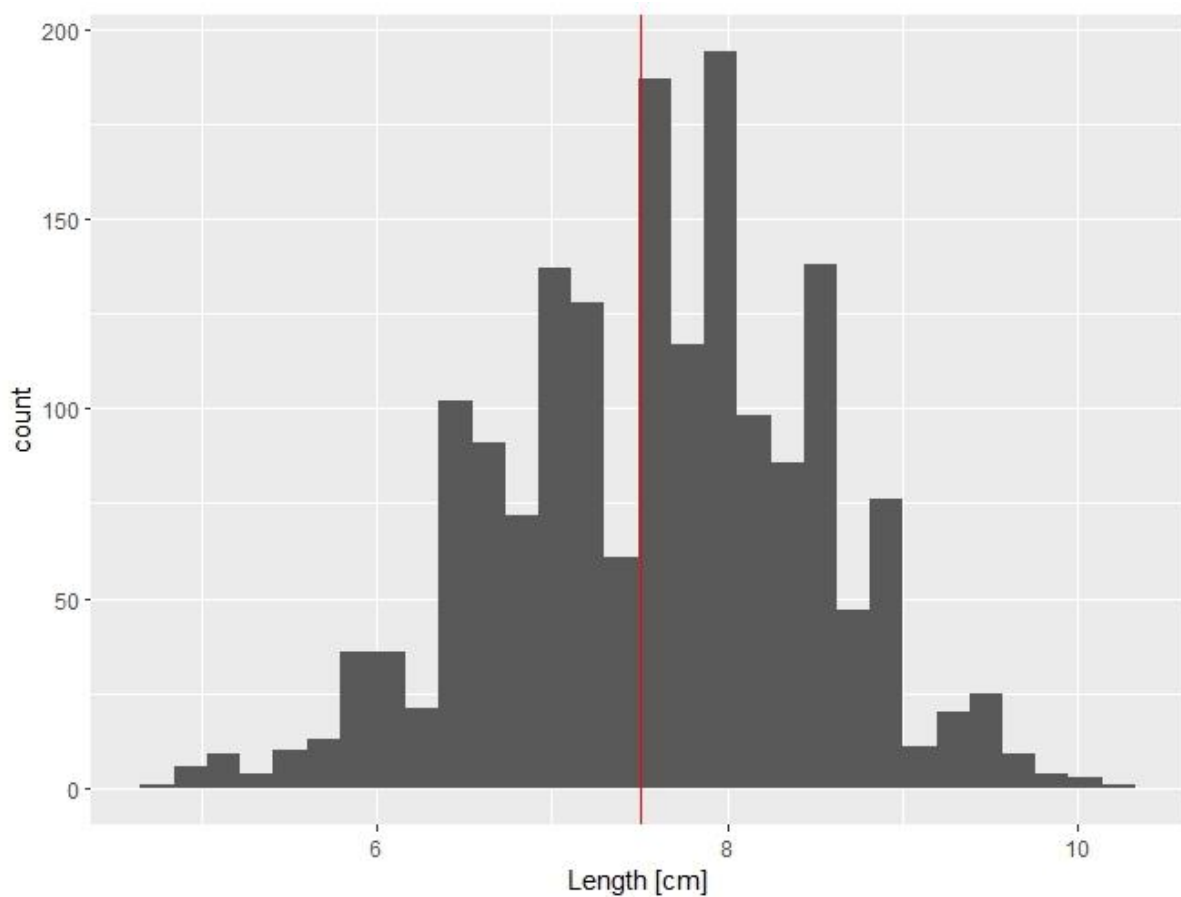


Figure 13: Length frequency distribution of Anchovy (Red horizontal line indicates the mean length of the distribution).

There were variations in size distribution observed across the eight sampling sites. The maximum size of Anchovy (10.5 cm) was landed at Sekondi and the minimum size (4.5 cm) at Bortianor (Figure 14). Comparing the monthly mean size distribution of Anchovy, the months of August, September and October (post-closure) showed an increase in mean fish size (Figure 14).

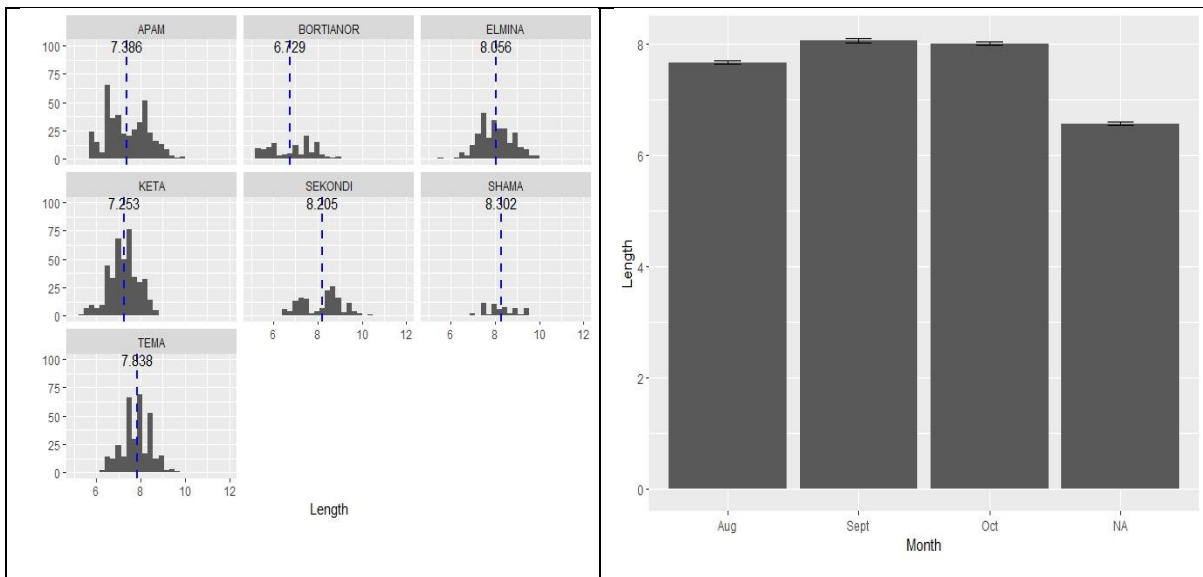


Figure 14: Length frequency distribution of Anchovy at sampling sites (left). Blue dash line indicates the mean length of the distribution. Monthly length frequency distribution by months (right).

The greater percentage of Anchovy landed within the period were above the minimum allowable landing size. The greater proportion of Anchovy landed at all sampling sites were above the minimum allowable landing size of 6 cm (Figure 15).

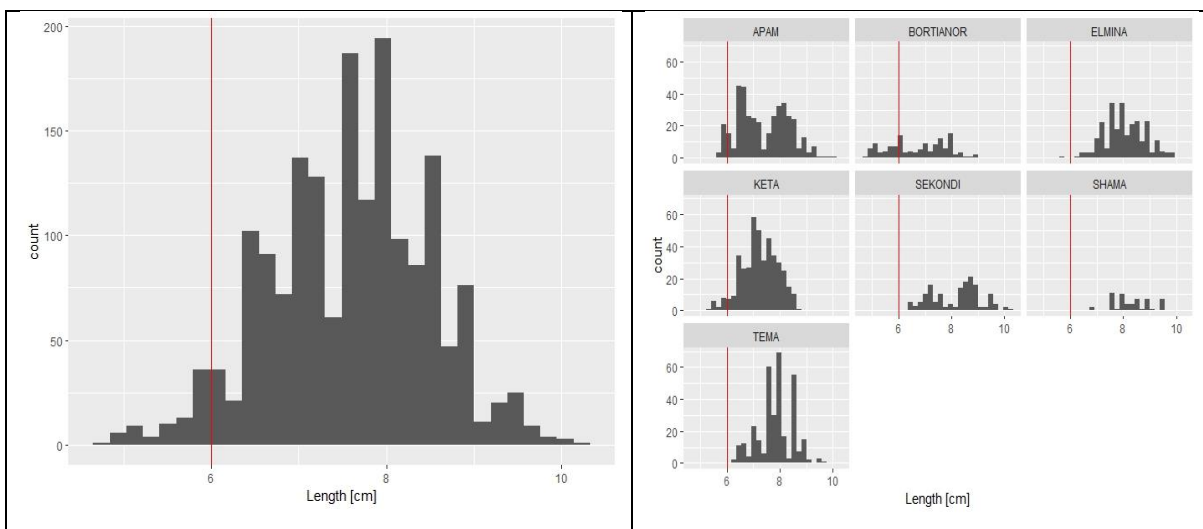


Figure 15: Length distribution of Anchovy in total sample (left) and at sampling sites (right) (The red line indicates the minimum allowable fish landing size (6 cm)).

### Mean Gonadosomatic Index (GSI)

The highest spawning activity for Anchovy was observed in August (post-closure) at Bortianor and the lowest at Tema in June (pre-closure). The gonadal development of Anchovy peaked after the closure (Figure 14).



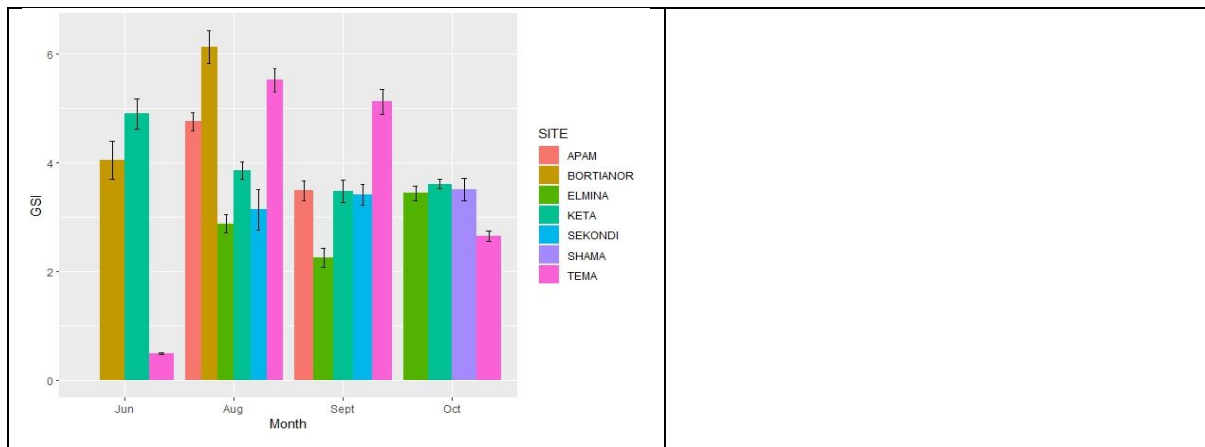


Figure 14: Monthly mean GSI of Anchovy at the sampling sites (left).



Fish sample

### Proportion of Maturity

In terms of maturity stages, higher proportion of mature Anchovy were landed in both pre-closure period (June) and post-closure period (August and September). The proportion of matured Anchovy were however higher in September compared to the other months (Figure 15).

The estimated length at first maturity ( $L_{50}$ ) of matured females of Anchovy was 6.6 cm (Figure 15).

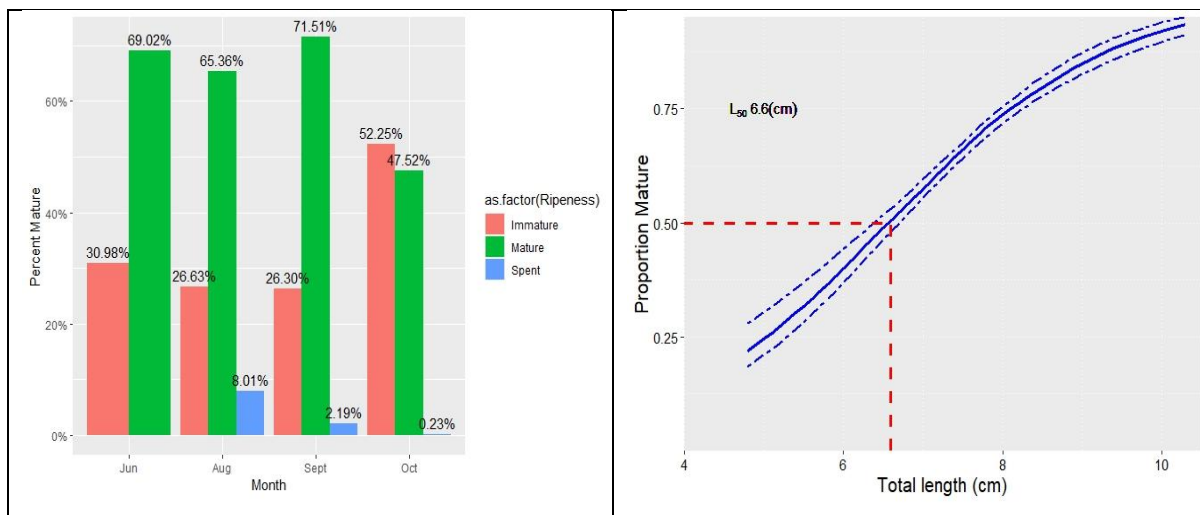


Figure 15: Proportion of gonadal stages of Anchovy by month (left) and length at first maturity ( $L_{50}$ ) of Anchovy (right).

Table 2: Comparing the maximum fish size between August 2021 and August 2023.

Species	Maximum length in 2021 (cm)	Maximum length in 2022 (cm)	Maximum length in 2023 (cm)
Round Sardinella	21.0	22.1	24.0
Flat Sardinella	21.0	25.5	24.3
Anchovy	8.0	11.2	10.3

Comparing the maximum sizes of fish landed in August 2021, August 2022 and August 2023, it was observed that the sizes of the Round sardinella increased in 2023. (Table 2).

### Recruitment of the Small pelagics into the Fishery

The highest proportion of Round sardinella recruitment were recorded in the post-closure months of August (65%) and September (76%) while the lowest took place in the pre-closure month of June (25%) (Figure 16). The highest proportion of Flat sardinella recruitment were recorded in the post-closure months of August (67%) and October (68%) while the lowest took place in the pre-closure month of June (39%) and post-closure month of September (35%) (Figure 16). The highest proportion of Anchovy recruitment were recorded in the post-closure months of September (71%) and October (73%) while the lowest took place in the pre-closure month of June (6%) (Figure 16). This indicates a greater recruitment of the small pelagic species into the fishery after the closed season.

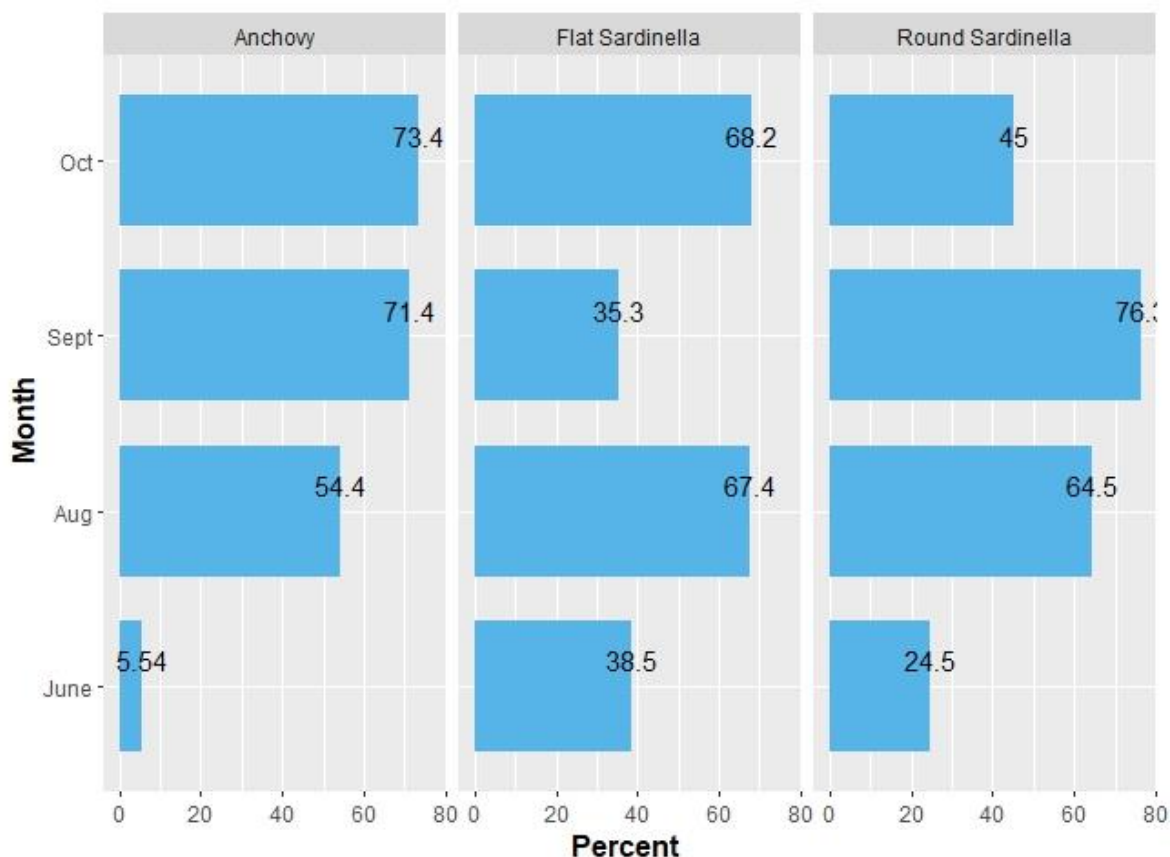


Figure16: Monthly proportions of recruitment of the Small pelagics into the fishery.

#### 4- CONCLUSIONS AND RECOMMENDATIONS

The closed season took place within the upwelling season and thus the closure of the fisheries in July enhanced the spawning potential of the small pelagic species. There was a reduction in Round sardinella landings for both purse seine and set net post-closed season. Similarly, Flat sardinella landings decreased post-closed season for the Purse seine gear but increased for the Set net. Anchovy landings increased, exhibiting the highest mean catch per trip of 485.34 kg after the closed season.

The average size of Round Sardinella, Flat sardinella and Anchovy across the eight stations were 16.5 cm, 16.0 cm and 7.5 cm respectively. The monthly mean size distribution of Round Sardinella showed an increase in mean fish size in the months of August and September (post-closure). The gonadal development for Round sardinella peaked after the closed season (August, September and October). In terms of maturity stages, higher proportion of mature Round sardinella were landed after the closure. This is an indication that the closure for the

fisheries in July enhanced growth. Similar biological observations were made for Flat sardinella and Anchovy.

The maximum size of Round sardinella increase was observed in 2023 compared to 2021 and 2022. The highest proportion of Round sardinella recruitment were recorded in the post-closure, indicating a greater recruitment of the species into the fishery after the closed season. Similar observations were made for the Flat sardinella and anchovy.

From these findings, it is recommended that the month of July should be maintained as the month for closed fishing season as it protects the spawning stock and enhance recruitment. This will help rebuild the fish stocks. It is also recommended that fisheries enforcement measures are enhanced to curb inappropriate methods of fishing that can erode some of the gains of the closed season.

#### **ACKNOWLEDGEMENT**

We acknowledge the support of Environmental Justice Foundation, the fishermen, the staff and Board of the Fisheries Commission for the closed season implementation monitoring.