# Local Ecological Knowledge and Trend of Catches on *Pseudotolithus typus, Lutjanus goreensis* and *Sphyraena afra* from Lagos Coastal Waters, Lagos State, Nigeria

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***Authors' contributions***

*This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.*

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## ABSTRACT

The present study examined the fishers' knowledge and a ten-year (2009 -2018) trend analysis of prices and catches on *Pseudotolithus typus, Lutjanus goreensis* and *Sphyraena afra* from Lagos coastal waters. While data for local ecological knowledge (LEK) were obtained with the aid of a semi-structured questionnaire, secondary data collected from both the field and the Federal Department of Fisheries were used to estimate the trend analysis of prices and catch composition respectively. The results showed that prices of all the fish species changed annually, with an annual average increase of 10.85%, 9.25% and 12.03% for *P. typus, L. goreensis* and *S. afra* respectively. *L. goreensis* and *S. afra* had an annual average increase of fish catch landed of 5.39% and 2.77%, while *P. typus* had -8.98% annual average decrease of fish landed. All the fishers were males and their modal age group was 41-60years (92.31%), while the least was 21-24years (7.69%). Sixty-nine percent (69%) and 31% of the fishers had secondary and primary school education respectively. Most fishers (69%) had a fishing experience of 21-25 years while the least fishing experience was 6-10 years. Most of the fishers had vast knowledge of the habitat of the fish species, morphological identification, causes of declined fish catches, conservation strategy, seasons of catch and problems of overfishing. In conclusion, this study showed a high

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level of agreement of fishers' ecological knowledge with the scientific literature, and such synergy could provide important additional biological information that could be used in the process of participative and sustainable management of marine resources.

## 1. INTRODUCTION

Understanding how fishing and environmental variability interact to produce an effect on target fish species has been an evolving and interesting question in fisheries science for decades. Adding to that, there is also the question that fisheries have to be evaluated in the context of a changing environment [1], which is better done under an ecosystem approach [2]. For most fisheries, the understanding of the environmental factors that affect and determine their catches over temporal and spatial scales is usually limited and often inferred without sound scientific information or technological geo-location support [3]. However, Fishers have enough accumulated knowledge to make them sensitive to some environmental changes, with the ability to interpret them and provide production estimates [4]. Such fishers' local ecological knowledge (LEK) is especially important in areas with scarce information on fishing statistics, and it can be sometimes the only information available to build up fisheries management strategies.

Today, there is a growing recognition that fishers' LEK could fill up gaps in biological, ecological and management knowledge as long as there is some caution in interpreting its quality and accuracy to science. Research findings have shown that the large extension of marine ecosystems makes it difficult, financially and technically, to gather detailed scientific information about them along the time [5]. On the other hand, fishers' LEK can cover large coastal and offshore areas and can also track changes over large temporal scales, potentially minimizing costs and improving management success [6]. Since LEK is acquired by an individual's hands-on experience and observations of the environment in which they work, heterogeneity of ecological knowledge between fishers can arise between different groups of fishers [7].

Davis and Wagner [8] highlighted the importance of identifying "experts" when researching LEK, to be able to use the most reliable and comprehensive LEK in fisheries management. Local ecological knowledge (LEK) is increasingly recognized as an important component of scientific research, conservation, and resource management [9]. LEK has contributed to structuring and refining the focus of scientific research projects [10]. Despite some classic studies on LEK, marine LEK research especially in Nigeria is relatively young and is evolving rapidly, and there is a critical need for more substantive, deep ethnographic and multi-scale research on marine ecosystems, as the ocean-dominated planet continues to evolve and change. It is against this background that this study opined to examine the local ecological knowledge of fishers on *Pseudotolithus typus, Lutjanus goreensis* and *Sphyraena afra* from Lagos coastal waters, and as well investigate the trend of catches and prices of the fish species.

## 2. MATERIALS AND METHODS

### 2.1 Study Area

The catches from Lekki and Badagry marine coastal waters landed at Kirikiri Terminal Station were focused for this study (Fig. 1). The fishing grounds of Lagos coastal waters extend approximately from 6° 24' 54" - 6° 25' 30" N and 3° 23' 06 - 3° 23' 06" E covering the Nigerian – Benin Republic Border in the West and to Lekki in the East. To the North, it is bounded by Five Cowrie Creek and to the South by the vast Atlantic Ocean [11]. The Lagos coast is a narrow coastal shelf that is relatively narrow about 15 km and predominantly soft and muddy [12].

### 2.2 Collection of Data and Analysis

Data for local ecological knowledge (LEK) were obtained with the aid of a semi-structured questionnaire. A total of 13 fishers were interviewed individually after they were introduced to the objectives of the study. To verify the consistency and validity of the responses, interviews were applied in a synchronic and diachronic situation as opined by Ferreira et al. [13]. The individual interview responses were compiled and analyzed as qualitative data.
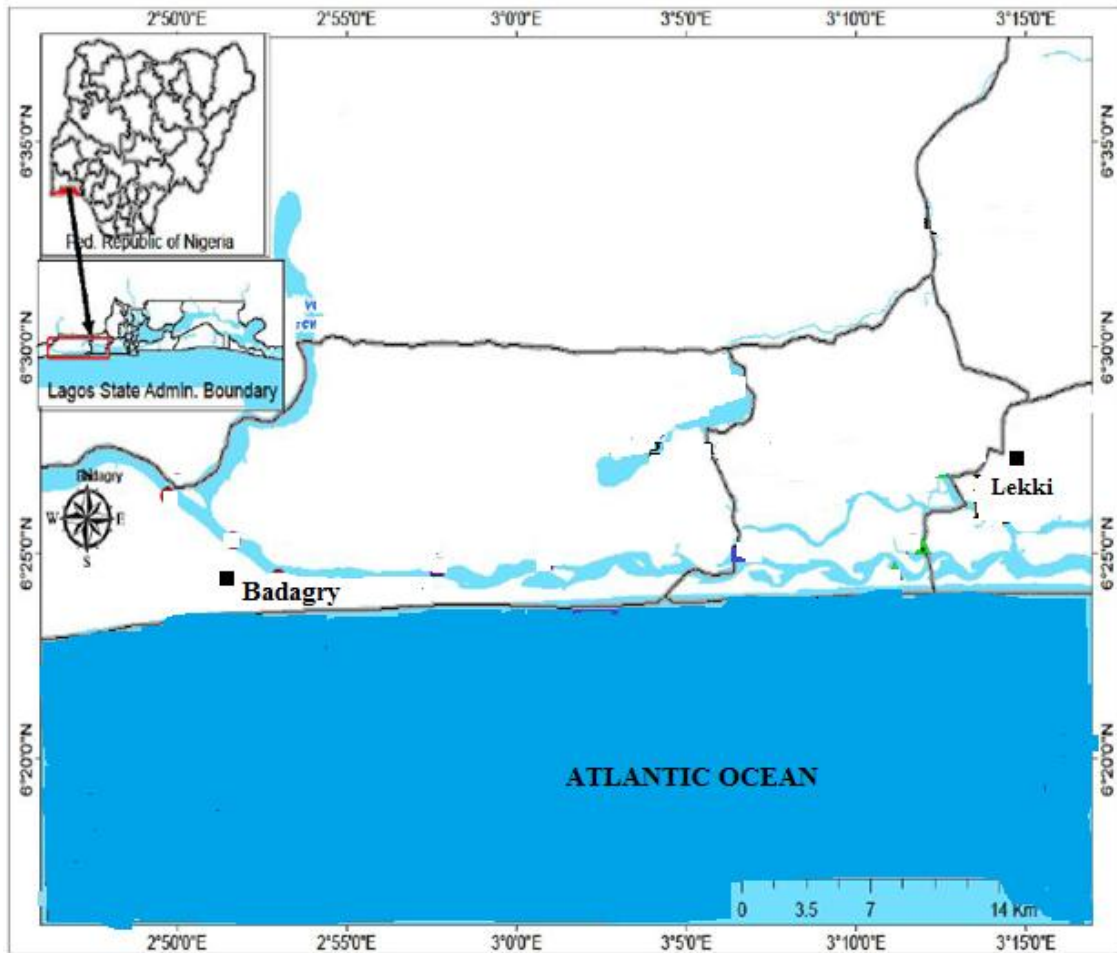
**Fig. 1. Location of study areas within Lagos coastal waters**

On the other hand, secondary data collected from the field and the Federal Department of Fisheries were used to estimate the trend analysis of prices and catch composition of *P. typus, L. goreensis* and *S. afra*. All values were presented in percentages and tabular form.

## 3. RESULTS

### 3.1 Socio-Economic Characteristics of Fishers in Coastal Water of Lagos State

The socio-economic feature of the fishers is presented in Table 1. The results revealed that the modal age group of the interviewed fishers was 41-60years (92.31%), while the least was 21-24years (7.69%). All the fishers were males and operate the job on full-time bases in the industrial fisheries sector. Sixty-nine percent (69%) of the fishers had secondary school education while 31% had primary school education. Most fishers (69%) had fishing experience of 21-25 years while the least fishing experience was 6-10 years. Sixty-two percent of the fishers had initiation on fish through the training while 38% of them had their initiation on fish via the family. The vessels used are trawlers with a length overall (LOA) of 13.3m and a gross tonnage (GT) of 29.38. The gears are trawl nets with a cod-end mesh size of 76mm while the fishing license is targeted at finfish. The common number of days was 4-5days (100%), due to the short operating range of small vessels, to the capacity for storing ice, food and fuel. Locations to set gears are detected via echo sounder while 3 hours (100%) was the time between shooting and hauling of nets.

### 3.2 Ecological Knowledge of *P. typus, L. goreensis* and *S. afra* Held by Fishers on the Fish Species

The reports from the fishers as regards their knowledge of the environment and morphology of the fish species, size distribution and market

prices; and conservation of the fish species were presented in Tables 2-4 respectively. Fishers divulged that the habitat of *Pseudotolithus typus* is muddy area (43.48%) and shallow water (56%) while 92% of the respondents opined that the habitat of *Lutjanus goreensis* is a rocky area. However, the fishers believed that *Sphyraena afra* are caught by chance as they move everywhere in search of food. In response to the question on what the fish species usually eat, 81%, 43% and 50% of the fishers respectively declared that the common food of *P. typus, L. goreensis and Sphyraena afra* are shrimp and fish. In respect of morphological identification of the fish species, 50% of the fishers believed that *P. typus* could be identified using the long neck and upturned head shapes. Fifty-nine percent (59%) and 41% of them respectively disclosed pink colour and blue band for identification of *L. goreensis,* while all respondents(100%) opined that they do not know any physical morphological characteristics for *S. afra.* In response to questions on the exact season and months by which the fish species are in abundance in Lagos coastal waters, fishers (21.43%) revealed that *P. typus* are usually in abundance between September and January. On the other hand, 84.82% and 92.31% of them divulged that *L. goreensis and S. afra* respectively are caught all year round. To investigate the size distribution of the fish species usually caught, fishers were asked to give an estimate of the total weight of their fish landings as well as the common weight range of the fish species. In this regard, they reported that the most common minimum weight of fish caught by them included < 50 g, 100-150 g and 150-200 g for *P. typus, L. goreensis and S. afra* respectively. However, the common maximum weight included 5000-10000 g, 5000-10000 g and 15000-20000 g for *P. typus, L. goreensis and S. afra* respectively. The fishers when asked about the form, current selling price and scale of sale for the fish species, responded that all the fresh fish species at landing sites are sold in kilograms to distributors or agents. *P. typus* are sold at ₦1700 per kilogram while *L. goreensis and S. afra* respectively are sold at ₦2300/kg. In respect of how they determine the spawning period of the fish species, fishers disclosed that it was difficult to know the exact spawning period of the fish since they don't catch baby fish (fingerlings) due to the mesh size of cod-end (76 mm) being used by them. Furthermore, they believed that they can't determine the wet and dry seasons again because of climate change which has altered the conventional seasons. When asked

about the sex of the fish species can be determined apart from the presence of eggs in the females, all respondents (100%) were not able to distinguish the sexes using any other features.

Some questions require the fishers to comment on the status of the current catch of the fish species and other anthropogenic factors that could be responsible for the present status. In response to these questions, all fishers (100%) revealed that there was a drastic decrease in the catch of the fish species and most of them attributed the problem to overfishing. However, 23% of them indict accumulation of plastic debris in the coastal waters as the cause of the catch decrease. More so, a closed season was the conservation strategy opined by all respondents to solve the decline in catch.

In this study, fishers were asked if there are species that usually co-exist with *P. typus, L. goreensis and S. afra.* Sequel to this question, fishers in Lagos coastal waters divulged that other fish species that co-exist with *P. typus* include Cephalopoda species, shrimps, lobster, *Pseudotolithus senegalensis*, *Pseudotolithus epipercus*, *Pseudotolithus moorii*, *Pseudotolithuselongatus*, and other Polynemidae and Polydactylus families. While *Lutjanus goreensis* co-exist with *Lutjanus dentatus*, *Lutjanus edencacanthus*, *Lethrinus* species, and Syrranidae families, *Sphyraena afra* co-exists with *Sphyraena guachancho*.

## 3.3 Analysis of Trends in Catch and Average Price for *P. typus, L. goreensis* and *S. afra* from Trawl Fish Landings Off Lagos Coast

The summary of the percentage (%) change in prices (₦/kg) for *P. typus, L. goreensis* and *S. afra* within Lagos coastal waters terminal is shown in Table 5, while the percentage change in total catch(metric tons, mt) of the fish species is presented in Table 6. The highest % change in price for *P. typus* (25.8%) was recorded in 2018 while the least % change in price (4.68%) was recorded in 2010. On the other hand, the least % change in price (5.80%) for *L. goreensis* was recorded in 2016 while the peak % change in price (17.73%) was recorded in 2011. Similarly, the least % change in price (0%) was recorded in 2010 for *S. afra* while the highest % price change was 30.77% in 2011. *L. goreensis and* S.afra had similar % changes in price in 2016 (5.80%), 2017 (18.61%) and 2018 (10.16%). The results

showed that the prices of all the fish species change annually, with an annual average change of 10.85%, 9.25% and 12.03% for *P. typus, L. goreensis* and *S. afra* respectively.

**Table 1. Socio-economic characteristics of the fishers**

| Variables | Frequency | Percentage |
|---|---|---|
| **Age Class( Years)** | | |
| <20 | 0 | 0 |
| 21-40 | 1 | 7.69 |
| 41-60 | 12 | 92.31 |
| >60 | 0 | 0 |
| **Sex** | | |
| Male | 13 | 100 |
| Female | 0 | 0 |
| **Educational Level** | | |
| Illiterate | 0 | 0 |
| Primary school | 4 | 30.77 |
| Secondary school | 9 | 69.23 |
| Tertiary | 0 | |
| **Fishing Experience(Years)** | | |
| 6-10 | 1 | 7.69 |
| 11-15 | 0 | 0 |
| 16-20 | 3 | 23.08 |
| 21-25 | 9 | 69.23 |
| **Initiation on Fish** | | |
| Family | 5 | 38.46 |
| Training | 8 | 61.54 |
| **Fishing Occupation Status** | | |
| Full Time | 13 | 100 |
| Part-Time | 0 | 0 |
| **Type of Vessel used** | | |
| Trawler | 13 | 100 |
| **Type of fishing License** | | |
| Shrimping | 0 | 0 |
| Fishing | 13 | 100 |
| **Fishing gears** | | |
| Trawl net | 13 | 100 |
| Hook and Line | 0 | 0 |
| Trawl net/Hook and Line | 0 | 0 |
| **No of days/fishing trip** | | |
| 1- 2 days | 0 | 0 |
| 4-5 days | 13 | 100 |
| >5 days | 0 | 0 |
| **Location to set gear** | | |
| Fish finder | 0 | 0 |
| Colour of water | 0 | 0 |
| Spawning area | 0 | 0 |
| Water depth(Echo sounder) | 13 | 100 |
| **Time between shooting and hauling of net** | | |
| 1 hour | 0 | 0 |
| 2 hours | 0 | 0 |
| 3 hours | 13 | 100 |
| 4 hours | 0 | 0 |

*Source: Field Survey, 2019*

**Table 2. Local knowledge of the environment and morphology of the fish species**

| Habitat | Croaker (*Pseudotolithus typus*) | | Red Snapper (*Lutjanus goreensis*) | | Barracuda (*Sphyraena afra*) | |
|---|---|---|---|---|---|---|
| | Number | Frequency (%) | Number | Frequency (%) | Number | Frequency (%) |
| Muddy area | 10 | 43.48 | 0 | 0 | 0 | 0 |
| Sandy area | 0 | 0 | 0 | 0 | 0 | 0 |
| Shallow water | 13 | 56.52 | 0 | 0 | 0 | 0 |
| Deepwater | 0 | 0 | 0 | 0 | 0 | 0 |
| Rocky area | 0 | 0 | 12 | 92.31 | 0 | 0 |
| Everywhere | 0 | 0 | 0 | 0 | 0 | 0 |
| Don't Know | 0 | 0 | 1 | 7.69 | 13 | 100 |
| **Food** | | | | | | |
| Fish | 3 | 18.75 | 3 | 17.65 | 13 | 50 |
| Shrimp | 13 | 81.25 | 8 | 47.06 | 13 | 50 |
| Don't know | 0 | 0 | 6 | 35.29 | 0 | 0 |
| **Morphological characteristics** | | | | | | |
| Narrow head | 13 | 50 | 0 | 0 | 0 | 0 |
| Upturned head | 13 | 50 | 0 | 0 | 0 | 0 |
| Blue band | 0 | 0 | 9 | 40.91 | 0 | 0 |
| Colour | 0 | 0 | 13 | 59.09 | 0 | 0 |
| Do not know | 0 | 0 | 0 | 0 | 13 | 100 |
| **Seasons of abundance** | | | | | | |
| June-Aug | 1 | 7.14 | 0 | 0 | 0 | 0 |
| June-Aug | 1 | 7.14 | 0 | 0 | 0 | 0 |
| July Aug | 1 | 7.14 | 0 | 0 | 0 | 0 |
| Aug-Dec | 2 | 14.29 | 0 | 0 | 0 | 0 |
| Sept –Nov | 1 | 7.14 | 0 | 0 | 0 | 0 |
| Sept-Dec | 3 | 21.43 | 2 | 15.38 | 1 | 7.69 |
| Oct-Jan | 3 | 21.43 | 0 | 0 | 0 | 0 |
| Nov Jan | 2 | 14.29 | 0 | 0 | 0 | 0 |
| All Season | 0 | 0 | 11 | 84.62 | 12 | 92.31 |
| **Reproductive period** | | | | | | |
| Wet season | 0 | 0 | 0 | 0 | 0 | 0 |
| Dry Season | 0 | 0 | 0 | 0 | 0 | 0 |
| Through the year | 0 | 0 | 0 | 0 | 0 | 0 |
| Don't know | 13 | 100 | 13 | 100 | 13 | 100 |
| **Where do they spend their juvenile stage** | | | | | | |
| Shallow water | 9 | 69.23 | 0 | 0 | 0 | 0 |
| Don't know | 4 | 30.77 | 13 | 100 | 13 | 100 |

*Source: Field Survey, 2019*

As shown in Table 6, the maximum percentage change in the total catch landed for *P. typus was* 20.17% while the lowest was -29.88%. These were recorded in 2011 and 2016 respectively. For *L. goreensis and S. afra* respectively, the highest % change in catch landed were 47.52% and 36.40%. On the other hand, their corresponding least % change in catch landed were -27.19% and -26.95%. Comparatively, *L. goreensis* which had the least % change in price (3.88%) in 2011 had the highest % change in catch (47.52%) in the same year.

## 4. DISCUSSION

The socio-economic features of fishers in this study are similar to those reported for marine fishermen in the Gulf of California, Mexico [14].

The information revealed by the fishers on habitat, food and feeding habits of the fish species agreed with the reports already in the literature. The modal age group of the interviewed fishers which was 41-60 years implies that majority of them are matured adults with vast experience in fishing activities and this was seen in their taking fishing job for full time. Similar age groups have been reported among fish marketers in Bayelsa State [15], and among fish marketers in Igbokoda [16]. It is a general belief that fishing activities are carried out by people with little or no formal education. However, in this study, majority of fishers had formal education. Similar results had been reported among fish marketers [17,18]. In this study, fishers had their initiation on fish through training and they all work in industrial fishing companies. The vessels used are trawlers with LOA of 13.3m and a GT of 29.38. The gears used are trawl nets with a cod-end mesh size of 76mm while the type of fishing license is for fishing only. This was in line with the national sea fisheries (Fishing) regulation as regards to the type of fishing license and cod-end mesh sizes. Reports from the fishers interviewed showed that the habitats of *Pseudotolithus typus* are muddy areas and shallow water while the habitat of *Lutjanus goreensis* was rocky area.

Majority of the fishers disclosed that the common food for *P. typus, L. goreensis and Sphyraena afra* was shrimp and fish. This implies that the three fish species are carnivores. Fakoya et al. [19,20] confirmed snappers as carnivores, Froese and Pauly [21] discovered S. afra to be carnivores while carnivorous feeding of *P typus* was reported by Edwards *et a*l., 2001 [22].In searching for a solution to the lack of technical information to preserve the aquatic ecosystem and its endangered species, scientists have been finding that the knowledge accumulated over generations by local fishermen can provide an alternative useful source of data [23]. By

**Table 3. Local knowledge of the fishers on size distribution and market prices of the fish species**

| Variables | Croaker (*Pseudotolithus typus*) | | Red Snapper (*Lutjanus goreensis*) | | Barracuda (*Sphyraena afra*) | |
|---|---|---|---|---|---|---|
| | Number | Frequency (%) | Number | Frequency (%) | Number | Frequency (%) |
| **Minimum weight of fish caught(g)** | | | | | | |
| <50 | 13 | 100 | 0 | 0 | 0 | 0 |
| 50-100 | 0 | 0 | 0 | 0- | 0 | 0 |
| 100-150 | 0 | 0 | 13 | 100 | 4 | 30.77 |
| 150-200 | 0 | 0 | 0 | 0 | 9 | 69.23 |
| **Maximum weight of fish caught(g)** | | | | | | |
| <5,000 | 0 | 0 | 1 | 7.69 | 0 | 0 |
| 5,000-10,000 | 9 | 69.23 | 6 | 46.15 | 3 | 23.08 |
| 10,000-15,000 | 3 | 23.08 | 5 | 38/46 | 1 | 7.69 |
| 15,000-20,000 | 1 | 7.69 | 1 | 7.69 | 9 | 69.23 |
| **Mode of selling** | | | | | | |
| Fresh | 13 | 100 | 13 | 100 | 13 | 100 |
| Processed | 0 | 0 | 0 | 0 | 0 | 0 |
| **Method Used in selling** | | | | | | |
| By Scale | 13 | 100 | 13 | 100 | 13 | 100 |
| By hand | 0 | 0 | 0 | 0 | 0 | 0 |
| By Bowl | 0 | 0 | 0 | 0 | 0 | 0 |
| **Price Rate/kg of the species** | | | | | | |
| ₦1700 | 13 | 100 | 0 | 0 | 0 | 0 |
| ₦2300 | 0 | 0 | 13 | 100 | 13 | 100 |
| **To whom do you sell** | | | | | | |
| International Market | 0 | 0 | 0 | 0 | 0 | 0 |
| Agent/Distributor | 13 | 100 | 13 | 100 | 13 | 100 |
| Market women | 0 | 0 | 0 | 0 | 0 | 0 |
| Consumers | 0 | 0 | 0 | 0 | 0 | 0 |

*Source: Field Survey, 2019*

**Table 4. Local ecological knowledge on conservation of the fish species**

| Variables | Croaker (*Pseudotolithus typus*) | | Red Snapper (*Lutjanus goreensis*) | | Barracuda (*Sphyraena afra*) | |
|---|---|---|---|---|---|---|
| | Number | Frequency (%) | Number | Frequency (%) | Number | Frequency (%) |
| **Population Status(Conservation)** | | | | | | |
| Increasing | 0 | 0 | 0 | 0 | 0 | 0 |
| Decreasing | 13 | 100 | 13 | 100 | 13 | 100 |
| The Same | 0 | 0 | 0 | 0 | 0 | 0 |
| Do not know | 0 | 0 | 0 | 0 | 0 | 0 |
| **What is responsible for the decrease** | | | | | | |
| Overfishing | 13 | 100 | 13 | 100 | 13 | 100 |
| **Anthropogenic factors that could be responsible for the present status of the fish stocks** | | | | | | |
| Plastic Debris | 3 | 23.08 | 3 | 23.08 | 3 | 23.08 |
| No idea | 10 | 76.92 | 10 | 76.92 | 10 | 76.92 |
| **Conservation Strategy** | | | | | | |
| At Sea Inspection | 0 | 0 | 0 | 0 | 0 | 0 |
| Non-trawling Zone | 0 | 0 | 0 | 0 | 0 | 0 |
| Closed Season | 13 | 100 | 13 | 100 | 13 | 100 |
| Use of BRD | 0 | 0 | 0 | 0 | 0 | 0 |

*Source: Field Survey, 2019*

**Table 5. Percentage change in price of *P. typus*, *L. goreensis* and *S. afra* at landing sites in lagos**

| Year | *P. typus* Price(₦/Kg) | % Change in Price | *L. goreensis* Price(₦/Kg) | % Change in Price | *S. afra* Price(₦/Kg) | % Change in Price |
|---|---|---|---|---|---|---|
| 2009 | 587.5 | - | 800 | - | 650 | - |
| 2010 | 615 | 4.68 | 850 | 6.25 | 650 | 0 |
| 2011 | 716 | 16.42 | 883 | 3.88 | 850 | 30.77 |
| 2012 | 800 | 11.73 | 1000 | 13.25 | 1000 | 17.65 |
| 2013 | 887.5 | 10.94 | 1075 | 7.50 | 1075 | 7.50 |
| 2014 | 937.5 | 5.63 | 1175 | 9.30 | 1175 | 9.30 |
| 2015 | 1000 | 6.67 | 1275 | 8.51 | 1275 | 8.51 |
| 2016 | 1047.5 | 4.75 | 1349 | 5.80 | 1349 | 5.80 |
| 2017 | 1162.5 | 10.98 | 1600 | 18.60 | 1600 | 18.61 |
| 2018 | 1462.5 | 25.80 | 1762.5 | 10.16 | 1762.5 | 10.16 |
| Mean | 921.6 | 10.85 | 1176.95 | 9.25 | 1138.65 | 12.03 |

*Source: Field Survey, 2019*

**Table 6. Total Quantity (Mt) of *P. typus*, *L. goreensis* and *S. afra* landed in lagos (2009-2018)**

| Year | *P. typus* | % Change | *L. goreensis* | % Change | *S. afra* | % Change |
|---|---|---|---|---|---|---|
| 2009 | 81.325 | - | 2.214 | - | 0.751 | - |
| 2010 | 77.898 | -4.21 | 1.612 | -27.19 | 0.608 | -19.04 |
| 2011 | 93.61 | 20.17 | 2.378 | 47.52 | 0.798 | 31.25 |
| 2012 | 73.042 | -21.97 | 2.383 | 0.21 | 0.883 | 10.65 |
| 2013 | 52.223 | -28.50 | 2.455 | 3.02 | 0.645 | -26.95 |
| 2014 | 52.522 | 0.57 | 2.307 | -6.03 | 0.684 | 6.05 |
| 2015 | 36.902 | -29.74 | 2.663 | 15.43 | 0.933 | 36.40 |
| 2016 | 25.877 | -29.88 | 2.774 | 4.17 | 0.815 | -12.65 |
| 2017 | 30.428 | 17.59 | 2.798 | 0.87 | 0.851 | 4.42 |
| 2018 | 28.957 | -4.83 | 3.092 | 10.51 | 0.807 | -5.17 |
| Mean±SD | 55.28±24.73 | -8.98 | 2.47±0.40 | 5.39 | 0.78±0.10 | 2.77 |

*Source: Federal Department of Fisheries (FDF), 2019*

comparing the information provided by experts with the available scientific literature, similarities can be noted between the two sources of knowledge. The morphological characteristics used by fishermen in this study for identification of the fish species agreed with that reported by

literature such as on *L. goreensis* from Five Cowrie Creek. Also in Brazil [24] in order to identify and distinguish the species of the snapper group, the fishermen used criteria related to their morphological aspects such as coloration and body shape.

Most of the fishers could not use physical vision to identify the sexual dimorphism of the fish and this was in agreement with the scientific view [25]. However, all the fishers opined that some other species of fish sex can be distinguished externally by color differences or by distinctive behaviors, although other species females may become so swollen with eggs. This statement is connoted with the report of Colin et al. [26]. The sales of fish species through the use of weighing scales as reported by fishers give them vast knowledge about the weight of the fish. Fishers could not provide detailed knowledge about the spawning period of the fish due to the mesh size of the fishing gear used. Similarly, they could not determine the wet and dry seasons again due to climate change which has altered the conventional seasons.

Although the integration of scientific study with the local ecological knowledge (LEK) of fishermen is a new area of investigation that integrates the efforts and interests of researchers in both natural and human sciences, numerous investigations have shown, however, that the importance of LEK for the conservation and management of fishing resources is important [27]. Also, most of the revealed LEK by fishers especially on the growth pattern and population structure of the fish species examined in this study was in line with the findings of Akinbobola and Fakoya [28]. The results from the present study may be highly valuable due to the lack of studies from Africa, with only 2–8% of the published articles on marine LEK from this region [9].

The summary of the percentage (%) changes in prices showed that *L. goreensis and* S. afra had similar % change in price in 2016, 2017 and 2018; however, there are fluctuations in % change in the total catch for these fish species. The annual average percentage changes in price (2009-2018) for *P. typus, L. goreensis and* S. afra are significantly different from the peak recorded in S. afra. This may be due to the decline in catch or other factors relating to the cost of production. However, the quantities of the fish landing were smaller in comparison with annual barracuda caught in Cochin, south-west

coast of India [29] and P. typus from Liberia coastal water [30]. Similar results of low catch composition have been documented for Yovoyan Coastal waters in Badagry [31].

## 5. CONCLUSION

Local ecological knowledge (LEK) is increasingly recognized as an important component of scientific research, conservation, and resource management. This study has shown that the local knowledge of the interviewed fishers regarding the biological and ecological characteristics of *P. typus*, *L. goreensis* and *S. afra* had a refined level of detail and a high agreement with the scientific literature, thereby confirming the potential integration between these two knowledge systems. Also, there is a fluctuation in the catch and prices of the fish species examined in this study.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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