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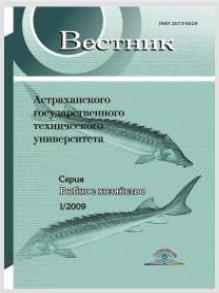

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Sohou Zacharie, Hinvi Cloud Lambert, Guidi Tognon Clotilde,
Semassou Clarence, Fiogbe Emile Didier

STUDY OF ENVIRONMENTAL SAFETY OF FLOATING NETS FOR SARDINELLA CATCHING

Abstract. The drift net is one of the most used fishing gear in Benin. It is easy to use and requires very little energy. The net has high interselectivity for ground fish that gives mixed results in many regions. Physical impact of drift nets on the seabed is not a matter of concern. The ecological risk from interselectivity of the net is also insignificant and mainly occurs as a result of their abundant usage, for example, by the artisanal fishermen deployed in the area of fishing during the strong sea conditions. The purest, in terms of ecology, nets are gillnets for the sardinella catching, which are placed at 10 cm deep below the surface with numerous floats. They drift freely under the influence of the water current or with the boats if they are moored. The old model of the net is used as an ecologically pure drift net at 12 to 20 m deep with a length of 360–400 meters per a set. A fisherman can deploy about 4–5 sets of sardinella nets. Madeiran sardinella (*Sardinella maderensis*) is the most widespread sardinella species in Benin continental shelf. Round sardinella are very few in the catch. The fishing objects are generally called sardinella. Fishing nets are called Sardinella nets. The number of fishes for the old kind of net varied from 120 to 600 fishes per 3.5 kg, and for the new model – 40 fishes per 5 kg. The fisherman's annual revenue increases from 2500 to 3000 CFA francs (Financial collaboration of the Countries of the Central Africa) while using the old kind of net and to 4000 CFA francs when using the new one. Respect of this selectivity participates in renewal of the stock.

Key words: drift net, gear, *Sardinella maderensis*, fishing objects, selectivity.

Introduction

Republic of Benin is a small country with approximately 114,763 km^2 of area (INSAE, 2003), with a coastline of 125 km along the Atlantic Ocean in the Gulf of Guinea. Because of its limited coastal zone, Benin has an Exclusive Economic Zone (EEZ) of 200 nautical miles and a small continental shelf of 3.100 km^2. Fish production of Benin comes from inland and marine fisheries. The fishermen use simple and diversified technology such as beach seine, purse seine, net or passive net, drifting nets and trawls. Except trawl, the artisanal fishermen use all the fishing gears. Fishing with beach seine used by artisanal fishermen has the disadvantage of destroying the spawning zone and ground fauna; the consequence of this destruction of sensitive coastal ground is overexploitation of marines resources mainly of *Sardinella maderensis* or the subsequent disappearance of the round sardinella [1]. The second consequence is a decrease of commercial length of Madeiran sardinella (*Sardinella maderensis*).

In general, the selectivity can be defined as the fishing practice liability to target and retain organism by size and species during fishing operation.

The selectivity of fishing net is the degree of discrimination relative to the species caught (selectivity interselectivity) and fish size (intraspecific selectivity). The commercial size of different fish species decreases considerably [2]. According to this situation, it is necessary to try to reduce the catching of juvenile species through responsible fishery management. This study shows different techniques for using the drift net to catch sardinella (*Sardinella aurita* and *Sardinella maderensis*). The study has been conducted for two years, in March during growing and recruitment of a lot of juvenile. We can mention that target species consist mainly of flat sardinelle (*Sardinella madrensis*). Round sardinella are by-catch species that are rare in the catch.

The main goal is to compare the catch performance of new and old drift net targeting sardinella.

Methodology

To study the selectivity of the sardinella net which is a drift net, we observe the size of different catches of sardinella. The monitoring of the net was made by the fishermen who had used before the old model.

On landing, the size of caught species is taken by measuring meristic parameters and calculating the proportion of fish of different sizes for both models: the new and the old gear used by the fishermen retained in the study.

Formule to calculate is $L50$; $L50 = L_{max}$ Somme (P, %).

Overview of the fishing gear

Drift net. Rectangular and very diversified by the size of the piece of net which includes in the gear, drift nets are encircling or vertically attached to the substrate or between two waters. The sardinella net or "Mahundô" is a floating gillnet. The sardinella net specializes in capturing Clupeidae in general. It is composed of several pieces of net 20–45 m long assemblies 200 length to more than 400 m with a height from 4–10 m [3].

The Sardinella net (Fig. 1) can be used as a drift net with a straight line for nighttime fishing or encircling for day fishing.

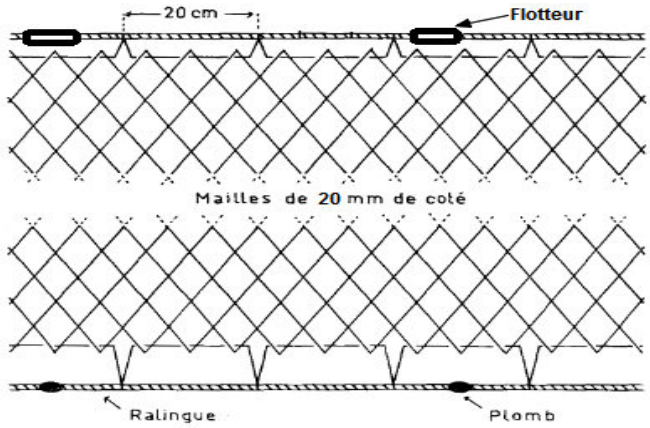

Fig. 1. Sardinella net

For daytime fishing net is wet around a shoal (fish group) and fishermen beat the water with their paddles to scare and guide the fish in the direction of the gear [4]. Today the fish shoal size decreases dramatically; so that fishermen are now using only night fishing of sardinella. The landing is done very early, at the arrival of fishermen who fish the night. The transaction for this species takes place earlier in the morning [5, 6].

Identical form resembling to fixed floating net, sardinella net is hung over at 10 cm under water surface because of many floats (Fig. 2).

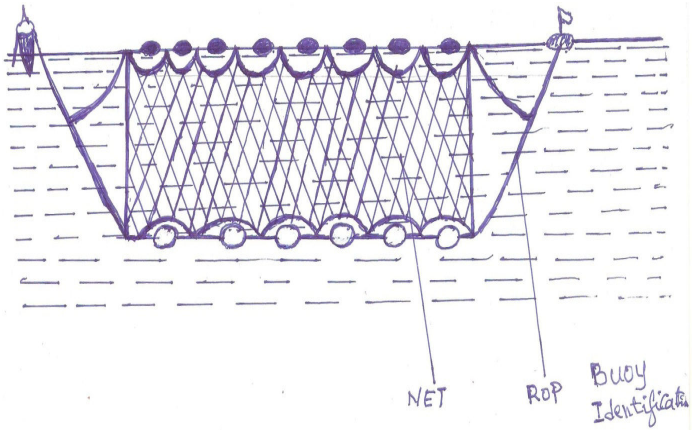

Fig. 2. Net installation in the sea water

They drift freely under the current influence or with a boat if they are moored. The old model is used as a drifting net 12–20 m height with 360 yards or 400 meters length per net package. One fisherman can take up to 4–5 sets of Sardinella nets (Tabl.).

Comparative data for both sardinella net

Specifications	Sardinalla net	
	Old model	**New model**
Net poses number into the sea	3 to 4 per boat	10 to 30 per boat
Weight of catch per pose	22 kg/pose	120 kg/pose
Nombre d'individus capturés par pose Number of fish catching per pose	120 to 600 for 3.5 kg weight	40 fishes for 5 kg weight
Catching species size	7 to 17 cm	17 to 28 cm
Sample size	120	40
Revenus (F CFA)	2.500 to 3.000 F CFA	4.000 CFA

The new model has 20 mm meshes and up to 15–30 sets so the length is 800 yards or 180 meters. The gear consists of a net mounted on an upper and lower rope. The ropes are weighted down by lead and up by floats that keep the gear on the surface or between two waters (Fig. 1). Most of the fishermen use now monofilament nets from polyethylene.

The performance capture with drift nets (Fig. 2) is specific and Beninese fishermen assign to each net names associated with a specific kind of fish.

In Fig. 3 there is a different part of fish retained in the mesh that depends on the mesh size, the fish size and slope.

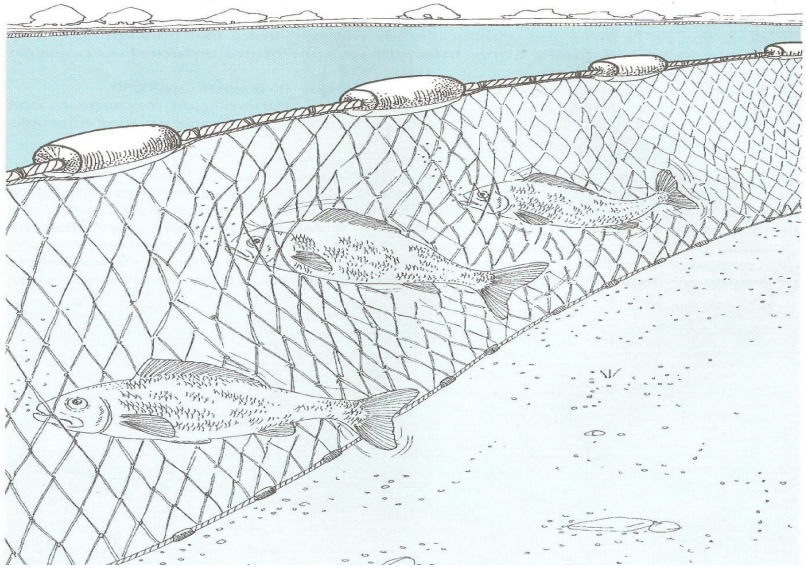

Fig. 3. Fish retained in different place of their body according to their size

Results and discussions

With the use of the old model, more than half of the catch is composed of juveniles (Fig. 4). It is observed from this figure that the old model caught a maximum of 8 cm juvenile while with the new model we have a maximum of 18 cm. Faced with this situation, the fishermen themselves complain but do not really know what to do. Thus, fish bowls were sold at prices of 3.000 FCFA.

With the use of the new model and a 20 mm mesh, the sardinella are retained at mesh correctly. Most of juveniles pass through the mesh and only remain those who reach mature size. The size of the 50 % capture is 13 cm, close to the size at first maturity (Fig. 4). The catch is composed of nearly 75 % of commercial fish size. Fishermen themselves are satisfied with their catch because they sell quarantine price of 4.000 CFA (Tabl.). Thus 60 % of fishermen, who oppose this measure that popularizes the fishermen's association of the National Union of Seamen and Fishermen Assimilated of Benin (UNAPEMAB) adopted a new gear, a sardinella net. It should be noted that with the decline in catch per unit effort, fishermen are still reluctant to the good practice of responsible fishing.

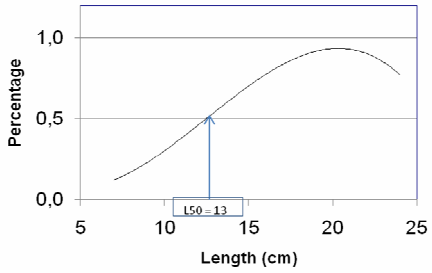

Fig. 4. Percentage retained by net with small mesh size (Old model)

According to Fig. 5, 18 cm size corresponds to high quality of fish (over 160 individuals) for the new gear, while using the old one we observe a great quantity of juvenile (8 cm size) with approximately 70 individuals.

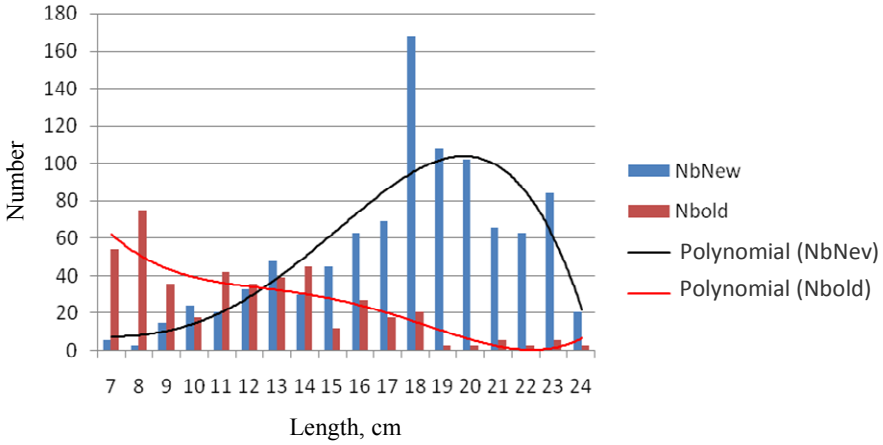

Fig. 5. Sardinella population distribution

The analysis gives us a clear idea. 18 cm is the maturity size of sardinella population. We can notice that the new gear is more selective than the old one.

Implications for the development

The sardinella net selectivity is involved in the preservation of sardinella and biodiversity conservation. The importance of this selectivity is the responsible management of sardinella fisheries and pelagic fish in general. Catch of commercial size fishes preserves the fish stock. The application of this measure contributes to increase in income of fishermen. Thus, fishermen can make their catch available for the population and the additional import of the species from neighbor's countries and sub-regions should decrease.

Conclusion

Thus, the new net model offers a benefit to the sustainable management of the stock because the juveniles proportion of fishes catch is low compared to the old model catch. This result can be included in fisheries management, which can contribute to the stock assessment as an important topic.

Facing to the adoption of the new model sardinella net by the majority of fishermen, we can conclude that we can convince fishermen to adopt a reform in the fishermen communities and all stakeholder; then they should be encouraged to begin some experiments and they find their interest.

The selectivity of the fishing gear that contributes to the sustainable management of the species should help preserve the stock. This measure can contribute to the efficient fish stock management. It should contribute to stock recruitment.

This is a responsible and selective fishing that fisheries managers should take into account in accordance with the FAO recommendations. Substantial revenue of fishermen is increasing and contributing to food security. Work is ongoing to determine accurately the catch per unit of effort in combination with a socio-economic aspect.

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ИССЛЕДОВАНИЕ ЭКОЛОГИЧЕСКОЙ БЕЗОПАСНОСТИ ПЛАВАЮЩЕЙ СЕТИ ДЛЯ ЛОВЛИ САРДИНЕЛЛЫ

Дрейф-сеть (плавающая сеть) является одним из наиболее часто используемых орудий лова в Бенине. Она проста в использовании и требует очень мало энергии. Сеть имеет высокую интерселективность для донных рыб, что дает неоднозначные результаты во многих регионах. Физическое воздействие дрейф-сети на морское дно незначительно. Экологический риск от интерселективности сети также незначителен и возникает в основном в результате использования их чрезмерного количества, например, рыбаками-кустарями, промыш-

ляющими в морских условиях. Наиболее чистыми с точки зрения экологии являются жаберные сети для ловли сардинеллы, которые размещаются на глубине 10 см ниже поверхности с многочисленными поплавками. Они свободно дрейфуют под воздействием токов воды или с пришвартованной лодки. Старая модель сетей используется как экологически чистая на глубине от 12 до 20 м с длиной 360–400 м в пачке. Рыбак может развернуть примерно от 4 до 5 комплектов сети для сардинеллы. Наиболее распространённый вид сардинеллы в континентальном шельфе Бенина – *Sardinella maderensis*. Круглой сардинеллы (*Sardinella aurita*) в улове обычно очень мало. Для объектов лова принято общее название сардинеллы. Рыболовные сети называются сардинелла-сеть. Количество рыбы для сети старой конструкции составляет от 120 до 600 рыб на 3,5 кг, для новой модели – от 40 рыб на 5 кг. Ежедневный доход рыбаков увеличивается с 2500 до 3000 франков СФА (Финансового сотрудничества стран Центральной Африки) при использовании сети старой модели и до 4000 франков – при использовании новой.

Ключевые слова: дрейф-сеть, снаряжение, *Sardinella maderensis*, объект лова, селективность.

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