

Evaluation of the Selectivity of Two CNRA Seine Prototypes on the Stock of *Pellonula leonensis* Boulenger, 1916 (Piscès; Clupeidae) in the Taabo Dam Lake (Bandama, Ivory Coast)

Ahoutou K. Eric^{1,3*}, Diomandé M.^{1,2}, Ani Abié P.¹, Soro K. D. et K. S. Da Costa¹

¹National Agricultural Research Center (CNRA), Research Station for Continental Fisheries and Aquaculture (SRPAC)

²Nangui Abrogoua University (UNA), Laboratory of Environment and Aquatic Biology (LEAB)

³Alassane Ouattara University (UAO) in Bouake, Faculty of Science and Technology (ST)

DOI: <https://doi.org/10.36347/sajb.2025.v13i11.011>

| Received: 02.10.2025 | Accepted: 25.11.2025 | Published: 29.11.2025

*Corresponding author: Ahoutou K. Eric

National Agricultural Research Center (CNRA), Research Station for Continental Fisheries and Aquaculture (SRPAC)

Abstract

Original Research Article

This study was conducted from April to June 2024 at the Taabo dam lake. It enabled the selectivity to be assessed by analyzing the catches of two CNRA seine prototypes and the reference seine. The results of the analysis show that the average length of *P. leonensis* captured by prototypes 1 and 2 are 31.20 ± 4.61 mm and 32.34 ± 4.76 mm, respectively. The reference seine catches a medium-sized stock of 30.22 ± 2.67 mm. The proportions of immature specimens in landings are 34.22%, 28.64%, and 36.31% for prototype 1, prototype 2, and the reference seine, respectively. Regarding mature individuals of *P. leonensis* in the catches, the rate is 65.78% for prototype 1, 71.36% for prototype 2, and 61.59% for the reference seine. Fish of optimal size account for 25.78% of catches with prototype 2, 20.80% with prototype 1, and 16.82% with the reference seine. From $R = 50\%$ corresponding to a size of 35.03 mm, the size frequencies decrease until they reach 65 mm for catches from prototype 2 and 61.38 mm for landings from prototype 1. Beyond 35.03 mm, the size of catches decreases to 43.29 mm in the reference seine.

Keywords: *Pellonula leonensis*, Seine Selectivity, Overexploitation, Mesh Size, Taabo Dam Lake, Immature Specimens.

Copyright © 2025 The Author(s): This is an open-access article distributed under the terms of the Creative Commons Attribution **4.0 International License (CC BY-NC 4.0)** which permits unrestricted use, distribution, and reproduction in any medium for non-commercial use provided the original author and source are credited.

INTRODUCTION

Inland fishing is of paramount importance for populations living along rivers and lakes (Bi *et al.*, 2019). Fishery products contribute, on the one hand, to food and nutritional security and, on the other hand, to monetary income and other socio-cultural benefits (Bi *et al.*, 2019). Fishing activities are also an economic issue for coastal communities and remain a significant source of protein (Bi *et al.*, 2019). However, the intensive and uninterrupted exploitation of these fishery resources poses a threat to the integrity of stocks. This is the case for *Pellonula leonensis* Boulenger, 1916 from Lake Taabo, which is a threatened species due to overexploitation (Ahoutou *et al.*, 2019). The impact of fishing on a fish stock depends on the gear used. Lévêque and Paugy (1999) indicate that this pressure can be exerted on adults or juveniles. However, fishing gear is designed to preferentially capture large specimens (Law, 2000). When a fishery is first established, large individuals are abundant, whereas the proportion of small fish increases in heavily exploited communities

(Pope and Knight, 1982; Murawski and Idoine, 1992). The average size of specimens is decreasing and the mode is shifting toward smaller size classes. Therefore, when the mesh size of fishing gear becomes very small, it catches fish that have not reached sexual maturity. This situation contributes in the long term to the dramatic collapse of fish populations. At Taabo Dam Lake, observation of changes in the mesh size of shore seines shows a downward trend from 2007 to the present (Yao, 2008). In fact, a mesh size of 35 mm was noted for seines at the start of the *Pellonula leonensis* fishery, whereas nowadays all fishing units systematically use mosquito nets on their seines. According to research by Ahoutou *et al.* (2019) on biological indicators of sustainability, these fishing gear indicate that the species is threatened. Therefore, doing nothing could lead to a loss of benefits from food-related services and income for those involved in this fishery, both in the immediate and long term (FAO, 1999). Also, seines are fishing gear commonly used in artisanal fisheries, but their effectiveness and selectivity can vary depending on their design.

Citation: Ahoutou K. Eric, Diomandé M., Ani Abié P., Soro K. D. et K. S. Da Costa. Evaluation of the Selectivity of Two CNRA Seine Prototypes on the Stock of *Pellonula leonensis* Boulenger, 1916 (Piscès; Clupeidae) in the Taabo Dam Lake (Bandama, Ivory Coast). Sch Acad J Biosci, 2025 Nov 13(11): 1558-1566.

According to Duthie (1992), gear selectivity can be defined as the ability of gear to target and capture fish by species, size, or during fishing operations, and to release any bycatch unharmed. It is in this context, for the sustainable management of the *Pellonula leonensis* stock, the CNRA proposed to design two prototypes of seine nets with different characteristics in order to test their selectivity on the *P. leonensis* “Mimie la go” population. The aim is to increase the catch size of this fish stock, which is crucial for the future of the communities living on the shores of Lake Taabo and beyond.

I-MATERIALS AND METHODS

1-1-Materials

The study equipment consists of three (03) seines, including one reference seine and two prototypes of CNRA seines for *Pellonula leonensis*. These consist of several layers of netting forming folding wings with a pocket in the central layer. The central pocket has two sections: an upper layer and a lower layer. Prototype 1 with characteristic 8/6 indicates that the upper layer of the pocket has a mesh size of 8 mm and the lower layer has a mesh size of 6 mm. Prototype 2 with characteristic 10/8 has a mesh size of 10 mm for the upper layer of the pocket and 8 mm for the lower layer. The reference seine with characteristics 4/2 is one of the seines used by fishermen targeting *P. leonensis* in Lake Taabo.

1-2-Methods

1-2-1-Sampling

To test the various CNRA prototypes of Mimie la go seines nets, fishermen conducted a series of fishing trips under the same conditions and in the same fishing areas on Lake Taabo. Species caught by seine net at *Pellonula leonensis* were sampled. The fish samples, namely *Pellonula leonensis* and incidental species caught, were examined at the dam, counted, and then sent to the laboratory. The morphometric parameters of the captured specimens (total length [TL], standard length [SL], body height [H], weight [W]) were measured using an ichthyometer and a precision scale accurate to 0.01 g.

1-2-2-Determining the frequency of size

The number of classes was determined using Sturge's rule $[1 + (3.3 \log N)]$ and the class interval (CI) using the formula below.

$$IC = \frac{LS_{max} - LS_{min}}{1 + 3,3 \times \log N}$$

With: LS_{max} = Maximum standard length; LS_{min} = Minimum standard length; N = Number of individuals.

1-2-3-Determining the size at first sexual maturity

According to Legendre and Ecoutin (1996), L_{50} refers to the average standard length at which there are as many mature individuals as immature ones. In this study, L_{50} was determined by considering specimens in stages 3, 4, and 5. The cumulative percentages for these stages were calculated globally. The percentages of

individuals per size class of 3.1 mm were grouped and weighted by the total number of individuals for each ordered class.

This function, which represents the probability of individuals being mature (P) relative to a standard reference length (SL), is expressed by (Ghorbel *et al.*, 1996):

$$P(x) = \frac{e^{-(\alpha + \beta x)}}{1 + e^{-(\alpha + \beta x)}}$$

With: α and β constants

To apply this technique, $p(x)$ should be assigned the probability of mature individuals and x should be assigned the median points of the size classes considered. The average size at which 50% of individuals are mature is deduced from the following formula:

$$LS_{50} = \frac{-\alpha}{\beta}$$

1-2-4-Determination of the proportion of specimens at optimal length (Lopt)

The optimal size is the size at which a minimum number of fish must be caught to obtain the highest possible yield. The objective of knowing this size is to capture 100% of individuals with more or less 10% of the L_{opt} so that the fishery is sustainable. In the case of this work, the L_{opt} indicated by Ahoutou *et al.* (2019) was the one selected, which is 37.21 mm. The optimal size range is therefore individuals measuring between 33.49 and 40.93 mm.

$$\% L_{opt} = \frac{\text{number of fish by size } [33,49 ; 40,93]}{\text{Total fish}} \times 100$$

With $\% L_{opt}$ = percentage of fish at optimal size

1-2-5-Determination of the proportion of super-reproducers (SR)

Super breeders are fish that have reached more than 10% of their optimal size. The size of *Pellonula leonensis* super-breeders at Lake Taabo is based on the work of Ahoutou *et al.*, (2019). This author's study data indicate that the minimum length is 40.93 mm for super-reproductive individuals. The proportion of these fish caught for each prototype is determined according to the following formula:

$$\%SR = \frac{\text{fish stock size} > 40,93 \text{ mm}}{\text{Total fish}} \times 100$$

$\%SR$ = percentage of super reproducer

1-2-6-Determining the maturity stages of specimens

In this study, to determine the exploited stock segments, specimens are grouped according to sex and maturity status. Thus, stage I and II fish, both female and male, are considered immature. Stage III, IV, and V fish are mature individuals (N'Goran, 1995).

1-2-7 Selectivity of seines

The selectivity considered in this study is the vulnerability of fish to fishing gear according to size. The

estimate of selectivity is based on differences in the size structure of catches from gear that has fished the same stock (Pop *et al.*, 1975). To calculate selectivity, a ratio R (ratio between catches of the gear to be tested and the reference gear) is established for each size class based on the size frequency distributions. We then compared the catch numbers from the selectivity zone defined here as where $R \geq 50\%$. To adjust the value of the R ratio, we determined a confidence interval (CI) for each size class.

$$Ri = \frac{N_2}{N_1}$$

$$IC = R \pm 1,96 \sqrt{\frac{N_2 (N_1 - N_2)}{N_1^3}} \text{ (Cantrelle et al., 1983)}$$

With Ri = catch ratio by size class and abundance; $N1$ = total abundance of catches in size class i for the reference gear; $N2$ = total abundance of catches in size class i for the prototype to be tested; CI = confidence interval

1-2-9-Statistical analysis

The Chi-square (χ^2) test was used in this study to compare the rates of immature, mature, and optimal-size (Lopt) specimens caught by the different prototypes. An analysis of variance (ANOVA) was also used to compare the average sizes of specimens caught by fishing gear.

II-RESULTS

2-1-Size class of *Pellonula leonensis* exploited by prototype

The specimens captured were divided into eleven (11) size classes for the two prototypes (Table I). The size class interval for individuals is 3.95 mm for prototype 1 and 3.87 mm for prototype 2. The size class interval for the reference seine is 3.10 mm. The general class interval for all of the “Mimie la go” seines tested is 3.1 mm.

Table I: Number and size range of *Pellonula leonensis* specimens caught with CNRA experimental seine prototypes and reference seine

Prototypes	Class number	Class interval
Prototype 1 : 8/6	10,87 ± 0,2	3,95 ± 0,06
Prototype 2 : 10/8	10,59 ± 0,2	3,87 ± 0,06
Référence seine	8,60 ± 0,2	3,10 ± 0,06
General class share	3,10 mm	

Observation of the histograms of variation among individuals by size class and by seine shows a single peak. The height of the peak is much greater for CNRA prototype seines than for reference seines (Figure 1). Specimens in the size class [28.83; 31.93[are the most numerous in catches in prototype 1 and in those of the reference seine (Figure 1A and C). These individuals constitute 31.12% and 34% respectively. As for prototype 2, the dominant individuals are in the class [31.46; 35.43[, representing a total of 284 individuals with a rate of 35.27% (Figure 1B)

2-2-Size spectrum of *P. leonensis* specimens captured by prototype

2-2-1-Variation in standard lengths (SL) of captured fish

The specimens of *Pellonula leonensis* caught during experimental fishing at Taabo Dam Lake ($n=1,779$) using CNRA prototypes of the “Mimie la go” seine net have a greater standard length than the standard length of specimens caught with the reference seine net (Table II). This standard-length ranges from 18 to 60 mm for prototype 1 (CNRA 8/6) for a sample of ($n = 976$) with an average of 31.20 ± 4.61 mm. For prototype 2 (CNRA 10/8), the standard-length ranges from 24 to 65

mm with a sample size of ($n = 803$). The average size with this prototype is 32.34 ± 4.76 mm. Specimens of Mimie la go caught with the reference seine have an average standard length of 30.22 ± 2.67 mm, with values ranging from 16.46 to 43.17 mm. Comparison of standard lengths indicates a significant difference between individuals caught by all seines (ANOVA, $p < 0.05$).

2-2-2-Variation in body height (BH) of captured fish

The tables below show that the body height of *Pellonula leonensis* individuals captured by the CNRA prototype Mimie la go seine nets was higher than that of specimens captured by the reference seine net. The maximum body height observed with prototype 1 (CNRA 8/6) is 15.05 mm, with a minimum height of 3.23 mm and an average of 6.4 ± 1.42 mm (Table II). For prototype 2 (CNRA 10/8), Table 3 shows a maximum body height of 14.88 mm and a minimum height of 3.27 mm, with an average of 6.98 ± 1.46 . The reference seine indicates individuals with a maximum body height of 10.55 mm and a minimum height of 2.06 mm, with an average of 5.49 ± 0.72 mm. A significant difference is observed for all seines in terms of body height (ANOVA, $p < 0.05$).

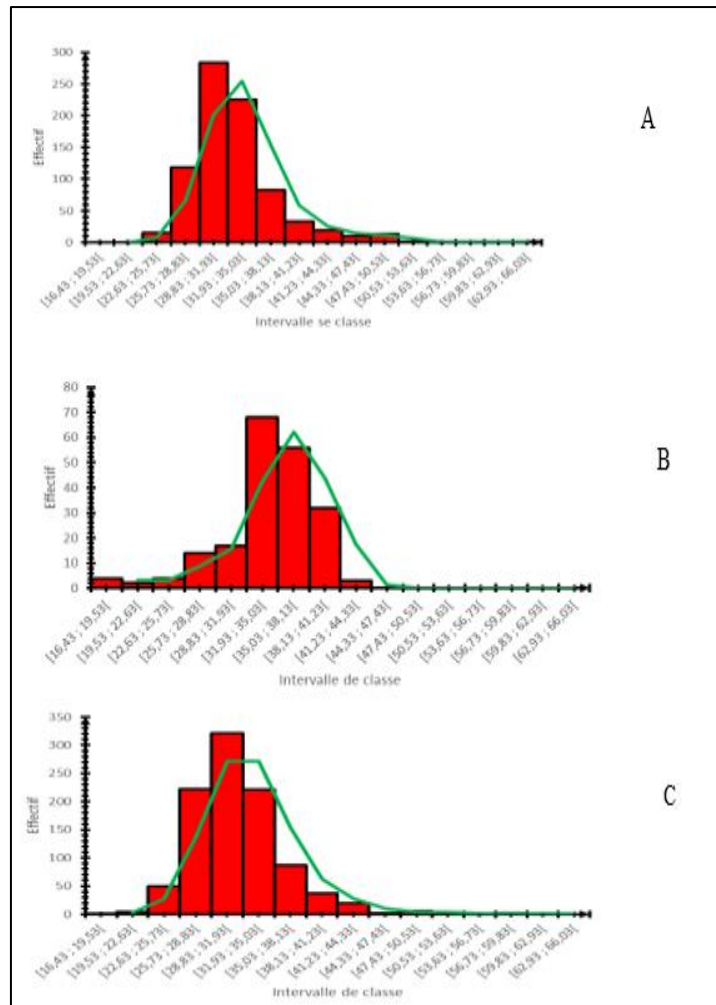


Figure 1: Size classes observed in specimens of *Pellonula leonensis* caught with the prototype experimental seines CNRA 8/6 (A), 10/8 (B) and the reference seine 4/2

2-2-3-Variation in the mass of *P. leonensis* specimens captured by prototype

The mass of individuals captured by the prototype (8/6) ranged from 0.1 g to 3 g, with an average of 0.58 ± 0.15 g. *P. leonensis* specimens from prototype landings (10/8) had a mass ranging from 0.1 to 4 g, with an average of 0.6 ± 0.15 g. The specimens from the

reference seine indicate a minimum weight of 0.04 g and a maximum weight of 1.48 g, with an average of 0.7 ± 0.15 (Table II). The reference seine catches individuals ranging in weight from 0.23 to 1.26 g, with an average of 0.48 ± 0.13 g. Analysis of variance of specimen weight reveals a significant difference for all seines (ANOVA, $p < 0.05$).

Table II: Morphometric characteristics of *Pellonula leonensis* specimens caught by prototype 1, prototype 2, and reference seines

		Prototype 1	Prototype 2	Reference seine
Total length (LT)	Moy	36,72 $\pm$ 5,47	38,04 $\pm$ 5,71	35,46 $\pm$ 4,06
	LTmin	26	28	19,97
	LTmax	72	82	53,36
Standard length (LS)	Moy	31,2 $\pm$ 4,61	32,34 $\pm$ 4,76	30,22 $\pm$ 2,67
	LSmin	18	24	16,46
	LSmax	61	65	43,29
Body height	Moy	6,4	6,98 $\pm$ 1,46	5,49 $\pm$ 1,6
	HCmin	3,23	3,27	2,06
	HCmax	15,05	14,88	10,55
Weight	Moy	0,58 $\pm$ 0,15	0,6 $\pm$ 0,15	0,48 $\pm$ 0,13
	Mmin	0,1	0,1	0,23
	Mmax	3	4	1,26

2-2-4-Size at first sexual maturity

The size at first sexual maturity of *P. leonensis* specimens caught using seines varies from one gear to another. This size is 28.73 mm for prototype 01 and 28.10 mm for prototype 02 CNRA 10/8. For the reference seine, the size reaches 27.35 mm.

2-3-Catch, abundance, and proportion by species and unit of effort

2-3-1-Proportion and diversity of bycatch species caught by gear

The capture of *Pellonula leonensis* schools during experimental fishing in the fishing areas of Lake Taabo reveals the presence of certain bycatch species. The overall catches of the CNRA prototypes of “Mimie la go” seine nets consist of 89.98% *P. leonensis* and 10.02% other species. Of the 1105 specimens sampled for prototype 01 (CNRA), 88.33% were *Pellonula leonensis*, compared to 11.67% for other species. A total of 11 fish species were observed in the catches. For prototype 02 (CNRA), we noted that 92.09% of total landings consisted of *Pellonula leonensis*, compared to 7.91% for the other seven species. These species, known as accessory species, are composed of *Coptodon zillii* (Gervais, 1848), *Brycinus nurse* (Rüppell, 1832), *Chromidotilapia guntheri* (Sauvage, 1882), *Hemichromis fasciatus* (Peters, 1852), *Chrysichthys nigrodigitatus* (Lacépède, 1803), *Hemichromis bimaculatus* (Gill, 1862), *Labeo parvus* (Boulenger, 1902), *Oreochromis niloticus* (Linnaeus, 1758), *Heterotis niloticus* (Cuvier, 1829), *Paraillia pellucida* (Boulenger, 1901), *Sarotherodon melanotheron* (Rüppell, 1852), *Schilbe mandibularis* (Günther, 1867), *Tilapia guineensis* (Günther, 1862) et *Tilapia sp.*

2-3-2-Size frequency of bycatch species captured by prototype seines

The size of bycatch species varies to a greater or lesser extent from one seine prototype to another. The species listed in this paragraph are those accounting for more than 3% of bycatch landings.

The size of *Brycinus nurse* in the catches of prototype 1 varies from 25 to 50 mm, with an average of 35.35 ± 5.54 mm. The average weight of this species caught by this prototype is 0.99 ± 0.52 mm. In prototype 2 landings, the standard length of this fish ranges from 28 to 65 mm, with an average of 37.53 ± 7.52 mm. *Brycinus nurse* individuals have an average weight of 1.25 ± 0.89 g.

Chrysichthys nigrodigitatus individuals captured using prototype 1 have a standard length ranging from 40 to 91 mm, while those captured using prototype 2 range from 40 to 43 mm. The average size for these devices is 57.5 ± 22.96 mm and 41.5 ± 1.29 mm, respectively. During this study, the average weight recorded was 4.86 ± 6.18 g for prototype 1 and 1.1 ± 0.52 g for prototype 2.

Prototype 1 gillnets capture specimens of *O. niloticus* ranging in size from 23 to 38 mm, with an average length of 29.25 ± 6.29 mm. The individuals caught by prototype 2 range in size from 32 to 75 mm, with an average of 51.40 ± 17.36 mm. The average weights observed were 1.25 ± 0.50 g and 6.5 ± 5.92 g for prototypes 1 and 2, respectively.

In landings, *Hemichromis fasciatus* ranges in size from 42 to 92 mm, with an average of 65.27 ± 12.95 mm for prototype seine 1 and 22 to 92 mm for prototype seine 2. The average standard length observed for prototype 2 is 51 ± 36.51 mm. The average weight of specimens is 8.34 ± 5.31 g and 8.20 ± 12.84 g for prototypes 1 and 2, respectively.

The standard length of *Tilapia sp* varies from 22 to 86 mm with prototype seine 1 and from 22 to 53 mm with prototype 2. The respective average sizes are 45.38 ± 13.99 g and 40.93 ± 12.20 mm. Individuals have an average weight of 3.90 ± 3.79 g for prototype 1 and 3.23 ± 2.24 g for prototype 2.

2-4-Proportion of immature, mature females, and mature males

The proportion of mature individuals in the CNRA prototype catches was determined to be 65.78%, of which 32.25% were female and 67.75% were male for prototype 1 CNRA 8/6. For this unit, the immaturity rate of individuals is 34.22%. As for prototype 2 CNRA 10/8, the proportion of immature individuals is 28.64% and that of mature specimens is 71.36%. In this stock of mature specimens, 30.72% are females and 69.28% are males. The reference seine catches 61.59% mature individuals and 36.31% immature individuals. The proportion of mature individuals consists of 26.15% females and 73.84% males (Table III). The proportion of mature and immature individuals for each seine reveals a significant difference (χ^2 ; $p < 0.05$).

Table III: Proportion of *P. leonensis* specimens caught with the CNRA prototype seines and the reference seine according to maturity

Type of seines	Mature Individuals (%)	Immature Individuals (%)	χ^2	p
Prototype 1 (8/6)	65,78	34,22	12,6	0,0003852
Prototype 2 (10/8)	71,36	28,64	18,25	0,00001937
Reference seine (4/2)	61,59	36,31	6,52	0,01062

2-5-Capture of *P. leonensis* specimens at optimal length (Lopt)

The optimal length of *Pellonula leonensis* specimens captured during this study at Taabo Dam Lake is 37.21 mm. Applying a margin of plus or minus 10% to this optimal size gives a size range extending from 33.49 to 40.93 mm. The number of specimens in this size range captured by prototype 1 was 203 out of a total of 976 individuals. These individuals accounted for 20.80% of the total (Table IV). For prototype seine 2, 207 specimens of *P. leonensis* of optimal size were caught. This represents 25.78% of the total catch of 803 specimens landed using this fishing gear. In the reference seine catches, only 37 specimens within the optimal size range were observed out of a total catch of 220. This represents a proportion of 16.82% (Table IV). Statistical analysis of the proportion of these individuals caught by

the different types of seines reveals no significant difference (χ^2 ; $p > 0.05$).

2-6-Capture of super reproducer (SR)

Analysis of the *Pellonula leonensis* shoals caught reveals the presence of super-producers that are more than 10% larger than the optimal size (40.93 mm). Super-producers account for 4.94% of total catches by CNRA seine prototypes (Table IV). Specifically, individuals larger than 40.93 mm represent 3.89% of catches by prototype 1 CNRA 8/6 and 6.23% of catches by prototype 2 CNRA 10/8. The proportion of super-reproducers is 0.45% in the reference seine catches. The Chi-square test reveals a significant difference only between prototype seine 2 and the reference seine ($\chi^2 = 5.00$; $p < 0.05$).

Table IV: Proportion of super-reproductive individuals, individuals of optimal size, and individuals smaller than the optimal size range captured by different types of seines.

	$\leq L_{opt}$	L_{opt}	SR
<i>Specimen size</i>	<i>taille < 33,49</i>	<i>33,49 ≤ taille ≤ 40,93</i>	<i>40,93 < taille</i>
Seine prototype 1 (8/6)	75,31 %	20,80 %	3,89 %
Seine prototype 2 (10/8)	67,99 %	25,78 %	6,23 %
Reference seine	82,73 %	16,82 %	0,45 %

2-7-Selectivity of CNRA prototype seines on *Pellonula leonensis*

2-7-1-Selectivity of prototype seine 1 (8/6) compared to the reference seine

In the case of the CNRA 8/6 prototype capture, preliminary results show a population size distribution that spans a wider range of sizes (Table V). The high confidence interval values starting at 36.58 mm show

that the number of individuals of this size is decreasing in the reference seine. The R values tend to decrease for the larger size classes. From $R = 50\%$, which corresponds to a size of 35.03 mm, the number of individuals caught by prototype 1 CNRA 8/6 gradually decreases until it reaches a minimum value at a size of 61.38 mm, while above 35.03 mm, the size of catches decreases to 43.29 mm in the reference seine (Table V).

Table V: Preliminary determinations of the selectivity of prototype 8/6

Classe de taille	N1	N2	$\pm R (\%)$	IC
$\leq 17,98$	0,1%	2%		
21,08	0,4%	1%		
24,18	4%	2%		
27,28	21%	7%	8	3%
30,38	32%	8,5%	5	2%
33,48	22%	34%	31	6%
36,58	11%	28%	64	10%
39,68	4%	16%	86	11%
42,78	3%	1,5%	15	15%
45,88	1%	0%		
48,98	0,7%	0%		
52,08	0,5%	0%		
55,18	0%	0%		
58,28	0,2%	0%		
$\geq 61,38$	0,1%	0%		

N1 = Number per size class of prototype 1 CNRA 8/6; N2 = Number per size class of reference seine; R = Ratio $N2/N1$; CI = Confidence interval

2-7-2-Selectivity of prototype seine 10/8 compared to reference seine

Preliminary results from the 10/8 prototype capture study show a population size distribution that spans a wider range of sizes (Table VI). The R ratio is well defined, with a high confidence interval for individuals in large size classes with smaller populations.

From $R = 50\%$, which corresponds to a size of 35.03 mm, assumed to be the selectivity zone, the size frequencies of individuals in the catch of prototype 2 (10/8) gradually decrease as the size of individuals increases to 65 mm, whereas above 35.03 mm, the size of the catches decreases to 43.29 mm in the reference seine (Table VI).

Table VI: Preliminary determinations of the selectivity of 10/8 mesh

Classes intervals	N1	N2	$\pm R (\%)$	IC
$\leq 17,98$	0%	2%		
21,08	0%	1%		
24,18	1%	2%		
27,28	14%	7%	18,05	6,53%
30,38	35%	8,5%	6	2,75%
33,48	27%	34%	30,22	6%
36,58	10,3%	28%	66,67	10,00%
39,68	2,5%	16%	7	6%
42,78	3,4%	1,5%	16	16,39%
45,88	2,4%	0%		
48,98	2,6%	0%		
52,08	0,6%	0%		
55,1	0%	0%		
58,28	0,6%	0%		
61,38	0%	0%		
$\geq 64,48$	0,6%	0%		

N1: Stock size class of prototype 2 CNRA 10/8; N2: Stock size class of reference seine; R: Ratio $N2/N1$; CI: Confidence interval

3 DISCUSSIONS

In the case of the *P. leonensis* fishery, the seines used are characterized by very small pocket meshes ranging from 1 to 5 mm (Ahoutou *et al.* 2019). These mesh sizes are one of the main constraints to the sustainable exploitation of stocks of the species in question. Hence the need to optimize them by identifying pocket meshes that can ensure the sustainable exploitation of the species *Pellonula leonensis* and the survival of the species. In this context, preliminary analysis of the results relating to catches using the CNRA 8/6 and 10/8 prototype “Mimie la go” seines compared to the reference seine highlights several areas of interest regarding the state of exploitation of this fishery. Analysis of catches from experimental fishing units shows that the standard size of *P. leonensis* caught by prototype 02 CNRA 10/8 is larger than that reported by Ahoutou *et al.* (2019). The presence of larger individuals in the catch of this prototype is due, on the one hand, to the size of the mesh in the nets used, which allows smaller individuals to escape through the mesh, and, on the other hand, to the specific technological characteristics of the CNRA prototypes of “Mimie la go” seine nets. The average length obtained by Ahoutou *et al.* (2019) is almost equal to that of the individuals sampled by prototype 01. However, the size distribution is higher for prototype 01 CNRA 8/6. The first capture size values at sexual maturity obtained are 28.73 for prototype 01

CNRA 8/6 and 28.10 for prototype 02 CNRA 10/8. These values are higher than those obtained by Koné (2012) but similar to those reported by Ahoutou *et al.* (2019) and Yao (2008). This variation in first maturity size is thought to be linked to the fact that fish develop strategies based on their environment in order to better adapt and take advantage of their ecosystem (Lévêque 2006). Overfishing and the use of certain fishing gear could also explain the difference in maturity size (Pauly, 2002). Indeed, Atsé *et al.*, (2009) showed that overfishing leads to a reduction in the size at first sexual maturity. In the present study, the differences in size observed could therefore be explained by the fact that the prototype seines tested only retain individuals of large catch size. The CNRA 1 and 2 seine prototypes capture 11 and 7 species respectively, in addition to the target species, *Pellonula leonensis*, in Lake Taabo. These species numbers are lower than those obtained by beach seines in the shallow coastal lakes of Brazil (Artioli *et al.*, 2022). According to these authors, the number of species recorded using the 5 mm mesh beach seine reached 40 species. This difference in species is thought to be linked to the specific richness of the sampled area. Indeed, the use of beach seines in shallow marginal areas, which are more protected and have more vegetation, was characterized by a more diverse assemblage (in terms of species richness) dominated by small species (Artioli *et al.*, 2022). Therefore, the low number of species in our study can be explained by the

purpose of using seine nets. In the work of Artioli *et al.* (2022), beach seines were used as a sampling method to obtain information on the abundance and composition of fish species. Individuals of *P. leonensis* smaller than the optimal size range are more prevalent in the landings of prototype purse seine 1 (75.31%) and the reference purse seine (82.73%). This percentage of specimens smaller than the optimal size is significantly higher than those reported by Ahoutou *et al.*, (2019) and Ndour *et al.*, (2013) for *Mugil cephalus* and *Pomatomus saltatrix* stocks. This increase in the percentage of specimens smaller than the optimal size is thought to be linked to the increasingly widespread and systematic use of mosquito nets in seine nets at Taabo Dam Lake. The proportion of individuals of optimal size caught by prototype 2 is higher (25.78%) than that caught by prototype 1 (20.80%) and the reference seine (16.82%). This proportion of *P. leonensis* at optimal size is lower than that obtained for *Mugil cephalus* (61%) and *Pomatomus saltatrix* (36.2%) stocks, according to the work of Ndour *et al.*, (2013). The objective of knowing the proportion of individuals of this size is to capture 100% of these specimens. The fishing gear with the highest percentage of fish at optimal size would be the most appropriate. Therefore, of these three seines, prototype 2 (10/8) is the one that would be recommended. Indeed, according to Froese (2004), an increase in the number of individuals below the optimal size and a decrease in the number of individuals that have reached the optimal size in landings leads to a decrease in yields and income. Also, according to the model known as “Closed Envelope,” the high percentage of specimens smaller than the optimal size range would result in low economic returns and a high negative impact on the resource. Thus, prototype seine 2, despite having a relatively high proportion of specimens below the optimal size range, would generate higher income and have a better impact compared to prototype seine 1 and the reference seine. The proportion of super-reproducers observed in this study is significantly lower than that observed by Ahoutou *et al.* (2019). This author noted an overall percentage of 9.20%. The low rate of these individuals indicates that the stock is threatened. In the case of our study, this rate of super-reproducers varies from one seine to another. The CNRA prototype 2 seine captures a higher proportion (6.23%) compared to prototype 1 and the reference seine. This observation in prototype 2 could reflect, on the one hand, the fact that this seine has a more negative impact on the reproductive capacity of the fish population than other seines and, on the other hand, it could indicate that the gear is selective for large individuals. These large specimens, particularly females, have the ability to be more fertile. According to Legendre and Ecoutin (1989), the number of eggs increases exponentially with size in most fish. Thus, large females tend to lay large eggs that are generally of better quality, giving the larvae a greater chance of survival. The results of our study reveal interspecific selectivity of the CNRA prototypes of “Mimie la go” seines due to the fact that, despite the abundance of

pelagic species in Lake Taabo, these prototypes have high rates of *P. leonensis* specimens in their catch. This rate is 90.25% for prototype 1 (CNRA 8/6) and 92% for prototype 2 (CNRA 8/6). This capture rate is higher than that noted by Ahouansou (2009). The effectiveness ratios obtained tend to decrease for larger species. This decline in effectiveness, which is independent of mesh selectivity, could be explained by behavioral tendencies such as avoidance of the gear, escape from underneath or over the top, but our results do not allow us to draw any conclusions. This finding from these preliminary results implies the adoption of new sustainable management measures focused on seines with optimal mesh sizes to limit or reduce the capture of juveniles and super-producers of *P. leonensis*. The CNRA 8/6 and 10/8 prototypes of “Mimie la go” seine nets could help achieve this goal. Their adoption as part of improved governance of the *P. leonensis* fishery in Lake Taabo paves the way for a gradual increase in the mesh size of the improved seines developed, with a view to raising the minimum catch size in line with the maximum size recorded for this species, i.e. between 120 and 150 mm (Traoré, 1996).

CONCLUSION

CNRA seine prototypes tend to capture larger specimens of *Pellonula leonensis* in terms of body height, standard length, and size at first sexual maturity compared to traditional or reference seines. This objective was pursued in order to reverse the trend of high catches of juveniles, and even larvae, of this species, which are significantly smaller than the minimum recruitment size. However, study data reveal a higher capture rate of mature individuals and super-reproductive specimens in CNRA prototype landings. However, thanks to CNRA seine prototypes, the minimum recruitment size of *P. leonensis* in catches will increase, and the number of individuals at optimal size will become more significant with a higher number of super-reproducers. On this basis, our work opens up the prospect of a research dynamic for the periodic identification of the side mesh sizes of Mimie la go seines that are appropriate for catching this species, depending on changes in the size structure of the exploited stock.

Acknowledgements

The authors would like to thank the National Agricultural Research Center (CNRA) and the Eranove-CIE Foundation for their financial and material support, which enabled this work to be carried out as part of the program to implement sustainable management of the *Pellonula leonensis* stock in the Taabo dam lake. We would also like to thank Aka Kouassi Archille, president of the MIMIE LA GO TAABO SCOOP Cooperative Society in Taabo village, for his contribution to the experimental fishing.

REFERENCES

- Ahoutou Konan Eric, Kouassi Sebastino Da Costa, Yéhé Mathieu Dietoa, and Essetchi Paul Kouamelan 2019. Diagnosis of the status of the *Pellonula leonensis* Boulenger, 1916 (Piscès; Clupeidae) stock in Lake Taabo dam by applying the sustainable biological indicators method. *International Journal of Innovation and Applied Studies*, 25(2), DOI : https://www.academia.edu/105785758/Diagnosis_of_stock_exploitation_of_Pellonula_leonensis_Boulenger_1916_Pisc%C3%A8s_Clupeidae_at_the_Taabo_reservoir_by_the_biological_indicator_method_application?uc-sb-sw=19019965
- Ahouanssou MS. 2009. Study of biodiversity and fish exploitation in the Pendjari River in Benin. Thesis submitted in partial fulfillment of the requirements for the degree of Doctor of Science, University of Agricultural Sciences, University of Abomey-Calavi, Benin, 218p.
- Artioli L., Clarice L., and Fialho B. 2022. Comparison of beach seine and gillnet sampling methods in fish assemblages of shallow coastal lakes in southern Brazil, *Biotemas*, 35 (2): 1–15. DOI : <https://dialnet.unirioja.es/servlet/articulo?codigo=8491620>
- Boua Célestin ATSE, Kouadio Justin KONAN, and N'Guessan Joël KOUASSI, 2009. Reproductive biology of the cichlid *Tylochromis jentinki* in the Ébrié lagoon (Ivory Coast). *Cybiu* 2009, 33(1): 11-19. DOI : <https://www.sfi-cybiu.fr/sites/default/files/pdfs-cybiu/03-Atse%2520573.pdf>
- Bi G., Brahim K., Tanoh Marius K., Siaka B., Paul K. 2019. Typology of fishing on the Buyo dam lake (Sassandra River, Ivory Coast), *International Journal of Innovation and Applied Studies*, 26 : 1220-1229. DOI : <https://ijias.issr-journals.org/abstract.php?article=IJIAS-19-003-11>
- Cantrelle I., Charles-Dominique E., N'Goran Y., Quensièrre J. (n.d.) 1983. Experimental study of the selectivity of two purse seines (25 mm mesh and mixed 14-25 mm mesh) in the Aby lagoon (Ivory Coast). DOI : https://horizon.documentation.ird.fr/exldoc/plains_textes/pleins_textes_7/b_fdi_59-60/010026630.pdf
- Duthie, A. 1992. Fish Capture Activities. International Conference on Responsible Fishing
- FAO, 1999. Fisheries management. Technical guidelines for responsible fisheries No. 4, Rome, 90 p.
- Froese R. Keep it simple: three indicators to deal with overfishing. *Fish and fisheries*, 5, pp 86-91, 2004, DOI :10.1111/j.1467-2979.2004.00144.x
- Ghorbel M., Jarbouli O., Bradai M. and Bouain A. 1996. Determination of the size at first sexual maturity using a logistic function in *Limanda limanda*, *Pagellus erythrinus* and *Scorpaena porcus*, *Bulletin INSTM*, 3: 24-27.
- Law R. 2000.- Fishing, Selection and phenotypic evolution. *ICES Journal of Marine Science*, 57 : 659-668. DOI : <https://doi.org/10.1006/jmsc.2000.0731>
- Legendre M. et Ecoutin J. 1989.- Suitability of brackish water tilapia species from the Ivory Coast for lagoon aquaculture. I-Reproduction. *Aquatic Living Ressources*, 2 : 71-79. DOI: <https://doi.org/10.1051/alr:1989009>
- Lévêque C. and D. Paugy, 1999. Fish of African continental waters: diversity, ecology, human use. Institute of Research for Development (formerly Orstom). © IRD Éditions. 213: 437.
- Lévêque C. 2006.- Growth and ontogeny in: Fish of African continental waters: Diversity, ecology, human use (Lévêque C and Paugy D., eds), IRD, PARIS, 177-190
- Murawski S. and Idoine 1992.- Multispecies size composition: a conservative property of exploited fishery systems. *Journal of Northwest Atlantic Fishery Science*, 14 :79-85. DOI : <https://www.nafo.int/Portals/0/PDFs/sc/1989/scr-89-076.pdf>
- NDour I., Diadhiou H., Le Loc F., Ecoutin J.M., Thiaw O. and Morais Luis T. Diagnosis of the exploitation status of *Mugil cephalus* and *Pomatomus saltatrix* stocks using indicators based on size frequencies on the north coast of Senegal. *Sciences Halieutic Aquatique*, 6 :pp 194-206, 2013, DOI : <https://hal.science/hal-01483072v1/document>
- N'Goran Y. 1995. Biology, Ecology, and Fishing of *Ethmalosa fimbriata* (Bowdich, 1825) in the Aby Lagoon (Ivory Coast), Doctoral Thesis, University of Western Brittany, 194p.
- Pope J.A., Margetts A.R., Hamley J.M., 1975. Manual of methods for fish stock assessment. Part III. Selectivity of fishing gear. FAO Technical paper n°41 (FIRS/T41 - Rev.1). DOI: <https://archive.org/details/manualofmethods/034714mbp/page/n19/mode/2up>
- Pope J. and Knights B. 1982. Comparaison of length distributions of combined catches of all demersal fishes in surveys in the North Sea and at Faroe Bank. In : Mercer, M. C., (eds) Multispecies approaches to fisheries management advice. Canadian Special Publication of Fisheries and Aquatic Sciences, 116-118.
- Traore K. 1996. State of knowledge on inland fisheries in Côte d'Ivoire. Consultation report, FAO Project TPC/IVC/4553, IDESSA, Bouaké, Côte d'Ivoire, 131p.
- Yao A. 2008. Preliminary data on the fishery of the small pelagic fish *Pellonula leonensis* Boulenger, 1916 (Piscès; Clupeidae) in the Taabo dam lake (Bandama Basin, Ivory Coast). D.A.A. thesis, ESA/INPHB/CNRA, Yamoussoukro, 87p.