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Fishing efficiency catch per unit effort and of selected artisanal fishing gear used in luubara creek, Niger Delta, Nigeria

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Abstract
The study on catch per unit effort and fishing efficiency of selected artisanal fishing gear used in Luubara Creek, was carried out twice a month for twelve months (September, 2018 to August, 2019). A total of 1348 individual fish constituting 43 species belonging to 23 families were recorded during the study. The major fishing gear identified in the creek was longline, gillnet, cast net and kara. Cast net caught a total of 348 out of 1348 individuals, followed by gill net 9298) and longline (232) while kara caught 102 species. Cast net was the most efficient fishing gear base on catch composition efficiency contributing (32.0%) followed by gillnet (30.0%) and longline (28.0%) while kara was the least efficient gear with 10.0%. In catch per unit effort (CPUE) efficiency, cast net was also the most efficient gear with a CPUE of 3.14kg followed by gill net (2.31) and longline 9(1.13) while kara was the least with CPUE of 0.82.

Keywords: catch per unit effort, artisanal, fishing gear, luubara

1. Introduction
Catch per unit effort (CPUE) is the quantity of fish harvested or extracted as an average weight of fish caught per day in respect to the time taken and the number of fishers involved using a particular type of fishing gear (Abiodun and John, 2017) [1]. Catch as applied here implies the estimated or weight of fish harvested from the wild during a fishing trip. The unit of effort can vary depending on the type of gear used and the time taken and number of fishers involve and the type of craft used, for example per gill net or per day. Catch per unit effort (CPUE) provides a standardized measure of the relative catch rate, with changes in catch per unit effort (CPUE) assumed to correspond to proportional changes in the abundance of fish population (Dunn *et al*., 2000 [11]; Schofield, 2015) [28]. This is to say that the catch per unit effort is the parameter most widely used to evaluate or assess the state of a population and as well as forecast fluctuation. For close to a century catch per unit effort has been used by fisheries scientists as an index of population abundance (Seber, 1982) [29]. Fluctuation in the catch usually reflects fluctuation in population number; this means that when there is high catches then there is high abundance of fish and short fall of fish caught is an indication of low level of fish abundance. This is a consequence of catch per unit effort being the most readily available piece of information for fisheries stock assessments because it is gathered with all fishing activity. Catch per unit effort is dependent on the catchability and fishing efficiency. The catchability here shows the relationship between the catch rate and true population of the stock while fishing efficiency defines the changes in fishing practices. Efficiency varies among gear, habitat and even among fish sizes of the same species. It is important to recognize that catch per unit effort is an index of population vulnerable to fishing gear (Maunder *et al*., 2006) [22]. This means that catch by a set of gear or by a vessel in unit time, is dependent on the species and on the gear. The quantity of fish caught per trip is usually as a result of the type of fishing gear used, its design characteristics, the vessels (boat or canoe) used and the targeted fish species. The use of catch per unit effort is an index of abundance is criticized, with many scientist preferentially using fisheries independent indices of abundance, especially when aggregations are targeted (Erisman *et al*., 2011) [12]. Hilborn (1985) [18]. After studying some factors such as variable efficiency of different vessels within a fleet opined that detailed information about abundance is encompassed in catch per unit effort. This fact indicates that catch per unit effort is one of the major parameters that can be used to measure index of abundance in fisheries (Campbell, 2004 [9], Clark, 2010). The aim of the study is to evaluate the catch per unit effort (CPUE) of the fishing gears used in Luubara creek such as gill net, cast net, longline and kara.

Material and methods
The study area
The study was carried out in Luubara creek in Khana Local Government Area of Rivers State of the Federal Republic of Nigeria for a period of one year from September, 2018 to August, 2019 (Figure1). The creek is found between longitudes $7^{0}15^{/\!/}$E —$7^{0}32^{/\!/}$E and latitudes 4°321-4°37$^{/\!/}$N in the eastern part of the Niger Delta (Deekae, *et al*., 2010a, 2010b; Gbarakoro *et al*., 2014) [17]. The Luubara creek has climatic rotation of wet and dry seasons. The wet season have a total annual rainfall of between 160mm and 298mm. while the dry season have an occasional precipitation in the month of November (Gbarakoro *et al*., 2014) [17]. This phenomenon shows that the area is in the humid tropical zone (Pyagbara, 2005; Gbarakoro *et al*., 2014) [17]. The creek is constituted of two distinct parts which include brackish water and freshwater. The brackish water is found between Bane and Kalooko while the freshwater stretch extensively from Bane to Bori. The brackish water area has the normal mangrove vegetation comprising of trees made of Rhizophora racemosa, avecennia afncana, Laguncularia racemosa etc (Deekae, 2009) [10]. The upper stream of the creek which reach the fresh water is occupied with dense forest vegetation

occupied with large trees, diverse palm and aquatic macrophytes

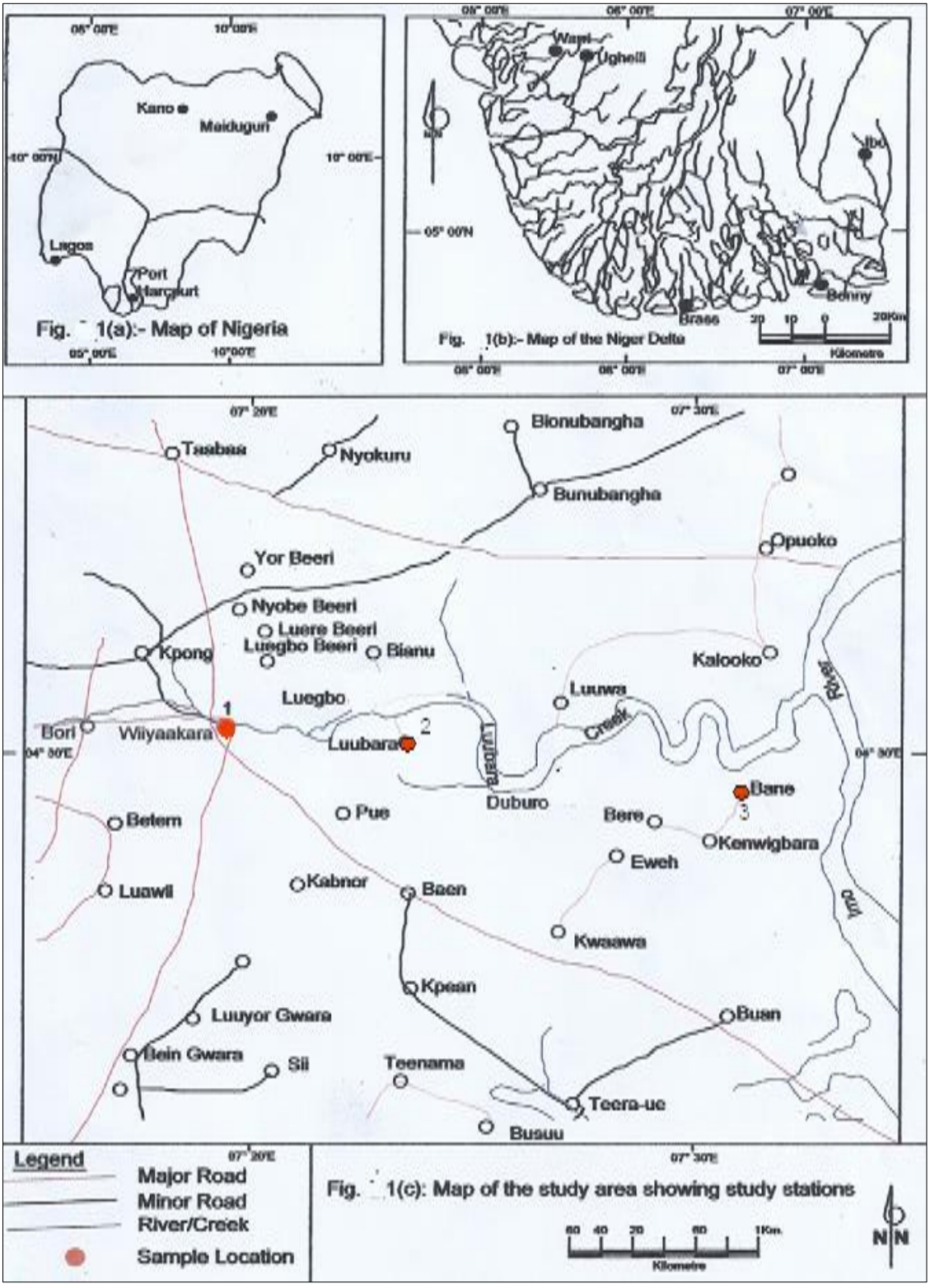

Fig 1: map of study areas showing study stations

Collection of fish samples

For each month the fishes were sampled by assessing the artisanal fisher men catches from normal operation using cast net, gill net, longline and kara. The sampling was done twice every month, for a period of one year. The fish species were identified to species level from monographic description, checklist and keys from authors (Holden and Reed 1972 [19]; Reed, *et al*., 1967; Idodo-Umeh, 2003 [20]; Olaosebikan and Raji 1998 [26]. and Olopade, *et al*., 2017) [27].

Morphometric Measurements

Total length (cm) of the fish sample from the fisher's catch was taken by measuring the fish from the tip of the mouth to the end of the caudal fin using measuring board and the weight (g) were taken by placing the fish on an electronic kitchen scale using model (S.F-400).

Catch per unit effort (CPUE)
To estimate the catch per unit effort (CPUE) of fisher folks in the area, the formulae of Meyer and Ikomi, (2012) [23]. were used as follow:

$$CPUE = \frac{\text{Total catch}}{\text{No. of fishers/fishing hours}}$$

Statistical Analysis
Percentage composition of each species was calculated over the total sampling stations using the formula:

$$D = \frac{ns}{N} \times 100$$

Where,
D = relative abundance
Ns = number of individual species

Results
Characteristics of the fishing gears used in luubara creek
The various fishing gear types and their respective design characteristics and are shown in Plates 1, 2, 3 and 4 below. The common fishing gear identified in Luubara creek are gill net, cast net, longline and kara. These identified fishing gear are explicit example of the artisanal fishing gear generally regarded as entangling net, falling net, hook and line and trap. These fishing gear can further be classified into two distinct categories base on the materials used for their construction. Base on this classification, cast net and gill net are grouped into netting material while longline and kara are categories into non-netting material.

1. Netting material
Cast net
Cast net was one of the common fishing gear used by the fishers in Luubara creek. The gear is white in colour and conical in shape with the netting material made of multifilament nylon. The mesh of the cast net as observed in the creek and displayed in (Plate 1) below was knotted and its contain lead material used as the sinker with a mesh size of 3.7m and length of 20m (Plate 1).

Gill net
Gill net was another common and frequently local fishing gear adopted by the fishers in Luubara creek. The gill net was made from knotted multifilament and monofilament polyamide material with a head rope length of 40m and foot rope length of 40m as well. The mesh size was 4cm and the sinker were made with lead material and buoys are made from obsolete bath room slippers and also absent in some (Plate 2).

2. Non netting material
Longline
Longline was also another common fishing gear after cast net and gill net that the fishers in Luubara creek regularly used. The hook sizes of the longline were 7, 8, 9 and 20 and their length were 16, 18, 20 and 24 mm respectively. The baits commonly used to attract the fishes were worms, termites and crayfish. The longline was operated by 1-2 fishers with the aid of plank and dugout canoes throughout the year (Plate 3).

Kara
Kara is another fishing gear regularly used in Luubara creek. This trap consist of two different types of designs and materials. The first one was the bamaboo trap made of raffia palm. The bamboo as shown in (Plate 4a) has a funnel-like shape mouth attached to a ring-like cane. The bamboo trap has two non-return valve that divided the trap into two chambers with an outlet at the end where the fish caught are evacuated (Plate 4a). The second trap used was drum (plate and metal). The entrance as shown in (plate 4b) contained a month constructed with fabricated netting nylon made of multifilament polyamide material with a mesh size of 4cm and posses a single chamber unlike the bamboo type with two chambers (Plate 4b).

Fishing gear efficiency in luubara creek/catch per unit effort
Fishing gear efficiency in Luubara creek showed that cast net caught 32.0% of the total catch, followed by gill net 30.0% and longline 28.0% while kara recorded the least catch of 10.0% of the total catch (Table 1).The best catches of the four fishing gear comprised of the families Scianidae, Clupeidae, Bagridae and Cichlidae. The dominant species caught by cast net were Ethmalosa fimbriata, Mugil cephalus, Pellonula leonensis and Pseudotolithus enlongatus while the least catch of castnet was P. peroteti and C. senegalensis. The prominent catches of gill net were Scomberomorus tritor, Hepsetus odoe, Eucinostomus melanopterus and Chrysichthys nigrodigitatus while the least species caught by gillnet was T. guineensis. The outstanding species caught by longline was P. enlongatus, C. nigrodigitatus, C. gariepinus and M. electricus while the least species caught by longline was P. jubelini. The main species caught by kara in an ascending order was C. gariepinus and P. bane, H. odoe and P. enlongatus and P. peroteti while H. proboscideus and S. afra were the least species caught. Table 2 showed the expression and evaluation of the different fishing gear using catch per unit effort (CPUE) ranking. Cast net recorded the highest catch per unit effort (3.14kg) followed or seconded by gill net (2.31kg) and longline having the recorded catch per unit effort of 1.13kg while kara recorded the least in ranking with catch per unit effort value of 0.82kg.

Table 1: Fishing gear efficiency in Luubara Creek

Species	LL	GN	CN	KA
Tilapia marie	5	10	7	-
T. dageti	5	10	5	-
T. guineensis	2	1	3	-
Chromidotilapia guennteri	-	-	10	-
Sarotherodon galileus	-	-	15	3
S. malanotheron	-	10	183	-
Ethmalosa fimbriata	-	-	4	-
Illisa Africana	-	-	15	-

Sardinella aurita	-	-	3	-
Sierrathrissa leonensis	-	20	44	-
Pellonula leonensis	-	9	62	-
Mugil cephalus	-	5	20	-
Liza grandisquamis	-	8	10	-
L. falcipinnis	-	6	12	-
L. dumerilii	-	-	27	-
Caranx hippos	-	-	27	-
C. latus	-	5	15	-
Carangoides chrysophys	-	15	20	7
Pomadasys peroteti	-	3	1	-
P. rogeri	5	4	14	-
P. jubelini	1	15	35	10
Pseudotolithus enlongatus	200	15	5	-
P. senegalensis	3	-	30	-
Syadum micrurum	-	2	4	-
Cithariccchthys stampflii	-	4	-	4
Galeodes decadactylus	-	18	-	3
Polydactylus quadrifilis	-	-		-
Schilbe mystus	-	-	20	-
Parailia pellucida	-	33	4	10
Hepsetus odoe	-	-	-	10
Gobis guinensis	-	-		-
Heteromycteris proboscideus	-	-	2	2
Psettias sebae	-	-	5	-
Chrysichthys nigrodigitatus	50	27	5	15
Cynoglossus senegalensis	5	6	1	-
E. Malanopterus	-	30	8	-
Spyraena afra	-	6	5	2
Scomberomorus tritor	-	40	5	-
Clarias gariepinus	10	6	-	27
Gymnarchus niloticus	-	8	2	-
Malapterurus electricus	15	-	-	5
Phractolaemus ansorgii	-	5	-	15
Petrocephalus bane	-	2	5	-
Total	232	289	348	102
%	28.0%	30.0%	32.0%	10.0%
Number of species	13	29	36	12

LL-longline GN-Gillnet CN-cast net KA-kara

Table 2: Catch per unit effort of longline, gill net, cast net and Kara used in Luubara creek

Fish gear	Catch per unit effort (CPUE)
Longline	1.13
Gill net	2.31
Cast net	3.14
Kara	0.82

Discussion

The four fishing gear: cast net, gillnet longline and Kara observed in this study were also the commonest artisanal fishing gear found in Kaiji Lake (Ago and Tafida, 2003 [3], Eyo and Ahmed, 2005) [13], Lake chad Basin (Bene and Neiland, 2003) [5], Lake Alau (Bankole *et al*., 2003), Orgodo River (Meyer and Ikomi, 2012) [23]. and lower Niger River (Abiodun and John, 2017) [1]. in Nigeria. Adeyemi *et al*. (2009) reported that cast net, longline, gillnet and Malian trap were the common fishing gear used frequently in Nigeria's waters. Other researchers such as Galib *et al.* (2009, 2013, 2015, 2016) [14, 15, 16, 21, 24, 25]; Moshin, *et al*. (2013); Chaki *et al*. (2014); Joader *et al*. (2015) and Sultana and Isalam (2016) reported the same finding in water bodies outside Nigeria.

There was notable variation in the fishing efficiency of the different fishing gear used in Luubara Creek. This could be attributed to the variation in mesh size and flexibility of the gear used which may influence species abundance and diversity (Meyer and Ikomi 2012 [23], Olopade *et al*., 2017) [27]. Backiel (1980) attributed gear efficiency to the behavior of fish and distribution of samples. The evaluation of the fishing gear efficiency based on percentage of catch composition of the fish species caught showed that castnet have the highest efficiency, followed by gillnet and longline respective while kara was the least in efficiency. This was in line with the findings of Meyer and Ikomi (2012) [23], and Olopade *et al*. (2017) [27]. all in Niger Delta. Kara with the least efficiency could be attributed to non-inclusion of baits when setting the trap as it is a common passive fishing gear that its efficiency is mostly influence by the presence of attractants (baits) to lure the fish inside. Cast net have the highest efficiency in catch per unit effort (CPUE) and was followed by gillnet and longline in efficiency and kara was the least as well. Similar observations was made by Abiodun and John (2017) [1]. Cast net is a passive gear that its efficiency can easily be influence by the length of time the fishers spend in fishing and the depth of water the gear will reach. Another reason that defined the efficiency of cast net is that, the more it is thrown into water the more the catch.

Conclusion

The commonest artisanal fishing gear types used in Luubara Creek are cast net, gill net, longline and kara. Cast net possesed the highest efficiency both in catch per unit effort

and catch composition efficiency. The highest catch per unit effort (CPUE) of 3.14 observed during the study showed that the creek is still productive and good for fisheries development if properly managed**.**

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