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Gears, artisanal fishing techniques of fish and their pressure on the ichthyological stand of the lower basin of the Comoé river (Côte d'Ivoire)

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Abstract

This study carried out in the lower basin of the Comoé River belonging to Grand Bassam wetland (Côte d'Ivoire) aims to assess gears, artisanal fishing techniques of fish and the pressure exerted on the ichthyological stocking. Ten (10) sites (Motobé, Palm-CI, Yaou, Adjékro, Campement Konian, Campement Kodjran, Campement, Ekressinville or 3 kilos, Delanoi, Adiaho and Kodjoboué.) were sampled from Jun 2014 to February 2016. The present paper highlights the variety and abundance of the fishermen's means of production consisting of boats (monoxy and board) and fishing gears. Sampling made it possible to collect 171 gillnets, 3,726 bow-nets (fish-traps), 351 longlines, 800 setups, including 690 in bamboo, 60 in cut wood and 50 in PVC tube, 6 hawks, three types of handcrafted harpoons, handline, arrow fishing. In terms of techniques it has been observed phantom fishing and disturbance of the surface of the water. The investigations revealed the lack of a service in charge of enforcing the fishing regulations. This allows the fishermen to operate as they see fit using prohibited gears, with little or no selective gears.

Keywords: Gears, artisanal techniques, pressure on the fish, lower basin, Comoé River, Côte d'Ivoire

1. Introduction

Because of its relatively low price compared to that of the meat, fish is accessible to the most modest households [1]. Over time, fish has become a product of high commercial value due to the rapid population growth and ever-increasing demand. Then humans sought to capture the maximum number of fish by means of a variety of gear and fishing techniques [2-3]. The lower basin of the Comoé River is subject to various threats, including the exploitation by the abusive and uncontrolled fishing of the fishery resources due to the increasing exploitation of fish in order to satisfy the demand. This situation raises more concerns as the resource is increasingly threatened. According to [4]. A common good in free access is doomed to degradation by the game of competition between operators seeking to maximize their individual interest unless a central authority intervenes. However, as [5] warn, too intensive fishing results in a shorter life span for the fish, a smaller size of the captured individuals, a decrease in abundance and yields, the profitability of fishing operations and often a change in the composition of catches to less prized species. Experience has shown that open access systems which give all those who wish it the right to exploit the concerned resource, can have very serious consequences. In the absence of any control, open access systems systematically result in overexploitation of the resources and lower revenues for participants [6]. In the other hand, in controlled system, that is to say, where access is limited, the State generally owns the resource. Then it is sometimes provided under certain conditions users must pay to obtain in one form or another a right of access or exploitation, or access is limited to a certain number of fishermen [7]. It is for this purpose that the Comoé Project entitled "Ecosystem Approach of Fisheries as a means of sustainable exploitation of fisheries resources in the Grand Bassam wetland" was initiated in order to prevent possible problems.

The objective of this part of the study is to inventory the boats, gears and to describe the artisanal fishing techniques used in the lower basin of the Comoé River to measure the impacts of the pressure exerted on the fish community. For a better understanding of this study, we Define "artisanal" gears as those used by local fishers. Afterwards, "artisanal fisheries"

are defined as small scale traditional fisheries that may be carried out for subsistence or commercial purpose in which the owner is directly involved in the day-to-day running of the enterprise and relatively small amounts of capital are used [8].

2. Material and methods of identification of fishermen and description of fishing techniques

The identification of the actors was made by means of individual survey questionnaire. Sampling to assess the amount of handicraft fishing had been done using gillnets, baited or unbaited longlines, traps and bait traps.

For this study, the choice of stations was made taking into account their accessibility and the importance of fishing and other anthropogenic activities (Industrial discharges, dumping of domestic waste, presence of plantations, breedings). In total, ten (10) sites were selected on the lower basin of the Comoé River as shown in Figure 1: Motobé, Palm-Cl, Yaou, Adjékro, Campement Konian, Campement Kodjran,

Campement Ekressinville or 3 kilos, Delanoi, Adiaho and Kodjoboué. Data collection was conducted from June 2014 to February 2016. In the absence of an available frame, the census of fishermen for each locality was conducted. The survey of activities have been carried out during the entire sampling campaign in the villages and camps on the shores. The surveys were carried out on evenings and rest days at the fisherman’s home. The questionnaire lasts between 15 and 20 minutes, the fisherman is isolated from the members of his entourage in order to reduce their influence on his answers to be given. It aimed to assess the specificity of this fishery, identify the actors, the fringe of the population involved and socio-economic indicators. The interview took into account both Aboriginal and non-Aboriginal fishers. The questions are either closed or open in order to give fishermen the freedom to develop their views. The answers were analysed using Excel 2013 software.

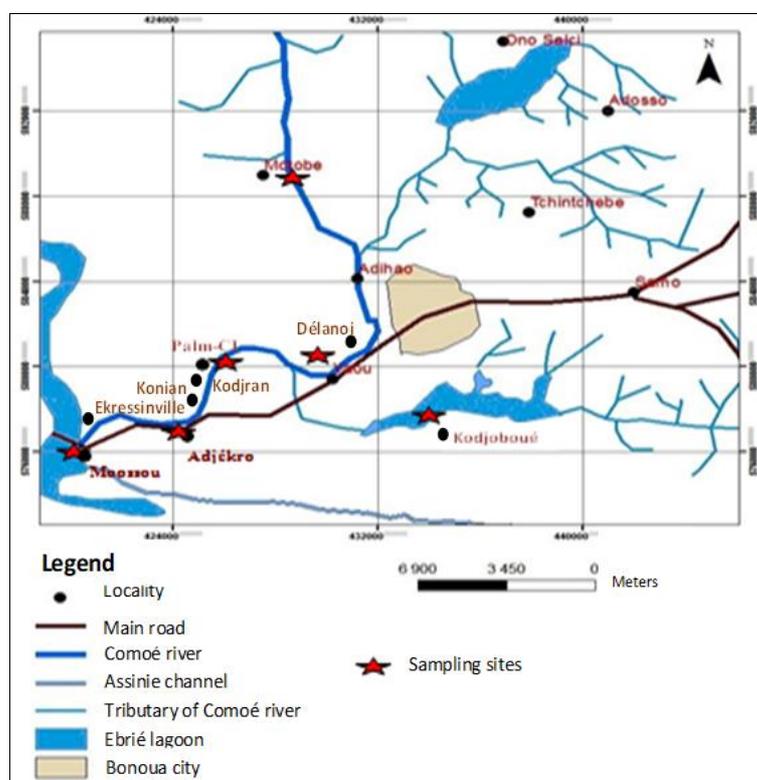


Fig 1: Location of the lower basin of the Comoé River and sampling station

3. Results

A typology of the means of production of fishermen consisting of canoes and fishing gears is presented in table 1 below.

Table 1: Typology of the means of production of fishermen in the lower basin of the Comoé River

Type of dugouts	Main gears
Dugouts built in boards	Gillnets (floating and fixed)
	Line and hooks bait / longline
Dugouts monoxyles	Line and unbaited hooks / longline
	Traps
	Hoop nets (fish traps or Creels)
	Hawks
	Arrow
	Harpoon craft (spears)

3.1 Boats used for fishing in the lower basin of the Comoé River

The boats are essentially board canoes and monoxyl canoes as illustrated in Figure 2. There are several of them on the river,

but only the canoes used for fishing have been taken into account. There are fishermen who do not have canoes but rent them for their activities at the rate of 300 to F CFA 500 per day. Lowland fishermen don’t use canoes. The investigation

made it possible to record 111 canoes mainly intended for fishing.



Comoé River: A = monoxyl canoe and B = board canoe

Fig 2: The two types of canoes used for artisanal fishing of fish in the lower basin of the

The dugout canoes are boats built from a wooden frame and boards. Several forms according to the usage were observed on the river. The monoxyl canoes are simple construction, dug in one piece in a tree trunk. They are less numerous on the river. Canoes, whatever their type, are propelled by paddle. We note however, they all generally lack in stability.

The inventory of fishing gear used in the study area identified several gear types. These are the hawk, gillnet, the net (metal mesh, net and bamboo), bamboo trap, PVC tub trap, cut wooden trap, line and surface longline.

3.2 Fishing gears used in the lower basin of the Comoé River

3.2.1 Gillnets

The study enumerated 171 gillnets as presented in Figure 3. These are individual gear used according to the sleeping net method. There are several of them per boat. They are made from sheets of monofilament nets. The most used nets have a length of 30 m or 40 m and a drop height of 1.5 m, respectively an area of 45 m² to 60 m². One end of the net is thrown into the water, the other end being attached to the end of a support. This type of gillnet works by following the direction of the stream. So the fishermen put them either across the river or on the edge. With this kind of net, the fish are caught by the ears. The nets are usually laid before 6 pm and are raised the next day between 3 am and 5 am.



Fig 3: grouped gillnets.

3.2.2 Bow-nets (Fish traps or hoop net)

A total of 3,726 bow-nets of which 3,104 were in bamboo, 424 in net and 198 in mesh, were recorded as summarized in Figure 4. The types of fish-traps observed during this study are in wire mesh, fishing net on cordless reinforcing, and woven bamboo without mesh. These bow-nets are usually 1.5 to 2 m long, 30 to 60 cm high and 5 to 10 cm in diameter. They are used massively during the rising waters.



Fig 4: Some types of bow-nets used by artisanal fishermen in the lower basin of the Comoé River

To catch fish, maize probe, palm seeds, dry coconut, cassava, bread and rice cakes mixed with oil and seasoned with garlic and fish powder (*Brycinus longipinnis*, *Parailia pellucida*, *Pollimyrus isidori*, *Pellonula leonensis*, etc.) are used as bait. Figure 5 illustrates two kinds of bait. The bait is deposited in the bow-net which is arranged in the vegetation in shallow areas. At the lower level of each trap 2 to 4 openings are provided to allow only the entry of the fish.



Fig 5: Two types of bow-net bait used by fishermen in the lower basin of the Comoé River:

A = maize probe and B = rice cake.

3.2.3 Longlines

A total of 351 longlines as shown in Figure 6, composed of 226290 hooks were recorded. Longlines are dormant gear wet on the bottom. Baited hooks are attached to the mother line. The total number of stakes depends on the length of the mainline. The length usually varies according to the fisherman. The ends are weighted by stones to hold the line in place. They extend for hundreds meters. They are visited the day after the installation. They often catch vulnerable and endangered large predators.



Fig 6: Longlines placed on a wooden stick

Baits are of various kinds. Figure 7 shows some of them.

- Gastropods of the family of Thiaridea : *Pachymelania byronensis*, *Pachymelania fusca*, *Corbula trigona* and *Patamocorbula adusta*;
- Shrimps of the kind (Genre) *Macrobrachium* : *Macrobrachium vollenhovenii*, *Macrobrachium macrobrachion*, *Macrobrachium felicinum* and *Macrobrachium* sp;

- Insects floating on the water;
- Termites;
- White soap for capturing *Chrysichthys maurus*



Fig 7: Some longline baits used by fishermen in the lower basin of the Comoé River: A=floating insects on the water, B=*Pachymelania byronensis*, C=*Pachymelania fusca*, D=chair des gasteropoda meat serving as bait, E=*Corbula trigona* or *Patamocorbula adusta*, F=termites.

3.2.4 Setup (Traps)

A total of 800 setups were identified, including 690 in bamboo, 60 in cut wood and 50 in PVC tube. These types of trap observed as shown in Figure 8 are used as follows:

- The bamboo setup that are pieces of Chinese bamboo with variable diameters, fully open on one end and pierced one small hole to the other. Those observed in the study area fishery consist of a consignment of a set of tubes joined by a rope.
- The PVC tubes are plastic pots with a varying opening and height. Their bottom is weighted. These pots are mounted on a rope, holes are made to pass a wire that allows to attach them to the rope. These traps are immersed, the rope is used to connect them with supports used as a surface marker; the length of this rope depends on the depth of immersion.
- The cut wooden setups are similar to PVC tubes and are used in the same way. They are laid horizontally on the bottom and held by pebbles or other supports.



Fig 8: Traps made of PVC tube, Chinese bamboo and cut wood used in the lower basin of the Comoé River. A=PVC tube setups, B=Chinese bamboo setup, C = carved wooden setup

3.2.5 Landing nets/Scoop nets/Hand nets

Landing nets are individual gears made of a small net stretched by a circular metal piece as illustrated in Figure 9. Operated by one fisher, mostly from the shore on foot, or from a boat. Very often, they are agitated to collect, the fisherman being in front on foot in the shallow environments. The net is drawn through the water towards the fish and then lifted up sharply. They are often used to preserve fish already caught. During this study their number could not be estimated because they were identified in the last sampling campaign. However, it appears that many fishermen have them.



Fig 9: Landing net used for fishing in the lower basin of the Comoé River

3.2.6 Harpoon craft

Figure 10 shows three types of artisanal harpoons used for fishing have been identified as. Their number could not be determined but it appears that almost all fishermen have it. They are used for a variety of purposes, including to control big fish, some recalcitrant fish such as *Sphyraena afra*, *Sphyraena guachanco*, *Chrysichthys nigrodigitatus*, *Chrysichthys maurus*, *Lates niloticus*, *Clarias gariepinus*, *Clarias anguillaris*, and to defend themselves against attacks by certain animals, etc.



Fig 10: Three types of harpoons encountered in the lower basin of the Comoé River

3.2.7 Hand line

The hand line used by neighbouring populations is composed of a main line of variable length on which is attached a branch line carrying a hook as presented in Figure 11. Small hooks are responsible for high capture of juveniles. This study has allowed to count 34.



Fig 11: Line fishermen in the lower basin of the Comoé River. Baits are usually pieces of earthworm *Lumbricus terrestris* as illustrated in Figure 12 or crab eggs.



Fig 12: Earthworm bait (*Lumbricus terrestris*) used for fishing in the lower basin of the Comoé River

3.2.8 Arrow fishing

Arrow fishing is a very underdeveloped technique in the study area. It is performed by divers with adequate equipment when the water is more transparent. This technique involves descending depths and capturing fish by means of an arrow, shoot after having targeted them well. Only one fisherman with this gear has been identified. According to this fisherman, he is not the only one to dispose of it.

3.2.9 Fishing with the hawk

The study made it possible to count 6 hawks. The hawk has a conical shape from its lower part to the end of the net. At the base of the cone are attached lead sinkers that allow the hawk to close when it is out of the water. The fisherman throws it in a vast circular motion so that the net spreads and falls completely open in the water. It captures all fish in the encircled area without sorting. The hawk is used in shallow water and in the open area of invasive aquatic plants. It is used by a few fishermen in the study area.

3.3 Other fishing techniques

3.3.1 Phantom fishing (Ghost fishing)

Indeed, this is not a fishing technique used by fishermen to catch fish. However, this kind of fishing is a phenomenon which results from the disappearance of fishing gears into the water. This disappearance is caused by the rejection of old gear in the water, or the current of the water that drives them during heavy rains. It is also because of the thieves who move them to better search. After searching the gears they throw them into the water. Sometimes fishermen lose the markers of the gear they have laid. At times it happens because of illness, impediment, they abandon them into the water. These gears, mostly non-biodegradable, continue to catch fish. Their production cannot be evaluated.

3.3.2 Fuss on the surface of the water

The disturbance of the surface of the water is a technique practiced only at Kodjoboué by some uncontrolled fishermen. It consists of placing the gillnets at the level of the vegetation where the fish are supposed to be refugees, then using paddles to beat the surface of the water producing great sounds to stun the fish and force them to move towards the gears.

4. Discussion

In the exercise of their activity, the actors of this fishery have a specificity of fishing exploitation of the Comoé River which makes it possible to resolve and avoid the intercommunity conflicts since 2013. All fishermen operate alternately in the same perimeters, regardless of their village, except for the fishermen who use traps. Thus the river is divided into two fishing area by an imaginary line known by all actors who use gillnets and those who use longlines. So for a week, while gillnet users are fishing on one side, longline gears are on the other side and vice versa. This results in a good cohabitation so that there is coordination of the use of fishing zones.

Related to gears used in artisanal fishing, their great diversity and fishing techniques reveal that fishermen are very knowledgeable about the ecological and biological characteristics of fish ^[9]. As proof, the main targets of the traps are *Chrysichthys nigrodigitatus* and *Chrysichthys maurus*. Knowing, in fact, that the fish come to take refuge in the bamboo to lay their eggs, the fishermen of the lower basin of the Comoé River use traps made of pieces of bamboo to capture *Chrysichthys nigrodigitatus* during the breeding

period. Considering, moreover, that the mastery of the method developed to obtain eggs of *Chrysichthys nigrodigitatus* consisted in confining pairs of these species of fish in the PVC tubes (similar to bamboo), the fisheries operate in the same way. One of the practices is to keep a specimen in the trap so that its cries attract other fish.

The loss of a net intended to catch fish is danger that goes well beyond the mere presence in water of another non-biodegradable object. It represents a real means of inestimable pressure on the fishery resource. In fact, agillnet can continue to fish, with decreasing efficiency, up to 10 years after its loss. This phenomenon, called phantom fishing or ghost fishing, occurs mostly in deep water where the majority of gillnets are lost ^[10]. The effects of phantom fishing are harmful but difficult to quantify. This is the reason they are illegal. In this part of the river several cases have been reported. This study corroborates what is said by ^[10]. If it is established that agillnet lost or thrown into the water causes as much damage, what will about the gillnet nets, wire mesh traps, PVC tubes, bamboo or wooden traps? How much fish are they capturing and what are the losses? This phenomenon of phantom fishing is a priority for which an action plan must be developed to develop methods for recovering lost gears. This involves, among other things, to clean the bottom of the water in all the sectors where fishing is concentrated and especially to study the phenomenon to better understand it. The implementation of such an action is certainly costly and the fundamental question is who pays. In this regard, in the short term it is expensive but in the long term it is better ^[11]. What is important to remember is that from an ecosystem perspective, these measures have the merit of reducing the overall pressure on the ecosystem. The effects of phantom fishing are harmful but difficult to quantify. To explain the decline in fish stocks, neighbouring populations in general and particularly fishermen are convinced that witches or geniuses would have hidden the big fish. Any awareness campaign should have to take into account this perception of the problem by these fishermen. Because it is obvious that they do not perceive their share of responsibility in this situation. Hence the need for an ecosystem approach to fisheries that justifies why attention should be paid to human dimensions ^[12]. This approach stipulates, on the one hand, that in the absence of any scientific data and, on the other hand, if we do not pay attention to the human aspects, all forms of improvement in the management of natural resources will lead to a certain failure. Accordingly, in the event of a risk of serious or irreversible damage, the absence of full scientific certainty should not be used as a pretext to postpone the adoption of effective measures to prevent environmental degradation ^[11]. At any rate, if we don't understand why people do or don't do certain things, policies, legal frameworks, and management plans, even with the best of intentions will face unintended consequences or will remain a dead letter As regards the disturbance of the surface of the water in Kodjoboué, a monitoring committee is set up by the traditional chiefdom to repress fraudsters. Thus, any offender's all equipment is confiscated until a fine of F CFA 150,000 is paid. This measure has borne fruit since less and less these cases are reported.

Artisanal fishing pressure from particular gear types shows an influence on the biomass of fish families. The strong influence of netting consistent with the targeting of these families by these fishing methods. Although the low biomass of fish populations is likely associated with past and existing

fishing practices, negative relationships between fishing pressure indices and fish biomass were consistent with the selectivity of different fishing gears. The implication for management is that both non-selective gears (netting) and selective fishing practices are capable of modifying the structure of fish populations and require active management controls ^[13]. Obviously, according to ^[14], problems with fisheries are usually associated with overfishing; in other words, with the deployment of “too many” fishing gears. However, overfishing is not the only problem. These authors argued that «collateral impacts of fishing methods on incidental take (bycatch) and on habitats are also cause for concern. Assessing collateral impacts, through integrating the knowledge of a wide range of fisheries stakeholders, is an important element of ecosystem management, especially when consensual results are obtained. This can be demonstrated using the “damage schedule approach” to elicit judgments from fishers, scientists, and managers on the severity of fishing gear impacts on marine ecosystems. The consistent ranking of fishing gears obtained from various respondents can serve as a basis for formulating fisheries policies that will minimize ecosystem impacts. Such policies include a shift to less damaging gears and establishing closed areas to limit collateral impacts» ^[14].

5. Conclusion

This study relates to gears, how they are used and their pressure on fish in the lower basin of Comoé River. Sampling made it possible to identify a wide range of gears used in all artisanal fishing areas. The most commonly used are bow-nets (3726), setups (800), longlines (351), gillnets (171) and hand line (34). The fishermen in this part of the Comoériver are artisans whose gear and fishing methods are traditional. The absence of a fisheries management service in Bonoua which should enforce the fisheries regulations has allowed fishermen to manage their fishing activities as they see fit. Thus, throughout the study area, the fishery is managed as a routine activity in which there is no prospect of sustainable exploitation of the fishery resources. Prohibited fishing gear and methods, such as fuss on the surface of the water, are used freely and according to the common sense of the fisherman. The impact of these fishing gears or methods on the habitat is apparent. These gears and fishing methods, indeed, certainly destroy habitat, including spawning areas, to the extent that they are not selective and do not comply with existing regulations. Their low selectivity causes a negative impact on the recruitment of stocks. Gillnets and other fishing gears used on the river are for the most part non-regulatory. In addition, worn gillnets thrown into the watercourse, forgotten or abandoned gear, moved by the stream or by thieves are sources of phantom (or ghost) fishing.

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