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Research article

SURVEY OF THE NOCUIÉTÉ OF THE CONTRACTIONS AND TECHNIQUES OF ARTISANAL FISHING ON THE POPULATIONS OF NAVY TURTLES OF THE BAY OF LOANGO (CONGO)

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ABSTRACT: *Chelonia* marine turtle species preservation is one of the international community challenges through the world. In Congo-Brazzaville, the Renatura organization (ONG) is engage to the biodiversity marine turtle species protection. Among the five of seven marine turtle species encountered in the coast, Turtle lute (*Dermochelys coriacea*); Green turtle (*Chelonia mydas*); Olive turtle (*Lepidochelys olivacea*); Turtle caouanne (*Caretta caretta*) and Turtle overlapped (*Eretmochelys imbricata*). All these species of navy turtles well that protected by different international conventions, undergo several threats among which the nets and contraptions of traditional fishing constitute one of the main reasons of their decline. Indeed the accidental captures in the nets of the traditional fishers represent a serious threat for the navy turtles. This problem is delicate to manage because these holds don't depend directly on the will of the fishers. Indeed the turtles take themselves inauspiciously in the nets and entangle themselves of it while trying to clear itself/themselves of the net. To remedy this situation, Renatura Congo has, in 2005, initiated a program of liberation of the accidental captures of navy turtles in the nets of traditional fishing. About 1500 liberations are done annually by the agents of Renatura Congo. The liberation of these turtles doesn't constitute a long-term solution. Also, before the size of their accidental captures, it appeared to us necessary to bring our contribution in the survey of the nocuit   of the contraptions and techniques of traditional fishing used to the bay of Loango in order to meter in evidence those that are more harmful. Such an objective reaches once, will allow us to improve these contraptions and techniques in order to reduce the risks of accidental captures while maintaining the level of the holds of fish and other aquatic organisms.

Key words: Navy turtles, Renatura Congo, accidental captures, net netting.

INTRODUCTION

Numerous animal cashes are in way of disappearance in the world. The conservation of these cashes threatened with disappearance became one of the preoccupations of the ecology's to promote the natural resource management and the lasting development. This one answers    the present generation needs without compromising the capacity of the generations future    to answer    theirs. To fight against poverty, to preserve the environment and to develop an economy respectful of the social and environmental realities, is the weapons proposed by this concept. Since the years 60, Republic of Congo implies itself for the protection of his/her/its natural heritage. This will has just materialized through the law n   37-2008 of November 28, 2008 on fauna and the protected areas. The main actors acting in favor of the world biodiversity remain the non governmental Organizations and the Associations   ouvrant    the local scale (Protat, 2010). It is the objective that Renatura, an association of biodiversity conservation, pursues    Congo since 2001. His/her/its main center of interest is the navy turtle conservation. The navy turtle preservation is, for the international community in general, Renatura Congo and Republic of Congo in particular, a necessary work. Five of the seven navy turtle cashes frequent the Congolese coastline: Turtle lute (*Dermochelys coriacea*); Green turtle (*Chelonia mydas*); Olive turtle (*Lepidochelys olivacea*); Turtle caouanne (*Caretta caretta*) and embedded Turtle (*Eretmochelys imbricata*). All these navy turtle cashes, although protected by different international conventions, undergo several threats due to the: poaching on the beaches of punter and in sea; the destruction of the marine habitats and punter; the pr  dation; the pollution by the garbage domestic and chemical; mortality misled by the accidental captures bound    fishes it.

Among these threats, the contraptions and techniques of artisanal fishing constitute one of the main reasons of the decline of several navy turtles. Indeed the accidental captures in the traditional fisher nets represent a serious threat for the navy turtles. This problem is delicate à to manage because these holds don't depend directly on the will of the fishers. Indeed the turtles take themselves inauspiciously in the nets and entangle themselves of it while trying to clear itself/themselves of the net. Has corrective measure defect, the navy turtles will be reduced of severe manner, what will have some bass tones consequences on the security of these cashes that be - à to say the preservation of their habitats that offers some sites ideal for their food and their growth. To remedy à this situation, Renatura Congo has, in 2005, initiated a program of liberation of the accidental captures of navy turtles in the nets of artisanal fishing. About 1500 liberations are done annually by the agents of Renatura Congo. The liberation of these turtles doesn't constitute a long-term solution. Also, before the size of their accidental captures, he/it appeared us necessary to bring our contribution in the survey of the nocuité of the contraptions and techniques of artisanal fishing used à the bay of Loango in order to meter in evidence those that are more harmful. Such an objective reaches once, will permit us to improve these contraptions and techniques in order to reduce the accidental capture risks all in maintaining the level of the holds of fishes and other aquatic organisms. The specific objectives of our work sum up à:

to " know the different contraptions and techniques of fishing used in the zone of survey as well as their frequencies of use;

to " determine the frequencies of captures and mortality of the turtles according to the contraptions and techniques;

to " analyze the nocuité of the fishing nets opposite the turtles;

to " analyze the time of steady on the mortality of the turtles.

This gait will permit us to put at the disposal of the necessary information authorities concerned allowing them to undertake the programs of improvements of the contraptions and techniques of artisanal fishing in the zone of survey in order to reduce the risks of accidental captures of navy turtles.

MATERIAL AND METHODS

Localization of the survey zone

The bay of Loango is situated on the coastline Congolese à the North of Pointe - Noire, capital economic of Republic of Congo. This bay is limited à the South by the Cape of Loango, named Pointe - Indienne and the mouth of the stream Kouilou à the North (Fig. 1) (ORSTOM, 2010).



Figure 1: Presentation of the survey zone

Feature natural of the survey zone

Middle abiotique

Climate:

The climate is of tropical type: hot, humid and rainy, although cools permanently by the trade winds, winds come from the west (Pounza and al. 1990). the temperatures are raised (23-26°C) and the yearly precipitations rise à 1175mm on average in the region of the Kouilou (Pounza and al. 1990). one distinguishes two seasons whose transition makes itself gradually: the dry season that lasts 3 à 4 months (of May à September) and the season of the rains of 8 à 9 months (of October à May). The rainiest month is November with 238 mm in 2001. A small dry season is sometimes described between the month of January and February (Pounza and al. 1990).

Geology and pedology

" Seafloors

The sedimentary formations of the inshore basin are formations of cover à sandy dominance of age tertiary secondary à. The topography of the seafloors is very variable. She/it is characterized by the presence of a tray shallow .Les realized studies in the zone permit to observe the zones say rocky and the zones constituted of another type of substrata (as the sand, silt or the earth) (Protat, 2010)..

The continental shelf has a middle width of 60 Km, covering thus a surface, deduction made of the zone reserved à the activities of oil extraction (about 1400 km²), of the order of 9300 km². Until 20 Miles à the large, the inshore zone is characterized by an alternation of funds furnitures and hard funds exploited simultaneously by the artisanal fishing and the industrial fishing (Protat, 2010).

The marine biotopes are rich and varied. They are essentially composed of coral formations and herbaria Cryptogames à (algae), where the navy turtles concentrate to nourish itself/themselves (Fontana, 1981).

Running marine

The oceanic circulation of the zone is complex enough insofar as a way of stratification of the water masses that can be enlivened of contrary movements exists and where the dynamics is very different according to the seasons. The cold waters go up northbound from the south - tropical convergence, it is about the waters of the current of Benguela that drift of the south à the North, sweeping the coasts of these cold waters (Giress, 1980).

Soils

From a pedological viewpoint, the territory of the Kouilou is varied very. Of after (Nzila, 1989), the inshore plain and the coastal forest massifs are characterized by: of the soils podzoliques that is poor in ores with a strong acidity, the pH varies between 3,9 and 4,5 and don't present any interest on the agronomic plan; of soils hydromorphes à sandblasting machine, that edges the lakes and lagoons.

Relief and hydrography

The relief of the region of the Kouilou is formed successively, while moving away then of the coastline, plains, trays and hills sublittoraux of weak altitude mountains (Pounza and al, 1990).

The first topographic element is the coast of 170 km of long. She/it is straight flat and sandy of S-E direction - N OH presenting a protected bay succession by tips (Pointe - Indienne, Pointe - Noire). This coast is made dangerous, à the mouth of the Kouilou, by a very strong rod. The bays of Pointe - Noire and Pointe - Indienne form an imposing setting

Backward some coast spreads a large inshore plain of about 50 km. She/it is discontinuous and let the place à southwards some places à the swampy depressions and northbound (Cayo lake, Nanga lake, lagoon of Conkouati).

The hydrographic network articulates around the courses of water, of which: the red river (Loubenda), Louémé, Matombi, Tchilassi, Nombi. Has these courses of water is added the lakes and of the lagoons edged of mangrove swamps that separate of the sea of the sandy coastal cords.

The red river marks the natural limit enters two departments (Kouilou and Pointe - Noire). À the North of the bay of Loango, the Kouilou-Niari stream throws itself in the Atlantic Ocean.

Biotic environment

Vegetation

Vegetation is completely different depending on whether one is à the North or à the South of the maritime coastline of Congo. The landscapes are varied very. Two big formations share the territory: the grassy savanna in the inshore plain southwards and the coastal forest. Has these two plant formations is added the artificial forest of eucalyptus.

Fauna

Fauna is constituted by a terrestrial and aquatic cash diversity.

The terrestrial fauna is characterized by the birds (wild and domestic), the reptiles, the mammals (domestic and wild), the birds, the bugs the amphibians.

The aquatic fauna: one finds there in the bay of Loango several gathered catches of the following manner:

‘piscatorial resources: Poissons, Crustacées, Reptilian,

‘macrofaune: Mollusks, Cnidaireses, Annelids or Ringed verses, Echinodermes,

One also notes the presence à the state natural of the Oysters and Molds as well as the five navy turtle catches: *Chelonia mydas*, *Lepidochelys olivacea*, *Eretmochelys imbricata*, *Dermochelys coriacea* and *Caretta caretta*.

Material

To achieve this work we used the material of land, the biologic material and the technical material.

Material of land.

Listed below different material has been used for the realization of our work on the land: a meter of 5m; a decametre; one camera; a weighs mechanical fish; a GPS; a weighted rope; a block notes and a pen; of the dugouts à oars of the traditional type.

Biologic material

He/it is constituted of four navy turtle catches collected by the fishers of the bay of Loango. It is about of: Green turtle (*Chelonia mydas*); Embedded turtle (*Eretmochelys imbricata*); Olive turtle (*Lepidochelys olivacea*); Turtle lute (*Dermochelys coriacea*).

Only one species (*Chelonia mydas*) has been observed in the consistent team nets; the other catches (*Eretmochelys imbricata*, *Lepidochelys olivacea* and *Dermochelys coriacea*) have been observed by the other fishers in the setting of the activities of the program of liberation of Renatura Congo.

Technical material

À the material above, are added: the books of identification of the turtles; the memoirs and previous publications of other researchers notably on the systematic of the turtles; the internet; the software Reverso; a laptop computer.

Methods of data gathering on the land

To really lead à this survey, we preceded à the organization of the sample surveys, of the interviews by the fishers and people resources, à the direct observation of the captures, à the identification of the turtles.

Sample surveys

These investigations consist, with the help of a questionnaire of basis, à to probe the opinions and the attitudes of the fishers on the fishing and the populations of the navy turtles.

The use of a plot permitted to take back a same investigation by the different people. The questionnaire was constituted mainly of open questions in order to let à the person interrogated the opportunity to express itself/themselves and of closed questions written down on the questionnaire.

This technique permits to cut up and to complete the information. These permitted us then to make the classification of the contraptions, then to target those that put the more of problems à the navy turtles.

These investigations took place à the beach of the bay of Loango.

The interrogated people have been landed of different manners. Every morning, the investigator surrenders à the beach and: interrogate people that want to answer à his/her/its questions; takes an appointment with the fisher or other people (ramendeurs, owners of contraptions); surrenders at home investigated without appointment and interrogate all present person.

The questions have been asked in the worry to approach all points with precision. The interrogated fishers don't fish à the same place. This nuance permitted us to have the information that take in account the variations according to the surroundings à the level of the techniques and contraptions, as well as au level of the frequencies of captures and mortalities.

The points landed with the fishers are the next one: on the fishing (contraptions and techniques): the names usual and vernacular of the technique, features of the contraptions (length, depth, size of stitch, number of floats, number of lead, number of utilized nets, size of the stringing), place of pose (rocher/sable/boue), period (or season) of use, place of use,; on the frequencies of captures and mortalities: one looks for à knowledge the techniques putting more problems à the navy turtles. For this reason one asks for the frequencies of capture for every type of techniques and contraptions.

Maintain

Interview with the professional and retired fishers.

The interviews with the fishers constitute for left it to us most important. They are the main source of concrete information on the land. The establishment of a trustworthy relation to get interesting information is primordial, what justified to take part à their profession, to help them and to follow them. We chose to be going to meet the fishers directly early on the beach the morning.

The interviews for most, took place thanks to non organized meetings (at random). À the course of our interviews, we solicited all fishers met on the place. So we conversed with ten eight professional fishers and two retired fishers met within the community. Often, our task has been facilitated while either meeting a fisher in full put activity of the captures of the previous fishing in process to repair his/her/its material.

This strength constitutes a representative sample of the artisanal fishing in the zone of survey.

Direct observations

We attended and participated à of the outlayses in sea for the small inshore fishing. The data gathering has been done on board of a dugout à rows traditional type. While the fishers collected their nets, our work consisted à to raise the GPS point, then to measure the depth of water with the help of a rope ballasted of lead of fishing à every place where the net was expanded.

Identification of the turtles

The identification of the turtles has been made by the agents of Renatura Congo.

Data processing

Analysis of the nocuité of the fishing nets opposite the turtles:

The statistical analysis carried on the number of turtles observed added on à an unit of fishing effort.

The objective of the analysis is to determine the standard deviation of the averages observed for every évènement of fishing, in order to permit some comparisons and to clear possible meaningful differences between the two types of nets.

The observation of a turtle taken in a net of fishing can be considered like a rare event. The hypothesis is therefore issued that the number of observed turtles at the time of a évènement of fishing follows an in conformity with distribution the law of Poisson.

The verisimilitude of an observation x_i following a law of Poisson Fish of λ parameter is:

$$L = \frac{e^{-\lambda} \lambda^{x_i}}{x_i!}$$

The hope (λ) is the distribution of Poisson gotten while searching for the value that minimizes $-\ln(L)$ and maximize the verisimilitude of the observations therefore in the model The verisimilitude ($-\ln(L)$) the observed bulk information is recomputed then while making vary the value of the λ parameter previously around the calculated value (-20%, -10%, +10% and + 20%).

The variations of $-\ln(L)$ according to the average are approached with the help of a polynomial of the second degree. The inverse of the second derivative of this polynomial à dawns it of the verisimilitude maximum permits to get a valuer of the variance of the average, the standard duration while taking his/her/its square root then the confidence limit à 95% because the valuers gotten by the method of the verisimilitude maximum are normal asymptotiquement:

Variance = 1/Derive second;

Standard duration (AND) = 1/Racine breve (second derivative);

Confidence limit (95%) = average + / - 2ET.

The initial hypothesis of Fish distribution is verified then while comparing the deviance ($-2 \times \ln(L)$) of the information observed in a model says saturated (hope of the model = observed value) with the deviance of the distribution established at the time of the first step. The difference of the deviances of the adjusted model and the saturated model follows a law of Chi - Square having a number of equal to degree of freedom the difference of the number of parameters. A value of $P < 0,05$ permit to reject the hypothesis that the observed information are descended of a Poisson distribution.

In the case where the distribution of Poisson is rejected, the distribution is all over again modélisée, with the help of a negative binomial law. The negative binomial distribution can be seen like a combination of Fish distributions and permits to manage a possible surdispersion thus.

The valuer of the standard deviation of the negative binomial distribution is gotten with the help of the software R while adjusting the model à the observed bulk information (function: `fitdistr()`).

Confidence limit (95%) = average + / - 2ET.

The hypothesis that the information adjust a negative binomial distribution is verified like previously.

Analysis of the effect in the days of steady of the net on the mortality of the turtles:

The length during which the net remained steady seems to have an influence on the mortality of the turtles taken in this net. We tempt to value a critical doorstep beyond of which the probability that the turtle dies increases meaningfully with the help of a diagram in bars.

RESULTS

The contraptions and techniques of fishing used in the bay of Loango.

The terms "contraption" and "technique" of fishing have each a precise significance. Contraption designates the material with which the fisher exercises his activity (example: Net of stitch 6 cm of 1,50 m high and 200 - m long) and the technique is the way of which it uses it (example: Steady à melts it in a vertical manner). The contraption cannot be dissociated of its technique, because it is this last that conditions the frequencies of captures and mortalities.

At the time of our investigations, we identified 4 big categories of contraptions and techniques of fishing that are: the rotating nets: beach senne; the netting nets understanding: net shackling sleeping small à nets or right net, net shackling sleeping thick à either nets insane of surface and madwoman of bottom, net shackling surrounding; the lobster pots or trays and finally the lines and Fishhooks.

Frequencies of use of the different contraptions and techniques of fishing

À the course of our investigation, we noted that the frequencies of use of the different contraptions and techniques are very variable. The introverted information permit to classify by order of magnitude these frequencies of use (Fig. 2).

The figure 2 raises that the right nets and the nets surrounding Aiguillette à are the most utilized à the bay of Loango. They are followed by the madwomen of bottom, the floating madwomen, the beach senne, the lobster pots, the lines and fishhooks and finally the fishing on foot and submarine hunt that is practiced little in the zone of survey.

Frequencies of capture and navy turtle mortality according to the contraptions and techniques

À the course of our survey, 1083 turtles have been captured in the bay of Loango of which 426 were not identified. These different captures constitute some questioning with regard to the different contraption interactions and techniques that don't cause any captures, cause few captures, cause some captures without mortality and cause some captures finally with mortality. To answer à these questioning us studied the different interactions between contraptions and techniques of fishing with the navy turtle captures.

Rotating net "interactions (beach senne) with the navy turtles

As fishes, the turtles who are in the zone of fishing are surrounded in the pocket of the senne and are brought back on the beach. À the course of our survey, 13 turtles have been captured and lax either 1, 2%. This technique doesn't cause any mortality therefore.

Netting net "interactions with the navy turtles

- Nets netting sleeping steady à melts it (Nets small stitches (right) and the madwoman)

Three hundred thirty seven turtles have been captured by the nets steady à melts it is 31,11%. Among the Three captured hundred thirty seven turtles, the right net represents twenty seven either a percentage of captures of 2,4%. Five turtles had died, either 0,46%.

The madwoman represents à her only three hundred ten either 28,62% of captures. Of these three hundred ten turtles, one harvested sixty seven dead turtles either about 6,18%. This result shows that the madwoman steady à melts it appears as the technique the more fishing and devastating.

Floating netting net interactions

According to the results of the program of navy turtle liberations, three hundred seven turtles have been captured in these nets in the bay of Loango, either 28% of captures. The number of dead turtles has not been identified.

Interactions of the trays with the navy turtles

The lobster pots are selective contraptions and with little of reverberated on the ecosystems and the habitats. À the course of our survey, no turtle has been captured.

Interactions of the lines with the navy turtles

The risks for a turtle to be captured by a fishhook are: either she/it clings à at random this last of his/her/its displacements (the most often by a fin), either she/it is attracted by the prey, swallow this one with the fishhook that remains hung in the mouth or in the œsophage. It is also possible that the turtle snarls in the lines. According to the fishers none case of capture or navy turtle mortality has not been identified again for this technique. These interactions justify our choice on the contraptions putting the more of problem à the navy turtles. So the evaluation of the frequencies of capture and navy turtle mortality as taking account of our non capture hypotheses, little capture, capture without mortality and capture with mortality is consigned in the table 1.

Analysis of the nocuité of the fishing nets opposite the navy turtles.

Case of the nets small à net

The adjustment of the Fish model on the information observed " small stitches " with the help of the maximum of verisimilitude permit to get a theoretical Lamda.

$$\lambda t = 0,07407407 ;$$

The observed average is : $\lambda o = 0,07407407$

We note that the theoretical lamda is equal to the average of the observed valeurs. We keep the model of the Fish law to describe the observed information distribution. We make vary the Lamda around his/her/its theoretical value, we got the results consigned in the table 2:

Table 1: Evaluation of the frequencies of captures and navy turtle mortality

Contraptions	and techniques of fishing	Number turtles captured	Frequencies of captures%	Number of turtles dead	Frequencies of mortality%	Appreciation of the contraptions and techniques of fishing
Senne of	Beach	13	0	0	0	Cause captures without mortality
Nets netting steady à melt it	Right net	27	2,4	5	0,46	Cause captures with mortality
	Folle	310	28,62	67	6,18	Cause captures with mortality
Nets	Netting floating	307	28	Non identifié	Non identifié	Cause captures, but one ignores the death rate
Lobster pots	or trays	0	0	0	0	Cause neither captures nor mortality
Lines and	Fishhooks	0	0	0	0	Cause neither captures nor mortality
Contraptions identified techniques	and non	426	39,33	Non identifié	Non identifié	Cause captures, but one ignores the death rate

Table 2: Result of the analysis of the nets small à net

Parameters of the fish model law for the information small stitches	
Equation polynomiale	$Y = 186,4x^2 - 27,928x + 8,2512$
Dérivée 2nd	372,8
Variance	0,002682403
Ecart-type de lambda	0,051791924
IC à 95% de lambda	0
	0,0177657919

Case of the nets thick à net

The adjustment of the Fish "model" law on the information observed "thick stitches" with the help of the maximum of verisimilitude permit to get a theoretical Lamda.

$$\lambda_t = 0,7419346$$

The observed average is :

$$\lambda_o = 0,709677419354839$$

The observed and theoretical deviances are compared with the help of a test of Chi - Square. If the P probability is lower à 0,01 (highly meaningful) the hypothesis is rejected. The gotten results are consigned in the table 3.

The gotten results show that the value of P is lower à 0,01. This result brings to reject the modelling according to the law of Fish. A negative binomial model is adjusted therefore in second intention on the share of the information "thick stitches ". We get the parameters consigned in the table 4.

Table 3: Result of the test of Chi - Square of the deviances.

Result of the test of X ² of the comparison of the deviances	
Valeur	162,4586732
DDL	1
P	3,28.10 ⁻³⁷

DDL : degré de liberté ; P: probabilité de l'hypothèse que la déviance théorique et observée soient identiques

Table 4: Result of the parameters of the binomial negative adjusted.

Parameters of the binomial negative adjusted	
Size (k)	0,5466549
Mu (M)	0,7419346
Ecart-type de Mu	0,2375203
IC à 95%	0,266894
	1,2169752

Paramètres de la loi binomiale négative : Size : paramètre de dispersion ; Mu : moyenne IC : intervalle de confiance

Effect in the days of steady on the navy turtle mortality

The securities in the days of steady on the navy turtle mortality bound à the nets à thick and small stitches are consigned in the pictures 5 and 6.

For the nets small à net, on the twenty seven events of fishing achieved, two turtles have been captured living. The rate of capture is weak either 0,07 turtle by event. The time of steady varies between 1 hs 30 and 16 hs For the nets thick à net, on the thirty one events of fishing followed, twenty three turtles have been captured of which five dead turtles and ten eight living. The rate of capture is raised either 0,67 turtle by event. The time of steady varies between 8 hs 30 and 24 hs.

Representations of the distributions of the turtles captured according to the time of steady

The representations of the distributions of the turtles captured according to the time of steady are represented in the figure 3 and 4.

The exam of the figure 3 shows that no dead turtle has been observed in the nets small à nets.

The exam of the results consigned in the face 4 shows that à a time of steady lower à 12 hs, we don't have case of mortality. Has a time of steady superior à 12 hs us observe cases of mortality. One can deduct therefore that more the net remained a long time in water, more the risk of mortality is raised.

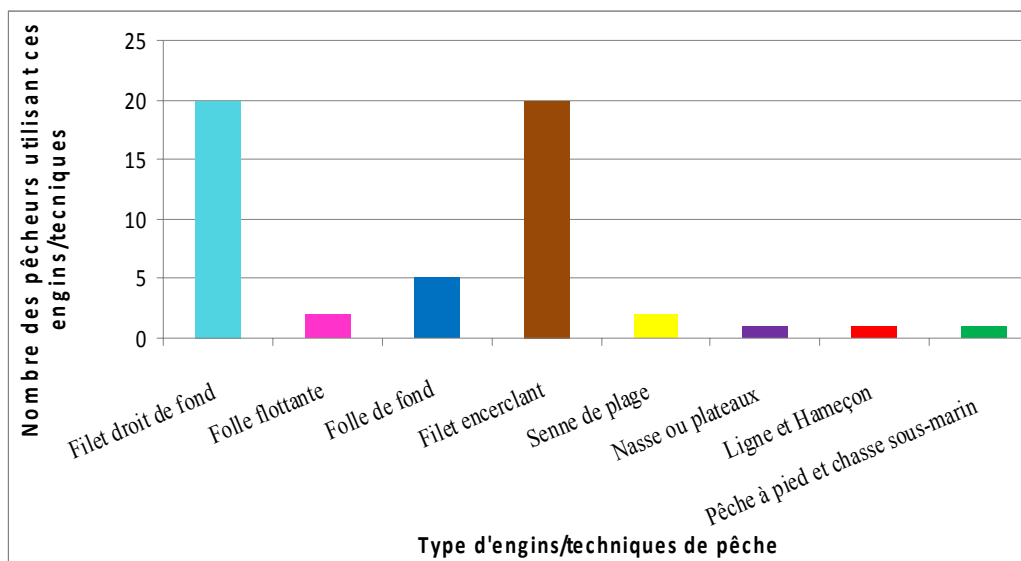


Figure 2: Frequencies of use of the contraptions and techniques of fishing.

Table 5: Accidental captures by event of fishing in the nets small à net

Number of the fishing event	Time of steady	Number of living turtles	Numbers Dead turtles
1	15h	0	0
2	14h	0	0
3	15h	0	0
4	15h	0	0
5	14h	0	0
6	15h	0	0
7	14h	0	0
8	14h	0	0
9	14h30	0	0
10	15h	0	0
11	15h	1	0
12	14h	0	0
13	14h	0	0
14	12h	0	0
15	14h	0	0
16	16h	0	0
17	14h	0	0
18	13h	1	0
19	14h	0	0
20	13h	0	0
21	12h30	0	0
22	11h30	0	0
23	12h	0	0
24	3h15	0	0
25	10h	0	0
26	1h30	0	0
27	7h	0	0

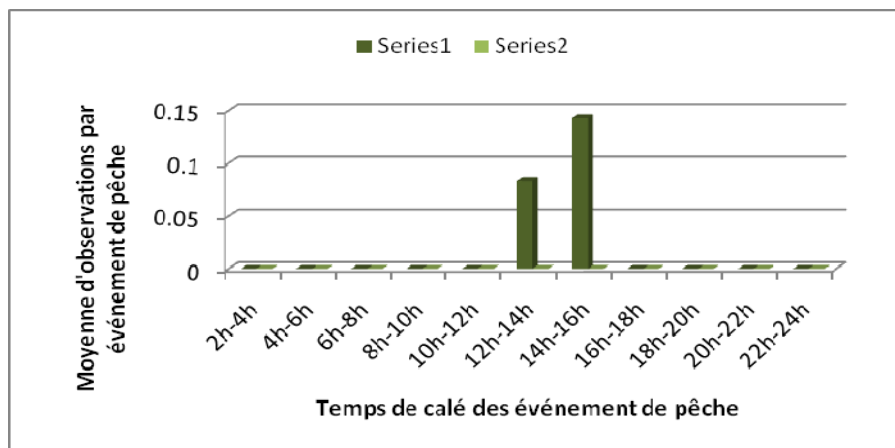


Figure 3: Number of turtles captured according to the time of steady in the nets small à net.

Table 6: Accidental captures by event of fishing in the nets thick à net

Number of the fishing event	Time of steady	Number of living turtles	Number of dead turtles
1	14h	0	0
2	14h	1	1
3	15h	0	0
4	13h30	0	0
5	15h	0	0
6	16h	0	0
7	16h	2	0
8	14h	3	0
9	10h	2	0
10	12h	2	0
11	8h30	2	0
12	13h	3	2
13	13h	0	0
14	14h	0	0
15	13h	0	0
16	14h	0	0
17	13h	0	0
18	14h	2	0
19	14h	0	0
20	16h	0	0
21	12h	0	0
22	11h30	0	0
23	23h	0	0
24	12h30	0	0
25	14h	0	0
26	11h	1	0
27	13h	0	1
28	12h30	0	0
29	24h	0	1
30	13h	0	0
31	13h	0	0

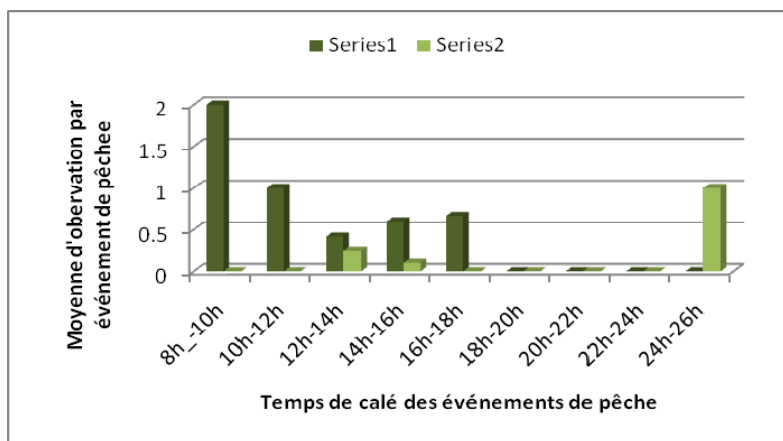


Figure 4: Number of turtles captured according to the time of steady in the nets thick à net

DISCUSSION AND PERSPECTIVES

The contraptions and techniques of fishing

The contraptions

Four types of fishing contraptions are used à the Pointe - Indienne à knowledge the sennes, the nets netting, the lobster pots or trays and the lines and fishhooks. These results are in agreement with those gotten of the led survey by (Ngokaka and al., 2009) à bases it Agip. Among the four contraptions, the netting nets are the most utilized. These results sustain the idea of (Leveque and al. 1999) that think that the netting nets have the advantage to be easy-to-operate; it is also due to the fact that these contraptions are used all year round.

The senne comes in second position by his/her/its use; it is due to the fact that she/it is used all year round.

Being about the measurements of the nets, the netting nets used à the Pointe - Indienne have a middle fall varying between 2 and 6 m and a medium length of 150 à 350 m. This result agrees with the one gotten by (Ngokaka and al, 2009). on the other hand, it defers the one gotten by (Mamonekene, 2006) .qui showed that the netting flounders used in the Likouala à the Herbs measure 45,72 - m long on 2 m of fall. It can be due to the fact that in the Likouala à the Herbs, these contraptions are used in waters à surfaces reduced, what is not the case à the bay of Loango. The measurements of the stitches of the nets vary according to the type of net shackling à knowledge the net surrounding, the right net and the madwoman. Besides one differentiates them by the size of the stitches. So the net surrounding has some tiny stitches (1 à 2 cm), the right net has some small stitches (4 à 8 cm), the madwoman has some thick stitches (12 à 20 cm). However one notes that if the nets thick à net (Madwomen) have measurements of the stitches recommended by the regimentation Congolese overhead à (10 cm) the right nets have measurements of the stitches lower à on the other hand those advisable (10 cm) by the literature. The nets also surrounding have measurements of the stitches lower à those advisable (superior à 6 cm).

The techniques of fishing

Six techniques of fishing are used à the bay of Loango à knowledge: the drawn net (beach senne), the nets steady à melt it, the floating nets, the nets surrounding, fishings à the lobster pot, fishings à lign offs it, fishings à feet and submarine hunt. The most utilized techniques are the nets steady à melts it that fish at depth mainly fishes very sought-after demerseaux for their quality and the floating nets that often capture the pelagic fishes very abundant on the Congolese coasts (Nzila, 1989). On the other hand, as he/it has been signalled earlier, these techniques, because of their simplicity, their frequency of use doesn't change all year round. on the other hand according to the information collected by the fishers, the frequency of use of some contraptions and techniques of fishing vary according to the seasons. In dry season for example the fishers don't use the nets surrounding anymore because the Aiguilletteses that are the cashes targeted there by this technique are not more present.

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Finally, without risk to deceive us, one can suggest that the frequency of elevated use of these techniques is dictated at a time by the quality of the products, their abundance and seasons. Of this fact, the fishers actively look for them while using the technique and the season appropriated.

Frequency of captures and navy turtle mortality according to the contraptions and techniques

À the course of our investigatings, we identified three categories of contraptions and techniques: the contraptions and techniques 1 that don't cause any captures, 2 that cause some captures without mortality and 3 cause some captures with mortality. We were interested more particularly à the third category. She/it gathers the contraptions and techniques that pose problem, of part their conception and their use. Indeed the nets netting steady à melt it (right nets and the madwomen) are the most harmful particularly the nets thick à net (madwomen) (picture 1). The realized studies show previously that the width of the stitches has an influence on the navy turtle holds: more the stitches are large, more the risk of captures is raised. (Gilman and al., 2009) return that the fishers targeting the navy turtles use the nets whose stitches measure 20 à 60 cm. The nuisance of the madwomen results of made it that they are constituted of the big stitches and they are often expanded on shallow bottom in the rocky zone. They occupy the whole depth therefore, the turtles who come to nourish themselves and himself insoler to benefit from the UVS rays indispensable à the synthesis of the D vitamin that is necessary to them for the growth smelts itself to take by this type of nets (it is the case of *Chelonia mydas*). The lobster pots, the lines and fishhooks cause neither captures nor mortality. Their use à the artisanal scale rarely presents real dangers. These techniques seem to be the best to be popularized in order to avoid the accidental navy turtle holds. Unfortunately the quality and the quantity of the products searched for by the fishers are not gotten with this type of contraptions and techniques.

Analysis of the nocuité of the nets of fishing à thick and small stitches

On the thirty one events of fishing achieved with the nets thick à net opened out on the rarely sandy shallow rocky funds, twenty three turtles have been captured either an average of 0,67 by event. On the other hand on the twenty seven events of fishing achieved with the small stitches two turtles have been captured either an average of 0,07. According to (Acosta and al., 1995), the preys taken in the netting nets snarl in their large stitches, what would explain the capture more frequent of thick individuals as the sharks, the stripes and the navy turtles. The nets small à net seem to capture few turtles. In our case, the weak rate of captures of turtles can be varied because only one fisher has been followed for this type of net and this fisher opened out his net on rarely rocky deep sandy funds. The same types of nets (small stitches) with the same size of the stitches and used according to the same technique (steady à melts it) but, expanded on funds rocky shallow rarely sandy à the bay of Loango by other fishers, captured several turtles. The nature of sea funds and the localization of the net seem important. The zones where the turtles are more abundant exists. The green Turtles, who constitute the essential of the turtles captured, and the embedded Turtles often come on the rocky funds to nourish itself/themselves of algae and animals benthiques. The pose of nets in these sectors increases the probability of capture. Insofar as the events of fishing " titles of agreement stitches " valued in this survey have all had place on the rocky funds us didn't have the possibility to test the influence of the substratum sands on the frequency of navy turtle holds.

Effect in the days of steady on the number and the navy turtle state

The time of steady it is the time that goes by between the moment of pose of the net in water and the moment of his/her/its withdrawal. The time of steady has an influence on the navy turtle mortality. These reptiles breathing à the free air, drown according to the hour that follows their holds in the nets of bottom. Indeed these nets remain several hours in general, or even in other cases several calm days without being raised. More the time of steady is long, more mortality by drowning of the turtles is mainly important beyond 12 hours (Fig. 3). At the present hour no regimentation exists on the time of steady. The definition of time of steady would oblige the fisher à to visit his/her/its nets regularly. What would reduce mortality. As affirms it (Louis Jean, 2006), to work on the definition of steady maximum time and to make accept could reduce them meaningfully the navy turtle drownings.

CONCLUSION

The accidental navy turtle captures during the artisanal fishings are a reality that constitutes one of their important threats. The present survey whose results are consigned in this document, consisted à to analyze the contraptions and techniques of artisanal fishing used à the bay of Loango in order to put in evidence those that achieve more captures accidental and later to look for the contraptions and alternative techniques capable to encourage the selective captures all in maintaining the level of the holds of fishes and other aquatic organisms. To arrive à this end, we analyzed the different contraptions and techniques of fishing, the frequencies of use,; valued the frequencies of captures and navy turtle mortality according to the contraptions and techniques; analyzed the nocuité of the fishing nets opposite the turtles and analyzed the effect finally in the days of steady on the navy turtle mortality. Our investigation raises that four big categories of contraptions and techniques of fishing used in the zone of survey à knowledge exist: the beach senne; the netting nets understanding: the net shackling sleeping small à nets or right net, the net shackling sleeping thick à either nets insane of surface and madwoman of bottom, the net shackling surrounding,; the lobster pots or trays and the lines and fishhooks.

The analysis of features of these different contraptions and techniques, their frequencies of use and their interactions with the turtles marinade permitted us to target the contraptions and most harmful techniques. It is in priority about the netting nets sleeping thick à net and small stitches wedged à melt it targeting fishes, the crustaceans and the navy turtles. The nets thick à either nets insane of bottom are in general little in particular contraptions selective with regard to the turtles. The madwomen pose more problem because of their big capacity à to capture noncommercial catches, of which the navy turtles that in certain case, died. The origin of these mortalities would be the asphyxia consequence of the drownings. Considering the biologic importance of the bay of Loango in general and of the Pointe - Indienne this zone constitutes an important ecological dog house in particular, for the aquatic organisms. Among these organisms, the navy turtles constitute an inestimable wealth for the Congolese coasts. It is an important zone to undertake the research on the migration, their food and their growth. In the future, It is possible to reduce the captures and the mortality of the turtles in the nets of artisanal fishing while limiting the activity à certain periods or seasons, while forbidding the activity of fishing in the rocky zone close to the beach, while reducing the time of steady.

It is possible to consider the measures that would permit à the administrators of the protective programs of the navy turtles also, to pursue their activities in quietude while taking account at a time of the conservation of biodiversity and the life of the fishers that pulls their daily while exploiting the navy resources. These measures would be proposed at the end of a series of experiment carrying on the use of contraptions and techniques of fishing modified in order to verify if the brought modifications decrease in fact the number of accidental captures and navy turtle mortalities. If this program is conclusive, of the measures incitatives and authorized should be taken in order to help the fishers à to change occupation in other practices.

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