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Discards in the Mauritanian shrimp fisheries
An evaluation of lost value

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Abstract

The discards of the shrimp fishery in Mauritania are calculated on basis of direct observations on board of commercial vessels from 2004-2006. Data were collected from 175 hauls in 12 trips. The fisheries for the three different shrimp fisheries take place at different depths and so have a different by-catch and discard composition. The percentage of discards varies from 80.7 to 86.4% in weight which corresponds to a volume of 31 516 tons of fish discarded annually. Commercial species constitute 58.8% of the discards in the gamba fishery and 73.8% in the langostino fishery. In particular the hake and round fish stocks experience a fishery mortality as discards, which is high compared to the mortality induced by the specialized fleets.

1. Introduction

The shrimp fishery is after the pelagic and octopus fisheries the third most important fishery in the industrial fisheries of Mauritania. The number of vessels involved which fish with a foreign, an “affreté” (joint venture like) or national license varies between 60 (in 2001) and 85 (in 2002). The number of vessels in 2003 was 73. Spanish interests dominate in the Mauritanian shrimp fishery while Spain is also the major export destination for the shrimps. There is no artisanal shrimp fishery in Mauritania, except a tiny one in the lagoons near the Senegal River which produces 30 tons of one species (langostino) during a whole year.

Discards are an important aspect of fisheries management. However, the volume, species and length/age composition are often unknown, as these data are not recorded in landing records or logbooks. In particular when important commercial species are discarded there is an unknown fisheries mortality factor. This often hampers a sustainable management of these stocks.

Fishing for shrimps, with small sized cod-end gears, has a notorious reputation concerning discards and interacts with other fisheries for commercial species. In particular where a shrimp fishery takes place in shallow coastal zones that are nursery areas for many fish species.

In Mauritania, only anecdotal or fragmentary data were available for the discards of the shrimp fisheries. The only relevant information based on locally collected data is the internal CNROP report of M’ Bodj (1993) which concerns the discards of small pelagics in the shrimp and hake fisheries.

Prior to the start of this project, observations on discards on board Mauritanian shrimp trawlers were made only by observers of the Mauritanian inspection service DSPCM (Délégation à la Surveillance Pêche et au Contrôle en Mer) from 1996-2001. A data set of 25 observer trips of the DSPCM programme was available. However, an analysis of these data showed that they were incorrect or incomplete.

For this reason, a special observer programme was initiated in the framework of the RIVO project, running from 2004 to 2006. The single objective of this programme was to record the catch of the vessels, fishing for shrimps in Mauritanian waters under a national license (NV). These vessels are – except one – under a Spanish captain and all are under Spanish management. There is in reality no difference in fishing practice between foreign (almost all Spanish) and national vessels and foreign or national license, with the exception that the national fleet is the oldest segment of the total shrimp fishing fleet.

The observers were IMROP scientists and technicians who had no inspection tasks.

The present report describes the results of the project and discusses the implications for management. Chapter 2 describes the methods used, while the results are presented in chapter 4. In chapter 5 the results are discussed and conclusions are given.

2. Material and methods

2.1. Methods used

Observers of IMROP collected all data on board of vessels, which operate in Mauritania with a National license for shrimps (NV). These vessels operate with a mesh size in the codend of 50 mm stretched mesh. Most vessels operate with two nets, one left and one right besides the ship (tango), while a few fish over the stern with a single net. All data in this report concern catches with a double net. Trawling speed is around 4 miles hr^{-1}.
Observers were instructed during a workshop before the beginning of this exercise and before each departure. Every observer was equipped with a manual.

Of the 430 hauls that were made, 175 were measured by the observers for species composition in number and weight. Length frequencies for the most important commercial species were made in Total length (TL). The observer did not know which areas would be fished when he was going on board. As the shrimp fleet is very flexible and switches frequent from fishing ground during one voyage we assume that the records reflect a representative sample of the whole fleet.

After hauling the catch and placing it on the deck of the ship, the crew selected al shrimps manually from the total catch. These shrimps are cleaned, graded and stored in boxes. The number of boxes is recorded for every haul and their weight is standard known (often 2.5 kg for a box disregarding size class). In this way the total catch of shrimps is known.

During the selection of shrimps all fish and debris is normally thrown over board. In case a representative sample is wanted for our research, one crewmember throws everything in a basket and the fraction of the total discard is known. In case this sample was still a large quantity, this volume was further divided till a sample of 50 kg at a minimum.

The total catch was defined as the sum of all fish, crustaceans, cephalopods, and turtles in the haul. Other organisms and objects such as sea grass, shells and debris were not included in the weight of the catch. Sea grass (*Zostera*) can constitute a major part of the total catch. Occasionally jellyfishes (medusa) were caught in great quantity in particular during October and November. These medusas form a particular problem, as their quantity is often so big and unmanageable that the total catch is discarded, including shrimps. In the data for this study we had 18 such records and these were all omitted.
Two observer trips were made that produced no data. During one of these trips, the observer worked on a vessel with shrimp license, which targeted octopus outside the distribution zone for shrimps. The other mission failed to produce results due to malfunctioning equipment. In total, 175 recorded catches from 10 trips were available for analysis.

The observer data provided good figures for division of the total catch in target, by-catch and discard species. Knowing the division in % of target, by-catch and discard species and the absolute volume in weight of the target species, we were able to calculate the volume of by-catch and discards.

From the observer records we also know the contribution in % of every discard species and by applying this to the total volume of discards we were able to calculate the total volume of discards of every species.

2.2. Reliability of data

The IMROP observers were introduced to the captains and ship managers as observers and not as inspectors. Captains were told to fish and to handle the catch as they were used to do. Nevertheless we think that some ships discarded langoustes for which they were not licensed just because of the presence of the observer. On the other hand one observer was placed on a vessel which was licensed for shrimps and fished with a shrimp fishing gear with 50 mm codend mesh, but that targeted small cephalopods during the whole trip and did not catch one shrimp.

Species identification of fish species is a serious problem, except for the most common species. This is partly due to synonyms in the taxonomy, and partly due to inexperienced observers. There are many different species in the area, some of which are not very common. Identification of commercial shrimps is no problem.

Highly improbable records were either corrected - when possible - or deleted from the data set.

3. Results

3.1. Distribution of shrimp fisheries

There are three major shrimp fisheries in Mauritania. The target species are:

1) *Penaeus notialis* – officially known as *Farfantepenaeus notialis* (Perez-Farfante, 1967). This fishery has a bycatch of *Penaeus kerathurus* (*Melicertus kerathurus* Forskal 1775). In Mauritania this species is called by its Spanish name Langostino [1] ;

2) *Parapenaeus longirostris* (Lucas, 1846). Locally named Gamba;

3) *Aristeus varidens* Holthuis, 1952. Locally called Alistado. This fishery has a bycatch of *Glyphus marsupialis* Filhol, 1884 and a smaller (incidental) bycatch of *Plesiopenaeus edwardsianus* (Johnson, 1867).

Shrimp vessels switch frequently (within 24 hours) from target species without changing gears. In particular Langostino and Gamba are often fished respectively during night and day.

[1] Wherever in this report (+) is used, we mean the target species with the bycatch species.

Penaeus (Farfantepenaeus) notialis Pérez-Farfante, 1967

Synonyms : *Penaeus brasiliensis* Latreille, 1817; also misidentified as *P. (Melicertus) duorarum* Burkenroad, 1939.

FAO names : **En** - Pink shrimp (southern); **Fr** - Crevette rose (du sud); **Sp** - Camarón rosado (sureño).

Size : 23 cm (males), 17 cm (females).

Fishing gear : in lagoons with artisanal gear: pots, stow-nets, conical nets, "azui" trawls, beach seines; at sea with bottom trawls (double rig).

Habitat : coastal marine waters, estuaries and lagoons. Lives on muddy bottoms by day and migrates upwards at night.

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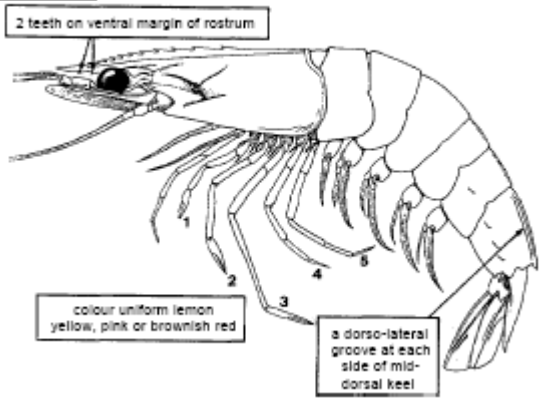

Parapenaeus longirostris (Lucas, 1846)

FAO names : **En** - Deepwater rose shrimp; **Fr** - Crevette rose du large; **Sp** - Gamba de altura.

Size : 19 cm.

Fishing gear : bottom trawls.

Habitat : sandy and muddy bottoms from 150 to 600 m depth.

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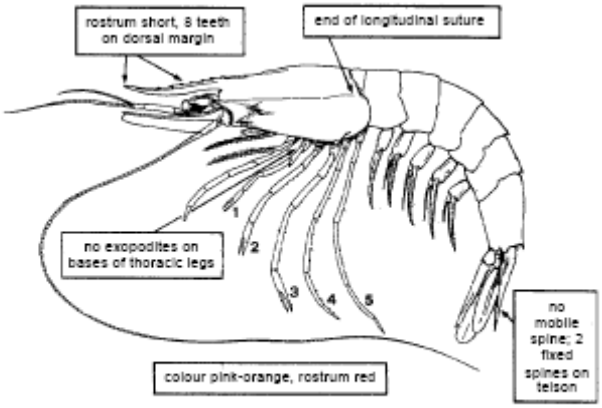


ARISTEIDAE

Aristeus varidens Holtuis, 1952

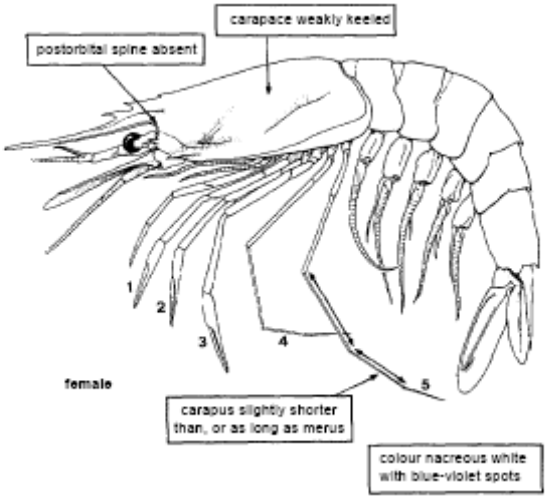
FAO names : **En** - Striped red shrimp; **Fr** - Gambon rayé; **Sp** - Gamba listada.

Size : 20 cm (females), 12 cm (males).

Fishing gear : bottom trawls.

Habitat : on muddy bottoms, from 300 to 600 m depth.

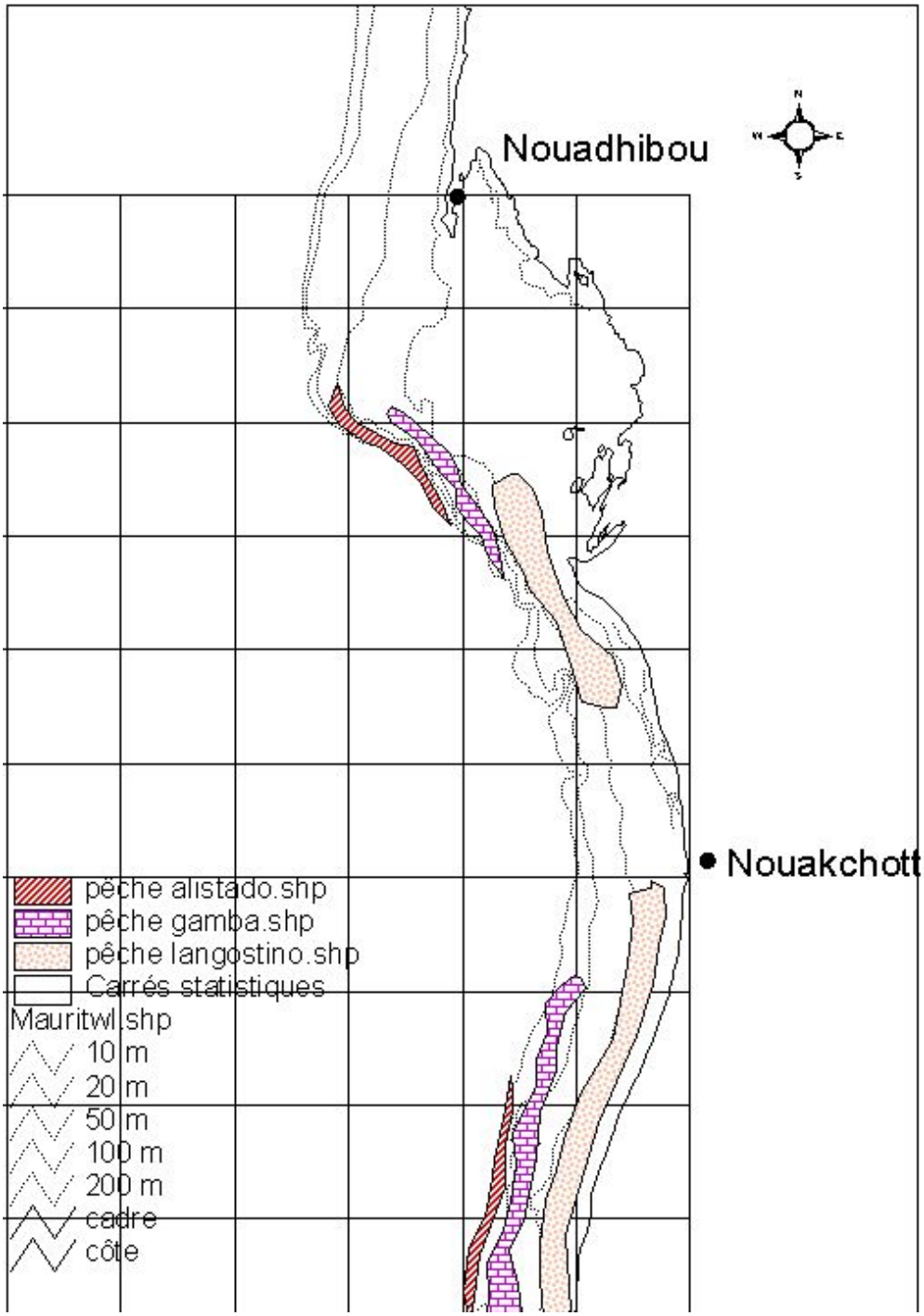
Loc.name(s) :



The three main species in Mauritanian shrimp fisheries: *Penaeus notialis, Parapenaeus longirostris* and *Aristeus varidens.*

Figure 1 demonstrates the difference in distribution of the fisheries for the three principal target species. Note that the area of the southern fisheries extends into Senegalese waters.

Fig. 1. The distribution of the commercial shrimp fisheries in Mauritanian waters



3.2 Trawling time

Longer trawling time increases the % contribution of large fishes to the total catch. Initially, large fishes swim in front of the net, but gradually they become exhausted and are caught in the cod-end. Trawling time is, therefore, a factor of importance in the estimation of bycatch and discards composition.

In Mauritania, trawling time differs according to target species (Table 1). Setting and hauling the nets in the Langostino and Gamba fisheries can be done within 10-15 minutes while it takes over an hour in the deep water Alistado fisheries, where over 1.5 km steel cables need to be shot and hauled. Longer trawling time also degrades the quality of the catch. For that reason the actual trawling time is a compromise between maximum fishing time and quality of the product.

Trawl duration is measured from the moment that the winches are stopped to the moment that they are set in action. The given depth is the actual depth of fishing (minimum and maximum) recorded during trawling.

Table 1. Trawling time for different Mauritanian shrimp fisheries as estimated from this study.

	Depth zone (m)	Total number of recorded hauls	Total observed trawling time (hrs:min)	Average trawling time (hrs:min)	Standard deviation in minutes
Langostino	11-80	347	874: 51	2: 31	32
Gamba	155-291	63	132: 08	2: 05	42
Alistado	440-490	20	105: 55	5: 30	33

From table 1 it can be concluded that trawling time for Langostino and Gamba is almost the same. Only the deepwater Alistado fishery has a remarkably longer trawling time.

3.3. Catch composition

The amount of debris is excluded when calculating the percentage of the target species, bycatch and discards. This debris can form the majority of the catch that comes on board, in particular if it concerns sea-grasses and medusas.

Table 2. Catch composition in % (weight) for the three shrimp fisheries in Mauritania in 2004-2006 based on observations of 499.3 hrs of trawling from 10 trips.

Type of fishery	Number of measured Hauls	Observed trawling time (hrs: min)	Target species (%)	Bycatch retained on board (%)	Discard (%)
P. notialis (+)	121	310: 20	17.2	2.1	80.7
Par. longirostris	34	83 : 05	13.0	0.5	86.4
A.varidens (+)	20	105: 55	14.0	3.8	82.2

The target species make up 13.0 to 17.2 % in weight of the total catch (excluding debris). The percentage discards varies from 80.7 to 86.4 %. These percentages do not differ very much

between ships or periods as far as this can be deduced from the available data, even though the catches of shrimps are not stable during the year.

3.4. Total discards in the Mauritanian shrimp fisheries

We have calculated the total bycatch (non-target species retained on board) and discards in the three shrimp fisheries on the basis of the amount of landed species provided by the DSPCM. For the landed shrimps which are "Unspecified" we applied the average % for target, bycatch and discards viz. 14.7%, 2.2% and 83.1%. Unspecified shrimp landings in 2004 were 1.4% and in 4.7% in 2005.

Table 3. Estimated bycatch and discards in the Mauritanian shrimp fisheries. Calculated from the total weight of landed shrimps in 2004 and 2005 (Source of data: DSPCM) Weight in tons.

2004	Target species Total weight (recorded)	Bycatch Total weight (calculated)	Discards Total weight (calculated)
P. notialis (+)	2 017	246	9 463
Par. Longirostris	3 131	120	20 809
A.varidens (+)	137	37	805
Unspecified shrimps	78	12	438
Total in 2004	5 363	416	31 516

2005	Target species Total weight (recorded)	Bycatch Total weight (calculated)	Discards Total weight (calculated)
P. notialis (+)	2 013	246	9 444
Par. longirostris	1 620	62	10 767
A.varidens (+)	197	53	1 154
Unspecified shrimps	100	15	567
Total in 2005	2 133	376	21 922

The total amount of discards in 2005 raised to the total catches of the Mauritanian shrimp fishing fleet is 21 922 tons and is approximately 30% less than the preceding year 2004. This is probably the result of much smaller landings of *P. longirostris* in 2005, which is most probably due to incomplete records. There is a remarkable gap in the data for December 2005. For that reason the 2004 data should be considered to represent the most reliable discard figures. In the following part of our report, discards per species are based on this total figure of 31,516 tons discards in 2004.

3.5. Composition of discards by species groups

As a result of the different depth preferences of commercial shrimp species (Fig. 1), the bycatch and discards differ among target species. Table 4 shows ten different components of the discards for each target shrimp species. This table is based upon the species lists of Appendix 1, 2 and 3 in the annex. All species are grouped into 10 categories. “Commercial” was used for a species if the species is in Mauritania regarded as such. “Non-commercial” species was used for the opposite although the same species may have a market value in Europe (e.g. Grenadier fishes, Macrouridae).

Table 4.
Composition of discards in % in three different shrimp fisheries in Mauritania

	Langostino	Gamba	Alistado
Commercial round fish	51.1	54.8	2.8
Commercial flat fish	6.0	0.2	-
Commercial pelagics	16.7	3.8	0.5
Total commercial fish	*73.8*	*58.8*	*3.3*
Non commercial species	9.8	22.6	77.4
Cartilaginous fishes	9.2	5.6	10.0
Decapods	5.1	10.1	0.1
Mollusks	1.1	0.1	-
Cephalopods	1.0	0.6	9.2
See urchins	0.1	-	-
Langoustes	-	2.2	-

There is a remarkably high percentage of commercial fishes (often juveniles) in the Langostino and Gamba fisheries. In the Alistado fishery the contribution of non-commercial species of 77.4% is dominated by *Nezumia aequalis*, which accounts for 54.1%. This species is commercially exploited in France.

Commercial roundfish and flat fish are registered in the landing as one category (“Poisson”). The fish discards for the Langostino fisheries is 57.1% of all discards, amounting to 5 403 tonnes of fish annually. For the Gamba the discards of 55% for commercial flat fish and round fish amount to 11 445 tonnes, while the 2.8% of Alistado amounts to a total of 22 ton. Together this is 16 870 tonnes of discarded commercial fish, while the total landings of fish (“Poisson”) in 2004 were 19 113 tons for the licensed “Poisson” fleet.
The discards of commercial fish species in 2004 in the Mauritanian shrimp fishery were 88.3% of the total landings of the industrial fleet.

All sharks and guitar sharks are discarded. Before being thrown overboard the fins are cut and preserved by drying, although “finning” is forbidden for any EU vessel or vessel with a EU captain. This is an unrecorded landing of sharks as crewmembers take these as personal property from board. The catches are not recorded in the logbook.

4. Results by type of fishery

4.1. The shrimp fishery for Alistado (440 – 490 m deep)

The species composition for the deep-water *Aristeus varidens* (Alistado) fishery is given in Annex 1. The data are based on 20-recorded hauls for which a combined sample weight of 452 kg was analyzed out of a total of 13 999 kg discards.

20 Species or species groups were recognized. The most abundant species is *Nezumia aequalis* (Günter, 1878), which accounts for over half of all discards (Appendix 1). Discarded cephalopod species (*Octopus vulgaris*, *Illex coindetii*, *Rossia macrosoma* (or *Neorossia caroli*) and Sepiolidae) form 5% of the catch.

Small sized *Lophius* with an average weight of 240 g are discarded (1.9%) although large individuals are (gutted, beheaded and skinned) kept on board and landed as bycatch.

Also a small quantity of hake, less than 1%, with an average weight of 820 g is discarded. This is due to low quality as a result of the long haul duration.

Just over 10% of the discards consist of sharks and rays.

Bycatch

The most important species in the bycatch is *Lophius budegassa*. Of a total amount of 14 tons of discards, 520 kg consisted of beheaded, gutted and skinned *Lophius*, which is 3.7% of the total catch. Unfortunately the weight of these fishes was not recorded before treatment. If we apply a rough estimate of 30% remaining after treatment, we estimate the weight to increase to around 1 560 kg. *Lophius* will form around 10% of the total catch.

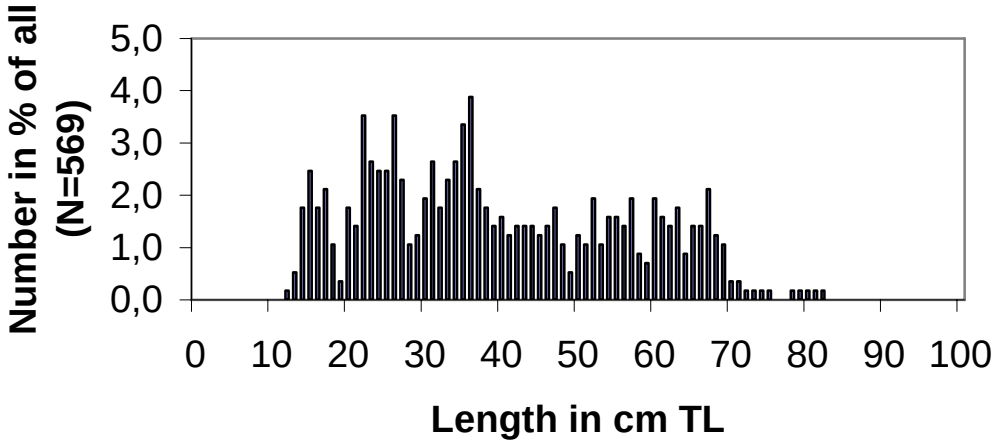


Fig. 2. Length frequency of Lophius budegassa taken as bycatch in the deep-see Alistado shrimp fisheries of Mauritania (August 2005)

The length frequency distribution shows that all fishes below 10 cm are lacking, as they most likely pass through the 50 mm codend. While *Lophius budegassa* can reach 100 cm TL (total length), fishes above 70 cm are rare and the majority is below 50 cm.

The second important bycatch of the deep-sea shrimp fisheries are crabs. The only crab species that was kept onboard was *Geryon longipes*. *Paromola cuvieri* was discarded. Most *Geryon longipes* males were less than 80 mm carapax width, but some larger individuals were found.

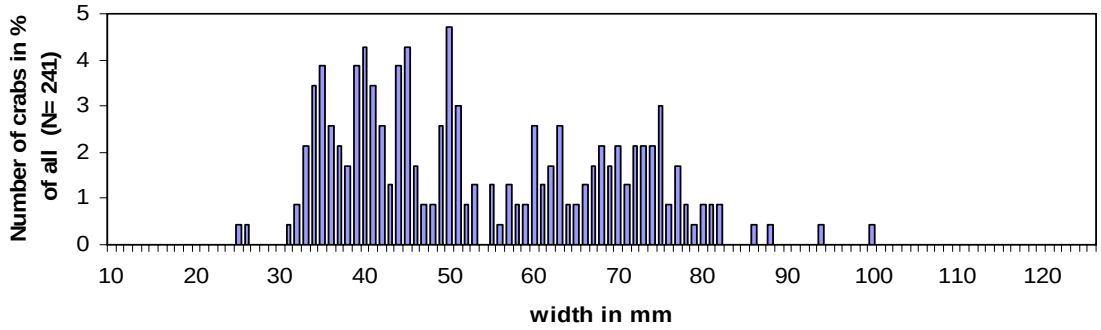


Fig. 3. Length frequency distribution of 524 crabs Geryon spp in the deep see shrimp fisheries of Mauritania. Carapax width measured in mm.

4.2. The shrimp fishery for Gamba (200 – 400 m deep)

The species composition for the medium deep-water Gamba fishery is given in Annex 2 and is based on 34 recorded hauls and a combined sample weight of 2 025 kg, representing a total of 20 545 kg discards.

Hake is the most common discard species in the Gamba shrimp fisheries viz. *Merluccius polli* (14.8%) and *Merluccius senegalensis* (2.4%), in total 17.2% or 3 579 ton of hake of the total discards of 20 809 tonnes. The total catch of the specialized hake fisheries in 2004 was 9 396 ton. The discards of hake in the Gamba fisheries therefore constituted 38% of the total landings in the specialized hake fishery.

The most common species, *Merluccius polli,* can reach a body length of 87 cm TL. The recorded length frequency of the discards in the Gamba fisheries does not surpass 40 cm, while the majority of the fish are below the size of first spawning (30 cm TL). (Fig 4.)

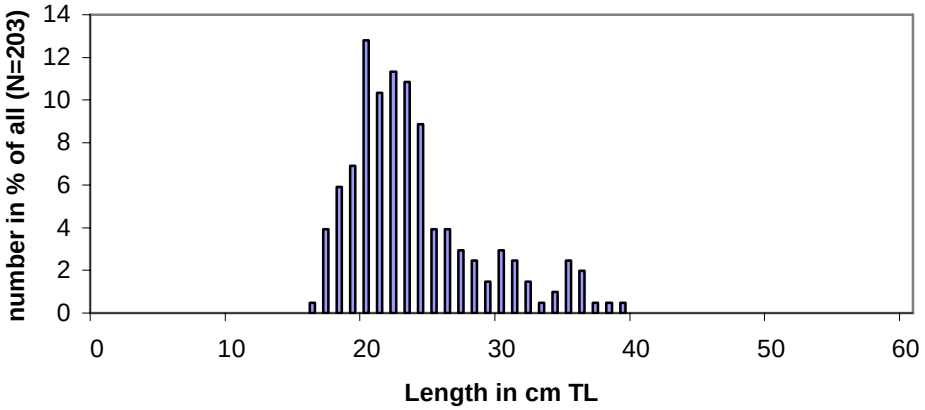


Fig. 4. Length frequency of discarded Merluccius polli in the Mauritanian Gamba fisheries

Merluccius senegalensis can reach a body length of 130 cm, but the discards in the Gamba fisheries are all below 56 cm TL, with the majority of the fish below 45 cm TL. As the size at

first maturity for *M. senegalensis* is around 30 cm TL, this means that almost all discards for this species are below first spawning size.

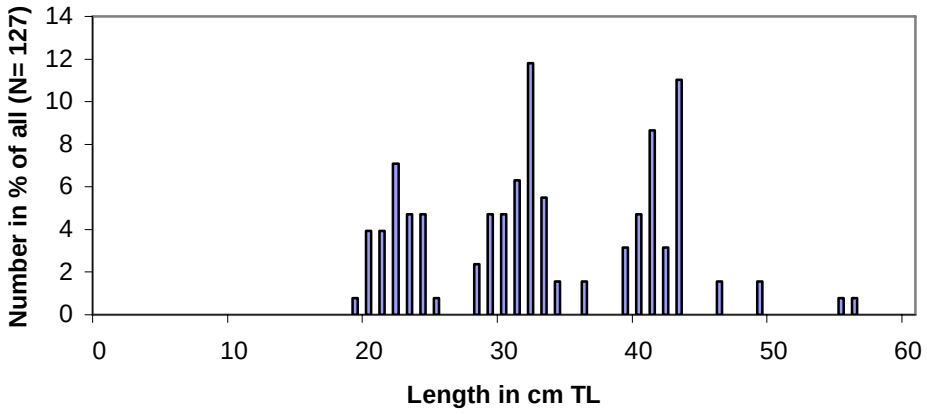


Fig. 5. Length frequency of discarded Merluccius senegalensis in the Mauritanian Gamba fisheries

A second important species is *Brotula barbata*, which contributes 11.5% to the discards. This corresponds to an absolute quantity of 2 393 ton of fish discarded. There are no detailed figures for the total landings of *Brotula* available for as these landings are included in a lumped category with other species. We cannot calculate, therefore, the ratio between discards in the gamba fisheries and the landings in other fisheries according to logbooks.
From the length frequency distribution it can be seen that the majority of the discarded fishes are below 45 cm and probably have not yet reproduced. *B. barbata* my reach 130 cm TL.

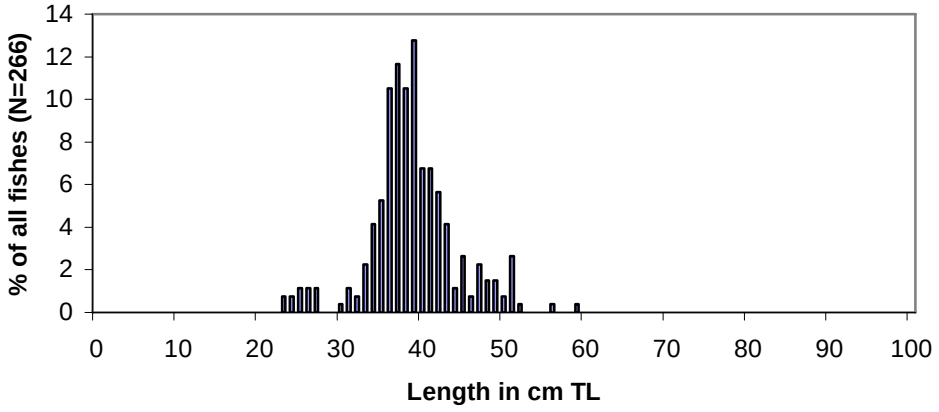


Fig. 6. Length frequency of discarded Brotula barbata in the Mauritanian Gamba fisheries

Zenopsis conchifer and *Zeus faber* are both valuable commercial fishes of another species type (Zeidae) and body shape. They represent respectively 5.8 % and 0.8 % of the total discards which corresponds to an estimated total quantity of 1 332 tons.

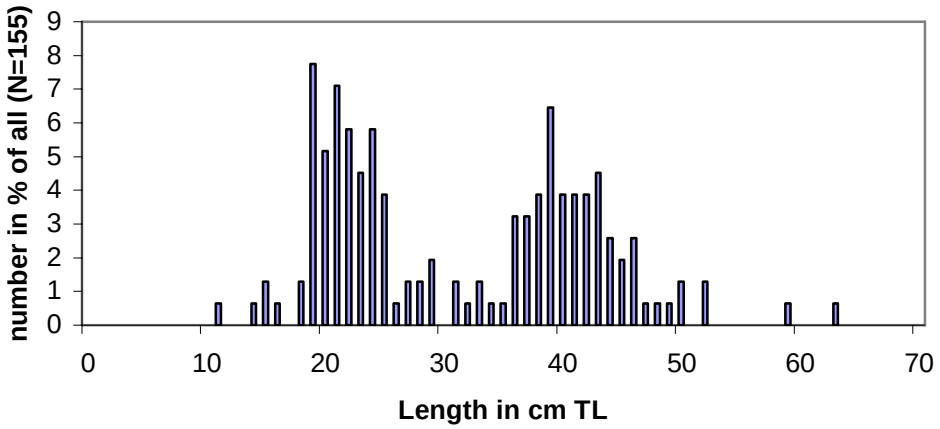


Fig. 7. Length frequency of Zenopsis conchifer in the Mauritanian Gamba fisheries

Zeus faber and *Zenopsis conchifer* can both reach a body length of 75 cm, while almost all fishes that are discarded in the gamba fisheries are below 50 cm. There even seem to be two length cohorts/ year classes. The number of measured individuals of Zeus faber is too small to be depicted but they fall within the same range.

4.3. The shrimp fishery for Langostino (30 – 70 m deep)

The species composition for the shallow water Langostino fisheries is given in Annex 3. It is based on 121 recorded hauls and a combined sample weight of 3 439 kg representing a total of 46 851 kg discards.

A total of over 178 species was recorded. The exact number is difficult to give due to taxonomic uncertainties and misidentifications. The majority of the species is however well known to the observers. The most remarkable aspect is the low contribution of each of the species to the total catch, with the exception of one, which surpasses the 10%: *Pagellus bellottii*.

The three most expensive fishes (species groups) in the Langostino shrimp fisheries are:

- Sparidae are one of the most valuable species groups. They form 21.4% of the total discards, corresponding to 2 025 tons of fish.
- Haemulidae, which form 9.6% of the total discards, corresponding to 908.5 ton rejected fish.
- Groupers, the most expensive fishes, form 0.34 %, which corresponds to 32.2 tons a year.

Pagellus bellottii (Sparidae) forms 15.1% of all discards in the Langostino fisheries. This corresponds to 1 429 tons of fish which is thrown overboard.

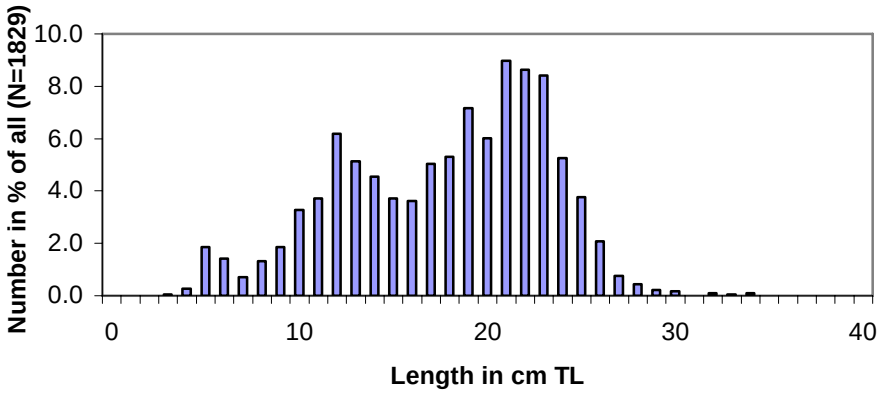


Fig. 8. Length frequency of Pagellus bellottii in the Mauritanian Langostino fisheries

Pagellus bellottii can reach a maximum length of 40 cm. From the length frequency distribution of the discards, it is seen that fishes above 30 cm are rare, while the bulk of the fishes is below 25 cm TL.
Among the Sparidae, *Pagrus (Sparus) caeruleostictus* is the most valuable species, which can reach a maximum length of 70 cm. In the discards of the Langostino fisheries almost all fishes are juveniles <30 cm.

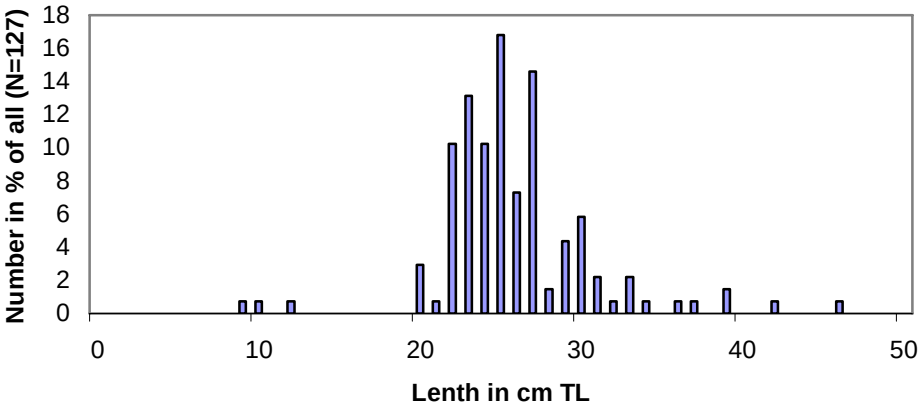


Fig. 9. Length frequency of Pagrus (Sparus) caeruleostictus in the Mauritanian Langostino fisheries

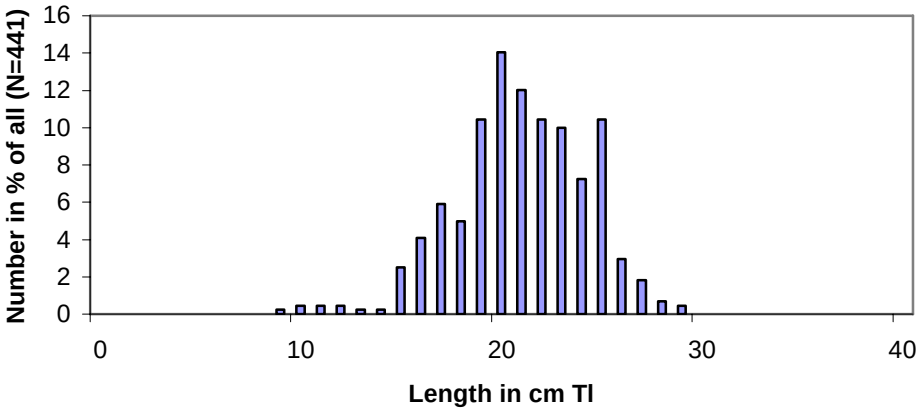


Fig. 10. Length frequency of Pomadasys incisus in the Mauritanian Langostino fisheries

Pomadasys incisus is the most common and the smallest of the Heamulidae in the Langostino fisheries. Maximum length is 30 cm and fish up to this size are found in the Langostino fisheries. The other *Pomadasys* species reach far bigger lengths but are less abundant.

Maigre, *Argyrosomus regius*, is the largest of the Sciaenidae. The largest specimen found by the senior author in Mauritania was 167 cm. Very large fishes are occasionally found in the discards of the Langostino fisheries as can be seen from Fig 11. However, the great majority of the fishes are below 40 cm and immature. *Argyrosomus regius* forms 2.3% of the total discards, corresponding to 217.7 tons.

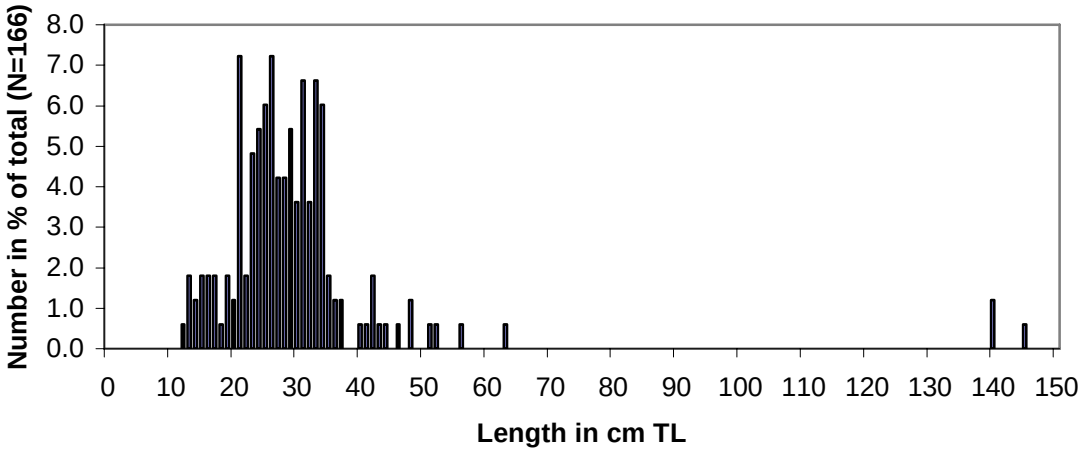


Fig. 11. Length frequency of Argyrosomus regius in the Mauritanian Langostino fisheries

As we saw earlier, *Brotula barbata* was an important component of the deepwater gamba fisheries. In the Langostino fisheries it constitutes 0.75% of the total discards amounting to 71 tons. From the length frequency distribution of *B. barbata* in the Langostino fisheries it can be seen that these fishes consist almost entirely of juveniles below 30 cm TL

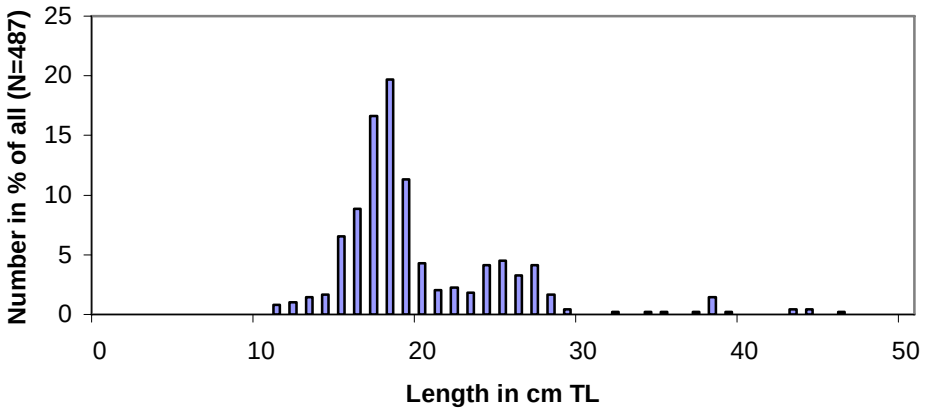


Fig. 12. Length frequency of Brotula barbata in the Mauritanian Langostino fisheries

Small pelagics form 16.7% of the discards in the Langostino fisheries. This corresponds to a total weight of 1 580.4 tons. Of the total landings of 761,165 tons of small pelagics in 2004, this is only 0,2%.
The main species (group) of small pelagics were the horse mackerel. From the length composition in Fig 13 it can be seen that these are almost all juveniles.

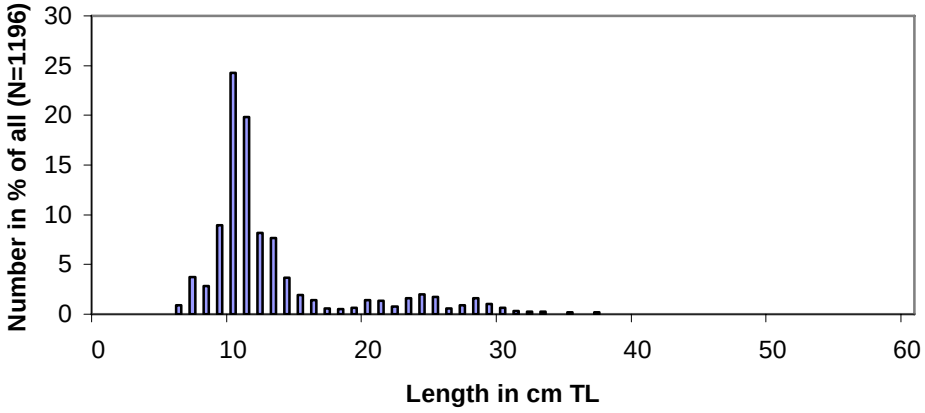


Fig. 13. Length frequency of horse mackerel in the Mauritanian Langostino fisheries

Trichiurus lepturus is another pelagic fish that is caught in the Langostino shrimp fisheries. It constitutes 3% of the total discards, corresponding to 284 tons. Over half of these fishes are juveniles below 50 cm (Fig 14).

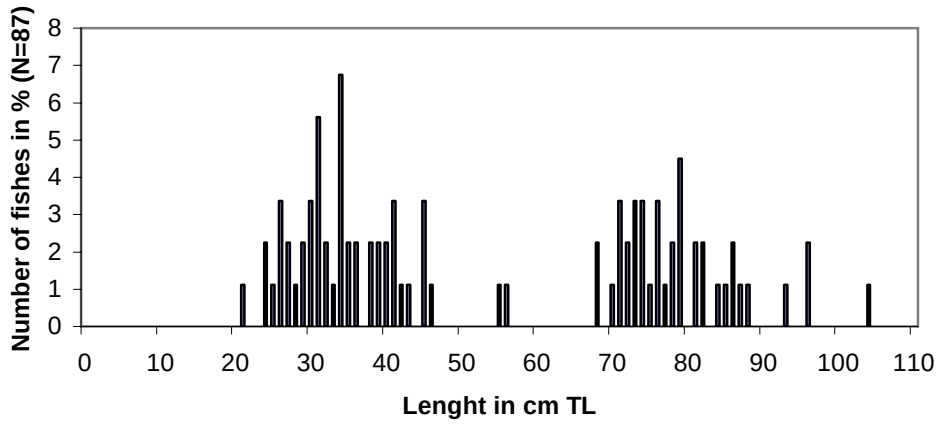


Fig. 14. Length frequency of Trichiurus lepturus in the Mauritanian Langostino fisheries

A specialized industrial fishery targeting flatfish does not exist in Mauritania. Still these are valuable species, targeted by fishermen in the "poisson" fisheries.
The discards of the Langostino fisheries comprise 6% flat fish, corresponding to a total amount of 567.8 tons. Soles (*Solea*), Tongue soles (*Cynoglossus*) and Spiny turbot (*Psettodus*) are the most important species groups.

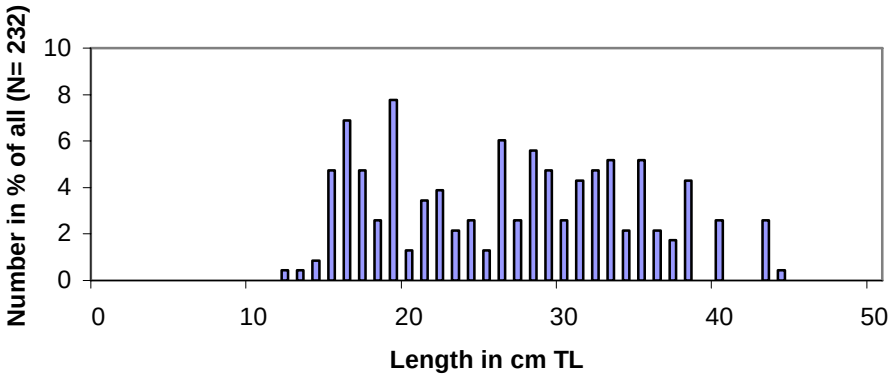


Fig. 15. Length frequency of Solea senegalensis and S. vulgaris in the Mauritanian Langostino fisheries

Solea senegalensis and *S. vulgaris* are difficult to distinguish but both species may reach a size of 70 cm. For that reason the length frequency distribution of both species are combined.
Small fishes below 12 cm are not found in the discards.

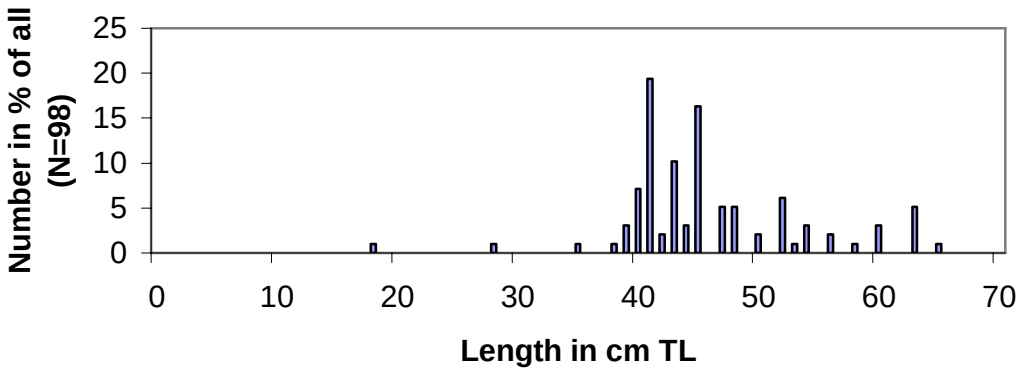


Fig. 16. Length frequency of Cynoglossus spp in the Mauritanian Langostino fisheries

Tongue soles of the *Cynoglossus* species group are difficult to identify to the species level and are therefore lumped. From Fig. 16 can be seen that small fishes (<40 cm TL) are scarce.

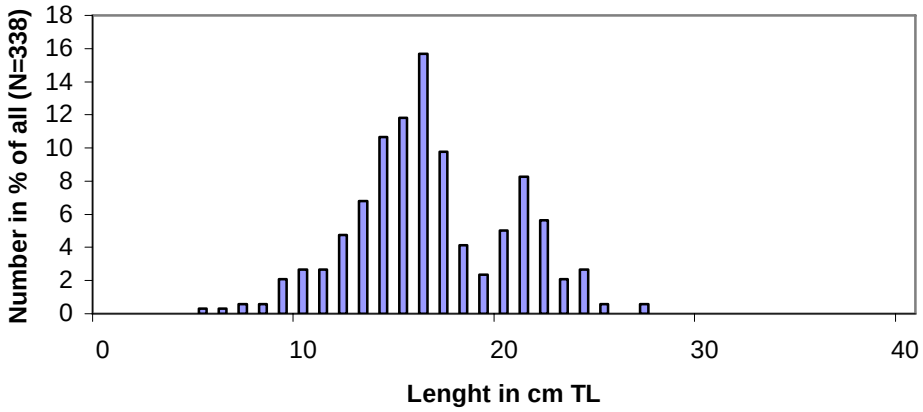


Fig. 17. Length frequency of Dicologoglossa cuneata in the Mauritanian Langostino fisheries

Discards of the wedge sole, *Dicologoglossa cuneata*, which can reach 30 cm TL, had a length range from 5 to 28 cm. A discard percentage of 1.5% corresponds to 142 ton of discards for this small but valuable sole.

Psettodes belcheri is a large turbot, which can reach over 100 cm TL. The number of measured fishes is small (31). They range from 32 to 52 cm. A discard percentage of 1.1 % corresponds to 104 ton of discards.

Pseudupeneus prayensis is an expensive species that forms 1.5% of the discards, which corresponds to 142 tons. Fishes can reach 50 cm, but the majority of the discards is between 15 and 25 cm TL.

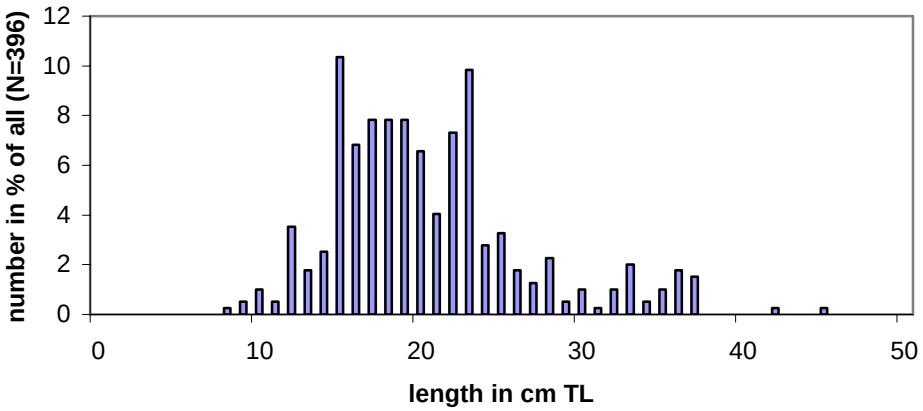


Fig. 18. Length frequency of Pseudupeneus prayensis in the Mauritanian Langostino fisheries

5. Discussion and Conclusions

Despite the fact that the industrial fishing vessels with a shrimp license are allowed to land 15% cephalopods and 20% fish as part of their total catch, most shrimp trawlers discard all fish and only preserve cephalopods for landings. Only incidentally the most expensive fish are preserved. The explanation given to us was that shrimp trawlers are not equipped for storage of fish, or for quick freezing of fish. This results in a large amount of valuable fish that is –dead– returned to sea.

In this survey we were able to estimate the amount of discards in the Mauritanian shrimp fisheries. This ranges from 80.7% to 86.4% in weight, depending on the target species of the fishery. In total we estimate an amount of 31 516 metric tons of discarded fish compared to the landings of 5 363 tons of shrimps for the year 2004.

Among the discards are commercial species some of which have a high economic value. Among the discarded fish the contribution of commercial valuable demersal species to the total catch ranges from 57.1% to 55.0% for the two most important shrimp fisheries.

From Fig 1 can be seen that the three different shrimp fisheries take place in different fishing zones. These zones are principally based on nearby reproduction and nursery areas and depth preferences for the adult shrimps. For the northern stock this is the zone just west of the Banc d'Arguin and for the southern stock the zones near the mouth of the River Senegal.

The fish species, which have an (almost) identical spatial distribution as the distribution of the target shrimp species, are most vulnerable.

Hake (*Merluccius* spp) is a good example of such a species where the shrimp fishery is likely to have a significant effect on the exploitation level; the shrimp fishery has large quantities of discards and moreover, almost all of the discarded hake are immature. We estimated that the total discards produced by the shrimp fishery, was 38 % of the total hake landings in Mauritania.
Although we have no data on the total landings of *Brotula barbata*, we presume that, as for hake, the same applies for this species.

This does not mean that species with a (major) distribution pattern outside the shrimp fishery zones are not vulnerable to the shrimp exploitation. Many species are migratory species and fill vacant places in the swept area of the commercial shrimp fishing zones.
This might be the case for species from the Sparidae and Haemulidae groups or *Pseudupeneus prayensis.*

Species with a distribution pattern where specific length (age) groups are present in the shrimp exploitation zones are also influenced in their abundance.
This is e.g. the case with *Argyrosomus regius*, where a large part of juveniles is caught. *Psettodes belcheri* is likely affected in the same way.
Soles and tongue soles show the opposite pattern, with only the larger individuals being caught and the small fishes being scarce. This is not due to a poor catchability since small specimens of *Dicologoglossa cuneata* are being caught.

In general we conclude that the shrimp fishery in Mauritania
1). Catches a large amount of valuable fish that is not landed;
2). Interferes with other fisheries;
3). Is likely to have a significant effect on the abundance of other commercial species.

The amount of discards in the Mauritanian shrimp fisheries could possibly be reduced by applying selective gears. One of the options would be the introduction of specialized shrimp

traps in the artisanal fishery in Mauritania. In the industrial fisheries selective grids could be introduced, which could reduce the by-catch as well as the discards.

Such methods are expected to have a positive effect on the fisheries for hake and round-fish as well as on other fisheries.

Signature: _____

Date: October 2006

Appendix 1

Species composition in % of total measured catches in the deepwater shrimp fisheries targeting for *Aristeus varidens*

Species	Contribution by weight in %	Presence over all recorded catches in %
Nezumia aquelis	54.1	100
Guenterus altivela	9.0	90
Centrophorus uyato	7.5	95
Octopus vulgaris	5.3	95
Trachyrhynchus trachyrhynchus	4.5	95
Ceratoscopelis maderensis	3.9	90
Illex coindetti	3.9	90
Hoplostethus mediterraneus	2.9	95
Ophictidae	2.0	75
Lophius budegassa	2.0	70
Rajidae	1.7	75
Lampanyctes crocodillus	1.0	45
Dasyatis spp.	0.8	25
Merluccius spp.	0.8	30
Aphanopus carbo	0.5	30
Paramola cuvieri	0.1	5
Chlorophtalmus atlanticus	0.0	10
Heterocarpus ensifer	0.0	5
Sépiolidae	0.0	5
Rossia macrosoma	0.0	20

Appendix 2

Species composition in % of total measured catches in the deepwater shrimp fisheries targeting for *Parapenaeus longirostris*

Species	Contribution by weight in %	Presence over all recorded catches in %
Merluccius polli	14.8	82.4
Brotula barbata	11.5	100.0
Helicolenus decadactylus	9.9	100.0
Munidae	7.7	97.1
Lopius	6.1	82.4
Zenopsis conchifer	5.8	76.5
Coeloryhnchus coeloryhnchus	5.7	64.7
Synagrops microlepis	4.9	61.8
Raja spp	4.2	20.6
Hoplostetus mediterraneus	4.0	88.2
Chlorophtalmus agassizi	2.6	76.5
Merlucius senegalensis	2.4	44.1
Palinurus spp	2.2	8.8
Trachurus trecae	2.2	47.1
Trachyrhynchus trachyrhynchus	1.7	41.2
Scorpena spp	1.6	64.7
Calappa spp	1.3	58.8
Galeus atlanticus	0.9	26.5
Zeus faber	0.8	8.8
Chloropthalmus atlanticus	0.8	26.5
Trachurus trachurus	0.7	20.6
Ruvettus pretiosus	0.7	2.9
Umbrina canariensis	0.6	5.9
Parapandalus naval	0.6	14.7
Ceratoscopelus maderensis	0.6	70.6
Elops lacerta	0.5	23.5
Pagellus bellottii	0.4	14.7
Trichurus lepturus	0.4	26.5
Galate	0.4	2.9
Ilex coindeti	0.4	11.8
Pomatomus saltator	0.3	5.9
Crabes	0.3	17.6
Pterothrissus belloci	0.3	17.6
Lepidotrigla	0.2	11.8
Malacocephalus occientalus	0.2	11.8
Octopus vulgarus	0.2	20.6
Squilla mantis	0.2	32.4
Pontinus kuhli	0.2	20.6
Trachunus draco	0.1	23.5
Spheroides spengleri	0.1	5.9
Dentex macropthalmus	0.1	17.6
Coquillage	0.1	11.8
Gonostoma atlanticum	0.1	2.9
Scomber japonicus	0.1	5.9

Epigonus telescopus	0.1	14.7
Todarodes sagittatus	0.1	14.7
Serpans	0.1	11.8
Cepola	0.1	5.9
Cybium micrurum	0.1	11.8
Pseudupeneus prayensis	0.1	5.9
Synchiropus pheton	0.1	17.6
Solea vulgarus	0.1	11.8
Peristedion cataphractum	0.1	8.8
Capros aper	0.0	8.8
Decapterus rhonchus	0.0	2.9
Gadella moraldi	0.0	11.8
Solenocera africana	0.0	8.8
Liocorcinus depuratar	0.0	5.9
Scyliorhinus stellaris	0.0	11.8
Laemonema laureysi	0.0	5.9
Anthias anthias	0.0	5.9
Michrocurus sp	0.0	11.8
Mustelus mustelus	0.0	5.9
Brachudeuterus auritis	0.0	5.9
Sepia elegans	0.0	5.9
Sardina pilchardus	0.0	5.9
Shedophilus permaco	0.0	5.9
Portunidae	0.0	2.9
Gephyroberyx darwini	0.0	2.9
Bathysolea	0.0	5.9
Belone brasiliensis	0.0	2.9
Lagocephalus laevigatus	0.0	2.9
Dicologolossa hexophtalma	0.0	2.9
Pasiphaea sivado	0.0	5.9
Ophidion barbatum	0.0	2.9

Appendix 3

Species compositions in % of total measured catch in the deepwater shrimp fisheries targeting for *Penaeus notialis*

Species	Contribution by weight in %	Presence over all recorded catches in %
Pagellus bellottii	15.1	89.3
Pomadasys spp	7.2	79.3
Galeoides decadactylus	4.5	52.9
Trachurus trecae	4.0	72.7
Diplodus spp	3.2	55.4
Arius spp	3.1	34.7
Decapterus rhonchus	3.0	49.6
Trichiurus lepturus	3.0	53.7
Rhinobatos rhinobatos	2.8	14.9
Argyrosomus regius	2.3	43.8
Calappa	2.2	46.3
Pseudotolithus senegalensis	1.9	22.3
Sparus sp	1.7	20.7
Lagocephalus lagocephalus	1.7	31.4
Mustelus mustelus	1.7	10.7
Selene dorsalis	1.6	37.2
Rhizoprionodon acutus	1.6	5.0
Squilla mantis	1.5	66.1
Pseudopeneus prayensis	1.5	52.1
Dicologoglossa cuneata	1.5	41.3
Campogramma glaycos	1.5	19.8
Brachdeuterus auratus	1.4	52.9
Sphoeroides sprengleri	1.3	59.5
Sphyraena sphyraena	1.3	19.0
Dasyatis spp	1.2	12.4
Solea spp	1.2	49.6
Syacium micrurum	1.2	37.2
Crabes non Calappa	1.1	19.0
Cymbium	1.1	20.7
Psettodes belcheri	1.1	16.5
Sardinella aurita	1.0	23.1
Sardina pilchardus	1.0	27.3
Plectorhyncus mediterranus	1.0	21.5
Raja spp	1.0	24.0
Lithognathus mormyrus	1.0	16.5
Congre	0.8	4.1
Brotula barbata	0.8	25.6
Chloroscombrus chrysurus	0.7	22.3
Stromateus fiatola	0.7	7.4
Uranoscopus spp	0.7	24.0
Chilomycterus spinosus	0.7	9.1
Halobatrachus didactylus	0.6	12.4
Sepia officinalis	0.6	32.2
Pomatomys saltatrix	0.6	9.1

Trigla lyra	0.5	21.5
Torpedo torpedo	0.5	24.8
Zeus faber	0.4	14.0
Citharus linguatula	0.4	28.1
Chelidonichtys	0.4	5.0
Bembrops heterurus	0.4	5.0
Scorpaena spp	0.4	30.6
Gobius spp	0.4	28.9
Synagrops microlepis	0.4	5.0
Scomberomorus tritor	0.3	0.8
Chaetodipterus gorrensis	0.3	2.5
Octopus vulgarus	0.3	18.2
Synaptura lusitanica	0.3	6.6
Nicholsina usta	0.3	10.7
Pteroscion peli	0.3	14.9
Dicentrarchus punctatus	0.3	5.8
Epinephelus guaza	0.3	13.2
Sardinella maderensis	0.2	9.1
Fistularia tabacaria	0.2	17.4
Spondylosoma cantharus	0.2	12.4
Trachurus trachurus	0.2	6.6
Leptocharias smithii	0.2	8.3
Cepola macrophtalma	0.2	21.5
Grammoplites gruveli	0.2	14.0
Dentex sp	0.2	19.0
Umbrina canariensis	0.2	17.4
Zanobatus atlanticus	0.2	5.8
Eucinostomus melanostomus	0.2	6.6
Priacanthus arenatus	0.2	9.9
Ephippion guttifer	0.2	6.6
Gerres	0.2	4.1
Cynoglossus spp	0.1	9.1
Lepidotrigla	0.1	11.6
Microchirus sp	0.1	13.2
Aluterus blankerti	0.1	2.5
Sarda sarda	0.1	2.5
Holothuridae	0.1	3.3
Palaemon serratus	0.1	9.9
Labridae spp	0.1	3.3
Mycteroperca rubra	0.1	5.0
Ophisurus serpens	0.1	6.6
Arnoglossus imperialis	0.1	5.8
Scyllaridae	0.1	9.9
Ariosoma balearicum	0.1	0.8
Stephanolepis hispidus	0.1	1.7
Anguilla spp	0.1	7.4
Alectis alexandrinus	0.1	3.3
Rhinoptera marginata	0.1	0.8
Xyrichtys novacula	0.0	4.1
Branchiostegus semifasiatus	0.0	5.0
Boops boops	0.0	9.1

Serranus scriba	0.0	9.9
Dactylopterus volitans	0.0	3.3
Antenarius sp	0.0	5.0
Monocanthidae	0.0	0.8
Bothus podas	0.0	9.1
Pegusa lascaris	0.0	0.8
Arenatus acantharus	0.0	0.8
Loligo vulgaris	0.0	7.4
Carcharhinus falciformis	0.0	0.8
Aristeus antennatus	0.0	5.0
Syngnathidae	0.0	2.5
Mugil spp	0.0	1.7
Capro aper	0.0	1.7
Gymnura altavela	0.0	2.5
Exocete	0.0	0.8
Pontinus kuhli	0.0	3.3
Sparisoma rubripine	0.0	0.8
Callionymus phaeton	0.0	1.7
Chaetodon hoefleri	0.0	0.8
Paragaleus pectoralis	0.0	2.5
Trachinus draco	0.0	5.0
Pterothrissus belloci	0.0	0.8
Hemiramphus brasiliensis	0.0	0.8
Rypticus saponaceus	0.0	1.7
Scomber japonicus	0.0	0.8
Balistes spp	0.0	1.7
Scycionia sp	0.0	2.5
Bathysolea	0.0	0.8
Parapristipoma octoliniatum	0.0	0.8
Engraulis engrassicolus	0.0	1.7
Platycepahalus indicus	0.0	1.7
Channomuraena vittata	0.0	0.8
Cephalopholus taeniops	0.0	0.8
Anthias anthias	0.0	0.8
Zevaia theophilla	0.0	0.8
Solenocera africana	0.0	1.7
Muraena helena	0.0	0.8