Annex 4.

Note on the selectivity of common octopus Octopus vulgaris from data of demersal survey

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1. Introduction

The selectivity of trawl net is essentially determined by the mesh size. It results in the variation of capture sizes by species according to their morphological characteristics.

The common octopus is a species of which body is not sustained by a rigid skeleton and the determination of sizes of this species caught by a given mesh size adds the complexity to the problem.

The present note aims an evaluation of capture sizes for the common octopus in Mauritania by a bottom trawl net of 70mm mesh size which correspondes the authorized one for the industrial trawlers targeting this species.

2. Material and method

The treated data originate from two surveys organized in May and September 2001 with R/V *Al-Awam* in the sutudy for the fisheries resources management plan in Mauritania. R/V *Al-Awam* of IMROP[1] is a trawler whose total length is 36.17m and the gross tonnage of 301. The R/V fishes with trawl net comprising six faces of polyethylene, of Japanese conception.

The method used during the two surveys is the double cod-end one and consist of utilization of a cod-end of trawl net of large mesh size (70mm) maintained and covered by another cod-end of small mesh size (20mm).

The trawling time and speed at the operations of fishing with this gear are respectively of 30 minutes and 3.2 knots.

The parameter used for the selectivity of the common octopus *Octopus vulgaris* is the total weight of individuals in grams.

One supposes that retention within interval of weight is considered 0 at the initial weight (P_O-1) and maximal to the maximal weight (P_F +1). That is to say, the catchability for the 70mm mesh size is 0 at the smallest classes of size and maximal at the large classes.

The software CurveExpert (1993) was used to realize the different types of adjustements of data to the theoretical curves and to select the most effective ones.

[1] Institute Mauritanien des Recherches Océanographiques et des Pêches.

3. Results and discussion

Table 1 shows the descriptive statistics (means, modes, standard deviation etc.) of catches of the common octopus in the different mesh sizes (20 and 70mm; mixed and total).

Results must be considered with precaution because of the small number of individuals (19) passing through the mesh of 70mm. Results led the conclusion that the P_{50} [2] and the P_{75} [3] are respectively 400g and 600g for individuals caught by the mesh of 70mm.

Table 1 Descriptive statistics of sizes (in gram) caught by types of mesh size used at *demersal surveys in 2001.*

Type of mesh	number	Mean	Median	Sum	1st Quartile	3rd Quartile	Range	Quartile Range
20mm	19	487	500	9250	250	750	750	500
70mm	155	1763	1500	273250	1000	2250	6750	1250
Mixed	636	914	750	581000	500	1250	5500	750
Total	810	1066	750	863500	500	1250	6750	750

Table 2 gives the retention ratio by center of the weight class, calculating cumulatively on all trawl stations with presence of the common octopus.

Table 2 Catch in number of the common octopus by weight class and the retention ratio.

	Catch in number		Total catch	Retention
Center of weight class	20mm	70mm	in number	ratio
125	7	2	9	0.222
375	7	6	13	0.462
625	4	9	13	0.692
875	1	25	26	0.962
1125	0	26	26	1.000
1375	0	20	20	1.000
1625	0	11	11	1.000
1875	0	11	11	1.000
2125	0	14	14	1.000
2375	0	11	11	1.000
2625	0	5	5	1.000
2875	0	3	3	1.000
3125	0	1	1	1.000
3375	0	5	5	1.000
3625	0	1	1	1.000

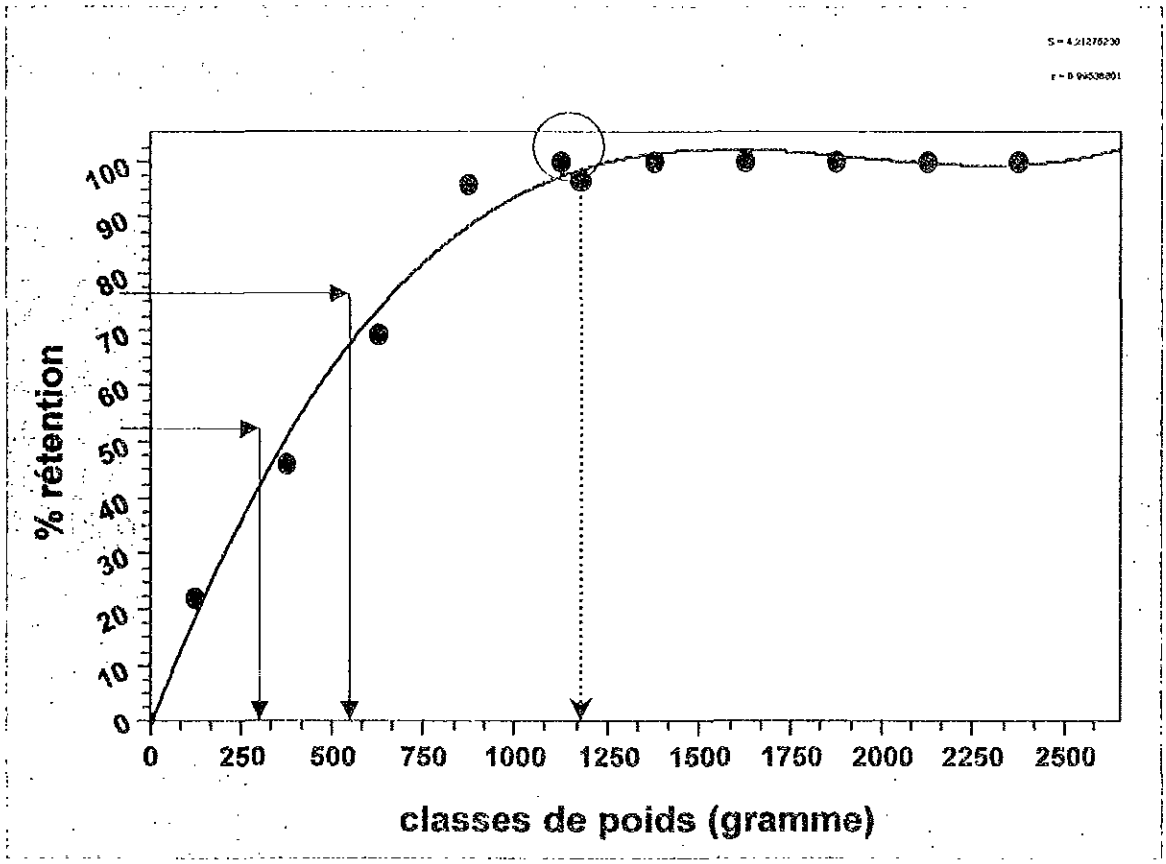
The software CurveExpert permitting to make several types of ajustements of which best was the one of the polynomial model has a cubic equation: $y=a+bx+cx^2+dx^3$.

While fixing Y = P (center of weight class) and x = p (retention ratio at each interval of weight), the

[2] Weight corresponding to 50% of individuals caught.
[3] Weight corresponding to 75% of individuals caught.

coefficients calculated on the basis of table 2 are:

a = -0.52968536
b = 0.16952046
c = -9.1023202e-005
d = 1.5730407e-008
Standard error: 4.2127523
Correlation coefficient: 0.9953869



Retention ratio (%)

Class of weight in g.

To compare our results with those of the other studies carried out in the region and that have used the mantle length as a parameter instead of the weight, a length (L_m) - weight (P) relation has been established by using the same software:

$L_m=a*P^b$

where

a = 10.142475
b = 0.36313684
Standard error: 16.1855461
Correlation coefficient: 0.9170034

With this relation, the P_{50} and the P_{75} have been converted into L_M50 and L_M75 whose values correspond with 8.93 and 10.66cm respectively.

These values are comparable to those obtained in Morocco (1993) that are L_m50 = 8.99cm and L_m75 = 11.82 cm, respectively.

These results must be used as a reference. Surveys oriented on the selectivity of the common octopus must be driven to improve the quality of results.

4. References

Ariz,J. and M.A.R. Fernandez., 1980- Selection on Octopus (*Octopus vulgaris*) and Sea Breams of the Spanish Cephalopods Bottom Trawl off North West Africa. International Council for the Exploitation of the Sea C.M. 1980/K :35.

Inejih, C.A. 2000., Dynamique spatio-temporelle et biologie du poulpe (*Octopus vulgaris*) dans les eaux mauritaniennes : modélisation de l'abondance et aménagement des pêcheries. Thèse de doctorat 3eme cycle.

Sanyo Techno Marine, INC. and Overseas Agro-fisheries Consultants CO.LTD., 2002-Rapport préliminaire de « Etude pour le plan d'aménaement des ressources halieutiques en République Islamique de Mauritanie ».

CurveExpert 1.34, 1993 A curve fitting system for Windows, double precision, 32 bit package, copyright Daniel Hyams,Microsoft Corporation, 1993. Unregistred evaluation copy.

Groupe de travail Maroc – CE sur la sélectivité des chaluts de pêche aux céphalopodes :cas du poulpe (*Octopus vulgaris*). Santa Cruz de Tenerife, 23-28 Aout 1993.

5. DIAGNOSIS OF THE CURRENT STATUS OF DEMERSAL SPECIES RESOURCES

5.1 Objective

From the results of the resources survey by bottom trawl, the stock size of each species in each survey season could be estimated by means of the area-swept method. Here, with the possibility of understanding the fisheries production aimed at those stocks, the assessment of the actual conditions of resource utilization under the current scope of fisheries becomes feasible. The results of such an assessment offer objective data on subjects such as the species that can be exploited in the future and the estimation of their stock, the methodology for the utilization on each fishing ground, a reasonable distribution of fishing effort, the establishment of closed fishing seasons or restrictions on fishing gear or fishing methods.

For this reason, the objective of this chapter was to seek to get an accurate picture focused on fisheries production to the nectobenthic resources of the IRM, so as to assess the actual conditions of those resources.

5.2 Methods

The main data that could be utilized for the above-mentioned objective were: (1) past data from the Mauritanian fisheries; (2) results from the cooperative resources survey (hereinafter referred to as *cold and warm season surveys*); and (3) results from the resource surveys conducted by the CNROP aimed at periods between seasons (referred to below as *transitional period surveys*).

An outline of the information utilized in the present work – including data gathering methods, collected past data and resources survey results – is presented below.

5.2.1 Fishery statistics

Data that could be obtained on Mauritanian fisheries production included fishery statistics published by FAO[1] and those by the fishery affairs agency of the IRM. Because the total productions in the statistic published by FAO (2001) differ considerably from those issued by DEARH, it was concluded that those numbers would not help in allowing for a diagnosis of the current status of fisheries.

However, for a summary of Mauritanian fisheries data, the report of the 4th Working Group in NDB (FAO, 1999) was utilized, as its main source of information were the results of surveys and research conducted by the CNROP.

The main sources of information on IRM fisheries production were public agencies such as DEARH, CNROP, DSPCM, SMCP, BCM, custom offices and others, each of them having made official publications. Of those, the statistics produced by the DEARH/MPEM and CNROP, counterpart agencies of this Study, were utilized as it is believed that the information published by those two institutions (see 5.4 References) represent the best data available on the current situation.

[1] In fact, the fishery statistic of FAO comprises only the catch of Mauritanian fleets, excluding the catch of foreign fleets fishing in the EEZ of the IRM.

5.2.2 Resources survey

The results of the biological survey obtained from the *cold and warm season surveys* were used as a source of biological information on the spawning and maturity stage of the target species. Also, the effect of fishing on target species resources exerted by the bottom trawl operations of industrial fisheries is thought to be overwhelmingly strong. In this chapter, the estimated stock size of the target species was calculated from the catch results of the *cold and warm season surveys*, utilizing a trawl net with a 70 mm cod-end mesh size limitation as currently regulated in the IRM. Therefore, the estimated stock size shows a catchable stock size.

In addition, throughout the study period, the CNROP conducted three *transitional period surveys*. In order to consolidate the stock size estimated from basic information obtained in both kinds of survey, the many data collected by the *transitional period surveys* was analyzed through the methodology described in Chapter 3. These results referred to the two-year period between 2000 and 2001, and the actual picture of short-term changes in stock size could be quantitatively studied.

5.3 Results

5.3.1 Actual status of the Mauritanian fisheries

In order to correctly evaluate the current situation of fishery resources in the EEZ of Mauritania, it is necessary to known the reality of fisheries as practiced in that zone. Based on the Report on the 4th Working Group of the CNROP here, the structure, production and trends of IRM's fisheries are summarized below.

Fishery resources there are being caught and utilized by artisanal and industrial fisheries.

Artisanal fisheries is generally divided into two categories. One is practiced in the PNBA, where motorboats are prohibited, with sailboats of Canary type. The other is operated along the coast with pirogues made of wood, aluminum, plastic or metal and equipped with engines of under 200 HP. The number of unpowered vessels has tended to remain stable, but that of motorized pirogues is said to have quadrupled in the seven years period between 1991 and 1997. Such a rapid expansion of motorized pirogues in recent years makes the artisanal fisheries subsector the main one in the fisheries sector of the IRM. Main fishing gears employed in the artisanal fisheries are octopus pot, gill net and hand line. Key species captured include: octopuses, lobsters, groupers, sea breams, rays and sharks, mullets, etc., which are highly valued in the commerce. Since 1989, a fluctuation in catch with a tendency toward decline was observed for octopuses, lobsters, croakers, rays and sharks.

Industrial fisheries generally utilize either iced storage vessels or freezer vessels[2] to preserve their catch products. A historical topic points to European vessels fishing demersal species in the region since the beginning of the 20th century, Japanese fleets hunting cephalopods in the 1960s, South Korean fleets entering the area in 1976, followed by a complete withdrawal of the Japanese in 1983. In the 1980s, fleets from South Korea, Spain, Libya, etc., that had been operating there previously started hiring

[2] This division is currently inadequate, as there is no much difference in performance and target species between iced storage vessels and freezer vessels (Inejih, 1997). However, since the available cumulative statistical data does conform to this classification, the latter is adopted here as well.

original crewmen and became IRM vessels. By the end of the 1980s, most iced storage vessels and freezer vessels were nationalized. Later, European fleets targeting demersal fishes started fishing there again, supported by the 1995 agreement between the IRM and the EU. As for fleet size in recent years, most of the freezer vessels are Mauritanian, followed by Spanish ones. Most of iced storage vessels are Mauritanian. Also, as for the main fishing area, the European fleets that are there since 1995 operate mostly in the central and southern zones, while Mauritanian vessels do so especially in northern waters. The increase in the fishing vessels led to a steady decline in landing volume that was particularly acute in octopus catches, and not a few freezer vessels have switched to capturing demersal fishes instead. Since 1995, the European fleets do not land their products in the IRM territory and thus the statistical data are not regularly provided.

5.3.2 Fluctuation of fisheries production by artisanal and industrial fisheries

According to the DEARH fishery statistics (ONS, 2001), total fisheries production of the IRM in the fifteen-year period from 1986 to 2000 varied from a minimum of 306,334 tonnes in 1994 to a maximum of 644,942 tonnes in 1998. A declining trend of the production was observed from 1986 to 1994, followed on the contrary by an increase from 1995 to 1998, then again a drop since 1999.

The production of artisanal fisheries was between 10,427 tonnes in 1990 and 22,236 tonnes in 1996, that is, between 2% and 5% of the total fisheries production. On the other hand, industrial fisheries made up for 95% to 98% of the total production (see Figure 5.1, Table 5.1).

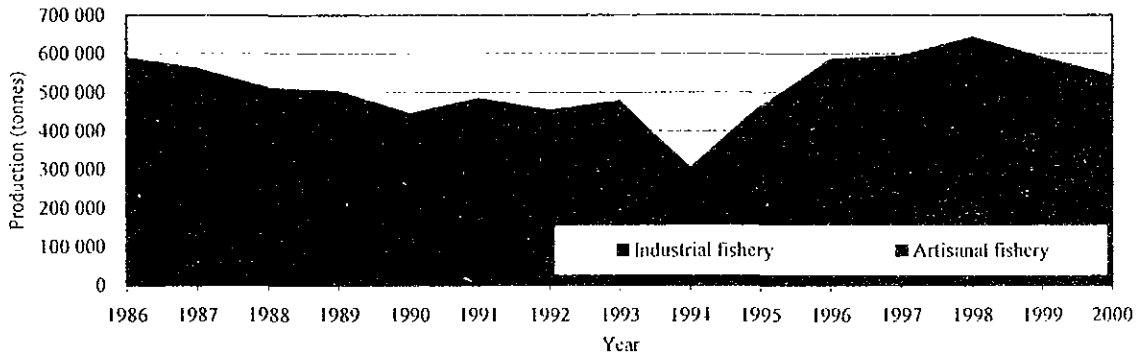


Figure 5.1 Fluctuation of annual production by artisanal and industrial fisheries *in the 1986–2000 period.*

Freezer and iced storage trawlers that capture demersal fish and cephalopod resources corresponding to the target species in this study were examined in detail. In the 1986-2000 periods, production of those two vessel categories varied from a minimum value of 20,471 tonnes in 1999 to a peak of 69,703 tonnes in 1987, making up for 3% - 14% of the industrial fisheries production with declining its ratio in recent six years. The combined production of those two vessel types suffered an annual decline from the 60,000 - 70,000 tonnes caught in 1986 and 1987 to a level of 20,000 tonnes in 2000. This decrease is due to the annual drop in production by freezer trawlers (see Fig. 5.2, Table 5.1).

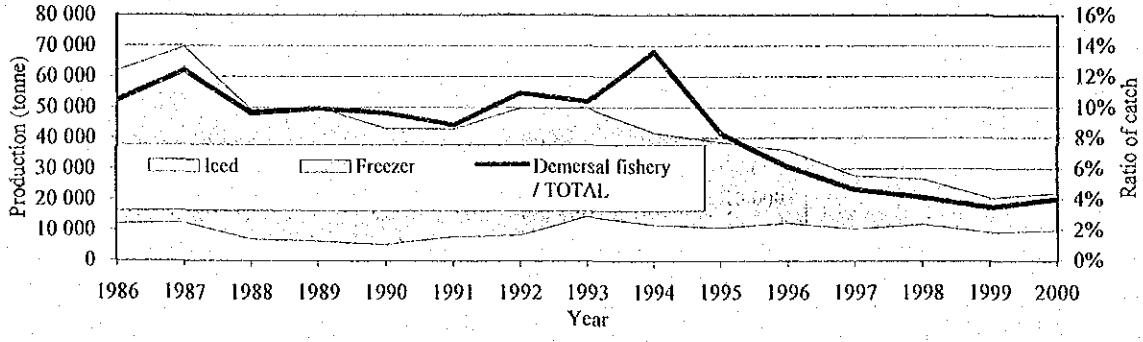


Figure 5.2 Fluctuation of annual industrial fisheries production in the 1986-2000 period.

Table 5.1 Annual fisheries production from 1986 to 2000.

Units : tonnes

	Artisanal fishery			Industrial fishery								
				Charter and authorized*								
	Traditional	Modern	Sub-total	Bottom trawler			*Pelagic fishery*	*Specialize fishery*	Sub-total	Licence	Sub-total	Total
				Iced	Freezer	Sub-total						
1986	10,000	6,000	16,000	11,900	50,000	61,900	466,500	0	528,400	46,800	575,200	591,200
1987	10,851	9,000	19,851	12,340	57,363	69,703	431,179	187	501,069	41,822	542,891	562,742
1988	12,971	9,054	22,025	6,919	42,342	49,261	408,176	200	457,637	33,130	490,767	512,792
1989	7,487	6,696	14,183	6,200	43,801	50,001	395,792	155	445,948	43,291	489,239	503,422
1990	6,187	4,240	10,427	5,145	37,891	43,036	336,288	60	379,384	57,021	436,405	446,832
1991	6,441	5,657	12,098	7,651	35,322	42,973	376,356	50	419,379	53,905	473,284	485,382
1992	7,013	8,428	15,441	8,133	41,671	49,804	367,871	90	417,765	22,584	440,349	455,790
1993	6,000	11,173	17,173	14,252	35,617	49,869	379,824	66	429,759	32,892	462,651	479,824
1994	6,657	8,671	15,328	11,535	30,148	41,683	213,634	7	255,324	35,682	291,006	306,334
1995	13,909	7,069	20,978	10,677	27,927	38,604	326,334	10	364,948	79,651	444,599	465,577
1996	12,988	9,248	22,236	12,110	23,891	36,001	465,995	12	502,008	62,807	564,815	587,051
1997	8,265	7,562	15,827	10,259	17,514	27,773	516,545	97	544,415	36,479	580,894	596,721
1998	9,653	8,390	18,043	11,773	14,962	26,735	531,782	444	558,961	67,938	626,899	644,942
1999	7,586	6,941	14,527	9,015	11,456	20,471	507,121	340	527,932	49,321	577,253	591,780
2000	11,364	8,092	19,456	9,663	12,280	21,943	458,093	364	480,400	45,069	525,469	544,925

Remarks: Data from "Profile de la Mauritanie. 2001. ONS.".
Data of Pêche artisanale from 1998 to 2000 are estimation.
* : Charter; AFFRETES, authorized; AUTORISEE.

5.3.3 Fisheries production by species

For a detailed analysis of the conditions for utilization of demersal species, it is necessary to get statistic data on each species. However, this kind of information has not been perfectly compiled in the IRM. A correspondence between the fish groups classified in published fishery statistics and the 22 target species in this study is presented in Table 5.2.

Of those, only four species of *Octopus vulgaris*, *Panulirus regius*, *Parapenaeus longirostris* and *Chaceon (Geryon) maritae*, show a perfect correspondence between the two classifications. This situation demands caution when corresponding between the two classifications except abovementioned 4 species. Also, those published statistical values correspond to volumes landed, and discards are presumably not accounted for.

Table 5.2 Correspondence of classification[3] of target species between IRM statistics and the study.

Target species	Species groups in fishery statistics	
	Name	Component
FISHES		-
Mustelus mustelus	-	-
Merluccius senegalensis	Merlus	*Merluccius* spp.
Zeus faber	-	-
Epinephelus aeneus	-	-
Argyrosomus regius	-	-
Pseudupeneus prayensis	-	-
Pagrus caeruleostictus	Dorades roses	*Dentex* spp., *Sparus* (*Pagrus*) spp., *Pagellus* spp.
Dentex angolensis		
D. canariensis		
Pagellus bellottii		
Mugil cephalus	-	-
M. capurrii	-	-
Liza aurata	-	-
Solea senegalensis	-	-
CEPHALOPODS*		
Octopus vulgaris	Poulpe	*Octopus vulgaris*
Sepia officinalis	Seiches	*Sepia* spp. and *Sepiola* spp.
Loligo vulgaris	Calamars	LOLIGINIDAE spp. and OMMASTREPHIDAE spp.
CRUSTACEA		
Panulirus regius	Langoustes	*Panulirus regius*
Palinurus mauritanicus	-	
Penaeus notialis	Langostino	*Penaeus notialis & P. kerathurus*
Parapenaeus longirostris	Gamba	*Parapenaeus longirostris*
Chaceon maritae	Geryon	*Geryon maritae*

*The other group, *divers cephalopods* compiled all cephalopods species, is found in the fishery statistic.

[3] The CNROP database of fish species for artisanal fisheries *(Correspondences des noms commerciaux et scientifiques)* is very detailed and lists 129 species. However, species-specific data on fisheries submitted by DEARH, an agency that comprises CNROP, are ultimately arranged into 24 groups.

In addition to the considerations above, the fluctuation of fisheries production of each species group in the six-year period between 1995 and 2000 is illustrated in Figures 5.3 to 5.11.

a) Hakes - Merluciidae (local designation: merlus; included target species: *Merluccius senegalensis*)

Cooperative survey results suggest the group "merlus" includes *Merluccius senegalensis* and *Merluccius polli*.

In the 1995-1998 period, the annual production of hakes declined from about 10,000 tonnes in 1995 to about 8,000 tonnes in 1998, followed on the contrary by an increase from 1999, and reached at a maximum of about 12,000 tonnes in 2000. The quarterly production tended to slightly increase in the first two quarters (January to June). The hake production did not exceed 1%–2% of the total, mostly caught by foreign-registered vessels licensed for specific fisheries (Figure 5.3).

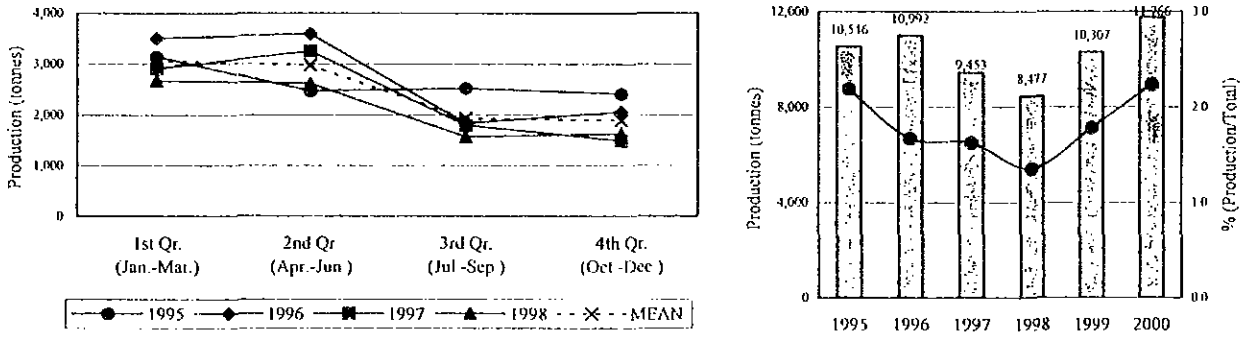


Figure 5.3 Fluctuation of the annual production of merlus from 1995 to 2000.

b) Sea breams - Sparidae (local designation: dorades roses; included target species: *Pagrus caeruleostictus, Dentex angolensis, Dentex canariensis, Pagellus bellottii*)

Cooperative survey results indicate the group "dorades roses" includes many species of the genera *Pagrus, Dentex, Diplodus* and *Pagellus*.

In the 1995-2000 periods, the annual production of sea breams[4] was at a peak of 3,489 tonnes in 1996. Since 1997, it declined and reached at a minimum of 1,368 tonnes in 2000. The quarterly production tended to slightly increase in the third quarter (July to September). The sea bream production was less than 1% of the total, but it seems that this group is caught by various fishing methods including artisanal fisheries (Figure 5.4).

[4] This production does not include by-catch of the pelagic fishery.

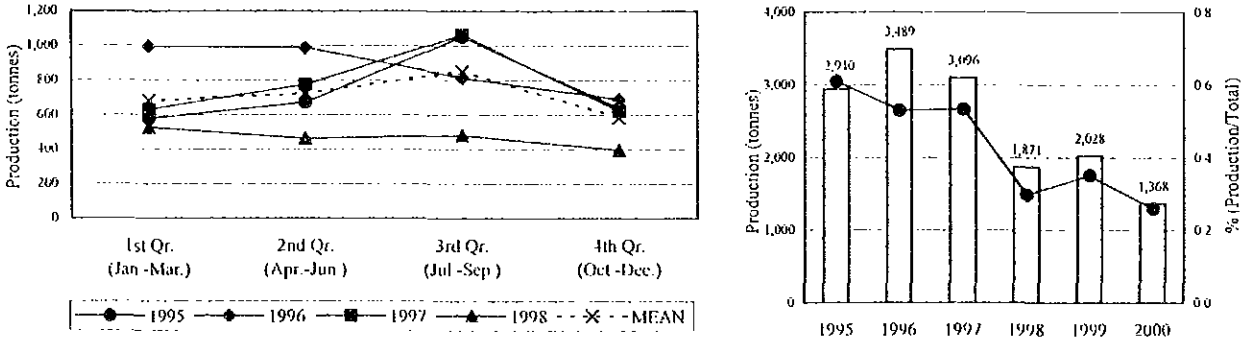


Figure 5.4 Fluctuation of the annual production of dorades roses from 1995 to 2000.

c) Squids (local designation: calamars; included target species: *Loligo vulgaris*)

Cooperative survey results indicate the group called "calamars" comprises mainly *Loligo vulgars* of Loliginidae. In fishery statistics, a certain number of species has been accounted for simply as "divers cephalopods", and the possible inclusion of squids could increase somewhat the biomass of the group.

In the 1995-2000 period, the annual production of squids was equilibrated at around 3,000 tonnes except a maximum of 4,942 tonnes in 1999. The quarterly production tended to increase in the fourth quarter (October to December). The squid production was less than 1% of the total, caught mainly by industrial trawl fisheries (unknown the catch ratio between the bottom trawler and the surface or midwater trawlers)(Figure 5.5).

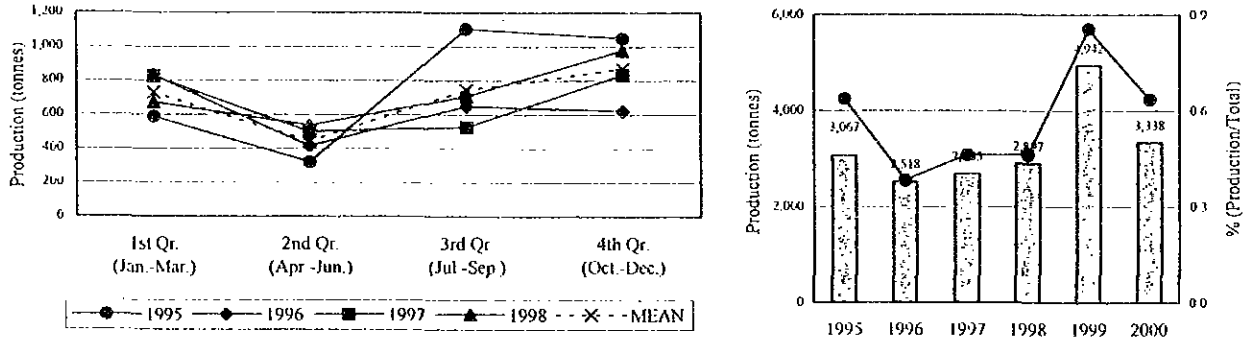


Figure 5.5 Fluctuation of the annual production of calamars from 1995 to 2000.

d) Cuttlefish (local designation: seiches; included target species: *Sepia officinalis*)

Cooperative survey results indicate the group called "seiches" includes *Sepia officinalis* and many other species of the same Genera.

In the 1995-2000 period, the annual production of cuttlefish declined every year till 1997 with a minimum of 3,038 tonnes, followed on the contrary by an increase from 1998 and reached at a peak of 5,477 tonnes in 1999. In 2000, the annual production of cuttlefish was 4,694 tonnes. The quarterly production tended to increase in the fourth quarter (October to December). The cuttlefish production was less than 1% of the total, caught mainly by industrial fisheries (Figure 5.6).

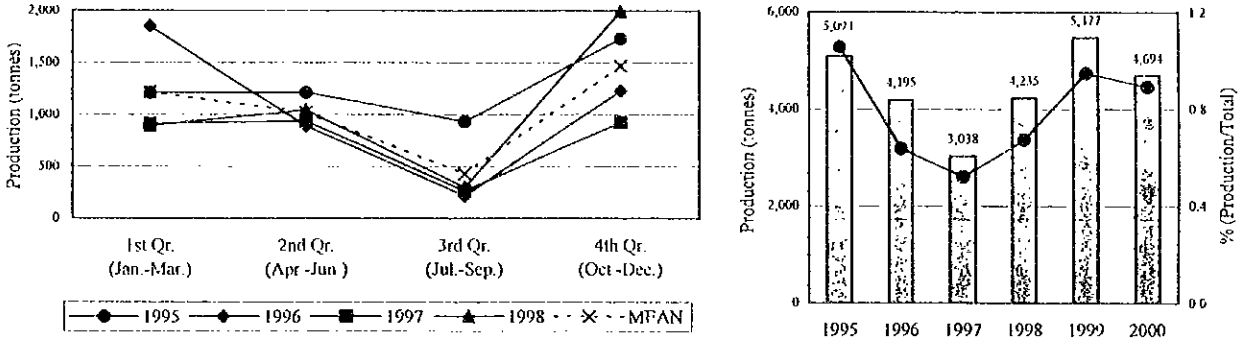


Figure 5.6 Fluctuation of the annual production of seiches from 1995 to 2000.

c) Octopus *Octopus vulgaris* (local designation: poulpe)

Cooperative survey results indicate the group called "poulpe" includes only the common octopus *Octopus vulgaris*.

In the 1995-2000 period, the common octopus production experienced a steady decline and dropped to 13,349 tonnes in 1998, but next year turned to increase and reached at a peak of 22,234 tonnes in 2000. The quarterly production did not show much difference between quarters, but after 1995 common octopus fishing was banned in September and October. The common octopus catches represented between 2% and 4% of the total production, a high percentage among demersal species. The common octopus is caught by pots and jig hooks in artisanal fisheries and industrial bottom trawlers of the IRM and EU fleets (Figure 5.7).

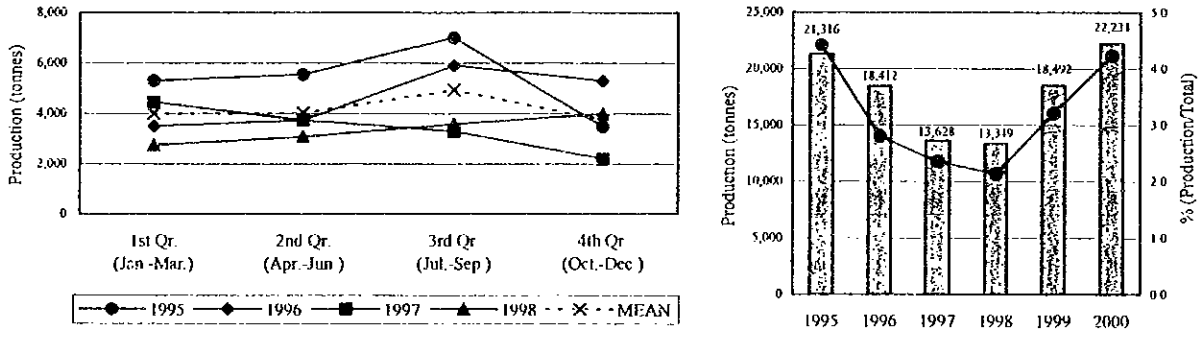


Figure 5.7 Fluctuation of the annual production of poulpe from 1995 to 2000.

f) Lobsters *Panulirus regius* (local designation: langoustes)

The royal spiny lobster production had a significant change over the years in the 1995-2000 period. Between the highest production of about 60 tonnes in 1996 and 1997 and the lowest of 4 tonnes in 2000, it is a 15-fold difference. The quarterly production also varied for each the year and no clear tendency could be observed. The royal spiny lobster catches represented less than 0.01% of the total production. The catches are done mainly by gill nets of artisanal fisheries (Figure 5.8).

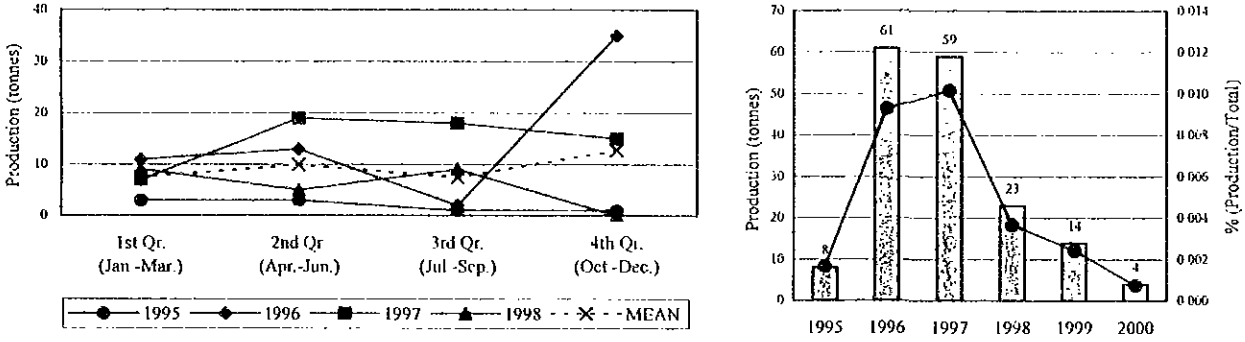


Figure 5.8 Fluctuation of the annual production of langoustes from 1995 to 2000.

g) Prawns (local designation: langostinos; included target species: *Penaeus notialis*)

Cooperative survey results indicate the group called "langostinos" seems to comprise mainly the southern pink shrimp *Penaeus notialis*, although it also includes the caramote prawn *Penaeus kerathurus*.

The prawn production never stopped increasing over the years in the 1995-1999 period, reaching a peak of 2,397 tonnes in 1999. But in 2000, the annual production of prawns reduced by half at 1,161 tonnes. The quarterly fluctuation of prawn production showed low numbers in the first two quarters (January to June) and high values in the last two (August to December). The prawns represented less than 0.3% of the total fisheries production. The catches are done mainly by artisanal fisheries, and also by licensed foreign-registered vessels (Figure 5.9).

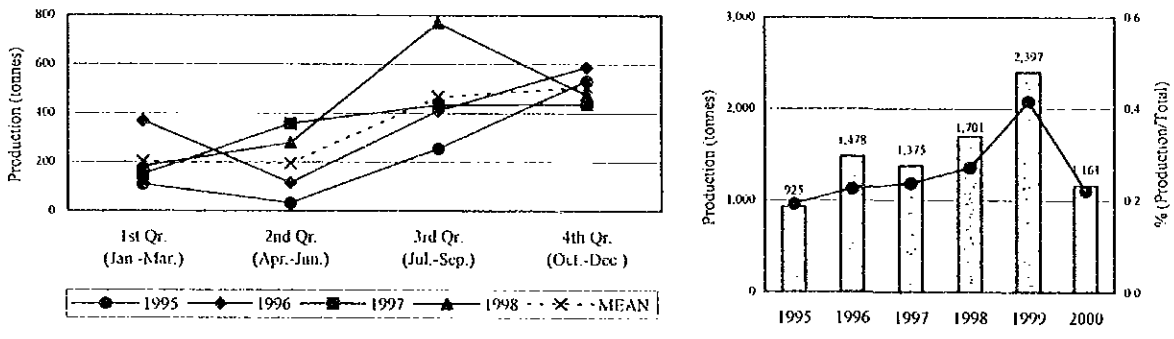


Figure 5.9 Fluctuation of the annual production of langostinos from 1995 to 2000.

h) Deep-water pink shrimp *Parapenaeus longirostris* (local designation: gamba)

The annual production of the deep-water pink shrimp in the 1995-2000 period increased, reaching a peak of 2,200 tonnes in 1998, and then varied between 1,451 tonnes in 1999 and 1,630 tonnes in 2000.

The quarterly production of the deep-water pink shrimp remained steady the year round. The deep-water pink shrimp production represented less than 0.4% of the total. The catches are done essentially by industrial fishery vessels (Figure 5.10).

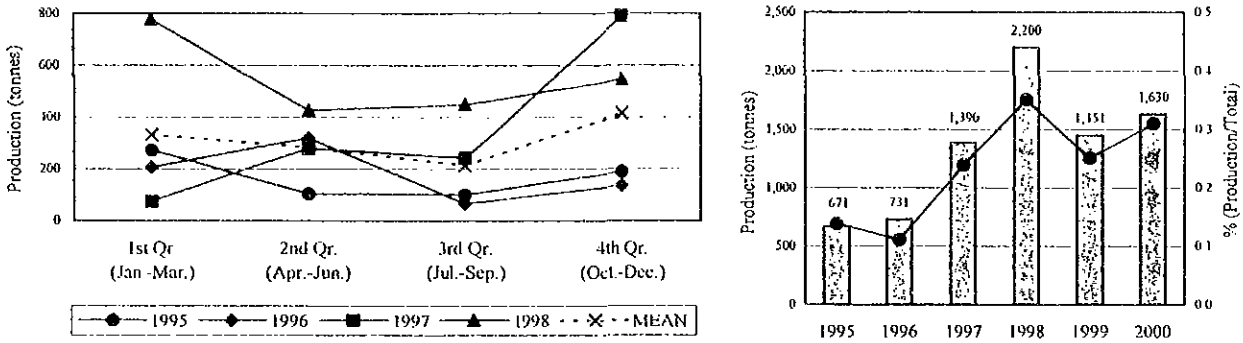


Figure 5.10 Fluctuation of the annual production of gamba from 1995 to 2000.

i) West African geryon *Chaceon (Geryon) maritae* (local designation: géryon)

The production of West African geryon in the 1995-2000 period varied between 100 tonnes and 400 tonnes at intervals of two or three years, in recent years showed a tendency to increase. The quarterly production of West African geryon tended to be lower in the first quarter (January to March). The West African geryon production represented less than 0.08% of the total. The catches are done essentially by traps set by licensed, foreign-registered vessels (Figure 5.11).

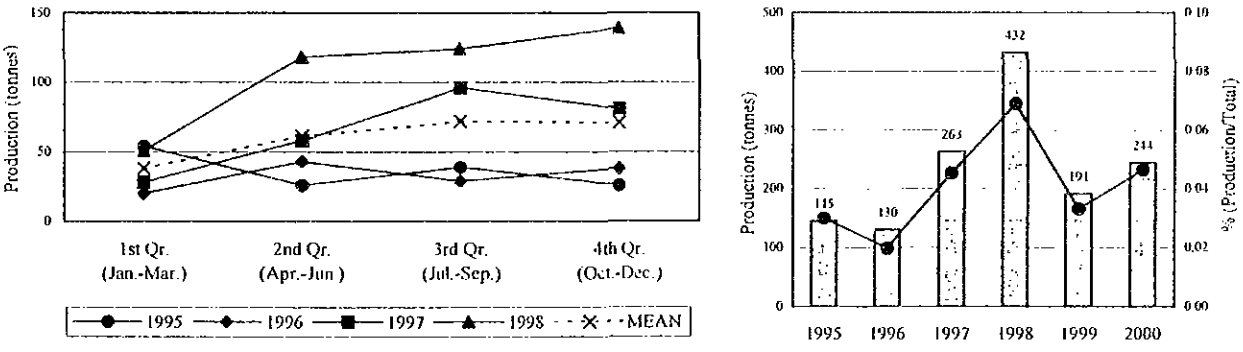


Figure 5.11 Fluctuation of the annual production of geryon from 1995 to 2000.

5.3.4 Status and evaluation of demersal species resources

One of the indicators that allow a quantitative representation of the status of resources is CPUE (catch per unit effort). In the 1992-2000 period, the catch of demersal fishes (including crustaceans and cephalopods) by the IRM and foreign fleets are gathered (see Figure 8.1.1). Thus here, utilizing the fishery production by fishing type (Table 5.1) and the number of licensed boats and vessels by fishing type (Table 5.3) from the DEARH/MPEM fishery statistics (ONS, 2001), the status of demersal species resources with respect to both artisanal and industrial fisheries was evaluated. Also, the short-term fluctuation of stock size is examined by using their results of both resources surveys in the cold and warm seasons and the transition between them. Moreover, based on the results from both resources surveys and the body length measuring in the Landing Site Survey, the status of demersal species resources is put into effect from the qualitative viewpoints. These results are comprehensively studied and led to the evaluation of the current situation of the Mauritanian fishery resources under the fishery system in operation.

(1) Fishing effort (number of licensed vessels)

Between 1986 and 2000, the number of fishing vessels of both artisanal and industrial fisheries never ceased increasing. This increase mainly applies to artisanal fishery boats, as the number of vessels of industrial fisheries tended to be stable, with slight fluctuations. The number of vessels of industrial fisheries with targeting the demersal species, mainly Mauritanian vessels, was decreasing since 1996 (Table 5.3, Figure 5.12).

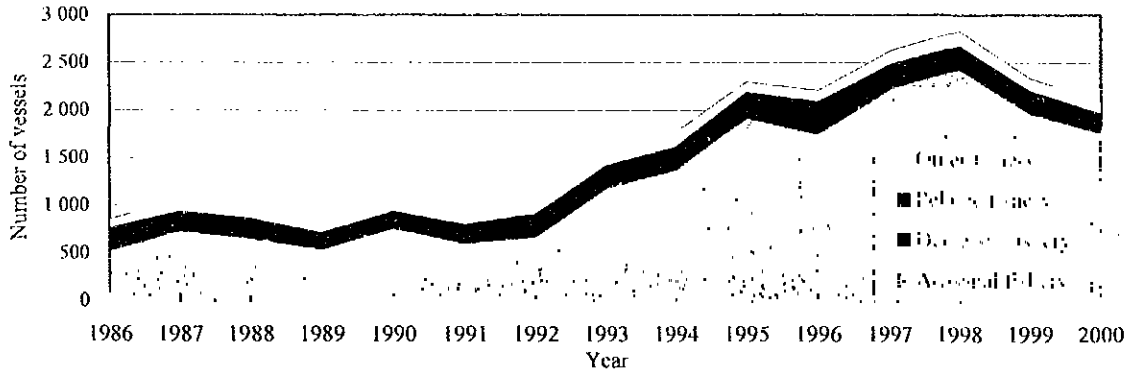


Figure 5.12 Fluctuations in number of licensed fishing vessels from 1986 to 2000.

Table 5.3 Fluctuations in number of licensed fishing vessels from 1986 to 2000.

Units : boats or vessels

Year	Artisanal fishery	Industrial fishery									Total
		Demersal fishery			Pelagic fishery			Other fishery			
		IRM	Foreign -Licence-	Sub-total	IRM	Foreign -Licence-	Sub-total	IRM	Foreign -Licence-	Sub-total	
1986	529	125	54	179	1	58	59	0	88	88	326
1987	735	148	20	168	0	42	42	9	110	119	329
1988	656	153	10	163	3	47	50	4	109	113	326
1989	540	123	7	130	3	45	48	1	128	129	307
1990	763	130	9	139	0	43	43	1	94	95	277
1991	607	142	14	156	0	44	44	0	101	101	301
1992	675	145	30	175	2	63	65	4	94	98	338
1993	1,185	142	60	202	3	33	36	4	155	159	397
1994	1,379	169	42	211	3	25	28	4	153	157	396
1995	1,923	163	60	223	1	47	48	4	103	107	378
1996	1,757	195	64	259	1	76	77	4	113	117	453
1997	2,230	168	40	208	1	48	49	8	131	139	396
1998	2,430	136	45	181	1	63	64	11	148	159	404
1999	1,964	110	49	159	0	80	80	18	112	130	369
2000	1,770	100	49	149	0	54	54	13	118	131	334

Remark. Data of artisanal fishing boat between 1991 to 2000 refer to Table 8.13 in chapter 8.1 (except for 1998).

(2) Catch per unit effort (CPUE)

The value of CPUE (catch in kg / number of licensed vessels) for artisanal and industrial fisheries was calculated from the data on Tables 5.1 and 5.3 respectively. For the artisanal fisheries mainly targeting the demersal species, from a value of 30.2 tonnes/boat in 1986, it followed a downward trend to mere 11.0 tonnes/boat in 2000, or a drop of 36% (Figure 5.13).

As for the industrial fisheries, based on the effort by the Mauritanian iced storage and freezer trawlers (number of licensed vessels) thought to be harvesting and utilizing demersal species and the production in tonnes of both trawlers, the value of CPUE (kg/number of licensed vessels) was established (Figure 5.13). In these conditions, the CPUE of a given vessel showed a decline from a value of 495.2 tonnes/vessel in 1986 down to 219.4 tonnes/vessel in 2000, or a loss of 56%. The "effort" implied in the value of CPUE refers to the number of licensed vessels, but the calculation also includes inoperative vessels. Also, since around 1991, the iced storage and freezer vessels supposedly switched to octopus with regarding the main target species (FAO, 1999). A corresponding tendency of CPUE fluctuation should not reflect directly in demersal species resources. However, the CPUE of the industrial fisheries from 1986 to 2000 showed a tendency of decline. If it should be noted that the artisanal and industrial fisheries have their differences in terms of fishing grounds and gear, the fact that the CPUE of both fisheries mainly targeting demersal species are decreasing simultaneously might indicate that the status of those resources is not good.

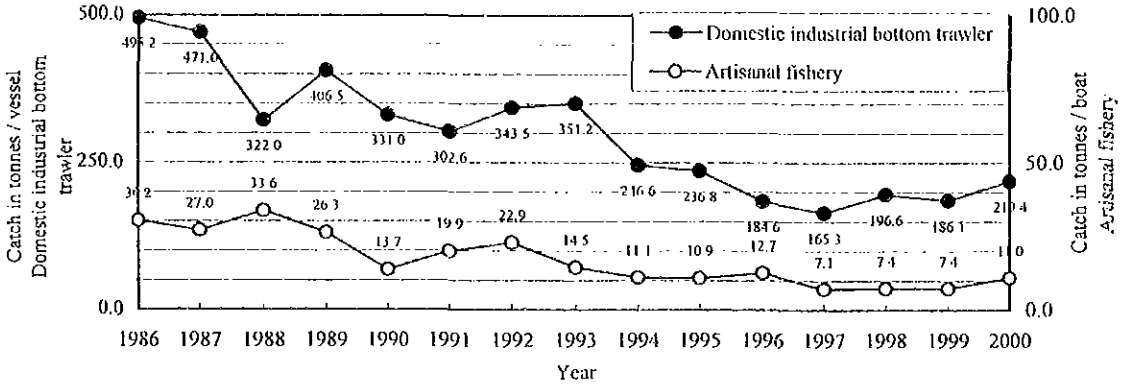


Figure 5.13 Fluctuation of annual CPUE by artisanal and industrial fisheries from 1986 to 2000.

For a CPUE value to accurately reflect the current status of a given species resource, the following points should be observed:

- The species is not being caught in a selective and intensive way.
- Fish is often landed only after having been selected on board for commercial sizes. If small size individuals other than commercial sizes were discarded, the status of this discard was understood.
- In order to increase fishing efficiency, vessels are being equipped with increasingly more sophisticated navigational devices, fish school detectors, gear, etc. Thus, it is possible to standardize the fishing efforts directly concerned with the CPUE.

(3) An estimation of the catchable stock size

The *cold and warm season surveys* took place in the cold season (March to May) and warm season (September and October) of 2000 (Phase 1) and in the cold season (April to May) and warm season (September to October) of 2001 (Phase2), and was conducted by the *Amrigue* in the Northern coastal area, while the coastal area except in the Banc d'Arguin and offshore area were explored by the *Al-Awam*.

In this survey, it was not possible to obtain the relative fishing efficiency rate, which is necessary for the estimation of stock size in the entire survey area based on the combined stock size of both vessels (see 3.4.1 Comparative experiment of fishing efficiency). Therefore, the results of the *Al-Awam*, which operated in a wider survey area, are presented here. The estimated stock size was based on catches by the cod end (3 kinds of mesh size: 45, 70 and 100mm) and the 20 mm covernet, and thus includes the recruitment stock size of each species. An accurate evaluation of current resources demands that the catchable stock size is known.

Current bottom trawl operations are conducted utilizing a minimum cod-end mesh-size of 70 mm and the catchable stock size of the target species have to be estimated from catches obtained under that regulation. In the *cold and warm season surveys* in 2001, the catchable stock size of the target species could be directly determined utilizing the regulation mesh-size. However, in 2000, a cod-end with a mesh-size of 45 mm was employed. Thus the total catch made with the 45mm cod-end and the 20mm

covernet in 2000 was corrected according to the ratio of the catch by 70mm cod-end to the total catch by 70mm cod-end and 20mm covernet in 2001, and then the catchable stock size of the target species was estimated.

The catchable stock size of the target species thus determined was distributed over the coastal area (depth 3-20 m) and the offshore area (divided into the 20–200 m deep continental shelf and the 200–400 m deep continental slope), as summarized in Table 5.4. As fishing efficiency of the using trawl gear is hypothesized as 1.0, that catchable stock size is considered the lower limit value. A number of distinctive features can be interpreted from the composition of catchable stock size of both target species and «other species», as presented in Table 5.4.

Focused below are the main features of the 2001 survey results.

- The total catchable stock size of the nectobenthos in 2000 was 72,180 tonnes (coastal area excluded) in the cold season and 120,689 tonnes in the warm season. On the other hand, the total catchable stock size in 2001 was 282,621 tonnes in the cold season and 264,983 tonnes in the warm season. In 2001, the catchable stock size in the coastal area, the continental shelf and the continental slope accounted for 85%, 10% and 15% of the total in the cold season and 61%, 24% and 15% of the total in the warm season, respectively: that is, in both seasons it was more abundant in the coastal area. In a similar way, the total catchable stock size of the target species was abundantly distributed over the costal area in both the cold and warm seasons, its occupation being 60% and 56% of the total respectively.
- The ratio of the catchable stock size of the target species to the total catchable stock size was, except for a 13% in the 2001 cold season, in 25–28%, stable overall.
- The catchable stock size by target species in the cold and warm season of 2001 was as follows: In the costal area, the bluespotted seabream *Pagrus caeruleostictus* was the most abundant, followed by the smooth-hound *Mustelus mustelus* and the Canary dentex *Dentex canariensis*. In the continental shelf, the red pandora *Pagellus bellottii* was very numerous, followed by the smooth-hound *Mustelus mustelus*, the Senegalese hake *Merluccius senegalensis* and the John dory *Zeus faber*. In the continental slope, the Benguela hake *Merluccius polli* was very numerous.
- The catchable stock size of the common octopus *Octopus vulgaris*[5] was 2,760 tonnes in the cold season and 2,447 tonnes in the warm season of 2001.

[5] The bottom trawl gear used in the survey was not for targeting octopus but demersal fishes, so the catchable stock size obtained from the catch of this gear was underestimated.

Table 5.4 Catchable stock size of target species obtained through the resources surveys by the *Al-Awam*.

(A) Phase 1 cold season — Units: tonnes

Scientific name	North				Central				South				Total			
	3-20m	20-200m	200-400m	Total	3-20m	20-200m	200-400m	Total	3-20m	20-200m	200-400m	Total	3-20m	20-200m	200-400m	Total
FISH																
Mustelus mustelus		45		45										45		45
Merluccius senegalensis (*Merluccius polli*)		872	689	1,561		1,241	2,458	3,699		978	667	1,644		3,091	3,814	6,905
Zeus faber		193		193		1,050		1,050		605		605		1,847		1,847
Epinephelus aeneus		13		13		172		172		43		43		227		227
Argyrosomus regius										2		2		2		2
Pseudupeneus prayensis		26		26		384		384		63		63		473		473
Pagrus caeruleostictus						84		84		29		29		113		113
Dentex angolensis		165		165		188		188		129		129		481		481
Dentex canariensis		23		23		396		396		19		19		438		438
Pagellus bellottii		1,234		1,234		834		834		148		148		2,215		2,215
Mugil capurrii						23		23						23		23
Mugil cephalus																
Solea senegalensis																
CEPHALOPODS																
Loligo vulgaris		395		395		44		44		11		11		450		450
Sepia officinalis		13		13						32		32		45		45
Octopus vulgaris		857	10	867		2,313	2	2,316		1,483	0	1,483		4,653	13	4,666
CRUSTACEA																
Penaeus notialis		1		1		0		0		4		4		5		5
Parapenaeus longirostris		1	2	3		14	74	88		42	81	124		58	158	215
Palinurus mauritanicus			3	3											3	3
Panulirus regius																
Target species total	-	3,836	705	4,541	-	6,743	2,534	9,277	-	3,588	748	4,337	-	14,167	3,987	18,154
Other species total	-	3,679	9,200	12,879	-	15,641	11,364	27,005	-	12,017	2,125	14,142	-	31,337	22,688	54,025
Whole species	-	7,515	9,904	17,419	-	22,385	13,898	36,282	-	15,605	2,873	18,478	-	45,505	26,675	72,180

Remarks. For phase 1, catchable stock size (by 70mm cod-end) was estimated by multiplying 61.3% to original catch record including covernet.
This estimation is also applied to the catch by 100mm cod-end and mixed samples in phase 2.

Table 5.4 continued.
(B) Phase 1 warm season

Units: tonnes

Scientific name	North				Central				South				Total			
	3-20m	20-200m	200-400m	Total	3-20m	20-200m	200-400m	Total	3-20m	20-200m	200-400m	Total	3-20m	20-200m	200-400m	Total
FISH																
Mustelus mustelus		1,333		1,333						45		45		1,378		1,378
Merluccius senegalensis (*Merluccius polli*)		54	735	789		506	4,273	4,779		543	1,183	1,726		1,103	6,192	7,294
Zeus faber		143		143		80		80		93		93		315		315
Epinephelus aeneus		12		12	43			43	46	4		51	89	16		105
Argyrosomus regius		133		133	52	8		59	202			202	254	141		395
Pseudupeneus prayensis		19		19	418	601		1,019	179	811		990	596	1,431		2,028
Pagrus caeruleostictus					461	99		560	795	122		918	1,256	221		1,477
Dentex angolensis										134		134		134		134
Dentex canariensis		98		98	163	149		311	3	305		308	166	551		717
Pagellus bellottii		2,135		2,135	322	5,274		5,596	0	3,083		3,083	322	10,492		10,814
Mugil capurrii									9			9	9			9
Mugil cephalus																
Solea senegalensis		17		17					0			0	0	17		17
CEPHALOPODS																
Loligo vulgaris		1,526		1,526		390		390		514		514		2,430		2,430
Sepia officinalis		112	0	113	195	159		354	43	194		237	239	465	0	704
Octopus vulgaris		1,438	6	1,444	230	1,083	10	1,322		1,080		1,080	230	3,600	16	3,846
CRUSTACEA																
Penaeus notialis		4		4	4	2		6	19	0		19	23	6		29
Parapenaeus longirostris		4	31	34		5	33	39		15	52	66		23	116	139
Palinurus mauritanicus			3	3											3	3
Panulirus regius					3			3					3			3
Target species total	-	7,027	775	7,802	1,890	8,355	4,317	14,561	1,298	6,942	1,235	9,475	3,187	22,323	6,327	31,838
Other species total	-	10,245	9,816	20,061	8,579	9,909	19,667	38,155	16,318	10,081	4,236	30,635	24,897	30,235	33,719	88,851
Whole species	-	17,271	10,592	27,863	10,469	18,264	23,983	52,716	17,615	17,023	5,472	40,110	28,084	52,559	40,047	120,689

Remarks. For phase 1, catchable stock size (by 70mm cod-end) was estimated by multiplying 61.3% to original catch record including covernet.
This estimation is also applied to the catch by 100mm cod-end and mixed samples in phase 2.

Table 5.4 continued.
(C) Phase 2 cold season

Units: tonnes

Scientific name	North				Central				South				Total			
	3-20m	20-200m	200-400m	Total	3-20m	20-200m	200-400m	Total	3-20m	20-200m	200-400m	Total	3-20m	20-200m	200-400m	Total
FISH																
Mustelus mustelus	4,477	80		4,557	10			10	4			4	4,492	80		4,572
Merluccius senegalensis		1,796		1,796		59	270	329		94	131	225		1,949	401	2,350
(*Merluccius polli*)		3		3		907	2,106	3,013		228	250	478		1,137	2,356	3,493
Zeus faber		157		157		526		526	9	712		721	9	1,396		1,405
Epinephelus aeneus	11	21		32	64			64	40			40	115	21		136
Argyrosomus regius	783			783	306			306	93	11		104	1,182	11		1,193
Pseudupeneus prayensis	187	70		257	1,768	43		1,811	176	125		302	2,131	238		2,369
Pagrus caeruleostictus	1,496	26		1,522	2,805	174		2,979	1,634	103		1,737	5,934	304		6,237
Dentex angolensis										8		8		8		8
Dentex canariensis	2,482	71		2,553	56	57		113	35	57		93	2,574	185		2,759
Pagellus bellottii	1,517	347		1,864	961	819		1,781	8	1,879		1,887	2,486	3,045		5,531
Mugil capurrii									30	15		45	30	15		45
Mugil cephalus					83			83	15			15	98			98
Solea senegalensis	31	4		35	34	1		35					65	5		70
CEPHALOPODS																
Loligo vulgaris	395	208		603	217	22		239	41	25		66	654	254		908
Sepia officinalis	1,011	21		1,032	268	2		270	131	21		152	1,411	43		1,454
Octopus vulgaris	105	384		489	84	1,210	4	1,298	7	966		973	196	2,561	4	2,760
CRUSTACEA																
Penaeus notialis	30	0		30	17	0		17	2	2		5	49	3		52
Parapenaeus longirostris		0		0		2	3	5		8	48	55		10	50	60
Palinurus mauritanicus											22	22			22	22
Panulirus regius									2			2	2			2
Target species total	12,524	3,188	-	15,713	6,673	3,824	2,383	12,879	2,229	4,255	450	6,934	21,426	11,267	2,833	35,526
Other species total	167,584	1,591	-	169,175	29,279	8,401	8,619	46,299	21,596	6,370	3,655	31,622	218,459	16,363	12,274	247,095
Whole species	180,109	4,779	-	184,888	35,952	12,225	11,001	59,178	23,824	10,626	4,106	38,556	239,885	27,630	15,107	282,621

Remarks. For phase 1, catchable stock size (by 70mm cod-end) was estimated by multiplying 61.3% to original catch record including covernet.
This estimation is also applied to the catch by 100mm cod-end and mixed samples in phase 2.

Table 5.4 continued.

(D) Phase 2 warm season

Units: tonnes

Scientific name	North				Central				South				Total			
	3-20m	20-200m	200-400m	Total	3-20m	20-200m	200-400m	Total	3-20m	20-200m	200-400m	Total	3-20m	20-200m	200-400m	Total
FISH																
Mustelus mustelus	10,327	7,365		17,691						256		256	10,327	7,621		17,947
Merluccius senegalensis		302	789	1,091		110	238	347		126	16	142		538	1,043	1,580
(*Merluccius polli*)		0	108	108		547	4,580	5,127		296	4,584	4,879		843	9,272	10,115
Zeus faber		241		241		124	5	129		54		54		419	5	424
Epinephelus aeneus	148	248		395	30	0		30	17	3		20	195	251		446
Argyrosomus regius	51	94		144	192	29		221	6	10		15	249	133		381
Pseudupeneus prayensis	23	192		215	418	282		699	66	415		481	507	889		1,395
Pagrus caeruleostictus	27,033	132		27,165	1,032	116		1,147	437	104		541	28,501	351		28,853
Dentex angolensis						8		8						8		8
Dentex canariensis	758	139		897	57	19		76	0	10		10	814	168		982
Pagellus bellottii	450	3,962		4,412	55	2,529		2,585	5	1,704		1,709	511	8,196		8,706
Mugil capurrii																
Mugil cephalus		19		19										19		19
Solea senegalensis		8		8										8		8
CEPHALOPODS																
Loligo vulgaris	69	220		289		159		159		138		138	69	517		586
Sepia officinalis	177	176		354	98	141		239	29	34		63	303	352		655
Octopus vulgaris	47	1,175	8	1,231	105	488		592		624		624	152	2,287	8	2,447
CRUSTACEA																
Penaeus notialis		4		4	0	9		9	3	1		4	3	13		16
Parapenaeus longirostris		0	9	9		0	5	5		1	0	2		2	14	16
Palinurus mauritanicus			16	16											16	16
Panulirus regius	91			91					8			8	99			99
Target species total	39,173	14,277	930	54,380	1,986	4,560	4,827	11,374	571	3,775	4,600	8,946	41,729	22,612	10,358	74,700
Other species total	94,879	16,954	14,121	125,954	12,382	14,038	13,820	40,241	12,107	9,101	2,881	24,088	119,368	40,093	30,822	190,283
Whole species	134,052	31,231	15,051	180,334	14,368	18,599	18,648	51,614	12,678	12,876	7,481	33,034	161,097	62,706	41,180	264,983

Remarks. For phase 1, catchable stock size (by 70mm cod-end) was estimated by multiplying 61.3% to original catch record including covernet.

This estimation is also applied to the catch by 100mm cod-end and mixed samples in phase 2.

(4) Resource standards of demersal species in short-term

In a preliminary conference with official participants from both countries aimed at the present Study (JICA, 1999), as well as in a binational study team meeting prior to the beginning of the Study, the importance of conducting a transitional period resources survey, covering a time frame beyond the cold and warm seasons targeted by the Sea-borne Survey, was already indicated, in order to apprehend as accurately as possible the actual conditions of demersal species resources.

The CNROP understood the importance of conducting a resources survey in the transitional period and carried out three ressources surveys in the 2000–2001 by the *Al-Awam*, based on the same techniques employed in the *cold and warm season surveys* (Table 5.1. shows trawl operation circumstances). The *cold and warm season surveys* and *transitional period surveys* added up to seven cruises, whose times and periods are listed in Table 5.5.

These *transitional period surveys* conducted by the CNROP basically applied the same random sampling method utilized in the *cold and warm season surveys*, as well as the same target regions, stratification and standardization of catch in weight.

Table 5.5 Times, periods and number of stations of the *cold and warm season surveys* and the *transitional period surveys*.

Survey season	Survey year	Survey period	No. of stations (20 - 200m)
Phase 1			
Cold season	2000	Mar. 28 - May 06	61
C to W *1		July 12 - July 27	75
Warm season		Sep. 05 - Oct. 09	62
W to C *2		Nov. 27 - Dec. 09	66
Phase 2			
Cold season	2001	Apr. 05 - May 09	64
Warm season		Sep. 05 - Oct. 08	56
W to C *2		Dec. 23 - Jan. 02, 2002	60

*1: Transitional season between cold and warm season is indicated as C to W.
*2: Transitional season between warm and cold season is indicated as W to C.

In order to combine the results of the *cold and warm season surveys* and the *transitional surveys* for a qualitative and quantitative study of short-term changes in resources, it is necessary to ensure the consistency of the basic data of both kinds of survey. For that purpose, the following main points were considered: (i) the catch made by the *Al-Awam* with a 45 mm cod-end was adopted as standard; (ii) the total catch, pelagic species excepted, was the object of analysis; (iii) swept area was calculated from the W (distance between the wing-tips) – D (water depth) equation (see 3.3.1 for the W-D equation and Appendix Table 5.2 for the area-swept in the *transitional period surveys*); (iv) catch was standardized (kg/km^2); (v) stock size was estimated from a stratum that allowed comparison through all seven surveys (those were the 20–30 m, 30–80 m and 80–200 m strata: the number of stations in Table 5.5 refers to

points carried out in these three strata). Stock size was estimated for those separate strata for the target species and others (Table 5.6). Also, considering the top ten among the target species with a stock size of over 1,000 tonnes in any survey, changes in the stock size of these top 10 species in chronological order through the *cold and warm season* and *transitional period surveys* were illustrated in Figure 5.14. The 95% confidence interval and coefficient of variation (CV) were calculated for the estimated total stock size by area (Table 5.7). Moreover, the estimated stock size by area and by stratum in the *cold and warm season* and *transitional period surveys* was drafted (Figure 5.15).

Based on Table 5.6, from a qualitative standpoint, the ratio of the stock size of the target species to the total stock size in the entire area changed, in chronological order, as follows: 33%, 42%, 45% and 42% (all in 2000), 31%, --[6], 38% and 25% (in 2001). Therefore, there was a decline in that ratio over the years. The stock size of the target species changed according to the time of survey (*cold and warm season* and *transitional period surveys*).

However, if species are classified according to their presence at stock-rich strata, three of them – the smooth-hound *Mustelus mustelus*, the West African goatfish *Pseudupeneus prayensis* and the bluespotted seabream *Pagrus caeruleostictus* – were mainly distributed at the 20–30 m stratum. Five target species were distributed at the 30–80 m stratum: the Canary dentex *Dentex canariensis*, the red pandora *Pagellus bellottii*, the European squid *Loligo vulgaris*, the common cuttlefish *Sepia officinalis* and the common octopus *Octopus vulgaris*. Finally, 2 species were distributed at the 80–200 m stratum: the Senegalese hake *Merluccius senegalensis* and the John dory *Zeus faber*. Eight of those ten species (the exceptions were *Mustelus mustelus* and *Sepia officinalis*) experienced a declining trend in stock size over the years (Figure 5.14).

The estimated stock size was also studied from a quantitative standpoint based on Table 5.7. The total stock size in each survey was, in chronological order, 66,426 tonnes, 84,889 tonnes, 75,225 tonnes and 92,204 tonnes (all in 2000), 43,327 tonnes, --[6], 84,247 tonnes and 67,254 tonnes (in 2001). Except for the total stock size in the cold season survey of 2001 (43,327 tonnes), the total stock size in each survey of this two-year period was in the range of 70,000–90,000 tonnes.

There are no negative values within the 95% confidence interval for the total stock size in the seven surveys, and the CV of 6-17% indicates estimates of good accuracy. From this fact, it is thought that these estimated values are sound basic data for resources assessment. These results made clear that, if 70 stations were surveyed in each cruise, it would be possible to collect basic data that are more than appropriate for an assessment of the current status of resources according to CV and confidence interval values. This is an observation that points out to methods to be used in future resource surveys.

In the fifteen-year period from 1982 to 1996, the CNROP has conducted resource surveys in the inshore and offshore zones of Mauritania aboard the *N'Diago*. In the future, based on the analysis and study of the results of the fifteen-year period surveys, the CNROP will be able to clarify the actual conditions and yearly changes in resources, aiming at a long-term outlook. The outcome of such inquiry should be compared with the results of this short-term survey, and allow for correctly understand the situation of demersal species stocks. It is thought this would consolidate the IRM management policy for fishery resources.

[6] The transitional period survey between cold and warm seasons in 2001 was not carried out, for two R/Vs were docked in Las Palmas.

Table 5.6 Estimated stock size of target species and other species in the *cold and warm season surveys* and the *transitional period surveys*.

Subarea	Stratum	Species category	Phase 1				Phase 2			
			Cold season *1	C to W *2	Warm season *1	W to C *3	Cold season *4	No survey *5	Warm season *4	W to C *3
North	20-30m	Target	460	3,687	3,576	876	520	-	6,393	1,904
		Others	297	7,456	12,682	482	956	-	2,571	10,214
		Total	757	11,143	16,258	1,358	1,475	-	8,965	12,118
	30-80m	Target	3,712	3,328	6,729	1,941	1,618	-	10,823	3,627
		Others	1,886	3,341	1,000	1,200	1,071	-	13,929	15,550
		Total	5,598	6,668	7,729	3,141	2,689	-	24,752	19,178
	80-200m	Target	1,718	614	795	2,301	1,466	-	1,176	783
		Others	3,001	1,233	1,509	7,407	909	-	3,123	1,524
		Total	4,719	1,847	2,304	9,708	2,375	-	4,300	2,308
	Total		11,074	19,658	26,291	14,207	6,539	-	38,016	33,603
Central	20-30m	Target	1,216	4,031	1,687	1,469	244	-	917	228
		Others	1,115	5,211	3,754	430	641	-	2,420	365
		Total	2,331	9,242	5,441	1,899	885	-	3,338	593
	30-80m	Target	3,867	7,545	9,831	3,658	1,861	-	5,928	1,316
		Others	4,217	7,332	3,671	3,259	1,069	-	6,053	3,584
		Total	8,084	14,877	13,502	6,917	2,930	-	11,981	4,899
	80-200m	Target	5,106	11,515	1,099	1,453	2,614	-	1,512	1,982
		Others	16,481	13,174	3,732	10,933	12,441	-	12,299	2,125
		Total	21,587	24,690	4,831	12,386	15,055	-	13,811	4,107
	Total		32,002	48,808	23,774	21,202	18,869	-	29,129	9,600
South	20-30m	Target	359	1,361	1,151	1,547	310	-	560	942
		Others	2,623	1,932	2,575	6,305	1,652	-	2,043	4,690
		Total	2,981	3,293	3,726	7,851	1,961	-	2,603	5,632
	30-80m	Target	2,070	2,043	7,266	22,422	3,002	-	3,519	3,456
		Others	5,934	5,573	8,381	10,941	3,562	-	5,613	6,096
		Total	8,005	7,616	15,646	33,363	6,564	-	9,133	9,552
	80-200m	Target	3,106	1,941	1,826	2,718	1,645	-	807	2,613
		Others	9,259	3,571	3,993	12,863	7,747	-	4,560	6,253
		Total	12,364	5,512	5,818	15,581	9,393	-	5,367	8,866
	Total		23,351	16,422	25,191	56,795	17,918	-	17,102	24,051
All	20-30m	Target	2,035	9,079	6,414	3,892	1,073	-	7,871	3,075
		Others	4,034	14,599	19,011	7,217	3,248	-	7,034	15,269
		Total	6,069	23,678	25,425	11,109	4,321	-	14,905	18,344
	30-80m	Target	9,649	12,916	23,826	28,021	6,481	-	20,270	8,399
		Others	12,037	16,246	13,052	15,399	5,702	-	25,595	25,230
		Total	21,687	29,161	36,877	43,420	12,183	-	45,865	33,629
	80-200m	Target	9,930	14,070	3,719	6,471	5,725	-	3,495	5,378
		Others	28,740	17,979	9,234	31,204	21,097	-	19,982	9,903
		Total	38,671	32,049	12,953	37,675	26,822	-	23,477	15,281
	Total		66,426	84,889	75,255	92,204	43,327	-	84,247	67,254

- indicates no trawl operated.

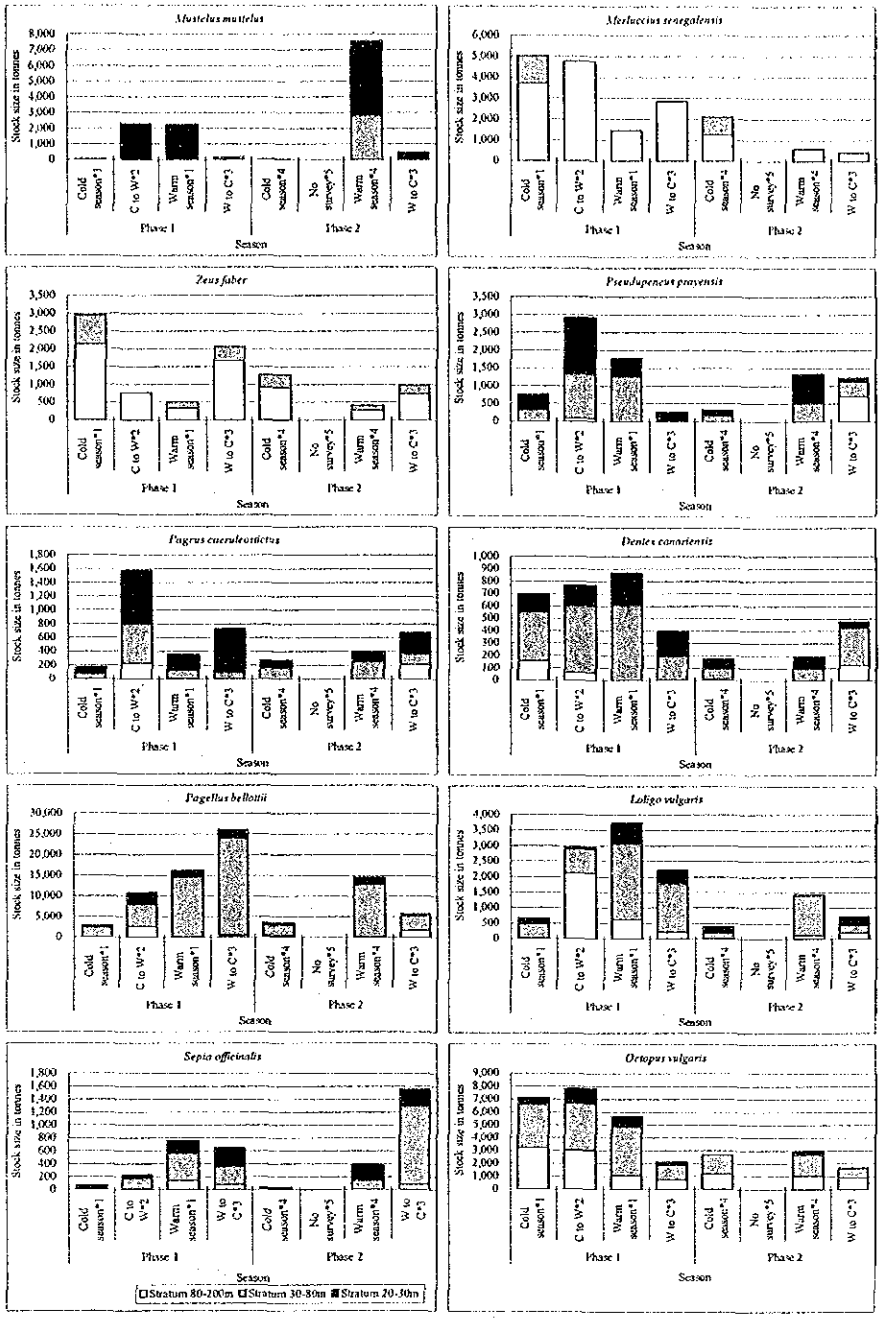
*1: Only 45mm cod-end data were used.

*2: Transitional season between cold and warm season is indicated as C to W.

*3: Transitional season between warm and cold season is indicated as W to C.

*4: Estimated value were used. [Original data (cod-end + covernet) x 90.7%]

*5: The research vessel *Al-Awam* and *Amrigue* were both in the dock of Las Palmas for maintenance.

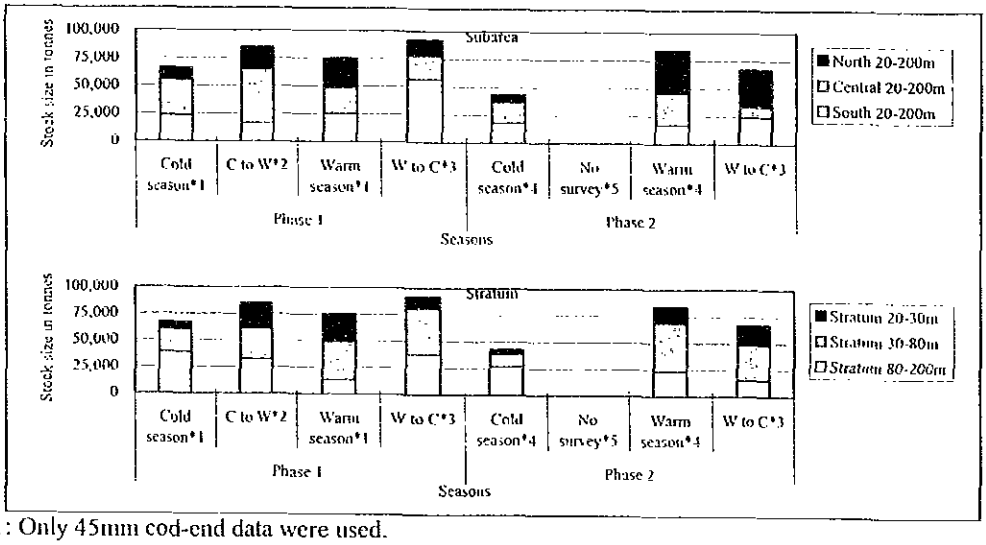


*1: Only 45mm cod-end data were used. *2: Transitional season between cold and warm season is indicated as C to W. *3: Transitional season between warm and cold season is indicated as W to C. *4: Estimated values were used. [Original data (cod-end + covernet) x 90.7%]. *5: The research vessel *Al-Awam* and *Amrigue* were both in the dock of Las Palmas for maintenance.

Figure 5.14 Estimated stock size of target species at each stratum in the *cold and warm season surveys* and the *transitional period surveys.*

Table 5.7 Estimated stock size, 95% confidence interval and coefficient of variation in the *cold and warm season surveys* and the *transitional period surveys*.

Subarea	Stratum	Area in km²	Phase 1				Phase 2			
			Cold season *1	C to W *2	Warm season *1	W to C *3	Cold season *4	No survey *5	Warm season *4	W to C *3
North	20-30m	1,290	757	11,143	16,258	1,358	1,475	-	8,963	12,118
	30-80m	2,924	5,598	6,668	7,729	3,141	2,689	-	24,752	19,178
	80-200m	1,147	4,719	1,847	2,304	9,708	2,375	-	4,300	2,308
	20-200m	5,361	11,074	19,658	26,291	14,207	6,539	-	38,016	33,603
	95% confidence int.		±4,803	±16,954	±21,708	±15,081	±3,408	-	±17,928	±20,207
	CV: coefficient of variation		19%	31%	28%	33%	26%	-	23%	36%
Central	20-30m	835	2,331	9,242	5,441	1,899	885	-	3,338	593
	30-80m	2,870	8,084	14,877	13,502	6,917	2,930	-	11,981	4,899
	80-200m	2,767	21,587	24,690	4,831	12,386	15,055	-	13,811	4,107
	20-200m	6,472	32,002	48,808	23,774	21,202	18,869	-	29,129	9,600
	95% confidence int.		±20,220	±12,970	±8,533	±13,294	±7,664	-	±16,876	±3,727
	CV: coefficient of variation		34%	16%	16%	34%	16%	-	36%	20%
South	20-30m	805	2,981	3,293	3,726	7,851	1,961	-	2,603	5,632
	30-80m	2,640	8,005	7,616	15,646	33,363	6,564	-	9,133	9,552
	80-200m	3,025	12,364	5,512	5,818	15,581	9,393	-	5,367	8,866
	20-200m	6,470	23,351	16,422	25,191	56,795	17,918	-	17,102	24,051
	95% confidence int.		±8,561	±6,289	±12,176	±40,725	±6,708	-	±6,807	±10,255
	CV: coefficient of variation		20%	20%	21%	31%	22%	-	18%	22%
All	20-30m	2,930	6,069	23,678	25,425	11,109	4,321	-	14,905	18,344
	30-80m	8,434	21,687	29,161	36,877	43,420	12,183	-	45,865	33,629
	80-200m	6,939	38,671	32,049	12,953	37,675	26,822	-	23,477	15,281
	20-200m	18,303	66,426	84,889	75,255	92,204	43,327	-	84,247	67,254
	95% confidence int.		±15,668	±11,403	±13,110	±31,678	±6,961	-	±15,016	±14,516
	CV: coefficient of variation		13%	6%	7%	17%	8%	-	10%	10%



*1: Only 45mm cod-end data were used.

*2: Transitional season between cold and warm season is indicated as C to W.

*3: Transitional season between warm and cold season is indicated as W to C.

*4: Estimated values were used. [Original data (cod-end + covernet) x 90.7%]

*5: The research vessel *Al-Awam* and *Amrigue* were both in the dock of Las Palmas for maintenance.

Figure 5.15 Estimated stock size by area (upper part) and by stratum (lower part) in the *cold and warm season surveys* and the *transitional period surveys*.

(5) Utilization of target species resources from the standpoint of size composition

By utilizing the results of the *cold and warm season surveys* and the *transitional period surveys* by the *Al-Awam*, combined with those of the Landing Site Survey, the utilization of demersal species resources inhabiting IRM waters was studied with respect to their body size.

During the *cold and warm season surveys*, body length measurements (by means of the punching-card method and multi-item biological measurements) were taken from the specimens caught in the 20 mm mesh covernet; size composition presumably reflects well the status of the target species in natural conditions (see 3.4.6 Biological findings on target species).

On the other hand, body length data taken during the *transitional period surveys*, while obtained through a similar methodology as the one utilized in the *cold and warm season surveys*, were collected using a 45 mm mesh-size cod-end, so the two sets of data cannot be compared at the same level. Also, the size of the target species specimens found in the Landing Site Survey was not that of the catch by artisanal fisheries, they often corresponded to commercial sizes. Therefore, the size composition of target species as collected by the Landing Site Survey is thought to be heavily biased. Also, the landed catch whose body length measurements were taken (with punching-cards), although being individuals captured by means of the fishing methods stated in Table 8.II.2 and landed, could not be easily sorted out by fishing method.

Listed below is the size composition of target species based on the *cold and warm season surveys*, the *transitional period surveys* and the Landing Site Survey. By comparing the corresponding time of measurement, the size of those species utilized as fishery products among stock in natural condition was examined. The body length data obtained from the Landing Site Survey, giving consideration to there representatively, took into effect the target species with more than 100 specimens collected.

The size composition of all target species caught in the *transitional period surveys* is presented in Appendix Figure 5.1. As a reference, a summary of the top species in estimated stock size and a list of the species caught in the *transitional period surveys* is given in Appendix Tables 5.3 and 5.4 respectively.

With reference to the *cold and warm season surveys*:

1) Smooth-hound *Mustelus mustelus*

The size composition of the smooth-hound from data obtained from the resources survey and the Landing Site Survey is illustrated in Figure 5.16. The total length class is indicated at intervals of 5 cm.

The size composition of the estimated stock number inferred from the Phase 2 cold season survey was in the 45–100 cm class. In the cold season, the dominant mode occurred at the 60–65 cm class, with the mean size of 62.8 cm. On the other hand, the size composition for this species obtained by the Landing Site Survey has wider limits, 50–120 cm class. The dominant mode in the cold season was present at the 90–95 cm class, with the mean size of 87.1 cm.

Landed specimens tended toward large sizes, and the mean size was about 24 cm larger than that for the estimated stock number. Most of the juveniles (about 60 cm at first maturity; see 3.4.6) were not landed.

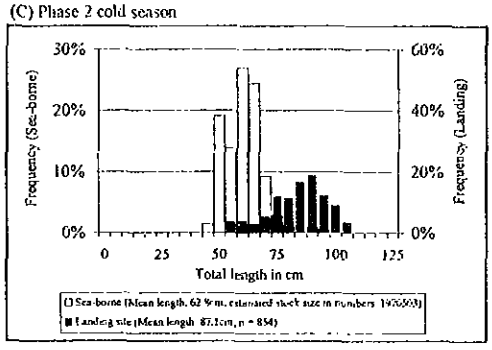


Figure 5.16 Size composition of estimated stock number and landed individuals for smooth-hound *Mustelus mustelus*.

2) White grouper *Epinephelus aeneus*

The size composition of the white grouper from data obtained from the resources surveys and the Landing Site Survey is illustrated in Figure 5.17. The total length class is indicated at intervals of 5 cm.

The size composition of the estimated stock number inferred from the Phase 1 warm season survey was in the 0-75 cm class. It had a poly-modal distribution, with the modes at the 15–20 cm, 35–40 cm and 50–55 cm classes, with the mean size of 33.7 cm. On the other hand, the size composition of specimens landed in the Phase 1 warm season was in the 35–85 cm class, with the dominant mode at the 50–55 cm class and the mean size of 56.5 cm.

The size composition of the estimated stock number inferred from the Phase 2 cold season survey was in the 5–80 cm class. The dominant mode for the cold and warm seasons was observed at the10–15 cm and 35–40 cm classes respectively. The mean size in the cold and warm seasons was 28.5 cm and 37.2 cm respectively. On the other hand, the seize composition of specimens landed in the cold and warm seasons of Phase 2 was in the 30–90 cm class. The dominant mode in the cold season was present at the 45–50 cm class and the modes in the warm season were observed at the 40–45 cm and 55-60 cm classes. The mean size was 54.9 cm and 55.7 cm respectively. In all seasons, landed individuals were comparatively larger, over 25 cm in total length.

According to Bouain (1980), in the Republic of Tunisia, the size at first maturity for females of this species is 40 cm. If that size is equally valid for the white grouper in the IRM, then the landed specimens were mostly parental individuals, and juveniles were scarce.

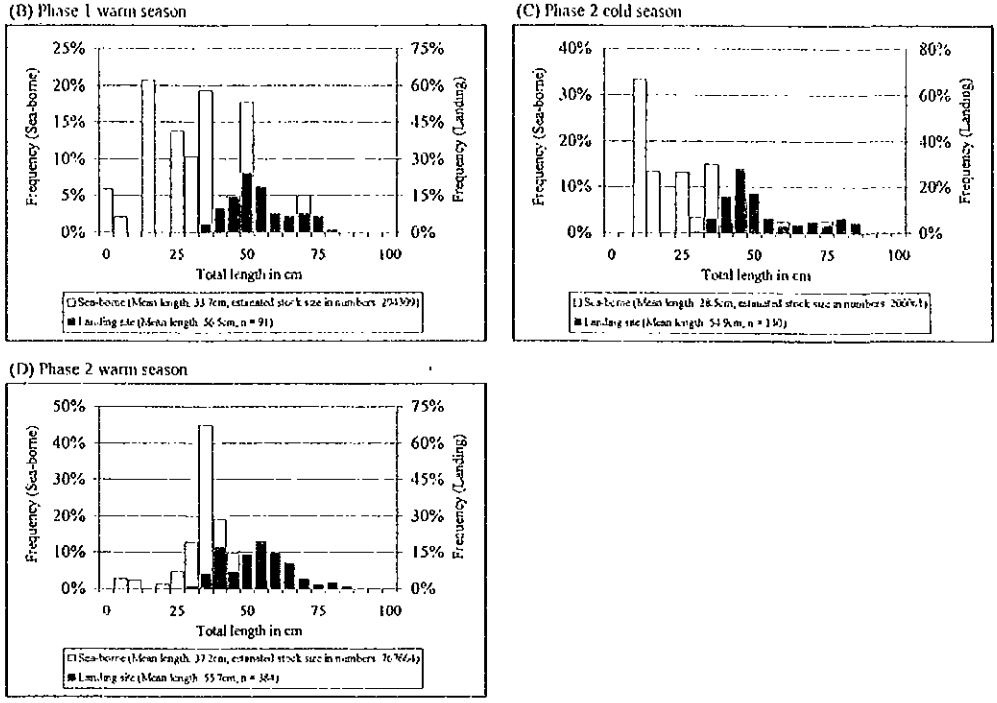


Figure 5.17 Size composition of estimated stock number and landed individuals for white grouper *Epinephelus aeneus*.

3) Meagre *Argyrosomus regius*

The size composition of the meagre from data obtained from the resources surveys and the Landing Site Survey is illustrated in Figure 5.18. The total length class is indicated at intervals of 5 cm.

The size composition of the estimated stock number inferred from the Phase 2 cold and warm season surveys was in the 5-115 cm class. In the cold season, the modes were present at the 15–20 cm and 30–35 cm classes. In the warm season, the modes occurred at the 15–20 cm, 25–30 cm and 45–50 cm classes. The mean size in the cold and warm seasons was 25.2 cm and 30.6 cm respectively. On the other hand, the size composition of specimens landed in both seasons was wider, in the 10–200 cm class. In the cold season, the dominant mode occurred at the 35–40 cm class, and the mean size was 68.8 cm. In the warm season, the dominant mode occurred at the 50–55 cm class, and the mean size was 99.7 cm.

In all seasons, the sizes of landed individuals were comparatively widely distributed in the right-hand side. No mature females were found in the surveys but, according to Tixerant (1974), the size at first maturity for females is 82 cm. This value indicated that most of the landed individuals were juveniles.

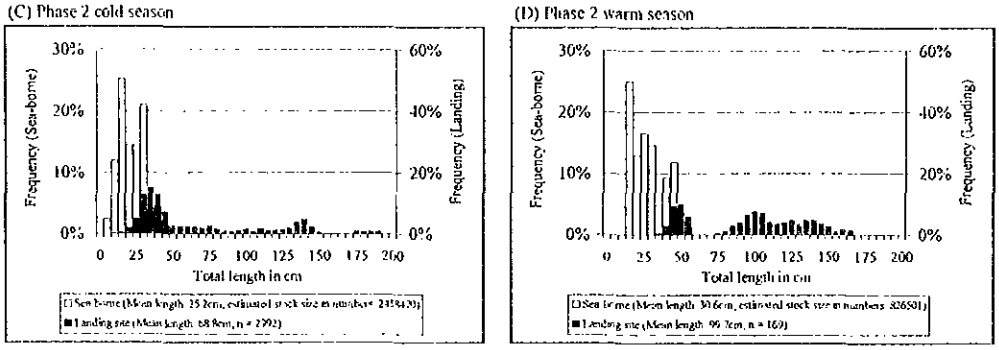


Figure 5.18 Size composition of estimated stock number and landed individuals for meagre *Argyrosomus regius*.

4) West African goatfish *Pseudupeneus prayensis*

The size composition of the West African goatfish from data obtained from the resources survey and the Landing Site Survey is illustrated in Figure 5.19. The fork length class is indicated at intervals of 1 cm.

The size composition of the estimated stock number inferred from the Phase 2 cold season survey was in the 9–26 cm class. In the cold season, the dominant mode occurred at the 18–19 cm class, with the mean size of 17.4 cm. On the other hand, the size composition of specimens according to the Landing Site Survey was in the 15–32 class; the dominant mode was present at the 19–20 cm class, and the mean size was 21.4 cm.

The mean size of landed specimens was 4 cm longer than that of the estimated stock number. In the cold season, the size at first maturity for females is about 15 cm (see 3.4.6): therefore, one realizes most of the juveniles were not landed.

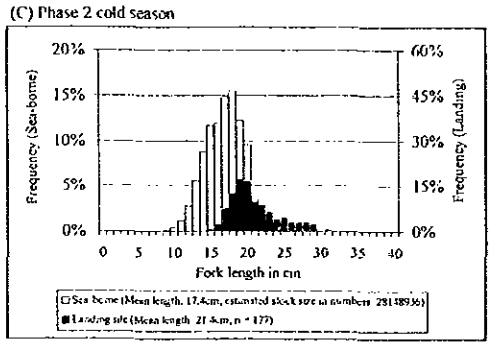


Figure 5.19 Size composition of estimated stock number and landed individuals for West African goatfish *Pseudupeneus prayensis*.

5) Bluespotted seabream *Pagrus caeruleostictus*

The size composition of the bluespotted seabream from data obtained from the resources survey and the Landing Site Survey is illustrated in Figure 5.20. The fork length class is indicated at intervals of 2 cm.

The size composition of the estimated stock number inferred from the Phase 1 cold season survey was in the 12–52 cm class. The dominant modes occurred at the 14–16 cm and 24–26 cm classes, and the mean size was 26.8 cm. On the other hand, the size composition of landed specimens was in the 16–42 class; the dominant mode was present at the 26–28 cm class, and the mean size was 26.4 cm.

The size composition of the estimated stock number inferred from the Phase 1 warm season survey was in the 4–40 cm class, with the dominant mode at the 24–26 cm class, and the mean size 19.6 cm. On the other hand, the size composition of landed specimens in the warm season was in the 20–38 cm class; the dominant mode occurred at the 24–26 cm class, and the mean size was 26.4 cm. The size composition of landed specimens was displaced to larger classes than those of the estimated stock number.

The size composition of the estimated stock number inferred from the Phase 2 cold and warm season surveys was in the 4–46 cm class. The dominant mode for these seasons was present at the 24–26 cm and 20–22 cm classes respectively, and the mean size was 24.7 cm and 20.4 cm respectively.

On the other hand, the size composition of specimens according to the Landing Site Survey was in the 16–50 class. In the cold season, the modes occurred at the 18–20 cm and 34–36 cm classes, and the mean size was 28.6 cm. In the warm season, the dominant mode was present at the 32–34 cm class, and the mean size was 31.7 cm.

The size at first maturity for females was about 24 cm in the cold season and some 19 cm in the warm season (see 3.4.6). The minimum capture size for this species according to IRM regulations is 18 cm. As a consequence, most of the juveniles of the bluespotted seabream cannot be landed, and one can realize how current fishing regulations are being observed.

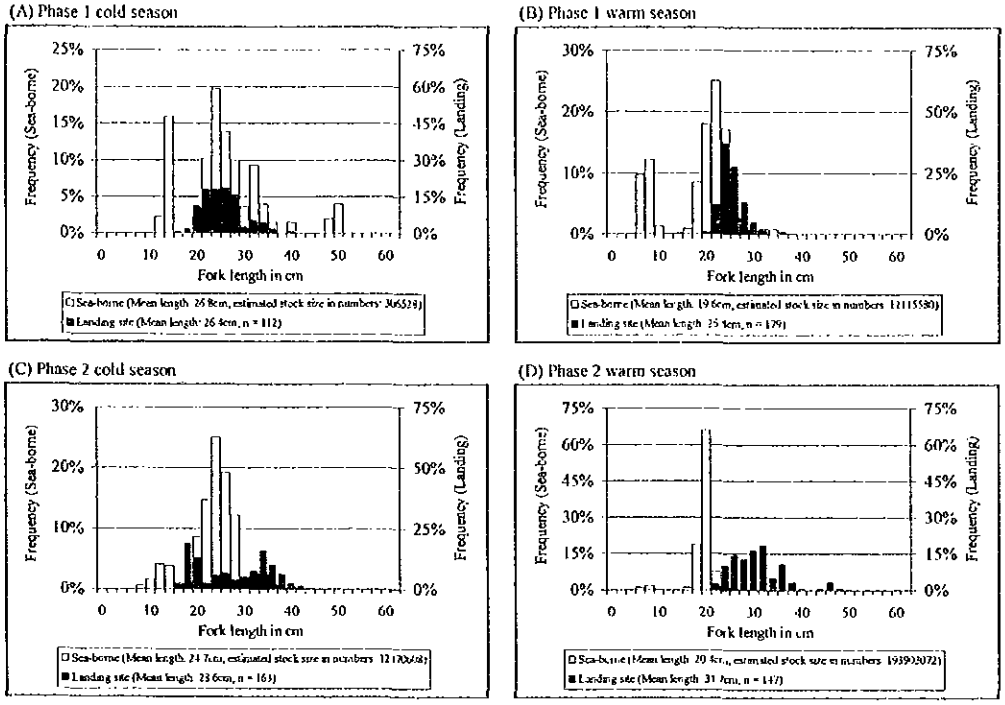


Figure 5.20 Size composition of estimated stock number and landed individuals for bluespotted seabream *Pagrus caeruleostictus*.

6) Canary dentex *Dentex canariensis*

The size composition of the Canary dentex from data obtained from the resources survey and the Landing Site Survey is illustrated in Figure 5.21. The fork length class is indicated at intervals of 2 cm.

The size composition of the estimated stock number inferred from the Phase 2 cold season survey was in the 12–36 cm class, with the dominant mode at the 16–18 cm class, and the mean size of 18.7 cm. On the other hand, the size composition of specimens landed in the cold season was in the 10–50 cm class; the mode occurred at the 26–28 cm class, and the mean size was 28.1 cm.

The size of landed individuals tended toward the large sizes found in the resources survey, and juveniles (size at first maturity for female: about 21 cm – see 3.4.6) were practically unseen.

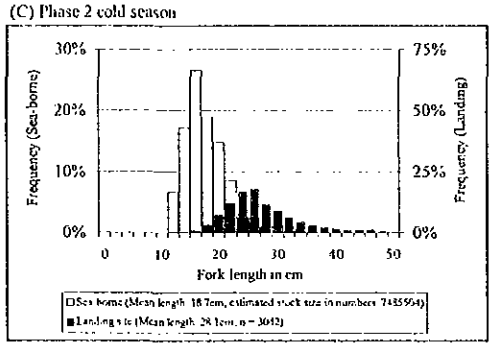


Figure 5.21 Size composition of estimated stock number and landed individuals for Canary dentex *Dentex canariensis.*

7) Red pandora *Pagellus bellottii*

The size composition of the red pandora from data obtained from the resources survey and the Landing Site Survey is illustrated in Figure 5.22. The fork length class is indicated at intervals of 1 cm.

The size composition of the estimated stock number inferred from the Phase 2 cold season survey was in the 4–32 cm class, with the dominant mode at the 8–9 cm class, and the mean size of 12.6 cm. On the other hand, the size composition of specimens landed in the cold season was in the 18–30 class; the mode occurred at the 22–23 cm class, and the mean size was 23.0 cm.

The size of landed individuals tended toward the large sizes found in the surveys (the right-hand side of the size composition). The size at first maturity for females was about 19 cm in the cold season (see 3.4.6). The minimum capture size for this species according to IRM regulations is 18 cm. As a consequence, one could realize that juveniles, though not numerous, were being landed.

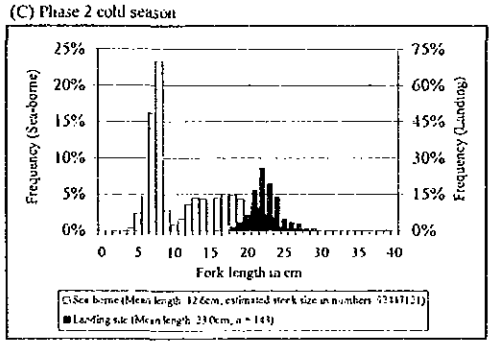


Figure 5.22 Size composition of estimated stock number and landed individuals for red pandora *Pagellus bellottii.*

8) Flathead mullet *Mugil cephalus*

The size composition of the flathead mullet from data obtained from the resources survey and the Landing Site Survey is illustrated in Figure 5.23. The fork length class is indicated at intervals of 2 cm.

The size composition of the estimated stock number inferred from the Phase 2 cold season survey was in the 10–66 cm class, with the dominant mode at the 36–38 cm class, and the mean size of 39.1 cm. On the other hand, the size composition of specimens landed in the cold season was in the 22–78 class; the mode occurred at the 40–42 cm class, and the mean size was 38.4 cm.

The size of landed individuals was quite close to that found in the resources survey. According to the Fish Base (http://www.fishbase.org), the size at first maturity for females of this species in the Lion Gulf (Golfe du Lion), France, is 33.0 cm. Assuming this size for mature females also applies to the IRM waters, a moderate number of juveniles should have been landed.

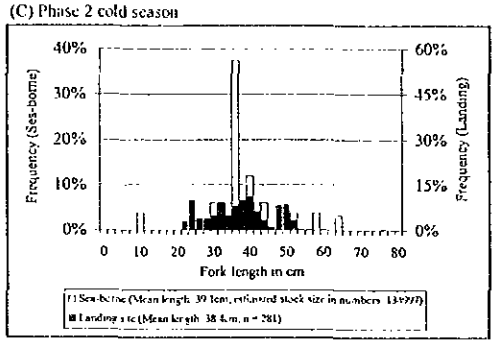


Figure 5.23 Size composition of estimated stock number and landed individuals for flathead mullet *Mugil cephalus*.

9) Senegalese sole *Solea senegalensis*

The size composition of the Senegalese sole from data obtained from the resources survey and the Landing Site Survey is illustrated in Figure 5.24. The total length class is indicated at intervals of 2 cm.

The size composition of the estimated stock number inferred from the Phase 2 cold season survey was in the 18–44 cm class, with the dominant modes at the 20–22 cm and 36–38 cm classes, and the mean size of 29.2 cm. On the other hand, the size composition of specimens landed in the cold season was in the 20–56 class; the mode was present at the 32–34 cm class, and the mean size was 37.0 cm.

The size of landed individuals tended toward the large sizes classes found in the resources survey. In the cold season, the size at first maturity for females was about 27 cm (see 3.2.6). Not many juveniles were landed.

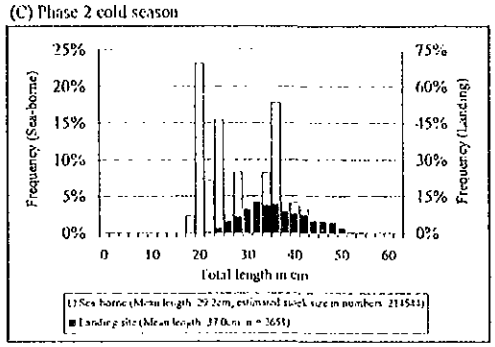


Figure 5.24 Size composition of estimated stock number and landed individuals for Senegalese sole *Solea senegalensis*.

10) European squid *Loligo vulgaris*

The size composition of the European squid from data obtained from the resources survey and the Landing Site Survey is illustrated in Figure 5.25. The mantle length class is indicated at intervals of 2 cm.

The size composition of estimated stock number of European squid inferred from the Phase 1 cold season survey was in the 4–44 cm class, with the dominant mode at the 6–8 cm class, and the mean size of 10.6 cm. On the other hand, the size composition of specimens landed in the cold season was in the 8–22 class; the mode was present at the 12–14 cm class, and the mean size was 14.2 cm.

The size of landed individuals was somewhat longer than that of squids found in the resources survey.

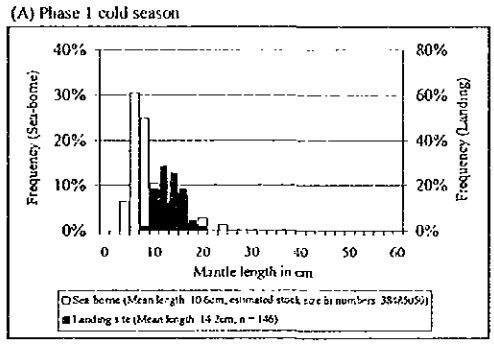


Figure 5.25 Size composition of estimated stock number and landed individuals for European squid *Loligo vulgaris*.

11) Common cuttlefish *Sepia officinalis*

The size composition of the common cuttlefish from data obtained from the resources survey and the Landing Site Survey is illustrated in Figure 5.26. The mantle length class is indicated at intervals of 1 cm.

The size composition of estimated stock number inferred from the Phase 1 cold season survey was in

the 16–26 cm class, with the dominant mode at the 20–22 cm class, and the mean size of 20.3 cm. On the other hand, the size composition of specimens landed in the cold season was in the 6–34 class; the mode occurred at the 17–18 cm class, and the mean size was 19.9 cm.

The size composition of estimated stock number inferred from the Phase 2 cold season survey was in the 10–33 cm class, with the dominant modes at the 20–21 cm and 25–26 cm classes, and the mean size of 21.1 cm. On the other hand, the size composition of specimens landed in the Phase 2 cold season was in the 10–48 class, a wide interval. The predominant mode was not observed clearly. The mean size of landed individuals was 27.7 cm.

The size at first maturity for females in the cold season was 11 cm (see 3.4.6). Most of the immature individuals were not landed.

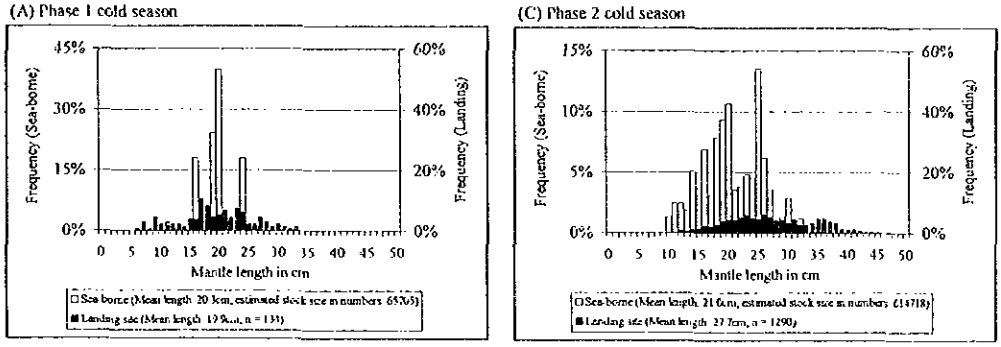


Figure 5.26 Size composition of estimated stock number and landed individuals for common cuttlefish *Sepia officinalis*.

12) Common octopus *Octopus vulgaris*

The size composition of the common octopus from data obtained from the resources survey and the Landing Site Survey is illustrated in Figure 5.27. The mantle length class is indicated at intervals of 1 cm.

The size composition of estimated stock number of common octopus inferred from the Phase 2 warm season survey was in the 4–24 cm class, with the dominant mode at the 11–12 cm class, and the mean size of 11.1 cm. On the other hand, the size composition of specimens landed was in the 8–31 class; the mode was slightly observed at the 15–16 cm class, and the mean size was 16.5 cm.

The size of landed individuals was as large as or even larger than large size of the common octopus found in the resources survey. The size at first maturity for females in the warm season was 6 cm (see 3.4.6). Apparently, not many immature individuals were landed.

The smallest size landed was present at the 8–9 cm class. The weight of those individuals with a mantle length of 8 or 9 cm, calculated by the length-weight equation $BW = 2.946 \times ML^{2.294}$ (see Figure 3.82), would be 347 g and 455 g respectively. In the IRM, the current minimum catch weight for this species is 500 g. Although in small numbers, individuals smaller than the minimum regulation size were being landed.

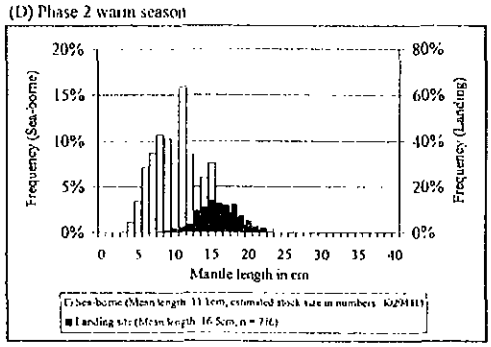


Figure 5.27 Size composition of estimated stock number and landed individuals for common octopus *Octopus vulgaris*

With reference to the *transitional period surveys*:

1) Smooth-hound *Mustelus mustelus*

The size composition of the smooth-hound from data obtained from the resources survey and the Landing Site Survey is illustrated in Figure 5.28. The total length class is indicated at intervals of 5 cm.

The size composition of the estimated stocks inferred from the resources survey between the warm season and the cold season in Phase 2 was in the 45–110 cm class, with the dominant mode at 65–70 cm class, and the mean size of 69.0 cm. On the other hand, the size composition of specimens obtained by the Landing Site Survey was in the 55–80 class; the dominant mode was present at the 60–65 cm class, and the mean size was 64.9 cm.

The size composition of specimens landed in the transitional period between the warm and cold season was located in the middle-size class as found in the resources survey.

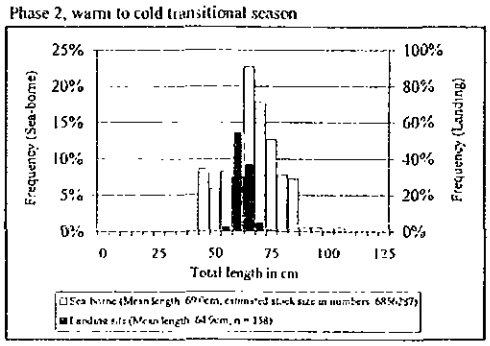


Figure 5.28 Size composition of estimated stock number and landed individuals for smooth-hound *Mustelus mustelus*.

2) Bluespotted seabream *Pagrus caeruleostictus*

The size composition of the bluespotted seabream from data obtained from the resources survey and the Landing Site Survey is illustrated in Figure 5.29. The fork length class is indicated at intervals of 2 cm.

The size composition of the estimated stock number inferred from the resources survey between the warm season and the cold season in Phase 2 was in the 14–26 cm class, with the dominant mode at the 20–22 cm class, and the mean size of 21.0 cm. On the other hand, the size composition of landed specimens was in the 16–46 class; the dominant mode was observed at the 24–26 cm class, and the mean size was 26.1 cm.

The size of landed individuals tended toward large sizes.

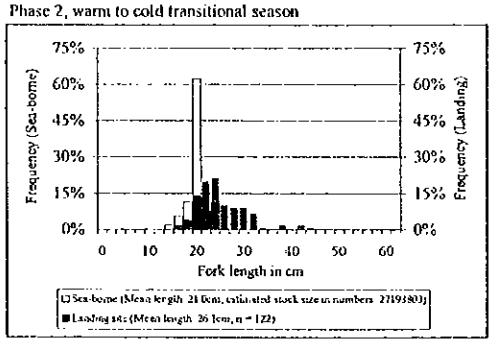


Figure 5.29 Size composition of estimated stock number and landed individuals for bluespotted seabream *Pagrus caeruleostictus*.

3) Red pandora *Pagellus bellottii*

The size composition of the red pandora from data obtained from the resources survey and the Landing Site Survey is illustrated in Figure 5.30. The fork length class is indicated at intervals of 1 cm.

The size composition of the estimated stock number inferred from the resources survey between the warm season and the cold season in Phase 2 was in the 8–29 cm class, with the two dominant modes at 12–13 cm and 18–19 cm in classes respectively, and the mean size of 15.5 cm. On the other hand, the size composition of landed specimens was in the 16–24 cm class; the dominant mode was present at the 21–22 cm class, and the mean size was 20.4 cm.

The size of landed individuals tended toward large sizes.

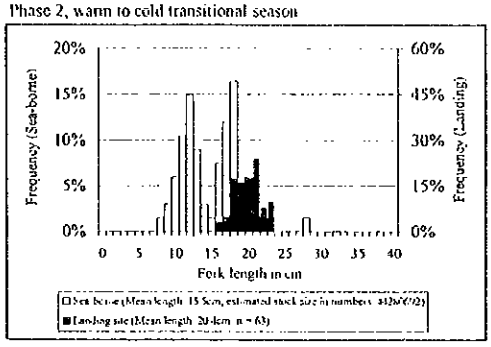


Figure 5.30 Size composition of estimated stock number and landed individuals for red pandora *Pagellus bellottii*.

(6) Evaluation of the status of demersal species resources

To evaluate the status of demersal species resources, basically the most important information is to know the stock size (biomass – see Table 5.4) and catch (in weight) of the species living in the fishing grounds and targeted by fisheries.

1) Species targeted by fisheries

The species targeted by artisanal fisheries were restricted to the ones landed during the Landing Site Survey. On the other hand, as for industrial fisheries, little is known of the portion corresponding to those "other species" apart from the target species of this survey with respect to their fishing conditions and utilization. For this reason, the species targeted by industrial fisheries were limited to the target species of the study.

2) Estimated stock size

The survey conducted by the *Al-Awam* (see Table 3.5) in the coastal area (3–20 m stratum) in the cold and warm seasons of 2000 did not fully cover the survey area, and the stock size in this area was not considered.

In 2001, the catchable stock size for artisanal fisheries – that is, the stock size of the entire nectobenthos at the 3–20 m stratum excepting the Banc d'Arguin, a potentially catchable stock size – was 239,885 tonnes in the cold season and 161,097 tonnes in the warm season, the mean value of both seasons being 200,491 tonnes.

As for the catchable stock size for industrial fisheries, it in the cold and warm seasons of 2000 at the 20–400 m strata was 72,180 tonnes and 92,606 tonnes respectively, with the mean value of 82,393 tonnes. The cold and warm seasons of 2001, the catchable stock size for industrial fisheries was 42,737 tonnes and 103,886 tonnes respectively, the mean value of both seasons being 73,312 tonnes.

3) Catch size

Production of artisanal fisheries in 2000 was 19,456 tonnes (Table 5.1). This production represents the combined catches of pelagic and demersal species, and the latter cannot be separated from the total catch. Also, the authorities in charge have not yet released official statistics on the production of artisanal fisheries in 2001. For this reason, it was not possible to apprehend the true picture of the utilization of resources by artisanal fisheries, or to estimate the actual exploitation of resources.

On the other hand, catch of industrial fisheries was the production yielded by iced storage and freezer trawlers aiming to harvest demersal species. For those two types of vessel, production of demersal species in 2000 was of 21,943 tonnes, according to the ONS fishery statistics (see Table 5.1). For 2001, since at the moment the related fishery statistics remain unpublished, the situation is unclear. Presuming the production of iced storage and freezer trawlers in 2001 was at the same scale as in the previous year, it should be around 21,000 tonnes.

4) Status evaluation

The catch size (landed quantity: production) and catchable stock size in 2000 and 2001, related to the above-mentioned demersal species stocks targeted by artisanal and industrial fisheries, are summarized in Table 5.8.

As for industrial fisheries, fishing rate – calculated from the mean value of catchable stock size in the cold and warm seasons and from production – was around 27% in 2000, and estimated as around 29% in 2001 by similar calculations. The estimated fishing rate of industrial fisheries presumes a fishing efficiency of 1.0 of the trawl gear in estimating the catchable stock size, and is thought to be lower than the value reported above.

Table 5.8 Catch (production) and catchable stock size for artisanal and industrial fisheries.

Units: tonnes

Year	Artisanal fishery		Industrial fishery	
	Products	Catchable stock size*1	Products	Catchable stock size*2
2000	-	-	21,943	72,180 ~ 92,606 (Mean: 82,393)
2001	-	161,097 ~ 239,885 (Mean: 200,491)	21,000	42,737 ~ 103,886 (Mean: 73,312)

Remark. *1: Estimated catchable stock size of all species caught in 3-20m stratum by *Al-Awam*.
*2: Estimated catchable stock size of all species caught in 20-400m stratum by *Al-Awam*.

5) Problems with status evaluation

As previously mentioned, separate catch statistics by species and by fishery category are essential for the better understanding of the utilization of demersal resources, but are not being consolidated in the IRM today. Therefore, as an alternative, data obtained from the ONS fishery statistics concerning the

production by fishery category was utilized.

One of the indicators of accuracy in estimating stock size is the coefficient of variation (CV), which should be below 20% to be of any significance to fishery resources. Among the target species in this study in the cold and warm seasons in 2000 and 2001, for each season, the CV of the total stock size of selected species (see Table 3.19) in relation to the five species with the highest stock size was: the smooth-hound *Mustelus mustelus*, 35–100%; the Senegalese hake *Merluccius senegalensis* (in Phase 1 possibly mixed with *Merluccius polli*), 13–44%; the bluespotted seabream *Pagrus caeruleostictus*, 31–67%; the Canary dentex *Dentex canariensis*, 37–49%, the red pandora *Pagellus bellottii*, 16–33%; the West African goatfish *Pseudupeneus prayensis*, 19–50%; the European squid *Loligo vulgaris*, 14–22%; the common octopus *Octopus vulgaris*, 9–20%. For those eight species, with the exception of the smooth-hound *Mustelus mustelus* and the bluespotted seabream *Pagrus caeruleostictus*, the mean CV was 25%, indicating their stock estimates are quite accurate.

Among the basic data here employed for status evaluation, as mentioned before, stock size estimate is thought to be highly reliable. However, the fishery statistics and landed quantity in contrast to the stock size estimate could have problems with the quality, accuracy or limits of applicability of the data utilized.

In 2001, the catchable stock size at the 3-20 m stratum, thought to be the target of artisanal fisheries, was quite abundant, with a mean value of 200,491 tonnes, about three times the amount present in the offshore area. Today, production of artisanal fisheries in 2001 could be tentatively estimated as about the same 20,000 tonnes of 2000, as all species concerned are demersal and the fishing rate of demersal species resources by artisanal fisheries was under 10% and stayed at a low scale.

Although this study could not make it clear, it is believed that the potential stock size in the coastal area is much more abundant than that of the offshore area. Because of this, to efficiently explore those resources and to plan the promotion of artisanal fisheries and the creation of employment, there is a need to proceed the continuation of this resources survey or to construct a more accurate system of fishery statistics.

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Appendix Table 5.1 Number of actual trawl stations for the *transitional period survey*.

Survey	Survey period	Survey area	Stratum						Total
			3-20m	20-30m	30-80m	80-200m	200-400m	Unidentified	
1TCW*1	12 July to 27 July 2000	North	3	5	7	3	0	0	18
		Central	12	7	16	9	0	0	44
		South	5	3	11	14	0	2	35
		Unidentified	0	0	0	0	0	1	1
		Entire	20	15	34	26	0	3	98
1TWC*2	27 November to 9 December 2001	North	8	5	8	6	0	0	27
		Central	8	1	10	7	0	0	26
		South	3	6	14	9	0	0	32
		Entire	19	12	32	22	0	0	85
2TWC*3	23 December 2001 to 2 January 2002	North	8	4	8	6	1	0	27
		Central	7	2	8	8	0	0	25
		South	4	4	12	8	0	0	28
		Entire	19	10	28	22	1	0	80

Remark. *1: Phase 1 cold to warm transitional season.
*2: Phase 1 warm to cold transitional season.
*3: Phase 2 warm to cold transitional season.

Appendix Table 5.2 Area swept per haul (km^2) by the trawl net of the *Al-Awam* for the *transitional period survey*.

	Survey		
	1TCW*1	1TWC*2	2TWC*3
Mean	0.0419	0.0432	0.0406
Standard deviation	0.0125	0.0119	0.0107
Range	0.007 - 0.064	0.006 - 0.085	0.006 - 0.080

Remark. *1: Phase 1 cold to warm transitional season.
*2: Phase 1 warm to cold transitional season.
*3: Phase 2 warm to cold transitional season.

Appendix Table 5.3 Estimated stock size of nectobenthos in tonnes and top five species for the *transitional period survey*.

(A). Phase 1, cold to warm transitional season

Top 5 ranked species	North					Central					South					Total
	Stratum				Total	Stratum				Total	Stratum				Total	
	3-20m	20-30m	30-80m	80-200m		3-20m	20-30m	30-80m	80-200m		3-20m	20-30m	30-80m	80-200m		
Mustelus mustelus	* 14336	* 2100	45		* 16481		7	32		39	4	8	86		98	* 16619
Rhinobatos cemiculus	2819	* 535	219	15	3587	22	168	36	10	237	133	63	26		222	4046
Zanobatus schoenleinii	49	28			77	71	92	10		172	185	* 225			410	659
Raja miraletus	82	75	* 449		606		10	292	356	659	1		* 364	44	409	1674
Dasyatis chrysonota marmorata	265	208	* 438		911	7	59	35	301	402	204	21	15		240	1553
Arius heudelotii	344	476	* 569	15	1404		* 924	99	2	1025	206	9	* 892	11	1118	3546
Merluccius senegalensis									* 4026	* 4026				* 758	758	4784
Dactylopterus volitans		104			104	* 249	2	3		254		2			2	360
Pontinus kuhlii									113	113				* 600	600	713
Eucinostomus melanopterus		3			3	23	* 508	83		614	432	* 202	53		687	1304
Pomadasys incisus	* 4812	261	57		* 5130		34	322	269	625	* 513	153	319	116	1100	6855
Brachydeuterus auritus		* 1950	93	* 472	2514	2	299	523	2	826	* 665		234	* 418	* 1317	4657
Plectorhinchus mediterraneus	* 27777	* 2150			* 29927	25	195	* 790	285	1295	* 821	191	* 1677	3	* 2692	* 33914
Dentex macrophthalmus			75	1	77			1	* 2773	* 2773				37	37	2887
Dentex maroccanus			4		4			43	* 3991	* 4035			11	313	324	4363
Diplodus sargus cadenati	* 4572				4572		132			132						4704
Diplodus bellottii	* 21164	114	16		* 21294	2				2						* 21296
Pagellus bellottii	2245	* 816	* 1916	* 79	* 5056	* 482	* 1453	* 2574	* 2653	* 7162	345	* 536	* 852	4	* 1737	* 13955
Galeoides decadactylus		54	47	* 396	497		428	414		843	* 1249	20	121		* 1390	2729
Pseudupeneus prayensis	11	43	30	8	91	* 629	* 1020	* 898	94	2640	62	* 503	328		894	3625
Drepane africana							352	41		393	* 784	30	71		885	1278
Trichiurus lepturus			262		262	53	252	* 2125	221	2650	91	45	16	* 837	990	3902
Psettodes belcheri	426	124	228	* 168	946	83				83						1029
Balistes carolinensis								20		20	91	* 463	280		835	855
Cymbium spp.	2188	14	194		2397	* 324	13	88	308	733	208				208	3338
Octopus vulgaris	437	277	* 895	* 404	2014	* 1465	* 846	* 2353	* 2006	* 6671	129	8	* 398	* 632	* 1167	* 9851
Zeus faber			+		+			9	700	709			1	67	67	776
Epinephelus aeneus		197	54	5	256	36	79	308		423	128	6	4		137	817
Pagrus caeruleostictus	1011	70	54		1134	127	505	307	230	1169	312	194	215		722	3025
Dentex angolensis									53	53			13	47	59	113
Dentex canariensis	919	7	16		942	11	61	445	63	580		94	86		180	1702
Argyrosomus regius		6		43	50		23			23	8			3	11	83
Solea senegalensis	240	61	27		328		29			29		12			12	368
Loligo vulgaris	264	32	256	60	612			499	1646	2144			38	407	446	3202
Sepia officinalis	327	44	30	13	414	225	7	111		343	53		21	2	76	833
Penaeus notialis		2	4	1	7	1	1	+		2	9		1		10	19
Parapenaeus longirostris									44	44				12	12	56
Palinurus mauritanicus	289	20			309											309
Panulirus regius		12			12						3				3	14
All of other species	13654	1361	689	166	15870	804	1743	2417	4544	9508	1788	510	1494	1199	4990	30368
Total	98231	11143	6668	1847	117889	4642	9242	14877	24690	53450	8423	3293	7616	5512	24845	196184

Remarks. Underline: target species, *: top five stocks in each category, +: stock less than 1 tonne.

Appendix Table 5.3 continued.

(B). Phase 1. warm to cold transitional season

Top 5 ranked species	North					Central					South					Total
	Stratum				Total	Stratum				Total	Stratum				Total	
	3-20m	20-30m	30-80m	80-200m		3-20m	20-30m	30-80m	80-200m		3-20m	20-30m	30-80m	80-200m		
Mustelus mustelus	* 6186	* 121		10	* 6317								7	11	19	6335
Rhinoptera sp.								* 276		276		9			9	284
Pterothrissus belloci				* 2394	* 2394				* 1814	* 1814				676	676	4884
Arius heudelotii	1358		29		1387	90		33		124	* 9743	341	* 1006		* 11090	* 12601
Brotula barbata				43	43				147	147		53	201	* 883	1137	1327
Merluccius senegalensis				* 1701	1701				38	38				* 1126	1126	2865
Halobatrachus didactylus	330	* 142	4		476	39		78		117		17			17	611
Zeus faber		8	* 230	275	513			98	* 814	912			55	592	647	2072
Capros aper				* 836	836				5	5						841
Pontinus kuhlii				* 551	551				* 1274	1274				* 2220	2220	4046
Synagrops microlepis				399	399				* 1811	* 1811			7	* 2744	2751	4962
Pomadasys incisus	* 19364	13	35	27	* 19438	* 702	* 195	205		1102	10	* 848	222		1080	* 21620
Pomadasys jubelini	13				13	307		38		345	* 3382	159	36		* 3578	3936
Brachydeuterus auritus	85				85	* 1568		95		1664	* 1624	* 1278	* 5102	363	* 8367	* 10116
Plectorhinchus mediterraneus	17				17	418	53	271	8	751	916	* 819	50	129	1914	2681
Pagrus caeruleostictus	1326		12		1338	331		83		414	296	* 621	14		931	2682
Boops boops	31	7	4		41	+	45	* 520	41	605		1	32	156	188	835
Dentex canariensis	839	46	6	3	894	292	* 60	103	3	458	17	86	87		190	1542
Dentex macrophthalmus			* 183	* 1260	1443			227	* 3245	* 3472				638	638	5553
Dentex maroccanus			* 288	81	369			94	180	274			145	* 891	1036	1679
Diplodus bellottii	* 2096	25			* 2121	401				401						2523
Pagellus bellottii	1674	* 127	169		1970	* 604	* 1138	* 2144	10	* 3896		460	* 21549	416	* 22425	* 28291
Galeoides decadactylus	* 1854				1854	* 4109		86		* 4195	* 2443	* 1122	* 475		* 4039	* 10088
Pteroscion peli	+				+	6		35		41	* 1330	437	* 721	20	2508	2549
Trichiurus lepturus	1175			313	1488	* 851	9	125	140	1125	532	190	471	259	1453	4066
Stromateus fiatola	* 1844		22		1867	93				93	44		50		94	2053
Aluterus sp.	105				105		* 75			75	26	16	13		55	235
Loligo vulgaris	863	* 275	* 961		* 2099	128	* 148	* 521	72	868	47	7	92	148	294	3261
Octopus vulgaris	417	* 186	* 499	256	1359	60	47	* 503	264	874	20	4	143	242	409	2641
Mugil cephalus											152				152	152
Epinephelus aeneus	29				29			61		61		18	3		22	112
Dentex angolensis				38	38				248	248			138		138	424
Argyrosomus regius	61	22			83	283				283	17	11	113		142	508
Pseudupeneus prayensis	61				61	205	45	46		296	67	148	25		240	597
Solea senegalensis	13				13	30				30	7	24			32	74
Sepia officinalis	416	91	63	19	589	343	32	97	4	475	315	164	120	57	656	1719
Penaeus notialis	252		1		253	13		2		15	24	4	74		101	370
Parapenaeus longirostris													2	123	125	125
All of other species	6973	295	635	1504	9407	2870	54	1176	2267	6366	7154	1016	2409	3884	14463	30236
Total	47383	1358	3141	9708	61590	13743	1899	6917	12386	34945	28166	7851	33363	15581	84961	181496

Remarks. Underline: target species, *: top five stocks in each category, +: stock less than 1 tonne.

Appendix Table 5.3 continued.

(C). Phase 2. warm to cold transitional season

Top 5 ranked species	North					Central					South					Total
	Stratum				Total	Stratum				Total	Stratum				Total	
	3-20m	20-30m	30-80m	80-200m		3-20m	20-30m	30-80m	80-200m		3-20m	20-30m	30-80m	80-200m		
Raja miraletus	357		45		402	38		8	10	56	170	* 249	* 646	73	1138	1596
Myliobatis aquila	* 8169				* 8169						98				98	8266
Pterothrissus belloci				* 289	289				125	125			58	44	102	515
Arius heudelotii	3328	* 3763	* 3214	7	* 10312	* 3334	3	25	201	* 3563	* 953	60	153		1166	* 15042
Merluccius senegalensis				* 225	225			1	176	177				16	16	418
Zeus faber			+	42	43	309		95	* 511	915			147	189	336	1293
Pontinus kuhlii				4	4				* 209	209				52	52	265
Priacanthus arenatus						876	* 176	* 571	38	1662			107	86	193	1855
Pomadasys incisus	* 6414	* 786	* 3129	3	* 10332	* 6024	7	18	73	* 6122	156	* 567	275	* 2971	* 3968	* 20422
Pomadasys perotaei							8	25	38	72	* 1638	205	167		* 2010	2082
Brachydeuterus auritus	5342	* 585	* 2105	36	8068	181			38	219	361	189	527	140	1217	9505
Parapristipoma octolineatum								* 526		526						526
Plectorhinchus mediterraneus	281	73	8		365	601		172		773		* 215	12	* 1272	* 1500	2636
Pagrus caeruleostictus	* 10077		8	7	* 10092	* 2460	7	64	52	2582	259	* 303	86	152	800	* 13474
Dentex macrophthalmus				* 173	173			16	13	29				25	25	228
Dentex maroccanus				21	21			7	36	43			458	* 296	754	818
Diplodus vulgaris	1232				1232	* 2829				* 2829						4061
Diplodus bellottii	* 10361	* 3017	* 1750		* 15128	568		1	3	573	315	183	10		10	* 15711
Pagellus bellottii	4263	25	1633	147	6067	* 6849	* 88	* 340	* 512	* 7790	315	183	* 1689	* 1015	* 3202	* 17059
Galeoides decadactylus	* 6039	359	85		6482	941			117	1058	* 1473	* 2191	* 660	151	* 4475	12015
Argyrosomus regius	546	* 1166	274		1985	153	3			157		1	115		116	2259
Pseudotolithus senegalensis		182			182				17	17	* 646	148	92	33	919	1119
Pteroscion peli		60	* 1697		1757				14	14	* 565	173	112		850	2621
Pseudupeneus prayensis	16		3		20	958	17	133	17	1125	199	67	298	* 698	1262	2406
Xyrichtys novacula							* 50			50						50
Trichiurus lepturus	618	46	1292	* 561	2517	620	* 49	* 1514	* 440	* 2623	249	130	* 793	217	1389	6529
Sepia officinalis	341	68	1158	2	1570	295	* 48	12	35	390	179	137	46	48	409	2369
Octopus vulgaris	28	5	132	* 266	432	158	48	* 385	* 486	1076			190	170	360	1869
Penaeus notialis	66	100	242		408	4	2	1	2	9	11	+	* 563	7	582	998
Mustelus mustelus	3343	444			3787							12	10		22	3809
Merluccius polli									9	9						9
Mugil capurrii		18			18											18
Mugil cephalus						185				185						185
Epinephelus aeneus	200		58		258	44		30		74	33	2	51	27	114	446
Dentex angolensis				51	51			5	158	162			74	25	99	312
Dentex canariensis	1108		7	9	1124	1918		198	17	2134	14	45	98	99	256	3514
Solea senegalensis	11	15			26							2			2	28
Loligo vulgaris	127	63	111	33	335	74	15	51	7	147	36	190	89	164	480	962
Parapenaeus longirostris									+	+			-	1	2	2
Panulirus regius		2			2											2
All of other species	22915	1344	2223	430	26913	5586	72	701	753	7112	1960	562	2026	892	5440	39465
Total	85183	12118	19178	2308	118787	35005	593	4899	4107	44605	9315	5632	9552	8866	33366	196758

Remarks. Underline: target species, *: top five stocks in each category, +: stock less than 1 tonne.

Appendix Table5.4 Appearance list of species for the *transitional period survey*. (1/12)

Order / Family / Species	Habitat	Area	Stratum (isobath range in m)											
			3-20m			20-30m			30-80m			80-200m			200-400m		
			1TCW	1TWC	2TWC	1TCW	1TWC	2TWC	1TCW	1TWC	2TWC	1TCW	1TWC	2TWC	1TCW	1TWC	2TWC
1 Carcharhiniformes																	
1 Scyliorhinidae																	
1 *Scyliorhinus canicula*	demersal	North											X	X			
		Central											X				
		South										X					
2 *Scyliorhinus stellaris*	reef-associated	North											X				
		Central															
		South															
2 Leptocharidae																	
3 *Leptocharias smithii*	demersal	North	X	X	X	X			X	X	X	X					
		Central		X		X			X								
		South	X	X	X	X	X		X	X	X						
3 Triakidae																	
4 *Mustelus mustelus*	demersal	North	X	X	X	X	X	X	X				X				
		Central				X			X								
		South	X			X		X	X	X	X		X				
4 Hemigaleidae																	
5 *Paragaleus pectoralis*	demersal	North		X													
		Central															
		South								X							
5 Carcharhinidae																	
6 *Rhizoprionodon acutus*	demersal	North		X	X			X			X						X
		Central															
		South			X		X	X		X							
7 *Sphyrna zygaena*	benthopelagic	North							X			X					
		Central				X			X								
		South	X						X		X	X					
8 *Sphyrna* sp	-	North															
		Central				X											
		South							X			X					
2 Hexanchiformes																	
6 Hexanchidae																	
9 *Heptranchias perlo*	bathydemersal	North															
		Central															
		South															
3 Rajiformes																	
7 Torpedinidae																	
10 *Torpedo torpedo*	demersal	North				X								X			
		Central	X		X				X	X		X	X				
		South			X		X		X	X	X	X	X	X			
11 *Torpedo marmorata*	demersal	North		X													
		Central															
		South			X		X										
8 Rhinobatidae																	
12 *Rhinobatos cemiculus*	demersal	North	X	X	X	X	X	X	X			X					X
		Central	X	X	X	X			X			X		X			
		South	X		X	X		X	X		X						
13 *Rhinobatos* sp.	-	North															
		Central		X	X												
		South		X			X			X							
14 *Zanobatus schoenleinii*	demersal	North	X	X	X	X		X			X			X			
		Central	X	X	X	X			X	X							
		South	X	X	X	X	X	X		X	X			X			
9 Rajidae																	
15 *Raja miraletus*	demersal	North	X	X	X	X	X		X	X	X						
		Central		X	X	X			X	X	X	X	X	X			
		South	X	X	X		X	X	X	X	X	X	X	X			
16 *Raja straeleni*	demersal	North	X			X			X				X				
		Central								X	X	X	X				
		South							X			X	X				
17 *Raja undulata*	demersal	North		X	X		X	X					X				X
		Central															
		South															
18 *Rajella barnardi*	bathydemersal	North					X										
		Central															
		South															
10 Dasyatidae																	
19 *Dasyatis centroura*	demersal	North															
		Central	X														
		South															
20 *Dasyatis chrysonota marmorata*	demersal	North	X	X	X	X	X	X	X								
		Central	X	X	X	X			X			X		X			
		South	X	X	X	X	X	X	X	X				X			
21 *Dasyatis pastinaca*	demersal	North			X												
		Central							X								
		South															

Remark. 1TCW: Phase 1, cold to warm transitional season 1TWC: Phase 1, warm to cold transitional season. 2TWC: Phase 2, warm to cold transitional season.

Appendix Table5.4 Appearance list of species for the *transitional period survey*. (2/12)

Order / Family / Species	Habitat	Area	Stratum (isobath range in m)													
			3-20m			20-30m			30-80m			80-200m			200-400m		
			1TCW	1TWC	2TWC	1TCW	1TWC	2TWC	1TCW	1TWC	2TWC	1TCW	1TWC	2TWC	1TCW	1TWC	2TWC
22 *Dasyatis* sp.	-	North			X			X									
		Central		X	X					X							
		South	X				X		X	X							
23 *Taeniura grabata*	demersal	North															
		Central															
		South		X													
11 Gymnuridae																	
24 *Gymnura altavela*	demersal	North	X		X	X		X									
		Central		X		X								X			
		South			X					X							
12 Myliobatidae																	
25 *Myliobatis aquila*	benthopelagic	North	X		X	X											
		Central															
		South			X				X								
26 *Rhinoptera bonasus*	benthopelagic	North															
		Central		X													
		South															
27 *Rhinoptera marginata*	benthopelagic	North															
		Central															
		South	X	X													
28 *Rhinoptera* sp.	-	North															
		Central								X							
		South					X										
4 *Albuliformes*																	
13 Albulidae																	
29 *Albula vulpes*	reef-associated	North															
		Central				X											
		South															
30 *Pterothrissus belloci*	bathydemersal	North							X				X	X			
		Central										X	X	X			
		South									X	X	X	X			
5 Anguilliformes																	
14 Ophichthidae																	
31 *Ophichthus rufus*	demersal	North															
		Central															
		South								X							
32 *Ophisurus serpens*	demersal	North															
		Central															
		South								X							
15 Congridae																	
33 *Ariosoma balearicum*	demersal	North							X								
		Central															
		South		X					X	X							
34 *Ariosoma* sp.	-	North				X											
		Central															
		South															
6 Siluriformes																	
16 Ariidae																	
35 *Arius heudelotii*	demersal	North	X	X	X	X		X	X	X	X	X		X			X
		Central		X	X	X		X	X	X	X	X		X			
		South	X	X	X	X	X	X	X	X	X	X					
7 Stomiiformes																	
17 Stomiidae																	
36 *Chauliodus* sp	-	North															
		Central	X						X								
		South															
8 Aulopiformes																	
18 Chlorophthalmidae																	
37 *Chlorophthalmus agassizi*	bathydemersal	North											X				
		Central										X	X	X			
		South										X	X				
38 *Chlorophthalmus* sp.	-	North															
		Central										X					
		South															
19 Synodontidae																	
39 *Synodus saurus*	demersal	North															
		Central							X								
		South										X	X				
40 *Synodus synodus*	demersal	North															
		Central				X											
		South									X						
41 *Trachinocephalus myops*	reef-associated	North															
		Central					X		X								
		South					X			X							

Remark. 1TCW: Phase 1, cold to warm transitional season. 1TWC: Phase 1, warm to cold transitional season. 2TWC: Phase 2, warm to cold transitional season.

Appendix Table5.4 Appearance list of species for the *transitional period survey* . (3/12)

Order / Family / Species	Habitat	Area	Stratum (isobath range in m)													
			3-20m			20-30m			30-80m			80-200m			200-400m		
			1TCW	1TWC	2TWC	1TCW	1TWC	2TWC	1TCW	1TWC	2TWC	1TCW	1TWC	2TWC	1TCW	1TWC	2TWC
42 *Saurida brasiliensis*	demersal	North							X		X			X			
		Central							X		X	X		X			
		South									X	X	X	X			
9 Ophidiiformes																	
20 Ophidiidae																	
43 *Brotula barbata*	benthopelagic	North											X				
		Central											X	X			
		South					X			X	X	X	X	X			
44 *Ophidion barbatum*	demersal	North															
		Central															
		South									X			X			
45 Ophidiidae	-	North															
		Central															
		South							X					X			
10 Gadiformes																	
21 Macrouridae																	
46 *Malacocephalus laevis*	benthopelagic	North															
		Central															
		South											X				
47 *Malacocephalus occidentalis*	benthopelagic	North											X				
		Central															
		South															
48 *Malacocephalus* sp.	-	North															
		Central															
		South											X				
49 *Caelorinchus caelorhincus caelorhinc*	benthopelagic	North											X				
		Central															
		South											X				
22 Moridae																	
50 *Laemonema laureysi*	benthopelagic	North															
		Central												X			
		South								X				X			
23 Phycidae																	
51 *Phycis phycis*	benthopelagic	North															
		Central								X							
		South					X			X							
24 Merlucciidae																	
52 *Merluccius polli*	demersal	North															
		Central												X			
		South															
53 *Merluccius senegalensis*	demersal	North											X	X			
		Central										X	X	X			
		South											X	X			
54 *Merluccius* sp.	-	North															
		Central												X			
		South												X			
11 Batrachoidiformes																	
25 Batrachoididae																	
55 *Halobatrachus didactylus*	demersal	North	X	X		X	X	X	X	X		X					
		Central	X	X	X	X			X	X	X			X			
		South				X	X				X						
12 Lophiiformes																	
26 Lophiidae																	
56 *Lophius budegassa*	bathydemersal	North															
		Central											X				
		South															
57 *Lophius* spp.	-	North											X				
		Central										X					
		South											X				
27 Antennariidae																	
58 *Antennarius senegalensis*	demersal	North															
		Central							X								
		South															
59 *Antennarius* sp.	-	North															
		Central															
		South								X							
60 Antennariidae	-	North									X			X			
		Central									X						
		South								X							
13 Mugiliformes																	
28 Mugilidae																	
61 *Mugil capurii*	benthopelagic	North						X									
		Central															
		South															

Remark. 1TCW: Phase 1, cold to warm transitional season. 1TWC: Phase 1, warm to cold transitional season. 2TWC: Phase 2, warm to cold transitional season.

Appendix Table5.4 Appearance list of species for the *transitional period survey*. (4/12)

Order / Family / Species	Habitat	Area	Stratum (isobath range in m)											
			3-20m			20-30m			30-80m			80-200m			200-400m		
			1TCW	1TWC	2TWC	1TCW	1TWC	2TWC	1TCW	1TWC	2TWC	1TCW	1TWC	2TWC	1TCW	1TWC	2TWC
62 *Mugil cephalus*	benthopelagic	North															
		Central			X												
		South		X													
14 Beloniformes																	
29 Belonidae																	
63 Belonidae	-	North															
		Central															
		South										X					
15 Beryciformes																	
30 Trachichthyidae																	
64 *Hoplostethus mediterraneus*	benthopelagic	North															
		Central															
		South											X				
16 Zeiformes																	
31 Zeidae																	
65 *Zeus faber*	benthopelagic	North					X		X	X	X		X	X			
		Central			X				X	X	X	X	X	X			
		South							X	X	X	X	X	X			
66 *Zenopsis conchifer*	benthopelagic	North											X				
		Central									X	X	X	X			
		South										X					
32 Caproidae																	
67 *Capros aper*	demersal	North											X	X			
		Central									X	X	X	X			
		South															
17 Gasterosteiformes																	
33 Syngnathidae																	
68 Syngnathidae	-	North									X						
		Central															
		South															
34 Fistulariidae																	
69 *Fistularia petimba*	demersal	North		X			X			X	X			X			
		Central		X		X				X							
		South							X	X	X			X			
70 *Fistularia tabacaria*	reef-associated	North	X			X				X							
		Central	X	X	X	X	X	X	X		X	X					
		South	X			X	X		X			X					
18 Scorpaeniformes																	
35 Dactylopteridae																	
71 *Dactylopterus volitans*	reef-associated	North				X											
		Central	X		X	X		X	X		X						
		South				X	X				X						
36 Scorpaenidae																	
72 *Helicolenus dactylopterus dactylopteru*	bathydemersal	North											X				
		Central							X								
		South											X				
73 *Scorpaena angolensis*	demersal	North															
		Central						X			X			X			
		South									X			X			
74 *Scorpaena elongata*	demersal	North											X	X			
		Central									X	X	X	X			
		South											X				
75 *Scorpaena normani*	demersal	North											X	X			
		Central									X	X	X				
		South								X		X	X				
76 *Scorpaena stephanica*	demersal	North	X	X	X					X	X			X			
		Central							X	X		X		X			
		South							X	X	X	X		X			
77 *Scorpaena* sp.	-	North								X			X	X			
		Central			X								X				
		South		X					X	X			X				
78 *Pontinus kuhlii*	bathydemersal	North											X	X			
		Central										X	X	X			
		South										X	X	X			
79 *Pontinus* sp.	-	North															
		Central															
		South										X	X				
37 Triglidae																	
80 *Chelidonichthys gabonensis*	demersal	North									X						
		Central	X		X	X		X	X		X	X		X			
		South	X						X	X	X			X			
81 *Lepidotrigla cadmani*	demersal	North				X			X		X	X		X			
		Central	X			X		X	X		X	X		X			
		South	X						X			X					

Remark. 1TCW: Phase 1, cold to warm transitional season. 1TWC: Phase 1, warm to cold transitional season. 2TWC: Phase 2, warm to cold transitional season.

Appendix Table5.4 Appearance list of species for the *transitional period survey*. (5/12)

Order / Family / Species	Habitat	Area	Stratum (isobath range in m)											
			3-20m			20-30m			30-80m			80-200m			200-400m		
			1TCW	1TWC	2TWC	1TCW	1TWC	2TWC	1TCW	1TWC	2TWC	1TCW	1TWC	2TWC	1TCW	1TWC	2TWC
82 *Lepidotrigla* spp.	-	North					X			X			X				
		Central			X				X	X	X	X	X	X			
		South							X	X	X	X	X	X			
38 Platycephalidae																	
83 *Solitas gruveli*	demersal	North					X		X		X			X			
		Central						X	X	X	X			X			
		South							X	X	X		X	X			
19 Perciformes																	
39 Acropomatidae																	
84 *Synagrops microlepis*	bathypelagic	North											X	X			
		Central									X	X	X	X			
		South								X		X	X	X			
40 Serranidae																	
85 *Serranus accraensis*	demersal	North															
		Central															
		South								X							
86 *Serranus africanus*	demersal	North											X				
		Central												X			
		South									X						
87 *Serranus cabrilla*	bathydemersal	North								X			X	X			
		Central							X	X	X		X	X			
		South							X	X		X	X				
88 *Serranus scriba*	demersal	North	X	X													
		Central			X												
		South				X								X			
89 *Serranus* sp.	-	North															
		Central			X												
		South															
90 *Epinephelus aeneus*	demersal	North		X	X	X			X		X	X					X
		Central	X		X	X			X	X	X						
		South	X		X	X	X	X	X	X	X			X			
91 *Epinephelus caninus*	demersal	North								X			X	X			
		Central	X		X				X	X							
		South															
92 *Epinephelus costae*	demersal	North		X													
		Central		X	X												
		South							X	X				X			
93 *Epinephelus goreensis*	demersal	North			X												
		Central			X									X			
		South															
94 *Epinephelus marginatus*	reef-associated	North			X												
		Central							X	X							
		South	X							X							
95 *Mycteroperca rubra*	demersal	North			X	X											
		Central	X	X		X											
		South				X	X		X		X			X			
96 *Rypticus saponaceus*	reef-associated	North	X	X													
		Central															
		South		X		X				X							
41 Priacanthidae																	
97 *Priacanthus arenatus*	reef-associated	North								X							
		Central			X			X			X			X			
		South									X			X			
42 Malacanthidae																	
98 *Branchiostegus semifasciatus*	demersal	North											X				
		Central							X				X				
		South										X					
43 Echeneidae																	
99 *Echeneis naucrates*	reef-associated	North												X			
		Central									X						
		South															
44 Bramidae																	
100 *Brama brama*	bathypelagic	North															
		Central	X						X								
		South															
45 Gerreidae																	
101 *Eucinostomus melanopterus*	demersal	North				X											
		Central	X			X			X								
		South	X	X	X	X			X		X						
46 Haemulidae																	
102 *Pomadasys incisus*	demersal	North	X	X	X	X	X	X	X	X	X		X	X			X
		Central		X	X	X	X	X	X	X	X	X		X			
		South	X	X	X	X	X	X	X	X	X	X		X			
103 *Pomadasys perotaei*	benthopelagic	North															
		Central						X			X			X			
		South		X	X			X			X						

Remark. 1TCW: Phase 1, cold to warm transitional season. 1TWC: Phase 1, warm to cold transitional season. 2TWC: Phase 2, warm to cold transitional season.

Appendix Table5.4 Appearance list of species for the *transitional period survey*. (6/12)

Order / Family / Species	Habitat	Area	Stratum (isobath range in m)																	
			3-20m			20-30m			30-80m			80-200m			200-400m					
			1TCW	1TWC	2TWC	1TCW	1TWC	2TWC	1TCW	1TWC	2TWC	1TCW	1TWC	2TWC	1TCW	1TWC	2TWC			
104 *Pomadasys jubelini*	demersal	North		X	X			X												
		Central		X	X	X			X	X										
		South	X	X	X	X	X		X	X										
105 *Pomadasys rogeri*	benthopelagic	North		X	X			X												
		Central	X	X	X				X											
		South		X	X	X	X		X	X										
106 *Brachydeuterus auritus*	benthopelagic	North		X	X	X		X	X		X	X		X			X			
		Central	X	X	X	X			X	X		X		X						
		South	X	X	X		X	X	X	X	X	X	X	X						
107 *Parapristipoma octolineatum*	demersal	North		X																
		Central							X	X	X	X								
		South																		
108 *Plectorhinchus mediterraneus*	demersal	North	X	X	X	X		X			X									
		Central	X	X	X	X	X		X	X	X	X	X							
		South	X	X		X	X	X	X	X	X	X	X	X						
47 Sparidae																				
109 *Sparus aurata*	demersal	North	X					X												
		Central			X				X		X									
		South							X											
110 *Pagrus auriga*	benthopelagic	North																		
		Central		X		X			X			X								
		South					X		X											
111 *Pagrus caeruleostictus*	benthopelagic	North	X	X	X	X			X	X	X			X						
		Central	X	X	X	X		X	X	X	X	X		X						
		South	X	X	X	X	X	X	X	X	X			X						
112 *Pagrus pagrus*	benthopelagic	North								X										
		Central								X	X									
		South								X	X		X	X						
113 *Boops boops*	demersal	North		X			X	X		X	X			X						
		Central	X	X	X	X	X		X	X	X	X	X	X						
		South					X			X	X	X	X	X						
114 *Dentex angolensis*	demersal	North											X	X						
		Central									X	X	X	X						
		South							X	X	X	X		X						
115 *Dentex canariensis*	benthopelagic	North	X	X	X	X	X		X	X	X		X	X						
		Central	X	X	X	X	X		X	X	X	X	X	X						
		South		X	X	X	X	X	X	X	X			X						
116 *Dentex gibbosus*	benthopelagic	North					X			X	X			X						
		Central		X						X	X									
		South								X	X									
117 *Dentex macrophthalmus*	benthopelagic	North							X	X		X	X	X						
		Central							X	X	X	X	X	X						
		South										X	X	X						
118 *Dentex maroccanus*	demersal	North							X	X			X	X						
		Central							X	X	X	X	X	X						
		South							X	X	X	X	X	X						
119 *Dentex* sp.	-	North																		
		Central							X											
		South																		
120 *Diplodus sargus cadenati*	reef-associated	North	X	X	X															
		Central			X	X							X							
		South																		
121 *Diplodus fasciatus*	benthopelagic	North																		
		Central		X																
		South																		
122 *Diplodus vulgaris*	benthopelagic	North		X	X		X			X										
		Central			X							X								
		South				X	X		X											
123 *Diplodus bellottii*	benthopelagic	North	X	X	X	X	X	X	X		X									
		Central	X	X	X						X			X						
		South									X									
124 *Diplodus* sp.	-	North			X															
		Central																		
		South																		
125 *Lithognathus mormyrus*	benthopelagic	North			X															
		Central		X		X			X											
		South		X		X	X	X	X		X									
126 *Pagellus acarne*	benthopelagic	North							X				X							
		Central							X											
		South								X			X							
127 *Pagellus bellottii*	demersal	North	X	X	X	X	X	X	X	X	X	X		X						
		Central	X	X	X	X	X	X	X	X	X	X	X	X						
		South	X		X	X	X	X	X	X	X	X	X	X						
128 *Sarpa salpa*	benthopelagic	North																		
		Central																		
		South										X								

Remark. 1TCW: Phase 1, cold to warm transitional season. 1TWC: Phase 1, warm to cold transitional season. 2TWC: Phase 2, warm to cold transitional season.

Appendix Table5.4 Appearance list of species for the *transitional period survey*. (7/12)

Order / Family / Species	Habitat	Area	Stratum (isobath range in m)																	
			3-20m			20-30m			30-80m			80-200m			200-400m					
			1TCW	1TWC	2TWC	1TCW	1TWC	2TWC	1TCW	1TWC	2TWC	1TCW	1TWC	2TWC	1TCW	1TWC	2TWC	1TCW	1TWC	2TWC
129 *Spondyliosoma cantharus*	benthopelagic	North		X	X		X			X										
		Central		X	X						X	X								
		South									X		X							
48 Centracanthidae																				
130 *Spicara alta*	benthopelagic	North											X	X						
		Central										X	X	X						
		South											X	X						
49 Polynemidae																				
131 *Galeoides decadactylus*	demersal	North		X	X	X		X	X		X	X					X			
		Central		X	X	X			X	X				X						
		South	X	X	X	X	X	X	X	X	X			X						
132 *Pentanemus quinquarius*	demersal	North																		
		Central																		
		South		X	X															
50 Sciaenidae																				
133 *Sciaena umbra*	demersal	North	X	X																
		Central																		
		South																		
134 *Argyrosomus regius*	benthopelagic	North		X	X	X	X	X				X	X							X
		Central		X	X	X		X												
		South	X	X			X	X		X	X	X								
135 *Pseudotolithus senegalensis*	demersal	North						X												
		Central		X						X				X						
		South	X		X		X	X	X	X	X			X						
136 *Pseudotolithus senegallus*	demersal	North																		
		Central																		
		South	X																	
137 *Pseudotolithus typus*	demersal	North																		
		Central		X																
		South							X											
138 *Pseudotolithus* sp.	-	North																		
		Central		X																
		South		X			X			X										
139 *Umbrina canariensis*	demersal	North		X				X	X	X	X		X	X						
		Central			X				X	X	X		X	X						
		South		X	X		X	X	X	X	X	X	X	X						
140 *Pentheroscion mbizi*	demersal	North																		
		Central																		
		South		X						X			X							
141 *Pteroscion peli*	benthopelagic	North		X				X	X		X									
		Central		X						X		X		X						
		South	X	X	X		X	X		X	X		X							
51 Mullidae																				
142 *Mullus barbatus*	demersal	North																		
		Central																		
		South									X									
143 *Mullus surmuletus*	demersal	North									X									
		Central																		
		South																		
144 *Pseudupeneus prayensis*	demersal	North	X	X	X	X			X		X	X								
		Central	X	X	X	X	X	X	X	X	X	X		X						
		South	X	X	X	X	X	X	X	X	X			X						
52 Drepanidae																				
145 *Drepane africana*	benthopelagic	North																		
		Central		X	X	X			X											
		South	X	X	X	X	X	X	X	X	X									
53 Chaetodontidae																				
146 *Chaetodon hoefleri*	demersal	North		X																
		Central	X	X	X			X		X	X	X								
		South	X	X			X			X				X						
147 *Prognathodes marcellae*	demersal	North																		
		Central									X									
		South																		
54 Cepolidae																				
148 *Cepola pauciradiata*	demersal	North					X			X				X						
		Central											X							
		South												X						
55 Pomacentridae																				
149 *Chromis limbata*	reef-associated	North																		
		Central						X			X	X								
		South																		
56 Labridae																				
150 *Bodianus speciosus*	reef-associated	North																		
		Central										X								
		South																		

Remark. 1TCW: Phase 1, cold to warm transitional season. 1TWC: Phase 1, warm to cold transitional season. 2TWC: Phase 2, warm to cold transitional season.

Appendix Table5.4 Appearance list of species for the *transitional period survey*. (8/12)

Order / Family / Species	Habitat	Area	Stratum (isobath range in m)													
			3-20m			20-30m			30-80m			80-200m			200-400m		
			1TCW	1TWC	2TWC	1TCW	1TWC	2TWC	1TCW	1TWC	2TWC	1TCW	1TWC	2TWC	1TCW	1TWC	2TWC
151 *Xyrichtys novacula*	demersal	North															
		Central	X			X		X	X	X							
		South															
57 Scaridae																	
152 *Nicholsina usta collettei*	demersal	North								X							
		Central	X	X						X							
		South															
153 *Sparisoma rubripinne*	reef-associated	North															
		Central	X														
		South															
58 Percophidae																	
154 *Bembrops greyi*	bathydemersal	North															
		Central															
		South										X					
155 *Bembrops heterurus*	demersal	North															
		Central															
		South								X			X				
59 Trachinidae																	
156 *Trachinus draco*	demersal	North			X	X	X	X	X	X	X	X		X			X
		Central		X	X		X		X					X			
		South															
157 *Trachinus lineolatus*	demersal	North															
		Central															
		South		X													
158 *Trachinus radiatus*	demersal	North	X														
		Central															
		South															
60 Uranoscopidae																	
159 *Uranoscopus albesca*	demersal	North															
		Central															
		South	X														
160 *Uranoscopus scaber*	demersal	North															
		Central	X														
		South															
161 *Uranoscopus polli*	demersal	North									X			X			
		Central				X		X	X		X			X			
		South						X	X		X			X			
162 *Uranoscopus* sp.	-	North				X			X	X							
		Central							X	X							
		South					X		X	X			X				
61 Blenniidae																	
163 *Blennius normani*	demersal	North								X			X				
		Central								X			X				
		South											X				
164 Blenniidae	-	North															
		Central							X					X			
		South												X			
62 Callionymidae																	
165 *Synchiropus phaeton*	demersal	North															
		Central															
		South											X				
63 Gobiidae																	
166 Gobiidae	-	North							X	X	X			X			
		Central							X	X	X	X	X	X			
		South								X	X	X	X	X			
64 Ephippidae																	
167 *Ephippus goreensis*	demersal	North	X			X											
		Central				X											
		South					X		X								
65 Acanthuridae																	
168 *Acanthurus monroviae*	demersal	North															
		Central			X	X											
		South															
66 Sphyraenidae																	
169 *Sphyraena* sp.	-	North															
		Central															
		South			X												
67 Gempylidae																	
170 *Ruvettus pretiosus*	benthopelagic	North								X							
		Central															
		South															
68 Trichiuridae																	
171 *Trichiurus lepturus*	benthopelagic	North		X	X			X	X		X			X	X		X
		Central	X	X	X	X	X	X	X	X	X	X	X	X	X		
		South	X	X	X	X	X	X	X	X	X	X	X	X	X		

Remark. 1TCW: Phase 1, cold to warm transitional season. 1TWC: Phase 1, warm to cold transitional season. 2TWC: Phase 2, warm to cold transitional season.

Appendix Table5.4 Appearance list of species for the *transitional period survey*. (9/12)

Order / Family / Species	Habitat	Area	Stratum (isobath range in m)													
			3-20m			20-30m			30-80m			80-200m			200-400m		
			1TCW	1TWC	2TWC	1TCW	1TWC	2TWC	1TCW	1TWC	2TWC	1TCW	1TWC	2TWC	1TCW	1TWC	2TWC
69 Centrolophidae																	
172 *Schedophilus pemarco*	benthopelagic	North		X						X	X						
		Central															
		South															
70 Ariommatidae																	
173 *Ariomma bondi*	demersal	North															
		Central															
		South											X				
71 Stromateidae																	
174 *Stromateus fiatola*	benthopelagic	North	X	X	X			X	X	X	X						X
		Central		X	X	X								X			
		South		X				X	X	X	X						
20 Pleuronectiformes																	
72 Paralichthyidae																	
175 *Syacium micrurum*	benthopelagic	North	X	X	X	X	X		X	X	X			X			
		Central	X	X	X	X		X	X	X	X	X		X			
		South			X	X	X		X	X	X			X			
73 Psettodidae																	
176 *Psettodes belcheri*	demersal	North	X	X	X	X	X	X	X	X	X	X					
		Central	X		X												
		South															
177 *Psettodes* sp.	-	North															
		Central		X													
		South															
74 Citharidae																	
178 *Citharus linguatula*	demersal	North							X	X	X		X	X			
		Central	X					X	X	X	X	X	X	X			
		South	X			X			X	X	X	X	X	X			
75 Bothidae																	
179 *Bothus podas*	demersal	North		X	X	X	X		X		X	X		X			X
		Central	X	X	X	X	X	X	X								
		South															
180 *Arnoglossus capensis*	demersal	North															
		Central															
		South										X					
181 *Arnoglossus imperialis*	demersal	North							X	X	X		X	X			
		Central	X					X	X	X	X	X	X	X			
		South							X	X	X	X	X	X			
182 *Monolene microstoma*	bathypelagic	North											X	X			
		Central										X	X	X			
		South								X		X	X				
76 Soleidae																	
183 *Pegusa lascaris*	demersal	North															
		Central															
		South					X			X			X				
184 *Solea senegalensis*	demersal	North	X	X	X	X		X	X								
		Central		X		X											
		South		X		X	X	X									
185 *Solea solea*	demersal	North				X			X			X					
		Central		X		X			X			X					
		South									X						
186 *Bathysolea polli*	bathydemersal	North															
		Central				X											
		South															
187 *Bathysolea* sp.	-	North															
		Central								X							
		South															
188 *Buglossidium luteum*	demersal	North										X					
		Central															
		South															
189 *Dicologlossa cuneata*	demersal	North					X	X		X	X			X			
		Central		X				X	X	X	X	X					
		South		X			X			X	X	X	X	X			
190 *Dicologlossa hexophthalma*	demersal	North											X				
		Central	X	X		X			X	X							
		South					X			X							
191 *Microchirus boscanion*	demersal	North							X	X		X	X	X			
		Central							X	X	X		X	X			
		South											X				
192 *Microchirus frechkopi*	demersal	North															
		Central															
		South									X			X			
193 *Microchirus ocellatus*	demersal	North															
		Central															
		South								X							

Remark. 1TCW: Phase 1, cold to warm transitional season 1TWC: Phase 1, warm to cold transitional season. 2TWC: Phase 2, warm to cold transitional season.

Appendix Table5.4 Appearance list of species for the *transitional period survey*. (10/12)

Order / Family / Species	Habitat	Area	Stratum (isobath range in m)											
			3-20m			20-30m			30-80m			80-200m			200-400m		
			1TCW	1TWC	2TWC	1TCW	1TWC	2TWC	1TCW	1TWC	2TWC	1TCW	1TWC	2TWC	1TCW	1TWC	2TWC
194 *Microchirus theophila*	demersal	North								X							
		Central							X				X				
		South								X							
195 *Microchirus variegatus*	demersal	North	X			X											
		Central												X			
		South															
196 *Microchirus* sp.	-	North															
		Central											X				
		South															
197 *Synaptura lusitanica*	demersal	North		X	X												
		Central		X	X									X			
		South	X	X													
198 Soleidae	-	North															
		Central															
		South			X												
77 Cynoglossidae																	
199 *Cynoglossus canariensis*	demersal	North						X									
		Central			X												
		South			X			X			X						
200 *Cynoglossus monodi*	demersal	North			X				X								
		Central				X											
		South	X														
201 *Cynoglossus senegalensis*	demersal	North															
		Central															
		South			X												
202 *Cynoglossus* sp.	-	North		X													
		Central															
		South		X			X				X						
21 Tetraodontiformes																	
78 Balistidae																	
203 *Balistes carolinensis*	benthopelagic	North															
		Central							X								
		South	X			X			X								
204 *Balistes punctatus*	demersal	North															
		Central	X														
		South			X						X						
79 Monacanthidae																	
205 *Stephanolepis hispidus*	demersal	North	X			X			X		X	X					
		Central	X		X	X											
		South	X			X											
206 *Aluterus schoepfii*	demersal	North															X
		Central			X												
		South						X						X			
207 *Aluterus* sp.	-	North		X													
		Central					X										
		South		X			X			X							
80 Tetraodontidae																	
208 *Ephippion guttifer*	demersal	North	X	X	X	X											
		Central	X	X	X												
		South		X													
209 *Lagocephalus* sp.	-	North				X											
		Central	X														
		South							X	X							
210 *Sphoeroides spengleri*	demersal	North	X	X		X			X	X	X	X		X			
		Central	X			X			X	X	X		X	X			
		South								X	X		X	X			
211 Tetraodontidae	-	North															
		Central												X			
		South															
81 Diodontidae																	
212 *Chilomycterus reticulatus*	demersal	North															
		Central	X	X		X			X			X					
		South	X			X	X		X								
213 *Chilomycterus spinosus mauretanicus*	benthopelagic	North		X													
		Central		X		X			X	X							
		South		X						X	X			X			
214 *Chilomycterus* spp.	-	North															
		Central															
		South					X										
215 *Diodon hystrix*	reef-associated	North															
		Central										X					
		South															

Remark: 1TCW: Phase 1, cold to warm transitional season. 1TWC: Phase 1, warm to cold transitional season. 2TWC: Phase 2, warm to cold transitional season.

Appendix Table5.4 Appearance list of species for the *transitional period survey*, (11/12)

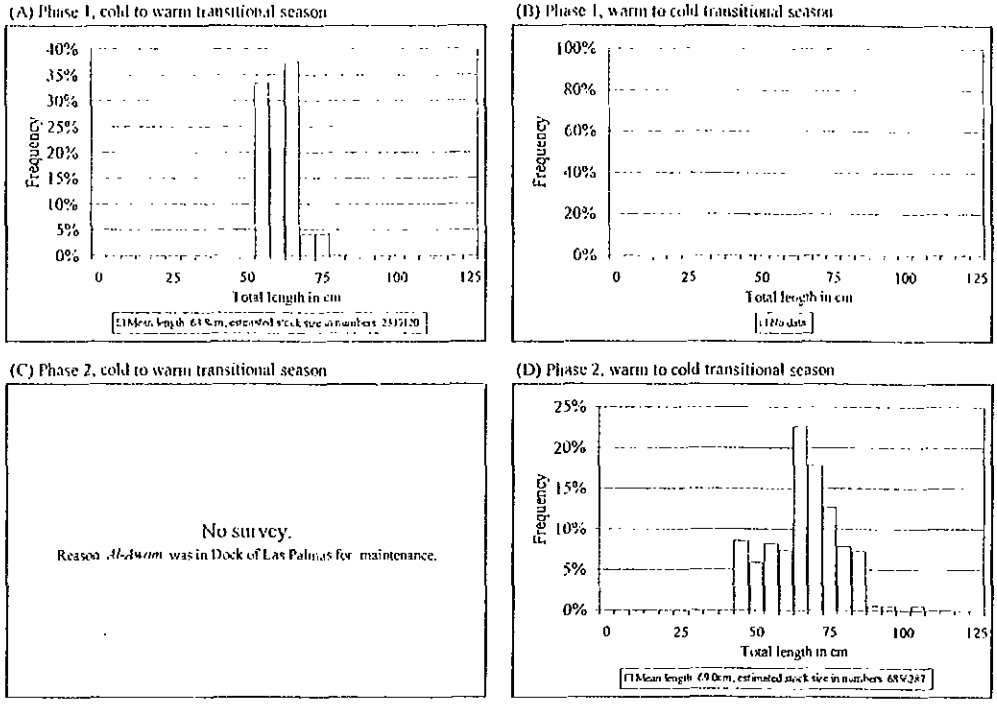
Order / Family / Species	Area	Stratum (isobath range in m)														
		3-20m			20-30m			30-80m			80-200m			200-400m		
		1TCW	1TWC	2TWC	1TCW	1TWC	2TWC	1TCW	1TWC	2TWC	1TCW	1TWC	2TWC	1TCW	1TWC	2TWC
22 Gastropods																
82 Volutidae																
216 *Cymbium cymbium*	North															
	Central															
	South	X														
217 *Cymbium* spp.	North	X	X		X	X		X	X							
	Central	X	X		X			X			X					
	South	X	X						X							
23 Bivalves																
83 Veneridae																
218 *Venus* spp.	North			X												
	Central															
	South															
24 Cephalopods																
84 Loliginidae																
219 *Alloteuthis africana*	North									X			X			
	Central			X			X			X			X			
	South			X						X	X		X			
220 *Loligo vulgaris*	North	X	X	X	X	X	X	X	X	X	X		X			X
	Central		X	X		X	X	X	X	X	X	X	X			
	South		X	X		X	X	X	X	X	X	X	X			
85 Onmastrephidae																
221 *Illex coindetii*	North								X			X				
	Central							X	X	X	X	X	X			
	South								X		X	X				
222 *Todarodes sagittatus*	North											X				
	Central								X		X	X				
	South										X					
223 *Todarodes eblanae*	North															
	Central								X	X			X			
	South															
224 Onmastrephidae	North															
	Central								X							
	South	X									X					
86 Sepiidae																
225 *Sepiella ornata*	North						X		X	X						
	Central								X							
	South					X			X			X				
226 *Sepia bertheloti*	North			X		X		X	X	X		X	X			
	Central	X	X		X		X	X	X		X					
	South					X		X	X	X	X	X	X			
227 *Sepia elegans*	North					X						X				
	Central							X								
	South															
228 *Sepia officinalis*	North	X	X	X	X	X	X	X	X	X	X	X	X			X
	Central	X	X	X	X	X	X	X	X	X		X	X			
	South	X	X	X		X	X	X	X	X	X	X	X			
229 *Sepia* sp.	North															
	Central															
	South								X							
87 Sepiolidae																
230 *Sepiola* sp.	North			X						X			X			X
	Central							X		X						
	South							X		X						
88 Octopodidae																
231 *Octopus vulgaris*	North	X	X	X	X	X	X	X	X	X	X	X	X			
	Central	X	X	X	X	X	X	X	X	X	X	X	X			
	South	X	X		X	X		X	X	X	X	X	X			
232 *Eledone* sp.	North															
	Central								X							
	South															
25 Stomatopoda																
89 Squillidae																
233 *Squilla mantis*	North						X									
	Central							X			X					
	South							X	X			X				
26 Decapoda																
90 Crangonidae																
234 *Pontocaris lacazei*	North				X											
	Central															
	South															
91 Pandalidae																
235 *Plesionika edwardsii*	North								X			X				
	Central															
	South															

Remark. 1TCW: Phase 1, cold to warm transitional season. 1TWC: Phase 1, warm to cold transitional season. 2TWC: Phase 2, warm to cold transitional season.

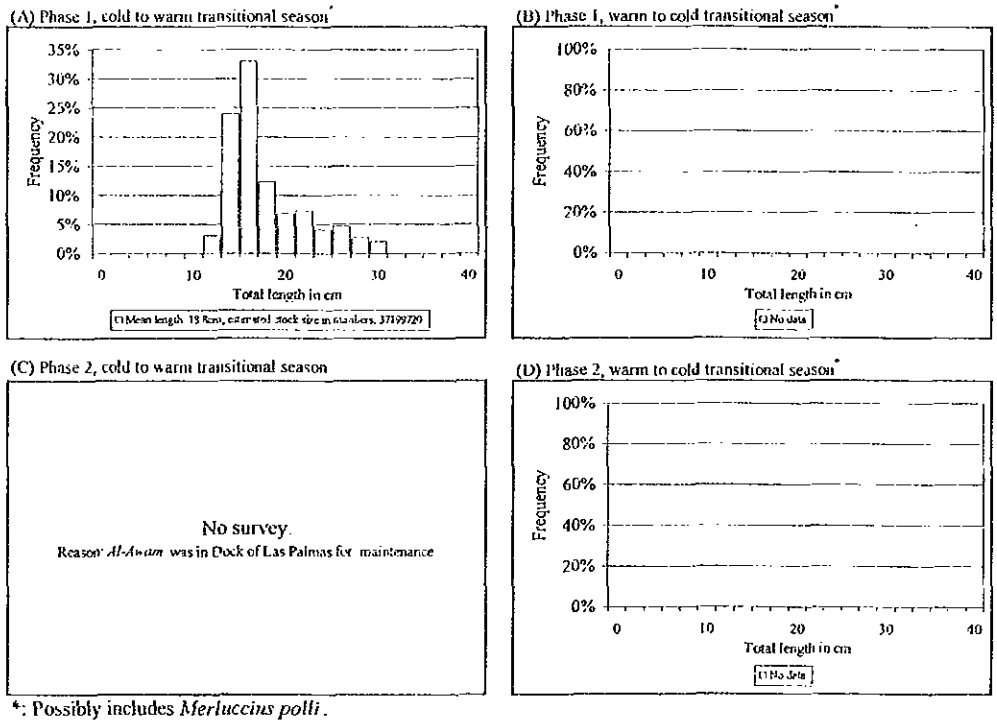
Appendix Table5.4 Appearance list of species for the *transitional period survey*. (12/12)

Order / Family / Species	Area	Stratum (isobath range in m)														
		3-20m			20-30m			30-80m			80-200m			200-400m		
		1TCW	1TWC	2TWC	1TCW	1TWC	2TWC	1TCW	1TWC	2TWC	1TCW	1TWC	2TWC	1TCW	1TWC	2TWC
236 *Plesionika heterocarpus*	North												X			
	Central															
	South															
237 Pandalidae	North															
	Central															
	South								X							
92 Penaeidae																
238 *Penaeus kerathurus*	North		X					X			X					
	Central		X	X									X			
	South					X										
239 *Penaeus notialis*	North		X	X	X			X	X	X	X	X				X
	Central	X	X	X	X			X	X	X	X		X			
	South	X	X	X		X		X	X	X	X		X			
240 *Parapenaeus longirostris*	North															
	Central											X		X		
	South								X	X	X	X	X			
93 Sicyoniidae																
241 *Sicyonia galeata*	North								X	X			X			
	Central															
	South							X								
94 Palinuridae																
242 *Palinurus mauritanicus*	North	X			X											
	Central															
	South															
243 *Panulirus regius*	North				X			X								
	Central															
	South	X														
95 Scyllaridae																
244 *Scyllarus* sp.	North								X							
	Central															
	South								X							
96 Galatheidae																
245 Galatheidae	North															
	Central											X				
	South											X				
97 Calappidae																
246 *Calappa granulata*	North		X	X					X							
	Central				X			X	X							
	South	X							X							
247 *Calappa pelii*	North															
	Central															
	South								X							
98 Portunidae																
248 Portunidae	North							X	X				X			
	Central							X	X		X	X				
	South							X			X	X				

Remark: 1TCW: Phase 1, cold to warm transitional season. 1TWC: Phase 1, warm to cold transitional season. 2TWC: Phase 2, warm to cold transitional season.

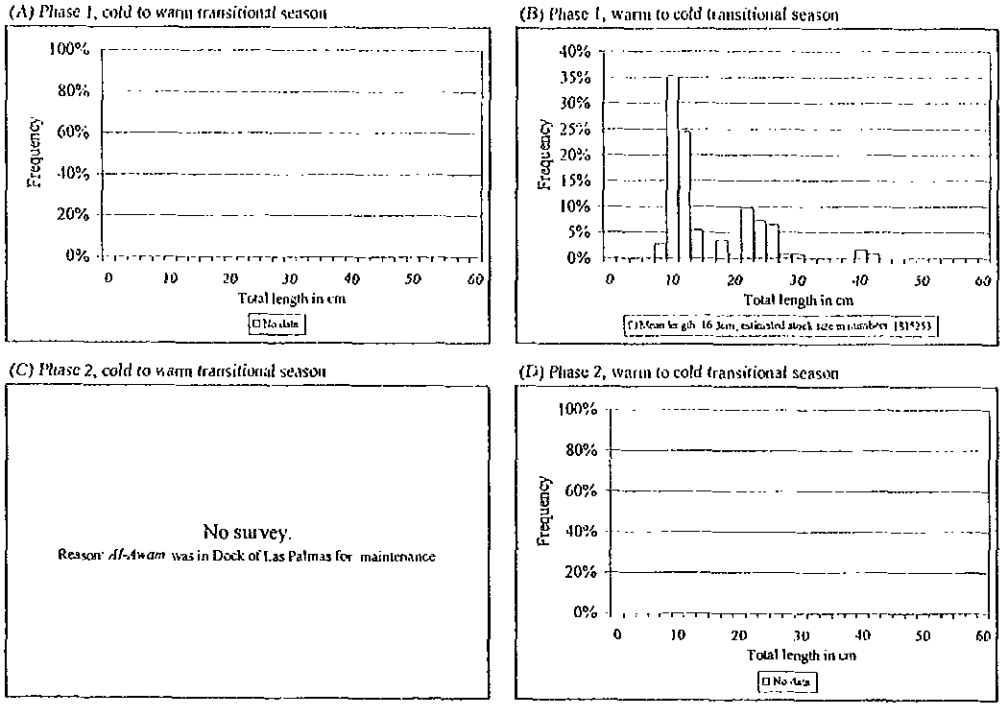


Appendix Figure 5.1 Size composition of stock number estimated by 45mm cod-end for smooth-hound *Mustelus mustelus*.

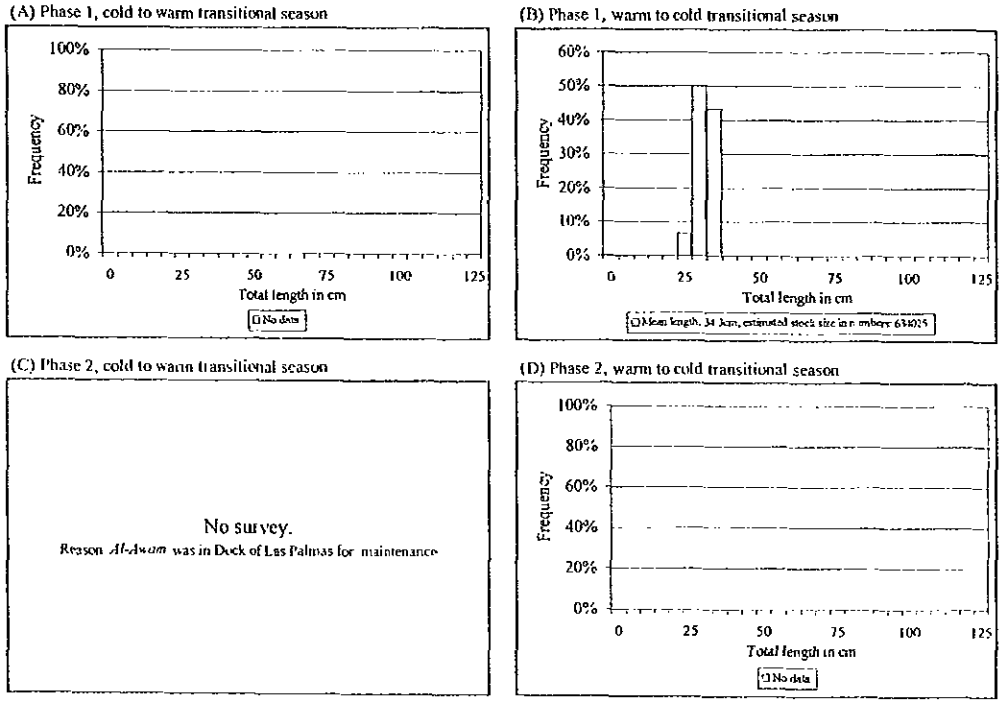


*: Possibly includes *Merluccius polli*.

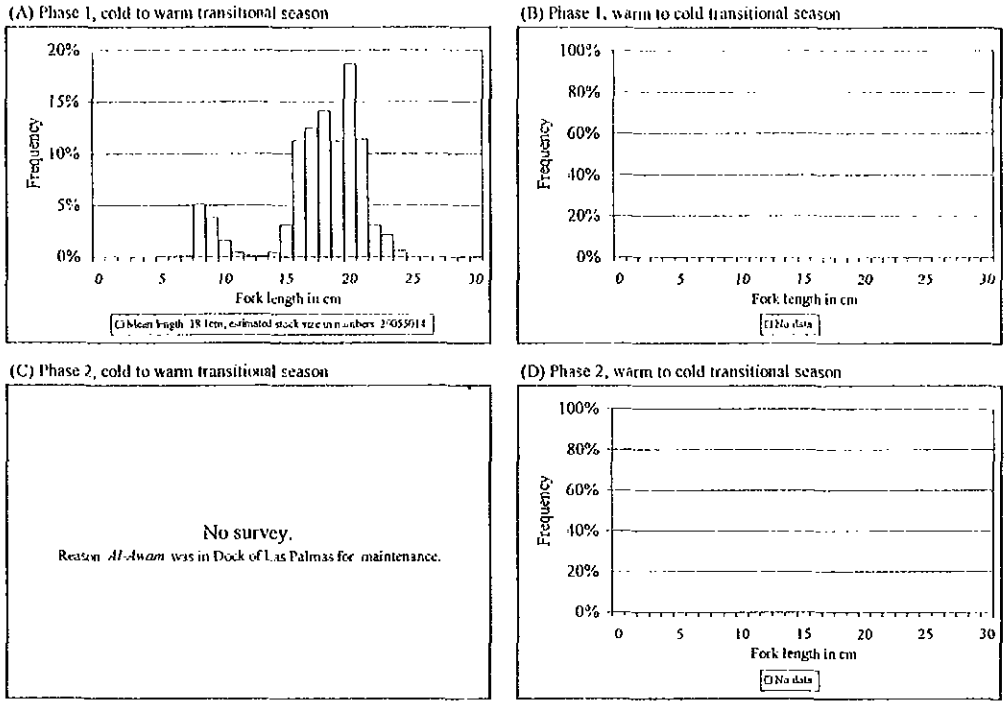
Appendix Figure 5.2 Size composition of stock number estimated by 45mm cod-end for Senegalese hake *Merluccius senegalensis*.



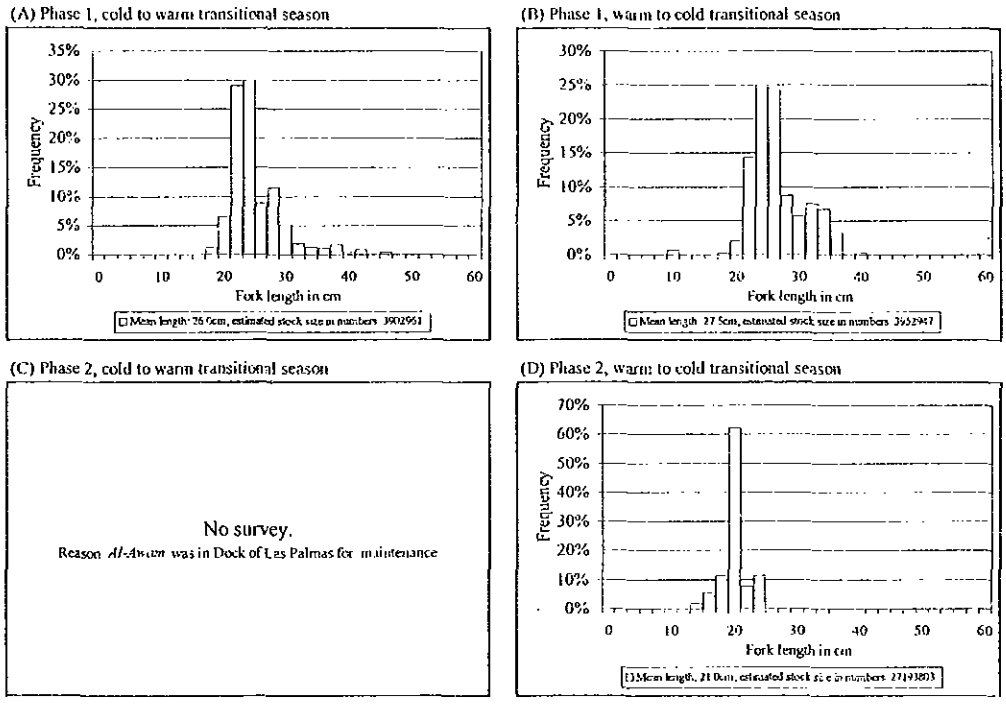
Appendix Figure 5.3 Size composition of stock number estimated by 45mm cod-end for John dory *Zeus faber*.



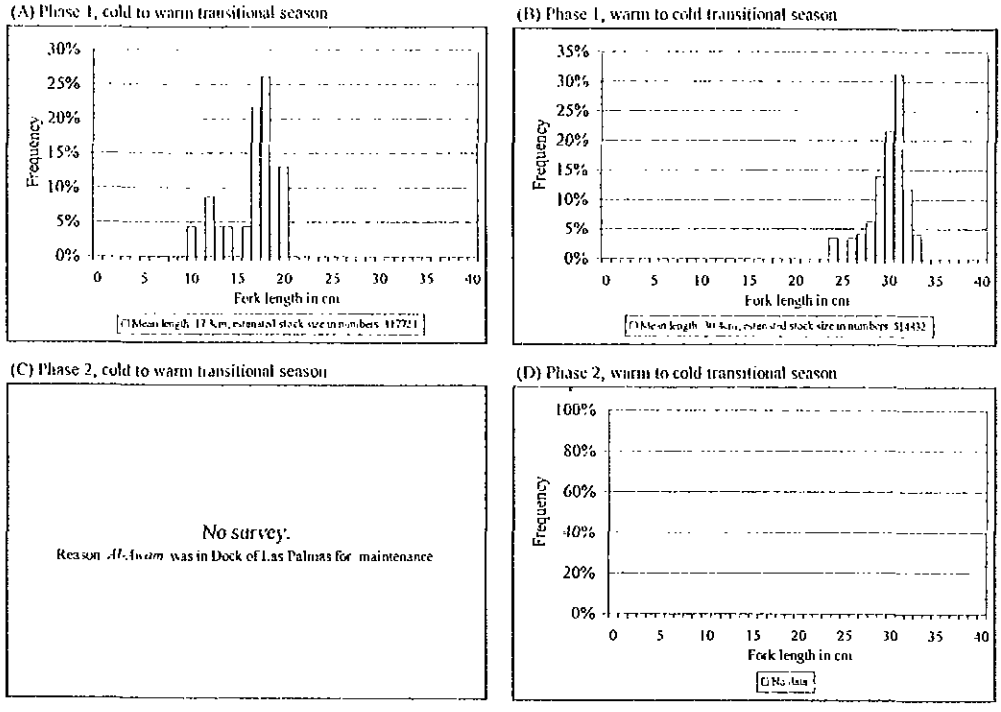
Appendix Figure 5.4 Size composition of stock number estimated by 45mm cod-end for meagre *Argyrosomus regius*.



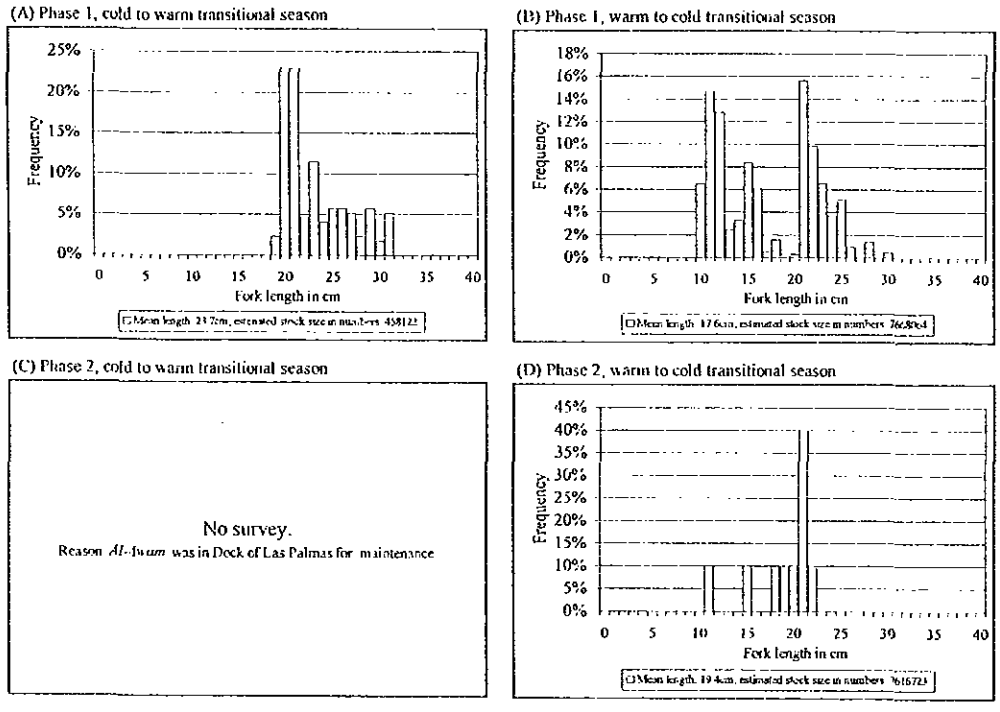
Appendix Figure 5.5 Size composition of stock number estimated by 45mm cod-end for West African goatfish *Pseudupeneus prayensis*.



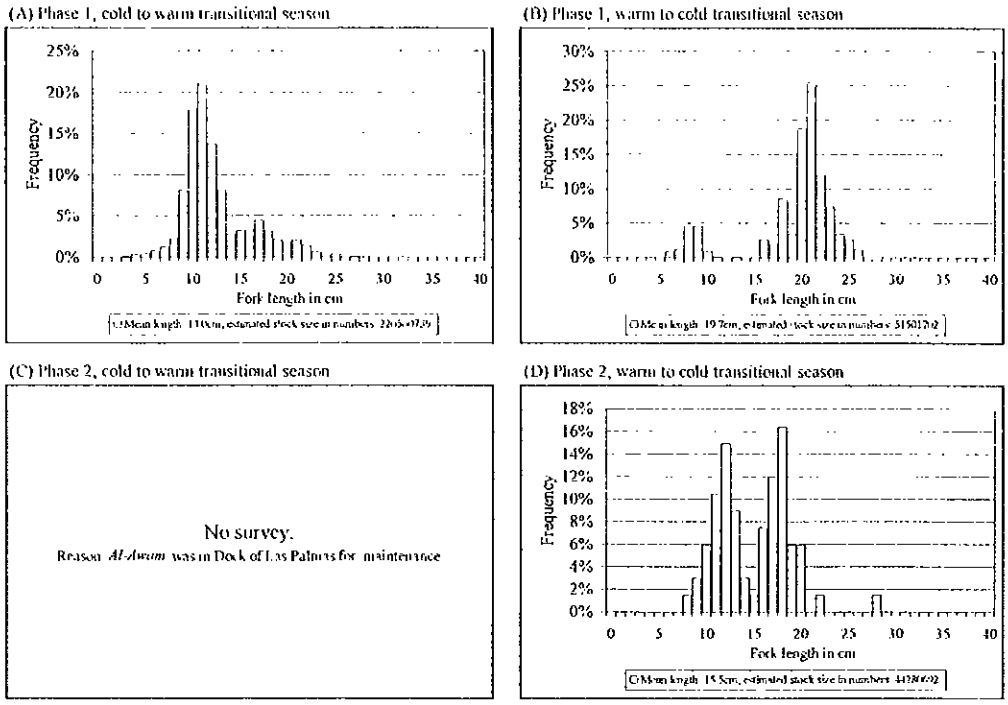
Appendix Figure 5.6 Size composition of stock number estimated by 45mm cod-end for bluespotted seabream *Pagrus caeruleostictus*.



Appendix Figure 5.7 Size composition of stock number estimated by 45mm cod-end for Angola dentex *Dentex angolensis*.



Appendix Figure 5.8 Size composition of stock number estimated by 45mm cod-end for Canary dentex *Dentex canariensis*.



Appendix Figure 5.9 Size composition of stock number estimated by 45mm cod-end for red pandora *Pagellus bellottii*.

6. UNUTILIZED AND UNEXPLOITED FISHERY RESOURCES AND DEVELOPMENT POSSIBILITIES

6.1 Objective

From the results of the resources survey, the stock size of each target species was estimated, and further, the top ranking species in terms of stock size were defined. They also revealed the existence of unutilized resources, which are caught by artisanal and industrial fisheries but are not landed. There are unexploited resources as well, species found in zones where both the fisheries do not operate currently. The study of those unutilized and unexploited resources aims at an efficient utilization of fishery resources overall, and their possibilities of development are discussed below, based on the data collected by the *Al-Awam*.

6.2 Specific methods of unutilized resources

Unutilized resources are often known through by catches obtained from current fishery activities or by means of resource surveys. However, for the active development of such resources, it is necessary to assess whether they would commercially feasible or if they occur in more than enough quantities to be harvested. Therefore, unutilized resources are defined as those that fulfill the following two conditions:

i) Species with a reasonably large stock size.
ii) Species with commercial utilization that are presently discarded.

As for condition (i), according to the results of both seasonal surveys of phase 2 (2001), a total of 54 species with a stock size exceeding 1,000 tonnes were selected, of which 42 in the cold season and 40 in the warm season. Of those species, those that fulfill condition (ii) were further selected by consulting the following sources:

a. Species whose utilization was confirmed by the landing site survey (see Appendix Table 6.1)
b. CNROP, 1991: Bulletin statistique pour l'année 1998. Archive N° 83:30-32.
c. MPEM; CNROP; MAPA; IEO, 1999: Guide et nomenclature nationale commerciale des espèces marines (poissons, crustacés et mollusques) pêchées en Mauritanie: 1-216, I-XII.
d. SMCP, date unknown: *Classification du poisson congelé*: 1-40.

The above indexes a–d refer to those in Table 6.1.

Out of the selected 54 species, the utilized 41 species (recorded in the references a-d[1]) were eliminated, establishing 13 species as unutilized.

The possibilities of utilization of the unutilized 13 species were checked with the list "Important fisheries" on the Fish Base website (http://www.fishbase.org), and seven of those were found under the "highly commercial" or "commercial" headings: striped panray *Zanobatus schoenleinii*, undulate ray *Raja undulata*, shortnose greeneye *Chlorophthalmus agassizi*, black slimehead *Hoplostethus cadenati*, Boe drum *Pteroscion peli*, prickly puffer *Ephippion guttifer* and thinlip splitfin *Synagrops microlepis* (this species was

[1] Some species considered to be commercially utilized, particularly those mentioned in references b and c, in reality are probably being discarded. This discard situation should be clarified by the continuous study conducted by the CNROP, particularly by the survey on the status of fishes discarded by industrial fisheries. Results of this study have not been made public up to date, however, based on those results, the scientist of CNROP pointed out that some fish species among the utilized 41 species (e.g. large-eye dentex *Dentex macrophthalmus*) are under-utilized.

tentatively included here, as there is no information on its importance in fisheries). Those seven species were considered unutilized resources. As for the remainder, five of them were labeled as "minor commercial", and the sixth was a goby of undetermined species.

Table 6.1 illustrates the process of defining those unutilized resources. The importance and utilization conditions of the 54 species selected in the first phase of the process are summarized in this Table according to Fish Base.

6.3 Results

6.3.1 Unutilized resources and their utilization

The geographical and vertical distributions of the seven species considered unutilized resources are summarized in Table 6.2. Geographically they are thus distributed: three species in the Northern area (striped panray, undulate ray, prickly puffer) and four in the Central and Southern areas (shortnose greeneye, black slimehead, thinlip splitfin, Boe drum). Vertically, four species occur inshore, or in the 3 – 20 m stratum (striped panray, undulate ray, Boe drum, prickly puffer) and three offshore, or in the two strata below 80 m in water depth (shortnose greeneye, black slimehead, thinlip splitfin), defining two groups.

Unutilized inshore and offshore species might be bycatched[2] by bottom trawls targeting octopus in the inshore zone and hake in the offshore area. It is believed that those bycatched species are discarded either because they cannot be sold, or because they command very low prices. However, beyond the IRM boundaries, there is a quantitative factor regarding the discard of unutilized and minor commercial species, and the discarded amount seems to increase with depth all over the world (Miwa, 1975; Kakehata, 1974 [3]).

The utilization of unutilized species depends on their being edible or not. For edible species, there are two ways of utilizing them: (1) offering for consumption as fresh fish, so their own flavor and form could be appreciated; or (2) offering for consumption as processed fishery products [4]. For non-edible species, some possible applications are: (1) feed from fishmeal[5]; (2) industrial oils and cosmetic materials from fish oils; (3) processed pet food; or (4) fresh or frozen fishes for aquaculture feed and fisheries bait.

The degree of utilization of edible fish species depends on the lifestyle, food culture and food habits of each country. Various Western European countries depend mostly on cattle to obtain animal protein; while in countries such as Japan, Portugal, Denmark, Sweden, Norway and the Philippines, seafood is well consumed (FAO, 1971). For instance, fishes from the same family as the aforementioned unutilized species (except for

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[2] The stock sizes reported in Table 6.1 refer to quantities respectively estimated from cod-end and cover net total catches, and not to the catchable stock size targeted by the trawl net (minimum mesh size 70 mm) used in the present industrial fishery. For instance, the catchable stock size of small-size species shortnose greeneye and thinlip splitfin should be less than 10% of the respective estimated stock sizes.

[3] In deep-sea trawls, the amount of unutilized species bycatched with utilized ones is twice the latter.

[4] Fish paste products, frozen minced fish meat, canned foods, seasoned processed foods, salted salt-preserved products preserves, dried products, smoked products, FRC: Fish Protein Concentrates, oils, etc.

[5] Presently in Japan, about one-forth of the fishes and mollusks caught are not utilized as food, but as fishmeal for animal feed. Some reasons for a given fish being diverted to the animal feed: (1) it does not please the consumer in its natural form; (2) its freshness soon deteriorates, with low freezing-resistance and processing aptitude; (3) it was landed on site during a restricted season; etc.

the thinlip splitfin) are utilized in Japan as food (Nose *et al.* [eds.] , 1989), as shown in Table 6.3. Also, in Northern Europe and Japan, sharks and rays have been until now directly or indirectly targeted by fisheries for the utilization of their meat, fins, skin, liver oil and cartilage. Despite this utilization being further promoted in Central America, Asia and Africa (Creuzer *et* Ahmad, 1978), it has not been rationally adopted yet.

As for the domestic consumption of unutilized resources in the IRM, one should not hold very high expectations because fish food culture is historically very recent in the country, and also the technology for processing fishery products for utilization is still undeveloped. In conclusion, the utilization of unutilized resources may be in the form of exports, having the maintenance of the market as a prerequisite condition. At that, considering the technology available in the IRM, the utilization of edible and unedible resources should be limited to fresh and frozen fish, or low-level processing products (mostly raw materials for the next processing level).

6.3.2 Exploitation possibilities of unexploited resources

Unexploited resources in the survey area in water depths of 3 – 600 m are defined as those distributed in regions where artisanal and industrial fisheries do not operate presently (excepting the Bane d'Arguin registered as a world heritage) and whose biomass is large to a certain extent.

Artisanal fisheries explore the inshore region, the continental shelf (depth, < 200 m) by octopus-seeking bottom trawlers either registered or chartered in the IRM, and the continental slope (depth, > 200 m) by licensed EU fishing vessels looking for hake. The current utilization of those resources does not wait well for an eventual proper exploitation of unexploited resources.

6.3.3 The effective utilization of fishery resources

Regardless of species being utilized or unutilized, the necessary technological development and policies for the effective utilization of catch include (1) the utilization of unutilized species; (2) a high degree of utilization of minor commercial or non-interest species (upgrading technology); (3) the complete utilization of nutrient contents; (4) safety assurance (prevention of fishes and mollusks pollution); (5) the improvement of food habits (Suzuki, 1976). Of these, efforts to implement (1) and (2) are today's problems in the entire world.

Table 6.1 Utilization details of species with estimated stock sizes of over 1,000 tonnes, and selection of unutilized species (1/3).

Families	Species	Stock size in tonnes		Entered in references				Proposed unutilized spp.	Fisheries importance/utilizations	Selected unutilized spp.
		Phase 2 cold	Phase 2 warm	a.	b.	c.	d.			
Leptochariidae	*Leptocharias smithii*	201	3,701	×	×	×			○/fresh, smoked or dried salted; skin for leather.	
Triakidae	*Mustelus mustelus**	4,902	22,933	×	×	×	×		●/gamefish;human consumption; oil and fishmeal.	
Rhinobatidae	*Rhinobatos cemiculus*	0	4,063	×					△/gamefish.	
	Zanobatus schoenleinii	1,289	1,035					×	◎/-	×
Rajidae	*Raja miraletus*	806	1,337			×	×		◎/gamefish.	
	Raja undulata	1,930	868					×	◎/-	×
Dasyatidae	*Dasyatis marmorata*	1,759	1,111	×			×		△/gamefish.	
Gymnuridae	*Gymnura altavela*	414	3,243					×	○/gamefish.	
Myliobatidae	*Myliobatis aquila*	1,423	163	×					○/gamefish;highly esteemed flesh.	
	Rhinoptera marginata	62	3,207	×					◎/seldom marketed.	
Albulidae	*Pterothrissus belloci*	1,519	3,005					×	○/-	
Ariidae	*Arius heudelotii*	2,134	2,302	×		×			◎/-	
Chlorophthalmidae	*Chlorophthalmus agassizi*	7,199	8,176					×	◎/fresh, fishmeal.	×
Macrouridae	*Caelorinchus caelorhincus*	221	1,909					×	○/-	
Merlucciidae	*Merluccius polli(*)*	4,749	14,505			×			○/fresh,frozen,fishmeal and oil.	
	*Merluccius senegalensis**	2,731	2,032			×			●/-	
Batrachoididae	*Halobatrachus didactylus*	2,042	391					×	○/-	
Trachichthyidae	*Hoplostethus cadenati*	1,608	1					×	◎/-	×

Remarks. *target species. Fisheries importance:●highly commercial, ◎commercial, ○minor commercial, △of no interest. -:no information.

Table 6.1 Utilization details of species with estimated stock sizes of over 1,000 tonnes, and selection of unutilized species (2/3).

Families	Species	Stock size in tonnes		Entered in references				Proposed unutilized spp.	Fisheries importance/utilizations	Selected unutilized spp.
		Phase 2 cold	Phase 2 warm	a.	b.	c.	d.			
Zeidae	*Zeus faber**	1,428	477	×	×	×	×		◎/gamefish;aquarium;excellent flesh.	
	Zenopsis conchifer	124	3,239			×			◎/-	
Caproidae	*Antigonia capros*	1	13,490					×	○/not regularly marketed	
Scorpaenidae	*Helicolenus dactylopterus*	9,049	16,652			×			◎/fresh.	
	Pontinus kuhlii	3,194	2,689				×		◎/-	
Acropomatidae	*Synagrops microlepis*	2,074	8,149					×	-/-	×
Haemulidae	*Pomadasys incisus*	36,843	40,271	×	×	×			○/-.	
	Pomadasys jubelini	2,445	5,072		×	×	×		○/-.	
	Brachideuterus auritus	4,689	4,839		×	×	×		●/-.	
	Plectorhinchus mediterraneus	75,394	4,069	×	×	×	×		◎/-.	
Sparidae	*Pagrus caeruleostictus**	6,381	43,180	×	×	×	×		◎/gamefish.	
	Boops boops	213	4,183			×	×		●/gamefish;bait;fresh and frozen.	
	*Dentex canariensis**	3,099	1,383	×	×	×	×		◎/important food fish.	
	Dentex gibbosus	57	1,031	×	×	×			◎/gamefish.	
	Dentex macrophthalmus	4,646	188		×	×	×		◎/-.	
	Dentex maroccanus	1,222	813		×	×	×		◎/-.	
	Diplodus sargus	4,635	1,066	×		×			◎/-.	
	Diplodus bellottii	96,882	101,262	×			×		◎/important food fish.	
	Lithognathus mormyrus	4,297	173	×	×	×	×		○/gamefish;fresh and dried.	
	*Pagellus bellottii**	6,826	16,748	×	×	×	×		◎/-.	

Remarks. *target species. Fisheries importance: ●highly commercial, ◎commercial, ○minor commercial, △of no interest. -: no information.

Table 6.1 Utilization details of species with estimated stock sizes of over 1,000 tonnes, and selection of unutilized species (3/3).

Families	Species	Stock size in tonnes		Entered in references				Proposed unutilized spp.	Fisheries importance/utilizations	Selected unutilized spp.
		Phase 2 cold	Phase 2 warm	a.	b.	c.	d.			
Sparidae	*Spondyliosoma cantharus*	1,393	2,033		×	×	×		◎/gamefish;aquarium;important food fish.	
Polynemidae	*Galeoides decadactylus*	7,406	7,292	×	×	×	×		◎/fresh, dried salted or smoked.	
Sciaenidae	*Argyrsomus regius**	1,264	442	×	×	×	×		◎/gamefish.	
	Pseudotolithus senegalensis	3,416	895	×		×	×		○/gamefish;most economically important fish in West African waters.	
	Pteroscion peli	1,840	617					×	◎/-	×
Mullidae	*Pseudupeneus prayensis**	2,963	2,446	×	×	×	×		◎/-	
Drepaneidae	*Drepane africana*	1,094	1,092			×			○/-	
Gobiidae	Gobiidae	1,075	173					×	-/-	
Trichiuridae	*Trichiurus lepturus*	1,834	10,081		×	×			●/gamefish;salted dried, frozen.	
Stromateidae	*Stromateus fiatola*	4,395	6,824		×	×	×		○/-	
Psettodidae	*Psettodes belcheri*	849	1,458	×		×	×		◎/-	
Citharidae	*Citharus linguatula*	1,132	220		×	×			○/-	
Tetraodonidae	*Ephippion guttifer*	611	2,470					×	◎/gamefish.	×
Loliginidae	*Loligo vulgaris**	1,144	1,671	×		×	×		Very important.	
Sepiidae	*Sepia officinalis**	1,455	852	×	×	×	×		do.	
Octopodidae	*Octopus vulgaris**	3,352	3,521	×	×	×	×		Most important.	

Remarks. *target species. Fisheries importance:●highly commercial, ◎commercial, ○minor commercial, △of no interest. -: no information.

Table 6.2 Geographical and vertical distribution of unutilized stocks.

Species	Geographical distribution (%)						Vertical distribution (%)									
	Phase 2 cold season			Phase 2 warm season			Phase 2 cold season (m)					Phase 2 warm season (m)				
	North	Central	South	North	Central	South	3-20	20-30	30-80	80-200	200-400	3-20	20-30	30-80	80-200	200-400
Zanobatus schoenleinii	72.1	14.3	13.6	85.7	5.5	8.8	97.1	1.8	1.0			89.5	10.5			
Raja undulata	99.7	0.3		100.0			99.7			0.3		91.0	4.7	4.3		
Chlorophthalmus agassizi	0.4	57.6	41.9	2.0	53.4	44.6			0.1	91.4	8.5				6.0	94.0
Hoplostethus candenati		0.9	99.1		100.0						100.0					100.0
Synagrops microlepis	0.2	51.4	48.5	11.7	62.6	25.7		+	6.0	92.0	2.0				69.1	30.9
Pteroscion peli		19.6	80.4		6.4	93.6	99.2	0.7	0.1			88.4	11.6			
Ephippion guttifer	46.4	53.6		82.5	16.3	1.2	100.0					93.5	6.5			

Table 6.3 Utilization in Japan of fishes of the same families as the seven unutilized species.

Families	Common name	Utilization
Rhinobatidae	guitarfish	*sashimi* or boiled with soy sauce and sugar; fins utilized for soup
Rajidae	skate	boiled with soy sauce and sugar; raw material for fish paste products
Chlorophthalmidae	green eye	fresh or dried for consumption
Trachichthyidae	rosy soldier fish	material for *kamaboko* (boiled fish paste)
Acropomatidae	Japanese splitfin	(not utilized)
Sciaenidae	croaker	raw material for fish paste products; *sashimi*, salt-grilled, boiled with soy sauce and sugar, *tempura*(deep fried); depending on the species
Tetraodontidae	Puffer-fish	Because many species of this family are venomous, preparation for consumption requires license; edible species are utilized as *sashimi*, boild in a pan or dried

6.4 References

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Appendix Table 6.1 Species whose utilization was confirmed by the landing site survey.

Families	Scientific name		Phase 1		Phase 2	
			cold season	warm season	cold season	warm season
Ginglymostomatidae	*Ginglymostoma*	*cirratum*			×	
Leptocharriidae	*Leptocharias*	*smithii*		×		
Triakidae	*Mustelus*	*mustelus*	×	×	×	×
Carcharhinidae	*Rhizoprionodon*	*acutus*		×	×	
	Sphyrna	*lewini*		×	×	
Rhinobatidae	*Rhinobatos*	*cemiculus*			×	
	Rhinobatos	*rhinobatos*	×			
Dasyatidae	*Dasyatis*	*chrysonota marmorata*			×	
	Dasyatis	*pastinaca*			×	
Myliobatidae	*Myliobatis*	*aquila*	×			
	Rhinoptera	*marginata*			×	
Clupeidae	*Sardinella*	*aurita*	×			
	Sardinella	*maderensis*			×	
	Ethmalosa	*fimbriata*			×	
Ariidae	*Arius*	*heudelotii*	×	×	×	
Mugilidae	*Mugil*	*capurrii*	×	×		
Zeidae	*Zeus*	*faber*			×	
Moronidae	*Dicentrarchus*	*punctatus*		×		
Serranidae	*Epinephelus*	*aeneus*		×	×	
	Epinephelus	*costae*		×		
	Epinephelus	*goreensis*		×		
	Epinephelus	*marginatus*		×		
	Cephalopholis	*taeniops*		×		
Carangidae	*Alectis*	*alexandrinus*			×	
	Chloroscombrus	*chrysurus*	×			
	Lichia	*amia*			×	
Haemulidae	*Pomadasys*	*incisus*	×			
	Plectorhinchus	*mediterraneus*	×	×	×	
Sparidae	*Pagrus*	*auriga*		×		
	Pagrus	*caeruleostictus*	×	×	×	×
	Dentex	*canariensis*		×	×	×
	Dentex	*gibbosus*				×
	Diplodus	*sargus cadenati*		×	×	
	Diplodus	*bellottii*		×		
	Lithognathus	*mormyrus*	×			
	Pagellus	*bellottii*		×		
	Sparidae	sp.			×	
Polynemidae	*Galeoides*	*decadactylus*	×		×	
Sciaenidae	*Argyrosomus*	*regius*		×	×	×
	Pseudotolithus	*senegalensis*			×	
	Umbrina	*canariensis*		×		
Mullidae	*Pseudupeneus*	*prayensis*			×	
Scaridae	Scaridae	sp.			×	
Scombridae	*Scomberomorus*	*tritor*	×	×	×	
	Sarda	*sarda*		×		
Psettodidae	*Psettodes*	*belcheri*		×	×	×
Soleidae	*Solea*	*senegalensis*		×	×	×
	Dicologoglossa	*cuneata*		×	×	×
	Synaptura	*cadenati*		×		
	Synaptura	*lusitanica*		×		
	Synaptura	sp.		×		×
Cynoglossidae	*Cynoglossus*	*canariensis*	×	×		
	Cynoglossus	*senegalensis*			×	
	Cynoglossus	sp.				×
Monacanthidae	*Stephanolepis*	*hispidus*			×	
Tetraodontidae	*Lagocephalus*	*laevigatus*			×	
Loliginidae	*Loligo*	*vulgaris*	×		×	
Sepiidae	*Sepia*	*officinalis*	×		×	
Octopodidae	*Octopus*	*vulgaris*	×		×	
Palinuridae	*Panulirus*	*regius*			×	

7. AGE DETERMINATION OF MAIN SPECIES OF FISHES AND CEPHALOPODS

7.1 Outline of the survey

7.1.1 Objectives of the survey

In IRM, there is a need to develop and establish methods for age determination that are indispensable for the assessment and management of fishery resources.

The objectives of this survey were, with respect to key demersal fishes and cephalopods: (a) to develop techniques for age determination; (b) to clarify their age and growth; and (c) to carry out technology transfer to the Mauritanian counterpart personnel through on-the-job training.

7.1.2 Survey period and location

The survey was totally conducted at the laboratory of the Department of Living Resources and Environment (DRVE) of the Oceanography and Fishery Research Center (CNROP). Survey period is shown in Table 7.1.

Table 7.1 Time and period of the age determination survey.

No.	Season	Period
1	Cold 2000	23 Mar. - 1 Jun. (72 days)
2	Warm 2000	26 Sep. - 14 Nov. (50 days)
3	Cold 2001	7 May - 22 Jun. (47 days)
4	Warm 2001	7 Oct. - 25 Nov. (50 days)

7.1.3 Survey team members

Japan: Dr. Naohiko Watanuki (OAFIC / JICA)[1,2,3,4]

IRM: Dr. Abdoulaye Wague (CNROP)1,2,3,4
Mr. Khallahi O. Mohamed Fall (CNROP)[2]
Mr. Abdoulaye N'Diaye (CNROP)[1,2,3]
Mr. Oumar M'Bodj (CNROP)[1,2,3]
Mr. Mamadou Lam (CNROP)[2]
Mr. Oumar Samba Tall (CNROP)[3,4]
Mr. Ahmed Diagne (CNROP)[4]

7.1.4 Equipment and chemicals

Main equipment used in the survey were as follows:

- BUEHLER ISOMET 5000 Linear Precision Saw
- NIKON ECLIPSE E400 Biological Microscope
- LEICA WILD M8 Binocular Microscope

- JVC KY-F55B 3-CCD Color Video Camera
- JVC BM-1400PN Color Video Monitor
- FLOVEL MC-70 Color Measure Unit

Chemicals were provided by the Department of Sanitary Inspection and Valorization (DVIS) of CNROP.

7.1.5 Sample size of target species

The target species were: bluespotted seabream *Pagrus caeruleostictus*, Senegalese hake *Merluccius senegalensis*, Senegalese sole *Solea senegalensis*, smooth-hound *Mustelus mustelus*, common octopus *Octopus vulgaris*, European squid *Loligo vulgaris*, common cuttlefish *Sepia officinalis* and broadtail shortfin squid *Illex coindetii*.

Table 7.2 Sample size of target species for age determination survey.

Scientific name	Common name	Age character	No.	
			Collected	Examined
Pagrus caeruleostictus	Bluespotted seabream	otolith	461	287
Merluccius senegalensis	Senegalese hake	otolith	98	98
Solea senegalensis	Senegalese sole	otolith	18	-
Mustelus mustelus	Smooth-hound	vertebra	110	70
Octopus vulgaris	Common octopus	beak/statolith	80/50	35/0
Loligo vulgaris	European squid	statolith	97	36
Sepia officinalis	Common cuttlefish	statolith	28	-
Illex coindetii	Broadtail shortfin squid	statolith	30	-

7.2 Survey details

1. In the beginning, at the request of IRM, the survey team was expected to study age and growth of, three teleost fishes *(Pagrus caeruleostictus, Merluccius senegalensis, Solea senegalensis)*, one elasmobranch fish (*Mustelus mustelus)* and four cephalopods *(Octopus vulgaris, Loligo vulgaris, Sepia officinalis, Illex coindetii)*. However, due to time and manpower constraints, and the poor catch of target species in the 2000 Sea-borne Survey, the number of target species was curtailed.

2. In the 2000 Sea-borne Survey, *Solea senegalensis* had a poor catch and was excluded from the age determination study (Table 7.2). As the collection and processing of statoliths are quite time-consuming, *Sepia officinalis* and *Illex coindetii* were also excluded. It was found that age determination techniques for *Loligo vulgaris* could be applied to other cephalopods as well. Five species ended up being targeted: *Pagrus caeruleostictus* (otoliths), *Merluccius senegalensis* (otoliths), *Mustelus mustelus* (vertebrae), *Octopus vulgaris* (beak/statoliths) and *Loligo vulgaris* (statoliths).

3. In March 2000, JICA provided an ISOMET saw for the preparation of otoliths, vertebrae and beaks. Also, in April 2001 and at the request of the survey team, JICA purchased laboratory equipment (biological microscope, color video camera, color video monitor, ring measurement unit) for age ring analysis (Figure 7.1). This equipment allowed the survey team to accurately and efficiently

analyze structures utilized in age determination.

Figure 7.1 Main equipment used for age determination studies.
Left, ISOMET 5000; right, microscope system.

4. CNROP designated Dr. Abdoulaye Wague, Researcher, as a counterpart of the JICA team. Throughout the survey, Dr. Wague and other researchers and various technicians were engaged in age determination activities.

5. Dr. Wague went to Japan in August 2000 for counterpart training. He visited Seikai National Fisheries Research Institute (Nagasaki, Ishigaki) and Nagasaki University, and learned a variety of techniques necessary for age determination studies on fishes and cephalopods. His training in Japan was very important to the survey and produced excellent results.

6. The first objective of the survey, i.e. development of age determination techniques using age characters (otoliths, vertebrae, beak, statoliths), was successfully attained in all target species except for *Octopus vulgaris*, whose statoliths could not produce good results. It is known among cephalopod researchers that age determination of *Octopus vulgaris* based on statolith analysis is riddled with difficulties.

7. The second objective of the survey, i.e. clarification of age and growth of target species, was achieved in *Pagrus caeruleostictus*, for which the periodicity of otolith rings led to clarify its age/body length relationship. This was also achieved for *Octopus vulgaris* and *Loligo vulgaris*, based on the results of previous age and growth studies. However, in the case of *Merluccius senegalensis* and *Mustelus mustelus*, age determination was not possible because of lack of samples during the transitional seasons.

8. As for the third objective, the transfer of age determination technology, considering the great need for the CNROP to reinforce its research capacity, the survey team put a great deal of effort by jointly conducting experiments, analyzing data and preparing reports. As a result of a technical transfer from the Japanese side to the Mauritanian side at both theoretical and practical levels, the know-how of age determination was acquired by the latter. One of the results is a manual for age determination (Wague & Watanuki, 2001). With this publication and all the project reports, the CNROP took an important step for the evaluation of fishery resources.