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Report of the FAO/CECAF Working Group on the Assessment of Demersal Resources Conakry, Guinea, 19–29 September 2003

Rapport du Groupe de travail FAO/COPACE sur l'évaluation des ressources démersales Conakry, Guinée, 19-29 septembre 2003

PROGRAMME FOR THE DEVELOPMENT OF FISHERIES
IN THE EASTERN CENTRAL ATLANTIC
FISHERY COMMITTEE FOR THE EASTERN CENTRAL ATLANTIC

PROGRAMME POUR LE DÉVELOPPEMENT DES PÊCHES
DANS L'ATLANTIQUE CENTRE-EST
COMITÉ DES PÊCHES POUR L'ATLANTIQUE CENTRE-EST

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FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
ORGANISATION DES NATIONS UNIES POUR L'ALIMENTATION ET L'AGRICULTURE
Rome, 2006

PREPARATION OF THIS DOCUMENT

The FAO/CECAF Working Group on demersal resources was created during the fifteenth session of the Fishery Committee for the Eastern Central Atlantic (CECAF) which was held in Abuja, Nigeria, from 1 to 3 November 2000 (FAO, 2000).

Initially, two meetings were held: one in Accra (September 2001) to review the information on the demersal resources of the Gulf of Guinea, and the second in Tenerife (September 2002) to continue the data preparation on all the CECAF demersal stocks and to review the assessment methods.

Subsequently, a permanent FAO/CECAF Working Group was created, composed of scientists from the coastal countries and from those countries or organizations playing an active role in demersal fisheries in Central-West Africa, and a Working Group was organized in Conakry, Guinea, from 19 to 29 September 2003.

The main objective of the Working Group is to improve the assessment of demersal resources as well as the analysis of management options and exploitation which would allow the best sustainable use of the resources.

In all, 33 researchers from 14 different countries participated in the second meeting of the Working Group.

The meeting was financed by the Netherlands Institute for Fisheries Research (RIVO) and by the FAO Marine Resources Service (FIRM).

FAO wishes to thank the participants of the Working Group who contributed towards this report. Our special thanks go to Stephen Cofield, Marie-Thérèse Magnan and Françoise Schatto for their assistance with the final preparation of this document.

PRÉPARATION DE CE DOCUMENT

Le Groupe de travail FAO/COPACE sur les ressources démersales a été créé au cours de la quinzième session du Comité des pêches pour l'Atlantique Centre-Est (COPACE) qui s'est tenue à Abuja (Nigéria) du 1er au 3 novembre 2000 (FAO, 2000).

Comme première étape, deux réunions ont été tenues: l'une à Accra (septembre 2001) pour passer en revue les informations sur les ressources de démersaux au large du Golfe de Guinée et la seconde à Ténérife (septembre 2002) pour continuer la préparation des données sur tous les stocks démersaux du COPACE et pour passer en revue les méthodes d'évaluation des démersaux.

Par la suite, un groupe de travail permanent FAO/COPACE, composé de scientifiques des Etats côtiers et des pays ou organisations qui jouent un rôle actif dans les pêcheries démersales de l'Afrique centre-occidentale, a été créé et un groupe de travail a été organisé à Conakry, Guinée, du 19 au 29 septembre 2003.

Les objectifs principaux du Groupe de travail sont l'amélioration de l'évaluation des ressources de démersaux ainsi que l'analyse des options de gestion et d'exploitation permettant d'assurer la meilleure utilisation durable des ressources.

En tout 33 chercheurs de 14 pays différents ont participé à la deuxième réunion du groupe de travail.

La réunion a été financée par l'Institut néerlandais de recherche halieutique (Netherlands Institute for Fisheries Research [RIVO]) et par le Service des ressources marines de la FAO (FIRM).

La FAO est reconnaissante aux participants du Groupe de travail qui ont contribué à la réalisation du présent rapport. Nos vifs remerciements vont à Stephen Cofield, Marie-Thérèse Magnan et Françoise Schatto pour l'assistance apportée à l'édition finale de ce document.

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ABSTRACT

A permanent FAO/CECAF Working Group composed of scientists from the coastal countries and from those countries or organizations playing an active role in demersal fisheries in Central-West Africa, was created by CECAF in 2000. The second meeting of this Group was organized in Conakry, Guinea, from 19 to 29 September 2003.

The main aims of the Working Group are to improve the assessment of the demersal resources as well as the analysis of management options and exploitation which would allow the best sustainable use of the resources providing economic benefit to all the CECAF countries. The study zone for the Working Group is the CECAF zone of the Eastern Central Atlantic Ocean between Cap Spartel and the Congo river.

For reasons of heterogeneity the species and stocks of the demersal Working Group were divided into eight subsets: hake, demersal fish north, demersal fish south 1, demersal fish south 2, demersal fish south 3, shrimp north, shrimp south and cephalopods. For each of these subsets, information is provided on the fisheries: sampling intensity, biological characteristics, stock identity, data on the fishery (catch, effort, biological data and abundance indices), assessment, management recommendations and future research.

Approximately 40 different stocks-units were analysed and the results discussed. The quality and trends in basic data (catch, effort, length distribution) collected by each different country and the sampling system, represented some of the main discussion topics of the second meeting 2003 of this Working Group.

The Working Group decided that the majority of the demersal stocks were fully exploited and that, for some of them, the fishing effort should be heavily reduced. A summary of the assessments and management measures is given at the end of this report.

RÉSUMÉ

Un groupe de travail permanent FAO/COPACE, composé de scientifiques des Etats côtiers et des pays ou organisations qui jouent un rôle actif dans les pêcheries démersales de l'Afrique centre-occidentale a été créé par le COPACE en 2000. La deuxième réunion de ce groupe a été organisée à Conakry, Guinée, du 19 au 29 septembre 2003.

Les objectifs principaux du Groupe de travail sont l'amélioration de l'évaluation des ressources démersales ainsi que l'analyse des options de gestion et d'exploitation permettant d'assurer la meilleure utilisation durable des ressources pour le bénéfice économique de tous les pays du COPACE. La zone d'étude pour le Groupe de travail est la zone COPACE de l'océan Atlantique Centre-Est, entre le Cap Spartel et le fleuve Congo.

En raison de l'hétérogénéité des espèces et des stocks, le Groupe de travail sur les démersaux a été divisé en huit sous-groupes: merlus, poissons démersaux nord, poissons démersaux sud 1, poissons démersaux sud 2, poissons démersaux sud 3, crevettes nord, crevettes sud et céphalopodes. Pour chacun de ces sous-groupes, des informations sont données sur les pêcheries: intensité d'échantillonnage, caractéristiques biologiques, identité du stock, données sur la pêche (capture, effort, données biologiques et indices d'abondance), évaluation, recommandations d'aménagement et de recherche future.

Environ 40 stocks-unités différents ont été analysés et les résultats discutés. La qualité et les tendances des données de base (captures, effort et distribution de taille) collectées par chaque pays et le système d'échantillonnage, étaient certains des principaux thèmes de discussion de la deuxième réunion 2003 de ce Groupe de travail.

Le Groupe de travail a conclu que la plus grande partie des stocks démersaux étaient pleinement exploités et que, pour certains d'entre eux, l'effort de pêche devrait être fortement réduit. Le résumé des évaluations et des mesures de gestion est présenté dans les tableaux à la fin de ce rapport.

Distribution :
Working Group participants/Participants au Groupe de travail
Fishery officers, FAO Regional Offices/Fonctionnaires des pêches des Bureaux régionaux de la FAO
FAO Fisheries Department/Département des pêches de la FAO

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1. INTRODUCTION

The second meeting of the FAO/CECAF Working Group on Demersal Resources met in Conakry, Guinea, from 19 to 29 September 2003. The Working Group was created during the fifteenth session of the Fishery Committee for the Eastern Central Atlantic (CECAF) which was held in Abuja, Nigeria, from 1 to 3 November 2000 (FAO, 2000).

The overall objective of the Working Group is to contribute to the improved management of demersal resources in West Africa through the assessment of the state of the stocks and fisheries to ensure sustainable use of these resources for the benefit of coastal countries.

The group is chaired by Mr Mika Diop of the Institut mauritanien de recherches océanographiques et des pêches (IMROP), Mauritania.

In all 33 researchers from 14 different countries took part in the meeting.

The meeting was financed by the Netherlands Institute of Fisheries Research (RIVO), The Netherlands and organized by FAO. This was a follow-up to the first meeting which took place in Tenerife, Spain from 17 to 20 September 2002, financed by Spain.

1.1 Terms of reference

The terms of reference of the Working Group which were adopted by the CECAF Sub-Committee (FAO, 2000) were:

1. To update (to 2002) the catch and effort statistics by country and by species.
2. To consolidate and update biological information on catches, in particular length and age, if available. To proceed with a review of the trends and quality of the available data.
3. To select the most reliable data sources and assessment methods.
4. To assess the current state of the different stocks in the subregion using the available catch and effort information, the biological data and the data from the scientific surveys.
5. To present the different stock management options for the various stocks, pointing out the long and short-term effects.
6. To identify gaps in the data which need to be remedied during future Working Group meetings.

1.2 Participants

Eduardo	Balguerias	Spain
Pedro	Barros	FAO/Rome
Said	Benchoucha	Morocco
Abdellatif	Boumaaz	Morocco
Ana Maria	Caramelo	FAO/Rome
Ibrahima	Diallo	Guinea
Samba	Diallo	Guinea
Mika	Diop (President)	Mauritania

Lourdes	Fernández Peralta	Spain
Charles	Gabche	Cameroon
Eva	García Isarch	Spain
Amélie	Gbaguidi	Benin
M'Hamed	Idrissi	Morocco
Cheikh	Inejih	Mauritania
Tapé	Joanny	Côte d'Ivoire
Kumbi	Kilongo	Angola
Fall	Massal	Senegal
Beyah	Meissa	Mauritania
Asberr	Mendy	The Gambia
Amina	Najd	Morocco
Samuel	Quaatey	Ghana
Ana	Ramos	Spain
Birane	Samb	Senegal
Kossi	Sedzro	Togo
Mohamed	Seisay	Sierra Leone
Aboubacar	Sidibe	Guinea
Ignacio	Sobrino	Spain
Merete	Tandstad	FAO/Rome
Sory	Traore	Guinea
Martin	Van Der Knaap	The Netherlands

1.3 Definition of the working area

The assessment area of the Working Group is the CECAF zone of the Eastern Central Atlantic Ocean, between Cap Spartel and the Congo river.

1.4 Methodology and software

For reasons of heterogeneity the species and stocks of the demersal Working Group were divided into 8 subsets: hake, demersal fish North, demersal fish South 1, demersal fish South 2, demersal fish South 3, shrimp North, shrimp South and cephalopods (Table 1.5.1).

Around 40 different stocks–units were analysed and discussed. The quality and trends in basic data (catch, effort, length distribution) collected by each different country and the sampling system, represented some of the main discussion topics of the 2003 meeting of the Working Group.

After reviewing the available data, the Working Group decided that the surplus production models were the only ones that could be applied to all stocks–units.

Description of the models used

The stocks in the area were assessed using a logistic surplus production model based on the Schaefer (logistic) population growth model.

The model uses four base parameters: virgin biomass K, intrinsic growth rate of the population r, initial rate of reduction D (initial biomass related to K) and catchability q. All other estimated parameters derive from these four.

After giving the best parameter estimates, the model calculates the reference points MSY, B_{MSY} , F_{MSY} as well as B_{ratio}, B_{Cur}/B_{MSY} (the ratio between estimated biomass for the last year of the data series and B_{MSY}), and F_{ratio}, F_{Cur}/F_{SYCur} (the ratio between effective effort exerted on the stock over the course of the last year of the data series and the effort that would have produced a sustainable yield during the same year).

The absolute values F_{MSY}, B_{MSY} and even K should not be taken into consideration as the model provides a more precise estimate of F_{ratio} and B_{ratio}.

The trends in these ratios and whether they are above or below 1.0 provide useful information on management.

B_{ratio}, B_{Cur}/B_{MSY} show the current state of the stock in relation to the biomass which would be produced by MSY.

Values less than 100 percent point towards a stock less than B_{MSY}, whereas values greater than 100 percent show a stock abundance greater than B_{MSY}.

F_{ratio}, F_{Cur}/F_{SYCur} measure the level of exploitation of the last year of available data, as a proportion of the level of exploitation that would be necessary to extract the sustainable catch at the levels of biomass estimated for the same year. Values less than 100 percent point to an eventual growth in the stock, whereas values higher than 100 percent suggest that the stock will decrease in the following year.

Implementation

The model and fits were recorded on an MS Excel spreadsheet and modified using the Biodyn software (FAO, 1998). The minimization algorithm used was the Newton-Raphson, provided in the MS Excel Solver add-in. Given that the different parameters have different scales, an automatic interval of the parameters was chosen.

The basic data used for each stock were estimates of the total annual catch, and a catch per unit effort (CPUE) series from the commercial fisheries or the research surveys.

The fit of the model was based on the fit of the observed CPUE series, taking into account an error of observation model. The objective function minimized was the sum of the squares of the logs of the residuals between observed and predicted CPUE.

Due to the uncertainties surrounding the data, it was decided not to combine the different CPUE series in a single assessment. Consequently, a single CPUE series was used for each run of the model, only adopting the series judged by the researchers to have the greatest probability of reflecting the underlying changes in the abundance of the stocks.

When more than one CPUE series was available, a separate run of the model was done for each of them. Particular care was taken to ensure that the initial values of the parameters were the same for all the CPUE series considered.

The four model parameters r, K, q and D are strongly related, a problem which is well known in the non-linear estimation of the model. For example, for the same data series, a higher

intrinsic estimate of the growth rate is necessarily tied to a smaller capacity and/or a greater catchability. To mitigate this problem, the initial depletion, D, was fixed, based on knowledge of the fishery, for the years preceding the beginning of the data series. When there were doubts about the ratio, the model was run several times with different ratio values and the results were subsequently compared. The most suitable values were chosen. The other three parameters, r, K and q were estimated using a non linear minimisation algorithm.

Initial values and constraints

The minimization algorithm generally varies greatly depending on the initial values of the parameters. The procedures below were followed to obtain suitable values:

1. A suitable value for B_1 was estimated for the average biomass over the study period, based on external knowledge of the fishery;
2. The initial value of q, q_1, was calculated by dividing the average value of the abundance index $\overline{U}$ by B_1,

$$q_1 = \frac{\overline{U}}{B_1};$$

3. The initial value of K, K_1, was estimated by taking the average value of the abundance indices over the first two years, dividing it by q_1 to obtain an estimate of the initial biomass, B_1 , and dividing by the initial value of the depletion, D:

$$K = \frac{1}{D} \times \frac{U_1}{q_1};$$

4. The initial value of r was estimated at 0.5 for slow-growing species with a long lifespan, and 1.0 for fast-growing species with a short lifespan. In the estimate, K and q are constrained to within a half and twice their initial values, r must only be positive.

$$\frac{q_1}{2} \le q \le 2 \times q_1, \quad \frac{K_1}{2} \le K \le 2 \times K_1$$

1.5 Structure of the report

Separate sections are devoted to the 9 different sub-groups: hake, demersal fish North, demersal fish South 1, demersal fish South 2, demersal fish South 3, shrimp North, shrimp South, cephalopods North and cephalopods South. For each of these sub-groups information is given on the fisheries: sampling intensity, biological characteristics, stock identity, data on the fishery (catch, effort, biological data and abundance indices), assessment, management recommendations and future research.

Table 1.5.1: Definition of the units analysed by each subgroup

Subgroup/Species/Group of species	Zone
Hake	
Merluccius merluccius	Morocco
Merluccius polli and *Merluccius senegalensis*	Morocco
Merluccius polli and *Merluccius senegalensis*	Mauritania
Merluccius polli and *Merluccius senegalensis*	Senegal–The Gambia
Demersal fish North	
Sparus aurata	Morocco + Mauritania
Pagellus bellottii	Morocco + Mauritania
Pagellus bellottii	Senegal + The Gambia
Dentex macrophthalmus	Morocco + Mauritania
Arius spp.	Senegal + The Gambia
Pseudotolithus spp.	Senegal + The Gambia
Epinephelus aeneus	Senegal + The Gambia + Mauritania
Demersal fish South 1	
Pseudotolithus elongatus	Guinea, Sierra Leone
Pseudotolithus spp.	Guinea, Sierra Leone
Galeoides decadactylus	Guinea, Sierra Leone
Arius spp.	Guinea, Sierra Leone
Sparidae	Guinea, Sierra Leone
Cynoglossus spp.	Guinea, Sierra Leone
Pomadasys spp.	Guinea, Sierra Leone
Demersal fish South 2	
Brachydeuterus auritus	Côte d'Ivoire + Ghana + Togo + Benin
Galeoides decadactylus	Côte d'Ivoire + Ghana + Togo + Benin
Dentex spp.	Côte d'Ivoire + Ghana + Togo + Benin
Pagellus bellottii	Côte d'Ivoire + Ghana + Togo + Benin
Pseudotolithus spp.	Côte d'Ivoire + Ghana + Togo + Benin
Demersal fish South 3	
Pseudotolithus spp.	Angola + Cameroon
Galeoides decadactylus	Cameroon
Dentex spp.	Angola
Cynoglossus spp.	Angola + Cameroon
Shrimp North	
Parapenaeus longirostris	Morocco
Parapenaeus longirostris	Mauritania
Parapenaeus longirostris	Senegal + The Gambia
Penaeus notialis	Mauritania
Penaeus notialis	Senegal + The Gambia

Table 1.5.1 (cont.)**:** Definition of the units analysed by each subgroup

Subgroup/Species/Group of species	Zone
Shrimp South	
Penaeus notialis	Guinea
Penaeus notialis	Sierra Leone
Penaeus notialis	Ghana
Penaeus notialis	Cameroon
Cephalopods North	
Octopus vulgaris	Dakhla (26N–20N)
Octopus vulgaris	Cap Blanc (20N–16N)
Octopus vulgaris	Senegal + The Gambia
Sepia spp.	Morocco
Sepia spp.	Senegal + The Gambia
Cephalopods South	
Sepia spp.	Guinea

2. HAKE

2.1 Fisheries

The white hake, *Merluccius merluccius,* is the main hake species caught by the fleet off the Atlantic coast of Morocco.

The black hakes, *Merluccius senegalensis* and *Merluccius polli*, are currently only targeted by EU and national fleets off the coasts of Mauritania and Senegal.

Until the end of 1999, Morocco, Spain and Portugal were the main countries exploiting the white hake stock off the North Atlantic coast of Morocco. The EU fleet was restricted to fishing outside the 12 mile zone and the national fleet to beyond the 6 mile zone. Since the 1999 fishing agreement between Morocco and the European Union ended, only the Moroccan fleet operates in these waters.

The Moroccan fleet is composed of small coastal vessels, trawlers and low range longliners which exploit the white hake and pink shrimp on the continental shelf. These boats rarely fish in depths greater than 150 m. The number of vessels in this category has not undergone any notable variation since 1992 when it stabilized at around 450 units.

Since 2002, Spanish boat owners employing around a dozen longliners have set up joint ventures with Moroccan boat owners to exploit the white hake in Morocco. These vessels also catch the Senegalese hake, but the catch size is unknown. In 2003, some Spanish vessels, affected by the “Prestige” catastrophe, have also been permitted to fish in Morocco.

Exploitation of hake in Mauritania began in the 1950s (FAO, 1990, 1995, 1997; CNROP, 1998). The black hake *Merluccius senegalensis* and *M. polli* are the main targets of this

fishery. Initially it was carried out by foreign fleets, most notably from the Russian Federation, Romania, Portugal and Spain.

In Mauritania, black hake is targeted by two fleets, (a) the Mauritanian trawler fleet, (b) the Spanish trawler and fresh fish longliner fleet. It should be noted that the Spanish freezer trawlers target the demersal fish under the European Union–Islamic Republic of Mauritania (EU–IRM) fishing agreement which was signed during a period of large black hake catches. Pelagic trawlers catch hake as a bycatch, which represents 10 percent of the total declared volume.

In Mauritanian waters, hake are fished between 100 and 600 metres in depth. During the cold season, the trawlers operate exclusively to the south of 19 °N up to 17 °N which represents their southern limit in Mauritania. With the warming of the waters beginning in May, the black hake migrate north and/or get closer to the shallower trawl zones. This then brings with it a seasonal movement of the fleet which concentrates its efforts, between July and September, to the north of 20 °N.

Statistics from 2002 show that sectors 18S10, 18S40, 20T40 and 20T10 are the main fishing zones with more than 43 percent of the catch being taken here (Figure 2.1.1).

In Senegal, the main fleet targeting black hake since 1985 is composed of Spanish trawlers. Other fleets catch little black hake.

2.2 Sampling intensity

2.2.1 Catch and effort

White hake catch statistics for the Moroccan coastal fishery are available by month and by port at the Institut national de recherche halieutique (INRH) in the form of raw data for all the segments. However, the landings are not separated by type of fishery (trawlers, longliners and mixed).

Catch and effort data for the Spanish trawlers targeting black hake in the waters of Mauritania and Senegal, are also available. Detailed information on the landing statistics of bycatches is available as well. The two black hake species are not separated in the catch statistics.

For the Spanish longliner fleet fishing in Mauritania, no sampling system exists. The only available information on catch and effort is that coming from the captains' log-books.

No landing data is available for the Spanish freezer vessels fishing in Mauritanian waters with a "demersal fish" licence. It is known however that these vessels catch a substantial amount of hake.

2.2.2 Biological parameters

There is no biological sampling plan for hake landings in the region.

Biological sampling in Morocco is carried out both in certain reference ports and on board the research vessel during the trawl surveys carried out twice a year by the Institut national de recherche halieutique. During the prospecting surveys at sea, after every trawl, the weight of

each species is determined as well as length measurements for the main species and the biological parameters (sex-ratio, sexual maturity, length–weight relationship).

In Mauritania, length sampling carried out by scientific observers on board foreign vessels covers between 2 and 5 percent of the total catch and between 0.33 and 1.44 percent of the trawls (Table 2.2.1).

Table 2.2.1: Mauritania – Sampling intensity and cover of 2002 catches

Type of vessel	Sampling intensity[1]	Cover[2]
Foreign cephalopod vessels	3.1%	0.81%
Foreign demersal fish trawlers	4.6%	1.44%
Foreign shrimpers	2.6%	0.33%
Foreign hake trawlers	1.9%	1,21%

[1] Sampling intensity = weight of the sample/total catch.
[2] Cover = number of trawls sampled/total number of trawls.

In 2002, the Spanish Oceanographic Institute (IEO) began a programme of scientific observers on board the Spanish hake trawlers operating in Mauritania. Two surveys were carried out during that year, the first in March–April (cold season) and the second in the transition season (July). Seventy-one trawls were sampled during these two periods which allowed data to be collected on the bathymetric distribution of the two hake species, the specific composition of the catches and the rejects, as well as the length frequencies by season and sex.

2.3 White hake (*Merluccius merluccius)*

2.3.1 Biological characteristics

The white hake is a temperate water species, with a relatively long lifespan (12–13 years) and moderate growth. The regeneration rate is from seven to nine years. Sexual maturity is reached at around the fifth year of life. Each female produces between two and seven million eggs. As far as diet is concerned, adult white hake generally eat other fish (young hake, anchovies, sardines and other gadoid species) and squids, the young eat crustaceans (in particular Euphausiides and Amphipodes).

Spawning Laying takes place all year round with two peaks, the first in summer and the second in winter. Recruitment takes place in spring and autumn. After Spawning, which generally happens at depths of between 150 and 100 metres, the eggs are carried by the current towards the surface. The larvae which hatch four days later are carried towards the coast, all the while growing in length, until they reach the juvenile stage. The adults on the other hand return to the deeper waters after spawning.

2.3.2 Stock identity

The Working Group decided to consider the white hake population (*Merluccius merluccius*) as a single stock. This species is found on the sandy, sandy-muddy, muddy and rocky bottoms of the Strait of Gibraltar at 21 ^{o}N.

2.3.3 Trends in the data

Catch

The annual catch registered by the coastal Moroccan fleet decreased between 1995 and 1998 (Table 2.3.3a and Figure 2.3.3a). From 1999 an increase in catches has been observed.

As far as the Spanish catches in the Moroccan zone are concerned, those of the trawlers saw a decrease from 1991, reaching 600 tonnes in 1999. With regard to the other types of vessel of the Spanish fishery, the catches of the liners remained practically stable from 1996, whereas the longliner catches followed the same trend as the trawlers. No estimate has been made of the rejects in the Moroccan fisheries.

Effort

Global fishing effort directed towards white hake has seen a decrease following the progressive reduction in effort of the European Union vessels (Table 2.3.3b and Figure 2.3.3b). The overall number of EU vessels decreased steadily between 1992 and 1999, going from 136 trawlers and 147 longliners to 83 trawlers and 96 longliners. The EU fleet withdrew completely from the fishery at the end of 1999.

By contrast, the overall number of Moroccan coastal trawlers has not changed greatly since 1992, maintaining a level of around 450 vessels.

The fishing effort of the Moroccan coastal trawlers saw a decrease between 1990 and 1995, from 25 581 to 15 514 fishing days. This was followed by a steady increase, stabilising at around 40 000 fishing days in 2001–2002.

The fishing effort of the Spanish trawlers saw a marked decrease between 1990 and 1999, going from 205 000 to 7 644 fishing days. In contrast to this, the effort of the Spanish longliners and liners showed an increasing trend, growing from 2 759 to 4 955 and 2 832 to 5 418 fishing days respectively over the same period.

Abundance indices

CPUE

The evolution in catch per unit of effort (CPUE) of the fleets targeting the white hake in the Moroccan zone (Figure 2.3.3c) shows that the CPUE of the Moroccan trawlers (expressed in kg/fishing days) reached its highest level in 1995, decreasing steadily until 1998. From 1999 onwards, the CPUE increases once again.

Analysis of the evolution of the CPUE of the Spanish vessels shows a general decreasing trend for all the fleets, particularly from 1996.

Scientific surveys

Since 1982, the Institut national de recherche halieutique has undertaken repeated trawl surveys of the stocks of white hake and shrimp with the research vessels “Ibnou Sina” from 1982 to 1986 and “Charif Al Idrissi” since 1987.

The zones surveyed are Larache (35°13 N)–El Jadida (33°15 N) and Essaouira (31°31 N)–Agadir (30°26N). These two zones are separated by a hard bottom area which is not trawlable.

The abundance indices of white hake from these surveys (Figure 2.3.3d) dropped drastically in the two zones from the end of 1995 until 1998. There was an increase from 1999 till 2000, when the indices begin to show a decreasing trend once again.

Biological data

Length composition and other data

There is currently no hake biological sampling plan of the landings in the region.

Analyses of the length compositions of the Moroccan coastal trawlers' catch samplings from 1988 to 1999 show that the average length (total length in cm) follows a stable trend (Table 2.3.3c). The data on length frequencies of the Spanish fleet show that the Spanish trawlers (50 mm mesh) caught young hake whereas the rest of the Spanish fleet (trawlers 60 mm mesh, longliners and liners) target the adults of the stock.

Table 2.3.3c: Average length (total length in cm) of the white hake (*Merluccius merluccius*) in the landings of the Moroccan coastal trawlers from 1988 to 1999

1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1988	1999
22.54	21.75	21.33	20.73	20.83	19.29	19.18	20.20	17.79	23.83	25.76	25.51

The length frequency data from the surveys carried out by the INRH research vessels show a decreasing trend in average length from 1993, both in the north and in the south. The average lengths recorded in June 2003 between Larache and El-Jadida show that the present stock of white hake is mostly composed of juveniles.

The biological parameters calculated from the survey results to determine sexual maturity, the length–weight ratio and the sex-ratio are given in Table 2.3.3d. It can be seen that the white hake stock shows a balance in the sexes. The length at first sexual maturity, L50, is 29.88cm (trawl survey, June 2003). The maximum observed length is 130cm.

2.3.4 Assessment

Methods

The logistic surplus production model was used to assess the state of the stock of white hake. This model is described in detail in Point 1.4.

Data

The series of total white hake (*Merluccius merluccius*) landings estimated by the Working Group was used as the series of total catches of the stock.

As a series of abundance indices the Working Group used three different abundance indices. These were the CPUE (tonnes/fishing day) of the Moroccan trawlers and the abundance

indices (kg/h) of the trawl surveys carried out in the zones of Larache–El Jadida and Essaouira–Agadir.

Results

The model used gave a reasonably acceptable fit to the three series of abundance indices (Figure 2.3.4a,b,c).

Analysis of the indices obtained using the three different abundance indices (Table 2.3.4a) shows that the results do not completely agree with the three assessments that were carried out. According to these, based on the abundance indices of the surveys, the stock is moderately to fully exploited, with the biomasses close to the level producing maximum sustainable yield. The fishing effort has been estimated to be below the level, on average, of sustainable fishing effort for the level of biomass present. Using the CPUE of the trawler fishery of Morocco as an abundance index, the model estimates a stock with a biomass equal to half the level necessary to produce the maximum sustainable yield and a fishing effort below the level necessary for a sustainable fishing effort at this level of biomass.

Table 2.3.4a: The state of the stock and the white hake (*Merluccius merluccius*) fishery of Morocco

Abundance index used	**B/B_{MSY}**	**F_{cur}/F_{SYcurB}**
Moroccan trawlers	47%	83%
Larache zone survey	136%	73%
Essaouira zone survey	106%	62%

Discussion

The three assessments carried out give varying results, although overall not very different from each other. It is not possible, with the available information, for the Working Group to decide which is closest to the actual situation of the fishery stock. All the series indicate however that the biomass of the stock is fairly unstable, probably due to environmental fluctuations, which create very different conditions for growth or reproduction. Thus an adjustment to the data will be necessary using a model that incorporates an environmental component.

Although the details are different, the three assessments all point to a stock that is fully exploited, but where there is the prospect of rapid recovery as the level of fishing effort is below that which would enable the biomasses to stabilise.

2.3.5 Management recommendations

Taking into account the results of the assessment and the uncertainties over the results, the Working Group has decided to recommend the following measures:

1. To adopt a precautionary approach and not increase fishing mortality (the current level of fishing effort) until the next assessment. If no major changes take place, this measure should allow a gradual recovery of the stock, providing that the juveniles are protected.

2. To stop fishing in the Larache–El Jadida zone so as to protect the white hake recruitment.
3. To encourage the use of separate trawls in order to separate the catches of white hake from those of shrimp.
4. To encourage certain vessels to convert to a fishery of less exploited resources.
5. To apply strict rules to the mesh size of the trawls.

2.3.6 Future research

In view of the improvement in the quality of the basic data for the assessment and the reduction in the uncertainty surrounding the results, the Working Group recommends concentrating research in the following areas:

1. Selection of fishing gears.
2. Assessment of the bycatches and the rejects in the hake and other fisheries.
3. Carry out surveys of the hard bottoms to assess the abundance of the fisheries resources on this type of bottom.
4. Continue the demersal trawl surveys during the seasons previously covered.
5. Recommence biological sampling of the commercial fish catches.
6. Obtain information (catch and fishing effort) on the activity of the joint Moroccan–Spanish fleets which began operating in Moroccan waters at the end of 2001.

2.4 Black hake (*Merluccius polli* and *Merluccius senegalensis*)

2.4.1 Biological characteristics

The black hake, *Merluccius senegalensis* and *Merluccius polli* are deep water species, with *M. polli* found at greater depths. According to data collected in November 2000 on board the Spanish longliners operating in Mauritanian waters, *M. senegalensis* is found between 150 and 450 metres, the abundance decreases as the depth increases. *M. polli* has an inverse distribution, with the abundance increasing as the depth increases up to nearly 1 000 m. For both species, length becomes greater as the depth increases (IMROP/IEO, 2002).

2.4.2 Stock identity

Merluccius polli and *Merluccius senegalensis* are not declared separately in the landings. Thus the Working Group decided to consider both species as a single stock.

2.4.3 Data trends

Catch

Total landings of black hake (Table 2.4.3a and Figure 2.4.3a) show a slight decreasing trend. The declared catches of black hake from Morocco and Senegal show far smaller fluctuations than those of Mauritania.

In Morocco (Figure 2.4.3b), the largest part of the landings comes from the Spanish liners. The catches show a marked decreasing trend until 1995, followed by an increase up until the fishery stops with the end of the fishing agreement between Morocco and the EU in 1999.

Between 50 and 90 percent of the declared black hake catches come from Mauritania. These catches (Figure 2.4.3c), have seen a strong increase since 1998, reaching an historic level of more than 15 500 tonnes in 2002. For the Spanish trawler fleet, the catches have varied between 8 300 and 10 700 tonnes between 1991 and 2001. The scientific observations carried out at sea in 2002 on board the Spanish trawlers operating in the Mauritanian EEZ show that the rejects of hake may on average reach 38 percent of the catch during the cold season and 47 percent during the transition season, being greater in the central zone (IMROP/IEO, 2003).

In Senegal (Figure 2.4.3d) almost all of the declared catches of black hake come from Spanish trawlers. Although they vary greatly, the overall trend is declining.

Effort

The efforts in fishing days of the fleets that target the black hake (*M. senegalensis* and *M. polli*) are given in Table 2.4.3b by zone and by fleet.

In Morocco (Figure 2.4.3b), the fishing effort decreased in 1995, but reached a maximum in 1997. There was another decrease in 1999 when the fishery was suspended.

In Mauritania, the fishing effort of the main fleet, the Spanish trawlers, grew from 1985 to 1990, thereafter it declined until 2000, with a slight increase coming after 2001 (Figure 2.4.3c).

In Senegal, the cessation of the hake fishery between 1988 and 1990 can be seen. Overall the effort shows a decreasing trend from 1985 (1 200 fishing days) to 2001 (200 fishing days) (Figure 2.4.3d).

Abundance indices

CPUE

In Morocco, the black hake CPUEs dropped significantly from the beginning of the fishery until 1983. This decrease was less marked thereafter until 1995. From 1995 until the end of the fishery, the CPUEs increased linearly with occasional marked increases (Figure 2.4.3b).

In Mauritania, the CPUE of the Spanish trawler fleet is the most important, and shows a regular increase from 1991 to 2000 going from 2 to 5 tonnes/day. From 2000 onwards the trend has been reversed and a decrease can be observed from 5 to 4 tonnes/day in 2001 (Figure 2.4.3c).

In Senegal, the CPUEs of the Spanish trawlers, the only fleet that targets hake, have increased since 1985, climbing from 3 to over 8 tonnes/day in 2001 (Figure 2.4.3d).

Scientific surveys

The data from the scientific surveys carried out on black hake were not available to the Working Group.

Biological data

Length composition and other data

The length compositions of *M. senegalensis* and *M. polli* obtained during the scientific surveys carried out on board the Spanish trawlers, (Figure 2.4.3e), show a bimodal distribution over the two seasons for *M. polli* whereas for *M. senegalensis* only one mode is seen at 40–45cm (IMROP/IEO, 2003).

Other biological data (growth, reproduction, feed, etc.) were not provided to the Working Group.

2.4.4 Assessment

Methods

The logistic surplus production model was used to assess the state of the stock of black hake. This model is described in detail in Point 1.4.

Data

The catch series of black hake estimated by the Working Group for each fishing zone was used as the series of total catch.

The CPUE series for the Spanish trawlers by zone were used as the abundance indices' series

Results

In the case of Morocco, the CPUE model fits the observed data well, except at the beginning of the series (Figure 2.4.4a). The results of fitting the model show that this zone is clearly overexploited. The black hake biomass in this zone for the last year of the series was around half that producing maximum sustainable yield, whereas the fishing effort was above that necessary to extract the whole natural production of the stock.

Table 2.4.4a: Indicators of the state of black hake stocks and fisheries in Morocco, Mauritania and Senegal

Zone/Abundance index used	B/B_{MSY}	F_{cur}/F_{SYcurB}
Morocco/Spanish trawlers in Morocco	47%	107%
Mauritania/Spanish trawlers in Mauritania	78%	97%
Senegal/Spanish trawlers in Senegal	68%	64%

For Mauritania, the model fits the data well, except between 1988 and 1991, years in which the abundance index falls dramatically with no explanation being able to be given by the trend in catches (Figure 2.4.4b). The model estimates that the current abundance of black hake in the zone is below that producing maximum sustainable yield. Fishing effort is assumed to be at a sustainable level, on average, for the current level of biomass.

In Senegal, the model CPUEs fit the fisheries output well (Figure 2.4.4c). The adjusted model estimates that the black hake biomass in the zone is less than that producing maximum sustainable yield. Fishing effort is assumed to be at a sustainable level, on average, for the current level of biomass, which explains the increase in the stock.

Discussion

In general, the results of the model agree with the history of the fisheries. In Morocco, the presence of a heavily overexploited zone reflects the intensity of the exploitation over the years preceding the end of operations.

For the Mauritanian fishing zone, the fishery extracts the whole natural production of the black hake resources, which therefore does not allow the biomass to increase in production capacity. With the present exploitation situation, being very close to maximum production, no increase in biomass can take place.

Finally, in the case of Senegal, the fishery does not extract the whole natural production of the stock, but given that the biomass had already been reduced to very low levels, it is recommended that the resource be allowed to grow to a level where its production will attain a maximum.

2.4.5 Management recommendations

For Morocco no recommendations can be given as the fishery ceased in 1999.

For the Mauritanian stock, taking into account the current level of exploitation, close to the maximum sustainable yield, it is recommended that fishing effort be reduced in order to allow better yields in the future. This recommendation should be applied both to the fleet that directly targets hake and to fleets that target other demersal species, as these have large bycatches of hake.

As far as Senegal is concerned, the Working Group recommends that fishing effort should not be increased, on the one hand because the stock should be allowed to replenish itself, and on the other because there are indications that this stock is the same as that in Mauritania.

2.4.6 Future research

Taking into account the uncertainties and difficulties encountered, the Working Group recommends the following:

1. That the CPUEs of black hake in Senegal be estimated.
2. That the catches of the two hake species be estimated separately.

3. DEMERSAL FISH, NORTH

3.1 Fisheries

Coastal demersal resources in Morocco, Mauritania, Senegal and The Gambia are composed of fish, crustacea and cephalopods. They are targeted (in part or entirely) by national and foreign fisheries, trawlers, longliners or artisanal. The stocks exploited are found in depths of 0–200 m.

This is a multispecies fishery, where generally more than one species is targeted. In addition, most of the species in this group are bycatch of other specialised fisheries, such as the fisheries of cephalopods, shrimp or hake. Certain species are more important than others either in terms of value or total catch size. For these species, or groups of species, specific data is available.

Considering the relative importance of the main species, and the availability of data, the Working Group decided to assess six main species or groups of species: *Pagellus bellotti*, *Dentex macrophtalmus*, *Sparus aurata*, *Arius* spp., *Pseudotolithus* spp. and *Epinephelus aeneus* (Table and Figure 3.1.1).

These species are not all of equal importance over the whole subregion, due to differences in the fisheries and the ecological conditions. Because of these differences, the Working Group decided to divide the zone into two subregions, one covering the exclusive economic zones (EEZs) of Morocco and Mauritania, and the other the EEZs of Senegal and The Gambia.

The Working Group identified several different fleets exploiting these species. These are:

Morocco:	- Moroccan cephalopod freezer trawlers
	- European cephalopod freezer trawlers
	- Moroccan coastal trawlers
	- Moroccan coastal longliners
	- Artisanal vessels
Mauritania:	- Mauritanian cephalopod freezer trawlers
	- European cephalopod freezer trawlers
	- Mauritanian ice trawlers
	- Mauritanian and European hake trawlers
	- Foreign pelagic trawlers
	- Fish trawlers
Senegal:	- Freezer trawlers the majority of which are Senegalese
	- Senegalese ice trawlers
	- Senegalese artisanal fishing canoes
The Gambia:	- Ice trawlers, the majority of which are European
	- Gambian artisanal fishing canoes

3.2 Sampling intensity

3.2.1 Catch and effort

Catch and effort data for the industrial fishery in Morocco are collected from the landings, from surveys, log-books and forms from fishing factories. The percentage of outings for which these files are available is close to 100 percent. There are many different landing sites for the artisanal fishery, so the sampling schemes are adjusted to collect data on catch and effort.

In Mauritania a sampling system has been established since 1996 on the European fleet which has enabled data to be collected on catch composition and demographic structure of the species caught by the European fleets in the Mauritanian EEZ. The sampling strategy consists in placing between 25 to 30 observers on vessels chosen from the list of European demersal fishery vessels. The choice of the vessels where the observers will go is done by stratified random sampling based on the types of licence and the number of vessels holding each type of licence. It covers around 30 percent of the fleet. Observers have mainly been involved in the demersal fishery, but since 1999, the system has been expanded to include the European pelagic fishery (mostly Dutch vessels).

Different sampling strategies of fisheries data have been set up in Senegal by the Centre de recherches océanographiques de Dakar-Thiaroye (CRODT). They cover the industrial fishery, the artisanal fishery and the scientific surveys.

For the fleet based in Dakar, the fisheries statistics come from three sources: surveys at the port of Dakar, the notebook (logbook) with fleet activities and forms from fishing factories. The first type is carried out daily at the end of the outing on board the trawlers and provides a great deal of data: name of the vessel, dates and departure hours, dates and arrival hours, fishing zones, depths, number of daily trawls, duration of trawls, receiving factory/buyer, weight by species or group of species, rejects, etc. For the second type a daily tally allows the effort to be determined whereas for the third type, the percentage of outings for which these files are available is close to 100 percent. For the fleet that is not based in Dakar, the declared catches and data from observers make up the sources of information. Collection of the artisanal fishery statistics in Senegal is done through surveys and a sampling of the catches and effort. The fish sampling centres cover around 70 percent of the Senegalese canoe fleet.

3.2.2 Biological parameters

There is no biological sampling plan for demersal fish landings in the region. Biological sampling of the seabream “measurement of weight and length” is done for the coastal fishery landings in the ports where there are INRH sampling stations.

Biological sampling by the Institut national de recherche halieutique (INRH) is only done on board the research vessel during the trawl surveys that are carried out twice a year between Bojdour and Lagouira and between Tangiers and Agadir. With each trawl the weight of each species is determined, the length of the main species and other biological parameters (sex-ratio, sexual maturity stages, length–weight relationship).

Since 1982, the Institut mauritanien de recherche océanographique et des pêches (IMROP) has been carrying out a programme of surveys at sea to study the demersal resources of the

Mauritanian EEZ continental shelf. As well as abundance indices by species and data on the population structure of the zones, the programme provides biological and demographic data on the main species. Table 2.2.1 of Point 2.2.2 of this report gives an approximate indication of the sampling intensity of all the fleets operating in the Mauritanian EEZ.

3.3 Red pandora (*Pagellus bellottii*)

3.3.1 Biological characteristics

No study of the biological characteristics of this species was provided to the Working Group this year.

3.3.2 Stock identity

The *Pagellus bellottii* species is sold under the common name of seabream or red pandora. The Working Group decided, taking into account its importance in each country, to examine the analyses by management unit (Morocco–Mauritania and Senegal–The Gambia). It appears to be a single stock that is exploited by the same types of fishery, industrial and artisanal.

3.3.3 Data trends

Catch

The total catch of *Pagellus bellottii* (Table 3.3.3a and Figure 3.3.3a), has seen an increase since 1990, and reached an historic level of over 12 000 tonnes in 1997. Subsequently the catches have fluctuated greatly, with a decrease in 1999.

Effort

The fishing effort series shows slight differences between the zones of Morocco, Mauritania and Senegal–The Gambia (Table 3.3.3b and Figure 3.3.3b). In Morocco and Mauritania, the national cephalopod trawler fleets dominate the fishery, but have shown a decrease in fishing effort since 1996/97. In the Senegal–The Gambia zone the fishery is dominated, in terms of fishing effort, by the Senegalese artisanal fishery which has shown an increasing trend since 1994. The other fleets do not show any clear trends in the effort.

Abundance indices

CPUE

The *Pagellus bellottii* CPUE series showed marked fluctuations over the study period (Figure 3.3.3c). The Senegal–The Gambia CPUE series show inverse trends, while the Senegalese artisanal fishery CPUE is decreasing, the Gambian industrial fishery CPUE is increasing. Both series have similar values, however, over the last years.

Scientific surveys

The scientific surveys data for *Pagellus bellottii* were not provided to the Working Group.

Biological data

Length composition and other data

The Working Group did not receive any data on length composition or other biological parameters (growth, reproduction, feed, etc.) for *Pagellus bellottii.*

3.3.4 Assessment

Methods

The logistic surplus production model was used to assess the state of the stocks and the fisheries of *Pagellus bellottii.* The model is described in detail in Point 1.4.

Data

The series of catches of *Pagellus bellottii* for each of the fishing zones, Morocco and Mauritania and Senegal–The Gambia, were used as the series of total catches. All of the data come from fisheries statistics and no estimate was made by the Working Group.

For the catch data, the Working Group combined the total catch of all the fleets of Morocco and Mauritania. For the CPUE series, the Group decided to adopt the CPUE series of the Moroccan cephalopod trawlers, as this fleet regularly fished in the region throughout the study period, and the CPUE series of the Gambian industrial fleet was used for Senegal–The Gambia.

Results

Morocco and Mauritania and Senegal–The Gambia

The model provides a reasonable fit to the data, although it does not manage to reflect the changes in CPUE towards the end of the study period (Figures 3.3.4a,b).

Considering the model to be acceptable, the results show that the stock is fully exploited. Even though the biomass is estimated to be above that producing maximum sustainable yield, fishing mortality is higher than the one needed to extract the whole natural production of the stock in Morocco and Mauritania. In Senegal–The Gambia fishing mortality is estimated to be close to the one needed to extract the whole natural production of the stock (Table 3.3.4a).

Table 3.3.4a: The state of *P. bellottii* and of the fishery in Morocco, Mauritania and Senegal–The Gambia

Zone/CPUE used	B/B_{MSY}	F_{cur}/F_{SYcurB}
Morocco and Mauritania/Moroccan cephalopod CPUE	143%	131%
Senegal–The Gambia/The Gambia IF CPUE	161%	85%

Discussion

The model provides a reasonable fit to the data, but less so over the more recent years. The estimated biomass is above that producing maximum sustainable yield, but the fishing mortality is higher than the one needed to extract the whole natural production of the stock. The stock is therefore considered to be fully exploited. Thus, taking into account the fit over the last few years, a precautionary approach is advised to allow the stock to increase. Particular attention should be paid to stock management, until the data situation for the last years has not been better investigated.

3.3.5 Management recommendations

The Working Group recommends that fishing effort in this fishery should not be increased. Taking into account that the species is an important bycatch of other fisheries, the bycatches of most of the other demersal fisheries should be examined to better control the catches of *Pagellus bellottii.*

3.4 Large-eye Dentex (*Dentex macrophthalmus*)

3.4.1 Biological characteristics

No analysis of the biological characteristics of this species was provided to the Working Group this year, however they are found throughout the whole region.

3.4.2 Stock identity

The *Dentex macrophthalmus* species is sold under the name of “dentés”. The Working Group decided, taking into account its importance and the available data in the EEZs of Morocco and Mauritania, to assess the two zones together. It appears to be a single stock that is exploited by the same types of fishery, industrial (mostly as bycatch) and artisanal.

3.4.3 Data trends

Catch

The total catches of *Dentex macrophthalmus* in the two zones of Morocco and Mauritania saw an increase from 1990 (Table 3.4.3a and Figure 3.4.3a), reaching a level of 4 000 tonnes in 1997. Subsequently the catches were stable, before dropping in 1999.

Effort

The stock of *Dentex macrophtalmus* in Morocco and Mauritania is targeted by the multispecies demersal fleets of the two countries, as well as by the international fleet that operates in the zone. Figure and Table 3.4.3b show the effort in fishing days of the main fleets that catch this species. The number of fishing days increased from 1991 to 1996 in Mauritania, it then stabilized with a slight decreasing trend. In Morocco, from 1990 to 1993 there was a decreasing trend, then in 1993 a slight increase can be seen until 1996. After 1996 the trend fluctuates, but is generally decreasing.

Abundance indices

CPUE

The CPUE series of the main fleets that target *Dentex macrophthalmus* in the two countries fluctuated over the study period (Figure 3.4.3c). The trends are not the same. The cephalopod trawler series operating in Mauritania shows an increasing trend between 1997 and 1999 with a peak in CPUE in 1998. The Moroccan cephalopod trawler series shows a decrease over the same period.

Scientific surveys

The scientific surveys data for *Dentex macrophthalmus* were not provided to the Working Group.

Biological data

Length composition and other data

The Working Group did not receive any data on length composition or other biological parameters (growth, reproduction, feed, etc.) for *Dentex macrophthalmus.*

3.4.4 Assessment

Methods

The logistic surplus production model was used to assess the state of the stocks and the fisheries of *Dentex macrophthalmus.* The model is described in detail in Point 1.4.

Data

The *Dentex macrophthalmus* catch series for the fishing zone (Morocco and Mauritania) were used as the total catch series. All the data come from fisheries statistics.

For the purposes of assessment, the Working Group decided to adopt the CPUE series of the Moroccan cephalopod trawlers as the main CPUE series, as this fleet fished regularly in the region throughout the whole study period and in the greater part of the distribution area of the species.

Results

Considering the model to be acceptable, the results show that the stock is fully exploited. Even though the biomass is estimated to be above that producing maximum sustainable yield, fishing mortality is at the level of that needed to extract the whole natural production of the stock (Table 3.4.4a).

Table 3.4.4a: The state of *Dentex macrophthalmus* and of the fishery in Morocco and Mauritania

Zone/CPUE used	B/B_{MSY}	F_{cur}/F_{SYcurB}
Morocco and Mauritania/Moroccan cephalopod CPUE	158%	95%

Discussion

The model provides a reasonable fit to the data, even though it does not manage to reproduce the changes in CPUE towards the end of the study period. The fit is not good for recent years (Figure 3.4.4a). The estimated biomass is above that producing maximum sustainable yield, but the estimated fishing mortality is at a level which would produce a sustainable yield for the current biomass. The stock is therefore considered to be fully exploited. Thus, taking into account the fit over the last few years, a precautionary approach is advised to allow the stock to be defined. Particular attention should be paid to stock management, until the data situation for the last years has not been better investigated.

3.4.5 Management recommendations

The Working Group recommends that fishing effort in this fishery should not be increased, taking into account that the species is an important bycatch of other fisheries, particularly the demersal.

3.5 Seabreams (*Pagrus caeruleostictus* and *Pagellus acarne)*

3.5.1 Biological characteristics

No analysis of the biological characteristics of this species was provided to the Working Group this year, however they are found throughout the whole region.

3.5.2 Stock identity

The Working Group decided, taking into account the importance of the seabreams in each country, to only proceed with an analysis in the Morocco–Mauritania zone. It appears to be a single stock that is exploited by the same types of fishery, industrial and artisanal.

3.5.3 Data trends

Catch

Overall the catches of *Pagrus caeruleostictus* and *Pagellus acarne* have increased dramatically in the region since 1990 (Table and Figure 3.5.3a). A strong fall was seen in 1999.

Effort

This stock is targeted by the multispecies demersal fleets of the countries as well as the international fleet that operates in the zone. The trends in effort of these fleets were described in Section 3.4.3.

Abundance indices

CPUE

The CPUE series fluctuated throughout the study period in the countries (Figure 3.5.3b). A decrease was seen in 1999, followed by an increase until 2001, then a slight decrease during the last year of the series.

Scientific surveys

The data from the scientific surveys of *Pagrus caeruleostictus* and *Pagellus acarne* were not provided to the Working Group.

Biological data

Length composition and other data

The Working Group did not receive any data on length composition or other biological parameters (growth, reproduction, feed, etc.) for *Pagrus caeruleostictus* and *Pagellus acarne.*

3.5.4 Assessment

Methods

The logistic surplus production model was used to assess the state of the stocks and the fisheries of *Pagrus caeruleostictus* and *Pagellus acarne.* The model is described in detail in Point 1.4.

Data

For the catch data of *Pagrus caeruleostictus* and *Pagellus acarne*, the Working Group grouped the total catches of all the fleets of the countries. For the CPUE series, the Group decided to adopt the CPUE series of the Moroccan cephalopod trawlers as this fleet regularly fished in the region during the study period and covered the majority of the distribution zone of the species. All the data come from fisheries statistics and no estimate had to be made by the Working Group.

Results

The model provides a reasonable fit to the data, even if the fit is less good over the last years of the study period (Figure 3.5.4a).

Considering the model to be acceptable, the results show that the stock is fully exploited. Even though the biomass is estimated to be above that producing maximum sustainable yield, fishing mortality is close to the level of that needed to extract the whole natural production of the stock (Table 3.5.4a).

Table 3.5.4a: The state of *Pagrus caeruleostictus* and *Pagellus acarne* and of the fishery in Morocco and Mauritania

Zone/CPUE used	B/B_{MSY}	F_{cur}/F_{SYcurB}
Morocco and Mauritania/Moroccan cephalopod CPUE	141%	111%

Discussion

The model provides a reasonable fit to the data, even if the fit is not so good for recent years. The estimated biomass is above that producing maximum sustainable yield, but the estimated fishing mortality is close to the level which would produce a sustainable yield for the current biomass. The stock is therefore considered to be fully exploited. Thus, particular attention should be paid to stock management, until a satisfactory explanation can be provided for the behaviour of the data over the last years.

3.5.5 Management recommendations

The Working Group recommends that fishing effort in this fishery should not be increased, taking into account that the species is an important bycatch of other fisheries, the bycatches of most of the demersal fisheries should be examined to better control the catches of *Pagrus caeruleostictus* and *Pagellus acarne.*

3.6 Marine catfish (*Arius* spp.*)*

3.6.1 Biological characteristics

No analysis of the biological characteristics of this species has been carried out, however they are found throughout the whole region.

3.6.2 Stock identity

The marine catfish, *Arius* spp. is considered to be a single stock over the whole of the Senegal–The Gambia continental shelf. The Group therefore decided to assess the stock of the southern part of the region (Senegal and The Gambia), and to treat that as a single stock.

3.6.3 Data trends

Catch

The *Arius* spp. species are targeted by the industrial and artisanal fleets of both Senegal and The Gambia. 1990, 1997, 1998 and 2001 were exceptional years where the catch exceeded 10 000 tonnes (Table and Figure 3.6.3a). Most of the fish landed is caught by the Senegalese artisanal fishery, followed by the Senegalese trawler fishery.

Effort

The *Arius* spp. stock is targeted by the multispecies demersal fleets of the countries. Effort is expressed in hours or days at sea by the industrial fishery and by fishing days or outings by the artisanal fishery. The effort of the Senegalese ice trawlers and the Gambian industrial

fishery trawlers shows a very large increase from 1994 to 2002 with a peak coming in 1999 for both fleets (Figure 3.6.3b).

Abundance indices

CPUE

The *Arius* spp. CPUE series show inverse trends (Figure 3.6.3c). The CPUEs of the Senegalese trawlers show a decreasing trend at the beginning of the series until 1996. After an increase in 1997 and 1998, the CPUEs decrease once again in 1999, with an increasing trend after that. The CPUEs of the Gambian fishery have remained relatively stable with a few fluctuations.

Scientific surveys

The data from the scientific surveys for *Arius* spp. were not provided to the Working Group.

Biological data

Length composition and other data

The Working Group did not receive any data on length composition or other biological parameters (growth, reproduction, feed, etc.) for *Arius* spp.

3.6.4 Assessment

Methods

The logistic surplus production model was used to assess the state of the stocks and the fisheries of *Arius* spp. The model is described in detail in Point 1.4.

Data

For the catch data, the Working Group grouped the total catches of all the fleets of the countries. For the CPUE series, the Group decided to adopt the CPUE series of the Senegalese trawlers. All the data come from fisheries statistics and no estimate had to be made by the Working Group.

Results

The model provides a very slight fit to the data as it is unable to follow the fluctuations observed in the CPUE series. There is therefore a great deal of uncertainty surrounding the results of the model.

Discussion

The Working Group decided that it was not possible to assess the distribution of the stock given the data available. Tentatively, the strong fluctuations in the observed CPUEs suggest that the stock is probably overexploited.

3.6.5 Management recommendations

Considering the results of the model and the strong fluctuations in the CPUE series, the Working Group recommends that the current fishing effort on this species be reduced. Particular attention should be paid to the bycatches of the cephalopod trawlers and the shrimpers.

3.7 Croaker (*Pseudotolithus* spp.)

3.7.1 Biological characteristics

No analysis of the biological characteristics of this species was given to the Working Group, however they are found throughout the whole region.

3.7.2 Stock identity

The croakers (*Pseudotolithus* spp.) stock is considered to be shared between The Gambia and Senegal.

These species are mostly distributed and exploited in the southern part of the region, namely in Senegal and The Gambia. Consequently the Working Group decided to assess this species as a single stock for the countries

3.7.3 Data trends

Catch

Pseudotolithus spp. are caught by the artisanal and industrial fleets. There is a potential market for the juveniles in Spain, which are sold under the false name of drums. After a high level in 1990 (around 6 000 tonnes), the catches have shown a decreasing trend, except in the years 2000–2001 where a considerable increase can be seen, close to 5 000 tonnes (Table and Figure 3.7.3a).

Effort

Pseudotolithus spp. are targeted by the multispecies demersal fleets of the countries. The effort is expressed in hours or days at sea by the industrial fishery and in fishing days or outings by the artisanal fishery. The effort of the Senegalese canoes has an increasing trend from 1990–2002 and the trawlers of the industrial fishery of The Gambia show a marked increase from 1994 till 2002 (Table and Figure 3.7.3b).

Abundance indices

CPUE

The CPUEs of the Senegalese canoes and the Gambian trawlers show a decreasing trend at the beginning of the series. However, the industrial fishery of The Gambia shows a strong increase in 2001 and 2002 (Figure 3.7.3c).

Scientific surveys

Data from the scientific surveys on *Pseudotolithus* spp. was not given to the Working Group.

Biological data

Length composition and other data

The Working Group did not receive any data on length composition or other biological parameters (growth, reproduction, feed, etc.) for *Pseudotolithus* spp.

3.7.4 Assessment

Methods

The logistic surplus production model was used to assess the state of the stocks and the fisheries of *Pseudotolithus* spp. The model is described in detail in Point 1.4.

Data

For the catch data, the Working Group grouped the total catches of all the fleets of the countries. For the CPUE series, the Group decided to adopt the CPUE series of the artisanal canoes of Senegal. The data for *Pseudotolithus* spp. for the years 2000–2002 were estimated for Senegal.

Results

The model provides a very slight fit to the data (Figure 3.7.4a). The current biomass is greatly below that producing maximum sustainable yield, and fishing mortality is far greater than that needed to extract the whole natural production of the stock of *Pseudotolithus* spp. (Table 3.7.4a).

Table 3.7.4a: The state of *Pseudotolithus* spp. and of the fishery in Senegal and The Gambia

Zone/CPUE used	B/B_{MSY}	F_{cur}/F_{SYcurB}
Senegal–Gambia/CPUE Senegalese artisanal canoes	13%	612%

Discussion

The model provides a slight fit to the data (Figure 3.7.4a). The fit is less good in the early years, but improves in recent years which gives some credibility to the conclusions. The stock is heavily overexploited. The biomass is exceedingly below that producing maximum sustainable yield, and fishing mortality is higher than that needed to extract the whole natural production of the stock. These results agree with the observations of the fishery. The effort on this species is increasing due to market demand.

3.7.5 Management recommendations

Taking into consideration the results of the survey, the trends in CPUE and the history of the fishery, the Working Group recommends greatly reducing the fishing mortality or the fishing effort on *Pseudotolithus* spp.

3.8 White grouper (*Epinephelus aeneus*)

3.8.1 Biological characteristics

No analysis of the biological characteristics of this species was given to the Working Group, however they are found throughout the whole region.

3.8.2 Stock identity

For the white grouper or "thiof" (*Epinephelus aeneus*), a single stock was considered for Mauritania, Senegal and The Gambia together.

This species is exploited commercially from Mauritania, south, with no clear indications of the methods of exploitation or trends in the fishery.

3.8.3 Data trends

Catch

The landings of *Epinephelus aeneus* show a decreasing trend over the study period (Table and Figure 3.8.3a), the quantity of fish landed at the moment being half what it was in 1990. Most of the landings are from the artisanal Senegalese fishery.

Effort

Epinephelus aeneus is targeted by the multispecies demersal fleets of all the countries, including the artisanal and industrial fleets. The effort is expressed in hours or days at sea in the industrial fishery and in fishing days or outings in the artisanal fishery. The effort of the Senegalese canoes has an increasing trend over the period 1990–2002 and the effort of the industrial fishery trawlers of The Gambia shows a marked increase from 1994 to 2002 (Figure 3.8.3a).

Abundance indices

CPUE

The CPUEs of *Epinephelus aeneus* show a decreasing trend over the period (Figure 3.8.3c). The most notable decrease is that of the Senegalese artisanal fishery which showed a four-fold decrease between 1994 and 1995.

Scientific surveys

Data from the scientific surveys on the *Epinephelus aeneus* were not provided to the Working Group.

Biological data

Length composition and other data

The Working Group did not receive any data on length composition or other biological parameters (growth, reproduction, feed, etc.) for white grouper (*Epinephelus aeneus*).

3.8.4 Assessment

Methods

The logistic surplus production model was used to assess the state of the stocks and the fisheries of *Epinephelus aeneus.* The model is described in detail in Point 1.4.

Data

For the catch data, the Working Group decided to group together the total catches of all the fleets of the countries. For the CPUE series, the Group decided to use the CPUE series of the Senegalese artisanal fishery as this fishery targets white groupers in preference to other species with a high commercial value. The data for 2000–2002 for the Senegalese fishery were estimated by the Working Group.

Results

The model provides a good fit to the data (Figure 3.8.4a). The results of the fitting show that the stock is heavily overexploited. The biomass is greatly below that producing maximum sustainable yield and the fishing mortality is higher than that needed to extract the whole natural production of the stock (Table 3.8.4a).

Table 3.8.4a: The state of *Epinephelus aeneus* and of the fishery in Mauritania, Senegal and The Gambia

Zone/CPUE used	B/B_{MSY}	F_{cur}/F_{SYcurB}
Senegal–The Gambia/CPUE Senegalese artisanal fishery	15%	8 749%

Discussion

The model provides a satisfactory fit to the data. The results indicate that the stock of *Epinephelus aeneus* in the region is heavily overexploited with a probable risk of extinction. These results agree with the history of the fishery as this species has seen the highest market value in the export market. Consequently the stock is the target of heavy overexploitation.

3.8.5 Management recommendations

Taking into account the results obtained during the assessment and the trends in CPUE, the Working Group believes the stock risks extinction, and recommends that the fishery directed at this species should be stopped completely.

3.9 Management recommendations for the northern zone demersal fishery

The fisheries assessed by the Working Group are relatively heterogeneous, but form part of a multispecies fishery that targets species that are widely caught. Many of these species are bycatch from other intensive fisheries such as the shrimp and cephalopod fisheries. The results for the stocks for which good data are available indicate that most of these species are fully or overexploited. Consequently a general reduction in the effort aimed at this fishery should be undertaken.

Special attention should be given to the problem of bycatch. Good statistical data on catches are an indispensable necessity if stock management is to be improved.

3.10 Future research

The work undertaken reveals gaps in the knowledge of the stocks in the region. To fill these gaps, the Working Group recommends investigations along the following lines of research:

1. To obtain, as far as possible, information relative to the landings and fishing effort as well as the specific yields of the experimental surveys. To establish good systems for data collection of catch and effort statistics in all countries.

2. To collect statistical data by vessel and fishing gear for the demersal fisheries.

3. To try to find an improved fishing effort index for the CPUEs and to make it available to the Working Group.

4. To obtain biological data (length frequency, sex ratio, age, reproduction zone and period).

4. SHRIMPS NORTH

4.1 Fisheries

The exploitation of crustacea along the coasts of West Africa dates back many years (Thiam *et al.*, 1981). From Morocco to Guinea–Bissau, two main groups of shrimp are commercially important, the coastal shrimp mainly comprising the southern pink shrimp, *Penaeus notialis*, and the deep water shrimp, of which the pink shrimp *Parapenaeus longirostris* is the most important. Other less important shrimp, due to their lesser abundance, are also caught in the zone: *Penaeus kerathurus*, *Aristeus antennatus*, *Aristeus varidens*, *Plesiopenaeus edwardsianus*, *Aristaeomorpha foliacea* and *Plesionika heterocarpus*.

In Morocco, shrimp are currently exploited by a national fleet composed of coastal trawlers which operate on the continental shelf and at depths of less than 150 m and long-range, ocean-going trawlers. There are around 300 coastal trawlers. They operate near their ports of registry and are at sea for short periods of time. The fishing activity in this zone is aimed above all at the white hake and the pink shrimp, however other demersal species are fairly abundant in the catches. The Moroccan ocean-going shrimp fleet began operations in 1985 and numbered around 55 vessels at the beginning of 1999, with an average tonnage of 200 GRT, staying at sea for between 45 and 50 days.

In Morocco, the Spanish fleet was primarily composed of fresh fish trawlers and freezer trawlers that operated under fishing agreements. Their zone of activity was limited to the north of Tarfaya (28°44'N parallel), outside the 12 mile zone. The Spanish vessels stopped operating in Morocco on 30th November, 1999, when the Morocco–European Union fishing agreement came to an end.

In 2003, the fishery in Mauritania counted around 70 vessels belonging to fleets from various nations. With 31 vessels the Spanish fleet was the largest, exploiting *P. longirostris* (46 percent) and *P. notialis* (40 percent). The next largest fleet is composed of Mauritanian and joint venture (Spain–Mauritania) vessels, numbering around 20.

From 1960 to 1981, the exploitation of demersal stocks in Senegal was done almost exclusively by Spanish trawlers. From 1982 a certain number of Spanish vessels took Senegalese nationality, thus marking the beginning of the national trawler fleet. At 80 percent of the total crustacea catch, *Parapenaeus longirostris* is the main target species. The crustacea fishery targeting coastal shrimp, mainly *P. notialis*, is very developed in Senegal and The Gambia with two well defined branches, the industrial fishery and the artisanal fishery.

4.2 Sampling intensity

4.2.1 Catch and effort

There is no sampling plan in the region for shrimp catch, therefore there are no figures to estimate the sampling intensity of the fishery.

4.2.2 Biological parameters

The Institut mauritanien de recherche océanographique et des pêches (IMROP) and the Institut national de recherche halieutique du Maroc carry out a programme of scientific surveys at sea, aiming at, among other things, the biological study of shrimp. There are no figures to estimate the biological parameters sampling intensity.

4.3 Deepwater rose shrimp (*Parapenaeus longirostris*)

4.3.1 Biological characteristics

The eggs, situated under the abdomen, are released into the water at the time of spawning which takes place at a depth of between 200 and 300 m, mostly on the edge of the continental slope. The young shrimp migrate towards the coast and are concentrated at depths of between 50 and 150 m. Once they reach adulthood they migrate to depths of between 200 and 300 m to reproduce.

In Morocco, the laying period has two peaks, with the winter peak being the most important. In Mauritanian waters this species also has a reproduction period with two peaks.

No studies were presented to the Working Group of the biological characteristics of this species in Senegalese and Gambian waters.

4.3.2 Stock identity

In Morocco, the pink shrimp (*Parapenaeus longirostris*) lives on the sandy-muddy bottoms at depths of between 50 and 700 m, with Cape Spartel (35°47'N) marking the northern boundary and Sidi Ifni (29°22'N) the southern.

In the Mauritanian waters, the fishery is mainly concentrated between 21° and 19°N. From 16 °N in the Senegalese waters, the fishery targeting pink shrimp starts once again.

Because of this geographic difference, the Working Group decided to adopt three fishing zones: Morocco, Mauritania and Senegal–The Gambia.

4.3.3 Data trends

Catch

There are variations in the catches of pink shrimp (*Parapenaeus longirostris*) in the region, with an overall increasing trend (Table and Figure 4.3.3a). Over the study period, the largest catches were recorded in 1999 with a decrease in 2002.

The annual catches in Morocco saw an increasing trend until 1995, then a fall of about 1 000 tonnes in 1996. Subsequently there was a recovery and in 1999 the highest level of 13 521 tonnes was recorded. They then fell off again, reaching 10 289 tonnes in 2002 (Figure 4.3.3c).

The pink shrimp catches in Mauritania dropped to their lowest level in 1992 before recovering. The largest catches were recorded in 2001 (over 3 000 tonnes) followed by a fall to less than 2 000 tonnes in 2002 (Figure 4.3.3d).

Over the last ten years, the shrimp catches in Senegal–The Gambia have fluctuated between 381 and 4 771 tonnes for the two series combined (Figure 4.3.3e). The shrimp catches of the two fisheries show similar values. During the study period, a large decrease can be seen for the Spanish fleet which began operating in Senegal–The Gambia in 1980–1981. Since this period, the catches have remained at a relatively stable level with a decreasing trend over the last few years.

Effort

Total fishing effort on the pink shrimp in the region showed fluctuations with the highest values coming in 1990 (Table 4.3.3b). Subsequently it decreased, reaching its lowest value in 1995 before recovering to previous levels from 1998.

The effort data series of Morocco shows a continual decrease in the effort of the Spanish vessels until 1999, the year in which the fishing agreement between Morocco and the European Union came to an end. The Moroccan fleet shows a steady increase over the whole of the study period (Figure 4.3.3c).

The fishing effort on pink shrimp in Mauritania increased dramatically from 1987 to 1989 going from 4 060 to more than 10 000 fishing days (Figure 4.3.3d). It then decreased, falling

to less than half in 1993 before stabilising at around 6 000 fishing days between 1994 and 1997. Since 1998 there has been a sharp increase and it now approaches 8 000 fishing days.

All fleets targeting the pink shrimp have seen an increase in effort, but this increase was greatest in the Mauritanian fleet.

The effort directed at the pink shrimp in Senegal–The Gambia showed a decreasing trend from the beginning of the series until 1997. There is then a slight change until 2002 (Figure 4.3.3e).

Abundance indices

CPUE

In general the CPUEs in Morocco are stable (Figure 4.3.3c) but there was a strong fall in 2002. Analysis of the yields of the sea-going Moroccan trawlers showed that the pink shrimp CPUEs have been relatively stable since 1994. During this period the values oscillated around 500 kg/fishing day. The pink shrimp yields of the coastal trawlers saw a progressive increase from 1989 (98 kg/fishing day) to 1995 (207 kg/fishing day), followed by a marked fall in 1996 (58 kg/fishing day) before recovering and stabilising over the rest of the period.

For the CPUEs in Mauritania, a relatively low period can be seen between 1986–1992, followed by a period of increase with some noticeable fluctuations. In 2002 a marked fall in CPUE was seen, dropping to 1992 levels (Figure 4.3.3d).

The pink shrimp CPUEs of the Spanish and Senegalese fleets in the waters of Senegal–The Gambia show a very similar trend for the series of years analysed (Figure 4.3.3e). The Spanish fleet has its highest yields at the beginning of the series (1980–1985). From 1986 a marked decrease can be seen followed by relative stability until 2002. As for the Senegalese fleet, this shows a more stable trend with a slight increase in yields, reaching a maximum in 1997, followed by a decrease in 1998.

Scientific surveys

The abundance indices estimated by the IMROP survey were relatively stable over the period 2000–2001 (Table 4.3.3f).

Table 4.3.3f: Yields (kg/30 mn) of pink shrimp (*Parapenaeus longirostris*) obtained during the IMROP surveys between 2000 and 2001

Species	2000	2001
Parapenaeus longirostris	1.00	1.03

Biological data

Length composition and other data

There is no biological sampling plan for pink shrimp catches in the region.

The average length of pink shrimp sampled during the INRH surveys showed an improvement between 1997 and 2001, increasing from 23 mm to 26 mm.

4.3.4 Assessment

Methods

The logistic surplus production model was used to assess the state of the stocks and the fisheries of *Parapenaeus longirostris.* The model is described in detail in Point 1.4.

Data

The series of total catch of pink shrimp *Parapenaeus longirostris* estimated by the Working Group for each fishing zone was used as the total catch series of the stock.

For Morocco, the Working Group chose the CPUE series of the Moroccan freezer trawlers.

For Mauritania, the CPUE series of the Spanish freezer trawlers was used.

Finally, for Senegal–The Gambia, the CPUE series of the Spanish freezer trawlers was chosen.

Results

The assessment models provide a reasonably acceptable fit to the three data series (Figure 4.3.4).

The results of the assessment are quite different for the three fishing zones (Table 4.3.4a).

In Morocco, the pink shrimp stock is clearly overexploited. The biomass is far lower than that producing maximum sustainable yield, and the level of fishing mortality is clearly above the level that the current biomass can maintain over the long term.

In Mauritania and Senegal on the other hand, the stock appears to be fully exploited. The biomass is close to that producing maximum sustainable yield over the long term, and the level of fishing mortality is also close to a sustainable level given the current biomass.

Table 4.3.4a: Results of the fitting of the model in the three fishing zones

Zone/Abundance index used	B/B_{MSY}	F_{cur}/F_{SYcurB}
Morocco/Moroccan freezer trawlers	43%	135%
Mauritania/Spanish freezer trawlers	98%	89%
Senegal–The Gambia/Spanish freezer trawlers	112%	56%

Discussion

The difficulty in fitting the model is due to the fact that the CPUE data lack contrast and that the stock of pink shrimp shows large fluctuations in abundance. Given these difficulties, the

results of the modelling should be used with caution. However, the results agree with other indicators from the fishery, and with the history of the fishery which reinforces confidence in the overall results.

4.3.5 Management recommendations

Taking into account the assessment results and the uncertainties that are still related to these results, the Working Group decided to recommend:

In Morocco

1. To reduce current catch and effort levels.
2. To enforce the use of regulation mesh sizes in order to reduce pressure on the juveniles.
3. To encourage the use of separate trawls.

In Mauritania and Senegal–The Gambia, taking into account the full exploitation of the resource, the Group recommends no increase in fishing effort.

4.3.6 Future research

The Working Group recommends priority be given to the following lines of research:

1. To begin biological sampling of the landings of the coastal trawlers and industrial shrimpers at port level.
2. To analyse the available shrimp catch data of the foreign fleets landing at Las Palmas.
3. To carry out an analysis of the CPUE series of some Moroccan freezer shrimpers.
4. To find an appropriate fishing effort index .
5. To improve knowledge of the biology of this species.
6. To carry out selectivity studies to reduce bycatches.

4.4 Southern pink shrimp (*Penaeus notialis*)

4.4.1 Biological characteristics

No studies of the biological characteristics of this species were presented to the Working Group.

4.4.2 Stock identity

Two different stocks have been identified in the zone under consideration. One in the reproduction and feeding zone situated in the Banc d'Arguin (Mauritania) and at the mouth of the river Senegal; the other in the waters of Senegal–The Gambia, with four substocks relating to the rivers Senegal, Saloum, Gambia and Casamance. Taking into account the impossibility of obtaining separated data (catch and effort) on the different substocks, the Working Group decided to carry out its assessment based on two stocks, one in Mauritania and the other in Senegal–The Gambia.

4.4.3 Data trends

Catch

The total catches of *Penaeus notialis* in the region (Table and Figure 4.4.3a) are variable. After 1999, when the largest catches were registered, they decreased sharply in 2000, before stabilising over the following years. In Mauritania, the catches increased until 1999. In 2000, there was a marked decrease in the catches of the Spanish trawlers, compensated by an increase in the catches of the Mauritanian and foreign trawlers. In Senegal–The Gambia, catches have remained more or less stable since 1992.

Effort

The fishing effort showed a slightly increasing trend until 1999, then a sharp fall in 2000, with a slight increase after that. This decrease is above all due to the reduction in effort in the Senegal–The Gambia zone (Figure 4.4.3c).

The effort series in Mauritania shows a period of increase during the years 1988–89, followed by a decrease. Currently the trend is increasing. For Senegal–The Gambia the effort regularly increases during the whole study period (Table and Figure 4.4.3b).

Abundance indices

CPUE

The CPUEs in Mauritania do not show any clear trend, but rather they fluctuate greatly from one year to the next (Figure 4.4.3b).

The CPUEs in Senegal–The Gambia have been more or less stable since 1992, with a clearly decreasing trend for the Gambian trawlers from 1999 to 2001 (Figure 4.4.3c).

Scientific surveys

The estimated abundance indices by the IMROP scientific surveys remained relatively stable in 2000, 2001 and 2002 respectively reaching 0.66, 0.63 and 0.62 kg per 30 minute trawl.

4.4.4 Assessment

Methods

The logistic surplus production model was used to assess the state of the stocks and the fisheries of *Penaeus notialis.* The model is described in detail in Point 1.4.

Data

The series of total catches of *P. notialis* estimated by the Working Group in Mauritania and Senegal–The Gambia was used as the series of total catches for the stock.

As an abundance index series, the Working Group used the CPUE series of the freezer trawlers on Spain and Senegal in each zone.

Results

The models provide an acceptable fit to the two data series (Figures 4.4.4a,b), though the fit is better in the case of Mauritania. The results of the assessment are different for the two fishing zones (Table 4.4.4a).

Table 4.4.4a: The state of *Penaeus notialis* and of the fishery in Mauritania and Senegal–The Gambia

Zone/CPUE used	B/B_{MSY}	F_{cur}/F_{SYcurB}
Mauritania/Spanish freezer trawlers	144%	108%
Senegal–The Gambia/Senegalese industrial fishery	59%	97%

In Senegal–The Gambia, the *P. notialis* stock is overexploited in 1999. The biomass is below that producing maximum sustainable yield, and fishing mortality is above the level that the current biomass can maintain in the long term. There are no data available after 1999.

In Mauritania the stock appears to be fully exploited. The biomass is slightly over that producing maximum sustainable yield in the long term, and the level of fishing mortality is close to the sustainable level with current biomass.

Discussion

The difficulty in fitting the model is due to the fact that the CPUE data lack contrast and that the stock of *P. notialis* shows large fluctuations in abundance. Given these difficulties, the results of the modelling should be used with caution. However, the results agree with other indicators from the fishery, and with the history of the fishery, which reinforces confidence in the overall results.

4.4.5 Management recommendations

Taking into account the assessment results and the uncertainties associated with them, the Working Group recommends that neither Mauritania nor Senegal–The Gambia increase fishing effort until the next assessments have been carried out with more recent data.

4.4.6 Future research

In view of the improvement in the quality of the basic data for the assessment and the reduction of uncertainty about the results, the Working Group recommends giving priority to the research below:

1. Improve knowledge of the biology of this species.
2. Improve the data on catch and fishing effort by fishing zone (the fleets of Senegal and The Gambia).
3. Study the possible relationships between environmental factors (SST, rainfall, etc.) and the abundance of the species.

5. CEPHALOPODS NORTH

5.1 Fisheries

The cephalopod fishery is carried out in the subregion by an heterogeneous fleet fishing equally for similar species or as bycatch. Three branches are generally considered: the artisanal fishery, the national and the foreign industrial fisheries.

The different species of cephalopod caught are octopus (*Octopus vulgaris)* and cuttlefish (*Sepia officinalis*, *Sepia hierreda*, *Sepia bertheloti*). A third category of molluscs which belongs to the group of cephalopods is the *Loligo vulgaris*.

The catches of cephalopods reach maxima of 210 000 tonnes and minima of 92 000 tonnes in 2002.

Of the cephalopods, the octopus is the main target species, making up the majority of the catches (65 to 75 percent).

In 1963 Spanish vessels began fishing in the zone between 21 ^{o}N and 26 ^{o}N. Freezer vessels quickly began operations and from 1969 numbered 39. The total number of vessels continued to increase reaching 297 freezer trawlers in 1980, however there were never more than 126 vessels operating in a single zone at any one time. Following the signature of fishing agreements between Spain and Morocco, and continued by the EU, the size of the fleet was heavily reduced until it disappeared completely in 1999 with the end of the fishing agreements.

The Moroccan cephalopod trawlers began operations between 21^{o}N and 26^{o}N from 1973 with four freezer trawlers, subsequently developing considerably before stabilizing in 1992.

Today the Moroccan national freezer trawler fleet numbers 290 (type Spanish). Outings last for around fifty days on average. The vessel length is between 30 and 40 metres. Their tonnage varies between 200 and 600 GRT with an engine capacity of between 600 and 2 000 hp. The national, coastal freshwater fishery is made up of around a hundred vessels. The engine capacity and average tonnage of this fleet is 400 hp and 60 GRT respectively. They use an atomic trawl and the outings last 6 to 10 days, during which the fish are preserved in boxes on ice. The national artisanal fishery is composed of small wooden boats weighing less than two tonnes and equipped with outboard engines of a capacity between 15 and 25 hp. This fishery is carried out with pots and jigging. The number of artisanal fishery vessels targeting octopus has seen a considerable increase since 1993. Currently there are more than 7 000 boats. The fishery is generally carried out in the coastal region, but the range can exceed 20 miles.

In the Mauritanian EEZ, the octopus industrial trawler fishery began in the sixties. However not until the early eighties did Mauritania possess its own industrial fishery fleet. It is composed of ice and frozen trawlers. The composition of the cephalopod fleet has been marked in recent years by the fishing agreements with the EU that came into force in 1996. Currently there are around 190 cephalopod vessels of which a third are foreign. Amongst these foreign fleets, the Spanish freezer trawlers make up the largest fleet with a number of vessels that increased from 14 in 1995 to 58 in 2001. Their average characteristics in 2002

were 247 GRT, 34 m in length and 910 hp. The trawler activity covers the whole of the Mauritanian coast.

The artisanal octopus fishery began in 1989 in Nouadhibou and is still primarily targeting octopus. In the Nouakchott zone, the catch mainly targets cuttlefish. Over the last few years, even though the "octopus pot" remains the most important type of gear, new types of gear have been introduced such as jigging and traps. These gears have been used in Nouakchott and Nouadhibou respectively.

The cephalopod fishery in Senegal and The Gambia has made progress over the last few years. It is carried out by Spanish and other foreign trawlers, Senegalese industrial fishery trawlers and artisanal fishery vessels also from Senegal. The number of Spanish freezer trawlers in this fishery varied over the 1991–2002 period from a minimum of 1 to a maximum of 6 vessels. Their average characteristics in 2002 were 229 GRT, 726 hp and 36 m in length.

5.2 Sampling intensity

5.2.1 Catch and effort

The cephalopod catch statistics for the Moroccan fishery are available by month and by port at the Institut national de recherche halieutique (INRH) in a data base of basic data for all the segments. The data for the artisanal octopus fishery are provided by surveys of landing sites, freezer factories and other sites. Fishing effort is obtained from surveys at the main ports on the number and duration of outings per vessel.

For Mauritania and Senegal–The Gambia please refer to Points 2.2 and 3.2.

Catch and effort data for the Spanish cephalopod fisheries in the whole region are obtained from logbooks and a network of surveys in the main landing ports (Las Palmas, Vigo, Cangas and Marín).

5.2.2 Biological parameters

Biological sampling is carried out in the main landing ports and on board research and commercial vessels. No biological parameters were available to the Working Group.

5.3 Octopus (*Octopus vulgaris*)

5.3.1 Biological characteristics

Cephalopods are characterized by their short lifespan, fast growth and strong seasonality. Both reproduction and recruitment have been well studied in the region. After spawning, the females of this species (and the males, for octopus) die.

5.3.2 Stock identity

The Working Group defined three cephalopod stocks in the north:

Dakhla stock (26°N–21°N)
Cap Blanc stock (21°N–16°N)

Senegal–The Gambia stock (16°N–12°N)

5.3.3 Data trends

Catch

Dakhla stock (26°N–21°N)

Over the last ten years octopus (*Octopus vulgaris*) production has varied between 70 000 and 100 000 tonnes. In 1995 the cephalopod fleet landed around 78 000 tonnes which fell dramatically to about 50 000 tonnes in 1997. This fall in catch was particularly felt due to the increased production means available to the octopus fishery in comparison to the previous period of the nineties. However from 1998 there was a reversal which could be due to the lengthening of the closed season during the spring to protect the octopus and cuttlefish laying. The total catch reached around 107 000 tonnes in 2000 before falling to 49 000 tonnes in 2002 (Table and Figure 5.3.3a).

Cap Blanc stock (21°N–16°N)

The catches of this stock once again show a decrease, after having increased slightly in 2000 (Table 5.3.3a and Figure 5.3.3d). Between 1990 and 2002 octopus production varied between 40 000 and 16 000 tonnes. It should be noted that the catches of octopus as bycatch do not appear to be declared by the other fisheries. Data analysis by observers shows that cephalopod catch accounts for 10 to 15 percent of the fish trawlers catch, 6 percent of the shrimper catch and 1.4 percent of the hake trawler catch. This points at a not inconsiderable underestimation of the total catch.

Senegal–The Gambia stock

For the Senegal–The Gambia stock over the period 1990–2002, the octopus catch varies between 1 000 tonnes in 2002 and 42 000 tonnes in 1999. The Senegalese data are not complete and 1999 is very different from the other years. The data include octopus catch from the trawlers of the national industrial fishery, the artisanal fishery and the foreign industrial fishery (Table 5.3.3a and Figure 5.3.3g).

Effort

Dakhla stock

Since 1973, the effort of the Moroccan freezer cephalopod trawlers has seen a continual increase. From 1992, the fishing effort stabilised at around 289 active vessels. During the course of this same period, the EU fleet effort decreased progressively going from 255 in 1978 to 86 in 1999 when the Morocco–EU fishing agreement came to an end.

For the Moroccan artisanal fishery in 1994 almost 2 000 vessels were fishing for octopus. In 1996, the artisanal octopus fishery was carried out by almost 4 000 vessels, currently the number is over 7 000. In the coastal fishery there are around 100 vessels (Table and Figure 5.3.3b).

Cap Blanc stock

Octopus fishing effort saw a large increase between 1995 and 1997 in terms of fishing days for both the industrial and the artisanal vessels. With the entry of the European fleet, a further large increase was seen. Very often the trends follow those of the catch with a time lag of one to two years (Table 5.3.3b and Figure 5.3.3e).

Senegal–The Gambia stock

Since 1995 the fishing effort of the Senegalese artisanal fisheries has seen a steady increase as have the efforts of the other fleets, but to a lesser degree (Table 5.3.3b and Figure 5.3.3h).

Abundance indices

CPUE

Dakhla stock

Octopus yields fell dramatically for the Moroccan freezer trawlers to 0.4 tonne/day in 1997, climbing to 0.9 tonne/day in 2000 before falling again to 0.5 tonne/day in 2002. For the Moroccan coastal trawlers the yields have decreased significantly from around 3 tonnes/day in 1999 and 2000 to 0.62 tonne/day. For the Spanish fleet the yields fell to 0.75 tonne/day in 1996 and 1997 before recovering to 1.3 tonne/day in 1999 (Figure 5.3.3c).

Cap Blanc stock

The octopus CPUEs of the Mauritanian freezer trawlers in the Cap Blanc zone show a decreasing trend since their peak in 1992. A slight increase can however be seen in 2000. The similarity in trends obtained in the different octopus CPUEs of the four sectors that target this species, leads one to think that there is an actual decrease in stock abundance (Figure 5.3.3f).

Senegal–The Gambia stock

The octopus CPUEs of the Senegal–The Gambia zone show a peak in 1999 then a decreasing trend followed by a slight recovery (Figure 5.3.3f).

Scientific surveys

Dakhla stock

The catches of the scientific surveys show a decrease in cephalopods from 2001. The most notable decrease is that of *Octopus vulgaris*.

Cap Blanc stock

The scientific surveys show a slight decrease in the indices, far less appreciable than that of the CPUEs. The consistency in these two indices confirms the decrease in the level of abundance of the stock.

Senegal–The Gambia stock

No scientific survey was provided to the Working Group this year on the Senegal–The Gambia octopus stock.

Biological data

Length composition and other data

New data on length composition and other biological aspects (growth, reproduction, feed, etc.) of *Octopus vulgaris* were not analysed by the Working Group.

5.3.4 Assessment

Methods

The logistic surplus production model was used to assess the state of the stocks and the fisheries of cephalopods. The model is described in detail in Point 1.4.

Data

Dakhla stock

The series of total catch estimated by the Working Group for the period 1990–2002 was used in the model as the series of total catch of the stock of *Octopus vulgaris* of the Dakhla stock. As a series of abundance indices the Working Group adopted the Moroccan industrial trawler CPUE series.

Cap Blanc stock

The series of total catch estimated by the Working Group for the period 1990–2002 was used in the model as the series of total catch of the stock of *Octopus vulgaris* of the Cape Blanc stock. As a series of abundance indices the Working Group adopted the Mauritanian freezer trawler CPUE series.

Senegal–The Gambia stock

The series of total catch estimated by the Working Group for the period 1990–2002 was used in the model as the series of total catch of the stock of *Octopus vulgaris* of Senegal–The Gambia. As a series of abundance indices the Working Group adopted the Spanish cephalopod trawler CPUE series, which specifically targets octopus.

Results

Dakhla stock

The model gives a reasonable fit to the data (Figure 5.3.4a). The results show that the current biomass is below that producing maximum sustainable yield (Table 6.1a). Taking into account what has been said before, the results of the model show that the stock risks being overexploited in relation to its biomass.

Cap Blanc stock

The model provides a reasonable fit to the data, though it cannot reproduce the changes in CPUE for the Cap Blanc stock at the beginning of the study period (Figure 5.3.4b). The results show that current biomass is greatly below that producing maximum sustainable yield and that fishing mortality is much higher than that needed to extract the whole natural production of the stock (Table 6.1a). The Cap Blanc octopus stock is overexploited in relation to its biomass and fishing mortality.

Senegal–The Gambia stock

The model provides a poor fit to the data, being unable to reproduce the observed fluctuations in the CPUE series. There is therefore great uncertainty about the results of the model.

Table 5.3.4a: The state of the octopus (*Octopus vulgaris*) stock North

Stock/CPUE used	B/B_{MSY}	F_{cur}/F_{SYcurB}
Dakhla/Moroccan freezer trawlers	49%	79%
Cap Blanc/Mauritanian freezer trawlers	19%	212%

Discussion

Dakhla stock

The model provides a reasonable fit to the data. The results show that the Dakhla stock of *Octopus vulgaris* is overexploited. These results agree with observations on the fishery.

Cap Blanc stock

The model provides a reasonable fit to the data. The results show that the Cap Blanc stock of *Octopus vulgaris* is overexploited. These results agree with the history of the fishery.

Senegal–The Gambia stock

The results of the stock assessment are not reliable, probably due to the basic data. The Working Group recommends checking the data during the next session. As a precautionary approach, the observed fluctuations in the CPUEs suggest that the stock is probably over or fully exploited.

5.3.5 Management recommendations

Dakhla stock, Cap Blanc stock and Senegal–The Gambia stock

Taking into account the assessment results and the uncertainties surrounding them, the Working Group decided to recommend a reduction in fishing effort.

5.4 Cuttlefish (*Sepia* spp.)

5.4.1 Biological characteristics

No new biological characteristics' study of this species was provided to the Working Group.

5.4.2 Stock identity

The Working Group adopted three stocks for *Sepia* spp. North

Dakhla stock (26°N–21°N)
Cap Blanc stock (21°N–16°N)
Senegal–The Gambia stock (16°N–12°N)

5.4.3 Data trends

Dakhla stock, Cap Blanc stock and Senegal–The Gambia stock

Catch

The total catch of cuttlefish for the three northern stocks varies between 16 000 and 39 000 tonnes, the highest catches were in 1999, 2000 and 2001 with 32 000 tonnes, 39 000 tonnes and 36 000 tonnes respectively, dropping to 16 000 tonnes in 2002 (Table and Figure 5.4.3a). Figure 5.4.3a shows a drop in total catch of *Sepia* spp. for the stocks of Dakhla, Cap Blanc and Senegal–The Gambia. In Figures 5.4.3b,c,d the catches of cuttlefish by fleet also show a decreasing trend for all the fleets operating in the Northern region.

Effort

Fishing effort is described in Paragraph 5.3.3. No fishing effort is aimed at cuttlefish, but rather at cephalopods and in particular octopus.

Abundance indices

CPUE

The CPUE series of *Sepia* spp. over the whole region and for all fleets fluctuated over the study period, and was very marked for the Senegal–The Gambia stock (Figure 5.4.3e,f,g). The series show a decreasing trend and a reduction in the CPUEs can be seen over the study period except for in 2002 for the Spanish and Senegalese–Gambian trawlers which increased from 179 kg/day to 419 kg/day.

Scientific surveys

The data from the scientific surveys on the Moroccan cephalopods were used to assess the *Sepia* spp. stock. The other countries did not provide the Working Group with survey data.

Biological data

Length composition and other data

New data on length composition and other biological parameters (growth, reproduction, feed, etc.) of *Sepia* spp. was not supplied to the Working Group.

5.4.4 Assessment

Methods

The logistic surplus production model was used to assess the state of the stocks and the fisheries of *Sepia* spp.. The model is described in detail in Point 1.4.

Data

Dakhla stock

The total catch series estimated by the Working Group in the region between 21ºN and 26ºN for the years 1990–2002 was used in the assessment model as the series of total catch of the Dakhla stock of *Sepia* spp. As abundance indices series the Working Group adopted the CPUE series of the Moroccan industrial trawlers and the abundance index series of the survey.

Cap Blanc stock

The total catch series estimated by the Working Group in the region between 21ºN and 16ºN for the years 1990–2002 was used in the assessment model as the series of total catch of the Cap Blanc stock of *Sepia* spp. As abundance indices series the Working Group adopted the CPUE series of the Mauritanian freezer trawlers and the CPUE series of the scientific surveys.

Senegal–The Gambia stock

The total catch series estimated by the Working Group in the Senegal–The Gambia region for the years 1990–2002 was used in the assessment model as the series of total catch of the Cap Blanc stock of *Sepia* spp. The CPUE series of the Spanish cephalopod fleet was used as abundance index.

Results

Dakhla stock

The Working Group considered the fit with the CPUE series of the Moroccan industrial trawlers and the Moroccan scientific surveys to be reasonable, even though it did not manage to reproduce the changes in CPUE towards the end of the study period (Figure 5.4.4a). The results of the model show that the stock is fully exploited or overexploited in relation to its biomass. The present biomass is estimated to be above that producing maximum sustainable yield, the present fishing mortality is estimated to be at the level of that producing a sustainable yield with the level of current biomass. (Table 5.4.4a).

Cap Blanc stock

The results of fitting the model to the available data were not satisfactory and the Working Group was unable to interpret the results. Therefore it was decided to abandon the assessment of this stock.

Senegal–The Gambia stock

The model provides a reasonable fit to the data even though it does not reproduce all the changes in CPUEs (Figure 5.4.4c). The results show that the current biomass is below that producing maximum sustainable yield and that the level of fishing mortality is below a sustainable level.

Table 5.4.4a: The state of *Sepia* spp. and the fishery in the Dakhla stock

Zone/CPUE used	B/B_{MSY}	F_{cur}/F_{SYcurB}
Dakhla/CPUE Moroccan industrial trawlers	61%	59%
Dakhla/Indices of the Moroccan scientific survey	60%	58%
Senegal–The Gambia/CPUE Spanish trawlers	58%	49%

Discussion

Dakhla and Senegal–The Gambia stock

The stocks of *Sepia* spp. in Dakhla and Senegal–The Gambia appear to be fully or over-exploited in relation to their biomass. The Working Group highlighted the observed reduction in CPUEs of the two stocks.

5.4.5 Management recommendations

Dakhla stock, Cap Blanc stock and Senegal–The Gambia stock

Taking into account the results of the assessments and the uncertainties still surrounding the results, the Working Group decided to recommend a reduction in fishing effort in the three *Sepia* spp. stocks

5.4.6 Future research

With the aim of improving basic data quality for the assessment and to reduce the uncertainty surrounding the results, the Working Group recommends giving priority to the following research:

1. To prepare seasonal or monthly data for the next Working Group

2. To continue studying the cephalopod stocks

3. To find a more suitable CPUE.

6. DEMERSAL SOUTH 1 SUBGROUP

Sierra Leone and Guinea

6.1 Fisheries

The fisheries in the two countries in this subgroup are organised quite differently from each other and are therefore described separately. Given the relative importance of the main species, and the availability of data, the Working Group decided to analyse seven species or groups of species, *Pseudotolithus elongatus, Pseudotolithus* spp., *Galeoides decadactylus, Arius* spp., Sparidae, *Cynoglossus* spp. and *Pomadasys* spp. (Table 6.1.1).

Sierra Leone

The country claimed a 200 mile EEZ in the early 1980s. With a coastline of some 500 km, the total area of the EEZ extends to some 155 700 km^2. Extensive mangrove swamps and a number of estuaries and rivers that are navigable for short distances, characterize the coastline. The country shelf is relatively narrow and reduces in width from about 100 km from the coastline at the northern end towards Guinea to approximately 20 km in the South towards Liberia. The narrower southern shelf has limited fish resources and is influenced by the eastward flowing Guinea current. The northern shelf constitutes the most productive fishing area of Sierra Leone. Both areas, however, have potential for demersal and pelagic fish including shrimp, cephalopods and molluscs.

Most small-scale fishing activities are concentrated in a zone of 15–45 km from the coast and a depth of less than 50 m.

The marine fisheries of Sierra Leone are divided into two major sectors :

- the artisanal fishery operating in estuaries and inshore waters extending from the shoreline to a depth of 15–45 m

- the industrial fishery operating in the open deep waters. This fleet includes trawlers, shrimpers, canoe support vessels (motherships) and carriers.

The artisanal fishery is a multigear fisheries utilizing diverse ranges of fishing craft and fishing nets. The gears used include castnets, ringnets, driftnets, beach seines, setnets and hooks. There are about 8 000 fishing crafts of different sizes utilizing these gears. About 10 percent of these vessels are motorised. This fishery exploits a multispecies demersal assemblage. The most important demersal species are *Galeiodes decadactylus, Pseudolithus* spp., Sparids, *Arius* spp., *Pomadasys* spp., *Cynoglossus* and *Brachydeuterus auritus*.

Over the last 20 years the industrial fishing fleet has consisted mainly of demersal trawlers, shrimpers, canoe support vessels and purse seiners. The number of licensed vessels reached a peak in 1987, after which there was a gradual decrease, principally due to the withdrawal of the then Soviet vessels, which dominated the fishery in the 1980s, and lately due to the effect of the civil war. Foreign industrial fishing vessels include vessels from a) Soviet Union b) Greece c) Spain d) Italy e) Liberia f) Senegal g) Panama, f) China and h) Korea. Currently, the industrial fishery is dominated by shrimp trawlers and demersal finfish trawlers. The shrimp trawlers take a large proportion of bycatch (estimated at 75 percent). The bycatch

includes mainly inshore demersal species such as *Galeiodes decadactylus*, *Pseudotolithus senegalensis*, *Pseudotolithus typus*, *Brachydeuterus auritus*, undersized *Sparids*, etc. The discard rate in this fishery has been estimated at 25 percent. The demersal finfish trawl fishery fishes mainly offshore and mainly targets deeper-water demersal resources like Sparids, Serranidae, Lutjanidae, Ariidae and other.

Guinea

Two main fisheries are involved in the exploitation of demersal fish: the industrial trawl fishery and the traditional artisanal fishery, motorised or otherwise. This last fishery is particularly important in Guinea where, until the years 1995 and 1996, the demersal catch was higher than that of the industrial trawl fishery. Today it is the opposite, where demersal species are exploited to a greater extent by the industrial fishery than by the artisanal. In 2000, the total Guinean demersal fishery catch was 65 000 tonnes, with 43 000 tonnes coming from the industrial fishery and 22 000 tonnes from the artisanal (Bul. Stat. CNSHB, 2001).

Since 1985 the demersal industrial fishery has been carried out almost exclusively by foreign fleets operating under licence. Except for around ten freezer trawlers of Guinean nationality, the remaining vessels are all of different nationalities : Chinese, Korean, French, Spanish, Russian, Greek, Italian, Maltese, Senegalese, Sierra-Leonean, Ukrainian, American or from the Côte d'Ivoire. Part of this fleet operates under fishing agreements (European Union and China) while the remainder operates using vessels chartered from Guinean ship owners. During the year 2000, 75 industrial vessels targeting demersal fish operated in Guinean waters. The vessels fishing for cephalopods (58 vessels) and the shrimpers (45 vessels) which fished in Guinea in the same year, accounted for between 20 and 30 percent of the demersal fish catch.

The industrial fishery exploits the so-called noble species of the muddy and sandy bottoms, which belong predominantly to the families Scianidae (e.g. *Pseudotolithus* spp.), Sparidae (e.g. seabream), Cynoglossidae (sole), Polynemidae (threadfins), Serranidae (e.g. groupers) and Mugilidae (e.g. red mullet).

The artisanal fishery canoe fleet numbers around 2 500 canoes today, with about 44 percent of these being motorized.

Six main types of gear are used today by the Guinean artisanal fishery : driftnets (29 percent), encircling gillnets (25 percent), longlines (Palangres) (20 percent), set gillnets (15 percent), handlines (9 percent) and purse seines (2 percent).

In 1997, 120 landing sites or "fishing ports" were counted along the Guinean coast, compared to 97 in 1992. Their importance varies greatly, going from under ten canoes in Sooti, Boffa, to more than one hundred in Boulbinet, Conakry.

The main fish resources exploited by the artisanal fishery are the pelagic species *ethmalosa* and sardinella, the demersal species of the family Sciaenidae and various types of seabream.

6.2 Sampling intensity

6.2.1 Catch and effort

Sierra Leone

The data from the industrial fishery are collected on board the vessels by government fisheries observers who record all catches by species and fishing effort (in fishing days, hours and by number of hauls) into a specially designed logbook. As means of verification, these data are also transmitted by radio to the office on a daily basis and further verified during ranshipments in the Port of Freetown. Other important information recorded includes total discards and positions of fishing.

Artisanal data for 2002 were obtained by a sample-based method, wherein only a few landing sites (about 15 percent) are sampled for catches, fishing effort and fish prices by different fishing units. Total catches and fishing effort are derived from estimated CPUEs, boat and gear activity coefficients and the frame survey data using the ARTFISH software.

The data for 1991–2001 were however estimated based on earlier artisanal catch data series in the 1980s.

Guinea

At the artisanal fishery level, the data are collected in two ways :

- The first takes place once a year and consists in a thorough census of the active vessels along the whole Guinean littoral zone. Thus the actual number of vessels and fishing gears used is known for each year in every port.

- The second consists in continually collecting data following a stratified sampling plan, on the number and duration of trips and landings by region and by type of gear of the commercial sector by species. This operation is carried out on a sample of 21 ports judged to be representative of all the Guinean artisanal fishing ports.

Total landings are estimated by extrapolating the observed landings in the 21 ports surveyed over the whole littoral zone based on the annual census data.

At the industrial fishery level, the data come from a “system of surveying industrial fisheries”(Lesnoff *et al.*, 1995). The total number and the technical characteristics of the active fishing vessels are collected annually in the Guinean EEZ on the basis of fishing licences granted by the fisheries administration. A continual follow up of the activities at sea is carried out by on board observers who collect data on effort (in fishing days) and on the preserved catches. The landings are carefully followed up at the autonomous port of Conakry by CNSHB officials. To obtain reliable estimates, only data collected by a group of observers carefully chosen by the CNSHB and embarked quarterly on the fishing vessels, following a stratified sampling plan, are used. These data are verified and corrected, then extrapolated over all the industrial fishing vessels active in the Guinean EEZ during the year under consideration.

6.2.2 Biological parameters

Sierra Leone

Length frequency data for *Dentex angolensis* were obtained from sampling onboard commercial fishing trawlers for August, September, December 2002 and January–March 2003. Sampling was conducted once a week (Table 6.2).

Guinea

Sampling of length frequencies is very poor in the commercial demersal fish catches in Guinea (Table 6.2).

Some biological data (sexual maturity, reproduction, etc.) from commercial catches of demersal fish are available in Sierra Leone (Table 6.2).

No data are available on sexual maturity, reproduction, etc. from commercial demersal fish catches in Guinea.

6.3 *Pseudotolithus elongatus*

6.3.1 Biological characteristics

Pseudotolithus elongatus has an inshore distribution and can occur in estuaries and brackish waters.

The species can easily grow to about 30 cm in total length and lengths in excess of 40 cm have been found. The species has a shoaling behaviour and migrates along the shore. In Sierra Leone, it is found in highest abundances during the period from August to November.

P. elongatus is exploited by both the industrial and artisanal fisheries. It is targeted by the artisanal fishery during the whole year, and by the demersal trawlers in the season of high abundance.

6.3.2 Stock identity

Due to a lack of complete and up-to-date biological data for the exploited species in the two countries (Guinea and Sierra Leone) in the "demersal South 1 area", the Working Group considered one stock for each species/group of species from each country.

6.3.3 Patterns in data

Catch

Sierra Leone

Catches fluctuated between 1994–1998 but peaked in 1999, followed by a new general decline until 2001 and a recovery in 2002 (Table and Figure 6.3.3a).

Guinea

The total catch has shown an increasing trend since 1997, followed by a decrease until 1999, and then increasing again until 2001. This increase can be explained by the fact that a much higher effort has been directed at this species due to the growing demand from the Asian market (Table and Figure 6.3.3a).

Fishing effort

Effort of the Guinean demersal trawler fleet in the region has increased markedly over the last years (1999–2002). Both the artisanal and industrial fisheries have seen an increase (Table and Figure 6.3.3b). There has been a weak rise for the trawlers operating in Sierra Leone.

Abundance indices

CPUE

CPUE values show relatively similar trends between the Guinean and Sierra Leone finfish trawler fleets (Figure 6.3.3c). There is a trend towards a decrease in the last couple of years. In general, CPUE values for the Guinean fleet are relatively higher than those for Sierra Leone's fleet.

Research surveys

Research survey data for *P. elongatus* were not presented to the Working Group.

6.3.4 Assessment

Methods

The logistic surplus production model was used to evaluate the status of the stocks and the demersal fisheries in the region by the Working Group. The model is described in detail in Section 1.4.

Data

For the catch data, the Working Group used a time series of total catch of each species/group of species, estimated separately by the Working Group for each country.

The abundance indices used were CPUE series for each species/group of species for trawlers in each country. It is believed that the CPUE data better reflect the abundance of these species than the CPUE series of the shrimp trawlers in Sierra Leone or those of the artisanal fishery in Guinea.

Results

The model does not fit the data well for the two countries. No conclusions could therefore be drawn from the results of the model.

Discussion

The trends in CPUE observed cannot be explained by changes in the biomass of the stock. The large increase in CPUE and the observation of a possible change in targeting makes these results unreliable for the assessment of the stock. However, the large increase in effort observed in the last two to three years and the corresponding decrease in CPUE are reason for concern about the status of the stock.

6.3.5 Management recommendations

In view of the fact that the fishery is multigear and multispecies, and given the observed trends in effort and CPUE, the Working Group decided to adopt a precautionary approach and recommend that effort should not be increased above that of 2002.

6.4 *Pseudotolithus* spp.

6.4.1 Biological characteristics

Pseudotolithus senegalensis and *P. typus* are both coastal species occurring in muddy and sandy bottoms. These two species have a greater coastal distribution than *P. elongatus*.

P. typus commonly occurs in estuaries. The two species are important in both the artisanal and industrial fisheries in both Guinea and Sierra Leone. Total length in excess of 60 cm is commonly observed for *P. typus* whilst *P. senegalensis* is commonly observed at around 40–50 cm.

6.4.2 Stock identity

Pseudotolithus senegalensis and *P. typus* mainly constitute the *Pseudotolithus* spp. in this study for both Guinea and Sierra Leone. These two species have an inshore distribution and grow larger than *P. elongatus*. As for the other species, separate stocks in each country are assumed for assessment purposes.

6.4.3 Patterns in data

Catch

The trends in the catches of *Pseudotolithus* spp. group closely follow those noted in *P. elongatus*. Catches in Guinea far exceed those in Sierra Leone. A large increase in total catch was noted from 1999. Catches stayed more or less stable last year (Table and Figure 6.4.3a).

Fishing effort

This stock is targeted by the multispecies demersal fleets of the countries. The trends in effort of these fleets were described in Section 6.3.3.

Abundance indices

CPUE

CPUE values show relatively similar trends between the Guinean and Sierra Leone finfish trawler fleets (Table and Figure 6.4.3c). There is a trend towards a decrease over the last couple of years. In general, CPUE values for the Guinean fleet are relatively higher than those for Sierra Leone's fleet.

Research surveys

Research survey data for this species were not presented to the Working Group.

Biological data

Length composition and other parameters

Data on length composition and other biological parameters (growth, reproduction, feed, etc.) for *Pseudotolithus* spp. were not provided to the Working Group.

6.4.4 Assessment

Methods

The logistic surplus production model was used to evaluate the status of the stocks and the demersal fisheries in the region by the Working Group. The model is described in detail in Section 1.4.

Data

In order to have a relatively long data series, catches between 1990 and 1994 were estimated for Guinea based on the number of boats in the industrial demersal fishery and the number of canoes in the artisanal fishery (Appendix 2). The abundance indices used for Guinea were the CPUEs of the industrial trawlers targeting demersal fish and for Sierra Leone the finfish trawler CPUEs.

Results

The model provided a reasonable fit to the data from the countries (Figure 6.4.4a,b).

Table 6.4.4a: Indicators on the state of the stock and fishery of *Pseudotolithus* spp. in Guinea and Sierra Leone

Country/Abundance index used	B/B_{MSY}	F_{cur}/F_{SYcurB}
Guinea/demersal finfish trawlers	110%	113%
Sierra Leone/finfish trawlers	182%	108%

Guinea

The model provided a better fit to the data. With the demersal trawlers' CPUE, the model showed that the stock is being overexploited as the present catches are greater than the natural biomass production of the stock (Table 6.4.4a).

Sierra Leone

The fit to the model suggests that current biomass is above the biomass producing maximum sustainable yield (Table 6.4.4a). Current fishing mortality is the same as fishing mortality producing sustainable yield at current biomass levels.

Discussion

The model provides a reasonable fit to this set of data. The overall result is that the stocks are either fully or overexploited. Given the uncertainty about the change in targeting, these results should be taken carefully.

6.4.5 Management recommendations

In view of the fact that the fishery is multigear and multispecies, and given the observed trends in effort and CPUE, the Working Group decided to adopt a precautionary approach and recommend that effort should not be increased above that of 2002.

6.5 *Galeiodes decadactylus*

6.5.1 Biological characteristics

This species occurs in sandy and muddy bottoms up to 50 m deep. It is exploited by both artisanal and industrial fisheries and is a major bycatch component of shrimp trawlers.

6.5.2 Stock identity

Galeiodes decadacytlus is found mainly in shallow waters in Sierra Leone and Guinea and may be considered as one stock.

6.5.3 Patterns in data

Catch

Landings of *Galeoides decadactylus* in the region were fairly stable from 1995 to 1998. From 1999 on, landings in Guinea increased almost exponentially while those in Sierra Leone remained stable (Table and Figure 6.5.3a).

Fishing effort

This stock is targeted by the multispecies demersal fleets of the countries. The trends in effort of these fleets were described in Section 6.3.3.

Abundance indices

CPUE

CPUEs have in general fluctuated markedly during the period. The CPUE series from the countries show matching fluctuations (Table and Figure 6.5.3b).

Research surveys

Research survey data for this species were not presented to the Working Group.

Biological data

Length composition and other parameters

Data on length composition and other biological parameters (growth, reproduction, feed, etc.) for *Galeoides decadactylus* were not provided to the Working Group.

6.5.4 Assessment

Methods

The logistic surplus production model was used to evaluate the status of the stocks and the demersal fisheries in the region by the Working Group. The model is described in detail in Section 1.4.

Data

In order to have a relatively long data series, catches between 1990 and 1994 were estimated for Guinea based on the number of boats in the industrial demersal fishery and the number of canoes in the artisanal fishery (Appendix 2). The abundance indices used for Guinea were the CPUEs of the industrial trawlers targeting demersal fish and for Sierra Leone the finfish trawler CPUEs.

Results

The model provides a reasonable fit. The indicators on the state of the stock suggest that the current level of biomass is equal to that producing maximum sustainable yield. However, fishing mortality is twice that corresponding to the current biomass level for Guinea and Sierra Leone.

The results in Sierra Leone indicate that current biomass is above that producing maximum sustainable yield (Table 6.5.4a). Fishing mortality is below that corresponding to maximum production at the current level of biomass (Figure 6.5.4a,b).

Table 6.5.4a: Indicators on the state of the stock and fishery of *Galeoides decadactylus* in Guinea and Sierra Leone

Country/Abundance index used	B/B_{MSY}	F_{cur}/F_{SYcurB}
Guinea/demersal finfish trawlers	101%	279%
Sierra Leone/finfish trawlers	193%	85 %

Discussion

The models apparently provide a reasonable fit to the data from the countries. However, the conclusions from each of them are quite different. Given that the two countries are neighbouring, care must thus be taken regarding the overall status of the stock.

6.5.5 Management recommendations

Given the contradictory results obtained for the two countries, a precautionary approach is necessary. Therefore the Working Group recommends not to increase fishing effort above that of 2002 until further information is available. This species is taken in significant number as bycatches in shrimp trawlers because of their inshore distribution. Thus enforcing regulations prohibiting fishing in the inshore areas reserved for artisanal fishery could help sustain the fishery for this stock.

6.6 *Pomadasys* spp.

6.6.1 Biological characteristics

Pomadasys jubelini and *P. incisus* are the main species included in this group. Both species are coastal in distribution. *P. jubelini* has however been commonly taken in depths in excess of 30 m and is the most abundant of the three species included in this group. *P. rogeri* also occur in landings from pelagic fishing gears like artisanal ringnets and shoals of this species are often targeted in these fisheries.

6.6.2 Stock identity

The three species occur in both Sierra Leone and Guinean waters. As in the case of other stocks, the Working Group ran a separate assessment for each country.

6.6.3 Patterns in data

Catch

There appears to be two periods in the exploitation pattern of these species during the period under review (Table and Figure 6.6.3a). The years 1994–1999 were a period of fluctuating but moderate catches, while these increased very significantly from 1999 to 2001. A decrease was observed in Sierra Leone catches in 2002.

Fishing effort

This stock is targeted by the multispecies demersal fleets of the countries. The trends in effort of these fleets were described in Section 6.3.3.

Abundance indices

CPUE

CPUE has been largely fluctuating during most of the period (Table and Figure 6.6.3c). However it must be noted that CPUE in Guinean fisheries has been declining since 1998. An increase in CPUE from Sierra Leone fisheries was noted from 1999 to 2001.

Research surveys

Research survey data for this species were not presented to the Working Group.

Biological data

Length composition and other parameters

Data on length composition and other biological parameters (growth, reproduction, feed, etc.) for *Pomadasys* spp. were not provided to the Working Group.

6.6.4 Assessment

Methods

The logistic surplus production model was used to evaluate the status of the stocks and the demersal fisheries for *Pomadasys* spp. in the region by the Working Group. The model is described in detail in Section 1.4.

Data

In order to have a relatively long data series for *Pomadasys* spp., catches between 1990 and 1994 were estimated for Guinea based on the number of boats in the industrial demersal fishery and the number of canoes in the artisanal fishery (Appendix 2). The abundance indices used for Guinea were the CPUEs of the industrial trawlers targeting demersal fish and for Sierra Leone the trawler CPUEs.

Results

The model gives a reasonably good fit to the data from Guinea (Figure 6.6.4a). The results indicate that the stock of *Pomadasys* spp. is heavily overexploited. Current biomass is a little below that producing maximum sustainable yield but fishing mortality is much higher than the natural production of the stock (Table 6.6.4a).

Table 6.6.4a: Indicators on the state of the stock and fishery of *Pomadasys* spp. Guinea and Sierra Leone

Country/Abundance index used	B/B_{MSY}	F_{cur}/F_{SYcurB}
Guinea/demersal finfish trawlers	46%	182%
Sierra Leone/finfish trawlers	–	–

The model does not manage to reproduce the behaviour of the CPUE in Sierra Leone . It does not follow the decrease in CPUE at the start of the series nor the recent decrease. These parts cannot be explained by the catches or the normal dynamics of the stock. Accordingly, it is considered that the level of uncertainty does not warrant producing an assessment of the stock.

Discussion

The model follows the trends in the fishery from Guinea, but not from Sierra Leone. The results from Guinea indicate a fully to overexploited stock. Given that there are some probabilities that this stock will be shared between the countries, care should be exercised in its management.

6.6.5 Management recommendations

The current assessment leaves some uncertainties unresolved. Given the current evaluation, the Working Group recommends reducing the fishing effort in the Guinean fishery and, at the very least, not increasing it in the Sierra Leonean fishery.

6.7 *Arius* spp.

6.7.1 Biological characteristics

The species *Arius latiscutatus* and *A. heudeloti* are the main species in this group. Both species are coastal in distribution. They are commonly caught in bottom trawls and bottom set nets. *Arius latiscutatus* can be found in brackish waters. Both species are common in both Sierra Leone and Guinean waters. Sizes between 60 and 70 cm have been observed in these species.

6.7.2 Stock identity

As in the case of other stocks, the Working Group ran a separate assessment for each country.

6.7.3 Patterns in data

Catch

The trends in total catches of this group of species are stable until 1999 when an increase is observed from the year 2000 (Table and Figure 6.7.3a). The period 1994–1999 was a period of moderately declining catches, while these increased very significantly from 1999 to 2001 and 2002. This pattern is similar in the countries, although it is more marked in Guinean catches.

Fishing effort

This stock of *Arius* spp. is targeted by the multispecies demersal fleets of the countries. The trends in effort of these fleets were described in Section 6.3.3.

Abundance indices

CPUE

Except for the peak observed in 2002, CPUEs of the industrial fishery were relatively stable for the period 1995–2000. The same stable tendency is observed in the artisanal fishery with a decrease observed in 1997 and 1998 (Table and Figure 6.7.3c). They increased markedly in 2000, to fall again in 2001.

Research surveys

Research survey data for this species were not presented to the Working Group.

Biological data

Length composition and other parameters

Data on length composition and other biological parameters (growth, reproduction, feed, etc.) for *Arius* spp. were not provided to the Working Group.

6.7.4 Assessment

Methods

The logistic surplus production model was used to evaluate the status of the stocks and the demersal fisheries in the region by the Working Group. The model is described in detail in Section 1.4.

Data

In order to have a relatively long data series for *Arius* spp., catches between 1990 and 1994 were estimated for Guinea based on the number of boats in the industrial demersal fishery and the number of canoes in the artisanal fishery (Appendix 2). The abundance indices used for Guinea were the CPUEs of the industrial trawlers targeting demersal fish and for Sierra Leone the finfish trawler CPUEs.

Results

The model gives a reasonably good fit to the data from Guinea (Figure 6.7.4a). The results indicate that the stock is fully to overexploited. Current biomass is close to that producing maximum sustainable yield, but fishing mortality is higher than the natural production of the stock (Table 6.7.4a).

Table 6.7.4a: Indicators on the state of the stock and fishery of *Arius* spp. in Guinea and Sierra Leone

Country/Abundance index used	B/B_{MSY}	F_{cur}/F_{SYcurB}
Guinea/demersal finfish trawlers	112%	139%
Sierra Leone/finfish trawlers	–	–

The model does not reproduce the behaviour of the CPUE in Sierra Leone (Figure 6.7.4b). The sudden increase in CPUE observed in 2000 cannot be explained by the catches or the normal dynamics of the stock. Accordingly, it is considered that the level of uncertainty does not warrant producing an assessment of the stock.

Discussion

The model follows the trends in the fishery from Guinea, but not from Sierra Leone. The results from Guinea indicate a fully to overexploited stock. Given that there are some probabilities that this stock will be shared between the countries, care should be exercised in its management.

6.7.5 Management recommendations

The current assessment leaves some uncertainties unresolved. Given the current evaluation, the Working Group recommends reducing the fishing effort in the Guinean fishery and, at the very least, not increasing it in the Sierra Leonean fishery.

6.8 *Cynoglossus* spp.

6.8.1 Biological characteristics

The main species include the flatfish *Cynogglossus senegalensis* (goreensis), *C. canariensis* and *C. monodi*. These species are members of the family Cynoglossidae and occur in sandy and muddy bottoms. *C. senegalensis* and *C. canariensis* can be found in depths of over 100 m whilst *C. monodi* is commonly found in shallow areas of less than 30 m depth.

Sizes of 25–40 cm are common in these species in both Guinean and Sierra Leone waters. *C. canariensis* can attain maximum sizes of between 50–60 cm.

6.8.2 Stock identity

As in the case of other stocks, the Working Group assumed a separate stock for each country.

6.8.3 Patterns in data

Catch

Total catch of this species showed an increasing trend in 1997 whereas levels in 1998 and 1999 were similar to 1995. Since 2000 an increase in catch has been observed. The large majority of the landings of these species are taken in Guinea (Table and Figure 6.8.3a).

Fishing effort

This species group is targeted by the multispecies demersal fleets of the countries. The trends in effort of these fleets were described in Section 6.3.3.

Abundance indices

CPUE

CPUE has shown different trends in the two countries (Table and Figure 6.8.3c). In Guinea, the CPUE series have been declining all through the time period with an occasional recovery in 1998 and 1999. In Sierra Leone, CPUEs have been increasing, although at a much lower level than in Guinea. In Guinea a level of 432 kg/day was observed in 1995 decreasing to less than 250 kg/day in 2001. In contrast an increase in CPUE has been observed in the artisanal fishery in 200 and 2001 compared to previous years.

Research surveys

Research survey data for this species were not presented to the Working Group.

Biological data

Length composition and other parameters

Data on length composition and other biological parameters (growth, reproduction, feed, etc.) for *Cynoglossus* spp. were not provided to the Working Group.

6.8.4 Assessment

Methods

The logistic surplus production model was used to evaluate the status of the stocks and the demersal fisheries in the region by the Working Group. The model is described in detail in Section 1.4.

Data

In order to have a relatively long data series for *Cynoglossus* spp., catches between 1990 and 1994 were estimated for Guinea based on the number of boats in the industrial demersal fishery and the number of canoes in the artisanal fishery (Appendix 2). The abundance indices used for Guinea were the CPUEs of the industrial trawlers targeting demersal fish and for Sierra Leone the finfish trawler CPUEs.

Results

The model gives a reasonably good fit to the data in Guinea and in Sierra Leone (Figure 6.8.4a,b). The results indicate that the stock is heavily overexploited in Guinea and moderately exploited in Sierra Leone. Current biomass is close to that producing the maximum sustainable yield and fishing mortality is higher than the natural production of the stock (Table 6.8.4a).

Table 6.8.4a: Indicators on the state of the stock and fishery of *Cynoglossus* spp. in Guinea and Sierra Leone

Country/Abundance index used	B/B_{MSY}	F_{cur}/F_{SYcurB}
Guinea/demersal finfish trawlers	74%	317%
Sierra Leone/finfish trawlers	126%	57%

Discussion

The results from fitting the model to the data from the two countries give different results. The data from Guinea indicate an overexploited stock while those from Sierra Leone give indications of a moderately exploited stock. The relatively reduced level of knowledge about these stocks does not allow one to decide which set of data shows the best indicatins. However, given that the Guinean fishery has a much higher level of landings, care should be taken with the overall stock.

6.8.5 Management recommendations

The current assessment leaves some uncertainties unresolved. Given the current evaluation, the Working Group recommends reducing the fishing effort in the Guinean fishery and, at the very least, not increasing it in the Sierra Leonean fishery.

6.9 Sparidae

6.9.1 Biological characteristics

In the present assessment, Sparidae include species like *Dentex* spp. (*D. angolensis*, *D. congoensis*, *D. canariensis*), *Pagellus bellottii*, *Pagrus* spp., *P. caeruleosticus*. The sparids are a demersal species and usually have a deepwater distribution.

Most Sparidae occur in deep waters in both Guinean and Sierra Leonean waters. They are exploited by demersal trawls and hook and line. It is likely that these species have a similar size distribution in Guinea and Sierra Leone.

6.9.2 Stock identity

As for the other species groups, the Working Group considered two stocks for this species, one for each country.

6.9.3 Patterns in data

Catch

Catches of these species are highly variable in the years preceding 1997 but become moderately stable between 450–850 tonnes from 1997 onwards (Table and Figure 6.9.3a).

Catches of Sparidae have been approximately stable during the period from 1995 to 1998. A large increase in catches in Guinea was noted in 2001. Most of the catches are taken in Guinea.

Fishing effort

This species group is targeted by the multispecies demersal fleets of the countries. The trends in effort of these fleets were described in Section 6.3.3.

Abundance indices

CPUE

CPUE has decreased markedly in Sierra Leone from 1995 to 2000 (Table and Figure 6.9.3a). A slight increase was noted from 2000 to 2002. Off Guinea, however, CPUE has been fluctuating around an approximately constant level.

Research surveys

Research survey data for this species were not presented to the Working Group.

Biological data

Length composition and other parameters

Data on length composition and other biological parameters (growth, reproduction, feed, etc.) for Sparidae were not provided to the Working Group.

6.9.4 Assessment

Methods

The logistic surplus production model was used to evaluate the status of the stocks and the demersal fisheries for Sparidae. The model is described in detail in Section 1.4.

Data

In order to have a relatively long data series for *Arius* spp., catches between 1990 and 1994 were estimated for Guinea based on the number of boats in the industrial demersal fishery and the number of canoes in the artisanal fishery (Appendix 2). The abundance indices used for Guinea were the CPUEs of the industrial trawlers targeting demersal fish and for Sierra Leone the finfish trawler CPUEs.

Results

The model gives a barely satisfactory fit to the Sparidae data in Guinea . This is probably due to the uncertainties over the large inter and intra differences in length . The model shows that the stock is overexploited as the current catches are greater than the natural production of the stock. (Table 6.9.4a).

The model gives a reasonably good fit to the data in Sierra Leone. The results from the fitting indicate that the stock is overexploited. Current biomass is very much reduced and fishing mortality is several times higher than the natural production of the stock (Table 6.9.4a).

Table 6.9.4a: Indicators on the state of the stock and fishery of Sparidae in Guinea and Sierra Leone

Country/Abundance index used	B/B_{MSY}	F_{cur}/F_{SYcurB}
Guinea/demersal finfish trawlers	72%	127%
Sierra Leone/finfish trawlers	19%	351%

Discussion

The results indicate different situations in the two countries. The situation is more negative for the stocks in Sierra Leone where a steep decline in CPUE has been detected. The results of the assessment match the trends in CPUE indicating overexploited stocks.

6.9.5 Management recommendations

Given the results obtained in the assessment and the trends in CPUE the Working Group recommends a reduction in fishing effort directed at these species.

6.10 Overall management recommendations

In view of the multispecies and multigear nature of the fishery in Sierra Leone, it is recommended to maintain the current fishing effort level (reference year 2002). This must be accompanied by close monitoring of the size, species composition and magnitude of catch of the demersal species. Technological innovations to increase the efficiency of fishing vessels and capacities should be monitored and regulated.

As for Guinea the Working Group recommends a reduction in fishing effort of between 20 and 30 percent.

A regular assessment of the catch composition and size composition of the bycatch in shrimp trawlers should be carried out with a view to reducing this bycatch. Thus active surveillance of inshore areas reserved for the artisanal fleet should be regularly conducted.

6.11 Future research

The work carried out revealed important gaps in current knowledge about the stocks in these areas. In order to address these, the Working Group recommends that the following lines of research be pursued :

- Obtain the specific catches of the main Sparidae species (for example *Sparus caeruleostictus* and *Pagellus bellottii*), and the estimated CPUEs using data from the surveys.

- Recommence the collection of biological data by sampling on board the demersal industrial fisheries vessels, giving priority to the main species, so as to obtain a complete catalogue of the basic biological parameters.

- Intensify the scientific trawl surveys by paying particular attention to the spatio-temporal distribution, to reproduction and to the recruitment of the main demersal species.

- Intensify sampling for length frequencies and species composition in all the main fisheries.

Research effort should be directed towards size and species composition studies and bycatch analysis in shrimp trawlers.

7. DEMERSAL SOUTH 2 SUBGROUP

Benin, Togo, Ghana and Côte d'Ivoire

7.1 Fisheries

The main demersal species are *Pagrus caeruleostictus, Dentex canariensis, Dentex gibbosus, Dentex angolensis, Dentex congoensis, Pagellus bellottii, Brachydeuterus auritus, Pseudotolithus senegalensis, Pseudotolithus typus* and *Galeoides decadactylus.* These species are exploited by trawlers and the artisanal fishery canoes. These species are also caught as bycatch by the shrimp trawlers. The artisanal fleet exploits these species in the coastal zone whereas the trawlers exploit these species at depths of 30 to 50 m. There is no bottom trawling at depths of around 70 m. In Ghana the industrial trawlers target these species for export. There has been no significant change in the size of the operational fleet nor on fishing strategies over the course of the last five years, with the exception of Togo where there was a total ban on industrial trawling between 1999 and 2002. In 2003 one industrial trawler obtained a licence to catch demersal fish in Togo.

7.2 Sampling intensity

7.2.1 Catch and effort

Table 7.2.1 shows the sampling intensity for all of the countries except Côte d'Ivoire.

Benin

For the industrial maritime fishery, data collection is carried out systematically on all vessels landing at the port of Cotonou.

For the artisanal maritime fishery, catch and effort data collection is based on a system of random sampling. This is carried out in the four strata along the whole coast: the Ouémé stratum, the port stratum, the Atlantic stratum and the Mono stratum.

In the past, a total of nine sites used for sampling were divided between these four strata. Using the ARTBASIC software, the level of accuracy of the data collected at the time, requires a revision of the system of data collection.

This revision is aimed at the size and frequency of the sampling. The number of sites grows from 9 to 11 of which four each are in the Atlantic and Mono strata, two in the Ouémé and one in the port.

- Catches will be checked three times a week for each vessel. Data on catch will be recorded by species, by number of individuals per species, by weight of the species sampled and by price per kilo.

- Fishing effort will be recorded for all fishing days for all vessels.

- The increase in number of sites has led to an increase in the number of samplers from 13 to 18.

Côte d'Ivoire

The landings are made from 5 p.m. to 10 p.m. by two or three boats. The fish are sold in pools (groups of species). Each commercial group is labelled by the dominant species. For example, in the commercial group "Fried fish" the most dominant species is *B. auritus*, in the group "Threadfin" the most dominant species is *G. decadactylus*. Each group of commercial fish is sold in three categories: "small", "medium" and "large". Very high quality fish are not landed, but reserved for supermarkets or restaurants. A part of the catch is given to the crew (one bag per person). All the landings sold on the wharf are reported and managed by the office of fishery. From 1968 to 1996, the "Centre de recherches océanologiques" of Côte d'Ivoire collected the daily reports of fishery activities. In addition, it collected samples of main fish sizes and weights of boxes.

Ghana

Data in the artisanal fisheries is collected primarily through catch assessment surveys involving a census of all canoes operating in the country which are taken periodically (canoe frame surveys). Banerji (1974), CECAF (1984) and Koranteng and Nmashie (1988) give the methodology for this survey.

Within each coastal region of Ghana a number of fishing villages are selected on the basis of the number of fishing units (canoes) present. This comprises the primary sampling unit (PSU). The secondary sampling unit (SSU) involves record taking every month on the sampling days selected for each target gear. These data are recorded on Forms 1A. For the tertiary sampling unit (TSU), catch and effort of landings from selected canoes are recorded. Selection of canoes for observation is based on the numbers (of canoes) that actually operate at the Centre on the sampling days. Technical assistants are provided with charts which guides them in the selection of canoes to be examined. For every canoe selected, the enumerator records on Form 1B:

- duration of fishing trip
- the number of crew
- the quantity(weight) and value of each species in the catch.

The processing of catch and effort data is done for every sampling centre in the region and estimates by gear in the region are combined to obtain the national estimate. At the sampling site, the estimated catch by any sampled gear for the month is given by:

$$C=(D/d)*X$$

where:

D = the number of fishing days in the month
d = the number of days on which samples were obtained
X = the estimated total catch at the centre for the d days

Raising factors are employed by combining regional estimates to give national estimates based on frame survey results. The catch values and fishing effort are similarly processed (IDAF Technical Report No. 49).

Processing of data is done with the aid of microcomputers using spreadsheets. This system of processing has been in use since 1972. A new method of processing the canoe catch data was initiated in the year 2000. This methodology, Approaches, Rules and Techniques for Fisheries Statistical Monitoring, codenamed "Artfish" complements the previous programme.

Like the artisanal, inshore data are collected by field enumerators at the landing centres from which the vessels operate. All the vessels are sampled every fishing day. However during peak seasons when large numbers of vessels operate, a sample of vessels are examined and raising factors are applied to arrive at final estimates on a monthly basis.

Appendixes B1 and B2 show forms used for recording monthly activities and catch and effort respectively.

On these forms estimates of catch, value and fishing effort are available by:

- vessel category
- fishing gear type
- month
- landing centre and region

Companies operating industrial vessels send catch and effort data on fishing activities and landings for onward processing by the Fisheries Directorate. Estimates of landings are obtained by computing monthly landings of all companies and summing them to produce estimates for the entire fleet.

Togo

In Togo coastal areas, there are 22 sites which are stratified in two major strata and three minor strata.

Among the three minor strata, harbour is considered as a site and minor stratum at the same time. Except harbor data are collected in three sites minimum of each minor stratum.

A minimum of 30 samples on the catches per month are collected at each site.

Before 1998, data on the artisanal fisheries were collected by a system which stratified the coast into two strata: Harbour and out harbour. Most data are collected by canoe, gear, species and fishing effort. All the data collected are summed and manually extrapolated monthly and annually.

Data for the industrial fishery are obtained by registering all landings from the boats.

7.2.2 Biological parameters

Benin

Length frequencies were recorded in a fragmentary way in 1997 for certain species such as: croaker, ribbon fish, treadfins, spadefish, bigeye grunt. Fork lengths were measured. Other biological data are not collected in Benin.

Ghana

From selected stations, biological samples are taken for species composition and length frequency (only for *Pagellus bellottii*).

In Ghana the sex ratio, maturity and stomach contents for analysis are obtained from the commercial vessels.

7.3 Bigeye grunt (*Brachydeuterus auritus*)

7.3.1 Biological characteristics

The species occur between 10 and 100 m deep but most commonly between 30 and 80 m. The species is semi-pelagic but caught mainly by artisanal and industrial bottom trawlers except in Côte d'Ivoire where they are caught in good quantities by the pelagic industrial trawlers.

7.3.2 Stock identity

The Working Group adopted one single stock for this subregion.

7.3.3 Patterns in data

Catch

Total catch of *Brachydeuterus auritus* has fluctuated significantly from year to year. The overall trend is that of a slight decrease in landings. Ghanaian landings dominate in the region (Table and Figure 7.3.3a).

Fishing effort

This stock is caught by the multispecies demersal fleets of the country. The series of efforts of both the industrial and artisanal fleets follow roughly the same trend in the region. The Ghanaian fleets dominate the effort in the region. The overall trend is a steady increase from 1990 to 1999, followed by a decrease in 2000. From 2000 to 2002, industrial effort increased very significantly, mostly due to the increase in effort in Côte d'Ivoire. Artisanal effort increased slightly from 2000 to 2001, and then stabilised (Table and Figure 7.3.3b).

Abundance indices

CPUE

CPUE has also varied appreciably from year to year. The overall trend is of a continuous decrease in CPUE from 1990 to 2002 (Table and Figure 7.3.3c)

Research surveys

Research survey data for this species were not presented to the Working Group.

7.3.4 Assessment

Methods

The logistic surplus production model was used to evaluate the status of the stocks and the demersal fisheries in the region by the Working Group. The model is described in detail in Section 1.4.

Input data

For the catch data series, the Working Group used the series of total catch estimated during the meeting. For abundance index, the series of Ghanaian industrial CPUE was used. The Working Group considered that this series best reflected the trends in abundance of the stock (Table 7.3.3a).

Results

The model gives a reasonable fit to the data (Figure 7.3.4a), even though some points are clearly over-estimated. The results indicate that the stock is heavily overexploited. Current biomass is appreciably below that producing maximum sustainable yield, and fishing mortality is higher than the one needed to extract the whole natural production of the stock (Table 7.3.4a).

Table 7.3.4: Indicators on the state of the stock and fishery – *Brachydeuterus auritus*

Country/Abundance index used	B/B_{MSY}	F_{cur}/F_{SYcurB}
Benin, Togo, Ghana and Côte d'Ivoire/Ghanaian industrial fleet	29%	147%

Discussion

The model provides a reasonable fit to this set of data. The results indicate that the *Brachydeuterus auritus* stock in the region is heavily overexploited, and these results are in accordance with the history of the fisheries. Therefore, the stock is considered to be overexploited in terms of both biomass and fishing mortality.

7.3.5 Management recommendations

Given the results obtained in the assessment and the trends in CPUE the Working Group recommends a marked reduction in fishing effort directed at these species. Special attention must be given to the bycatch of these species in non-directed fisheries.

7.4 Threadfin (*Galeiodes decadactylus*)

7.4.1 Biological characteristics

This species occurs mostly in sandy and muddy bottoms up to 50 m deep and is commonly found in coastal waters. Thus, the species is easily accessible to the artisanal fleet. It is also a major bycatch component in shallow-water shrimp trawling.

7.4.2 Stock identity

The Working Group adopted one single stock for the whole region.

7.4.3 Patterns in data

Catch

Landings of *Galeoides decadactylus* were approximately stable at around 2 500 tonnes throughout the period investigated. A period of decreased landings is observed between 1997 and 1999. In subsequent years, landings recovered to previous levels. From the industrial fishery the highest catches are from the Côte d'Ivoire fleet. The Ghanaian artisanal fleet dominates the fishery in this zone (Table and Figure 7.4.3a).

Fishing effort

This stock is targeted by the multispecies demersal fleets of the countries. The trends in effort of these fleets were described in Section 7.3.3.

Abundance indices

CPUE

CPUE in artisanal fleets was approximately stable during most of the period. The exception is the CPUE from Togo, where an extraordinary increase is observed in 1999. This increase is probably due to the sampling procedure (Table and Figure 7.4.3c).

Research surveys

Research survey data for this species were not presented to the Working Group.

7.4.4 Assessment

Methods

The logistic surplus production model was used to evaluate the status of the stocks and the demersal fisheries in the region by the Working Group. The model is described in detail in Section 1.4.

Input data

For the catch data series for *Galeoides decadactylus*, the Working Group used the series of total catch estimated during the meeting. For abundance index, the series of Ghanaian industrial CPUE was used. The Working Group considered that this series best reflected the trends in abundance of the stock (Table 7.3.3a).

Results

The model gives a reasonable fit to the data (Figure 7.4.4), even though it does not manage to reflect the whole dynamic of the CPUE. The results indicate that the stock is overexploited. Current biomass is appreciably below that producing maximum sustainable yield, and fishing mortality is higher than the one needed to extract the whole natural production of the stock (Table 7.4.4).

Table 7.4.4: Indicators on the state of the stock and fishery – *Galeoides decadactylus*

Country/Abundance index used	B/B_{MSY}	F_{cur}/F_{SYcurB}
Benin, Togo, Ghana and Côte d'Ivoire/Ghanaian industrial fleet	56%	111%

Discussion

The model provides a reasonable fit to this set of data, capturing the main trends, if not the details of the changes in CPUE (Figure 7.4.4).

The results indicate that the *Galeoides decadactylus* stock in the region is heavily overexploited, and these results are in accordance with the history of the fisheries. Therefore, the stock is considered to be overexploited in terms of both biomass and fishing mortality.

7.4.5 Management recommendations

Given the results obtained in the assessment and the trends in CPUE, the Working Group recommends that current fishing levels should be maintained or, if possible reduced. Special attention must be given to the bycatch of these species in non-directed fisheries.

7.5 Seabreams (*Dentex* spp.)

7.5.1 Biological characteristics

The *Dentex* spp. group defined by the Working Group consisted of *Dentex canariensis, D. gibbosus, D. angolensis, D. congoensis* and *Pagrus caeruleostictus*. *P. caeruleostictus* and

D. canariensis are not separated in the catch, neither are *D. angolensis* and *D. congoensis*. Thus, the Working Group considered this group of species as one single stock for assessment purposes. These species are distributed over a wide range of depths (10 to 250 m) and on hard and soft bottoms.

7.5.2 Stock identity

The Working Group adopted one single stock for the whole region.

7.5.3 Patterns in data

Catch

Landings of the *Dentex* species group have fluctuated over the years. The amplitude of fluctuations has increased since 1996. The highest level was observed in 1999 and the lowest in 2000. As in most other stocks in the region the landings from Ghana make up most of the total landings (Table and Figure 7.5.3a).

Fishing effort

This stock is targeted by the multispecies demersal fleets of the countries. The trends in effort of these fleets were described in Section 7.3.3.

Abundance indices

CPUE

The CPUE series of the industrial fleets show contradictory trends over time. It is not possible to determine a clear pattern in this set of CPUE series. However, the Ghanaian series, which corresponds to most of the landings, suffered a marked decrease in 1998 followed by a recovery, although not to previous levels, in 2000, and has kept stable since then (Table and Figure 7.5.3c).

Research surveys

Research survey data for this species were not presented to the Working Group.

7.5.4 Assessment

Methods

The logistic surplus production model was used to evaluate the status of the stocks and the demersal fisheries in the region by the Working Group. The model is described in detail in Section 1.4.

Input data

For the catch data series for *Dentex* spp., the Working Group used the series of total catch estimated during the meeting. For abundance index, the series of Ghanaian industrial CPUE

was used. The Working Group considered that this series best reflected the trends in abundance of the stock (Table 7.5.3).

Results

The model gives a good fit to the data (Figure 7.5.4). The results indicate that the stock is heavily overexploited. Current biomass is appreciably below that producing maximum sustainable yield, and fishing mortality is several times higher than the one needed to extract the whole natural production of the stock (Table 7.5.4).

Table 7.5.4: Indicators on the state of the stock and fishery – *Dentex* spp.

Country/Abundance index	B/B_{MSY}	F_{cur}/F_{SYcurB}
Benin, Togo, Ghana and Côte d'Ivoire/Ghanaian industrial fleet	35%	274%

Discussion

The model fits the data for the stocks appreciably well. The results indicate that the *Dentex* spp. stock in the region is heavily overexploited, and these results are in accordance with the history of the fisheries. In fact, the species is on the one hand heavily targeted, and on the other, a major bycatch of the shrimp trawler fishery. Therefore, the stock is considered to be heavily overexploited.

7.5.5 Management recommendations

Given the results obtained in the assessment and the trends in CPUE the Working Group recommends a marked reduction in fishing effort directed at these species. Special attention must be given to the bycatch of these species in the shrimp trawler fishery.

7.6 Red pandora (*Pagellus bellottii*)

7.6.1 Biological characteristics

This species inhabits the same depth range and bottom as *Dentex* spp. and it is usually caught together with the latter species group.

7.6.2 Stock identity

The Working Group adopted one single stock for the whole region.

7.6.3 Patterns in data

Catch

The landings have shown remarkable fluctuations throughout the time series. A period of increasing landings from 1995 to 1999 was followed by a sharp decrease in 2000. Landings have kept stable since, but with fluctuations (Table and Figure 7.6.3a).

Fishing effort

This stock is targeted by the multispecies demersal fleets of the countries. The trends in effort of these fleets were described in Section 7.3.3.

Abundance indices

CPUE

The trends in the different fleets are somewhat different. However the overall trend is that of a decrease in CPUEs throughout the series or at least in the most recent years (Table and Figure 7.6.3c).

Research surveys

Research survey data for this species were not presented to the Working Group.

7.6.4 Assessment

Methods

The logistic surplus production model was used to evaluate the status of the stocks and the demersal fisheries in the region by the Working Group. The model is described in detail in Section 1.4.

Input data

For the catch data series for *Pagellus bellottii*, the Working Group used the series of total catch estimated during the meeting. For abundance index, the series of Ghanaian industrial CPUE was used. The Working Group considered that this series best reflected the trends in abundance of the stock (Table 7.6.3).

Results

The model gives a good fit to the data (Figure 7.6.4). The results indicate that the stock of *Pagellus bellottii* is heavily overexploited. Current biomass is appreciably below that producing maximum sustainable yield, and fishing mortality is higher than the one needed to extract the whole natural production of the stock (Table 7.6.4).

Table 7.6.4: Indicators on the state of the stock and fishery – *Pagellus bellottii*

Country/Abundance index used	B/B_{MSY}	F_{cur}/F_{SYcurB}
Benin, Togo, Ghana and Côte d'Ivoire/Ghanaian industrial fleet	20%	161%

Discussion

The model fits the data for the stocks appreciably well. The results indicate that the *Pagellus bellottii* stock in the region is heavily overexploited, and these results are in accordance with the history of the fisheries. In fact, the species is on the one hand heavily targeted, and on the

other, a major bycatch of the shrimp trawler fishery. Therefore, the stock is considered to be heavily overexploited.

7.6.5 Management recommendations

Given the results obtained in the assessment and the trends in CPUE the Working Group recommends a marked reduction in fishing effort directed at these species. Special attention must be given to the bycatch of these species in the shrimp trawler fishery.

7.7 Croaker (*Pseudotolithus* spp.)

7.7.1 Biological characteristics

Three species of *Pseudolithus* occur in area. These are *P. senegalensis*, *P. typus* and *P. elongatus*. They are not separated in catch and therefore considered as a single stock. The distribution and habitat of these species is similar to that of *G. decadactylus*.

These three species are mostly coastal species occurring in muddy and sandy bottoms.

7.7.2 Stock identity

The Working Group adopted one single stock for the whole subregion.

7.7.3 Patterns in data

Catch

As with other species, landings have shown appreciable fluctuations. A period of increasing catches was observed from 1993 to 1997, followed by a sharp decrease until 2000, and a recovery since then (Table and Figure 7.7.3a).

Fishing effort

This stock is targeted by the multispecies demersal fleets of the countries. The trends in effort of these fleets were described in Section 7.3.3.

Abundance indices

CPUE

CPUE has shown a mostly decreasing trend for most of the period (Table and Figure 7.7.3c).

Research surveys

Research survey data for this species were not presented to the Working Group.

7.7.4 Assessment

Methods

The logistic surplus production model was used to evaluate the status of the stocks and the demersal fisheries in the region by the Working Group. The model is described in detail in Section 1.4.

Input data

For the catch data series for *Pseudotolithus* spp., the Working Group used the series of total catch estimated during the meeting. For abundance index, the CPUE series of the industrial fleet in Côte d'Ivoire was used. The Working Group considered that this series best reflected the trends in abundance of the stock (Table 7.7.3c).

Results

The model provides a good fit to the data (Figure 7.7.4). The results indicate that the stock of *Pseudotolithus* spp. is heavily overexploited. Current biomass is appreciably below that producing maximum sustainable yield, and fishing mortality is several times higher than the one needed to extract the whole natural production of the stock (Table 7.7.4).

Table 7.7.4: Indicators on the state of the stock and fishery – *Pseudotolithus* spp.

Country/Abundance index used	B/B_{MSY}	F_{cur}/F_{SYcurB}
Benin, Togo, Ghana and Côte d'Ivoire/Ghanaian industrial fleet	10%	542%

Discussion

The model fits the data for the stocks appreciably well. The results indicate that the *Pseudotolithus* spp. stock in the region is heavily overexploited, and these results are in accordance with the history of the fisheries. In fact, the species are heavily targeted by all fleets, being highly prized both locally and for export. Therefore, the stock is considered to be heavily overexploited.

7.7.5 Management recommendations

Given the results obtained in the assessment and the trends in CPUE the Working Group recommends a marked reduction in fishing effort directed at this species.

7.8 Overall management recommendations

The fisheries assessed by this Working Group are quite heterogeneous, but are part of a multispecies finfish fishery targeting highly valued species. Many of them are also a bycatch of other intensive fishery, like the shrimp trawler fishery. The results for the stocks on which better data is available indicate that most are fully or overexploited. Therefore, a general reduction of the effort deployed in this fishery should be attempted. Special attention should be given to the problem of bycatch. Better catch statistics are an indispensable requirement for improving the management of the stocks.

7.9 Future research

The work carried out revealed important gaps in the current knowledge about the stocks in these areas. In order to address these, the Working Group recommends that the following research lines be pursued:

- Effort should be made to obtain the specific catches of the main species.
- Better systems for the collection of catch and effort statistics should be put in place in all countries.
- In order to improve the quality of the assessment, it is necessary to intensify the collection of the biological data (through landings on board commercial vessels and surveys giving priority to the main species so as to obtain a complete catalogue of the basic biological parameters.
- Research effort should be directed towards size and species composition studies, including bycatch analysis in shrimp trawlers.

8. DEMERSAL SOUTH 3 SUBGROUP

Angola and Cameroon

8.1 Fisheries

The fisheries in the two countries in this subgroup are organized quite differently from each other. Therefore, they are described separately.

Cameroon

In Cameroon, demersal species are caught by both the artisanal (bottom gill nets and line) and industrial demersal trawlers on the shelf area (15 400 km^2), with an approximate 80 percent of commercial catch coming from the industrial fisheries. The catches are landed in Douala port. The main national fishing companies operating within Cameroon's 20 nautical miles are PECAM, COPEMAR, COTONNEC and CHALUTCAM.

This is mostly a multispecies fishery, in which all the high-value demersal species are targeted. Many of these species are also important bycatch in the shrimp fishery.

Angola

In Angola, demersal fish are mainly caught by the demersal industrial trawlers (70 percent) between 20 and 100 m of depth, and by the artisanal fishery (30 percent), using gill nets and line. The industrial catches are landed frozen in Luanda, and the artisanal catch, represented mainly by the big specimens, are sold fresh or dried.

For some species, mainly *Dentex*, an important part can be caught by the shrimp trawler fleet.

8.2 Sampling intensity

8.2.1 Catch and effort

The catches fromthe countries are from the industrial demersal trawlers, registered from 1990 to 2001 for Cameroon, and 1995 to 2001 for Angola. No numbers of sampling were presented to the Working Group.

8.2.2 Biological parameters

The sampling data for length composition and other biological characteristics from the industrial and artisanal fisheries of Cameroon were presented to the Working Group.

8.3 Croaker (*Pseudotolithus* spp.)

8.3.1 Biological characteristics

The sciaenid group of demersal fish of the genus *Pseudotolithus* is mainly represented in the catches of Angola and Cameroon by three species: *P. typus*, *P. senegalensis* and *P. brachygnathus.* *P. typus* is dominant in the landings in the countries.

These three species are mostly coastal species occurring on muddy and sandy bottoms.

8.3.2 Stock identity

The Working Group adopted one separate stock for each country.

8.3.3 Patterns in data

Catch

Landings from this group of species were generally stable between 1995 and 2001 (Table and Figure 8.3.3a). Reported landings are much higher in Cameroon than in Angola.

Fishing effort

Effort has shown different trends in the different fisheries of the two countries. Effort in the demersal fish finfish trawler fleets of Cameroon has been stable and even decreasing. Effort from the finfish trawler fleet in Angola and the shrimp trawlers in Cameroon, on the other hand, has shown a marked increasing trend (Table and Figure 8.3.3b).

Abundance indices

CPUE

The trends in CPUE are quite different in the two countries. In Angola, CPUE has for the most part been stable with a slight decrease in trend, while in Cameroon an increasing trend is seen except for the years after 2000 (Table and Figure 8.3.3c).

Research surveys

Research survey data for this species were not presented to the Working Group.

8.3.4 Assessment

Methods

The logistic surplus production model was used to evaluate the status of the stocks and the demersal fisheries in the region by the Working Group. The model is described in detail in Section 1.4.

Input data

The Working Group used the catches of *Pseudotolithus* spp. for each country as shown in Table 8.3.3a. For Angola the data from the period 1995–2001 were used and for Cameroon 1990–2001.

The abundance indices used were the CPUE series from the demersal finfish trawlers in each of the two countries (Table 8.3.3c).

Results

The model provided a reasonable fit to the data fromthe countries (Figures 8.3.4a and 8.3.4b).

Cameroon

The fit for the Cameroon data suggests that stock biomass is well above the one producing maximum sustainable yield, and current fishing mortality is still below the one needed to extract the whole natural production of the stock (Table 8.3.4a). The stock is thus not fully exploited.

Table 8.3.4a: Indicators on the state of the stock and fishery of *Pseudotolithus* spp. in Cameroon

Country/Abundance index used	B/B_{MSY}	F_{cur}/F_{SYcurB}
Cameroon/industrial trawlers	169%	50%

Angola

The model provides an acceptable fit to the data. The results (Table 8.3.4b) indicate that the stock of *Pseudotolithus* spp. in Angola is overexploited, both in terms of biomass, current biomass is below the biomass producing the maximum sustainable yield, and in terms of fishing mortality.

Table 8.3.4b: Indicators on the state of the stock and fishery of *Pseudotolithus* spp. in Angola

Country/Abundance index used	B/B_{MSY}	F_{cur}/F_{SYcurB}
Angola/industrial trawlers	21%	179%

The stock can thus be considered overexploited.

Discussion

The model provides a reasonable fit to this set of data. The overall results are quite different for the two countries. For Cameroon, the indication is that the stock is not fully exploited. For Angola, on the other hand, the model suggests an overexploited stock.

However, given the uncertainty about the suitability of the abundance indices used, these results should be taken carefully.

8.3.5 Management recommendations

In view of the fact that the fishery is multigear and multispecies, and given the observed trends in effort and CPUE, the Working Group decided to adopt a precautionary approach and recommend that effort should not be increased above that of 2002. Further and more detailed investigations into these stocks are urgently needed.

8.4 Threadfin (*Galeiodes decadactylus*)

8.4.1 Biological characteristics

This species occurs mostly in sandy and muddy bottoms to 50 m deep. It is exploited in both the artisanal and industrial fisheries and is a major bycatch component of shallow-water shrimp trawlers.

Galeoides decadactylus is one of the most important demersal species off Cameroon. Its catches represent approximately 20 percent of the demersal landings. In Angola, this species is also targeted by the commercial trawlers, but the catch information is not well documented, due to the low market value.

8.4.2 Stock identity

The Working Group decided to adopt two different stocks of *Galeoides decadactylus* one for each country.

8.4.3 Patterns in data

Catch

In Cameroon, catches were reduced to almost zero in 1998 but have since recovered appreciably. In Angola, catches more than doubled from 1997 to 1999, but have stayed stable since.

Fishing effort

This stock is targeted by the multispecies demersal fleets of the countries. The trends in effort of these fleets were described in Section 8.3.

Abundance indices

CPUE

CPUEs in Cameroon fell in 1998, but have recovered since. In Angola, CPUE has shown an increasing trend but with marked fluctuations.

Research surveys

Research survey data for this species were not presented to the Working Group.

8.4.4 Assessment

Methods

The logistic surplus production model was used to evaluate the status of the stocks and the demersal fisheries in the region by the Working Group. The model is described in detail in Section 1.4.

Input data

The Working Group used the catches of *Galeoides decadactylus* for each country given in Table 8.4.3a. For Angola the period 1995–2001 was considered and for Cameroon from 1990 to 2001.

The abundance indices used were the CPUE series from the demersal finfish trawlers in the two countries (Table 8.4.3c).

Results

The model provided a reasonably good fit to the data from Cameroon (Figure 8.4.4a), but not for Angola. Therefore, no assessment was attempted for the Angolan data.

Cameroon

The estimated parameters indicate that current biomass is significantly below the biomass producing maximum sustainable yield (Table 8.4.4a). Current fishing mortality is however, below what could be sustained at current biomass levels.

Table 8.4.4: Indicators on the state of the stock and fishery of *Galeoides decadactylus* in Cameroon

Country/Abundance index used	B/B_{MSY}	F_{cur}/F_{SYcurB}
Cameroon/industrial trawlers	44%	66%

Discussion

The results of the modelling indicate that stock biomass is strongly reduced, but that fishing mortality is below the one needed to extract the whole natural production of the stock. Therefore, the stock can be considered to have been overexploited, but in a trend of recovery. However, given the uncertainties about the CPUEs used and even the total catch, care should be exercised in the management of these stocks.

8.4.5 Management recommendations

No management recommendations are given for the Angolan stock. As for the Cameroon stock, results lead the Group to recommend that fishing effort should not be increased. The situation should be reviewed once more when better data are available.

8.5 Sole fish (*Cynoglossus* spp.)

8.5.1 Biological characteristics

The *Cynoglossus* genus is represented in the catches of Angola and Cameroon by three species: *C. cuneata, C. monsodi* the dominant, and *C. senegalensis*, registered as one species in the commercial landings.

In the countries, they are commercially caught by the demersal industrial trawlers. They are not target species in either of the countries, but are caught as bycatch with the target species, mostly *Pseudotolithus* spp. in Cameroon, and *Dentex* spp. in Angola.

8.5.2 Stock identity

As in the case of other stocks, the Working Group assumed a separate stock for each country.

8.5.3 Patterns in data

Catch

Landings of this group of species have fluctuated with a peak in 1997 in Angola and the total of the two countries following the Angolan trend (Figure 8.5.3a)

Fishing effort

This stock is targeted by the multispecies demersal fleets of the countries. The trends in effort of these fleets were described in Section 8.3.3.

CPUE

CPUEs show fluctuations with a decreasing trend.

Research surveys

Research survey data for this species were not presented to the Working Group.

8.5.4 Assessment

Methods

The logistic surplus production model was used to evaluate the status of the stocks and the demersal fisheries in the region by the Working Group. The model is described in detail in Section 1.4.

Input data

The Working Group used the catches of *Cynoglossus* spp. for each country given in Table 8.5.3a. For Angola the period 1995–2001 was considered and for Cameroon from 1990 to 2001.

The abundance indices used were the CPUE series from the demersal finfish trawlers in the two countries (Table 8.5.3c).

Results

Cameroon

The fit of the model to the data is unsatisfactory. No assessment can be carried out with this data.

Angola

The model gives a reasonably good fit to the data (Figure 8.5.4). The results indicate that the stock is heavily overexploited. Current biomass is appreciably below that producing maximum sustainable yield, and fishing mortality is higher than the one needed to extract the whole natural production of the stock (Table 8.5.4a).

Table 8.5.4: Indicators on the state of the stock and fishery of *Cynoglossus* spp. in Angola

Country/Abundance index used	B/B_{MSY}	F_{cur}/F_{SYcurB}
Angola/industrial trawlers	19%	120%

Discussion

The data available to fit the model is clearly insufficient. This is most evident in the case of Cameroon, but no assurance can be given for Angola. Overall, the results from fitting the model to the data from Angola indicate a heavily overexploited stock, where stock biomass is strongly reduced and fishing mortality continues to be above the one necessary to extract the whole natural production of the stock. Unless a strong reduction in fishing mortality is achieved, it is expected that this stock might be very much reduced in abundance.

8.5.5 Management recommendations

No management recommendations can be given for the Cameroon stock. For the Angolan stock however, the Working Group recommends that fishing mortality should be strongly reduced.

8.6 Seabreams (*Dentex* spp.)

8.6.1 Biological characteristics

The *Dentex* genus is the most important of the demersal resources in the Angolan catches, mainly represented by *D. macrophthalmus, D. angolensis, D. banardi* and *D. congoensis*. *D. macrophthalmus* is the dominant species in the landings, and some of the other dentex (mainly *Dentex angolensis*) are registered as *D. macrophthalmus.*

Dentex species are most abundant in deeper waters, between 100–200 m.

The genus is commercially caught by the demersal industrial trawlers (60 percent), by the artisanal fishery using gill nets and line gear, and as bycatch in the pelagic trawls and shrimp trawlers.

8.6.2 Stock identity

Dentex species are not important in Cameroon. Therefore, the Working Group considered only the Angolan stock

8.6.3 Patterns in data

Catch

Landings of *Dentex* in Angola show a continued increase for the whole data series from 1995 to 2001.

Fishing effort

This stock is targeted by the multispecies demersal fleets of the countries. The trends in effort of these fleets were described in Section 8.3.3.

Abundance indices

CPUE

CPUE shows a very large increase from 1996 to 1999, but a decrease in the two years after that.

Research surveys

Research survey data for this species were not presented to the Working Group.

8.6.4 Assessment

Methods

The logistic surplus production model was used to evaluate the status of the stocks and the demersal fisheries in the region by the Working Group. The model is described in detail in Section 1.4.

Input data

The Working Group used the catches of *Dentex* spp. for Angola from 1995 to 2001 (Table 8.5.3a).

Results

The model gives a good fit to the data (Figure 8.8.4a). The results indicate that the stock is heavily overexploited. Current biomass is appreciably below that producing maximum sustainable yield, and fishing mortality is higher than the one needed to extract the whole natural production of the stock (Table 8.6.4a).

Table 8.6.4: Indicators of the state of stock and fishery of *Dentex* spp. in Angola

Country/Abundance index used	B/B_{MSY}	F_{cur}/F_{SYcurB}
Angola/industrial trawlers	31%	160%

Discussion

The model fits the data for the stocks appreciably well. The results indicate that the *Dentex* stock in Angola is heavily overexploited, and these results are in accordance with the history of the fisheries as the species is both heavily targeted, and also a major bycatch of the shrimp trawlers fishery. Therefore, the stock is considered to be heavily overexploited.

8.6.5 Management recommendations

Given the results obtained in the assessment and the trends in CPUE the Working Group recommends a marked reduction in fishing effort directed at these species. Special attention must be given to the bycatch of these species in the shrimp trawler fishery.

8.7 Overall management recommendations

The fisheries assessed by this Working Group are quite heterogeneous, but are part of a multispecies finfish fishery targeting highly valued species. Many are also bycatch in other intensive fishery, like the shrimp trawler fishery. The results for the stocks on which better data are available indicate that most are fully or overexploited. Therefore, a general reduction of the effort deployed in this fishery should be attempted. Special attention should be given to the problem of bycatch.

8.8 Future research

The work carried out revealed important gaps in current knowledge about the stocks in these areas. In order to address these, the Working Group recommends that the following lines of research be pursued:

- Obtain the specific catches of the main species.

- In order to improve on the quality of the assessment, it is necessary to intensify the collection of the biological data (through commercial landing surveys) and catch data from the commercial trawlers and artisanal fisheries.

- Recommence the collection of biological data by sampling on board the demersal industrial fisheries vessels, giving priority to the main species, so as to obtain a complete catalogue of the basic biological parameters.

- Intensify the scientific trawl surveys by paying particular attention to the spatio-temporal distribution, to reproduction and to the recruitment of the main demersal species.

- Intensify sampling for length frequencies and size and species composition in all the main fisheries.

- Research effort should be directed towards size and species composition studies and bycatch analysis in shrimp trawlers.

9. SHRIMP SOUTH SUBGROUP

Guinea, Sierra Leone, Ghana and Cameroon

9.1 Fisheries

The fisheries in the different countries of this subgroup are organized quite differently from each other. Therefore, they are described separately. Due to the lack of data on the deepwater rose shrimp (*Parapenaeus longirostris*) in the southern zone, the assessments were only made on the Southern pink shrimp (*Penaeus notialis*) in Guinea, Sierra Leone, Ghana and Cameroon.

Guinea

The main shrimp species exploited by the commercial fishery in Guinean waters are *Penaeus notialis*, *Parapenaeopsis atlantica* and *Parapenaeus longirostris*. The first two species are coastal shrimp and found in depths of up to 40 m while the last species is found in the open sea on bottoms at depths greater than 400 m.

These shrimp are caught entirely by the demersal industrial trawlers, including not only the shrimpers which target them, but also the demersal and cephalopod vessels which take them as bycatch.

The shrimpers are entirely composed of freezer trawlers, the number of which increased from 6 to 43 between the years of 1995 and 2001. This fleet is made up of vessels whose gross tonnage is generally not in excess of 500 tonnes. In 2001, the authorised shrimpers came from the following countries : Belize (4 vessels), South Korea (5 vessels), Spain (3 vessels), Guinea (21 vessels), Greece (1 vessel), Portugal (1 vessel) and Sierra Leone (8 vessels).

Sierra Leone

Over the last 20 years the industrial fishing fleet has consisted mainly of demersal trawlers, shrimpers, canoe support vessels and purse seiners.

Currently, the industrial fishery is dominated by shrimp trawlers and demersal finfish trawlers. The principal target species in shrimp trawl fishery is the tropical pink shrimp (*Penaeus notialis*), which is the most abundant species and occurs off Freetown Peninsular, especially around Banana Island. The shrimp trawlers take huge amounts of bycatches of coastal inshore species, which constitutes 75 percent of the total catch, with an estimated 25 percent annual discard rate.

Ghana

The *Penaeus notialis* resources in Ghanaian waters are exploited by the industrial shrimpers. These vessels started operating in 1986 in Ghanaian waters and target the species for export. They are restricted by the Fisheries Law to operate between $1^{o}45'$ W to $2^{o}30'$ W and $0^{o}15'$ E to $1^{o}12'$ E and in waters greater than 30 m in depth. They operate throughout the year with the highest catches between July and September. In the last five years the number of operating vessels has decreased from 17 in 1996 to 6 in 2001. This decrease is due to low catch rates.

Cameroon

There are about 25 000 shrimp nets (SN) with mesh sizes ranging between 20 and 60mm in the artisanal fisheries sector. The main landing sites are found in the creeks with very low accessibility.

Trawlers used for catching shrimps are 50–100 GRT powered with 430–440 hp engines, 22 m long with stretched mesh sizes of 36–41 mm and others with 142–177 GRT with an average trawling speed of 3.8–4 knots of duration ranging between 3 and 4 hours. The fishing grounds are based around the estuaries at depths of between 6 and 25 m. The main fishing companies operating within Cameroon’s 20 nautical miles are all national.

9.2 Sampling intensity

9.2.1 Catch and effort

No information.

9.2.2 Biological parameters

No information.

9.3 Southern pink shrimp (*Penaeus notialis*)

9.3.1 Biological characteristics

Penaeus notialis is a shallow-water shrimp species usually associated with estuaries.

9.3.2 Stock identity

The Working Group adopted one separate stock of *Penaeus notialis* for each country.

9.3.3 Patterns in data

Catch

Catch data are available for Guinea (1995–2001), Sierra Leone (1980–2001), Côte d'Ivoire (1980–1988, 1998–2000), Ghana (1990–2001), Benin (1997–2001), Nigeria (1992–2000) and Cameroon (1992–2001).

Figure 9.4.3a shows the evolution of total catch and that of the available national catches. The most important catches are in Nigeria, Sierra Leone and Ghana. The poor catches in Benin and complete lack of catches in Togo should be noted. The trend in total catch increases from 1991 to 1999 when it begins to decrease.

Fishing effort

Effort data expressed in fishing days considered by the Working Group are for shrimpers. These data cover Guinea (1995–2001), Sierra Leone (1991–2002), Ghana, for the tangon fishery (1993–2000) and Cameroon (1990–2001).

Figure 9.4.3b shows the evolution of these efforts. The effort of Sierra Leone shows an increase till 1999, after which it begins to decrease. It appears that this continual decrease is due to the fishing activity being transferred outside the zone.

The effort of the shrimpers in Guinea is only available between 1995 and 2001 and shows marked fluctuations. This effort tends to increase until 2000 (with the exception of 1998) and then shows a slight decrease in 2001.

In Ghana, the tangon fishing effort shows slight variations during the period under consideration, with a net decrease during the years 2000 to 2002.

From 1990 to 2000, the fishing effort in Cameroon tends to increase, while from 2000 to 2001 there is a slight decrease.

Abundance indices

CPUE

The available data allowed us to calculate the CPUEs for the fisheries of *P. notialis* developed in Guinea (shrimpers), Sierra Leona, Ghana (tangon), Nigeria (tangon) and Cameroon. Figure 9.4.3c shows the CPUE trends followed in the series of years analysed.

The initial data of Guinea are from 1995. In this year the maximum yield of the series analysed was reached (212 kg/fishing days), with the minimum coming in 2002 (82 kg/fishing days).

In the case of Sierra Leone, the CPUE trend is more stable over the whole analysed series (1991–2001), with values around 200 kg/fishing days.

The trend followed by the yields obtained by the Ghanaian tangon fisheries is similar to that of Sierra Leone, but with lower values, around 120 kg/fishing days.

Cameroon had its maximum CPUE (420 kg/fishing days) at the beginning of its series in 1990. From this year to 1992, the yield suffered a strong decrease, however the trend seems to be quite stable until the end of the series.

Research surveys

Research survey data for this species were not presented to the Working Group.

9.3.4 Assessment

Methods

The logistic surplus production model was used to evaluate the status of the stocks and the demersal fisheries in the region by the Working Group. The model is described in detail in Section 1.4.

Guinea

Input data

For the catch data series, the Working Group used the series of total catch estimated for the country from 1995 to 2002 during the meeting. For the abundance index, the CPUE series from the shrimp trawling fleet was used. The Working Group considered that this series best reflected the trends in abundance of the stock.

Results

The fit of the model to the data is reasonably good (Figure 9.3.4a). The results indicate that current biomass is below the one which produces maximum sustainable yield, and that fishing mortality is about twice what would be necessary to extract the natural production of the stock (Table 9.3.4a). According to this diagnosis the stock is thus overexploited, both in terms of biomass and fishing mortality

Table 9.3.4a: Indicators on the state of the stock and fishery of *Penaeus notialis* in Guinea

Country/Abundance index used	B/B_{MSY}	F_{cur}/F_{SYcurB}
Guinea/shrimp trawlers	74%	205%

Discussion

The model fits the data reasonably well. Trends of both estimated and observed CPUE show a decline in stock abundance. The results of an overexploited stock match the data supplied by the Guinean scientists. The group thus concluded that the diagnosis of overexploitation is relatively secure for this stock.

Sierra Leone

Input data

For the catch data series, the Working Group used the series of total catch estimated for the country from 1991 to 2002 during the meeting. For the abundance index, the CPUE series from the shrimp trawling fleet was used. The Working Group considered that this series best reflected the trends in abundance of the stock.

Results

The fit of the model to the data is reasonable (Figure 9.3.4b), but a non informative trend is detected, with apparently random fluctuations. Still, the model manages to detect and follow the main changes in CPUE, and the group therefore decided to accept the estimated parameters.

The results from the fit (Table 9.3.4b) indicate that biomass is above the one that would produce maximum sustainable yield, and that fishing mortality in the last year of data is below the one necessary to extract the whole natural production of the stock. Given the fluctuations without trend of the CPUE the Working Group concluded that the stock is fully exploited.

Table 9.3.4b: Indicators on the state of the stock and fishery of *Penaeus notialis* in Sierra Leone

Country/Abundance index used	B/B_{MSY}	F_{cur}/F_{SYcurB}
Sierra Leone/shrimp trawlers	174%	89%

Discussion

The modelling exercise leaves some uncertainty about the true model parameters, but the diagnosis of the stock status is reasonably stable. Therefore, the Group decided to accept the conclusion of a fully but not overexploited stock.

Ghana

Input data

For the catch data series, the Working Group used the series of total catch estimated for the country from 1991 to 2002 during the meeting. For the abundance index, the CPUE series from the shrimp trawling fleet was used. The Working Group considered that this series best reflected the trends in abundance of the stock.

Results

The model fits the data reasonably well (Figure 9.3.4c). Fitting indicates a reasonably stable stock, with no particular trends. The indicators from the model show that biomass is around the one producing maximum sustainable yield, and that fishing mortality is below the one necessary to extract the whole natural production of the stock (Table 9.3.4c). The Working Group thus concluded that the stock is probably not fully exploited.

Table 9.3.4c: Indicators on the state of the stock and fishery of *Penaeus notialis* in Ghana

Country/Abundance index used	B/B_{MSY}	F_{cur}/F_{SYcurB}
Ghana/shrimp trawlers	117%	20%

Discussion

The modelling provided reasonable results, which are consistent with the trends observed over time by the Ghanaian scientists. The Working Group accepted the modelling results, but, given the uncertainty over the suitability of the CPUEs and the non informative trend in abundance, decided to provisionally consider the stock as fully exploited.

Cameroon

Input data

For the catch data series, the Working Group used the series of total catch estimated for the country from 1990 to 2002 during the meeting. For the abundance index, the CPUE series from the shrimp trawling fleet was used. The Working Group considered that this series best reflected the trends in abundance of the stock.

Results

In the case of the Cameroon data, the model provided a good fit to the data (Figure 9.3.4d). The diagnosis indicators from the model show that biomass is about 1/4 of the one that would produce maximum sustainable yield, while fishing mortality is above the one necessary to extract the full natural production of the stock (Table 9.3.4d). Therefore, the Working Group concluded that the stock is overexploited in terms of both biomass and fishing mortality.

Table 9.3.4d: Indicators on the state of the stock and fishery of *Penaeus notialis* in Cameroon

Country/Abundance index used	B/B_{MSY}	F_{cur}/F_{SYcurB}
Cameroon/shrimp trawlers	26%	144%

Discussion

The model provided a good fit to the data, giving clear indications about the status of the stock. The results from this modelling match the indications from auxiliary data that showed

the stock as being heavily overexploited. The Working Group considers that, if current trends are allowed to continue, the fishery may be at risk.

9.4 Overall management recommendations

Guinea

The shallow-water shrimp stock (*Penaeus notialis*) is currently overexploited and fishing effort should be reduced.

Sierra Leone

Catches of shallow-water shrimp (*Penaeus notialis*) should be reduced to allow the stock to recover to a more satisfactory level.

Ghana

The shallow-water shrimp fishing effort (*Penaeus notialis*) should be maintained at year 2000 levels.

Cameroon

As the stock is overexploited, it is recommended that the effort directed at shallow-water shrimp (*Penaeus notialis*) be reduced.

9.5 Future research

Having examined the data provided by the countries, recommendations were made as to how to improve it.

- The Working Group noted the lack of availability of shrimp statistics for a number of countries in the Southern zone, notably Liberia, Gabon and the Congo. It was agreed that an effort should be made to index all the information available for the whole zone.

- Taking into account the difficulty in identifying the various species grouped together under the name “shrimp” in the statistics from Benin, this country is asked to carry out investigations into how the data could be further improved. The Working Group needs to have shrimp statistics available in the future for each species.

- All the countries were asked to provide as much effort data as possible for shrimp.

- Catch and effort statistics by fishing gear need to be obtained at country level.

- Sampling of the landings should be continued in order to obtain landing data by fishing gear and to extend the system to other fleets which are not as yet covered.

- Fishing effort data should be provided separately for hake and shrimp. For vessels carrying out mixed fishing, multivariable analysis is encouraged to identify which groups of vessels direct their effort at hake and which at shrimp.

10. CEPHALOPODS SOUTH

10.1 Fisheries

The cephalopod fishery is carried out in the subregion by an heterogeneous fleet fishing equally for similar species or as bycatch. Three branches are generally considered: the artisanal fishery, the national and the foreign industrial fisheries.

The different species of cephalopod caught are octopus (*Octopus vulgaris)* and cuttlefish (*Sepia officinalis, Sepia hierreda* and *Sepia bertheloti*). A third category of molluscs which belongs to the group of cephalopods is the *Loligo vulgaris*. Only data from Guinea were presented to Working Group.

In Guinea, cephalopods are targeted by the industrial and artisanal fisheries. The Spanish fleet began operating in 1986 under a fishing agreement with the European Union, which guaranteed continuous operations and regular renewal of the agreement. In 1990, the fleet operating in the zone numbered 27 vessels. The numbers progressively declined to just one in 1994 and varied between one and four until 2001. During the last years of the period under consideration, the vessles had the following characteristics: 229 GRT, 31 m long and 849 hp. A large part of these vessels also operate in the Guinea–Bissau zone.

Cuttlefish (in particular *Sepia hierredda*) are the dominant species in the Guinean cephalopod catches. This, combined with the fact that the species has a limited distribution and migration, could justify the existence of a distinct stock in the zone, which the Working Group decided to evaluate separately.

10.2 Sampling intensity

10.2.1 Catch and effort

Catch and effort data for the Spanish cephalopod fisheries in the whole region are obtained from logbooks and a network of surveys in the main landing ports (Las Palmas, Vigo, Cangas and Marín). The origin of the catches landed at Las Palmas is known only by the FAO statistics division. Those from the Guinea–Conakry zone are registered in the 34.3.3 division which also includes the fishing zones of Senegal, The Gambia and Guinea–Bissau. The statistical breakdown by country was done by applying the percentage of the annual catches of the Spanish cephalopod trawlers in each zone.

10.2.2 Biological parameters

Biological sampling is carried out in the main landing ports and on board research and commercial vessels. No biological parameters were available to the Working Group.

10.3 Cuttlefish (*Sepia* spp.)

10.3.1 Biological characteristics

No new study of biological characteristics of this species was provided to the Working Group.

10.3.2 Stock identity

The Working Group adopted one stock for *Sepia* spp.:

South Guinea stock: **(11ºN – 9ºN)**.

10.3.3 Patterns in data

Catch

The catch data presented to the Working Group are from 1995 to 2001. Cuttlefish, catches are in the order of 6 000 tonnes, 1995–2001 average of all fisheries, that is to say the industrial fishery of the Spanish and other foreign trawlers fishing in Guinean waters under licence (Figure 10.3.3).

Effort

No fishing effort is aimed at cuttlefish, but rather at cephalopods and in particular octopus.

Abundance indices

CPUE

For the Guinea stock only the Spanish trawlers have a series of CPUE varying between around 1 700 kg/day in 1996 to 328 kg/day in 2000 increasing to around 350 kg/day in 2001 (Figure 10.3.3).

Scientific surveys

No survey data was provided to the Working Group.

Biological data

Length composition and other data

New data on length composition and other biological parameters (growth, reproduction, feed, etc.) of *Sepia* spp. was not supplied to the Working Group.

10.3.4 Assessment

Methods

The logistic surplus production model was used to assess the state of the stocks and the fisheries of *Sepia* spp.. The model is described in detail in Point 1.4.

Data

Contrary to what happens in the fishing zones situated more to the North, where octopus is the most abundant species in the catches of the cephalopod fleets, cuttlefish (in particular *Sepia hierredda*) is the dominant species in the catch of the cephalopod vessels fishing in

Guinea–Conakry. This, combined with the fact that the species has a limited distribution and migration, could justify the existence of a distinct stock in the zone, which the Working Group decided to evaluate separately.

Catch data used for the stock evaluation were:

- Catches by foreign trawlers, other than the Spanish cephalopod trawlers, fishing in Guinea–Conakry between 1990–2001. This fleet is composed of Chinese and Italian cephalopod trawlers, fishing trawlers and shrimp trawlers.

- Estimates of the catches from Guinea–Conakry landed in Las Palmas by other foreign fleets operating in the region between 1990–2001.

The abundance indices used for the analyses were the CPUEs of the Spanish cephalopod trawler fleet (the only one that specifically targets cuttlefish in the zone) for which data are available for the whole period under consideration (1990–2001).

Results

The results of fitting the model to the available data were not satisfactory and the Working Group was unable to interpret the results with the high value of 1996, so the Working Group decided to remove this value (Figure 10.3.4). The results indicate that the *Sepia* stock in the region is overexploited, both in terms of biomass and fishing mortality. The results are quite clear on this, and match the general trends in the fishery observed by Guinean scientists. A marked reduction in CPUE for sepia has been observed for several years.

Table 10.3.4: The state of *Sepia* spp. and the fishery in the Guinea stock

Zone/CPUE used	B/B_{MSY}	F_{cur}/F_{SYcurB}
Guinea/CPUE Spanish trawlers	33%	206%

Discussion

The results show that the current biomass of the stock is less than that producing maximum sustainable yield, which indicates that the stock is over-exploited in terms of biomass which has been calculated at around 67 percent (B/B_{MSY} = 33 percent. The high catches for most of the years in the time series (higher than the corresponding annual production) look like they are leading the stock to a progressive diminution of its biomass, away from the B_{MSY} value. This situation is reflected in the high value of the ratio Fcu/F_{SYcurB} (206 percent).

The stocks of *Sepia* spp. in Guinea appear to be fully or overexploited in relation to their biomass.

10.3.5 Management recommendations

Taking into account the results of the assessments and the uncertainties still surrounding the results, the Working Group decided to recommend a reduction in fishing effort in the Guinea *Sepia* spp. stocks.

10.3.6 Future research

With the aim of improving basic data quality for the assessment and to reduce the uncertainty surrounding the results, the Working Group recommends giving priority to the following research :

- To prepare seasonal or monthly data for the next Working Group.
- To continue studying the cephalopod stocks.
- To find a more suitable CPUE.

11. GENERAL CONCLUSIONS

1. The Working Group analysed the quality of the basic data trends (landings, catch, effort and length distribution) collected by each country. On the basis of these analyses the Working Group concluded that the only category of methods applicable to all stocks/units were the logistic surplus production models.

2. For some stocks several data series of CPUE are available, but due to the limitations of the data it was decided not to combine the different series in any assessment. When several CPUE series were available, the model was run separately on each of them. This resulted in differing results for some stocks and consequently the Working Group decided that a more complete analysis of the data should be carried out before the next meeting. CPUE series are affected by changes in fleet fishing strategy and consequently the changes observed in the CPUEs does not necessarily reflect the variations in stock abundance. This should be considered for when analysing CPUEs.

3. Sampling intensity in some fisheries and during some of the research surveys was reviewed. A general lack of biological sampling was noted. An adequate sampling to assess the stocks of all the fisheries covered by the Working Group needs to be defined.

4. It was also decided that better data on catch and effort need to be obtained for the stock assessments.

5. The Working Group concluded that most of the demersal stocks were fully exploited and that fishing effort should be greatly reduced for some of them.

6. A summary of the assessments and management measures is given in Tables 11.1a,b and 11.2a,b.