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REPORT OF THE ACMRR/ICES WORKING PARTY ON THE FISHERY RESOURCES OF THE EASTERN CENTRAL AND SOUTHEAST ATLANTIC

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Supplement 1 to the Report of the fifth session of the

ADVISORY COMMITTEE ON MARINE RESOURCES RESEARCH

Rome, 8-13 July 1968

Report of the ACMRR/ICES Working Party on the fishery resources of the eastern Central and Southeast Atlantic

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
ROME, 1968

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PREPARATION OF THIS DOCUMENT

A first draft of this report was prepared at the time of the Working Party meeting. This was circulated after the meeting to all members of the Working Party. The present revised report was prepared by the FAO participants (J.A. Gulland - Chairman; L.P.D. Gertenbach) following comments received on the draft. A summary of the report, distributed as document No. COFI/68/Inf.10, was considered by the third session of the Committee on Fisheries (24-30 April 1968).

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CONTENTS

1. INTRODUCTION

1.1. Following discussions in the FAO Advisory Committee on Marine Resources Research, and subsequently in the FAO Committee on Fisheries and the FAO Council, and discussions between FAO and ICES, a joint ACMRR/ICES Working Group was established. This Working Group was requested to study the fishery resources of the Eastern Central Atlantic and of the Southeast Atlantic, to evaluate the state of the stocks, to advise on conservation measures required for their rational exploitation, and to advise on future research requirements, including the collection of routine statistical and biological information.

The meeting was held in the University of La Laguna, Tenerife, Canary Islands, from 29 March to 4 April 1968, following immediately on the ICES/FAO Symposium on the Living Resources of the African Continental Shelf (25 - 28 March 1968). Representatives from ICES, FAO and observers, including an observer from SCOR, took part in the discussions (see Appendix 2).

1.2. For purposes of analysis the Working Group considered separately the stocks in three regions - from the Straits of Gibraltar to Cape Blanco (20° North latitude); from Cape Blanco to the mouth of the Congo River; and from the Congo southwards (see Sections 3, 4, and 5). The Group also made a detailed study of the present available statistics and made proposals for the improved national supply to international agencies (see Section 2) and some general observations concerning the problem of mesh regulation, future research, including echo-surveys, etc. which are applicable to all areas (see Section 6).

2. STATISTICS

2.1 The Working Group was greatly hindered in its work by the lack of adequate statistical data on catch, especially regarding the species composition, and the area of capture, and on fishing effort. For some countries, especially those operating only large vessels, the required data, where not already available, can be produced through the regular statistical offices with minor modifications to the present system of recording and reporting. For other countries, especially but not exclusively the developing countries, the basic administrative and statistical machinery would not be able to produce complete statistical data without large changes. In some of these developing countries, assistance in the improvement of the fishery statistics is one form of technical assistance which could have the most useful long-term results for the scientific appraisal of the fish resources.

2.2 Even at present, when the official statistics lack important detail, the Working Group's experience has shown that most of the important detail can be supplied by scientists who are familiar with the fishery in question. Their estimates may not have the high apparent precision of official statistics, but can usually be accurate to within a few percent, and it must be emphasized that if the random errors in the estimates are no worse than this, and there is no bias in the estimates, then the accuracy of the scientific study of the stocks is not seriously affected.

The Group therefore recommends that in submitting statistical data to international organizations for compilation and publication, there should be the closest cooperation between national statistical offices and scientists familiar with the fisheries. Such cooperation should pay particular attention to species identification, area of capture (rather than landing places), and basis of weight used (live weight rather than landed weight, which may be gutted, heads off, etc.).

The Working Group recommends that the staffs of national research laboratories and national statistical offices should cooperate to ensure (a) the speedy introduction of the species lists and the new area (divisional) breakdown as outlined in the section below, and (b) the recalculation of data for the years back to 1960 on these new classifications.

2.3 The Working Group noted that efficient reporting of statistical material is greatly assisted by the use of proper forms. Such forms have been developed for use in the North Atlantic, and the Group therefore suggests that the existing STANA reporting system now used by ICES/ICNAF/FAO

in the whole of the North Atlantic could be extended to the Eastern Central Atlantic and to the Southeast Atlantic. After some years of experimental use the arrangements should be reviewed, taking into account the coordinating tasks of the Coordinating Working Group in this system. The Working Group feels that the eventual establishment of an Atlantic-wide system for collecting and reporting fishery statistics for international purposes could expedite the increased flow of data from national reporting offices while contributing to a reduction in their work.

2.4 The Working Group noted that several of the species details for the two scombriform groups (tunas and possibly mackerels) might eventually be deleted as soon as the proposed International Commission for the Conservation of Atlantic Tuna is in a position to operate its own agency statistics program in coordination with other sea-area bodies in the Atlantic.

2.5 Area division - The Working Group noted that other fishery bodies have already considered the boundaries of two broad regions covering the Atlantic waters off the West Coast of the African continent.

It took note of the boundaries of these two broad areas defined as follows:

2.5.1 Eastern Central Atlantic (CECAT Area):

"The area of the Committee is defined as all the waters of the Atlantic bounded by a line drawn as follows: from a point on the high water mark on the African Coast at Cape Spartel (lat. 35°47'N, long. 5°55'W) following the high water mark along the African Coast to a point at Ponta da Moita Sêca (lat. 6°07'S, long. 12°16'E) along a rhumb line in a northwesterly direction to a point on 6° south latitude and 12° east longitude, thence due west along 6° south latitude to 20° west longitude, thence due north to the Equator, thence due west to 30° west longitude, thence due north to 5° north latitude, thence due west to 40° west longitude, thence due north to 36° north latitude, thence due east to 6° west longitude, thence along a rhumb line in a southeasterly direction to the original point at Cape Spartel."

(extracted from the promulgation of the statutes of the FAO Fishery Committee for the Eastern Central Atlantic, established under Article VI of the FAO Constitution; quoted in FAO Committee on Fisheries document COFI/68/4, Item 3.1, dated 20 February 1968)

2.5.2 Southeast Atlantic

"In the Southern Hemisphere, beginning from a point at 30°00' east longitude, on the coast of the continent of Africa, due south along 30°00' east longitude to 50°00 south latitude, thence due west along 50°00' south latitude to 20°00' west longitude thence due north along 20°00' west longitude to 6°00' south latitude, thence due east along 6°00' south latitude to 12°00' east longitude, thence in a southeasterly direction along a rhumb line to a point at 6°07' south latitude and 12°16' east longitude on the west coast of the continent of Africa, thence along the coast of southern Africa to the point of beginning at 30°00' east longitude."

(extracted from Article I (i) of the Draft Convention on the Conservation of the Living Resources of the Southeast Atlantic as quoted in FAO Committee on Fisheries document COFI/68/5, Sup. 1, dated 4 March 1968)

2.6 The Working Group also considered it advisable to subdivide the Eastern Central Atlantic by a line drawn from near to Cape Blanco along 20° North latitude.

2.7 The Working Group considered the further division of the Eastern Central Atlantic and the Southeast Atlantic and recommends that the old ICES divisions used currently by France, Portugal, Italy, etc. be abolished. The Working Group recommends the introduction by all national offices of a new series of "divisions" for statistical purposes. The Working Group notes that the Secretary-General of ICES will report this recommendation to the ICES Statutory Meeting in October 1968 and that he and the Secretary of the CWP will prepare papers and maps to this effect.

The new divisions are defined below:

2.8 Central Eastern Atlantic

(a) The part of the Central Eastern Atlantic north of 20° north latitude will be divided into the following divisions:

1. Morocco Coastal division lying between 36° north latitude and 26° north latitude, east of 13° west longitude and a rhumb line from 29° north latitude, 13° west longitude until 26° north latitude, 16° west longitudes (comprising the whole of the old "Xa" and parts of old "Xb" and old "XIa").

2. Canaries/Madeira Insular division, comprising the rest of old "Xb" and old "XIa" (western border along 20° west longitude, old border along 30° north latitude to be deleted).

3. Sahara Coastal division lying between 26° north latitude and 20° north latitude and east of 20° west longitude (comprising the greater (the northernmost) part of old "XIb").

4. An oceanic division lying between 36° north latitude and 20° north latitude and 40° west longitude and 20° west longitude (not designated in the old system).

(b) The part of Central Eastern Atlantic south of 20° north latitude will be divided into the following divisions:

1. A Cape Verde Coastal division east lying east of 20° west longitude and between 20° north latitude and 10° north latitude (the old "XIIa" and the southern part of old "XIb").

2. A Cape Verde Insular division lying between 20° north latitude and 10° north latitude and between 30° west longitude and 20° west longitude (this involves a slight extension of the Portuguese old "XIIc").

3. A Cape Sherbro division lying between east of 20° west longitude and 8° west longitude and between 10° north latitude and 0° north latitude (including the French version of old "XIIb").

4. A Western Gulf of Guinea division lying between 8° west longitude and 3° east longitude, north of the Equator.

5. A Central Gulf of Guinea division lying east of 3° east longitude, north of the Equator.

6. A Southern Gulf of Guinea division lying east of 3° east longitude, and between the Equator and 6° south latitude.

7. An oceanic division, not yet subdivided, covering all the waters of the Eastern Central Atlantic, south of 20° north latitude, not covered by preceding six divisions, i.e. the waters lying (a) between 20° north and 5° north latitudes and between 30° west and 40° west longitudes; (b) between 10° north latitude and the Equator and between 20° west longitudes and 30° west longitude; and (c) between the Equator and 6° south latitude and between 20° west longitude and 3° east longitude.

2.9 South Eastern Atlantic (ABBC area)

(a) A coastal sub-area, east of 10° east longitude and north of 40° south latitude, to be subdivided into the following divisions:

1. Cape Palmeirinhas division lying between 6° south latitude and 10° south latitude.

2. Cape Salinas division lying between 10° south latitude and 15° south latitude.

3. Cunene division lying between 15° south latitude and 20° south latitude.

4. Cape Cross division lying between 20° south latitude and 25° south latitude.

5. Orange River division lying between 25° south latitude and 30° south latitude.

6. Cape of Good Hope division lying south of 30° south latitude and west of 20° east longitude.

7. Western Agulhas division lying between 20° east longitude and 25° east longitude.

8. Eastern Agulhas division lying between 25° east longitude and 30° east longitude.

(b) An oceanic sub-area or sub-areas covering the rest of the waters of the South Eastern Atlantic not covered by the eight divisions of the afore-mentioned coastal sub-area, i.e. the waters lying (a) between 6° south and 50° south latitudes and between 20° west and 10° east longitude; (b) between 40° south and 50° south latitudes and 10° east and 30° east longitudes. It is noted that the former of these two "oceanic" waters include several oceanic islands which serve or might serve as basis for fisheries: (a) Tristan da Cunha and Gough, (b) Ascension, and (c) St. Helena. It is recommended that fishery statistics are collected separately for each of these three insular areas.

2.10 The Working Group also noted that FAO will issue and distribute to all countries interested in the fisheries and fishing areas reviewed by this group, maps showing these new divisions. The Working Group recommended that eventually equal area maps will be published for both the Eastern Central Atlantic and the South Western Atlantic similar to those available for both Western and Eastern North Atlantic and for the Southeast Atlantic.

2.11 Species Groupings - There are extremely large numbers of species caught off Western Africa. It would be impossible to report nationally and publish internationally statistics according to individual species. The Working Group therefore drew up two lists (one for the Eastern Central Atlantic, Appendix 3, and a second for the Southeast Atlantic, Appendix 4) giving proposed categories and groupings for reporting and publishing statistics on an international basis.

2.12 It was recognized that even with such broad categories, arranged within the standard FAO species groupings, the number of categories in these lists, in particular the one for the Eastern Central Atlantic, is still very large, and that some national statistical offices may, e.g. because of a lack of proper species identification in fish markets and at other landing points along their coasts, find it very difficult at present and in the immediate future to produce the required information through the routine statistical reporting system. In such cases the possibilities of using the knowledge in research laboratories and elsewhere to produce reasonable close and realistic estimates has already been pointed out (paragraph 2.1 a bove); such collaboration is particularly important when the quantities caught are large.

2.13 The species and area categories, divisions, groupings, etc. suggested above are still rather broad. Many categories (within the main FAO groups) contain several species, and some areas may contain several stocks of the same species. For proper studies of the more important stocks more detailed information than the minimum requirements listed in 2.4 and 2.5 above will ultimately be required. The difference between the general requirements for the statistical reporting of all statistics and the special requirements for certain of the most important species has been recognized by both ICNAF and ICES. The latter has a list of so-called "asterisked" species for which special additional data on place of capture, effort, size composition, etc. are reported. These details are generally published in a mimeographed form (ICES Statistical Newsletters) rather than in the printed ICES Bulletin Statistique.

2.14 The Working Group considers that such special studies of certain species of major importance will be necessary in the Western African region. A preliminary list of such species has been drawn up for the "central area" (between Cape Blanco and the mouth of the Congo River) (see Section 4). No such list was prepared for the other two areas considered by the Group but the analysis of the state of the stocks in these areas shows that such a list should include the Merluccius spp. in the south and the more important species of sparids (Dentex, Pagrus, Pagellus, etc.) in the north.

3. NORTHERN ZONE

3.1 General:

The catches of fish in this area, from the Straits of Gibraltar to Dakar were, in 1966, about

1 million tons. This total was taken by a number of quite separate fisheries, for different species by different countries. The major fisheries were as follows:

small pelagic fish – 280,000 tons, principally sardine landed in Morocco, but also small quantities of Sardinella spp. landed in Senegal.

medium pelagic fish– 100,000 tons, principally horse mackerel (Trachurus spp., Bluefishes (Temnodon saltator) and mackerels (Scomber spp.), mostly caught by trawlers from USSR and other East European countries.

large pelagic fish – 140,000 tons . This total includes all tunas caught in the Eastern Central Atlantic, not all of which were caught in the northern part. In this total the major species were albacore (25,000 tons), yellowfin (66,000 tons), and bluefin tuna (10,000 tons), the last being the most important in the coastal fisheries of N.W. Africa.

large demersal fish– 300,000 tons, mainly a variety of sparids, breams, etc. taken by trawlers from southern and eastern European countries, but including also 20,000 tons of hake.

Cephalopods – 150,000 tons. These are taken mainly by Spanish and Japanese vessels, and include squid, cuttlefish and octopus.

other molluscs, crustaceans – 4,000 tons. There is no major fishery, though because of the high unit value, the French fishery for lobsters and similar species is not insignificant.

3.2 Small pelagic fish

The biggest catches are of sardine, taken in the northern part of the area (north of 26°north latitude). Recent catches are set out in detail below, Table 3.1

Table 3.1 Recent catches of sardines off N.W. Africa (thousands of tons)

Country	1958	1961	1962	1963	1964	1965	1966
Morocco	123	122	123	123	133	155	241
France	-	5	4	4	6	7	12
Spain	?	?	?	?	8	9	23
Total	124	130	131	132	147	171	276

No other country catches significant quantities of sardines, and the figures above are believed to be reliable, except that the increased catches by Morocco may include a proportion of anchovy used for fish meal.

There has been a gradual increase in Moroccan catches, with a very big increase between 1965 and 1966. This increase is believed to be due to changes in the fishing effort, rather than stock changes. Changes in the French catches are certainly due mostly to changes in effort, the amount of fishing in this area being dependent on success of the main French sardine fishery in the Bay of Biscay and adjacent waters; if this fishery is poor, more French vessels come to Morocco. There is therefore no good measure of the abundance of the sardine stock. Data on the distribution and abundance of eggs and larvae have been collected, and might be examined to see if they could be used to estimate the abundance of the adult stock, e.g. by the methods of Cushing (1957). There may also be data not examined by the Group, of sizes of sardine, e.g. Moroccan data on the average weight as measured by the mean number per kilogram, and if the limit to the potential total is being approached, the effort of the recent increases in total, particularly in 1966, would be expected to show in these data. At the moment, however, no useful statement can be made concerning the state of the sardine stock.

3.3 Another stock, or stocks, of small pelagic fish which are at the moment certainly underexploited are those of anchovy. Two species are concerned, Engraulis encrasicholus in the north, and Engraulis hepsetus in the south. Several pieces of information - incidental catches by Moroccan vessels looking for sardine, stomach contents of larger pelagic fish (Lichia vadigo, Pomatomus saltatrix), echo-surveys and experimental catches by Russian vessels - all suggest that these stocks are very large. No very precise figure can yet be suggested, but a comparison with present catches of sardines, and of the main predators of anchovy, suggest that an estimate potential catch of 100,000 tons would be a conservative lower limit.

3.4 Medium pelagic fish

As used here, this group includes the mackerels, horse mackerels, bluefish, etc., many of which are caught by pelagic and bottom trawl, and are therefore not strictly pelagic all the time. Until the development of fishing by long-distance trawlers, particularly from Eastern Europe, in the last few years, these species were very lightly fished, the total catch in 1958 being probably no more than about 25,000 tons. Since then the catches have increased some six-fold, though there has been a decrease in fishing between 1964 and 1966, particularly for mackerel by USSR. This has been due to a deliberate avoidance of mackerel by Russian fishermen for market reasons rather than to a decrease in stock. The details of catch statistics for recent years are summarized in Table 3.2 This gives the data as available to FAO; in addition the unsorted catches of some countries, e.g. Poland, includes quantities of this group of species, as do the catches by East German vessels (13,500 tons in 1967).

Table 3.2 Catches of medium size of pelagic fish (jacks, mackerels, etc.) landed from the Eastern Central Atlantic, 1958-66 (thousand metric tons)

Species/Countries	1958	1961	1962	1963	1964	1965	1966
Horse mackerel							
USSR	—	(5.0)	(12.5)	(28.9)	46.4	35.2	20.9
Other countries	2.0	(10.0)	(10.0)	(14.1)	16.6	16.8	(20.1)
Other jacks, etc.	13.0	18.0	17.0	12.0	17.0	13.0	32.0
Mackerels							
Morocco	7.8	10.3	9.3	13.3	7.6	9.7	(5.6)
Poland	—	—	1.3	1.8	2.7	2.4	7.5
USSR	—	—	(6.7)	(28.7)	60.6	22.0	12.9
Other countries	1.2	—	(1.5)	(1.5)	1.5	1.9	2.0
Total	24.0	46.8	47.3	100.3	153.0	101.0	101.0

Catch rates of these species by midwater and bottom trawls have been very high, e.g. Polish trawlers caught up to 10 tons per haul. Russian data on the catch per unit effort of mackerel and horse mackerel show no decrease in the 4-year period 1962 to 1966, though the figures are rather variable. There also does not appear to have been any clear change in the size composition of the catches of horse mackerel during the same period, though the group did not examine the data in detail.

These stocks therefore show no evidence of the effect of fishing, and are probably not heavily exploited, and do not at present require regulation. Proposals for an echo-survey of these

stocks to provide a better estimate of abundance, and of the potential for further increase in catches, are described in more detail in a later section.

3.5 Large pelagic fish

These are, as noted, mainly tuna, and of the total reported from the whole East Central Atlantic, more come from the tropical area than from the present area. There is also a close connection between the tuna stocks in these areas, and in adjacent areas to the west and north. The state of all the stocks of tuna is therefore discussed together (Section 6).

3.6 Large demersal species

This group includes a large number of species (sparids, serranids, hakes, etc.). Until the mid nineteen-fifties these stocks were exploited on a small scale by local fishermen, and by trawlers from Spain and Portugal. More recently exploitation by long-distance vessels from Southern and Eastern Europe has increased greatly, and there have been definite signs that these stocks have been reduced by fishing. This has led to complaints by fishermen and others.

Due to the large number of species involved, the absence of good information concerning any separation of stocks of the major species, precise assessment of the state of the stocks is difficult, but a preliminary evaluation of the available data is made below for two major groups - sparids (Dentex, Pagrus, Pagellus, etc.), and hakes.

3.7 Hake

Stock separation: Three species of hake have been described in this area (Merluccius merluccius, M. senegalensis and M. cadenati). In appearance these are very similar, and are not separated in any national statistics, nor is it likely that such separation could be achieved without regular and careful sampling of the landings by scientists. Also the sizes caught of the three species seem to be rather similar, so that they probably have rather similar growth and mortality rates, and react to fishing in a similar way. Therefore the treatment of the three species together, which is inevitable at least for past data, will probably produce results that are not greatly in error.

There are probably also differences in stocks from north to south, but there is no good evidence concerning this separation, and most of the fishing, at least by Portugal, is in the central area (old ICES area "XIa").

3.8 Statistics

Very good statistics of both catch and effort were available from Portugal. These effort data are particularly valuable because they refer to a fleet of similar side-trawlers which have changed little and have also had a major interest in catching hake, so that their catches per unit effort probably provide a good index of the abundance of hake.

Other countries for which catches of hake are reported from N.W. Africa are Morocco and Spain. The Spanish reported catches of 400 tons are the landings in the Canary Islands. In addition Spanish trawlers from the peninsula (Coruna, Vigo, Cadiz and Huelva) also land hake caught off Africa. The exact quantity is not known; to provide a rough measure for the immediate purposes of the Working Group it was assumed that 25% of the merluza (large hake), and 10% of the pescadilla (small hake) landed at these ports were caught off Africa. This gives an estimated total for 1966 of 6,100 tons; this is about 60% of the Portuguese catch, which is not inconsistent with the relative abundance of Portuguese and Spanish trawlers on the grounds.

Hake are probably also important to Italian and Greek fishermen. Details are not available, but it is assumed that 10% of their catch were hake.

Hake is not important to trawlers from USSR and Japan, and only 2% of their catches of "unsorted" fish (i.e. about 0.5% of the total) was assumed to be hake.

Table 3.3 Estimated catches of hake off North West Africa, catches per hour by Portuguese trawlers, and estimated total effort, 1955-66

(thousand metric tons)

Years	Portugal	Morocco	Spain	Italy	Greece	Japan	USSR	Total	Portuguese catch/hour	Total Effort
1955	7.1	(2.5)	(4.3)		(0.6)			13.5	128	105
1956	7.4	(2.5)	(4.5)		(0.6)			15.0	86	174
1957	8.4	(2.0)	(5.0)	(0.4)	(0.8)			16.6	68	189
1958	10.0	2.1	(6.0)	0.6	(0.8)			19.5	103	189
1959		(2.0)	(4.6)	(0.8)	(1.0)			16.1	66	243
1960		(2.0)	(4.7)	(1.0)	(1.0)			16.6	66	252
1961	6.7	2.3	(4.6)	1.2	1.4			15.6	73	214
1962	4.8	1.8	(2.9)	1.7	1.7	0.1		13.0	37	352
1963	2.7	2.2	(1.6)	2.1	1.9	0.4		10.9	24	454
1964	4.7	2.1	(2.8)	3.4	2.1	0.4	0.1	15.5	35	446
1965	9.5	2.6	(5.7)	4.3	2.7	0.4	0.1	25.2	78	323
1966	10.4	2.7	6.1	4.9	3.0	0.5	0.1	27.7	81	342

Table 3.4 Portuguese fishing effort (hours), catches, and catches per unit effort of hake, and two groups of sparids (Pagrus and Dentex), 1935-54

Years	Total		Hake		Pagrus		Dentex		Effort (hours)
	c.p.u.e. kg/h	Catch '000 m.t.	c.p.u.e. kg/h	Catch '000 m.t.	c.p.u.e. kg/h	Catch '000 m.t.	c.p.u.e. kg/h	Catch '000 m.t.	
1935	300	11.4	55	2.1	69	2.6	41	1.6	38 094
1936	307	13.2	65	2.8	57	2.4	50	2.1	42 855
1937	309	13.8	65	2.9	56	2.5	62	2.8	44 805
1938	305	17.2	76	4.3	47	2.7	73	4.1	56 535
1939	307	18.7	76	4.6	52	3.2	67	4.1	60 766
1940	327	15.6	101	4.8	58	2.8	56	2.7	47 653
1941	402	17.0	149	6.3	97	4.1	69	2.9	42 137
1942	458	15.9	140	4.9	79	2.8	93	3.2	34 812
1943	415	15.8	114	4.3	60	2.3	82	3.1	38 020
1944	450	18.8	109	4.6	90	3.8	87	3.6	41 770
1945	471	18.1	83	3.2	127	4.9	85	3.3	38 445
1946	455	21.5	95	4.5	100	4.7	89	4.2	47 172
1947	473	23.2	85	4.2	124	6.1	84	4.1	49 034
1948	457	29.8	115	7.5	113	7.4	96	6.2	65 151
1949	437	30.8	124	8.8	101	7.1	91	6.4	70 574
1950	399	30.2	76	5.7	134	10.1	83	6.3	75 648
1951	398	28.7	102	7.4	116	8.4	87	6.3	72 116
1952	410	32.2	135	10.6	118	9.3	76	6.0	78 538
1953	423	31.6	153	11.4	97	7.2	75	5.6	74 600
1954	407	32.0	133	10.5	97	7.6	68	5.9	78 714

3.9 The resulting estimates of hake catches since 1955 are set out in Table 3.3. This table also gives the Portuguese catches per unit effort, and the estimate of total effort. Table 3.4 gives the statistics of Portuguese catches before 1955, including the statistics for Pagrus and Dentex as well as hake. For this period no attempt was made to calculate total catch.

Table 3.3 should be treated with considerable care, in view of the estimation procedures outlined in the previous paragraphs. It does show where improvement in the statistics is most critical in improving the accuracy of the estimate of total hake catch, i.e. where there may well be an error of 1,000 tons or more in the figures in the table. These are:

(a) species breakdown for Italy and Greece;

(b) proportion of the hake landed on the Spanish mainland which came from the N.W. African grounds.

3.10 Stock assessment

The statistics of catches, effort and catch per unit effort given in detail in Table 3.3 , can be summarized, by five-year periods, as follows:

Years	1935-9	1940-4	1945-9	1950-4	1955-9	1960-4	1965-6
Average catch per hour (kg)	67.4	121.6	100.4	119.8	95.4	47.0	79.5
Average total annual catch (M tons)	(3,340)	(4,970)	(5,620)	(9,120)	16,140	14,320	26,450
Average total annual effort (thousand hours)	(49.4)	(40.8)	(54.1)	(60.8)	180	346	332

The catches and effort for the years before 1955, shown in brackets, are only for the Portuguese fishery. The figures suggest that an increase in effort has resulted in an increase in total catch, although the catch per unit effort has decreased. That is, the hake stocks are moderately or heavily exploited, but not so heavily that they are "overfished" in the sense of there being an opportunity to increase the catch by reducing the effort. Some other forms of management, e.g. protection of the smallest fish, may already give some benefit.

3.11 The conclusion can be made at least apparently more quantitative by plotting the catch per unit effort against the total effort. The data for the period before 1955 were used by assuming that the total catch was twice the Portuguese catch. The results are plotted in Figure 1. Apart from the point for the period 1935-9, which seems too low (probably because the efficiency of the fishing in that period was low), the points lie quite well on a curve, which has an intercept on the y-axis (for zero fishing) of about 140 kg per hour. A curve slightly concave upwards has been drawn, rather than the mathematically simpler straight line, since this seems to agree better with some theoretical models, and with experience with hake stocks further north, off the west of Scotland. The catch per unit effort in the 1960s had been reduced to about half the unfished value.

3.12 This curve of catch per unit effort against effort can be used to provide a curve of catch against effort, by multiplying by the effort. This curve is shown in Figure 2. The catch increases with increasing effort over the range of fishing efforts observed, but the curve is flattening out, and the potential average catch seems to be no more than about 20-25,000 tons. There are no detailed data on the length or age composition on which to estimate mortality rates, or changes in such rates. Portuguese data are available for catches of three size categories,

Figure 1 - Relation between fishing effort and catches per unit effort of hake off North West Africa (means of 5 - year periods)

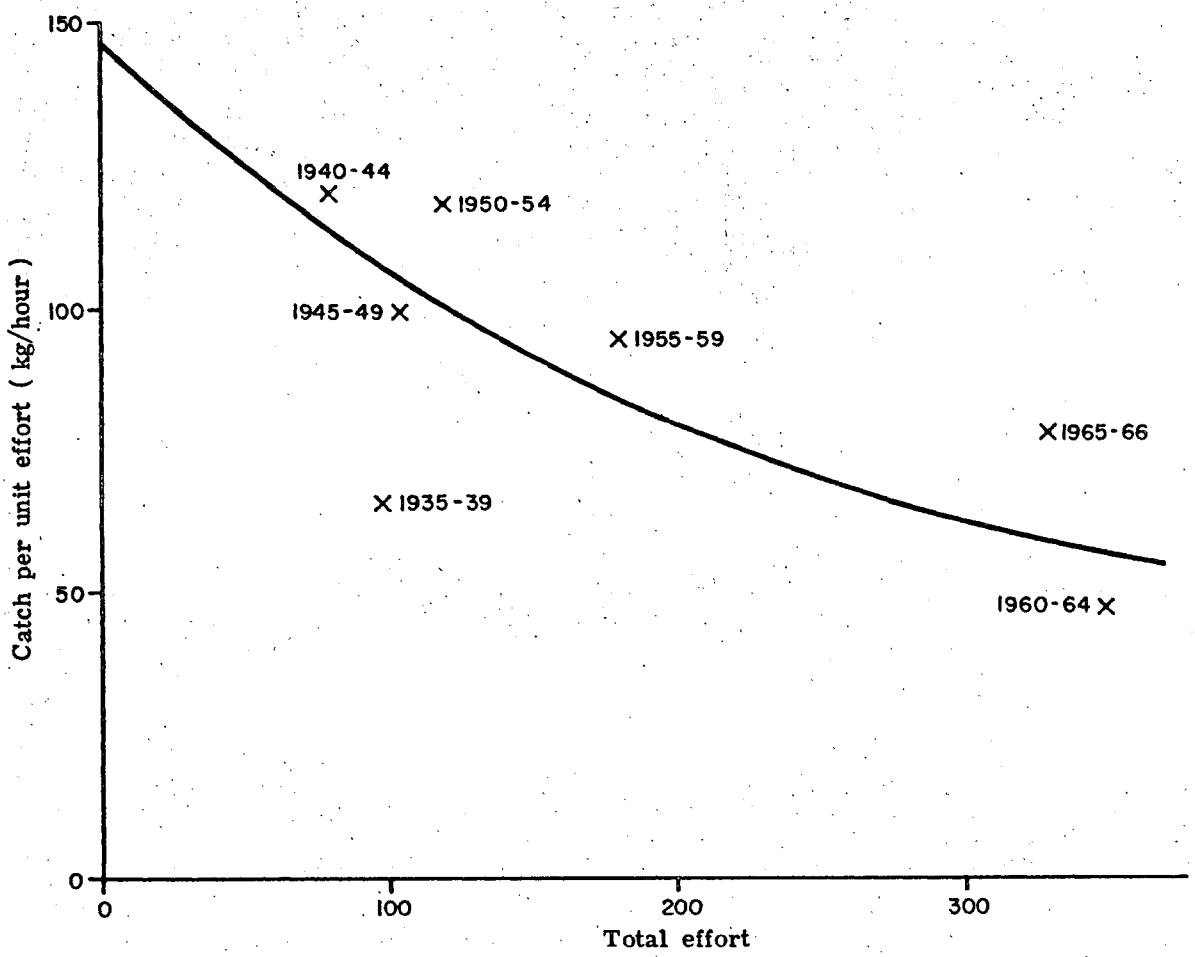
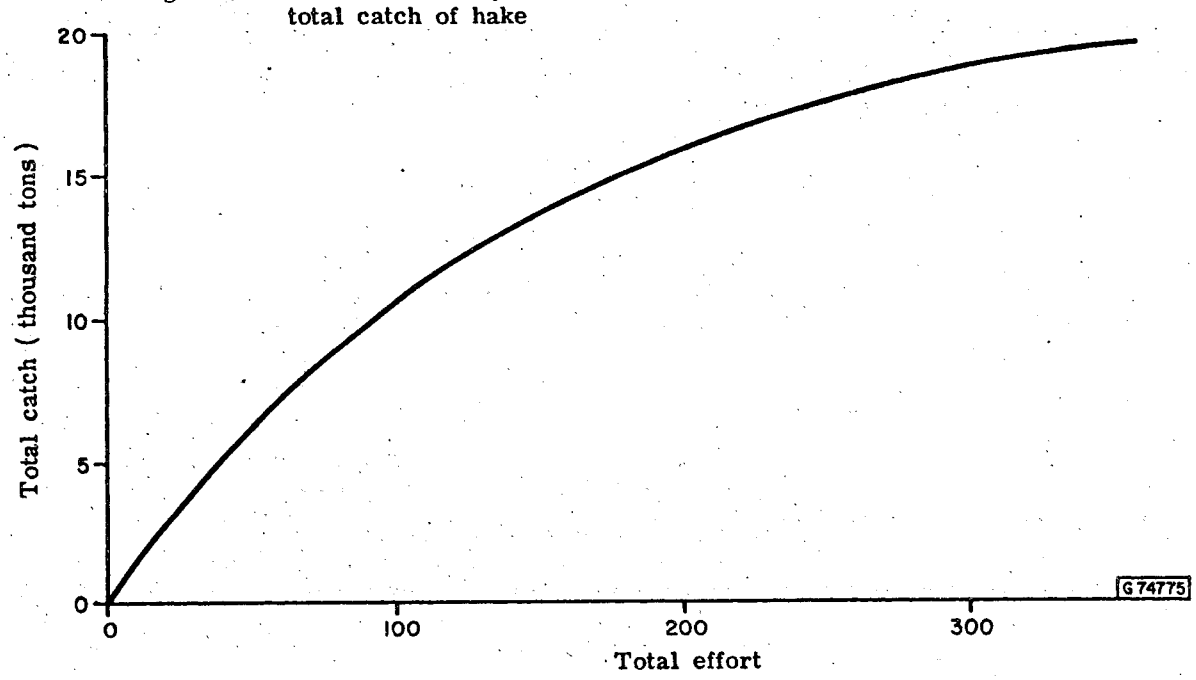


Figure 2 - Estimated steady state relation between fishing effort and average total catch of hake



and there has been a big decrease in the abundance of large hake, which agrees with the supposition that the decrease in catch per unit effort has been due to an increase in the mortality due to increased fishing.

3.13 These results are, of course, no more reliable than the data on which they are based, and depend particularly on the trends in non-Portuguese fishing having been similar to the pattern suggested in the tables. Better data may cause some revision to the present conclusions, but may also provide better support for these conclusions. Thus it is known that, following the decrease in stocks in the northern part of the area in the 1960s, there has been some shift in Greek (and possibly Italian) fishing further south on to more tropical species, so that in 1966-7 the percentage of hake in the catch of these countries was much less than the 10% assumed here. The total catch and total effort in these years would therefore have been overestimated, and in Figure 1 the point should be moved to the left, making it fit the curve rather better.

3.14 Despite these reservations the following conclusions can be made with fair confidence:

(a) the stock abundance is now less than it used to be some 20 years ago, and this reduction is almost certainly due to fishing;

(b) increased fishery has, at least up to the present level of fishery, resulted in increased total catches (the Portuguese catch in 1966 was the highest for all but 3 years - 1952, 53, 54).

3.15 Possible regulation measures

The above conclusions show that there would be no advantage, other than some increase in catch per unit effort, in restricting the amount of fishing of hake to below the present level, and no regulation of total catch or effort is desirable.

There are no data either on the present sizes of fish caught or on mesh sizes in use available to make any definite proposals concerning mesh size. It is believed that some countries use very small meshes (ca 40 mm stretched mesh), which would correspond to a 50% selection point of 4 x 40 = 16 cm. Since the average size of hake in the catches is probably around 35 cm (about 10 times the weight of a 16 cm hake), and the fishing intensity is quite high, it would almost certainly result in a long-term increase in hake catches if these small fish were protected, but lacking data on the sizes of hake caught and especially of the proportion less than 20-25 cm caught by trawlers other than those from Portugal, a quantitative estimate of the benefit cannot yet be made. For the hake fishery therefore a mesh size greater than 40 mm would be desirable. However, in this area there is a wide variety of species being caught, for some of which a smaller mesh size might be desirable.

3.16 Sparids

Though several genera are included in this group, they are not separated in the available statistics of most of the countries fishing in the area. For the present purposes of the Working Group they have therefore been considered together.

Table 3.5 Catches of sparids from off the North West African coast
(thousand metric tons)
Portuguese catches per unit effort, and estimated total effort 1955-66

Year	Morocco	Senegal	Portugal	Spain		Poland	USSR	Japan	Italy	Greece	Total	C.p.u.e.	Effort
				Canary	Peninsula								
1955	(2.0)					—	—	—	—	(3.0)		163	
1956	(2.0)					—	—	—	—	(3.0)		173	
1957	(2.0)					—	—	—	(2.0)	(4.0)		182	
1958	1.7	(2.0)	15.6	(30.0)	9.4	—	—	—	(3.0)	(4.0)	83.7	154	54
1959	(2.0)					—	—	—	(4.0)	(5.0)		165	
1960	(2.0)					—	—	—	(5.0)	(6.0)		134	
1961	1.4	(25.0)	14.7	(30.0)	(8.8)	—	(10.0)	(10.0)	(5.8)	(7.2)	112.9	114	99
1962	2.4	(30.0)	11.6	(30.0)	(7.0)	—	(35.0)	15.2	(8.2)	(8.5)	147.9	90	164
1963	1.7	(35.0)	10.0	(30.0)	(6.0)	4.0	(55.0)	20.5	(10.3)	(9.3)	181.8	84	216
1964	2.2	(28.8)	8.5	34.5	(5.1)	4.6	48.5	16.6	(16.8)	(10.5)	176.1	60	293
1965	1.8	(34.2)	7.8	27.7	(4.7)	3.1	18.2	15.2	(18.2)	(13.5)	144.5	52	278
1966	(2.0)	(41.8)	6.0	26.3	(3.6)	2.6	16.2	19.2	(19.4)	(14.8)	151.9	41	370

3.17 The estimated catches of this group of species are given in Table 3.5. In this table the catches of Morocco, Portugal, Spain (landed in the Canary Islands), Poland, USSR and Japan are obtained directly from available statistical tables. For Senegal 50% of the unsorted catch was added to the reported total of sparids and related species. For Italy and Greece sparids were assumed to be 50% of the total catch. Landings by Spanish vessels in ports in the peninsula (Cadiz, Vigo, etc.) were assumed to be 60% of the Portuguese catch. The statistics available internationally which most urgently need improvement are therefore the same as for hake.

3.18 Data on catch per unit effort are available from the Portuguese trawlers. These data, which are the sums of catches per unit effort of "Pagrus" and "Dentex", and the corresponding estimates of the total effort, are also shown in Table 3.4. Catch per unit effort data are also available since 1962 for USSR large factory trawlers. These are given by fishery seasons (October to February) and are therefore not corresponding to the same periods as the Portuguese data, but the difference is unlikely to be important. The data for the two fisheries are set out in Table C.6. below (the USSR data for 1962/63 are given under 1962, etc.). For ease of comparison each set of data has been expressed on percentages of the mean for the period.

Table 3.6 A comparison of the catches per unit effort of sparids by Portuguese and Russian trawlers

Country	1962	1963	1964	1965	1966	Mean
Portugal						
Catch per hour (kg)	90	84	60	52	41	65
% of mean	138	129	92	79	63	
USSR						
Catch per hour (kg)	550	420	140	170	310	318
% of mean	173	132	44	53	98	

There is a reasonable degree of agreement between the two sets of figures. This can be seen more clearly in Figure 3; the trend lines for the two sets of data are almost identical, though the Russian data show a greater degree of year-to-year variation. For the present, therefore, the Portuguese data will be taken as providing a reasonable index of the stock abundance of sparids.

3.19 Using this index, and the corresponding estimate of total effort, the relation between catch per unit effort and total effort can be examined. Two relations were considered, between catch per unit effort, and total effort in the same year, and between catch per unit effort and the average effort in the same year, and the previous year. These relations are shown in Figures 4 and 5. The points in both figures lie closely on a smooth curve; this has been drawn by eye, and the corresponding relation between total effort and total catch is also shown in the figures. There is not much difference between the two figures. Since the full effect on the stocks of any increase in effort is probably not felt in the same year that it takes place, the relation between catch per unit effort and the mean effort over two years is probably closer to the real relation in a state of steady fishery. The other relation probably slightly underestimates the effect of fishing.

3.20 The figures suggest very clearly that fishery has had a very pronounced effect on the stocks of sparids and, though less clearly, that the maximum catch, of around 150,000 tons, would be taken with a fishing effort less than that in 1965 and 1966. (The catches in 1963 and 1964 were greater than 150,000 tons, but this excess over the potential catch was probably due to the removal of the accumulated unfished stock, and could only be maintained for one or two years.)

3.21 Since several species, and probably several stocks of at least some species, have been combined in this evaluation, these figures and their interpretation can be considered as no more than a rough guide to the present state of the stocks. Probably there are some stocks that are even

Figure 3 - Comparison of catches per unit effort of sparids off North West Africa by trawlers from USSR and Portugal

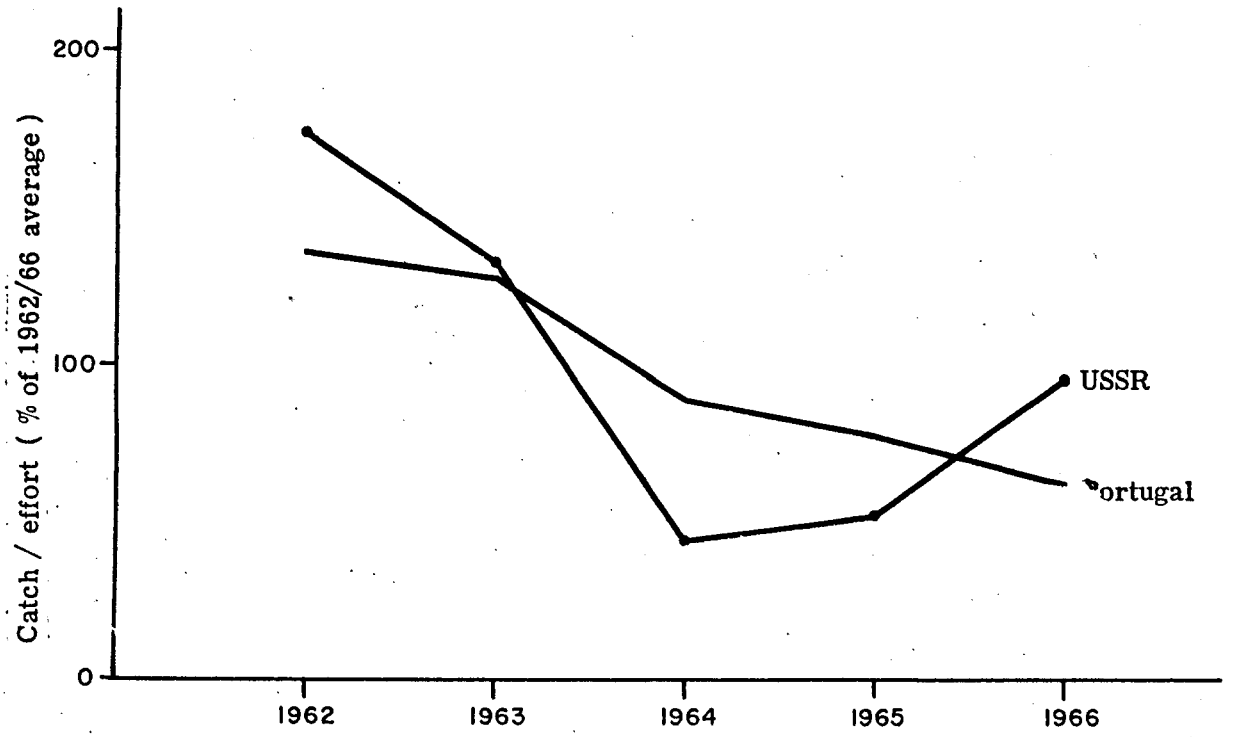


Figure 4 - Relation between fishing effort and catches per unit effort in the same year of sparids off North West Africa, and corresponding relation between total effort and average total catch

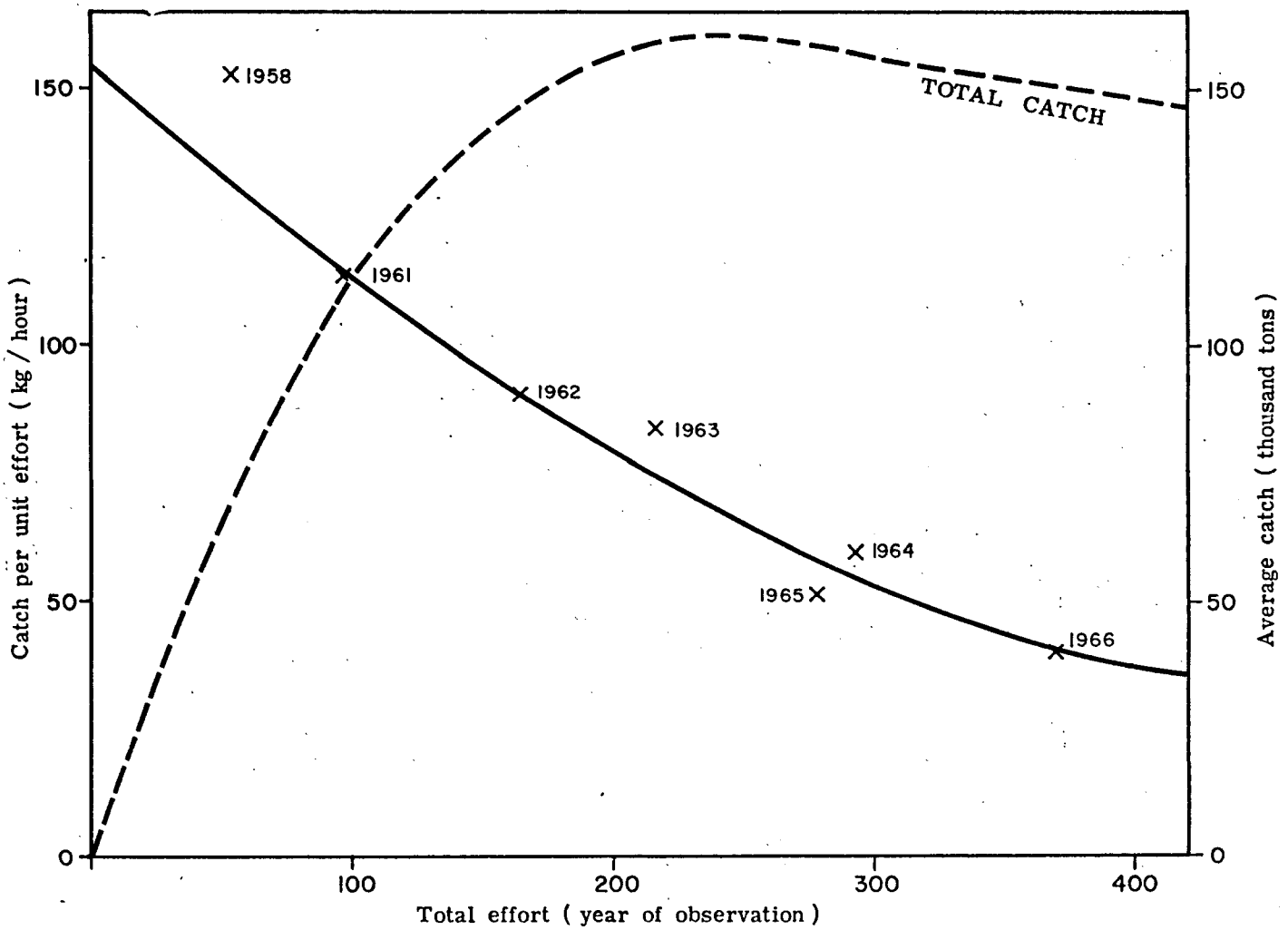
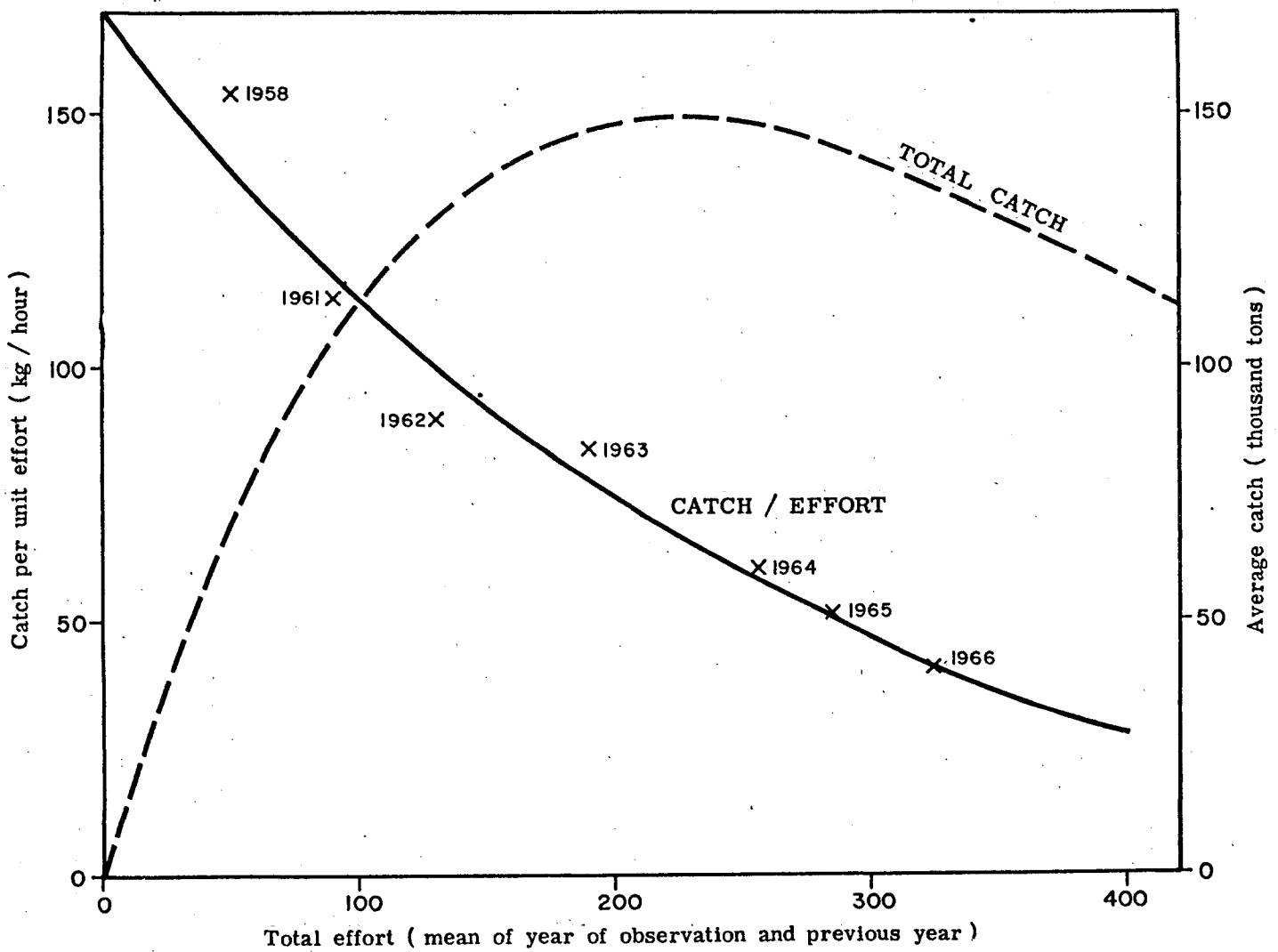


Figure 5 - As Figure 4, but effort calculated as the mean effort during the year of observation and the previous year



more heavily exploited than the figures suggest for the combined stocks, while other stocks, probably the less commercially attractive, may still not be yet fully exploited. There is therefore an urgent need for detailed investigations dealing with each stock separately. One prerequisite for this is statistics in sufficient detail - by species, or at least a finer grouping than "total sparids", and by areas - as well an improvement in the statistics from these countries where even the figure for total "sparids" has had to be estimated.

3.22 The size (and if possible age) composition of the catches of each species and especially any changes since the increase in fishing in the last ten years should be examined. There were no such data available to the group, but it was noted that the French research vessel "Thalassa" had made a trawl survey in the area in 1962, and was at the moment making a similar survey. A comparison of the size composition of the catches in the two periods, especially stratified by depth, could provide a very useful check on the present conclusions based on catch and effort statistics.

There is also an urgent need for reliable series of data on the size composition of commercial catches. No such data were available to the group, but it appears that some regular measurements have been made on Polish vessels.

3.23 Conservation and management

Figures 4 and 5 suggest that a reduction in fishing effort to about half the present level would result in a small increase in the average total catch. While this conclusion may not be completely accurate, it is certain that a substantial decrease in fishing effort would give a considerable increase in the catch per unit effort (the return to the individual fisherman, or the individual fishing vessel), and would cause little decrease in total catch, and might increase the total catch slightly. Serious consideration should therefore be given to the question of reducing the fishing on the sparid stocks in the area and the national and international administrative problems involved. At the least, further increase in the amount of fishery should be prevented, pending the solution of the more difficult problems of reduction of effort.

3.24 Lacking data on the sizes of fish caught, the mesh sizes of nets in use, and their selectivity, clearly no quantitative assessment of the effect of increasing the minimum mesh size of trawls can be made. Since the fishing effort is so high that the catches can be increased by reducing the amount of fishing thus allowing the fish to grow to a better size, it can reasonably be assumed that the catch could also be increased by allowing the fish to grow by protecting the smaller fish by larger mesh sizes.

3.25 The optimum mesh size is likely to vary from stock to stock; also the mesh size used must take into account the needs of other species, including both those for which, because of their small size, a small mesh is desirable, and other, e.g. hake (see above) for which a larger mesh is needed. To some extent the demands for different mesh sizes for different stocks may be resolved by dividing the region into smaller areas in each of which the composition of the catches is more uniform. However, experience in the North Atlantic suggests that administrative and practical requirements, as well as the problem of adequate enforcement of regulations, make it desirable for the same minimum mesh size to be required over as wide an area as possible.

3.26 Cephalopods (northern area)

These now support an important fishery. The approximate total catches in 1966 from north of 20° north latitude were as follows (metric tons):

Table 3.7 Catches of cephalopods off North West Africa in 1966

Species	Japan	Spain	Portugal	Italy	Others	Total
Cuttlefish	25,500	7,800	1,200	—	(1,000)	35,500
Octopus	21,900	39,100	—	—	(1,000)	62,000
Squids	5,500 (a)	4,700	300	—	(1,000)	11,800
Total	53,200	51,600	1,500	9,600	3,000	118,900

a) 25% of unsorted fishes

These catches are a very big increase over the catches only 10 years ago, which were only about 5,000 tons. It has been suggested that there has been a real increase in the abundance of cephalopods following the decrease of demersal fish stocks, but the Group had no data to support this. Certainly the increased catches have been at least to a large extent due to the development of special cephalopod fisheries by both Japan and Spain - for Spain in particular in the most recent years since the large factory ship "Galicia" has been stationed in the area especially for processing cephalopods. Higher estimates of the total cephalopods catch have been mentioned. It is possible that the catches processed by the Spanish factory vessels, much of which are exported to Japan, have not been included in the above reported figures. The true catches might therefore exceed the above figures by around 50,000 tons.

The Group also had no data to show whether or not the fishing was having any effect on the stocks.

3.27 Crustaceans

The fishery for various species of lobsters (Homarus, Palinurus, and Panulirus), have shown many of the classical signs of overfishing, including a recovery in catch rates during the war. The total stocks are probably small, and good fishing can only be maintained by suitable management measures. These were not examined in detail, but should probably include protection of the small animals (e.g. size limits) and control of the total catch or total effort.

There were little data available to the Group on shrimps and other small crustaceans. The decline in the Moroccan catches from a peak of 1,600 tons in 1962 to 700 tons in 1965 was probably due to a decline in the effective effort on shrimps since the trawlers concerned tend to fish closer inshore where shrimps are less abundant. The most recent review of the crustacean resources off Senegal has been given by Crosnier (1967).

4. CENTRAL ZONE

4.1 Definition of zone

The inter-tropical zone of the Eastern Atlantic extends from off Cape Blanco (20° north latitude) to the mouth of the Congo River (6° south latitude). It is characterized by the presence either all the year round, or during some seasons, of warm low salinity surface waters. Beyond the maximum extent of these waters, the fish fauna progressively changes into that of the zones to the North and South.

4.2 Subdivision of the zone

On the basis of the seasonal hydrographic regimes, the zone can be subdivided into five regions, two of which have surface waters that are permanently warm and of low salinity, while the remaining three experience seasonal upwelling bringing cold water from the bottom to displace the warm surface waters. These regions listed from North to South are as follows:

The Cape Verde Region: (from 20° north to 10° north latitude). This region belongs to the boreal (northern) regime and upwelling occurs in winter. In summer, the warm, low salinity "Liberian" waters from the south extend northwards and cover this region.

The Cape Sherbro Region: (from 10° north latitude to 8° west longitude). It is characterized by the formation of the "Liberian" surface waters which form the surface waters here all the year round.

The Western Gulf of Guinea Region: (from 8° west longitude to 3° east longitude). Here upwelling occurs in the shelf during the austral winter (July/August). Warm low salinity waters appear on the surface during the austral summer (December).

The Central Gulf of Guinea Region: (from 3° east longitude to the Equator). The warm low salinity "Guinean" surface waters originate here and permanently occupy the surface all the year round.

The Southern Gulf of Guinea Region: (from the Equator to 6° south latitude). It belongs to the southern regime. The warm "Guinean" waters occupy the surface from October to April. Then from May to September the cold South Atlantic Central waters upwell to the surface.

At the southern limit of the Southern Gulf of Guinea Region, the effluent of the Congo River forms a microregion of permanently warm low salinity water.

In the upwelling regions where warm surface waters alternate seasonally with cold upwelled waters, there are not just two seasons in a year, one warm and one cold. Rather, there are four with a short warm water season followed by a short cold water season interposed between the long cold water seasons and the long warm water season. The data given above are those of the main seasons.

4.3 Consideration of the major fish stocks

From available evidence, the demersal fish in the zone as a whole do not make long range migrations along the coastline. They only move towards or away from the shore line. For practical purposes therefore, and until there is evidence to the contrary, each exploited area of the shelf can be considered as a separate stock. These areas are separated from one another by intervening shelf areas where little fishing takes place because the adjacent country has not developed its fishery and the shelf is not rich or wide enough to attract vessels from more distant areas. The areas are as follows:

MAJOR DEMERSAL FISHING AREAS	Areas with little fishing (separating the major fishing areas)
BISSAGOS, GUINEA, SIERRA LEONE	
	Liberia
IVORY COAST AND GHANA	
	Togo and Dahomey
NIGERIA	
	Cameroon to Cape Lopez
CAPE LOPEZ TO CONGO BRAZZAVILLE	

4.4 Fishes and shrimps in the zone spend only 2-3 years and 1-2 years respectively in the fishery before they are fished out, and the growth rates of the recruits are so high that they are recruited into the catch by the time they are six months old. So the regeneration of the fishery is fast and the recovery of a depleted area will be due to its own regenerative powers rather than to immigration from adjacent lightly fished areas.

4.5 Of the major demersal fishing grounds, the best are in areas of upwelling and of these the Bissagos ground has the largest biomass, because the continental shelf is particularly wide (200 km). Furthermore and on a smaller scale, river mouths usually provide rich trawling grounds where large sized fish (sciaenidae, polynemidae, ariidae, skates) are caught. The best example of this is the mouth of the Congo River.

4.6 The richest prawn grounds (Penaeus duorarum) are off large river mouths or lagoon entrance to the sea, e.g. Southern Senegal, Eastern Ivory Coast, Nigeria.

4.7 In the pelagic inshore fishery, the presence of Sardinella spp. is correlated with the presence of upwelling. Sardinella spp. are therefore abundant mainly off Senegal, Ivory Coast and Ghana, Gabon and the Congo, and in Northern Angola.

4.8 Catch and effort statistics

All the countries along the coastline of the zone (except Gambia) have, at one time or another, sent catch statistics to FAO. It may therefore be assumed that mechanism for obtaining fishery statistics exists for the zone as a whole. Often, presumably due to oversight, some of the countries fail to send catch figures to FAO; for example, the following countries have sent in their catch figures only up to the year in brackets against each country:

Mauritania (1964)
Portuguese Guinea (1965)
Nigeria (1964)
Cameroon (1965)
Guinea (1964)
Japan (1965)

It is presumed that these countries only need to be reminded and they would furnish the data for which they are in arrears and resume regular submission of future data. The FAO/UNESCO/OAU Abidjan Symposium, realizing that many of the catch figures are only intelligent guesses, recommended that the improvement of national landing records should be given a high degree of priority.

4.9 It is essential that the broad fish groupings for which catch figures are submitted should contain the same fish species throughout the zone. Furthermore it is observed that the small individuals of various species which when large are separated in the statistics are sometimes lumped together with other small sized fish and recorded as "miscellaneous", "unsorted" fish or "friture". It is recommended that the miscellaneous or unsorted group be regularly sampled so that the young members of the principal fish species can be extracted from it and put in their appropriate groups.

4.10 Fishing effort should be standardized in the following manner: for inshore pelagic fisheries it is found that number of days at sea is a good and simple estimate of fishing effort. For trawlers, the product of the horsepower of the vessel and the hours spent actually trawling is a satisfactory measure of effort. The simplification of using hours spent at sea, instead of hours spent trawling, will be satisfactory if the correlation between the two times is high. As far as possible, an indication should be given of the locality of the fishing effort. At least each effort data should be capable of being accurately placed in one of the five regions into which the zone is divided. To this end, where fishing skippers use log sheets for reporting their catches, these sheets can be redesigned to provide the following additional information: name of vessel; hour of departure and arrival; area of operation; average depth; number of hours of actual trawling.

4.11 Selection of species of immediate importance for detailed analysis

The limited studies that have been made of fishes in this zone have in fact been of those of immediate economic importance. They consist of the following species:

Demersal species:

Rays: Raja miraletus, Dasyatis margarita
Ariidae: Arius spp.
Cynoglossidae: Cynoglossus spp.*
Polynemidae: Galeoides decadactylus*, Pentanemus quinquarius*
Pamadasydae: Brachydeuterus auritus*
Stromatidae: Paracubiceps lodanoisi
Sparidae: Dentex angolensis, Pagellus coupei
Sciaenidae: Pseudotolithus senegalensis**, P. typus**, P. (Fonticulus) elongatus*, Pteroscion peli
Shrimps: Penaeus duorarum**, Parapenaeopsis atlantica, Parapenaeus longirostris

Inshore pelagic:

Clupeidae: Sardinella aurita**, S. eba**, Ethmalosa fimbriata, Anchoviella guineensis
Scombroideae: Scomber japonicus*
Carangidae: Trachurus trecae*
Pomadasydae: Brachydeuterus auritus**

Note: Three grades of importance have been attached to the species listed above. Those asterisked twice are the most important, followed by those asterisked once, and then by those not asterisked, which are least important.

4.12 The amount of work that has been done for the above species varies considerably. More advanced investigations have been done for the Sardinellas and the Sciaenidae. In these families direct age determinations have been made using otoliths for the Sciaenidae and scales for the Sardinellas. From these, accurate growth curves have been described. The determination of mortality and exploitation rates have been started for the two Sciaenidae species. Statistical data on catch and effort have been well recorded for croakers in Nigeria and for Sardinellas in Senegal, Ivory Coast, Ghana, and Congo. Work on mesh selectivity and the likely effects of proposed mesh regulations on the multi-species fishery have been studied in Nigeria.

4.13 The other species have not been as intensively studied as the Sciaenidae and the Sardinellas, at least not by West African laboratories. Work on shrimps started only recently and that was in Nigeria, Senegal and Congo. As prawn fishing intensifies and expands, it is expected that research on prawns will increase and will spread to Ghana and Ivory Coast. Table 4.1 summarises the nature of research done or in progress on the vaious species listed above, according to available information at the time of writing.

Table 4.1 Research activities by species studied, in the central zone

Species	Countries (or laboratory)	Catches	Fishing effort	Age determinat.	Growth	Mortality	Reproduction	Eggs and larvae	General biology and ecology	Feeding	Condition factor	Tagging	Selectivity	Serology, stock separation	Fishing Technology
Sardinella	Dakar	x	x												
	Freetown	unknown													
	Abidjan	x	x		x		x	x	x	x	x			x	
	Tema	x	x	x	x		x	x			x	x		x	
	Pointe Noire	x	x	x	x		x	x	x						
	Poland														
	USSR	x	x	x	x	x	x	x	x	x	x			x	x
Anchoviella guineensis	Abidjan							x							
	Tema							x							
Trachurus trecae	Poland														
	USSR	x		x	x	x	x	x	x	x	x				
Ethmalosa fimbriata	Dakar	x	x												
	Freetown	x	x					x		x					x
	Tema														
Pseudotolithus Senegalensis and P. typus	Freetown														
	Monrovia								x						
	Abidjan			x	x		x		x	x	x	x			
	Lagos	x	x	x	x	x	x	x	x	x	x	x	x	x	x
	Pointe Noire			x	x	x	x		x		x		x		
Pseudotolithus (Fonticulus) elongatus	Freetown				x										
	Lagos	x	x		x										
	Pointe Noire			x	x	x	x		x		x				
Brachydenterus auritus	Lagos			x	x	x	x				x		x		
	Abidjan				x										
	Pointe Noire												x		
Galeoides decad.	Lagos						x								
Dentex angolensis	Abidjan			x	x		x		x	x	x				
	Pointe Noire			x	x		x		x		x				
Penaeus duorarum	Dakar	x	x		x		x		x			x			
	Abidjan				x										
	Lagos	x	x				x	x	x						x
	USSR	x		x	x	x	x		x	x	x			x	x
Parapenaeopsis atlantica	Lagos							x	x	x					
	Pointe Noire				x		x		x						
Parapenaeus longirostris	Dakar	x	x						x						
	Pointe Noire								x						

4.14 Review of data on length and age composition

There are data on length and age composition for many species although only a few are recorded on a regular basis. The list below is of fish for which length and age composition data are available according to reports about the activities of fisheries laboratories interested in the zone.

Dakar:
- Sardinella aurita
- S. eba
- Penaeus duorarum

Abidjan:
- Sardinella eba
- S. aurita
- Pseudotolithus senegalensis
- P. typus
- Dentex angolensis

(In 1966 a transect of 11 stations, between 15 and 200 m was sampled every 3 weeks for length frequency distributions of 14 species of fishes and shrimps. These frequencies are expected to yield growth curves for the species, using the Petersen method.)

Tema:
- Sardinella eba
- S. aurita
- Cereus hippos

Lagos:
- Pseudotolithus senegalensis
- P. typus
- Cynoglossus spp.
- Galeoides decadactylus
- Arius spp.
- Brachydeuterus auritus
- Penaeus duorarum

Pointe Noire:
- Pseudotolithus senegalensis
- P. typus
- Fonticulus elongatus
- Dentex angolensis
- Sardinella aurita
- S. eba
- Peneaus duorarum
- Parapenaeopsis atlantica
- Parapenaeus longirostris

4.15 Heavily fished stocks and those in need of protection

All the major inshore demersal fish stocks in the zone show signs of heavy fishing. It is known that the productivity of the zone as a whole is not as high as to the north and south. Furthermore, the shelf is narrow - except at Bissagos (120 miles wide) - generally only between 5 to 30 miles. Catch rates have fallen everywhere, sometimes quite considerably. For example in Ivory Coast the catch per effort in 1965 was only one-fifth of what it was in 1955. The data for Nigeria presented in Table 4.2 below also show a similar trend.

Table 4.2 Fishing statistics for the Lagos inshore trawling fleet

Year	Total catch	Effort (Hp X hours)	Catch per unit effort (Kg X 100 Hp hours)
	metric tons	1,000	kg
1960	3,481	6,390	54.5
1961	3,561	5,815	61.2

Year	Total catch	Effort (Hp X hours)	Catch per unit effort (kg X 100 Hp hours)
	metric tons	1,000	kg
1962	3,263	5,283	61.8
1963	4,146	6,693	61.9
1964	2,172	4,908	44.3
1965	889	2,599	34.2
1966	865	3,846	24.8
1967	1,185	2,827	42.0

The signs of heavy fishing are due not only to the large fishing effort, in terms of number of fishing vessels, but also to the small mesh size of the codends employed. The mesh size used is 40 mm and often smaller.

4.16 There is no evidence, at present, of overfishing in the inshore pelagic stocks of the zone.

4.17 Lightly fished stocks - Unexploited potential - Demersal

Brachydeuterus is, by weight, the most important species on the shelf. In many countries it is not landed because of its low market value. However, in Ivory Coast (1966), 2,000 tons were landed by trawlers and 4,000 tons by seiners. They have about the same market value there as sardines. Countries which need more fish may wish to take note of this.

4.18 Experimental fishing along transects across the shelf had shown that in depths shallower than 40 m, catch rates were high. From 40 to 50 m the rate fell sharply, to rise again in the 70-100 m zone to a level not as high as that above 40 m. Most of the fishing has been above 40 m and as catch rates in this region are now falling, it would be worthwhile to consider moving into the 70-100 m zone, especially during the cool season when sparids are known to be plentiful. It is this 70-100 m zone that is fished by foreign trawlers catching Sardinella aurita, horse mackerels, mackerels, sparids, and Paracubiceps.

4.19 The recent development of the Nigerian prawn fishery has shown that stocks of economic importance exist in the West African Continental shelf. Other countries, e.g. Senegal, have also recently developed their prawn fisheries. Experimental trawling in Ivory Coast shows that the local prawn fishery can be increased many fold. These prawn grounds are adjacent to large networks of brackish water and freshwater opening into the sea. Therefore prawn grounds may be expected in areas where these conditions exist provided that the ground is not too sandy or rocky. These conditions favorable to prawns appear to exist off Gabon, Dahomey and Guinea. Prawn stocks could also be important on the continental slope (Parapenaeus, Plesiopenaeus).

4.20 Pelagic

Large stocks of Sardinella spp. exist off Congo to Gabon and Senegal which are not much exploited at present. Fishing gears other than the present purse seines may make possible the fishing of Sardinella spp. in areas where they are at present not caught. Russian and East German vessels have sometimes caught Sardinella aurita at 50-100 m by bottom trawls, e.g. off Takoradi. Also large seines of the Norwegian type as used for the North Sea herrings could be used to catch sardinella at any depth on the shelf. Mid-water trawls may also yield good results.

4.21 The amount of anchovy eggs and larvae in plankton hauls suggests that large quantities of unexploited anchovies exist.

4.22 Recommendations

(a) Attempts should be made to collect effort statistics, having regard to the suggested units of effort.

(b) The size of the demersal fishing fleet cannot be increased indefinitely. Increase in catch can be brought about by increasing the minimum mesh size and this must be enforced in all countries exploiting the same stock. As a first step, and on the basis of the mesh assessment that has been done in Nigeria, the mesh size should be increased to 60-70 mm.

(c) The possibility of extending the demersal fishing grounds to the 70-100 m zone should be explored. Also areas which appear to be suitable prawn grounds should be surveyed to confirm the presence of prawns in commercial quantities.

(d) Where considerable expansion of the fisheries is necessary, the expansion should be in pelagic rather than in the demersal sector.

5. SOUTHERN ZONE

5.1 The hake fishery

The area of the fishery - the main catches of hake are taken from the waters off the coasts of South Africa and South West Africa in depths up to about 450 fm.

5.2 Stock separation

In the commercial trawl fisheries for hake, the catches usually consist of about 80-90% hake. The other main species caught are kingklip (Genypterus capensis), horse mackerel (Trachurus trachurus) and bream (Pterogymnus laniarius). The hake in this fishery has generally been considered to be Merluccius capensis. A second form, Merluccius paradoxus, has been described from the coasts of Angola and northern South West Africa, but recent data suggest that M. paradoxus is more widespread. It is certain that both species are represented in the commercial hake landings but in what proportions is not known. As far as the commercial fishery is concerned no distinction is made between the two species, which are superficially very similar, and the available catch statistics make no distinction between the species and represent total hake landed. Therefore for the purposes of this report the hake of the Southeast Atlantic will be considered a single stock although in reality it is certain that two species are involved and possibly there are separate self-contained stocks within each species. A third species, M. polli, is caught in small quantities off the coast of Angola.

In recent English investigations off the coast of South West Africa, pure catches of M. paradoxus were taken in the deeper water (270 fm) and pure catches of M. capensis in shallower water (180 fm) with the two species mixed together in intermediate depths. However, these observations are rather limited and more detailed data are needed on the distribution of these two hake species.

5.3 Catch statistics

The available statistics of hake landings in recent years are summarized in Table 5.1. Up to about 1961, South Africa was the only nation catching hake in any quantity with most of the catch being taken from a relatively small area in the vicinity of the Cape Peninsula with small quantities being caught off Port Nolloth and on the eastern side of Agulhas Bank. Subsequently increasing fishing activity by vessels from Europe and Japan has resulted in a dramatic increase in the total landings, particularly in the period 1963-66. This increase in catches has been accompanied by an expansion in the area fished, which now extends from East London in the southeast to Cape Frio in the northwest. It is known that vessels from several nations other than those indicated in Table E.1. are fishing hake in this area, but no statistics of landings are presently available for these countries.

Table 5.1 Catches of hake landed from the Southeast Atlantic, 1957-67
(Thousands of tons, live weight)

Countries	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967
Angola	0.1	0.3	0.2	0.4	0.2	0.2	0.2	0.1	-	0.1	
Germany (Eastern)										1.2	
Germany (Fed. Rep. of)									0.4	7.3	(7.7)*
Israel					0.3	0.3	0.9	1.0	1.0	7.0	
Japan									17.4	31.8	
South Africa	90.6	93.9	104.3	115.0	106.9	105.8	102.3	106.5	100.6	121.7	(117.0)*
South West Africa	0.2	0.2	0.1	+	+	+	+	+	+	+	+
Spain						4.1	18.0	46.3	118.3	156.1	184.6
USSR		0.2	0.5	0.5	0.5	0.5	-	2.2	81.8	135.4	
Total	90.9	94.6	105.1	115.9	107.9	110.9	121.4	156.1	319.5	460.6	

* ( ) Provisional figure.

5.4 As well as the quantities of hake landed a large quantity of fish is caught but not landed as fish for human consumption. The smaller vessels frequently discard small fish at sea or may land them for fish meal, while the larger freezer or factory trawlers frequently use small hake for the production of fish meal in reduction plants on board the vessels. The quantities of hake discarded will vary between the vessels of the various nations and also vary with the catch rate. Some data on the quantities of fish discarded are available for South African vessesl which indicate that discard rates in 1966 probably averaged between about 10% and 30% by weight.

5.5 Fishing effort and catch per unit effort

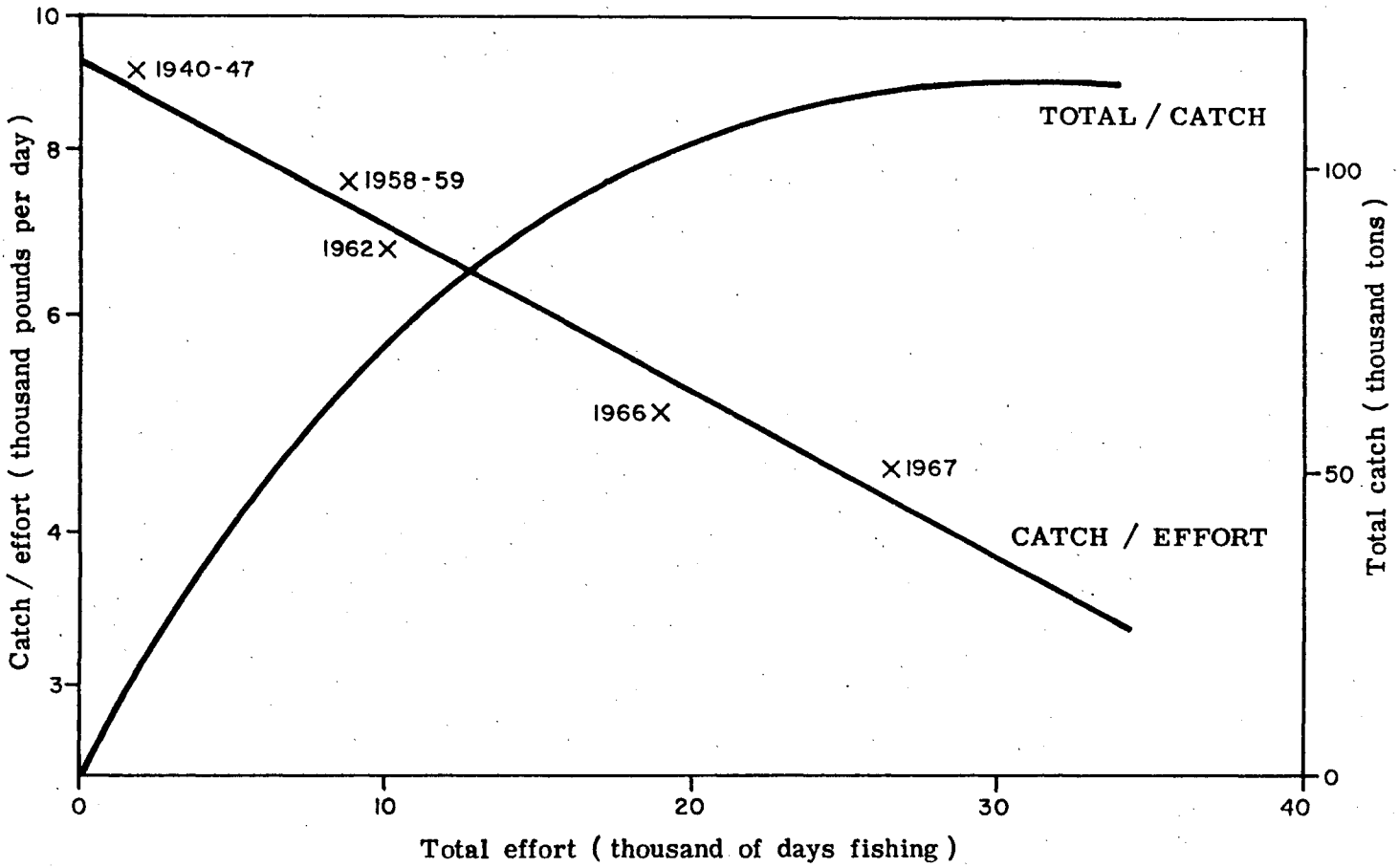
Detailed effort data are available for the South African fleet for the years 1955-62 and 1966 onwards from detailed records kept by South African skippers on log sheets provided by the Division of Sea Fisheries. Less detailed catch and effort data for the South African fleet have been published by Roux (1949) for the period 1940-47. There are also catch and effort data available from a sample of the Spanish fleet.

Using the data for the South African vessels it is possible to obtain estimates of catch, effort, and catch per unit effort for the Cape Grounds (south of 31°S and west of 20°E). Table E.2. has been taken from Jones and van Eck (1967) with additional data for 1967 and expressed in metric units.

Table 5.2 Catches and fishing effort of hake on the Cape Grounds

Period	Average annual catch	Catch per unit effort	Effort
	Metric tons landed weight	Tons per day fishing by standard trawler	Days fighing by standard trawler
1940-47	17,000	9.5	1,790
1958-59	65,500	7.7	8,506

Figure 6 - Relation between effort and catch per unit effort of hake on the Cape Grounds, and corresponding relation between total effort and total catch



Period	Average annual catch	Catch per unit effort	Effort
	Metric tons landed weight	Tons per day fishing by standard trawler	Days fishing by standard trawler
1962	68,300	6.8	10,044
1966	95,000	5.0	19,000
1967	112,000	4.5	24,889

5.6 The relationship between effort and catch per unit effort is plotted in Figure 6, together with the curve of sustainable yield calculated by multiplying catch per unit effort by effort.

It is clear that for the Cape Grounds there has been a clear trend of decreasing catch-rate with increasing fishing effort. Data for 1967 are not yet fully analyzed but a preliminary examination of a sample of the data indicates that catch-rates fell only slightly below the 1965/6 level although there was probably an appreciable increase in fishing. South African data for the Lüderitz Grounds (25°S - 28°S) are available for 1966 and 1967. Here again there has been a decline in catch-rate from 1.1 tons per hour in 1966 to 0.7 tons per hour (provisional estimate) in 1967.

5.7 Spanish catch per effort and effort

The fish are caught by freezers and by trawlers and the latter transship their catches to factories where they are sampled. The catch of gutted headless fish is estimated by the captain each day as the number of blocks. Each block is from 18 to 25 kg. The daily estimates are corrected to the total catch for the voyage of three months. They are also raised to the weight of whole fish using a conversion factor, depending on the nature of the cut, Spanish of Japanese.

About one-third of the fleet was sampled in this way in 1965 and 1966. There are about three kinds of ship employed, each of which will be adequately represented in the sample in the future. From the sample it was shown that the average fishing effort was 200 days/year. The total effort in the sample is given by the number of ships, each raised by its registered tonnage. The same procedure is carried out for the rest of the fleet, the sample being considered representative. The efforts for the sample and for the rest of the fleet are then summed to give the total fishing effort.

5.8 So there are available estimates of catch per effort from the sample, by 5° sectors of latitude and by month for each of the three years 1965, 1966 and 1967. Given the total catch and sample estimates of catch per effort, it is possible to make estimates of total effort.

The Spanish stock density indices from the sampled vessels are, in kg/ton days:

Year	Freezers 20° - 30°S	Non freezers 30° - 35°S
1965	33.1 (3 quarters)	36.2 (12 months)
1966	16.4 (4 quarters)	34.1 (5 months)
1967	13.4 (4 quarters)	
	(averaged by quarters)	(averaged by months)

The stock densities are not comparable between the two groups of ships because much of the registered tonnage of a freezer is not used for catching.

5.9 The catch and effort figures for the sampled vessels and the totals are:

Year	Freezers 20° - 30°S		Non freezers 30° - 35°S		Total catch
	Effort	Catch	Effort	Catch	
1965	64,320	2,259 (3 quarters)	380,000	14,248 (12 months)	118,000
1966	536,920	8,139 (4 quarters)	92,970	3,226 (5 months)	156,000
1967	418,300	5,852 (4 quarters)			185,000
	(ton days)	(t)	(ton days)	(t)	(t)
	(summed by quarters)		(summed by months)		

Assuming that the sample of freezers represents the fraction of fish caught in the north it is possible to estimate total effort in the north by raising the sample effort by the ratio of total freezer catch to the catch of the sampled freezers. The only catch data are for total catch all vessels (freezer plus non-freezers) but it is known that freezers account for a great proportion of the Spanish landings. It is estimated that the total landings for freezers did not exceed 100,000 tons in 1965 and 140,000 tons in 1966. Thus total Spanish effort in the northern area is given by:

$$1965 \quad 64{,}320 \times \frac{100{,}000}{2{,}259} = 2{,}847{,}000 \text{ ton days}$$

$$1966 \quad 536{,}920 \times \frac{140{,}000}{8{,}139} = 9{,}236{,}000 \text{ ton days.}$$

These figures may overestimate fishing effort for the freezers but an independent estimate for 1966, based on the number of vessels fishing, was 8,152,000 ton days. Thus it seems likely that there was at least a doubling of Spanish effort in the northern area between 1965 and 1966.

Taking the South African and Spanish data together it is clear that fishing effort for hake has been increasing over the area as a whole, but the stage has not yet been reached where the total catch has begun to decline for increased effort. However, on the basis of catch and effort data above it would appear that for the Cape Grounds at least the present catch is close to the maximum sustainable yield as estimated in Figure 6.

5.10 Growth rate

Independent estimates of growth rates were available from South African age determination from otoliths from fish caught on the Cape Grounds, from East German data from the Walvis Bay area, from English age determinations for the Walvis Bay area, West German data based on the Petersen method and Spanish age determinations from the Walvis Bay area. These data make no distinction between the various hake species but there appears to be very little difference in the growth rates of M. capensis and M. paradoxus. Agreement between the various sets of data was good. English estimates of mean lengths of age-groups are given below as being representative:

Age-group	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Mean length (cm)	14.8	28.1	37.7	46.6	54.6	62.1	68.7	76.8	80.1	84.0	88.0	90.8

(Otholiths collected in November and age-groups based on a 1 July birth date. The sample consisted predominantly of female fish.)

The van Bertalanffy growth parameters for these data are:

$K = 0.14$
$L_\infty = 110.7$ cm
$W_\infty = 9{,}000$ cm
$t_o = -0.1$

It was noted that several different birth dates were being used by the various workers and it is recommended that 1 January is adopted as the birth date for age determination purposes. The actual spawning season seems to vary over the region and at present it is not possible to define the spawning season with any precision. On the Cape Grounds the main spawining season appears to be late winter to spring (June-September). But on the more northern grounds spawning probably occurs earlier in the year.

5.11 Length composition of the landings

A regular measuring program for the South African landings was commenced in 1966 and length composition data are available, by grounds, for 1966 and 1967. Length compositions per unit fishing effort for the Cape and Lüderitz Grounds are shown in Table 5.3. It can be seen that for both grounds in 1967 there has been a decrease in the abundance of larger fish and an increase in the abundance of smaller fish compared with 1966.

Table 5.3 Length composition of hake catches, 1965 and 1966
(Thousand of fish per 100 hours fishing)

Length (cm)	Cape Grounds		Lüderitz Grounds	
	1966	1967	1966	1967
30-34	1.7	0.7	0	0
35	6.2	9.4	0.7	1.1
40	12.0	17.1	5.5	11.0
45	14.0	12.6	22.5	21.9
50	16.0	11.9	29.7	34.9
55	15.5	11.8	20.7	20.5
60	12.8	7.2	14.7	9.6
65	5.5	3.0	9.6	3.5
70	2.3	0.9	6.3	1.9
75	1.1	0.4	3.1	1.2
80	0.6	0.2	1.6	0.8
85	0.3	0.1	0.6	0.3
90	0.2		0.3	0.2
95	0.1		0.2	
100+			0.1	

5.12 Age composition of catches and total mortality rates

In order to make a preliminary estimate of coefficients of total mortality, the English age determination data in the form of an age-length key have been applied to the South African landings for 1966 and 1967. The data for the Cape and Lüderitz Grounds have been treated separately. Age distributions per unit fishing effort for the two years are given in Table 5.4.

Table 5.4 Age distributions per unit fishing effort of South African landings of hake

Age Group	Cape Grounds		Lüderitz Grounds	
	1966	1967	1966	1967
	No.	No.	No.	No.
III	20	81	32	30
IV	216	252	163	270
V	250	190	401	420
VI	150	104	208	184
VII	98	57	149	94
VIII	27	13	58	22
IX	31	14	57	27
X	8	4	18	8

5.13 Total mortality coefficients have been estimated for the two grounds in two ways. Firstly within each year by calculating the average rate of decline in abundance from one age-group to the next from the catch curve and secondly by calculating mortality rates from the abundance of the same year-class in 1966 and 1967.

Table 5.5 Estimates of total mortality coefficient of hake

(a) From the catch curve

Year	Cape Grounds	Lüderitz Grounds
1966	0.68 (49%)	0.57 (43%)
1967	0.72 (51%)	0.59 (55%)

(b) Between years 1966-67

V - VI	0.88	0.78
VI - VII	0.97	0.80
VII - VIII	2.02	1.91
VIII - IX	0.66	0.76
Average	1.13 (68%)	1.06 (65%)

In considering these mortality estimates it must be remembered that only a single age-length key was available and this had to be applied to all the length compositions. Mortality estimates from the catch curve can in any case only be regarded as a rough estimate. In the results in Table 5.5 (b) the coefficients calculated between age-groups VII and VIII appear to be artificially high, and if these values are omitted, average values of 0.84 (57%) and 0.78 (54%) are obtained.

5.14 Independent estimates of mortality are available from Spanish age composition data for 1966 and 1967 which give values of Z of about 1.2 taking an average between the years for age-groups III-IV and IV-V.

These estimates taken together should provide a reasonable guide to the order of magnitude of the coefficient of total mortality. No attempt is made here to separate the total mortality rate into fishing mortality and natural mortality rates. However this has been attempted in the following section dealing with direct assessment of the total hake stock.

5.15 Direct assessment of the hake stock by echo survey

Two echo surveys have been made in the region to assess directly the magnitude of the total stock of hake in the region. The first survey covered the continental shelf from Cape Point to Walvis Bay and is described by Cushing (1968). The second survey in November 1967 covered the area from Walvis Bay to Cape Frio.

5.16 Area sampled by the echo survey

Catches are recorded as from Southeast Atlantic, i.e. from 6°S to 30°E, around the coast. In fact all catches (except 100 tons from Angola) are taken from Cape Frio. The echo survey covers the area from Cape Town to Walvis Bay. There are three areas:

Cape Frio – Walvis Bay	4° x 1.25°,	240 x 75;	18,000 mls^2
Walvis Bay – Cape Town	4° x 1°,	240 x 60;	14,400
	5° x 2.3°,	300 x 240;	72,000
	2° x 1°,	120 x 60;	7,200
			93,600 mls^2
Cape Town – Port Elizabeth	7° x 2°,	420 x 120;	50,400 mls^2

From the Kirkella voyage between Walvis Bay and Cape Frio in November 1967, 30% of the fish echoes are hake, so we take one-third of the 18,000 miles:

Cape Frio – Walvis Bay	6,000	(30% of 18,000)
Walvis Bay – Cape Town	93,600	
Cape Town – Port Elizabeth	50,400	
	150,000	

The area sampled by echo survey is 93,600/150,000 or 62% of the total statistical area. So the estimated stock of 2.52 million tons should be raised by 1.61.

5.17 Proportion of hake in catches

Trawl hauls by the Africana II outside the areas immediately exploited by the commercial fleet show that the proportion of hake was not quite so high in the catches as originally thought. The following table gives the percentage of hake in the research ship's catches by area:

	Cape	Port Nolloth	Lüderitz	W. Bay	C. Kuene
Oct. 67	85.7	71.7	81.8	11.7	33.3
		83.3	16.0		
		85.0	36.3		
		71.4	57.1		
		84.2	50.0		
		87.5	66.7		
		83.3			
Jan. 68	98.7	70.8	58.1	34.6	41.5
				7.1	36.4
				25.0	
Average	92.2%	71.1%	79.4%	33.9%	37.1%
			56.6%		

5.18 The correction used in the previous section of 1/3 for the area Walvis Bay - Cape Frio is reasonable. But we have assumed that the stock on other grounds was all hake. We may subdivide the area into Cape Grounds, Port Nolloth Grounds and Lüderitz/Walvis Bay Grounds; the proportions of the total fish recorded by the echo sounder in each of the 3 areas were 25.6%, 38.9% and 35.5% respectively. So on the Cape Grounds 92.2% was hake and 92.2% x 25.6% of the total was hake; applying this correction by area and by proportion we find that 71% of the fish sampled by echo survey were hake.

The estimate of stock was 2.52 million tons. By area it should be multiplied by 1.61 and by proportion of hake it should be multiplied by 0.71; 1.61 x 0.71 = 1.15. In weight the stock corrected for the whole area and for hake is: 2.90 million tons or 3.56×10^9 fish. The survey was completed in February 1966 and so represents the stock for the year 1965. The Spanish freezer catches per effort for the years 1965-7 represent the change in stock density in the northern area. In the echo survey, the area of abundance lay north of the Orange River so the Spanish catches per unit effort probably represent the changes in stock density since the time of the survey. The catch per unit effort in 1965 was 33.1 kg/ton day and that in 1967 was 13.4 kg/ton day. So the stock of 2.90 million tons in 1965 (as sampled in February 1966) has declined to $\frac{2.90 \times 13.4}{33.1}$ = 1.17 million tons in 1967. The catch in 1966 was 0.5 million tons, making an allowance for fish discarded or used for fish meal, and it is likely that in 1967 it was also 0.5 million tons. An estimate of F is 0.5/1.17 = 0.43. If Z = 0.6, M = 0.17; if Z = 0.8, M = 0.27 or an average 0.22. Allowance should also be made for catches by countries other than those listed in Table 5.1., for which detailed statistics are not available.

5.19 Selectivity

Detailed data on the selectivity of hake by polyamide trawl codends are available from the joint German/South African experiments conducted during 1967. These experiments have been described by van Eck, Botha, von Brandt and Bohl (1968). This work was carried out on the Cape and Lüderitz Grounds and the results showed a clear negative correlation between selectivity and codend catch size. For the polyamide codends used the selection factors obtained were about 4.0 for small catches (less than 1.5 tons), 3.5-3.6 for medium catches (3.0-4.5 tons) and 2.6 for large catches (7.5-9.0 tons). The results of these experiments also showed that for hake there is a wide selection range.

Codend mesh sizes (stretched mesh) in recent use in hake fishery are believed to be as follows:

Germany (F.R.)	100 mm
Germany (Eastern)	90-120 mm (mainly 120 mm)
Japan	100 mm
South Africa	100 mm
Spain	80 mm
USSR	100-120 mm (mainly 120 mm)

Adopting a selection factor of 3.5 as being an average value for medium catches, 50% retention lengths for a range of mesh sizes are given below:

Mesh size	50% retention length
80 mm	28 cm
90 mm	31.5 cm
100 mm	35 cm
110 mm	38.5 cm
120 mm	42 cm

5.20 It is known that small hake taken in the catches are frequently discarded or used for fish meal and it is unlikely that fish of a size less than 30 cm would be retained for human consumption. Data for South African vessels indicate that fish below about 40 cm are frequently discarded or used for fish meal. For factory vessels the Baader filleting machines normally used will not accept fish of less than 35 cm in length. On the evidence available it would appear that the immediate adoption of a minimum mesh size of 110 mm would be well advised in the interests of conservation of the hake fishery. Because the smallest fish have little or no value it is

unlikely that any immediate loss would result from the use of a 110 mm mesh. In this respect the Spanish Government has taken a lead and is introducing legislation with effect from 1 July 1968 that will require Spanish vessels fishing in this region to use a minimum mesh size of 110 mm for hemp, 108 mm for polyamide or 118 mm for polyethylene codends, and will prohibit the landing of hake of less than 30 cm in length. It is recommended that a minimum mesh size of 110 mm be generally adopted for the Southeast Atlantic hake fishery and that this recommendation be reviewed as more data become available.

5.21 Pelagic fish

Table 5.6 Catches of pelagic fish from the Southeast Atlantic

Years	South Africa (a)						South West Africa (b)		Angola (c)
	Total	Pilchard	Anchovy	Horse mackerel	Mackerel	Total	Pilchard	Anchovy	Pilchard
1957	655.7	107.5		86.7	7.1	201.3	222.8		241.6
1958	520.2	194.6		59.6	20.1	274.3	223.7		92.2
1959	629.1	260.3		21.0	33.1	314.4	271.3		43.4
1960	758.0	317.8		69.0	29.1	415.9	283.0		59.1
1961	902.0	402.4		45.3	52.3	500.0	346.4		55.6
1962	982.5	410.7		72.5	21.2	504.4	400.8		77.3
1963	1 311.2	400.9	23.3	25.9	13.4	463.5	571.8		75.9
1964	1 275.7	257.1	94.9	27.4	52.0	431.4	735.2	0.7	108.4
1965	1 350.8	207.3	208.6	60.6	39.8	516.3	777.1	0.6	56.8
1966	1 219.9	118.4	156.8	30.3	55.6	461.1	687.1	1.9	64.8

(a) by Spanish and South African vessels.

(b) by South African, South West African and Russian vessels.

(c) by Angolan vessels.

Table 5.6 shows that large catches of pelagic fish are made in the Southeast Atlantic, and that after an initial rise in 1957-62 the total catches remained fairly constant at about 1,200 x 10^3 tons. In southern Angola and South West Africa the landings are almost exclusively pilchard (Sardinops ocellata) but in South Africa the pelagic fishery is based on the following four species:

Pilchard	(Sardinops ocellata)
Anchovy	(Engraulis capensis)
Horse mackerel	(Trachurus trachurus)
Mackerel	(Scomber spp.)

In South Africa fishing takes place between 30° - 35° latitude and the total catches made in this area as well as the catches by species are shown in Table 5.6. A fleet of South African vessels accounts virtually for the whole catch and only recently have Spanish vessels operated in the area. Their catches amounted to less than 4 per cent of the total landings. It is apparent from the table that from 1957 the pilchard catch rose steadily to about 400,000 tons in 1961, after which it remained constant for 3 years. In 1964 to 1966 the catches fell markedly. This was in spite of a high level of fishing effort and must be attributed to a decline in stocks.

5.22 Simultaneously with this decline the catches of anchovy increased, a situation which has been observed in Japanese, Californian and Mediterranean pelagic fisheries. The changeover in South

Africa has been documented by le Roux and Stander (1968) and it would appear that a reduction in the pilchard population enabled the anchovy to establish itself to the detriment of the pilchard. The replacement of pilchard by anchovy occurred at different times off Japan (1930's), California (late 1940's), Mediterranean (late 1950's) and off South Africa (early 1960's). This suggests that a common environmental effect did not cause the replacement but that it might be a consequence of the reduction of the pilchard (or sardine) stocks by fishing.

5.23 Landings of the other two species listed in Table 5.6 have fluctuated but there would seem to be no clear trend in these catches. It is also interesting to note that the pilchard and anchovy catches at least are complementary, for in spite of the decline in pilchards the total pelagic landings have remained fairly steady at about 500,000 tons since 1961.

5.24 Size composition and total catch by species have been collected since 1950. In the late 1950's a collection of catch statistics was begun, which was additional to a record of the number and hold capacity of the boats involved in the fishery during each fishing season. There are also some egg survey data for the pilchard. Scales and otoliths for pilchard have been collected since about 1960 and more recently this sampling was extended to the other species. A preliminary paper on pilchard growth has been published (Davis, 1958), but generally the aging of pelagic fish in this area seems difficult. A concentrated effort is now being made to solve age determination problems and it is hoped that pilchard age compositions will be available for periods before and after the important changeover to a predominantly anchovy catch. Anchovy material is also being examined, and it is likely that the age composition of catches of this species will also be available.

5.25 A stock assessment of the fishery is expected to be complicated as four species are involved. It will be difficult to allocate fishing effort between species and in addition the effect of competition between species, e.g. pilchards and anchovy, will have to be accounted for in yield functions which deal with the species separately or the fishery as a whole.

5.26 In South West Africa pilchard fishing is centred mainly around Walvis Bay and to a lesser extent at Lüderitz. The landings of shore based factories are regulated by an annual catch quota. Initially quotas were fairly conservative but as it became apparent that fish were plentiful the quotas were gradually raised and this accounts for the fairly orderly step-wise rise in landings which may be seen in Table 5.6. More recently factory ships from other countries have started fishing for pilchards in waters off South West Africa outside the twelve-mile limit. These vessels are obviously not limited by a quota and this will certainly complicate the regulation of future catches in waters off the coast between the Orange and the Cunene Rivers.

5.27 Some data suitable for an assessment of the pilchard stocks in these waters are available from the Marine Research Laboratory at Walvis Bay. This laboratory conducted a large-scale tagging program during 1957 to 1966, the results of which are now being processed and good estimates of mortality are expected from these data. Landed weight and catch size composition data are available since 1952, but as in South Africa waters, age determination is not easy. There are no estimates of fishing effort other than a record of the number and size of the boats based at Walvis Bay and Lüderitz which fished in each season. Some egg surveys have also been carried out in this area.

5.28 From the results of the tagging program, catch levels and a preliminary growth curve, a preliminary stock assessment will be done. This should be available in the near future.

The landings of pilchard in Angola are also shown in Table 5.6. At the time of the meeting no details are available about research in the area.

6. GENERAL CONSIDERATIONS

6.1 Tuna

Though the tuna fisheries are very important in the area, they are not discussed in detail in this report. This was done for two reasons; first, the tuna stocks and the tuna fisheries extend over the whole of the warmer waters of the Atlantic, so that the situation off the

West African coast cannot be considered in isolation; and second, a Working Group to consider the stock assessment of tuna, set up under FAO's Expert Panel for the Facilitation of Tuna Research, is expected to meet in Miami at the beginning of August 1968. This Group will be paying particular attention to the Atlantic stocks of tuna.

6.2 For the present it was noted that much of the data essential to a proper evaluation of the stocks were being collected, and log book systems for the recording of catch and effort statistics by areas were in operation on both the surface (purse-seine and live-bait) and the Japanese long-line fisheries. Data were also being collected on the size composition of the catches of some of these fisheries. In general, therefore, the collection of basic data is satisfactory, but it is important that this information should also be collected from the rapidly growing fisheries from Korea and Taiwan.

6.3 It was also noted that assessments have been made of the state of the yellowfin tuna stocks by French, American and Japanese scientists. There are slight differences in the interpretation in these studies, particularly concerning the relative effects on the stocks of the surface and long-line fisheries - it will be one task of the proposed Miami Working Group to resolve these differences - but it is clear that the yellowfin stocks are being heavily exploited. On one interpretation of the data, continued fishing at around the present level will rapidly result in a very substantial reduction in the total catch. There is therefore an urgent need to resolve the scientific doubts, and, as necessary, introduce suitable conservation measures to maintain the catch at the optimum level.

6.4 While the scientific problems may be resolved by appropriate Working Groups, such as the one in Miami, the appropriate body taking action on regulation is the International Commission for the Conservation of Atlantic Tuna. The Group therefore noted with regret that insufficient ratifications had as yet been received to bring this Commission into force. Unless this Commission is rapidly brought into operation, and thereafter takes appropriate regulatory action, based on the scientific evidence, there is a definite risk that catches may be severely reduced.

6.5 Mesh regulation

The separate analyses for different regions have shown that in most areas off the West African coast the average catch of some of the more important species would be increased by an increase in the trawl mesh size in use.

Experience in the North Atlantic has shown that there are many problems involved in the introduction and enforcement of minimum mesh regulations. These include:

(a) the method of measuring the mesh size;
(b) varying selectivity of different materials;
(c) chafing gear, and other modifications of the trawl which might reduce its selective action;
(d) enforcement, especially the reassurance of the fishermen of one country that the regulations are being obeyed by fishermen in other countries;
(e) fishing for small species.

The attention of all those concerned with possible mesh regulation in the Eastern Atlantic is drawn to the reports of the two North Atlantic Commissions (ICNAF and NEAFC) concerning these problems.

6.6 Regarding mesh measuring, the Group recommends that mesh sizes should be specified as the internal stretched diameter, as measured by a gauge 2 mm thick exerting a fixed pressure in the plane of the mesh, the value of which may be varied in accordance with the size of mesh and/or the breaking strength of the netting twine. Such a measurement is achieved by the standard ICES gauge, but there seems no need to specify the precise type of gauge to be used. In fact, measurement and enforcement using a simple flat wedge-shaped non-pressure gauge can give entirely satisfactory results provided the operators concerned can regularly calibrate their measurements against a pressure gauge.

6.7 Regarding the selectivity of different materials, the Group recommends that mesh sizes should be specified so as to obtain the desired selectivity (i.e. 50% selection point) with the

material in common use which appears least selective (has the lowest selection factor). If fishermen find it to their immediate advantage to use materials with a higher selectivity, this is bound to be to the long-term advantage also of other fishermen exploiting the same stock.

6.8 Regarding chafing gear, the Group believed that the only satisfactory solution would be to prohibit such gear completely. With modern synthetics, chafing gear seems unnecessary, and does not appear to be widely used in the Northern and Southern areas. In the tropical area a double codend is quite generally used to discourage sharks from eating fish gilled in the codend meshes, and damaging the nets. The Group therefore recommends (i) that an immediate investigation be made concerning the use of chafing gear in the area, and (ii) depending on the results of this investigation, chafing gear should be prohibited either at once or as soon as technical measures can be taken to make its use unnecessary.

6.9 Regarding enforcement, the Group recommends that arrangements for adequate enforcement, preferably on an international basis, should be an integral part of any proposals for the introduction of minimum mesh sizes.

6.10 Echo surveys

The Group noted the successful survey of the hake stocks in the Southern area which provided valuable quantitative estimates of the abundance of these stocks (Sections 5.15. - 18.), and believe that with modern equipment this technique can be used very widely, to aid both the development of fisheries (by describing the pattern of distribution of fish in time and space), and the early determination of when conservation and management are becoming necessary.

6.11 As an example of what might be done an outline proposal for a survey of the northern upwelling zone is given below (6.12. - 15.). The Group also noted the national and regional surveys of Sardinella being carried out with the support of the United Nations Development Program (Special Fund). The details of this work were not examined, but the Group believes that in principle such work should be given strong national and international support.

6.12 The North African upwelling area may be split into four sectors, each with different seasons of upwelling:

Coastline	Season	Length	Width	Steaming distance
		(miles)	(miles)	(miles)
1. Cap Verga - Dakar	Oct.-Apr.	310	125	1 500
2. Dakar - Cap Blanc	Jan.-May	375	100	1 500
3. Cap Blanc - Cap Yubi	Apr.-Aug.	500	100	1 950
4. Cap Guir - Mazagan	May-Sept.	125	65	375

The steaming distance is calculated assuming a grid with lines normal to the coast 30 miles apart. If 6 hauls of one hour each were made in each day, taking up 9 hours, the daily distance steamed at 8 knots would be 110 miles. The length of cruise in the first three areas would be 12-17 days; that in the fourth area would be about three or four days (but see below for the effective length, taking into account the best methods of capture).

6.13 The main species available for examination are:

Pelagic: sardines, sardinellas, horse mackerels, mackerels and anchovies;

Demersal: sparids, sciaenids, hake, mackerels, Paracubiceps, Sardinella aurita.

The pelagic fish distributions appear to be related to the temperature distributions and the bottom fish often live on the sides of canyons. All should be available for capture, for identification purposes, by midwater trawl at night and by bottom trawl in the daytime. In other words pelagic fish are examined by night and demersal fish in the daytime.

6.14 An echo sounder like the Kelvin Hughes Humber gear should be used for the demersal survey because in general the fish are resolved into individuals in the fathom above the bottom and can be readily counted. For pelagic fish a high resolution, high frequency machine, like the Lowestoft 100 kHz machine should be used; the Lowestoft machine has a circuit which separates the individuals from the shoals. At night pelagic fish tend to disperse and it is easy to count them as individuals. The survey should be arranged to cover an area by night and to identify the echoes by capture during that night with a midwater trawl. In the daytime, the same area is investigated for demersal fish. This procedure doubles the times given above if fish are dense; in all regions there are blank areas and so the time for a cruise would be effectively 18-24 days rather than 12-18 days.

The upwelling system should be described during the cruises. Frequent temperature observations with a bathythermograph (or a cheap thermistor chain) are imperative - perhaps every 15 minutes. Nutrient and salinity observations are useful in describing upwelling processes. If analyzed automatically on board with autotechnicon methods, no time is lost.

6.15 If a survey were made once a month, 28 cruises would cover the upwelling area. This means that two ships would be employed, one from October to September, and the other from January to September. It might be worthwhile to employ a third ship on special problems of upwelling.

6.16 Future work

The detailed area analyses have shown how dependent an analysis of the state of stocks is upon strong national programs of research. The most important need for the future is therefore the strengthening of such national programs, including the adequate provision of good series of basic information on the weight caught, the fishing effort, the size composition of the major species, etc.

6.17 The Group believes that this report is as good an evaluation of the present state of the stocks as can be made with the data available. As more data become available it is certain that it will be possible and in fact extremely desirable to make better estimates. The Group also believes that such improved estimates would be best produced by a small Working Group of scientists selected in their individual capacity, similar to the present one. In view of the setting up of new regional fishery bodies in the area, which might wish to accept responsibility for setting up such a Group, or Groups, no definite proposal was made for the continuance of the work of this ACMRR/ICES Group in its present form.

7. SUMMARY

7.1 Statistics

The statistics for the area, as available to the Group, had many shortcomings. These included a poor identification of the types of fish being caught, and of the area in which the catch was taken, absence of information of the fishing effort expended, poor specification of the weight basis used (live weight, or landed weight, after gutting, etc.), and absence of information on fish discarded.

Detailed proposals are made on the way in which the very large number of species caught in the region should be grouped for reported statistics, and also the area divisions to be used. These requirements imply a considerable increase in the detail reported by many national statistical offices to international organizations. However, it is believed that much of the information is already available, either in the national offices or with the commercial firms, especially those operating long-distance vessels.

Though the statistics must be improved, the present statistical and other information from some of the fisheries is sufficient to make useful appraisals of the general state of some of the major stocks in the region, as set out below.

7.2 State of stocks

The state of the stocks was reviewed separately for the three main subdivisions of the area - northern (north of 20° north latitude), the central or tropical subdivision (20° north latitude to 6° south latitude), and the southern (south of 6° south latitude).

In the north some of the major demersal stocks, which include a number of different species - sparids (Dentex, Pagrus, etc.) and hakes - are being very heavily exploited. Probably any further increase in fishing would give no appreciable increase in catch; a moderate decrease in fishing might give an increase in catch, and would certainly decrease the catch per unit effort. The catch might also be increased by use of a rather larger mesh size. The state of some other stocks (horse mackerels, mackerels, blue fish, cephalopods, etc.) is not at present known. One potentially important group of species - the anchovies - is certainly underexploited, and could provide substantial catches. A proposal is made for a detailed echo survey which could give better information on the abundance and distribution of these stocks.

In the central area the demersal stocks also appear to be heavily exploited. The use of a larger trawl mesh might be beneficial to the fisheries. The main possibilities for further development of the fisheries in this region are for the pelagic fish (Sardinella, etc.) and probably also for shrimps.

In the southern area the major demersal fishery, on hake, for which there are good data available, was studied in detail. The data available included good information on catches and fishing effort, size and age composition, and direct estimation of the stock abundance from precision echo surveys. There appears to be some separation between stocks; there has been a general decrease in catch per unit effort, especially in the southern grounds (1967 catch per unit effort less than half the 1940-47 average). On these latter grounds at least, further increase in fishing effort will give no appreciable sustained increase in total catch. Because of the low value of small hake, many of which are rejected, there will be little immediate loss, and probably some long-term gain, from increasing the mesh size in use. As a first step, pending further analysis, a minimum mesh size of 110 mm is recommended.

The pelagic stocks, which provide a total catch of over 1 million tons, were not studied in such detail, though a good supply of information is available in the local laboratories. The stocks are probably at least moderately heavily fished, and in the south there appears to be a similar fishery-induced change in the species composition - from sardines to anchovy - as is believed to have occurred in other areas, e.g. off California.

The important tuna stocks in the tropical Atlantic were also not considered in detail, to avoid duplication of work with another Working Group to take place in August. There is, however, good evidence that the stocks at least of yellowfin are heavily fished, and that conservation measures may be required.

FIGURE LEGENDS

Figure 1 - Relation between fishing effort and catches per unit effort of hake off North West Africa (means of 5-year periods).

Figure 2 - Estimated steady state relation between fishing effort and average total catch of hake.

Figure 3 - Comparison of catches per unit effort of sparids off North West Africa by trawlers from USSR and Portugal.

Figure 4 - Relation between fishing effort and catches per unit effort in the same year of sparids off North West Africa, and corresponding relation between total effort and average total catch.

Figure 5 - As Figure 4, but effort calculated as the mean effort during the year of observation and the previous year.

Figure 6 - Relation between effort and catch per unit effort of hake on the Cape Grounds, and corresponding relation between total effort and total catch.

APPENDIX 1

AGENDA

1. Division of work by different areas of West African coast (north, central and south)
2. Report from ICES/FAO Symposium
3. Review of statistics on catch and fishing effort
4. Selection of species of immediate importance for detailed analysis
5. Evidence on stock separation
6. Estimation of total catch, catch per unit effort and total effort for major stocks
7. Review of data on length or age composition of major stocks
8. Identification of stocks which are (i) heavily fished, and appear in need of conservation, or (ii) lightly fished, and represent a large and relatively unexploited potential
9. For the heavily fished stocks, quantitative estimation of the degree of exploitation (e.g. from the ratio F : M) and assessment for these stocks of the effects on stock abundance and catches of possible regulations of (i) mesh size of trawls, (ii) amount of fishing (fishing mortality)
10. Recommendations for future work: (i) catch and effort statistics; (ii) biological and environmental research; (iii) other
11. Preparation of report
12. Any other business

APPENDIX 2

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Other scientists attending the ICES/FAO symposium immediately preceding the Working Group also took part in some of the meetings of the Working Group.

APPENDIX 3

LIST OF STATISTICAL CATEGORIES: EASTERN CENTRAL ATLANTIC

FAO/ISSCAAP "DIVISIONS", "GROUPS OF SPECIES", "Statistical categories"	Families, Genera, Species, included in each "Statistical category"
1 FRESHWATER AND DIADROMOUS FISHES	
15 SHADS, MILKFISHES, ETC.	
15(a) Bonga	*Ethmalosa fimbriata*
15(z) Various shads	All species belonging to Group 15 but not identified more specifically above
2 MARINE FISHES	
21 FLOUNDERS, HALIBUTS, SOLES, ETC.	
21(a) Pleuronectiforms	Soleidae *Solea* spp. *Dicologlossa* spp. *Pegusa* spp. *Synaptura* spp. Any other species belonging to the Soleidae Cynoglossidae *Cynoglossus* spp. Any other species belonging to the Cynoglossidae Psettodidae Bothidae (= Scophtalmidae) *Lepidorhombus* spp.
21(z) Various teleostean flatfishes . .	All species belonging to Group 21 but not identified more specifically above
22 CODS, HAKES, HADDOCKS, ETC.	
22(a) Hakes	Merlucciidae *Merluccius merluccius* *Merluccius senegalensis* *Merluccius cadenati* Any other species belonging to the Merlucciidae
22(z) Various gadoids	Gadidae *Gadus luscus* *Phycis (= Urophycis)* spp.
23 REDFISHES, BASSES, CONGERS, ETC.	
23(a) Congers, moray eels	Congridae *Conger* spp. *Phyllogramma* spp. Any other species belonging to the Congridae and Muraenidae

APPENDIX 3 (Continued)

FAO/ISSCAAP "DIVISIONS", "GROUPS OF SPECIES", "Statistical categories"	Families, Genera, Species, included in each "Statistical category"
23(b) Croakers	Sciaenidae *Otolithus (Pseudotolithus)* spp. *Fonticulus* spp. *Sciaena (Johnius)* spp. *Umbrina* spp. *Larimus* spp. *Pteroscion* spp. *Pentheroscion* spp. Any other species belonging to the Sciaenidae
23(c) Goatfishes, surmullets	Mullidae *Mullus* spp. *Upeneus (= Pseudupeneus)* spp. Any other species belonging to the Mullidae
23(d) Grunters	Pomadasyidae *Pomadasys* spp. *Parapristipoma* spp. *Brachydeuterus auritus* Any other species belonging to the Pomadasyidae
23(e) Gurnards	Triglidae *Trigla* spp. *Lepidotrigla* spp. Any other species belonging to the Triglidae
23(f) John Dories	Zeidae *Zeus faber* Any other species belonging to the Zeidae
23(g) Marine catfishes	Ariidae (= Bagridae) *Arius (= Tachysurus)* spp. Any other species belonging to the Ariidae
23(h) Snappers	Lutjanidae *Lutjanus* spp. Any other species belonging to the Lutjanidae
23(i) Scorpionfishes	Scorpaenidae *Scorpaena* spp. *Pontinus* spp. *Helicolenus* spp. Any other species belonging to the Scorpaenidae
23(j) Sea-basses, sea-perches, groupers	Serranidae *Epinephelus (Serranus)* spp. *Polyprion* spp. *Morone* spp. *Paracentropristis (= Serranellus)* spp. Any other species belonging to the Serranidae

APPENDIX 3 (Continued)

FAO/ISSCAAP "DIVISIONS", "GROUPS OF SPECIES", "Statistical categories"	Families, Genera, Species, included in each "Statistical category"
23(k) Sea-breams, porgies	Sparidae *Dentex* spp. *Pagellus* spp. *Pagrus* spp. *Sparus* spp. *Boops* spp. *Lithognathus* spp. *Sarpa* spp. *Diplodus* spp. *Spondyliosoma* spp. *Puntazzo* spp. Any other species belonging to the Sparidae
23(l) Butterflyfishes	Chaetodontidae *Drepane africana* *Ephippus* spp. Any other species belonging to the Chaetodontidae
23(m) Alfonsinos	Berycidae *Beryx* spp. *Platyberyx* spp. Any other species belonging to the Berycidae
23(z) Various demersal percomorphs . .	All species belonging to Group 23 but not identified more specifically as belonging to 23(a) through 23(m) above
24 JACKS, MULLETS, ETC.	
24(a) Amberjacks	Seriolidae *Seriola* spp. Any other species belonging to the Seriolidae
24(b) Barracudas	Sphyraenidae *Sphyraena* spp. Any other species belonging to the Sphyraenidae
24(c) Bluefishes	Pomatomidae *Pomatomus (= Temnodon) saltator* Any other species belonging to the Pomatomidae
24(d) Butterfishes	Stromateidae *Stromateus* spp. Any other species belonging to the Stromateidae
24(e) Horse mackerels, mackerel scads .	*Trachurus* spp. *Selar crumenophthalmus* *Decapterus* spp. *Decapterus (= Caranx) rhonchus*

APPENDIX 3 (Continued)

FAO/ISSCAAP "DIVISIONS", "GROUPS OF SPECIES", "Statistical categories"	Families, Genera, Species, included in each "Statistical category"
24(f) Mullets	Mugilidae *Mugil* spp. *Liza* spp. Any other species belonging to the Mugilidae
24(g) Other carangids	Carangidae *Caranx* spp. *Lichia* spp. *Trachinotus* spp. *Vomer setipinis* *Hynnis goreensis* *Chloroscombrus chrysurus* Carangidae, n.e.s. Any other species belonging to the Carangidae
24(h) Pomfrets	Bramidae *Brama rait* Any other species belonging to the Bramidae
24(i) Threadfins	Polynemidae *Polydactylus quadrifilis* *Galeoides decadactylus* *Pentanemus quinquarius* Any other species belonging to the Polynemidae
24(z) Various pelagic percomorphs . . .	All species belonging to Group 24 but not identified more specifically as belonging to 24(a) through 24(i) above
25 HERRINGS, SARDINES, ANCHOVIES, ETC.	
25(a) Anchovies	Engraulidae *Engraulis encrasicholus* *Engraulis hepsetus* *Anchoviella guineensis* Any other species belonging to the Engraulidae
25(b) European sardine (Pilchard) . . .	*Sardina pilchardus*
25(c) Round sardinella	*Sardinella aurita*
25(d) Flat sardinella	*Sardinella eba*
25(z) Various marine clupeoids	All species belonging to Group 25 but not identified more specifically as belonging to 25(a) through 25(d) above
26 TUNAS, BONITOS, SKIPJACKS	
26(a) Albacore	*Thunnus (= Germo) alalunga*
26(b) Bigeye tuna	*Thunnus (= Parathunnus) obesus*
26(c) Bluefin tuna	*Thunnus thynnus*
26(d) Atlantic bonito	*Sarda sarda*

APPENDIX 3 (Continued)

FAO/ISSCAAP "DIVISIONS", "GROUPS OF SPECIES", "Statistical categories"	Families, Genera, Species, included in each "Statistical category"
26(e) Frigate mackerel	*Auxis thazard*
26(f) Little tuna	*Euthynnus alletteratus*
26(g) Skipjack	*Euthynnus (= Katsowonus) pelamis*
26(h) Yellowfin tuna	*Thunnus (= Neothunnus) albacares*
26(z) Various tuna-like scombriforms .	All species belonging to Group 26 but not identified more specifically as belonging to 26(a) through 26(h) above
27 MACKERELS, BILLFISHES, CUTLASSFISHES	
27(a) Billfishes	Istiophoridae *Istiophorus* spp. *Makaira* spp. *Tetrapterus* spp. Any other species belonging to the Istiophoridae
27(b) Cutlassfishes	Trichiuridae *Lepidopus caudatus* *Trichiurus lepturus* *Aphanopus carbo* Any other species belonging to the Trichiuridae
27(c) King mackerels, Wahoo	Cybiidae *Scomberomorus maculatus* *Scomberomorus* spp. *Acanthocybium solandri* Any other species belonging to the Cybiidae
27(d) Chub (Spanish) mackerel	*Scomber (= Pneumatophorus) colias* *(= Scomber japonicus)*
27(e) Broadbill swordfish	*Xiphias gladius*
27(z) Various mackerel-like scombriforms	All species belonging to Group 27 but identified more specifically as belonging to 27(a) through 27(e) above
28 SHARKS, RAYS, CHIMAERAS	
28(a) True (large) sharks	Lamnoidei, Scyliorhinoidei *Isurus* spp. *Alopias* spp. *Carcharodon* spp. Carcharhinidae Sphyrnidae Any other species belonging to the Lamnoidei, Scyliorhinoidei

APPENDIX 3 (Continued)

FAO/ISSCAAP "DIVISIONS", "GROUPS OF SPECIES", "Statistical categories"	Families, Genera, Species, included in each "Statistical category"
28(b) Dogfishes, hounds, etc.	Squalidae Squatinidae Scyliorhinidae *Mustelus* spp.
28(c) Guitarfishes, skates, etc. . . .	Rhinobatidae, Trygonidae, Myliobatidae *Rhinobatos* spp. *Rhynchobatos* spp. *Dasyatis* spp. *Myliobatis* spp. *Pteromylaeus* spp. Any other species belonging to the Rhinobatidae, Trygonidae, Myliobatidae
28(d) Rays and smallish rajiforms . . .	Rajidae, Trygonidae *Raja* spp. *Dasyatis margarita* Any other species belonging to the Rajidae, Trygonidae
28(z) Various cartilaginous fishes . .	All species belonging to Group 28 but not identified more specifically as belonging to 28(a) through 28(d) above
29 UNSORTED AND UNIDENTIFIED FISHES	
29 - Unsorted and unidentified fishes .	(i) Unsorted and mixed fishes not otherwise classifiable (ii) Unidentified fishes (iii) Unspecified catches and landings
3 CRUSTACEANS, MOLLUSCS AND OTHER INVERTEBRATES	
31 CRUSTACEANS	
31(a) European lobster	*Homarus vulgaris*
31(b) Norway lobster	*Nephrops norvegicus*
31(c) Green spiny lobster	*Panulirus regius (= rissoni)*
31(d) Spiny lobsters, n.e.s.	*Palinurus vulgaris* *Palinurus mauritanicus*
31(e) Rosy shrimp	*Parapenaeus longirostris*
31(f) Deepsea red prawns	Penaeidae *Plesiopenaeus edwardsianus* *Aristeus antennatus* *Aristeomorpha foliacea* Any other species belonging to the Penaeidae

APPENDIX 3 (Concluded)

FAO/ISSCAAP "DIVISIONS", "GROUPS OF SPECIES", "Statistical categories"	Families, Genera, Species, included in each "Statistical category
31(g) Pink shrimps	*Penaeus duorarum* *Penaeus kerathurus*
31(h) "Vili" shrimp	*Parapeneopsis atlantica*
31(i) Crabs and crab-like crustaceans .	Brachiura spp. Anomura spp.
31(z) Various marine crustacesns	All species belonging to Group 31 but not identified more specifically as belonging to 31(a) through 31(i) above
32 MOLLUSCS	
32(a) Squids	Loliginidae, Ommastrephidae *Loligo* spp. *Illex* spp. *Todaropsis* spp. *Ommastrephes* spp.
32(b) Cuttlefishes	*Sepia* spp.
32(c) Octopuses	*Octopus* spp.
32(d) Various Cephalopoda	All species belonging to the Cephalopoda other than those identified under 32(a) through 32(c) above
32(e) Oysters	*Ostrea* spp.
32(f) Mussels	Mytilidae
32(g) Clams, scallops, etc.	All species belonging to the Pelecypoda other than those identified under 32(e) through 32(f) above
32(z) Various marine molluscs	All molluscs (excluding Cephalopoda and Pelecypoda) belonging to the Gastropoda and Amphineura, i.e., all other species not identified under 32(a) through 32(g) above.
7 AQUATIC PLANTS	
71 AQUATIC PLANTS	
71(a) Red seaweeds	Rhodophyceae
71(z) Various seaweeds	All species belonging to Group 71 but not identified more specifically above.

APPENDIX 4

LIST OF STATISTICAL CATEGORIES: SOUTHEAST ATLANTIC

FAO/ISSCAAP "DIVISIONS", "GROUPS OF SPECIES", "Statistical categories"	Families, Genera, Species, included in each "Statistical category"
1 FRESHWATER AND DIADROMOUS FISHES	
15 SHADS, MILKFISHES, ETC.	
15(a) Bonga	*Ethmalosa fimbriata*
15(z) Various shads	All species belonging to Group 15 but not identified more specifically above
2 MARINE FISHES	
21 FLOUNDERS, HALIBUTS, SOLES, ETC.	
21(a) Soles	*Austroglossus pectoralis* *Austroglossus microlepis*
21(z) Various teleostean flatfishes . .	Any other species belonging to the Heterosomata
22 CODS, HAKES, HADDOCKS, ETC.	
22(a) Hakes	Merlucciidae *Merluccius capensis* *Merluccius paradoxus* *Merluccius polli* Any other species belonging to the Merlucciidae
22(z) Various gadoids	Any other species belonging to the Gadiformes
23 REDFISHES, BASSES, CONGERS, ETC.	
23(a) Anglerfish	*Lophius piscatorius* Any other species belonging to the Lophiidae
23(b) Congers, moray eels	Congridae, Muraenidae, *Phillogramma* spp.
23(c) Croackers	Sciaenidae, Coracinidae *Otolithus ruber* *Johnius (Argyrozona) hololepidotus* *Sciaena capensis* *Atractoscion aequidens* *Sciaena (= Umbrina) macroptera* *Coracinus capensis* Any other species belong to the Sciaenidae and Coracinidae
23(d) Goatfishes, surmullets	Mullidae *Upeneus (= Pseudupeneus)* spp. Any other species belonging to the Mullidae
23(e) Kinglip	*Xiphirius (= Genypterus) capensis*

APPENDIX 4 (continued)

FAO/ISSCAAP "DIVISIONS", "GROUPS OF SPECIES", "Statistical categories"	Families, Genera, Species, included in each "Statistical category"
23(f) Grunters	Pomadasyidae *Pomadasys commersoni* *Pomadasys olivaceum* *Pomadasys operculare* *Pomadasys* spp. *Parapristipoma* spp. Any other species belonging to the Pomadasyidae
23(g) Gurnards	Triglidae *Trigla kumu* *Trigla queketti* *Trigla capensis* *Trigla lyra* Any other species belonging to the Triglidae
23(h) John Dories	Zeidae *Zeus faber*
23(i) Marine catfishes	Ariidae (= Bagridae) *Arius* (= *Tachysurus*) spp. Any other species belonging to the Ariidae
23(j) Scorpionfishes	Scorpaenidae *Sebastichthys capensis* *Helicolenus maculatus* Any other species belonging to the Scorpaenidae
23(k) Sea-basses, sea-perches, groupers .	Serranidae *Epinephelus andersoni* *Epinephelus grammatophorus* *Epinephelus guaza* *Epinephelus* spp. *Polyprion americanus* Any other species belonging to the Serranidae
23(l) Sea-breams, porgies	Sparidae, Denticidae *Diplodus sargus* *Diplodus trifasciatus* *Rhabdosargus globiceps* *Rhabdosargus sarba* *Rhabdosargus tricuspidens* *Sparodon durbanensis* *Cymatoceps nasutus* *Pachymetopon aeneum* *Pachymetopon grande* *Pachymetopon blochii* *Chrysoblephus cristiceps* *Chrysoblephus gibbiceps* *Chrysoblephus laticeps* *Chrysoblephus puniceus* *Cheimerius* (= *Dentex*) *nufar* *Polysteganus undulosus* *Polysteganus praeorbitalis*

APPENDIX 4 (continued)

FAO/ISSCAAP "DIVISIONS", "GROUPS OF SPECIES", "Statistical categories"	Families, Genera, Species, included in each "Statistical category"
23(l) Sea-breams, porgies (concluded)	*Petrus rupestris* *Argyrozona argyrozona* *Lithognathus lithognathus* *Lithognathus mormyrus* *Gymnocrotaphus curvidens* *Pagellus natalensis* *Pterogymnus laniarius* *Spondyliosoma emarginatum* *Porcostoma dentata* *Dentex* spp. *Pagrus* spp. *Sarpa* spp. *Sparus* spp. Any other species belonging to the Sparidae and Denticidae
23(m) Butterfishes	Chaetodontidae *Drepane africana* *Ephippus* spp. Any other species belonging to the Chaetodontidae
23(n) Smares	Centracanthidae
23(o) Snappers	Lutjanidae
23(p) Scavengers	Lethrinidae *Lethrinus nebulosus* Any other species belonging to the Lethrinidae
23(z) Various demersal percomorphs . . .	All species belonging to Group 23 but not more specifically identified as belonging to 23(a) through 23(p) above.
24 JACKS, MULLETS, ETC.	
24(a) Amberjack	*Seriola pappei* Any other species belonging to the Seriolidae
24(b) Barracuda	*Sphyraena japonica* Any other species belonging to the Sphyraenidae
24(c) Bluefish	*Pomatomus (= Temnodon) saltator*
24(d) Butterfishes	Stromateidae *Stromateus* spp. Any other species belonging to the Stromateidae
24(e) Maasbanker	*Trachurus trachurus (capensis)*

APPENDIX 4 (continued)

FAO/ISSCAAP "DIVISIONS", "GROUPS OF SPECIES", "Statistical categories"	Families, Genera, Species, included in each "Statistical category"
24(f) Horse mackerels, mackerel scads .	*Selar crumenophthalmus* *Decapterus* spp. *Decapterus (= Caranx) rhonchus*
24(g) Mullets	Mugilidae *Mugil cephalus* *Mugil tricuspidens* *Mugil richardsoni (= Liza ramada)* *Mugil euronotus* Any other species belonging to the Mugilidae
24(h) Other carangids	Carangidae *Naucrates ductor* *Megalaspis cordyla* *Selar* spp. *Vomer* spp. Any other species belonging to the Carangidae except those classified elsewhere under this Group 24
24(i) Pomfret	*Brama rati* Any other species beloning to the Bramidae
24(j) Threadfins	*Polydactylus* spp. *Pentanemus* spp.
24(z) Various pelagic percomorphs . . .	All species belonging to Group 24 but not identified more specifically as belonging to 24(a) through 24(j) above.
25 HERRINGS, SARDINES, ANCHOVIES, ETC.	
25(a) Cape anchovy	*Engraulis capensis (= japonicus)*
25(b) South African pilchard	*Sardinops ocellata*
25(c) Round sardinella	*Sardinella aurita*
25(d) Flat sardinella	*Sardinella eba*
25(z) Various marine clupeoids	Any other species of Engraulidae, *Sardinella* spp. and other marine Clupeidae not identified more specifically as belonging to 25(a) through 25(d) above.
26 TUNAS, BONITOS, SKIPJACKS	
26(a) Albacore	*Thunnus (= Germo) alalunga*
26(b) Bigeye tuna	*Thunnus (= Parathunnus) obesus*
26(c) Bluefin tuna	*Thunnus thynnus*
26(d) Atlantic bonito	*Sarda sarda*

APPENDIX 4 (continued)

FAO/ISSCAAP "DIVISIONS", "GROUPS OF SPECIES", "Statistical categories"	Families, Genera, Species, included in each "Statistical category"
26(e) Frigate mackerel	*Auxis thazard*
26(f) Little tuna	*Euthynnus alletteratus*
26(g) Skipjack	*Euthynnus (= Katsowonus) pelamis*
26(h) Yellowfin tuna	*Thunnus (= Neothunnus) albacares*
26(z) Various tuna-like scombriforms . .	All species belonging to Group 26 but not identified more specifically as belonging to 26(a) through 26(h) above.
27 MACKERELS, BILLFISHES, CUTLASSFISHES, ETC.	
27(a) Billfishes	Istiophoridae *Istiophorus* spp. *Makaira* spp. *Tetrapterus* spp. Any other species belonging to the Istiophoridae
27(b) Cutlassfishes	Trichiuridae *Lepidopus caudatus* *Trichiurus lepturus* Any other species belonging to the Trichiuridae
27(c) King mackerels, Wahoo	Cybiidae *Scomberomorus commersoni* *Scomberomorus maculatus* *Scomberomorus guttatus* *Acanthocybium solandri* Any other species belonging to the Cybiidae
27(d) Chub (Spanish) mackerel	*Scomber (= Pneumatophorus) colias* *(= Scomber japonicus)*
27(e) Snoek	*Thyrsites atun*
27(f) Broadbill swordfish	*Xiphias gladius*
27(z) Various mackerel-like scombriforms	All species belonging to Group 27 but not identified more specifically as belonging to 27(a) through 27(f) above.
28 SHARKS, RAYS, CHIMAERAS	
28(a) True (large) sharks	Lamnoidei, Scyliorhinoidei *Isurus* spp. *Alopias* spp. *Carcharodon* spp. Carcharhinidae Sphyrnidae Any other species belonging to the Lamnoidei and Scyliorhinoidei

APPENDIX 4 (continued)

FAO/ISSCAAP "DIVISIONS", "GROUPS OF SPECIES", "Statistical categories"	Families, Genera, Species, included in each "Statistical category"
28(b) Dogfishes, hounds, etc.	Squalidae Squatinidae Scyliorhinidae *Mustelus* spp.
28(c) Guitarfishes, skates, etc. . . .	Rhinobatidae, Trygonidae, Myliobatidae *Rhinobatos* spp. *Rhynchobatos* spp. *Dasyatis* spp. *Myliobatis* spp. *Pteromylaeus* spp. Any other species belonging to the Rhinobatidae, Trygonidae and Myliobatidae
28(d) Rays and smallish rajiforms . . .	Rajidae, Trygonidae *Raja* spp. *Dasyatis margarita* Any other species belonging to the Rajidae and Trygonidae
28(z) Various cartilaginous fishes . .	All species belonging to Group 28 but not identified more specifically as belonging to 28(a) through 28(d) above.
29 UNSORTED AND UNIDENTIFIED FISHES	
29 - Unsorted and unidentified fishes .	(i) Unsorted and mixed fishes not otherwise classifiable
	(ii) Unidentified fishes
	(iii) Unspecified catches and landings
3 CRUSTACEANS, MOLLUSCS AND OTHER INVERTEBRATES	
31 CRUSTACEANS	
31(a) Cape spiny lobster	*Jasus lalandii*
31(b) Tristan spiny lobster	*Jasus tristani*
31(c) Natal spiny lobster	*Palinurus gilchristi*
31(d) Transkei spiny lobster	*Panulirus burgeri*
31(e) Shrimps and prawns	Penaeidae
31(f) Crabs	Brachiura, Anomura spp.
31(z) Various marine crustaceans . . .	All species belonging to Group 31 but not identified more specifically as belonging to 31(a) through 31(f) above.

APPENDIX 4 (concluded)

FAO/ISSCAAP "DIVISIONS", "GROUPS OF SPECIES", "Statistical categories"	Families, Genera, Species, included in each "Statistical category"
32 MOLLUSCS	
32(a) Squids	*Loligo* spp.
32(b) Cuttlefishes	*Sepia* spp.
32(c) Octopuses	*Octopus* spp.
32(d) Various Cephalopoda	All species belonging to the Cephalopoda other than those identified under 32(a) through 32(c) above.
32(e) Oysters	*Ostrea* spp.
32(f) Mussels	Mytilidae
32(g) Abalones	*Haliotis* spp.
32(h) Clams, scallops, etc.	All species belonging to the Pelecypoda other than those identified under 32(e) through 32(g) above.
32(z) Various marine molluscs	All molluscs (excluding Cephalopoda and Pelecypoda) belonging to the Gastropoda and Amphineura, i.e., all other species not identified under 32(a) through 32(h) above.

APPENDIX 5

Eastern Central and Southeast Atlantic:
Map for statistical purposes

REFERENCES

Crosnier, A. and E. De Bondy, Les crevettes commercialisables de la côte ouest de l'Afrique
1967 inter-tropicale. Paris, ORSTOM, Document 380-SP

Cushing, D.H., The abundance of hake off South Africa. Fishery Invest.,Lond.(2), 21(5):27 p.
1968

_____, The number of pilchards in the Channel. Fishery Invest.,Lond.(2), 21(5):27 p.
1957

Davies, D.H., The South African pilchard (Sardinops ocellata). Preliminary report on the
1958 age composition of the commercial catches, 1950-55. Investl Rep.Div.Fish.Un.S.Afr.,
33:1-19

Jones, B.W. and T.H. van Eck, The Cape hake: its biology and the fishery. S.Afr.Shipp.News
1967 Fishg ind.Rev., 22(11):90-97

Stander, G.H. and P.J. le Roux, Notes on fluctuations of the commercial catch of the South
1968 African pilchard (Sardinops ocellata), 1950-1965. Investl Rep.Div.Fish.Un.S.Afr.,
65:1-14

van Eck, T.H. et al., The selectivity of synthetic febre codends for the capture of South
1968 African hake. S.Afr.Shipp.News Fishg ind.Rev., 23(1)