DEVELOPMENTS AND TRENDS IN EEC FISHERIES WITH SPECIAL REFERENCE TO AQUACULTURE

by

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M. Phil. Thesis

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Summary

This study analyses official data submitted by national authorities to international organisations or published nationally in order to determine the developments in EEC fisheries. For the relevant technical aspects of fisheries a literature survey has been made.

With the extension of economic zones the Community's supply of traditional food fish has dropped by about 1 million tonnes per year since 1971. Catches of these fish in distant waters are less than half the level in 1971. The Community's total fish production only remains at its earlier level because of a doubling of the catch of industrial species and a five-fold increase in catches of non-traditional food fish.

The future catch from marine waters will probably be at the same level as at present. Many of the fish stocks will be subjected to more stringent management measures but a deep water fishery could be developed. Community interest in the Antarctic krill fishery is thought to be minimal.

With the redistribution of catches amongst fishing nations the volume of foreign trade in fish and related products has increased and will probably continue to do so.

The number of distant water fishing vessels has decreased with the limitation on access to these waters. The tonnage of near water vessels has increased slightly as a result of the effort to make up the deficit in distant water catches.

Aquacultural production in the Community has not fulfilled earlier forecasts. It will never be large enough to make up the deficit from marine fisheries but there are good prospects for the production of higher valued species. The level of such production will depend on technological progress and on the encouragement given by the central authorities.

Aquaculture, EEC, Fisheries, Future, Trends.

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SIGNS AND ABBREVIATIONS

-	zero
0	less than half the last digit recorded
:	unknown
≠	estimated by the national authorities or EUROSTAT
*	estimated by the author
t	metric ton (tonnes)
Mt	million tonnes
m	metre
km	kilometre
kg	kilogram
GRT	gross registered tonnage (of vessels)
DM	Deutsch mark
FF	French franc
LIT	Italian lire
HFL	Florin (Guilder)
BFR	Belgian franc
LFR	Luxembourg franc
UKL	Pound sterling (£)
IRL	Irish pound
DKR	Danish crown
EUA	European unit of account (see Appendix A for definition).

ACRONYMS

EEC	European Economic Communities
EIFAC	European inland Fisheries Advisor Council
EUROSTAT	Statistical Office of the European Communities
EUR 6	Six original Member States of the EEC (FR Germany France, Italy, Netherlands, Belgium and Luxembourg)
EUR 9	EUR 6 plus United Kingdom, Ireland and Denmark
EUR 9+3	EUR 9 plus three applicant states (Greece, Spain and Portugal)
FAO	Food and Agriculture Organisation of the United Nations
ICES	International Council for the Exploration of the Sea
ICNAF	International Commission for the Northwest Atlantic Fisheries (superceded by NAFO)
NAFO	Northwest Atlantic Fisheries Organisation
NEAFC	North East Atlantic Fisheries Commission
OECD	Organisation for Economic and Cooperative Development
"3"	The three applicant members of the EEC (Greece, Spain and Portugal).

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Lastly, I would like to thank my wife, Elisabeth, for her encouragement and for cheerfully assuming more than her share of parental responsibilities during the period of the study.

Luxembourg,
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AUTHOR'S NOTE

Although this study was conducted as part of my duties in the Statistical Office of the European Communities, I am solely responsible for the content thereof. Certainly any interpretation of data and opinions expressed in the study should not be assumed to represent the views and policies of the Statistical Office and its parent body, the Commission of the European Communities.

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CHAPTER 1

INTRODUCTION

INTRODUCTION

A. History of Community Fisheries

The Member States of the European Communities have been actively involved in fisheries for many centuries. Indeed, one of the earliest commercial fisheries, commencing about 1 000 A.D. was that exploiting the herring stocks of the southern North Sea by vessels from ports on the east coast of England (notably Great Yarmouth), and on the Dutch coast. The technique developed by the Phoenicians of preserving fish in salt was late in reaching Western Europe but when it did, in the Middle Ages, an important and valuable trade in fishery products developed. The extent of this trade may be assessed from the fact that in the 16th century about one fifth of the Dutch population was directly or indirectly involved in fishing, and it is widely considered that the Dutch financed their successful campaign for liberation from Spanish domination from the proceeds of the herring trade.

The coastal states of Western Europe are very fortunate in their position, the Northeast Atlantic being one of the most productive areas of the world's oceans. This high productivity is due to the effect of the warm waters of the Gulf Stream mixing with the minerally rich run-off from the European continent and is witnessed by the high level of production of phytoplankton of the region (see Fig. 1.1). Since phytoplankton is the base of the food chains of all harvested products of the sea, the productivity of the latter is correspondingly high. Some impression of this high productivity may be gained from the catch per unit area of the region compared with other regions (see Table 1.1). These data may not be taken as direct measures of the productivity since differences in the intensity of fishing have not been considered. Indisputably, the intensity of fishing in the Northeast Atlantic is higher than in many of the other areas, but the differences in the apparent productivity, as measured by the catch per unit area, are unlikely to be due to the intensity of fishing alone.

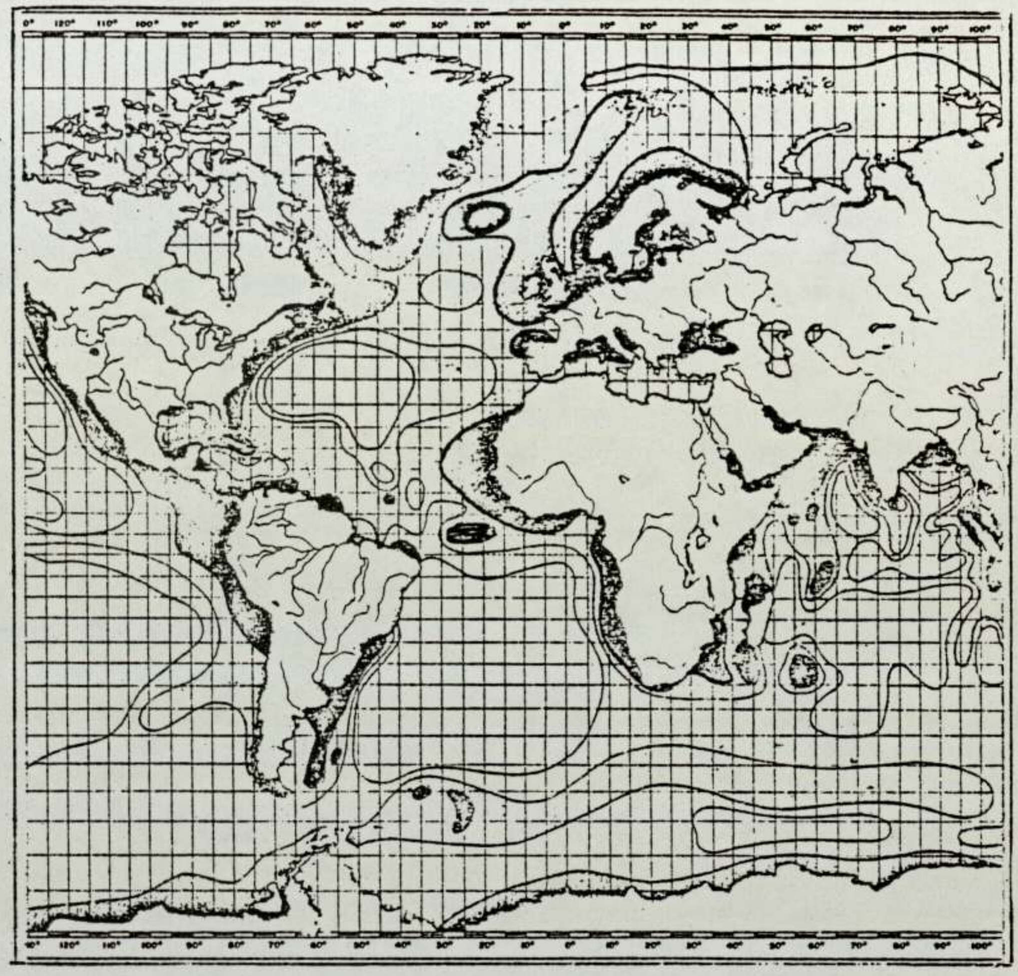


Figure 1.1: The production of phytoplankton

(The heavier the shading, the denser the phytoplankton.)

Region	Catch (000 tonnes)	Area (000 sq. km)	Catch/unit area (tonnes/sq.km)
Atlantic NW	3 461	5 207	0.54
NE	12 035	16 877	0.71
WC	1 853	14 681	0.13
EC	3 046	13 979	0.22
SW	1 394	17 756	0.08
SE	3 292	18 594	0.18
Medit. + Black Sea	1 239	2 980	0.42
Indian Oc. W	2 316	30 198	0.08
E	1 340	29 485	0.05
Pacific NW	19 828	20 476	0.97
NE	1 840	7 503	0.25
WC	6 164	33 530	0.18
EC	1 850	57 467	0.03
SW	338	33 212	0.01
SE	5 246	16 471	0.32
Antarctic, Atlant.	295	12 298	0.02
Ind. Oc	94	12 624	0.01
Pacific	-	10 386	-
Total	72 379	361 060	0.20

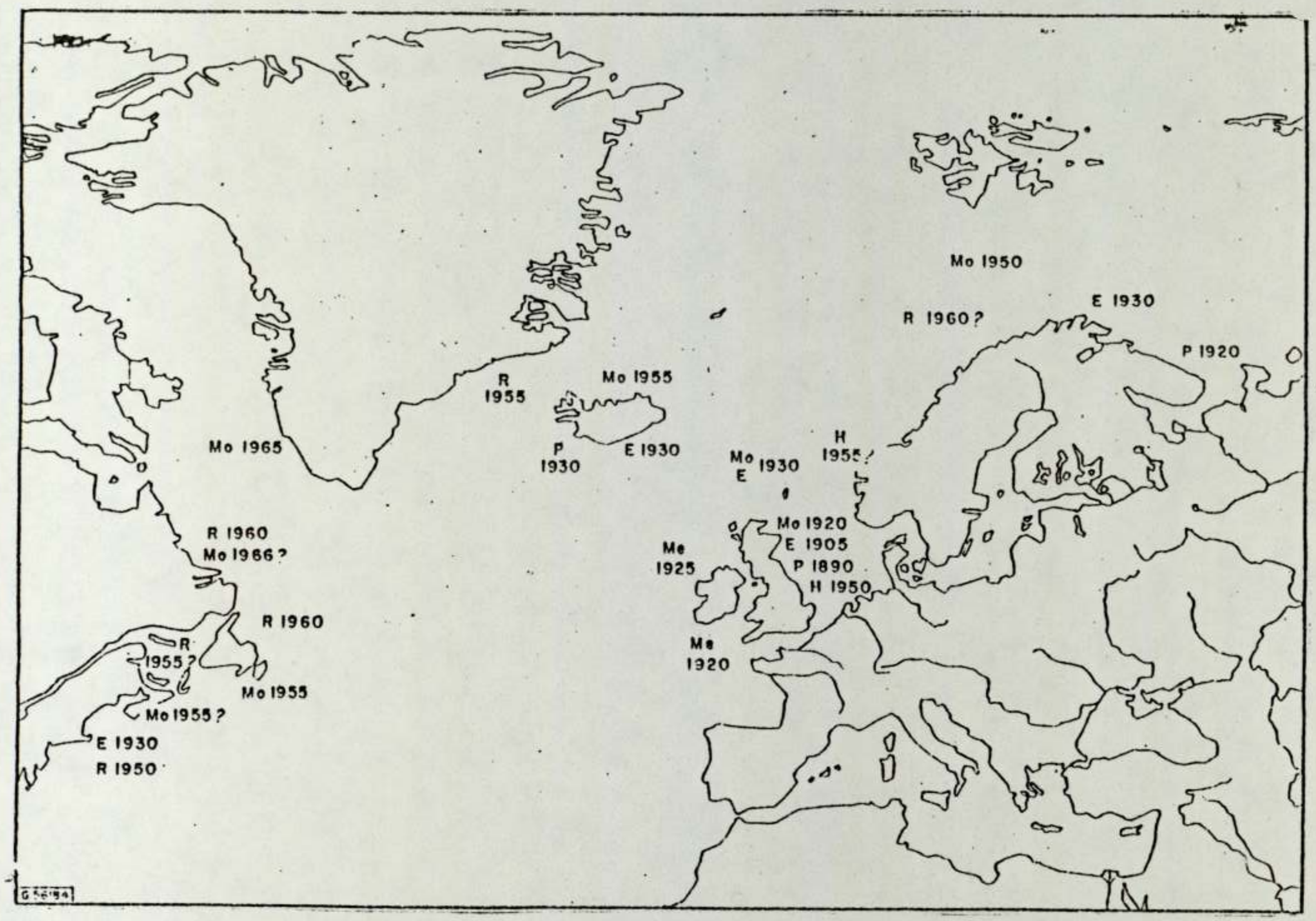
Table 1.1: Catch of fish and shellfish per unit area of sea-bed for the major regions of the world's oceans in 1978.

Source: FAO

The productivity of the oceans could probably have overcome the activities of man had not the Industrial Revolution taken place. However the advent of steam-powered vessels towing large trawls, the mouths of which were kept open by the speed of the vessels, and which replaced the sail driven vessels towing small heavy beam trawls, increased the pressures on the fish stocks. These pressures were further increased with the development of such fish detection gear as echo-sounders and sonar. Indeed, fishing has now progressed from the stage of chance encounters with fish, aided by man's imprecise knowledge of the normal habits of fish, to the directed searching for fish with highly sophisticated equipment. Thus, whereas even 25 years ago, it was quite widely thought that there were more fish in the sea than had ever been caught, there was a sudden realisation that the resources of the sea were limited and would have to be managed. The full seriousness of the situation was not realised until the mid-1960's: the views of the biologists meeting at international organisations began to be more cautionary. Many fish stocks in the North Atlantic were being over-fished and the situation was well summarised by FAO in 1967 with the publication of the map shown in Fig. 1.2.

The outstanding feature of marine fisheries is that they are international; with very few exceptions, if any, does one country have the sole proprietary interest in a particular fish stock. Thus the management measures necessary to protect fish stocks had to be by international agreement. Certain international agreements have been possible, but they have been generally voluntary agreements which could be broken without fear of retribution if the situation suited. Furthermore, the methods of policing such agreements were extremely limited because of the retraints of international maritime law.

Historically, a nation's territorial limits extended to three miles from the low-water mark and generally within that zone the nation reserved fishing for its own vessels. With the returns from fishing diminishing when viewed against the effort involved, a natural consequence of over-fishing, many nations



P = Plaice
Mo = Cod
Me = Hake
E = Haddock
H = Herring
R = Redfish

The years indicated are those approximately at which the fishing of the stocks reached a level that an increase in fishing did not result in a corresponding increase in catch

Figure 1.2: The over-exploitation of the fish stocks of the North Atlantic.

Source: FAO (1967)

sought to protect the interests of their own fishermen by extending their territorial limits unilaterally. Three miles became twelve and more recently several countries (e.g. Iceland and Guinea Bissau) increased this to 200 miles.

These problems of fisheries, and, initially at least, the more important problem of the mineral wealth on the sea bed which advancing techniques are making available, caused the United Nations to reconvene its Conference of the Law of the Sea. Several lengthy sessions of the Conference were held but agreement on the problems of the seas' wealth, both biological and mineral, was not forthcoming. Not the least of the problems was the demand of a block of land-locked countries for a share of this heritage.

A number of countries, including those of the European Economic Community, realised that decisions would not be taken in the immediate future, yet delay was worsening the position of the fish stocks. Accordingly they declared their intention to extend their jurisdiction to 200 miles. This particular limit was chosen because it was widely considered to represent the approximate limits of the continental shelf. The Member States declared their 200 mile limits as operative from 1st January 1978: initially, each Member State was responsible for its own zone, with the intention that the Community would assume responsibility from 1st January 1979. In fact, this intention has only been achieved with regard to relations with third countries; at present no agreement has been reached on the internal arrangements.

The implications for the Community's fisheries were rather wider than would first appear because, although the Community has a 200 mile zone in which its fishermen have a privileged position, if not an exlusive right, other countries bordering the North Atlantic also declared 200 mile limits. Particularly important in this respect were Iceland, Canada and the United States because within their zones Community fishermen had previously been very active. The situation is aggravated by the fact that many of the Community vessels which were involved in these fisheries are large freezer-trawlers for which it is difficult to find alternative economic fishing grounds.

Thus to summarise the effects on Community fisheries of these historical events, in the last few decades many of the important fish stocks have been overfished and production will not be able to increase at the rate of recent years. In addition a number of traditional fishing grounds that now fall within the extended economic zones of third countries will not be available to Community vessels. The situation is such that, in 1980, extended economic zones cover an area roughly equivalent to the earth's land surface.

B. Fisheries Management

Before discussing the scope of this study, it is pertinent to consider the changes which must take place in the management of fisheries. The first steps in the development of fisheries management were taken at the turn of the century, but as far as the fish stocks of the North Atlantic are concerned, the management procedures have mostly developed since the 2nd World War (Cushing, 1975). Although the Northwest and the Northeast Atlantic have different organisations (with differing structures) for the management of the fish stocks the basic systems do not differ. Since the Northeast Atlantic is of greater importance to the Community, the management procedure in that region has been taken as the example for this study.

Fisheries management is normally a result of a two-fold operation. Initially, the fish stocks are assessed by biologists using data on catch and the corresponding fishing effort and biological data (age determinations of fish commercially landed, research ship surveys of young fish yet to enter the fishery, etc.). These biologists issue guidance as to the quantities of fish that may be taken from the stock in the coming year (the Total Allowable Catch, TAC), and/or to certain technical measures (e.g. mesh regulations, minimum landing size) to be applied in order that a pre-determined management programme may be achieved. This biological advice is then studied by the fisheries administrators who consider it in the light of the social and economical implications. A schematic representation of these operations (which should be integrated) is given in Fig. 1.3.

In the Northeast Atlantic the biologists meet in a series of assessment groups (one for each geographical grouping of species) under the auspices of the International Council for the Exploration of the Sea (ICES), an organisation founded in 1902 with its secretariat in Copenhagen, and the advice is collected together by the Liaison Committee (subsequently renamed the Advisory Commitee on Fisheries Management).

This Committee's report was, prior to 1977, considered by the North East Atlantic Fisheries Commission (NEAFC) which had the same membership as ICES, namely most of the states fishing in the region. The Commission then proposed the regulatory measures it considered necessary from a hopefully balanced view of the biological, social and economic implications.

Although the Commission was founded by an international convention (in 1954), any Member State could, by formally registering an objection, ignore a given regulatory measure. Indeed should three Member States register their intent to ignore a measure approved by the majority, none of the remaining members were obliged to observe the measure. It was thus surprising that NEAFC managed to achieve such a measure of control of fisheries in the region. Obviously, despite normally a conscientious approach to management by most Member States, such a system of more or less voluntary controls was bound to be questioned when most of the waters originally under international control came under the jurisdiction of one Member State or another. Thus with the extension of economic zones, the work of NEAFC virtually ceased.

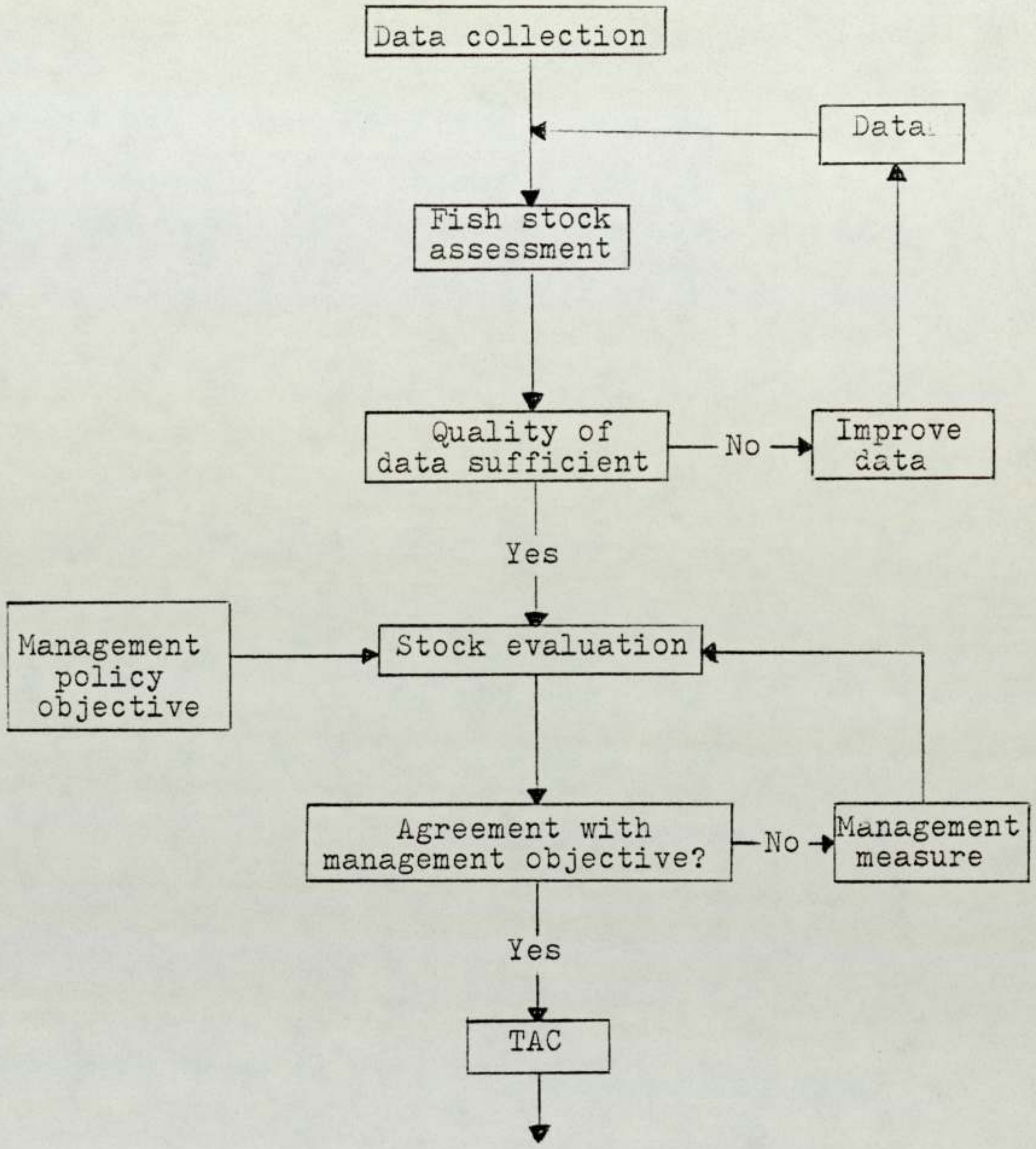


Figure 1.3: A simplified schematic diagram showing how TACs are derived.

Fortunately, although most countries wished for greater control of the fisheries within their jurisdiction, it was realised that few if any of the fish stocks are restricted to a single economic zone. Thus there seems to be a general willingness to cooperate in the work on fish stock assessments even to the extent of accepting biological and other data of a country fishing another's waters. The stock assessment work is still being conducted by the ICES assessment groups and it seems most likely that ICES will continue to have an important role to play in giving scientific advice to the various management organisations for the region (Parrish, 1979).

The future of NEAFC is obviously more contentious. A new convention is being proposed which will create an organisation to regulate the fisheries in the limited international waters and to provide a forum for coordination and discussion of all aspects of the region's fisheries. It must be said that the transition for the scientific bodies as a result of extension of economic zones has been easier in the Northeast than in the Northwest Atlantic where both regulatory and scientific functions have been performed by a single organisation, the International Commission for the Northwest Atlantic Fisheries (ICNAF). Within this Commission the scientific function was conducted by a committee, the Standing Committee on Research and Statistics (STACRES).

The new regime for fisheries management in the European Community is slowly emerging in spite of the lack of a Common Fisheries Policy. At present the report from the ICES Advisory Committee for Fisheries Management is reviewed by the Commission's Scientific and Technical Committee for Fisheries. Then, armed with the advice of this Committee, the Commission makes proposals for catch quotas and other technical measures for adoption by the Council of the European Communities.

Although fishing by Community vessels in distant waters is very much restricted, it has not ceased completely. In part this is due to agreements that the Community has been able to reach with a number of third countries. These agreements are of two basic types:

1) Where both parties wish to exchange the right to fish in each others waters. Such agreements have been concluded with, for example, Norway, and are of interest to both parties because fish migration renders fishing unprofitable in some areas at certain times of the year or because the species found in the other countries' waters are of more interest than species found in their own waters.

2) Where the country wishing fishing rights in the waters of a second country has no opportunity of offering reciprocal rights. An example of this is the agreement for Community vessels to fish in the coastal waters of Senegal and the United States. Thus fishing rights are negotiated in exchange for trade agreements, monetary payments, offers of economic aid etc.

Agreements have been concluded with most of the coastal states of the North Atlantic in whose waters Community vessels have traditionally fished and the Community is actively seeking fishing rights in what may be described as new fisheries for vessels of many of its Member States; for example, the waters off the West Coast of Africa.

However, it does not seem likely that these agreements will result in catches at the same level as in earlier years nor that the deficit can be made up from the quantities of fish the vessels from third countries will be permitted to take from Community waters, at least in terms of preferred food species. (This point is examined in detail later in the study). Further, it seems most likely that management regimes will become tougher with more stocks being allocated TACs and more restraint being placed on the activities of the fishing fleet.

C. Scope of the Study

The purpose of this study is to evaluate the effect of these developments on Community fisheries and the various alternatives open in order **at least to** maintain fish production at its present level. The following topics are amongst those to be discussed:

1) How important are fisheries in the Community, both in terms of the contribution they make to the economy and to the food supply of the population? It has been mentioned that fishing was extremely important in many of the coastal regions of the Community but this was before agricultural technology developed and output increased accordingly. It may be that, rather than strive to make a success of fishing in what will obviously be difficult times, it would be better to try to replace the production from fisheries by increased agricultural production. Two examples of proteinaceous food that could replace fish and for which production could be increased are poultry meat, using intensive culture techniques, and artificial meats made from soya bean meal.

2) What has been the trend in catches of fish in recent years? Restrictions on access to distant water grounds has obviously had some impact on the catches but how serious is the situation and is it possible to foresee the future trends? For example it may be that the consumer will have to accept that the traditional food-fish cod and herring are in short supply and learn to accept alternative fish species.

3) If traditional species are going to be in short supply, what are the prospects of finding new species? The popular press has made much recently of the possibility of developing a fishery for blue whiting but how realistic are the forecasts? Another possibility is that new fishing grounds may be exploited. These may be existing fisheries where the original exploiting nation has been excluded by the extension of

economic zones and the resultant political activity, or they may be unexploited grounds. In many cases new fishing techniques may have to be used and these may affect the economic viability of the exercise. For example, if deep water fishing grounds are to be exploited it may be found that the catch per unit effort (effort being measured as a time dependant variable) is equivalent to that observed in conventional fisheries or even better where expenditure on special fishing equipment is necessary.

4) The restriction of access to distant water grounds has obviously affected fishing activities but how is this reflected in the structure of the fishing fleet? Fishing vessels are extremely expensive to buy (a 140 ft vessel would cost approximately £2 million) and to operate (£3 400 per day for the freezer vessel, £2 000 per day for a wetfish vessel with a crew of 15). What then are the trends in the development of the fleet now that more emphasis seems likely to be placed on near-water fisheries?

5) What have been the trends in fish prices? Fish used to be the cheapest source of protein but with declining catches, increasingly expensive vessels and increasing operating costs will fish be able to compete with other sources of protein? There has always been a very ready market for cheap fish but it is relevant to consider whether there would be such a demand for fish should its price place it amongst the luxury foods.

6) Although it is generally accepted that freshwater fisheries are not as productive as sea-fisheries, and the acceptability of the product on the market is less, is there the possibility that freshwater fisheries could be exploited more intensively than at present in order to make up any shortfall from marine fisheries? One possibility is that sea-ranching could be one method of achieving this. This technique involves, for example, the liberation of young diadromous

fish such as salmon in the rivers and then harvesting the adult fish on their return from the sea.

7) **Sea ranching is intermediate between the hunting of fish and the farming of fish.** To many people it is disappointing that production from aquaculture has not generally increased as rapidly as has been forecast. However, what are the prospects of making up at least part of a shortfall in the 'hunting' fisheries?

8) Fish meal is used extensively in the farming of fish and the production of pigs and poultry. Whilst some of the meal is manufactured from fish waste, by far the greater part is made from 'industrial' fish species. Industrial fisheries have developed rapidly in the last 20 years but their future is not so bright. Firstly, many of these fisheries have been over-exploited (e.g. Peruvian anchoveta fishery) and catches are declining. Secondly, opposition to these fisheries is developing because the young of important food species are often an important by-catch of the fishery (for example the Norway pout fishery to the east of the Shetland Isles often results in the capture of appreciable quantities of young haddock and whiting) and because the species towards which the fishery is directed are often an important dietary component of food species. What then is the future of fish meal production? What are the possibilities of using this fish meal for human consumption rather than adopting the inefficient method of inserting another link in the food chain?

9) One solution to the problem of possible reduced levels of fish meal production would be to find alternative materials which could be used in fish farming. What are the likely developments in this field?

10) Although in the fresh state fish is a highly perishable product, the foreign trade in fishery products is very im-

portant. This study will look at this aspect of fisheries to determine the position of the Community in world trade of fishery products and to try to foresee future developments.

11) The Community is currently composed of nine Member States. Three countries have however applied for membership; namely Greece, Spain and Portugal. The first of these will accede in 1981 but the effect on Community fisheries of Greece's entry will be insignificant compared with the possible effect of the subsequent entry of Portugal and particularly Spain. Although there is currently a feeling that the entry of these countries should be delayed to enable the ten Member States to overcome existing problems, particularly of a budgetary nature, both have well-developed fishing industries and thus a study of the future of the Community fisheries would be incomplete if their entry was ignored. Thus, wherever possible, data for the three applicant Member States have been included.

CHAPTER 2

THE ECONOMIC AND SOCIAL IMPORTANCE OF FISHERIES

THE ECONOMIC AND SOCIAL IMPORTANCE OF FISHERIES

A. Economic Importance

As a base mark for the study as a whole, this chapter attempts to show the importance of fisheries to the European Economic Community and the three applicant states. Unfortunately it is very difficult to measure this importance in finite terms that are meaningful. One method that has been used is to consider the contribution fisheries make to the economy as measured by its contribution to the gross domestic product.

Table 2.1: Value of landings of marine fish and shellfish in 1978 as a percentage of the gross domestic product at market prices

	Gross domestic product (10^9 EUA)	Value of landings (10^6 EUA)	Landings/ GDP (%)
FR Germany	500.3	149.0	0.03
France	369.5	528.1	0.14
Italy	185.9	381.2	0.21
Netherlands	101.9	146.0	0.14
Belgium	73.8	39.8	0.05
Luxembourg	2.7	-	-
United Kingdom	238.0	382.7	0.16
Ireland	9.4	34.6	0.37
Denmark	43.1	259.9	0.60
EUR 9	1 524.5	1 922.2	0.13
Greece	24.7	115.5	0.47
Spain	110.7	1 069.2	0.97
Portugal	14.0	104.8	0.75
EUR 9 + 3	1 673.9	3 211.7	0.19

Source: EUROSTAT, OECD

Table 2.1 shows that in all the countries fisheries contributed less than 1% to the gross domestic product and, in most cases, significantly less. (It will be noted that the gross domestic product and the value have been quoted in European Units of Account (EUA). This has a value which is fixed from a 'basket' of currencies and its use permits a comparison to be made between the different Member States. A more complete account of the EUA is given in Appendix A and the conversion rates used are given in Appendix C).

The low level of contribution to the GDP made by fisheries is perhaps not so surprising when one considers that most of the countries are highly developed industrial states. The perspective may be improved by comparing fisheries with agriculture. The agricultural equivalent of the value of landings at first sales is the final production of agriculture which accounts for between 4 and 6% of the gross domestic product.

However, this comparison of the value of fish landings with the gross domestic product is of limited validity for fisheries (as, indeed, it is for many other sectors of industry) for a number of reasons. One of the practical considerations concerning fisheries is that the value taken into account is the value at first sales. However, in Community states about 60% of the fish landings are further processed. This processing adds appreciably to the value of the product as may be demonstrated by the unit values of exports of fresh fish and processed products. (Production data would have been preferable but they are generally not available.) Table 2.2 shows that the production of the more highly processed fishery products more than doubles the value of the product compared with the fresh product.

B. Employment

The number of people emplyed in the industry may also be used as an indicator of the contribution made by fisheries. If, initially, one considers the fishermen, one finds that this is

Product	UK	Netherlands	Denmark
Fresh herring	729	931	895
Cured or salted herring	912	1 356	1 122
Smoked herring	1 680	2 217	2 451
Canned herring	1 300	1 945	1 777

Table 2.2: Unit values (EUA/tonne) of herring exports in 1978

one sector in which the statistics are poorly harmonised (see Chapter 10). Various concepts are applied when defining a fisherman and distinguishing between full- and part-time employment. However, accepting the limitations of the data, table 2.3 shows the contribution made by fishermen to the total working population. This amounts to less than 1% of the working population in the present Member States. In the three applicant Member States the percentage is somewhat greater although still of rather insignificant proportions. This compares with 8.2% of the population working in agriculture in the present Member States.

These data only relate to the fishermen and take no account of the support industry ashore, i.e. the ship-building and repair yards, the fish processing industry, the fishing-gear manufacturers and the ship provisioning organisations. As with the fishermen, the statistics are difficult to obtain and probably unreliable. The most that can be said with certainty is that for each active fishermen there is more than one man ashore providing support facilities and that this increases the importance of the industry.

C. Regional Aspects

All the methods of looking at the economic and social importance of fisheries given above have overlooked one vital point. In some areas, for example, many regions of Ireland, the West Coast of Scotland and the Brittany coast of France, fisheries are of vital importance in that, were they not to exist, there would often be a very great problem finding alternative employment for the inhabitants. An example of this regional importance may be given by the town of Fraserburgh in Scotland. Although for the Community as a whole the percentage of the work force employed in the ancillary industry probably does not exceed 1%, the proportion in Fraserburgh (population 11 111) in 1976 was approximately 30%. This is by no means an isolated example.

Country	Number of fishermen	% of working population
FR Germany	5 024	0.02
France	22 456	0.10
Italy	45 000 ≠	0.30
Netherlands	3 604	0.08
Belgium	914	0.02
United Kingdom	22 186	0.09
Ireland	8 620	0.76
Denmark	14 909	0.59
EUR 9	122 713	0.13
Greece	46 500 ≠	1.45
Spain	111 005	0.83
Portugal	32 341	0.79
EUR 9 + 3	312 559	0.26

Table 2.3: The percentage of fishermen in the working population in 1978

D. Dietery Aspects

Fish is a source of high quality protein and thus a review of the importance of fisheries should consider the contribution fish makes to the diet. This subject is dealt with in greater detail in Chapter 7 but it is interesting to note here that fish contributes 5.5% of the protein in the diet of the present and applicant Member States. Although this is not a very large proportion of the total protein there is considerable variation between Member States, with the figure for Portugal reaching 14.6%. Further there is certainly a variation within the countries since fisheries are often of great importance in regions where the livestock and dairy production is not at a high level.

E. Conclusions

This short survey of the importance of fisheries cannot be said to have produced irrefutable statistical evidence. Unfortunately, in many sectors only global data are available, thus masking the regional significance of fisheries. But it is relevant to note that in the proposal before the European Council for the establishment of a Community system for the conservation and management of fishery resources (Council document No R/168/78 of 8 February 1978) there is a provision that 'particular attention shall be paid .... to the vital needs of areas in which the local populations are particularly dependant on fishing and related industries inter alia, Ireland, Greenland and the northern parts of the United Kingdom and for whom restrictions on fishing could have particularly serious social and economic consequences.'

CHAPTER 3

RECENT TRENDS IN COMMUNITY MARINE FISHERIES

RECENT TRENDS IN COMMUNITY MARINE FISHERIES

A. The EEC and the World Situation

In the period 1960–78 the world's catch of fishery products has nearly doubled until in 1978 it was 72.4 million tonnes (see Fig. 3.1). The increase was much larger (an average of 2.9 Mt per year) and more regular in the period 1960–68 than subsequently (an average of 0.9 Mt per year). Indeed, in several years in the latter period decreases were recorded. The largest of the decreases, in 1972, may be attributed to the failure of Peru's anchoveta fishery and indicates the importance of that one fishery to the world total.

In 1978 the European Community (EUR 9) contributed 4.9 Mt (6.8%) to the total, compared with 3.6 Mt (8.9%) in 1960. The 1978 catch was only surpassed by Japan (10.8 Mt, 14.9%) and the USSR (8.9 Mt, 12.3%). If the three applicant members of the EEC, Spain, Greece and Portugal, are included the Community (EUR 9 + 3) caught 7.0 Mt (9.5%) in 1978 compared with 5.1 Mt (12.7%) in 1960).

B. Trends within the European Community and Applicant States

The trends in the period 1960–78 for the eight fishing Member States and three applicant states are shown in Fig. 3.2. The 11 states may be divided into 4 groups:

1) In this group are two states, Denmark and Spain, who have shared the largest catches for many years. Denmark's performance in more than tripling its catch from 581 200 t in 1960 to a peak of 1 912 000 t in 1976 is outstanding and may be attributed largely to the development of industrial fisheries.

2) This group is characterised by having relatively high and stable levels of catches, the United Kingdom's being about 1 Mt per year and that of France 0.8 Mt per year.

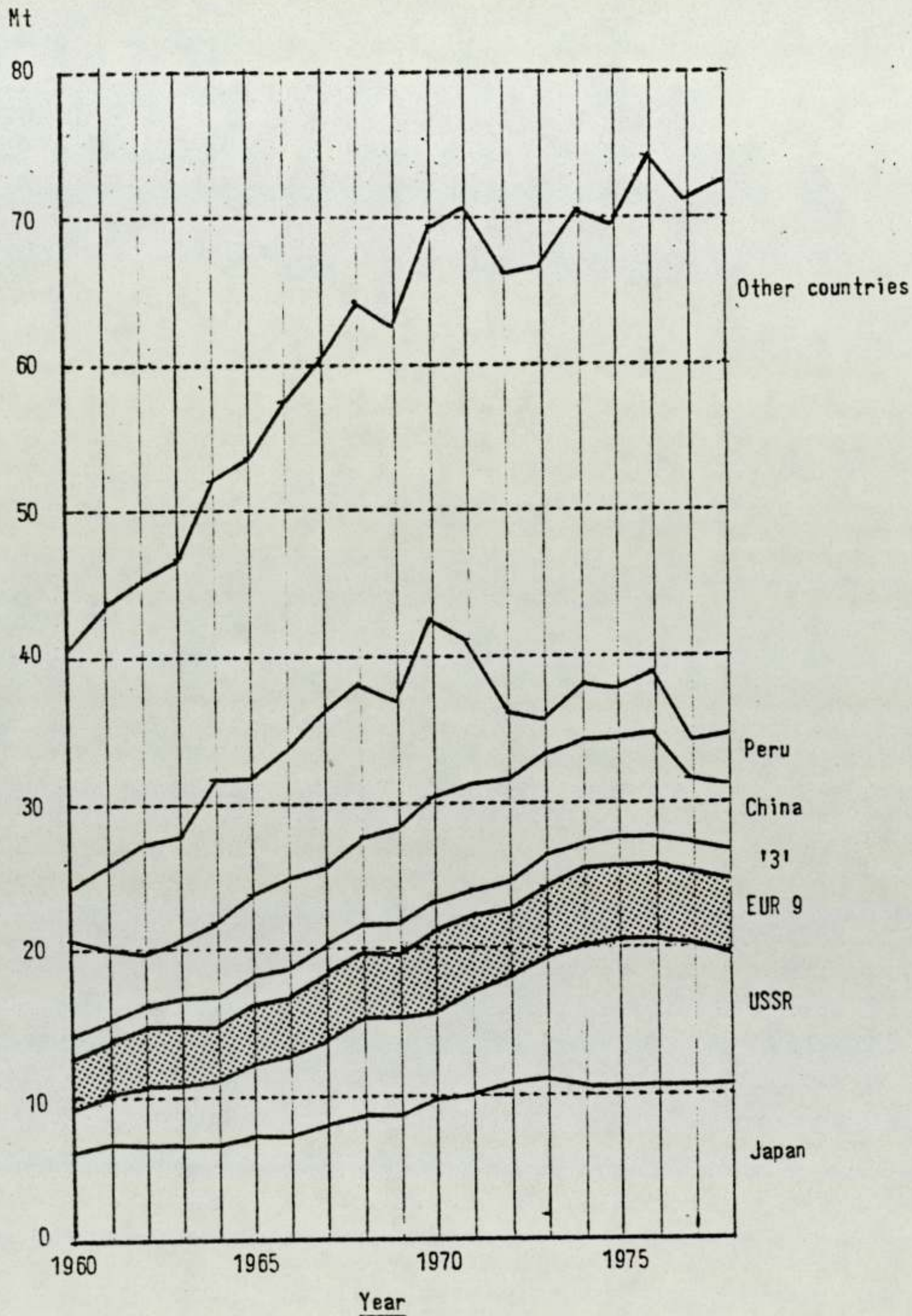


Fig. 3.1: Nominal catches of all marine products by major fishing nations (cumulative representation)

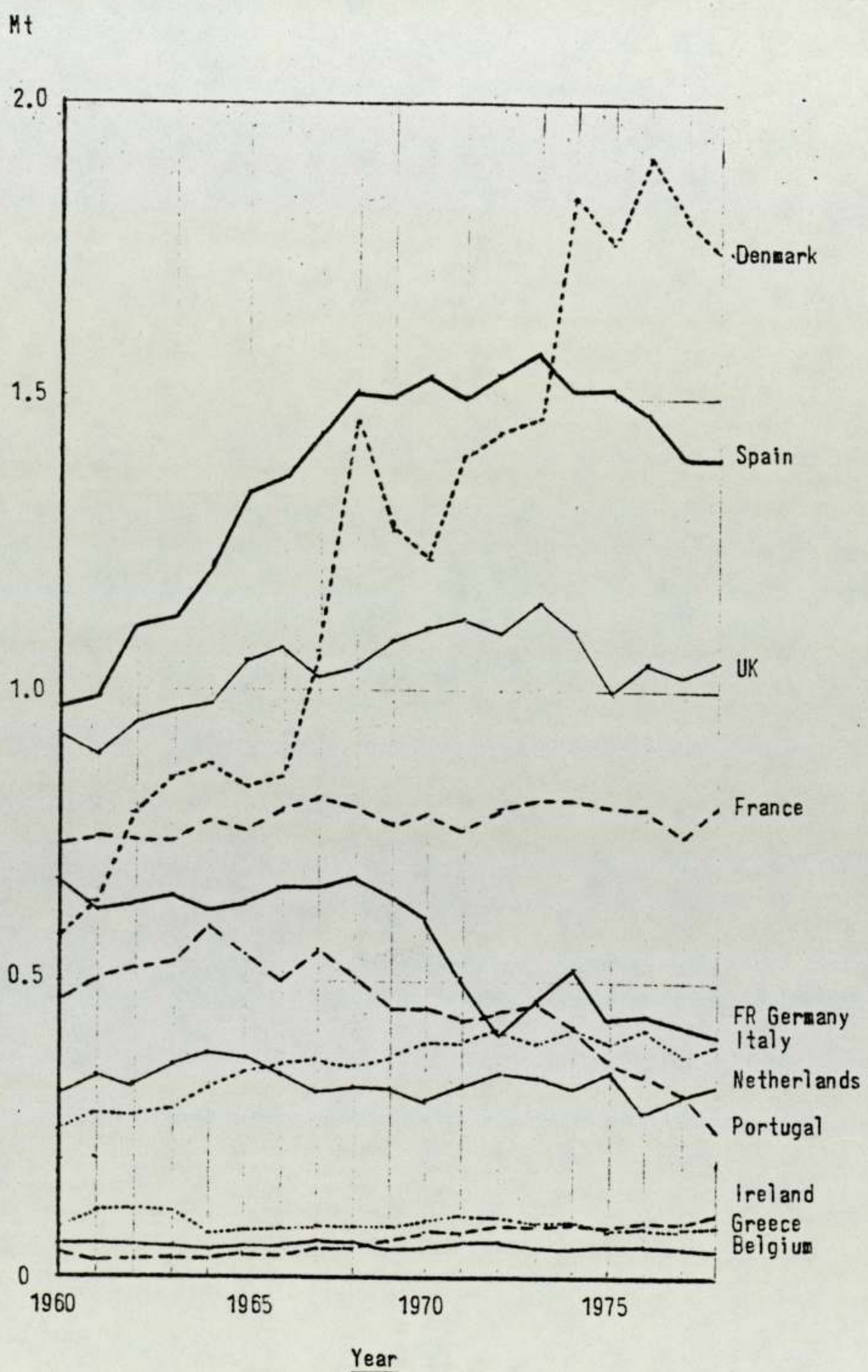


Fig. 3.2: Nominal catches of all marine products by Community states (members and applicants).

3) In the third group are four states having catches of between 0.25 and 0.7 Mt per year. In the FR Germany catches remained relatively constant until 1968 but have declined more recently. Italian catches have increased slowly but regularly in the period studied. The Portuguese catch has decreased by over 30% in the period 1960-78. The Netherlands has had a very stable level of catches.

4) This group of three states, Belgium, Greece and Ireland, have all registered annual catches not exceeding 120 000 t. However, whereas the first two have shown net decreases over the period, Ireland's catches have more than doubled.

C. Regional Distribution of World Catches

Figure 3.3 shows the mean annual catches of marine fish and shellfish in the period 1972-78 in each of the major fishing regions designated by FAO (see Figure 3.4). Two regions between them contribute nearly one half of the total, namely the Northwest Pacific (region 61) with 29%, and the Northeast Atlantic (region 27) with 20%. Following these two, in decreasing order of contribution to the total come the West Central Pacific (region 71) with 9%, the Southeast Pacific (region 87) with 8%, the Northwest Atlantic (region 21) and the East Central Atlantic (region 34) with 6% and the Southeast Atlantic (region 47) with 4%.

In the period 1972-78 the Atlantic Ocean and adjacent waters contributed 43% to the total catches of marine species.

D. Trends in the Regional Distribution of World Catches

Having studied the importance of the various fishing regions it is interesting to observe the trends in the period 1970-78 (see Fig. 3.5). Of note is the increase of 52% in the catches of the Northwest Pacific (region 61) in the period and the increase of 25% in those of the Northeast Atlantic (region 27) in the period 1972-76. The latter is particularly interesting when

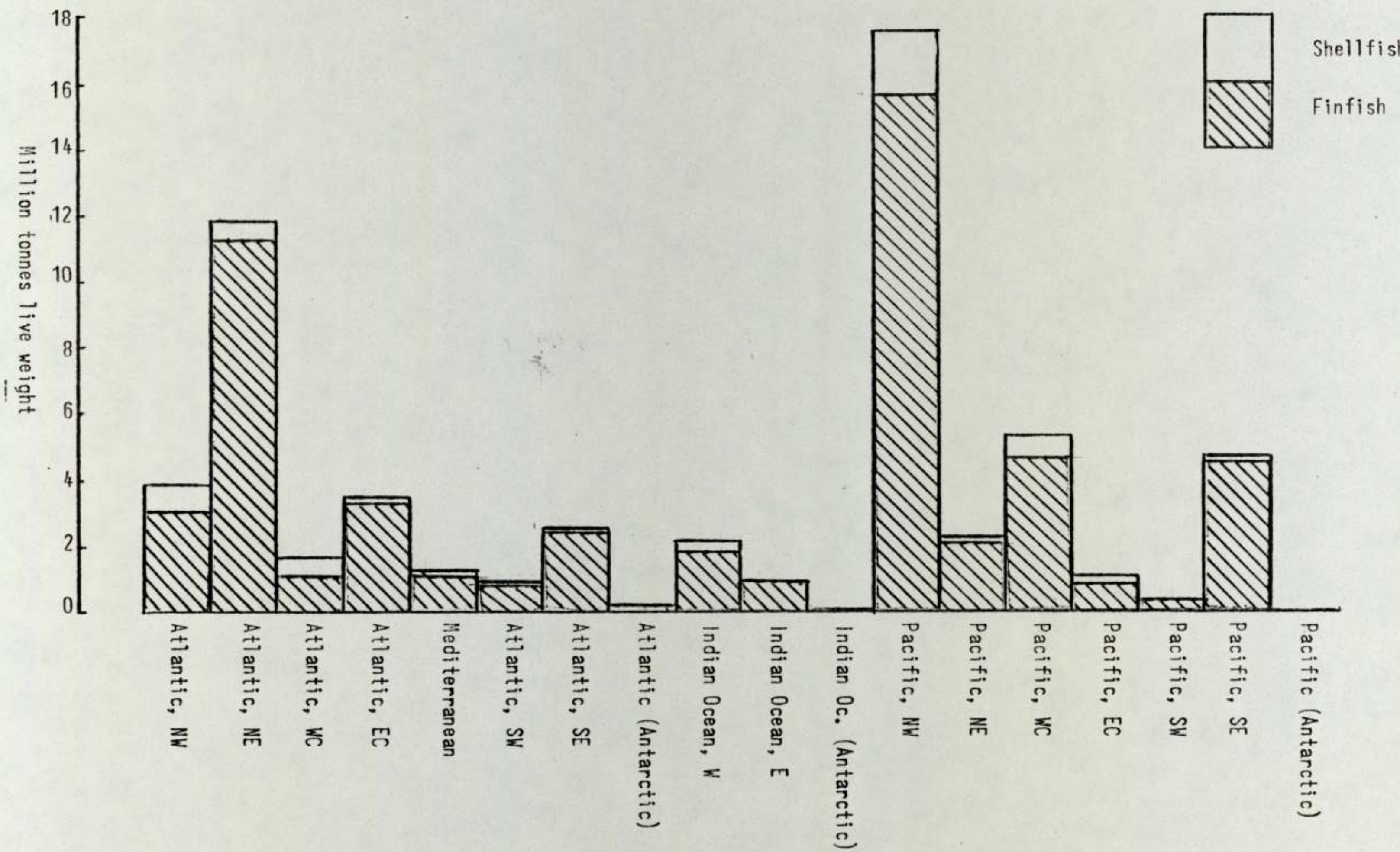
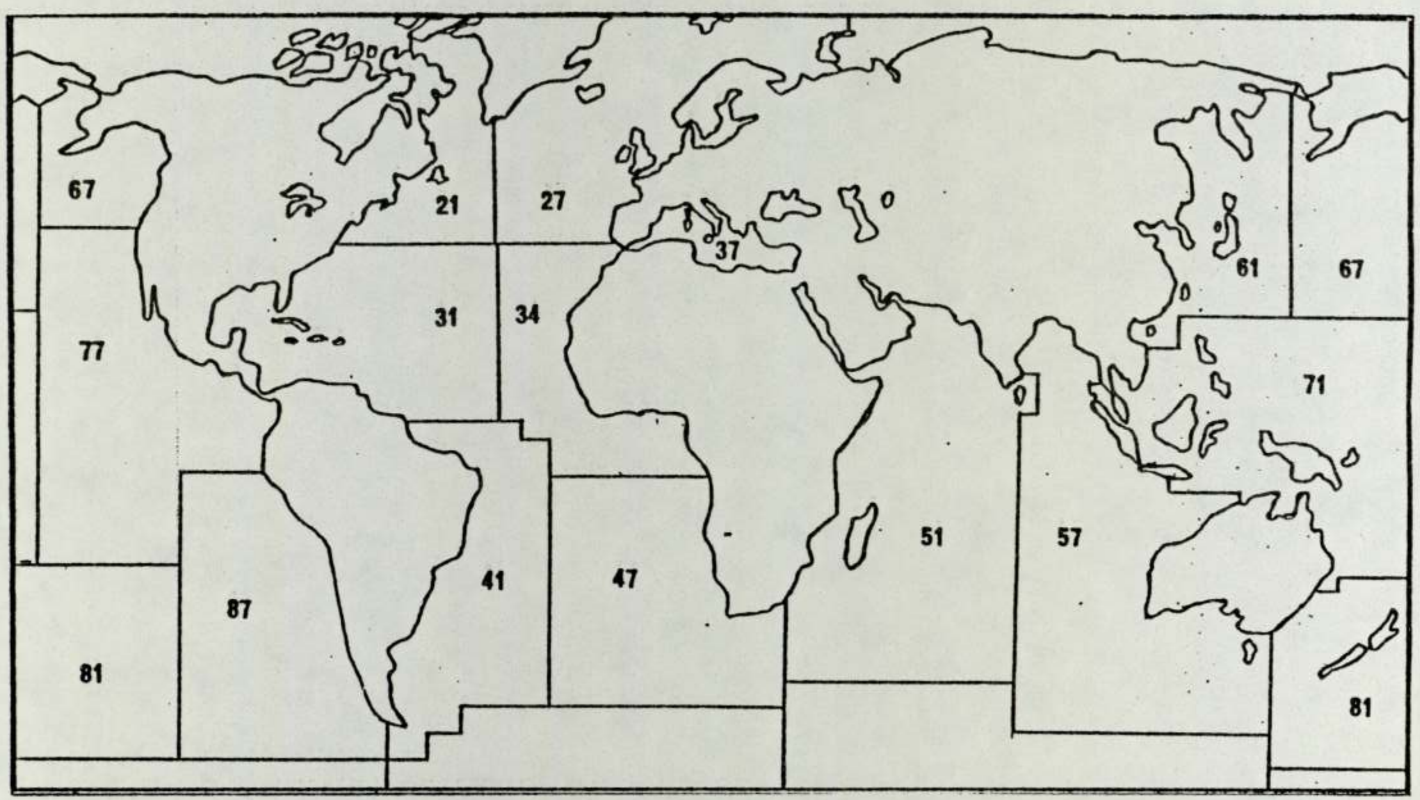


Fig. 3.3: Nominal catches of marine fish and shellfish in the major fishing regions (1972-78).



21 Northwest Atlantic
27 Northeast Atlantic
31 West Central Atlantic
34 East Central Atlantic
37 Mediterranean & Black Sea
41 Southwest Atlantic
47 Southeast Atlantic
51 W. Indian Ocean
57 E. Indian Ocean
61 Northwest Pacific
67 Northeast Pacific
71 West Central Pacific
77 East Central Pacific
81 Southwest Pacific
87 Southeast Pacific

Fig. 3.4: Major fishing regions of the world as designated by FAO

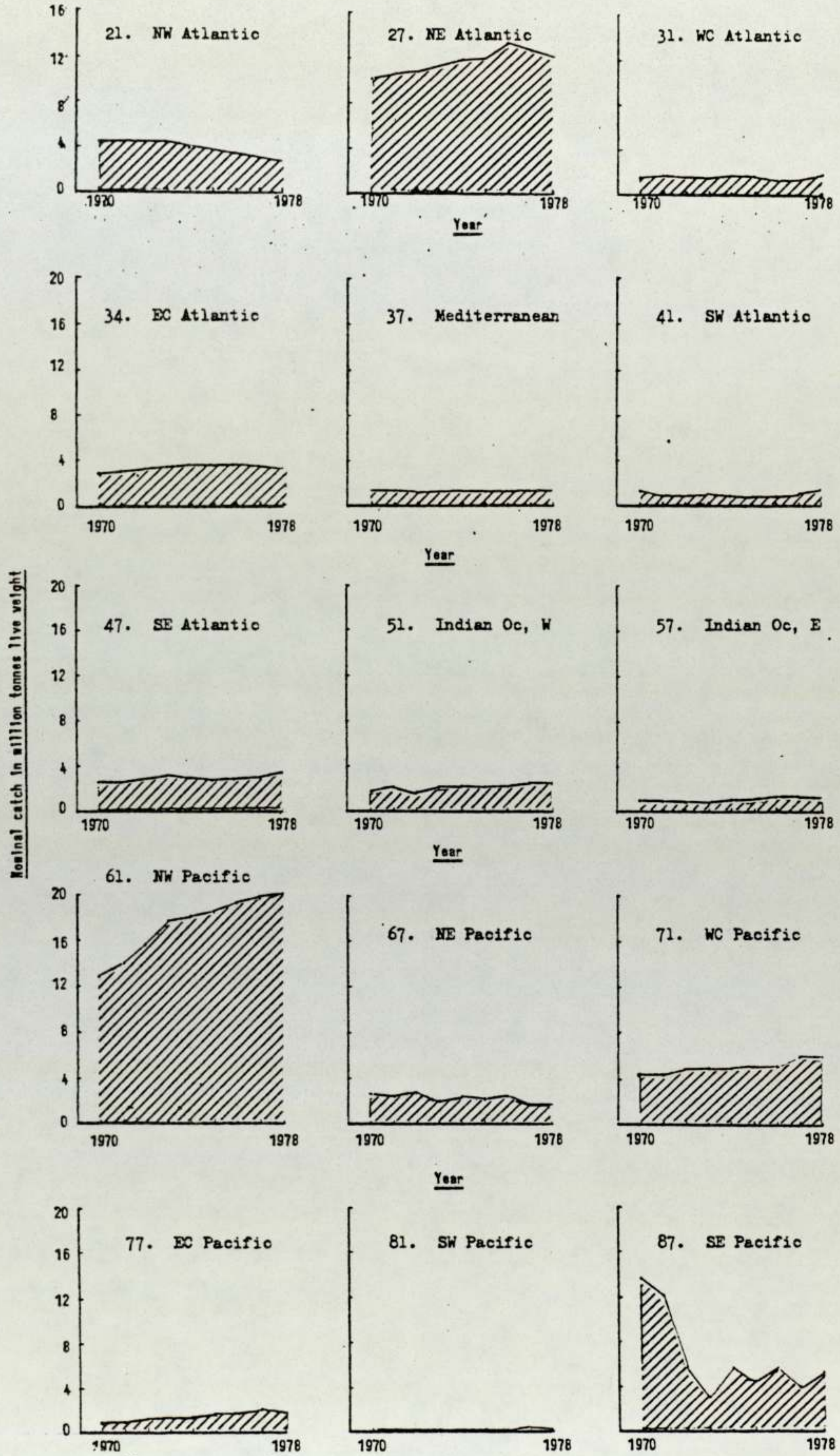


Fig. 3.5: Nominal catch of all marine fish and shellfish in the major fishing regions in 1970–78.

seen against the decrease of 20% for the neighbouring region, the Northwest Atlantic (region 21) in the same period.

The decline of the Peruvian anchoveta fishery is well indicated by reference to the Southeast Pacific (region 87). This region, which for about ten years held top place, suffered a diminution of 78% in its production in the three years to 1973.

The West Central Pacific (region 71) and the East Central Atlantic (region 34), both regions subjected to relatively minor exploitation compared with their northerly neighbours, have shown the most regular increases (each of about 40%) in the period 1970-77.

E. Regional Distribution of Community Catches

For this study the fishing regions have been divided into two groups (see Fig. 3.6); near waters being those bordering the Member States of the Community. It must be stressed that this division has been based upon the breakdown of the North Atlantic by international organisations for statistical purposes; it does not bear any relationship to the limits of economic zones. (For example 'near water' region A_2 includes part of the EEC and Norwegian zones.) However, this division is justified when considering that the components of the distant water fleet tend to be larger and more sophisticated (at least in terms of fish processing equipment) than those of the near water fleet.

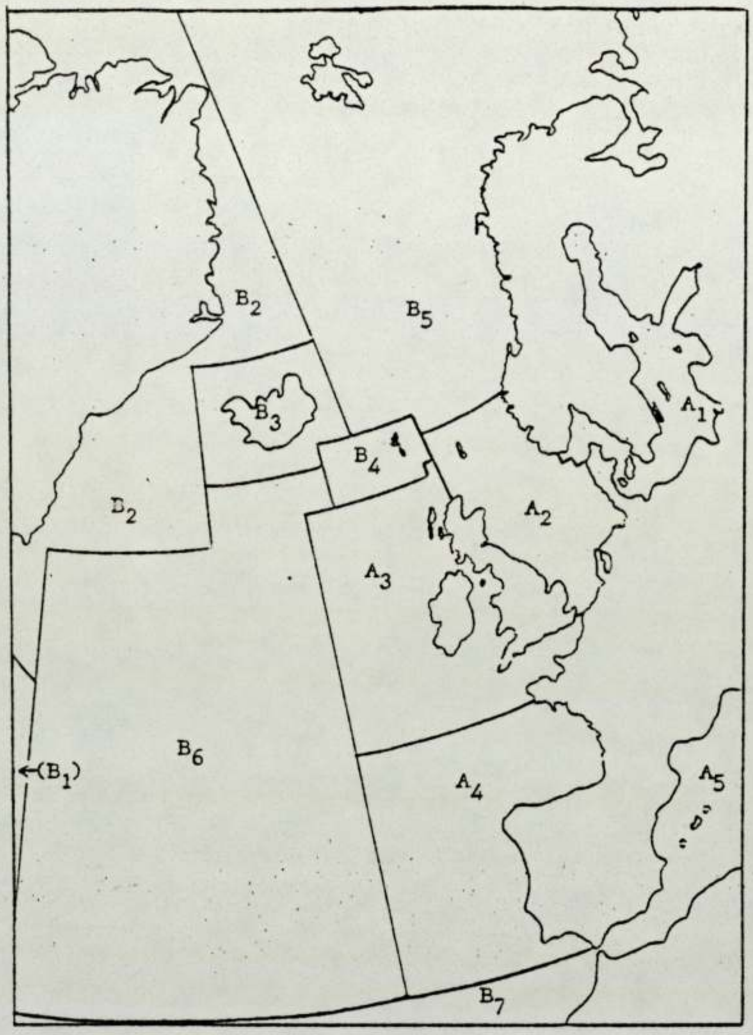
Table 3.1 shows the mean annual catch of fish and shellfish by member and applicant states of the Community in the period 1970-78. Several of the Member States (the Netherlands, Ireland and Denmark) obtain most of their catch in near waters whereas the remaining countries and all the applicants rely heavily on distant water fisheries, the supreme example being FR Germany which averaged 63% of its catch from these fisheries.

F. Trends in the Regional Distribution of Community Catches

The long term trends in the regional distribution of catches

Tonnes live weight	NEAR WATERS					Total near waters	DISTANT WATERS									Total distant waters	TOTAL MARINE WATERS
	Baltic	North Sea	SW Coast of Brit. Isles	SW Coast of Europe	Mediterranean		NW Atlantic (except Greenland)	Greenland	Iceland	Faroes	NE Arctic	Azores	EC Atlantic	SE Atlantic	Other regions		
FR Germany	33742	125130	8800	-	-	167672	70970	45498	72940	12699	73843	-	-	4889	2444	283283	450955
France	249	96052	233930	165988	47889	544108	40291	1529	1461	25755	36154	1141	57467	2022	267	166084	710194
Italy	-	-	-	-	337789	337789	-	-	-	-	-	-	39056	4744	314	49170	386959
Netherlands	2628	270750	31661	92	-	305131	-	-	-	340	109	-	-	-	-	449	305580
Belgium	319	33702	7886	29	-	41936	-	-	8959	2	123	-	-	-	-	9084	51020
United Kingdom	53	445442	131069	-	-	576564	5686	1436	115844	30905	129162	-	-	-	-	283033	859597
Ireland	-	371	60797	-	-	61168	1967	-	-	18	-	-	-	-	-	1985	63153
Denmark	376291	1219579	2326	-	-	1598196	1771	-	1923	225	-	-	-	-	-	3931	1602127
EUR 9	413282	2191026	476469	166109	385678	3632564	123982	50234	199204	71642	239616	1141	96523	11655	3022	797019	4429583
Greece	-	-	-	-	62618	62618	-	-	-	-	-	-	29178	-	-	29178	91796
Portugal	-	-	-	218971	-	218971	105042	4709	-	-	7903	9863	30987	22772	-	181276	400247
Spain	-	402	41285	552212	129834	723733	147486	8084	169	501	16950	889	358436	200916	1897	735328	1459061
EUR 9+3	413282	2191428	517754	937292	578130	4637886	376510	63027	199373	72143	264469	11893	515124	235343	4919	1742801	6380687

Table 3.1: Mean annual catch of fish and shellfish by member and applicant states of the EEC in the period 1970–78.



Near waters		Distant waters	
A_1	Baltic	B_1	Northwest Atlantic (except Greenland)
A_2	North Sea	B_2	Greenland
A_3	South & West Coasts of the British Isles	B_3	Iceland
A_4	Southwest Coast of Europe	B_4	Faroes
A_5	Mediterranean	B_5	Northeast Arctic
		B_6	Azores
		B_7	East Central Atlantic
			Southeast Atlantic
			Others (Southeast Pacific, Southwest Atlantic, West Central Atlantic, Western Indian Ocean)

Fig. 3.6: Classification of Community fishing regions.

has been summarised in Table 3.2 which shows the proportion of the total catch of each state coming from distant waters in the period 1964-78. In most of the states there was a decline in the percentage of the catch coming from distant waters which was generally more pronounced in the period 1970-78 than in the earlier period.

FR Germany, the United Kingdom and France were the three Member States to suffer most from the decrease in catches in distant waters. For the FR Germany catches in these waters decreased without there being an increase in near water catches, resulting in a net loss of catches. However, in the cases of France and the United Kingdom, decreases in the catch in distant waters were approximately balanced by increases in the near water catch.

The overall situation for EUR 9 has been analysed in greater detail in Fig. 3.7. Although the trend was for an increase in total catches (an average annual increase of 50 000t in the period 1970-78) the trend in distant waters was for a decrease of about 60 000t per year, the end result only being achieved by an increase in near water fisheries of 110 000t per year. The greater part of the increase in near water catches was due to the increase in Denmark's industrial fisheries.

Without doubt the greatest decreases in catches were in the Northwest Atlantic, at Greenland and Iceland. In comparison the fisheries at the Faroes, in the Northeast Arctic and in the East Central Atlantic were less affected, at least at the Community level. Indeed the trends were less readily seen since they are masked by much larger fluctuations. Some compensation for the general trend has been the increased catch by EEC Member States (largely FR Germany and Italy) in the Southeast Atlantic.

For the three applicant states the picture is rather different (see Table 3.3) in that, although the distant water catches have fallen, so have the near water catches, particularly from the

Table 3.2: Percentage of the total catch of fish and shellfish caught in distant waters.

	1964	1970	1971	1972	1973	1974	1975	1976	1977	1978
FR Germany	62	66	69	64	51	64	64	60	60	48
France	41	35	24	24	20	24	20	21	21	17
Italy	18	16	16	15	13	11	9	11	14	10
Netherlands	1	0	0	0	0	0	0	1	0	0
Belgium	24	28	24	18	15	17	17	14	13	11
United Kingdom	49	41	32	30	37	31	28	23	15	6
Ireland	0	0	0	0	0	0	7	8	4	1
Denmark	0	0	0	0	0	0	0	0	1	1
EUR 9	31	26	21	18	16	18	16	15	13	9
Greece	30	35	40	38	38	34	28	26	28	20
Spain	48	49	51	38	49	54	50	51	52	52
Portugal	49	55	48	47	44	54	44	43	32	28
EUR 9 + 3	36	36	30	28	28	29	27	25	24	20

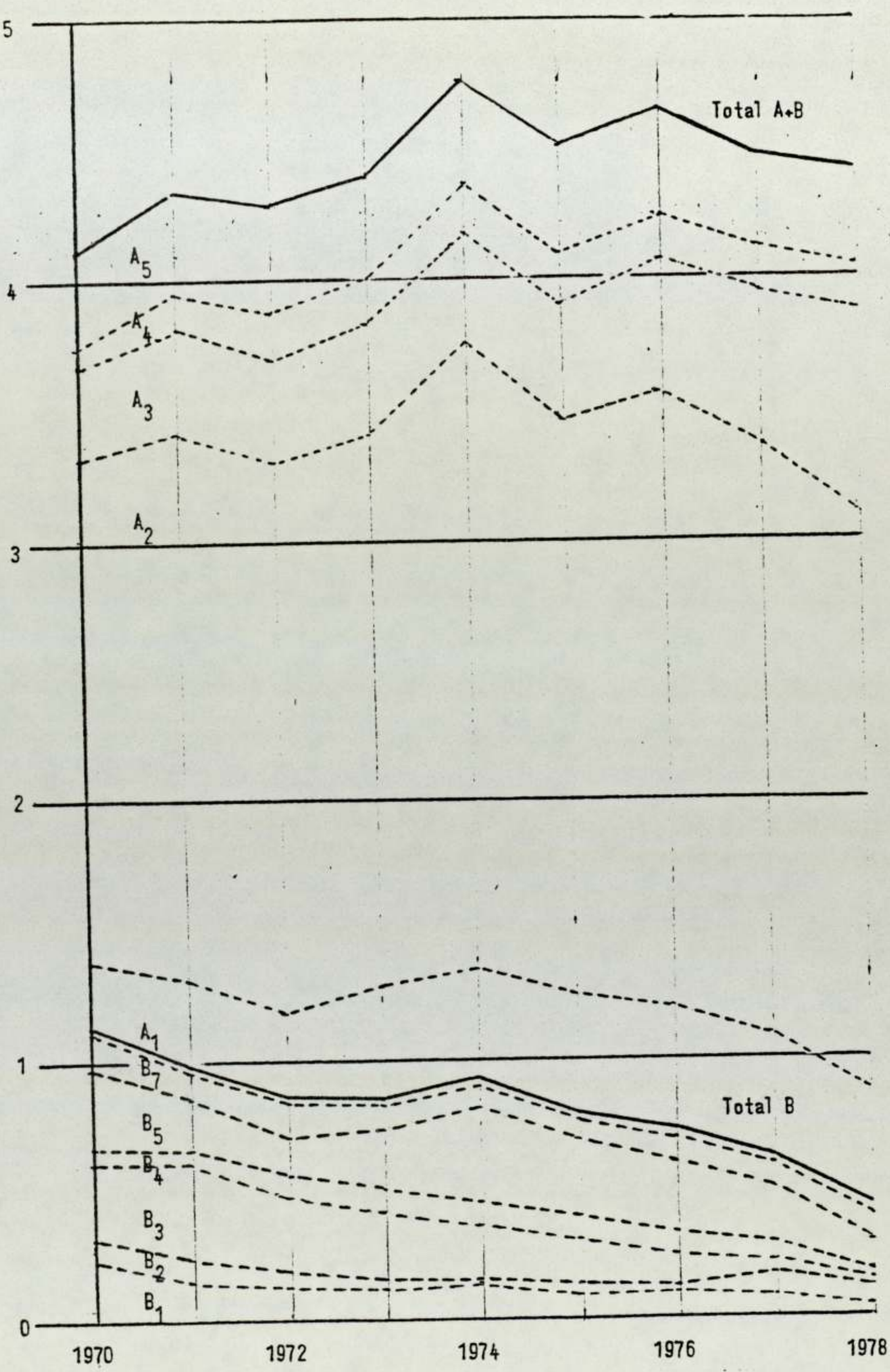


Fig. 3.7: Nominal catches of marine fish and shellfish by fishing region for 1970–78 (cumulative presentation)
(A - near waters: B - distant waters. See figure 3.6 for full details)

	1970	1971	1972	1973	1974	1975	1976	1977	1978
Total all waters	1662 401	1576 881	1639 355	1584 472	1599 139	1532 477	1497 544	1323 422	1328 973
Near waters									
Baltic	-	4	-	-	-	-	-	-	-
North Sea	-	148	35	-	1 843	1 229	365	-	-
S+W Coast of Brit. Isles	-	21 425	27 334	12 368	125 587	130 488	116 107	28 776	14 334
SW Coast of Europe	406 093	362 924	517 556	384 900	242 097	267 653	251 696	261 908	304 342
Mediterranean	183 400	184 900	146 600	177 100	176 049	202 076	223 352	215 161	223 430
TOTAL	589 493	569 401	691 525	574 368	545 576	601 446	591 520	505 845	542 106
Distant waters									
NW Atlantic(ex Greenland)	447 186	386 368	351 320	297 096	312 372	204 826	132 621	82 382	58 584
Greenland	27 514	29 032	21 580	18 604	16 129	16 683	12 059	1 052	-
Iceland	-	61	1 289	-	-	-	-	-	-
Faroes	-	-	1 015	-	1 500	1 673	324	-	-
NE Artic	-	13 315	17 449	885	50 935	45 951	62 044	21 704	6 396
Azores	8 208	8 604	10 177	11 419	12 176	6 339	6 934	20 536	12 378
EC Atlantic	323 700	297 300	314 900	428 300	482 676	436 956	467 341	489 321	526 907
SE Atlantic	266 300	272 800	230 100	249 500	174 861	215 258	223 381	200 486	180 506
Other regions	-	-	-	5 300	2 914	3 345	1 320	2 096	2 096
TOTAL	1072 908	1007 480	947 830	1010 104	1053 563	931 031	906 024	817 577	786 867

Table 3.3: Combined catches (in tonnes) of marine fish and shellfish by Greece, Spain and Portugal by fishing region in the period 1970–78.

waters off the southwest coast of Europe. As with EUR 9, the catches by the three applicant states have fallen sharply in the Northwest Atlantic and at Greenland. Some of this loss was made up for by increased catches in the Northeast Arctic and the East Central Atlantic. In the other major distant water region of interest to these states, the Southeast Atlantic, catches remained at about the same level although there were considerable annual fluctuations.

G. Catches by Groups of Marine Fish

In this study marine fish have been grouped using the classification of FAO:

1 Flounders, halibuts, soles etc (= Marine flatfish)
2 Cods, hakes, haddocks etc (= Gadiformes)
3 Redfishes, basses, congers, etc (=Demersal percomorphs)
4 Jacks, mullets, sauries, etc (= Pelagic percomorphs)
5 Herrings, sardines, anchovies, etc (= Clupeoids)
6 Tunas, bonitos, billfishes, etc (= Tuna-like fish)
7 Mackerels, snoeks, cutlass fishes etc (= Mackerel-like fish)
8 Sharks, rays, chimaeras, etc (= Elasmobranchs)
9 Miscellaneous marine fishes.

From Fig. 3.8 it is apparent that two groups were of paramount importance in the contribution they made to the world catches in the period 1970-78. Herrings, sardines, anchovies etc (group 5) and cods, hakes and haddocks etc (group 2) contributed 28 and 21% respectively to the total. Miscellaneous marine fish (group 9), the large proportion of which should more properly be called 'unsorted fish', filled third place (17% of the total) but the contribution in the differing fishing regions was extremely variable. In all the regions contributing significantly to the Community catches, the quantities registered in this group were well below the world average of 17%.

H. Regional Distribution of the World Catch by Groups of Marine Fish

Figure 3.9 shows the breakdown of the catch by groups of marine

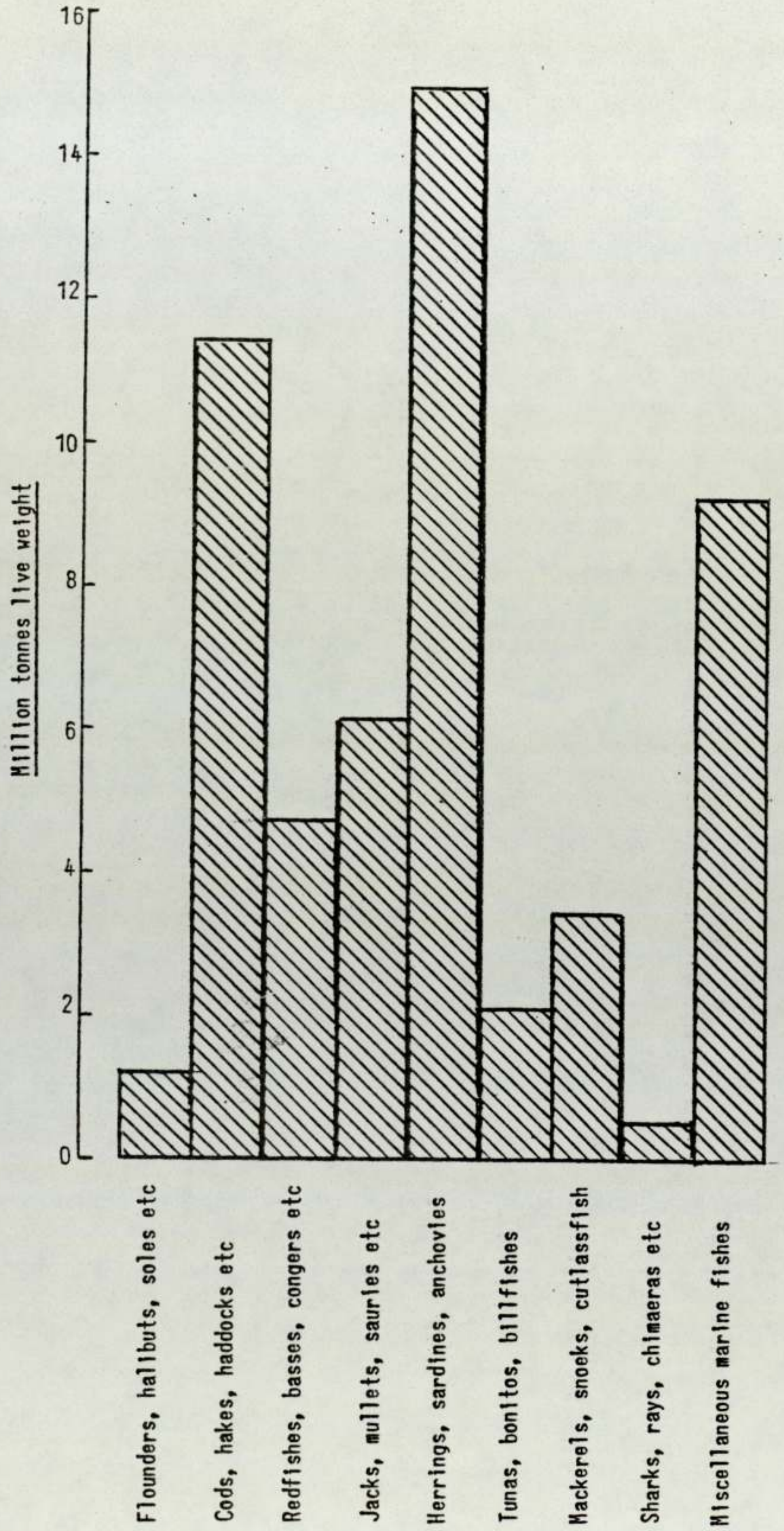


Fig. 3.8: World nominal catches of the different groups of marine fish (mean 1970–78).

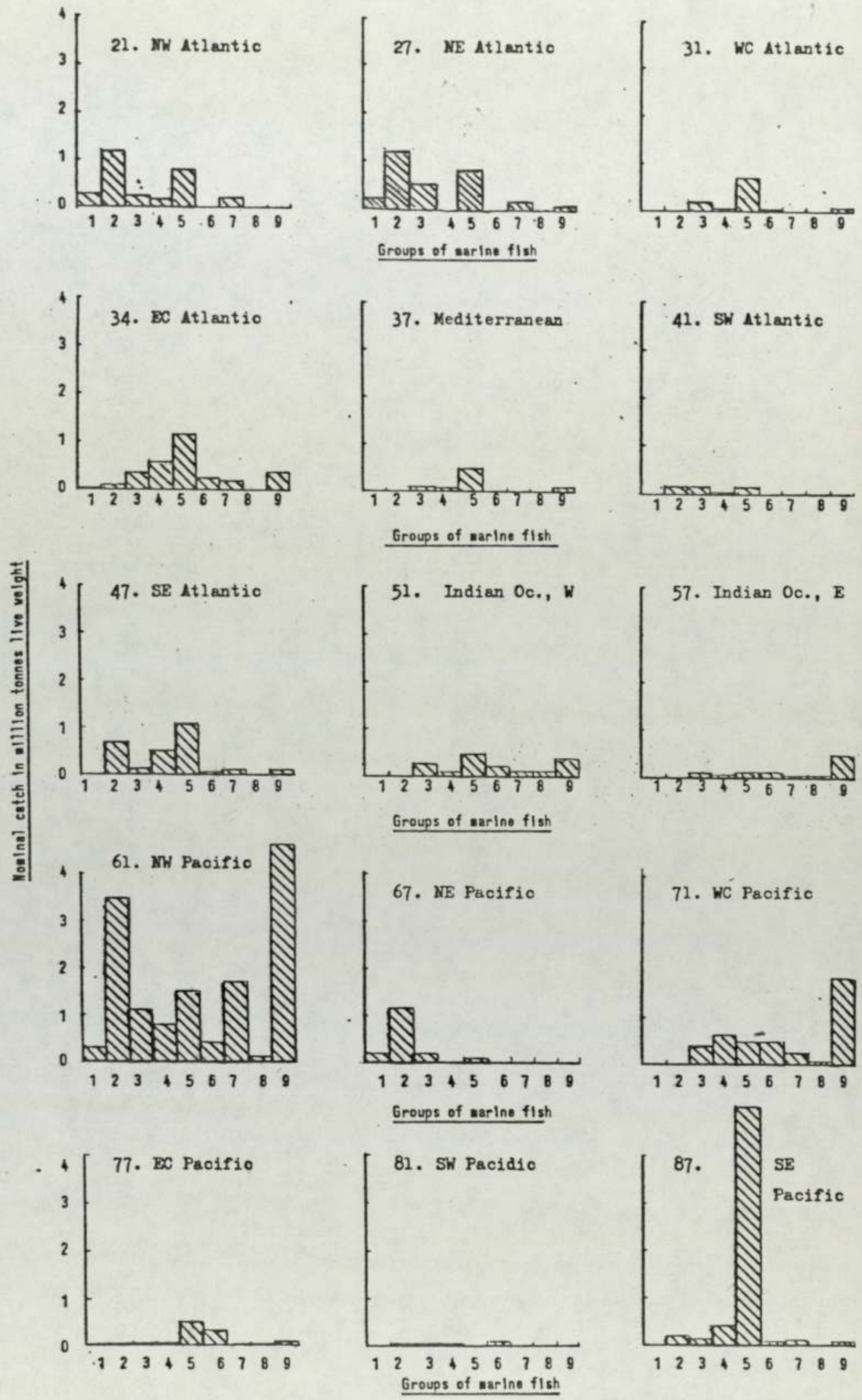


Fig. 3.9: Nominal catches of the different groups of marine fish in the main fishing regions (mean 1970-78)

1 - Marine flatfish; 2 - Gadiformes; 3 - Demersal percomorphs; 4 - Pelagic percomorphs; 5 - Clupeoids; 6 - Tuna-like fish; 7 - Mackerel-like fish; 8 - Elasmobranchs; 9 - Miscell.

fish species for the major fishing regions in the period 1970-78. Species in group 5 (herring, sardines, anchovies, etc) are particularly important in the more southerly fishing regions. In fact they predominate in the catches of the Southeast Pacific (region 87), the Mediterranean and Black Sea (region 37), East Central Atlantic (region 34), West Central Atlantic (region 31), Southwest Atlantic (region 41), Southeast Atlantic (region 47) and Western Indian Ocean (region 51).

On the other hand, cods, hakes, haddocks etc (group 2) are more abundant in the catches from more northerly waters. This group, apart from predominating in the catches of the two most important fishing regions in recent years (the Northeast Atlantic and the Northwest Pacific) also figures largely in the catches of the Northwest Atlantic and the Northeast Pacific.

The importance of miscellaneous marine fish (group 9) in the Eastern Indian Ocean (region 57), the West Central Pacific (region 71) and the Northwest Pacific (region 61) is an indication of the inadequacy of statistical reporting in the coastal states of Southeast Asia.

I. Important Species for the Member and Applicant States of the European Community

Below are listed the species contributing at least 10% to the nominal catches for each of the member and applicant states and the contribution to the total fishery production, the data being the annual means for the period 1970-78.

FR Germany

Total catch	528 573 t	
Atlantic cod (Gadus morhua)	127 578 t	(24%)
Saithe (Pollachius virens)	74 086 t	(14%)
Atlantic redfishes (Sebastes spp)	63 234 t	(12%)

France

Total catch	792 257 t
Atlantic cod (Gadus morhua)	84 928 t (11%)
Saithe (Pollachius virens)	82 267 t (10%)

Italy

Total catch	392 014 t
European anchovy (Engraulis encrasicolus)	55 568 t (14%)
European pilchard (Sardina pilchardus)	45 287 t (12%)

Netherlands

Total catch	329 254 t
Blue mussel (Mytilus edulis)	104 609 t (32%)
European plaice (Pleuronectes platessa)	48 506 t (15%)
Atlantic herring (Clupea harengus)	44 380 t (13%)

Belgium

Total catch	54 755 t
Atlantic cod (Gadus morhua)	15 649 t (29%)
European plaice (Pleuronectes platessa)	6 797 t (12%)

United Kingdom

Total catch	1 079 301 t
Atlantic cod (Gadus morhua)	281 709 t (26%)
Haddock (Melanogrammus aeglefinus)	151 760 t (14%)

Ireland

Total catch	75 974 t
Atlantic herring (Clupea harengus)	32 580 t (43%)
Atlantic mackerel (Scomber scombrus)	13 567 t (18%)

Denmark

Total catch	1 436 098 t
Sandeels (Ammodytes spp)	451 788 t (31%)
Norway pout (Trisopterus esmarkii)	274 853 t (19%)
Sprat (Sprattus sprattus)	217 894 t (15%)
Atlantic herring (Clupea harengus)	216 782 t (15%)

Greece

No individual species are identifiable as contributing significantly to the total. Miscellaneous marine fish are registered at 19 534 (20%).

Spain

Total catch	1 466 938 t
European pilchard (Sardina pilchardus)	166 828 t (11%)
Cape hakes (Merluccius capensis, M. paradoxus)	162 901 t (11%)

Portugal

Total catch	371 613 t
Atlantic cod (Gadus morhua)	89 544 t (24%)
European pilchard (Sardina pilchardus)	86 472 t (23%)
Atlantic horse mackerel (Trachurus trachurus)	48 130 t (13%)

It will be noted that cod, Gadus morhua, was the most important species in five of the eleven states. This importance is further reflected in an examination of the species important at the Community level (see Fig. 3.10). The inclusion of the three applicant states makes some notable changes to the list of the more important species. For example, the European pilchard (Sardina pilchardus), the Cape hakes (Merluccius capensis, M. paradoxus) and the Atlantic horse mackerel (Trachurus trachurus) appear in the top 12 species for EUR 9 + 3 whereas they did not for EUR 9.

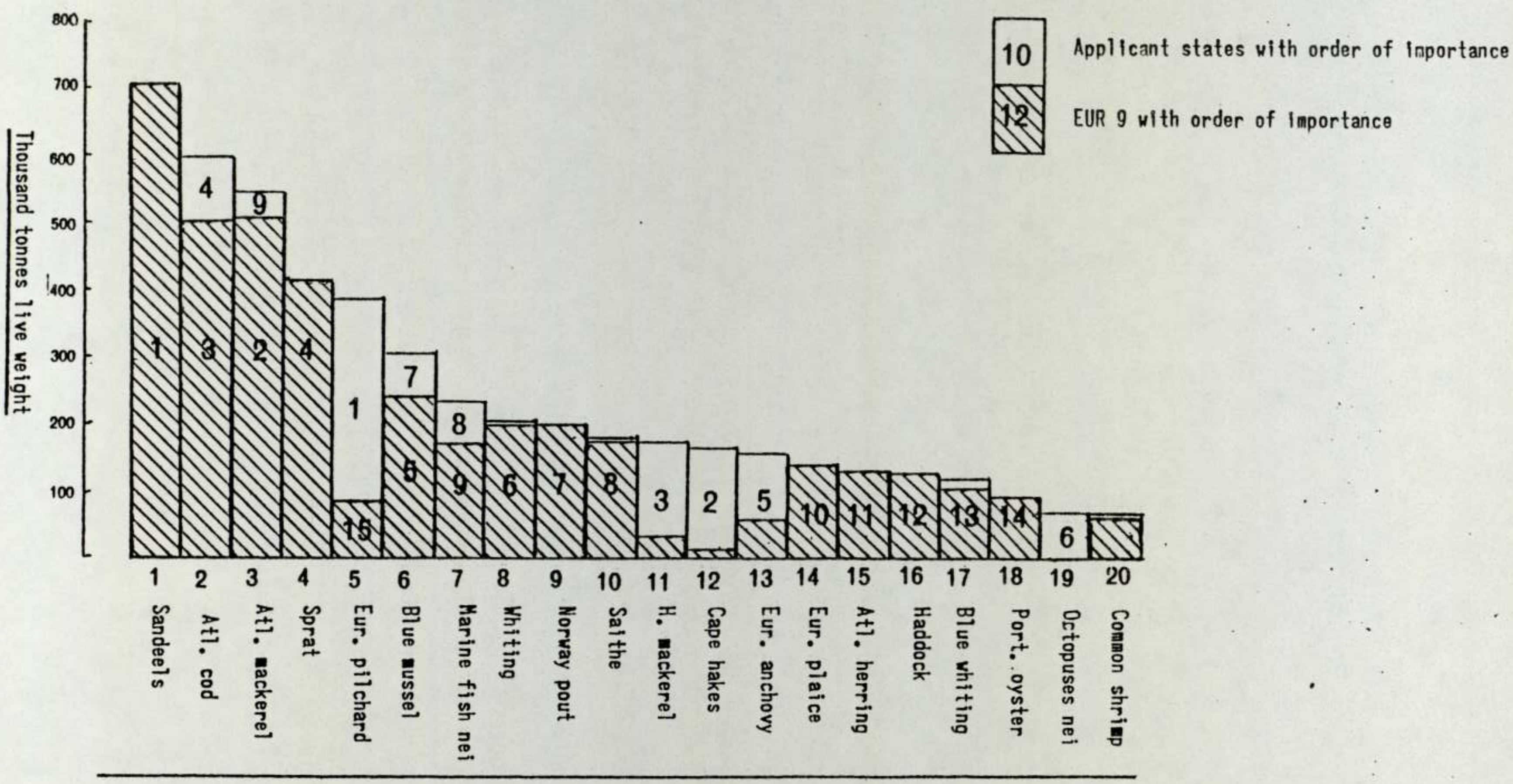


Fig. 3.10: Principal species caught by Community vessels in 1978.

The remainder of this study is devoted to a more detailed analysis of the situation with regard to the 13 most important species for EUR 9 + 3. It must be stressed that the selection of species was governed solely by the weight of fish landed. No account was taken of the value of the landings: if it had been, some of the industrial species (Norway pout, sandeels, sprat) may have been replaced by higher valued species for human consumption. Furthermore the species were selected for their importance at Community level: this has resulted in the exclusion of certain species which are important principally to individual states (for example, redfish (*Sebastes* spp) for FR Germany).

J. Sandeels (*Ammodytes spp*)

The total catches of this species have increased greatly though irregularly in the period 1970-78. All the catches, other than very small quantities by the USA in the Northwest Atlantic, were from the Northeast Atlantic.

Northeast Atlantic (region 27) /see Fig. 3.11/

Catches in this region have increased, albeit irregularly, from 191 600 t in 1970 to 811 947 t in 1978. The fishery for sand-eels is conducted predominently by Denmark. Indeed, in spite of an increasing interest in the fishery shown primarily by Norway but also by the United Kingdom, Denmark currently records a little over 80% of the catch.

K. Atlantic cod (*Gadus morhua*)

In the period 1970-78 the world production of Atlantic cod fell by an average of 120 000 t per year to 2 172 382 t in 1978. This decrease which amounted to 31% over the period, resulted very largely from a decrease in catches of 42% by EUR 9 and of 80% by Spain and Portugal combined. Indeed, in this period EUR 9 + 3's contribution to the total fell from 40% to 25%.

Northeast Atlantic

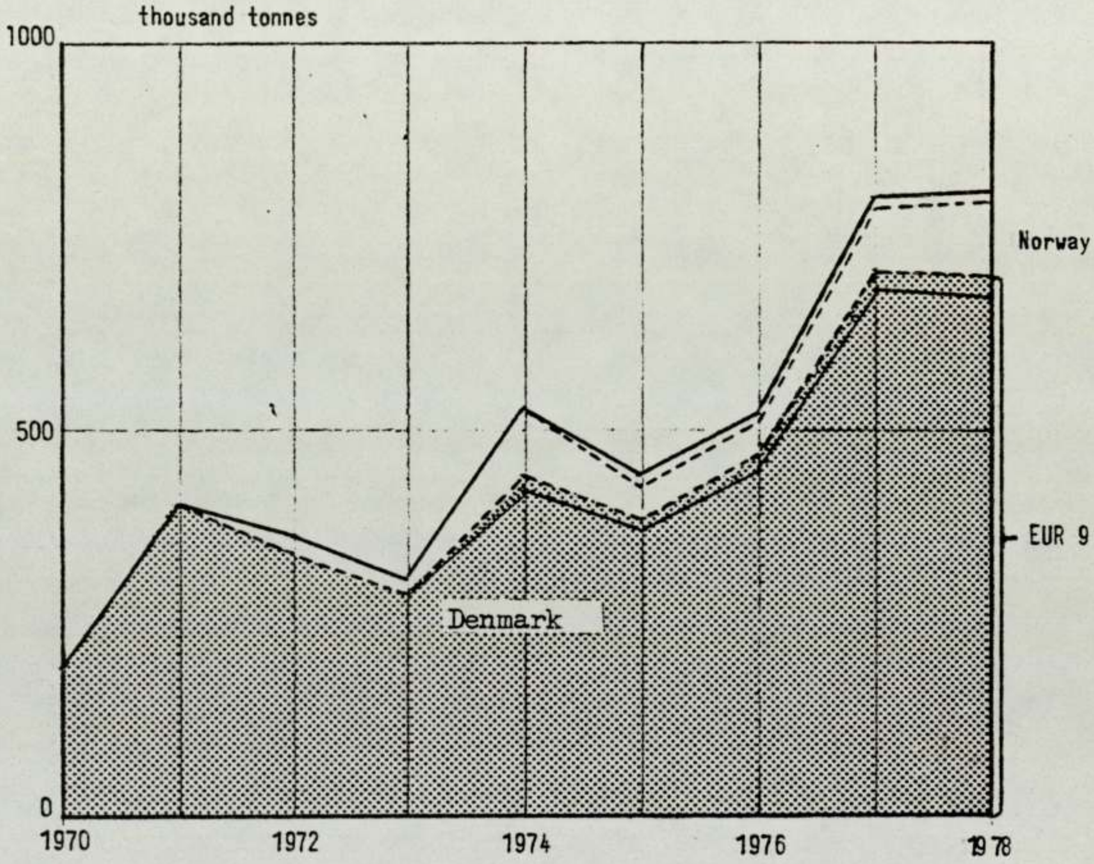


Fig. 3.11: Nominal catches of sandeels by principal countries for the period 1970–78 (cumulative presentation)

Northwest Atlantic (region 21) [see Fig. 3.12a]

In this region the catch of Atlantic cod fell sharply from 1 198 800 in 1970 to 482 522 in 1978. This decrease, which averaged 90 000 t per year, accounted for a large part of the drop in world production. Although most countries fishing in the region registered decreasing catches EUR 9 + 3 seems to have fared particularly badly. Its catches decreased by an average of 71 000 t per year and of the component states FR Germany, Portugal and Spain suffered decreases of 93%, 91% and 93% respectively.

Northeast Atlantic (region 27) [see Fig. 3.12b]

Since 1970 the catches of Atlantic cod in this region have fluctuated around 1 850 000 t per year, making it the most important source of the species. Catches by individual countries (notably the USSR) have fluctuated widely. The EUR 9 + 3 catch, of which the United Kingdom contributes about one half, has decreased slightly in recent years but is still about one third of the region total.

L. Atlantic mackerel (Scomber scombrus)

Between 1970 and 1976 the total catches of Atlantic mackerel increased by 60% to 1 088 910 t, a level previously reached in 1967 and 1968. The 1977 and 1978 catches were at about the same level as those of 1970, about 70 000 t.

Northwest Atlantic (region 21) [see Fig. 3.13a]

Catches of mackerel in this region rose from 15 544 t in 1965 to a maximum of 419 678 t in 1973, only to decline sharply to 29 994 t in 1978. The major catches in the region were made by the USSR, Poland and German DR. EUR 9 + 3 countries caught less than 1% of the total.

Northeast Atlantic (region 27) [see Fig. 3.13b]

From a high point of 1 015 900 t in 1967 catches of mackerel in

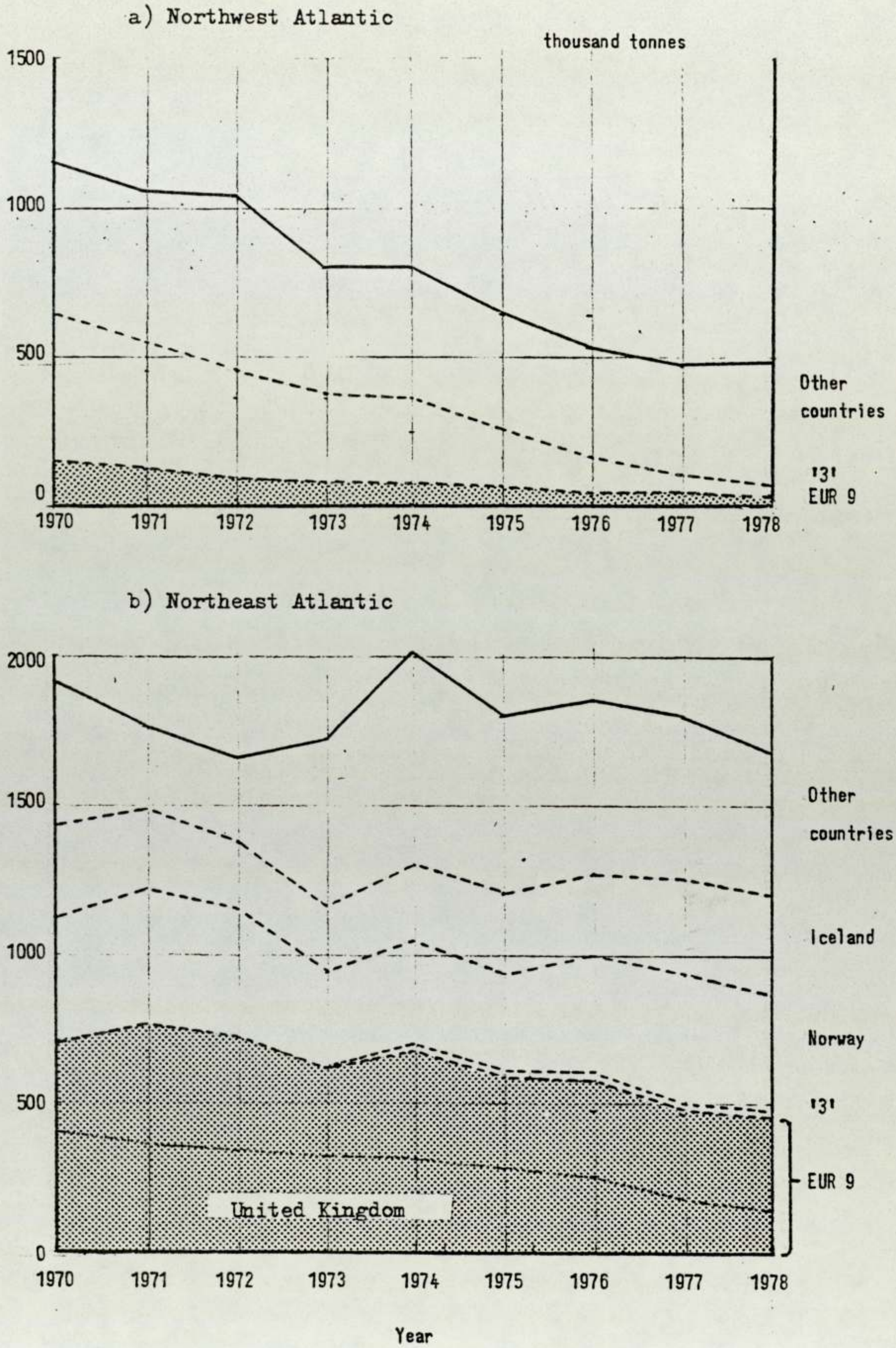


Fig. 3.12. Nominal catch of cod by the principal countries in the period 1970-78 (cumulative presentation)

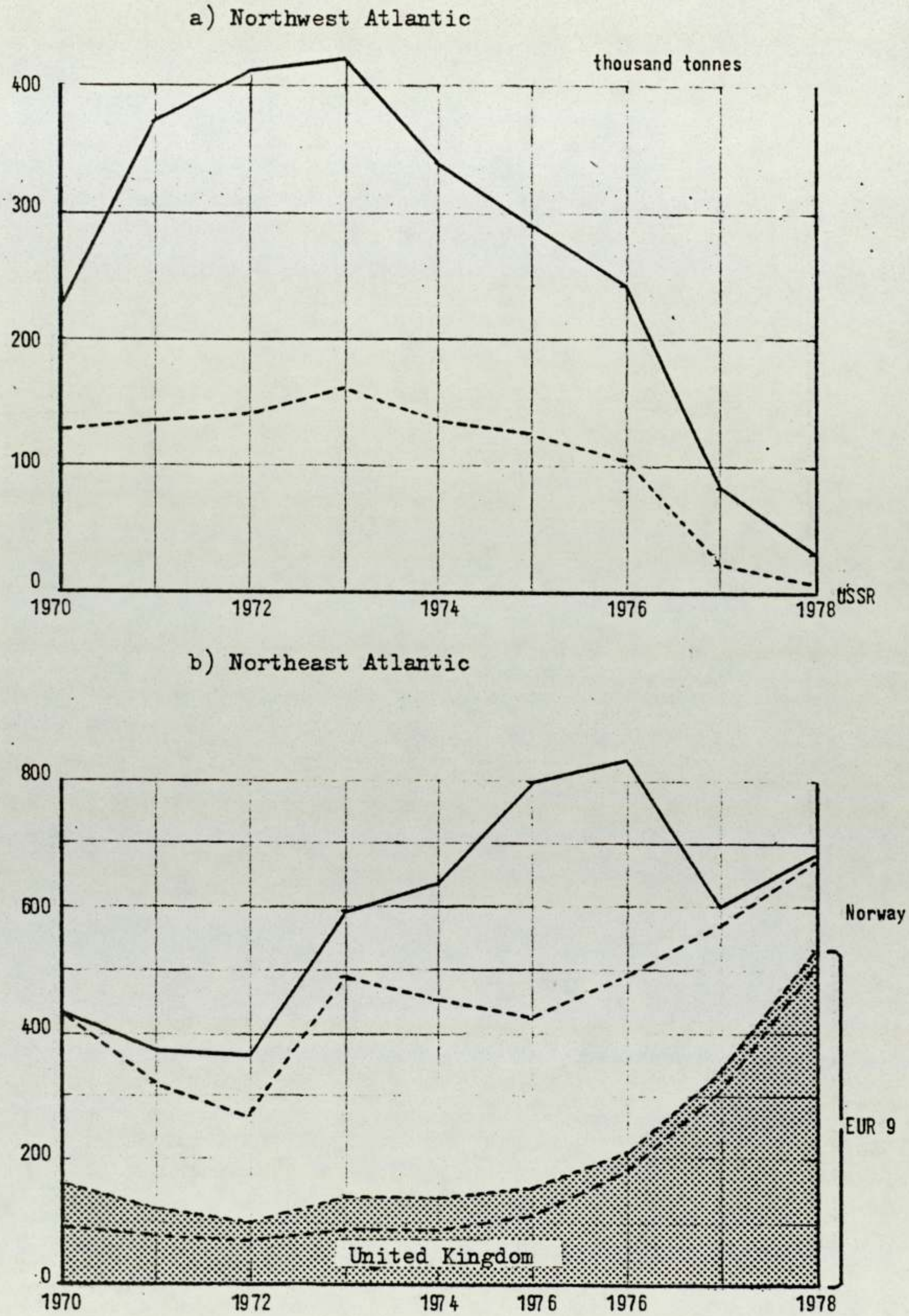


Fig. 3.13. Nominal catch of Atlantic mackerel by principal countries in the period 1970–78 (cumulative presentation)

the Northeast Atlantic decreased to 367 800 t in 1972. Subsequently the catch has increased to around 700-800 thousand tonnes. There has been a great change in the countries making these catches. Whereas the USSR and Norway used to predominate, the EUR 9 countries now catch about 75% of the total. The United Kingdom with a catch of 320 921 t in 1978 makes the largest single contribution although Ireland's 33 165 t is nationally very important.

Mediterranean (region 37)

This region, of relatively minor importance for catches of Atlantic mackerel, has suffered a decline in recent years from an annual catch of 20-25 000 t in the 1960's to under 10 000 t currently. France, Italy and Spain contributed 77% to the total catch of 8 649 tonnes in 1978.

M. Sprat (Sprattus sprattus)

The world catch of this species increased nearly four-fold from 241 300 t in 1970 to 913 954 t in 1976 but has declined to 691 255 t in 1978. By far the most important country for the capture of this species is Denmark which in the period 1975-78 averaged 41% of the world total.

Northeast Atlantic (region 27) [see Fig. 3.14]

All but about 5% of the total catch of sprat was taken in this region. Apart from the dominant part played by Denmark, the USSR and Norway have taken considerable quantities of the species.

N. European pilchard (Sardina pilchardus)

Data prior to 1972 are unreliable since it appears that the USSR may have been giving incomplete returns. However, after 1972 the world catch nearly doubled from 674 700 t in 1972 to 1 315 652 t in 1976. Subsequently the total dropped to 800 935 t in 1978.

Northeast Atlantic

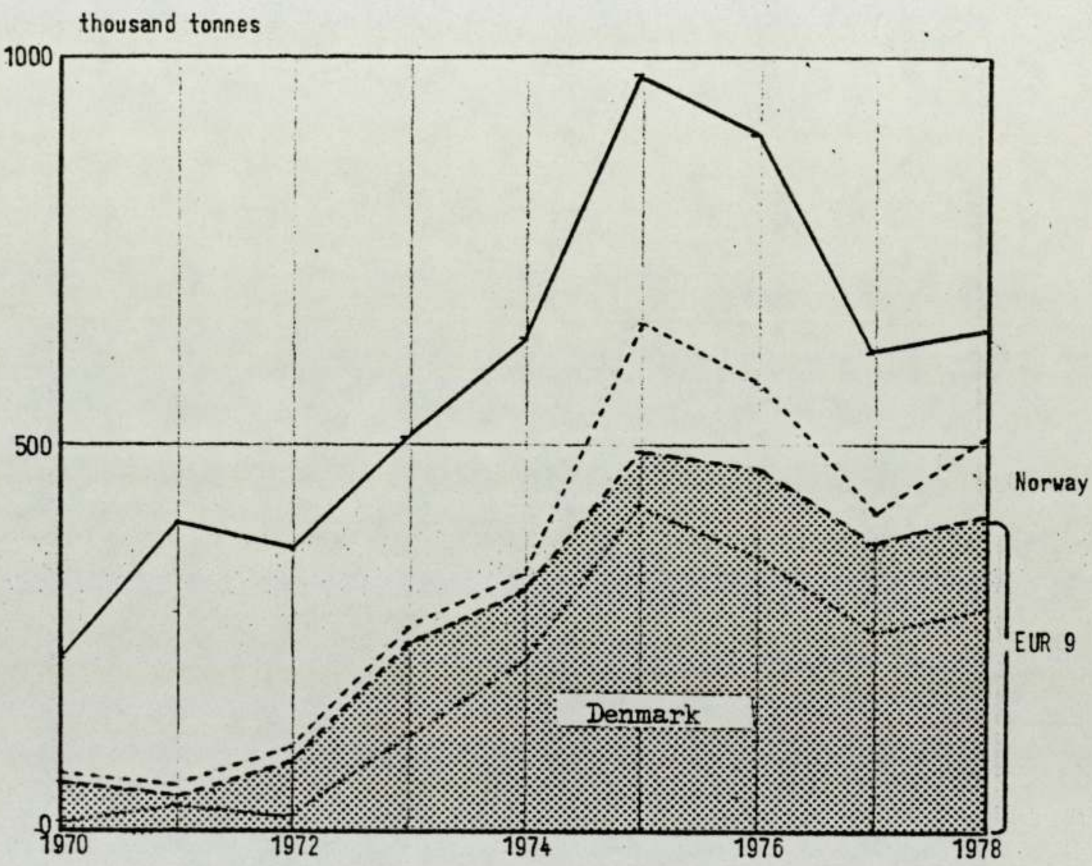


Fig. 3.14: Nominal catches of sprat by principal countries in the period 1970–78 (cumulative presentation)

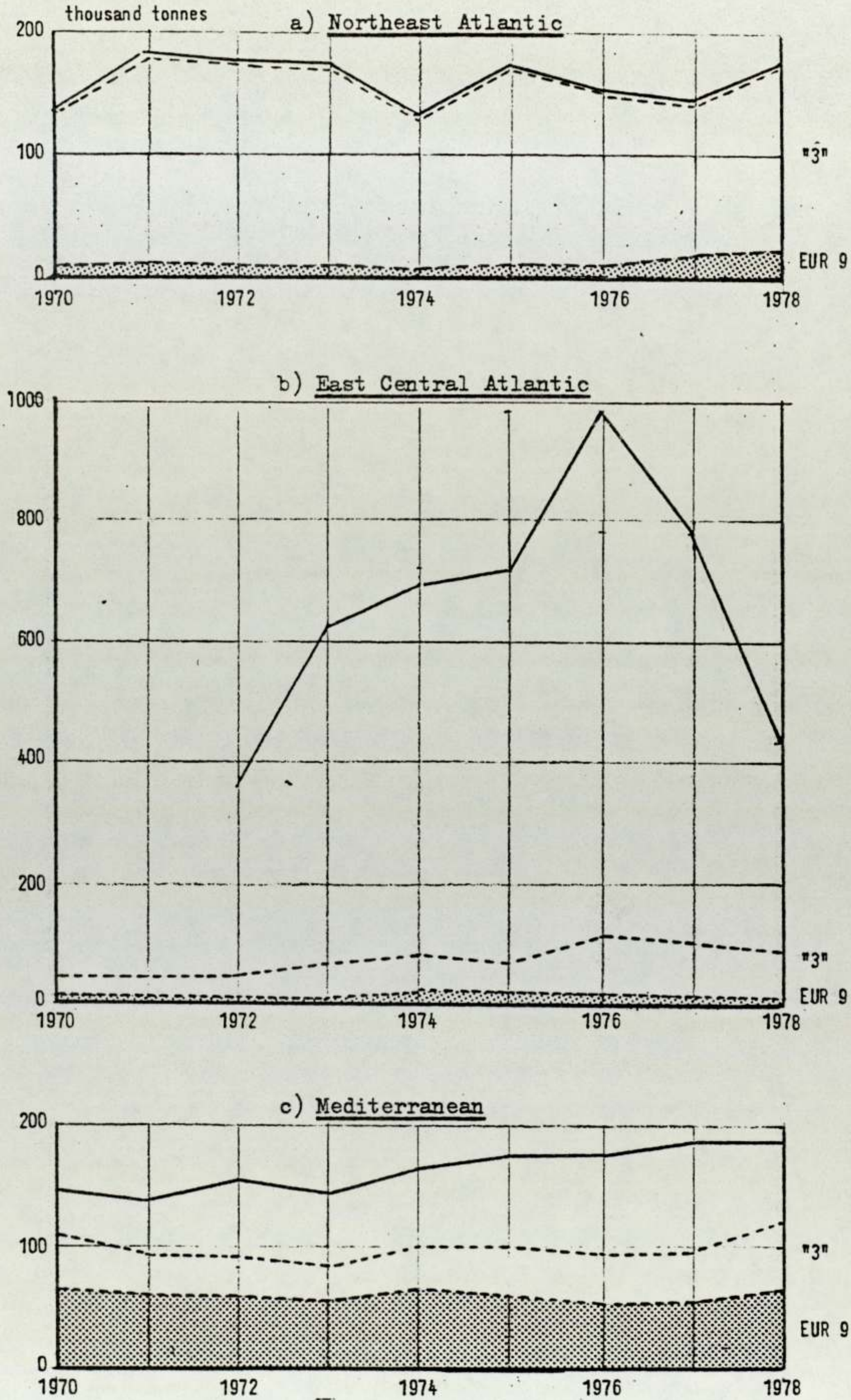


Fig. 3.15: Nominal catches of European pilchard by principal countries in the period 1970–78 (cumulative presentation)

Northeast Atlantic (region 27) [see Fig. 3.15a]

Spain and Portugal between them have been responsible for about 90% of the mean annual catch of 160 000 t.

East Central Atlantic (region 34) [see Fig. 3.15b]

The USSR and Morocco are the countries largely exploiting the European pilchard in this region, catching about 70% of the total. The total catch for the region increased steadily to just under a million tonnes in 1976 and then decreased to 435 593 t in 1978. The EUR 9 + 3 catch has increased from 38 600 t in 1971 to 89 520 t in 1978, but this statement rather masks an interesting development. In the period the French catch decreased from 11 600 t in 1970 to zero in 1978 with the Spanish catch increased from 27 300 t to 89 520 t.

Mediterranean and Black Sea (region 37) [see Fig. 3.15c]

The EUR 9 + 3 catch in this region has remained relatively constant at a little under 100 000 t since 1970. Italy and Spain were the two countries having the largest catches in the region with 53 522 t and 41 460 t respectively in 1978. However, sizeable contributions were also made by France and Greece (11 412 t and 12 234 t respectively in 1978). The EUR 9 + 3 proportion of the total catch fell during the period from 75% in 1970 to 63% in 1978, due largely to increases in the catches of Yugoslavia, Algeria and Morocco.

O. Whiting (*Merlangius merlangus*)

With the exception of very small quantities (never exceeding about 1% of the total catch) from the Mediterranean, the fishery for whiting is restricted to the Northeast Atlantic.

Northeast Atlantic (region 27) [see Fig. 3.16]

When looking at the period 1970-78 it is difficult to see any trend in catches. However, on extending this period back to

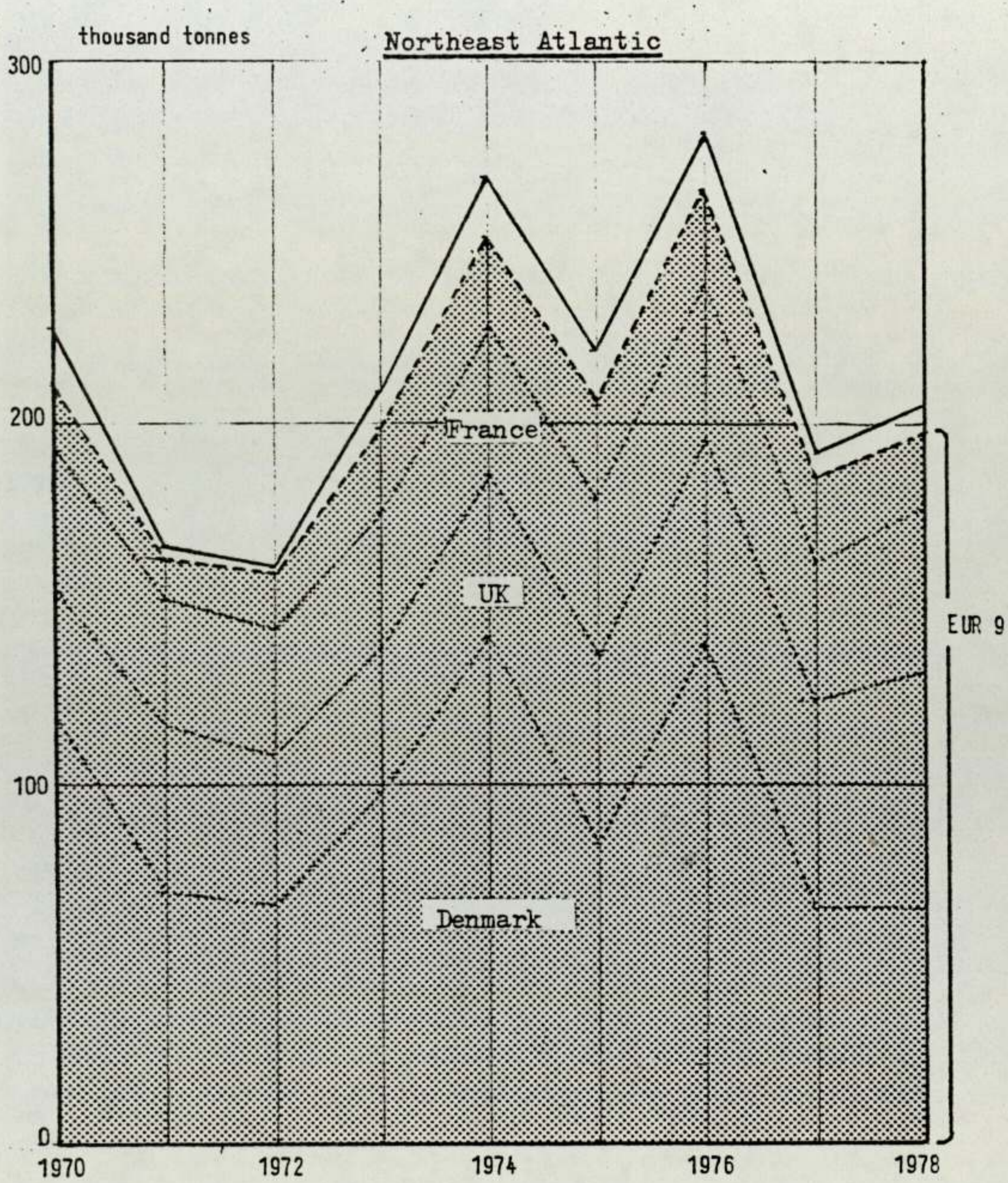


Fig. 3.16: Nominal catches of whiting by principal countries in the period 1970–78 (cumulative presentation)

1961 the trend appears to be one of catches increasing by about 5 000 t per year but with considerable fluctuations about the trend. In 1966 Denmark replaced France as the major producer of whiting and subsequently strengthened its position, being responsible for an average of 39% of the total catch in the period 1975-78. France and the United Kingdom each caught between 15-20% of the total and the dominant position of the Community is underlined by the fact that in 1978 EUR 9 accounted for 97% of the 206 180 t caught in 1978.

P. Norway pout (Trisopterus esmarkii)

Northeast Atlantic (region 27) [see Fig. 3.17]

The fishery for Norway pout is restricted to the Northeast Atlantic. In the period up to and including 1974 the catches increased greatly to a maximum of 878 768 t but subsequently the catches have decreased equally rapidly to reach 425 233 t in 1978. Throughout the period two countries, Denmark and Norway, have between them been responsible for 80-90% of the catch, their respective contributions fluctuating between 40-55% and 30-45%. The catches of Norway have progressed in a much steadier fashion than those of Denmark where the catches doubled in 1974 only to return to the original level the following year.

Q. Saithe (Pollachius virens)

The total catch of saithe has increased from 640 600 t in 1970 to 750 005 t in 1976 only to drop rapidly to 459 141 t in 1978. In this period less than 7% was caught in the Northwest Atlantic; the greater part of the catches were recorded from the Northeast Atlantic.

Northeast Atlantic (region 27) [see Fig. 3.18]

The total catch of saithe in the Northeast Atlantic has flucuated between 520 000 and 720 000 tonnes per year in the period

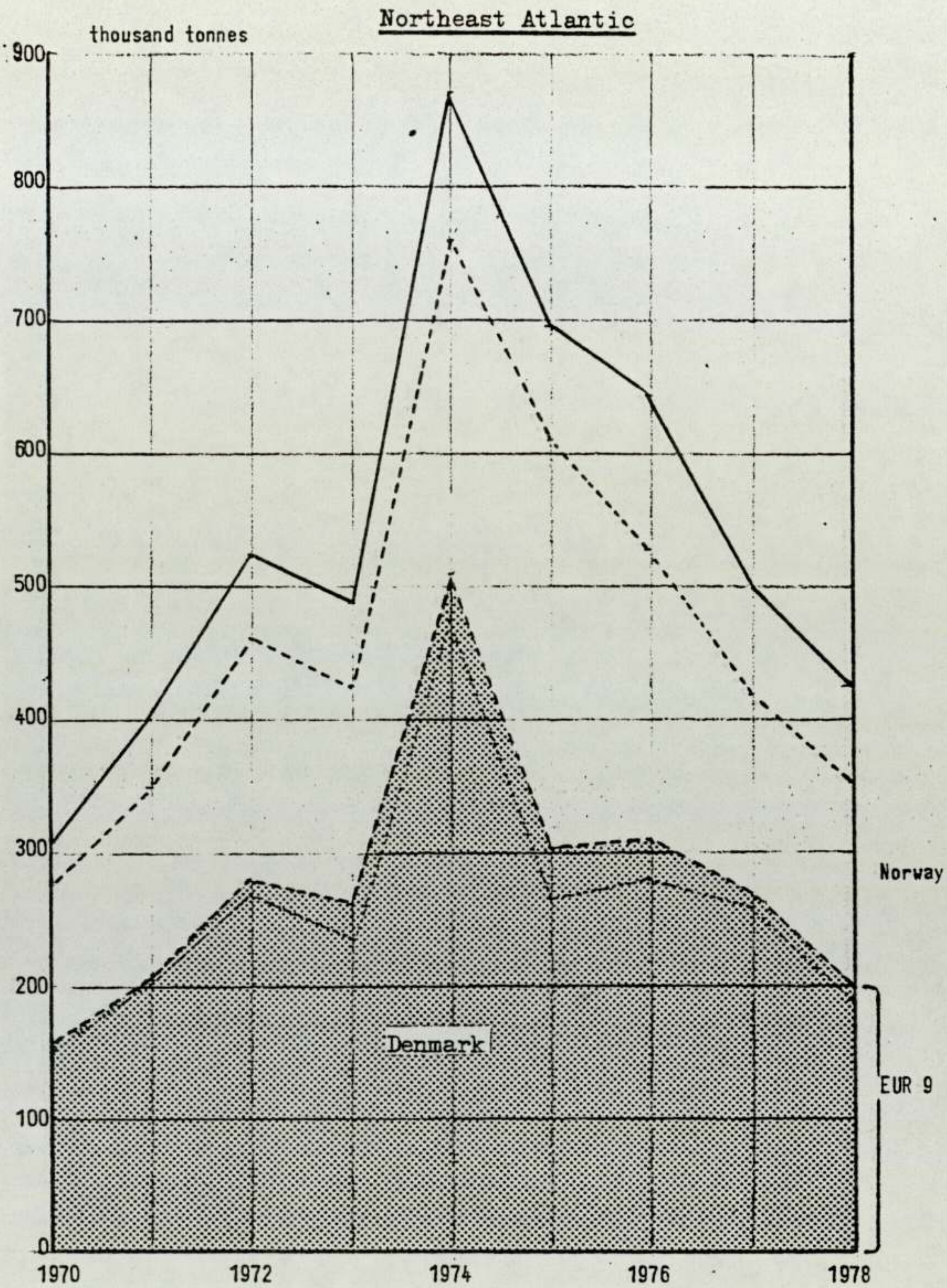


Fig. 3.17: Nominal catches of Norway pout by principal countries in the period 1970–78 (cumulative presentation)

Northeast Atlantic

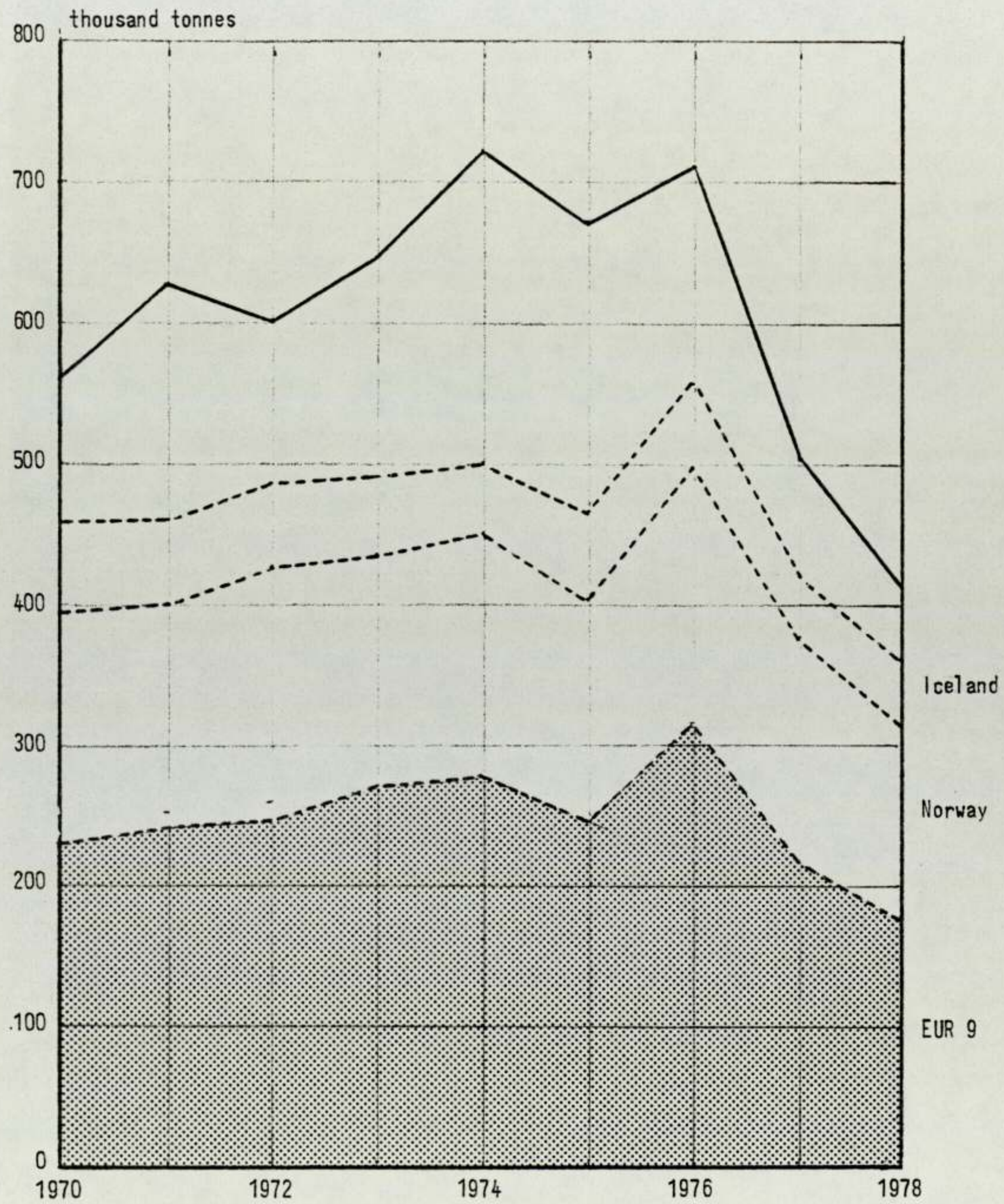


Fig. 3.18: Nominal catches of saithe by principal countries in the period 1970-78 (cumulative presentation)

1970-78. EUR 9 + 3 contributed about 40% to the total, the main countries responsible for this being France, FR Germany and the United Kingdom.

R. Atlantic horse mackerel (*Trachurus trachurus*)

Fish of the genus *Trachurus* are caught in several of the major fishing regions but the Atlantic horse mackerel is only recorded as such from the Northeast Atlantic.

Northeast Atlantic (region 27) [see Fig. 3.19]

The total catches of this species in the Northeast Atlantic have shown a fairly regular increase in the period 1965-76, the 1976 catch at 381 747 t being nearly treble that for 1965. Subsequently the catch has been more than halved to 174 771 in 1978. Although the EUR 9 catches have increased steadily to 33 650 t in 1978 this is still only 19% of the much reduced total catch. This species is very much more important for Spain and Portugal where, since 1971, combined catches have annually been at least 120 000 t.

The outstanding feature of the fishery in the region has been the very great expansion of USSR interest in the species in the late 1960's. This increase continued to reach 188 803 t in 1976 (53% of the total) only to fall to negligible quantities in 1978 due to the restrictions placed on the Soviet fishing fleet.

S. Cape hakes (*Merluccius capensis, M. paradoxus*)

Southeast Atlantic (region 47) [see Fig. 3.20]

In the 1960's this fishery developed rapidly and regularly but more recently the catches have fluctuated widely. This development and the later fluctuations can be tied closely to the USSR catch. The catches of the remaining principal countries in the fishery, South Africa, Japan and Spain, have remained relatively steady throughout the period, the latter's catch being between

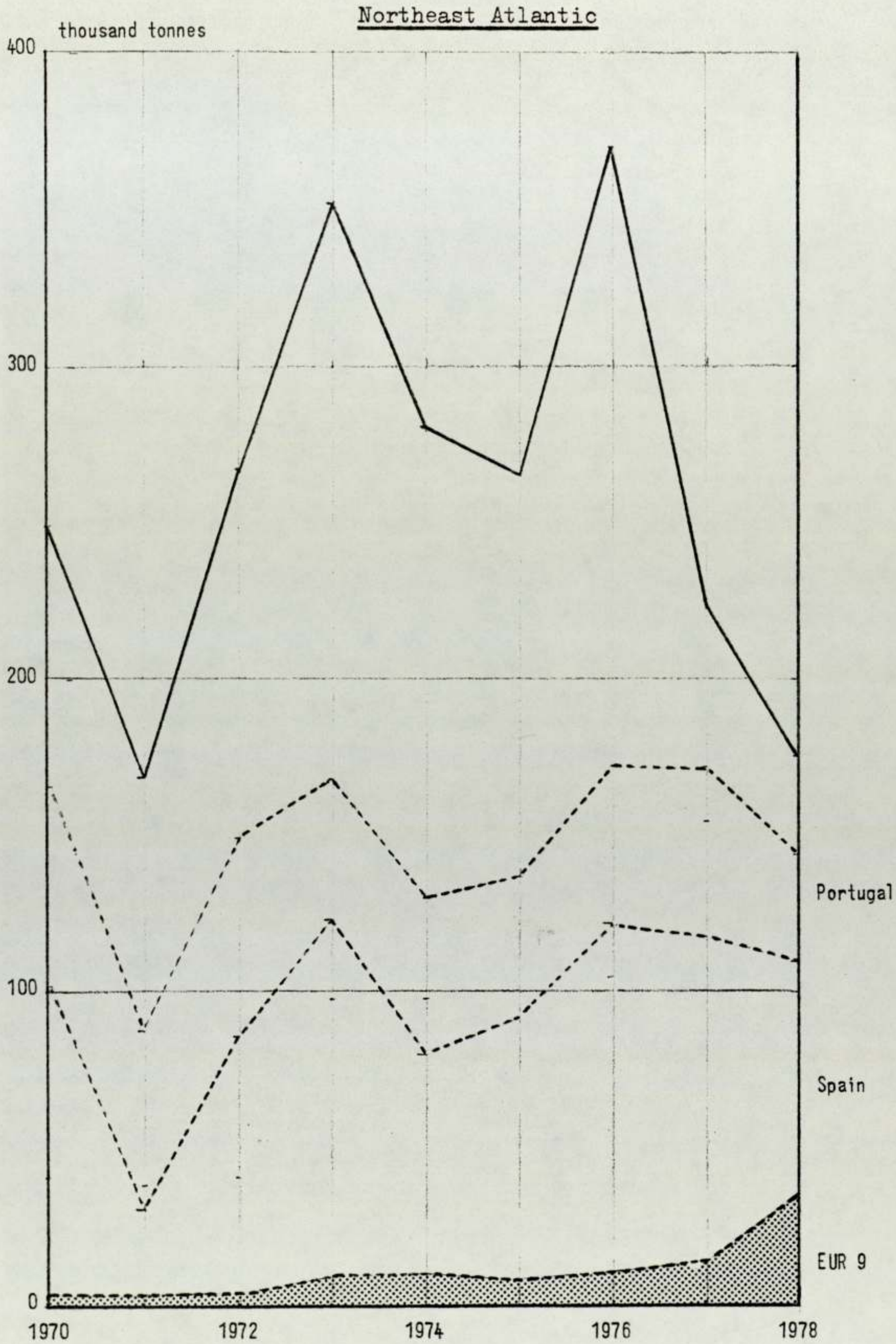


Fig. 3.19: Nominal catches of Atlantic horse mackerel by principal countries in the period 1970–78 (cumulative presentation).

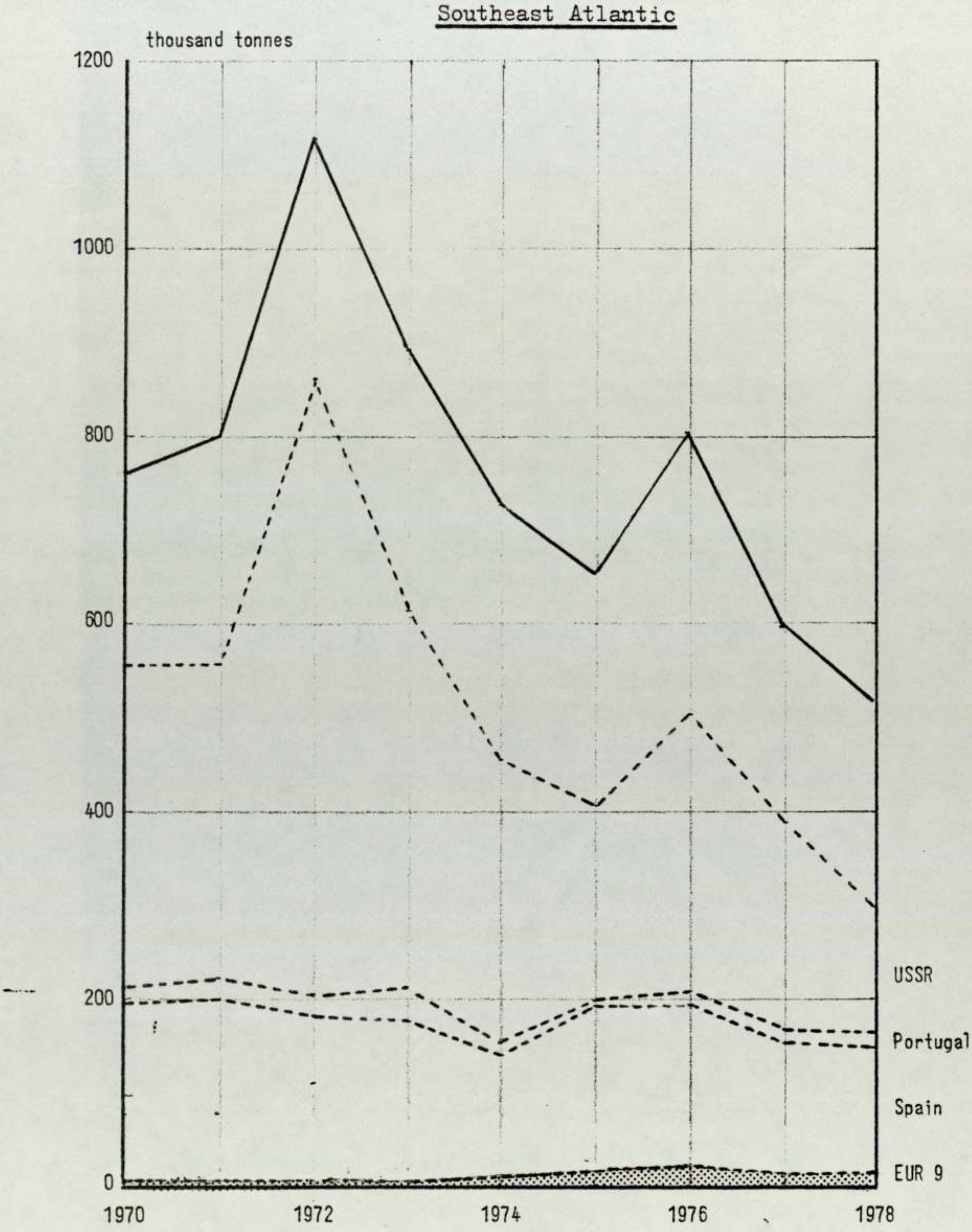


Fig. 3.20: Nominal catches of Cape hakes by principal countries in the period 1970-78 (cumulative presentation)

100 and 170 thousand tonnes. It is interesting to note that the FR Germany, France and Italy have recently entered the fishery; at present they contribute under 5% of the total catch.

T. European anchovy (Engraulis encrasicolus)

The total catch of this species has increased in the period from 1970, although with some fluctuations, until it stood at 407 213 t in 1978.

Northeast Atlantic (region 27) [see Fig. 3.21a]

Catches in the mid-1970's decreased from 46 800 in 1970 to 29 588 in 1975 only to recover to 61 675 t in 1978. Spain was the main country involved in the fishery catching an average of 89% of the catch in the period 1970-78.

East Central Atlantic (region 34)

Relatively small quantities of anchovies are caught in the East Central Atlantic. There are various gaps in the data which render the determination of a trend hazardous but the total catch from the region probably has not exceeded 20 000 t per year.

Mediterranean and Black Sea (region 37) [see Fig. 3.21b]

This region contributes about 80% to the total catch of the species. The catch increased from 277 800 t in 1970 to 557 767 t in 1974, only to decrease again to 343 109 t in 1978. The EUR 9 + 3 contribution amounts only to about 25% of the region total, the major contributions being made by the USSR and Turkey.

U. European plaice (Pleuronectes platessa)

Northeast Atlantic (region 27) [see Fig. 3.22]

The fishery for European plaice is conducted mainly in the Northeast Atlantic. From 1965 the catch of this species has

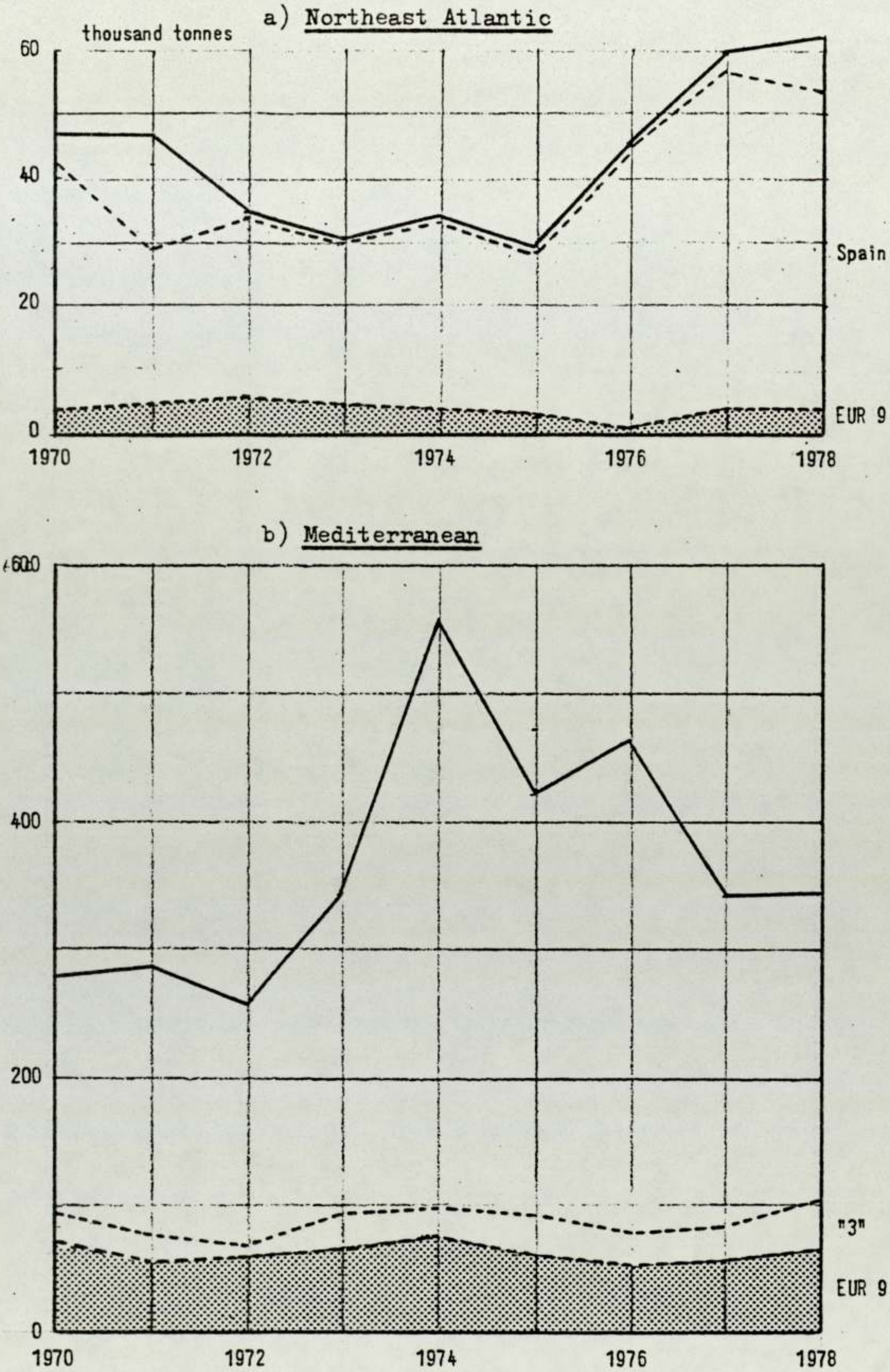


Fig. 3.21: Nominal catches of European anchovy by principal countries for the period 1970-78 (cumulative presentation).

Northeast Atlantic

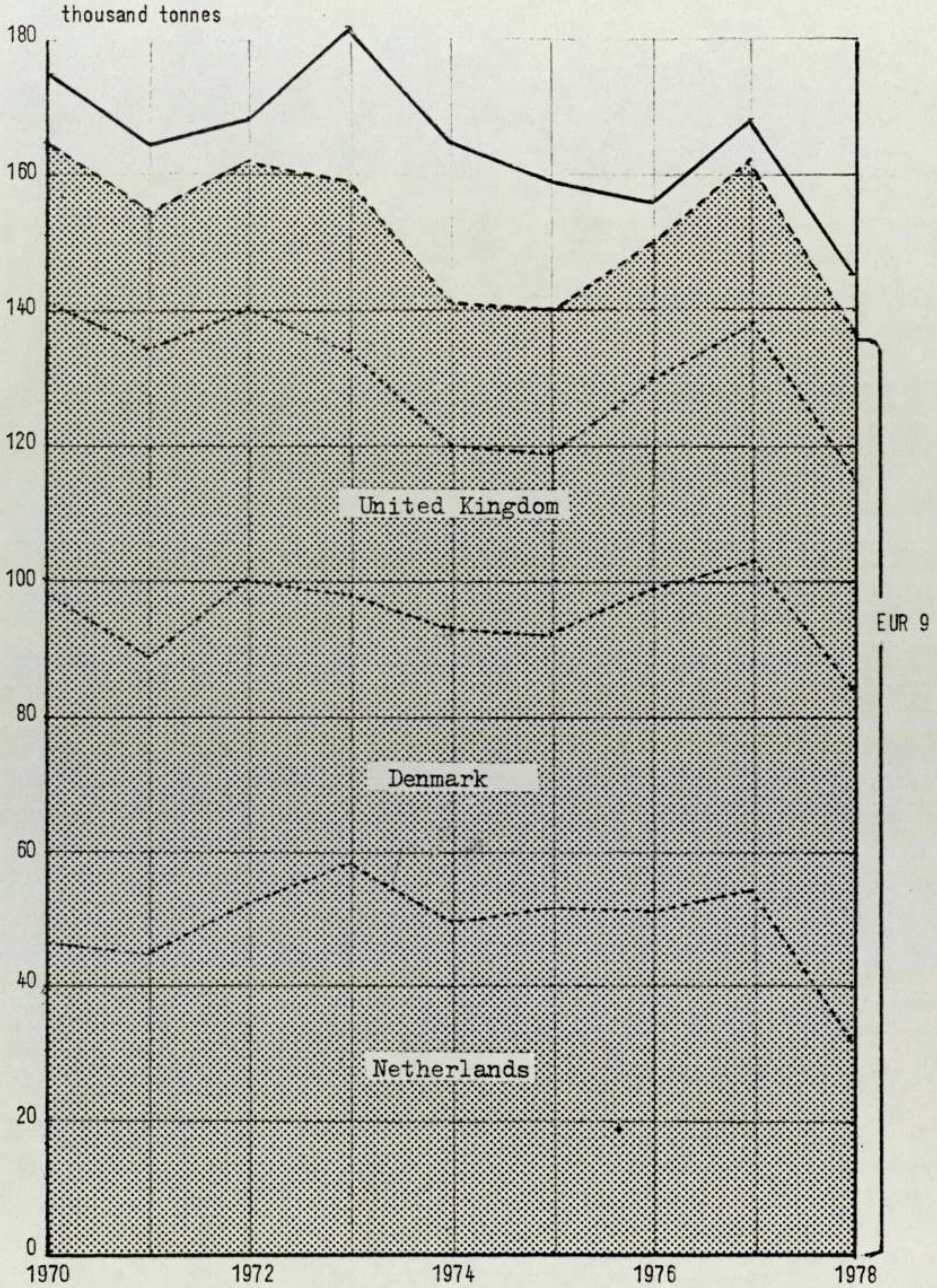


Fig. 3.22: Nominal catches of European plaice by principal countries in the period 1970-78 (cumulative presentation).

remained remarkable steady between 140-180 000 t. This is perhaps the closest one gets to a Community fishery in that in the period 1970-78 EUR 9 was responsible for 96% of the total catch. The three applicant states do not register catches of this species.

V. Atlantic herring (Clupea harengus)

The total catches of Atlantic herring were 2 321 700 t in 1970 and 935 954 t in 1978, a decrease of 60% over the period. (Since 1965, when the maximum post-war catch of 4 001 000 t was recorded, the total catch has fallen by 76%.) It is to be noted that while Italy and the three applicant states do not record catches of herring, the remaining Community states catch about one third of the total.

Northwest Atlantic (region 21) [see Fig. 3.23a]

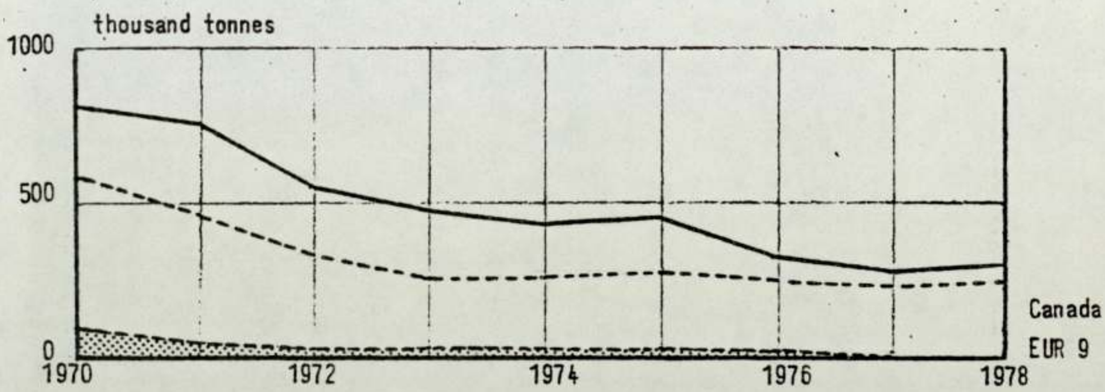
The total catches in this region were 890 500 t in 1970 and 293 071 t in 1978, a decrease of 67%. Not unexceptionally, the coastal states take the very large proportion of the total catch although the USSR, Poland and German DR all used to catch quantities of herring in the region.

Northeast Atlantic (region 27) [see Fig. 3.23b]

Nearly all the coastal states in the region play appreciable rôles in the herring fisheries of the region. The importance of the region is underlined by the fact that an average of 70% of the catch was made in the NE Atlantic in the period 1970-78. Contributing such a large proportion to the total catch, it is not surprising that the general trend of decreasing catches is seen in this region. In fact the decrease of 56% in the above period is rather less than for the NW Atlantic but still very significant.

About 40% of the catches were made by Member States of the Community and, although Denmark and the United Kingdom were most important in terms of the absolute quantity, one should not forget the important position of herring in the national pro-

a) Northwest Atlantic



b) Northeast Atlantic

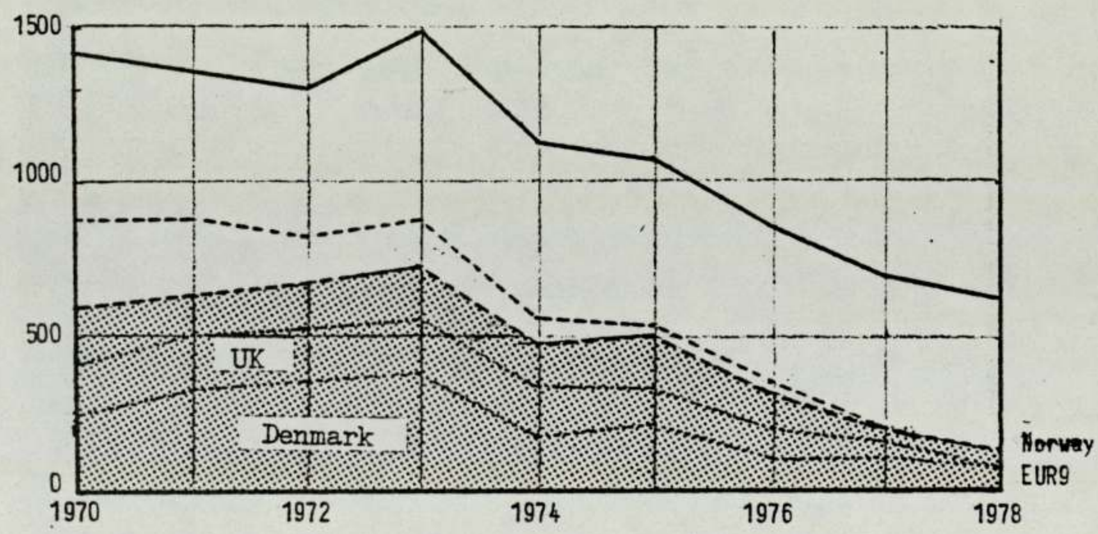


Fig. 3.23: Nominal catches of Atlantic herring by principal countries for the period 1970–78 (cumulative presentation).

duction (for example, Ireland; see section I).

W. Conclusion

The current situation of Community fisheries has been summarised in table 3.4 which shows the contribution of the Community in 1978 to the catches of the more important fish species in each of the major fishing regions frequented by its vessels.

Table 3.5 summarises the overall position with regard to distant and near water fisheries and the supply of food and industrial species in 1971 and 1978. In drawing up this table the following assumptions have been made:

1) Community distant water fisheries are only for food species. (This is a reasonable assumption)

2) Community industrial fisheries are for Norway pout, blue whiting, sandeels, argentines and sprats. The near water food fish data have been derived as the difference between the total near water catch and the catch of industrial species. Thus the food fish figures are maxima (and the industrial fish minima) since the former include often appreciable quantities of food fish (eg herring, whiting and cod) used for industrial purposes.

3) Non-traditional food fish are Atlantic mackerel and Atlantic horse mackerel.

This table shows that the total supply of food fish decreased between 1971 and 1978 by 12% and that, when non-traditional food fish are excluded, the decrease was 24%. It should also be noted that the supply of traditional food fish from near waters decreased by 14%: in finite terms this was comparable with the decrease in distant waters.

If this study of the supply of traditional food fish is restricted to 33 of the most important finfish species one finds that the catch decreased by 39% from 2.9 Mt in 1971 to 1.8 Mt in 1978. In the same period the period the total catch of these same species by all countries only decreased by 1%.

Table 3.4 Catches of selected species in 1978

	Total catch(t)	EUR 9		EUR 9+3	
		Total	%	Total	%
All waters					
All species	72 379 500	4 892 747	7	6 633 107	9
Atl. cod	2 172 382	500 205	23	594 458	27
Sprat	691 255	415 120	60	417 366	60
Sandeels	812 559	703 783	87	703 783	87
Saithe	459 141	178 126	39	181 329	39
Atl. herring	435 954	139 214	15	139 214	15
Eur. pilchard	800 935	87 405	11	385 515	48
N. pout	425 233	197 794	47	197 794	47
Whiting	206 180	197 850	96	202 451	98
Haddock	338 394	124 877	37	125 474	37
Atl. mackerel	718 059	505 630	70	543 589	76
Cape hakes	519 517	18 923	4	166 212	32
Eur. plaice	144 959	137 706	95	137 706	95
Atl. horse mackerel	174 991	34 343	20	173 070	99
NW Atlantic					
All species	2 184 772	96 957	3	155 541	6
Atl. cod	482 522	34 769	7	70 812	15
Atl. herring	293 071	-	-	-	-
Atl. mackerel	29 994	272	1	308	1
Saithe	45 871	31	0	31	0
Haddock	61 382	14	0	14	0
NE Atlantic					
All species	12 035 289	4 235 871	35	5 174 743	43
Atl. cod	1 689 860	465 436	28	523 646	31
Sprat	652 379	415 116	64	417 192	64
Sandeels	811 947	703 783	87	703 783	87
Saithe	413 170	178 095	43	181 298	44
Atl. herring	642 883	139 214	22	139 214	22
Eur. pilchard	177 377	22 471	13	177 367	100
N. pout	425 233	197 794	47	197 794	47
Whiting	204 050	197 850	97	202 451	99
Haddock	277 012	124 863	45	125 460	45
Atl. mackerel	679 401	501 215	74	536 609	79
Eur. plaice	144 948	137 695	95	137 695	95
Atl. horse mackerel	174 771	34 343	20	173 070	99
EC Atlantic					
All species	3 045 683	85 511	3	395 249	13
Eur. pilchard	435 593	-	-	89 520	21
Mediterranean					
All species	1 239 026	377 437	30	597 644	48
Sprat	38 876	4	0	174	0
Eur. pilchard	187 965	64 934	35	118 628	63
Atl. mackerel	8 649	4 143	48	6 672	77
SE Atlantic					
All species	3 293 381	24 670	1	206 171	6
Cape hakes	519 517	18 923	4	166 212	32

(t live weight)

	1971	1978	% change
NEAR WATERS			
Total food fish	2 987 202	3 033 763	+2
Traditional food fish	2 893 959	2 493 775	-14
Non-traditional food fish	93 243	539 988	+479
Industrial fish	701 031	1 418 592	+102
Total	3 688 234	4 452 356	+21
DISTANT WATERS			
Traditional food fish	956 866	438 090	-54
Total	956 866	438 090	-54
ALL WATERS			
Total food fish	3 944 068	3 471 853	-12
Traditional food fish	3 850 825	2 931 865	-24
Non-traditional food fish	93 243	539 988	+479
Industrial fish	701 031	1 418 592	+102
Total	4 645 100	4 890 446	+5

Table 3.5: Community (EUR 9) catches of food and industrial fish in near and distant waters in 1971 and 1978

The developments in Community fisheries may thus be summarised as follows:

1) there has been a general decline in the catches from traditional distant water fisheries,
2) this decline has been offset to a certain degree by increased catches from near water fisheries,
3) catches of the Community's traditional food fish have decreased but catches of industrial fish and non-traditional food fish have increased markedly.

CHAPTER 4

CRITICAL ANALYSIS OF TRENDS IN CATCHES

CRITICAL ANALYSIS OF TRENDS IN CATCHES

A. CURRENT TRENDS

Perhaps the most illuminating data to emerge from the study of catches in the previous chapter is that, although the Community's total annual catch remained relatively constant at 4.6 - 4.8 mt in the period 1971-78, the catch of 33 of the most important food species declined by 39% from 2.9 to 1.7 Mt in the same period. This trend towards declining catches of food species has been particularly marked in distant waters. Three main causes are apparent:

1) Overfishing. In favourable environmental conditions an unexploited fish population (that is, a population not subjected to fishing activities) is self-sustaining. The population size may be subject to considerable fluctuations due to natural phenomena such as climate, disease and food supply; that is, the population is subject to natural mortality. Provided adverse conditions are not too severe nor too long-lasting, the population has the ability to recover and this makes it possible for the population to be exploited. When thus exploited, the population is subject to both natural and fishing mortalities. When the population is over-exploited (or overfished) one result is a marked decrease in the mean age and size of the individuals within it but, in its less severe form, sufficient young are produced to ensure the survival of the population, at least in the short term. In more extreme cases of over-fishing the population is reduced to such a level that insufficient young are produced to ensure the survival of the population. Many of the populations of important food species have been over-exploited for many years (see Fig. 1.2).

2) Extension of territorial limits. In recent years this has become a very important cause of declining catches in distant waters. From very early times Member States of the European Communities developed important fisheries in the North-

west Atlantic, for example the cod and halibut fisheries off Newfoundland. Fisheries, other than high seas fisheries for such pelagic species as tuna, are generally restricted to waters of less than 100 fathoms in depth and thus to the waters of the continental shelf. Until the late 1950's territorial limits were 3 miles from the low-water mark, leaving a large proportion of the continental shelf as international waters in which anyone had the right to fish. Then certain countries whose populations relied very heavily on fishing for a livelihood (eg Iceland) attempted to reserve more of the coastal fisheries for their own fishermen by extending the territorial limits to 12 miles from the coastline. This, of course, limited the activities of the distant water fleets. The more recent further extension of limits to 200 miles has closed most of the fishing grounds to distant water fleets. Where it has been possible to negotiate fishing rights within these limits the quantities of fish permitted to be caught are almost invariably less than previously.

3) Management regimes. Even in the remaining international waters, an increasing number of fish stocks are being regulated by international agreement. These agreements place an upper limit on the catches of fish, the so-called Total Allowable Catch (TAC).

The first cause of reduced fishing in distant waters gave rise to, or was stated to be, the reason for the implementation of the other causes. In any event the overall effect is that the distant water fleets find most of the stocks on which they used to fish freely subject to more or less stringent control and, in most cases, fishing is at best permitted only to continue at its previous levels.

It is rather early to state at present the effect on the fish stocks of the reduced levels of fishing but indications are that certain stocks in the Northwest Atlantic have shown a remarkable increase in strength in the last few years (Hodder (Assistant Executive Secretary, NAFO), pers. comm.).

B. FUTURE CATCHES

The management regimes operating in the various fishing regions permit certain short-term predictions as to future catches. For those species for which quotas have been allocated (and this includes most of the commercially important food species) catches will correspond closely to those quotas. The remaining food species are generally caught in relatively minor quantities and often as a by-catch of a mixed fishery principally aimed at species under quota. In these circumstances it is safe to assume that catches of these species will not significantly alter the trend for all food fish.

The Commission of the European Communities is reported as having estimated that, should its proposals be accepted, Member States will have the possibility of catching 931 838 tonnes of six important food fish species (cod, haddock, whiting, saithe, plaice and redfish) in all waters in 1980 (Anon,1980a). This catch has been expressed in 'cod-equivalents' and if the catches recorded for earlier years are treated similarly the proposed 1980 catches of these six species represents a 17% decrease on the catch in 1978 and a 32% decrease on the catch in 1971-78. The possibilities for catches of non-food species and of food species not readily accepted in the Community in 1980 are of about the same order as the recorded catches in recent years.

The reason for the prediction of declining catches of the major food species even in near waters may be seen from Table 4.1 which classifies the major fish stocks of the Northeast Atlantic by the extent to which they are exploited. The exploitation has been graded by increasing severity:

Under-exploited: the stock could withstand an increase in exploitation without suffering any ill-effects.

Table 4.1: Classification of some major fish stocks of the Northeast Atlantic

Source: ICES Cooperative Report No 62 (1977)

<table>
<tr><th rowspan="2">Under-exploited</th><th rowspan="2">Fully exploited</th><th colspan="2">Over-exploited</th><th rowspan="2">Depleted</th></tr>
<tr><th>Growth overfishing</th><th>Recruitment overfishing</th></tr>
<tr><td rowspan="4">Blue whiting
Iceland capelin</td><td rowspan="4">Barents Sea capelin</td><td>Minch herring
Celtic Sea herring</td><td>North Sea mackerel</td><td>Atlanto-Scandian herring</td></tr>
<tr><td>North Sea cod
North Sea haddock
North Sea whiting
North Sea plaice
Arctic haddock
Saithe stocks
West Scotland cod
West Scotland haddock
West Scotland whiting
Irish Sea cod
Bristol Channel cod
Bristol Channel haddock
Bristol Channel whiting
Bristol Channel plaice
English Channel plaice
English Channel sole</td><td colspan="2">North Sea herring</td></tr>
<tr><td colspan="2">Arctic cod
North Sea sole
Iceland cod
Iceland haddock</td><td></td></tr>
<tr><td>Faroe cod
Faroe haddock
Irish Sea sole
Bristol Channel sole
Hake stocks</td><td></td><td></td></tr>
</table>

Fully exploited: the stock cannot be subjected to an increase in exploitation without results diminishing.

Over-exploited:

Growth overfishing: overfishing has resulted in a decrease in the mean size of the stock. At present the stock is able to produce sufficient young to ensure its future.

Recruitment overfishing: the stock has been reduced to such a level that the number of young fish is insufficient to ensure survival of the stock.

Depleted: recruitment overfishing has been allowed to continue for such a time that the stock has been reduced to a level such that unless immediate drastic action is taken (e.g. a complete ban on fishing) the stock will fail to survive.

It will be seen that the great majority of food fish stocks fall within the over-exploited or depleted categories and thus will require the application of strong management techniques to redress the situation. Certainly, in the short term at least, there is no hope that an increase in catches may be anticipated.

At the present time TAC's have been allocated for nearly 30 species (or species groupings) in Community waters. This number increases to over 90 when species/fishing region combinations are taken into account.) These species make up over 70% of the Community's total catch and, although some species are caught in regions in which they are not subject to TAC's, the management procedures obviously have a great influence on the level of the total catch.

Table 4.1 showed that many fish stocks in the Northeast Atlantic are over-exploited. If they were permitted to completely ignore the social and economic implications of their decisions, fishery managers would probably require a great reduction in fishing for many fish stocks. The consequence of not being able to ignore the social and economic aspects is that the management policies have to be relatively mild and the biological management policies have to be long-term plans. It is therefore inconceivable that catches of the more important species for human consumption will increase greatly in the near future. This underlines the necessity of having a well-developed policy for the structure of the industry, a point which will be taken up in Chapter 18.

CHAPTER 5

FOREIGN TRADE IN FISHERY PRODUCTS

FOREIGN TRADE IN FISHERY PRODUCTS

A. Introduction

In the first chapter it was mentioned that historically fishery products have played an important part in the foreign trade of Member States of the European Community. With improved methods of preservation and transportation fishery products have become more readily available for trade and the volume of products for such purposes has increased enormously in recent years.

In this study of the Community's foreign trade fishery products have been classified as follows:

Total fishery products

- Fresh, chilled or frozen fish
- Salted, smoked or dried fish
- Crustaceans and molluscs; fresh, frozen, dried, salted, etc
- Fish products and preparations, whether or not in airtight containers
- Crustacean and mollusc products and preparations, whether or not in airtight containers
- Oils and fats, crude or refined, of aquatic animal origin
- Meals, solubles and similar feedingstuffs, of aquatic animal origin.

For each of the major groups of products the analysis has been divided into two parts:

1) The Community's position in world trade. This has been illustrated by the calculation of the percentage contribution of Member States' imports and exports to the total trade in 1976. Other principal importing and exporting countries have been included for comparison.

   The Community trade has been broken down into the trade between Member States (indicated in the figures by 'intra') and the trade of the Member States with third countries (indicated by 'extra'). It should be noted that the percentages recorded in the figures are valid only for the total of the nine Member States. If the Community is regarded as a single state the percentage contribution of the third countries to world trade would have to be increased.

It should also be noted that exports includes re-exports, that is, the exportation of products previously imported. For certain products in certain countries, these re-exports make an appreciable contribution to the total. For example, in 1976, 20% of the fish meal and 32% of the fish oils imported by the Netherlands were subsequently exported. These re-exports, which are often little more than transshipments, tend to over-emphasise the importance of foreign trade.

2) The trade balance in fishery products. This has been calculated as the difference between the imports and exports of each of the major product groups in the member and applicant states. This method of study minimises the effect of re-exportations in that only exports of products imported in the previous year are included. An excess of imports over exports has been indicated as a positive figure; where exports exceed imports, the data are negative.

An important point to note is that, whereas the data for individual states include trade with all other states, the data for EUR 9 and EUR 9 + 3 exclude trade between countries within the groupings. Data for the years 1961, 1966, 1971, 1976 and 1978 have been selected in an attempt to detect trends in the trade balance.

Before passing to a study of the individual product groups, it is interesting to look at the change that has taken place in the percentage contribution of the major product groups in the foreign trade of the Member States in the period 1961-1976 (see Table 5.1). It can be seen that, for the world trade, the major change has been an increase in the importance of trade in fresh,

Table 5.1: Percentage contribution of the major product groups to the total weight of foreign trade in 1961 and 1976

	EUR 9 Imports		World trade		EUR 9 Exports	
	1961	1976	1961	1976	1961	1976
Fresh, chilled or frozen fish	23	32	26	37	46	39
Salted, smoked or dried fish	6	4	12	5	17	6
Crustaceans & molluscs, fresh, frozen, salted, etc.	4	7	5	12	12	10
Fish products & preparations, whether or not in airtight containers	7	8	11	10	7	6
Crustacean & mollusc products & preparations, whether or not in airtight containers	0	2	1	2	0	1
Oils & fats, crude or refined, of aquatic animal origin	21	19	15	8	8	13
Meals, solubles & similar feedingstuffs, of aquatic animal origin	37	29	30	28	9	25
TOTAL FISHERY PRODUCTS	100	100	100	100	100	100

frozen or chilled fish and fresh, frozen and salted crustaceans and molluscs and a decrease in the importance of that for fats and oils.

With the trade for the Community, in 1961, the pattern of imports corresponded much more closely with the world situation than did that for exports, for the latter the oustanding difference being with fresh, chilled or frozen fish and fish meal. In 1976, both the Community imports and exports were very much more in line with the world trade, the change being largely due to the increase in Community exports of fish meal (mainly by Denmark).

One general point to note is that three groups of products, fresh, frozen or chilled fish, oils and fats and fish meal, are responsible for a very large part of the trade in fishery products, often over 80% of the total.

B. Total Fishery Products

Since this total grouping contains products of very different compositions and unit values, this section of the study has been conducted both in terms of the weight and the value of the products.

The Community's position in World trade (Fig. 5.1)

The European Community is a major importer of fishery products: indeed, if intra-Community trade is included, it makes the largest single contribution to the total, both in terms of the value (30%) and the weight (37%). However, intra-Community trade accounts for about 37% of the total Community imports and 69% of the total Community exports. If these intra-EUR 9 exchanges are then excluded from the foreign trade (i.e. the Community is considered as a single state) the Community imports amount to 20% by value and 27% by weight of the world trade in fishery products. Although this reduces the importance of the Community, it is still on a par with the other major importing states, the USA and Japan.

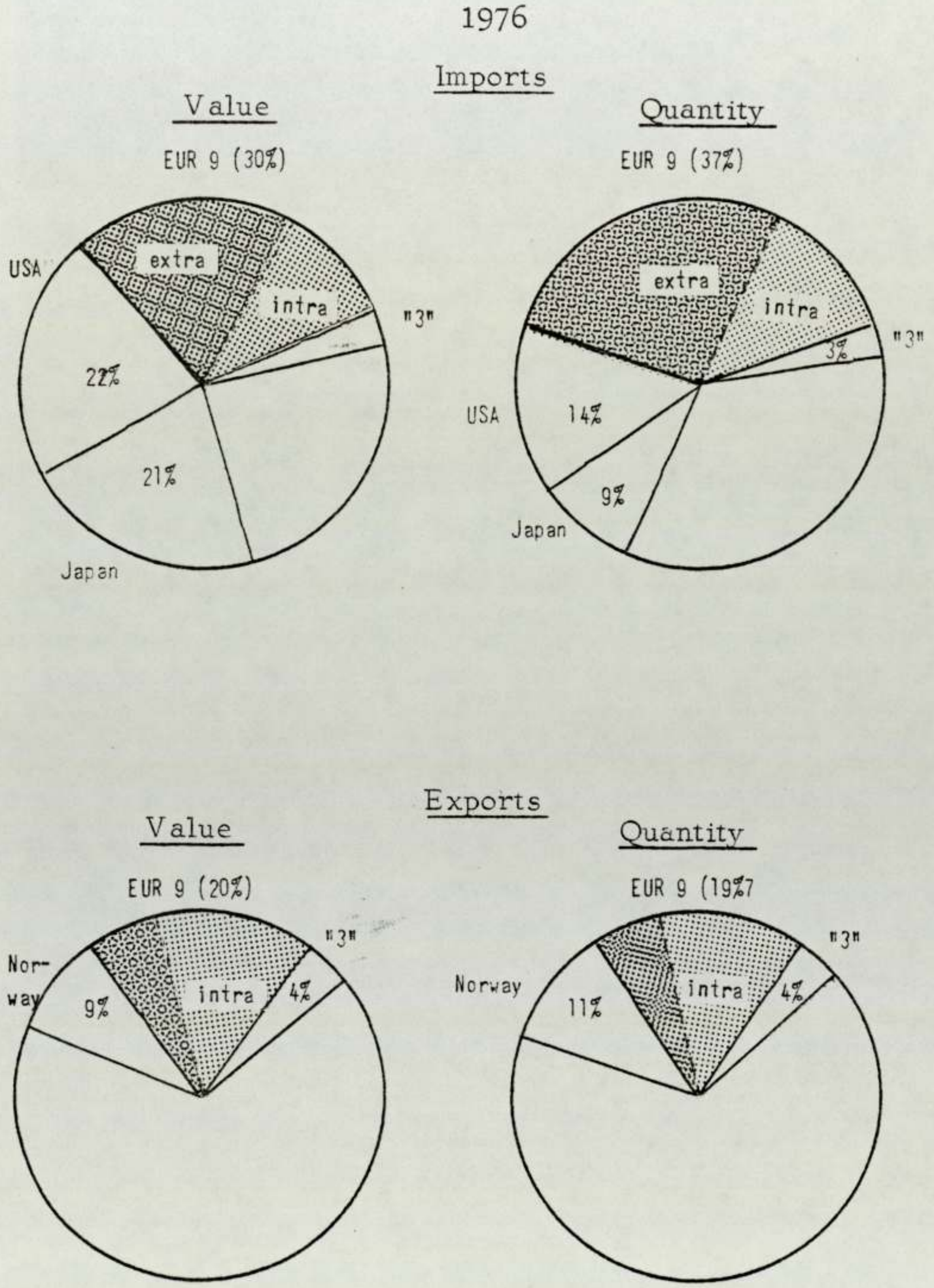


Fig. 5.1: Contribution of the Community's trade in all fishery products to the World total.

As far as exports are concerned, the Community does not play such a major role in World trade. If intra-EUR 9 trade is included, the Community's contribution to the total is 19% by weight and 20% by value. If intra-EUR 9 exchanges are excluded this contribution drops to 6 and 5% respectively.

The trade balance in fishery products (see Figs 5.2 - 5.5)

In terms of the value of the foreign trade the deficit of exports over imports has increased in the EEC and most of the Member States in the period studied. The exceptions to this generality are the Netherlands, Ireland and Denmark, where the trend has been the converse. The trade balance in the three applicant states is much nearer equilibrium than in most of the existing Member States and thus does not make a significant difference to the overall situation.

When the trade balance is considered in terms of the weight of products the trend of increasing deficits is less marked, indeed, in the later years in a number of countries and for the Community as a whole the reverse trend is apparent. The reasons for this will be discussed when the individual product groups are dealt with.

One interesting point to note is that, while when viewed in terms of the value the Netherlands had an excess of exports over imports, the position is reversed when looking at the volume of trade. This is due almost entirely to the important deficits in the trade in the relatively low-valued fats, oils and fish meals.

C. Fresh, Chilled or Frozen Fish

The Community's position in World trade (Fig. 5.6)

The European Community is responsible for 33% of the World imports of fresh, chilled or frozen fish. This predominant position is reduced to 20% when intra-EUR 9 trade is deducted but it remains an important importer of this group of products.

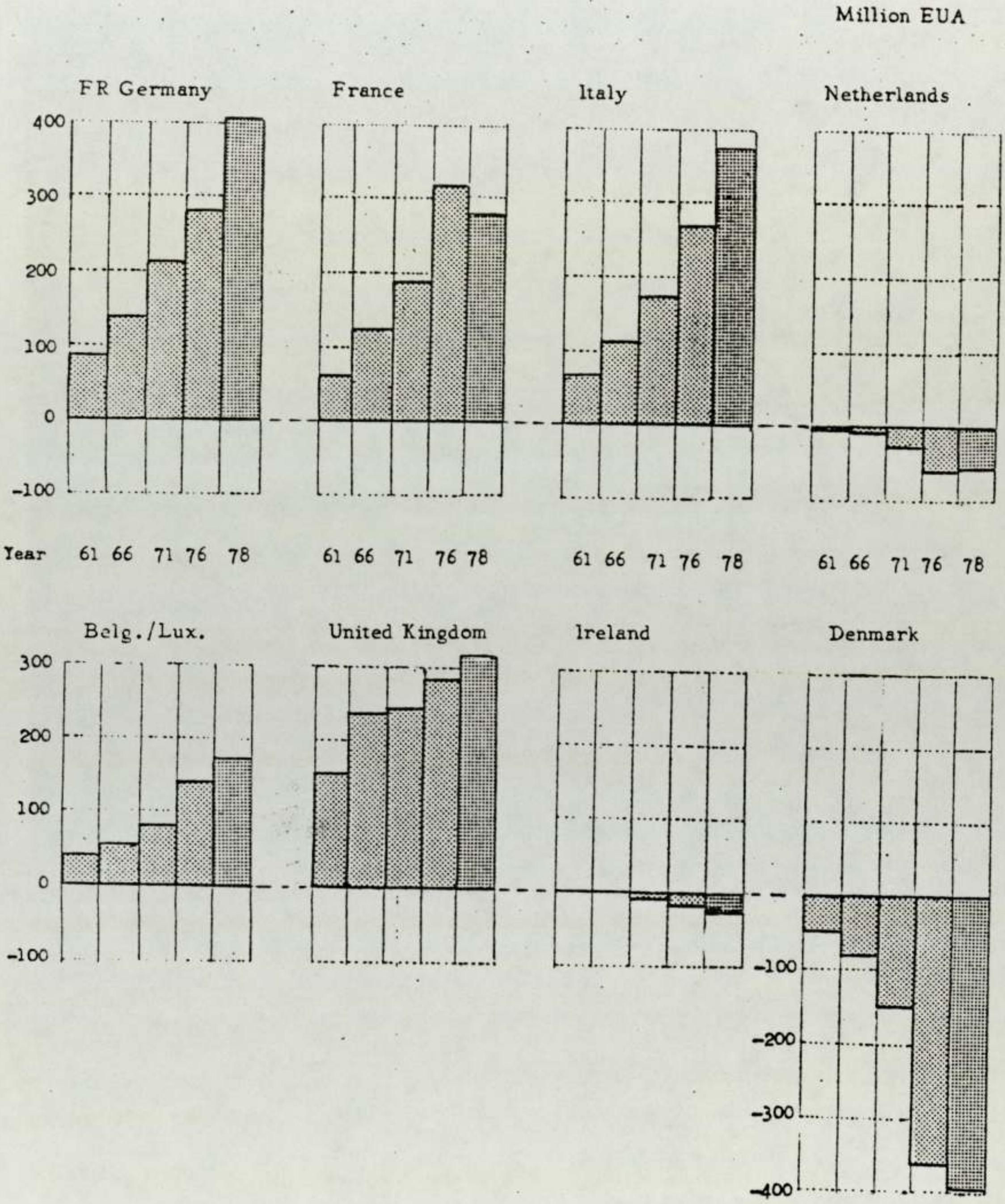


Fig. 5.2: Trade balance for total fishery products (amount by which imports exceed exports).

Million EUA

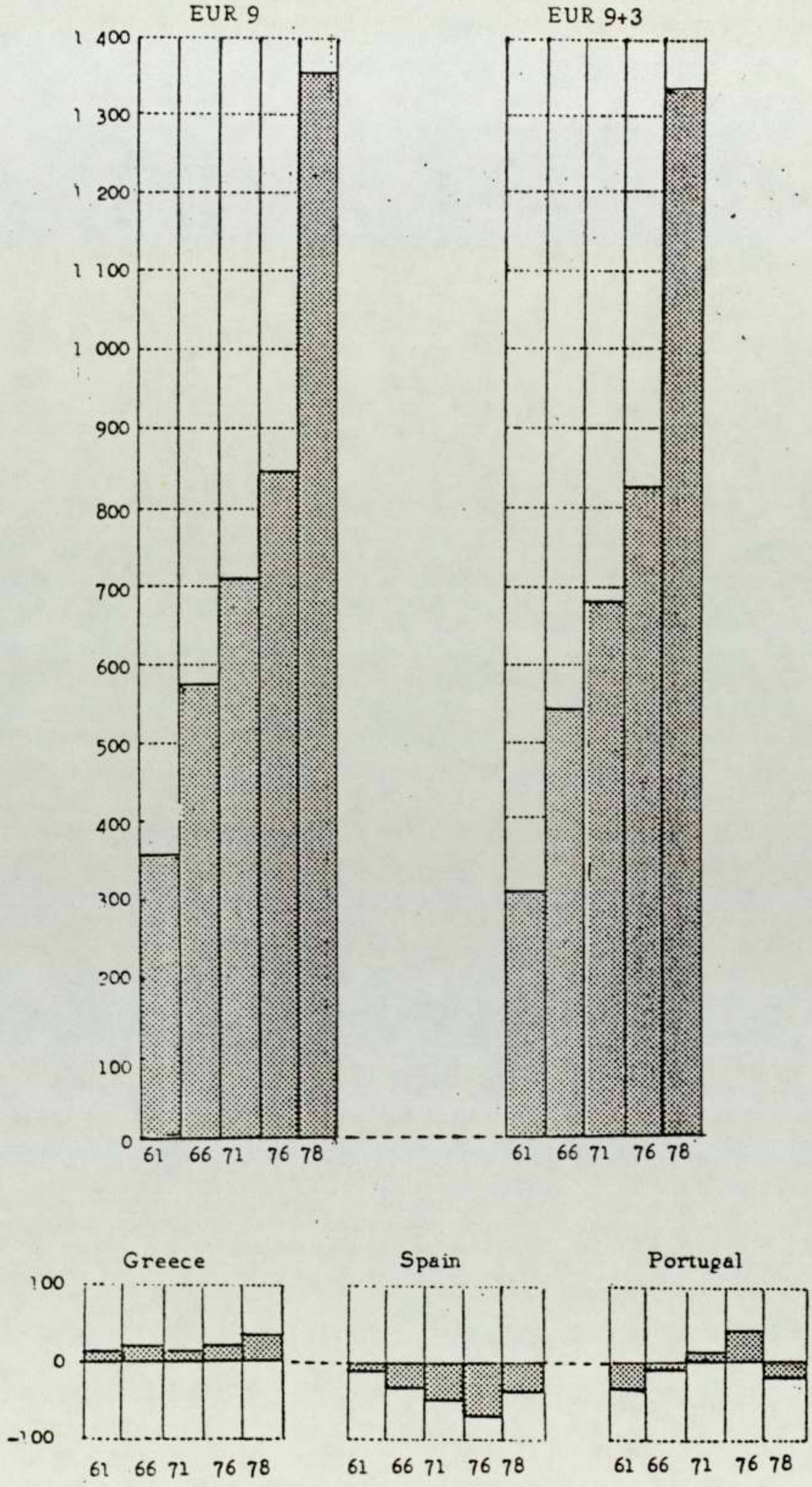


Fig. 5.3: Trade balance for total fishery products (amount by which imports exceed exports)

Thousand metric tons

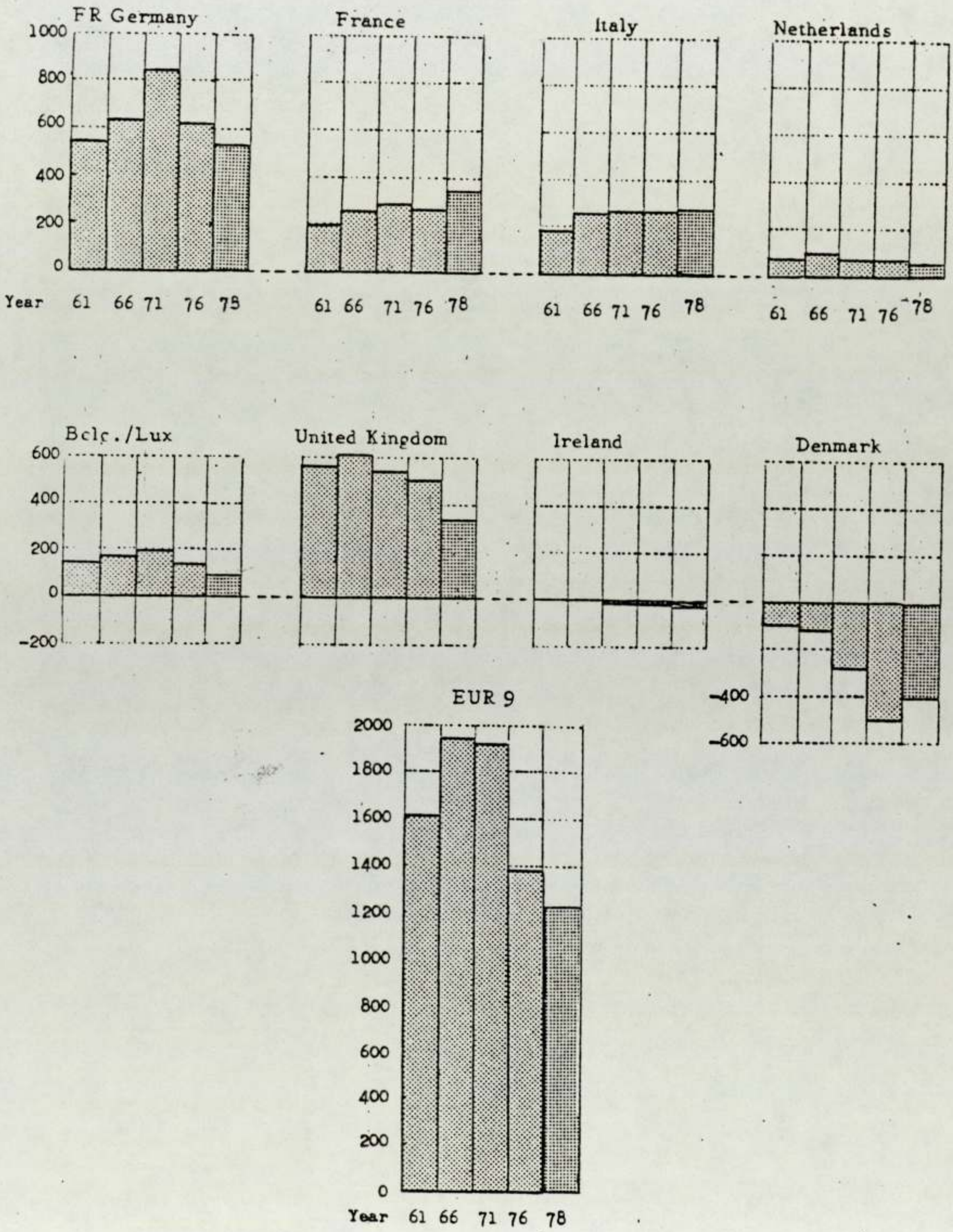


Fig. 5.4: Trade balance for total fishery products (amount by which imports exceed exports).

Thousand metric tons

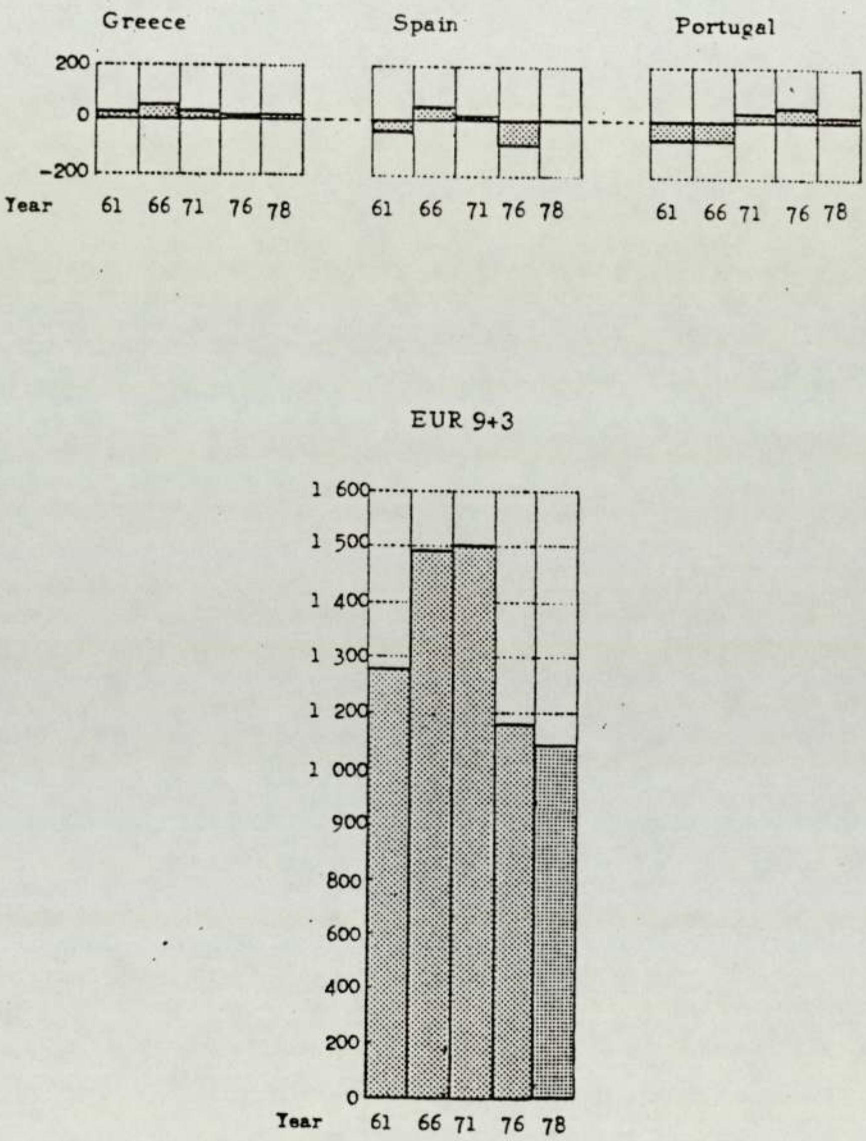
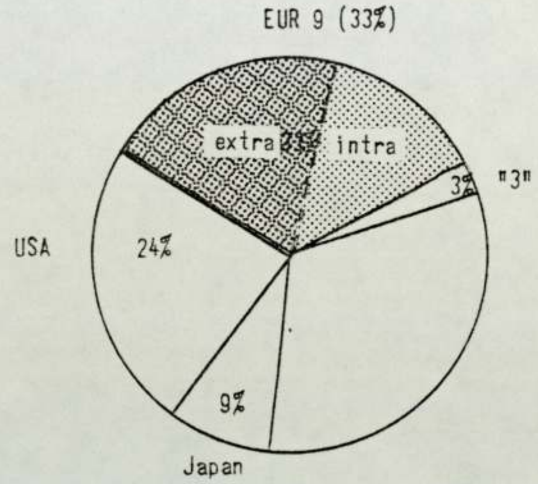


Fig. 5.5: Trade balance in total fishery products (amount by which imports exceed exports).

1976

Imports



Exports

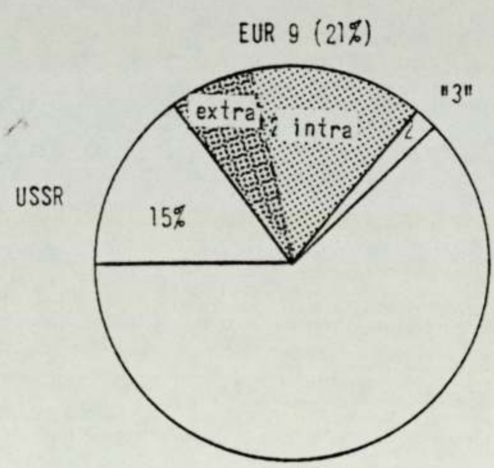


Fig. 5.6: Contribution of the Community's trade in fresh, chilled or frozen fish to the World total.

When intra-Community trade is included the EEC is the largest single exporter of the group of products (21% of the total trade) but this is cut to a third, and hence a very much less significant ranking of importance, when intra-Community trade is deducted.

The trade balance in fresh, chilled or frozen fish (see Fig. 5.7 - 5.8)

Only in Netherlands, Ireland and Denmark of the current Member States have exports consistently exceeded imports: otherwise the Member States show generally a deficit and of an increasing trend. However, it is interesting to note that the United Kingdom has improved the trade balance from a deficit of about 120 000 tonnes to a surfeit of the same order. This improvement has resulted from the development of the fishery for mackerel and other species for which the domestic consumption is very limited. Table 5.2 shows that the exports of mackerel have increased about 20 times, both in volume and value, in the period 1974-78. This table also shows that in the same period imports of cod, and indeed other food fish, have increased considerably. In volume this increase is much less than for mackerel and similar species but in terms of value the increase has been much greater for the imports than for exports, resulting in part in the situation already noted in the trade balance in total fishery products.

The EUR 9 deficit is only about 150 000 tonnes, which is equivalent to less than 5% of the Community's landings.

The three applicant Member States are not very active in the foreign trade for this group of products, although there are indications of a trend of increasing imports in Portugal.

D. Salted, Dried or Smoked Fish

The Community's position in World trade (Fig. 5.9)

The European Community is by far the biggest importer of this group of products. Even when intra-Community trade is excluded, Thousand metric tons.

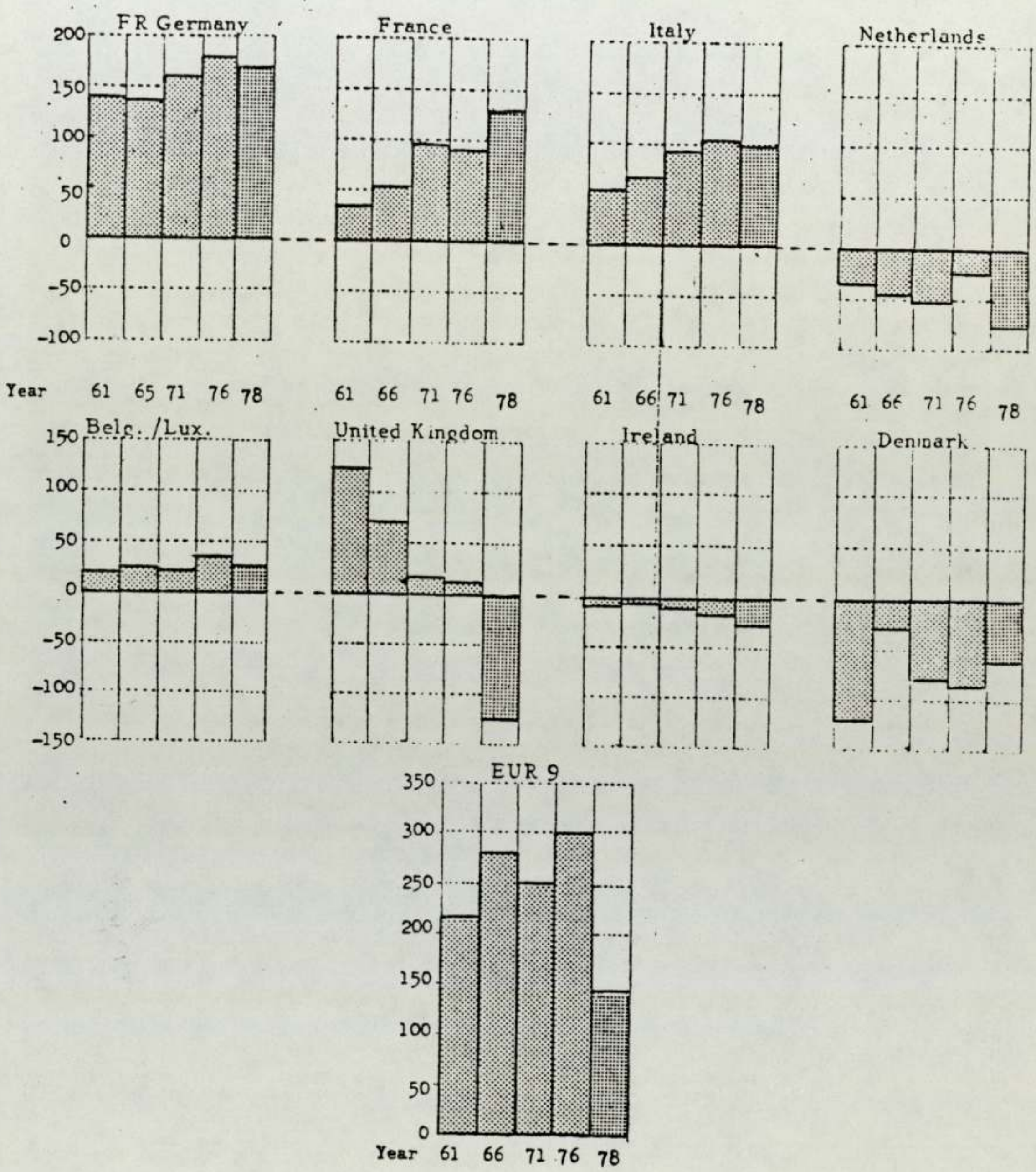
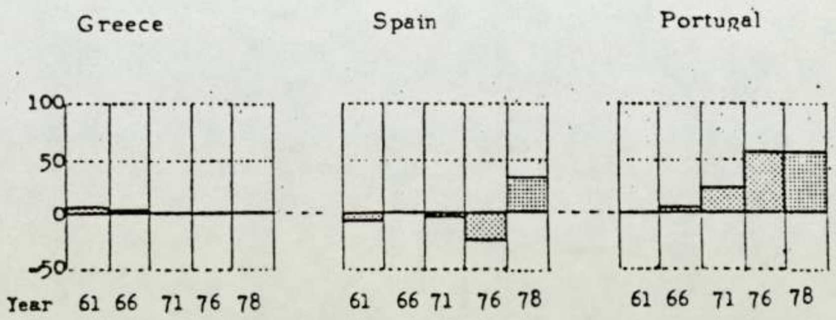
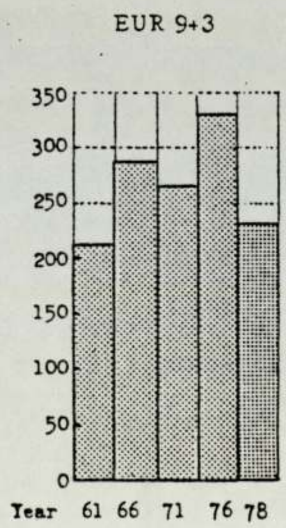


Fig. 5.7: Trade balance for fresh, chilled or frozen fish (amount by which imports exceed exports).

Thousand metric tons





<u>Fig. 5.8</u>: Trade balance for fresh, chilled or frozen fish (amount by which imports exceed exports).

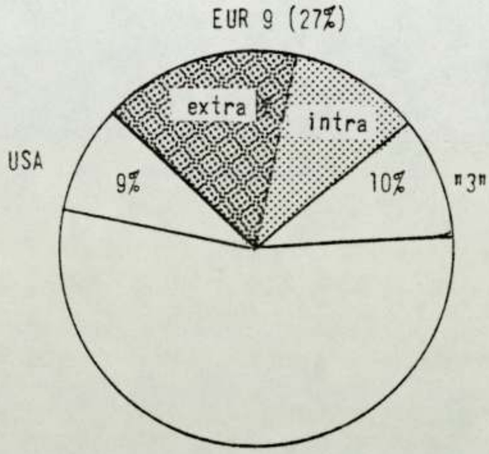
	Cod imports			Mackerel exports		
	Weight (tonnes)	Value (thousand EUA)	Unit value (EUA/tonne)	Weight (tonnes)	Value (thousand EUA)	Unit value (EUA/tonne)
1974	7 857	3 880	494	13 060	2 667	204
1975	8 213	3 339	407	14 811	2 801	189
1976	18 797	9 706	516	25 332	5 331	210
1977	26 244	19 461	742	52 643	11 502	218
1978	51 401	37 530	730	249 523	47 289	191

Source: EUROSTAT

Table 5.2: The United Kingdom's trade in cod and mackerel in 1978.

1976

Imports



Exports

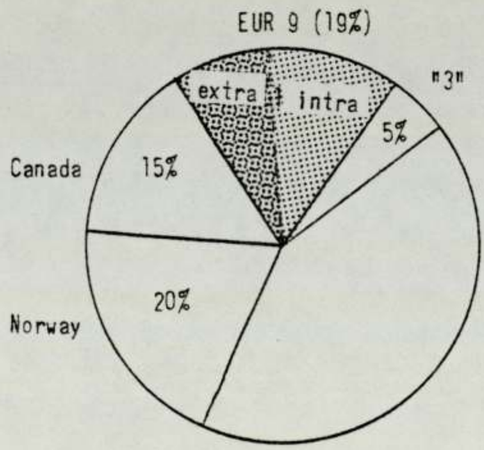


Fig. 5.9: The contribution of the Community trade in salted, dried or smoked fish to the World total.

at 16% of the total, EEC imports are about double those of the nearest competitor, the USA. The three applicant Member States, and notably Portugal, are relatively major importers.

As exporters the Member States contribute 19% to the total but, since much of this is destined to other Member States, the EC as such is of minor importance as an exporter compared with Norway and Canada.

The trade balance in salted, dried or smoked fish (see Figs 5.10 and 5.11).

Two Member States, Italy and the Netherlands are the most influential in the trade for this group of products. Italy is a big net importer, though the trend is for a decline, whereas the Netherlands are net exporters. The remaining Member States all fall within about 20 000 tonnes either side of equilibrium.

For the three applicant Member States there is difficulty in detecting any trend but Spain and Portugal are active in the trade; the first as an exporter, the second as an importer.

E. Crustaceans and Molluscs; Fresh, Frozen, Dried, Salted, etc.

The Community's position in World trade (Fig. 5.12)

The outstanding feature of trade in this group of products is the part played by Japan as an importing country. Compared with this contribution of 37% to the total, the European Community's 23% including intra-Community exchanges (12% when they are excluded) is rather insignificant.

Although only 8% of the exported quantity of this product originates from the EEC, the Community is one of the biggest exporting states since the contribution to exports comes from a considerable number of third countries rather than being concentrated in a few countries as with most of the other product groups.

Thousand metric tons

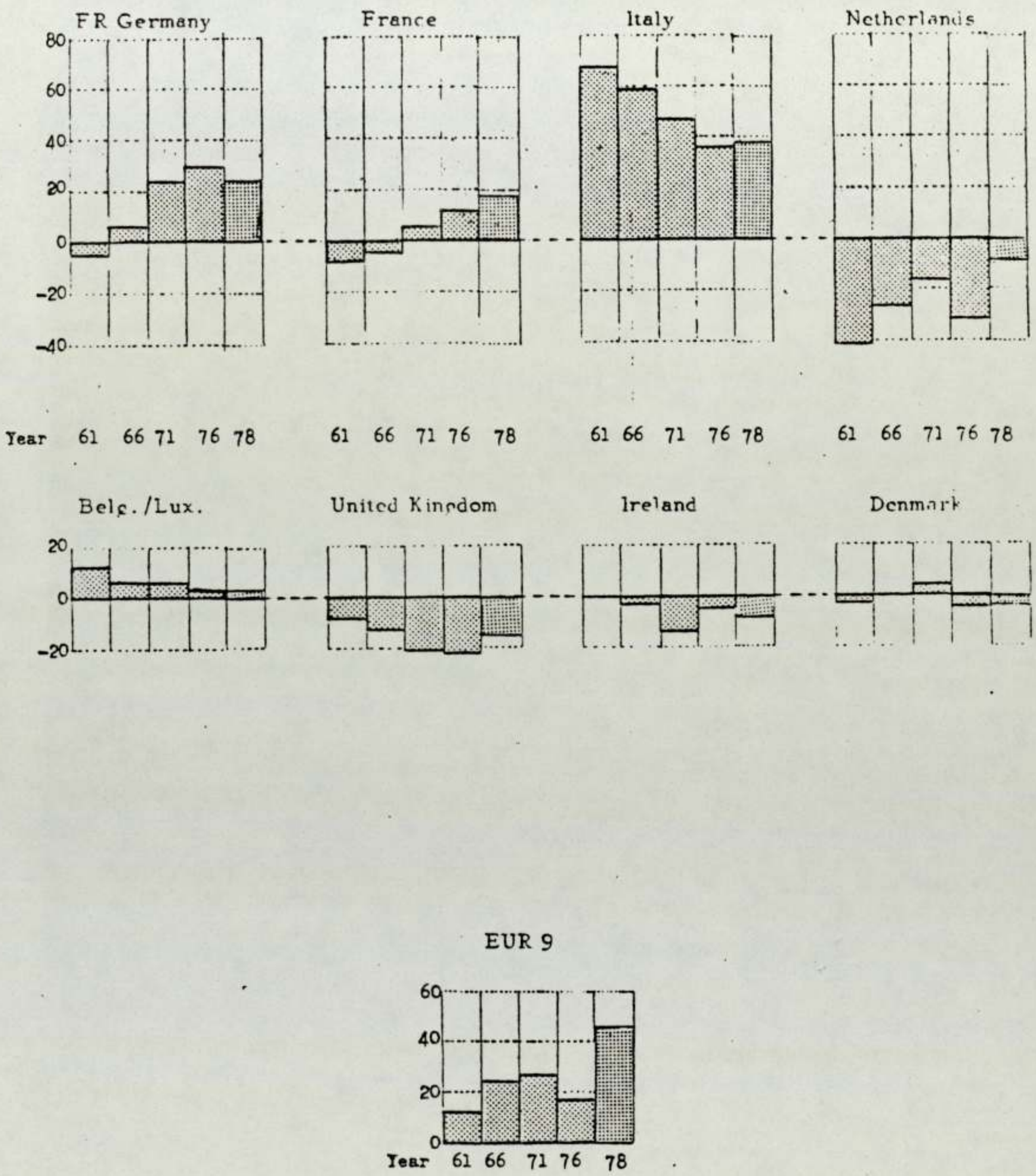


Fig. 5.10: Trade balance for salted, dried or smoked fish
(amount by which imports exceed exports)

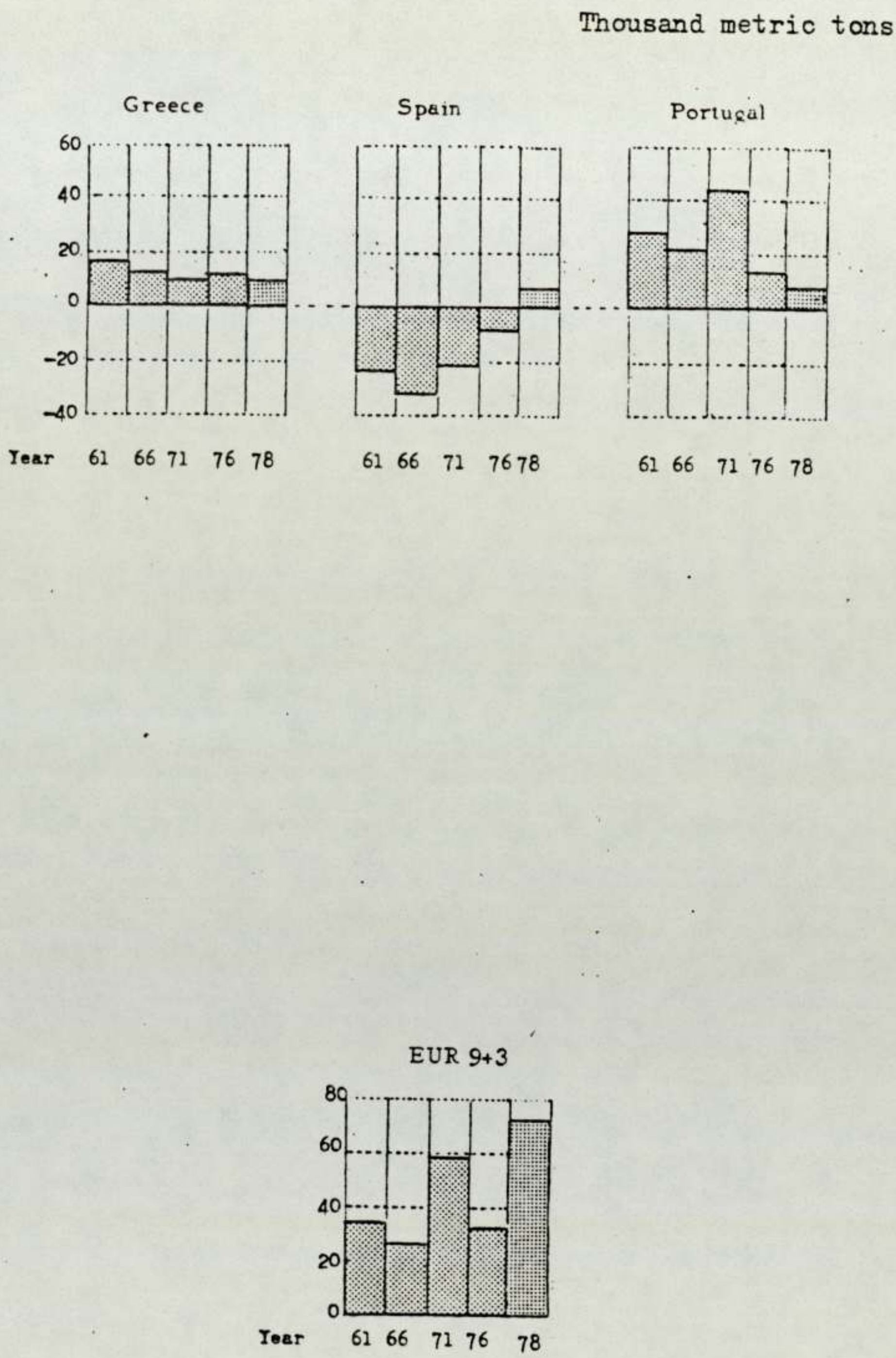
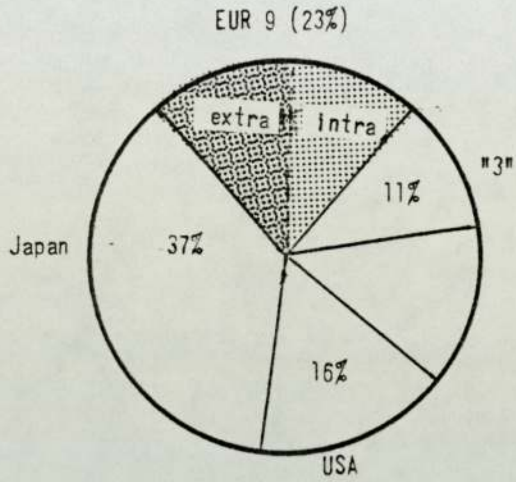


Fig. 5.11: Trade balance for salted, dried or smoked fish (amount by which imports exceed exports)

1976

Imports



Exports

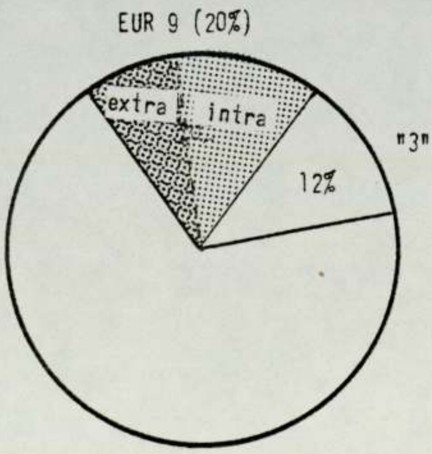


Fig. 5.12: Contribution of Community trade in fresh, dried, frozen or salted crustaceans and molluscs to the World total.

The trade balance in fresh, frozen, dried, salted crustaceans and molluscs (see Figs 5.13 and 5.14)

This product group is remarkable for the fact that five of the existing Member States are, or have been in the recent past, net exporters, albeit mostly of small quantities. Thus the EUR 9 position is very largely influenced by the big importing nations, France and Belgium/Luxembourg and the biggest net exporter, the Netherlands, and is closer to equilibrium than for any other group of products.

With the three applicant Member States included the deficit is narrowed even further.

F. Fish Products and Preparations

The Community's position in World trade (see Fig. 5.15)

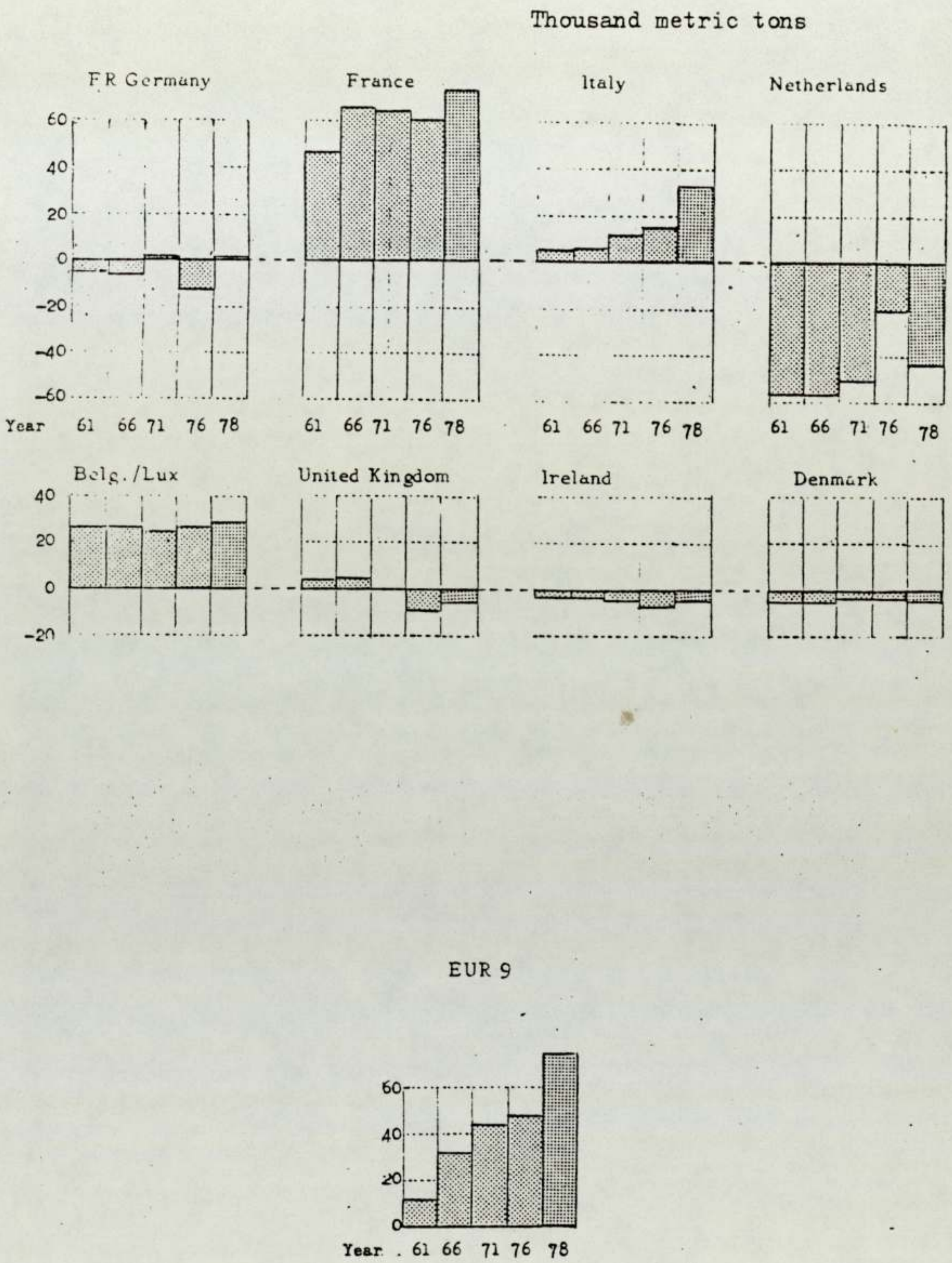
The European Community has a very dominant position as a major importer of this group of products (31% of the total against 12% for the next highest contributor, the USA). Even when intra-Community trade is deducted, the contribution is 25%.

As an exporter the Community is relatively unimportant, contributing only 10% to the total, a little over half of which is intra-Community trade. These contributions are insignificant compared with Japan's 31%. Spain and Portugal are both very big exporters of canned fish, thus improving the performance of EUR 9 + 3.

The trade balance in fish products and preparations (see Figs 5.16 and 5.17)

The EC has a very large deficit of trade in this product group (approximately 120 000 tonnes in 1978). This deficit is derived from appreciable contributions from FR Germany, France, Italy, Belgium/Luxembourg and the United Kingdom. The remaining states have trade balances near equilibrium.

This product group is one for which two of the three applicant Member States make an important contribution to restoring the



<u>Fig. 5.13</u>: Trade balance for crustaceans & molluscs, fresh, frozen, dried or salted (amount by which imports exceed exports).

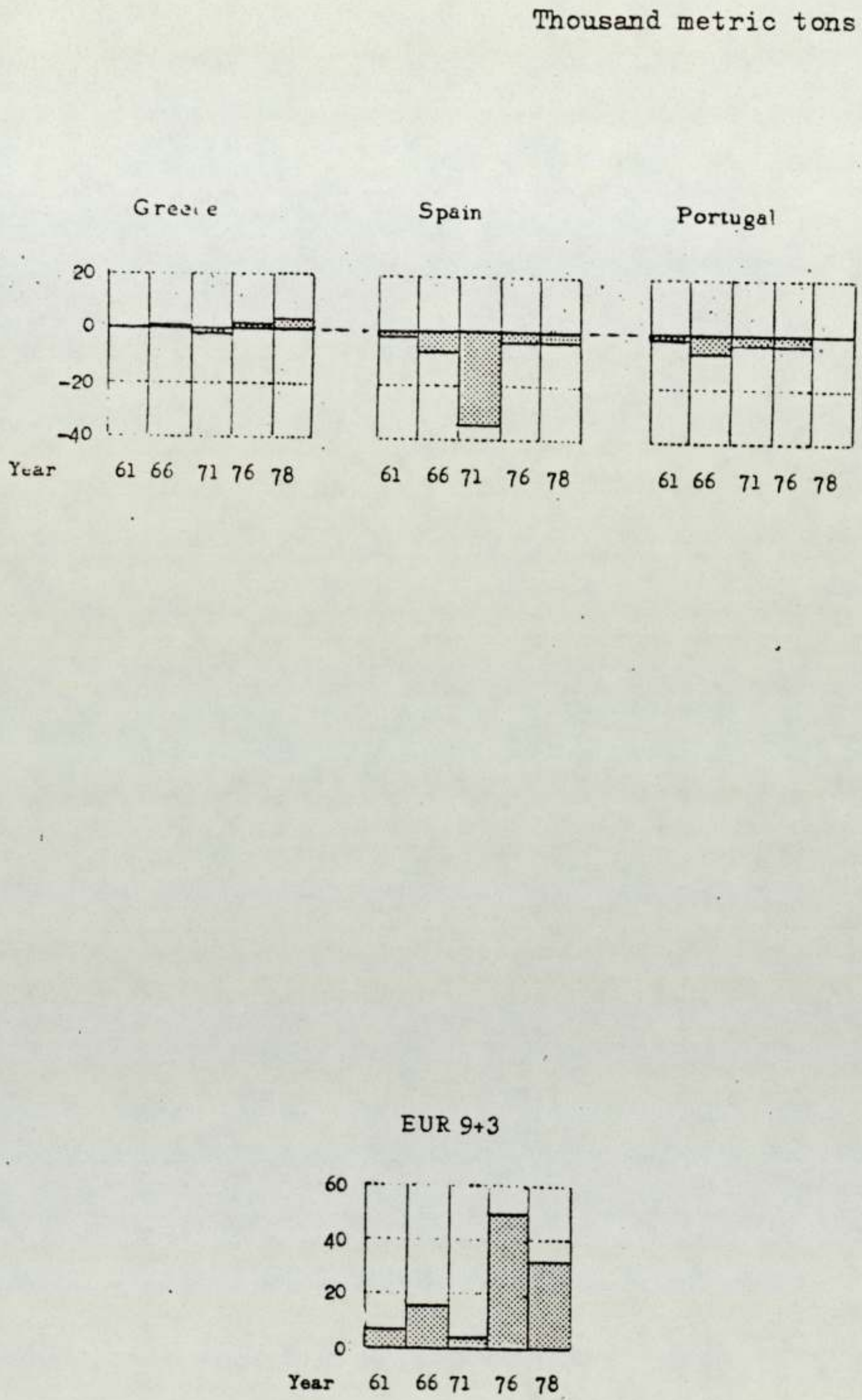
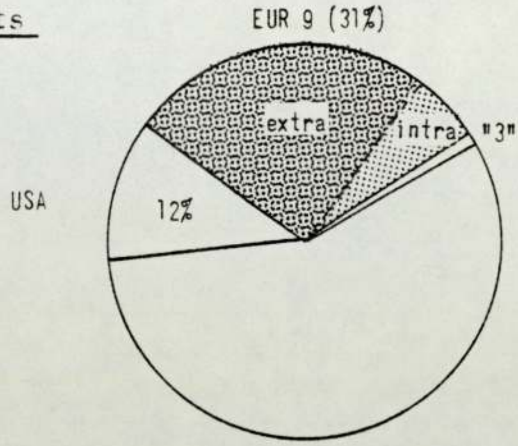


Fig. 5.14: Trade balance for crustaceans & molluscs, fresh, frozen, dried or salted (amount by which imports exceed exports).

1976

<u>Imports</u>



<u>Exports</u>

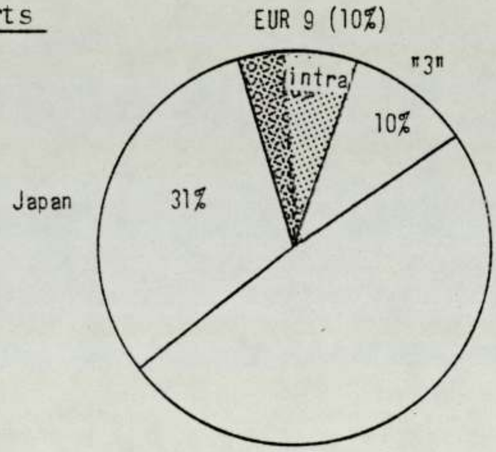


Fig. 5.15: The contribution of Community trade in fish products and preparations to the World total.

Thousand metric tons

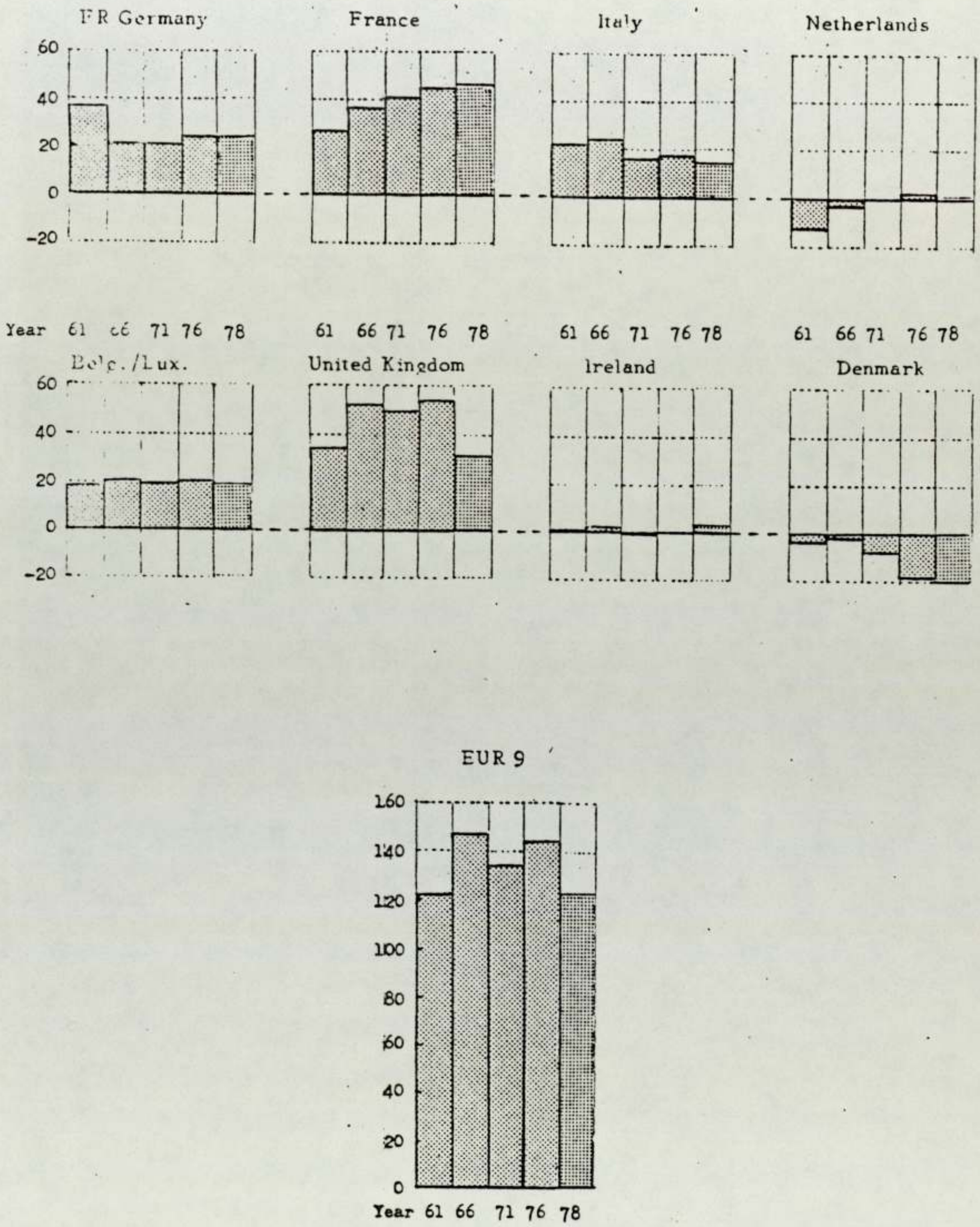
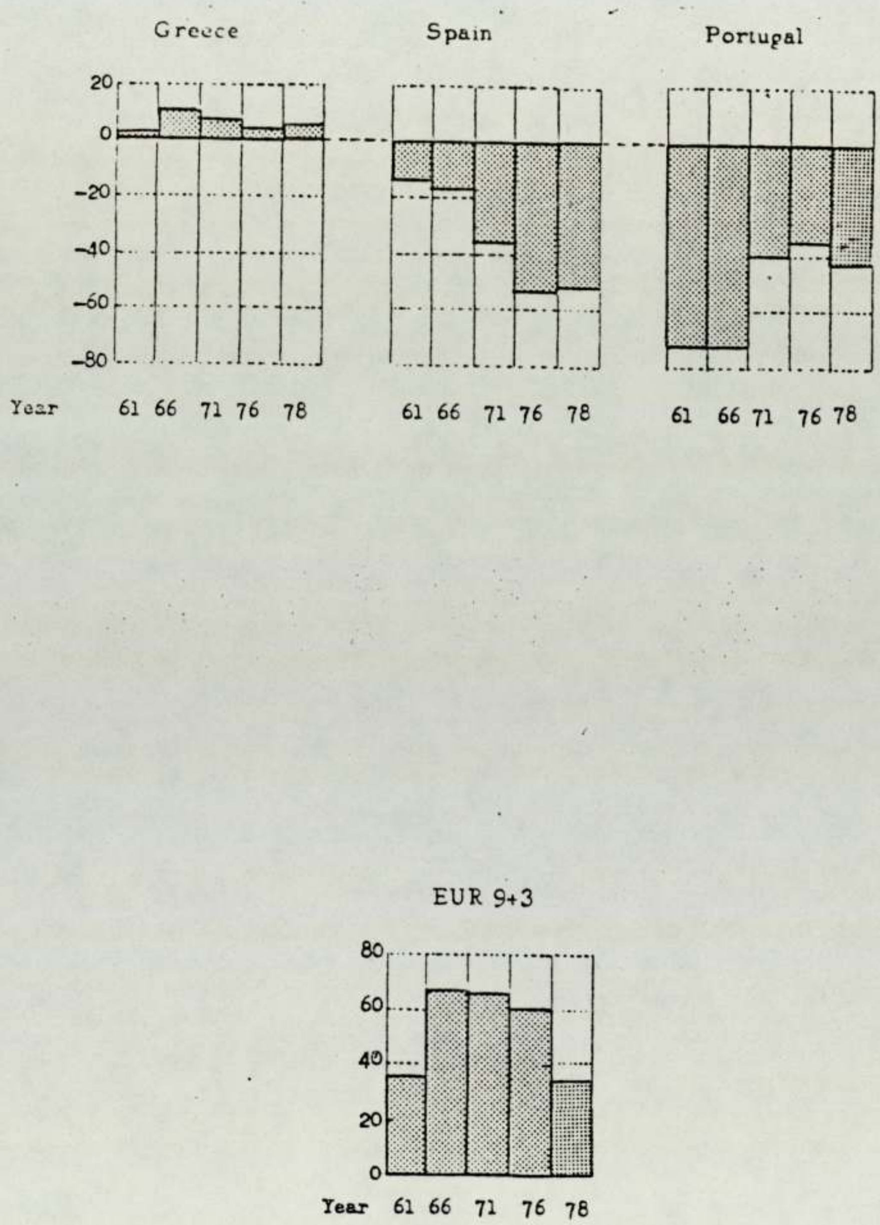


Fig. 5.16: Trade balance for fish products and preparations (amount by which imports exceed exports)

Thousand metric tons



<u>Fig. 5.17</u>: Trade balance in fish products and preparations (amount by which imports exceed exports).

overall situation for EUR 9 + 3 to equilibrium. With the large excesses of Portugal and Spain, the overall deficit is reduced by half to approximately 60 000 tonnes.

G. Crustacean and Mollusc Products and Preparations

The Community's position in World trade (Fig. 5.18)

As with the previous group the European Community is the largest single importer of this group of products. Including and excluding intra-Community trade it contributes 35% and 28% respectively to the total. The other two major importing nations are the USA (20%) and Japan (16%).

No single state has a dominant position as an exporter of this group of products. The 20% contribution of the Community reduces to 7% when intra-Community trade is excluded and places the EC on a level with a group of countries including Malaysia, Japan and the USA.

The trade balance in crustacean and mollusc products and preparations (see Figs 5.19 and 5.20)

The Member States' trade balances in this product group show much the same situation as with the previous group, although at a very reduced level. Indeed, the Community deficit is only a little over 30 000 tonnes.

The three applicant Member States do not play an important part in this trade and thus have little effect on the overall balance.

H. Oils and Fats

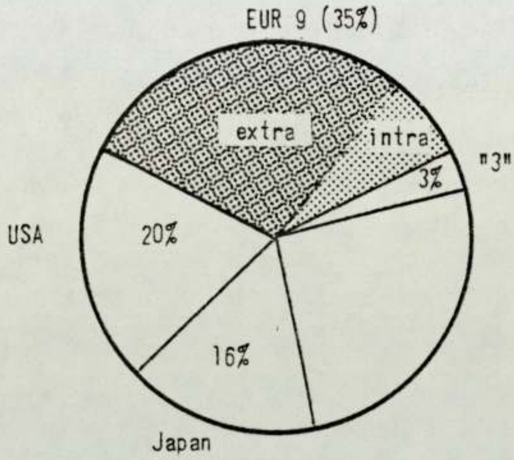
The Community's position in World trade (Fig. 5.21)

The European Community monopolises the trade in this group of products by importing 83% of the total. This is reduced to 77% when intra-Community trade is excluded.

It is therefore evident that the European Community cannot play a major role as an exporter of fats and oils. Indeed, most of

1976

Imports



Exports

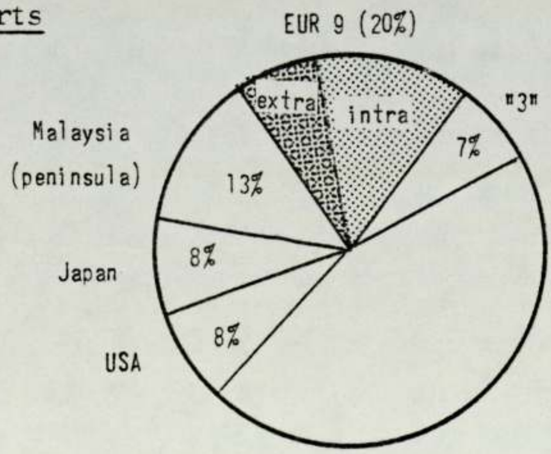
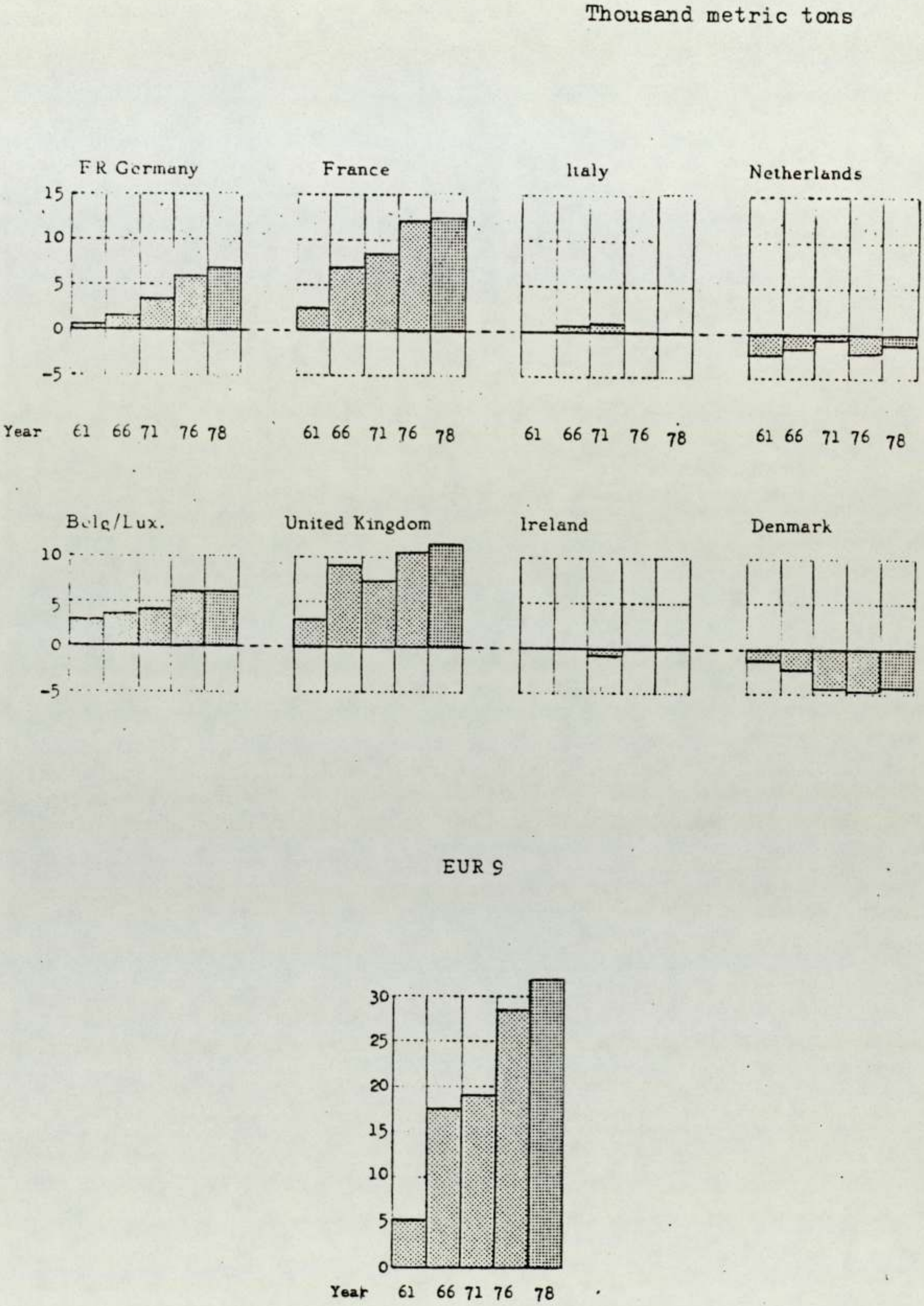
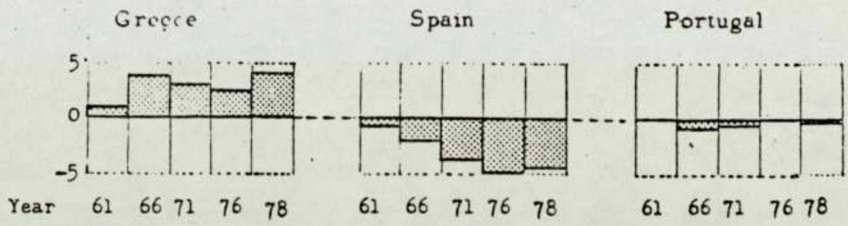


Fig. 5.18: The contribution of Community trade in crustacean and mollusc products and preparations to the World total.



<u>Fig. 5.19</u>: Trade balance for crustacean & mollusc products and and preparations (amount by which imports exceed exports).

Thousand metric tons



EUR 9+3

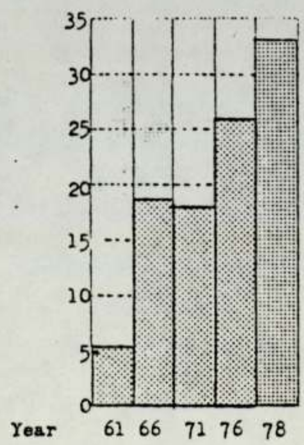
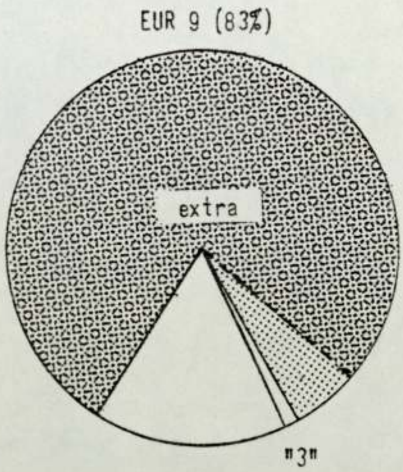


Fig. 5.20: Trade balance for crustacean & mollusc products and preparations. (amount by which imports exceed exports).

1976

Imports



Exports

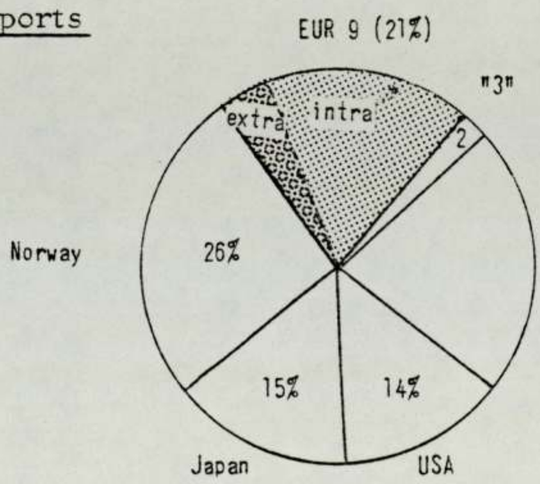


Fig. 5.21: The contribution of Community trade in fats and oils from aquatic animals to the World trade.

the exports from Member States are destined for other Member States. Community exports to third countries account for only 4% of the world trade in these products.

The trade balance in oils and fats from aquatic animals (Figs 5.22 and 5.23)

The European Community has a very large deficit of between 400-500 000 tonnes and largely results from the contribution of FR Germany, United Kingdom and the Netherlands, the first two being the world's biggest importers. Only Denmark has a respectable excess of exports over imports.

The three applicant Member States make no significant contribution to the foreign trade in these products and thus have little effect on the overall situation.

I. Meals, Solubles and Similar Feedingstuffs

The Community's position in World trade (Fig. 5.24)

The European Community figures very strongly as an importer of meals and solubles, being responsible for 40% of the world total. This reduces to only 34% when intra-Community trade is deducted. This is about six times the contribution of the next largest importing state, the USA.

Peru and Norway are the biggest exporting states but the European Community with 19% of the total (10% when intra-Community trade is deducted) makes a significant contribution to the total.

The trade balance in meals, solubles and similar feedingstuffs (see Figs 5.25 and 5.26)

Although the Community's trade deficit has been much reduced in recent years by the failure of the Peruvian anchoveta fishery and the use of substitute products, it remains at about 400 000 tonnes. As with oils and fats, the FR Germany and the United Kingdom are the world's biggest importers and, of the present Member States, only Denmark's exports exceed the imports.

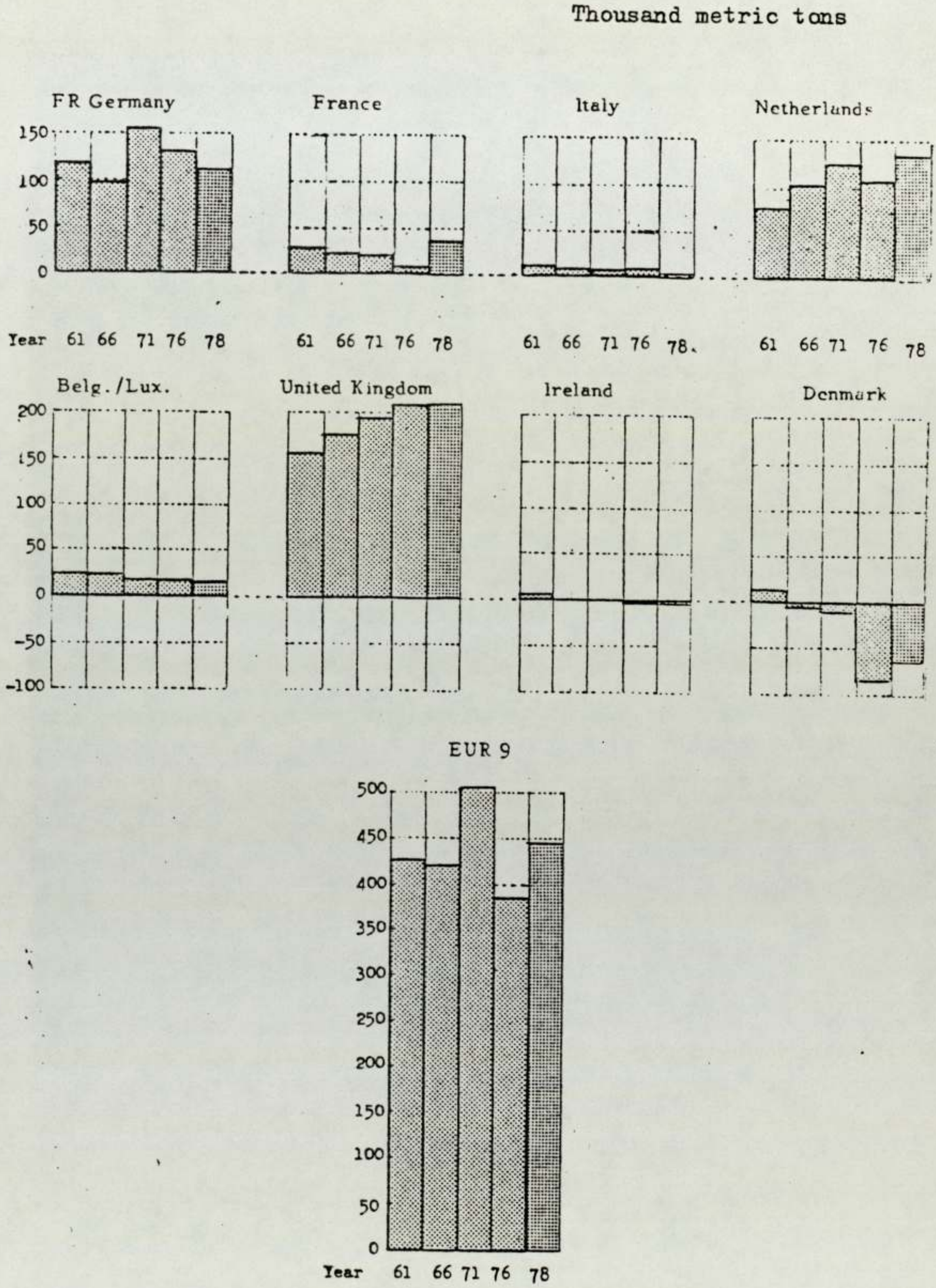


Fig. 5.22; Trade balance for fish oils and fats (amount by which imports exceed exports).

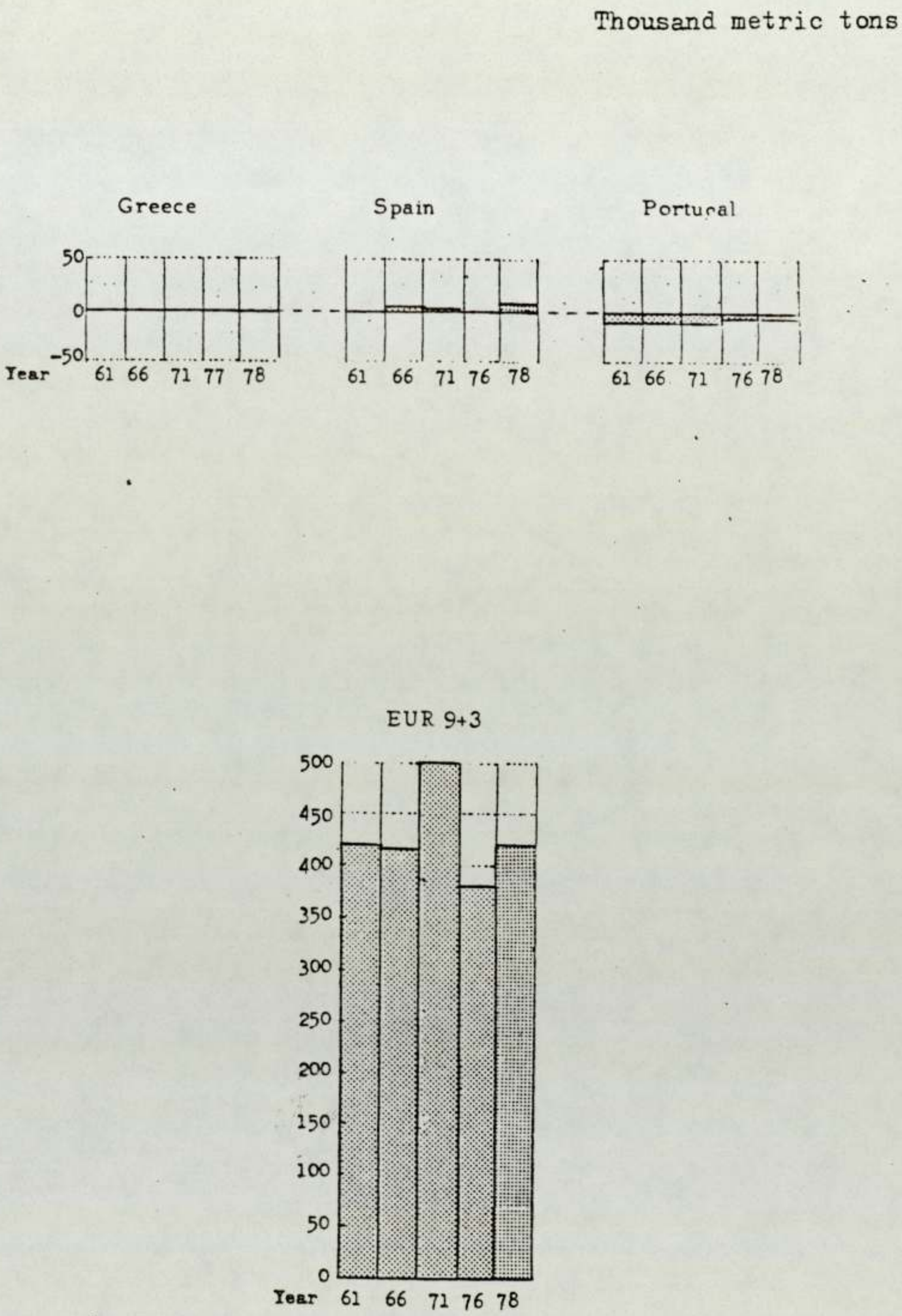
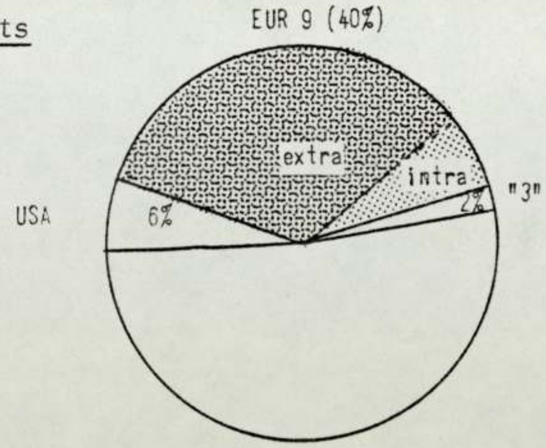


Fig. 5.23: Trade balance for fish oils and fats (amount by which imports exceed exports).

1976

Imports



Exports

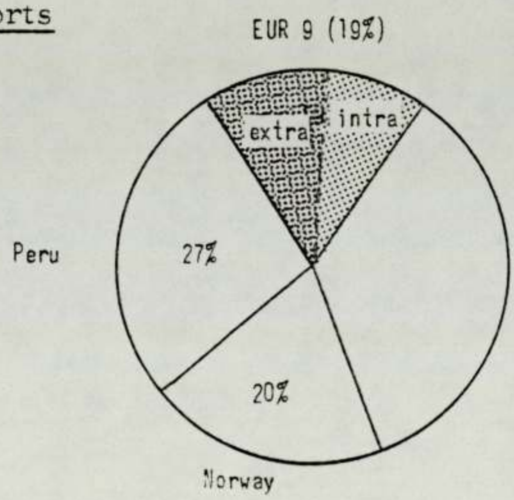


Fig. 5.24: The contribution of Community trade in meals, solubles and other feedingstuffs from aquatic animals to the World trade.

Thousand metric tons

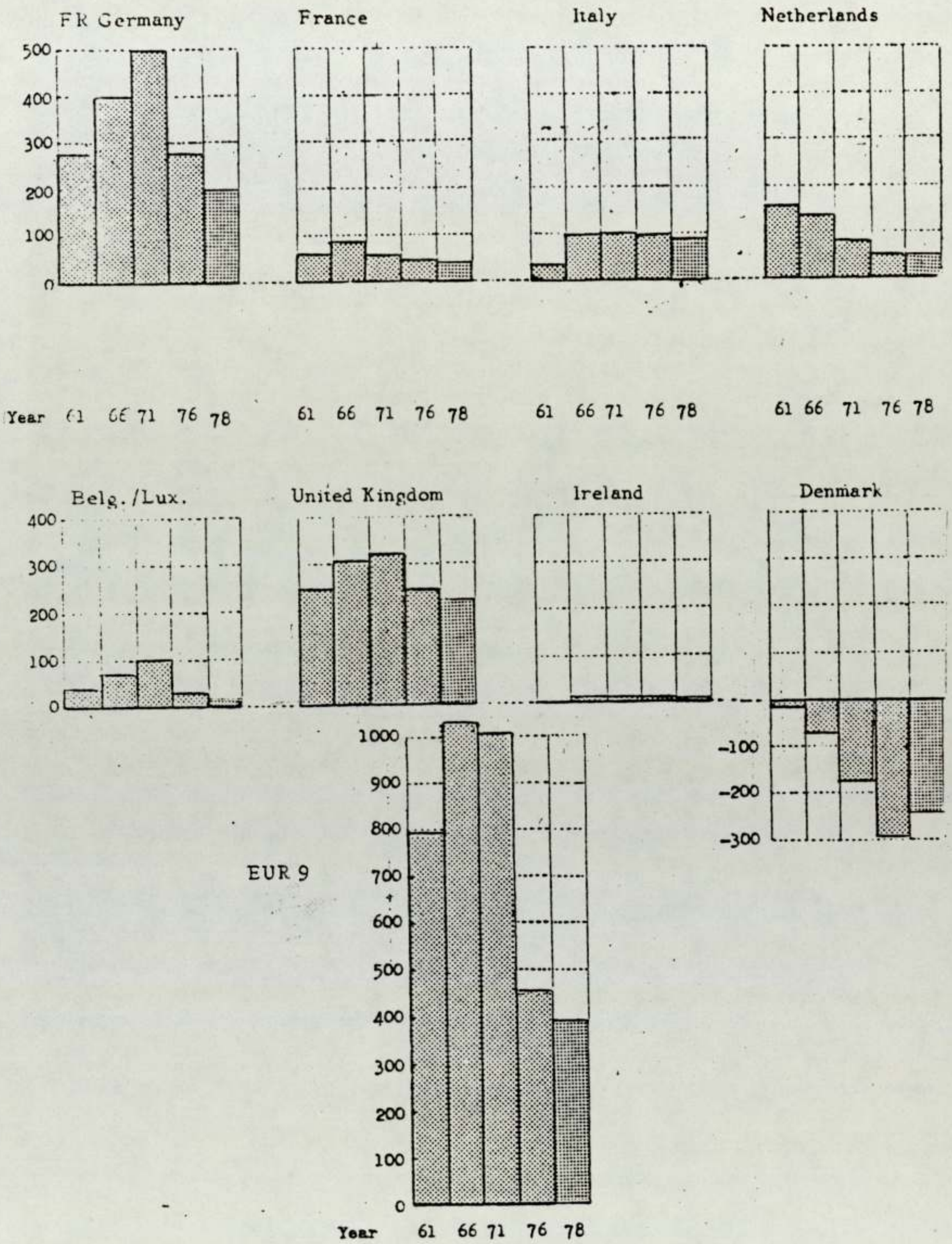


Fig. 5.25: Trade balance for fish meals, solubles & similar feedingstuffs (amount by which imports exceed exports).

Thousand metric tons

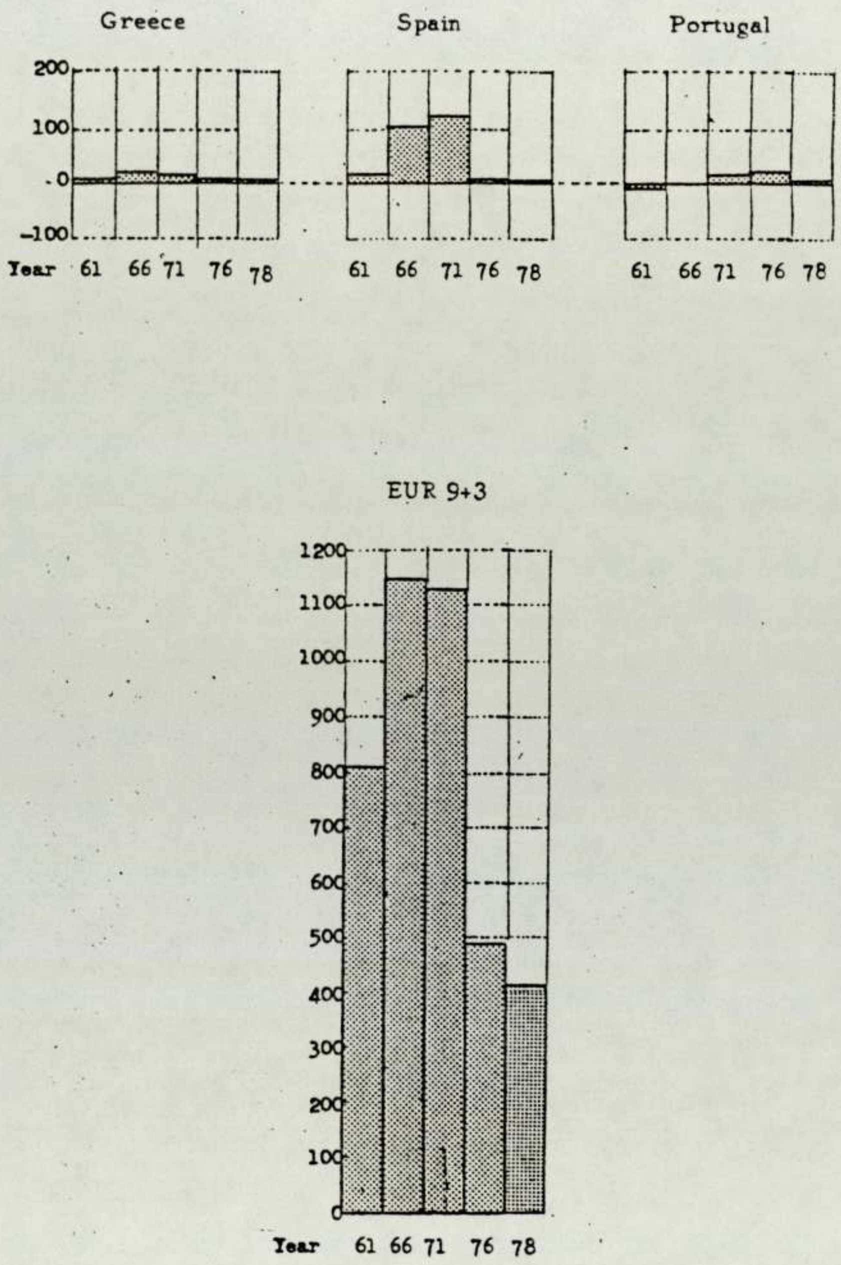


Fig. 5.26: Trade balance for fish meals, solubles & similar feedingstuffs (amount by which imports exceed exports).

The three applicant Member States do not figure prominently in the trade in meals and solubles and do not affect the overall situation greatly.

J. Summary

The European Community plays an important role as an importer of most groups of fishery products (see Table 5.3). Indeed, together with the USA and Japan, the Community is responsible for over 50% of the total imports.

No small group of countries shares such a dominant position as far as exports are concerned but the Community is certainly amongst the leading group together with Japan, Norway, Canada and the USA.

The existing Member States may be divided into two distinct groups when considering their trade in fishery products. Firstly, there are FR Germany, France, Italy, Belgium/Luxembourg and the United Kingdom: all these states are net importers of all groups of fishery products (with the exception of the United Kingdom for fresh, chilled or frozen fish in 1978). Then there are the Netherlands, Ireland and Denmark who, for the majority of products at least, are net exporters.

With the exception of fish products and preparations and, to a lesser extent, salted, dried or smoked fish, the three applicant Member States do not play a significant role in the trade in fishery products.

One point that must be considered as an unsatisfactory development is the recent great increase in exports of fresh fish from the Community. These exports are largely little more than trans-shipments of low value species (mackerel and horse mackerel) to East European factory vessels aboard which the fish are processed. If these species were processed either by Community vessels or ashore then the Community could use the increased value of these processed products to finance the importation of more highly prized food species.

Table 5.3: Percentage contribution of EUR 9 to world trade (by weight).

	Imports		Exports	
	Including intra-EC trade	Excluding intra-EC trade	including intra-EC trade	Excluding intra-EC trade
Fresh, chilled or frozen fish	33	20	21	7
Salted, smoked or dried fish	27	16	19	8
Crustaceans & molluscs, fresh, frozen, dried, salted, etc	23	12	20	8
Fish products & preparations, whether or not in airtight containers	31	25	10	4
Crustaceans & mollusc products & preparations, whether or not in airtight containers	35	28	20	7
Oils & fats, crude or refined, of aquatic animal origin	83	77	21	4
Meals, solubles & similar feeding stuffs, of aquatic animal origin	40	34	19	10
TOTAL FISHERY PRODUCTS by weight	37	27	19	6
by value	30	20	20	5

The overall evolution of foreign trade between 1971 and 1978 is shown in Table 5.4. It can be seen that for all edible products except salted, dried or smoked fish there has been a substantial increase in foreign trade. This is not surprising when one considers that there has been a great redistribution of catches as a result of the extension of economic zones. Many of the catching countries have found that they now do not have fish of the desired type to satisfy the home market and thus they have to seek supplies from countries in a better situation. Many coastal states that now have large catches but relatively small home markets are also very keen to encourage the development in the trade for fishery products.

It seems highly likely that the trade in edible fishery products will increase still further in the near future at least. The longer term future is more difficult to predict. It may be that trade will not continue to rise because either the population accepts a smaller proportion of fish in its diet or it switches to a variety of fish that is available from domestic sources. However it may be a few years before the pattern is apparent because, although the level of catches may be changed drastically from one year to the next, consumption patterns are much more resistant to change.

(tonnes product weight)	1971	1978	% change
FRESH, CHILLED OR FROZEN FISH			
World exports	2 164 500	3 901 167	+80
EEC exports	536 200	934 748	+74
EEC imports	785 100	1 083 355	+38
SALTED, DRIED OR SMOKED FISH			
World exports	489 000	453 510	-7
EEC exports	101 000	67 454	-33
EEC imports	127 800	116 794	-8
FISH PRODUCTS & PREPARATIONS			
World exports	627 600	822 752	+31
EEC exports	46 300	88 474	+91
EEC imports	181 300	210 500	+16
CRUSTACEANS & MOLLUSCS, FRESH, DRIED ETC			
World exports	522 700	921 269	+76
EEC exports	105 200	157 275	+49
EEC Imports	149 500	240 372	+61
CRUSTACEANS & MOLLUSCS PRODUCTS & PREPS.			
World exports	70 800	106 534	+50
EEC exports	11 000	24 847	+126
EEC imports	30 600	56 955	+86
TOTAL EDIBLE FISH			
World exports	3 874 600	6 205 232	+60
EEC exports	799 700	1 272 798	+59
EEC imports	1 274 300	1 707 976	+34
OILS AND FATS			
World exports	709 400	702 246	-1
EEC exports	42 900	99 119	+131
EEC imports	539 300	540 802	+0
MEALS, SOLUBLES, ETC			
World exports	3 034 100	2 080 921	-31
EEC exports	315 800	360 596	+14
TOTAL FISHERY PRODUCTS			
World exports	7 618 100	8 988 399	+18
EEC exports	1 158 400	1 732 513	+50
EEC imports	3 086 500	2 972 137	-4

Table 5.4: World and EEC trade in the major groups of fishery products in 1971 and 1978.

CHAPTER 6

SELF-SUFFICIENCY IN FISHERY PRODUCTS

SELF-SUFFICIENCY IN FISHERY PRODUCTS

The concept of self-sufficiency, and the method of its calculation, are fully described in the section on methodology of supply balance sheets (see Appendix B). However it may be defined briefly as the domestic production of a territory expressed as a percentage of the quantity used within that territory. Because it is difficult to know if the raw products used in the manufacture are of domestic origin or imported, the self-sufficiency is calculated only for certain total balance sheets.

It should be said that, the balance sheets being established by the Member States for EUROSTAT, no data are yet available for the three applicant Member States.

A. Total Fish

The self-sufficiency in total fishery products is given in table 6.1. It can be seen that currently the Community as a whole produced about 60% of its requirements from its own resources. However, there is considerable variation between the Member States, ranging from the FR Germany and Belgium, that only produce about 20% of their requirements, to Denmark which is a big net exporter. If the Danish data are excluded, it will be noted that there has been a general improvement in the period from about 1970. Up until this time the self-sufficiency had been decreasing. The main reason for the improvement, the decreased availability of fish meal as a result of the decline of the Peruvian anchoveta fishery, is discussed more fully in Chapter 16. However, as is shown in Figure 6.1, the improvement in the degree of self-sufficiency was achieved, not by an increase in production, but by a marked decrease in the quantity required.

For Denmark, the overall situation is rather different. This country has, with the development of its industrial fisheries, consistently improved on its overall self-sufficiency in fishery products until, in the late 1970's, it produced approximately 5 times as much as it used.

Table 6.1: Self-sufficiency in fishery products (%)

Year	EUR 9	D	F	I	NL	B/L	UK	IRL	DK
Total fishery products									
1959/60	53	46	78	33	35	22	47	103	150
1960/61	46	33	73	32	28	20	39	71	153
1961/62	43	28	62	29	27	19	37	72	172
1962/63	42	28	58	24	22	18	38	63	172
1963/64	39	25	55	24	25	16	35	39	179
1964/65	38	21	54	26	27	12	35	34	194
1965/66	40	23	55	27	29	12	39	46	195
1966/67	39	22	56	25	28	13	32	44	204
1967/68	40	20	53	27	24	12	28	43	342
1968/69	37	20	52	25	22	11	30	39	302
1969/70	40	18	51	28	27	9	36	52	259
1970/71	44	17	54	28	38	10	41	82	336
1971/72	49	18	58	32	50	11	40	79	355
1972/73	59	20	62	36	65	14	50	116	338
1974	67	24	66	40	64	19	53	114	320
1975	61	21	58	33	58	16	43	89	583
1976	61	21	56	31	58	15	42	76	510
1977	62	24	50	30	55	17	45	80	491
Fish for consumption									
1976	83	62	71	57	168	31	87	167	332
1977	77	64	62	52	139	36	85	178	264
Fish for industrial uses									
1976	43	1	-	1	1	-	10	15	578
1977	44	1	-	1	-	-	4	10	617
Fish meal									
1976	53	20	29	0	0	-	24	24	485
1977	:	18	:	17	-	9	27	22	570

Source: EUROSTAT

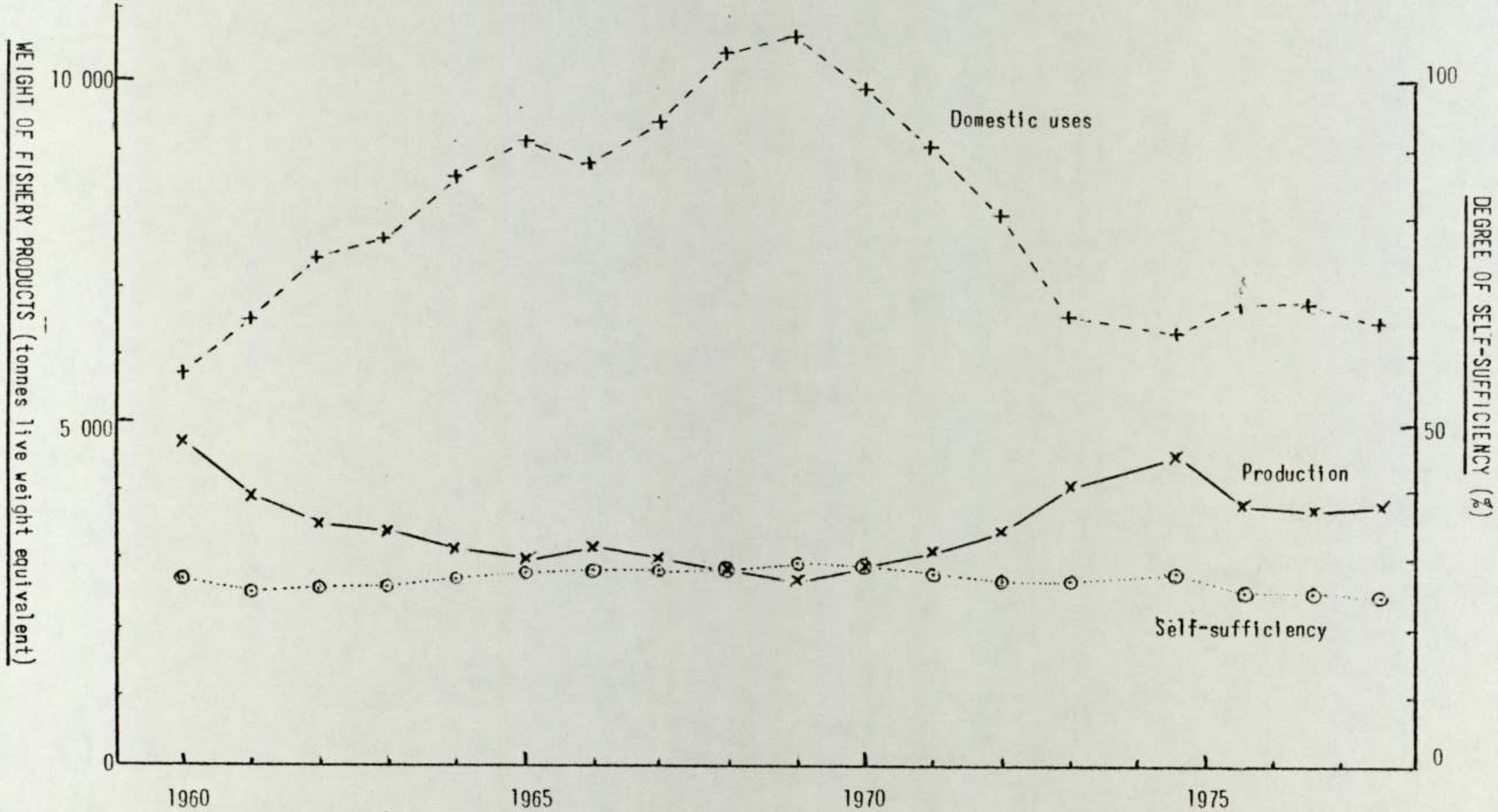


Fig. 6.1: Self-sufficiency in fishery products by EEC Member States (except Denmark)

B. Fish for Human Consumption

Although long time series are not available for the self-sufficiency in fish for human consumption, it is instructive to look at the variation between the situations in the different Member States. Three Member States, the Netherlands, Ireland and Denmark, are self-sufficient and all of the Member States, except Belgium, are more than 50% self-sufficient. This apparently more healthy situation than for the total fishery products is probably not so satisfactory in reality and highlights one of the weaknesses of the calculation of self-sufficiency. The United Kingdom may be used as an example. As has been seen in the previous chapter, in recent years this country has exported a greater weight of fresh fish than it has imported. However much of the exported fish was relatively low-valued mackerel and horse mackerel while the imports were the more expensive cod, haddock, herring and other species more readily accepted in the diet than those exported. The calculation of self-sufficiency in terms of weight ignores value differences and dietary preferences.

C. Fish for Industrial Uses

Again only a very limited quantity of data is available but it shows the expected situation; namely, that, with the exception of Denmark, all of the Member States import the greater part of the products required.

D. Fish Meal

Fish meal is the subject of Chapter 16 but a brief discussion of the self-sufficiency in fish meal is included here because of the connection between the balance sheets for industrial uses and the balance sheet for fish meal. Although a major source of fish meal is the catch from industrial fisheries, in certain countries, notably the FR Germany and the United Kingdom, appreciable quantities of fish meal are produced from fish offal. This offal is not included in the balance sheets of fish for industrial uses so as to avoid a double count with the balance sheets of fish for human consumption (see Annex B). Consequently, Member States are more self-sufficient in fish meal than would be expected from the former balance sheets. (It must be mentioned that the balance sheet for fish meal over-estimates, though to a minor degree, the self-sufficiency in fish meal by not distinguishing between fish meal producted from home-produced raw material (fish and offal) and that produced from imported raw material).

E. Summary

This study of the overall situation for fishery products shows that the Community produces about 80% of the weight of fish required for human consumption, though not necessarily of the desired quality of product, and about 60% for fishery products as a whole. When these figures are compared with data for other animal products (Table 6.2) it is seen that the Community is less self-sufficient in fishery products than in these other products.

	Fish	Meat	Eggs
FR Germany	64	86	79
France	62	93	98
Italy	52	76	98
Netherlands	139	190	196
Belg/Lux	36	122	160
UK	85	73	100
Ireland	178	266	95
Denmark	264	310	99
EUR 9	77	96	100

Table 6.2: Self-sufficiency of the Community in animal products in 1977 (%).

Source: EUROSTAT

CHAPTER 7

CONSUMPTION OF FISHERY PRODUCTS

THE CONSUMPTION OF FISH AND FISHERY PRODUCTS

A. Fish as a Food

Fish is a rich source of protein in the human diet and has advantages over the other main sources of protein (meat, milk and eggs) in that the amino acid composition of fish flesh is better balanced than in these other foods. This composition is given in Chapter 16 and it will suffice here to limit the detail to a brief comparison between fish and various meats.

Table 7.1 shows the composition obtained from analyses of raw edible portions of muscle flesh. Cooking causes a variable loss of proteins depending on the method used, so, for the purpose of comparison, the raw values are more suitable. It can be seen that the protein content of fish is approximately the same as for meat but that for white fish the fat content is considerably lower. This results in a considerably lower calorific value, an important consideration in affluent Western European countries.

Oily fish are a very important source of vitamins A and D. Apart from eggs and enriched margarine, fish is the only real source of this second vitamin. It should also be noted that the table refers to fish fillets and does not take account of the vitamin D found in fish livers (including such white fish as cod and halibut) nor the vitamin E found in sprats at certain times of the year.

Although richer than meat in calcium, fish is not as valuable a source as milk products. Where fish does have an outstanding advantage is in its content of iodine and fluorine. In fact, fish is the most reliable source of these elements in the diet.

B. Consumption Levels

Having established the value of fish in the human diet it is of interest to examine how important a part it plays in the

	White fish	Herring	Beef	Lamb	Pork	Chicken
Protein (g)	17.3	16.9	18.3	15.8	15.8	20.8
Fat (g)	0.7	18.3	16.9	30.3	29.6	6.7
Calories (kcal)	74	233	226	335	332	145
Calcium (mg)	15.8	31.7	7.1	7.1	7.1	10.6
Iron (mg)	0.4	0.7	1.8	1.4	0.7	1.4
Vitamin A (ug)	0	46	0	0	0	0
Vitamin D (ug)	0	22.5	0	0	0	0
Thiamine (mg)	0.07	0	0.07	0.07	0.56	0.04
Riboflavin (mg)	0.07	0.18	0.18	0.18	0.18	0.18
Nicotinic acid (mg)	4.9	7.1	8.1	7.4	7.1	9.5

Table 7.1: Composition of raw edible portions of muscle flesh (per 100g) (MAFF, 1976)

Community's diet. FAO (1977) has published a series of balance sheets for the main groups of food products. While these balance sheets are probably not as accurate as those compiled by EUROSTAT in that, where conversion factors are used, they have been applied at a later stage in the aggregation process, the conversion into the consumption of protein and oil and in terms of the calorie intake does permit a better overall view of the contribution of the various components of the diet.

Figure 7.1 which shows the consumption in gms per day per capita for the main groups of food products is interesting in several ways. Firstly, the consumption is greater in the Developed Market Economies, Western Europe and, more particularly in the EEC than for the world generally. (The groupings of the countries is given in Appendix A).

Secondly, with one exception (the United Kingdom) the per capita consumption of protein has risen in the period 1961/63 to 1974. This increase is particularly marked in the more southerly of the countries observed (Italy, Greece, Spain and Portugal). Between 40 - 60% of the total protein is derived from animals (including fish) and the general rise in consumption is almost entirely attributable to an increase in the consumption of animal protein. The consumption of vegetable protein, largely derived from cereals, has shown little if any increase.

Lastly, though most important for the purpose of this study, is the level of consumption of protein from fishery products. Only in Portugal (with about 15%) does the consumption of fishery products account for more than 10% of the total protein intake. Indeed, only in Denmark of the existing Member States does this contribution account for more than 5% of the total.

More recent information published by EUROSTAT (see Table 7.2) confirms the relatively minor contribution made by fish to the total protein intake. These data, all expressed in the weight

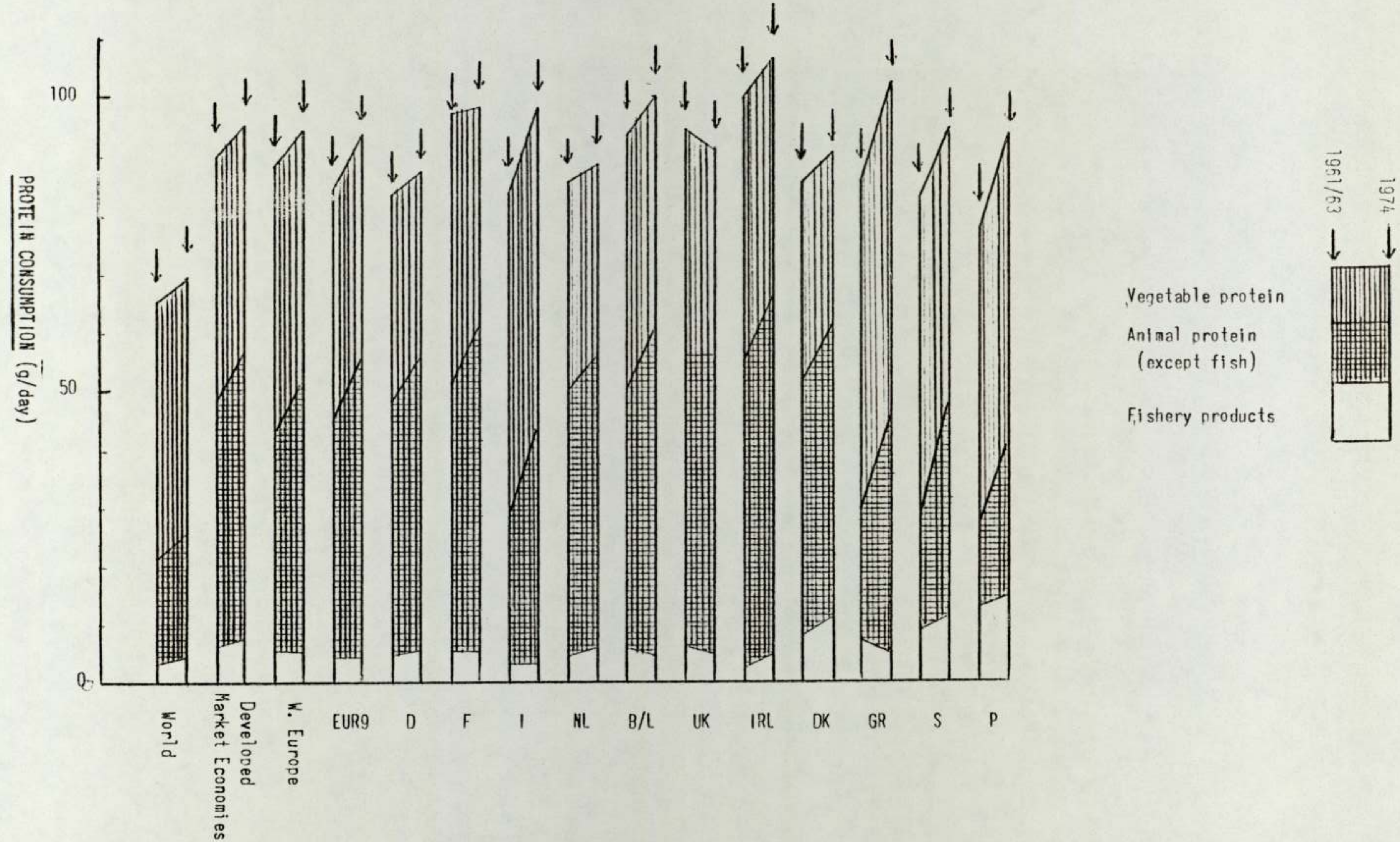


Fig. 7.1: Protein consumption in the period 1961/63 to 1974. Source: FAO

Table 7.2: Per capita consumption of fish, meat and eggs in 1977 (kg/head/year)

	Fish	Meat	Eggs
EUR 9	12	84	14
FR Germany	9	93	17
France	15	104	13
Italy	9	70	11
Netherlands	9	74	11
Belg/Lux.	13	92	13
UK	16	71	15
Ireland	9	91	12
Denmark	20	73	12

Source: EUROSTAT

of product, indicate that generally in the Community over six times as much meat is eaten as fish and that the consumption of fish is of about the same level as for eggs.

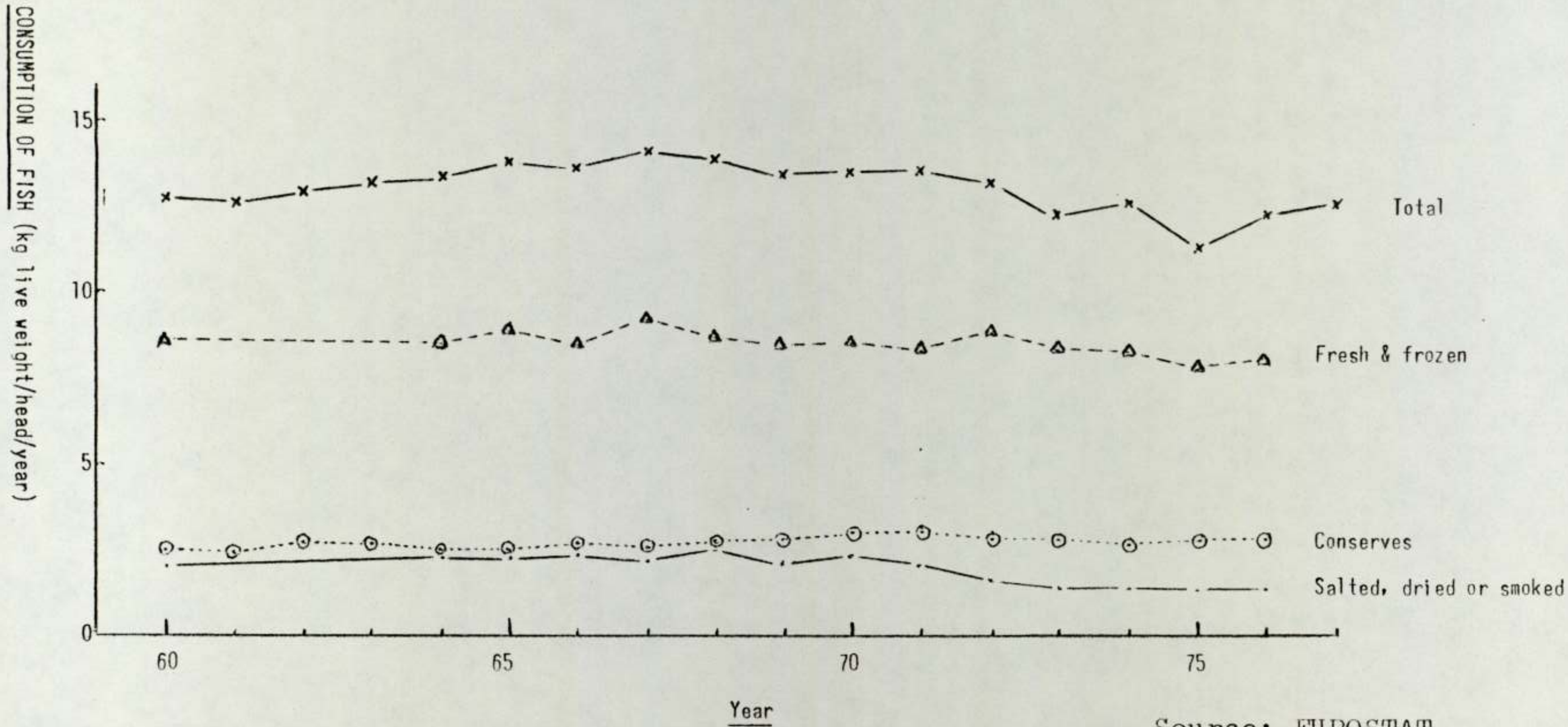
Figure 7.2 shows how the consumption of fish has developed since 1960. There appears to have been a higher level of consumption in the mid-1960's than before or after, although it must be stressed that this increase may be more apparent than real. The range of consumption is less than 2 kg/head/year and it is suspected that this may be well within the limits of accuracy in establishing the supply balance sheets (see Appendix B). However, the figure does show the contributions made by the different forms of fishery products to the total. Fresh and frozen fish account for 65% of the total, with salted, dried and smoked fish and fish conserves making relatively small contributions of 23 and 12% respectively.

There are considerable variations both in the quantity and composition of the fish consumed in the Member States (Table 7.3). Consumption is greatest in Denmark and lowest in the Netherlands. Fresh and frozen fish makes up 80% of the fish consumed in the United Kingdom and Ireland but only 40% in FR Germany. Fresh fish is consumed in far greater quantities than frozen fish in France, Italy and Denmark while the converse is found in FR Germany and Ireland.

Consumption of salted, smoked or dried fish does not exceed 2 kg/head/year in any of the Member States. About double the quantity of conserves are eaten in most of the Member States than of salted, dried or smoked fish. The outstanding feature of consumption of fish conserves is the high value attributed to Denmark, over 7 kg/head. Much of this consumption is probably of semi-conserves (that is, products that have a limited shelf-life).

Thus, to summarise, fish does not contribute more than about 5% of the protein to the diet of the Community but this is high

Fig. 7.2: Per capita consumption of fishery products for the EEC.



Source: EUROSTAT

	Fresh	Frozen	Salted, smoked or died	Conserves	TOTAL
FR Germany	1.4	2.4	1.8	3.9	9.5
France	9.4	1.3	1.3	3.1	15.1
Italy	5.5	0.6	1.9	1.5	9.4
Netherlands	5.5		1.1	1.9	8.5
Belg/Lux.	4.7	2.9	1.4	3.6	12.6
UK	6.2	6.8	0.9	2.3	16.0
Ireland	1.5	6.0	0.9	1.0	9.4
Denmark	9.5	2.9	0.3	7.4	20.1
EUR 9	8.1		1.4	2.8	12.3

Table 7.3: Consumption of fishery products in the EEC in 1976 (kg live weight equiv./head/year)

Source: EUROSTAT

quality protein and, for white fish at least, the associated carbohydrate content is low. When the mineral content is then taken into account it is no surprise that dietitions recommend the inclusion of one of two seafood meals in the weekly diet.

CHAPTER 8

THE PRICE OF FISH.

THE PRICE OF FISH

A. INTRODUCTION

Fish used to be considered a cheap source of protein and one wonders if this continues to be so. In 1975 EUROSTAT conducted a wide-ranging study of retail prices in the Community capital cities. Included in the survey was a range of food products; table 8.1 shows the prices recorded for a selection of these foods. If one accepts that cod fillets are a basic food product, in 1975 fish would appear to have been cheaper than most meats throughout the Community. The meat that was the exception was chicken which was cheaper than fish throughout the Community. This is probably a reflection of the highly efficient broiler industry for poultry.

However the price which is most revealing, and perhaps the most promising as far as the future of aquaculture is concerned, is the price of sole. This fish is considered as a luxury in most countries and this is reflected in the retail price. Only in the Netherlands, where sole has traditionally been one of the basic species sought by fishermen, is the price lower than for beef. Although this species does have problems as a subject for aquaculture (see Chapter 13) it is often said that, if aquaculture is to be successful, it will have to be with culture of such a high valued species. This survey would support this view.

A later survey, although less comprehensive, shows that the situation has changed greatly. In February 1979 all of the species surveyed, except herring, had a retail price in the United Kingdom that was at least equal to that of many cuts of meat (see table 8.2) and from similar surveys conducted since June 1976 the mean increase in price of fish, at 18% per annum, was nearly twice that for most of the meat products selected.

	BONN (DM)	PARIS (FF)	ROME (LIT)	AMSTERDAM (HFL)	BRUSSELS (BFR)	LUXEMBOURG (LFR)	LONDON (UKL)	DUBLIN (IRL)	COPENHAGEN (DKR)
Sole, black whole fish.	23.20	27.73	5608	15.65	280.18	368.00	3.200	2.344	63.33
Cod, fresh fillet	8.03	18.39	:	8.82	163.00	161.00	1.387	1.385	18.31
Cod, deep-frozen fillet	6.78	21.05	2378	8.03	170.00	166.40	1.468	1.755	30.25
Beef, silverside	16.58	27.09	4340	16.79	243.00	224.57	1.836	1.509	36.33
Pork, loin chops	11.98	19.67	3336	11.66	155.11	148.00	1.800	1.852	28.41
Lamb, leg	16.35	31.07	3980	13.10	188.67	201.67	1.560	1.351	33.24
Chicken, roasting	6.48	11.08	1501	5.79	83.13	84.56	0.830	0.959	15.75
Chicken, roasting deep-frozen	4.76	:	1868	4.07	69.33	68.26	0.652	0.827	12.62

Source: EUROSTAT(1976) Survey of Retail Prices, 1975.

Table 8.1: Retail prices of fish and meat in Community capital cities in September - November 1975 (Price in national currency per kg.)

Table 8.2: Average retail food prices in the United Kingdom in February 1979

Product	Price (pence/lb)
Chuck steak (home killed)	105.2
Pork leg (home killed)	81.8
Broiler, frozen, 3 lb	47.8
Beef sausages	46.0
Cod fillets	100.2
Haddock fillets	109.3
Plaice	111.3
Herring	62.6

Source: UK Dept of Employment

B. EEC MARKETING ORGANISATION

In the 1960's the European Community established a system for the management of the market for fishery products. The system is complicated but, briefly, fish marketed through recognised producer organisations are guaranteed a minimum price at first sales. Fish not reaching this 'withdrawal' price on the market are withdrawn from the market and, normally, consigned for reduction. The fisherman receives the withdrawal price for his fish, the difference between the market price and the withdrawal price being made up from Community funds. In principle the withdrawal price is set once annually for about a dozen fish species and, although the calculation is complicated and includes an element of weighting representing the management policies, a prime consideration is the mean price obtained by the product at predetermined 'representative' ports in the previous three years. In 1974 and early 1975 market prices were very poor and a considerable quantity of fish landed was withdrawn from the market. However, more recently the market has improved and very little fish is failing to reach the withdrawal price.

This system of market management has not apparently prevented considerable variation in the prices obtained for fish in the different Member States of the Community. It must be stressed that uniformity of price is not the major objective of the system. National and even regional preferences for certain species will inevitably cause price differentials. The policy is basically to ensure that the fishermen receive fair returns for their efforts.

C. VARIATIONS IN VALUE BETWEEN MEMBER STATES

Figs 8.1 and 8.2 record the mean unit prices of six fish species, all included in the management programme and all major food species, in the Member States in 1976. Three points are worthy of comments:

a) for these six species the unit values in Ireland were lower than in the rest of the Community. This may be because Ireland has principally a fleet of small vessels handling fresh fish and has only a small processing industry. Consequently much of the fish is marketed for immediate consumption. The other Member States are better placed geographically for the purposes of distribution of fresh products and/or have other outlets than direct human consumption;

b) the values in France are consistently high, not falling below 89% of the highest Community value;

c) the values in Belgium and the Netherlands are consistently very similar and around the Community mean. This could be due to the very central position of these two states within the Community and the possibility of vessels being able to readily switch to ports in neighbouring countries when prices are higher than in the home ports.

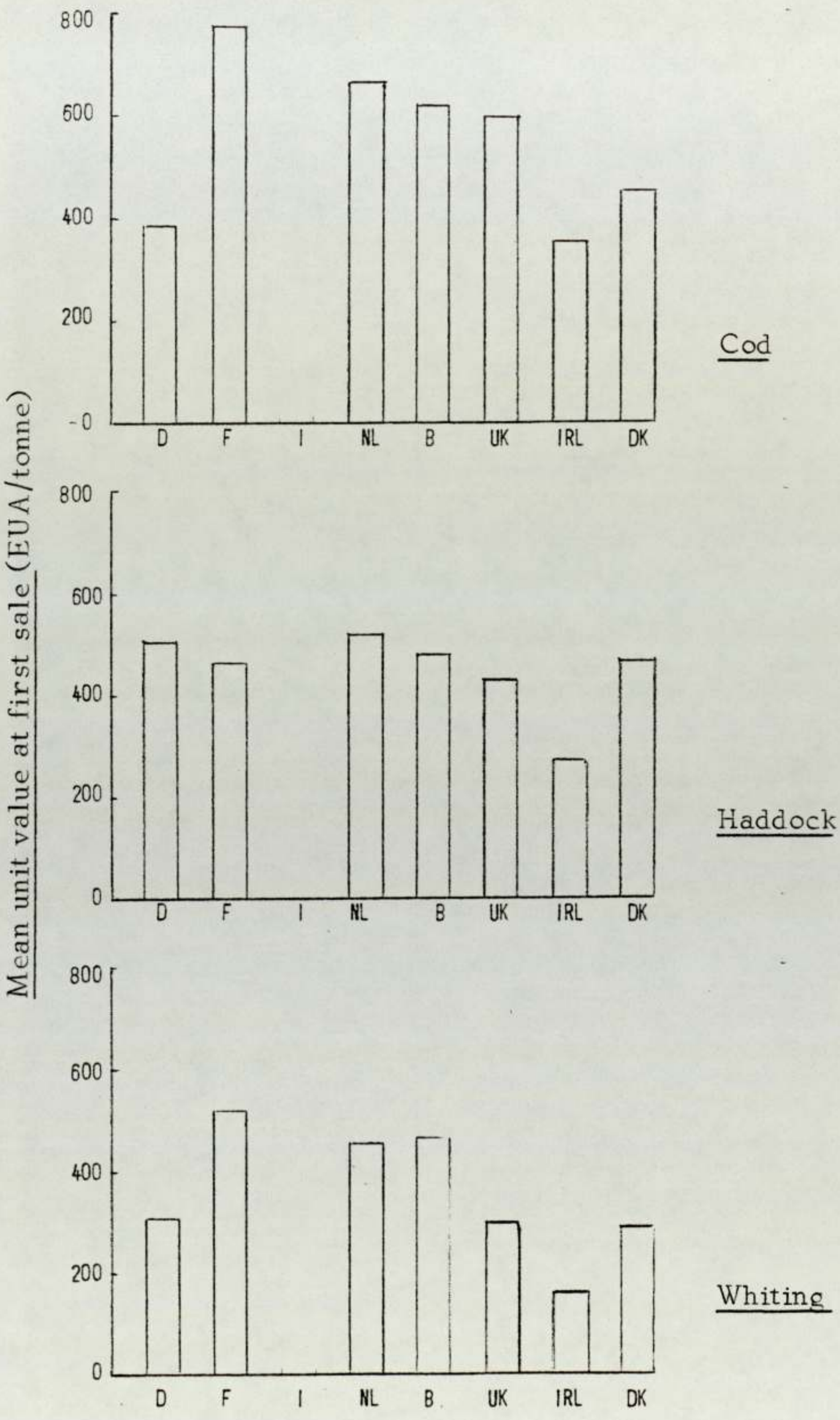


Fig. 8.1: Mean unit values at first sale in 1976

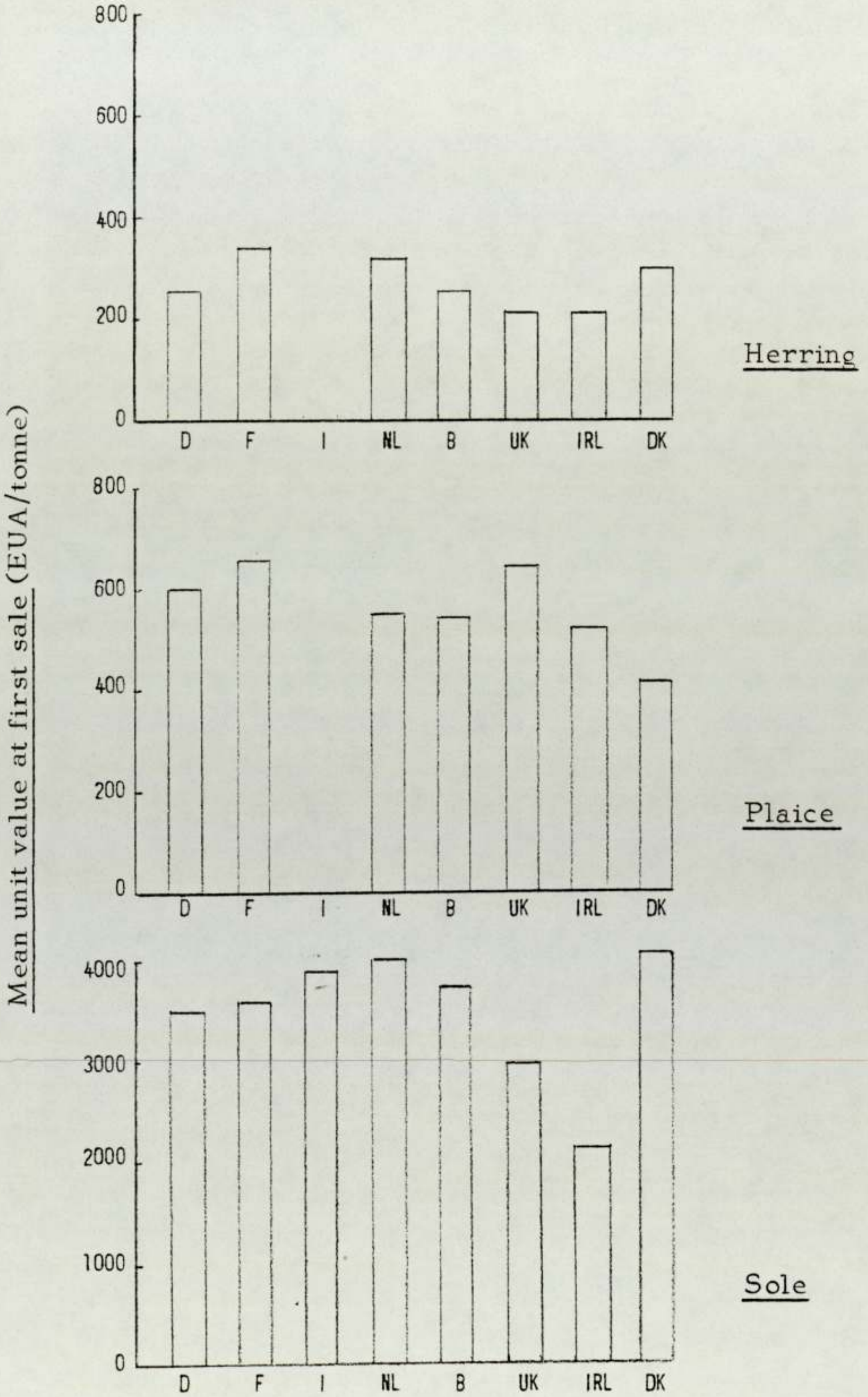


Fig. 8.2: Mean unit values at first sales in 1976

D. TRENDS IN UNIT VALUES

It is interesting to study the evolution of values over a period of years. For this study five of the same six important fish species have been chosen and the unit values of these species in the United Kingdom, the Netherlands, France and the FR Germany have been followed in the period 1960-78. Fig. 8.3 shows the result of following the unit value of cod at first sales in the four Member States. (In fact, very similar pictures were obtained for the other four species, the one major difference being the range of unit values.) The outstanding point of the graph is the very rapid increase in values after 1968 in comparison with the earlier period. The data were therefore divided into those relating to the period 1960-68 and those to the period 1968-78. The trends for these two periods were calculated by estimating the best fit straight line (see Appendix A for the methodology). For the period 1960-68 it was not possible to detect a trend in the unit values for any of the fish species in the four Member States. Since the quantities on the market did not fluctuate to the same extent this is an indication of unstable marketing conditions. Although it is difficult to find comparable long-term series of unit values of non-Member States, cod values in Norway and Canada showed an upward trend in the period 1960-68. These two countries export considerable quantities of cod (the four Member States selected are importers of cod) and rely on market stability if they are to be able to guarantee the supply to importing nations.

However for the period 1968-78 the picture is very different. Without exception logarithmic plots of unit values against time showed highly significant linear correlations, indicating that there was a uniform rate of increase in unit values over this period. This is believed to be a reflection of more stable marketing conditions and it is probable that the Community's marketing policies, which became effective towards the end of the 1960's, are, at least, responsible. It is not the contention that the

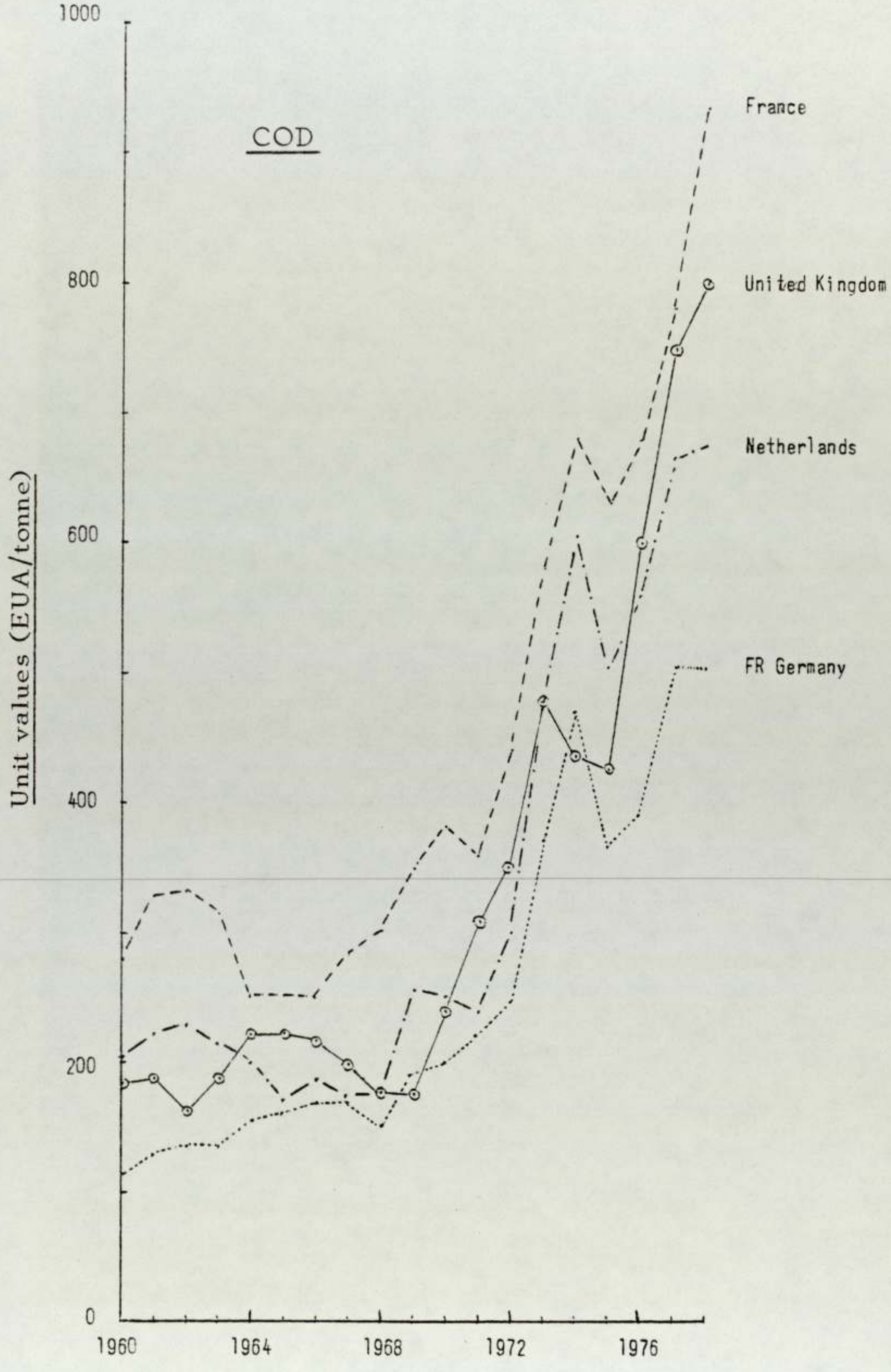


Fig. 8.3: Unit values at first sales in the period 1968-78

Community's policy resulted in the rapid increase in unit values which started in 1968. The rapid increase was more likely the result of difficulties in maintaining supplies (with the extension of territorial limits and the more stringent resource management policies) combined with the increased cost of fuel. It is believed that the Community's market management policy was instrumental in making this an orderly increase. The results of this analysis have been summarised in Figs 8.4 - 8.8.

Table 8.3 shows the rate of increase of unit values for fish in the four Member States in the period 1968-78 with, for comparison, the rates for cod in Canada and Norway and the rates of increase of selling prices for four other animal products in the Member States.

Table 8.3: Annual percentage increase in unit values (EUA/tonne) for the period 1968-78

	FR Germany	France	Netherlands	UK	Norway	Canada
Sole	15.5	10.0	14.0	12.0	-	-
Plaice	14.4	10.9	17.2	9.9	-	-
Cod	13.1	11.7	14.7	16.8	14.5	11.9
Haddock	13.6	11.0	18.0	14.5	-	-
Herring	11.8	9.5	14.9	24.2	-	-
Chicken	7.5	5.2	7.4	8.8	-	-
Milk	11.3	9.5	9.9	7.9	-	-
Eggs	7.3	10.2	8.1	7.6	-	-
Cattle	9.9	9.6	9.1	8.9	-	-

From this table three main points are evident:

1) For France, where it has already been mentioned that the unit values were generally higher than for the other Member States in 1976, the annual rate of increase was lower for the period 1968-78. This will have led to a decrease in the differences in unit values between France and the other Member

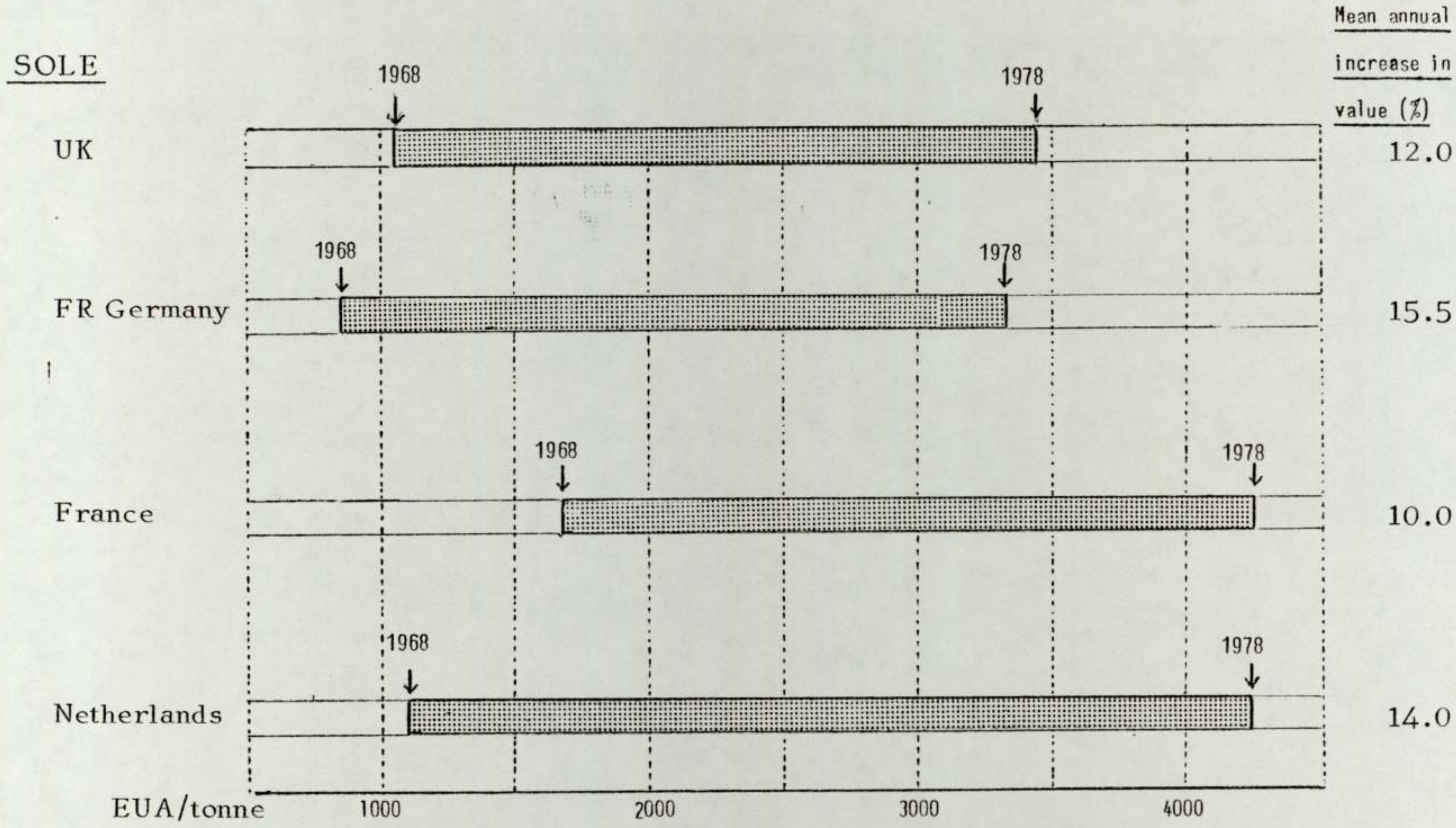


Fig. 8.4: Increase in unit value at first sale in the period 1968-78

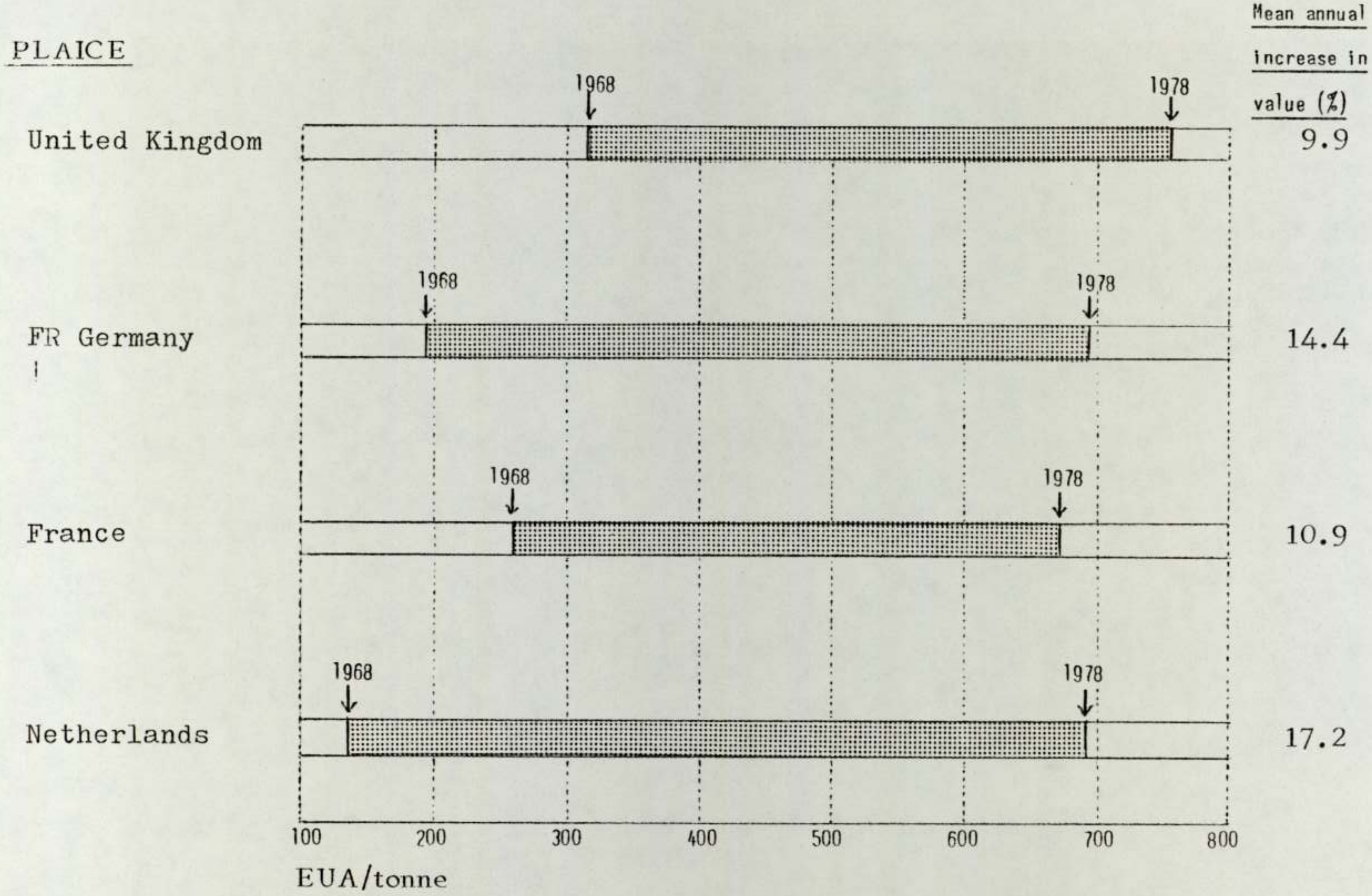


Fig. 8.5: Increase in unit value at first sale in the period 1968-78.

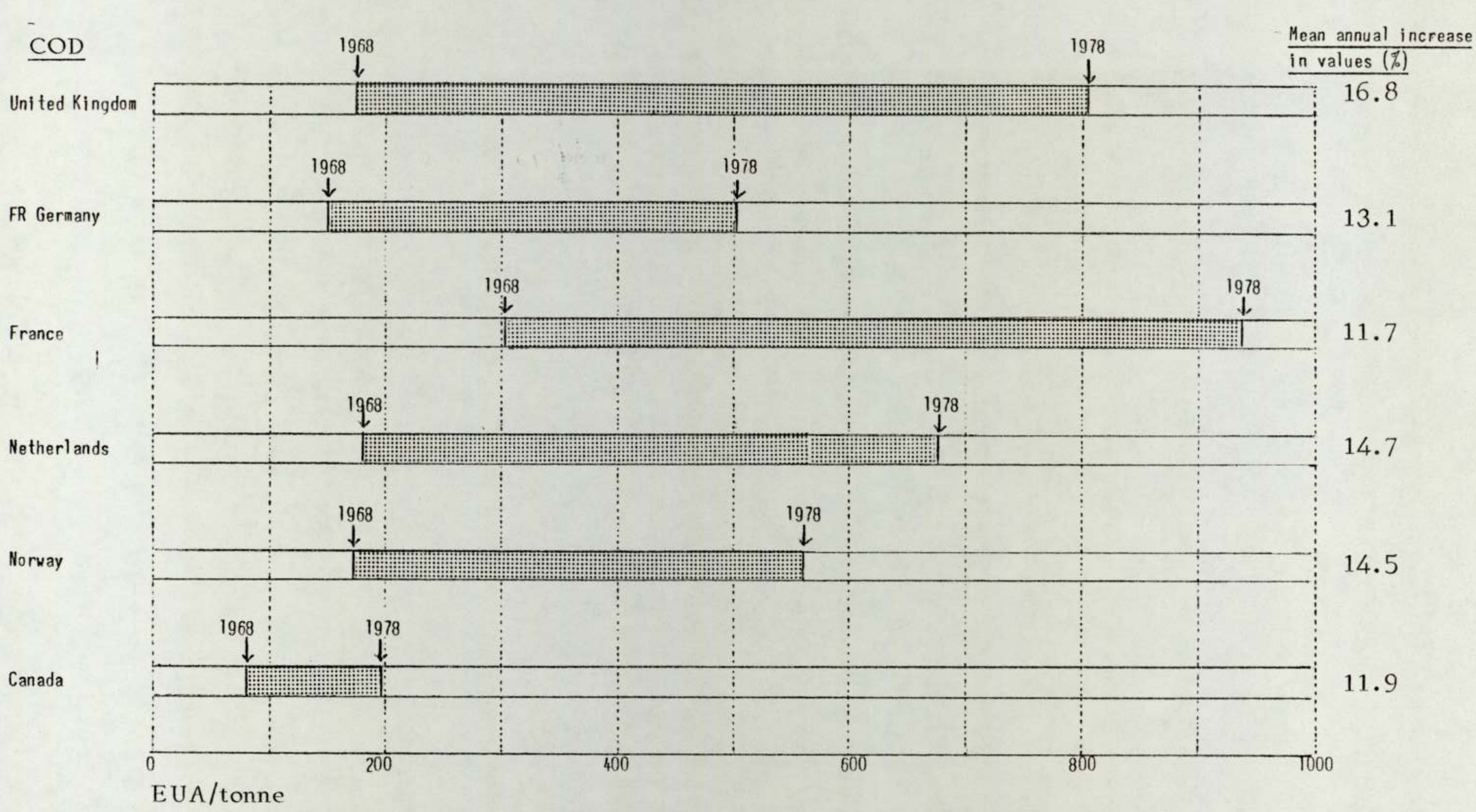


Fig. 8.6: Increase in unit value at first sale in the period 1968-78.

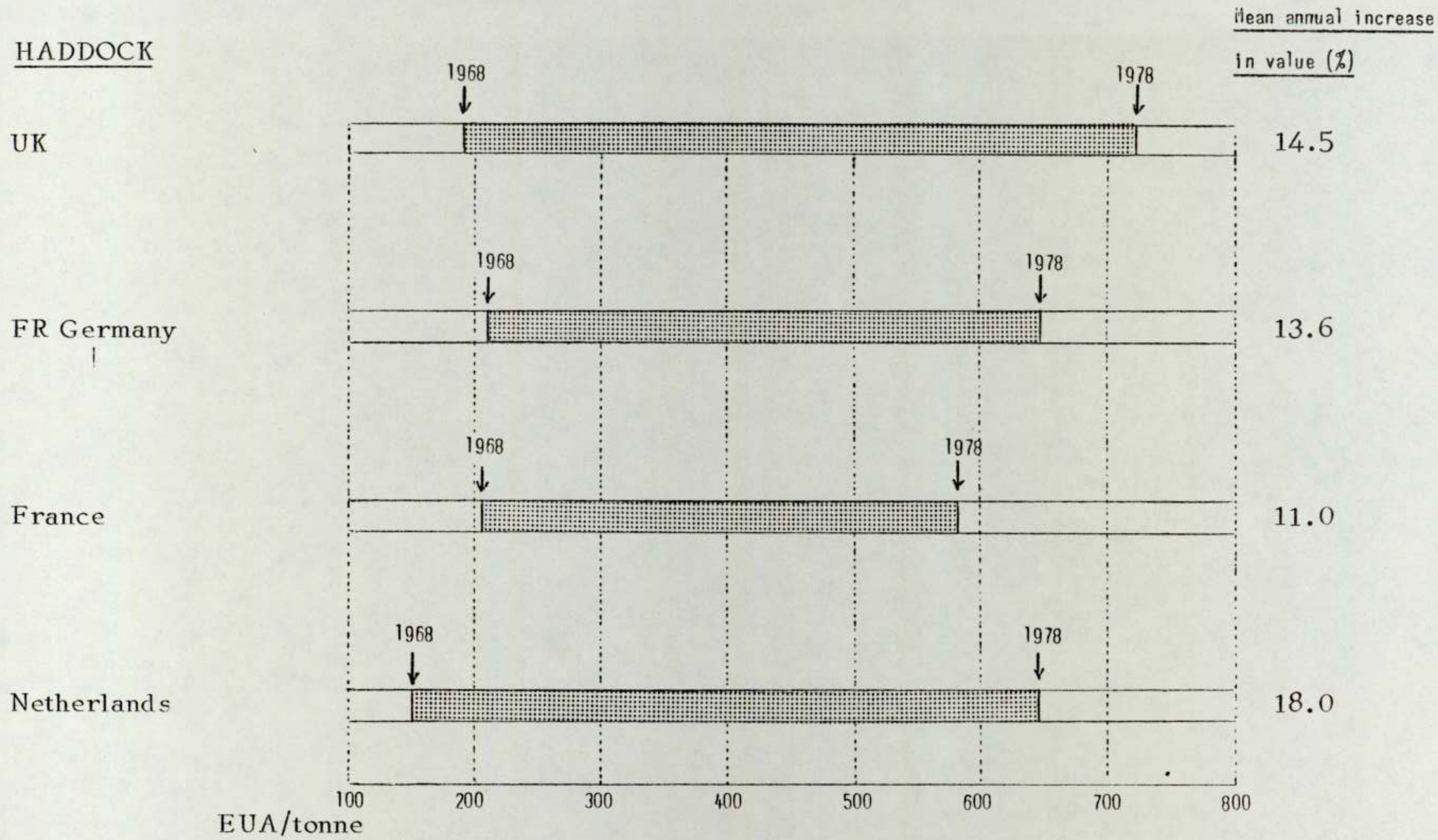


Fig. 8.7: Increase in unit value at first sale in the period 1968-78.

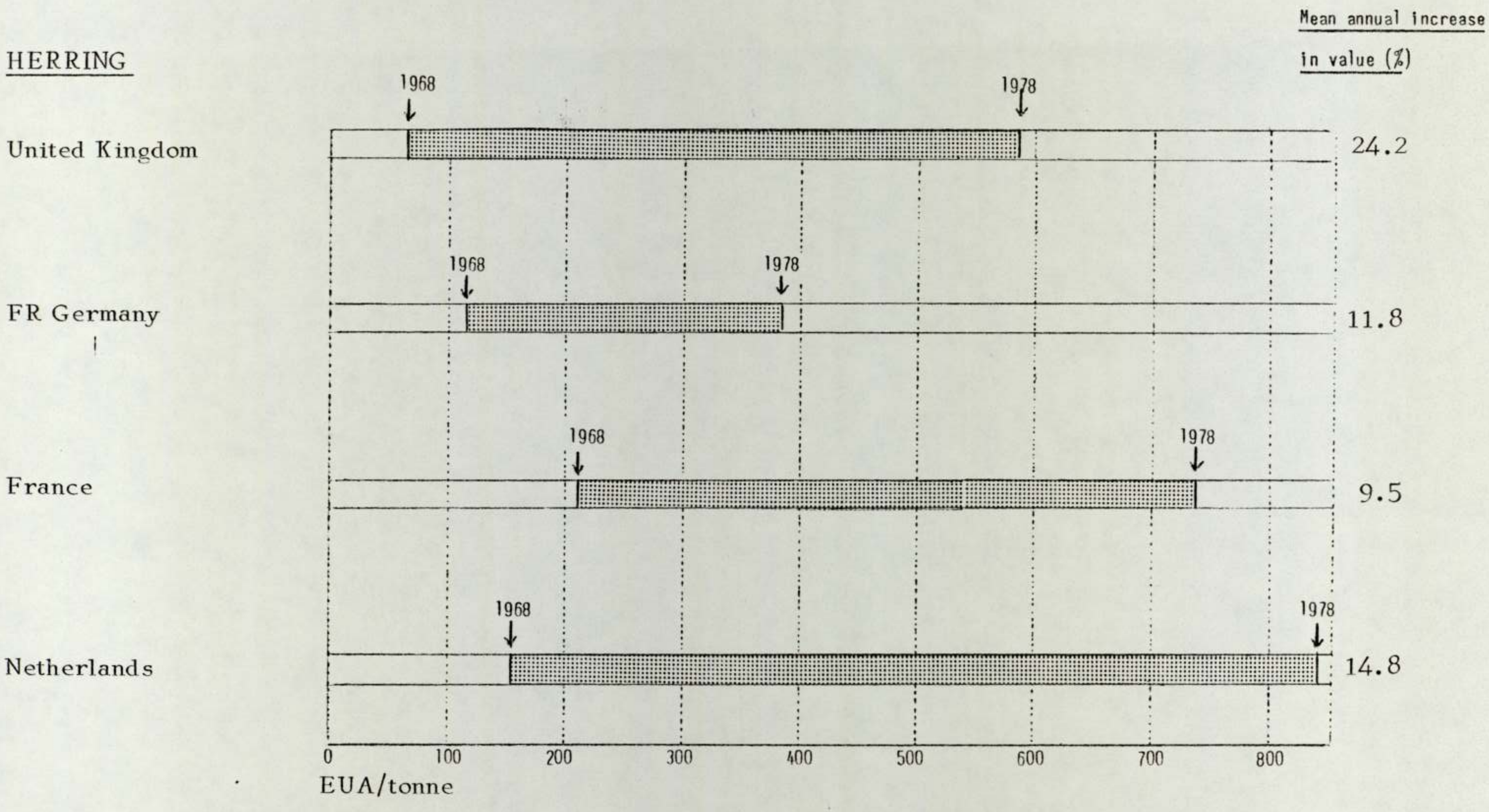


Fig. 8.8: Increase in unit values at first sales in the period 1968-78.

States.

2) The rates of increase for cod in Canada and Norway were in the same range as those for the Member States. It should be noted that the annual increases of 14.5 and 11.9% for Norway and Canada respectively in the period 1968–78 were considerably higher than the rates (5.9 and 6.7%) recorded in the period 1960–68.

3) The annual increases in values of fishery products are, almost without exception, considerably higher than for other animal products. This supports the proposition that fish is not as cheap a source of protein in comparison with other animal products as it used to be.

E. A 'BASKET' OF FISH

In an attempt to obtain an overall impression of the situation in the four Member States of the Community a 'basket' of fish was established. This 'basket' contained the five marine species considered above in the proportions in which they were caught by the four Member States. Thus the basket contained 1 t sole, 4.48 t plaice, 26.17 t cod, 9.19 t haddock and 12.54 t herring. The value of this basket was calculated for each Member State and may be summarised as follows:

Table 8.4: Values of a basket of fish in four EEC Member States

	Value of basket (EUA)		Annual rate of increase (%)
	1968	1978	(1968–1978)
United Kingdom	9 335	41 807	15.5
France	15 248	46 273	11.1
Netherlands	9 734	41 466	15.3
FR Germany	9 094	30 261	13.4

The outstanding feature of this table is that, although the basket was most expensive in France throughout the period, the difference was less in 1978 than in 1968. (In 1978 the basket was 15% more expensive in France than the mean for the four Member States, compared with 40% in 1968.)

F. FISH FOR AQUACULTURE

Apart from the reference to sole, nothing has been said so far about the species of interest to aquaculture. Of the marine species, turbot is perhaps the most promising prospect and one for which unit value data are most readily available (from Ireland, the United Kingdom, Netherlands and Denmark). The data have been summarised in Fig. 8.9; this shows that the 1978 unit values were high compared with those of all the other species studied except sole (see Figs 8.4 - 8.8). It was also found to be valid to apply a mean rate of increase to these unit values: these rates were within the ranges found for the other marine species.

The unit values at first sale of salmon were also studied. Although rather curtailed series showing a general increase in unit values were available for Denmark and Ireland, there were considerable fluctuations in value which probably reflected the supply situation. A report in Fishing News International (Anon 1979e) says that, at Billingsgate market, in 1979 the merchants were showing an increased interest in farmed salmon, a product for which market resistance had occurred earlier. This was thought to be due to the assured supply of guaranteed quality.

For freshwater species, data on values at first sales are difficult to obtain, partly because of the lack of a well-developed market organisation (see Chapter 11). Thus it was necessary to resort to foreign trade data. For eels and carp, the data used relate to the unit values of the imports by the original six Member States, whereas for trout the data are for the Danish exports. The data have been summarised in table 8.5.

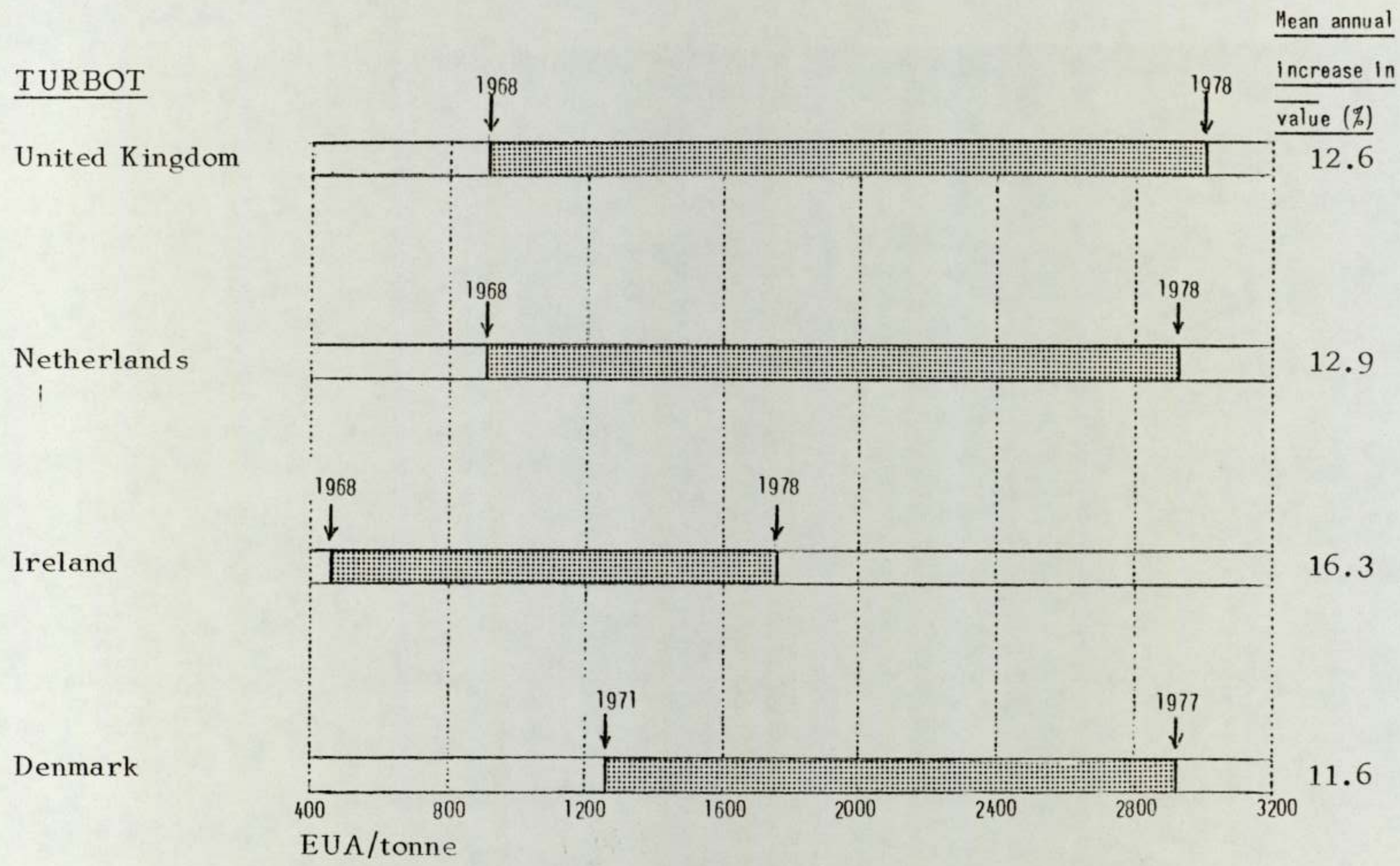


Fig. 8.9: Increase in unit values at first sales in the period 1968-78.

Table 8.5: Unit values of foreign trade in freshwater fish

	Trout	Carp	Eels
1978 unit value (EUA/tonne)	2 665	1 203	3 657
% annual increase (1968-1978)	9.5	8.6	8.9

Although the unit value of foreign trade is not strictly comparable with the unit value at first sale, the data in the above table show that each of the three species (and particularly trout and eels) have values at least as high as many of the marine species. However the annual rates of increase are rather lower.

G. CONCLUSION

In conclusion, this study has shown that fish is no longer a cheap source of protein when compared with agricultural products. Indeed, most of the preferred fish species are more expensive than many meats and with production of these species unlikely to increase greatly in the foreseeable future this difference in price will probably increase. The cost of fish will surely have risen in 1979 since fuel, which contributes about 25% to the running costs of a deep-water trawler (Gerherdsen, 1957), increased in cost by over 60% that year. The hopes of fish as a cheap source of protein in the Community would seem to depend on the acceptance as food of hitherto poorly regarded species (e.g. mackerel and horse mackerel), large quantities of which are currently being reduced to meal and oil or exported.

This study has also shown that both freshwater and marine species being used or considered for use in aquaculture have relatively high values and that, for freshwater species, the annual rate of increase in value is lower than for marine species. Provided these values still permit the fish farmer to make an adequate return on his investment this may help to promote the sale of his product.

CHAPTER 9

THE FISHING FLEET.

FISHING FLEET

A. Introduction

One general observation that may be made when looking at statistics related to the structure of the fishing industry is that the data are often difficult to obtain, are of doubtful reliability and may not be comparable. This may be because, apart from grants (to assist the building or scrapping of fishing vessels) and, more recently, fuel subsidies, national measures to regulate the fishing industry have been largely concentrated on the limitation of production. However, with the realisation that the capacity of the industry generally exceeds the productivity of the biological resource greater emphasis is being placed on measures to restructure the industry, and consequently the quality of data required to administer such policies should improve.

The data on fishing vessels are an instance where certain improvements to data on the structure of the industry would be welcome. The problems associated with the data are described in the section on General Methodology (see Annex A) but, accepting that in certain cases great care has to be taken with the data, it has been possible to obtain reasonable time series showing the number of vessels in each of four tonnage classes namely:

0 - 49.9	GRT	(inshore vessels)
50 - 149.9	GRT	(middle-water vessels)
150 - 499.9	GRT	(middle - distant water vessels)
500 +	GRT	(distant water vessels - many equipped to process fish)

These groupings of vessels as to their fishing grounds should only be taken as a very rough indication of the likely fishing grounds.

B. FR GERMANY

0 - 49.9 GRT

The number of vessels in this group decreased from 1 475 in 1970 to 1 056 in 1977 (-27%). This group contained a considerable number of vessels used in sport fishing and when they were excluded in 1978 the number of vessels dropped to 538.

50 - 149.9 GRT

The number of these vessels dropped by about 20% from 195 in 1970 to 155 in 1978.

150 - 499.9 GRT

The number of these vessels was identical in 1970 and 1978 (10) although inbetween it did rise to a maximum of 20 in 1974 and 1975.

500 + GRT

This class of vessels shows the biggest decrease (-46%) from 112 in 1970 to 60 in 1978.

Summary

Germany has a relatively short coastline - a fact that is reflected in the structure of the fishing fleet. Only 19% of the total tonnage of fishing vessels have a tonnage of less than 150 GRT. This compares with 45% for France which has a longer coastline and therefore a greater area of coastal waters open to these craft. Germany has a well-developed distant water fleet - a fleet which was responsible for 72% of the landings of fish in Germany in 1978. The distant water fleet has suffered from the decreased availability of fishing in the Northwest Atlantic and has decreased accordingly.

C. FRANCE

0 - 49.9 GRT

The number of vessels of under 50 GRT has remained relatively constant at between 12 and 13 000. Although this has fallen in the last year or so to 10 700 it is perhaps too early to detect a trend.

50 - 499.9 GRT

For part of the period 1970-1978 it is not possible to have the breakdown into the groups 50 - 149,9 and 150 - 499,9 GRT. However, it is clear that the numbers of both groups have declined by about 55%, from 264 and 462 in 1970 to 118 and 204 respectively in 1978.

500 + GRT

In the early 1970's the number of vessels in this group increased by nearly 50% from 63 in 1970 to 91 in 1975. Subsequently the number has decreased to 78 in 1978.

Summary

France shows a less extreme view in the structure of its fishing fleet than either Germany, where the distant water vessels predominate, or Ireland, where the coastal water vessels predominate. The coastal water vessels contribute 45% to the total tonnage of fishing vessels. In terms of tonnage the fleet has decreased by about 15% in the period 1970-78, in spite of the stability in the composition of the smaller vessels.

D. ITALY

0 - 49.9 GRT

Over the period 1970-78 the number of vessels of under 50 GRT increased by 13% from 19 774 to 22 388.

50 - 149.9 GRT

The number of vessels in this group increased at a faster rate of 24% from 605 in 1970 to 754 in 1978.

150 - 499.9 GRT

The number of vessels in this group almost doubled from 56 in 1970 to 110 in 1978.

500 + GRT

The number of vessels of 500 GRT and over remained stable over the period 1970-78 although there was an increase in mean size from 931 to 1 068 GRT.

Summary

In all but the largest vessel group there has been an increase in the number of Italian fishing vessels. This increase was lower for the small vessels fishing in the heavily exploited coastal waters than for the larger vessels capable of exploiting more distant waters, for example, off the West African coast. The success of such a development will obviously depend on agreement the Community is able to reach with the relevant coastal states for fishing rights. It is relevant to note that agreements have recently been negotiated with Senegal and Mauritania which could benefit the Italians.

E. NETHERLANDS

0 - 49.9 GRT

As is mentioned in the General Methodology (Annex A) the data for this group, which contains most of the vessels fishing in coastal waters and in the Ijsselmeer, have been obtained by difference from the data for the other groups. Accepting that any errors in the other groups will thus be reflected in the present group, it is apparent that the number of vessels has decreased by about 45% (from 769 in 1970 to 428 in 1978). The mean tonnage of these vessels has also fallen from 30 GRT in 1970 to 24 GRT in 1978, suggesting that the decrease has been greatest with the larger sea-going vessels.

50 - 149.9 GRT

The number of vessels in this grouping has fallen by 21% from 365 in 1970 to 290 in 1978. A very sharp decrease and subsequent rise in the period 1974-76 would appear to be due to anomalous data for 1975. [It should be noted that this results in a distortion of the data for the 0 - 49.9 GRT group for the same period.]

150 - 499.9 GRT

This group shows a large increase in numbers from 118 in 1970 to 202 in 1978 with most of the rise taking place in the earlier years of the period.

500 + GRT

Only about 2% of the total tonnage of the Dutch fishing fleet falls within this group, and the numbers are too small to detect any noticeable trend.

Summary

The Dutch fleet has changed little as regards the total tonnage of fishing vessels. This general statement hides the fact that there has been a marked decrease in the number of small vessels accompanied by an increase in the number of larger vessels. Dutch fishing vessels operate only in the Northeast Atlantic at present (there is talk of the Netherlands being interested in the fishing resulting from the agreements negotiated by the Community with West African countries) and, indeed, mainly in the nearer waters of this area as might be anticipated by the relative lack of large fishing vessels.

F. BELGIUM

0 - 49.9 GRT

The number of vessels of under 50 GRT has decreased by 45% from 121 in 1970 to 66 in 1978.

50 - 149.9 GRT

From 179 vessels in 1970 the number of vessels in this group fell by 32% to 121 in 1978.

150 - 499.9 GRT

Throughout the period 1970-78 the number of vessels has remained relatively constant at between 26 and 32 vessels.

500 + GRT

Of the six vessels in this group in 1970 only one vessel at the lower end of the size group remained in 1978.

Summary

The Belgian fleet of smaller fishing vessels has decreased in line with the fleets of other countries fishing in the North Sea and adjacent waters. Belgium does not show the decrease in the number of larger vessels exhibited by other Member States (e.g. FR Germany and the United Kingdom). This may be explained by the fact that the Belgian government, aided by the relatively small number of vessels, was able to negotiate fishing agreements with the Faroe Islands and Iceland.

G. UNITED KINGDOM

0 - 49.9 GRT

The number of vessels under 50 GRT has increased from 5 225 in 1970 to 6 367 in 1978 (+22%).

50 - 149.9 GRT

There has been a nearly doubling of the vessels in this group, from 218 in 1970 to 406 in 1978.

150 - 500 GRT

This group shows an almost reverse situation from that of the previous group. The number of vessels has decreased from 317 in 1970 to 208 in 1978 (-34%).

500 + GRT

The decrease in number of vessels has been even more marked with the group of the largest vessels (-52%) from 147 in 1970 to 71 in 1978.

Summary

The increase in the total number of vessels from 5 907 in 1970 to 7 053 in 1978 and the decrease of 22% in the total tonnage of fishing vessels reflects the situation with the United Kingdom's fishing fleet - namely an increase in the number of small vessels accompanied by the decrease in the number of large vessels. The reduced availability of the distant water grounds is an obvious cause of the decline of the larger vessels and it is to be supposed that the increase in the number of small vessels may be a reaction to this in an attempt to maintain the previous level of fish supplies.

H. IRELAND

0 - 49.9 GRT

The number of Irish fishing vessels under 50 GRT has increased by 48% from 849 in 1970 to 1 256 in 1978.

50 - 149.9 GRT

There has been an increase of 137% in the number of fishing vessels in this group from 83 in 1970 to 197 in 1978.

150 - 499.9 GRT

It is only in the latter part of the period that this group of vessels has been represented in the Irish fishing fleet and, even then, only modestly.

500 + GRT

A single Japanese owned and crewed vessel of 1 960 GRT entered the Irish fishing fleet in 1974.

Summary

The data summarised above show clearly that the Irish fishing fleet is almost entirely of small vessels which fish in coastal waters. The policy of the Irish government and, more latterly, of the European Communities in promoting the development of the Irish fishing industry is clearly indicated in the increase in number of vessels in the period 1970-78.

I DENMARK

0 - 49.9 GRT

In the period 1970-77 (data are not available for 1978) the number of vessels under 50 GRT decreased slightly (-6%) from 7 188 to 6 752.

50 - 149.9 GRT

There was a very much greater increase (+34%) in the number of fishing vessels in the tonnage class from 306 in 1970 to 410 in 1977. Most of the increase was in the earlier half of the period.

150 - 499.9 GRT

The increase in the number of fishing vessels in this group was even greater (+98%) from 84 in 1970 to 166 in 1978.

500 + GRT

This group of vessels was only represented in the Danish fishing fleet, and then only to a limited extent, in the latter part of the period.

Summary

Although the Danish fishing fleet has a large relatively stable number of small vessels there has been a striking increase in the number of larger vessels in recent years.

J. GREECE

The data are too unreliable and incomplete to attempt the same analysis of the Greek fishing fleet as has been possible for the other countries. There are about 50 long-range fishing vessels fishing in the East Central Atlantic. These vessels are now rather aged and the difficulty in negotiating fishing rights with the coastal states casts doubt on their replacement. About 800 vessels fish in other than coastal waters of the Mediterranean and then there are about 25 000 vessels (both with and without motors) fishing in coastal waters. Although the Greek government provides loans and other assistance for the development of the fishing fleet, only limited use appears to be made of these facilities (OECD, 1978).

K. SPAIN

0 - 49.9 GRT

The number of Spanish fishing vessels of under 50 GRT has increased from 12 306 in 1970 to 13 878 in 1978 (+13%).

50 - 149.9 GRT

The number of vessels in this group has remained relatively constant at around 1 780 vessels.

150 - 499.9 GRT

There has been an increase of 39% in the number of vessels of this group, from 1 009 in 1970 to 1 406 in 1978.

500 + GRT

The number of vessels of over 500 GRT increased from 145 in 1970 to 184 in 1977, only to fall again to 159 in 1978.

Summary

There has been an overall increase of 13% and 16% in the number and total tonnage respectively of the Spanish fishing fleet.

L. PORTUGAL

0 - 49.9 GRT

There has been a steady increase in the number of vessels of under 50 GRT from 3 885 in 1970 to 4 380 in 1978 (+13%).

50 - 149.9 GRT

There has been a similar steady increase in the number of this class of vessel from 219 in 1970 to 256 in 1978.

150 - 499.9 GRT

A greater (+23%) though still steady increase was recorded for this group, from 85 in 1970 to 110 in 1978.

500 + GRT

The number of vessels in this group also increased steadily from 70 in 1970 to 78 in 1978.

Summary

The outstanding feature of the Portuguese fishing fleet is that there has been an increase in numbers in all the tonnage classes. This has resulted in an overall increase of 13% and 29% in numbers and total tonnage respectively.

M. GENERAL SUMMARY

Table 9.1 permits and overall view of changes in fishing fleet structure in the period 1971-1978 to be obtained. The first point to note is that there has been a pronounced reduction in the total tonnage of the fleets of those countries which have traditionally relied upon the more distant waters of the North Atlantic for an appreciable proportion of their fish landings (FR Germany, France, Belgium and the United Kingdom). Those fishing predominantly in near waters of the North Atlantic (Netherlands, Ireland and Denmark) or in other fishing regions (Italy, Spain and Portugal) have either recorded a lower decrease or an increase in the total tonnage of fishing vessels.

Table 9.1 also shows that the change in the composition of the fleet, when viewed from the proportion of vessels over 150 GRT, has not been very great for most countries. The exceptions are the United Kingdom (where a decreased tonnage of larger vessels was accompanied by a big increase in tonnage of smaller vessels), the Netherlands and Denmark, where the average size of larger vessels was close to the lower boundary limit. Although not shown by this table there has been a big decrease in the numbers of larger German fishing vessels. This has been masked in the table by the removal from the fleet statistics in 1977 of a large number of small sports fishing vessels and the replacement of some of the larger vessels by a smaller number of even larger vessels (between 1971 and 1978 the mean tonnage of vessels in the class 500 GRT and over increased from 1109 to 1747 GRT).

This decrease in the number and tonnage of the larger fishing vessels is seen clearly in table 9.2 which gives the total number and tonnage of vessels for the Community as a whole. The number of vessels over 500 GRT has decreased by 28% and this reflects the decreased availability of distant water

Table 9.1 Total tonnage of vessels of 150+ GRT as a percentage of that of the total fishing fleet.

	1971	1978	% change in total tonnage 1971-1978	Mean tonnage per vessel of 150+ GRT in 1978
FR Germany	80	81	-8	1 514
France	59	53	-19	430
Italy	29	29	+20	519
Netherlands	39	57	+2	245
Belgium	35	31	+32	223
United Kingdom	73	55	-22	450
Ireland	- *	10		436
Denmark (1)	15	26	+21	223
EUR 9	51	46	-6	445
Greece	:	:	:	:
Spain	60*	66	+22	333
Portugal	71	71	+12	671
EUR 9+3	:	:	:	:

(1) 1977 data

Table 9.2 Total number and tonnage of vessels in EUR 9

	Total number			Total tonnage		
	1971	1978	% change	1971	1978	% change
0 - 49.9 GRT	48 236	48 602	+1	403 645	410 284	+2
50 - 149.9 GRT	2 164	2 450	+13	188 433	219 495	+16
150- 499.9 GRT	1 080	931	-14	255 020	227 903	-11
500+ GRT	384	278	-28	371 041	311 078	-16
Total	51 864	52 261	+1	1 218 139	1 168 760	-4

grounds which would normally be exploited by these vessels. It is also interesting to note that the number of vessels of 50-149.9 GRT has increased by 13%, a result of the effort to make up the deficit of distant water catches.

The only criterion which has been considered thus far in this survey of the fleet is the tonnage of the vessels. However, although good statistical data are absent, attention must be paid to the type of vessel. It is now becoming clear that there is a very limited future for the very large factory fishing vessels that were developed in the late 1960's and early 1970's. These vessels are only economically viable when they are able to fish in highly productive regions where the large quantity of fish caught compensates for the high running costs. These vessels would generally not be economically viable in the nearer waters of the Northeast Atlantic and the opportunities for fishing elsewhere are becoming limited.

The likely trend in the structure of the fishing fleets is for the introduction of smaller more versatile vessels which will be able to fish using different gears (to take account of seasonal fisheries and catch quota restrictions) and which will be able to land fresh fish, or fish stored in refrigerated sea water, for processing ashore.

CHAPTER 10

THE FISHERMEN

THE FISHERMEN

A. INTRODUCTION

The data on the number of fishermen are particularly difficult to interpret due to a general lack of homogeneity between Member States. This is in part due to differences in defining a fisherman: at what stage does a sports fisherman who sells part of his catch become a professional. Further, most countries distinguish between full- and part-time fishermen but the demarcation between the two classes is not fixed similarly in all countries. Firstly, the characteristic used may be the proportion of his working time he spends fishing or it may be decided on the proportion of his revenue he obtains from fishing. Then, secondly, value of the demarcation level may differ. While a time series of data from individual Member States may be analysed, great caution has to be exercised when making Community totals and when comparing data from different Member States. Consequently, in this study, the analysis has been limited to the changes in individual Member States with only the most general of references to the overall Community situation.

B. FR GERMANY

The great problem with data for Germany is that the national authorities have submitted different data to EUROSTAT and OECD, with no apparent reason for the difference. However, both sets of data indicate that the total number of fishermen has fallen steadily in the period 1970-78. The EUROSTAT data show a decrease of 27% from 6 861 in 1970 to 5 024 in 1978. The OECD data puts the decrease at at least 32%.

Differences also exist in the submitted data for full-time fishermen. The OECD data show a decrease of 36% from 6 940 in 1970 to 4 476 in 1978. The EUROSTAT data show that the number of full-time fishermen fell steadily (with the exception of one year) from

4 459 in 1970 to 3 340 in 1977 but then rose to 5 024 in 1978! The two sets of data are difficult to reconcile but, if the EUROSTAT 1978 figure is ignored, at least both sets show a fall of around 30% in the period 1970-77.

C. FRANCE

The total number of fishermen has fallen from 35 799 in 1970 to 22 456 in 1978, a drop of 37%. While a decrease in number was recorded in each year except 1972 it was very much greater in 1978 than in earlier years.

France does not use the breakdown between full- and part-time but creates two classes 'à la part' and 'au minimum garanti'. This distinguishes between fishermen who receive a share of the value of the landing and those receiving a guaranteed minimum wage for a trip. Most of the share ('à la part') fishermen could be termed full-time though the converse does not follow. The number of share fishermen fell from 31 826 in 1970 to 25 999 in 1977, a decrease of 18%. However, there was a proportionally greater decrease in the guaranteed minimum fishermen from 3 973 in 1970 to 2 853 in 1977 (-28%).

D. ITALY

Very little can be said about the number of fishermen in Italy except that the estimate of about 45 000 is very approximate. Certainly it would be unwise to comment on any trend, although there is no other evidence to suggest that the number has changed greatly in recent years.

No distinction is made between full- and part-time fishermen though a large proportion of the 45 000 fishermen would ordinarily be classed as part-time.

E. NETHERLANDS

The data on the total number of fishermen in the Netherlands follow the same pattern as in France; namely a drop from 6 611 in

1970 to 3 604 in 1978 (-45%) with the greater part of the drop occurring in the later years.

No breakdown into full- or part-time fishermen is available for the Netherlands.

F. BELGIUM

As with most of the earlier Member States the total number of fishermen in Belgium has decreased. This time the fall has been steady from 1 244 in 1970 to 914 in 1978 (-27%). All of the fishermen in Belgium are recorded as being full-time.

G. UNITED KINGDOM

The United Kingdom presents a rather different picture, with the total number of fishermen remaining very much more stable and with the indication of a peak at 23 476 in 1973. The lowest value recorded in the period 1970-78 is within 8% of this figure. Separate data are available for the different regions of the United Kingdom. Nearly 50% of the total number of fishermen are based in economically disadvantaged regions of Scotland and Northern Ireland.

The data on the number of full-time fishermen show an exaggerated version of the trend in total fishermen, rising from 17 628 in 1970 to 19 110 in 1973 (+8%) followed by a decrease to 16 467 in 1978 (-14%). The number of part-time fishermen increased steadily from 4 023 in 1970 to 5 719 in 1978 (+42%).

H. IRELAND

As might be expected in the light of earlier comments on the development of the Irish fishing industry in recent years, the total number of fishermen has increased significantly from 5 862 in 1970 to 8 620 in 1978 (+47%). An increase was apparent in both the number of full-time and part-time fishermen (+29% and 46% respectively) in the period 1972-78.

I. DENMARK

The total number of fishermen fell very slightly from 15 457 in 1970 to 14 909 in 1978 (-4%) but the figures oscillated to such an extent that a definite trend would be difficult to detect. Similarly it is difficult to determine any definite trend in the data broken down into full- and part-time fishermen.

J. GREECE

Two apparently conflicting sets of data are published in Greece. It is believed that the larger figure (of 46 500 in 1977) refers to data obtained in part from a specific survey. However, the facts that only a short time-series is available and that the rounded nature of the figures suggest that an estimate has been made, it is impossible to detect a trend. The smaller figure (of 9 377 in 1977) is thought to refer to the number of fishermen in the distant water fleet. The variations in this latter set of data are so great that no trend may be detected.

K. SPAIN

With the increase in the size of the Spanish fishing fleet one might expect the number of fishermen to have increased. Indeed, the data record an increase in number of fishermen from 69 059 in 1970 to 111 005 in 1978 (+61%). However some doubt as to the homogeneity of the series arises as a result of the recorded increase from 72 124 in 1976 to 113 241 in 1977.

L. PORTUGAL

Likewise the total number of fishermen has increased from 15 352 in 1970 to 32 341 in 1978 (+111%). However, the increase from 15 232 in 1972 to 33 639 in 1973 again causes one to suspect that a change of content may have taken place.

M. SUMMARY

Although attention has already been drawn to the danger of adding data for individual Member States to obtain a Community figure, certain general conclusions may be drawn. In four of the present Member States (FR Germany, France, Netherlands and Belgium) the total number of fishermen has decreased sharply (by at least 27%) in the period 1970-78. In Italy, the United Kingdom and Denmark the change, if any, has been at a very reduced level: only in Ireland is there a significant increase. The Community as a whole (EUR 9) has therefore recorded a considerable decrease in the number of fishermen.

Should the increases recorded for Spain and Portugal prove to be valid (and the increases in the size of their fishing fleets would support this) the overall picture for the enlarged Community (EUR 9 + 3) would probably be very different: indeed an increase in the number of fishermen may be recorded.

CHAPTER 11

FRESHWATER FISHERIES

FRESHWATER FISHERIES

A. INTRODUCTION

In this section freshwater fisheries are to be taken as the fisheries conducted on wild fish which spend at least part of their lives in fresh water. Thus fish reared in aquaculture are, in principle, excluded and the fish include such species as salmon, sea trout and eels that spend part of their lives in the sea and which may be the target of fisheries conducted in the sea or in estuaries. Further, the statistics have been confined, as far as possible, to those relating to commercial fisheries: catches by sportsfishermen have been excluded.

Statistics on freshwater fisheries are difficult to obtain and are frequently of doubtful reliability. This is due to the combination of the following four causes:

a) in most countries the authorities responsible for the collection and compilation of fishery statistics are those concerned with marine fisheries;

b) there is seldom the same well-developed market structure for freshwater as there is for marine fish. In fact, a very large proportion of freshwater fish is not marketed in the traditional sense, much passing into the hotel and catering trade or being the subject of private contracts;

c) as has been mentioned above, this section is restricted to wild-caught fish but it is often very difficult to distinguish in the statistics between wild-caught fish and farmed fish;

d) many of the species included in the above 'definition' of freshwater fisheries are caught in other than strictly freshwaters and it is often very difficult to ascertain whether the data refer to the total catches or simply to the catches in one of the environments. It is interesting to note that EUROSTAT, in an attempt to improve freshwater fishery statistics by introducing a specific questionnaire on the subject comparable with those used for marine fisheries, sought a definition of freshwater fisheries. Initially it was thought that, for the United Kingdom at least, these fisheries could be defined as those operating within the administrative sphere of the regional water authorities. However, their responsibilities were found to extend legally 6 miles seawards from the river mouths

Since the reliability of the statistics varies more from country to country than from species to species, below is given an account of freshwater fisheries in each of the Member States of the European Community and the problems in collecting the relevant statistics.

B. UNITED KINGDOM

The problem of collecting statistics on freshwater fisheries is covered by the first three causes listed above. Further, the situation is not helped by the fact that, as far as fisheries are concerned, the United Kingdom is split into three administrative regions, England and Wales, Scotland and Northern Ireland. (In the context of freshwater fisheries one may ignore two other administrative regions, the Isle of Man and the Channel Islands, where the central government has no authority to collect statistics).

Commercial fisheries for freshwater fish are restricted to fishing for salmon, sea trout and eels. Most of this fishing is conducted in the coastal waters or estuaries: very little commercial fishing takes place in inland waters which comprises about 1% of the United Kingdom's surface area (1% of 225 000 km^2). There are 44 800 km of rivers, most of which are relatively short, and 4 645 km of navigable canals.

Salmon is the most important freshwater species commercially exploited in the United Kingdom. The latest year for which FAO has received complete returns for the United Kingdom's salmon catch is

1974 (!): a catch of 3 712 t was recorded. The main problem with the official statistics since this time appears to be with the lack of information on the inland waters catch of salmon in England and Wales. However this would appear to be an instance of the responsible unit not receiving, or not being sufficiently motivated to search out the data. Reference to the annual reports of the Water Authorities, which licence the commercial netsmen in estuaries, permits one to estimate the United Kingdom catch of salmon in 1977 at 2 425t.

There is no separate fishery for sea trout, the catches being a by-product of the salmon fishery. The 1975 catch was 235 t.

The commercial fishery for eels in the United Kingdom is largely centred on the trawl fishery in Loch Neagh, Northern Ireland, where the annual catch is of the order of 800 t. FAO data for England and Wales reveals a catch in 1978 of 19 t but Stott (1976) obtained a figure of 270 t from the returns to questionnaires he sent to fishery officers of the Water Authorities. No precise data for the capture of elvers exists for England and Wales but Stott (1976) estimates the annual catch at between 7 and 15 t, much of which is exported. No official statistics are available for eel catches in Scotland though Sedgewick (1972) reports that many efforts have been made to establish a commercial fishery in Scotland. As in England, the fishery for eels would appear to be local and conducted by part-timers behind a curtain of secrecy. Shearer (1969) reports that the average catch of migrating silver eels from a loch in Central Scotland was about 3 000 lbs (1.4 t) annually with a value of £800.

The future of freshwater fisheries in the United Kingdom is thought to be one of little change. The inland water resources are under-exploited, indeed, if one excludes the three species detailed above, non-exploited. It was shown during the 2nd World War that a commercial fishery for perch, for canning, was possible in Lake Windermere but, when other foods became more readily available, market pressure caused the closure of the fishery. The projected increase in water-holding capacity may be an opportunity to develop fisheries for eels but there would be a conflict of interests with recreational activities on which many authorities appear to be concentrating.

A potential exists for the introduction of salmon ranching in some areas but this would have to be very carefully controlled (see Chapter 13). Otherwise the fishery for salmon and sea trout will probably remain at the present level.

C. IRELAND

About 2% of Ireland's surface area of 70 283 km^2 is covered by water. However the major 'freshwater fisheries' are in the estuaries and the immediate coastal region. As with the United Kingdom, the main species caught are salmon, sea trout and eels.

The catches of salmon, which have declined in recent years from about 2 000 t to 1 300 t, are recorded by FAO as being taken in the Northeast Atlantic but this almost certainly is a reference to catches in river estuaries.

Eel fisheries in Ireland are concentrated in the western Galway and Limerick regions of the country, the total production being recorded by FAO as 108 tonnes in 1977. The 112 km long mouth of the River Shannon is the most productive region. The official data are probably underestimates (not an uncommon occurrence in freshwater fisheries). Sedgewick (1972) reports that hundreds of tonnes of brown and silver eels are caught in Ireland every year. At the time of that report the offically recorded catch was 50 t.

D. DENMARK

There is a considerable discrepancy between the data published by FAO and that contained in the national yearbook. In 1977 Danish fishermen are recorded in the national statistics as having taken a total of 1 807 t of freshwater fish (including salmon and sea trout) whereas the data recorded by FAO shows a catch of 3 706 t. Part of the discrepancy is probably due to the landed weight being quoted in the national statistics whereas live weight is used in the FAO statistics. However, since, apart from some fish landed gutted, head on (for which a factor of 1.2 may be taken as appropriate for the conversion to live weight), most of the fish is landed whole, the discrepancy is difficult to explain. In this study, as indeed in the study by Dill (1976), the national data are assumed to be more accurate than the FAO data, if only because the former are more detailed and thus have been probably subjected to greater scrutiny.

In Denmark freshwater fish are caught commercially in lakes, rivers, reservoirs and brackish water fjords. In freshwaters the total catch in 1977 was 582 t. Dill (1976), who gives the catch broken down by the type of water in which the fish were taken in 1973, shows that 87% of the fish were taken in lakes and 11% in reservoirs. In 1976 cyprinids and eels made up 52 and 31% of the catch respectively.

The fjord fishing for freshwater fish was largely concentrated in the Ringkøbing and Nissum fjords where the catch in 1977 was 103 t of freshwater fish and 223 t of eels. Cyprinids made up 83% of the freshwater fish. The salmon catch of 1 094 t gutted, head on weight (which corresponds well with the 1 214 t live weight quoted by FAO) was taken almost exclusively in the Baltic Sea and landed on the island of Bornholm.

In 1977 the total catch of salmon, eels and freshwater fish proper was 1 807 t or about 0.6% of the total catch for human consumption. All but a very small part of the 582 t of fish caught in purely freshwater was taken in lakes and reservoirs having a total of 61 200 hectares, a production of over 9 t per 100 hectares. Such a rate of production suggests that freshwater fisheries in other Member States have yet to be exploited fully. For example, the

United Kingdom has an inland water area about 30 times that of Denmark yet the annual production, almost exclusively of eels, is only half that of Denmark's.

E. FR GERMANY

Commercial fisheries for freshwater fish in Germany in 1977 had an estimated production of 3 000 t (von Castell, 1978). These fisheries were conducted in the river Weser and in Lake Constance (the Bodensee). The data are only estimated because, although freshwater fish are sold on the Kiel fishmarket, a great deal is sold directly to the consumer.

The fishery on Lake Constance, which is shared with Austria and Switzerland, has been very productive in recent years. From a mean annual production in the period 1965–74 of 162 t the production in 1977 was 1 079 t, of which 53% was charr, 26% cyprinids and 11% perch. In 1978 the catch dropped to 697 t due almost entirely to a decrease in the catch of charr. German fishermen take about 43% of the total catch from the Lake Constance fishery.

In 1977, 164 t of freshwater fish were sold on Kiel fishmarket and 78% of that was for human consumption. The main species represented were eels (40 t), perch (24 t), roach (20 t) and pike (19 t).

FAO records that, in 1977, 382 t of eels and 36 t of salmon from the Northeast Atlantic (which includes the Baltic Sea) and these fish were almost certainly caught in coastal and estuarine waters.

Dill (1976) reports that there are 78 814 hectares of water being exploited for inland fisheries but that the waters are badly affected by pollution.

F. NETHERLANDS

The total area of inland waters in the Netherlands is 340 600 hectares or about 8% of the total surface area. FAO reports the total catch of freshwater fish at 3 589 t in 1977, whereas the national Annual Report of Fisheries gives the catch at 3 168 t. The major species caught were eels and pike-perch, both making between 25-30% of the total but considerable quantities of perch and European smelt were also taken (both accounting for about 15% of the total). All the true freshwater fish were caught in Lake Ijssel as was about 85% of the eels. Cyprinid fish, which used to be an important part of the catch, are now of lesser importance, due to them being selected against by poor marketing situations. The production of areas such as Lake Ijssel is very much greater than is indicated from the above summary data because considerable quantities are taken by sport fishermen.

These reported catches of freshwater fish represent about 1% of the Netherlands' total catch of fish.

G. BELGIUM

There are no commercial freshwater fisheries in Belgium.

H. LUXEMBOURG

There are no commercial freshwater fisheries in Luxembourg.

I. FRANCE

In France there are 250 000 km of rivers, 11 800 km of canalised rivers, 4 680 km of canals, 171 700 hectares of lakes, 40 000 hectares of reservoirs and 31 500 hectares of brackish water lagoons.

The above information is about the only firm information that is available about French freshwaters. Considerable difficulty was found in ascertaining the responsible authorities and then obtaining quotable data from them.

Appreciable quantities of eels and elvers are taken in French rivers, estuaries and coastal waters. Guillou (pers. comm.) says that large but unrecorded quantities of elvers are landed on the Brittany coast between the months of November and March. The French authorities reported to FAO that eel catches in 1977 and 1978 were 1 538 and 2 455 t respectively but the official foreign trade data records exports of fresh or frozen eels in the two years of 2 702 and 2 928 t respectively!

Dill (1976) reports that the catches in 1974 from large lakes was 11 000 t of 'whitefish'. Billard (pers. comm.) puts the current catch at about 30 000 t. It is also thought that in many cases the catch from the smaller lakes should not be attributed to freshwater fisheries but to a form of extensive aquaculture.

Thus the picture of French freshwater fisheries is extremely fragmentary making an assessment very difficult. However, none of the authorities expected freshwater fisheries to expand but rather anticipated a slow decline.

J. ITALY

As with France there is great difficulty in obtaining reliable information on freshwater fisheries in Italy. Data that are quoted usually do not distinguish between freshwater fisheries and aquaculture and, where freshwater fisheries are specified, there is no distinction between commercial and sports fisheries. Dill (1976) gives the catch from freshwater fisheries at 4 410 t in 1972, of which about 82% was taken by commercial fishermen. No single species predominates; the catch includes salmonids, eels, pike, perch and cyprinids. Sedgewick (1972) shows a plan of an old and large eel fishery in Northern Italy.

K. GREECE

Although most of the rivers in Greece are of a torrential nature, there are about 60 000 hectares of lakes, 2 000 hectares of reservoirs and 40 000 hectares of lagoons.

Catches in freshwaters and brackish lagoons decreased steadily from 12 000 t in 1968 to 5 000 t in 1974 (Dill 1976). These data include about 500 t of farmed trout. FAO records that the catch had risen again to 9 262 t. No explanation for these fluctuations was found but an improvement in the management of lakes and reservoirs appears to be necessary.

L. SPAIN

FAO records a catch of cyprinids of approximately 10 000 t per annum. Since farming of cyprinids is not practised in Spain (see Chapter 12), this catch must be of 'wild' fish. FAO also records a catch of 1 073 t of eels and 9 500 t of trout in 1977, although the latter were mostly farmed fish.

M. PORTUGAL

Once again little information is available on the freshwater fisheries of Portugal. FAO records the catch in 1978 as 6 t of freshwater fish and 44 t of eels. This 1978 figure for freshwater fish is rather strange in that for each of the previous 5 years the catch was between 100–130 t.

With the traditional emphasis in Portugal on marine fisheries it does not seem likely that freshwater fisheries will expand significantly.

N. SUMMARY

Although the information on freshwater fisheries presented above is incomplete, it can be seen that, locally at least, they make a significant contribution to the supply of fish. The available data have been summarised in Table 11.1. However it must be stressed that the data are for the most part only rough estimates and data include the catches of migratory species in other than strictly freshwaters.

With regard to the future of freshwater fisheries, no great expansion is expected due to the scarcity of under-utilised waters of suitable quality, a general market resistance to the fish, and the competition of the fisheries with the other uses of water, in particular industrial and amenity.

	Salmon	Trout	Eels	Others	TOTAL
FR Germany	20	-	300	-	3 000
France	-	-	3 000	30 000	33 000
Italy	-	-	:	:	4 400
Netherlands	-	-	900	2 300	3 200
Belgium	-	-	-	-	-
Luxembourg	-	-	-	-	-
United Kingdom	2 400	200	1 150	-	3 550
Ireland	1 200	-	100	-	1 300
Denmark	1 100	:	:	:	1 800
Greece	-	-	-	4 500	4 500
Spain	-	-	1 000	10 000	11 000
Portugal	-	-	-	100	100

Table 11.1: Estimated production from freshwater fisheries in the EEC (tonnes)

CHAPTER 12

FIN-FISH CULTURE: THE CURRENT SITUATION.

FINFISH CULTURE: THE CURRENT SITUATION

A. INTRODUCTION

FAO estimates that the world production from aquaculture was about 6 million tonnes in 1975, that is about 7% of the total fish production. The aquaculture is largely centred on China and India but there is considerable worldwide interest in aquacultural techniques. Indeed, a production of 45 million tonnes has been forecast for the year 2000.

For many years very optimistic forecasts have been made for aquacultural production in Western Europe but they seem to have been largely unfulfilled. The main reason for this failure is probably that the forecasters overlooked the fact that the situation in industrialised countries is very different from that in underdeveloped countries. The environmental niche into which aquaculture has to fit is very much more restricted; in the former, competition for both space and water with other interests drastically reduces the possibility of employing extensive culture techniques and the technology of intensive culture is much more complex and the margin for error much less. Studies in Western European conditions have shown that the earlier forecasts underestimated the problems and the current forecasts, many of which are still very optimistic, are probably more realistic. Before reviewing the potential of aquaculture a study of the current situation will be advantageous.

Pillay (1977) recognises seven basic aims of aquaculture:

a) producing human food,

b) improving natural stocks through artificial recruitment and transplantation,

c) producing sport-fish,

d) producing ornamental fish,

e) producing bait for commercial and sport fishing,

f) recycling organic wastes,

and

g) producing industrial fish or fishery products (for reduction to meal or fertiliser, seaweed for marine colloids, oysters for cultured pearls).

In Western Europe the production of finfish (shellfish culture is considered in Chapter 14) is largely concentrated on the first four categories. Furthermore, in Britain, up until about 10 years ago, the production for human food was of relatively minor importance compared with the other three categories.

Community statistics on aquaculture are, to say the least, fragmentary. Only in the FR Germany have surveys of aquaculture establishments been conducted on a thorough nationwide scale and no attempt has been made to harmonise any available statistics at the international level. One therefore has to be very careful in comparing the situation in different countries. For example, one statistic that is generally available is the number of establishments but there is little information on the comparative sizes of establishments in different countries. Production could be used as a comparative measure but the available data are rather unreliable. Thus, this section proceeds with a summary account, country by country, of the situation within the European Community.

B. FRANCE

In France there were about 700 trout farms in 1975, although about 200 of these were farms where the fish were bought in at about 160 g, fed for a few weeks and then sold to the hotel trade at 180-200 g (Brown, 1977). The profits in this type of business result largely from buying in in bulk and selling in small quantities.

Most of the trout farms are small with an annual production of 10-20 tonnes and it is estimated that 50 large farms account for half the total production. The total production in 1978 was estimated by the European Federation of Salmonid Rearers to be about

17 000 tonnes (S. Cancellieri, pers. comm.). Undoubtedly this is an increase on the production in earlier years, though the extent of the increase is disputable. For example, Brown (1977) gives the production in 1966 as 4 418 tonnes while an article in 'Connaissance de l'Agriculture' (Anon, 1975a) gives a figure of 10 000 tonnes for the same year. Toogood (1974) gives the annual increase in production between 1968 and 1974 at 13%.

Although initially trout production in France was concentrated in the northwest of the country (that is close to the principal fishing ports with their marketing facilities), farms are now found in all regions of France. The structure of the farms differs significantly between the northern and the southern parts of the country. For example, in 1971 only one third of the farms were found in Northern France but they produced a little over two thirds of the national production. There is also a different marketing pattern in the two halves of the country. In the northern part fish are sold outside the region of production whereas in the South the market is distinctly local.

The market situation in France is a cause of some concern. Due to possible water shortages the farmers of Northern France present a large part of their production on the market in April-June, causing the prices to fall. Obviously, if this presentation on the market could be more evenly distributed throughout the year the returns to the farmers could be better. In the South there is not the same problem. The relatively smaller production is sold mainly directly through the catering trade and consequently the returns are better.

Although most of the trout production in France is for direct human consumption a recent development has been a number of put-and-take fisheries, largely concentrated to the south of Paris. It is estimated that these recreational fisheries take about 5-10% of the total production.

There is only one intensive carp farmer in France and he has an annual production of about 250 tonnes. This is a productivity of about 1.25 tonnes per hectare. However there are perhaps several hundred extensive enterprises (that is, the fish are not fed and the ponds are not artificially fertilised) with a production of about 0.18 tonnes per hectare. Very few if any of these farmers make a living from carp farming: it would seem to be supplementary to some other agricultural enterprise. The fish are generally sold at the end of three summers of growth at a weight of about 1 kg.

It is difficult to obtain estimates of the total carp production in France. Brown (1977) suggests that the production is between 5 000 and 14 000 tonnes with the most likely figure between 8 000 and 10 000 tonnes. Billard (pers. comm.) puts the production of carp in pond culture at 5 000 tonnes.

In 1975 there were only three intensive eel farms and their future was in doubt (Brown, 1977). This appears to be due to the high mortalities found in the young stages and the general lack of interest in eels as food in France. Most of the eel production in France results as a by-product of the extensive culture of marine fish species in coastal lagoons. It is one of the oldest forms of fish culture practised in France but is one that should grow. The fry of certain species, mostly mullet (Mugil cephalus) gilthead (Sparus auratus) and the eel migrate into the coastal lagoons where they are caught and used to populate about 870 hectares of lagoons. The production amounts to about 70 tonnes of mullet and 40 tonnes of a mixture of giltheads and eels (Pullin, 1977). Until recently the development of this fish-farming has been limited by the poor and uncertain availability of the fry (Kirk, 1979). However recent developments in the artificial breeding of the fish could remove this constraint.

Great efforts are being made on the Brittany coast to develop salmon culture stations. Both coho and Atlantic salmon have been included in the trials and the current production is approximately 100 tonnes (Kirk, 1979).

C. LUXEMBOURG

In 1979 there was only one government-owned trout farm. Although there has been a drop in production in recent years it had returned to its previous level of 12 tonnes in 1978. All of these fish were used for restocking purposes. Fish for consumption in Luxembourg are all imported, mostly live, from Denmark.

In Luxembourg there also occurs a small artisanal production of cyprinids, mostly carp, tench and roach, for human consumption. It is all marketed locally and the Ministry of Waters and Forests puts the production in 1978 at 2 tonnes.

D. BELGIUM

In 1975 there were 18 trout farms in Belgium producing about 300 tonnes of food fish per year (Brown, 1977; Dill, 1976). The trout are reared mostly from ova imported from Italy, Denmark and France or, to a lesser extent, from imported fingerlings. Small quantities of catchable-sized trout are also stocked in public waters for recreational purposes.

In 1975 there were 19 enterprises producing cyprinids in Belgium. The total production of such fish as carp, tench, roach and pike was less than 100 tonnes and most was destined for the restocking of angling waters.

There is no eel culture in Belgium.

E. DENMARK

In 1975 it was estimated that there were about 530 trout farms in Denmark. About 150 of these produce only eggs, fry or fingerlings which are either supplied to growing-on enterprises or exported (see Belgium above). Currently production of trout is about

15 000 tonnes annually. About 43% of this is sold as live fish, 37% frozen and 21% iced. About 90% of the production is exported and 30% of the home consumption is in the form of smoked fish.

Rainbow trout are not stocked in public waters but a number of small put-and-take fisheries have recently been established in private enclosed waters, mainly to cater for German tourists.

Production of trout is concentrated in Central Jutland where the middle-sized farm has 35 - 60 ponds of about 300 m^2 each. Three farms producing a total of about 200 tonnes annually use brackish waters.

Common carp are reared in small quantities in Denmark; in 1973 the production was 2.7 tonnes. There is no culture of eels.

F. NETHERLANDS

In the Netherlands there are a number of enterprises rearing fish but the production is used almost exclusively for the restocking of angling waters (Dill, 1976). Indeed, up to about 3.5 million fish (roach, rudd, pike-perch, carp, pike and rainbow trout) or about 200 tonnes are used annually for restocking purposes (Brown, 1977).

There is one commercial trout farm in the Netherlands, producing about 50 - 60 tonnes of rainbow trout for human consumption. There is no eel culture in the Netherlands.

G. FR GERMANY

There are about 1 500 enterprises producing trout in Germany. These enterprises, which had a production of 8 000 tonnes in 1977 (von Castell, 1978), are concentrated in the southern part of the country (Brown, 1977). Although most of the production is in earthern ponds, there is some production in raceways and cages. There is at least one farm using warm water effluents.

About half of the trout eggs required are produced domestically, the remainder are imported from Denmark. About 70% of the fish production is sold in portion size for direct consumption; the rest, rather larger fish, are sold for smoking. Only about 40% of the demand for trout in Germany is met by domestic production.

In 1972 there were 4 300 carp farms, predominently concentrated in the southwest of the country (Anon, 1975b). In 1977 the production from these farms amounted to about 4 000 three-year old fish for direct consumption. However, large numbers of one-and two-year old fish are produced for sale to angling clubs, to put-and-take fisheries and for restocking of public waters. Carp for consumption are generally marketed at a weight of 1 kg. The total production is currently probably in the region of 4 000 tonnes (Brown, 1977).

Tench are reared as a food fish in Germany, mainly together with carp. However, the growth rate is low compared with carp. The production is estimated at about 300 tonnes per year (Brown, 1977) Pike are also reared by many carp producers, either for stocking angling waters as one- or two- summer fish or for direct consumption as two-summer fish. One estimate of the current production is 350 tonnes per year.

H. ITALY

Starting in the early 1960's trout farming developed rapidly on the plains south of the Alps, so that by 1965 Italy became an exporting nation. Currently Italy, with a production of about 18 000 tonnes anually, is the largest producer in Western Europe. Until about 1974 40% of the production was supplied to put-and-take fisheries but this percentage is thought to have fallen recently.

There are several eel farms in Italy. Of the annual production of about 2 200 tonnes, 90% is produced in brackish waters. Although the greater part of the production is in the North of Italy many of the more interesting developments have taken place in the South. The elvers are mainly obtained from the west coast, a little north of Naples.

There is now very little carp farming in Italy. It used to be conducted in conjunction with rice farming in the Po valley. However, the use of selective herbicides and insecticides, to which carp are susceptible, has resulted in a greatly increased production of rice that more than compensates for the loss of carp production.

Fish culture in brackish waters has a long history in Italy. In nature the culture is very similar to that practised in the lagoons of the French coast (see above). Apart from eels, the species currently produced are mullet, sea-bass and gilt-head. The total production is thought to be about 6 000 tonnes, more or less evenly split between the main species. Until recently most of the fry used in this culture were obtained from the sea but the recent development of induced spawning and the establishing of a government-financed hatchery appreciably enhance the prospects of this form of aquaculture.

I. GREECE

Statistics on Greek aquaculture are particularly difficult to obtain. Most of the production is of trout and one estimate of the total production is of 1 600 tonnes in 1978 (Anon, 1979a). There are about 70 trout farms.

J. SPAIN

The only species cultured for human consumption in Spain is the rainbow trout. In 1975 there were 112 trout farms producing about 6 000 tonnes of trout (Brown, 1977). More recently this figure has risen to about 8 000 tonnes.

There are 23 state-run hatcheries producing a number of species for restocking of waters. In 1974 nearly 11 million fingerlings were produced for this purpose.

There is no eel culture in Spain.

K. PORTUGAL

Fish culture in Portugal is a development of the last ten years or so. Trout and carp are the main species reared, with the productions in 1976 being 250 and 50 tonnes respectively (Brown, 1977).

L. UNITED KINGDOM

The main species farmed in the United Kingdom is the rainbow trout. The production in 1978 is commonly quoted at about 2 800 tonnes from about 150 farms. However, Lewis (1979) believes that most of the estimates apply more properly to Great Britain rather than to the United Kingdom. It would seem appropriate to add another 200 tonnes at least for the production of Northern Ireland. Currently the total UK trout production has probably risen to about 5 000 t annually.

Information on the production of other species is more difficult to obtain. About 100 tonnes of carp are produced with, it seems, the destination being split between stocking and human consumption. There are reports which are difficult to confirm, that salmon production from farms was about 400 tonnes in 1978. Certainly about 30 tonnes of Scottish farmed salmon were sold on Billingsgate market in 1979 (Anon, 1979e).

Eel culture, using warm water effluents, has reached the pilot stage and beyond. It is believed that cultured eels are being marketed, although it is difficult to obtain firm data as to the extent of the market. A report (Anon, 1979b) records the export of 300 kg of cultured eels. One view expressed to the author was that current production totalled about 200 tonnes. Some idea of the interest in eel culture may be obtained from the report that a national Eel Producers Association has been formed with Coates-Paton, Tomalin, Blue Circle Cement and Marine Farms Ltd as founder members (Anon, 1979c).

Research into the farming of marine fish has been conducted for many years (Lucas and Rae, 1964; Kerr and Kingwell, 1977). Kirk (1979) reports that between 5 and 6 tonnes of cultured turbot have been marketed recently and that much more will be marketed in the near future.

M. IRELAND

In 1977 there were 7 commercial producers of rainbow trout in freshwater with a production of 206 tonnes of fish for consumption. A preliminary report for the ICES Statistics Committee Liaison Working Group records that in 1979 this had increased to 16 producers who, as well as selling fingerlings for ongrowing, produced about 275 tonnes of fish (of around 250 g each). Even if one accepts a production of about 100 tonnes for restocking and production of fingerlings for ongrowing, the Brown's (1977) estimate of total production of 500-600 tonnes is probably too large.

The above-mentioned Department of Fisheries report to ICES records the existance of 6 sea-cage operations producing about 50 tonnes of rainbow trout (of 0.5 - 1.0 kg each) and 50 tonnes of salmon. A personal communication from D. Piggins, the manager of one of these sea-cage operations puts the current production of salmon at about 150 tonnes from 8 operations.

At present there is no production of eels or carp in Ireland.

N. SUMMARY

Accepting that many of the data are, at best, estimates, the overall production from aquaculture has been summarised in table 12.1. The total production of about 90 000 tonnes from aquaculture accounts for only a little over 1% of the Community's production from all fisheries.

Table 12.1: Current aquaculture production (tonnes) in the EEC and applicant states

	Trout	Eels	Carp	Salmon	Others	Total
FR Germany	8 000	–	4 000	–	300	12 000
France	17 000	50	5 000	100	–	22 150
Italy	18 000	2 200	–	–	7 700	27 900
Netherlands	50	–	–	–	–	50
Belgium	300	–	–	–	100	400
Luxembourg	12	–	–	–	2	14
United Kingdom	5 000	200	100	400	–	5 700
Ireland	325	–	–	150	–	475
Denmark	15 000	–	3	–	–	15 003
EUR 9	63 687	2 450	9 103	650	8 102	83 992
Spain	8 000	–	–	–	–	8 000
Greece	1 100	–	–	–	500	1 600
Portugal	250	–	50	–	–	300
EUR 9 + 3	73 037	2 450	9 153	650	8 602	93 892

CHAPTER 13

FIN-FISH CULTURE: THE FUTURE.

AQUACULTURE: THE FUTURE

A. THE ADVANTAGES OF AQUACULTURE

If aquaculture is to develop to any appreciable extent it must be shown to have advantages over the major sector of food production, agriculture. Without doubt, the technology of agriculture is further advanced than that of aquaculture and there has therefore to be an incentive to promote the development of the latter.

In fact it is not difficult to see the attraction of fish culture. Fish are, in most cases, more efficient protein converters than most animals. If this conversion is measured in terms of the edible protein produced from the crude protein eaten, fish are at least as efficient as the other sources of human food (see Table 13.1). Fish are able to use high levels of protein in the diet whereas terrestrial animals lose considerable quantities of amino acids through deamination. Pillay (1977) quotes examples of poultry where almost one half of the amino acids are deaminated and weanling pigs lose two thirds of the amino acids through deamination.

Little work appears to have been done in Western Europe on the economics of production of aquaculture compared with that for agricultural products. But work in Hungary has shown that fish production costs are lower than for beef, poultry and pork production and in India the profits from fish production were 3 to 4 times greater than for the production of wheat, rice and millet (Pillay, 1977). It seems likely that these differences will be greater with the rise in production costs due to the energy crises.

B. TYPES OF AQUACULTURE

There are various types of fish-farming from the view of the life-cycle of the fish. Perhaps the simplest for is where the input material is wild-caught young fish. These fish are then reared to marketable size. This form of culture is practised where there is a plentiful supply of wild young fish and/or there are technical difficulties associated with the breeding of the fish and the rear-

Species	$\frac{\text{Edible protein}}{\text{Crude protein eaten}} \times 100$
Rainbow trout	25
Turbot	18 - 26
Sole	23
Broiler	17
Turkey	18
Rabbit	13
Bacon pig	17
Early lamb	4
Cereal beef	18
Eggs	22
Milk	20

Source: Windsor and Cooper, 1977

Table 13.1: Protein conversion by farmed species

ing of the young fish in captivity. Two species which are currently primarily reared from wild-caught young are the sea-bass and eels. There are various disadvantages to this form of aquaculture among which are the uncertainty of regular supply of young fish due to climatic conditions and natural variations in brood strengths and the uncertain quality of the input material. Where this culture is practised extensively there is a real risk that recruitment to the wild breeding stock is reduced and the survival of the wild stock thus threatened. ICES and EIFAC are currently both concerned that the capture of elvers for consumption as such and for rearing on is a serious threat to the survival of the eel Anguilla anguilla. Thus the development of aquaculture depending on the supply of wild fish is not encouraged and does not seem to have more than a limited future. With reference to the two species mentioned above, it must be said that considerable efforts have been made to produce spawning stocks on fish farms and it is pleasing to note that in Italy a hatchery has been built to produce 4 million sea-bass fingerlings per annum (Kirk, 1979) and that artificial breeding of eels has produced encouraging results in Germany (Meske, 1973). (Perhaps this preliminary report was too optimistic because it appears that Meske has not continued with the work.)

A more sophisticated stage in fish culture is the capture of wild ripe adults, their stripping and the rearing of the fry. This form of culture was developed largely for salmonid fish where the survival of the wild stock was thought to be threatened by the destruction or non-accessibility of spawning sites due to water impoundments. Generally the fish were released either as fry or smolts to their native waters with the aim of increasing the wild stock. Undoubtedly notable successes have been recorded but, on the other hand, there has in many cases been good reason to doubt the viability of these released fish and a cynical approach has been to consider that, while the releases may not have been beneficial to the wild stock, they have enhanced the public image of the authority threatening the natural spawning beds.

However, the techniques developed in the production of young fish from wild-caught ripe adult fish have resulted in the prospect of fish ranching. The survival of salmonids to the smolt stage is very much better under the controlled conditions of aquaculture than in the wild and provided these fish are viable when released there is a good chance that the wild stock may be significantly increased and than an increased catch of returning adults will be obtained by commercial fishermen. This method has the advantage over many forms of aquaculture in that capital investment is restricted to the equipment required to rear the young fish and to the equipment needed to harvest the adult fish. Disadvantages of the method are that survival rates in the wild are normally lower than in captivity (although this is balanced by the absence of costs of supplying the food and the attention required in captivity) and, more important, the rearer of the fish loses all propriety rights to the fish once they have been released. Of course, initially they may be protected in the 'natal' region by close seasons and mesh-size restrictions but control on the high seas is more difficult. For example, an appreciable proportion of the salmon from W. European waters have their feeding grounds off Greenland. Enforceable international agreements which were reached only after long and difficult negotiations have been necessary to at least limit the quantity of fish taken while on the feeding grounds. Further, when adults return to their natal waters there is a need to restrict the exploitation, both in terms of the quantity of fish taken and by whom they are taken so that the future of the stock is assured and so that the catches are made by fishermen who have contributed to the stocking programme. This form of fish-farming is not then for a single small enterprise but has generally to be organised on a regional basis. A central authority would be responsible for the stocking programme and would licence the fishermen permitted to harvest the returning adults. In theory, at least, there are many sites in the EEC which could support such sea-ranching schemes but, in practice, the potential is limited by poor water quality threatening the survival of the young fish in passage to the sea and of the adult fish before they are taken by the fishermen.

The final stage in sophistication in fish-farming is where the whole life cycle of the fish is spent under controlled conditions. Young fish are produced from a brood stock under natural, simulated natural or artificial conditions and are reared in controlled conditions to a marketable size. Thus the supply of quantity and quality of the input material is under some control and the final production may be geared both in terms of quantity and timing to the anticipated market conditions. This is obviously a much more satisfactory situation than less sophisticated methods mentioned above and, although it is not without risk, as will be mentioned later, it does provide the best future for aquaculture. Consequently the rest of this study will be devoted to this form of aquaculture.

Two degrees of this form of aquaculture exist but no well defined line may be drawn between them. Firstly, there is the extensive culture mainly practised as a subsidiary venture to the main interest of a small farmer. Fish are released into a habitat with defined physical limits and are left there with little or no effort to control the environment until they are of marketable size. Since the fish has to find its food from the habitat the stocking level has to be kept low and consequently the productivity is generally low. The productivity can be increased by artificial feeding or by fertilisation of the water but, of course, this increases the costs of the venture. Boyer and Lloyd (1976) cites examples of how carp production may be increased by the fertilisation and supplementary feeding of ponds (see Table 13.2). The great advantage of extensive aquaculture is that the cost of capital equipment is low.

Productivity from extensive aquaculture may also be improved by the use of polyculture methods. Many variants are possible but the principal are:

1) Polyculture with a vegetable crop. As has been mentioned in the previous chapter on the current state of aquaculture, in Italy carp have been reared in rice fields. Rice was the principal product, carp being a bonus obtained with very little

	Productivity kg/hectare/year
Natural pond	25 - 50
Shallow managed pond	200 - 300
Fertilised pond	500 - 600
With supplementary feeding	3000

Table 13.2: Productivity of carp ponds in Eastern Europe

Source: Boyer and Lloyd, 1976

expenditure of time or money. However the rice crop was subject to insect infestation, particularly from aphids, and the farmers applied insecticides which were toxic to the fish. The increased harvest of rice more than compensated for the loss in fish production. There may be a limited future for the re-emergence of this form of culture as insect resistant varieties of rice are introduced. The production would be limited to about 5 500 tonnes of carp assuming that the area under rice in Italy is about 190 thousand hectares and a fish productivity of 30 kg/hectare/year would be obtained.

b) Polyculture with birds. In many parts of the world, though only occasionally in the EEC, waterfowl are reared in the same ponds as fish. The excess food and the faeces of the waterfowl enrich the environment of the fish and thus improve productivity. However, the rearing of waterfowl is only a minor practice in the EEC and thus no great future can be predicted for this form of culture.

c) Polyculture with other fish species. Experiments in Eastern Europe have shown that fish productivity may be increased if selected species are reared together. One combination which has shown promising results is the grass carp (which eats mainly higher plants and whose faeces contain a large proportion of finely divided semi-digested plant material), the silver carp (which feeds on the resultant algal bloom) and the bighead (which feeds on zooplankton). It would not be wise to translate these results in Eastern Europe directly to Western Europe with its shorter cooler growing season but a limited trial in the United Kingdom showed that the resultant biomass of a population of bream was nearly doubled when the bream were reared with grass carp compared with when they were reared alone (Stott <u>et al</u>, 1971).

Although there are methods of increasing the productivity of extensive aquaculture, the author is drawn to the conclusion that the potential for increasing significantly the aquaculture of the EEC by such techniques is restricted to certain isolated regions.

The principal reasons for this conclusion are:

a) since productivity is generally low a considerable area of water would be required to produce the fish. Suitable areas of water are rare in the EEC;

b) the total production of an enterprise would be low and this in turn would result in marketing problems. The farmer would have difficulty in establishing contacts with an outlet for his small supply and cooperative sales ventures with other producers would give distribution problems;

c) in many cases, the waters would not be designed for the rearing of fish and consequently efficient harvesting of fish could be difficult;

d) not having control of the fish, nor indeed sight until harvesting, the farmer would not be able to guarantee the quality or the quantity of the product.

The other variant of aquaculture where the whole life cycle is spent in captivity is intensive culture in which the fish are retained within physical limits and the environment is more or less completely controlled. Intensive culture certainly seems to offer the most promising prospect for the development of aquaculture in the EEC. Certainly high productivities can be obtained although, as discussed in greater detail later, a high level of capital investment is normally required, high stocking rates increase the risks of disease and the ventures are highly dependant on a regular supply of cheap food.

In this study the species being considered are principally those for which a market already exists (even though it may need to be expanded to meet future production targets). This approach is justified by the fact that capital investment in intensive aquaculture is high and investors will need to be assured that there is a ready market for the product before the production unit is established. Thus the prospect of having new species produced by aquaculture techniques is rather remote at the present time when there are few established units in a position to consider diversification. By market it is intended that this should refer to an existing home or export market for the product. An example of a current non-existent market which it is hoped to develop is the export of mussels from Ireland to the European mainland where there are well-developed home markets. However there is real doubt as to whether the Irish mussel will, with transportation costs taken into account, be able to compete with the home products.

The principal species under consideration are the rainbow trout, the Atlantic salmon, eels, common carp, marine flatfish and sea-bass.

C. RAINBOW TROUT

Two basic products are possible, the individual portion size and and larger fish for processing (for example, smoking). Until recently, interest has been focussed almost exclusively on the portion-sized fish but a market is being developed for the larger trout. Indeed, in Norway, some of the effort in cage culture is being diverted away from salmon to trout (Edwards, 1978).

Two major factors seem to be restricting the development of trout production. Firstly, there is the uncertain future supply of cheap food. Trout require a high protein food and, although alternative sources are being sought (see Chapter 17), the main component has been fish-meal. The future supply of this is in doubt as a result of the failure of the Peruvian anchoveta fishery and the threatened closure or running-down of other industrial fisheries. Secondly, there is the quality and quantity of of the water supply. Trout require clean, well-aerated water and this restricts the number of sites available for development as trout farms. The problem may be minimised by mechanical aeration of the water and recirculation techniques. Both of these increase the capital investment and the running costs.

A marketing problem exists in that, at present at least, it is difficult to compete with the Danes and the Japanese in the production of deep-frozen individual portion packs of trout and it seems advisable for any increase in production to be directed at quality fresh or live fish for supply to large retail outlets or, for the smaller producer, to local catering establishments.

D. ATLANTIC SALMON

Considerable effort is being made to establish the rearing of salmon using cage-culture techniques in Scotland and Western Ireland. Other areas, e.g. NW France and Western Denmark are being considered as suitable sites for such developments. If Norwegian experiences can be transplanted, and the initial successes in Scotland and Ireland continued, the development of salmon culture is promising. The incentive to develop this form of aquaculture has been increased by the fact that most of the areas under consideration are under-privileged areas within the Community. (This aspect of aquaculture within these areas is discussed later.) Several large companies are investing time and money in the development of this cage culture and the forecasts of the potential are very promising. If these forecasts are anything like realistic the production of farmed reared Atlantic salmon will soon outstrip the catch of wild caught fish. Presumably the investors believe that the stability of the market for fresh or smoked fish may be maintained by diverting the 'surplus' production into processed products (e.g. canned fish) or seeking other (foreign) markets. These large companies are well suited to develop such alternative outlets.

One possible restraint to the development of cage-culture techniques is the fact that most of the existing and proposed sites are in remote areas and this may give rise to problems in the establishment of the units, in finding suitably qualified staff and in the transport of goods to and from the site. While such problems may result in the production estimates of Kerr and Howard (1975) for the United Kingdom being over optimistic, it should be noted that most of the promising early work has been conducted in such areas.

Before passing to the next section it is relevant to note that the French are concentrating their salmon culture work on the coho salmon (Pullin, 1977). This enterprise required the development of a new product but Kirk (1979) reports that a good market has been obtained. However, according to Munro (1979), the mariculture potential of the coho salmon has not yet been fully established, the principal problem being early sexual maturity and two diseases, vibrosis and bacterial kidney disease.

E. EELS

Although good markets for eels do not exist in all Member States, good prices are obtained and experts believe that the limiting factor on the market has been supply rather than demand. This combined with the natural hardiness of the species has encouraged research into the culture of eels.

Present techniques in the culture of eels involve the use of wild-caught elvers as the input material. These are caught in large quantities in coastal waters or while migrating up rivers. However, some authorities are expressing concern that these catches, which are destined for consumption as well as for rearing on, are at such a level that the existence of the wild stock is threatened. (It must be said that the experts at the ICES/EIFAC Symposium on Eel Research and Management advised that their predictions were severely limited by the quality of the statistics available.) It has been mentioned above that in Germany, Denmark and Japan induced spawning of eels has been successfully achieved though reports suggest that the survival of the fry has been poor.

Eel culture has the advantage that since the eel does not require the high protein diet of salmonids, some of the expensive proteins may be replaced by cheaper carbohydrates. A disadvantage is that with the ambient water temperatures of Western Europe, development from the elver to marketable size can take four years. This is too long for economic culture and the use of warm water effluents is being investigated.

F. COMMON CARP

As with eels there is an existing limited market for carp in the

Community and again expert advice is that, in some regions (e.g. FR Germany), the quantity marketed could be increased substantially without adversely affecting the price structure. Against this it should be noted that carp are included in the Community's marketing regulations and that this suggests that the market for carp needs support. This support is in the form of protection from cheap imports from Eastern Europe. It would seem likely that such a situation would mitigate against great investment being made in the rearing of carp.

Again, as with the eel, the basic technical problem in carp culture is that in Western Europe the growth rate under natural conditions is too low for economic management. Some attention is being paid in Germany to the use of fast growing races of carp (from Israel) and to the use of warm water effluents to increase growth rates.

G. MARINE FLATFISH

There is without doubt a ready market for marine flatfish, some of the species (e.g. sole) being amongst the most expensive of fish fleshes. Work, mostly in the United Kingdom, has shown that it is possible to rear several species of flatfish, with the best prospects being shown for sole and turbot. At the present time sole present a problem in the development of a hatchery programme since the adults cannot be stripped but have to be allowed to spawn naturally. Further there is difficulty getting the young fish to accept dry food. On the other hand turbot can be stripped of their eggs and milt (thus allowing better planning of the hatchery programme) and the young fish are readily weaned to dry foods. The survival rate of young turbot is not very high (8 to 22% has been reported by Bromley, 1978) but it is probable that with the fish having a very high fecundity it may be better to accept this high mortality rather than take expensive measures to improve the survival. Kirk (1979) reports that small quantities of farmed turbot have already been marketed and that at least three producers are involved in plans to produce, at a conservative estimate, about 1 000 t of turbot within the next five years.

Perhaps one of the major obstacles to the commercial viability of marine flatfish rearing is in the food requirements. Initially the fry require live food: <u>Artemia</u> are currently being used but the variable quality of the brine shrimp eggs coupled with their high price makes it necessary that an alternative live food be found or, at least, that the fry are weaned on to a dry food as early as possible. Flatfish require a high protein food and most of the dry foods employed at present contain a high percentage of expensive fish meal (up to 90% according to Bromley, pers. comm.). The prospects of economic viability would obviously be improved if the fish meal could be replaced by a cheaper form of protein.

In the United Kingdom the use of warm water effluents has greatly improved growth rates, marketable fish being produced in trials within 21-30 months of spawning.

H. SEA-BASS

Market prices for this fish are very high in France and Italy and the fish has been reared successfully using wild-caught fry as the input material. However the availability of the fry is an ever-present uncertainty and research in the above-mentioned countries has been centred on the artificial culture of the fry. Many of the early problems were similar to those seen with turbot but most of them have now been overcome. In both countries commercial hatcheries are, or have been established to sell weaned juvenile fish to farmers for growing on. However there is currently a reluctance on the part of the fish farmers to purchase the fry because the wild fry are cheaper and their survival is considered to be better. Community catches of wild fish of marketable size are low (under 1 700 t in 1978) and it remains to be seen whether, should artificial rearing of the fish increase greatly, the market will remain stable enough to support the industry.

I. WARM WATER

Several times in this study mention has been made of the use of warm water effluents to improve poor growth rates. Being poikilothermic animals, fish are dependant on the environmental temperature and the growth rate may be increased by increasing the water temperature. However the heating of all but very small volumes of water by conventional methods is too expensive to be economical in aquaculture. Consequently interest has been focused on cheaper sources of energy and an immediate candidate is the 'waste' warm water effluent from industry. (In the literature the term 'waste' is often used to describe such effluents whereas, as will be seen later, is often unwarrented.) Many industrial enterprises, and particularly electricity generating stations, are situated adjacent to large water supplies, a proportion of the water being used to cool the plant before being returned to the source. The idea is that the heat transferred to the water and which would be wasted when the water is returned to source should be used by diverting the effluent through fish ponds. There are a number of promising results obtained from such ventures but the number of sites available is limited by the following considerations:

1) the water supply used by the industrial plant must be of good quality. Apart from a gross filtration, the industrial plant will not, for example, reduce the level of heavy metal ions in the intake water;

2) in order to reduce fouling of the cooling system, it is common practice to chlorinate the water. This chlorine, which would be toxic to fish, has to be removed before the water is passed to the fish ponds or preferably a non-toxic anti-fouling agent, e.g. ozone, has to be used;

3) another potential danger is that the cooling water will pick up toxic metal ions from the tubing of the cooling system. This problem has really to be foreseen at the design stage of the plant when, for example, titanium could be used to replace brass tubes;

4) the supply of warm water should be continuous. A peak-load electricity generating station would be an unsatisfactory site for a fish farm because rapid increases and decreases in tem-

perature may be detrimental to the fish;

5) while the heat in the water may be considered as waste, the water is not. The water has been filtered and treated with anti-fouling agents and would be re-used. Frequently there is only a 20% replacement of water. The effluent from the fish ponds would probably require refiltering to remove detritus and it may not be as cool as the water taken from the bottom of the cooling towers. Thus the efficiency of the cooling system would be reduced and the costs increased. Further, the ponds would probably be at a lower level than the bottom of the cooling towers and should it be decided to re-use the water from the ponds, or replace it with fresh water, additional pumping costs would be incurred.

These increased costs may be considerable and, in the author's experience of discussions with power station engineers on the use of the cooling water to increase the growth rate of grass carp, could make a small venture uneconomic. Certainly in the above venture, there was a scaling down effect and it should be noted that the industrial concern, an environmental polluter, may be prepared to defray some of the costs in order to improve its public image.

Some of the problems mentioned above may be overcome by the use of heat exchangers in the bottom of the fish ponds but the cost of the installation would be high and the water ready to be returned to the industrial plant could be too warm to use in the cooling plant.

Although the problems mentioned above have to be considered thoroughly, there is no doubt that suitable sites do exist where waste heat may be used in fish farming. Various pilot scale plants exist in several Member States using such waste heat and a successful trout farm has been established in Germany using the cooling water from a dairy (OECD, 1979). A site is more likely to be a success if it is possible to take the requirements of the fish farm into consideration when planning the industrial plant.

J. DISEASE

As soon as animals are kept in close contact with one another, there is danger of diseases reaching epidemic proportions. This danger is certainly recognised in intensive aquaculture but the threat has, in some cases at least (e.g. Corrie, 1979 a, b) been exaggerated. McAnuff (1979) reports that worlwide disease losses are less than 20% of the total losses. (Other causes of losses include severe weather, accident, equipment failure and mismanagement.) As with all farming, good husbandry can minimise the threat of diseases. This underlines the importance of trained personnel who are capable of applying relatively simple regimes of hygiene and who are capable of recognising the symptoms of disease of infestation by parasites at an early state so as to render the application of treatment efficient and practicable.

It has been mentioned earlier that the water available for aquaculture is limited and thus, if aquaculture production is to increase significantly, fish farms will be concentrated in the regions with suitable water and there will be a considerable risk of diseases spreading from adjacent farms. Two measures will greatly reduce this risk: an inspection system to ensure that the husbandry practised on the farms meets required standards and disinfection of the effluents from a farm (for example by ultraviolet irradiation) to protect the farms downstream. The import of material from potentially dangerous sources has been restricted for a number of years but control measures are being stepped up internationally by registration of fish-farms and a general limitation on movements of fish to those from disease-free stocks. One current constraint to the improvement of these control measures is that there are not sufficient establishments to conduct the extensive control of the farm conditions and transportation of fish.

It is not the intention in this study to give an account of diseases affecting cultures fish. Detailed accounts of these are given in Sarig (1976), Sinderman (1970) and Roberts and Shepherd (1974) and a general account of the problems is given by Reay

(1979). It is evident that provided most non-viral diseases are noticed at an early stage there is a remedy available. Further, it seems probable that more work will have to be done on viral infections, both in the detection of the organism and the treatment of the infected stock.

K. SELECTIVE BREEDING

Animal breeding has played an important role in the development of agriculture. Very few, if any, of the animals found on modern farms bear much relation to the wild stock from which they were derived. As yet genetic breeding has not played a significant role in the development of aquaculture. But it is evident that it could be used to overcome many of the same problems encountered in agriculture.

Breeding could be used in some instances to overcome disease problems. One could imagine that problems with a species particularly susceptible to ectoparasites could be overcome if it were possible to develop a race having a copious epidermal secretion (it is widely recognised that the common tench, a fish having such a secretion, is more resistant to such infections that most other fish).

Selective breeding may also be the answer to a problem mentioned earlier for a number of species, namely a poor growth rate. Development of faster growing races of, say, carp could result in its culture being a commercially viable venture. The Israelis are particularly well advanced in this field and their experiences are being studied to determine their relevance to Western European conditions.

Salmonids that become mature before reaching a marketable size are a problem. This maturation results in changes in the quality of the flesh, a decrease in the growth rate and an increase in mortality, all of which reduce the profitability of the product. Male fish being produced for the 500g portion size market are particularly susceptible but it is also becoming a problem with the females, which generally mature at a larger size, now that emphasis is being placed on the market for larger fish for processing. Bromage et al (1979) discuss the problem, the factors causing it, and the consequences. Various methods are being investigated to overcome the problem. Needham (1979) reports that a study of different strains of salmon has shown that there are considerable differences in the proportion of grilse (that is fish maturing at about 1.8 kg after one winter in the sea compared with normal maturity at about 4 kg after two winters in the sea) between the races. Although environmental factors probably play a role, it is believed that selective breeding may reduce the incidence of the problem.

The suppression of 'precocious' development is also being investigated using chemo-therapeutic techniques. It has been found that a very large proportion of grilse are males and thus if stocks of all female fish are developed precocious development is substantially reduced. If fry are fed diets containing male sex hormones all develop into males. These fish which should have been females will have the female genotype and when they are crossed with normal females only female offspring will be produced (Purdom, 1979; Anon, 1979d, Johnstone et al, 1978, 1979). Another method of preventing premature development being investigated at Aberdeen University is the immunisation of salmon against their own gonads (Needham, 1979).

L. RECIRCULATION OF WATER

Western Europe is one of the most highly industrialised regions of the world and, unfortunately, industry almost invariably results in a polluted environment. Indeed, one of the biggest restraints on the development of aquaculture is the scarcity of water of good quality. Thus efforts have to be made to maximise the use of this water and considerable work has been done on the development of recirculation problems. The recirculation system has to incorporate a filtration and oxygenation plant to remove suspended solids and carbon dioxide. McAnuff (1979) reports that the British Oxygen Company has developed a reoxygenation system that reduces the normal water requirement by over 90%. Some replacement of water is necessary to prevent the build up of highly toxic waste products (e.g. ammonia) and suspended solids.

It should also be noted that the effluent from an intensive fish culture unit can have a polluting and eutrophicating effect on the water course. This can have serious implications when, to maximise the use of good quality water, several fish farms are placed in close proximity along the water course. This problem has already been encountered in Denmark (Hansen, 1979) and increasingly stringent legislation for the control of water quality may well require fish farms to install treatment plants to keep the quality of the effluent to an acceptable level.

M. ECONOMICS OF FISH FARMING

Not surprisingly it is difficult to obtain information on the economics of fish farming. Successful fish farmers are never keen to open their books to possible competitors. However, certain generalities can be drawn from existing fish farms in Norway and Denmark and from studies made on experimental fish culture stations.

Richardson (1974) points out that, from an investment point of view, aquaculture is a very much more risky venture than the closely related agriculture industry. Whereas most governments have provisions for development grants for agriculture, these generally do not exist for aquaculture and should disease cause the stock to be compulsorily slaughtered there is generally not the compensation that is available in agriculture.

Aquaculture is a capital intensive industry. Various figures have been quoted for the capital outlay required to establish a fish farm (Boyer and Lloyd, 1976; Kerr and Kingwell, 1977; Solomon et al, 1975; Anon, 1973) but, accepting that there will be differences caused by the precise type of culture being considered, the projected annual production and the geographical location, an investment of between £1 500 - £2 000 per tonne of annual production will be required. Kerr and Kingwell (1977) report that for a vertically integrated company holding the brood stock, producing eggs, juveniles and growing stock and marketing the product (often as a processed product), the break-even point of profitability is achieved with an annual production of 80 - 100 tonnes. Profitability does not appear to increase with increasing production above 150 tonnes per annum. Thus maximum profitability would require an investment of at least £225 000. However, Edwards (1978) and Kerr and Kingwell (1977) point out that smaller farms having a readily available and cheap source of fingerlings and run by one full time man may be profitable with annual productions as low as 20 tonnes.

An important consideration, at least initially, is that, with some species taking up to two and a half years to reach a marketable size, there can be cash flow problems. For example, a small farmer producing 20 tonnes of fish per annum would need to invest at least £30 000 and then wait a minimum of one year before seeing any return on this investment. As Edwards (1978) remarks, there is a strong temptation for the farmer to market the fish at the earliest opportunity rather than waiting longer and obtaining greater profitability from the premium price obtained by larger fish. Taking as an example the culture of trout, although the market for larger fish still has to be fully developed and there could be problems of 'precocious' development in the rearing of larger fish, there are advantages in not marketing fish as soon as they have reached the minimum market size. The price per unit weight would almost certainly be better and the mortality rate of the larger fish would almost certainly be lower than for the smaller fish.

An important consideration in the economic viability of a venture is the choice of species to be cultured. For example, trials of marine fish farming in Britain began on plaice (Lucas and Rae, 1964; McIntyre, 1966; Shelbourne, 1975; Swift, 1969) but it became apparent in 1972 that, aside from certain technical and biological problems encountered (Steele, 1967; MacKenzie, 1969), the cost of producing plaice could not be recovered from the sales value. In 1977, plaice, although ninth in the list of the most valuable species marketed in the United Kingdom, was still not an economically viable species to farm (Kerr and Kingwell, 1977). Since 1970 research effort in Britain has been concentrated on more valuable species such as sole and turbot.

The other major cost in rearing fish is the food. It it is assumed that the capital depreciates over a 5-year period, food has been quoted as being responsible for between 40 - 60% of the total cost of trout production (Anon, 1973; Arroyo, 1973; Boyer and Lloyd, 1976; Solomon _et al_, 1975). Edwards (1978) says that food contributes 40% to the total costs of salmon production. The success of an aquaculture enterprise thus depends heavily on an assured and cheap supply of food. Fish meal is currently a major component of most fish foods (see Chapter 17) and, with the increase in price of this product together with the uncertainty of future supplies, underlines the importance of seeking alternative foods. Edwards (1978) points out that it would be unwise to switch from an expensive food to a cheaper food without taking into account the effects of the poorer conversion rates that may result. Palfreman (1973), in a paper giving economic models for use in the analysis of aquacultural economics, supports this view. An account of the technical aspects in the search for alternative foods for use in fish culture is given in Chapter 17.

It is when one attempts to obtain an absolute measure of the profitability of aquaculture that one encounters the greatest problems. Nearly all the data available for Western Europe relate to trout farms; not surprisingly because few other fish farms are currently economically viable. Solomon _et al_ (1975) have estimated that the cost of producing trout in ponds at 31p per pound at a time when the sale value would have been 35p per pound. This represents a 12% return on the investment. Saunders-Davis (1977) states that it is absolutely vital to aim at a return of not less than 30% on total fixed and working capital. Edwards (1978) puts the return on investment at 43 and 62% for one-year and 18 month cage culture of trout in Norway respectively. Arroyo (1973) shows that cage culture of trout in Chile can produce returns of between 28 - 36% per annum, depending on the size of the enterprise. Edwards (1978) shows that salmon cage culture is more profitable than trout culture, producing a profit of 191% of the cost in a two year cycle but points out that trout are easier to rear than salmon.

N. MARKETING PROBLEMS

The marketing of aquacultural products does present some problems, in particular for those species for which there is no established market. Even with species for which a market exists, there has been an initial resistance to farmed fish. This may be illustrated by the salmon where, initially, farmed fish were not welcomed on Billingsgate Market but fish merchants have now recognised the merits of the assured supply and quality that is possible with farmed fish (Anon, 1979e).

For a number of other species there are markets, albeit of a limited specialised nature. Examples of these are the markets for carp and eels in the United Kingdom. Although these local markets may be expanded by intensive selling techniques, it may be that the future of these products may depend on the culture being undertaken by vertically integrated companies that are able to exploit foreign markets and markets for processed products. Certainly, with the drastic reduction that has taken place in the number of retail outlets for fresh fish (McAnuff, 1979), the future of the aquaculture industry will depend on close attention being placed to the development of processed convenience foods.

O. TRAINING AND ADVISORY SERVICES

Aquaculture is certainly not a domain for the unqualified. It is a common experience for national administrations to be approached by individuals who have access to suitable water and a sum of money to spend and who wish to establish a fish farm. They have read reports advocating the development of fish farms and the apparently rich rewards to be obtained. In most cases where the caution issued by the administrations is ignored, the individual is doomed to disappointment. Properly conducted, aquaculture is a capital intensive industry (fish tanks, pumps, warning systems, back-up equipment etc) and has an associated high risk. Disease can eradicate the entire stock and a year's work more or less overnight, or flood conditions can wash away the whole stock and, perhaps, much of the equipment. Thus the uninitiated is best advised to invest money in a lower risk source of income.

The staff of a fish farm require considerable training. At least one highly trained technician has to be available at each establishment to oversee the operations. He has to be able to detect problems at an early stage (e.g. onset of diseases or nutritional problems) and to apply the appropriate remedy. Under him are required men to perform the daily operation of the farm, feeding the fish, cleaning and generally maintaining a suitable regime of hygiene and maintaining the equipment. Of course, all the functions would have to be performed by one man in the case of the small 20 tonnes-per-annum farms mentioned by Edwards (1978).

It is the combined degree of training and devotion required that casts doubt on the assertion that the development of aquaculture in under-developed retions would provide employment for the sons of fishermen (Corrie, 1979 a, b). Even with training it is by no means certain that the man would have the affinity and dedication to make a successful worker in aquaculture. Thus the development of aquacultural enterprises in under-developed areas may not have a marked effect on the employment in such areas.

One factor that could affect the development of aquaculture is the official view of such ventures in many countries. In many Western European countries one finds that aquaculture is neither classified as agriculture, nor fisheries, nor industry and thus is not elegible for the grants or low-interest loans available to those enterprises readily classified. Indeed the situation is often worse in that aquacultural enterprises are subject to taxation from which agriculture is exempt (for example, local rates on permanent buildings in England). If aquaculture is to develop, these restraints must be lifted.

Another area in which aquaculture is at a disadvantage is in the advisory services that are available. In most countries the farmer has a wide range of advisory and technical services to which he can turn. The aquaculturist, on the other hand, often has difficulty in finding technical facilities available to him. In most countries national centres are available for diesease diagnosis but there are few regional laboratories. This means that the fish farmer, unless the farm is situated close to the national centre, has problems in obtaining the required diagnosis in sufficient time to apply an effective treatment. It is also curious that the number of practitioners in the veterinary profession competent to advise on fish is very limited.

While most central governments employ full-time agricultural advisers, few aquacultural advisers exist: where advice is available from the central authority the duty is given to an official usually as a minor part of his duties. Private consultants do exist but there is no control of their professional abilities: indeed, at least one case is known to the author where a financial set-back suffered by a fish farmer could be directly attributed to advice received from a private consultant. Aquaculture will certainly benefit from an improvement in the technical and advisory services offered by the central government and from some form of control (e.g. registration) of fishery consultants.

Even with the availability of advisory and technical services, aquaculture would be a risky venture. With a few exceptions, mostly in the developed countries, the fish farmer will find difficulty taking out an insurance policy covering all the risks likely to be encountered. If his stock has to be destroyed to prevent the spread of disease, unlike most similar cases in agriculture, he would receive no compensation from the central government and he could have difficulty in finding an insurance company willing to take the risk.

There are legal restraints to the development of aquaculture. For example, in the United Kingdom the law relating to the use of the foreshore and adjacent waters for the development of, for example, a farm for cage-rearing of salmon, is complex and to conform to the various legal requirements, approval of the venture has to be obtained from a number of bodies. A fish farmer may also find that he is technically breaking the law by marketing farmed fish during the closed season for wild fish, by using small meshed nets for netting the fish from his ponds and even for keeping fish of below marketable size. Further, while there are often bye-laws protecting the ownership of shellfish cultures on the foreshore and inshore waters, there is often doubt as to the extension of these laws to cover fin fish kep in floating cages. Obviously, the law relating to aquaculture needs to be studies closely in order to facilitate the development of the industry.

P. ORGANISATION OF THE INDUSTRY

In several countries the formation of fish farming associations can play an important part in the development of the industry. These associations are able to exert pressure that result in changes to the legislation to benefit the fish farmer and may promote the exchange of experiences on technical and marketing matters. A number of organisations already exist: for example, in the United Kingdom there is the Aquaculture Section of the National Farmers Union, the Eel Producers Association (already mentioned in Chapter 12) and the British Trout and Salmon Marketing Association. Similar organisations exist in other countries and at the international level (e.g. the European Federation of Salmonid Rearers).

Q. RESEARCH AND DEVELOPMENT

Although national administrations are undertaking research into fish-farming, much of the research is done by commercial companies. Naturally, these companies having invested considerable sums of money in the enterprises, are not likely to publicise the results of their research very widely. Although this attitude is perfectly understandable it does tend to stifle technical progress of aquaculture.

McAnuff (1979) reports that there were recently 127 separate projects connected with fish farming in 23 British universities and polytechnics and suggests that the development of aquaculture would benefit from more of thes projects being financed by other than short-term grants and by better coordination between the various sectors of research and development, private, governmental and academic.

R. THE POTENTIAL AQUACULTURAL PRODUCTION IN THE COMMUNITY

It will be apparent from the earlier remarks that the future development of aquaculture is dependant to some degree on political attitudes. However, when considering the potential aquacultural production in this section, these have been ignored. It is also important to note that aquacultural technology, particularly that associated with cage rearing, is fast developing and, since the potential has been assessed from the current state of technology, it may have been underestimated.

a) United Kingdom

Both Brown (1977) and Solomon et al (1975) consider that the UK market could absorb up to 50 000 tonnes of rainbow trout. With current production at about 5 000 tonnes there is obviously room for expansion. Such an expansion would require a ten-fold increase in the current level of consumption in the UK or a drive to develop an export market. Dill (1979) believes that the industry will grow, especially for larger trout and that the situation will be brought about by improvements to the dry-weather flow of rivers due to impoundments. Further the anticipated doubling of reservoir area and five-fold increase in the gravel pit area by the end of the century could result in the large-scale development of extensive fisheries or of cage culture. Brown (1977) believes that production may be limited by profit margins and this view is supported, by implication at least, by the inclusion by Solomon et al (1975) of water-saving techniques, utilisation of under-exploited foodstuffs and the development of new foodstuffs in the list of worth-while research topics.

The potential of salmon farming is more difficult to assess if only because much of the recent effort in this sector has been made by a small number of commercial companies and Brown (1977) found difficulty in obtaining any information on present and future production levels. Sedgwick (1975) believes that the production will reach 20 000 to 30 000 tonnes by the mid-1980's. What appears at first sight to be a more modest prediction is made by Kirk (1979) who quotes a correspondent as predicting an output of at least 1 000 tonnes within the next three years. The more optimistic estimate would result in the United Kingdom's consumption of salmon increasing about four-fold, even assuming that the increased production were to be used to replace imported fish. It does seem likely that the stability of the market could be maintained by the large vertically integrated companies diverting 'excess' production into processed products or by exportation.

The development in marine fish farming in the UK have been mentioned earlier but the potential is difficult to assess because no economically viable unit is yet marketing fish. Kirk (1979) reports that one large company has definite plans for rearing 500 tonnes of turbot annually and at a conservative estimate that production could reach 1 000 tonnes per annum within the next five years. Estimates by Kerr and Howard (1975) on the basis of the availability of suitable sites put the potential production at 50 000 tonnes by farming the sea and 8 000 tonnes per annum using waste heat of industrial processes. This represents about 5% of the current UK consumption of fish by weight but with a concentration on the more highly prices species, could reach 20% of the value of the fleet's catch. It must be stressed that Kerr and Howard's estimate has been based on the availability of suitable sites and that this may not be readily translated into production after thorough consideration of the other limiting factors discussed above.

The potential for the development of farming of other species is not so bright. Carp and eels probably offer the best chances but heated water techniques would probably have to be used to improve the growth rates to economical levels and, in the UK at least, there would probably not be the market to support the high price required to make for paying ventures.

b) Ireland

A further increase in the culture of rainbow trout is forecast to give a production towards the end of the 1980's of approximately 1 000 tonnes.

The experimental cage culture of salmon appears to be proving a success with currently 8 farms involved in producing salmon. In a personal communication, Piggins, the manager of one of these operations believes that a realistic prediction of future production is of the order of 500 tonnes per annum. Along the West Coast there are many inlets which would offer protection for fish culture and the water is of good quality and is warmed by the Gulf Stream. Although these sites are remote, they are mostly within 20-30 miles of population centres and thus road net-works, services, power and labour are within reasonable distance.

c) Denmark

Production of rainbow trout is unlikely to increase greatly in Denmark. The two principal constraints are the availability of suitable water and the uncertain future of industrial fisheries. There are currently over 500 trout farms distributed along the 12 000 km of waterways. These are generally slow flowing small streams and the development of new trout rearing facilities may only be accomplished by placing them close to existing farms. Disease control problems would then become more acute and there would have to be very rigorous control of the water quality, requiring the installation of expensive equipment to purify the effluents. Much of the success of Danish trout rearing has been due to the availability of cheap trash fish. At very best industrial fisheries are not likely to expand and the trout farmers will be obliged to use a greater quantity of the more expensive dried commercial products. This would mean that the Danish fish, the greater part of which are exported, would be as expensive to produce as trout in other countries and sales would be more difficult to make.

There is a limited possibility of cage culture methods developing in lagoons and sea inlets. Although the waters of the West Coast do not have the advantage of being warmed by the Gulf Stream, the shallow waters of the Baltic become warm enough to promote good growth rates. Two commercial establishments for the cage-rearing of rainbow trout encourage further development.

d) FR GERMANY

Although aquaculture has been traditionally practised in Germany, there is little reason to believe that production will increase greatly. In spite of the fact that Germany only produces about 35% of the trout it consumes, production is not likely to become much larger. This is due to a lack of suitable waters and, more important, currently trout can be imported at a lower price from Denmark and Italy. Trout culture using warm water effluents is being considered in Germany along with the culture of more exotic species (see later in this section) but it is doubtful if this will increase the total production significantly.

The low price of imports, this time from Eastern Europe, is likely to restrict any significant expansion of carp farming in Germany. However, extensive culture of carp is unlikely to decline if only because there is no other economical use for the ponds and the culture requires a minimum of effort and expenditure on the part of the farmer. One sector that is receiving particular attention in Germany is the use of warm water effluents for the rearing of a number of species, including exotics (e.g. Tilapia). Theoretically very large quantities of warm water effluent could be used in this way and a number of plants, some of them beyond the pilot project stage, have been established. However, there is a danger of over-estimating the potential in terms of the likely increase in production and attention is drawn to the problems mentioned in the earlier section on warm water culture.

e) Netherlands

An expansion of fish farming, at least for consumption species, is not envisaged in the Netherlands. Most of the species consumed can be imported at a lower price and, in any case, the water quality is generally too poor to promote salmonid culture.

f) Belgium

The comments made about the future of aquaculture in the Netherlands are equally applicable to Belgium.

g) France

In recent years trout farmers in France have been troubled by low water flows in dry summers and it seems that production will only be increased if greater use is made of recirculation techniques. One trout farm in France which recycled two-thirds of its water had a production, expressed as the weight of fish for a unit flow of water, of about double the average for the rest of the country (Brown, 1977). Thus, with improved techniques, albeit requiring capital investment and increased running costs, trout production in France could be increased significantly.

Cage rearing of salmon (both Salar salar and Oncorhynnchus kisutch) is receiving considerable attention in France. According to Kirk (1979), a production of 3 200 tonnes is predicted for 1982 and the eventual aim is to become self-sufficient in salmon. (In 1978, France imported over 13 000 tonnes of fresh or frozen salmon.)

Also at an advanced stage is the culture of marine species in lagoons on the Mediterranean coast. A large farm has been established for the cage culture of, principally, sea-bass and sea-bream in a 7 000 hectare lagoon (Dennis, 1977). This farm is combining the fish production with oyster culture and makes use of warm geothermal water to promote, by way of heat exchanges, the growth of the juvenile stages of the sea-bass and sea-bream. The present establishment would be capable of producing 3 000 tonnes of fish annually and it would obviously have an impact on French aquaculture should it prove viable.

h) Italy

Italy has perhaps the greatest potential for aquacultural development of any of the Community Member States.

Brown (1978) predicts that trout production, given more complete use of the available water, more efficient use of the water (e.g. water recirculation systems) and better diesease control, could increase to about 30 000 tonnes, that is an increase of 67% on the present level of production.

Eel culture has been developing rapidly in Italy from negligible quantities 5 years ago to over 2 000 tonnes currently. It is predicted that this increase will continue to reach a production of 8 000 to 10 000 tonnes annually. This prediction is encouraged by the plans to establish a plant for the mass culture of elvers which will then be sold to small scale eel-farmers for growing on.

Culture of marine species should also develop rapidly from what is currently largely extensive culture to more intensive methods. The major constraint, mentioned by Dill (1976), namely the supply of fry for stocking purposes, seems to have been overcome and a marine hatchery is to be established on the Adriatic coast. The production will concentrate on mullets, sea-bass and giltheads and it is believed that the production could increase 15-fold to over 90 000 tonnes.

(The prediction of 360 000 tonnes in Corrie (1979 a, b) is almost certainly too high: it would amount to 86% of the present total production of all Italian fisheries!)

Another important constraint to the development of Italian aquaculture, both in fresh and brackish water, which has been highlighted by Dill (1976) is the quality of the water. Italian legislation on pollution control is inadequate and the water management is generally ineffective, resulting in the disorderly competition between the different water users. If Italy's great potential in aquaculture is to be realised this problem has to be solved.

i) Greece

As has been mentioned earlier, data on Greek aquaculture are difficult to obtain but it does appear that trout production could be made more efficient and an annual production of over 5 000 tonnes has been visualised (Dill, 1976). However, a source of artificial feeds will have to be found and FAO has suggested to the Greek government that some of the effort in trout production should be switched to carp which do not require the costly high protein food and yet which, in 1973, were being sold at a higher price than trout in some areas.

At present, no serious aquacultural activity takes place in lagoons but this does offer an opportunity for development.

j) Spain

Currently trout production in Spain is increasing and possibly at a higher rate than the 10% predicted by Brown (1977). This may be because, apart from using more of the available water, more efficient use of the water is being made using recirculation and re-aeration techniques. Brown shows that, if work in America on the use of aeration techniques to overcome problems of water availability can be taken as a base, production of trout in Spain could be increased significantly with the use of such a technique. Without improved efficiency, production would be limited to about 10 000 tonnes.

Studies are also being made of salmon culture in Spain. Little is known of the present situation but Brown (1977) predicts that the production may never exceed several hundred tonnes annually. The potential production of 10 000 tonnes reported by Corrie (1979 a, b) is probably over-estimated.

k) Portugal

Portugal has no tradition of aquaculture and the emphasis on marine fish means that aquaculture in fresh-water is unlikely to develop greatly. An increase in production of trout of 20% in the next 10 years is predicted but with the current production at only 250 tonnes, this increase is insignificant compared with those of other countries.

Some work is being done on the culture of marin species but, as yet, no commercially viable establishments exist and there is considerable doubt as to whether or not the cultured fish will ever be able to compete in price with wild caught fish.

S. CONCLUSIONS

By its very nature, the above assessment of the potential production from aquaculture has contained an element of crystal-ball gazing. It would be unwise to total the various potentials mentioned for the individual countries in order to arrive at a Community potential because there are so many gaps in the information, the estimates are of differing reliability and with differing time scales and because, in some sectors, developments are so rapid as to soon render the estimates out of date. In the latter case, an up-dating would probably result in an increase in the predicted production. This, together with the fact that in many cases the author has deliberately aimed at the pessimistic side of realism, means that, in the final analysis, the potential will have been very conservatively estimated.

Several general conclusions may be drawn:

1) In most of the Community countries nearly all of the available fresh waters are being used. Expansion of production should be possible with the more efficient use of the available

water in all countries, but particularly in France, Italy and Spain.

2) There will be a development of cage culture of salmon along the northwest seaboard of the Community and the potential production could be at least equivalent to the current wild catch. The development in this sector will depend to some extent on the availability of trash fish, or other animal waste, as food.

3) Considerable effort is being made in a number of Community countries to develop farming of marine species and, although there are few if any existing commercially viable establishments, there is a considerable potential. This culture will not be aiming to supplement the catches of the more traditional marine food fish (e.g. cod, haddock, plaice) but will be aiming for the upper end of the market (e.g. turbot, sea-bass).

4) On a limited scale, successful use is being made of warm water effluents. Although care should be taken not to over-estimate the potential, it does provide the possibility of increasing production on selected sites.

5) In the northern part of the Community, the culture of carp and eels, without the use of warm water, does not have a great potential due largely to the time required to reach a marketable size. In the case of carp an additional constraint is the competition with cheap imports from Eastern Europe.

6) Finally it must be repeated that all forms of aquaculture are in direct competition with the 'wild-caught' industry. In the present unsettled situation of fisheries management policies which may greatly affect the supply of trash fish and the price of wild-caught food fish, to name but two examples, will have a great effect on the development of aquaculture and it would not be surprising if potential investors in aquaculture awaited a clarification of the political situation.

CHAPTER 14

SHELLFISH CULTURE

SHELLFISH CULTURE

A. Introduction

The previous two chapters have dealt with the present situation and the future of fin-fish culture. However, shellfish culture, particularly of molluscs, is currently more important, at least in terms of the volume of production, than that of fin-fish.

The great problem is distinguishing clearly between culture techniques and the harvesting of wild stocks. Many shellfish being sessile creatures, or having limited powers of movement for the greater part of their lives (e.g. oysters and mussels), makes the use of methods to improve the habitat more economical. Thus wild stocks may be encouraged to settle and multiply in a natural habitat by such methods as the scattering of oyster shell on a ground to encourage the settling of spat or by introducing frames to increase the available surface which may be colonised. /The Liaison Working Group of the ICES Statistics Committee considered this problem recently when discussing the improvement of statistics on aquaculture and one suggestion was that aquaculture production should include the production of stocks which are physically isolated from wild stocks or which are grown using introduced structures which assist harvesting/ Unfortunately in the current statistics little or no distinction is made between wild and cultured stocks and even in the paper entitled 'Marine fish and shellfish culture in the Member States of the European Economic Community' (Kirk, 1979), it is clear that the production data quoted include harvesting of what are properly wild stocks.

B. Current Situation

With the exception of very small quantities of farmed shrimps, farming of shellfish in the European Community is restricted to the production of mussels and oysters. The production statistics (see Table 14.1) do not distinguish between wild and cultured stocks but most of the oysters are probably cultured, since the wild stocks have been much reduced in recent years. Indeed, most of the production, 97% of which comes from France, is of the Japanese oyster (Crassostrea gigas) which does not normally spawn in natural conditions in Community waters. The situation with mussels is very much less clear. Although the Netherlands is the biggest producer, France, Denmark and Spain also produce appreciable quantities. Much of the production is from 'wild' spat that have been encouraged to settle on the designated beds or introduced structures. In addition there are purely wild stocks that are being exploited but in many cases these stocks give a product of lower quality than those from cultured beds. Part of the reason for this is that these wild stocks tend to come from deeper waters where the shell is of a lighter colour.

C. The Future of Shellfish Culture

The prospects for true culture of molluscan shellfish would seem to depend largely on a form of sea-ranching. In various situations breeding stations are developing techniques for producing spat of a number of species, including oysters, scallops and carpet shells, which are then liberated on the beds in regions where the natural spat-fall is insufficient or variable. While there would appear to be good prospects for oyster culture the main restraints to development for other species do not appear to be technical but of marketing. Mussels are a low-value product and thus very large quantities have to be produced to make the venture economically viable. For other molluscs being considered (for example the ormer and razor shells) markets have really to be developed. However, studies have shown promising prospects in certain cases: Ventilla (1977) estimated that production costs for scallops and queen scallops in Scotland could be kept within commercially favourable limits assuming reasonably high levels of spat production.

Crustacean shellfish have generally a very high market value and thus it is not surprising that much research is being conducted on their culture. Kirk (1979) does not believe there will be major progress in the controlled production of crustaceans although sea-ranching of lobsters may expand. Most of the other species being considered for culture are not endemic to the region. This may give rise to marketing problems and it seems likely that culture of shrimps and similar crustaceans will be successful only on a limited scale in favourable conditions.

Table 14.1: Production of cultured shellfish species in the EC in 1978 (metric tons live weight)

	Oysters	Mussels	Total
FR Germany	1	11 760	11 761
France	95 304	50 417	145 721
Italy	0	4 807	4 807
Netherlands	1 124	118 485	119 609
Belgium	-	-	-
United Kingdom	450	7 200	7 650
Ireland	756	3 018	3 774
Denmark	-	46 756	46 756
EUR 9	97 635	242 443	340 078
Greece	-	-	-
Spain	422	65 770	66 192
Portugal	0	6	6
EUR 9 + 3	98 057	308 219	406 276

CHAPTER 15

UNDER-UTILISED FISHERY RESOURCES

UNDER-UTILISED FISHERY RESOURCES

A. INTRODUCTION

The decline in catches of some of the traditionally important food fishes (e.g. cod and herring) in recent years and the fact that many of the other stocks are currently being exploited to such an extent that they can, at best, only make up a small part of the deficit has caused the fishing industry to look for under-utilised fishery resources. These resources may be divided into two major groups. Firstly, there are those species that are currently marketed but for which catches could be increased considerably. Secondly, there are those species which are currently not target species (that is, species at which a fishery is primarily directed) but for which considerable catches could be made and a worthwhile market developed.

It should be noted that this section was compiled partly from a symposium on 'Under-utilised fish resources' organised by the Fisheries Society of the British Isles at Queen Elisabeth College, London on 9 January 1977. The proceedings of this symposium have not been published but the programme is given in Appendix A.

B. MARKETED SPECIES

i) Blue whiting

The development of a fishery for this species has been given a great deal of publicity in the last few years but, as for many species which have not been fished to any great extent in the past, there are large gaps in our knowledge of the biology and population dynamics which could cause the estimates of the potential for the fishery to be revised.

This fish, which grows up to about 40 cm in length, is found widely in the NE Atlantic (see Figure 15.1), mainly along the edge of the continental shelf. Large spawning populations are

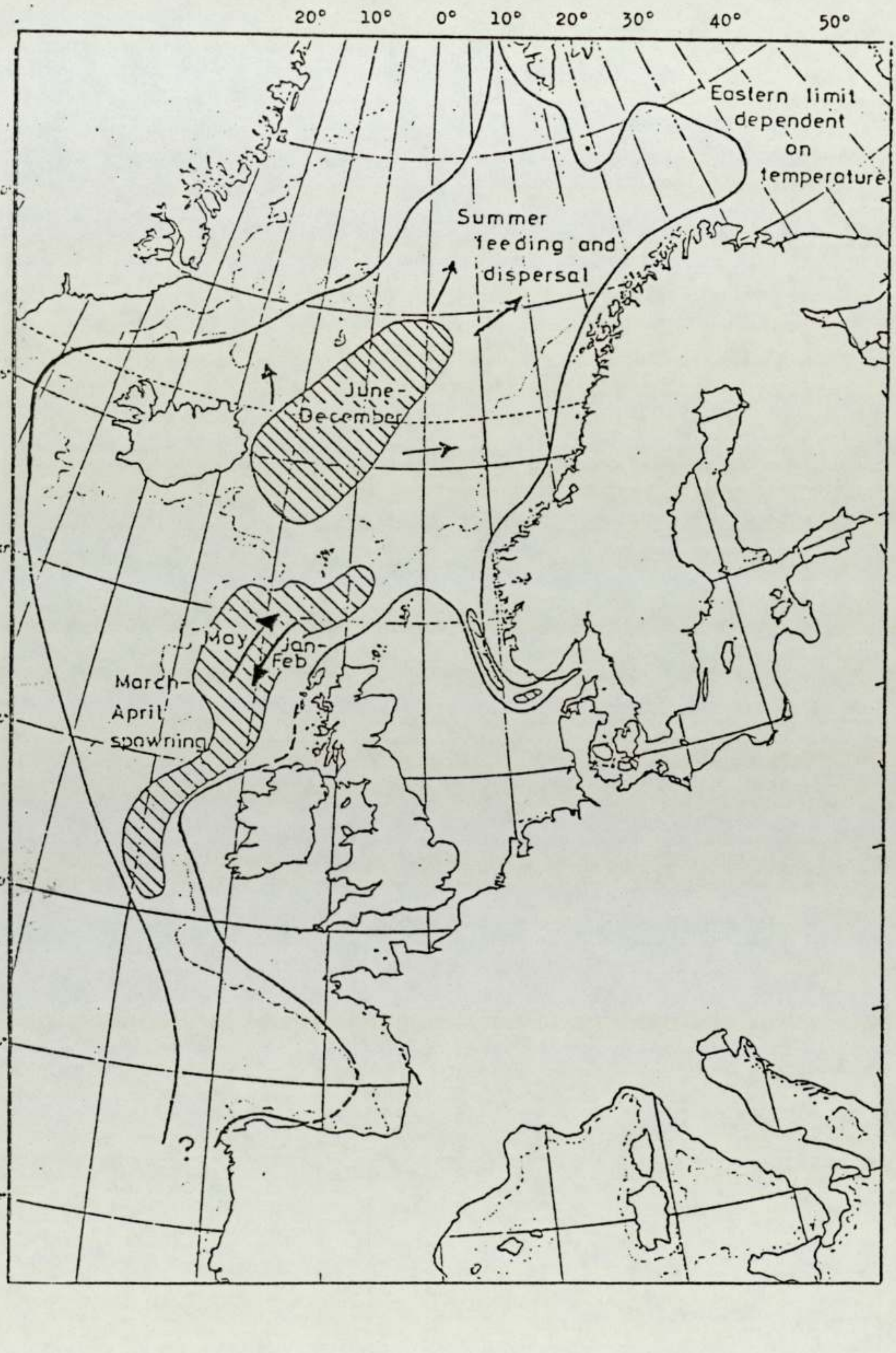


Fig. 15.1: Adult distribution and migrations of Blue Whiting.

found off the W and NW coasts of the British Isles in March and April (ICES, 1977a). The species is also found and exploited to a limited extent in the Mediterranean. Its food is fish eggs, young fish and krill.

Table 15.1 shows the nominal catches of blue whiting in the NE Atlantic in recent years. It can be seen that catches have increased sixteen fold in the period studied. Population estimates on blue whiting stocks have been largely conducted by acoustic surveys. This method is not of great accuracy but it does produce minimal estimates for the spawning population of 10 million tonnes (ICES, 1977a). Since the fish only matures at 3 years of age and fish up to 20 years are found in the population only a relatively small proportion of this total would provide the level of a maximum sustainable yield. However catches could probably be increased considerably without adverse effects on the population (ICES, 1978a).

At the present time most of the catch is reduced to fish meal but fish of about 30 cm in length are suitable for processing. The flesh is palatable but the fillet is small. Other disadvantages are that the black membrane of the body cavity is not liked by the processing industry and the liver is often heavily parasitised. In spite of these disadvantages this species would appear to offer possibilities for the processing industry.

The main fisheries, which are generally conducted using a mid-water trawl on the edge of the continental shelf, are shown in Figure 15.2. Some of these fisheries are within the EEC's economic zone.

ii) Atlantic mackerel

As was seen in Chapter 3 on the recent trends in catches the Community's mackerel catches have been increasing rapidly within the last few years until in 1978 mackerel became the

Country	1970	1971	1972	1973	1974	1975	1976	1977	1978
USSR	21600	63700	13200	8200	2187	18090	26730	71027	210857
Spain	10300	10300	19800	18800	17683	22212	18199	17883	9672
Norway	-	-	700	2400	3420	8319	25859	40109	117768
Faroe Is	-	-	-	4900	4100	482	14080	29689	43478
Denmark	-	-	-	-	-	-	7560	34816	78302
FR Germany	-	-	-	-	2657	35	33	10113	16281
UK	-	-	-	-	3	734	1974	4643	6898
TOTAL	32000	74100	34300	34700	30510	54581	111700	234942	536063

Table 15.1: Nominal catches (tonnes) of blue whiting in the NE Atlantic in 1970-78.

Source: FAO

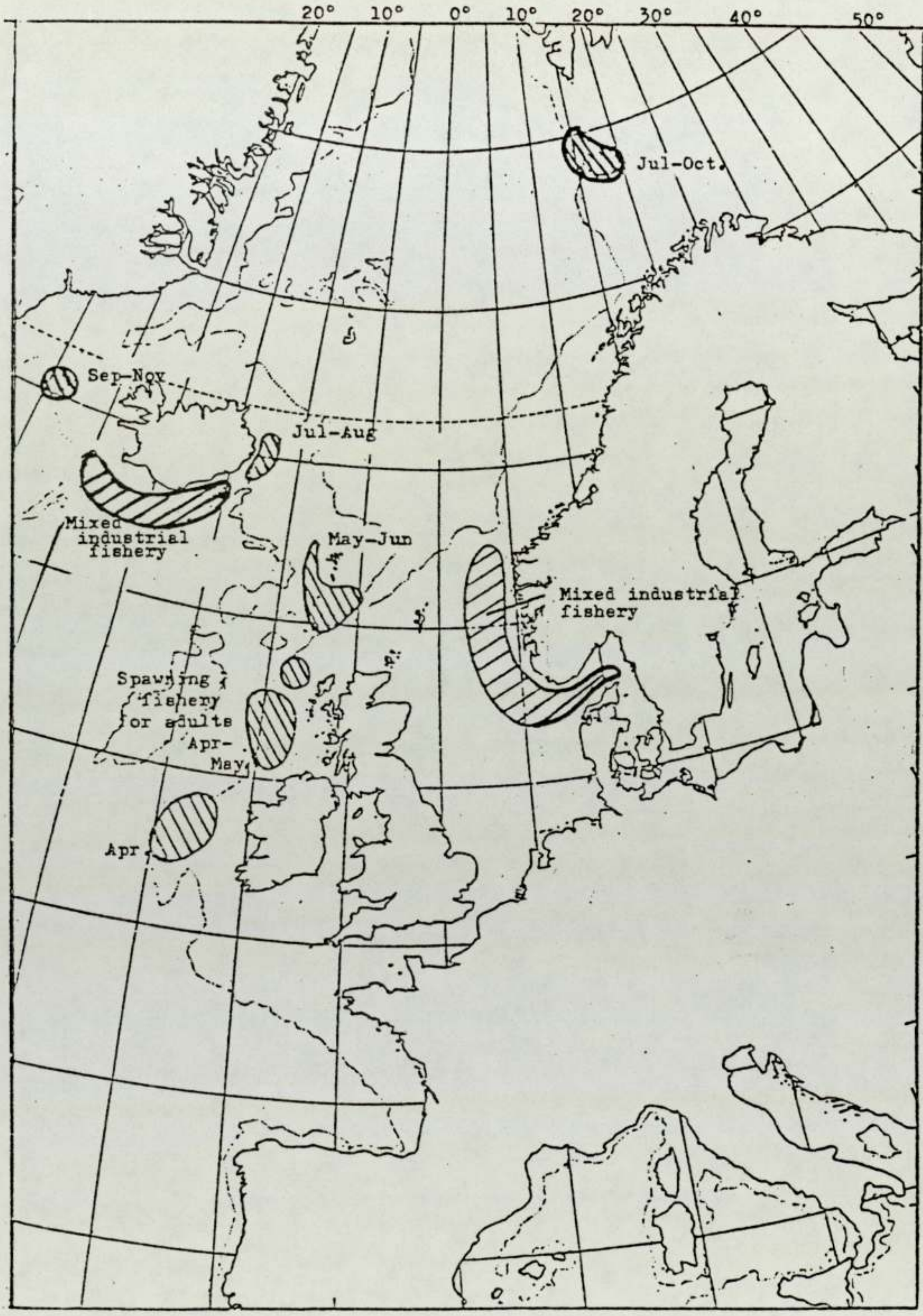


Fig. 15.2: Fishing areas for Blue Whiting

Source: ICES, 1978a

most important of all species, in terms of the weight caught. This increase was anticipated because the exclusion of the USSR from the Community zone in 1977 meant that the Soviet catch of about 1/4 million tonnes annually was available to Community vessels which had been excluded from distant water grounds.

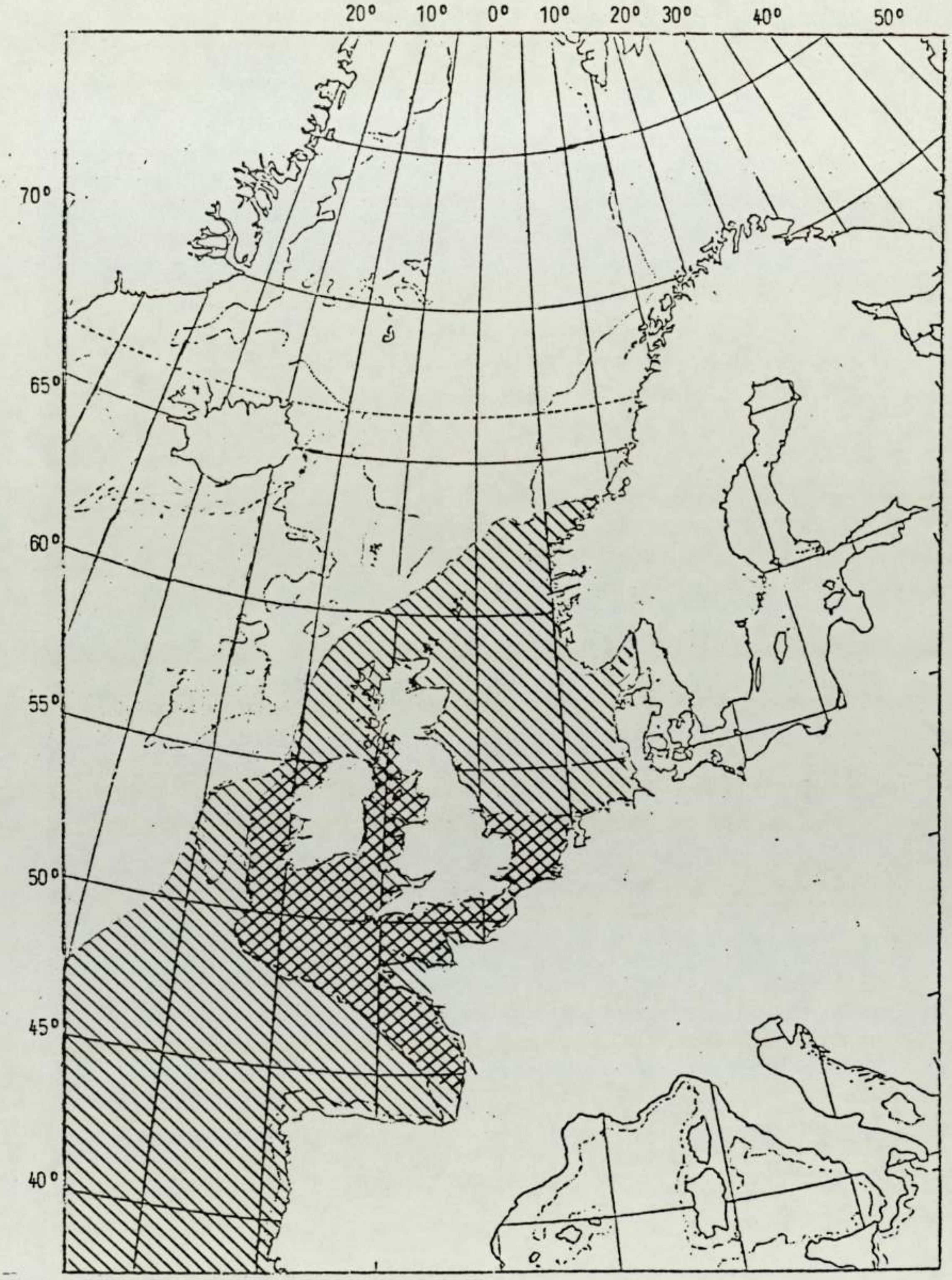
There are two stocks of this species in the NE Atlantic: a western stock, which is fished off the Cornish coasts between November and March and in the Minch in the summer, and a North Sea stock for which the main fishing season is July to October. There is a considerable migration of the western stock into the North Sea and a more limited migration in the other direction (Lockwood, 1978). At the present time about 60% of the total mackerel catch is obtained in the Western area.

The state of the two stocks is very different. Stock assessment experts are in general agreement that the fishery in the North Sea will have to be carefully controlled and currently offers little hope for expansion. This fishery, largely conducted by Norwegian vessels using purse-seines, produces fish for reduction to meal and oil. The situation in the Western area is rather less clear. Advice from the assessment working groups of ICES has changed considerably in a relatively short time. For example in 1977 the total allowable catch (TAC) was set at 250 000 t: the following year the TAC had risen to 450 000 t. Lockwood (1978) explains this change in advice on improvements in the methods of stock assessment and the availability of improved data. A TAC of 450 000 t would permit the Community to take up the quantity of fish not now being taken by the Soviet Union without danger to the fish stock. More recently, some experts, particularly the British, are expressing the need for caution in the expansion of the fishery. Other experts believe that this caution is unwarranted at the present time and suggest that it may be associated with the negotiations on the Common Fisheries Policy!

A large proportion of the catch from the western stock is transferred by mainly British vessels to factory vessels from Eastern European countries and the resultant processed products are exported to West Africa. Mackerel is currently not greatly esteemed as a food fish in the United Kingdom and much of the catch landed in that country is consigned for reduction to meal and oil. An intensive publicity campaign has increased the consumption of cured and canned mackerel but it does seem likely that the greater part of the catch will be exported either in the fresh state (that is, transferred to foreign factory vessels) or as canned products. It is to be hoped that the latter becomes more important than the former in order that the Community may use the increased value of a processed product against that of the raw material to at least finance the import of the more expensive and more appreciated traditional food species.

iii) Horse mackerel

This species has about the same distribution as that of the mackerel (see Figure 15.3) and is another which is not consumed to any great extent in Western Europe. Although catches are made in the North Sea, by far the greater proportion of the catches come from Norwegian waters and western areas. Until their exclusion from Community waters the Russians were the most important nation in the fishery, taking about 100 000 t annually. Although data for stock assessments are limited, there appears to be general agreement among the experts that there would be no harm to the fish stock if the former Soviet catch were taken by the Community.



<u>Fig 15.3</u>: Total range and main distribution area of horse mackerel in the Northeast Atlantic.

<u>Source</u>: ICES, 1977b

Horse mackerel is a good substitute for mackerel but, consumption in Western Europe being low, the best market for products would appear to be in W. Africa. At present the greater proportion of the British catch is consigned for reduction to meal and oil (Lockwood and Johnson, 1977). It does have one disadvantage over mackerel in that the roughness of the skin causes handling problems, both on board ship and in processing.

C. NON-MARKETED SPECIES

In the previous section much of the emphasis was directed to finding new grounds, at least as far as the Community is concerned, on which to fish for species for which an interest already exists on the market. The present section is concerned with finding new species. The most promising new species are deepwater fish caught at depths down to 500 m (normal trawling activities do not extend much below 200 m). Exploratory surveys to the West of Ireland by the British Ministry of Agriculture, Fisheries and Food have shown that existing fishing gears can be used down to such depths with only minor modifications (Bridger, 1978). Indeed the only major adaptation necessary is the fitting of a trawl winch large enough to carry over 3 000 m of warp. One of the major advantages shown by these surveys was that the catches were of appreciable quantities and showed little seasonal variation. (This should be compared with the fishery for blue whiting which although promising good quantities is seasonal in nature. Indeed the season for blue whiting tends to overlap with that of mackerel fishery in the Southwest of England.)

The catch from these surveys may be divided into four categories:

i) Marketable species. These species for which markets already exist made up about 17% of the total catch. The major component was blue ling but smaller quantities of hake, angler, tusk and rays were also caught.

ii) Potentially marketable species. Species placed in this category amounted to 40-60% of the catch and the following were the most frequently encountered:

a) Roundnose grenadier (*Coryphaenoides rupestris*) This species which is widely caught in marketable quantities by USSR in the NW Atlantic has a flesh with a cod-like texture but the fillet is rather small.

b) Black scabbard fish (*Alphanopus carbo*) This fish for which there is a long-established commercial long-line fishery off Madeira is a bathy-pelagic species. Thus bottom trawling is probably not the appropriate method of capture. It is not a species easy to gut by hand because of its long sharp teeth and a sharp spine near the anus. Its flesh is very firm, white, of pleasant flavour and has good keeping qualities.

c) Director fish (*Gephyroberyx darwini*) This fish was unfortunately not caught in large quantities. The flesh has a pleasant sweet flavour and, being a deep-bodied fish of 50-70 cm in length, it would be a popular fish with the processing industry.

iii) Sharks. These fish made up 20-25% of the total catch and were represented by about 20 species. The palatability of the species tested was considered to be in no way inferior to the commonly marketed spur dog but the rough skin was difficult to remove and made the general handling of the catch difficult.

iv) Trash fish. These species which made up about 20% of the total catch are very watery (e.g. *Alepocephalus* spp), have a very bitter tasting flesh (e.g. *Chimaera monstrosa*), are very bony (e.g. *Hoplostethus mediterraneus*) or are simply too rarely caught to be of commercial interest.

D. GENERAL CONSIDERATIONS

These deep-water fishing grounds lie within 200 miles of the British Isles (and thus within the Community zone): indeed the most productive grounds in the recent surveys were within 100 miles of Scotland and the Irish Republic. Although little is known of the population dynamics of the fish from these grounds, it has been estimated that there is 100 - 400 000 t of potentially marketable fish available. The cost of deep-water trawling is not much greater than on the present grounds, although, because of the time required for shooting and hauling the trawl, the number of hours fishing is reduced from about 18 hours/day on normal grounds to 15 hours/day. It has been estimated that a 28 day trip to one of the more productive of these deep-water grounds would produce about 260 tonnes of marketable fish compared with 200 tonnes from a trip of similar length to conventional distant water grounds. This means that, if the gross receipts from a deep-water trip are to exceed those for a conventional trip, the price of the deep-water species would have to be about 80% of the price for cod and haddock.

It must be stressed that, for most of the species mentioned in this chapter, insufficient information is available on the population dynamics and, in particular, on the inter-specific relationships. It will be most important for the management of these under-utilised resources that such information should be available.

Another problem that has to be overcome with many of the species is that the housewife will have to be weaned away from the conventional fish species. The new species will have to be subjected to an intensive publicity campaign. In many cases it seems that the new species will only be accepted in a processed form.

CHAPTER 16

KRILL.

KRILL

A. INTRODUCTION

Much attention has been focused in recent years on the work into research and development of the fishery for krill in the Antarctic. Among the nations working in this sector are the USSR, Japan, Poland, FR Germany and Chile. It must be said that, at the present time, there is no commercial fishery for krill and that great care has to be taken in translating the results of exploratory exercises into the prospects for an economically viable fishery.

B. KRILL AND ITS BIOLOGY

Before considering the fishery, it is necessary to look a little at the target of the fishery. Krill is a euphausid crustacean and the use of the common name is generally restricted to Euphaisia superba (see Fig. 16.1); in fact at least five other euphausids are found in the Antarctic but E. superba is usually found in larger concentrations and is of a larger size (5 cm) (Everson, 1977). The distribution of krill is geographically limited to the circumpolar waters south of the Antarctic concergence (Marr, 1962) (see Fig. 16.2). This convergence is the well defined northern limit of the cold Antarctic surface water and lies between a latitude of 50 - 60°S (Everson, 1977). However, the distribution is very variable (Marr, 1962; Mackintosh, 1973; Nemoto, 1968) and the suggestion has been made that there may be geographically distinct populations (Mackintosh, 1973) or even distinct races (Makarov, 1974).

Marr (1962) reports that the vertical distribution of krill is in the upper 100 m and more frequently in the top 10 m. However, Shevtsov and Makarov (1969) have found significant numbers of krill down to 400 m. These same workers have also found that there is a tendency for sexually mature krill to undergo diurnal

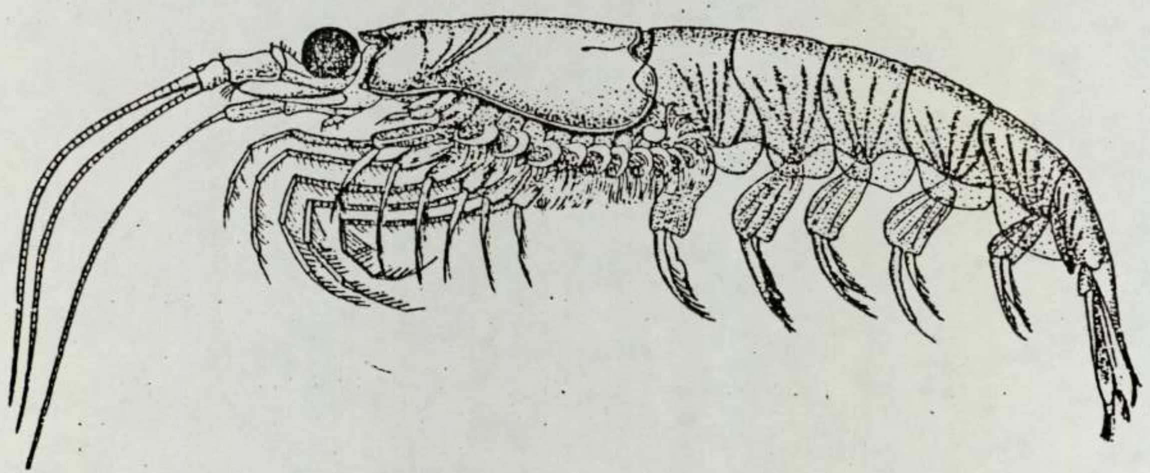


Fig. 16.1: The euphausiid *Euphausia superba* (5cm), the krill of Antarctic waters.

Source: Clarke and Herring, 1971.

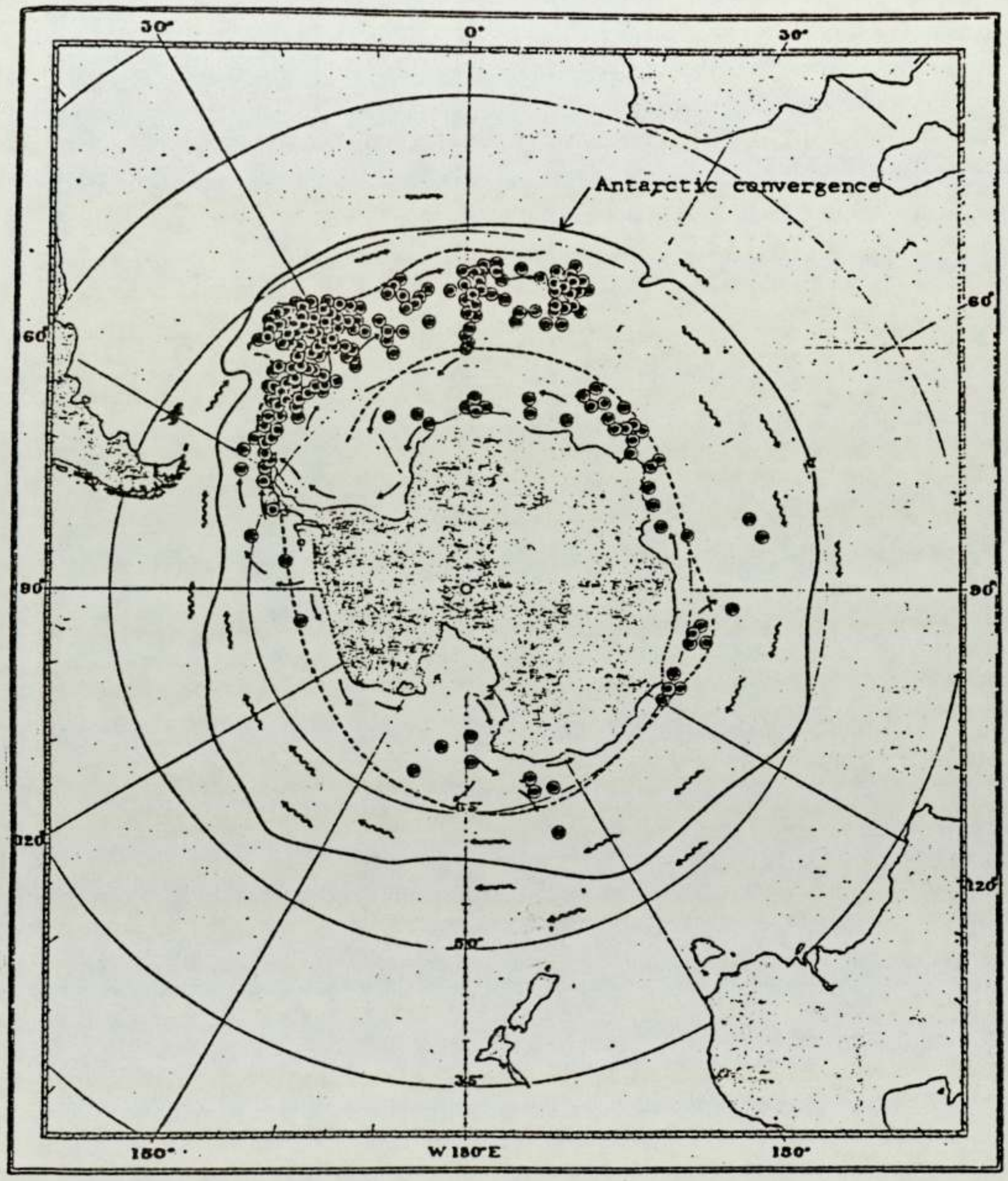


Fig. 16.2: Principal concentrations of the Antarctic krill (Marr, 1962).

vertical migration in the top 80 m and Pavlov (1974) has related this to the feeding of krill on the surface phytoplankton. Nakamura (1973) suggests that light intensity governs these vertical migrations, the densest swarms being found on dark nights.

Krill certainly form dense swarms; a swarm being defined as a dense aggregation of individuals moving harmoniously (Everson, 1977). These swarms may be several hundred metres across. An important point still requiring investigation for the management of the resource and for the rational exploitation of the fishery is the density of the swarms. Marr (1962) suggests that after hatching only very few krill exist outside of swarms and that the density of these krill is approximately 6 kg krill per cubic metre of water. Other workers are less sure; Pavlov (1969) and Shust (1969) believe swarms to be transient and related to food availability. Nakamura (1973) has related swarming to light intensity.

Krill feed very largely on phytoplankton but Mauchline and Fisher (1969) have shown that krill also accept detritus and animal matter. These feeding habits are important because the phytoplankton may taint the krill (Eddie, 1977) and may even make the krill toxic to humans (Sahrhage, unpublished)

At the present time, only very approximate estimates are available of the quantity of krill that may be available for harvesting. Krill are eaten in considerable quantities by whales, seals, birds, fish and cephalopods and the estimates of potential yields of krill have been made by a comparison of the populations of whales and other predators before the whales were very heavily exploited by man with the present population of predators. Laws (1977) estimates the surplus production of krill, that is, the quantity of krill that may be available to man without adversely affecting the environment, at about 150 Mt. Sahrhage (mimeo) puts the quantity rather higher at 200 Mt but suggests that to obtain this the seal populations, which have increased with the decrease in whale populations, should be cropped. Of course, these estimates would have to be drastically revised should strict management measures result in a large increase in the whale populations. In any case the estimates are rather crude and are no substitute for a direct knowledge on the population dynamics of krill, a topic which has received very little attention up to the present. But, in any case, there would appear theoretically, at least, to be a considerable potential for the development of a krill fishery.

C. CONSIDERATIONS IN THE DEVELOPMENT OF THE FISHERY

The development of the fishery poses a number of technical questions to which answers cannot be supplied from experience in other fisheries. The magnitude of the problem may be ascertained from the following list of sample questions:

1) How may the swarms of krill be located?
2) How can the composition of a swarm be determined? Does it contain a large proportion of other animals of little or no commercial value e.g. salps? Is the swarm feeding and thus likely to produce a final product of inferior quality?
3) What is the best method of harvesting krill?
4) What is to be the capacity of the processing plants aboard the vessels?
5) Given the frequent adverse weather of the Antarctic, what are the support facilities required by the fishing vessels?
6) In what form is the product to be marketed?
7) Is the fishery likely to be economically viable?

D. DETECTION OF SWARMS

Thus the initial problem is one of detecting the presence of a swarm and ascertaining its composition. The first part of this presents no great problem in that it is accepted that the vertical echo-sounder is a suitable device for detecting a swarm. When the krill are at a depth beyond the range of the sounder the technique of detecting the fish feeding on the swarm has emerged (Eddie, 1977). Low frequency transmissions have proved useful in determining which of the swarms are of high density. Rakusa-Suszewski (1976) states that with experience it is possible to distinguish between the echoes from krill and those from salps but more work is needed on this topic. From these remarks it will be seen that this specific point has been covered fairly well and certainly should not be a limiting factor on the success of the fishery.

E. METHODS OF CAPTURE

Early attempts to catch krill seem to have concentrated on the use of purse seines, that is nets which surround the swarm, the bottom of which is then closed. However, the attempts by the Russians and the Japanese do not appear to have been very satisfactory and have apparently been discontinued (Eddie, 1977). More recent fishing trials have been conducted using midwater or pelagic trawls. One important behavioural pattern of krill which has implications in the method of capture is that krill are not shepherded by a net. When trawling for fish the boards in front of the net and the mouth region of the net both tend to direct the fish into the cod-end. Consequently the mesh of the net at its foremost end can be considerably greater than would be required to retain the fish. Only in the cod-end does the mesh have to be finer. Krill take no avoiding action and thus would pass straight through the mesh in the mouth of the net if it were not of very fine mesh. The absence of a shepherding effect of the trawl boards (which greatly enhances the power of a normal trawl) means that the trawl would have to have a very large mouth to have an adequate fishing power. However, the very small mesh required increases the drag to such an extent that only nets with a mouth of about 400 sq m are practicable (compared with a normal mid-water trawl with a mouth of 2 000 sq m). Being of small mesh the nets are constructed from finer materials and this causes a problem in that the net is not as strong as may be considered desirable (Eddie, 1977). Various methods have been used to increase the strength of the net including reinforcing certain panels and enclosing the krill net inside a more conventional trawl.

Even with a trawl of limited dimensions the power required to tow it is considerable and it is apparent that trawling for krill will only be practised by the larger fishing vessels or by vessels having other methods of increasing their power (e.g. thrust-augmenting nozzles).

Another behavioural pattern of krill which needs to be taken into account when designing fishing gear is the tendency for krill to clump together. This may occur in the net well in front of the cod-end, and in order to limit the resultant strain, circumferential reinforcement has to be added.

F. VESSEL DESIGN

In the choice of vessels for a krill fishery, a number of important factors have to be considered. Firstly, for Community countries at least, the vessels would be required to stay at sea for long periods. The krill fishing season lasts only for about six months and the economics of the fishery would be seriously affected should frequent visits to a port be required. Thus the ship will have to carry a great quantity of stores and have comfortable accomodation for the crew. It will also have to have a considerable space for the storage of the fishery products. Some of these problems may be alleviated by the use of a mother or supply ship but this non-productive unit would influence the viability of the venture.

Krill deteriorates very quickly after capture and, preferably, has to be processed within an hour. Catch rates, even with the small trawls are reported to be large (20 t/hr) (Eddie, 1977) and although various trials have been initiated to spread evenly the flow of krill to the processing plants (by, for example, having a flexible tube from the cod-end of the vessel) the technicalities involved cast doubt on their effectiveness and one has to accept that the processing plants will have to have a large throughput capacity to cope with the bursts of activity to which they will be subjected. (In this respect krill fisheries differ from normal distant-water freezer trawlers. In the latter the processing plants can have a relatively small capacity because it is possible to have buffer storage in which fresh fish may be stored for several hours while awaiting processing.)

G. SUPPORT FACILITIES

Closely associated with the harvesting are the back-up facilities which will be required in one of the world's least hospitable regions. The probable necessity for mother or supply vessels has already been mentioned. Land bases are rather infrequent in many areas and one can easily be 4 days by sea from the nearest aircraft landing strip; in cases of accidents this delay could be critical. In the area south of the Antarctic convergence there are no normal facilties for taking on stores, bunkering or obtaining repairs. Most of the old whaling stations had such facilities but they have fallen into disrepair. Radio and navigational aids in the region will also need improving. Obviously there will have to be a considerable effort made to provide the safeguards necessary for the fleet and the cost of supplying the safeguards has to be taken into account in the final analysis of the viability of the venture.

H. MARKETING OF KRILL

Of course, one of the major considerations in the development of a krill fishery is the method of marketing the product. A range of products are being developed, from meal to paste to blocks to whole tails. Krill meal has certain advantages in that it requires no grading of the krill (all sizes can be used) and of course requires a minimum of storage space, which could be a vital consideration in such a fishery. However, it would have the disadvantage of fetching a low price. Krill tails would probably be at the other end of the market. It is more expensive to produce in that the larger krill have to be selected and then passed through a number of processes; centrifuging to remove the guts and other internal organs and then cooking, freezing and sand-blasting to remove the shell. But it does seem certain that the final product of high quality meat would obtain a good price.

In between these two products are the pastes and the constituted blocks. These products are obtained by cooking, mincing and pressing. Various other products are under trial though little information is available about them. The Japanese seem to have developed a method of individually freezing fresh krill (bulk freezing of fresh krill results in an inferior product), and the Russians have tried salting and canning methods but seem to have had only a limited success.

I. KRILL AS A FOOD

As a food, krill would appear to have a good future. Grantham (1977) reports that on average it has a dry weight composition of 65% protein, 14% fat and 6% carbohydrate. All the essential amino-acids are well represented and krill is potentially a significant source of vitamins A, D and the B group complex. One disadvantage of krill is the very high proteolytic enzyme activity. This results in autolysis and the fresh product rapidly deteriorates in quality, accounting for the necessity of rapidly processing fresh krill. This processing normally includes a cooking process to inactivate the enzyme. Krill products can give rise to other storage problems due to the oxidation of the volatile fats present.

J. ECONOMIC VIABILITY OF KRILL FISHING

The last question posed earlier in this study is the most difficult to answer. No commercial fishery, at least in the way commercial is used in the Western world, yet exists for krill and great care has to be taken in relating the experience of research cruises to the economic viability of such a fishery. For example research vessels have achieved catches of about 20 tons per hours fishing; could this encouraging level of catches be expected on a routine basis by commercial vessels?

An important point is the potential yield from the fishery. The estimates quoted earlier in this study were made not from observations on the krill but from studies of predators. It is quite probable that the potential yield has been greatly over-estimated.

While krill would appear to be an acceptable human food no large scale studies have yet been undertaken to test its acceptability to the general public. At the present time it is not possible to put a market price on the products; it could well be that a price determined from the requirement for a just return on the expenditure of time and materials would price the product out of the market. At present it certainly seems that krill meal as an animal food will not be an economic proposition.

K. SUMMARY

The brief account of some of the technical problems shows that they are frequently outside of experience gained in other fisheries. Certainly new techniques of fishing will have to be learned and the crews trained accordingly.

It seems highly probable that the fishery would require specially constructed vessels, or at least extensively modified existing vessels. They would have to be very sea worthy to withstand the frequent adverse weather conditions of the region, having very comfortable crews quarters, considerable storage space (for stores, fuel and the products of the fishery) and good navigational equipment. The processing equipment aboard would be highly specialised (except where meal was being produced) and capable of a high throughput. The fishery would only last for about six months per year and efforts would have to be made to find another gainful activity for the vessels. However, at present, there would appear to be no other fishery to which these vessels could be diverted. This is a very serious consideration in a viability study.

Brief mention has been made of the support facilities that will be required. These will include improved communications and navigational aids. Land bases will have to be established or extended to supply and succour the men and vessels. In a fishery lasting only half the year the vessels' owners will obviously wish to have the vessel working for as much of that time as possible. This could involve the provision of mother ships to permit refueling and the taking on of stores at sea. It may also be considered desirable to have the relief crews available to extend the proportion of the time that is spent fishing. It would certainly be unreasonable to expect one crew to work continuously for six months in such a region. All of the costs of these items must be charged against the fishery.

In conclusion it can be said that there is a resource that does have potential for the development of a fishery for krill, but that the unbounded optimism that has been expressed in some quarters is probably misplaced. It should not go unnoticed that the research and development involving exploratory cruises have all been undertaken by governmentally sponsored organisations. As far as the author is aware no commercial organisation has yet made a serious attempt to exploit the resource.

CHAPTER 17

FISH MEAL AND OTHER PROTEIN SOURCES FOR ANIMAL FEED.

FISH MEAL AND OTHER PROTEIN SOURCES FOR ANIMAL FOOD

A. FISH MEAL

Originally fish meal found its major use as a fertiliser but it is now considered much too valuable a product for this purpose, being used extensively in the rearing of pigs and poultry and in aquaculture. Its value is attributed to the quality and quantity of protein present: about 85% of the solids are protein and the balance and availability of the constituent amino acids (see Table 17.1) are superior as animal feed to those found in, for example, meat meal and soya bean meal.

Fish meal is the ground solid product resulting from the removal of most of the water and some or all of the oil from fish. Fish oils are highly reactive and are removed to improve the keeping qualities of the fish meal. The simplest method of producing fish meal is to dry the fish in the sun. However, the climatic conditions in Western Europe preclude this and the fish meal is produced here using special machinery which cooks, presses, dries and grinds the raw material. Since the composition of fish differs widely from species to species and from season to season, the quantity of meal obtained from a given quantity of raw material will vary. But, as a specific example, 1 000 kg of an oily fish might be expected to yield 212 kg of meal and 108 kg of oil (Windsor, 1971). It is also difficult to generalise on the extent of the reduction in water content that takes place in the manufacturing process but, again as one example, in an oily fish the water content is reduced from 70% in the raw fish to 9% in the final product (see Table 17.2).

B. FISH MEAL BALANCE SHEET

The supply situation may be best followed by the construction of simple supply balance sheets from data on production and foreign trade published by FAO. These should not be treated as true balance sheets (see Appendix B: Methodology of Supply Balance

Table 17.1: Composition of raw fish and fish meal

	Water	Solids	Fats
Raw fish	70%	18%	12%
Fish meal	9%	85%	6%

Table 17.2: Amino acid composition of fish meal (g/100 g protein)

Amino acid	Herring meal	White fish meal
Lysine	7.7	6.9
Methionine	2.9	2.6
Tryptophan	1.2	0.9
Histidine	2.4	2.0
Arginine	5.8	6.4
Threonine	4.3	3.9
Valine	5.4	4.5
Isoleucine	4.5	3.7
Leucine	7.5	6.5
Phenylalanine	3.9	3.3
Cystine	1.0	0.9
Tyrosine	3.1	2.6
Aspartic acid	9.1	8.5
Serine	3.8	4.8
Glutamic acid	12.8	12.8
Proline	4.2	5.3
Glycine	6.0	9.9
Alanine	6.3	6.3

Sheets) since there may be differences in definition both between the countries and between the different items recorded. Furthermore, no account is taken of the variation in stocks: under favourable conditions fish meal may be stored for several years with little spoilage and almost certainly considerable stocks do build up. However, the extent of these stocks is not generally known and, for these tables, the 'variation in stocks' should be assumed to be included in 'domestic uses'. It follows that the definition of self-sufficiency formulated in Appendix B has been modified; the quotient now becomes 'the total of variation in stocks and domestic uses'. This may have an effect on the short-term calculations of self-sufficiency but the effect will be less pronounced in the long-term. Table 17.3 is the balance sheet for fish meal established for the year 1978.

This table shows that three Member States of the EEC, namely Denmark, the United Kingdom and FR Germany, account for 95% of its production of fish meal. The latter two of these states are also remarkable in being the world's two biggest importers of fish meal. In the period 1951-78 the Community's production of fish meal has tripled to about 500 thousand tonnes per year (see Fig. 17.1): in the same period the world production increased six-fold to 4.7 million tonnes (see Fig. 17.2). The Community's self-sufficiency fell sharply in the period to 1970 but subsequently rose, a fact that will be discussed later.

C. COMMUNITY IMPORTS OF FISH MEAL

As to the origin of the Community's imports, Table 17.4 shows that in 1969 768 thousand tonnes of imported fish meal were from Peru and Chile. This accounted for 75% of all fish meal imported by EUR-6. In 1969, Peru and Chile produced 38% of the world's fish meal, the production being based on the industrial fishery for anchoveta in the Southeast Pacific. Fig. 17.3 shows that this fishery for anchoveta expanded very rapidly from almost negligible quantities caught in 1956 to 13 million tonnes in 1970. However,

Table 17.3: Supply balance sheet for fish meal in 1978

(Thousand metric tons)

	Production	Imports	Exports	Total supplies
F.R. Germany	44.7	277.1	56.1	265.7
France	18.2≠	54.7	20.4	52.5
Italy	1.5≠	89.1	2.0	88.6
Netherlands	0	56.6	6.7	47.9
Belgium/Luxembourg	2.5	31.3	13.0	20.8
United Kingdom	80.0≠	191.5	8.1	263.4
Ireland	3.5≠	14.5	2.8	15.2
Denmark	273.0	10.6	251.6	32.0
EUR 9	423.4	561.1	198.4	786.1
Greece	0≠	5.0≠	-	5.0
Spain	35.7≠	6.1	1.2	40.6
Portugal	12.8	12.2	-	25.0
EUR 9 + 3	471.9			856.7

Fig. 17.1: Supply situation for fish meal in EUR 9 for the period 1951-78

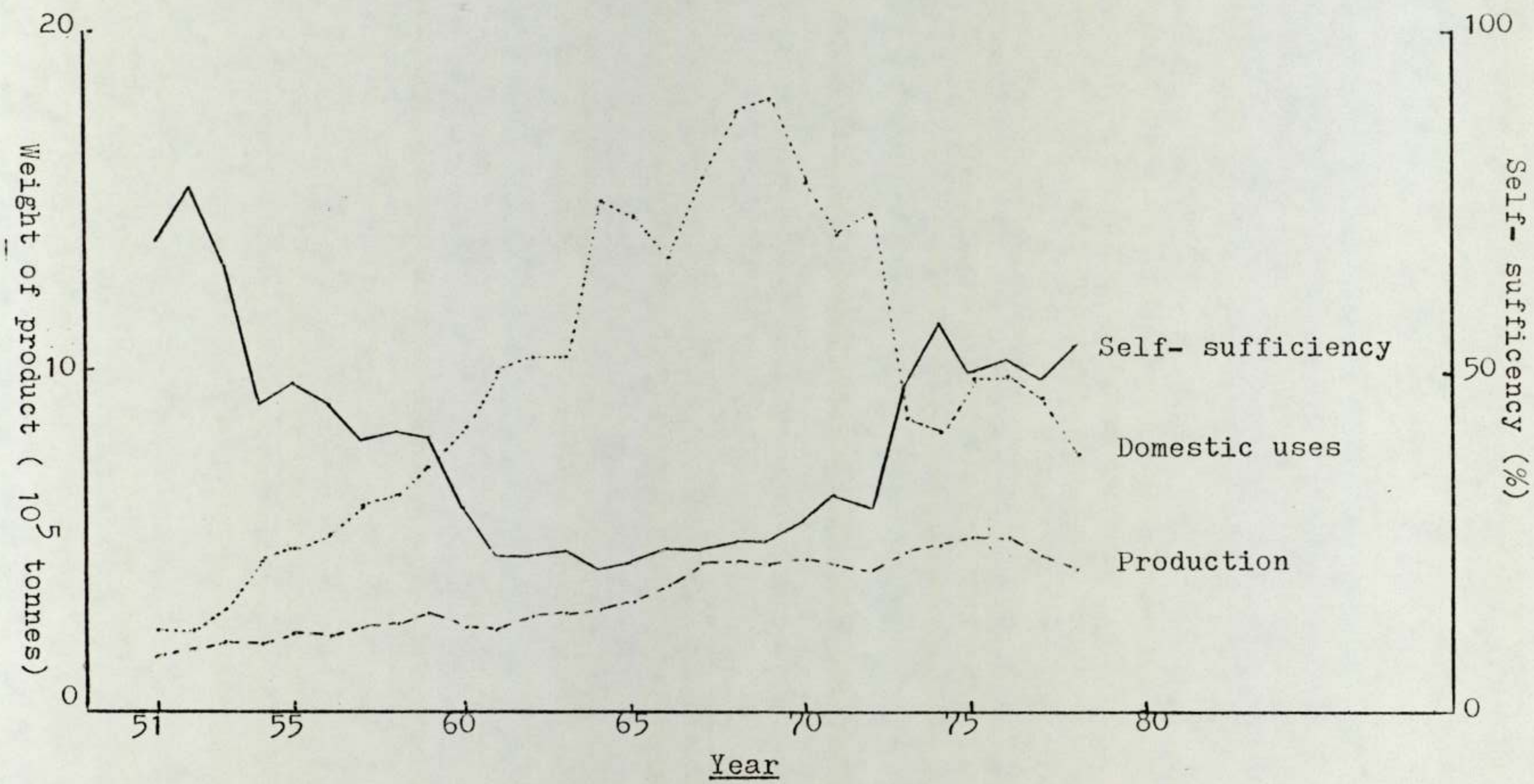
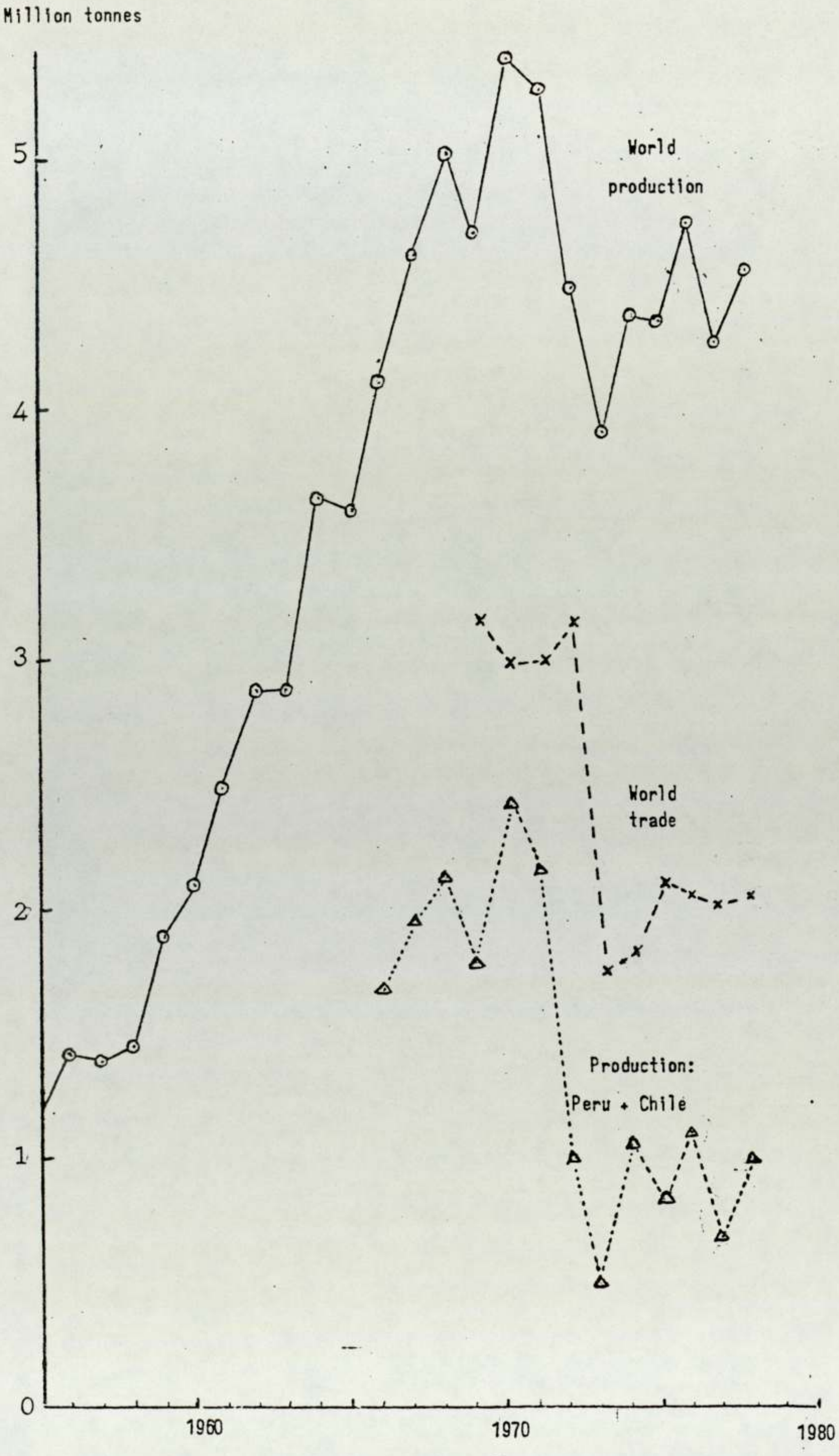


Fig. 17.2: Production and world trade in fish meal



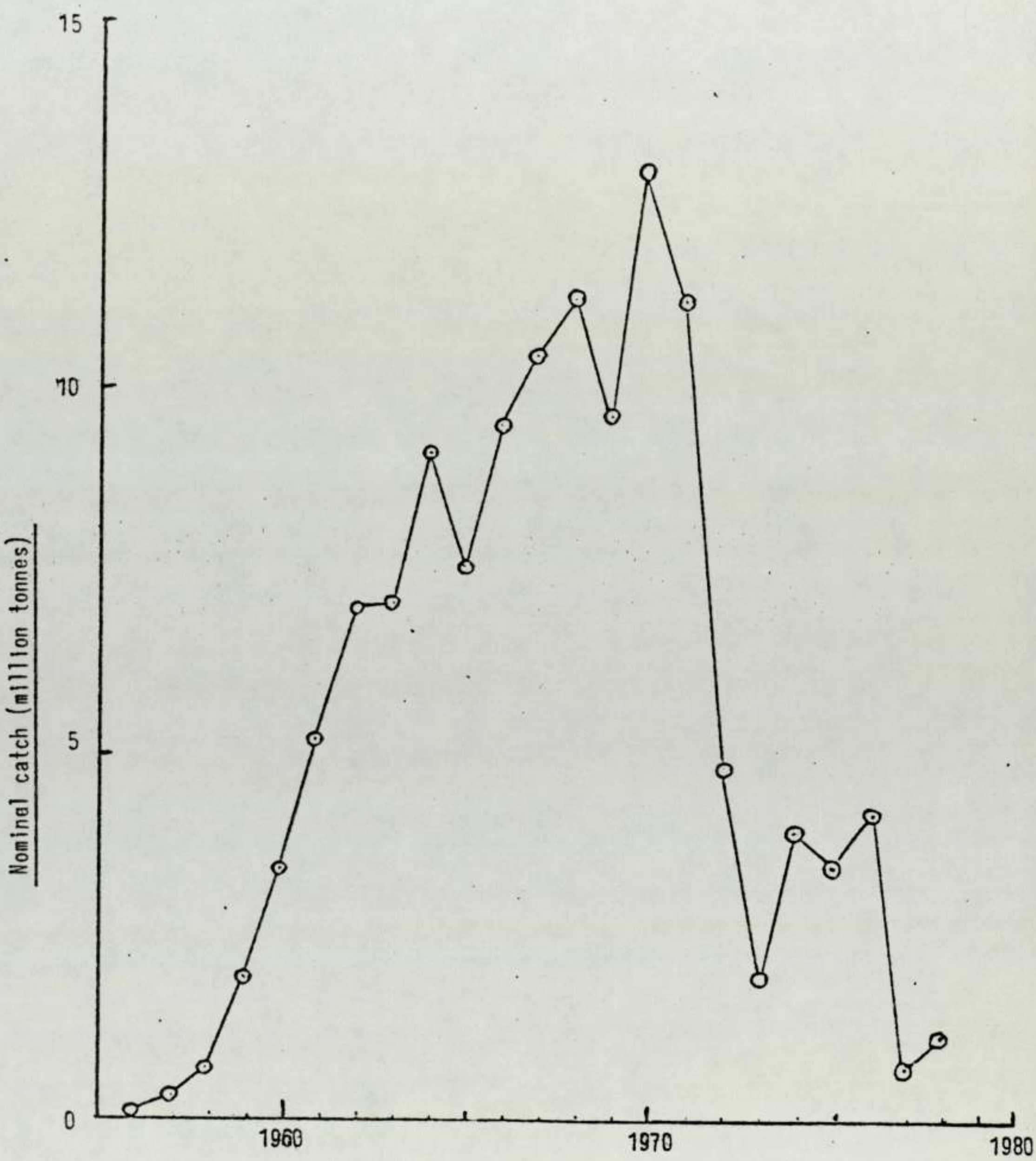


Fig. 17.3: Nominal catches of anchoveta in the Southeast Pacific.

as a result of two years of poor recruitment and, more important, overfishing, after 1970 the catches started a rapid decline until in 1973 the catches were less than 20% of those in 1970. Naturally the production of fish meal in Peru and Chile fell accordingly. Although the world production of fish meal did not fall to the same degree (the production in 1973 was 70% of the production in 1970 [see Fig. 17.2]) several of the big producing countries (particularly the USSR and Japan) are also big consumers and the quantity on the world market, as indicated by total imports, fell by 42%.

D. PRICE OF FISH MEAL

It is not surprising that the price of fish meal rose sharply in 1973. Data compiled by OECD from several primary sources indicates that between 1966 and the end of 1972 the price fluctuated around 200 US dollars per tonne (see Fig. 17.4). By the beginning of 1973 the price started to rise very rapidly until at the end of 1974 it had reached 630 US dollars per tonne. Since then the price has fallen slightly though there does not appear to be the stability in the market that existed prior to 1973.

The crisis in the supply and demand situation for fish meal in 1973 was aggravated by another factor. A direct competitor of fish meal in the animal feed industry is soya bean meal. In 1973 the USSR had very poor harvests for cereals and soya and was buying large quantities on the world market. Accordingly the price of soya bean meal rose sharply at the same time as that for fish meal rose (see Fig. 17.4 - because of the differing sources of the primary data, direct comparisons should not be made of the relative values of products on this figure).

E. EFFECT OF PERUVIAN ANCHOVETA FISHERY

However, the primary factor in the increase in price of fish meal was the decline in the anchoveta fishery as may be shown by reference to the situation with fish oil. Fish oil is a by-product

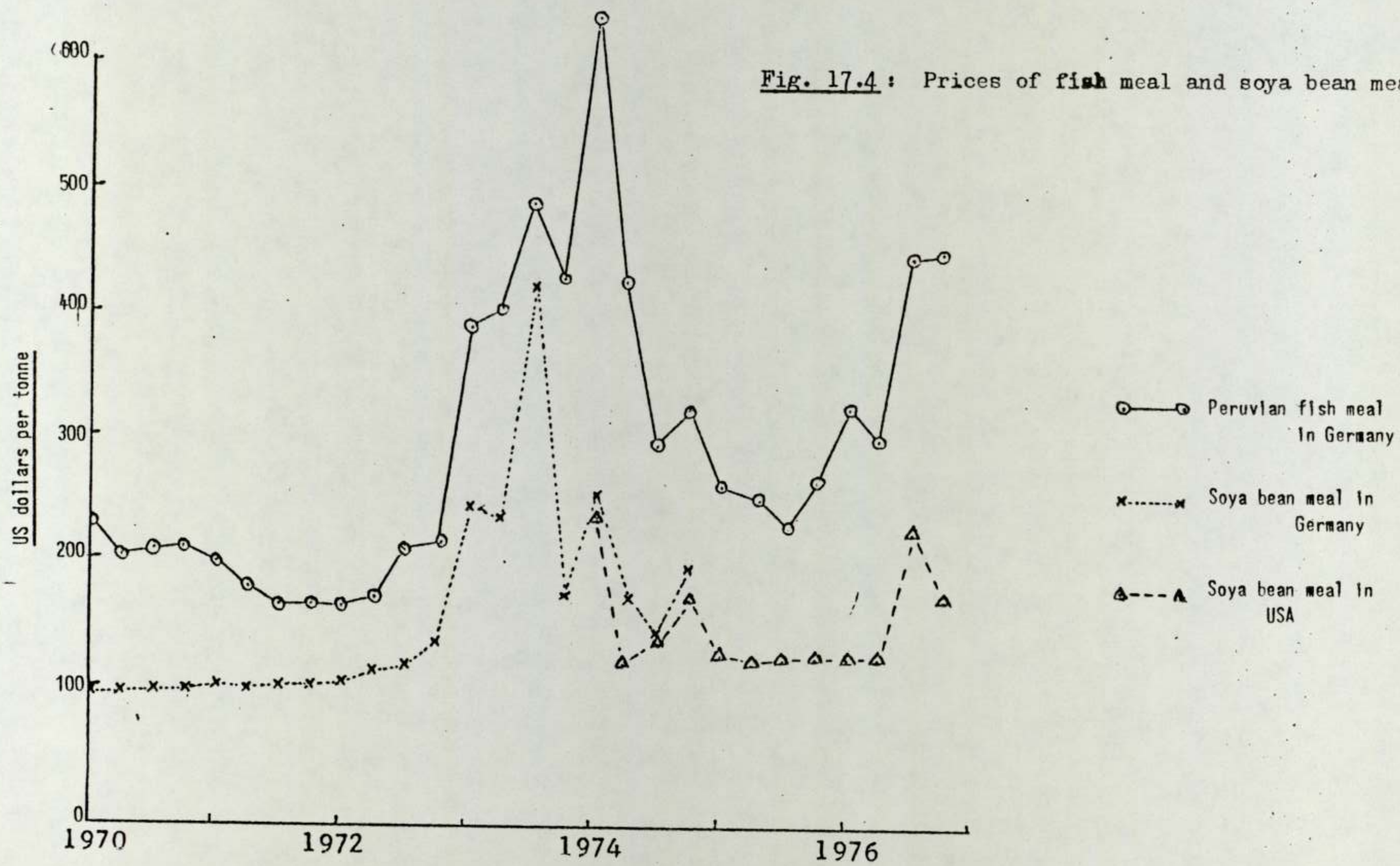


Fig. 17.4 : Prices of fish meal and soya bean meal.

of the fish meal industry and, from the point of view of this illustration, is important because it is not in direct competition, at least to any great degree, with products of commodities in which the USSR was interested. Although like soya bean oil and maize oil it is used in the food industry, the principal use of fish oil is in the paint and varnish industries where its main competitors are linseed and castor oils. Fig. 17.5 shows that, as might be expected, the general decline in production of fish meal was closely followed by that of fish oils and Fig. 17.6 shows that the price of fish oils (as indicated by the mean value of imports) closely followed the trend set by fish meal. Since there was no similar spectacular increase in the prices of linseed and castor oils, the increase in the price of fish oil may be mainly attributed to reduced production of fish oil. Thus it would appear that, given the close correlation between fish meal and oil production, the increase in the price of fish meal was caused by the failure of the anchoveta fishery rather than the intervention of the USSR on the world commodity market.

Biological opinion is that the anchoveta fishery of the Southeast Pacific was grossly overfished in the late 1960's and the early 1970's and that the maximum annual substainable yield for this fishery is much below the 13 million tonnes caught in 1970. Indeed, some experts believe that, once the stock recovers (and this will only occur after several years of much reduced fishing, the maximum sustainable yield could be as low as 7 million tonnes per year. In terms of fish meal this would give an annual production from the fishery of about 1.5 million tonnes.

As has been mentioned, a large proportion of the Community's imports of fish meal were from Peru and Chile. The world market in fish meal is limited by the fact that several big producing countries are also big consumers and Table 17.4 indicates that apart from an increase in imports from Norway and Denmark, the Community has not made up for the reduced level of supplies from South America. Indeed, the improvement in the degree of self-sufficiency

Fig. 17.5: Production and world trade in fish oil.

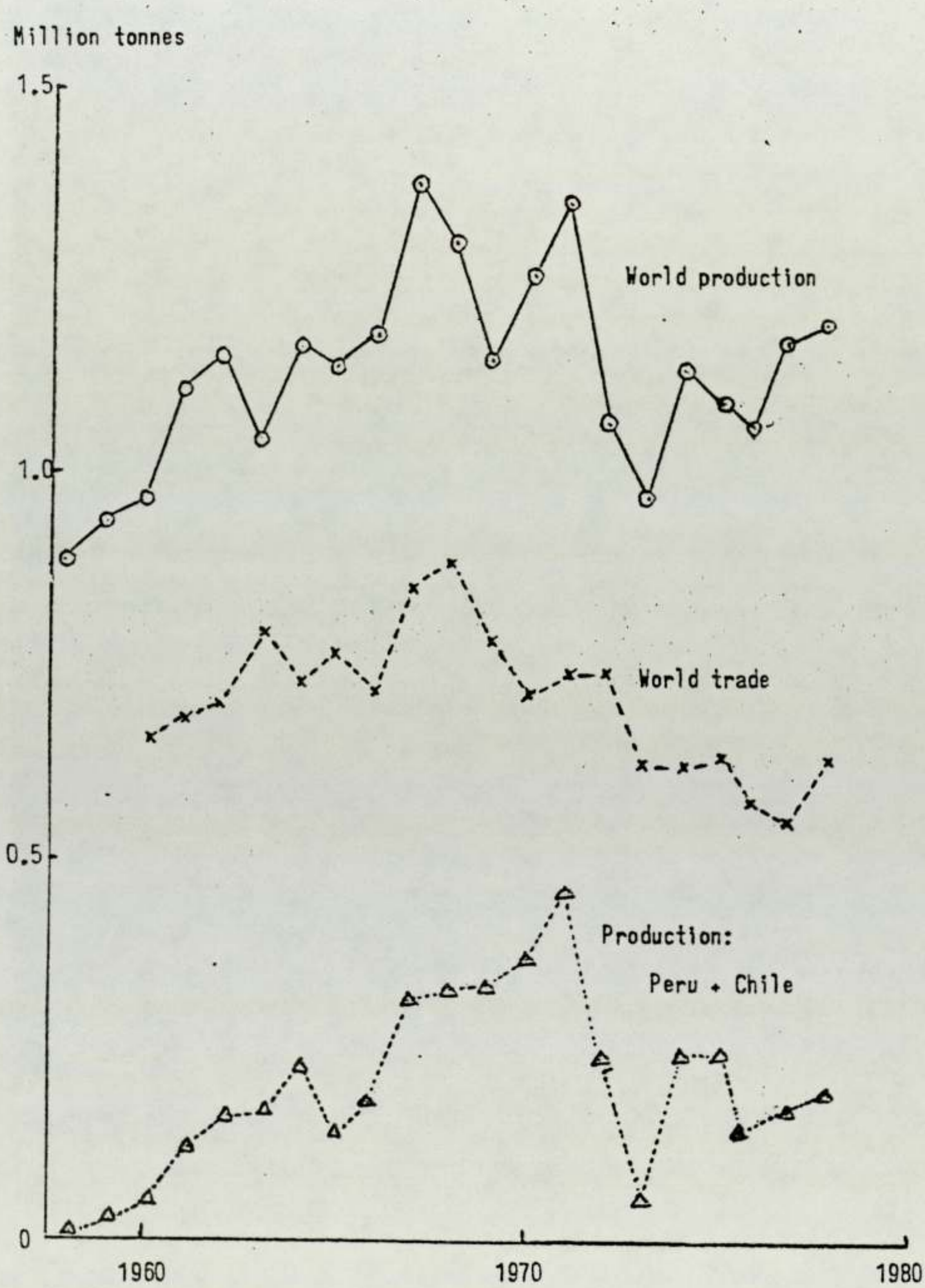


Fig. 17.6: Value of world imports of fish meal and oils

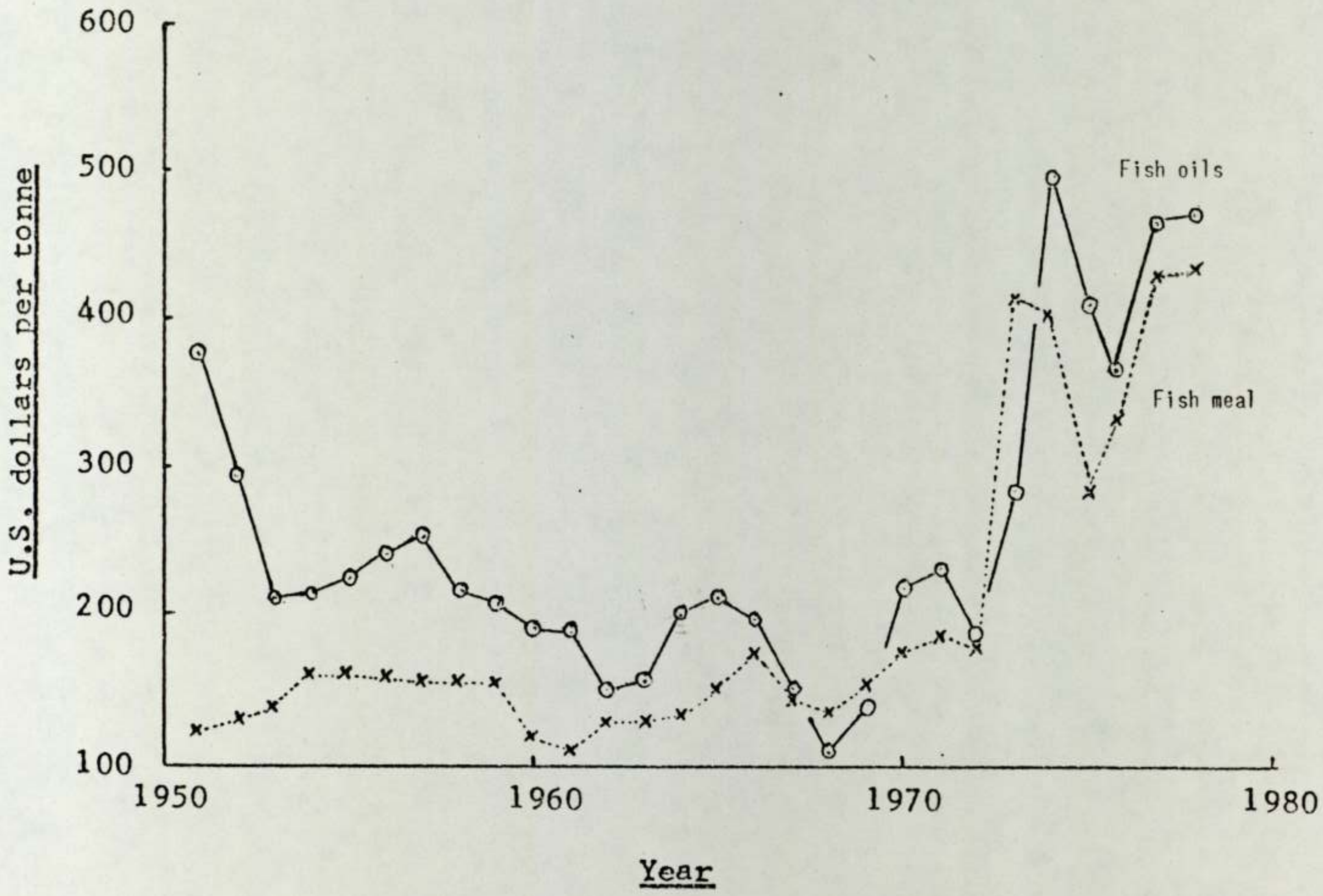


Table 17.4: Community imports of fish meal

(Thousand tonnes)

Exporting countries	Importing countries		
	EUR-6		EUR-9
	1969	1976	1976
Denmark	28	60	-
Norway	91	142	220
South Africa	47	11	14
USA	-	11	11
Canada	-	-	9
Bermuda	-	-	19
Ecuador	-	-	11
Peru	700	152	157
Chile	68	84	93
Pakistan	8	8	8
Others	88	126	109
Total	1 030	534	632

Source: EUROSTAT

noted in the early 1970's has been accomplished largely by a reduction in the quantities going for use as animal feed.

F. FISH MEAL PRODUCTION IN THE COMMUNITY

Before going further into the future for fish meal and the relationship with other animal feeding-stuffs, the situation in Denmark has to be considered. As has been mentioned in earlier sections, in the 1950's and 1960's a considerable industrial fishery for the production of fish meal was established in Denmark, initially to support the pig-rearing industry and subsequently for export. These fisheries are in the North Sea and are based on the young of a number of valuable food fishes as well as species being the food of the adults of these and other food species. The biological welfare of the fish stocks of the 'Community Sea' would undoubtedly benefit if these industrial fisheries were run down or, preferably, discontinued. The political, economic and social consequences may well limit a decline in industrial fisheries but it is inconceivable that production from fish meal from industrial fisheries will do anything other than decrease.

In the Community fish meal is produced from three main raw materials:

a) fish from industrial fisheries,

b) fish withdrawn from the market (because of poor quality or low prices), and

c) fish offal.

The national statistics generally fail to distinguish between the first two categories but since only very small quantities of landed fish are currently withdrawn from the market in normal circumstances the production of meal from such fish is thought not to be significant. The proportion of fish meal manufactured from whole fish varies greatly from Member State to Member State. Table 17.5 shows that Denmark relies largely on whole fish for meal production whereas the FR Germany uses mainly fish offal. The United Kingdom adopts a median position.

G. OFFAL AS A SOURCE OF FISH MEAL

It is the use of fish offal that offers the greatest promise for increasing the production of meal in the Community. Large quantities of offal are produced both at sea and in shore establishments which could be used for meal production. However, the quantities are small in any given period or are a considerable distance from the processing plants. At present no practical and economical method exists for preserving offal but, if one were found, small quantities could be stored and accumulated until such time that transportation to a processing plant was practicable. (One possibility is that the offal could be converted into fish silage for direct feeding to live-stock.) The quantity of offal that, theoretically, could have been produced in the Community from such a source in 1976 may be estimated as follows:

Total fish landings (live weight)	4 405.0	thousand	tonnes
Less whole fish consigned for meal	1 533.1	"	"
Less whole fish as animal food	134.0	"	"
Whole fish for human consumption	2 737.9	"	"

Of this only approximately 40% is edible (fillet without skin)

Thus, total offal produced	1 642.7	"	"
Offal actually used in meal production	872.1	"	"
Remaining offal theoretically available for meal production	770.6	"	"
Theoretical meal production	161.8	"	"

This 160 thousand tonnes of fish meal is a maximum that could be achieved by a better rationalisation of present resources. Had this occurred and had the meal been used solely to reduce imports as opposed to increasing the total quantities available, then the Community's degree of self-sufficiency in fish meal could have risen from 53% to 70% and could have saved the Community about 49 million EUA (£30 million).

H. SUBSTITUTES FOR FISH MEAL

It was noted above that since 1973 the quantities of fish meal used in the Community have remained at a reduced level and it is interesting to look briefly at how this has been achieved. The first point to note is that the production of pork and poultry, which accounts for major quantities of fish meal, has remained at about the same level over this period, indicating that the reduced availability of fish meal was compensated for by increasing supplies of other feeding-stuffs. Soya-bean meal is the main competitor of fish meal and a study of the supply situation for the former provides a possible answer as to how the gap in supplies has been filled. EUROSTAT's supply balance sheets for soya bean meal show that in the seven year period from 1971/72 total supplies have increased by 53% (see Table 17.6). EUROSTAT also produces feed balance sheets which are useful in the present context because, besides indicating changes in the availability of animal feeding-stuffs, they show the relative contributions to the livestock industry of the main sources of protein. A summary of these supply balance sheets is given in Table 17.7, the quantities available for animal feed being expressed in terms of crude protein units. These units indicate the total proteins available rather than the availability of digestible protein.

From this table it can be seen that even when its contribution was greatest, in 1971/72, fish meal accounted for only 5.6% of the marketed feeding-stuffs, when expressed in terms of crude protein. Although this shows its contribution to the industry as a whole rather than the more important role it plays in the pork and poultry sectors and it undervalues the quality of the protein available in fish meal, the scarcity of fish meal from 1973 can be seen to be no great problem in itself to the feeding-stuff industry. However, forecasts of the protein requirements of the Community are that the demand will increase by 3% per annum. The animal feeding-stuff industry has not met this target and it is in this light that a deficiency in any one sector becomes more

Table 17.5: Proportion of the fish meal production derived from whole fish and fish offal

(Thousand tonnes)

	Total fish meal production	of which from	
		Whole fish	Fish offal
F.R. Germany	56.2	3.3	52.9
United Kingdom	74.1	60.8	13.3
Denmark	314.8	285.2	29.6

Source: EUROSTAT

Table 17.6: Total quantities of soya bean meal available for domestic uses

(Thousand tonnes product weight)

	EUR-6	EUR-9
1971/72	6 092	:
1972/73	6 585	:
1973/74	7 001	8 455
1974/75	8 046	9 644
1975/76	8 606	10 425
1976/77	8 863	10 763
1977/78	9 304	12 103

Source: EUROSTAT

	1970/71	1971/72	1972/73	1973/74	1974/75	1975/76	1976/77
MARKETED ANIMAL FEEDING-STUFFS	17 642	18 032	18 401	18 440	18 579	19 361	19 996
<u>Plant origin</u>	7 248	7 349	7 723	7 708	7 571	7 226	7 121
Cereals	6 502	6 596	6 963	7 008	6 830	6 547	6 461
Dried pulses	179	174	180	134	151	143	113
Potatoes	258	227	171	163	173	115	95
Processed green forage	243	262	298	328	344	346	332
Others	72	93	124	75	67	75	120
<u>By-products of processing</u>	7 844	8 018	8 323	8 348	8 527	9 620	10 313
Milling	1 243	1 237	1 191	1 188	1 145	1 203	1 311
Oil cakes	5 504	5 729	5 989	5 913	6 139	7 032	7 380
of which: Soya	(3 330)	(3 427)	(3 745)	(3 978)	(4 516)	(4 880)	(5 038)
Others	1 204	1 041	1 113	1 207	1 335	1 385	1 622
<u>Animal origin</u>	2 550	2 665	2 355	2 384	2 481	2 515	2 562
Marine animals	914	1 001	701	483	607	644	601
Land animals	408	466	464	700	732	727	699
Milk & dairy products	1 228	1 198	1 190	1 201	1 142	1 144	1 262
NON-MARKETED ANIMAL FEEDING STUFFS (eg pastures & green forage)	30 739	30 103	30 832	31 330	30 477	30 225	26 915
TOTAL ANIMAL FEEDING-STUFFS	48 381	48 135	49 233	49 770	49 056	49 586	46 911

Source: EUROSTAT

<u>Table 17.7</u>: Total supplies of animal feeding-stuffs (thousand tonnes crude protein) for EUR 9

serious. At first sight the deficiency in supplies of fish meal is more than compensated for by the increase in supplies of soya but this ignores the real problem. This problem is being considered in the overall study of the protein supply of the Community and a number of projects, e.g. culture of protein-rich micro-organisms, the substitution of low protein crops by higher protein crops, etc, are being proposed. But, whatever the conclusions of these studies, it is very clear that the future protein supplies of the Community can not depend to any degree on the production of fish meal.

I. FISH MEAL IN AQUACULTURE

One aspect of the protein supply merits particular mention, however; namely, the use of fish meal in the dry foods used in aquaculture. The composition of these foods varies according to the species to which they are being fed; Bardach et al (1972) record that fish meal makes up 15%, at least 30% and 65% of the dry foods fed to channel catfish, trout and eels respectively. It would appear that the manufacturers use 20-40% in trout food. The dependance of the foods on a high content of fish meal has, with the current supply situation in fish meal, caused a considerable effort to be made to find substitute sources of good quality protein. Tiews et al (1978) have produced fish meal free foods based on poultry by-product meal, hydrolysed feather meal, soya bean meal concentrate, corn gluten meal, alkane grown yeast, bacterial protein and krill meal that produce results which are comparable with those for more conventional foods. Gropp et al (1979) have successfully used lupin and field bean meals to reduce significantly the fish meal meal content of trout diets.

J. UNICELLULAR PROTEINS

The most interesting developments in this feed technology have been the experiments with unicellular proteins. Matty and Smith (1978) showed that a yeast produced overall better results than a bacterium and an alga and Beck et al (1978) confirmed the promising prospects of using alkane grown yeasts. Tacon (1978) has reported promising results using activated-sludge single cell protein but suggests, as indeed do other authors, that the evaluation trials should be conducted over periods of at least 12 months.

Ehrenberg (1980) reports on a commercial venture to produce the algae Chlorella and Spirulina for incorporation into fish foods. It appears that, under intensive culture, the yield per acre is 10-15 times that of soya beans.

The great problem in assessing the future of unicellular proteins for incorporating into fish foods is the cost of the protein. In most cases the production is at the pilot plant stage and most of the companies producing the proteins are not in a position to quote realistic prices for the product until reliable information is available on the demand for the product. Several companies are offering the products at very attractive prices to fish farmers willing to conduct trials with the products. These prices probably do not indicate the future price of the product. One point to note is that one of the products that has been used successfully in trials, alkane grown yeast (Tiews et al, 1978; Matty & Smith, 1978) is a product of the petro-chemical industry, a sector where prices have increased very rapidly in the last few years. It should also be noted that these unicellular proteins are not only undergoing trials as fish food but are being considered for introduction as a feed for other animals. It has been estimated that in 1985 the animal feed industry in the EEC will have to produce 60 million tons of feed.

The introduction of these proteins may encounter other problems. For example, British Petroleum has found that the Italian legislation will not accept the incorporation of unicellular proteins into pig foods.

K. SUMMARY

A summary of the present situation is that the supply of fish meal is uncertain, both as a result of the failure of the Peruvian anchoveta fishery and of the uncertain future of industrial fisheries generally. Considerable efforts are being made to find alternative sources of protein, both of vegetable and unicellular origins, to replace fish meal, or at least reduce significantly the content of fish meal, in animal feeding stuffs. Even if the supply of fish meal were to remain at its present level, this work is to be encouraged since the insertion of another link in the food chain between fish and man only reduces the efficiency of the exploitation of fishery resources. However it is too early to assess reliably the future of these other protein sources since, in many cases more extensive feeding trials need to be conducted and because the economics of the production are at present uncertain.

CHAPTER 18

CONCLUSIONS.

CONCLUSION

A. EEC Fisheries Policy

At the outset of this study (in May 1977) it was envisaged that it would be possible to consider the effect a Common Fisheries Policy (CFP) had had on the Communities' fisheries. In the event a CFP has not been agreed. Some of the broad principles have been agreed, if not formally, then informally while awaiting decisions on the more politically sensitive issues. For example, the Communities' policy towards non-Member States, the method by which the Total Allowable Catch and other regulatory measures are set and the method of monitoring the catches have become clear. Among decisions of a politically sensitive nature still awaited are how these TACs should be allocated between Member States, what preferences should be given to fishermen operating within their national waters, what compensation should be given to those Member States who have suffered from the limited access now available to water of non-Member States and how should the policy be orientated so as to assist those under-developed regions heavily dependant on fishing.

In some respects this delay in the development of the CFP may be considered an advantage in the long-term. It may be that now the situation arising from the extension of economic zones has stabilised, in the North Atlantic at least, in particular with regard to the access to be granted to other nations' vessels, one can look calmly at how the fishing industry must adapt to the changed situation. Had the CFP developed while the general situation in the North Atlantic was still in a state of flux, it is more than likely that measures applied would have to be basically revised within a short time. Now that the situation is more stable it should be possible to develop more long-term policies.

B. National fisheries policies

While one can put forward the argument as to the possible long-term advantage in the delay on agreement of a CFP, it is unquestionable that there have been disadvantages. National authorities have been reluctant to implement short-term measures without knowing how they would fit in with the CFP, an agreement on which has been expected month by month since the EEC Commission published its first proposal in October 1976. Had it been known in 1976 that no policy would be agreed before the end of 1980 at the earliest, th national authorities would have probably been more willing to take more positive measures, even perhaps to apply, with other Member States, common measures in certain limited areas.

As it is, national measures, when they have been applied, have often caused bad feeling in other Member States. For example, fishing restrictions imposed in national waters by one Member State have often been considered by the remaining Member States as having a greater effect on the activities of their vessels than on the former's. (Indeed the EEC Court of Justice has been asked on several occasions to rule on the legallity of national measures because of their effect on the fishing activities of other Member States.)

There has certainly been little coordination between Member States as to the application of national measures. One example example of this is the price which the fishermen have to pay for their fuel. In France and Italy the fishermen receive a subsidy (which is probably illegal under Community law) for the purchase of their fuel(Anon, 1980b). As a result the highest cost of fuel is in the UK, followed by Denmark, Germany and Italy with the French paying only half the price paid by the French motorist. The increase in the cost of fuel in the last few years has placed an increased burdon on the fishing industry. Work in Holland has shown that fuel costs now account for 10% of the value of the catch (Anon, 1980c). In France the cost of fuel has been estimated at

13% of the receipts for the catch (Anon, 1980d). Ill-feeling between the industries in the different Member States will obviously arise from subsidies preferentially applied to cushion the effect of rising costs of what is becoming an important contribution to the total costs to the industry.

C. The importance of the fishing industry

It was indicated in Chapter 2 that the importance of the fishing industry was difficult to express in finite terms. Taking the EEC as a whole, fishing does not make a great contribution to the economy, the employment of the work-force and the production of food. However, regionally, fishing may be very important in all three aspects. If the fishing industry was not encouraged in these regions acute economic and social problems could result and it seems likely that much of the aid in these regions will be used to support the fishing industry.

This aid should not be used to simply maintain the industry in its present state but should be used to adapt the existing fisheries to the changed situation. Many of the fisheries in these under-developed regions have been artisanal and are poorly equipped to survive in the more competetive situation which has developed in near water fisheries. While these fisheries may be protected by limitations of access to vessels from other regions, the local industry should be developed to be self-supporting. The fishermen should be encouraged to operate within organisations , many of the smaller vessels could be replaced by larger more versatile and more economic ones, a bigger proportion of the catch should be marketed through recognised channels and the establishing of processing plants within the region should be encouraged to permit that region to receive the biggest return on its resource.

D. The price of fish.

Fish is no longer a cheap source of protein. Indeed, it is now more expensive than most meats. It is not difficult to see how the change from being one of the cheapest foods to what is close to a luxury food has occurred. Given the relatively constant size of the population of the Community and the conservative attitudes to changes in diet, it is reasonable to assume that the demand for fish has remained steady. However, the supply of the traditional food species has decreased by an estimated 24% since 1971. This deficit has been partially overcome by increased imports of these traditional fish species and by attempts to induce the population to transfer its allegiance to such non-traditional fish species as mackerel. The law of supply and demand dictates that with a steady demand but a decreased supply the price will rise. A similar increase in price has not been experienced with other animal products because, while the demand has remained constant, so has the supply. The situation for fish may have been aggravated by the very rapid increase in fuel prices in recent years. It has been mentioned earlier that fuel accounts for 25% of the running costs of a deep-sea trawler. This is probably a higher figure than for that of a meat production plant.

One cannot see much hope for any improvement in the situation. It is not certain that publicity campaigns will make a significant contribution in reducing the demand for traditional fish by increasing the demand for non-traditional species and the situation may be worsened should the supply of traditional fish be further reduced. There does not appear to be any similar threat to the price of meat: indeed the Community's excess production of dairy produce may well result in interest being diverted away from dairy cattle to beef cattle, thereby increasing the supply of meat. The end result could be that fish will become so expensive relative to other sources of animal protein that it could only be considered as a luxury food.

E. Traditional marine fisheries

The catch of the main species for human consumption has decreased significantly, probably by over 1 Mt for the Community as a whole since 1971. The main factor in this decline has been the closure of many of the distant water grounds to Community vessels. As a direct result of this there has been a 28% decrease in the number of vessels of 500 GRT and over, the vessels most suited to operating in these distant waters. (In some quarters it has been suggested that the increased fuel costs have been an important factor in the decrease in the size of the distant water fleet: however a Dutch report suggests that the fuel cost increases have affected the near water vessels more than the distant water vessels (Anon, 1980c).) The future for these distant water vessels is not very bright. Many of the countries in whose waters the Community vessels used to fish are currently increasing the sizes of their fleets so that they may be able to exploit to a greater extent their resources themselves. It is therefore unlikely that any improvement in fish stocks would result in improved Community quotas. Indeed there is a threat that, as these countries develop their own fishing capacity, the Community share of the resource will be further cut.

Some of this deficit in food fish could be made up by the development of a deep-water fishery in the Community's western waters. It was suggested in Chapter 14 that up to about 400 000 tonnes (or about 1/3 - 1/2 of the deficit) of marketable fish could be obtained from these waters and it would probably be the distant water vessels that would be best adapted to operate in these waters. Since these deep-water fisheries do not appear to be of a seasonal nature, the distant water vessels would be able to switch to them whenever restrictions were placed on their activities on more traditional grounds.

These large distant water vessels would also be suitable in some respects for an Antarctic krill fishery. They are designed to operate for long periods at sea and they would provide suitable working conditions and have the durability to withstand the conditions in that inhospitable region. They would also have the power required to tow the small-meshed net necessary to catch krill. However, much of their processing equipment would have to be replaced since krill fishing vessels require specialised equipment which is able to handle large quantities of raw material (storage of fresh krill is not possible). The krill fishery only lasts for about six months of the year and it would not be economical to have these vessels remaining idle for the remainder of the year, yet the modifications to the vessels would probably render them unsuitable for other fisheries.

Catches in near waters have compensated for the decrease in distant water catches when one considers the total fishery production. However, this has been due largely to increased catches of industrial species for reduction to meal and oil and of species which are not rated highly in the Community as food fish. Four industrial species (blue whiting, sandeels Norway pout and sprats) and two potential food species (mackerel and horse mackerel) accounted for increased catches of 750 000t and 450 000t respectively since 1971. Community catches in near waters of traditional food species have decreased by about 400 000t since 1971.

The tonnage of fishing vessels exploiting near water fisheries (assumed to be vessels of 150 GRT or less) has increased by 6% since 1971. These vessels are fishing stocks of traditional food species that are fully or over exploited, stocks of non-traditional food species for which fishery administrators and biologists are seriously considering the application of fishery limits, and stocks of industrial species for which many people believe the fishery should be much reduced or even completely halted. It has to be admitted that the knowledge of the population dynamics of certain species is inadequate at present to be able to predict accurately the level of exploitation that will be tolerated by the stocks but it would be wise to accept that the future for near water fisheries, although not as gloomy as that for distant water fisheries, does not hold out a promise of great expansion.

In this light one should not envisage an increase in the size of the near water fishing fleet. It seems more likely that the trend will be for the vessels to become more versatile and be able to switch from one fishery to another according to the season or the requirements of fishery management.

With regard to the fisheries for mackerel and horse mackerel it is hoped that the Community will utilise these resources more to its advantage than at present. In Chapter 2 it was noted that the value of fish may be more than doubled by processing. Thus it is regrettable that much of the catch of these two species is exported as fresh fish to Eastern European vessels for processing. It would be much better if this fish were processed within the Community. The processed fish could then be exported and the increased revenue used to offset the cost of increased imports of traditional food species. (Successful though the publicity campaigns have been to increase the Community's consumption of mackerel, it is unlikely that it will replace the traditional food fish in the Community's diet to any great degree.)

The cause of the apparent decrease in the number of Community fishermen is difficult to determine because, the exact magnitude is uncertain and no information is available as to which sectors of the industry have been affected most. One would also have to have more information as to the relationship between the number of fishermen and the size of the vessels and the degree of fish handling aboard the vessels. All that can be said is that, although the decrease is insignificant when considered from the view of the total working population of the Community, there could be very grave social implications if this loss of fishermen were concentrated in regions where there is little alternative employment.

F. Foreign trade in fishery products

The extension of economic zones and the redistribution of fish catches which resulted has brought about changes in the pattern of foreign trade. Countries which are now not able to catch the species they require are obliged to purchase the fish from more fortunate countries. Conversely, some countries are now catching fish for which there is no ready domestic market and hence overseas buyers are being sought. An example of these situations is the Community's increase in the foreign trade in cod and mackerel. The traditionally favoured food fish, the cod, is not being caught in sufficient quantities to meet the home demand. Consequently cod is being imported from Iceland and the Faroe Islands which, since the extension of economic zones, have a supply which exceeds home demand. Similarly the Community has not well-developed market for mackerel, a species which, in the absence of available stocks of traditional fish, is being caught in large quantities by Communit vessels. The only outlet for this fish is the export market.

That the change in the trade pattern, which is world-wide, not just restricted to the EEC, is apparent from the fact that 47% of the world production of fresh, chilled or frozen fish was exported in 1978 compared with 32% in 1971 and the volume of exports increased by 80% in the same period. Although this increase in foreign trade is greater for fresh, chilled or frozen fish, there has been a general increase in the trade in edible fishery products: the latter increased by 60% in volume and 265% in value in the period 1971-78.

In the future it is likely that the foreign trade in fishery products will increase. Certain countries (eg Canada) are actively looking for outlets for their anticipated fishery production which exceeds the domestic consumption. It has already been suggested that the EEC might gain increased access to Canadian waters as a result of accepting more Canadian fishery products.

G. Freshwater fisheries

Only regionally and for a limited number of species (eg eels, salmon) are freshwater fisheries important. There are good resons for believing that freshwater fisheries have no significant rôle to play in making up the deficit in the supply of food fish: namely,

1) there is only a limited possibility for the expansion of freshwater fisheries in the EEC. These fisheries would have to compete with the other uses of water in what is one of the more industrialised and populous areas of the world,
2) with a few exceptions, freshwater fish are not esteemed as food in the Communities. It is by no means certain that an intensive marketing campaign would change this situation greatly.

H. Aquaculture

At the outset it must be clear that aquaculture will not be able to make up the production deficit from marine fisheries. Unless there is a dramatic technical breakthrough, aquaculture production will only be economically viable for the more highly valued species. Even with the increased cost of fish compared with other sources of protein in the diet it is inconceivable that the culture of such species as cod or herring could ever be a viable proposition. However there is certainly a future for the culture of higher valued species such as salmon, trout and eels. It is difficult to estimate the future level of such aquaculture because technical advances would probably soon render the estimates out-of-date and because development of the industry will depend on the support given by national and Community authorities. It is to be hoped that these authorities will act to remove the legal barriers to development, improve the technical and advisory services available to the fish farmers and increase the financial assistance that may be given both to develop new techniques and to establish the production units. The industry could probably help itself by not guarding quite so jealously the information on developments. At the present time there appears a ready market for all the fish the industry can produce and the industry would probably have a better immage, both from the point of view of the fishery administration and general public, should the number of enterprises increase.

I. <u>Fish meal and substitutes</u>

Fish meal production world-wide has decreased greatly in recent years. This has been associated with the decline in the Peruvian anchoveta fishery. The future for this fishery is still not promising and a general switch in the policies of the Peruvian authorities to encourage the use of fish for canning rather than for fish meal does not offer much hope for a rise in the production of fish meal. Within the Community there is a considerable opposition to industrial fisheries because of the by-catch of young food fish involved and because the industrial fish species are the food of food species. It remains to be seen how Community policy towards the industrial fisheries develops.

The Community has adapted to the decreased supply of fish meal in recent years by increasing the use made of soya bean meal. This product is not a completely satisfactory replacement for fish meal in all animal feeds (for example, in fish food) but work on the production of uni-cellular proteins is producing promising results both from the technical aspects of production of the proteins and their acceptance as animal feedingstuffs.

J. The further enlargement of the EEC

Greece becomes a member of the EEC on 1 January 1981. Throughout this study it will be seen that, as far as fishing is concerned, the entry of Greece will not have a great impact on the fishery. That is not to say that Greece does not hope that its fishing industry will gain from accession. At the present time the distant water fleet which fishes mainly off the west coast of Africa is comprised of old vessels and is experiencing problems of obtaining access to these waters. Greece hopes that the Community will provide aid to re-equip this fleet and that the Community will have the political power to negotiate better fishing agreements for the Greeks with the West African nations. As far as the Community is concerned the problems of the Greek fishing industry are relatively minor compared with those of the other states. The Greek fleet and fishery production is relatively small and the activities of the industry do not conflict with those of other Member States (with the limited exception of France and Italy).

The future accession of Spain, and to a slightly lesser extent, Portugal will present much greater problems. The Spanish fishing industry is large and will have a profound influence on Community policy. At the present time the activities of the Spanish fleet in Community waters are strictly limited. With accession to the Community the Spanish fisherman will be expecting improved access to Community waters. The Community does not stand to gain a great deal from improved access to Spanish waters because in general these waters are less productive than the more northerly waters of the Community.

There could also be certain marketing problems. Frequently in the past the Community has had to restrict the imports of fresh sardines from Spain in order to stabilise the market. With the accession of Spain such a barrier to trade would be illegal. Spain would be better able to compete with France and Italy in the market for canned products as a Community member than as a third country: obviously this competition will not be welcomed by the existing Member States.

On the positive side for the Community is the fact that with the accession of Spain the Community will have a much greater influence in the Mediterranean. Although one might think that Community policies have been slow to develop in the Northeast Atlantic, progress has been fast compared with that in the Mediterranean. When the coastal states of the region begin in earnest to develop a policy the negotiations will be very complicated, given the number of nations concerned and their close proximity. A block of four countries (Spain, France, Italy and Greece) could prove to be a powerful force in the region.

K Summary

A summary of the conclusions of this study is that Community catches of traditional food fish in marine waters have declined in recent years principally as a result of severe limitations on fishing in distant waters. Catches of industrial species and non-traditional food fish have increased to maintain the total catches at their earlier level. It is unlikely that future catches of traditional food fish will increase greatly and it is possible that greater restrictions will be placed on the fisheries for industrial species and non-industrial food species.

The reduced supplies of traditional food fish has undoubtedly been largely responsible for the increased price of fish relative to other sources of animal protein. With no great improvement in the supply situation envisaged, fish could well become a luxury food.

The change in the pattern of catches has been reflected in the structure of the fishing fleet. The number of distant water vessels has decreased significantly while the tonnage of near water vessels has increased slightly. The Community's fishing fleet in the future is likely to have a larger proportion of smaller, more versatile vessels than at present.

Some of the deficit in the supply of food fish may be made up by the development of deep-water fisheries: these fisheries could be conducted using vessels from the current distant water fleet.

With the change in the distribution of catches between the fishing nations, an increase in the volume of foreign trade in fishery products has been noted and is expected to continue.

The future for aquaculture lies in the production of the more high-valued species. There would appear to be a ready market for these products. Future production cannot be forecast accurately but, if the current technological progress continues and the industry receives encouragement from the central authorities, a considerable increase in production could be expected.

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APPENDIX A

GENERAL METHODOLOGY

GENERAL METHODOLOGY

1. Statistical sources

Most of the data used in this study have been collected by national official organisations and published in national yearbooks or submitted to international organisations for publication (see Bibliography). The international organisations are responsible only for the collation and aggregation of these data submitted by national authorities. Limited use has also been made of data disseminated by semi-official and professional organisations.

2. Statistical concepts

For many years the international organisations interested in fishery statistics have been working on the harmonisation of concepts, definitions and classifications used in fishery statistics largely through the Coordinating Working Party on Atlantic Fishery Statistics. Considerable success has been achieved and most countries use these concepts, at least in their submissions to international organisations. These concepts and definitions have been used in this study.

The English names of fish species are those used by FAO. Occasionally these may vary from those used in national publications.

3. Reliability of statistics

Although the national systems of fishery statistics are generally well developed there is a considerable variation in the reliability of the data. In this context it should be noted that the data for Italy, Greece and Spain are often of a lower reliability than those for other countries and thus great care has to be taken when comparing situations in different countries. Data for Greece, for example, often only refer to the distant water fisheries.

4. European unit of account

In various chapters (notably Chapters 2 and 8) values of fishery products have been quoted in European units of account (EUA). This is a composite unit which is based on a basket made up of a certain amount of each Member States currency. Its value in any given currency is that of the sum of equivalent values in that currency of the following amounts:

1 EUA = DM 0.828 + FF 1.15 + LIT 109 + HFL 0.286 + BFR 3.66
+ LFR 0.14 + UKL 0.0885 + IRL 0.00759 + DKR 0.217

These amounts were fixed in such a way that, on 28 June 1974, 1 EUA = 1 SDR = USD 1.20635. The conversion rates used in this study are shown in the Statistical Appendix.

5. Weight units

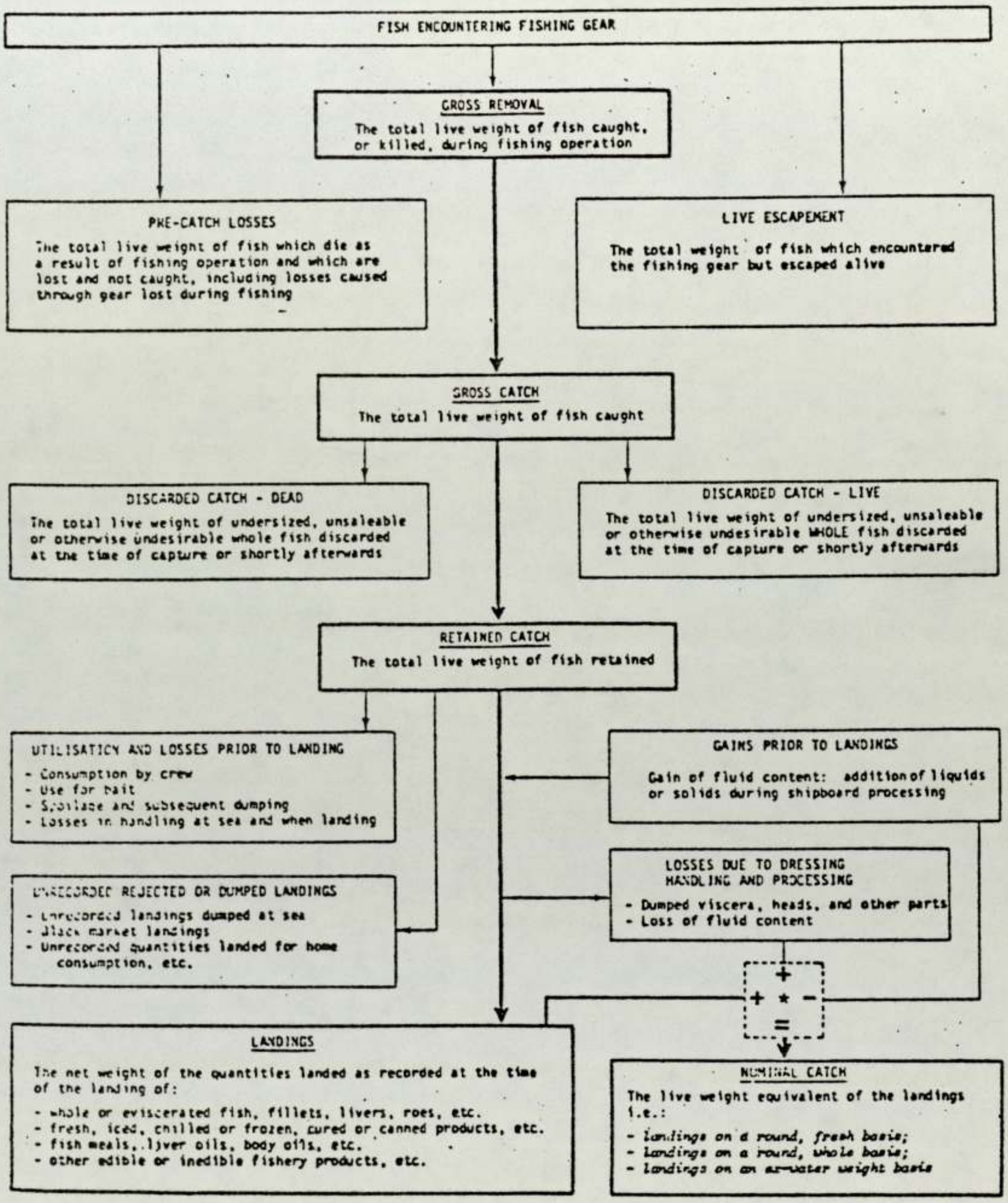
When referring to the quantity of fish caught the weight unit used is the live weight equivalent of landings in metric tons. This is normally calculated by the application of conversion factors to the quantity landed. The relationship between this live weight equivalent of landings and the gross catch (the weight of fish actually taken from the water) is shown in Fig. A.1

Except when "catch" is specified, the weight recorded is the product weight, that is the weight, including normally the immediate packaging, of the product at the time it is recorded.

6. The price of fish

In Chapter 8 on the price of fish, logarithmic plots have been used to produce linear regressions for the calculation of trends. This is justified by the following argument: in the calculation of a trend for a period of years one assumes that the rate of increase has been constant throughout the period. If this is applied to unit values of fish the following equation is obtained:

Fig. A.1: Relationship between catch and landings.



* Conversion factors applied to landings data

$$V_n = V_o r^{n-1}$$

where V_o = unit value in base year

V_n = unit value in year n

r = mean annual rate of increase

This is, of course, not the equation of a straight line and thus a logarithmic transformation is made:

$$\log V_n = \log V_o + (n-1) \log r$$

Provided log r is a constant, plotting log V_n against n-1 should produce a straight line. The fact that the unit value data given in the Statistical Annex produced good fits to the straight line indicates that log r, and hence r, approximated to a constant. Accordingly it was justifiable to assume amean rate of increase.

7. Country groupings

In the supply balance sheets established by FAO quoted in Chapter 7 (see in particular Fig. 7.1) the countries are classified in a number of economic groupings. The composition of these groupings is shown below:

Developed Market Economies

North America : Canada, United States.

Western Europe : Austria, Belgium-Luxembourg, Denmark, Finland, France, Federal Republic of Germany, Greece, Iceland, Ireland, Italy, Malta, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom, Yugoslavia.

Oceania : Australia , New Zealand.

Other Developed Market Economies : Israel, Japan, South Africa.

Developing Market Economies

Africa : Algeria, Angola, Benin, Botswana, Burundi, Cameroon, Cape Verde, Central African Empire, Chad, Comoros, Congo, Ethiopia, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Ivory Coast, Kenya, Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritania, Mauritius, Morocco, Mozambique, Namibia, Niger, Nigeria, Reunion, Rhodesia, Rwanda, São Tomé and Principe, Senegal, Sierra Leone, Somalia, Swaziland, Tanzania, Togo, Tunisia, Uganda, Upper Volta, Zaire, Zambia.

Latin America : Antigua, Argentina, Bahamas, Barbados, Belize, Bolivia, Brazil, Chile, Colombia, Costa Rica, Cuba, Dominica, Dominican Republic, Ecuador, El Salvador, Grenada, Guadeloupe, Guatemala, Guyana, Haiti, Honduras, Jamaica, Martinique, Mexico, Netherlands Antilles, Nicaragua, Panama, Paraguay, Peru, St. Lucia, St. Vincent, Surinam, Trinidad and Tobago, Uruguay, Venezuela.

Near East : Afghanistan, Cyprus, Egypt, Iran, Iraq, Jordan, Lebanon, Libya, Saudi Arabia, Sudan, Syria, Turkey, Yemen Arab Republic, Democratic Yemen.

Far East : Bangladesh, Bhutan, Brunei, Burma, Hong Kong, India, Indonesia, Republic of Korea, Lao, Macau, Malaysia (Peninsular Malaysia, Sabah, Sarawak), Maldives, Nepal, Pakistan, Philippines, Singapore, Sri Lanka, Thailand.

Other Developing Market Economies: Fiji, French Polynesia, New Caledonia, New Hebrides, Papua New Guinea, Samoa, Solomon Islands, Tonga.

Centrally Planned Economies

Asia : China, Democratic Kampuchea, Democratic People's Republic of Korea, Mongolia, Viet Nam.

Europe and USSR : Albania, Bulgaria, Czechoslovakia, German Democratic Republic, Hungary Poland, Romania, USSR.

8. Under-utilised fishery resources

Much of the background material for the section on under-utilised fishery resources was obtained by attendance at a meeting organised by the Fisheries Society of the British Isles at Queen Elizabeth College, London in January 1979. The proceedings of the meeting which was entitled "Under-utilized Aquatic Food Resources have not been published, and thus orthodox referencing cannot be made. However, the following is the list of papers presented:

Blue whiting. M Pawson

Mackerel and horse mackerel. S Lockwood

Deep water species. T Bridger and T Williams

Other marine species. R Bailey

Freshwater Fish. B Stott and DJ Solomon

Processing, utilisation and product innovation. JN Keay

The White Fish Authority Surimi Project. M Hatfield

The catching industry view. D Carden

The processing industry view. C Willcocks

9. Fishing fleet statistics

Particular difficulty was experienced in compiling data for Chapter 9 on the fishing fleet. Complete sets of data were not available for all countries even for the relatively short period 1970-78. Further, frequently one found several different sets of data. The extreme example was for the Netherlands where four different sets of data were found. One explanation for this was the inclusion in at least one set of data for vessels operating in the Ijsselmeer but a complete explanation for all the data was not found.

Fishing fleet statistics for Greece relate only to the distant water vessels. Little information is published for the smaller near water vessels, though the basic information is held by the Greek Statistical Service.

Data relating to the smaller vessels are particularly suspect in many countries. Surveys of the number of smaller vessels are not conducted annually (for example, vessels under 5 GRT are only recorded once every five years in Denmark).

APPENDIX B

METHODOLOGY OF SUPPLY BALANCE SHEETS

METHODOLOGY OF SUPPLY BALANCE SHEETS

1. INTRODUCTION

The aim of supply balance sheets is to show the equilibrium between the supply and the uses of a product for a given region and period of time. They originated after the Second World War when the food situation was such that it was necessary to determine how far the production of primary materials was fulfilling the requirements. Although the importance of this primary objective may have decreased in recent years, supply balance sheets are still very useful when studying the flow of raw materials from production to consumption, in its broadest meaning.

In the early 1960's EUROSTAT established an extensive system of supply balance sheets for agricultural products and, in order that the overall food supply situation may be studied, these balance sheets were also prepared for fish and fishery products. Derived from these balance sheets is the level of self-sufficiency of a country in the supply of its foods, data essential for the realistic development of economic and agricultural policies. Another important derived statistic is the apparent per capita consumption of a product.

The balance sheets follow the standard book-keeping form, permitting a comparison of the supplies (credits) with the uses (debits) for a product or a group of products. The general scheme for the balance sheets:

Supplies:	a) Initial stocks	= available quantities remaining from the previous period
	b) Production	= quantity produced in the zone and period considered
	c) Imports	= quantities coming from outside of the zone in the period considered
Uses:	a) Exports	= quantities sent outside of the zone in the period considered
	b) Domestic uses	= quantities used in the zone in the period considered
	c) Final stocks⁻	= quantities remaining at the end of the period considered.

There are various ways of equating these terms but for practical reasons associated with the fact that initial and final stocks are often poorly known whereas the variation in stocks from the beginning to the end of the period may frequently be estimated with acceptable accuracy, the following arrangement has been chosen for EUROSTAT's balance sheets:

Production + Imports = Change in stocks + Exports + Domestic uses

Two points are worth noting:

a) Change in stocks = Final stocks - Initial stocks
   It may be a negative quantity.
b) The balance sheets of other organisations (e.g. OECD) have other formulations of these principal items.

So far the remarks have been general ones applicable to all balance sheets. The balance sheets for fish and fishery products are now considered in greater detail. These were first established for the original six members of the EEC (German Federal Republic, France, Italy, Netherlands, Belgium and Luxembourg) commencing with the year 1959/60. The reference period chosen was the agricultural year, 1 July to 30 June. The intention behind such a reference period was to derive a total balance sheet for all food products (expressed in a common unit, e.g. protein content or calorific values). Crop product statistics normally have an agricultural year reference period and while animal product statistics are normally expressed for the calendar year, there is no theoretical objection to the agricultural year. However the total balance sheet was never established and current opinion is that, theoretically and practically, the result would be of doubtful validity. Fishery statistics are normally expressed for the calendar year and the split year, besides causing difficulties for the national services compiling the balance sheets, made the checking of the results by EUROSTAT very difficult. Thus it was decided to accept the calendar year as the reference period; the first balance sheets using this period were those for 1974.

The schema used in the supply balance sheets for fish and fishery products is shown in Fig. B1.

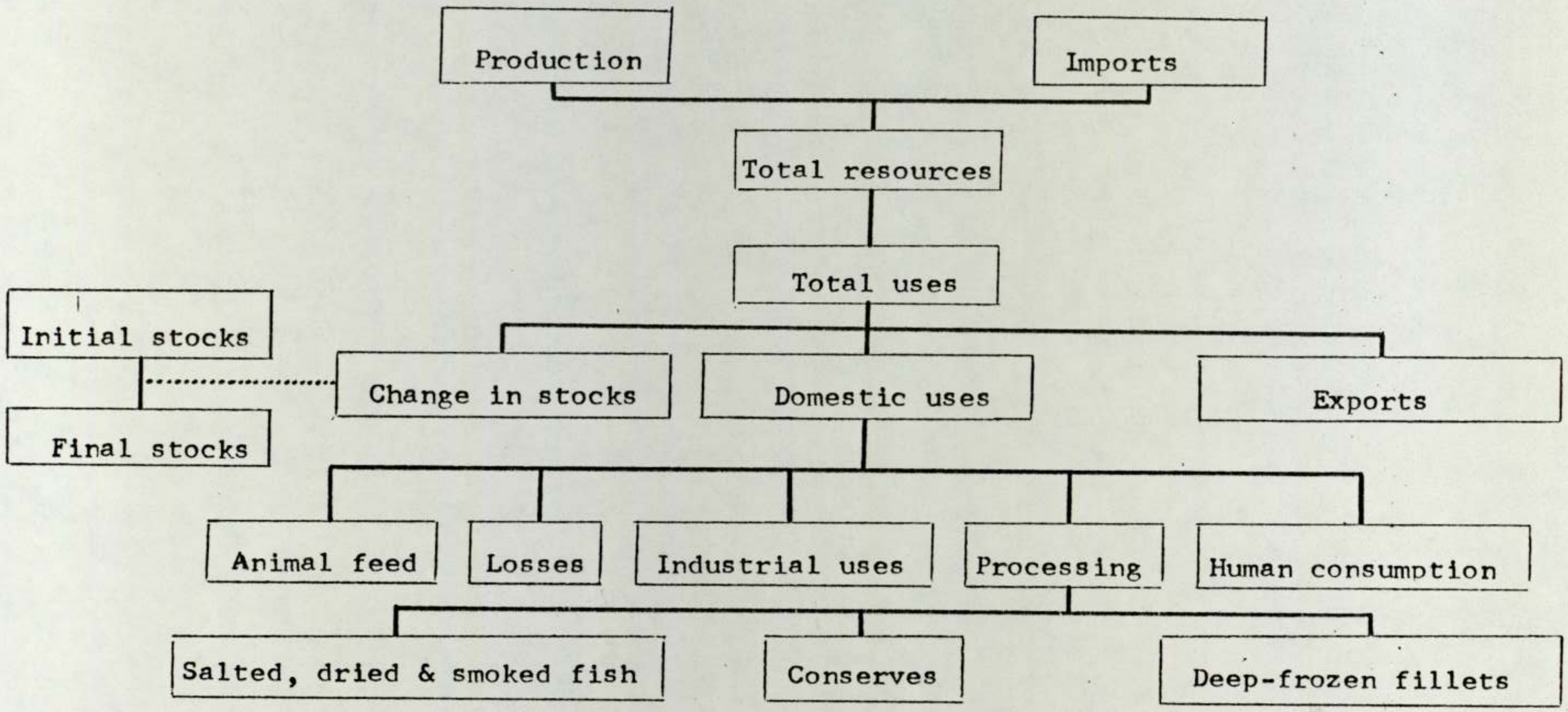
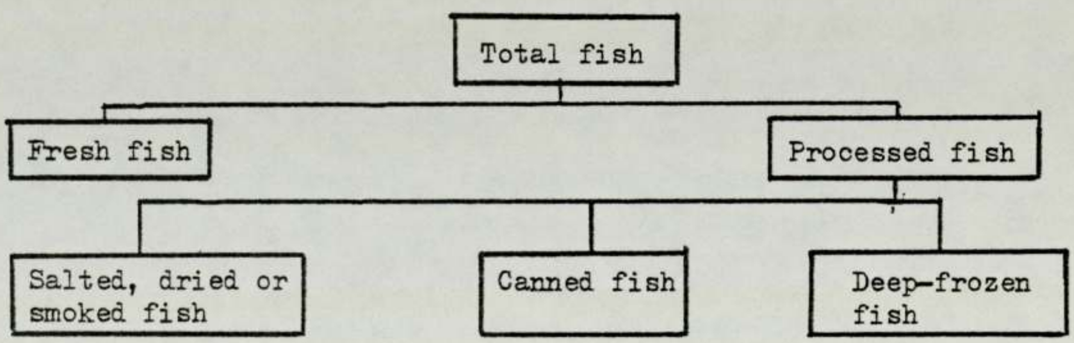


Figure B.1: Schema for supply balance sheets for fish and fishery products.

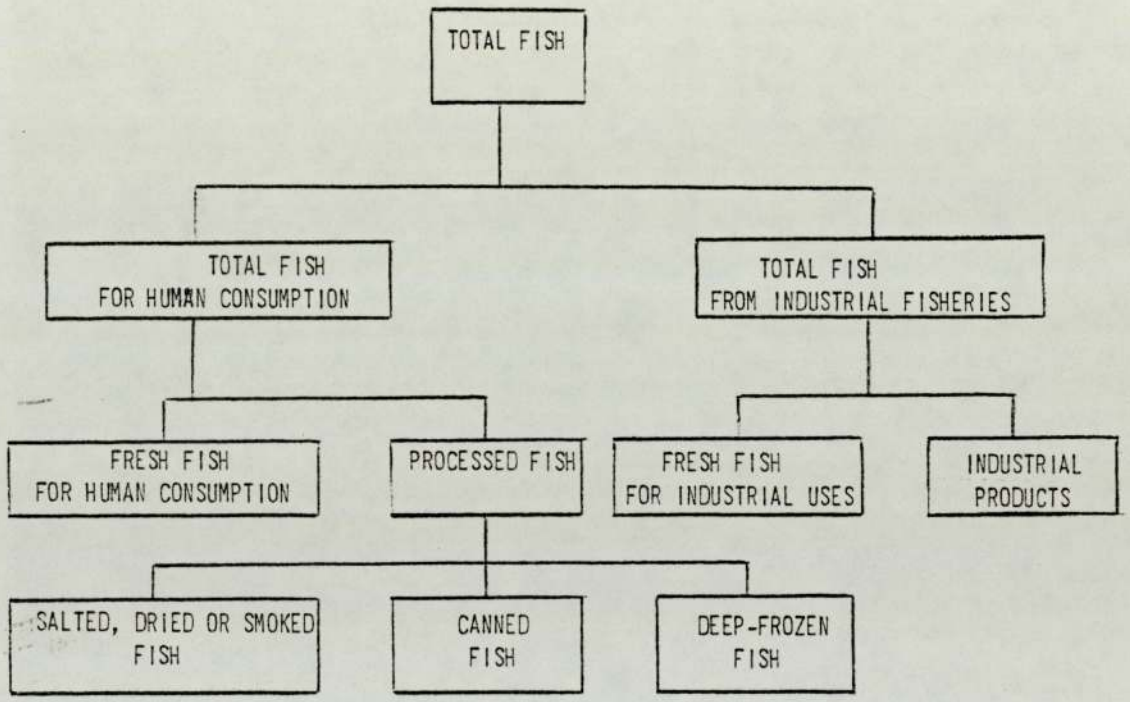
From 1959/60 until 1970/71 the balance sheets were established for the original six Member States: the procedure adopted was for the national services to complete a questionnaire which was returned to EUROSTAT who checked the results and compiled the Community balance sheet. The three new Member States (the United Kingdom, Ireland and Denmark) were not able to establish the balance sheets themselves for the first two years after accession because of pressure of work. However EUROSTAT compiled balance sheets for these countries for the years 1972 and 1973 from nationally published data and from data contributed to other international organisations, principally FAO and OECD. Being taken from differing sources the data may not be harmonised as to the definitions and concepts used. Although this may reflect on the validity of the results, it must be noted that the balance sheet for 1974 and subsequent years established by the new Member States themselves do not differ greatly from EUROSTAT's attempts for 1972 and 1973.

Between 1959/60 and 1972/73 the following balance sheets were produced:



In fact this arrangement was perfectly satisfactory if, by 'Total fish' one assumed it to mean 'Total fish <u>for human consumption</u>'. The balance sheets took into account the foreign trade in fresh and processed fish but they did not take into account the large quantities of fish meal imported for animal feed. Further at the production level, in these Member States virtually all the fish landed is for human consumption.

However with the accession of the three new Member States the existing system of balance sheets was rather unsatisfactory. Both Denmark and, to a lesser extent, the United Kingdom have industrial fisheries, that is fisheries where the object is to catch fish for reduction to fish meal and oil. Thus to retain the overall survey of fisheries and yet distinguish between the two sectors of the industry (for which differing policies might be applied) the following arrangement of balance sheets was developed:



In addition to the dichotomy introduced to account for industrial fisheries, a change will be noted in the treatment of frozen fish.

In the balance sheets a concept that has been adopted is that where fish undergoes two or more forms of processing it is the last process that is considered definitive since it is this process which more precisely determines the shelf-life of the product. However the problem in operating this concept, or indeed any other similar concept, is that, whereas the quantity of product leaving a processing plant is usually recorded, the precise nature of the raw materials entering the plant may not. The result is that a product undergoing two forms of processing will be registered under each method and the quantity destined for direct human consumption (which is usually derived as the quantity remaining when the other uses have been deducted from the total domestic use) will be underestimated by this same quantity. It should be apparent that the total consumption will be accurately recorded; it is only the division between fresh and processed products that may be unreliable.

This source of error can be limited by identifying processed products which are likely to undergo subsequent further processing. One ideal candidate is frozen whole fish. This is a product which may be stored for long periods and, after thawing, the product is amenable to various forms of processing. In view of the largely unpredictable supply and cost of fresh and chilled fish, deep-frozen whole fish is widely used as a raw product in processing plants. Thus, to avoid the double count of processed products in the supply balance sheets, frozen whole fish is treated as a fresh product. This procedure is further justified in that only for specialised products, e.g. individually packaged rainbow trout, is frozen whole fish available on the retail market.

2. UNITS FOR SUPPLY BALANCE SHEETS. Before studying in greater detail the individual balance sheets it is necessary to consider the unit in which they are expressed. Obviously to permit the combination necessary to obtain the total balance sheets, a common unit must be used. For certain well-defined products, e.g. deep-frozen fish fillets, the product weight is a suitable unit in which to express the balance sheets but this unit does not permit addition of balance sheets for different products. An alternative unit is the landed

weight but this unit relates more to the time of measurement than it does the condition of the product. Consequently the products may vary in form from meal and oil to fresh ungutted fish and it would not be meaningful to combine the balance sheets for the different products.

Of the various alternatives, only the live weight equivalent is really satisfactory. All the products are converted back to the weight of live fish from which they were derived. Naturally, when deriving the total balance sheet, care has to be taken that two products both derived from the same fish are not both converted to the live weight equivalent.

By its very nature the live weight equivalent is almost invariably a derived value obtained by applying a conversion factor to the landed weight or the product weight. This factor is established by a technical study, and should be reviewed periodically to take account of changes in processing methods. Examples of the factors used to convert landed weight (or product weight) to the live weight equivalent are shown in the example at the end of this

3. BALANCE SHEET FOR FRESH FISH FOR HUMAN CONSUMPTION

This balance sheet contains all the fresh fish which, at the time of capture, was intended for human consumption. It may be that subsequent events (e.g. poor market prices or poor quality) may determine that the fish is sent for reduction but this should not be permitted to change the designation of the product. In fact, the grouping is a little broader than the title suggests in that frozen whole fish are not satisfactorily categorised as processed fish (they are almost invariably defrosted and consumed 'fresh' or further processed). Frozen whole fish are thus included in the fresh fish balance sheet. The items on the balance sheet are the following:

Production. A Member State's production is taken as the landings by the state's vessels in home and foreign ports. The landings in foreign ports are also included in the item 'exports'. Landings by foreign vessels in the Member State's ports are excluded from this item but are entered in the item 'imports'. The landings, in whatever form they are made, are converted to the live weight equivalent of the fish. To these landings should be added the production of fish farms and the catches from inland fisheries.

Imports. Registered here are the quantities of fresh fish, deep-frozen whole fish and other semi-processed fish (subsequently to be further processed) entering the country in the reference period. Imports also include quantities of fish landed directly in the country by foreign fishing vessels. In the Community balance sheets, i.e. for EUR 6 and EUR 9, the quantity entered is the total originating from outside the Community and is thus not the total of the imports of the individual Member States.

Total resources = Production + Imports = Total uses

Exports. Quantities of fresh fish, frozen whole fish and semi-processed fish, for subsequent further processing, which are sent to another country are included here. Also included are the direct landings by the Member State's fishing vessels in a foreign port. As for imports the Community data are of exports from the Community, not from individual Member States. In order to obtain a balance, the quantity of products exported from the Community is calculated as the total exports of the individual Member States minus the total quantity imported by the individual Member States from the other Member States. The import data are used for the intra-Community trade because they are generally more reliable than export data.

Change in stocks. This is the difference between the stocks held at the beginning and the end of the reference period. A positive quantity indicates an increase in stocks; a negative, a decrease. For the fresh fish balance sheet the only stocks are likely to be deep-frozen whole fish or semi-preserved fish for further processing. The Member States very seldom register quantities here. This is usually because the data are poorly known but it may be reasonably assumed that the quantities are small and probably short-lived. In principle the stocks to be considered here are, as for the other balance sheets, the stocks held by the producers, the processers and the wholesalers; retail stocks are excluded.

Domestic uses = Total uses - Exports - Change in stocks. This item is then sub-divided.

Animal feed. Registered here is the quantity of fresh fish which, at the time of capture, was intended for human consumption but which, for various reasons usually associated with the market conditions, is fed directly to animals, without further processing. Only whole fish is included; fish waste and offal is excluded, being considered a product of lesser import than the edible part of the fish which will be included elsewhere. Two exceptions to the principle that only fresh fish fed directly to animals is to be included. Firstly, the fish included in pet foods is included here since the processing is minimal. Secondly, fish silage made from whole fish which, immediately after capture, is digested in formic acid and then fed to animals is included. It should be noted that fish silage is generally a product of industrial fisheries and thus normally would not appear in this balance sheet.

Losses. These are the quantities of whole fish which are lost between the moment of landing and the arrival at the retailers (e.g. on the market, in transport, during stocking at the wholesalers).

Industrial uses. This item contains the quantities of whole fish (fresh or deep-frozen) which, at the time of capture, were intended for human consumption but which, for various reasons, usually associated with the market conditions, are used by the industry for the production of non-alimentary products. In the fishery context the principal industrial products are fish meal and oil. (It should be noted that although quantities of fish oil are destined for human consumption, fish oil is considered a by-product, albeit a valuable one, of the production of fish meal and it has to undergo considerable refining before it may be incorporated in alimentary products, e.g. margarine. Its pure industrial uses in pharmaceuticals and the paint industry are considered of greater import.) Fish waste and offal used in the manufacture of meal and oil are excluded since the fish from which they were derived are included elsewhere in the balance sheet.

Processing. This item includes all the quantities of whole fish, fresh, deep-frozen or semi-processed, which are used in the industry for the production of an alimentary product. Where possible this item is subdivided into three types of processing: a) salting, drying or smoking, b) conserves and preserves and c) deep-frozen fillets. By convention, if a fish undergoes two or more forms of processing, e.g. filleting, smoking and then canning, it is the final processing that is taken as definitive. On a practical point, it is to be noted that the quantities of fish entering the processing plants is seldom known. This means that the quantity entered under processing is the production of processed product to which has been applied a factor to convert the product weight to the live weight equivalent, the unit in which the balance sheet is expressed.

Human consumption. Quantities of fresh whole fish or deep-frozen whole fish which are destined for direct human consumption are included in this item. This is very seldom a basic statistic but is derived as the quantity remaining when the other domestic uses have been subtracted from the total (with the losses usually being registered as zero). The losses at the retail market level and at the household level are included. This quantity thus is really the apparent human consumption and more exactly records the quantities which are available for human consumption at the retail level.

4. BALANCE SHEET FOR PROCESSED FISH

The balance sheet for processed fish includes all fish which, after processing, are destined for human consumption. Separate balance sheets are established for the following groups of products:

Salted, dried or smoked fish,
Fish conserves and preserves,
Deep-frozen fish fillets.

Units. Originally only the balance sheet for total processed fish was expressed in terms of the live weight equivalent. The other balance sheets were expressed in terms of product weight. However product weight balance sheets are of limited value in assessing the amount of fish consumed since within the major groups listed above are products having very different fish contents. For example, and not an extreme one at that, salted whole herring have a factor for the conversion of product weight to live weight of 1.46 while that for salted herring fillets is 3.50; yet both products are in the same group of products; salted, dried or smoked fish. A change in the relative quantities of these two products produced in different years, or a preferential selection of one of the products in the foreign trade would distort the picture of the amount of fish consumed. Thus EUROSTAT now prefers to quote the supply balance sheets for processed fish in terms of the live weight equivalent, with the exception of certain groups of products, e.g. frozen fish fillets, which are known to have uniform fish compositions. For this study, EUROSTAT's balance sheets for processed fish, previously published in product weight, have been re-evaluated in live weight equivalent.

Production. This is the quantity of processed products produced from domestic and imported raw products expressed in the live weight equivalent. The item corresponds with the item 'processing' on the fresh fish balance sheets. As indicated in the fresh fish balance sheets, where a product undergoes two or more stages of processing, it is the final process that is definitive in deciding in which of the subsidiary balance sheets it should appear.

Imports and Exports. It should be noted here that the foreign trade data, in principle, excludes fish in a semi-processed state. However, having said that, it should be realised that usually it is very difficult to determine the final destination of items in the foreign trade and particularly for exports.

Variation in stocks. This item is the difference between the stocks held at the start of the reference period and those at the end. However, for fishery products the stocks are usually poorly known and the Member States usually register a zero change in stocks in order to obtain a complete balance sheet. With the possible exception of deep-frozen fish fillets, this is not thought to give rise to large errors.

Domestic uses. By definition the balance sheet is for processed fish for human consumption and thus the items 'Animal feed' and 'Industrial uses' are not found on this balance sheet. Also the product is in its final state and thus the item 'Processing' is not applicable. The remaining items, 'Losses' and 'Human consumption', are as in the balance sheet for fresh fish.

5. TOTAL BALANCE SHEET OF FISH FOR HUMAN CONSUMPTION

This balance sheet is derived by combining the balance sheets for fresh fish for human consumption and for processed fish. The method used to combine the balance sheets is given below:

Production = the item 'Production' of the fresh fish balance sheet

Imports = the total of the imports on the fresh fish and processed fish balance sheets

Total resources = Production + Imports = Total uses

Exports = the total of the exports of fresh fish and processed fish

Change in stocks = the sum of the change in stocks of fresh and processed fish

Domestic uses = Total uses - Exports - Change in stocks. The items within this group are composed as follows:

Animal feed. The total of the animal feed and the industrial uses items on the fresh fish balance sheets. This figure represents the fish fed to animals either as fresh fish or as fish meal. It should not be forgotten that at the time of capture this was fish intended for human consumption but that for various reasons, usually associated with the market conditions, was diverted to other uses.

Losses. The sum of the losses recorded on the two component balance sheets.

Industrial uses
Processing
} These items are not applicable.

Human consumption. The sum of the items 'Human consumption' on the two component balance sheets.

6. BALANCE SHEET FOR FRESH FISH OF INDUSTRIAL FISHERIES

This balance sheet is reserved for fresh fish which, at the time of capture, were intended for reduction to meal and oil. Normally the fish are landed directly at the fish meal factories or are loaded directly onto lorries for transport to these factories and thus do not follow the same marketing procedure as the fish for human consumption. Due to this difference the national statistics often differentiate between the two types of fish.

Unit. The balance sheet is expressed in the live weight equivalent of the fish.

Production. This is the live weight equivalent of the landings by the state's vessels in home or foreign ports. Landings in home ports by foreign vessels are excluded. These landings are of whole fish: fish offal or waste is excluded.

Imports. Included here are the imports of whole fish from industrial fisheries. Since fish meal is most effectively produced from fresh fish and methods of preservation are too expensive to use in this type of fishery, most of the imports will be direct landings by foreign vessels in home ports.

Total supplies = Production + Imports = Total uses

Exports. Most of the exports will be in the form of direct landings by the Member State's fishing vessels in foreign ports.

Change in stocks. As has been indicated above preservation methods are not used in industrial fisheries. Thus stocks, if they exist, will be of extremely short duration and do not merit consideration.

Domestic uses = Total uses - Exports - Change in stocks. This item is subdivided as follows:

Animal feed. Whole fish caught in an industrial fishery which are fed directly to animals, that is, without any processing other than preparation of silage.

Losses are the losses which take place between the landing of fish and the reduction process. They are normally recorded as zero.

Industrial uses. This item records the quantity of whole fish from industrial fisheries entering the reduction plants.

Processing) not applicable.
Human consumption)

7. BALANCE SHEET FOR INDUSTRIAL PRODUCTS

It is these balance sheets which cause most of the theoretical problems in the balance sheets for fish. This balance sheet has been included in order that the foreign trade in industrial products may be included in the overall survey of industrial fisheries and the global fishery situation. Since by definition it is a balance sheet for industrial products produced from whole fish it does not represent the full picture for industrial products, a considerable proportion of which are produced from fish waste and offal. As has been mentioned before, this balance sheet was missing from the original EUROSTAT system but has now been included because of the importance of industrial fisheries in two of the three new Member States and because the Community is a very large net importer of industrial products. However, it must be stressed that, because it does not represent the full picture, this balance sheet should not be used in isolation from the other balance sheets. In this respect it cannot be used in the same way as the balance sheet of processed fish (for human consumption) could be used.

The problems with this balance sheet can best be illustrated by considering the items.

Production. This balance sheet, as all the others, is expressed in the live weight equivalent of the products. The best figure to use for the production is thus the live weight equivalent of the fish entering the reduction plant. This is the figure entered under 'Industrial uses' on the balance sheet for fresh fish from industrial fisheries.

Imports. The two major problems associated with this balance sheet arise in a consideration of the foreign trade.

The first problem is that there are two major industrial products of fish, meal and oil, and it has to be decided how to deal with both these products in the foreign trade. The problem is that oil is a by-product of the production of fish meal and thus to take account of both products, by summing up their live weight equivalents, in the foreign trade, could cause a double count of the original raw fish input. Of course if the foreign trade in these products, expressed in live weight equivalents, gave the same result then it would be ncessary to consider only one product. Unfortunately it is very difficult to set a factor for the conversion of oil to live fish: the extraction rate varies very much from one species to another and from one time of the year to another. A very generalised estimate would be about 10%. The corresponding figure for meal, which is more constant, is 21%. It so happens that the Community's imports of fish meal are about double the imports of fish oil. Thus an acceptably accurate estimate of the situation can be achieved by considering only one of the products: of these, fish meal has been chosen because it is easier to locate in the foreign trade data, it can be considered as the main product, and the conversion factor is more reliable.

A second problem now arises: the balance sheet is for products derived from whole fish and there is no way of determining in the foreign trade data the quantity made from fish offal and waste. However, 77% of the Community's imports in 1973 came from 10 major meal producing countries. FAO in its Yearbook of Fishery Statistics records the total quantities of fish meal produced in these countries and the quantities of fish, in live weight, being considered for reduction. Dividing one figure by the other gives an apparent extraction rate for fish meal on 0.22, which is very close to the accepted figure of 0.21. Thus it is reasonable to assume that these countries exporting meal to the EEC produce most of the meal from whole fish.

Total resources = Production + Imports = Total uses

Exports.The same problems arise here as for imports.

As with imports the exports of fish meal and oil are approximately proportional to the extraction rates from fresh fish, given that the extraction rate of oil is variable. Thus only one product need be considered and for the same reasons as with imports, fish meal has been chosen to be that product.

As to the source of the fish meal exported by the Community it is clear that, with the exception of Denmark, considerable proportions of fish meal are made from offal and waste. The apparent conversion factors derived from data published in the FAO Yearbook of Fishery Statistics are mostly very much greater than the accepted factor of 0.21.

	Production of meal (1000 t prodct weight)	Fish for reduction (1000 t live weight)	Apparent conversion factor
EUR 9	416,4	1 256,2	0.33
EUR 6	84,0	42,1	2.00
FR Germany	58,7	32,6	1.80
France	18,1	1,5	12.1
Italy	2,0	5,6	0.36
Netherlands	0,2	0,0	-
Belgium	5,0	2,4	2.1
United Kingdom	83,3	139,8	0.6
Ireland	4,1	8,0	0.51
Denmark	245,0	1 066,3	0.23

Thus there is a possibility of a double count between this balance sheet and that for fresh fish for human consumption (see Fig. B 2). If is is now assumed that <u>all</u> the meal exported by Member States has been manufactured from offal and waste the extent of the double count may be estimated.

	Exports of meal (in live weight equivalent)	Total uses (from total fish balance sheet)	Exports of meal/total uses (%)
EUR 9	=	=	=
EUR 6	223,7	4 966,4	4.5
FR Germany	166,2	2 258,9	7.4
France	58,9	1 102,3	5.3
Italy	1,8	1 011,9	0.2
Netherlands	197,8	771,0	25.7
Belgium	4,3	387,8	1.1
United Kingdom	46,0	2 337,0	2.0
Ireland	4,8	135,0	3.6
Denmark	=	=	=

The calculation has not been made for Denmark (and thus neither for EUR 9) because it appears that the hypothesis as to the origin of the

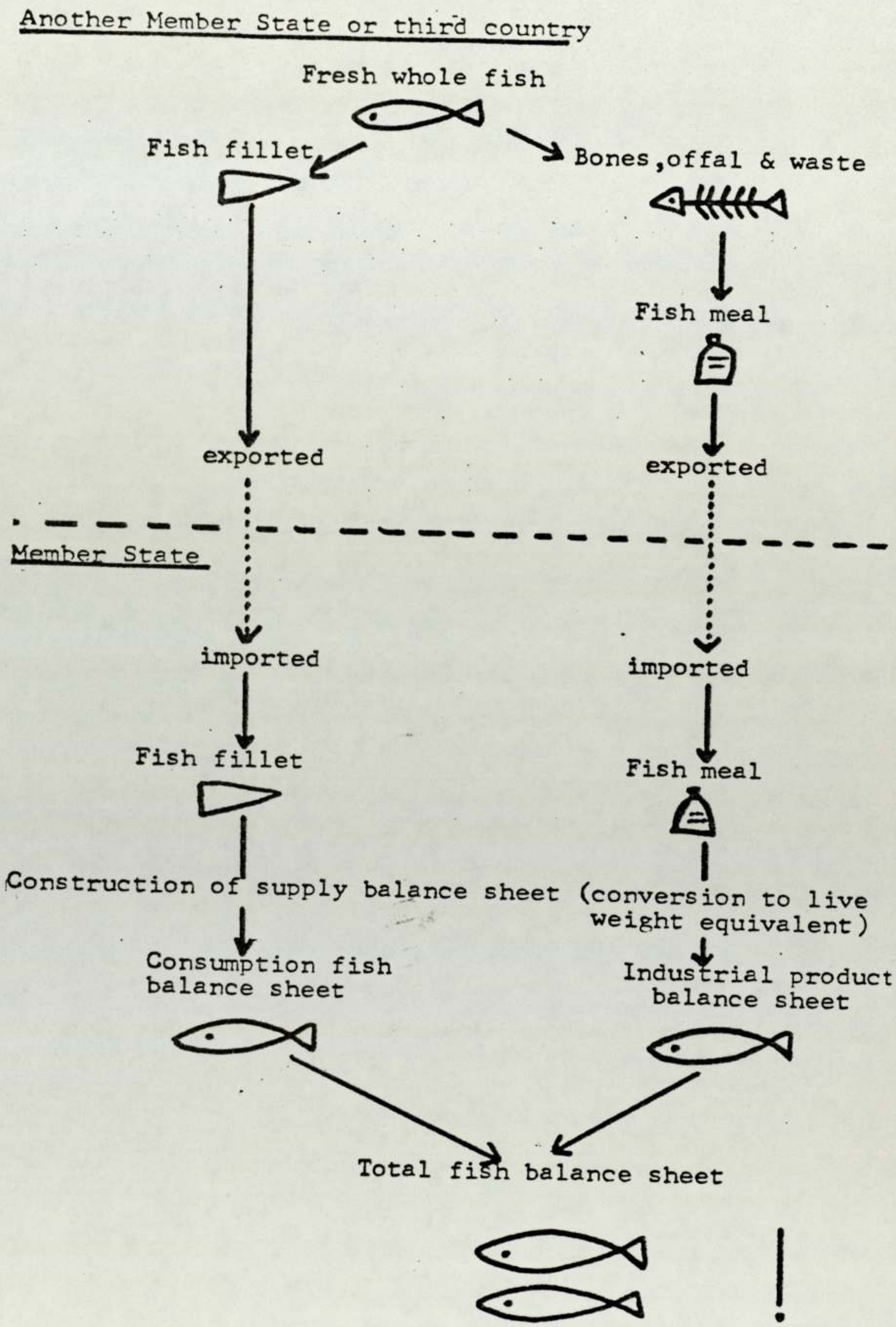


Fig. B2 : Diagramatic representation of the possible double count in the balance sheets due to fish meal made from offal.

meal is not valid. These values, which are maximum values of the double count , show that only in the Netherlands is the error likely to be serious. However the production of meal in the Netherlands is very small and the exports are re-exported (that is, exports of products previously imported). The countries of origin of the greater part of these imports are Denmark, Iceland, Norway, Peru and Chile: all countries that make the greater part of their fish meal from whole fish. Thus it is concluded that the possible extent of a double count is not serious for any of the Member States.

Change in stocks. The data entered here is the difference between the initial and final stocks of fish meal, converted to live weight equivalent. It is assumed that the meal is derived totally from whole fish.

Total domestic uses = Total uses - Exports - Change in stocks.

The only subdivision of the item in this balance sheet are losses and animal feed. Neither of these two is usually known but it is assumed that the losses are negligible and thus the item 'animal feed' is equated to 'Total domestic uses'.

TOTAL BALANCE SHEET FOR FISH FROM INDUSTRIAL FISHERIES

This balance sheet is derived by combining the balance sheets for fresh fish from industrial fisheries with that for industrial products. The method of combination is comparable to that used to derive the total balance sheet for fish destined for human consumption.

TOTAL BALANCE SHEET FOR FISH

This balance sheet is derived by the simple addition of the corresponding items on the total balance sheet for fish destined for human consumption and the total balance sheet for fish from industrial fisheries. The form and method of combining balance sheets may be seen in Table B1 in the example of a balance sheet established, following the lines indicated above, by the United Kingdom authorities.

Thousand tonnes live weight equivalent	TOTAL FISH	FISH FOR CONSUMPTION			FISH DESTINED FOR INDUSTRIAL USES		
		Total	Fresh	Processed	Total	Fresh	Industrial products
PRODUCTION	898.3	785.9	785.9	419.8	112.4	112.4	132.3
IMPORTS	1 475.5	322.9	71.7	251.2	1 152.6	19.9	1 132.7
from EUR 9	482.7	73.9	35.5	38.4	408.8	5.6	403.2
TOTAL RESOURCES	2 373.8	1 108.8	857.6	671.0	1 265.0	132.3	1 265.0
EXPORTS	198.1	169.7	80.6	89.1	28.4	0.0	28.4
to EUR 9	124.7	109.5	67.2	42.3	15.2	0.0	15.2
Initial stocks	:	:	:	:	0.0	0.0	0.0
Final stocks	:	:	:	:	0.0	0.0	0.0
CHANGE IN STOCKS	-4.9	-4.9	-0.6	-4.3	0.0	0.0	0.0
TOTAL DOMESTIC USES	2 180.6	944.0	777.6	586.2	1 236.6	132.3	1 236.6
Animal feed (total)	1 376.9	140.3	15.4	X	1 236.6	0.0	1 236.6
as fresh fish	15.4	15.4	15.4	X	0.0	0.0	X
as fish meal	1 361.5	124.9	X	X	1 236.6	X	1 236.6
Losses	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Industrial uses	X	X	124.9	X	X	132.3	X
Processing	X	X	419.8	X	X	X	X
Human consumption	803.7	803.7	217.5	586.2	X	X	X
as fresh fish	217.5	217.5	217.5	X	X	X	X
as processed fish	586.2	586.2	X	586.2	X	X	X
TOTAL USES	2 373.8	1 108.8	857.6	671.0	1 265.0	132.3	1 265.0
DEGREE OF SELF-SUFFICIENCY (%)	41	83	X	X	9	X	X
PER CAPITA CONSUMPTION (kg/head /year)							
Total	14.4	14.4	3.9	10.5	X	X	X
Fresh fish	3.9	3.9	3.9	X	X	X	X
Processed fish	10.5	10.5	X	10.5	X	X	X

Table B.1: Supply balance sheet for fish for the United Kingdom in 1975.

8. DERIVED CALCULATIONS

Per capita consumption. This is estimated by dividing the item 'Human consumption' by the resident population of the country at the mid-point of the reference period. As has been mentioned above this gives only the apparent per capita consumption, being the quantity per head of population that enters the retail stage of the market. Thus it includes losses at the retail and domestic level as well as retail stocks. As such it must be considered a maximum figure. Another criticism of this calculation is that the resident population is chosen as the denominator. In some countries, notably Italy, there are large numbers of people who are registered as resident in the country but who are living in other countries for most of the year as migrant workers. In spite of this criticism, the resident population is still reckoned to be the best estimate of the population.

Degree of self-sufficiency. This calculation which indicates the extent to which a country has supplied its own requirements of a product is derived as the production expressed as a percentage of the total domestic uses. Until recently EUROSTAT published data for this calculation for virtually all its balance sheets but it is now generally recognised that its use should be very restricted. Two examples will indicate the more serious problems.

In the fresh fish balance sheet the item 'Processing' could include considerable quantities of fish which, after processing, are exported. Thus they should not be considered as part of the country's requirements and the calculation of the degree of self-sufficiency for such a balance sheet would produce a result which is too low.

Then, consider the case of a balance sheet for a processed product where the raw material was imported but processed in the country. Although it appears in the item 'Production' it should perhaps not be counted as truly a product of that country. The calculation of degree of self-sufficiency from this data would product a result which was inflated. In some such balance sheets for agricultural products it is possible to differentiate the processed products made from indigenous materials and those made from imported materials. In these cases the self-sufficiency is calculated by replacing the item 'Production' by the item 'Production from indigenous raw materials'. In fisheries, it is generally not possible to distinguish the origins of the raw materials and thus it is believed to be unwise to calculate the degree of self-sufficiency for balance sheets for processed products.

Because of these considerations, it has been decided that the degree of self-sufficiency is only valid for total balance sheets, where a product is followed from its production to its final destination.

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Up to now, only the balance sheets for fish and fishery products have been considered. However at least two other groups of supply balance sheets are used in this study, though to a lesser degree:

9. FEED BALANCE SHEETS. These balance sheets cover a very broad spectrum of products which are used as animal feed. A number of these, while not fishery products, are interesting in the fishery context because they can be substitutes for these products. In fact, at the present time they are not strictly balance sheets because only the resources side has been developed. The balance sheets are expressed in product weight, in protein units and in forage units.

10. SUPPLY BALANCE SHEETS FOR SHELLFISH. Three balance sheets are established:

Total balance sheet for shellfish
Balance sheet for fresh shellfish
Balance sheet for processed shellfish

These correspond exactly with the three balance sheets established for fish destined for human consumption. It is assumed there is no industrial fishing for shellfish. This is not strictly true (the German shrimp fishery) but its impact is small and may be ignored.

11 COMMUNITY BALANCE SHEETS have been established by aggregating the returns from the individual Member States. However it will be noted that these Community balance sheets do not give data for the extra-Community trade. This is because either the breakdown of the intra-

and extra- trade was not available from the Member States or frequently, when available, the total intra- trade exceeded the total exports. These problems could probably have been overcome but it would be time-consuming work and would give little extra valuable information. The important data, the balance of Community trade can be readily derived from the difference between the production and the total domestic uses.

12. EXAMPLE OF THE CONSTRUCTION OF SUPPLY BALANCE SHEETS

The following has been chosen to show how balance sheets are established from the basic data.

Basic data available: (all expressed in PRODUCT WEIGHT)

Total fresh fish landed	302 000 t
salted fish landed	8 500 t
Imports of fresh fish	150 000 t
Exports of fresh fish	28 000 t
Fresh fish used for animal feed	1 000 t
Production of salted, dried & smoked fish ashore	9 300 t
Production of canned fish and other conserves	104 400 t
Production of frozen fish fillets	90 500 t
Production of fishmeal from whole fish	6 800 t
Imports of salted, dried and smoked fish	24 100 t
Imports of canned fish	42 700 t
Imports of frozen fish fillets	13 300 t
Imports of fish meal	305 200 t
Exports of salted, dried and smoked fish	300 t
Exports of canned fish	20 100 t
Exports of frozen fish fillets	30 400 t
Exports of fish meal	34 600 t

Most Member States are able to supply greater detail of production and foreign trade (e.g. broken down by species) but such detail has been avoided in this example for simplicity.

The only additional data required are factors for converting the product weight to the weight at the time of capture, i.e. the live weight equivalent. For each species, product and item of the balance sheet separate factors would be sought. These factors, derived by technical institutes, should be constantly under review since changes in methods of processing may affect the factors. In the example chosen only a limited number of factors have been used.

Conversion factors (product weight to live weight equivalent)

a)	Fresh fish	
	1) Landings, imports and exports	1.2
	2) Fish destined for animal feeding	1.0
b)	Salted, dried and smoked fish	
	1) Processed at sea	1.1
	2) Processed ashore, imports and exports	1.2
c)	Fish conserves	
	1) Production, imports and exports	1.3
d)	Deep-frozen fish fillets	
	1) Production, imports and exports	2.6
e)	Fish meal	
	1) Production, imports and exports	4.8

For processed products, the following balance sheets may be established by applying the conversion factors to the basic data:

	Salted, dried or smoked	Conserves	Frozen fish fillets	Total processed fish
Production	8.5x1.1 + 9.3x1.2 = 20.5	104.4 x 1.3 = 135.7	90.5 x 2.6 = 235.3	391.5
Imports	24.1 x 1.2 = 28.9	42.7 x 1.3 = 55.5	13.3 x 2.6 = 34.6	119.0
Total resources = Total uses	49.4	191.2	269.9	510.5
Exports	0.3 x 1.2 = 0.3	20.1 x 1.3 = 26.1	30.4 x 2.6 = 79.0	105.4
Change in stocks	-*	-*	-*	-
Domestic uses	49.1	165.1	190.9	405.1
Losses	-*	-*	-*	-
Human consumption	49.1	165.1	190.9	405.1

This balance sheet is expressed in thousand tonnes live weight. Note that in the production of salted, dried and smoked fish, fish processed at sea and on land have been included. Since no data were available for 'change of stocks' and 'losses' (a frequent occurrance) it has been assumed they are non-existent. The figures in rectangular boxes have been derived by addition or difference, horizontally and/or vertically.

Assuming that the Member State has no industrial fishery, the following balance sheet for industrial products may be established in thousand tonnes live weight equivalent:

Production	-	-
Imports	305.2 x 4.8	1465.0
Total resources = total uses		[1465.0]
Exports	34.6 x 4.8	166.1
Change in stocks		-*
Domestic uses		[1298.9]
Animal feed		[1298.9]
Losses		-*

In precisely the same way the balance sheet for fresh fish for human consumption may be established:

Production	302.0 x 1.2 + 8.5 x 1.1	371.8
Imports	150.0 x 1.2	180.0
Total resources = total uses		[551.8]
Exports	28.0 x 1.2	33.6
Change in stocks		-*
Domestic uses		[518.2]
Animal feed	1.0 x 1.0	1.0
Losses		-*
Industrial uses	6.8 x 4.8	32.6
Processing	–	391.5
Human consumption (direct)		[93.1]

In the establishment of this last balance sheet the following points should be noted:

a) All the foreign trade in fresh fish was assumed to be of fish for human consumption;

b) The production figure includes the salted fish processed at sea (converted to its live weight equivalent). This fish also figures in the quantity 'Processing'.

c) 'Changes in stocks' and 'Losses' have been assumed to be zero.

d) Since the country has no industrial fishery, all the fish meal produced was from fish withdrawn from the consumption market for one reason or another.

e) The figure entered for 'Processing' is that appearing under 'Production' in the balance sheet for processed fish.

It is now possible to build up the total balance sheets. The result is shown in Fig. B.3. Since the two sub-total balance sheets, i.e. those for total fish for consumption and for industrial fish, are not obtained by simple addition, an indication has been given as to how they were derived. The total fish balance sheet is obtained by simple addition of these two sub-total balance sheets.

(Thousand tonnes live weight equivalent)

	FISH FOR CONSUMPTION			FISH FOR INDUSTRIAL PURPOSES			TOTAL FISH
	Fresh	Processed	Total	Fresh	Industrial products	Total	
Production	371.8	391.5	371.8	–	–	–	371.8
Imports	180.0	+ 119.0	+ 299.0	–	+ 1465.0	+ 1465.0	1764.0
Total resources = total uses	551.8	510.5	= 670.8	–	1465.0	= 1465.0	2135.8
Exports	33.6	+ 105.4	– 139.0	–	+ 166.1	– 166.1	305.1
Change in stocks	–*	+ –*	– –	–*	+ –*	– –	–
Domestic uses	518.2	405.1	= 531.8	–	1298.9	= 1298.9	1830.7
Animal feed	1.0	–	33.6	–	1298.9	1298.9	1332.5
Losses	–*	+ –*	= –	–	+ –*	+ –	–
Industrial uses	32.6	X	X	–	X	X	X
Processing	391.5	X	X	X	X	X	X
Human consumption	93.1	+ 405.1	+ 498.2	X	X	X	498.2

Fig. B.3: Construction of supply balance sheets

Then given that the resident population of the country at the mid-point of the reference period was 62 million

per capita consumption of fresh fish = = 1.5 kg/head/yr

processed fish = 6.5 kg/head/yr

Degree of self-sufficiency in total fish

$$= \frac{371.8 \times 100}{1830.7} = 20.3\%$$

Degree of self-sufficiency for consumption fish

$$= \frac{371.8 \times 100}{531.8} = 69.9\%$$

Degree of self-sufficiency for industrial fish

$$\frac{0.0 \times 100}{1298.9} = 0.0\ \%$$

APPENDIX C

STATISTICAL TABLES

STATISTICAL TABLES

Note

This annex contains tabulations of statistical data which

a) are not contained in publications of fishery statistics,

and b) have been compiled from various sources for analysis in the present study. In this case the author bears full responsibility for the presentation of the data.

Statistical data which are readily found in the yearbooks of ICES, ICNAF (NAFO), FAO and OECD have not been included in this annex.

Tables	C1 - C2	General tables
	C3 - C14	Price statistics
	C15 - C24	Fleet statistics

Table C.1: Resident population of the European Communities (31 December)

(thousands.)

	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
FR Germany	57 389	57 971	58 619	59 148	59 286	59 500	60 067	60 651	61 302	61 672	61 976	62 054	61 829	61 531	61 400	61 327
France	47 816	48 310	48 758	49 164	49 548	49 915	50 318	50 772	51 251	51 701	52 118	52 460	52 705	52 892	53 078	53 277
Italy	51 199	51 601	51 988	52 332	52 668	52 987	53 317	53 661	54 005	54 412	54 913	55 413	55 830	56 168	56 461	56 714
Netherlands	11 966	12 127	12 295	12 456	12 598	12 730	12 878	13 039	13 194	13 329	13 439	13 545	13 666	13 774	13 856	13 942
Belgium	9 614	9 706	9 795	9 862	9 916	9 955	9 984	9 996	10 018	10 059	10 095	10 129	10 160	10 176	10 188	10 198
United Kingdom	53 691	54 033	54 377	54 653	54 933	55 157	55 372	55 522	55 712	55 869	56 000	56 011	55 981	55 959	55 919	55 902
Ireland	2 850	2 864	2 876	2 884	2 900	2 913	2 926	2 950	2 978	3 014	3 051	3 090	3 127	3 162	3 192	3 311
Denmark	4 685	4 722	4 759	4 798	4 836	4 865	4 892	4 929	4 963	4 992	5 022	5 045	5 060	5 073	5 089	5 104
EUR 9	240 148	241 334	243 467	245 297	246 685	248 022	249 754	251 520	253 423	255 048	256 614	257 747	258 358	258 735	259 183	259 775

Source: EUROSTAT

	FR Germany DM	France FF	Italy LIT	Netherlands HFL	Belgium/Lux. BFR/LFR	United Kingdom UKL	Ireland IRL	Denmark DKR	USA $	EUR 9 *
1960	444.605	521.454	66012.6	401.357	5281.01	37.7215	37.7215	729.535	105.621	105.620
1961	430.742	526.950	66708.4	389.854	5336.67	38.1191	38.1191	737.224	106.734	106.737
1962	427.921	528.168	66862.6	387.268	5349.01	38.2073	38.2073	738.928	106.981	106.980
1963	427.921	528.168	66862.6	387.268	5349.01	38.2073	38.2073	738.928	106.981	106.980
1964	427.921	528.168	66862.6	387.268	5349.01	38.2073	38.2073	738.928	106.981	106.980
1965	427.921	528.168	66862.6	387.268	5349.01	38.2073	38.2073	738.928	106.981	106.980
1966	427.921	528.168	66862.6	387.268	5349.01	38.2073	38.2073	738.928	106.981	106.980
1967	425.924	525.703	66550.6	385.461	5324.04	38.7652	38.7652	742.293	106.482	106.460
1968	411.554	507.967	64305.2	372.456	5144.42	42.8702	42.8702	771.663	102.889	102.888
1968	402.622	529.027	63886.6	370.032	5110.93	42.5912	42.5912	766.640	102.219	102.212
1970	374.138	567.767	63889.5	370.049	5111.16	42.5931	42.5931	766.675	102.223	102.223
1971	364.566	577.214	64741.4	365.750	5086.63	42.8583	42.8583	775.264	104.776	102.336
1972	357.681	565.717	65426.4	359.991	4936.11	44.8941	44.8941	778.909	112.178	102.238
1973	327.644	546.775	71646.0	342.853	4780.09	50.2321	50.2321	741.598	123.173	98.3112
1974	308.352	573.386	77574.3	320.224	4639.94	50.9803	50.9803	725.927	119.270	95.4980
1975	304.939	532.923	80954.5	313.490	4556.90	56.0026	56.0026	712.266	124.077	93.8341
1976	281.545	534.486	93015.0	295.515	43L6.54	62.1578	62.1578	676.176	111.805	88.2561
1977	264.831	560.607	100678.5	280.010	4088.26	65.3701	65.3701	685.567	114.112	83.9820
1978	255.607	573.883	108021.6	275.409	4006.11	66.3910	66.3888	701.945	127.410	83.0075

* Eurodollars.

Table C.2: Value of European Unit of Account (EUA). (Average values per calendar year). 100 EUA = ... national currency.

Table C.3:

UNIT VALUES AT FIRST SALE

United Kingdom EUA/tonne

Year	Sole	Plaice	Cod	Haddock	Herring
1960	916	367	185	199	64
1961	448	375	188	210	73
1962	454	358	168	196	87
1963	680	333	188	216	73
1964	1 518	406	221	179	76
1965	1 548	406	221	179	81
1966	1 263	409	216	199	70
1967	1 170	349	198	222	71
1968	1 051	314	175	192	65
1969	1 186	314	175	192	65
1970	1 589	338	240	185	77
1971	1 678	382	310	227	84
1972	1 769	426	351	303	87
1973	2 008	503	476	360	117
1974	2 126	554	436	395	170
1975	2 253	605	426	384	168
1976	2 903	642	603	436	208
1977	3 167	645	750	581	459
1978	3 441	753	803	720	587

Source : FAO, OECD, EUROSTAT

Table C.4:

UNIT VALUES AT FIRST SALES

France | EUA/tonne

Year	Sole	Plaice	Cod	Haddock	Herring
1960	1 235	296	279	182	144
1961	1 214	288	326	205	134
1962	1 268	302	330	196	202
1963	1 373	239	314	176	162
1964	1 705	265	249	134	132
1965	1 729	255	247	148	194
1966	1 486	223	251	146	196
1967	1 586	241	286	194	200
1968	1 679	261	300	207	211
1969	1 698	267	352	226	193
1970	1 873	301	380	220	211
1971	1 955	348	363	245	215
1972	1 930	369	441	255	197
1973	2 566	383	579	353	255
1974	2 551	466	681	408	257
1975	2 978	527	630	381	231
1976	3 208	571	682	404	296
1977	3 635	674	776	496	339
1978	4 260	669	935	580	735

Source: FAO, OECD, EUROSTAT

Table C.5:

UNIT VALUES AT FIRST SALE

FR Germany EUA/tonne

Year	Sole	Plaice	Cod	Haddock	Herring
1960	610	197	115	167	101
1961	617	204	128	183	112
1962	634	206	136	198	113
1963	818	184	136	213	87
1964	1 371	209	153	224	96
1965	1 233	262	162	219	118
1966	784	281	168	236	109
1967	803	224	168	254	109
1968	867	193	152	210	116
1969	1 036	208	189	218	126
1970	1 481	265	202	211	156
1971	1 395	301	218	279	168
1972	1 575	323	243	237	160
1973	2 349	428	370	364	196
1974	2 360	551	470	435	237
1975	2 632	522	364	449	236
1976	3 561	601	392	508	256
1977	3 447	623	502	623	320
1978	3 333	689	501	645	383

Source: FAO, OECD, EUROSTAT

Table C.6:

UNIT VALUES AT FIRST SALE

Netherlands EUA/tonne

Year	Sole	Plaice	Cod	Haddock	Herring
1960	745	159	201	143	78
1961	750	154	223	145	76
1962	801	137	226	158	133
1963	819	111	216	126	74
1964	1 449	139	196	89	78
1965	1 082	192	172	59	124
1966	879	188	188	111	131
1967	1 036	160	174	139	143
1968	1 097	137	180	149	155
1969	1 284	159	254	125	162
1970	1 833	214	250	179	190
1971	1 721	244	239	210	161
1972	2 064	302	297	268	188
1973	2 611	424	481	360	204
1974	2 451	469	606	424	192
1975	2 737	486	507	380	251
1976	3 547	478	555	436	282
1977	4 032	575	664	636	518
1978	4 244	690	674	647	841

Source: FAO, OECD, EUROSTAT

Table C.7:

UNIT VALUES AT FIRST SALES

Cod EUA/tonne

Year	Norway	Canada
1968	173	81
1969	165	80
1970	180	91
1971	225	117
1972	243	129
1973	291	163
1974	374	211
1975	346	168
1976	431	265
1977	596	192
1978	560	196

Source: FAO, OECD

Table C.8:

UNIT VALUE AT FIRST SALES

Turbot — EUA/tonne

Year	Ireland	United Kingdom	Netherlands	Denmark
1968	460	912	904	
1969	462	875	975	
1970	495	997	1187	
1971	532	1216	1221	1263
1972	612	1372	1545	1480
1973	712	1173	1698	1545
1974	870	1353	1909	1681
1975	910	1700	2148	1936
1976	1285	2125	2431	2341
1977	1751	2507	2649	2400
1978	1854	2994	2917	

Source: National yearbooks

Salmon

Year	Denmark	Ireland
1971	2850	2053
1972	3118	2848
1973	3138	2522
1974	2557	2297
1975	3398	2387
1976	5297	5718
1977	6255	5369

Source: National yearbooks

Table C.9:

Value of a basket of fish (EUA)

Year	United Kingdom	France	Netherlands	FR Germany
1960	10 033	13 341	9 010	7 303
1961	9 893	14 600	9 561	7 967
1962	9 347	15 591	10 449	8 353
1963	9 992	14 310	9 055	8 250
1964	11 487	12 295	8 997	9 574
1965	11 811	13 128	8 541	10 139
1966	11 455	12 853	9 304	9 975
1967	10 846	14 441	9 377	9 904
1968	9 335	15 248	9 734	9 094
1969	9 752	16 603	11 824	10 497
1970	12 050	17 834	13 362	11 875
1971	14 642	17 961	13 018	13 119
1972	16 739	19 938	16 010	13 566
1973	21 494	25 867	22 965	19 752
1974	21 780	29 433	26 715	24 098
1975	21 748	28 224	24 822	21 582
1976	23 747	31 039	27 756	24 391
1977	36 779	35 772	36 325	29 115
1978	41 807	46 273	41 466	30 261

For the explanation of the method of calculation, see section 8 of the text.

Table C.10:

UNIT VALUES AT FIRST SALES

United Kingdom £/tonne

Year	Sole	Plaice	Cod	Haddock	Herring
1968	450.6	134.6	75.0	82.3	27.9
1969	505.1	133.7	74.5	81.8	27.6
1970	676.8	144.0	102.2	78.8	32.8
1971	719.2	163.7	132.9	97.3	36.0
1972	794.2	191.2	157.6	136.0	39.1
1973	1 008.7	252.7	239.1	180.8	58.8
1974	1 083.8	282.4	222.3	201.4	86.7
1975	1 261.7	338.8	238.6	215.0	94.1
1976	1 804.4	399.1	374.8	271.0	129.3
1977	2 070.3	421.6	490.3	379.8	300.0
1978	2 284.5	499.9	533.1	478.0	389.7

Source: FAO, EUROSTAT, OECD.

Table C.11:

UNIT VALUE OF EXPORTS

Denmark EUA/tonne

Year	Salmon & Trout
1970	1 592
1971	1 423
1972	1 424
1973	1 685
1974	1 988
1975	1 924
1976	2 622
1977	2 808
1978	2 665

Source: Fiskeriberetning, Copenhagen.

Table C.12:

UNIT VALUE OF COMMUNITY IMPORTS

EUR 6 (includes intra-Community trade).

EUA/tonne

Year	Eels	Carp
1966	1 391	-
1967	1 456	-
1968	1 358	-
1969	1 434	-
1970	1 636	-
1971	1 923	719
1972	1 976	673
1973	2 084	759
1974	2 332	792
1975	2 518	822
1976	2 898	970
1977	3 378	1 118
1978	3 657	1 203

Source: EUROSTAT

Table C.13:

SELLING PRICES OF AGRICULTURAL PRODUCTS

EUA/tonne

Year	FR Germany	France	Netherlands	United Kingdom
Milk (3.5% fat)				
1969	91.2		93.7	81.7
1970	93.3		93.8	84.0
1971	103.4		104.4	91.7
1972	113.2		111.6	92.0
1973	126.4	114.6	119.6	90.1
1974	142.0	119.3	135.6	106.0
1975	162.3	144.2	152.0	128.7
1976	186.5	155.6	170.4	139.0
1977	203.5	158.1	193.6	143.3
Fresh eggs				
1969	40.5	32.5	28.5	
1970	37.4	27.6	22.5	
1971	43.1	32.1	23.9	
1972	43.9	35.9	28.7	20.7
1973	53.9	42.0	37.5	39.7
1974	57.5	42.2	36.2	38.9
1975	53.8	43.2	32.7	32.1
1976	62.9	53.3	42.5	35.4
1977	65.7	70.5	46.0	38.4

Source: EUROSTAT

Table C.14:

SELLING PRICES OF AGRICULTURAL PRODUCTS

EUA/tonne live weight

Year	FR Germany	France	Netherlands	United Kingdom
Heifers				
1969	675.1	-	-	434.4
1970	686.9	715.1	708.3	441.8
1971	699.7	750.8	751.6	524.0
1972	888.8	936.5	913.9	609.9
1973	978.3	1 095.6	1 003.0	703.4
1974	979.8	987.1	949.8	603.3
1975	1 130.4	1 187.6	1 069.6	683.0
1976	1 233.9	1 264.6	1 199.3	837.2
1977	1.372.6	1 356.6	1 363.2	853.1
Chickens				
1969	429.7	525.5	418.4	505.5
1970	433.0	493.2	418.3	551.7
1971	425.2	507.6	407.4	585.2
1972	438.9	540.9	438.1	563.5
1973	581.6	618.0	546.6	686.9
1974	586.8	587.0	507.4	788.9
1975	573.9	671.2	583.1	848.0
1976	674.8	699.7	658.8	867.0
1977	728.8	742.1	696.8	968.8

Source: EUROSTAT

Table C.15 : Number and total tonnage of motor fishing vessels in the period 1970-78: FR Germany.

Tonnage class	1970	1971	1972	1973	1974	1975	1976	1977	1978
					Total number				
0 - 49.9 GRT	1 475	1 481	1 466	1 362	1 328	1 294	1 296	1 056	538
50 - 149.9	195	193	192	193	185	172	166	158	154
150 - 499.9	13	10	11	8	12	20	16	14	11
500+	109	101	100	83	74	71	66	66	60
Total number	1 792	1 785	1 769	1 646	1 599	1 557	1 544	1 294	763
					Total tonnage				
0 - 49.9 GRT	14 722	14 449	14 575	13 813	13 184	13 026	13 560	12 998	11 903
50 - 149.9	14 657	14 808	15 111	15 881	15 367	13 553	13 548	13 669	13 517
150 - 499.9	4 131	3 135	3 391	2 330	3 003	3 792	3 318	3 258	2 686
500+	116 930	112 050	124 342	134 252	124 006	121 621	114 011	111 447	104 843
Total tonnage	150 440	144 442	157 419	166 277	155 560	151 992	145 298	141 250	132 949

Source: OECD, EUROSTAT

Table C.16 : Number and total tonnage of motor fishing vessels in the period 1970-78 : France

Tonnage class	1970	1971	1972	1973	1974	1975	1976	1977	1978
				Total number					
0 - 49.9 GRT	12 638	13 273	13 446	12 672	12 620	12 334	12 139	11 942	11 728
50 - 149.9	264	220	642	180	174	160	539	499	118
150 - 499.9	462	458		413	390	382			200
500+	63	65	75	82	84	91	86	83	82
Total number	13 427	14 016	14 163	13 347	13 268	12 967	12 764	12 524	12 128
				Total tonnage					
0 - 49.9 GRT	91 643	94 487	96 415	94 731	96 409	95 996	96 776	92 091	91 701
50 - 149.9	22 204	21 000	105 971	12 868	12 762	12 053	88 392	74 322	14 583
150 - 499.9	99 131	92 617		84 813	77 484	81 262			49 005
500+	61 579	72 916	76 958	79 271	83 812	86 594	75 813	72 210	72 504
Total tonnage	274 557	281 020	279 344	271 683	270 467	275 905	260 981	238 623	227 793

Source: OECD, EUROSTAT

Table C.17 : Number and total tonnage of motor fishing vessels in the period 1970-78 : Italy.

Tonnage class	1970	1971	1972	1973	1974	1975	1976	1977	1978
					Total number				
0 - 49.9 GRT	19 055	19 460	19 743	19 972	20 074	20 379	20 582	20 854	21 467
50 - 149.9	605	587	612	632	658	692	693	778	754
150 - 499.9	56	61	72	79	92	102	107	111	110
500+	58	58	57	59	59	54	54	55	56
Total number	19 774	20 166	20 484	20 744	20 883	21 227	21 436	21 797	22 388
					Total tonnage				
0 - 49.9 GRT	120 908	125 432	126 652	128 155	128 945	132 166	133 199	133 478	144 220
50 - 149.9	48 493	50 146	52 643	54 540	56 795	60 219	60 446	64 579	65 448
150 - 499.9	16 324	18 227	19 688	22 260	23 681	24 929	25 232	26 754	26 552
500+	53 988	52 863	53 895	57 413	57 373	52 261	52 261	56 099	59 761
Total tonnage	239 713	246 668	252 878	258 350	266 794	269 575	271 138	280 910	295 981

Source: OECD, EUROSTAT

Table C. 18 : Number and total tonnage of motor fishing vessels in the period 1970-78 : Netherlands

Tonnage class	1970	1971	1972	1973	1974	1975	1976	1977	1978
					Total number				
0 - 49.9 GRT	769	652	618	599	568	622	508	442	428
50 - 149.9	365	352	343	313	303	240	312	289	290
150 - 499.9	118	122	138	182	226	207	201	198	202
500+	5	4	3	2	4	4	4	4	4
Total number	1 257	1 130	1 102	1 096	1 101	1 073	1 025	933	924
					Total tonnage				
0 - 49.9 GRT	22 975	20 558	19 681	19 348	17 996	20 189	11 793	10 590	10 488
50 - 149.9	33 544	32 582	31 880	30 058	29 104	23 592	27 922	26 630	27 079
150 - 499.9	30 611	31 300	34 811	45 339	55 839	50 392	48 537	47 856	48 419
500+	2 930	2 321	1 793	1 233	2 293	2 139	2 139	2 139	2 139
Total tonnage	90 060	86 761	88 165	95 978	105 232	96 312	90 391	87 215	88 125

Source: OECD, EUROSTAT

Table C. 19 : Number and total tonnage of motor fishing vessels in the period 1970-78 : Belgium.

Tonnage class	1970	1971	1972	1973	1974	1975	1976	1977	1978
					Total number				
0 - 49.9 GRT	121	114	102	88	80	74	73	68	66
50 - 149.9	179	172	167	164	159	149	147	121	121
150 - 499.9	26	27	26	27	28	31	32	29	28
500+	6	6	6	6	1	1	1	1	1
Total number	332	319	301	285	268	255	253	219	216
					Total tonnage				
0 - 49.9 GRT	4 042	3 821	3 468	3 058	2 778	2 628	2 610	2 510	2 476
50 - 149.9	16 582	15 999	15 620	15 525	15 047	14 260	14 156	11 862	11 789
150 - 499.9	6 045	6 182	6 028	6 182	5 661	6 461	6 723	6 073	5 917
500+	4 516	4 516	4 516	4 516	555	555	555	555	555
Total tonnage	31 185	30 518	29 632	29 281	24 042	23 904	24 044	21 000	20 737

Source: OECD, EUROSTAT

Table C. 20 : Number and total tonnage of motor fishing vessels in the period 1970-78 : United Kingdom

Tonnage class	1970	1971	1972	1973	1974	1975	1976	1977	1978
					Total number				
0 - 49.9 GRT	5 225	5 383	5 619	5 834	6 200	5 924	5 978	6 242	6 367
50 - 149.9	218	219	229	257	279	390	450	389	406
150 - 499.9	317	311	314	311	282	248	221	220	208
500+	147	150	153	154	148	120	56	89	71
Total number	5 907	6 063	6 315	6 556	6 909	6 682	6 705	6 940	7 053
					Total tonnage				
0 - 49.9 GRT	60 422	63 083	65 538	69 736	73 405	69 891	67 307	69 409	70 370
50 - 149.9	17 306	16 390	16 732	19 727	20 960	28 591	29 884	28 878	30 640
150 - 499.9	87 177	86 037	87 210	87 674	80 684	72 211	66 030	63 510	58 380
500+	125 685	126 375	129 389	131 588	129 051	106 042	88 177	81 607	67 316
Total tonnage	290 590	291 885	298 869	308 725	304 100	276 735	251 399	243 404	226 706

Source: OECD, EUROSTAT

Table C.21 : Number and total tonnage of motor fishing vessels in the period 1970-78 : Ireland.

Tonnage class	1970	1971	1972	1973	1974	1975	1976	1977	1978
					Total number				
0 - 49.9 GRT	849	852	944	988	1 006	967	1 049	1 161	1 256
50 - 149.9	83	100	127	137	152	164	186	190	197
150 - 499.9	-	-	1	-	[illegible]	-	1	6	6
500+	-	-	-	-	1	1	1	1	1
Total number	932	952	1 065	1 125	1 159	1 132	1 237	1 358	1 460
					Total tonnage				
0 - 49.9 GRT	:	:	:	10 170	10 700	10 880	11 207	12 290	11 985
50 - 149.9	:	:	:	10 157	11 526	12 384	14 250	14 483	15 137
150 - 499.9	-	-	174	-	-	-	250	1 093	1 093
500+	-	-	-	-	1 960	1 960	1 960	1 960	1 960
Total tonnage	:	:	:	20 327	24 186	25 722	28 410	29 832	29 832

Source: OECD, EUROSTAT

Table C.22 : Number and total tonnage of motor fishing vessels in the period 1970-78: Denmark.

Tonnage class	1970	1971	1972	1973	1974	1975	1976	1977	1978
Total number									
0 - 49.9 GRT	7 188	7 021	6 857	6 805	6 812	6 886	6 862	6 752	:
50 - 149.9	306	321	350	379	400	414	417	410	:
150 - 499.9	84	91	67	61	97	141	162	166	:
500+	-	-	-	-	1	3	3	3	:
Total number	7 578	7 432	7 274	7 245	7 310	7 444	7 444	7 331	:
Total tonnage									
0 - 49.9 GRT	76 076	73 045	69 988	68 872	69 633	70 951	70 293	67 141	:
50 - 149.9	27 616	30 094	34 614	38 303	40 441	41 715	42 001	41 302	:
150 - 499.9	15 944	17 522	13 159	12 550	20 252	29 782	34 709	35 851	:
500+	-	-	-	-	820	2 146	2 146	2 000	:
Total tonnage	119 636	120 611	117 761	119 725	131 146	144 594	149 149	146 294	:

Source: OECD, [illegible]STAT

Table C.23 : Number and total tonnage of motor fishing vessels in the period 1970-78 : Spain.

Tonnage class	1970	1971	1972	1973	1974	1975	1976	1977	1978
Total number									
0 - 49.9 GRT	12 306	12 597	12 989	13 018	13 555	13 567	13 807	13 784	13 878
50 - 149.9	1 780	1 776	1 756	1 771	1 771	1 774	1 743	1 743	1 731
150 - 499.9	1 009	1 040	1 098	1 169	1 293	1 362	1 415	1 441	1 406
500+	145	141	155	155	164	179	183	184	159
Total number	15 240	15 554	15 998	16 113	16 783	16 882	17 148	17 152	17 174
Total tonnage									
0 - 49.9 GRT	:	:	102 220	103 108	:	:	109 313	109 240	109 661
50 - 149.9	:	:	155 208	157 089	:	:	155 870	155 779	155 231
150 - 499.9	:	:	256 385	275 097	:	:	349 736	359 213	353 720
500+	:	:	160 797	159 856	:	:	192 445	193 292	167 030
Total tonnage	:	:	674 610	695 150	744 833	780 900	807 365	617 524	785 642

Source: OECD, EUROSTAT

Table C.24 : Number and total tonnage of motor fishing vessels in the period 1970-78: Portugal.

Tonnage class	1970	1971	1972	1973	1974	1975	1976	1977	1978
					Total number				
0 - 49.9 GRT	3 885	3 962	4 025	4 069	4 113	4 179	4 280	4 362	4 380
50 - 149.9	219	224	229	237	242	247	255	256	256
150 - 499.9	85	91	99	102	102	104	109	109	110
500+	70	70	72	73	75	76	77	78	78
Total number	4 259	4 347	4 425	4 481	4 532	4 606	4 721	4 805	4 824
					Total tonnage				
0 - 49.9 GRT	27 421	27 812	28 186	28 504	28 787	29 208	29 809	30 357	30 711
50 - 149.9	16 743	17 110	17 755	18 207	18 643	19 033	19 743	19 886	19 886
150 - 499.9	23 028	24 183	25 930	26 487	26 487	26 879	27 895	27 897	28 095
500+	88 302	88 302	89 907	92 311	96 689	97 493	98 297	98 297	98 217
Total tonnage	155 494	157 406	161 549	165 509	170 605	172 613	175 746	176 437	176 909

Source: OECD, EUROSTAT