COMMISSION OF THE EUROPEAN COMMUNITIES

SEC(92) 423 final

Brussels, 12 March 1992

REPORT FROM THE COMMISSION TO THE COUNCIL

on the discarding of fish in Community fisheries:
causes, impact, solutions

TABLE OF CONTENTS

INTRODUCTION

1. DISCARDING: TYPES, CAUSES AND CONSEQUENCES

1.1 Types of discards
- 1.1.1 Definitions
- 1.1.2 Variations depending on fishing techniques and practices
- 1.1.3 Variations depending on zone and time

1.2 Origins and causes of discards
- 1.2.1 Ecological constraints
- 1.2.2 Technical constraints
- 1.2.3 Economic constraints
- 1.2.4 Legal and administrative constraints

1.3 Impact of discards
- 1.3.1 Biological and management aspects
- 1.3.2 Economic aspects
- 1.3.3 Ecological aspects

2. DISCARDS IN COMMUNITY FISHERIES

2.1 Discards in the Mediterranean
- 2.1.1 France
- 2.1.2 Italy
- 2.1.3 Greece
- 2.1.4 Spain

2.2 Discards in the Atlantic
- 2.2.1 Round fish in the North Sea
- 2.2.2 Bottom trawls using small meshes
- 2.2.3 Specialized deep-sea fisheries
- 2.2.4 Fishing for bivalves using dredges
- 2.2.5 Crab fisheries
- 2.2.6 Demersal fisheries in the western Atlantic

2.3 Summary
- 2.3.1 Mediterranean
- 2.3.2 Atlantic seaboard

CONTENTS (cont.)

3. THE OBLIGATION TO DISCARD AND A DISCARD BAN

3.1 Obligation to discard in Community waters
3.1.1 Community legal obligations
3.1.2 Justification for the legal obligation to discard

3.2 The ban on discards in Norwegian waters
3.2.1 Norwegian Regulation
3.2.2 Adaptation of Community rules

3.3 Possibility of banning discards in Community waters
3.3.1 Assessment criteria
3.3.2 Assessment of the effects of a discard ban

4. OVERALL STRATEGY ON DISCARDS

4.1 Eliminating catches of potential discards
4.1.1 Permanent and temporary boxes
4.1.2 Developmentof selective fishing

4.2 Reduction in compulsory discards
4.2.1 Greater flexibility of the system of TACs and quotas
4.2.2 Minimum sizes, by-catches

4.3 Development of an economic context in which discarding is unattractive
4.3.1 Improving the return on catches
4.3.2 Adaptation of vessels to selective fishing methods

4.4 The need for integrated action
4.4.1 Combination of different instruments
4.4.2 Inclusion in an overall policy

CONCLUSION

SUMMARY

LIST OF ANNEXES

I. Estimate of discards which could theoretically result from quotas being used up during 1990

II. Summary of studies available on the practice of discarding in Community fisheries

III. Bibliography

IV. Potential interest of available tools to deal with the various types of discards

LIST OF FIGURES

Fig. 1 Hake fishing in the Bay of Biscay

1A distribution of size frequencies (absolute)

1B Selection curves

1C Breakdown of total catches by size category

Fig. 2 Short-term effect of increasing mesh size on landings and discards in the Bay of Biscay hake fishery

INTRODUCTION

All fishing methods aim to catch wild species in their natural habitat. In addition to the target species, these activities result in the catching of other fish, either of the same species but unsuitable for marketing or of species with a lower food or commercial value, often referred to as by-catches. Whether such catches are occasional, frequent or of regular occurrence, they are usually thrown back into the sea as soon as they have been sorted and separated from the part of the catch to be marketed. The survival rate of the discarded fish depends on the species, the conditions under which they were caught and how they are discarded.

Discarding may a result from technical limitations imposed by the gear or fishing methods used, whether accidental (e.g. breakdowns or storms) or intentional, from economic constraints or choices which the fishermen have to make or from the legal or administrative obligations imposed upon them.

The quantity of fish discarded into the sea is substantial since, although the practice varies considerably, it is followed by virtually all vessels. The seriousness of the problems to which it gives rise should be assessed in objective terms, whether as losses of a certain amount of a raw material, economic losses for the sector or ecological impact, particularly in terms of the protection of biological resources and the environment. Further problems include compliance with Community rules, which makes discarding compulsory, and with Norwegian legislation, which partially prohibits it, albeit in different circumstances.

These problems mean that consideration must be given to banning discarding in Community waters and to alternative solutions such as abrogation of certain obligations to discard contained in Community legislation. This can be done only with reference to the context in which discarding takes place, while so far there have been few studies of the practice of discarding and its underlying causes or estimates of its extent and any results that exist are scattered among different sources.

This report endeavours to consider the harmful effects of discarding by looking at its various manifestations and considering the technical, commercial and legal constraints which give rise to it. Since there are no estimates of these, it then surveys discards observed in Community fisheries and estimates their relative magnitude where statistics permit. It goes on to compare Community and Norwegian rules on discards to see how compatible they are and assesses whether Community rules on fishing could prohibit discarding and how effective such a ban would be. Finally, it sets out the various possible remedies for the different forms which discarding takes.

1. DISCARDING: TYPES, CAUSES AND CONSEQUENCES

1.1 Types of discards

The practice of discarding embraces a variety of situations which depend on the methods and gear employed, fishing zones and seasons and the markets in question. A failure to appreciate the different situations which arise has led to a number of misleading generalizations.

1.1.1 Definitions

Discards may be grouped in a number of categories, depending on the frequency of the catches giving rise to them (occasional, frequent or regular), the sensitivity of public opinion to the deaths they entail ("sensitive species") and their economic importance (whether or not species are marketable).

Marketable species may be discarded when they do not comply with regulatory requirements (exceeding of quotas, by-catch rates, prohibited catch zones, etc.) or when they are of low commercial value (too small or unacceptable in appearance or on health grounds). By-products of marketable species (guts, gonads, heads, skin, bones, bodies of crabs from which the claws have been removed) are also discarded, often as a matter of course, even when they could be sold.

By-catches of species which are not marketed may include sensitive species (dolphins, seals, turtles and sea birds) as well as species which do not attract public affection (sharks, shellfish, etc.). While both may be discarded, there may also be substantial traditional market outlets for them.

A further distinction may also be made between those species which, when discarded, may survive easily (shellfish or particularly resistant fish), those which are unlikely to survive or whose chances of survival are slight (juvenile flat fish in shrimp fisheries, Norway lobster, crabs without claws) and those which are already dead.

1.1.2 Variations depending on fishing techniques and practices

Discards vary, sometimes to a considerable extent, both in quantity and quality depending on the fishing technique employed. The quantity of discards generated by a fishing method depends on its ability to take only fish of marketable size belonging to the target species and in a state acceptable to the consumer in terms of both health and appearance. While virtually no fishing technique can guarantee that there will be no discards, some (pots and lines) result in a much lower level than others (trawls and dredges). Similarly, the conditions under which a fishing technique is employed are decisive in determining the quantity of discards: delays in hauling in towed gear are of the utmost importance because a large proportion of the fish caught in a net which has remained immersed for too long will have to be discarded and the effect of excessively long trawls is similar. The length of fishing trips is also a factor because, where fishing on the high seas is for human consumption, only those species which can be easily kept and sold can be retained on board and the cost of packing and preserving must be covered where trips are long. Hence, because of the length of their fishing trips, vessels fishing for swordfish by line retain on board only sharks caught during the final days of the voyage.

1.1.3 Variations depending on zone and time

The variations in discards arising from fishing methods and gear are aggravated by the seasonal nature of fisheries and the biological phenomena attendant on recruitment and migration. This means that discards vary from one fiching ground to another (as does the breakdown by species from the stocks exploited).

Differing market conditions also result in variations in discards depending on the port of landing. For example, attractive prices are offered in the Mediterranean for small fish which would be discarded in the North Sea.

1.2 Origins and causes of discards

1.2.1 Ecological constraints

Depending on the patterns of distribution of species in their natural habitats (determined by the nature of stocks, the temperature, the seasons and the sea bed), fishing may be confined to a single species or target a number of species. In the latter case, catching a mixture of species using unselective gear may result in unwanted species being taken and then discarded. This situation cannot be ignored, and it is difficult to find a solution (e.g. mixed catches of Norway lobster and young hake).

1.2.2 Technical constraints

Fishing gear is selective both between species and within the same species and this selectivity may be modulated. Fishing operations are subject to a number of technical constraints related to the gear used and storage conditions, which themselves may result in discards, either occasionally (e.g. when accidents or breakdowns occur) or regularly. They are an important factor in determining whether discards can be reduced, or even eliminated altogether.

Although accidental losses are always likely, they cannot be foreseen and so are difficult to avoid. In this they differ from regular losses, which may be reduced or even eliminated altogether whether they are caused by fishing gear (shells broken by dredges, fish crushed in overfull seine nets) or whether they arise even before the fish have been hauled aboard (fish coming loose from hooks or slipping from nets). In most cases, improving the set or adjusting the gear is an adequate solution. The number of fish escaping may be reduced, either by adjusting the hanging ratio used on driftnets, by reducing the rate at which longlines are hauled in or by adjusting the size and shape of hooks on lines.

1.2.3 Economic constraints

Economic considerations are a further reason for discards. In the last analysis, every decision to discard may be said to have an economic basis. This includes decisions to comply with legal obligations, where those contemplating fraud compare the gains it offers to the risks posed by penalties. Economic considerations merit all the more attention because they will determine whether any attempt to limit discards can be applied or made to work. Here a distinction is to be made between discards on the grounds of low market value and those provoked by limited storage or processing capacity on board.

As already stated, many species are discarded because there is no market for them, even though an increasing number of species can now be used, through new processing techniques, or sold, thanks to the development of new markets. There are many examples, including the shore crab (recently developed in France and Ireland for export to Spain), Galatea (a recently marketed by-catch of trawling for Norway lobster), grenadiers, blue whiting and horse mackerel (sold as fillets or for processing into surimi).

Marketable species may also be discarded because of their biological quality or on health grounds (bacteria content or taste and smell) since these factors have a considerable influence on price. For example, the very specific requirements of the Japanese market determine the criteria for discarding herring and capelin fished for their roe. By contrast, it is the point in a long voyage at which mackerel caught in a trawl or a shark caught on a longline were taken which determines whether or not they will be discarded.

Discards of species with a low market value may be regarded as the result of the limited storage space available to the fishermen. However, any decision to store fish on board, whether or not processed, implies a commercial choice. Any handling (packing, preservation on board and unloading) entails a cost, even if only the opportunity cost. It would not be rational to process or store a catch whose selling price did not cover this cost.

On-board storage and processing capacity are necessarily limited so that fishermen have to allocate them as best they can between the various species caught, giving priority to those which will provide the best return for the various factors of production (labour and capital). Hence only those species where the added value is greatest will be filleted or frozen on board.

In many cases, the costs of running the vessels determine whether by-catches are discarded or not. The installation of blast freezers on board tropical shrimpers limits their storage capacity. Although small, this is adequate for the volume of shrimps retained, which constitute only a small percentage of the total catch. However, the high running costs of these vessels would make it unprofitable for them to process species with a low market value, most of which are therefore discarded.

1.2.4 Legal and administrative constraints

In general, legal obligations are imposed by the regulations on the minimum size of fish, percentages of by-catches, prohibited zones and gear and restrictions due to catch quotas. These rules assume, often implicitly, that fish which are too small or which belong to a protected species or one for which the quota is exhausted will be discarded.

However, there is a risk that discards arising from the search for the best possible allocation of the factors of production will be aggravated by the rules and the type of fishing to which they are applied. The system of management by annual quotas has an impact on fishing for a single species different from that on fishing for several species. When quotas for the former type are exhausted, the fisheries are closed and the fishing grounds are no longer worked. This is not the case when quotas for a one species have been exhausted in a context of fishing for a number of species.

Theoretical calculations have been carried out (Annex I) to assess the level of discards after the exhaustion of quotas in multispecies fisheries in 1990. They show that the key factor is how fleets are managed. Where the only restrictions are TACs and quotas and corresponding periods of closure, quotas are used up rapidly. If the quota for a given stock is 50 000 tonnes, the early stopping of a fishery with a fairly high discard rate, and if discard obligations are respected, is calculated to result in discards over the whole year totalling 7 500 tonnes in the case of a single-species fishery and of 50 000 (the amount of the quota) in the case of a fishery covering a number of species (continuing activity in the same fishing ground).

Introduction of a system of individual quotas would enable fishing enterprises to spread their catches better over the whole year so that fishing grounds would certainly be closed later. It would, however, favour the selection of large fish, which command a higher price because they offer higher processing yields, and the discarding of smaller fish. Since each vessel would seek to exploit its quota to best advantage, the discard rate could increase substantially. If it rose by 13%-15%, for example, discards would be considerably higher than under the previous arrangements, whether fishing was targeted on one or several species.

Conversely, introduction of a limited fishing period or a system of seasonal licences for access to certain fishing grounds would tend to reduce discards, since each vessel would seek to make best use of the time available for it to fish. Furthermore, the season could be fixed at a time when the composition of catches (large fish content) or their biological state (e.g. sexual maturity, fat content) would lead to few discards. This could result in the discard rate falling from, for example, 15% to 5%, which appears an excellent compromise between the objectives of managing the fishing effort and reducing discards as far as possible.

This theoretical analysis shows that the effectiveness of any solution designed to solve the problems engendered by discards can be assessed only in the light of the measures applied to the fisheries concerned.

1.3 Impact of discards

1.3.1 Biological and management aspects

One of the main problems arising from the practice of discarding fish concerns the regulation of catches and hence the management of fish stocks. This problem is fundamental for the Community method of regulation, which is based on TACs and quotas. Figures on landings are the only basis for estimating actual catches and hence fish mortality and to them must be added the quantity of discards. Equating catches with landings assumes that discards are negligible.

The system currently used by the Community to manage stocks includes a self-correcting factor, in that TACs are set lower to compensate for the discounting of discards. This system of "offsetting" the margin of error constitutes only a very partial solution, since the proportion of discards varies from year to year.

1.3.2 Economic aspects

Discards of species with a low market value involve a loss of raw material which could have been exploited by processing (conversion into starch, protein flesh, etc.) or by reduction to oil and meal, a method which adds very little value to catches but which avoids discards. However, the commercial losses caused by discards at sea have to be set against losses due to withdrawal of products from the market, either because of the application of the rules or on grounds of quality or price.

1.3.3 Ecological aspects

A distinction has to be made between those ecological effects which are objectively verifiable and those which are not. Discards have a growing political impact, particularly on organizations concerned with protection of the environment or consumers. Some of these bodies have attacked discards (which they term waste) arising from the legal requirements of the current Community system for managing resources.

A number of consumer bodies have also spoken out against discards on the grounds that they represent a pointless destruction of fish benefiting neither the producer nor the consumer ("Consumers in the European Community Group", letter of 8 January 1990).

Historically, environmental bodies have opposed the hunting of marine mammals, either because they are threatened with extinction (the blue whale), because they are biologically over-exploited (seals and fin whales), because methods of slaughter appear unacceptable (so-called baby seals) or because the creatures are considered to be relatively sentient (dolphins). Some of these bodies have then extended their concern to fishing activities responsible for the deaths of small cetaceans, pinnipeds, turtles and sea birds. This has led to their interfering with a number of fishing grounds or opposing fishing methods (large deep-water drift nets, tuna seining) regarded as responsible for the unacceptable deaths of threatened or sensitive species. Ultimately, a number of ecological organisations are expressing concerns about the overall ecological impact of fisheries on the marine environment, the need to ensure sustainable use of its natural resources, and the effect of by-catches and their rejects on the equilibrium of the environment or on the benthic fauna.

Although the ecological impact of fishing, by-catches and discards on the balance of the marine environment has been much discussed both by those working in the fishing industry and the media, it is poorly understood. A typical area is the effect on sea-bed fauna (invertebrates and others) of trawls fitted with heavy chains which are seen as churning up the bottom. The accusation of waste levelled against the technique of discarding is sometimes answered in terms of "restoration to the sea", in that the discarded fish provide food for other species which are also fished, but genuine environmental benefits are difficult to quantify. It is, however, likely that the food chain will be skewed in favour of scavengers which feed on carrion.

Assessment of the impact of discards is further impeded by the fact that there is very little documentation on the types of by-catches, the quantities of discards caused by such by-catches or the rules in force. A survey of discards in Community fisheries is therefore necessary.

2. DISCARDS IN COMMUNITY FISHERIES

The statistics available are not adequate to describe or assess precisely the state of discards in Community fisheries so the following is simply an overview arranged by sea zone and fishery in order to take account of geographical and technical variations as regards discards.

2.1 Discards in the Mediterranean

2.1.1 France

Estimates of discards by the fishing fleet of metropolitan France are derived from a survey of a number of fishermen in the Gulf of Lions during February 1991; which found that 2 200 small fishermen made only a very small number of discards while 45 seiners engaged in fishing for small deep-water fish discarded between 5% and 30% of their catch each year, mainly species with a low market value (bogues, sprats, sardinella, small mackerel, etc.). The statistics for 1986 to 1989 suggest an annual discard of 500 to 2 500 tonnes of sardines and of 150 to 750 tonnes of anchovies.

Deep-water trawlers discard slightly more than seiners (10% to 40% depending on season), mainly of the above species. This puts discards at 1 000 to 4 500 tonnes of sardines and 600 to 2 400 tonnes of anchovies. The mixture of species with a low market value with targeted species presents trawler crews with a problem of sorting. Discards from the 26 tuna seiners were not estimated but there is evidence that they are very rare and insignificant in quantity.

Bottom trawlers go out every day and their discards consist mainly of invertebrates without commercial value and of some species of fish with a low market value (horse mackerel, bogue and picarel).

2.1.2 Italy

(a) Bottom trawlers: Where fishing trips by Italian vessels last a week, horse mackerel, bogue and blue whiting are discarded during the first five days. Subsequently, these species, which then remain fresh, are kept on board to be sold as prime fish. Where fishing is on a daily basis, there are virtually no discards.

(b) Purse seiners: No discards except where horse mackerel is mixed with sardines, which are then discarded because they are damaged by the bony spines of the horse mackerel.

(c) Deep-water trawling: Anchovies, which command a high price, are never discarded and discards of sardines are very rare because when prices are poor the boats do not go to sea. Certain coastal fisheries practise deep-water trawling which sometimes results in the discarding of many small species or individual fish. Since industrial fishing was prohibited, discards may again be occurring but their extent is not known.

(d) Large driftnets: Italy banned fishing for swordfish and long-finned tuna with large driftnets from 31 July 1990. Fishing for skipjack tuna is still permitted, although by-catches and discards of marine mammals associated with this type of fishing have never been quantified. Some 700 vessels are engaged in this type of fishing and they are now receiving re-equipment grants to install longlines, for which the discard rate is not known.

(e) Longlines: Long-line by-catches which are discarded include moonfish, Atlantic mantas, turtles (mainly *Carreta carreta)* and sting-rays (almost 10% of catches in Sicilian fisheries). It is hard to assess the chances of survival of discarded turtles since some have been recaptured alive with a number of hooks in their stomachs.

2.1.3 Greece

(a) Trawlers: There are no figures on discards by Greek trawlers of fish without commercial value (flat fish, blennies, gobies, gurnards and deep water fish) but exploratory fishing has shown that they vary significantly by ground and season.

Discards of under-sized fish which belong to species with a high market value are small, either because the price is itself high (mullet and bream) or because demand is high (picarel). Discards of undersized specimens of comparatively cheaper species (hake, bronze bream and large-eyed dentex) may reach 3% to 5%. Rates for species with a low market value are probably highest, although this depends both on the fishing ground and market conditions. If these are particularly unfavourable, discards of capelan, blue whiting and horse mackerel may reach 5% to 20%.

(b) Purse seiners: Data on discards in purse seine fisheries are just as sparse as those for trawlers. Experiments have shown that during the recruitment period (March-April) small sardines caught in meshes are destroyed and discarded. However, the use of small meshes (14 mm stretched) for purse seines would cut such discards to about 2% to 3%.

(c) Coastal fishing: There are no general figures on discards in these fisheries or specifically on by-catches of monk seals by driftnet fishermen in the Sporades.

(d) Deep-sea fishing (Scombridae): No discards known.

2.1.4 Spain

(a) Trawlers: With the exception of certain vessels whose fishing zones are further away and which stay at sea for three to four days (shrimping off the Balearic Islands and off the island of Alborán), coastal trawlers usually go out for only one day. Most discards are of invertebrates with no commercial value and certain species of low value fish (horse mackerel, bogue and picarel).

(b) Purse seiners: Discards by seiners are mostly of small fish or ones with a low market value (sardines, horse mackerel and bogue). In view of their high price, anchovies are not discarded. Figures are difficult to establish since they depend on place and price.

(c) Surface lines: Fishing for swordfish using surface lines entails discards of small numbers of mackerel sharks and blue sharks and the catching of two types of turtle, which are normally released alive. Although it is not unusual to catch turtles with a number of hooks in their mouths, there is some evidence that hooks are "swallowed" and expelled.

2.2 Discards in the Atlantic

2.2.1 Round fish in the North Sea

(a) English fisheries: The slight data on discard rates by English vessels collected some years ago by observers at sea are not an adequate basis for estimates that can be extrapolated to cover the whole fleet. They do, however, suggest that the main species discarded are whiting and cod, and that discards of cod have increased since the minimum length was raised from 30 cm to 35 cm. The conclusions of a study by the Sea Fish Industry Authority, financed by the EEC, covering trawl and seine net fleets operating from the north-east coast of England should be available at the end of 1991.

(b) Danish fisheries: The results of a fairly detailed study on discards from trawlers and Danish seine fishing are summarized in Annex II.1. Species with a low market value in Denmark are discarded either in their entirety (grey gurnard) or almost so (whiting, dabs) while such fish are marketed in southern Europe. Discard rates for other species (plaice, haddock, cod) vary widely with that for plaice reaching as much as 42% in shallow coastal waters where small plaice are concentrated. The rate for cod (about 20%) could be still higher if fishermen complied with the (national) minimum size of 40 cm. In view of the poor state of the cod stock, large fish are rare and many cod between 35 cm (the EEC minimum) and 40 cm are landed.

(c) Dutch beam trawl fleet: A very detailed study of discards by the beam trawl and pair trawl fleet is summarized in Annex II.2. This shows that discards from such fishing consist of large amounts of miscellaneous debris, a lot of dabs (61% by weight is discarded), plaice (24% discarded) and sole (9% to 36% discarded). Discard rates are very high for whiting (92% to 100%) because of the small sizes and quotas per vessel and for cod (80% in the plaice box and 51% elsewhere), flounders (often approaching 100%) and deep-sea species taken as by-catches (mackerel, horse mackerel and herring, all approaching 100%). The discard rates for seven other species are very variable.

(d) Dutch fleet using pair and demersal trawls: The study referred to above found substantial discards of whiting, cod (quotas per vessel and small fish near the coast, discard rates from 4% to 75%), dabs (by-catches, substantial discards: 84%), pout (88%), etc.

(e) Scottish fishery: Discards in this fishery have been monitored for over 67 years (Annex II). For a very long time, rates, which vary depending on the year, season, fishing ground and gear, have been regarded as substantial. Overall, for whiting they amount to about 15% for trawlers and 30% for Danish seiners, and for haddock 15% for trawlers and 20% for Danish seiners.

(f) German fishery: Only discards of cod are covered (Annex II). These vary considerably depending on the state of the stock (up to 53% by number and 19% by weight) over the period studied.

(g) All North Sea fleets: The summary in Annex II shows that in 1990 discards of haddock totalled 19 000 tonnes compared with 50 000 tonnes landed and discards of whiting totalled 54 000 tonnes compared with 150 000 tonnes landed. Attempts should be made to avoid this considerable economic loss, particularly since in both cases discards involve mainly small fish.

2.2.2 Bottom trawls using small meshes (beam trawling for shellfish)

(a) North Sea shrimp fisheries: Traditionally fishing for common shrimps takes place in the same areas as flat-fish hatcheries (sole, plaice, dabs, etc.) and gadidae (whiting, pout, etc.), juveniles of which constitute the bulk of discards. The nature, quantity and survival rate of these discards depends primarily on the trawl used and the means employed to sort (by size) the shrimps on board. Several estimates suggest a very high discard rate although no overall figure is available.

Hence a "selective" trawl of the Asselin type (derived from the Devismes trawl) used on the French Channel coast may result in virtually no by-catch while a "classic" trawl with two sewn-in pockets may sweep up a lot of young fish. However, the use of "selective" trawls varies considerably in the southern North Sea. It may reflect a desire to take only shrimps although such fishing is still widely practised in conjunction with fishing for flat fish.

There have been few studies of the survival rate of discards. It appears that juvenile gadidae and, in the case of flat fish, dabs are the most vulnerable, with virtually none surviving discard. Automatic sorters appear to have a considerable impact on these survival rates but their use is very patchy. In France they are not used because of the small size of the shrimpers, in Germany mechanical oscillating sieves are sometimes used and in the Netherlands, where vessels are larger, a rotating sieve discharging directly into the sea reduces mortality due to sea bird predation.

This albeit brief survey demonstrates that shrimping without a selective trawl or automatic sorting of the shrimps engenders enormous losses of juvenile flat fish and gadidae. This damages recruitment levels and at all events constitutes a substantial loss for those who set out to catch such species in marketable sizes.

However, these economic losses should be seen in the context of those caused by fishing for flat fish using non-regulation meshes in coastal waters. The number and high power of the vessels concerned means that their impact is probably much greater.

(b) English Norway lobster fishery (Farn Deeps stock): Information on this fishery is available from the sampling carried out from 1985 to 1990 for the largest fleet (North Shields) during the main fishing season (October-March) by the MAFF's Lowestoft office. In 1991 the University of Newcastle began work on a study part-financed by the EEC covering two complementary fleets over the period from January to September.

The table below shows discards of Norway lobster as estimated by the MAFF programme. Since estimated survival rates elsewhere do not exceed 50%, discards of Norway lobster, a species for which substantial market demand exists, constitute a considerable economic loss.

Season	% of catch by numbers	by weight
1984/85	68	44
1985/86	64	44
1986/87	46	25
1987/88	76	53
1988/89	67	47

(c) English Norway lobster fisheries in the eastern Irish Sea: Observations carried out in 1980-81 showed that 19% of Norway lobster, particularly those with a carapace length of less than 27 mm, one third of whiting and a number of commercially important species such as dabs, clupeids, gurnard, plaice, dogfish, mackerel, anglerfish, rays and other flat fish, were discarded. Since these observations were carried out, the mesh size has been increased from 60 mm to 70 mm (in July 1986) to bring these fisheries into line with those elsewhere. There is a tendency for the size of Norway lobster landed to increase but since they are now landed whole (rather than as detached tails) discards of small Norway lobster appear to be growing.

2.2.3 Specialized deep-sea fisheries (herring roe)

(a) Irish fleet: Most fishing for herring for roe takes place in the Celtic Sea and there is little scientific information about discards. These concern only herring and there are three possible reasons:

- The herring is unsuitable for the Japanese roe market, i.e. the ovaries are insufficiently ripe. When fishermen realize this they discard the whole catch after a quick examination of the content of the net as it lies alongside the vessel. All the herring discarded is regarded as dead.

- The herring cannot be marketed because they are too small.

- Since Irish trawlers are subject to catch restrictions (quotas per vessel and per night or day of fishing), fishermen discard excess catches.

Following a number of measures to restrict or prevent discards, it is estimated that discards of herring over the last few years amount to 20% of the catch. In the first of the situations described above, fisheries are closed until exploratory fishing from commercial vessels shows that the herring is mature. In the second case, a national measure was introduced to close the fishery when the zone contains over 50% of herring measuring less than 25 cm. No solution has been found to the third situation, although a reduction in net sizes and the compulsory fitting of detectors to show the number of fish in the net have been proposed.

A phenomenon analogous to discarding takes place on land when there is a market only for herring roe and a limited market for herring fillets. In this case, surplus fish are processed into meal. Unlike other fleets, Irish trawlers do not currently use automatic sorters to separate fish by size or to select females.

It is reported that, during the summer, certain factory ships fishing for other deep-water species, principally horse mackerel, also catch herring and mackerel which are discarded after sorting since they are damaged by contact with the lateral spines of the horse mackerel. Probably one third of the mackerel caught in this way is discarded.

(b) Dutch fleet: Until the results of a study financed by the EEC are available at the end of 1991, the following comments are based on personal notes by observers and preliminary reports. They mainly concern three fisheries:

- Summer fishing for herring in the western and northern North Sea: In June and July pair trawlers and freezer-trawlers sometimes fish a mixture of adult and juvenile herring (two years old). Freezer vessels use sorters to separate herring by girth. Normally, depending on market demand, two-year-old herring and some of the three-year-old herring are discarded. Percentages discarded cannot be predicted since they depend mainly on the distribution of the various age groups in the catches. It has been found, however, that in the deeper parts of the North Sea, catches contain larger fish and so discards are much reduced.

- Fishing of herring for roe (Japanese market): This takes place in the spawning grounds of the central North Sea (August) and the Channel (December) where catches are considered to be of the highest quality (biggest eggs) and fishing grounds are totally accessible (no boxes). As in the case of the Irish trawlers, herring which are excessively small and immature females are discarded and mortality rates approach 100%. Mechanical sorters ("sex machines"), which are still at the experimental stage, are being developed to reduce the labour needed and so the cost of sorting herring by sex. Systematic use of these machines on freezer-trawlers could lead to increased discards of male herring in the near future.

- Fishing for horse mackerel and mackerel west of the British Isles: These fisheries have developed in recent years as a result of restrictions in the North Sea. Discards are intended to make better use of quotas (discards of small mackerel) and, where mackerel and herring are fished together, herring are discarded when the quota is exhausted. In the case of fishing for horse mackerel west and south-west of Ireland (second quarter of the year), mackerel is discarded because it is of poor quality at that time of year and fishermen do not wish it to be set against their quota.

(c) Scottish fleet: This fleet too discards large quantities of pelagic species, which vary depending on the fishing zone and are increasing as mechanized sorting permits disposal of herring and small mackerel when a vessel's quota is exhausted.

(d) English and Welsh fleets: While discards of sardines, horse mackerel and herring appear low, those of small mackerel appear to be higher (particularly in the box) when authorized by-catches are exceeded. There are also substantial discards of horse mackerel caught as a by-catch in certain fisheries (e.g. the Channel).

2.2.4 Fishing for bivalves using dredges

In an attempt to compensate for the lack of scientific information, IFREMER of Brest has begun a five-year programme on the effect of dredging. It appears that scallop fishing in St Brieuc Bay generates limited quantities of discards, mainly broken shells and scallops which do not reach the Community minimum size of 10 cm. Mortality is believed to reach 10% of the catch each time the dredge is used. A number of non-marketable species are also discarded (crepidules, jingle shells, brittle stars and starfish).

Belgian beam trawlers and English dredgers fishing in the Channel probably cause considerable losses of spider crabs, which are vulnerable at the moulting season (15 July to 15 September). This problem does not appear to occur in the French fishery, which is closed at that time. Greater power and speed of dredges may lead to extra deaths among discards (crushed by water force) and on the sea bottom (greater disturbances to the ecosystem there).

2.2.5 Crab fisheries

Discards of crabs from pots are often considerable and range from 5% to 80%, comprising those not of a standard size, clear specimens (recently moulted) and edible crabs whose shells carry a large number of parasites. In the fishery which has recently been developed some 50 miles off the River Humber, those crabs which are infected by bacteria and whose shells have black spots are discarded.

Mortality from such discards is, however, minimal so that fishing for crabs by means of pots may be considered not to pose a problem, unlike fishing by driftnet, where a large proportion of crustaceans are discarded after the claws have been removed. This practice seems frequent off the south coast of the Untied Kingdom (west of Brixham and north Cornwall) and is probably usual in Belgian beam trawl fisheries in the 6 to 12 mile zone off the east coast of the United Kingdom. Fishermen in Jersey and Guernsey have complained of substantial discards of spider crabs by vessels using driftnets off the French coast.

Fishing for spider crabs using nets may result between August and October in discards of specimens which, having moulted recently, are of no commercial value. Their poor physical state coupled with the long period spent in the net means that most discards die.

By-catches of edible crabs in nets set for ray, turbot, anglerfish and Norway lobster are often substantial. A vessel using 30 km of nets off western Brittany may capture two to three tonnes of crab per month. Valuable specimens (particularly large males) are disentangled and sold live while the bodies of the others are discarded after removal of the claws. Since a crab cannot survive without claws, these by-catches in nets cause a considerable number of deaths. This would not be a problem in itself if the marketing of claws alone did not mean that less than full value was being obtained from the crabs.

2.2.6 Demersal fisheries in the western Atlantic

(a) French trawlers in the Bay of Biscay: The main fishery generating discards is that for shellfish using bottom trawls on the main tidal bank or the coastal flats south of Brittany or the Gironde. In 1989 330 trawlers caught 2 900 tonnes of whiting and 5 700 tonnes of Norway lobster. Only 14% of the Norway lobster were less than 20 mm long (length of the carapace) and so had to be discarded. Their survival rate is estimated at 30%.

Catches of juvenile hake are substantial because they occupy the same grounds as Norway lobster and because of the type of net used for this fishing. The reports of ICES working parties on fisheries in sub-areas VII and VIII and on hake (Anon, 1990 a and b) suggest that 72.4% of hake caught are less than the minimum legal size and should be discarded. In practice, the proportion of small hake (undersized) in landings suggests that actual discards run at considerably less than 70%.

There are some 170 French vessels trawling primarily for sole, hake, anglerfish and cephalopods and secondarily for whiting, pout and gurnard. Analysis of the size of fish caught shows that 29% of the 7 500 tonnes of hake and 27% of the 2 700 tonnes of sole caught are of less than the legal size and so, under current Community rules, should be discarded.

(b) French trawlers in the Celtic Sea: When 60 mm trawls were being used, French vessels fishing for Norway lobster in the Celtic Sea theoretically discarded, on the grounds of size, 80% of dabs, 52% of hake and 34% of lemon sole, not to mention other species (Annex II.10). Minimum mesh sizes have increased to 70 mm but the initial results of a study now under way suggest that there are still substantial discards of small megrim (60% to 65% by number) and small whiting (100% of one-year-old fish and 75% of two-year-old fish).

(c) Spanish deep-sea trawlers in ICES divisions VI, VII and VIII: These fleets make trips averaging seven days (VIII), nine days (VII) or twelve days (VI). They catch a variety of species of which only the most valuable (hake, anglerfish, megrim, Norway lobster and other demersal fish) are kept on board. According to the ICES mackerel working party in 1989, the quantity of pelagic species discarded is equivalent to that retained on board. Most discards are of species which cannot be retained on board without a significant loss of quality as far as human consumption is concerned (mackerel, horse mackerel, blue whiting). Most demersal fish under 20 cm long are discarded (Moguedet and Perez, 1989).

Figures 1 and 2 show the short-term effects of increasing mesh sizes to 60, 80 and 100 mm in the hake fishery in the Bay of Biscay by Spanish trawlers.

In the long-term, the aging of the hake stock will be still more dramatic. If the Community regulation size of 27 cm were respected (in which case all the small hake would have to be discarded) percentage discards would diminish as mesh size increased. Naturally, as shown in the following table, these percentages would be still lower if the current practice of selecting by size continued.

Mesh size (mm)	60	80	100
	Percentage discards		
Current practice	16	11	8
Compliance with 27 mm	32	20	15

Of course, this goal will be achieved more rapidly if technical measures complement those concerning the selectivity of gear and minimum catch and landing sizes.

(d) Spanish deep-sea longliners in ICES divisions VI, VII and VIII: These fleets discard principally mackerel, horse mackerel and large blue whiting, although in very small quantities. Discards of mackerel amounting to as much as 10% of total catches were recorded by the ICES mackerel working party (1989) in spring (April and May) but these did not involve under-sized fish.

(e) Spanish coastal fisheries: Discards by these fleets are usually negligible. Seine fishermen discard by slipping the seine, which gives the fish which escape a good chance of survival unless they are very tightly packed inside the net.

(f) British fisheries in the Irish Sea, the Celtic Sea and the Bristol Channel: The only available data for cod, whiting and sole date from work carried out 15 years ago. Discards of plaice in the Irish Sea were estimated in 1987-88 to assess the effects of quota restrictions. Data on fishing for Norway lobster in the eastern Irish Sea are summarized at the end of 1.2.2.B.

2.3 Summary

2.3.1 Mediterranean

Although data on discards of Mediterranean fish are extremely incomplete, the figures available indicate that, contrary to what the particular features of the Mediterranean market might suggest (high average prices, consumption of very small fish), discarding is substantial. It has been estimated that French vessels alone discard up to 7 000 tonnes of sardines per year. In each of the four Community countries (Spain, France, Italy and Greece), certain species (horse mackerel, bogue and blue whiting) are not highly regarded and are discarded almost as a matter of course.

Discards are practised by both demersal and pelagic trawlers and purse seiners, longliners and drifters although the extent of the problem varies depending on the fishing methods, zones and periods.

2.3.2 Atlantic seaboard

In the case of round fish in the North Sea, the variability of discard rates is explained by differing patterns of consumption; for example, Danish and Dutch vessels systematically discard whiting while French fishermen sell it. Discards of whiting in the North Sea are put at over 54 000 tonnes and those of haddock at 19 000 tonnes. These figures are already high (up to 80% off the Dutch and German coasts) and would rise if minimum catch sizes were better respected. By contrast, a substantial increase in mesh sizes in the North Sea would lead to a reduction in discards, as demonstrated by the STCF (November 1990, SEC(90) 2498).

The use of non-selective bottom trawls, particularly for shrimps in the North Sea, leads to substantial discards of juvenile flat fish and gadidae, for which the survival rate appears very low.

In the case of English vessels fishing for Norway lobster (Farn Deeps stock), discards often exceed 60% by number but the extent of the problem depends on their survival rate. Despite an increase in mesh sizes to 70 mm, fisheries in the eastern Irish Sea generate considerable discards of fish and Norway lobster.

Discards in deep-sea fisheries for herring and mackerel are substantial, particularly when herring and horse mackerel are caught together and the figures could be increased by on-board sorting.

Discards of crabs with the claws removed and of spider crabs, both of whom have virtually no chance of survival, are caused principally by driftnet fishing.

In the case of demersal fisheries in the western Atlantic, discards are mainly the result of the presence of Norway lobsters in hake "nurseries" and the use of trawls which are insufficiently selective as regards mesh size. If the 27 cm minimum size were respected, discards of hake would exceed 70%. Other examples show how mesh sizes do not reflect the needs of conservation and reveal failure to respect minimum sizes (Figure 1).

This analysis demonstrates that:

- quantities discarded are higher in fisheries using trawls, Danish seines or driftnets than where dredges, pots and longlines are used;

- in the case of purse seines, discards vary enormously depending on how they are used;

- fishing with small meshes in "nurseries" in coastal zones seems responsible for substantial discards of juveniles, which entail substantial commercial losses to the industry.

3. THE OBLIGATION TO DISCARD AND A DISCARD BAN

Given the extent of the practice of discarding and its harmful effects (wastage of raw materials, bad stock management), ways of finding a solution to it should be found. Since Norway has adopted a policy banning discards, priority should be given to assessing the effectiveness of such a policy and whether it could be applied in the Community. To make such an assessment, the Community regulations governing the legal obligation to discard in Community waters must first be analysed.

3.1 Obligation to discard in Community waters

3.1.1 Community legal obligations

Community regulations entail, implicitly or explicitly, a number of legal obligations to discard. Without wishing to provide a detailed legal classification, a number of discard types may be identified according to the obligation from which they stem.

It was the need to define directed fishing according to target species and fix minimum catch rates which led to compulsory discards being introduced. The very nature of fishing, regardless of whether it is mono- or multispecies, means that the composition of catches cannot be known until the fishing gear is hauled in.

(a) Regulation on technical measures (No 3094/86): An analysis makes it possible to identify five types of discard as follows:

- to conform with the minimum percentage of target species (directed fishing) for the minimum mesh size;
- to conform with the maximum percentage of protected species;
- to avoid catches of undersized fish;
- to avoid out-of-zone catches;
- to avoid catches using forbidden fishing gear.

The first two are laid down in Article 2(4) of the Regulation, which makes sorting compulsory in order to eliminate catches of protected species in excess of the percentages laid down in Annex I, which defines the "authorized target species" (directed fishing).

The third results from Article 5(3), which lays down that "Undersized fish, crustaceans and molluscs (...) shall be returned immediately to the sea", and that therefore they cannot be retained on board, or be transhipped, landed, transported, stored, sold, displayed or offered for sale.

Finally, Article 6 of the Regulation lays down the obligation to discard salmon and sea trout caught outside the 12-mile Community limit (4 miles in IIIa) or caught with a trawl with mesh size smaller than 70 mm, which leads to discards to avoid out-of-zone catches and discards to avoid catches using forbidden fishing gear.

Articles 7 and 8 are further examples of discards to avoid out-of-zone catches of herring and mackerel. Likewise, Article 9(1) implies compulsory discards to avoid out-of-zone catches of herring in a box in subarea VII with a tolerance of 5% and discards to avoid catches using forbidden fishing gear if the quantity of the protected species caught with purse seines exceeds 5%.

In practice minimum sizes are determined by ICES on a proposal from the STFC, taking account of the size at which the fish have a 25% or 50% chance of being retained by nets whose minimum mesh size is optimal. However, there is no systematic review of this minimum fish size when the mesh size increases. In addition a choice must be made in the case of multispecies fishing using several mesh sizes. Finally, the minimum fish sizes of catches do not always correspond to those set in the market place.

(b) Regulation on the logbook: An estimate of discards is provided for at point 16 of the Community logbook (Annexes I and II to Regulation No 2807/83). Annexes IV and V (points 2.4.3) provide for the declaration (optional for Community waters and compulsory for NAFO waters) of the quantities of fish discarded, in kilograms liveweight or in another unit of measure.

Although the Regulation lays down that "This information is provided for scientific purposes only and is not taken into account for the calculation of quotas", comments by Community inspectors show that fishermen only rarely declare their discards in the NAFO zone (where such declarations are compulsory), and that they never do for Community zones (where such declarations are optional).

(c) Regulation on TACs and quotas: Article 5 of Regulation No 3926/90 (1991 TACs and quotas) implies an obligation to discard by laying down that it is prohibited to retain on board or to land catches from stocks for which TACs or quotas have been fixed except in six special cases. To summarize, these obligations result in various types of discard, the most important of which are as follows:

- discard of species whose quotas are exhausted;
- discard of species whose share of the TAC available to the Community (not allocated by quota among Member States) is exhausted;
- discard of all species other than herring and mackerel mixed with other species and taken with nets whose mesh size is greater than 32 mm in Regions 1 and 2 (or 40 mm in Region 3), which are not sorted either on board or on landing;
- discard of all species other than herring and mackerel not mixed with other species and taken with nets whose mesh size is less than 32 mm in Regions 1 and 2 (or 40 mm in Region 3), which are not sorted either on board or on landing;
- discard of herring caught with a small-mesh net, if mixed with sprat, exceeding 10% of the total combined weight or 5% if mixed with other species (Article 5(2));
- discard of mackerel exceeding 10% of the total combined weight if mixed with horse-mackerel or pilchard (Article 5(1)(v));
- discards to avoid out-of-zone catches of herring (Article 6);
- discards to avoid out-of-zone catches and catches of sprat using forbidden fishing gear (Article 7), and of sprat and herring (Article 8);
- discards to avoid out-of-zone catches and discards to avoid catches using forbidden fishing gear for any trawl with a mesh size of less than 100 mm in the "cod box" (Article 9).

3.1.2 Justification for the legal obligation to discard

An analysis of the reasons behind Community regulations and of their recitals reveals some of the justification for the obligation to discard, albeit only in general terms, as for example, the following recitals of the Regulation on technical measures (Regulation (EEC) No 3094/86) :

- "to ensure the protection of marine biological resources" (first recital);
- "increased protection of nursery areas, in particular of sole and plaice, should be provided for" (eighth recital);
- "certain minimum landing sizes should be increased" (tenth recital).

Community regulations impose the obligation to discard in order to discourage fishing activities which run against the principles of the conservation of marine resources. However, the implicit goal of this obligation is to deprive defrauders of the fruit of their fraud. By making operations which do not comply with the rules uneconomical, fishermen are to be obliged to abandon fishing grounds in which only juveniles are to be found and avoid fishing directed towards species whose quota is exhausted.

The basic assumption is that such an obligation leads to a limitation of the overall fishing effort for young fish or species whose TAC has been used up. The discard inventory for Community waters shows that this is not necessarily true. In many cases, particularly in multispecies fisheries, fishing operations are continued at profitability levels which justify their pursuit, despite the high discard rate.

However, there is an obvious contradiction between the objective pursued and the means used to achieve it. Furthermore, fishermen themselves frequently question the obligation to discard fish which are already dead and which could produce a commercial profit. This has led to the possibility being considered of banning discards in Community waters as they are in Norwegian waters.

3.2 The ban on discards in Norwegian waters

3.2.1 Norwegian Regulation

The Norwegian rules (Article 23 of the amendment of 20.12.1988) on technical measures forbid, since 30.6.1990, the discard of ten stocks involving seven species caught in the Norwegian Economic Zone (cod, haddock, saithe, redfish, mackerel, herring and smelt). They do not forbid the discard of gutting products. This ban applies to all vessels, including Community vessels, fishing to the north of latitude 62° N.

Consequently, discards of the seven fish species concerned are banned in Norwegian waters, whereas in Community waters the opposite applies. It is forbidden to keep on board undersized fish of species whose catch quotas are exhausted, or in a number of situations set out in section 3.1.1.c).

The discard ban is part of Norway's fishery management policy. Its purpose is to minimize catches of undersized fish, by authorizing the landing and utilization of these catches in order to:

- prevent the loss of usable raw materials;
- upgrade scientific data on the basis of which the TACs are calculated by taking all fish caught into account;
- achieve better conservation since all fish caught count against the quotas.

For completeness, an analysis of the effects of the Norwegian discard ban ought to take account of the discard practices of Norwegian fishermen prior to adoption of these rules. In the absence of such information it can only be assumed that the same principles governed the same practices for both Norwegian fisheries and Community fisheries.

3.2.2. Adaptation of Community rules

Given the discard ban for Community vessels operating in the Norwegian Economic Zone, four options are open to the Community:

(a) to allow vessels returning from Norwegian waters to land and sell (subject to compliance with minimum "market" sizes) for human consumption all catches made in those waters, including fish under the minimum size laid down by Community legislation on technical conservation measures, as well as fish caught beyond quota limits;

(b) to allow vessels returning from Norwegian waters to land and sell (subject to compliance with minimum "market" sizes) for human consumption all catches made in those waters, including fish under the minimum size laid down by Community legislation on technical conservation measures, but not fish caught beyond quota limits (solution presently enforced);

(c) to adopt complementary legislation to reduce the possibility of Community legislation applicable in its waters being circumvented. This legislation could make it compulsory for vessels to declare the composition of catches on board, including the quantity of undersized fish, as soon as they leave the Norwegian zone. If it were possible to administer and apply such legislation, it would limit landings of undersized fish in Community ports. In addition, it would enable Member States to close the fishing season before quotas are totally exhausted by anticipating by-catches in Norwegian waters;

(d) to adopt a regulation similar to the Norwegian, banning discards in Community waters. This option is assessed below.

3.3 Possibility of banning discards in Community waters

3.3.1 Assessment criteria

The question as to whether Community rules should be amended to ban discards depends on the effectiveness of such a ban and whether it can be implemented. Its effectiveness can be measured against biological, ecological, economic and social criteria. How well it can be implemented depends on technical, administrative, economic and social factors.

The purpose of any ban on discards of undersized fish or fish subject to quotas covering all the species fished in Community waters would be to solve the large number of problems caused by these discards. Therefore these problems determine which assessment criteria are to be used and the context in which they are set.

(a) Biological and ecological criteria: The effectiveness of a ban can be measured in terms of the reduction in the raw material losses it produces, the percentage of young fish it saves until they reach a minimum catch size, and the reduction of catches in excess of quotas.

It can also be measured against the resultant improvement in catch and stock assessments, since landings will then correspond to catches. Finally, it will depend on the impact of the ban on the environment, i.e. on by-catches (whether of sensitive species or not), and on the conservation of marine ecosystems.

(b) Economic and social criteria: The economic effectiveness of a measure aimed at reducing discards can be measured in terms of the increase in the net turnover of fisheries (production, processing and marketing) that it induces. This may result from an increase in the volume of production, an increase in the average value of this (due to an increase in the average fish size of catches, for example), or greater possibilities for extracting value from the product.

On the other hand, the increase in net turnover may be offset by an increase in production costs imposed by changes in fishing methods. A discard ban policy will be more readily accepted and respected if the technical modification costs involved are low and the economic benefits for producers high.

Finally, legislation will be all the more acceptable socially, and therefore politically, if the way the resultant costs and advantages are shared out in the fisheries sector is not perceived to be unjust, either because it creates inequalities, or shifts existing inequalities (problems of relative stability).

(c) Administrative acceptability: A reject ban has a greater chance of being accepted if it is easy to enforce (simplicity), which means in particular that the control costs for the administration responsible for applying it must be low.

3.3.2. Assessment of the effects of a discard ban

(a) Effectiveness: In the short term a discard ban would lead to an increase in landings of little or no commercial value, which would reduce raw material losses. A large part of these landings could be reduced to oil and meal for feed, unless provision were made to sell undersized fish or non-quota catches to extract greater value from them. In order to prevent such trade from inducing producers to go looking for these catches, it could be done for the benefit of the general community and not of individual producers.

In the longer term, producers would adopt fishing gear or fishing strategies making it possible to minimize undersized fish catches (increase in mesh sizes) or non-quota catches (selective fishing gear, boxes), and this all the more rapidly if it provided the incentive of a commercial advantage. The problem in these cases is the cost involved in improving fishing gear selectivity, adopting more selective fishing gear, or changing fishing strategies (zones, periods).

In the extreme case, a discard ban could entail such high costs for converting fishing methods or vessels that it leads to the abandonment of some fisheries. Since modern vessels are frequently designed specifically for one fishing method, any change in the method could make major structural modifications necessary (deck layout, engines). Furthermore, changing the method could lead to an increase in the crew's workload, if not make their work considerably more arduous.

The theory that a discard ban for undersized fish, i.e. fish of little commercial value, would lead inevitably to fishermen not catching them, is based on the implicit assumption that each fisherman has a personal interest in refraining from catching them. This assumption only holds good if every fisherman is penalized for his catches of undersized fish or catches in excess of the quota, not only by a significant reduction in the value of his catches on landing, but also by a reduction in his share of TACs and quotas. If all fishermen were to be penalized for catches of undersized fish made by some of them, by a reduction of collective quotas, it is doubtful whether the fall in individual turnover would be enough to encourage a vessel to change fishing zone or its fishing methods (fishing gear and strategies).

The outcome of this discussion is that a ban on discard practices would not be reflected in an increase in average fish sizes caught and therefore in the average value of catches, although this is an essential objective of the ban. Except in special circumstances, the biological, ecological and economic effectiveness of a ban could well be limited.

(b) Ability to be implemented: There is a risk that a discard ban would be applied inadequately or ineffectively, not only as a result of the large number and complexity of rules already in force, but also because only the detection of discards by a duly appointed observer could justify the institution of proceedings.

It is impossible to prove a posteriori that discards have been made. The absence or low proportion of certain species or fish size categories in a particular vessel's landings proves nothing since the composition of catches does not obey precise biological laws. It also depends on the selectivity of the fishing methods used.

On the other hand, catching a forbidden species (because the quota is exhausted) or a fish smaller than the minimum size cannot be considered a priori to be a deliberate infringement. For most Community fisheries, it is virtually impossible to know the composition of catches by species (multispecies fishing) or fish size (mono- and multispecies fishing) until they have actually been made, i.e. until the fish lands on the deck.

The introduction of a discard ban for catches in excess of quota would therefore invalidate the TAC and quota system, since fishermen could always continue to land unlimited quantities of species subject to quotas and claim they were looking for species not subject to quotas in multispecies fisheries.

To provide an incentive for producers to minimize their catches of undersized fish or those in excess of the quota, should a discard ban be introduced, their percentage in catches could be limited. For example, the Norwegian regulation provides for the administrative confiscation of undersized fish on landing and the institution of legal proceedings in cases where a tolerance threshold is exceeded. The adoption of such a policy would make it necessary to conduct continuous sampling of landings, with the obvious high costs which that involves. It assumes that the discard ban would be applied effectively, although experience shows that the national authorities are reluctant to impose penalties unless the authorized limits are massively exceeded.

Furthermore, at the meeting of the Advisory Committee on Fisheries on 30 November 1990, European fishery industry representatives, asked about a document describing discards in Community fisheries (XIV/399/90 of 19 November 1990), stated that a discard ban would require an increase in TACs so that including discards would not penalize producers unduly, whereas the STFC recommends that TACs be reduced for most stocks.

For all these reasons, the Community fishery inspectors (DG XIV-C-3), at their meeting on 14.2.1991, agreed that a discard ban in all Community waters would be very difficult to impose and impossible to police. This is demonstrated by the problems in applying the ban on degassing by oil tankers, of which there are far fewer and which are much easier to monitor than fishing vessels in Community waters.

4. OVERALL STRATEGY ON DISCARDS

In theory, the simplest response to the problems posed by discards is to ban them. However, it is not possible to propose an outright ban for all Community fisheries. If measures banning discards are to be acceptable and effective, they should be taken only under certain conditions, as regards both economics and controls.

In addition to, and to a large extent complementing measures to ban discards, there are a whole range of instruments which can be used to control or even remove the discard problem. Such measures have been discussed in the preceding pages. The scope of and grounds for these measures are analysed in more practical terms in what follows: the idea behind each one is discussed, its purposes and limits assessed and implementing measures proposed.

Basically, the instruments in question have three purposes:
- to eliminate catches of individuals likely to be discarded,
- to make the rules which give rise to discards more flexible,
- to create economic conditions in which the unsold part of catches can be reduced.

4.1. Eliminating catches of potential discards

The best way to reduce discards is to prevent catches of fish which the fishermen will not keep. This can be achieved either by banning fishing where (and when) the fish which must be discarded are particularly numerous, or by using more selective fishing methods.

4.1.1. Permanent and temporary boxes

(a) Principles: Permanent or temporary boxes could be established in areas with large concentrations of small fish, commonly grouped under the generic term nursery, even though this term has a more specific meaning for biologists. This could indirectly benefit other animal or vegetal species which conservation is required because of their status. Community rules already include such provisions, but they could be put to fuller and more varied use.

Greater variation could be introduced by defining boxes where not all fishing is banned, but only fishing with the least selective gear, particularly trawls using derogatory mesh sizes. In order better to control access to such areas, licensing arrangements would be particularly useful. In addition to strictly defined boxes, sensitive areas could be introduced, where direct practical controls on fishing would be applied. Such areas could be closed whenever catch composition is unsatisfactory, particularly when there is a danger of discards.

In addition, the definition of sensitive areas should be extended to join strictly ecological considerations to fisheries management objectives. The two aspects could even be combined when creating reserves situated in nurseries, which would lead to the creation of repopulation areas based on an interdisciplinary approach.

(b) Evaluation: Such provisions would be particularly suited to the problems of discards related to minimum sizes. They would also make it possible to control certain types of discards for commercial reasons, as, for example, when fishermen are specifically looking for fish of a given size and/or gender. They would also go some way towards meeting ecological concerns with the overall protection of the marine environment, in particular the impact on the benthos of dragged gear such as dredges and beam trawls.

Such provisions pose potential problems of fairness, since some fishermen might be more affected than others by restricted access, and difficulties in managing the more delicate procedures. However, solutions can be found to these problems.

(c) Implementation: Before these measures can be implemented, the scientific establishment will have to be consulted in order to carry out a review of sensitive areas and the provisions suitable for each one and the Regulation on technical measures will then have to be amended accordingly. The Member States and the fishing industry must be consulted so that real-time procedures for managing certain sensitive areas can be organized.

In addition, studies will be needed to refine the biological and technical knowledge required. This presupposes that the Commission has the necessary means, particularly financial resources. The most straightforward way of ensuring this would be a substantial increase in the budget for biological studies. Lastly, the contribution made by new technologies, primarily that of satellites for surveillance of boxes, must be analysed.

4.1.2. Development of selective fishing

(a) Principles: This question has a regulatory aspect and a scientific and technical aspect. The economic aspect will be dealt with later.

The most obvious component of the regulatory aspect is an increase in mesh sizes and the option of making certain devices and rigging methods compulsory, such as square-mesh sections. However, it is also linked to the question of boxes referred to above, the regulation of certain dragging methods (mesh sizes, gear dimensions, immersion, etc.) and the encouragement under certain conditions of techniques such as longlining.

As regards the scientific and technical aspect, it will be necessary to promote the required studies on gear and detection and identification techniques.

(b) Evaluation: Increasing mesh sizes and requiring the fitting of devices to make trawls more selective will greatly reduce discards of juveniles. Improving detection techniques will also help, and could also reduce discards motivated by commercial constraints, for example by indicating the unsuitability of a shoal before it is caught. The regulation of nonselective dragged fishing methods would help limit discards of fish damaged before nets are hauled in and the capture of a number of sensitive species (birds and marine mammals).

In the long run, the main difficulties of this approach will lie in the policing of certain rules, such as those on selective trawls. In the short term, two different problems are posed by gaps in the available technical know-how and the reticence of fishermen. The latter problem is especially acute in Member States which have no structures or programmes for research into selectivity.

(c) Implementation: Priority must be given to research on improving selectivity. This will require adjustments to the priorities for research tendering procedures. Above all, it is necessary to undertake studies which are more technical than scientific in nature, clearly specifying the type of work to be done. In this case also, the simplest solution would be significantly to increase the budget for biological studies. Concertation with research establishments in the Member States must also be stepped up.

In combination with these measures, the ground must be prepared for an amendment to the Regulation on technical measures giving clear preference to selective techniques while removing certain restrictions on access. At the same time, there is a need to curb the development and deployment of nonselective fishing methods such as fixed nets, which have to date received only summary attention. This could also be accomplished by amending the Regulation on technical measures.

4.2. Reduction in compulsory discards

4.2.1. Greater flexibility of the system of TACs and quotas

(a) Principles: Making the system of TACs and quotas more flexible could focus on two elements: the introduction of multiannual and of multispecies TACs. In both cases an overrun on a quota for a species for one year would be possible provided that the overrun is offset by a reduction in the quota for another species in the same group, or for the same species the following year. Transfers would be restricted by a system of penalty coefficients. These two ways of making the system more flexible would put an end to the practice of discarding fish because the quota for a species has been overrun, which still gives rise to by-catches when fishing is changed to another species. Safeguard clauses would be required to prevent overruns from being accumulated one year after another; such clauses could be linked, for example, to the situation of a particularly vulnerable stock, and would lead to the total closure of entire fisheries under certain circumstances. Such closures would certainly end the inducement to discard presented by the rules currently in force.

(b) Evaluation: These steps to enhance the flexibility of the system will be all the more useful because they underline the multispecies nature of fisheries and because it is difficult to set exact annual TACs.

Excessive flexibility could weaken the system of TACs and quotas to the point that it becomes inoperable. Very stringent safeguard clauses must therefore be laid down and effectively applied. Any coefficients linked to possible transfers from one stock or year to another must also be clearly defined. If such coefficients are too prohibitive, they could give rise to a new form of discards.

(c) Implementation: This idea, which was introduced in the 1991 CFP report, must be developed and specified. The scientific establishment and the fishing industry must therefore be involved in order to develop the idea, at least in the form of pilot projects, and the rules must be defined very precisely. In addition, all the necessary steps must be taken to ensure that policing becomes equally effective, otherwise the new flexibility could lead to the destruction of the system of TACs and quotas.

4.2.2. Minimum sizes, by-catches

(a) Principles: The current obligation to discard certain undersized fish or by-catches exceeding the percentages laid down for certain types of fishing could be lifted. There is no question of allowing such catches to be marketed, as that would be tantamount to abandoning the rules on catch composition. However, in very specific cases a restriction of minimum sizes could be envisaged and special rules on sales could be considered.

Such an approach would no more than supplement those discussed above, should efforts to encourage boxes and selective techniques be insufficient to prevent situations which perpetuate catches of undersized fish or excessive proportions of by-catches.

(b) Evaluation: The danger of such an approach is that it could gradually lead to abandoning rules on minimum sizes and by-catches. Discards could be reduced in this way, but only at the price of giving up the efforts already made to reduce catches of juveniles. The use of derogatory mesh sizes would no longer be restricted by the rules on catch composition and could therefore become widespread, with no means of discouraging the use of the least selective possible trawls when it is commercially desirable to catch fry.

(c) Implementation: It is necessary to identify the situations in which this approach would be justified, if only for experimental purposes. To this end, the opinions of the Scientific and Technical Committee on Fisheries and the Advisory Committee are needed. Closer links must also be created with the market regulations, if only to prevent markets from being flooded with catches of small fish.

4.3. Development of an economic context in which discardin is unattractive

4.3.1. Improving the return on catches

(a) Principles: There are two aspects to the efforts to increase the proportion of catches which can be sold: firstly, technical improvements in the preservation and/or processing of certain species and secondly, sales promotion to develop certain markets where possible.

The fisheries to be targeted would be those in which a large part of catches are made up of low-value species. An effort should be made to identify such situations, but some of the species directly concerned are already known, such as whiting and crab in the North Sea. Markets already exist in southern Europe for some of these species, such as crab. Specific mention should be made of the fact that small individuals of some species, such as Norway lobster, do not deep well, and therefore do not sell. Lastly, if a greater proportion of catches could be sold, it would be possible to reduce discards of less marketable parts of certain fish: the Community currently imports fish roe, when major Community fleets do not keep the roe of these same species.

(b) Evaluation: Measures to improve the preservation and saleability of small individuals run the risk of increasing exploitation of the corresponding groups of species. Solving the problem of discards in this way runs the classic risk of prompting other forms of misexploitation. It is important to refrain from overemphasizing measures to promote certain species, and to do nothing which might lead to massive increases in catches which will have to be disposed of at artificially high withdrawal prices.

(c) Implementation: It would be possible at a very early stage to examine the desirability of launching promotion campaigns in particularly favourable cases, and to organize the dissemination of information with a view to creating the necessary commercial channels where they do not now exist. At the same time, microeconomic studies are needed to define the conditions in which discards would no longer be commercially viable for fishermen. Lastly, the necessary resources must be made available for research on preservation and processing technology. This will require the definition of clear priorities in a very wide field, which in turn will require the services of a group of experts.

4.3.2. Adaptation of vessels to selective fishing methods

(a) Principles: Discussions must cover not only fishing gear, but also vessels and how they are fitted out. Shore infrastructures could also be included in this measure, in order to help cut landing and transport costs and restrict operations which might degrade the quality of products, such as certain auctions. However, these matters will not be discussed in detail here because they belong in a much wider context than that of discards.

In all of the above-mentioned cases, measures could be mandatory or on an incentive basis.

Gear: The question of banning or restricting certain gear has already been raised. However, it would also be possible to create incentives for fishermen using the most selective methods, even without contemplating financial aid. This is already the case where selective gear is not subject to certain restrictions on access, in accordance with the rules referred to above. This logic could be extended in the allocation of access and catch rights.

Equipment: Improvements in automatic sorting, which bring immediate economic gain, also encourage discards. This linkage requires careful handling, with the economic benefits and dangers of adapting the rules being analysed in each case. The decision reached in the case of sorting equipment used in pelagic fisheries illustrates both the need for action and the difficulty of achieving the necessary precision. While restrictions on sorting equipment would be coercive, all attempts to improve the means of identification before capture are the reverse of this negative coin. What should be encouraged therefore is not increased efficiency of acoustic detection techniques but their ability to determine the composition of shoals (species, or even length) before capture.

Vessels: Although vessels are generally multipurpose to a certain extent, so that they can switch to more or less selective fishing methods, such flexibility has limits. Some vessels are more suited than others to selective fishing. Vessels which have inadequate capacity for packing and/or transport in relation to their capacity to catch fish are likely to pose a high risk of discards. Longliners, in contrast, are more satisfactory. Likelihood of discards is therefore a criterion which should be given more importance in current and future Multiannual Guidance Plans (MAGPs).

(b) Evaluation: As the heading of this paragraph implies, the measures discussed above are designed to target commercially motivated discards. Attention is therefore focused on pelagic fisheries, by-catches with demersal trawls and nets. Restrictive measures should be judicious so as not to impede technological progress. However, care must be taken to ensure that positive measures do not result in a loss of realism or disguised subsidies and do not render coercive measures useless.

(c) Implementation: In this case also, fisheries should be screened to identify the appropriate scope of restrictive and incentive measures and of measures concerning gear, equipment or vessels. Economists have a vital role to play in analysing the factors determining individual behaviour.

4.4. The need for integrated action

4.4.1. Combination of different instruments

The different approaches discussed above must be combined in the definition of an overall strategy. Each of the suggested remedies will be more or less effective depending on the type of discard and its cause. The possibility of banning discards altogether should not be discounted, where such an approach is useful and warranted. The search for optimal efficiency also means that it must be possible to combine different approaches to the same problem, since there are many forms of synergy.

4.2.2. Inclusion in an overall policy

The question of discards cannot be isolated from the other elements of the CFP. The problem is being aggravated by overexploitation, which explains why large fish have become extremely scarce. Catches are concentrated in sectors where small fish are abundant, since the portion of catches which does not meet the minimum size requirements must be discarded. The scarcity of resources is exerting such economic pressure on fishermen that they cannot avoid types of fishing which involve massive discards, even though they are themselves appalled by this practice.

The choice of management tools is also crucial. A pure quota system poses a greater risk than a procedure based on licences. This would be all the more so if a system of individual quotas were used.

It is also important to place the problem of discards in the broader context of the CFP so as to make sure that combating discards at all costs will not lead to other forms of misexploitation and wastage. The likely undesirable consequences of the different solutions must be emphasized. For example, if the minimum size requirement were abandoned, more small juveniles would be caught. This could lead to disastrous overexploitation but with, ironically, no discards. In each case, therefore, measures to reduce discards must be seen in their overall context.

CONCLUSION

It is hoped that this report will bring home the importance of the problem of discards to those who were hitherto unaware of it. While laymen tend to be indignant about the issue, calling for rapid and radical solutions, those who have been involved in fisheries for years, and therefore know about the problem of discards, sometimes succumb to resignation. This report proposes a middle path requiring lucidity and perseverance.

The first step is to encourage debate, and this report can help towards this. The issue is highly complex and debate cannot be avoided if the problem is to be solved, since cooperation is required from all those involved. Among the forums for such debate are the competent committees, including scientific committees. The Commission will be responsible for organizing such consultations. Detailed legal work will also be required to analyse what amendments must be made to the rules.

However, certain measures must be undertaken immediately, well before the discussions have been completed. The first step, the importance of which cannot be overstated, is to obtain the basic data. Effective policies cannot be formulated without exact information. This is true now and will remain so. The problem of discards will continue to arise, perhaps in different forms. A sustained effort will therefore continue to be needed to obtain the data with which to keep track of the development of this phenomenon. To date, this aspect has not been stressed strongly enough, particularly in the keeping of logbooks. Obtaining up-to-date information is therefore a priority.

The preceding paragraphs also show specific problems which warrant immediate decisions. Corresponding pilot measures will make it possible to gain the necessary experience.

In addition, efforts must be made without delay to promote research, given the time required to complete such work. Alongside the consultations and coordination referred to above, the Commission must develop an integrated plan, within the framework of the AIR programme, covering all aspects of the problems of selectivity, from biology to economics, including the technology of gear and equipment. The Commission must also have at its disposal the means needed to rapidly initiate the necessary technical studies, either by drawing up contracts and subcontracts as required, or (which is in no way contradictory) by encouraging cooperation with research establishments in the Member States.

Once the general discussion has defined possible solutions more precisely, once the legal basis has been specified and once sufficient experience has been gained from pilot measures, it will be possible to pursue a vigorous strategy, using the solutions best suited to each problem to achieve significant results within the context of a broader policy.

SUMMARY

SCALE AND COMPLEXITY OF THE PROBLEM

A common feature of fisheries is the discarding at sea of creatures which have little or no prospect of surviving. The species discarded include those not marketed at all, some of which (mammals, birds, turtles, etc.) enjoy considerable public sympathy although the environmental drawbacks are not confined to them alone (cf. sharks, brittle stars, sea urchins, etc.). Species normally marketed are discarded, too, for example when a particular regulation applies or marketing problems arise. As a rule, the whole animal is discarded but processing at sea can mean that not only the viscera and/or head are thrown back, but sometimes the major part of a fish or shellfish, with only the high-value portion being retained (e.g. white muscle meat of scallops, crab claws, etc.).

Discards are a feature of fisheries worldwide, the outstanding example being tropical shrimp fisheries which, all told, each year dump a total estimated by the FAO at 5 million tonnes of fish.

In Community fisheries, too, discards are common although varying from case to case. Accurate figures are rarely available, but two examples will set the scene:

- In the North Sea haddock fisheries, discards quite often exceed what is kept from each haul. Discards have been estimated overall for 1985 at 460 million individuals compared with landings of 500 million.
- In the Bay of Biscay/Celtic Sea area, hake discards in 1985 were estimated to be 130 million as against landings of 110 million.

The problem is not confined to one region. The two examples above concern regions 2 and 3, while shrimp fisheries involve Community fleets in various parts of the world. The Mediterranean too is affected, even though in that region the rules do not make discards mandatory and the high prices obtaining there reduce marketing problems: discard rates of 10% are common.

Virtually no fishery is free of discarding, with the exception perhaps of pots. Some fishing techniques present a greater threat (towed gear: trawls and dredges), but even the longline takes unwanted species (turtles, rays, etc.). Catches in purse seines can be damaged by the presence of "rough" fish (horse mackerel), and it is not always possible to ensure the survival of fish surrounded by a seine which are intended to be released. Gillnets create problems of a different order altogether from those created by driftnets.

It would be incorrect also to say that small-scale or industrial fisheries, or inshore or distant-water fisheries are responsible for most discards. Problems vary from one sector to another but occur in all. Distant-water fisheries have their own problems, linked with keeping on board, especially from the early part of a sea voyage, those species of low commercial value. They generally operate in deep-sea waters, however, while inshore fisheries operate in sectors which frequently comprise concentrations of small fish, various mammals and sea birds. Discards by large distant-water vessels can reach spectacular proportions, but those of inshore trawlers, often fishing under special exemptions or even unlawfully, are frequently appalling in terms of the number of juveniles. Nets set close to the seashore can take catches of sensitive species, especially birds, that can be significant.

REASONS FOR DISCARDS

There are two immediate reasons why discards take place, the first as a result of obligations contained in regulations, and the second on grounds of commercial expediency. Community rules require certain species that can be marketed to be discarded. These include undersized fish, or catches that would lead to an overrun either of the percentage by-catch allowed for "protected" species or of the quota for the target species concerned. Such losses are regarded as just tolerable in order to make commercially unattractive certain fishing practices whose uncontrolled expansion would have even more serious repercussions.

Apart from mandatory discards, there are the many which are at the discretion of skippers, who see no reason to burden themselves with catches offering little prospect of an adequate financial return. This is true of species with no commercial value, such as brittle stars and a whole range of invertebrates, but also where there is no regular commercial outlet for a fleet (e.g. the grey gurnard fisheries in the North Sea). It is true also where the particular circumstances of a fishery mean that the costs of packaging, preservation and landing far exceed the likely sales price, or where room must be made for higher-value products. The targeting of very high-value products leads generally to an increase in discards, as is illustrated by some freezer vessels. We must not forget either the problems created by fish which are damaged while being caught.

It should be pointed out, lastly, that there would be no discards if fishermen were able to make the required selection before the catch is taken. There is no perfectly selective technique however. Advances in this direction are slow, while progress in on-board sorting is generally better and can much reduce the drudgery of selection for crews. This development is dangerous too, however, because it becomes possible to make an automatic selection within catches which themselves are not highly selective with a view to keeping certain fish only, of the "right species", right size, and even sex and degree of maturity. This situation, which can be seen in certain herring and mackerel fisheries, opens the way to the threat of a great surge in discards.

THE REPERCUSSIONS OF DISCARDS

The discarding of any fish or sea creature represents an unnecessary loss in absolute terms. This moralising statement is not sufficient, however, to justify criticism of "waste". Yet discards present many more obvious drawbacks, justifying rejection of the current situation.

Where they concern species of commercial value, discards constitute an undoubted loss to the stocks from which fishermen derive their livelihood. They are especially serious where they consist of fish with valuable commercial potential, such as young sole, haddock or hake. This situation has become even more untenable at a time when Community fisheries are short of stocks.

Discards also undermine the very foundations of the common fisheries policy, since limiting the size of landings alone is ineffectual when actual catches at sea surpass them by a wide margin. The introduction of minimum sizes also becomes meaningless when only white scallop meat or crab claws are landed, unless ratios are laid

down that would quickly become ludicrous.

Discards associated with the capture of sensitive species (mammals, turtles) can pose a threat to the future of the most vulnerable populations, and seriously undermine in all ways the image of fisheries in the eyes of the public. Apart from the sensitive species, unnecessary fishing alters ecosystems without offering any apparent offsetting advantage, although discards do provide feeding for scavenger species, some of which, it is reported, have been proliferating. In fairness, however, it must be said that mandatory discarding does contribute to discouraging certain unwelcome practices.

POSSIBLE SOLUTIONS

Clearly, the most direct method of controlling discards is the one applied by Norway, which has simply banned them. To incorporate this approach into the common fisheries policy would entail a complicated but feasible revision of a series of legislative texts based on mandatory discards. In some cases it would involve reviewing relatively stable rules, since account would have to be taken in quotas of the proportion of catches actually dumped. Arrangements would have to be made also for the disposal of catches which are not marketed. Finally, and above all, the monitoring of actual compliance with bans on discards would prove very difficult.

If, instead of a ban on discards, the rules on mandatory discards were relaxed, other rules would have to adopted at the same time to prevent a proliferation of harmful practices. If no minimum size rule were applied, the market in small hake could lead to a catastrophic deterioration of the situation of specialized fisheries. Any relaxation of the rules in force in the event of an overrun of a quota would have to be offset by a system of penalties sufficiently dissuasive not to make the quotas meaningless, otherwise the TACs policy could be abandoned altogether. Derogatory mesh sizes justified by the target species cannot be allowed as "pretext" fisheries.

In the control of discards, the reduction of unnecessary catches remains a sensible weapon. Encouragement should therefore be given to developing increasingly selective methods of fishing, including means of detection for evaluating the composition of shoals before irrevocable damage is done to them. It is necessary also to secure the maximum result from simple increases in mesh sizes. In many cases, just simple compliance with the existing rules would be very effective. The rules need to be modified to make them more easily applied and to limit the exceptions to what is strictly unavoidable. In many cases, too, the basic mesh sizes need to be increased. The example of the haddock fisheries shows that firm action is the only way of being effective.

A further possibility would be to establish new permanent or seasonal boxes in sensitive areas. Lastly, these fixed bans on fishing could be accompanied by operational procedures closing an area where the composition of the catches within them is unsatisfactory. This is what occurs in Iceland and Norway and in some Community fisheries (herring). Obviously it would involve wide-ranging delegation of decisions to appropriate management structures.

Lastly, it is worth creating outlets whenever possible to capitalize on the potential of catches which at present are discarded, at least in some fisheries.

CONCLUSIONS

The problem of discards is of such importance and its repercussions of such gravity that drastic solutions must be sought now, at a time when the increasing scarcity of stocks is of great concern to Community fisheries and when the ecological damage, true or imagined, caused by fishing is raising more and more questions. The Commission acknowledges that some of the existing Community rules contain drawbacks. The search for solutions will only be possible, however, if all the forms of and reasons for discards are considered.

Imagination will be required in finding remedies, and perhaps combining different ones. The Commission is eager to apply measures other than the usual coercive ones. In return, however, the fishing industry must be prepared to accept the need for restrictions. To ensure that the alternatives for relaxing the rules do not lead to the disappearance of the last restraints on practices more serious still than the present situation, various protections will have to be built in. Although not much liked, increased mesh sizes clearly remain an essential instrument.

ANNEX 1: ESTIMATE OF DISCARDS WHICH COULD THEORETICALLY RESULT FROM QUOTAS BEING USED UP DURING 1990

The estimate is based on the calculation shown below for sole (Div. II, IV):

- Date: 26 October 1990 Quota: 1 715t
- Ten months of fishing and two months of closed season
- Discards estimated over two months: 1 715 x 2/10 = 340 tonnes

The discards by stock and by country are taken from the table below.

Species	Stock	MS	Date	Quota	Theoretical discard
Cod	VI	D	11. 4	465	995
Whiting	VII	B	19. 4	230	560
Sole	VIIa	B	25. 4	520	1 050
Mackerel	VI,VII, VIII	ES	27. 4	20	40
Whiting	VIIa	B	29. 4	75	150
Mackerel	VI, VII, VIII	NL	2. 5	30 870	61 740
Hake	VI, VII	D	21. 6	57	60
Sole	IV	DK	7. 7	1 265	1 265
Herring	IVc, VIId	DK	8. 7	0	0
Hake	VIIIa	NL	8. 7	20	20
Plaice	VIIf,g	B	10. 8	470	300
Hake	IIIa,b,c,d	DK	22. 8	1 300	650
Plaice	VIIf,g	IRL	9. 9	130	60
Hake	IV	NL	17. 9	80	30
Pollack	VII	ES	25. 9	30	10
Mackerel	IIa,IIIabcd,IV	NL	18.10	1 075	280
Sole	IV	D	26.10	1 715	340
Mackerel	IIIabc,IV	DK	31.10	8 795	1 760
Sole	IV	B	16.11	1 935	270
Sole	VIIf,g	FR	17.11	75	10
Anchovy	VIII	FR	17.11	3 000	420
Sole	IV	NL	19.11	18 000	2 500
Plaice	VIIf,g	UK	22.11	450	50
Salt cod	VI	UK	24.11	8 371	760
Sole	IIIabcd	DK	26.11	580	50
Mackerel	VI,VII,VIIIa	FR	6.12	13 840	1 250
Herring	IVa,b	DK	7.12	70 190	6 380
Horse mackerel	VIIIc	ES	8.12	20 620	1 870
Sole	IV	UK	8.12	1 670	150
Megrim	VIIIc,IX,X	P	15.12	400	20
Whiting	VIIb	FR	15.12	14 400	620
Hake	IV	FR	15.12	600	25
Sole	VIId	B	15.12	1 035	45
Sole	VIIe	UK	15.12	530	20

The estimate is based on the following assumptions:

- The data concerning catches (in effect, landings in terms of live weight) are taken to be accurate.
- The date on which the fishery is closed is that on which the quota is used up.
- Fishing continues for the rest of the year under the same conditions (the same catch availabilities and the same fishing grounds).
- The rules in force are actually applied (no fraud).

These estimates must not be used for mackerel which constitutes a single-species fishery. The target species should be easily identifiable and fishing would genuinely have ceased. However, although the hypothesis that fishing continues for the remainder of the year under the same conditions is debatable in practice for some pelagic species, the table below gives an overview of potential discards arising where catches continue to be taken after the fishery has been closed. actice of discarding could be particularly significant for species such as sole and cod.

Species EEC zone	Quotas reached before end of 1990	Potential discards after closure of fishing
Sole	27 000	5 550
Whiting	14 705	1 330
Cod	23 900	2 590
Hake	2 057	785
Herring	70 190	6 380
Plaice	1 050	410
Anchovy	18 000	2 500
Horse mackerel	20 620	1 870

ANNEX 2: SUMMARY OF STUDIES AVAILABLE ON THE PRACTICE OF DISCARDING IN COMMUNITY FISHERIES

Information concerning discards can only be obtained at sea during commercial fishing trips. Specific information collected by observers is often very precise but rarely representative of a fleet because the composition of catches and the rates of discard disclose wide variations between areas and seasons. The compiling of satisfactory information on discarding calls for an intensive sampling programme on board commercial fleets, and for many countries this has not been carried out. Scientific journals contain very little historical data on discards. It is much more difficult to collect data on discards than on landings at ports and greater effort and cooperation with sampling is required on the part of the industry. It is not compulsory, furthermore, to enter particulars of discard declarations in Community log books. It is not surprising therefore that the information available is limited. It is given below by fleet and by country.

1. Danish fleet (Kirkegaard E., Poulsen F.D., 1989)

Quantitative information concerning the Danish fleet in the North Sea has been the subject of a study contract concluded with the Commission of the European Communities and is presented in this section. Further results, for 1990, will be available early in 1991 (this section will be revised if necessary).

The Danish discards sampling programme does not cover fishing with gillnets, which are said to be responsible for few discards, but instead with trawls and Danish seines for round fish and flatfish. The results for landings and the percentages discarded are presented by types of fishing gear, three-month periods, basic statistical zones, species, average catches for 100 hours of fishing and for 41 species. They are complicated to summarize, therefore, particularly since variations between vessels can be considerable. The following comments can be made nevertheless concerning the main species.

The principal species taken with Danish seines are plaice, dab and cod, which account for the bulk of catches, followed by ray and catfish. The main species taken by trawlers, too, during the first half of the year are plaice, dab and cod, but also haddock and, in the north, pollack. Large quantities of ray are caught and discarded in both fisheries. Grey gurnard, found in most catches, is all dumped.

Major commercial species such as saithe, catfish, monkfish, hake, lemon sole and halibut are rarely, if ever, discarded. The proportion of cod, plaice and haddock discarded varies considerably; virtually all whiting and dab are discarded.
For example, plaice discards range from 0% to 42% with the highest percentages being dumped close to the Danish coast. Discards of cod are high in both fisheries and there does not appear to be a trend difference according to area or season. For haddock, variations between areas are significant, the highest percentages being recorded in the south and west.

As for the size breakdown of landings and discards, for plaice the 25 cm limit represents a fairly clear-cut restriction. For cod and haddock, while minimum landing lengths in Denmark are 40 cm and 35 cm

respectively, landings comprise large quantities of cod of between 35 and 40 cm and, for haddock, between 30 and 35 cm.

To sum up, it seems that the scale of the discards of small plaice is consistent with their area of distribution in the rather shallow waters close to the coast. In the case of cod, the present poor state of stocks means that there are few large fish, with the result that fishermen at present are landing many cod of between 35 and 40 cm, in spite of the minimum landing size being 40 cm. Danish seines are taking fish measuring 40 cm, this being the borderline between discard and landing. The situation is the same for haddock, with the fish being caught measuring between 30 and 35 cm.

The study will be supplemented, once the figures for 1990 are available, to show the level of discards, which is likely to be of the order of 5% to 30% for plaice and 20% for cod. The percentages for haddock will probably be higher still.

2. Dutch fleet (Van Beeck F.A., 1990)

A discards sampling programme in the North Sea has been the subject of a study funded partly by the Commission of the European Communities. The information in this report demonstrates the complexity of the situation.

(a) Beam trawl: Catches taken by this type of gear fall into three subcategories: that which is landed, discards and debris. The latter accounts for between 37% and 75% of total catches and comprises everything other than fish, i.e. chiefly echinoderms (starfish, sea urchins), crabs, fossil shells and consumer waste. The part represented by the catch varies between 5% and 43 % from one trip to another. It consists mainly of sole, plaice and to a lesser extent turbot, brill, cod, whiting and, occasionally, flounder, gurnard and pout.

Discards as a proportion of total catches vary from 13% to 37% and are made up mainly of dab (61% by weight), plaice (24% by weight) and whiting (7% only). Around ten other species are also dumped:

- Common dab: the specimens caught vary in length from 12 to 23 cm. The minimum size is 23 cm. Dab has little commercial value in Holland however and large fish only are sometimes kept on board. Virtually all fish shorter than 24 cm are dumped, the result being a discard rate of 98% to 100%.

- Plaice: the minimum landing size is 27 cm. The percentage dumped varies from 9% to 84%. The absolute quantity of discards is largely dependent on the extent of the age category of the youngest groups. The age distribution of discards shows that most of them are 2 or 3 years old. In 1989 a plaice box was established along the Danish, German and Dutch coasts with the aim of protecting fish smaller than the legal minimum. Fishing for demersal species in this area is limited. The average percentage of discards for the period 1976 to 1990 was 83% compared with 36% outside the area and the average quantity of discards was 850 fish per hour of fishing as against 175 fish outside the area.

- **Sole:** the percentage of discards varies from 9% to 36%. The relatively high rates of discards observed recently are to be considered in conjunction with plentiful cohorts. The Community minimum size for sole is 24 cm.

- **Whiting:** With a view to managing the national quota, a rule has been adopted on the by-catches taken by beam trawls during the sampling period allowing a maximum of 80 kg to be landed for each fishing trip. The minimum size for whiting is 30 cm. Since most of the fish are smaller, some whiting have occasionally been brought on board and landed. The percentage of discards, the quantity depending on the fishing area, varies between 92% and 100%.

- **Cod:** Under the rules on by-catches a maximum of 200 kg may be landed for each trip. The somewhat poor catches of cod are linked with the calamitous state of stocks. A comparison of the rates of discards within and outside the plaice box area reveals rates of 80% in the box as against 51% outside.

- **Flounder:** This species is caught by trawls at certain times of the year. During the spawning period in late winter and early spring, they show up in the fishing grounds and for the remainder of the year are to be found in fresh water. Because of their low value plantiful supplies of flounder push down the price of plaice. Flounder is therefore often entirely dumped. The minimum legal size is 25 cm.

  Turbot, brill and lemon sole: Because of their high value turbot and brill are important by-catches in beam trawl fisheries. Small quantities of lemon sole are sometimes found in the catches of Dutch beam trawls which fish over gravelly seabeds. The minimum legal size of turbot and brill is 30 cm. Discards are not at all common because specimens smaller than the legal minimum remain vey close to the coastline.

- **Mackerel, horse mackerel and herring:** these pelagic species are rarely found in the catches of demersal fisheries. They have considerable commercial value but the small quantities taken in beam trawls are all discarded.

- **Gurnard:** Sapphirine gurnard is a southern species rarely found in northern waters, though frequently in catches following mild winters. The bulk of the few fish caught can be marketed and hence discard rates are extremely low. Because of the small size of grey gurnard catches, they are all dumped.

- **Dragonet:** This species is frequently found in the southern part of the North Sea. It has no commercial value and consequently is dumped.

- **Scaldfish:** This small flatfish is commonly found in shallow waters in northern Europe. Catch lengths vary from 9 to 17 cm. Most fish escape through net meshes.

- **Yellow sole:** This is also a small flatfish of which there are plentiful supplies in certain areas but not at all times of the year. It varies in length from 9 to 13 cm. Most of the fish escape through net meshes. It has no commercial value and all catches are dumped.

- **Armed bullhead:** This small fish is commonly found in coastal waters. The specimens taken in discard samples vary in length from 9 to 18 cm. Most escape through net meshes. It has no commercial value and hence is dumped.

- **Weaver:** A small fish very plentiful locally in certain sandy areas of the North Sea but hardly found at all in some years. The length of specimens found in discard samples varies from 5 to 20 cm. Like the armed bullhead, they escape from nets and have no commercial value.

- **Pout:** This fish occurs frequently in coastal waters, especially where there are rocks and is caught by beam trawls but only in small quantities. Its low commercial value means that most catches are dumped but it is used in industrial fishing.

- **Capelin (poor cod) and sand eels:** These are of value only in industrial fishing. Most specimens, being small and slim, escape through the net meshes. They are plentiful in certain locations and a few are sometimes trapped in the cod-end of trawls. They are all dumped.

(b) Bottom trawl: Their discards consist mainly of whiting, dab and cod and, sometimes, plaice. The other species dumped are haddock, pout, sapphirine gurnard, grey gurnard, mackerel, horse mackerel and herring. Small quantities of a number of industrial species are caught: capelin, sand eels, sprat and Norway pout. The flatfish species found in small numbers in catches are flounder, brill, lemon sole and Atlantic long rough dab. Other species are occasionally caught such as bull head, dragonet, armed bullhead, weaver, twaite shad, thornback ray and lumpfish.

- **Cod:** This is the most significant target species of pair trawl and demersal trawl fleets. Landings in 1989 and 1990 were limited, under national rules, to a maximum quantity, which varied during the year, according to the vessel and the week. The percentage of discards per trip varies appreciably from 4% to 75%. The average percentage of discards in recent samples was 44% as against 20% over the year. The recent rise in discards is attributable to the calamitous state of adult stocks at the moment and not to a rise in numbers. Traditionally most discards occur along the Dutch coast and the coastal areas of the German Bight.

- **Whiting:** This constitutes the largest by-catch in these fisheries. Where there is no cod, whiting is sometimes regarded as the target species. Here too landings are limited by national rules. Whiting accounts for the bulk of discards in these fisheries.

- **Haddock:** This species is of little importance in Dutch pair trawl and demersal trawl fisheries. It is not very plentiful in the southern part of the North Sea where these fisheries operate.

- **Plaice:** This is a by-catch of pair trawls. The average percentage of discards is 64%, which is very high compared with that of demersal trawls.

- **Dab:** By-catches of dab in this fishery are larger than in the beam trawl fishery and a larger proportion is landed. The average percentage of discards is 84%.

- **Pout:** This is a by-catch in the southern part of the North Sea. Discards represent 88% on average.

- **Grey gurnard and sapphirine gurnard** are also by-catches.

- **Mackerel:** In the pair trawl and demersal trawl fisheries mackerel is a by-catch not normally found in landings other than where a significant quantity is caught within a short space of time.

- **Horse mackerel:** This species is a by-catch of little relevance in these fisheries. At certain times of the year these same fleets use pelagic gear to practise directed inshore fishing for horse mackerel.

- **Herring:** This too is a by-catch of no importance in these fisheries. The bulk of it probably escapes through net meshes. As for horse mackerel, at certain times of the year there is directed fishing.

- **Industrial species:** Capelin, Norway pout, sand eels and sprat sometimes occur in small quantities in catches but most escape through the meshes.

- **Flatfish:** Small quantities of four other species are caught: flounder, brill, Atlantic long rough dab and lemon sole.

- **Occasional species:** Catches also contain from time to time bull head and dragonet, as well as the occasional armed bullhead, weaver, twaite shad, thornback ray and lumpfish.

3. Scottish fleet

Between 1924 and 1930 discards of haddock represented 51% in terms of numbers and 35% by weight of the catch as against 30% to 40% in 1962. In 1976 and 1977 they ranged from 4% to 31% for trawls and from 8% to 76% for seines, with certain variations related to location and time. Whiting discards varied from 3% to 66% for trawls and from 2% to 100% for seines. From 1975 to 1979 the lengths on the basis of which 50% of the haddock and whiting was discarded remained relatively stable (29 cm for haddock and 28 cm for whiting) although this varied considerably for cod. The table below gives a summary of the average figures (Jerwyn A.S., A.P. Robb, 1981):

	Haddock		Whiting	
	Trawl	Seine	Trawl	Seine
Rate of discards (by weight)	14%	20%	14%	29%
Rate of discards (in numbers)	26%	46%	26%	46%

4. Round fish working group report (ICES, 1991)

This report contains detailed tables, with particulars of discards, from which the data (in thousands of tonnes) in the table below can be extracted. Discards of haddock consisted primarily of groups 0 and 1, while catches for human consumption start at age 1 but predominantly at 2. Whiting discards mainly comprised groups 1 and 2, while catches for human consumption begin at age 2 but for the most part at 3. Information on discards for other stocks is not available.

	Zone	1989	1990
Haddock	IV	26/79 landed	19/50 landed
Haddock	VIa	3/17 landed	4/12 landed
Whiting	IV	35/83 landed	54/150 landed

5. German fleet (Lamp F., W.Weber, 1984)

This paper on fishing for cod by the German fleet in the German Bight makes a comparison of the variations in terms of length and weight of discards in 1984 as against 1982, and attributes the variations in the rate of discards to the fact that supplies in age category 0 are plentiful. At their lowest, discard rates were around 4.5% by weight and 15% in terms of numbers in 1983 and 19% by weight and 53% in terms of numbers in 1984. The 1983 cohort, which at that point was very plentiful, was dumped in large quantities in the catches for 1984. The size of the fish dumped varies from 15 to 35 cm and that of the fish landed from 30 to more than 65 cm.

6. Mackerel fisheries (North Sea and western stock)

Norway introduced a minimum size of 30 cm in 1971 to protect the plentiful stock of the 1969 cohort and prevent it being fished by the industrial fishing fleet. It applies in the North Sea only and there would seem to be no need for it to be extended to the western zone since this would cause an increase in the quantity of juveniles likely to be dumped (Mackerel Working Group, 1989).

Estimates of discards for one fleet in 1988 and 1989 are 5 800 t and 4 900 t, and hence an underestimate of actual discards. Between 1978 and 1982 discards varied from 21 000 t to 60 000 t annually, but that predated the establishment of the Cornwall box. The current problem is confined to the dumping of small mackerel. In addition, in the horse mackerel fisheries in zones VI and VII, and in zone VIIa-e and IXa, mackerel are said to be discarded because they are bruised (Mackerel Working Group, 1990).

7. Horse mackerel in region VII (Perez N., Moguedet P., 1989)

Estimates of the quantity of horse mackerel dumped in region VII, which are available for Spanish trawlers only, were 800 t in 1988. The composition of these discards by size shows the mode at 29 cm within a range from 20 to 43 cm.

8. Spanish trawler fleet, region VII (Moguedet P. and others, 1989)

Discard curves are given for 5 species showing sigmoid curves where L50 and L10 are the lengths for which 50% and 10% respectively of catches are dumped. In other words, 50% of very small hake measuring 20 cm are kept in spite of the minimum size permitted under Community rules.

	L50	L10	Minimum L permitted
Megrim	20 cm	23 cm	25 cm
Hake	20 cm	27 cm	30 cm
Anglerfish	20 cm	22 cm	-
Norway lobster	23 mm	30 mm	20 mm

9. **French fisheries in the Celtic Sea** (Conan, 1982)

A study funded by the Community of fisheries in the Celtic Sea was made in 1979-81 on Norway lobster vessels using mesh size 60 mm. More than 1 000 hauls were sampled. The proportions of fish smaller than the minimum sizes are shown in the table below (where the reject index is given by the formula b/ax100):

	Megrim	Plaice	Dab	Lemon sole
Number of fish measured (a)	114 874	909	2 289	5 098
Smaller than min. size (b)	26 677	14	1 826	1 745
Discard index	23	1.5	80	34

(continued)

	Haddock	Whiting	Hake	Cod
Number of fish measured (a)	824	14 671	22 965	3 329
Smaller than min. size (b)	136	311	15 636	79
Discard index	17	2.1	22.2	2.4

10. French fisheries in the Bay of Biscay (IFREMER, 1991)

This study shows that some species of major commercial interest, such as anglerfish, are virtually never discarded, while others such as flounder in the benthic and Norway lobster fisheries are very often dumped (close to 70% of males and 20% of females) in quite considerable quantities. Discards in the case of the latter consist not only of small sized juveniles but also of adults of poor commercial value (damaged or too thin), particularly those aged 3 or 4 years (less than 28 cm). Discards of demersal species (cod, whiting, hake) in the demersal and Norway lobster fisheries consist primarily of juveniles aged 1 or 2 years, and more especially the Norway lobster fleet in the case of hake.

11. Trawling off the West of Scotland (Div. VIa), (IFREMER, 1989)

The French fishing fleets in question comprise "industrial-size" vessels (39 to 55 m) operating out of Brittany and Boulogne-sur-Mer and Breton "semi-industrial scale" vessels (33 to 38 m). A study carried out with Community assistance (DG XIV/B/1: 2307 of 22.6.1989) gives an estimate of the weight (in tonnes) of haddock dumped as against the quantity landed.

Haddock	1986	1987	1988
Discards (t)	524	3 296	962
Landings (t)	4 457	5 355	2 949

12. Sicilian fisheries (Mazzola A. and others 1989, Andaloro F., 1985)

The results of exploratory trips, looking at discards as a resource that can be used in aquaculture, show that 22% of total catches are subsequently dumped. The discards comprise 43 species, including 7 species of decapod crustaceans, 5 of cartilaginous fish and 31 of bony fish. The most plentiful species is the horse mackerel, which is regularly dumped regardless of the size of the catch on account of its poor commercial value.

By-catches taken by long lines and gillnets fishing for the major pelagic species (Xyphias gladius and Tunnus alalunga) can reach more than 50% of total catches while discards account for around 10% and consist mainly of whip-tailed sting ray. On the other hand, in the case of trawling, where catches are more homogenous, more sardines are taken even where yields are smaller. The sardines are normally processed into meal. Large-scale fishing is carried on in three distinct areas: the mesobathyal zone (2%), the area close to the shore (28%) and the epibathyal zone (70%).

In the mesobathyal zone, which is exceptionally deep, highly selective gear means that discards are limited in terms of quality and quantity. They can account for up to 42% of total catches and consist mainly (94%) of fish (elasmobranchs and teleosts). Discards in the inshore zone are unusual in that up to 50% by weight consists of vegetation. Of the catch, 85% represents discards which includes fish (30%) and invertebrates (20%). In the epibathyal zone, where the target species is Parapaeneus longirostris, discards can reach 82% of total catches. Discards constitute a biomass of 62 000 tonnes annually, of which 2% (invertebrates) serves no commercial use.

ANNEX 3: BIBLIOGRAPHY

ANDALORO F. - 1985: "Discards e by-catches nella pesca siciliana" i Pesca e trasformazione dei Prodotti Illici Siciliani; Trapani, 6/7/XII.

ARMSTRONG D.: "Discarding of haddock and whiting" (foredrag).

ARMSTRONG D.W., W.B. HALL - 1987: "Collection, processing and retrieval of data from catches by Scottich commercial fishing vessels of demersal fish species 1950-1982" i Development in Fisheries Research in Scotland; udgivet af R.S. Bailey og B.B. Parrish; Fishing News Books (Ltd), s. 19-39.

CFRD.: "Working group on discards" (mundtlige indlæg).

EF.GD XIV/C/1 - 1990: "Situation regarding the discarding of fish in Community fisheries." Dokument udarbejdet af Kommissionen - GD XIV/C/1.

CONAN G. - 1982: "Captures accessoires et rejets des chalutiers langoustiniers français en Mer Celtique." - Centre National pour l'Exploitation des Océans - Afsluttende rapport EF/CNEO.

CONSUMERS IN THE EUROPEAN COMMUNITY GROUP - 1991: "Fishing and fish farming: The consumer interest."

DE FORGES H. - 1973: "Etude du poisson rejeté par la pêche hauturière bretonne. Etude des espèces, estimation, transformation." Dataarkivet ENSA-Rennes, fiskeriafdelingen.

EVANS S.M., J.E. HUNTER - 1991: "Estimation of the quantity and size composition of Nephrops and by-catch species discarded in the fiserhy off the NE coast of England." Dove Marine Laboratory.

I.C.E.S. - 1990: "Report of the working group on fisheries units in the sub-areas VII and VIII." - Nantes 13.-20. juni 1990.

I.C.E.S. - 1991: "Round fish working group." - Aberdeen 11.-23. oktober 1990.

IFREMER - 1989: "Les pêcheries démersales et benthiques de l'ouest de l'Ecosse (sous-zone CIEM VI). Modélisation des interactions techniques." - Afsluttende rapport EF/IFREMER.

IFREMER - 1991: "Evaluation des rejets d'espèces commerciales: Théorie et application aux pêcheries multispécifiques du Golfe de Gascogne et de la Mer Celtique." Afsluttende rapport EF/IFREMER. Studie GD XIV/C/1, nr. 4930 af 22.4.1991.

JERMYN A.S, W.B. HALL - 1978: "Sampling procedures for estimating haddock and whiting discards in the North Sea by Scottish fishing vessels in 1976 and 1977." - I.C.E.S.

JERMYN A.S., A.P. ROBB - 1981: "Review of the cod, haddock and whiting discarded in the North sea by Scottish fishing vessels for the period 1975-1980". - I.C.E.S.

KIRKEGAARD E., POULSEN F.D. - 1989: "Discard sampling programme for the North sea. Danish participation." - Danmarks Fiskeri- og Havundersøgelser. EF-studie.

LAMP F., F.W. WEBER - 1984 : "Further investigations on discarding of cod in the German bight by fishermen of the Federal Republic of Germany." - ICES

MACKEREL WORKING GROUP - 1989 : ICES. "§ 3.5.1. Minimum size regulation."

MACKEREL WORKING GROUP - 1990 : ICES. "§ 5.1.1. Discards."

MAZZOLA A., ARCUELO M., G. BONO - 1989 : "Lo scarto di pesca come risorsa utilizzabile in acquicoltura : risultati di due campagne sperimentali nel basso mediterraneo."

MOGUEDET P., N. PEREZ - 1989 : "Estimates of dicards from the spanish trawler fleets in the sub-area VII." - Working group on fisheries units in the sub-areas VII and VIII - Nantes 23-30 june 1989.

PEREZ N., P. MOGUEDET - 1989 : "Estimates of the horse-mackerel (Trachurus trachurus) discards from the Spanish trawler fleets in the I.C.E.S. division VII." - Working group on the assessment of pelagic stocks in divisions VIIIc and IX and horse-mackerel - Copenhagen 10-19 May 1989.

REEVES S.A. - 1990 : "Linear modelling of discard data from Scottish demersal fisheries." - I.C.E.S.

VAN BEEK F.A. - 1990 : "Discard sampling programme for the North sea. Dutch participation." - Rijksinstituut voor Visserijonderzoek. EEC study.

WEBER W., F. LAMP - 1983 : "Discarding of cod in the German bight by fishermen of the Federal Republic of Germany." - I.C.E.S.

ANNEX 4 : POTENTIAL INTEREST OF AVAILABLE TOOLS
TO DEAL WITH THE VARIOUS TYPES OF DISCARDS
(Scale : from + to +++)

DISCARDING RATIONALE		TOOLS	SELECTIVE FISHING					MODIFYING DISCARDING RULES		CHANGING ECONOMIC ENVIRONMENT	
			BOXES		MESH SIZES & GEAR REGULATIONS	PROMOTING SPECIFIC GEAR	DETECTION/ ACOUSTICAL DETECTION	EASING OUT TAC & QUOTAS	MINIMUM SIZES BY-CATCHES	HIGH GRADING CATCH VALUE	VESSELS IMPROVEMENT
			PERMANENT	TEMPORARY							
REGULATORY RATIONALE		QUOTAS	+	++		+	+	+++			
		BY-CATCHES	++	++	++	+	+	++	++		
		SIZE LIMITA-LIMITATONS	++	++	++	+	+		+		+
ECONOMICAL RATIONALE	MARKET LIMITS	SIZE-MOTIVATED	+	+	+	+	+			++	+
		SPECIES MOTIVATED	+	+	+	+	+			++	++
		BY-PRODUCTS								++	++
		DAMAGED SPECIMENS		+	+	++					
		MAXIMIZATION CATCH VALUE		++							
PROTECTED SPECIES			+	++	+	++	+				+

84

Fig. 1: Hake fishery in the Bay of Biscay:

1A: Distribution of size frequencies (absolute)

1B: Selection curves (probability of being caught) using mesh sizes 60, 80, 100 and 120 mm. Curve (1) shows the probability of discard, as practised in this fishery, in relation to the length of the hake (independently of mesh size)

1C: Breakdown of total catches by size category, account being taken of discards according to curve (1) in figure 1B.

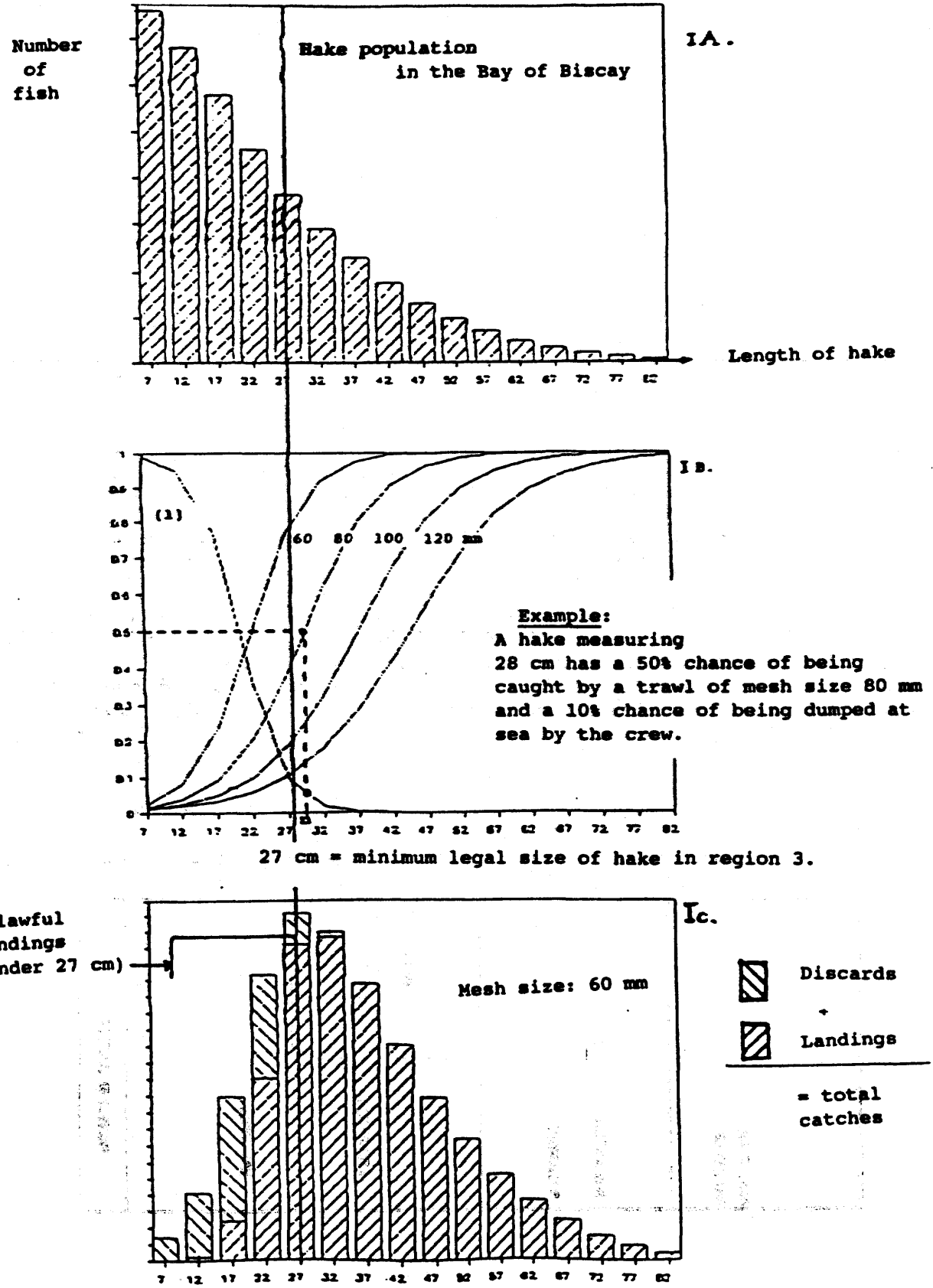
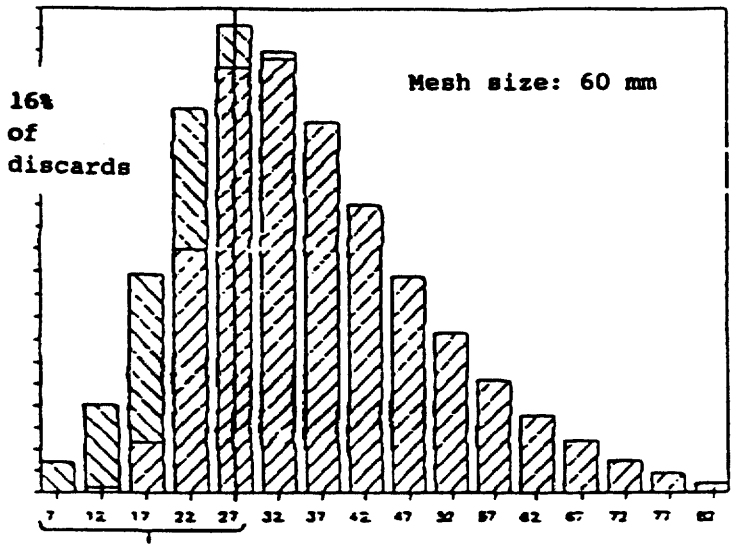
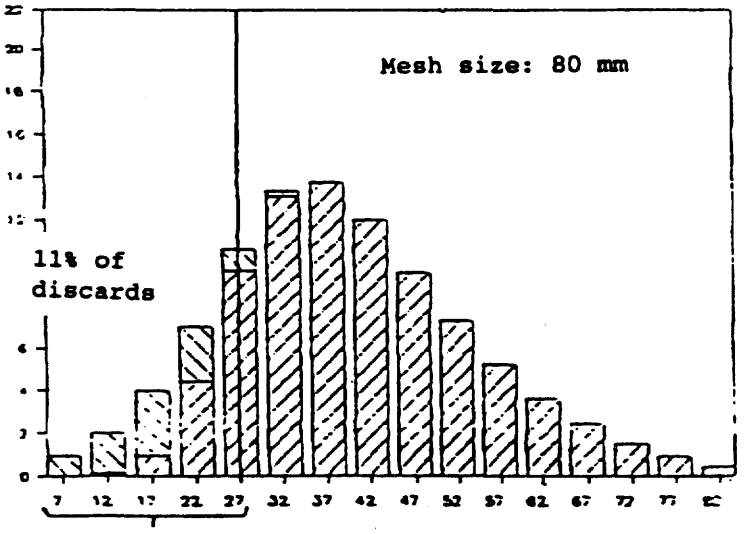
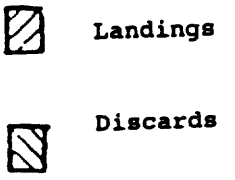


Fig. 2:
Short-term effect of increasing mesh size on landings and discards in the Bay of Biscay hake fishery



32% of theoretical discards





20% of theoretical discards