# *PART III: SOUTH-EASTERN NORTH ATLANTIC*

## THE FRENCH FISHERIES IN THE NORTH-EAST ATLANTIC (ICES AREAS VII AND VIII), 1996-1998

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**ABSTRACT**
We present a brief summary of how French fisheries data are compiled, and compare landings data from the French national fishing institute (IFREMER) with ICES data. We noted discrepancies between the two sources that result from fish being caught in one area but landed and reported for another area. After ICES landing statistics by species were allocated to the various French fleets, we used discard rate estimates from three studies to estimate discards and reconstruct the catch of each species by fleet and area. We estimated that, on average, 18.1% of the catch in area VII and 21.0% in area VIII was discarded. Trawlers caught the majority of the total catch and had the highest discard rate of any fleet.

### FISHERIES STATISTICS AND THE STRUCTURE OF DATA ACQUISITION

Species landings and fishing effort statistics are recorded separately in France. Landings information comes from either the auction or non-auction network, depending on the type of marketing chosen by the fisher.

#### *The auction network (RIC)*

The auction ('inter criée') network concerns the landings sold within the auction system under the supervision of the local authority ('halle à marée'). Tonnage per species, market prices, and discard prices ('prix de retraits') are collected by the National Inter-professional Office of Fisheries and Aquaculture Products (OFIMER; FIOM before 1997), which reports the data to the Regional Centre of Statistical Treatment (Centre Régional des Traitements Statistiques, CRTS) of the region (Boulogne, Saint Malo or La Rochelle). This information is centralized at the Administrative Centre for Maritime Affairs (Centre Administratif des Affaires Maritimes, CAAM) and is used for the creation of ZA files, in which catch and effort are given by port and by period.

#### *The non-auction ('hors criée') network*

The Scientific and Technical Institute of Marine Fisheries (Institut Scientifique et Technique des Pêches Maritimes, ISTPM) created an inspectors network in 1966 in order to improve the compilation of information by distributing fishing forms to fishers. The system initially included only two species at the La Rochelle port, but was eventually extended to all French ports and to almost all commercially exploited species. Today, these reporting forms are collected by local committees and forwarded to the French Research Institute for the Exploitation of the Sea (IFREMER) who propose to CAAM the required corrections for information taken from the non-auction network. In spite of its role of scientific adviser, IFREMER is not involved in validating this information.

Little information collected from both the auction and non-auction networks are used in the creation of the national statistical database on French production. Only the non-auction statistics of the Bay of Biscay are taken into account by CAAM (A. Forest, IFREMER, pers. comm.).

#### *Other sources of information*

*Logbooks*
All ships measuring more than 12 meters have to fill out European Union logbooks which include information on fishing hours, fishing zone, gears used and catch per species. The information is collected by marine affairs officers and analyzed at CAAM. The landings from vessels less than 12 m would only be recorded by the non-auction network.

*The 'États A'*
The marine administration has also designated staff to verify the coherence between declared catches and real catches. Their opinions are called 'États A'. Once validated by CAAM, the fishery statistics are edited by OFIMER each year. Many organizations published these data by ports or by region ('quartiers'), with variable number of species and varying degrees of precision. The Marine Fisheries Direction (Direction des Pêches Maritimes)

presents exhaustive statistics for both species and ports from 1860 to 1988. Aggregated information of the most important species, by marine region, is presented by the Central Committee for Marine Fisheries (from 1970 to 1992), FIOM (from 1993 to 1996), and OFIMER (from 1997 until the present).

### *Summary of the information*

The matching of production data and fishing activity information from the logbooks is undertaken at CAAM. This results in the creation of ZA files, in which catch and effort are given by port and by period. These data become the official French fisheries statistics that are reported to international organizations (FAO and ICES). The ZA files are forwarded to the IFREMER office in Brest, where they are corrected with information coming from fishing forms. Unfortunately, the electronic files are not available for public consultation as basic fishing data are used in the European Union bargaining process. An attempt was made to build a time series of effort using historical data on boat descriptions and effort. See Appendix 1 for a brief description of the fishing activity and effort of various fleets between 1961-1975.

## COMPARISON OF IFREMER AND ICES LANDINGS DATA

Landings data for the period of 1996-1998 were obtained from IFREMER. The database included 224 species and was divided by year, port, region, and vessel origin. It included foreign vessels (i.e., Spanish, Portuguese etc.) unloading in French ports. However, we assumed landings in French ports by other countries to be minimal. Only the Atlantic ports were considered.

The average annual estimate by IFREMER of total landings in area VII, 194,388 tonnes, was much lower than the ICES estimate of 529,038 tonnes. Conversely, in area VIII the IFREMER total landings estimate of 161,628 tonnes was somewhat higher than the ICES estimate of 137,213 tonnes. Discrepancies between the two data sources in each fishing area occurred for several taxonomic groups (Figure 1). In area VII, ICES landing estimates were higher for all groups, especially algae, groundfish, molluscs, and elasmobranchs (skates, rays, dogfish and other sharks) (Figure 1a). Echinoderm landings have been omitted from Figure 1 as they were low and similar between data sources in both areas. The yearly trends in landings from 1996 to 1998 are inconsistent between data sources for some taxonomic groups. For example, ICES data show a steady decrease in algae landings, whereas IFREMER landings show a sharp increase in 1997 followed by a decrease in 1998. (Although, the original ICES data also showed a substantial increase in 1997 to over 600,000 tonnes. We determined that the algal group comprising the majority of this weight, *Macrocystis*, was likely overestimated after looking in detail at algal species landings. We therefore used a lower estimate in our analysis (Figure 1) that was at least comparable to other sources.) Similarly, ICES data show an increase in landings of molluscs and pelagic fish, whereas IFREMER data show a slight decrease. In area VIII, the landing estimates are more similar between data sources for all taxonomic groups, with the exception of groundfish (Figure 1b).

It is interesting to note that IFREMER estimates for groundfish landings were less than ICES estimates in area VII by nearly the same amount as they were greater than ICES estimates in area VIII. In other words, the groundfish landings from areas VII and VIII combined were very similar between data sources (Figure 1c). Thus, there appears to be uncertainty about the location of fishing grounds. Assuming that the methods of extrapolation from sampled landings to total landing estimates were similar in both areas and between organizations, there are two possibilities as to how this might arise: (i) either groundfish catches from area VIII were recorded for area VII by ICES, or (ii) catches from area VII were recorded for area VIII by IFREMER.

Looking at individual groundfish species, we note that landings of Atlantic cod (*Gadus morhua*), megrim (*Lepidorhombus whiffiagonis*), anglerfish (*Lophius piscatorius*), whiting (*Merlangius merlangus*), and hake (*Merluccius merluccius*) were proportioned differently between fishing areas even though the total landings from these areas were similar (Figure 2). In each case, IFREMER landing estimates were less than ICES estimates in area VII but greater than ICES estimates in area VIII. By themselves, the differences in landings of these five species between data sources and fishing areas accounted for over half the differences in all groundfish landings shown in Figure 1. Other species showed similar patterns, such as long-fin tuna (*Thunnus alalunga*) and Norway lobster (*Nephrops norvegicus*). Comparing this trend with the location of fishing grounds in areas VII and VIII for these species (Abbes, 1991) (Table 1), we see that the principal fishing grounds for some species such as *Gadus morhua* were concentrated in area VII, whereas they were concentrated in area VIII for other species such as *Thunnus alalunga*. For these

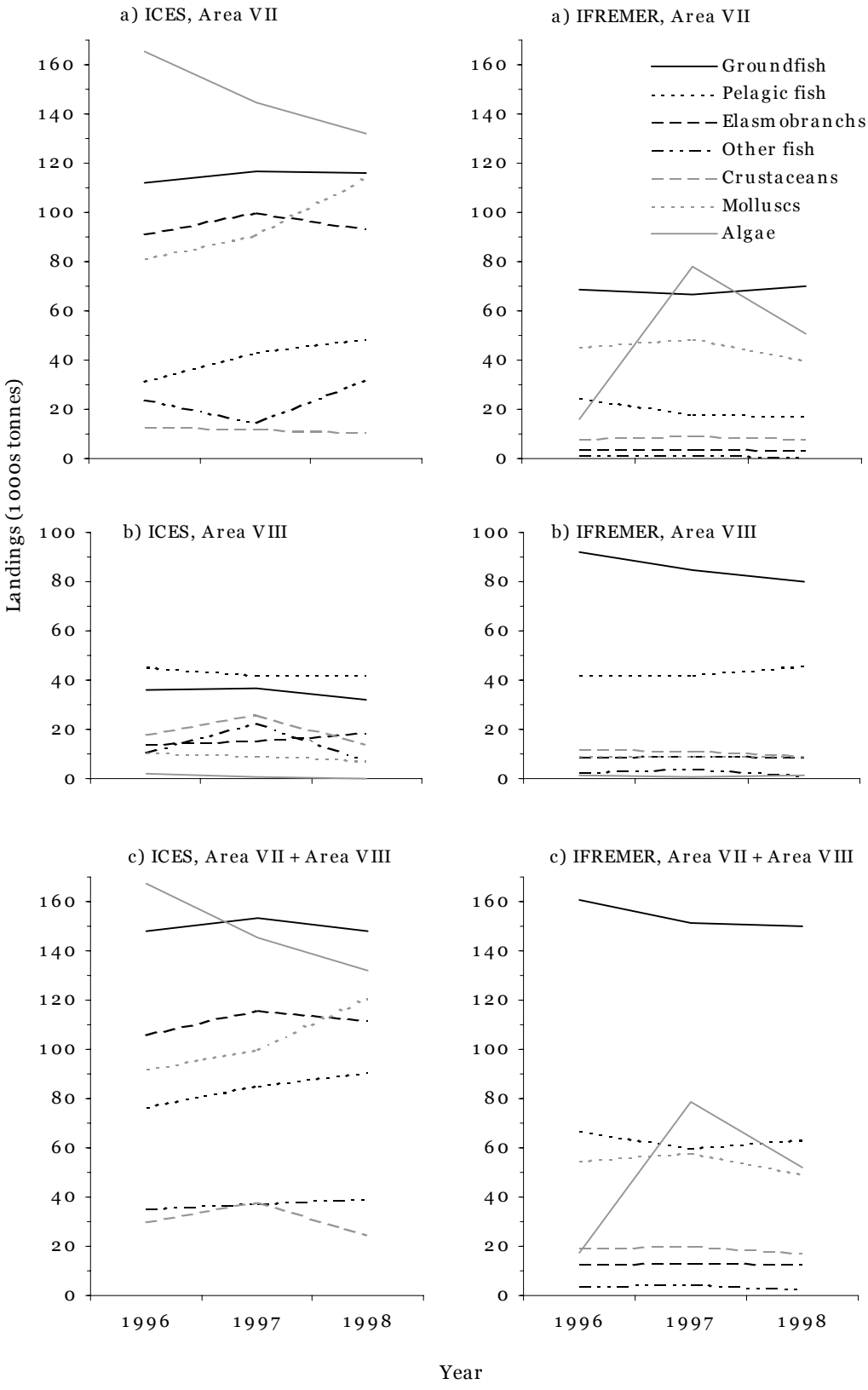


**Figure 1.** French landings in ICES areas VII (a), area VIII (b) and both areas combined (c) from 1996 to 1998, according to ICES (left column) and IFREMER (right column). Data are divided into major functional groups. Note: ICES landings statistic for *Macrocystis* (an alga) in area VII in 1997 is 520,960 tonnes. However, this figure is suspect, and we considered a landing of 52,096 tonnes to be more realistic and subsequently used this in our analysis.

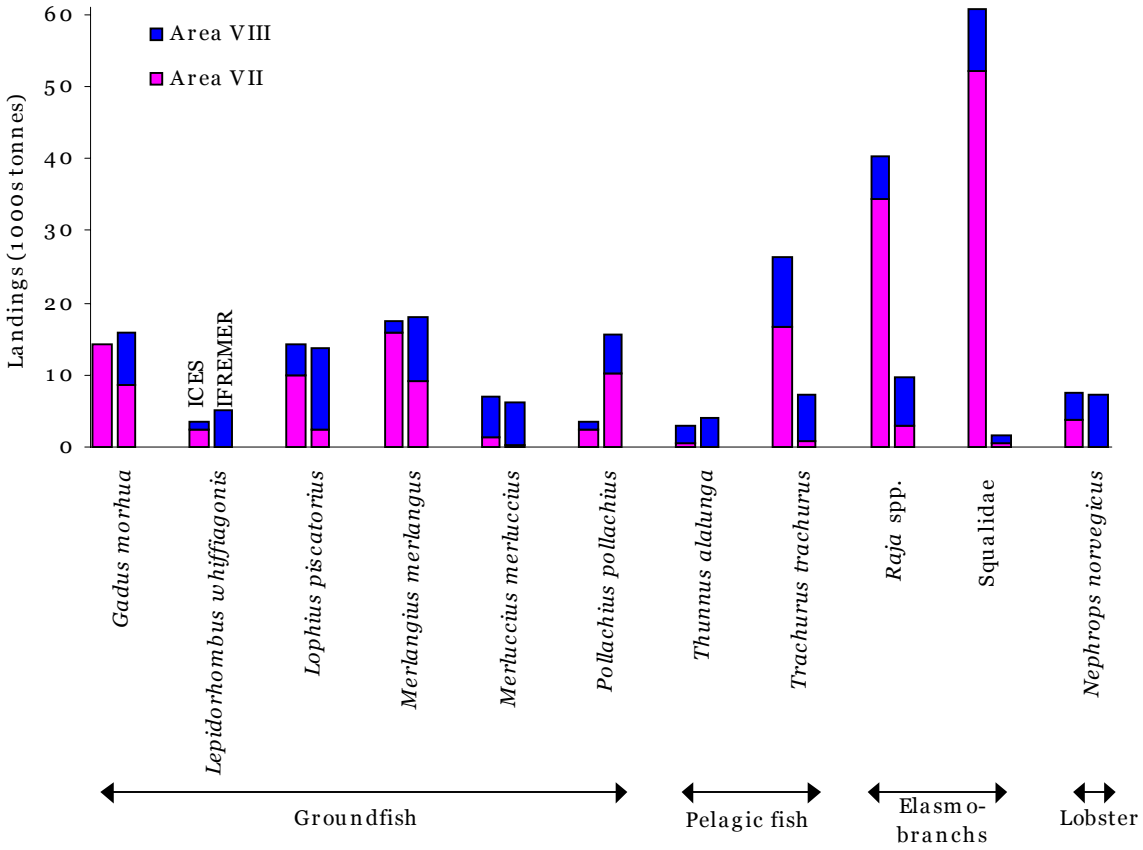


**Figure 2.** Selected species with either large differences in landings between ICES and IFREMER estimates (pollack [*Pollachius pollachius*], Atlantic horse mackerel [*Trachurus trachurus*], rays [*Raja* spp.], dogfish [Squalidae]) or similar landings that are proportioned differently between areas VII and VIII (cod [*Gadus morhua*], megrim [*Lepidorhombus whiffiagonis*], anglerfish [*Lophius piscatorius*], whiting [*Merlangius merlangus*], hake [*Merluccius merluccius*], long-fin tuna [*Thunnus alalunga*], Norwegian lobster [*Nephrops norvegicus*]). Data are yearly averages of French landings from 1996-1998.

species that ICES listed as 'relatively more caught in area VII' and IFREMER listed as 'relatively more caught in area VIII', it appears as if most principal fishing grounds were in area VII. Thus, possibility (ii) seems more likely, that is, ICES had more often attempted to record the catch by where it was caught, while data from IFREMER were more often collected by port of landing regardless of where they came from. ICES recorded far greater landings than IFREMER of other species in area VII, without the negative compensation in area VIII. The sum of landings from areas VII and VIII were much greater in the ICES data for Atlantic horse mackerel (*Trachurus trachurus*), rays (*Raja* spp.) and dogfish (Figure 2). Pollack (*Pollachius pollachius*) is one of the few species for which the opposite was true (Figure 2). Therefore, of the two sources, ICES data may be a more complete estimate of the total biomass landed by the French fisheries in areas VII and VIII.

## Reconstruction of actual catch and discards for French fisheries

We used ICES landings data to estimate the total weight caught and discarded by French fisheries from 1996 to 1998. The species list for ICES landings was shorter than the IFREMER list because minor species landings were grouped into larger, or 'general' categories (e. g. 'Miscellaneous marine molluscs', 'Sparidae', etc.). First, we allocated the catch of each species among various fleets by estimating what proportion of the catch was taken by each of the following French fleets: coastal demersal trawls, offshore demersal trawls, pelagic trawls, purse seines, pole and lines, long lines, gill nets, and 'other coastal gears' that include cephalopod pots, hand lines, and crustacean traps. These proportional fleet allocations for individual species and taxonomic groups in areas VII and VIII are listed in Appendix 2. Next, we applied fleet-specific discard rates to the landings of each species or 'general' group in order to estimate the total weight caught and discarded in each fleet.

**Table 1.** Fishing grounds by species (Abbes, 1991)[a].

| **Species** | **Fishing zones** | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ------IV------ | | | ---VI--- | | ----------VII---------- | | | | | | | | | | | ----------VIII---------- | | | | | ---IX--- | | X | XII |
| | a | b | c | a | b | a | b | c | d | e | f | g | h | I | j | k | a | b | c | d | e | a | b | | |
| *Gadus morhua* | P | S | P | P | | **S** | **S** | | **P** | **S** | **P** | **P** | **S** | | **S** | | | | | | | | | | |
| *Thunnus alalunga* | | | | | | | | | | | | | | | **P** | **P** | **P** | **P** | **P** | **P** | **P** | P | P | P | P |
| *Merluccius merluccius* | S | | | P | | **S** | **S** | | | **S** | | **P** | **P** | **S** | | | **P** | **P** | | | | | | | |
| *Merlangius merlangus* | P | P | P | S | S | **S** | | | **P** | **S** | | **P** | **S** | **S** | | | **P** | **P** | | | | | | | |
| *Lophius piscatorius* | S | | | P | | | **S** | **S** | | **P** | | **P** | **P** | | **S** | **S** | **P** | **S** | | **S** | | | | | |
| *Nephrops norvegicus* | | | | | | **P** | **P** | **P** | | **P** | **P** | **P** | **P** | **P** | **P** | **P** | **P** | **P** | | | | | | | |
| *Sardina pilchardus* | | | | | | | | | | | | | | | | | P | P | | | | | | | |
| *Pollachius virens* | P | | | P | | S | S | S | | S | S | S | S | S | | S | | | | | | | | | |
| *Melanogrammus aeglefinus* | P | S | | P | | | S | S | | S | S | S | S | S | | | | | | | | | | | |
| *Molva molva* | P | | | P | | | | | | P | S | P | P | | S | | S | | | | | | | | |
| *Lophius budegassa* | S | | | P | | | S | S | | P | | P | P | | S | S | P | S | | S | | | | | |
| *Solea vulgaris* | | | | | | | | P | P | S | S | S | S | | | | P | P | | | | | | | |
| Skates | | | | | | S | | | S | P | | P | P | S | | | P | S | | | | | | | |
| *Maja squinado* | | | | | | | | | | P | | | | | | | | | | | | | | | |
| *Sepia officinalis* | | | | | | | | | C-F | C-F | | | F | | | | C-F | F | | | | | | | |
| *Pectens maximus* | | | | | | | | | P | P | | | | | | | P | | | | | | | | |
| *Lamaria* spp. | | | | | | | | | | P | | | | | | | | | | | | | | | |
| *Venerupis rhoboides* | | | | | | | | | | P | | | | | | | | | | | | | | | |
| *Glycymeris glycymeris* | | | | | | | | | | P | | | | | | | P | | | | | | | | |
| *Spisula* spp. | | | | | | | | | | P | | | | | | | P | | | | | | | | |

[a] P = Principal fishing area, S = Secondary fishing area, C = Coastal fishery, F = Offshore fishery.

The fleet-specific discard rates (the percent of the total catch that was discarded) came from three studies that focused on various gear types in one or both ICES areas. Pérez *et al.* (1996) calculated discard rates of all species in catch samples from Spanish demersal trawlers and longliners in area VII, and demersal trawlers, longliners, purse seiners, and gillnets in area VIII. Morizur *et al.* (1996a) calculated discard rates from various pelagic trawls, mostly in area VIII, and some in area VII as well. Morizur *et al.* (1996b) gave the number of individuals caught and discarded per length class for French coastal demersal trawls, offshore demersal trawls, and gillnets in area VII. The mean body weight of individuals ($W_i$) of each length-class ($L_i$) was calculated, after Beyer (1987), as:

$$W_i = \frac{1}{L_{i+1} - L_i} * \frac{a}{b+1} * \left( {L_{i+1}}^{b+1} - {L_i}^{b+1} \right) \quad ...1)$$

where $W_i$ is weight, $L_i$ is total length, and $a$ and $b$ are parameters of a length-weight relationship of the form $W=aL^b$. For species that were caught in very small numbers and for which we had no length distribution, we assumed weight corresponding to juvenile individuals for the large species and average length for the others (see Appendix 3).

When a discard rate for a given species and fleet in one area was not available, we assumed it to be the same as that from the other area. In cases where a discard rate for a certain species and fleet was not available for either area, we estimated it from that of a species in the same genus, if possible. Otherwise, we calculated the weighted average of discard rates of similar species caught in that fleet and applied it to the species with the missing discard rate. Similarly, discard rates were applied to the 'general' species groups as the weighted average of the known discard rates of species in that group. If more than one study reported a discard rate for a certain species from the same fleet in the same area, then the estimate which we considered most reliable, based on the extent of sampling, was selected instead of the others.

Only species or 'general' groups that were regularly landed (target species) would be properly represented in the estimation of total catch based on landings and discard rates. The actual catch of species that were rarely or never landed (non-target species) could be mis-represented if it were reconstructed from its own landings, so it was therefore linked to the catch of a target species. A species with over 100 tonnes landed annually in either area VII or area VIII was assumed to be a target species in that area. Likewise, any species or 'general' groups with annual landings under 100 tonnes were not considered a target species, but a by-catch of a fishery targeting another species. Species were separated into target and non-target species in order to properly estimate catch.

For target species, we reconstructed their actual catch (before discards) by fleet and area based on their landings in that area, the allocation of the catch among different fleets, and discard rates, as:

$$C_{sfa} = \frac{L_{sa} * \%allocation_f}{1 - \%discard_{sfa}} \quad ...2)$$

where $C_{sfa}$ is catch and $L_{sa}$ is landings for the target species $s$ by fleet $f$ in area $a$. To calculate the estimated discards by species, fleet, and area, we multiplied the total catch by the % discard rate. In order to verify our calculations, actual landings were compared to our estimated landings (catch minus discards). For all target species in each area, the sum of estimated landings of all fleets was equal to the ICES landings data.

The small landings of non-target species may have yielded unrealistic extrapolations of estimated catch if it had been reconstructed from landings. Instead, the estimated catch of non-target species in each fleet and area was linked to the estimated catch of a main target species in that fleet and area. The catch ratio (before discards) between these non-target species and the main target species was taken from two sampling studies of the catch of different fleets. In other words, the ratio of non-target species $a$ catch to target species $b$ catch taken by an entire French fleet in one area should be the same ratio as non-target species $a$ catch to target species $b$ catch in a sampling study for the same fleet and area. Thus, catch of non-target species $C_{nfa}$ was estimated as:

$$C_{nfa}\,estimated = C_{sfa}\,estimated * \frac{C_{nfa}\,sampled}{C_{sfa}\,sampled} \quad ...3)$$

where $n$ is a non-target species and $s$ is the main target species for that fleet and area. From the sampling study by Pérez *et al.* (1996), we used the following target species to link our estimated catch of non-target species: hake (*Merluccius merluccius*), for coastal demersal trawls, offshore demersal trawls, and longlines in both areas VII and VIII; anglerfish (*Lophius piscatorius*), for gillnets in area VIII (and applied to area VII also); and sardine (*Sardina pilchardus*), for purse seines in area VIII (and applied to area VII also). From Morizur *et al.*

(1996a), we used these target species: European seabass (*Dicentrarchus labrax*), for pelagic trawls in area VII, and European anchovy (*Engraulis encrasicolus*), for pelagic trawls in area VIII. We also applied this catch-linking method to discarded species that do not occur on the ICES list because they are seldom landed, but are known to be caught in areas VII and VIII. We did not link the catch of non-target species to target species in the 'pole and line' or 'other coastal gears' fleets because no catch ratio information was available for these fleets. However, as we consider these gear types to be more species-specific, the number of non-target species caught by these fleets is probably very low.

We calculated the estimated discards of non-target species by fleet and area by applying discard rates to their estimated catch. We then compared the sum of estimated landings (catch minus discards) of all fleets to the ICES landings data for that species in that area. As the estimated catch of a non-target species was linked rather than reconstructed from its own landings, we do not expect the estimated landings to be exactly the same as the ICES data. However, estimated landings were not unreasonable for any species when compared to the ICES data.

### ESTIMATED CATCH AND DISCARDS BY FLEET, AREA, AND SPECIES

Under our proportional fleet allocation (Appendix 2) and discard rate regimes, our reconstruction predicts a total annual catch (1996-1998) for all French fleets combined of 646,685 tonnes in area VII and 176,842 tonnes in area VIII. We estimate that total discards were 117,001 tonnes (18.1%) in area VII and 37,190 tonnes (21.0%) in area VIII. The resulting estimated landings (529,684 tonnes in area VII and 139,652 tonnes in area VIII) differed by less than 1% from the ICES landings data. It is unlikely that our linking method of reconstructing catches of non-target species led to considerable overestimations of the total catch, as non-target species only made up 1.3% of the total estimated catch in area VII and 5.0% in area VIII.

The landings of algae, groundfish, molluscs, and elasmobranchs were all considerably larger in area VII than in area VIII (Figure 3), but the discard rates were generally similar between areas (Table 2). Small pelagic fish, however, had nearly identical landings between areas but had a greater discard rate in area VII (55.2%) than in area VIII (33.1%). Overall, crustaceans also had higher discard rates in area VII (34.3%) than in area VIII (14.9%). However, this difference seems less when we compare discard rates of lobsters, crabs, shrimps, and other crustaceans separately, due to the large variation among species (Table 2). Conversely, when we compare mollusc groups separately, greater differences in the discard rates of cephalopods between areas VII and VIII are revealed (Table 2). Echinoderms and 'miscellaneous' invertebrates (cnidarians, etc.) are not shown in Figure 3, as their catches were quite low.

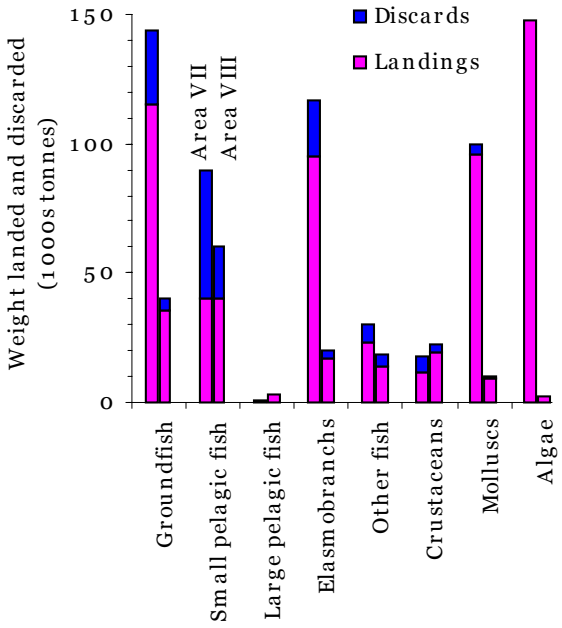


**Figure 3.** Estimated weight of landings and discards of different functional groups by the French fisheries in ICES areas VII and VIII. Estimates are yearly averages from 1996-1998.

The most highly discarded species in terms of weight in both areas VII and VIII was Atlantic horse mackerel (Figure 4). They were particularly high in area VII because 60% of the catch was taken by demersal trawlers in area VII (Appendix 2) that had high discard rates. Excluding algae, this species also had the greatest landings in area VII and the second greatest landings in area VIII, after European anchovy. The second most highly discarded species in both areas was mackerel (*Scomber scombrus*, Figure 4). Other species with high levels of discards included sardines in area VIII, whiting, haddock, and blue whiting in area VII, and crab (*Cancer pagurus*) and pouting (*Trisopterus luscus*) in both areas. Algae are not shown in Figure 4; the green alga *Chondrus crispus* had the highest landings of any species in area VII (93,833 tonnes), with no discards. Species which were only listed by ICES under family names or under 'general' groups are

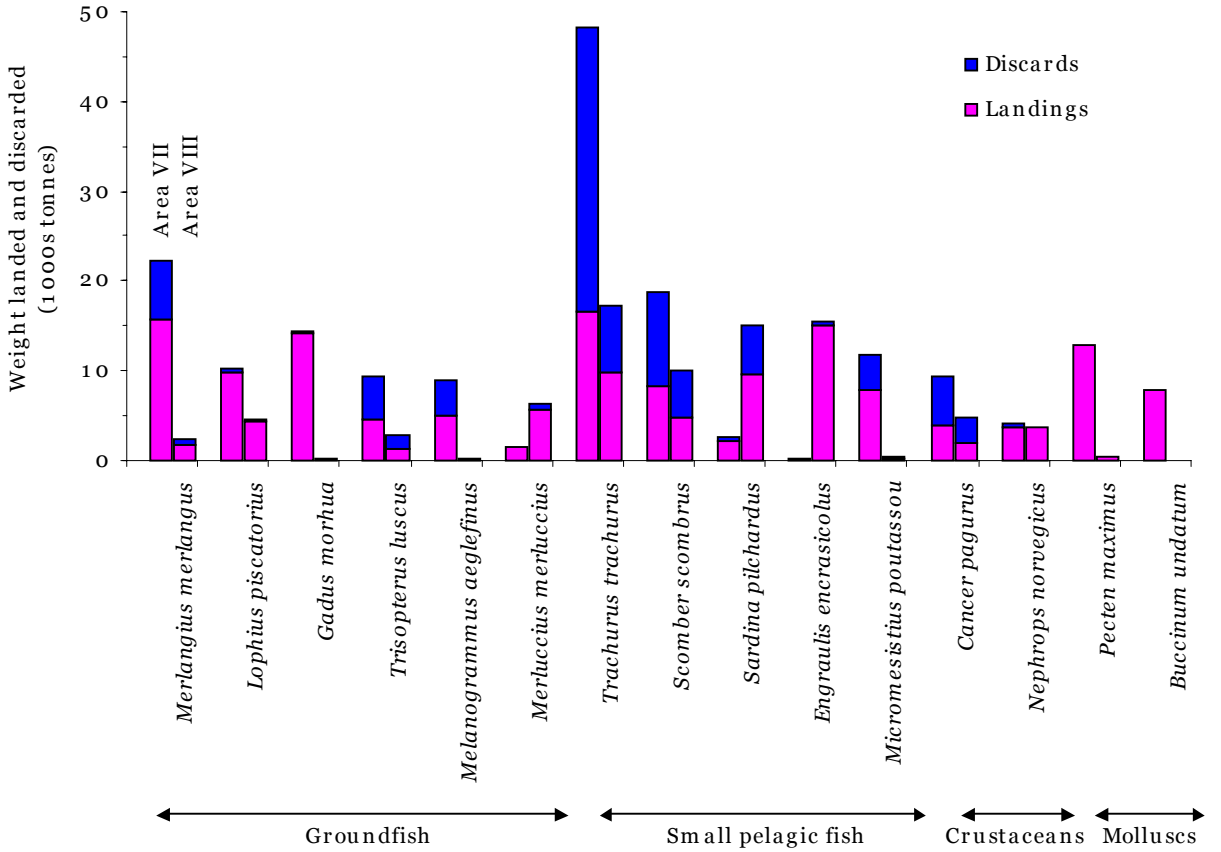


**Figure 4.** Estimated weight of landings and discards of several highly commercial species by the French fisheries in ICES areas VII and VIII. Estimates are yearly averages from 1996-1998.

also not included in this figure. For example, rays (*Raja* spp.) and dogfish had high levels of landings and discards in both areas, but they were not identified to species or were not listed by species. Similarly, Sparidae (seabreams) and Sepiidae (cuttlefish) had high landings in both areas, and Triglidae (searobins) had high discards in both areas.

When the total catch is separated by fleets, again we observe differences in estimated landings and discards between areas and between different fleets (Figure 5). As expected from our proportional fleet allocation, the three trawling fleets had much larger catches than those of purse seines, pole and lines, longlines, or gillnets, especially in area VII (Table 3). Catches from the 'other coastal gears' fleet were also high in area VII, with algae forming 68% of the landings, and crustaceans and molluscs making up most of the rest.

The trawling fleets also had the highest discard rates (Table 3; Figure 5). By itself, Atlantic horse mackerel accounted for a large proportion of the discards by demersal trawlers (29.3% of all coastal demersal trawl discards in area VII, and 27.1% in area VIII; 36.6% of all offshore demersal trawl discards in area VII, and 37.4% in area VIII).

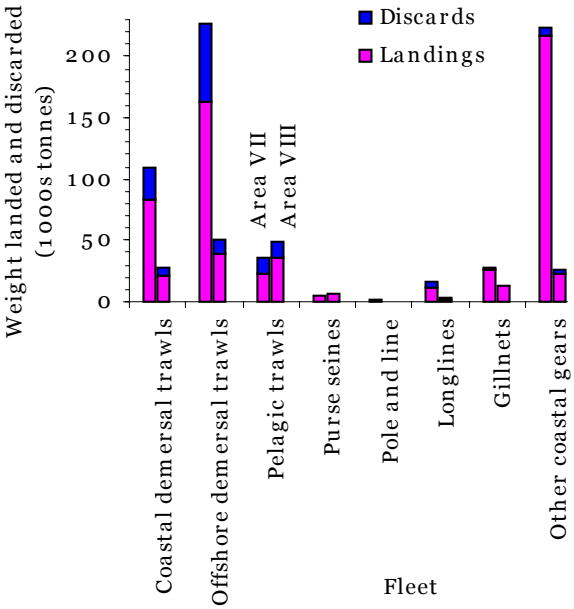


**Figure 5.** Estimated weight of total landings and discards by different French fleets in ICES areas VII and VIII. Landings are averages of species data from 1996-1998 allocated among different fleets. Percent discard rates from Pérez *et al.* (1996) and Morizur *et al.* (1996 a, b) were applied to the species landings data. Estimated total catch by fleet is the sum of landings and discards.

The catches of the coastal and offshore demersal trawling fleets were dominated by elasmobranchs and groundfish (Figure 6). The offshore demersal trawling fleet caught more groundfish and had higher discard rates (24.8% in area VII and 19.5% in area VIII) than the coastal demersal trawling fleet (19.5% in area VII and 16.8% in area VIII). Elasmobranchs (sharks, skates and rays), on the other hand, had similar landings by coastal and offshore demersal trawlers, but the discard rate was higher for coastal (20.7% in area VII and 20.2% in area VIII) than for offshore demersal trawls (11.4% in area VII and 10.3% in area VIII). Small pelagic fish formed a substantial proportion of the total discards from offshore demersal trawls.

Obviously, small pelagic fish were the main catch and discards of pelagic trawls (Figure 6), and were much less in pelagic trawls (33.3% in area VII and 26.8% in area VIII) than they were in coastal demersal trawls (83.1% in area VII and 84.0% in area VIII) or offshore demersal trawls (72.0% in area VII and 76.9% in area VIII). Mackerel made up 33.0% of all pelagic trawl discards in area VII, while sardines made up 41.7 % of pelagic trawl discards in area VIII. Most of the groundfish, elasmobranchs, and 'other' fish caught by pelagic trawls in area VII were discarded (72.7%, with balck seabream [*Spondyliosoma cantharus*] forming most of the total discard), while only 20.0% were discarded in area VIII.

Overall discard rates were also high for longlines (Table 3) due to the large discard of elasmobranchs (50.0% in area VII and 40.0% in area VIII). Conversely, overall discard rates were much lower for purse seines, pole and lines, gill nets, and 'other coastal gears' (Table 3; Figure 5). The discard rate for gillnets and 'other coastal gears' is even lower if we exclude crabs, of which smaller body sizes were discarded. Crabs accounted for 30.9% of all gillnet discards in area VII and 23.0% in area VIII, as well as 88.7% of all 'other coastal gears' discards in area VII and 93.9% in area VIII.

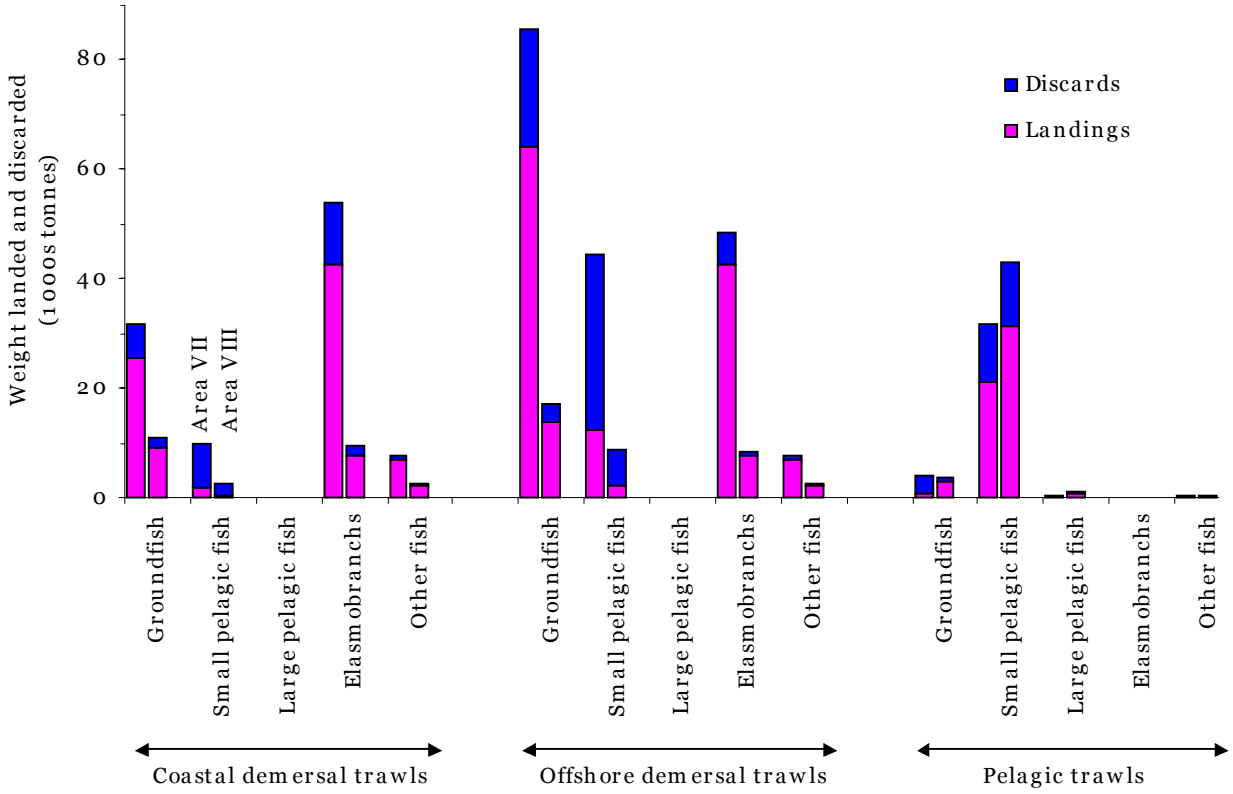


**Figure 6.** Estimated weight of landings and discards of different fish groups by the French trawling fleets in ICES areas VII and VIII. Estimates are yearly averages from 1996-1998.

**Table 2.** Reconstructed annual catch and overall discard rate of various species groups caught in the French fisheries (all fleets combined) between 1996-1998 in ICES areas VII and VIII.

| Species group | Estimated catch (t) | | % of catch discarded | |
|---|---|---|---|---|
| | Area VII | Area VIII | Area VII | Area VIII |
| **Fish** | 380,948 | 141,675 | 28.0 | 23.0 |
| Groundfish/demersals | 143,444 | 40,552 | 19.9 | 12.1 |
| Small pelagics | 89,882 | 59,926 | 55.2 | 33.1 |
| Large pelagics | 712 | 3,104 | 0.8 | 8.1 |
| Sharks/skates/rays | 116,406 | 19,753 | 18.4 | 15.6 |
| Anadromous (mostly eels) | 68 | 6,325 | 1.3 | 1.3 |
| Other or 'general' fish | 30,436 | 12,015 | 22.9 | 37.5 |
| **Crustaceans** | 17,924 | 22,648 | 34.3 | 14.9 |
| Lobsters | 4,715 | 4,341 | 10.1 | 5.7 |
| Crabs | 12,689 | 5,621 | 44.5 | 50.2 |
| Shrimp | 73 | 435 | 0.3 | 0.1 |
| Other or 'general' crustaceans | 447 | 12,251 | 4.5 | 2.4 |
| **Molluscs** | 100,123 | 9,775 | 4.1 | 7.0 |
| Bivalves | 20,698 | 819 | 0.0 | 0.4 |
| Cephalopods | 14,951 | 5,835 | 18.9 | 9.4 |
| Other or 'general' molluscs | 64,475 | 3,120 | 2.0 | 4.1 |
| **Echinoderms** | 82 | 188 | 100.0 | 96.5 |
| **Algae** | 147,505 | 2,247 | 0.0 | 0.0 |
| **Cnidarians and other animals** | 103 | 310 | 100.0 | 100.0 |

**Table 3**. Reconstructed annual catch and overall discard rate of different French fleets (all species combined) between 1996-1998 in ICES areas VII and VIII.

| Fleet | Estimated catch (t) | | % of catch discarded | |
|---|---|---|---|---|
| | Area VII | Area VIII | Area VII | Area VIII |
| Coastal demersal trawls | 109,818 | 27,600 | 24.4 | 24.6 |
| Offshore demersal trawls | 225,986 | 50,794 | 28.1 | 24.2 |
| Pelagic trawls | 36,335 | 48,177 | 37.7 | 26.3 |
| Purse seines | 5,194 | 7,176 | 8.8 | 12.9 |
| Pole and line | 1,720 | 775 | 0.0 | 0.0 |
| Longlines | 16,013 | 2,456 | 33.5 | 27.3 |
| Gillnets | 28,458 | 13,807 | 6.1 | 8.6 |
| Other coastal gears | 223,161 | 26,057 | 2.5 | 10.1 |

## POSSIBLE SOURCES OF ERROR IN THE RECONSTRUCTION OF TOTAL CATCH

The estimated weight of discards and catch that we reconstructed from species landings depend directly on the proportional allocation of the catch to each fleet, and on the percent discard rate of each species within each fleet. Alternate fleet allocation regimes would change our estimated catch and discards. Allocating too much of the catch to fleets with higher discard rates would result in overestimating discard estimates. Further, the discard rates that we assumed from the catch sample studies may not be representative of the entire French fleets as a result of different fishing grounds, fishing tactics, or seasonal fishing variations. If the discard rate for a given species, fleet and area from the sampling studies is higher than the actual rate of the fleet that landed that species in that area, then the total discard weight would likely be overestimated. Finally, we have not attempted to correct for unreported catches, only for discarded catch. The total catch and landings are therefore likely somewhat higher than what we have estimated.

## ACKNOWLEDGEMENTS

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## APPENDIX 1

### EARLIER FISHING ACTIVITY - FLEET DESCRIPTION

The description of French fleets are based on the records of the merchant navy and edited each year in annual reports of the Direction of Maritimes Fisheries, from the end of last century to 1979. From 1950 to 1958 they present the number of ships, propulsion type, region, tonnage classes, and tonnage and total power per type of propulsion. From 1959 to 1979, they present the number of ships, gear type, region, and tonnage and total power per gear type. For 1986-1987, they present tonnage, number and power (HP) of ships, region, and length class. The IFREMER inspectors network also collects information about fishing activity (gear type, zone and fishing time) by using logbooks. All the data were integrated together, but because of imprecision in each source, it is not possible to link the fleets with the fishing areas.

The second data set comes from the appendices from the Marine Fisheries Institute (Guillou and Njock, 1978), which resulted in a file integrating the numbers of ship per region and weight class for ships of Atlantic ports fishing in the North-east Atlantic, and a second file listing the fishing effort of ships related to Atlantic ports (trawlers per ICES zone in days and HP, other ships in month*ships).

### FISHING EFFORT

Effort data were available by region, vessels and hours and is broken down by tonnage class and gear type for the period 1961-1975. The first suggested unit to measure standard fishing effort of all the ships was horse power (HP). This unit, chosen by Europe to regulate the development of the fleets requires, however, according to the data available, a key of conversion for power by gear and class of tonnage. The day*HP does not really consider effort of ships not using trawlers (gill net effort, for example, is quantified more rigorously by the mileage of nets employed). Fishers change gear often, according to fish availability in the sea within a fishing season. Due to its mixed gear nature, effort for the fleet was characterized by number of ships by tonnage class for each portion of the month using one specific gear (Guillou and Njock, 1978). The effort developed by these fleets is thus quantified in months (number of month during which the boats used the gear each year), or in boats (crew members of the virtual fleet).

In absence of conversion data, we used published results to allocate effort in the Northeast Atlantic from 1961-1975. Trawlers effort (in day*HP) were

already attributed to ICES fishing zones, while other ships effort (in month*boat) have been attributed to a zone, based on the bibliography available according to the following criteria. For most ships, the allocation of effort by zone was obtained from Guillou and Njock (1978). Effort of ships of less than 25 GRT have been attributed to the zone based on the species targeted or the gear type. As tuna 'germon' is fished during its migration from zone IX to zone VII, tuna boat effort was equally apportioned to the two zones. Because of the migratory and gregarious nature of tuna, the fishing activity includes long searching periods and considerable mobility. Thus the proportion of captures and effort may vary considerably among years and fishing zones.

The trawlers total effort vary among Atlantic ports and ICES zones (Figure 1.1) with areas VII and VIII having the largest effort compared to areas IV and VI. Effort increased continuously from 1962 to 1975. During this period, trawlers were probably the most important fleet in French fisheries. However, some other gear type, such as dredges, gillnets, tremaille, longlines and various types of traps were also used in French fishery. These gears effort seem to have remained constant during the study period (Figure 1.2).

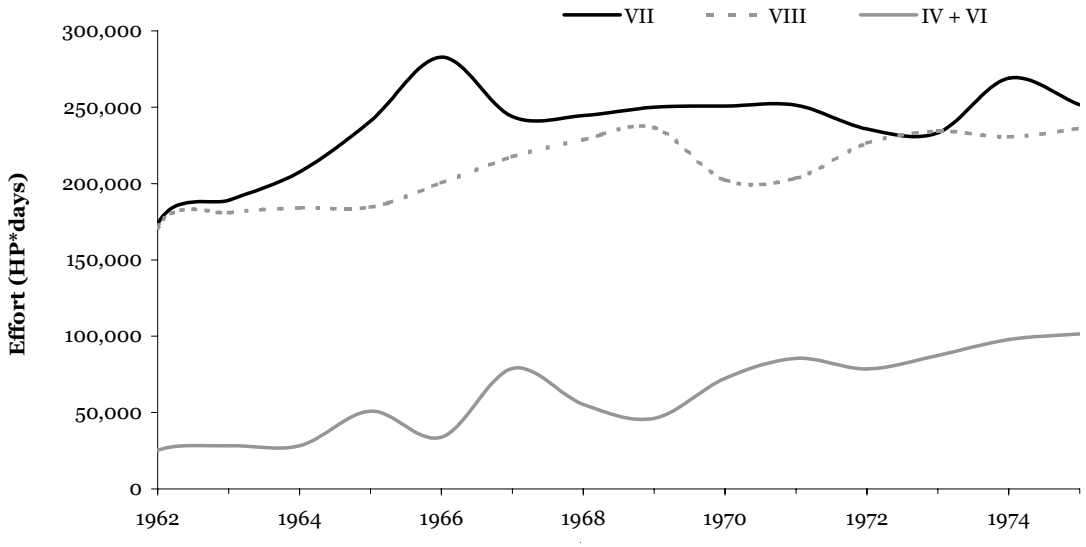


**Figure 1.1.** Total fishing effort of French trawlers in ICES areas IV, VI, VII and VIII from 1962 – 1975.

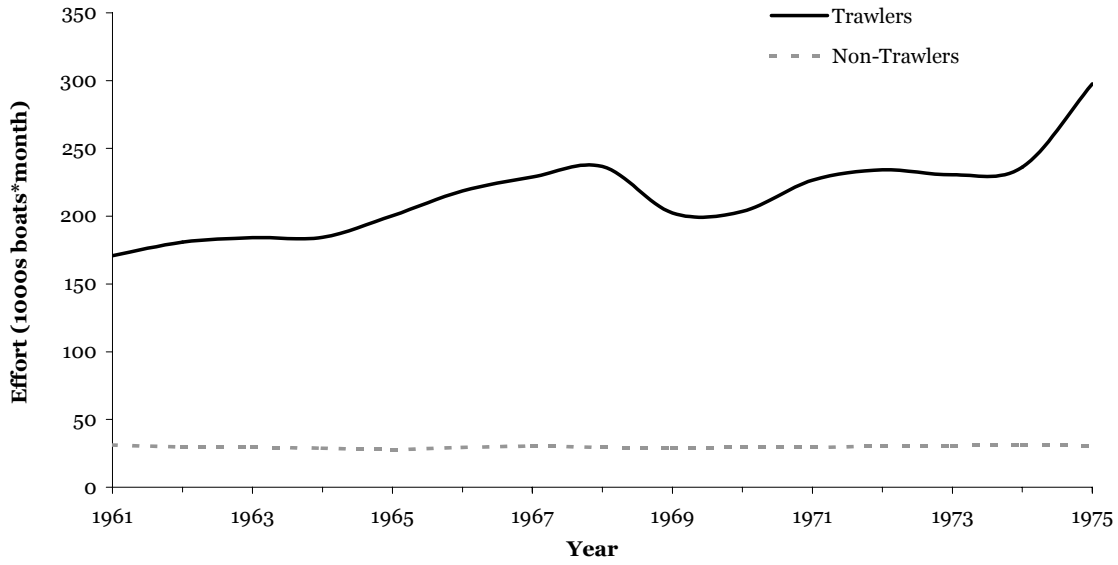


**Figure 1.2.** Fishing effort in ICES area VIII for trawlers and non-trawler fleets, from 1961 - 1975.

## APPENDIX 2

The proportional fleet allocations of the total catch of individual species and larger taxonomic groups are listed in Table 2.1, for area VII, and Table 2.2, for area VIII.

**Table 2.1.** Fleet allocation for French catches in ICES area VII (all figures in %).

| Species / taxonomic group | Coastal demersal trawls | Offshore demersal trawls | Long-line | Gill-net | Pole and line | Other coastal | Purse seine | Pelagic trawls |
|---|---|---|---|---|---|---|---|---|
| Fish | | | | | | | | |
| Groundfish/demersals | | | | | | | | |
| *Merluccius merluccius* | 10 | 45 | 35 | 10 | - | - | - | - |
| *Spondyliosoma cantharus* | 20 | 15 | 5 | | - | - | - | 60 |
| *Dicentrarchus labrax* | 5 | 10 | 10 | 15 | - | - | - | 60 |
| *Solea solea/vulgaris* | 60 | 30 | - | 10 | - | - | - | - |
| *Pollachius pollachius* | 15 | 65 | 5 | 15 | - | - | - | - |
| *Merlangius merlangus* | 10 | 90 | - | - | - | - | - | - |
| *Gadus morhua* and other cods | 10 | 69 | 1 | 10 | 10 | - | - | - |
| *Lepidorhombus whiffiagonis* | - | 100 | - | - | - | - | - | - |
| *Lophius piscatorius* | 10 | 60 | 30 | - | - | - | - | - |
| *Melanogrammus aeglefinus* | | 100 | - | - | - | - | - | - |
| *Trisopterus luscus* | 10 | 90 | - | - | - | - | - | - |
| Other groundfish | 35 | 35 | 4 | 25 | - | 1 | - | - |
| Small pelagics | | | | | | | | |
| *Engraulis encrasicolus* | - | - | - | - | - | - | 10 | 90 |
| *Sardina pilchardus* | - | - | - | - | - | - | 90 | 10 |
| *Trachurus trachurus* | 10 | 50 | - | - | - | - | - | 40 |
| *Micromesistius poutassou* | - | - | - | - | - | - | - | 100 |
| *Scomber scombrus* | - | 50 | - | - | - | - | - | 50 |
| Other small pelagics | - | - | - | 10 | - | - | 45 | 45 |
| Large pelagics | | | | | | | | |
| *Xiphias gladius* | - | - | 100 | - | - | - | - | - |
| Tunas and other large pelagics | - | - | - | 34 | 33 | - | - | 33 |
| Other mackerels, tunas, bonitos | - | - | - | 10 | 10 | - | 40 | 40 |
| Sharks, skates, and rays | 45 | 45 | 5 | 5 | - | - | - | - |
| Anadromous fishes (mostly eels) | - | - | - | - | - | 100 | - | - |
| Other Perciformes | 30 | 30 | - | 20 | - | 20 | - | - |
| Miscellaneous marine fishes | 20 | 20 | - | - | - | 20 | 20 | 20 |
| Crustaceans | | | | | | | | |
| Lobsters | - | 50 | - | - | - | 50 | - | - |
| Crabs | - | - | - | 10 | - | 90 | - | - |
| Shrimp | 20 | - | - | - | - | 80 | - | - |
| Other crustaceans | - | 50 | - | - | - | 50 | - | - |
| Molluscs | | | | | | | | |
| Bivalves | 5 | - | - | - | - | 95 | - | - |
| Cephalopods | 40 | 50 | - | - | - | 10 | - | - |
| Other molluscs | 5 | - | - | - | - | 95 | - | - |
| Echinoderms | - | - | - | - | - | 100 | - | - |
| Algae | - | - | - | - | - | 100 | - | - |

**Table 2.2**. Fleet allocation for French catches in ICES area VIII (all figures in %).

| Species / taxonomic group | Coastal demersal trawls | Offshore demersal trawls | Long-line | Gillnet | Pole and line | Other coastal | Purse seine | Pelagic trawls |
|---|---|---|---|---|---|---|---|---|
| Fish | | | | | | | | |
| Groundfish/demersals | | | | | | | | - |
| *Merluccius merluccius* | 30 | 25 | 5 | 10 | - | - | - | 30 |
| *Spondyliosoma cantharus* | 30 | 20 | - | - | - | - | - | 50 |
| *Dicentrarchus labrax* | 5 | 5 | 10 | 20 | 10 | - | - | 50 |
| *Solea solea/vulgaris* | 30 | - | - | 70 | - | - | - | - |
| *Pollachius pollachius* | 10 | 40 | - | 40 | 10 | - | - | - |
| *Merlangius merlangus* | 10 | 60 | - | - | - | - | - | 30 |
| *Gadus morhua* and other cods | 10 | 85 | - | 5 | - | - | - | - |
| *Lepidorhombus whiffiagonis* | - | 100 | - | - | - | - | - | - |
| *Lophius piscatorius* | 10 | 80 | - | 10 | - | - | - | - |
| *Melanogrammus aeglefinus* | - | 100 | - | - | - | - | - | - |
| *Trisopterus luscus* | 20 | 80 | - | - | - | - | - | - |
| Other groundfish | 35 | 35 | 4 | 25 | - | 1 | - | - |
| Small pelagics | | | | | | | | |
| *Engraulis encrasicolus* | - | - | - | - | - | - | 10 | 90 |
| *Sardina pilchardus* | - | - | - | - | - | - | 40 | 60 |
| *Trachurus trachurus* | 4 | 10 | - | - | - | - | - | 86 |
| *Micromesistius poutassou* | - | 50 | - | - | - | - | - | 50 |
| *Scomber scombrus* | - | 20 | - | - | 5 | - | 5 | 70 |
| Other small pelagics | - | - | - | 10 | - | - | 45 | 45 |
| Large pelagics | | | | | | | | |
| *Xiphias gladius* | - | - | 10 | 60 | - | - | - | 30 |
| Tunas and other large pelagics | - | - | - | 60 | 10 | - | - | 30 |
| Other mackerels, tunas, bonitos | - | - | - | 10 | 10 | - | 40 | 40 |
| Sharks, skates, and rays | 45 | 45 | 5 | 5 | - | - | - | - |
| Anadromous fishes (mostly eels) | - | - | - | - | - | 100 | - | - |
| Other Perciformes spp. | 30 | 30 | - | 20 | - | 20 | - | - |
| Miscellaneous marine fishes | 20 | 20 | - | - | - | 20 | 20 | 20 |
| Crustaceans | | | | | | | | |
| Lobsters | - | 50 | - | - | - | 50 | - | - |
| Crabs | - | - | - | 10 | - | 90 | - | - |
| Shrimp | - | - | - | - | - | 100 | - | - |
| Other crustaceans | - | 50 | - | - | - | 50 | - | - |
| Molluscs | | | | | | | | |
| Bivalves | 2 | - | - | - | - | 98 | - | - |
| Cephalopods | 30 | 70 | - | - | - | - | - | - |
| Other molluscs | 2 | - | - | - | - | 98 | - | - |
| Echinoderms | - | - | - | - | - | 100 | - | - |
| Algae | - | - | - | - | - | 100 | - | - |

## APPENDIX 3

Table 3.1. Outline of the method used to calculate weights of discards for species for which the generic length-weight relationships described in the text were not employed.

**Table 3.1.** Method used to assign weight to discards of species for which the generic length-weight relationships described in the text were not employed.

| | | | | | Length-weight parameters used | | | |
|---|---|---|---|---|---|---|---|---|
| **Species** | **Max length (cm)** | **Mean length (cm)** | **Max weight (kg)** | **Mean weight (kg)** | **a** | **b** | **Source** | **Note** |
| *Palinurus elephas* | - | - | - | - | 0.00056 | 3 | Data for *Scyllarus latus*, Mediterranean locust lobster (Anon., 1998) | 2% (in numbers) was discarded, we assumed they were small specimens which led to negligible weight |
| Spider crab | - | - | - | - | 0.79464 | 3.2754 | Based on Tanner crabs in Alaska (Clark *et al.*, 1999) | Based on length structure of discards |
| *Conger conger* | 300 | - | 110 | - | 0.0006 | 3.22 | Fishbase[a)] | Assumed that fish discarded were small, 1 kg on average |
| *Labrus bergylta* | 60 | 16.5 -47.5 | 4.35 | - | 0.0119 | 3.115 | Fishbase[a)] | Assumed discarded fish are on average 10 cm long (13.59 g) |
| *Loligo vulgaris* | - | - | - | 0.5 | | | | Mean weight based on the lower range of Azores catches (Martins, 1982) |
| *Microchirius variegatus* | - | - | - | - | 0.0089 | 3.079 | (Morizur *et al.*, 1996b) | Based on length structure of discards |
| *Squalus acanthias* | 160 | 90 | 9.1 | - | 0.01 | 3 | Fishbase[a)] | Based on length structure of discards |
| *Spondyliosoma cantharus* | 60 | - | - | - | 0.01 | 3.14 | Fishbase[a)] | Based on length structure of discards |
| *Cancer pagurus* | - | - | - | - | 7.9E-05 | 3.27 | | Based on length structure of discards |

[a)] see *www.fishbase.org*