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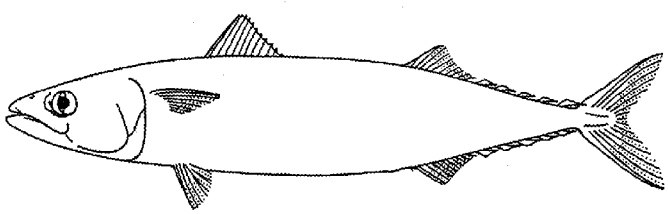
ICES-FishMap

Mackerel	*Scomber scombrus* Family Scombridae	Max size: 66 cm Max age: 17 years



Introduction

Taxonomy: Mackerel *Scomber scombrus* Linnaeus, 1758 (Order: Perciformes, Family: Scombridae) is one of two members of the genus in north-west European seas [1]. Spanish mackerel *Scomber japonicus* is a more oceanic species inhabiting waters further south and is reported only occasionally from the North Sea area.

common names			
Danish	Makrel	*Icelandic*	Makríll
Dutch	Makreel	*Latvian*	Makrele
English	Mackerel	*Norwegian*	Makrell
Estonian	Makrell	*Polish*	Makrela
Faroese	Makrelur	*Portuguese*	Cavalla / Sarda
Finnish	Makrilli	*Russian*	Скумбрия
French	Maquereau commun	*Spanish*	Caballa
German	Makrele	*Swedish*	Makrill

General: Mackerel, like most scombrids, are highly-streamlined, fast-swimming, pelagic fish, and they are widespread in shelf seas of the North Atlantic, usually at depths of less than 200 m. They are a classic shoaling fish, with shoals of up to 9 km long, 4 km wide, and 40 m deep being reported [2]. Mackerel is caught in large quantities with purse seines and large pelagic trawls, but is also rewarded by anglers as a sporting fish. Having no swim bladder, even dense schools do not show up clearly on echo sounders.

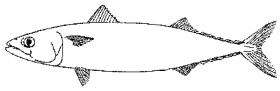
Minimum Landing Size: 30 cm in the North Sea; 20 cm in the Skagerrak.

Distribution

Biogeographical distribution: Wide-ranging pelagic species, distributed from North-west Africa to Iceland and northern Norway in the eastern North Atlantic, including the Black Sea, Mediterranean and western Baltic, and from North Carolina to Labrador in the western North Atlantic [1].

Typically epipelagic species, though sometimes occurring near the bottom. Mainly caught in shelf seas and along the shelf edge in waters of 15-200 m depth [1], but may move into inshore waters during summer.

Mackerel | *Scomber scombrus* Family Scombridae



Spatial distribution in North Sea: Mackerel are widespread throughout the North Sea. During winter, both immature and mature mackerel tend to be more abundant along the edges of the continental shelf and the Norwegian Deeps as well as in the central parts of the North Sea (Fig. 1). Densities increase during the summer [3], when mackerel enter the Southern Bight through the Channel and the northern North Sea around Scotland.

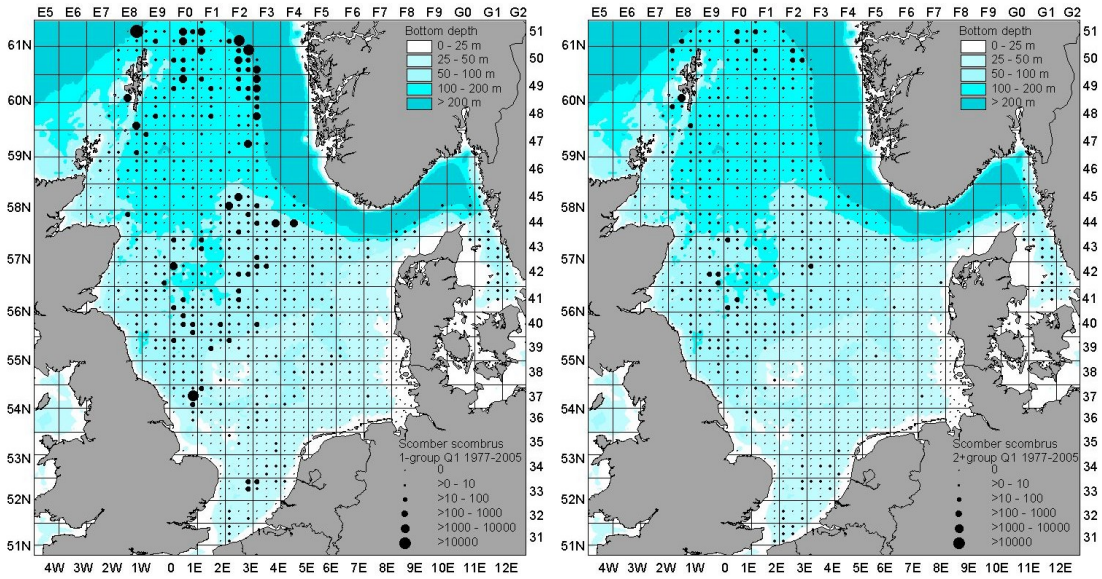


Figure 1. Average annual catch rate (number per hour fishing) for 1-group and 2^{+}-group mackerel in the quarter 1 IBTS survey, 1977–2005.

Habitat characteristics: Mackerel make extensive annual migrations, and their distribution is likely to be affected by a variety of hydrographical features as well as the abundance and composition of zooplankton and other prey species [4,5]. Mackerel in the western North Atlantic are reported to prefer waters of between 5 and 16ºC [6], but are found during summer at considerably higher temperatures on the eastern side.

Life history

Age, growth rates, longevity, length-weight relationship: Mackerel grow to a maximum length of 66 cm, though fish >50 cm are uncommon. Growth rates are difficult to determine from catches, because schools are sorted by size and their mobility prevents representative sampling [7]. Recent estimates [8] of length, weight and proportion of catch at numbers by age (%) for mackerel in the North Sea (IV), and for the North East Atlantic (NEA) as a whole are given in Table 1. The mean length and proportion mature at age, as observed in IBTS surveys are illustrated in Figure 2.

The following relationship between weight (W) and total length (L) has been reported [9]: $W = 0.00381 * L^{3.21}$

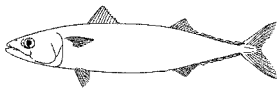


Table 1. Estimates of length (cm), weight (g) and proportion of catch at numbers by age (%) for mackerel in the North Sea, and for the North East Atlantic as a whole [adapted from 8].

	Length		Weight		Proportion of catch	
Age	IV	NEA	IV	NEA	IV	NEA
0	23.4	22.0	103	81	1	1
1	27.4	27.7	166	170	18	11
2	31.2	31.5	257	269	17	16
3	34.2	33.8	357	337	6	5
4	35.2	35.1	404	388	14	17
5	34.7	36.6	388	440	13	14
6	34.5	37.4	385	478	13	11
7	37.6	38.5	503	525	6	8
8	39.6	39.6	612	576	3	6
9	40.1	40.3	617	617	2	4
10	41.0	40.7	669	637	2	3
11	40.8	41.1	639	654	1	2
12	42.4	41.5	708	685	1	1
13	41.0	42.0	651	731	1	<1
14	42.3	42.4	708	744	1	<1
15	40.8	43.2	671	780	1	<1

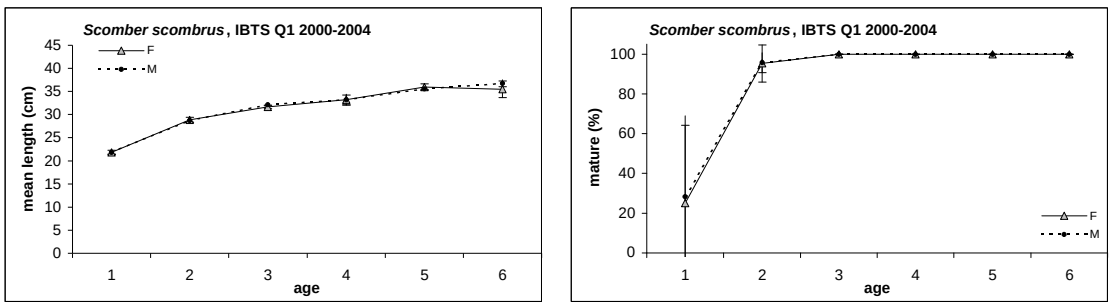
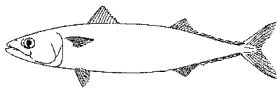


Figure 2. Mean length (left) and proportion mature (right) at age for mackerel in the North Sea and Skagerrak/Kattegat, based on IBTS data 2000–2004

Reproduction: Mackerel are batch spawners, females shedding their eggs in some twenty batches during the course of the spawning season [10]. The maximum number of ripe eggs for a 30 cm specimen is about 255,000 [10], which, assuming a weight of 200 g [2], is equivalent to 1,275 eggs per gram body weight. Maturity estimates for North-east Atlantic mackerel as a whole indicate that more than half are mature at age 2, with 100% maturity at age 7 [7], although IBTS data indicate that in the North Sea more than 90% have reached maturity at age 2 (Fig. 2). Mackerel spawn between May and July [2,11]. Spawning areas have been variable in the past, but are mainly situated in the central North Sea, with extensions along the southern coast of Norway and in the Skagerrak [12,13]. In 2005, eggs were distributed in a broad band running obliquely from the north English coast to the Norwegian Deeps (Fig. 3) [14].



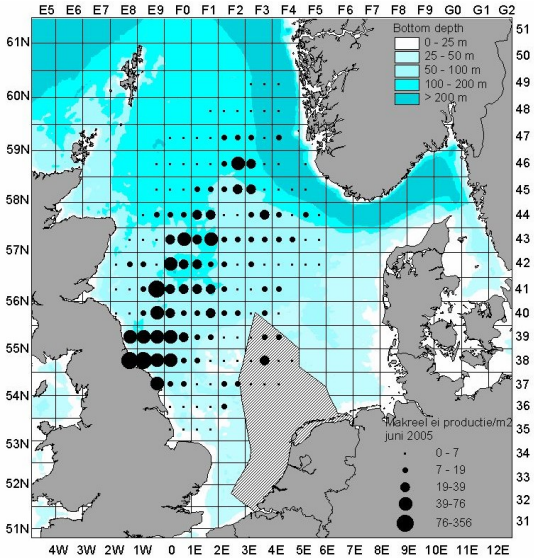


Figure 3. Distribution of stage I mackerel eggs (as number per m^2) during spring 2005 [14].

The eggs are pelagic, 1.0–1.38 mm in diameter, and are usually found in the mixed upper layer, above 26 m [15,16], but have been found to a depth of 60 m [2]. It has been suggested that the adults concentrate in this warmer upper layer during the spawning season [2]. Larvae (<5 mm) are also abundant in the upper layers of the water column, with highest numbers occurring in June and July, at depths of 6-8 m [15].

Migrations: In aquaria, a maximum sustained swimming speed of up to 3.5 body lengths per second has been recorded, which is approximately 4 km/h for a 30 cm fish [17]. Accordingly, the species undertakes long migrations. One tagged specimen of the western stock had travelled approximately 1,200 km in thirteen days when it was recaptured [2]! In the North Sea, mackerel overwinter in deep water along the edge of the continental shelf (i.e. to the north and east of Shetland, and along the edge of the Norwegian Deeps) and, in the spring, adult mackerel migrate south to the spawning areas in the central North Sea (Fig. 4). After spawning, the North Sea stock mixes with immigrants of the western stock on the feeding grounds in the southern Norwegian Sea and the northern North Sea, before returning to their over-wintering areas [2,11,18]. In the south, mostly juveniles immigrate through the Channel during spring to leave the area almost completely in winter. However, it is uncertain whether these individuals found in the southern North Sea, off the coast of Denmark, and along the western and southern coasts of Norway, belong to the North Sea stock and it has been suggested that these nurseries are used by part of the western mackerel stock [19].

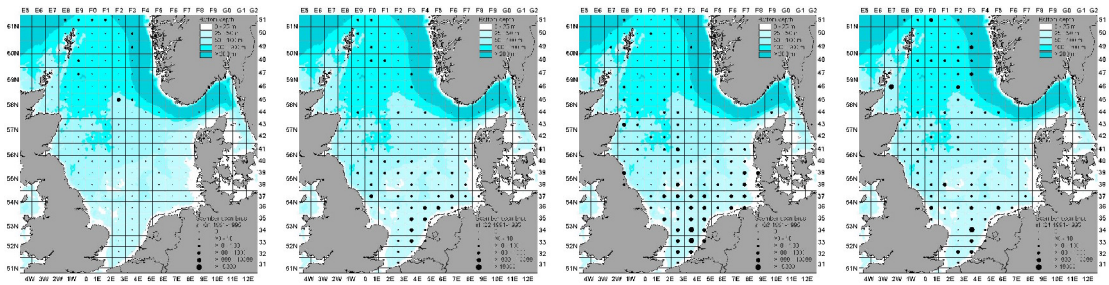
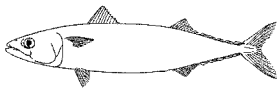


Figure 4. Average quarterly catch rate (number per hour fishing) for mackerel in the IBTS survey, 1991–1995.



Food habits: Mackerel feed on a variety of pelagic crustaceans and small fish, including herring, sprat, sandeel and Norway pout. Feeding patterns vary seasonally and spatially. Mackerel stop feeding almost completely during winter. Euphausids and copepods represent major food items in the north, and fish are the most important prey in the south, especially for larger individuals [20]. Diurnal patterns have also been reported, feeding activity being greatest during the afternoon and until sunset [21].

Predation: Mackerel is an important food resource for larger pelagic predators, including sharks and marine mammals, and are also preyed upon by a variety of sea birds.

Population structure

Age and length composition: Within the North Sea, the majority of mackerel are less than 8 years of age, with a greater proportion of 1 and 2-group fish (<30 cm) in the south, and a dominance of older and larger (30-40 cm) fish in the north.

The length composition of the Skagerrak/Kattegat catches is shifted to the larger size compared to those for the North Sea (Fig. 5).

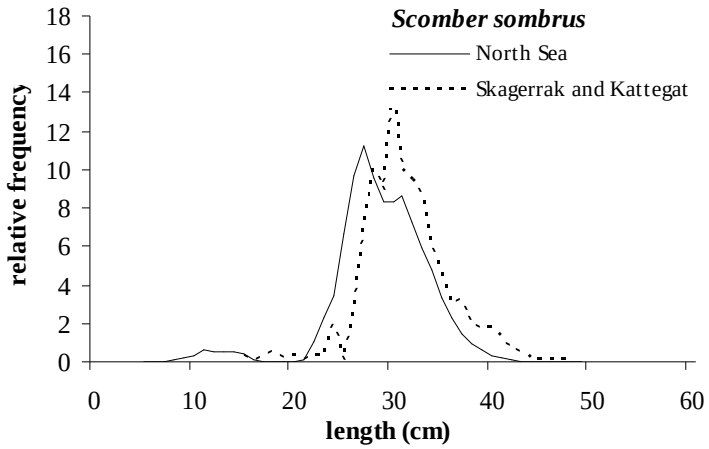
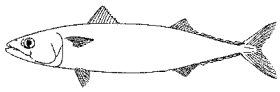


Figure 5. Length-frequency of mackerel caught in IBTS quarter 3 surveys averaged over the years 1985–2005.

Changes in abundance: The North Sea mackerel stock used to be in the order of a few million tonnes, but this stock was decimated in the 1960s and 1970s at the same time when also the herring stock collapsed. While the herring stock recovered after fishing was stopped, this did not happen to the mackerel. However, in the 1980s the western stock changed its migration pattern and increasingly incorporated the northern North Sea and the Norwegian Sea in their summer feeding grounds. Part of the western stock also started to migrate into the southern North Sea. As a consequence of this large-scale mixing, it is difficult to estimate the size of the North Sea stock proper. Although the triennial egg-surveys indicate that the stock is increasing in recent years, it is nowhere near to the original size in the 1950s. Still, the total quantity of mackerel present during summer may be in the same order of magnitude. IBTS data also indicate that overall catch rates are increasing.

Mackerel	*Scomber scombrus* Family Scombridae	

Stock structure: The Northeast Atlantic mackerel stock is currently considered to comprise three main unit stocks (southern, western and North Sea), with variable proportions of these three mixing on the northerly feeding grounds. Although the North Sea spawners form to some extent a discrete unit from the other ones, commercial catches cannot be allocated to individual stocks, and therefore assessments are undertaken for the combined stock.

Exploitation in the North Sea

Main métiers targeting the stock: In the 1960s, the North Sea mackerel stock was mainly targeted by Norwegian purse seiners for reduction purposes. Nowadays, an extensive pelagic trawl fishery (from Scotland in particular) targets mackerel in the northern North Sea, taking advantage of the immigrants of western stock origine. These fisheries exploit the resource throughout the year but peak landings are made in the 3rd quarter (July to September).

Landings: The majority of mackerel landings are from the seas surrounding the Shetland and Orkney Isles, and stretching into the central North Sea. Annual catches rose steeply after the introduction of the purse seine fleet in 1964, but after a record high of 900 000 t in 1967 and a temporary revival in 1973 owing to the strong 1969 year class, catches dropped to an extremely low level in the 1980s [22]. After the mid-1980s, landings have ranged between 200–400 000 t (Fig. 6), but presumably the major part of these comprise representatives of the western stock.

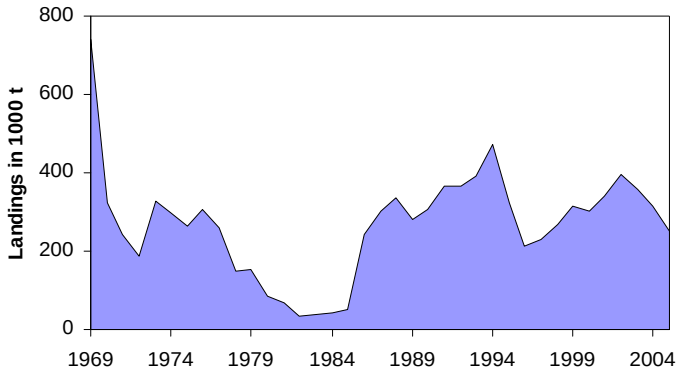
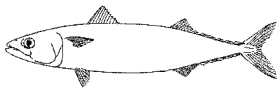


Figure 6: Catch (‘000 t) of mackerel in the North Sea (Subarea IV) and Skagerrak (III) [23].

Spawning Stock Biomass and fishing mortality: The spawning stock biomass of the total North East Atlantic mackerel stock (all units combined) in 2005 has been estimated to be around the precautionary biomass (B_{pa}) of 2.3 million t [23]. Based on the 2005 egg survey, preliminary estimates of the North Sea spawning stock biomass range from 220 000 to 290 000 t [14].

Stock status: The North Sea mackerel stock has been at a very low level for many years as a consequence of extreme overexploitation in the 1960s and 1970s, followed by poor recruitment. Recent ICES advice classifies the stock as being harvested unsustainably [23] and proposed that the limit fishing mortality should not exceed 23 % [23].

Protection and management: To afford protection to the North Sea mackerel stock existing management measures include the prohibition of targeted mackerel fishing in the Skagerrak, central and southern North Sea (divisions IIIa and IVb,c) at any time of year; the prohibition of mackerel fishing in the northern North Sea (division IVa) between 15 February to 31 July, and a minimum landing size of 30 cm [23]. There is also a TAC for the Norwegian Sea (Division IIa) and the North Sea (sub-area IV) combined. The 2006 TAC for North East Atlantic mackerel was 444 000 t.



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