

Introduction

Taxonomy: The spurdog (or spiny or piked dogfish) *Squalus acanthias* Linnaeus, 1758 (Order: Squaliformes, Family: Squalidae) is one of about 10 species withinin the genus, and the sole member of the genus in the North Sea. Squaliform sharks are characterised by the absence of an anal fin and by having spines associated with the dorsal fins.

common names						
Danish	Pighaj	Icelandic	Háfur			
Dutch	Doornhaai	Latvian	Dzeloņhaizivs / Katrāns			
English	Spurdog / Spiny dogfish	Norwegian	Pigghå			
Estonian	Ogahai	Polish	Kolen			
Faeroese	Hávur	Portuguese	Galhudo malhado			
Finnish	Piikkihai	Russian	Катран			
French	Aiguillat commun	Spanish	Mielga / Galludo			
German	Dornhai	Swedish	Pigghaj			

General: Spurdog is one of the more common shark species in the North Sea. At the beginning of the 20th Century it was abundant, and often considered a nuisance by commercial herring fishermen, as they caused damage to the nets and catches. Landings increased rapidly during the late 1950's and early 1960's, though landings have since declined.

Minimum Landing Size: None in EC waters, 70 cm in Norway.

Distribution

Biogeographical distribution: Spurdog occurs worldwide in temperate and boreal waters. It is recorded from the North-West Atlantic (Cuba to Greenland), North-East Atlantic (northern Norway to Morocco, including the Mediterranean and Black Seas), South-West Atlantic (Uruguay and Argentina) and South-East Atlantic (South Africa). Within the Pacific, it is recorded from Chile, New Zealand and southern Australia in the south, and from Japan to Mexico (including the Bering Sea) in the north [1].

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Spurdog occurs throughout the water column along the continental shelf of north-west Europe and has been recorded to depths of 900 m [1]. However, it is most common from 10–200 m [2]. The majority of the landings are from the Norwegian Sea (IIa), Kattegat and Skagerrak (IIIa), North Sea (IV), North-West Scotland (VIa), Irish and Celtic Seas (sub-area VII) and northern Bay of Biscay (VIIIa).

Spatial distribution in the North Sea: Spurdog was formerly widespread and abundant throughout most of the area, but is currently most abundant in the western North Sea and off the Orkney and Shetland (Fig. 1). Large catches of juveniles have been made off Northern Scotland [3]. Tagging experiments have shown that spurdog may migrate all around the British Isles. Thus, the North Sea component is considered to represent part of a much larger stock.



Figure 1. Average annual catch rate (number per hour fishing) for spurdog in the IBTS survey for the years 1977-2005 (all quarters).

Habitat characteristics: Spurdog are demersal and mid-water predators, but little is known about specific habitat requirements [4]. Parturition is supposed to occur in coastal bays [5], and studies in the North-West Atlantic indicate that males tend to occupy deeper, more saline water than females [6] and that the species tends to prefer waters of 7-15°C [7].

Life history

Age, growth rates, longevity, length-weight relationship: Several investigators have used the annuli present on the second dorsal spine for estimating the age and growth parameters for spurdog from the North Atlantic [8,9,10]. Recent tag returns cast doubt on the use of annuli on the spines and caution should be used when utilising age data. According to increments measured from tagged specimens, growth varies between 3.6 cm and 0.1 cm per year [11]. The maximum sizes in the North-East Atlantic are approximately 83 cm and228 cm for males and females respectively. Tag returns indicate a maximum lifespan of over 40 years.



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The following relationships between weight (W) and total length (L) have been reported [12]:

Females (Q1,Q2,Q4):	$W = 0.00108 * L^{3.301}$
Females (Q3):	$W = 0.00595 * L^{2.889}$
Males (Q1-Q4):	$W = 0.00576 * L^{2.890}$

Reproduction: Spurdog is aplacentally viviparous, giving birth to live young that are reliant on yolk reserves during embryonic development [13]. In the North-East Atlantic, female spurdog typically start to mature at 69–73 cm, with 50% of females being mature at 74–83 cm, and males mature at a length of 55-64 cm [5,14,15]. Fecundity increases with size, and maximum estimates range from 16 oocytes to 13 free embryos [14,15]. Studies elsewhere in the world indicate a fecundity, ranging from 1-32 young [16,17]. The gestation period lasts approximately 22–24 months and the sex ratio of pups is about 1:1 [15,16]. The size at birth ranges from 19-30cm, though is typically 26-28cm [14,15]. Off Plymouth the main pupping season (i.e. the period when the females give birth) is from August to December [18].

Migrations: British and Norwegian scientists have tagged spurdog since the late 1950s, with many thousands of fish tagged [19,20,21]. Preliminary examination of the data indicated little mixing between northern waters and southern areas, with the greatest number of recaptures from Scottish and Norwegian waters. Hence, the existence of Scottish-Norwegian and Channel stocks were claimed [19,22,23]. There were, however, a few recaptures from outside the area, including the Barents Sea, west coast of Ireland, English Channel and northern Bay of Biscay [19]. Though fewer fish have been tagged in more southerly areas, fish tagged in the Irish Sea have moved to northern Scotland and the Celtic Sea, and fish tagged in the Celtic Sea were recaptured from all around the British Isles [11]. Changes in the migration patterns of spurdog in the North Sea have also been reported [24]. Hence, the most recent analyses of tagging studies have suggested that there is a single North-East Atlantic stock [11]. Transatlantic migrations have also been reported, albeit very infrequently [25,26].

Food habits: Spurdog is an opportunistic feeder that takes a wide range of predominantly pelagic prey. Important fish prey includes herring, sprat, small gadoids, sandeel, and mackerel, but crustaceans (swimming crabs, hermit crabs and euphausids), squid and ctenophores also represent important prey [27,28].

Predation: Spurdog are predated on by marine mammals and larger sharks, including porbeagle [7], whilst juveniles are also eaten by large teleosts.

Population structure

Age and length composition: No age composition data are available owing to difficulties with ageing.

Spurdog tend to aggregate by sex and size. Specimens between 60-100 cm length dominate the IBTS catches, with neonatal fish represented by the peak at 21-34 cm (Figure 2).



Figure 2. Length-frequency of spurdog caught in the North Sea. Data from the quarter 1 IBTS, 1985–2005.

Sex ratio: Reported sex ratios often differ from 1:1, because spurdog often aggregate in shoals dominated by one sex.

Stock structure: Tagging studies (see above) indicate that there is a single North-East Atlantic stock.

Exploitation in the North Sea

Main métiers targeting the stock: Spurdog is commercially exploited, principally for human consumption, but markets are limited and large parts of the catch may be discarded. It is mainly caught as by-catch in trawl fisheries, especially otter-trawl fisheries, though directed fisheries using gillnets and long-lines operate at certain times of year [29], especially in inshore waters. Spurdog are captured less frequently in beam trawl fisheries, which may be due in part to gear selectivity (specifically the low height of the beam may affect the catch rate of a largely pelagic species), but also most beam trawling activity occurs in the southern North Sea, where spurdog are less abundant.

Landings: Spurdog fisheries peaked in the late 1950's and early 1960's. Elasmobranchs are often landed and reported as a mixture of species. Several species of small dogfishes and sharks occur in the North Sea, and these have often been reported as 'mixed dogfishes and hounds', with no information on the species composition. For spurdog, the most accurate species-specific landings data occur after the fisheries peaked. Annual landings from the North Sea and Skagerrak were in excess of 25,000 tonnes in the 1970's, falling to 10,000 tonnes per year in the 1980's and early 1990's. Landings in recent years have generally been less than 5,000 tonnes per year, and between 1999 and 2003 were lower than the TAC allocated to EU vessels (Fig. 3).



Figure 3. Landings (t) of spurdog in the North Sea and Skagerrak (Source: ICES), with TAC allocated to EU vessels indicated (black line).

Stock status: A low fecundity, coupled with an extremely low growth rate, makes spurdog vulnerable to commercial overexploitation. North Sea landings of spurdog have declined markedly, and the North-East Atlantic stock is considered depleted. The stock biomass is estimated to be at approximately 5% of the biomass after the Second World War [30].

Protection and management: Spurdog in the North Sea are currently managed by quota, with the Total Allowable Catch (TAC) reduced by 87% between 1999 and 2005 (Table 1).

Table 1. TAC (t) for spurdog in the EU waters of the North Sea (IV) and IIa for EC nations and Norway (the Norwegian quota includes long line catches of other shark species in these and adjacent ICES sub-areas).

Year	EC	Norway	Total	EC Regulation No
1999	8870	-	-	1570/1999
2000	8870	(600)	9470	2742/1999
2001	8870	(200)	9070	2848/2000
2002	7100	(200)	7300	2555/2001
2003	5640	(200)	5840	2341/2002
2004	4472	(200)	4672	2287/2003
2005	1136	(100)	1236	27/2005





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