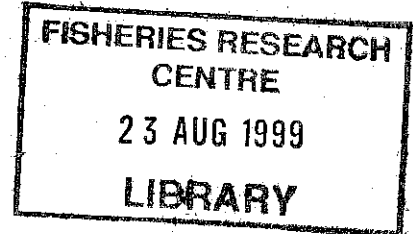
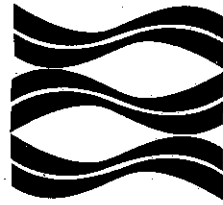


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# Fisheries Bulletin

## No. 11 (1992)



**Roinn na Mara**

**(Department of the Marine)**

**THE WESTERN SPURDOG *SQUALUS ACANTHIAS* L. FISHERY  
IN 1989 AND 1990, WITH OBSERVATIONS ON THE FURTHER  
DEVELOPMENT OF THE GILLNET FISHERY  
DIRECTED ON THE SPECIES**

by

Edward Fahy

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The western spurdog *Squalus acanthias* L. fishery in 1989 and 1990, with observations on the further development of the gillnet fishery directed on the species

by

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### ABSTRACT

Between 1987 and 1990 the western fisheries of spurdog briefly harvested heavy then progressively reduced landings. These were sampled in each year. The peak and post-peak fisheries have been described and this account is of the fishery in 1989 and 1990. Although the catch per effort has declined substantially from the peak fishery spurdog remains an important target species.

The fishery is assessed from 856 individuals captured in 1989 and 688 the following year. The following criteria of sampled fish classified according to method of capture were examined: sex ratio, weight, age and a growth index. Gillnet-caught females are regarded as indicators of the broodstock which shows signs of having made some recovery from its immediate post peak condition.

The Carrigaholt gill net fishery, the index fishery which has been monitored for the four years, exploits a range of species by gill net, spurdog and gadoids being the principal ones to date, and it has increased its fishing capacity over the period. In 1989 and 1990 effort was directed on hake; some characteristics of these landings are given and compared with gill net caught hake from other parts of the country.

### INTRODUCTION

Investigations of the then expanding fishery for spurdog, which was concentrated on the west coast of Ireland commenced in 1987. An account of the peak southwestern fishery and of the post-peak fishery is contained in Fahy (1989a) and Fahy and Gleeson (1990). In 1989, the latest year for which statistics are available, the reported tonnages of spurdogs landed were:

Division VIa	996 tonnes
VIIb, c	530
VIIg, h	41
VIII, k	681
VIIa	233

In division VIa the landings had halved from those in 1987 and they amounted to less than 25% of the peak catch in 1985. Landings in the southwestern fishery were reduced to one third of the total captured in 1987, the peak year for that fishery.

Shark fisheries are vulnerable to over-fishing and their mechanism of recovery is not known. Monitoring of this fishery is maintained, firstly, to ascertain how the stock is responding to continued exploitation and, secondly, to establish how the gill net fishery, the principal method of capture, is adjusting to its depleted target species.

As in previous appraisals, the fishery whose records are used for index purposes is the West Clare Fishermen's Co-operative in Carrigaholt. Collection of spurdog census materials was by student bursars based in Burtonport and Dingle for two months of the year; this is the sampling regime practised since 1988.

### RESULTS

#### *Continued development of the fishery*

Although the tonnage of spurdogs landed at Carrigaholt declined from the peak fishery of 1987 and 1988, and landings, rarely exceeding 50 tonnes per month, were subsequently recorded (during the peak fishery a maximum of 330 tonnes had been recorded in one month and more than 150 tonnes in several) at times of the spring and autumn north-south migrations.

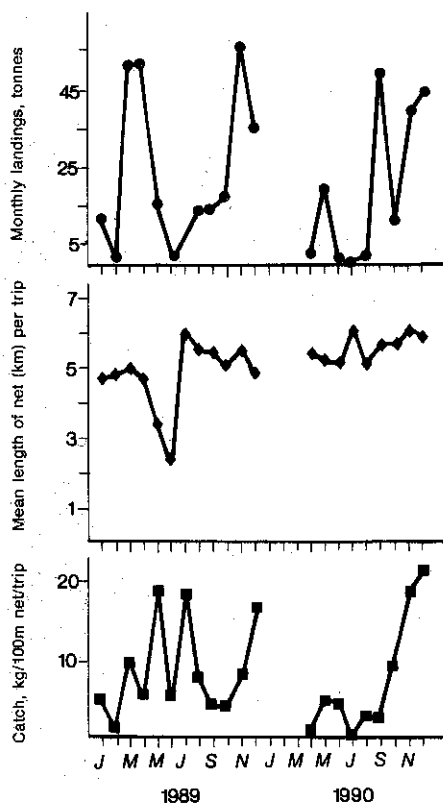


Fig. 1 Details of the Carrigaholt gillnet fishery for spurdog: monthly landings, length of net (km) set per fishing trip and catch (kg per 100 m net per trip).

The fishing effort varied considerably (Fig. 1), from more than 1,000 km of net set in April 1989, to no fishing because of adverse weather conditions in the first three months of the following year. The length of gear carried per vessel stabilized between 5 and 6 km from June 1989, an increase from a maximum of between 4 and 5 km in 1988. Catch per effort fluctuated considerably, although it did not exceed half the maximum recorded in the first year of the fishery.

*Biological characteristics of the landings*

As in the earlier investigations in this series, samples were collected in Burtonport, Co. Donegal (Division VIa) and Dingle, Co. Kerry (Division VIII). Samples were examined on a random basis and the second dorsal spine was removed to the laboratory to be aged.

The main characteristics of the collections in the two years were as follows:

Centre	Method of capture	Sex	1989	1990
Burtonport	Gill net	male	181	194
	Trawl	male	126	76
	Gill net	female	57	113
	Trawl	female	94	21
Dingle	Gill net	male	74	6
	Trawl	male	141	161
	Gill net	female	40	6
	Trawl	female	133	111
Totals			856	688

*Characteristics of spurdogs taken by gill net*

The exploitation of spurdog is particularly associated with gill nets which take individuals of larger size and greater value than do trawls: these fish are more representative of the broodstock than are trawl-caught spurdogs. The Carrigaholt gill net fishery was directed on spurdog.

Age frequency distributions of male and female spurdogs sampled in the western fishery in each year since the commencement of sampling in 1987 are set out in Table 1. These suggest that year on year differences result from the exploitation of different segments of the population. These variations are particularly marked for females.

The average weights (kg) of individuals landed by gill net since the commencement of the fishery were:

	Females	Males
1987	2.17	1.48
1988	1.47	1.34
1989	2.40	1.38
1990	2.08	1.37

The numbers aged and the mean ages of landings by gill net were:

Year	Females		Males	
	Mean	No examined	Mean	No examined
1987	19.1	1321	18.4	315
1988	15.8	342	17.3	1607
1989	22.4	189	20.4	367
1990	17.4	133	17.6	280

A growth curve was devised, based on material gathered in 1987. An attempt to repeat the exercise on the following year's samples was unsuccessful, possibly because spurdogs examined in that year were captured by nets fishing deeper water which are frequented by shoals of immature fish of both sexes. On this occasion, a comparison of the growth of gill-net caught fish is made by averaging the mean values of lengths at age for the range 15 to 25 years inclusive (Table 2). The resulting "growth index" falls from 82 cm to 77 between 1987 and 1988 and thereafter appears to recover, being 80 cm in 1989 and 82 cm in 1990. There is less variation among males.

Corroboration of between year differences in the growth of female spurdogs is sought by an analysis of variance, for which the raw data are the mean lengths (Table 3). Comparison of the mean lengths through the various years was undertaken by a one way analysis of variation; comparison of the mean lengths in individual years was also carried out. Results are summarised in Table 4 ( $P < 0.05$ , significant;  $P < 0.01$ , very significant). While some significant differences occur between age groups in every combination of years, most of the very significant differences occur when the year 1988 is involved, supporting the contention that female spurdogs exploited in that year belonged to a sub-group of different growth characteristics.

*Other species taken by gill net at Carrigaholt*

The length of gill-net set by the Carrigaholt fishery declined from 3,890 to 1,307 km between 1989 and 1990, some of that reduction being attributable to bad weather. In spite of its depletion, spurdog remains the major target species and, in 1990 its catch per effort increased by 30%.

The remaining species in Table 5 have been taken in this fishery since its inception and as a by-catch, gadoids being an alternative target to spurdog. In the majority of species, the catch per effort declined between 1989 and 1990.

An exception was the fishery for hake which, in 1990, became the target of a directed gill net effort, its landings increasing by 200% over those of the previous year.

### The hake fishery

Targetting hake with gillnets is a new departure for the Irish inshore fishery. A programme of port sampling, conducted on a random basis, did not record any significant quantity of hake taken by this method between 1986 and 1988 inclusive. In 1989 32% of hake sampled were taken by gillnet ( $n = 3,152$ ) as did 16% the following year ( $n = 9,588$ ). Exactly how representative is this sampling is unclear but the capture of hake by gillnet is clearly becoming substantial and a brief account of it in association with the Carrigaholt fishery is appropriate.

At Carrigaholt the capture of hake is concentrated in the spring and autumn months, the fishery in May being associated with spawning aggregations of the fish in the southwest (Table 6). The majority of the fish are between 0.5 and 2.0 kg in weight and the majority of damaged fish, which were not examined, are reported by the fishermen concerned as belonging to this size range. Damaged hake in 1990 amounted to 8.7% of the landings.

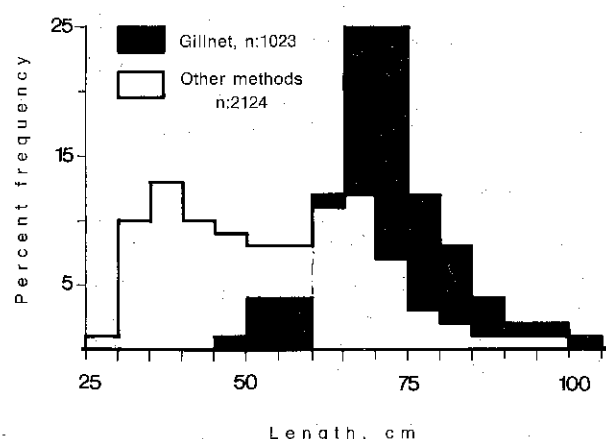


Fig. 2 Length frequency distribution of hake taken by gill net and by all other commercial methods of capture, from a port survey of landings in 1989.

The length frequency distributions of hake sampled in the national port survey in 1989 are set out as captures by gill net and by all other methods combined in Fig. 2. Gillnet-caught hake, like spurdog (Fahy and Gleeson, 1990), conform to a unimodal length frequency distribution and, in Table 7, the percentage weight taken in a particular grade nationally is expressed approximately as is done in the records of landings to Carrigaholt. Because the gear used in Carrigaholt is believed to be substantially similar to that in general use throughout the country, the difference between the two weight frequencies is noteworthy and suggests that the fish exploited by the Carrigaholt fleet are smaller than those which are captured elsewhere.

### DISCUSSION

A reason for extending these investigations is to ascertain the potential mechanism of recovery of the spurdog stock although fishing pressure is still sufficiently high to inhibit expansion in the population.

The mean by which exploited shark populations subsequently recover are disputed. Three compensatory, density adjustment mechanisms have been proposed: growth, natural mortality and fecundity. The evidence for these in various spurdog stocks was reviewed by Fahy (1989b) who suggested that the immigration of un- or under-exploited populations to occupy depleted nursery areas in the course of the annual north-south migrations was a likely alternative.

Indicators suggests a further depletion in the spurdog stock(s) off the west coast. The characteristics of the sampled fish have fluctuated widely from one year to the next. Spurdogs taken by gillnet display certain fairly consistent trends and they are of particular interest because fish taken by this method include whatever elements of the female broodstock are available.

The average weight of males taken by gillnet declined after the peak fishery in 1987 and subsequently recovered only slightly. The average weight of females also declined sharply in 1988 but thereafter recovered to a higher value in 1989 after which there was again a slight reduction. This pattern is reflected in the variations in average age of capture and by the growth index. This fell after the peak fishery, suggesting that females of smaller size (and consequently less mature, maturity being size and age related (Fahy, 1989a)) were being taken by gill net. From 1988 however the growth index has gradually increased.

Although it is under heavy fishing pressure, the spurdog stock(s) on the west coast have shown signs of reassembling a female broodstock.

For the Carrigaholt fleet, a small but well documented fishery, spurdog remains an important target species. The fleet has gradually adjusted, some larger boats being purchased, and the length of net carried on board has increased. For this fleet the depletion of the spurdog stock has necessitated finding alternative targets and gadoids, which provided one, have been replaced by hake on which effort is being directed. The preliminary observations on the hake fishery suggest the Carrigaholt fleet is taking smaller individuals than do similar nets in other parts of the country.

#### ACKNOWLEDGEMENTS

Gratitude is expressed to Mr Ruary Rudd for assistance with the statistical treatment of the data.

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Table 1. Percentage age frequency of female and male spurdogs captured by gill net in four successive years.

Age	Females				Males			
	1987	1988	1989	1990	1987	1988	1989	1990
4				1				
5				1				
6				1				
7								
8		1			1			
9		1	1	2	1		1	1
10		4		4	2	2		
11		5	1	5	3	3		1
12		10	1	4	4	5	3	3
13		11	1	3	6	5	2	1
14	12	10	1	3	9	6	3	4
15	7	12	1	4	6	9	5	4
16	10	7	3	13	8	10	8	10
17	5	8	1	9	5	11	5	5
18	10	5	5	8	8	11	7	8
19	10	6	9	8	9	9	2	8
20	6	4	11	8	5	10	10	10
21	9	5	14	3	8	6	9	9
22	4	5	6	4	3	5	8	6
23	5	1	9	8	4	2	6	5
24	4	2	6	3	3	2	8	7
25	2		3	3	1	1	5	4
26	3		5	3	2	1	6	4
27	2	1	6	2	1		2	2
28	4		5	1	3		4	3
29	2		2		1		1	1
30	1		1	1	1		2	2
31	2		2		1		2	1
32	1		2		1			
33			2					
34	1				1			
35+	1		1	1	1		1	1

Table 2. Mean length (cm) at age of female and male spurdogs captured by gill-net in four successive years. The average length for the range 15 to 25 years inclusive is given.

Age	Females				Males			
	1987	1988	1989	1990	1987	1988	1989	1990
4				59				
5				59				
6				59				
7		59						
8		65			62	67		
9		65	55	67	64	69	68	57
10		63		63	66	70	75	67
11		65	61	71	70	73		70
12		68	77	71	71	74	72	68
13		72	73	72	71	74	75	69
14	71	71	81	76	73	73	73	72
15	74	74	73	76	73	76	75	70
16	76	72	78	76	74	75	73	72
17	79	75	73	78	75	76	74	72
18	81	75	78	84	76	75	75	75
19	83	75	81	85	76	77	75	74
20	85	77	82	86	76	76	74	76
21	86	79	83	81	76	77	77	77
22	88	78	87	84	76	76	76	76
23	89	72	83	84	77	76	77	77
24	90	77	81	89	78	77	75	77
25	92	89	83	83	77	78	76	75
26	93	81	88	102	78	77	76	76
27	94	81	90	94	78	77	75	74
28	94	75	85	101	81	77	77	85
29	95		85		78	78	77	77
30	96		77	105	78	82	76	77
31	97		86		78	77	74	81
32	97		85		78	78	71	
33	98		90		78	75	71	
34	98		103					
35 +	99							
Average (15-25 years)	84	77	80	82	76	76	75	75



Table 3. Length at age characteristics of female spurdogs aged 15 to 25 years inclusive, captured from 1987 to 1990 inclusive.

1987				1988			
Age	Number examined	Mean length (cm)	S.D.	Age	Number examined	Mean length (cm)	S.D.
15	92	73.9	4.2	15	43	73.8	6.0
16	131	75.9	3.8	16	25	71.9	5.2
17	65	79.2	3.9	17	28	74.7	5.7
18	131	81.3	2.9	18	16	74.6	4.4
19	131	83.0	4.5	19	21	74.7	4.1
20	78	84.8	4.2	20	15	76.8	4.9
21	118	86.3	3.7	21	17	78.9	5.3
22	52	88.2	3.5	22	16	77.7	5.7
23	65	89.1	3.1	23	3	71.8	6.3
24	52	90.4	3.6	24	8	76.7	5.9
25	26	91.8	5.2	25	1	89.1	—

1989				1990			
Age	Number examined	Mean length (cm)	S.D.	Age	Number examined	Mean length (cm)	S.D.
15	1	73.2	—	15	5	76.0	4.3
16	3	77.7	6.5	16	15	76.4	5.5
17	1	72.9	—	17	11	77.7	6.8
18	4	78.3	7.2	18	9	83.8	6.3
19	8	80.9	5.4	19	9	84.6	4.4
20	10	82.4	4.1	20	10	85.8	4.0
21	12	83.1	5.2	21	4	80.9	9.9
22	5	87.0	5.4	22	5	84.4	4.2
23	8	82.7	6.3	23	10	84.3	5.4
24	5	81.0	4.3	24	4	88.8	6.2
25	3	82.8	7.7	25	3	83.4	8.5

Table 4. Analysis of variance in length at age of female spurdog by F test.

Age	Comparison of lengths at age by year					
	87/88	87/89	87/90	88/89	88/90	89/90
15	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.
16	v.s.	n.s.	n.s.	sig.	v.s.	n.s.
17	v.s.	n.s.	n.s.	n.s.	n.s.	n.s.
18	v.s.	n.s.	sig.	n.s.	v.s.	sig.
19	v.s.	n.s.	n.s.	sig.	v.s.	n.s.
20	v.s.	n.s.	n.s.	v.s.	v.s.	n.s.
21	v.s.	sig.	sig.	sig.	n.s.	n.s.
22	v.s.	n.s.	n.s.	n.s.	v.s.	n.s.
23	sig.	sig.	sig.	n.s.	n.s.	n.s.
24	sig.	v.s.	n.s.	n.s.	v.s.	v.s.
25	n.s.	sig.	sig.	n.s.	n.s.	n.s.
Totals						
n.s.	2	7	7	7	5	9
sig.	2	3	4	3	0	1
v.s.	7	1	0	1	6	1

Table 5. Species taken by gill net at Carrigaholt in 1989 and 1990, expressed as kg/100 m net set during the year (+ signifies less than 0.1 kg).

Species	1989	1990
Total gillnet set (km)	3890	1307
Spurdog ( <i>Squalus acanthias</i> )	7.3	9.5
Saithe ( <i>Pollachius virens</i> )	1.1	.5
Pollock ( <i>Pollachius pollachius</i> )	1.6	.8
Cod ( <i>Gadus morhua</i> )	2.2	1.1
Ling ( <i>Molva molva</i> )	.5	.4
Whiting ( <i>Merlangius merlangus</i> )	.1	+
Hake ( <i>Merluccius merluccius</i> )	.7	2.1
Bass ( <i>Dicentrarchus labrax</i> )	+	+
Shark ( <i>Prionace glauca</i> or <i>Lamna nasus</i> )	+	+
Pouting ( <i>Trisopterus</i> sp)	+	+
Gurnard ( <i>Eutrigla?</i> )	+	+
Haddock ( <i>Melanogrammus aeglefinus</i> )	.2	.1
Lemon sole ( <i>Microstomus kitt</i> )	+	+
Ray ( <i>Raia</i> spp)	.1	.5
Dory ( <i>Zeus faber</i> )	+	+
Witch ( <i>Glyptocephalus cynoglossus</i> )	+	+
Megrím ( <i>Lepidorhombus whiffiagonis</i> )	+	+
Conger ( <i>Conger conger</i> )	+	+
Torsk ( <i>Brosme brosme</i> )	+	+
Angler ( <i>Lophius</i> spp)	+	.1
Sole ( <i>Solea solea</i> )	+	+
Plaice ( <i>Pleuronectes platessa</i> )	+	+
Dab ( <i>Limanda limanda</i> )	+	+
Turbot ( <i>Scophthalmus maximus</i> )	+	+
Brill ( <i>Scophthalmus rhombus</i> )	+	+

Table 6. Details of hake captured by gill-net at Carrigaholt in 1989 and 1990.

		Grades (kg)				Damaged	Total (tonnes)
		<1.0	1.0-2.0	2.0-4.0	>4.0		
1989	Jan	56	724	401	94		1.28
	Feb		235	118			.35
	Mar	61	1690	384	42		2.18
	Apr	95	3271	3088	346		6.80
	May	11	569	514	105		1.20
	Jun		96	70	32		.20
	Jul		98	170	39		.31
	Aug	12	926	608	135		1.68
	Sep	65	2027	1535	361		3.99
	Oct	207	1560	1610	506		3.88
	Nov	281	1117	1285	202		2.89
	Dec	59	119	294	43		.52
1990	Jan						
	Feb						
	Mar						
	Apr	57	1760	1946	1025	199	4.99
	May		1882	7509	5704	1328	16.42
	Jun		104	82	64	62	.31
	Jul		420	54	56		.53
	Aug		16	17	5	2	.04
	Sep		1486	694	56	459	2.70
	Oct		215	234	60	159	.67
	Nov		242	294	59	82	.68
	Dec		298	341	59	74	.77
	Total landed =	904	18855	21248	8993	2365	52.37
	Total graded =	50000					
Percentage distribution =	2	38	42	18			

Table 7. Length and weight frequency distribution of hake taken by gill net in divisions VIa and in VIIb, g, j in 1989. Weights are for gutted fish. Number sampled 1023. Grades are arranged as in Table 6. Sample raised to 100 t.

Length interval (cm)	Mean weight (g)	Numbers caught per 100 t	Weight (kg) per size interval	Total weight per grade	Percent weight per grade	Grade (kg)
40	471	119	56			
45	661	238	157			
50	895	1428	1278	1435	1	0-1.0
55	1180	1468	1732			
60	1520	4839	7355			
65	1921	10194	19583	28670	29	1.0-2.0
70	2386	10274	24514			
75	2921	4998	14599			
80	3532	3292	11627	50740	51	2.0-4.0
85	4223	1507	6364			
90	4999	992	4959			
95	5866	793	4652			
100	6827	397	2710			
105	7890	0	0			
110	9057	0	0			
115	10336	40	413	19099	19	> 4.0
			Total =	99944		