

Final Report

Programme 9: Spurdog in the Irish Sea

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February 2010

Executive Summary

Large numbers of spurdog were caught during the first sampling trip, with 217 tagged with Petersen discs and released. The second sampling trip yielded few spurdog, although catches at that time of year are known to be small. Spurdog were not observed on the first three days of the third trip, but reasonable numbers were captured on the last day, just off the Mull of Galloway. The fourth trip (late October to early December) yielded some reasonably large catches of spurdog from the grounds just off Anglesey.

The spurdog caught were generally in good condition, although the bait stripper can damage the jaws, and those fish tagged and released were considered to be in a good state of health.

The length range of spurdog caught was 49–116 cm, with catches in Q1 and Q3 being mainly large (>90 cm) females. Catches in Q4 yielded a greater proportion of smaller fish.

The sex ratio of fish caught was heavily skewed towards females, with more than 99% of the spurdog caught in Q1 female. Although more males were found in Q3 and Q4, females were still dominant, accounting for 87% and 79% of the spurdog catch, respectively.

Numerically, between 16.5 and 41.9% of spurdog captured were >100 cm, the current Maximum Landing Length.

The largest immature female spurdog was 84 cm, with the smallest mature female 78 cm. The smallest mature female observed to be active was 82 cm. All females ≥ 90 cm were mature and active.

The observed uterine fecundity was 2–16 pups, and larger females produced more pups. In Q1, the embryos were either in the length range 11–12 cm or 14–18 cm, and no females exhibited signs of recently having given birth. In Q3, near-term pups were observed at lengths of 16–21 cm. During Q4, near-term and term pups of 19–24 cm were observed, and several females showed signs of recently having pupped. The Irish Sea may be an important site for spurdog to give birth during late autumn and early winter, although it is unclear if there are locations in the area that are important for pupping.

Three tagged spurdog have been returned, all of which were tagged in Q1. It is hoped that more tagged fish will be returned in the coming years to better gauge longer-term discard survival.

Introduction

In January 2003, the Government announced a package of funding for the fishing industry, which included £1 million in 2003/2004 for fishers and scientists to work in partnership. Following the announcement, industry and Cefas developed a programme to improve knowledge of our fish stocks. A further £1 million was provided for projects in the following financial year, another £1 million per year was guaranteed for each of the three financial years 2005/2006–2007/2008, then a similar amount was granted for the financial years 2008/2009–2010/2011. The objectives of the Fisheries Science Partnership (FSP) programme are to build relationships between UK fishers and scientists and to involve fishers in the co-commissioning of science.

The spurdog *Squalus acanthias* (Figure 1) is a small shark that is widespread on the continental shelves of the Atlantic and Pacific Oceans. Within the NE Atlantic, it is found in shelf seas (10–200 m deep, although it has been recorded as deep as 900 m) from Iceland and the northern coasts of Norway to the coast of Northwest Africa, including the Mediterranean and Black Seas.



Figure 1: Spurdog *Squalus acanthias*

Landings data indicate that spurdog are most common in the Norwegian Sea (ICES Division IIa), Kattegat and Skagerrak (IIIa), North Sea (IV), Northwest Scotland (VI), Irish and Celtic Seas (sub-area VII), and northern Bay of Biscay (VIIIa). They are less common farther south, where they co-exist with some closely related species. Although there have been occasional transatlantic recaptures of tagged spurdog, these are infrequent in relation to the many thousands tagged in the 1960s, so the NW and NE Atlantic stocks are considered to be separate (Holden, 1967; Vince, 1991; Pawson and Ellis, 2005; and references therein).

The spurdog is a long-lived species (Holden and Meadows, 1962; Tucker, 1985), and tagged fish have been recaptured after 40 years at liberty. Female spurdog attain a maximum length of ~120 cm, but males tend to be smaller, reaching ~90 cm. Females generally mature at a length of 74–83 cm, and males at 55–64 cm. The females produce few young (Figure 2), with 2–21 pups born after a gestation period of 22–24 months (Holden and Meadows, 1964; Gauld, 1979; Ellis and Keable, 2008). The pups are born at a length of 19–30 cm (Gauld, 1979). Spurdog are opportunistic feeders, preying primarily on pelagic and demersal fish (e.g. herring, sprat, mackerel and gadoids), as well as ctenophores, crustaceans and cephalopods (Ellis *et al.*, 1996).



Figure 2: Mature female spurdog and pups

Spurdog have traditionally been one of the most abundant small sharks in UK waters, and although they were considered nuisance fish in the 1800s, commercial landings increased during the first half of the 20th century. Landings have declined since the peak of the fishery in the 1960s, and the occurrence and the relative abundance of spurdog in scientific trawl surveys have declined in the past two decades (Dobby *et al.*, 2005; Hammond and Ellis, 2005).

The spurdog is taken in a variety of commercial fisheries, including as a bycatch in various trawl and gillnet fisheries, and it is also an important component of inshore,

longline fisheries along certain parts of the coasts of England and Wales. Large-scale longline fisheries that fished extensively for spurdog in the 1980s and 1990s have now ceased, with the remaining longline fisheries based on small, inshore vessels that fish for spurdog on a seasonal basis.

Given the concern over the Northeast Atlantic stock of spurdog, ICES (2006) advised that *“The stock is depleted. All experimental assessments indicate that the stock is at a record low level. The frequency of the occurrence of spurdog in trawl surveys has declined and, although large shoals are still caught, the frequency of these has also declined. Survey CPUE also indicates a declining trend. The absolute level of exploitation is unknown but the trends in fishing mortality and the continuous decline in landings indicates that exploitation has been, and continues to be well above sustainable levels...Targeted fisheries should not be permitted to continue, and bycatch in mixed fisheries should be reduced to the lowest possible level. The TAC should cover all areas where spurdog are caught in the northeast Atlantic and should be set at zero for 2007”*.

ICES (2006) also noted that *“spurdog are long-lived, slow-growing, have a high age-at-maturity, and are particularly vulnerable to fishing mortality. Population productivity is low, with low fecundity and a protracted gestation period. In the light of this, the risk of depletion of reproduction potential is high. It is recommended that exploitation of this species should only be allowed when indicators and reference points for stock status and future harvest have been identified and a management strategy, including appropriate monitoring requirements has been decided upon and is implemented”*.

The TAC for spurdog, which was first established for EC waters in the North Sea (IV and IIa) was set at 9470 t in 2000 (Table 1), but this was reduced subsequently, to 1051 t in 2006. In 2007, the North Sea TAC was reduced again (841 t) and a bycatch rule established (where spurdog should *“not comprise more than 5% by live weight of the catch retained on board”*), and a TAC was also introduced for other ICES divisions. In 2008, the TACs were further reduced and the bycatch rule was extended to areas outside the North Sea. The bycatch rule was considered problematic by the fishing industry, because in their opinion it resulted in more discarding. It also severely restricted the operations of small, inshore, longline vessels, because

spurdog can be locally and/or seasonally abundant in certain areas, and the selectivity of longlining means that few other species (e.g. skates and rays, cod, conger eel, bass, and other dogfish) are caught, and this is particularly evident for longline fisheries in the Irish Sea (ICES Division VIIa), where spurdog may account for >90–95% of reported landings.

Table 1: History of the TAC for spurdog (2000–2009) and other management measures

| Year | TAC (t) | UK allocation | | TAC (t) | | UK allocation | |
|------|--------------------|---------------|------|------------------------|---------------------|---------------|------|
| | II a and IV | Tonnes | % | Area | Tonnes | % | |
| 2000 | 9 470 | 7177 | 75.8 | | | | |
| 2001 | 9 070 | 7177 | 79.1 | | | | |
| 2002 | 7 300 | 5745 | 78.7 | | | | |
| 2003 | 5 840 | 4564 | 78.2 | | | | |
| 2004 | 4 672 | 3618 | 77.4 | | | | |
| 2005 | 1 236 | 919 | 74.4 | | | | |
| 2006 | 1 051 | 778 | 74.0 | | | | |
| 2007 | 841 ^[1] | 640 | 76.1 | IIIa, V-VIII, XII, XIV | 2828 | - | |
| 2008 | 631 ^[1] | 470 | 74.5 | V-VIII, XII, XIV | 2004 ^[1] | 739 | 36.9 |
| 2009 | 316 ^[2] | 216 | 68.4 | I, V-VIII, XII, XIV | 1002 ^[2] | 368 | 36.7 |
| | | | | IIIa | 104 ^[2] | - | |

[1] Bycatch quota where spurdog “shall not comprise more than 5% by live weight of the catch retained on board”
[2] “A maximum landing size of 100 cm (total length) shall be respected”

ICES (2008) reiterated the advice for 2006 and added that “Simulation modelling has shown there are strong potential benefits to the stock by protecting mature female spurdog in this long-lived species. If a non-zero TAC would be set, ICES recommends the introduction of a maximum landing length (MLL). This is expected to deter fisheries targeting areas where large females occur. The maximum landing length should initially be set at 100 cm”¹. In 2009, the EC removed the bycatch limit and brought in a maximum landing size of 100 cm. The quota was also reduced to 316 t (North Sea), 104 t (IIIa) and 1002 t (EC and international waters of I, V–VIII, XII and XIV).

¹ “The length at 50% maturity for female spurdog is just over 80 cm and the maximum size of females is about 120 cm. The maximum size of males is about 90 cm. Fecundity of spurdog increases with length and females of 100–120 cm length generally produce the highest amount of pups (10–21)”

Given the scientific concern over the state of the stock and the concerns from the fishing industry about the efficacy and effects of management measures, a project to address some of the current issues relating to the stock was initiated. The aims of this FSP project were to:

- (a) evaluate the role of spurdog in longline fisheries and examine the catch rates and sizes of fish taken in a longline fishery;
- (b) provide biological samples so that more recent data on the length at maturity and fecundity can be calculated;
- (c) tag and release a number of individuals to inform on the potential discard survivorship from longline fisheries.

The results from the project will hopefully supplement our knowledge of the spatial and temporal dynamics of spurdog in western waters, provide contemporary data on those reproductive parameters used in demographic models, and increase our understanding of the discard survival of fish caught under commercial conditions.

This report summarises work undertaken during the four trips undertaken, although the tagged fish have not been at liberty for a long period of time, so further analyses of the tagging data will be undertaken in future, when more tag returns have been received.

Methods

Studies focused on spurdog taken by longliners operating in the Irish Sea. This fleet of small, inshore vessels is based primarily in Holyhead (North Wales), and the study was undertaken on the *Sarah H*, a 17.58 m (overall length), 16 m (registered length) potter/liner built in 1939 (Figure 3). The project plan (see Appendix I) was to undertake sampling four times during the year, and this report provides details on all four trips (see Table 2, Appendix II).

The first trip was undertaken from 31 March to 2 April 2009, with feeler lines deployed at 16 stations and main lines at five stations. Feeler lines (each of 40 hooks) were deployed as either one or two strings in close proximity (i.e. these

stations were of 40–80 hooks), with main lines comprising 1750 hooks. Mackerel was used as bait. The second trip was undertaken during late May 2009, with 22 stations fished with feeler lines. Owing to the poor catch rates of spurdog then, no main lines were set during this survey.

The third trip (9–12 September 2009) fished mostly feeler lines (21 stations), with good catches made only on the last day, when two main lines were also set. The fourth trip (22–23 October, and 4 and 10 December 2009) was interrupted by a protracted period of poor weather for most of November. The first two days included five stations fished with feeler lines, with main lines (of 3–5 boxes of lines) fished at six stations. The final two days of the survey saw 4–5 main lines set per day.

On each survey, some of the spurdog were tagged with Petersen discs (Figure 4) and released after biological information was recorded, including sex, length and a qualitative index of health state (1, lively; 2, sluggish). This will allow the longer term survival of discarded fish to be examined. The remaining parts of the catch were measured, and a subsample of females was dissected to collect information on the reproductive biology. Maturity stages were assigned as indicated in Table 3. Given that longlining for spurdog can result in large catches, it was not always possible to quantify catches completely, but large catches were subsampled and raising factors estimated.

The rest of the catch was generally quantified (time permitting), and some other elasmobranch species, such as tope *Galeorhinus galeus* and greater-spotted dogfish *Scyliorhinus stellaris*, were also tagged and released.

Table 2: Dates of longline studies in the Irish Sea

| Trip | Date | Stations fished |
|------|----------------|--|
| Q1 | 31 Mar 2009 | Five stations fished with feeler lines * |
| | | Three stations fished with main lines (1 750 hooks each) |
| | 01 Apr 2009 | Six stations fished with feeler lines * |
| | | No main lines deployed |
| Q2 | 02 Apr 2009 | Five stations fished with feeler lines * |
| | | Two main lines fished (1750 hooks each) |
| Q3 | 20 May 2009 | Seven stations fished with feeler lines * |
| | | No main lines fished |
| | 21-22 May 2009 | Eleven stations fished with feeler lines * |
| | | No main lines fished |
| Q4 | 23 May 2009 | Four stations fished with feeler lines * |
| | | No main lines fished |
| | 09 Sep 2009 | Eight stations fished with feeler lines * |
| | 10 Sep 2009 | Three stations fished with feeler lines * |
| Q5 | 11 Sep 2009 | Seven stations fished with feeler lines * |
| | 12 Sep 2009 | Three stations fished with feeler lines * |
| | | Two stations fished with main lines (2200 hooks) |
| | 22 Oct 2009 | Two stations fished with feeler lines * |
| Q6 | | Three stations fished with main lines (660–1100 hooks) |
| | 23 Oct 2009 | Three stations fished with feeler lines * |
| | | Three stations fished with main lines (880 hooks) |
| | 04 Dec 2009 | Four stations fished with main lines (3000 hooks in total) |
| Q7 | 10 Dec 2009 | Five stations fished with main lines (4000 hooks in total) |

* Two lines with 40 hooks each, although some stations were fished with only one feeler line



Figure 3: Inshore vessel *Sarah H* sailing out of Holyhead

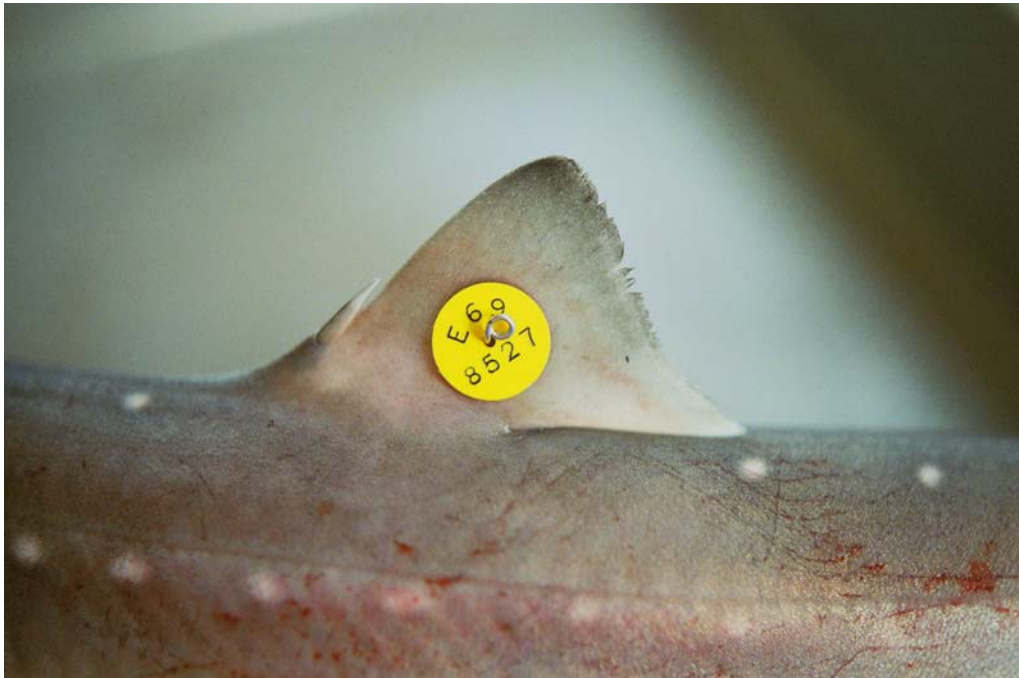





Figure 4: Dorsal fin of spurdog with a Petersen disc attached

Table 3: Maturity stages of spurdog

| STAGE | MATURITY STAGES OF MALES |
|--------------|--|
| A | Immature: Claspers undeveloped, shorter than extreme tips of posterior margin of pelvic fin. Testes small and thread-shaped, sperm ducts straight |
| B | Maturing: Claspers longer than posterior margin of pelvic fin, their tips more structured, but the claspers are soft and flexible and the cartilaginous elements are not hardened. Testes enlarged, sperm ducts beginning to meander. |
| C | Mature: Claspers longer than posterior margin of pelvic fin, cartilaginous elements hardened and claspers stiff. Testes enlarged, sperm ducts meandering and tightly filled with sperm. |
| D | Active: Clasper reddish and swollen, sperm present in clasper groove, or flows if pressure exerted on cloaca. |

| STAGE | | MATURITY STAGES OF FEMALES | |
|-------|-----------------------|--|--|
| A | Immature | Ovaries small, gelatinous or granulated, no differentiated oocytes visible. Oviducts small and thread-shaped, width of shell gland not much greater than the width of the oviduct. | |
| B | Maturing | Ovaries enlarged and with more transparent walls. Oocytes differentiated in various small sizes (<5 mm). Oviducts small and thread-shaped, width of the shell gland greater than the width of the oviduct, but not hardened. | |
| C | Mature (Non gravid) | Ovaries large with very large, yolk-filled oocytes, (ca. 10-30 mm in diameter). Shell gland fully formed and hard. Uteri fully developed but without yolky matter (Stage D) or embryos (Stages E-F), and not dilated (Stage G) | |
| D | Mature (Early gravid) | Uteri filled with yolky matter (candles), which appear segmented. Each segment should eventually form a pup. |  |
| E | Mature (Mid-term) | Uteri filled with large yolk sacs and developing embryos. |  |
| F | Mature (Late gravid) | Uteri filled with well-developed/near-term pups, with their yolk sacs greatly reduced/absent. |  |
| G | Mature (Post-partum) | Post-parturition: Similar to stage C, but with a greater number of degenerating follicles, and uteri dilated and saggy (pups have been shed). | |

Results

Catches

Across all four surveys, an estimated 2873 spurdog were captured, of which 416 (14% of the total estimated catch) were tagged. A further 168 specimens were dissected and information on the maturity stage and fecundity recorded. Overall, and including those fish tagged or sampled for reproductive information, 1810 spurdog (63% of the estimated total catch) were measured (Table 4).

Table 4: Catches and sampling of spurdog collected by quarter (* denotes those surveys when some catches were subsampled and total numbers estimated)

| Quarter | Number of spurdog | | | Total catch |
|---------|-------------------|-----------------------|----------------|-------------|
| | Tagged | Sampled for fecundity | Total measured | |
| Q1 | 217 | 34 | 647 | 837 * |
| Q2 | 2 | 0 | 2 | 2 |
| Q3 | 81 | 24 | 178 | 1 051 * |
| Q4 | 116 | 110 | 983 | 983 |
| Total | 416 | 168 | 1 810 | 2 873 |

In addition to spurdog, selected specimens of greater-spotted dogfish ($n = 72$), tope ($n = 12$) and starry smooth hound ($n = 1$) were also tagged and released during the course of the fieldwork.

Species that were also caught during the survey included lesser-spotted dogfish, which were landed for use as pot bait, but only small numbers of other fish were caught (e.g. spotted ray and whiting), and these were discarded.

Spatial distribution and relative abundance

Good numbers of spurdog were taken on two of the three days fished during the first trip (late March / early April), with good catches to the northwest and southwest of Holyhead. The time spent fishing to the north of Anglesey was largely unsuccessful in terms of spurdog catch (Figure 5).

The second trip (May 2009) fished grounds to the north of Anglesey and to the west of Anglesey and the Lleyn Peninsula, including several offshore sites, although only two feeler lines yielded spurdog. It is recognised that that time of year is not peak time for the spurdog fishery.

The third trip (September 2009) fished extensively with feeler lines, and although some lesser-spotted dogfish and greater-spotted dogfish were captured, no spurdog were caught during the first three days. Fishing was undertaken around the Isle of Man on the fourth day, and the last fishing stations were undertaken south of the Mull of Galloway, with sites there yielding reasonable catches of spurdog.

The fourth trip (late October / early December) was disrupted by severe weather conditions. Small numbers of spurdog were taken on main lines deployed in late October, and better catches were made in early December. All catches were taken north and west of Anglesey.

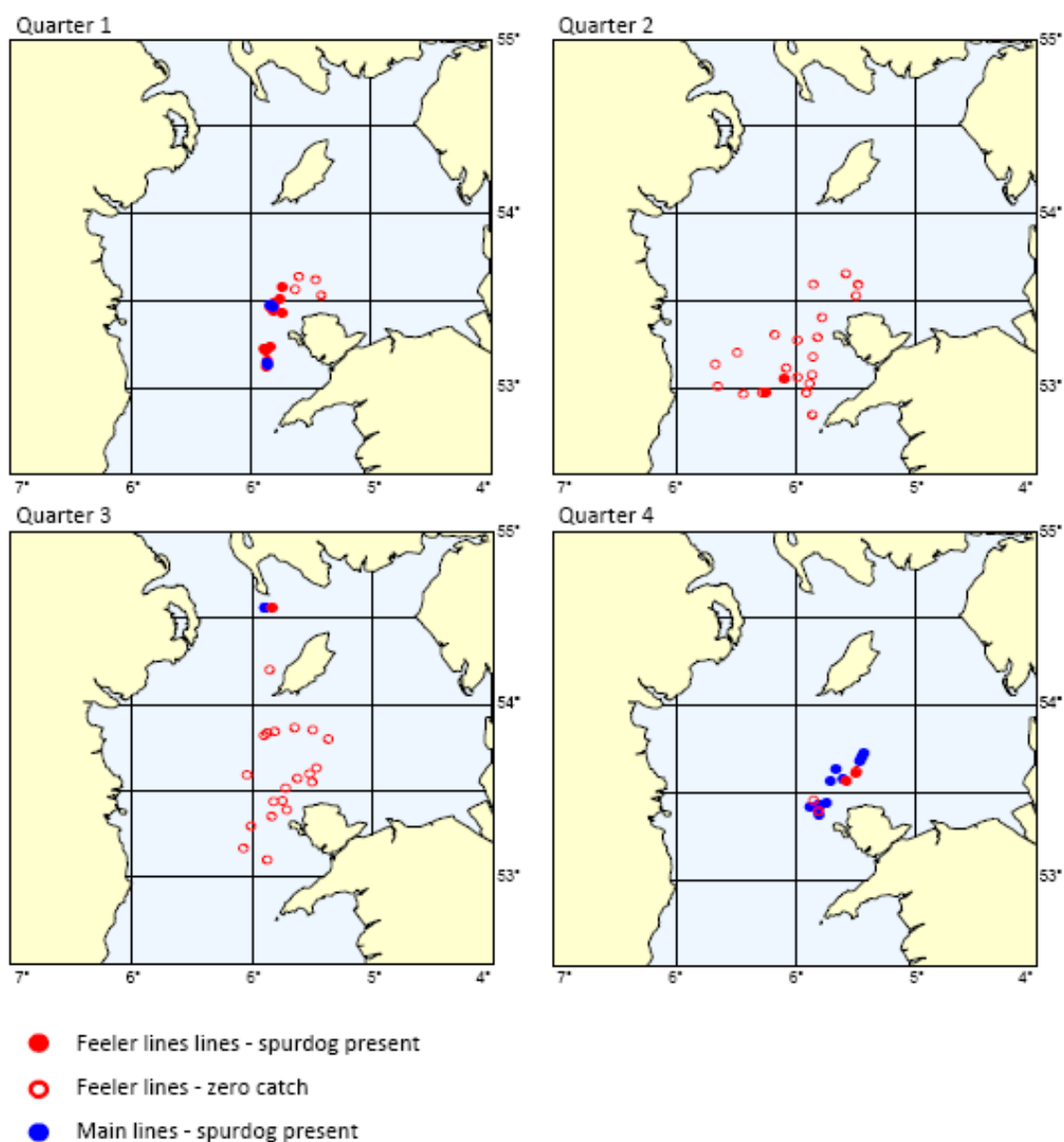


Figure 5: Distribution of sampling stations by quarter showing the locations of stations sampled with feeler lines (red circles; open circles denoting no spurdog, filled circles denoting spurdog were present) and stations fished with main lines (blue circles)

Sex ratio and length composition

Females were the main constituent of the catches, and ranged in length from 53 to 116 cm; almost 70% of the female catch was of fish ≥ 90 cm. Males were caught less often, and over a length range of 49–88 cm, confirming the large difference in the maximum length between the two sexes of this species (Figure 6).

Although the length range of females caught was quite consistent over the course of the year (Table 5), there was some difference in the overall length frequency, with catches in Q1 and Q3 comprising mostly larger fish (≥ 90 cm), and Q4 accounting for proportionally more smaller fish (Figure 7).

Table 5: Observed length range, estimated numbers and sex ratio of spurdog by trip

| Trip | Females | Males | Sex ratio (M:F) |
|------|-------------------------|------------------------|-----------------|
| Q1 | 60–116 cm ($n = 835$) | 63–86 cm ($n = 2$) | 1 : 417.5 * |
| Q2 | 88 cm ($n = 2$) | – | – |
| Q3 | 68–113 cm ($n = 916$) | 63–85 cm ($n = 135$) | 1 : 6.8 * |
| Q4 | 53–115 cm ($n = 764$) | 49–88 cm ($n = 219$) | 1 : 3.5 * |

* Sex ratios for Q1, Q3 and Q4 were statistically significantly different from a 1:1 sex ratio

Only two males were recorded during Q1, but more were taken in Q3 and Q4. Once again, catches in Q4 included more small males (Figure 8), the overall length ranges observed in Q3 and Q4 being 63–85 and 49–88 cm, respectively.

A Maximum Landing Length (MLL) was established in 2009 for spurdog, so the proportion of fish caught (by numbers) above this size was estimated, and also for length intervals above and below it (Table 6). The proportion of spurdog captured that were greater than the MLL was 14.8% in Q4 (when more small fish were captured), but 31.2–41.9% in Q1 and Q3. The proportion of fish captured that were >105 cm ranged from 5.8 to 14.7%.

Table 6: Proportion of spurdog (by number) ≤ 100 cm (current MLL is 100 cm) and in adjacent size categories

| Length | Q1 (<i>n</i> = 837) | | Q3 (<i>n</i> = 1 051) | | Q4 (<i>n</i> = 983) | | Total (<i>n</i> = 2873) | |
|------------|----------------------|-------------|------------------------|-------------|----------------------|-------------|--------------------------|-------------|
| | % of catch | | % of catch | | % of catch | | % of catch | |
| | \leq length | > length | \leq length | > length | \leq length | > length | \leq length | > length |
| 80 | 4.6 | 95.4 | 14.4 | 85.6 | 47.1 | 52.9 | 22.7 | 77.3 |
| 85 | 10.7 | 89.3 | 20.7 | 79.3 | 53.3 | 46.7 | 28.9 | 71.1 |
| 90 | 20.3 | 79.7 | 24.0 | 76.0 | 62.4 | 37.6 | 36.1 | 63.9 |
| 95 | 42.8 | 57.2 | 35.7 | 64.3 | 72.2 | 27.8 | 50.3 | 49.7 |
| 100 | 68.8 | 31.2 | 58.1 | 41.9 | 85.2 | 14.8 | 70.5 | 29.5 |
| 105 | 91.6 | 8.4 | 85.3 | 14.7 | 94.2 | 5.8 | 90.2 | 9.8 |
| 110 | 98.7 | 1.3 | 97.1 | 2.9 | 99.0 | 1.0 | 98.2 | 1.8 |

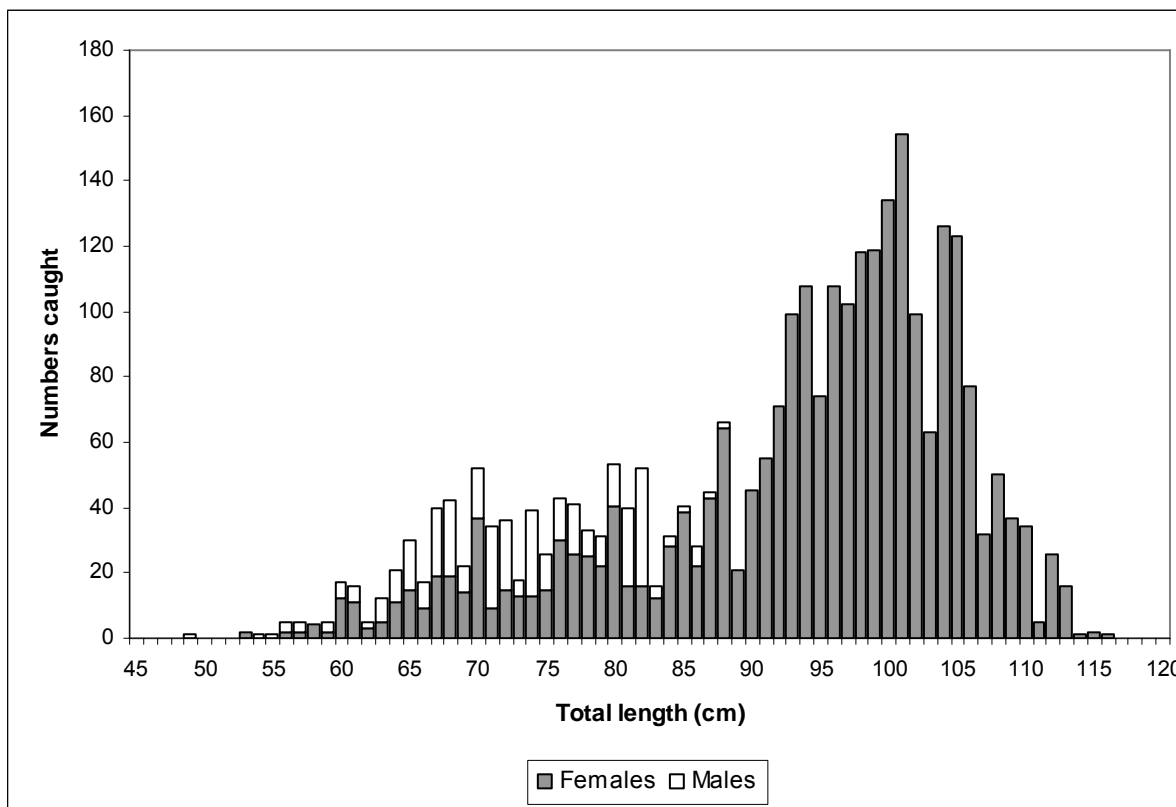


Figure 6: Total length frequency of male and female spurdog taken during the course of the project, raised for those catches that were subsampled (*n* = 2517 females and 356 males)

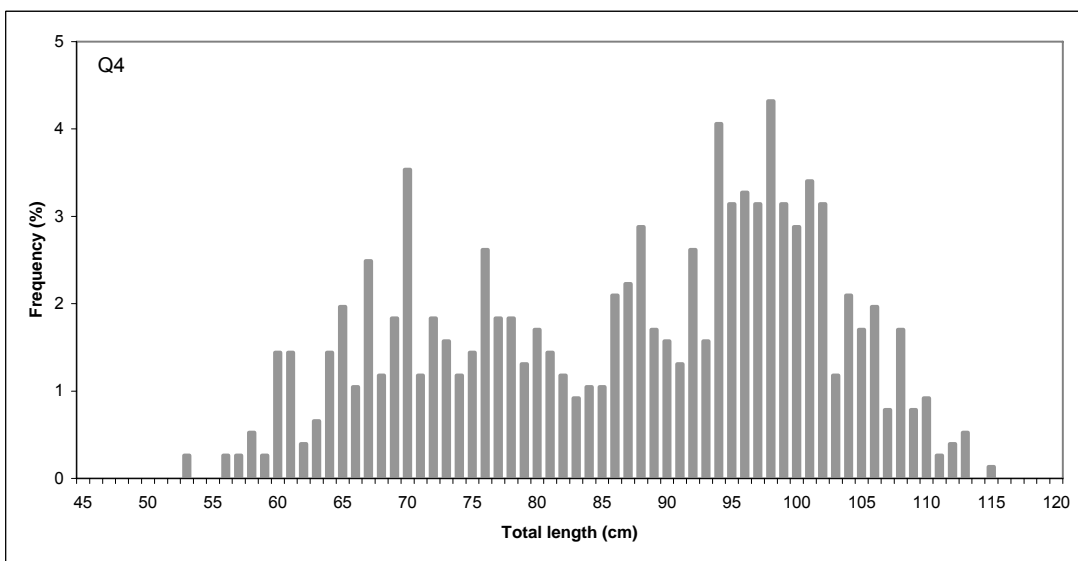
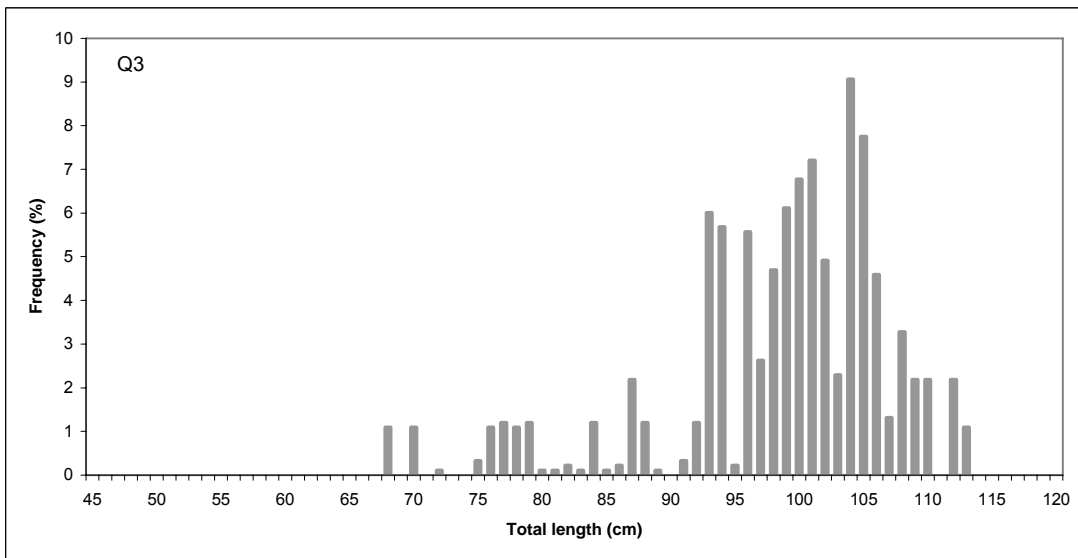
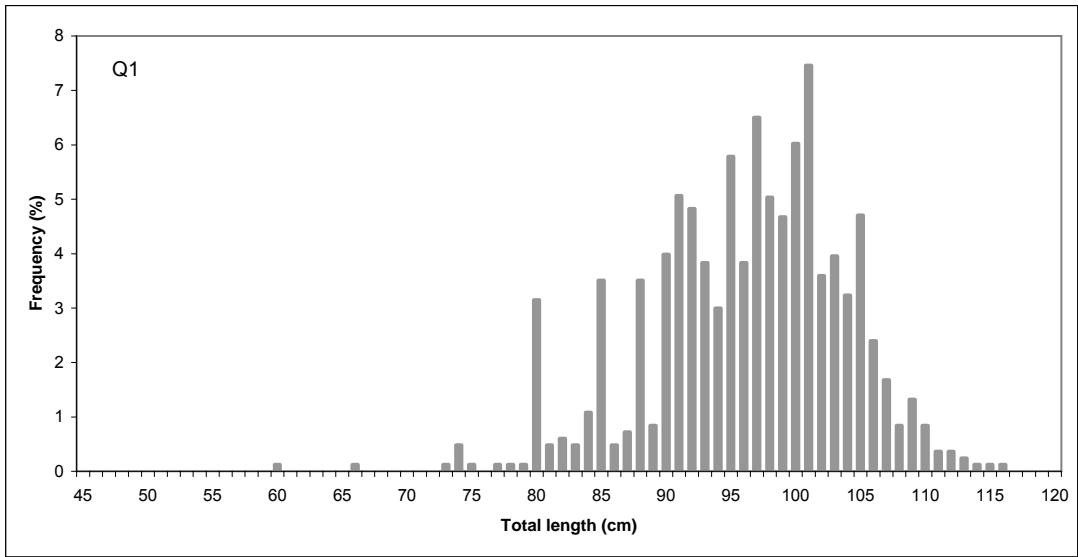


Figure 7: Length frequency (%) of female spurdog taken during Q1, Q3 and Q4. Note the increased frequency of immature spurdog during Q4.

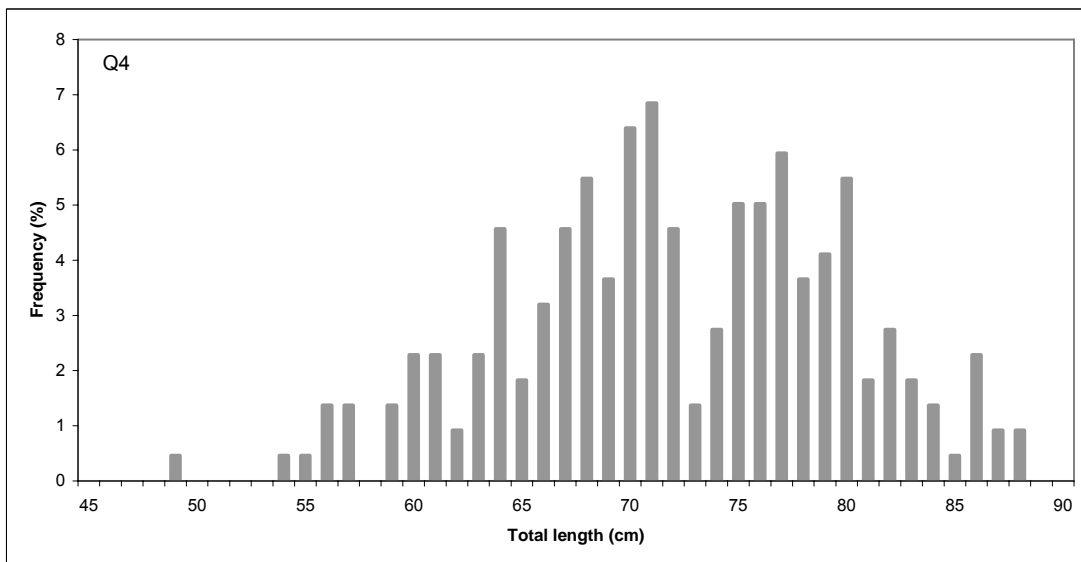
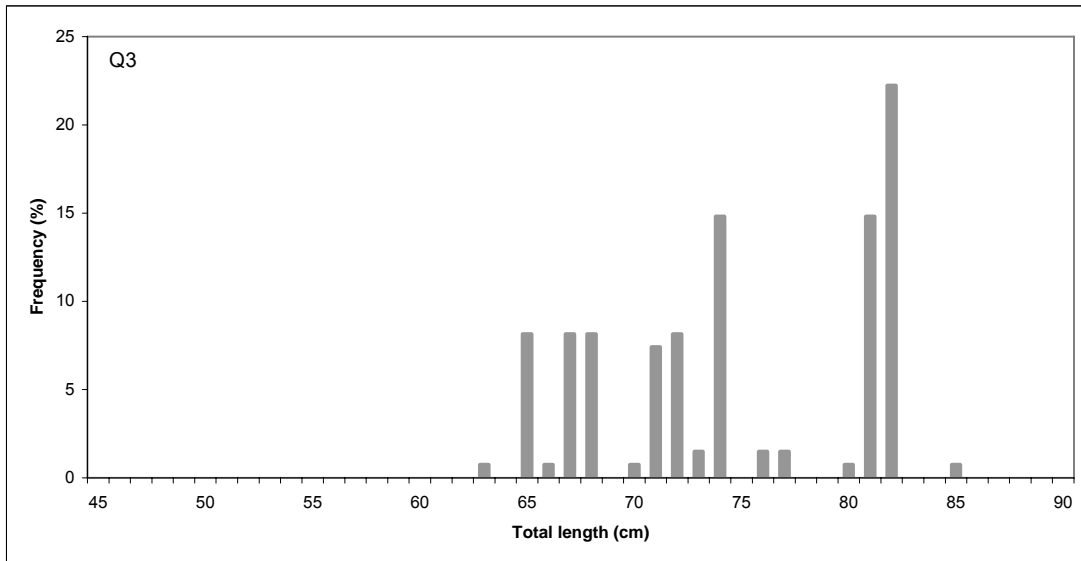


Figure 8: Length frequency (%) of male spurdog taken during Q3 and Q4.

Maturity

A subsample of 168 females was examined during the course of the project to collect information on biological maturity (Figure 9). The largest immature female (stage A) observed was 84 cm, with maturing fish (stage B) observed from 73 to 88 cm. The smallest mature female (stages C–G) was 78 cm, although the smallest female that was reproductively active (stages D–G) was 82 cm. All females ≥ 90 cm were mature and active (stages D–G).

Uterine fecundity estimates were available for 116 mature females (at stages D–F), with the fecundity ranging from 2 to 16 and increasing significantly with maternal length (Figure 10).

In Q1 embryos were in the length ranges 11–12 cm (stage E) and 14–18 cm (stage F), with no females exhibiting signs of recently having given birth (i.e. stage G was not evident). In Q3, near-term pups were observed at lengths of 16–21 cm. During Q4, near-term and term pups of 19–24 cm were taken, and several females showed signs of recently having pupped (stage G).

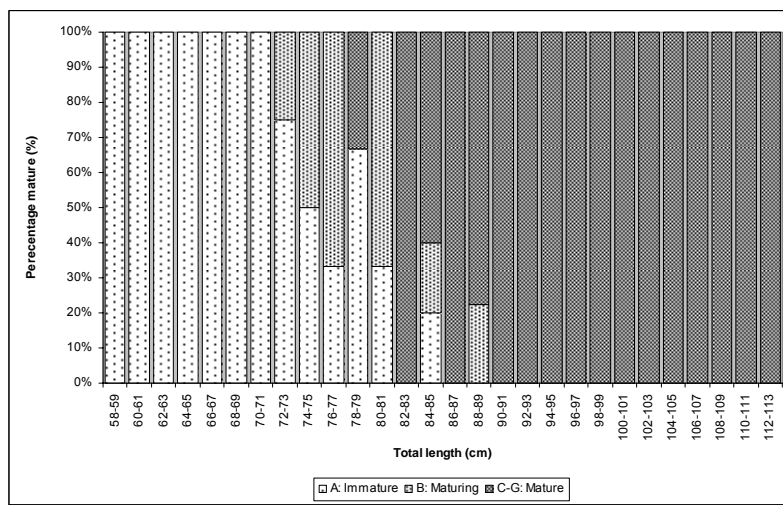


Figure 9: Proportions of immature (Stage A), maturing (Stage B) and mature (Stages C–G) female spurdog by 2 cm length class

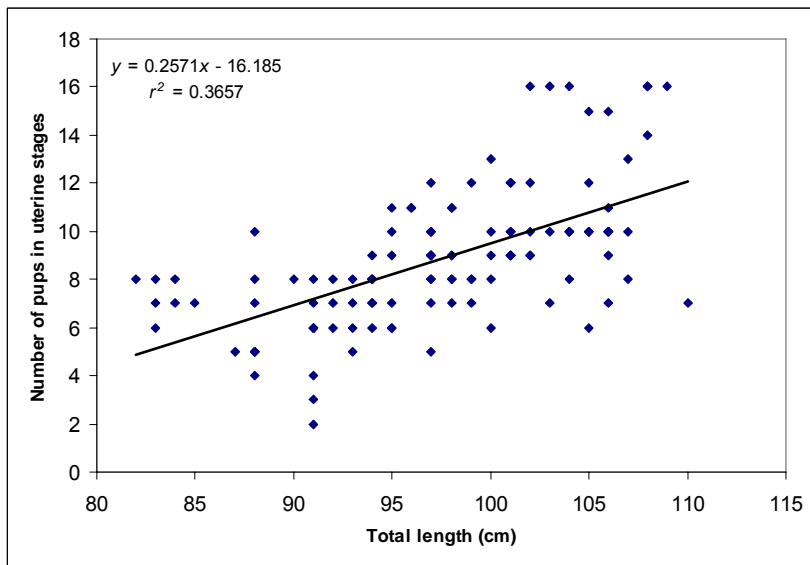


Figure 10: Relationship between the number of developing embryos / pups and maternal length

Tagging

Across the four trips, 416 spurdog were tagged with Petersen discs and released. Additionally, 72 greater-spotted dogfish (55–115 cm), 12 tope (86–116 cm) and one starry smooth-hound were also tagged and released.

To date there have been three recaptures from spurdog tagged and released in Q1, a return rate of 1.4%. These returns were from fish processed at Howth and Fleetwood (Irish Sea ports) and Grimsby, although the latter could have been over-landed.

Although this is currently a low percentage return rate, it should be stressed that the fish have been at liberty for a short period of time, and that there has been a reduction in spurdog fisheries in EC waters. Nevertheless, it does demonstrate that the fish are surviving being discarded, and it is hoped that further recaptures will be made over time. Indeed, it should be remembered that, in the past, tagged spurdog have been returned after 40 years at liberty!

Even though longlining and the use of bait strippers can damage the jaws or fish that escape or are discarded, a variety of dogfish species, including spurdog, show evidence of such damage having healed in fish taken in trawl surveys (Figure 11).



Figure 12: Trawl-caught spurdog showing evidence of prior damage to jaws that was healing.

Length–weight relationship

Although no data on the weight of individual fish could be recorded in the current project, the species has been subject to biological investigations on Cefas groundfish surveys sampling in the Irish and Celtic Seas as part of the internationally coordinated southern and western International Bottom Trawl Survey (IBTS). Length–weight data were available for 890 spurdog (covering a length range of 22–117 cm and a weight range of 44–8.6 kg), and the relationship between total length (L , cm) and total weight (W , g) was defined by the equation $W = 0.0026L^{3.101}$ ($r^2 = 0.99$; Figure 12).

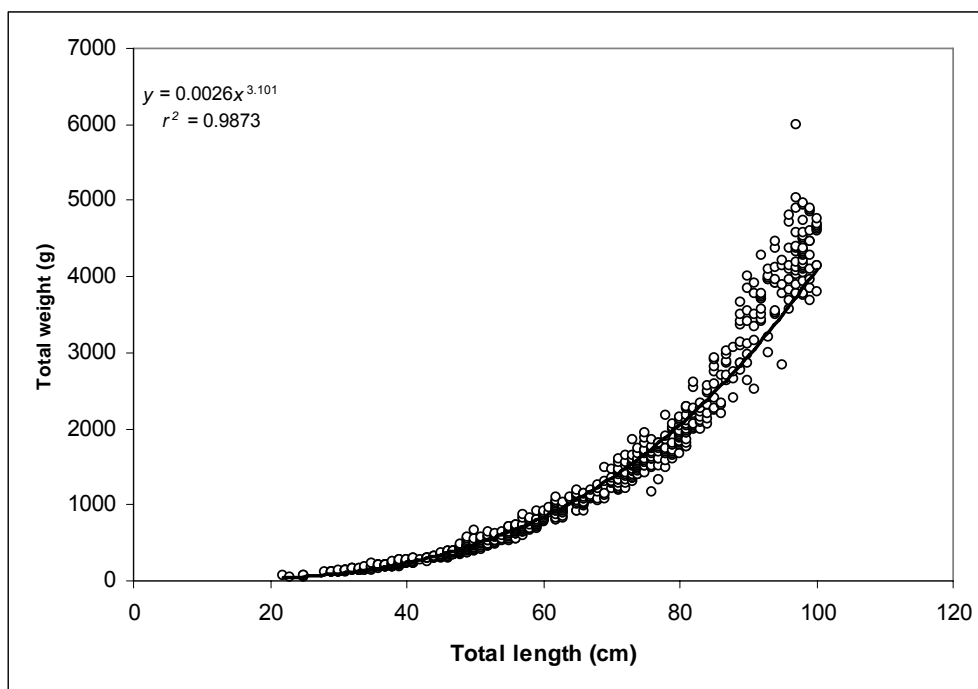


Figure 12: Length–weight relationship for spurdog ($n = 890$)

Acknowledgements

We thank the skipper and crew of the *Sarah H* for their hard work and support during the course of the surveys.

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Appendix I: Detailed Operational Plan

Detailed Operational Plan agreed for the survey

1. Vessel: Sarah H

2. Skipper: Jonathan Henson

3. Agent: Solitaire Marine Services

4. Port of operations: Holyhead

5. Period and location of Survey: 4 trips (each one of four days per trip). Total survey time not to exceed 16 days. To be conducted during the period between 1st March and 15th November 2009. Vessel can fish within ICES area VIIa for the period of the survey. Provisional agreed sailing dates are end of March/April, mid-May/mid-June, August and October. These dates are not fixed, for instance if bad weather delays operations. The vessels will sail to and from Holyhead subject to operational and safety considerations. Trips may stay out overnight, depending on catches, sea conditions, and staff availability. The maximum number of working hours per day per Cefas staff member should still fall within the maximum allowance stated in 9 below.

6. Quota: Vessel will be off quota and the relevant dispensation from European Council Regulation 850/98 will be issued, as will exemption from the maximum landing size in Council Regulation 43/2009. This is to be carried onboard by Cefas representative scientist all times onboard during the survey. The dispensation will only be valid if the terms of the dispensation are met in full. Cefas will make arrangements with Defra for the dispensation to be issued.

7. Primary aim of the survey: To target spurdog with longlines, record catches, tag and release some fish to estimate discard survival, collect length-frequency information and maturity information for fish that are not tagged.

8. Why do this survey? The data obtained will demonstrate the discard survival of spurdog after capture in longline fisheries, it will also allow for catch rates to be examined, and for the reproductive stages that occur in the area to be examined over the course of the year. The collection of length frequency data can be viewed in the context of the effects of the recently established Maximum Landing Length.

9. Fishing operations: After sailing, feeler lines will be used to identify potential sites for setting the main lines. Feeler lines (2 strings of 30 hooks) will be deployed (the position and depth to be recorded), and the catches quantified. Fish from these lines will likely be sexed, measured, tagged and released. Main lines will also be set, with the number and location deployed dependent on the catch rates observed on the feeler lines, and tidal state etc. The skipper will decide exactly when and where to deploy the longlines to ensure appropriate sampling. Each box of lines contains 220 hooks, and under normal circumstances 4 lines each comprising 4–6 boxes will be deployed. The number of boxes in each string and the position (latitude, longitude and depth) of the lines will to be recorded. On hauling the main lines, a number of fish will be tagged and released (up to ca. 100 spurdog per day, including those captured in the feeler lines). Remaining fish (or a representative sub-sample) will be measured and maturity data collected from a sub-sample.

Sufficient time must be allowed for the catches from the main line to be processed by the Cefas scientist prior to hauling subsequent lines.

As specified in the Tender (A.4.5), no commercial fishing in addition to the lining specified in the Detailed Operations Plan will be allowed at any time during the period of the survey.

Landed fish should be recorded in logbooks and will need to be signed by the ILO as FSP-derived before they are returned to the MFA, so that off-quota catches can be recorded.

It should be noted that scientific staff work under the Working Times Directive, and as such should not generally work more than 13 hours per day and have 8 hours continuous rest per 24 hour period.

10. What data need to be recorded?

a) Haul details

Date / Time / Position of lines (Markers buoys latitude and longitude) / No. of boxes / No. of hooks/box / Depth range / ICES rectangle / Time of shooting / Time of hauling / Soak time / Any other useful comments such as tidal flow, weather etc.

b) For tagged spurdog

Sex, length, health state, maturity (males only), tag number and release position (only if very different to haul details). If tope or greater-spotted dogfish are taken, then these may also be tagged and released if time permits. It is hoped to tag and release in the range of 100 spurdog per day.

c) For Untagged fish

Species, sex, and length for all fish (or a representative sub-sample of each grade of spurdog if they are taken in exceptionally high numbers) will be recorded.

For a sub-sample of fish, maturity data will also be collected. Females will be cut open and the reproductive stage and number of pups recorded.

11. Crew and skipper. The crew are to be available to assist the Cefas scientist on board whenever requested / required. The skipper will retain the usual authority and responsibilities and has the overriding responsibility to ensure safety of the vessel and all persons aboard.

12. Cruise reports. On completion of each of the trips a short summary of the cruise, including successes and failures, points of interest should be compiled by the Cefas scientist. The skipper / owner should be shown and sign agreement with the contents of that report.

13. Scientist seagoing qualifications. The onboard Cefas scientist must bring all necessary seagoing qualifications with him/her during the trips.

I agree to adhere to this detailed operational plan

..... on behalf of CefasDate

..... Skipper Sarah HDate

Appendix II: Trip reports

Vessel: MFV Sarah H

Port: Holyhead

Aims:

- 1) To evaluate the role of spurdog in longline fisheries and examine the catch rates and sizes of fish taken in a longline fishery
- 2) To provide biological samples so that more recent data on the length at maturity and fecundity can be calculated
- 3) To tag and release a number of individuals to inform on the potential discard survivorship from longline fisheries.

Trip 1

Dates: 31 March – 02 April 2009

Staff: Shaun Doran, Frank Armstrong

Narrative:

The MFV *Sarah H* sailed from Holyhead at 05:30 hrs GMT on Tuesday 31st March 2009. After a 90 minute steam the vessel shot two feeler lines of 40 hooks each (80 hooks total) with a soak time of 40 minutes. A further five sets of feeler lines were shot during the course of the day with three main lines shot in the vicinity of the third feeler line. The main lines comprised 1 750 hooks, and the soak times ranged from 3–3.75 hrs. Following successful completion of the fishing, MFV *Sarah H* returned to port at 18:00 hrs GMT.

The following day MFV *Sarah H* sailed from Holyhead at 06:30 hrs GMT and after a two hour steam shot a set of feeler lines (80 hooks total) for a soak time of 25 minutes. A further five sets of feeler lines were shot during the course of the day, but catches were low and no main lines were shot that day. MFV *Sarah H* then returned to port, arriving back in Holyhead at 20:00 hrs GMT.

On 2nd April, MFV *Sarah H* sailed from Holyhead at 05:30 hrs GMT and following a 90 minute steam a set of feeler lines (80 hooks total) were shot with a soak time of 20 minutes. A further four sets of feeler lines and two main lines were shot (1 750 hooks, soak time 2–3 hrs), and following successful fishing operations the vessel arrived back in Holyhead 20:00 hrs GMT.

Trip 2

Dates: 20–23 May 2009

Staff: Gary Dunlin, Jim Ellis (day 1 only)

Feeler lines of 40 hooks were baited and set at various locations to search for the presence of spurdogs. If the feeler lines caught large numbers of spurdog, then main lines consisting of some 1400 hooks were to be shot and set for 40 minutes or so. Spurdog caught on feeler lines were measured, sexed, tagged and released. If the specimen was a male its sexual maturity was determined from the size of the claspers. Other fish caught were recorded, with other elasmobranchs (excluding lesser-potted dogfish) also tagged and released (e.g. tope and greater-spotted dogfish). If mainlines were set then any catch from this would be measured and tagged if alive and, if dead, the females were to be dissected to record sexual maturity and fecundity. If numbers were to great then sub-sampling would be carried out. A work station was set up mid ships so that fish could be passed over and sampled.

20 May: This trip concentrated on an area immediately around Holyhead so that the trip could be completed in one day allowing Cefas personnel to train the sampler for the rest of

the trip. Feeler lines were laid to the west of Holyhead with little success. Various stations were tried moving south then east and back north in a circular route. One spurdog was caught along with a tope and a few greater-spotted dog fish. All were tagged and recorded. The weather got progressively worse making the sampling difficult and the vessel returned to port.

21–22 May: As no spurdog was caught in the vicinity of Holyhead it was decided to steam further west to extend the search to other stations. This required the vessel to stay out overnight due to the distances needing to be steamed between stations.

Feeler lines were set mid way between Holyhead and Ireland on a bank known to attract spurdog, but with little success and little sign of any species. The search was extended to the coast of Ireland and stations explored along various depths heading south. Very strong tidal conditions slowed down the steaming considerably but the vessel moved steadily south. One station produced a single spurdog so further feeler lines were laid in the hope this animal could have been on the edge of a small pack. There was no further catch from this area and the vessel moved on to other stations. Overall, one spurdog and several greater-spotted dogfish were caught and tagged.

23 May: The search was concentrated to the north of Holyhead to complete a search of the whole local fishing grounds. No spurdog were caught and a few greater-spotted dogfish were tagged. The weather deteriorated and the vessel headed home with this sampling trip over.

Trip 3

Dates: 9–12 September 2009

Staff: Stuart Hetherington (9-11 September), Nigel Skea

The FV *Sarah H* sailed from Holyhead at 05:00 on 9th September 2009. Following a 2 hour steam (approximately), the skipper and crew shot a pair of feeler lines (40 hooks each) north west of the Skerries at 53° 26.00'N, 04° 48.47'W. The lines were left to soak for 30 minutes and then hauled. No spurdog were caught (although 11 lesser-spotted dogfish, *Scyliorhinus canicula* were taken) and so the skipper headed north, 20 miles (approximately) south east of the Isle of Man. During the passage north, 4 feeler lines were shot over ground likely to yield good catches of spurdog, but to no avail. Instead the 4 feeler lines caught only five lesser-spotted dogfish.

Upon reaching the fishing ground south east of the Isle of Man at approximately 13:00, 6 feeler lines were shot over a 4 hour period, left to soak for ~30 minutes and then hauled to locate the presence of spurdogs, but again with no success. Thirteen 13 lesser-spotted dogfish and 3 greater-spotted dogfish (*Scyliorhinus stellaris*) were caught. During the evening, fishing with 4 feeler lines moved east, and south, but with no success apart from catching 16 lesser-spotted dogfish and one greater-spotted dogfish.

During the early hours of 10th September 2009 the decision was taken to abandon fishing in this area and steam south of Holyhead. The opportunity to 'turn-in' was taken and fishing recommenced at 05:10 on 10th September 2009, shooting 2 feeler lines in the vicinity of 53°N 17.76, 05°W 00.60. No spurdog were caught, with one feeler line being lost, so fishing moved to the west and south, shooting a further 4 feeler lines, catching only 19 lesser-spotted dogfish.

The greater-spotted dogfish that were caught were measured, sexed (males were maturity staged from the claspers), tagged with Petersen discs) and released. This was done with the assistance of Mr Nigel Skea with the purpose of training him to conventionally tag spurdog and to gather other biological information, in a competent manner, in the absence of a Cefas scientist aboard. The FV *Sarah H* returned to port at 13:00 on 10th September 2009.

The following day the FV *Sarah H* sailed from Holyhead at 06:00, steamed for one hour and shot two feeler lines, north east of Holyhead at 53° 23.80'N, 04° 46.70'W. The search over likely and local fishing grounds continued throughout the day, shooting a further 11 feeler lines. Although no spurdog were caught during this third day, 41 lesser-spotted dogfish and 10 greater-spotted dogfish were brought aboard the vessel. The greater-spotted dogfish were again measured, sexed (males were maturity staged from the claspers) tagged and released. The FV *Sarah H* returned to port at 17:30 on 11th September 2009.

As no spurdog had been caught during the initial three days, the Cefas scientist was unable to provide species-specific training, although training had been provided by measuring, sexing, tagging and releasing greater-spotted dogfish. A full and detailed explanation of the data record sheets was provided to the skipper and Mr Nigel Skea and they were deemed competent and suitable to complete the tasks delegated to them in the absence of a Cefas scientist on the fourth day of the survey.

FV *Sarah H* sailed from Holyhead on 12th September with Mr Nigel Skea working for Cefas, and steamed northwards to the Isle of Man. The first two feeler lines yielded no spurdog, and so the *Sarah H* continued north to an area south of the Mull of Galloway. Here a feeler line was set, and with reasonable numbers of spurdog captured, two main lines were set (each with 2,200 hooks) just after 23:00. With good numbers of spurdog captured, *Sarah H* steamed southwards docking in Holyhead on the morning of the 13th September. Overall, 81 spurdog were tagged and released and sub-samples examined for maturity and size frequency.

Trip 4

Dates: 22–23 October, 4, 10 December 2009

Staff: Jennie Keable (days 1-2), Nigel Skea

The FV *Sarah H* sailed from Holyhead at 07:00 (BST) and headed north-west, and the first two feeler lines were set at 8:10 (BST). The wind was SW4-5 and freshened during the day. Two more feeler lines were set further north with little success. The *Sarah H* then headed further north and set three main lines (of 3, 4 and 5 boxes respectively). After two hours soak the lines were recovered and a sample of spurdog was tagged. The remaining spurdog were measured and a sub sample of the females were sampled for maturity and fecundity after the *Sarah H* docked at approximately 19:30 (BST). During the day, 63 fish were tagged and released (including 53 spurdog, eight greater-spotted dogfish and two tope), 138 spurdog were measured and 14 female spurdog were sampled for maturity.

The following day, the *Sarah H* sailed from Holyhead at 08:00 (BST) and headed north, setting the first two feelers just before 10:00 (BST). The *Sarah H* then continued north east setting 4 more feelers with little success. After heading further north-east, three main lines of 4 boxes each, were set. After two hours soak the lines were recovered with very few fish. All the spurdog caught and a number of tope and greater-spotted dogfish were tagged and released. *Sarah H* docked at approximately 20:00 (BST). During the course of the day, 49 fish were tagged comprising 19 spurdog, 25 greater-spotted dogfish and five tope.

The final two days of this trip were delayed by an extended period of very poor weather during November. *Sarah H* undertook the final two days on the 4th and 10th of December, operating on those grounds just off Anglesey. Four sets of main lines were set on the 4th December, yielding good catches of spurdog, with 37 tagged and released and the catches for the first three lines fully sampled for length-frequency. The catches from the fourth line was sub-sampled. Thirty three spurdog were sampled for maturity and fecundity. Five main lines were set on 10th December, with sub-samples of fish measured and 63 sampled for maturity and fecundity.

Appendix III: Comments from skipper

Thank you for the final report, I feel the Survey went well and found it very interesting. The first four days I feel, were a very accurate picture of Spurdog in Irish Sea at that time of the year. The second four day period - May - has always been a very poor time of year, even when Spurdog were in huge numbers they were often not seen to be caught in longlines at this time, though trawlers saw an increase in this same period. I feel they can lie dormant on the sea bed for long periods of time. The third four day survey was disappointing on the first three days, where I would have expected to see more fish in a local area around Anglesey. Day four was a success, but this meant travelling up to the Mull of Galloway which is one of the best fishing grounds for spurdog at this time of year.

On the final four day survey we shot large amounts of baited hooks on each day regardless of feeler catches, this provided fish on each day but is a practice known as Kamikaze due to the unknown quantity of fish on the sea bed.

In conclusion I feel this was not a good year for spurdog in the Irish Sea and feel though stocks are depleted, I would have expected to see more abundance of fish, especially in the summer period, we do have good and bad years and always have had in this fishery. Now I feel, to have a true picture of spurdog numbers and recovery, another survey next year would be a very interesting exercise.

Finally, now there is a zero TAC on spurdog this will inevitably lead to discards, which will not help the recovery at all!

Jonathan Henson

Skipper – Sarah H GY377