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Fisheries Research 71 (2005) 121–124
FISHERIES RESEARCH
www.elsevier.com/locate/fishres

Short communication

The survival of discarded lesser-spotted dogfish (*Scyliorhinus canicula*) in the Western English Channel beam trawl fishery

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Received 9 January 2004; received in revised form 16 July 2004; accepted 26 July 2004

Abstract

A large number of lesser-spotted dogfish (*Scyliorhinus canicula*) are caught and discarded in the Western English Channel beam trawl fishery. Using onboard survival aquaria, the survival rate of such fish discards was estimated to be very high (98%). The fish had been subjected to harsh conditions during the capture, towing and deck-sorting processes suggesting that the species is relatively resilient to such rigours.

Keywords: Lesser-spotted dogfish; *Scyliorhinus canicula*; Discards; Elasmobranch; Survival; Beam trawl; Western English Channel

1. Introduction

In many trawl fisheries a large number of non-target species are captured alongside the target species (e.g. Hall, 1996; Crowder and Murawski, 1998; Stobutzki et al., 2001a,b). Unwanted by-catches and discarding are regarded as an unacceptable waste of natural resources, and may have a variety of adverse population, food-web, ecosystem and conservation consequences. Determining the survival rates of discards is a key stage towards understanding these wider consequences.

In the mixed catches of the Western English Channel beam trawl fishery, a large number of lesser-spotted dogfish (*Scyliorhinus canicula*) are caught (ca. 55,700 fish in 1158 observed hauls). Most fish are discarded (>99%), but we could find no information on their survival rate in this fishery. Understanding discard survival alongside other sources of mortality and mortality patterns will contribute to a better understanding of their population dynamics (Bonfil, 1994; Stevens et al., 2000).

The Western English Channel is located in ICES rectangle VIIe and supports a diverse demersal fish assemblage (Rogers et al., 1998, 1999). The fishing grounds are regularly exploited by a number of beam trawlers, primarily from the English ports of Brixham and Plymouth.

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0165-7836/$ – see front matter © 2004 Elsevier B.V. All rights reserved.
doi:10.1016/j.fishres.2004.07.006

The aim of this work was to determine the survival rates of discarded lesser-spotted dogfish in the Western English Channel beam trawl fishery that had been exposed to the commercial processes of capture, towing and deck-sorting.

2. Materials and methods

2.1. Location, time of study and vessel

The study was conducted aboard a commercial beam trawler working south of Devon in the Western English Channel in ICES statistical rectangles 29 E6 and 29 E7 (Fig. 1) during winter 2002 and summer 2003. Fewer trials were completed during winter than in summer owing to the poor weather conditions in winter, which made ship-borne aquarium trials problematic. The commercial beam trawler 'Jacoba' (BM77) (length overall, 27 m; gross tonnage, 108; main engine, 537 kW) was chartered for the duration of the study. The vessel was rigged for twin 8 m beam trawling using chain matrix ground gears and trawls with a codend mesh opening of 80 mm. It is a vessel typical of the fleet.

2.2. Tows and catch processing

All tows were conducted in a manner reflecting normal commercial practice. The tows were 2 h long and conducted at a towing speed of 4–5 knots over the ground in waters 60–80 m deep. The catches were emptied directly onto a purpose-sectioned area of the deck and the crew sorted the catch in the usual manner, selecting for target species (primarily flatfish).

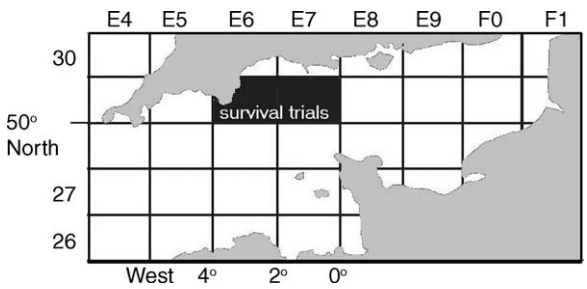

Fig. 1. Location of the survival trials and beam trawl surveys in Western English Channel.

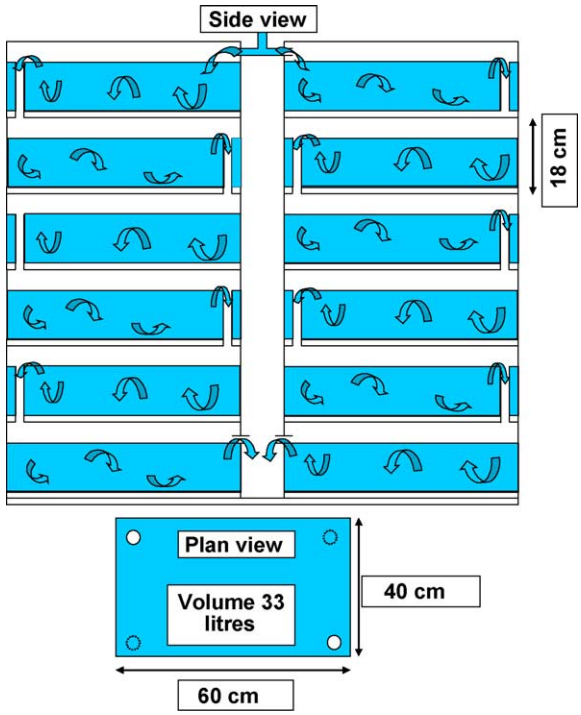

Fig. 2. Schematic of the survival tanks. The upper portion shows a front view and the lower portion shows a view of one tank from the top.

This invariably involved the crew walking among and over many discard fish. After 20 min of sorting, lesser-spotted dogfish were removed from the catch and transferred to a rack-mounted system of plastic survival tanks (Fig. 2). There were no control fish.

2.3. Sampling

Four fish were randomly removed from each tow during six separate tows until the tank system was full, with 24 dogfish. The 12 tanks were stocked at a density of two fish per compartment and contained no substratum material. They were supplied with a constant flow of fresh seawater (10–15 l/min) and no feeding took place during the subsequent observation period (Table 1). The average observation period was 48 h. The tanks were secured inside the forward shelter deck and were therefore subject to some vessel motion. The whole procedure was repeated a total of five times, providing survival data from 120 fish taken from 30

Table 1
Survival rate of discarded lesser-spotted dogfish (*S. canicula*)

Date	Observation period (h)	Number of fish placed in survival tanks	Number of fish alive after observation period	Number of mortalities	Time of death (h)	Survival rate (%)
December 2002	60	24	22	2	0[a]	92
July 2003	48	24	24	–	–	100
July 2003	48	24	24	–	–	100
August 2003	48	24	24	–	–	100
August 2003	36	24	24	–	–	100
Total	Mean = 48	120	118	2	0	Mean = 98

[a] Both fish.

separate commercial tows. The body length of the fish ranged from 40 to 70 cm (measured to 1 cm below) and fish < 40 cm were not caught during the trials, suggesting that they were either not encountered or not retained by the trawl.

The fish were observed once daily and declared dead if they had stopped respiring, moving and exhibited *rigor mortis*. Following identification, dead fish were removed from the aquarium system and excluded from further study.

3. Results

3.1. Survival rate

In all, 120 fish from 30 separate tows in five different trials undertaken in both summer and winter were used in the survival analysis. Only two of the 120 fish studied failed to survive the 48 h trials, indicating that the discarded dogfish exhibited a very high survival rate of 98%. Many animals were weak, lethargic and apparently disorientated when first placed in the tanks, but most of those surviving were lively and difficult to handle after 48 h, suggesting recuperation within the observation period.

4. Discussion

The lesser-spotted dogfish caught during this study had been subjected to harsh conditions. They had passed through heavy chain matrix ground gear and had been towed for up to 2 h at 4–5 knots inside the nets. While in the trawl nets the dogfish would have been exposed to a constant abrasive barrage of suspended sediment, consisting of stones, shells and debris 'kicked up' by the chain matrix. Underwater camera footage taken during the trials confirmed the high level of suspended material. They would have been subject to increased compression in the codend as the catch accumulated. Once aboard they were exposed for 20 min to air and direct sunlight and had no contact with seawater, and many were stood on as the catch was sorted. Some fish had been buried for much of their time on deck in sand/shells/benthos, which sometimes filled their mouths and gill openings. Despite these harsh conditions, as well as vessel motion while in the survival tanks, the majority (98%) survived and appeared to have fully recuperated within 48 h.

The species appears to be robust and able to survive the rigours of capture and discarding, suggesting that they will survive discarding in most other mobile fisheries, in cases where the conditions experienced by the fish are similar or less harsh.

Rodriguez-Cabello et al. (2001) reported broadly comparable survival rates for discarded lesser-spotted dogfish (average, 78%; range, 47–91%) in studies undertaken aboard otter trawlers off the northern coast of Spain. However, it is difficult to make direct comparisons between this study and that of Rodriguez-Cabello et al. (2001) because the latter study used longer tows (3–6 h), in deeper water (106–357 m) and longer deck-sorting times (18–85 min). The criteria used to declare a fish 'dead' also differed between the two studies. It is possible that these factors, or other non-quantified factors could account for the different survival rates obtained in the two studies, rather than the different fishing techniques themselves. However, both studies produced high estimated survival rates for discarded lesser-spotted dogfish within 25% of each other, so are at least in broad agreement.

Compared with other elasmobranches, the life history of lesser-spotted dogfish is unusual; it has a relatively small maximum body length, it matures young and has fast somatic growth rate and intrinsic rate of population increase (Pastoors, 2002; Rodriguez-Cabello et al., 2002; Frisk et al., 2002). Consequently, the relatively minor mortality associated with discarding would be expected to have little impact on its population dynamics. Small-bodied elasmobranchs have been found to increase in abundance as other species have declined (van der Elst, 1979; Murawski and Idoine, 1992; Walker and Heessen, 1996; Rogers and Ellis, 2000). This has been explained by their relatively short life histories (Dulvy et al., 2000; Stevens et al., 2000) and/or the increased availability of food subsidies from discarding (Walker and Hislop, 1998). This study suggests it may be worth also considering discard survival rates of elasmobranchs to help understand such patterns.

This study would support the idea that lesser-spotted dogfish might proliferate in heavily fished waters where more susceptible species were removed or killed by such mobile fishing gears.

Acknowledgments

The authors acknowledge the assistance of the owner and crew of the M.F.V. ‘Jacoba’ during sampling, the survey data retrieval of John Cotter (CEFAS) and Alex Tidd (CEFAS), the manuscript review of Andrew Payne (CEFAS), the financial support of Defra.

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