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Results of bass tagging in Poole Bay during 1992

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CONTENTS Page

1. Introduction 5

2. Patterns of bass movement 5

3. 1992 Poole Bay tagging 5

4. The tags 5

5. Log-books 7

6. Seismic survey 7

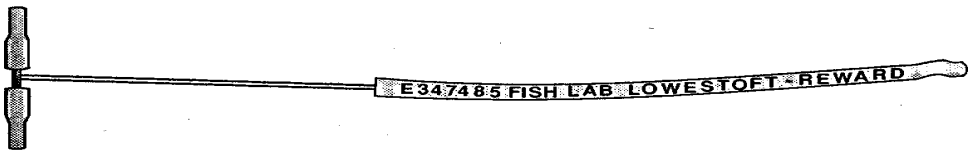
7. Pattern of recaptures 8

8. Interpretation of the tagging results 8

9. Catch rates of bass in 1992 10

10. Discussion 10

11. Further reading 11



Hallprint 'T' bar tag (shown at about twice actual size)

1. INTRODUCTION

During the summer of 1992, while carrying out a seismic survey to the west of the Isle of Wight, Elf Enterprise provided sponsorship to extend the bass tagging programme carried out along the south coast by MAFF's Directorate of Fisheries Research since 1984. The intention was to provide the bass biologists with an opportunity to learn more about bass distribution and movement, as well as to assess local catch rates during the course of the survey. The aims of the work were to tag bass in the vicinity of the seismic survey — an area in which no bass had been tagged before — and to compare their movements with those of bass tagged in adjacent areas. The tagging experiments were carried out by Fawley Aquatic Research Laboratories Ltd (FAWLEY arl Ltd) and the returns have been analysed at the Fisheries Laboratory, Lowestoft.

2. PATTERNS OF BASS MOVEMENT

Extensive tagging carried out in the English Channel and on the east and west coasts during the 1980s suggests that bass of all sizes generally move only short distances from coastal tagging sites during summer and early autumn in the year of tagging. Juvenile bass also tend to stay fairly close to their coastal haunts in winter, but from November onwards adult fish range further afield. Some adults migrate to warmer, deeper waters off south-western coasts, before returning in late spring, often to the areas where they were originally tagged. Other young adults (36-45 cm) emigrate and are caught subsequently in other fisheries. Under normal circumstances, therefore, the pattern of recaptures of bass tagged in Poole and Christchurch Bays and the Solent would be expected to be similar to that shown in Figure 1.

3. 1992 POOLE BAY TAGGING

During the summer and autumn of 1992 FAWLEY arl Ltd, under the guidance of MAFF's Directorate of Fisheries Research, carried out an extensive tagging exercise in Poole Bay (ICES rectangle 30E8) in areas normally fished by bass fishermen adjacent to the area of the seismic survey. Between 22 May and 24 October, 1248 bass were tagged and released using two chartered commercial boats working out of Poole. Fishing was concentrated at the eastern and western ends of Poole Bay and in the area around the entrance to Poole Harbour. The fish were caught using rod-and-line with live sand eels as bait. The tagging areas and the location of the seismic survey, which lasted from 1 June to 14 October, are shown in Figure 2. Bass caught by the boats involved in the tagging tended to be small, although the average weight of the tagged fish (0.6 kg) was similar to that landed by other vessels that fished from Poole and Swanage during the summer and autumn of 1992. Most (830 or 66%) of the tagged bass were above the minimum landing size (MLS) of 36 cm and most of the rest (418 fish) were expected to reach the MLS by the end of 1992, or the beginning of 1993. Fish caught at the eastern end of Poole Bay (length range 28-53 cm; mean length 36.5 cm) were mostly smaller than those caught at the western end of the bay (length range 33-56 cm; mean length 39.8 cm), probably because smaller fish are usually found in shallower water. At site A the water was 24-30 m deep; at site C, which was closer inshore, it was only 7-9 m deep.

4. THE TAGS

Hallprint 'T'-bar anchor tags (frontispiece) were used to mark the fish and each tag incorporated an orange-coloured 'streamer' with a unique number and a return message. The tag was attached via

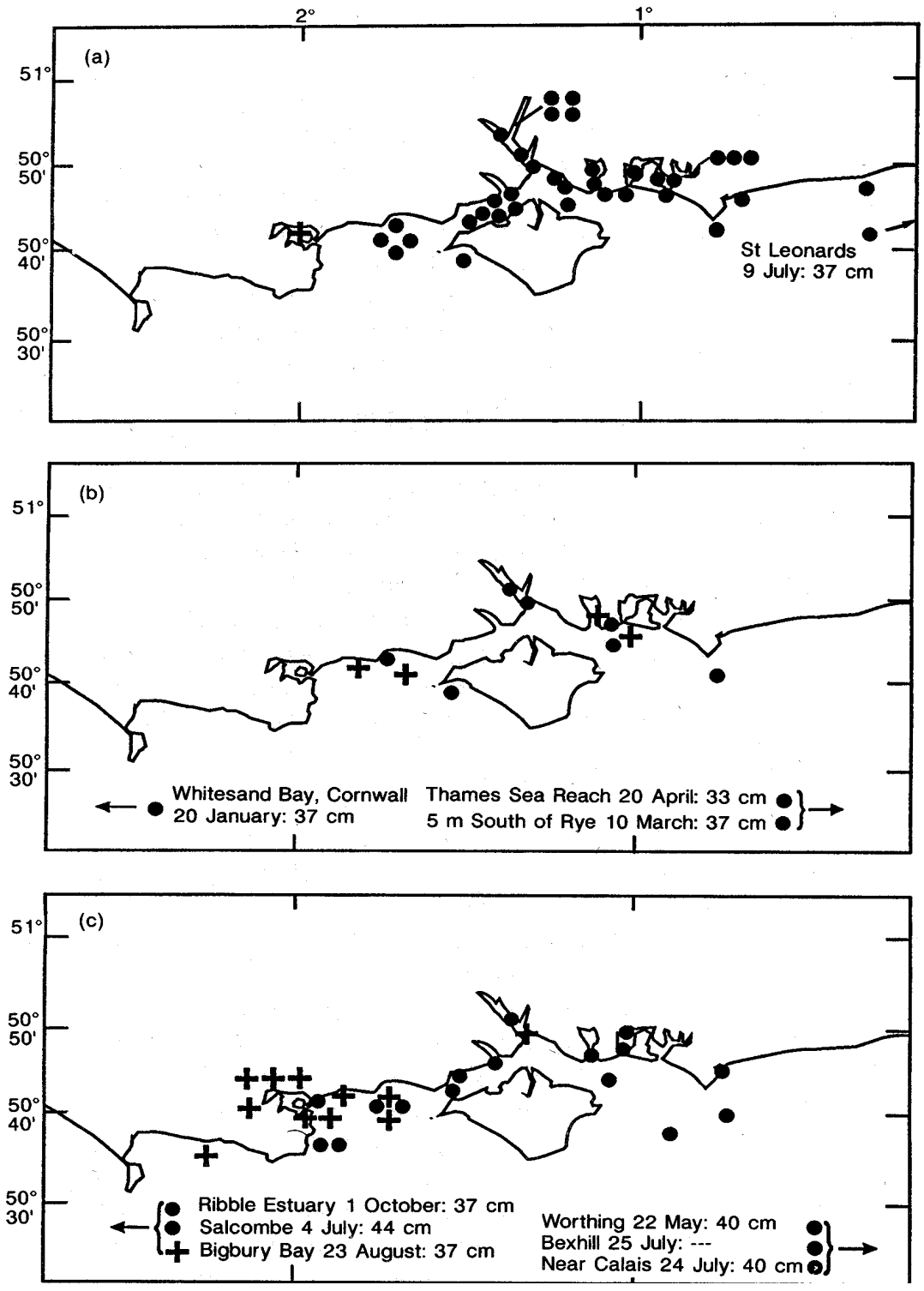


Figure 1. Recaptures of bass: (a) during May-October in the year of release; (b) during the following November-April; and (c) between May-October in subsequent years. MAFF tagged 1213 bass in the eastern Solent and Langstone and Chichester Harbours (●) between 1984 and 1993. The fish were 28-71 cm long (mean 34.3 cm) on release and there have been 67 (5.5%) returns to August 1994. MAFF tagged a further 138 bass (>28 cm) in Poole Haven (+) between 1989 and 1991 and 18 (13%) have been returned (including one winter recapture not shown here)

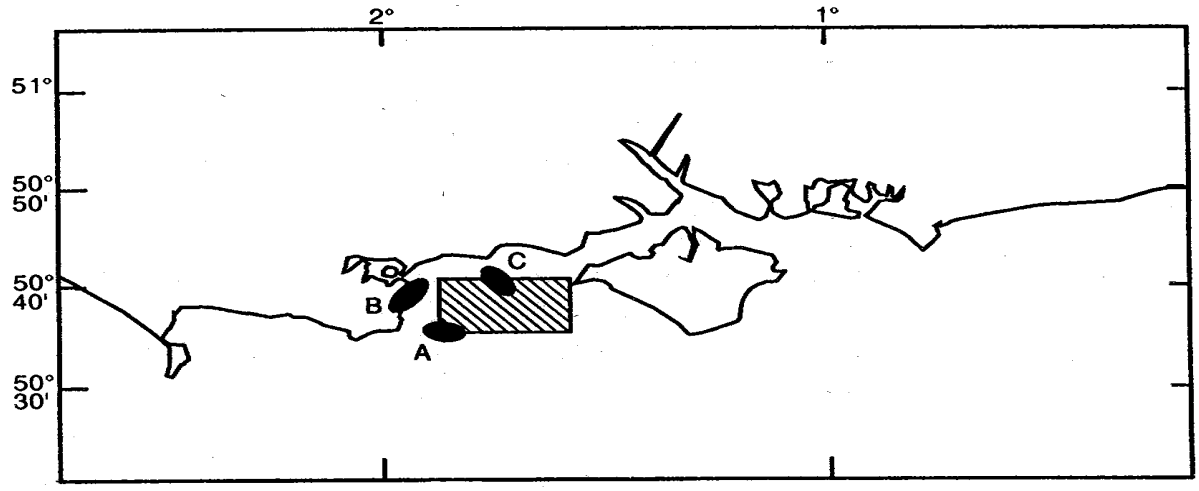


Figure 2. The location of the three tagging sites in relation to the seismic survey area (hatched) in Poole Bay

a small incision approximately 2 cm in front of the vent and 2 cm up the side of the body. A small sample of scales was then taken from the area behind and above the tip of the pectoral fin; these scales were subsequently used to estimate the age of the fish. Total length was recorded to the nearest centimetre, and the condition of the fish was noted on its return to the water. Tag returns were reported to the Directorate of Fisheries Research at Lowestoft, where they were collated using the laboratory's fish tagging data base. Tag returns for which there were no specified recapture positions were excluded from the analysis of the data.

5. LOG-BOOKS

Catch log-books were distributed to 12 skippers who fished in the survey area from ports around Poole Bay and the Isle of Wight, and had volunteered to provide daily records of their catch throughout the period of the seismic survey. Seven log-books were completed and returned, six of them by boats using baited hooks and lines to catch bass on or close to the bottom. The catch data were analysed by standard statistical methods. (These methods assumed that the data followed a Poisson-type distribution and included a routine correction to allow for larger than expected variances).

6. SEISMIC SURVEY

The seismic survey vessel towed two arrays of air guns, which were fired alternately to produce a pressure pulse approximately every 10 seconds. Each array was 14.3 m long and consisted of 8 air guns with a total volume of 20 litres and an operating pressure of 135 bar. The source level pressure of the air gun array (202 dB re 1 μPa Hz^{-1} at 1 m) was about 2.5 times less than that typically used for seismic surveys in the deeper waters of the North Sea. The seismic survey comprised 17 east-west transect lines, each 18 km (10 nautical miles) long. Towing speed was approximately 3.5 knots and towing depth 3 m. The survey lasted from 1 June to 14 October 1992.

7. PATTERN OF RECAPTURES

By the end of 1993 there were 152 returns (4 without positions) of tagged bass (12%). This was a significantly ($P < 0.001$) higher return rate than that (5-6%) recorded for similar bass tagging experiments in the Solent between 1984 and 1993 but similar to returns (13%) from tagging in Poole Haven betweeen 1989 and 1991. Although the recapture positions ranged from the southern North Sea in the east to Start Point (50° 10'N 3° 38'W) in the west, most of the returns were from inshore waters. The net movement of most fish was very limited, with 121 (82%) of the recaptures made within 10 km of the release position (Table 1). The size range of the recaptured fish was 33-49 cm (mean 39 cm).

Table 1. Shortest distances between positions of release and recapture of bass tagged in Poole Bay and Christchurch Bay in 1992

Season	Distance (km)			Totals
	0-10	10-50	>50	
May-October 1992	55	3	1	59
November 1992-April 1993	10	5	7	22
May-September 1993	56	8	3	67

Analysis of the recapture positions of tagged fish during the *summer and early autumn* of 1992 (May-October) showed no evidence of any overall emigration of the bass population. During this period 58 bass were recovered from the tagging area and one was caught in the eastern Solent (Figure 3(a)). Six of these fish were released at site A at the western side of Poole Bay and recaptured at site C on the eastern side of the bay; two fish were released at site C and recaptured at site A (Figure 2).

Over the ensuing *winter* period (November 1992 to April 1993, inclusive) a further 22 tagged bass were recaptured and 7 of these (32%) were caught outside the tagging area. Four were caught well offshore, three to the south-east of Start Point and one on Greenwich Bank (Figure 3(b)); all were longer than 36 cm. Most of the tagged bass (84%) recaptured during the *summer* (May to September) of 1993 were returned from within 10 km of their original release position (Figure 3(c), Table 1).

8. INTERPRETATION OF THE TAGGING RESULTS

The high number of recaptures of tagged bass from within a few miles of the original tagging position in May-October 1992 indicates little movement of the bass population away from Poole Bay during the period of the seismic survey and immediately afterwards. The pattern and range of recaptures (Figure 3(a)) was visually similar to that observed from the eastern Solent and Poole Haven releases in previous years (Figure 1(a)) when there was no seismic activity in the area. There appears therefore to have been no discernible effect on the distribution of tagged bass in the vicinity of Poole Bay while the seismic survey was in operation. Because the positions of recapture

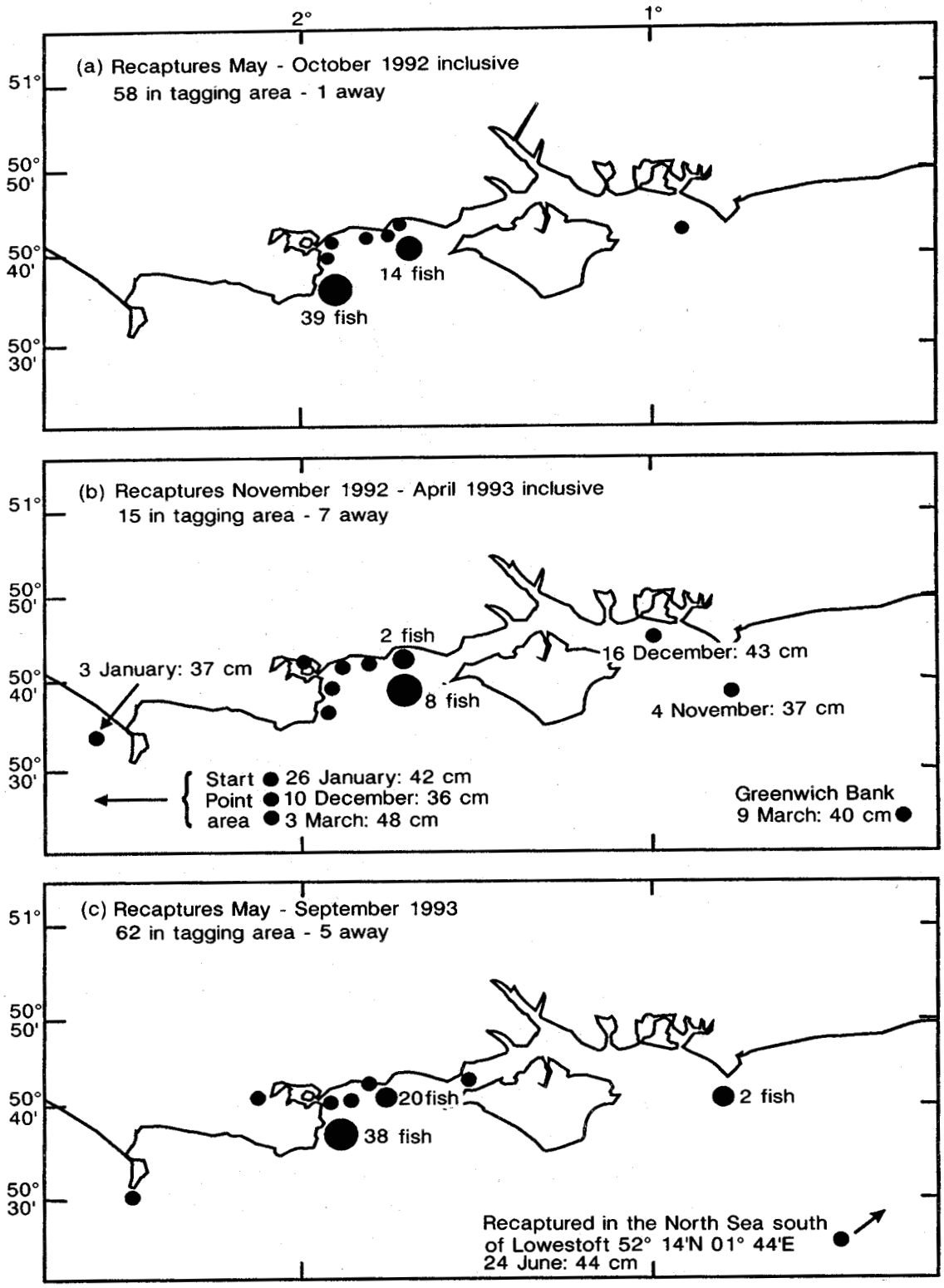


Figure 3. Recaptures of bass tagged by FAWLEY arl Ltd in Poole Bay in 1992 during the seismic survey: (a) during May-October 1992; (b) between November 1992 and April 1993; and (c) between May and September 1993. These fish were 28-56 cm on release (mean length 37.9 cm) and 1248 were tagged. There have been 152 returns (12%) to date

of tagged fish over the following winter and summer (Figure 3(b and c)) similarly conform to the pattern of returns observed in previous studies (Figure 1(b and c)), there appears also to have been no discernible cumulative or longer-term effects on the distribution and movement of this part of the Poole Bay bass population.

9. CATCH RATES OF BASS IN 1992

Six log-books were returned from fishing boats using lines and baited hooks, whose catches were most likely to be reduced if — rather than scaring the fish away — the noise made by the seismic air guns stopped the fish feeding. There was a wide variation in the total quantities and sizes of bass caught by the various boats over the period May to October, ranging from 172 bass with an average weight of 2.0 kg each to 1225 bass with an average weight of 0.6 kg each. The average size of bass caught by each boat remained fairly constant throughout the period, however. Two boats had very low catch rates (around 2 bass per day) but were known to also be catching other species. The highest average catch rate of landable bass (above the 36 cm minimum size) for a single boat over the whole period was 14.3 bass per day and the maximum rate in any one month was 27 bass per day (September). In addition to landable catch the boats reported a high proportion of undersize bass in their catches. The one vessel that kept an accurate record caught 4429 undersized bass and returned 3204 (72%) to the sea. Undersize fish were present on the fishing marks throughout the period.

The average catch rate of landable bass for the six boats combined was 5.4 bass per day in May and 6.3 bass per day for the period June-October. The overall average was 6.1 bass per day. Catch rates were 30% lower than the average in July and August (4.5 bass per boat day) and 30% to 120% higher than the average in June and October (8.4 and 14 bass per boat day (Figure 4)). The highest average catch rate (18 bass per boat day) occurred in October on the days when the seismic survey was in operation. This rate was three times higher than that recorded on days when the survey was suspended because of bad weather and the same pattern of catches was evident in July and September. At first sight this is an unexpected result but it seems likely that lower catch rates on non-survey days occurred because fishing was adversely affected by poor weather conditions in the same way as the seismic operations. On average, over the course of the whole survey, catch rates were about 23% lower on days when the seismic survey was not in operation but this reduction was not statistically significant ($P = 0.08$), probably because the data were unbalanced. The statistical analysis of the data showed that there were significant differences in catch rates between the boats and there were also significant differences in catch rates between months.

10. DISCUSSION

Although in no sense a controlled experiment, the Poole Bay observations suggest that the seismic survey had no discernible effect on either local catch rates, the average size of the fish caught, or the distribution and movement of bass in the area. In particular, the absence of recaptures outside the survey area during the period of the seismic survey suggests that there was no large scale emigration of fish as a result of the seismic air gun operations. If true, this observation contrasts with the results of earlier, controlled experiments in deep water (200-300 m) in the North Pacific and in the Barents Sea. These experiments demonstrated pronounced reductions in local catch rates of redfish

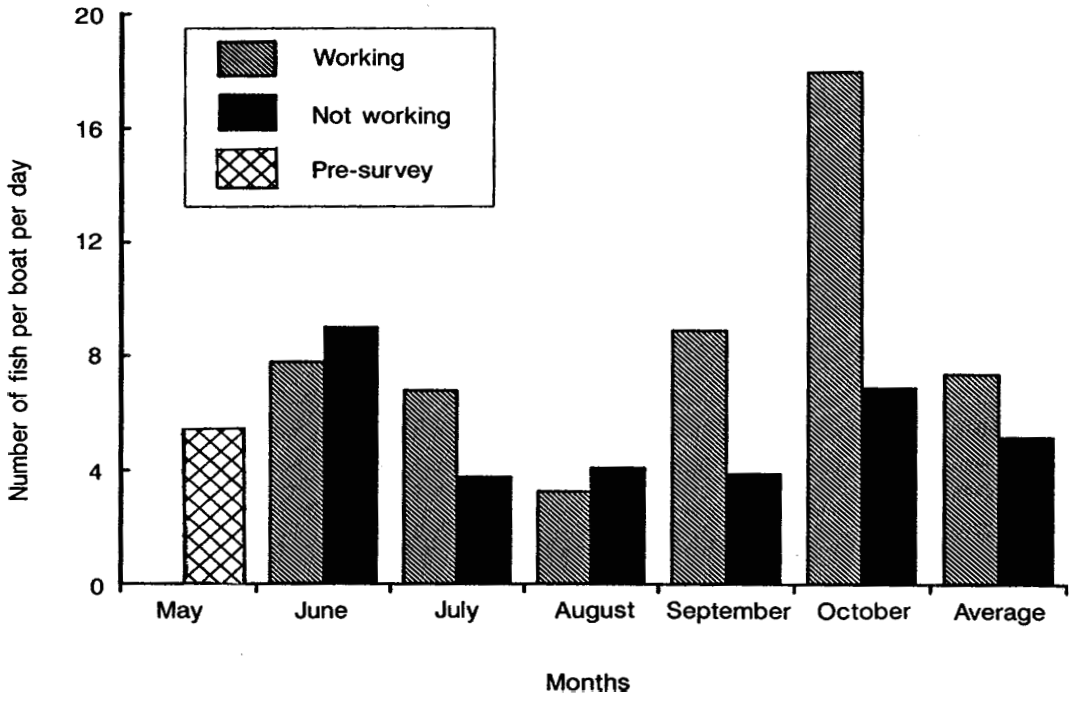


Figure 4. ***Catch rates (numbers of fish per boat per day) from six boats fishing for bass with baited lines in Poole Bay during the summer and early autumn of 1992. The catch rate in May before the start of the seismic survey was 5.4 bass per boat per day. During the period of the survey (1 June -14 October) catch rates are shown separately for days when the survey vessel was working and days when it was not, usually because of bad weather***

(*Sebastes* spp.) in the Pacific and prolonged effects on the local distribution of large (>60 cm) cod and haddock in the Barents Sea. One possible explanation for the contrasting results is that the seismic air guns used in Poole Bay were less powerful than those normally used in deeper water and will have produced proportionately less noise. The lower sound intensities may have been masked in the shallow waters of Poole Bay by ambient noise generated by waves and tidal currents. They may also have been less readily detected by bass of the size recaptured during the survey period, which were on average only about 39 cm long (max. 49 cm). These fish would probably have been rather less sensitive to sound than larger fish because of the smaller size of their swimbladders. A fish, such as a bass or a cod, has a closed gas-filled swimbladder which acts as an amplifier for incident sound and increases in volume as the fish grows. Further research is needed to confirm and explain the Poole Bay observations, in particular by investigating the propagation of seismic air gun sounds in shallow water and exploring the relationship between sound sensitivity and the volume of the swimbladder.

11. FURTHER READING

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