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EFFECT OF ATTRACTANT DISTRIBUTION ON CATCH RATE AND SIZE SELECTION OF NORWAY LOBSTER CAUGHT BY POTS

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ABSTRACT

In comparative fishing trials with Norway lobster (*Nephrops norvegicus*) pots, the attractant property of an aqueous extract of mackerel was tested against that of natural mackerel bait. The catch rate of the natural mackerel bait was three times that of the extract. There was also a clear difference in size selectivity, with mean total lengths of 19.3 and 16.8 cm for Norway lobsters caught on natural mackerel bait and mackerel extract, respectively. It is suggested that the difference in catch rate and selectivity are caused by a higher release of attractants from the mackerel bait with a corresponding larger field of smell distribution.

INTRODUCTION

Attraction of marine animals by bait is mainly utilized in fishing with longlines and pots. The attractants or chemical stimuli that are released from the bait are carried by the current, so that over time and expanding odour plume is established, which size and shape are mainly determined by the stimuli release rate and the current (Olsen and Laevastu 1983). Animals within the range of this plume may respond to the attractants by positive rheotaxis and move towards the bait, given that the animal is motivated for feeding and that the stimuli are potent (Atema 1980). To be potent, the stimuli must be of the right quality or chemical composition (Hara 1975; Carr and Derby 1986), and its concentration must exceed the animal's threshold for detection of attractants.

Several investigations have been done on the effect of bait type (quality) on catch rate and species selection (e.g. Martin and McCracken 1954; Imai and Shirakawa 1972), and fish reaction to baited gears has been studied in the near field, both in the laboratory and in the natural environment (Sutterlin et al. 1982; Bjordal 1986; Løkkeborg et al. 1989). However, little information exists on the interplay between the chemical stimuli and the attractance of marine animals in the far field. Although recent investigations have given valuable knowledge on distance of attractance and other trap fishing parameters for some species (Sainte-Marie and Hargrave 1987; Sante-Marie 1991), there are still large gaps in our understanding on the effective range of odour plumes, and how the attractance of animals of different species and size varies with different initial stimuli concentrations, current velocities and hence with stimuli distribution and dilution.

Although both longline and pot fishing are based on fish attraction with bait, there is a fundamental difference between the two gears with respect to the function of the bait. In hook fishing the bait must not only release effective attractants, but taste, shape, size and texture of the bait are also essential factors. In pot fishing, however, the animals are captured before they get access to the bait, and consequently the only function of the bait is to release adequate rates of effective attractants. Since smell stimuli mainly are water soluable, a fluid bait, e.g. an aqueous extract of traditional bait organisms could be an alternative in pot fishing. In the present study, comparative fishing trials with pots for Norway lobster (*Nephrops norvegicus*) were conducted to test possible differences in catch rate between mackerel bait and mackerel extract.

MATERIAL AND METHODS

The extract was made from frozen mackerel of the same origin as that used for natural bait. Whole mackerel were minced and mixed with two parts of water and centrifugated for 10 min. at 6500 rpm. The resultant filtrate (extract) was filled into 50 ml plastic tubes with lid and deep frozen until use. About 20 g mackerel was used to make 50 ml extract. The pots were baited either with mackerel (4 pieces, total weight about 100 g) or with extract (50 ml). Both mackerel bait and extract tubes were put into bait containers (500 ml, perforated with 120 holes of 2 mm diameter, Fig. 1). Release of extract was obtained by passive leaching through holes that were drilled in the tube lids. Release rate tests were conducted, once prior to and twice during the fishing trials, with 1-9 holes of 2 mm diam. In the fishing trials, the following hole combinations were used: 1×2 mm, 2×2 mm, 5×2 mm, 1×3 mm, 2×3 mm, 1×4 mm, 2×4 mm and 1×5 mm.

The pot construction is shown in Figure 2. Pots with mackerel bait and extract were set in alternating positions in fleets of 25-30 pots, with a pot spacing of 30 m. The fishing trials were conducted in the Fanafjord area (south of Bergen) at 60 to 150 m depth, from 18 February to 1 March 1991, and 22 fleets with a total of 535 pots were hauled. At retrieval of the pots, the extract dilution was judged by visually comparing of the content of the tube relative to a standard dilution series from 0 to 6 (0 = undiluted extract, 1 = 50% dilution of the 0-concentration, ... and 6 = 50% dilution of the 5-concentration). For each pot the catch was recorded (Norway lobster and bycatch) and for the last part of the experiment (fleet 14–22) all Norway lobsters were sexed and length measured (total length, rostrum-telson).

RESULTS

In the pre-test, most of the extract was washed out after 22 h soak time, while similar dilution tests at greater depth during the fishing trials showed much lower release rates (Table 1). This was expected as the pre-test was done in an area with a relatively strong tidal current. As indicated in Table 1, even a relatively large diffusion area (e.g. 4 mm hole diam.) and long soak time gave only a slight dilution of the extract. This was also the general case for the fishing trials, as the majority of the extract tubes were of dilution categories 0-1-2. There was no good correlation between dilution and soak time, depth or diffusion area, and hence no correlation between dilution and catch rates.

A total of 213 Norway lobster were caught in pots baited with mackerel bait versus 68 in pots with mackerel extract. Omitting two fleets with no catch, the corresponding catch rates were 0.87 and 0.30 Norway lobster per pot, respectively, or close to a three -old higher catch rate on mackerel bait ($p < 0.001$, Wilcoxon signed rank test).

The mean total length of Norway lobster caught by mackerel bait was significantly higher than that of mackerel extract, 19.3 and 16.8 cm, respectively ($p < 0.001$, *t*-test). The difference in size distribution is shown in Figure 3. If the sexes are separated, it is obvious that the males make the main contribution to the total difference in size distribution between the two baits. The mean length of males caught on mackerel bait was 20.7 versus 18.3 cm for extract ($p < 0.001$), while the corresponding difference for females was smaller and non-significant, 16.3 and 15.7 cm, respectively ($p = 0.210$).

DISCUSSION

Bjordal (1981; 1986) showed that Norway lobster caught by trawl were considerably smaller than those caught by pots in the same area. This was partly explained by the fact that the feeding range of the animals increases with their size (Chapman and Howard 1979), and hence the proportion of large animals that are attracted to the pot does increase with extention of the attractant plume.

Since the water soluable attractant was similar for both bait types, the observed differences in catch rate and size selection are most likely caused by a higher release rate from the mackerel bait, with a corresponding, larger odour plume than for the extract. It is therefore suggested that mackerel bait triggered food search in Norway lobster over a larger area, and hence attracted more and larger individuals than did the extract.

In this investigation the initial concentration and release rates of extract were obviously too low compared with the mackerel bait. However, the results reveal very interesting possibilities for improving catch rates and selectivity in baited fishing gears by extending the attractant plume range beyond that of natural bait. This can be achieved by increasing the initial extract concentration and controlled extract release rate.

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Table 1. Dilution of extract in tubes with different diffusion areas in pre-test (2 m depth) and two tests during the fishing trials. Dilution category 0 = undiluted extract, category 6 = highest dilution.

Depth (m)			2	145	110
Soak time (hours)			22	52	18
No. of holes	Hole diam. (mm)	Diffusion area (mm^2)	Dilution category (0–6)		
1	2	3.1	3	1	2
2	2	6.3	2	2	3
3	2	9.4	1	1	3
4	2	12.6	3	1	3
5	2	15.7	6	1	3
6	2	18.8	6	2	3
7	2	22.0	6	2	3
8	2	25.1	6	-	5
9	2	28.3	6	1	6
1	3	7.1	-	1	1
1	3.5	9.6	-	1	1
1	4	12.6	-	1	2

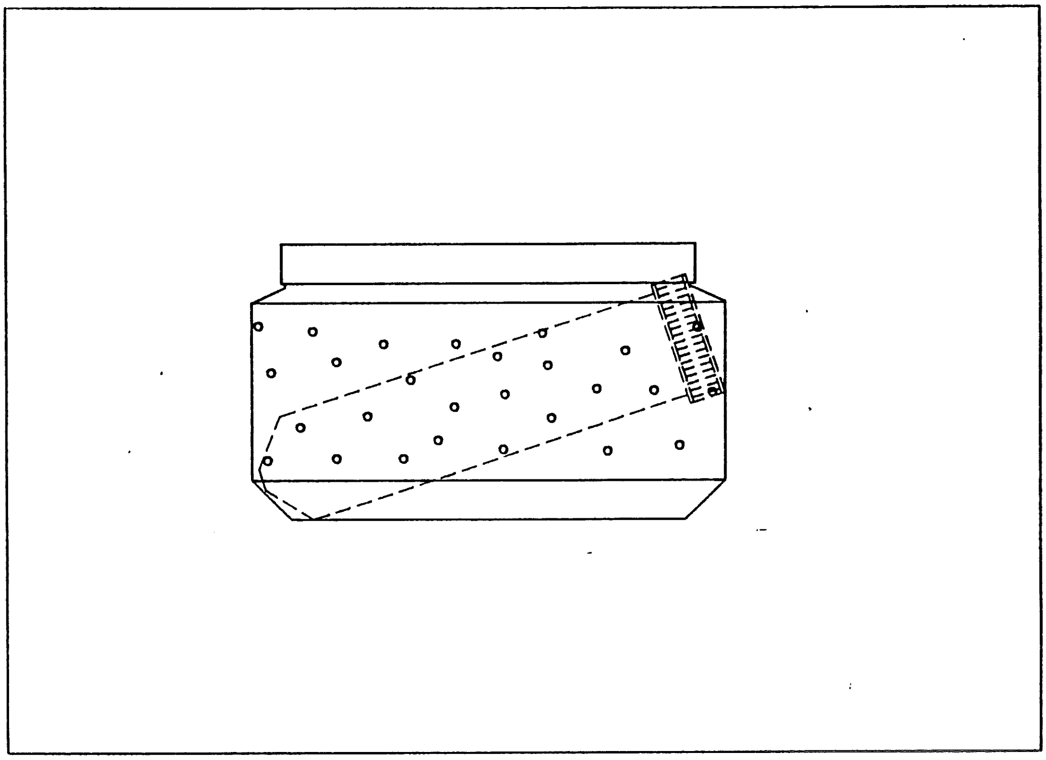

Figure 1. Bait container with extract tube.

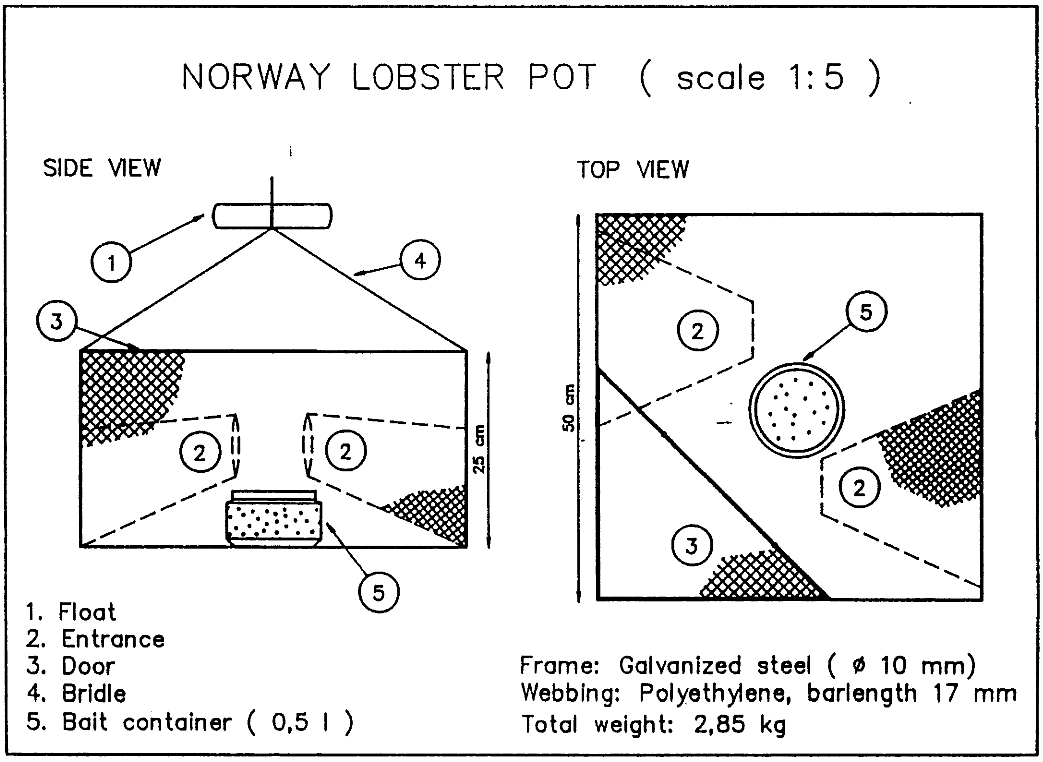

Figure 2. Norway lobster pot.

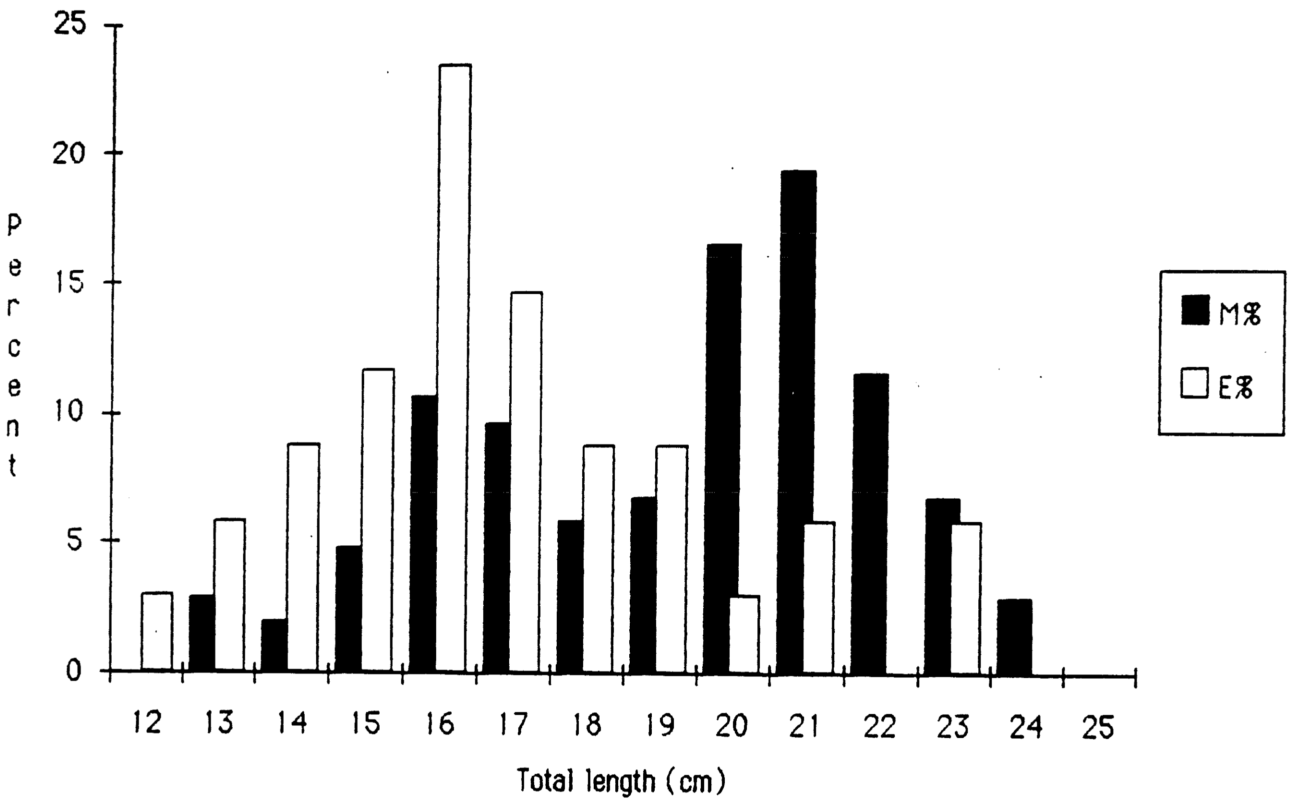

Figure 3. Length distribution of Norway lobster caught in pots with mackerel bait (M%, n = 103) and extract (E%, n = 34).