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BRIEF COMMUNICATIONS

Spawning and fecundity in the lesser sandeel, *Ammodytes marinus* Raitt, in the north-western North Sea

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Little has been published on the biology of *A. marinus* from the north western North Sea. The present investigations, a series of winter surveys as part of a study into the biology and behaviour of the lesser sandeel, were carried out to determine whether population and reproductive parameters differed from those recorded for the southern North Sea in the 1960s (Macer, 1966). The areas surveyed were the Shetland Isles (December 1985, January 1987), Fair Isle (January 1987) and Lossiemouth (December 1985) (Fig. 1).

Free-swimming *A. marinus* were sampled using a sandeel trawl fitted with a 7-mm mesh codend and buried specimens were sampled using a dredge. At Fair Isle and Lossiemouth sampling was restricted to a single site, whilst at Shetland several sites were sampled and the data combined as representative of the Shetland area. All sampling was carried out in shallow water (< 100 m) in areas of sandy substratum within 10 km of the shore. From each

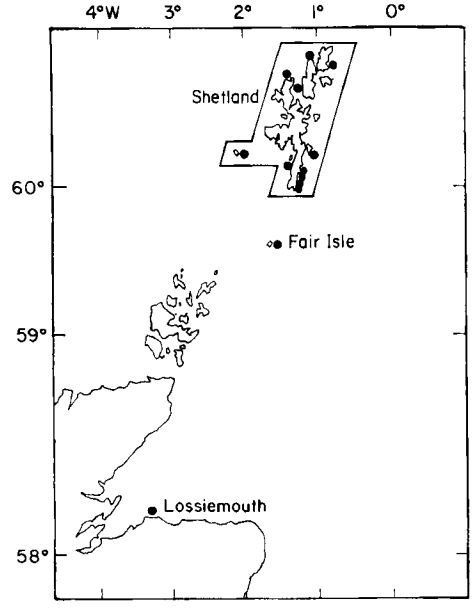

FIG. 1. Location of sampling positions for *Ammodytes marinus*.

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TABLE I. Estimated parameters of fecundity–length relationships in *Ammodytes marinus* and fitted values of egg production at fish length

Area	Regression parameters				No eggs/fish length		
	n	Log a (+95% C.L.)	b (+95% C.L.)	r^2	120 mm	150 mm	180 mm
Shetland (1985)	156	−3·75 (+0·50)	3·51 (+0·23)	0·85	3531	7728	14 656
Moray Firth (1986)	17	−4·54 (+0·99)	3·87 (+0·44)	0·96	3209	7612	15 414
Fair Isle (1987)	50	−5·03 (+1·59)	4·07 (+0·67)	0·73	2706	6710	14 092
Southern North Sea/Faroe (Macer, 1966)	35	−2·74	3·05		3995	7890	13 759

haul samples of 200–350 fish were measured and up to 10 fish per 5-mm length class were examined for age, sex, maturity stage and fecundity.

To facilitate comparison of data collected in December and January a nominal birth date of 1 December was assumed. Maturity was determined using a six-stage maturity scale (Macer, 1966). Sex of small fish (< 105 mm) was not recorded unless gonads showed signs of maturing. Estimates of fecundity (F) were derived using a photoelectric egg counter (accuracy ±2%) and the number of eggs were fitted against fish length (L) using the model $\log F = a + b \log L$. Data were also collected on body and gonad weights and egg size. A mean egg weight, taken from mature fish (maturity stage 4), was determined from batches of 500 eggs dried at 60° C for 24 h before weighing.

Both immature and mature *A. marinus* were present at all sampling sites. The spawning period, identified from the presence of mature and spent gonads (maturity stages 4 and 5), ranged from early December to late January. This is similar to the period given by Macer (1966) for the southern North Sea.

The smallest fish in which maturation was observed at Shetland measured 95 mm, and at Fair Isle and Lossiemouth 100 mm. In general, all fish > 135 mm were maturing. In 1-group (fish aged 13–14 months) the percentage maturing was 17·7% at Lossiemouth ($n = 164$), 15·1% at Shetland ($n = 3382$) and 2·3% at Fair Isle ($n = 216$). In 2-group, maturation ranged from 80 to 100%, and in 3- and 4-groups it was practically 100%. The corresponding percentages maturing in the southern North Sea were 5, 81·5 and 97·9% (Macer, 1966).

A greater number of males than females matured at age 1. The ratios of maturing 1-group males to females at Shetland and Lossiemouth were 3·3 : 1·0 ($n = 512$) and 6·3 : 1·0 ($n = 29$), respectively. The respective mean lengths of these fish were 113 mm and 116 mm (males) and 110 mm and 119 mm (females). At Fair Isle only five maturing 1-group were caught.

The weight/length relationships for mature males and females were significantly different ($P < 0·001$):

	n	Log a (+95% C.L.)	b (+95% C.L.)	r^2
Mature males	18	−6·45 (+1·42)	3·43 (+0·65)	0·89
Mature females	70	−6·30 (+0·74)	3·39 (+0·34)	0·85

Analyses of covariance showed the slopes to be similar but the intercepts to be significantly different ($P < 0·01$), females being the heavier. For mature females the mean gonado-somatic index was 28·2 (GSI = gonad weight/body weight × 100).

The relationships between fecundity and length for each sampling area (Table I) are similar to the single relationship given by Macer (1966) for specimens from the southern North Sea and the Faroe Islands.

Egg size (diam.) was unimodel and uniform within individual ovaries. No significant relationship was found between egg size and fish length. The mean size of egg in mature fish (maturity stage 4) was 0·92 mm (0·82–0·95 mm; $n = 645$) and had a mean dry weight of 0·084 mg (0·052–0·099 mg; $n = 5000$). In those eggs having a single oil globule the mean size of globule was 0·24 mm (0·21–0·27 mm; $n = 195$). No significant relationship was found between oil globule size and egg size. The mean sizes of egg 1·02 mm (0·87–1·20 mm) and oil globule 0·33 (0·27–0·42 mm) reported by Winslade (1971) for southern North Sea fish were somewhat greater but were derived from spawned eggs collected in aquaria.

The findings reported here show that the reproductive parameters among widely separate populations of *A. marinus* within the North Sea are similar. The estimates of fecundity indicate that, as in other parts of the species range, reproductive potential in *A. marinus* is largely dependent on fish aged 2 years and older.

References

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