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THE EPIFAUNA OF A PLAICE NURSERY GROUND

by

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Summary

The epifauna in the shallow water of a flatfish nursery ground is described. It was surveyed by divers using a diving sledge towed along established transects. The observations which were recorded on tape, showed that the community consisted of 30 species of invertebrates including echinoderms, molluscs, crustaceans and coelenterates. Of these, five species only were dominant, and distributed between 2-10 m depth. These species represented a biomass of 0.6-1.2 g dry weight m^{-2}. Over the three year period of study the population of the main species showed a steady decrease, accompanied by the disappearance of some of the less abundant species. The effects of trawling on the community and the possible influence of other factors responsible for this decrease are discussed.

Introduction

In a previous ICES report (C.M. 1967/K:18) the qualitative and quantitative aspects of the infauna of Firemore Bay (Loch Ewe), on the west coast of Scotland, have been described and its importance as a nursery ground for a population of flatfish emphasised. This was followed by the present study of the epifaunal community. This includes the larger echinoderms, molluscs and crustaceans which form an integral part of the food web as predators and competitors of fish for the same resources. The present study was designed to identify the epifaunal community, find its quantitative and qualitative distribution and biomass and follow its evolution over a three-year period.

The area

The surveyed area, Firemore Bay (Fig. 1) is approximately 800 m across and 400 m from LW to its outer limit (10 m depth). It is a shallow bay (maximum depth 11 m) with a smooth gradient and mostly fine sediments (median diameter = 200-250 μ). The bay is moderately exposed to the SW prevailing winds, with an exposure gradient, increasing from north to south. Because of the shallow depth the bay is particularly affected by oceanic swell entering the loch.

Methods

As the conventional grabs and trawls were found to be inadequate for the reliable sampling of the epifaunal community which consisted of large, motile and sparsely distributed species, a new technique had to be adopted. Thus the survey was carried out by means of a diving sledge towed at a speed of 1-1$\frac{1}{2}$ knots by a 26 ft boat (Fig. 2). The sledge was manned by

two divers who made observations on the diversity, density and distribution of the animals on the bottom of the bay. A two-way telephone communication between the divers and the boat allowed the transmission and recording of all the information provided by the divers. Additional information on visibility, duration of dive, and operational depth were also reported by the divers. Information on the type of sediment and bottom relief was provided by a camera with a time lapse mechanism. The observations were carried out along definite transects stretching from the LW mark to the 10 m depth (Fig. 3). The area which can be surveyed accurately by this method was a belt of 1 m across the front of the moving sledge.

A parallel method for density and biomass estimates of the epifauna by means of large quadrats (2-4 m^2 each) was also used in many stations covering all depths. All biological material collected was preserved in 10% buffered formalin.

Observations were carried out over a three-year period (1970-72); they were however restricted to the period of better sea conditions and higher temperatures (summer-autumn).

Results obtained from the above techniques were compared with results obtained from beam trawling (where a 2 m beam trawl of known efficiency was used) carried out in the same area.

The physico-chemical characteristics of the area were also surveyed using standard equipment and the summarised results for the year 1971 are shown in Table 1.

The fauna

The epifaunal community of Firemore Bay was predominantly a sandy bottom community including 30 species of invertebrates. The fauna which is summarised in Table 2 consists of eight echinoderms, six molluscs, fifteen decapod crustaceans and one coelenterate. Of these, five species only were dominant while some others which were burrowers (such as the echinoid Echinocardium cordatum, the gastropod Nassarius reticulatus, and the crab Corystes cassivelaunus), or fast swimmers (such as the crustaceans Crangon crangon, Pandalus montagui, the cephalopod Sepiola atlantica etc) could not be adequately surveyed by this technique and therefore they were not considered in the present study. The remaining species were represented either by single individuals or by a very small density of individuals scattered in the bay.

The five dominant species were the asteroids Asterias rubens and Astropecten irregularis, the gastropod Buccinum undatum, and the decapods Pagurus bernhardus and Cancer pagurus. Two additional species, Leptasterias mulleri and Pagurus prideauxi, represented only 7 and 3% respectively of the population of Asterias rubens and Pagurus bernhardus and therefore they were considered along with the main species. The main species remained dominant at all times, with the exception of the crab Cancer pagurus whose population was decimated by frequent trawling. Other species with restricted populations such as the echinoid Echinus esculentus, the asteroids Marthasterias glacialis and Solaster papposus, the bivalves Chlamys spp. and Pecten maximus were either depleted or disappeared altogether from the bay, as a result of selective removal by trawls and divers operating in this area.

The bathymetric distribution of the fauna showed that there was very little fauna to be found in the zone down to 2 m depth and most species were present in deeper water (5-10 m). Some species such as Marthasterias,

Solaster, Ophiura, Chlamys spp, and Pecten were found only in depths greater than 8 m. There was evidence of a fringe effect with species of crabs and hermit crabs coming closer inshore at the edges of the bay. Furthermore, there was evidence of faunistic differences from north to south with some species such as Nassarius and the coelenterate Cerianthus being found only at the northern and more sheltered part of the bay.

The dominant animals Asterias, Astropecten, Buccinum, Pagurus and Cancer were universally though not uniformly distributed in the bay. Asterias and Buccinum were more abundant in deeper water (> 8 m) while the remaining species were most abundant in the 6-8 m zone. Their annual mean densities and population estimates are shown in Table 3. Mortality and recruitment were responsible for seasonal fluctuations in the population. Nevertheless there was evidence of an overall continuous decrease in the total population over the period of three years. The hermit crab Pagurus bernhardus living in Littorina and Thais shells was the most abundant species with a mean density ranging from a maximum of 0.8 ind-m^{-2} in 1970 to a minimum of 0.1 ind-m^{-2} in 1972. It showed an aggregated distribution at certain depths (6-8 m), particularly in early summer when settlement was heavy, reaching a density as high as 15 ind-m^{-2}. The population was dominated by 1+ year class of a mean carapace length of 6 mm, although new recruits do become very numerous in the period August to October. There was a noticeable scarcity of older individuals (2-4 year old) of 25-30 mm carapace length.

The asteroid Asterias rubens was also common but less abundant with its mean density of 0.2 ind-m^{-2} in 1970 maintained to 0.1 ind-m^{-2} over each succeeding year. Its density increased with depth reaching a maximum of 1.0 ind-m^{-2} in certain months. The population was dominated by 7-9 cm (radius length) individuals, possibly representing the 2 year old class, and there was a scarcity of individuals larger than 10 cm. Another asteroid Astropecten and the gastropod Buccinum showed similar mean densities (0.01 ind-m^{-2}) for 1970-71 decreasing to 0.006-0.007 ind-m^{-2} in 1972. The former was found equally distributed in most depths while the latter was found mostly in the deeper parts of the bay. Populations of both species were dominated by mature individuals, with the seasonal appearance in the population of a very small number of young Astropecten recruits. The populations of both species showed a similar decrease, although Astropecten numbers remained higher than Buccinum.

The crab Cancer was mostly found in the 5-8 m zone, in densities not exceeding 0.002 ind-m^{-2}. A small population of Cancer consisting of mature individuals only gradually decreased and in 1972 was totally decimated and was then represented only by the odd individual.

The biomass values of the epifauna are shown in Table 4. The highest value of 1.29 g dry weight-m^{-2} was obtained in 1970, decreasing steadily to a low value of 0.64 g-m^{-2} in 1972. This was the result of the overall population decrease particularly at Asterias and Pagurus. However, other crabs and some molluscs including Buccinum maintained the same value as a result of compensation between species.

Population estimates derived from trawling, were substantially lower (up to 60%) than the results obtained with the diving sledge method. The validity of the results obtained with the latter method was confirmed by the similar results obtained by the use of quadrats.

Discussion

The survey showed that the epifaunal community consisted of 30 species of which only five were numerically important. The populations of these species have been constantly decreasing over the 3 year period. This could

be attributed to natural mortality not compensated by successful recruitment. Failure in recruitment may be the result of unsuitable environmental factors or may well be through predation at the early stages of the life cycle. A decrease in the population of the bivalve Tellina tenuis in Firemore Bay, has been reported by McIntyre (1970). His study carried out over the same period of time attributed the decrease to the same environmental and biotic influences.

Fishing mortality of the older individuals through trawling explained the existing gaps in the population structure of many species, and may be responsible for any decrease in the reproductive vigour of the population. Moreover mechanical disturbance of the sediments by the chains of the trawl may also contribute towards a substantial mortality of the young stages of many species.

The biomass of the sublittoral macrobenthic infauna in Firemore Bay has been estimated as 3.7 g-dry weight-m^{-2} (McIntyre and Eleftheriou 1968). The addition to this figure of the biomass of the epifaunal community (0.6-1.2 g dry weight-m^{-2}) would increase the total benthic biomass of the bay to 4.3-4.9 g dry weight-m^{-2}.

The position of the epifaunal community in the food chain is not clarified yet and further studies are required. From information gathered so far it seems that the members of this community are mostly predators of fish and other invertebrates and compete with juvenile flatfish for the same resources.

References

McIntyre, A.D. 1970 The range of biomass in intertidal sand, with special reference to the bivalve Tellina tenuis. J. mar. biol. Ass. U.K., 50, 561-575.

McIntyre, A.D., Eleftheriou, A. 1968 The bottom fauna of a flatfish nursery ground. J. mar. biol. Ass. U.K., 48, 113-142.

Table 1

Physicochemical characteristics of Firemore Bay for the year 1972

Characteristics:		
Exposure		Moderate - bay exposed to NW winds and oceanic swell but not to the SW prevailing winds.
Tidal range (m):	springs	4.5
	neaps	1.8
Median sand particle size (/u)		200-250
Temperature (0°C) (bottom)		7.1-12.4
Salinity (‰) (bottom)		31.4-33.6
Chlorophyll in sand /ug/g		0.76-5.19
in water /ug/l		0.56-1.05
Organic carbon in sand /ug/g		287-1 366
in water /ug/l		135-364

Table 2

Epifauna of Firemore Bay

Coelenterata

Cerianthus lloydi Gosse

Crustacea

Pandalus montagui Leach
Hippolyte varians Leach
Crangon crangon (L.)
Galathea strigosa (L.)
Porcellana longicornis (L.)
Pagurus bernhardus (L.)
Pagurus prideauxi Leach
Macropipus puber (L.)
Macropipus depurator (L.)
Carcinus maenas (L.)
Cancer pagurus L.
Corystes cassivelaunus (Pennant)
Hyas araneus (L.)
Inachus dorsettensis (Pennant)
Macropodia rostrata (L.)

Mollusca

Buccinum undatum L.
Nassarius reticulatus (L.)
Pecten maximum (L.)
Chlamys distorta (da Costa)
Chlamys opercularis (L.)
Sepiola atlantica d'Orbigny

Echinodermata

Astropecten irregularis (Pennant)
Solaster papposus (L.)
Asterias rubens L.
Leptasterias mulleri (M. Sars)
Marthasterias glacialis (L.)
Ophiura texturata Lamarck
Echinus esculentus L.
Echinocardium cordatum (Pennant)

Table 3

Mean population estimates of the main species and their mean densities (individuals-m^{-2})

		1970	1971	1972
Asterias	Population	61 155	39 483	37 200
	Mean density	0.22	0.14	0.14
Astropecten	Population	3 105	4 698	1 890
	Mean density	0.01	0.01	0.007
Pagurus	Population	218 700	43 866	33 210
	Mean density	0.81	0.16	0.12
Buccinum	Population	3 105	3 285	1 620
	Mean density	0.01	0.01	0.006
Cancer	Population	540	396	+
	Mean density	0.002	0.002	+

Table 4

Biomass in grams dry weight per m^2

	1970	1971	1972
Asterias and Astropecten	0.84	0.57	0.47
Pagurus	0.32	0.06	0.04
Various crabs	0.03	0.03	0.03
Buccinum and other molluscs	0.10	0.10	0.10
Total	1.29	0.76	0.64

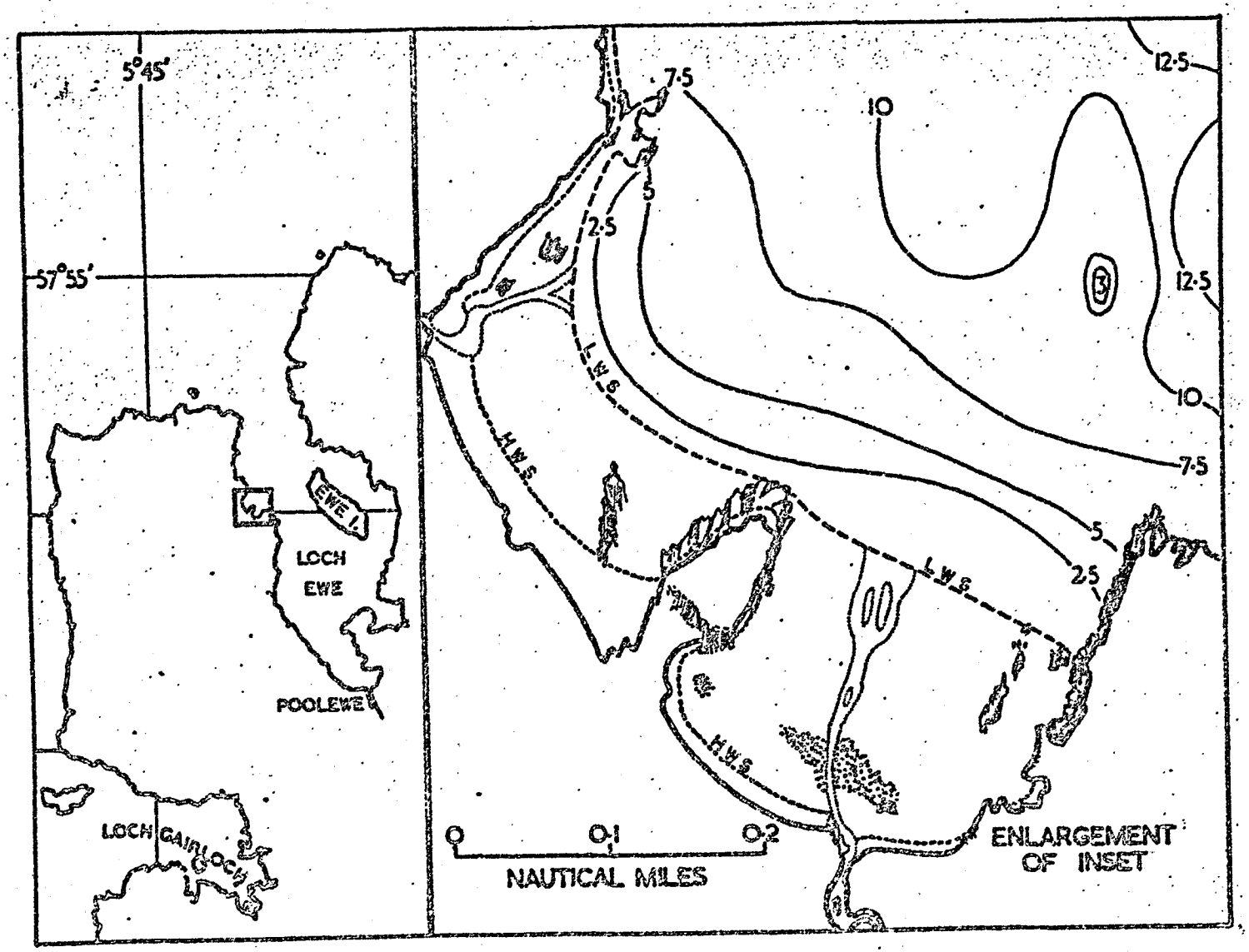
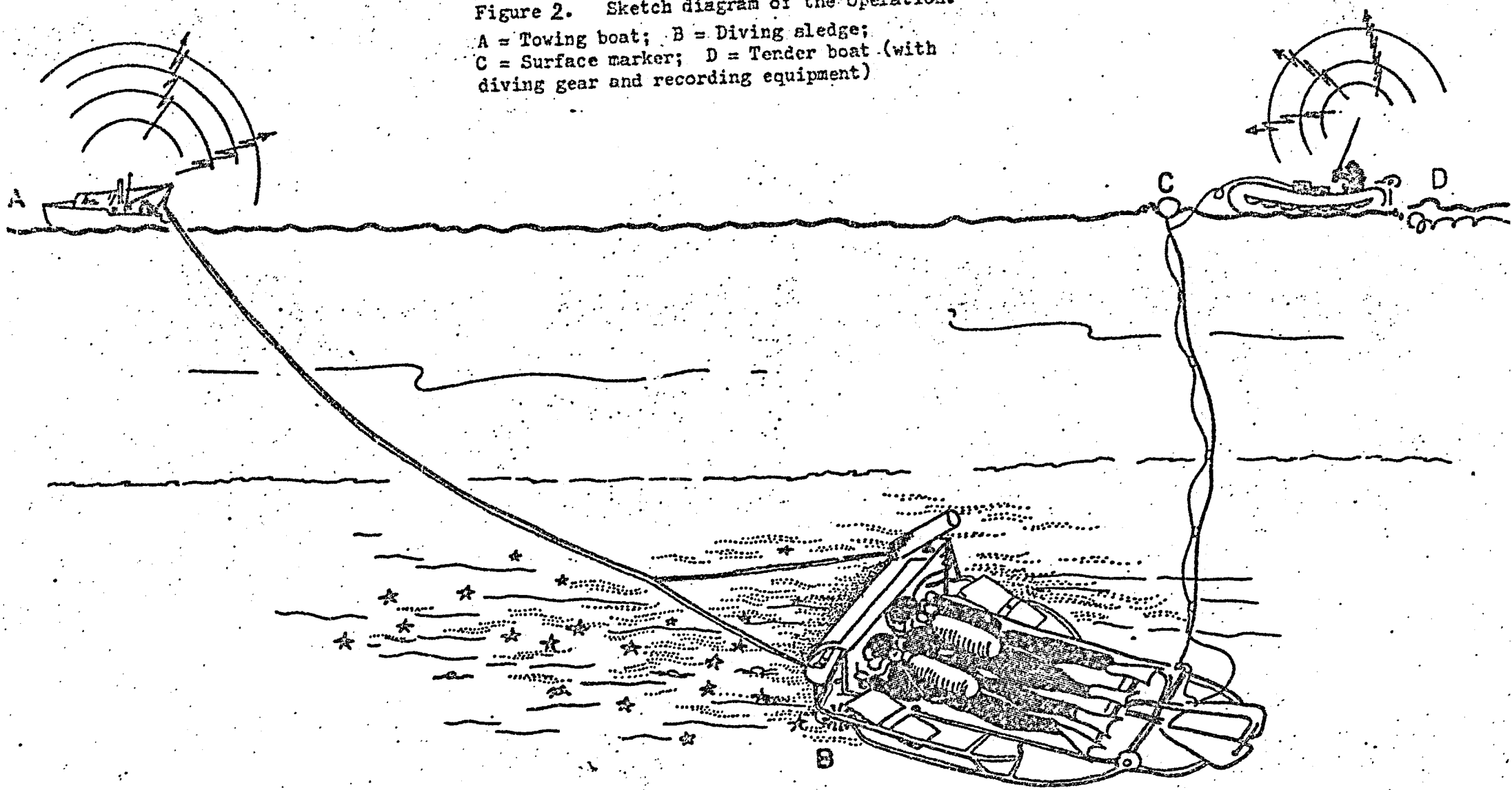


Figure 1. Loch Ewe and Firemore Bay.

Figure 2. Sketch diagram of the operation.
A = Towing boat; B = Diving sledge;
C = Surface marker; D = Tender boat (with diving gear and recording equipment)



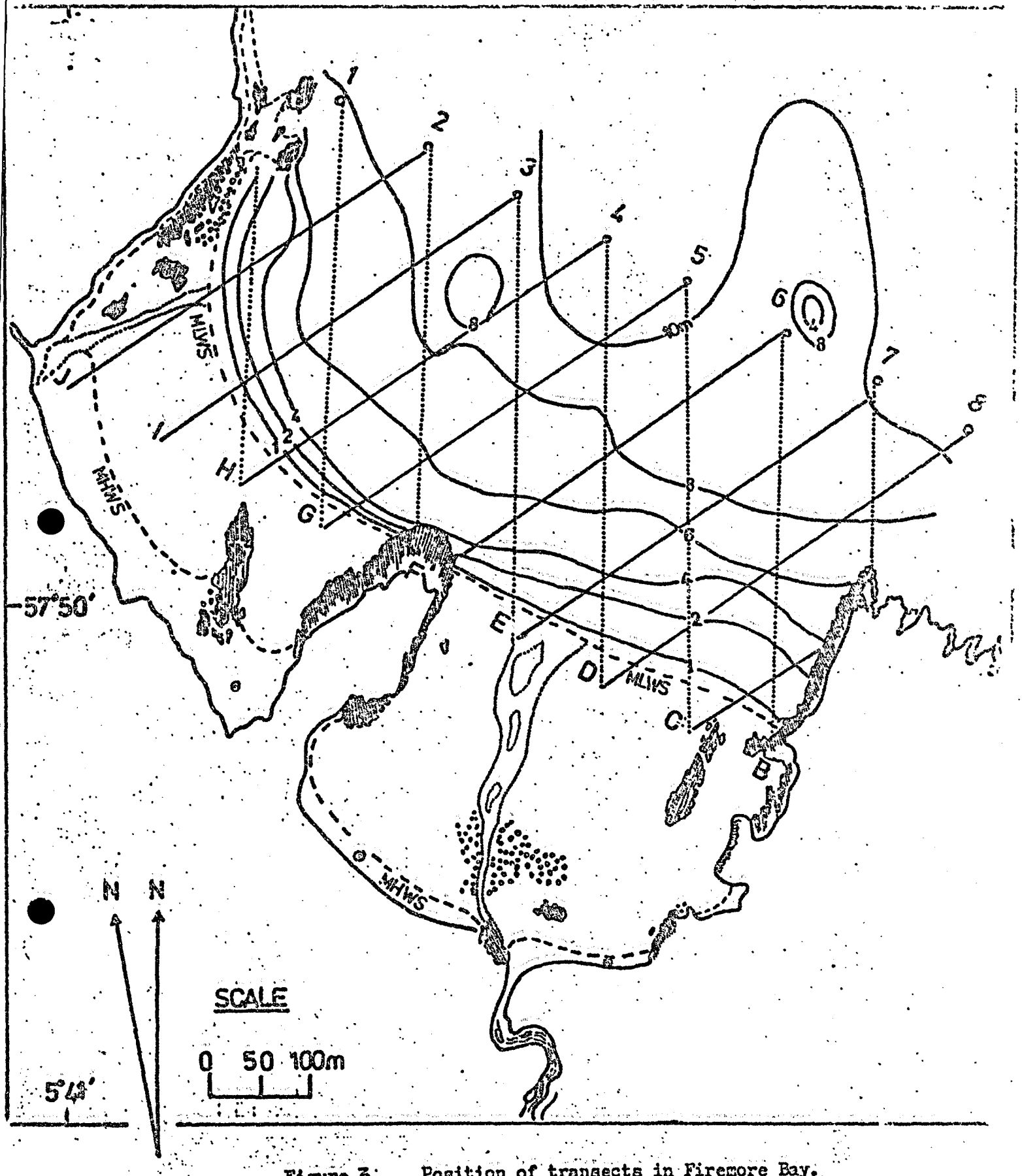


Figure 3: Position of transects in Firemore Bay.