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Behaviour aspects of fish in relation
to oil platforms in the North Sea

by

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ABSTRACT

Fish distribution around structures of the Ekofisk oil field in the central North Sea was investigated by means of gillnet fishing, longlining, jigging and echosurveying. The studies were carried out during one week in August 1978. The greatest fish densities were observed in the vicinity of the structures, being 3 and 10 times higher for cod and saithe respectively in the distance interval 0 - 200 m from the structures, compared to the area further away than 500 m. Fish density at the time of study was, however low and of minor interest for commercial fishing.

INTRODUCTION

Structures situated on or above the sea bed are known to attract large quantities of marine organisms, including different species of fish (CARLISLE et al. 1964, HASTINGS et al. 1974, UNGER 1966 and WICKHAM et al. 1973).

Platforms built in recent years for offshore oil production have thus introduced many new artificial habitats for fish (TREYBIG 1971, REID & STEIMLE 1978).

In the United States where offshore oil production has taken place for at least 50 years, it is recognized that the number of fish around platforms often surpasses by 20 to 50 times that found on surrounding flat, muddy or sandy bottoms (SIMPSON 1977).

During the 15 years of offshore oil activity in the North Sea there have been numerous reports of successful fishing in the vicinity of oil platforms. This phenomenon, however, has not been studied in any detail until our Institute in 1977 initiated a project to estimate gradients in density of different fish species related to distance from oil installations. Field investigations were carried out in the Ekofisk area during two cruises, in April/May 1977 and again in August 1978. The results from the preliminary studies in 1977 were presented in an ICES-report by OLSEN & VALDEMARSEN (1977). The present report mainly deals with results from the latest cruise, carried out by the commercial fishing vessel M/S "Valderøy".

INVESTIGATION AREA

Ekofisk is a Norwegian oil field in the central part of the North Sea. The Ekofisk Complex, consisting of 13 installations connected through bridges is the main site of oil rigs in the area. The Complex was the study area during both cruises.

Water depth is about 70 m. The bottom is flat with muddy and sandy sediments.

Historically the Ekofisk area is not known as a successful fishing ground for white fish. Since oil production started, high activity of Scottish seiners close to the 500 m safety border has been reported.

EXPERIMENTS

To evaluate the distribution of different species relative to the constructions, gillnets and longlines were set in straight lines from the installations or parallel to them (Figure 1). The catches per unit length of gillnet or string or longline were recorded and analysed relative to the distance from the platforms.

Jig fishing and echosurveying the area were used as additional methods to complete the picture of fish distribution around the platforms. Numbers of echos above a preset level were counted and integrated per 1/8 nautical mile (radar estimates). A scale from 0 to 4 was used as index of abundance in the different distance intervals. This method of course gives only a rough indication of biomass present, since echos from fish were impossible to distinguish from other organisms.

Mesh sizes in the two types of gillnets used, were 150 and 180 mm, and their height 6 and 3.5 metres, respectively. Length of gillnet strings were either 900 meters (150 mm meshsize) or 1300 meters (180 mm meshsize).

Samples of fish caught with different gears were length-measured and some fishes were analysed with regard to stomach contents.

Species and length composition of catches.

The numbers of different species caught during the trials are presented in Table 1. The total fishing effort by each method is given as length of gillnets strings and longlines and as hours fished with jig.

Out of 15 fish species recorded, saithe and cod were captured in highest numbers. When studying Table 1, however, one must have in mind the difference in gear efficiency for various sizes and species of fish. Saithe and pollack for example, were not caught on longlines since pelagically feeding fishes seldom take baits laying on the bottom. On the other hand, the highest catch rates of haddock were obtained on longlines, which might be due to feeding habits as well as fish size relative to the mesh sizes of gillnets used.

The length distributions of cod caught by gillnets of 150 and 180 mm meshsize and jig are illustrated in Figure 2. Although few in number, the cod caught with jig was smaller than fish captured in gillnets. This indicates that meshes in gillnets were too large to catch all sizes of cod present in the vicinity of the oil rigs, as well as smaller fish might be more pelagically distributed than the larger fish.

Fish distribution.

The gillnet and longline catches were also greatest in the vicinity of the installations (Table 2 and 3) for most species. Dogfish was the only species that was most numerous on both gears further away than 500 m from the platforms.

There were significant larger catches of saithe and cod in the interval 0 - 200 m than in the area further away from installations than 500 m. Mean differences of 10 and 3 times in gillnet catches were recorded in the two distance intervals for saithe and cod, respectively. The catches of cod in the 200 - 500 m interval were not significantly different from those in the 0 - 200 m interval. For saithe, however, there were a significant reduction in catches in the 200 - 500 m interval, compared to those in the interval closest to the structures.

The echo survey show a similar pattern of distribution (Figure 3) as the fishing experiments. It has to be mentioned that echo-surveying until 4 nautical miles from the Ekofisk Complex indicated sparse concentrations of demersal fishes.

Jig fishing resulted in small quantities of fish, and fish were captured by jiggging only close to the installations (25 m). This was in accordance with findings in the previous year (OLSEN & VALDEMARSEN, 1977).

Feeding habits

The availability of food is mentioned as one reason why fish aggregate around oil platforms. In our trials 46 cod were examined for their stomach contents. In addition to traditional food as sandeel and krill (Meganyctiphanes norwegicus), cod was found feeding upon food wasted from the platforms. Stomach contents of saithe were dominated by sandeels, but also krill were recorded.

DISCUSSION

All methods used in this study indicates that demersal fish aggregate around oil platforms in the North Sea. The gradients in density estimated with gillnets are, however, somewhat uncertain. A more vertical distribution of fish among the shafts of the platforms than in the surrounding areas and because gillnet had to be set at minimum distances from the installations, probably underestimate the real density close to the platforms. That cod and saithe really may stay very close to structures was apparent from similar trials at a wreck in the North Sea the following week (VALDEMARSEN 1978).

Whether fish resources recorded in the trial period are representative on an annual basis is yet not answered. Seasonal fluctuations might well result in other species compositions and quantities of fish in the vicinity of the oil rigs during other parts of the year.

Catches with the different gears were probably too small for commercial fishing in the platform area. The only exception was one of the gillnet settings (G1) resulting in good catches of saithe.

The reasons why fish aggregate around oil platforms as well as other structures in the sea is still unknown. Solitary organisms growing on the structures, planctonic aggregations as a result of eddies in the current system and of light and wasted food from human consumption, enriches the food supply, and are one of the possible explanations suggested. The stomach contents analysis of cod indicates to a certain extent that this might be truth. The possibility of hiding from predators, and that the structures may serve as points of reference for stationary fishes, are other factors that might cause this aggregation.

The effect on the availability of fish in an area occupied by oil platforms is neither quite understood. An important question is whether structures attract and concentrate fish, that otherwise would be more evenly distributed in the general area, or if presence of platforms really increase productivity of larger fish in this area by more efficient conversion of the passing microscopic

organic material. Our present knowledge about these problems are sparse and therefore need a lot more attention in the future.

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Table 1. Species caught with different fishing gears at Ekofisk in August 1978. Effort is given as total length in metres of gillnets and longline and as fishing time in minutes with jig.

Species	Gillnet 9300 metres	Longline 2700 metres	Jig 135 minutes
Cod (<i>Gadus morhua</i>)	235	5	14
Haddock (<i>Melanogrammus aeglefinus</i>)	16	49	1
Saithe (<i>Pollachius virens</i>)	414		
Ling (<i>Molva molva</i>)	5	2	1
Pollack (<i>Pollachius pollachius</i>)	18		
Dogfish (<i>Squalus acanthias</i>)	59	16	
Ray (<i>Raja</i> .(sp))	66	29	
Plaice (<i>Pleuronectes platessa</i>)	5	2	
Witch (<i>Glyptocephalus cynoglossus</i>)	7		
Lemon Sole (<i>Microstomus kitt</i>)	3		
Angler (<i>Lophius piscatorius</i>)	4		
Catfish (<i>Anarhichas lupus</i>)		2	
Garpike (<i>Belone belone</i>)		1	
Basking shark (<i>Cetorhinus maximus</i>)	1		
Crab (<i>Cancer pagurus</i>)	1		

Table 2. Catch data from gillnet trials in 3 distance intervalls at Ekofisk. Numbers of fish per 100m of gillnet are index of catch. Abbrevations : C = cod, S = saithe, D = dogfish and A = other fish species.

Setting no.	Setting		Fishing time (hours)	Mesh size (mm)	Lenght/ gillnet	No. gillnet	0 - 200 m				200 - 500 m				> 500 m			
	Date	hour					C	S	D	A	C	S	D	A	C	S	D	A
G1	15.8	12.10	21	150	28	31	7,1	66,0	0,5	4,0	10,4	36,8	2,1	1,1	2,6	8,4	2,8	0,8
G2	15.8	12.45	19	180	62	21	1,1	0,0	0,0	2,1	2,6	1,0	1,6	1,0	1,1	0,1	1,1	0,4
G3	15.8	13,25	23	180	62	22	6,5	4,8	0,0	5,4	1,9	0,3	0,0	3,5	0,9	0,5	0,8	0,7
G4	16.8	15.10	16	180	62	22	1,9	8,9	0,0	2,7	1,1	1,8	0,5	1,6	0,8	0,3	0,0	0,3
G5	16.8	16.40	19	150	28	31	6,4	9,1	1,0	1,7	7,1	4,8	2,4	0,0	-	-	-	-
G6	16.8	17.15	16	180	62	23	1,4	0,1	0,1	1,3	0,6	0,9	0,0	0,3	1,1	0,3	0,7	1,2
G7	17.8	12.30	7	150	28	31	1,3	0,1	0,0	0,2	-	-	-	-	-	-	-	-
G8	17.8	20.30	10	150	28	31	6,1	8,2	0,2	1,9	2,1	3,3	0,1	1,7	-	-	-	-

Table 3. Catch data from longline trials in 3 distance intervalls at Ekofisk. Numbers of fish per 100m of gillnet are index of catch. Abbrevations : C = cod, H = haddock, D = dogfish and A = other fishes.

Setting no.	Setting		Fishing time (h)	Distance between hooks (m)	Longline lenght (m)	0 - 200 m				200 - 500 m				> 500 m			
	Date	hour				C	H	D	A	C	H	D	A	C	H	D	A
L1	15.8	16.00	3	2	1500	-	-	-	-	0,7	4,7	0,0	4,7	0,4	3,3	1,8	1,8
L2	16.8	07.15	7	3	1500	0,0	1,8	0,0	1,3	0,2	1,7	0,2	0,8	0,0	1,3	2,1	0,8

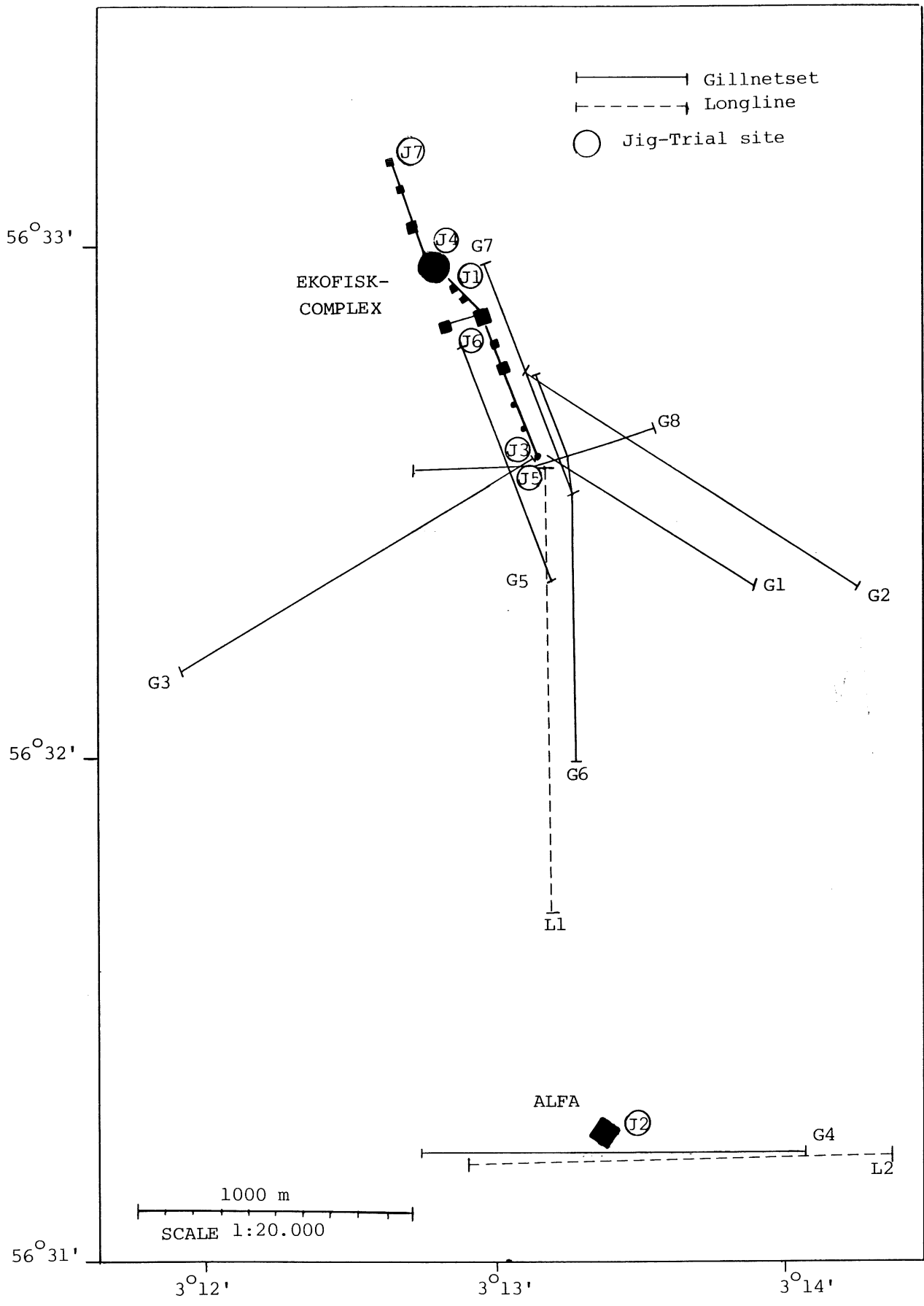


Figure 1. Installations and positions for trials with gillnets, long lines and jigs at Ekofisk.

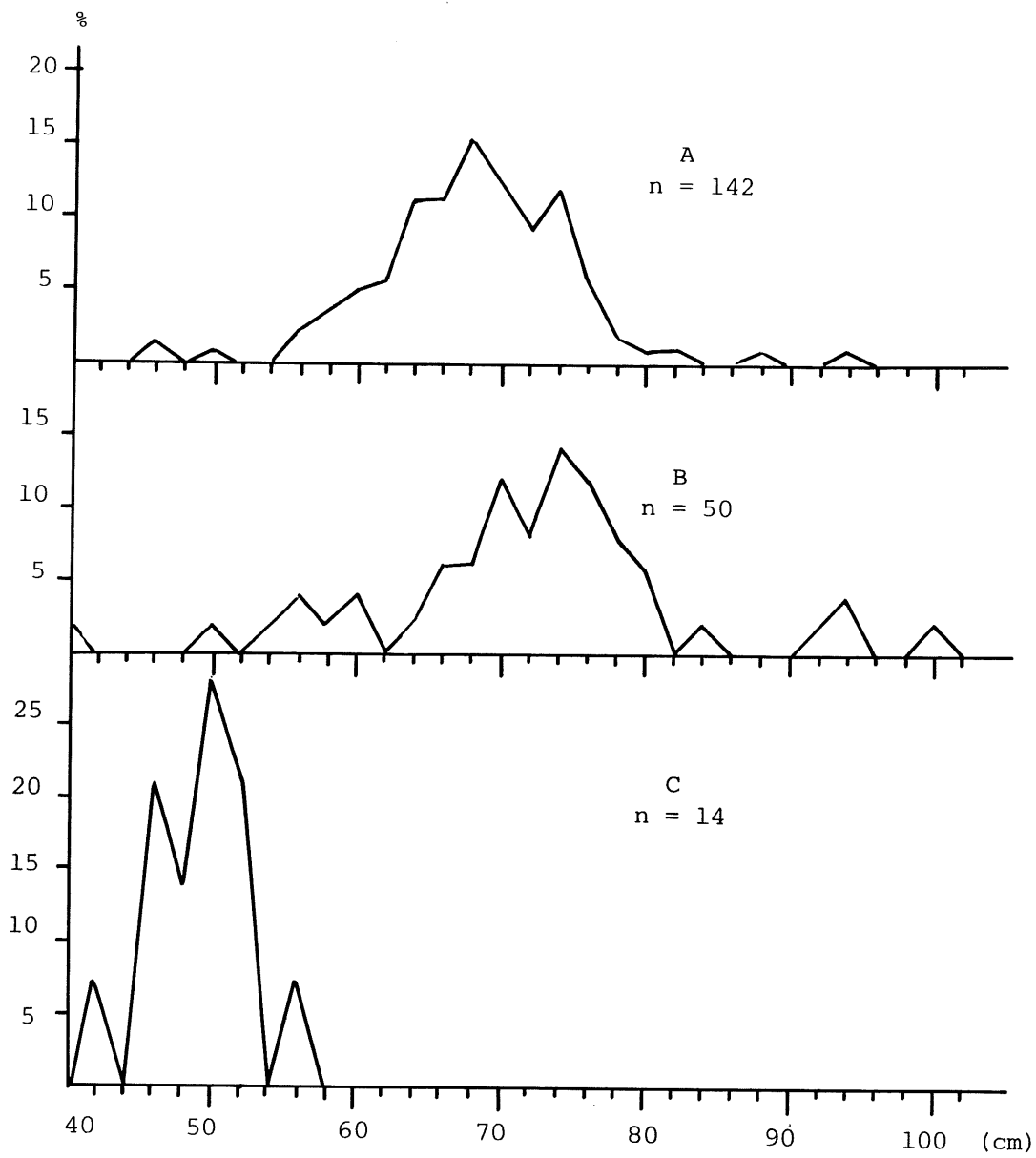


Figure 2. Length distributions of cod in 2 cm length groups caught at Ekofisk on A) gillnets with 150 mm's mesh size, B) gillnets with 180 mm's mesh size and C) jig.

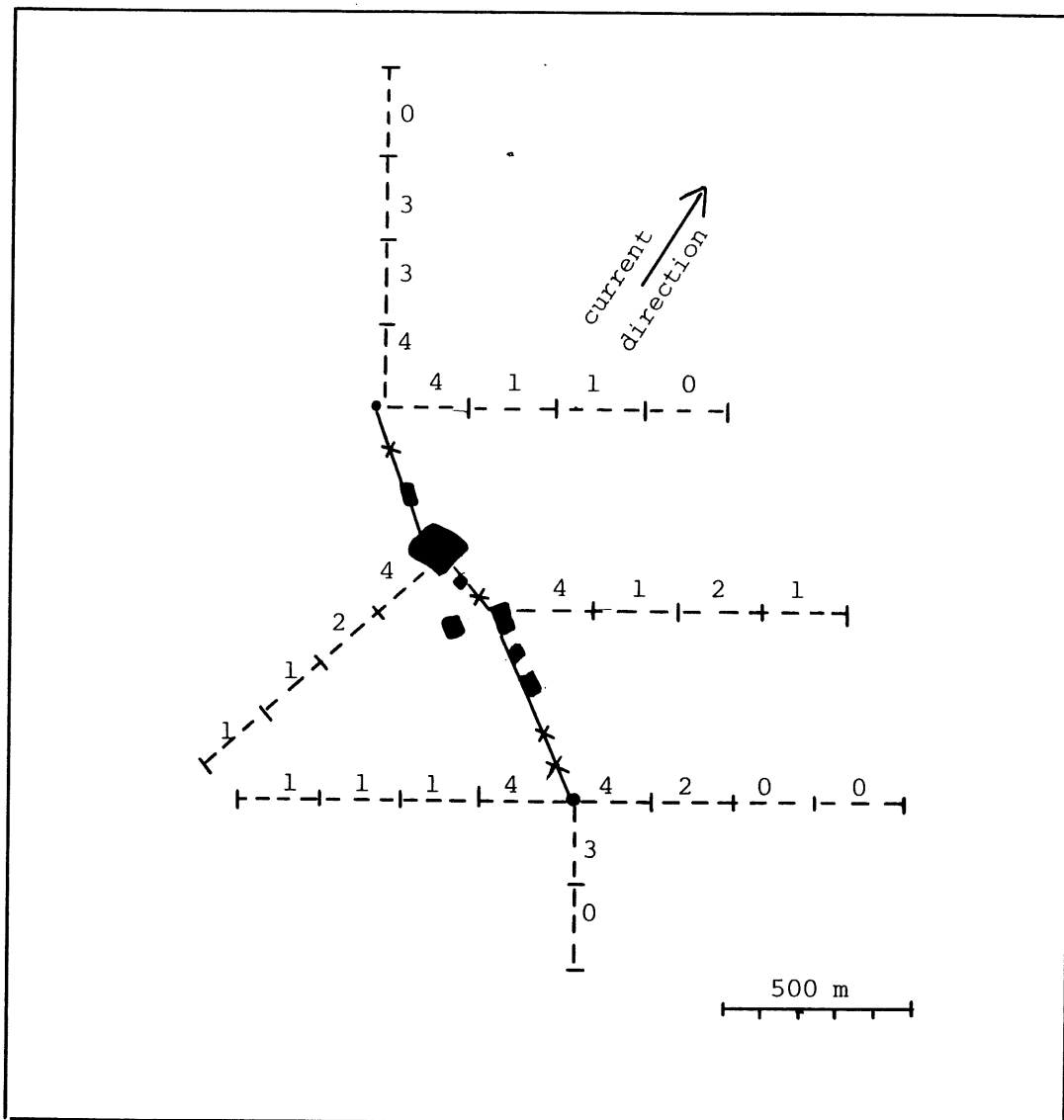


Figure 3. Coursepattern for echosurvey at the Ekofisk Complex.
 Abundance indexes are given in 1/8 n.m. intervalls.
 Abundance indexes: 0 = 0 echos pr. 1/8 n.m., 1 = 1-5 echos pr. 1/8 n.m., 2 = 6-10 echos pr. 1/8 n.m., 3 = 11-20 echos pr. 1/8 n.m., 4 = >20 echos pr. 1/8 n.m.