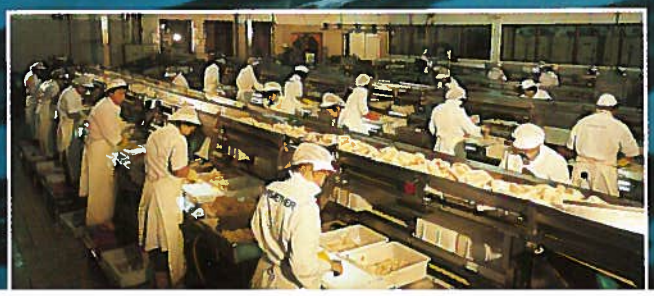
FISKERITEKNOLOGISK FORSKNINGSINSTITUTT
INSTITUTE OF FISHERY TECHNOLOGY RESEARCH

OPPDRAGSRAPPORT

Fangstseksjonen

PROBAIT - KUNSTIG LINEAGN I NORSK LINEFISK

Nr. 1 - 90



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Nr. 1 - 90

FORFATTER:

Svein Løkkeborg

PROSJEKT:

"Probait - kunstig lineagn i norsk linefiske"

DATO:	PROSJ.NR.:	PROSJ. ANSV.:
11.1.1990	6127	Åsmund Bjordal

OPPDRAGSGIV. REF.:	OPPDRAGSGIVERS REF.:
Effektiviseringsmidler	Eff. 83/87

EKSTRAKT:

Prosjektets målsetning har vært å videreutvikle det kunstige agnet "Probait" for norsk linefiske. Agnet kan lagres ved romtemperatur, og det viste meget gode egenskaper med hensyn til egning og lavt agntap. I vårtorskefiske med pelagisk line ga agnet like høge fangstrater som naturlig rekeagn. I dette fiskeriet viste agnet også interessante selektive egenskaper med svært lav innblanding av undermåls torsk. Kunstig agn tilsatt henholdsvis makrell- og akkarsmak ga i sammenligning med naturlig agn lovende resultater for brosme. For torsk, hyse og lange var resultatene dårlige; sannsynligvis fordi man ikke har klart å rekonstruere stimuli-stoffene i makrell og akkar, og muligens fordi det kunstige agnet gir for rask stimuli-utvasking. Stimuli-sammensetningen for disse artene og forlenga utvaskingstid bør derfor stå sentralt i den videre FoU-aktiviteten på kunstig agn.

4 STIKKORD:

Kunstig lineagn	Seleksjon
Fangsteffektivitet	Praktiske egenskaper

FARTØYSEKSJON
VESSEL AND MARINE ENGINEERING DIVISION
P.o. 4153 Valentinlyst
7002 Trondheim
Tlf. (07) 595650

HOVEDKONTOR
MAIN OFFICE
FOREDLINGSSEKSJON
PROCESSING DIVISION
Universitetsområdet Breivika
Tromsø
Telefon (083) 86586
Postboks 677 9001 N-Tromsø
Telex FTFIN N-75902

FANGSTSEKSJONEN
FISHING GEAR AND METHODS DIVISION
C. Sundtsgt. 64, Bergen
Telefon (05) 323770 - Telefax (05) 315852
Postboks 1964
N-5024 Bergen

BAKGRUNN

Prosjektets målsetting har vært å videreutvikle og tilpasse det kunstige agnet "Probait" for norsk linefiske. Agnet er opprinnelig utvikla ved Universitetet i Florida med tanke på anvendelse i sportsfiske etter marine arter. Det er basert på et polyurethan-legeme som kan tilsettes ulike kunstige eller naturlige lukt- og smaksstoffer. Prosjektet har vært innlemma i Fangstseksjonen's ordinære line-program finansiert av NFFR og Fondet for fiskeleting og forsøk, og utført i samarbeid med Universitetet i Florida og O. Mustad & Søn A/S.

RESULTATER

Et innledende forsøk har vist at dette agnet har flere positive praktiske egenskaper. Det er reinslig og behagelig å arbeide med under egning. Den fysiske styrken til agnet gjør at det henger godt på kroken og gir et meget lavt agntap. Ens form og størrelse gjør agnet velegna for tilpasning til mekanisert linedrift. Videre har agnet den svært gode egenskapen at det kan lagres ved romtemperatur uten kvalitetsforringelse.

"Probait"-agnet tilsatt rekesmak har vært testa i vårtorskefisket (pålesatt line) på Finnmarks-kysten i to påfølgende sesonger (1987 og 1988). Disse forsøkene ga to meget interessante resultater. For det første var fangstratene under brukbare fiskeforekomster like høge for det kunstige agnet som for naturlig rekeagn. Videre fanga det kunstige agnet torsk som i gjennomsnitt var større enn torsk fanga med naturlig reke. Denne forskjellen i middellengde økte med økende størrelse av det kunstige agnet. Forskjellen skyldes en lavere andel undermåls fisk (<42 cm) i fangstene tatt med kunstig agn i forhold til naturlig agn (henholdsvis 0.6 og 3.0%). Andelen torsk under 47 cm var også lavere for kunstig agn (henholdsvis 4.6 og 12.3%). Dette siste resultatet er spesielt interessant med tanke på at minstemålet for torsk nå er heva til 47 cm.

Forsøk utført i banklinefisket med "Probait" tilsatt makrellsmak ga lovende resultater for brosme (ca. 70% fangstrate sammenligna med naturlig makrellagn), mens fangsten av lange var lav (30%). Tilsatt akkarsmak ga det kunstige agnet lave fangstrater for både brosme og lange. Forsøk med disse to agntypene i kystlinefisket etter torsk og hyse ga langt lavere fangstrater enn naturlig agn. På bakgrunn av disse forholdsvis dårlige resultatene blei det foretatt analyser

for å kartlegge den kjemiske sammensetningen av makrell og akkar og dermed få en "oppskrift" for en kunstig lukt- og smaks-etterligning av disse agnråstoffa.

Kvalitative og kvantitative analyser av aminosyrer og andre stoffgrupper (nukleotider, kvartære ammonium-forbindelser og organiske syrer) som er påvist å stimulere beiteatferd hos fisk og derfor er viktige for fiskens tiltrekning til og akseptering av et kunstig agn, blei utført ved Universitetet i Florida. I tillegg blei fettinnholdet, sammensetningen av lipidklasser og fettsyrefordelingen analysert ved Sildeolje- og Sildemelindustriens Forskningsinstitutt. På grunnlag av resultatene fra disse analysene blei ulike varianter av kunstig agn med henholdsvis makrell- og akkarsmak utvikla og produsert.

Fiskeforsøk utført i kystlinefisket ga lave fangstrater av torsk og hyse for disse kunstige agntypene sammenligna med naturlig makrell og akkar. Disse første forsøkene tyder derfor ikke på at resultatene av de kjemiske analysene har bidratt til å øke fangsteffektiviteten for torsk og hyse. Bifangsten av brosme viste imidlertid positive resultater for kunstig agn med akkarsmak. Dette agnet ga like høge fangster av brosme som naturlig akkar.

Det kunstige rekeagnet som har vist lovende resultater under vårtorskefisket på Finnmarkskysten blei testa i ulike varianter under Lofotfisket i 1989. Det mest effektive agnet fanga 60% av fangstraten til naturlig reke. Et dårligere resultat for kunstig rekeagn i dette forsøket skyldes sannsynligvis at fangstratene generelt var lave, og at fisken i den aktuelle perioden foretrakk makrellagn framfor reke. Som i tidligere forsøk viste det kunstige agnet positive selektive egenskaper ved at det fanga større fisk enn naturlig agn.

De selektive egenskapene til "Probait" er antatt å skyldes dets form (rektangulært) og muligens konsistens som avviker mye fra fiskens naturlige byttedyr. Denne forskjellen har sannsynligvis størst effekt på små fisk som derfor i mindre grad angriper en krok egna med dette agnet. For å undersøke effekten av agnets form mer i detalj, er det utført atferdsstudier der responsen mot et rektangulært agn blei sammenligna med et agn forma som en fisk. Resultatene fra dette forsøket er ikke ferdigbehandla, men foreløpige resultater indikerer ingen forskjell i responsen mot de to agntypene.

KONKLUSJONER

"Probait"-agnet har meget gode praktiske og fysiske egenskaper med hensyn til lagring, manuell og mekanisert egning, og agntap. I vårtorskefiske med pelagisk line har agnet vist interessante selektive egenskaper med svært lav innblanding av undermåls fisk. I dette fiskeriet har agnet gitt like høge fangstrater av torsk som naturlig rekeagn. Kunstig agn tilsatt henholdsvis makrell- og akkarsmak har vist lovende resultater for brosme, mens resultatene for torsk, hyse og lange har vært betydelig dårligere. Dette skyldes sannsynligvis at man for disse artene ikke har klart å rekonstruere lukt- og smakssammensetningen av makrell og akkar. I tillegg kan det skyldes at agnlegemet i "Probait" gir en for rask utvasking av stimuli-stoffene.

Gjennom det arbeidet som er utført på kunstig agn er det oppnådd resultater og bygd opp en kunnskapsbakgrunn og kompetanse som viser at løsningen på kunstig agn problemet sannsynligvis er innen rekkevidde. Det er oppretta kontakt med internasjonale samarbeidspartnere både i USA og Sovjetunionen som har verdifull kompetanse innen ulike sider av denne problemstillingen. Videre har det avslutta prosjektet vært en del av et arbeid som har ført fram til Dr. Scient.-avhandlingen "Longline bait: Fish behaviour and the influence of attractant release rate and bait appearance".

I den videre FoU-aktiviteten på kunstig agn bør det derfor fortsatt arbeides med å komme fram til stimuli-sammensetninger som er effektive for de aktuelle artene og i de forskjellige sesong-fiskeriene. Et alternativt agnlegeme (polymer) som muliggjør en forlengelse av utvaskingstiden for lukt- og smaksstoffene bør også utprøves.

DOKUMENTASJON

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VEDLEGG

Framdriftsrapporter NFFR-prosjektet "Kunstig lineagn" (3 stk.)
FTFI-arbeidsnotater (6 stk.)

ARBEIDSNOTAT

PROSJEKTTITTEL:

LINE

NOTATET GJELDER:

Testing of artificial bait in longlining for cod and haddock, April 1987

FORFATTER: Svein Løkkeborg
Åsmund Bjordal

Seksjon: Fangst | Dato: 1.6.87.

GÅR TIL:

	Orientering	Uttalelse	Behandling	Etter avtale
Seksjonsleder Steinar Olsen				
Prosjektleder Åsmund Bjordal				
University of Florida				
O. Mustad & Søn A/S				

1 INTRODUCTION

This report describes a fishing trial with an artificial longline bait using shrimp extract and chemicals identified in shrimp as feeding stimulants. The catch efficiency of this bait has earlier been shown to be lower than natural squid bait in a fishery where squid are regarded as the most efficient bait (LØKKEBORG 1986). The properties of the bait with regard to handling, baiting and bait loss were, however, superior to natural bait.

In this study the bait was compared with natural shrimp and tested in a fishery where shrimp are usually used as bait. The current bait was made such that the stimulant should last longer and the bait remain effective longer than the bait tested in the earlier trial.

2 MATERIAL AND METHODS

2.1 Fishing ground and gear.

The fishing trial was conducted during the period 23-30/4, 1987 at Lopphavet about 20 nm west of Sørøya (Nothern Norway). The depth on the fishing ground varied between 185 and 285 m. The trial was carried out from a 65 foot vessel (M/S "Bjørnsvik") operating in commercial longlining.

A semi-pelagic monofilament longline was used. Gear parameters are specified in Table 1. Sinkers and floats were attached to the groundline at intervals of 25 hooks, floating the line 2-4 m above the bottom (Fig. 1). 18 skates containing about 290 hook each were set every day except Sunday and hauled 2 or 3 days later.

2.2 Experimental design.

An artificial bait made by incorporating feeding stimulants into polyurethane formulation was compared with salt-boiled and frozen shrimp (Pandalus borealis). Two different types of feeding stimulants were tested, shrimp extract prepared from small and raw males and synthetic chemicals comprising the major feeding stimulants identified in shrimp (see CARR 1976, CARR and CHANEY 1976). The artificial baits were prepared by the Whitney Marine Laboratory of the University of Florida. The bait sizes are shown in Table 2.

Each experiment was based on paired comparison between one of the artificial baits and natural shrimp. The experimental longlines were baited with the two baits in clusters of intervals of about 50 similary baited hooks. 1730 and 1920 hooks were set in the two comparisons, respectively. From the 18 skates set every day, between 1 and 6 were used for the trial. The artificial baits were tested on lines soaked for both 2 and 3 days.

2.3 Data recording.

Data from every hook was recorded on a portable data terminal (Micronic 445, FLOEN 1985) during hauling of the gear. For hooks that had caught a fish, the species and hooking position (mouth, swallowed or elsewhere/not observed) were recorded. Cod and haddock lengths were measured (total length). For cod the weight of the catch was estimated by grouping the lengths into 5 cm cells and using the relation

$$W=\sum n_i \, a L_i^3$$

where W is the weight in grams, n_i the number of observations in cell i, L_i the cell midpoint in centimeters and a the condition factor. 0.007 was used as condition factor for lengths below 47 cm and 0.008 for length above 47 cm, according to the condition factors estimated for cod at 3 and 4 years and cod at 5 years and older, respectively (K. SUNNANÅ, Institute of Marine Research, pers. com.).

Hooks without catch were classified according to the hook status: hook missing, bait loss, bait remnant or intact bait.

The data was transferred to a computer for storing, processing and hypothesis testing. The following statistical tests were used: two-tailed binomial test for catch data, two-sample t test for length data and chi-square analysis of contingency table for hooking position and bait status (ZAR 1974). A significance level of 5% was used.

3 RESULTS

The catch during this fishing trial was mainly cod (Gadus morhua) and haddock (Melanogrammus aeglefinus). The by-catch included species such as redfish (Sebastes marinus) and torsk (Brosme brosme). The catch results are given as number of fish and catch rate (number of fish per 100 hooks, excluding loosed and entangled hooks).

The artificial baits gave significantly lower catch rates (in

number) compared with shrimp bait (Table 3a and 4a). For cod the negative catch difference was more pronounced for bait flavoured with shrimp extract than for bait flavoured with synthetic chemicals (32% and 23%, respectively), while there was no difference for haddock (96% negative catch difference for both of the artificial baits).

However, by weight the catch difference was much lower. Artificial bait flavoured with synthetic chemicals caught 485 grams of cod per hook compared to 512 grams for natural bait, giving a catch decrease of only 5%. For the comparison of artificial bait flavoured with shrimp extract and natural bait the catch in weight was 205 grams and 265 grams per hook, respectively, giving a catch decrease of 23%.

The mean length of cod and haddock caught on artificial bait was about 4 cm higher than on natural bait (except for haddock caught on artificial bait flavoured with shrimp extract). From the length-frequency distributions for cod (Fig. 2 and 3) it can readily be seen that the artificial baits were as efficient or even more efficient than natural bait for fish ranging above 62 cm.

The artificial baits gave a significantly higher proportion of cod that had swallowed the hook compared with natural bait (Table 3b and 4b). The number of haddock caught on artificial bait was too low to indicate any difference in hooking position.

The bait status (Table 3c and 4c) clearly demonstrates the ability of the artificial baits to withstand bait loss, while there was a considerable loss of natural bait.

In Table 5 the catch results for cod are shown separately for 2 and 3 days soak time. The negative catch difference was more pronounced for 3 days soak time than for 2 days soak time for both types of artificial bait. The loss of natural bait was higher for 3 days soak time than for 2 days soak

time in testing artificial bait flavoured with synthetic chemicals, while an opposite and smaller difference was found in testing artificial bait flavoured with shrimp extract.

4 DISCUSSION

The results achieved with these artificial baits are very promising. The baits were shown to be as efficient as shrimp bait for catching large cod, and by weight the total catch of cod caught on the syntheticly flavoured artificial bait was almost equal to that of shrimp bait.

For catching haddock and small cod, however, the artificial baits were less efficient than natural bait. The bait size has earlier been demonstrated to affect the effectivity for haddock and the selectivity for cod, with larger bait giving lower catch rates for haddock and smaller cod (JOHANNESSEN 1983). It is therefore reason to believe that the greater size of the artificial baits has had a negative effect on the catch rates, especially for haddock and small cod. However, this selective effect should be regarded as a positive property.

The artificial baits may also be somewhat inferior to the natural bait with regard to attraction and acceptance. This is indicated by the results for large cod since the low bait loss for artificial baits would otherwise resulted in a higher catch rate.

In this study the artificial bait was shown to catch less cod in the mouth, a result that may be due to the greater size of this bait. When a fish is biting without swallowing a baited hook, increased bait size is likely to affect the probability to come into contact with the hook in a way that leads to lower hooking probability for the bigger bait.

The artificial baits caught more cod that had swallowed the bait than the shrimp bait. This interesting finding indicates

that the artificial bait is better than shrimp at induce the ingestion and swallowing response more effectively.

Three days soak time gave a more pronounced catch difference for the artificial baits than two days soak time. This result is rather surprising as the artificial baits withstand bait loss much better than shrimp bait. However, the effective fishing time of a longline bait is also dependent on the rate of release of feeding stimulants. The result, therefore, indicates that the artificial baits release stimulants over a shorter period of time than the shrimp bait. The rate of stimulant release for the artificial baits can be altered, and tested by the method reported by LØKKEBORG (1985).

The observed difference in catching power between the two types of artificial bait is probably due to the different feeding stimulants. It is interesting that the most promising result was achieved with the bait flavoured with synthetic chemicals. The same result was found in an earlier fishing trial with these baits (LØKKEBORG 1986). A bait flavoured with shrimp extract prepared from mature females might have been more efficient than an extract prepared from small males since mature females are regarded as a better natural bait.

The artificial baits caught very few haddock and small cod and were thus much more selective than the shrimp bait both with regard to size and species selectivity. Use of artificial baits may therefore improve the selectiveness of longline fishing.

5 CONCLUSION

The promising catch results for this artificial longline bait are clearly encouraging with respect to futher developments.

A natural progress will incude testing of baits flavoured with extract and/or synthetic stimuli mixtures of squid and mackerel to be tested in the longline fishery for torsk and

ling.

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Table 1. Gear parameters for monofilament longline.

MAINLINE	- Material:	Polyamide monofilament
	- Diameter:	2.0 mm
	- Length:	750 m per skate
GANGION	- Material:	Polyamide monofilament
	- Diameter:	0.8 mm
	- Length:	70 and 90 cm
	- Mounting:	Swivel
HOOK	- Type:	Mustad Wide Gap
	- Quality:	72940
	- Size:	No. 5
	- Number:	Ca. 290 per skate
	- Hook spacing:	2.5 m

Table 2. Weight (in grams) and size (in centimeters) of natural shrimp and artificial bait. The dimensions given are average values for 25 baits.

Bait type	Weight	Lenght	Width	Thickness
Natural shrimp	9.2	7.8	-	-
Artificial bait	2.5	5.1	2.2	0.8
*Artificial bait	20.1	6.1	2.4	1.4

*) Bait that has been soaked for 3 days.

Table 3a. Comparison of natural shrimp (N) and artificial bait flavoured with synthetic chemicals (A). Catch and length data.

Species	Bait type	Catch				Length (cm)			
		No.	Rate	Diff.%	p	Mean	Conf.95%	No.	p
Cod	N	266	27.7	-22.9	<0.01	59.6	1.1	266	<0.001
	A	184	21.3			64.0	1.3	181	
Haddock	N	138	14.3	-96.0	<0.001	44.0	1.0	121	>0.05
	A	5	0.6			48.2	6.6	6	
Total	N	416	43.2	-46.9	<0.001				
	A	198	22.9						

Table 3b. Hooking position for cod and haddock caught on natural shrimp and artificial bait flavoured with synthetic chemicals.

Species	Bait type	Mouth		Swallowed		Not obs.		p
		%	No.	%	No.	%	No.	
Cod	Natural	73.3	195	24.4	65	2.3	6	<0.001
	Artificial	37.0	68	60.3	111	2.7	5	
Haddock	Natural	94.9	131	1.4	2	3.6	5	*
	Artificial	100.0	5	0.0	0	0.0	0	

*) The sample size is not sufficiently large for an unbiased chi-square calculation.

Table 3c. Bait status for natural shrimp and artificial bait flavoured with synthetic chemicals.

Bait type	Intact		Remnant		Loss		p
	%	No.	%	No.	%	No.	
Natural	33.3	182	1.6	9	65.0	355	<0.001
Artificial	96.4	641	0.0	0	3.6	24	

Table 4a. Comparison of natural shrimp (N) and artificial bait flavoured with shrimp extract (A). Catch and length data.

Species	Bait type	Catch				Length (cm)			
		No.	Rate	Diff.%	p	Mean	Conf.95%	No.	p
Cod	N	106	14.1	-32.3	<0.01	59.7	1.7	111	<0.05
	A	68	9.5			63.5	2.4	68	
Haddock	N	119	15.8	-95.6	<0.001	45.1	1.7	104	>0.5
	A	5	0.7			45.8	2.4	5	
Total	N	237	31.4	-64.8	<0.001				
	A	79	11.1						

Table 4b. Hooking position for cod and haddock caught on natural shrimp and artificial bait flavoured with shrimp extract.

Species	Bait type	Mouth		Swallowed		Not obs.		p
		%	No.	%	No.	%	No.	
Cod	Natural	65.1	69	34.9	37	0.0	0	<0.001
	Artificial	35.3	24	63.2	43	1.5	1	
Haddock	Natural	95.0	113	4.2	5	0.8	1	*
	Artificial	80.0	4	0.0	0	20.0	1	

*) The sample size is not sufficiently large for an unbiased chi-square calculation.

Table 4c. Bait status for natural shrimp and artificial bait flavoured with shrimp extract.

Bait type	Intact		Remnant		Loss		p
	%	No.	%	No.	%	No.	
Natural	25.0	129	3.3	17	71.8	371	<0.001
Artificial	98.6	626	0.0	0	1.4	9	

Table 5. Comparison of natural shrimp (N) and artificial bait (A). Catch results for cod and proportion of intact bait given separately for 2 and 3 days soak time.

Exp.	Soak time	Bait type	No.	Rate	Diff %	Intact bait %
1)	2 days	N	120	22.8	-17.4	37.1
		S	86	18.8		96.1
	3 days	N	146	33.6	-28.1	27.7
		S	98	24.1		96.7
2)	2 days	N	57	15.8	-22.3	22.3
		S	39	12.3		98.2
	3 days	N	49	12.5	-41.3	27.7
		S	29	7.3		98.9

[1] Artificial bait flavoured with synthetic chemicals.

[2] Artificial bait flavoured with shrimp extract.

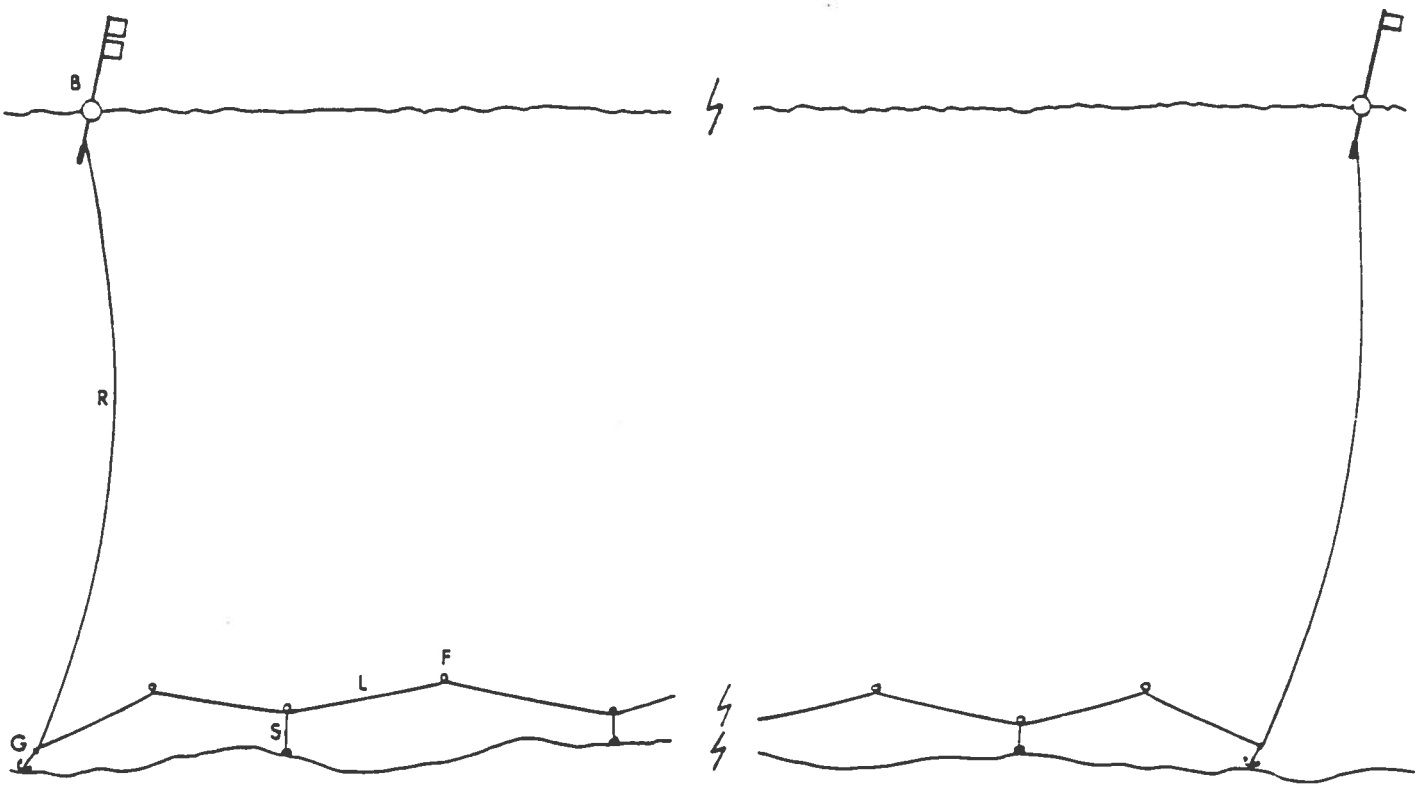

Fig. 1. Semi-pelagic longline. B) Buoy, F) float, G) grapnel, L) longline, R) rope, S) sinker.

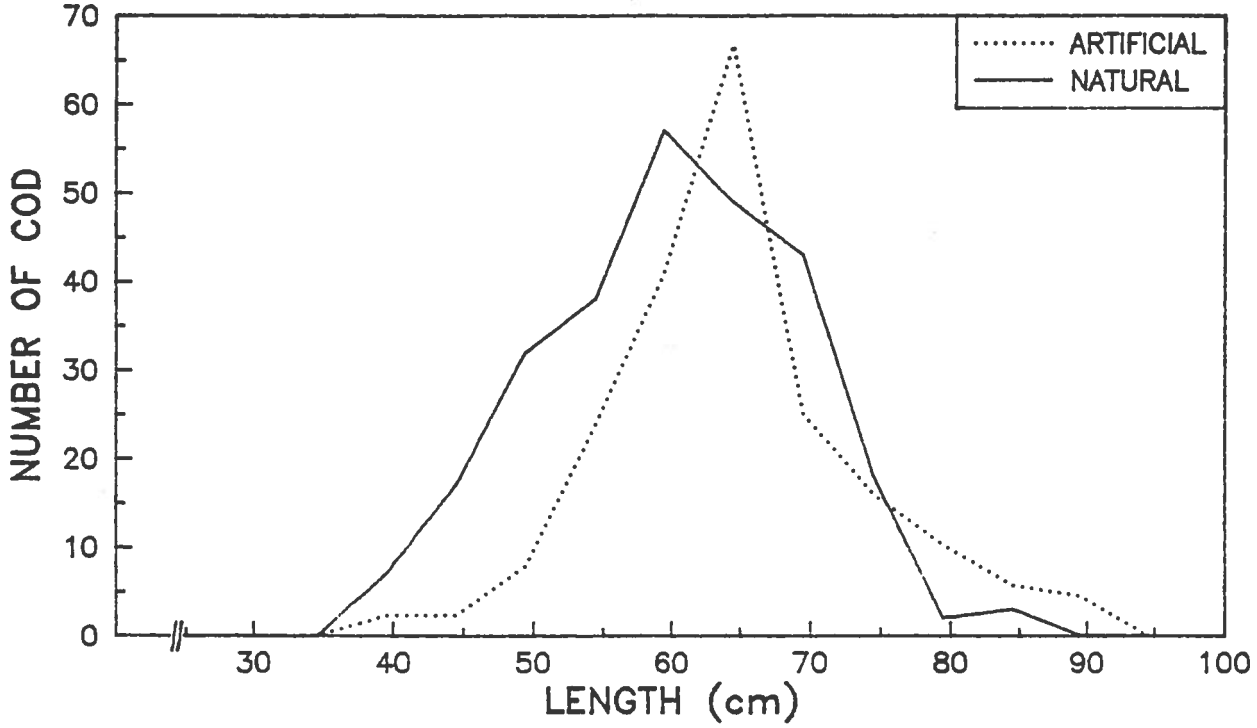

Fig. 2 Length-frequency distributions of cod caught on natural shrimp and artificial bait flavoured with synthetic chemicals.

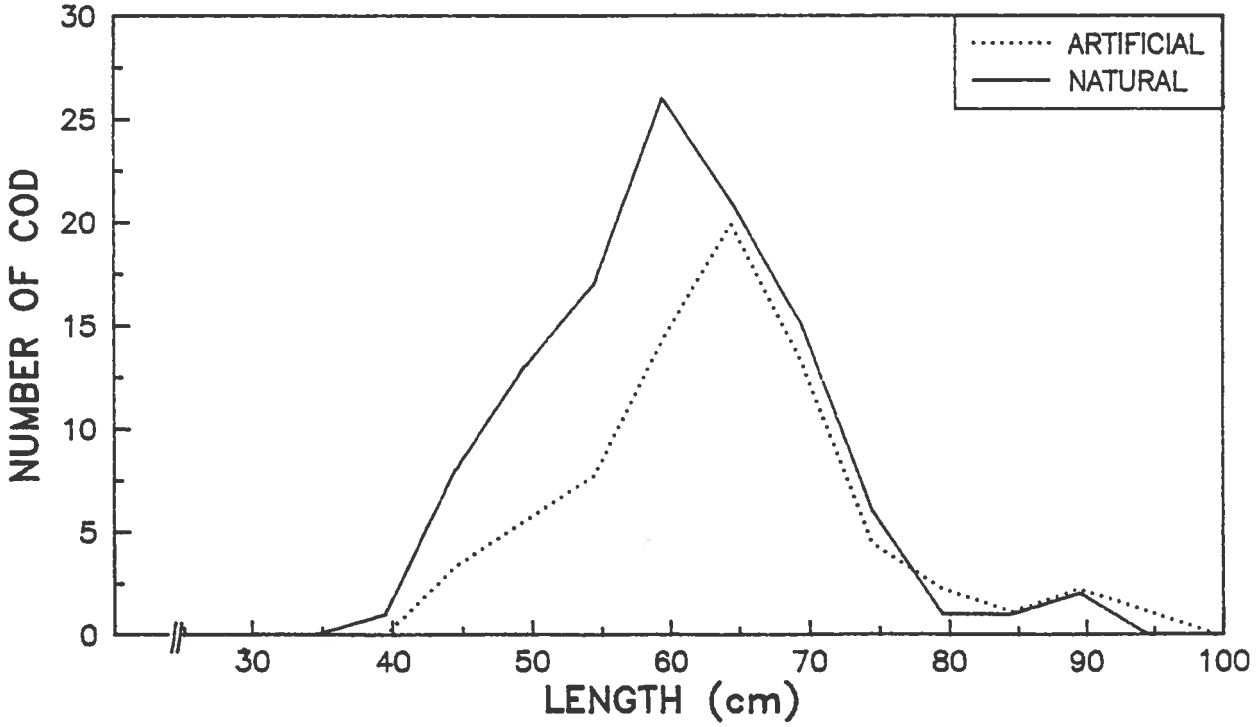

Fig. 3 Length-frequency distributions of cod caught on natural shrimp and artificial bait flavoured with shrimp extract.

ARBEIDSNOTAT

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PROSJEKTTITTEL:

LINE

NOTATET GJELDER:

Testing of mackerel and squid flavoured artificial bait in longlining for torsk and ling, October -87.

FORFATTER: Svein Løkkeborg
Dag Furevik, Åsmund Bjordal

Seksjon: Fangst | Dato: 28.10.87.

GÅR TIL:	Orientering	Uttalelse	Behandling	Etter avtale
Seksjonsleder Steinar Olsen				
Prosjektleder Åsmund Bjordal				
University of Florida				
O. Mustad & Søn A/S				
NFFR				
FTFI-Tromsø, Tr.heim				

1 INTRODUCTION

An artificial bait developed by Whitney Marine Laboratory, University of Florida has given promising results in the winter fishery for cod (LØKKEBORG and BJORDAL 1987). Bait flavoured with synthetic chemicals proved to be nearly as efficient as natural shrimp, which is regarded as an efficient bait in this fishery.

In the present study the bait was tested in the fishery for torsk (*Brosme brosme*) and ling (*Molva molva*), where a combination of squid and mackerel bait is used. The effectiveness of artificial baits containing feeding stimulants prepared from squid and mackerel was tested against natural baits.

2 MATERIAL AND METHODS

2.1 Fishing ground and gear.

The fishing trial was conducted on a commersial longliner (M/S "Nesbakk") on Frøyabanken (off the coast of Western Norway) during the period 2-11. October 1987. The vessel was operating with four fleets of bottom set longlines, each fleet containing 8 skates of about 180 hooks each (Table 1). The fishing depth ranged from 237 to 411 m.

2.2 Experimental design.

Artificial baits were prepared by incorporating feeding stimulants into a polyurethane formulation. Two different flavours were used. Bait flavoured with a mixture of squid extract and synthetic chemicals identified in squid was compared with natural squid bait, and bait flavoured with mackerel extract was compared with natural mackerel bait. The artificial bait is heated during a drying step in the preparation. This may alter the composition of the stimulants. Therefore, a small sample of the mackerel flavoured bait was prepared by an alternate process that does not expose the material to prolonged high temperature.

The experiments were based on paired comparison, and the longlines were baited with artificial and natural bait in clusters of intervals of about 45 similarly baited hooks. The experimental skates were set in the middle of the fleet with at least one standard skate at each end of the fleet. The soak time varied between 5 and 8 hours.

2.3 Data recording.

During hauling of the gear data from every hook was recorded on a portable data terminal (Micronic 445, FLOEN 1985). For hooks with catch, the species and hooking position (mouth, swallowed or elsewhere/not observed) were recorded. Torsk and

ling lengths were measured (total length) to the nearest cm. Hooks without catch were classified according to the hook status: hook missing, bait loss, bait remnant or intact bait.

The data was transferred to a computer (Hewlett-Packard 1000) for storing, processing and hypothesis testing. The following statistical tests were used: two-tailed binomial test for catch data, two-sample t test for length data and chi-square analysis of contingency table for hooking position and bait status (ZAR 1974). A significance level of 5% was used.

3 RESULTS

The catch results are given as number of fish and catch rate (number of fish per 100 hooks, excluding lost and entangled hooks) for torsk, ling and the total catch of marketable species which also include species such as redfish (*Sebastes marinus*) and saithe (*Pollachius virens*).

Artificial bait flavoured with mackerel gave significantly lower catch rates than natural mackerel bait (Table 2a). The catch decrease was about 30% for torsk, the dominant species. The mean length of torsk caught on natural bait was also significantly higher than for torsk caught on artificial bait. As shown in Fig. 1 this difference is due to a higher number of small torsk (< 45 cm) caught on artificial bait.

There was, however, a higher proportion of torsk that had swallowed the artificial bait than the natural bait (Table 2b). The catch of ling was too low to estimate the catch difference or any difference in mean length or hooking position.

As shown in Table 2c, the bait loss of the artificial bait was insignificant compared to that of mackerel bait.

The sample of mackerel flavoured bait prepared by an alternate process (not exposed to prolonged heating) was low (100

pieces), and only ten marketable fish were caught in this experiment, all torsk. The artificial bait caught six torsk and the natural bait caught four.

The results for artificial bait flavoured with squid are shown in Table 3a-c. For torsk the artificial bait gave 75% lower catch rate than natural squid. There was no significant difference in mean length or hooking position, but the results indicate a lower proportion of swallowed bait for the artificial bait.

Also this experiment demonstrated the high tear strength of the artificial bait.

4 DISCUSSION

The results achieved in this fishing trial should not be compared with the promising results with this type of artificial bait for cod (LØKKEBORG and BJORDAL 1987) without considering the difference in the respective fisheries. The trial for cod was conducted in a fishery that takes place after the spawning season and where semi-pelagic longlines are used. In this season the fish is very hungry and visual cues are regarded as an important stimulus to trigger the attack response (JOHANNESSEN and MORK 1984). In addition the gear is soaked for a long periode of time in this fishery, a factor that favours baits with high tear strength.

For bottom set longline in deep waters, however, chemical stimuli are dominant and the chemical composition of the bait is essential for the catching power of the gear. From this point of view the results achieved with the mackerel flavoured artificial bait should be regarded as promising.

This bait caught as many torsk that had swallowed the bait as natural mackerel bait, and the catch decrease was due to less fish hooked in the mouth. The same result was found in an earlier fishing trial with this bait (LØKKEBORG and BJORDAL

1987). This finding may indicate that some aspects of the physical properties (probably the strength and size) of the artificial bait negatively affect the hooking probability, whereas the swallowing response is induced more effectively.

The artificial baits seemed, however, to be inferior to the natural bait with regard to attraction and acceptance, as the high tear strength of the artificial bait should otherwise increased the catch. This applies especially to the squid flavoured bait. For the mackerel flavoured bait the inferiority could possibly be due to the heating during the drying step. The experiment with bait that was not exposed to high temperature could indicate that this alternate process more accurately retained the flavour of fresh mackerel. This hypothesis should, however, be tested in a more extensive experiment. The low catching power for squid flavoured bait is probably due to lack of critical stimulants, and indicates that this bait does not compromise the composition of squid.

The attracting and accepting performances are also influenced by the rate of release of feeding stimulants. An earlier fishing trial indicated that the artificial bait released stimulants over a shorter periode of time than shrimp bait (LØKKEBORG and BJORDAL 1987). The soak time was, however, much shorter in the present study, and the results therefore not comparable with regard to release rates.

The fact that mackerel flavoured bait caught a higher number of small torsk than natural bait is difficult to explain. One possible explanation is that the smaller fish are moving slowlier than the bigger one and therefore come into contact with the gear later. By then the bait loss may have influenced the number of intact artificial and natural bait in different proportion.

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LØKKEBORG, S. and Å. BJORDAL 1987. Testing of artificial bait in longlining for cod and haddock, April 1987. Field Rep. inst. Fish. Tech. Res. Bergen, 01.06.87.

ZAR, J.H. 1974. Biostatistical analysis. Prentice-hall, Inc., Englewood Cliffs. N.J. 620 pp.

Table 1. Gear parameters.

Mainline:	Spun polyester, 180 m (length), 7 mm (diam.).
Gangion:	Terylene, 60 cm (length), nr. 12.
Mounting:	Knotted.
Hook:	Mustad Kirby Sea, Qual. 7330, nr. 6 (kirbed).
Hook spacing:	1.85 m, ca. 90 hooks pr. line.

Table 2a. Comparison of natural mackerel (N) and artificial bait flavoured with mackerel (A). Catch and length data.

Species	Bait type	Catch				Length (cm)			
		No.	Rate	Diff.%	p	Mean	Conf.95%	No.	p
Torsk	N	106	11.2	-32.6	<0.05	55.1	1.3	106	<0.05
	A	69	7.6			52.8	1.8	69	
Ling	N	14	1.5	-70.4	<0.05	94.1	6.1	14	>0.25
	A	4	0.4			100.5	10.9	4	
Total	N	122	12.9	-37.2	<0.005				
	A	74	8.1						

Table 2b. Hooking position for torsk and ling caught on natural mackerel and artificial bait flavoured with mackerel.

Species	Bait type	Mouth		Swallowed		Not obs.		p
		%	No.	%	No.	%	No.	
Torsk	Natural	53.8	57	38.7	41	7.5	8	<0.01
	Artificial	30.4	21	62.3	43	7.2	5	
Ling	Natural	78.6	11	7.1	1	14.3	2	[a]
	Artificial	50.0	2	0.0	0	50.0	2	

[a] The sample size is not sufficiently large for an unbiased chi-square calculation.

Table 2c. Bait status for natural mackerel and artificial bait flavoured with mackerel.

Bait type	Intact		Remnant		Loss		p
	%	No.	%	No.	%	No.	
Natural	15.4	122	4.4	35	80.2	634	<0.001
Artificial	90.2	752	0.1	1	9.7	81	

Table 3a. Comparison of natural squid (N) and artificial bait flavoured with squid (A). Catch and length data.

Species	Bait type	Catch				Length (cm)			
		No.	Rate	Diff.%	p	Mean	Conf.95%	No.	p
Torsk	N	137	16.6	-75.4	<0.001	54.0	1.2	136	>0.25
	A	30	4.1			55.1	3.9	30	
Ling	N	28	3.4	-96.0	<0.001	96.0	6.4	28	>0.25
	A	1	0.1			115.0	-	1	
Total	N	174	21.1	-80.0	<0.001				
	A	31	4.2						

Table 3b. Hooking position for torsk and ling caught on natural squid and artificial bait flavoured with squid.

Species	Bait type	Mouth		Swallowed		Not obs.		p
		%	No.	%	No.	%	No.	
Torsk	Natural	29.9	41	62.8	86	7.3	10	>0.05
	Artificial	50.0	15	46.7	14	3.3	1	
Ling	Natural	78.6	22	7.1	2	14.3	4	[a]
	Artificial	100.0	1	0.0	0	0.0	0	

[a] The sample size is not sufficiently large for an unbiased chi-square calculation.

Table 3c. Bait status for natural squid and artificial bait flavoured with squid.

Bait type	Intact		Remnant		Loss		p
	%	No.	%	No.	%	No.	
Natural	69.3	447	0.3	2	30.4	196	<0.001[a]
Artificial	95.0	668	0.0	0	5.0	35	

[a] The category "remnant" is not included in the test.

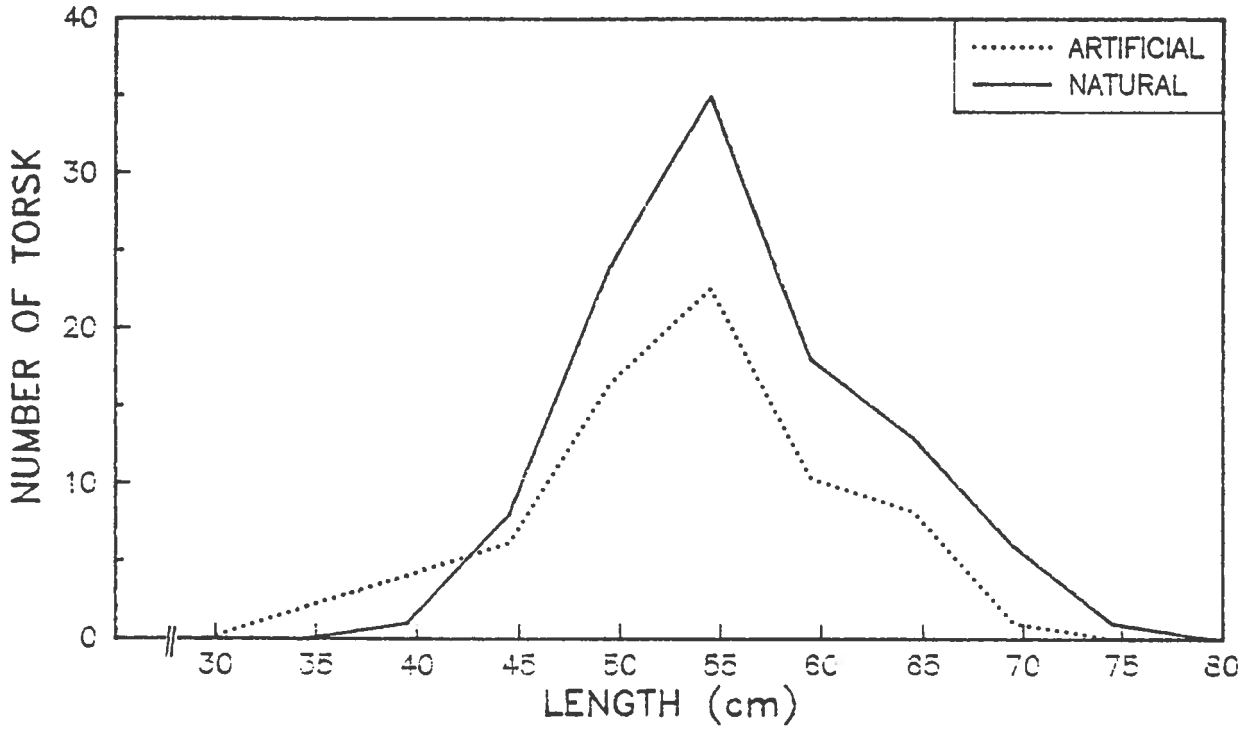

Fig. 1. Length-frequency distributions of torsk caught on natural mackerel and artificial bait flavoured with mackerel.

ARBEIDSNOTAT

Prosjekt nr.	Notat nr.
1101	

PROSJEKTTITTEL:

LINE

NOTATET GJELDER:

Testing of mackerel and squid flavoured artificial bait in longlining for cod and haddock, December 1987.

FORFATTER: Svein Løkkeborg
Bjørn Totland
Åsmund Bjordal

Seksjon: Fangst | Dato: 6.1.88.

GÅR TIL:	Orientering	Uttalelse	Behandling	Etter avtale
Seksjonsleder Steinar Olsen				
Prosjektleder Åsmund Bjordal				
Univ. of Florida				
O. Mustad & Søn A/S				
NFFR				
FTFI-Tromsø, Trondheim				

1 INTRODUCTION

Earlier fishing trials with an artificial bait developed by Whitney Marine Laboratory, University of Florida have given promising results both in fishery for cod (LØKKEBORG and BJORDAL 1987) and in fishery for torsk and ling (LØKKEBORG et al. 1987). In the former trial bait flavoured with synthetic chemicals proved to be nearly as efficient as natural shrimp. In the latter trial bait flavoured with mackerel gave about 70% catch rate for torsk compared to natural mackerel, while bait flavoured with squid gave low catch rate.

In this study baits flavoured with mackerel and squid, repectively, were tested in a fishery for cod and haddock where squid is normally used as bait. The current bait was smaller than the bait tested in earlier trials and prepared by an alternate process that does not expose the material to high temperature.

2 MATERIAL AND METHODS

2.1 Fishing ground and gear.

The trial was conducted during the period 5.-7. December 1987 on a commersial longliner (M/S "Bjørnsvik") operating 60-85 nm off the coast of Finnmark (Nothern Norway). The depth on the fishing ground was about 300 m. Gear parameters are specified in Table 1.

2.2 Experimental design.

Artificial bait flavoured with a mixture of squid extract and synthetic chemicals identified in squid was compared with natural squid bait, and bait flavoured with mackerel extract was compared with natural mackerel bait. The bait sizes are shown in Table 2.

The experiments were based on paired comparison, and the longlines baited with artificial and natural bait in clusters of intervals of 50 similarly baited hooks. 750 baits of each type were tested. The soak time varied between 21 and 25 hours.

2.3 Data recording.

During hauling of the gear data from every hook was recorded. For hooks with catch; species, hooking position (mouth, swallowed, or elsewhere/not observed) and total length (only for cod and haddock) were recorded. Hooks without catch were classified according to the hook status: hook missing, bait loss, bait remnant and intact bait.

3 RESULTS

The catch during this trial was mainly cod (*Gadus morhua*) and haddock (*Melanogrammus aeglefinus*), but included also species such as redfish (*Sebastes marinus*) and Greenland halibut (*Reinhardtius*

hippoglossoides). The mean length of fish caught on different bait types ranged from 54 to 62 cm for cod and from 48 to 50 cm for haddock.

As shown in Table 3a, the catch rates for artificial bait flavoured with squid were very low compared to natural squid bait. Also bait flavoured with mackerel gave low catch rates compared to natural mackerel bait (Table 4a). Based on the total catch of marketable species the catch decrease was 96% for squid flavoured bait and 90% for mackerel flavoured bait.

The numbers of cod and haddock caught on artificial bait were too low to indicate any differences in mean length or hooking position between fish caught on artificial and natural bait.

The bait status shows that bait loss of artificial bait was insignificant, whereas a considerable proportion of natural bait was lost (Table 3b and 4b).

4 DISCUSSION

The artificial bait caught very few fish compared to natural bait. Considering the positive results that have been achieved with this bait in earlier trials (LØKKEBORG and BJORDAL 1987, LØKKEBORG et al. 1987), the present result is surprising.

There are, however, some important differences between these trials that partially may explain the result. When comparing the trials for cod, seasonal factors must be taken into consideration. The former trial was conducted immediately after the spawning season. At this time the fish is very hungry, semi-pelagic longlines are used and the period of daylight is long. Therefore, the fish is probably voracious and it is likely to assume that visual cues are an important stimulus.

The present study, however, took place shortly before the fish starts its spawning migration. At this time the fish do

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LØKKEBORG, S., D. FUREVIK and Å. BJORDAL 1987. Testing of mackerel and squid flavoured artificial bait in long-lining for torsk and ling, October -87. Field Rep. inst. Fish. Tech. Res. Bergen, 28.10.87.

Table 1. Gear parameters.

Mainline:	Polyamide, 480 m (length), 4.8 mm (diam.).
Gangion:	Polyamide monofilament, 55 cm (length), 0.8 mm (diam.).
Mounting:	Swivel.
Hook:	O´Shaugnessy, Qual. 34184, nr. 4/0.
Hook spacing:	1.60 m, 300 hooks pr. line.

Table 2. Weight (in grams) and size (in centimeters) of natural and artificial bait. The dimensions given are average values for 25 baits.

Bait type	Weight	Lenght	Width	Thickness
Natural squid	18.6	4.1	2.6	2.2
Natural mackerel	17.2	5.4	2.0	2.1
Artificial bait[a]	2.7	3.9	2.0	0.6

[a] Measured in dry condition (before soaking).

Table 3a. Comparison of natural squid and artificial bait flavoured with squid. Catch data.

Species	Cod		Haddock		Total catch	
Bait type	Nat.	Art.	Nat.	Art.	Nat.	Art.
No. of fish	271	4	73	10	349	15
Catch rate[a]	38.0	0.6	10.2	1.5	48.9	2.2
Catch difference	-98.5%		-85.8%		-95.5%	
p-value[b]	<0.001		<0.001		<0.001	

[a] Number of fish per 100 hooks.
[b] Two-tailed binomial test.

Table 3b. Bait status for natural squid and artificial bait flavoured with squid.

Bait type	Intact		Remnant		Loss		p-value
	%	No.	%	No.	%	No.	
Natural	23.0	76	3.0	10	73.9	244	<0.001[a]
Artificial	97.6	653	0.0	0	2.4	16	

[a] Chi-square contingency table analysis.

Table 4a. Comparison of natural mackerel and artificial bait flavoured with mackerel. Catch data.

Species	Cod		Haddock		Total catch	
Bait type	Nat.	Art.	Nat.	Art.	Nat.	Art.
No. of fish	229	6	90	19	327	31
Catch rate[a]	32.8	0.9	12.9	2.8	46.8	4.6
Catch difference	-97.3%		-78.2%		-90.2%	
p-value[b]	<0.001		<0.001		<0.001	

[a] Number of fish per 100 hooks.
[b] Two-tailed binomial test.

Table 4b. Bait status for natural mackerel and artificial bait flavoured with mackerel.

Bait type	Intact		Remnant		Loss		p-value
	%	No.	%	No.	%	No.	
Natural	19.1	62	20.6	67	60.3	196	<0.001[a]
Artificial	97.0	677	0.0	0	3.0	19	

[a] Chi-square contingency table analysis.

NOTAT

Oppdragsnummer eller spesiell referanse.

FORTROLIG

GÅR TIL	Orientering	Uttalelse	Behandling	Etter avtale
Steinar Olsen				
W. Sørensen				
O. Mustad & Søn A/S				

Gjelder:
Development of Probait (artificial bait) for longlining.
Report from meeting in Bergen, February 1988.

Underskrevet av: Å. Bjordal
W.E.S. Carr
S. Løkkeborg
J. Netherton

Avd.: Fangst | Dato: 29.2.88.

Til FTFI's adm.: 1 ekspl. for arkivering

Skjemaet brukes til rapportering fra reiser, møter, konferanser etc. etc. Omtal fortrinnsvis bare en sak på hvert skjema. Til påfølgende sider benyttes vanlig papir.

1. INTRODUCTION

The Whitney Marine Laboratory of the University of Florida (WML), Norwegian Institute of Fishery Technology Research (FTFI) and the Norwegian Company O. Mustad & Søn A/S (OMSAS) are collaborating on the development of artificial bait (Probait) for longlining in a joint project. The activity at WML is partly funded by OMSAS from January 15, 1987 to April 1, 1988, according to a contract between OMSAS and University of Florida.

During this study, four field trials have been conducted as follows:

1) In the Barents Sea for cod and haddock, Nov. -86.
2) At Lopphavet for cod and haddock, April -87.
3) At Frøyabanken for torsk and ling, Oct.- 87.
4) In the Barents Sea for cod and haddock, Dec. -87.

A fifth field trial will be conducted in March/April 1988 in Lofoten.

Of the four fishing trials, two have given very good or promising results for cod and torsk while two trials (including the last one) gave poor catch rates compared with natural bait.

To evaluate the project and propose plans for further progress, representatives from WML (W.E.S. Carr, J. Netherton) and FTFI (Å. Bjordal, S. Løkkeborg) met in Bergen 15th - 20th of February 1988. In addition, S. Olsen (Chief of Research, FTFI) and F. Pedersen (Dir., OMSAS) participated in the meeting for one day.

The main objectives of the meeting were as follows:
- To evaluate prior results;
- To decide upon both short and long term research plans that will increase the rates of production and testing of baits, and will lead to improvements in the mackerel and squid flavoured baits.

2. RESULTS

The following items are included below in our evaluation of the performance of the baits (probait) employed in the completed trials: 1) practical properties; 2) potential for quality control; 3) catching efficiency.

2.1 Practical properties

The following desirable properties are inherent features of the bait:

A. It can be stored at room temperature.
B. Baiting is easy because individual pieces are clean, dry and of uniform size.
C. Hook cleaning is easy.
D. The bait stays on the hook and is not readily removed by target species, scavengers or birds.
E. It is ideally suited for mechanical baiting.

2.2 Quality control

With baits made of synthetic materials, there is an ability to carefully control the ingredients added to successive

batches and to be certain that all batches are virtually identical in composition and release rate properties. This high degree of quality control is not easily attainable with natural baits or with artificial baits that are produced from natural baits.

2.3 Catching efficiency

The catch results of the four prior trials are summarized in the tables below:

Trial 1: Barents Sea, Nov. -86

Bait type	Cod		Haddock	
	No. caught	Diff.	No. caught	Diff.
Synt. shrimp flav.	51	-69%	12	-89%
Standard (Squid)	170		107	
Nat. shrimp flav.	8	-99%	32	-78%
Standard (Squid)	169		147	

Trial 2: Lopphavet, April -87

Bait type	Cod		Haddock	
	No. caught	Diff.	No. caught	Diff.
Synt. shrimp flav.	184	-23%	5	-96%
Standard (Shrimp)	266		138	
Nat. shrimp flav.	68	-32%	5	-96%
Standard (Shrimp)	106		119	

Trial 3: Frøyabanken, Oct. -87

Bait type	Torsk		Ling	
	No. caught	Diff.	No. caught	Diff.
Synt. mackerel flav.	69	-33%	4	-70%
Standard (Mackerel)	106		14	
Synt. squid flav.	30	-75%	1	-96%
Standard (Squid)	137		28	

Trial 4: Barents Sea, Dec. -87				
Bait type	Cod		Haddock	
	No. caught	Diff.	No. caught	Diff.
Synt. mackerel flav.	6	-97%	19	-78%
Standard (Mackerel)	229		90	
Synt. squid flav.	4	-99%	10	-86%
Standard (Squid)	271		73	

The main conclusions from the field trials are as follows:

A. The April -87 trial yielded the best results ever obtained for cod using an artificial bait. The shrimp flavoured Probait caught 77 % as many cod pr. hook as natural shrimp. However, there was no significant difference between the catch rates obtained on the two baits when the catch is expressed as grams of fish per hook.

B. In the October -87 trial, the mackerel flavoured Probait caught 67 % as many torsk as the natural mackerel bait. We view this as a very promising result since this is one of the best results ever obtained for torsk on an artificial bait.

C. The low catch of haddock in the April -87 trial may be due to the fact that large thick baits (2.2 x 5.1 x 0.8cm) were employed, and the hooking behaviour of the haddock is likely to require a much smaller and thinner bait.

D. No explanation is apparent for the low catch of ling in the October -87 trial.

E. We have two plausible explanations for the ineffectiveness of the artificial squid baits in both the Oct.- and Dec.-87 trials, and the ineffectiveness of the artificial mackerel bait in the Dec.-87 trial. 1) Our analyses of the tissue constituents of both squid and mackerel were done on specimens that had been frozen for several months

at -20°C, rather than on very fresh specimens. Hence our analyses may not be representative of the constituents present in very fresh squid and mackerel. By contrast, the shrimp bait used in the successful trials of Apr.-87 was the result of analyses conducted on the tissue of live shrimp. 2) In the Dec.-87 trial, the artificial baits were hooked onto wet longlines and stored under wet conditiors in tubs for 1 to 2 days prior to the actual field trial. The prewetting of these baits probably resulted in the premature softening of the surface coat of each bait and the subsequent loss of the surface coat before the baits settled to the bottom. Hence it is likely that the artificial baits fished in the Dec.-87 trial had only a foam layer that was lacking the stimulant-laden surface coat.

F. We feel that the overall effectiveness of Probait for the major target species can be improved by decreasing the bait size.

3. PLANS FOR FURTHER DEVELOPMENT

3.1 Short term objectives

The short term goal is to produce and field test another group of shrimp flavoured baits for the March/April cod and haddock fishery. In an effort to maximize the information obtained from this trial, 450 baits of each of four different types will be prepared. The stimulant in the surface coat of each of the baits described below will be the same synthetic shrimp mixture as used in the successful April -87 field trial. The amount of stimulant on the surface of each bait type will be kept constant. The foam portion of the baits will be varied as follows:

a. Stimulant = Norwegian Shrimp.
   Baits will be cut to 2.2 x 5.1 x 0.8 cm. These are the same as the baits used in the April -87 trial.

b. Stimulant = Norwegian Shrimp.
   Baits will be cut to 2 x 3.5 x 0.5 cm. This smaller size may be more compatible with the hooking behaviour of haddock.

c. Stimulant = Synthetic shrimp attractant.
   Baits are to be cut to 2 x 3.5 x 0.5 cm. The reason for the size is as described above.

d. Stimulant = Norwegian Shrimp.
   Baits are to be cut to 2 x 3.5 x 0.2 cm. This very thin bait will be used to see if the previously low catch rate for haddock can be improved upon, since the thinner bait may be more compatible with its hooking behaviour.

The baits described above will be sent by WML to FTFI no later than 1st April 1988.

3.2 Long term objectives

A. We will conduct analysis of the low molecular weight constituents of muscle tissue from live, or very fresh, squid, mackerel and shrimp used in the Norwegian longline fishery. These analyses will be used to provide stimulant formulations for the production of new artificial baits for field trials in the fishery where squid and mackerel are used as natural baits.

B. We will determine if the incorporation of high-grade fish oils into certain of the artificial baits results in a greater catch efficiency.

C. We will increase the size and production capacity of the bait facility at the WML in order to provide larger and more frequent samples of new bait variations for testing in field trials. This objective can be accomplished by

constructing a small pilot plant (ca. 800 - 1000 ft^2) on land available for this purpose at the WML. An objective would be to provide FTFI with samples of at least 1000-2000 baits every 3 to 5 weeks.

As an alternative to the construction of a pilot plant, an independent company could be contracted to manufacture the foam portion of the bait.

4. REFERENCES.

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LØKKEBORG, S. & Å. BJORDAL, 1987. Testing of artificial bait in longlining for cod and haddock, April 1987. Field Rep.inst.Fish.Tech.Res.,Bergen, 01.06.87.

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LØKKEBORG, S., B. TOTLAND & Å. BJORDAL, 1988. Testing of mackerel and squid flavoured artificial bait in longlining for cod and haddock, December 1987. Field Rep.inst. Fish.Tech.Res., Bergen, 06.01.88.

ARBEIDSNOTAT

PROSJEKTTITTEL:
LINE

NOTATET GJELDER:
Testing of shrimp flavoured artificial baits of different sizes in longlining for cod and haddock, April 1988

FORFATTER: Svein Løkkeborg, Bjørn Totland og Jan Tore Øvredal

Seksjon: Fangst | Dato: 30.05.88

GÅR TIL:

	Orientering	Uttalelse	Behandling	Etter avtale	
Seksjonsleder S. Olsen					
Prosjektleder Å. Bjordal					
University of Florida					
O. Mustad & Søn A/S					
NFFR					
FTFI-TØ, TH.					

1 INTRODUCTION

An artificial bait flavoured with synthetic chemicals has proved to be nearly as efficient as natural shrimp in longline fishing for cod during the spring fishery off the coast of Finnmark (LØKKEBORG and BJORDAL 1987). The bait gave, however, low catch rates for haddock and small cod, probably because of the greater size of this bait.

In the present study another group of shrimp flavoured baits were field tested in the same season and at the same fishing ground. The objective of this fishing trial was three-fold: a) to try to reproduce the results of the successfull April-87 trial, b) to improve the effectiveness of the bait by decreasing the bait size and c) to compare the catching power of synthetic and natural shrimp flavour.

A/S Peder Nordøye

prevent wetting of the artificial baits prior to setting, thin plastic sheets were laid between the baits and the long-line. Five skates containing about 290 hooks each were set in each comparison.

2.3 Data recording

During hauling of the gear data from every hook was recorded on a portable data terminal (FLOEN 1985). For hooks with catch; species, hooking position (mouth, swallowed or elsewhere/not observed) and total length (only for cod and haddock) were recorded. Hooks without catch were classified according to the hook status: hook missing, bait loss, bait remnant or intact bait.

3 RESULTS

The catch during this trial was mainly cod (*Gadus morhua*) and haddock (*Merlanogrammus aeglefinus*), but included also species such as torsk (*Brosme brosme*) and redfish (*Sebastes marinus*).

The artificial baits of large and medium sizes (Type I, II and III) gave all significantly lower catch rates compared with natural bait (Table 2a-4a). The catch rate was about 60% lower for cod and about 95% lower for haddock.

The artificial bait of small size (Type IV) gave about the same catch rate for cod as natural bait, while the catch rate for haddock was 77% lower (Table 5a). The five skates set in this experiment showed, however, great variations in the result for cod. One skate gave a catch rate of 58.6 (82 cod) for artificial bait and 40.7 (59 cod) for natural bait, while the total catch rates for the four other skates were 8.7 (48 cod) and 15.2 (86 cod), respectively.

The mean length of cod caught on all types of artificial bait was higher than for cod caught on natural bait (Table 2a-5a). The difference in mean length increased in relation to the

difference in bait size (except for Type II where the sample size was low). The length-frequency distributions for cod in the experiments with artificial baits of small and large size are shown in Fig. 1 and 2, respectively (the distributions in Fig. 2 are representative for the artificial baits of medium size). The small artificial bait was as efficient as the natural bait for fish ranging above 47 cm, while the bait caught few fish below this length. The larger artificial baits caught relatively few fish below 62 cm, but were nearly as efficient as natural bait for fish ranging above this length. The catch rates for large fish were, however, low in these experiments. A great majority of the cod caught both on artificial and natural baits were below 65 cm.

The proportion of fish that had swallowed the bait was low, but there was no clear difference between artificial and natural baits (Table 2b-5b). The loss of artificial baits were insignificant, while there was a considerable loss of shrimp bait (Table 2c-5c).

4 DISCUSSION

The small artificial bait gave about the same catch rate for cod as natural shrimp. This is the best result that ever has been achieved with this type of bait. The great variation in catch for different skates indicate, however, that the catchability of the bait is influenced by the catch rate. This variation may be due to the motion created by hooked fish. The struggeling of a hooked fish has been shown to stimulate the cod to attack a baited hook (LØKKEBORG 1985), and this stimulus will probably be stronger at higher catch rates.

The large artificial bait gave lower catch rate than when this bait was tested in the same fishery one year earlier (LØKKEBORG and BJORDAL 1987). The reason for this may be that there was less fish in the area the present year (the total catch rate was lower) and the proportion of large fish (above

65 cm) was much lower. The result for the small bait indicated that the catchability of this bait type increase with increasing catch rate and the artificial bait has proved to be more efficient for large than for small fish.

The artificial baits of medium size (Type II and III) gave both the same catch result relative to natural bait, indicating that bait with the foam flavoured with synthetic chemicals is as efficient as bait with natural extract in the foam. The catch rates when testing artificial bait with natural extract in the foam were, however, very low and the sample size in this experiment is therefore to small to give a reliable result.

The results for all experiments clearly demonstrate the effect of bait size on the length selection of cod. The three different bait sizes tested all caught cod larger in size than the natural bait. Furthermore, the difference in mean length between fish caught on artificial and natural bait increased with increasing size of the artificial bait. This result is of special interest because it shows how the gear can be made more selective.

5 REFERENCES

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LØKKEBORG, S. 1985. Faktorer som påvirker fangstegenskapene til naturlig og kunstig agn. Thesis inst. Fish. Biol., Univ. of Bergen. (Unpublished).

LØKKEBORG, S. and Å. BJORDAL 1987. Testing of artificial bait in longlining for cod and haddock, April 1987. Field Rep. inst. Fish. Tech. Res. Bergen, 01.06.87.

Table 1. Weight (in grams) and size (in millimeters) of natural and artificial bait. The dry weight is average value for 100 baits, while the other dimensions are average values for 25 baits. The values in brackets are for dry baits measured before soaking.

Bait type	Weight	Length	Width	Thickness
Natural shrimp	11.2	79	33	14
Art. bait, Type I	15.6(1.9)	56 (49)	22 (20)	15 (7)
Art. bait, Type II	8.1 (1.3)	39 (35)	23 (20)	10 (5)
Art. bait, Type III	7.9 (1.4)	39 (34)	24 (19)	9 (5)
Art. bait, Type IV	2.8 (1.0)	35 (35)	21 (20)	4 (2)

Table 2a. Comparison of natural shrimp (N) and artificial bait of large size, Type I (A). Catch and length data.

Species	Bait type	Catch				Length (cm)			
		No.	Rate[a]	Diff.[b]	p[c]	Mean	Conf.95%	No.	p[d]
Cod	N	158	22.4	-60.8	<0.001	57.5	2.1	155	<0.10
	A	59	8.8			61.5	3.9	62	
Haddock	N	68	9.7	-98.5	<0.001	41.0	1.2	60	-
	A	1	0.1			51.0	-	1	
Total	N	245	34.8	-70.4	<0.001				
	A	69	10.3						

[a] Number of fish per 100 hooks.
[b] Difference in catch rate calculated as percent of the catch rate for natural bait.
[c] Two-tailed binomial test.
[d] Two-sample t test.

Table 2b. Hooking position for cod and haddock caught on natural shrimp and artificial bait of large size, Type I.

Species	Bait type	Mouth		Swallowed		Not obs.		p[a]
		%	No.	%	No.	%	No.	
Cod	Natural	89.9	142	8.2	13	1.9	3	<0.05[b]
	Artificial	76.3	45	20.3	12	3.4	2	
Haddock	Natural	100.0	68	0.0	0	0.0	0	[c]
	Artificial	100.0	1	0.0	0	0.0	0	

[a] Chi-square contingency table analysis.
[b] The category "not observed" is not included in the test.
[c] The sample size is not sufficiently large for an unbiased chi-square calculation.

Table 2c. Bait status for natural shrimp and artificial bait of large size, Type I.

Bait type	Intact		Remnant		Loss		p[a]
	%	No.	%	No.	%	No.	
Natural	14.6	67	1.1	5	84.3	386	<0.001
Artificial	98.3	591	0.0	0	1.7	10	

[a] Chi-square contingency table analysis.

Table 3a. Comparison of natural shrimp (N) and artificial bait of medium size, Type II (A). Catch and length data.

Species	Bait type	Catch				Length (cm)			
		No.	Rate[a]	Diff.[b]	p[c]	Mean	Conf.95%	No.	p[d]
Cod	N	54	7.8	-62.7	<0.001	54.6	3.0	56	<0.10
	A	19	2.9			60.2	6.8	21	
Haddock	N	67	9.7	-92.1	<0.001	43.1	1.2	62	>0.10
	A	5	0.8			44.6	4.0	5	
Total	N	137	19.8	-75.2	<0.001				
	A	32	4.9						

[a,b,c,d] See Table 2a.

Table 3b. Hooking position for cod and haddock caught on natural shrimp and artificial bait of medium size, Type II.

Species	Bait type	Mouth		Swallowed		Not obs.		p[a]
		%	No.	%	No.	%	No.	
Cod	Natural	70.4	38	27.8	15	1.9	1	>0.10[b]
	Artificial	94.7	18	5.3	1	0.0	0	
Haddock	Natural	89.6	60	1.5	1	9.0	6	[c]
	Artificial	80.0	4	0.0	0	20.0	1	

[a,c] See Table 2b.
[b] Only the category "mouth" is included in the test.

Table 3c. Bait status for natural shrimp and artificial bait of medium size, Type II.

Bait type	Intact		Remnant		Loss		p[a]
	%	No.	%	No.	%	No.	
Natural	50.5	280	5.1	28	44.4	246	<0.001
Artificial	99.0	613	0.0	0	1.0	6	

[a] See Table 2c.

Table 4a. Comparison of natural shrimp (N) and artificial bait of medium size, Type III (A). Catch and length data.

Species	Bait type	Catch				Length (cm)			
		No.	Rate[a]	Diff.[b]	p[c]	Mean	Conf.95%	No.	p[d]
Cod	N	125	18.1	-65.0	<0.001	55.3	2.4	124	>0.10
	A	43	6.3			57.5	3.5	43	
Haddock	N	53	7.7	-94.2	<0.001	42.6	1.3	49	>0.10
	A	3	0.4			36.3	22.5	3	
Total	N	203	29.3	-67.5	<0.001				
	A	65	9.5						

[a,b,c,d] See Table 2a.

Table 4b. Hooking position for cod and haddock caught on natural shrimp and artificial bait of medium size, Type III.

Species	Bait type	Mouth		Swallowed		Not obs.		p[a]
		%	No.	%	No.	%	No.	
Cod	Natural	80.0	100	13.6	17	6.4	8	>0.10
	Artificial	81.4	35	11.6	5	7.0	3	
Haddock	Natural	92.5	49	0.0	0	7.5	4	[c]
	Artificial	100.0	3	0.0	0	0.0	0	

[a,c] See Table 2b.

Table 4c. Bait status for natural shrimp and artificial bait of medium size, Type III.

Bait type	Intact		Remnant		Loss		p[a]
	%	No.	%	No.	%	No.	
Natural	37.2	182	3.3	16	59.5	291	<0.001
Artificial	96.9	596	0.2	1	2.9	18	

[a] See Table 2c.

Table 5a. Comparison of natural shrimp (N) and artificial bait of small size, Type IV (A). Catch and length data.

Species	Bait type	Catch				Length (cm)			
		No.	Rate[a]	Diff.[b]	p[c]	Mean	Conf.95%	No.	p[d]
Cod	N	145	20.4	-8.0	>0.10	62.7	2.7	147	>0.10
	A	130	18.8			64.1	2.5	129	
Haddock	N	50	7.0	-77.4	<0.001	42.9	1.1	45	<0.001
	A	11	1.6			37.3	3.6	10	
Total	N	210	29.5	-25.3	<0.01				
	A	153	22.1						

[a,b,c,d] See Table 2a.

Table 5b. Hooking position for cod and haddock caught on natural shrimp and artificial bait of small size, Type IV.

Species	Bait type	Mouth		Swallowed		Not obs.		p[a]
		%	No.	%	No.	%	No.	
Cod	Natural	91.7	133	5.5	8	2.8	4	>0.10[b]
	Artificial	94.6	123	2.3	3	3.1	4	
Haddock	Natural	96.0	48	2.0	1	2.0	1	[c]
	Artificial	100.0	11	0.0	0	0.0	0	

[a,b,c] See Table 2b.

Table 5c. Bait status for natural shrimp and artificial bait of small size, Type IV.

Bait type	Intact		Remnant		Loss		p[a]
	%	No.	%	No.	%	No.	
Natural	31.5	158	4.2	21	64.3	322	<0.001
Artificial	98.5	532	0.0	0	1.5	8	

[a] See Table 2c.

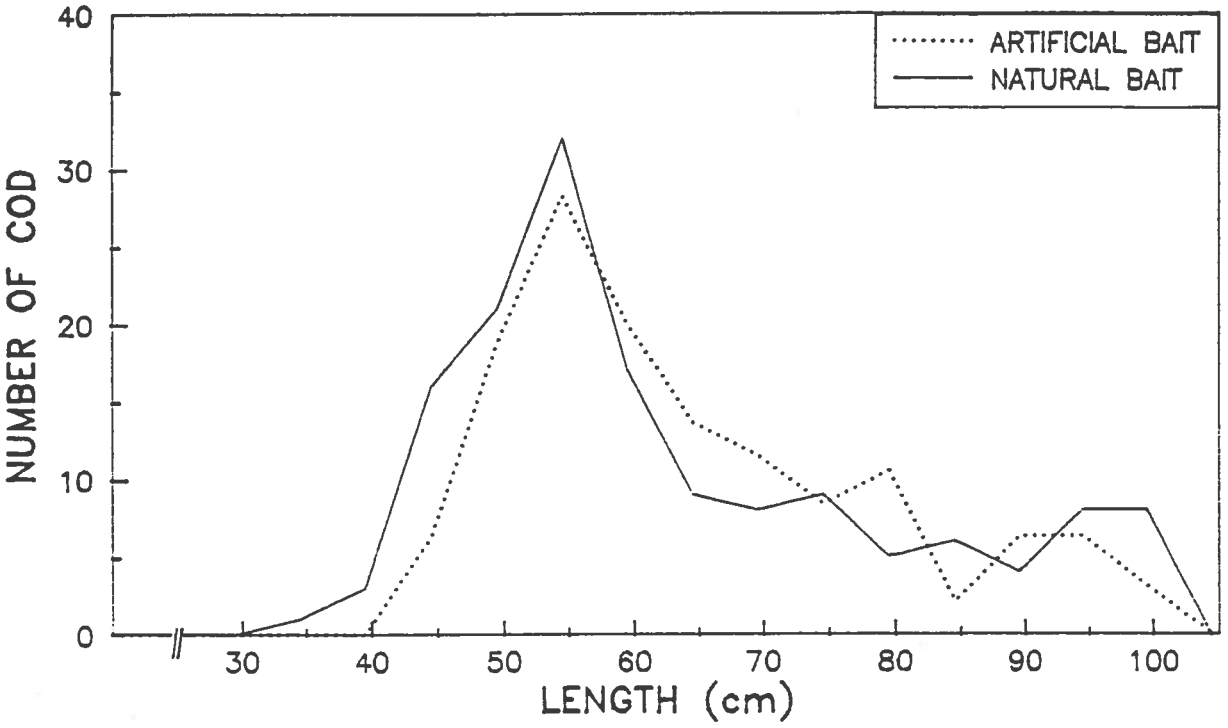

Fig. 1 Length-frequency distributions of cod caught on natural shrimp and artificial bait of small size, Type IV.

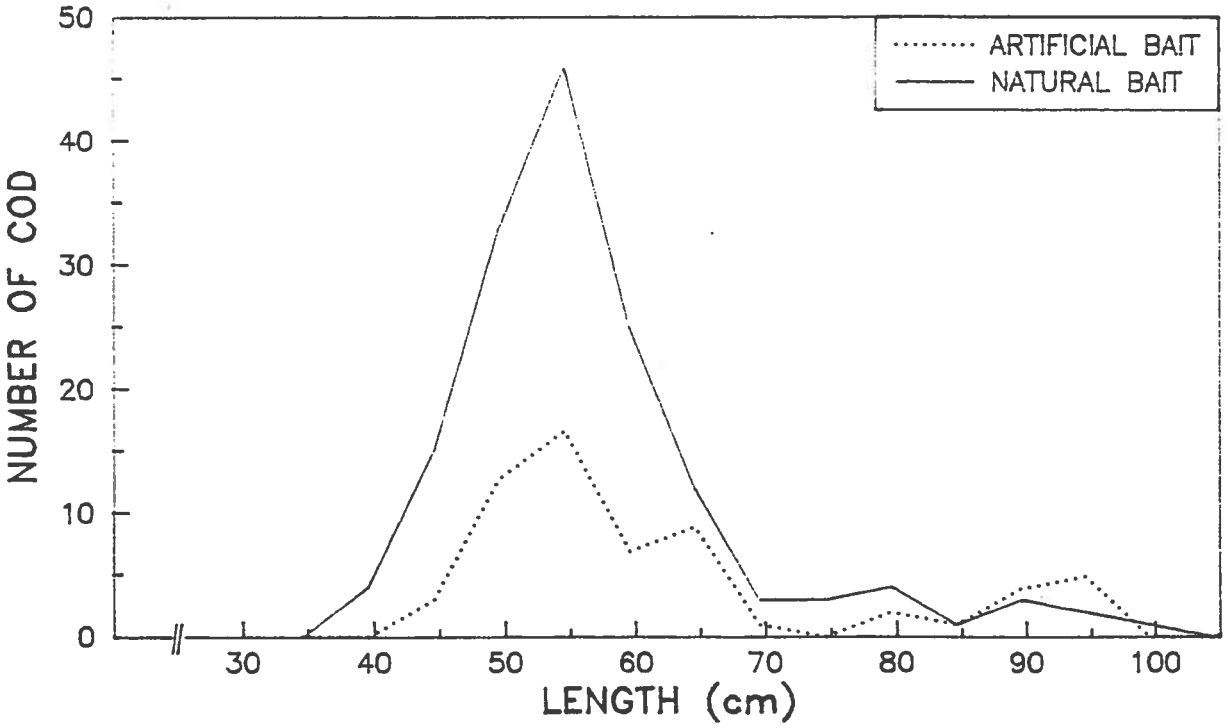

Fig. 2 Length-frequency distributions of cod caught on natural shrimp and artificial bait of large size, Type I.

ARBEIDSNOTAT

PROSJEKTTITTEL:

LINE

NOTATET GJELDER:

Fishing experiment with different types of shrimp flavoured artificial baits in longlining for spawning cod, April 1989.

FORFATTER:

Svein Løkkeborg, Roar Skeide

Seksjon: Fangst | Dato: 27.6.89

GÅR TIL:	Orientering	Uttalelse	Behandling	Etter avtale
Seksjonsleder Steinar Olsen				
Prosjektleder Åsmund Bjordal				
University of Florida				
O. Mustad & Søn A/S				
NFFR				
FTFI, Tromsø, Trondheim				

1 INTRODUCTION

This report describes a fishing trial with an artificial bait flavoured with a combination of synthetic chemicals and an aqueous shrimp extract. This bait has proven to be about as efficient as natural shrimp in longline fishing for cod during the spring fishery (Løkkeborg and Bjordal 1987, Løkkeborg et al. 1988). In the present study different flavours of this bait type were tested in the spawning season.

A/S Peder Norbye

2 MATERIAL AND METHODS

2.1 Fishing ground and gear.

The fishing trial was conducted from April 10 to 18, 1989, on a commersial longliner (M/S "Bjørnsvik") operating at Moskenesgrunnen off the coast of Lofoten (Northern Norway) at 120-195 m depth.

A semi-pelagic monofilament longline, floated 4-35 m above the bottom was used (see Løkkeborg and Bjordal 1987). The soaking time was two days.

2.2 Experimental design.

The artificial baits were supplied by Whitney Marine Laboratory, University of Florida. They were prepared by incorporating feeding stimulants into a polyurethane foam covered with a surface coat. Two of the bait types tested had no surface coat. Bait types flavoured in five different ways were tested:

Type I. Natural shrimp extract in the foam and synthetic shrimp mixture in the surface coat. This bait is the reference and has been tested in previous trials (Løkkeborg and Bjordal 1987, Løkkeborg et al. 1988)

Type II. Natural shrimp extract in the foam, with no surface coat.

Type III. Synthetic shrimp mixture both in the foam and the surface coat.

Type IV. Modified synthetic shrimp mixture in the foam and the surface coat. The nucleotides were left out of this mixture.

Type V. Synthetic shrimp mixture in the foam, with no surface coat.

The baits were cut into a size of 35 x 20 x 3 mm, and their real size when fishing was 39.5 x 23.5 x 6.0 mm.

The experiments were based on paired comparisons between one of the artificial baits and natural shrimp bait. The experimental longlines were baited with the two baits in clusters of about 50 similarly baited hooks. To prevent wetting of the artificial baits prior to setting, thin plastic sheets were laid between the baits and the longline. Three or four skates containing about 290 hooks each were set in each comparison.

During hauling of the gear the fate of each hook (species of hooked fish, loss of bait, entanglement, loss of hook) and the total length of cod and haddock were recorded.

3 RESULTS

The catch consisted mainly of cod (*Gadus morhua*), but included also species such as haddock (*Merlanogrammus aeglefinus*), torsk (*Brosme brosme*) and saithe (*Pollachius virens*).

Artificial baits of all types gave significantly lower catch rates than natural shrimp bait (Table 1). The catch rates were from 40% to 80% lower for the artificial baits. The highest catch rates were achieved with artificial bait of Type II (natural extract in the foam, no surface coat) and of Type IV (modified synthetic mixture in the foam and the surface coat), whereas Type III (complete synthetic mixture in the foam and surface coat) and Type V (complete synthetic mixture in the foam, no surface coat) gave the lowest catch rates.

All artificial baits caught cod of higher mean length than natural shrimp bait. These differences were, however, not significant.

The numbers of haddock caught were low both for artificial and natural baits. Pooled across all comparisons, artificial baits caught 2 haddock and natural bait caught 15 haddock.

The bait loss of artificial baits varied from 1% to 6%,

whereas the loss of shrimp bait varied from 17% to 43%.

4 DISCUSSION

The results achieved in the different comparisons are somewhat surprising and difficult to explain. There are, however, two factors that are of importance when trying to explain these results. First, natural shrimp bait soaked for 48 h prior to baiting gave about the same catch rate as fresh shrimp, indicating that olfactory stimuli are not of great importance in attracting the cod to a pelagic longline (Johannessen 1984). The taste of the bait is, however, probably important to trigger the approach and attack response towards the baited hook. Second, the catch on artificial bait relative to that on natural bait has shown to be higher at higher total catch rate, indicating that the catchability is influenced by the total catch rate or fish density (Løkkeborg et al. 1988).

The artificial baits of Type II and V were made to test the importance of the surface coat, and their catchabilty should be compared to Type I and Type III, respectively. The results indicate that the surface coat, which is made to prolong the release of attractants, does not improve the catchability of the bait. The explanation may be that a prolonged release of attractants is not important in the fishery for spawning cod. These cod are migrating and fish will come into contact with the gear even if the baits are releasing attractants below the thresholds for detection. An alternative explanation may be that the attractants in the coat are not lasting long enough to be effective. Higher total catch rate and higher bait loss for natural bait when testing Type II bait than Type I bait explain the higher catch rate for this bait.

The results for artificial baits of Type III and IV indicate that the nucleotides make no positive contribution to the catching power. On the contrary, the results indicate a negative effect. However, also in this comparison the total catch

rate and the bait loss for natural bait were higher when testing Type IV bait than when testing Type III bait. Furthermore, when testing Type IV bait larger fish were caught. The artificial bait has in earlier fishing trials proven to be more efficient for larger cod (Løkkeborg and Bjordal 1987, Løkkeborg et al. 1988).

The highest catch rates were obtained for artificial baits that had natural shrimp extract in the foam (Type I and II), whereas except for Type IV bait, completely synthetic artificial baits (Type III and V) gave low catch rates. This indicates that a natural extract may be important for the catchability of the bait or that the synthetic mixture is lacking some of the stimulating compounds.

5 REFERENCES

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LØKKEBORG, S. and Å. BJORDAL 1987. Testing of artificial bait in longlining for cod and haddock, April 1987. Field Rep. inst. Fish. Tech. Res. Bergen, 01.06.87.

LØKKEBORG, S., B. TOTLAND and J. T. ØVREDAL 1988. Testing of shrimp flavoured artificial baits of different sizes in longlining for cod and haddock, April 1988. Field Rep. inst. Fish. Tech. Res. Bergen, 30.05.88.

Table 1. Numbers and mean lengths of cod caught on shrimp bait and artificial baits.

Type of bait	Hooks fished[a]	Number caught	Catch per 100 hooks	Difference[b]	Mean length
Shrimp bait	563	49	8.7	-56.7%***	65.0
Art. bait, Type I	557	21	3.8		67.1
Shrimp bait	436	58	13.3	-40.8%*	63.0
Art. bait, Type II	419	33	7.9		67.4
Shrimp bait	429	69	16.1	-86.5%***	60.4
Art. bait, Type III	415	9	2.2		61.6
Shrimp bait	420	81	19.3	-40.0%**	65.4
Art. bait, Type IV	380	44	11.6		68.1
Shrimp bait	426	56	13.1	-80.3%***	62.1
Art. bait, Type V	424	11	2.6		65.8

[a] Number of hooks recorded during hauling excluding entangled and lost hooks.

[b] The difference in catch rate between artificial and natural bait calculated as the percentage of the catch rate for natural bait. A significant difference in catch rate was tested by binomial test (*$p<0.05$, **$p<0.01$, ***$p<0.001$).

(Rapporteringsfrist 1.7. og 1.1.)

Skjema S19

Framdriftsrapport

Norges Fiskeriforskningsråd
NFFR – Nedre Bakklandet 60
Telefon (07) 51 59 33. Telefax (07) 52 21 78
7004 Trondheim

Ansvarlig institusjon
Fiskeriteknologisk Forskningsinstitutt
Fangstseksjonen

NFFR-nr.
II 2100.021

Postadr. Tlf.
Postboks 1964 Nordnes 05 32 37 70
5024 Bergen

Prosjekttittel
Kunstig lineagn

Kontaktperson
Svein Løkkeborg

Faglig hovedansvarlig
Åsmund Bjordal

Mål og prosjektsammendrag Utvikling og tilpasning av et fangsteffektivt og selektivt kunstig agn for norsk linefiske. Arbeidet baseres på meget positive resultater med et syntetisk lineagn i et samarbeid med Whitney Marine Laboratory/ University of Florida og O. Mustad & Søn A/S.

Tidsramme

	Startår:	Sluttår:
2 år	1988	1989

Økonomi (Tilnærmede tall aksepteres. Brukes ikke for regnskapsoppfølging)

Sum disponible midler i budsjettåret:

NFFR-bevilgning, pluss evt. overførte midler ..... Kr 790 000
Andre bevilgninger ..... Kr
Forventede kostnader pr. 30.6.19 88 / pr. 31.12.19 ..... Kr
- herav til direkte lønn og felleskostnader ..... Kr

Eventuell prosjektstøtte ikke inkludert foran (oppgi type og omfang):

Prosjektmedarbeidere

Åsmund Bjordal og Svein Løkkeborg

Avvik Følger prosjektet den godkjente plan? Hvis nei, gi en kort redegjørelse Ja ☒ Nei ☐

Ved forsinkelse, hvor store midler ventes ubrukt ved budsjettårets slutt: Kr

Status/videre planer Kortfattet orientering om prosjektets framdrift gis på side 2 (eller på egne ark).

Se vedlegg

Vedlegg på.....maskinskrevne sider
er merket med prosjektnr. og -tittel.

Faglig hovedansvarlig
(sign.)

Kontaktperson
(sign.)

Kunstig lineagn

Dette delprosjektet har i hovedsak omfatta videre utvikling av det kunstige agnet "Probait" i samarbeid med Whitney Marine Laboratory, Universitetet i Florida (WML) og O. Mustad & Søn. I februar blei to representanter for WML invitert til et diskusjonsmøte i Bergen. På møtet blei resultater fra tidligere forsøk og kortsktige og langsiktige planer for videre framdrift av prosjektet diskutert.

Probait i tre ulike størrelser tilsatt syntetisk rekesmak blei testa i vårtorskefisket på Finnmarkskysten. Det minste agnet viste best resultat og for torsk var fangstratene for dette agnet like høge som for naturlig rekeagn. Fangstresultatet for hyse var negativt. Det kunstige agnet ga meget interessante resultater med hensyn til hvordan selektiviteten til lina kan påvirkes og forbedres ved å øke agnstørrelsen. Alle tre størrelsene av det kunstige agnet fanga torsk med større middellengde enn naturlig agn, og forskjellen i middellengde mellom fisk fanga på kunstig og naturlig agn økte med økende størrelse på det kunstige agnet.

Dette arbeidet vil bli videreført i 2. halvår -88, med planlagt utprøving av Probait i banklinefisket etter brosme og lange og i torskelinefisket.

Dokumentasjon

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(Rapporteringsfrist 1.7. og 1.1.)

Skjema S19

Framdriftsrapport

Norges Fiskeriforskningsråd
NFFR – Pir-Senteret
Telefon (07) 51 59 33, Telefax (07) 52 21 78
7005 Trondheim

Ansvarlig institusjon
Fiskeriteknologisk Forskningsinstitutt
Fangstseksjonen

NFFR-nr.
II 2100.021

Postadr.
Postboks 1964 Nordnes
5024 Bergen

Tlf.
05 32 37 70

Prosjekttittel
Kunstig lineagn

Kontaktperson
Svein Løkkeborg

Faglig hovedansvarlig
Åsmund Bjordal

Mål og prosjektsammendrag Utvikling og tilpasning av et fangsteffektivt og selektivt kunstig agn for norsk linefiske. Arbeidet baseres på meget positive resultater med et syntetisk agn i et samarbeid med Whitney Marine Laboratory/ University of Florida og O. Mustad & Søn A/S

Tidsramme

	Startår:	Sluttår:
2 år	1988	1989

Økonomi (Tilnærmede tall aksepteres. Brukes ikke for regnskapsoppfølging)

Sum disponible midler i budsjettåret:

NFFR-bevilgning, pluss evt. overførte midler ..... Kr 790 000
Andre bevilgninger .....fartøyleie FFFF..... Kr 500 000
Forventede kostnader pr. 30.6.19 / pr. 31.12.1988 ..... Kr
- herav til direkte lønn og felleskostnader ..... Kr

Eventuell prosjektstøtte ikke inkludert foran (oppgi type og omfang):

Prosjektmedarbeidere
Åsmund Bjordal, Svein Løkkeborg, Svein Floen, Bjørn Totland

Avvik Følger prosjektet den godkjente plan? Hvis nei, gi en kort redegjørelse Ja ☒ Nei ☐

Ved forsinkelse, hvor store midler ventes ubrukt ved budsjettårets slutt: Kr

Status/videre planer Kortfattet orientering om prosjektets framdrift gis på side 2 (eller på egne ark).

se vedlegg

Vedlegg på 2 maskinskrevne sider er merket med prosjektnr. og -tittel.

Faglig hovedansvarlig (sign.) for Åsmund Bjordal
Åse Lavoll Pedersen

Kontaktperson (sign.)

STATUS

Prosjektet bygger i hovedsak på et samarbeid med University of Florida og Mustad & Søn A/S om videreutvikling og tilpasning av det kunstige agnet "Probait" for norsk linefiske. Det er utført 2 fiskeforsøk i 1988, ett i linefisket etter torsk og hyse på Finnmarkskysten (april) og ett i banklinefisekt etter lange og brosme på Storegga (oktober).

Forsøkene under vårtorskefisket ga som i 1987 lovende fangstresultater for torsk. Av tre størrelser kunstig rekeagn, ga det minste agnet like god fangstrate som for naturlig agn. De to andre agnstørrelse ga lavere total fangtstrate, men like godt resultat som naturlig agn for stor fisk. De kunstige agna fanget alle fisk med høyere gjennomsnittslengde enn naturlig agn og denne forskjellen i størrelsesselektivitet økte med økende størerelse på det kunstige agnet.

Kunstig rekeagn ga lave fangstrater av lange og brosme sammenlignet med naturlig agn (akkar og makrell).

På bakgrunn av relativt dårlige fangstresultater for brosme og lange på agn med rekesmak, er det satt i gang analyser av makrell og akkar med sikte på å utvikle kunstig agn imitasjoner av disse agntypene. Aminosyreanalyser utføres av University of Florida, mens fettanalysene er utført av SSF.

VIDERE PLANER

Testprogrammet med kunstig rekeagn for torsk vil bli videreført. I tillegg vil det bli lagt innsats i utprøving av kunstig akkar- og makrellagn med sikte på å forbedre fangstresultatet for brosme og lange.

DOKUMENTASJON

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(Rapporteringsfrist 1.7. og 1.1.)

Skjema S19

Framdriftsrapport

Norges Fiskeriforskningsråd
NFFR – Håkon Magnussons gate 1B
Telefon (07) 92 18 11. Postboks 1853. 7001 Trondheim

Ansvarlig institusjon

Fiskeriteknologisk Forskningsinstitutt
Fangstseksjonen

NFFR-nr.

II 2100.021

Postadr.

Postboks 1964
5024 Bergen

Tlf.

05-32 37 70

Prosjekttittel

KUNSTIG LINEAGN

Kontaktperson

Åsmund Bjordal/
Svein Løkkeborg

Faglig hovedansvarlig

Åsmund Bjordal

Mål og prosjektsammendrag (Se side 3) Utvikling og tilpasning av et fangsteffektivt og selektivt kunstig agn for norsk linefiske. Arbeidet baseres på meget positive resultater med et syntetisk agn i et samarbeid med Whitney Marine Laboratory/ University of Florida og O. Mustad & Søn A/S.

Tidsramme

2 år

Startår: 1988

Sluttår: 1989

Økonomi (Tilnærmede tall aksepteres. Brukes ikke for regnskapsoppfølging)

Sum disponible midler i budsjettåret:

NFFR-bevilgning, pluss evt. overførte midler ..... Kr _____

Andre bevilgninger ..... Kr _____

Forventede kostnader pr. 30.6.1989 / ~~31.12.89~~ ..... Kr _____

- herav til direkte lønn og felleskostnader ..... Kr _____

Eventuell prosjektstøtte ikke inkludert foran (oppgi type og omfang):

Prosjektmedarbeidere

Åsmund Bjordal, Svein Løkkeborg, Svein Floen, Bjørn Totland

Avvik Følger prosjektet den godkjente plan? Hvis nei, gi en kort redegjørelse Ja ☒ Nei ☐

Ved forsinkelse, hvor store midler ventes ubrukt ved budsjettårets slutt: Kr _____

Status/videre planer Kortfattet orientering om prosjektets framdrift gis på side 2 (eller på egne ark).

Se vedlegg.

Vedlegg på...2.....maskinskrevne sider
er merket med prosjektnr. og -tittel.

Bergen, 30.6.89.

Faglig hovedansvarlig
(sign.)

Kontaktperson

STATUS

Prosjektets målsetting er å videreutvikle og tilpasse det kunstige agnet "Probait" for norsk linefiske i samarbeid med Whitney Marine Laboratory, University of Florida og O. Mustad & Søn A/S. Siste halvår er det utført kjemiske analyser av ulike agnråstoff, et atferdsforsøk med torsk og tre fiskeforsøk etter torsk og hyse.

Kjemiske analyser blei gjort av akkar, makrell og reke. University of Florida analyserte innholdet av aminosyrer og andre nitrogenholdige forbindelser som kan være viktige for fiskens tiltrekning til og akspetering av et kunstig agn. Analysen av fettinnholdet, sammensetningen av lipidklasser og fettsyrefordelingen blei utført ved Sildeolje- og Sildemelindustriens Forskningsinstitutt.

Formålet med atferdsforsøket var å undersøke betydningen av fettstoffer for fiskens akseptering av et kunstig agn. På grunn av lav respons og aktivitet hos fisken ga imidlertid ikke forsøket grunnlag for å trekke konklusjoner om dette. Forsøket blei utført i vinterhalvåret, og årsaken til den lave responsen kan ha vært generelt lav aktivitet hos fisken på denne årstida.

Fiskeforsøkene blei utført med kunstig agn tilsatt henholdsvis akkar-, makrellog rekesmak. Forsøkene med akkar- og makrellagn ga lave fangstrater av torsk og hyse for kunstig agn sammenlignet med naturlig agn. Bifangsten viste imidlertid positive fangstegenskaper for brosme. I forsøket med rekeagn blei ulike varianter av det kunstige agnet testet. Det mest effektive agnet fanget 60% av fangstraten til naturlig reke. Agn med rekesmak har i tidligere forsøk gitt like høge fangstrater som naturlig agn. Et dårligere resultat i år skyldes sannsynligvis at fangstratene generelt var lave når forsøket blei utført, og at fisken foretrakk makrellagn framfor reke. Som i tidligere forsøk viste det kunstige agnet positive selektive egenskaper ved at det fanga større fisk enn naturlig agn.

I tillegg er det holdt tre møter i denne rapporteringsperioden, henholdsvis med W.E.S. Carr fra University of Florida, representanter fra firmaet GRACE som er en produsent av polymerer, og russiske forskere som arbeider med kunstig agn ved Klaipeda Branch of Scientific and Commercial Association of Fisheries (NPO). I samtalene med Carr blei en videreføring og oppskalering av prosjektet diskutert. På møtet med GRACE blei et samarbeid med dette firmaet vurdert. Anvendelsen av en polymer fra GRACE i et kunstig agn vil gjøre det mulig

å oppskalere agnproduksjonen og å øke utvaskingstiden for agnet. Kontakten med Klaipeda Branch of NPO vil bli fulgt opp med en gjenvisitt i juli, og et videre samarbeid vil i første rekke bestå av utveksling av data og resultater.

VIDERE PLANER

På bakgrunn av kjemiske analyser som er gjort av akkar, makrell og reke vil utprøvingen av nye varianter av det kunstige agnet bli videreført. Det vil også bli utført atferdsforsøk for å kunne studere fiskens respons mot agnet mer i detalj. Videre er det som nevnt lagt opp til et samarbeid med en produsent av polymerer (GRACE) og med russiske forskere ved Klaipeda Branch of NPO. Det søkes finansiering fra flere kilder for videreføring og oppskalering av prosjektet.

DOKUMENTASJON

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