DTU Aqua
Institut for Akvatiske Ressourcer

Outline of the Danish fisheries research/fishing industry survey for cod in the Kattegat 4nd quarter

November 2020

National Institute of Aquatic Resources
Technical University of Denmark
2800 Kgs. Lyngby
Denmark
Marie Storr-Paulsen
Peter Vingaard

Fiskerivärket

Box 423, 401 26, Göteborg
Sweden
Katja Ringdahl
Johan Løvgren

Introduction

Since 2003 the cod fishery in Kattegat has been restricted by steadily decreasing quotas due to low abundance of cod estimated from the cod assessment. ICES consider, however, the cod assessment in Kattegat uncertain due to the catch data quality and the analytic assessment has not been accepted by ACFM in recent years. The assessment has shown a discrepancy between the estimated fishing mortality and the reported landings and ICES assumed that the majority of the unallocated mortality was caused by discard, but other factors such as migration, non reported landings and re-allocation of catches also could be part of the problem. Furthermore, the surveys conducted at present in the Kattegat area are not very suited for estimation of cod abundance mainly due to the low coverage and sampling intensity. The abundance estimate in the areas is hence rather uncertain and only shows trends in stock development, and the assessment of the cod stock would, without doubt, benefit significantly from a survey directly aimed at cod. The 5 August 2006 a tender was submitted by Swedish Board of Fisheries, Institute of Marine Research (IMR-SE) in response to the open call for tenders, Reference No FISH/2006/15 Studies and Pilot projects for carrying out the common fisheries policy, Lot No 3: "Evaluation of the pilot effort regime in Kattegat" from Directorate-General for Fisheries and Maritime Affairs.
Both Swedish and Danish scientists and the fishermen's organisations aggress that the poor survey quality hampers the assessment of the cod stock in Kattegat and an expert group consisting of people from the fisherman's organisations and scientists has designed an improved survey. The initiative has been taken by the LOT 3 project group and was originally a strictly Swedish project. However, the involvement of Denmark has been considered as an improvement of the project and the survey has been designed in all details in agreement between fishers and scientists from both countries. The survey has been conducted since 2008 with a gap in 2012 and only Swedish vessels participating in 2013. The survey strata has been moderated slightly since 2013 to take into account the closed area very a separate strata has been placed.

The goal

The goal of the Kattegat cod survey is to estimate the abundance, biomass and distribution of cod and to establish a fisheries independent time series of catch and effort series. Furthermore, a recruitment index will be established. The results should be used, together with commercial catch and effort data to strengthen the scientific advice on the cod stock in Kattegat. The survey will also monitor the amount and distribution of cod within the proposed "closed area" in order to analyse the effect of the closure.

Restrictions

The 2 commercial Swedish trawlers participating in the survey conduct the survey without any restrictions in the vessels quota, days at sea regulation and with dispensation from all by-catch regulations. From Denmark the Danish scientific vessel Havfisken is participating.

Survey design

Survey area

The survey area is restricted to the Kattegat area covering from Skagen, to the Tistlarna lighthouse and in south by an south-eastwards line between Ellekilde Hage and Lerbjerg and south-westwards by a line between Gniben og Hassensør on Djursland. Further, the area is restricted by the 20 m depth contour line and the area is split in areas "North" and "South" (Fig. 1).
However, in two fjords Laholmsbugten and Skældervigen fishing at stations shallower than 20 meter will take place and 1 or two stations will be placed in a small area in The Sound “Kilen”.

Survey method and stratification

The survey is designed as a random stratified bottom trawl survey. The survey area is since 2013 stratified in four strata: a stratum with high cod density, a stratum with medium density and a stratum with low cod density based on information from the fishers a forth strata has been designate to make sure not stations are placed within the closed area. Each stratum is further subdivided in 5*5 nm squares. Most stations according to the area are allocated to the high density stratum. In the forthcoming years stations will be allocated to the different strata in order to minimize the variance of the estimation of the cod biomass. The survey design allows a post-stratification of the survey area if necessary without loosing comparability with previous surveys and hence to take changes in the main focus area into account if the stock distribution is changing between years or the stock is increasing or decreasing.

Station (tow) location

The survey is planed with in average 3.3 trawl hauls per day in 6 days for each of the vessels i.e in total 80 trawl hauls. The hauls are allocated randomly to the 5*5 nm squares and each vessel is allocated 20 different squares. In the high and medium density strata several vessels are allowed to fish in the same square. In the low density stratum only one haul is allowed in each square. Furthermore the low density area is divided in a Southern and Northern area.

Numbers of stations by vessel, stratum and area

Ship	High density	Medium density	Low density (South)	Low density (North)	Closed area	Total
DK Havfisken	12	10	7	7	4	40
SE Tärnan	6	5	7		2	20
SE Cindy	6	5		7	2	20

Stations valid for Havfisken 4Q 2020

New_square	New_strata	New_domaine	New_declat	New_declon	New_DK Havfisken
41	Röd	Nord	57.53518342	10.74764237	1
42	Röd	Nord	57.61832402	10.75163291	1
86	Röd	Nord	57.61365013	11.06146812	1
108	Röd	Nord	57.61102861	11.21634795	1
149	Röd	Nord	57.3559157	11.50886366	1
69	Röd	Syd	56.20033007	10.98500756	1
91	Röd	Syd	56.19784543	11.13415329	1
92	Röd	Syd	56.28098488	11.13878365	1
112	Röd	Syd	56.11204852	11.2783475	1
114	Röd	Syd	56.27831216	11.2882278	1
115	Röd	Syd	56.36144186	11.29320738	1
134	Röd	Syd	56.1092133	11.42712163	1
136	Röd	Syd	56.27545919	11.43764559	1
139	Röd	Syd	56.52481715	11.45364257	1
160	Röd	Syd	56.43864711	11.59832166	1
147	Gul		57.18970768	11.49757944	1
148	Gul		57.27281242	11.50320621	1
184	Gul		56.60160848	11.76039508	1
189	Gul		57.01706835	11.79112623	1
191	Gul		57.18324146	11.80365249	1
205	Gul		56.51508662	11.90465194	1
206	Gul		56.59817247	11.91102887	1
210	Gul		56.93049996	11.93688091	1
227	Gul		56.51147974	12.05492286	1
207	Grön		56.68125673	11.91743998	1
208	Grön		56.7643394	11.92388551	1
209	Grön		56.84742048	11.93036574	1
230	Grön		56.7606984	12.07514776	1
232	Grön		56.92683595	12.08881292	1
249	Grön		56.50769133	12.20515812	1
251	Grön		56.6738149	12.21926387	1
271	Grön		56.50372147	12.35535597	1
272	Grön		56.58677164	12.36271815	1
273	Grön		56.66982007	12.37011976	1
274	Grön		56.75286674	12.37756109	1
295	Grön		56.66564275	12.52093592	1
246	Blå		56.25849333	12.18427937	1
267	Blå		56.17150341	12.32629584	1
269	Blå		56.33761591	12.34074875	1
270	Blå		56.42066956	12.34803293	1

Desuden er der udtrukket nogle reserve stationer i tilfælde af nogle af de udvalgte stationer ikke kan gennemføres.

N	Station	Område	Område	LatDec	LonDec	DK Havfiske
11	107	Röd	Nord	57.52791	11.21130	reserv
25	171	Röd	Nord	57.35276	11.66261	reserv
44	113	Röd	Syd	56.19518	11.28327	reserv
64	201	Röd	Syd	56.18273	11.87948	reserv
81	186	Gul		56.76780	11.77259	reserv
82	187	Gul		56.85089	11.77873	reserv
109	248	Grön		56.42463	12.19816	reserv
114	253	Grön		56.83993	12.23352	reserv
126	247	Blå		56.34156	12.19120	reserv

Hoved art

Togtet er målrettet mod dermasale arter i Kattegat og designet specielt mod torsk. Fangsten af alle arter skal dog registreres og afleveres også til bestandsvurdering af rødspætter og jomfruhummer.

Togt periode

Togtet skal foregå i slutningen af November / start December 2020. Der er planlagt 40 stationer samt udtrukket 6 ekstrastationer der kan benyttes hvis en given station ikke kan tages. Der må kun fiskes fra 15 min før solopgang til 15 min efter solnedgang. Deltager på dette års togt er :

Torsketogt	**39195-20**	***3/12 - 14/12***	**12**		Aage Thaarup		Skipper
					Søren Grønby		Styrmand
					Reinhardt Jensen		
					Flemming Thaarup		Togtleder

Skib og redskab

Skib :

Togtet bliver gennemført med 2 kommercielle svenske skibe og Havfisken. Tidligere blev også den danske del af togtet gennemført med kommercielle skibe.

DK-Vessel 1

Danish participant	Havfisken
Engine (KW):	
Tonnage (BRT):	48
Length (m):	17,5
Door type/size	
Owner	DTU Aqua

Trawler er et kommercielt bund trawl betalt af LOT 3 projektet.

Trawl (see annex): A Swedish TV-trawl 112 ft 24-464
13 pieces of 8'' balls and 16 pieces of 6'' balls.
4 thumps rubber discs at 10 cm
Mesh size in cod end: 70 mm stretch mesh.
Otter boards: 64"-66" "Thyborøn"
Warp: 35 mm .

Mellem liner der benyttes må varierer i længden mellem 54 og 154 meter. "Grimdelen" på 27 meter skal bi- beholdes hvilket gives en total længde på mellem 81 og 181 meter. Det er bare vigtigt at notere hvor lang en line der er benyttet.

Trawlet skal løbende tjekkes før og under togtet.

Under fiskeri
Må skipper selv bestemme hvordan fiskeriet skal foregå optimalt (dvs. Den eksakte position, retning wire længde mm). Max. 5 min a trawltiden bør ligge udenfor den planlagte kvadrat.

Træk tid: 60/30 min (træk tid ned til 25 min er accepteret).
Hastighed: Mellem 2.7 kn. Og 3.4 kn over bunden, man bør tilstræbe at holde en jævn fart under et træk.
Træk start: Når trawlet bliver vurderet til at gå stabilt som regel 5-7 min efter wirene er helt ude.
Slut på træk: Når tiden er gået om man begynder at fire ind.
Trawlet distance: fås fra plotter.

Ca.50% af alle træk kan blive gennemført med 30 min træk tid. Det er op til skipper at tage stilling til hvilke træk det er men man skal tilstræbe de bliver jævnt fordelt ud over togt området. Det er vigtigt at det fremgår tydeligt hvilke stationer der er gennemført med 30 min træk og hvilke der har 60 min.

Registrering af fiskeriet
Der skal udover besætning deltage 2 videnskabelige medarbejder fra DTU Aqua.

Fangsten oparbejdes tilsvarende som på BITS. Efter hvert træk skal all fangsten oparbejdes og sorteres på art samt vejes til nærmeste 0.1 kg. Alle fisk (undtagen tobis, sild og brislinger) skal måles i cm i total længde. Tobis, sild og brisling i scm. Jomfruhummer måles i mm og det er ikke nødvendigt at kønne dem.

For torsk skal der tages 1 otolith per cm per station

Til genetik:

Fra 2 stationer per farveområde (Rød nord/ Rød syd / Gul, Blå og Grøn) tages genetik af 1 fisk per cm per station (samme som hvor der tages øresten).

Kvalitetssikring af data
All data skal før indtastning undersøges for fejl, blandt andet ved længde – vægt plot, at fisk med genetik prøver får dette markeret I fiskeline, stationer ikke ligger på land mm.

Data
Data tastes i Fiskeline og kan overføres til DATRAS. Det skal senest være klart til start februar følgende år

Estimation of stock indices
CPUE kan beregnes som gennemsnitlig fangst i kg eller antal per alder og time.

Biomass og abundance
Da ingen stationer er dybere end 100 meter kan biomasse og abundance beregnes mellem 20 og 100 meter dybde. Togtet er stratificeret i 4 områder med forskelig tæthed af torsk og dækker et område på . 19037.6 km^2 (Table 1).

Stationerne er på forhånd udvalgt tilfældigt og swept area kan udregnes ved:

Swept area= (estimated trawling speed *1.852)* wing spread * trawling time/60

using the recorded towing speed, wing spread and trawling time and taking the catchability coefficient as 1.0 and the stratum area as weighting factor (Cohran, 1977).

Alle fangster kan standardiseres til fangst per km2

Reporting
The survey results are reported to WGBFAS as a working document. The document includes information about aerial distribution, CPUE, biomass, abundance and length frequencies on cod, sole, plaice and Norwegian lobster together with age distribution of cod.

References

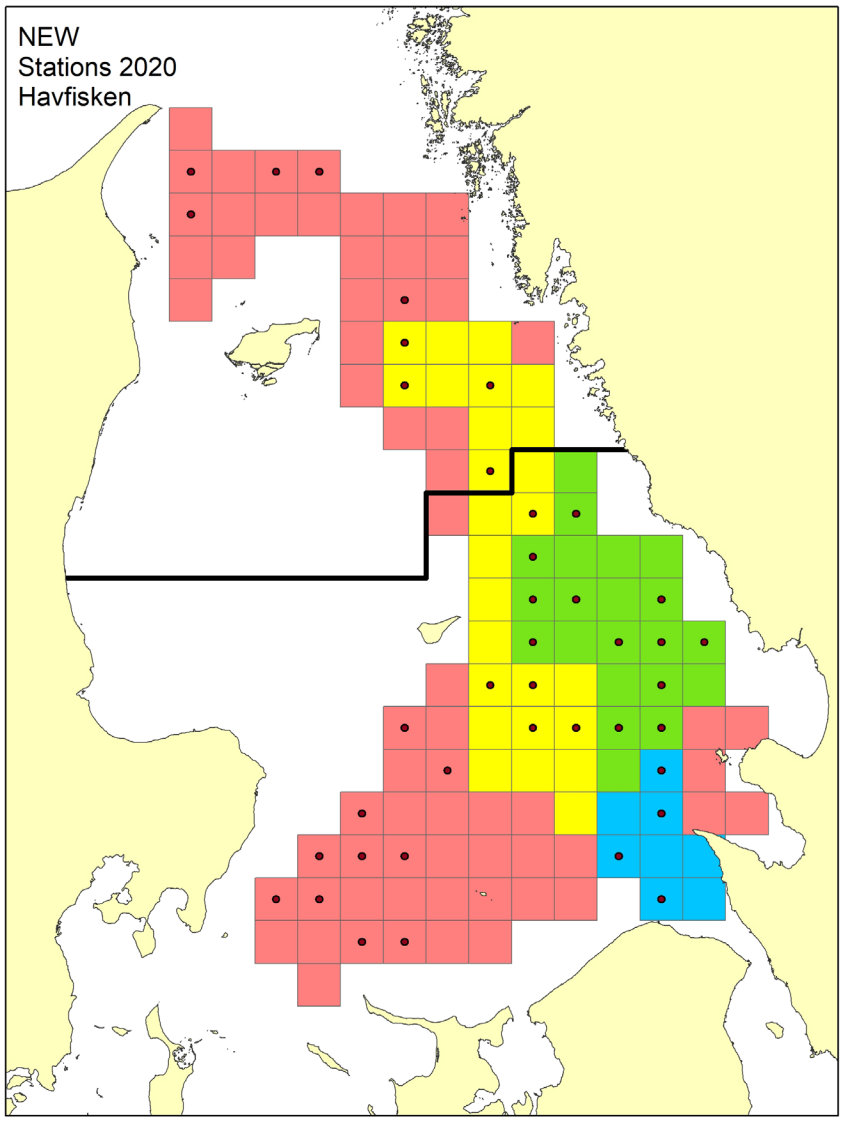
Cochran, W.G. 1977. Sampling Techniques. Third edition. Wiley & Sons.

ICES. 2005. Report of the Workshop on Survey Design and Data Analysis (WKSAD). ICES CM 2005/ B:07, 174 pp.

Wieland, K. and Storr-Paulsen, M. 2006. Effect of tow duration on catch and size composition of Northern shrimp (*Pandalus borealis*) and Greenland halibut (*Reinhardtius hippoglossoides*) in the West Greenland Bottom trawl survey. Fisheries Research 78: 276-285.

Wieland, K., E.M. Fenger Pedersen, H.J. Olesen & J.E. Beyer (2008): Survey results from a Danish collaborative biologist-fishermen project on spatially-explicit management methods (REX) for North Sea cod. Working document, ICES WGNSSK, 7.-13. May 2008.

Fig. 1. Distribution of all hauls by type and squares.


NEW
Stations 2020
Havfisken

DTU

DTU Aqua
Institut for Akvatiske Ressourcer

N	Station	Område	Område	LatDec	LonDec	SE Cinc	SE Tärna	DK Havfiske
1	39	Röd	Nord	57.36890	10.73973			
2	40	Röd	Nord	57.45204	10.74367			
3	41	Röd	Nord	57.53518	10.74764		1	
4	42	Röd	Nord	57.61832	10.75163			1
5	43	Röd	Nord	57.70146	10.75565			
6	62	Röd	Nord	57.44981	10.89790			
7	63	Röd	Nord	57.53295	10.90222			
8	64	Röd	Nord	57.61608	10.90656			
9	85	Röd	Nord	57.53052	11.05677			
10	86	Röd	Nord	57.61365	11.06147		1	
11	107	Röd	Nord	57.52791	11.21130			
12	108	Röd	Nord	57.61103	11.21635			1
13	125	Röd	Nord	57.19266	11.34450			
14	126	Röd	Nord	57.27578	11.34978			
15	127	Röd	Nord	57.35889	11.35509			
16	128	Röd	Nord	57.44200	11.36043			
17	129	Röd	Nord	57.52511	11.36580			
18	146	Röd	Nord	57.10660	11.49198		1	
19	149	Röd	Nord	57.35592	11.50886			1
20	150	Röd	Nord	57.43902	11.51455			1
21	151	Röd	Nord	57.52212	11.52027		1	
22	166	Röd	Nord	56.93727	11.63291		1	
23	167	Röd	Nord	57.02037	11.63879			
24	168	Röd	Nord	57.10347	11.64469			
25	171	Röd	Nord	57.35276	11.66261			
26	172	Röd	Nord	57.43585	11.66864		1	
27	173	Röd	Nord	57.51894	11.67471			1
28	214	Röd	Nord	57.26280	11.96330		1	
29	291	Röd	Nord	56.33349	12.49026			
30	292	Röd	Nord	56.41653	12.49787			1
31	293	Röd	Nord	56.49957	12.50551			
32	313	Röd	Nord	56.32919	12.63972			
33	315	Röd	Nord	56.49524	12.65563			1
37	68	Röd	Syd	56.11718	10.98072			
38	69	Röd	Syd	56.20033	10.98501			1
39	89	Röd	Syd	56.03156	11.12497			
40	90	Röd	Syd	56.11470	11.12955			
41	91	Röd	Syd	56.19785	11.13415			1
42	92	Röd	Syd	56.28098	11.13878	1		
43	112	Röd	Syd	56.11205	11.27835	1		
44	113	Röd	Syd	56.19518	11.28327			
45	114	Röd	Syd	56.27831	11.28823	1		
46	115	Röd	Syd	56.36144	11.29321	1		
47	134	Röd	Syd	56.10921	11.42712	1		
48	135	Röd	Syd	56.19234	11.43237			
49	136	Röd	Syd	56.27546	11.43765			1
50	137	Röd	Syd	56.35858	11.44295			
51	138	Röd	Syd	56.44170	11.44828			
52	139	Röd	Syd	56.52482	11.45364			1
53	156	Röd	Syd	56.10620	11.57587	1		
54	157	Röd	Syd	56.18931	11.58144			
55	158	Röd	Syd	56.27243	11.58704	1		
56	159	Röd	Syd	56.35554	11.59266			
57	160	Röd	Syd	56.43865	11.59832			1
58	161	Röd	Syd	56.52176	11.60401			
59	162	Röd	Syd	56.60486	11.60973			
60	178	Röd	Syd	56.10301	11.72459			
61	179	Röd	Syd	56.18611	11.73047			
62	180	Röd	Syd	56.26921	11.73640			
63	181	Röd	Syd	56.35231	11.74235			
64	201	Röd	Syd	56.18273	11.87948			
65	202	Röd	Syd	56.26582	11.88572			
66	203	Röd	Syd	56.34891	11.89200			1
67	223	Röd	Syd	56.17917	12.02845			
68	224	Röd	Syd	56.26225	12.03502			1
73	147	Gul		57.18971	11.49758			1
74	148	Gul		57.27281	11.50321			1
75	169	Gul		57.18657	11.65063			
76	170	Gul		57.26966	11.65660			
77	182	Gul		56.43541	11.74833			
78	183	Gul		56.51851	11.75435			
79	184	Gul		56.60161	11.76040		1	1
80	185	Gul		56.68470	11.76648	1		
81	186	Gul		56.76780	11.77259		1	
82	187	Gul		56.85089	11.77873		1	
83	188	Gul		56.93398	11.78491			
84	189	Gul		57.01707	11.79113	1		1
85	190	Gul		57.10016	11.79737			
86	191	Gul		57.18324	11.80365		1	1
87	192	Gul		57.26633	11.80997	1		
88	204	Gul		56.43200	11.89831			
89	205	Gul		56.51509	11.90465			1
90	206	Gul		56.59817	11.91103			1
91	210	Gul		56.93050	11.93688			1
92	211	Gul		57.01358	11.94343			
93	212	Gul		57.09665	11.95002			
94	213	Gul		57.17973	11.95664			
95	225	Gul		56.34533	12.04162			1
96	226	Gul		56.42840	12.04825	1		
97	227	Gul		56.51148	12.05492	1	1	1
98	228	Gul		56.59455	12.06163			
101	207	Grön		56.68126	11.91744			1
102	208	Grön		56.76434	11.92389			1
103	209	Grön		56.84742	11.93037		1	1
104	229	Grön		56.67763	12.06837	1		
105	230	Grön		56.76070	12.07515		1	1
106	231	Grön		56.84377	12.08196		1	
107	232	Grön		56.92684	12.08881			1
108	233	Grön		57.00990	12.09570	1		
109	248	Grön		56.42463	12.19816	1		
110	249	Grön		56.50769	12.20516		1	1
111	250	Grön		56.59075	12.21219			
112	251	Grön		56.67381	12.21926			1
113	252	Grön		56.75687	12.22637			
114	253	Grön		56.83993	12.23352			
115	271	Grön		56.50372	12.35536			1
116	272	Grön		56.58677	12.36272		1	1
117	273	Grön		56.66982	12.37012	1		1
118	274	Grön		56.75287	12.37756	1		1
119	275	Grön		56.83591	12.38504			
120	294	Grön		56.58261	12.51320	1		
121	295	Grön		56.66564	12.52094		1	1
125	246	Blå		56.25849	12.18428			1
126	247	Blå		56.34156	12.19120			
127	267	Blå		56.17150	12.32630	1		1
128	268	Blå		56.25456	12.33350			
129	269	Blå		56.33762	12.34075		1	
130	270	Blå		56.42067	12.34803			1
131	289	Blå		56.16740	12.47516		1	
132	290	Blå		56.25045	12.48269	1		1

Table 1. Area (km^2) 20-120 m depth by depth area.

High density	Medium density	Low density	Closed area	All
21 squares	26 squares	65 squares	8 squares	120 squares
1800.8 km^2	2229.5 km^2	5573.8 km^2	686 km^2	10290 km^2

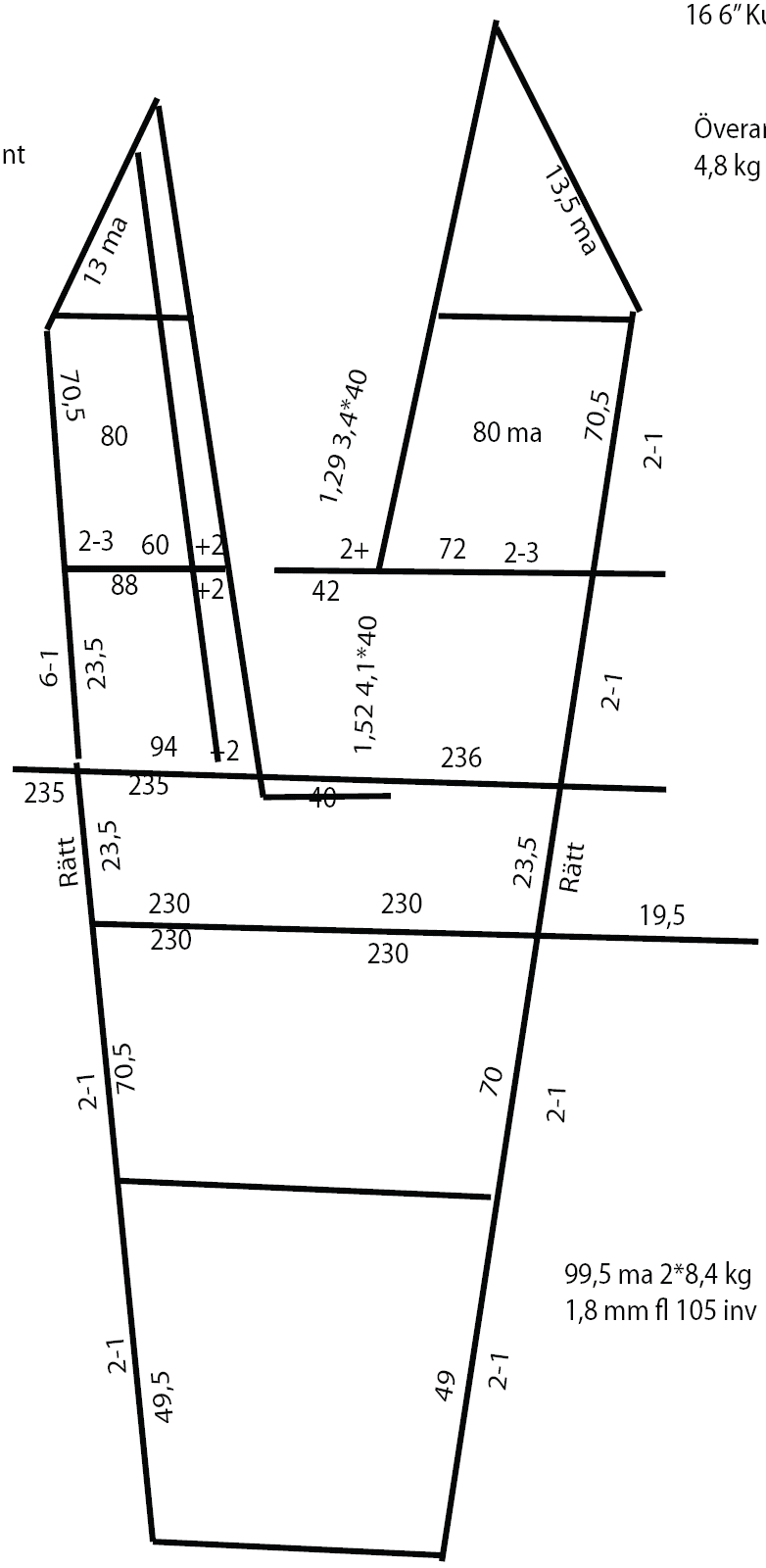
DTU Aqua
Institut for Akvatiske Ressourcer

TV112 - 24 -646

13 8" Kulor
16 6" Kulor

Underarmar
4,6 kg 1,8 ma fl
80 mm utan kant
med kil

Överarm
4,8 kg utan kant



99,5 ma 2*8,4 kg
1,8 mm fl 105 inv

Tabel 11. To eksempler på hvordan afstanden mellem skovlene kan beregnes ud fra spilet i wirerne.

1. metode

1) En pind, skruenøgle, kniv eller hvad man nu har for hånden sættes ind, hvor afstanden mellem wirerne lige svarer til længden af genstanden. Fra dette punkt finder man ud af, hvor mange gange dette mål kan ligge langs wiren op til det sted, hvor wirerne går sammen.
2) Afstanden mellem skovlene fås ved at dele wirelængden med »antallet af mål«.
   Eksempel: Fra det sted på wirerne, hvor spredningen er 1 skruenøgle, er der 5,5 skruenøgle op til hvor wirerne går sammen.
   Wirelængde: 150 fv = 274 m.
   Afstand mellem skovle: 274:5,5 = 50 m.

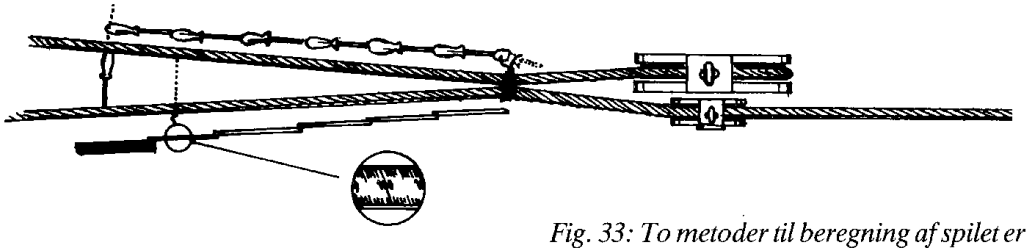
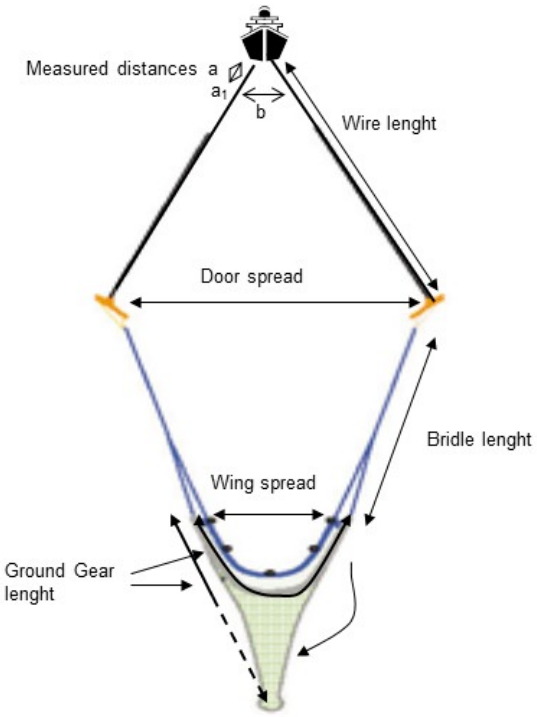


Fig. 33: To metoder til beregning af spilet er her illustreret. Det letter udmålingen, hvis wirerne kan samles med et bændsel.

2. metode

1) Mål afstanden mellem wirerne 1 meter fra, hvor de går sammen.
2) Afstanden hér ganget med wirelængden giver afstanden mellem skovlene.
   Eksempel: Spredningen på 1 meter: 18 cm = 0,18 m
   Wirelængde: 150 fv = 274 m
   Afstand mellem skovle: 0,18 × 274 = 49 m



Calculations of door spread and wing spread

Assuming that the distance between the trawl doors and the wires form an equilateral triangle, the door spread have been calculated as

$$\text{Door spread} = \frac{\text{Wire length x measured distance b}}{\text{measured distance a}}$$

For every haul, a length on the wire (distance a) and the length between the wires measured at a_1 (distance b) have been recorded.

Wing spread is estimated as:

$$\text{Wing spread} = \frac{\text{Ground gear length x Door spread}}{\text{Bridle length + Ground gear length}}$$

(Calculation from "Course in Trawl Gear Technology", May 2006, SeaFish Flume Tank, Hull, UK)

NOTE: Figure not according to scale