Outline of the joint Swedish and Danish fisheries research/fishing industry survey for cod in the Kattegat

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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 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 4 commercial 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.

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 stratified in three 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. Each stratum is further subdivided in 5*5 nm squares (Fig. 1). 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 4 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)	Total
Den_1	6	8	6		20
Den_2	6	8		6	20
Swe_1	6	8	6		20
Swe_2	6	8		6	20

Target species

The survey is directed to demersale species in Kattegat, but designed for cod. The catch of all species is, however, recorded and the survey results are also made available for the assessment of sole, plaice and Norwegian lobster.

Survey period

The survey will take place during November 22 - December 10- 2010. There is planned with 6 fishing days for each vessel. The survey period can, however, be extended in case of bad weather or technical problems. Trawling is restricted to 15 min. before sunrise to 15 min. after sun set.

Vessels and Fishing gear

Vessels

The survey is conducted by three commercial chartered trawlers and 1 scientific vesel, two covering the northern and two the southern area, respectively. Two vessels are Swedish and the other two are Danish. The vessels have been appointed due to the similarity in engine power, length and applicability for scientific investigations. Further, it has been taken into considerations that the owner of the vessel will participate in the surveys in the future. In 2010 one of the Danish commercial vessel was sold and Havfisken, the Danish scientific vessel was included instead after a thorough discussion with the seine maker.

DK-Vessel 1

Danish participant	1 (Havfisken)
Engine (KW):	368 kW
Tonnage (BRT):	20
Length (m):	13
Door type/size	
Owner	DTU - Aqua

DK-Vessel 2

Danish participant	2 (FN370- Susanne H)
Engine (KW):	220 kW
Tonnage (BRT):	52.6
Length (m):	18.4
Door type/size	
Owner	Hans Jørgen Hansen

SW-Vessel 1

Swedish participant	1 (VG 37 – Ganler)
Engine (KW):	373 kW
Tonnage (BRT):	74
Length (m):	17.94
Door type/size	
Owner	Kjell Svahn

SW-Vessel 2

Swedish participant	2 (VG 104 – Tärnan)
Engine (KW):	272 kW
Tonnage (BRT):	68
Length (m):	15.73
Door type/size	

Owner Börje Nilsson

Gear
The trawl is a commercial bottom trawl provided by the LOT 3 project.

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 i 2010 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.

The trawls are checked continuously during the survey.

Fishing operation
Within each square the skipper decides on the best way to fish at the location (e.g. exact position, tow direction). Such an approach has been used successfully in the north-eastern North Sea and the Skagerrak in comparable projects (Wieland et al. 2008).
Maximum 5 min of the total trawling time should be outside the allocated square. If the 5 minutes are exceeded the haul should be terminated.Trawl procedure:

Towing time: 60 min (towing time down to 20 min is accepted).
Towing speed: Between 2.7 kn. and 3.4 over the seabed, but speed should not vary within a station.
Hauls start: when the trawl is considered going stable on the bottom, roughly 5-7 min after wires are connected.
Haul end: when hauling back starts.
Trawled distance: is estimated from the plotter.

Sampling of catch
There will be two technicians/scientists from DTU-Aqua (Danish vessels) or from Fiskeriværket (Swedish vessels), who will be responsible for processing the catch, on board each vessel. However, the crew should help the scientific staff whenever possible.

The catch will be processed in accordance with BITS standard operating procedures for trawl surveys. After each haul the catch is sorted by species and weighed to nearest 0.1 kg and the number of specimens recorded. All fish species are measured as total length (TL) to 1.0 cm below. Norwegian lobster is measured in mm.

Cod otoliths (2 per cm group) are sampled for age determination by each vessel in each of the two areas.

Additional scientific samples can be collected if requested (genetic, tagging, frozen samples, etc.).

Screening of data
All trawl data (position, wingspread, towing speed etc.) and catch and length frequency data on sole, cod, plaice and Norwegian lobster are screened for unrealistic figures before further estimations.

Data
Data are stored in a standard data base and can will, if the survey continues, be uploaded to the ICES DATRAS system.

Estimation of stock indices
CPUE
CPUE is estimated as mean catch (kg or number) per hour (cod also number by age per hour).

Biomass and abundance
Hence no stations are deeper than 100 m, biomass and abundance is estimated for depths between 20 and 100 m. The survey area is stratified in density strata and the area between 20 and 100 m has been estimated. The total survey area is 19037.6 km^2 (Table 1).

Biomass and abundance estimates is based on the randomly selected stations and obtained by applying the swept area method:

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).

All catches are standardized to 1 km^2 swept prior to further calculations.

Reporting
The survey results are reported to WGBAFS 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 hauls by type and ICES squares. The yellow colour indicate stations from the southern Danish vessel.

Fig. 2. Distribution of hauls by type and ICES squares. The green colour indicate stations from the northern Danish vessel.

Fig. 3. Distribution of hauls by type and ICES squares. The red colour indicate stations from the northern Swedish vessel.

Fig. 4. Distribution of hauls by type and ICES squares. The blue colour indicate stations from the southern Swedish vessel.

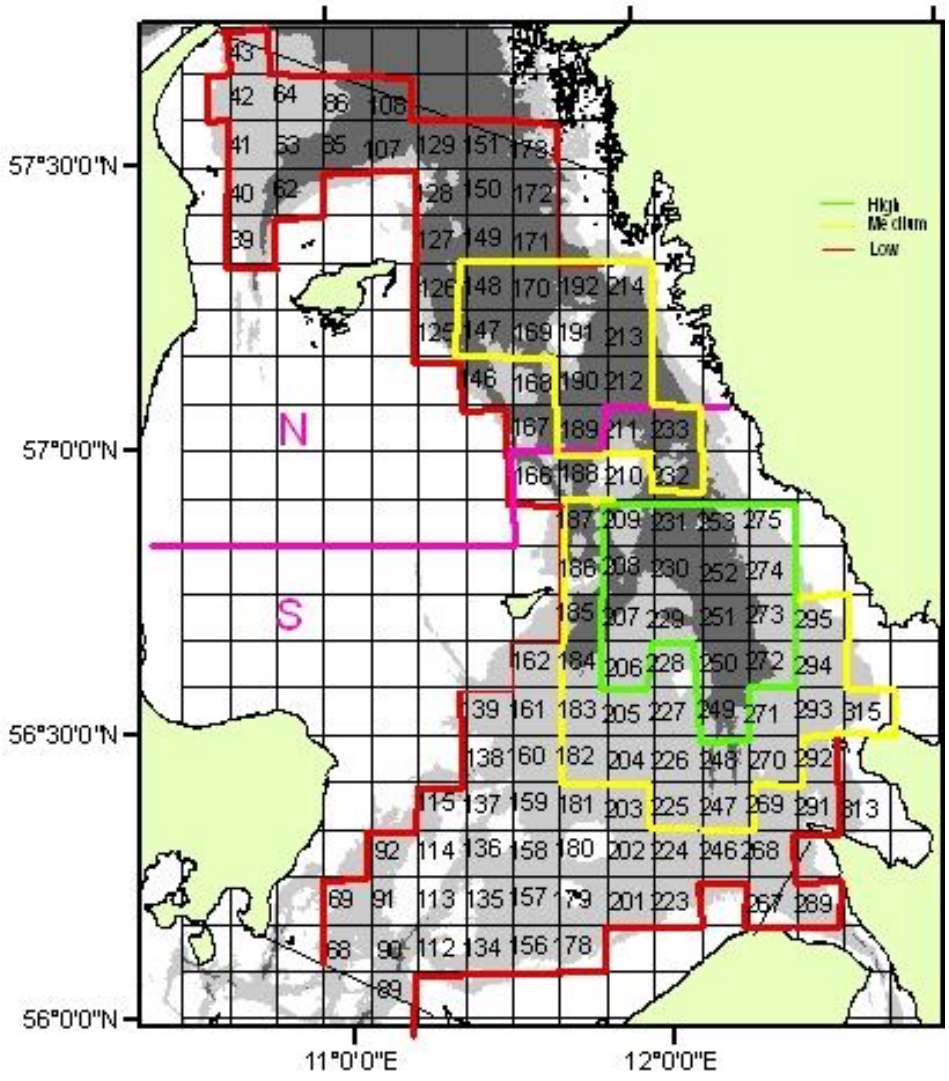
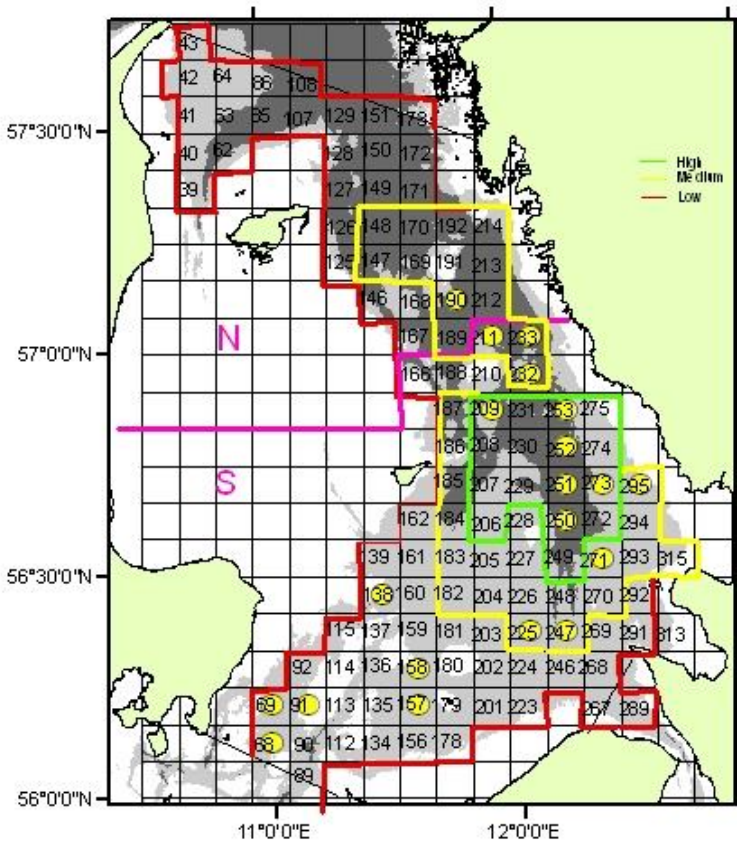
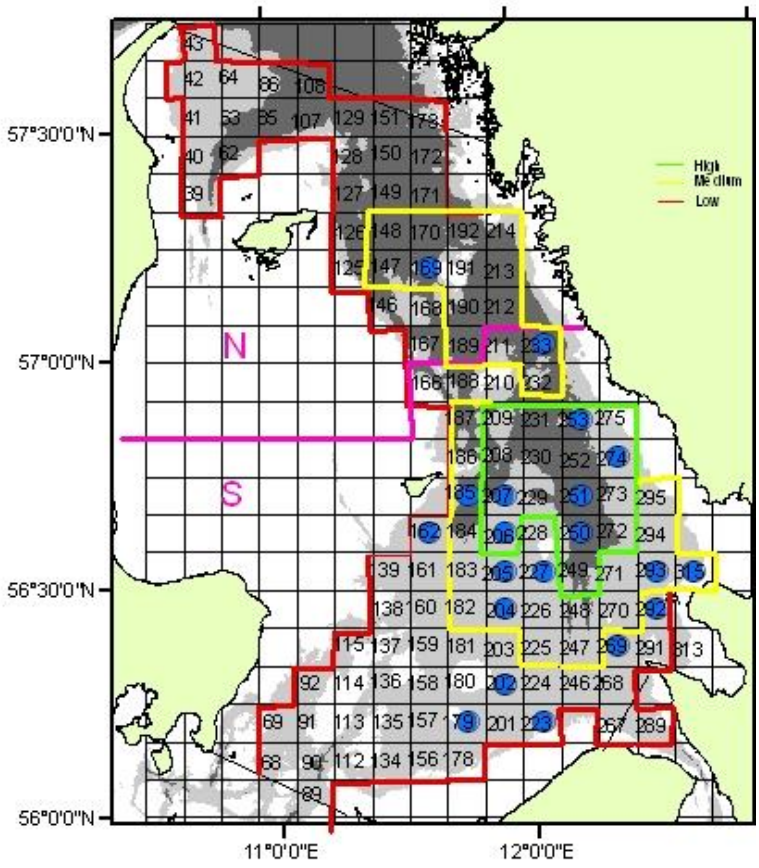


Figure 1. The re-stratified areas with high (green), medium (yellow) and low (red) cod biomass.



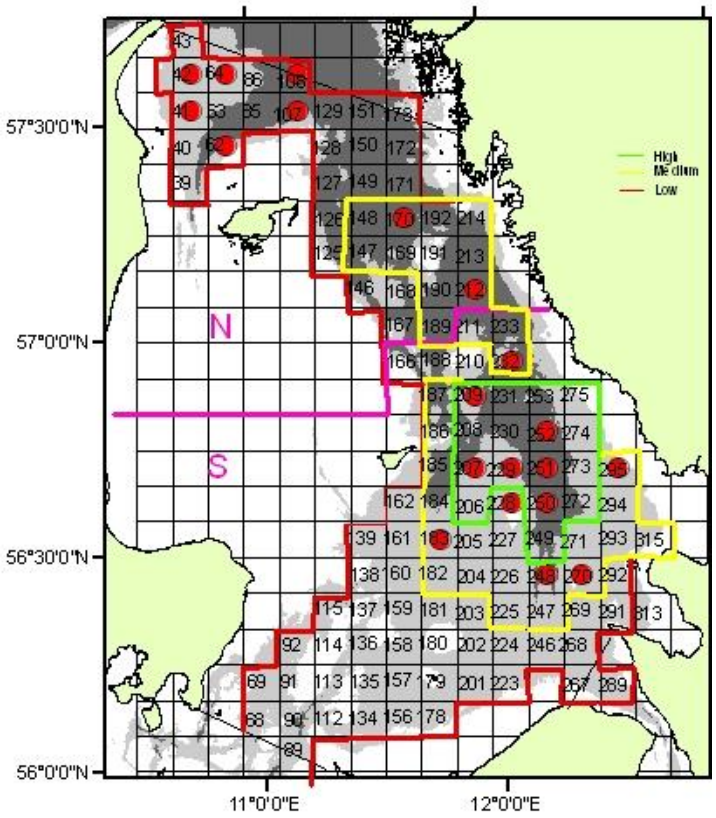
stat	lat	long
68	56,11718	10,98072
69	56,20033	10,98501
91	56,19785	11,13415
138	56,44170	11,44828
157	56,18931	11,58144
158	56,27243	11,58704
190	57,10016	11,79737
211	57,01358	11,94343
225	56,34533	12,04162
232	56,92684	12,08881
233	57,00990	12,09570
247	56,34156	12,19120
271	56,50372	12,35536
295	56,66564	12,52094
209	56,84742	11,93037
250	56,59075	12,21219
251	56,67381	12,21926
252	56,75687	12,22637
253	56,83993	12,23352
273	56,66982	12,37012

Figure and table 2. Positions for the Danish vessel Havfisken in the South western area.



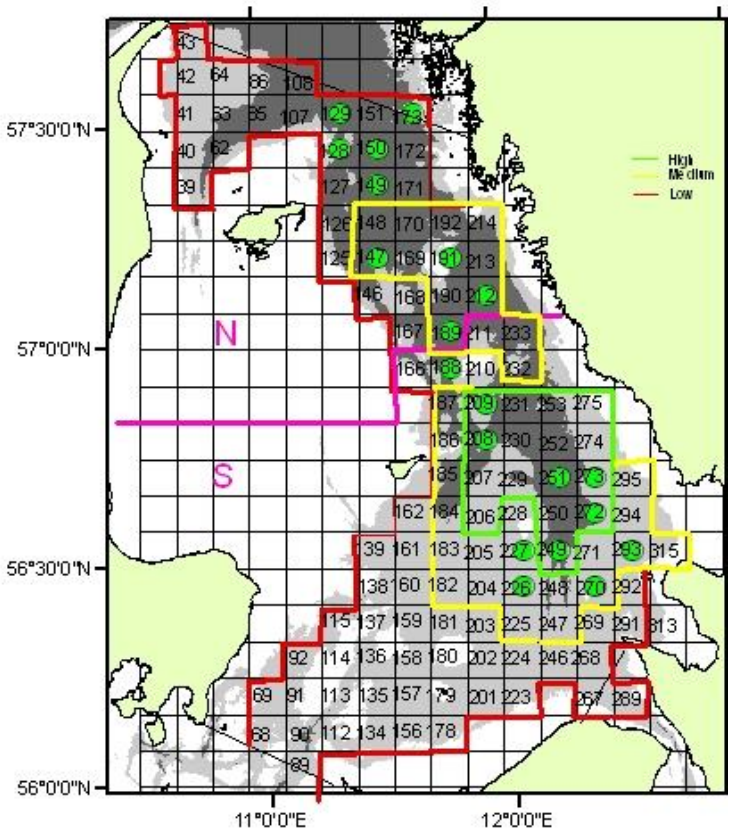
stat	lat	long
162	56,60486	11,60973
179	56,18611	11,73047
202	56,26582	11,88572
223	56,17917	12,02845
269	56,33762	12,34075
292	56,41653	12,49787
169	57,18657	11,65063
185	56,68470	11,76648
204	56,43200	11,89831
205	56,51509	11,90465
227	56,51148	12,05492
233	57,00990	12,09570
293	56,49957	12,50551
315	56,49524	12,65563
206	56,59817	11,91103
207	56,68126	11,91744
250	56,59075	12,21219
251	56,67381	12,21926
253	56,83993	12,23352
274	56,75287	12,37756

Figure and table 3. Positions for the Swedish vessel VG 104 Tärnan in the South eastern area.



stat	lat	long
41	57,53518	10,74764
42	57,61832	10,75163
62	57,44981	10,89790
64	57,61608	10,90656
107	57,52791	11,21130
108	57,61103	11,21635
170	57,26966	11,65660
183	56,51851	11,75435
212	57,09665	11,95002
228	56,59455	12,06163
232	56,92684	12,08881
248	56,42463	12,19816
270	56,42067	12,34803
295	56,66564	12,52094
207	56,68126	11,91744
209	56,84742	11,93037
229	56,67763	12,06837
250	56,59075	12,21219
251	56,67381	12,21926
252	56,75687	12,22637

Figure and table 4. Positions for the Danish vessel Susanne H in the North western area.



stat	lat	long
162	56,60486	11,60973
179	56,18611	11,73047
202	56,26582	11,88572
223	56,17917	12,02845
269	56,33762	12,34075
292	56,41653	12,49787
169	57,18657	11,65063
185	56,68470	11,76648
204	56,43200	11,89831
205	56,51509	11,90465
227	56,51148	12,05492
233	57,00990	12,09570
293	56,49957	12,50551
315	56,49524	12,65563
206	56,59817	11,91103
207	56,68126	11,91744
250	56,59075	12,21219
251	56,67381	12,21926
253	56,83993	12,23352
274	56,75287	12,37756

Figure and table 5. Positions for the Swedish vessel VG 37 Ganler in the North eastern area.

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

High density	Medium density	Low density	All
16 squares	34 squares	68 squares	118 squares
1372 km^2	2915.5 km^2	5831 km^2	10118.5 km^2

Station allocation

Station	Center_y	center_x	Station	Center_y	center_x	Station	Center_y	center_x
0	55.95720	10.52753	51	56.53524	10.85190	101	57.02918	11.18159
1	56.04037	10.53082	52	56.61839	10.85597	102	57.11230	11.18647
2	56.12354	10.53412	53	56.70154	10.86006	103	57.19543	11.19138
3	56.20670	10.53744	54	56.78469	10.86418	104	57.27855	11.19632
4	56.28987	10.54078	55	56.86783	10.86831	105	57.36167	11.20129
5	56.37304	10.54413	56	56.95098	10.87247	106	57.44479	11.20628
6	56.45620	10.54751	57	57.03412	10.87665	107	57.52791	11.21130
7	56.53937	10.55090	58	57.11726	10.88086	108	57.61103	11.21635
8	56.62253	10.55431	59	57.20040	10.88508	109	57.69414	11.22142
9	56.70569	10.55773	60	57.28354	10.88933	110	55.94578	11.26857
10	56.78885	10.56118	61	57.36668	10.89360	111	56.02891	11.27345
11	56.87201	10.56464	62	57.44981	10.89790	112	56.11205	11.27835
12	56.95516	10.56813	63	57.53295	10.90222	113	56.19518	11.28327
13	57.03832	10.57163	64	57.61608	10.90656	114	56.27831	11.28823
14	57.12147	10.57515	65	57.69921	10.91093	115	56.36144	11.29321
15	57.20463	10.57869	66	55.95088	10.97222	116	56.44457	11.29821
16	57.28778	10.58225	67	56.03403	10.97646	117	56.52770	11.30325
17	57.37093	10.58583	68	56.11718	10.98072	118	56.61082	11.30831
18	57.45408	10.58943	69	56.20033	10.98501	119	56.69395	11.31339
19	57.53723	10.59304	70	56.28348	10.98931	120	56.77707	11.31851
20	57.62038	10.59668	71	56.36662	10.99365	121	56.86019	11.32365
21	57.70352	10.60034	72	56.44977	10.99800	122	56.94331	11.32882
22	55.95527	10.67578	73	56.53291	11.00237	123	57.02643	11.33402
23	56.03843	10.67939	74	56.61605	11.00678	124	57.10955	11.33924
24	56.12160	10.68301	75	56.69919	11.01120	125	57.19266	11.34450
25	56.20476	10.68665	76	56.78233	11.01565	126	57.27578	11.34978
26	56.28792	10.69031	77	56.86547	11.02012	127	57.35889	11.35509
27	56.37108	10.69399	78	56.94861	11.02461	128	57.44200	11.36043
28	56.45424	10.69769	79	57.03174	11.02913	129	57.52511	11.36580
29	56.53740	10.70141	80	57.11488	11.03368	130	57.60822	11.37120
30	56.62055	10.70515	81	57.19801	11.03825	131	57.69132	11.37663
31	56.70371	10.70891	82	57.28114	11.04284	132	55.94296	11.41671
32	56.78686	10.71269	83	57.36427	11.04746	133	56.02609	11.42190
33	56.87001	10.71649	84	57.44740	11.05210	134	56.10921	11.42712
34	56.95316	10.72031	85	57.53052	11.05677	135	56.19234	11.43237
35	57.03631	10.72415	86	57.61365	11.06147	136	56.27546	11.43765
36	57.11946	10.72801	87	57.69677	11.06619	137	56.35858	11.44295
37	57.20261	10.73190	88	55.94842	11.12041	138	56.44170	11.44828
38	57.28575	10.73580	89	56.03156	11.12497	139	56.52482	11.45364
39	57.36890	10.73973	90	56.11470	11.12955	140	56.60793	11.45903
40	57.45204	10.74367	91	56.19785	11.13415	141	56.69105	11.46445
41	57.53518	10.74764	92	56.28098	11.13878	142	56.77416	11.46990
42	57.61832	10.75163	93	56.36412	11.14344	143	56.85727	11.47537
43	57.70146	10.75565	94	56.44726	11.14812	144	56.94038	11.48088
44	55.95316	10.82401	95	56.53039	11.15282	145	57.02349	11.48642
45	56.03632	10.82793	96	56.61353	11.15755	146	57.10660	11.49198
46	56.11948	10.83188	97	56.69666	11.16231	147	57.18971	11.49758
47	56.20263	10.83584	98	56.77979	11.16709	148	57.27281	11.50321
48	56.28579	10.83982	99	56.86292	11.17190	149	57.35592	11.50886
49	56.36894	10.84383	100	56.94605	11.17673	150	57.43902	11.51455
50	56.45209	10.84786						

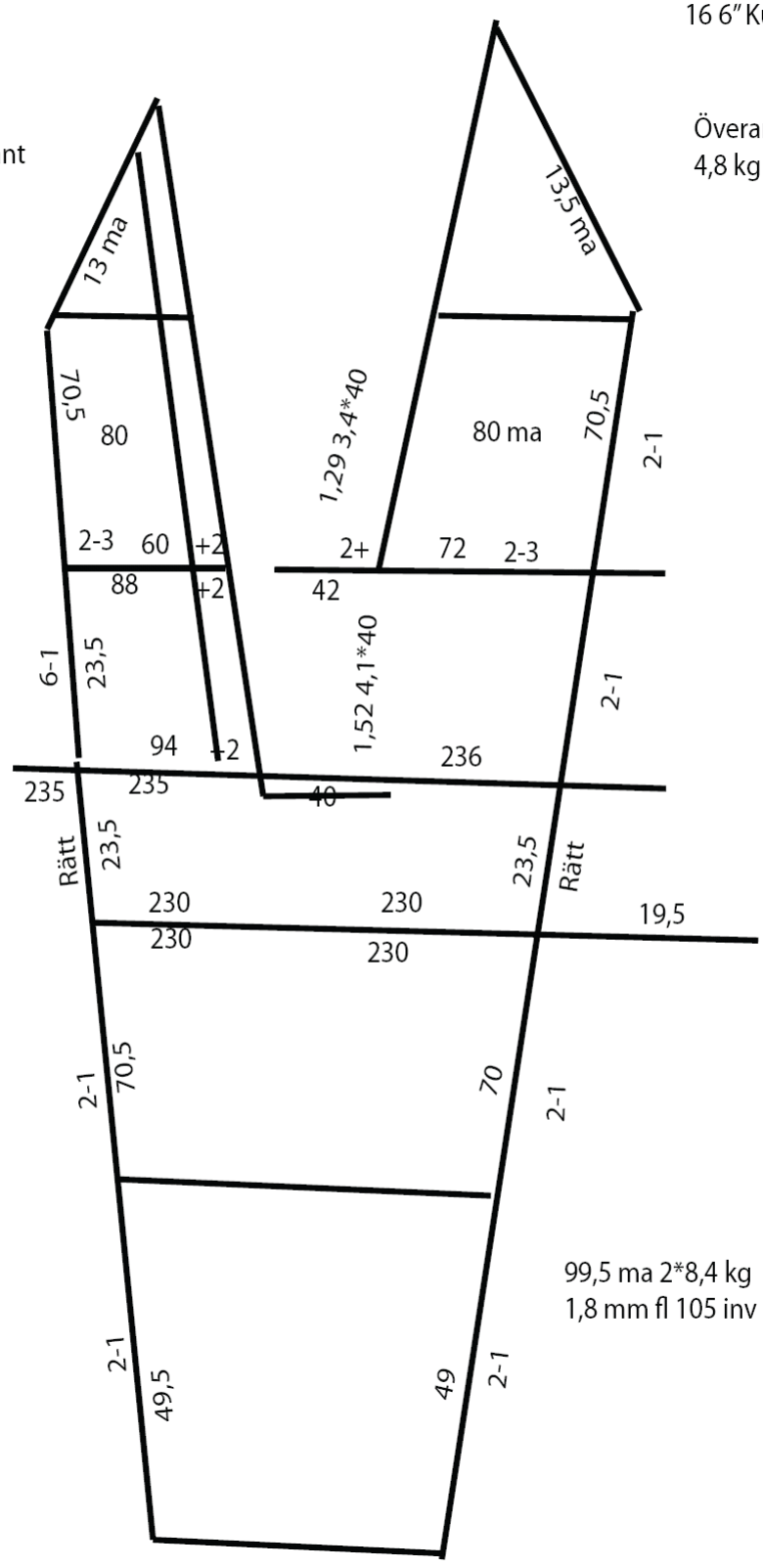
Station	Center_y	center_x	Station	Center_y	center_x	Station	Center_y	center_x	Station	Center_y	center_x
151	57.52212	11.52027	201	56.18273	11.87948	251	56.67381	12.21926	301	57.16382	12.56821
152	57.60522	11.52602	202	56.26582	11.88572	252	56.75687	12.22637	302	57.24684	12.57623
153	57.68831	11.53180	203	56.34891	11.89200	253	56.83993	12.23352	303	57.32986	12.58431
154	55.93997	11.56482	204	56.43200	11.89831	254	56.92299	12.24071	304	57.41288	12.59242
155	56.02308	11.57033	205	56.51509	11.90465	255	57.00604	12.24793	305	57.49590	12.60058
156	56.10620	11.57587	206	56.59817	11.91103	256	57.08909	12.25520	306	57.57891	12.60879
157	56.18931	11.58144	207	56.68126	11.91744	257	57.17214	12.26250	307	57.66192	12.61704
158	56.27243	11.58704	208	56.76434	11.92389	258	57.25519	12.26984	308	55.91402	12.60069
159	56.35554	11.59266	209	56.84742	11.93037	259	57.33824	12.27723	309	55.99706	12.60841
160	56.43865	11.59832	210	56.93050	11.93688	260	57.42129	12.28465	310	56.08009	12.61618
161	56.52176	11.60401	211	57.01358	11.94343	261	57.50433	12.29212	311	56.16313	12.62399
162	56.60486	11.60973	212	57.09665	11.95002	262	57.58737	12.29962	312	56.24616	12.63183
163	56.68797	11.61548	213	57.17973	11.95664	263	57.67041	12.30717	313	56.32919	12.63972
164	56.77107	11.62126	214	57.26280	11.96330	264	55.92232	12.30490	314	56.41221	12.64766
165	56.85417	11.62707	215	57.34587	11.96999	265	56.00538	12.31199	315	56.49524	12.65563
166	56.93727	11.63291	216	57.42894	11.97672	266	56.08844	12.31913	316	56.57826	12.66365
167	57.02037	11.63879	217	57.51201	11.98349	267	56.17150	12.32630	317	56.66128	12.67171
168	57.10347	11.64469	218	57.59508	11.99029	268	56.25456	12.33350	318	56.74430	12.67981
169	57.18657	11.65063	219	57.67814	11.99713	269	56.33762	12.34075	319	56.82732	12.68796
170	57.26966	11.65660	220	55.92991	12.00897	270	56.42067	12.34803	320	56.91034	12.69615
171	57.35276	11.66261	221	56.01300	12.01543	271	56.50372	12.35536	321	56.99335	12.70439
172	57.43585	11.66864	222	56.09608	12.02192	272	56.58677	12.36272	322	57.07636	12.71267
173	57.51894	11.67471	223	56.17917	12.02845	273	56.66982	12.37012	323	57.15937	12.72099
174	57.60203	11.68081	224	56.26225	12.03502	274	56.75287	12.37756	324	57.24238	12.72936
175	57.68511	11.68695	225	56.34533	12.04162	275	56.83591	12.38504	325	57.32539	12.73778
176	55.93679	11.71290	226	56.42840	12.04825	276	56.91895	12.39256	326	57.40839	12.74624
177	56.01990	11.71873	227	56.51148	12.05492	277	57.00200	12.40013	327	57.49140	12.75475
178	56.10301	11.72459	228	56.59455	12.06163	278	57.08504	12.40773	328	57.57440	12.76330
179	56.18611	11.73047	229	56.67763	12.06837	279	57.16807	12.41537	329	57.65740	12.77190
180	56.26921	11.73640	230	56.76070	12.07515	280	57.25111	12.42306	330	55.90961	12.74852
181	56.35231	11.74235	231	56.84377	12.08196	281	57.33414	12.43079	331	55.99263	12.75656
182	56.43541	11.74833	232	56.92684	12.08881	282	57.41718	12.43856	332	56.07565	12.76464
183	56.51851	11.75435	233	57.00990	12.09570	283	57.50021	12.44637	333	56.15867	12.77277
184	56.60161	11.76040	234	57.09297	12.10263	284	57.58324	12.45423	334	56.24168	12.78094
185	56.68470	11.76648	235	57.17603	12.10959	285	57.66626	12.46212	335	56.32470	12.78915
186	56.76780	11.77259	236	57.25909	12.11659	286	55.91826	12.45281	336	56.40771	12.79741
187	56.85089	11.77873	237	57.34215	12.12363	287	56.00131	12.46022	337	56.49072	12.80571
188	56.93398	11.78491	238	57.42521	12.13071	288	56.08436	12.46767	338	56.57373	12.81405
189	57.01707	11.79113	239	57.50827	12.13782	289	56.16740	12.47516	339	56.65674	12.82244
190	57.10016	11.79737	240	57.59132	12.14498	290	56.25045	12.48269	340	56.73975	12.83088
191	57.18324	11.80365	241	57.67437	12.15217	291	56.33349	12.49026	341	56.82275	12.83936
192	57.26633	11.80997	242	55.92621	12.15695	292	56.41653	12.49787	342	56.90575	12.84788
193	57.34941	11.81632	243	56.00928	12.16373	293	56.49957	12.50551	343	56.98875	12.85645
194	57.43249	11.82270	244	56.09235	12.17054	294	56.58261	12.51320	344	57.07175	12.86507
195	57.51557	11.82912	245	56.17542	12.17739	295	56.66564	12.52094	345	57.15475	12.87374
196	57.59865	11.83557	246	56.25849	12.18428	296	56.74868	12.52871	346	57.23774	12.88245
197	57.68172	11.84206	247	56.34156	12.19120	297	56.83171	12.53652	347	57.32073	12.89121
198	55.93344	11.86095	248	56.42463	12.19816	298	56.91474	12.54438	348	57.40372	12.90001
199	56.01654	11.86709	249	56.50769	12.20516	299	56.99777	12.55228	349	57.48671	12.90887
200	56.09963	11.87327	250	56.59075	12.21219	300	57.08079	12.56022	350	57.56969	12.91777
									351	57.65268	12.92672

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.

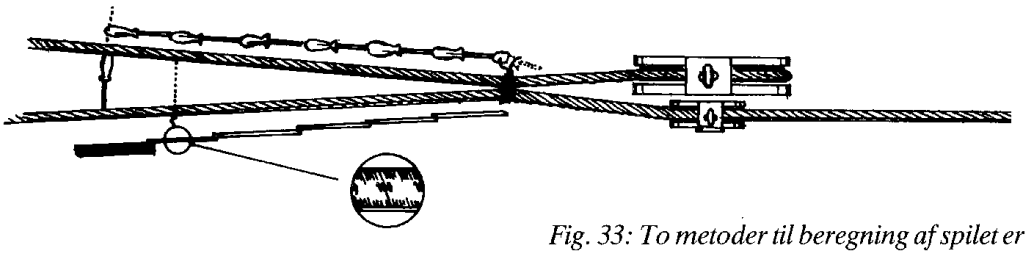


Fig. 33: To metoder til beregning af spilet er her illustreret. Det letter udmålingen, hvis wirerne kan samles med et bændsel.

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