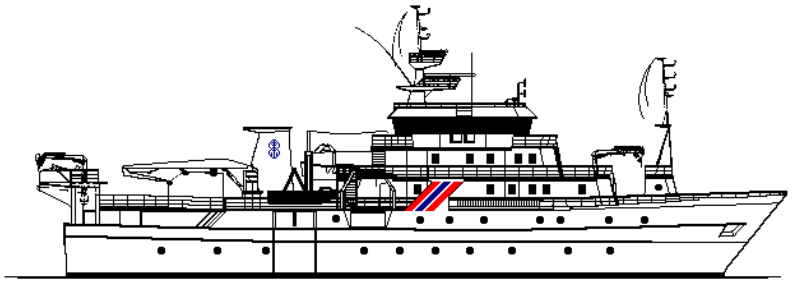
CRUISE REPORTS "DR. FRIDTJOF NANSEN"



BENEFIT SURVEYS

Cruise Report No 2/2000

EFFECTS OF BRIDLE LENGTH ON CATCH RATES OF HAKE
27 April - 17 May 2000

by

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1. INTRODUCTION

Objective

The main objective of the cruise was to study the effect of different sweep lengths on the catch rates and length composition of hake.

The swept area of a trawl haul is a crucial parameter in swept area survey methodology, particular if the survey is meant to estimate total biomass of the stock and not just give an annual index. Most species are herded towards the net mouth area by the doors, sand clouds and sweeps/bridles, thus the effective swept area is larger than the net opening. The swept area for a fixed door spread, however, varies with different species and size groups. During the Dr. "Fridtjof Nansen" hake bottom trawl surveys a swept width of 18.5 m was used, slightly less than the wingspread of the trawl (approximately 22 m). Earlier experiments carried out in Namibian and South African waters indicated that hake seem to be less herded than for instance cod and haddock. The question is, however, if herding takes place at all. If it does, we are overestimating the hake population. If herding is size specific, and larger fish are more prone to herding than smaller fish, then the catch at age data from the surveys will over estimate survival and therefore underestimate the total mortality rate, Z. To estimate swept area for different species and size groups is very complicated, as it is almost impossible to isolate each parameter involved, such as escapement of fish under and over the trawl. The first approach to evaluate if herding takes place has often been to compare the catch composition using two different sweep lengths. One should, as pointed out above, have in mind that this gives no estimate of swept area, but an indication if fish are herded by trawl doors, sand clouds and bridles/sweeps towards the net mouth area of the trawl.

Participation

The scientific staff consisted of the following:

From Namibia:

Titus Ilende, Paul Kainge, Shaun Wells.

From South Africa:

Robin Leslie, Benita Maritz, Charlene Rogers

From Norway:

Arill Engås, Thor Egil Johansson, Terje Jørgensen, Tore Mørk, Jan Tore Øvredal

Narrative

27 April	Departure Walvis Bay
6 May	Call on Saldhana Bay
16 May	Arrival Cape Town

2. MATERIAL and METHODS

Sweep length comparisons

The trawling experiments comparing different sweep lengths, 40 m and 100 m, were carried out off the coast of Namibia and South Africa (Figure 1a, b and c). The water depth varied between 290 m (area D) and 450 m (area E). The seabeds in the worked areas in Namibian waters were classified from the echo-recordings to be softer than the working areas in the South African waters.

The standard sampling trawl, Gisund super (Figure 2) used by "Dr. Fridtjof Nansen" for hake and 7.9 m^2 Thyborøn doors were used. The trawl was fished with door spread restriction consisting of a 10 m rope between the warps 140 m in front of the doors to ensure stable door and wing spreads and to prevent the trawl from being overspread (Fig. 3a).

The standard rigging of the survey trawl with 40 m bridles is shown in Figure 3a. Initial trials with 100 m sweeps/bridles were made with single sweep extension of 60 m between the doors and the 40 m standard rigging (Figure 4b). Measurements showed that the vertical opening of the trawl was substantially reduced compared to the vertical opening with the standard

rigging. The reason was that the weight of the 60 m extension forced the upper sweep closer to bottom, preventing the trawl from open properly (Figure 4b). It was thus decided to use rigging with bridles going all the way forward to the trawl doors (Figure 4c). A slightly higher (4.8 vs. 4.6 m) vertical trawl opening was obtained with this rigging compared to standard rigging.

In order to obtain the same bridle angle with the two different riggings, the restrictor rope (10 m) was moved to a position 270 m in front of the doors when the 100m bridles were used (Figure 3 b).

The two bridle lengths were compared by alternate hauls. The duration of a tow was ½ h at a speed of 3 knots. The first trawl haul of the day was shot approximately at 0700 h, and the last at 1600h. The two hauls of a pair were carried out in the same area, with towing direction the same. All trawl hauls were monitored by SCANMAR trawl sensors (door spread, wing spread, vertical opening and symmetry of the trawl). In addition, the distance of the restrictor rope from seabed when mounted 140 and 270 m in front of the trawl doors was measured during 4 hauls. The warp length to depth ratio was 3 for all hauls.

During two trawl hauls with 40 and 100 m bridles respectively; a scanning sonar (FS 3300) mounted on an underwater vehicle (FOCUS) was towed approximately 30 m above the trawl in order to measure the distance between the sand cloud and the wingtip of the trawl.

Hydrography and meteorology

CTD stations were carried out in each working area, usually each afternoon after the last trawl haul. Temperature, salinity, oxygen and light were measured. Two Niskin bottles were triggered for water samples on each station, one near the bottom (approximately 5 m from the bottom) and one near the surface (5 m depth). The oxygen content was determined using the Winkler method. Wind (speed and direction), air temperature, global radiation and sea surface temperature (5 m depth) were logged automatically throughout the cruise using an Aanderaa meteorological station.

Behavioural studies

A scanning sonar (FS 3300) was mounted on the centre of the headline during 6 hauls (station number 589, 596, 614, 621, 631) to record the entrance of fish in the net mouth area. A concentration of fish within a particular area of the net mouth can indicate that hake respond to stimuli, i.e. that they are not caught by solely a passive sieving process.

In addition, two trawl hauls were carried out in shallow waters (100 m depth, area C) for the purpose of studying the behaviour of hake using the underwater vehicle and the self-recording camera unit mounted on the headline.

3. RESULTS

Trawl dimensions

The trawl performance was stable in all hauls. An overview of trawl geometry for the two riggings is given in Table 1. The ratio between the measured door-spreads, i.e., door-spread with long bridles divided by door-spread with short bridles, was approximately 1.6. The sweep angle with both bridles was calculated to be approximately 17 degrees. The sand cloud was measured to be at a distance of approximately 9 m from the wingtip with 40 m sweeps, while it was approximately 17 m outside the wingtip with 100 m sweep. Based on measurements of the distance of the restrictor rope above seabed, the warp angle was estimated at approximately 13 degrees both with the restrictor rope 140 and 270 m in front of the trawl doors (assuming no sag of the warp).

Table 1.Trawl geometry measurement.

Sweep length (m)	Door spread (m)	Wing spread (m)	Vertical opening (m)
40	53	22	4.6
100	86	22	4.8

Comparison of catches

A total of 22 paired comparisons were carried out, six in area A, four in area B, four in area D and eight in area E. The catch compositions in area A, B, D and E for the two bridle lengths are given in Appendix 1. The catch consisted mainly of the two hake species, *Merluccius capensis* and *Merluccius paradoxus*, except for area D, where the catch consisted mainly of snoek (*Thyrsites atun*) and angelfish (*Brama brama*).

The length distributions of the two hake species for the two bridle lengths are given in Figures 5 and 6. There was no evidence of a difference in length frequency for the two hake species caught with 40 and 100 m long bridles.

The catch ratio in weights of the two hake species (catch long bridle/catch short bridle) are given in Figure 7. The plots indicate a marked effect of herding in area E, while the effect was less marked in the other areas. A rigorous statistical analysis of the data has yet to made.

Behavioural studies

Few fish were observed during stations 589 and 596(both area B), while substantial number of fish was observed during stations 615, 621, 625 and 631 (all in area E). With the catch consisting nearly of 100 % of deepwater (*M. paradocsus*) hake during the four last stations, we can be fairly sure that it was deepwater hake we observed by the scanning sonar. The entrance of fish was mainly close to the seabed. A picture of the screen is presented in Figure 8. It was estimated that more than 90 % of the observed fish entered less than 2.5 m from seabed. Few observations were made closer than 1 m from the headline. These observations indicated that the slightly higher vertical opening of the trawl with 100 m long bridles should not affect the comparisons. As the main entrance of fish was found in the central lower part of the net mouth area, it indicates that fish responded to the net by maximising their horizontal distance from the sides of the net.

Due to low visibility in area C, no observations of fish behaviour could be carried out with the underwater vehicle (FOCUS) and the self-recording camera unit mounted on the headline. Trials with the self recording camera unit using artificial light in area D and E showed that the visibility was too low to quantify any behaviour of fish.

Hydrography and meteorology

Temperature, salinity and oxygen levels within 10 m from the seabed are given in Table 2. Temperature and salinity were nearly similar in areas A, B, and D but in area E temperature was approximately 2 degrees lower than in the other areas. The main difference between the areas was the oxygen level which was more than three times as high in area E compared to area A.

Wind speed and sun radiation for the cruise are given in Figure 9 and 10**.**

Table 2. Average temperature, salinity and oxygen levels within ten meters from the bottom for the different working area

Working area	Temperature (°C)	Salinity	Oxygen (ml/l)
A	8.83	35.27	1.43
B	8.80	35.14	2.32
D	8.44	35.00	3.26
E	6.71	34.87	4.53

4. CONCLUSION

The results of the investigation showed herding for hake but the extent of it was highly variable between the different working areas. The reason for the difference is unknown but it is speculated that the oxygen level could have an important influence by affecting the swimming capacity of the hake and thereby their herding by doors, sand cloud and bridles.

Scanning sonar observations of entrance of fish in the net mouth area of the trawl in working area E provided further support for the conclusion that fish responded to gear stimuli during the capture process.

The observed large variation in herding between areas has important implications for assessments based on trawl surveys. We therefore recommend that the studies be continued to establish a better understanding of the main factors controlling herding in hake. We further

suggest that these studies should be accompanied by behavioural observations of hake as such information has proven essential to the understanding of the response of fish to gear stimuli during the catching process.

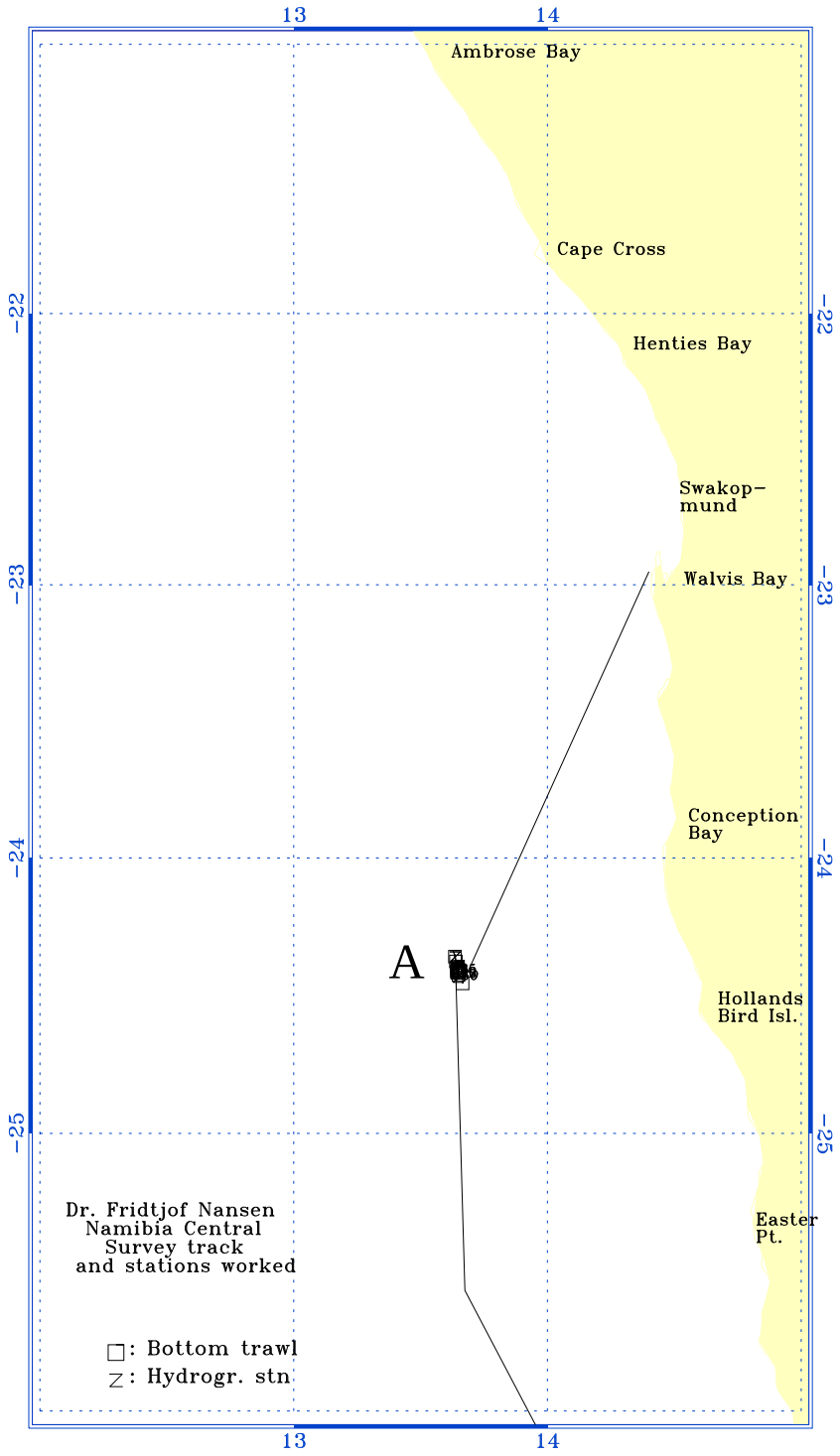


Figure 1a. Working area A.

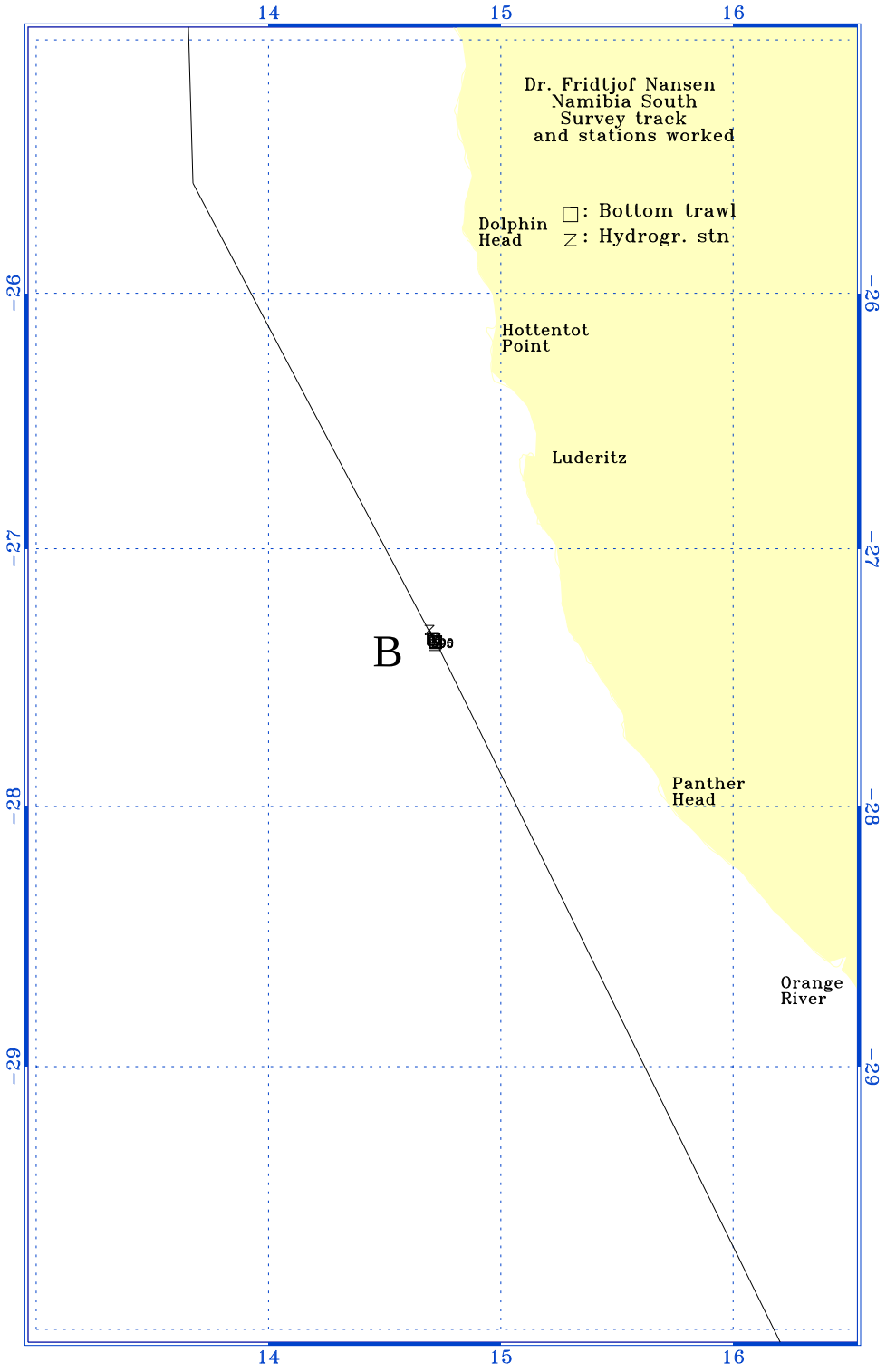


Figure 1b. Working area B.

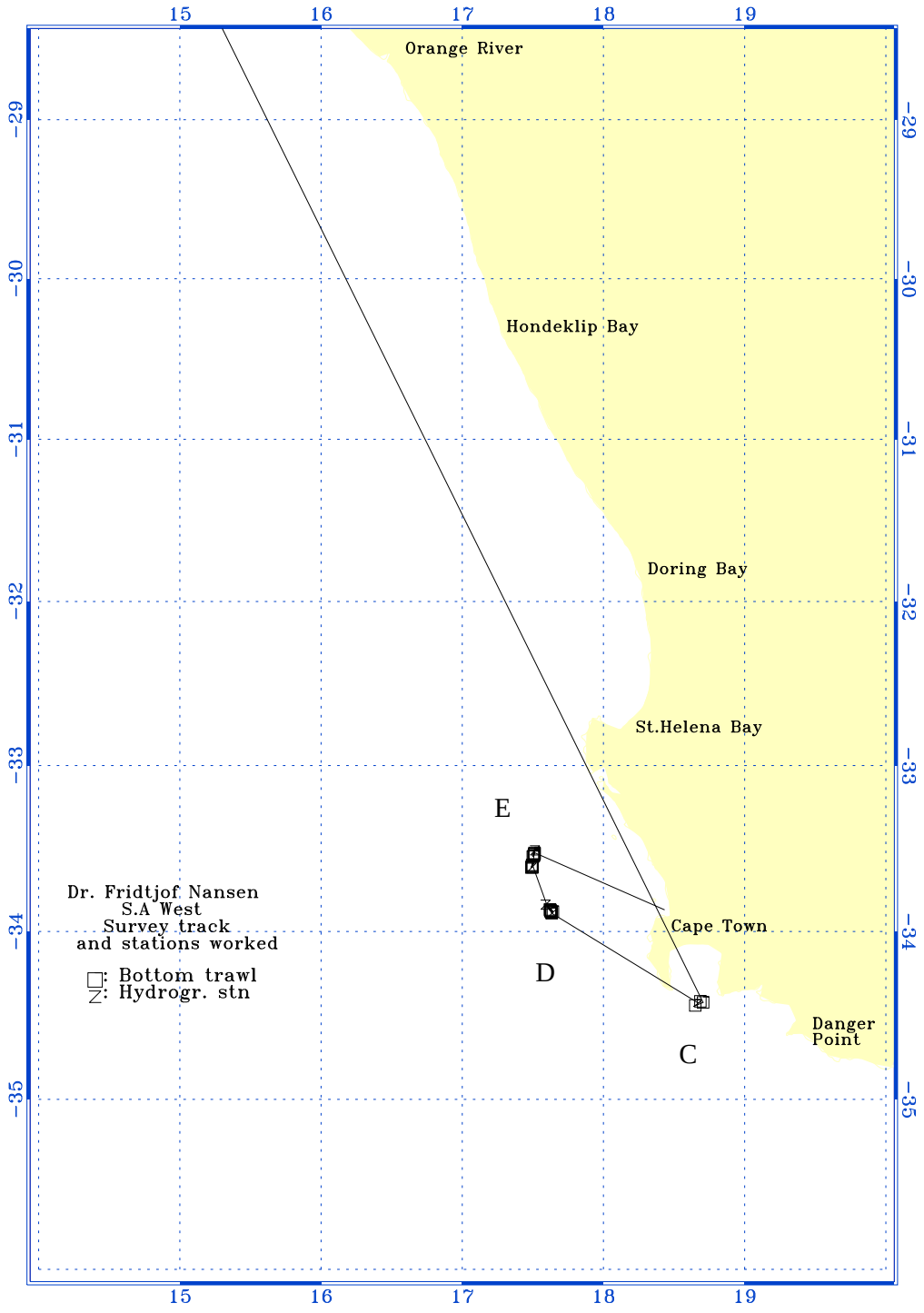


Figure 1c. Working areas C, D and E.

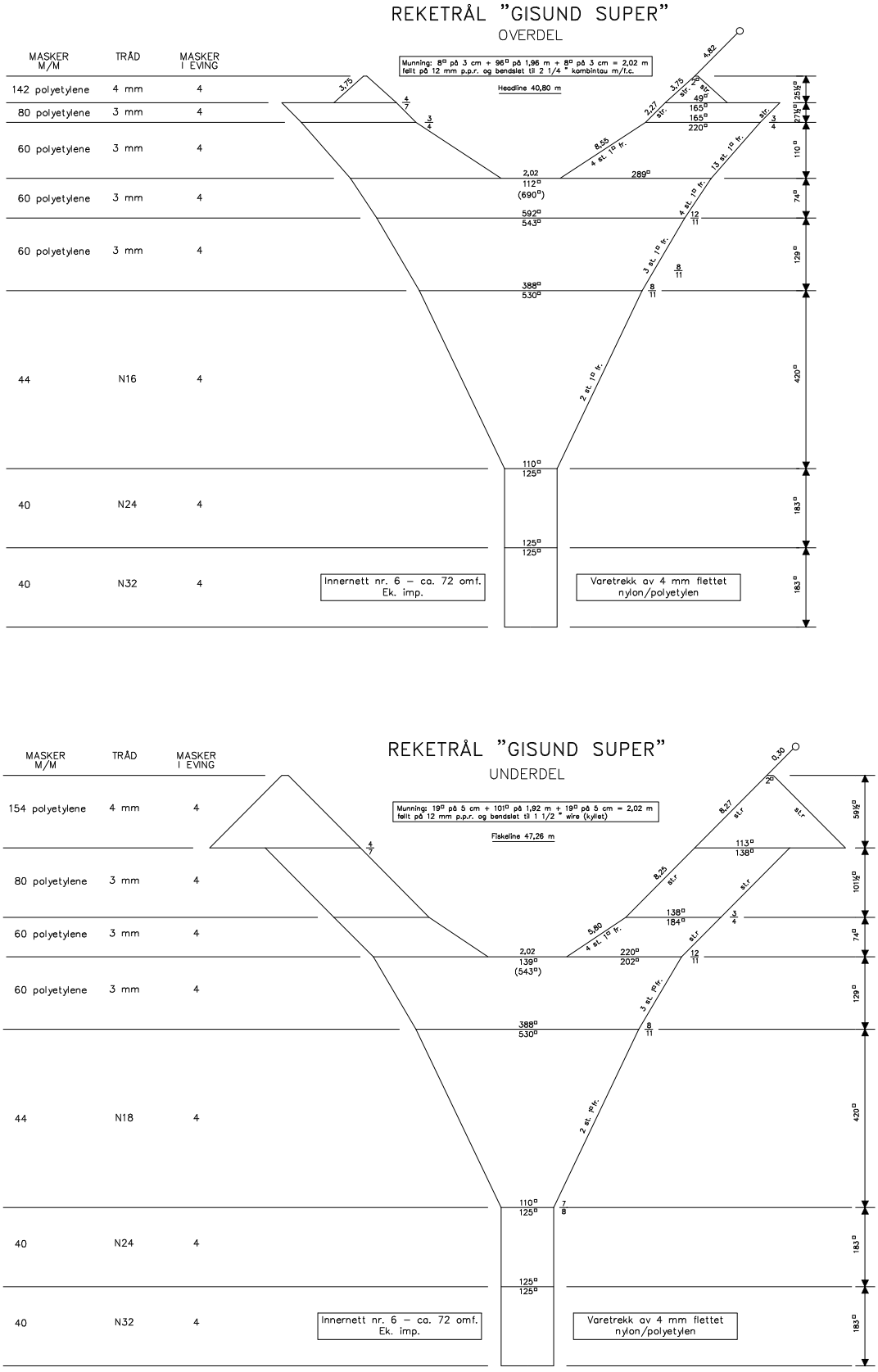


Figure 2. Design of the trawl used.

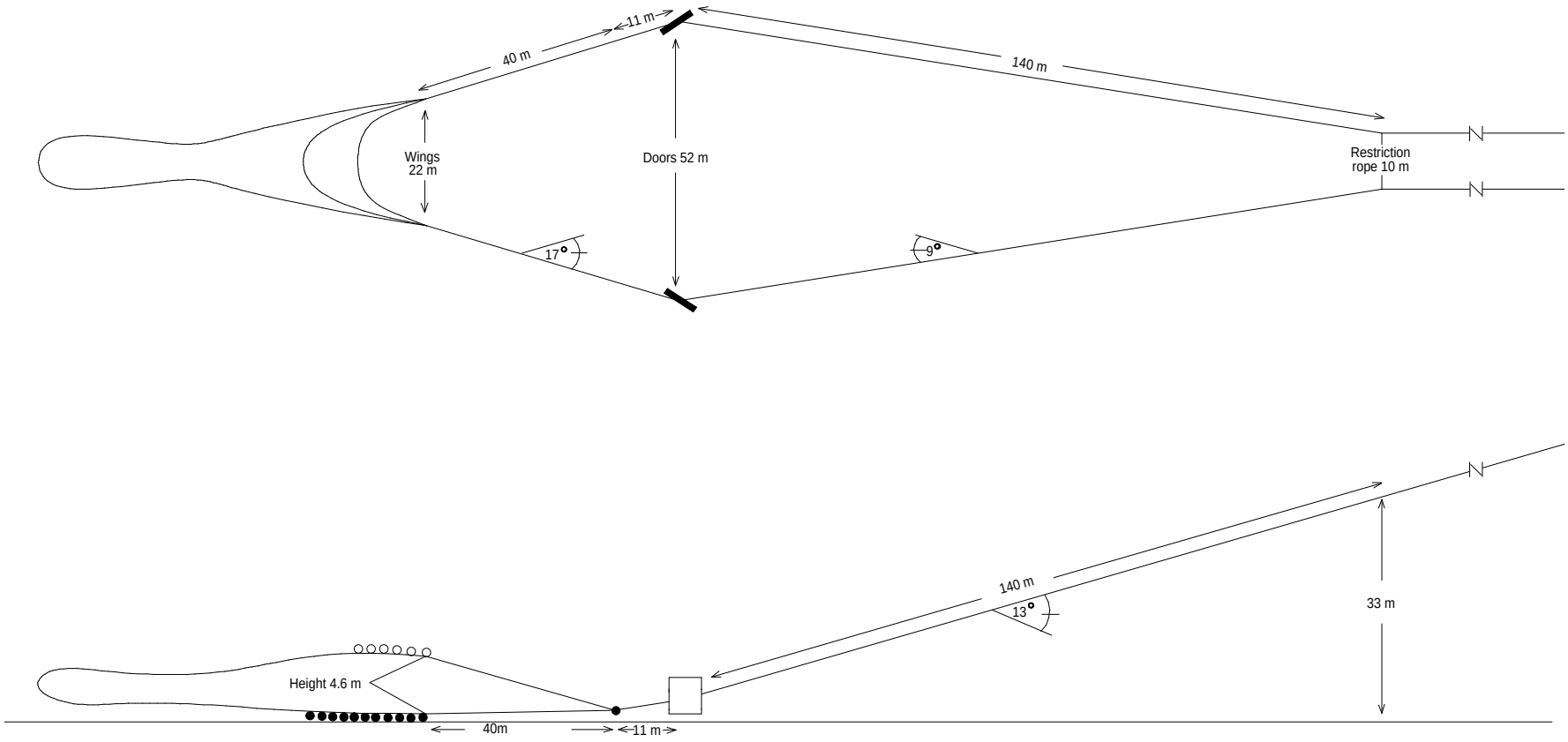


Figure 3a. Schematic presentation of trawl geometry with 40 m long bidles.

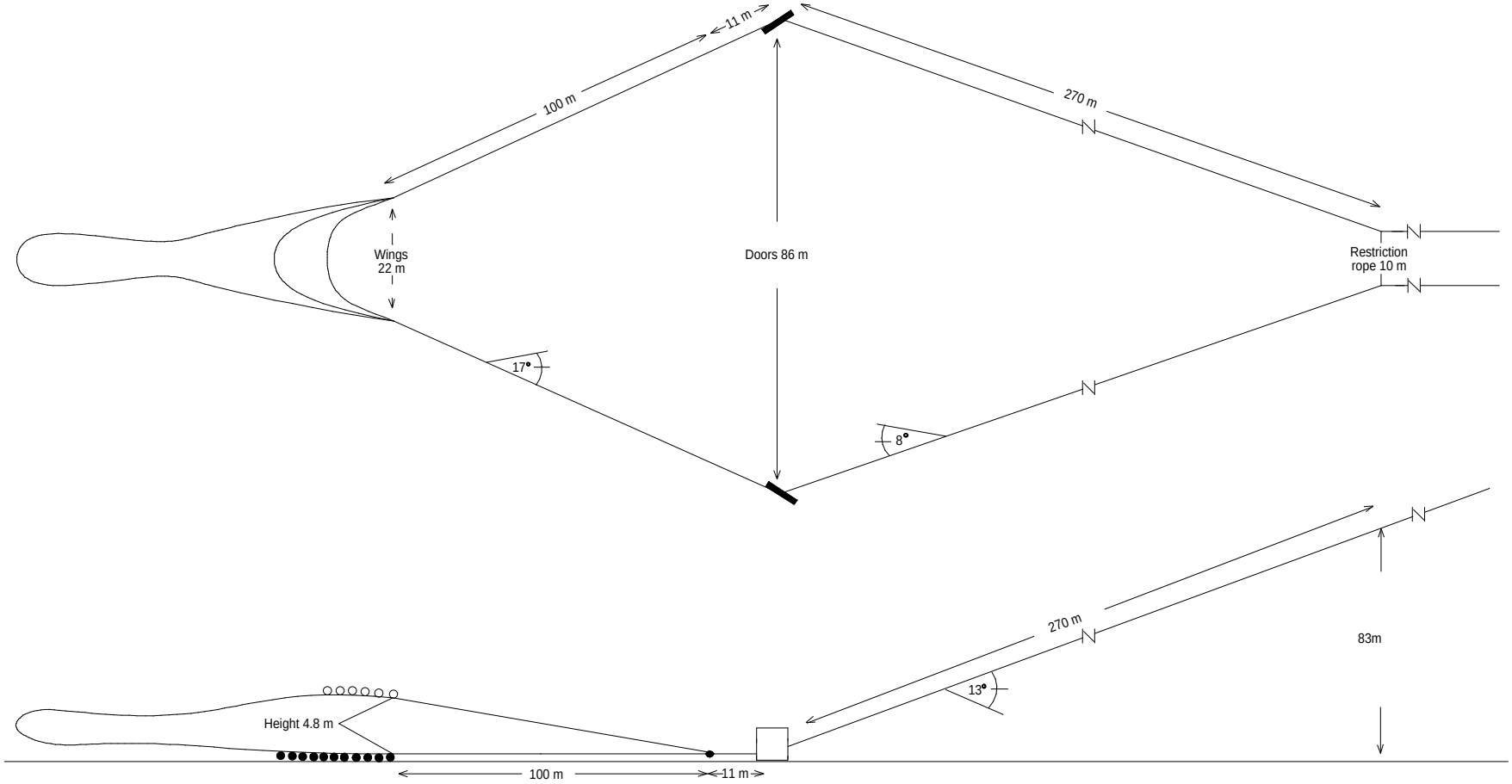


Figure 3b. Schematic presentation of trawl geometry with 100 m long bidles.

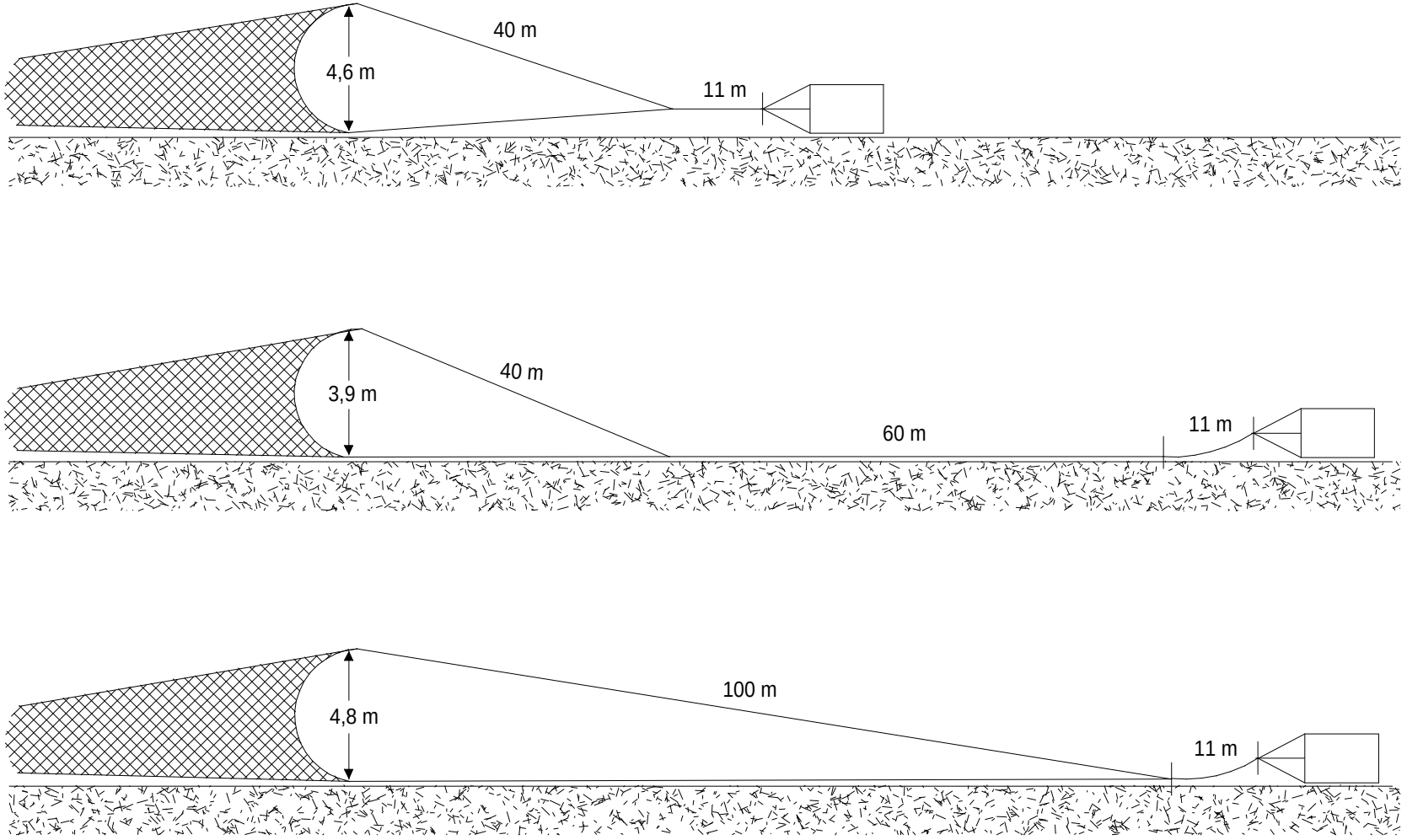


Figure 4. Schematic presentation of the bridle/sweep designs.

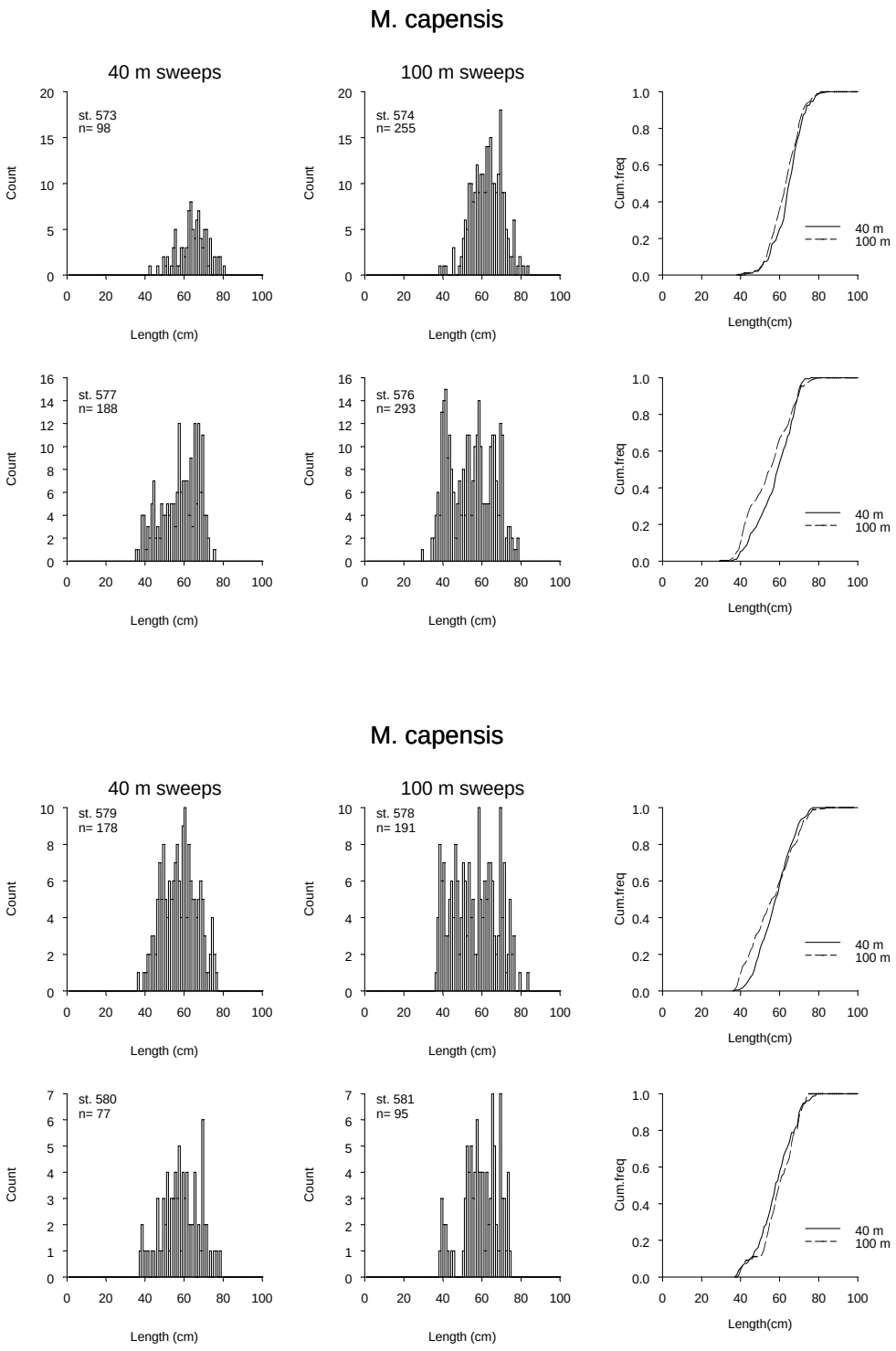


Fig. 5. Length frequency distribution of M. capensis caught in alternate hauls when using 40 m long bridles (left panel) and when using 100 m long bridles (centre panel). The relative cumulative length frequency distributions are also shown (right panel). n is the total number of fish in each haul. Area A.

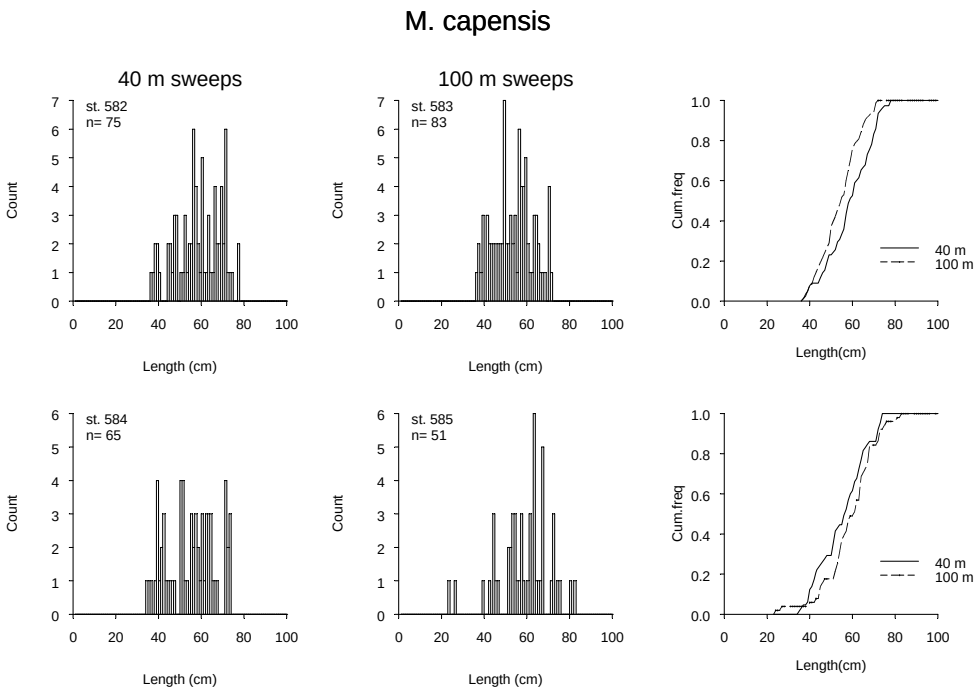


Fig. 5 Continued. Area A.

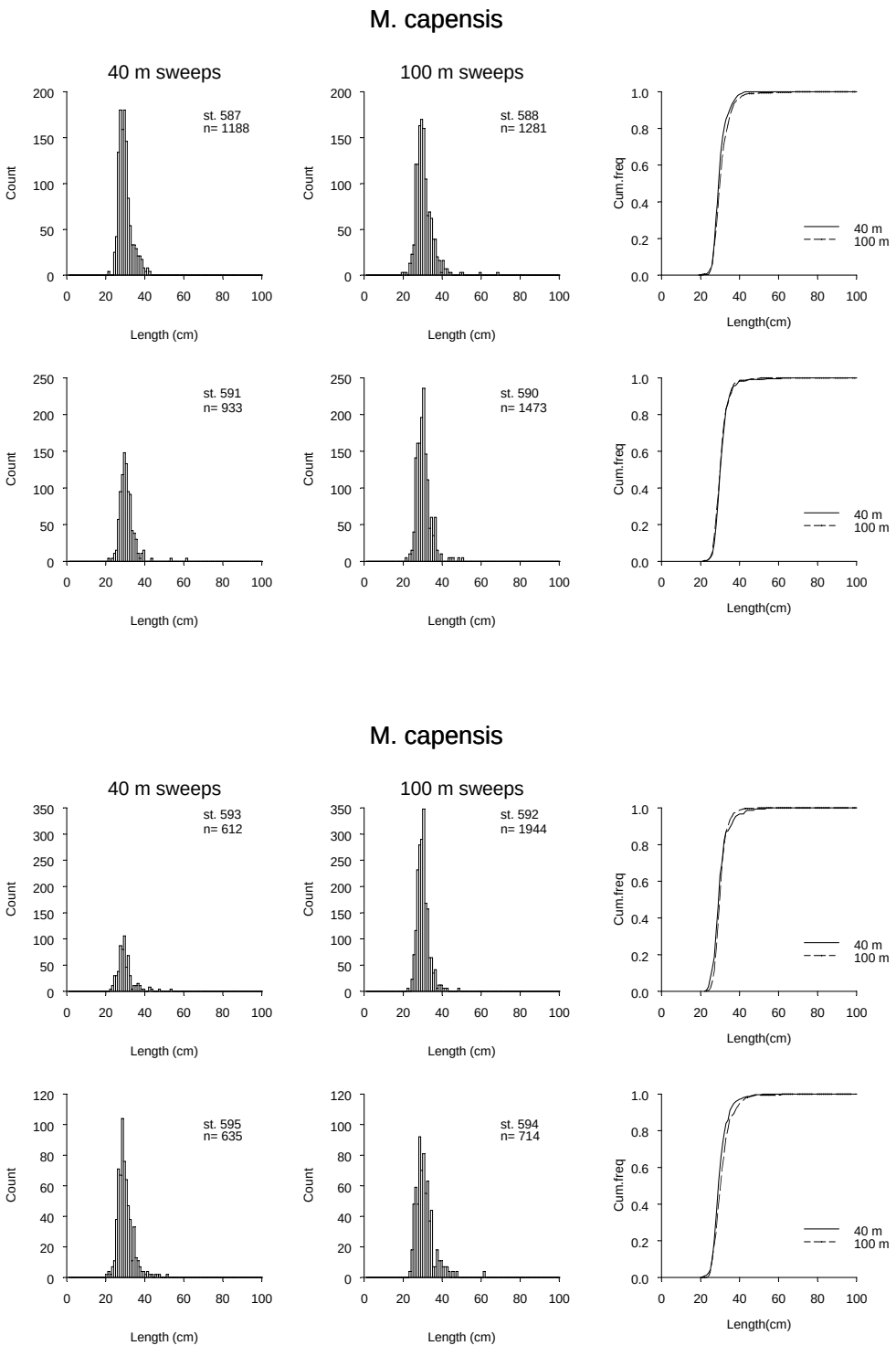


Fig. 5. Continued. Area B.

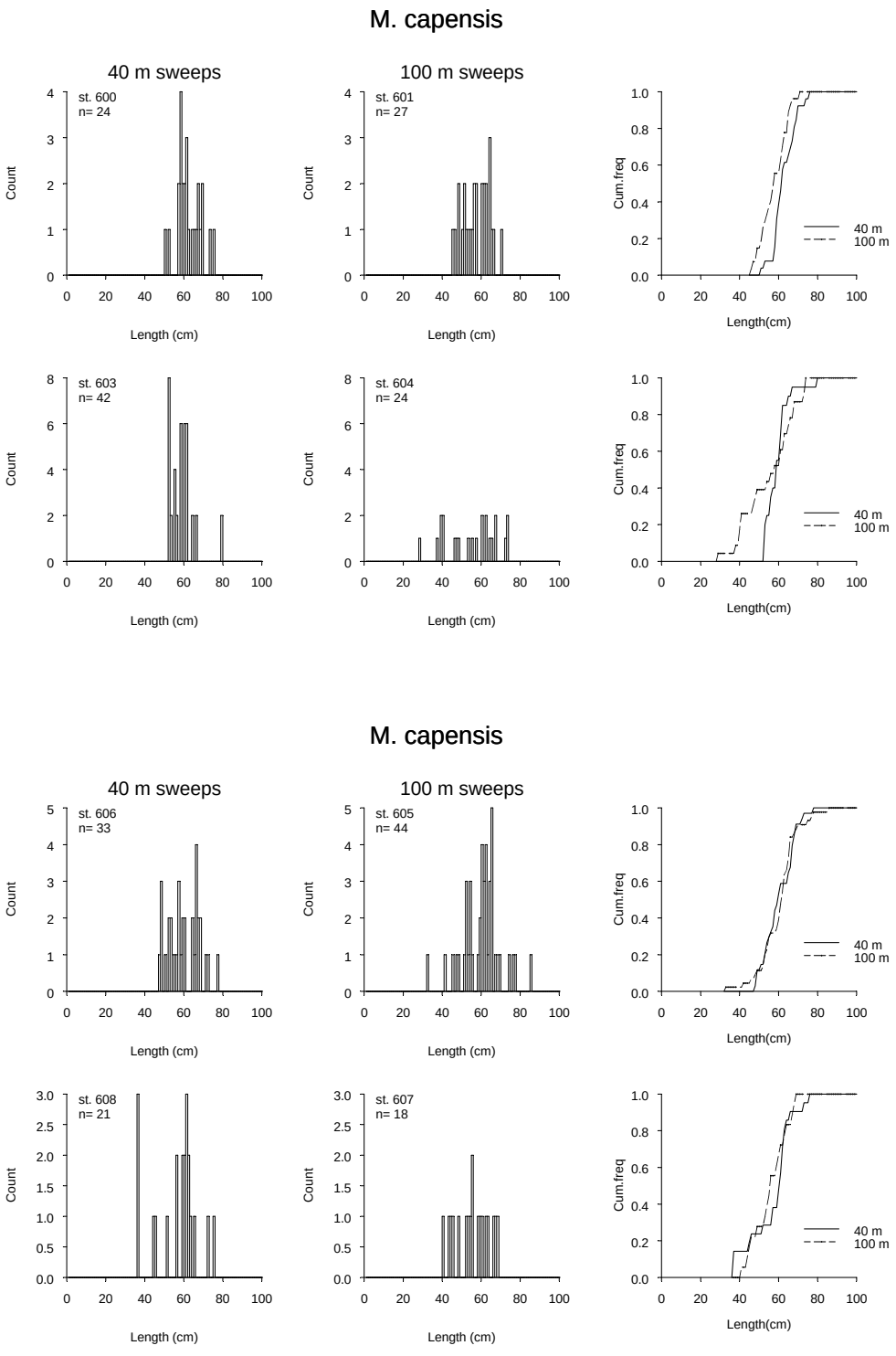


Fig. 5. Continued. Area D.

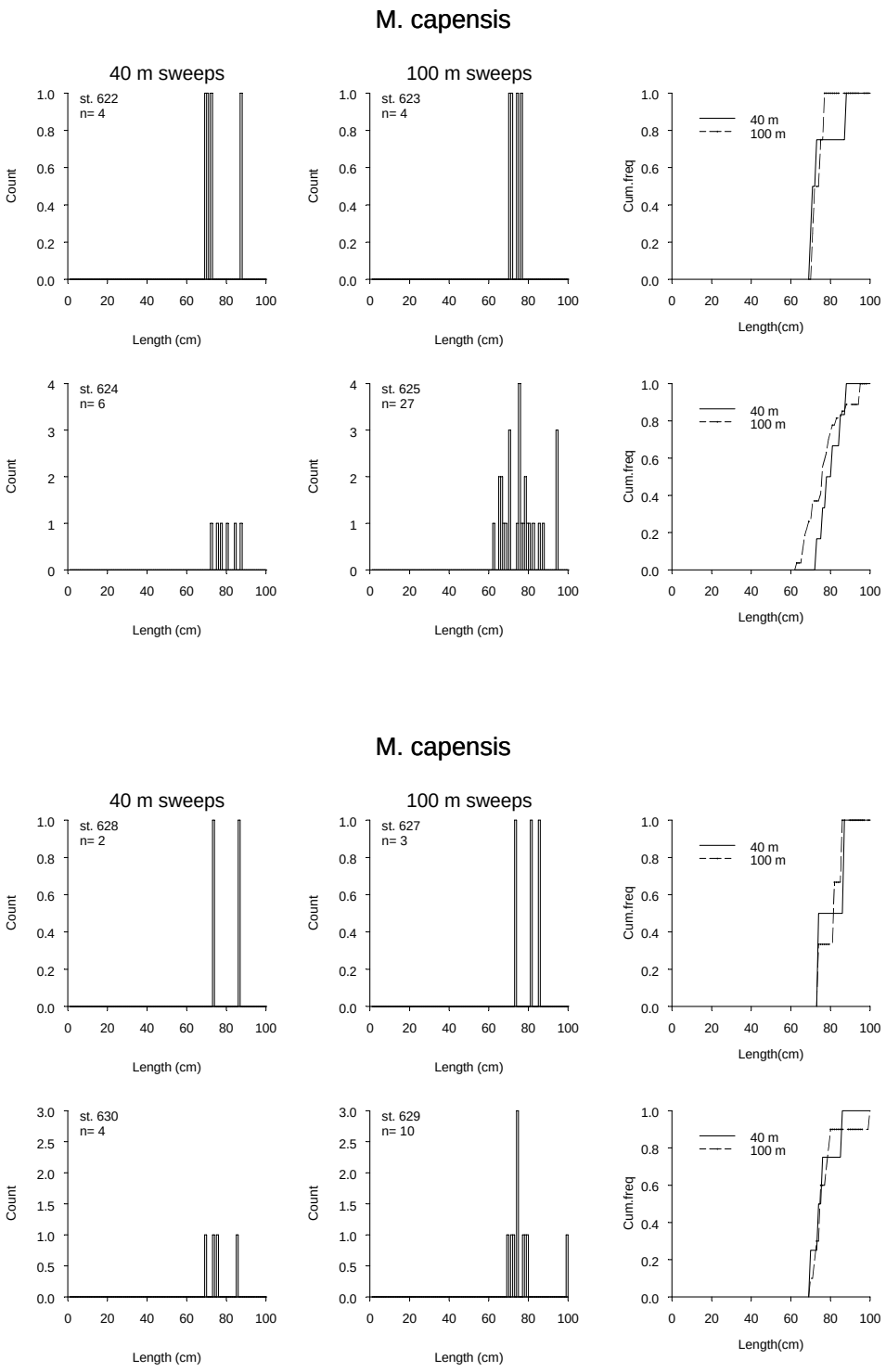


Fig. 5. Continued. Area E.

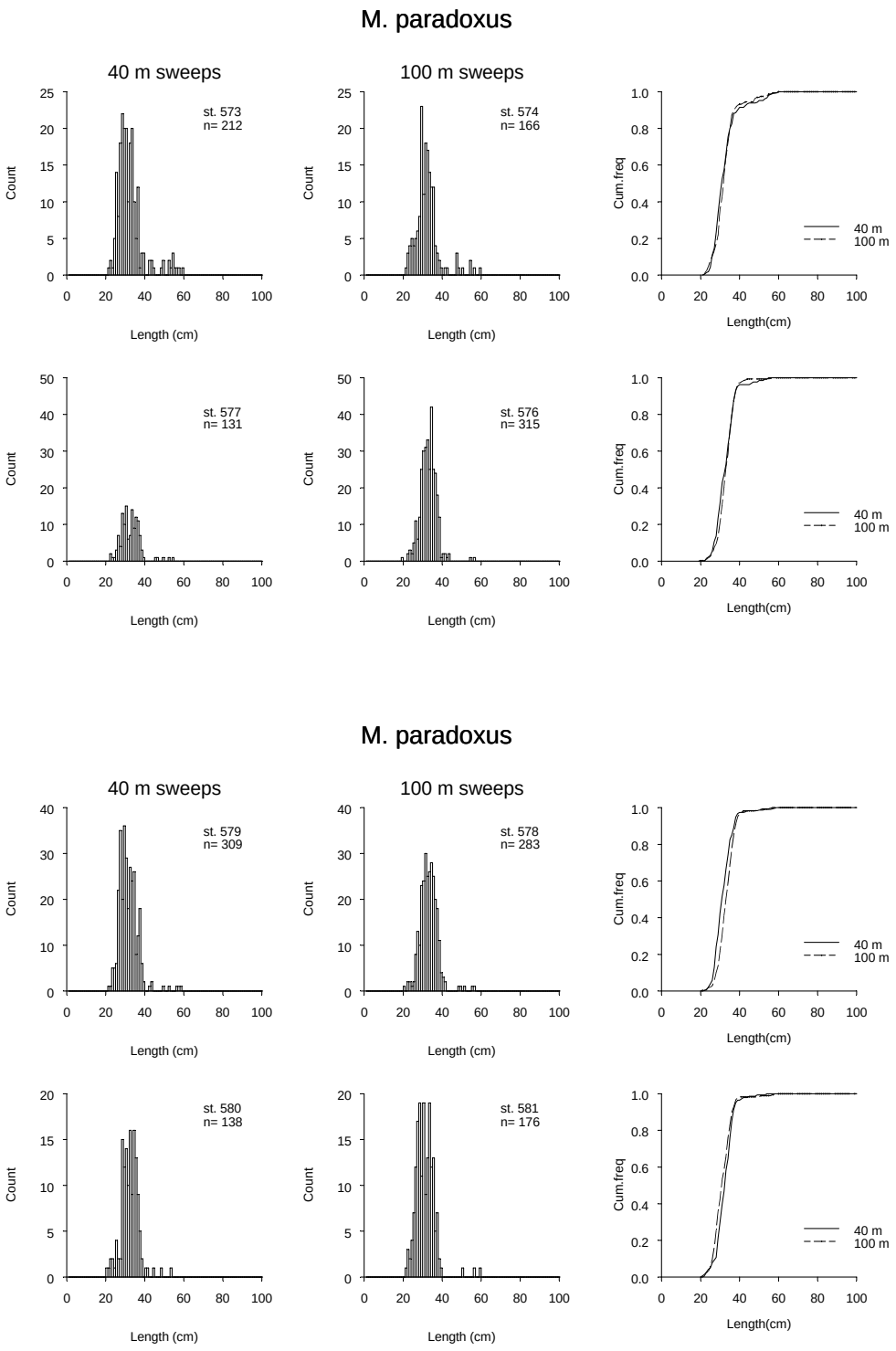


Fig. 6. Length frequency distribution of M. paradoxus caught in alternate hauls when using 40 m long bridles (left panel) and when using 100 m long bridles (centre panel). The relative cumulative length frequency distributions are also shown (right panel). n is the total number of fish in each haul. Area A.

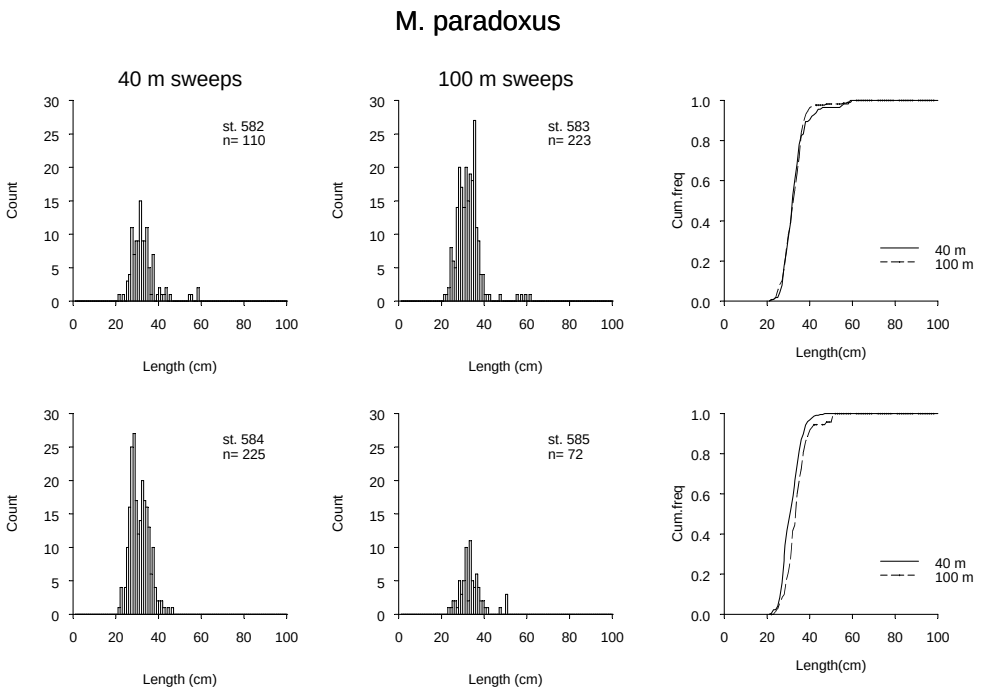


Fig. 6. Continued. Area A.

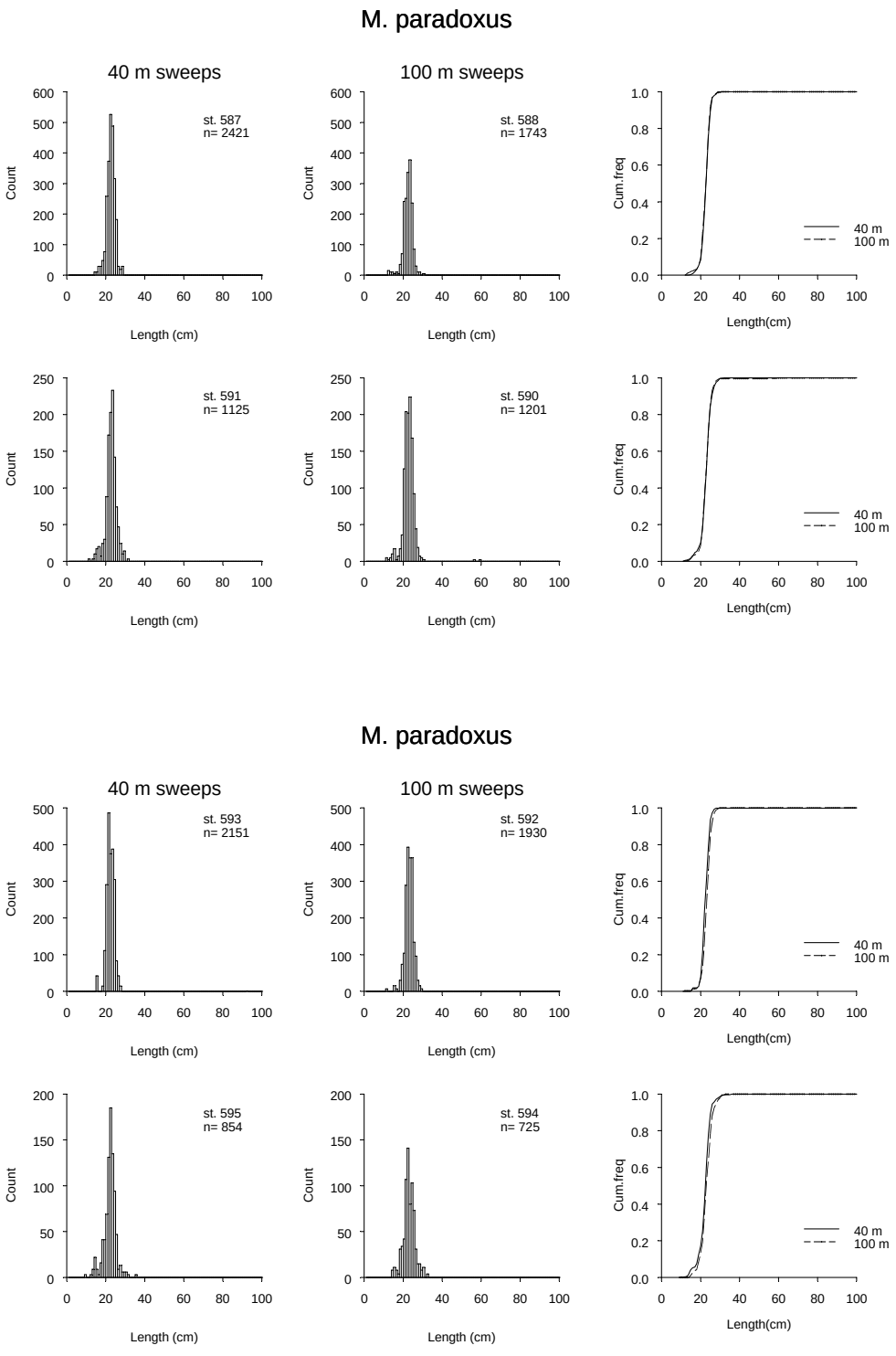


Fig. 6. Continued. Area B.

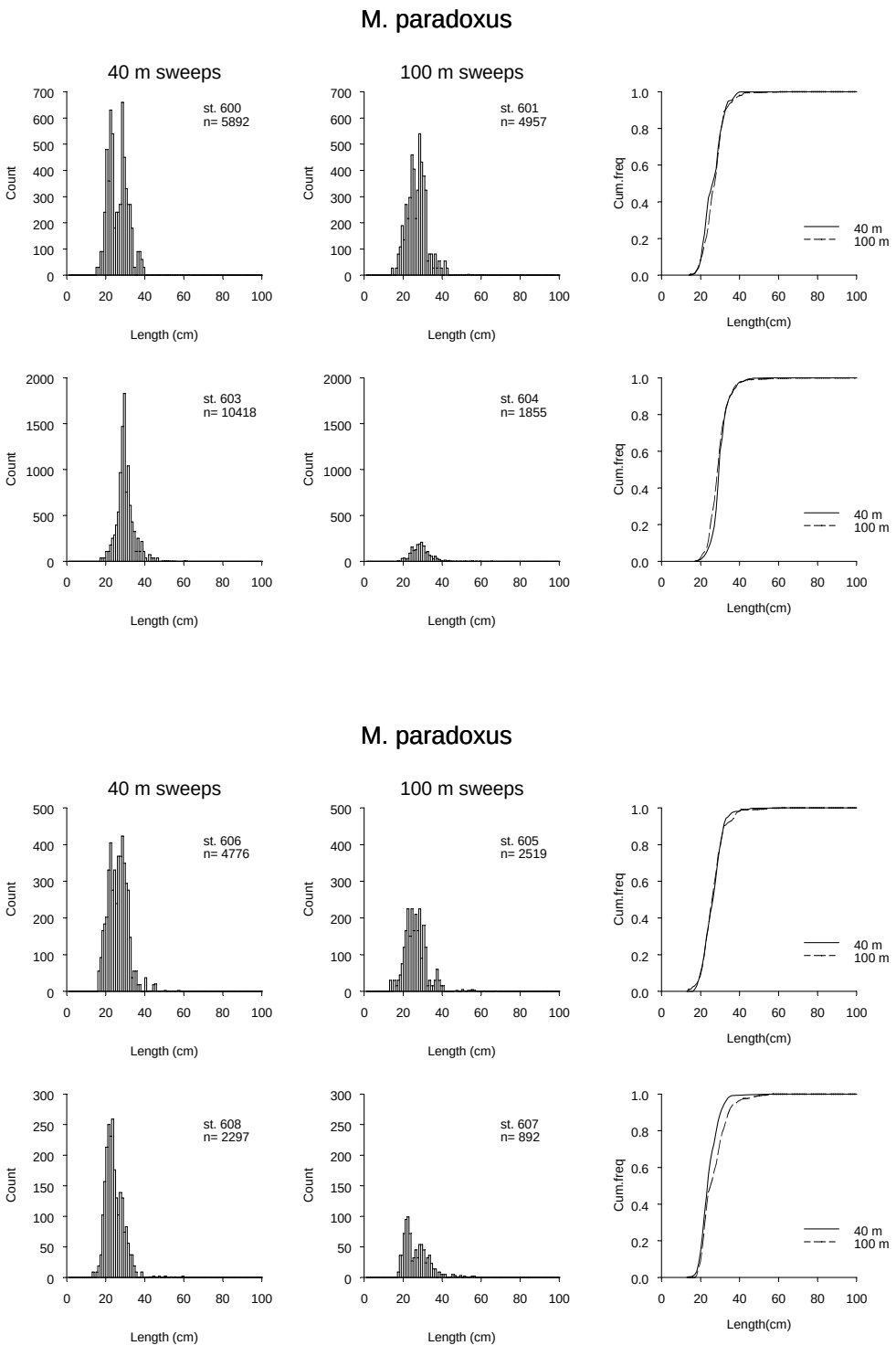


Fig. 6. Continued. Area D.

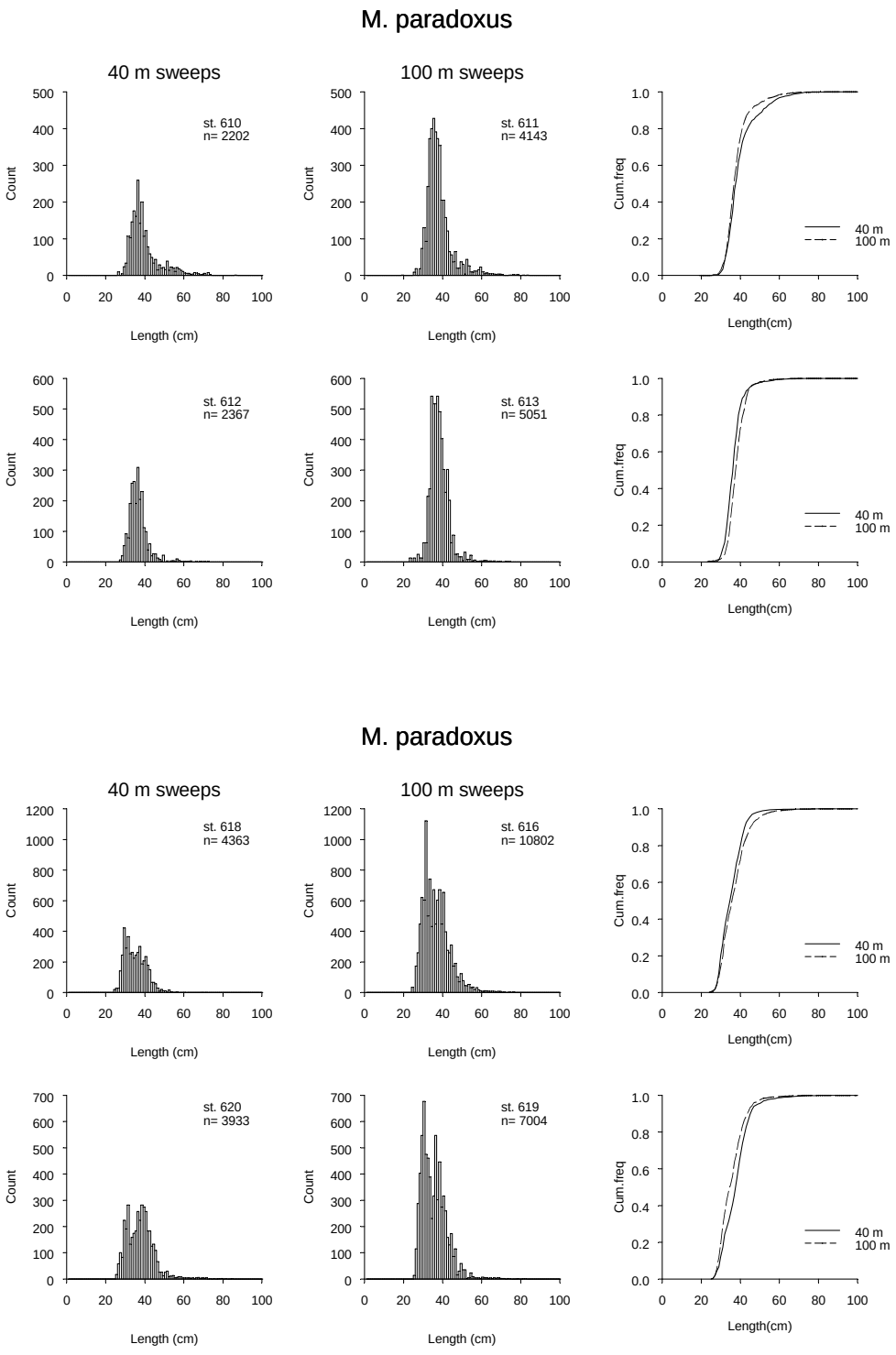


Fig. 6. Continued. Area E.

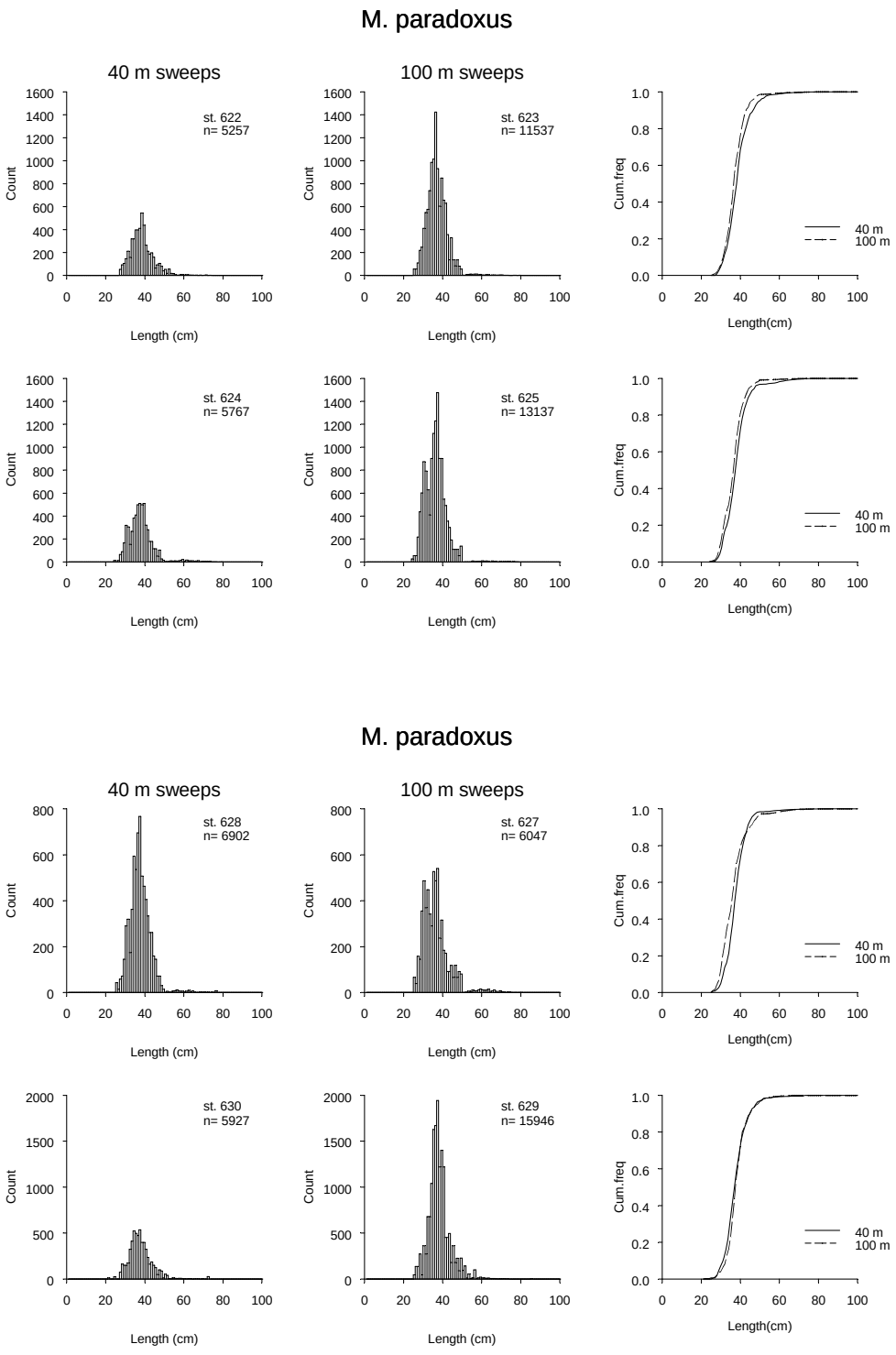


Fig. 6. Continued. Area E.

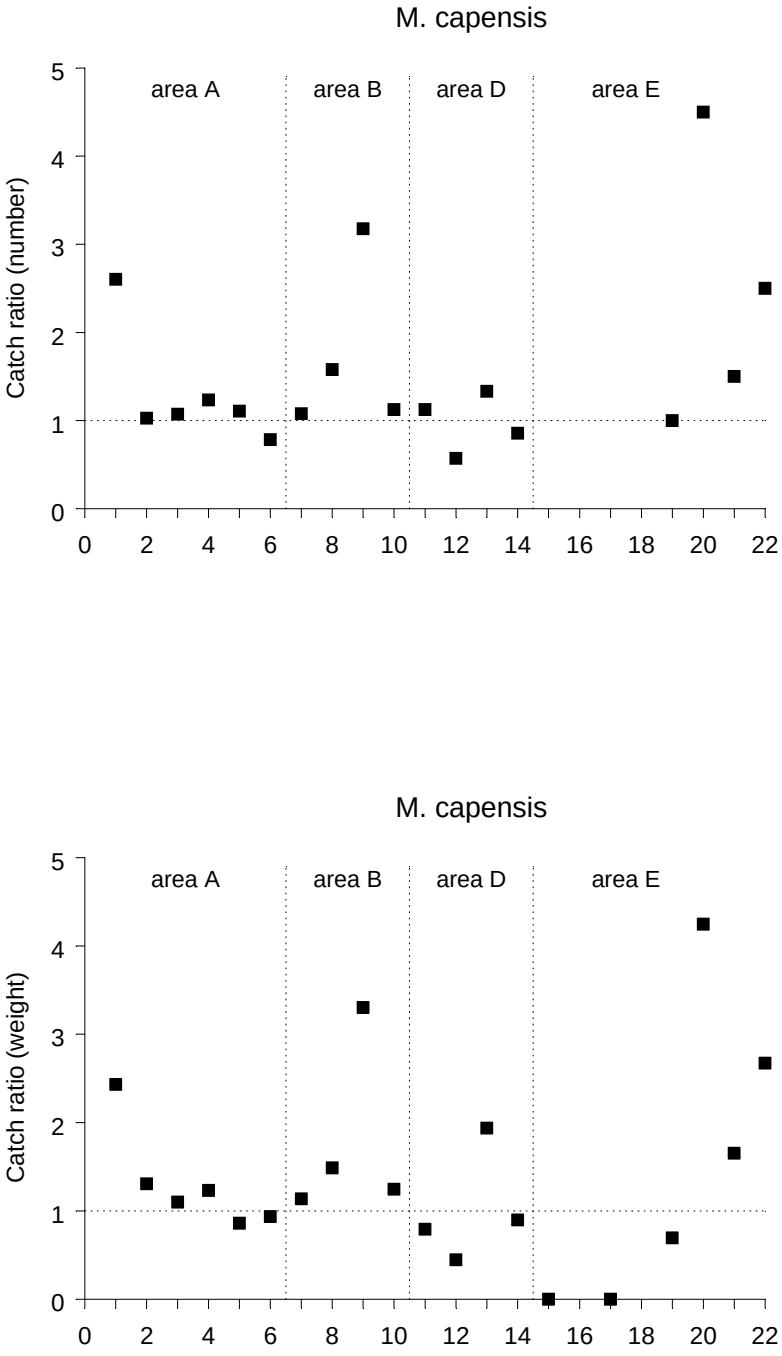
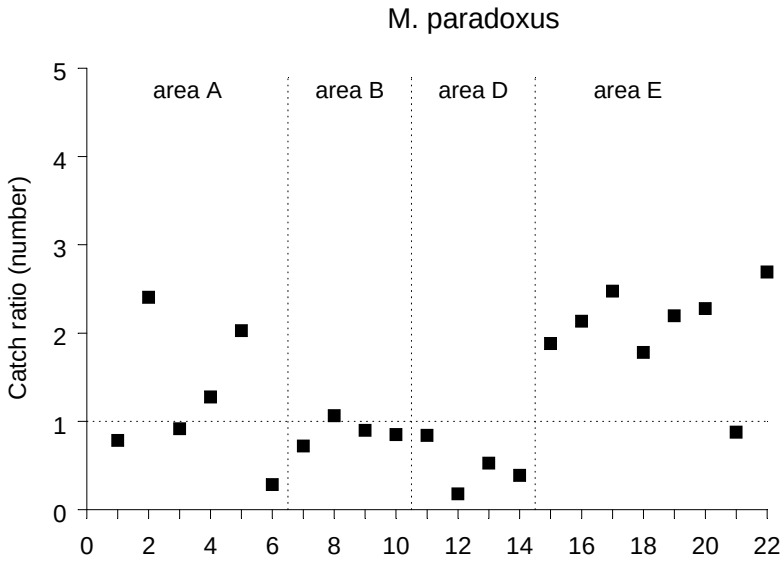


Fig. 7. Ratio of the catch of M. capensis with 100 m and 40 m long bridles for each of pairs of hauls. The ratio was calculated for catch by number (upper graph) and catch by weight (lower graph).



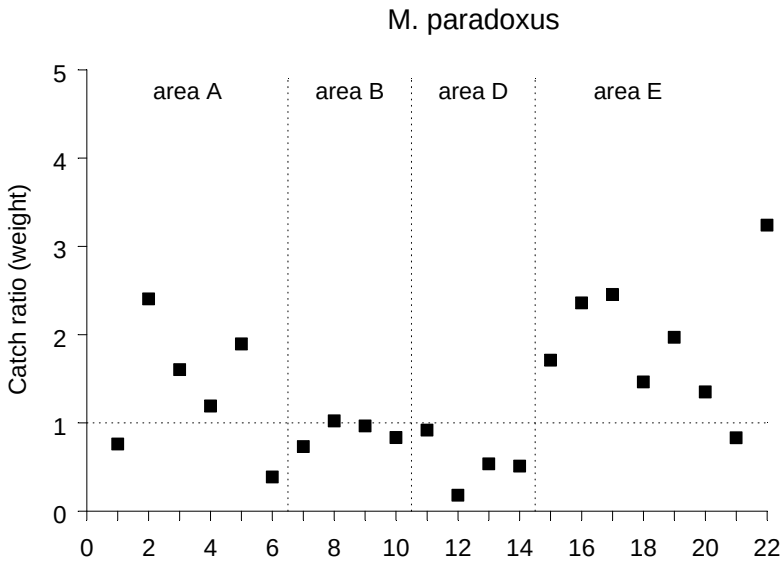
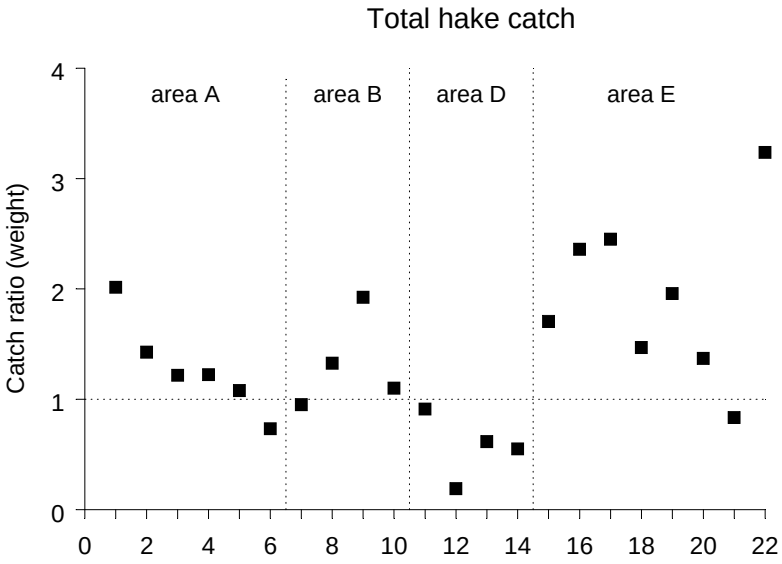


Fig. 7. Continued. Data for M. Paradoxus.



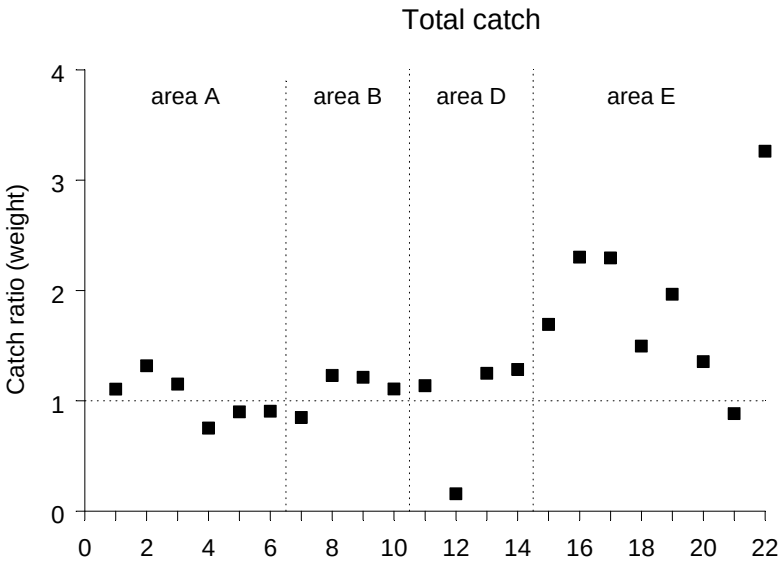


Fig. 7. Continued. Data for total hake catch (upper graph) and the total catch (lower graph)

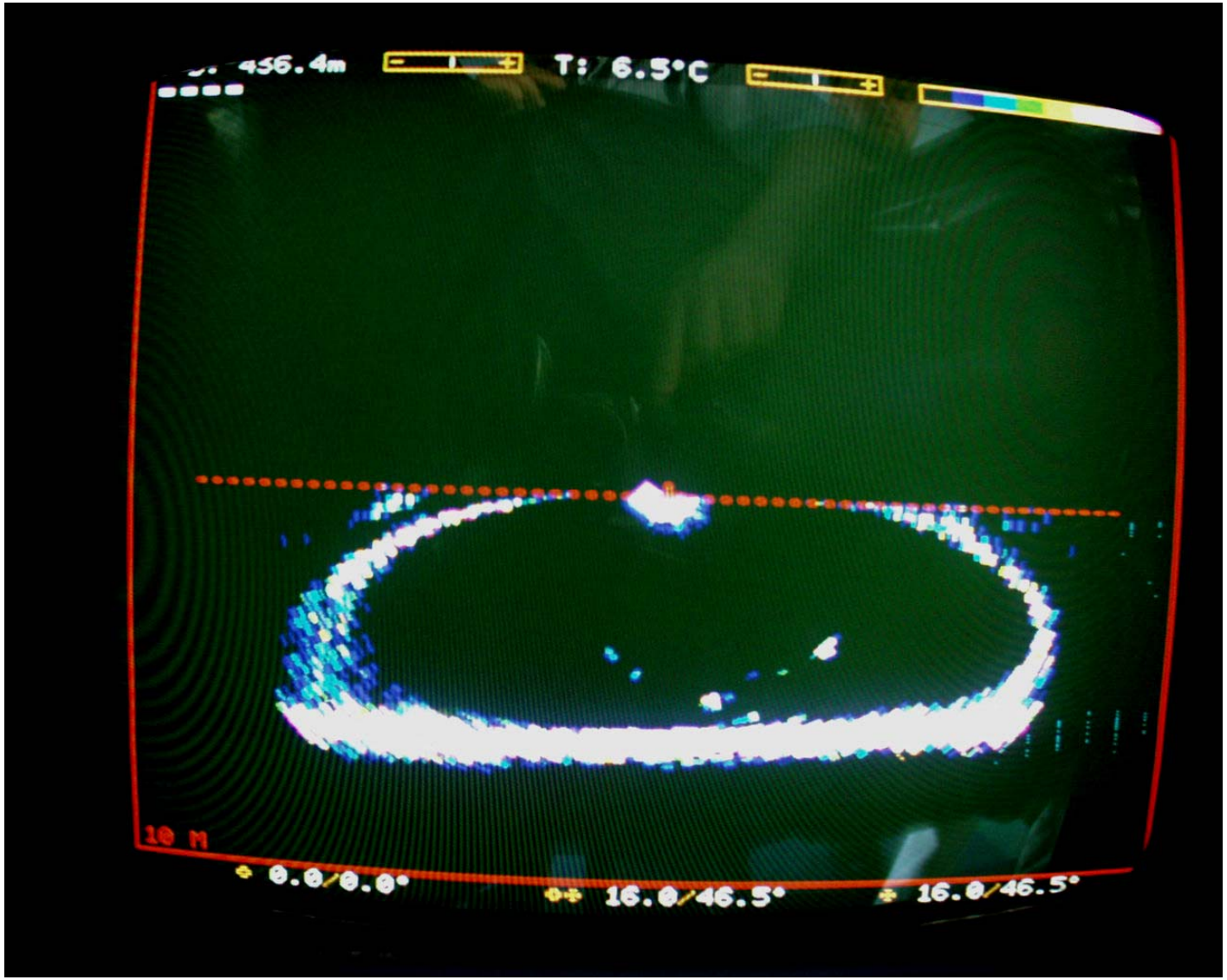


Figure 8. An example of a scan made with the scanning sonar

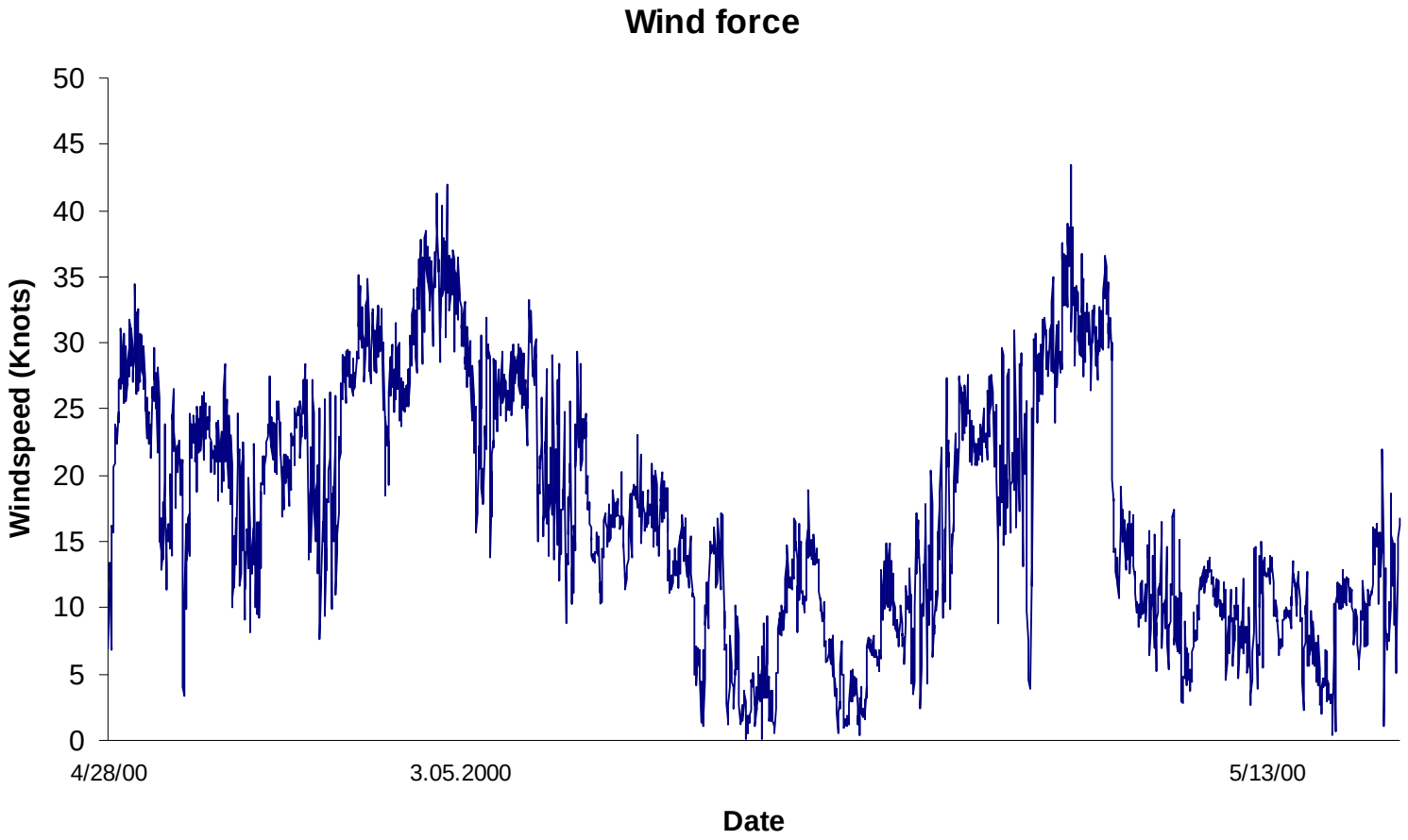


Figure 9 Wind force recorded from 28 April to 15 May.

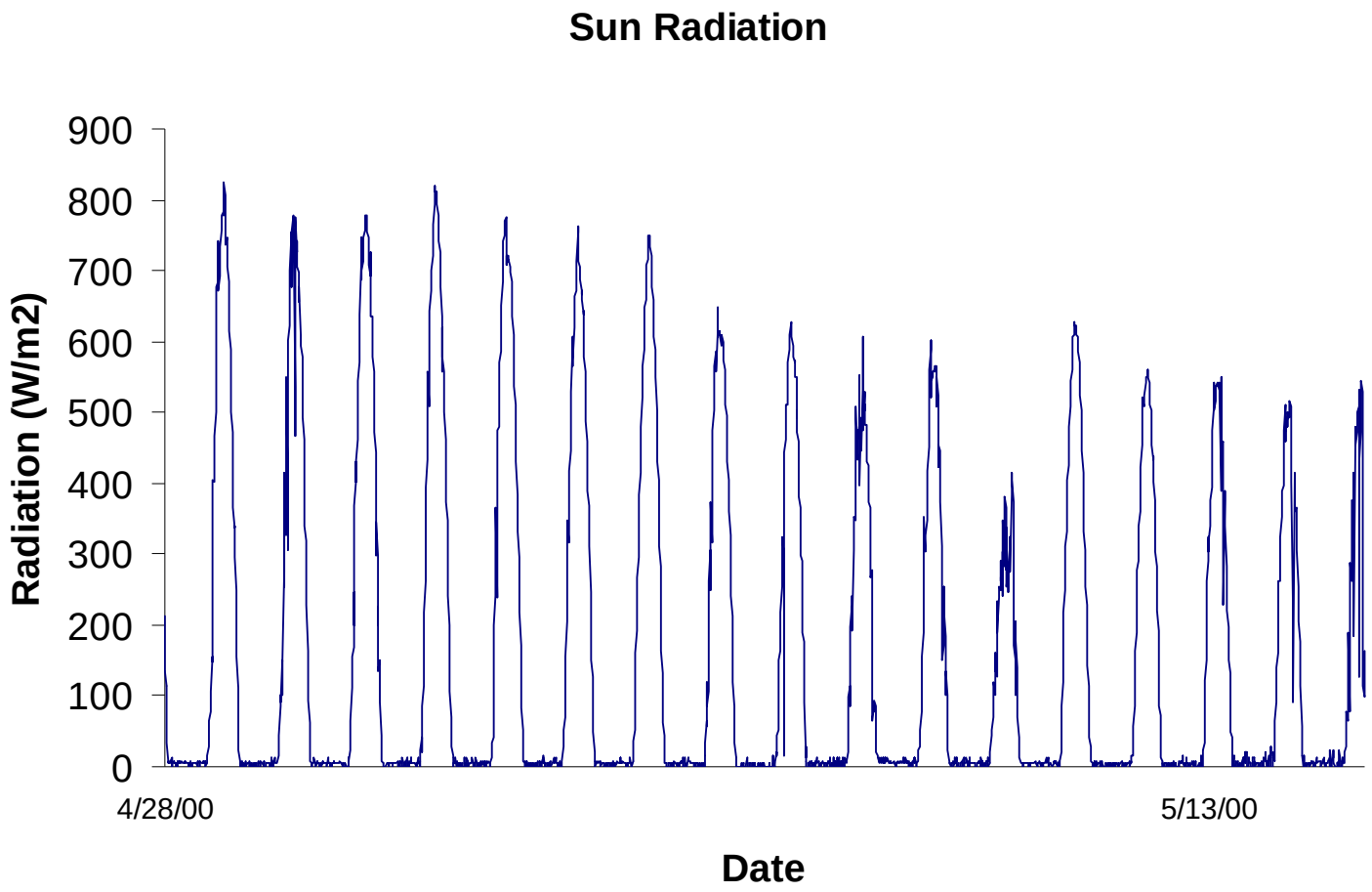


Figure 10 Sun radiation recorded from 28 April to 15 May.

Appendix 1: Catch composition in the four working areas (A0 40m and B 0 100m bridles)
Area A: Catch per species per station

Station	BE 573	BE 574	BE 576	BE 577	BE 578	BE 579	BE 580	BE 581	BE 582	BE 583	BE 584	BE 585
Trawl number	A-01	B-01	B-02	A-02	B-03	A-03	A-04	B-04	A-05	B-05	A-06	B-06
Date	29/04/00	29/04/00	30/04/00	30/04/00	30/04/00	30/04/00	01/05/00	01/05/00	01/05/00	01/05/00	01/05/00	01/05/00
Time (GMT)	07:55	10:18	06:37	08:49	10:21	11:53	06:13	08:16	09:59	11:45	13:27	15:09
Depth (m)	359	354	353	351	340	336	345	344	345	345	342	344
Duration (min)	29	28	31	30	31	29	31	31	31	30	30	30
Number of species	15	23	22	23	21	19	18	21	22	19	18	19
Hexanchus griseus	0	0	0	0	0	0	0	0	1.2	0	0	0
Galeus polli	30	11.6	19.61	16.67	11.9	13	8.11	2.56	8.63	5.76	5.07	4.6
Maurolicus muelleri	0	0	0.04	0	0	0	0.23	0.14	0.21	0.08	0.29	0.1
Notacanthus sexspinis	2	2.3	19.9	14.92	0.44	0	31.19	19.99	18.5	21.11	0	3.84
Myctophidae	0	0.02	0.48	1.74	0.58	0	0.16	0.38	0.94	0.7	1.24	0.96
Lampanyctus sp.	0	0	0	0	0	0	0	0.05	0	0	0	0
Symbolophorus boops	0	0.05	0	0.05	0.36	0.27	0	0.09	0	0.23	0.19	0
Chloropthalmus punctatus	0	0.1	0.08	0.05	1.02	0.82	0	0.19	0.16	0.02	0.1	0.96
Caelorinchus simorhynchus	92.7	18.3	57.1	40.63	44.4	97.31	69.71	30.03	34.19	38.79	46.43	61.2
Nezumia micronychodon	46.8	6.4	11.2	14.71	10.16	35.04	22.92	14.4	20.68	7.32	7.28	13.91
Merluccius capensis	181.3	425.7	385.3	285.2	295	250.6	124.6	153.6	121.7	101.3	88.2	82.5
Merluccius paradoxus	60.2	44.2	86	34.6	128.3	74.9	36	42.86	32.8	60.1	52.1	20.2
Hoplostethus mediterraneus	0	0.3	0.32	1.74	0	0.41	0.78	0	0.05	0.16	0.1	0.29
Epigonus telescopus	4.4	2.3	2.2	3.27	2.61	1.23	0.31	0.76	0.73	2.1	1.29	0.67
Trachurus capensis	2.1	0.7	3.68	0.3	4.92	0.86	0	0	0	0	0	0
Schedophilus huttoni	3.4	2.3	2.44	11.3	22.1	1.24	0	0	6.82	0	0	0
Selachophidium quentheri	2.4	0.9	6.22	7.95	2.18	1.64	7.88	2.18	0.35	1.25	2.01	3.74
Genypterus capensis	4.1	4.7	2.14	2	4.9	2.68	3.6	1.3	3.82	1.92	0	1.98
Helicolenus dactylopterus	35.6	11.2	21.4	18.19	14.8	22.04	21.68	10.71	20.78	21.34	14.46	15.83
Ebinania costaecanarie	4.2	0.4	0.48	1.53	0.58	0.96	0.94	0.47	1.25	0	0.1	0.86
Lophius vomerinus	40.4	14.1	32.3	35.3	28.1	14.7	26.8	10.2	28.9	16.1	15.1	10.06
Todarodes angolensis	0	5.1	32.68	7.93	12.76	0	0	0	0	0	0	0
Unidentified cephalopod	0	0	0	0.33	0	0	0	0	0	0	0	0
Bathynectes piperitus	0	0.9	3.5	1.96	0.58	0.41	3.12	0.28	1.45	0.31	0.86	0.57
Squilla sp	0	0.9	6.5	8.5	11.75	4.79	1.33	3.41	6.44	2.73	8.52	8.63
Chrysaora sp	0	31.5	0	0	0	0	0	61.29	11.85	0	0	0
Unsorted "trash" species	22.5	16.1	40.6	30.5	82.26	29.02	42.88	9.28	21.2	17.37	31.02	17.36
TOTAL	532.1	600.07	734.17	539.37	679.7	551.92	402.24	364.17	342.65	298.69	274.36	248.26

Appendix 1 continued

Area B: Catch per species per station

Station	BE 587	BE 588	BE 590	BE 591	BE 592	BE 593	BE 594	BE 595
Trawl number	A-07	B-07	B-08	A-08	B-09	A-09	B-10	A-10
Date	03/05/00	03/05/00	04/05/00	04/05/00	04/05/00	04/05/00	04/05/00	04/05/00
Time (GMT)	10:53	12:50	06:08	07:46	09:28	11:08	13:09	14:58
Depth (m)	312	311	307	310	310	310	310	310
Duration (min)	30	29	30	30	31	30	30	30
Number of species	21	17	16	24	20	21	21	24
Squalus acanthias	0	0.68	0	0	0	2.4	1.7	0
Squalus megalops	1.74	0.48	4.8	2.06	1.96	0	0.44	1.96
Hexanchus griseus	0	0	0	0	1.46	0	0	7.58
Scyliorhinus capensis	4.42	3.46	0	0	3.04	0	0.32	0
Galeus polli	0.25	0	0	0.16	0.22	0.6	0	0.18
Holohalaelurus regani	0.82	0	2.18	0.86	0	0	0.84	0.68
Galeorhinus galeus	0	0	0	5.86	0	2.7	2.92	2.22
Raja straeleni	10.7	11.12	26.82	7.64	9.91	10.7	10.5	29.5
Raja pullopunctata	5	0	0	0	0	5.1	0	0
Zu elongatus	3.74	0	0	0	0	0	1.5	0
Myctophidae	103.26	44.77	0	30.9	347.4	267.2	49.8	31.1
Caelorinchus simorhynchus	12.56	3.5	11.18	15.6	13.34	18.9	10.5	24.5
Malacocephalus laevis	0	0	0.12	0	0.44	0	0.18	0.14
Merluccius capensis	258	283.3	318.64	214.4	455.72	133.5	181.6	145.7
Merluccius paradoxus	217.2	153.4	116.92	114.2	191.75	192.32	66.8	80.1
Epigonus telescopus	0	0	0.02	0.5	0	2.2	0	0
Trachurus capensis	0	0.18	0	0	0.4	2.7	0	0.6
Centrolophus niger	0	0	3.3	0	0	0	0	0
Schedophilus huttoni	0	0	0	0	0	0	0	1.5
Brama brama	16.1	9.52	2.52	8.2	31.7	76.5	100.7	2.56
Thyrsites atun	5.8	3.9	3.96	1.96	2.2	10.6	0	0
Genypterus capensis	0	0	0	0.92	0	1	0.16	1.12
Helicolenus dactylopterus	5.6	4.94	3.26	4.38	7.27	6	3.81	2.6
Lophius vomerinus	0.68	0	0	4.9	2.8	25.4	8.1	3
Todarodes angolensis	7.41	14	11.34	11.9	6.16	8.1	8.8	2.78
Lycoteuthis diadema	0	0	0	0.32	0	0	0.09	0.005
Sepia hieronis	0.04	0	0	0.1	0	0	0	0.08
Bathynectes piperitus	0.4	0.04	0.1	1	0.61	0.6	0.26	0.12
Squilla sp.	0.62	0.24	0.08	0.9	1.1	3.5	0.41	0.84
Suberites sp.	46.85	12	0	54.2	19.2	47.7	0	34.6
Aequorea aequorea	0	0	0	0.72	0	0	0	0
Chrysaora sp	0	0	0	2.8	0	0	0	0
Unidentified shrimp	7.65	9.73	48.7	23.6	11.89	66.8	1.77	33.8
TOTAL	708.84	555.26	553.94	508.08	1108.57	884.52	451.2	407.265

Appendix 1 continued

Area D: Catch per species per station

Station	BE 600	BE 601	BE 603	BE 604	BE 605	BE 606	BE 607	BE 608
Trawl number	A-11	B-11	A-12	B-12	B-13	A-13	B-14	A-14
Date	09/05/00	09/05/00	09/05/00	09/05/00	10/05/00	10/05/00	10/05/00	10/05/00
Time (GMT)	06:18	08:10	13:02	15:30	06:26	08:20	10:13	12:07
Depth (m)	291	289	289	289	285	289	290	289
Duration (min)	32	30	30	29	30	31	30	30
Number of species	18	19	15	10	19	20	17	19
Maurolicus muelleri	4.1	8.87	0.31	0	3.24	6.84	1.08	0.65
Lampanyctodes hectoris	3.61	17.61	5	0	2.04	4.18	1.26	7.96
Caelorinchus simorhynchus	93.48	76	32.83	7.8	45.7	55.48	19.26	50.32
Malacocephalus laevis	0	3.8	0	0	1.3	4.56	1.08	2.41
Merluccius capensis	58.6	43.5	75.72	32.7	87.8	46.8	30.3	33.8
Merluccius paradoxus	994.73	856.3	2272.5	398.9	400.48	773.4	152.55	298.45
Physiculus capensis	0	0	0	0	0	0	0	0.19
Zeus capensis	5.9	4.05	4.69	0	9.25	17.86	13.5	13.88
Cynoglossus zanzibarensis	0.49	0	0	0	0	0	0	0
Paracallionymus costatus	1.48	0.13	0	0	0.93	1.14	0.27	0.93
Trachurus capensis	18.86	15.96	105.7	0	5.18	7.98	5.4	12.03
Centrolophus niger	0	0	0	5.44	0	0	0	0
Brama brama	23.1	395.7	551.4	8.8	260.8	228	794.5	450.1
Thyrsites atun	247.4	143.8	340.5	46.6	868.5	33.4	117.7	4
Lepidopus caudatus	0.328	46.3	88.4	1.8	69	51.5	58.2	31.3
Genypterus capensis	5.8	0	1.7	0	2.9	2.2	0.8	0.5
Helicolenus dactylopterus	136.94	92.47	28.46	24.4	142.45	115.9	34.2	45.33
Lophius vomerinus	2.6	3.8	1.5	0	9.9	7.3	3.5	6.7
Todaropsis eblanae	11.48	15.2	1.88	0	0	5.7	5.94	6.48
Todarodes angolensis	0	14.95	0	0	2.78	0	0	0
Rossia enigmatica	0	0	0	0	0	0.1	0	0
Octopus magnificus	0	6	0	0	2.3	0	0	0
Parapagurus dimorphus	26.48	5.57	0	0	0.93	41.8	0	5.92
Rochinia sp.	0	0	0	0	0	0.02	0	0
Aequorea aequorea	55.27	217.36	141.03	1000	53	309.7	108	230.79
Unsorted "trash" species	0	0	0	10	0	0	0	0
TOTAL	1690.648	1967.37	3651.62	1536.44	1968.48	1713.86	1347.54	1201.74

Appendix 1 continued

Area E: Catch per species per station

Station	BE0610	BE0611	BE0612	BE0613	BE0616	BE0618	BE0619	BE0620
Trawl number	A-15	B-15	A-16	B-16	B-17	A-17	B-18	A-18
Date	12/05/00	12/05/00	12/05/00	12/05/00	13/05/00	13/05/00	13/05/00	13/05/00
Time (GMT)	06:12	08:07	09:56	11:49	06:16	10:02	11:53	13:59
Depth (m)	443	437	440	446	445	445	444	447
Duration (min)	30	33	29	30	30	30	30	30
Number of species	21	22	28	18	18	25	19	27
Myxine capensis	0	0	0	0	1.54	0.61	0	0.86
Squalus mitsukurii	0	0	0	0	0	0	0	6.48
Scyliorhinus capensis	0	0	0	0	0	0	0	6.8
Photichthys argenteus	0.62	8.7	6.09	4.88	0	0	0	0
Maurolicus muelleri	0	0	0	0	0	0	0	0
Notacanthus sexspinis	0.47	0	0	0	0	0	0	0
Lampanyctodes hectoris	0.04	0.15	0.65	0.33	0	3.67	2.27	1.4
Symbolophorus boops	0.16	0.44	0.33	0	0	0	0	0.05
Symbolophorus barnardi	0	0.15	0	0	0	0	0	0
Chloropthalmus punctatus	0	0	0	0	0	0	0	0
Caelorinchus braueri	0.54	0.44	0.57	0.65	0	0.2	0	0.11
Caelorinchus simorhynchus	31.85	39.3	58.91	34.13	112.2	96.9	152.28	70.7
Malacocephalus laevis	0.47	0	1.54	0.33	0	0	0.65	0
Lucigadus ori	0	0.29	0.41	0	0.11	0.2	0.08	0.05
Tripterophysis gilchristi	0.85	0	0.08	0.33	0.66	1.02	0	0.32
Merluccius capensis	3.66	0	0	0	0	2.78	7.8	0
Merluccius paradoxus	1143.8	2151.3	869.5	2121.5	3809	1552.4	2607	1780.4
Physiculus capensis	0.75	0.29	1.06	0.33	0.22	1.33	0	0.32
Zeus capensis	2.25	0	0	0	14.96	7.55	24.79	9.94
Beryx splendens	0	0.22	0.2	0	0	0	0	0
Hoplostethus mediterraneus	0	0.58	0.33	0	0	0	0	0.43
Paracallionymus costatus	0.08	0	0.24	0	0	0.05	0	0
Champsodon capensis	0		0.01	0	0	0	0	0
Epigonus sp.	0		0.04	0.16	0	0	0	0
Emmelichthys nitidus	0	0	0	0	0	0	0	0.48
Centrolophus niger	0	0	0	0	5.5	0	0	0
Scomber japonicus	0	0	0	0	0	0	0	0.9
Brama brama	0	5.8	7.4	7.7	0	1.9	0	1.7
Lepidopus caudatus	0	0	0	0	0	0	0	0
Genypterus capensis	4.9	7.12	3.9	4.7	18.1	10.8	7.9	5.6
Helicolenus dactylopterus	3.5	6.48	3.5	1.06	10.78	12.34	8.1	3.78
Psychrolutes macrocephalus	0	0	0	0	0.66	0.05	0	0
Bassanago albescens	0	1.98	9.2	5.7	17	33.5	32.5	2.6
Lophius vomerinus	2.3	0.68	1.4	0	7.5	14.2	10.2	13.9
Todaropsis eblanae	0.93	1.31	3.66	3.58	10.78	5.61	21.55	15.23
Lycoteuthis diadema	0	0.73	0.41	0.16	0	0	0.65	0
Rossia enigmatica	0	0	0	0	0	0.2	0.16	0.32
Octopus magnificus	1.6	4.76	5.8	0	1	0	2.6	0
Parapagurus dimorphus	0	0	0	0	0	0.1	0	0
Parapagurus pilosimanus	0	0	0.04	0	0	1.12	0.81	1.3
*Stereomastis*sp.	0.08	0.07	0.08	0.08	0	0.05	0	0.11
Rochinia sp.	0	0	0	0	0.11	0.1	0.32	0.11
Jasus lalandi	0	0	0	0	0	0	0	0
Funchalia woodwardi	0.31	0.29	0.41	0.16	0.22	0.41	0.32	0.32
TOTALS	1199.16	2231.08	975.76	2185.78	4010.34	1747.09	2879.98	1924.21

Appendix 1 continued

Area E: Catch per species per station

Station	BE0622	BE0623	BE0624	BE0625	BE0627	BE0628	BE0629	BE0630
Trawl number	A-19	B-19	A-20	B-20	B-21	A-21	B-22	A-22
Date	14/05/00	14/05/00	14/05/00	14/05/00	15/05/00	15/05/00	15/05/00	15/05/00
Time (GMT)	06:17	08:05	09:56	11:54	06:25	08:13	10:00	
Depth (m)	451	448	440	442	449	444	438	0
Duration (min)	30	29	30	30	31	30	30	0
Number of species	28	24	22	26	27	22	25	24
Myxine capensis	0	0	0	0	0	0	5.18	0
Squalus mitsukurii	6	0	5.51	0	0	0	5.1	6.72
Scyliorhinus capensis	0	0	0	10.04	0	0	19.68	0
Photichthys argenteus	0	0	0	0	0	0	0	0
Maurolicus muelleri	5.02	0.02	0	1.62	4.99	2.55	10.88	1.48
Notacanthus sexspinis	0	0	0	0	0	0	0	0
Lampanyctodes hectoris	3.08	3.8	20.52	2.92	1.09	2.35	33.15	7.22
Symbolophorus boops	0.65	0.58	0	0	0.16	0	0	0
Symbolophorus barnardi	0	0	0	0	0	0	0	0
Chloropthalmus punctatus	0	0	0	0	0	0	0	0.08
Caelorinchus braueri	0.16	0.15	0.11	0.16	0.08	0.2	0	0.16
Caelorinchus simorhynchus	110.16	179.29	138.62	162.32	220.43	86.83	166.28	63.3
Malacocephalus laevis	0.32	0	1.14	0	0	0	0	0.33
Lucigadus ori	0.08	0.29	0.11	0.65	0.16	0.59	0	0.08
Tripterophysis gilchristi	0.32	0.58	0.91	0.32	0.08	0	0	0.16
Merluccius capensis	21.6	14.5	27.7	117.6	13.5	7.9	44.1	16.5
Merluccius paradoxus	2492.7	4746.5	2744.8	5250.7	2791.2	3244.3	8334	2571.3
Physiculus capensis	0.16	0.58	0	0.16	0.47	0.2	2.07	0
Zeus capensis	6.64	55.77	48.11	14.9	0.42	16.66	74.59	29.85
Beryx splendens	0	0	0	0	0	0	5.7	0
Hoplostethus mediterraneus	0	0	0	1.94	0	0	0	0
Paracallionymus costatus	0.08	0.01	0	0.16	0.08	0	0.26	0
Champsodon capensis	0	0	0	0	0	0	0	0
Epigonus sp.	0	0	0	0	0	0	0	0
Emmelichthys nitidus	0	0	4.1	0	0	0	0	0
Centrolophus niger	6.2	7.48	0	0	0	0	2.1	0
Scomber japonicus	0	0	0	0	0	0	0	0
Brama brama	1.5	21.6	2.7	6.7	0	10.9	31.9	3.9
Lepidopus caudatus	0	0	0	0	0	1.18	0	0
Genypterus capensis	3.7	26.5	7.3	46.8	13	15.86	25.3	17.7
Helicolenus dactylopterus	4.54	0.26	1.14	7.13	16.22	5.49	80.29	0.66
Psychrolutes macrocephalus	0.32	0.58	0	0	0.78	0	0.26	0
Bassanago albescens	30.78	51.1	39.22	11.66	37.28	17.25	0	3.28
Lophius vomerinus	4.7	15.3	3.6	16	6	8.6	17	10
Todaropsis eblanae	15.88	36.5	10.26	34.99	19.03	13.52	119.66	22.3
Lycoteuthis diadema	0	0	0	0	1.56	0.1	0	0
Rossia enigmatica	0.16	0	0	0.32	0.39	0	0	0
Octopus magnificus	0	1.4	0.18	7.5	6	7.1	2.5	0
Parapagurus dimorphus	0	0	0	0	0	0	0	0
Parapagurus pilosimanus	4.54	0.02	1.14	0.32	0.47	0.2	7.77	0.16
*Stereomastis*sp.	0.16	0	0	0.16	0.31	0	0.26	0
Rochinia sp.	0.16	1.17	0.11	0.08	0.08	0.2	0	0.16
Jasus lalandi	0	0	0	1.94	0	0	0	0
Funchalia woodwardi	0.49	0	0.91	0	0.47	0.39	4.15	0.98
TOTALS	2720.099	5163.979	3058.19	5697.09	3134.33	3442.37	8992.181	2756.38