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Report on Groundifsh Survey of the Walter Barth in Subarea 2 during autumn 1979

by

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Introduction

Carrying on the 1978 work of the RV "Ernst Haeckel" a stratified random survey covering Subarea 2 was made in 1979.

The "Walter Barth" started working on 19 November at the latitude of Cape Chidley and finished on 13 December in the South of Div. 2 J.

Methods

The methodology of this survey was kept as close as possible to that of the 1978 survey. Therefore only the differing items are given herewith.

Stratification and selection of stations

In general, the for the 1978 survey selected stations were fished again. Only the non fishable ones (listed in Res. Doc. 79/VI/127, Appendix 1) were replaced, using the procedure described in the cited paper.

Fishing operations

Aboard "W. Barth" a Doppler Log to control the trawling speed was not installed. Because of the more powerfull engine compared with that of RV "Ernst Haeckel", it is estimated to be close to the upper limit (4 kn). Except of a few tows fishing was restricted to the daytime (single shift working mode).

Hydrography

Due to technical defects some of the temperatur measurements (mainly in 2 G) are not relevant to the depth fished and therefore not used in the calculations.

Results

Sampling Effort and Success

Tables 0 and 1 provide informations on the station coverage in connection with the quantity of biological and hydrographical material collected. The number of samples for age and length as well as the total number of fish measured and aged are given in table 2. All samples were taken as handom samples. The distribution of samples by species and division is presented in tables 3 and 4.

Tables 5-7 give the fishing success and relative catch composition by area and species with respect to main species. The fishing success was estimated as total catch in weight and the arithmetic mean catch per 30-minute tow.

Compared with 1978 the average catch per tow for redfish and Greenland halibut in Subarea 2 shows a considerable decline in 1979. For cod and roundnose grenadier an increase from 1978 to 1979 was observed. On the other hand it seems questionable that changes can be used as indications for abundance alterations, because time of the survey has changed and therefore the environmental conditions were different for both surveys.

Detailed informations on distribution of catches of the three main species by environmental factors (depth, bottom temperature, and diurnal phase) are given in tables 8-11, and plotted in Figure 1-3. In addition an attempt was made do describe the effects of these environmental factors on the catch per tow using regression techniques. The following second-order model with three independent variables was choosen :

$$\text{Catch/30' tow} = C_D \cdot D + C_{D^2} \cdot D^2 + C_T \cdot T + C_{T^2} T^2 + C_{\varphi(t)} \cdot \varphi(t) + C_{const}$$

where

D = depth

T = bottom temperature

$\varphi(t) = 1 - \cos(t \cdot 15^\circ)$

The parameters of the model were estimated by the method of least squares and are given in Table 12. The relationship between the actually observed catch per tow and the predicted values using the regression equation is plotted for redfish, Greenland halibut and roundnose grenadier for 1978 as well as 1979 in Figures 4-9.

Mean Trawlable Biomass

The mean trawlable biomass (MTB) of redfish and Greenland halibut for the fished strata was calculated for each devision from the stratified mean catch per tow using the areal method. The applied formula is

$$B = \bar{Y}_{st} \frac{A}{\bar{a}}$$

where B = MTB (per division)

$\bar{Y}_{st}$ = stratified mean catch per tow

A = sum of strata areas

$\bar{a}$ = area swept per tow

The sum of fished stratum areas increased slightly for each division in 1979 compared with 1978. Area swept per tow ($\bar{a}$) is calculated on the basis of the horizontal distance between wings, the towing time and a constant towing speed of 4 knots.

Additionally, the standard deviation of the estimated MTB and the coefficient of variation were calculated. The formula applied here is

$$s(B) = \frac{A}{\bar{a}} s(\bar{Y}_{st})$$

$$= \frac{1}{a} \sqrt{\sum_h \frac{A_h^2 \cdot s_h^2}{n_h}}$$

where $s(B)$ = standard deviation of B

$s(y_{st})$ = standard deviation of $\bar{y}_{st}$

A_h = area of the h-th stratum

n_h = number of tows in the h-th stratum

s_h^2 = sample variance of the h-th stratum

The coefficient of variation is $CV = \frac{s(B)}{B}$

calculated MTB values are given in Table 13, based on the information listed in Table 14.

References

U. Berth, N. Schultz and B. Vaske — Report on groundfish survey carried out by the RV Ernst Haeckel in Statistical Area 0, Subarea 2 and Div. 3K during autumn 1978. ICNAF Res. Doc. 79/VI/127, Serial No. 5523

Table 0: planned station coverage

NAFO division	number of strata	area of strata [1]	number of tows	stratum area per tow [1]
2 G	8	4.914	22	223
2 H	5	4.381	15	292
2 J	18	6.666	42	159
Total	31	15.961	79	202

1) square nautical miles

Table 1:

NAFO division	fishing stations worked	fished	evaluable	hydrography stations	TIS
2 G	22	22	20	17	34
2 H	15	15	15	15	30
2 J	42	42	41 [1]	41	82
Total	79	79	77 [1]	73	146

1) tow 3 in stratum 229 evaluable for redfish only; share of other species nogle

Table 2: Distribution of samples by area

NAFO division	No. of species	Length measurements samples	specimens	Analyzed samples	specimens
2 G	41	288	8302	16	1448
2 H	42	242	4703	9	827
2 J	53	608	16478	36	3023
Total	57	1138	29483	61	5298

Table 3: Distribution of samples by species

Species	Length measurements samples	Length measurements specimens	Analyzed samples	Analyzed specimens
Reinh. hippogl.	75	5289	27	2074
Sebast. mentella	73	11352	17	1700
Macrour. rupestr.	23	2987	9	886
Macrour. berglax	74	1834	2	141
Gadus morhua	43	996	6	497

Table 4: Distribution of samples by species

No.	Species	Length measurements samples	Length measurements specimens	pres. in area 2G	2H	2J
1	Centr. fabr.	21	174	.	.	.
2	Raja radiata	39	237	.	.	.
3	Raja senta	17	30		.	.
4	Raja fyllae	11	12	.	.	.
5	Raja spinic.	19	23	.	.	.
6	Alepoc. baird.	5	27		.	.
7	Argent. silus	2	3		.	.
8	Mallot. villos.	10	21			.
9	Chaul. sloani	5	6			.
10	Stomias boa	3	4		.	.
11	Malac. niger	2	2		.	.
12	Bathyl. eury.	4	13		.	.
13	Myct. gen. sp.	30	100	.	.	.
14	Paral. brevis	13	17	.		.
15	Paral krøyeri	6	7	.	.	.
16	Nemich. scolop.	1	1	.		
17	Serriv. beani	3	3	.	.	.
18	Macdon. rostr.	1	1			.
19	Notacanth. nasus	20	59	.	.	.
20	Simen. paras.	1	2			.
21	Antim. rostr.	18	415	.	.	.
22	Boreog. saida	22	626	.	.	.
23	Gadus ogac	2	3	.		.
24	Gaid.(On.)ensis	31	136	.	.	.
25	Microm. pout.	1	1			.
26	Nezum. bairdi	42	365	.	.	.
27	Trachy. murr.	5	10			.
28	Anarrh. latifr.	67	431	.	.	.
29	Anarrh. lupus	33	242	.	.	.
30	Anarrh. minor	27	58	.	.	.
31	Lycod. vahlii	66	1178	.	.	.
32	Lycod. esma.	24	46	.	.	.
33	Lycod. retic.	10	24	.	.	.
34	Lycen. sarsi	10	12	.	.	.
35	Cottunc. micr.	47	183	.	.	.
36	Arted uncinat.	26	218	.	.	.
37	Cottunc. thomp.	5	7	.		.
38	Trigl. nybell.	7	16	.	.	.
39	Trigl.murr.	15	70	.	.	.
40	Agonus decag.	5	21	.	.	
41	Aspido. monop.	15	34	.	.	.
42	Aspido. otriki	1	1			.
43	Cylopt. lump.	19	23	.	.	.
44	Eumic. spin.	1	4			.
45	Liparis koef.	2	7	.		
46	Liparis tunic.	10	102	.	.	.
47	Liparis gelatin.	5	6	.	.	
48	Synap. kaupi	25	242	.	.	.
49	Eumes. praec.	1	2			.
50	Glypto. cynog.	24	195			.
51	Hippog. platess.	58	1580	.	.	.
52	Hippog. hippog.	13	25	.	.	.

Table 5: Distribution of total catches (kg) by area and species

NAFO Division	Reinhardtius hippoglossoides	Sebastes mentella	Macrourus rupestris	Macrourus berglax	Gadus morrhua	No.o tows
2 G	2653	968	2209	286	259	20
2 H	3311	770	359	315	480	15
2 J	3379	12760	2583	590	1370	42
Total	9343	14498	5151	1191	2109	77
Total 1978:	10733	19273	1760	699	998	59

Table 6: Distribution of mean catches (kg) per 30' tow by area and species

NAFO Division	Reinhardtius hippoglossoides	Sebastes mentella	Macrourus rupestris	Macrourus berglax	Gadus morrhua	No. of tows
2 G	133	48	110	14	13	20
2 H	221	51	24	21	32	15
2 J	80	304	62	14	33	42
Total	121	188	67	15	27	77
Total 1978:	183	327	26	12	17	59

Table 7: Percentage distribution of catches by area and species

NAFO Division	Reinhardtius hippoglossoides	Sebastes mentella	Macrourus rupestri	Macrourus berglax	Gadus morrhua	total catch
2 G	33	12	28	4	3	7955
2 H	52	12	6	5	8	6316
2 J	14	54	11	2	6	23814
Total	25	38	14	3	6	38085
Total 1978:	30	53	5	2	3	

Table 8: Mean values, grouped by depth

group m / depth (mean)	325	375	425	475	525	573	625	675	725	775	825	875	925	975
depth (m)	329	373	430	470	514	574	606	681	715	788	822	855	914	955
temp. (°C)	3,16	3,36	3.53	3.56	3.36	3.47	3.68	3.52	3.79	3.71	3.52	3.66	3.62	3.88
(t)	1.75	1.55	1.68	1.57	1.88	1.81	1.74	1.49	1.59	1.76	1.77	1.89	1.73	1.67
S.ment(kg)	111	360	440	41	91	58	233	25	68	3	24	31	8	9
R. hipp.(kg)	24	60	70	71	382	131	215	198	144	181	95	236	231	32
M. rup.(kg)	0	12	0	0	36	39	46	65	394	10	524	17	486	169
n	10	9	10	4	7	4	5	2	1	1	3	1	2	1

Table 9: Mean values, grouped by temperature

group °C / mean	2.38	2.63	2.88	3.13	3.38	3.63	3.88
depth (m)	372	323	442	445	465	637	516
temp. (°C)	2.34	2.69	2.87	3.13	3.35	3.65	3.82
(t)	1.97	1.90	1.75	1.58	1.72	1.72	1.67
S. ment (kg)	47	1	2	69	88	67	539
R. hipp (kg)	28	72	89	70	112	146	183
M. rup. (kg)	0	0	0	18	8	187	64
n	2	1	3	6	18	15	15

Table 10: Mean values, grouped by σ_t (t)

group / mean	0.13	0.38	0.63	0.88	1.13	1.38	1.63	1.88
depth (m)			388		489	421	546	516
temp. (°C)			3.88		3.43	3.49	3.44	3.44
(t)			0.72		1.17	1.40	1.60	1.90
S.ment.(kg)			14		43	176	141	233
R.hipp.(kg)			43		97	79	103	159
M.rup.(kg)			0		0	0	60	91
n	0	0	1	0	3	6	18	32

Table 11: 2G, H, J mean values of 1978; grouped by depth

mean \ group(m)	325	375	425	475	525	575	625	675	725	775	825
depth (m)	322	370	426	480	524	571	625	667		773	830
temp (^{o}C)	3.47	3.30	3.40	3.65	3.59	3.68	3.82	4.01		3.60	4.00
(t)	1.25	1.19	0.83	1.02	0.85	0.79	0.95	1.78		0.55	2.00
S.ment.(kg)	474	671	481	294	17	52	463	185		2	2
R.hipp (kg)	231	167	124	286	152	62	124	127		79	24
M.rup.(kg)	0	0	42	5	68	55	27	91		35	396
n	9	10	8	8	7	5	4	1	0	1	1

Table 12: Coefficients (C) of Regressions
1978/2G, H, J (calculated from table 11)

C of	unit	S. ment.	EEx	R. hipp.	EEx	M.rup.	EEx
D	$kg/_{m}$	-4.551	0	3.312	0	-4.526	-1
D^2	$kg/_{m^2}$	7.795	-4	-3465	-3	1.025	-3
T	$kg/^{o}_{C}$	-5.604	4	8.407	3	3.658	3
T^2	$kg/^{o}_{C^2}$	8.004	3	-1.164	3	-5.404	2
(t)	kg	-7.890	2	4.092	2	2,247	1
Const	kg	1.009	5	-1.614	4	-6.179	3

1979/2G, H. J (calculated from table 8)

C of	unit	S.ment	EEx	R.hipp	EEx	M.rup.	EEx
D	$kg/_{m}$	-6.270	0	3.833	0	-1.588	0
O^2	$kg/_{m^2}$	4.045	-3	-2.811	-3	2.036	-3
T	$kg/^{o}_{C}$	1.891	4	3.382	3	5.024	3
T^2	$kg/^{o}_{C^2}$	-2.559	3	-5.474	2	-7.498	2
(t)	kg	4.116	2	2.625	2	-4.206	0
Const	kg	-3.318	4	-6.599	3	-8.083	3

$C_D \cdot D + C_{D^2} \cdot D^2 + C_T \cdot T + C_{T^2} \cdot T^2 + C_{\varphi(t)} \cdot \varphi(t) + C_{Const} \cdot 1 = catch/30'tow\ (kg)$

Table 13: Biomass calculations

NAFO division	$\bar{y}st$ (kg)	Biomass (m.tons)	s (B) (m.tons)	C_v
Greenland halibut				
2 G	162.10	40.977	5.677	0.14
2 H	186.27	41.980	15.348	0.37
2 J	73.24	25.116	2.839	0.11
Redfish				
2 G	51.12	12.923	5.653	0.44
2 H	35.92	8.095	2.076	0.26
2 J	295.33	101.274	15.793	0.16

Table 14: Total area of strata by division and mean area fished per tow

NAFO division	Total area of strata A (n m^2)	Mean area fished per tow $\bar{a}$ (n m^2)
2 G	4.914	0.019439
2 H	4.381	0.010439
2 J	6.666	0.019439

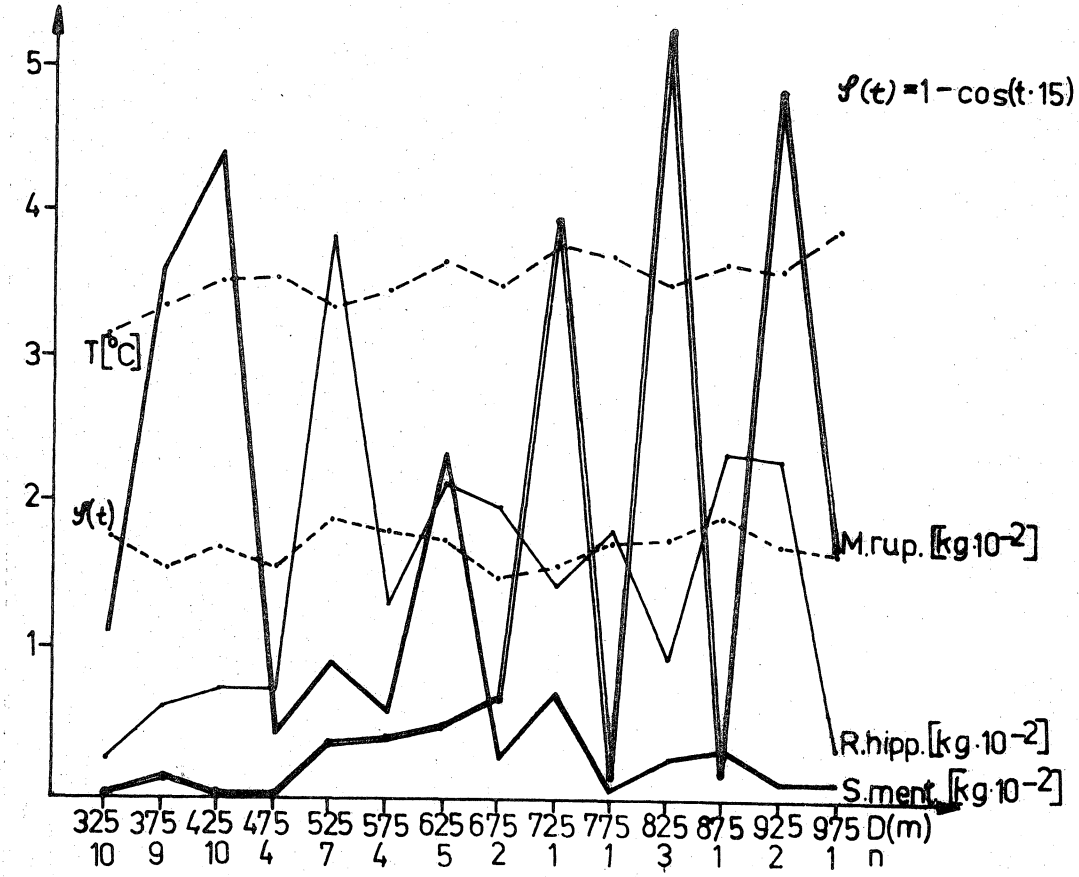

Fig.1 Distribution of catch per tow by environmental factors (values grouped by depth)

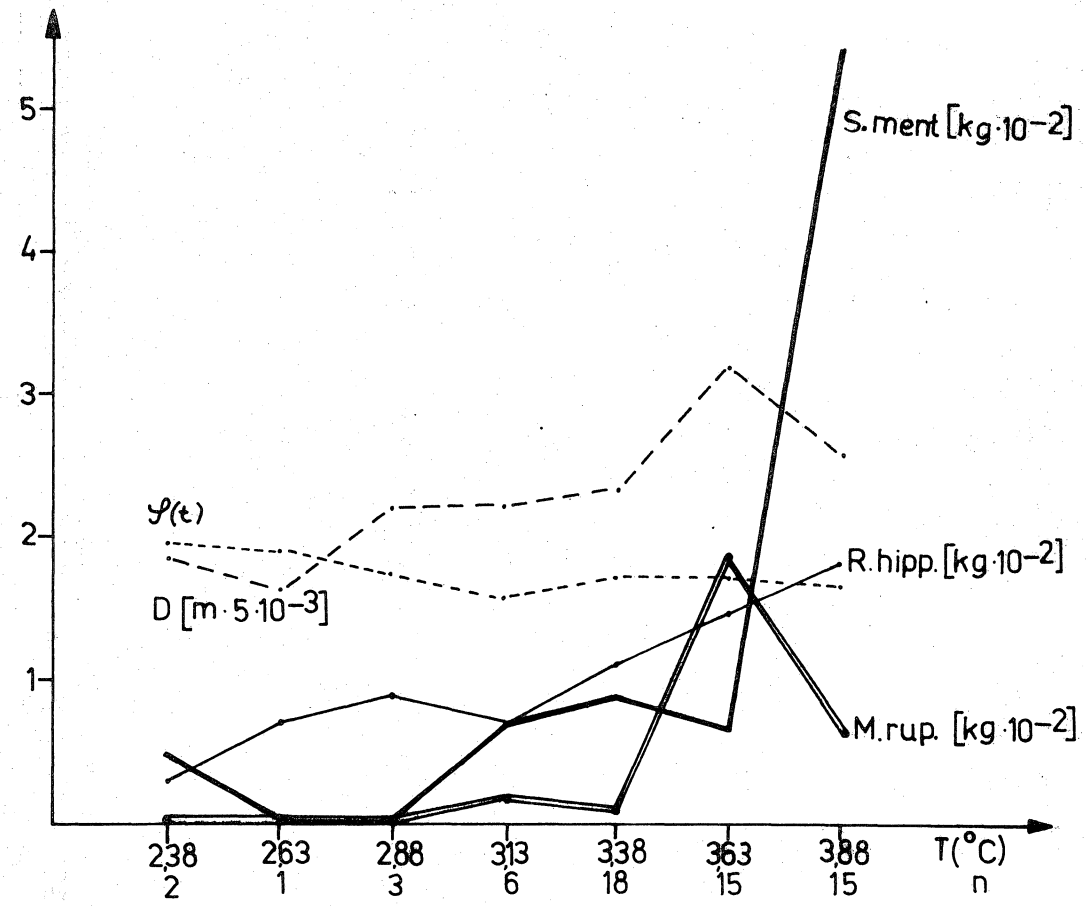

Fig.2 Distribution of catch per tow by environmental factors (values grouped by temperature)

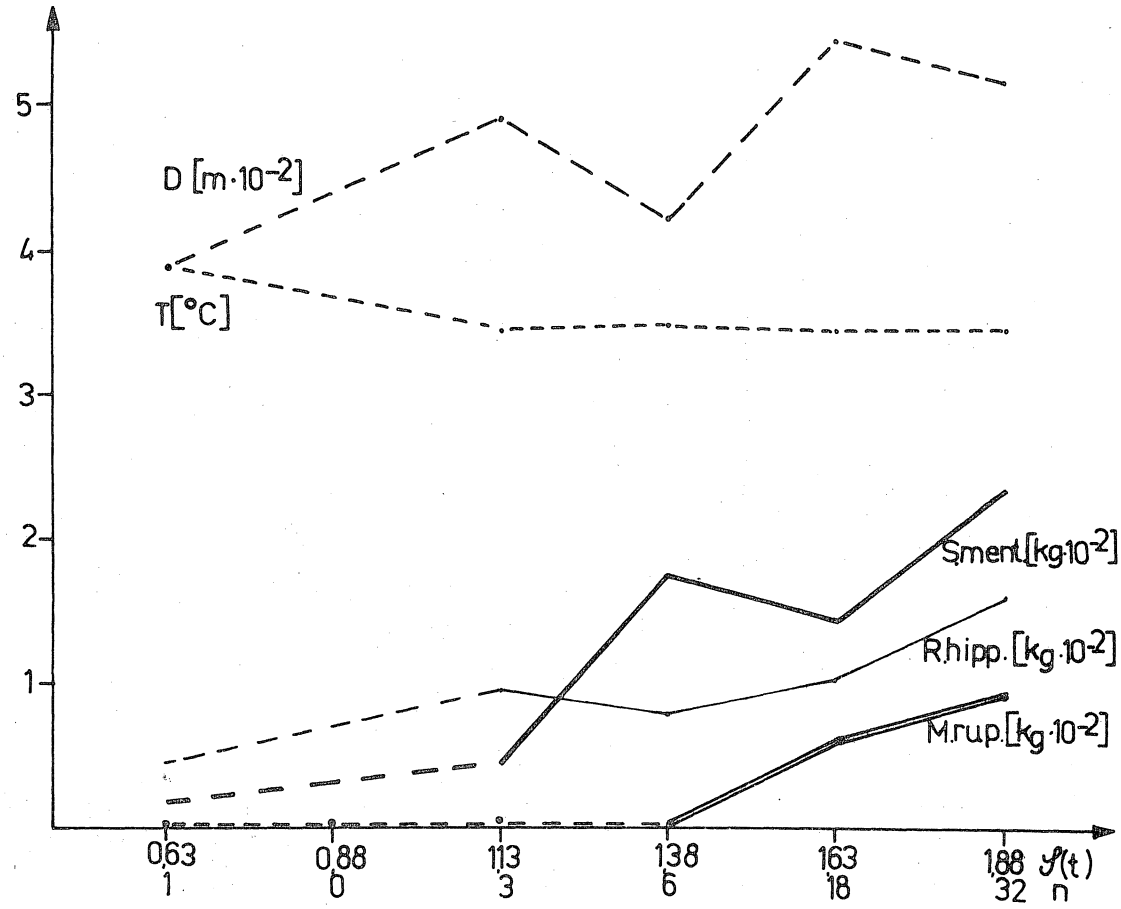

Fig.3 Distribution of catch per tow by environmental factors (values grouped by a function of local time)

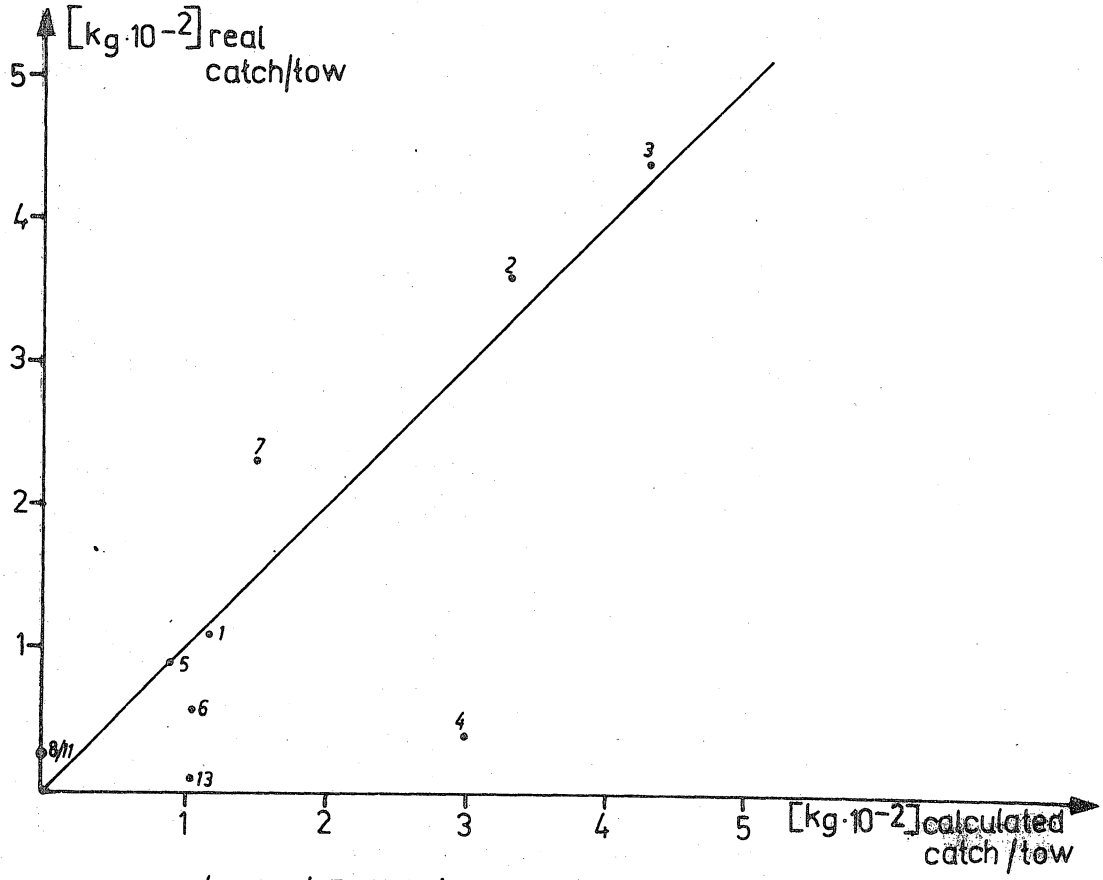

Fig.4 1979/2G,H,J/ Redfish (for explanations see text)

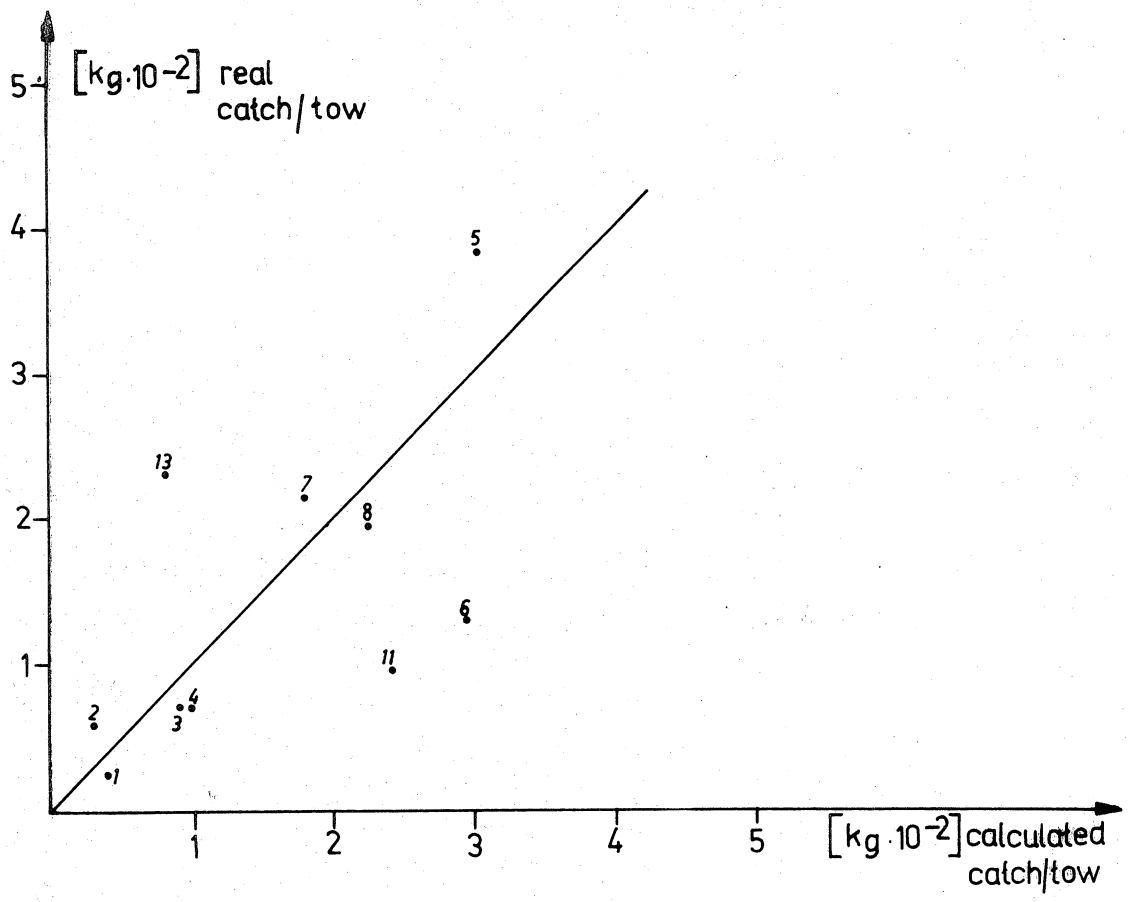

Fig.5 1979 / 2G, H, J / G. Halibut (for explanations see text)

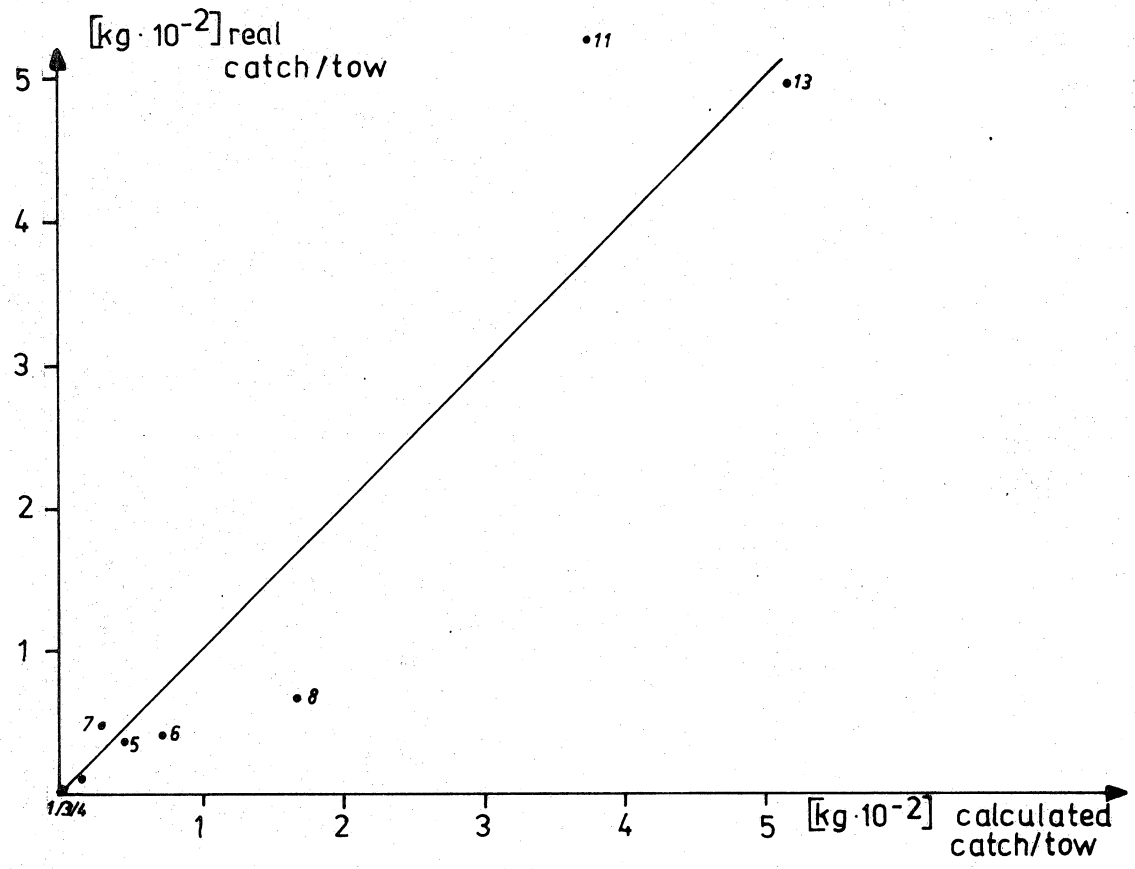

Fig.6 1979/2G,H,J / Grenadier (for explanations see text)

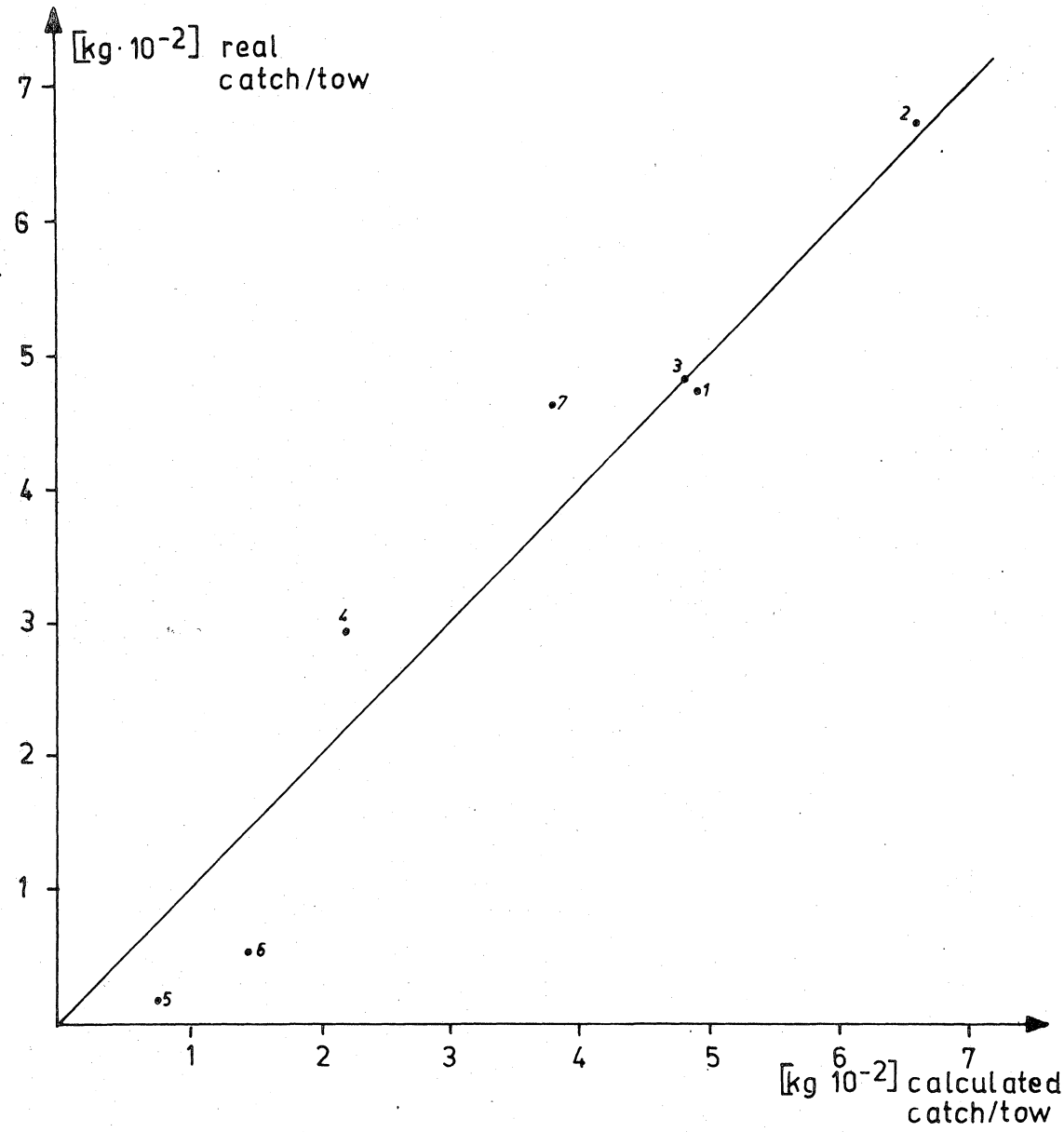

Fig.7 1978 / 2G,H,J / Redfish (for explanations see text)

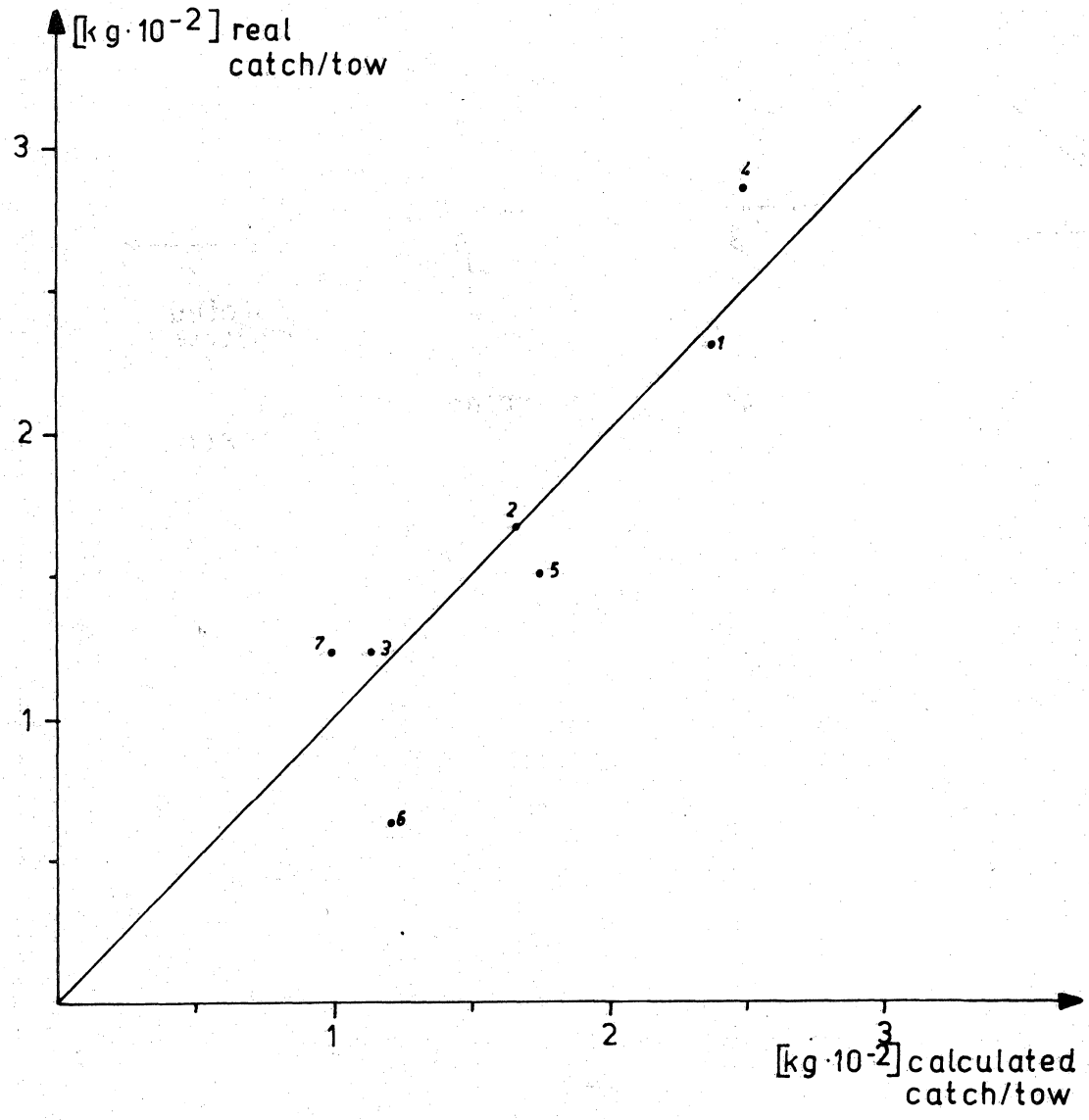

Fig. 8 1978 / 2 G, H, J / G. Halibut (for explanations see text)

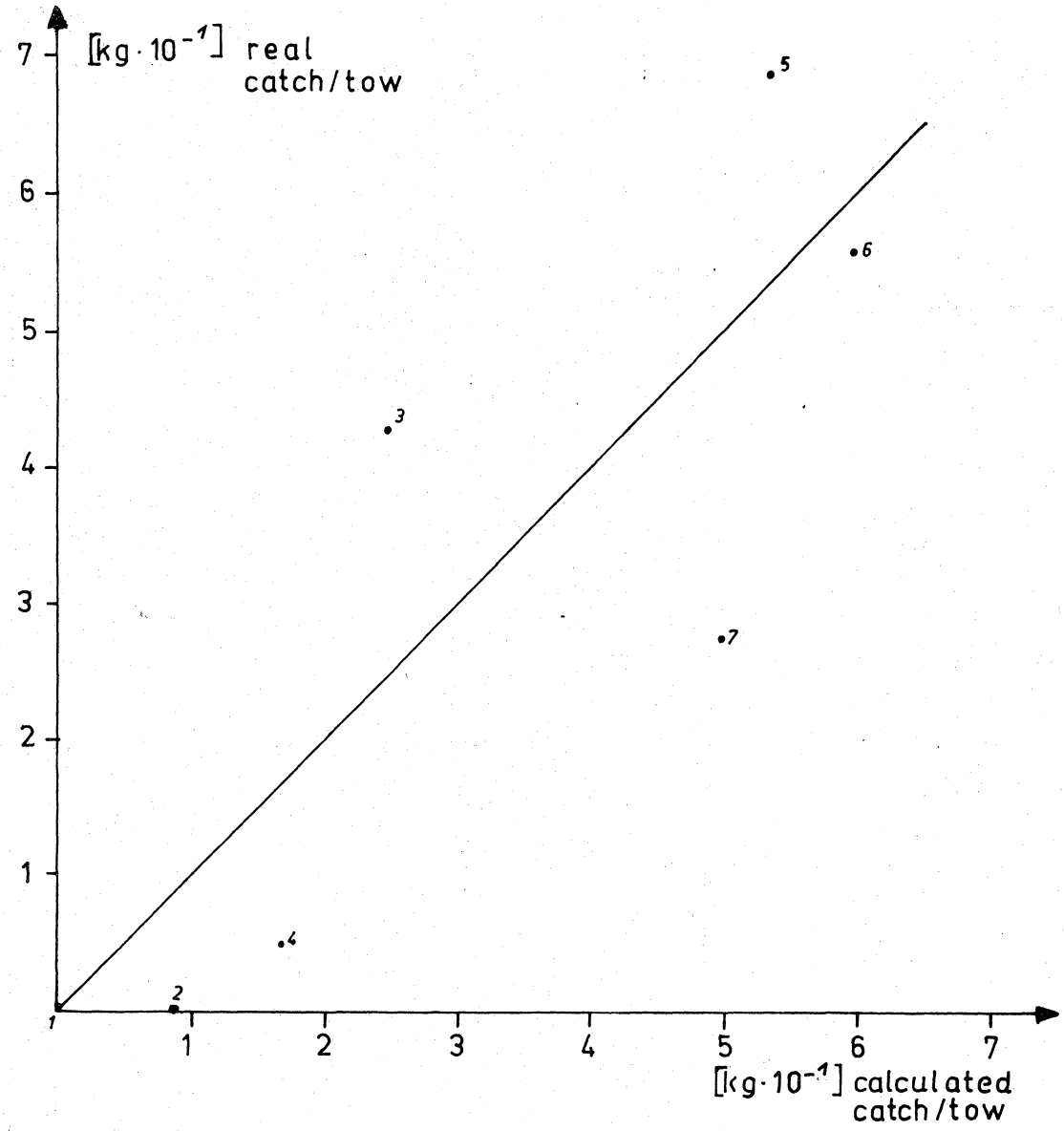

Fig. 9 1978 / 2G,H,J / Grenadier (for explanations see text)