INTERNATIONAL COUNCIL FOR THE
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C.M. 1978/G: 38
Demersal Fish Committee

ON THE RELIABILITY OF THE "TRIDENS" I- AND II-GROUP SURVEYS 1969 - 1977 FOR PREDICTING NORTH SEA SOLE RECRUITMENT.

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Introduction

In order to predict future catches in The Netherlands' flatfish fisheries the relative abundance of the I- and II-group has been assessed in the Dutch coastal area along three lines of stations perpendicular to the coast viz. the Scheveningen-, the Ymuiden- and Texel-lines for a number of years since 1949. The surveys were carried out four times a year by the R.V. "Antoni van Leeuwenhoek", a small cutter, later replaced by the R.V. "Willem Beukelsz", a large cutter. The gear used was a standard small mesh otter trawl. The information obtained from this programme could only be of restricted value since it covered a small part of the total area occupied by young flatfish in the North Sea.

Since August 1968 a new programme was initiated in which the larger R.V. "Tridens" fished with a standard (4.5 cm meshed) beam trawl. The number of lines had been increased to cover the coastal area from Scheveningen to Esbjerg with 10 lines of stations. Since October 1973 6 lines north of Esbjerg were added and the programme in which two censusses per year (April - May and September - October) are being carried out, covers the continental young fish area in the North Sea from Scheveningen to the Kattegat.

In contrast to such young fish surveys as the International Young Herring (and Gadoid) Survey, the choice of the stations is far from free. A number of restrictions interfere with the lay-out of the station grid such as the condition of the bottom (mud, stones, a.s.o.) prevent uninterrupted beam trawling and the fact that Dutch research vessels are not allowed to fish with bottom gear in parts of the eastern North Sea, in the so-called mine field area.

For flatfish sampling, the station grid should be composed of lines perpendicular to the coast e.g. to illiminate the uneven distribution of plaice year classes owing to the average length - depth relationship (Heincke's law). Figure 1, giving the positions of the lines of stations, shows the compromise we had to make. Black dots stand for stations which could be fished without trouble; open circles denote stations which had to be abandoned in the course of time owing to repeated damage to the net.

Moreover in five cases the lines could not be positioned perpendicular to the coast owing to the presence of the mine fields and where fishing could only be carried out in the swept traffic lanes. Thus the Terschelling-, Norderney- and Sylt-lines are parallel to the coast and the Borkum- and Heligoland-lines only semi perpendicular. Still the data from these lines can be used provided the surveys are carried out in the same months each year.

The results of the two cruises have been published each year in Annales Biologiques (Ann. Biol. 30, 31, 32 a.s.o.) and the details of the gear used and data on the weather conditions during the cruises can be found in these publications.

At the moment the number of years (eight) justifies an attempt to analyse the data and to find out how reliable the indices of year class abundance obtained are as compared with data obtained from the adult sole fishery. In the following only the data from the Scheveningen to Esbjerg lines will be discussed. Those obtained from the other northern lines cover only five years, too short a period still for an analysis.

The "Tridens" I- and II-group information on sole can be compared with the catch of two year old recruits per unit effort of the Dutch beam trawl fishery and with the stock data on recruiting year classes in the VPA by means of regression analysis.

It is also possible to analyse the spatial distribution of each year class by comparing the "Tridens" data per line with the Dutch beam trawl catch per effort data of the smallest size category in the landings per corresponding groups of statistical rectangles. This is an extra possibility to verify how reliable the pre recruit indices are.

Analysis

Table I gives the abundance index of a year class as I-group, as II-group and as I- and II-group combined for all 10 lines. The I- as well as the II-group index is based on the spring and autumn cruise data. In general the index as I-group and as II-group for a given year class is of the same level. However, the 1968, 1972 and 1974 year classes declined in abundance from I- to II-group whereas the 1975 year class greatly improved There is possibly a correlation between the indices of both age groups ($r = 0.64$, $p = 0.025$).

The number of two year old recruits in the stock was taken from the VPA in the 1978 report of the North Sea Flatfish Working Group (Anon., 1978). As an index of the recruiting year class in the fishery the catch in number per unit effort of the two year old soles in the Dutch beam trawl fishery in the third and fourth quarter has been taken.

A third index following from the forgoing is the catch per effort of the smallest size category in the beam trawl landings in August, September and October. It is a rather rough index because in the case of large year classes not only the smallest size category contains individuals of this year class but also the next size category. In poor year classes members of older classes can be found in the smallest size category. This type of index has been chosen because it can be used for analysing the spatial distribution of year classes.

Regression equations have been calculated using the natural logs of the values in Table I which are given in Table II together with an index of the degree of association expressed as the correlation coefficient r. All regressions are significant and the regression equations 1 - 4 are shown

in figure 2. The high values for the correlation coefficient suggest that the I- and II-group data collected by "Tridens" are quite reliable for predicting recruitment strength. In the diagrams of figure 2 the confidential limits of 95 % are given for each regression-line.

The large differences in the indices for I- and for II-group in some year classes (notably the 1972 and 1975 year class) warn us, however, not to be too confident. Not only do we have to consider indices of year class abundance for the whole North Sea sole stock as one unit but we have also to study the spatial distribution.

Regression 5 in Table II shows a high correlation between VPA stock size and the catch per unit effort of beam trawlers of two year old soles. Moreover the latter demonstrates a very high correlation with the catch per effort of the smallest size category (4) in the beam trawler landings in August, September and October, the months of full recruitment in the fishery.

We are thus allowed to compare the c.p.u.e. of the "Tridens" for the lines separately with the August - October c.p.u.e. of the smallest size category in the beam trawl fishery in the same statistical rectangles of groups of rectangles in which the "Tridens" lines are situated.

Table III gives the relevant data for the eight year classes concerned. Figures 3 to 6 give a comparison of the spatial distribution of the year classes as I- and II-group combined in the "Tridens" line surveys shown as black circles of which the surface is proportional to the average number per line and the spatial distribution in August, September and October of the smallest size category in the landings of the Dutch beam trawlers.

In the bottom row of Table III the correlation coefficients of the regression of the $\log_e$ values of both indices of year class strength are given. All show some positive relationship but only the cases of the 1972 and 1973 year classes are significant and the 1968, 1969 and 1971 year classes probably significant. However, when the $\log_e$ values of all year classes are pooled the correlation coefficient $r = 0.71$ is highly significant. One should bear in mind that the c.p.u.e. of the smallest size category is rather a poor index of the abundance of a year class, but nevertheless/ correlation observed between spatial distributions of the "Tridens" indices and those derived from the fishery gives us additional evidence for the reliability of the I- and II-group surveys as an instrument for predicting future recruitment. The differences in spatial distribution between the various year classes too tells us that for a pre recruit survey one has to sample all the nurseries and that information from one single nursery area has only limited value and can easily lead to wrong assumption on year class strength.

/the positive

References

Anon., 1978 Report of the North Sea Flatfish Working Group, ICES C.M. 1978/G : 9.

Annales Biologiques, 30 (1975), 31 (1976), 32 (1977), 33 (1978).

/MV

Table I - Estimates of year class abundance in North Sea sole 1968 - 1975 and its natural logs (underlined).

Year class	"Tridens" pre recruit-survey (Scheveningen - Esbjerg-lines) in numbers as:			VPA number of recruits at age two x 1000	Catch per unit effort 3rd + 4th quarter beam trawl in numbers x 1000	Catch per unit effort category 4 all squares in weight in tons
	I-group	II-group	I- + II-groups			
1968	1263.3	851.8	1057.6	47,371	1740.3	219.9
	7.141	6.747	6.964	10.766	7.462	5.393
1969	3070.0	2802.5	3050.4	140,255	6817.4	677.8
	8.029	7.938	8.023	11.851	8.827	6.519
1970	470.0	306.7	414.3	33,485	1642.2	140.3
	6.153	5.726	6.027	10.419	7.404	4.944
1971	698.4	904.4	803.6	77,158	2565.0	286.7
	6.549	6.807	6.689	11.254	7.850	5.658
1972	2708.1	499.9	1790.9	100,688	3574.9	451.5
	7.904	6.214	7.490	11.520	8.182	6.113
1973	921.1	853.3	887.4	96,012	4099.6	445.1
	6.826	6.749	6.788	11.472	8.319	6.098
1974	320.6	66.6	195.3	36,447	514.1	91.4
	5.770	4.199	5.275	10.504	6.353	4.514
1975	729.5	2029.4	1379.5	116,473	3576.6	318.1
	6.592	7.615	7.229	11.665	8.182	5.762
1976	1896.7					
	7.548					

Table II - Regression equations and correlation coefficients.

Type of regression	Equation	Correlation coefficient
1. "Tridens" I-group c.p.u.e. in numbers (x_1). Dutch beam trawl age group 2 c.p.u.e. 3rd and 4th quarter in numbers (y_1).	$\log_e y_1 = 2.78 + 0.73 \log_e x_1$	$r = 0.89$ $p < 0.01$
2. "Tridens" II-group c.p.u.e. in numbers (x_2). Dutch beam trawl age group 2 c.p.u.e. 3rd and 4th quarter (y_1) in numbers.	$\log_e y_1 = 4.07 + 0.58 \log_e x_2$	$r = 0.77$ $p = 0.01$
3. "Tridens" I-+ II-group c.p.u.e. in numbers (x_3). Dutch beam trawl age group 2 c.p.u.e. 3rd and 4th quarter (y_1) in numbers.	$\log_e y_1 = 2.33 + 0.81 \log_e x_3$	$r = 0.91$ $p < 0.01$
4. "Tridens" I- + II-group c.p.u.e. in numbers (x_3). VPA age 2 stock numbers (y_2).	$\log_e y_2 = 7.45 + 0.55 \log_e x_3$	$r = 0.86$ $p < 0.01$
5. Dutch beam trawl age group 2 c.p.u.e. 3rd and 4th quarter (y_1) in numbers. VPA age 2 stock numbers (y_2).	$\log_e y_2 = 6.11 + 0.65 \log_e y_1$	$r = 0.89$ $p < 0.01$
6. Dutch beam trawl size category 4 (smallest) c.p.u.e. in August, September and October in weight (y_3). Dutch beam trawl age group 2 c.p.u.e. 3rd and 4th quarter in numbers (y_1)	$\log_e y_1 = -0.98 + 0.84 \log_e y_3$	$r = 0.97$ $p < 0.01$

Table III - Comparison of "Tridens" estimate of year class abundance (I- + II-group) along lines of stations and the catch per unit effort of the beam trawl (x 10^3 kg) in August, September and October in corresponding statistical squares.

Underlined are the $\log_e$ values.

Lines	Year class 1968	C.p.u.e. Aug-Oct. 1970	Year class 1969	C.p.u.e. Aug-Oct. 1971	Year class 1970	C.p.u.e. Aug-Oct. 1972	Year class 1971	C.p.u.e. Aug-Oct. 1973	Year class 1972	C.p.u.e. Aug-Oct. 1974	Year class 1973	C.p.u.e. Aug-Oct. 1975	Year class 1974	C.p.u.e. Aug-Oct. 1976	Year class 1975	C.p.u.e. Aug-Oct. 1977
Scheveningen	1175	256.7	4178	1035.4	229	64.8	300	167.2			1545	1007.7	322	207.4	1252	629.6
	7.069	5.548	8.338	6.943	5.434	4.171	5.704	5.119			7.343	6.915	5.775	5.335	7.132	6.445
Ymuiden	796	223.3	7259	1060.7	190	89.9	482	191.8	225	267.2	1044	817.3	150	186.7	1539	387.9
	6.680	5.409	8.890	6.967	5.247	4.499	6.178	5.256	5.416	5.588	6.951	6.706	5.011	5.230	7.339	5.961
Texel	1006	233.3	3689	959.4	504	146.5	672	214.9	657	397.7	741	620.8	186	145.9	1136	191.8
	6.914	5.452	8.213	6.866	6.223	4.987	6.510	5.370	6.488	5.986	6.608	6.431	5.226	4.983	7.035	5.256
Cleaverbank	310	177.6	1103	1023.7	393	185.3	172	238.3	391	467.0	50	316.5	50	107.8	385	240.8
	5.737	5.180	7.006	6.931	5.974	5.222	5.147	5.474	5.969	6.146	3.912	5.757	3.912	4.680	5.953	5.484
Terschelling	6901	327.7	4677	1357.3	1245	280.0	763	364.1	837	981.8	993	576.0	213	121.3	2356	323.4
	8.839	5.792	8.450	7.213	7.127	5.635	6.637	5.897	6.730	6.889	6.901	6.356	5.361	4.798	7.765	5.779
Borkum	553	288.3	1699	784.3	80	285.7	1330	570.7	1298	1354.7	1713	692.3	441	228.5	832	444.7
	6.315	5.664	7.438	6.665	4.382	5.655	7.193	6.347	7.169	7.211	7.446	6.540	6.089	5.432	6.724	6.097
Heligoland	900	445.0	3069	1335.0	683	470.3	523	1197.3	1347	1763.0	1123	1038.0	135	193.7	2420	824.0
	6.802	6.098	8.029	7.197	6.526	6.153	6.260	7.088	7.206	7.475	7.024	6.945	4.905	5.266	7.792	6.714
Norderney	2386	742.5	3545	1453.0	469		1533	1305.0	3743	1310.0	1415	1386.6	276	720	2113	921.7
	7.777	6.610	8.173	7.281	6.151		7.335	7.174	8.228	7.178	7.255	7.235	5.620	4.277	7.656	6.826
Sylt	388	300.5	601		275	193.8	1334	776.8	7403	1044.3	121	448.0	63	136.5	665	721.6
	5.761	5.705	6.399		5.617	5.267	7.196	6.655	8.910	6.951	4.796	6.105	4.143	4.916	6.500	6.581
Esbjerg	457	109.0	684	676.3	75	148.5	927	488.7	217	475.7	129	150.8	117	95.3	1097	311.3
	6.125	4.691	6.528	6.517	4.317	5.001	6.832	6.192	5.380	6.165	4.860	5.016	4.762	4.557	7.000	5.741
Hvide Sande							133		67		267		0		137	
							4.890		4.205		5.587				4.920	
Thyborøn							267				60		74		27	
							5.587				4.094		4.304		3.296	
Holmen Ground							100		20		0		0		0	
							4.605		2.996							
Jammer Bay									67		17		0		0	
									4.205		2.833					
Kattegat									25				0		0	
									3.219							
Correlation coefficient of Scheveningen - Esbjerg lines	r = 0.54 p = 0.025		r = 0.65 p = 0.025		r = 0.34 p = > 0.10		r = 0.65 p = 0.025		r = 0.75 p = < 0.001		r = 0.81 p = < 0.001		r = 0.32 p = > 0.10		r = 0.39 p = > 0.10	

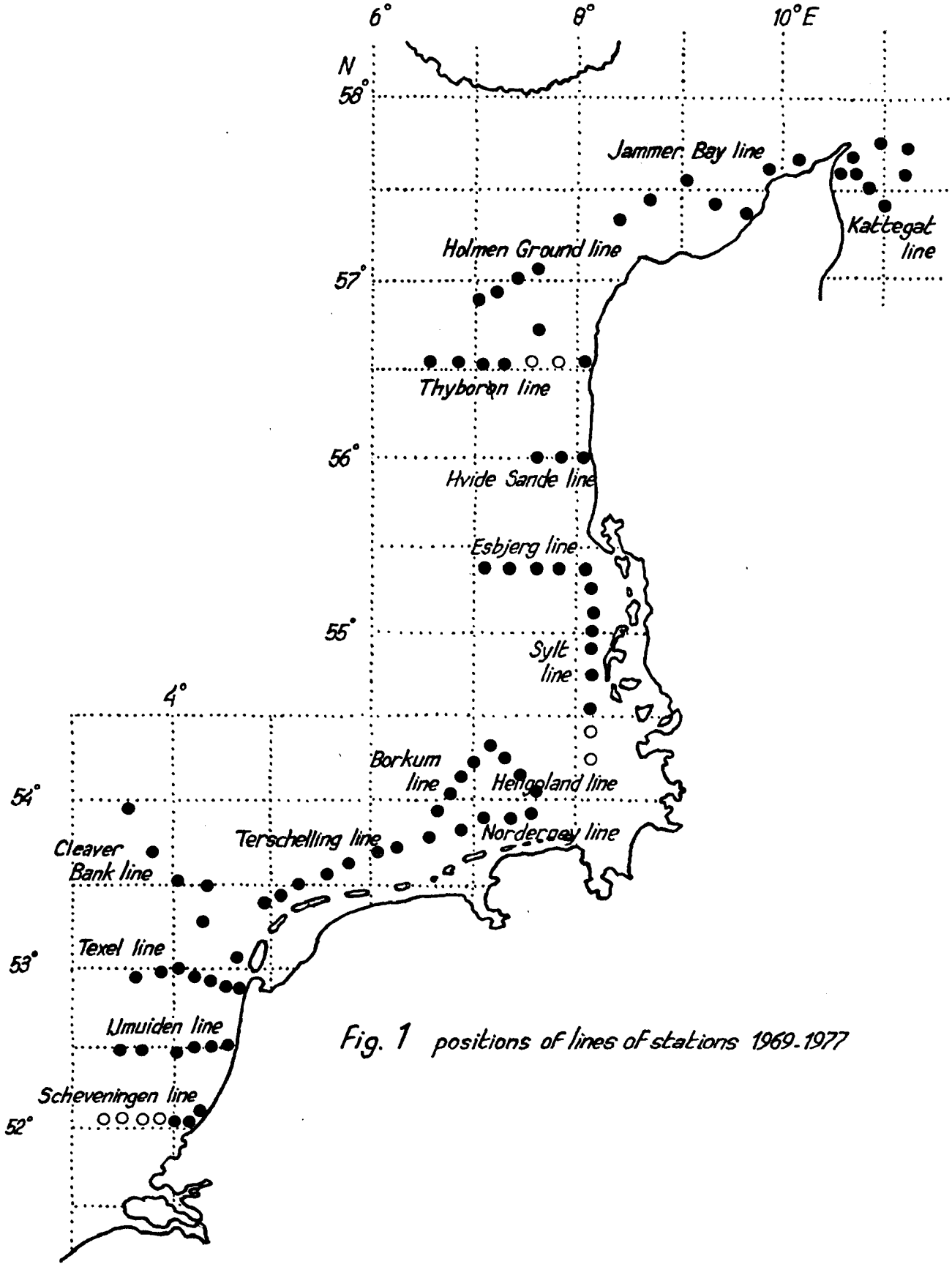
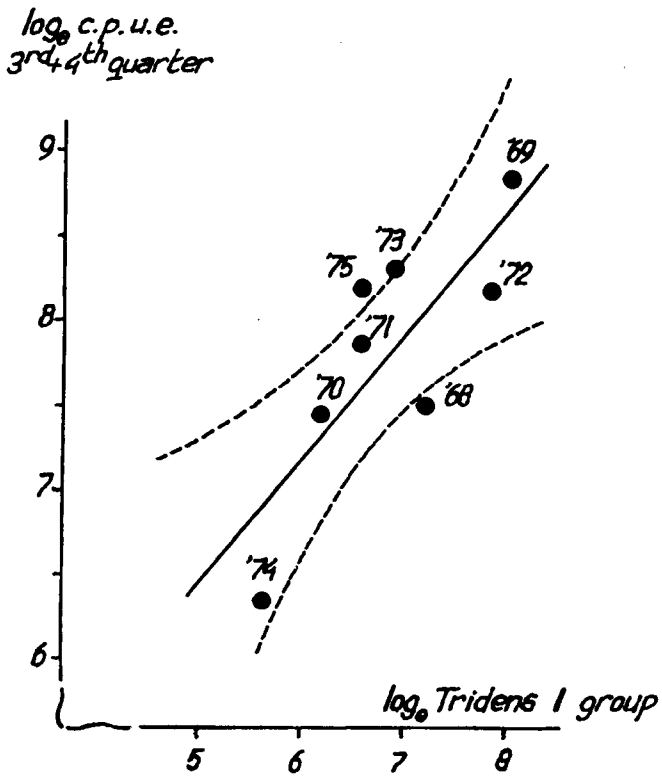


Fig. 1 positions of lines of stations 1969-1977

Fig. 2


log$_e$ c.p.u.e.
3rd+4th quarter
9
8
7
6
'69
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5
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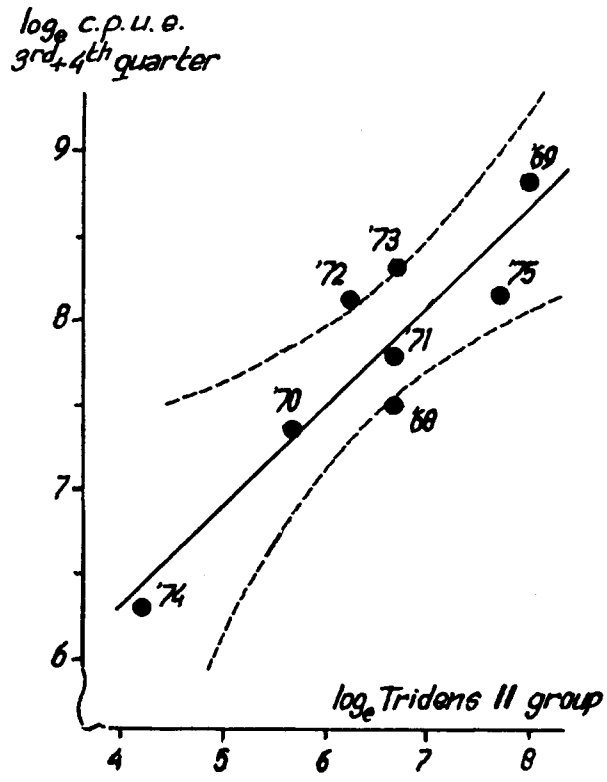
8
log$_e$ Tridens I group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3rd+4th quarter
9
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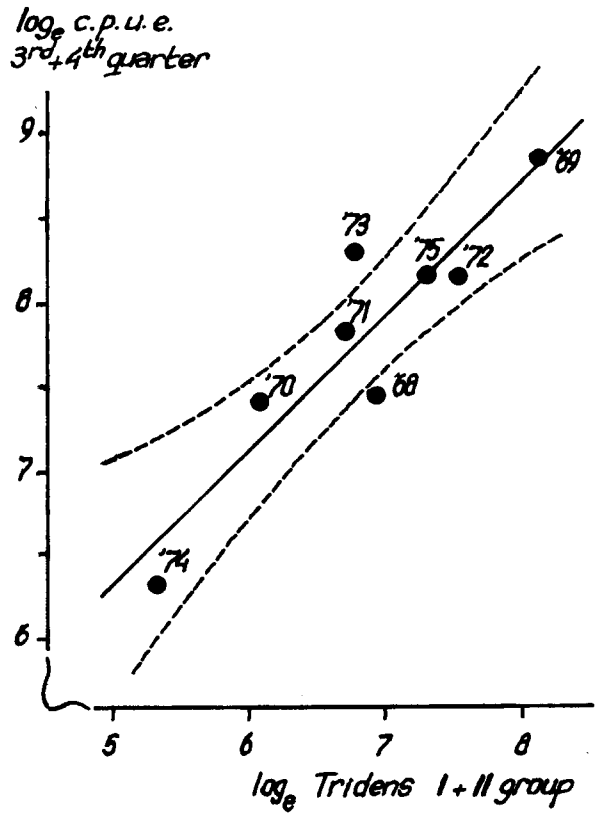
log$_e$ Tridens II group


log$_e$ c.p.u.e.
3rd+4th quarter
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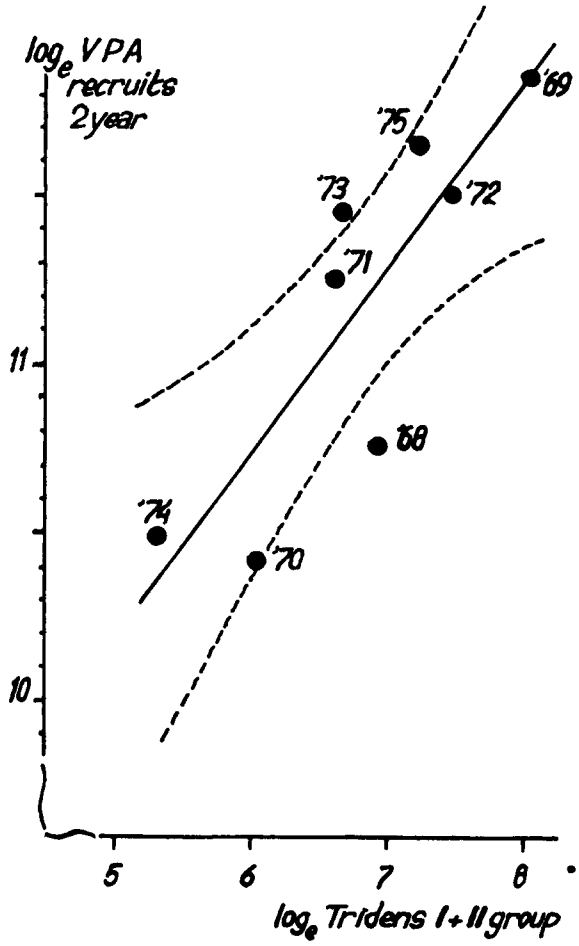
log$_e$ Tridens I+II group


log$_e$ VPA
recruits
2year
11
10
'69
'75
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'70
5
6
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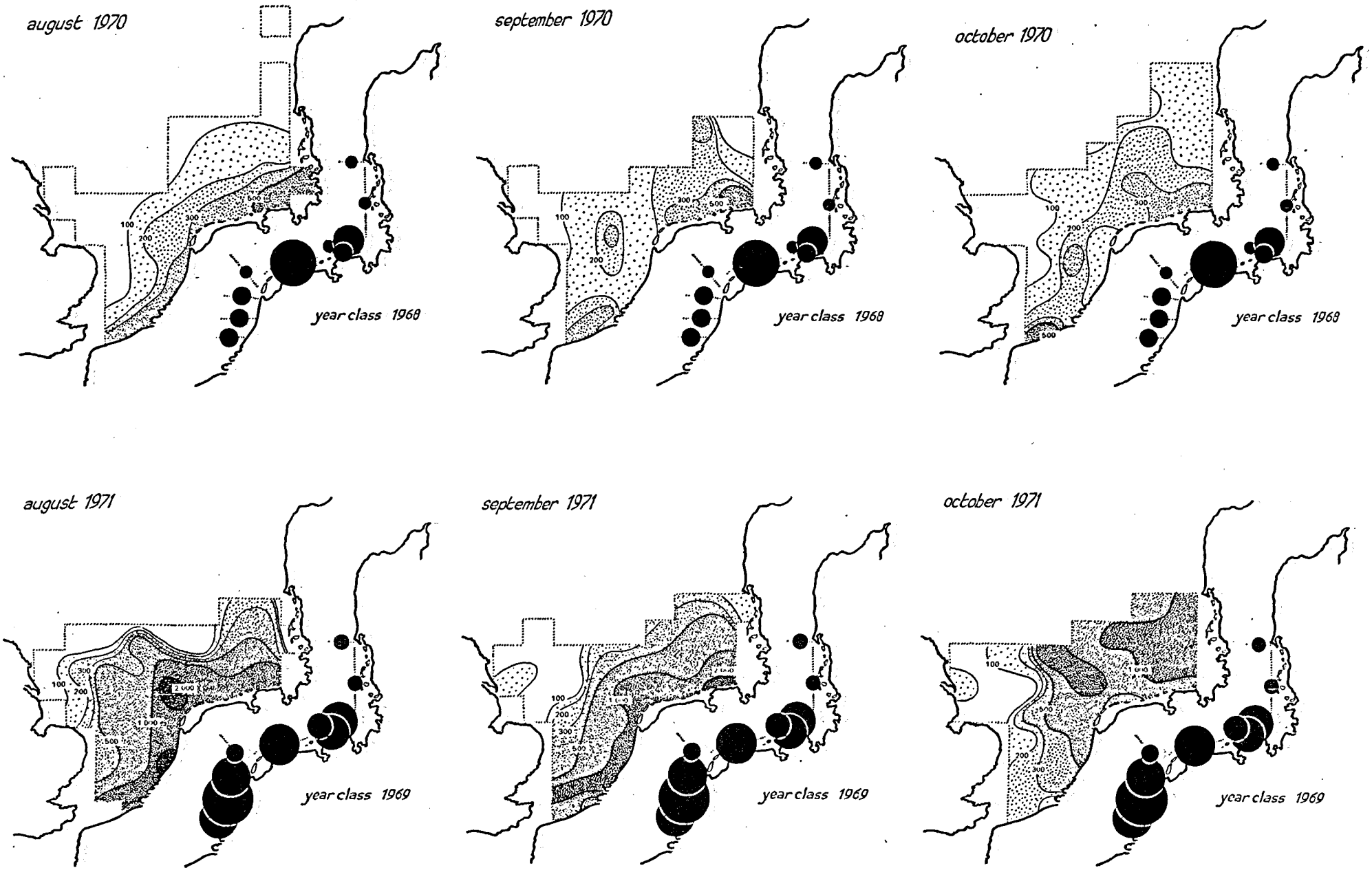
8
log$_e$ Tridens I+II group

Fig. 3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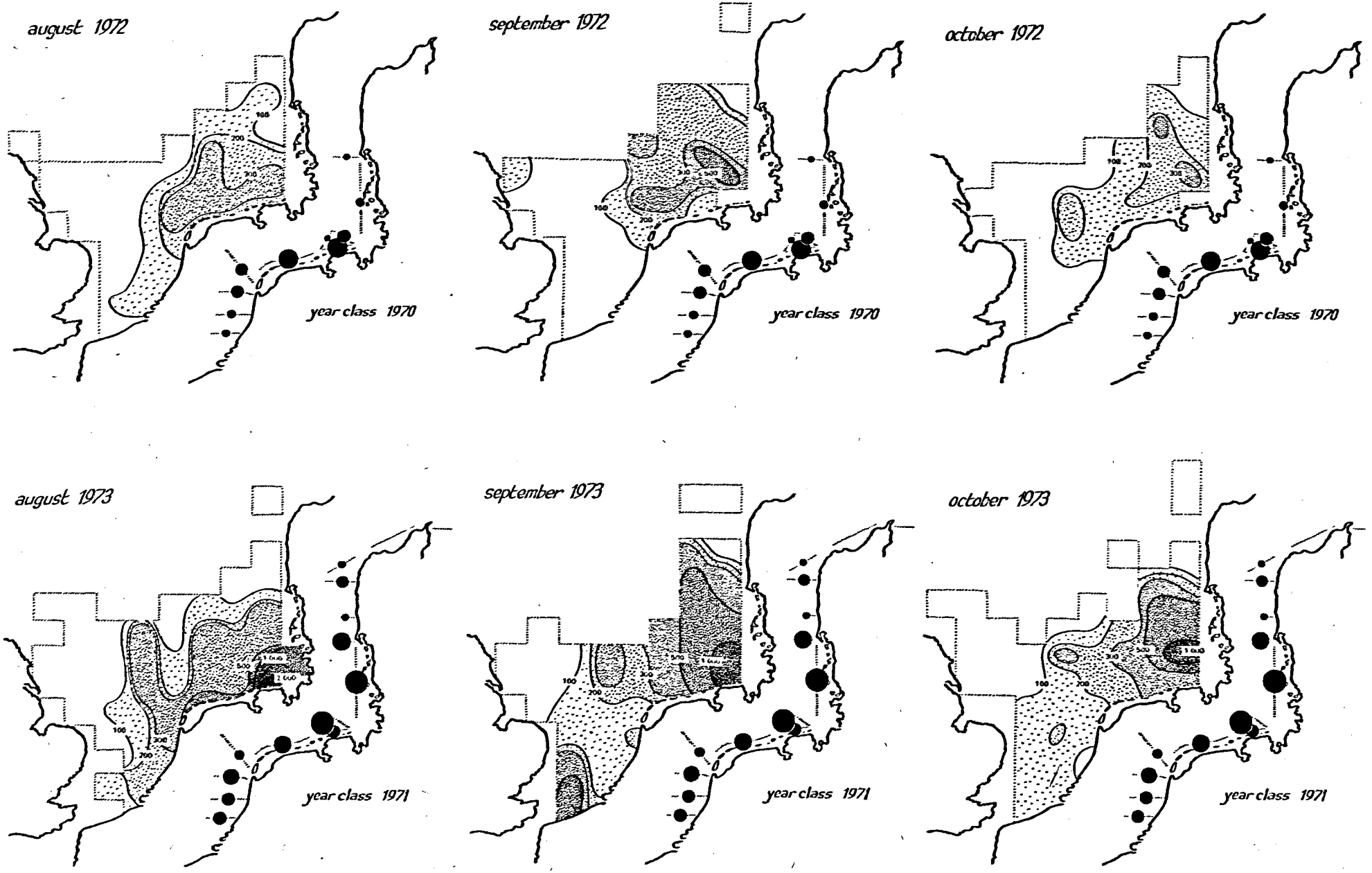
october 1971
year class 1969

Fig. 4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year class 1971

Fig. 5

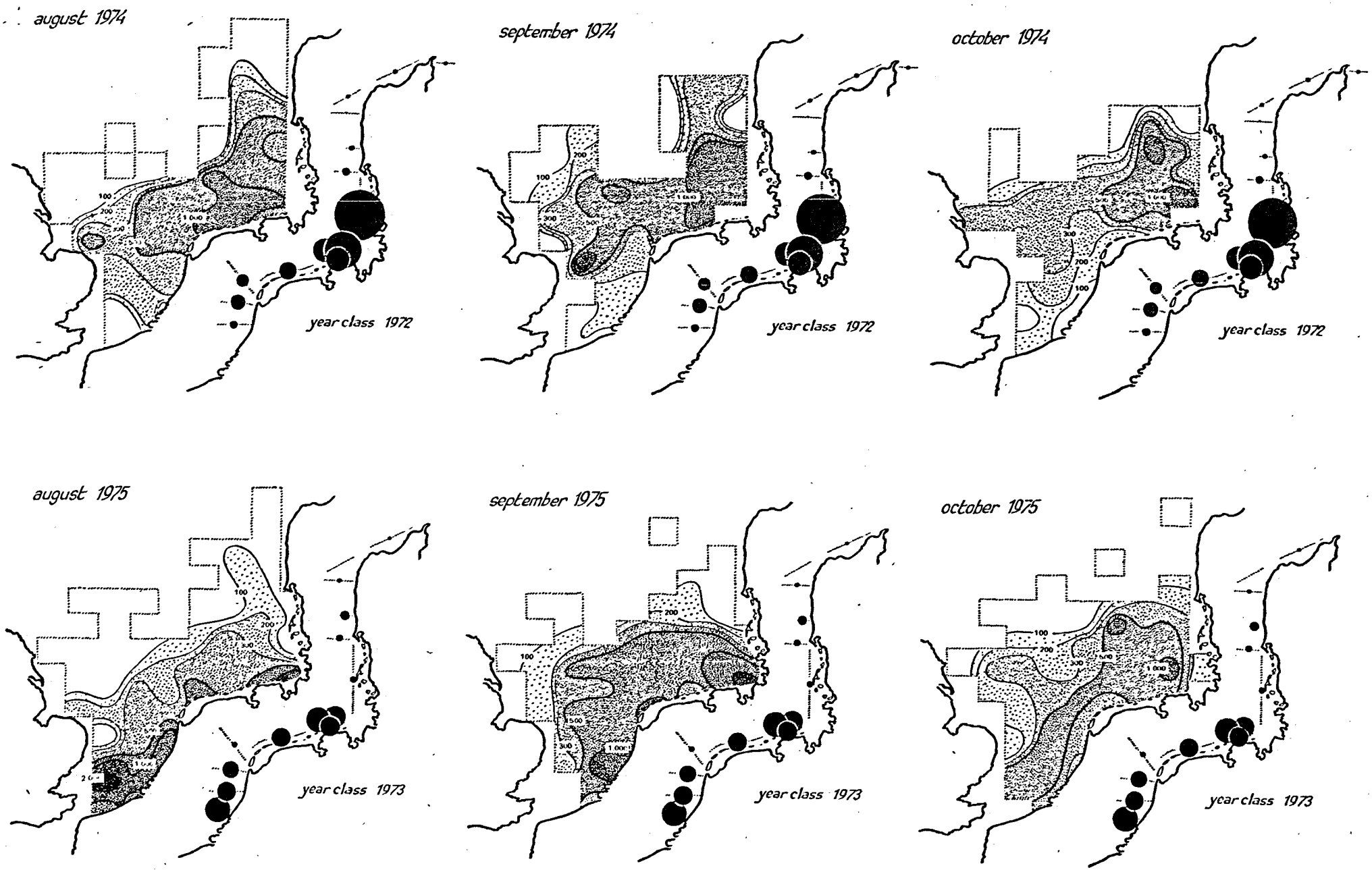
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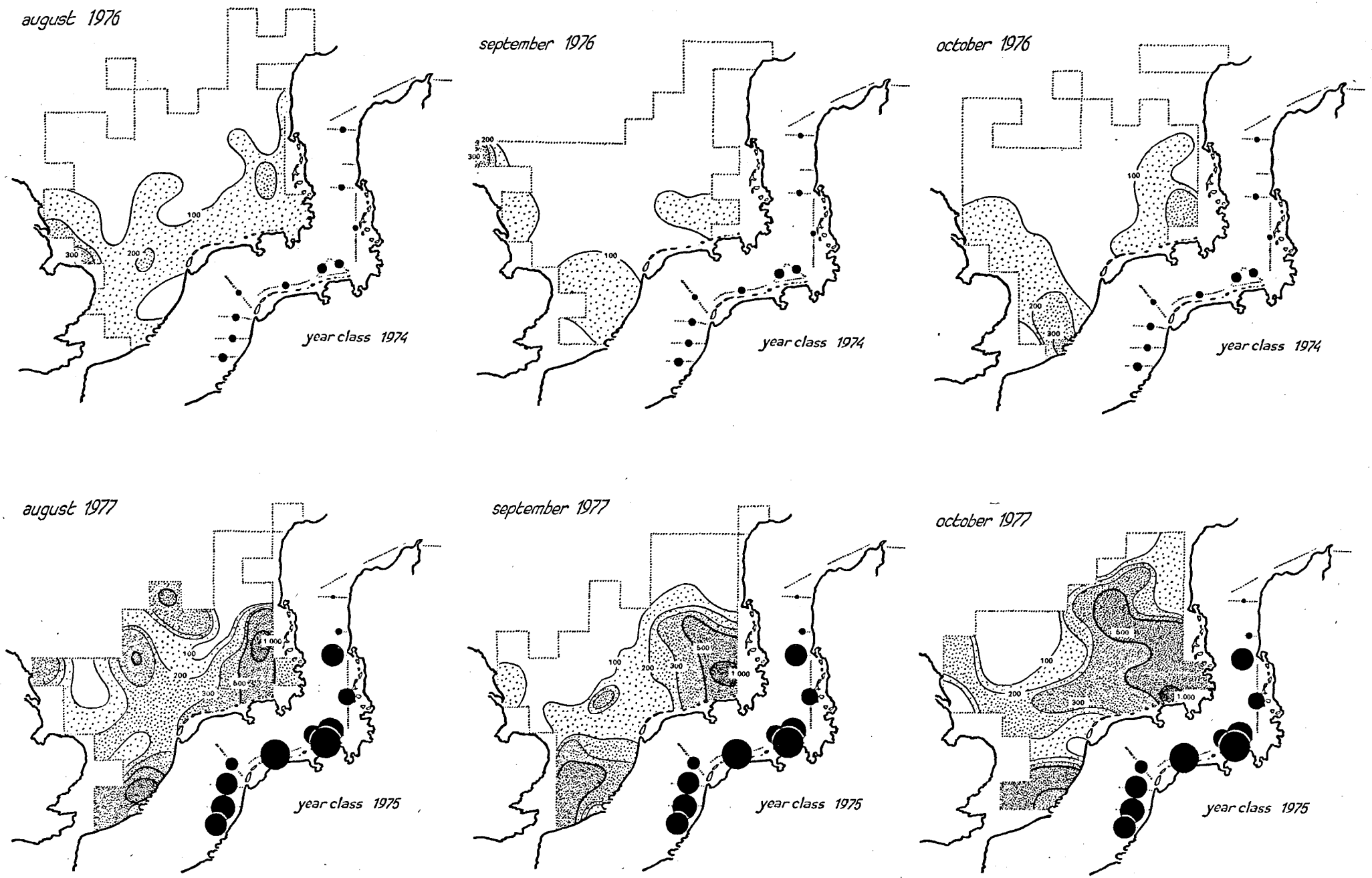
Fig. 6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