INTERNATIONAL COUNCIL FOR THE
EXPLORATION OF THE SEA

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FOUR YEARS PHYTOPLANKTON INVESTIGATIONS IN THE DUTCH COASTAL AREA 1973 - 1976.

by

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Abstract.

During four successive years (1973-1976) a monthly phytoplankton monitoring program was carried out in a 70 km wide area along the Dutch coast.

This coastal water is a mixture of Channel water originating from the Atlantic and the Rhine, Meuse and Scheldt river run-offs. A selection has been made out of the manifold on data and resulted in a chronological description of the most occurring species, a list of all species identified and 46 figures in which the quantitatively distribution in the area are given for some of the remarkable species, where possible in four successive years.

Species diversity was computed for diatoms and dinoflagellates, values of these calculations are presented in 17 figures, isohalines included.

In 1973 phytoplankton investigations were started in an area along the coast of The Netherlands ranging from Callantsoog to Terheijden. Once a month samples were collected in 6 stations on each of 4 alignments placed perpendicularly on the coast. These 6 stations were sited respectively 4, 10, 20 and 30 km offshore.

In the following years, 1974, 1975 and 1976, the area of investigation was extended to the open sea and southwards to the Belgian boundary. There are 6 alignments now, each consisting of 5 fixed stations, respectively 3, 4 or 5, 10, 20, 30 and 70 km offshore. The geographical positions are given in table I and figure 1.

The phytoplankton investigations in the coastal area of The Netherlands have been carried out in close cooperation with Rijkswaterstaat Directie Noordzee.

TABLE I - Geographical positions.

Callantsoog	Egmond	Noordwijk
C 3 52°53'N 4°40'E	E 3 52°38'N 4°34'E	N 3 52°16'N 4°24'E
C10 52°54'N 4°34'E	E10 52°39'N 4°29'E	N10 52°18'N 4°20'E
C20 52°55'N 4°25'E	E20 52°41'N 4°20'E	N20 52°22'N 4°13'E
C30 52°56'N 4°16'E	E30 52°43'N 4°12'E	N30 52°26'N 4°06'E
C70 52°59'N 3°41'E	E70 52°50'N 3°39'E	N70 52°41'N 3°40'E

Terheijden	Schouwen	Appelzak
T 3 52°03'N 4°09'E	S 5 51°44'N 3°38'E	A 4 51°24'N 3°19'E
T10 52°08'N 4°05'E	S10 51°46'N 3°34'E	A10 51°26'N 3°15'E
T20 52°11'N 3°59'E	S20 51°50'N 3°28'E	A20 51°29'N 3°09'E
T30 52°15'N 3°54'E	S30 51°53'N 3°21'E	A30 51°33'N 3°02'E
T70 52°32'N 3°32'E	S70 52°03'N 2°54'E	A70 51°48'N 2°35'E

The investigations were primarily undertaken:

a. To study the qualitative and quantitative composition of the phytoplankton in the coastal section of the North Sea, which is more than others affected by pollution from the rivers Scheldt, Rhine and Meuse. Observations made over a long series of years could make it possible to discover long-term changes in the pattern.

b. Moreover, the results of these investigations can be used to check the occurrence of toxin-producing phytoplankton blooms, particularly those caused by some species of dinoflagellates.

Sampling method

The water samples were collected with a bucket from the surface. Two polyethylene bottles, each of one litre, were filled, one was immediately fixed with iodine-potassium iodide-sodium acetate solution, the other bottle was placed in a cool dark place on board the ship, from where it reached the laboratory within a few hours. Microscopical investigations were undertaken as soon as possible to facilitate detection of those micro-organisms, which may easily lose their shape and features. This is in particular the case in the unarmoured dinoflagellates. So these dinoflagellates were in general identified in fresh material.

Enumeration of phytoplankton

From the fixed samples, the supernatent was decanted after a sedimentation period of at least 4 days. The sample was concentrated to a volume - according to the phytoplankton density - suitable for counting. The enumeration of the species was carried out with the Utermöhl Counting Chamber, with the aid of an inverted Zeisz microscope.

To prevent undesirable current which could disperse or concentrate the micro-organisms on the bottom of the counting chamber, one should keep the temperature as equally as possible.

Results of the enumeration are presented in numbers of cells per litre.

Species diversity

The species diversity of a group of micro-organisms is an index for both the number of species and the observed number of individuals in each species. When one finds in a given sample, a small number of species represented in a great number of individuals then the diversity index is considered to be low. A high degree of diversity is recorded, when the composition of the phytoplankton consists of a great number of species each represented in a rather small number of individuals. If it assumed that pollution will first of all lead to killing the more sensitive species, this will result in reduction of interspecific competition which may favour the development of the remaining species. Therefore a declining ecosystem will be revealed by a reduction of the diversity index.

Though one cannot be sure that this assumption will always hold good, calculations of the diversity index has been used as a possibility to enlarge the insight in the phytoplankton pattern in the Dutch coastal area. Diversity indices have been calculated from a total count of both dinoflagellates and diatoms, making use of the formule

$$I = - \sum_{i} \frac{n_i}{N} \ln \frac{n_i}{N}$$

Discussion

The computed values of diversity indices as presented in figures 50 to 66 do not show a clear-cut relation to the degree of pollution, if the latter is expressed as the degree of admixture with fresh water revealed by salinity data for the Dutch coastal waters. Therefore up to now no definitive conclusions can be drawn as to the possible influence of pollutants from the continent on the phytoplankton composition in the area investigated.

The succession of the phytoplankton populations

In the phytoplankton surveys special attention has been paid to those phytoplankton species, which dominated in the period of investigation. The distribution of the most remarkable species is given - on base of the symbols of figure 2 and 3 - in figure 4 to 49. Rare or only scarcely occurring micro-organisms, not mentioned in the description are, however, duty inserted in the list of species.

Results

1973

January. Though in general only few phytoplankton species were represented, the diatom Melosira sulcata was, even in the surface samples, quite numerous. Nitzschia closterium and Thalassionema nitzschioides were observed in smaller numbers.

Diplosalis lenticula is found in a few samples, whereas Coccolithus pelagica was scarcely present in the area.

February. Compared with the January samples, there is hardly any change to record. The species mentioned above are still present. Prorocentrum micans and Torodinium robustum were only sporadically observed. The diatom Skeletonema costatum increased in numbers up to 20 000 cells. At the end of the month Asterionella glacialis, Rhizosolenia hebetata, Odontella aurita and Thalassionema nitzschioides began to reveal their spring bloom. In the northern part of the area investigated, the dinoflagellates Ceratium fusus and Peridinium pellucidum completed the total phytoplankton pattern at that time.

March. At the end of this month dinoflagellates such as Peridinium pellucidum, P. pentagonum, P. punctulatum were observed. The diatoms: Asterionella glacialis, Chaetoceros decipiens, Coscinodiscus concinnus, C. radiatus, Guinardia flaccida, Rhizosolenia delicatula, R. hebetata, R. stolterfothii and Thalassiosira gravida were in most of the samples present in increasing numbers. Phaeocystis pouchetii occurred in many samples, but did not take a dominating position among the micro-organisms. Coccolithus pelagica was found in small numbers only.

April. A strong development of Skeletonema costatum was recorded, up to 200 000 cells or over were counted per litre. Coscinodiscus concinnus one of the largest diatoms, was present in more than 1 000 cells per litre. Melosira sulcata, Raphoneis amphiceros, Podosira stelliger, Asterionella glacialis and Rhizosolenia stolterfothii were present. In the whole area Phaeocystis pouchetii was still maintaining its position and unidentified species of flagellates and Gymnodinium were observed.

May. Although the phytoplankton density was very low in this month, there was compared with samples from April a ten-fold increase of the diatom Skeletonema costatum; some millions of cells per litre were counted.

Asterionella glacialis was still maintaining its position and so did Nitzschia closterium. This was, however, not observed in the entire area. Both species reached only in one sample about 100 000 cells per litre.

In the northern part of the area dinoflagellates were present in a great number of species, but in limited numbers of individuals only. Katodinium rotundatum and Gyrodinium spirale, however, occurred everywhere, sometimes up to 40 000 - 100 000 cells per litre. There was a mass development of one or more unidentified flagellates. The holozoical way of living of one flagellate species involving the diatom Skeletonema costatum was very remarkable.

June. Though a discontinuing effect of spring diatom bloom was to be expected, several micro-organisms were still numerous e.g. Chaetoceros spp., Eucampia zodiacus, Guinardia flaccida (1 000 - 15 000/1). Lauderia annulata, Rhizosolenia delicatula and R.hebetata showed an average of some 20 000 cells per litre. Asterionella glacialis was in station T 20 very numerous, almost half a million

of cells being counted in this sample. Skeletonema costatum was only found closely inshore. In samples of the C- and E-alignment, Rhizosolenia stolterfothii was observed, numerous individuals of the Peridinium spec. were also present in that area, and a modest development of Ceratium fusus reached 1 500 cells per litre. Katodinium glaucum and Noctiluca miliaris were the most numerous species throughout the whole area.

July. A high concentration of Ceratium fusus, with a maximum of 68 000 cells per litre was found in sample C 10. The species Ceratium furca, C. lineatum and C. horridum did nowhere reveal more than 5 000 cells per litre. Small numbers of Noctiluca miliaris were found and Gonyaulax spinifera was sporadically noticed. The second bloom of Skeletonema costatum exploded closely inshore, again some millions of cells were counted. A "newcomer" in this period was the diatom Bacteriastrum hyalinum best represented in the C- and E-alignment. Other important diatoms were Guinardia flaccida showing a maximum of 40 000 cells in sample T 20. Rhizosolenia delicatula and R. hebetata were present all over, the latter showing very high numbers in the N-samples, collected closely inshore. In station N 70 Leptocilindrus danicus occurred in great numbers (>400 000 cells per litre), but did not occur anywhere else in the area.

August. There was a high diversity of phytoplankton species now. Among the Ceratium spp. : Ceratium fusus dominated over C. furca and C. horridum. Peridinium claudicans, Protoperidinium conicus, Peridinium monospinum and Protoperidinium steinii were the most important Peridinium species and in C 30 and E 30 the beautiful Polykrikos schwarzi reached respectively 7 000 and 4 200 cells per litre. Asterionella glacialis is very numerous, millions of cells per litre were present in most of the samples. In small amounts Bacteriastrum hyalinum, Odontella mobiliensis, Cerataulina bergonii, Guinardia flaccida were occurring in different samples. Leptocilindrus danicus came closely inshore. In the whole area Lauderia annalata, Nitzschia seriata, Rhizosolenia delicatula, R. hebetata and Skeletonema costatum were present in fair numbers, whereas Rhizosolenia imbricata and R. stolterfothii were only observed in the Terheijden and in the Noordwijk alignments.

September. Besides Ceratium spp. already occurring in August, among which C. furca and C. fusus were quantitatively the most important. Dinophysis acuta made its appearance in numbers up to 9 000 cells per litre. Prorocentrum micans maximum 10 000 cells per litre and Pr. redfieldii maximum 6 300 cells per litre, whereas Peridinium mite and Protoperidinium trochoidum did not reach more than a thousand of cells per litre. The same diatoms as observed during August were present, be it now in smaller amounts.

October. Phacocystis pouchetii was only incidentally found in October. The Ceratium spp. and Dinophysis acuta were present in the same composition as recorded for September. Prorocentrum redfieldii, however, reached in this period a maximum of up to 30 000 cells per litre. Small amounts of diatoms were recorded in the southern part of the area. Most species of diatoms were found in the C- and E-lines.

Ditylum brightwellii, Leptocilindrus danicus, Nitzschia seriata and Rhizosolenia delicatula reached an average of 4 000 cells per litre. Of Nitzschia closterium, Pleurosigma angulatum, Rhizosolenia hebetata and R. stolterfothii smaller numbers were observed. In consequence of gales in the month of November, the last set of samples for 1973 was collected in December.

December. In this winter month too the Ceratium spp. were reasonably represented. The diatom population was reduced to species such as Melosira sulcata and Podosira stelliger, whereas Odontella aurita, O. regia and O. sinensis appeared in modest numbers only in the phytoplankton pattern. Rhizosolenia firma was very rare in this region.

1974

February. In the whole area Melosira sulcata, Podosira stelliger, Actinoptychus undulatus were present. In the northern part Ceratium fusus and Coccolithus pelagicus were found to occur sporadically and in the southern part development of the diatoms Thalassiosira, Odontella and Rhizosolenia was observed.

March. Several species of diatoms are developing in the northern part of the area of investigation: Cerataulina bergonii, Chaetoceros curvisetum, Ch. danicum, Ch. decipiens, Ch. densum, Ch. radians, Coscinodiscus granii, C. radiatus, Ditylum brightwellii, Eucampia zodiacus, Lauderia annulata, Leptocilindrus danicus, Odontella regia, Plagiogramma vanheurckii, Rhizosolenia delicatula, Rh. fragillissima, Rh. imbricata, Rh. stolterfothii. Their numbers varied from 1 000 - 20 000 cells per litre. In the whole area were present: Fragillaria oceanica, Melosira sulcata, Nitzschia closterium, Pleurosigma angulatum, Podosira stelliger, Rhizosolenia hebetata, Thalassionema nitzschioides and Distephanus speculum. In the regions of the C- and E-alignments the calcico-flagellate Cocolithus pelagicus has been recorded.

April. Nearly all diatoms recorded during March appeared to be still present. Cerataulina, Ditylum, Guinardia, Odontella and Rhizosolenia up to 10 000 cells per litre. Only in sample A 10, Cosinodiscus concinnus was observed, while Schroderella schroderi and Skeletonema costatum were only scantily distributed in the area with the exception of the stations of the C-alignment.

Phaeocystis pouchetii is present in smaller or greater numbers all over the area, sometimes in great abundance; in one sample viz. N 30 this micro-organism dominated in the pattern.

Dinoflagellates were observed in small numbers only: Gymnodinium heterostriatum, Katodinium glaucum, Gyrodinium spirale, Protoperidinium conicus, P.pellucidum, Prorocentrum micans and Torodinium robustum. The ciliate, Mesodinium pulex present in the samples of every alignment, failed in the areas in close proximity of the mouths of the rivers Meuse and Rhine.

During May diatom populations were decreasing and quite a few species mentioned for March were failing now, so did Phaeocystis pouchetii. Katodinium glaucum and Noctiluca miliaris were observed in the whole area, whereas Prorocentrum micans and Torodinium robustum were maintaining their positions in C-, E-, N- and T-alignment samples.

In many of the samples collected 30 km offshore, there was a flagellate flora of an unidentified species predominated.

June. From the north, development of several Ceratium species was observed, among which Ceratium fusus appeared to be spread over the whole area. Although present in the whole area, Noctiluca miliaris did not reveal larger numbers, neither did Peridinium, Prorocentrum, Phalacroma, Dissodinium and Torodinium, whereas Katodinium glaucum showed increasing numbers in the samples E 20 and E 30 of up to 15 000 cells per litre. Of some importance were the diatoms: Cerataulina bergonii, Eucampia zodiacus, Guinardia flaccida, Leptocilindrus danicus, Rhizosolenia imbricata and Rh. stolterfothii of which Leptocilindrus showed in sample N 20 a real explosion up to 200 000 cells per litre. Rhizosolenia stolterfothii reached in the sample taken at 70 km offshore a maximum of about 100 000 cells per litre. Samples collected at the same time in the English Channel showed predominance of Rhizosolenia stolterfothii. These records reveal a certain relation between the areas. Mesodinium pulex was in some samples present in great numbers.

July. Increasing numbers of Ceratium fusus (5 000 cells per litre) were accompanied by Katodinium glaucum. The latter reached in sample E 20 a level of 26 000 cells per litre. Development of other Ceratium species, for instance Ceratium lineatum was limited to the northermost regions with a maximum of 2 000 cells per litre. Peridinium, Phalacroma, Polykrikos and Dissodinium were recorded in smaller numbers. Only 3 species of diatoms were qualitatively of some importance and distributed over the area. Guinardia flaccida revealed a maximum in E-slignment closely inshore with 35 000 cells per litre. In the A-alignment samples, Rhizosolenia delicatula reached a maximum of 40 000 and Rh. imbricata revealed an outburst of up to 156 000 cells per litre. This condition for a Leptocilindrus bloom remained favourable, as some samples clearly revealed and so it was for Mesodinium. A second bloom of Phaeocystis pouchetii did not reach such high concentrations as observed in April.

August. A mass development of Ceratium fusus made its appearance in August, counts of 200 000 cells per litre being made in the samples T 30 and E 20. It appeared that the inshore area did not favour the development of Ceratium horridum. Up to 8 000 of this micro-organisms per litre were found in samples 70 km offshore, whereas in the samples nearest to the coast only some 1 000 cells per litre could be counted. The same quantities were found of Gymnodinium, Peridinium and Dinophysis, occasionally also of Prorocentrum micans, which micro-organism occurred in A 30 with 4 000 cells per litre.

September. The second diatom bloom came into being with a mass development of Rhizosolenia delicatula (4 millions of cells per litre) in S 10 and 60 000 Rhizosolenia imbricata in samples of C- and E-alignment. These are the most important representatives of the diatom population, besides Cerataulina bergonii, Eucampia zodiacus, Leptocilindrus danicus, Asterionella glacialis and Nitzschia seriata. While Ceratium spp. occurred in decreasing numbers only, a true explosion of Prorocentrum micans and P. redfieldii took place respectively with 3 600 and 16 000 cells per litre, in the area of the E 20.

October. The diatom flora of October appeared to be in general qua composition equal to that of September, the numbers of species were, however, on the decrease. The "newcomers" in the autumn bloom were Chaetoceros, Odontella and Stauroneis membranacea. The latter showed in sample C 30 a maximum with 20 000 cells per litre. Silico- and calcico-flagellates were sometimes appearing over the whole area.

November. The phytoplankton in November was characterized by a high level of diversity. This was due to dinoflagellate species such as: Dinophysis, Exuviaella, Gymnodinium, Gyrodinium, Peridinium, Phalacroma, Polykrikos, Pouchetia, Prorocentrum, Dissodinium and Torodinium and to the diatom species: Actinoptychus, Chaetoceros, Coscinodiscus, Ditylum, Guinardia, Leptocilindrus, Melosira, Nitzschia, Odontella, Podosira, Rhizosolenia and Thalassionema. Most of these species are quantitatively below 10 000 cells per litre, except Rhizosolenia delicatula, of which in sample A 70 35 000 cells per litre were recorded.

1975

The first survey in the year 1975 was made in April. Due to a period of bad weather only samples of Appelzak- and Schouwen-alignment could be collected. The most remarkable dinoflagellates in this area were Prorocentrum micans, Torodinium robustum with some Peridinium spp. . Of the diatoms Odontella regia, Rhizosolenia stolterfothii (40 000 cells per litre), Thalassionema nitzschioides (13 000 cells per litre), Nitzschia delicatula (35 000 cells per litre) and Rhizosolenia imbricata (9 500 cells per litre) were present especially in samples S 70 and S 30, whereas Phaeocystis pouchetii was dominating. The samples of the Appelzak-alignment were difficult to analyze because of admixture with suspended matter.

May. A mass development of Cerataulina bergonii was recorded in samples C 10, E 10, N 10 and T 10, reaching a maximum of 300 000 cells per litre, whereas in the southern part of the investigated area less than 5 000 cells per litre were counted. Rhizosolenia stolterfothii was, however, best developed in A 10, 114 000 cells per litre. In northern sector the diatom occurred in declining numbers: in T-alignment 80 000 cells per litre were encountered. In smaller numbers Guinardia flaccida was observed with a maximum of 10 000 cells per litre in Callantsoog-alignment.

Eucampia zodiacus was spreading in the area and reached a few thousands of cells per litre in some sampling stations. Although small in numbers, dinoflagellates occurred in this period in several species such as Ceratium lineatum, Diplopsalis lenticula, Protoperidinium conicum, Dissodinium pseudolunula, Torodinium robustum, Gyrodinium spp., Peridinium spp.; Prorocentrum micans was sporadically observed.

June. The two diatom species which showed a strong development during the month of May, had increased so much that half a million cells per litre were counted of Cerataulina bergonii in sample T 10. In the area 70 km offshore Rhizosolenia stolterfothii was encountered in quantities of over 100 000 cells per litre. Closely inshore this diatom occurred in declining numbers; a maximum of 10 000 cells could be recorded. The only exception in this region was sample T 10 with 57 000 cells per litre. Individuals of Rhizosolenia delicatula were distributed throughout the whole area, but station C 70 showed a maximum with 66 000 cells per litre, sample T 10 showed half that much cells viz. 33 000 cells per litre. It was striking, that Eucampia zodiacus and Guinardia flaccida occurred in sample T 10 in ten-fold concentration as compared with the samples of the remaining part of the area investigated.

July. Samples of July showed a relatively low phytoplankton density. Ceratium spp. was still present and Ceratium fusus considered as a commonly occurring species, failed completely during this period. In general the species diversity was rather high in the offshore stations of every investigated alignment, where the numbers of individuals of every species did nowhere exceed 1 000 cells per litre. The small Protoperidinium bipes made an exception and 11 000 cells per litre were present in C 70. Katodinium glaucum, the nakes dinoflagellate revealed in T 20 a strong development, 23 000 cells per litre being recorded. A real explosion of Leptocilindrus danicus was observed in both northern alignments, whereas a maximum of almost one million individuals being counted in sample E 20. In the remaining part of the investigated area, this diatom was only sporadically encountered. Also Rhizosolenia imbricata favoured the northern regions of the investigated area, high concentrations of up to 40 000 cells per litre were found in C 70 and E 70. Five Rhizosolenia spp. were observed in Appelzak- and Schouwen-alignment, from which Rhizosolenia delicatula was the most numerous in sample A 30 (58 000 cells per litre) whereas the number of Rh. imbricata did not exceed 12 000 cells per litre. Rhizosolenia hebetata and R. setigera developed very modestly and did not exceed 7 000 respectively 1 500 cells per litre. Rhizosolenia stolterfothii was only sparsely found. Small unidentified flagellates abounded throughout the area investigated.

August. Although the development of the Ceratium spp. was not more than modest in August, up to a few thousands of cells were counted in samples of Callantsoog- and Egmond-alignment. It was remarkable that Ceratium fusus and Katodinium glaucum were not seen in Appelzak-alignment. Noctiluca miliaris was present all over.

The greatest number of individuals of Dinophysis acuta were recorded for C 20 viz. 1 500 cells per litre. The diatoms Guinardia flaccida and Rhizosolenia imbricata were dominating species now. Of the first mentioned species the mean number was almost 10 000 cells per litre, whereas Rhizosolenia imbricata revealed 25 000 cells in Callantsoog alignment and a maximum of 120 000 cells per litre in sample N 70. Rhizosolenia delicatula, not present in every sample, showed in T 30 up to 34 000 cells per litre, and from the small diatom Skeletonema costatum 336 000 cells per litre were counted in T 10. No concentration higher than that was recorded in any sample so closely inshore in 1975. The remarkable numbers of 120 000 cells of the ciliate Mesodinium pulex was noted for sample N 10. Phaeocystis pouchetii was found in modest numbers in only few samples.

September. Phytoplankton density in September had increased a little in comparison with the preceding month. The overnight appearance of Ceratium fusus reached in the samples C 10 and E 10 up to 10 000 cells per litre; Ceratium furca reached a maximum in sample T 30 of 4 500 cells per litre, and C.horridum was very numerous in sample E 20, where 23 000 cells per litre were found. There was an increase of Dinophysis sp. and development of Exuviaella apora 55 000 cells per litre from which the nucleus of the bloom was situated in sampling station C 30. This micro-organism was only sporadically noticed and failed in the southern part of the area investigated. The most amazing development was observed of Prorocentrum redfieldii showing in sample N 10 952 000 individuals per litre! In comparison with the years 1974 and 1973, the increase of this bivalved dinoflagellate is enormous. Prorocentrum micans was mostly present in a few thousand of cells in several samples. In this period the diatom Cerataulina bergonii was dominating. Present in every sample, this micro-organism occurred with 1 500 000 cells per litre in C 20, with one million in E 20 and in the samples N 10 and T 30 with 900 000 cells per litre, in this way showing a very extended area of mass development. Guinardia flaccida was usually present in the samples collected 70 km offshore of every alignment, where in sample N 70 a maximum was recorded with 136 000 cells per litre. Ditylum brightwellii appeared only in regions of Appelzak- and Schouwen-alignment. The nucleus of the Rhizosolenia imbricata bloom had moved to the north and situated in C 30 where 68 000 cells were still present. Rhizosolenia delicatula and R. stolterfothii were not encountered in every sample and their maximal quantities were respectively 10 000 and 5 000 cells per litre. Skeletonema costatum was found in most of the stations, but in none of the samples the numbers of cells reached values as high as those recorded in the autumn of 1973. The µ-flagellates were very numerous mostly from 10^5 to 10^6 cells were counted per litre.

October. Samples of October 1975 showed a decline in Ceratium spp. no more than 1 000 cells per litre were enumerated. Exuviaella apora is no longer limited to the most northern regions, but had extended its range over the whole area of investigation. It occurred with 10 000 cells per litre in several samples as E 10, N 30, N 70 and T 30. Most species of the genus Peridinium were present

in S 30, while they occurred only sporadically in the remainder of the area. Both Prorocentrum species viz. P. micans and P. redfieldii had decreased very much, but of the latter species 4 000 cells per litre were counted in A 20. In the samples of Noordwijk-alignment this micro-organism was completely absent. Most of the diatom species were present in Appelzak- and Schouwen-alignment, viz. Asterionella glacialis, Chaetoceros spp., Ditylum brightwellii, Eucampia zodiacus, Rhizosolenia imbricata, Stauroneis membranacea and Stephanopyxis turris, all together favouring a high degree of diversity. Odontella spp. appeared only in the C alignment. Over the entire area Melosira sulcata, Podosira stelliger, Pleurosigma angulata and Rhizosolenia robusta are encountered in reasonable numbers. Rhizosolenia stolterfothii was still occurring in the stations 70 km offshore. The Calcico-flagellate Coccolithus pelagicus had its maximum in sample E 70 with 21 000 cells per litre, whereas this species failed in Schouwen- and Appelzak alignment Distephanus speculum was more frequently observed. In decreasing amounts the µ-flagellates were found in all samples.

November. Ceratium spp. were still present in quantities equal to those recorded for October (< 1 000 cells per litre). Increasing numbers were, however, observed of Exuviaella spp. and Gyrodinium spp. The total count of Exuviaella apora and E. perforata reaching 14 000 cells per litre in N 30 whereas Gyrodinium calyptoglyphe reached up to 10 000 cells per litre. Prorocentrum redfieldii showed 5 000 cells per litre in the samples N 10 and N 20. Fewer dinoflagellates were encountered in Appelzak- en Schouwen-alignment. During the winter period it was almost impossible to analyze the samples of Appelzak-alignment, because of a strong admixture with detritus. In general Guinardia flaccida, Rhizosolenia delicatula, Rhizosolenia robusta and Thalassionema nitzschioides were scattered over the total area of investigation showing no more than 1 000 cells per litre. Coccolithus pelagica had again a high score of 23 000 cells per litre in sample T 30. The appearance of microcytair bluegreen algal colonies recurred in this period.

December. A rather poor phytoplankton had been expected for the month of December. Nevertheless the amount of dinoflagellates was surprising, most samples revealed Ceratium spp., Exuviaella perforata, Gyrodinium calyptoglyphe, G. spirale, Prorocentrum micans, Torodinium robustum, Phalacroma rotundatum, and Peridinium punctulatum. Scarcely occurring were the diatoms Odontella spp., Coscinodiscus concinnus, Guinardia flaccida, Rhizosolenia stolterfothii, Streptotheca tamesis and Thalassionema nitzschioides. Even the Calcico flagellate Coccolithus pelagicus was still present. The phytoplankton of Schouwen- and Appelzak-alignment was less rich, due to large amounts of detritus.

1976

February. The phytoplankton pattern of February showed dominance of litoral diatoms mostly Melosira sulcata, Thalassiosira nitzschioides was also occurring in the total area of investi-

gation, however, reaching its highest concentration in Callantsoog- and Egmond-alignment, viz. 10 000 and 20 000 cells per litre.

Odontella sinensis was mostly found in the northern part of the area, in the south part there were more Rhizosolenia spec. namely R. hebetata and R. imbricata. About 10 species of dinoflagellates were, although not numerous, dispersed in the area. Most of them occurred in Noordwijk- and Callantsoog-alignment.

March. Increase of all phytoplankton species which occurred already in the month of February Thalassionema nitzschioides was revealing 50 000 cells per litre in 30 km offshore samples. Modest development of Asterionella glacialis, A. kariana and Skeletonema costatum was found in the total area. In several sampling points Thalassiosira spp. were appearing from which Thalassiosira nordenskjöldii was the most numerous species in the Egmond alignment. In both Callantsoog- and Egmond-alignments most of the Odontella sp. were encountered, particularly O. aurita, O. regia and O. sinensis. No more than 2 000 cells per litre of each species were counted. Prorocentrum micans was not depending of temperature as it was to see in sample C 30 where 2 000 individuals were present. Torodinium robustum was ubiquitous and showed already 1 000 cells per litre. Dinoflagellates were lacking in Terheijden and Noordwijk alignments. Coccolithus pelagicus, Ebria tripartita and some ciliates were present in very low concentrations. Phaeocystis pouchetii was developing in the Egmond alignment samples, no dominance of this species was observed.

April. More species were present in relation to the month of March although there was no strong development of each species. Gyrodinium spirale and Torodinium robustum were present in the total area. In sample T 30 G. spirale 5 000 cells per litre were counted, whereas Torodinium robustum reached not more than 1 000 cells per litre. In some nearshore sampling points Asterionella glacialis was very numerous (T 10 250 000 cells per litre in C 10 34 000 cells per litre). In most of the samples Chaetoceros spp. were observed, moreover in the southern part of the area Rhizosolenia spp. were dominating. Development of Phaeocystis pouchetii in sampling point T 10 was rather numerous.

May. Both Gyrodinium spirale and Torodinium robustum did not change in comparison with records of April, except sampling point C 30 where the dinoflagellate increased till 21 000 cells per litre. Decreasing amounts of Asterionella glacialis were found. Nitzschia, Plagiogramma, Pleurosigma, Podosira occurred modest in the total area, while Chaetoceros spp. mostly appeared in the Egmond and Noordwijk alignment. The sampling points A 30 and S 30 showed of Rhizosolenia delicatula, viz. 400 000 and 124 000 cells per litre. Schroderella schroderi was scattered in the area. While Skeletonema costatum appeared mostly in Terheijden alignment in T 10 with 25 000 cells per litre. Flagellates occurred in the total area, although they were most numerous in the nearshore samples.

June. did not reveal a great diversity in phytoplankton. The most remarkable species were Lauderia, Rhizosolenia, Chaetoceros, in less extent occurred Guinardia and Eucampia. Lauderia annulata mostly appeared in the samples T 10 en T 20 where at least 500 000 cells per litre were encountered. Strong development was also found in A 30 where 370 000 cells per litre and in N 10 where 260 000 cells per litre were counted. In the other nearshore samples not more than 1 000 cells per litre were present and in the 70 km offshore samples Lauderia sp. did not even occur. In the total area Rhizosolenia delicatula was present in mean quantity of a few thousands per litre except in sample E 70 where 350 000 cells per litre were recorded. The highest concentrations of Rhizosolenia imbricata were found in the area of 20 - 30 km offshore, the density of this diatom came to 20 000 till 50 000 cells per litre. Eucampia zodiacus was ranging between 1 000 - 6 000 cells per litre in the total area. Chaeroceros densus appeared mostly in Appelzak alignment while of the same genus Chaetoceros, C. decipiens only occurred in the northern part of the area of investigation. The dinoflagellates Ceratium fusus, Dinophysis acuta and some Peridinium spp. occurred only in C alignment, while Katodinium glaucum, Gyrodinium spirale and, Torodinium robustum have a more ubiquitous character. It was striking that Prorocentrum minimum was only found in sample N 20.

July. The midsummer phytoplankton pattern did not show much variety since last month. Lauderia annulata, Rhizosolenia delicatula and R. imbricata have maintained, although the nucleus of the R. delicatula bloom was now situated in the Appelzak alignment where sample A 20 presented 200 000 cells per litre, in the Noordwijk and Terheijden areas 50 000 cells per litre were counted, while in the remaining sampling points no higher concentrations were found than 10 000 cells per litre. The amount of Rh. imbricata was a manifold in 30 km offshore samples in relation to the same samples in June. The more nearshore samples were showing a decrease and spt was at the ends of the alignments in the 70 km samples. Guinardia flaccida and Eucampia zodiacus did not appear in every sampling place, no more than 4 000 cells per litre were counted. Ceratium fusus was dispersed now in the total area, it was, however, quantitatively not numerous. The ubiquitous unarmoured dinoflagellates Katodinium glaucum and Gymnodinium simplex were presenting a more or less explosion in sample C 10 where 100 000 - 200 000 cells per litre were recorded. The content of sample E 70 is conspicuous by the presence of Ceratium furca Prorocentrum redfieldii and Prorocentrum minimum, while those micro-organisms did not occur anywhere in the area of investigation. In the same sample Protoperidinium trochoideum was more or less exploded 12 000 cells per litre were counted and a lot of cysts of this dinoflagellate were present. In the "heighbouring" samples C 70 and N 70 no more than 1 000 cells of Protoperidinium trochoideum were found. In the total area flagellates were occurring. Mesodinium pulex concentrations were roughly estimated highest in sample N 10.

August. Occurring in every alignment Rhizosolenia spp. namely R. delicatula, R. imbricata and R. stolterfothii; Chaetoceros spp., Bacteriastrum hyalinum and Eucampia zodiacus were mostly present in the northern part of the area. Guinardia flaccida and Leptocilindrus danicus were dispersed in the total area. Asterionella glacialis and Ditylum brightwellii and Skeletonema costatum were only present in the Appelzak alignment. Different species of Thalassiosira appeared in several sampling places dispersed in the area. Stephanodiscus palmeriana was sporadically seen. The dinoflagellates Ceratium fusus, C. furca, Dinophysis acuta and D. acuminata stayed extended now till 3 most northern alignments of the area. Some Peridinium spp. appeared more frequent in the southern part. In the whole area Protoperidinium trochoideum was found, although in low numbers. Prorocentrum micans is present in the Appelzak and Schouwen alignment, but not numerous, while Prorocentrum redfieldii is more developed in the northern alignments and so were Phaeocystis pouchetii and Emiliania huxleyi. Sporadically observed were Torodinium robustum and the Coccolithophorid: Coccolithus pelagicus.

September. Several diatom species are present in great numbers but they did not occur in every sampling point. Asterionella glacialis now appeared in highest concentration in C 20 50 000 cells per litre and is lacking in the Appelzak alignment now, and so is Bacteriastrum hyalinum with concentrations of 1 500 cells per litre. Chaetoceros spp. strongest development in C 20 and E 20, total concentration of up to 120 000 cells per litre. Chaetoceros debile was dominating in the sample. In the total area Coscinodiscus spp., Ditylum brightwellii, Eucampia zodiacus, Guinardia flaccida, Lauderia annulata were scarcely distributed. Nitzschia closterium and N. longissimum were mostly present in the samples 70 km offshore. Whereas the more nearshore samples revealed mostly Nitzschia seriata. Rhizosolenia delicatula showed diminishing values. Only sample C 10 was high in cell number, namely 76 000 cells per litre, in the remaining part of the area cell numbers are varying between 1 000 and 10 000 cells per litre. Rhizosolenia stolterfothii was only observed at the end of the alignment. The cell number is up to 10 000 cells per litre. Mass development of Ceratium furca in C 10 nearly 100 000 cells per litre in both northern alignments, this micro-organism was present up to 10 000 cells per litre, in the remaining area C. furca showed cell numbers of 1 000 cells per litre. The mean concentration of Ceratium fusus came to 2 000 cells per litre. Dinophysis sp. Prorocentrum micans, P. redfieldii and P. minimum were also highest in cell number in the samples C 10 and E 10. The amounts of cells of Dinophysis sp. were 44 000 in C 10 and 15 000 in E 10. Prorocentrum micans was respectively 16 000 and 25 000. Of P. minimum the cell numbers were 35 000 and 9 400 and P. redfieldii revealed in the same samples viz. 13 000 and 15 000 cells per litre. Of those species mean cell numbers were about 1 000 cells per litre. No high cell numbers were counted of Katodinium glaucum, Gyrodinium spirale and Torodinium robustum, although they were present in most of the samples. Coccolithus pelagicus and Emiliania huxleyi were sporadically observed. Different flagellate species were numerous.

October. Of all occurring phytoplankton species Rhizosolenia delicatula was dominating in several of the most offshore samples. Up to 100 000 cells per litre were counted in the samples E 70 and T 70, in the nearshore samples the mean cell number was 10 000 and in the southern part of the area in sample S 30 38 000 cells, in A 10 and A 20 65 000 cells per litre were counted. The cell number of Rh. stolterfothii were much smaller in C 30 revealing 12 000 cells per litre, in the remaining samples, cell numbers stayed from 2 000 - 6 000 per litre.
Of R. hebetata, R. imbricata and R. robusta present in some of the samples the cell number did not extend 2 000 per litre.
Most of the Chaetoceros species appeared principally in the Appelzak and Schouwen alignment. Of the species: Ch. debile, Ch. decipiens, Ch. densum , Ch. didymum, Ch. sub secundum the cell number did not exceed 10 000 cells per litre, except Ch. radians which was much higher in cell number. Odontella sinensis and Thalassiosira spp. appeared both in the Schouwen and Callantsoog alignment in the remaining samples only sporadically. Litoral benthic diatoms just as Actinocyclus ehrenbergii, Melosira sulcata and Podosira stelliger, Ceratium species and Dinophysis species were found only in the four northern alignments of the area. Ceratium furca reached a mean cell number of 1 000 cell per litre and so is Dinophysis. Ceratium fusus was quantitatively equal, but was lacking in the offshore 70 km samples. Ceratium horridum was sporadically present in the Callantsoog alignment. Very dispersed were Gymnodinium, Gyrodinium and Peridinium spp. it seemed to be that mostly the samples with highest salinity were favoured. Prorocentrum micans was scarcely present, Pr. redfieldii was present in the total area of investigation, no more than 2 000 cells were counted, the same pattern was followed by Torodinium robustum. Flagellates nom det. occurred everywhere. During this period the highest concentration of about 500 000 cells per litre was in general found in the 30 km offshore samples. The 70 km offshore samples did not show more than 1/10 of the cell number mentioned in the 30 km samples.
Coccolithum pelagicus were mostly present in the Callantsoog and Egmond alignment where sample E 30 presents 14 000 cells per litre. In the Noordwijk and Terheijden alignments cell numbers were decreasing and in the Schouwen and Appelzak alignment the Coccolithophorids were not present at all. In this area Distephanus speculum appeared, which was just lacking in the northern part of the area. Microcytair (blue green?) colonies were dispersed in the total area.

November. The only difference between October and November phytoplankton pattern was that during October density was highest in the Schouwen and Appelzak alignment, in November the distributions were more equal, that means that of Chaetoceros sp., Coscinodiscus concinnus, C. granii, Ditylum brightwellii, Eucampia zodiacus, Guinardia flaccida, Lauderia annulata, Odontella, Rhizosolenia robusta and R. stolterfothii, Thalassionema nitzschoides low concentrations of about 500 - 2 000 cells per litre were recorded.

occurred in the total area,

Rhizosolenia delicatula was present in increasing numbers, where sample E 70 showed the most extreme concentration of 36 000 cells per litre. The "neighbouring" samples C 70 and N 70 presented respectively 4 500 and 6 000 cells per litre. The dinoflagellates Ceratium furca and C. fusus were still present in small quantities in four of the most northern alignments. Prorocentrum micans and P. redfieldii were sporadically observed. In the total area, Gyrodinium spirale and Torodinium robustum maintaining in varying quantities up to 1 500 cells per litre. Scattered in small numbers are Coccolithus pelagicus and Distephanus speculum. No difference was observed in the amount of the total flagellates in relation to the October period. Microcytaire (blue green?) colonies were still present.

Some specific remarks

Some remarks are to be made about the characteristics of some species.

1. Cerataulina bergonii appeared in September 1974 and in September 1975 in an unusual shape, the diameter of the valve being 7.5 - 10 µ, the pervalvar axis measuring 34 - 40 µ (normally the valva diameter is 40 - 50 µ and pervalvar axis measured 60 - 100 µ). The featuring processes on the valve were rudimentary and often lacking at all. In that case the shape of Cerataulina bergonii showed resemblance to Leptocilindrus danicus. In general the latter appeared, even in fixed samples, in more solid chains.

2. In the developing period of Ceratium horridum, young stadia of this species appeared with apical and antapical horns of different length, which was expected. Sometimes the angle formed by the two antapical horns appeared to be wider, than was given in the description of Ceratium horridum, it is therefore easily mistaken for other species of the genus Ceratium.

   In a few cases both apical and antapical horns were branched.

3. The, in Coscinodiscus concinnus developing fungus, Lagenisma coscinodisci was only sporadically observed.

LIST OF SPECIES

Bacillariophyceae

Actinocyclus ehrenbergii Ralfs
Actinoptychus splendens (Shadb.) Ralfs
Actinoptychus undulatus (Bail.) Ralfs
Asterionella formosa Hassall
Asterionella glacialis Castracane
Asterionella kariana Grunow
Aulacodiscus argus (Ehrenberg) Schmidt
Auliscus sculptus (Wm. Sm.) Ralfs
Bacillaria paradoxa Gmelin
Bacteriastrum hyalinum Lauder
Bacteriastrum hyalinum var. princeps (Castr.) Ikari
Bellerochea malleus (Brightw.) v. Heurck
Cerataulina bergonii Peragallo
Chaetoceros compressum Lauder
Chaetoceros costatum Pavillard
Chaetoceros curvisetum Cleve
Chaetoceros danicum Cleve
Chaetoceros debile Cleve
Chaetoceros decipiens Cleve
Chaetoceros densum Cleve
Chaetoceros diadema (Ehrenberg) Gran
Chaetoceros didymum Ehrenberg
Chaetoceros eibenii (Grunow) Meunier
Chaetoceros lorentzianum Grunow
Chaetoceros pseudocrinitum Ostenfeld
Chaetoceros radians Schütt
Chaetoceros radicans Schütt
Chaetoceros sociale Lauder
Chaetoceros teres Cleve
Chaetoceros tortissimum Gran
Chaetoceros whigami Brightwell
Corethron criophylum Castracane
Coscinodiscus apiculatus Ehrenberg

Coscinodiscus biconicus Van Breemen
Coscinodiscus granii Gouch
Coscinodiscus perforatus Ehrenberg
Coscinodiscus radiatus Ehrenberg
Coscinosira polychorda (Gran) Gran
Cyclotella striata (Kützing) Grunow
Cymatosira belgica Grunow ex van Heurck
Diploneis crabro Ehrenberg
Ditylum brightwelli (West) Grunow
Epithemia species
Eucampia zodiacus Ehrenberg
Fragillaria oceanica Cleve
Fragillaria species
Grammatophora marina (Lyngbye) Kützing
Guinardia flaccida (Castr.) Peragello
Gyrosigma fasciola (Ehrenberg) Cleve
Lauderia annulata Cleve
Leptocilindrus danicus Cleve
Leptocilindrus minimus Gran
Lithodesmium undulatum Ehrenberg
Melosira granulata (Ehrenberg) Ralfs
Melosira moniliformis (Müller) Agardh
Melosira sulcata (Ehrenberg) Kützing
Navicula species
Nitzschia acicularis Wm. Smith
Nitzschia closterium (Ehrenberg) Wm. Smith
Nitzschia delicatissima Cleve
Nitzschia longissima (Bréb.) Ralfs
Nitzschia seriata Cleve
Nitzschia species
Odontella aurita (Lyngbye) Agardh
Odontella mobiliensis (Bailey) Grunow
Odontella regia (Schultze) Simonsen
Odontella rhombus (Ehrenberg) Kützing
Odontella sinensis (Greville) Grunow
Plagiogramma brockmanni Hustedt
Plagiogramma vanheurckii Grunow

Pleurosigma angulatum Queckett Wm. Smith
Pleurosigma species
Pleurosigma species (395μ)
Podosira stelliger (Bailey) Mann
Raphoneis amphiceros Ehrenberg
Rhabdonema adriaticum Kützing
Rhizosolenia alata Brightwell
Rhizosolenia delicatula Cleve
Rhizosolenia firma Karst
Rhizosolenia fragillissima Bergon
Rhizosolenia hebeta (Bail.) Gran
Rhizosolenia imbricata (Shrubsolei)
Rhizosolenia robusta Norman
Rhizosolenia setigera Brightwell
Rhizosolenia stolterfothii Peragallo
Rhizosolenia styliformis Brightwell
Roperia tessalata (Roper) Grun. ex v. Heurck
Schroderella schroderi (Bergon) Pavillard
Sceletonema costatum (Grev.) Cleve
Stauroneis membranacea (Cleve) Hustedt
Stephanodiscus hantzschii Grunow
Stephanopyxis palmeriana (Grev.) Grunow
Stephanopyxis turris (Greville) Ralfs
Streptotheca tamesis Shrubsole
Thalassionema nitzschioides Grunow
Thallassiosira eccentrica (Ehrenberg) Cleve
Thalassiosira decipiens (Grun.) Jörg
Thalassiosira gravida Cleve
Thalssiosira hyalina (Grun.) Gran
Thalassiosira c.f. minima Gaarder
Thalassiosira nordenskjöldii Cleve
Thalassiosira polychorda (Gran) Jörgensen
Thalssiosira rotula Meunier
Thalassiosira tenera Proschkina-Lavrenko
Triceratium favus Ehrenberg
Trigonium alternans (Bailey) Mann

Dinophyceae

Amphidinium herdmanni Kofoïd and Swezy
Amphidinium dentatum Kofoïd and Swezy
Amphidinium scissum Kofoïd and Swezy
Amphidinium truncatum Kofoïd and Swezy
Ceratium articum (Ehrbg) Cleve
Ceratium furca (Ehrenberg) Cl. and Lachmann
Ceratium fusus (Ehrenberg)
Ceratium horridum (Cleve) Gran.
Ceratium lineatum (Ehrenberg) Cleve
Ceratium longipes (Bailey) Gran.
Ceratium macroceros (Ehrenberg) Vanhöffen
Ceratium tripos (O.F. Müller) Nitzsch.
Ceratium tripos v. atlantica Ostenfeld
Cochlodinium c.f. brandti Wulff
Cochlodinium c.f. vinctum Kofoïd and Swezy
Cochlodinium species
Dinoflagellata cyste spec. div.
Dinophysis acuminata Claparède and Lachmann
Dinophysis acuta Ehrenberg
Dinophysis norvegica Claparède and Lachmann
Dinophysis ovum Schütt
Dinophysis punctata Jörgensen
Dinophysis rotundata Clap. and Lachmann
Dinophysis species
Diplopsalis lenticula Bergh
Diplopsalopsis orbicularis (Paulsen)
Diplopeltopis minor Lebour
Dissodinium pseudolunula Swift
Exuviaella apora Schiller
Exuviaella compressa (Bailey) Ostenfeld
Exuviaella perforata Gran
Gonyaulax spinifera (Cl. and L.) Diesing
Gymnodinium abbreviatum Kofoïd en Swezy
Gymnodinium heterostriatum Kofoïd en Swezy
Gymnodinium hyalinum Lebour
Gymnodinium lebouri Pavillard

Gymnodinium marinum Saville Kent
Gymnodinium rhomboides Schütt
Gymnodinium simplex (Lohm.) Kofoïd en Swezy
Gymnodinium splendens Lebour
Gymnodinium variabile Herdman
Gyrodinium britannia Kofoïd en Swezy
Gyrodinium calyptoglyphe Lebour
Gyrodinium cochlea Lebour
Gyrodinium cuneatum Kofoïd and Swezy
Gyrodinium fissum (Levander) Kofoïd and Swezy
Gyrodinium lacryma (Meunier)
Gyrodinium obtusum (Schütt) Kofoïd and Swezy
Gyrodinium pingue (Schütt)
Gyrodinium spirale (Bergh)
Katodinium glaucum (Lebour) Loeblich III
Katodinium rotundatum (Lohmann) Loeblich
Mesoporus perforatus (Gran) Lillick
Minuscula bipes (Paulsen)
Nematodinium armatum (Dogiel) Kofoïd en Swezy
Nematodinium partitum Kofoïd en Swezy
Noctiluca miliaris Suriray
Peridinium achromaticum (Lemm) Paulsen
Peridinium claudicans Paulsen
Peridinium conicoïdes Paulsen
Peridinium curvipes Ostenfeld
Peridinium cyste
Peridinium denticulatum Gran en Braarud
Peridinium devaricatum Meunier
Peridinium excentricum Paulsen
Peridinium leonis Pavillard
Peridinium mite Pavillard
Peridinium monospinum Paulsen
Peridinium oblongum (Aurivillius)
Peridinium pallidum Ostenfeld
Peridinium pedunculatum Schütt
Peridinium pellucidum (Bergh) Schütt
Peridinium pentagonum Gran

Peridinium punctulatum Paulsen
Peridinium subinerme Paulsen
Peridinium thorianum Paulsen
Peridinium triqueta (Stein)
Peridinium trochoideum (Stein)
Phalacroma irregulare Lebour
Prorocentrum micans Ehrenberg
Prorocentrum minimum (Pavillard) Schiller
Prorocentrum redfieldi Bursa
Protoerythropsis vigilans Marshall
Protoperidinium bipes (Paulsen) Balech
Protoperidinium brevipes (Paulsen) Balech
Protoperidinium conicum (Gran) Balech
Protoperidinium depressum (Bailey) Balech
Protoperidinium divergens (Ehrenberg) Balech
Protoperidinium globulus (Stein) Balech
Protoperidinium oceanicum (Vanhoeffen) Balech
Protoperidinium ovatum (Pouchet) Balech
Protoperidinium steinii (Jörgensen) Balech
Polykrikos hartmanni Zimmermann
Polykrikos kofoïdi Chatton
Polykrikos schwartzi Butschli
Pouchetia species
Thecadinium kofoïdi Kofoïd and Skogsberg
Torodinium robustum Pouchet Kofoïd and Swezy
Warnowia species

Coccolithophoridae - Silicoflagellatae

Coccolithus pelagicus Ostenfeld
Distephanus speculum (Ehrenberg) Haeckel
Ebria tripartita (Schumn.) Lemmermann
Emiliania huxleyi (Lohmann) Kamptner

Flagellata etc.

Flagellata species div.
Phaeocystis pouchetii (Har.) Lagerheim
Pseudopedinella species

Pyramimonas species
Microcystis species
Chlorophyceae
Ciliaten not. dt.
Mesodinium pulex
Helicostomella fusiformis

1973

Stations	20 Feb		22 Mar		25 Apr		16 May		13 Jun		17 Jul		14 Aug		13 Sep		16 Oct		12 Dec	
	S. ‰	°C	S. ‰	°C	S. ‰	°C	S. ‰	°C	S. ‰	°C	S. ‰	°C	S. ‰	°C	S. ‰	°C	S. ‰	°C	S. ‰	°C
T 4	29,40	5,0	28,97	6,1	28,08	8,4	29,38	10,8	25,18	11	30,88	17,0	29,74	18,2	27,21	17,8	33,84	13,8	20,79	6,2
T 10	22,72	5,1	29,45	6,1	25,60	8,3		11,0	30,29	10,5	31,19	16,8	30,33	18,6	30,54	17,8	34,16	14,0	29,16	6,4
T 20	32,85	5,2	33,34	6,2	29,60	8,6	26,84	11,2	32,28	11	32,47	16,8	29,07	18,7	33,31	18,0	33,50	14,8	32,84	6,8
T 30	34,34	5,4	33,68	6,5	29,42	8,5	30,40	11,0	33,02	12	33,09	16,8	32,98	18,4	33,52	18,0	34,24	15,0	34,14	7,0
T 50											34,00	16,0								
T 70											35,00	15,6								
N 4	30,57	5,1	30,21	7,0	30,49	9,0	28,71	11,5	28,30	14,1	28,94	18,4	30,72	18,7	34,99	18,2	31,10	13,8		
N 10	31,86	5,1	32,12	6,5	30,97	9,2	28,05	10,9	29,74	14,0	30,67	18,2	32,49	18,5	31,91	18,2	31,75	14,1		
N 20	33,02	5,4	33,53	6,7	32,07	8,6	28,34	11,2	30,85	13,1	31,16	17,9	33,06	18,3	32,65	18,2	32,58	14,2		
N 30	34,49	5,8	33,91	7,0	32,06	8,9	31,02	11,3	33,72	13,1	31,60	17,8	33,44	18,4	32,17	18,1	33,48	14,2		
N 50												16,9								
N 70											34,86	15,8								
E 4	31,43	5,3	32,47	7	32,02	8,9	28,36	10,9	30,78	14,0	31,06	18,2	30,41	18,4	31,26	18,2	30,97	13,4	30,20	5,8
E 10	32,75	5,7	33,32	7	32,25	8,8	30,01	10,9	31,67	13,8	32,11	17,8	30,54	18,4	32,18	18,2	31,49	13,4	31,37	6,2
E 20	34,24	5,8	34,07	7	33,46	8,6	30,33	10,6	32,73	13,4	32,66	17,2	30,22	18,8	33,27	18,0	33,27	13,8	32,48	6,2
E 30	35,19	6,0	33,27	8	32,46	8,6	32,49	10,5	34,29	12,9	33,77	16,6	31,69	18,7	33,02	17,8	34,24	14,2	33,45	6,8
C 4	31,97	5,3	33,45	7	32,76	8,1	30,20	10,6	31,52	13,9	31,67	18,0	30,33	18,2	32,72	17,9	32,27	13,8	31,44	5,8
C 10	32,78	5,6	32,27	7	32,88	8,2	29,15	10,6	31,42	13,8	31,78	17,8	30,69	17,9	33,53	17,8	32,73	14,2	34,50	6,2
C 20	34,20	5,9	33,43	7	33,32	8,1	30,07	10,7	32,68	13,2	34,04	16,9	30,88	18,0	33,69	17,7	34,13	14,2	33,35	6,2
C 30	35,03	6,3	34,27	7,0	34,48	8,1	32,99	10,7	34,24	13,0	34,57	16,4	32,40	18,0	34,14	17,6	34,66	14,2	31,73	6,4

1974

Station	5-6-7- Febr.		12-13-14- March		9-10-11 April		14-15-16 May		13-14 June		9-10-11 July		6-7-8 Aug.		11-12-13 Sept.		1-2-3 Oct.		5-6-7 Nov.	
	S ‰	t°C	S ‰	t°C	S ‰	t°C	S ‰	t°C	S ‰	t°C	S ‰	t°C	S ‰	t°C	S ‰	t°C	S ‰	t°C	S ‰	t°C
C 3-4	31.07	6	31,87	5,5	32,27	9	32,05	12	32,09	14,5	30,29	17	31,92	18	-	17	31,87	14	30,41	9
C 10	31,54	6	31,99	5,5	32,73	9	31,80	12	33,68	14,5	32,59	16	32,10	18	-	17	32,48	14	33,10	10
C 20	33,86	6,5	33,92	6	33,84	9	33,52	12	33,60	14,5	33,41	16	33,93	18	-	17	34,84	15	34,41	11
CC30	34,27	6,5	34,94	6,5	34,39	9	33,17	12	33,58	14,5	34,72	16	34,36	18	-	17	35,07	15	34,98	11
C 70	-		35,21	7,5	35,35	9	35,30	11	35,24	13	-	-	34,85	16,5	-	17	35,13	15	34,39	11
E 3-4	29,84	-	30,86	5,5	30,64	9,5	30,79	12	31,16	15	28,03	17	30,08	18	-	17	31,30	14	28,76	9,5
E 10	31,11	-	32,25	5,5	32,15	9	31,14	12	32,98	14,5	30,70	17	31,22	18	-	17	32,26	14	30,99	10
E 20	33,08	-	33,27	6	33,18	9	31,61	12	33,03	14	32,41	17	33,27	18	-	17	34,25	14	32,34	10
E 30	33,77	-	34,32	6	33,79	9	33,35	12	32,93	14	34,58	16	33,77	17,5	-	17	35,03	15	34,29	11
E 70	-		35,21	7,5	35,33	9	35,34	11	35,26	13	-	-	34,84	16,5	-	17	35,11	15	34,52	11
N 3-4	30,52	5,5	30,43	6	30,65	10	28,98	12	29,56	15	26,91	18	30,56	18	-	17	31,20	14	28,98	10
N 10	32,35	5,5	31,09	6	31,12	9,5	29,70	12	30,24	14,5	26,98	18	31,32	18	-	17	31,78	14	29,32	10
N 20	33,18	6	32,04	6,5	32,42	9	31,13	12	32,23	14,5	31,81	16	32,11	18	-	17	33,50	14	31,62	10
N 30	34,23	6	32,91	6,5	33,57	9	31,64	12	32,80	14,5	32,65	16	33,09	18	-	17	34,79	15	33,73	11
N 70	-		35,11	7	35,28	9	35,29	11	35,28	14,5	35,14	15	34,95	17	-	17	35,09	15	34,95	11
T 3-4	30,66	6	28,92	6	29,18	9	27,02	11	30,94	14,5	26,08	17	29,40	18	-	17	30,35	14	24,33	10
T 10	33,18	6	25,95	6	31,23	9	29,15	11	30,23	14,5	32,25	17	29,33	18	-	17	31,44	14	26,20	11
T 20	34,31	6	30,59	6,2	32,35	9	31,49	11	29,31	14,5	31,86	16	33,37	17,5	-	17	34,66	14	28,65	10
T 30	34,45	6,5	32,10	6,2	33,34	9	33,60	11	30,26	14,5	33,42	16	33,45	17,5	-	17	34,80	14	33,48	11
T 70	-		35,18	7,5	25,27	9	35,22	11	35,27	14,5	34,94	15	35,03	17	-	17	35,07	15	35,02	11
S 5	-	6	32,92	6	32,16	9	32,57	11,5	-	-	32,29	17	32,76	18,5	-	17	33,87	13	31,61	10
S 10	-	6,5	33,30	6,5	33,10	8,5	32,49	11	-	-	32,42	17	33,44	18	-	17	33,97	14	31,00	11
S 20	-	7	33,90	7	33,79	8,5	32,97	11	-	-	33,05	17	33,83	18	-	17	34,55	15	32,71	11
S 30	-	8	34,54	7	34,40	9	33,60	11	-	-	33,61	16	34,31	17,5	-	17	34,83	15	34,28	11
S 70	-	9	35,25	8	35,19	9	-		-	-	35,09	15	35,09	17	-	17	35,03	15	35,07	11
A 4-5	-	6	31,74	5,5	31,08	9,5	31,03	11,5	-	-	31,58	17	32,06	18,5	-	16,5	32,87	14	29,56	9,5
A 10	-	6	32,78	5,8	32,72	9	31,44	11,5	-	-	31,89	17	32,95	18	-	16,5	34,54	14	30,68	10
A 20	-	6,5	32,95	6	32,83	9	31,66	11,5	-	-	32,46	17	33,02	18	-	17	34,14	14	31,68	10
A 30	-	7,5	33,23	6,5	32,92	8,5	32,92	11	-	-	33,50	16	34,04	18	-	17	34,74	14	32,30	10
A 70	-	9	35,10	8	35,25	9	34,76	11	-	-	35,13	15	35,22	17	-	17	35,05	15	34,89	11,5

L.S. Samples of September were fixed and therefore unsuitable to determine salinity.

1975

Station	24 April		28-29-30 May		16-17-18-19 June		14-15-17-18 July		12-13 Aug.		8-9-10-11 Sept.		6-7-8 Oct.		4-5 Nov.		8-9-10-11 Dec.	
	S ‰	t°C	S ‰	t°C	S ‰	t°C	S ‰	t°C	S ‰	t°C	S ‰	t°C	S ‰	t°C	S ‰	t°C	S ‰	t°C
C 3-4			31,56	12	31,58	15	29,06	18	31,42	20,5	30,71	19	29,98	16,2	30,57	12,2	30,97	8,2
C 10			31,72	12	31,39	15	27,63	18	32,11	19,5	31,36	18	31,85	15,9	31,95	12,9	31,19	8,7
C 20			33,43	11,5	33,33	14	33,36	17	33,59	19,5	33,03	18,5	33,53	15,6	33,35	13	33,39	9,6
C 30			33,93	11	34,20	13,5	34,25	16,5	34,12	19	33,94	18,5	33,99	15,9	33,73	13,1	33,65	9,2
C 70			34,32	11	34,94	13	34,49	16	34,37	17,5	34,18	18	34,13	16,2	33,42	13,9	34,59	10,6
E 3-4			31,72	12	30,41	15	27,27	18,1	30,83	20,5	29,00	19,5	29,94	16	29,89	12	30,23	8,3
E 10			32,43	12	31,60	15	30,63	18	31,33	19,5	30,33	19,5	31,13	15,9	30,66	12,2	31,60	8,6
E 20			33,32	12	32,68	14	31,02	17,9	32,23	19,5	32,25	18	32,86	16,5	32,16	12,6	32,81	8,8
E 30			33,88	11,5	33,79	14	33,48	17	33,01	19	33,48	18	33,67	16	33,42	13	34,92	10
E 70			34,98	11	34,94	13	34,32	15,5	34,43	18	34,09	17,5	34,18	16,5	34,70	14	34,85	10,5
N 3-4			30,51	12	29,34	15	25,82	18,5	28,62	21	28,15	19,5	28,66	16,5	29,25	12,6	28,99	8,3
N 10			31,13	12	31,12	14	28,99	18	29,56	21	28,90	19,5	30,12	15,9	29,68	12,7	29,27	8,4
N 20			32,56	12	31,58	14	31,18	17,5	30,49	20	30,00	19,5	32,25	16	30,86	12,8	30,77	8,7
N 30			33,57	11	32,88	14	32,84	17	31,91	20	32,15	19	32,43	16,5	33,20	13,4	33,72	9,3
N 70			34,96	11	34,78	13	34,15	16,5	34,23	18	33,94	18	34,53	16,2	34,86	14	34,94	10,3
T 3-4			30,37	12,5	29,48	14	27,16	17,3	25,45	20,5	28,49	19	29,13	16	29,38	12,7	25,67	7,9
T 10			30,91	12	29,40	14,5	30,93	17	28,10	20	29,89	18,5	31,24	15,9	30,84	12,8	29,48	8,3
T 20			32,25	12	32,18	14	32,27	17	31,16	19,5	31,60	20	32,94	16,5	31,71	13	32,19	8,8
T 30			33,32	10,5	33,37	14	32,76	16,9	32,17	19	32,16	18	33,32	16	33,02	13,2	32,69	9
T 70			34,94	11	34,97	13	33,93	16	34,09	18	33,89	18	34,62	16	34,76	14	34,89	10
S 5	23,53	-		12	31,41	15	31,13	17,5	31,46	21	31,55	19,5	32,53	16	32,72	12,8	30,09	8,2
S 10	27,49	-		11	31,60	15	30,86	17,5	31,82	20,5	32,22	19,5	33,07	16	32,98	12,9	31,96	8,6
S 20	28,72	-		10,5	32,23	14	31,63	17,8	32,37	20	32,94	19,5	33,49	16,1	33,71	13,2	32,99	9,2
S 30	29,44	-		10,5	32,90	14	32,35	16,5	32,83	19	33,53	19,5	34,39	17	34,26	13,6	33,67	9,7
S 70	29,91	-	34,35	10,5	34,35	13	33,94	16	33,95	18,5	34,78	18	34,89	16,7	34,91	14,3	34,77	10,8
A 4-5	23,81	-		13	30,12	14,5	29,46	19	30,80	20,5	31,49	20	32,65	15,5	31,74	11,5	31,19	7,8
A 10	26,71	-		12,5	30,96	14,5	30,16	19	31,16	20	31,59	20	32,69	16	32,24	11,7	31,87	7,7
A 20	28,03	-		11,5	31,18	14,5	30,24	18,5	31,30	20	31,84	19,5	33,14	16	32,53	12,2	32,36	8,4
A 30	27,42	-		11	31,67	14,5	31,17	18	32,15	20	32,70	20	34,69	17	33,39	12,7	32,88	9
A 70	30,54	-		10,5	34,14	14	33,53	16	34,75	18	34,91	18	34,83	16	-	14	34,72	10,7

1976

Stations	16-19 Feb		16-18 Mar		06-08 Apr		11-13 May		15-17 Jun		13-15 Jul		23-25 Aug		21-23 Sep		18-20 Oct		15-19 Nov		09-14 Dec	
	S. ‰	t °C	S. ‰	t °C	S. ‰	t °C	S. ‰	t °C	S. ‰	t °C	S. ‰	t °C	S. ‰	t °C	S. ‰	t °C	S. ‰	t °C	S. ‰	t °C	S. ‰	t °C
C 4	32,38	3,5	31,26	4,0	32,04	5,9	31,76	9,9	32,00	14,8	32,75	18,9	33,56	19,0	32,40	15,9	31,57	14,0	32,46	10,0	32,65	6,2
C 10	32,83	3,7	31,95	4,2	32,87	5,8	32,64	9,5	32,35	14,7	33,25	18,6	33,96	18,8	33,06	15,8	32,23	15,0	31,72	9,8	33,08	6,3
C 20	33,48	3,8	33,07	4,2	33,46	5,8	33,31	9,2	32,62	14,7	34,42	17,8	34,09	18,9	33,45	15,9	33,30	14,5	33,62	11,0	34,58	7,1
C 30	34,34	4,2	33,99	4,7	33,91	5,8	34,45	8,8	32,98	14,2	34,84	17,2	34,42	18,9	34,63	15,9	34,49	14,0	35,13	11,5	34,76	7,8
C 70	34,89	5,2	34,86	5,2	34,55	6,2	34,67	8,5	35,00	12,2	35,11	15,9	34,94	18,3	34,80	15,8	35,04	14,8	35,05	11,8	35,19	8,4
E 4	31,06	3,2	30,07	4,0	33,47	6,0	30,16	10,7	30,79	15,0	31,72	18,8	32,53	19,0	30,98	16,0	30,70	13,2	31,22	10,0	31,49	5,8
E 10	31,30	3,5	30,67	4,0	33,52	6,0	31,59	10,0	32,04	14,3	32,30	18,5	32,96	19,1	31,59	16,0	31,29	13,4	32,30	9,9	32,14	6,1
E 20	32,48	4,0	32,15	4,5	33,59	6,0	32,83	9,9	33,81	13,5	33,85	17,9	33,73	19,2	32,53	16,0	32,59	13,7	33,86	11,0	33,58	6,2
E 30	33,60	4,2	32,98	4,8	33,80	6,0	34,18	9,2	34,79	13,3	34,41	17,6	34,33	19,2	33,28	16,0	33,87	14,0	34,53	11,1	34,80	7,8
E 70	34,87	5,3	34,90	5,5	34,81	6,0		8,8	35,15	12,2	34,99	15,9	34,88	18,2	35,14	16,0	34,97	14,8	34,96	12,1	34,97	8,2
N 4	29,76	3,6	30,86	4,3	30,87	5,9	30,55	10,0	30,00	14,9	31,41	19,7	31,74	19,0	31,34	15,8	30,82	13,0	31,89	10,2	30,48	5,8
N 10	30,59	3,8	31,33	4,3	31,67	5,7	31,44	9,2	30,70	14,3	32,11	18,7	32,30	19,1	32,35	15,8	31,89	13,5	32,29	10,2	31,64	6,1
N 20	32,10	4,0	32,73	4,5	32,98	5,5	32,62	9,0	32,88	14,1	32,69	18,0	32,45	18,9	33,30	15,9	33,05	13,8	33,18	10,5	33,78	6,7
N 30	33,39	4,5	33,69	4,8	34,08	5,5	33,53	9,0	33,00	13,5	33,52	17,7	33,37	18,8	34,51	16,0	33,83	14,1	34,27	10,8	34,88	7,0
N 70	34,88	5,0	34,82	5,4	34,73	6,2	34,85	8,8	35,07	12,4	34,76	15,5	34,97	17,9	35,16	16,0	34,92	14,7	34,89	11,8	34,85	8,6
T 4	30,88	3,8	31,19	4,5	30,68	6,5	30,17	9,9	29,31	14,8	30,15	18,8	31,08	18,9	32,09	16,0	30,50	13,0	29,38	10,0	26,22	5,5
T 10	31,49	3,9	31,80	4,5	31,27	6,0	32,27	9,5	30,80	14,1	31,69	18,2	30,63	18,9	32,24	16,2	31,49	13,5	32,72	10,0	30,06	6,2
T 20	30,77	4,0	32,65	4,5	33,14	6,0	32,82	9,1	31,51	14,0	32,87	17,8	32,37	18,5	33,49	16,0	33,30	14,0	33,91	10,8	34,74	6,8
T 30	32,63	4,2	34,09	5,0	33,92	6,0	33,37	9,0	34,04	13,0	33,78	17,6	33,23	18,5	34,65	16,4	33,97	14,0	34,86	11,1	34,78	7,1
T 70	34,75	5,5	34,77	5,2	34,84	6,2	34,71	8,8	35,10	12,2	34,74	15,5	34,91	17,8	35,13	16,5	35,08	14,8	34,84	12,0	34,84	8,6
S 4	31,47	3,2	32,09	4,0	31,08	6,0	32,15	10,1	32,43	15,9	32,58	19,6	31,71	18,9	32,64	16,0	33,05	12,0	34,26	9,5	33,86	6,8
S 10	32,02	3,5	31,80	4,1	32,27	6,0	32,32	9,5	32,59	15,1	33,16	19,0	32,77	19,0	32,52	16,0	34,09	13,5	34,19	10,1	34,03	6,9
S 20	32,62	4,2	32,36	4,5	33,21	5,5	32,83	9,0	32,98	14,3	33,50	18,2	33,43	19,1	33,11	16,7	34,54	14,0	34,58	10,1	34,25	8,2
S 30	33,28	4,7	32,96	5,0	33,97	6,0	33,51	9,0	33,61	14,1	34,09	17,8	34,16	19,1	33,76	17,0	34,97	14,5	34,86	11,5	34,46	7,5
S 70	34,77	5,8	34,80	5,9	35,06	7,0	35,01	8,9	34,76	12,4	35,02	16,0	35,07	18,2	35,10	17,0	35,06	14,7	35,09	12,0	35,08	9,3
A 4	30,90	3,2	31,34	4,1	31,40	6,5	31,13	11,0	32,07	16,4	32,61	20,4	32,13	19,0	32,18	15,0	33,23	13,0	33,45	9,2	33,18	5,1
A 10	31,55	3,5	31,34	4,0	32,11	6,5	31,52	11,0	32,25	16,5	32,68	19,8	32,34	19,0	32,24	15,0	34,89	13,0	33,72	9,0	34,09	5,8
A 20	31,58	3,5	31,80	4,2	32,55	6,0	31,90	10,5	32,40	15,5	32,11	19,6	32,90	19,0	32,38	15,7	34,98	14,0	34,06	9,0	34,01	5,8
A 30	32,23	3,5	32,48	4,5	32,63	6,0	32,51	10,0	32,82	14,9	33,13	18,0	32,98	19,0	33,04	16,0	34,91	14,5	34,45	10,0	34,61	7,8
A 70	34,39	5,5	34,76	5,8	35,19	8,0	35,01	9,5	34,98	12,6	35,13	16,1	34,92	18,1	34,99	16,5	34,91	14,9	35,01	12,0	35,09	7,0

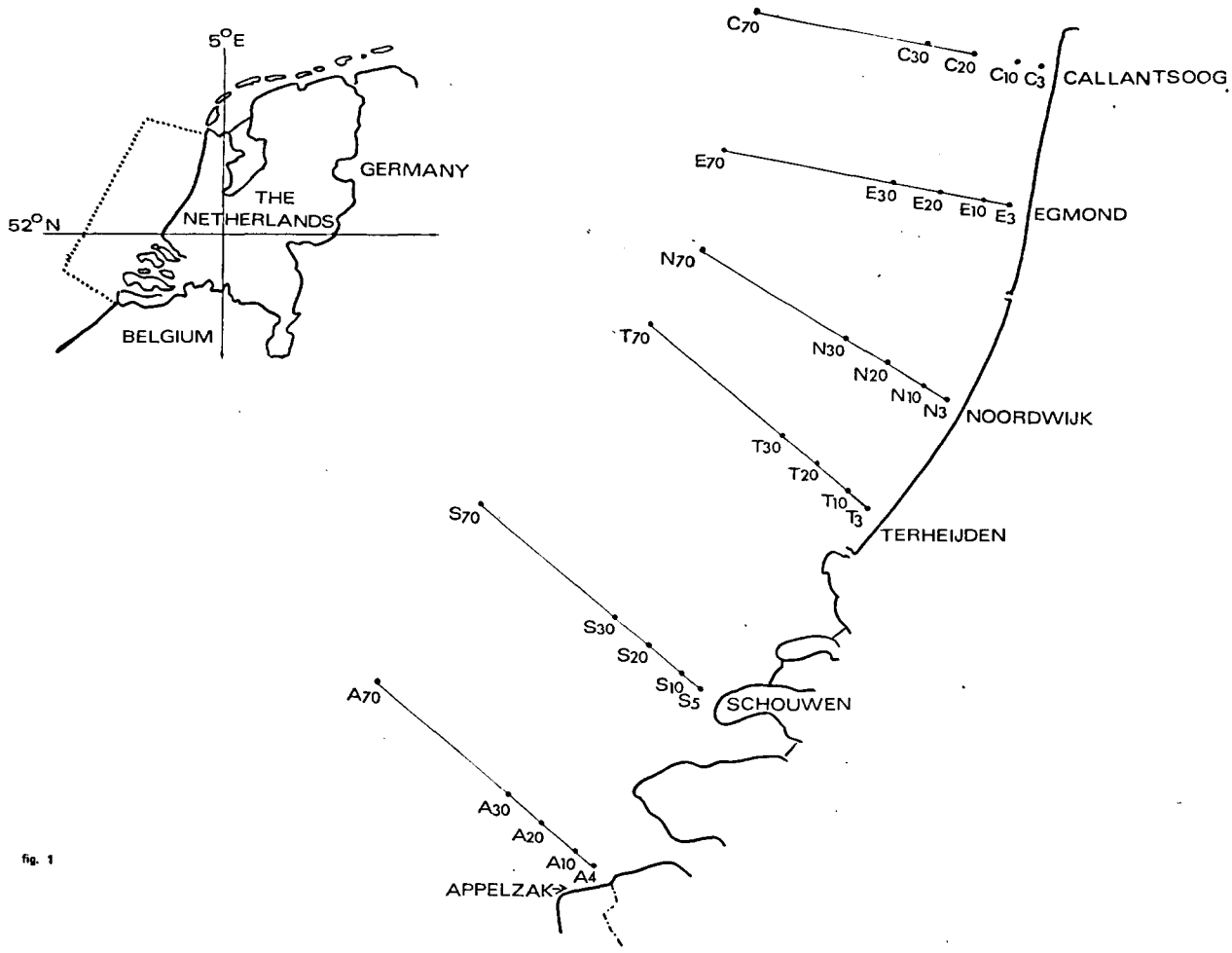


fig. 1

number of cells per liter

- o 0
- • <1000
- • 10^3-10^4
- • 10^4-10^5
- • 10^5-10^6
- • >10^6
- Δ present (not counted)
- X no sample

fig. 2

Diversity index

$I = -\Sigma_i p_i \ln p_i$

- ○ < 1.0
- ◎ 1.1-2.0
- ◎ 2.1-3.0
- ● >3.0

fig. 3

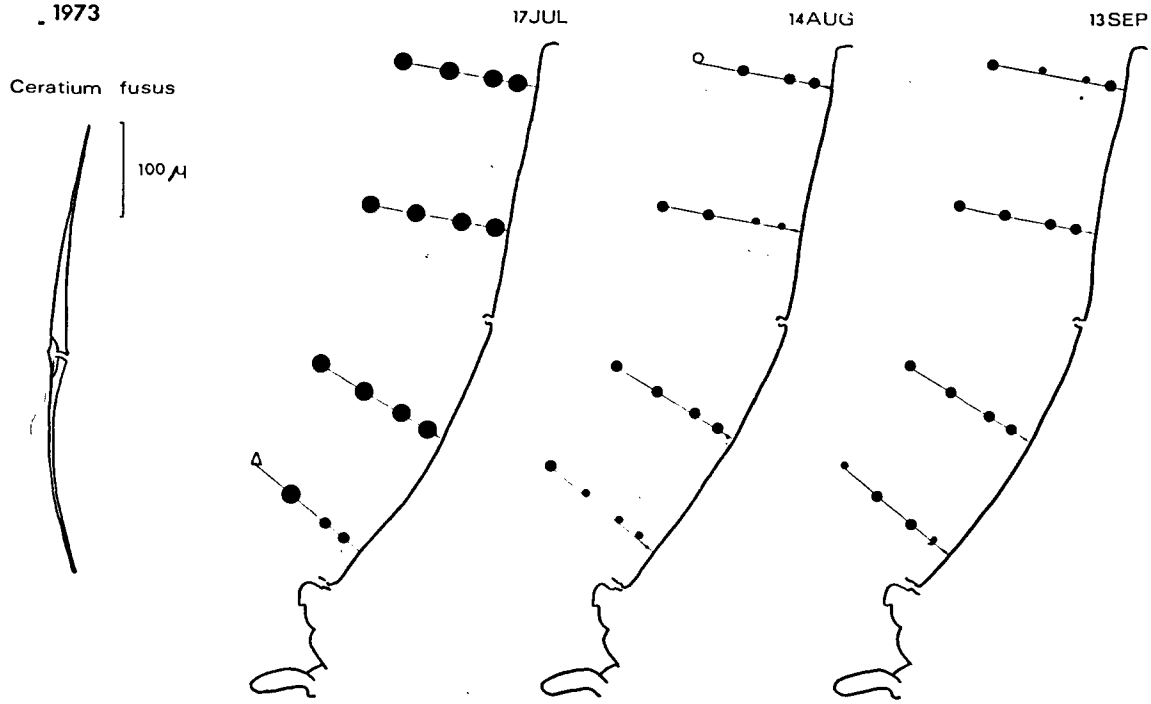

1973
17JUL
14AUG
13SEP
Ceratium fusus
100 µ

fig. 4

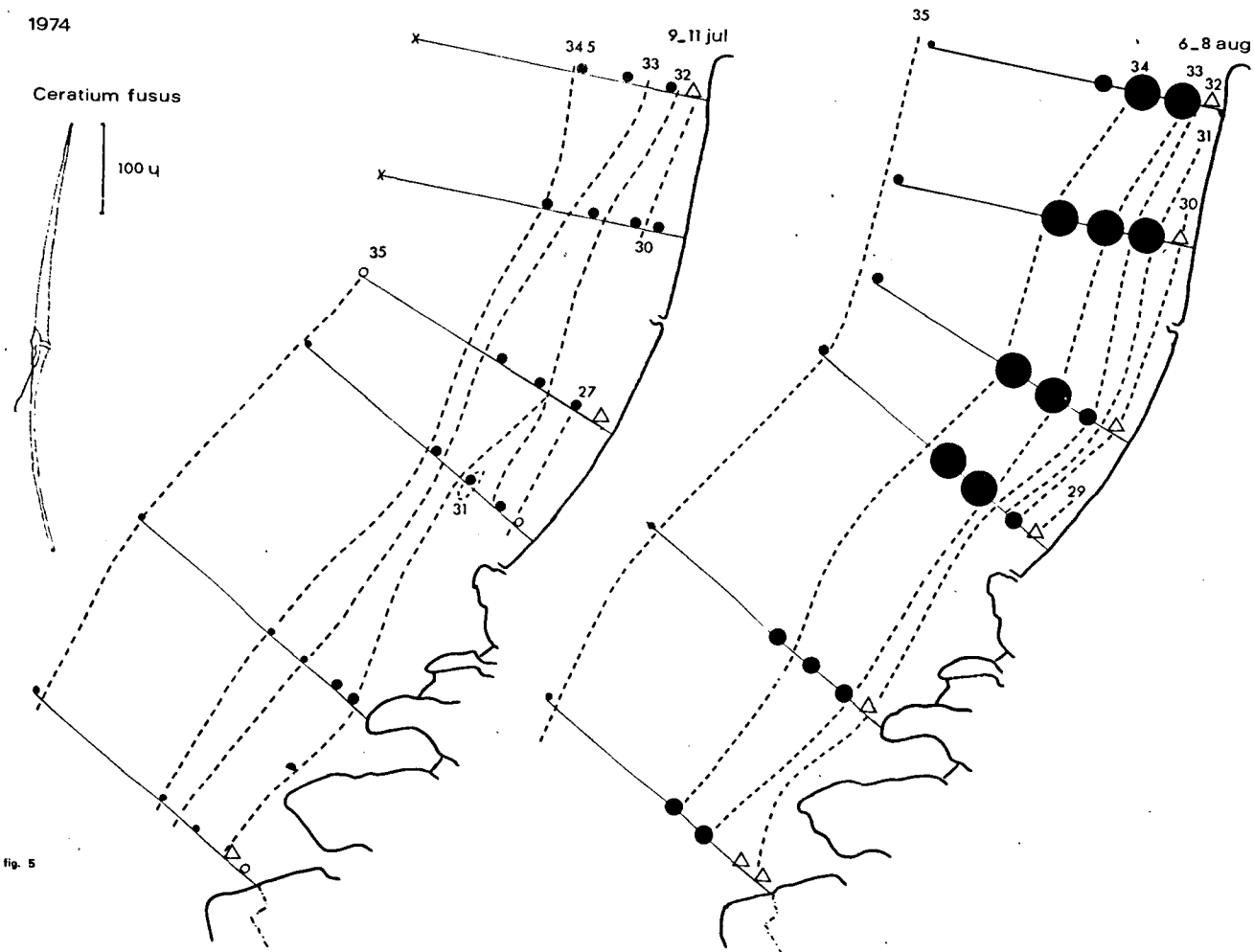

1974
9_11 jul
6_8 aug
Ceratium fusus
100 µ
35
34
33
32
31
30
29
27

fig. 5

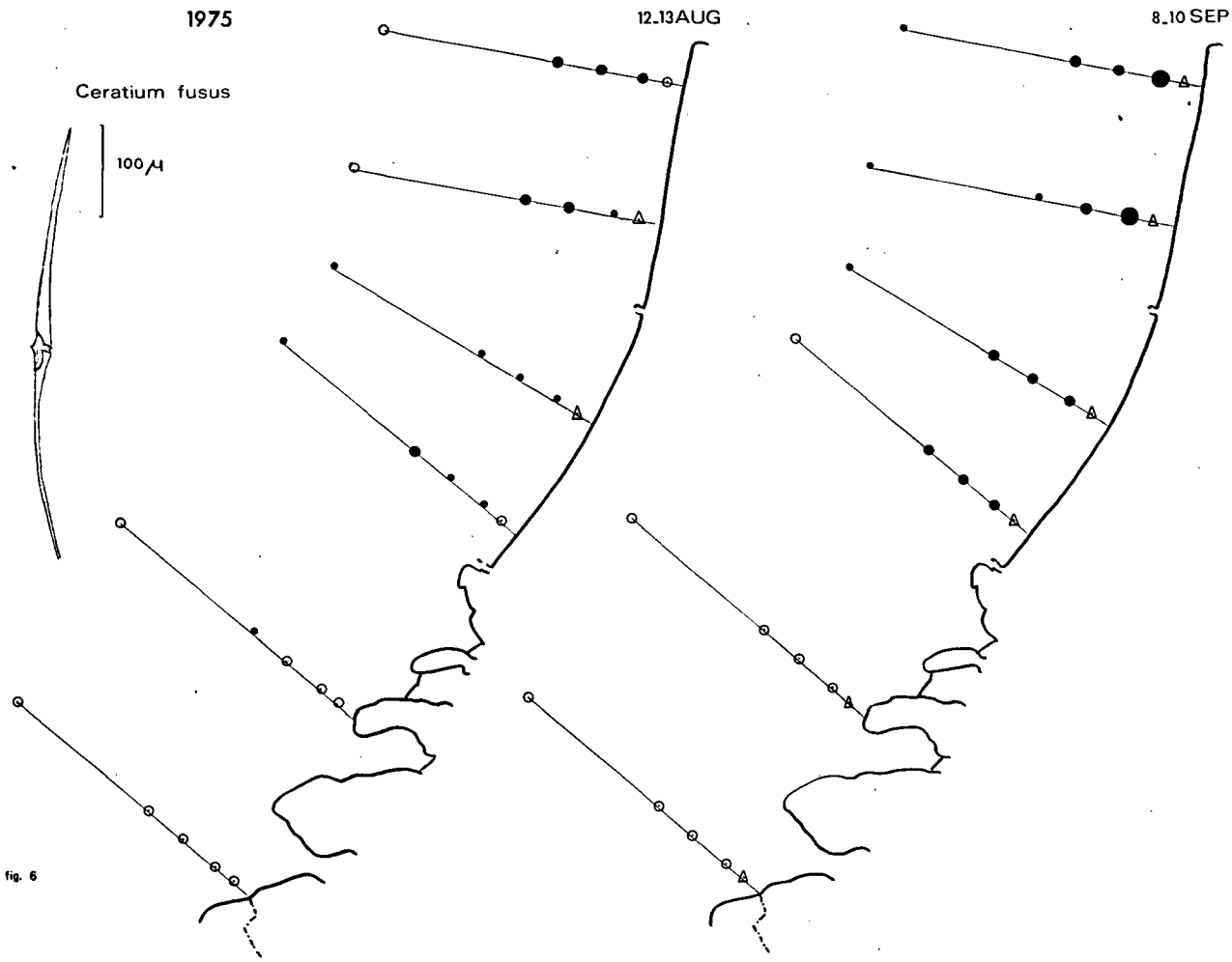

1975
12_13AUG
8_10 SEP
Ceratium fusus
100 µ

fig. 6

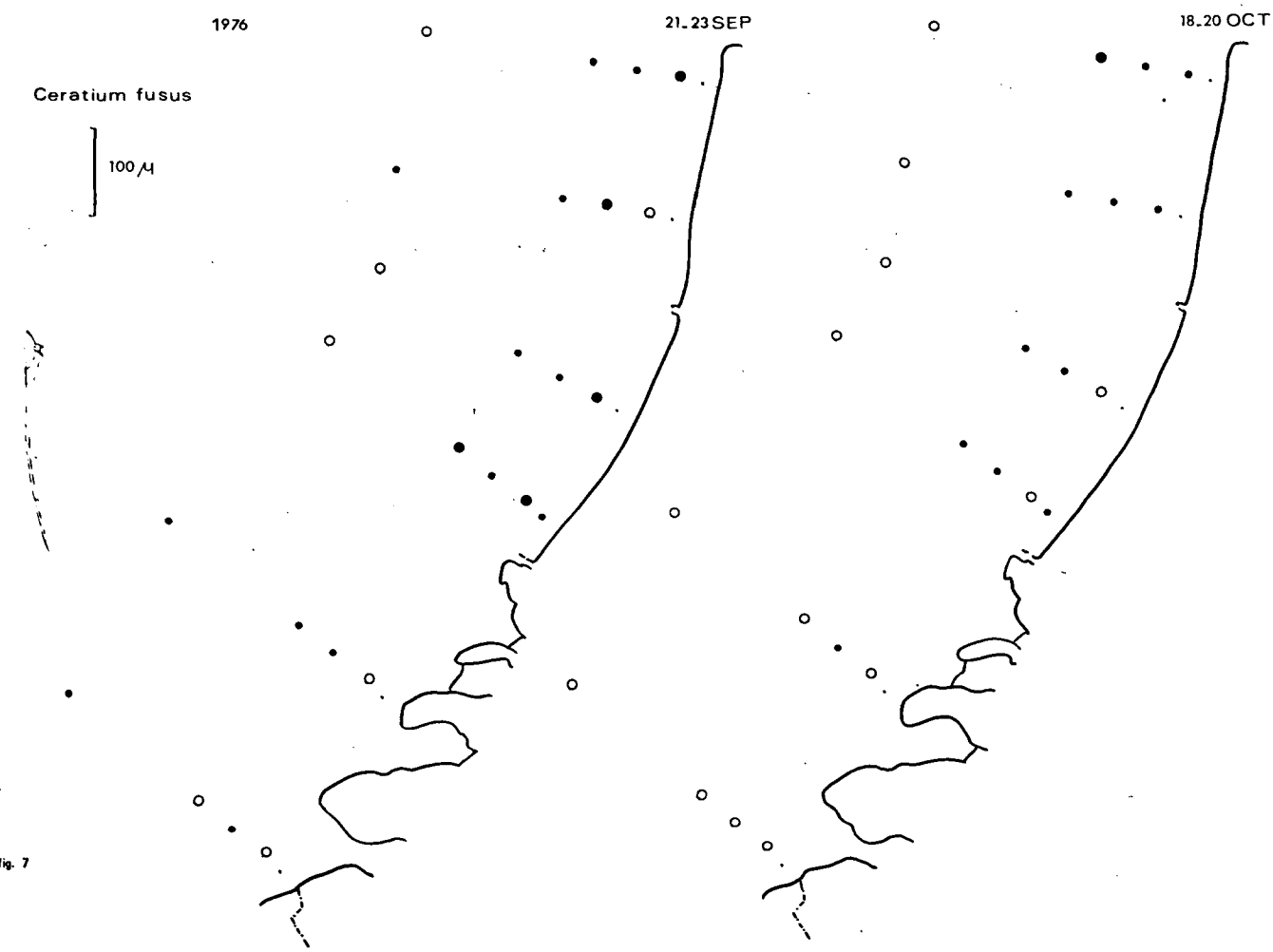

1976
21_23 SEP
18_20 OCT
Ceratium fusus
100 µ

fig. 7

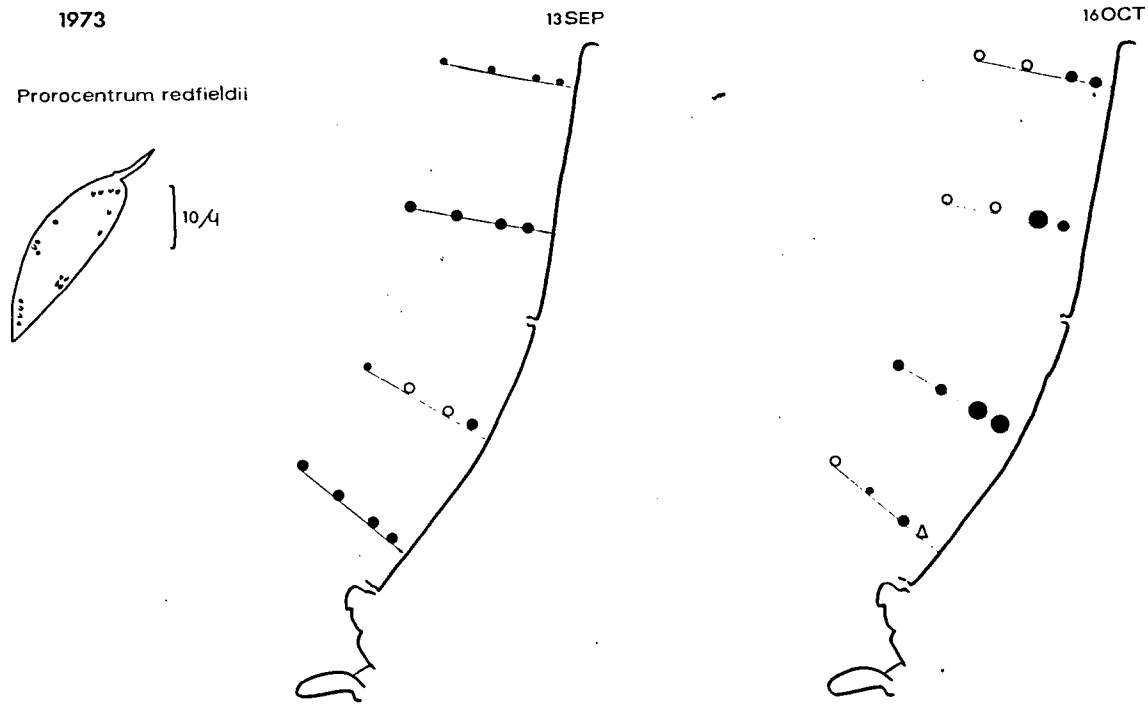

1973
13 SEP
16 OCT
Prorocentrum redfieldii
10 µ

fig. 8

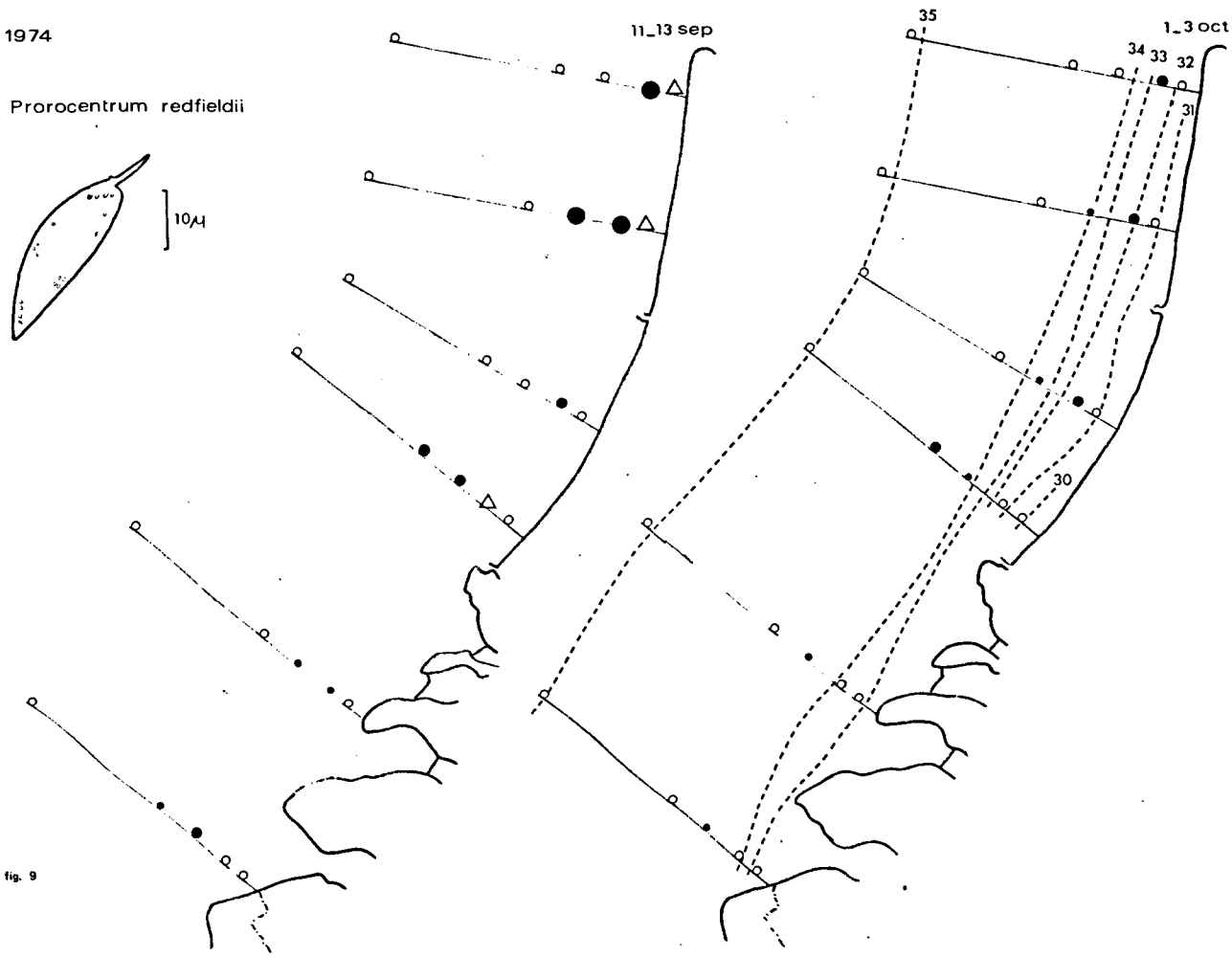

1974
11_13 sep
1_3 oct
Prorocentrum redfieldii
10 µ
35
34
33
32
31
30

fig. 9

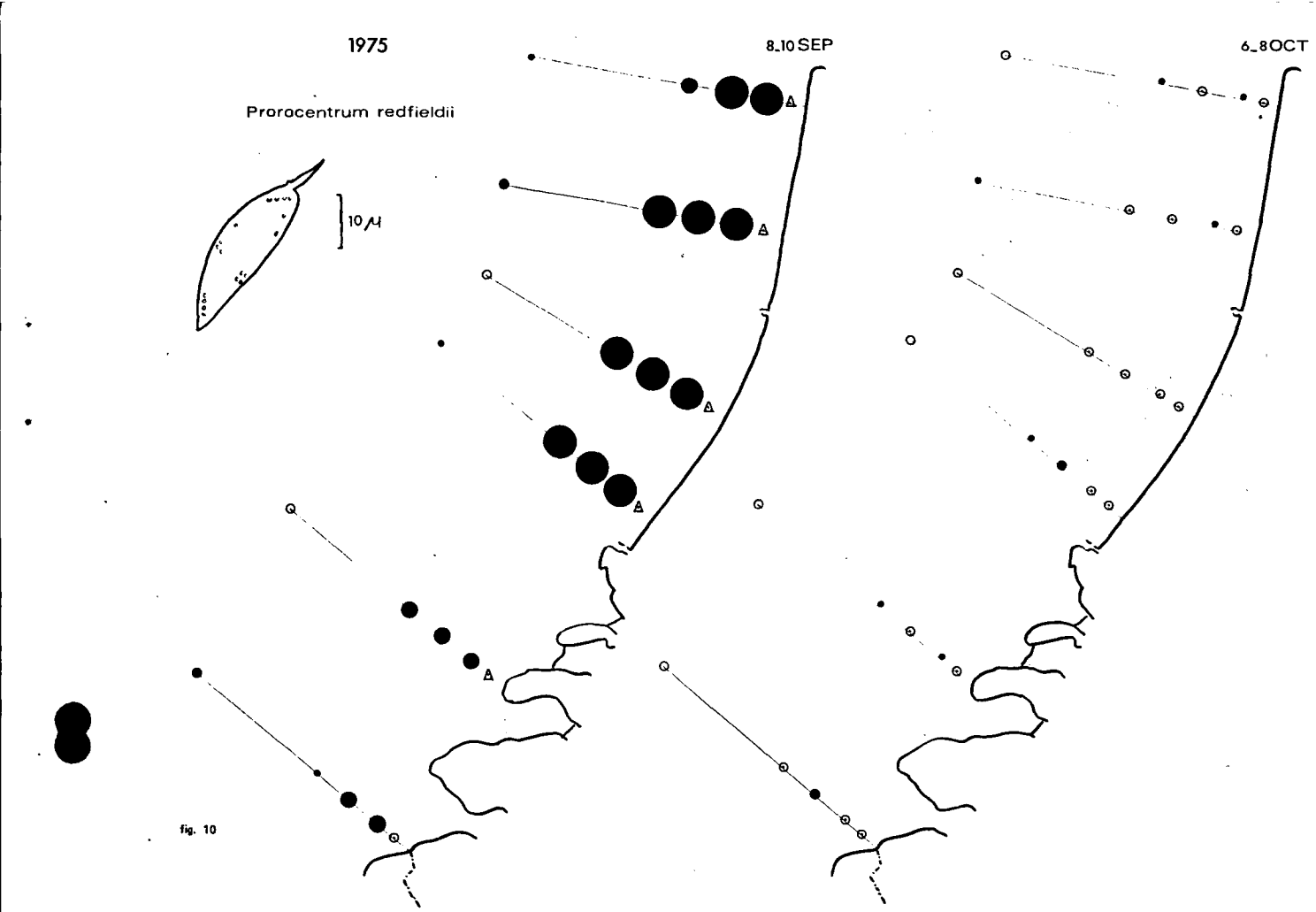

1975
8_10 SEP
6_8 OCT
Prorocentrum redfieldii
10 µ

fig. 10

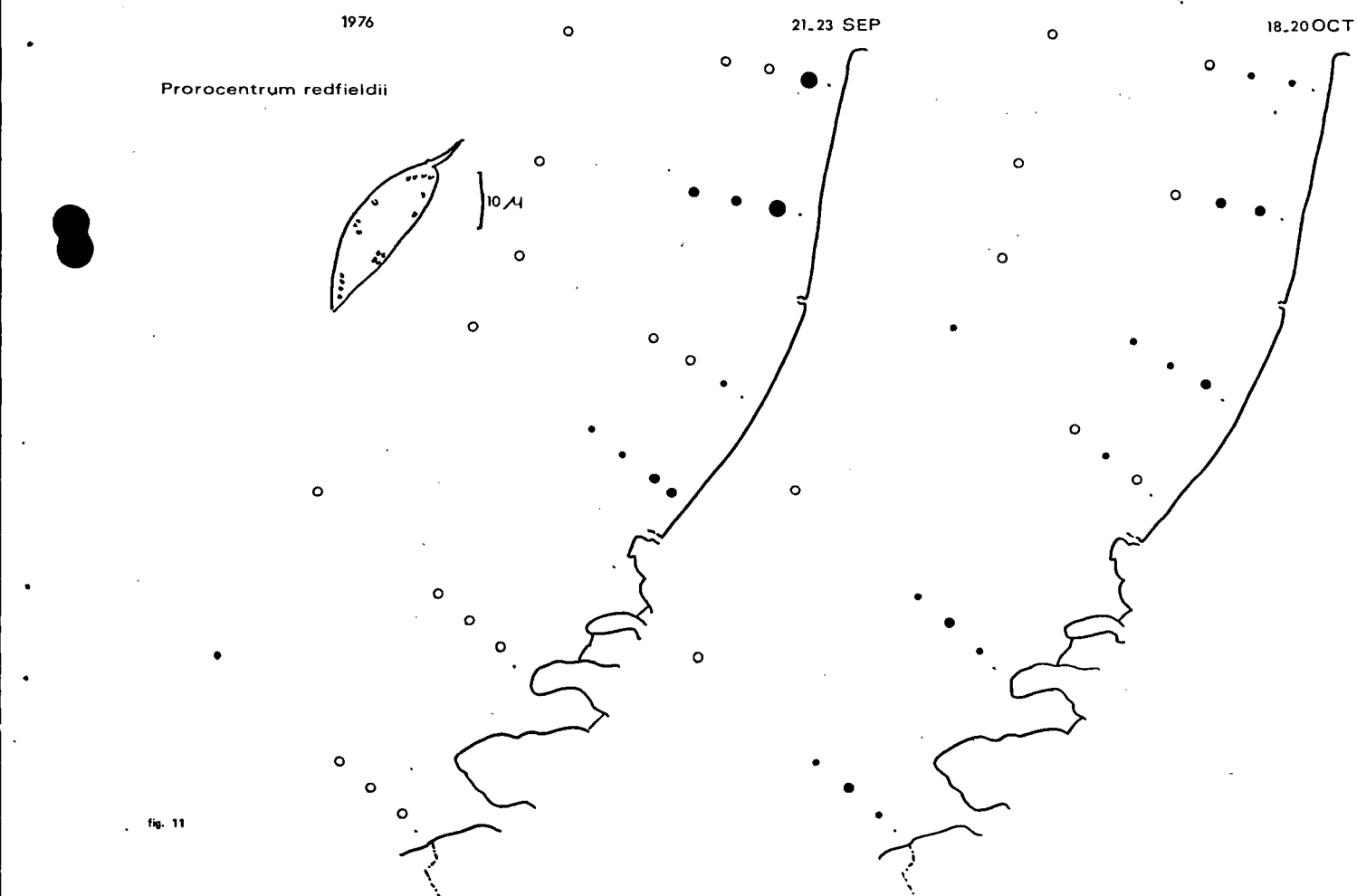

1976
21_23 SEP
18_20 OCT
Prorocentrum redfieldii
10 µ

fig. 11

1976

13_15 SEP

Prorocentrum minimum

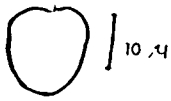


fig. 12

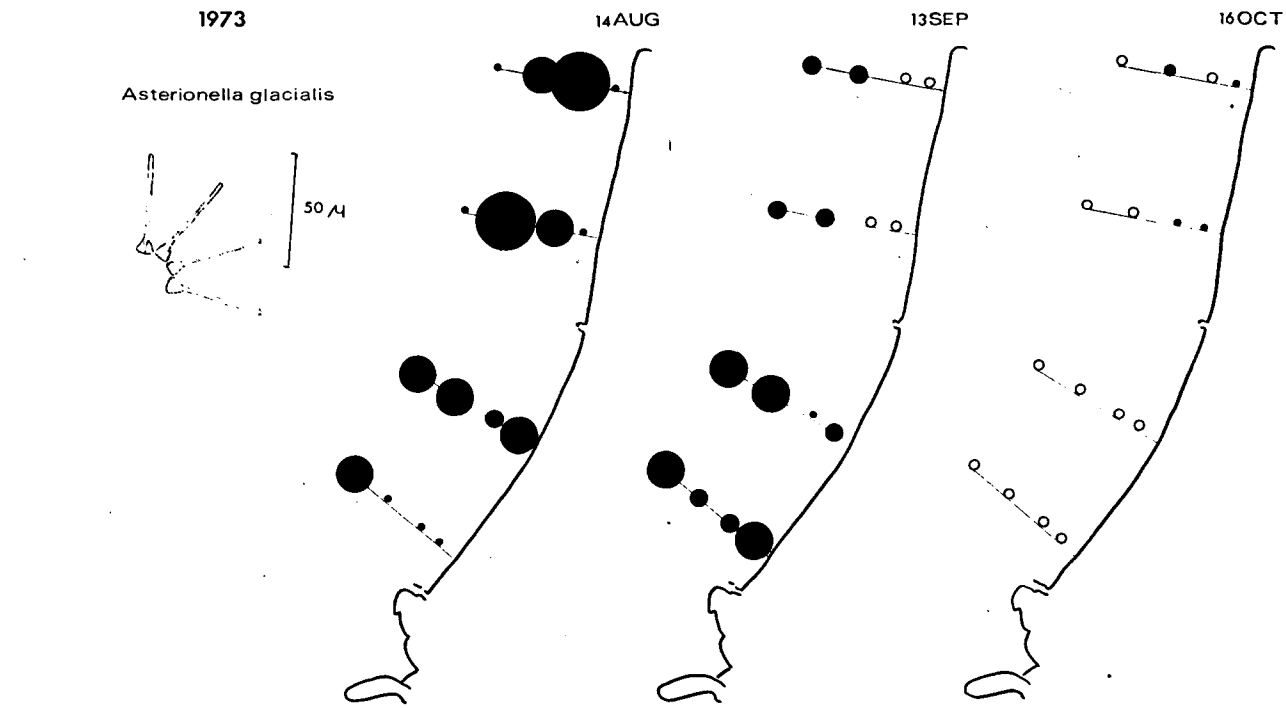

1973
14AUG
13SEP
16OCT
Asterionella glacialis
50 µ

fig. 13

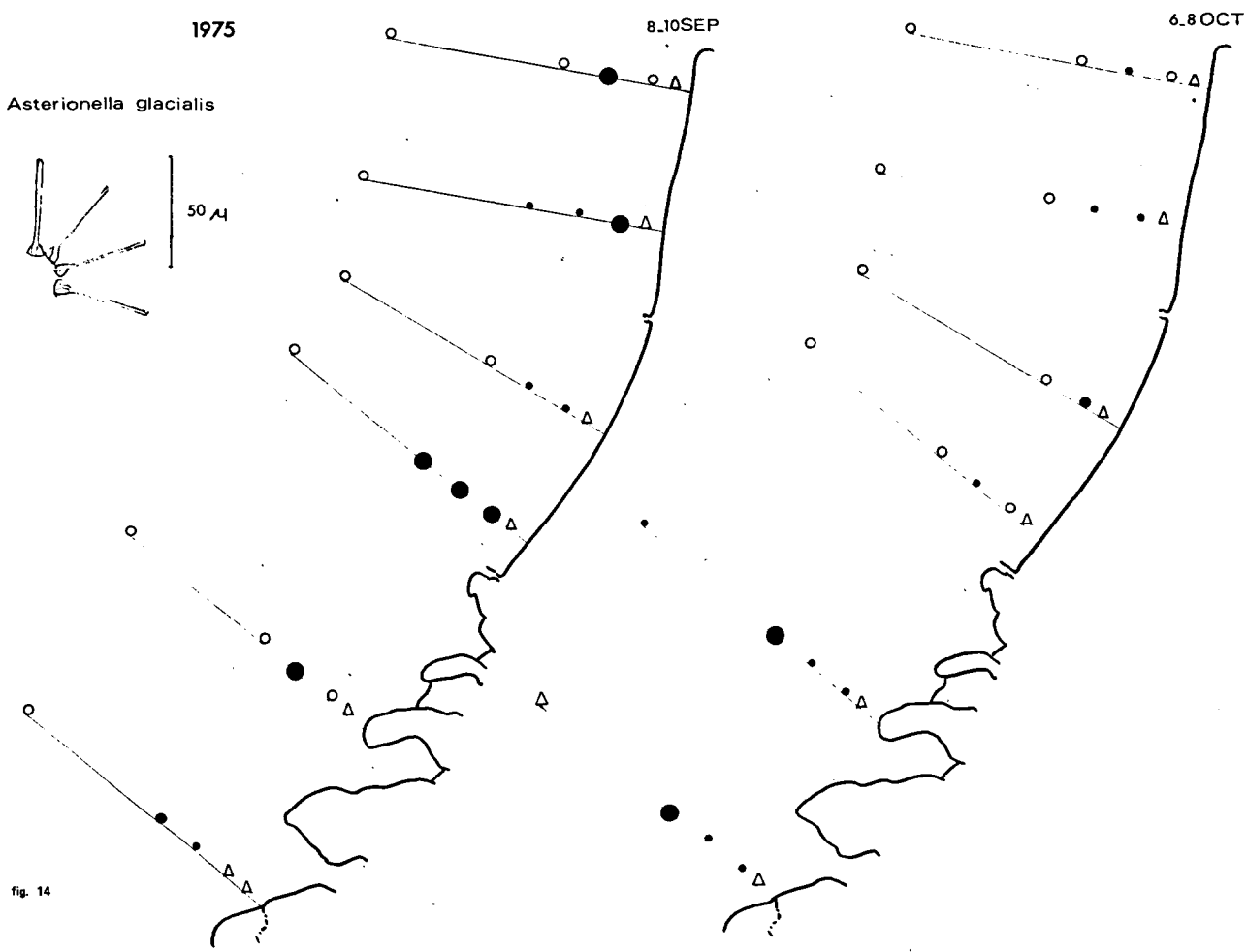

1975
8_10SEP
6_8OCT
Asterionella glacialis
50 µ

fig. 14

1975

28_29 MAY

16_19JUN

Cerataulina bergonii

100 µ

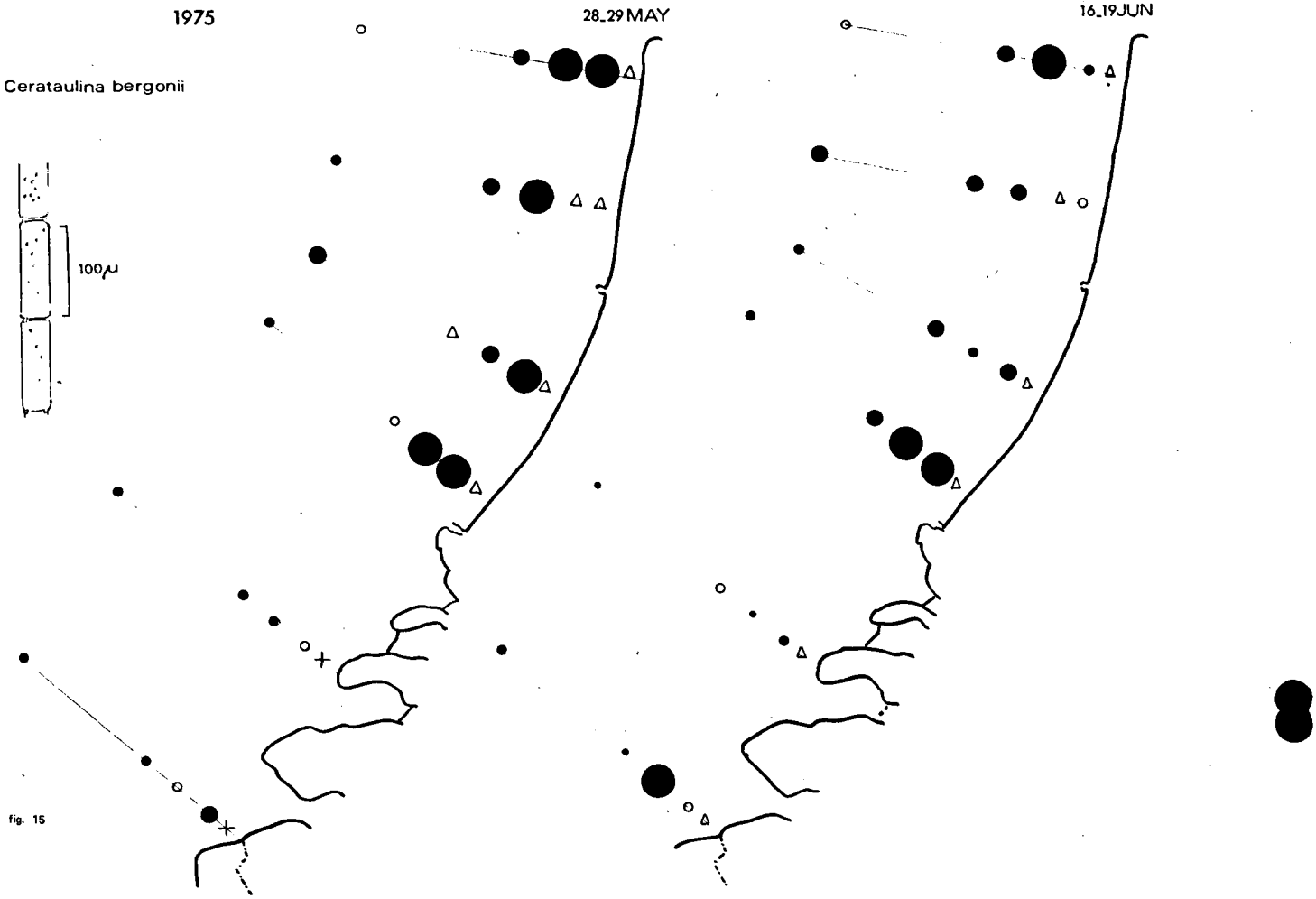


fig. 15

1975

8_10SEP

6_8OCT

Cerataulina bergonii

30 µ

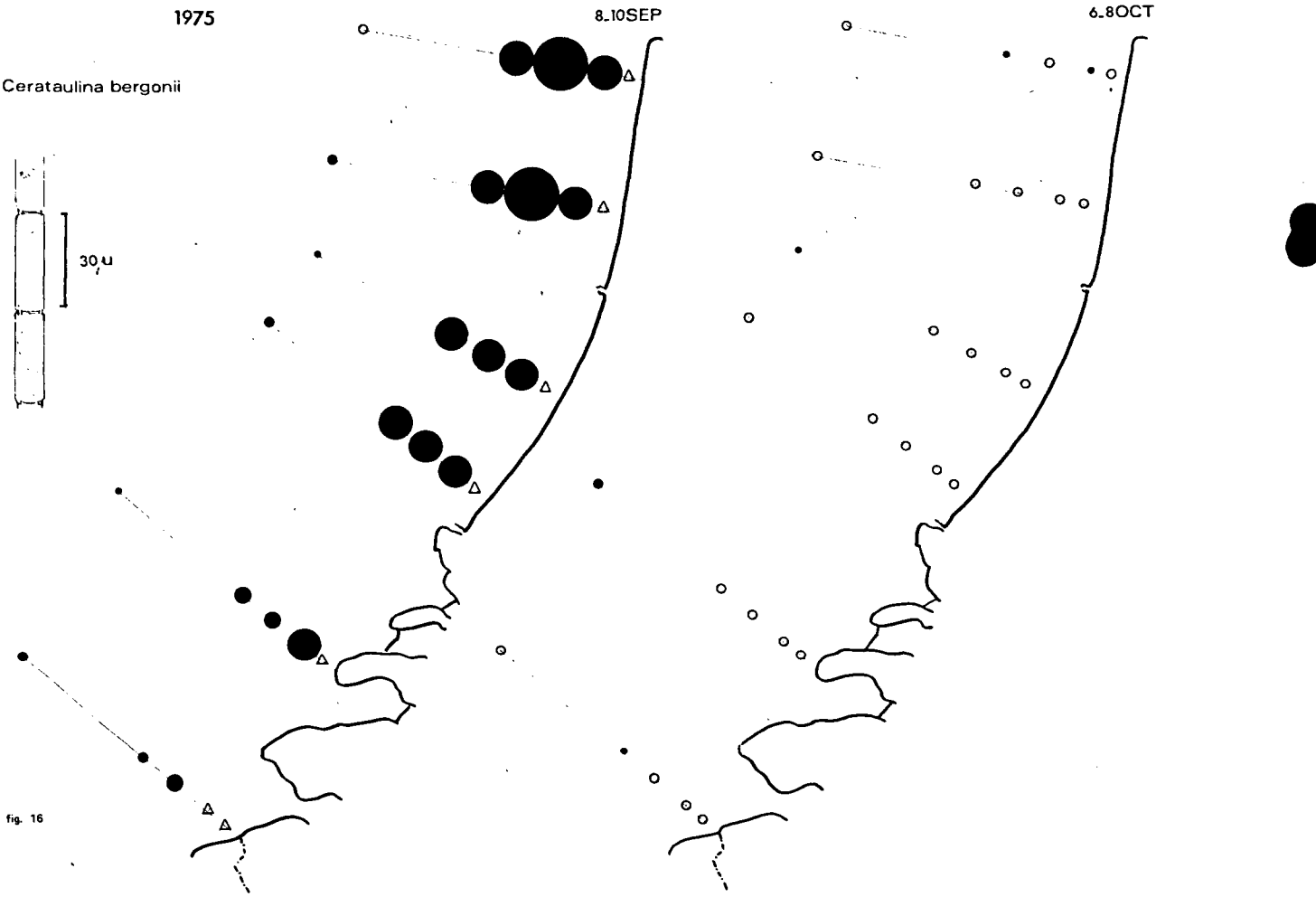


fig. 16

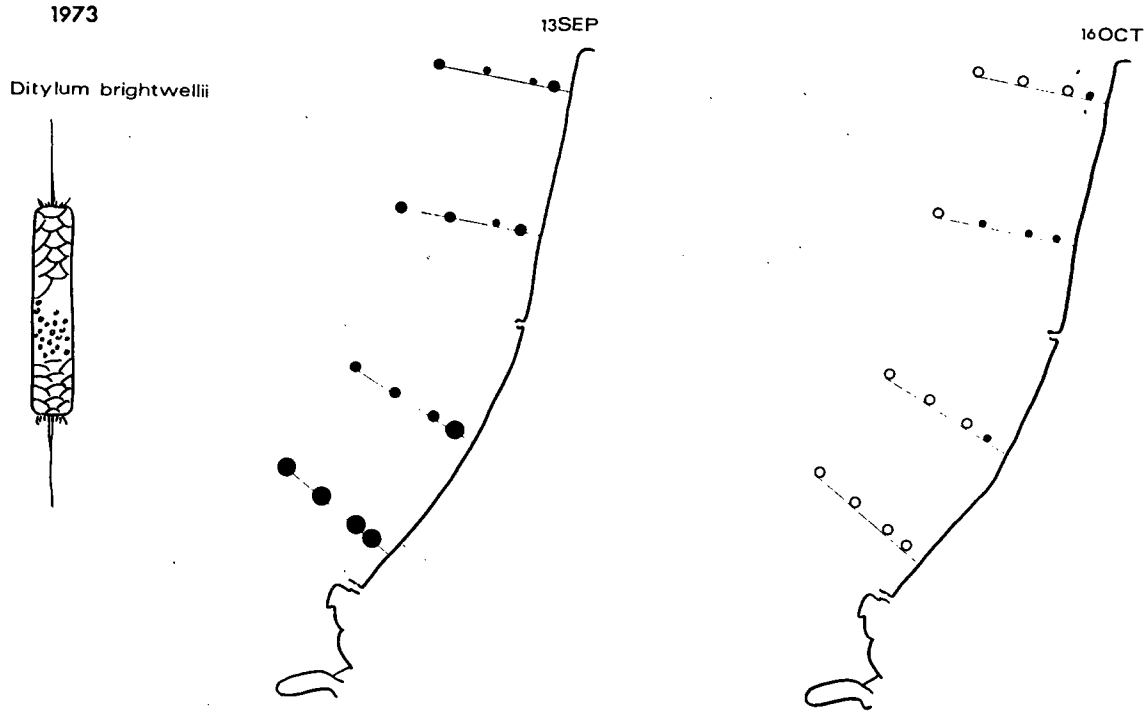

1973
Ditylum brightwellii
13SEP
16OCT

fig. 17

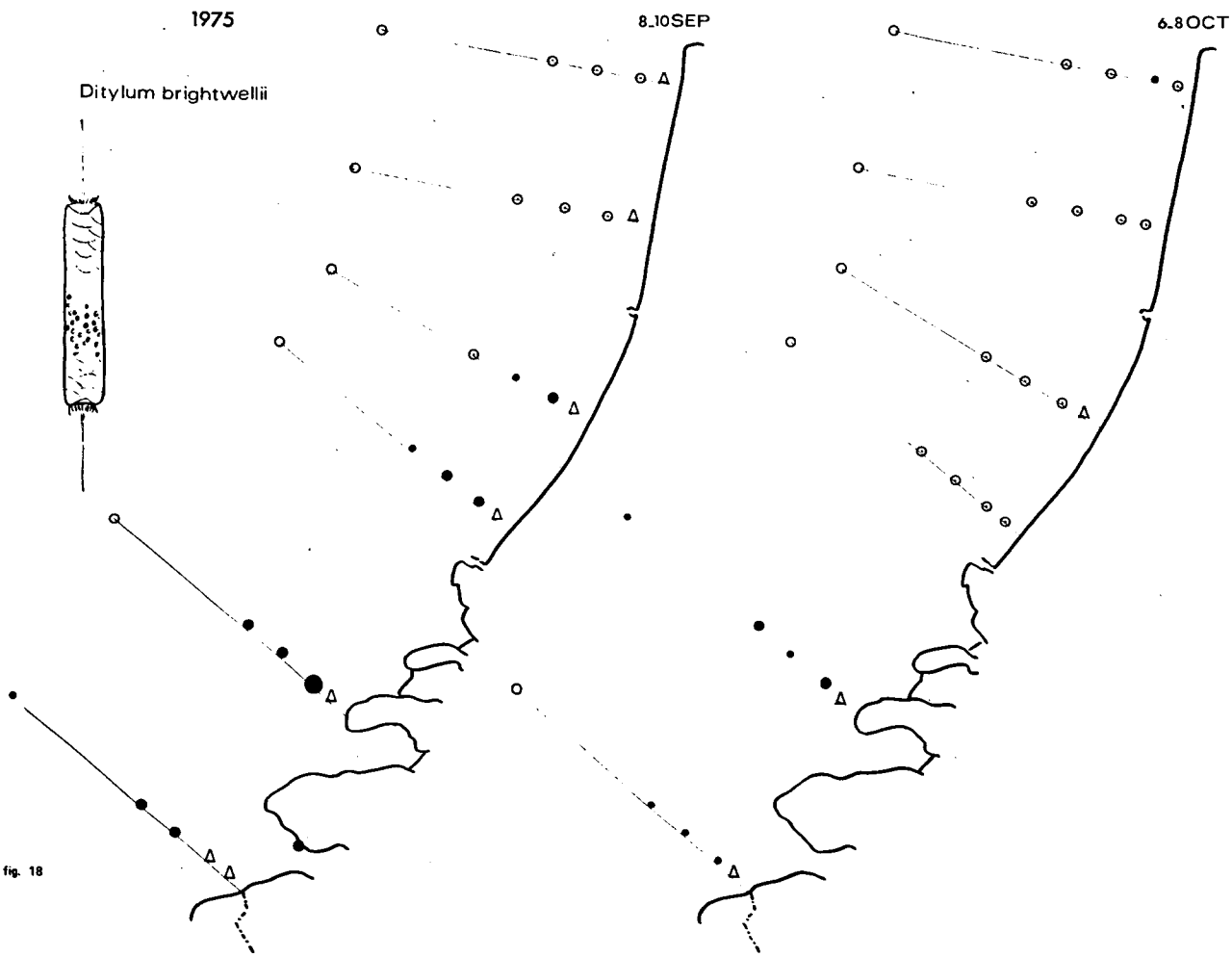

1975
Ditylum brightwellii
8_10SEP
6_8OCT

fig. 18

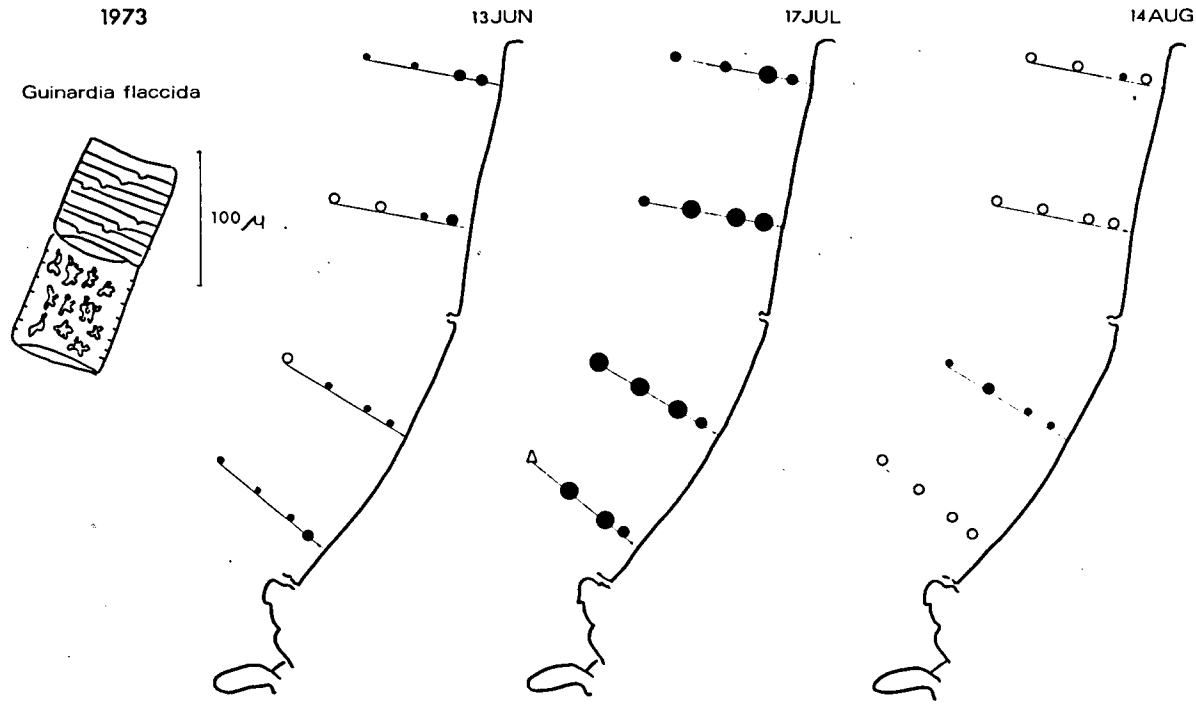

1973
13JUN
17JUL
14AUG
Guinardia flaccida
100 µ

fig. 19

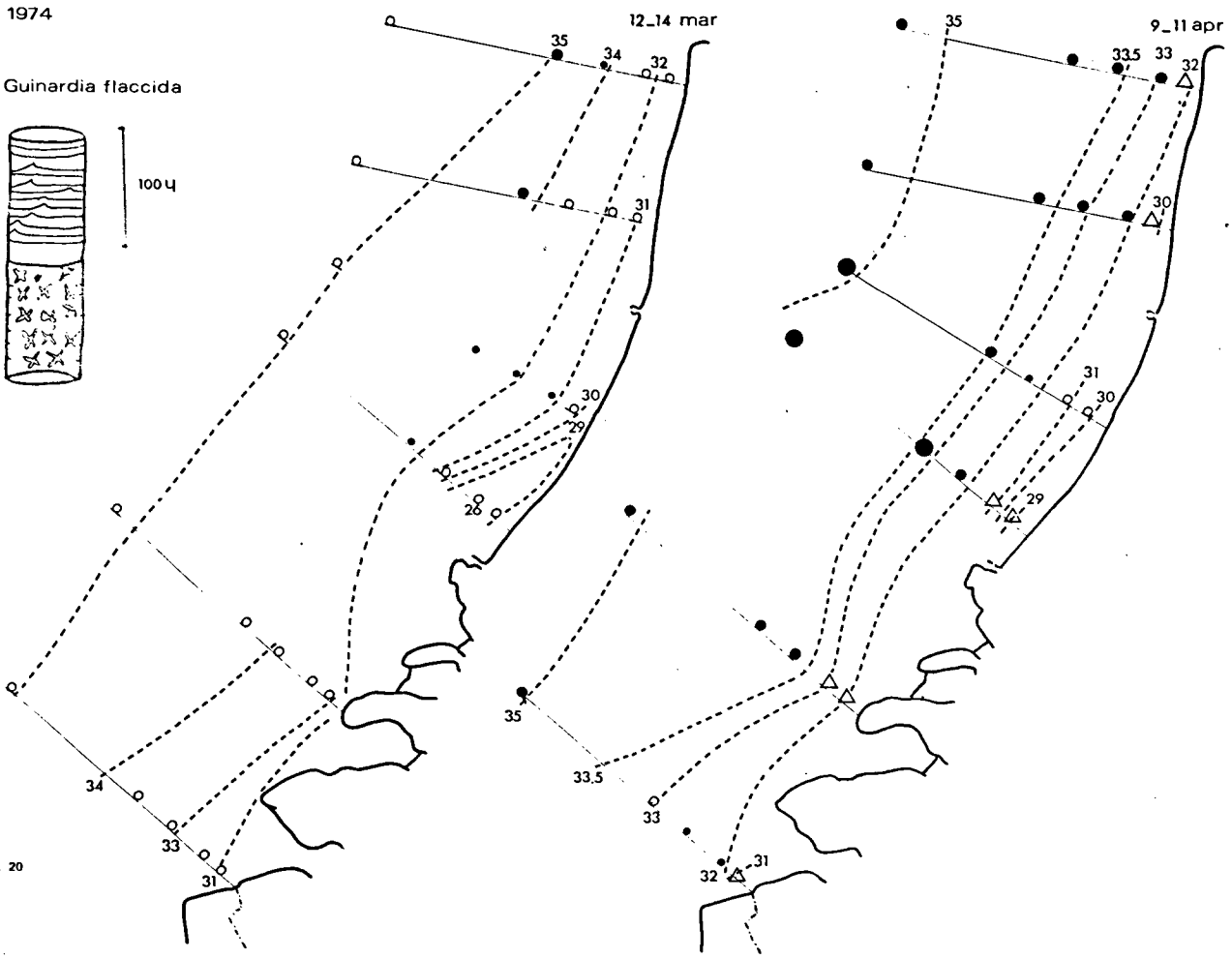
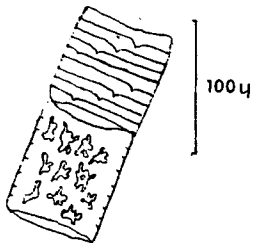

1974
12_14 mar
9_11 apr
Guinardia flaccida
100 µ
35
34
33
32
31
30
29
28
33.5

fig. 20

1974

Guinardia flaccida



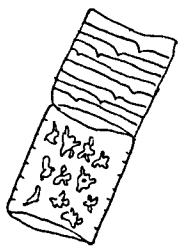
14_16 may

13_14 jun

fig. 21

1974

Guinardia flaccida



9_11 jul

6_8 aug

fig. 22

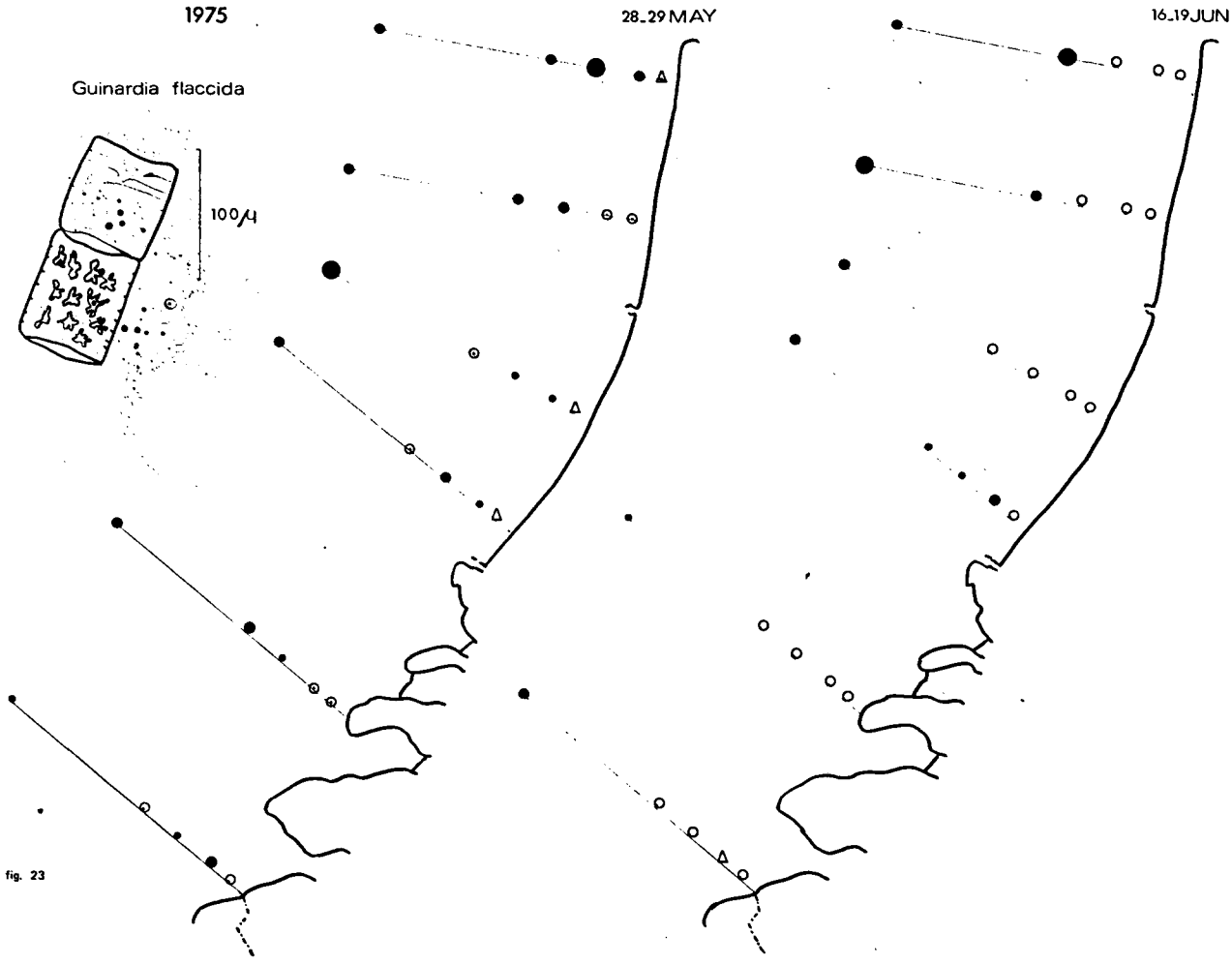

1975
28_29 MAY
16_19 JUN
Guinardia flaccida
100 µ

fig. 23

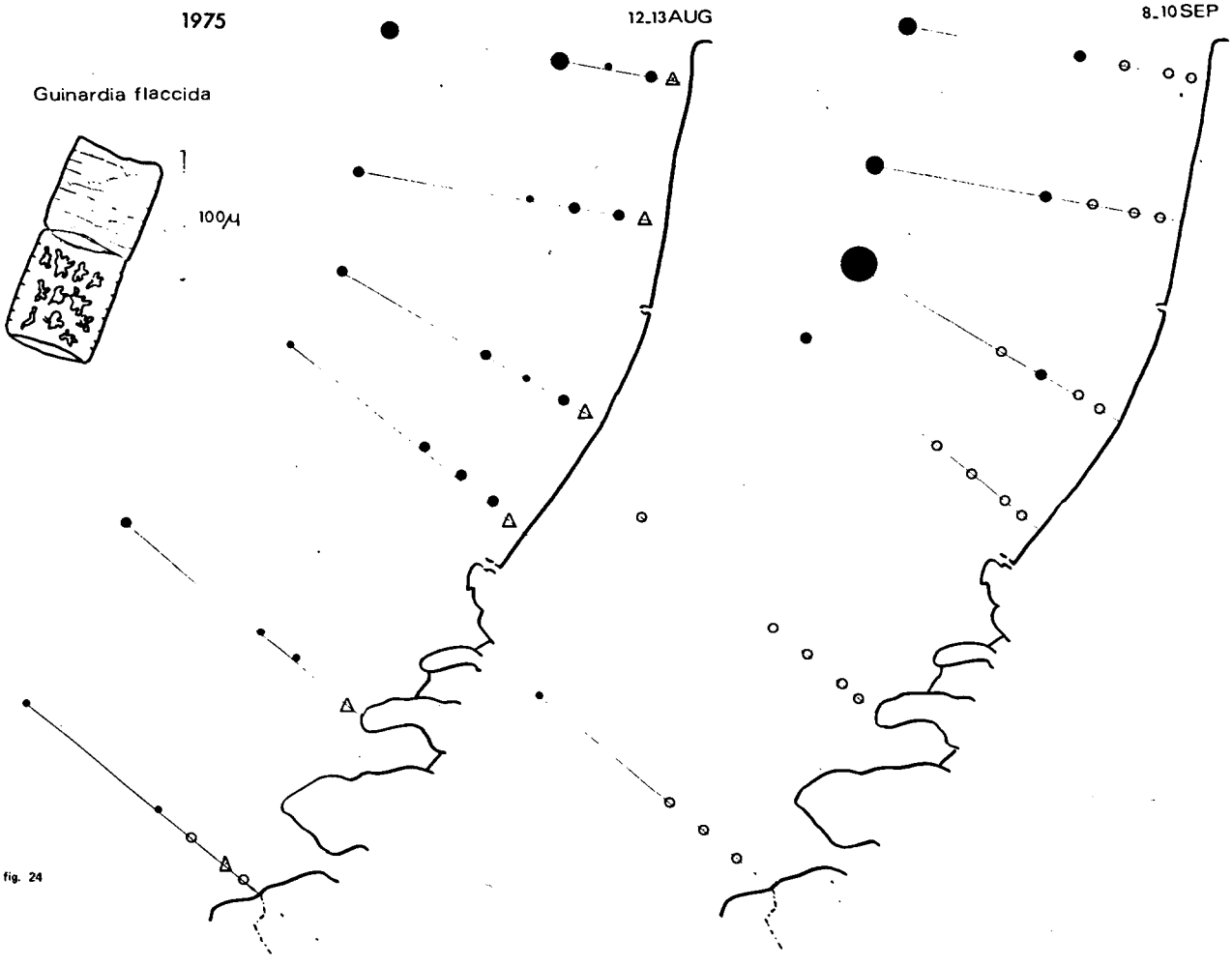

1975
12_13 AUG
8_10 SEP
Guinardia flaccida
100 µ

fig. 24

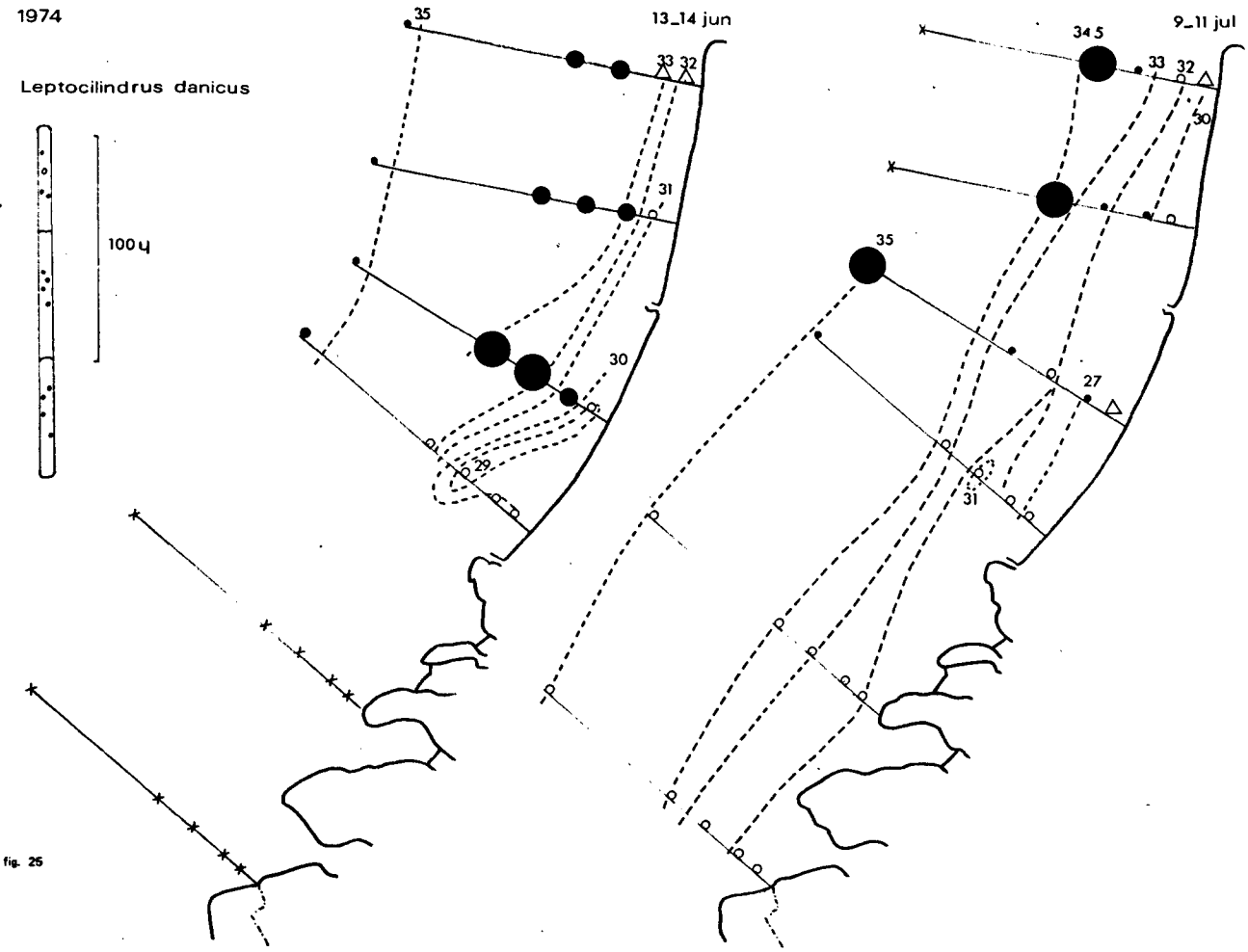

1974
Leptocilindrus danicus
100 µ
13_14 jun
9_11 jul
35
33
32
31
30
29
34.5
27

fig. 25

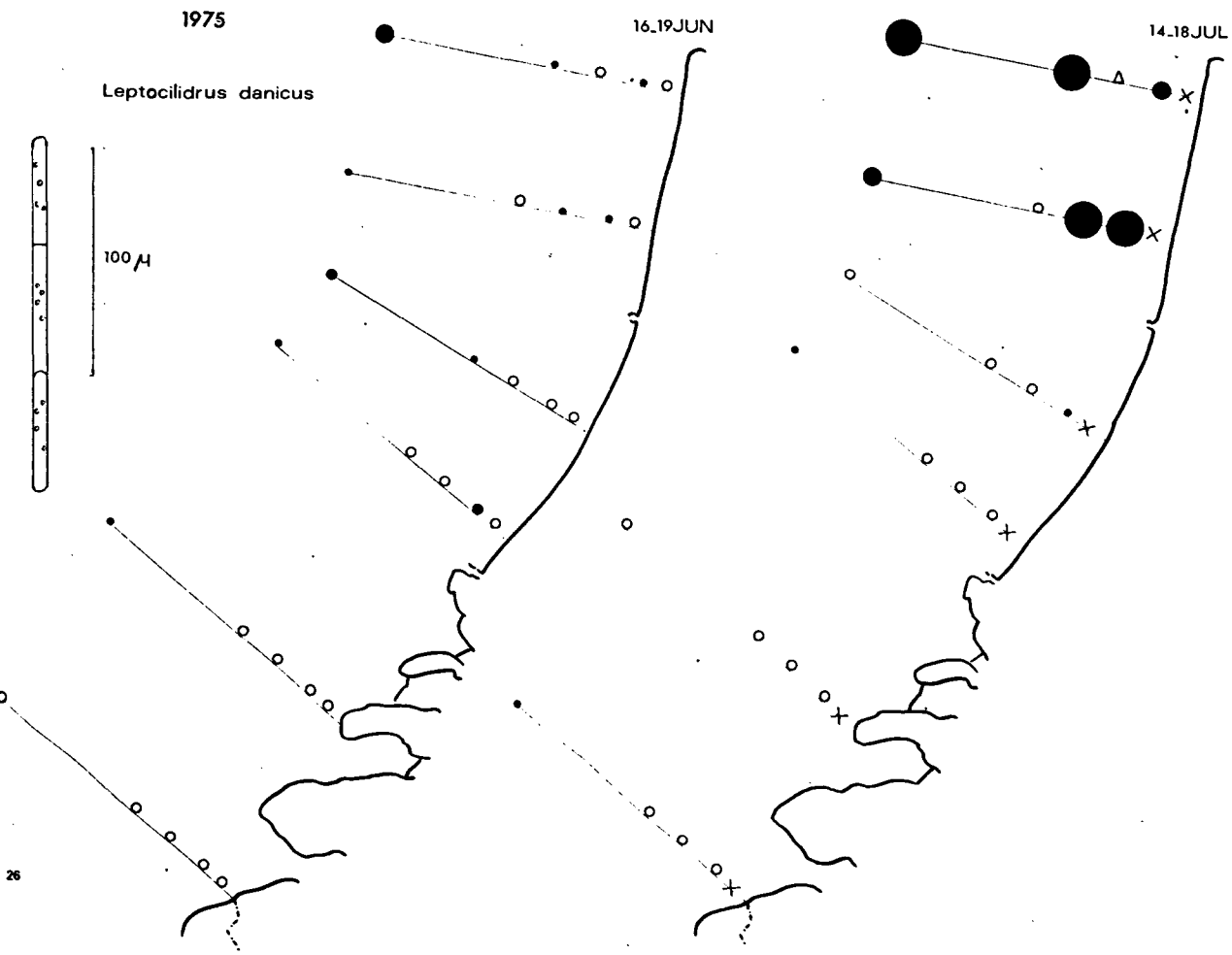

1975
Leptocilidrus danicus
100 µ
16_19JUN
14_18JUL

fig. 26

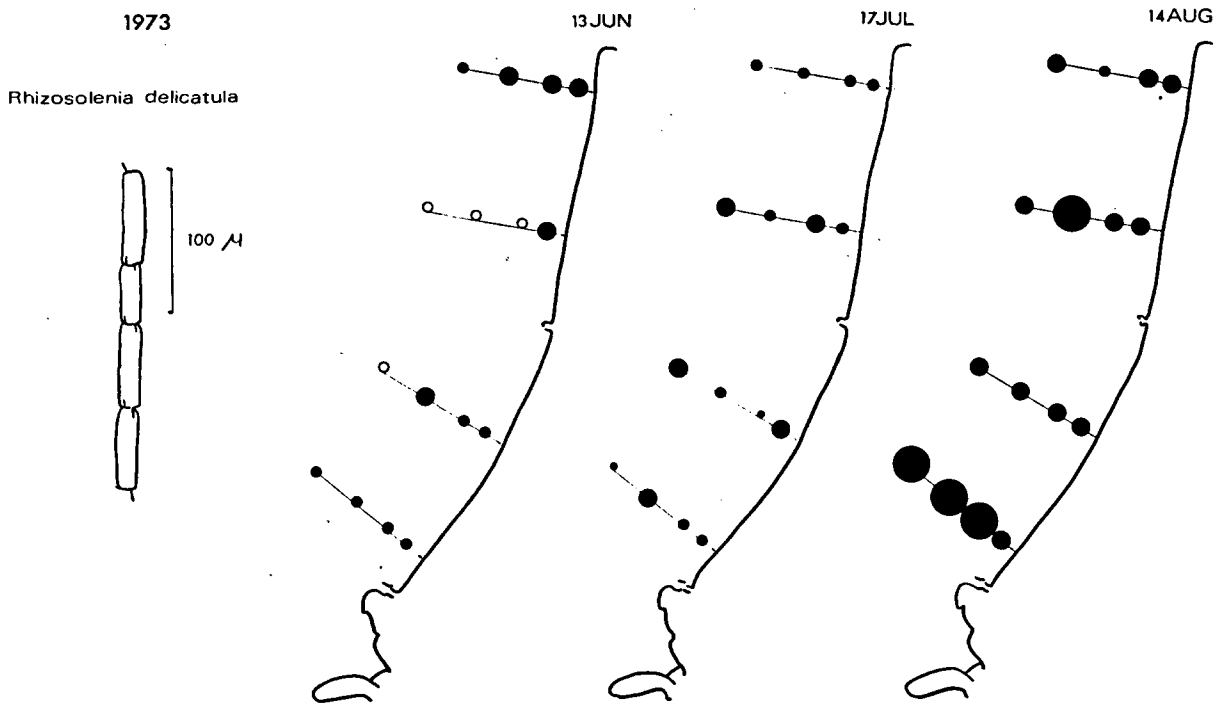

1973
13JUN
17JUL
14AUG
Rhizosolenia delicatula
100 µ

fig. 27

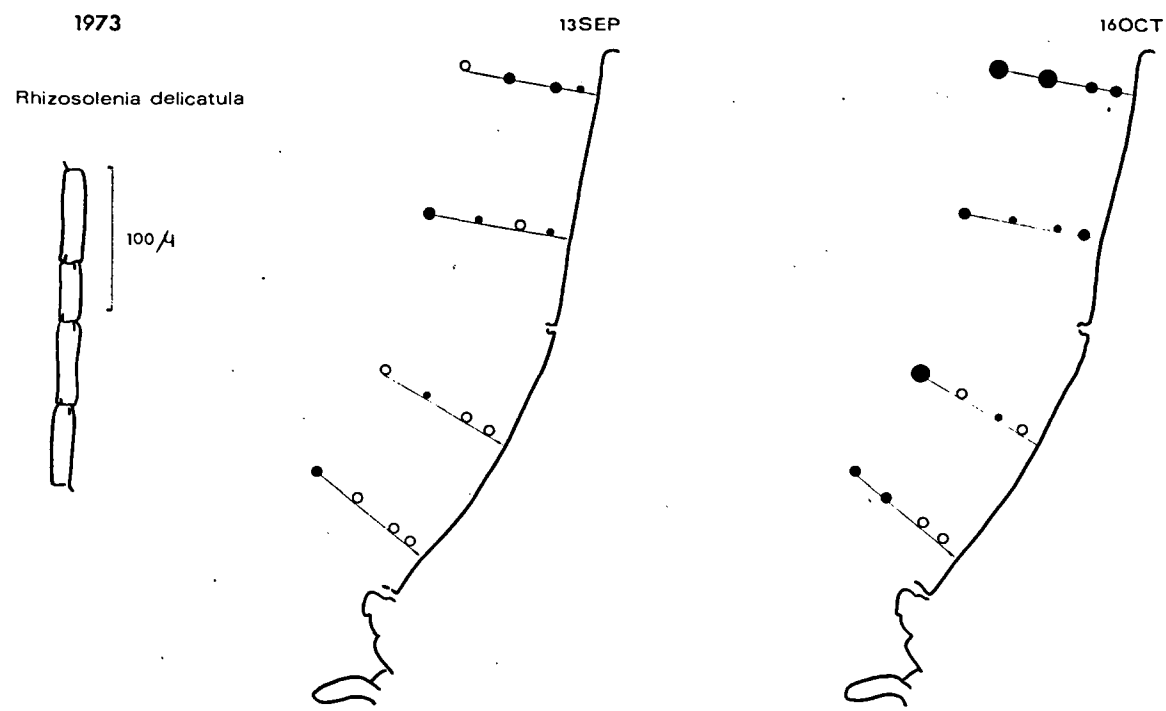

1973
13SEP
16OCT
Rhizosolenia delicatula
100 µ

fig. 28

1974

Rhizosolenia delicatula

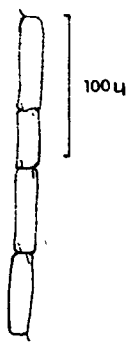
9_11 jul

6_8 aug

fig. 29

1974

Rhizosolenia delicatula



11_13 sep

1_3 oct

fig. 30

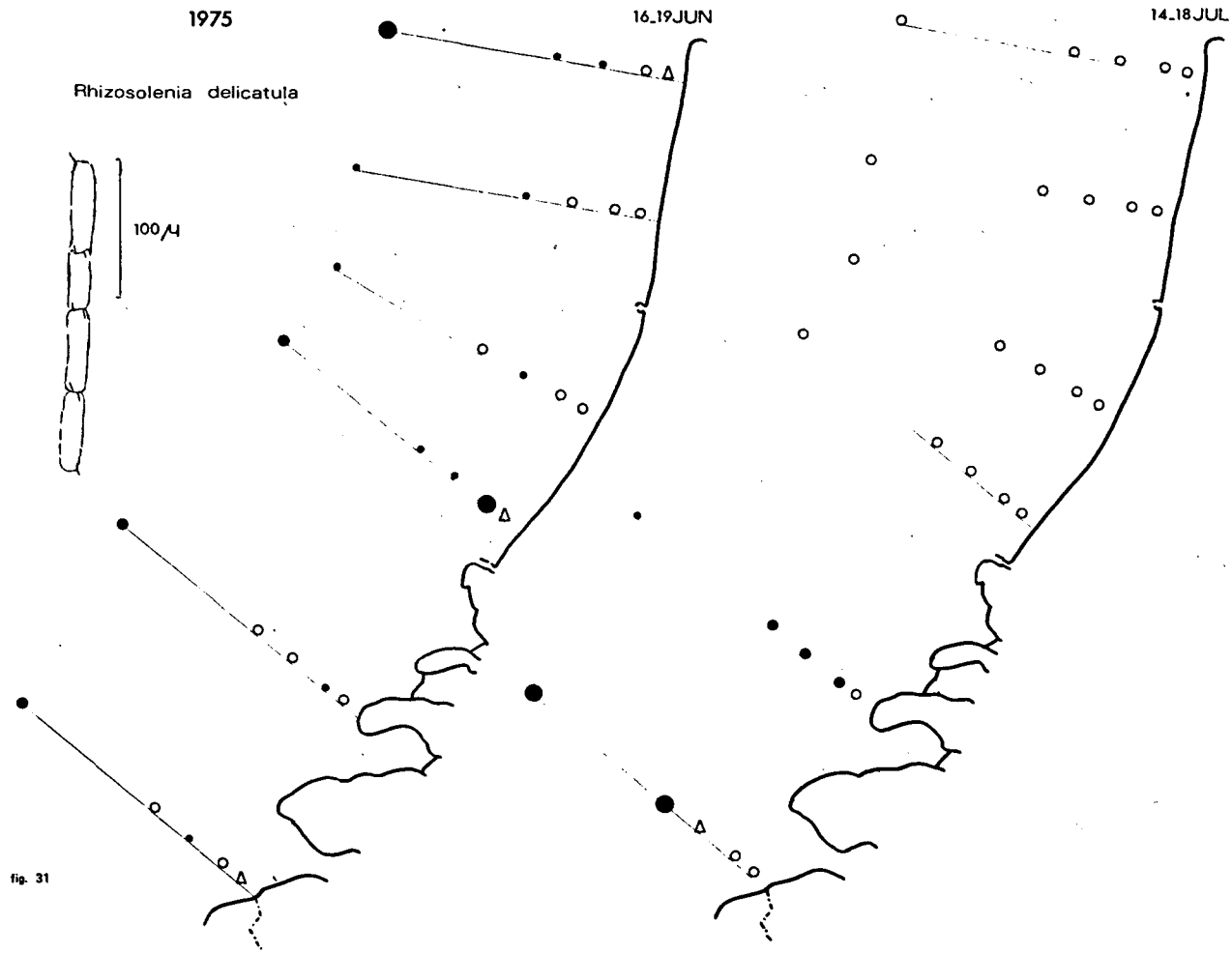

1975
16_19JUN
14_18JUL
Rhizosolenia delicatula
100 µ

fig. 31

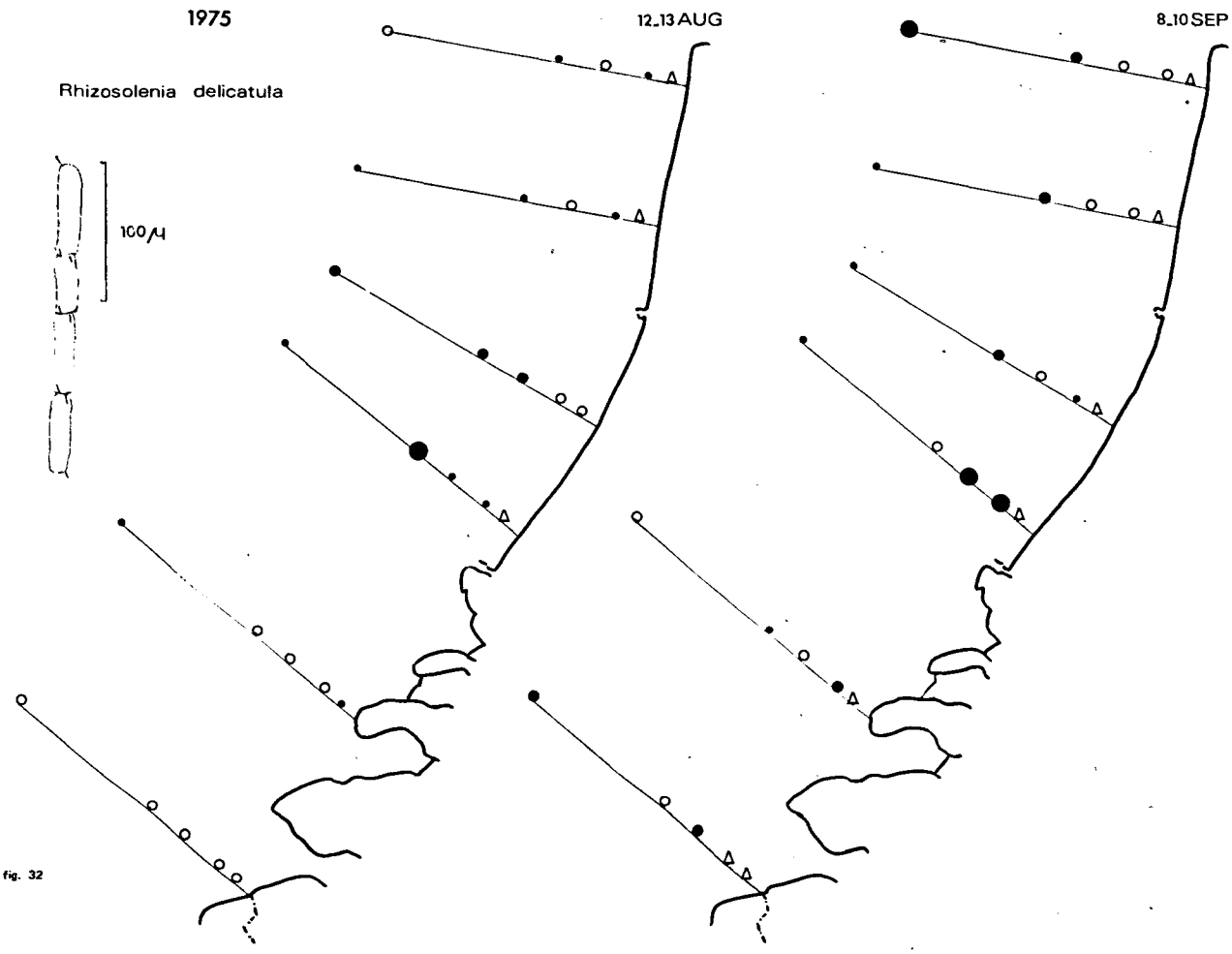

1975
12_13AUG
8_10SEP
Rhizosolenia delicatula
100 µ

fig. 32

1976

15_17JUN

13_15JUL

Rhizosolenia delicatula

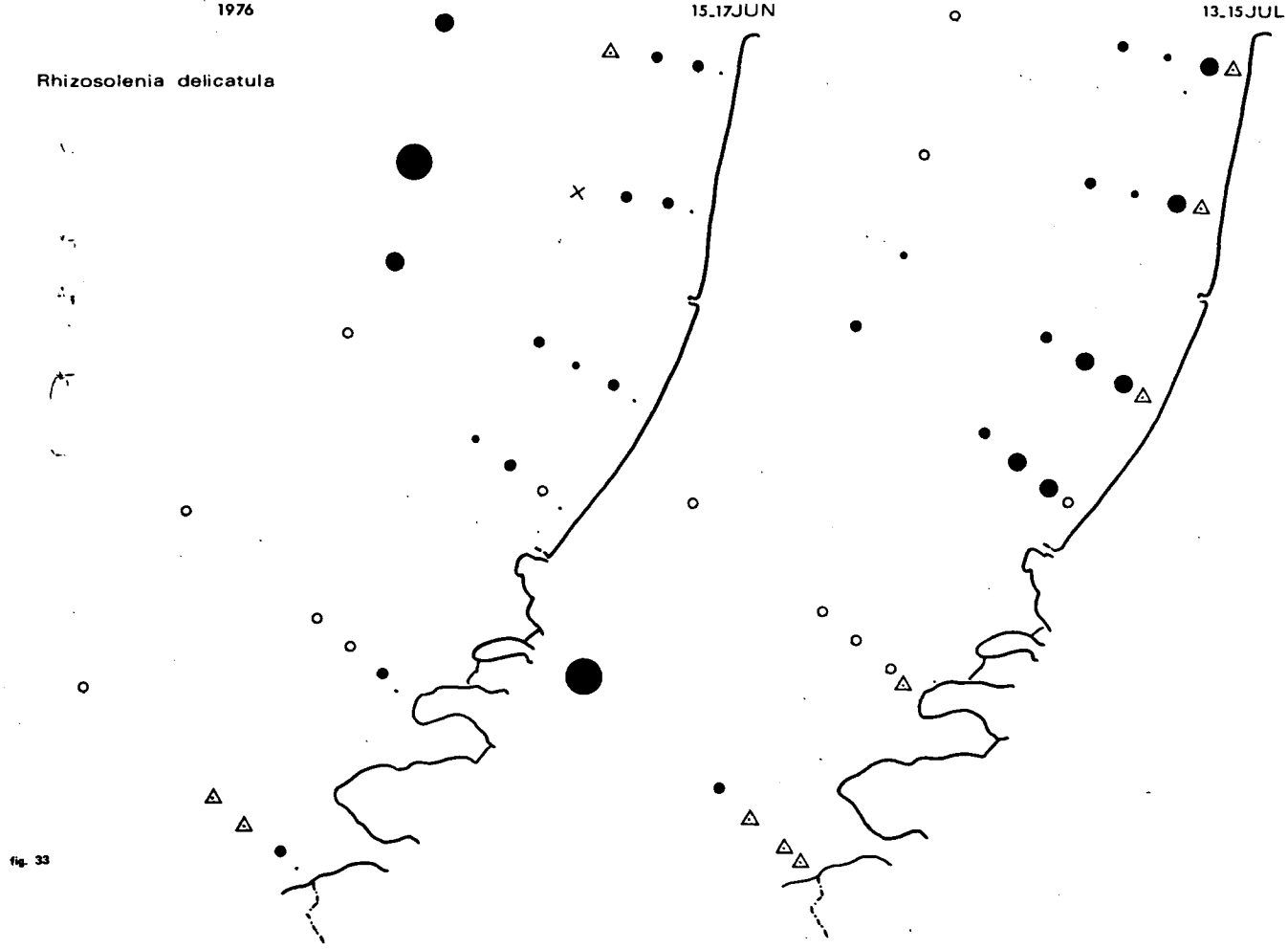


fig. 33

1976

21_23 SEP

18_20 OCT

Rhizosolenia delicatula

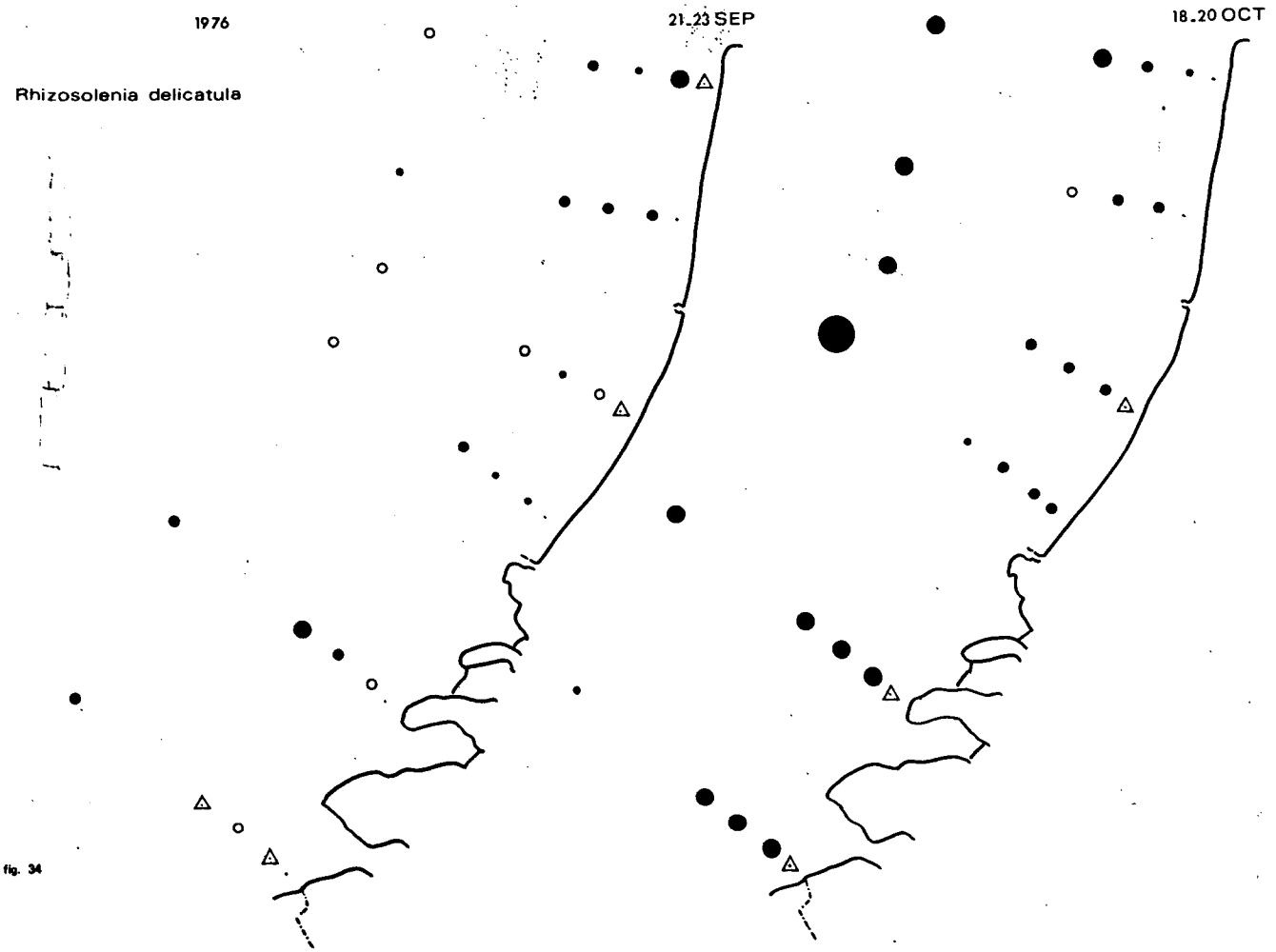


fig. 34

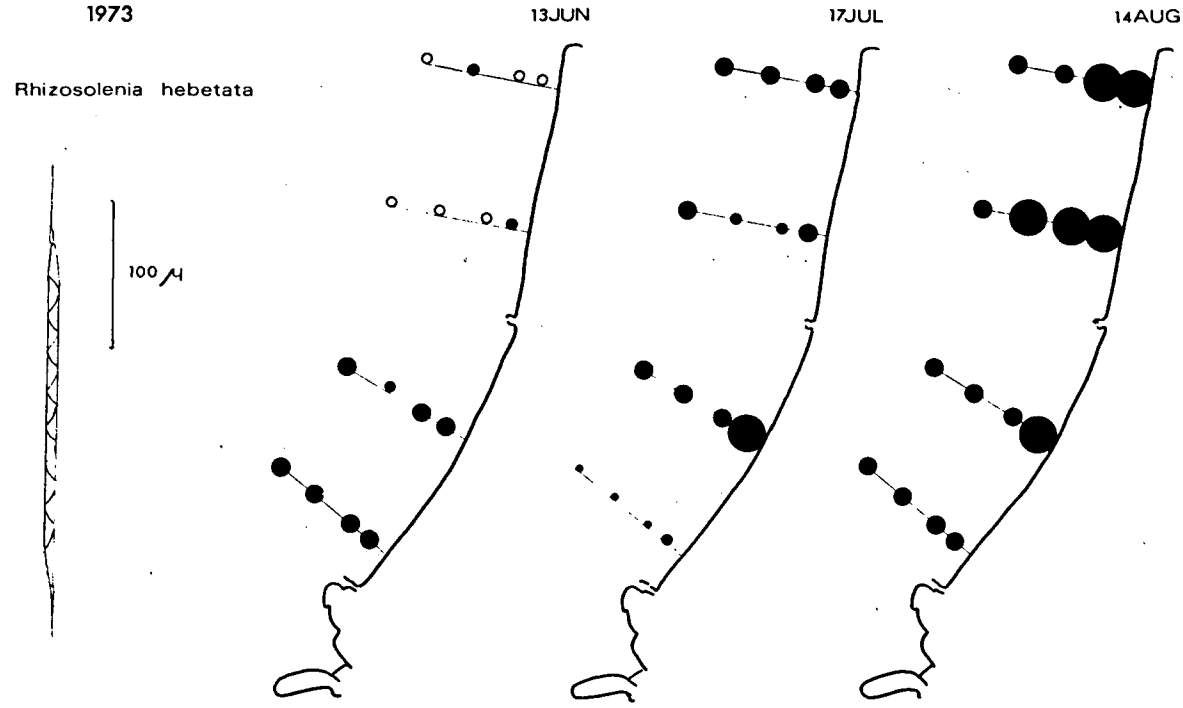

1973
13JUN
17JUL
14AUG
Rhizosolenia hebetata
100 µ

fig. 35

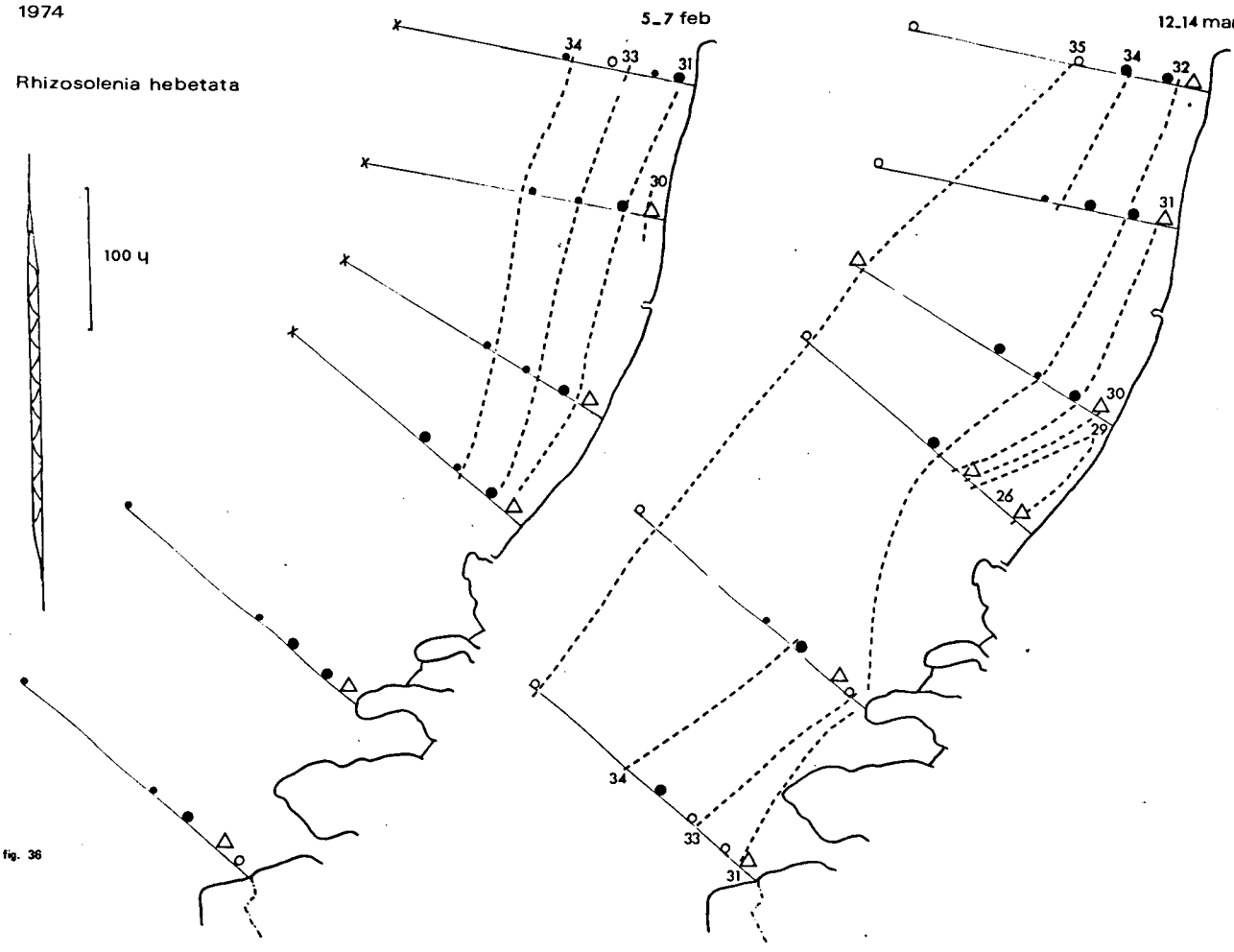

1974
5_7 feb
12_14 mar
Rhizosolenia hebetata
100 µ
34
33
31
30
35
32
29
26

fig. 36

1974

Rhizosolenia hebetata

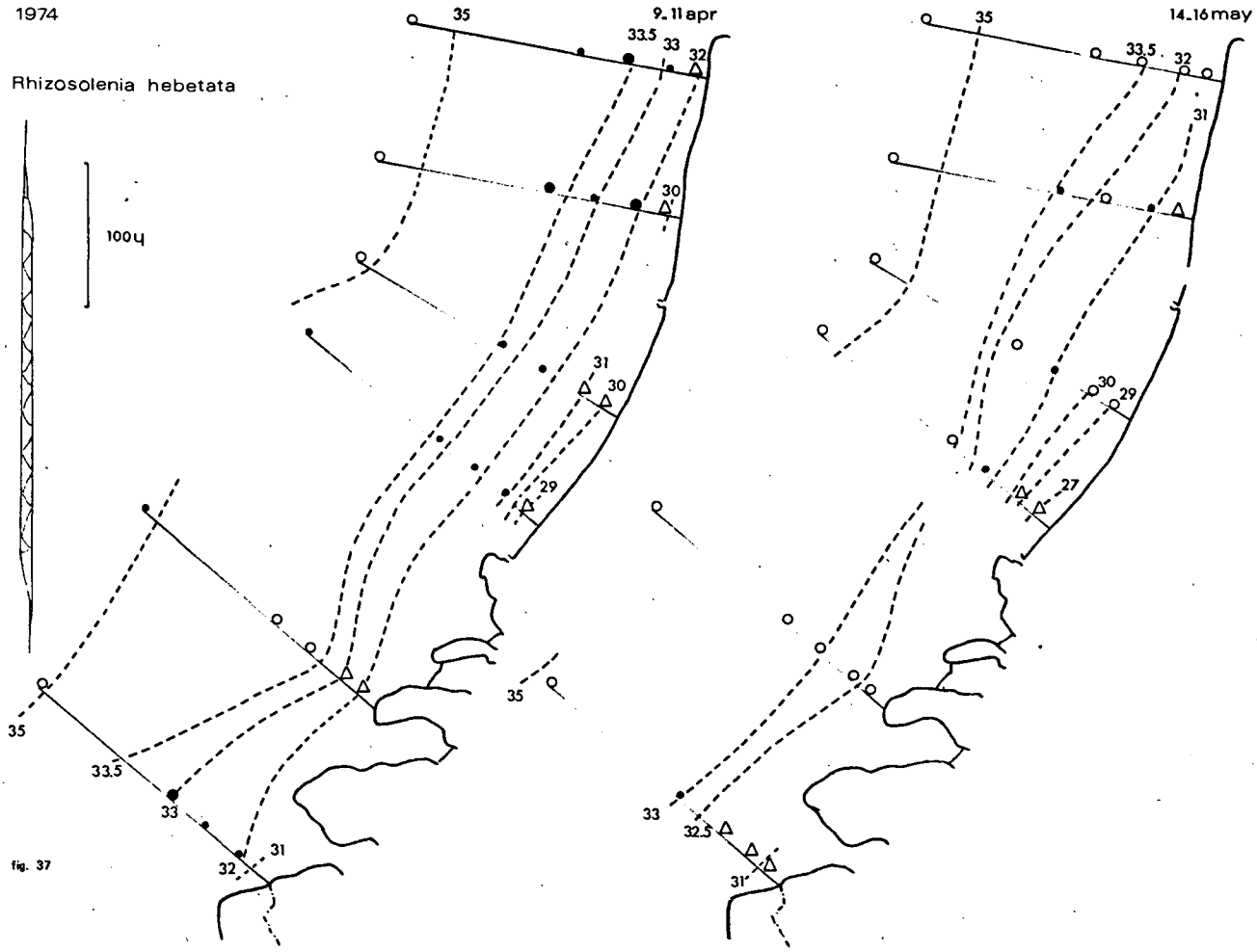


fig. 37

1974

Rhizosolenia hebetata

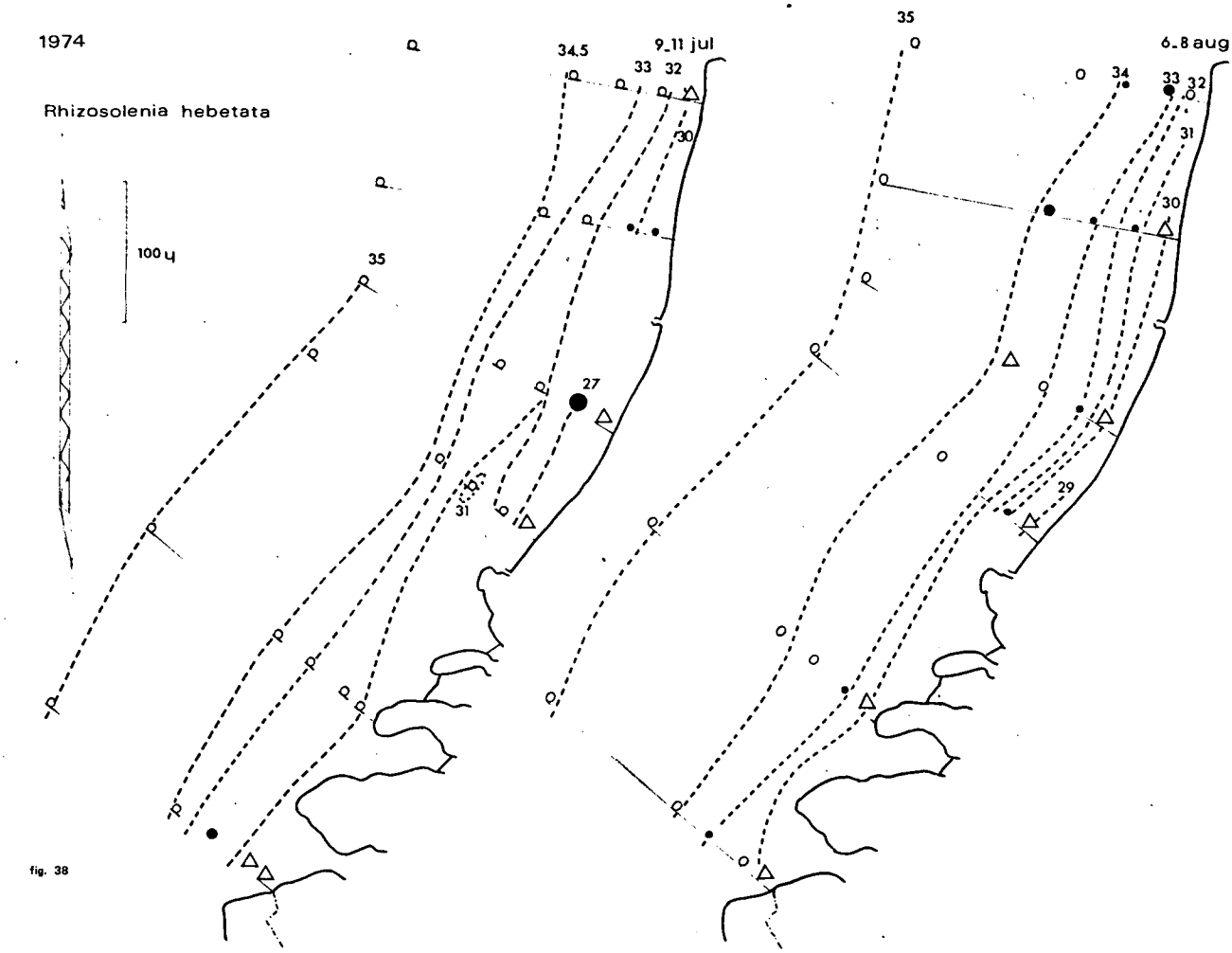


fig. 38

1975

16_18JUL

12_13AUG

Rhizosolenia hebetata

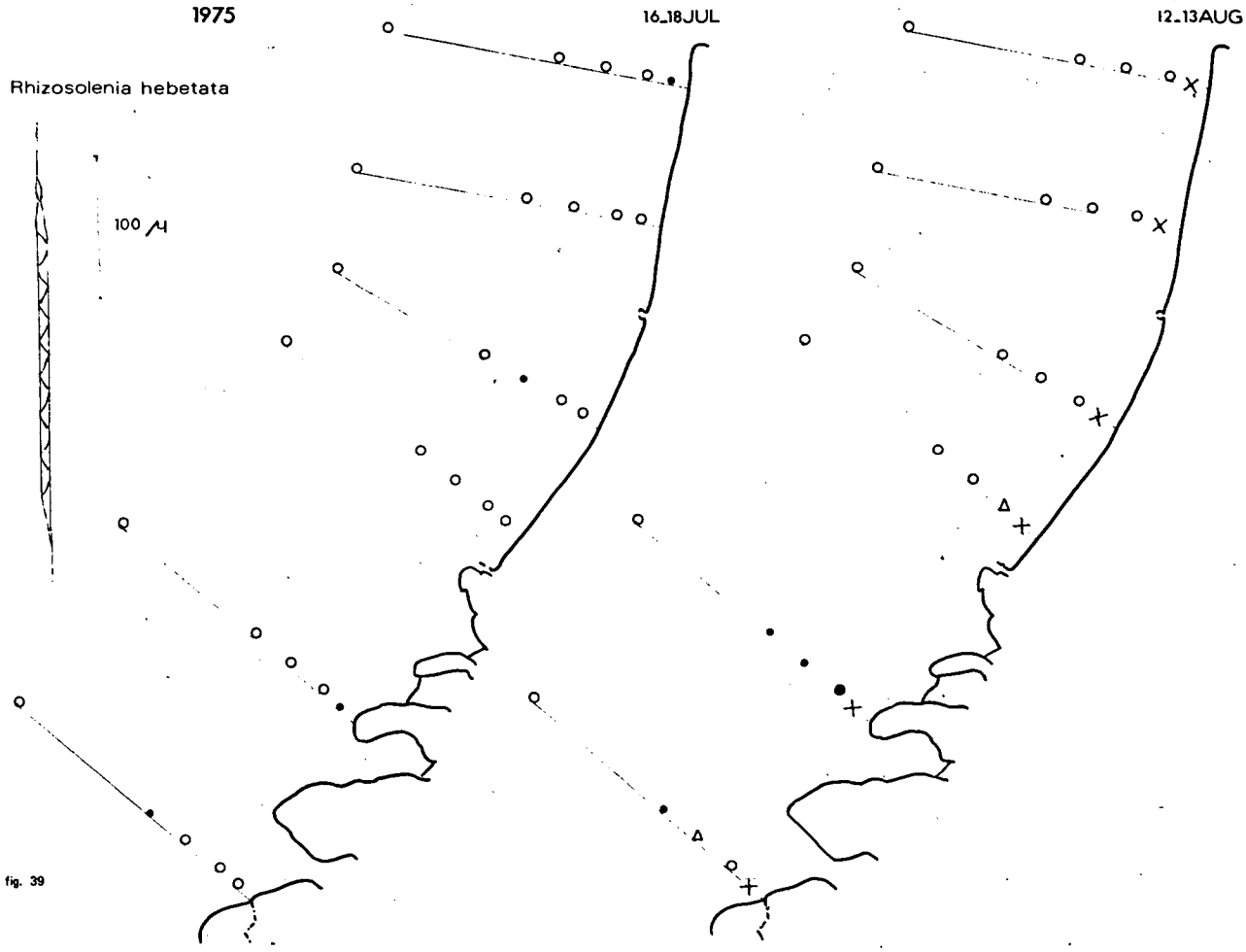


fig. 39

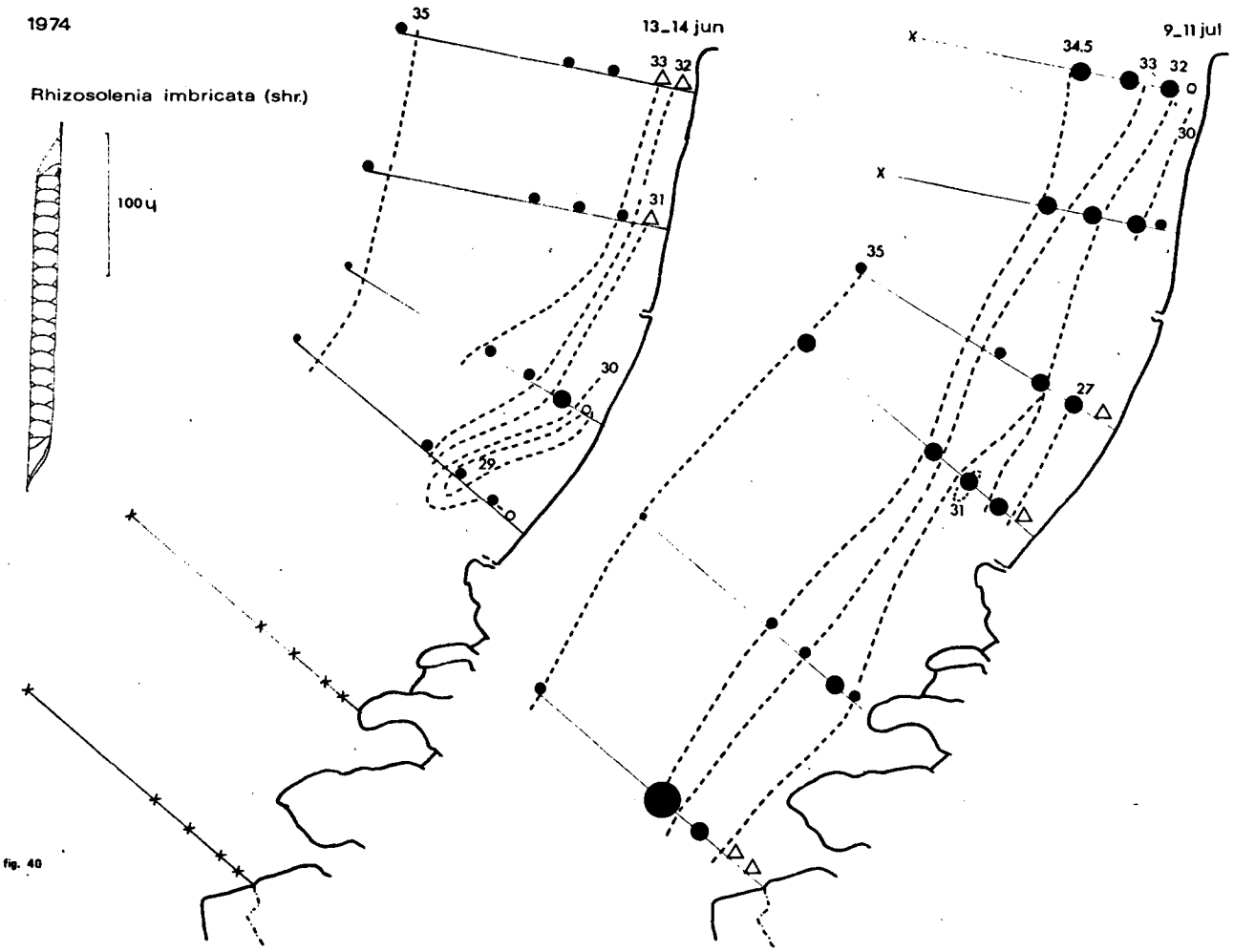

1974
Rhizosolenia imbricata (shr.)
100 µ
13_14 jun
9_11 jul
35
34.5
33
32
31
30
29
27

fig. 40

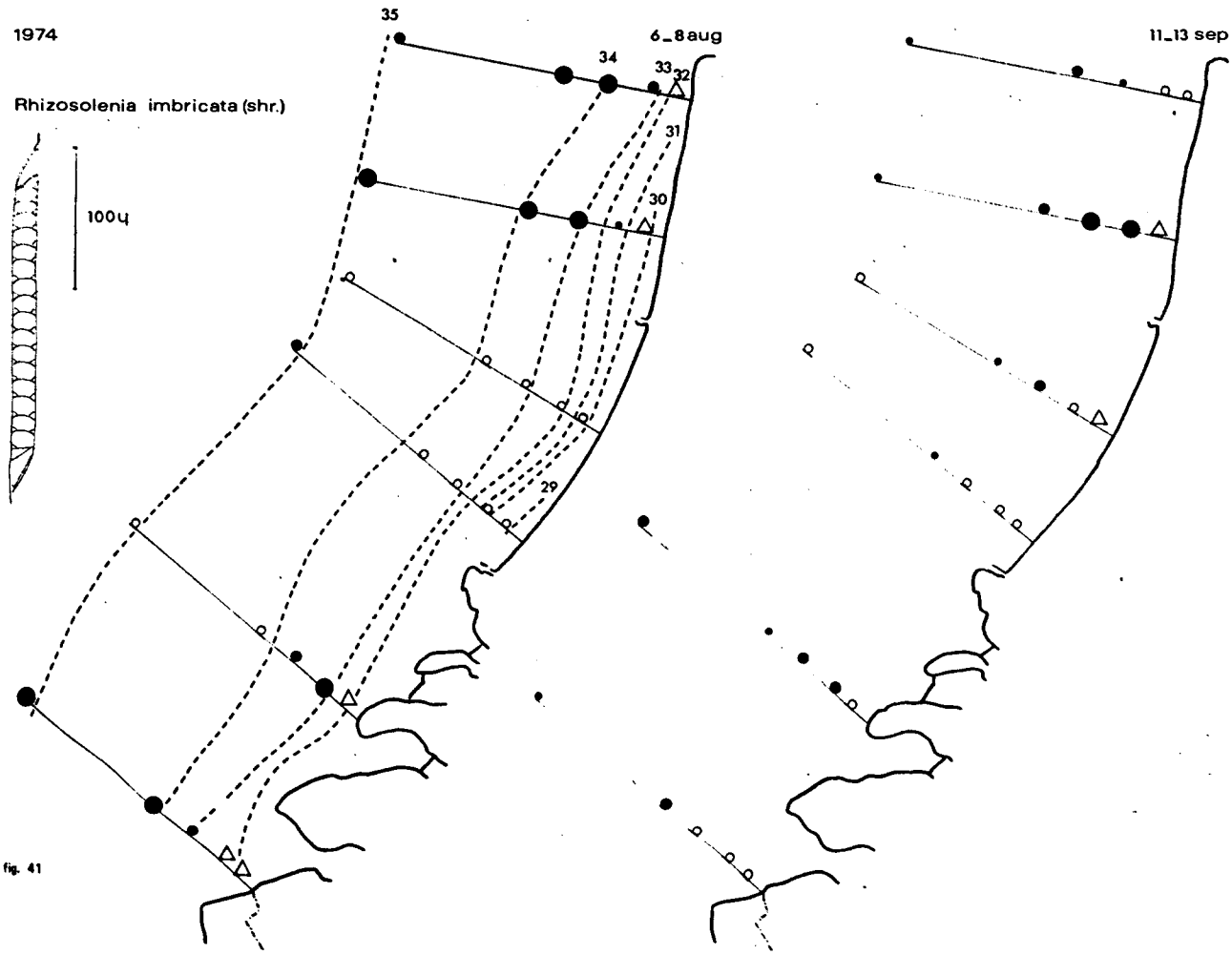

1974
Rhizosolenia imbricata (shr.)
100 µ
6_8 aug
11_13 sep
35
34
33
32
31
30
29

fig. 41

1975

16_19JUN

14_18JUL

Rhizosolenia imbricata

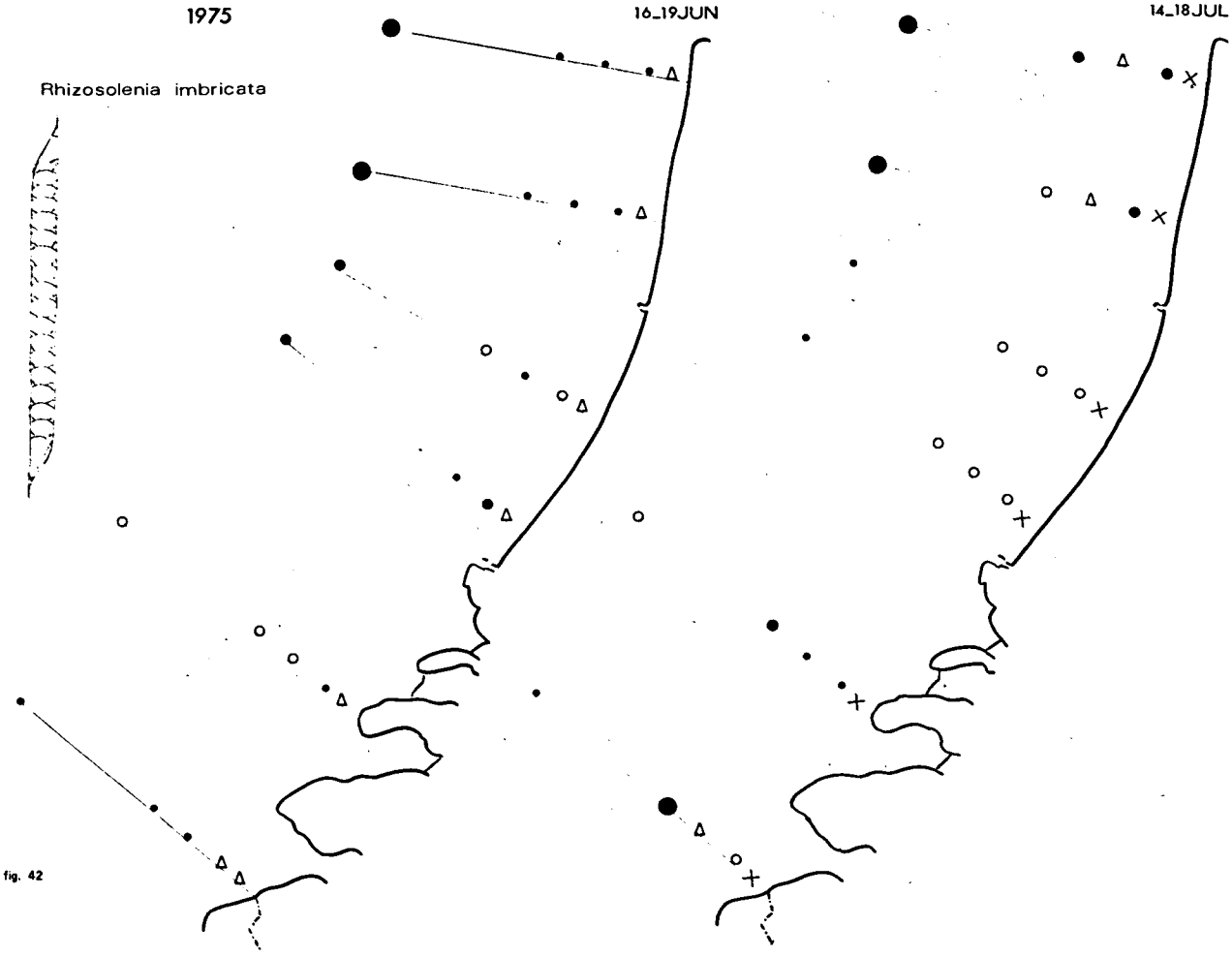


fig. 42

1975

12_13AUG

8_10SEP

Rhizosolenia imbricata

100 µ

fig. 43

1976

Rhizosolenia imbricata

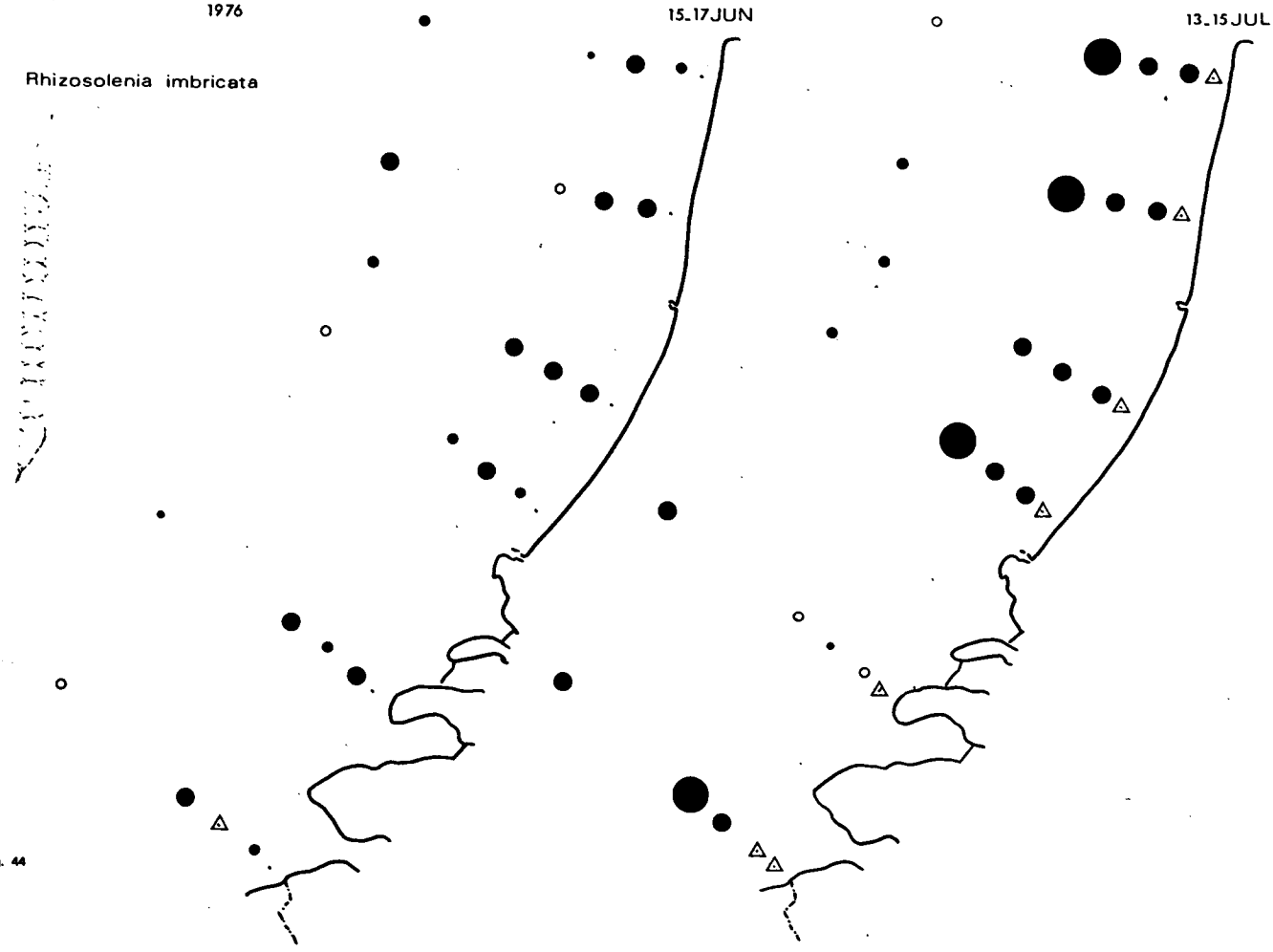


fig. 44

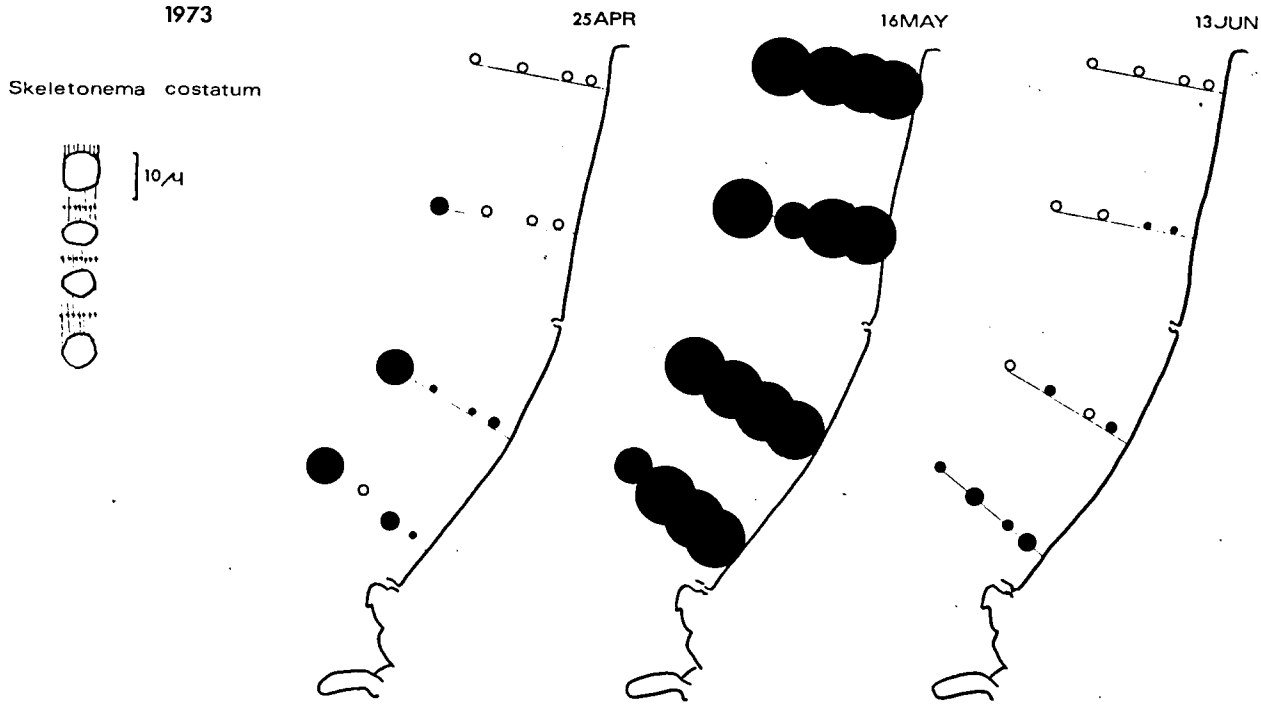

1973
Skeletonema costatum
10 µ
25APR
16MAY
13JUN

fig. 45

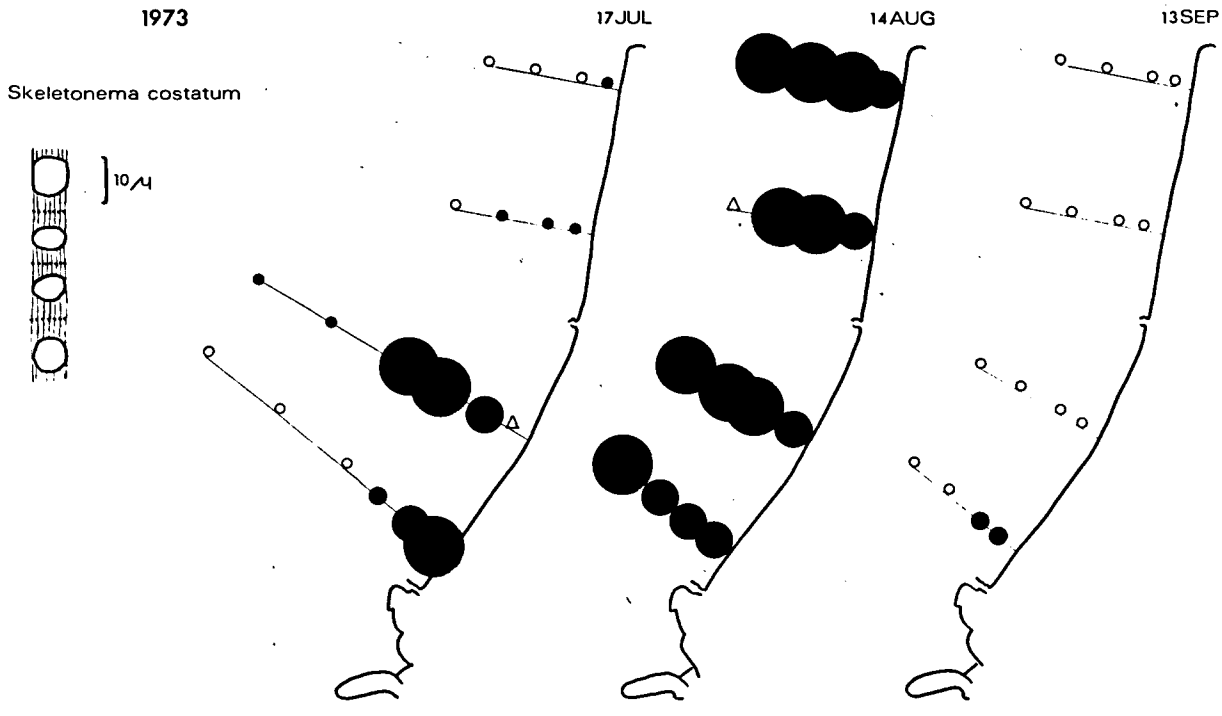

1973
Skeletonema costatum
10 µ
17JUL
14AUG
13SEP

fig. 46

1974

Skeletonema costatum

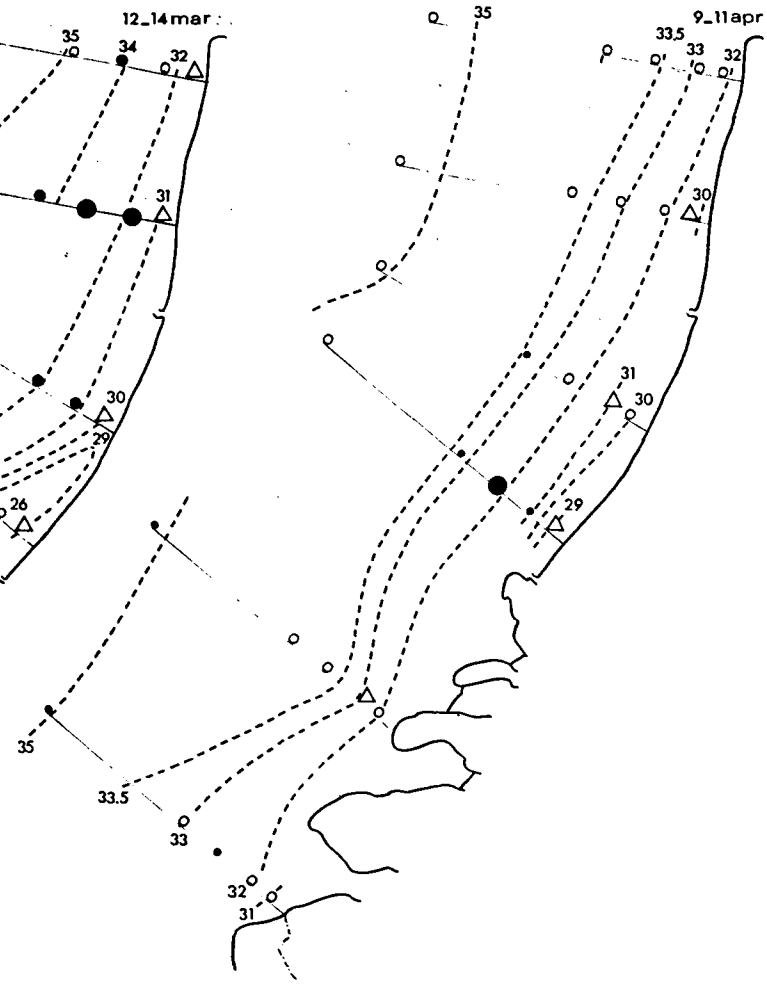
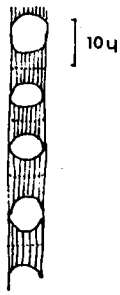


fig. 47

1974

Skeletonema costatum



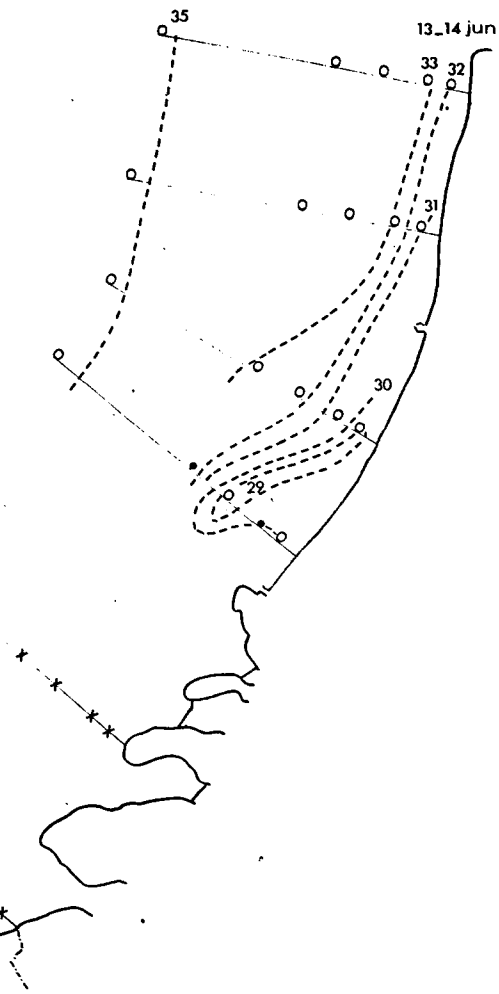


fig. 48

1974

Skeletonema costatum

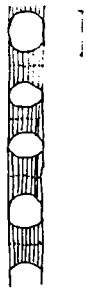


fig. 49

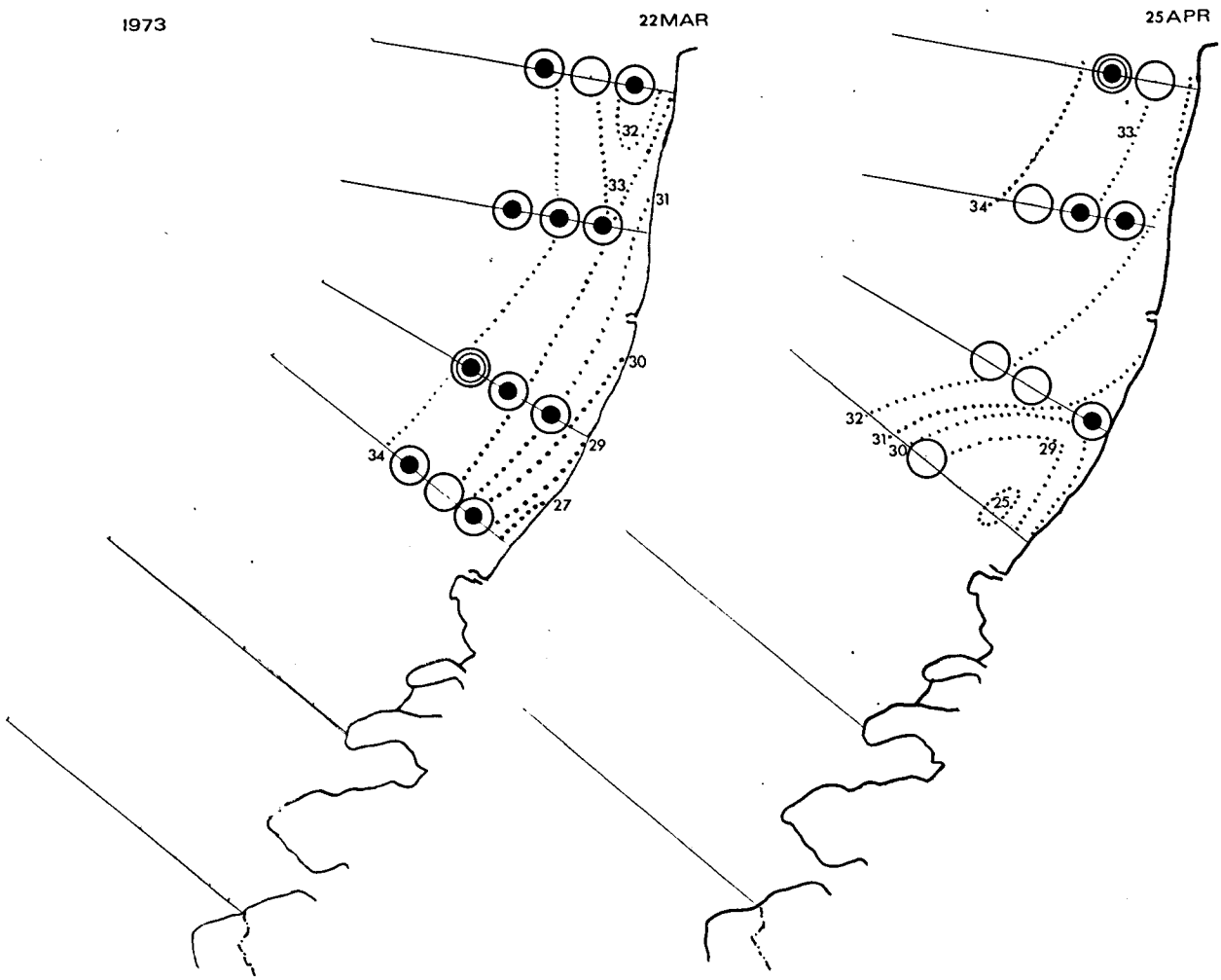

1973
22MAR
25APR
32
33
31
30
34
29
27
33
34
32
31
30
29
25

fig. 50

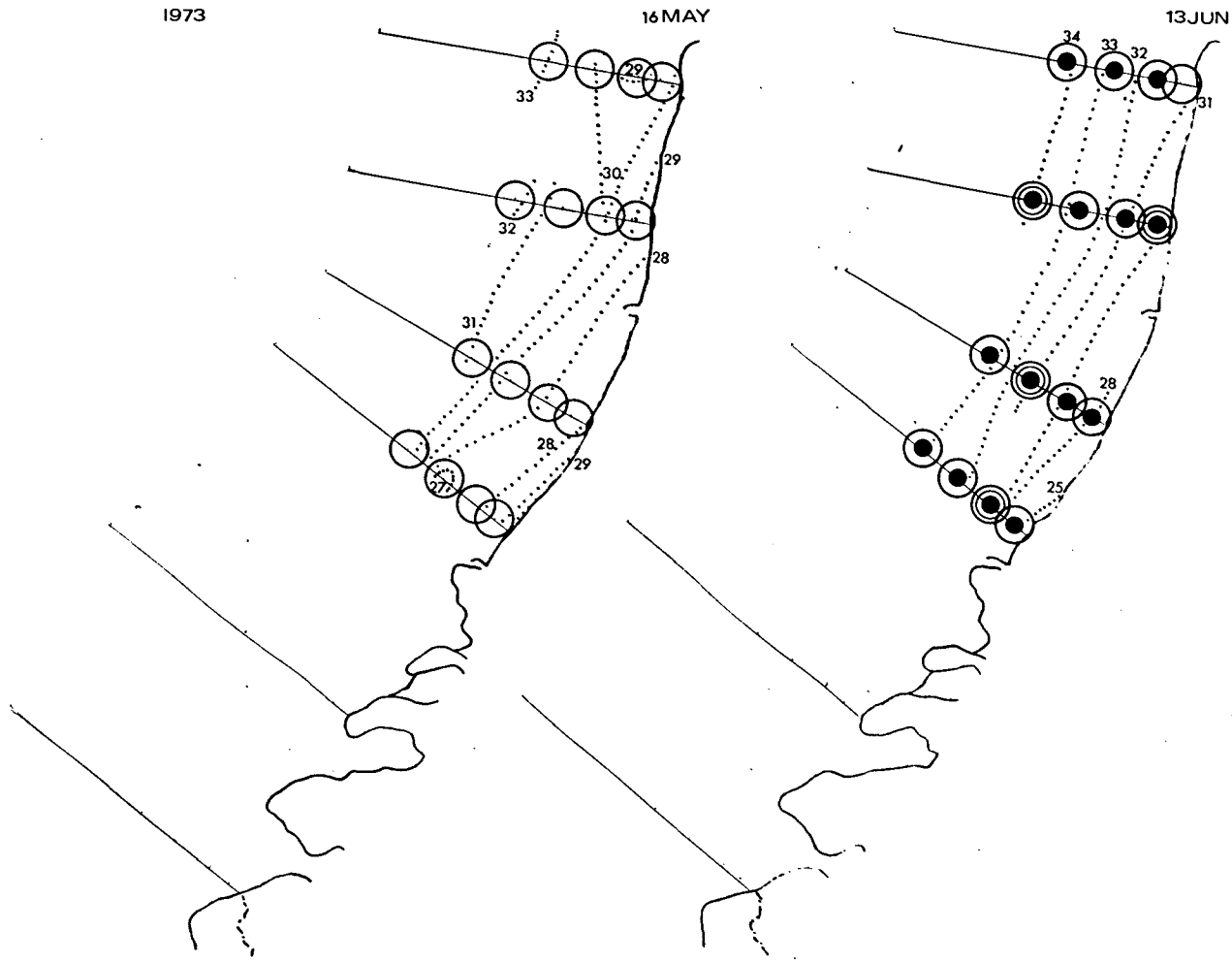

1973
16MAY
13JUN
33
29
30
29
32
28
31
28
29
27
34
33
32
31
28
25

fig. 51

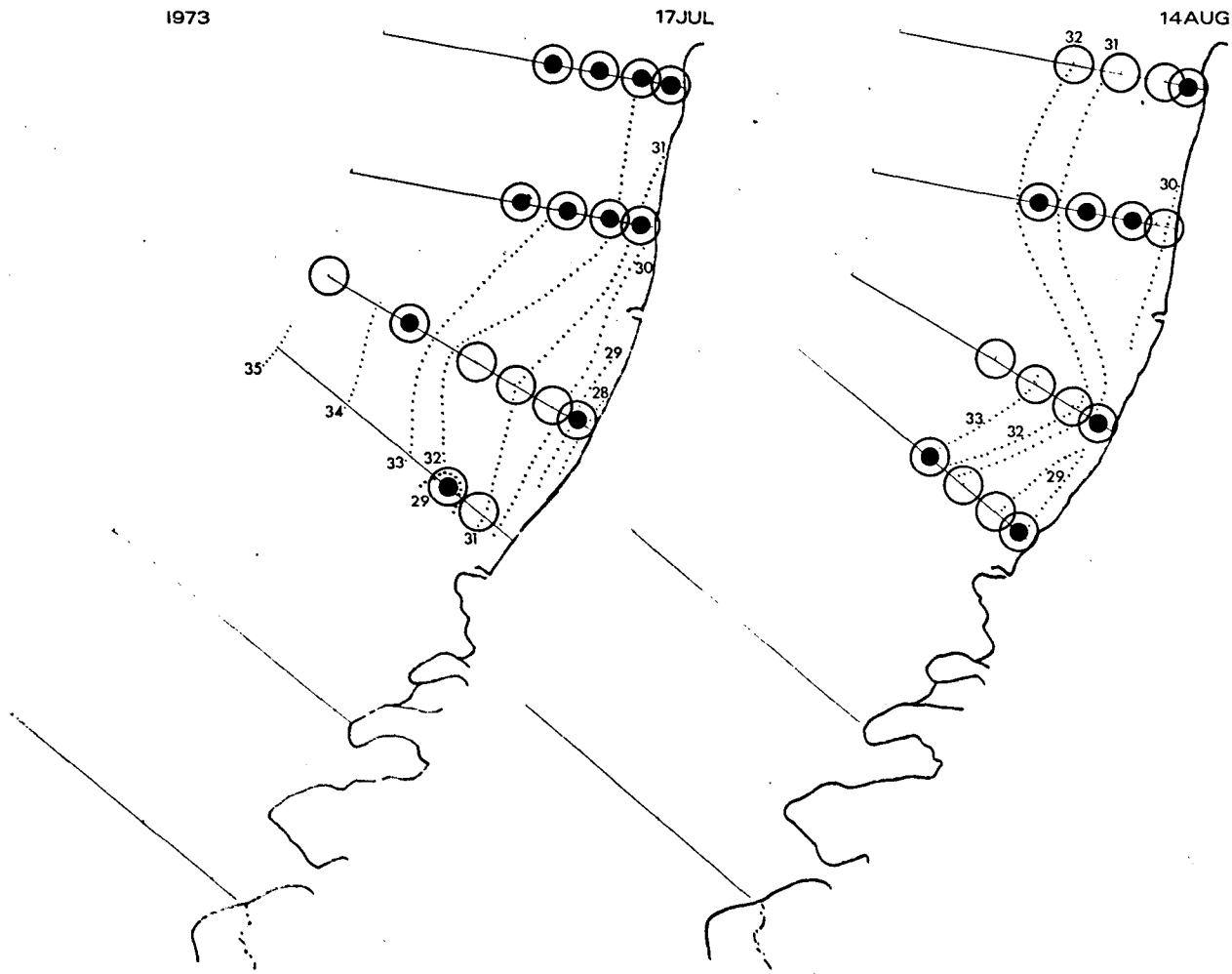

1973
17JUL
14AUG
35
34
33
32
31
30
29
28
27

fig. 52

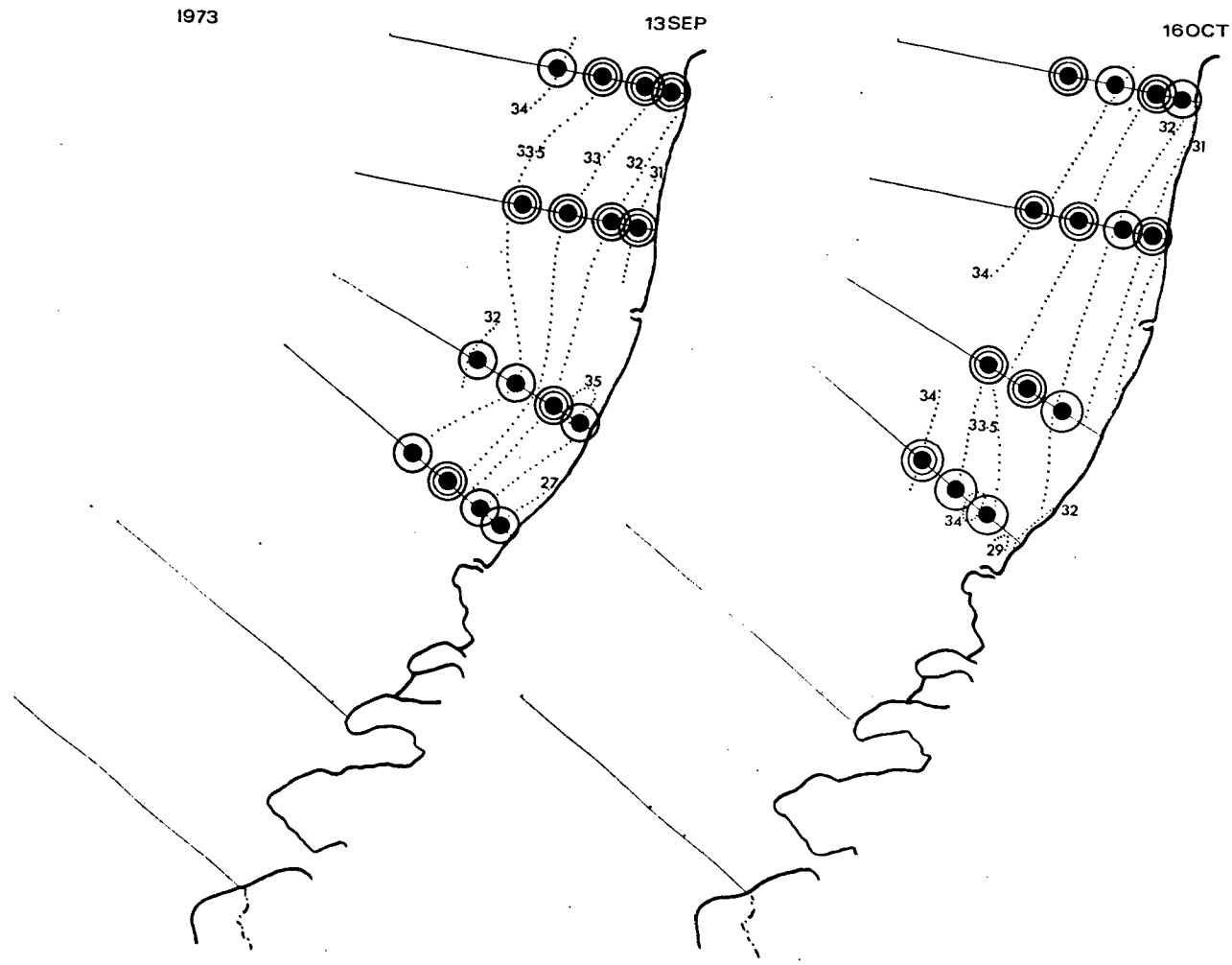
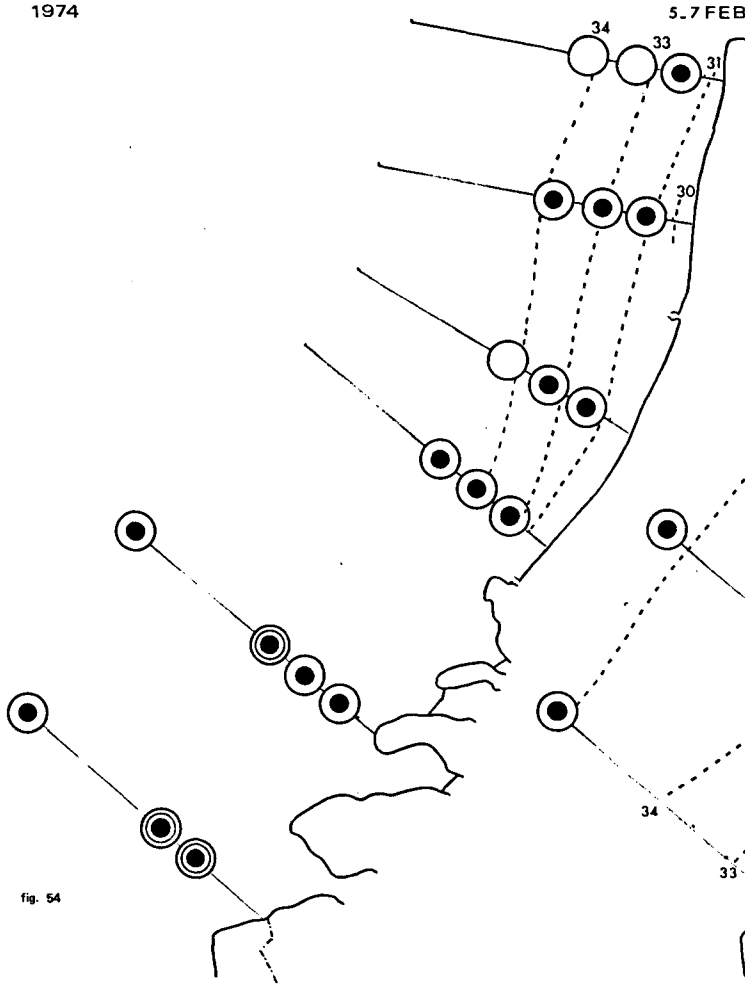

1973
13SEP
16OCT
34
33.5
33
32
31
35
27
29

fig. 53

1974

5-7 FEB



12-14 MRT

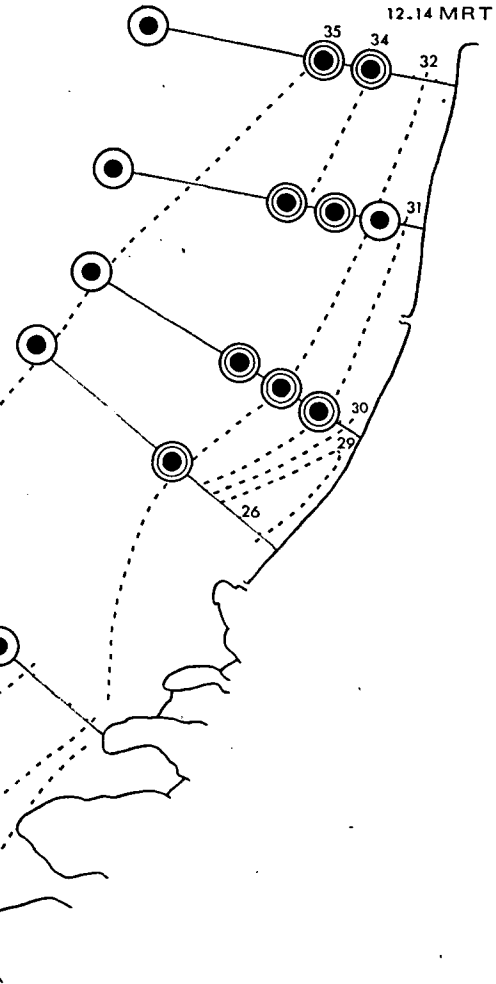
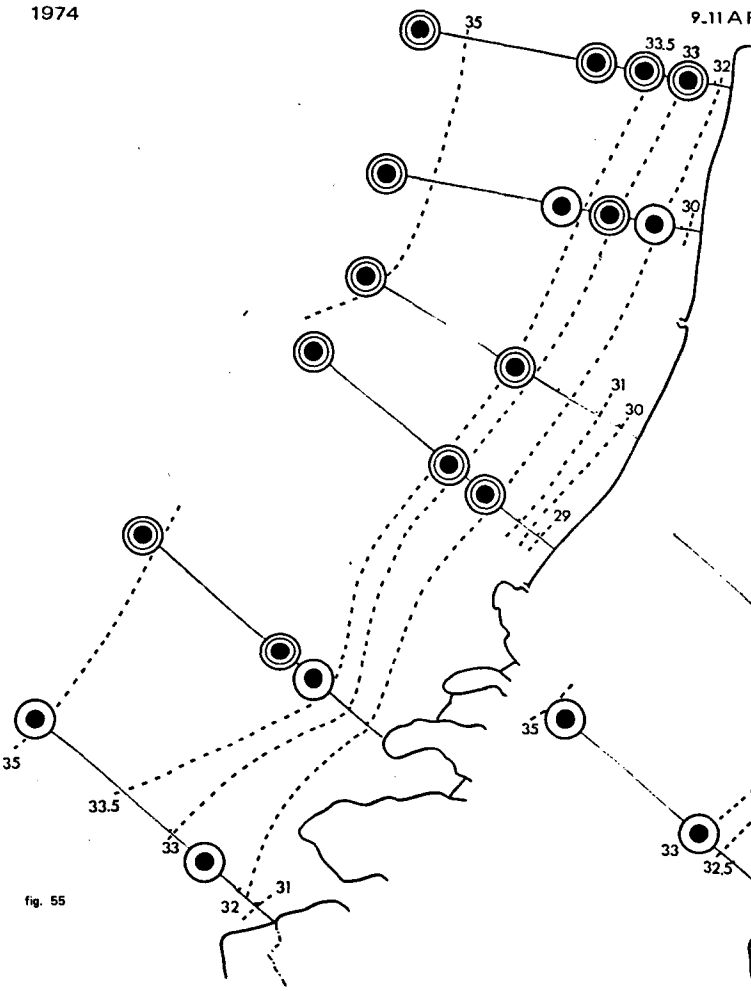


fig. 54

1974

9-11 APR



14-16 MAY

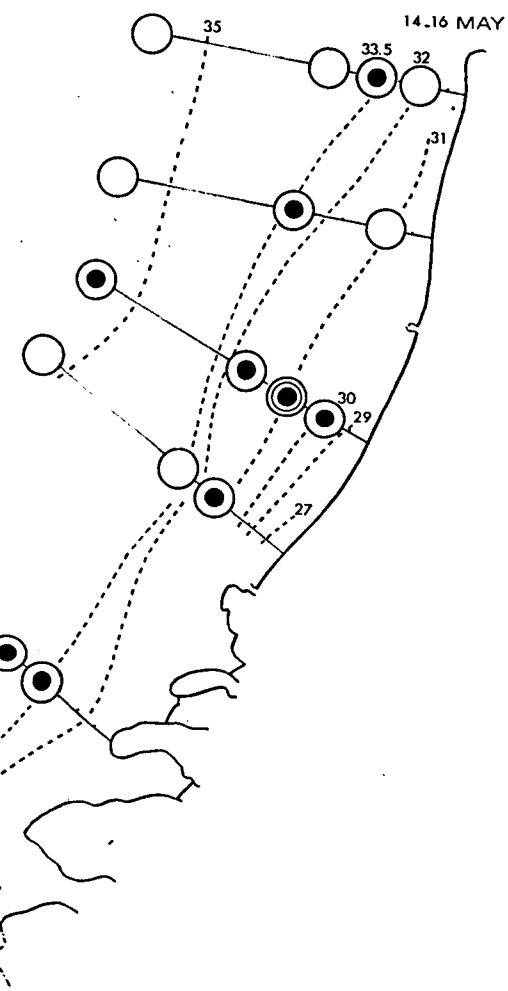


fig. 55

1974

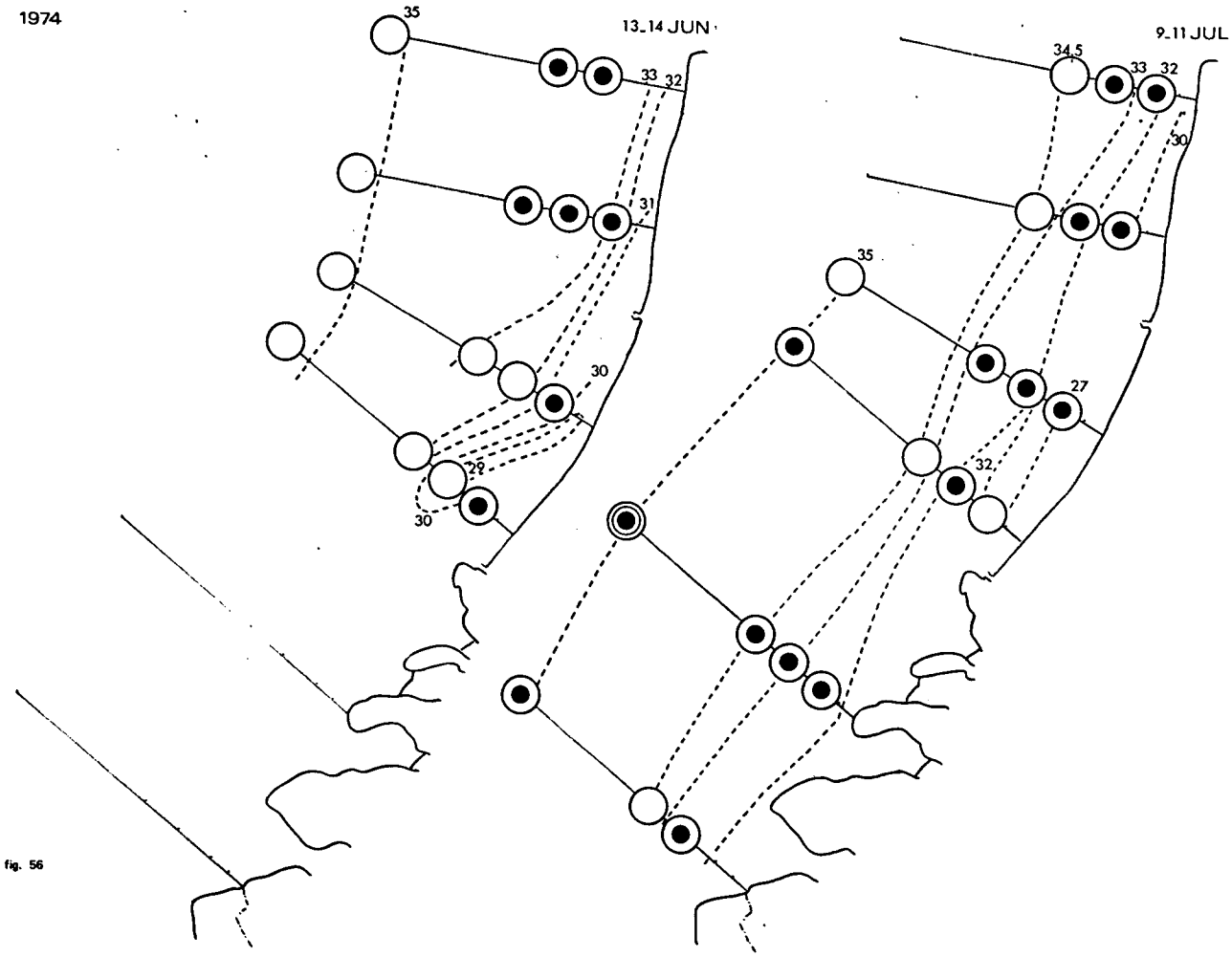


fig. 56

1974

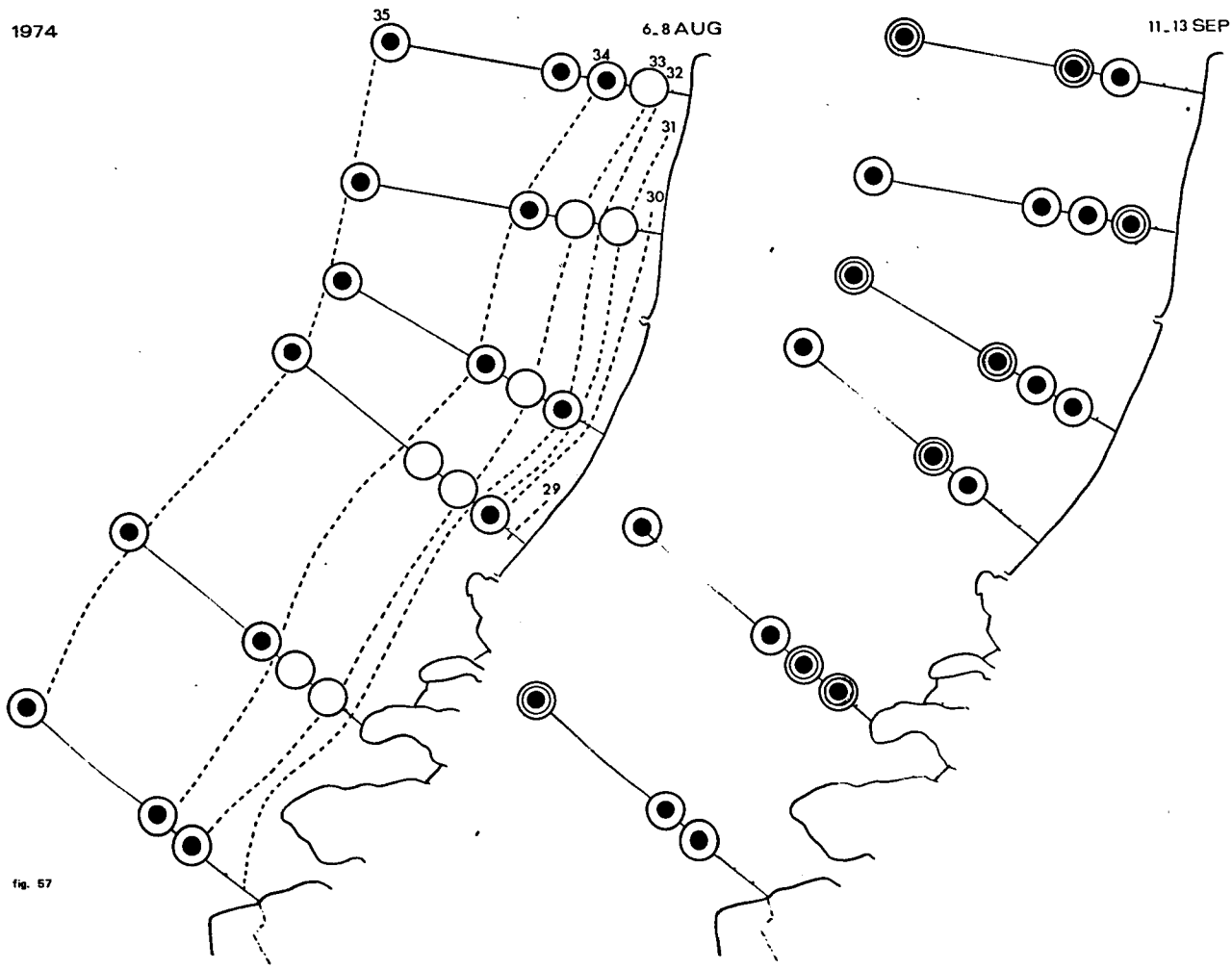


fig. 57

1974

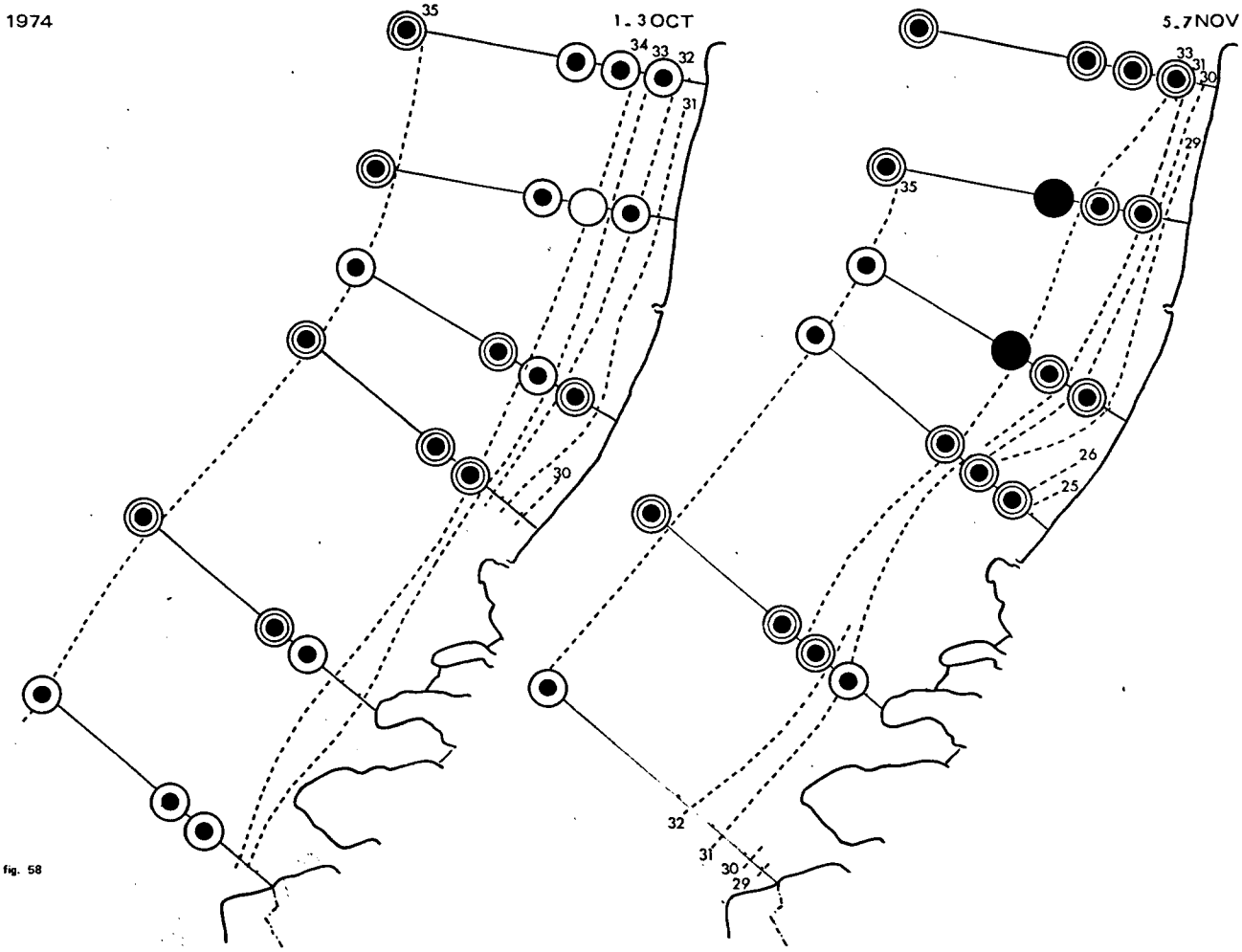


fig. 58

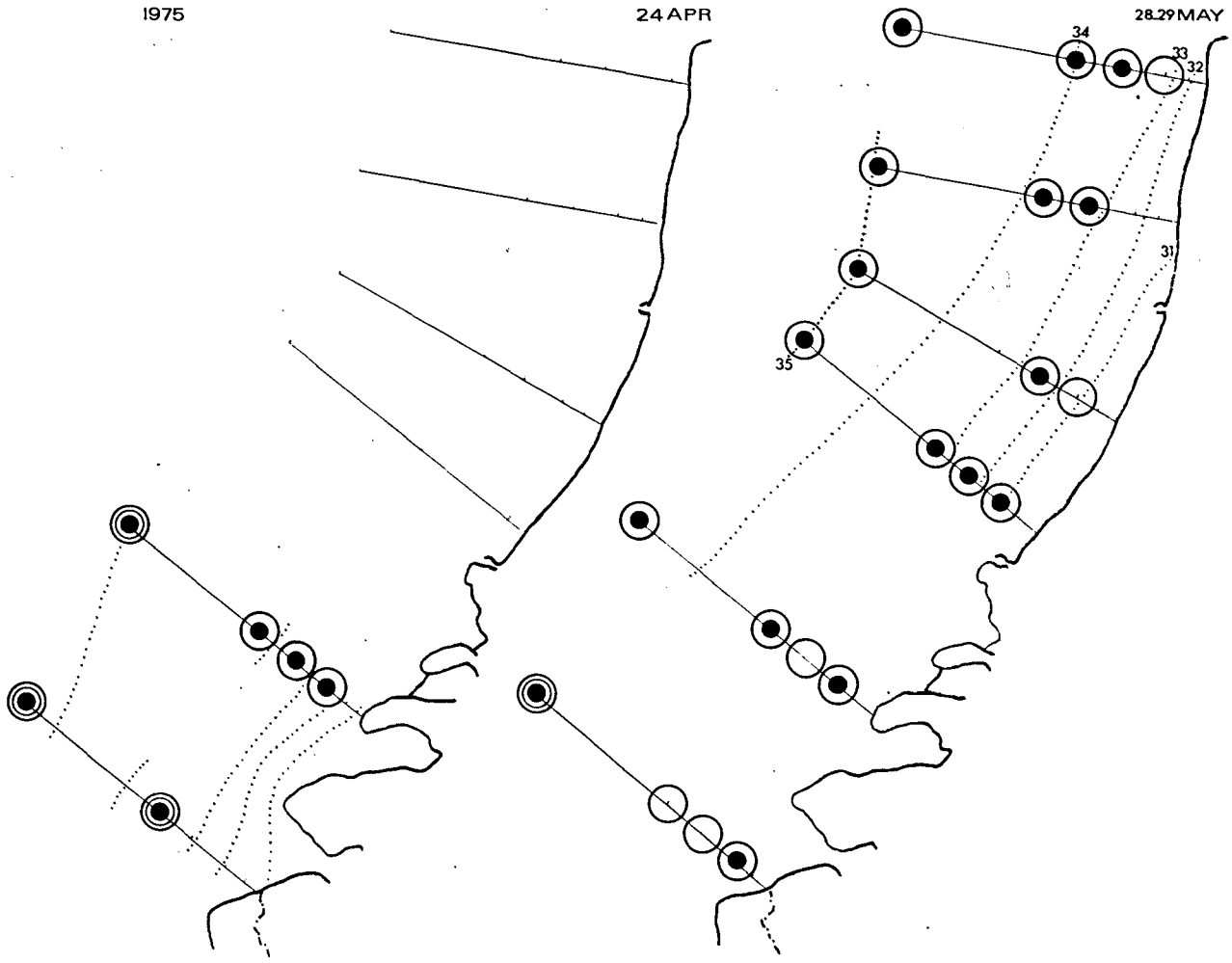

1975
24 APR
28.29 MAY
34
33
32
31
35

fig. 59

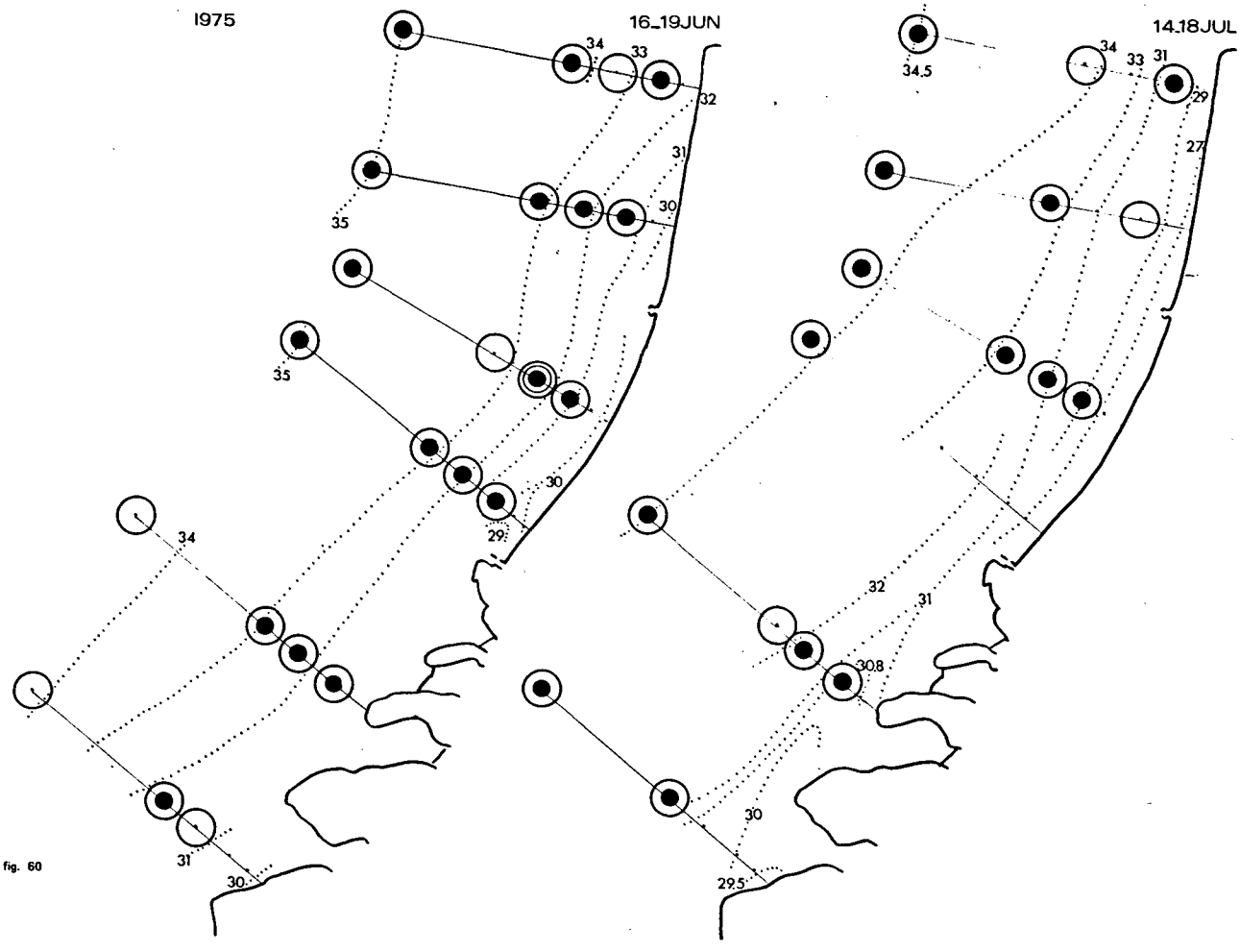

1975
16_19JUN
14.18JUL
34
33
32
31
35
30
29
34.5
27
30.8
29.5

fig. 60

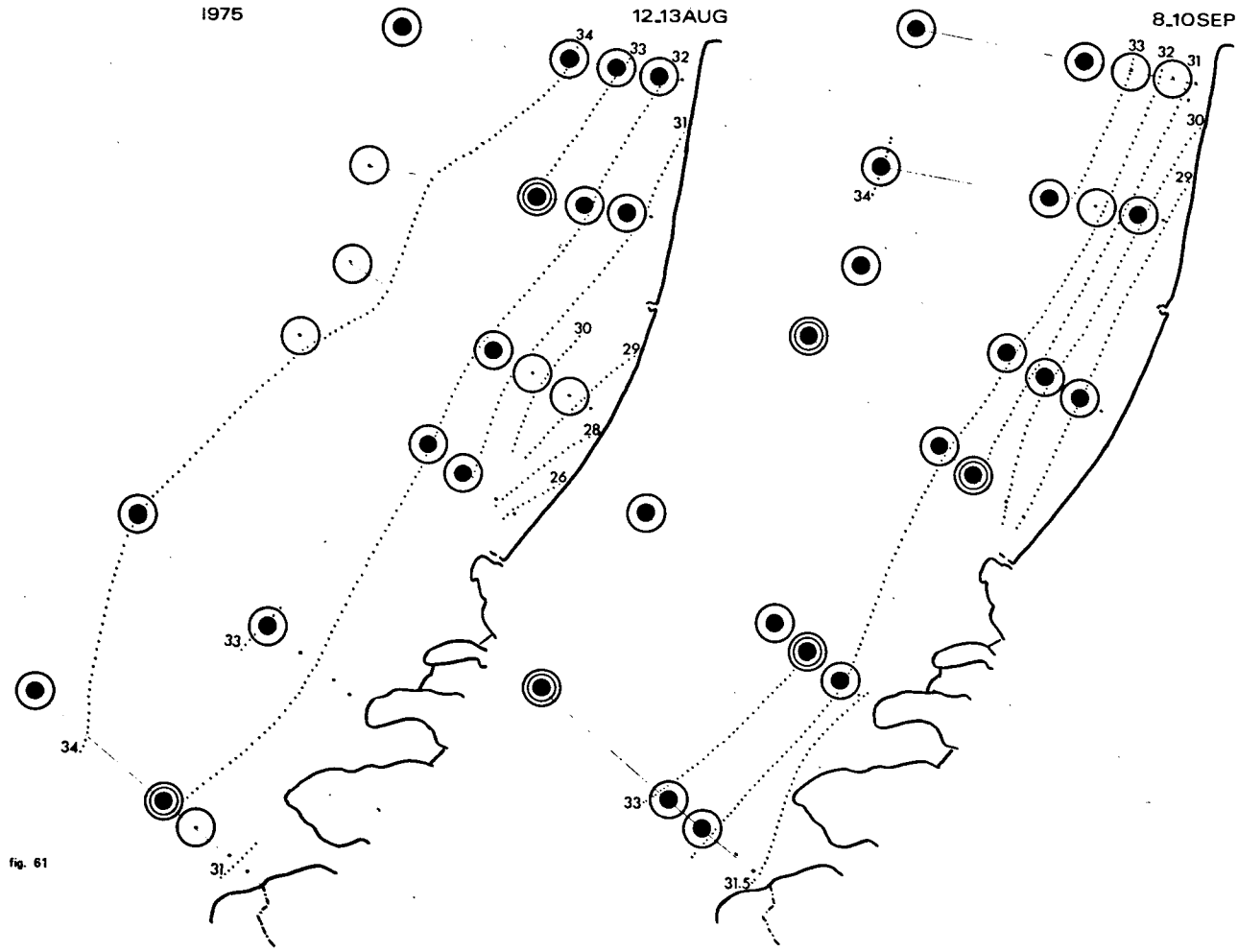

1975
12_13AUG
8_10SEP
34
33
32
31
30
29
28
26
33
34
31
33
31.5

fig. 61

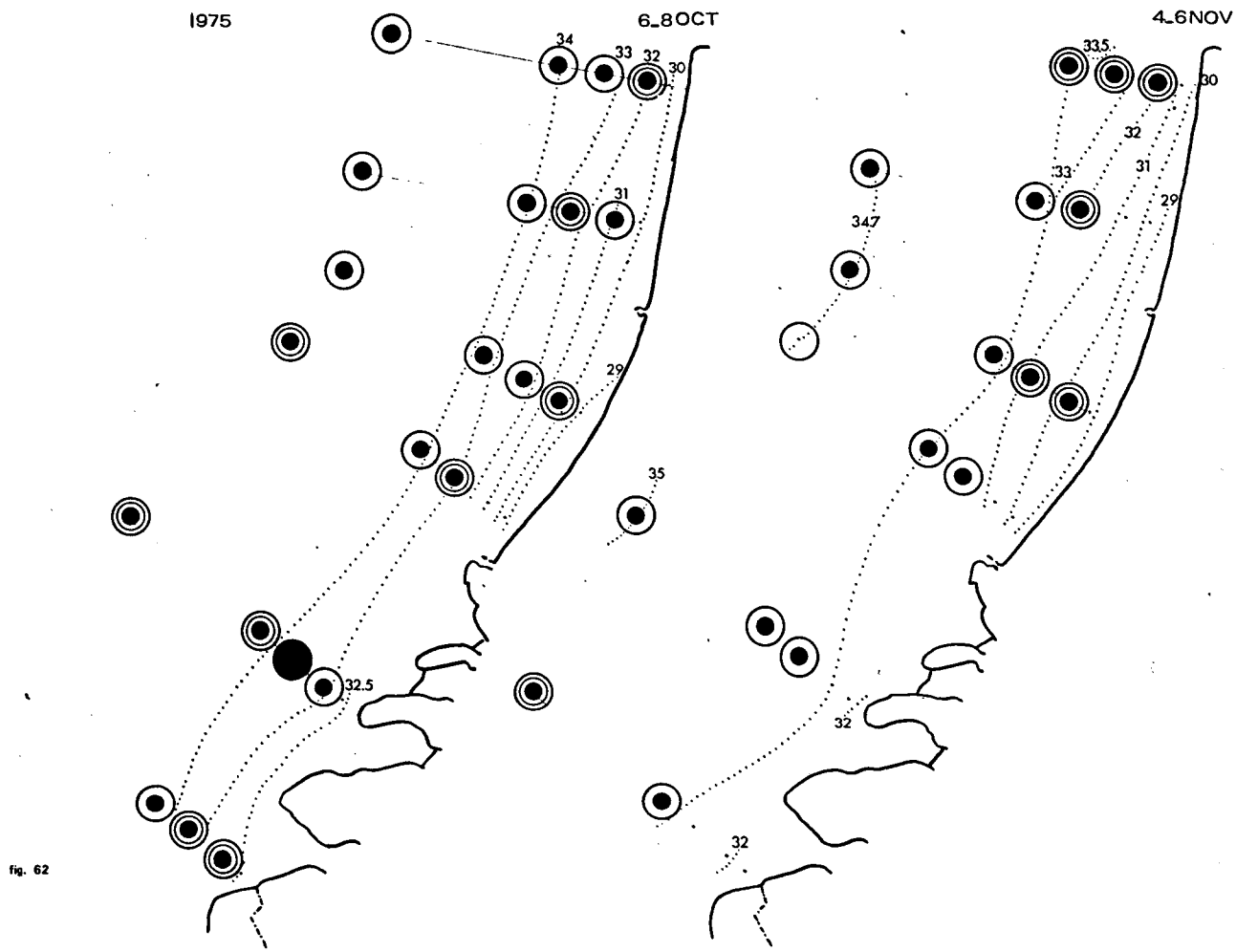

1975
6_8OCT
4_6NOV
34
33
32
30
31
29
35
32.5
33.5
34.7
32
32

fig. 62

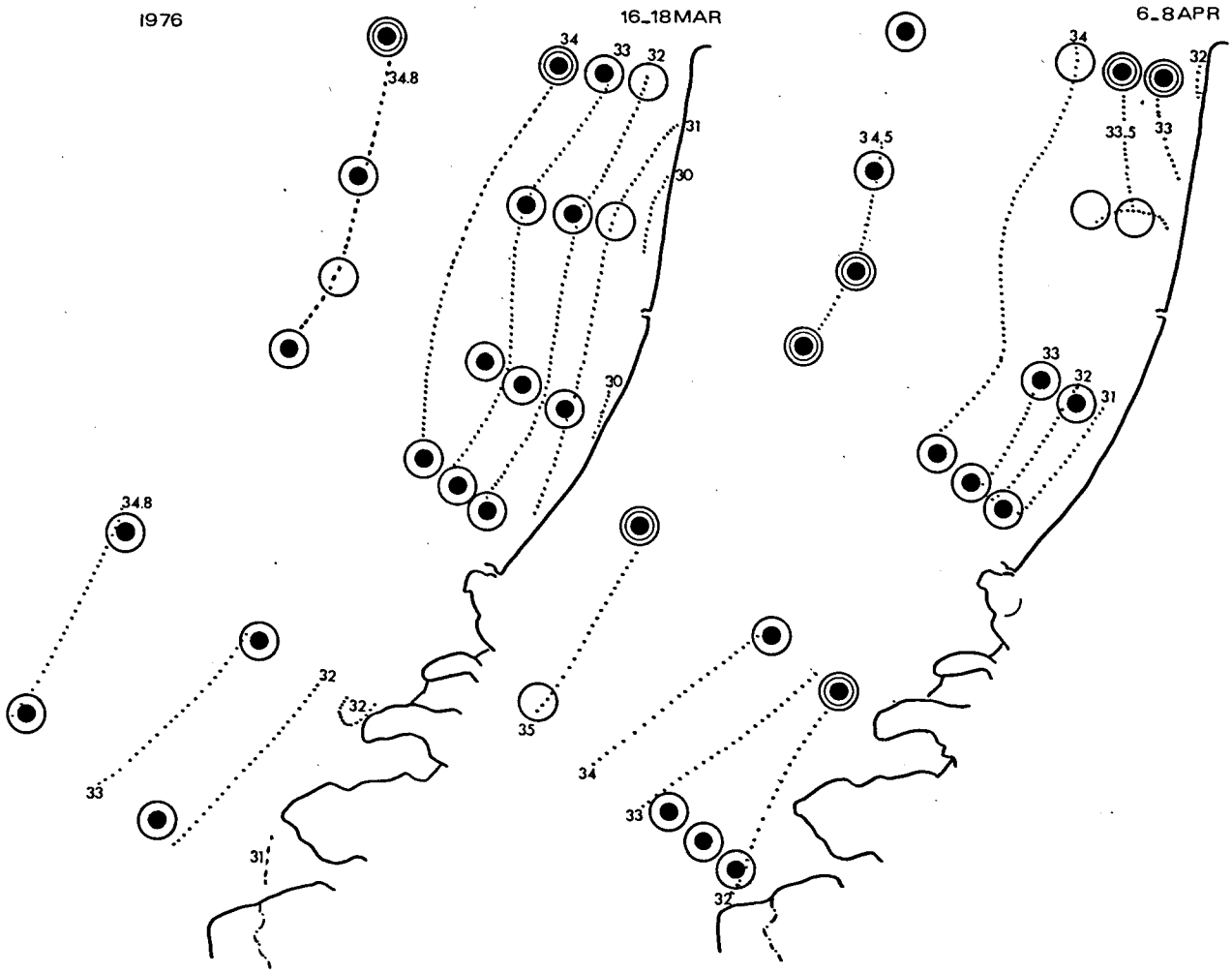

1976
16_18MAR
6_8APR
34.8
34
33
32
31
30
34.5
33.5
35

fig. 63

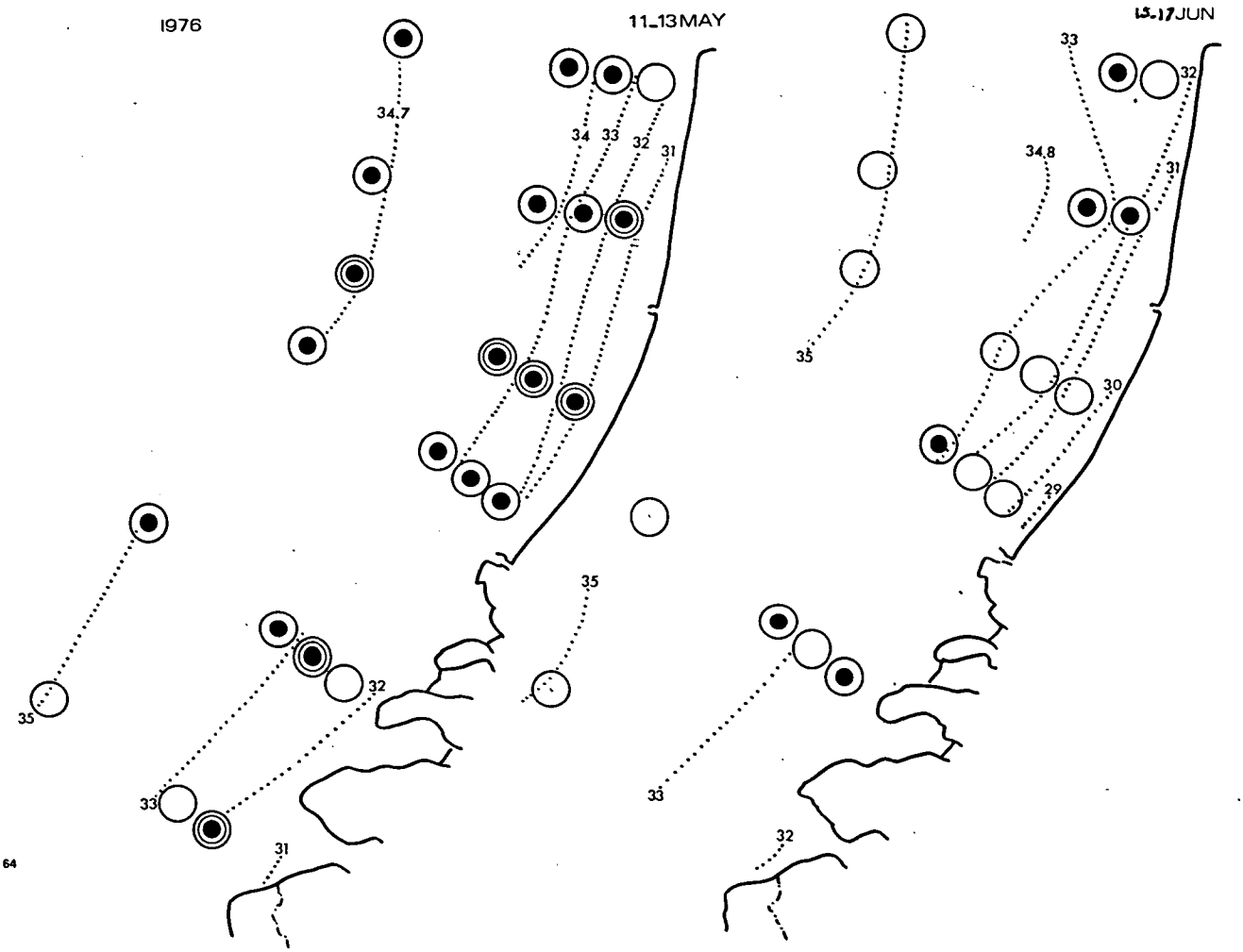

1976
11_13MAY
15_17JUN
34.7
34
33
32
31
34.8
30
29
35

fig. 64

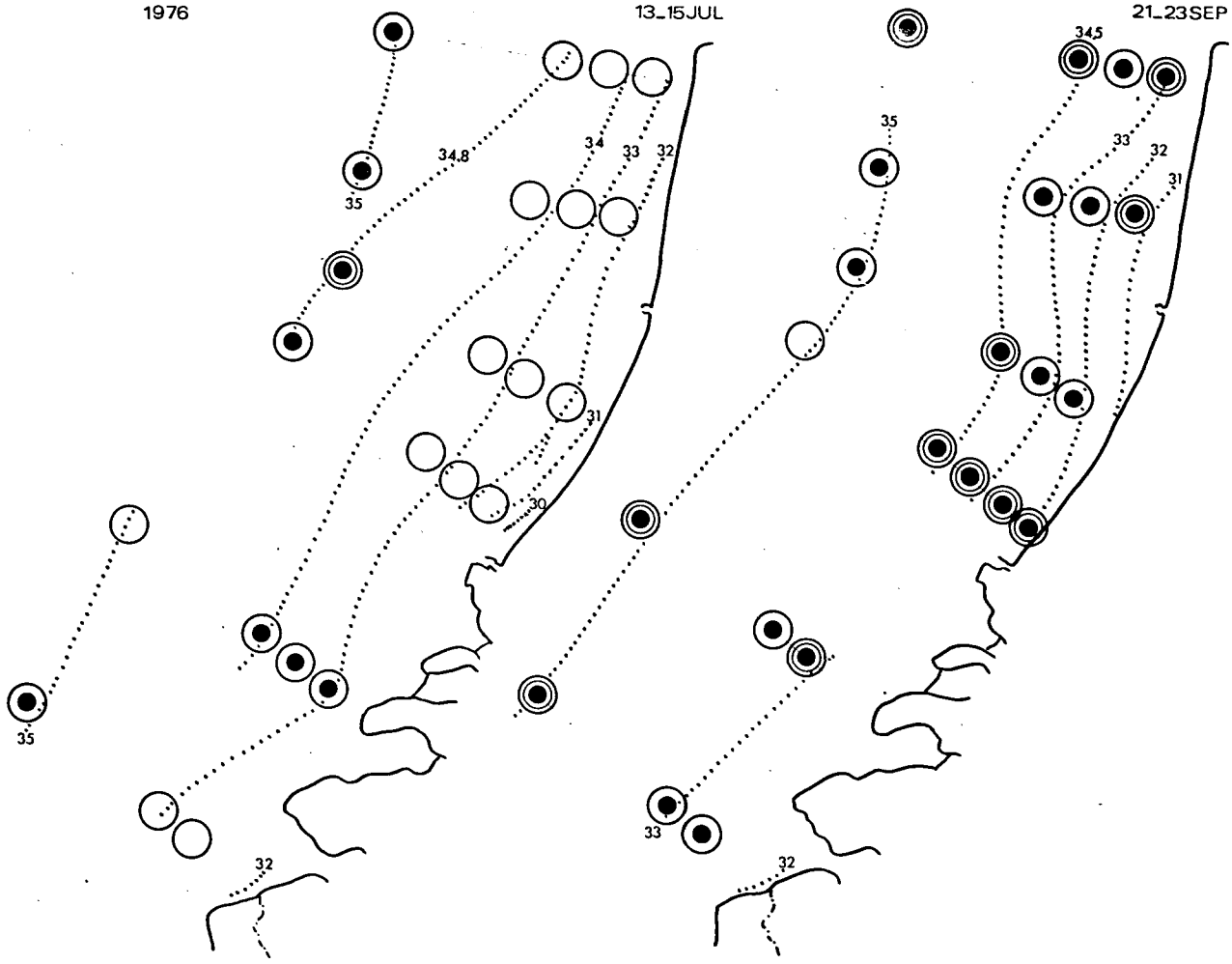

1976
13_15JUL
21_23SEP
34.8
34
33
32
31
30
35
34.5

fig. 65

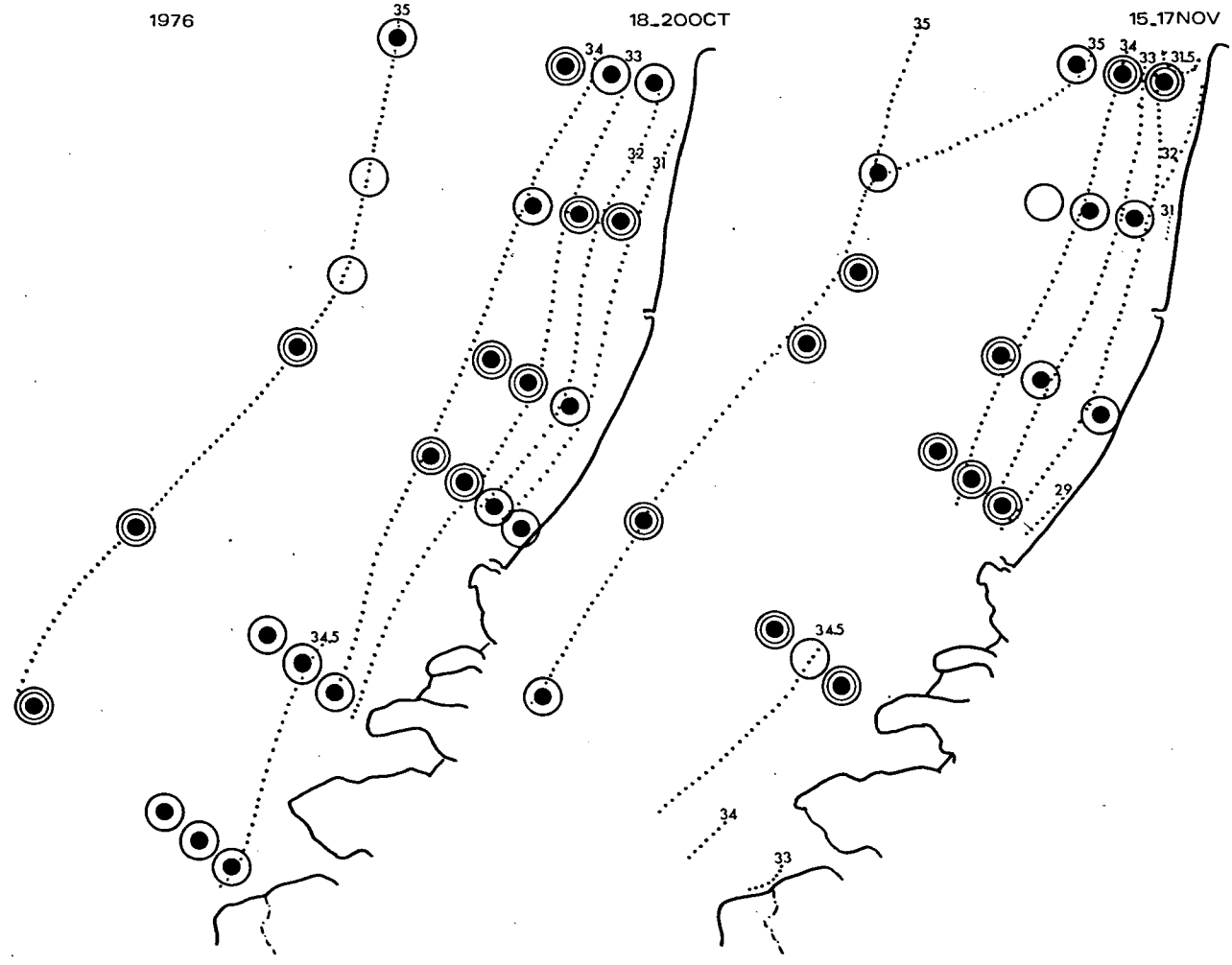

1976
18_20OCT
15_17NOV
35
34
33
32
31
34.5
29

fig. 66