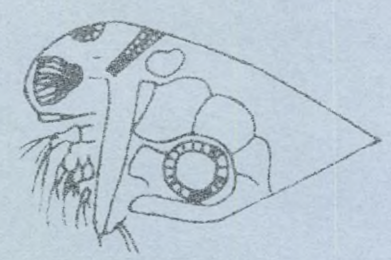

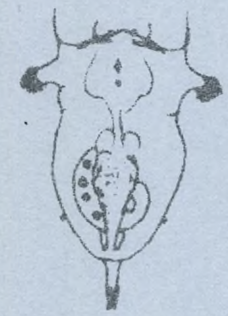

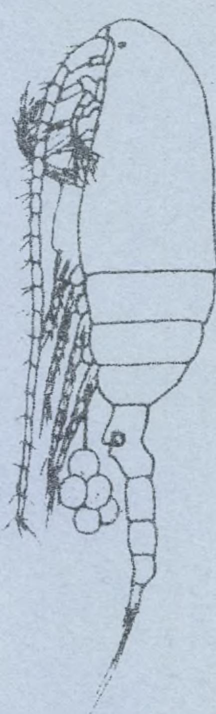

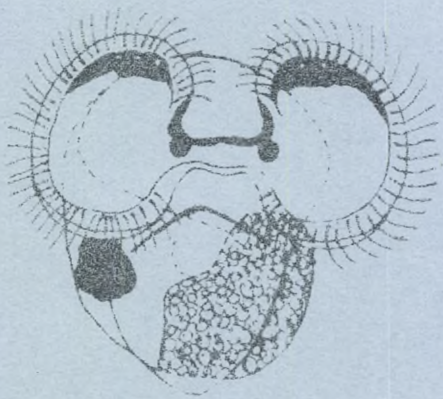

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The amount of zooplankton expressed as numbers, wet weight and carbon content in the Askö area (The Northern Baltic proper).

by

Hans Ackefors

- OKT. 1972

The amount of zooplankton expressed as numbers, volume, wet weight and carbon content in the Askö area (The Northern Baltic proper).

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In order to be able to compare earlier published values about the amount of zooplankton with the results published by other authors from different parts of the ecosystem, the author converted the results of zooplankton investigations in the Askö area 1963 - 1965 (Ackefors; 1965 and 1969 a) into numbers, volume, wet weight and carbon content per m^2 and numbers per m^3. The carbon and wet weight values will be especially examined and discussed as compared to the results of other authors. In this paper the methods used will be described in detail. Next paper (Ackefors & Hernroth, in preparation) will describe the amount of zooplankton off the coast in the Baltic proper. These papers will also compare the amount of zooplankton with published values of phytoplankton and primary production, and the next paper will also take into consideration the amount of fish caught per m^2 in the Baltic proper.

Methods and material

All plankton samples were taken at station 2 in the Askö area (pos.58°48'N 17°38'E) in the Northern Baltic proper. A map describing the area was published in an earlier paper (Ackefors 1969 b). The depth is 36 m and the hauls were always taken from about 35 m to the surface.

The samples were taken with a Nansen net, with a diameter of 50 cm. The mesh size was 0.16 mm from May, 1963, to December, 1964. In 1965 the mesh size was 0.09 mm. The values have been converted into individuals per m^2 by multiplying the numbers caught by the net with a factor of 5. The filtration coefficient is supposed to be about 0.7. Some of the values have therefore been corrected by multiplying the numbers per m^2 with 1.43 (table 2). In figure 1 all values are corrected.

The values have also been converted into numbers per m^3. The volume filtrated by the net from bottom to surface is 6.9 m^3. In order to express the volume of zooplankton the old technique employed by Lohmann (1908) was used. A new estimate was made by the Water Conservation Laboratory of Helsinki, especially adapted for plankton in the Baltic. Those values as well as values estimated by the author are included in table 1. If the density of zooplankton can be considered to be 1 g/cm^3 the values can be converted to wet weight. The dry weight can be considered to be 13% of the wet weight and the carbon content of zooplankton can roughly be estimated to 40% of the dry weight (Mullin, 1969). This means that about 5.2% of the wet weight is carbon content.

All hydrographical methods used in this investigation were described in an earlier paper (Ackefors, 1969 a).

Results

The total number of zooplankton varied very much during the 37 observations from 1963 to 1965 (fig. 1 and table 2). The highest abundance was found in August both in 1963 and in 1964 when the water temperature was highest. In 1963 the abundance was higher than in 1964. If the values are corrected for a filtration coefficient of 0.7, the maximum value will be 482 000 ind./m^2 in the middle of August, 1963. The minimum values were always found in January and February, 20 000 - 40 000 ind./m^2, but even in May and June, 1963 - 1964, such low values were found. In 1965, however, the number of zooplankton per m^2 was much higher during that time, about 170 000 per m^2.

As it is evident from table 2 the cladocerans began to appear in June - July and disappeared in November. (In this case single specimens not mentioned). The dominating species was Podon polyphemoides (cf. Ackefors, 1969 a,b). The highest density appeared in July - August when 60 000 - 130 000 cladocerans per m^2 were caught (not corrected for the filtration coefficient), and the main part of the specimens was P. polyphemoides.

The dominating plankton group at Askö was the copepods and the most abundant species was Acartia bifilosa. During winter time this species made more than 95% of the whole sample on many occasions.

The group "other species" was dominated by the rotifers of the genus Synchaeta. From June and until September Synchaeta spp. were very abundant on many occasions.

In table 2 the number of specimens per m^3 is also reproduced. The values are not corrected for the filtration coefficient. The calculation is made upon the theoretical calculated amount of water when the net is towed from bottom to surface. The highest values from July - August are in the range of 3 000 - 9 600 ind./m^3 and the lowest values in January - February in the range of 400 - 800 ind./m^3. In May and June the number of individuals may also be of the same magnitude as in January - February.

If the values are converted to g/m^2 wet weight (wwt) the curves will not be equal to the curves for ind./m^2 and ind./m^3 in all respects. As it is evident from table 1 the different species and their developmental stages have very divergent volumes and consequently divergent wet weight. A good example of this is July and August, 1963, when the wet weight in the middle of July was as high as in the middle of August although there were nearly twice as many organisms in August as in July (fig. 1 and table 2). In this case adult individuals of Acartia spp. influenced the value very much in July and compensated for the lower abundance of ind./m^2 on that occasion.

When regarding the values it is evident that the wet weight per m^2 was normally in the range 2.5 - 8.0 g from July to September except one low value - 1.3 - in September, 1964, 1 - 2.5 g from October to December, 0.3 - 1 g from January to April, 0.4 - 2.5 g from May to June. The greatest differences between the years appeared in May - June; 1963 the values were in the range 1.6 - 2.5; in 1964 0.4 - 0.7 and in 1965 1.1 - 1.6. May - June is a period with unstable water conditions in the Askö area when the water temperature rises very much (see fig. 1). Normally the surface temperature rises from about 4°C to 14°C during that period.

As the carbon values make 5.2% of the wet weight the curves of the carbon content are similar to those of the wet weight (fig.1). The highest values were found from July to September when the amount of C/m^2 fluctuated from 0.07 to 0.41 g (cf. table 2). During the months of October - December, January - April, May - June the values were in the range 0.04 - 0.13 g, 0.02 - 0.06 g and 0.02 - 0.09 g respectively.

In table 3 the volume, the wet weight and the carbon content for every sampling occasion during 1963 - 1965 are reproduced. In table 4 the values are arranged as monthly means. The carbon content in zooplankton was highest in July and/or August, 1963 - 1964, with values about 0.30 gC/m^2. The lowest values appeared in January and February when the amount of carbon was as low as 0.02 - 0.03 g/m^2. But as it is evident from table 4 such low values could also be found in April.

The average values for the first and second part of the year as well as individual values for different months shows that the productivity is higher in the second part of the year. The mean values for January - June, 1964, and January - June, 1965, are 0.04. The corresponding values for July - December, 1963 and 1964, are 0.18 and 0.14 gC/m^2 respectively. The average for the whole year 1964 is 0.09 gC/m^2. The figures indicate that the amount of plankton calculated as carbon content is 3 - 4 times higher during the second part of the year than during the first part of the year in the Askö area.

In table 5 mean values for two months interval are reproduced. They have been calculated in order to be able to compare them with the investigations off the coast in the Baltic proper where plankton samples have been taken 3 - 5 times per year. A paper in preparation will show the results of those investigations (Ackefors & Hernroth, to be published). The values in table 5 will therefore be discussed and compared with those values.

The secondary production of zooplankton in the Askö area can be calculated. The instantaneous mortality rate for the most important copepods Acartia spp. and Eurytemora sp. was in the range 0.69 - 0.95 with an average of about 0.85 per month or 10.2 per year. If Z (total mortality) is constant the mortality can be calculated by the following formula:

$N_t = N_o e^{-Zt}$ N_o = numbers at time $t = o$

$\log_e N_t = \log_e N_o - Zt$

The monthly mean value for zooplankton biomass was 0.1 gC m^{-2} if the whole period 1963 - 1965 is taken into consideration (cf. table 4). If we suppose that the instantaneous mortality rate for Acartia spp. and Eurytemora sp. can be adapted for the whole plankton fauna in the area we can calculate the secondary production. The value would be 10.2 times the mean value of standing crop which was 0.1 gC m^{-2}. This means that the secondary production in the Askö area is about 1 gC m^{-2}x $year^{-1}$.

Discussion

a. Methods

The methods used to calculate volume, wet weight, dry weight and carbon content in zooplankton are discussed in many papers, e.g. Cushing et al., 1958, Krey 1958, Tranter 1960, Beers 1966, Mullin 1969, Omori 1969. The standard values used in this paper (Mullin 1969) are a rough method in order to convert the amount of zooplankton to carbon content. There are great variations between the carbon content for different seasons, different areas and different plankton groups as cladocerans, copepods as well as for different species within those groups (see e.g. Beers 1966 and Omori 1969). Omori (op. cit.) found that the average value of carbon content for zooplankton in the North Pacific Ocean was about 45% of the dry weight. However, there were great variations, and the carbon content in certain copepods was as high as 66.6% of the dry weight and that 60% can be accepted as a mean value for subarctic species. As long as there are no analytical investigations performed in the Baltic area the author has considered that the standard value of 40% can be used for carbon content and a value of 13% for the dry weight. The zooplankton equivalents proposed by the Committee on Terms and Equivalents

(Cushing et al. 1958) for carbon content and dry weight are now considered to be too high (cf. Omori 1969).

The value of the dry weight in relation to the wet weight is divergent in different investigations. The main reason to this seems to be the various methods used by different authors. Tranter (1960) used the Ealy's apparatus with a modified technique to determine the plankton volume. In this way he determined the dry weight of 1 ml raw plankton consisting of only copepods to 128 mg. This gives a value of about 13%. A similar value, 13.6%, has been proposed by Krey (1958). However, the dry weight seems to vary much in different analyses. Omori (1969) found a value of 81.1% water content in copepods, i.e. a dry weight of 18.9%.

Because of the different information about the values of dry weight and carbon content the author has used the above mentioned standard values proposed by Mullin (1969)(dry weight 13% of the wet weight, carbon content 40% of the dry weight) when converting zooplankton samples to gram carbon per m^2. The author's values can easily be recalculated in a future when more precise analytical investigations have been performed in the Baltic area.

b. The productivity in the Askö area

The productivity near the coast in the outer archipelago of the northern Baltic proper seems to be very low in comparison with the conditions off the coast in the Baltic proper. During the most productive time in July - August the amount of zooplankton was only 3 - 8 g m^{-2} (wwt), with an average of 5.9 g m^{-2} in 1963 and 4.5 g m^{-2} in 1964. This corresponds to an average of 13.9 g m^{-2} at station F 78 (The Landsort Deep) off the coast in the northern Baltic proper and an average for the whole Baltic proper of 10.0 g m^{-2} during the same time (Ackefors & Hernroth, in preparation). The corresponding carbon values are 0.23 - 0.31 gC m^{-2} for the Askö area, 0.74 gC m^{-2} for station F 78 and 0.52 gC m^{-2} for the whole Baltic proper. While the Askö area is most productive in the period July - August during the year the sea area off the coast is more productive in the period September - October. During this time the amount of zooplankton at station F 78 was 18.8 g m^{-2} and the average for the whole Baltic proper 18.7 g m^{-2}, corresponding to 0.98 and 0.97 gC m^{-2}.

The lowest amount of zooplankton biomass appeared in January - February but even in April - May the values may be as low as 0.3 - 0.5 g m^{-2} (wwt) or 0.02 - 0.03 gC m^{-2}. This is not in accordance with the conditions off the coast. In January - February the amount of zooplankton for the two northern plankton stations in the Baltic proper (F 78 and F 72) were 3.4

and 8.3, and the average for the whole Baltic proper was 6.9 g m^{-2} (wwt). This corresponds to values of 0.17 and 0.43 gC m^{-2} and a mean value of 0.36 gC m^{-2}. The lowest amount of zooplankton off the coast is found in March - April. It is therefore evident that both maximum and minimum values occur earlier in the season in the coastal area of Askö than off the coast.

The lower productivity in the Askö area in comparison to the area off the coast in the northern Baltic proper can be explained by different reasons. The area is rather shallow, about 20 - 40 m depth. Such species as Pseudocalanus m. elongatus, which prefer colder water, below the thermocline in summer has a great need for deep waters. This species as well as Temora longicornis - the most important species off the coast - are prevented to enter the area to a certain part because shallow areas form a barrier to the connection with deeper areas off the coast. The deeper water off the coast will also give a bigger volume for the plankton.

The unstable hydrographical conditions in the coastal area of Askö is probably an disadventage for the development of zooplankton populations. Changes in weather conditions influence the hydrography as well as the plankton populations (cf. Ackefors 1965, 1969 a, 1969 b, 1971).

Very rapid changes of the water masses with temperature changes of 5 - 10^{o}C from one day to the other may occur in the Askö area. The experiences of all our investigations are that such changes of water temperature occur very seldom off the coast where the amount of zooplankton do not change rapidly.

The slightly lower surface temperature in the area during the summer in comparison with both the inner archipelago and the areas off the coast in the southern Baltic proper influence the abundance very much of certain species as Bosmina coregoni maritima (cf. Ackefors & Hernroth 1970, 1971).

Finally the salinity of 6 - 7 ‰ in the area is the critical limit for the distribution of many fresh water and marine species in the brackish water (cf. Remane 1940). In connection with the unfavourable conditions mentioned above the salinity factor may be more decisive than off the coast, where the salinity in deeper levels is just higher than the critical salinity of 6 - 7 ‰.

The summing up of the main reasons for lower productivity in the area in comparison with other areas in the Baltic proper seem to be; a. lower depth in the area, b. unstable hydrographical conditions, c. lower surface temperature, d. the critical salinity of 6 - 7 ‰ for many fresh water and marine species.

The mean value of zooplankton biomass from 1963 - 1965 can be compared with recently made studies on primary production and on phytoplankton biomass in the Landsort area during 1970 - 71 (Hobro & Nyquist, 1972). Sampling station 1(A) in their studies is very close to the author's station 2 in the Askö area. They found an annual primary production of 119 gC m^{-2}. The main part of the carbon (60%) was synthesized during July - September, i.e. during the same time as the zooplankton maximum occured in the area. During spring they found two maxima with about 20% of the synthesized carbon in each maximum.

The phytoplankton studies showed one strong peak value in April - May of 101 cm^3 m^{-2} mainly consisting of diatoms (Hobro & Nyquist, op.cit.). After that the biomass decreased very much and the values were less than 3 cm^3 m^{-2} for the rest of the year except a small maximum in August consisting mainly of blue-green algae. The value was then 8 cm^3 m^{-2}. The phytoplankton equivalent in relation to carbon content reported by the Committee on Terms and Equivalents is 1 mg phytoplankton biomass to 0.024 mg C (Cushing et al., 1958). This means that the maximum value in April - May of 101 cm^3 m^{-2} is equivalent to 2.42 gC m^{-2} and the value in August equivalent to 0.19 gC m^{-2}. The rest of the year the phytoplankton biomass is lower than 0.07 gC m^{-2}. These values can be compared with the maximum values for zooplankton biomass which were about 0.4 gC m^{-2} in July - August, and the minimum values which were 0.02 - 0.04 gC m^{-2} in January - February.

From the relation between the biomass of plankton algae and the standing crop of zooplankton, it is difficult to say anything about the food supply for zooplankton. Concerning the phytoplankton biomass, the cited study, as well as most other studies, embraces only the bigger species. It seems reasonable to suppose that the nanoplankton are the main part of the phytoplankton in the primary production. On certain occasions 90% of the carbon content comes from the nanoplankton (Nyquist, pers. comm.). This fraction of phytoplankton is directly and indirectly an important source of food for meso- and macrozooplankton ($>$ 0.2 mm) studied by the author. Bacteria are considered to be unimportant food. But Riley (1963) reported about dissolved organic matter which formed particles onto the surface of bubbles in which bacteria, protozoans and inorganic material were found. Marshall & Orr (1955) showed that diatoms, dinoflagellates as well as small nanoplankton flagellates down to a size of 2 - 3 µ were eaten by the copepod Calanus. Certain species belonging to the genus Ceratium were avoided. The small copepods as those occuring in the Askö area, Pseudocalanus, Temora and Acartia, eat diatoms and certain flagellates (Gauld 1951, Raymont 1963). The nanoplankton also constitute the main food supply for smaller zooplankton as tintinnids which are important food for the cladocerans e.g. Evadne nordmanni (cf. Bainbridge, 1958) and the fraction of microzooplankton in general is supposed to be important for copepods (cf. Conover, 1964). The bigger phytoplankton species (= the above mentioned figures for phytoplankton biomass) are also a source of food both for certain filter-feeding zooplankton as well as for fish larvae and adult fish e.g. certain anchovy species. A third important source of food for zooplankton is particulate organic material (cf. Baylor & Sutcliffe, 1963).

The primary production of 119 gC m^{-2} $year^{-1}$ in the Askö area (Hobro & Nyquist op.cit.) can be compared with the secondary production of 1 gC m^{-2} $year^{-1}$ reported by the author. The difference between the two values is too big to suppose that all zooplankton species in the Askö area are herbivorous and belong to the trophic level nr 2 in the food chain.

We must suppose that the food resources for meso- and macrozooplankton species consist of nanoplankton flagellates, diatoms, dinoflagellates, microzooplankton and dissolved organic material (see fig. 2). The hypothetic model for the energy flow is shown in the figure 2. The following assumptions have to be made:
90 % of the primary production consists of nanoplankton and 90 % of this amount is consumed by microzooplankton. 90 % of the energy flow is lost in every level of the trophic chain and that the phytoplankton production consumed by the zooplankton is in the order of 30 %. (Riley and Bumpus (1946) showed that the grazing is less than 10 % until April but rises sharply in May to over 40 % in the Georges Bank area.) The primary production was calculated to 119 gC m^{-2} $year^{-1}$. If 90 % or 97 g of the nanoplankton is utilized for microzooplankton production and the rest 11 g for meso- and macrozooplankton we get 2.97 g microzooplankton and 0.33 g meso- and macrozooplankton. The microzooplankton in its turn will give 0.09 g meso- and macrozooplankton. The bigger phytoplankton species (about 10 % or 11 g) will give 0.33 g meso- and macrozooplankton and the rest of the secondary production of zooplankton (0.25 g) will be formed by the assimilation of dissolved organic material.

In order to test this hypothetic model for the energy flow in the plankton community it is necessary to investigate the fraction of zooplankton called microzooplankton, to study the food relation between different types of zooplankton and phytoplankton and to study the organic particulate matter in the sea water in relation to zooplankton.

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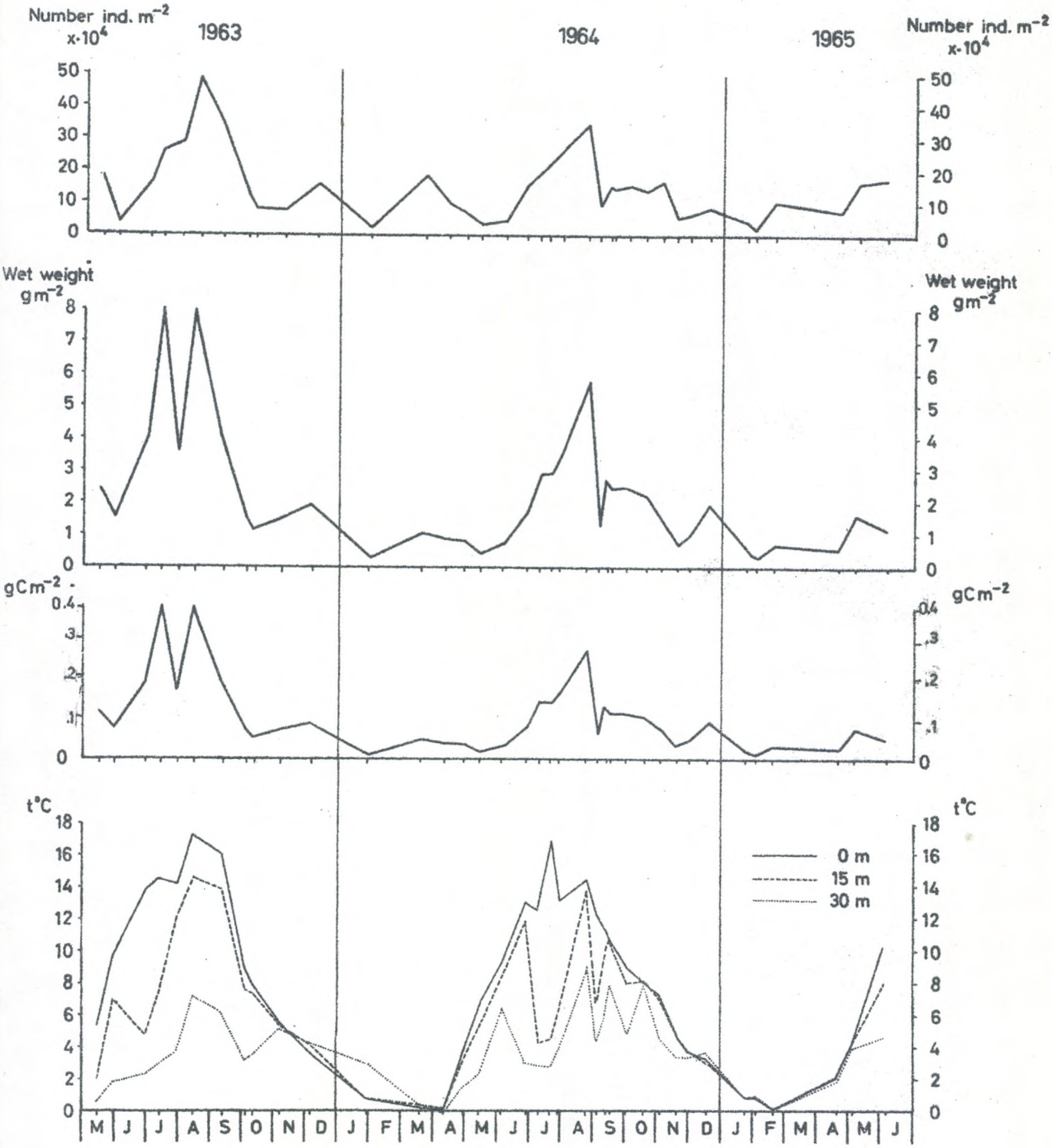

Fig.1. The amount of zooplankton in the Askö area, 1963 - 1965, at station 2 expressed as number ind.m^{-2}, g m^{-2} (wet weight) and g C m^{-2}. All values are corrected for a filtration coefficient of 0.7. The temperature curves for 0 m, 15 m and 30 m are reproduced in the lower part of the figure.

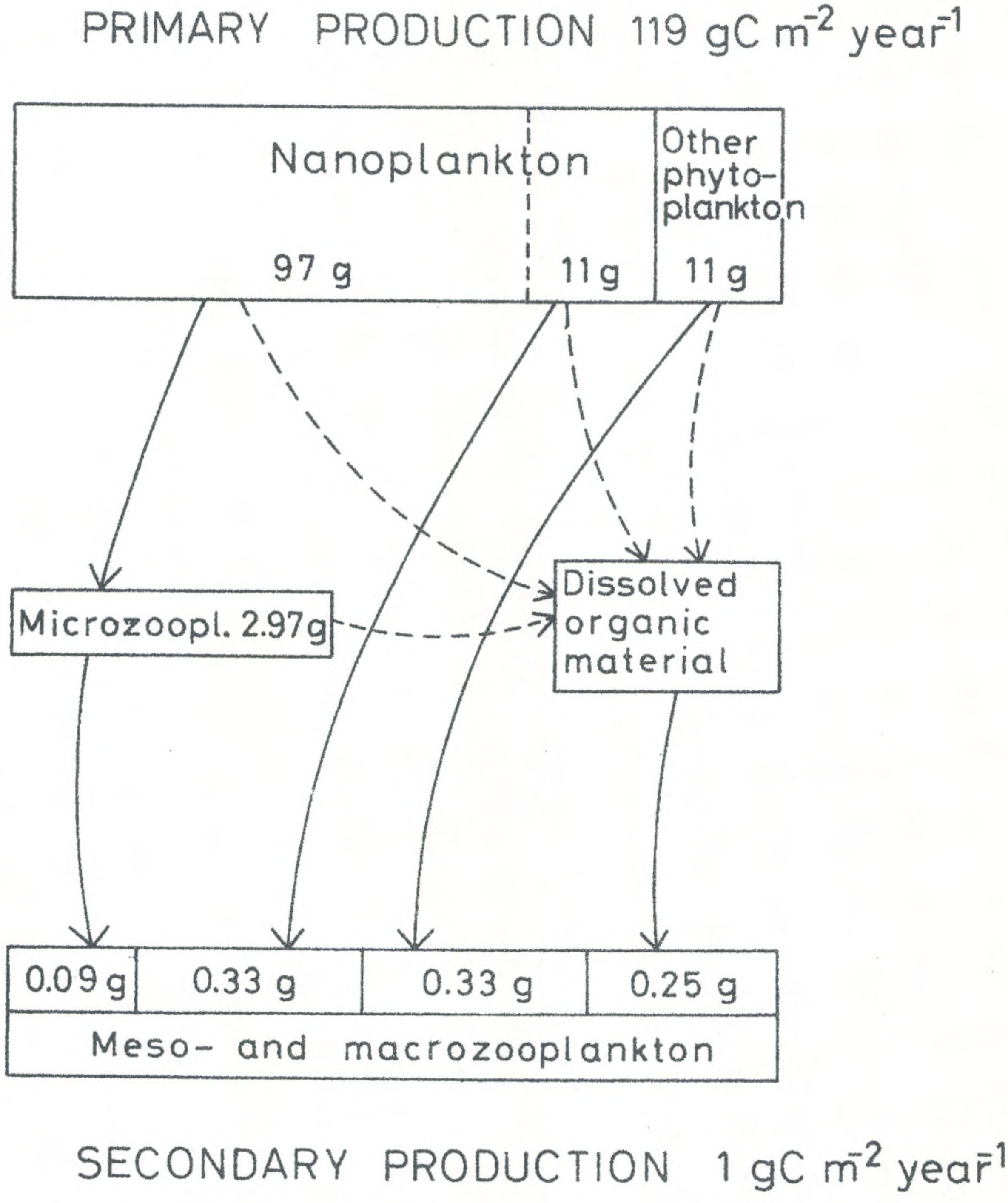

Fig. 2. The hypothetic model of energy flow in the plankton community in the Askö area. For further explanations, see the text.

Table 1. Calculated volume of zooplankton in μ^3. The values are estimated by The Water Conservation Laboratory of Helsinki. All values marked with figure 1 are estimated by the author.

		Volume in μ^3
Aurelia aurita Ephyra larva	ø 5 mm	10 000 000 000[1]
	ø 6 mm	14 000 000 000[1]
Cyanea capillata Ephyra larva	ø 7 mm	20 000 000 000[1]
	ø10 mm	40 000 000 000[1]
Pleurobrachia pileus Cydippid larva	ø 0.7 mm	180 000 000[1]
Keratella quadrata quadrata		200 000
" " platei		200 000
" cochlearis recurvispina		76 000
" cruciformis eichwaldi		76 000
Synchaeta spp.		2 000 000
Harmothoe sarsi		12 000 000
Bosmina coregoni maritima		10 000 000
Podon intermedius		20 000 000
Podon polyphemoides		10 000 000
Podon leuckarti		10 000 000
Evadne nordmanni		10 000 000
Limnocalanus macrurus (L.grimaldii)	ad.	400 000 000
" "	cop.stage	50 000 000
" "	naup.stage	1 000 000
Acartia bifilosa & A. longiremis	ad.	80 000 000
" " "	cop.stage	10 000 000
" " "	naup.stage	1 000 000
Eurytemora sp.	ad.	77 000 000
"	cop.stage	10 000 000
"	naup.stage	1 000 000
Centropages hamatus	ad.	80 000 000
" "	cop.stage	10 000 000
" "	naup.stage	1 000 000
Pseudocalanus m. elongatus	ad.	160 000 000[1]
" "	cop.stage	20 000 000[1]
" "	naup.stage	2 000 000[1]
Temora longicornis	ad.	80 000 000
" "	cop.stage	10 000 000
" "	naup.stage	1 000 000
Cyclops spp.	ad.	30 000 000
"	cop.stage	8 000 000
"	naup.stage	470 000
Oithona similis	average value for all stages	3 000 000
Harpacticoida	ad.	8 000 000
"	cop.stage	2 000 000
"	naup.stage	500 000
Balanus improvisus	naup.stage	10 000 000
" "	cypris stage	52 000 000
Mysis relicta	size 15 mm	90 000 000 000[1]
Hyperia galba	size 6 mm	16 000 000 000[1]
Gastropoda	larva	1 000 000[1]
Lamellibranchiata	larva	1 000 000[1]
Sagitta elegans baltica	length: 20 mm	45 000 000 000[1]
Fritillaria borealis		10 000 000[1]

Table 2. The amount of Cladocera, Copepoda, other species and total amount of zooplankton per m^2 and per m^3 at station 2 in the Askö area, 1963 - 1965. The total numbers per m^2 also corrected for the filtration coefficient of o.7. The total wet weight and carbon content per m^2 (corrected values) and dominating species are also reproduced.

Cod number for species:

1. Acartia spp.	ad.		9. Temora longicornis	ad.	
2. " "	C. IV-V		10. " "	C. IV-V	
3. " "	C. I-III		11. " "	C. I-III	
4. " "	N.		12. " "	N.	
5. Eurytemora sp.	ad.		13. Synchaeta spp.		
6. " "	C. IV-V		14. Podon polyphemoides		
7. " "	C. I-III				
8. " "	N.				

	Line	Date 1963 14.5	30.5	1.7	12.7	1.8
Cladocera/m^2 x 10^{-2}	1	-	-	380.0	601.8	1260.0
Copepoda/m^2 x 10^{-2}	2	1234.0	255.0	576.3	948.6	357.0
Other species/m^2 x 10^{-2}	3	15.5	18.9	198.9	257.5	384.7
Total/m^2 x 10^{-2}	4	1249.5	273.9	1155.2	1807.9	2001.7
Total/m^2 x 10^{-2} (corrected x 1.43)	5	1786.8	391.7	1651.9	2585.3	2862.4
Cladocera/m^3 x 10^{-2}	6	-	-	6.9	17.1	35.8
Copepoda/m^3 x 10^{-2}	7	35.1	7.2	16.4	27.0	9.9
Other species/m^3 x 10^{-2}	8	0.4	0.6	9.5	7.0	10.8
Total/m^3 x 10^{-2}	9	35.5	7.8	32.8	51.1	56.5
Total wet weight g/m^2 (corrected x 1.43)	10	2.5	1.6	4.0	7.9	3.6
Total gC/m^2 (corrected x 1.43)	11	0.13	0.08	0.26	0.41	0.19
Dominating species	12	2,3	1,2	1,14	1,14	14,13

Table 2., continued

Line	Date 15.8 (1963)	10.9	4.10	11.10	7.11	6.12	28.1 (1964)	19.3
1	543.1	214.2	63.8	35.7	10.2	-	-	-
2	2098.6	1422.9	719.1	418.2	471.8	1063.4	155.3	1280.1
3	729.4	749.7	73.9	99.5	45.9	43.3	1.7	-
4	3371.1	2386.8	856.8	553.4	527.9	1106.7	157.0	1280.1
5	4820.7	3413.1	1225.2	791.4	754.9	1582.6	224.5	1830.5
6	15.4	6.1	1.8	1.0	0.3	-	-	-
7	59.7	40.4	20.4	11.9	13.4	30.2	4.4	36.3
8	20.6	20.6	2.1	2.4	1.3	1.2	0.1	-
9	95.7	67.1	24.3	15.3	15.0	31.4	4.5	36.3
10	7.9	4.3	1.6	1.2	1.5	1.9	0.3	1.1
11	0.41	0.22	0.08	0.06	0.08	0.10	0.02	0.06
12	10,11,13	3,13	3,6	3,13	7,1-4	3,12	3	4

Line	Date 9.4	28.4	12.5	5.6	25.6	10.7	17.7	30.7
1	-	-	-	61.2	349.4	721.7	673.2	323.9
2	675.7	469.2	217.5	206.6	214.2	423.3	400.4	647.7
3	2.6	7.6	2.5	51.0	502.3	305.9	487.0	884.8
4	678.3	476.8	220.0	318.8	1065.9	1450.9	1560.6	1856.4
5	970.0	681.8	314.6	455.9	1524.2	2074.8	2231.7	2654.7
6	-	-	-	1.7	9.9	20.5	19.1	9.2
7	19.3	13.0	6.3	5.9	6.1	12.0	11.4	18.4
8	-	0.2	0.1	1.5	14.3	8.7	13.9	25.2
9	19.3	13.2	6.4	9.1	30.3	41.2	44.4	52.8
10	0.9	0.8	0.4	0.7	1.7	3.0	3.0	3.5
11	0.05	0.04	0.02	0.04	0.09	0.16	0.16	0.18
12	3	3	3	3,13	13,14	14,13	14,13	13,11

Table 2., continued

Line	Date 1964 21.8	4.9	11.9	15.9	1.10	17.10	2.11	16.11
1	51.0	15.3	-	17.9	17.9	20.4	5.1	-
2	2001.8	535.5	849.2	963.9	1027.7	821.1	1129.7	362.0
3	372.3	104.6	201.4	45.9	13.1	117.3	12.7	5.2
4	2425.1	655.4	1050.6	1027.7	1078.7	958.8	1142.4	367.2
5	3467.9	937.2	1502.4	1469.6	1542.5	1371.1	1633.6	525.1
6	1.4	0.4	-	0.5	0.5	0.6	0.1	-
7	56.9	15.2	24.1	27.4	29.2	23.3	32.1	10.3
8	10.6	3.0	5.8	1.8	1.5	3.9	0.4	0.1
9	68.9	18.6	29.9	29.2	30.7	27.2	32.5	10.4
10	5.8	1.3	2.7	2.4	2.5	2.2	1.5	0.7
11	0.30	0.07	0.14	0.12	0.13	0.11	0.08	0.04
12	2,3,6,7	1,2,3,11	3,11	2,3,7	2,3,11	3,7	3,7	3

Line	Date 1964 30.11	16.12	1965 21.1	1.2	17.2	21.4	7.5	4.6
1	-	-	-	-	-	-	-	10.2
2	410.6	601.8	281.0	151.2	719.1	522.8	1152.6	239.7
3	40.8	2.6	-	-	-	-	-	946.1
4	451.4	604.4	281.0	151.2	719.1	522.8	1152.6	1196.0
5	645.5	864.3	401.8	216.2	1028.3	747.6	1648.2	1710.3
6	-	-	-	-	-	-	-	-
7	11.7	17.1	8.0	4.3	20.4	14.9	32.8	6.8
8	1.1	0.1	-	-	-	-	2.9	27.2
9	12.8	17.2	8.0	4.3	20.4	14.9	35.7	34.0
10	1.0	1.9	0.4	0.3	0.7	0.5	1.6	1.1
11	0.05	0.10	0.02	0.02	0.04	0.03	0.08	0.08
12	2,3,10,11	2,3	4	4	4	4,3	3.13	13,3

Table 3. The volume, wet weight and carbon content per m^2 of zooplankton at station 2 in the Askö area, 1963 - 1965. The values are corrected for a filtration coefficient of 0.7.

	Station A2 Date	Volume mm^3/m^2	Wet weight g/m^2	Carbon content gC/m^2
1963	14.5	2 481	2.48	0.129
	30.5	1 629	1.63	0.085
	1.7	4 021	4.02	0.209
	12.7	7 937	7.94	0.413
	1.8	3 564	3.56	0.185
	15.8	7 941	7.94	0.413
	10.9	4 311	4.31	0.224
	4.10	1 552	1.55	0.081
	11.10	1 175	1.18	0.062
	7.11	1 473	1.47	0.076
	6.12	1 870	1.87	0.097
1964	28.1	287	0.29	0.015
	19.3	1 094	1.09	0.056
	9.4	862	0.86	0.045
	28.4	789	0.79	0.041
	12.5	398	0.40	0.021
	5.6	704	0.70	0.037
	25.6	1 679	1.68	0.088
	10.7	2 959	2.96	0.154
	17.7	2 960	2.96	0.154
	30.7	3 486	3.49	0.181
	21.8	5 754	5.75	0.299
	4.9	1 316	1.32	0.068
	11.9	2 698	2.70	0.140
	15.9	2 425	2.43	0.126
	1.10	2 450	2.45	0.127
	17.10	2 174	2.17	0.113
	2.11	1 493	1.49	0.078
	16.11	731	0.73	0.038
	30.11	978	0.98	0.051
	16.12	1 945	1.94	0.101
1965	21.1	376	0.38	0.020
	1.2	265	0.27	0.014
	17.2	725	0.73	0.038
	21.4	543	0.54	0.028
	7.5	1 557	1.56	0.081
	4.6	1 114	1.11	0.058

Table 4. The monthly mean values of volume, wet weight and carbon content per m^2 of zooplankton at station 2 in the Askö area, 1963 - 1965. The values are corrected for a filtration coefficient of 0.7.

		Volume mm^3/m^2	Wet weight g/m^2	Carbon content gC/m^2
1963				
	May	2 055	2.1	0.11
	July	5 979	6.0	0.31
	Aug.	5 752	5.8	0.30
	Sept.	4 311	4.3	0.23
	Oct.	1 364	1.4	0.07
	Nov.	1 473	1.5	0.08
	Dec.	1 870	1.9	0.10
Mean value	July-Dec.	3 458	3.5	0.18
1964				
	Jan.	287	0.3	0.02
	Mar.	1 094	1.1	0.06
	Apr.	826	0.8	0.04
	May	398	0.4	0.02
	June	1 191	1.2	0.06
Mean value	Jan.-June	759	0.8	0.04
	July	3 135	3.1	0.16
	Aug.	5 754	5.8	0.30
	Sept.	2 146	2.1	0.11
	Oct.	2 312	2.3	0.12
	Nov.	1 067	1.1	0.06
	Dec.	1 945	1.9	0.10
Mean value	July-Dec.	2 727	2.7	0.14
Mean value	Jan.-Dec.	1 832	1.8	0.09
1965				
	Jan.	376	0.4	0.02
	Febr.	495	0.5	0.03
	Apr.	543	0.5	0.03
	May	1 557	1.6	0.08
	June	1 114	1.1	0.06
Mean value	Jan.-June	817	0.8	0.04

Table 5. The mean values of volume, wet weight and carbon content per m^2 of zooplankton at station 2 in the Askö area, 1963 - 1965. The values are arranged as two months interval. The values are corrected for a filtration coefficient of 0.7.

		Volume mm^3/m^2	Wet weight g/m^2	Carbon content gC/m^2
1963	May-June	2 055	2.1	0.11
	July-Aug.	5 865	5.9	0.31
	Sept.-Oct.	2 838	2.9	0.15
	Nov.-Dec.	1 672	1.7	0.09
1964	Jan.-Febr.	287	0.3	0.02
	Mar.-Apr.	960	1.0	0.05
	May-June	795	0.8	0.04
	July-Aug.	4 445	4.5	0.23
	Sept.-Oct.	2 229	2.2	0.12
	Nov.-Dec.	1 506	1.5	0.08
1965	Jan.-Febr.	436	0.5	0.03
	Mar.-Apr.	543	0.5	0.03
	May-June	1 336	1.4	0.07