Contribution from the Norwegian IBP/PF

Studies of the Helminth Fauna of Norway XXXV: Production of parasites of brown trout (Salmo trutta L.) from Øvre Heimdalsvatn, Norway.

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ABSTRACT

Lien, L. 197 . Studies of the Helminth Fauna of Norway XXXV: Production of parasites of trout (Salmo trutta L.) from Øvre Heimdalsvatn, Norway.

A sample of Salmo trutta was examined monthly for helminth parasites during the period December 1969 to December 1971, and three samples were examined during 1972. Discocoltyle sagittata (Leuckart, 1842), Phyllodistomum conostomum (Olsson,1876), Crepidostomum farionis (Müller, 1874), C. metoecus (Braun, 1900), Diplostomum spathaceum (Rud.,1819)(?), Proteocephalus sp. Weinland, 1858, Cyathocephalus truncatus (Pallas, 1781), Diphyllobothrium ditremum (Creplin, 1825), Capillaria sp. Zeder, 1800 and Eustrongylides sp. Jägerskiöld, 1909 were found. Production estimates were based on mean values of annual biomass, "Allen production curves", parasite longevity and the total number of trout in each year class. Annual helminth production was 0.28 - 0.60 mg dry weight pr. m^2 lake surface, or 0.11 - 0.23 % of the trout production.

INTRODUCTION

In connection with the Norwegian IBP production studies of the lake Øvre Heimdalsvatn a number of trout (Salmo trutta) were examined for helminth parasites. This study will present production estimates of the trout parasites during their stay in the fish.

The lake is situated in the subalpine region of southern Norway, 1090 m above sea level. In addition to the trout a small population of the minnow Phoxinus phoxinus was found in the lake. Detailed description of the lokality is given in Vik (197).

METHODS

A total of 330 trout taken by gill netting all over the lake, were quantitatively examined for helminth parasites. Ten trout were investigated each month during the period December 1969 to December 1971, and 25 trout were examined each of the months, April, August and December 1972. The trout were evenly distributed between the weight groups 0 - 100 g, 100 - 200 g, 200 - 300 g and greater than 300 g. The fish were examined the same day they were caught while all the parasites were still alive. The following organs were examined: eyes, mouth cavity, gills, alimentary canal, gall bladder, kidneys, urinary bladder, swim bladder and body cavity. The pyloric region, containing possible attached Cyathoephalus truncatus, was kept in tap water for 24 hours to release the parasites.

The Allen curve method (Allen 1951) was used for calculating the production of the dominant cestode species with an expected longevity of one year in the fish. For shorter or uncertain longevities the mean numbers and dry weights of the various parasite within each time period were used for production estimates.

The biomass and production figures of the parasite population were estimated according to the intensities of infection within each year-class of trout together with the estimated number of fish within the year-classes in the lake given by Jensen (197).

RESULTS

The helminth parasites of the trout population from Øvre Heimdalsvatn are given in Table I together with their location in the fish, their mean intensity of infection and the dry weights of the parasites. The mean intensities of infection for the Crepidostomum spp. were grouped together including small C. farionis from the gall bladder which had a mean infection of 4.4. Table II shows the varying intensity of infection with the different age groups of trout. Discocotyle sagitata, Crepidostomum spp. and Cyathocephalus truncatus show an increasing intensity of infection with increasing age of the trout, while the mean values for Phyllodistomum conostomum and Proteocephalus sp. decreased with increasing age of the host.

Cyanthocephalus truncatus and Proteocephalus sp. were the only parasite species which showed a regular seasonal fluctuation during the study period. These cestodes were found in increasing numbers during the autumn and winter, while the intensities of infection fell in the spring, reaching a minimum in August/September (Fig. 1.). During the period of new infections of Proteocephalus sp. (September to April), only a small growth of the parasite was registered (Fig.2.), and the differentiation of the genital organs started as late as in March/April followed by an increasing growth rate in April/May. In order to use the "Allen production curve" the mean number of infection of March, April and May for 1970 and for 1971 and the value of April 1972 was used as starting-points at weight zero.

Cyathocephalus truncatus showed regular fluctuations in numbers (Fig. 1.), and the monthly mean weights of this parasite in the trout increased from a minimum in August to a maximum in April, decreasing again during the spring. However, ripe worms were found throughout the whole year, and the longevity of this parasite is therefore uncertain. Due to probably continously new infections and shedding of older individuals during the year, the "Allen production curve" could not be used. Calculation of production was based on the monthly biomasses minus the weight of the larvae which was found to be 1.37 ± 0.18 (S.D.) mg. A possible longevity of one month in the trout gives total production figures of 62.63, 72.47 and 49.16 mg dry weight for C. truncatus for the years 1969/1970, 1970/1971 and 1971/1972 respectively (Table IV).

Annual mean biomass of the helminths lacking seasonal fluctuatuions are given in Table III. With a possible longevity of one year for this parasites, the biomass values can be used as minimum production figures (Table IV). The total annual production of all trout parasites for the three different years studied (Table IV) varied between 217 and 466 g dry weight, or 0.28 and 0.60 mg dry weight per m^2 lake surface.

DISCUSSION

Ten helminth species were found in the trout population of Øvre Heimdalsvatn (Table I). Proteocephalus sp., which appeard to have the greatest annual production (Table IV) was not identified to species, but a detailed description is given in Borgstrøm & Lien (1973). As earlier indicated (Lien & Borgstrøm 1973), this cestode showed a regular pattern of a one year life cycle (Fig. 1) and the annual production was calculated according to Allen (1951) (Fig. 2.).

The intensity of infection and weight of Cyathocephalus truncatus followed an annual rhythm. This could therefore indicate a longevity of one year in the trout. However, this longevity are not in agreement with other studies which stated longevities between 14 days (Wolf 1906) and more than one month (Vik 1958). These production estimates were based on one month duration of the parasite in the final host (Table IV). The apparent intensity fluctuation of one year in Øvre Heimdalsvatn might consist of several "generations" of C. truncatus. The low intensity of infection during the summer (Fig. 1) could be explained by the quite low feeding of the trout on the intermediate host, Gammarus lacustris, at this time of the year (Lien 197).

Regarding the other trout parasites, seasonal periodicity has been reported, eg Discocotyle sagittata (Paling 1965, Campbell 1974) and Crepidostomum metoecus (Thomas 1958, Awachie 1968), but no regular intensity fluctuation or periodicity was recorded in Øvre Heimdalsvatn. The longevity of D. sagittata and C. metoecus could be about one year in the final host (Paling 1965, Awachie 1968), but little is known concerning the other parasites. The production estimates were based on longevities of one year for all parasites listed in Table III. Any different longevities for some of these parasites, probably of minor importance regarding the annual parasite production, would not essentially alter the total production figures.

Compared with calculations of the trout production (Lien & Jensen 197) the parasites accont for only 0.11 - 0.23 % of total trout production.

The influence of parasites on the production of trout was taken into account. Some parasites found in this study have been reported to have negative effects upon the host in different ways: Crepidostomum farionis (Bauer 1958), Diplostomum spathaceum (Bykhovskaya & Pavlovskaya 1962) and Cyathocephalus truncatus (Vik 1973). However, mass infections of for instance D. spathaceum of 500 specimens per eye reported by Bykhovskaya & Pavlovskaya (1962) and C. truncatus infections of about 400 reported by Vik (1954) are much higher than found in this study (Table I). In the present material with the moderate infections no helminth influence on the trout production was found.

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TABLE I.

Helminth parasites of trout from Øvre Heimdalsvatn, their location in the trout, the range of monthly mean dry weights of the parasites and their minimum, maximum and mean intensity of infection. (l): larvae.

		Location	Range of monthly mean mg dry wt.		Intensity of infection		
					Minimum	Maximum	Mean
Monogenea							
	Discocotyle sagittata	[illegible]l	0.011	-0.119	1	20	2.5
Digenea							
	Phyllodistomum conostomum	k[illegible], urinary bladder	0.038		1	57	10.7
	Crepidostomum farionis	gall bladder, intestine	0.0016	-0.0165	1	~1000	215
	Crepidostomum metoecus	intestine	0.00656				
	Diplostomum spathaceum (?) (l)	vitreous body of eye	0.0017		1	155	11.8
Cestoda							
	Proteocephalus sp.	intestine, pylorie caeca	0.008	-2.726	1	190	10.9
	Cyathocephalus truncatus	pyloric caeca, (intestine)	1.188	-1.732	1	60	6.6
	Diphyllobothrium ditremum (l)	body cavity	0.9		7	7	0.02
Nematoda							
	Capillaria sp. (l)	intestine	0.011		1	23	1.0
	Enstrongylides sp. (l)	body cavity	9.0		1	4	0.01

TABLE II

Mean intensity of parasite infection arranged according to the age of trout. The figures in parenthesis indicate the number of fish examined from Øvre Heimdalsvatn within each age group during the period 1969 - 1972.

Trout age group	3-4 yrs.	5 yrs.	6 yrs.	≥7 yrs.
	(69)	(84)	(78)	(98)
Discocotyle sagittata	0.5	1.7	2.4	4.7
Phyllodistomum conostomum	13.7	10.8	9.2	6.3
Crepidostomum farionis / *Crepidostomum metoecus*	147	229	234	253
Diplostomum spathaceum	12.0	10.8	5.9	17.2
Proteocephalus sp.	13.5	11.8	11.4	7.8
Cyathocephalus truncatus	3.1	4.9	7.3	9.7
Diphyllobothrium ditremum	0	0	0	0.1
Capillaria sp.	1.1	1.6	0.8	0.6
Eustrongylides sp.	0	0	0	0.01

TABLE III.

Annual average biomass of trout parasites from Øvre Heimdalsvatn, 1970 - 1972. Figures in paranthesis are calculated from 1971 and 1972 values.

	mg. dry weight			
	1970	1971	1972	mean
Discocotyle sagittata	2695	2075	1923	2231
Phyllodistomum conostomum	4283	3744	3629	3885
Crepidostomum spp.	(15378)	16502	10884	14255
Diplostomum spataceum	192	180	159	183
Diphyllobothrium ditremum	9	-	-	3
Capillaria sp.	(90)	122	57	90
Eustrongylides sp.	-	-	9	3
Sum	22647	22623	16661	20650

Table IV. Annual production of trout parasites from Øvre Heimdalsvatn, 1969 - 1972.

	g. dry weight			
	1969/1970	1970/1971	1971/1972	Mean
Proteocephalus sp.	380.47	315.76	151.38	282.54
Cyathocephalus truncatus	62.63	72.47	49.16	61.42
Other parasites	22.65	22.62	16.66	20.65
Total parasite production	465.75	410.85	217.20	364.61
mg dry weight/m^2 lake surface	0.60	0.53	0.28	0.47

Fig. 1. Seasonal variation in the total number of Cyathocephalus truncatus and Proteocephalus sp. in Øvre Heimdalsvatn. The monthly figures are based on the examination of 10 - 25 trout and adjusted to the number of fish within each year-class.

Fig. 2. Relationship between monthly mean dry weight and estimated number of Proteocephalus sp. (No.) in Øvre Heimdalsvatn during the period January 1970 - August 1972.

Fig. 2.

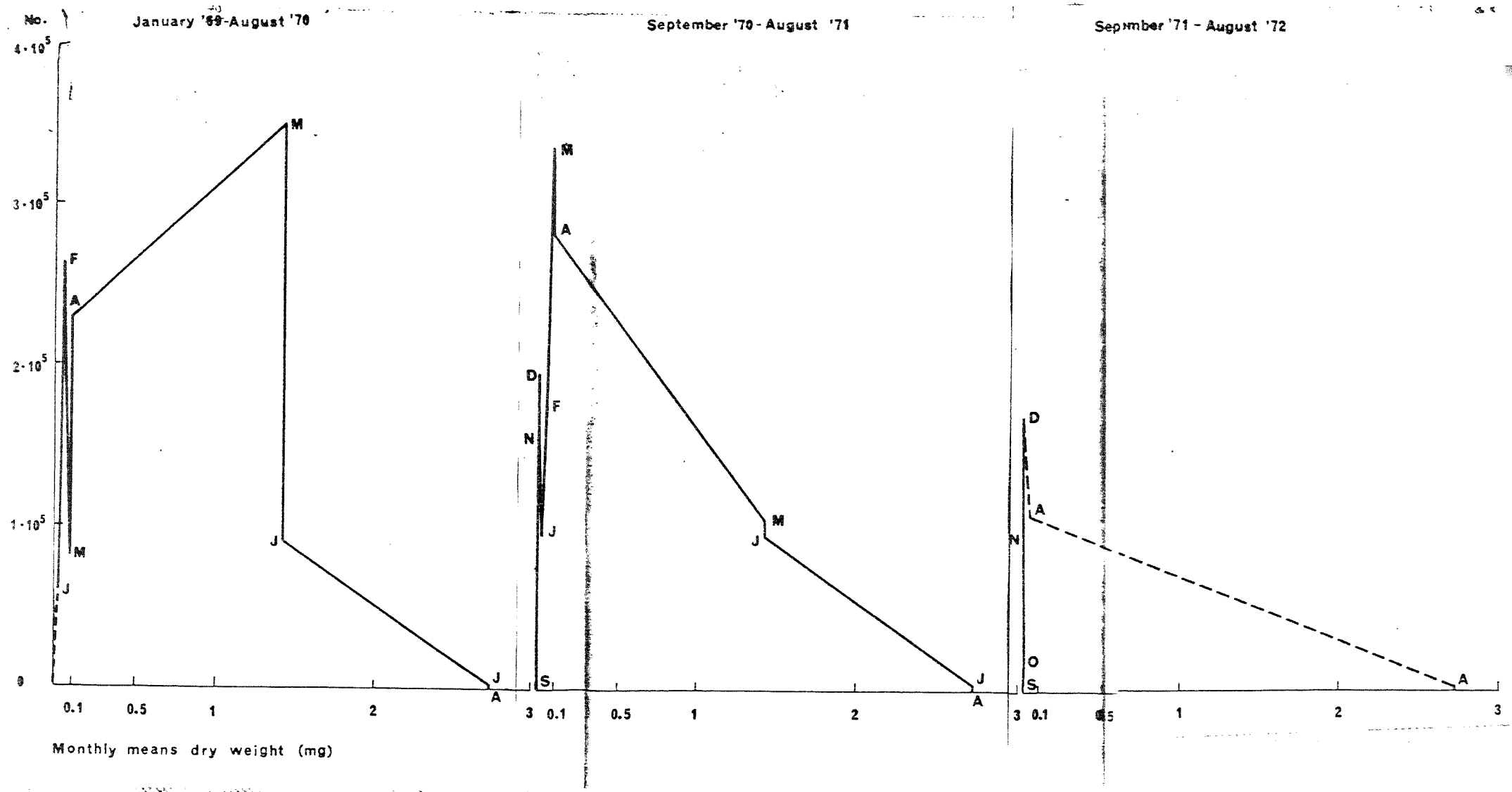
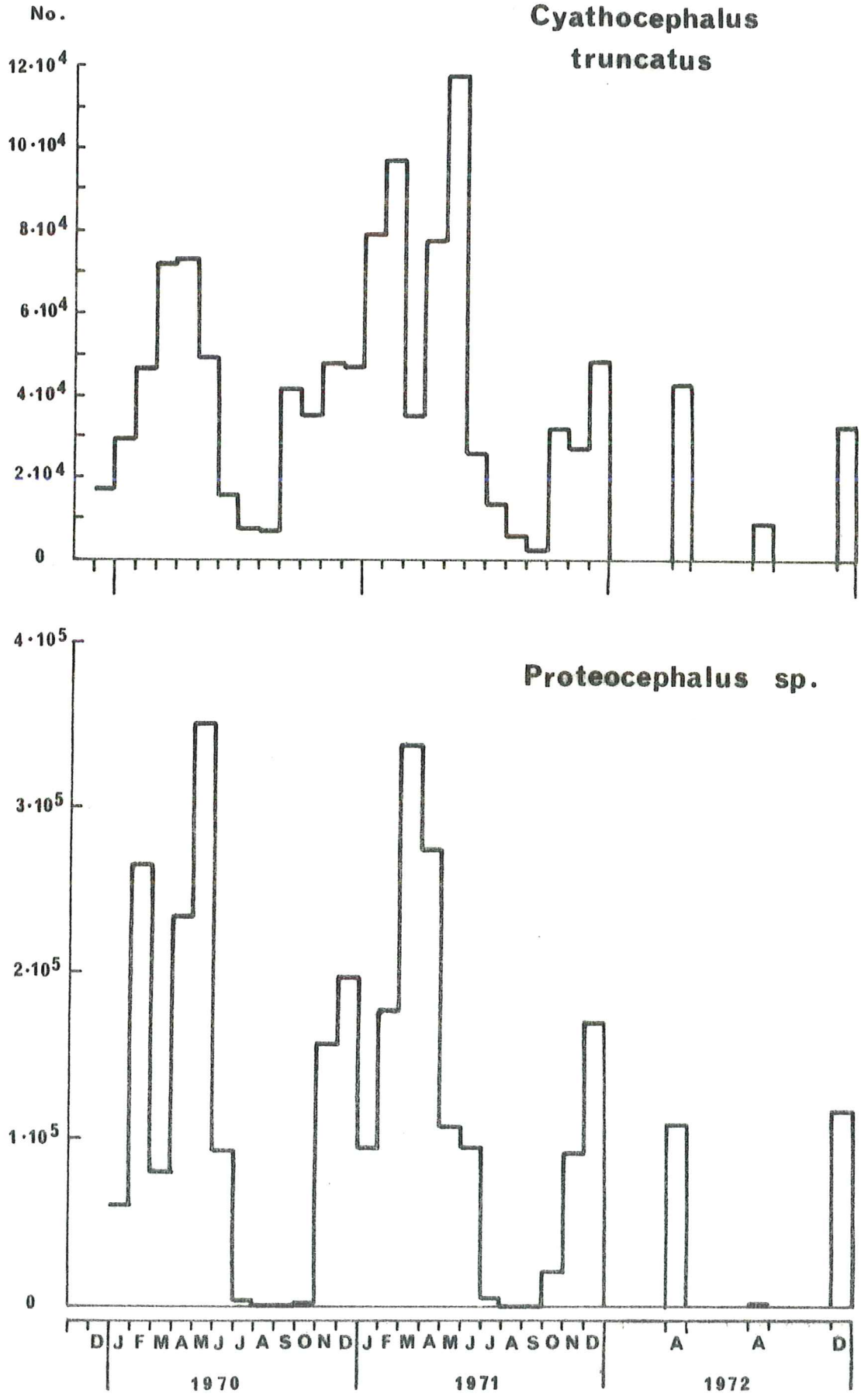

No.
January '69-August '70
September '70 - August '71
September '71 - August '72
4·10^5
3·10^5
2·10^5
1·10^5
0
M
F
A
M
J
J
J
A
M
D
F
N
J
M
A
J
J
S
A
D
A
N
O
S
A
0.1
0.5
1
2
3
Monthly means dry weight (mg)

Fig. 1


No.
Cyathocephalus truncatus
12·10⁴
10·10⁴
8·10⁴
6·10⁴
4·10⁴
2·10⁴
0
Proteocephalus sp.
4·10⁵
3·10⁵
2·10⁵
1·10⁵
0
D J F M A M J J A S O N D J F M A M J J A S O N D A A D
1970
1971
1972