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ECOLOGY OF THE CHIRONOMIDAE

(DIPTERA) IN SOME GRAVEL AND SAND PITS

PART II

TABLES AND FIGURES.

Site	Z_m (m)	A (ha)
Trentham Park	1	0.1
British Industrial Sands Congleton	6	3.0
Linford, Black Horse	3	2.5
Linford, Dovecote	3	3.0

Table 2.1 Summary of principle morphometric parameters of the sand and gravel pits investigated. The maximum depth (Z_m) and surface area (A) is given for each lake.

	Dovecote	Black Horse	Experimental Ponds 1	2	3	4	5	6	Trentham Park	BIS	Rodhe (1949)
HCO_3	2.22	2.56	3.32	2.03	2.29	1.93	2.17	2.38	0.40	2.96	2.79
Cl	0.80	0.78	0.77	0.87	0.72	0.73	0.74	0.79	0.35	0.58	0.42
SO_4	2.28	2.69	2.53	2.63	1.89	2.22	2.18	2.10	0.46	2.06	0.65
Na	0.59	0.67	0.59	0.59	0.57	0.56	0.59	0.62	0.14	0.45	0.64
K	0.09	0.13	0.10	0.16	0.09	0.08	0.13	0.18	0.08	0.05	0.14
Ca	4.14	4.48	5.19	5.14	4.24	3.79	4.39	5.29	0.97	3.69	2.63
Mg	0.43	0.46	0.45	0.46	0.42	0.43	0.42	0.48	0.09	1.64	0.72
cond µS	362	375	403	403	348	330	367	431	96.30	368	360
pH	8.1	8.1	7.9	7.9	8.0	8.1	8.0	8.0	7.0	8.2	-

Table 2.2 Chemical composition of Gravel Pit Water (in mEq l^{-1}). The composition of standard water with a conductivity of 360 µS is given in the column labelled Rodhe (1949).

	Black Horse, Linford				British Industrial Sands, Congleton
	Main Lake	Lagoon Area			
		C1	C2	C3	
Loss on ignition	7.49	8.51	11.40	8.79	6.98
% Carbon	2.37	2.93	4.23	3.23	1.00
% Nitrogen	0.24	0.27	0.34	0.27	0.08
C:N ratio	9.88	10.85	12.44	11.96	12.50

Table 2.3 Chemical analysis of mud sediment for carbon, nitrogen and loss on ignition. Data for Linford are the mean of three separate analyses.

Sample	Particle Category				Soil Type
	Coarse	Fine	Silt	Clay	
Linford, Black Horse Main lake/Lagoon area	11.7	19.4	41.7	27.4	Loam
A	22.4	32.1	18.1	26.8	Sandy Loam
B	8.1	27.9	37.5	26.5	Loam
C	4.1	34.1	46.8	15.0	Loam
D	4.0	28.2	50.5	16.7	Loam
E	22.8	15.6	39.3	22.3	Loam
F	36.0	25.9	24.8	13.3	Sandy Loam
G	5.8	23.7	44.8	25.7	Loam
H	9.1	26.7	47.1	17.1	Loam
J	19.7	31.3	10.2	38.8	Sandy Loam
Congleton British Industrial Sands	0.0	0.5	26.0	73.5	Clay

Table 2.4 Physical analysis of sediment into particle size categories, values given are percentages by weight.

Fig. 2.1 Outline map of the gravel pit lakes at Newport Pagnell, Buckinghamshire

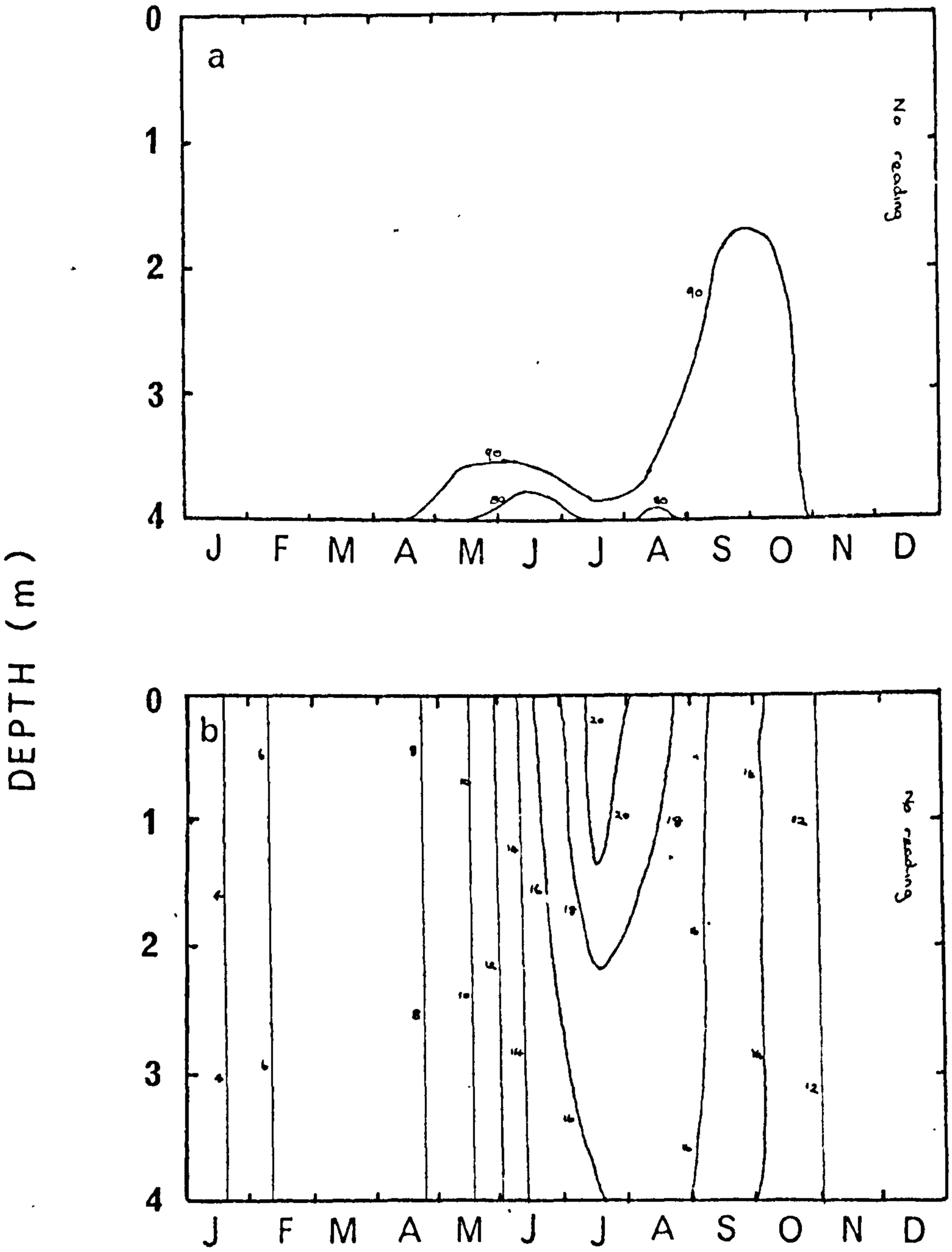
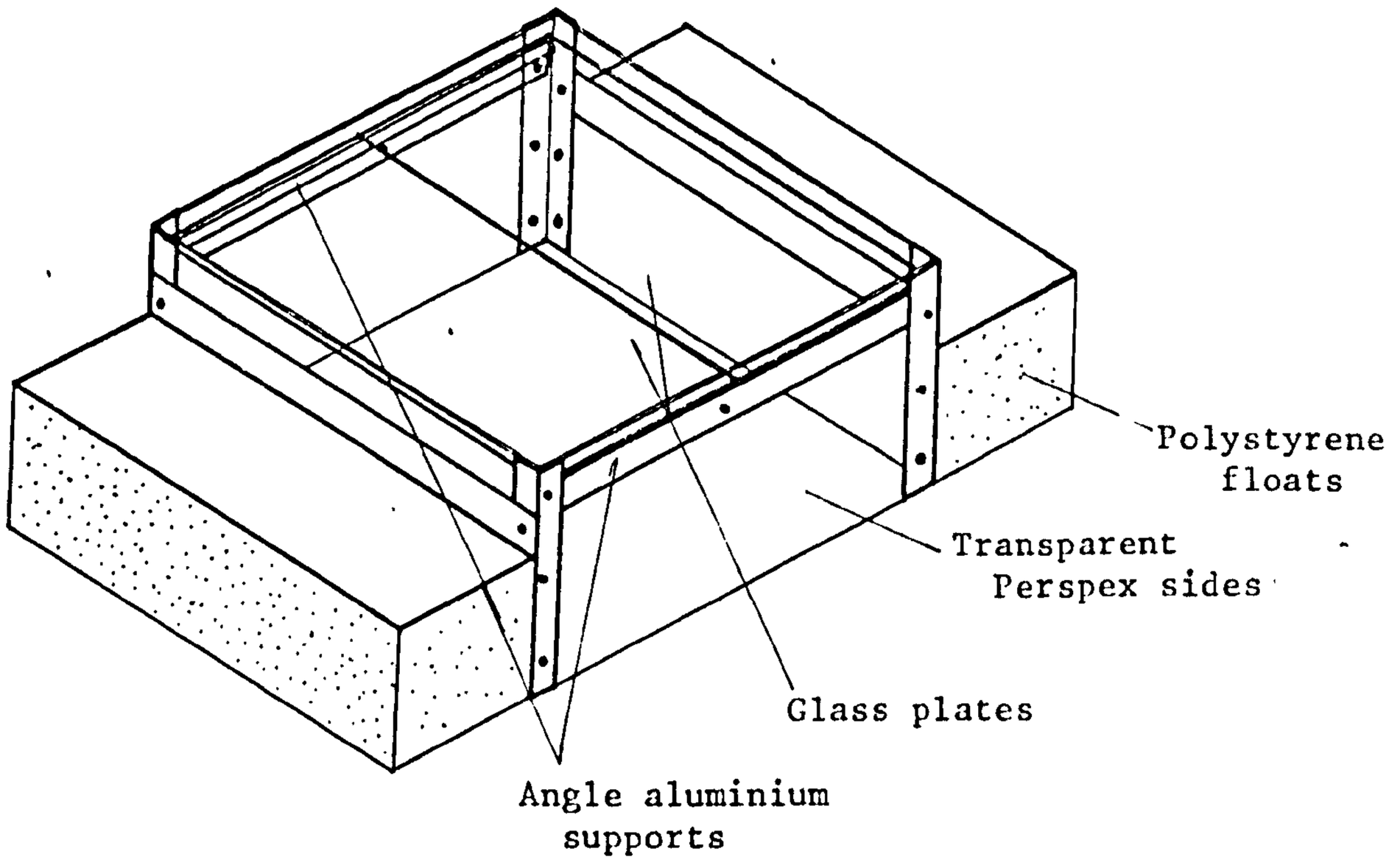


Fig. 2.2 Depth-time isopleths for (a) oxygen saturation at Congleton Sand Pit during 1977 and (b) temperature during the same period

(a)



(b)

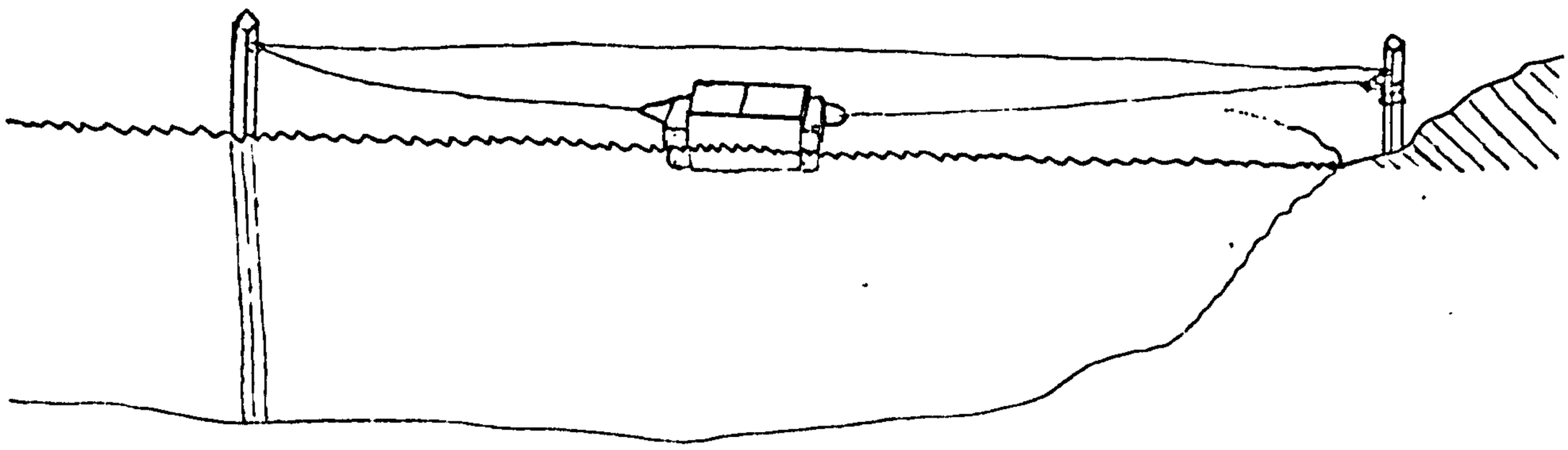


Fig. 3.1 'Sticky' emergence traps: (a) trap design and (b) method of anchorage. See text for details of operation

Year	Trap Number	Depth (M)	Substratum	Vegetation	Site
1975	1	0.2	Silt Clay	Myriophyllum spicatum L. Potomogeton pectinatus L. Elodea canadensis Michx.	Sheltered pool near margin
	2	1.5	Silty clay	none	Pool in centre of lagoon area
	3	1.5	Silty clay	none	Pool next to main lake
	4	4.0	Clay	none	Main lake
	5	0.1	Silty clay on Gravel	Scirpus maritimus L.	Margin
1976	1 + 2	1.0	Silty clay	Elodea canadensis Michx. Myriophyllum spicatum L.	Isolated pool
	3 + 4	1.0	Silty clay	Elodea canadensis Michx.	Sheltered pool

Table 4.1 Summary of physical and biotic characteristics of each emergence trap site

Species	1975 May	1975 June	1976 May	1976 June	1976 July	1976 August
Tanypus punctipennis (Meigen, 1818)		———		———		—
Tanypus vilipennis (Kieffer, 1918)		—	———			—
Procladius choreus (Meigen, 1804)	———		———			
Procladius simplistilus Freeman, 1948		—				
Psilotanypus rufovittatus (Wulp, 1874)		—				
Clinotanypus nervosus (Meigen, 1818)				—		
Ablabesmyia monilis (Linnaeus, 1758)	—	—	—	—		—
Ablabesmyia phatta (Egger, 1863)					—	
Rheopelopia ornata (Meigen, 1838)				—		
Acricotopus lucens (Zetterstedt, 1850)				—		
Cricotopus intersectus (Staeger, 1839)		———		———	—	—
Cricotopus sylvestris (Fabricius, 1794)		———		———	—	—
Microcricotopus bicolor (Zetterstedt, 1838)	—					
Paracladius conversus (Walker, 1856)		———		—		
Paratrichocladius rufiventris (Meigen, 1830)	—			—	—	—
Psectrocladius obvius (Walker, 1856)					—	
Corynoneura edwardsi Brundin, 1949					—	
Thienenemanniella sp.					—	
Chironomus cingulatus Meigen, 1830	—	———	———	———		—
Chironomus dorsalis Meigen, 1830		—		—		
Chironomus plumosus (Linnaeus, 1758)	———		———	—		—
Chironomus salinarius Kieffer, 1915	—					
Cryptochironomus albofasciatus (Staeger, 1839)				—		
Cryptochironomus psittacinus (Meigen, 1830)		—				
Cryptochironomus supplicans (Meigen, 1830)	—	—				
Einfeldia dissidens (Walker, 1856)		———		———	—	
Einfeldia longipes (Staeger, 1839)				—		
Einfeldia paganus (Meigen, 1838)						—
Endochironomus albipennis (Meigen, 1921)	———			———	—	
Endochironomus dispar (Meigen, 1830)				—		
Glyptotendipes gripekoveni (Kieffer, 1913)				—		
Glyptotendipes glaucus (Meigen, 1818)	———		———	———	—	—
Glyptotendipes viridis (Macquart, 1834)					—	
Harnischia fuscimana Kieffer	—					
Leptochironomus tener (Kieffer, 1918)		—				
Limnochironomus lobiger Kieffer, 1921					—	
Limnochironomus nervosus (Staeger, 1839)		—				
Microtendipes pedellus (Degeer, 1776)	—	———		———		
Parachironomus arcuatus (Goetghebuer, 1919)	—	———		———	—	—
Parachironomus vitiosus (Goetghebuer, 1921)		—				
Pentapedilum sordens (Wulp, 1874)	———	—		———	—	—
Polypedilum nubeculosum (Meigen, 1818)	—	———	—	———	—	
Cladotanytarsus nigrovittatus (Goetghebuer, 1922)	———			———		—
Tanytarsus gracilentus Holmgren, 1883		—				
Tanytarsus holochlorus Edwards, 1929		—				
Tanytarsus pallidicornis (Walker, 1856)		—	—	—		
Tanytarsus verralli Goetghebuer, 1928	—	———		—		

Table 4.2 A summary of the emergence periods of each species identified

Date	1	4	7	9	11	14
Males	51	133	115	107	85	78
Females	12	59	106	142	74	95
Intersex	1	23	7	18	1	0

Table 4.3 Numbers of *Einfeldia dissidens* emerging in the first half of June 1976 to show the extent to which intersex specimens were present.

			1975										1976									
			MAY					JUNE					MAY				JUNE				JULY				AUG		
			1	2	3	4	5	1	2	3	4	5	1	2	3	4	1	2	3	4	1	2	3	4	1	2	4
1975	MAY	1	xx	55	67	51	48						53	39	47	56											
		2	44	xx	64	78	48						49	40	35	43											
		3	44	80	xx	54	43						47	41	56	59											
		4	27	56	40	xx	46						42	34	26	31											
		5	55	38	32	25	xx						43	40	34	47											
	JUNE	1						xx	61	53	34	44					51	31	42	53							
		2						70	xx	69	31	56					36	20	60	70							
		3						57	55	xx	43	52					29	14	64	73							
		4						42	39	48	xx	24					17	5	28	27							
		5						58	56	50	40	xx					32	17	34	48							
	MAY	1	39	43	43	23	48						xx	62	65	56											
		2	35	38	38	27	32						67	xx	39	43											
		3	24	33	33	20	29						50	45	xx	71											
		4	44	50	40	21	45						44	40	36	xx											
1976	JUNE	1						55	45	55	33	47					xx	43	44	32							
		2						52	50	59	29	39					64	xx	13	21							
		3						52	50	61	36	44					50	62	xx	68							
		4						62	60	55	45	47					45	57	67	xx							
	JULY	1																			xx	62	27	34			
		2																			30	xx	23	24			
		3																			42	27	xx	46			
		4																			42	27	50	xx			
	AUG	1																							xx	50	25
		2																							18	xx	25
		4																							17	11	xx

Table 4.4 Comparative indices for communities sampled at each trap site. Jaccard index values are read to the left, below 'xx' marks and Raabe values to the right above this division.

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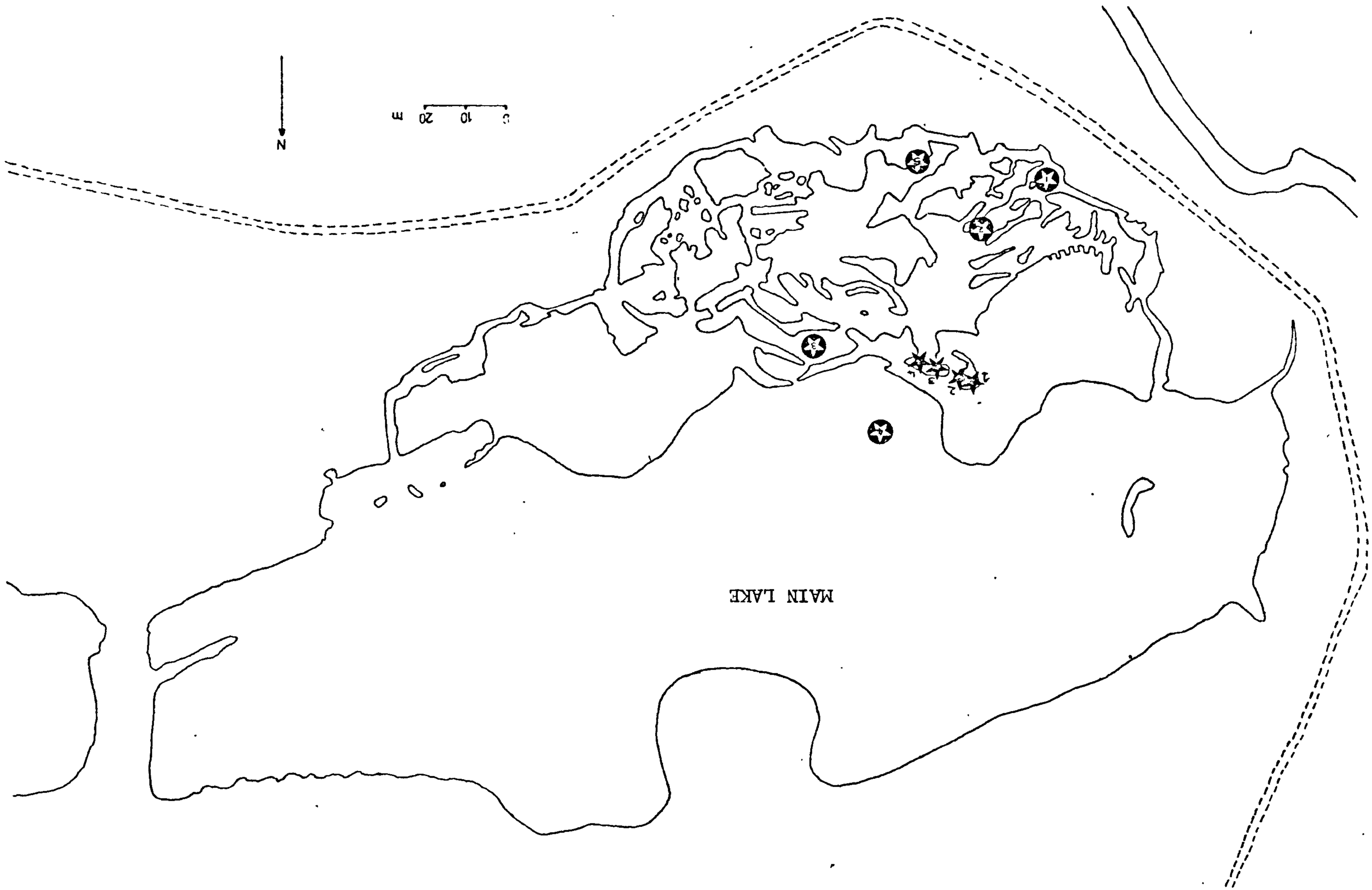
Fig. 4.1 Outline map of study area with positions of emergence traps marked; 1975 - ✪ 1-5; 1976 - ★ 1-4



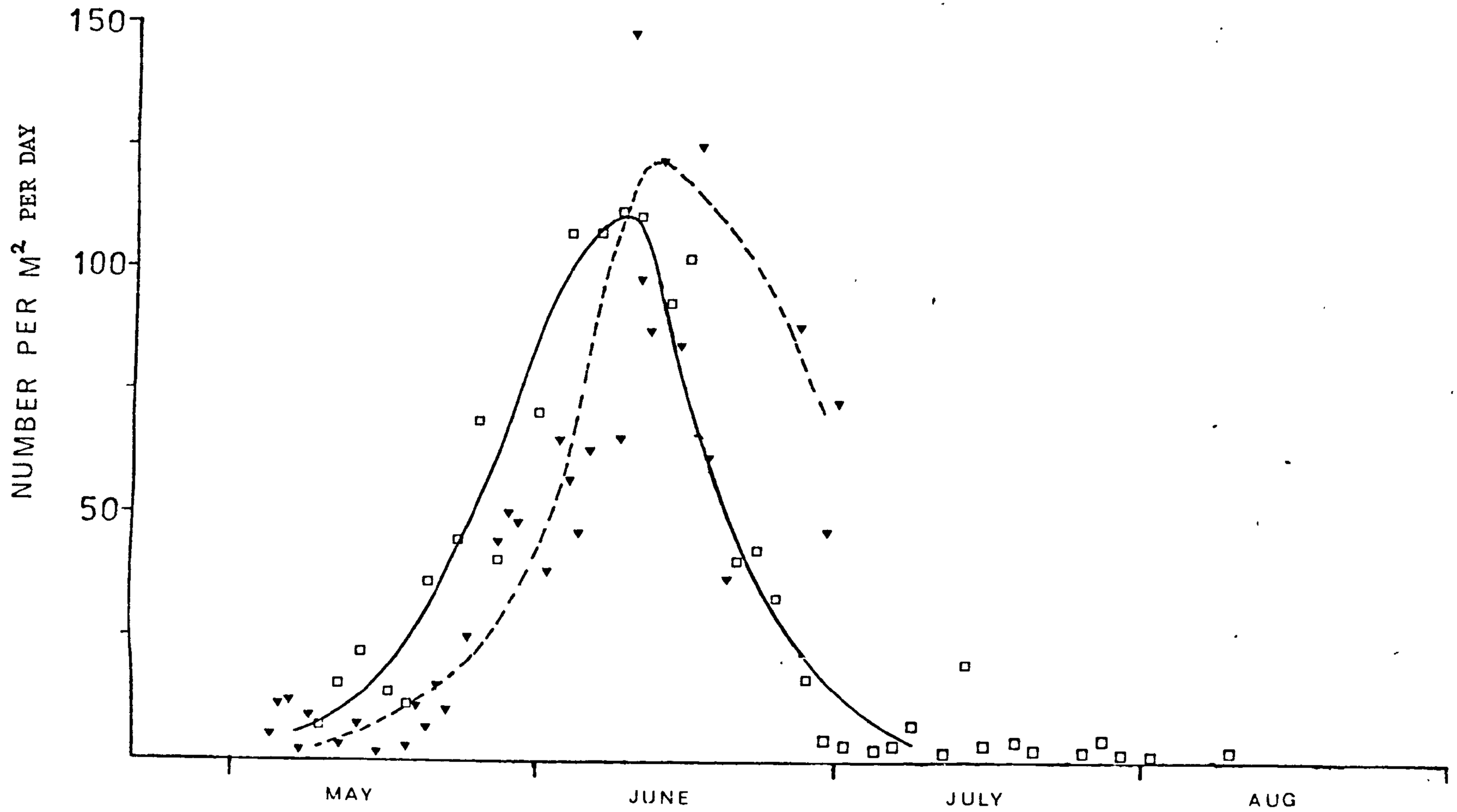


Fig. 4.2 Seasonal emergence pattern estimated from traps 1-4
1975 - ▼ (dotted line); 1976 - □ (solid line)

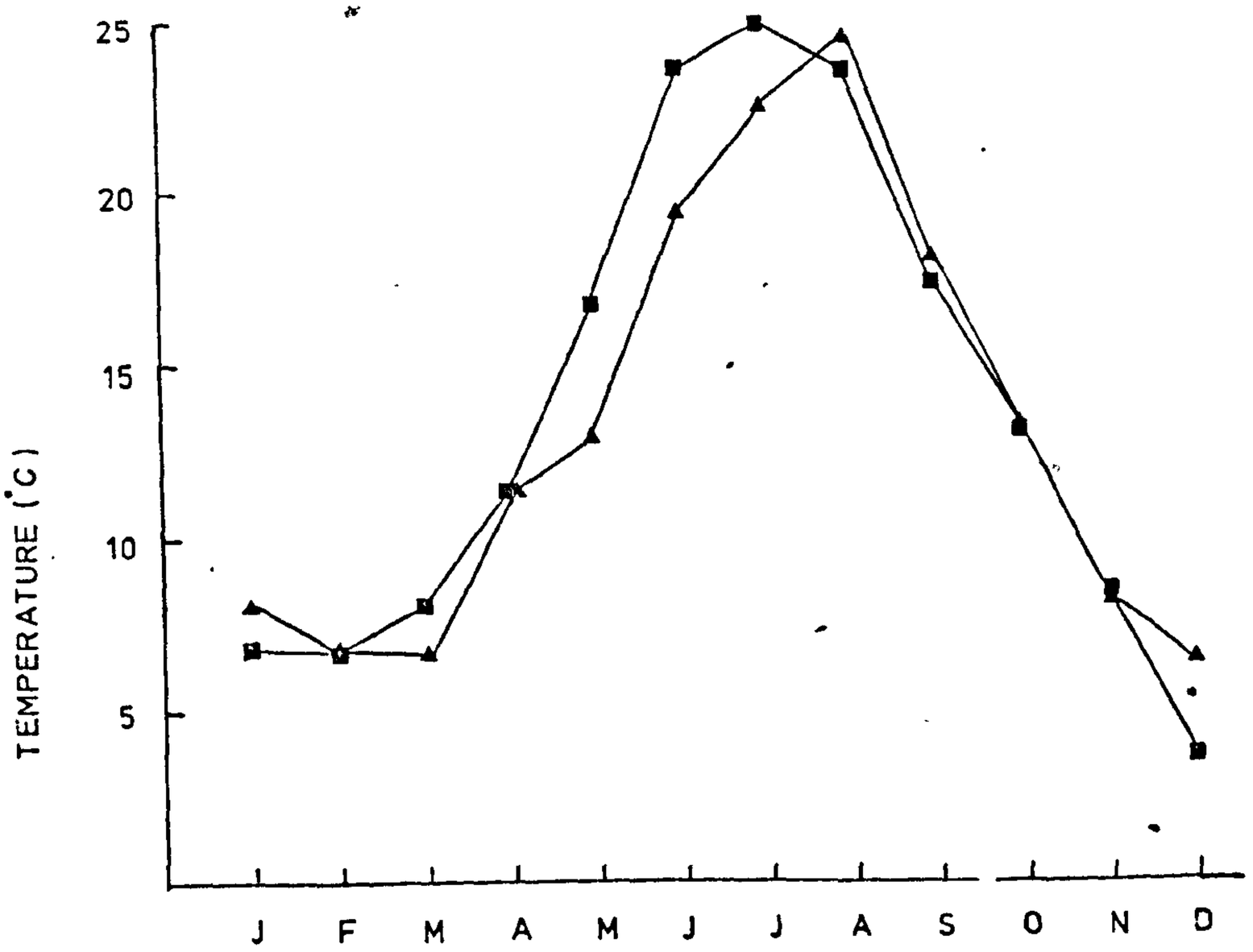


Fig. 4.3 Mean monthly air temperatures at 15.00 hours GMT. 1975 - ▲ , 1976 - ■ . Taken at Cardington, Beds. (Met. Office; 1975, 1976)

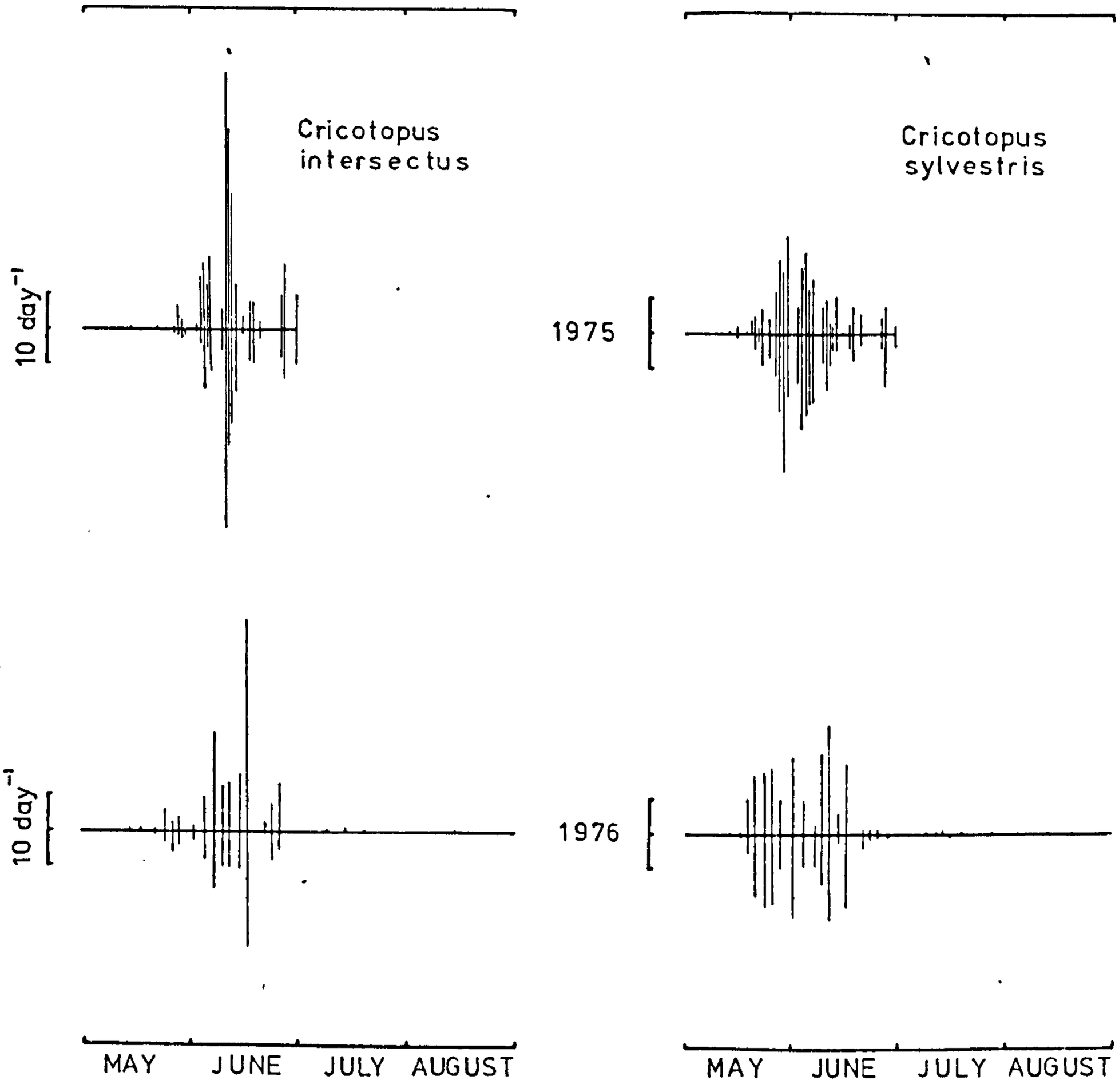


Fig. 4.4 Emergence of the two most numerous species of Orthocladiinae at all sampling sites in 1975 and 1976. The upper graph of each pair is for 1975 (May to August), males are plotted above and females below the axis and the scale to the left represents 10 individuals per day of each sex.

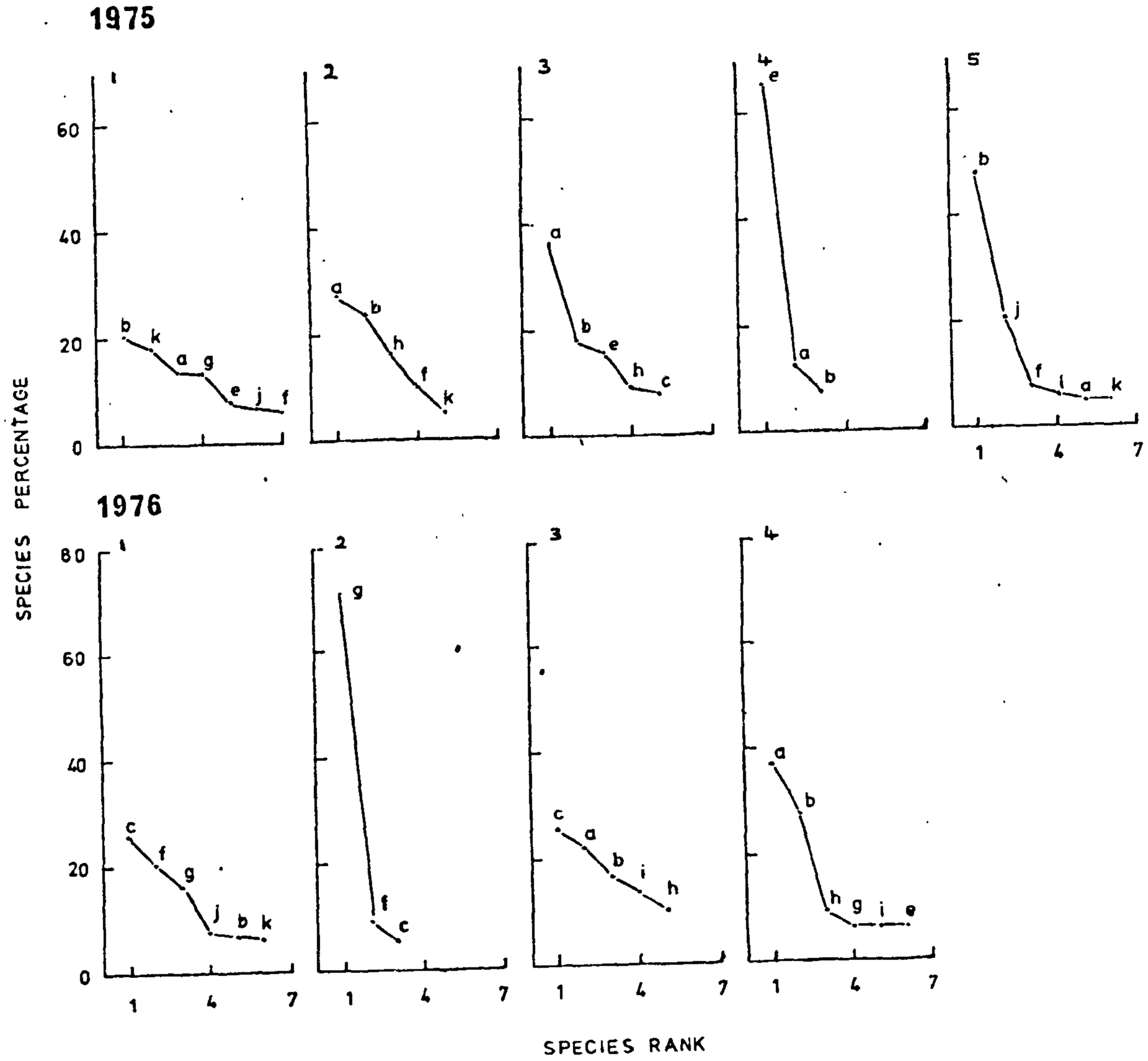


Fig. 4.5 Rank-percentage curves for total number of males of each of the common species (≥ 5% of total) emerging in June at each trap. Species labels follows that in figs. 4-6 and the percentagesof the community which a species accounted for is plotted against its rank.
a *Cricotopus intersectus*, b *Cricotopus sylvestris*, c *Tanypus punctipennis*, e *Procladius choreus*, f *Chironomus cingulatus*, g *Einfeldia dissidens*, h *Parachironomus arcuatus*, i *Endochironomus albipennis*, j *Microtendipes pedellus*, k *Polypedilum nubeculosum*.

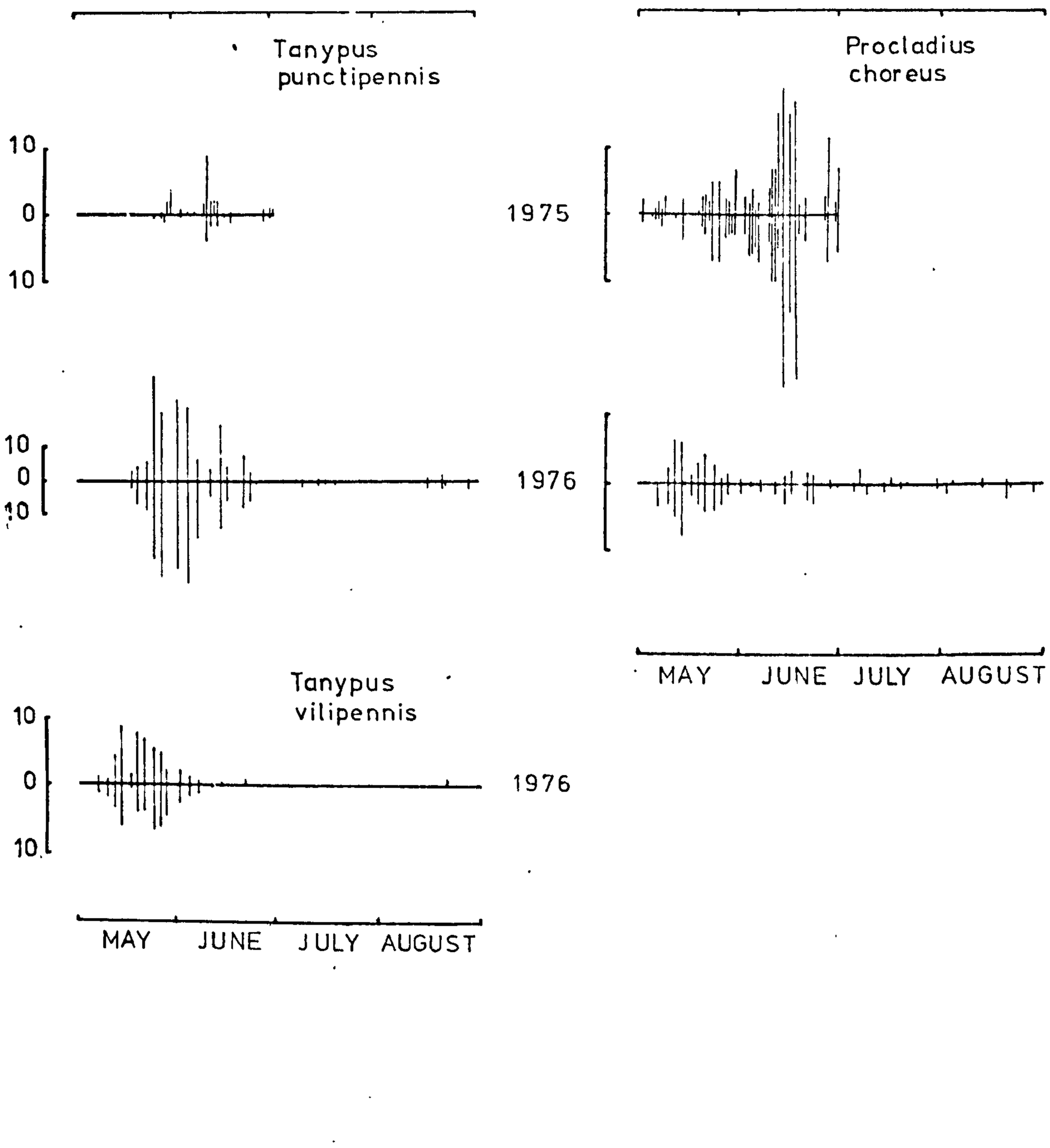


Fig. 4.6 Emergence of Tanypodinae, format as for fig. 4.
(*Tanypus vilipennis* 1976 only)

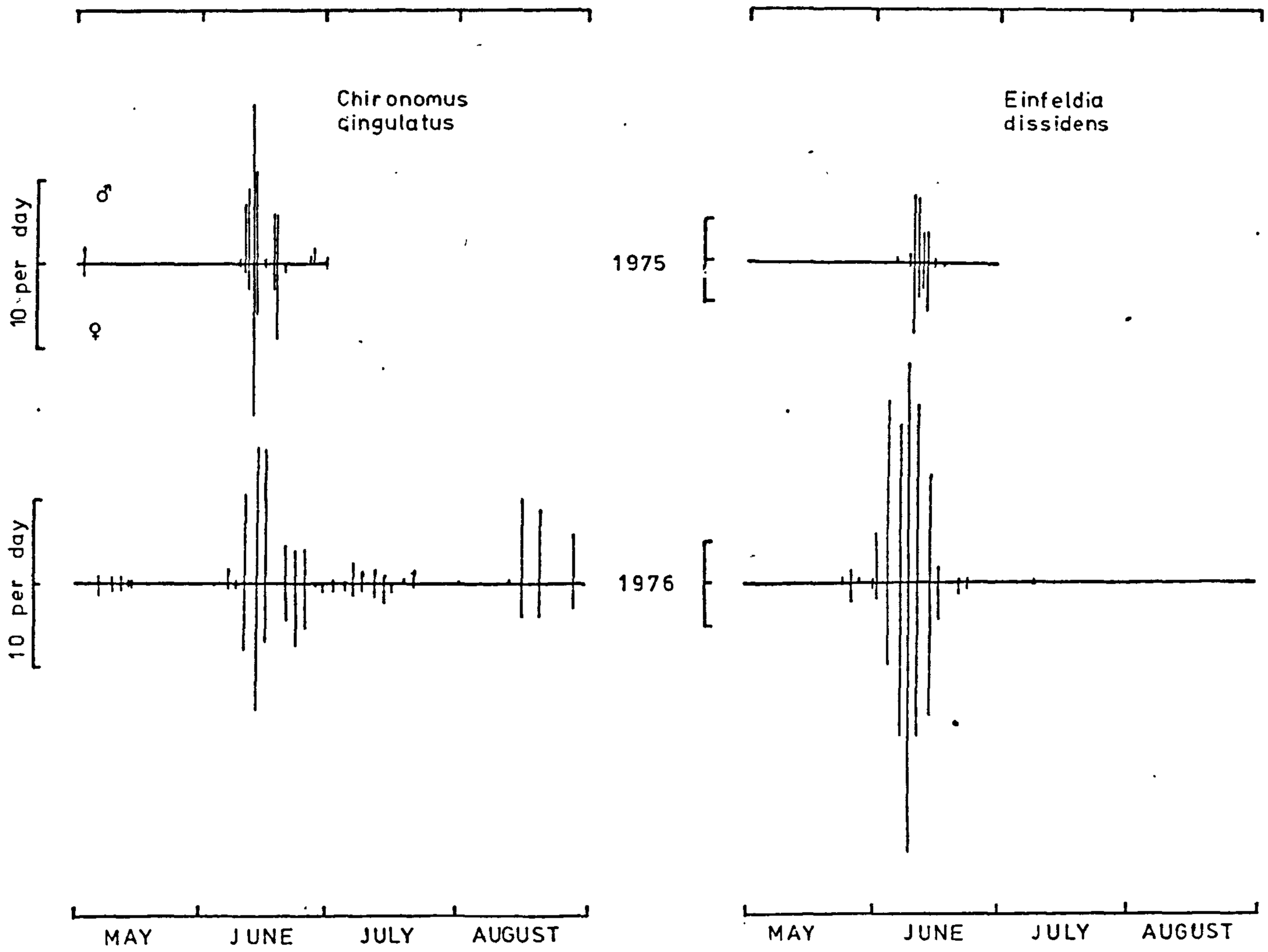


Fig. 4.7 Emergence of the two most numerous chironomid species, format as for fig. 4.4

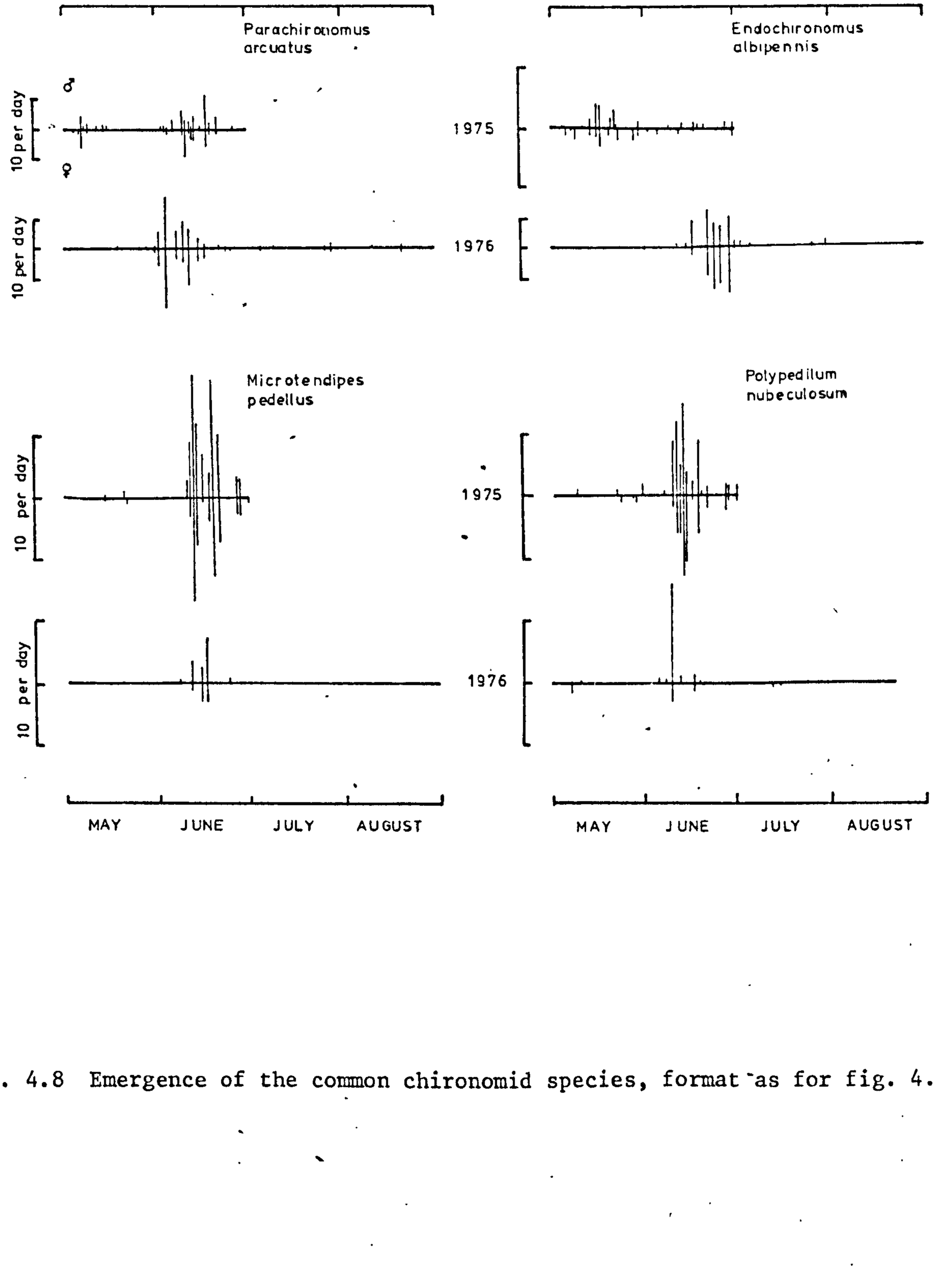


Fig. 4.8 Emergence of the common chironomid species, format as for fig. 4.4

Site	Station	Depth (m)	Substratum
Trentham Park	1	1	Clay
BIS Congleton	1	0.2	Sand
	2	3	Clay
	3	4	Clay
	4	2.5	Clay
Linford, Dovecote	1	1	Topsoil
	2	3	Topsoil
	3	3	Topsoil
	4	1	Topsoil
Linford, Black Horse	2	2	Sandy silt
	3	2	Sandy silt
	4	3	Sandy silt

Table 5.1 Summary of sampling stations with water depth and main sediment component.

MONTHS	*Crypto-chironomus sp.*			*Polypedilum sp.*			*Procladius sp.*				*Tanypus sp.*				*Chironomus sp.*			*Micro-cricotopus sp.*	TOTAL
Instar	3	4	T	3	4	T	2	3	4	T	2	3	4	T	3	4	T	T	
J	4	2	6	1	7	8	0	1	31	32	0	0	0	0	0	2	2	0	49
F	3	3	6	1	2	3	0	1	20	21	0	0	0	0	0	6	6	0	38
M																			
A	0	5	5	0	8	8	6	1	7	14	1	0	1		0	7	7	0	30
M	2	6	8	0	4	4	0	6	12	18	0	1	1		0	5	5	0	31
J	0	4	4	0	0	0	1	2	5	8	1	2	7	10	0	0	0	0	25
J	0	1	1	1	0	1	0	2	0	2		1	5	6	1	2	3	0	14
A	0	1	1	0	0	0	5	10	2	17		3	0	3	0	8	8	1	30
S	1	0	1	0	0	0	1	6	0	7		0	2	2	0	3	3	0	13
O	0	3	3	0	0	0	0	1	0	1		0	4	4	3	8	11	0	19
N	0	2	2	0	0	0	0	2	3	5		0	1	1	2	11	13	0	21
D	0	6	6	0	16	16	0	2	1	3		0	6	6	0	5	5	0	42
TOTAL	10	33	43	3	38	41	13	34	81	128	1	7	26	34	6	57	63	1	310
% Species Composition			14%			13%				41%				11%			20%	-	

Table 5.2 Species abundance and instar analysis for chironomid larvae caught at Trentham Park lake in 1977.

Larval taxa	Total number caught and % catch Stations							
	1		2		3		4	
	N	%	N	%	N	%	N	%
Chironomus	53	3	108	35	95	36	74	14
Cryptochironomus	5	-	0	0	0	0	1	-
Glyptotendipes	9	1	0	0	1	-	0	0
Endochironomus	1	-	0	0	0	0	0	0
Polypedilum	1149	72	17	6	28	11	130	25
Stictochironomus	3	-	0	0	0	0	0	0
Tanytarsini	51	3	0	0	0	0	1	-
Pentanura	1	-	0	0	0	0	0	0
Procladius	276	17	182	59	136	52	308	60
Tanypus	1	-	0	0	1	-	0	0
Phaenopsectra	0	0	1	-	0	0	0	0
Microcricotopus	38	2	0	0	0	0	0	0
Total taxa	11		4		5		5	

Table 5.3 Total larvae caught at each station at Congleton sand pit in 1977, total samples from each site = 24.

		Chironomus sp STATION				*Polypedilum sp* STATION			
		1	2	3	4	1	2	3	4
MONTH	J	0	6	0	2	24	0	2	2
	F	1	4	15	6	230	3	0	0
	M	0	7	12	7	0	1	0	0
	A	4	17	15	5	117	0	0	13
	M	0	17	18	12	10	0	0	4
	J	0	8	8	4	0	0	0	0
	J	0	11	3	0	1	1	0	0
	A	13	5	5	8	160	2	0	11
	S	8	24	6	11	95	2	2	12
	O	1	1	1	7	239	4	6	21
	N	2	8	4	7	290	4	9	26
	D	0	5	8	4	0	0	9	41

		Procladius sp STATION			
		1	2	3	4
MONTH	J	0	58	3	13
	F	90	1	4	4
	M	1	1	0	0
	A	1	0	0	45
	M	13	14	1	37
	J	1	8	5	17
	J	22	37	5	1
	A	28	3	6	37
	S	63	21	17	35
	O	32	24	42	44
	N	24	33	23	37
	D	1	13	30	40

Table 5.4 Seasonal pattern of abundance of common species at Congleton sand pit in 1977. Numbers of larvae per 2 Ekman grab samples

TAXA	1		2		3		4	
	N	%	N	%	N	%	N	%
Chironomus	2	1	32	8	23	12	27	7
Cryptochironomus	7	4	17	4	7	4	13	3
Harnischia	0	0	1	-	0	0	0	0
Limnochironomus	2	1	4	1	0	0	2	1
Polypedilum	114	61	214	54	58	29	232	60
Tanytarsini	17	9	15	4	9	5	2	1
Clinotanypus	0	0	0	0	0	0	1	-
Pentanura	3	2	3	1	37	19	17	4
Procladius	34	18	112	28	60	30	86	22
Tanypus	0	0	0	0	2	1	1	-
Microcricotopus	7	4	2	1	1	1	6	2
Number of taxa	8		9		8		10	

Table 5.5 Total larval catch from Dovecote lake in 1977 for each station

	2		3		4	
	N	%	N	%	N	%
Chironomus	193	26	98	17	158	51
Cryptochironomus	21	3	8	1	11	3
Glyptotendipes	85	12	64	11	1	-
Polypedilum	77	10	142	24	13	4
Microtendipes	0	0	1	-	0	0
Tanytarsini	4	1	11	2	0	0
Clinotanypus	0	0	1	-	0	0
Procladius	178	24	92	16	117	37
Tanypus	175	24	165	28	12	4
Microcricotopus	0	0	3	1	1	-
Number of taxa	7		10		7	

Table 5.6 Total catch of larvae from Black Horse lake in 1977

		Chironomus spp STATION			*Procladius sp* STATION		
		2	3	4	2	3	4
MONTH	J	21	11	43	58	6	34
	F	14	10	37	21	12	12
	M	15	0	21	13	13	12
	A	–	–	–	–	–	–
	M	8	9	2	3	8	10
	J	4	11	2	1	0	16
	J	17	9	3	0	0	0
	A	–	–	–	–	–	–
	S	10	26	16	1	12	0
	O	20	1	15	18	12	1
	N	27	2	4	36	10	10
	D	46	6	12	27	19	21

		Tanypus sp STATION			*Polypedilum sp* STATION		
		2	3	4	2	3	4
MONTH	J	0	0	0	15	15	0
	F	0	0	0	29	74	5
	M	5	0	0	21	15	5
	A	–	–	–	–	–	–
	M	3	50	1	0	1	1
	J	25	10	9	0	0	0
	J	5	5	0	0	1	0
	A	–	–	–	–	–	–
	S	12	19	1	1	4	0
	O	30	42	0	1	6	0
	N	70	14	0	4	10	2
	D	25	25	1	6	17	2

Table 5.7 Seasonal abundance of common larvae in the benthos of Black Horse lake in 1977, number caught per 2 Ekman grab samples

	Trentham Park	Congleton				Dovecote				Black Horse		
		1	2	3	4	1	2	3	4	2	3	4
Chironomus	20	3	35	36	14	1	8	12	7	26	17	51
Cryptochironomus	14	–	0	0	–	4	4	4	3	3	1	3
Endochironomus	0	–	0	0	0	0	0	0	0	0	0	0
Glyptotendipes	0	1	0	–	0	0	0	0	0	12	11	–
Harnischia	0	0	0	0	0	0	–	0	0	0	0	0
Limnochironomus	0	0	0	0	0	1	1	0	1	0	0	0
Microtendipes	0	0	0	0	0	0	0	0	0	0	–	0
Polypedilum	13	72	6	11	25	61	54	29	60	10	24	4
Stictochironomus	0	–	0	0	0	0	0	0	0	0	0	0
Tanytarsini	0	3	0	0	–	9	4	5	1	1	2	0
Clinotanypus	0	0	0	0	0	0	0	0	–	0	–	0
Pentaneura	0	–	0	0	0	2	1	19	4	0	0	0
Procladius	41	17	59	52	60	18	28	30	22	24	16	37
Tanypus	11	–	0	–	0	0	0	1	–	24	28	4
Microcricotopus	–	2	0	0	0	4	1	1	2	0	1	–
Phaenopsectra	0	0	–	0	0	0	0	0	0	0	0	0
Number of taxa	6	11	4	5	5	8	9	8	10	7	10	7
Diversity H'	1.47	0.92	0.86	0.99	0.96	1.24	1.27	1.62	1.23	1.65	1.72	1.12
Equitability J	0.82	0.38	0.62	0.62	0.60	0.59	0.58	0.78	0.53	0.85	0.75	0.58

Table 5.8 Percentage composition of chironomid larvae at the sampling stations examined in 1977.

		Trentham Park	Congleton				Dovecote				Black Horse		
			1	2	3	4	1	2	3	4	2	3	4
Trentham Park		-	35	69	74	71	37	54	61	47	67	56	70
Congleton	1	55	-	26	32	46	86	78	54	83	33	47	26
	2	43	25	-	93	79	25	42	48	35	56	38	77
	3	57	45	50	-	77	30	47	53	40	62	44	79
	4	57	45	50	43	-	45	62	68	55	50	55	56
Dovecote	1	56	58	33	30	63	-	82	59	87	33	45	27
	2	50	54	30	27	56	89	-	74	88	46	52	44
	3	75	73	33	44	63	78	70	-	68	51	56	51
	4	60	62	27	36	50	80	73	80	-	43	50	37
Black Horse	2	63	64	38	71	71	50	45	67	55	-	80	62
	3	60	62	27	50	50	50	46	64	67	70	-	42
	4	86	64	38	71	50	50	45	67	55	75	70	-

Table 5.9 Comparative indices for all stations sampled in 1977. Raabe values are given above the principle diagonal of the matrix and the Jaccard values below this.

SPECIES	MAY	JUNE	JULY
Chironomus cingulatus			
Chironomus plumosus			
Cryptochironomus psittacinus			
Cryptochironomus supplicans			
Cryptotendipes pfeulgeri			
Einfeldia dissidens			
Endochironomus albipennis			
Glyptotendipes glaucus			
Limnochironomus nervosus			
Microtendipes pedellus			
Parachironomus arcuatus			
Polypedilum nubeculosum			
Tanytarsus lestagei Goet.			
Clinotanypus nervosus			
Anatopynia varia			
Procladius choreus			
Psilotanypus lugens (Kieff.)			
Tanypus punctipennis			
Cricotopus sylvestris			
Cricotopus intersectus			
Cricotopus obnixus (Walk.)		—	
Corynoneura edwardsii	—		

Table 5.10 Summary of emergence in 1977 from Black Horse lake

Site	Reference	Sieve Mesh (μm)	Density (N m^{-2})
Trentham Park		375	700
Congleton sand pit		375	1300
Dovecote		375	720
Black Horse lake		375	1204
Blake Mere	(Bowman, 1976)	375	1000 (@ 3.5m)
Newton Mere	" "	375	1000 (@ 3m)
Crose Mere	" "	375	3000 (@ 3m)
Loch Levan	(Maitland & Hudspith, 1974)	500	14000-24,400
Eglwys Nunydd	(Potter & Learner, 1974)	150	30,250
Lough Neagh	(Carter, 1976)	180	3000

Table 5.11 Total larval abundance in gravel and sand pit lakes in comparison with that in other lakes

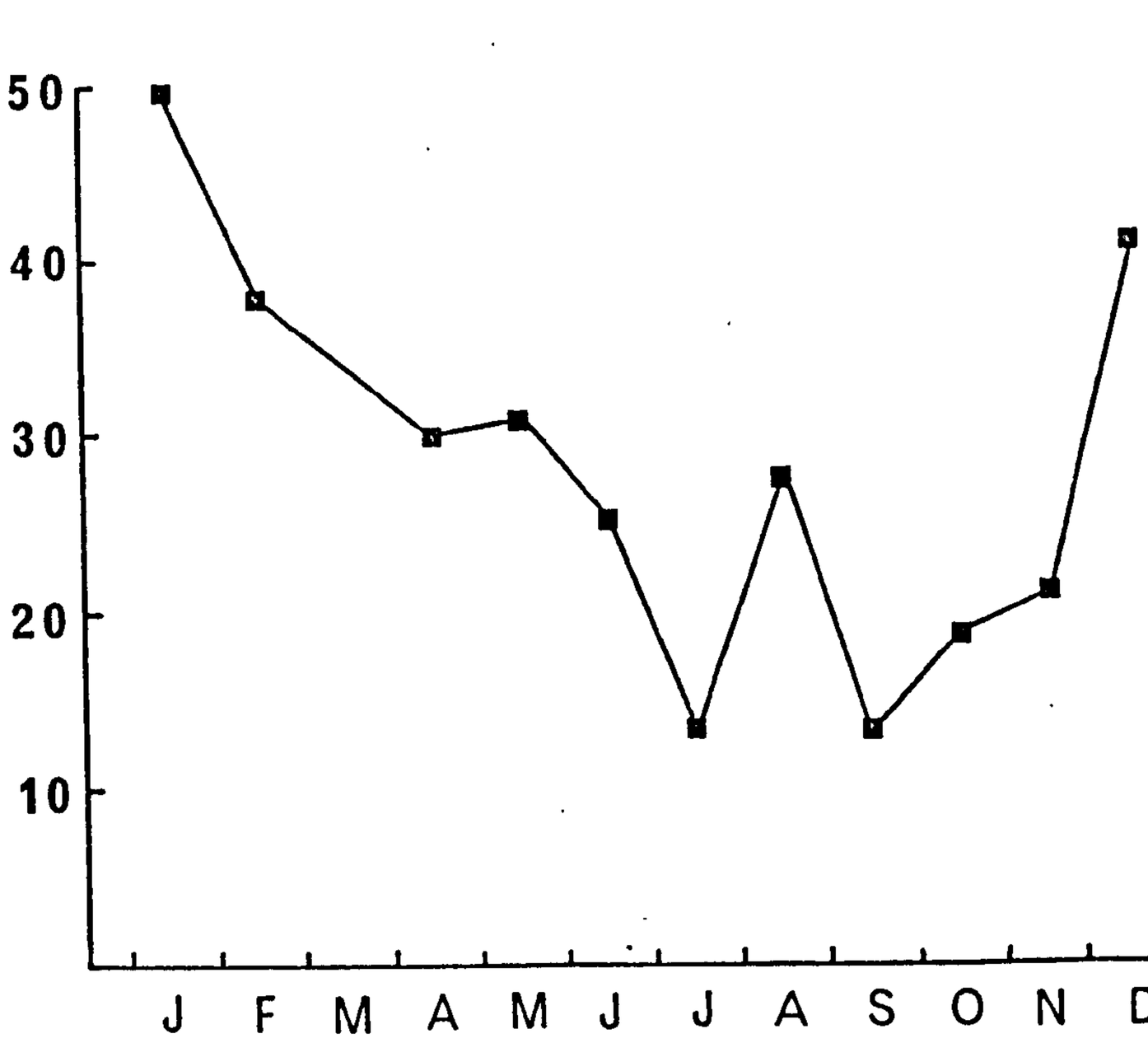


Fig. 5.1 Total abundance of larvae taken in one Allen grab sample at Trentham Park in 1977. Each point represents the average of two samples.

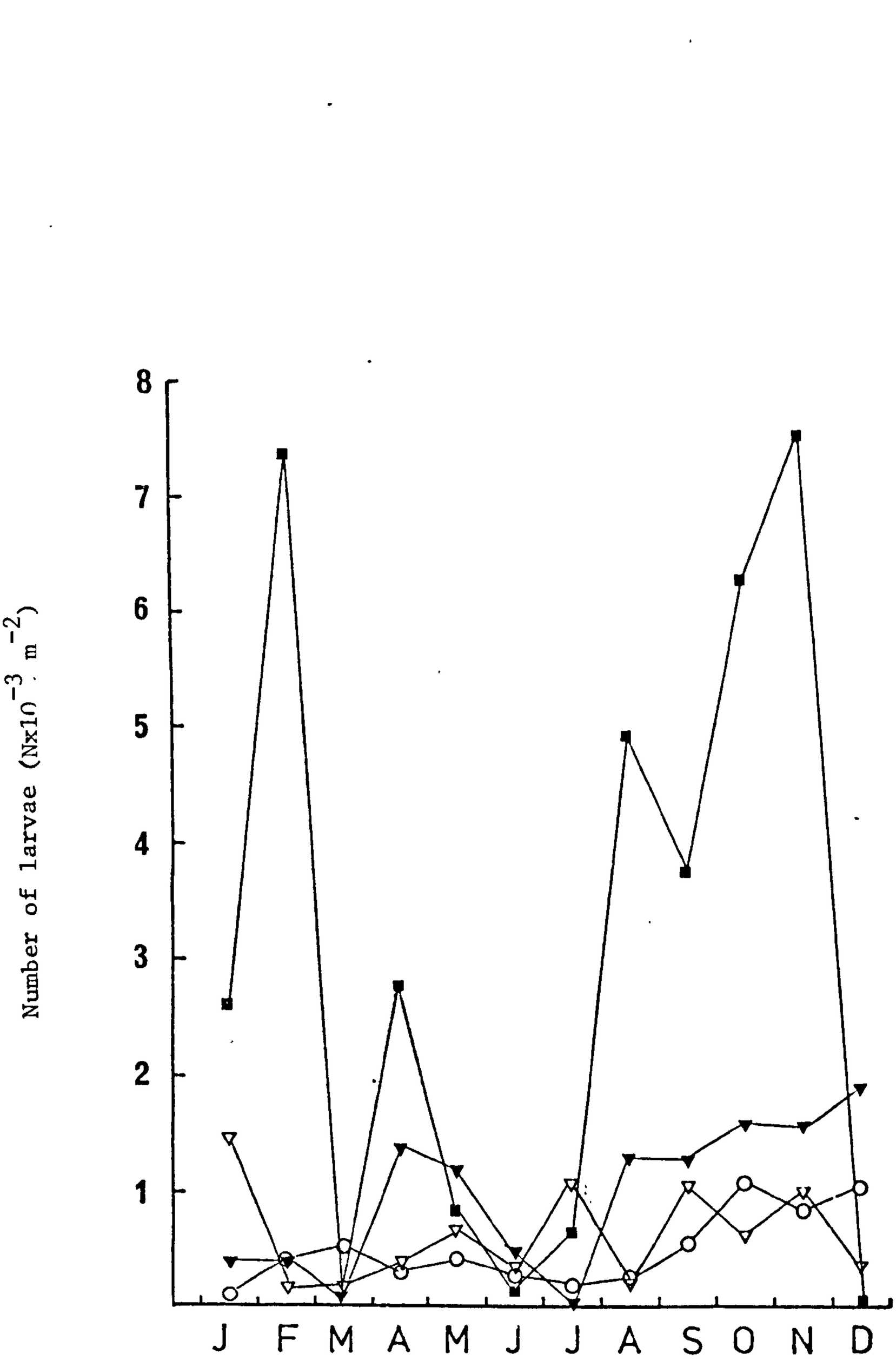


Fig. 5.2 Total abundance of larvae from the four sampling stations at Congleton Sand Pit: station 1 - ■, station 2 - ▽, station 3 - 0 and station 4 - ▼. Each point is the average of two samples.

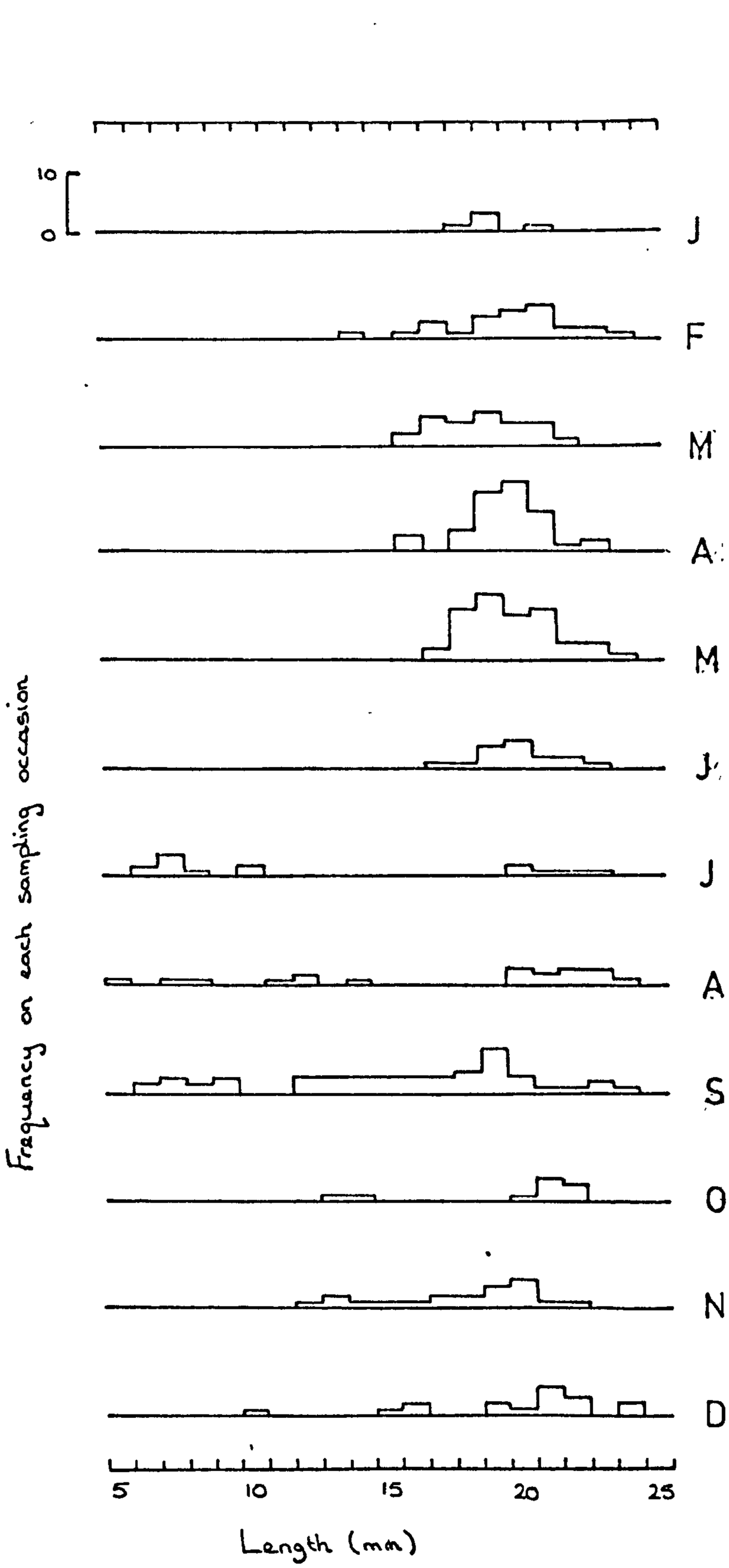


Fig. 5.3 Length-frequency histograms for *Chironomus* larvae from Congleton Sand pit in 1977

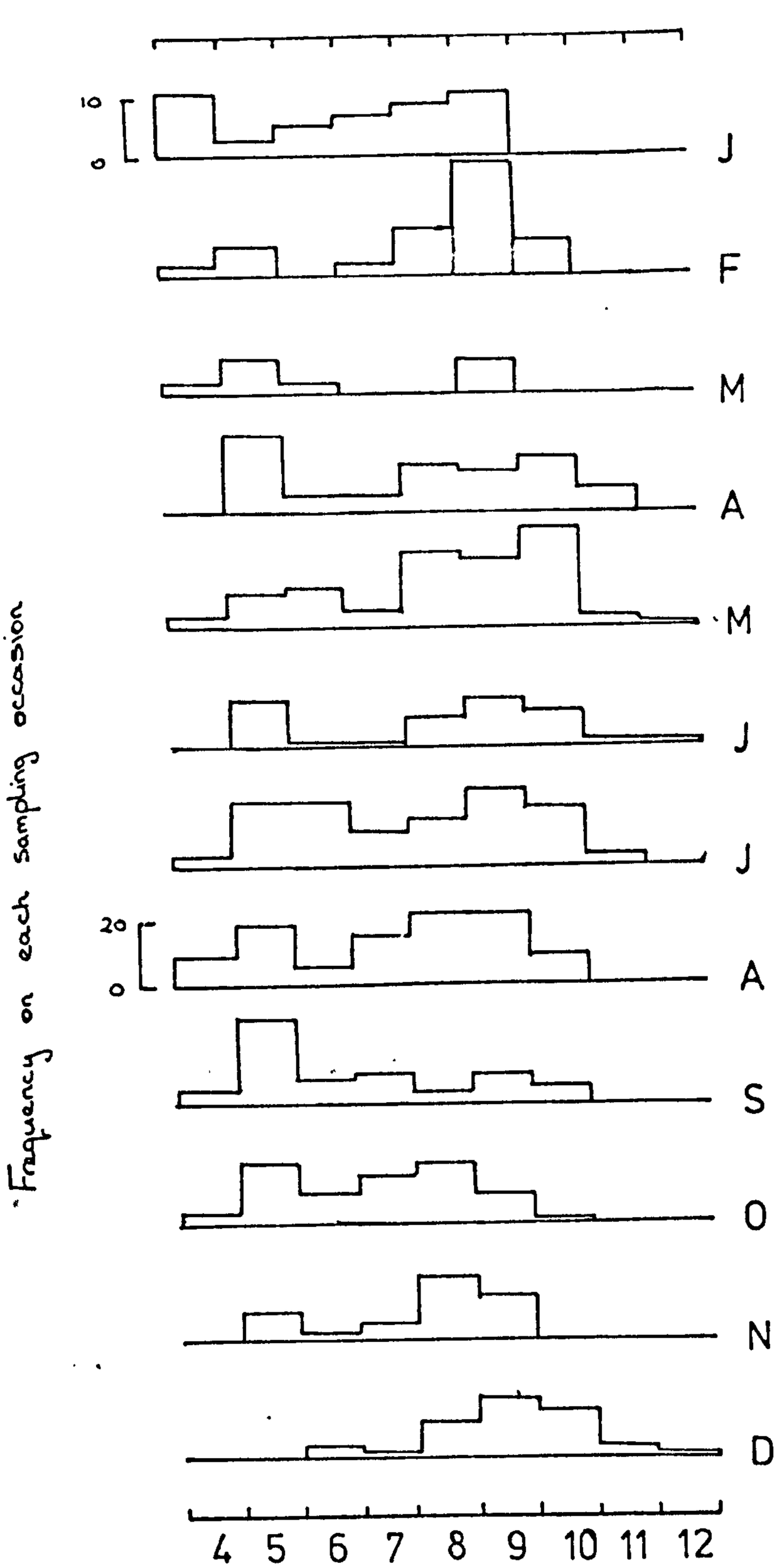


Fig. 5.4 Length-frequency histograms for *Procladius* larvae at Congleton (the sample from August has a different frequency scale to all other months)

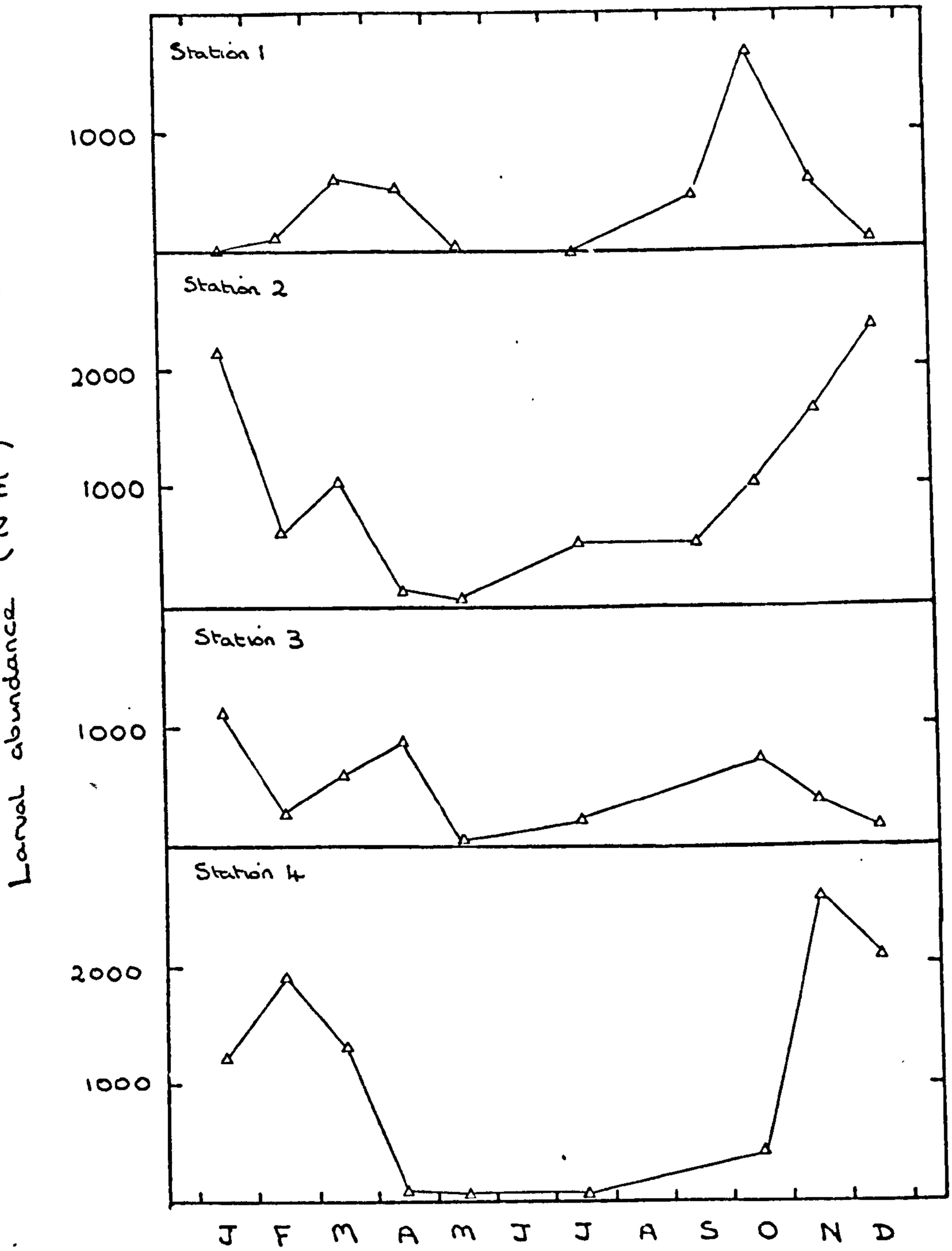


Fig. 5.5 Seasonal pattern of total abundance of larvae in Dovecote lake, Linford, in 1977. Each point is the average of two samples.

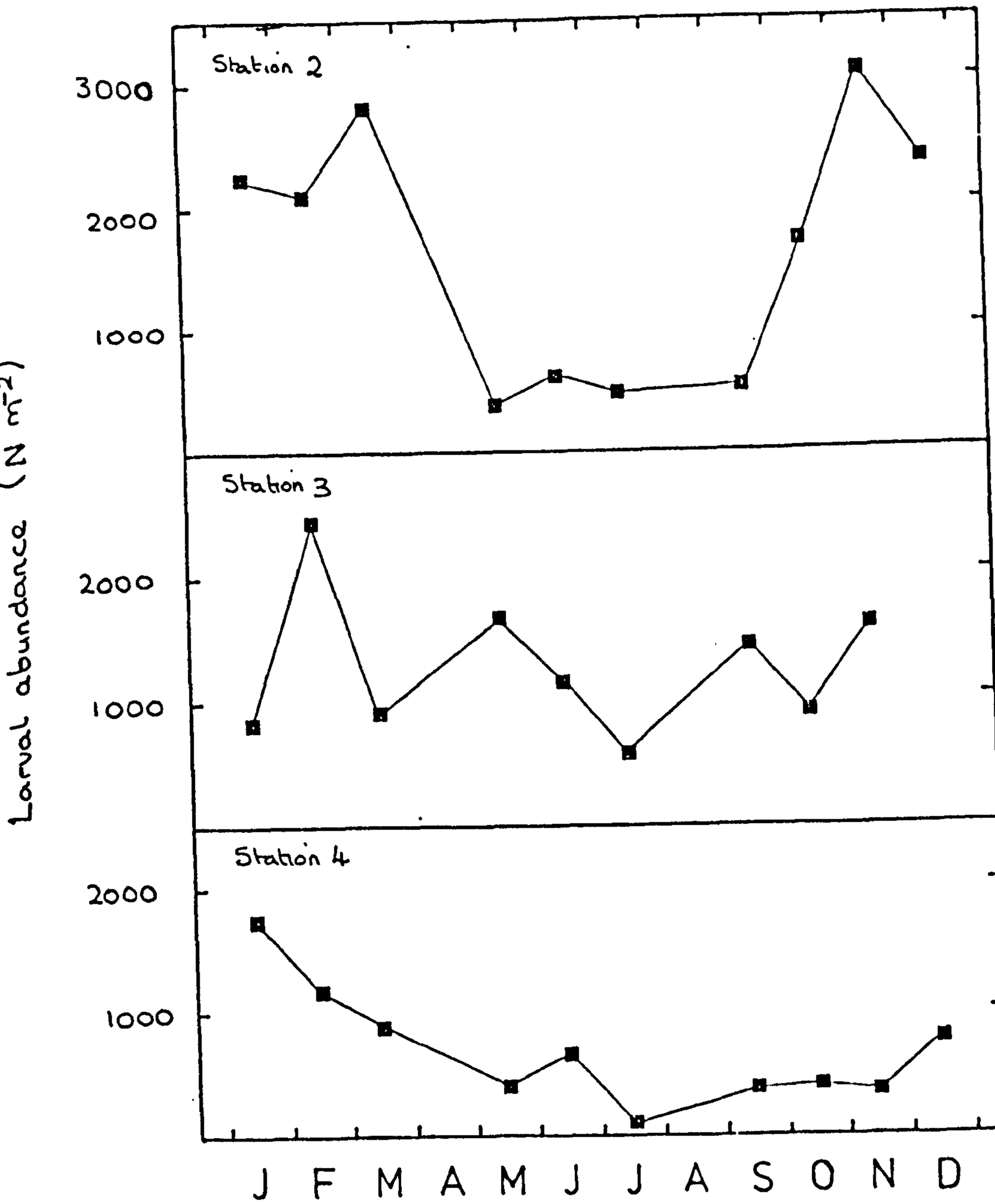


Fig. 5.6 Seasonal pattern of total abundance of larvae at Black Horse lake, Linford, in 1977. Each point is the average of two samples.

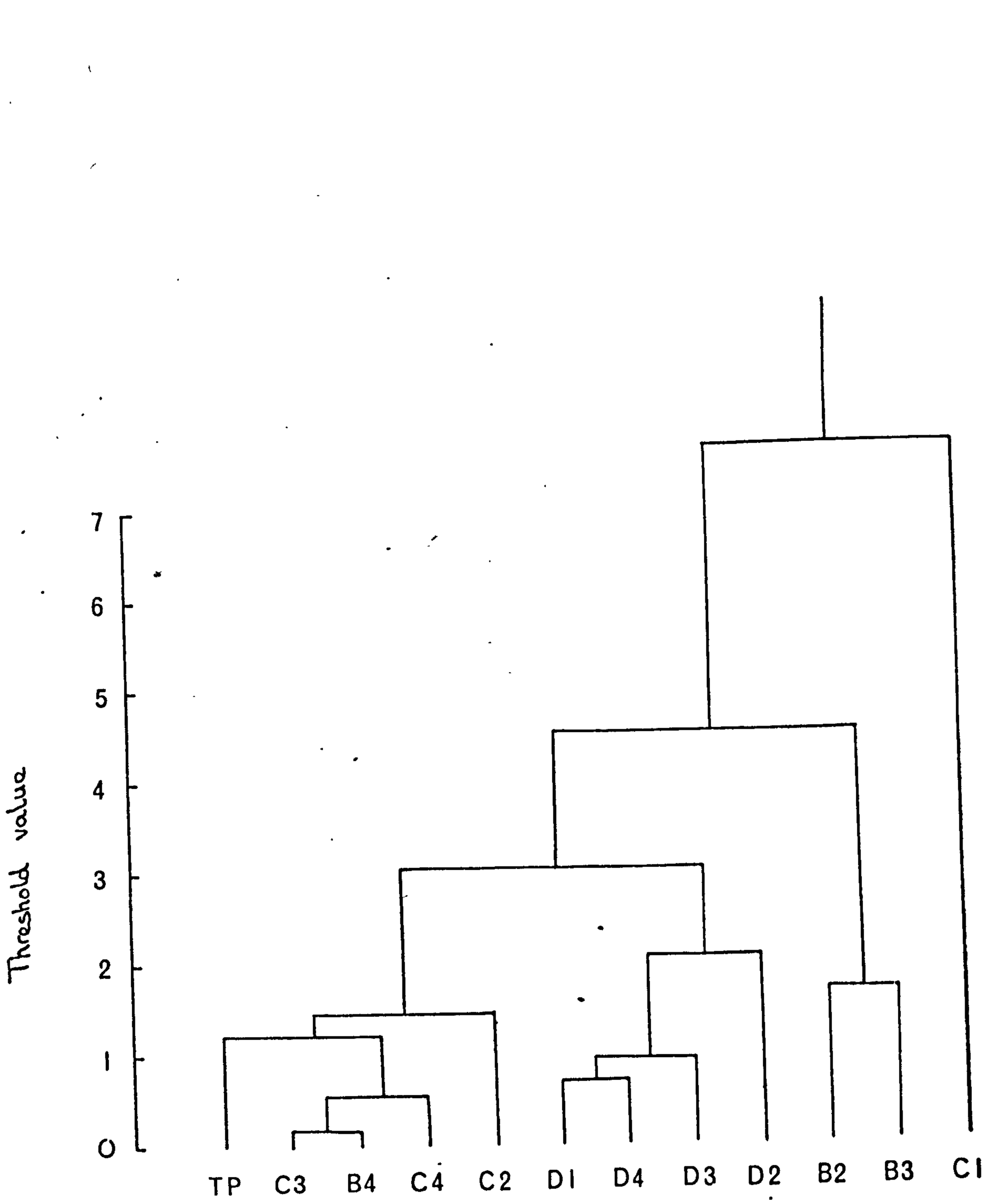


Fig. 5.7 Dendrogram of cluster analysis using Ward's method to show hierarchical relationships between sites; each site is indicated by its initial letter followed by the station number

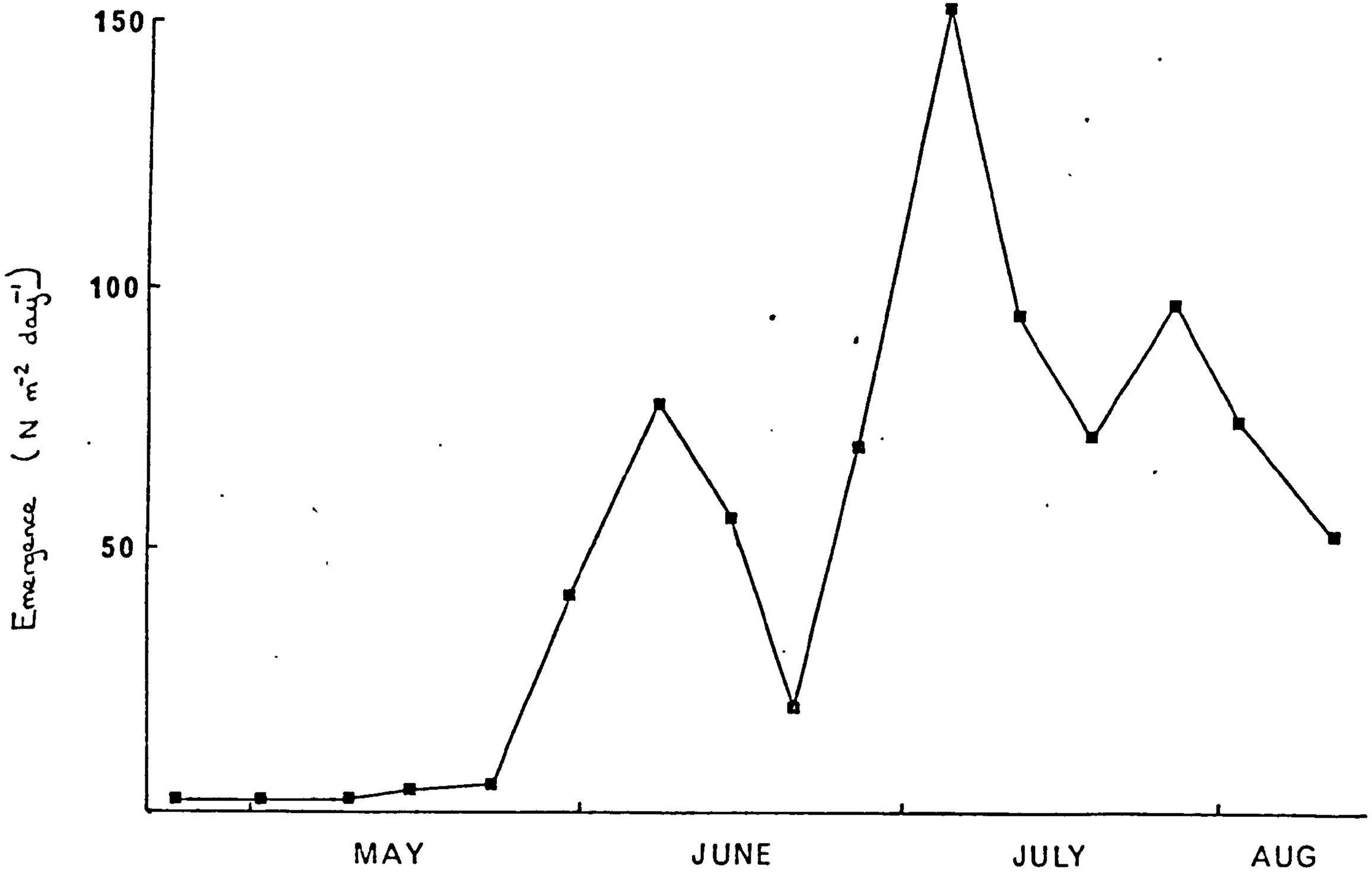


Fig. 5.8 Total chironomid emergence in Mundie traps from Black Horse, Linford in 1977

Food Categories	Scale
Detritus	Percentage of field covered
Algae	
Navicula	Number per field
Synedra	Number per field
Filamentous types	Number of filaments per field
Others	Number per field
Oligochaetes	0 - absent 1 - present
Crustacea	IBID

Table 6.1 The food categories recognised in the gut analysis of chironomid larvae together with the enumeration method used.

	12/4	25/4	10/5	24/5	6/6	23/6	5/7	19/7	1/8	16/8	31/8	14/9	11/10
Chironomus	2.4 0.4–4.4 9.2 1.0–17.9	3.3 1.8–4.9 13.7 6.3–21.3	0.8 0.0–1.8 2.6 0.0–6.7	1.0 0.0–2.2 2.4 0.0–4.9	0.9 0.1–1.5 3.7 0.5–6.3	0.6 0.0–1.3 1.7 0.0–4.3	0.3 0.0–0.9 0.6 0.0–2.4	0.4 0.0–1.0 2.0 0.0–5.2	0.4 0.0–1.0 1.9 0.0–6.5	0	0	0	0
Endochironomus	0.1 0.0–0.4 0.1 0.0–0.2	0	0	0	0	0	0	0	0	0	0	0	0
Polypedilum	0.7 0.1–1.3 0.4 0.0–0.8	1.5 1.0–2.0 0.7 0.1–1.3	0.6 0.0–1.3 0.4 0.0–1.0	0.5 0.0–1.1 0.2 0.0–0.5	0.2 0.0–0.5 0.2 0.0–0.4	0.2 0.0–0.6 0.2 0.0–0.5	0	0.2 0.0–0.6 0.1 0.0–0.3	0.8 0.2–1.5 0.3 0.0–0.5	0	0	0.2 0.0–0.6 0.01 0.0–0.02	0
Procladius	10.6 5.2–15.5 4.2 2.0–6.2	9.3 5.3–13.4 4.1 2.5–5.8	10.6 3.1–19.6 4.3 1.1–7.9	18.8 5.9–35.6 4.0 1.4–7.2	8.0 2.9–11.1 2.3 0.8–3.4	15.4 8.6–23.4 5.0 2.3–8.7	19.8 11.4–30.8 6.4 3.7–10.0	8.4 2.0–17.9 2.8 0.6–5.7	27.2 21.6–33.2 6.0 5.3–6.9	9.0 0.3–25.1 3.0 0.2–7.1	5.0 0.0–10.3 1.2 0.0–2.9	22.6 3.4–62.7 4.3 0.9–9.3	28.8 14.8–4 6.3 3.5–9.
Pentaneura	0	0	0	0	0	0	0	0	0.4 0.0–1.0 0.2 0.0–0.6	0	0	0	0
Total	13.9 8.1–19.4 13.9 5.0–23.3	14.2 9.6–18.3 18.5 11.0–25.8	12.0 4.1–21.5 7.3 2.3–14.0	20.3 6.1–31.0 6.7 1.4–12.6	9.1 4.1–12.5 6.2 3.0–9.2	16.2 9.0–24.7 6.9 3.0–12.3	20.0 12.0–30.3 7.1 5.5–9.0	9.0 2.2–19.5 4.9 1.2–10.7	28.8 22.5–35.6 8.4 5.4–11.2	9.0 0.3–25.1 3.0 0.2–7.1	5.0 0.0–10.3 1.2 0.0–2.9	22.8 3.4–63.5 4.3 0.9–9.3	28.8 14.8–4 6.3 3.5–9.

TABLE 6.2 Mean larval abundance and biomass, per Ekman grab sample, for all larval genera at Congleton in 1978. The figure on the same line as the generic name are the number of larvae identified on each occasion, the 95% confidence limits are given below; the weight (in mg.) and its 95% confidence limits are given below this.

Table 6.3 Mean larval abundance and biomass (with 95% confidence limits) for all larval genera at Linford Black Horse lake station 2 in 1978.

	4/4	19/4	3/5	17/5	31/5	14/6	28/6	12/7	26/7	9/8	23/8	5/9	19/9	2/10
Chironomus	8.0 3.9-12.7 26.9 13.1-44.4	6.8 3.9-10.0 24.0 13.2-37.9	10.8 8.5-13.3 46.4 35.7-59.9	3.8 2.3-5.5 15.7 7.0-27.0	3.0 1.8-4.3 12.2 7.3-17.3	4.4 2.8-6.2 17.4 8.7-29.5	3.8 0.6-7.6 8.0 1.1-20.5	10.4 8.0-13.0 27.1 19.9-36.0	6.4 4.3-8.7 19.3 10.8-30.5	9.4 6.8-12.2 23.1 15.8-31.5	10.8 5.3-17.6 33.2 17.3-55.2	5.0 0.5-10.4 16.0 0.9-36.6	3.8 0.3-9.0 4.8 0.0-12.1	6.8 1.9-13. 4.4 1.9-7.8
Cryptochironomus	0.4 0.0-1.0 0.3 0.0-0.6	0.6 0.0-1.5 0.4 0.0-0.8	0.4 0.0-1.0 0.2 0.0-0.4	0.6 0.0-1.5 0.6 0.0-1.5	1.6 0.2-3.4 1.0 0.3-1.9	0	0.6 0.0-1.5 0.3 0.0-0.7	5.2 3.0-7.7 3.4 1.7-6.1	2.4 0.9-4.2 1.3 0.0-2.5	3.4 1.3-6.0 1.7 0.8-2.8	2.8 0.3-6.3 0.6 0.0-1.6	1.6 0.0-3.8 0.3 0.0-0.7	1.2 0.0-3.0 0.1 0.0-0.7	5.4 1.5-10. 0.9 0.1-2.1
Endochironomus	0	0	0	0	0	0	0	0.2 0.0-0.6 0.1 0.0-0.2	0	0.2 0.0-0.6 0.0 0.0-0.1	0	6.6 0.0-15.5 1.1 0.0-2.6	1.0 0.0-2.3 0.3 0.0-0.5	12.6 0.0-28. 2.8 0.0-7.0
Glyptotendipes	0	0.2 0.0-0.6 0.2 0.0-0.7	0	0	1.4 0.2-3.4 0.5 0.1-1.0	0.6 0.0-1.3 0.3 0.0-0.6	0	0	0	6.4 0.8-14.1 0.6 0.1-1.3	2.4 0.1-5.4 0.4 0.0-0.9	7.6 1.2-16.9 1.2 0.3-2.4	5.2 2.6-8.2 0.7 0.3-1.0	0.2 0.0-0.6 0.0 0.0-0.0
Microtendipes	0	0	0	0	0	0	0	0.2 0.0-0.6 0.1 0.0-0.3	0	0	0	0	0	0
Parachironomus	0	0	0	0	0	0	0	0	0	0	0	1.4 0.0-3.3 0.2 0.0-0.7	0	0
Polypedilum	4.2 1.7-8.9 4.0 0.8-8.2	5.0 2.6-7.9 4.7 1.9-8.3	0.8 0.0-1.8 0.7 0.0-1.6	0.2 0.0-0.6 0.1 0.0-0.4	0	1.6 0.5-2.8 0.5 0.2-0.9	5.8 1.3-12.0 2.7 0.6-5.6	12.2 4.7-22.4 6.1 2.1-11.6	5.8 2.4-9.9 2.9 0.7-5.7	3.2 0.0-8.2 0.9 0.0-2.1	1.4 0.1-3.0 0.6 0.1-1.2	0.8 0.0-1.8 0.4 0.0-0.9	0.8 0.0-2.0 0.2 0.0-0.5	0.4 0.0-1.0 0.0 0.0-0.1
Tanytarsus	0.2 0.0-0.6 0.0 0.0-0.1	0	0.2 0.0-0.6 0.0 0.0-0.1	0	0	0	0	0.2 0.0-0.6 0.0 0.0-0.0	0	0.2 0.0-0.6 0.0 0.0-0.0	0.2 0.0-0.6 0.0 0.0-0.0	0.2 0.0-0.6 0.0 0.0-0.0	0.4 0.0-1.0 0.1 0.0-0.1	0.2 0.0-0.6 0.0 0.0-0.1
Clinotanypus	0.2 0.0-0.6 0.1 0.0-0.3	0	0	0	0	0	0	0	0	0	0	0	0	0
Pentaneura	0	0	0	0	0	0	0	0	0	0	0	0.2 0.0-0.6 0.2 0.0-0.5	0	0
Procladius	35.4 15.6-60.9 15.6 7.1-26.3	28.6 16.9-41.8 13.7 7.5-20.9	14.4 6.3-24.7 6.8 2.7-11.9	8.2 5.4-11.3 3.9 2.2-5.9	10.4 5.2-16.6 4.7 2.4-7.5	7.2 4.1-10.7 3.9 2.3-5.6	1.4 0.2-2.9 0.6 0.0-1.4	5.4 2.3-8.6 2.2 1.1-3.8	7.2 3.6-11.4 2.2 1.1-3.7	11.0 5.9-16.6 3.3 1.9-5.0	8.6 4.1-14.2 2.7 1.3-4.4	19.4 7.5-35.9 5.7 2.3-10.7	34.8 25.5-45.1 8.1 5.4-11.0	8.8 4.7-13. 2.3 1.4-3.2
Tanypus	7.3 0.9-20.6 4.0 0.6-9.4	10.6 6.4-15.5 5.6 1.9-11.6	15.4 11.3-20.0 8.4 7.0-9.6	12.8 7.2-19.2 5.4 3.3-6.9	35.2 23.2-49.1 12.4 7.3-20.2	22.2 14.3-30.2 10.8 6.9-15.2	8.2 2.5-15.7 4.9 1.7-8.9	13.8 10.1-17.9 6.0 4.2-8.0	10.6 3.4-19.9 5.0 1.7-8.8	30.2 23.6-37.3 11.2 8.9-14.0	9.6 4.2-16.4 3.6 1.7-5.9	7.0 3.6-11.0 2.6 1.4-4.0	34.2 21.9-48.0 5.2 4.5-5.9	10.2 5.3-15. 2.0 1.0-3.2
Cricotopus	0	0	0	0	0	0	0	0	0	0	0	2.4 0.2-5.3 0.5 0.0-0.6	0.6 0.0-1.3 0.2 0.0-0.4	0.4 0.0-1.0 0.1 0.0-0.3
Total	56.2 36.3-83.8 51.1 32.0-73.3	49.8 31.0-71.4 49.8 31.8-71.2	42.0 31.3-53.7 62.6 48.7-79.0	25.6 21.1-30.4 26.1 16.4-36.4	51.8 35.4-70.5 32.2 22.6-41.9	35.0 25.8-44.9 36.0 23.2-45.1	19.8 8.2-33.3 17.6 6.2-31.1	47.6 41.5-54.0 46.1 34.1-58.5	32.4 19.0-48.4 31.6 18.8-45.0	54.0 49.5-79.7 42.0 35.3-47.3	35.8 15.5-64.1 41.9 21.6-68.4	52.2 37.1-69.1 28.4 9.7-60.0	32.0 59.4-35.3 19.8 13.0-26.9	45.0 23.5-70. 13.5 5.5-22.0

	4/4	19/4	3/5	17/5	31/5	14/6	28/6	12/7	26/7	9/8	23/8	5/9	19/9	2/10
Chironomus	1.8 1.3-2.4 4.5 3.9-5.2	5.6 2.8-9.0 18.1 8.8-31.2	1.6 0.0-3.8 8.0 0.0-23.9	0.2 0.0-0.6 1.0 0.0-2.5	0	4.0 0.4-9.3 4.3 0.6-10.4	14.4 11.3-17.7 33.4 31.2-35.7	11.2 7.9-14.8 32.9 25.3-40.5	5.0 3.3-6.9 16.1 7.8-27.5	2.4 0.4-5.1 7.8 0.6-19.6	5.2 1.4-10.5 21.3 5.7-49.9	0.2 0.0-0.6 0.8 0.0-2.0	2.0 0.3-4.3 16.5 0.1-16.8	5.6 1.6-11.1 16.8 1.7-47.3
Cryptochironomus	0.2 0.0-0.6 0.1 0.0-0.1	0.2 0.0-0.6 0.3 0.0-0.6	0.2 0.0-0.6 0.1 0.0-0.1	0.2 0.0-0.6 0.7 0.0-1.3	0	0	1.6 0.3-3.3 1.4 0.0-2.2	0	2.4 0.1-5.4 0.4 0.0-1.0	1.4 0.0-3.6 0.8 0.0-2.2	0.6 0.0-1.3 0.8 0.0-2.4	1.4 0.2-2.9 0.4 0.1-0.9	1.0 0.0-2.3 0.2 0.0-0.5	4.8 2.9-6.9 1.7 0.6-2.4
Endochironomus	0.2 0.0-0.6 0.1 0.0-0.3	0	0	0	0	0	0	0	0	0	0	4.4 0.0-7.9 0.6 0.0-1.6	8.3 0.0-20.6 0.9 0.0-2.0	2.6 0.0-5.6 0.8 0.0-2.0
Glyptotendipes	0.4 0.0-1.2 0.1 0.0-0.2	0.2 0.0-0.6 0.1 0.0-0.2	0.8 0.2-1.5 0.1 0.0-0.3	0.2 0.0-0.6 0.1 0.0-0.2	0.5 0.0-1.8 0.2 0.0-0.7	0	0	0	0	0	0	1.0 0.0-2.3 0.1 0.0-0.2	2.4 0.6-4.6 0.5 0.0-1.0	0
Parachironomus	0	0	0	0	0	0	0	0	0	0	0	0	0.8 0.0-2.0 0.2 0.0-0.4	0
Pentapedilum	0.2 0.0-0.6 0.1 0.0-0.2	0.2 0.0-0.6 0.1 0.0-0.3	0	0	0	0	0	0	0	0	0	0	0	0
Polypedilum	7.2 2.2-13.2 6.0 1.1-13.3	6.6 2.2-11.6 6.8 2.2-12.1	2.2 0.3-4.8 2.4 0.1-5.4	0.2 0.0-0.6 0.2 0.0-0.8	0	3.8 0.2-8.8 1.4 0.0-3.0	20.4 10.9-31.9 9.0 4.0-14.9	4.4 1.9-7.3 2.0 0.9-3.1	3.6 0.5-8.3 1.7 0.4-3.5	0.4 0.0-1.0 0.1 0.0-0.3	0.6 0.0-1.3 0.3 0.0-0.7	0.8 0.2-1.5 0.4 0.0-0.9	0	2.2 0.4-4.7 0.2 0.0-0.3
Tanytarsus	1.2 0.0-2.8 0.2 0.0-0.3	0	0	0	0.5 0.0-1.4 0.0 0.0-0.1	0.6 0.0-1.6 0.0 0.0-0.0	0	0	0.2 0.0-0.6 0.0 0.0-0.0	0.4 0.0-1.0 0.0 0.0-0.1	0	1.8 0.0-4.1 0.1 0.0-0.1	0	0.2 0.0-0.6 0.0 0.0-0.0
Procladius	9.2 4.5-15.2 5.7 3.0-9.0	10.4 6.2-15.2 5.7 3.1-8.8	7.2 2.5-13.3 4.6 1.9-7.7	4.2 2.6-6.0 2.6 1.6-3.7	1.3 0.0-4.1 0.6 0.0-1.7	2.2 0.3-4.8 0.2 0.1-1.7	3.8 1.6-6.3 1.8 0.8-3.0	2.8 1.2-4.7 1.1 0.5-1.9	3.4 0.4-7.8 1.1 0.1-2.3	6.3 3.8-9.3 2.1 1.2-3.2	12.0 9.0-15.3 3.1 3.2-5.2	22.2 6.6-44.1 5.6 1.9-10.2	30.8 18.4-45.3 6.3 5.0-9.3	32.0 23.5-41.4 7.6 5.6-9.7
Tanypus	8.0 0.8-20.7 3.9 0.4-8.8	22.8 13.8-33.2 10.1 6.3-15.7	11.2 1.3-25.4 5.8 0.6-13.7	15.4 11.4-19.9 8.3 6.4-10.3	19.0 8.3-35.1 11.1 4.6-21.2	4.0 1.4-7.3 2.4 1.0-4.1	3.2 0.8-6.1 0.9 0.0-1.9	8.2 2.5-15.3 2.9 1.2-5.7	10.4 3.7-19.1 4.4 1.5-7.8	16.2 5.4-32.4 7.1 2.5-13.4	8.8 4.0-14.9 4.0 1.8-6.8	3.8 0.4-8.8 1.5 0.2-3.1	0.4 0.0-1.0 0.3 0.0-0.7	3.6 1.0-6.8 1.3 0.3-2.2
Cricotopus	1.6 0.0-3.8 0.6 0.0-1.5	0.6 0.0-1.5 0.2 0.0-0.5	0	0	0.5 0.0-1.8 0.1 0.0-0.2	0	0	0	0	0	0	1.2 0.0-2.9 0.1 0.0-0.2	3.0 0.0-7.0 0.5 0.0-1.2	0
Total	29.8 16.4-45.6 21.0 13.2-29.7	46.8 34.6-60.1 40.7 26.7-57.3	23.2 8.1-42.5 20.9 11.1-33.3	20.4 15.9-25.3 12.7 10.1-15.3	21.8 11.2-36.5 12.0 5.9-20.7	14.6 7.0-23.9 8.9 5.0-13.9	43.0 28.9-58.7 46.5 33.5-52.3	26.5 16.2-38.4 33.8 32.0-46.3	25.4 12.1-42.5 24.4 18.0-31.3	27.2 12.5-46.4 18.7 8.6-28.9	27.2 19.8-35.4 29.5 12.7-58.1	36.8 9.0-75.0 9.8 3.1-18.0	48.6 32.4-67.4 16.0 8.7-22.9	51.0 40.4-62.6 28.4 11.5-48.9

TABLE 6.4 Mean larval abundance and biomass (with 95% confidence limits) for all larval genera at Linford Black Horse lake station 3 in 1978.

	4/4	19/4	3/5	17/5	31/5	14/6	28/6	12/7	26/7	9/8	23/8	5/9	19/9	2/10
Chironomus	3.4 0.3-8.0 6.8 0.5-17.6	3.0 0.5-6.6 10.76 1.2-30.9	3.3 2.6-3.9 15.6 10.0-19.4	2.2 0.3-4.8 9.2 0.7-24.5	1.8 0.7-3.1 10.1 3.2-19.0	16.2 11.0-22.0 11.6 9.0-15.5	8.8 4.2-14.6 25.5 15.7-38.3	9.0 2.9-19.1 32.7 9.5-78.4	13.0 6.1-21.6 45.1 15.9-87.3	8.0 3.9-13.0 17.4 7.5-27.4	1.8 0.9-2.8 6.0 1.0-14.6	4.8 0.5-11.3 10.8 0.8-30.2	9.2 5.7-13.1 22.1 10.2-37.8	8.2 4.9-11.9 17.0 10.0-24.7
Crypto -chironomus	0.2 0.0-0.6 0.1 0.0-0.2	0.2 0.0-0.6 0.04 0.0-0.1	0	0.4 0.0-1.0 0.2 0.0-0.3	0.8 0.0-1.8 1.0 0.0-1.9	0	1.2 0.0-2.8 0.4 0.0-0.6	4.8 1.5-9.6 4.1 0.4-5.1	1.6 0.2-3.4 1.3 0.0-1.6	0.2 0.0-0.6 0.3 0.0-0.6	0	0	0.2 0.0-0.6 0.0 0.0-0.1	0.8 0.2-1.5 0.1 0.0-0.2
Einfeldia	0	0	0	0	0	0	0	0	0	0.2 0.0-0.6 0.0 0.0-0.1	0	0	0	0
Polypedilum	1.8 0.3-3.8 1.2 0.0-2.6	2.4 1.2-3.8 1.5 0.7-2.3	1.5 0.0-4.2 1.2 0.0-3.9	0.4 0.0-1.0 0.5 0.0-1.1	0	2.4 0.4-5.1 1.0 0.1-2.1	2.8 1.9-3.8 1.3 0.5-2.2	3.0 0.0-9.3 1.0 0.0-2.7	0.2 0.0-0.6 0.1 0.0-0.3	0.4 0.0-1.0 0.1 0.0-0.2	0	0	0	0
Tanytarsus	0.2 0.0-0.6 0.0 0.0-0.0	0	0.4 0.0-1.0 0.1 0.0-0.2	0.2 0.0-0.6 0.0 0.0-0.1	0.6 0.0-1.5 0.1 0.0-0.2	0.2 0.0-0.6 0.0 0.0-0.1	0.4 0.0-1.0 0.1 0.0-0.1	0	0	0	0	0	0	0.2 0.0-0.6 0.0 0.0-0.6
Procladius	18.8 15.2-22.7 7.1 5.4-8.8	12.0 8.7-15.6 6.1 5.2-6.5	13.8 5.5-25.8 7.5 3.5-13.4	14.8 11.7-18.1 7.3 6.3-8.3	3.8 1.4-6.8 1.8 0.8-2.9	7.0 2.1-12.5 1.9 0.2-3.9	6.6 2.3-12.2 2.9 1.2-5.2	3.8 0.8-8.6 1.6 0.2-3.8	9.4 4.2-16.1 3.2 1.4-5.5	8.6 6.3-11.1 2.7 1.8-3.6	3.0 1.8-4.3 1.4 0.7-1.1	9.5 4.5-15.3 2.5 1.5-3.5	19.0 8.4-31.9 2.6 1.4-4.3	22.0 14.6-30.4 2.7 1.6-4.0
Tanypus	0	1.6 0.0-3.8 0.3 0.0-0.6	1.3 0.0-4.1 0.3 0.0-0.8	4.0 1.6-7.1 0.9 0.3-1.6	6.8 4.7-9.1 2.9 2.1-4.5	2.2 0.6-4.1 1.3 0.5-2.1	3.0 0.2-6.8 1.0 0.2-2.2	1.5 0.8-2.4 0.6 0.3-0.9	7.0 3.9-10.8 2.4 1.7-3.0	17.2 11.9-23.2 5.7 4.0-7.6	7.4 5.2-9.8 3.2 2.3-4.1	2.0 0.9-3.2 0.9 0.3-1.6	0.2 0.0-0.6 0.1 0.0-0.3	0.2 0.0-0.6 0.1 0.0-0.3
Cricotopus	0	0	0	0	0	0	0	0	0	0	0.6 0.0-1.6 0.1 0.0-0.1	0	0	0
Total	24.4 15.3-31.1 15.1 7.1-25.2	19.4 16.6-22.3 18.5 10.5-28.1	20.3 10.3-34.4 24.8 17.2-30.7	22.0 18.8-25.4 18.1 10.3-27.1	13.6 9.5-18.2 15.8 7.6-25.3	28.0 17.9-39.2 15.8 11.1-22.1	22.8 12.1-35.5 31.2 19.8-45.7	22.0 9.9-40.4 40.1 13.3-84.5	31.2 25.4-37.3 51.3 24.0-87.3	34.6 28.7-40.9 26.2 16.7-34.5	12.8 10.4-15.3 10.6 5.4-16.1	16.2 7.7-27.0 14.2 3.4-30.2	28.6 14.8-45.2 24.8 13.0-39.6	31.4 23.2-40.5 20.0 12.3-29.2

TABLE 6.5 Mean larval abundance and biomass (with 95% confidence limits) for all larval genera at Linford Black Horse lake station 4 in 1978.

Species	$\log_e$ a	b	r	N
Chironomus spp	-0.24 ± 0.52	1.18 ± 0.29	0.79	41
Polypedilum sp	-0.07 ± 0.11	1.40 ± 0.17	0.95	34
Procladius sp	0.15 ± 0.67	1.45 ± 0.29	0.84	42
Tanypus sp	-0.02 ± 0.44	1.25 ± 0.20	0.90	41

Table 6.6 Regression coefficients, 95% confidence limits, r and N for the Taylor Power Law log-log regressions.

Species	α	β	r	N
Chironomus spp	0.61 ± 0.85	0.99 ± 0.11	0.94	38
Polypedilum sp	0.11 ± 0.58	1.16 ± 0.10	0.98	26
Procladius sp	-0.19 ± 0.81	1.12 ± 0.06	0.99	42
Tanypus spp	0.99 ± 0.98	1.02 ± 0.07	0.98	38
Procladius sp (Congleton)	6.56 ± 2.49	0.83 ± 0.28	0.89	13

Table 6.7 Regression coefficients, 95% confidence limits, r and N for Iwao plots of mean crowding against mean density.

	DETRITUS	ALGAE				ANIMALS	
	Detritus	Navicula	Synedra	Filamentous	Others	Crustacea	Oligochaetes
1 *Chironomus spp*	0.734	0.004	0.093	0.064	0.105	0	0
2 *Cryptochironomus sp*	0	0	0	0	0	0	1
3 *Polypedilum sp*	0.684	0.017	0.214	0.009	0.077	0	0
4 *Procladius sp*	0.004	0	0.023	0.055	0.033	0.885	0
5 *Tanypus sp*	0.041	0.109	0.342	0.454	0.055	0	0

Table 6.8 Proportional abundance of food categories in the diet of the five larval genera of chironomids examined.

		j				
		1	2	3	4	5
	1	0.563				
	2	0	1			
i	3	0.531	0	0.519		
	4	0.012	0	0.011	0.783	
	5	0.097	0	0.111	0.035	0.340

Table 6.9 Matrix of $\sum_{h} P_{ih}.P_{jh}$ values calculated from the previous table.

Key to species 1 - *Chironomus*, 2 - *Cryptochironomus*, 3 - *Polypedilum*, 4 - *Procladius*, 5 - *Tanypus*.

		i			
		1	2	3	4	5
	1	-	0	1.023	0.015	0.285
	2	0	-	0	0	0
j	3	0.943	0	-	0.014	0.326
	4	0.021	0	0.021	-	0.103
	5	0.172	0	0.214	0.045	-

Table 6.10 Matrix of α_{ij} and α_{ji} values calculated from the previous matrix using the equation of Levins (1968) cited in the text. α_{ij} values are below the dashed diagonal and α_{ji} values above this line.

Key to species 1 - *Chironomus*, 2 - *Cryptochironomus*, 3 - *Polypedilum*, 4 - *Procladius*, 5 - *Tanypus*.

Genera	Taylor Power Law		Iwao plots	
	F	N	F	N
Chironomus	64.8	41	298.6	38
Polypedilum	281.4	34	566.9	26
Procladius	98.9	42	1668.6	42
Tanypus	165.4	41	897.9	40
Procladius (Congleton)	0.7	13	40.4	13

Table 6.11 F-ratios for the regressions used to parameterise the Taylor Power Law and the Iwao equation as indices of aggregation.

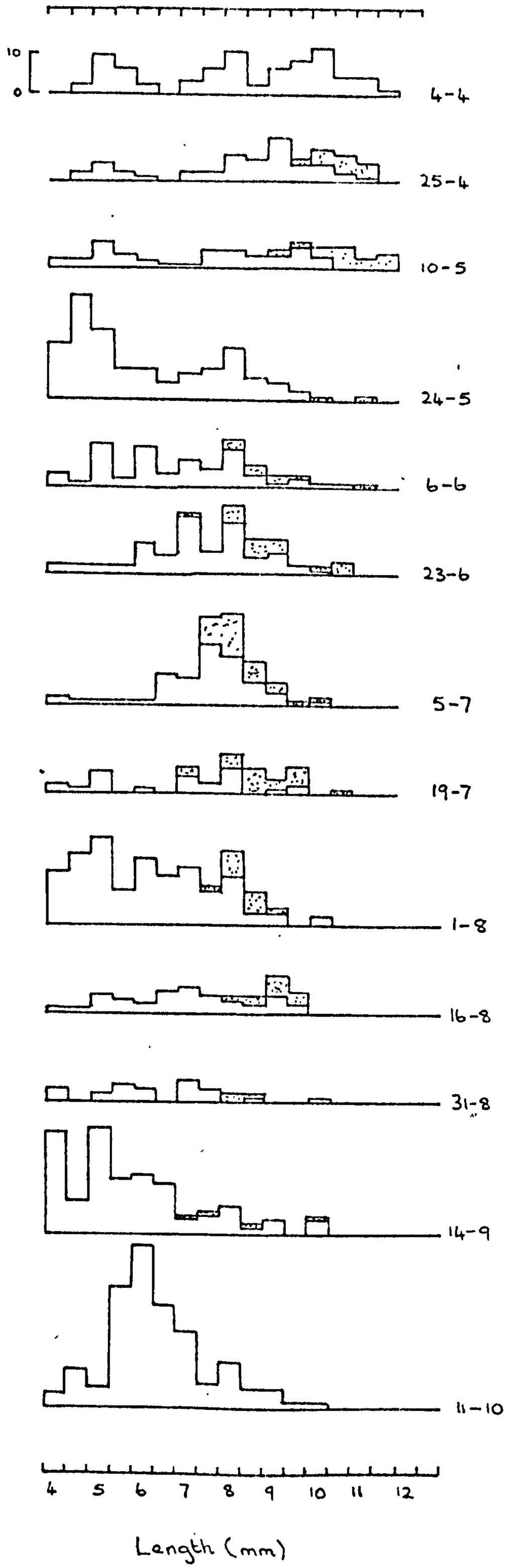


Fig. 6.1 Length-frequency histograms for *Procladius* larvae from Congleton in 1978; stipled area indicates pharate larvae.

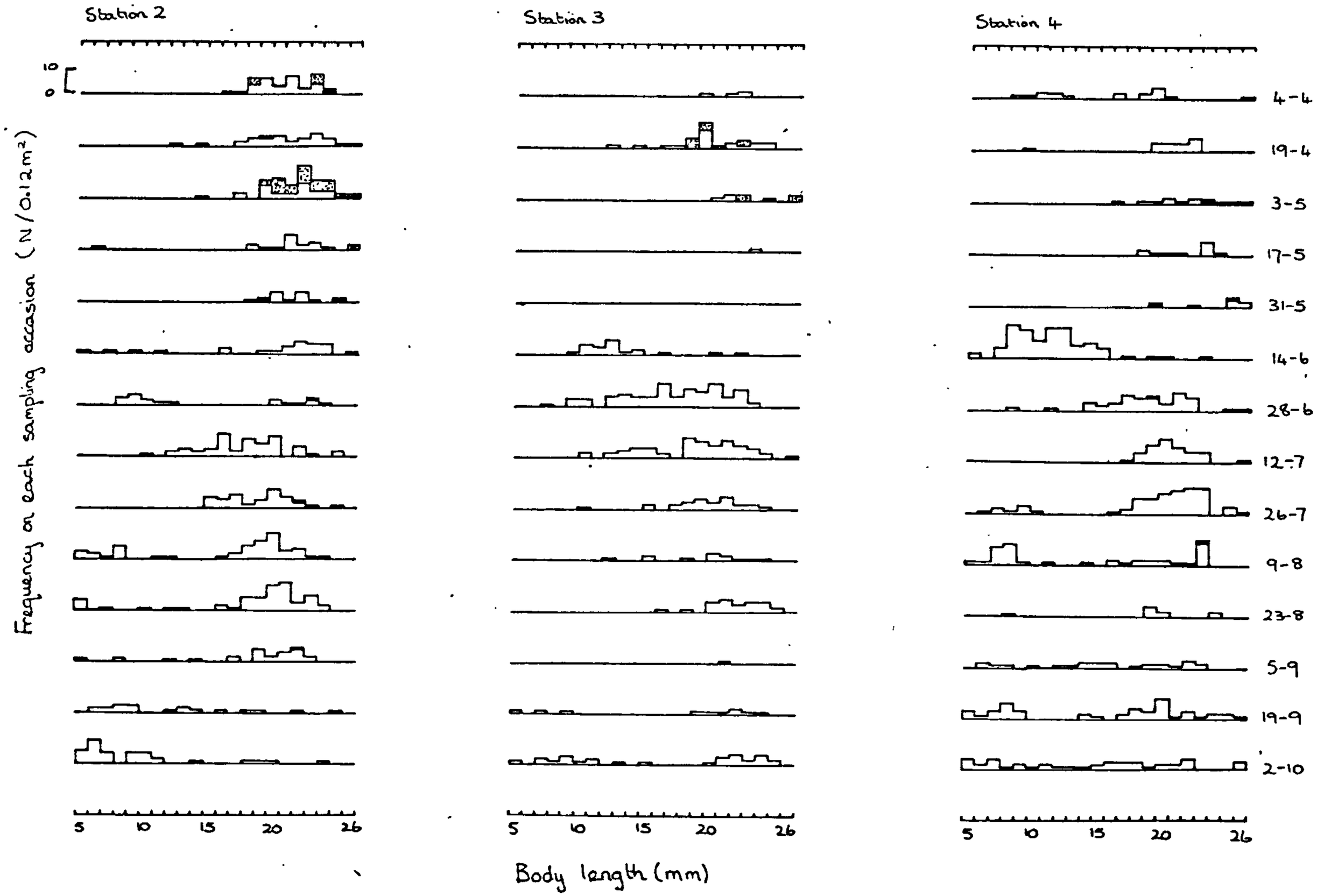


Fig. 6.2 Length-frequency histograms for *Chironomus spp* larvae from Black Horse lake, Linford in 1978

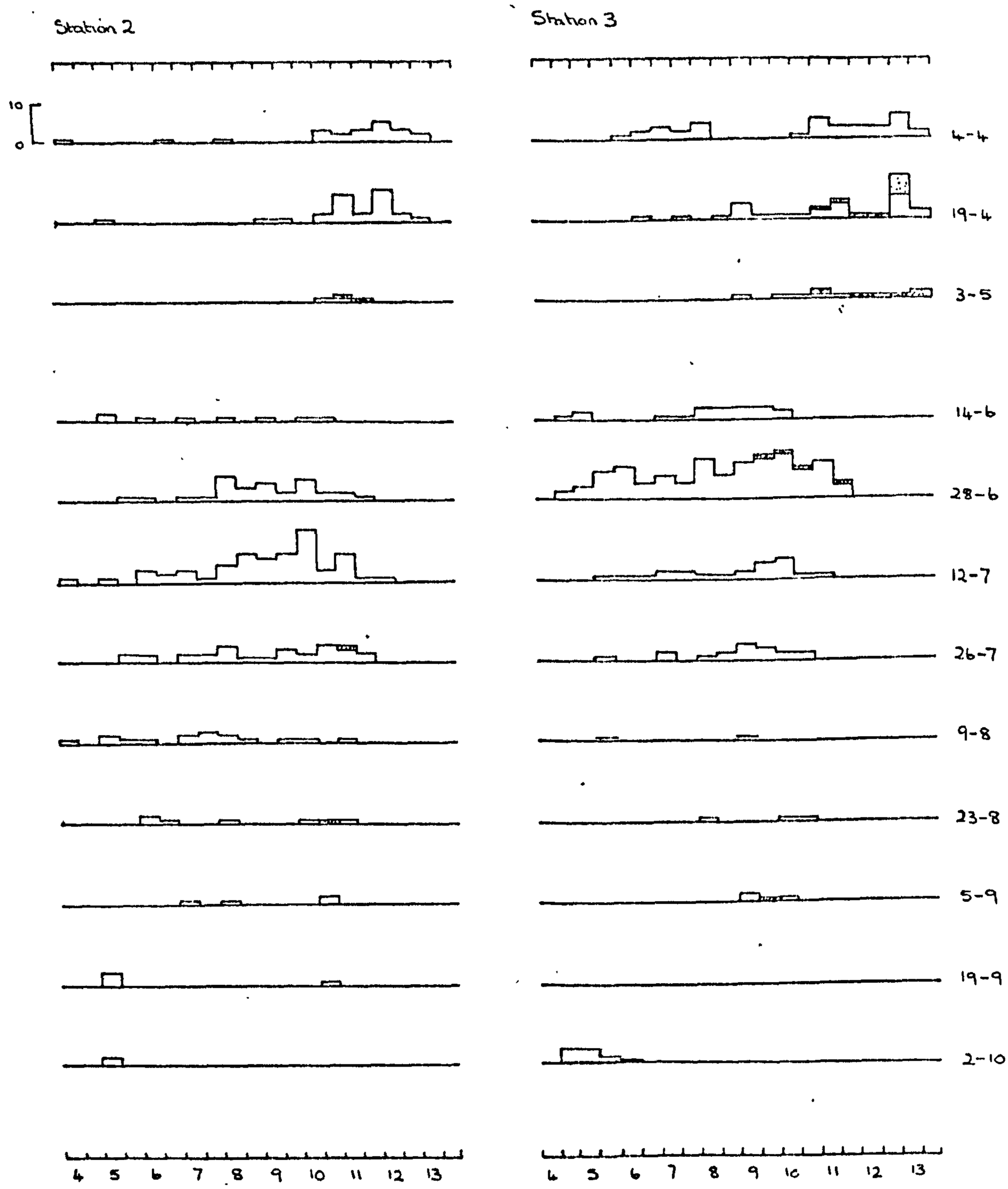


Fig. 6.3 Length-frequency histograms for *Polypedilum* larvae from Black Horse lake, Linford, in 1978; (a) Station 2, (b) Station 3

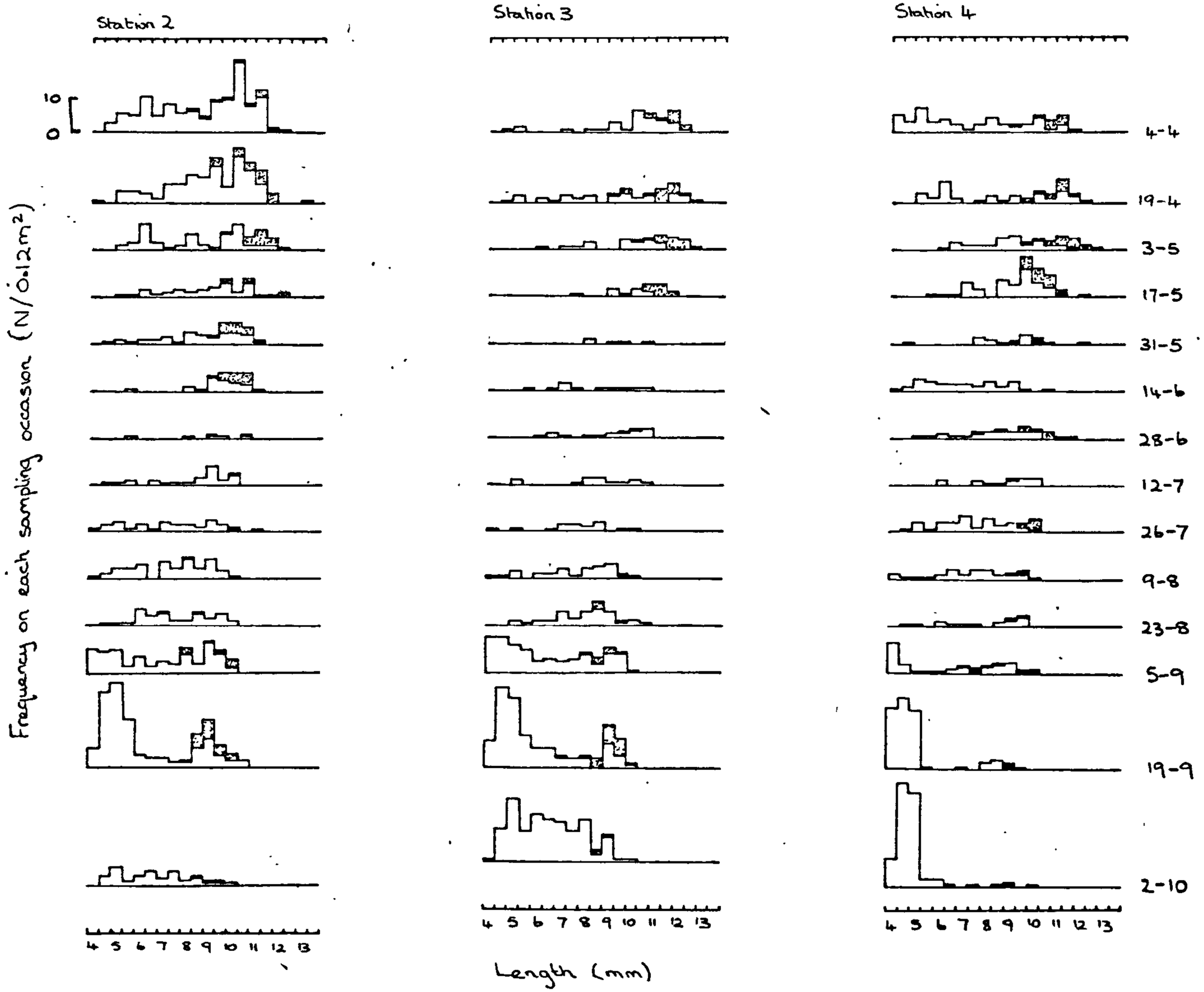


Fig. 6.4 Length-frequency histograms for *Procladius* larvae from Black Horse lake, Linford in 1978

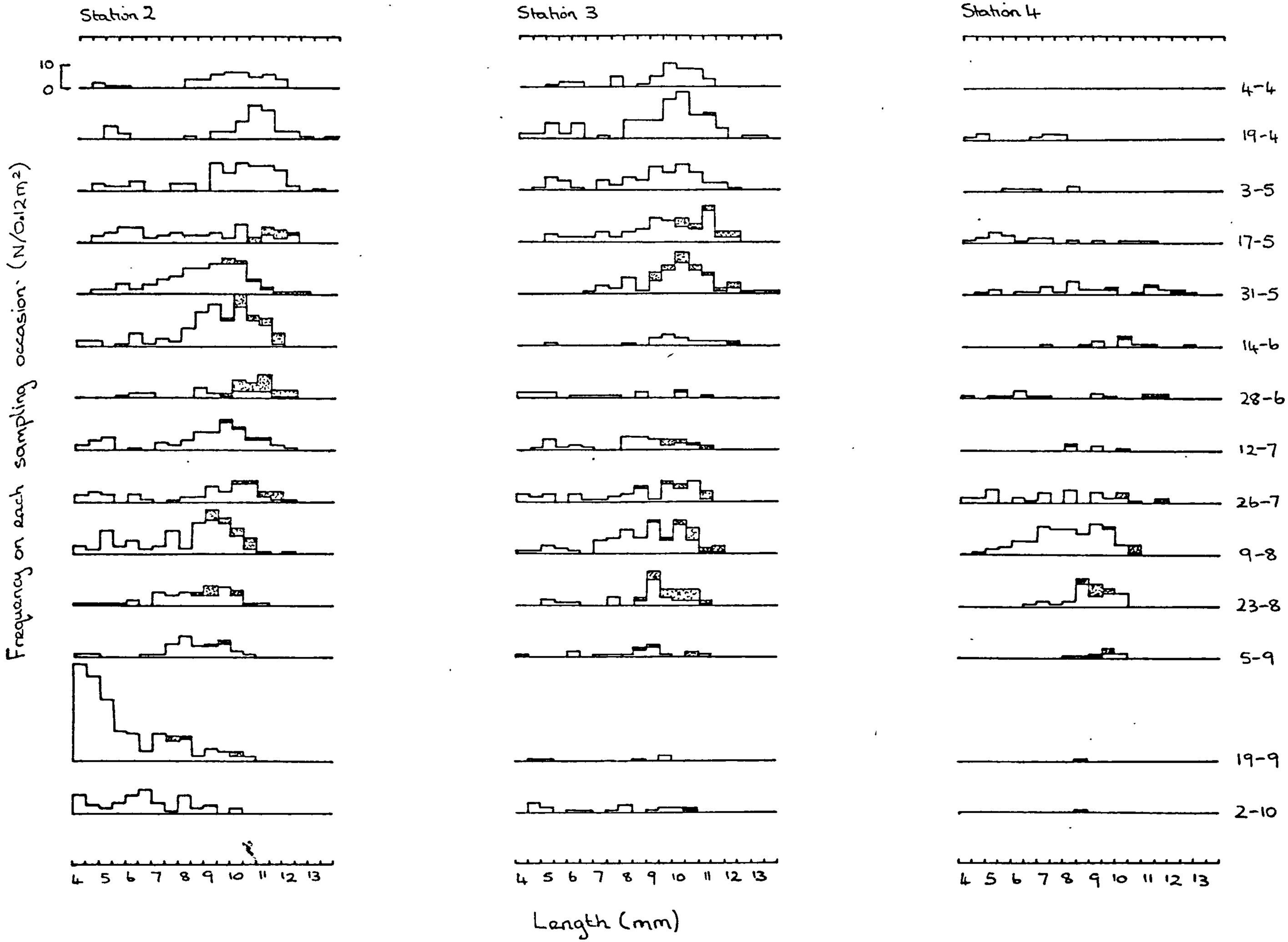


Fig. 6.5 Length-frequency histograms for *Tanypus* larvae caught at Black Horse lake, Linford in 1978

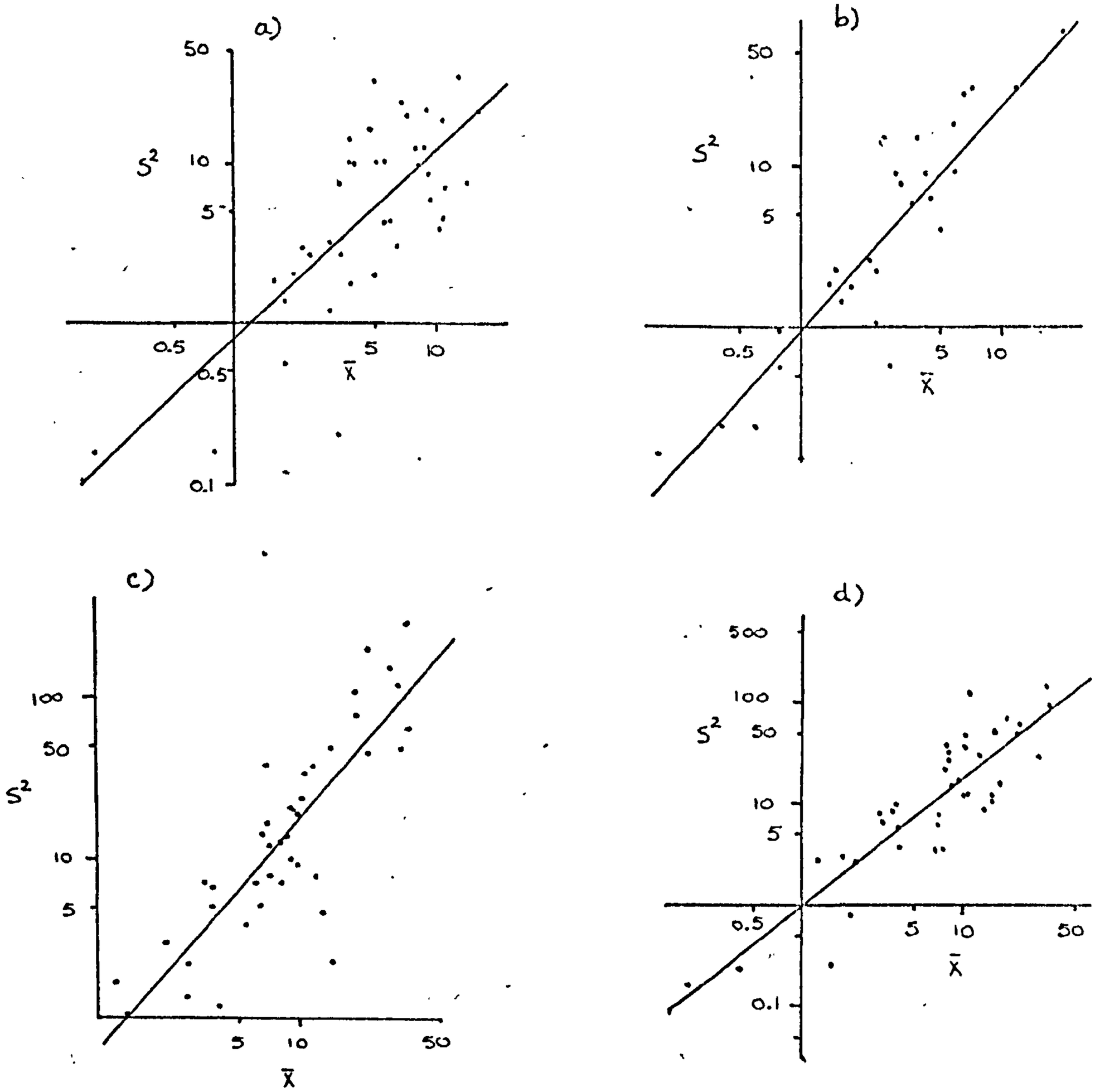


Fig. 6.6 Taylor Plots of variance against mean for abundant species at Linford. (a) *Chironomus*, (b) *Polypedilum*, (c) *Procladius* and (d)*Tanypus*

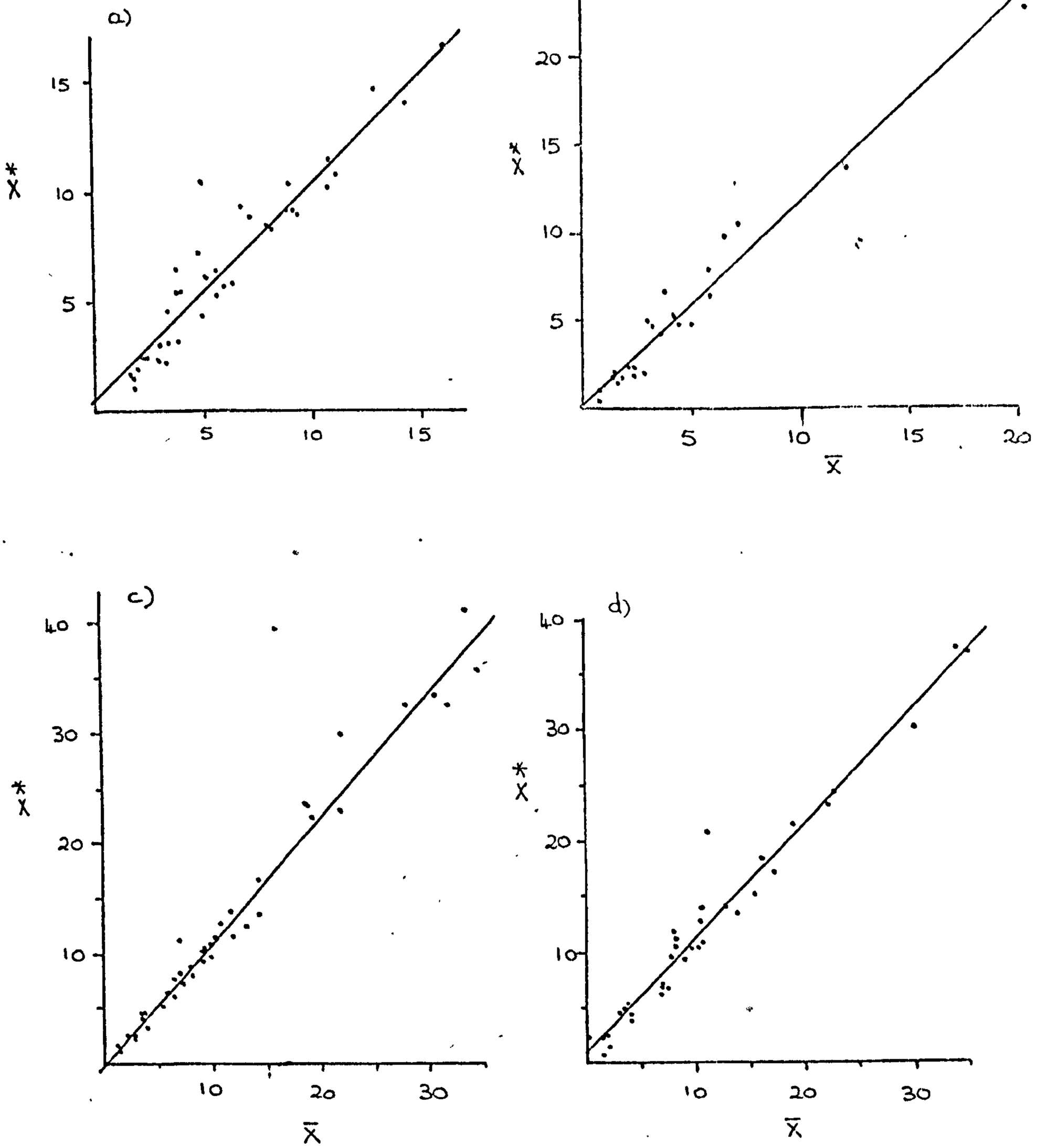


Fig. 6.7 Iwao plots of mean crowding against mean density for species abundant at Linford. (a) *Chironomus*, (b) *Polypedilum*, (c) *Procladius*, (d)*Tanypus*

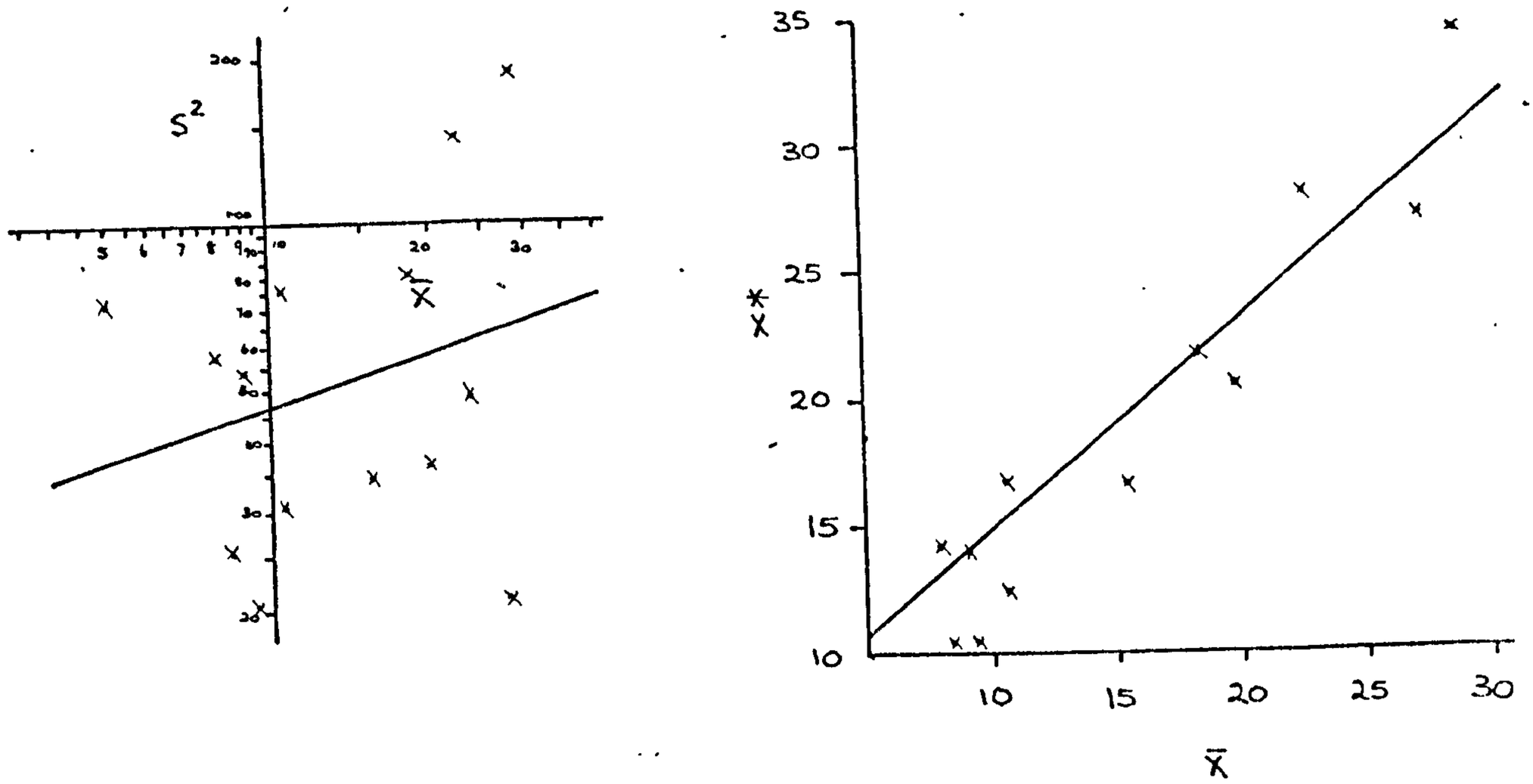


Fig. 6.8 Taylor plot and Iwao plot for *Procladius* at Congleton sand pit

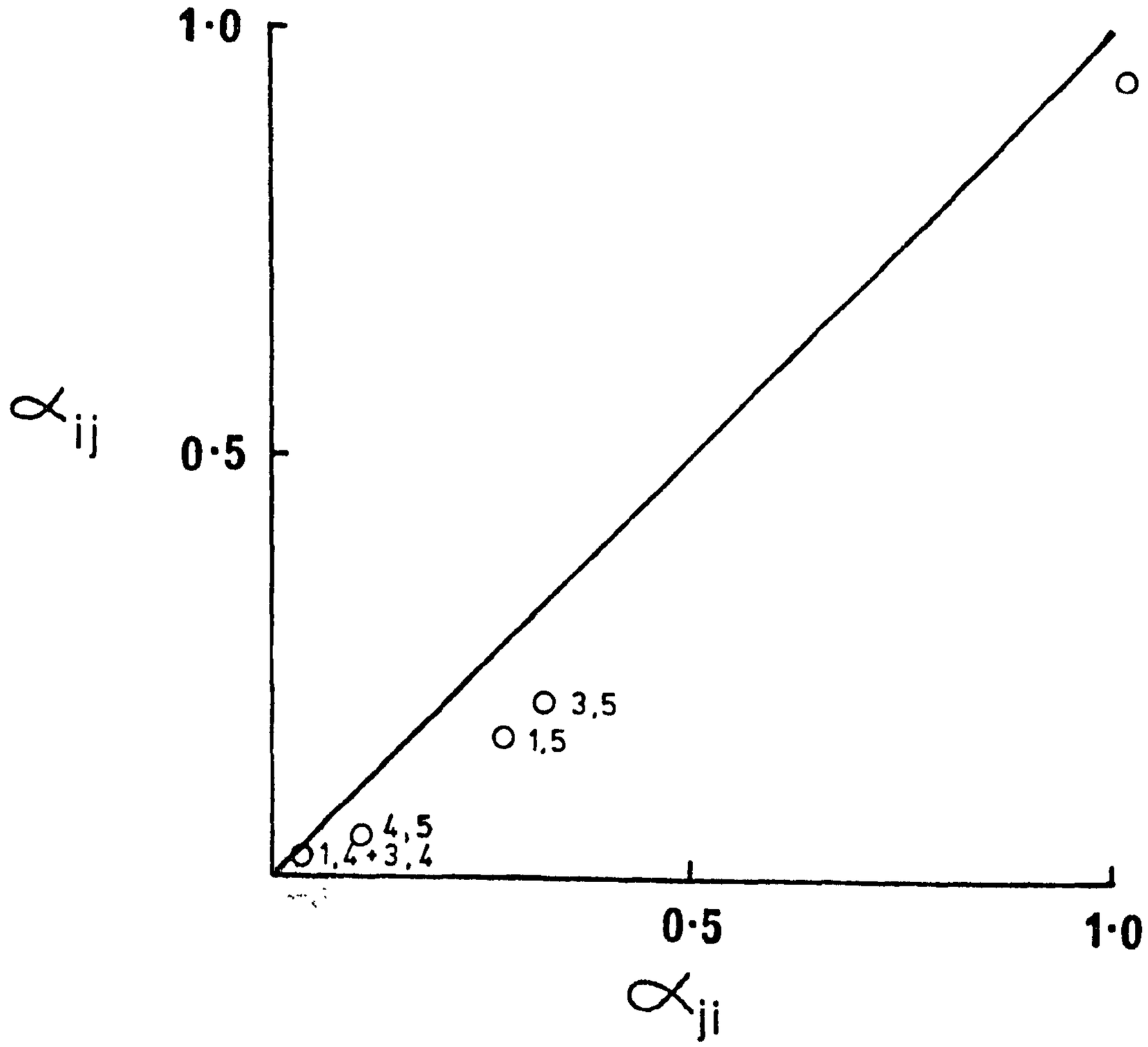


Fig. 6.9 Food resource segregation for genera abundant in Black Horse lake, Linford. Genera numbered

1- *Chironomus* 2- *Cryptochironomus*

3- *Polypedilum* 4- *Procladius*

5- *Tanypus*

Site	Genus	L_{min} (mm)
British Industrial Sands	*Chironomus*	6.0
	Procladius	5.0
Linford, Black Horse	*Chironomus*	6.0
	Cryptochironomus	6.5
	Polypedilum	5.5
	Procladius	5.5
	Tanypus	6.0

Table 7.1 Minimum lengths of the most abundant larval genera that were quantitatively retained by the sieves used

Species	α	β	N	Range of Lengths (mm)	R
Procladius sp (BIS)	0.43	3.12	45	4.0 - 11.5	.93
Chironomus sp (BIS)	1.38×10^{-5}	6.31	14	19.5 - 24.0	.83
Polypedilum sp (BIS)	0.77	2.62	8	7.0 - 12.5	.94
Procladius	3.30	2.25	29	4.0 - 12.0	.91
Tanypus sp	0.84	2.84	47	4.0 - 14.0	.94
Chironomus sp	0.55	2.91	51	4.5 - 24.0	.95
Cryptochironomus sp	1.18	2.83	21	5.0 - 14.0	.94
Polypedilum sp	0.38	3.22	33	4.0 - 10.5	.96

Table 7.2 Length-weight coefficients α and β, the number of data pairs N, range of length records and the correlation coefficient for the regression of log dry weight against log length.

Species	Station		Production (P) kg $ha^{-1}yr^{-1}$	Standing Crop (B) kg ha^{-1}	Emergence (E) kg ha^{-1}	P:B	P:E
Chironomus sp	Black Horse	2	50.10	8.77	7.14	5.7	7.0
		3	31.30	5.38	13.72	5.8	2.3
		4	42.92	7.28	17.44	5.9	2.5
Polypedilum sp	Black Horse	2	1.85	0.79	0.68	2.4	2.7
		3	2.37	0.93	1.00	2.5	2.4
Procladius sp	Black Horse	2	8.82	2.07	3.04	4.3	2.9
		3	6.14	1.40	4.72	4.4	1.3
		4	5.24	1.21	9.36	4.3	0.6
		BIS	8.42	1.71	-	4.9	-
Tanypus sp	Black Horse	2	11.98	2.45	4.24	4.9	2.8
		3	9.35	1.89	7.88	4.9	1.2
		4	7.17	2.93	2.12	2.4	3.4

Table 7.3 Summary of production, standing crop and emergence biomass calculated from field data collected in 1978 at Black Horse lake, Newport Pagnell (stations 2-4) and Congleton sand pit.

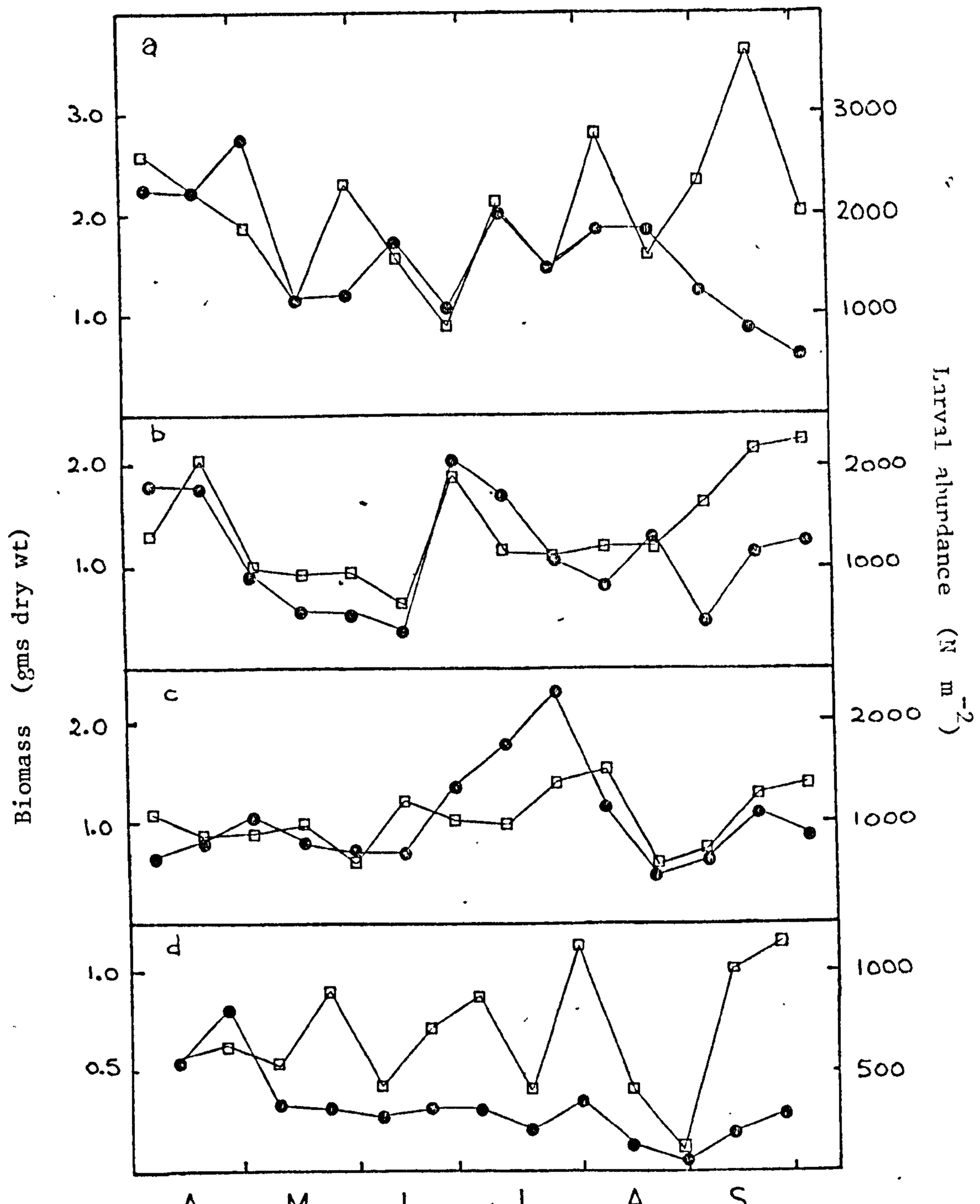


Fig. 7.1 Seasonal pattern of abundance and biomass at Black Horse, Linford, stations 2(a), 3(b) and 4(c) and at Congleton (d)

Variable	F To Enter	Significance	Multiple R	Overall F
Date	46.43	0.00	.891	46.43
Sunlight	2.17	0.17	.910	26.57
Wind	0.19	0.67	.912	16.48
T_{max}	0.16	0.70	.914	11.36
T_{min}	0.02	0.89	.914	8.11

Table 8.1 Summary of multiple regression analysis of the specified variables against number of chironomids emerging

MAY

Station	Year	2			3			4		
		75	77	78	75	77	78	75	77	78
2	75	-								
	77	66	-							
	78	61	40	-						
3	75	64	63	47	-					
	77	64	54	71	48	-				
	78	65	63	55	45	62	-			
4	75	73	53	64	54	57	56	-		
	77	28	28	11	11	13	26	21	-	
	78	59	41	55	38	47	58	49	23	-

JUNE

Station	Year	2			3			4		
		75	77	78	75	77	78	75	77	78
2	75	-								
	77	60	-							
	78	51	67	-						
3	75	69	54	58	-					
	77	35	52	66	33	-				
	78	63	77	66	67	46	-			
4	75	31	30	36	43	21	36	-		
	77	36	52	46	46	25	62	33	-	
	78	46	53	56	61	34	64	65	59	-

JULY

Station	Year	2		3		4	
		77	78	77	78	77	78
2	77	-					
	78	18	-				
3	77	39	42	-			
	78	37	53	44	-		
4	77	34	16	47	37	-	
	78	45	32	43	51	41	-

Table 8.2 Comparison between stations during same months. Values in elipses are for different traps in the same year

STATION 2

Year	Month	75 M	75 J	77 M	77 J	77 J	78 M	78 J	78 J
75	M	**							
	J	42	**						
77	M	65	34	**					
	J	44	60	63	**				
	J	25	61	14	37	**			
78	M	61	44	40	40	27	**		
	J	46	51	53	67	42	48	**	
	J	25	19	33	40	17	40	47	**

STATION 3

Year	Month	75 M	75 J	77 M	77 J	77 J	78 M	78 J	78 J
75	M	**							
	J	43	**						
77	M	48	40	**					
	J	17	33	28	**				
	J	38	58	41	45	**			
78	M	45	46	63	43	51	**		
	J	56	67	46	46	70	53	**	
	J	35	45	39	25	44	38	45	**

STATION 4

Year	Month	75 M	75 J	77 M	77 J	77 J	78 M	78 J	78 J
75	M	**							
	J	33	**						
77	M	21	39	**					
	J	43	32	22	**				
	J	34	36	12	75	**			
78	M	49	39	23	36	36	**		
	J	42	65	40	59	52	51	**	
	J	33	66	36	35	41	60	68	**

Table 8.3 Comparative values for same station in different months. Boxed values indicate July '77 with June in other years and values in a elipse for the same month in different years

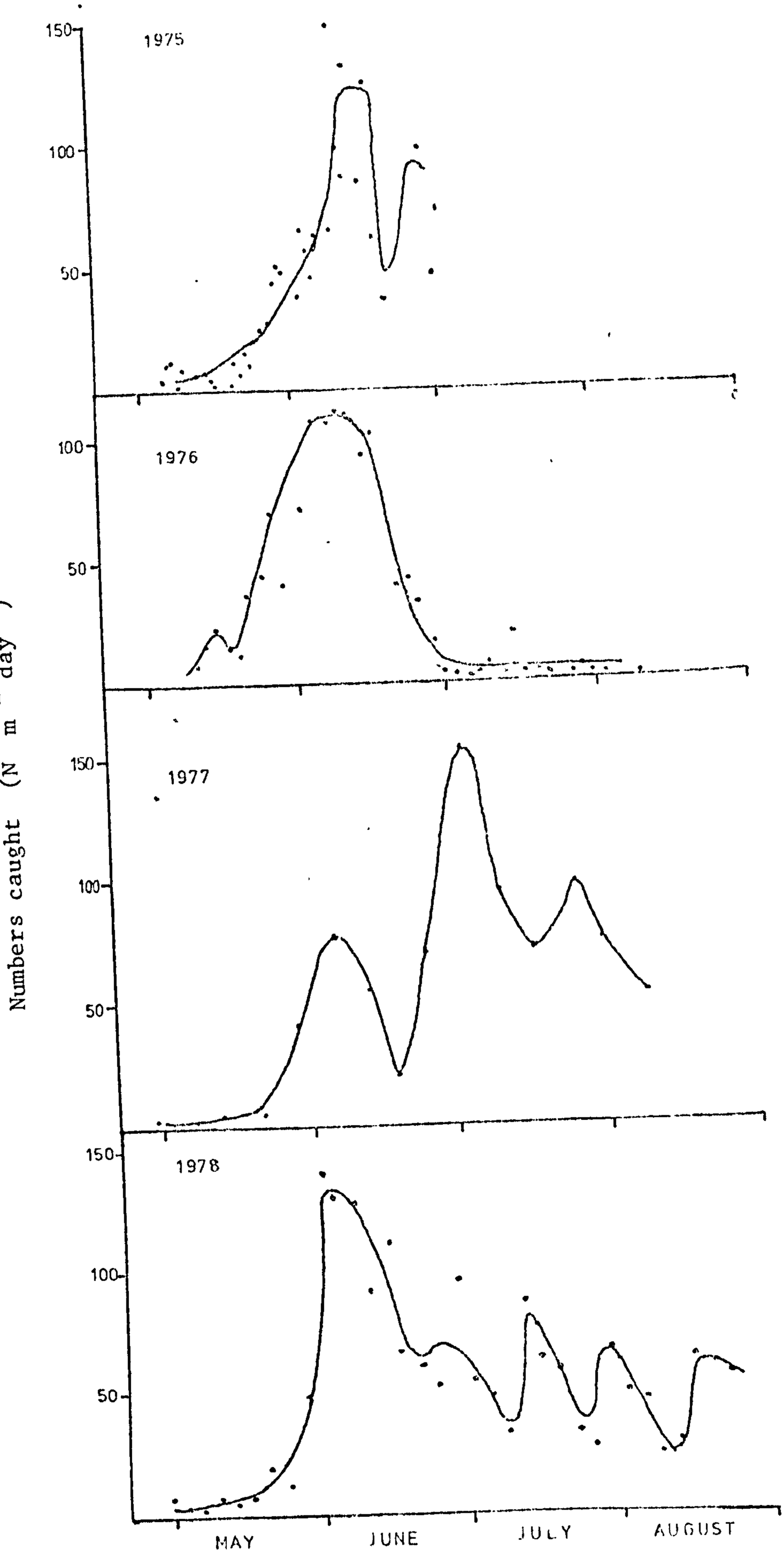


Fig. 8.1 Total emergence from emergence traps during the four year period

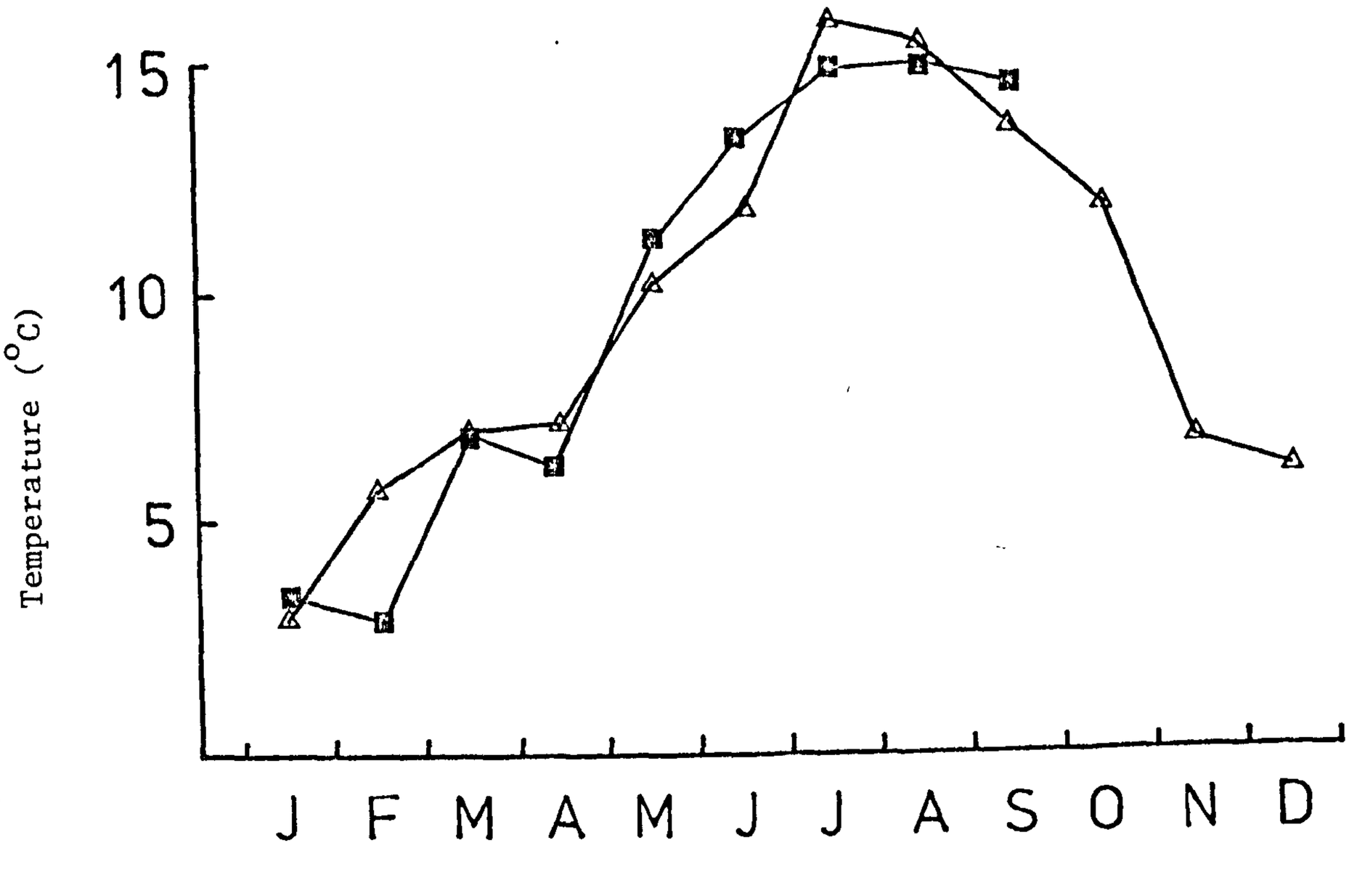


Fig. 8.2 Mean monthly air temperature from Cardington, Bedfordshire in 1977 - △ and 1978 - ■

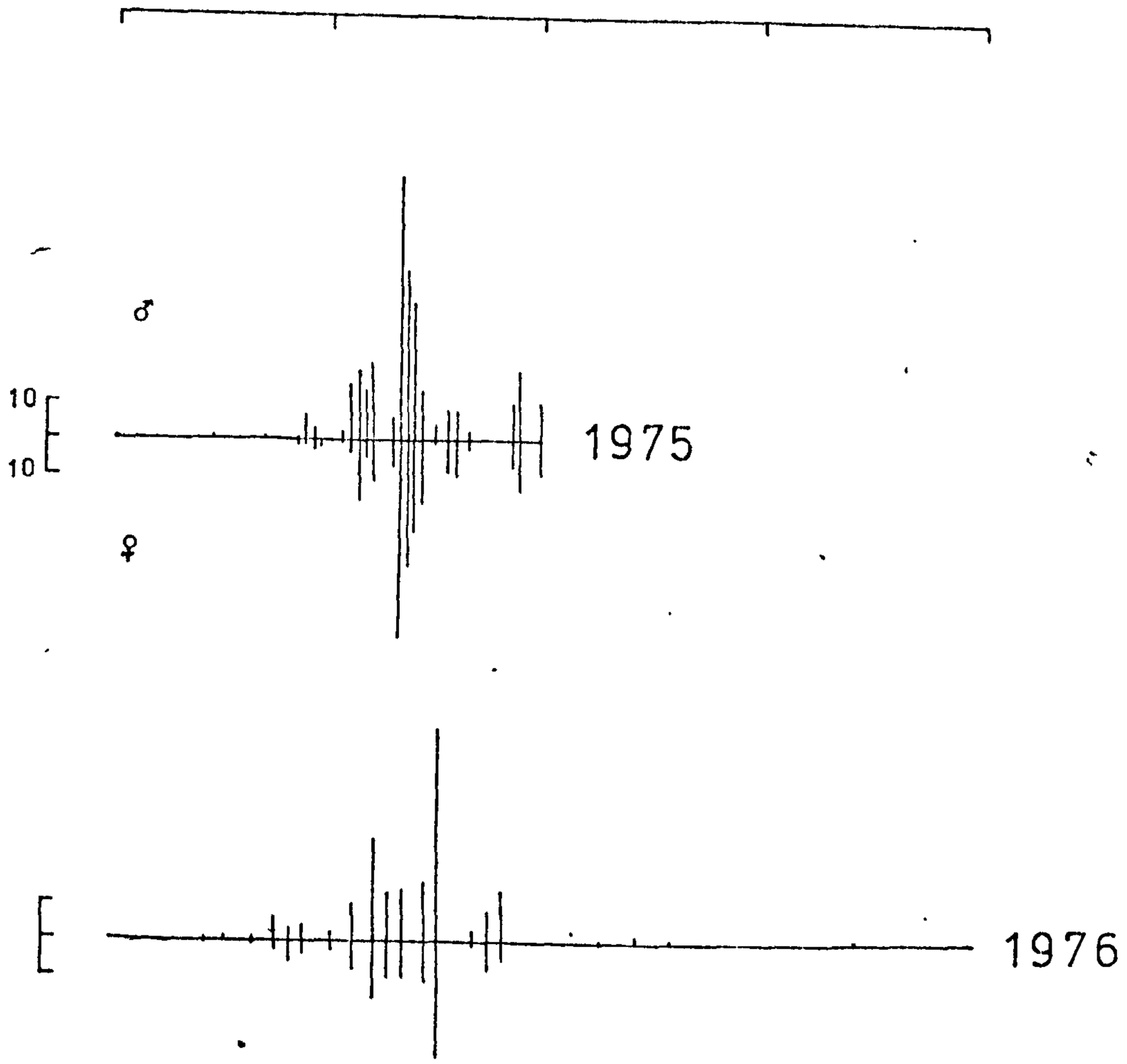


Fig. 8.3 Emergence of *Cricotopus intersectus* at all stations in 1975-1978; males are plotted above and females below the axis and the scale to the left represents the number of individuals of each species caught. Numbers are total caught per day in all traps used.

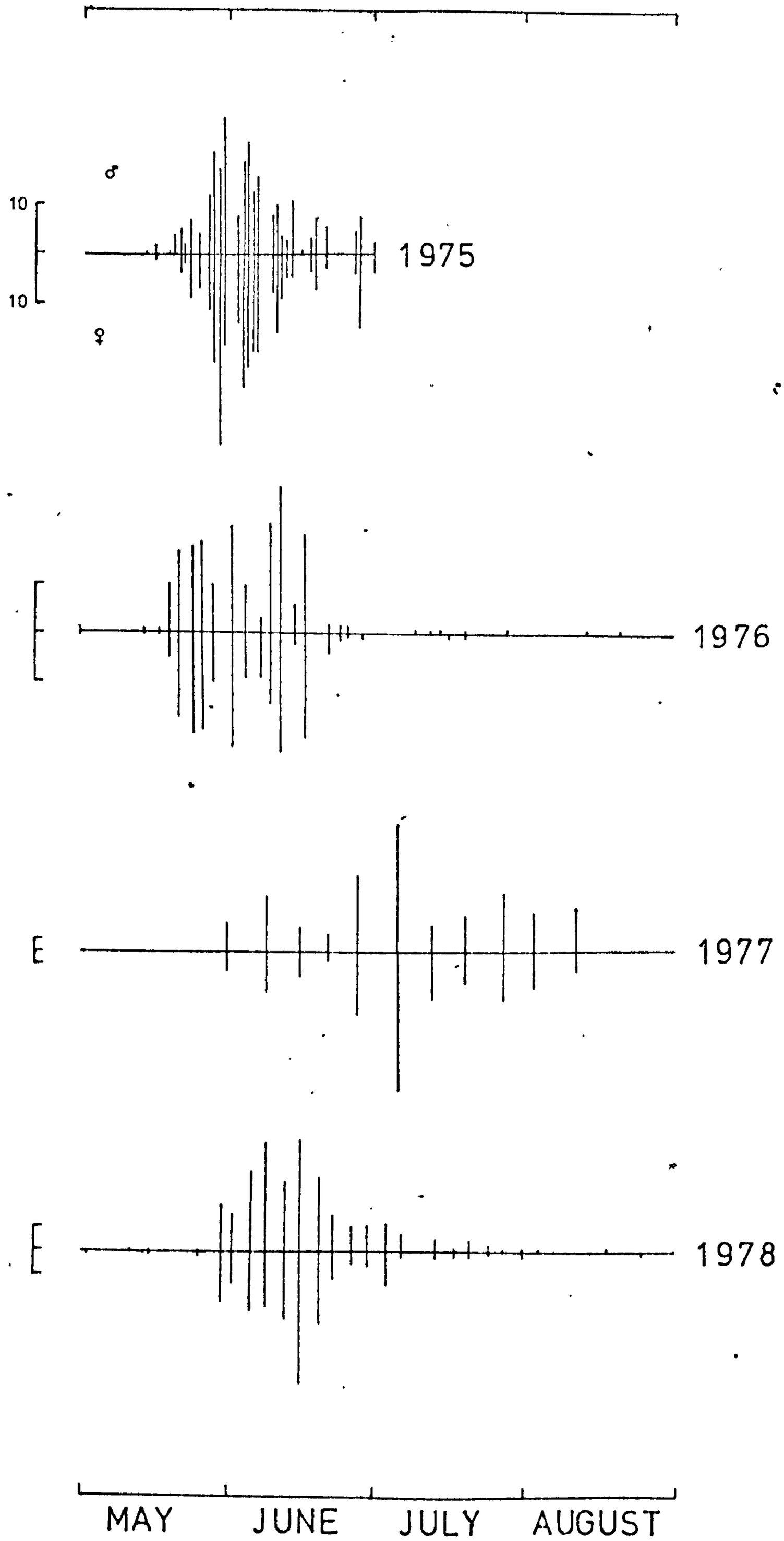


Fig. 8.4 Emergence of *Cricotopus sylvestris*; format as in fig. 8.3

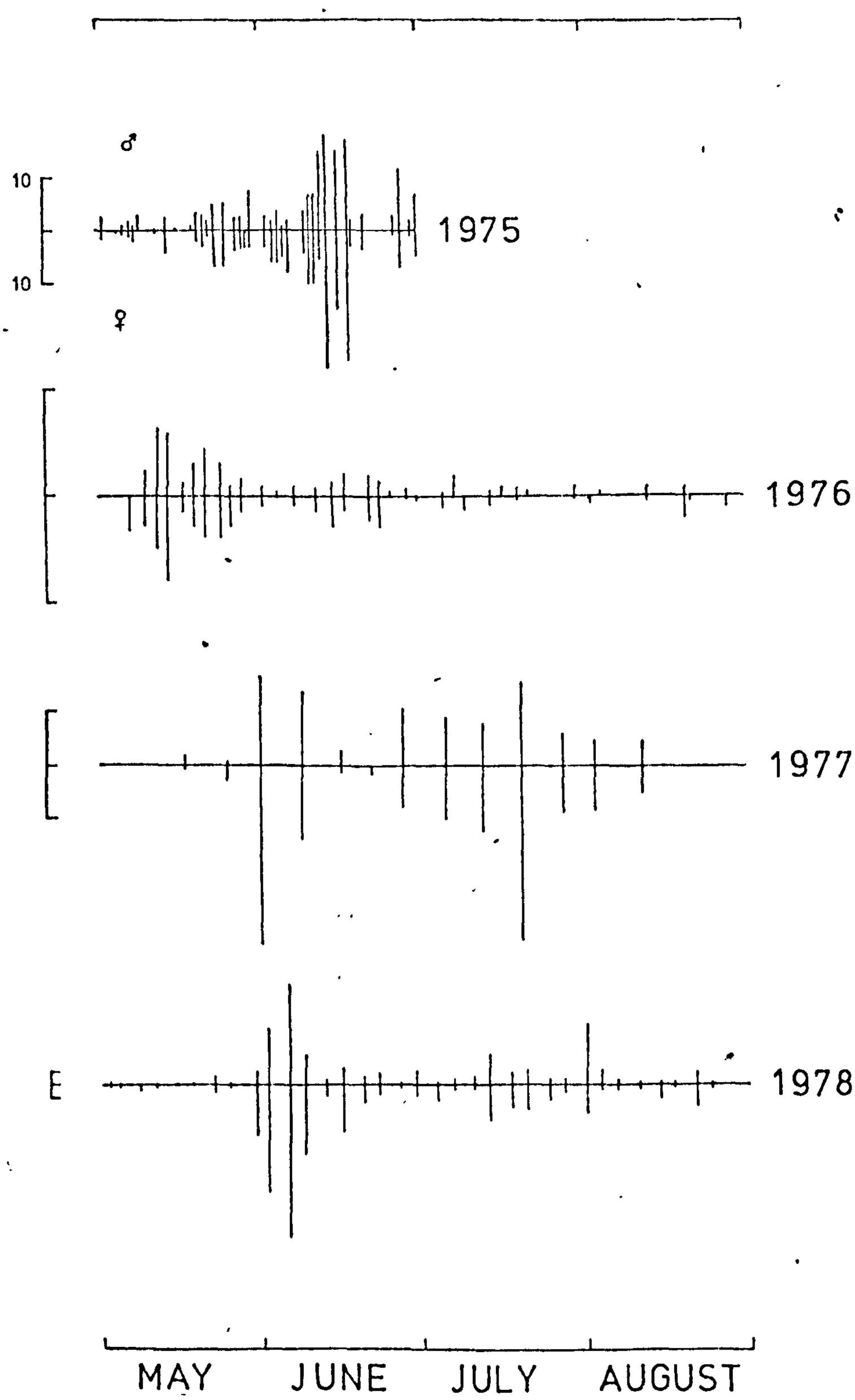


Fig. 8.5 Emergence of *Procladius choreus*; format as in fig. 8.3

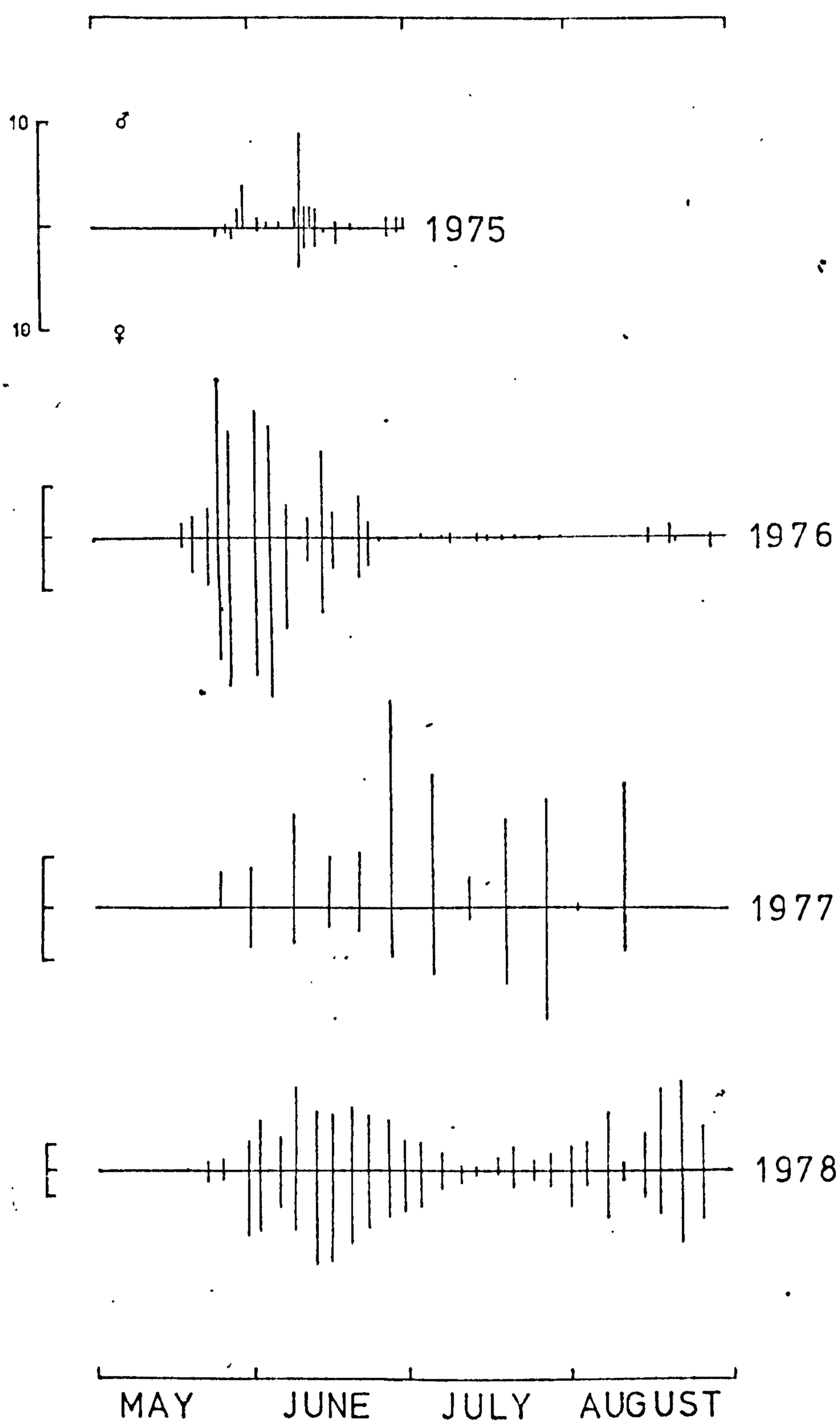


Fig. 8.6 Emergence of *Tanypus punctipennis*; format as in fig. 8.3

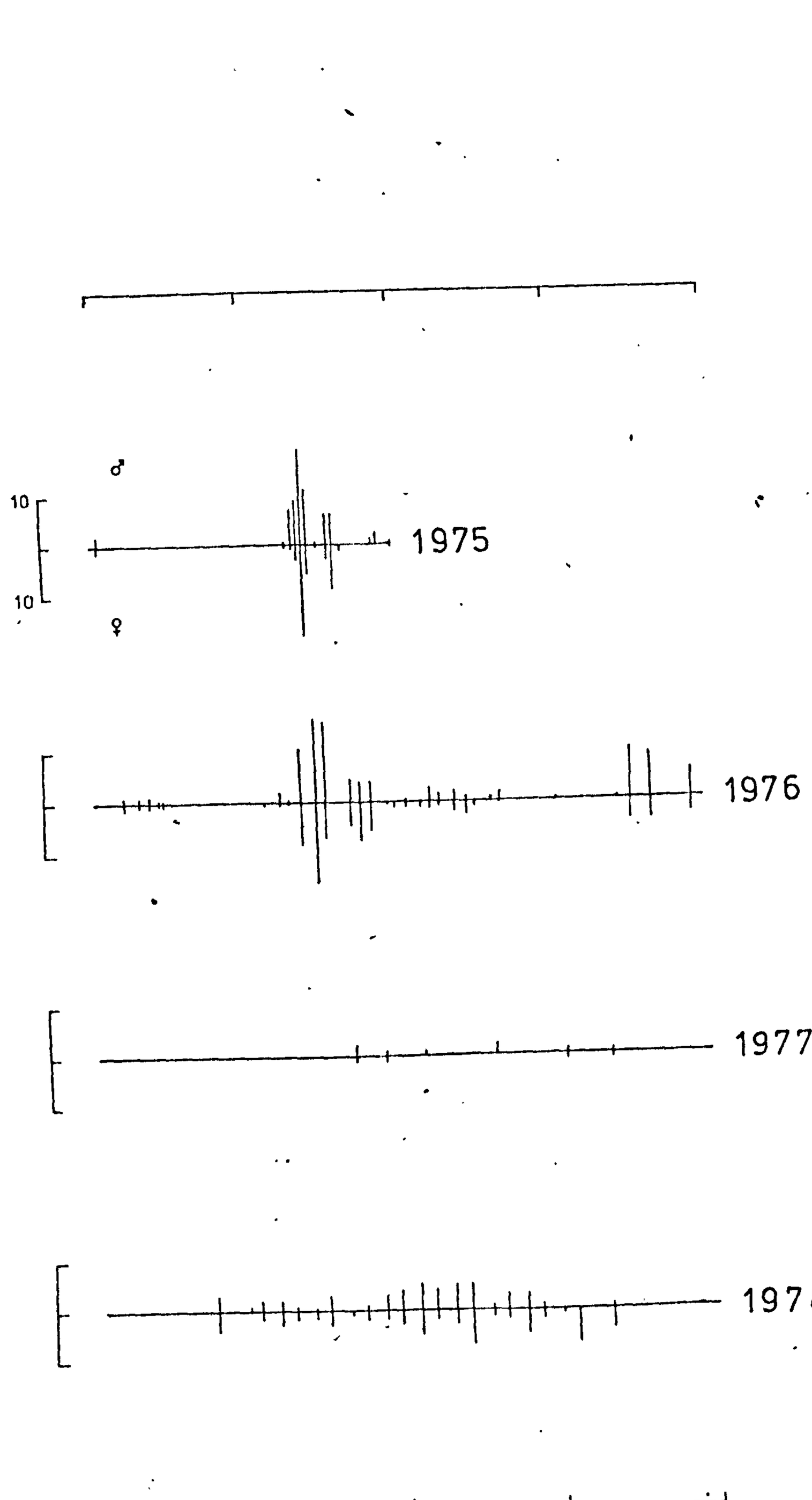


Fig. 8.7 Emergence of *Chironomus cingulatus*; format as in fig. 8.3

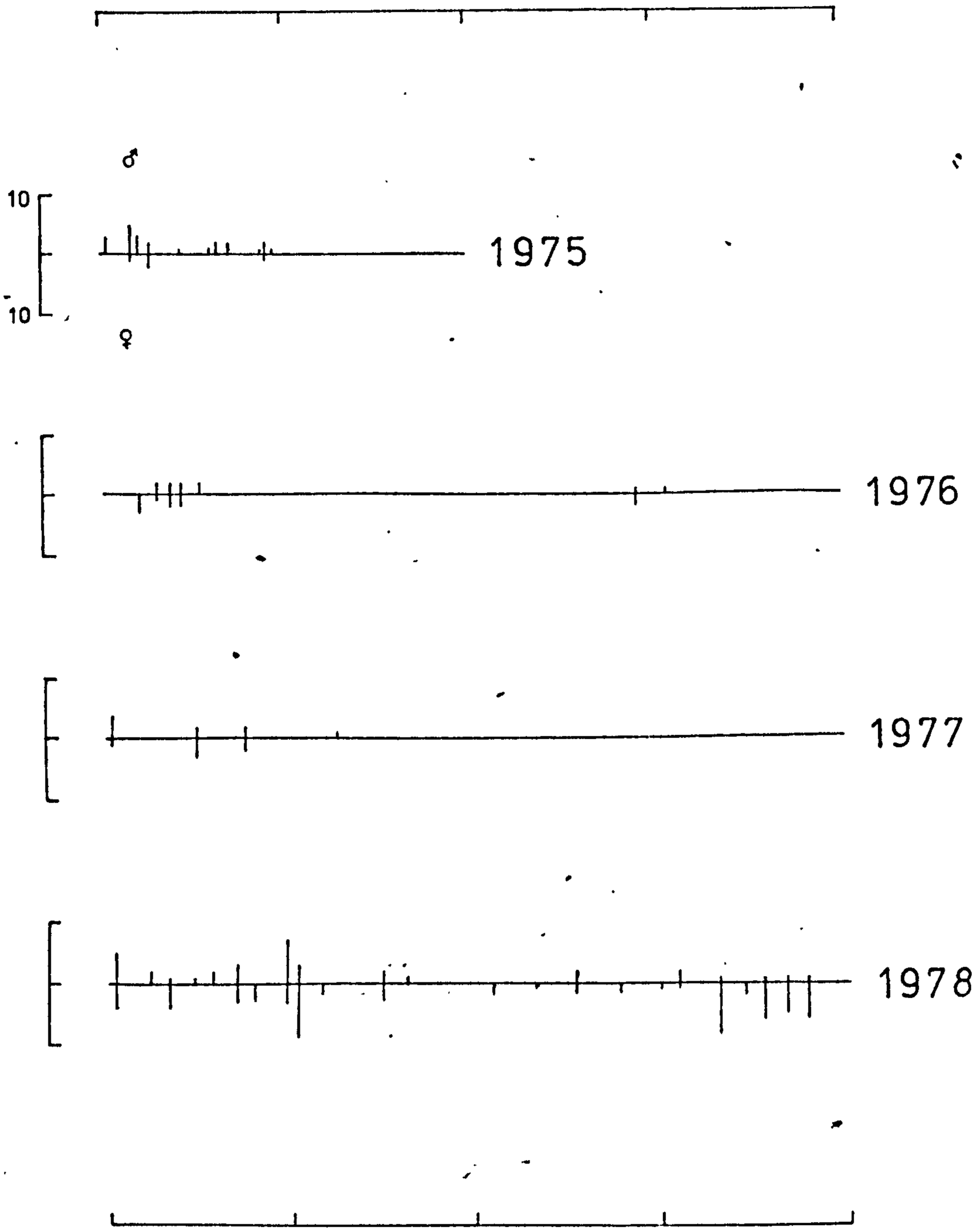


Fig. 8.8 Emergence of *Chironomus plumosus*; format as in fig. 8.3

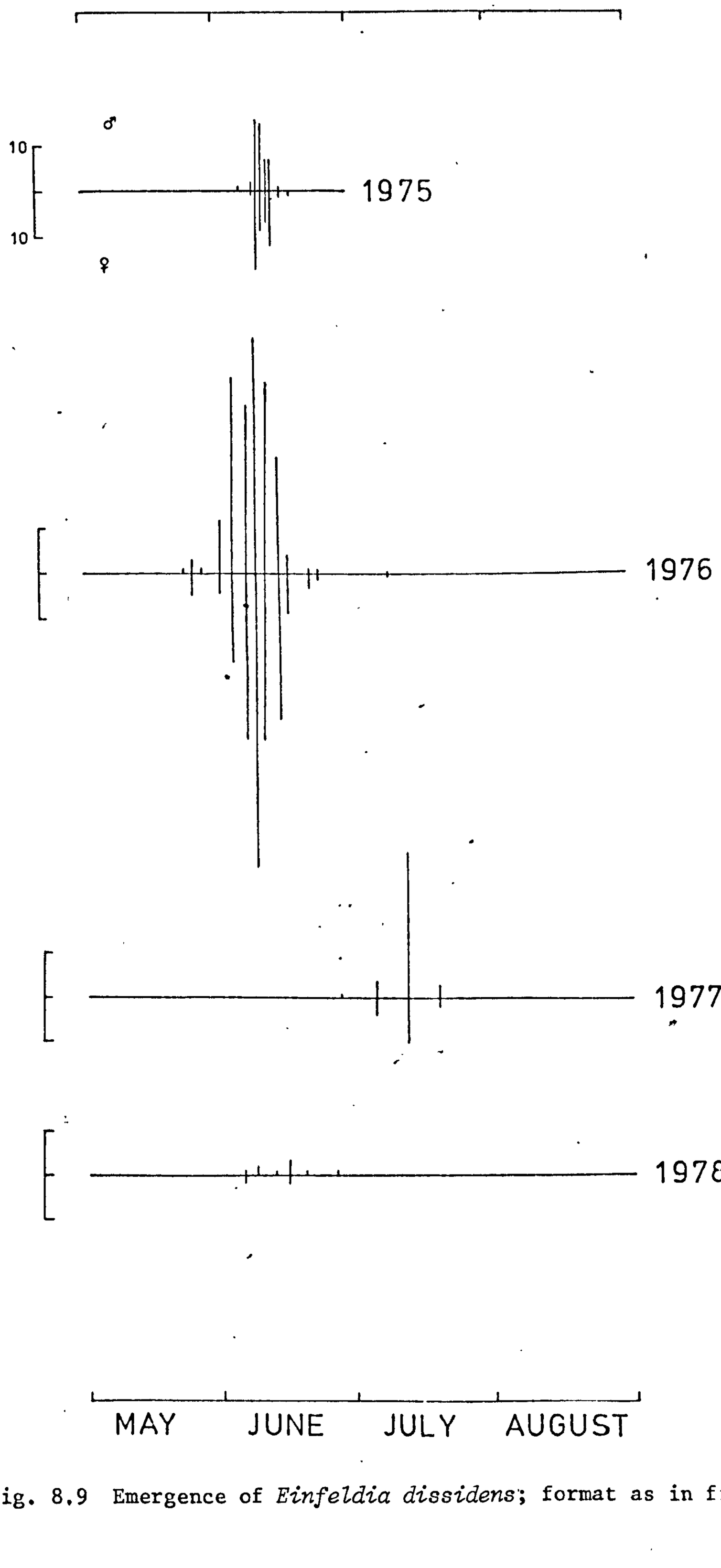


Fig. 8.9 Emergence of *Einfeldia dissidens*; format as in fig. 8.3

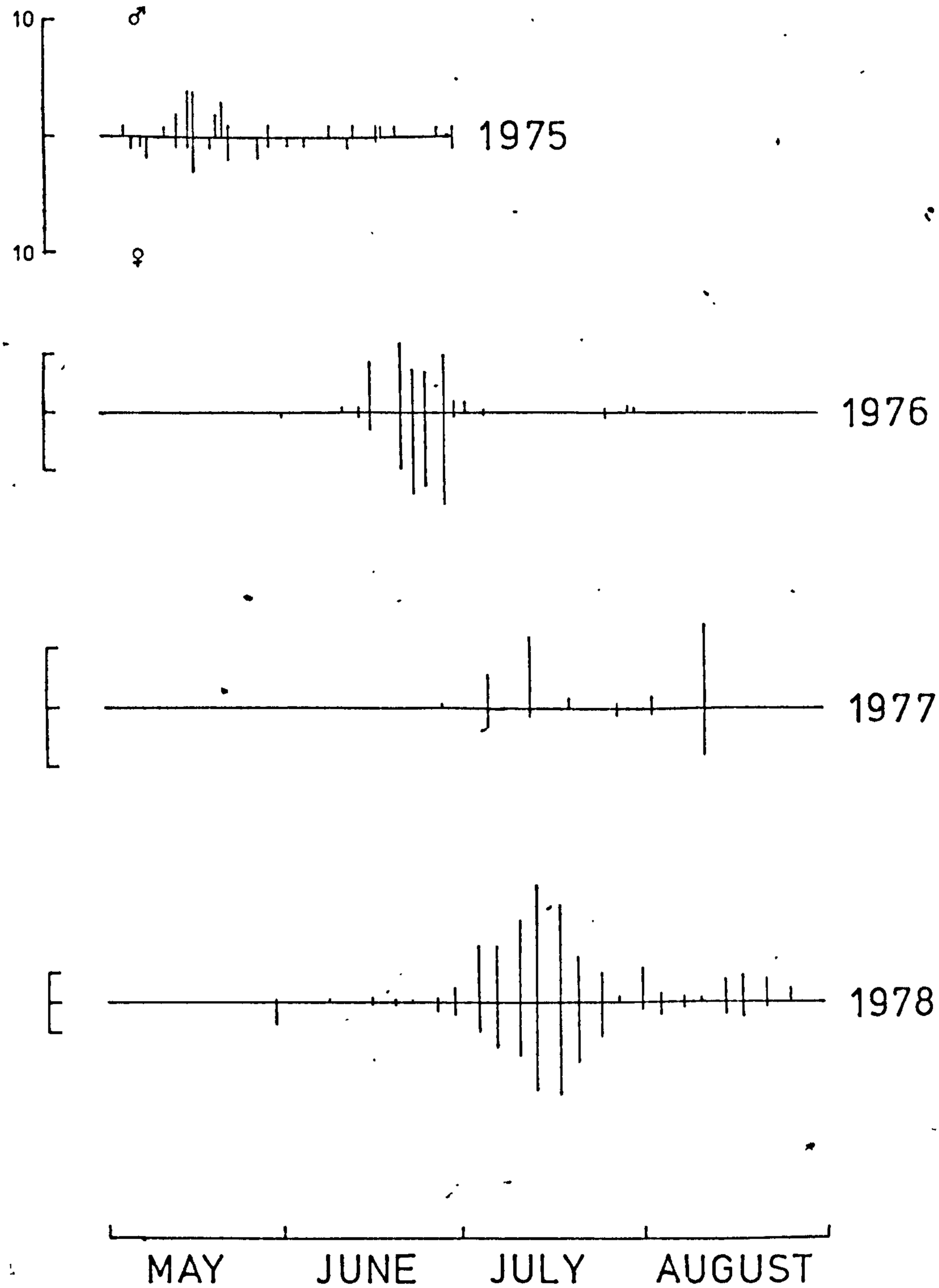


Fig. 8.10 Emergence of *Endochironomus albipennis*; format as in fig. 8.3

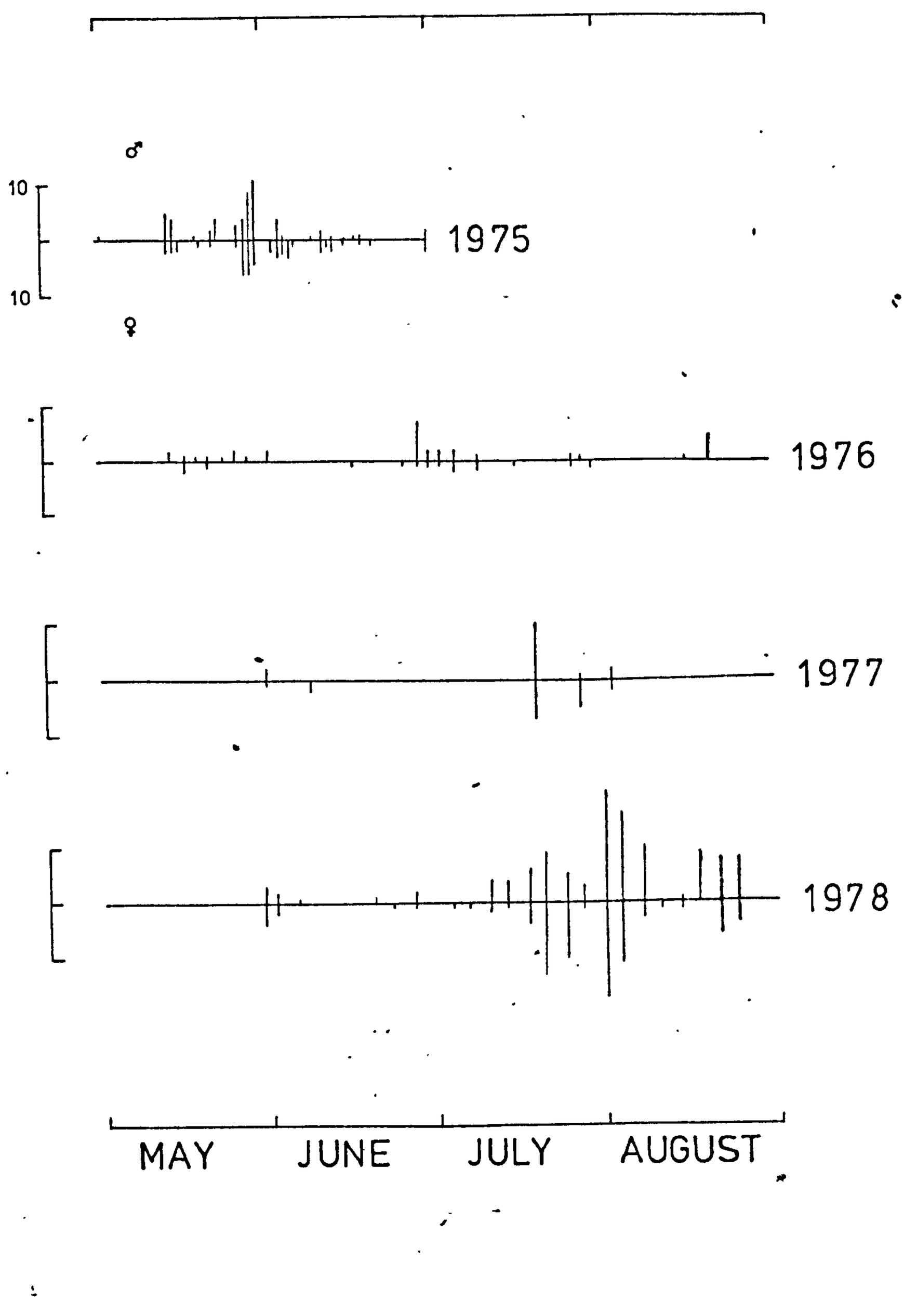


Fig. 8.11 Emergence of *Glyptotendipes glaucus*; format as in fig. 8.3

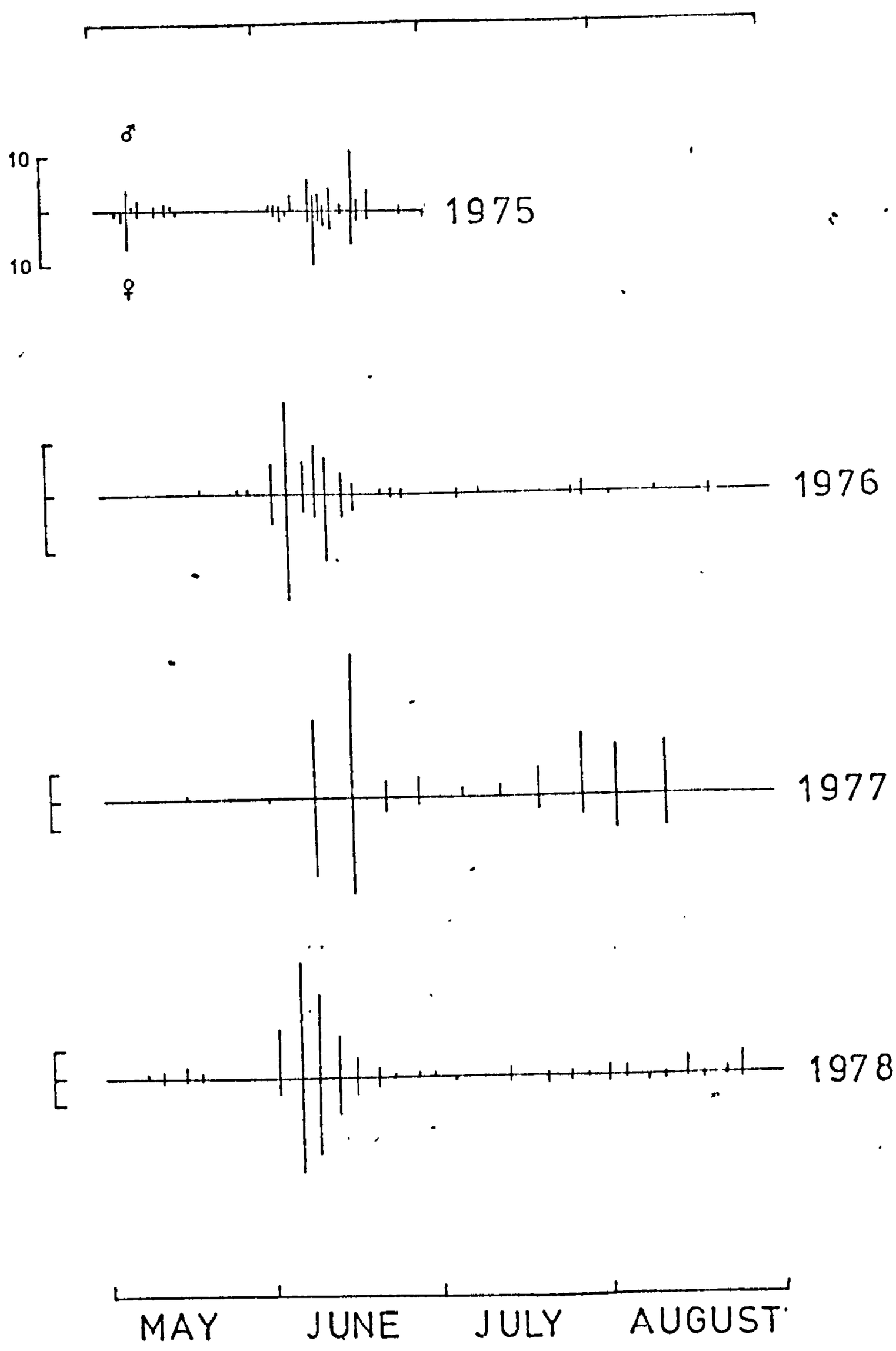


Fig. 8.12 Emergence of *Parachironomus arcuatus*; format as in fig. 8.3

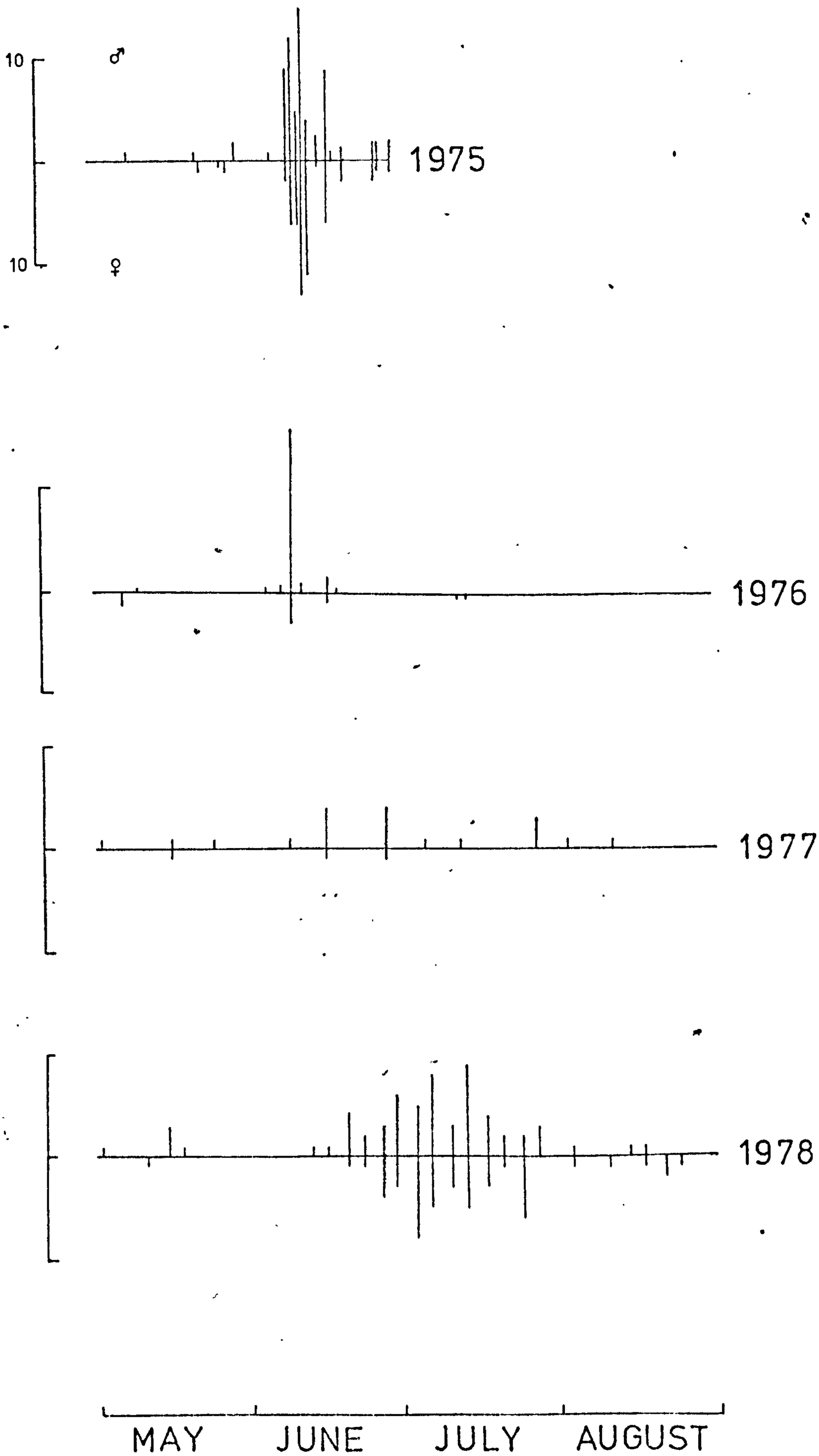


Fig. 8.13 Emergence of *Polypedilum nubeculosum*; format as in fig. 8.3

Taxon \ Date	29th April	20th May	10th June	1st July	1st August
Chironomus sp A	78	392	286	74	2
Chironomus sp B	0	0	163	87	3
Polypedilum sp	0	0	2	51	5
Tanytarsus sp	4	22	1	3	10
Tanypus sp	1	0	0	0	0
Procladius sp	10	0	1	7	0
Cricotopus sp	0	2	1	0	0
Orthocladiinae	13	0	0	0	0
Microcricotopus sp	0	0	0	1	0
Cryptochironomus sp	0	0	0	0	1
Endochironomus sp	0	0	0	0	2
Total (N m^{-2})	442	1733	1892	929	96
H'	0.873	0.237	0.723	1.602	1.521
J	0.543	0.216	0.404	0.894	0.849

Table 9.1 The abundance, diversity and evenness of the genera of chironomid larvae in Ekman grab samples from the experimental ponds in 1977

	Site	1	2	3	4	5	6	Mature
Experimental Ponds	1	-	*63*	*67*	*71*	*55*	*63*	*58*
	2	27	-	*89*	*72*	*70*	*72*	*38*
	3	44	40	-	*80*	*75*	*80*	*41*
	4	48	74	46	-	*77*	*85*	*47*
	5	45	35	48	47	-	*88*	*34*
	6	29	15	40	25	44	-	*44*

Table 9.2 Raabe percentage similarity values for between site comparisons of chironomid emergence. Values for 1977 are in italics, those for 1978 in upright print

Species	1977	1978
Chironomus cingulatus	x	5.5
Chironomus riparius Meigen	4.2	
Cryptochironomus supplicans	x	x
Endochironomus albipennis		1.5
Graceus ambiguus Goetghebuer	x	
Limnochironomus nervosus		x
Microtendipes chloris (Meigen)		x
Microtendipes pedellus	x	2.4
Parachironomus arcuatus	x	x
Parachironomus tenuicaudatus (Malloch)	x	
Parachironomus varus (Goetghebuer)		x
Polypedilum nubeculosum	1.1	x
Cladotanytarsus nigrovittatus	x	10.6
Micropsectra lindrothi		1.4
Tanytarsus bathophilus Kieffer	x	
Tanytarsus gracilentus	59.1	x
Tanytarsus holochlorus	x	
Tanytarsus heusdensis Goetghebuer	x	x
Tanytarsus lestagei		4.9
Tanytarsus pallidicornis	2.5	x
Tanytarsus veralli	x	10.3
Ablabesmyia monilis	x	x
Procladius choreus	16.8	17.5
Psectrotanypus varius (Fabr.)		x
Psilotanypus rufovittatus		x
Tanypus punctipennis		x
Tanypus vilipennis	x	
Cricotopus intersectus	1.5	2.1
Cricotopus obnixus		7.3
Cricotopus sylvestris	10.1	12.0
Orthocladius obtexens Brundin	1.4	
Paratrichocladius rufiventris		x
Psectrocladius barbimanus (Edw.)		x
Psectrocladius obvius		1.6
Psectrocladius sordidellus (Zett.)		17.8
Thienemaniella sp.	x	
TOTAL SPECIES	24	28

Table 9.3 Chironomid species caught in emergence traps in 1977 and 1978, x indicates presence for those species for which a percentage abundance value is not given

Year	Site	1	2	3	4	5	6	Mature
1977	H'	1.77	1.24	1.37	1.41	0.76	1.09	1.97
	J	0.64	0.60	0.49	0.55	0.35	0.46	0.75
1978	H'	2.40	1.77	2.26	1.97	2.11	1.70	-
	J	0.85	0.74	0.94	0.82	0.82	0.68	-

Table 9.4 Shannon-Weaver diversity (H') and evenness (J) for the total emergence from the ponds in 1977 and 1978

Ion ($mEq\ l^{-1}$)	Mean for six ponds	Black Horse
Na^{+}	0.60	0.7
K^{+}	0.13	0.1
Ca^{++}	4.67	4.5
Mg^{++}	0.45	0.5
HCO_3^{-}	2.35	2.6
SO_4^{--}	2.25	2.7
Cl^{-}	0.76	0.8
Conductivity (μS)	591	576
pH	7.98	8.1

Table 9.5 Chemical composition of the six experimental ponds and for Black Horse lake. Composition is given in $mEq\ l^{-1}$.

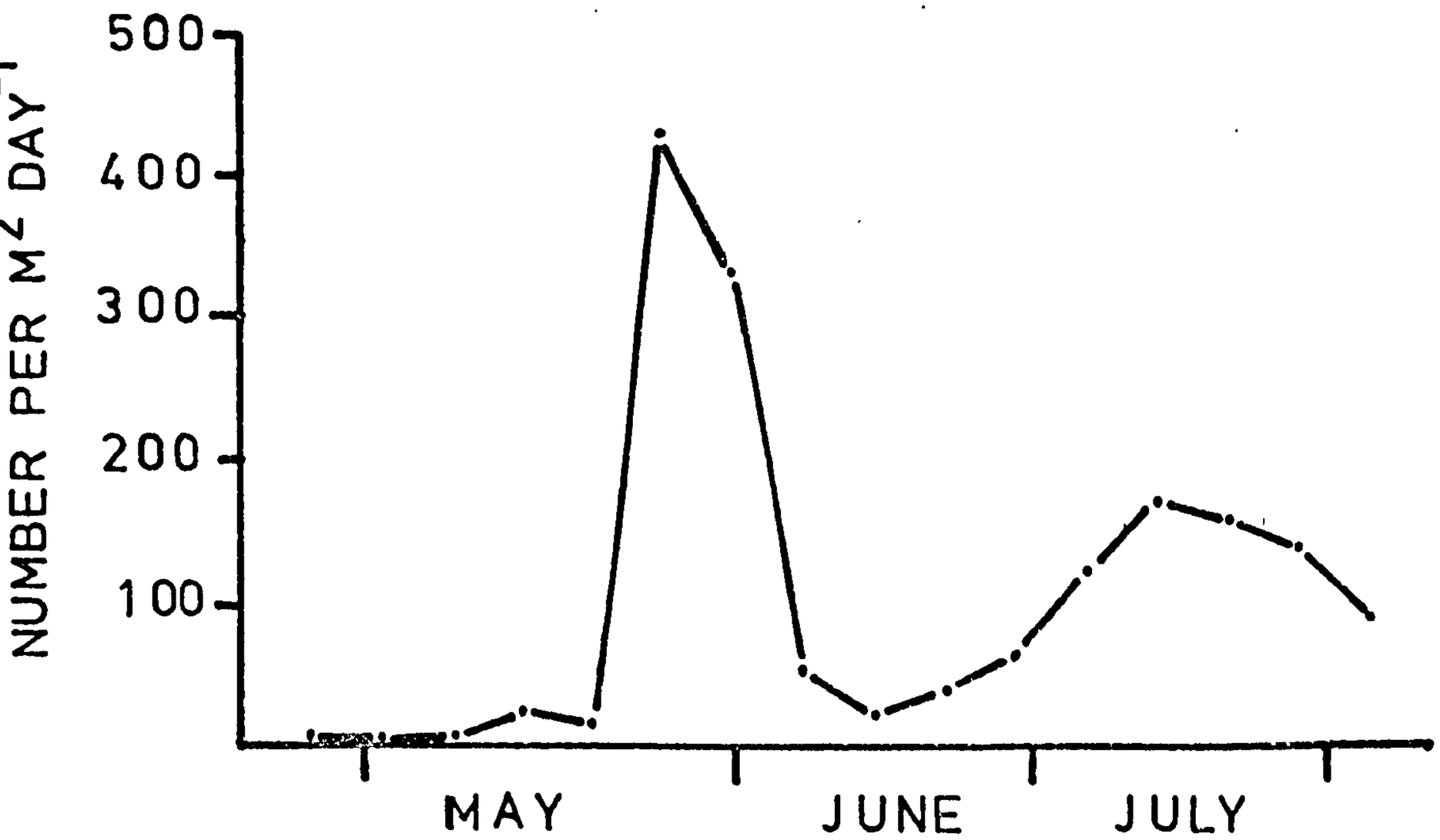


Fig. 9.1 Mean emergence of chironomids from six experimental ponds in 1977

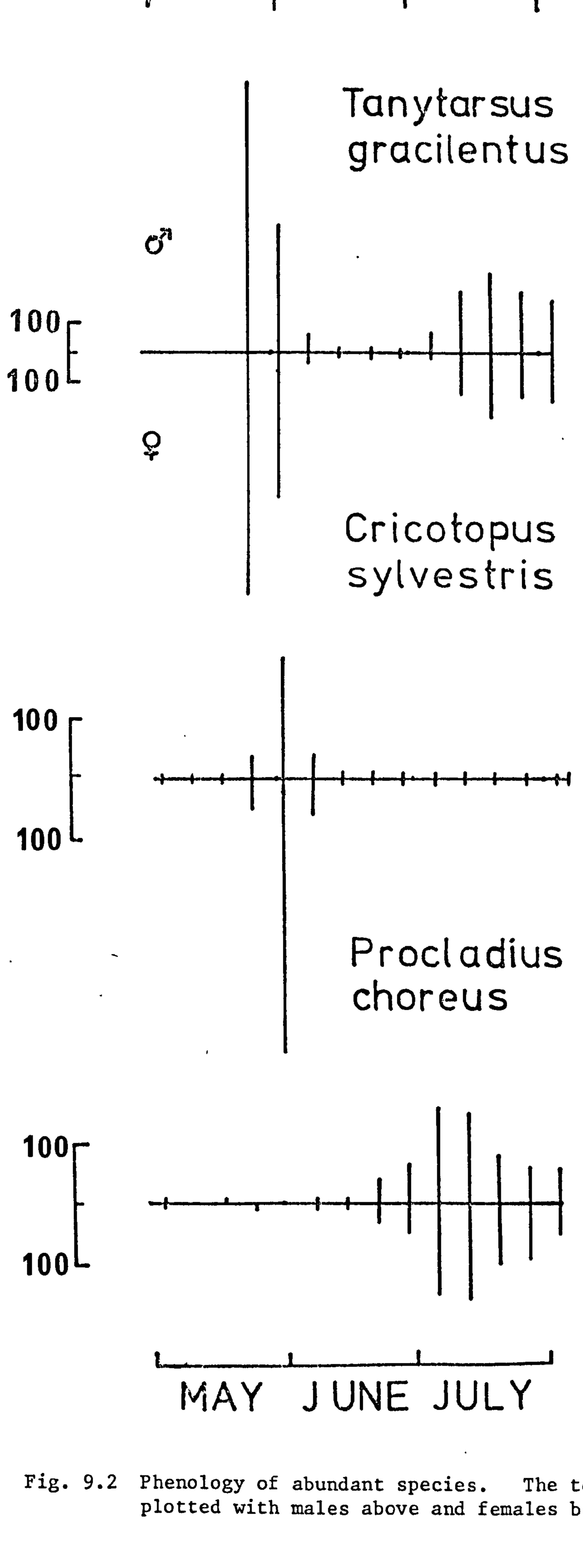


Fig. 9.2 Phenology of abundant species. The total weekly catch is plotted with males above and females below the axis

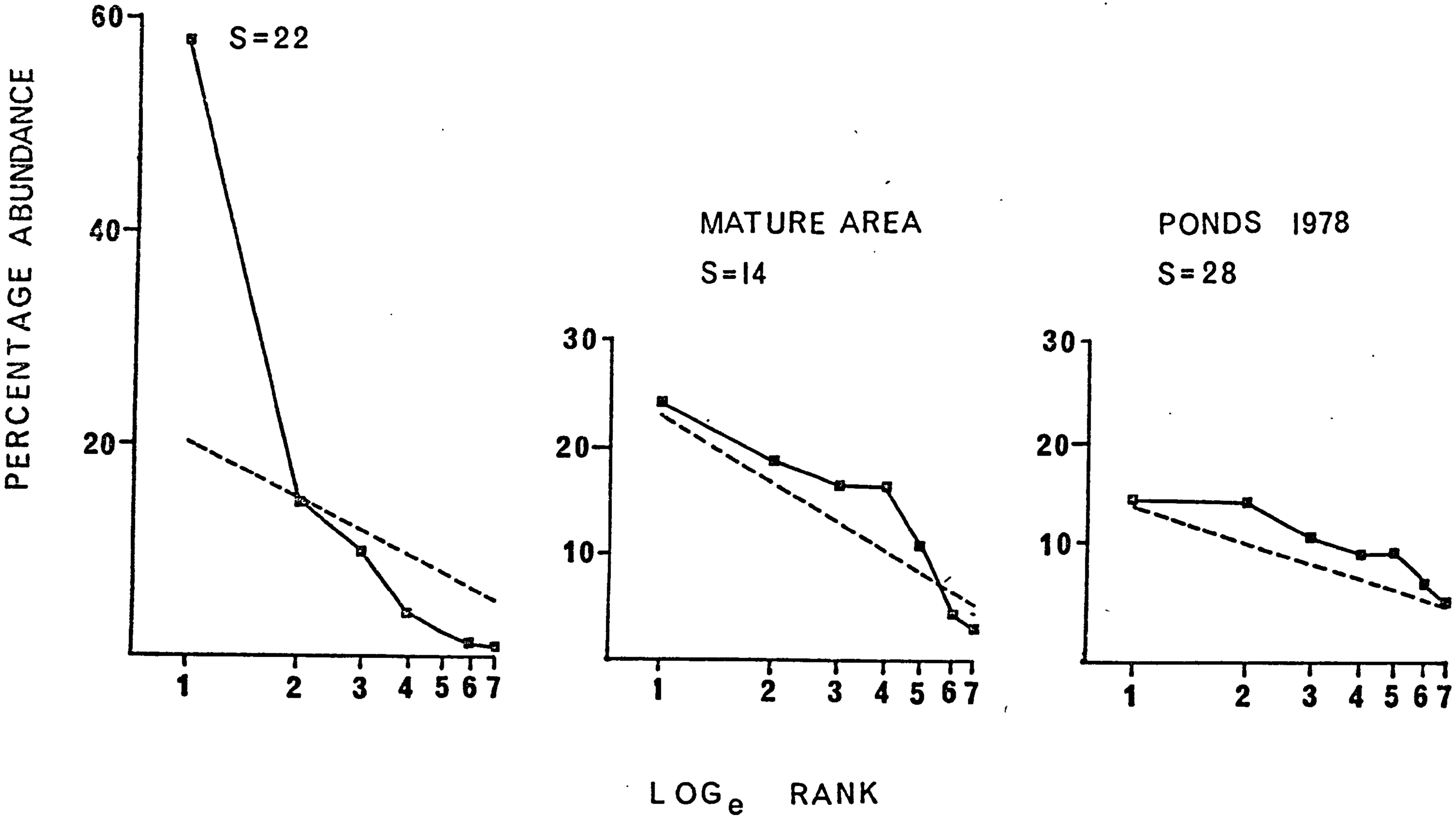


Fig. 9.3 Log-rank percentage abundance curves for the chironomid communities in the experimental ponds 1977, a mature area1977, and the experimental ponds in 1978. The dashed line on each graph is that predicted by MacArthur's broken stick model for the communities

Species	Site	Swarming time	White Marker
Cricotopus sylvestris	Tip of willow tree in shade side	Day or dusk	None
Cricotopus intersectus	0.3 m above path through rough grass	Day or dusk	+
Paracladius conversus	Tips of trees	Dusk	None
Metriocnemus hygropetricus	Tips of willow branches	Dusk	None
Tanypus punctipennis	Above light patches of ground	Dusk	+
Parachironomus arcuatus	0.3 m above thistles	Dusk	None
Tanytarsus lestagei	0.6 m above path	Day	None

Table 10.1 Summary of swarming sites, times and reaction to a 0.6 diameter white circle (+ indicates movement towards the circle)

Species	2.vi.1978 morning		2.vi.1978 afternoon		5.vi.1978		6.vi.1978	
	E	10	E	10	E	10	E	10
Einfeldia dissidens	4(0)	4(0)	0(0)	2(1)	0(0)	1(1)	0(0)	11(1)
Tanypus punctipennis	1(0)	0(0)	0(0)	14(10)	0(0)	1(1)	0(0)	5(4)
Cricotopus sylvestris	14(8)	0(0)	13(6)	0(0)	10(22)	3(0)	13(11)	7(0)
Total number of species	11	5	8	6	5	3	4	5
Total chironomids	40(16)	11(4)	27(25)	27(16)	14(30)	5(2)	18(14)	27(7)

Table 10.2 Abundance of chironomids at the water's edge (E) and 10 m inland on four occasions in June 1978. Numbers of females are given in parentheses following the number of males

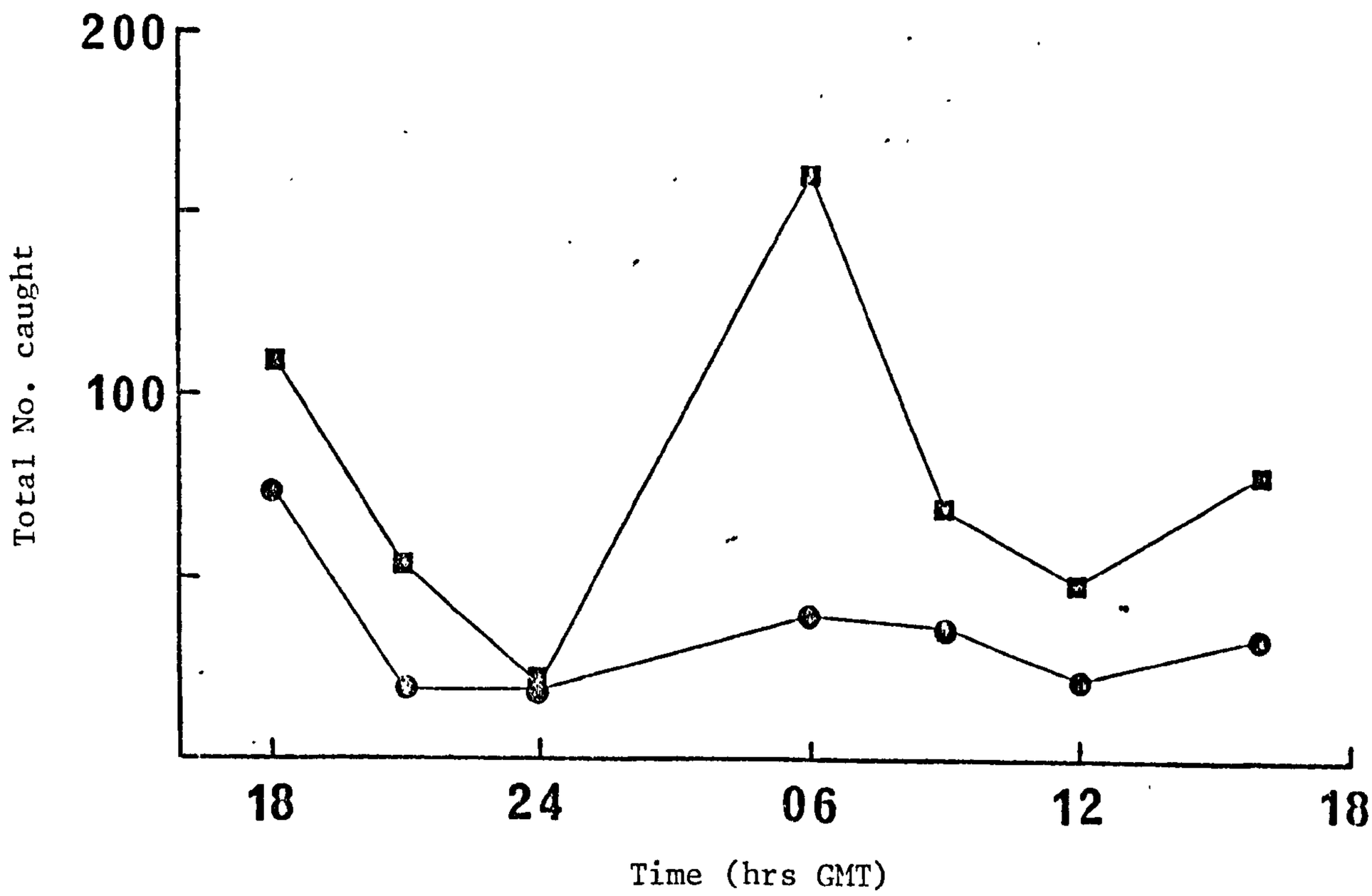


Fig. 10.1 Diurnal pattern of abundance of chironomids on a uniform area of grass. The data for males ■ and females ● are plotted separately

Variable	Canonical Variates		
	I	II	III
Head width	3.18	2.47	4.03
Inter-eye distance	2.74	-3.14	1.92
Labial palp	0.52	-0.51	0.68
Tibia	0.25	0.46	-0.79
Tarsus 1	-2.93	6.46	0.86
Tarsus 1-5	1.42	-2.07	-2.27
Tarsal beard	3.60	-3.11	-2.51
Wing	0.43	1.67	-1.44
f-Cu - Cu_1 tip	1.69	-0.85	-2.65
r-m - M_1 tip	-2.24	-1.97	-0.22
r-m - R_{2+3} tip	1.23	-1.25	8.15
r-m - R_{4+5} tip	-2.81	0.31	0.33
Eigenvalues	17.03	1.58	0.18
Percentage variability	90.6	8.4	1.0

Table 11.1 Canonical variates for the morphometric variables used to determine the effect of parasitisation by mermithid nematodes on adult morphology. (Variables unless stated otherwise are length measurements).

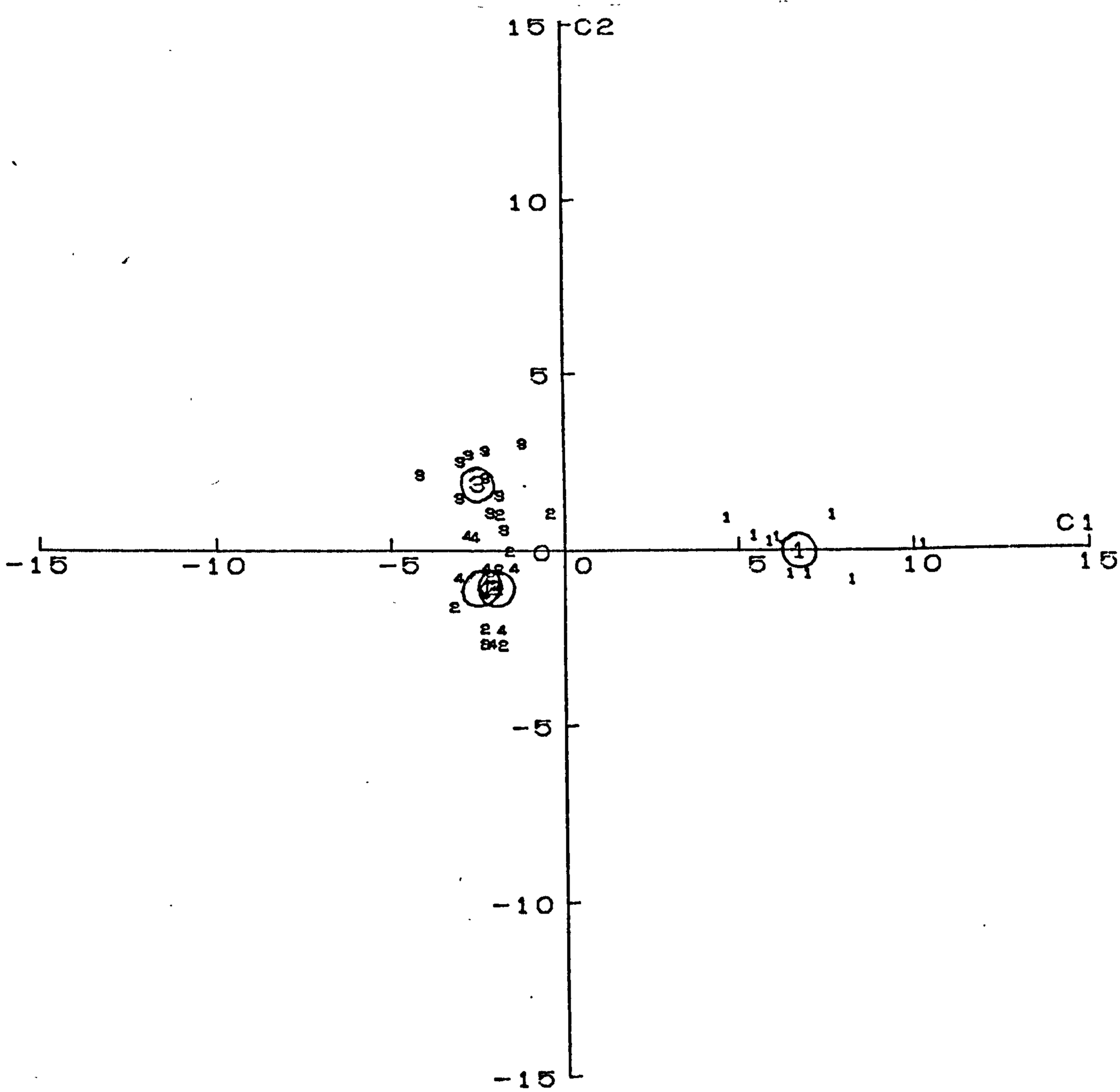


Fig. 11.1 Plot of individuals and group centres with respect to the first two canonical axes (C1 and C2), Group 1 were unparasitised males, Group 2 parasitised males, group 3 unparasitised females and group 4 parasitised female *Einfeldia dissidens*