The littoral Chironomidae (Diptera) of saline lakes in central British Columbia

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Collections of chironomid larvae, pupae, and adults were taken from the 1-m depth zone of 15 lakes of varying salinities in central British Columbia. Thirty-four species were identified.

The littoral chironomid fauna of the lake series is divided into predominant associations whose existence seems to depend on salinity and productivity levels. A *Cricotopus abanus – Procladius bellus* association prevails in the lowest salinities (40 to 80 μmho/cm (1 mho = 1 S) conductivity) while in conductivities between 400 and 2800 μmho/cm a *Glyptotendipes barbipes – Einfeldia pagana* association predominates. In the most saline lakes (conductivity 4100 to 12 000 μmho/cm) a *Tanytarsus gracilentus – Cryptotendipes ariel* association is characteristic.

Using these three chironomid associations it is possible to divide the 15 lakes into three groups. Waters with conductivities from 40 to 80 μmho/cm have chemical characteristics and a chironomid fauna distinct from those of higher salinities. The 10 lakes showing increasing conductivity (400 to 2800 μmho/cm) have physical, chemical, and biotic characters related to high productivity. In the particular case of this saline lake series, lakes with salinities about 3‰ (conductivity above 4000 μmho/cm) have a reduced productivity and a chironomid fauna characteristic of high salinities.

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Des récoltes de larves, de pupes et d'adultes de chironomides dans la zone de 1 m de profondeur de 15 lacs de salinité différentes de la région centrale de la Columbie Britannique ont donné un total de 34 espèces.

La faune littorale de chironomides dans cette série de lacs présente des associations prédominantes dont l'existence est reliée à la salinité et au taux de productivité. L'association *Cricotopus abanus – Procladius bellus* prédomine aux salinités les plus basses (conductivité 40–80 μmho/cm (1 mho = 1S)), alors quà des conductivités de 400–2800 μmho/cm, l'association prédominante est *Glyptotendipes barbipes – Einfeldia pagana*. Les lacs les plus salés (conductivité 4100 – 12 000 μmho/cm) sont caractérisés par l'association *(Tanytarsus gracilentus – Cryptotendipes ariel*.

Ces associations de chironomides permettent de classifier les 15 lacs en trois groupes. Les eaux à conductivité de 40–80 μmho/cm ont des caractéristiques chimiques et une faune de chironomides distincte de celles des eaux plus salées. Les 10 lacs à conductivité plus élevée (400 à 2800 μmho/cm) ont des propriétés physiques, chimiques et biotiques reliées à une productivité élevée. Dans les cas de la série de lacs dont il est question ici, les lacs à salinité supérieure à 3‰ (conductivité supérieure à 4000 μmho/cm) ont une productivité réduite et une faune de chironomides typiques des salinités élevées.

[Traduit par le journal]

Introduction

ıis paper describes an ecological study of some e Chironomidae inhabiting a saline lake series e Chilcotin and Cariboo regions of British Co-ıia. The chironomid complex of a saline lake s has never been thoroughly examined before. son and Moore (1944) and Lauer (1969) have ioned chironomids in connection with work on waters and others have recorded and studied us species in waters of differing salinities ghout the world (Remmert 1955; Sutcliffe Palmen 1962; Bayly and Williams 1966; mer *et al.* 1975), but little information has been red on how chironomid populations differ in a of lakes of varying salinity.

is type of study is particularly interesting since it is well known that chironomids display extensive adaptation to a wide variety of environments (Brundin 1966) and are often able to thrive where many other animals cannot. The broad salinity tolerance of the Chironomidae gives them special prominence in saline habitats. This fact, in conjunction with their usual great abundance and wide diversity, makes chironomids useful organisms with which to study changes in the structure of species complexes that occur with variations in physical, chemical, and biological conditions.

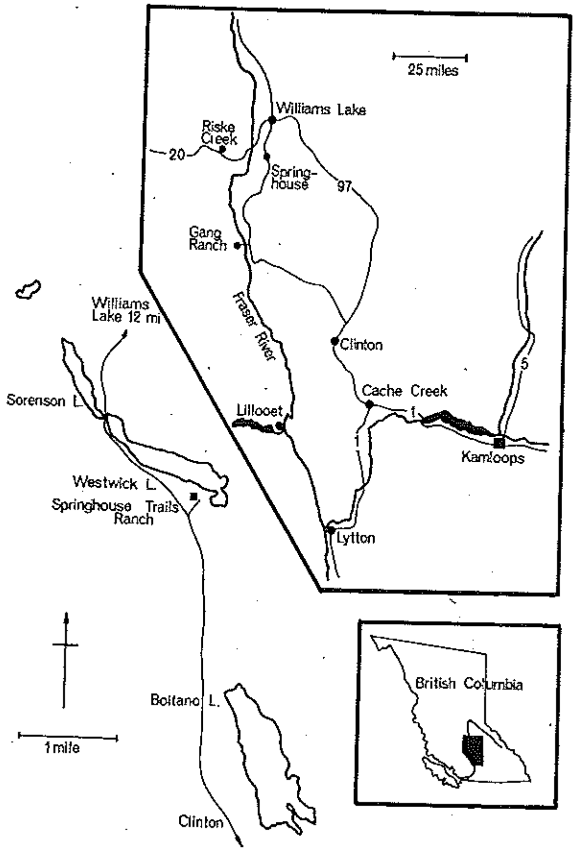
The physical and chemical characteristics of the lakes examined are discussed by Topping (1969, 1971) and Topping and Scudder (1977) and this information, in conjunction with extensive data collected on larval numbers and ad

used in an examination of the major species of the 1-m depth zone. The distribution of these species is discussed and description of several associations is advanced, along with a classification of the lakes based on their chironomid faunas.

The Study Area

The study was undertaken in the Cariboo and Chilcotin areas of central British Columbia. The 15 water bodies examined are situated in two distinct but adjacent areas (Fig. 1), the Springhouse region southwest of Williams Lake and Becher's Prairie near Riske Creek on the west side of the Fraser River (Fig. 2). The water bodies studied were as follows: (*a*) Springhouse area: Sorenson Lake, Westwick Lake, and Boitano Lake; (*b*) Becher's Prairie: Barnes Lake, Round-up Lake, Lake Lye, Lake Jackson, Lake Greer, Rock Lake, Near Phalarope, Near Opposite Crescent, Box 17, Barkley Lake, East Lake, and Box 27.

The lakes are contained in the Chilcotin and Cariboo parklands biotic areas (Munro 1945; Munro and Cowan 1947) at an elevation of about 1000 m. The terrain is a rolling savanna-type upland characterized by *Agropyron spicatum* and stands of *Populus tremuloides*, *Pseudotsuga menziesii*, and *Pinus contorta*.



The climate is characterized by relatively low average annual temperatures (the mean daily temperature for January and July at Big Creek being −11.6 and 13.7°C respectively), large fluctuations in seasonal and daily temperatures (Jansson and Scudder 1974; Scudder 1975), and low precipitation (annual mean 340.2 mm at Big Creek). The lakes are ice covered from mid-October to late April.

The water bodies were chosen in order to obtain a wide range of salinities with respect to chironomid inhabitation. While water chemistry varied, the use of this particular lake series kept other environmental parameters such as physical location and climate as similar as possible. In addition, the waters lack inlet and outlet streams, lack fish predation, and are subject to disturbance by cattle (Scudder 1969).

The lakes vary both in size and character; the larger, more saline lakes are generally dominated by $NaHCO_3$ while in the smaller, fresher ones $MgCO_3$ often prevails. Detailed physical and chemical properties of the water bodies are given in Topping (1969) and Topping and Scudder (1977) and are summarized in Table 1.

Some shorelines are relatively steep and firm while others are very shallow and extremely soft. The latter character seems to be associated with certain productivity or chemical levels supporting marginal *Scirpus validus* growth (Sorenson L., Westwick L., Near Phalarope) and heavy concentrations of rooted aquatics such as *Myriophyllum spicatum* (Rock L., Barkley L.), *Najas* (Sorenson L., Westwick L.), and *Potamogeton natans* (Box 27) (Reynolds and Reynolds 1976).

From mid-June onwards algal blooms are common in most lakes, especially filamentous greens (*Spirogyra*, *Zygnema*) in Sorenson L., and blue-greens such as *Aphanizomenon* in Near Opposite Crescent, L. Jackson, L. Greer, and East L. In the more saline lakes (mean conductivity above 4000 μmho/cm (1 mho = 1 S)) emergent vegetation is absent, as are algal blooms. These lakes usually have relatively firm margins ringed with white salt deposits.

Methods

At weekly intervals from May 23 to August 29, 1970, duplicate larval samples were taken from each lake at a depth of 1 m. A 15 × 15 cm Ekman dredge was used for the sampling. The samples were washed and seived through a 0.56-mm mesh screen; the chironomids were extracted live from the mud and preserved in 70% ethanol. The volume displacement of each

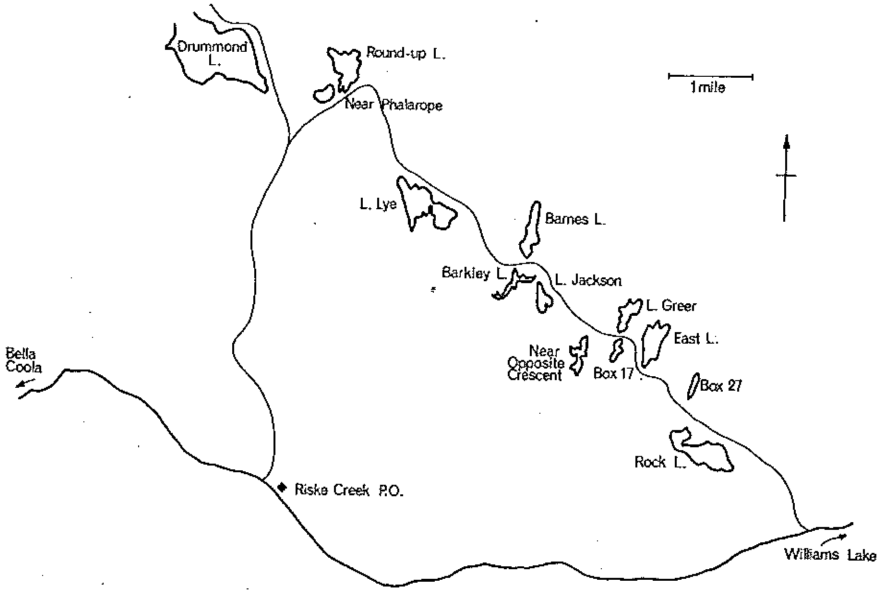


FIG. 2. Becher's Prairie study area.

TABLE 1. Physical and chemcical properties of the lakes studied (from Topping 1969; Topping and Scudder 1977)

Water body	Area, ha	Mean depth, m	Max. depth, m	Main cation	Main anion	Highest recorded conductivity, μmho/cm	Mean conductivity, μmho/cm, 25°C	TDS, mg/ℓ	Na, mequiv/ℓ	K, mequiv/ℓ	Ca, mequiv/ℓ	Mg, mequiv/ℓ	CO_3, mequiv/ℓ	HCO_3, mequiv/ℓ	Cl, mequiv/ℓ	SO_4, mequiv/ℓ	O_2, mg/ℓ	Highest recorded pH	Mean pH	% organic carbon
Barnes L.	17.20	2.0	4.5	Na	HCO_3-CO_3	20 000	11 816	9786	131.17	13.40	0.43	2.95	49.56	53.92	37.30	25.84	5.6	9.7	9.3	2.47
Round-up L.	30.84	2.6	6.2	Na	HCO_3-CO_3	9 000	6 885	5360	73.64	5.25	0.60	3.05	14.86	32.21	25.40	11.34	5.3	9.3	9.2	4.90
L. Lye	46.50	2.8	5.4	Na	HCO_3-CO_3	12 000	6 548	4941	69.62	5.11	0.74	2.94	15.77	33.97	22.07	6.99	5.1	9.6	9.1	7.22
Boitano L.	80.70	2.7	4.5	Na	HCO_3-CO_3	9 000	4 108	3139	33.98	3.21	0.74	11.51	5.06	17.79	4.47	22.83	4.7	9.2	8.9	6.52
L. Jackson	5.83	1.4	2.3	Na-Mg	SO_4	3 730	2 766	2500	16.19	1.53	1.42	16.15	2.08	6.00	3.61	23.89	7.0	9.3	9.0	5.24
L. Greer	15.18	1.0	2.3	Na	HCO_3	2 200	1 602	1221	13.77	1.56	0.56	2.93	1.57	12.83	1.13	3.20	5.3	9.5	8.6	1.92
Rock L.	34.60	1.1	2.5	Na	HCO_3	2 600	1 496	1130	14.91	0.98	0.62	1.74	4.32	12.35	1.57	0.18	5.3	10.5	8.9	1.46
Near Phalarope	5.06	1.3	3.0	Na	HCO_3	1 790	1 334	862	8.05	1.45	0.93	5.75	1.40	14.38	0.79	0.73	3.3	9.1	8.4	4.20
Westwick L.	58.32	1.3	4.5	Mg	HCO_3-CO_3	2 200	1 287	969	4.66	0.83	1.02	11.21	1.59	7.62	0.23	7.21	2.8	9.1	8.9	8.09
Sorenson L.	—	—	—	Mg	HCO_3-CO_3	—	1 500	1031	4.43	0.69	1.15	11.95	1.33	6.38	0.34	9.29	2.8	9.1	8.8	12.25
Near Opposite Crescent	6.88	1.4	3.3	Mg	HCO_3-CO_3	940	810	598	3.37	0.60	0.97	4.40	0.81	6.42	0.35	1.34	3.2	9.7	8.6	9.83
Box 17	2.67	1.1	3.3	Mg	HCO_3-CO_3	950	741	571	3.32	0.61	0.76	4.66	2.28	7.69	0.14	0.17	5.9	9.2	8.6	4.27
Barkley L.	4.53	0.7	2.2	Mg	HCO_3-CO_3	750	592	450	1.96	0.62	0.38	5.13	0.44	5.73	0.24	0.40	4.9	10.1	8.7	5.43
East L.	27.03	1.9	6.5	Na	HCO_3	600	488	372	3.16	0.45	0.55	1.66	0.88	4.96	0.21	0.32	5.3	9.7	8.3	4.92
Box 27	4.30	0.5	1.5	Mg	HCO_3-CO_3	75	40	16	0.09	0.10	0.23	0.16	0.10	0.29	0.10	0.09	4.9	7.0	6.4	4.36

Pupal and adult midges were sampled with emergence traps of a design similar to those used by Hamilton (1965), with the area of the trap mouth 0.1 m^2 (Cannings 1972). Duplicate traps were set in each lake at a depth of 1 m and were emptied every 4 days from May 23 to August 29, 1970.

Specimens were preserved in 70% ethanol and those to be examined in detail were mounted on slides, following the method of Saether (1969). Identification followed Edwards (1929), Townes (1945), and Roback (1971). Further determinations were performed by Dr. D. R. Oliver and Dr. J. E. Sublette. The nomenclature follows Roback (1971) and Sublette and Sublette (1965) and additions and revisions in subsequent Sublette papers. Representative specimens are deposited in the Spencer Entomological Museum at the University of British Columbia.

Physical and chemical data are from Topping (1969) and Topping and Scudder (1977). These data represent information gathered from surface waters or at a depth of 1 m averaged over the summer. For details on the collection and analysis of these data, and for a more comprehensive discussion of the physical and chemical properties of the lakes, see Topping and Scudder (1977).

For each lake a species diversity index was calculated. The function used is the entropy formula as applied to information analysis (Khinchin 1957; Margalef 1968). The use of this function for estimating species diversity in ecosystems has been widespread (MacArthur and MacArthur 1961; Johnson and Brinkhurst 1971).

Results

Table 2 shows the distribution of species collected at a depth of 1 m in the lakes. This should be considered only a preliminary list of the chironomid fauna of this depth zone. Adults representing 34 species, 15 genera, and 3 subfamilies were trapped and are listed in Fig. 3 along with their ranges of salinity tolerance. Twelve adults were associated with their larval forms (Table 2).

In order to characterize the chironomid complex in the saline lakes series it is useful to describe the chironomid associations and group the lakes according to the predominant species. Referring to Table 3 it can be seen that the species associations may be divided into three main groups.

The Cricotopus abanus – Procladius bellus Association

In the lakes studied this association is restricted to Box 27 where low salinity (mean conductivity 40 μmho/cm and a total dissolved solids (TDS) level of 15 to 20 ppm) and low pH (6.4) are especially evident. The flora in this magnesium carbonate – bicarbonate lake is dominated by a discrete assemblage of plants, notably *Potamogeton natans* and *Sparganium emersum* (Reynolds and Reynolds 1976). It has a varied chironimid fauna with a relatively high index of diversity (2.14) (Fig. 4). Although there is a high diversity the density of

TABLE 2. Occurrence of Chironomidae in the lakes at the 1-m depth

	Barnes L.	Round-up L.	L. Lye	Boitano L.	L. Jackson	L. Greer	Rock L.	Nr. Phalarope	Westwick L.	Sorenson L.	Nr. Op. Crescent	Box 17	Barkley L.	East L.	Box 27
Tanypus punctipennis Meigen					x	x	x			x		x	x		x
**Derotanypus alaskensis* (Malloch)	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Derotanypus n.sp.				x	x	x	x	x				x	x	x	
**Procladius bellus* (Loew)					x		x		x		x	x	x	x	x
Procladius nietus Roback						x	x			x				x	
Procladius freemani Sublette	x	x	x	x		x	x		x	x		x	x	x	
Procladius ruris Roback	x	x	x	x							x				
Procladius dentus Roback	x	x	x	x			x		x	x	x		x	x	
Procladius clavus Roback	x	x	x	x											
Procladius sublettei Roback		x	x	x											
Procladius n.sp.	x														
**Ablabesmyia peleensis* (Walley)													x	x	x
Eukiefferiella n.sp.												x			
**Cricotopus abanus* Curran												x	x	x	x
Cricotopus flavibasis Malloch		x	x	x	x	x	x	x	x	x	x	x	x	x	
Cricotopus trifasciatus (Panzer)						x		x					x		
Acricotopus nitidellus (Malloch)										x					
**Psectrocladius barbimanus* (Edwards)	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Psectrocladius zetterstedti Brundin															x
Psectrocladius n.sp.					x	x	x	x	x	x					
**Chironomus anthracinus* Zetterstedt				x	x	x	x	x	x	x	x	x	x	x	
Chironomus atrella (Townes)										x					
**Chironomus tentans* Fabricius				x	x	x	x	x	x	x	x	x	x	x	
Chironomus plumosus (Linnaeus)				x			x				x		x		
**Chironomus athalassicus* Cannings	x	x	x	x	x	x	x	x	x	x	x	x	x	x	
Chironomus n.sp.								x							
**Einfeldia pagana* (Meigen)	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
**Cryptochironomus psittacinus* Meigen		x	x	x											
**Cryptotendipes ariel* (Sublette)	x	x	x	x											
Endochironomus nigricans Johannsen							x					x		x	
**Glyptotendipes barbipes* (Staeger)	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Polypedilum n.sp.		x							x						
Tanytarsus gracilentus Holmgren	x	x	x	x											
Tanytarsus holochlorus Edwards	x		x	x					x	x		x	x		x

*Species with associated larvae and adults.

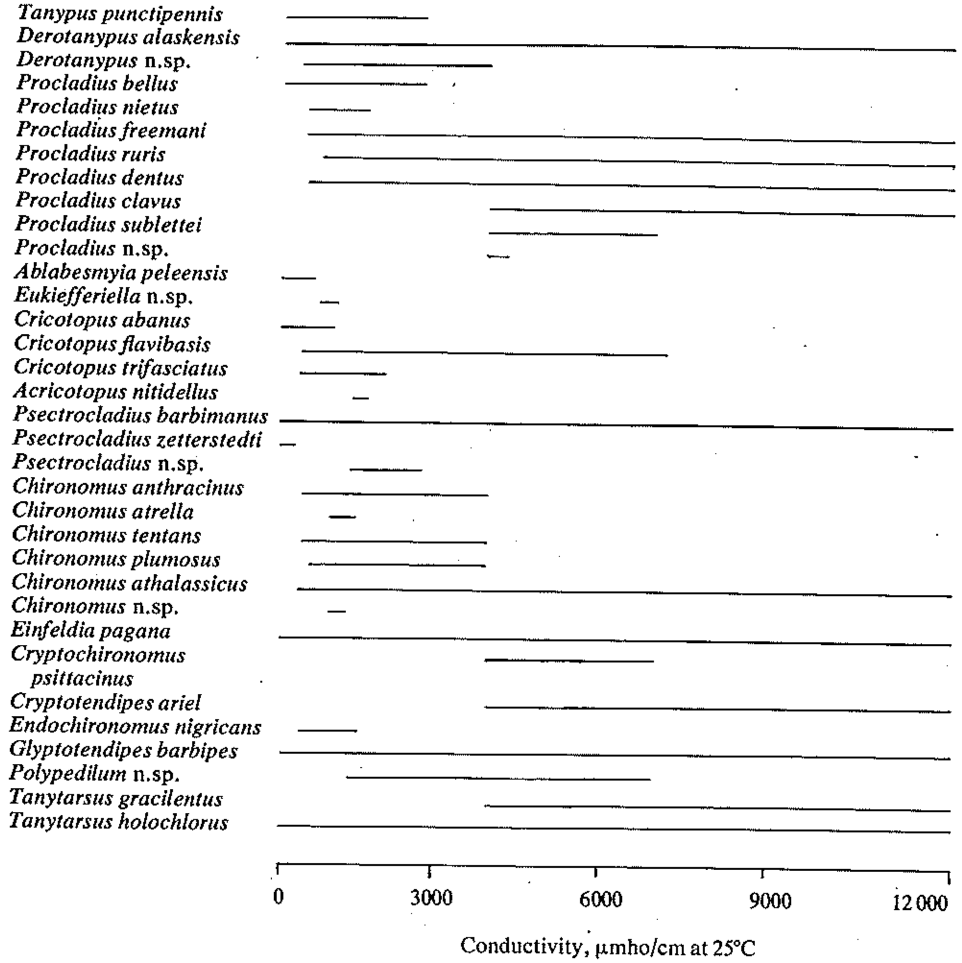


FIG. 3. Distribution of Chironomidae with respect to water conductivity.

larvae is the lowest in the lake series (Fig. 4). The chironomid fauna is very distinctive. Only three emerging species were trapped: *Procladius bellus* (64%), *Ablabesmyia peleensis* (14%), and *Cricotopus abanus* (22%). *Procladius bellus* and *A. peleensis* are free-living tanypodine predators.

The Glyptotendipes barbipes – Einfeldia pagana Association

These two species dominate lakes having mean conductivity measures ranging from 488 (East L.) to 2766 (L. Jackson) µmho/cm. (Table 1). The main predatory chironomid is *Derotanypus alaskensis*.

The group is conveniently divided into three subgroups depending on the abundance of species secondary to *G. barbipes* and *E. pagana*. (i) The *Cricotopus – Chironomus anthracinus* subgroup contains species prominent in three lakes (East L., Barkley L., Box 17) having conductivities ranging from 488 to 741 µmho/cm and TDS of 372 to 571 mg/ℓ. The Orthocladiinae, especially the genus *Cricotopus*, are important, and the genus *Chironomus*, represented especially by *C. anthracinus*, makes an appearance. (ii) The *Chironomus tentans* subdivision includes species characteristic of conductivities from 810 to 1500 µmho/cm (Near Opposite Crescent to Rock L.). It reaches its most distinctive form in Westwick and Sorenson Lakes wherein the most important features are high levels of organic carbon, low oxygen tensions, *Najas* beds in deep mud, *Scirpus validus* at the margins, and large mats of *Spirogyra*. At 1 m the characteristic chironomid is *C. tentans*. (iii) *Chironomus athalassicus* is characteristic of the most saline lakes dominated by *G. barbipes* and *E. pagana* (L. Greer and L. Jackson) with an upper limit of 2766 µmho/cm conductivity and 2.5‰ salinity. Large blue-green algal blooms (*Aphanizomenon*) are common from June to September.

The major predaceous chironomid is

TABLE 3. Percentage composition of predominant species in the littoral zone of the lakes based on emerging adults (A) and bottom-dwelling larvae (L); larval percentages (all instars) are in parentheses. Adult sample size ranges from 80 (Box 27) to 919 (Boitano L.); larval sample size from 292 (Box 27) to 8600 (Near Opposite Crescent)

	A	L
Barnes L.		
Chironomus athalassicus	46	(57)
Cryptotendipes ariel	17	(25)
Procladius clavus	30	—
Procladius dentus	4	(8)*
Others	3	(10)
Boitano L.		
Tanytarsus gracilentus	71	(23)*
Chironomus athalassicus	16	(12)
Procladius freemani	4	(17)*
Derotanypus alaskensis	2	(10)
Others	7	(38)
Rock L.		
Einfeldia pagana	37	(39)
Glyptotendipes barbipes	31	(19)
Derotanypus alaskensis	15	(4)
Chironomus anthracinus	—	(16)
Others	17	(22)
Round-up L.		
Cryptotendipes ariel	47	(18)
Tanytarsus gracilentus	24	(9)*
Procladius clavus	10	(49)*
Cryptochironomus psittacinus	—	(10)
Others	19	(14)
L. Jackson		
Einfeldia pagana	35	(67)
Glyptotendipes barbipes	29	(17)
Chironomus athalassicus	16	(7)
Derotanypus alaskensis	9	(5)
Others	11	(4)
Near Phalarope		
Einfeldia pagana	—	(54)
Glyptotendipes barbipes	8	(15)
Psectrocladius barbimanus	65	—
Derotanypus alaskensis	5	(10)
Others	22	(21)
L. Lye		
Tanytarsus gracilentus	28	(12)*
Derotanypus alaskensis	25	(35)
Procladius clavus	9	(34)*
Psectrocladius barbimanus	32	(2)
Others	6	(17)
L. Greer		
Einfeldia pagana	20	(52)
Glyptotendipes barbipes	22	(31)
Chironomus athalassicus	16	(6)
Derotanypus alaskensis	22	(3)
Others	20	(8)
Westwick L.		
Einfeldia pagana	73	(43)

TABLE 3. (*Concluded*)

	A	L
Derotanypus alaskensis	4	(13)
Others	4	(19)
Sorenson L.		
Einfeldia pagana	18	(20)
Glyptotendipes barbipes	36	(18)
Chironomus tentans	18	(22)
Derotanypus alaskensis	—	(12)
Others	28	(28)
Barkley L.		
Einfeldia pagana	21	(73)
Glyptotendipes barbipes	21	(17)
Psectrocladius barbimanus	12	—
Cricotopus flavibasis	12	—
Others	34	(10)
Near Opposite Crescent		
Einfeldia pagana	31	(51)
Glyptotendipes barbipes	65	(27)
Derotanypus alaskensis	1	(2)
Chironomus tentans	—	(1)
Others	3	(19)
East L.		
Einfeldia pagana	25	(54)
Glyptotendipes barbipes	29	(27)
Derotanypus alaskensis	23	—
Cricotopus flavibasis	11	—
Others	12	(19)
Box 17		
Einfeldia pagana	23	(41)
Glyptotendipes barbipes	29	(31)
Chironomus anthracinus	20	(3)
Cricotopus abanus	14	—
Others	14	(25)
Box 27		
Procladius bellus	64	(24)
Cricotopus abanus	22	(53)
Ablabesmyia peleensis	14	—
Einfeldia pagana	—	(5)
Others	—	(18)

*Larvae of this genus, probably mostly of this species.

tanypus alaskensis which reaches its greatest density in the higher salinities. The most interesting observation concerning the *G. barbipes–E. pagana* association is the fact that the three species of *Chironomus* are found in all 10 lakes, but at 1 m each is most prominent in a particular group of lakes. Thus *C. anthracinus* reaches greatest proportions in the fresher lakes, *C. tentans* in the medium salinities, and *C. athalassicus* in the most saline lakes dominated by *G. barbipes* and *E. pagana*.

The Tanytarsus gracilentus – Cryptotendipes ariel Association

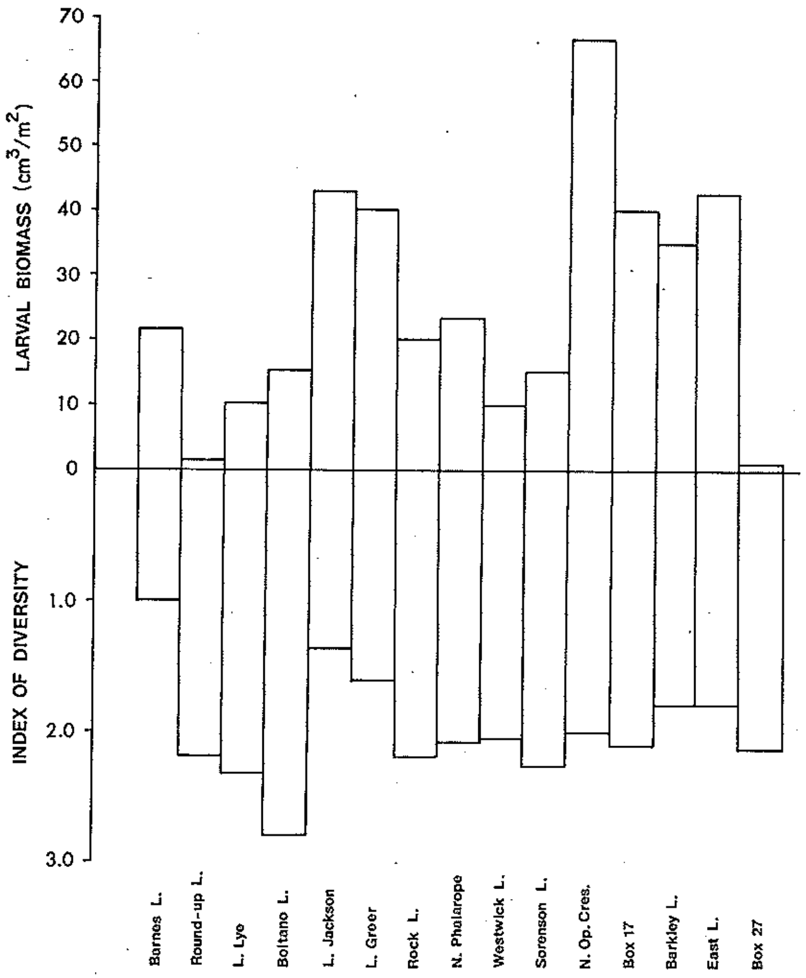


FIG. 4. Larval biomass and index of diversity in the lakes.

with conductivities up to 12 000 μmho/cm and mean pH from 8.9 to 9.3 (Boitano L., L. Lye, Round-up L., and Barnes L.). *Tanytarsus gracilentus* is one of the dominant species in the lower salinities of this lake series; it tends to be replaced by *Cryptotendipes ariel* as the salinity increases. *Chironomus athalassicus* is the major component of the Barnes L. chironomid fauna (57% of larvae and 46% of emerging adults) and makes up 12% of the larvae and 16% of the emerging chironomids in Boitano L. It is not abundant in Round-up L. or L. Lye. *Derotanypus alaskensis* is most abundant in L. Lye, but is largely replaced by *Procladius clavus* as the main predaceous chironomid in the high salinities of Round-up and Barnes lakes.

The biomass figures for this association of species are relatively low (Fig. 4). Although there and especially Boitano L. (2.74) are relatively high. Barnes L. has the lowest index of all the lakes (0.90), certainly a reflection of the lake's high salinity. The biomass is about 16 times that of Round-up L. principally because of the presence of large numbers of *Chironomus athalassicus*, a species that reaches a considerable size.

Discussion

It has long been known that the aquatic Diptera (and Chironomidae in particular) represent one of the most diverse and adaptable freshwater groups. Suworow (1908) found a species of *Chironomus* in Lake Bulack on the Kirgiz Steppe in salinities of 285‰, eight times the salinity of the sea. *Chironomus plumosus* is known to live in nature at pH of 2.3 (Harp and Campbell 1967).

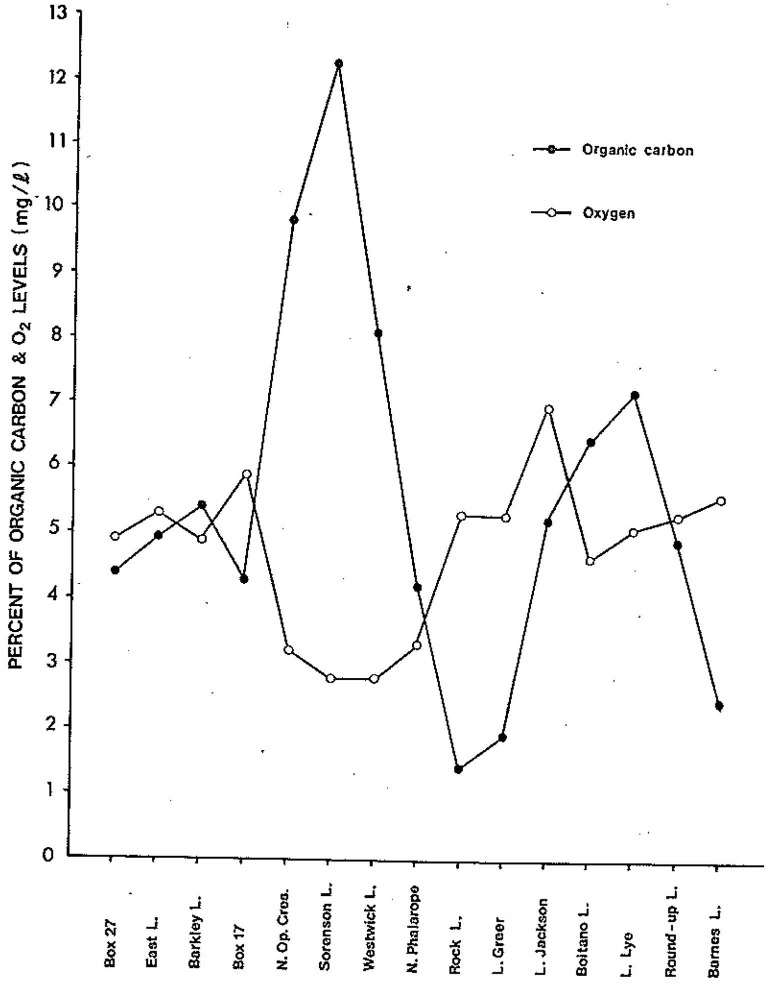


FIG. 5. Oxygen levels and organic carbon content of mud in the lakes.

ion patterns described? In the past, chironomid listribution data has largely come from studies on he classification of lake types using the dominant ›rofundal chironomid fauna present (Humphries 936; Brundin 1949, 1951). This classification was nainly the result of differential tolerance of oxygen eficits (correlated to productivity levels), by the arious chironomid species. As Saether (1975) otes, the littoral zone does not characterize a lake s a whole in the same way as the profundal zone, ut merely a local habitat of the lake. Nevertheless, eneral patterns of littoral productivity, affected y, or in conjunction with, solute concentration nay affect the distribution of the chironomid pecies under consideration. A saline lake series as never before been studied in this context.

The similar morphometry and the lack of ther-nocline formation in the lakes under study (or at

under consideration) results in comparable oxygen concentrations throughout the lake series. As oxygen would seem to have little influence on overall distribution patterns, an examination of productivity trends could be instructive.

It might be expected that organic carbon would be a suitable measure of general productivity, with oxygen levels decreasing in areas of abundance much in the way oxygen deficits appear in highly eutrophic waters. Although organic carbon and oxygen levels show an inverse relationship (Fig. 5), there is not much indication that these parameters follow the general trend of increasing productivity with increasing salinity (Rawson and Moore 1944). A high abundance of chironomids in Westwick and Sorenson lakes might be expected since the organic carbon levels peak there, but the larval density is quite low. Furthermore, these low numbers are

to withstand easily the lower oxygen levels present. No indication that this paucity was owing to increased predation was found.

The photosynthetic activity in the lake studies was not examined. Preliminary light and dark bottle studies have recently been instigated, however, and seem to indicate that the fresh and moderately concentrated lakes display three to five times the photosynthetic production of the very saline water bodies (Reynolds, personal communication). The lakes where the *Glyptotendipes barbipes – Einfeldia pagana* association prevails have salinities ranging from 0.3 to 2.5‰ (mean conductivities ranging from 448 to 2766 μmho/cm). These concentrations are not so high as to adversely affect primary production and consequently the lakes have a large phytoplankton stock and in most cases a peripheral belt of emergent vegetation. Such eutrophic conditions are ideal for the larger Chironomini. Moreover, there is some evidence that the fresher lakes are less productive than the moderately saline ones, according to Reynolds (personal communication). In Box 27 the chironomids usually dominating the substrate of the lakes are conspicuously few, while *Chironomus* species are entirely absent. This is no doubt owing to the lack of dissolved nutrients and resulting low level of phytoplankton. Lellak (1965) and Jonasson (1954) note that the production of *Chironomus* species is dependent on the amount of phytoplankton in the water column.

Amounts of dissolved solids in the water are often used as measures of productivity. In a large number of British Columbia lakes Northcote and Larkin (1956) found that plankton and benthic fauna increased with increasing TDS, although the concentrations they considered were comparable with only the fresher lakes in the present study. Rawson and Moore (1944) examined a large number of lakes on the Saskatchewan prairie, some of them very similar to the lakes in the Cariboo–Chilcotin area, and observed a trend of increasing abundance of bottom fauna with increasing TDS up to a concentration of 2250 ppm (about 2700 μmho/cm conductivity). The number of bottom organisms decreased past this point. A salinity of 2250 ppm approximates that of L. Jackson.

Figure 4 shows the chironomid larval biomass in the lake series and reveals a similar decrease in concentrations above 2250 ppm. The low levels in Rock L., Near Phalarope, Westwick L., and Sorenson L. are anomalous in this context; a linear regression performed on the graph showed the probability of the slope being zero was 0.29. It is

is a poor indicator of relative productivity in lakes and that the inclusion of other benthic and planktonic organisms would alter the relative biomass results. Indeed, Topping (1975) has shown that seasonal standing crop of plankton plotted against total dissolved solids for these same lakes, shows a positive curvilinear function, and has indicated also a decrease in productivity at higher values of total dissolved solids.

Chironomid biomass in the eutrophic, blue-green algae rich L. Greer and L. Jackson is high, mainly owing to large numbers of *Glyptotendipes barbipes*, *Einfeldia pagana*, and *Chironomus athalassicus*. But because of this domination the numbers of species and the diversity are low. The biomass in the four lakes representing salinities above 3‰ is very low while the diversities in the freshest two of these lakes (Boitano L., L. Lye) are higher than in any other lake, perhaps owing to the presence of species that can tolerate high salinities as well as moderate ones.

Although it is expected that rooted plants complicate any environment and encourage diversity by increasing niches and stabilizing interactions (Wohlshlag 1950), the absence of rooted plants in the high-salinity lakes does not seem to have a great effect on diversity. The very low diversity in Barnes L. is certainly a reflection of very high ionic concentrations rather than the result of any reduced complexity owing to the absence of aquatic plants. Primary production in the higher salinities is reduced. This, along with the above-mentioned productivity–diversity relationship in L. Greer and L. Jackson, reinforce MacArthur's (1965) contention that an increase in productivity is not always accompanied by an increase in diversity.

The increase in chironomid biomass in Barnes L. is owing to the high densities of *Chironomus athalassicus* which reaches a considerable size. The reasons for the low numbers of this species in Round-up L. and L. Lye are not clear, but it would seem to be something other than solute concentration. *Chironomus athalassicus* occurs in greatest numbers where the diversity is lowest; this low diversity does not seem to be entirely a result of its own high numbers. In similar situations, the absence from fresher water of a species adapted to high salinities is not owing to hyporegulation difficulties, but is more likely to be the result of biotic interactions leading to exclusion by other species (Beadle 1943; Lauer 1969; Scudder *et al.* 1972).

In the lake series as a whole, it would seem that the basic distributional pattern is largely the result

TABLE 4. Lake chemistry and predominant littoral chironomid associations in the lakes

	Box 27	East L. → L. Jackson	Boitano L. → Barnes L.
Conductivity, μmho/cm	40–80	400–2800	4100–12 000
pH	6.4	8.3–9.0	8.9–9.3
Chironomid associations	*Cricotopus abanus* *Procladius bellus*	*Glyptotendipes barbipes* *Einfeldia pagana*	*Tanytarsus gracilentus* *Cryptotendipes ariel*

ery low densities of larvae and the high diversity in ox 27 are notable; its chironomid fauna, angio- perm flora, and chemistry give the lake a special lace in the lake series. In salinities above that of ox 27 the species types change markedly and the akes are characterized by large, mud-dwelling pecies of the Chironominae having very high ensities, a typical situation in productive ponds. It s interesting to note that the Orthocladiinae *Cricotopus*, etc.), usually prevalent in unproduc- ive waters, are most evident in lakes with low alinities. If the figure of Williams (1966) is adopted, hose lakes with a salinity of 3‰ (Boitano L.) and bove can be classed as saline like the lakes de- cribed by Decksbach (1924), Hutchinson *et al.* 1932), Rawson and Moore (1944), and Bayly and illiams (1966). This demarkation applies nicely to is study since the change from a chironomid una typical of highly productive waters to a com- unity rather restricted to high salinities occurs at is 3‰ salinity point (Table 4). In conclusion, it ay be noted that in the saline lakes studied the eshest waters appear to be distinct from the edium salinities while lakes having salinities reater than 3‰ have physical, chemical, and bio- gical characteristics peculiar to themselves.

Acknowledgements

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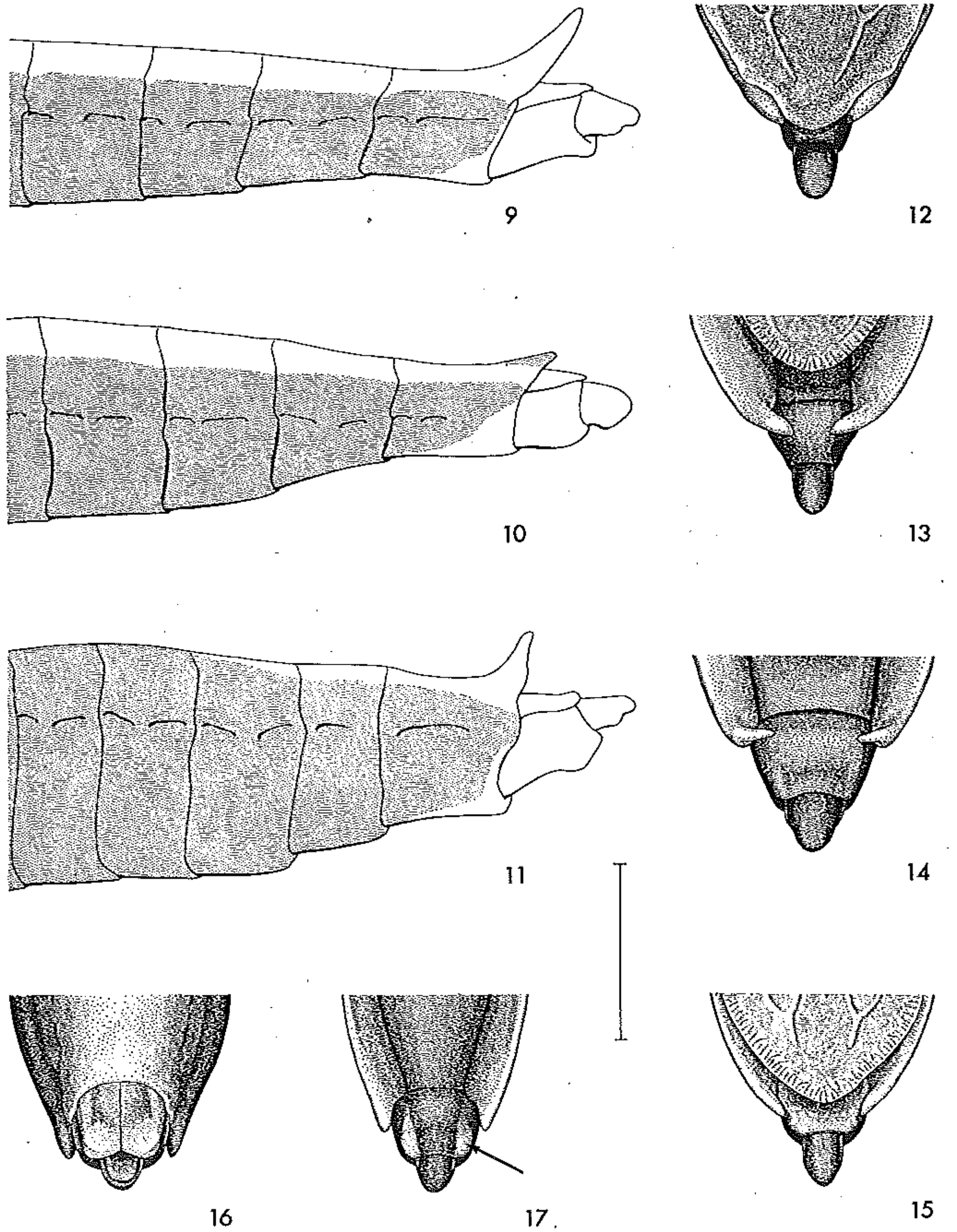

Figs. 9-17. 9-11, Side view of abdomen of female **Gerris**: 9, **G. incognitus**; 10, **G. incurvatus**; 11, **G. pingreensis**. 12-15, dorsal view of terminal part of abdomen of female **Gerris**: 12, **G. incognitus**; 13, **G. incurvatus**; 14, **G. pingreensis**; 15, **G. comatus**. 16-17, structure of end of abdomen in female **G. buenoi**: 16, ventral view; 17, dorsal view. Scale line = 1.00 mm.: colour pattern shown only on pregenital segments in Figs. 9-11.

THE GERRIDAE (HEMIPTERA) OF BRITISH COLUMBIA

G. G. E. SCUDDER[1]

ABSTRACT

Eight species of **Gerris** are recorded from British Columbia. The distribution and co-existence is documented and a key to species is included.

INTRODUCTION

Downes (1927) has reported six species of Gerridae from British Columbia, namely *G. buenoi* Kirk., *G. incognitus* D. & H., *G. incurvatus* D. & H., *G. notabilis* D. & H., *G. remigis* Say and *G. rufoscutellatus* Latr. Drake & Harris (1934) added *G. nyctalis* D. & H. to the list and noted that *G. rufoscutellatus* did not occur in North America; this has been confirmed by Kelton (1961). Three additional species have been recorded from British Columbia in the very early literature, *G. marginatus* Say (Parshley, 1921), *G. dissortis* D. & H. (Criddle, 1926) and *G. gilletti* Leth. & Sev. (Bueno, 1925). However, these latter species have not been recognised in recent studies on the fauna of the province.

In research on the fauna of saline lakes in the interior of British Columbia (Scudder, 1969a), I have discovered two additional species that have not previously been recorded from the Province, namely *G. comatus* D. & H. and *G. pingreensis* D. & H. It thus is appropriate to review the records of this family in British Columbia, to assess their occurrence and distribution, and to give a key to the species.

MATERIAL AND METHODS

Most of the material considered in this paper is located in the Spencer Entomological Museum at the University of British Columbia (U.B.C.). The waterbodies mentioned in the Cariboo and Chilcotin areas of the interior are listed in full in Scudder (1969a, 1969b). Additional records from insects in the Canadian National Collection (C.N.C.) have also been obtained.

RESULTS

This study has shown that eight species of *Gerris* are present in British Columbia. The records of *G. dissortis*, *G. gilletti*, *G. marginatus* and *G. rufoscutellatus* have not been confirmed.

The eight species and their distribution are as follows:

Gerris buenoi Kirkaldy

Gerris buenoi Kirkaldy 1911, Ent. News 22: 246 (Orig. descr.)

Gerris buenoi, Drake & Harris, 1934, Ann. Carnegie Mus. 23: 195 (Descr.)

Gerris buenoi, Brooks & Kelton, 1967, Mem. ent. Soc. Can. 51:47 (Descr.)

A small species, recognised by the pale lateral pronotal stripe, and the short and broad genital segments. It is known mostly from macropterous specimens in B.C., but short-winged and apterous individuals also are present. The species is widely distributed in the province on small freshwater lakes and ponds. Observations on the life history of this species have been made by Hoffman (1924) and the fifth instar larva has been described by Sprague (1967).

B.C. Material examined: Brunson L., vi (G.G.E.Scudder); Boitano L., v (G.G.E.S.); Cariboo, 83 mile, v (G.G.E.S.); pothole near Boitano L., vi (G.G.E.S.); Chilcotin — Moon's L., East L., Box 17, Nr. Phal., Crescent pothole, iv-v (G.G.E.S.); Clinton, 6 mile lake, vi (G.G.E.S.); Dutch Creek, vi (G.G.E.S.); Fort St. John, vi (A. B. Acton); Kamloops, ix (G.J.Spencer); Lac du Bois area (LB3) near Kamloops, v (G.G.E.S.); Kinbasket, vi (G.G.E.S.); Loon Lake, v (G.G.E.S.); Malahat, viii, ix (W.Downes); Manning Park, beaver pond, viii (G.G.E.S.); Marion Lake, v (G. Jamieson); McIntyre Lake, vi (G.G.E.S.); Nicola, vii (G.J.S.); Osoyoos, iii (H.B.Leech); Quesnel, vi (G.J.S.); Quick, viii (G.J.S.); Saanich Distr., vi, ix (W.D.); Springhouse, v-vi (G.G.E.S.); Steelhead, ix (G.G.E.S.); Vancouver, ix (W.D.); Victoria, vii (W.D.); Westbank, ix (W.D.); Westwick Lake, v-vi (G.G.E.S.); Williams Lake Distr., v (G.G.E.S.); W. Crescent Valley, v (J. Sheppard) (U.B.C.). Creston, v (G. Stace-Smith); Summerland, iv (A.N.Gartrell) (C.N.C).

Range: a transcontinental species occurring throughout the northern part of the United States and southern Canada (Drake & Harris, 1934; Moore, 1950; Strickland, 1953; Brooks & Kelton, 1967; Cheng & Fernando, 1970). I have also seen specimens from Mile 550, Alaska Highway, 31.v.1962 (I. Stirling). Recorded previously from

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Saanich by Parshley (1921) and Vancouver by Downes (1927).

Gerris comatus Drake & Harris

Gerris comatus Drake & Harris 1925. Ohio J.Sci. 25:270 (Orig. descr.)

Gerris comatus, Drake & Harris, 1934, Ann. Carnegie Mus. 23:193 (Descr.)

Gerris comatus, Brooks & Kelton, 1967, Mem. ent. Soc. Can. 51: 46 (Descr.)

This species is without a pale lateral stripe on the pronotum. The male has distinct lateral tufts of long hairs on the genital segment (segment VIII) and the female has the connexivum of segment VII not greatly incurved dorsally. Macropterous insects outnumber micropterous forms (9:1) in the B.C. material studied. The species seems to be confined to the central and northern interior of the province. The fifth instar larva has been described by Sprague (1967).

B.C. Material examined: Brunson L., vi (G.G.E.S.); Cariboo, pothole near Boitano L., vi (G.G.E.S.); Cariboo, Sorenson L., v (G.G.E.S.); Cariboo, Springhouse, v (G.G.E.S.); Cariboo, 155 mile, Old Cariboo Hwy., v (G.G.E.S.); Chilcotin, Moon's L., East Lake, v-vi (G.G.E.S.); Fort St. John, vi (A.B.A.); Stuart L., viii (G.J.S.); Vanderhoof, viii (G.J.S.); Williams Lake Distr. vi (G.G.E.S.) (U.B.C.). Rolla, vii (P.N.Vroom) (C.N.C.).

Range: from the Atlantic coast, east to Montana, being recorded from most of the intervening states (Drake & Harris, 1934). In Canada recorded from Ontario (Drake & Harris, 1934: Cheng & Fernando, 1970), Quebec (Moore, 1950), Alberta (Strickland, 1953), Manitoba, and Saskatchewan (Brooks & Kelton, 1967). Not previously recorded from B.C.

Gerris incognitus Drake & Harris

Gerris incognitus Drake & Harris 1925, Proc. Biol. Soc. Wash. 38: 73 (Orig. descr.)

Gerris incognitus, Drake & Harris, 1934, Ann. Carnegie Mus. 23: 193 (Descr.)

A species with pale lateral stripe to the pronotum, and male with distinct lateral tufts of long hairs on the genital segment (segment VIII). Macropterous and apterous forms occur in about equal numbers in the material examined. This species has been recorded mostly in the southern parts of the province and on the west coast. However, it does occur in the Kootenays and the interior.

B.C. material examined: Cariboo, 83 mile, v (G.G.E.S.); Courtenay, ii; Galiano Is. iv (G.G.E.S.); Hat Creek, vii (G.J.S.); Kimberley, North Star Mt., slough at 4,500 ft., v (I. Stirling); Lakelse Lake, v (R. Drent); Kamloops, vi (G.J.S.) Marion Lake, v-vi, viii (J. Maynard; G.J.); Qualicum, v (W.D.); Queen Charlotte Is.: Port Clements, Tlell, iii (A.B.A.); Texada Is., Paxton L., v (G. Larsen); Vancouver, iii, v-vi (G.J.S.; G.G.E.S.; H.B.L.); W. Crescent Valley, v (J.S.) (U.B.C.) Mission City, vi (E. Mason); Mt. Revelstoke, vii (G.J.S.); Squamish, 3200 ft., viii (G.J.S.) (C.N.C.).

Dr. L. Kelton informs me that the C.N.C. also contains specimens from Rolla.

Range: A western North American species for the most part, being recorded from Washington, Oregon, California, Montana, Idaho, British Columbia (Kaslo) (Drake & Harris, 1934). However, it is also reported from Quebec (Drake & Harris, 1934; Moore, 1950). Recorded from Goldstream in B.C. by Downes (1927).

Gerris incurvatus Drake & Harris

Gerris incurvatus Drake & Harris 1925, Proc. Biol. Soc. Wash. 38: 71 (Orig. descr.)

Gerris incurvatus, Drake & Harris, 1934, Ann. Carnegie Mus. 23:192 (Descr.)

A moderate sized species, without a pale stripe laterally on the pronotum, and the male without lateral tufts of long hairs on the genital segment. The species is widely distributed in the province. Macropterous and short-winged forms have been examined and the former is most abundant in the B.C. material studied.

B.C. material examined: Endiver, vi (G.G.E.S.); Hat Creek, vii (G.J.S.); Kamloops, vi, viii (G.J.S.); Malahat, ix (W.D.); Marion Lake, iv-viii (J.M.; G.J.); Nicola, vi-vii (G.J.S.); Saanich Distr., ix (W.D.); Saanich Distr., Elk L., iv (W.D.); Vancouver, v-vi (G.J.S.; H.B.L.); Vernon, ix (W.D.); previously determined by H. B. Hungerford as *G. marginatus;* Victoria, vii (W.D.); Wellington, vi; West Vancouver, Lions Bay, v (G.J.S.) (U.B.C.). Copper Mt., v (G.S.-S.); Douglas Lake, vii (N.C.); Minnie Lake, vii (N.C.) (C.N.C.).

Material from Summerland and White Lake is also present in the C.N.C.

Range: A western species, recorded from Washington, Oregon, California, Idaho, Montana and British Columbia (Drake & Harris, 1934). Drake & Harris (1934) also record the species from Illinois. It was recorded from Saanich and Vernon by Downes (1927), who also noted that this is the species that was reported from Beaver Lake as *G. marginatus* by Parshley (1921).

Gerris notabilis Drake & Hottes

Gerris notabilis Drake & Hottes 1925, Ohio J.Sci. 25:46 (Orig. descr.)

Gerris notabilis, Drake & Harris, 1934, Ann. Carnegie Mus. 23: 189 (Descr.)

Gerris notabilis, Brooks & Kelton, 1967, Mem.ent.Soc.Can. 51: 45 (Descr.)

A rather large and slender, somewhat rufous species, with sternum VII of male simply emarginate. It is widely distributed in the province. Drake & Harris (1934) note that the species usually inhabits streams and is only known as the macropterous form.

B.C. material examined: Adams River, viii (G.J.S.); Aleza Lake, vii (H. Barclay); Cariboo, pothole near Boitano Lake, vi (G.G.E.S.); Brunson Lake vi (G.G.E.S.); Cariboo, Springhouse, v (G.G.E.S.); Cedarvale, viii (G.J.S.); Chilcotin, v-vi (G.G.E.S.); Duncan, ix (W.D.); Endiver, vi (G.G.E.S.); Florence Lake, xi (G.M.Neal); Forbidden Plateau, viii; Goldstream, vii (K.F.Auden); Haney, ix (W.D.); Hat Creek, vii (G.J.S.); Jesse Is., vi (G.J.S.); Kamloops, vi (G.J.S.); Kinbasket, vi (G.G.E.S.); Lake Cowichan, vi-viii (R.W.Pillsbury); 5 mi. E. of Lone Butte, vii (A.Jansson); Malahat, ix (W.D.); Marion Lake, v, viii (J.M.; G.J.); McIntyre Lake, vi (G.G.E.S.); New Westminster, ix (W.D.); Nicola, vii (G.J.S.); 30 Mls. E. of Prince George, viii (G.G.E.S.); Saanich, vi (W.D.); Vancouver, v (G.J.S.); Vancouver, Mt. Seymour, vii (H.B.L.); Vancouver, Mt. Seymour, Nacy Lake, ix (R. Leech); Vernon, x (W.D.); Vanderhoof, vii (G.J.S.); Victoria, ix (G.J.S.); Walhachin, vii (E.R.Buckell); Westwick Lake (outlet of Sorenson Lake), v (G.G.E.S.); W. Crescent Valley, v (J.S.) (U.B.C.). Copper Mt., v (G.S.-S.); Keremeos, vii (J.E.H.Martin); Minnie Lake, vii (N.C.); Mission City, v (G.J.S.); Summerland, ix (A.N.G.); Vaseaux Lake, v (A.N.G.); Westbank, iv (A.N.G.) (C.N.C.).

In the C.N.C. there are specimens also from Kitimat, Mt. Adams, Mt. Revelstoke, Queen Charlotte Is., and Terrace.

Range: California, Oregon, British Columbia, Idaho, Montana, Wyoming, Utah, Colorado, Iowa (Drake & Harris, 1934), Alberta (Brooks & Kelton, 1967). Recorded from Saanich and Vernon by Downes (1927), who notes that this was reported by Parshley (1919) as *G. rufoscutellatus.*

Gerris nyctalis Drake & Hottes

Gerris nyctalis Drake & Hottes 1925, Ohio J.Sci. 25: 47 (Orig. descr.)

Gerris nyctalis, Drake & Harris, 1934, Ann. Carnegie Mus. 23: 190 (Descr.)

This species is very similar to *G. remigis*, but the male of *G. nyctalis* has a broader keel on the genital segment: usually apterous, but macropterous individuals are known (Drake & Harris, 1934). I have not seen material of this species from British Columbia, but Dr. L. A. Kelton informs me that there is material from Yahk in the C.N.C.

Range: Idaho, Colorado, Montana, Washington, California, eastern British Columbia, Newfoundland (Drake & Harris, 1934), Quebec (Moore, 1950), Alberta (Strickland, 1953).

Gerris pingreensis Drake & Hottes

Gerris pingreensis Drake & Hottes 1925, Ohio J.Sci. 25: 49 (Orig. descr.)

Gerris pingreensis, Drake & Harris, 1934, Ann. Carnegie Mus. 23: 194 (Descr.)

Gerris pingreensis, Brooks & Kelton, 1967, Mem.ent.Soc.Can. 51: 46 (Descr.)

A moderate sized species without long silvery hair tuft on the genital segment of the male, but with a pale lateral stripe on the pronotum and abdominal sternum VII with a median longitudinal impression. The species would seem to be confined to the interior and northern part of British Columbia. Apterous individuals seem to outnumber macropterous forms (3:1).

B.C. material examined: 45 mls. N. of Atlin, vi (A.B.A.); Boitano L., v (G.G.E.S.); pothole near Boitano L., vi (G.G.E.S.); Chilcotin: Barkley Lake, Box 17, Moon's Lake, Round-up Lake, v-vi (G.G.E.S.); Clinton (LE 4), viii (G.G.E.S.); Dease Lake, viii-ix (I.S.); Fort St. John, vi (A.B.A.); Kamloops, Lac du Bois area, v-vi (G.G.E.S.); Loon Lake, v (G.G.E.S.); Meadow Lake, v (G.G.E.S.); Nicola, vii (G.F.S.); Sorenson Lake, v (G.G.E.S.); Westwick Lake, v (G.G.E.S.) (U.B.C.)

Range: streams and lakes at higher altitudes of Montana, Colorado, Idaho, Alberta (Drake & Harris, 1934; Strickland, 1953), Alberta, Saskatchewan, Manitoba (Brooks & Kelton, 1967), Quebec (Moore, 1950), Yukon-NWT, 4.vii .1944 (P.A.Larkin). Not previously recorded from British Columbia.

Gerris remigis Say

Gerris remigis Say 1832, Heter, New Harmony: 35 (Orig. descr.)

Gerris remigis, Drake & Harris, 1934, Ann. Carnegie Mus. 23: 189 (Descr.)

Gerris remigis, Brooks & Kelton, 1967, Mem.ent.-Soc.Can. 51: 45 (Descr.)

A large and robust species, with pronotum rather brownish. It is widely distributed in the province: both apterous and macropterous forms are present, but the former predominate by far. The life history and habits of the species have been studied by Bueno (1917) and Riley (1921, 1922). This species frequents small brooks with rapid current (Sprague, 1967). The fifth instar larva is described and figured by Sprague (1967).

B.C. material examined: Alta Lake, v (J. Scudder); Cultus Lake, iv, viii, x (J. Boone; R.D.; G.G.E.S.); Cayuse River, vii (G.S. Brown); Coal Creek., 1.5 mls. S. Pt.-no-Pt., v (R.D.); Courtenay; Departure Bay, vi (G.J.S.); Hatzic Prairie, ix; Jordan River, vi (K. Taylor); Kelsey Bay, vii (G.G.E.S.); Lakelse Lake, v (R.D.); Lynn Valley, vii (H.B.L.); Marion Lake, ii, v, viii (G.J.; J.M.); Milner, viii (G.G.E.S.); Nanaimo, vi (G.J.S.); Nicola, vii (G.J.S.); Osoyoos, v (M. H. Ruhman); Paul Lake (Kamloops), viii (W. A. Clemens); Pavilion Lake, vi (G.G.E.S.); Penticton, iv (E.R.B.); 9m. and 12m., E of Princeton, iii (H.B.L.); Roberts Lake (Vancouver Is.), vii (G.G.E.S.); Royal Oak, vii (G.J.S.); Saanich Distr., x (W.D.); Salvus, viii (G.J.S.); Sweltzer Creek, iv. (R.D.); Trout Lake, x (M. Miyaona); Vancouver, viii (K.F.A.); Vernon, ix (H.B.L.); Victoria, vii (K.F.A.; G.J.S.); Walhachin, vi (G.J.S.); W. Crescent Valley, v (J.S.) (U.B.C.). Errock Lake, nr. Deroche, vii (G.J.S.); Keremeos, vii (J.E.H.M.); Mission City, vii (W.R.M.Mason); Oliver, ix (C.B.Garrett); Qualicum Bay, vi (R. Coyles); Summerland, viii (A.N.G.) (C.NC.).

In the C.N.C there is also material from Kleena Kleene.

Range: widely distributed in North America, and recorded from Canada in the north to Mexico and Guatemala in the south (Drake & Harris, 1934). Recorded previously from Vernon and Saanich by Downes (1927), and Jordan Meadows by Hardy (1949).

KEY TO GERRIDAE OF BRITISH COLUMBIA

Males

1. Venter with sternum VII simply emarginate (Fig. 1) .... *notabilis* D. & H.

— Venter with sternum VII double emarginate . . 2.

2. Larger species (over 11.00 mm.); first genital segment with a strong keel .... 3.

— Smaller species (under 11.00 mm.); first genital segment with a weak keel .... 4.

3. Species 11.50 - 16.0 mm. in length and brownish on the pronotum; genital keel narrower (Fig. 2) .... *remigis* Say

—Species 11.50 - 13.0 mm. in length and quite fuscous on pronotum; genital keel broader (Fig. 3) .... *nyctalis* D. & H.

4. First genital segment with a tuft of long silvery hairs on each side of keel (Figs. 4-5) .... 5.

— First genital segment without a tuft of long silvery hairs on each side of keel (Figs. 6-8) . . . 6.

5. Pronotum with pale stripe laterally; hairs on genital segment in a line (Fig. 4) .... *incongitus* D. & H.

— Pronotum without pale stripe laterally; hairs on genital segment in a tuft or group (Fig. 5) .... *comatus* D & H

6. Pronotum with pale stripe laterally .... 7.

— Pronotum without pale stripe laterally; genitalia as in Fig. 6 .... *incurvatus* D. & H.

7. First genital segment as broad as long (Fig. 7); sternum VII without a median longitudinal groove .... *buenoi* Kirk.

— First genital segment longer than wide (Fig. 8); sternum VII with a median longitudinal groove (Fig. 8) .... *pingreensis* D. & H.

Female[2]

1. Pronotum laterally with pale stripe .... 2.

— Pronotum laterally without a pale stripe ..... 6.

2. Large and rather slender species, length 15.0-20.0 mm.; with very long legs; colour rather rufous; pale stripe on pronotum laterally, usually continuous with the rather pale posterior part of the pronotum .... *notabilis* D. & H.

— Smaller species, less than 16.0 mm. in length; pale lateral stripe to pronotum not continued posteriorly .... 3.

3. Larger and robust species, over 11.0 mm. in length .... *remigis* Say.

—Smaller and less robust species, less than 11.0 mm. in length .... 4.

4. Genital segment rather quadrate (Fig. 16); tergum VIII dorsally with lateral prominences (Fig. 17); small species, 7.0-8.5 mm. in length. .... *buenoi* Kirk.

— Genital segments not quadrate (Figs. 12-15) . . 5.

5. Lateral margins of anterior abdominal sterna not broadly pale, but fuscous to margin (Fig. 11); sterna very hirsute .... *pingreensis* D. & H.

— Lateral margins of anterior abdominal sterna broadly pale (Fig. 9); sterna not densely hirsute .... *incognitus* D. & H.

6. Connexival spines on segment VII, when viewed from above, greatly incurved and directed towards centre of tergum (Fig. 13) ... . *incurvatus* D & H

—Connexival spines on segment VII, when viewed from above, not greatly incurved, but directed caudad (Fig. 15) .... *comatus* D & H

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[2] *G. nyctalis* not included.

Coexistaence in *Gerris*

'Gause's Principle, Gause's Hypothesis or the Competitive Exclusion Principle holds that two species with similar ecology cannot live together in the same place indefinitely (Gilbert *et al.*, 1952; Hardin, 1960). During the course of studies on the aquatic insects of British Columbia, several localities have been found where more than one species of *Gerris* may be observed together and breeding at the same time.

While the biology of these species has yet to be worked out in detail, it seems worthwhile to record the occurrence of this situation. Table I presents the localities where this coexistence has been observed, and the species involved are noted. Work now being undertaken hopefully will clarify the biological significance of this coexistence in *Gerris*.

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		Species						
Area	Water body	buenoi	comatus	incognitus	incurvatus	notabilis	pingreensis	remigis
Fraser Plateau	Boitano L.	x					x	
	Westwick L.	x				x	x	
	McIntyre L.	x				x		
	Brunson L.	x				x		
	Box 17	x					x	
	Moon's L.	x	x				x	
	Boitano PH	x	x			x	x	
	LB3 (nr.Lac du Bois)	x					x	
Lower Fraser Valley	Marion L.	x		x	x	x		x

TABLE 1. Records of coexistence of species of Gerris in British Columbia. Water bodies arranged in order of decreasing salinity.

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Figs. 1-8. Ventral view of genitalia of male **Gerris**. 1, **G. notabilis**; 2, **G. remigis**; 3, **G. nyctalis**; 4, **G. incognitus**; 5, **G. comatus**; 6, **G. incurvatus**; 7, **G. buenoi**; 8, **G. pingreensis**. Scale line = 1.00 mm.; colour pattern not indicated.