Verh. Internat. Verein. Limnol.	19	3127—3133	Stuttgart, Dezember 1975

Nearctic chironomids as indicators of lake typology

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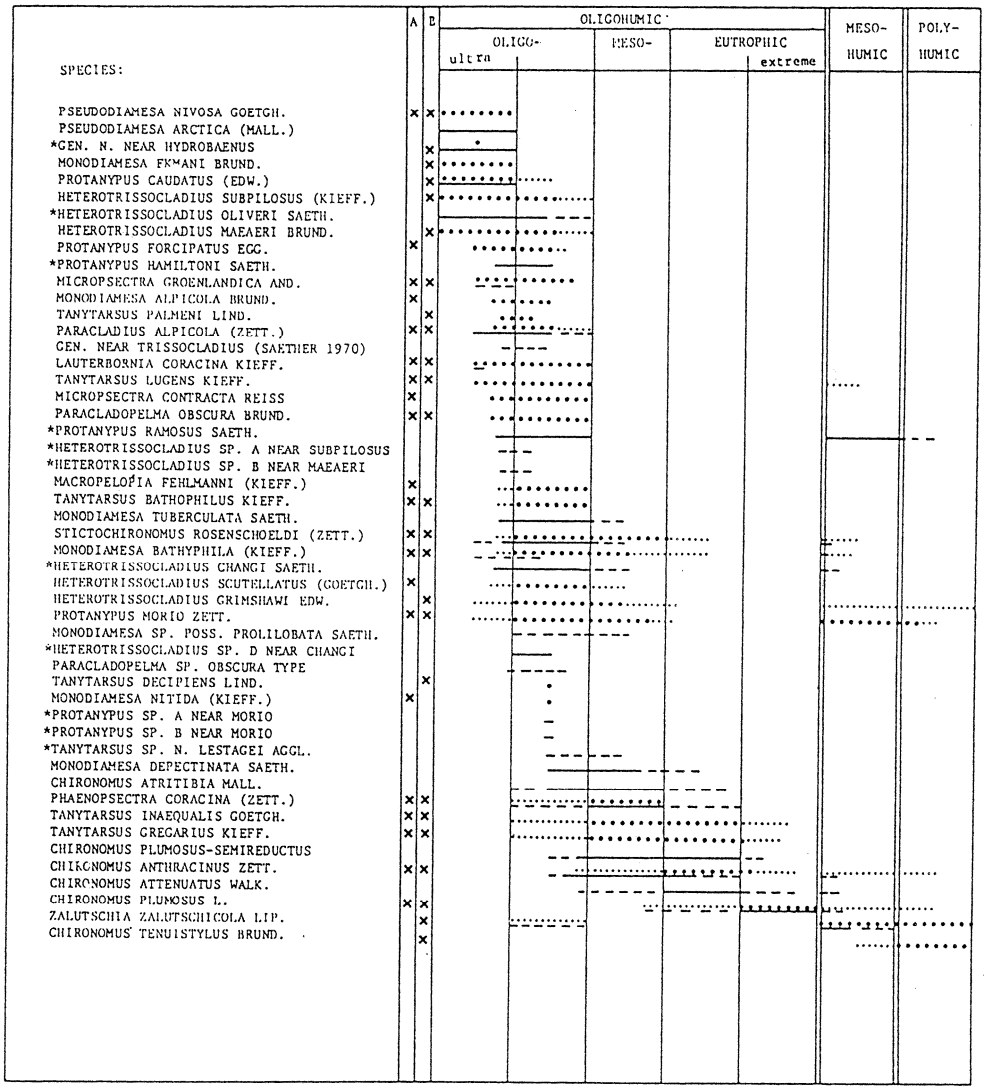
With 1 figure and 2 tables in the text

The validity of chironomid communities as indicators of trophic levels in areas outside Europe is treated by Brundin (1956). He shows that the typology founded on chironomids probably has a world-wide validity, and not only with regard to causal ecological principles, but also with regard to most of the different types of members of indicator communities chosen. The species may not be the same, but they are replaced by species within the same species group or at least by species within the same genus or closely related genera. The use of chironomids as indicators of the trophic level of lakes has, in North America, barely passed the first stage when the lakes were classified according to the genera found. The lack of knowledge of the specific identities of the typologically more important forms has prevented the development of valid lists of indicator communities with the exception of the ultraoligotrophic communities described by Oliver (1963, 1964). The paucity of information on the zoogeographic distribution and general ecology of these species has further limited their prospective usefulness. Recent and ongoing revisions in chironomid taxonomy, new descriptions and more material (Sæther 1973, 1975 a, b, c, d) have, however, made it possible to develop the first lists of indicator communities for North America (Tab. 1). Comparison with European indicator communities show a remarkable similarity in species composition. (The ecology of the European species is primarily based on Brundin 1949, 1952, 1956; Fittkau 1962; Reiss 1968 a, b; Reiss & Fittkau 1971.) Often the same closely related species will occupy a similar niche on both continents. Profundal species common to Europe and North America are the ultra-oligotrophic *Protanypus caudatus* (Edw.) and a new genus near *Hydrobaenus* Fries, the ultra- to moderately oligotrophic *Micropsectra groenlandica* And., *Paracladius quadrinodosus* Hirv. and *Lauterborniа coracina* Kieff., the moderately oligotrophic and mesotrophic *Stictochironomus rosenschoeldi* (Zett.), *Monodiamesa bathyphila* (Kieff.) and *Phaenopsectra coracina* (Zett.), the more eutrophic *Chironomus anthracinus* Zett. and *Chironomus plumosus* L. and the dystrophic *Zalutschia zalutschicola* Lip. (syn. *Trissocladius naumanni* (Brundin)). (The identification of the Nearctic specimens of *Protanypus caudatus* (Edw.), *Stictochironomus rosenschoeldi* (Zett.) and *Phaenopsectra coracina* (Zett.), however, is not quite certain.) Of these species, however, *Stictochironomus rosenschoeldi* (Zett.), *Monodiamesa bathyphila* (Kieff.) and *Chironomus anthracinus* Zett. all appear to have their Nearctic occurrences shifted towards more oligotrophic conditions. However, there are some indications that not only the temperature regime but also the light regime to a large part is governing their distribution. Thus, if this is the case, species from northern and central Europe can be expected to be restricted primarily to Canada which has a colder climate and lower number of eutrophic lakes than European areas of similar latitude (Fig. 1). The difference in ecology may thus only be apparent. The presence of competitors in Nearctic lakes which are lacking in the European lakes may also cause differences in occurrence. In Europe there are only 6 species of *Stictochironomus* and only one of them is a profundal inhabitant, while in North America there are 11 described species of the genus and probably 2—3 profundal inhabitants. In North America, *Chironomus decorus* Joh. is much more common and widespread than *Chironomus anthra-*

Tab. 1. Characteristic profundal chironomids in Nearctic (- - - - -) and Palaearctic lakes (. . . .). (After this paper went to press I found that the specimesn called *Paracladius alpicola* ZETT. mostly belong to *P. quadrinodosus* HIRV. *Chironomus attenuatus* WALK. is a nomen dubium and should be replaced by *Chironomus decorus* JOH. in the tables.)



A: IN EUROPE, ALPINE

B: IN EUROPE, BOREAL

*: NEW SPECIES OR NEW COMBINATION, IN PRESS

cinus ZETT. and *C. decorus* JOH. appears to have take the ecological niche occupied by *C. anthracinus* ZETT. in Europe. The value of the easily recognizable *Zalutschia zalutschicola* LIP. as a member of the communities characteristic for dystrophy may also be restricted by a limited distribution (Fig. 1). Limited distribution pattern is also found in *Monodiamesa bathyphila* (KIEFF.) with one record from South Indian Lake in northern Manitoba and one new record from Alaska.

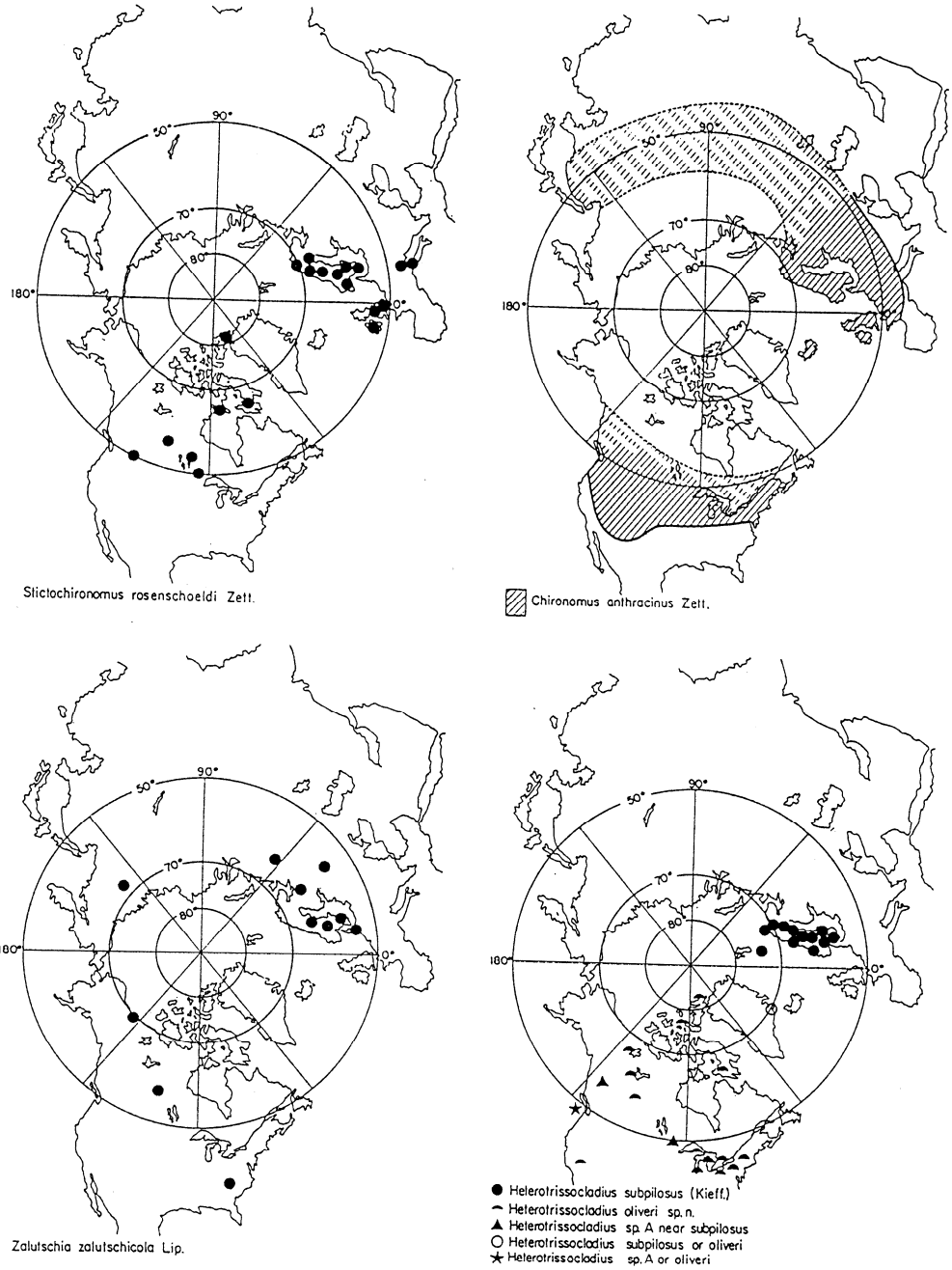


Fig. 1. Nearctic and Palaearctic distribution of some chironomids (the broken lines give approximate distribution for *Chironomus anthracinus* Zett.).

In most cases when the species are not Holarctic, a Palaearctic species or a pair of Boreal and Alpine species are, in North America, substituted by one or two sister species or at least by species within the same genus. The Palaearctic ultra-oligotrophic

Pseudodiamesa nivosa GOETGH. appears to be replaced by the Nearctic *Pseudodiamesa arctica* (MALL.). The Palaearctic *Protanypus morio* ZETT. common in oligotrophic lakes appears in North America constituted by two closely related species known only from larvae. The Palaearctic *Protanypus forcipatus* EGG. is replaced by *Protanypus hamiltoni* SÆTH. and *Protanypus ramosus* SÆTH. Particularly interesting in the distribution of the groups of *Heterotrissocladius* (Fig. 1). The species giving the ultra-oligotrophic *Heterotrissocladius subpilosus* community its name is limited to Fennoscandia, Bear Island and possibly East Greenland. Its close Nearctic sister species, *H. oliveri* SÆTH. similarly ultra-oligotrophic is limited to the arctic and subarctic areas of Canada with relict occurrences in the Great Lakes, in Cayuga Lake, New York, and in Lake Tahoe, California. A third species as yet known only from immatures seemingly occupies the area between. In the *Heterotrissocladius maeaeri* group, *H. maeaeri* BRUND. is northern European while a sister species only known from larvae is present in the Great Lakes and Cayuga Lake. In the *H. grimshawi* group, one species, *H. scutellatus* (GOETGH.) is found in the Alps, one, *H. grimshawi* EDW. in Northern Europe, one, *H. changi* SÆTH. in several lakes in and east of the Rocky Mountains including the Great Lakes, Lake Winnipeg, and Cayuga Lake, and one only known from immatures from Okanagan Lake west of the Rocky Mountains. In both the *H. maeaeri* and the *H. grimshawi* group the sister species appear to occupy exactly the same niche in different geographical areas.

There are, however, a few instances where an ecological equivalent within the same species group or genus seem to be lacking. A Nearctic sister species of the Alpine *Monodiamesa alpicola* BRUND. and the Boreal *M. ekmani* BRUND. is *M. prolilobata* SÆTH. However, the last species appears to have a far wider ecological range than the first two ultraoligotrophic species. European ecological equivalents of the oligotrophic to mesotrophic *Heterotrissocladius latilaminus* SÆTH. as well as of the primarily moderately oligotrophic and mesotrophic *Chironomus atritibia* MALL. have not been found. The ecology as well as the larval morphology of the Tanypodinae and the Tanytarsini is not well enough studied to draw any conclusions. However, in most cases there appears to be Nearctic ecological equivalents. The *Chironomus plumosus-semireductus* type in North America is a typical *Chironomus plumosus* L. in male, female and pupae, but has shortened blood-gills in the larvae. Even the chromosomes are apparently identical to *C. plumosus* L. However, the distribution of this type often within the same lake as *C. plumosus* L., but without any intermediates and in more oligotrophic parts of the lakes make it clear that the two at least should be regarded as different forms. *C. plumosus-semireductus* have been mentioned by CHERNOVSKI (1949) as typical in several Russian lakes and has also been found in a eutrophic lake in Norway. However, the Palaearctic specimens have not been definitely associated and are not incorporated in the table.

Following the scheme of BRUNDIN the corresponding Nearctic indicator species communities can be outlined.

	Europe (BRUNDIN 1949, 1956)		North America
Harmonic Lakes			
I	*Heterotrissocladius subpilosus-lakes*	I	*Heterotrissocladius oliveri*-lakes
II	*Tanytarsus lugens*-lakes (with *Heterotrissocladius grimshawi* or *H. scutellatus)*	II	*Tanytarsus* sp. ?-lakes (with *Monodiamesa tuberculata* and *Heterotrissocladius changi)*

II/III	*Stictochironomus rosenschoeldi*	II/III	*Chironomus atritibia* and *Phaenopsectra coracina*-lakes
III	a) *Chironomus anthracinus*-lakes b) *Chironomus plumosus*-lakes	III	a) *Chironomus decorus*-lakes b) *Chironomus plumosus*-lakes
Disharmonic (Dystrophic lakes)			
IV	*Chironomus tenuistylus*-lakes (with *Zalutschia zalutschicola)*	IV	*Chironomus* sp. ?-lakes (with *Zalutschia zalutschicola)*

The sublittoral and littoral zones do not characterize a lake as a whole in the same way as the profundal zone, but merely a local habitat of the lake. The gradation in Tab. 2 thus refers only to this habitat and not to the lake as a whole. This table is an even more selective list than Tab. 1 and primarily gives known stenotopic species as well as the most common more eurytopic species with known autecology. The most conspicuous feature of the table is that while there are some coldstenothermic species of the sublittoral-littoral zones in the arctic-subarctic ultra-oligotrophic lakes which are restricted to merely this type, there are no eutrophic species which also do not have occurrences in the mesotrophic or even moderately oligotrophic habitats. The coldstenothermous profundal species may in the arctic-subarctic or alpine lakes be present in the littoral, and stenoxybiont species can in the littoral zone occupy more eutrophic biotopes. As in the profundal chironomid fauna the sublittoral-littoral fauna shows a remarkable similarity of species composition with the European fauna. A number of species are Holarctic and appear to have the same ecology on both continents. [It should be noted that *Polypedilum laetum* (MEIG.) has not been regarded as Nearctic since the species so called in North America probably is a different species (see BRUNDIN 1949, p. 770).] Other Palaearctic species are, in North America, replaced by one or two species within the same genus and apparently similar ecology. For instance in oligotrophic and dystrophic lakes the Palaearctic *Zalutschia tornetraeskensis* (EDW.), Z. *mucronata* (BRUND.), *Heterotanytarsus apicalis* (KIEFF.) and *Pagastiella orophila* (EDW.) are replaced by *Zalutschia trigonacies* SÆTH. and *lingulata* SÆTH., Z. *obsepta* (WEBB), *Heterotanytarsus perennis* SÆTH. and *nudalus* SÆTH., and *Pagastiella ostansa* (WEBB), respectively. A few species do not seem to have an ecological equivalent on the other continent. To a large extent, however, this is a result of inadequate knowledge of the Nearctic fauna.

With proper considerations to the zoogeographical distribution, temperature regimes as well as other ecological niche parameters, the species composition of the chironomid community of a lake can help evaluate both lake types and stresses occurring within a lake. However, much remains to be done in North America both with regard to taxonomy, autecology and zoogeography of the chironomids and this paper should be regarded just as representing a beginning stage in the use of North American chironomids for lake typological work.

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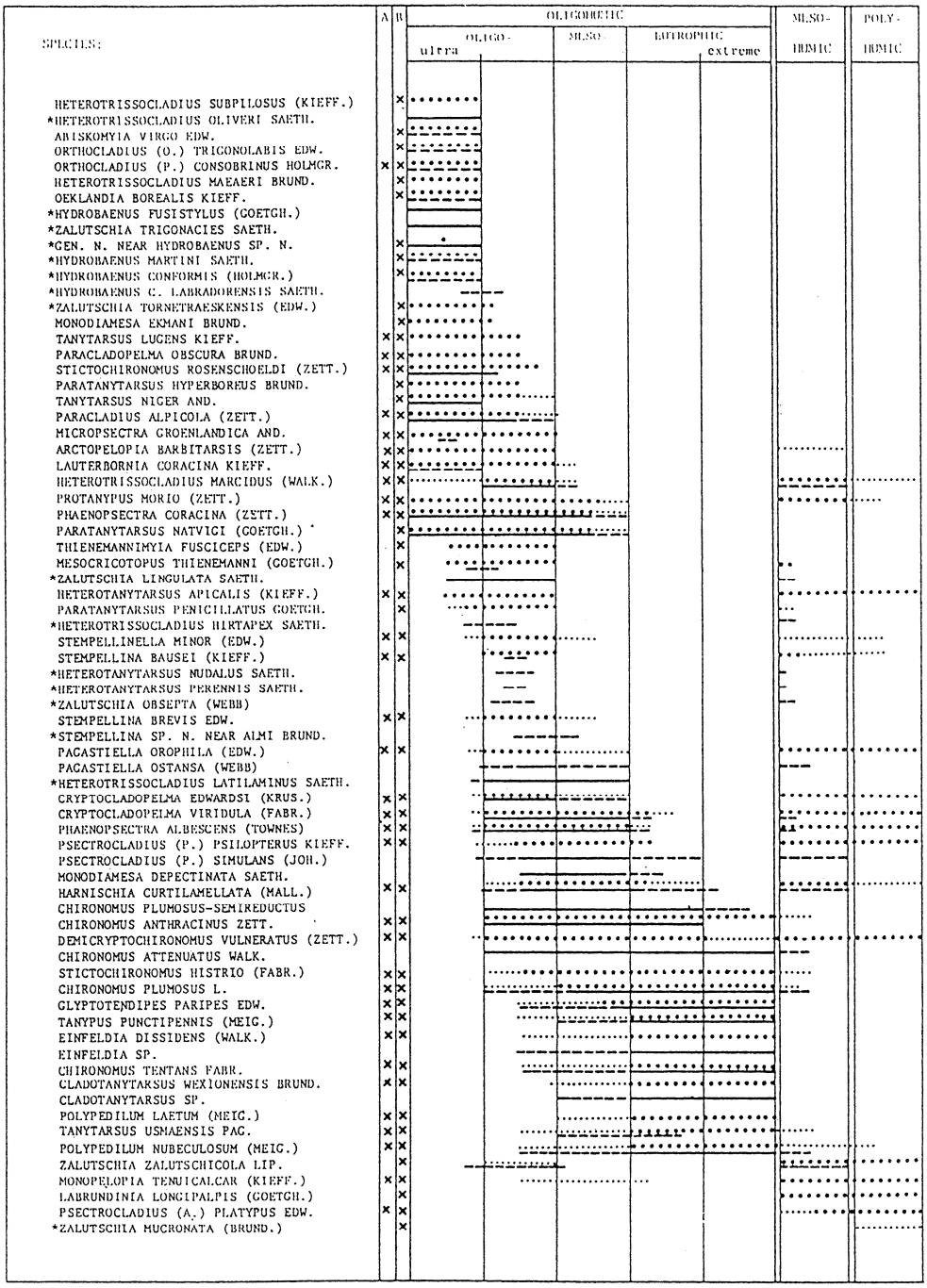
Tab. 2. Characteristic sublittoral and littoral chironomids of habitats in Nearctic (- - - -) and Palaearctic lakes (. . . .). (See Tab. 1)



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— 1975 c: Nearctic and Palaearctic *Heterotrissocladius* (Diptera: Chironomidae). — *Fish. Res. Board Can. Bull.*, 193, 1—67.

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Discussion

Wiederholm: In Europe the genus *Micropsectra*, closely related to *Tanytarsus*, is apparently more important than *Tanytarsus* in lakes of the *Tanytarsus* type. Could you comment on the significance of *Micropsectra* compared to *Tanytarsus* in the Nearctic regions?

Sæther: *Micropsectra groenlandica* And. is present in North America but has so far only been found in the arctic regions. It is not unlikely that this species also is present in the Great Lakes where *Micropsectra* spp. plays the same significant role in the profundal benthos as it does in European lakes. However, in the lakes from west of the Rocky Mountains as well as in Lake Winnipeg *Micropsectra*, although present, plays a numerically insignificant role. As in Europe the genus *Tanytarsus* as a whole is common in a wide range of lake types and it is necessary to go to the specific level to make particular use of its species as members of indicator communities.