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ANNOTATED CHECKLIST OF THE FREE-LIVING COPEPODS OF THE GREAT LAKES

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ABSTRACT. *An annotated checklist of the free-living copepods of the Laurentian Great Lakes is developed on the basis of published records. Synonymies are included for each species, relating, wherever possible, invalid names in the literature with currently recognized taxonomy. Twelve species of calanoids, six species of planktonic cyclopoids, nine species of benthic/littoral cyclopoids, and fourteen species of harpacticoids have been reported from the Great Lakes. Ten of the calanoids and four of the cyclopoids are characteristic of limnetic waters. Three calanoids and two planktonic cyclopoids have been reported infrequently and are perhaps accidental occurrences. The composition of the planktonic copepod fauna in most subregions of the Great Lakes is well-known. In contrast, the sampling of benthic/littoral cyclopoids and harpacticoids has been so infrequent that their kinds, areas of occurrence, and relative abundances are still poorly understood.*

INTRODUCTION

In a recent note we discussed the need for, and value of, the development and publication of checklists for Great Lakes biota (Gannon and Robertson 1978). Stoermer and Kreis (1978) have initiated efforts along these lines by publishing a preliminary checklist of the diatoms in the Great Lakes. In the present paper we continue such efforts by presenting an annotated checklist for the free-living Great Lakes copepods.

This paper is divided into three sections corresponding to the three orders of free-living copepods found in the Great Lakes, i.e., Calanoida, Cyclopoida, and Harpacticoida. In the section for each order, there is a table that includes the species for that order that have been reported from the Great Lakes, as well as the distributions of these species in relation to broad geographical subdivisions of the lakes. For the planktonic species (all the calanoids and part of the cyclopoids), it has been possible to provide an indication of the relative abundance of each species in the various subareas. However, for the benthic/littoral species (all the harpacticoids and some of the cyclopoids), it has been possible only to indicate presence or absence. The microfauna of benthic/littoral environments has rarely been sampled and identified in the Great Lakes, and so records of the benthic/littoral forms are too few to allow meaningful estimations of relative abundance. In fact, most of the records for these species are actually for individuals collected in plankton samples. In such cases, the plankton net probably came very close to or even touched bottom or the individuals were collected during a temporary migration into the water column. Thus, even the records for presence or absence of these forms in various areas are undoubtedly very incomplete and so should be treated as tentative. Each section also contains an annotated list of the species considered, and, for each species, a short discussion of its most obvious environmental pref-

erences, as well as a list of the synonyms used for it in records from the Great Lakes. Throughout this paper all listings of species are arranged in alphabetical order. Although phylogenetic ordering is preferred, this was not attempted because there is presently no generally accepted phylogenetic scheme for any of the three orders.

The compilation of this copepod faunal list has entailed the examination of numerous references, too many to list all the records for each species. Instead, the more important recent references used in this study have been listed by geographical subarea in Table 1. This will allow entry into the literature for those who want to examine in more detail the information available on the copepods of a certain part of the Great Lakes.

TABLE 1. Major recent references that consider copepods in various areas of the Great Lakes.

Lake Superior—Selgeby (1975), Watson and Wilson (1978)
Lake Michigan—Wells (1960), Roth and Stewart (1973), Gannon (1975)
Green Bay—Gannon (1974)
Lake Huron—Watson and Carpenter (1974)
Georgian Bay and North Channel—Carter (1969, 1972), Carter and Watson (1977)
Lake St. Clair—Leach (1973), Bricker *et al.* (1976)
Western Basin of Lake Erie—Davis (1968, 1969), Waston and Carpenter (1974), Watson (1976)
Central Basin of Lake Erie—Davis (1968, 1969), Watson and Carpenter (1974), Watson (1976), Czaika (1978b)
Eastern Basin of Lake Erie—Davis (1968, 1969), Watson and Carpenter (1974), Watson (1976), Cap (1980)
Lake Ontario—Patalas (1969), Czaika (1974, 1978a), McNaught *et al.* (1975)
All Great Lakes—Robertson (1966), Patalas (1972, 1975), Watson (1974)

CALANOIDA

The relative abundances of calanoid species in the subareas of the Great Lakes are presented in Table 2.

Note that in this table and in the list below, the diaptomids are placed in two genera (i.e., *Leptodiaptomus* and *Skistodiaptomus*) rather than in the broad, inclusive genus *Diaptomus* as is usually done for records from North America. These restricted genera are the same as the diaptomid subgenera referred to in Wilson and Yeatman's (1959) key to the North American calanoids. This has been done to bring the treatment of genera in North America more in line with what is done elsewhere in the world and because the authors believe that such subdivisions correspond to relatively major groupings of the diaptomids and so are useful in implying phylogenetic and quite probably ecological distinctions. The raising of these names to generic status, long recognized in Europe, was originally suggested for North America by Kincaid (1953) and has been followed by several authors, including Hutchinson (1967).

List of Great Lakes Calanoids

Epischura lacustris S. A. Forbes 1882—This species is widely distributed in the upper lakes during the warmer months of the year, but usually in low concentrations. In Lake Superior it is largely a nearshore form, developing an inshore population during June through August and briefly extending offshore in September through October (Watson and Wilson 1978). Although this species was considered to be quite common in Lake Erie during the 1930s (e.g., Chandler 1940, Wilson 1960), it is presently uncommon (Watson 1976). Only two records exist for Lake Ontario, Pritchard (1931) from fish stomachs and Patalas (1969) from occasional single specimens from nearshore waters. Great Lake synonymy: None.

Eurytemora affinis (Poppe) 1880—This species was first reported in Lake Ontario in 1958 (Anderson and Clayton 1959) and has since been found in all the Great Lakes. It is present during the warmer months of the year, usually in rather low concentrations. This species may favor nearshore areas, where it can become locally more prevalent (e.g., McNaught, Buzzard, and Levine 1975). It has been observed to be relatively more abundant among littoral vegetation than in limnetic waters (Gannon 1974). Great Lakes synonymy: None.

Leptodiaptomus ashlandi (Marsh) 1893—This is a common perennial species in the upper lakes. It is relatively less abundant in the lower lakes and, in fact, is rare and presumably accidental in Lake Ontario, where it was first reported in 1972 (McNaught and Buzzard 1973). In Lake Erie it is consistently present throughout the year, but is usually a relatively minor constituent of the crustacean plankton (Watson and Carpenter 1974). This

TABLE 2. The relative abundances of calanoid copepods in major subareas of the Great Lakes. C = common, individuals of this species are often collected in the water body under consideration. U = uncommon, individuals of this species are not usually collected in the water body under consideration. R = rare, individuals of this species are very seldom collected in the water body under consideration. – = absent, individuals of this species have never been collected in the water body under consideration.

	Superior	Michigan	Green Bay	Huron	Georgian Bay	St. Clair	Erie, West-Basin	Erie, Central-Basin	Erie, East-Basin	Ontario
Epischura lacustris	C	C	U	U	U	C	U	U	U	R
Eurytemora affinis	U	C	C	U	U	C	C	U	U	C
Leptodiaptomus ashlandi	C	C	C	C	C	C	C	C	U	R
Leptodiaptomus minutus	C	C	C	C	C	C	C	C	U	C
Leptodiaptomus sicilis	C	C	U	C	C	C	C	U	U	C
Leptodiaptomus siciloides	R	—	C	U	—	C	C	C	C	U
Limnocalanus macrurus	C	C	U	C	C	U	U	U	U	C
Onchydiaptomus birgei	—	—	—	—	—	—	R	—	—	—
Senecella calanoides	C	C	—	C	C	—	—	—	—	R
Skistodiaptomus oregonensis	U	C	C	C	C	C	C	C	C	C
Skistodiaptomus pallidus	—	—	—	—	—	—	—	R	R	R
Skistodiaptomus reighardi	—	R	—	—	U	—	U	U	—	R*

*Not in lake proper, see text.

species seems to have decreased in importance in the eastern end of Lake Erie between 1928 and 1974 (Cap 1980). Because it favors relatively oligotrophic environments, this change is probably related to the deterioration in water quality that has taken place in Lake Erie between these years. Great Lakes synonymy (in addition to *Diaptomus ashlandi*): *Diaptomus sicilis* var. *imperfectus* (Forbes 1891).

Leptodiaptomus minutus (Lilljeborg) 1889—This is a major component of the crustacean plankton in Lakes Huron, Michigan, and St. Clair, but is relatively less prevalent in the other three lakes. It is a perennial species in Lakes Michigan and Huron and in Green Bay (Gannon 1974, 1975; Watson and Carpenter 1974). In Lake Superior it is a summer-fall form, restricted primarily to inshore regions (Watson and Wilson 1978). In Erie and Ontario its absolute abundance is as high as or higher than in Michigan or Huron, but its percentage of the crustacean plankton is lower because a number of species of cyclopoids and cladocerans are much more abundant than in these latter two lakes (Patalas 1969, Watson and Carpenter 1974). Great Lakes synonymy (in addition to *Diaptomus minutus):* None.

Leptodiaptomus sicilis (S. A. Forbes) 1882—This is an important member of the crustacean plankton throughout the year in the upper lakes, especially Lakes Huron and Superior (Watson and Carpenter 1974, Watson and Wilson 1978). In the lower lakes it occurs at concentrations similar to those in the upper lakes, but as with *L. minutus* is a less important constituent of the crustacean plankton because total numbers of crustacean plankters are much higher than in those lakes. As with *L. ashlandi*, a decrease in importance of this species, which is probably related to deteriorating water quality, has been detected in the eastern end of Erie between 1928 and 1974 (Cap 1980). This species is often common below the thermocline and appears to favor cooler water than the other diaptomids. Great Lakes synonymy (in addition to *Diaptomus sicilis*): None.

Leptodiaptomus siciloides (Lilljeborg) 1889—This species is reported in appreciable numbers only in Lakes St. Clair and Erie and in Green Bay. Its presence at the mouths of the Detroit and Maumee rivers in 1930 was considered accidental by Tidd (1955), but by 1967 it was fairly common throughout the lake (Davis 1968, 1969). It has not been reported from Lake Michigan except in Green Bay and has only been reported from one sample in Lake Superior (Upper Lakes Reference Group 1977). It is uncommon in Lake Huron, but a recent survey did find low numbers on a number of cruises (Watson and Carpenter 1974). It was a numerically important species in Irondequoit Bay of Lake Ontario in 1939–40 (Tressler, Austin, and Orban 1953), but is an infrequent species in the lake proper (Patalas 1969; Czaika 1974, 1978a; McNaught *et al.* 1975). It is primarily a southerly form that seems to prefer warmer, eutrophic waters in the Great Lakes. Great Lakes synonymy (in addition to *Diaptomus siciloides*): None.

Limnocalanus macrurus Sars 1863—This perennial species is quite common in the deep parts of the

Great Lakes. It is a cold-water stenothermic species that is most prevalent in open waters of Lakes Superior, Michigan, Huron, and Ontario. It is largely absent from Lakes St. Clair and Erie and the bays and nearshore areas of the other lakes. It was more abundant in Lake Erie during the 1930s, but has been practically eliminated, probably because of the effects of eutrophication and predation by rainbow smelt (Gannon and Beeton 1971). Sporadic occurrences of this species in Lakes St. Clair and Erie appear to be cases of individuals transported from Lake Huron into these lakes by the St. Clair and Detroit rivers (Gannon and Beeton 1971; Bricker, Bricker, and Gannon 1976). Great Lakes synonymy: *Limnocalanus macrurus* var. *auctus* (Forbes 1891).

Onychodiaptomus birgei (Marsh) 1894—A single report of this species has been recorded from the Great Lakes, that of Smith and Fernando (1978) from Lake Erie. It was collected in the littoral zone near Point Pelee (K. Smith, Dept. of Environmental Biology, Univ. of Guelph, Guelph, Ontario, personal communication). This species is primarily a small lake and pond form; therefore, its occurrence in the Great Lakes may be due to it being carried along in recently introduced river water. Great Lakes synonymy: None.

Senecella calanoides Juday 1923—This perennial, cold-water stenothermic species occurs in the deeper waters of the upper lakes. It is absent from Lakes Erie and St. Clair and all major embayments except Georgian Bay (Carter 1969, 1972; Carter and Watson 1977). It was recorded for Lake Ontario from fish stomachs by Pritchard (1931), but has not been observed in more recent investigations. Great Lakes synonymy: None.

Skistodiaptomus oregonensis (Lilljeborg) 1889—This species is an important constituent of the plankton year-around in all the lakes but Superior. In Lake Superior, it is confined to the nearshore waters and to the warm seasons (Watson and Wilson 1978). Great Lakes synonymy (in addition to *Diaptomus oregonensis*): None.

Skistodiaptomus pallidus (Herrick) 1879—This species has been found rarely in Lakes Erie (Patalas 1972, Cap 1979) and Ontario (Patalas 1969, 1972; Czaika 1974). It seems to be a small-lake form that occasionally enters the lower lakes. Great Lakes synonymy (in addition to *Diaptomus pallidus*): None.

Skistodiaptomus reighardi (Marsh) 1895—This species has been found only occasionally in the Great Lakes. It has been reported sporadically from the open nearshore waters of Lakes Michigan (Roth and Stewart 1973), Erie (Jahoda 1949; Rolan, Zack, and Pritchau 1973), and Ontario (USEPA 1973), as well as Sodus Bay on the south shore of Lake Ontario (Marsh 1912) and Georgian Bay (Carter 1972). Moreover, the record from the open waters of Lake Ontario (USEPA 1973) was obtained from a preliminary examination of a series of zooplankton samples, and the presence of *S. reighardi* was not confirmed by subsequent detailed examinations (S. C. Czaika, Great Lakes Laboratory, State University College at Buffalo, Buffalo, New York, personal communication). Thus, this species has not been found in the lake proper but solely in Sodus Bay, which is basically a separate body of water with only a narrow channel connecting it with the lake. Great Lakes synonymy (in addition to *Diaptomus reighardi*): None.

Questionable Calanoid Record

Osphranticum labronectum S. A. Forbes 1882—This species has been reported in Lakes Superior and Michigan by Swain, Olson, and Odlaug (1970) and in these two lakes plus Lake Huron by Smith and Fernando (1978). K. Smith (Dept. of Environmental Biology, Univ. of Guelph, Guelph, Ontario, personal communication) has informed us that this latter record is based on the occurrences reported by Swain *et al.* (ibid) and that the inclusion of Lake Huron is an error. The presence of this form in the open waters of the Great Lakes, as reported by Swain *et al.* (ibid), is surprising because, although it occurs quite generally throughout the Great Lakes region, all previous records are from ponds or small lakes. Consequently, as there is only this one record, we regard the question as to whether this species occurs in the Great Lakes as unsettled at present. Great Lakes synonymy: None.

CYCLOPOIDA

The relative abundances of species of planktonic cyclopoids in the subareas of the Great Lakes are presented in Table 3. The occurrence of the benthic/littoral species is indicated in Table 4.

As with the calanoids, it has been decided to use a somewhat narrower definition of certain genera

TABLE 3. The relative abundances of planktonic cyclopoid copepods in major subareas of the Great Lakes. The meanings of the symbols are the same as in Table 2.

	Superior	Michigan	Green Bay	Huron	Georgian Bay	St. Clair	Erie, West-Basin	Erie, Central-Basin	Erie, East-Basin	Ontario
Acanthocyclops vernalis	U	U	C	U	U	C	C	C	U	C
Cyclops scutifer	—	—	—	—	R	—	—	—	—	—
Cyclops strenuus	R	—	—	—	—	—	—	—	—	—
Diacyclops thomasi	C	C	C	C	C	C	C	C	C	C
Mesocyclops edax	U	U	C	U	C	C	C	C	C	U
Tropocyclops prasinus mexicanus	U	C	C	C	C	C	C	C	U	C

TABLE 4. The presence (+) or absence (−) of benthic/littoral cyclopoid copepods in subareas of the Great Lakes.

	Superior	Michigan	Green Bay	Huron	Georgian Bay	St. Clair	Erie, West-Basin	Erie, Central-Basin	Erie, East-Basin	Ontario
Diacyclops nanus	−	−	−	−	+	−	−	+	−	−
Ectocyclops phaleratus	−	−	−	−	−	+	−	*	*	−
Eucyclops agilis	+	+	+	−	−	+	+(?)	+	+	−
Eucyclops prionophorus (?)	−	−	−	−	−	−	−	−	−	+
Eucyclops speratus	−	+	−	−	−	−	*	*	*	+(?)
Macrocyclops albidus	+	−	+	−	−	+	+	+	+	+
Macrocyclops ater (?)	−	−	−	−	−	+	+	−	−	−
Macrocyclops fuscus (?)	−	−	−	−	−	−	−	+(?)	+(?)	−
Paracyclops fimbriatus poppei	−	+	−	−	−	−	−	+	+	−

*Recorded as occurring in Lake Erie but the basin not specified.

for the cyclopoids than that employed by most previous North American workers. In this case, the genus *Cyclops* as used by Wilson and Yeatman (1959) in the classic North American cyclopoid key has been split into several more restricted genera (i.e., *Acanthocyclops, Diacyclops,* and *Cyclops s. str.*), which are the same as Wilson and Yeatman's subgenera of *Cyclops*. In this we follow the lead, not only of European and certain North American workers, but also, specifically for Great Lakes cyclopoids, of Watson (1974, 1976), Watson and Carpenter (1974), and Watson and Wilson (1978).

List of Great Lakes Planktonic Cyclopoids

Acanthocyclops vernalis (Fischer) 1853—This species is present in all areas of the Great Lakes, but is usually relatively uncommon in the upper lakes. Generally, it is more abundant in the near-shore areas of a lake than in the open-water, limnetic zone. In Erie it is more common in the shallow, western end than in the other two basins (Watson 1976). All indications are that it favors the warmer, more eutrophic parts of the Great Lakes. This species occurs in both the plankton and the benthos. It exhibits highly variable morphology and actually may be an assemblage of several closely related morphologically similar species (Price 1958). Its variability has caused confusion that has resulted in a lengthy list of synonyms in the literature. Until further systematic information becomes available, we will regard *A. vernalis* as a single species. Great Lakes synonymy (in addition to *Cyclops vernalis*): *Acanthocyclops robustus brevispinosus* (Chappuis and Delamare Deboutteville 1958); *Cyclops americanus* (Ewers 1933, Chandler 1940, Davis 1954, Tidd 1955); *Cyclops brevispinosus* (Marsh 1893, 1895; Reighard 1894; Sars 1915; Chandler 1940; Tidd 1955); *Cyclops parcus* (Reighard 1894, Marsh 1895); *Cyclops robustus* (Wilson 1929a,b; 1960); *Cyclops viridis* (Eddy 1934, Wilson 1960, Conway *et al.* 1973); *Cyclops viridis* var. *brevispinosus* (Marsh 1912); *Cyclops viridis brevispinosus* (Hankinson 1916); *Cyclops viridis* (probably var. *parcus*) (Hankinson 1914); *Cyclops vulgaris* (Wilson 1929a, 1960).

Cyclops scutifer Sars 1863—In the Great Lakes this species has been observed only in Georgian Bay (Carter 1972) and there only at one station very near shore. It is common in inland lakes of northern Ontario, and its occurrence in the Great Lakes may be due to being washed in from such lakes. Great Lakes synonymy: None.

Cyclops strenuus Fischer 1851—The only record

of this species in the Great Lakes is the report by Selgeby (1975); he found it infrequently in samples from the outlet of Lake Superior. Great Lakes synonymy: None.

Diacyclops thomasi (S. A. Forbes) 1882—This species is found throughout the Great Lakes and is by far the most common cyclopoid copepod. It is generally present in the plankton year-around, although dormancy of copepodids has been suggested in westcentral Lake Erie in response to hypolimnetic anoxia (Heberger and Reynolds 1977). This form was orginally described from the Great Lakes as a new species, *Cyclops thomasi* (Forbes 1882). Most subsequent reports from the Great Lakes have not followed this lead, but instead have considered the form either completely synonymous with the European pond species *C. bicuspidatus* or, at most, a subspecies of this form, *C. bicuspidatus thomasi*. However, as pointed out by Kiefer (1978) and Yeatman (1944), there are several distinct morphological characteristics that separate *thomasi* from the typical *C. bicuspidatus*. Thus, we follow Kiefer (1978), and for the Great Lakes Torke (1976), as well as other authors, in completely separating the *thomasi* form from *bicuspidatus* and in calling it *Diacyclops thomasi*. Unless subsequent studies invalidate this separation, we recommend that all future Great Lakes references to this animal use this designation. Great Lakes synonymy (in addition to *Cyclops thomasi, C. bicuspidatus, C. bicuspidatus thomasi* (Chappuis and Delamare Deboutteville 1958); *Cyclops pulchellus* (Marsh 1893, 1895; Reighard 1894).

Mesocyclops edax (S. A. Forbes) 1891—This species is found in all the lakes during the warm seasons, but tends to be rather uncommon in offshore waters except in Lake Erie. In Lake Michigan it was probably more abundant before the advent of large populations of alewives, for Wells (1970) suggests that these fish have reduced it greatly. Great Lakes synonymy (in addition to *Cyclops edax*): *Cyclops leuckarti* (Marsh 1893, 1895, 1912; Reighard 1894; Wickliff 1920; Ewers 1930, 1933; Eddy 1934; Chandler 1940; Tressler *et al.* 1953; Tidd 1955; Wilson 1929a, 1960); *Mesocyclops leuckarti* (Andrews 1953, Davis 1954, Fabian 1960, Conway *et al.* 1973); *Mesocyclops obsoletus* (Wilson 1929a,b; 1960).

Tropocyclops prasinus mexicanus Kiefer 1938—This species is very small and undoubtedly has been undersampled in many Great Lakes zooplankton studies. It has been found in all of the Great Lakes and is often temporally and spatially well distributed. There are a number of Great Lakes records that refer to *Tropocyclops prasinus* without specifying the subspecies. Because only the subspecies *mexicanus* has been identified from the Great Lakes and vicinity, all these records are believed to refer to this subspecies. Torke (1974, 1976) does not consider *T. prasinus mexicanus* a valid subspecies, but offers no supporting documentation or justification for this view. Until more systematic information is accrued, we will continue to use the subspecific designation. Great Lakes synonymy (in addition to *Tropocyclops prasinus* and *Cyclops prasinus*): *Cyclops fluviatilis* (Reighard 1894, Marsh 1895); *Eucyclops prasinus* (Wells 1960).

List of Great Lakes Benthic/Littoral Cyclopoids

Diacyclops nanus (Sars) 1863—This species has been found only in benthic samples from Parry Sound (Hare and Carter 1976), a deep inlet off Georgian Bay, and in the central basin of Lake Erie (Evanko 1977). However, the species probably has a wide distribution in the Great Lakes, but has been overlooked because of its preference for relatively deep benthic habitats. Great Lakes synonymy (in addition to *Cyclops nanus*): None.

Ectocyclops phaleratus (Koch) 1838—This species has been reported from Lakes St. Clair (Marsh 1895) and Erie (Wilson 1929a,b; 1960), although it is not completely clear from Wilson's papers whether it was obtained from the eastern or central basin of Lake Erie or even whether it was collected in the lake proper rather than from shoreline ponds. This form is a small, bottom-dwelling species and may be found in other parts of the Great Lakes when more thorough meiobenthic studies are conducted. Great Lakes synonymy (in addition to *Cyclops phaleratus*): *Paracyclops phaleratus* (Wilson 1929b); *Platycyclops phaleratus* (Wilson 1929a).

Eucyclops agilis (Koch) 1838—This species has been found in most of the subareas of the Great Lakes and probably will be detected in the others when more sampling of benthic microinvertebrates is carried out. There are several older Great Lakes records referring to a form designated *Cyclops serrulatus* and one from Lake Superior (Forbes 1891) referring to *C. pectinifer*, which is a synonym

of *C. serrulatus* (Herrick and Turner 1895). One of the *serrulatus* records, that of Wilson (1960) reporting the form from the eastern and central basins of Lake Erie, almost surely refers to *E. agilis* as the two names are equated in the paper. The other records, however, can only be questionably assigned to *E. agilis* for, as Wilson and Yeatman (1959) indicate, this name has, at various times, been used to refer to a number of forms. This uncertainty has forced us to designate *E. agilis* as of questionable occurrence in the western basin of Lake Erie (Table 4) where there are no records of it, but two of *C. serrulatus*, both from fish stomachs (Wickliff 1920, Ewers 1933). Great Lakes synonymy (in addition to *Cyclops agilis*): *Cyclops pectinifer* (? Forbes 1891); *Cyclops serrulatus* (? Marsh 1893, 1895; ? Reighard 1894; ? Wickliff 1920; ? Ewers 1933; Wilson 1960); *Eucyclops serrulatus* (? Smith and Fernando 1978); *Leptocyclops agilis* (Wilson 1929a).

Eucyclops prionophorus (?) Kiefer 1931—A form that has been found rarely off the Genesee River mouth on the southern shore of Lake Ontario has been tentatively identified as this species (USEPA 1973; Czaika 1974, 1978a). This species is found in small ponds and slow-moving creeks (Wilson and Yeatman 1959) and it is probably limited in the Great Lakes to associate with river inflows. Great Lakes synonymy: None.

Eucyclops speratus (Lilljeborg) 1901—This species has only been reported a few times in the Great Lakes. Stewart (1974) reports some animals from southeastern Lake Michigan, and Watson and Carpenter (1974), as well as Watson (1976), report it from Lake Erie, although the basin or basins of occurrence are not specified. Based on a personal communication from J. Selgeby (K. Smith, Dept. of Environmental Biology, Univ. of Guelph, Guelph, Ontario, personal communication), Smith and Fernando (1978) list it as occurring in Lake Superior. It is also probable that Marsh's (1912) record of *Cyclops serrulatus* var. *elegans* from Sodus Bay of Lake Ontario is this species since Wilson and Yeatman (1959) consider this latter name to be a probable synonym of *E. speratus*. Great Lakes synonymy: *Cyclops serrulatus* var. *elegans* (? Marsh 1912).

Macrocyclops albidus (Jurine) 1820—This species has been reported from most of the subareas of the Great Lakes and will probably be found in the others when their benthic microinvertebrates are sampled more extensively. Great Lakes synonymy (in addition to *Cyclops albidus*): *Cyclops gyrinus* (Forbes 1891); *Macrocyclops annulicornis* (Wilson 1929a,b); *Pachycyclops annulicornis* (Wilson 1929a).

Macrocyclops ater (Herrick) 1882—This form has been reported only as *Cyclops ater* and only from Lakes St. Clair (Reighard 1894, Marsh 1895) and Erie (Ewers 1930). As cyclopoid taxonomy has evolved substantially since the time of these studies, there is considerable question as to whether these identifications really refer to animals that would be called *M. ater* today. For this reason, we consider this species to be of questionable presence in the Great Lakes. Great Lakes synonymy (in addition to *Cyclops ater*): None.

Macrocyclops fuscus (Jurine) 1820—This cyclopoid has only been reported once from the Great Lakes, from the stomach of a perch seined along the American shore of the eastern or central basin of Lake Erie (Wilson 1929b, 1960). This evidence of occurrence is quite weak, and so the species has been designated in Table 4 as only of questionable occurrence in the Great Lakes. Great Lakes synonymy (in addition to *Cyclops fuscus*): *Macrocyclops signatus* (Wilson 1929b, 1960).

Paracyclops fimbriatus poppei (Rehberg) 1880—This species has been reported only from Lakes Michigan (e.g., Eddy 1927, Roth and Stewart 1973, Evans and Stewart 1977) and Erie (e.g., Wilson 1960, Rolan *et al.* 1973). However, it is primarily a creeping form found on detritus in shallow water (Wilson and Yeatman 1959). Such habitats have received very little study in the Great Lakes, and so this form may be widely distributed around the shores of the lakes. Great Lakes synonymy (in addition to *Cyclops fimbriatus*): *Platycyclops fimbriatus* (Wilson 1929a,b).

Cyclopoid Identifications of Uncertain Status

For several records of cyclopoids from the Great Lakes, the species being referred to is so unclear in terms of modern taxonomy that it seems prudent to designate the records as uncertain as follows:

Cyclops bicolor was reported in Lake St. Clair by Reighard (1894) and Marsh (1895) and in Lake Erie

by Ewers (1930). This is a valid name for a littoral, bottom-dwelling species that occurs in North America. However, most early records given this name really refer to *C. varicans rubellus* according to Wilson and Yeatman (1959). Therefore, it is unclear to which species the Great Lakes records refer.

Cyclops quadricornis was reported from Lake Erie by Kellicott (1878) and Vorce (1881) (in the water supplies of Buffalo and Cleveland, respectively). It is impossible to relate these very old records to any currently accepted name. In fact, it is not even clear from the illustrations in Vorce's paper that his record refers to a cyclopoid at all. Synonymies in Herrick and Turner (1895) and Forbes (1897) do not clarify any possible associations between *C. quadricornis* and any present name.

HARPACTICOIDA

Indications of the presence of harpacticoid species in the subareas of the Great Lakes are presented in Table 5. As pointed out previously, there have been few studies dealing with Great Lakes benthic/littoral copepods. This is especially true for the harpacticoids. These animals are generally smaller than the cyclopoids and have probably even been missed by some studies that have collected benthic/littoral cyclopoids. Because these animals have been studied so little in the Great Lakes, the indications of absence in Table 5 are only tentative. Also very little is known about the environmental preferences of these species.

Attheyella illinoisensis (S. A. Forbes) 1882—This species has been reported only from the stomachs of fish collected alongshore in the eastern basin of Lake Erie (Wilson 1929a,b; 1960). Great Lakes synonymy: *Canthocamptus illinoisensis* (Wilson 1929a,b; 1960).

Attheyella nordenskioldii (Lilljeborg) 1902—In the Great Lakes this form has only been reported from Duluth Harbor (Maschwitz, Wedlund, and Wiegner 1976). It is very similar to the preceding form, and the two may well be just morphological varieties of the same species (Wilson and Yeatman 1959). Great Lakes synonymy: None.

Bryocamptus nivalis (Willey) 1925—This species has only been reported from Lakes Superior (Maschwitz *et al.* 1976) and Ontario (Czaika 1974, 1978a). Great Lakes synonymy: None.

Bryocamptus zschokkei (Schmeil) 1893—This species has been found so far in Lakes Michigan (Evans 1975), St. Clair (Bricker *et al.* 1976), and Ontario (Czaika 1978a), and it is probably widely distributed in the Great Lakes. Great Lakes synonymy: None.

Canthocamptus robertcokeri M. S. Wilson 1958—This form is the most commonly observed harpacticoid in the Great Lakes, and it has been found in most areas except Lakes Huron and Superior. It is quite commonly collected in plankton samples and may have a tendency to be somewhat more planktonic than most other harpacticoids. It is possible that its increased frequency of collection relative to other harpacticoids is due as much to such a tendency as to high relative abundance. Great Lakes synonymy: *Canthocamptus staphylinoides* (Davis 1954).

TABLE 5. The presence (+) or absence (−) of harpacticoid copepods in subareas of the Great Lakes.

	Superior	Michigan	Green Bay	Huron	Georgian Bay	St. Clair	Erie, West-Basin	Erie, Central-Basin	Erie, East-Basin	Ontario
Attheyella illinoisensis	−	−	−	−	−	−	−	−	+	−
Attheyella nordenskiodii	+	−	−	−	−	−	−	−	−	−
Bryocamptus nivalis	+	−	−		−	−	−	−	−	+
Bryocamptus zschokkei	−	+	−	−	−	+	−	−	−	+
Canthocamptus robertcokeri	−	+	+	−	−	+	+	+	−	+
Canthocamptus staphylinoides	+	+	−	−	−	−	+(?)	−	+(?)	+
Epactophanes richardi	−	−	−	−	−	−	−	−	−	+
Maraenobiotus sp.	−	−	−	−	−	+	−	−	−	−
Mesochra alaskana	−	−	−	−	−	+	−	−	−	+
Moraria cristata	−	−	−	−	−	−	−	−	−	+
Nitrocra hibernica	−	−	−	−	−	−	−	−	−	+
Nitocra spinepes	−	−	−	−	−	−	−	−	−	+
Parastenocaris delamarei	−	−	−	−	−	−	−	−	+	−
Parastenocaris lacustris	−	−	−	−	−	−	−	−	+	−

Canthocamptus staphylinoides Pearse 1905—This form has been reported from all the Great Lakes except Huron and is quite probably also present there. However, Davis (1962) points out that his 1954 record of this species is really *Canthocamptus robertcokeri*, and he cautions that the earlier records of *C. staphylinoides* in Erie (i.e., Chandler 1940; Wilson 1929a,b; 1960) may also be *C. robertcokeri*, although this cannot be verified. Thus, the occurrences of *C. staphylinoides* in Erie have been marked as questionable in Table 5. Great Lakes synonymy: None.

Epactophanes richardi Mrazek 1893—So far this species, as well as the subsequently listed species *Moraria cristata, Nitocra hibernica,* and *N. spinepes*, has only been reported from Lake Ontario (Czaika 1974, 1978a). Great Lakes synonymy: None.

Maraenobiotus sp.—This genus has only been reported from the American side of Lake St. Clair (Bricker *et al.* 1976). Great Lakes synonymy: None.

Mesochra alaskana M. S. Wilson 1958—This species has been reported only from Lake Ontario (Czaika 1974, 1978a) and the American side of Lake St. Clair (Bricker *et al.* 1976). Great Lakes synonymy: None.

Moraria cristata Chappuis 1929—See *Epactophanes richardi.* Great Lakes synonymy: None.

Nitocra hibernica (Brady) 1880—See *Epactophanes richardi.* Great Lakes synonymy: None.

Nitocra spinepes Boeck 1864—See *Epactophanes richardi.* Great Lakes synonymy: None

Parastenocaris delamarei Chappuis 1958—This species and the following one are very small and are found in the interstices of sand and other coarse sediments. They have been found only on the Canadian shores of the eastern basin of Lake Erie (Chappuis and Delamare Deboutteville 1958), but are quite likely more widely distributed as this type of habitat has been sampled only rarely in the Great Lakes. Great Lakes synonymy: None.

Parastenocaris lacustris Chappuis 1958—See *Parastenocaris delamarei.* Great Lakes synonymy: None.

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