

Abstracts

submitted for presentation during the

XV International Symposium on Chironomidae



12-14 August 2003

University of Minnesota

Compiled By

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17 July 2003

ABSTRACT FOR THE THIENEMANN HONORARY LECTURE

THE ROLE OF CHROMOSOMES IN CHIRONOMID SYSTEMATICS, ECOLOGY AND PHYLOGENY

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Chironomids have giant chromosomes with useful characters: different chromosome number, different combination of chromosome arms, number and position of nucleolar organizers, amount of heterochromatin, presence of puffs and Balbiani rings, banding pattern. For comparison of species, it is important that the bands or groups of bands can be homologized.

Chromosomes are nearly independent of environmental factors, however they show variability in form of structural modifications and inversion polymorphism.

Systematic aspects: New species of chironomids have sometimes been found on the basis of chromosomes, e.g. morphologically well defined "species" turned out to contain two or more karyotypes. Chromosome preparations were also sometimes declared as species holotypes. Moreover, chromosomes were helpful to find errors in previous investigations or to rearrange groups.- Nevertheless, where morphology and chromosomal data are not sufficient for species identification, additional results of electrophoresis of enzymes or hemoglobins as well as molecular-biological data were often helpful and necessary .

Ecological, parasitological and zoogeographical aspects: An example of niche formation are the endemic *Sergentia*-species of the 1500 m deep Lake Baikal in Siberia. Some species are stenobathic and restricted to certain depth regions.

The genetic sex of nematode-infested *Chironomus* was unresolved for a long time. External morphological characters were misleading, because parasitized midges have predominantly female characters. However, transfer of the parasites to species with sex-linked chromosomal characters (strains of *Camptochironomus*) could show that half of the parasitized midges are genetic males.

The chromosomal comparison of populations of holarctic species (*Camptochironomus*-species, *Chironomus plumosus* and *entis*) on different continents demonstrates - as a consequence of isolation- differences up to species rank and suggests a migration from Palearctic (Siberia) to Nearctic.

Phylogenetic aspects: Investigations on the phylogenetic position of species are beginning using "Wagner-nets". In the genus *Chironomus*, they show remarkable world-wide distribution of certain banding patterns, the formation of "centers" (groups of species with identical banding pattern) as well as as banding pattern that are continent-overlapping and cytochrome-overlapping .

In statistical attempts, using the frequency (and probability) of band neighbourhoods, species can be arranged by the commonness of band neighbourhoods. A summarizing picture suggests, that species with common band neighbourhoods, continent- and cytochrome-c-overlapping patterns and that are central in Wagner-nets, are basic (ancestral).

Construction of phylogenetic trees will be most realistic if the five well studied chromosome arms from all continents, especially Australia and South-Eastern Asia, are included. A comparison to the phylogenetic trees based on molecular biology is necessary.

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CHIRONOMIDAE (DIPTERA) IN STREAMS AND SPECIAL ENVIRONMENTS FROM BRAZIL

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The Chironomidae biodiversity in southeastern Brazil was studied in protected areas such as Intervales State Park, Juréia-Itatins Ecological Station, and some special environments. Larvae were collected using Surber and manual sampling from different order streams, springs, macrophytes, rock pools and temporary ponds. Larvae were reared to adult in order to obtain associated material (pupae and adult forms). Adults were collected using light traps. Tanypodinae genera *Ablabesmyia* (*Karelia*) sp., *Clinotanypus* sp., *Coelotanypus* sp., *Fittkauimyia* sp., *Labrundinia* sp., *Larsia* sp., and the species *Monopelopia tenuicalcar* (*Kieffer*) were identified from both lentic and lotic environments. *Paramerina* sp. and *Apsectrotanypus* sp. were sampled only in low order streams and *Tanypus* sp. was collected only in lentic environments. Chironominae genera occurring both in lentic and lotic environments were; *Chironomus* sp., *Tanytarsus* spp., *Harnischia* complex, *Goeldichironomus* sp., *Parachironomus* sp and *Polypedilum* spp., and *Caladomyia* spp. Genera found predominantly in lentic environments were; *Fissimentum* sp., *Stenochironomus* sp., and *Zavreliella* sp. Genera found only in lentic environments were; *Omisus* sp., *Paratendipes* sp., *Tribelos* sp., *Phaenopsectra* sp., *Caladomyia* sp., *Paratanytarsus* sp., *Rheotanytarsus* sp., *Stempellina* sp., *Stempellinella* sp., *Xestochironomus* sp. and the species, *Beardius parvus* Reiss & Sublette. *Dicrotendipes* sp. was found frequently associated with macrophytes. Orthoclaadiinae genera found in lotic systems were; *Corynoneura* sp., *Cricotopus* sp., *Nanocladius* sp., *Lopescladius* sp., *Rheocricotopus* sp., *Parametriocnemus* sp. and *Ichthyocladus* sp. Orthoclaadiinae genera found in semi-terrestrial environments were; *Gymnometriocnemus* sp., *Psectrocladius* sp., *Pseudosmittia* sp., *Antillocladius* spp., *Bryophaenocladus* spp., *Paraphaenocladus* sp., and two new undescribed genera. This survey increases the number of Chironomidae genera known from Brazil and the associated material will allow species level identification and description of new species.

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RESPONSE OF CHIRONOMIDS TO A VOLCANIC EVENT IN AN ANDEAN LAKE (CHILE)

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In a study to determine sub-fossil remains of chironomids, one short core was collected from the deepest part of Lake Galletue in Chile (38° 41' S, 71° 17,5' W).

The core was first inspected with x-rays to evaluate possible mixing of sediments due to bioperturbation. This analysis revealed a distinct layer, completely different from the sediments of the rest of the core. Visual inspection and granulometric analyses indicated the layer consisted of coarse particles. Mineralogical analysis showed the particles were lava clasts from a large volcanic event.

For analysis of chironomids, 2 cc of wet sediment from the layer were deflocculated in KOH 10% and mounted for microscopic inspection. Initial finding showed a low number of head capsules in the 2 cc section of sediment, with an average number of only 21 head capsules per centimeter.

To evaluate possible changes in chironomid assemblages due to the volcanic event, the head capsule composition in the upper centimeter of the section was compared with one centimeter of sediment immediately above the volcanic event layer. Only nine taxa occurred in the two samples, with *Ablabesmyia* more frequent in the lower centimeter and *Cricotopus* the dominant genus in the upper centimeter. Shannon's diversity index calculated for each centimeter was very similar for both samples indicating apparently no difference in community diversity. However, additional cores and sections of cores will need to be examined to increase the number of head capsules from sediment sections in and after the volcanic event. It is also necessary to complement our study with data obtained from sediment below the lava clast layer. In addition we are presently attempting to integrate information about volcanic activity in the area to better define the timing and magnitude of the volcanic event.

This work was funded by a grant of Escuela de Graduados, Universidad de Concepcion and partially by research project FONDECYT N° 1010640. The authors also would like to provide a special acknowledgement of the *Chironomus* Newsletter Grant.

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COMMUNITY ANALYSIS OF CHIRONOMIDAE (DIPTERA) FROM SHORELINE POND AND SHORELINE LAKE HABITATS OF LAKE HOVSGOL, MONGOLIA

Jamie Bachmann and Barbara Hayford

Chironomidae (Diptera), were collected from Lake Hovsgol, Mongolia and its affluent streams during July of 1995 and 1997. Lake Hovsgol is an ancient lake located in north central Mongolia and its effluent stream is part of the Selenge River watershed, which is the largest affluent stream for Lake Baikal, Russia. Pupal exuviae and larvae of chironomids were collected to compare lake and shoreline pond communities. Affluent streams flowing into Lake Hovsgol are often dammed at the shoreline forming ponds that have high concentrations of nutrients relative to the ultra oligotrophic lake. Despite having no barriers to recruitment between the shoreline pond and littoral zone of the lake we hypothesized a difference in chironomid communities due to differing trophic characteristics of these two habitats. The following subfamilies of chironomid were present: Diamesinae, Prodiamesinae, Tanypodinae, Orthoclaadiinae, and Chironominae. Chironominae dominated in shoreline, pond and stream habitats. In particular, the tribe Chironomini dominated in all three habitats. Orthoclaadiinae were the next dominant subfamily in both shoreline and pond habitats, whereas the subfamily Tanypodinae dominated in ponds. Results from similarity analysis and cluster analysis support different and distinct chironomid communities in the littoral lake shore and pond habitats.

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PRODUCTION ECOLOGY OF *Chironomus major* WUELKER AND BUTLER IN KENTUCKY LAKE, USA

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Chironomus major is a large chironomid (larval length up to 50 mm) that occurs sporadically in lakes and ponds throughout the eastern U.S. *C. major* is the dominant chironomid in Kentucky Lake in western shoreline depositional zones 6-10 m deep with mean densities of about 30/m². It is generally found in silty-clays with < 1% organic carbon in association with populations of *Hexagenia limbata* and *Sphaerium striatinum*. Adult emergence begins in early October (water temp 22 °C) and peaks about the first week in November. Mean larval dry weights are 0.002, 0.76, 2.98, and 4.98 mg for first, second, third, and fourth instars. Mean head capsule widths are 0.13, 0.55, 0.78 and 1.03 mm for first, second, third, and fourth instars. Production was calculated as 3.7 g dry mass/m² for the period of October 2003-April 2003. Although the densities of *C. major* larvae were low, the high standing stock biomass (1.1 g dry mass/m²) contributed to much of the production. The life cycle appears to be univoltine, and data from regular monitoring are being used to determine secondary production for the full year.

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MIDGE SPECIATION BY INTROGRESSIVE HYBRIDIZATION (CHIRONOMIDAE, DIPTERA)

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Differing stages of hybridogenesis have been proposed as possible mechanisms of midge speciation. *Chironomus usenicus* Loginiva et Belyanina of hybrid origin and hybrid populations of *Glyptotendipes* – *G. pallens* Mg. and *G. glaucus* Mg., *G. gripekoveni* Kieff. (*G. gr. gripekoveni* and *G. gr. paragripekoveni*) have been used as examples. At present, one can observe hybrid formation of *Glyptotendipes* as the initial stage of hybridogenesis. Cross-breeding takes place between subspecies of *G. gripekoveni gripekoveni* and *G. gr. ?aragripekoveni*, *G. pallens* and *G. glaucus*. In spite of distinct karyotypical differences between *G. gripekoveni gripekoveni* and *G. gr. paragripekoveni* (unequal content of centromeric heterochromatine, homozygote inversions in B, D, E, F, G arms), reproductive isolation hasn't been reached between subspecies. Hybrids of subspecies are able to cross with similar hybrids or with one of the parental subspecies. Repeated return cross-breeding results in appearance of a population consisting of hybrid forms with a recognizable combinations of chromosome disc sequences. The hybrids of this sort are the most optimal for the environmental conditions of today, and can be maintained by selection for a long time without transition to the second stage.

At the second stage in the evolution of hybrid forms the forms are maintained by selection, and ecological differentiation takes place. Benthic larvae of *Chironomus* feed on plant detritus and therefore they depend less on the patterns of evolution of angiosperms than in *Glyptotendipes*, and so analysis of the benthic species of *Chironomus* reveals more pronounced results of effects of selection on chromosome sequences of discs of hybrids. For instance, the speciation of *Chironomus usenicus* resulted from of a hybrid form (*C. plumosus* ? *C. behningi*) ? *C. plumosus*, based on models of chromosome reconstructions including duplication of centromeric heterochromatin and other parts of chromosomes, paracentric inversion in the F arm, its fixation and accumulation of other heterozygote reconstructions in the species karyofund. By contrast, maintenance of hybrid formations between forms which haven't reached species status will depend on the fitness as a function of particular environmental conditions. We propose that appearance of hybrid forms can be a chance phenomenon reflecting low degree of interspecies differentiation (*G. pallens* and *G. glaucus*) which can serve as the initial stage of a new speciation event.

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CONTROL OF PESTIFEROUS EMERGENCES OF CHIRONOMIDAE: A CASE STUDY OF *Polypedilum nubifer*

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Kealia Pond National Wildlife Refuge, Maui, HI, was established to preserve, restore, and manage an essential foraging and resting wetland for two endangered waterbirds: the Hawaiian stilt and Hawaiian coot. The seasonal flooding, eutrophic conditions, and shallow depths in Kealia Pond have created a favorable environment for the establishment and proliferation of an exotic chironomid, *Polypedilum nubifer*. Although *P. nubifer* is likely an important food resource for these birds, swarms of emerging adults are a nuisance to nearby condominium residents and businesses. A 7-wk study was conducted to assess the efficacy, localized control, and non-target effects of two insecticides: a spore-producing bacterium, *Bacillus thuringiensis* var. *israelensis* (*Bti*) and methoprene (Strike®), a juvenile hormone analog, in controlling populations of *P. nubifer*. Four experimental plots along each of six transects were established in the pond with plots on each transect receiving *Bti* (13.9 lbs/acre), low methoprene (5 lbs/acre), high methoprene (10 lbs/acre), or no treatment (control). Benthic invertebrates were sampled from each experimental plot using a PVC core and emerging adults were collected using submerged emergence traps. In addition, untreated areas downwind of treated plots (off-site) also were sampled to assess non-localized effects of insecticide applications. The only benthic non-target organism collected was a native chironomid, *Chironomus hawaiiensis*. *Polypedilum nubifer* emergence was significantly reduced ($p < 0.05$) only in methoprene plots with reductions lasting for 10-d (low rate) and 17-d (high rate) post-treatment. *Chironomus hawaiiensis* emergence was not significantly affected. Larval densities of both species in *Bti* and methoprene plots were not significantly different from control plots. In addition, larval densities or adult emergence of either species were not affected at off-treated sites. These results suggest that methoprene is effective at reducing the emergence of *P. nubifer*, and will not impact larval populations in untreated areas, which serve as important foraging areas for endangered waterbirds.

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A NEW SPECIES OF *Paratanytarsus* (DIPTERA: CHIRONOMIDAE) WITH UNUSUAL LARVAL AND ADULT MALE MORPHOLOGY

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Paratanytarsus longistylus sp. n. is described as male, pupa, and larva. The larvae have the Lauterborn organ pedicel longer than antennal segments 3-5 combined and the pecten epipharyngis composed of three pectinate plates. The adult male lacks crests on the anal point. These character states are unusual for a species that otherwise best fits in *Paratanytarsus*. The new species inhabits cool streams in eastern North America.

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THE IMMATURE STAGES OF *Chasmatonotus unimaculatus* LOEW (DIPTERA: CHIRONOMIDAE: ORTHOCLADIINAE) WITH NOTES ON THEIR HABITAT

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The larval and pupal exuviae of *Chasmatonotus unimaculatus* Loew were collected from soil samples from which two adult males emerged. The collection site was located in the Hocking Hills area of southwestern Hocking County, Ohio within the relatively sheltered, cool, and moist conditions of a wooded ravine which has a spring fed stream flowing through it. The soil inhabited by the immature stages was damp, but not wet, and appeared spongy with high humus content mixed with sand. The immature stages are described. Pupae can be distinguished from other genera by having the combination of a short lobe shaped thoracic horn, a large oval mound-like tubercle which occupies most of the thorax anterior to the thoracic horn, the abdominal tergites II-VIII are completely covered by strong spinules, and the anal lobe is without setation. The larvae share several morphological characters with other terrestrial taxa such as mentum with reduced number of teeth (9), anterior parapods fused, procercus absent, anal setae absent, and posterior parapods reduced. Larvae can be distinguished from other genera by having the above combination of characters in addition to not having a pecten epipharyngis and having simple SI. This is the first description of the immature stages for the genus *Chasmatonotus*.

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CHIRONOMID COMMUNITIES FROM URBAN STREAMS IN A RAPIDLY EXPANDING CITY IN NEW ZEALAND

Ian K. G. Boothroyd*

The North Shore City of Auckland is expanding rapidly with new subdivisions around the margins of the City and infill housing within the existing residential areas. These changes have placed considerable pressure on the existing stream resources with changes to the hydrological regime, channel morphology and instream habitat and riparian vegetation. As part of an extensive investigation of streams within the City boundaries, chironomid communities were examined for changes resulting from urbanisation. An investigation of stream types ranging from semi-natural forested streams to concrete channels revealed a total of ten chironomid taxa occurring in urban waterways. Chironomid communities of highly modified concrete or channelised waterways were dominated by *Limnophyes vestitus* and *Paratrichocladus pluriserialis*, while forested and semi-forested urban waterways exhibited lower chironomid diversity and abundance.

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THE ICE WORM, *Zealandochlus latipalpis*, FROM NEW ZEALAND

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While the abominable snowman and the yeti live in the mythology of other countries of the world, New Zealand has its own ice bound creature - the "ice worm". Despite its name however, the ice worm is not a worm at all but the larva of *Zealandochlus latipalpis* Brundin. The ice worm is found only on the glaciers of southwest New Zealand and the entire life cycle is spent on the surface of glaciers. The adult males of *Zealandochlus latipalpis* are brachypterous, and have reduced wings, and cannot fly but hop on the ice surface, while females have enlarged wings. The larvae occur in meltwater pools and ice caves, where they survive the changes in light and temperature that occur on the surface of the ice. Examination of the gut contents reveals that the larvae consume the fine organic dust material that occurs on the surface of the ice. The larvae resemble those of closely related *Parochlus* larvae, but are distinguished by the 5-segmented antenna. Segments 3 and 4 are poorly differentiated but annulations are present on all of the 3^d and the fused basal component of the 4th segment. The mentum has an enlarged median tooth and rather evenly decreasing lateral teeth. *Zealandochlus* appears to form a sister group to closely related Podonominae genera *Podonomus* and *Parochlus*.

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INFLUENCE OF RIPARIAN MANAGEMENT ON CHIRONOMID COMMUNITIES IN HARVESTED PINE FORESTS IN NEW ZEALAND

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Production pine forests are an increasing feature on the New Zealand landscape. The effects of harvesting these pine forests has the potential to alter the communities of stream biota. The retention of a riparian buffer or management zone is frequently advocated as a suitable method to mitigate the influence of landuse, including pine forest harvesting. The influence of riparian management on chironomid communities was investigated at 28 sites in the Whangapoua River catchment of the Coromandel Peninsula of New Zealand. Stream reaches were surveyed in native forest, mature pine plantations with and without native riparian vegetation, and in clearcut forests with and without riparian vegetation. A total of 18 chironomid taxa was recorded from all sites. Most taxa were found at all riparian and forest categories, but differed in abundance and relative abundance. *Tanytarsus vespertinus* was most common and abundant within all riparian and forest types, with the exception of pine forests with no riparian vegetation where *Eukiefferiella brundini*, *Kaniwhaniwhanus chapmani* and Tanypodinae dominated. Changes in chironomid communities are discussed in relation to stream morphology and riparian management and forest type.

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DO CHIRONOMIDS PLAY A KEY ROLE IN THE ONSET OF CHOLERA EPIDEMICS?

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Cholera is a potentially life-threatening and epidemic disease. It is a diarrheal disease caused by the gram-negative bacterium *Vibrio cholerae*, and an estimated 120,000 deaths from cholera occur globally every year. There have been seven cholera pandemics since 1817. The seventh and current pandemic began in 1961 and is the longest one to date. Cholera continues to be an important cause of morbidity and mortality in many areas of Asia, Africa, and Latin America. The fatal effects of the disease are mainly due to the toxin produced by specific serogroups O1 and O139 of *V. cholerae*.

The natural reservoir of *V. cholerae* has long been assumed to be humans, but it appears that there is no chronic state of the disease. Up to 2001 it was claimed that the natural reservoir of *V. cholerae* is not known. Broza & Halpern (NATURE, 412, 40, 2001) reported the isolation of *V. cholerae* from chironomid egg masses. The bacteria feed on the gelatinous matrix only. It may serve as the sole source of carbon for *V. cholerae*, thereby providing a natural reservoir for the organism. Eggs chorion looks normally but damage to the internal structure of the eggs was observed. The eggs sunk to the floor and most of them did not hatch. Our study includes a year-round survey in three sites in Israel, as well as a short term study in India and Africa. Thirty-two different serogroups of *V. cholerae* were identified among the bacteria isolated from chironomids. However, we have not yet isolated the two pandemic-pathogenic serogroups O1, O139. This is most likely due to our inability to spend weeks at a time in areas affected by an outbreak. *V. cholerae* non O1 non O139 were isolated also from adults *Chironomus*, collected in nature with light traps. Do adults disseminate cholera disease by aerial transfer?

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***Chironomus tigris*, SPEC. NOV., A NEARCTIC SPECIES WITH A UNIQUE LARVA AND KARYOTYPE**

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As early as 1967, the karyotype of an unknown Nearctic *Chironomus* was reported by Wuelker, Sublette, and Martin to have only two haploid chromosomes, rather than the four (or sometimes three) typical for this genus. The species has been referred to as “*Chironomus* species r” in Jon Martin’s list of North American cytospecies. We re-discovered a species with this chromosomal number in 1993 in a Minnesota lake, and describe it here as *C. tigris* on the basis of its unique karyotype, its larval morphology, and reared adults. The species is now known from several eutrophic lakes in Minnesota, Wisconsin, and Quebec, and can be identified readily by its unique larval characters and distinctive karyotype. Larvae are of the plumosus-type and reach 18-19mm in the final instar. *C. tigris* is the only known deep-water *Chironomus* in North America with a darkly-pigmented frontoclypeal apotome. Brown markings against a yellow-orange ground color give imagines a tiger-striped appearance. The karyotype is derived from the normal thummi-complex chromosomal arm pattern (AB CD EF G) by fusion of arm G with arm A, and fusion of arm D with arm E, but including a small translocated portion of arm F carrying the EF centromere. Although two centromeric bands are evident in both the long, metacentric CDEF and the shorter, submetacentric GAB, only one centromere appears to be active in each of these complex fused chromosomes. This karyotype is distinct from the other known example of a *Chironomus* species in which N=2: a Siberian species with metacentric BACD and telocentric FGE arm combinations.

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DESCRIPTION OF THE IMMATURE STAGES AND ADULT FEMALE OF *Neostempellina reissi* (DIPTERA: CHIRONOMIDAE)

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The immature stages and adult female of *Neostempellina reissi* are described based upon reared specimens from NY and OH. A slightly emended description for the adult male is provided based on rearings, as well as additional adult specimens from FL. The larva has most often been recognized as *Stempellina* in published reports, and its highly developed procerci and antennal bases are both distinctive and diagnostic. The larva can best be characterized as climber/sprawler/clinger in sandy substrates with a trophic relationship of shredder-herbivore, preferring cool spring runs to large rivers in relatively undisturbed watersheds. Features of the pupa and adult female are discussed. The pupa is quite similar to that of *N. thienemanni*, except for the presence of a vortex on S IV. Adult female characters are similar to other members of the *Zavreliina*. Available data indicates an Arctogaeon distribution pattern for *Neostempellina*, with possible extension into the Neotropics.

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LAND-USE EFFECTS ON CHIRONOMID COMMUNITY STRUCTURE IN NATURAL AND CONSTRUCTED WETLANDS

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Farm ponds experience a variety of disturbances from agricultural practices. Sediments, pesticides, herbicides, and fertilizers are transported by run-off from surrounding-agricultural watersheds and deposited into receiving ponds. The objective of this study was to determine how patterns in chironomid richness, relative abundance, and growth vary across farm ponds under different land uses. Larvae were collected from four types of pond, based on wetland type and adjacent land use: (1) natural wetlands, and constructed agricultural ponds adjacent to (2) row-crop agriculture, (3) grazed grassland, and (4) non-grazed grassland. Constructed ponds were classified based on the land-use practices within the first 100 m of their surrounding drainage basin. We sampled ten ponds from each land-use type. Epi- and in-faunal chironomid assemblages were collected during three separate sampling periods in the summer of 2001. Data collected from the first time period was used to test the hypothesis that chironomid richness would vary dependent upon local-landscape condition (i.e., pond type). All larvae were identified to the generic level and counted. Mean taxa richness from each pond type was compared using analysis of variance (ANOVA). Significant differences were found in taxa richness between natural ponds and ponds surrounded by row-crop agriculture and natural ponds and ponds surrounded by grazed grasslands. Chironomid responses to environmental variables (depth, % forest, % row crop agriculture, dissolved total nitrogen and total phosphorus) were explored using detrended correspondence analysis (DCA). The first gradient separated chironomid taxa by pond depth and dissolved nutrient concentration. A second gradient separated taxa across a transition between forest and agricultural land-use. The relationships among the chironomid taxa and environmental variables were significantly different from random (Monte Carlo permutation test, $p < 0.02$). Our initial findings suggest that local-landscape condition and potential disturbance affect chironomid community structure. Future analyses will focus on the effects of local land-use on chironomid community function (i.e., as measured by average growth rate for a suite of taxa).

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EFFECTS OF SEX AND AGE ON THE SUPERCOOLING POINTS OF *Diamesa mendotae* MUTTKOWSKI

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Adults of *Diamesa mendotae* Muttkowski commonly emerge during winter from groundwater-dominated streams in Minnesota. Adults are active on snow, mate and fly at ambient air temperatures below 0°C., indicating possible physiological mechanisms to prevent freezing. Our objective was to determine the supercooling point (SCP) of field-collected adults as an initial attempt to understand the cold-adapted strategies of this species. The SCP is defined as the temperature at which body fluids spontaneously freeze when cooled below the melting point. Additionally, SCP is one indicator used to compare relative cold hardiness of related species or of stages within a species.

In order to determine if supercooling points vary by sex and age post-emergence, two hundred sixty five adults were collected on 12 March 2003 from snowbanks along the Kinnickinnic River south of River Falls, Wisconsin. Adults were placed individually in vials and maintained at 6°C until tested for SCP. Batches of 10 males and 10 females were randomly selected and their SCP determined at 3, 5, 9, 12 and 17 days post-collection. Supercooling points of adults were recorded using surface contact thermometry and a cooling rate of ca. 1°C min⁻¹. The SCP was determined as the lowest temperature reached before the release of latent heat of fusion.

Supercooling points of females averaged -22.81°C, -23.76°C, -23.85°C, -23.65°C, and -20.87°C on each date post-collection and did not differ significantly over time ($p > 0.05$, one-way ANOVA). Supercooling points of males were also statistically similar and averaged -21.75°C, -23.53°C, -23.68°C, -23.66°C, and -22.92°C on each date post-collection. Paired comparisons of female/male SCPs on each date post-collection did not show significant differences ($p > 0.05$, paired ttests). Supercooling points of *D. mendotae* are substantially lower than values of -5.3°C and -5.7°C published for adults and larvae of field-collected *Belgica antarctica* and -12.0°C for larvae of *Paraclunio alaskensis*. However, no adults survived after the SCPs were determined, and further studies are necessary to determine if *D. mendotae* is a freeze-intolerant insect. Nevertheless, our results suggest that low SCPs could be used as a mechanism to facilitate winter emergence and adult activity for this species.

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THE SEMIOTICS OF *Semiocladius* – HALF RIGHT AND HALF WRONG ?

Peter S. Cranston* & Sophia Dimitriadis**

The chironomid genus *Semiocladius* (Diptera, Chironomidae, Orthocladiinae) was described by Sublette and Wirth from adult midges from sea shores of the south-eastern Pacific, with an Australian species *Camptocladius crassipennis* Skuse designated as genotype, a new species described from subAntarctic New Zealand (*S. kuscheli*), and the Japanese marine species *Semiocladius endocladiae* (Tokunaga) included. Immature stages were associated only tentatively by co-occurrence rather than rearing. On grounds of phylogeny and resemblance to other taxa the larva has been suggested to be unrelated.

In the course of studying estuarine Chironomidae of south-eastern Australia, a distinctive larva resembling that described for *Semiocladius* gave a strong signal for certain mesohaline positions on the salinity gradient of the Clyde River estuary, sometimes approaching marine conditions. Although difficult to rear, eventually the complete life history was obtained, showing that the larva develops to a pupa identical to the speculatively associated exuviae of *Semiocladius*. Furthermore, the solitary reared adult male fits closely to descriptions of *Semiocladius crassipennis*. Evidently existing diagnoses for immature stages of *Semiocladius* are correct: the pupa is scarcely distinguishable from those of *Thalassosmittia*, but the larva could not be mistaken for any other saline/mesohaline taxon.

The distribution of the genus remains western Pacific, from eastern Australia, including Lord Howe Island, New Zealand, including subAntarctic islands and northwards to Japan. It is absent from sampled subcoastal lakes even in saline pahse. Species diversity of *Semiocladius* may be greater than reported given the modest sampling of the preferred habitat in a region with substantial shorelines surrounding isolated islands of differing geological ages.

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RELATING MORPHOLOGICAL TRAITS OF CHIRONOMIDS TO THE ENVIRONMENT

Brian R. Creutzburg* and Charles P. Hawkins**

Ecologists have used statistical analyses to separate organisms based on their morphological traits, and to correlate assemblages of organisms to environmental conditions. Uncovering relationships between environmental conditions and morphological traits in a natural setting would be additionally informative. Such an analysis could yield an objective, empirical description of the adaptive traits that certain environments select for. In this study, we examined if morphological traits of larval chironomids were associated with environmental conditions. To do so, we constructed a matrix of morphological traits and environmental conditions. This matrix was then compared to a distribution of 1000 random matrices to determine which combinations of morphological traits and environmental conditions fell outside of a normal distribution. Our results indicate that, overall, midge morphology was associated with a different set of environmental conditions than were midge taxa. Numerous non-intuitive correlations existed between morphological traits and environmental conditions. These results can be refined by more detailed analysis of midge morphology and by inclusion of smaller-scale environmental data.

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THE STATE OF CHIRONOMIDAE PALAEOECOLOGY IN AUSTRALIA

Sophia Dimitriadis* and Peter S. Cranston**

Palaeoecological studies using biotic proxies from terrestrial and aquatic environments such as pollen, diatoms, beetles and Chironomidae (Insecta: non-biting midges) preserved in lake sediments are used to address some of the most important environmental issues of the new millennium. Most effort is directed towards understanding biotic diversity and providing information pertinent to conserving aquatic species assemblages in the context of dynamic faunal distributions, climate change, and increasing anthropogenic impact. The subfossil chironomid assemblages of the northern hemisphere have been studied most intensively to estimate the magnitude of Late Glacial temperature fluctuations. Such work has commenced only recently in Australia, where subfossil chironomid assemblages from lakes typically have a maximal diversity of around 30 taxa in temperate and tropical regions. These show similarly distinct and statistically significant relationships to temperature, as observed in the northern hemisphere. The most notable differences in the lentic fauna appear to result from more extreme environmental conditions and a dominance of the littoral fauna even where profundal habitats are available. As a consequence, littoral-associated taxa such as *Stempellina* and certain Orthoclaadiinae are more important indicators than the cool stenothermic taxa typically used in the northern hemisphere to reconstruct past conditions. Another difference is the high covariance observed between variables known to strongly influence chironomid species distributions such as temperature, water level/aridity and salinity that necessitate a more individualistic interpretation in the southern hemisphere. Individual species thus carry more weight in reconstructions and lakes are interpreted as uniquely behaving systems, even though broader climatic controls and regional influences usually override local peculiarities.

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CHIRONOMIDAE RESPONSE TO RESOURCE LIMITATION

SALLY ENTREKIN* AND BRUCE WALLACE**

Terrestrial litter inputs and wood were excluded from a southern Appalachian headwater stream, and reference data were collected from a similar stream. Following three years of exclusion, removing large woody debris, and small woody debris, detrital inputs were shown to control key ecosystem processes in this headwater stream, reducing abundance, biomass, and secondary production of shredders, gatherers, primary consumers and predators. We examined the effects of detrital limitations on Chironomidae (Insecta: Diptera). The subfamilies Chironominae, Orthocladiinae, Tanyptodinae, Diamesinae, and Podonominae were identified. Total abundance and biomass of the subfamily Tanyptodinae significantly declined, as did the tribe Tanytarsini (Chironominae), however; there was no significant decline in the total abundance and biomass of Orthocladiinae and Chironomini (Chironominae). Before litter exclusion, several genera of Tanytarsini dominated the treatment stream: *Constempenilla*, *Micropsectra*, and *Cladotanytarsus*. After the exclusion of leaves and removal of wood, Orthocladiinae became the most dominant subfamily with a dramatic increase in a psammanophilous genus: *Lopescladius*. Several other Orthocladiinae (i.e. *Parachaetocladius*, *Krenosmittia*, *Hydrobaenus*, and *Parametriocnemus*) were able to persist. Not only did the dominant taxa shift from Tanytarsini to Orthocladiinae taxa, the community assemblage was much more variable within the treatment stream, suggesting that these taxa were unable to successfully complete their lifecycle. These results were likely a response to the loss of leaves and wood as a food resource and essential habitat.

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***Phytotelmatocladus*, A NEW GENUS FROM BROMELIADS IN FLORIDA
(DIPTERA: CHIRONOMIDAE: ORTHOCLADIINAE)**

John H. Epler

Phytotelmatocladus delarosai, new genus, new species, is described from bromeliad phytotelmata in southern Florida. The larva had previously been keyed and diagnosed as *Metriocnemus* sp. B in Epler (1992, 1995) and Orthocladiinae genus H in Epler (2001). The pupa lacks a thoracic horn and pedes spurii A and B, has tergites II-VII and anal lobe mostly covered with shagreen spines, with well developed spinules on the conjunctiva between most tergites and sternites, and has only two macrosetae on each of its truncated anal lobes. The female has bare eyes, scalpellate acrostichals, only one seta on the squama, a long comb of 40+ sensilla chaetica on the mid leg basitarsus and seminal capsules without microtrichia. This new genus shows similarities to *Comptosmittia*, *Limnophyes*, *Paralimnophyes* and *Thienemannia*. Only female adults and pupae have been collected or reared, leading one to assume that this taxon may be parthenogenetic.

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PARASITIZATION OF CHIRONOMIDAE BY WATER MITE LARVAE IN A SPRING OF THE GRAN SASSO MASSIF (CENTRAL ITALY)

Uberto Ferrarese* & Bruno Cicolani**

Host-parasite relationships between Diptera and water mites in a small rheocrenic spring of the Gran Sasso Massif (central Italy) have been investigated. Chironomidae represented the Diptera family most affected by parasite water mite larvae, with 79 parasitized individuals versus 7 of the other Diptera altogether (6 Dixidae and 1 Simuliidae). In the samples, performed by means of insect emergence traps and hand nets from December 1999 to December 2000, 31 species of adult chironomids were found, indicating a noticeable species diversity for a single rheocrenic spring. In this paper 16 species of water mites larvae, belonging to 6 genera, are reported as parasites of 9 species of Chironomidae, all referred to the subfamilies Orthoclaadiinae or Chironominae. Although in the spring also Tanypodinae were numerous and rich in species, no individual of this subfamily has been found parasitized. These results suggest that larval mites of species parasitizing chironomids in this spring search their hosts on the bottom rather than in the water column. Seasonal patterns of prevalence, abundance and intensity of larval parasitism have been analysed and discussed. Host specificity, attachment-sites preference and sympatry conditions are also reported. Comparing the results of the present investigation to those on other European springs, it is suggested that host choice is linked to the host's ability of spreading and colonising different water habitats. Moreover the results of the present study confirm that attachment sites preference depends on the size both of host and water mite larvae. All the collected data confirm some previous observations of an aggregated distribution of parasites on hosts as well as a parasitic strategy essentially aimed to dispersal rather than growth.

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LONGEVITIES OF *Diamesa mendotae* MUTTKOWSKI, A HIBERNAL EMERGING SPECIES OF CHIRONOMIDAE

Leonard C. Ferrington, Jr*., Dan Hansen*, Byron Karns and R. Will Bouchard***

Field collected adults of *Diamesa mendota* Muttkowski were maintained at 6 degrees C. in controlled environmental chambers to determine their patterns of survivorship. Adults were collected from snow at five different groundwater dominated streams on 11 dates over three years, and longevities were determined for 729 individuals. Specimens were provided access to water to prevent dehydration but were not provided food. Average adult longevities ranged from 12.1 days to 33.0 days for individual collections, and averaged 18.6 days for all 11 collection dates. Maximum longevities ranged from 25 days to 54 days per collection, and averaged 36.8 days for all 11 collection dates. Females had slightly greater longevities, but maximum survivorship was strongly influenced by oviposition. Females that did not oviposit lived longest, but females that oviposited earlier in the experiments lived longer than females that oviposited later. Additionally, females that oviposited earlier survived longer post-oviposition than did females that oviposited later. Measurements in the field show that small protected areas near the water surface in streams that are strongly groundwater fed can be warmed by heat from the stream to temperatures of 6 degrees C. or more, even when ambient air temperatures away from the stream are significantly below freezing. Our results suggest that adults emerging in winter can have relatively long adult survivorship and increased probability of successfully mating and ovipositing in small protected areas near streams that are groundwater dominated even in high latitudes where colder thermal regimes predominate.

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A NEW TECHNIQUE FOR USING CHIRONOMID REMAINS IN PALEOCLIMATE RESEARCH

Donna R. Francis¹, Matthew J. Wooller², Gifford H. Miller³, Ian R. Walker⁴, Marilyn L. Fogel⁵, and Alexander P. Wolfe⁶

Remains of larval Chironomidae (mostly as head capsules) recovered from lake sediment cores have proven to be an extremely valuable tool in reconstructing past temperatures, and therefore past climates, as well as other environmental variables. Inference models, or transfer functions, based on the distributions of modern midges are used to quantitatively estimate paleotemperatures from the faunal assemblages found in sediment cores. We are developing an independent proxy for mean annual air temperatures (MAT), based on the oxygen-18 isotopic content of the head capsule chitin. At high latitudes, $\delta^{18}\text{O}$ of precipitation is highly correlated with mean annual temperature, and the $\delta^{18}\text{O}$ of arctic lakewater is set by the $\delta^{18}\text{O}$ of precipitation. Here we show that the $\delta^{18}\text{O}$ values in the head capsules are equilibrated with the $\delta^{18}\text{O}$ of the lakewater in which they live, and thus because of the above correlations, chironomid $\delta^{18}\text{O}$ can be used to provide quantitative estimates of past changes in mean annual air temperature (plus or minus 1 °C). We compare our Holocene temperature reconstructions based on chironomid $\delta^{18}\text{O}$ with temperature reconstructions derived from chironomid faunal assemblages in two Arctic lakes. This demonstration of the potential of chironomid $\delta^{18}\text{O}$ for paleotemperature reconstructions will help to resolve many questions regarding the onset of Holocene warmth in the North Atlantic region.

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TERRESTRIAL CHIRONOMIDS IN DISTURBED HABITATS

Jan Frouz

This contribution summarizes the results of several research projects dealing with the initial stages of secondary succession in old fields, and areas disturbed by industrial use, post fire succession and driven succession used for restoration of species rich meadows in various part of the Czech Republic, Poland and Slovakia. Terrestrial Chironomidae are frequently abundant in these situations, and in many cases they dominate the soil macro-fauna. Species from the genera *Bryophaenocladus* and *Smittia*, particularly *S. aterrima*, are most frequent in such situations. *Smittia atterima* and some other species are often more abundant in disturbed places than in the surrounding undisturbed landscape. Sites with a high abundance of chironomid larvae usually had little cover of higher plants, although areas with sparse vegetation were often preferred over completely bare sites. Food resource analyses indicated that the presence of attractive food sources such as terrestrial algae, mosses and their protonemata are the main reason for preferential use of these habitats. However seasonal drought and microclimatic conditions may pose particularly severe problems for chironomid larvae in these habitats. The response of midge populations on these habitats is described and discussed.

Study supported by grants of Grant Agency of the Czech Republic No. 256/98/P156, 526/01/1055 and 526/02/0036.

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**BODY ALLOMETRY IN GYNANDROMORPHS OF A TERRESTRIAL CHIRONOMID,
Bryophaenocladus cf. *illimbatus***

Jan Frouz

Large number of gynandromorphs of terrestrial chironomid *Bryophaenocladus* cf. *illimbatus* was trapped in yellow traps in suburban fallow near České Budejovice in spring 1999. In this study I focused on question How morphological changes in genitalia correspond with other morphological changes in other parts of body, namely in antennae?

Morphology of genitalia, wing length and morphology of antennae were measured and compared using ordination techniques. More or less gradual transition between male and female genitalia and male and female antennae was recorded. Specimens with more male shaped genitalia have more likely also more male shaped antennae.

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BIOCHEMICAL CHARACTERIZATION OF *Chironomus* SPP. EGGMASS AND ITS CONSUMPTION BY *Vibrio Cholerae*

Hanan Gancz¹, Malka Halpern², Yechezkel Kashi¹ and Meir Broza²

Nolte (Entomol. scand. Suppl., 43, 1993) reviewed the current knowledge on the structure of the egg masses of the different subfamilies of Chironomidae. In *Chironomus* eggmass a few hundred eggs are arranged in double rows and folded into loops around a pair of "central fibres". They are embedded in a gelatinous inner layer (the "tube") and all encased in an outer layer of gelatinous matrix. The *Chironomus* eggmass ends in a "stalk", a gelatinous process which never contains eggs. It is a process with which an eggmass is attached to a substratum. The recent findings of Broza and Halpern (2001) that *Vibrio cholerae* utilize the *Chironomus* egg mass as their only carbon source has driven us to explore the biochemical nature of this eggmass. Selective staining methods were employed in order to characterize the various components of the egg mass. It includes the Commassie brilliant blue, silver stain, Acid Schiff Reagent, and Congo red staining. The gelatinous like matrix was found to consist of glycoproteins while the central fibres consist of protein alone. The stalk has been demonstrated to be hydrophobic in contrast to the rest of the gelatin matrix. Although superficially the stalk seems a direct continuation of the outer layer of the gelatin, a better examination shows that it had also higher viscosity. The gelatinous matrix consists of massive sugar component, which is, at least in part, a proteoglycan. In liquid media the culture of the bacterium *Vibrio cholerae* supernatant lyses the gelatinous-like matrix of the egg mass. The extracellular factor responsible for the degradation was purified and identified as hemagglutinin/ protease (HA/P) of *V. cholerae*. Thus HA/P may play a role in the co-evolution of this host – pathogen interrelationship. Both HA/P activity on the egg mass and that of proteinase K (a broad range protease) cause the degradation of the gelatinous matrix. The degradation products show both peptide and sugar like characteristics. The degradation products were analyzed on TLC plates and SDS-PAGE. When culturing *V. cholerae* on eggmass, the bacteria totally consumes the gelatinous matrix, leaving a clean central fibres (not degraded by *V. cholerae* enzymes). Strenzke noted that the central fibres are species-specific and because taxonomists were unable to extract them in regular technique, the HA/P enzyme could be tested as a practical tool.

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USING CHIRONOMIDS AS INDICATORS IN IMPLEMENTING THE EU WATER FRAMEWORK DIRECTIVE

Xavier-Francois Garcia*, Mario Brauns*, Martin Pusch*, Norbert Walz*

The EU Water Framework Directive (WFD) provides a new legal framework for the sustainable management of European inland and coastal waters. As a first step, the WFD requires that the current ecological status of each aquatic ecosystem be assessed by conducting comparisons of current ecological conditions with reference conditions specific to each type of water body, where the water body types must first be defined based on their hydromorphological characteristics.

In order to set up a typology and assessment scheme for the larger lakes of north-eastern Germany, we sampled 31 lakes located in Brandenburg (EU Ecoregion Number 13: lowland plains). We collected benthic macroinvertebrates from the infra-profunda and littoral-profunda zones (1.5 to 6 m depth) with an Ekman-Birge grab sampler. Using cluster analysis, the 31 lakes were classified into different types based on five hydromorphological parameters unrelated to trophic status; viz. mixis, water residence time and mean depth. Based only on mixis and water residence time, the lakes were classified initially into two groups (a group of 16 lakes connected to a river network and 15 lakes independent of a river network). Adding mean depth allowed a finer classification into a total of four groups.

Using canonical correspondence analysis, it was demonstrated that faunal assemblages are also dependent on mixis, water residence time and mean depth, leading to the conclusion that faunal assemblages coincide with the four abiotic types mentioned above. However, an overlap between lake type and the level of degradation of the 31 lakes is observed, since lakes closely connected to a river network tend to be more disturbed than others because of the heavy degree of anthropogenic influence to which most the rivers in Europe have been exposed. This makes identification of type-specific reference assemblages difficult. Nevertheless, by comparing abiotic typology and biotypology using a co-inertia analysis it was possible to assess the level of degradation of each lake for each of the four types.

In our lake studies, chironomids are of great interest as they constitute 50 % of the species recorded. These chironomid species include type-specific and pollution-sensitive species, but also a large number of pollution-tolerant species adapted to different levels of disturbance. As previously suggested by Thienemann, chironomids reflect very clearly the ecological status of a lake. Due to their relatively slow temporal population dynamics, their value as ecological indicators appropriate for lake assessment purposes far exceeds that of the plankton.

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THE PRODUCTION OF CHIRONOMIDS IN A SUBARCTIC RIVER

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In the River Laxá, N-Iceland the production of Orthoclaadiinae, the dominant subfamily of Chironomidae was estimated by the average cohort method at three stations, from 1978-1985. They were at 2, 6 km and 24 km downstream from the outlet of Lake Mývatn.

Chironomidae populations have been monitored since 1977 in the River Laxá at the two upstream stations. The blackfly, *Simulium vittatum*, accounted for 90% of all insects caught in the traps but dominating orthoclad species were: *Eukiefferiella minor*, *E. claripennis*, *Orthocladus consobrinus* and *O. oblidens*.

The benthic production of the river was dominated by *S. vittatum* with as much as 75 % of the total benthic production at 2 km from the outlet, and a lower proportion downstream. The larval blackfly population, which feeds on drifting FPOM, fluctuated much more than the chironomid populations. The fluctuation is reflected by changes occurring in the phytoplankton production in Lake Mývatn. We suggest that the chironomid populations in the river are more dependent on benthic algal production and the blackfly larvae are depended on drifting FPOM.

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CHIRONOMID SPECIES RICHNESS IN STREAMS DRAINING AREAS OF SERPENTINE VS. NON-SERPENTINE BEDROCK

Susan E. Gresens* and Leonard C. Ferrington, Jr.**

Chironomid pupal exuviae were collected from two woodland streams in the Maryland (U.S.A.) piedmont to determine how species richness and community composition differed between a stream draining an area of serpentine outcrops (Chimney Branch) compared to one draining an area underlain by metamorphic schist and gneiss (Baismans Run). These streams are potential reference sites in a larger survey of streams in Baltimore City and County, which span a gradient of urban development. However the presence of chromium and other metals in the serpentine rock suggested that Chimney Branch might have an unusual chironomid community unsuitable for use as a reference. Collections of exuviae were made at 3-week intervals from early February to late August 2002 (a period of extreme drought) and also in November and December. Baismans Run had a mean pH of 7.2 and higher nitrate levels (2.0 mg/l) whereas Chimney Branch had a mean pH of 7.8, higher total phosphorus (12.7 µg/l) and more abundant periphyton. The physical habitat differed greatly between streams, with 46% of the bed of Baismans Run composed of fine sediment, whereas Chimney Branch was dominated by larger rocks, and had only 7% fine sediment.

Seventy-one species were collected from Baismans Run and 73 species from Chimney Branch. At a coarser level of comparison, the chironomid communities of the two streams appeared similar. In each case, the Orthocladiinae represented over 75 % of all exuviae, with *Corynoneura* and *Thienemanniella* alone representing at least 60% of all exuviae. The Tanytarsini composed a further 15% of all exuviae. In contrast, the Chironominae represented 32 – 41 % of the total species collected. Rarefaction analysis showed that in Chimney Branch, maximum species richness coincided with maximum emergence, in mid-June. However, in Baismans Run maximum species richness occurred in April, whereas peak emergence was observed in early June. In both streams, temporal change in species composition was most rapid from February to May and slowed during the summer. However the overall similarity in species composition between streams was only 47%, reflecting differences in the occurrence of many rare species. Chironomid taxa associated with leaf detritus were well represented in both streams, and it appeared that differences in stream substrate and abundance of algal food resources had more influence on the fauna than any negative effect of serpentine.

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NEW RECORDS OF CHIRONOMIDAE FROM THE LAKE HOVSGOL REGION, MONGOLIA

Barbara Hayford

Lake Hovsgol, Mongolia, is an ancient lake located in south central Siberia and is part of the Lake Baikal Rift Zone. Lake Hovsgol's connection to Lake Baikal and its age have led to numerous studies on its species diversity, endemism, and ecology. Erbaeva *et al.* (in press) have identified a total of 106 species of Chironomidae from Lake Hovsgol. Recent ecological analysis of the lake indicates a unique region of chironomid diversity associated with the island Modon Hui, located in the southern third of the lake. Adults were collected along the shore by sweep netting and resulted in the identification of *Heterotrissocladius subpilosis* Kieffer, a new record for Mongolia, and one possible new species each for *Pseudosmittia* Goetghebuer and for *Neozavrelia* Goetghebuer. Larvae and pupal exuviae were collected off shore of the island and on the shore of the island respectively, resulting in the identification of six pupal types or species not previously listed for Mongolia: *Neozavrelia* Pe 1, *Paracladius* Hirvenoja., *Psectrocladius sordidellus* group, *Psectrocladius schliezi* Wülker, *Parakiefferiella* cf. *smolandica* (Brundin), and *Protanypus* sp. The pupae of *Parakiefferiella* did not fit in with descriptions for either of the two species already listed for the lake, *Parakiefferiella gracillima* (Kieffer) or *Parakiefferiella bathophila* (Kieffer). The pupae of *Protanypus* did not key out within existing keys, but did come closest to fitting within the description of *Protanypus morio* Zetterstedt, which has been described from the lake. However, the thoracic horn is much shorter and the shagreenation of the tergites is not as strong as is described for *Protanypus morio*, perhaps indicating that this is a new species.

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BANK PROTECTION WORKS IMPACT ON CHIRONOMID FAUNA IN THE MIDDLE REACHES OF THE CHIKUMA RIVER IN CENTRAL JAPAN

Kimio Hirabayashi* & Masaru Yamamoto**

In order to clarify the impact of bank protection works on the species composition and abundance of aquatic insects, we conducted an investigation especially on chironomid midges by a light trap from April 19 to September 30 in 2001 and 2002. A large bank protection works were undertaken during winter (from late October in 2001 to late March in 2002) in the middle reaches of the Chikuma River, Japan's longest river, and the riverbed structure largely changed. A total of 133,965 individual aquatic insects were collected in 2001 (before construction). Trichoptera (31.4%), Tipulidae (17.1%) and Chironomidae (28.5%) were predominant. Then, a total of 165,036 adult insects were collected in 2002 (after construction), the great majority of which were chironomid midges (50.1%). Male chironomid midges, the dominant species of chironomids, i.e., *Cricotopus sylvestris*, did not change in both years, but the number of species and the species diversity index (H') indeed changed. There were 66 species ($H' = 3.9$) in 2001, against 44 species ($H' = 2.7$) in 2002. Moreover, the patterns of temporal succession of H' in the occurrence of chironomid fauna throughout the investigation periods were very different in 2001 and 2002. After construction in 2002, it took about 150 days to recover the same H' level as in 2001. It was suggested that the bank protection works impacted the abundance and seasonal trend of adult chironomid midges in the river ecosystem.

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Odwin Hoffrichter*

The Chironomidae (Diptera) are a most remarkable insect taxon due to their ecological diversity and number of species. With over 10,000 species, they exceed all other dipteran families; they are extraordinarily widespread, extending from the high Arctic to the Antarctic, from Himalayan glaciers to the great depths of Lake Baikal and into the world's oceans. Pisciculture and allergology are prime examples connecting them with man. Due to their multiplicity, diverse scientific branches have been engaged in their study since the time of Aristotle, who was the first to write about them. Literature on Chironomidae has been systematically classified for over 30 years. Following the publications from 1976 and 1981 (Gunneria 26 and 37), approximately 300 new publications have appeared annually over the last decade in the Chironomus Newsletter, with regular supplements. This ongoing task has resulted in a comprehensive bibliography of the Chironomidae, amounting to over 20,000 titles. It is planned to publish it in a compact form in the near future. Currently, a CD is considered to be the most convenient format. The Symposium should provide a platform to discuss and decide which type of database would be most suitable for the majority of potential users.

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CHIRONOMID-HYDROPERIOD RELATIONSHIPS IN EVERGLADES NATIONAL PARK

Richard E. Jacobsen* & Sue A. Perry*

The proposed Comprehensive Everglades Restoration Plan includes numerous structural and operational changes to the existing Central and Southern Florida Project, that will alter the volume and path of water deliveries into Everglades National Park. The National Park Service, U.S. Department of the Interior, is seeking sensitive and efficient methods for monitoring the health and integrity of Everglades marshes during this restoration effort. We are using floating midge pupal exuviae sampling to develop midge community metrics for detecting changes in hydropatterns and water quality in Everglades marshes. Determining relationships between chironomid species and hydrological factors such as hydroperiod is fundamental for developing reliable metrics for assessing hydrological change.

In order to determine the hydroperiod (HP) preferences of chironomid species in Everglades marsh systems, we collected midge pupal exuviae samples monthly for a year from 22 sites categorized as either short-HP (8 sites), medium-HP (8 sites), or long-HP sites (6 sites) based upon known plant community-hydroperiod relationships. Each species collected was scored for their HP preference using 3 different criteria: 1) the ratio of their mean percent relative abundance in long-HP versus short-HP habitats, 2) their indicator values (IV) in an Indicator Species Analysis (INSPAN), and 3) the weighted average HP of all sites from which pupal exuviae were collected.

Chironomid species in Everglades marshes can be grouped into 4 general categories based upon their distributions, and their temporal and spatial dynamics, along hydroperiod gradients: (1) long-HP species that are strongly associated with substrates and plant species found exclusively in long-HP habitats (HP > 9.5 months), (2) long-HP species that apparently show no strong associations with substrates and plant species in long-HP habitats, and that have spatially dynamic populations responsive to short term, seasonal changes in hydrological conditions; (3) ubiquitous species; and (4) species adapted to short-HP habitats (HP < 6 months).

The distributions and biological attributes of species comprising each of these 4 groups will be discussed with respect to their usefulness in assessing long-term and short-term changes in Everglades marsh hydropatterns.

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COMMUNITY STRUCTURE OF CHIRONOMID LARVAE WITHIN THE SURF ZONE OF ICELANDIC LAKES

Erlín Emma Jóhannsdóttir*, Hilmar J. Malmquist* & Jón S. Ólafsson**

The community structure of Chironomidae larvae on rocky substrate in the littoral surf zone was studied in 32 lakes in Iceland in relation to geological and physico-chemical variables. All the chironomids identified belong to four sub-families: Orthocladiinae, Diamesinae, Chironominae and Tanypodinae. Both total densities of Chironomidae and density contributions of the four sub-families varied considerably between lakes, with average density between 49-62,000 ind./m². Of the four sub-families, Orthocladiinae larvae were most abundant in all the lakes with a contribution ranging between 38-100% of Chironomidae total density. The density of Chironominae larvae, which was the second most abundant group, was between 0-40%, followed by Tanypodinae larvae, 0-46%. The variability in the chironomid community structure is partly accounted for by geological and geochemical factors. Thus, both chironomid total densities and the contribution of Orthocladiinae larvae are significantly higher in spring-fed lakes, situated on a bedrock of recent origin (<0.1m.y.) as compared to direct-run off lakes in areas with older bedrock (0.1-13 m.y.). This probably reflects quite favorable life conditions in general for invertebrates in spring-fed lakes with catchments of neo-volcanic nature, as shown for instance by higher concentrations of dissolved nutrients, higher pH and total phosphorus concentrations in comparison to lakes located in areas with older, denser and less permeable bedrock. Also, rocky substrate in lakes of neo-volcanic areas consists of rocks which have not weathered and have therefore rough surface texture. Therefore, these rocks have relatively great surface to volume ratio, which provides more space and shelter for chironomids than rock substrate in lakes within areas outside the neo-volcanic zone in Iceland.

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EFFICACY OF COLLECTIONS OF SURFACE-FLOATING PUPAL EXUVIA FOR ESTIMATING EMERGENCE FREQUENCIES OF ABUNDANT SPECIES

Jeffrey L. Kavanaugh*, **R. Will Bouchard**** and Leonard C. Ferrington Jr**

Collections of surface-floating pupal exuvia (SFPE) have been used to determine species composition and estimate relative abundance of emerging Chironomidae in numerous types of studies. Although the collections are not quantitative in the sense of determining numbers emerging per unit area of stream, it has generally been assumed that the relative frequency of species in the collections closely corresponds to their absolute frequencies of emergence within the area sampled. In this paper we show how the estimated relative frequency of *Chironomus riparius* Meigen, an abundant species in organically enriched streams in Kansas, varies as the number of SFPE samples and size of a collection of SFPE increases.

Collections of SFPE were made from three sites on three dates during summer in Mill Creek downstream of the waste-water treatment facility of the city of Olathe in Johnson County, Kansas. Each site consisted of one riffle and the adjoining downstream pool habitat. The three sites were adjacent to each other, and were all sampled from downstream to upstream on each date. SFPE were collected with a 30.48 cm X 25.40 cm plastic pan and filtered through a standard testing sieve with 125 micron aperture. The smallest sample that could consistently be collected was made with a single dip of the pan, and 20 single-dip samples were collected at each site on each date (total=180 samples). All samples were sorted in the lab under 12X magnification and the frequency of *Chironomus riparius* was calculated. Individual sample results were (1) averaged to determine the effect of increasing samples on estimated frequency and (2) added to determine how the emergence frequency varied as numbers of exuviae increased. Twenty-four random simulations were then run to average or add samples in different sequences in order to model the pattern of the emergence estimates and to determine their standard errors as a function of numbers of samples and numbers of exuviae.

Our results demonstrate that 12-15 single-dip samples are sufficient to produce an estimated emergence frequency for *Chironomus riparius* that is relatively stable and usually within +/- 6% of the estimate obtained when all 20 samples are used. Similarly, a single composited "sample" of 200 to 300 exuvia provided an estimate that was usually within +/- 8% of the sum of exuvia of all 20 samples.

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PROPERTIES IN RESPIRATIONAL PHYSIOLOGY OF A JAPANESE CHIRONOMID, *Prosilocerus akamusi*

Koichiro Kawai*, Kyoko Abe**, Atsushi Ishimatsu*** and Hiromichi Imabayashi*

Properties in respirational physiology of larvae of a Japanese chironomid, *Prosilocerus akamusi*, were examined on several aspects. Survival time of the species was at least 4 times longer than other species under an anaerobic condition. Oxygen consumption rate of the species was constant at higher oxygen saturation level than as low as 16%. Glycogen content in the body under an anaerobic condition was not different from that under an aerobic condition and it was largely constant from 2 days after initiation of exposure to an anaerobic condition on. Water content in the body under an anaerobic condition was also not different from that under an aerobic condition and it was constant after initiation of anaerobic exposure. Therefore, dormancy was considered not to contribute to the anaerobic resistance of the species. On the other hand, Hb content of the species was at the same level of the average of those of other species. However, P50 value of a total Hb of the species was lower than one fourth of those of other species. Besides, the total Hb of the species showed both Bohr effect and Root effect. On the basis of cluster analysis of Hb composition, revealed by ECL western blotting, this species was proved to be highly distant from other species. In comparison of N-terminal amino acid sequence among the prevailing Hb component of the species and the corresponding components of other chironomid genera, the prevailing component of *P. akamusi* showed only 47% of homology at the highest in the sequence. These results suggest that a strong resistance to anaerobic environments of *P. akamusi* larvae be partly attributable to acquirement of unique Hb components with an extremely high oxygen affinity.

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CHIRONOMIDAE (DIPTERA) ASSOCIATED WITH SPRINGS IN THE SOUTHWESTERN UNITED STATES OF AMERICA.

J.H. Kennedy* and L.C. Ferrington Jr**

The distribution and taxonomy of the chironomid fauna of the southwestern United States is poorly known. This is especially true of the species associated with springs in this largely arid region. This paper presents results of a survey of chironomids found in springs from sites located in the Henry Mountains, Utah; Guadalupe Mountain National Park, Texas; Big Bend National Park, Texas; Love Creek Nature Preserve, Bandera, Texas; and Diamond Y spring, Ft Stockton, Texas. The isolated springs we have examined contain species with curious distributions and species new to science. To date over 80 species of chironomids have been identified from these sites. The distributions observed have probably been influenced by historical geological factors. During the Pleistocene, glaciation at higher latitudes caused species immigration into our study region. This region was much wetter and cooler during this period. Climatic changes associated with the Holocene resulted in a much drier and warmer region. As these changes occurred isolated springs throughout the study area provided refugia for the chironomids resulting a high regional endemism. Losses of springs through pumping of ground water and agricultural practices associated with cattle ranching are an increasing threat to this diversity.

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CHROMOSOMAL EVOLUTION OF NEARCTIC AND PALEARCTIC *Chironomus* SPECIES

Iya I. Kiknadze*, Malcolm G. Butler**, Larissa I. Gunderina*. Albina G. Istomina*, Vladimir D. Gusev*** & Lyubov A. Nemytikova***

We used chromosomal rearrangements as genetic markers to trace the phylogeny of *Chironomus* in the Holarctic region. We analyzed banding patterns of polytene chromosomes from 90 species, including 16 species known only from North America (Nearctic species), 67 species from Eurasia (uniquely Palearctic species), and 7 Holarctic species found on both continents. Most species studied were chromosomally polymorphic: the “karyopool” of each species (the total number of known banding sequences) varied from 8 to 47. Comparative, computerized analysis was made for 688 *Chironomus* banding sequences found in five of the seven chromosomal arms (A, C, D, E and F). Phylogenetic trees were constructed based on sequences in each arm, as well as on sequences pooled from all 5 arms. Some banding sequences have been found only in Eurasia (Palearctic sequences), some only in North America (Nearctic sequences), and some sequences occur on both continents (Holarctic sequences). Overall cytogenetic divergence between Palearctic and Nearctic *Chironomus* results both from different banding sequences in species unique to each continent, as well as from divergence within Holarctic species where Nearctic populations have sequences differing from populations in the Palearctic. Some Nearctic species have a karyopool comprised only of endemic, Nearctic sequences that have not been found in the Palearctic (*C. tigris*, *C. crassicaudatus*, *C. utahensis*, *C. stigmaterus*, *Chironomus* sp. B2, *Chironomus* sp. B3). These species are most cytogenetically divergent from Palearctic species. The karyopools of other Nearctic species include both Nearctic and Holarctic banding sequences (hbs): one hbs in *Chironomus* sp. B1, two hbs in *C. atrella* and *Chironomus* sp. Is, three hbs in *C. staegeri* and *C. dilutus*, five hbs in *C. cucini*. All hbs are “basic sequences” widespread and presumed primitive in the genus *Chironomus*, and their presence in both Nearctic and Palearctic faunas establishes a phylogenetic connection between the *Chironomus* fauna of both zoogeographic zones. The cytophylogeny of *Chironomus* species suggests that Palearctic sequences were ancestral to Nearctic sequences.

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CAN GONOSTYLUS HEEL OF *Procladius* (*Holotanypus*) BE A KEY CHARACTER TO IDENTIFY SPECIES?

Tadashi Kobayashi*

At the generic level in *Procladius* there is little difficulty in recognition, but the individual species within the genus are among the most difficult to determine within the Tanypodinae (Murray & Fittkau 1989). The length of gonostylus heel mainly has been used to identify species (e.g. Pinder 1978). Twelve species of *Procladius* have been inconceivably recorded in Japan. To decide upon species of *Procladius* occur in Japan, the review is carried out. Morphological items of 62 and 8 ratios on 307 adult males collected from various places in Japan are examined in detail. Especially as a method of measuring length of gonostylus heel more accurately, the reciprocal of gonostylus ratio ($1/GsR$) is adopted which is improved method on Roback's (1971) GsR (gonostylus ratio). The measuring data were analyzed by cluster analyze and others. Results: (1) Non key characters to determine species clearly was found except length of gonostylus heel; (2) *P. signatus* was not found in this study; (3) Three specimens from western Japan are recorded by Kawai under the name *P. simplicistilus* because of absence of heel. According to the original description of *P. simplicistilus* (Freeman, 1948), it was collected on a 'tarn' in the Lake District, Lancashire, England. On the other hand Japanese specimens from Hiroshima were collected at mouth of a river near seaside. Japanese species may be a new species by their unique habitat. (4) Among specimens with heel, $1/GsR$ seems vary from 0.039 to 0.407 almost continuously. However it becomes clear that specimens are divided into two groups at 0.22 of $1/GsR$ by cluster analysis under variables of length of Gs and length of heel. (5) In western Japan, only short heel type ($1/GsR$: 0.22 and below) occurs, and it was designated to *P. choreus*. (6) Long heel type (over $1/GsR$: 0.22) and short heel type occur in north of Kanto District ; in spring and autumn long type occurs, and in summer short type does which was considered to be *P. choreus*. Long heel type may be *P. crassinervis* (Zetterstedt) according to Pinder's key (1978). (7) The graph on heel length and occurrence month shows there is few intermediate type, and heel length does not shorten gradually from spring toward summer; in spring long type occurs first and decreases in number toward summer, on the contrary short type (*P. choreus*) increases simultaneously. The contrary phenomenon presents from summer toward autumn. Therefore average of $1/GsR$ of month seems like decreases every month toward summer, increases toward autumn gradually.

There are two possibilities to be considered: one is they are two seasonal variations, and the other is the presence of two or three species.

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THE APPLICATION OF MAXIMUM PARSIMONY APPROACH TO THE ANALYSIS OF CHIRONOMID'S (DIPTERA) SPATIAL DISTRIBUTION

L.S. Kravtsova and D.Yu. Shcherbakov

More than 300 rivers and creeks inflow into Lake Baikal. Terrigenous material, allochthonous organic matter, as well as organisms of vegetation and animal origin inhabiting water flows income into Lake Baikal via waterflows system. The interaction of water catchment basin with a water body can be one of mechanisms of formation of faunal diversity in aquatic ecosystems.

The chironomid's fauna of Pre-Baikalian in rivers, creeks and lakes is diverse. More than 300 species and larvae forms of chironomids, including larvae identified up to species groups, are registered. Larvae of 2 subfamilies Chironominae and Orthocladiinae dominate. The maximal number of taxa of the subfamily Chironominae is found in the lakes, while in the creeks and rivers there is a high diversity of the subfamily Orthocladiinae. The representatives of the subfamily Podonominae are not registered in the lakes. 111 chironomids taxa are found both in lacustrine and in riverine ecosystems of Pre-Baikal. It is shown that Lake Baikal littoral is a buffer zone between water catchment basin and water body. Habitat conditions in Lake Baikal littoral promote formation of limno-rheophilic complex of chironomids.

Cladistic approach have been applied to describe regional Baikalian fauna of the Chironomids. The community structure and its variation have been studied in the Chironomids occurring at different biotopes in Lake Baikal and it's tributaries. Cladograms describing species compositions of the Chironomid larvae along three transects have been built. In all cases single maximum parsimonious trees have been inferred which reveal strict boundary between two major clades into which all the communities fall. One clade is Baikalian, another consists of all near-shore communities. The boundary does not follow the shoreline, but is at 2.5-5 m deep. This boundary a cladogram is represented by branch having maximal length. Molecular phylogenetic analysis of Baikalian Chironomid groups and non-Baikalian Chironomids belonging to palearctic genus *Chironomus* and mostly Baikalian *Sergentia* suggests that species which were able to cross the boundary and occurring at the lake are monophyletic and are distantly related to non-Baikalian Chironomids.

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ECOLOGY AND DISTRIBUTION OF CHIRONOMIDS IN MOUNTAIN STREAMS IN THE ITALIAN ALPS

Valeria Lencioni*, Bruno Maiolini* & Bruno Rossaro**

The chironomid fauna was studied at forty-seven sites in NE-Italy (46°N) during the melting season from 1996 to 2001. The sites were situated in a wide range of streams, from small springbrooks and lake outlets to large glacier-fed streams, draining mountain regions in two river basins (Sarca and Noce) within two protected areas (Adamello-Brenta Regional Park and Stelvio National Park). All but one of the survey sites were located above tree line (2100-2833 m a.s.l.) and within 3 km downstream from their source. Twenty-six sites, distributed on seven main streams, were monitored monthly from June to September/October. At these stations, geomorphological, physical, chemical and biological data were collected. 640 zoobenthos kick samples were taken investigating 5-10 microhabitats of 0.1 m² in each site and date. Drift nets, sweep nets and emergence traps were also used to catch pupal exuviae and adults. In the other twenty-one sites, only water temperature was recorded and semi-quantitative and qualitative zoobenthos samples were taken using pond or drift nets, in one/two occasions. The longitudinal and temporal distribution of chironomids (larvae and pupae) was analysed in the seven main streams in relation to stream source and habitat features in an autoecological perspective. In the main twenty-six sites, chironomids represented about 50% of the zoobenthos, with 60 taxa identified from 37,843 larvae and pupae. Their total density ranged from 2 to 4,727 ind. m⁻², with highest values in the non-glacial sites (median 736 ± 1,321 ind. m⁻²) than in those dominated by glacial runoff (median 164 ± 552 ind. m⁻²). Diamesinae (16 taxa) and Orthocladiinae (38 taxa) were found to be the most represented, accounting respectively for 49% and 44% of the chironomid fauna. A clear longitudinal trend was observed for population density and taxa richness, both increasing downstream of the source in both glacial and non-glacial streams. The identification of 42,772 specimens (larvae, pupae, pupal exuviae, adults) collected at the forty-seven sites, produced a list of 133 species/groups of species (among which some are new for Italy) and 46 genera, distributed in 7 tribes and 5 subfamilies, amounting to about 25% of the Italian species pool. *Diamesa* was the most frequent and abundant genus, with *zernyi* and *latitarsis* groups as prevalent taxa. About one third of the taxa were found at only one site and ten in at least 50% of sites. Relationships between distribution and abundance of common and rare species have been investigated. A relatively high chironomid richness was recorded despite harsh conditions, with clear differences between sites related mainly to different stream origin (glacial/non-glacial). This research emphasizes the necessity of identifying biodiversity hot spots in mountain regions, in order to develop appropriate management and conservation strategies of these ecosystems which are more and more threatened by local and global environmental changes.

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DESIGNING EFFICIENT SAMPLING PLANS USING A SPATIO-TEMPORAL CHIRONOMIDAE (DIPTERA) LARVAL DISTRIBUTION MODEL

Richard J. Lobinske* and Arshad Ali*

A spatio-temporal larval distribution model of the nuisance midge *Glyptotendipes paripes* (Diptera: Chironomidae) was used to design resource efficient sampling plans for the assessment of location(s) supporting nuisance levels of this species in Lake Monroe (central Florida, USA). This model used bathymetric and sediment maps with lake water levels and temperatures of the prior month to estimate lake areas supporting relatively low larval populations ($<100 /m^2$) that require minimal monitoring effort, and areas that potentially support nuisance levels of *G. paripes* larvae, requiring greater sampling resources. The advantage of this system is that the geographic stratification can be altered for each sampling effort to meet prevailing conditions in the lake and without relying on a generic stratification that may not match the current lake situation.

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INFLUENCE OF SELECTED SEDIMENTS PHYSICAL PARAMETERS ON SPATIAL DISTRIBUTION OF LARVAL *Glyptotendipes paripes* (DIPTERA: CHIRONOMIDAE) IN THREE CENTRAL FLORIDA LAKES

Richard J. Lobinske*, Arshad Ali*, and Robert J. Leckel, Jr.*

Spatial distribution of the pestiferous midge, *Glyptotendipes paripes* in relation to selected sediment physical conditions was monitored for one year in three eutrophic central Florida lakes. Two of these lakes (Monroe and Wauburg) supported a distribution pattern of high densities on the firm peripheral sediments of the lakes, while the third lake (Eustis) displayed the opposite pattern of higher densities in the soft sediments at the lake center. Linear and multivariate analyses revealed that the presence of larval fecal pellets and larger particle sizes in the Lake Eustis sediments were strongly associated with the latter distribution pattern. In all three lakes, sediment dry weight, and particle size composition were not significantly associated with larval density. In these lakes, *G. paripes* distributions appear to be strongly influenced by the physical structure of the soft, organic sediments at the lake center; sediments with large particles and considerable accumulation of fecal pellets would support higher densities of the larvae which also exist in relatively firm sediments close to the lake margin.

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IDENTIFICATION AND PHYSICAL MAPPING OF GENES INVOLVED IN HEAVY METAL METABOLISM IN *Chironomus*

Jon Martin*, Thavamalar Balakrishnan*, Charles Robin* and Henry Chung*

Larvae of the genus *Chironomus* are often able to survive high levels of pollution. This makes them of value as potential indicators of pollution and for studies of the genetic mechanisms that permit such survival. Identification of genes that are up-regulated in the presence of pollutants, such as heavy metals, provides the potential to detect increasing levels of pollution, and so take appropriate remedial action before pollution levels become high enough to cause irreparable damage. Much work will be required before this ideal is achieved.

We have begun preliminary studies using Australian species, notably *C. duplex*, to identify genes that are known to be involved in the metabolism of heavy metals in other species of plants and animals. Once cloned and sequenced, the clones can be labelled and their physical location determined by *in situ* hybridization to the polytene chromosomes. These, and other genes already cloned, can provide anchor loci for a genomic map of *Chironomus*. One big advantage is that a map constructed for one species can be extrapolated to other species of interest in the genus, because of the good knowledge of the phylogenetic relationships of the banding patterns of the polytene chromosomes. Some examples from the chromosome arms of *C. duplex* and *C. dilutus* will be given.

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DEFINITION AND ASSIGNMENT OF INDICATOR WEIGHTS TO DIFFERENT CHIRONOMID SPECIES

Laura Marziali* , Carlotta Casalegno* , Valeria Lencioni** & Bruno Rossaro*

The distribution and the response to different environmental factors was analyzed using more than 400 species known from Palaearctic. Data were processed using Microsoft ACCESS and MATLAB package. A database was created to store information and to perform statistical analysis. Taxonomic data (species names, authors, synonyms, characters used for identification), sampling sites (springs, streams, rivers, lakes) including geographical information were filed into separated tables. A join of common fields allowed to define the relations in the database.

The most abundant species were distinguished into "lentic", "lotic" and "ubiquitous". Means and standard deviations weighted by the abundance of the Chironomid species were calculated for each environmental variable: water temperature, conductivity, dissolved oxygen, pH, nutrients etc. Minimum and maximum values measured in sites where the species was present were also recorded.

The aim was to separate "tolerant" and "intolerant" species, described by indicator scores able to discriminate the response to different environmental variables; indeed a species could be sensitive to one variable (e.g. dissolved oxygen), but tolerant to others (e.g. conductivity). Species scores were given for water temperature, dissolved oxygen, conductivity, pH and ammonia. Scores for larger taxonomic units (groups of species, genera, groups of genera, tribes etc.) were proposed as requested in biomonitoring.

In the present database water temperature and conductivity were the variables which better discriminated the species response. Few information are still available about tolerance to other factors, such as nutrients and toxic substances.

The development of indicator weights was hindered by the very opportunistic response of the investigated species. A "spike" or "pulse" model can be suggested to explain Chironomid response. Data analysis emphasized that often species reach large numbers in very restricted periods without a relation to spatial and temporal factors be evidenced. A well planned experimental design and a large database (long time series, large spatial range) are needed to overcome this drawback.

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THE CHIRONOMIDS OF THE TARO RIVER (ITALY)

Laura Marziali*, Carlotta Casalegno*, Giorgio Hanozet**, Giuseppe Parenti**, Matilde Forcella**, Elisa Berra**, Roberto Giacchini** & Bruno Rossaro*

Chironomids were collected every month for 2 years in 5 stations in the Taro river, a tributary of the Po river (Italy). Seventy-seven species were documented during the investigation. Discovery of *Buchonomyia thienemanni*, *Eukiefferiella ancyla*, *Orthocladus marchettii*, *Orthocladus pedestris*, *Cricotopus* Pe 1 Langton, *Cricotopus levantinus* in the river are interesting taxonomic and biogeographic findings.

A general linear model was used to analyze the influence of spatial and temporal factors; water temperature, conductivity, dissolved oxygen, pH, nutrients concentrations, microbial load were introduced in the model as covariates. Even among sites where species abundance varied markedly between the downstream and the upstream stations, the seasonal component of variation was more significant than the spatial one. Differences among years were also observed: in spring 2003 river discharge was lower and conductivity was higher than in spring 2002. When the source of variation associated with covariates was removed, seasons accounted for 86%, stations for 11.5% and years for 2.5% of the source of variation. The multivariate analysis emphasized that there was a principal gradient from cold and oxygen-rich sites to warm oxygen-poor ones and a second gradient separating sites with different water quality (microbial load, nutrients).

Diamesinae and Orthocladiinae were confirmed to be composed of cold stenothermal species: many of them (*Diamesa tonsa*, *Sympotthastia spinifera*, *Orthocladus marchettii*) are restricted to developing during the coldest months in the upstream stations. Preliminary tests on enzymatic activity emphasized significant differences for LDH and GST within tribes (Diamesini, Orthocladiini and Tanytarsini); spatial and temporal variations were also observed.

This research emphasizes that Chironomids show useful indicator properties, but much work must be done to better clarify the response of such a large number of species.

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ALLOMETRY IN CHIRONOMID (DIPTERA) MORPHOLOGY AND RATIOS UNDER EXPERIMENTAL TEMPERATURE MANIPULATIONS.

Brendan McKie*, **Peter S Cranston**** and Serica Zwack**

Exposure of developmental stages of geographically disparate populations of Australian chironomids to a controlled range of temperatures reflecting those naturally encountered across a continent, induced allometric responses in traditional ratios used in systematics. Both sexes of both species were consistently larger at lower temperatures, with allometrically disproportionately longer terminal antennal flagellomeres and proximal leg segments compared to sub-apical flagellomeres (AR) and distal leg tarsomeres (BV) respectively. Other ratios derived from partial leg segments (LR, SV) and two wing veins (VR) behaved erratically. Previous observations of relationships between AR, body size and seasonality are confirmed and extended. We caution on the naive use of such ratios in taxonomy (as in species discrimination) and in systematics, as phylogenetic character states. A putative adaptive significance is suggested through the allometric "tuning" of the sound-sensing, adult male antenna to the expected aerial temperature at emergence.

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TWO NEW BRAZILIAN SPECIES OF THE *Axarus* "*rogersi*-GROUP" (DIPTERA, CHIRONOMIDAE)

Humberto F. Mendes* & Trond Andersen**

Two new *Axarus* Roback species from Brazil are described and figured, *A. n. sp. A* from the state of Pará as male only, and *A. n. sp. B* from the state of Amazonas as male and pupa. Both have setose extensions of the posterior margin of tergite X to each side of the anal point, and thus group with *A. rogersi* (Beck & Beck), *A. dorneri* (Malloch) and *A. froehlichii* Andersen & Mendes in the "*rogersi*-group". A key to the males of the Neotropical species of this group is given.

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CYTOGENETIC BIOMARKERS IN *Chironomus riparius* (CHIRONOMIDAE: DIPTERA) AS INDICATORS OF HEAVY METAL POLLUTIONS

Paraskeva Michailova*, Ninel Petrova**, Gabriella Sella***, Stefano Bovero***, Keith.White**** & Liliana Ramella***

The comparative cytogenetic response of *Chironomus riparius* Mg. larva treated chronically with three concentrations of lead (Pb) and chromium (Cr) was examined. A common functional reaction was observed following exposure to these heavy metals. The Babliani rings (BR) and the nucleolar organizer (NOR) were particularly sensitive to Pb and Cr. Both metals induced a reduction in the activity of BR system, which contain genes responsible for the synthesis of proteins involved in development. The decreased activity of NOR in response to the heavy metals will result in the inhibition of RNA synthesis which can impair general metabolic functions.

Significant differences in somatic aberrations (inversions, deletions, duplications) were found in chromosomes AB CD EF and G of exposed and unexposed *Chironomus riparius*. Deletions of chromosome G converted this chromosome to the so-called 'pompon' form. Most somatic chromosome aberrations were concentrated in the heterochromatin regions where copies of transposable or families of satellite DNA elements are present. The transposable or repetitive DNA elements mediate chromosome rearrangements by ectopic recombinations. The mechanism involved in the formation of the somatic alterations is discussed.

The functional and somatic cytogenetic damage, together with the formation of "pompon" chromosomes, are proposed as sensitive biomarkers, which can provide an early warning of adverse long-term effects of heavy metals on aquatic organisms.

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REVIEW OF MORPHOLOGY OF LARVAE AND PUPAE OF *Cryptochironomus* (DIPTERA: CHIRONOMIDAE) FROM EUROPEAN WATERBODIES

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Early descriptions of adults and pupae of *Cryptochironomus* are from Kieffer, Walker, Harnisch and Pagast. By today's standards, the descriptions of adults are very incomplete and ineffective, so identification is problematic. Consequently it is necessary to make new descriptions of the species. More recently Chernovsky (1949), Lenz (1954-1962), Shilova (1966,1969), Reiss (1968), Beck & Beck (1969), Saether (1977, 1980), Rodova (1978), Pankratova (1983), Langton (1984, 1991), ?iknadze, Shilova (*et al.* 1991) and Zorina (2000) have described or revised species. Presently, 11 species of *Cryptochironomus* are recorded from the Palearctic: *?. denticulatus* (Goetghebuer 1921), *C. obreptans* (Walker 1856), *C. supplicans* (Meigen 1830), *?. rostratus* Kieffer 1921, *C. psittacinus* (Meigen 1830), *C. defectus* (Kieffer 1913), *C. redekei* (Kruseman 1933), *C. ussouriensis* (Goetghebuer 1933), *?. albofasciatus* (Staeger 1839), *C. crassiforceps* Goetghebuer 1931 and *C. tamayoroi* Sasa *et* Ichimori 1983.

For identifying pupae the most reliable diagnostic parameters are: shape of anal process, shape of thoracic horn, presence of pedes spurii B on abdominal segment II, shape of reticulation on tergites, body colour, shape of cephalic tubercles, gap of the hook row on tergite II, length of the cephalic tubercles, number of anterior thoracic mounds and size of granulation on the anterior cephalothorax.

For identifying larvae the most reliable diagnostic parameters are: pigmentation of the gula, pigmentation of the posterior occipital margin, colour of mentum, colour of midmental tooth, shape of the claws of anterior parapods, head width, lengths of the head, antennal segments, ventromental plate, mandible distance from top midmental tooth to end posterior occipital margin, distance between S_3 , S_3/A_1 index ($S_3 - S_3$ divided by length of first antennal segment), and size of ventromental plate striae.

Morphological characters (eg. body length, head length, body length/head length, head width, mentum width, antennal segments length, length total mentum from top midmental tooth to end of posterior occipital margin) have been studied from 1423 instar IV larvae of *C. obreptans* and 216 instar IV larvae of *C. defectus* from the Volga River reservoir during summer 2000. Morphological characters of the larvae of *C. obreptans* range from 5.2%–13.9%, in *C. defectus* 6.1%–14.3%. Body length and body length to head length are most variable. The ratio of body length to head length varies with body length in both larvae of *C. obreptans* ($r = 0.92$) and *C. defectus* ($r = 0.91$). Other averages of characters for larvae of *Cryptochironomus* from the Volga River reservoir do not depend on age, size and environmental factors.

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MECHANISM INDUCING ANHYDROBIOSIS IN THE SLEEPING CHIRONOMID

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Some microscopic organisms, like nematodes or plankton are fully desiccated to go into a complete metabolic arrest (anhydrobiosis). Once desiccated, the dormancy may last forever, unless water is given. There is a chironomid exhibiting such desiccation dormancy. That is the sleeping chironomid, *Polypedilum vanderplanki*, lives in temporal rockpools in Africa. When the pool water is dried up during dry season, the larvae are completely dehydrated. When rainy season comes and the pool is filled with water however, the larvae can revive after rehydration. The desiccated larvae become resistant to extreme temperatures, such as +106 or -270 degrees C. The longest record of the dormancy period is so far 17 years. Recently we have succeeded in rearing them in the laboratory conditions and started experiments focusing on the physiology and biochemistry.

Quick desiccation within 12 h leads the chironomid larvae to death, while all the dried larvae under slower desiccation within 24h could revive after rehydration. Accumulation of trehalose was a key factor in success of the anhydrobiosis. When larvae were deprived of the head and completely dehydrated, the brainless larvae could accumulate a large amount of trehalose during the desiccation followed by successful recovery after rewatering, suggesting that individual tissues and cells could prepare for entering anhydrobiosis themselves without cerebral regulation. .

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MOUTHPART MORPHOLOGY AND DIET OF CHIRONOMID LARVAE WITH SPECIAL EMPHASIS ON THE FIRST INSTAR LARVAE

Jón S. Ólafsson

The mouthparts of chironomid larvae show a great variety in structure and function, which allow segregation of the larvae into different feeding guilds. However, feeding guilds of chironomid larvae are mainly based on the larval diet rather than the combination of morphology and the larval diet. Furthermore, these guilds have mainly been based on the last larval instar, neglecting the earlier ones. The diet as well as the larval mouthpart morphology was studied in first and fourth instar larvae of some common lentic chironomids in temperate shallow lake in SW England.

In general, the mouthpart morphology of the first instar larvae resembles that of some later instars, which exhibit predaceous feeding habits. This appears for instance in the reduction or absence of setae in the oral region and prominence of the mandibular apical tooth. The diet of the first instar larvae consisted either of diatoms (*Cryptochironomus*, *Procladius* and *Tanytus*) or mixture of diatoms and detritus (*Cladotanytarsus*, *Dicrotendipes*, *Glyptotendipes*, *Microtendipes* and *Polypedilum*). The diet of the fourth instar larvae was similar to that among conspecific first instar larvae, except for *Cryptochironomus* and *Procladius*, which become predaceous at later instars. For both first and fourth instar larvae of *Cladotanytarsus*, *Dicrotendipes*, *Glyptotendipes*, *Microtendipes* and *Polypedilum*, the composition of the gut content was similar to that found at the sediment surface, though a significant preference for diatoms was recorded amongst some taxa of first instar larvae. All other genera were found to have a preference for certain food type, such as oligochaets, crustaceans or large species of diatoms.

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CHIRONOMID LARVE AND THE GREEN ALGAE *CLADOPHORALES*; A TALE FROM A SUB-ARCTIC LAKE

Jón S. Ólafsson^{*}, Árni Einarsson^{**}, Arnthor Garðarsson^{*}, Anna Halldórsdóttir^{*} & Sigurður S. Snorrason^{*}

The chironomid, *Tanytarsus gracilentus* and *Chironomus islandicus* are among the most abundant macroinvertebrate in Lake Mývatn, northern Iceland. These species as well as some Orthocladinae and Tanytopodinae species comprise the bulk of the lake benthos. Two species of the green algae, *Cladophorales*, *Aegagropila linnae* and *Cladophora glomerata* characterise the benthos to a great extent in this shallow lake.

Both chironomids and algae show severe fluctuation in abundance and distribution between years. The distribution of the green algae is most prominent within the west and the south-west areas of the lake, at a depth of 2 - 3.5 m. The aim of this presentation is to demonstrate the spatial distribution of chironomid larvae in relations to the characteristics of the various benthic habitats though with special reference to the green algae.

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SUBFOSSIL CHIRONOMID ASSEMBLAGES IN THE PYRENEAN LAKES

Maria Rieradevall, Rosa Casanovas-Berenguer, Narcís Prat and Jordi Catalán

The composition and temporal change of the chironomid assemblages in cold oligotrophic lake ecosystems has been studied by the analysis of chironomid larval head capsules remains from the surface (present) and 15 cm depth (pre-industrial period) sediments from 68 high mountain lakes in the Pyrenees. The studied lakes were situated on a longitudinal (E-W) and altitudinal (1620-2880m) gradient, which essentially included the whole Pyrenees. In every lake, a total of 40 environmental variables were measured that could be grouped within four categories: Physiographic, Physicochemical, lake basin characteristics and littoral substrate composition.

A total of 81 taxa were identified including present and pre-industrial sediments. While littoral taxa responded to the local variations of each lake, deep taxa (*Micropsectra radialis*, *Heterotrissocladius marcidus*, *Micropsectra* cf. *contracta*, *Tanytarsus* group *lugens*, *Procladius* sp. and *Chironomus commutatus*) were widely distributed in the Pyrenees and alternated themselves in a gradient dependent on maximum lake depth, residence time, DOC, forest vegetation cover of the catchment and altitude.

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CHIRONOMIDS OF THE HIGH MOUNTAIN LAKE REDÓ (PYRENEES, SPAIN)

Maria Rieradevall & Narcís Prat

The lake Redó is a relatively small lake (24 Ha.) but deep (max. 73 m) and therefore very steep, situated in the Spanish Pyrenees at 2240 m a.s.l. It was chosen according to the requirements of being a MOLAR's site (Mountain Lake Research (MOLAR): Measuring and modelling the dynamic response of remote mountain lake ecosystems to environmental change (ENV4-CT-0007)): that is to be above the timberline, in an undisturbed catchment and with a relative remoteness.

The study was conducted with monthly visits during two ice-free seasons (May to October), and samples were taken from three littoral sites (kick sampling) of the lake and in the profundal zone (Ekman grab). Once in summer, we collected samples each 2 m along a transect in depth of stones and sediments by diving.

Globally, 19 chironomid species were found in the modern fauna, being *Psectrocladius octomaculatus*, *Zavrelimyia* spp., *Corynoneura arctica*, *Macropelopia* sp., *Paratanytarsus austriacus* and *Polypedilum albicorne* the most abundant species in the littoral; while in the profundal zone *Micropsectra radialis*, *Heterotrissocladius marcidus* and *Pseudodiamesa nivosa* were the most representative. Interannual variability in seasonal changes in densities and life cycles appeared to be high

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PRELIMINARY STUDY OF SUBFOSSIL CHIRONOMID AND BIOGENIC SILICA IN A PATAGONIC LAKE.

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In this work, we studied the records of subfossil chironomid assemblages and biogenic silica from the last 200 yr in Lake El Trébol (Argentina). This lake (41° 30' S; 71° 31' W) is a small closed basin located at 758 m a.s.l., with a maximum depth of 11 m and surface area of 0.4 km².

A short core (60 cm), subsampled every 1-2 cm, was dated by using the ²¹⁰Pb technique. The estimated mean deposition rate was 22.00 ± 0.90 mg.cm⁻².y⁻¹ (0.2042 ± 0.0084 cm.y⁻¹). We identified 13 taxa corresponding to Subfamilies Tanypodinae, Orthocladiinae and Chironominae (including the tribes Tanytarsini and Chironomini), and their relative composition was analyzed.

Chironomus sp. distribution pattern along the core shows a correspondence with the biogenic silica profile. Conversely, *Tanytarsus* gr. behaves with the opposite tendency, with minimum values in the layers where biogenic silica reaches the highest concentrations.

The results are evidence of natural releases of nutrients throughout the trophic history of this lake.

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CHIRONOMIDAE AND OTHER MACROINVERTEBRATES OF *Eichhornia azurea* IN JATAÍ ECOLOGICAL STATION – SP, BRAZIL

Marlon Pelaez-Rodriguez¹, Susana Trivinho-Strixino² and Fabio de Oliveira Roque²

Macroinvertebrates have a main role in continental aquatic systems, contributing most of secondary production, and constituting a strategic link of energy and nutrient transfers. Several authors have pointed out the importance of aquatic macroinvertebrates as primary converters of vegetable matter into animal protoplasm. Among macroinvertebrates associated with aquatic macrophytes, chironomid larvae are frequently the most abundant. The goal of this study was to analyze the macroinvertebrate community structure associated with *Eichhornia azurea* in one oxbow lake of the Mogi-Guaçu river basin (Diogo Lake, Jataí Ecological Station - Luiz Antônio – SP – Brazil).

The collections were made in a dry season (July /2002) and a rainy season (January/2003). Samples of macrophyte were divide into two parts (leaves and rizhomes + roots). The sorted organisms were fixed in 70% ethylic alcohol and identified with specialized keys .

Of the 1,102 identified organisms, 63.0% were Chironomidae. Cerapogonidae (10.9%), Libellulidae (5.6%), Culicidae (3.5%), and Naididae (3.3%) were the other most abundant groups. The phytofauna of *E. azurea* showed well defined differences among the two analyzed periods, with higher numerical density during the dry season. Chironomidae were dominant in both periods, but differences in other group's relative abundances were observed (e.g., Culicidae and Ceratopogonidae). The main groups presented similar distribution among plant parts except, however, for chironomid taxa, which showed distinct distributions among parts of the plant. It was determined that genera with mining habits (*Stenochironomus*) and/or herbivores (*Goeldichironomus*, *Endotribelos*), which use the vegetable tissue of leaves as food source, were more common in the leaf fraction. By contrast, detritivorous genera (e.g., *Cricotopus*, *Polypedilum* and *Tanytarsus*) were more abundant in the roots.

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CHIRONOMIDAE (DIPTERA) LIVING IN FRESHWATER SPONGES FROM BRAZIL

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In this study, Chironomidae larvae living in or on freshwater sponges from Brazilian aquatic ecosystems were analyzed. The sponges were collected by scuba-diving or by snorkeling at depths ranging from 1-20m, mainly in areas of the Amazon River and the Paraná River Basin. The larvae were sorted under a stereomicroscope and afterwards reared. The organisms were identified to the lowest possible taxonomic level, taking the limited knowledge of the Neotropical fauna into consideration. Four criteria were used to establish the ecological relation between the chironomids and the freshwater sponges: gut contents; distribution and occurrence of the larvae in sponges from a wide area of Brazil; morphological analyses of larvae; and restricted occurrence of larvae in sponges. Although 18 morphospecies have been identified, only five showed characteristics that allowed us to hypothesize a strong association with freshwater sponges: *Xenochironomus xenolabis*, *Xenochironomus* sp. n., *Oukuriella* spp (third group), *Ablabesmyia* sp. and Chironomini sp. The new species are described and figured, and some ecological and evolutionary aspects of the chironomids in freshwater sponges are discussed.

The State of São Paulo Research Foundation (FAPESP) within the BIOTA/FAPESP – The Biodiversity Virtual Institute Program supported this work and the *Chironomus* News Letter Grant sponsored our presentation at this Congress.

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RECONSTRUCTING LAKE CHEMISTRY FROM PUPAL SKIN TRAINING SETS

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Seasonally-integrated chironomid pupal skin data from over 50 British lakes were used to determine significant indicator species assemblages among lake types based on geology (alkalinity/conductivity) and depth. Species assemblages tolerant of acidification or nutrient enrichment were then separately identified among lake types in addition to identifying sensitive species expected to return if these pressures were removed. Temporal reference state prior to modern human perturbation was determined for an acidified and an enriched lake. Contemporary pupal skin data were used to reconstruct environmental change from identified subfossil chironomid larval heads found in mud core samples. Congruence with environmental change inferred from subfossil diatom data, and some direct observations, indicated that use of easily obtainable chironomid pupal data would provide suitable monitoring of environmental change relative to spatial or temporal reference conditions of lakes.

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THE POLYTENE CHROMOSOMES OF *KIEFFERULUS (NILODORUM) 'SPECIES YAMUNA'* (GOETGHEBUER) (DIPTERA: CHIRONOMIDAE)

Sumitra Saxena*

The salivary gland nuclei of *Kiefferulus (Nilodorum) 'species Yamuna'* (Goetghebuer) contain three metacentric and one acrocentric chromosomes. The centromeres of these chromosomes are fused together to form a heterochromatic block, the chromocenter, from which seven arms radiate out. The cytological features and chromosomes of this species have been described here for the first time to serve as standard chromosome maps for future cytogenetic and cytotaxonomic studies. A comparison of polytene chromosomes of *Kiefferulus (Nilodorum) 'species Yamuna'* with other cytologically characterized species of the genus *Kiefferulus* reveals that 'species Yamuna' is cytologically distinct. The banding pattern of the polytene chromosomes of 'species Yamuna' however, shows some homologies in certain regions of arms A-G with the Indian species *Kiefferulus tainanus=Nilodorum biroi*

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***Ferringtonia*, A NEW ORTHOCLAD GENUS FROM ARGENTINA AND SOUTHERN CHILE (DIPTERA: CHIRONOMIDAE)**

Ole A. Sæther* & Trond Andersen*

Diagnoses of all stages of *Ferringtonia* n. gen. are given. *F. patagonica* (Edwards) comb. n. (= *Spaniotoma* (*Orthocladius*) *patagonica* Edwards 1931: 290) from Argentina is described from male, female, pupa and a tentatively associated larva. *F. caudicula* sp. n. from Chile is described from male imago and pupae. The genus appears to belong near *Botryocladus* Cranston & Edward and *Unniella* Sæther. The male differ primarily by possessing pulvilli, single, scale-like virga and parallel-sided anal point; the pupa by lacking anal lobe fringe and by having the anal lobe ending in tapering cylindrical projections; and the tentatively associated larva by having palmate S I and median tooth of mentum high and broad with adpressed first lateral teeth.

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DNA PROFILING FOR BIOMONITORING OF AQUATIC ECOSYSTEMS

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Freshwater aquatic ecosystems are of vital importance to Australia. Due to the scarcity of freshwater, effective management of this precious resource continues to come under close scrutiny, and rapid bioassessment monitoring studies are routinely conducted. Chironomidae larvae often represent a major component of the benthic fauna in deteriorated sites and are frequently used as bioindicators in freshwater aquatic ecosystems. Members of the genus *Chironomus* have proven to be useful bioindicators in Europe, mainly due to the observed variation in sensitivity to pollution that exists between species. However, similar use of *Chironomus* in Australia is limited due to problems with species identification and lack of knowledge on species-specific differences to pollution. To address the problems associated with species identification we have developed DNA profiles for Australian *Chironomus* species. Using PCR-RFLP (Polymerase Chain Reaction - Restriction Fragment Length Polymorphism) of the mitochondrial COI gene species-specific haplotypes were obtained that unambiguously identify nine *Chironomus* species commonly found in Australia. This research demonstrates that PCR-RFLP of mtDNA provides a cost-effective, rapid and reproducible method for the identification of morphologically similar *Chironomus* species. This technique will complement the facilitation of accurate species identification for rapid biomonitoring of aquatic ecosystems.

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CHIRONOMIDAE OF A FLOODPLAIN POND IN CÓRDOBA, ARGENTINA

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Small freshwater ponds occur on the floodplain of the río Segundo as it flows toward the large, saline lake Laguna Mar Chiquita in eastern Córdoba, a notably flat landscape. Preliminary sampling suggested that chironomids were abundant in the ponds. One of them, Laguna Sandroni, was sampled on eight dates from August to June to find out the kinds and abundance of chironomids in it. Its area was one hectare, most less than one meter deep and without macrophytes. Some years it dried up completely, as evidenced by fence posts in its basin. Four 15x15-cm Ekman samples were taken at each of three stations ranging in depth from 15 to 97 cm. Samples were sieved through a 250 μ m sieve. Larvae were sorted while live, and most were reared. Eleven genera were collected; these were, in order of frequency of occurrence (dates and stations): *Coelotanypus*, Chironomini genus A, *Chironomus*, *Polypedilum*, *Tanytarsus*, *Procladius*, *Tanypus*, *Cryptochironomus*, *Cryptotendipes*, *Dicrotendipes*, and *Djalmabatista*. *Coelotanypus* was the most consistently abundant, with more than 1000/m² on 11 occasions (maximum 3707/m²). *Chironomus*, Chironomini genus A, and *Tanypus* were the only other genera to exceed 1000/m². *Chironomus* and *Tanypus* were abundant only in October, yet *Chironomus* had a maximum abundance of 6949/m², more than any other genus. Some genera (especially *Polypedilum* and *Tanytarsus*) likely have more than one species, but description of new species was not attempted.

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CHANGES IN CHIRONOMID COMMUNITY STRUCTURE IN RURAL AND URBAN AREAS OF THE UPPER TRINITY RIVER BASIN, NORTH CENTRAL TEXAS

Jaynie M. Stephenson* and James H. Kennedy**

Macroinvertebrate community structure was quantified at 10 sites along the Elm and West forks of the Trinity River, at their confluence, and further downstream on the main stem of the Upper Trinity River. The headwaters of the Elm and West Forks are located in rural areas containing primarily forest and grassland cover, whereas the beginning of the main stem is located in the densely populated Dallas-Fort Worth metroplex and contains predominantly urban land use which shifts to primarily agricultural land use further downstream. Sites adjacent to forest or grassland cover, excluding a single site on the Elm Fork below a waste water treatment plant (WWTP), contained extremely low flow, dissolved oxygen, and high water temperatures, whereas sites in urban areas are directly or indirectly below WWTP's that maintain constant flow, higher dissolved oxygen levels and cooler temperatures. Chironomid density was dominant at all sites, excluding the relatively high flow site on the Elm Fork where Ephemeroptera density was greatest followed by Chironomidae. Chironominae was the dominant subfamily at all sites, except at the relatively high flow site on the Elm Fork where Tanypodinae was the dominant subfamily within Chironomidae. Chironomid species richness decreased with cropland, grassland, and forest cover, and increased with urban land use. Compositions of chironomids shifted from predominantly *Asheum*, *Dicrotendipes* and *Glypotendipes* species in forested or grassland areas to *Polypedilum* and *Rheotanytarsus* species in urban and agricultural areas. Mechanisms for changes in chironomid species compositions and community structure along urban and agricultural land use gradients will be explored.

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COLONIZATION OF RICE CROPS BY CHIRONOMIDS IN SOUTHERN AUSTRALIA

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Larval chironomids are serious pests of establishing rice crops in New South Wales (NSW), Australia. *Chironomus tepperi* Skuse is known to cause extensive crop damage, and many aspects of its biology and management have been investigated. In contrast, there is almost no information available on the biology and pest status of other chironomid species associated with rice crops in NSW. This study was undertaken as a first step towards resolving this problem.

Chironomid larvae were sequentially sampled from small experimental rice bays at Yanco Agricultural Institute in southern NSW. Sampling was undertaken during the 1995, 1997, 1998 and 1999 crop establishment periods, starting 10 days after flooding (DAF) and continuing at 5 day intervals until 35 or 40 DAF. Eighteen species were identified from the 3,965 larvae recovered. The most abundant species were *C. tepperi* (0 to 91 % of 35 day totals), *Procladius paludicola* Skuse (6 to 78%) and *Polypedilum nubiferum* (Skuse) (1 to 12%). No other species accounted for more than 8% of recovered larvae in the first 35 DAF of any year. Species richness increased progressively during the first 25 DAF and then started to plateau. *C. tepperi* colonized fields more rapidly than other taxa and, when present, had only a single generation. The abundance of *C. tepperi* varied dramatically from year to year: in 1996 it was totally absent, however in 1998 the peak density of *C. tepperi* larvae exceeded 13,000 m⁻². Application of multi-dimensional scaling and ANOSIM2 analysis (PRIMER) shows significant differences in community structure between post-flood sampling times (DAF, $P < 0.01$) and also between years ($P < 0.02$). Analysis of modified data sets (from which numerically dominant species were excluded) demonstrates that variations in *C. tepperi* abundance were the principle source of year to year variation in community development. Fluctuations in *P. paludicola* populations were the main source of differences between communities at different post-flood sampling times. Comparison of rice plant densities in the monitored bays to those in nearby bays receiving effective chemical protection shows that plant loss increased in response to higher *C. tepperi* populations.

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NEW RECORDS AND RANGE EXTENSIONS FOR SEVERAL CHIRONOMID GENERA IN LAKE SUPERIOR

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Recent USEPA investigations of Lake Superior benthos in Minnesota, Wisconsin, and Michigan waters have resulted in the discovery of six uncommon genera of Chironomidae. Five new records of genera for Lake Superior and five significant Nearctic range extensions are reported. New records for Lake Superior include the genera *Acalcarella*, *Doncricotopus*, *Lipiniella*, *Kloosia*, and *Paracladius*. In addition, the uncommon genus *Protanypus* is reported from many additional sites in Lake Superior. Significant Nearctic range extensions are reported for the genera *Acalcarella*, *Doncricotopus*, *Kloosia*, *Lipiniella*, and *Paracladius*. This is the first report of *Acalcarella* from the contiguous United States and the second reports of *Doncricotopus*, *Kloosia*, *Lipiniella*, and *Paracladius*. Reports of *Protanypus* have also been minimal.

This abstract does not necessarily reflect EPA policy. Work was partially funded under EPA contract 68-D-98-168.

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STRUCTURAL AND FUNCTIONAL CHANGES OF THE THORACIC CAVITY IN *Diamesa steinboeckii* GOETGHEBUER

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The wing's reduction that takes place in some dipteran families is related to various adaptive factors. Apterism or brachypterism are often related to a parasitic behaviour (e.g. in Nycteribiidae), or to environmental conditions, like very low temperatures, snow and strong wind (as in Chironomiidae, Tipulidae, Limoniidae, Sciaridae and Sphaeroceridae). In the temperate area, these climatic conditions occur throughout all year in the high mountains and glaciers, or during the winter also at lower altitudes. The species living in those environments often have their habitats under stones and snow or into clefts, where higher protection and favourable microclimatic conditions can be found. The factors that selected the loss of power of flight are numerous and synergic: low temperature, blowing wind, narrow habitats, and the shortness of the optimal period to complete the life cycle.

A regression of the flight muscles is associated to wing reduction. The thoracic cavity, partially emptied by the lack of musculature, is filled in different ways among different species and often, within the same species, in males and females.

In this work a research performed on various populations of *Diamesa steinboeckii* Goetghebuer (Diptera, Chironomidae) in the Dolomites (north-eastern Italy) is reported. In the studied populations we observe different degrees and modes of wing reduction: the collected specimens show differences in wing size (width/length) and in veins structure. The thoracic features differ between males and females and muscles are only partially replaced by fat-bodies. Many individuals, collected from Alpine glaciers, are highly parasitized by nematodes, that occupy a large space inside the body, mainly in the thoracic cavity. There are remarkable differences with another apterous species, *Chionea alpina* Bezzi (Diptera, Limoniidae), living in the same environments. In *Ch. alpina* both in males and females, the thoracic cavity, completely lacking flight muscles, is filled by fat-bodies. Furthermore in that of females there is an ovarian sac containing five eggs with a shell thicker than that of the abdominal ones.

In our paper histological sections of thorax and abdomen of *D. steinboeckii*'s compared to those of *Ch. alpina* are presented.

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THE HISTORY, STATUS QUO AND FUTURE PROSPECTS OF CHIRONOMID STUDY IN CHINA

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The history, Status quo and future prospects of chironomid research in China are reviewed in the present paper. By the end of 2002 more than 200 papers concerning chironomid studies had been published. The research fields include taxonomy; systematics; cytology; ecology; environment biology, toxicology; medical chironomids, agriculture chironomids, and aquaculture chironomids, fossil chironomids. The Chinese chironomid research history can be divided into three main periods, having developed greatly in the last 20 years. The present problems and prospects for further work on chironomid research in China are analyzed and discussed.

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THE CHIRONOMIDAE OF THE KENAI RIVER, ALASKA FROM COLLECTIONS OF PUPAL EXUVIAE

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The Chironomidae of Alaska are not well known although they are undoubtedly a major taxonomic and biomass component of virtually all streams in Alaska. Even well done monitoring programs like the NAWQA studies done by USGS have found only a small number of midges in the Kenai River. The use of Rapid Bioassessment Protocols by various entities has further relegated the Chironomidae to obscurity by categorizing the entire Family as being indicative of harmful human impact. The small size of the larvae makes them especially difficult and time consuming to collect from benthic samples. Collections of cast pupal skins are very easy to collect & sort and relatively easy to identify as well. This study of Chironomidae pupal exuviae was undertaken to determine a species list for the Kenai River which is touted as being one of the best fishing streams in the world.

Chironomidae pupal exuviae were collected every two weeks from a site on the upper Kenai River from ice-out(March) until cessation of emergence(November) in 1999. The study was repeated in 2002 with exuviae being collected every two weeks at three sampling sites on the Kenai River.

More than 60 species of Chironomidae were found over the two years. The first emergers in March, when the river temperatures were just barely above 0 degrees C, were also the last ones to be emerging at the end of the season when the water temperatures returned to 0 degrees C again. The greatest number of taxa emerged from the Kenai River in early and mid July.

Chironomidae appear to supply the majority of the taxonomic richness among all of the macro invertebrates for the Kenai River. As well, the small size of Chironomidae probably makes them a major food item for the alvins and fingerlings of the many salmonid species found in the Kenai River.

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THE FEMALE OF *Bethbilbeckia floridensis* FITTKAU, 1988 WITH A REVIEW OF THE GENUS (DIPTERA: CHIRONOMIDAE)

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The genus *Bethbilbeckia* belongs to the Tribe Macropelopiini of the Subfamily Tanypodinae, Family Chironomidae. Currently it contains a single species, *B. floridensis* Fittkau. The female is described for the first time. They resemble females of *Macropelopia decedens* (Walker), but have numerous sensilla chaetica on the first tarsal segment of both the mesothoracic and metathoracic legs. The diagnostic characters of all life stages are reviewed and corrections are made to the original description. The larva has four antennal segments, not five as originally reported. The distribution is reviewed and the species is reported from Virginia for the first time. *Bethbileckia floridensis* larvae occur in cold seeps, springs and small streams throughout the eastern United States. *Bethbilbeckia floridensis* appears most closely related to *Macropelopia* in all life stages, but lacks several characters considered diagnostic for that genus. Unique pupal characters provide additional support for keeping *Bethbilbeckia* as a separate genus for the time being. A better knowledge of the Neotropical and Australasian Macropelopiini should clarify relationships and generic limits among the tribe.

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CHIRONOMIDAE OF THE RYUKYU ARCHIPELAGO - I. TWO SPECIES OF THE GENUS *Stictochironomus* KIEFFER FROM IRIOMOTEJIMA ISLAND

Masaru Yamamoto

Iriomotejima Island is one of the main islands of Yaeyama located in the subtropical region in southernmost part of Japan near Taiwan. During the recent surveys of this area planned by myself, two stictochironomid species including immatures were collected. One is *S. multannulatus* (Tokunaga, 1938) and the other is an undescribed species. These two species are quite distinct from other species distributed in Japan such as *S. pictulus*, *S. akizukii* and *S. sticticus* in having the paler body coloration, peculiar wing markings and rather small bodies. In larvae, the undescribed species shares the following features in the mentum with *S. multannulatus*: 1) outer pair of median teeth bulbous, 2) first and fourth lateral teeth somewhat depressed. Furthermore, the undescribed species is characterized from any other species of the genus *Stictochironomus* in having only 3 median teeth. Recently Sasa (1999) described a new species, *Polypedilum shimantomaculatus*, which should be transferred to the genus *Stictochironomus*. This species closely resembles to *S. multannulatus* in many adult characters. Although the immatures of the species are not found, it is inferred that the species shares the same mental character states with *S. multannulatus*.

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