

Boris Carl Kondratieff, a Lifetime of Scholarship and Service to Aquatic Entomology

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It is with great sadness that I share with you the death of Dr. Boris Carl Kondratieff (30 April 1954 to 14 August 2022) (Fig. 1). Boris was a 35 year employee of Colorado State University (CSU). He served as Director of the C. P. Gillette Museum of Arthropod Diversity, a collection of nearly 3.5 million specimens, most of which were amassed after his hire in 1986. He taught many courses at CSU and they were nearly always filled to capacity. Boris served as advisor for some 50 master's and PhD students. He was highly sought after for graduate committees. His students conducted many high-quality research projects on the taxonomy, biogeography, and ecology of aquatic insects. In later years he collaborated with such luminaries of aquatic ecology as N. LeRoy Poff and James V. Ward, both of CSU.



FIGURE 1. Boris C. Kondratieff, image taken in 2022. Credit, Tom Eckberg, by permission.

Most of us knew him as an aquatic entomologist, but Boris had broad interests that included the taxonomy of Mydas Flies (Mydidae) in North America, Costa Rica, and in Madagascar. He also conducted research on orchard and crop pests including Apple Maggot (Tephritidae) and fly pests of millet. He was interested in the effects of agricultural practices and how fires affected terrestrial insect assemblages. Forensic entomology was an interest. Boris published several papers on the insects found inhabiting corpses.

Boris collaborated on many projects with his CSU colleagues that resulted in funding from the National Science Foundation, several student degrees, and important findings in the Andes and Rocky mountains (Gill *et al.* 2014, 2016; Polato *et al.* 2017; Poff *et al.* 2018). Just after his death, NSF awarded a collections improvement grant to CSU which will aid with digitization of Hymenoptera in Gillette museum. Boris was well known for his service to CSU, the museum, and local schools. His friends and colleagues knew him as the most selfless and generous of human beings.

Boris's death occurred just two weeks after his visit to the University of Illinois to attend our hosting of the virtual conference of the 2022 XVIth International Conference on Ephemeroptera and XXth International Symposium on Plecoptera. Because of Boris's visit many of us had the privilege of sharing a few hours with him, either in person or

via our Zoom assisted conference. Even in that short time, Boris befriended my PhD student, Phillip Hogan, sending him several boxes of books in the space of time before his death.

LeRoy Poff and Rose Lew of Fort Collins, Colorado hosted a memorial for Boris on 5 November 2022. I was glad to represent the mayfly and stonefly scientific community at the memorial. Nearly 100 of his family, friends and loyal colleagues attended the event. Friends he kept in touch with since the early 1960s showed up to pay their respects. While there I met Laurence Hallas (of *Prostoia hallasi* Kondratieff & Kirchner, 1984 fame), who shared several heartwarming stories of Boris. His colleagues reminded the audience of Boris's warmth, generosity, and kindness.

After the memorial his family, friends, and colleagues contributed to a heartwarming obituary and tribute to his life (<https://www.dignitymemorial.com/obituaries/ft-collins-co/boris-kondratieff-10890375>). From this obituary and memorial we can tell that those who knew him best thought the world of Boris. The obituary contains information about his family, education, and professional career. There are many photographs and anecdotes about Boris's life and time with family and friends. You may add anecdotes and photos if you like. I will not duplicate the contents of the obituary; it is thorough and well done.

What I will do is elaborate on Boris's great contributions to mayfly and stonefly science. As you can tell, we do not have a sole claim to his accomplishments. He was prolific in so many other areas of insect taxonomy and more broadly in collaborative ecological research, museum science, teaching, mentoring, and public outreach.

Publications and collaborations. Boris's publication record is long and prolific, spanning 46 years (1977 to 2022). LeRoy Poff suggests the full publication record is near 225 papers. I know from study and the curriculum vita provided to me by his colleagues that he penned at least 172 papers that dealt with mayflies, stoneflies, EPT, aquatic insects, and a few popular books on insects (all of these are presented in the References section, and summarized in Fig. 2). He was most prolific working on stoneflies (at least 118 papers, DeWalt *et al.* 2023) but also contributed to the taxonomy, distribution, and ecology of mayflies (at least 38 papers). Other papers were broader treatments including combined Ephemeroptera, Plecoptera and Trichoptera assemblages (EPT taxa, 5 papers) and aquatic insect assemblages (at least 9). The popular audience books were written with Whitney Cranshaw (Kondratieff & Cranshaw 1995; Cranshaw & Kondratieff 2006). He co-authored with James V. Ward "An Illustrated Guide to the Mountain Stream Insects of Colorado", which is now in its second edition (Ward *et al.* 2002). It has been used by many students who took aquatic entomology and aquatic ecology classes at CSU. Its focus on Colorado made it all the more useful for CSU students.

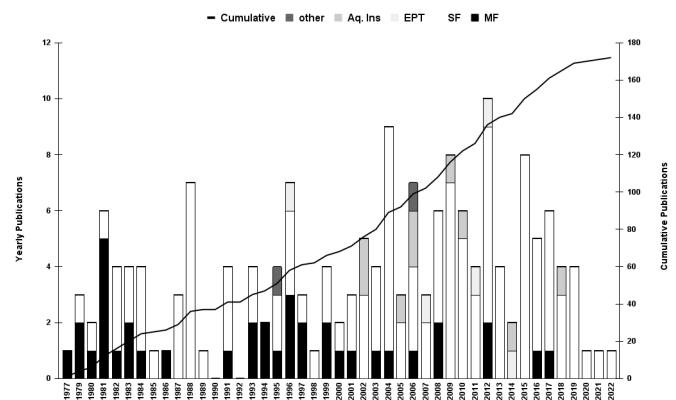


FIGURE 2. Boris C. Kondratieff mayfly, stonefly, EPT and aquatic insect and other publications by year and cumulatively.

Boris focused his early attention on mayflies. Ten of his mayfly papers were with his master's and PhD advisor Reese Voshell (Virginia Polytechnic Institute and State University, Blacksburg). Boris's revision of the *Isonychia* (Kondratieff & Voshell 1984) was seminal work and is still used today for the identification of both adults and nymphs. Boris continued to work on mayflies throughout his career and knew the fauna of North America well.

Most of Boris's work was on stoneflies. His love of stoneflies was contagious. He took many trips all over the continent, and an invite from him to go along was highly prized. He was most passionate about the fauna of the southeastern U.S.A., referring to them as "sweet" due to their species diversity. Boris had often spoken of his intent to move back to Tennessee or North Carolina in the heart of stonefly diversity in North America. He had no poker

face for his love of stoneflies. When we would talk about a great trip or a fantastic discovery, he would lean forward slightly, flex his shoulders and start rubbing his big hands together while wearing a gleeful smile. He was thinking about the stoneflies that were a major portion of his life.

Boris collaborated with many stonefly workers throughout his career. A favorite collaborator was R. Fred Kirchner (US Army Corp of Engineers, Huntington, West Virginia), with whom he described at least 26 stonefly species. Early in his stonefly career he also worked with Charlie Nelson (University of Tennessee at Chattanooga, Tennessee) describing *Alloperla*, *Isoperla* and *Remenus* species. Collaborations with Richard ‘Dick’ Baumann (Brigham Young University, Provo, Utah) resulted in at least 22 papers. They made a great team even if they squabbled like close relatives. Another extremely productive collaboration was with Bill Stark with whom he co-authored 21 papers. A major work was a review of the *Anacroneuria* (Perlidae) of Mexico and upper Mesoamerica (Stark & Kondratieff 2004). They described 16 new species and provided information for 48 valid species, synonyms, and nomina dubia. While Stark was not an author on another important work, a first ever key to 32 species of adult Perlodinae of eastern North America (Kondratieff 2004), he was co-editor of the volume and was closely involved in the work (Stark & Armitage 2004).

A major culmination of Boris’s career was a decade-long collaboration with Stanley W. Szczytko (deceased, University of Wisconsin, Stevens Point) on the Isoperlinae (primarily *Isoperla*) of eastern North America (Szczytko & Kondratieff 2015). The two of them described 22 new *Isoperla* species and compared all 60 species across the region. Like all good revisions, this work laid the foundation for further work in these notoriously difficult stoneflies, already having resulted in several more descriptions.

TABLE 1. Patronyms of mayflies and stoneflies honoring the late Boris C. Kondratieff. † indicates fossil taxon.

Ephemeroptera

Isonychiidae

Isonychia (*Borisonchia* McCafferty, 1989) *diversa* Traver, 1934 (recently extinct)

Plecoptera

Peltoperlidae

†*Borisoperlinae* Chen & Xu, 2020

†*Borisoperla* Chen & Xu, 2020

†*Borisoperla kondratieffi* Chen & Xu, 2020

Capniidae

Paracapnia boris Stark & Baumann, 2004

Nemouridae

Amphinemurinae

Protonemura boris Murányi, Manko, Kovács, Vinçon, Žiak, 2023 (this volume)

Nemourinae

Soyedina kondratieffi Baumann & Grubbs, 1996

Zapada kondratieffi Chen, 2022

Perlodidae

Isoperlinae

Isoperla borisi Beaty, Holland & Lenat 2017

Perlodinae

Yugus kondratieffi Nelson, 2001

Perlidae

Acroneuriinae

†*Largasoperla borisi* Chen, 2018

Anacroneuria kondratieffi Stark, 2001

TABLE 2. Species of mayflies and stoneflies described by Boris C. Kondratieff. Synonyms placed below parent.

Ephemeroptera	Plecoptera continued
Ameletidae	Peltoperlidae
<i>Ameletus janetae</i> Kondratieff & Meyer, 2010	<i>Peltoperla tarteri</i> Stark & Kondratieff, 1987
Isonychiidae	<i>Sierraperla tolowa</i> Stark & Kondratieff, 2015
<i>Isonychia bernerri</i> Kondratieff & Voshell, 1984	<i>Tallaperla maiyae</i> Kondratieff, Kirchner & Zuellig, 2007
<i>Isonychia hoffmani</i> Kondratieff & Voshell, 1984	
<i>Isonychia sicca</i> Walsh, 1862 (not Kondratieff)	Chloroperlidae
syn. <i>Isonychia edmundsi</i> Kondratieff & Voshell, 1984	<i>Alloperla biserrata</i> Nelson & Kondratieff, 1980
Leptophlebiidae	<i>Alloperla lenati</i> Kondratieff & Kirchner, 2004
<i>Paraleptophlebia jensenii</i> McCafferty & Kondratieff, 1999	<i>Haploperla fleeki</i> Kondratieff, Kirchner & Lenat, 2005
<i>Paraleptophlebia kirchneri</i> Kondratieff & Durfee, 1994	<i>Haploperla parkeri</i> Kirchner & Kondratieff, 2005
<i>Paraleptophlebia traverae</i> McCafferty & Kondratieff, 1999	<i>Suwallia wardi</i> Kondratieff & Kirchner, 1991
Siphlonuridae	<i>Sweltsa durfee</i> Kondratieff & Baumann, 2009
<i>Siphlonurus demaryi</i> Kondratieff & Voshell, 1981	<i>Sweltsa hoffmani</i> Kondratieff & Kirchner, 2009
Plecoptera	<i>Sweltsa holstonensis</i> Kondratieff & Kirchner, 1998
Capniidae	<i>Sweltsa pocahontas</i> Kirchner & Kondratieff, 1988
<i>Allocapnia sequatchie</i> Kondratieff & Kirchner, 2000	<i>Sweltsa voshelli</i> Kondratieff & Kirchner, 1991
<i>Allocapnia simmonsi</i> Kondratieff & Voshell, 1981	<i>Triznaka sheldoni</i> Baumann & Kondratieff, 2008
<i>Allocapnia starki</i> Kondratieff & Kirchner, 2000	<i>Triznaka wallowa</i> Kondratieff & Baumann, 2012
<i>Capnia decepta</i> Banks, 1897 (not Nelson & Kond., 1988)	Kathroperlidae
syn. <i>Capnia arapahoe</i> Nelson & Kondratieff, 1988	<i>Kathroperla siskiyou</i> Stark & Kondratieff, 2015
<i>Capnia nelsoni</i> Kondratieff & Baumann, 2002	Perlidae
<i>Paracapnia baumanni</i> Kondratieff & Lee, 2010	<i>Acroneuria hitchcocki</i> Kondratieff & Kirchner, 1988
Leuctridae	<i>Acroneuria kosztarabi</i> Kondratieff & Kirchner, 1993
<i>Zealeuctra stewarti</i> Kondratieff & Zuellig, 2004	syn. <i>Acroneuria kirchneri</i> Stark & Kondratieff, 2004
<i>Zealeuctra uwharrie</i> Verdone, Beaty, Holland & Kondratieff, 2019	<i>Acroneuria yuchi</i> Stark & Kondratieff, 2004
Nemouridae	<i>Anacroneuria bandido</i> Kondratieff & Armitage, 2019
<i>Lednia borealis</i> Baumann & Kondratieff, 2010	
<i>Lednia sierra</i> Baumann & Kondratieff, 2010	<i>Anacroneuria baumanni</i> Stark & Kondratieff, 2004
<i>Malenka diablo</i> Verdone & Kondratieff, 2018	<i>Anacroneuria brailovskyi</i> Stark & Kondratieff, 2004
<i>Malenka murvoshi</i> Baumann & Kondratieff, 2010	<i>Anacroneuria buenoi</i> Stark & Kondratieff, 2004
<i>Prostoia hallasi</i> Kondratieff & Kirchner, 1984	<i>Anacroneuria contrerasi</i> Stark & Kondratieff, 2004
<i>Soyedina amicalola</i> Verdone & Kondratieff, 2017	<i>Anacroneuria izapa</i> Stark & Kondratieff, 2004
<i>Soyedina parkeri</i> Grubbs & Kondratieff, 2019	<i>Anacroneuria kayceae</i> Kondratieff & Gill, 2012
Taeniopterygidae	<i>Anacroneuria malkini</i> Stark & Kondratieff, 2012
<i>Oemopteryx leei</i> Baumann & Kondratieff, 2009	<i>Anacroneuria mixteca</i> Stark & Kondratieff, 2004
<i>Taeniopteryx nelsoni</i> Kondratieff & Kirchner, 1982	<i>Anacroneuria olmec</i> Stark & Kondratieff, 2004
	<i>Anacroneuria pareja</i> Stark & Kondratieff, 2004
	<i>Anacroneuria pichincha</i> Stark & Kondratieff, 2012

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TABLE 2. (Continued)

Plecoptera	Plecoptera continued
<i>Anacroneuria quetzalcoatl</i> Stark & Kondratieff, 2004	<i>Isoperla major</i> Nelson & Kondratieff, 1983
<i>Anacroneuria ratcliffei</i> Stark & Kondratieff, 2004	<i>Isoperla myersi</i> Szczytko & Kondratieff, 2015
<i>Anacroneuria senahu</i> Stark & Kondratieff, 2004	<i>Isoperla nelsoni</i> Szczytko & Kondratieff, 2015
<i>Anacroneuria shepardii</i> Stark & Kondratieff, 2004	syn. <i>Isoperla smithi</i> Szczytko & Kondratieff, 2015
<i>Anacroneuria sonora</i> Stark & Kondratieff, 2004	<i>Isoperla pauli</i> Szczytko & Kondratieff, 2015
<i>Anacroneuria tuberculata</i> Kondratieff & Armitage, 2019	<i>Isoperla poffi</i> Szczytko & Kondratieff, 2015
<i>Anacroneuria wellsi</i> Stark & Kondratieff, 2004	<i>Isoperla powhatan</i> Szczytko & Kondratieff, 2015
<i>Anacroneuria zaculeu</i> Stark & Kondratieff, 2004	<i>Isoperla pseudolata</i> Szczytko & Kondratieff, 2015
<i>Anacroneuria zaga</i> Stark & Kondratieff, 2004	<i>Isoperla pseudosimilis</i> Szczytko & Kondratieff, 2015
<i>Hansonoperla cheaha</i> Kondratieff & Kirchner, 1996	<i>Isoperla reesi</i> Szczytko & Kondratieff, 2015
<i>Hansonoperla hokolesqua</i> Kondratieff & Kirchner, 1996	<i>Isoperla siouan</i> Szczytko & Kondratieff, 2015
<i>Inconeuria chimu</i> Stark & Kondratieff, 2003	<i>Isoperla starki</i> Szczytko & Kondratieff, 2015
<i>Perlesta beatyi</i> Kondratieff, Zuellig & Lenat, 2011	<i>Isoperla stewarti</i> Szczytko & Kondratieff, 2015
<i>Perlesta bjostadi</i> Kondratieff & Lenat, 2006	<i>Isoperla tutelo</i> Szczytko & Kondratieff, 2015
<i>Perlesta cranshawi</i> Kondratieff & Kirchner, 2006	<i>Isoperla yuchi</i> Szczytko & Kondratieff, 2015
<i>Perlesta dakota</i> Kondratieff & Baumann, 1999	<i>Isoperla zuelligi</i> Szczytko & Kondratieff, 2015
<i>Perlesta durfee</i> Kondratieff, Zuellig & Kirchner, 2008	<i>Pictetiella lechleitneri</i> Stark & Kondratieff, 2004
<i>Perlesta etnieri</i> Kondratieff & Kirchner, 2002	<i>Remenus daniellae</i> Verdone & Kondratieff, 2018
<i>Perlesta georgiae</i> Kondratieff, Zuellig & Lenat, 2008	<i>Remenus duffieldi</i> Nelson & Kondratieff, 1995
<i>Perlesta leathermani</i> Kondratieff & Zuellig, 2006	<i>Remenus kirchneri</i> Kondratieff & Nelson, 1995
<i>Perlesta mihucorum</i> Kondratieff & Myers, 2011	
<i>Perlesta puttmanni</i> Kondratieff & Kirchner, 2003	
<i>Perlesta roblei</i> Kondratieff & Kirchner, 2003	
<i>Perlesta teaysia</i> Kirchner & Kondratieff, 1997	
<i>Perlinella zwicki</i> Kondratieff, Kirchner & Stewart, 1988	
Perlodidae	
<i>Diploperla janeae</i> Kondratieff & Verdone, 2017	
<i>Diploperla kanawholensis</i> Kirchner & Kondratieff, 1984	
<i>Diploperla morgani</i> Kondratieff & Voshell, 1979	
<i>Isoperla catawba</i> Szczytko & Kondratieff, 2015	
<i>Isoperla cherokee</i> Szczytko & Kondratieff, 2015	
<i>Isoperla chickamauga</i> Szczytko & Kondratieff, 2015	
<i>Isoperla dewalti</i> Verdone & Kondratieff, 2017	
<i>Isoperla evanescens</i> Verdone & Kondratieff, 2016	
<i>Isoperla fauschi</i> Szczytko & Kondratieff, 2015	
<i>Isoperla kirchneri</i> Szczytko & Kondratieff, 2015	
<i>Isoperla lenati</i> Szczytko & Kondratieff, 2015	

A last productive chapter in Boris's career was devoted to mentoring future scientists. Some examples are warranted. For a few years in the mid 2010s he hosted Zhi-Teng Chen, (a prolific stonefly scientist now of Jiangsu University of Science and Technology, Zhenjiang, China). Chen was then a graduate student in the Dr. Yu-Zhou Du laboratory (Yangzhou University, Yangzhou, China). He came to the U.S.A. to learn from Boris about stoneflies, expand his understanding of insect taxonomy, and to become more familiar with museum practice. Boris and Chen

conducted collecting trips across the country, collaborated on papers, and learned from each other. Chen's experience at CSU made him a more well-rounded scientist. The close bond between them is apparent in the several patronyms with which Chen honored Boris.

A recent student, Chris J. Verdone (North Carolina Department of Environmental Quality, Raleigh) graduated with a master's degree in 2018 working on the systematics of *Remenus* (Perlodinae) (Verdone & Kondratieff 2018). Boris poured time, experience, resources, and much joint field work into Chris's research. Their collaboration from 2015 to 2022 resulted in 13 papers. With Boris's guidance Chris has become the best of the young North American stonefly taxonomists and has landed a position with the highly respected North Carolina DEQ. He continues his prolific work on stonefly taxonomy.

Boris was also helpful to the graduate students of other colleagues. Eric J. South (Lyon College, Batesville, Arkansas) was a student of mine who published a phylogeny of stoneflies in North America using transcriptomes (messenger RNA at the time of expression). We needed live material for nearly 100 species for this work. Boris sent many live specimens through the mail to Eric resulting from his own collecting, sometimes at considerable expense. He also hosted Eric for collecting of specific species found only in the western Mountains. Without his involvement, and that of others working with us, the project would not have been possible (South *et al.* 2021).

Patronyms. Boris was honored by his colleagues with several patronyms (Table 1). A single mayfly patronym exists as a subgenus *Borisonchia* McCafferty, 1989 with the single species *Isonychia (B.) diversa* Traver, 1934 (McCafferty). It was recently listed as extinct (Jacobus & McCafferty 2023). In Plecoptera there are 11 taxa named for Boris. Chen (2018) and Chen (2020) named a fossil subfamily, genus and two species for Boris. Chen (2022) followed with an extant nemouriid species for Boris. Stark & Baumann (2004) and Baumann & Grubbs (1996) named a capniid and a nemourid species, respectively. Beaty *et al.* (2017) added an *Isoperla* from North Carolina. A *Yugus* species was added by Nelson (2001) and Stark (2001) added an *Anacroneuria* (Perlidae) species to round out the list. The latest patronym is in a paper in this issue (*Protonemura boris* Murányi, Manko, Kovács, Vinçon, Žiak, 2023). I fully expect that other patronyms are planned by his colleagues.

Species described by Boris C. Kondratieff. The species described by Boris and co-authors are found in Table 2. He described eight North American mayflies in three families. One has since been synonymized (*Isonychia edmundsi* Kondratieff & Voshell, 1984 is a synonym of *I. sicca* Walsh, 1862). He also described the unknown life stages of six other species.

A total of 106 stonefly species were described by Boris and his co-authors. Three of these species have since been synonymized. *Capnia arapahoe* Nelson & Kondratieff, 1988 was recently reported by Young *et al.* (2019) as a hybrid between *Arsapnia decepta* (Banks, 1897) and *Capnia gracilaria* Claassen, 1924. DeWalt *et al.* (2023) placed this species in synonymy with *A. decepta* as shorthand for the hybrid relationship. *Acroneuria kirchneri* Stark & Kondratieff, 2004 was found by Verdone *et al.* (2022) to have identical morphology and close DNA barcode sequences with *A. kosztarabi* Kondratieff & Kirchner, 1993. *Isoperla smithi* Szczytko & Kondratieff, 2015 was found by Verdone & Kondratieff (2017) to be of identical aedeagal morphology and egg ultrastructure to that of *I. nelsoni* Szczytko & Kondratieff (2015). Despite the synonyms, Boris was a prolific describer of North American Plecoptera, his tally standing at 103 valid species. This is a little more than 13% of the current North American stonefly fauna (DeWalt & Ower 2019). His rate of synonymy was low at 2.8%.

Conclusion. Boris was a great person, a dedicated scientist, a devoted father to his daughter Maiya, and a highly sought after advisor and committee member to students at CSU and elsewhere. He was a remarkable person, the likes of which come along only rarely.

In the coming year I will be enlisting the help of the committees leading our groups to help form a scholarship in Boris's name. LeRoy Poff, his colleagues at CSU, and I discussed such an honor last fall at the memorial. The objective of the scholarship and all details are still unknown.

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