

Cladocera (Crustacea: Branchiopoda) of South East Asia: history of exploration, taxon richness and notes on zoogeography

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ABSTRACT

The history of Cladocera studies in South-East Asia is reviewed, beginning from the early start of explorations in the end of the 19th century by J. Richard and T. Stingelin. In the first half of the 20th century, extensive research was carried out by V. Brehm, who investigated material collected by the Wallacea-Expedition and the Deutschen Limnologischen Sunda-Expedition. Later, in the 1970-1980s, C.H. Fernando and collaborators, besides a few other researchers, provided a new series of regional studies of the cladoceran faunas together with the systematic revisions of some taxa from tropical Asia. Then and up to present, investigations of the Cladocera have concentrated in Thailand and many species have been revised and described as new to science. In total, 298 taxa of species rank have been recorded in SE Asia but only comparatively few of them (67 taxa; 22.5%) can be regarded good species, of which the valid status has been confirmed by recent studies, while others are synonyms (68; 22.8%) or taxa of uncertain taxonomic status, including those which definitely represent complexes of species (163; 54.7%). Most total taxa of species level and good species are known from Thailand (155 and 54, respectively), followed by Malaysia (plus Singapore), Indonesia, Philippines, Vietnam, and Cambodia in this respect (70-119 total taxa and 23-33 good species respectively). Laos, Burma (Myanmar) and Brunei remain practically unexplored. Only good species were used for the zoogeographic analysis. Of them, about a quarter is known only in SE Asia but more species are distributed in tropical/subtropical/temperate Asia and Australia, others in tropics/subtropics of the eastern hemisphere (17.9%) or even wider. Tropical species, constituting the primary part of the cladoceran fauna of SE Asia, can penetrate the neighboring subtropical and southern temperate zones to a different degree. Only a small fraction of species (7 or 10.5%) here are of more or less northern origin, they are distributed predominantly in the subtropical/southern temperate or in the northern boreal latitudes. Few species are suggested to penetrate SE Asia from the north using the Mekong river and its tributaries. Generally, the cladocerans of SE Asia are poorly known and only continuous extensive taxonomic studies would improve this situation.

Key words: Cladocera, South-East Asia, taxon richness, taxonomic status, zoogeography.

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INTRODUCTION

South-East (SE) Asia is a huge geographical region, which is almost fully, except small elevated part of northern Myanmar (Burma), located in tropical latitudes. It lies on the intersection of geological plates, with heavy seismic and volcanic activity. There are two main geographical regions: Mainland SE Asia also known as Indochina (Cambodia, Myanmar, Laos, Thailand, Vietnam, and West Malaysia) and Maritime SE Asia, comprising numerous islands of Indonesia, the largest archipelago of the world, Philippines, etc.

The climate of SE Asia is mainly monsoonal tropical-hot and humid with plentiful rainfall. An exception to this type of climate is the mountaneous areas in the north and some other regions, where high altitudes lead to milder temperatures and drier landscapes. The highest mountains are situated in northern Myanmar and in Borneo (up to 4000-5881 m asl). Historically, the SE Asian biota has been studied since the middle of the 19th century, espe-

cially by the outstanding zoologist Alfred Wallace, who traveled in particular to the Malay archipelago. He investigated abundant zoological collections, many collected by himself, which, however, mostly represented the terrestrial fauna which were the main focus of attention of most researchers of that time. As a result of these intensive zoological studies, some fundamental zoogeographical summaries have been composed and published (e.g., Wallace, 1876). In particular, the Malay archipelago has been split by the so-called Wallace-, Weber-, etc. zoogeographical lines, which run along what is now known to be a tectonic plates boundary and largely separate the Asian and Australasian faunas. The islands between Java/Borneo and New Guinea form a mixed zone, where both types occur, known as *Wallacea*.

The inland freshwater fauna of SE Asia, especially invertebrates, attracted the researchers' attention later. It was explored significantly less intensely than the terrestrial biota (Lim, 1980; Fernando, 1980; Dussart *et al.*, 1984; Ho, 1995). In particular, a detailed overview of the Clado-

cera fauna of the region has never been made. Only Fernando (1980) attempted to do this in the context of his review of all freshwater zooplankton of the Oriental Region, but his data, containing interesting facts and conclusions, are preliminary. The subsequent review publications were regional, containing brief summary data (Idris and Fernando, 1981; Idris, 1983), and most concerned the fauna of Thailand (Boonsom, 1984; Sanoamuang, 1998, especially detailed in Maiphae *et al.*, 2005, 2008). It should be noted, however, that the latter studies did not distinguish adequately from poorly studied taxa, thus preventing taxonomic and zoogeographic analysis.

The aim of this paper is to present an overview of studies of Cladocera, one of the main group of crustaceans of inland waters in SE Asia, to estimate their known taxon richness and validity, and outline some zoogeographical peculiarities.

APPROACHES AND DEFINITIONS

The present work required a comprehensive analysis of published data on cladoceran taxa recorded in SE Asia from the early beginning of these studies to now. The list of taxa has been compiled and presented in Tab. 1. The closer analysis of literature sources (Tab. 1) clearly showed quite a different quality of the taxa presented. From the modern point of view, many of them were described inadequately, thus having an unclear taxonomic status. For this reason, it was important to select the credible taxa of species rank, thus creating the basis for further faunistic and zoogeographical analysis.

The only reliable criterion to select such taxa was to evaluate them with consideration of principles of the modern cladoceran taxonomy, developed in last decades (Frey, 1982, 1987b; Korovchinsky, 1996). These principles require the detailed morphological study of the material favoring the description of real biological units (species, genera, *etc.*). The effectiveness of this method was confirmed by the following genetic analysis of taxa, sometimes provided together with morphological descriptions (Kotov *et al.*, 2006; Elias-Gutierrez and Valdez-Moreno, 2008). Our approach was that the only credible or *good* species, were those recently described or redescribed on the basis of such studies or at least, of which validity was confirmed by recent taxonomic revisions (Van Damme *et al.*, 2010), have been chosen for further analysis (Tab.1, taxa marked in bold). The list of these taxa was supplemented by some species with peculiar taxonomic traits (*e.g.*, *Latonopsis australis* Sars, *Scapholeberis kingi* Sars, *Daphnia lumholtzi* Sars), which have not yet been comprehensively revised but which were originally described from SE Asia or from the neighboring regions (Australia, India, Sri Lanka) and whose valid taxonomic status and occurrence in SE Asia seem quite probable.

HISTORICAL OVERVIEW

Studies of the Cladocera of SE Asia started in 1890s and the beginning of the 1900s, when J. Richard and T. Stingelin published their pioneer papers on zooplankton of the region, collected in a few localities in Sumatra, Celebes (Sulawesi), and Tonkin (Northern Vietnam) (Richard, 1891, 1894a, 1894b; Stingelin, 1900). In total, 17 forms were recorded, among which four *good* species were described. Among others, the honeycombed *Chydorus* was recorded in SE Asia for the first time (Richard, 1894b). Slightly later, more extensive explorations were provided by G.O. Sars (1903) and especially by Stingelin (1905), who recorded zooplanktonic animals (41 species, subspecies, and varieties) from Sumatra, Java, Siam (Thailand), Singapore, and Cochinchina (Saigon) (now in the south of Vietnam). Among them, three *good* species were described, some initially described as new variety of a known species (*e.g.*, *Diaphanosoma sarsi* var. *volzi* Stingelin=*D. volzi* Stingelin). Also *Daphnia* (*D. longispina* O.F. Müller), rare in the tropics, was recorded first from Java by Sars (1903).

After the pioneer studies, the investigations on the mainland were abandoned for a long time, up to the 1960s, while they were more steadily continued on the islands. For example, Grochmalicki (1915) described 12 species from Java, including three new ones, but all of them seem to be invalid (see Smirnov, 1971). Heberer (1923) found a population of *Daphnia cephalata* Schödler in Flores Island, and Spandl (1925) provided the first study of the Cladocera from Borneo (Sarawak). Surprisingly, the latter author recorded exclusively temperate species from the genera *Daphnia*, *Simocephalus*, and *Moina*. The late 1920-1930s was a period of extensive surveys. During the Deutschen Limnological Sunda-Expedition and the Wallacea-Expedition, materials were collected on different islands of the Malay archipelago (Sumatra – mostly in lake Toba and its surroundings – Sulawesi, Java, Bali, and Flores) and the Philippines. The collections were studied mainly by V. Brehm, who published some papers in 1933-1939 (Brehm, 1933a, 1933b, 1933c, 1933d). One specifically on the Cladocera of the Deutschen Limnologischen Sunda-Expedition (Brehm, 1933a) was most extensive. It contains the descriptions of 51 species and varieties including several ones new to science (*Diaphanosoma perarmatum* Brehm, *D. paucispinosum* Brehm, *Guernella sumatrensis* Brehm, *Moina latidens* Brehm, *Alona arenaria* Brehm, *A. archeroides* Brehm, *Alonella granulata* Brehm, *Chydorus herrmanni* Brehm, *etc.*). However, in the following revisions (Smirnov, 1971, 1976, 1992, 1996; Korovchinsky, 1992; Van Damme *et al.*, 2010) nearly all these taxa have been regarded invalid or vague. A few other researchers (Aurich, 1934; Rammner, 1937) also studied material from the SE Asian islands (Philippines, Java); in particular, they analyzed morphological variability in some species of the

Tab. 1. Taxa of Cladocera recorded in South-East Asia. Good species are in bold.

Taxa		Thailand	Malaysia and Singapore	Vietnam	Philippines	Indonesia	Cambodia
Sididae							
<i>Sida crystallina</i> (O.F. Müller, 1776)	s	+(6, 9)		+(3, 4, 5)			+(2)
<i>S. crystallina ortiva</i> Korovchinsky, 1979	g	+(8)					
<i>Diaphanosoma sarsi</i> Richard, 1894	g	+(1, 4, 5, 6, 7, 8, 9)	+(1, 5, 6, 7)	+(4, 5)	+(1, 2, 3, 4, 8)	+(1, 2, 3, 5, 8)	+(1)
<i>D. sarsi</i> var. <i>celebensis</i> Stingelin, 1900	s					+(2)	
<i>D. celebensis</i> Stingelin, 1900	g		+(8)	+(6)		+(10)	
<i>D. sarsi</i> var. <i>volzi</i> Stingelin, 1905	s	+(1)					
<i>D. volzi</i> Stingelin, 1905	g	+(5, 8, 9)	+(8)		+(5)	+(10)	
<i>D. aspinosum</i> Chiang, 1956	s		+(5, 6)				
<i>D. cf. volzi</i> Stingelin, 1905	v	+(4)					
<i>D. excisum</i> Sars, 1885	g	+(3, 4, 5, 6, 7, 8, 9, 10)	+(1, 4, 5, 6, 7)	+(2, 10)	+(3, 4, 8)	+(2, 4, 6)	+(1, 2)
<i>D. paucispinosum</i> Brehm, 1933	s		+(3)	+(4, 5)		+(5)	+(1)
<i>D. leuchtenbergianum</i> Fischer, 1850	s			+(4, 5)			
<i>D. modigliani</i> Richard, 1894	g		+(5, 6)*		+(1, 2, 3, 4)*	+(1, 5, 8, 10)	+(1)*
<i>D. cf. modigliani</i> Richard, 1894	v	+(4)					
<i>D. perarmatum</i> Brehm, 1933	v					+(5)	
<i>D. dubium</i> Manuilova, 1964	g	+(8, 9)	+(8)	+(6)	+(5)		
<i>D. tropicum</i> Korovchinsky, 1998	g	+(8)	+(8)	+(10)*	+(5, 8)		
<i>D. orghidani transamurensis</i> Korovchinsky, 1986	g				+(5)		
<i>D. senegal isanensis</i> Korovchinsky et Sanoamuang, 2008	g	+(8)					
<i>D. macrophthalma</i> Korovchinsky et Mirabdullaev, 1995	g	+(8)					
<i>D. elongatum</i> Korovchinsky et Sanoamuang, 2008	g	+(8)					
<i>D. brachyurum</i> (Lievin, 1848)	v			+(3)			
<i>Daphnella excisa</i> Sars, 1885	s					+(1)	
<i>Pseudosida szalayai</i> Daday, 1898	g	+(1, 8)				+(2, 10)	
<i>P. bidentata</i> Herrick, 1888	s	+(5, 6, 7, 9, 10)	+(5, 6, 7)	+(3, 4)	+(3, 4)	+(7)	+(2)
<i>P. cf. bidentata</i> Herrick, 1888	v	+(4)					
<i>P. ramosa</i> (Daday, 1904)	v	+(5, 6, 9)					
<i>Latonopsis australis</i> Sars, 1888	g	+(4, 5, 6, 7, 8, 9)	+(5, 6)	+(2, 4, 5)	+(2, 3, 4)	+(4, 5, 6, 8, 9)	+(2)
<i>Sarsilatona serricauda</i> (Sars, 1901)	v	+(9)					
<i>S. papuana</i> (Daday, 1900)	v						+(2)
<i>S. cf. fernandoi</i> Rane, 1983	v			+(6)			
<i>Sarsilatona</i> sp.	v	+(8)					
<i>Latona setifera</i> (O.F. Müller, 1776)	v			+(3)			
Daphniidae							
<i>Daphnia lumholztzi</i> Sars, 1885	g	+(4, 5, 7, 9)		+(5)			+(2)
<i>D. similis</i> Claus, 1876	s	+(4)	+(5, 6)			+(5)	
<i>D. similoides</i> Hudeč, 1991	g		+(9)				
<i>D. carinata</i> King, 1853	sc			+(5)		+(5)	
<i>D. cephalata</i> Schoedler, 1877	sc					+(5)	
<i>D. rosea</i> Sars, 1862	v			+(3)			
<i>D. catawba</i> Coker, 1926	v			+(3)			
<i>D. longispina</i> (O.F. Müller, 1776)	sc		+(1)	+(3)		+(3)	
<i>D. cucullata</i> Sars, 1862	v			+(5)			
<i>D. pulex</i> Leydig, 1860	v			+(3)			
<i>D. magna</i> Straus, 1820	v		+(1)				
<i>D. triquetra</i> Sars, 1903	v		+(1)				
<i>Scapholeberis kingi</i> Sars, 1888	g	+(1, 4, 5, 6, 7, 9, 10)	+(5, 6, 7)	+(3, 4, 5)	+(1, 3, 4)	+(2, 3, 5, 8)	+(2)
<i>S. mucronata</i> var. <i>intermedia</i> Daday, 1898	v					+(4)	
<i>Simocephalus elizabethae</i> (King, 1853)	v	+(1)		+(4, 5)		+(2)	
<i>S. vetulus</i> (O.F. Müller, 1776)	v	+(3, 4, 5, 9)	+(4)	+(3)	+(3, 4)	+(8)	+(1)
<i>S. cf. vetula</i> (O.F. Müller, 1776)	v				+(1)	+(5)	
<i>S. exspinosus</i> (Koch, 1941)	v	+(5, 9)	+(1)			+(3, 8)	
<i>S. mesostris</i> Orlova-Bienkowskaja, 1995	s	+(5, 6)					
<i>S. heilongjiangensis</i> Shi et Shi, 1994	g	+(7, 9)	+(9)	+(7)	+(6)	+(11)	+(2)
<i>S. serrulatus</i> (Koch, 1841)	g	+(5, 6, 7, 9)	+(5, 6)	+(5, 7)		+(5, 6, 8)	+(2)
<i>S. serrulatus</i> var. <i>productifrons</i> Stingelin, 1904	s				+(1)	+(2)	
<i>S. serrulatus</i> var. <i>mixta</i> Grohmalicki, 1915	s					+(4)	
<i>S. mixtus</i> Sars, 1903	g			+(7)			
<i>S. latirostris</i> Stingelin, 1906	s	+(4)	+(2, 5, 6)		+(3, 4)		
<i>S. acutirostratus</i> (King, 1853)	g				+(3, 4)		
<i>S. australiensis</i> Dana, 1852	v					+(4)	
<i>Ceriodaphnia cornuta</i> Sars, 1885	sc	+(4, 5, 6, 7, 9, 10)	+(3, 5, 6)	+(10)	+(1, 2, 3, 4, 8)	+(2, 4, 5, 6, 8, 9)	+(2)
<i>C. rigaudi</i> Richard, 1894	s	+(3)	+(4)	+(1, 2, 3, 4, 5)	+(1)	+(2, 3, 5, 6, 7)	+(1)

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Tab. 1. Continued from previous page.

Taxa		Thailand	Malaysia and Singapore	Vietnam	Philippines	Indonesia	Cambodia
<i>C. dubia</i> Richard, 1894	v					+ (1, 5, 8)	
<i>C. cf. dubia</i> Richard, 1894	v					+ (5)	
<i>C. pulchella</i> Sars, 1862	v	+ (4)			+ (3, 4)		
<i>C. reticulata</i> (Jurine, 1820)	sc	+ (4)		+ (3)			
<i>C. megalops</i> Sars, 1862	v			+ (3)			
<i>C. lacustris</i> Birge, 1893	v			+ (3)			
<i>C. quadrangula</i> (O.F. Müller, 1785)	v			+ (3, 5)			
<i>C. laticaudata</i> P.E. Müller, 1867	v			+ (5)			+ (2)
Moinidae							
<i>Moina dubia</i> Guerne et Richard, 1892	s	+ (3)	+ (4)	+ (4, 5)	+ (1, 2)	+ (5)	
<i>M. dubia parva</i> Jenkin, 1934?	s		+ (3)			+ (6)	
<i>M. micrura</i> Kurz, 1874	sc	+ (4, 5, 6, 7, 9, 10)	+ (5, 6, 7)	+ (10)	+ (2, 3, 4, 8)		+ (2)
<i>M. macrocopa</i> (Straus, 1820)	v	+ (4)		+ (3)	+ (3, 4)		
<i>M. brachiata</i> (Jurine, 1820)	v		+ (1)	+ (3)	+ (3, 4)		
<i>M. rectirostris</i> Baird, 1850	s			+ (3)			
<i>M. macrophthalma</i> Stingelin, 1913	s				+ (1)		
<i>M. weberi</i> Richard, 1891	s				+ (1)	+ (1, 5)	
<i>M. weismanni</i> Ishikawa, 1896	v						+ (1)
<i>M. paradoxa</i> Weismann, 1880	s					+ (2)	
<i>M. propinqua</i> Sars, 1885	s					+ (2, 4)	
<i>M. latidens</i> Brehm, 1933	s					+ (5)	
<i>Moinodaphnia macleayi</i> (King, 1853)	g	+ (1, 4, 5, 6, 9, 10)	+ (5, 6)	+ (3, 5)	+ (3, 4)	+ (3, 5)	+ (2)
Macrothricidae							
<i>Guernella raphaelis</i> Richard, 1892	sc	+ (5, 6, 7, 9, 10)	+ (5, 6)		+ (3, 4)		+ (2)
<i>G. sumatrensis</i> Brehm, 1933	v					+ (5, 6)	
<i>Grimaldina brazzai</i> Richard, 1892	v	+ (9)	+ (5, 6)	+ (3)	+ (1, 3, 4)	+ (5)	+ (2)
<i>Macrothrix triserialis</i> Brady, 1886	g	+ (1, 6, 9, 10)		+ (2, 4, 5)	+ (3, 4)	+ (2, 4, 5, 6, 7, 8, 9)	
<i>M. cf. triserialis</i> Brady, 1886	v	+ (4, 5)	+ (1, 5, 6)		+ (1)		
<i>M. spinosa</i> King, 1853	g	+ (1, 3, 5) 6, 7, 9, 10	+ (1, 4, 5) 6, 7	+ (5)	+ (3, 4)	+ (1, 2, 3, 5, 6, 8)+ (2)	
<i>M. cf. spinosa</i> King, 1853	v					+ (5)	
<i>M. flabelligera</i> Smirnov, 1992	g	+ (5, 6, 7)					+ (2)
<i>M. laticornis</i> (Fischer, 1851)	v	+ (5, 7)		+ (3)	+ (1)		
<i>M. cf. laticornis</i> (Fischer, 1851)	v	+ (9)					
<i>M. paulensis</i> Sars, 1900	v	+ (9)					
<i>M. cf. paulensis</i> (Sars, 1900)	v	+ (5, 6)					
<i>M. pholpunti</i> Kotov <i>et al.</i> , 2005	g	+ (9, 12)					+ (2)
<i>M. hirsuticornis</i> Norman et Brady, 1867	v	+ (4)					
<i>M. cf. gauthieri</i> Smirnov, 1976	v	+ (6, 9)					
<i>M. malaysiensis</i> Idris et Fernando, 1981	g	+ (6, 9)	+ (5, 6, 10)				
<i>M. odiosa</i> Gurney, 1907	g	+ (6, 9, 12)	+ (10)				
<i>M. cf. sioli</i> (Smirnov, 1982)	v	+ (6)					
<i>M. cf. superaculeata</i> Smirnov, 1982	v	+ (6, 9)					
<i>M. sumatrensis</i> Brehm, 1933	v		+ (2)			+ (8)	
<i>M. capensis-monodi</i> Gauthier, 1930	s		+ (5, 6)				
<i>M. rosea</i> (Lievin, 1848)	v			+ (3)			
<i>M. cf. squamosa</i> Sars, 1888	v				+ (1)	+ (7)	
<i>M. tobaensis</i> Johnson, 1956	v					+ (8)	
<i>M. vietnamensis</i> Silva-Briano <i>et al.</i> , 1999	g			+ (7)			
<i>Echinisca rosea</i> (Jurine, 1820)	s				+ (3, 4)		
<i>Streblocerus pygmaeus</i> Sars, 1901	s	+ (4, 5, 6, 9)	+ (5, 6)				
<i>S. spinulatus</i> Smirnov, 1992	g		+ (8)				
<i>Bunops cf. tuberculatus</i> (Fryer et Paggi, 1972)	v						+ (2)
Ophryoxidae							
<i>Ophryoxus gracilis</i> Sars, 1862	v			+ (3)			
Ilyocryptidae							
<i>Ilyocryptus halyi</i> Brady, 1886	s	+ (1)	+ (1)	+ (5)		+ (2, 6, 7, 8)	
<i>I. spinifer</i> Herrick, 1882	sc	+ (4, 6, 7, 9, 12)	+ (2, 10)		+ (3, 4)	+ (5)	+ (2)
<i>I. cf. spinifer</i> Herrick, 1882	v	+ (5, 6)	+ (5, 6)				
<i>I. cf. bhardwaji</i> Battish, 1981	v	+ (9)					
<i>I. cf. varidentatus</i> Smirnov, 1989	v	+ (9, 12)					
<i>I. thailandensis</i> Kotov et Sanoamuang, 2004	g	+ (9, 12)		+ (11)			
<i>I. isanensis</i> Kotov <i>et al.</i> , 2005	g	+ (9, 12)					

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Tab. 1. Continued from previous page.

Taxa		Thailand	Malaysia and Singapore	Vietnam	Philippines	Indonesia	Cambodia
<i>I. longiremis</i> Sars, 1888	s				+(1)	+(1, 3, 5, 6)	
<i>I. verrucosus</i> Daday, 1905	s				+(1)		
Chydoridae							
<i>Pleuroxus laevis</i> Sars, 1862	s	+(1, 9)	+(5, 6)	+(9)		+(5)	
<i>P. aduncus</i> (Jurine, 1820)	sc	+(4)		+(1)	+(3, 4)	+(5)	
<i>P. aduncus</i> var. <i>laticaudatus</i> Brehm, 1933	v					+(5, 8)	
<i>P. denticulatus</i> Birge, 1879	s	+(4)		+(3)			
<i>P. uncinatus</i> Baird, 1850	v	+(6, 9)					
<i>P. hamatus hamatus</i> Birge, 1879	s			+(4, 5)			
<i>P. similis</i> Vavra, 1900	v			+(5)	+(3, 4)		
<i>P. trigonellus</i> (O.F. Müller, 1785)	v					+(5)	
<i>P. trigonellus</i> var. <i>brevicornis</i> Brehm, 1933	v					+(5)	
<i>P. australis</i> Henry, 1922	s					+(5)	
<i>Picripleuroxus laevis</i> (Sars, 1862)	v	+(6, 7)					
<i>P. quasidenticulatus</i> Smirnov, 1996	v	+(7, 9)					
<i>Chydorus barroisi</i> (Richard, 1894)	s	+(1)	+(1, 3, 5, 6, 7)	+(2, 3)	+(1, 2, 3, 4)	+(2, 5, 6, 8)	
<i>Ch. barroisi barroisi</i> (Richard, 1894)	s			+(4, 5)			
<i>Ch. sphaericus</i> (O.F. Müller, 1776)	sc	+(3, 4, 9)		+(3)		+(3, 6, 8)	
<i>C. sphaericus sphaericus</i> (O.F. Müller, 1776)	s			+(4, 5)			
<i>Ch. sphaericus</i> var. <i>parvus</i> Daday, 1898	s	+(1)				+(2)	
<i>Ch. cf. sphaericus</i> (O.F. Müller, 1776)	v		+(7)		+(1)	+(5)	
<i>Ch. leonardi</i> King, 1853	v		+(1)			+(5)	
<i>Ch. sphaericus</i> cf. <i>leonardi</i> King, 1853	v					+(8)	
<i>Ch. alexandrovi</i> (Poggenpol, 1874)	v			+(4, 5)			
<i>Ch. herrmanni</i> Brehm, 1933	v				+(1)	+(5)	
<i>Ch. eurynotus</i> Sars, 1901	v	+(4, 5, 6, 7, 9)	+(2, 5, 6)		+(3, 4)		+(2)
<i>Ch. eurynotus eurynotus</i> Sars, 1901	v			+(5)			
Ch. parvus Daday, 1898	g	+(5, 6, 7, 9)	+(5, 6)		+(3, 4)		
<i>Ch. pubescens</i> Sars, 1901	v	+(5, 6, 9)					+(2)
<i>Ch. cf. pubescens</i> Sars, 1901	v	+(7)	+(5, 6)				
Ch. ventricosus Daday, 1898	g	+(4, 5, 6, 7, 9)	+(5, 6, 11)		+(3, 4, 7)	+(4, 13)	+(2, 3)
<i>Ch. cf. ventricosus</i> Daday, 1898	v					+(8)	
Ch. reticulatus Daday, 1898	g	+(5, 6, 9)	+(5, 6, 11)			+(5)	+(2)
Ch. sinensis Frey, 1987	g	+(5, 9)					
<i>Ch. obscurirostris</i> Frey, 1987	v	+(9)					+(2)
<i>Ch. obscurirostris obscurirostris</i> Frey, 1987	v	+(6)					
Ch. o. tasekberae Frey, 1987	g	+(6)	+(11)				
Ch. opacus Frey, 1987	g	+(9)					
<i>Ch. faviformis</i> Birge, 1893	v		+(5, 6)				
Ch. invaginatus Frey, 1982	g	+(14)					
<i>Ch. gibbus</i> Sars, 1891	v			+(3)			
<i>Ch. robustus</i> Stingelin, 1905	s					+(2, 5, 8, 9)	
<i>Ch. robustus</i> var. <i>laticornis</i> Brehm, 1953	s				+(1)		
<i>Ch. globosus</i> Baird, 1843	s					+(6)	
<i>Ch. cf. dentifer</i> Daday, 1905	v						+(2)
<i>Chydorus</i> sp. with honeycombed valves	v			+(1)			
<i>Alonella karua</i> Sars, 1888	s	+(1)	+(1)	+(2)	+(1)	+(2, 5, 7)	
A. breviceps Stingelin, 1905	g	+(1)					
<i>A. nana</i> (Baird, 1850)	v	+(4, 6, 9)	+(5, 6)				
A. clathratula Sars, 1896	g	+(5, 6, 9)					+(2)
<i>A. excisa</i> (Fischer, 1854)	v	+(5, 6, 9)	+(1, 5, 6, 7)		+(1, 3, 4)	+(2, 5, 6, 8)	+(2)
<i>A. excisa excisa</i> (Fischer, 1854)	v			+(5)			
<i>A. exigua</i> (Lilljeborg, 1853)	v						+(2)
<i>A. hamulatus</i> (Birge, 1910)	s		+(5, 6)				
<i>A. sculpta</i> Sars, 1901	s				+(1)	+(2, 5)	
<i>A. sculpta</i> var. <i>insulcata</i> Stingelin, 1905	s			+(2)			
<i>A. dadayi</i> Birge, 1910	v			+(3)			
<i>A. kulczynskii</i> Grohmalicki, 1915	s				+(1)	+(4)	
<i>A. globulosa</i> Daday, 1910	s					+(5)	
<i>A. diaphana</i> King, 1853	s					+(5)	
<i>A. granulata</i> Brehm, 1933	v					+(5)	
<i>Disparalona hamata</i> (Birge, 1879)	v	+(5, 6, 7, 9)					+(2)
D. caudata Smirnov, 1996	g	+(5, 6, 9)					+(2)
<i>D. rostrata</i> (Koch, 1841)	v	+(9)	+(5, 6)	+(5)			

To be continued on next page.

Tab. 1. Continued from previous page.

Taxa		Thailand	Malaysia and Singapore	Vietnam	Philippines	Indonesia	Cambodia
<i>Ephemeroporus barroisi</i> (Richard, 1894)	sc	+ (4, 5, 6, 7, 9, 10)					+(2)
<i>E. hybridus</i> (Daday, 1905)	v	+(6, 9)					
<i>E. phintonicus</i> (Margaritora, 1969)	v	+(6, 9)					
<i>E. tridentatus</i> (Bergamin, 1939)	v	+(6, 9)					
<i>Dadaya macrops</i> (Daday, 1898)	g	+ (1, 4, 5, 6, 7, 9, 10)	+ (1, 2, 5, 6)	+ (3, 5)	+ (3, 4)	+ (2, 5, 9)	+(2)
<i>Dunhevedia crassa</i> King, 1853	g	+ (1, 4, 5, 6, 7, 9)	+ (5, 6)	+ (4, 5)	+ (1, 3, 4)	+ (2, 5, 7, 9)	
<i>D. serrata</i> Daday, 1898	g	+ (5, 6, 7, 9)	+ (5, 6, 11)		+ (3, 4, 7)	+ (13)	+(2)
<i>D. siedleckii</i> Grohmalicki, 1915	v					+ (4)	
<i>Pseudochydorus globosus</i> (Baird, 1843)	sc	+(9)	+(5)				+(2)
<i>Alona acuticostata</i> Sars, 1903	g					+(3)	
<i>A. cf. acuticostata</i> Sars, 1903	v						+(1)
<i>A. acuticostata</i> var. <i>tridentata</i> Stingelin, 1905	v	+(1)					
<i>A. diaphana</i> King, 1853	s	+(5, 6, 7)		+(3)			+(2)
<i>A. guttata</i> Sars, 1862	v	+(3, 6, 7, 9)	+(5)	+(2, 5)	+(3, 4)	+(2, 3, 5, 6)	+(2)
<i>A. cf. guttata</i> Sars, 1862	v		+(6, 7)				
<i>A. rectangula</i> Sars, 1862	sc	+(5, 6, 7, 9)	+(5)	+(3, 4, 5)			+(2)
<i>A. cf. rectangula</i> Sars, 1862	v		+(6)				
<i>A. affinis</i> (Leydig, 1860)	sc	+(4, 5, 6, 9)	+(2, 5, 6)	+(3)		+(5)	+(2)
<i>A. cf. affinis</i> (Leydig, 1860)	v				+(1)		
<i>A. affinis</i> var. <i>elegantula</i> Brehm, 1933	v					+(5)	
<i>A. quadrangularis</i> (O.F. Müller, 1875)	sc	+(6, 9)	+(5, 6)				
<i>A. verrucosa</i> Sars, 1901 s.l.	sc	+(4, 6, 9, 10)	+(1, 5, 6)	+(2)	+(1)	+(8)	
<i>A. verrucosa verrucosa</i> Sars, 1901	s	+(5)					
<i>A. pseudoverrucosa</i> (Smirnov, 1971)	s						+(2)
“ <i>A. verrucosa pseudoverrucosa</i> Smirnov, 1974”, probably <i>A. pseudoverrucosa verrucosa</i> (Sars, 1901)	s	+(5)					
<i>A. sarasinorum</i> Stingelin, 1900	g	+(6, 9)			+(1)	+(2, 5)	
<i>A. cf. sarasinorum</i> Stingelin, 1900	s		+(5, 6)			+(5)	
<i>A. davidi</i> Richard, 1895	v	+(4)	+(5, 6)	+(4, 5)	+(3, 4)	+(2, 7, 8)	
<i>A. davidi punctata</i> (Daday, 1898)	v						+(2)
<i>A. karua</i> King, 1853	s	+(4, 5)	+(5, 6)	+(3)	+(1)	+(8)	+(1)
<i>A. cambouei</i> Guerne et Richard, 1893	v		+(3)	+(1, 4, 5)	+(2, 3, 4)	+(5)	
<i>A. cf. cambouei</i> Guerne et Richard, 1893	v	+(5, 9, 10)				+(8)	
<i>A. costata</i> Sars, 1862	sc	+(5, 6)	+(5, 6)	+(3)			+(2)
<i>A. eximia</i> Kiser, 1948	s		+(5, 6)	+(9)			
<i>A. cf. eximia</i> Kiser, 1948	v	+(5)					
<i>A. milleri</i> Kiser, 1948	g	+(5, 9)					
<i>A. monacantha</i> Sars, 1901	sc	+(6, 9, 10)	+(5, 6)	+(3, 4, 9)			
<i>A. monacantha tridentata</i> Stingelin, 1905	v	+(5)					+(2)
<i>A. pulchella</i> King, 1853	v	+(6, 9, 10)			+(3, 4)		+(2)
<i>A. cf. pulchella</i> King, 1853	v	+(5)	+(5, 6)				
<i>A. dentifera</i> (Sars, 1901)	v			+(3)			
<i>A. cf. dentifera</i> (Sars, 1901)	s	+(6, 9)	+(5, 6)				
<i>A. cf. karelica</i> Stenroos, 1897	s	+(6)	+(5, 6)				
<i>A. archeri</i> Sars, 1888	sc	+(9)			+(1)	+(2)	
<i>A. cf. archeri</i> Sars, 1888	v					+(5)	
<i>A. arenaria</i> Brehm, 1933	v						
<i>A. archeroides</i> Brehm, 1933	v					+(5, 8)	
<i>A. cheni</i> Sinev, 1999	g	+(9)					
<i>A. intermedia</i> Sars, 1862	v	+(9)	+(5, 6)		+(1)	+(5)	+(2)
<i>A. cf. intermedia</i> Sars, 1862	v					+(8)	
<i>A. intermedia</i> var. <i>minor</i> Stingelin, 1905	v			+(2)			
<i>A. globulosa</i> Daday, 1898	s			+(3)	+(1)		
<i>A. bukobensis</i> Weltner, 1896	sc				+(1)		
<i>A. pseudanodonta</i> Brehm, 1933	v				+(1, 3, 4)	+(5)	
<i>A. alonopsiformis</i> Brehm, 1933	v				+(1)	+(5)	
<i>A. circumfibriata</i> Megard, 1967	v				+(3, 4)		
<i>A. sarsi</i> Richard, 1891	v					+(1)	
<i>A. tenuicaudis</i> Sars, 1862	s					+(3)	
<i>A. glabra</i> Sars, 1901	v					+(5, 8)	
<i>A. siamensis</i> Sinev et Sanoamuang, 2007	g	+(14)	+(12)				
<i>A. kotovi</i> Sinev, 2012	g			+(8)			
<i>Pseudalona longirostris</i> Daday, 1905	s				+(1)	+(3, 5)	+(1)

To be continued on next page.

Tab. 1. Continued from previous page.

Taxa		Thailand	Malaysia and Singapore	Vietnam	Philippines	Indonesia	Cambodia
<i>Matralona freyi</i> (Idris et Fernando, 1981)	g		+ (5, 6)				
<i>Armatalona macrocopa</i> (Sars, 1894) s.l.	g	+ (9, 14)					
<i>Karualona iberica</i> (Alonso et Pretus, 1989)	v	+ (6, 9, 10)					
<i>K. karua</i> (King, 1853)	g	+ (9, 10)					+ (2)
<i>Anthalona obtusa</i> Van Damme <i>et al.</i> , 2011	g					+ (13)	
<i>A. harti harti</i> Van Damme, Sinev et Dumont, 2011	g	+ (14)		+ (8)			+ (4)
<i>A. sanoamuangae</i> Sinev et Kotov, 2012	g	+ (14)		+ (8)			
<i>Celsinotum macronyx</i> (Daday, 1898)	g	+ (5, 6, 13)	+ (5, 6, 11)		+ (7)	+ (5, 13)	
<i>Kurzia longirostris</i> (Daday, 1898)	g	+ (4, 5, 6, 7, 9, 13)	+ (2, 5, 6, 11)	+ (4, 5)	+ (3, 4, 7)	+ (13)	+ (2)
<i>K. brevilabris</i> Rajapaksa et Fernando, 1986	g	+ (9, 13)	+ (11)		+ (7)	+ (13)	
<i>K. latissima</i> (Kurz, 1875)	v			+ (3)			
<i>Biapertura karua</i> (King, 1853)	s			+ (4, 5)	+ (3, 4)		
<i>B. pseudoverrucosa</i> Smirnov, 1971	s				+ (3, 4)		
<i>B. pseudoverrucosa verrucosa</i> (Sars, 1901)	s			+ (5)			
<i>B. affinis</i> (Leydig, 1860)	s				+ (3, 4)		
<i>B. affinis vietnamica</i> Thanh, Bau et Mien, 1980	v			+ (5)			
<i>B. intermedia</i> (Sars, 1862)	s			+ (5)			
<i>Euryalona orientalis</i> (Daday, 1898)	g	+ (1, 4, 5, 6, 7, 9, 13)	+ (5, 6, 11)	+ (5)	+ (3, 4, 7)	+ (2, 5, 8, 9, 13)	+ (2)
<i>E. occidentalis</i> (Sars, 1901)	s			+ (3)			
<i>Acroperus harpae</i> (Baird, 1834)	g	+ (6, 9, 14)	+ (5, 6, 7)	+ (9)		+ (5, 6)	
<i>Alonopsis singalensis</i> Daday, 1898	s			+ (2)		+ (2, 5)	
<i>A. lomnicki</i> Grohmalicki, 1915	s					+ (4)	
<i>Camptocercus australis</i> Sars, 1896	v	+ (6, 7, 9)				+ (2)	
<i>C. cf. australis</i> Sars, 1896	v		+ (5, 6)				
<i>C. rectirostris</i> Schoedler, 1862	v	+ (4)	+ (4)	+ (3)			+ (2)
<i>C. uncinatus</i> Smirnov, 1971	v	+ (5, 9)			+ (3, 4)		
<i>C. vietnamensis</i> Thanh, Bau et Mien, 1980	g			+ (5, 8)			
<i>Leydigia acanthocercoides</i> (Fischer, 1854)	v	+ (4, 5, 7, 9)	+ (5, 6)	+ (3, 4, 5)	+ (3, 4)	+ (5)	
<i>L. laevis</i> Gurney, 1927	v	+ (5, 9)					
<i>L. ciliata</i> Gauthier, 1939	sc	+ (9)					+ (2)
<i>L. australis</i> Sars, 1885	v	+ (9)					+ (2)
" <i>L. hamulatus</i> Birge", probably <i>Pleuroxus hamulatus</i> Birge, 1910	v			+ (3)			
" <i>L. striatus</i> Schoedler", probably <i>Pleuroxus striatus</i> Schoedler, 1858	v			+ (3)			
<i>L. propinqua</i> Sars, 1903	s					+ (3, 5)	
<i>L. leydigi</i> (Schoedler, 1863)	v					+ (8)	
<i>Leydigiopsis</i> sp.	v	+ (5, 6)					+ (2)
<i>Nicsmirnovius excimius</i> (Kiser, 1948)	g	+ (6, 7, 9, 14)	+ (12)				+ (2)
<i>Notoalona globulosa</i> (Daday, 1898)	g	+ (5, 6, 7, 9)	+ (11)		+ (7)	+ (13)	+ (2)
<i>N. freyi</i> Rajapaksa et Fernando, 1987	v	+ (6, 9)					
<i>Oxyurella singalensis</i> (Daday, 1898)	g	+ (4, 5, 6, 7, 9, 10)	+ (5, 6)	+ (4, 5)	+ (3, 4)	+ (9)	+ (2)
<i>O. longicaudis</i> (Birge, 1910)	v			+ (3)			
<i>O. tenuicaudis</i> (Sars, 1862)	v			+ (4)			+ (2)
<i>Graptoleberis testudinaria</i> (Fischer, 1851)	sc	+ (9)	+ (5, 6)				
<i>Indialona macronyx</i> (Daday, 1898)	s	+ (9)			+ (3, 4)		
<i>I. globulosa</i> (Daday, 1898)	s		+ (5, 6)		+ (3, 4)	+ (9)	
<i>Leberis diaphanus</i> (King, 1853)	g	+ (9)					
<i>Monospilus dispar</i> Sars, 1862	v			+ (5)			
Bosminidae							
<i>Bosmina longirostris</i> (O.F. Müller, 1785) s.l.	v	+ (3, 4, 6, 9)	+ (4)	+ (3, 4, 5)	+ (1, 2, 3, 4)	+ (5)	+ (1)
<i>B. meridionalis</i> Sars, 1904	v	+ (5, 6, 7, 9)		+ (10)		+ (5)	+ (2)
<i>B. fatalis</i> Burckhardt, 1924	v	+ (9)			+ (1, 3, 4, 8)	+ (5)	+ (2)
<i>B. fatalis-philippinensis</i> Aurich, 1934	v				+ (1)		
<i>B. coregoni</i> Baird, 1857	v			+ (3)			
<i>Bosminopsis deitersi</i> Richard, 1895	sc	+ (3, 4, 5, 6, 7, 9, 10)	+ (3, 4, 5, 6)	+ (3, 4, 5, 10)	+ (1, 2, 3, 4)		+ (1, 2)
Polyphemidae							
<i>Polyphemus pediculus</i> (L.)	sc			+ (3)			

g, good species; s, synonym; v, vague species; sc, species complex. *The species was recorded in the country but really does not occur there.

To be continued on next page.

Tab. 1. Continued from previous page.**Note to Tab. 1**

Thailand

- 1) Stingelin (1905)
- 2) Ueno (1966)
- 3) Mizuno and Mori (1970)
- 4) Boonsom (1984)
- 5) Sanoamuang (1998)
- 6) Maiphae *et al.* (2005)
- 7) Sa-artrit and Beamish (2005)
- 8) Korovchinsky and Sanoamuang (2008a, 2008b, unpublished data)
- 9) Maiphae *et al.* (2008)
- 10) Maiphae *et al.* (2010)
- 11) Korovchinsky (1998, 2000b)
- 12) Kotov and Dumont (2000); Kotov and Sanoamuang (2004a); Kotov *et al.* (2005); Kotov and Štifter (2006)
- 13) Rajapaksa and Fernando (1985, 1986a, 1986b, 1987a); Hudeč (2000)
- 14) Van Damme *et al.* (2003); Kotov and Sanoamuang (2004b); Kotov (2006); Sinev and Sanoamuang (2007); Sinev (2009); Sinev and Kotov (2012)

Malaysia and Singapore

- 1) Stingelin (1905; Singapore); Spandl (1925; Sarawak)
- 2) Johnson (1963; Singapore)
- 3) Ueno (1966)
- 4) Mizuno and Mori (1970)
- 5) Idris and Fernando (1981a, 1981b)
- 6) Idris (1983)
- 7) Lim *et al.* (1984)
- 8) Smirnov (1992); Korovchinsky (1993, 1998, 2000b)
- 9) Hudeč (1991); Orlova-Bienkowskaja (1995b, 1998, 2001)
- 10) Kotov and Dumont (2000); Kotov *et al.* (2005)
- 11) Michael and Hann (1979); Frey (1982, 1987b); Rajapaksa and Fernando (1985, 1986a, 1986b, 1987a, 1987b, 1987c); Hudeč (2000)
- 12) Van Damme *et al.* (2003); Kotov and Sanoamuang (2004b); Sinev *et al.* (2007); Sinev and Sanoamuang (2007); Sinev and Kotov (2012)

Vietnam [North (N), South (S)]

- 1) Richard (1894a, N)
- 2) Stingelin (1905, S)
- 3) Shirota (1966, S)
- 4) Thanh and Mien (1979, S)
- 5) Thanh *et al.* (1980, N)
- 6) Korovchinsky (1989, S; 2000b, N; 2011, S)
- 7) Orlova-Bienkowskaja (1995a, 1995b, 1998, 2001); Silva-Briano *et al.* (1999)
- 8) Sinev (2011, S); Sinev and Kotov (2012, S); Sinev (2012, S)
- 9) Thanh and Hai (2001)
- 10) Zhdanova (2012)
- 11) Jeong *et al.* (2012)

Philippines

- 1) Aurich (1934); Brehm (1939, 1954)
- 2) Ueno (1966); Frey (1969); Lewis (1973)
- 3) Mamaril and Fernando (1978)
- 4) Mamaril (2001)
- 5) Korovchinsky (1995, 1998, 2000a, 2000b)
- 6) Orlova-Bienkowskaja (1995b, 1998, 2001)
- 7) Rajapaksa and Fernando (1985, 1986a, 1986b, 1987a, 1987b, 1987c); Hudeč (2000)
- 8) Papa *et al.* (2012)

Indonesia

- 1) Richard (1891; Sumatra and Celebes); Richard (1894b; Sumatra)
- 2) Stingelin (1900, 1905; Celebes and Sumatra)
- 3) Sars (1903; Sumatra)
- 4) Grohmalicki (1915; Java)
- 5) Brehm (1933a, Celebes; 1933b, Celebes; 1933c, Bali; 1933d, Sumatra, Java, Bali; 1939, Celebes, Java, Flores, Bali); Ruttner (1952, Java, Sumatra, Bali)
- 6) Rammner (1937; Java)
- 7) Brehm (1954; Kalimantan)
- 8) Johnson (1956; Sumatra)
- 9) Green *et al.* (1976; Java)
- 10) Frenzel (1987); Korovchinsky (1991, 1995, 1998, 2010)
- 11) Orlova-Bienkowskaja (1995b, 1998, 2001)
- 12) Kotov and Dumont (2000)
- 13) Rajapaksa and Fernando (1985, 1986a, 1986b, 1987a, 1987b, 1987c); Hudeč (2000); Van Damme *et al.* (2011)

Cambodia

- 1) Blaché (1951); Brehm (1952, 1954); Mizuno and Mori (1970)
- 2) Tanaka and Ohtaka (2010)
- 3) Rajapaksa and Fernando (1986b)
- 4) Sinev and Kotov (2012)

genera *Bosmina* and *Diaphanosoma*. Ruttner (1952) published an extensive ecological work on the zooplankton of large and deep lakes of Sumatra, Java, and Bali based on the material of the Sunda-Expedition. Among other things, he recorded the mass occurrence of *Daphnia carinata* King in the pelagic zone of Ranau See (Sumatra) and an astonishing occurrence of the abundant littoral species *Simocephalus serrulatus* (Koch) and *Latonopsis australis* in the pelagic zone of the lake Danau Maninjau (Sumatra). Brehm (1954) continued the investigations of the Cladocera of Borneo and then Johnson (1956) actually made the last considerable investigation of the Cladocera of Indonesian islands (lake Toba and its surroundings), presenting descriptions and important comments on 31 species, including one new to science (*Macrothrix tobaensis* Johnson of unclear taxonomic status) and others that were later recognized as new (e.g. *Anthalona obtusa* Van Damme, Sinev et Dumont; Van Damme *et al.*, 2011). In 1950-1970s, some authors (Blachè, 1951; Brehm, 1952, 1954; Ueno, 1966; Frey, 1969; Mizuno and Mori, 1970) published only small and routine species lists (among them the first data on Cambodia by Blachè) but it is notable that during this period, cladoceran studies returned to the continent again, with inclusion of the Philippines.

In this period, the work by Shirota (1966), on the zooplankton of Southern Vietnam, was peculiar, due to the fact that the author recorded many temperate cladoceran species (28 of 48 species listed), among which there are four *Daphnia* species, *Ophryoxus gracilis* Sars and *Polyphemus pediculus* (L.). Judging from his publication, the author was not familiar with the Cladocera well enough and he probably also used American identification books (and possibly borrowed drawings from them), therefore his identifications often look incorrect. On the other hand, part of his samples was collected in montane water bodies, where findings of northern species could be possible [as in *Löffler islands*, see Van Damme and Eggermont (2011)]. Moreover, the above mentioned *Ophryoxus* and *Polyphemus* both have quite characteristic appearances, and are not likely to be misidentified. Nevertheless, all records by Shirota remain questionable and require further reinvestigation.

A more extensive, though rather routine, investigation was made on the Cladocera of the Philippines, with 49 species recorded by Mamaril and Fernando (1978). This survey was the last for these islands (for cladocerans). The species list published later (Mamaril, 2001), fully repeated the list from the previous publication. Other studies concerned only individual water bodies (Papa *et al.*, 2011, 2012).

Publications on South and North Vietnam contained records on 30 and 45 species respectively, including new ones (Thanh and Mien, 1979; Thanh *et al.*, 1980). The following summary on the Vietnamese crustaceans (Thanh

and Hai, 2001) added five species only. Also a first short list of the Laotian cladocerans (7 species) was presented (Heckman, 1974).

In the 1980s, the first extensive studies were made in Malaysia (Idris and Fernando, 1981a, 1981b; Idris, 1983) and Thailand (Boonsom, 1984). While the latter one resulted only in a list of 47 species, the former authors provided a more detailed work: 62 species, including two new ones (*Macrothrix malaysiensis* Idris et Fernando, *Alona freyi* Idris et Fernando), were either described or commented. It is remarkable that just at this time Prof. C.H. Fernando and his collaborators provided the great program on taxonomic revisions of a number of South Asian cladoceran species of the genera *Alona*, *Chydorus*, *Euryalona*, *Dunhevedia*, *Kurzia*, *Dadaya* and described a new genus *Notoalona* (Rajapaksa and Fernando, 1982, 1985, 1986a, 1986b, 1987a, 1987b, 1987c). Among other material, these researches were based on collections from many countries in SE Asia. Some other researchers followed in this respect: Frey (1987a) revised the honeycombed *Chydorus* species, Frenzel (1987) reevaluated the data of T. Stingelin's collection, and Korovchinsky (1989, 1991, 1993, 1995, 1998, 2000a, 2000b) started the revision of SE Asian *Diaphanosoma* species.

Since the 1990s, the taxonomic and faunistic studies of the Cladocera, had concentrated in Thailand, mainly thanks to the enthusiastic efforts by Professor Dr. L. Sanoamuang and her students. Due to these efforts, many regions of the country were surveyed and additional taxa have been revised or described as new to science (Sanoamuang, 1998; Kotov and Sanoamuang, 2004a, 2004b; Kotov *et al.*, 2005; Maiphae *et al.*, 2005, 2008; Sinev and Sanoamuang, 2007; Korovchinsky and Sanoamuang, 2008a, 2008b; *etc.*). Recently, a new species of Chydoridae was named in honor of Prof. Sanoamuang (Sinev and Kotov, 2012).

Professor L. Sanoamuang and her collaborators also made extensive collections in Laos and Cambodia. Very recently, the first extensive annotated list of 60 species of the Cambodian Cladocera has appeared (Tanaka and Ohtaka, 2010), but most results of these surveys remain unpublished and are under study. Some of the data have been processed during the submission of this paper (on Laos, Kotov *et al.*, 2013), therefore these new results could not be included in time in the current analysis. The same is true for the other newest updates the SE Asia Cladocera, that were made during the course of this investigation and of which the results could not be included, yet which contain most important updates on faunistics, new insights in important habitats and the description of new species (on Vietnam and South Thailand, Sinev and Korovchinsky, 2013; Van Damme *et al.*, 2013; Van Damme and Sinev, 2013).

RESULTS

In total, 298 cladoceran taxa of species rank have been recorded in SE Asia for the whole period of its investigation (Tab. 1). Comparatively few (67 taxa or 22.5%) can be regarded as *good* species (27 of them were originally described from SE Asia), while others either are synonyms (68; 22.8%) or taxa of uncertain taxonomic status, including those definitely representing poorly investigated species groups (163; 54.7%).

The largest number of *good* species is observed in the Sididae (14 or 42% of all taxa of the family) and the Chydoridae (35 or 20.7%, mostly in the Aloninae (22; 22.2%), then in Chydorinae (13; 18.6%), while in Daphniidae and Macrothricidae their number is low (7 and 8 respectively) constituting 20% and 28% of all locally known taxa of these families. The worst situation is in the Moinidae and the Bosminidae, having no recently revised species (only *Moinodaphnia macleayi* (King) could be tentatively regarded *good* species because it was originally described from the neighboring Australia having many taxa in common with tropical Asia). It is unfortunate that the species composition of some genera, dominating in the planktonic communities of SE Asia (*Moina*, *Ceriodaphnia*, *Bosmina*, *Bosminopsis*), remain taxonomically unexplored.

Most number of taxa and *good* species are known in Thailand (155 and 54, respectively). Malaysia (+Singapore), Indonesia, Philippines, Vietnam, and Cambodia follow it in this respect (70-119 taxa and 23-33 valid species respectively). Laos, Burma (Myanmar), and Brunei remain practically unexplored (but see new update by Kotov *et al.*, 2013 on Laos, which was not ready by the time this study was conducted).

Only *good* species might be used for zoogeographic analysis. Of them, a quarter (17; 25%) is known only in SE Asia (Tab. 2) but larger portion of species (25; 37.3%) is distributed in tropical/subtropical/temperate Asia and Australia. Other species were recorded in tropics/subtropics of Eastern hemisphere (12; 17.6%) or also in Western hemisphere thus found in tropics/subtropics worldwide (8; 11.8%). A small fraction of species (*Sida crystallina ortiva* Korovchinsky, *Simocephalus serrulatus* Koch, *S. mixtus* Sars, *Acroperus harpae* (Baird)) has even wider distribution, either worldwide or in northern latitudes.

As for latitudinal distribution of the SE Asian Cladocera, large part of their species (29; 42.6%) is known only in SE Asia (Tab. 2). In southern tropical/subtropical China (up to 30-34°N), 17 species (25%) were recorded while other species (10 or 15.0%) go far north, to the subtropical/temperate Eastern China and South Korea (up to 40°N). Only comparatively few species (7) occur up to the Amur river basin (44-54°N) and fewer others (4) in even more northern latitudes (up to 65-70° N). On the other hand, a conspicuous number of *good* species known in SE Asia (20) (Tab. 2) also occur in Australia, sometimes reaching the south-eastern portion of the country

[e.g., *Daphnia lumholtzi* Sars, *Simocephalus acutirostratus* (King), *Dunhevedia crassa* (King), *Alona pulchella* King), and even in New Zealand (*Armatalona macrocopa* (Sars)], thus demonstrating very wide latitudinal distribution in southern direction as well.

Rare species, known only from one-three localities, constitute a considerable fraction among the SE Asian species (18; 26.5%). Of them, for example, *Diaphanosoma modigliani* Richard is known only from two ancient lakes, lake Toba (in Sumatra) and lake Tempe (in Sulawesi) (Korovchinsky, 1998). *D. elongatum* Korovchinsky et Sanoamuang has been recorded only from two localities in Thailand (Korovchinsky and Sanoamuang, 2008a, 2008b and *unpublished data*), and *Matralona freyi* (Idris et Fernando) was found just from one locality in Western Malaysia (Idris and Fernando, 1981b; Sinev and Kotov, 2012).

DISCUSSION

The above described species evaluation and the selection of *good* species required certain assumptions. This is because, for example, not all taxa, which were formally revised and included in the recently published identification books (e.g., Korovchinsky, 1992; Smirnov, 1992, 1996), have been studied comprehensively. For this reason, the estimation of such taxa (22 of 67; 32.8%) as *good* species would be only tentatively realistic, as they require an accurate confirmation. Furthermore, a wide geographical distribution of some *good* taxa of species rank may testify to some uncertainty of their taxonomic status as well. For example, according to recent revision, *Euryalona orientalis* (Daday) has been suggested as pantropical (Rajapaksa and Fernando, 1987a) while more often paleotropical species were found to be different from their neotropical congeners (Rajapaksa and Fernando, 1987b, 1987c; Frey, 1987a). Also, in few taxa, there have been subtle but stable differences recorded between specimens from SE Asia and neighboring regions. In *Chydorus obscurirostris* Frey, specimens from Malaysia and Australia were attributed to different subspecies (Frey, 1987a), some intercontinental morphological differences were also reported for *Armatalona macrocopa*, *Leydigia ciliata* Gauthier, 1939 (Sinev *et al.*, 2007; Sinev and Sanoamuang, 2011), *Alona archeri* Sars (Maiphae *et al.*, 2008) and *Pseudosida szalayii* Daday (Korovchinsky, 2010) but they have not yet been evaluated taxonomically. Thus, the real number of *good* species could be considerably less than it has been formally accepted.

The next assumption concerns the identifications of taxa by non-taxonomists, specialising on particular groups. In such cases, when the interspecies morphological differences have been proven to be more subtle than thought before and many taxa remain undescribed, the probability of misidentifications increases. Also the data of older monographs on regional faunas may be often in-

adequate. For example, in the context of the present study, the monograph on the Chinese Cladocera (Chiang and Du, 1979), containing information on the northern distribution of many SE Asian species, is informative, though often there is no confidence about its adequateness. In such situation, the recently published comprehensive works on the cladoceran faunas of the Amur river basin (Kotov *et*

al., 2011a, 2011b; Kotov and Sinev, 2011) and South Korea (Kotov *et al.*, 2012) are more informative, containing more reliable data on species composition and distribution in Eastern Asia.

Based on all the available data, the distribution of SE Asian Cladocera in the eastern part of Asia may be summarized as follows. About a quarter of the species are known

Tab. 2. Longitudinal and latitudinal distribution of *good* cladoceran species and subspecies known in SE Asia.

Longitudinal distribution (number of species)	Latitudinal distribution in Northern hemisphere				
	SE Asia	SE Asia - Southern China (up to 30° N)	SE Asia - Eastern China and S. Korea (up to 32 - 40° N)	SE Asia - Amur river basin	SE Asia - northern boreal regions (up to 70° N)
SE Asia (19)	<i>Diaphanosoma modigliani</i> <i>D. elongatum</i> <i>D. senegal isanensis</i> <i>Macrothrix pholpunti</i> <i>M. malaysiensis</i> <i>M. vietnamensis</i> <i>Streblocerus spinulatus</i> <i>Ilyocryptus thailandensis</i> <i>I. isanensis</i> <i>Chydorus obscurirostris tasekberae</i> <i>Alona acuticostata</i> <i>A. sarasinorum</i> <i>A. siamensis</i> <i>A. kotovi</i> <i>Matralona freyi</i> <i>Anthalona obtusa</i> <i>A. sanuamuangae</i>		<i>Camptocercus vietnamensis</i>		<i>Sida crystallina ortiva</i>
Tropics-subtropics of Asia and Australia (25)	<i>Diaphanosoma celebensis</i> <i>Macrothrix flabelligera</i> * <i>Chydorus reticulatus</i> <i>Ch. invaginatus</i> <i>Ch. opacus</i> * <i>Disparalona caudata</i> * <i>Armatalona macrocopa</i> *	<i>Diaphanosoma tropicum</i> <i>Simocephalus acutirostratus</i> * <i>Chydorus ventricosus</i> <i>Ch. sinensis</i> <i>Alonella breviceps</i> <i>Alona milleri</i> <i>Notoalona globulosa</i> <i>Celsinotum macronyx</i>	<i>A. cheni</i> <i>Karualona karua</i> * <i>Kurzia brevilabris</i> <i>Leberis diaphanus</i>	<i>Diaphanosoma dubium</i> <i>D. orghidani transamurensis</i> <i>D. macrophthalma</i> <i>Pseudosida szalayi</i> * <i>Daphnia similoides</i> <i>Nicsmirnovius eximius</i>	
Tropics-subtropics of Eastern hemisphere (12)	<i>Macrothrix odiosa</i> <i>Chydorus parvus</i> <i>Alonella clathratula</i> * <i>Dunhevedia serrata</i> <i>Anthalona harti harti</i>	<i>Diaphanosoma sarsi</i> * <i>D. excisum</i> * <i>D. volzi</i> * <i>Daphnia lumholtzi</i> *	<i>Scapholeberis kingi</i> * <i>Oxyurella singalensis</i>	<i>Simocephalus heilongiangensis</i>	
Pantropics-pansubtropics (8)		<i>Macrothrix spinosa</i> *	<i>Latonopsis australis</i> * <i>Moinodaphnia macleayi</i> * <i>Macrothrix triserialis</i> <i>Dadaya macrops</i> * <i>Dunhevedia crassa</i> * <i>Kurzia longirostris</i> <i>Euryalona orientalis</i>		
Wide distribution (3)					<i>Simocephalus serrulatus</i> * <i>S. mixtus</i> <i>Acroperus harpae</i>
Total	29	13	14	7	4

*Species recorded from Australia.

only in SE Asia, but considerably more species (25) are known as distributed wider, either in the whole of Southern Asia or also in Australia. With the latter continent, SE Asia shares seven species, two of them (*Simocephalus acutirostratus*, *Armatalona macrocopa*) occur up to the south-eastern part of Australia, and New Zealand. Fewer species (12) have also been recorded in Africa, others (8) in the Western hemisphere, thus being pantropical/pansubtropical. All the intercontinental records of taxa of species rank should be checked carefully because many of them, especially the latter ones, undoubtedly represent different species (documented by numerous recent revisions; Frey, 1982, 1987b; Korovchinsky, 1996; *etc.*). To all appearance, there are no species common between SE Asia and America, excluding those resulted from the possible or real human-mediated invasions (Shirota, 1966; Fernando, 1980; Segers, 2001).

Most species (46; 67.6%) are known to occur mostly south of 30°N (of them, only five species [*Dadaya macrops* (Daday), *Euryalona orientalis*, *Alona cheni* Sinev, *Kurzia brevibrabis* Rajapaksa et Fernando, *Notolona globulosa* (Daday)] were recorded slightly further to the north, reaching 32–34°N thus considered predominantly tropical taxa; 21 other species have been accepted as to be penetrating further north. Of them, 10 reach approximately 35–40°N (Central and Eastern China, South Korea, Japan) and 7 others are found in the Amur river basin (*Simocephalus heilongjiangensis* Shi et Shi, *Daphnia similoides* Hudeč, *Nicsmirnovius eximius* (Kiser), *Pseudosida szalay* Daday, *Diaphanosoma dubium* Manuilova, *D. orghidani transamurensis* Korovchinsky, *D. macrophthalma* Korovchinsky et Mirabdullaev). Though the distribution of some of the species is poorly known, most of them are known also to be predominantly tropical. Only the three latter species dominate subtropical and southern temperate latitudes (Korovchinsky, 2004) penetrating the tropics comparatively deeply and abundantly (*D. dubium*), or scarcely (*D. o. transamurensis*, *D. macrophthalma*) (Korovchinsky, 2000b, 2004; Korovchinsky and Sanoamuang, 2008b, unpublished data). Four species (*Sida crystallina ortiva*, *Simocephalus serrulatus*, *S. mixtus*, *Acroperus harpae*) recorded in SE Asia are widely distributed in the Northern Eurasia up to 65–70°N and thus should be considered of northern origin.

It is interesting to note that some species of SE Asia in the western part of their range have a different distributional pattern, extending more deeply to the north. *Diaphanosoma sarsi* Richard and *D. excisum* Sars reach North India and Uzbekistan (~41°N) (Korovchinsky, 2004), *Daphnia lumholtzi* – delta of the Volga river (~46°N) (Behning, 1941), and *Anthalona harti harti* Van Damme *et al.* has been recorded in Abkhazia (~43°N) (Van Damme *et al.*, 2011). At the same time, in Eastern Eurasia, these common and widely distributed species either are limited in their distribution by the territory of SE Asia or reach the latitudes

25–28°N in Southern China. This difference may originate both from poor knowledge of species distributions and different biological properties – including possible different taxonomic attitudes as it was noted for *Daphnia lumholtzi* by Behning (1941) – of eastern and western populations of species under consideration.

Thus, tropical species (not surprisingly) constitute the primary part of the cladoceran fauna of SE Asia, which can penetrate the neighboring subtropical and even southern temperate zones to a different degree. Only a small fraction of the species (7; 10.4%) here are of more or less northern origin dominating in the subtropical/southern temperate or in northern boreal latitudes. In general, much more tropical species tend to occupy subtropical/temperate zones than subtropical/temperate species penetrate the tropics. The same tendency was observed in the cladoceran fauna in the south-east of the Korean Peninsula (Kotov *et al.*, 2012).

At the same time, the northern faunal component may be more strong in SE Asia than it is known now; *i.e.*, it is evident from the above discussed data by Shirota (1966) as well as from even earlier records by Spandl (1925) and Brehm (1933a), which listed respectively the North Eurasian *D. longispina*, *D. magna* Straus, *D. triquetra* Sars, and *Diaphanosoma perarmatum* Brehm (the latter is not well studied taxon of the *D. brachyurum* species group). Though some of these records are in fact results of misidentification or could be human introduction (Fernando, 1980) as it was also noted for rotifers (Segers, 2001), others probably represent real records that need to be investigated. In particular, Cladocera of montaneous areas which occupy considerable territories both in Mainland and Insular SE Asia, have been studied quite poorly.

Few species (*S. crystallina ortiva*, *D. macrophthalma*), likely arrived from the north to the south up to southernmost Vietnam using the Mekong river and its tributaries as a migration route. In Thailand, these species were found only in the north-eastern part of the country which is under the strong influence of the Mekong river, but they were absent in its northern part which is more elevated and comparatively isolated from large river basins (Korovchinsky and Sanoamuang, 2008b, unpublished data).

Previous authors published different numbers of the cladoceran species in different countries of SE Asia, from 45 to 62 (Shirota, 1966; Thanh *et al.*, 1980; Idris, 1983), which clearly indicates an underestimation of species richnesses. Recently Maiphae *et al.* (2008) recorded 99 species (+10 unidentified forms) in Thailand, which is comparable with species numbers for the whole Oriental zone (107 species). The latter value, however, is the lowest when compared to other zoogeographical zones (Forró *et al.*, 2008), which again is proof of an underestimation of the parameter.

To estimate, at least roughly, the real species richness of the Cladocera in SE Asia, we need to evaluate the number of potential *good* species, which are hidden under the names of vague taxa, clearly representing specific but not revised taxonomic units requiring further investigations: *Diaphanosoma perarmatum*, *Leydigiopsis* sp., *Guernella raphaelis* Richard, *Pseudochydorus globosus* (Baird), *Alonella nana* (Baird), *Graptoleberis testudinaria* (Fischer), *Bosminopsis deitersi* Richard, *Bosmina meridionalis* Sars *etc.* The analysis of such taxa, based on data of Tab. 1, leads to the number of approximately 90-100 extra taxa of species rank which may be validated in the course of future taxonomic work. This result approaches a potential species richness of Cladocera in SE Asia to approximately 200 species, almost three times more than it is accepted now for the region and comparable with the estimation of a potential diversity of the global fauna (Forró *et al.*, 2008). The largest portion of such taxa is represented by members of the (most speciose) family Chydoridae. Daphniidae and Macrothricidae follow them in this respect.

At present, only Thailand, more strictly, North-East Thailand and South Thailand, as well as Vietnam (small area in its south) are in the focus of the most extensive and detailed taxonomic and faunistic studies of the Cladocera (Sanoamuang, 1998; Maiphae *et al.*, 2005, 2008; Korovchinsky and Sanoamuang, 2008a, 2008b; Sinev, 2011; Sinev and Sanoamuang, 2011; Korovchinsky, 2011; Sinev and Korovchinsky, 2013; Van Damme *et al.*, 2013). In all other countries such studies either are at the initial stage of samples' collection and identification (*e.g.*, Cambodia) or surveys and faunistics are absent completely.

CONCLUSIONS

The cladoceran species richness of SE Asia is still poorly known. From the modern point of view, only a small fraction of the species in this region has been described properly. Many of these species are known only from a single locality or very few localities, range boundaries can be tentatively outlined in some cases only. Most of the SE Asian countries are not included in the cladoceran studies. These huge gaps in knowledge, prevent a proper zoogeographic analysis. Further extensive and detailed taxonomic studies are especially needed to improve the situation.

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REFERENCES

- Aurich H, 1934. [Mitteilungen der Wallacea-Expedition. Mitteilung XII: Bosminidae (Cladocera)]. [Article in German]. Zool. Anz. 108:59-74.
- Behning AL, 1941. [Cladocera of the Caucasus]. [Book in Russian]. Gruzmedgiz, Tbilisi: 383 pp.
- Blachè J, 1951. [Aperçu sur le plancton des eaux douces du Cambodge]. [Article in French]. Cybium 6:62-94.
- Boonsom J, 1984. The freshwater zooplankton of Thailand (Rotifera and Crustacea). Hydrobiologia 113:223-229.
- Brehm V, 1933a. [Die Cladoceren der Deutschen Limnologischen Sunda-Expedition]. [Article in German]. Arch. Hydrobiol. Suppl. 11 (Tropische Binnengewässer):631-771.
- Brehm V, 1933b. [Mitteilung von der Wallacea-Expedition Woltereck. Mitteilung V. Phyllopoden]. [Article in German]. Zool. Anz. 104:31-40.
- Brehm V, 1933c. [Mitteilung von der Wallacea-Expedition Woltereck. Mitteilung VI. Die *Alona*- und *Alonella*-Arten von Dagiangan]. [Article in German]. Zool. Anz. 104:77-84.
- Brehm V, 1933d. [Mitteilung von der Wallacea-Expedition Woltereck. Mitteilung VII. Neue und wenig bekannte Entomostraken]. [Article in German]. Zool. Anz. 104:130-142.
- Brehm V, 1939. [Die Cladoceren der Wallacea-Expedition]. [Article in German]. Int. Revue ges. Hydrobiol. Hydrogr. 38:99-124.
- Brehm V, 1951. [Cladocera und Copepoda Calanoida von Cambodja]. [Article in German]. Cybium 6:95-124.
- Brehm V, 1952. [Notizen zur Süßwasser-Microfauna von Borneo und Cebu (Philippinen). Sitzungsber]. [Article in German]. Öster. Akad. Wiss. Wien 162:163-169.
- Brehm V, 1954. [Süßwasser-Entomostraken aus Cambodja]. [Article in German]. Öster. Zool. Zeitschr. 5:273-280.
- Chiang SC, Du NS, 1979. [Fauna Sinica, Crustacea, Freshwater Cladocera]. [Book in Chinese]. Science Press, Beijing: 297 pp.
- Dussart BH, Fernando CH, Matsumura-Tundisi T, Shiel RJ, 1984. A review of systematics, distribution and ecology of tropical freshwater zooplankton. Hydrobiologia 113:77-91.
- Elias-Gutierrez M, Valdez-Moreno M, 2008. A new cryptic species of *Leberis* Smirnov, 1989 (Crustacea, Cladocera, Chydoridae) from the Mexican semi-desert region, highlighted by DNA barcoding. Hydrobiologica 18:63-74.
- Fernando CH, 1980. The species and size composition of tropical freshwater zooplankton with special reference to the Oriental region (South East Asia). Int. Revue ges. Hydrobiol. 65:411-426.
- Forró L, Korovchinsky NM, Kotov AA, Petrusek A, 2008. Global diversity of cladocerans (Cladocera; Crustacea) in freshwater. Hydrobiologia 595:177-184.
- Frenzel P, 1987. [Theodor Stingelin (1872-1932): Typen und Status

- seiner Cladoceren-Taxa]. [Article in German]. Arch. Hydrobiol. Suppl. 74:488-507.
- Frey DG, 1969. A limnological reconnaissance of Lake Lanao. Verh. Int. Verein. Limnol. 17:1090-1102.
- Frey DG, 1982. Questions concerning cosmopolitanism in Cladocera. Arch. Hydrobiol. 93:484-502.
- Frey DG, 1987a. The North American *Chydorus faviformis* (Cladocera, Chydoridae) and the honeycombed taxa of other continents. Phil. Trans. R. Soc. Lond. B 315:353-402.
- Frey DG, 1987b. The taxonomy and biogeography of the Cladocera. Hydrobiologia 145:5-17.
- Green J, Corbet SA, Watts E, Lan OB, 1976. Ecological studies on Indonesian lakes. Overturn and restratification of Ranau Lamongan. J. Zool. Lond. 180:315-354.
- Grochmalicki J, 1915. [Beitrage zur Kenntnis der Susswasserfauna Javas. Phyllopora, Copepoda und Ostracoda]. [Article in German]. Bull. Acad. Sci. Cracovie B 6/7:217-242.
- Heberer G, 1923. [Über eine Population von *Daphnia cephalata* aus Flores]. [Article in German]. Verh. Dtsch. Zool. Ges. 32:70-78.
- Heckman CW, 1974. The seasonal succession of species in a rice paddy in Vientienne, Laos. Int. Revue ges. Hydrobiol. 59:489-501.
- Ho SC, 1995. Status of limnological research and training in Malaysia, p. 163-189. In: B. Gopal and R.G. Wetzel (eds.) Limnology in developing countries, vol. 1, SIL Publ.
- Hudeč I, 1991. A comparison of populations from the *Daphnia similis* group (Cladocera: Daphniidae). Hydrobiologia 225:9-22.
- Hudeč I, 2000. Subgeneric differentiation within *Kurzia* Crustacea: Anomopoda: Chydoridae) and a new species from Central America. Hydrobiologia 421:165-178.
- Idris BAG, 1983. Freshwater zooplankton of Malaysia (Crustacea: Cladocera). Penerbit University Pertanian Malaysia, Serdang, Selangor, Malaysia: 153 pp.
- Idris BAG, Fernando CH, 1981a. Cladocera of Malaysia and Singapore with new records, redescription, and remarks on some species. Hydrobiologia 77:233-256.
- Idris BAG, Fernando CH, 1981b. Two new species of cladoceran crustaceans of the genera *Macrothrix* Baird and *Alona* Baird from Malaysia. Hydrobiologia 76:81-85.
- Jeong HJ, Kotov AA, Lee W, 2012. A new species of the genus *Ilyocryptus* Sars, 1862 (Cladocera: Anomopoda: Ilyocryptidae) from the East Asian Palearctic. Zootaxa 3475:36-44.
- Johnson DS, 1956. Systematic and ecological notes on the Cladocera of Lake Toba and the surrounding country, North Sumatra. J. Linn. Soc. London 43:72-91.
- Johnson DS, 1963. The occurrence of *Simocephalus latirostris* Stingelin (Crustacea: Cladocera) in South-East Asia. Bull. Nat. Mus. Singapore 32:160-161.
- Korovchinsky NM, 1989. Redescription of *Diaphanosoma celebensis* Stingelin, 1900 (Crustacea, Cladocera). Hydrobiologia 184:7-22.
- Korovchinsky NM, 1991. A redescription of *Diaphanosoma modigliani* Richard, 1894 (Crustacea: Daphniiformes: Sididae) and an evaluation of its occurrence outside Lake Toba (Sumatra). Hydrobiologia 222:179-186.
- Korovchinsky NM, 1992. Sididae & Holopediidae. Guides to the identification of the microinvertebrates of the continental waters of the world 3. SPB Acad. Publ., The Hague: 82 pp.
- Korovchinsky NM, 1993. New records of *Diaphanosoma celebensis* Stingelin, 1900 (Crustacea: Daphniiformes: Sididae) in tropical Asia, with remarks on the morphological variability and biology of the species. Rev. Hydrobiol. Trop. 26:119-125.
- Korovchinsky NM, 1995. Redescription of *Diaphanosoma volzi* Stingelin, 1905 (Crustacea: Daphniiformes: Sididae), with remarks on comparative morphology, biology and geographical distribution. Hydrobiologia 315:189-201.
- Korovchinsky NM, 1996. How many species of Cladocera are there? Hydrobiologia 321:191-204.
- Korovchinsky NM, 1998. Revision of the *Diaphanosoma modigliani* - *Diaphanosoma dubium* species group (Crustacea: Ctenopoda: Sididae), with description of a new species from tropical Asia. Hydrobiologia 361:113-123.
- Korovchinsky NM, 2000a. Redescription of *Diaphanosoma dubium* Manuilova, 1964 (Branchiopoda: Ctenopoda: Sididae), and description of a new, related species. Hydrobiologia 441:73-92.
- Korovchinsky NM, 2000b. Species richness of pelagic Cladocera of large lakes in the eastern hemisphere. Hydrobiologia 434:41-54.
- Korovchinsky NM, 2004. [Cladocera Ctenopoda of the world fauna: morphology, systematics, ecology and zoogeography]. [Book in Russian]. KMK Publishing, Moscow: 410 pp.
- Korovchinsky NM, 2010. A taxonomic revision of *Pseudosida szalayi* Daday, 1898 (Crustacea: Cladocera: Sididae) over its Asian range, with focus on the northernmost populations first recorded from the Amur River basin (Far East of Russia). Zootaxa 2345:1-18.
- Korovchinsky NM, 2011. Description of *Sarsilatona fernandoi* (Rane, 1983) (Crustacea: Cladocera: Sididae) found in the south of Vietnam. Zootaxa 3129:29-38.
- Korovchinsky NM, Sanoamuang L, 2008a. *Diaphanosoma senegal* Gauthier, 1951 (Crustacea: Cladocera: Sididae) in South-East Asia. Zootaxa 1695:53-60.
- Korovchinsky NM, Sanoamuang L, 2008b. Overview of Sididae (Crustacea: Cladocera: Ctenopoda) of Northeast and East Thailand, with description of a new species of the genus *Diaphanosoma*. Zootaxa 1682:45-61.
- Kotov AA, 2006. Adaptations of the Anomopoda (Cladocera) for benthic mode of life. Zool. Zh. 85:1043-1059.
- Kotov AA, Dumont HJ, 2000. Analysis of the *Ilyocryptus spinifer* species group (Anomopoda, Branchiopoda), with description of a new species. Hydrobiologia 428:85-113.
- Kotov AA, Ishida S, Taylor DJ, 2006. A new species in the *Daphnia curvirostris* (Crustacea: Cladocera) complex from the eastern Palearctic with molecular phylogenetic evidence for the independent origin of neckteeth. J. Plankton Res. 28:1067-1079.
- Kotov AA, Jeong HJ, Lee W, 2012. Cladocera (Crustacea: Branchiopoda) of the south-east of the Korean Peninsula, with twenty new records for Korea. Zootaxa 3368:50-90.
- Kotov AA, Korovchinsky NM, Sinev AY, Smirnov NN, 2011. [Cladocera (Crustacea: Branchiopoda) of the Zeya River basin (Amurskaya area, Russian Federation). 3. Systematic-faunistic and zoogeographic analysis]. [Article in Russian]. Zool. Zh. 90:402-411.
- Kotov AA, Maiphae S, Sanoamuang L, 2005. Revision of *Macrothrix paulensis*-like species (Anomopoda, Cladocera, Branchiopoda) in Asia, and phylogeny of the *paulensis*-group. Arch. Hydrobiol. Suppl. 151/3 (Monogr. Studies): 269-299.

- Kotov AA, Sanoamuang L, 2004a. Comments on the morphology of *Nicsmirnovius eximius* (Kiser, 1948) (Aloninae, Anomopoda, Cladocera) in Thailand, with description of its male. *Hydrobiologia* 519:117-125.
- Kotov AA, Sanoamuang L, 2004b. *Ilyocryptus thailandensis* sp.nov. (Cladocera: Anomopoda: Ilyocryptidae) from North Thailand. *Int. Revue. Hydrobiol.* 89:206-214.
- Kotov AA, Sinev AY, 2011. [Cladocera (Crustacea: Branchiopoda) of the Zeya River basin (Amurskaya area, Russian Federation). 2. Description of new taxa]. [Article in Russian]. *Zool. Zh.* 90:272-284.
- Kotov AA, Sinev AY, Korovchinsky NM, Smirnov NN, Bekker EI, Sheveleva NG, 2011. [Cladocera (Crustacea: Branchiopoda) of the Zeya River basin (Amurskaya area, Russian Federation). 1. New taxa for Russian fauna]. [Article in Russian]. *Zool. Zh.* 90:131-142.
- Kotov AA, Štifter P, 2006. Cladocera: family Ilyocryptidae (Branchiopoda: Cladocera: Anomopoda). Guides to the identification of the microinvertebrates of the continental waters of the world 22. Kenobi Prod., Ghent, Backhys Publ., Leyden: 172 pp.
- Kotov AA, Štifter P, Sanoamuang L, 2005. Notes on the genus *Ilyocryptus* Sars, 1862 (Cladocera: Anomopoda: Ilyocryptidae). 8. *Ilyocryptus isanensis* sp. n. from North-East Thailand. *Arthropoda Selecta* 14:229-239.
- Kotov AA, Van Damme K, Bekker EI, Siboualipha S, Silva-Briano M, Ortiz AA, De La Rosa RG, Sanoamuang L, 2013. Cladocera (Crustacea: Branchiopoda) of Vientiane province and municipality, Laos. *J Limnol* 72(Suppl.2):e7.
- Lewis WM, 1973. A limnological survey of Lake Mainit, Philippines. *Int. Rev. ges. Hydrobiol.* 58:801-818.
- Lim RP, 1980. Limnological research and education with reference to natural ecosystems in Malaysia. In S. Mori and I. Ikusima (eds.), *Proc. 1st Workshop on the Promotion of Limnology in the Developing Countries*, Kyoto, p. 57-65.
- Lim RP, Abdullah MF, Fernando CH, 1984. Ecological studies of Cladocera in the ricefields of Tanjung Karang, Malaysia, subjected to pesticide treatment. *Hydrobiologia* 113:99-103.
- Maiphae S, Pholpuntin P, Dumont HJ, 2005. Species richness of the Cladocera (Branchiopoda: Anomopoda and Ctenopoda) in southern Thailand, and complementarity with neighboring regions. *Hydrobiologia* 537:147-156.
- Maiphae S, Pholpuntin P, Dumont HJ, 2008. Taxon richness and biogeography of the Cladocera (Crustacea: Ctenopoda, Anomopoda) of Thailand. *Ann. Limnol.-Int. J. Limnol.* 1:31-41.
- Maiphae S, Limbut W, Choikaew P, Pechrat P, 2010. The Cladocera (Ctenopoda and Anomopoda) in rice fields during a crop cycle at Nakhon Si Thammarat province, southern Thailand. *Crustaceana* 83:1469-1482.
- Mamaril AC, 2001. Zooplankton diversity in Philippine lakes. In C.B. Santiago, M.L. Cuvin-Aralar and Z.U. Basiao (eds.), *Conservation and ecological management of Philippine lakes in relation to fisheries and aquaculture*. SE Asian Fish. Dev. Center: p. 81-93.
- Mamaril AC, Fernando CH, 1978. Freshwater zooplankton of the Philippines (Rotifera, Cladocera and Copepoda). *Bull. Nat. Sci. Univ. Philippines* 30:107-221.
- Michael RG, Hann BJ, 1979. On the resurrection of the cladoceran species *Chydorus reticulatus* Daday, 1898 (Chydoridae, Cladocera) and its relationship to *Chydorus ventricosus* Daday, 1898. *Hydrobiologia* 65:225-232.
- Mizuno T, Mori S, 1970. Preliminary hydrobiological survey of some Southeast Asian inland waters. *Biol. J. Linn. Soc.* 2:77-117.
- Orlova-Bienkowskaja MY, 1995a. A revision of the *Simocephalus (latirostris)* species group (Crustacea: Anomopoda: Daphniidae). *Hydrobiologia* 316:43-58.
- Orlova-Bienkowskaja MY, 1995b. [A revision of the *Simocephalus serrulatus* (Crustacea, Anomopoda, Daphniidae) species group]. [Article in Russian] *Zool. Zh.* 74:57-71.
- Orlova-Bienkowskaja MY, 1998. A revision of the cladoceran genus *Simocephalus* (Crustacea, Daphniidae). *Bull. Nat. Hist. Mus. Lond. (Zool.)* 64:1-62.
- Orlova-Bienkowskaja MY, 2001. Cladocera: Anomopoda Daphniidae: genus *Simocephalus*. Guides to the identification of the microinvertebrates of the continental waters of the world, 17. Backhuys Publ., Leyden: 130 pp.
- Papa RDS, Tordesillas DT, Mamaril AC, 2012. An updated taxonomic account of limnetic crustacean zooplankton in Lake Taal, Philippines. *Philipp. J. Sci.* 141:243-252.
- Papa RDS, Zafaralla MT, Eckmann R, 2011. Spatio-temporal variation of the zooplankton community in a tropical caldera lake with intensive aquaculture (Lake Taal, Philippines). *Hydrobiologia* 664:119-133.
- Rajapaksa R, Fernando CH, 1982. The first description of the male and ephippial female of *Dadaya macrops* (Daday, 1898) (Cladocera, Chydoridae), with additional notes on this common tropical species. *Can. J. Zool.* 60:1841-1850.
- Rajapaksa R, Fernando CH, 1985. Relocation of *Indialona macronyx* (Daday, 1898) (Cladocera, Chydoridae) to the genus *Alona*. *Can. J. Zool.* 63:970-976.
- Rajapaksa R, Fernando CH, 1986a. A review of the systematics and distribution of *Chydorus ventricosus* Daday, 1898, with the first description of the male and redescription of the species. *Can. J. Zool.* 64:818-832.
- Rajapaksa R, Fernando CH, 1986b. Tropical species of *Kurzia* (Crustacea, Cladocera) with a description of *Kurzia brevilabris* sp. nov. *Can. J. Zool.* 64:2590-2602.
- Rajapaksa R, Fernando CH, 1987a. A redescription of *Euryalona orientalis* (Daday, 1898), with a consideration of the other species in the genus *Euryalona* (Cladocera: Chydoridae). *Hydrobiologia* 150:75-90.
- Rajapaksa R, Fernando CH, 1987b. Redescription and assignment of *Alona globulosa* Daday, 1898 to a new genus *Notoalona* and a description of *Notoalona freyi* sp. nov. *Hydrobiologia* 144:131-153.
- Rajapaksa R, Fernando CH, 1987c. Redescription of *Dunhevedia serrata* Daday, 1898 (Cladocera, Chydoridae) and a description of *Dunhevedia americana* sp. nov. from America. *Can. J. Zool.* 65:432-440.
- Rammner W, 1937. [Beitrag zur Cladocerenfauna von Java]. [Article in German]. *Int. Revue ges. Hydrobiol. Hydrogr.* 35:35-50.
- Richard J, 1891. [Entomostraces d'eau douce de Sumatra et de Celebes. I. Phyllopes, Cladoceres et Copepodes]. [Article in French]. *Zool. Ergebn. Reise Niederl. Ost-Indien* 2:118-128.
- Richard J, 1894a. [Entomostraces recueillis dans le lac Toba (Sumatra)]. [Article in French]. *Ann. Mus. Storia Nat. Genova Ser. 2* 14:565-578.

- Richard J, 1894b. [Sur quelques animaux inferieurs des eaux douces du Tonkin]. [Article in French]. Mem. Soc. Zool. France 7:237-243.
- Ruttner F, 1952. [Planktonstudien der Deutschen Limnologischen Sunda-Expedition]. [Article in German]. Arch. Hydrobiol. Suppl. 21:1-271.
- Sa-ardrit P, Beamish FWH, 2005. Cladocera diversity, abundance, and habitat in western Thailand stream. Aquat. Ecol. 39:353-365.
- Sanoamuang L, 1998. Contribution to the knowledge of the Cladocera of north-east Thailand. Hydrobiologia 362:45-53.
- Sars GO, 1903. Freshwater Entomostraca from China and Sumatra. Archiv For Mathematik Og Naturvidenskab, Kristiania 25:3-44.
- Segers H, 2001. Zoogeography of the Southeast Asian Rotifera. Hydrobiologia 446/447:233-246.
- Shirota A, 1966. The plankton of South Viet-Nam. Freshwater and marine plankton. Overseas Techn. Coop. Agency, Japan: 489 pp.
- Silva-Briano M, Quang Dien N, Dumont HJ, 1999. Redescription of *Macrothrix laticornis* (Jurine, 1820), and description of two new species of the *M. laticornis* – group. Hydrobiologia 403:39-61.
- Sinev AY, 2009. Discrimination between two sibling species of *Acroperus* (Baird, 1843) from the Palearctic (Cladocera: Anomopoda: Chydoridae). Zootaxa 2176:1-21.
- Sinev AY, 2011. Redescription of the rheophilous cladocera *Campotocercus vietnamensis* Thanh, 1980 (Cladocera: Anomopoda: Chydoridae). Zootaxa 2934:53-60.
- Sinev AY, 2012. *Alona kotovi* sp.n., a new species of Aloninae (Cladocera: Anomopoda: Chydoridae) from South Vietnam. Zootaxa 3475:45-54.
- Sinev AY, Korovchinsky NM, 2013. Cladocera (Crustacea: Branchiopoda) of Cat Tien National Park, South Vietnam. J Limnol 72(Suppl.2):e9.
- Sinev AY, Kotov AA, 2012. New and rare Aloninae (Cladocera: Anomopoda: Chydoridae) from Indochina. Zootaxa 3334:1-28.
- Sinev AY, Sanoamuang L, 2007. *Alona siamensis* sp.n., a new species of Cladocera from South-East Asia, related to *Alona dentifera* (Sars, 1901) (Anomopoda: Chydoridae). Arthropoda Selecta 16:143-150.
- Sinev AY, Sanoamuang L, 2011. Hormonal induction of males as a method for studying tropical cladocerans: description of males of four chydorid species (Cladocera: Anomopoda: Chydoridae). Zootaxa 2826:45-56.
- Sinev AY, Sawitri Nachai, Sanoamuang L, 2007. Occurrence of the Australian cladoceran *Armatalona macrocopa* (Sars, 1894) (Cladocera: Anomopoda: Chydoridae) in Thailand. Invertebr. Zool. 4:25-29.
- Smirnov NN, 1971. [Chydoridae of the world. Fauna of the USSR 101]. [Book in Russian]. Nauka, Leningrad: 531 pp.
- Smirnov NN, 1976. [Macrothricidae and Moinidae of the world. Fauna of the USSR 112]. [Book in Russian]. Nauka, Leningrad: 236 pp.
- Smirnov NN, 1992. The Macrothricidae of the world. Guides to the identification of the microinvertebrates of the continental waters of the world 1. SPB Acad. Publ., The Hague: 143 pp.
- Smirnov NN, 1996. Cladocera: the Chydorinae and Sayciinae (Chydoridae) of the World. Guides to the identification of the microinvertebrates of the continental waters of the world 11. SPB Acad. Publ., Amsterdam: 197 pp.
- Spandl H, 1925. [Entomostraken von Borneo]. [Article in German]. Ann. Nat. Mus. Wien 38:89-95.
- Stingelin T, 1900. [Beitrag zur Kenntnis der Süßwasserfauna von Celebes]. [Article in German]. Entomostraca. Rev. Suisse Zool. 8:193-207.
- Stingelin T, 1905. [Untersuchungen über die Cladocerenfauna von Hinterindien, Sumatra und Java, nebst einbe Beitrage zur Cladoceren kenntnis von Hawaii Inseln (Reise von Dr. Walter Volz)]. [Article in German]. Zool. Jahrb. Abt. Syst. 21:327-370.
- Tanaka S, Ohtaka A, 2010. Freshwater Cladocera (Crustacea, Branchiopoda) in Lake Tonle Sap and its adjacent waters in Cambodia. Limnology 11:171-178.
- Thanh DN, Bai TT, Mien PV, 1980. [The freshwater invertebrates of North Vietnam]. [Book in Vietnamese]. Publishing House for Science and Technology, Hanoi: 573 pp.
- Thanh DN, Hai HH, 2001. [Freshwater crustaceans]. [Book in Vietnamese]. Publishing House for Science and Technology, Hanoi: 239 pp.
- Thanh DN, Mien PV, 1979. [Contribution to the study of freshwater zooplankton of South Vietnam]. [Article in Vietnamese]. Biol. Rev. 1:1-6.
- Ueno M, 1966. Freshwater zooplankton of Southeast Asia. Southeast Asian Stud. Kyoto Univ. 3:94-109.
- Van Damme K, Chiambeng G, Maiphae S, Dumont HJ, 2003. New species of the rheophilous genus *Nicsmirmovius* Chiambeng & Dumont, 1999 (Branchiopoda: Anomopoda: Chydoridae) and reassignment of *Alona eximia* Kiser, 1948 and *Alonella fitzpatricki* Chien, 1970. Hydrobiologia 499:25-49.
- Van Damme K, Eggermont H, 2011. The Afromontane Cladocera (Crustacea: Branchiopoda) of the Rwenzori (Uganda - D.R. Congo): taxonomy, ecology and biogeography. Hydrobiologia 676:57-100.
- Van Damme K, Kotov AA, Dumont HJ, 2010. A checklist of names in *Alona* Baird, 1843 (Crustacea: Cladocera: Chydoridae) and their current status: an analysis of the taxonomy of a lump genus. Zootaxa 2330:1-63.
- Van Damme K, Maiphae S, Sa-ardrit P, 2013. Inland swamps in South East Asia harbour hidden cladoceran diversities: species richness and the description of new paludal Chydoridae (Crustacea: Branchiopoda: Cladocera) from Southern Thailand. J Limnol 72(Suppl.2):e11.
- Van Damme K, Sinev AY, Dumont HJ, 2011. Separation of *Anthalona* gen.n. from *Alona* Baird, 1843 (Branchiopoda: Cladocera: Anomopoda): morphology and evolution of scraping stenothermic alonines. Zootaxa 2875:1-64.
- Wallace AK, 1876. The geographical distribution of animals. Macmillan, London: 503 pp.
- Zhdanova SM, 2012. [The planktonic crustaceans (Cladocera, Copepoda) of man made lake of Central Vietnam], p. 190-193. In: A.V. Krylov (ed.), [Actual problems of investigation of crustaceans of continental waters]. [Book in Russian]. Kostroma: Kostromskoi pechatnyi dom. ed.